The Drowning World

The visual culture of climate change

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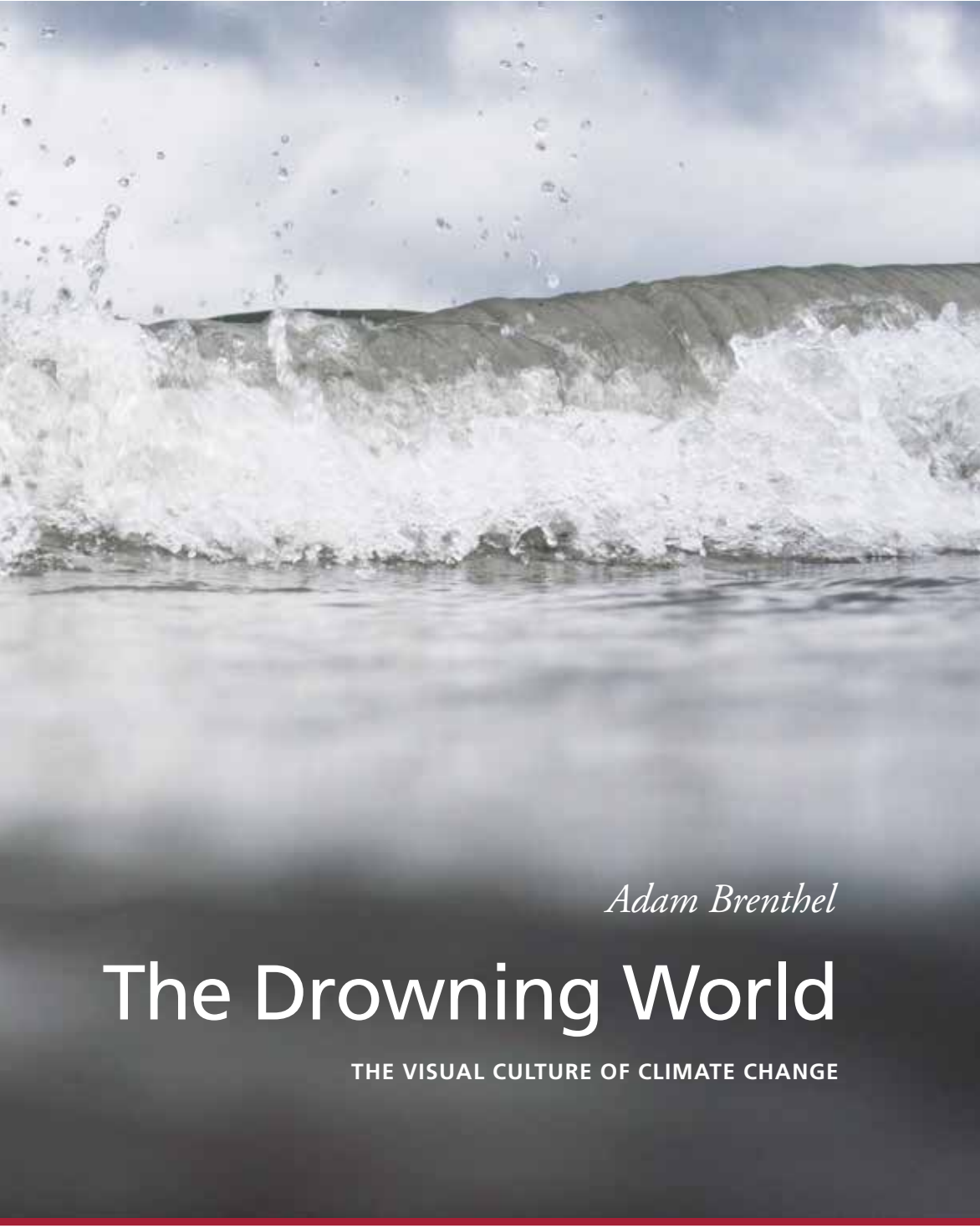

Adam Brenthel

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THE VISUAL CULTURE OF CLIMATE CHANGE

LUND STUDIES IN ARTS AND CULTURAL SCIENCES 9

THE DROWNING WORLD

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The visual culture of climate change

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Lund Studies in Arts and Cultural Sciences 9

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To Linda and Klara

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Abbreviations

AR 4–5	IPCC Assessment Reports 1, 2, 3, 4, and 5 published from 1990 to 2014. The first AR published in 1990 is abbreviated FAR (First Assessment Report), the second as SAR in 1996, and the third as TAR in 2001.
CALP	Collaborative for Advanced Landscape Planning
COIN	Climate Outreach and Information Network
COP	Conference of the Parties
CSPR	Centre for Climate Science and Policy Research
DKRZ	Deutsche Klimarechenzentrum
IPCC	Intergovernmental Panel of Climate Change
MPI-M	Max-Planck Institute Meteorology
NAD	North Atlantic Drift
NASA	National Aeronautics and Space Administrations
NGO	Non-Governmental Organization
RCP	Representative Concentration Pathways as defined in AR 5
SPM	Summary for Policy Makers in the IPCC reports
TS	Technical Summary in Assessment Reports
WG 1-3	IPCC Working Group 1, 2, and 3 are the three groups writing one part each of the full Assessment Report (AR). WG 1 is the Physical Science Basis, WG 2 is Impacts, Adaptation and Vulnerability, and WG 3 is Mitigation of Climate Change. The fourth part is the Synthesis Report (SYR).

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Introduction

This doctoral thesis in Art History and Visual Studies analyses the visual culture of climate change. Much of visual material dealing with climate change available today comes from scientific articles, reports, websites, pamphlets, videos, and other kinds of public outreach material produced by research institutes. A central problem that is being studied in the empirical material of this thesis is how researchers and communicators are articulating the communication challenges within these outreach materials. Because, there is a general understanding that the message of these materials does not have much of an impact on the intended audiences. Mike Hulme describes how the "perception of a communication failure – can lead to a variety of reactions", and some of them are counterproductive.[1] Trying to solve these perceived problems within the prevalent deficit model of communication is, in his eyes, a problem in itself, and I agree with Hulme.

The deficit model is a sender-receiver communication model and it is asymmetrical, "it depicts communication as a one-way flow from science to its publics [and] implies a passive public".[2] We will see how climate communicators fear that the general public will drown in a media noise and this anxiety leads to a need to control the out-going message. Many scholars criticize this communication and therefore recommend other kinds of climate communication. Susan Joy Hassol places responsibility on the climate researchers themselves, and she writes that "[n]ot least important is how scientists communicate – or fail to do so … [r]easons for that failure include what scientists talk about as well as how they talk about

1 Mike Hulme, *Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity*, Cambridge, 2009.

2 Alan G. Gross, "The roles of rhetoric in the public understanding of science," *Public Understanding of Science* 3, no. 1 1994.

it", and she argues that the solution to ineffective communication is improving how the story is told.[3] Nevertheless, she still tends to subscribe to the communication model that Hulme criticizes. No matter how the problem is articulated, most would agree with the editorial "On the Message" of the *Nature Climate Change* journal in December 2013 which states that the "need for more effective science communication in the context of climate change has been widely debated over recent years, with scientists and communication experts increasingly engaged in the discussion" and they recommend that....[4] I also intend to engage in this discussion with this thesis.

I argue that only some problems of climate communication discussed in general. The most common view is that the proclaimed failure of climate change messages to out reach and impact audiences is a pedagogical problem: either the general public lacks the scientific literacy to understand the message or simply is not paying attention at all. Consequently, it becomes the "receiver's" fault in both instances. I bracket the word receiver as I regard it misleading given that meaning is produced and not received in a communication context by the readers, listeners and viewers.

Paradoxically, the criticism that climate communication does not reach out is often implied at the same time as the sender-receiver model of communication is rejected. The problem that I see here is the sender-receiver model is implicitly criticized for being inefficiently used and thrown out with claims that it never actually worked anyway by the same scholar. I argue that the critique should be based on a model that corresponds to how communication actually happens as a starting point.

The alternative to the seemingly failing communication of climate change is new narratives and new modes of presentation or ever-more advanced visualization technologies. Nevertheless, I regard many of the proposed new solutions as incomplete, partly because the alternatives still imply a one-way communication – from knowledgeable sender to a receiver lacking knowledge. This is problematic for several reasons, some of which are discussed at length in the literature but I see additional

3 Susan Joy Hassol and Richard C. J. Somerville, "Communicating the science of climate change," October 2011.

4 Editorial, "On message," *Nature Clim. Change* 3, no. 12 2013.

problems. For example, there is not one sender who knows the future, and the future depends on many factors, of which some are known unknowns and others are necessarily unknown unknowns. The representation of this openness of the future is especially problematic within the scientific visual climate communication, which I categorize as a specific visual regime. I conceive the climate sciences as submitting to this regime that regulates their ways of visual expression. Admittedly this regime overlaps a lot with the natural sciences in general but the introduction of "visual regime" serves a heuristic purpose.

I have observed that the communication solutions where new technology is the answer often reuse much of the old visual material, and I argue that the problem lies somewhere else. We must ask why the new presentation technology is not used to give different images than the old. This is why I would argue that climate change communication is not mainly a pedagogical or a technological challenge, but rather a representational. One hypothesis tested in this thesis is that representation of climate change mainly becomes problematic within the *visual regime* of the climate sciences. The regime upholds limits for what can be expressed visually in the scientific context. These boundaries are social, cultural, and epistemological – or maybe it is the other way around, maybe the visual regime is produced by hegemonic social, cultural, and epistemological concepts within the climate sciences. I will not dwell much on the social or economic boundaries other than when they come to be expressed visually.

Instead, my main question is if it is possible within this regime to visually communicate the worldviews that the climate sciences embrace. Of course, there are several ways to communicate conceptions of the climate sciences, but the pressing question here is if the central aspects that are needed in order to understand climate change can be fully visualized within the boundaries of the visual regime. I observe that some ideas inherent in the climate sciences appear counterintuitive and that they are challenging to communicate with figurative depiction because they refer to abstract entities that cannot be photographed or depicted as objects, while other ideas are mental images that also contradict engagement and behavioural change among the general public due to a sense of determinism

or even a belief in an impending apocalypse. For example, a climatically dystopian future can appear both inevitable and unalterable to the common person, and this view is counterproductive because one aim of climate change communication is to promote behavioural change in people's everyday lives. The feeling might be, "Why engage if the race is already lost?"

This is a visual regime that is prone to use figurative depictions of things we can recognize. When graphs and diagrams are used in out-reach material, they most often refer to things that can be measured such as weight, concentration, length, and so on. There is a inclination toward the tangible when the changing world is explained to the lay viewer. However, I argue that the really essential "things" that need to be communicated to promote public awareness and understanding of climate change are the opposite: interconnections, time, risk, uncertainty, potentiality, unknown states of the world, i.e., non-things. All these "non-things" are challenging to depict in a way that make them recognizable to the lay viewer and there are few symbols that can be used to signify them. There are also another aspect of this problem. Climate researchers claim that even if it was possible to make depictions of a long-term climatically changed future it is likely that we would not recognize it as our world, as the changes are described as major, according to an thought provoking article cited in IPCC, AR5, WG1.[5] Yet, things are not necessarily hopeless, because there are images that add needed multiplicity beyond the limitations of the visual regime. These additions are in focus in this thesis, and it is the conclusion of this thesis that these images often appear in close relationship to and as supplements to scientific images such as the graphs, diagrams, and maps. Even if these scientific images can be both figurative in different ways or have an abstract relationship to its objects they do not communicate the essential non-things but the supplements sometimes adds what the scientific images lacks.

I will present artwork, documentaries, news reporting, and other climate-related material that can also be said to be demonstrative of the

5 Andreas Schmittner et al., "Future changes in climate, ocean circulation, ecosystems, and biogeochemical cycling simulated for a business as usual CO2 emission scenario until year 4000 AD," Global Biogeochemical Cycles 22, no. 1 2008.

visual culture of climate change as a whole. However, the most important empirical material of this thesis is the supplementary images that appear next to the climate scientific images. Important are also the aestheticized scientific images in the visual culture of climate change that show kinship with the supplementary images. For heuristic reasons, I describe images as either scientific or aesthetic, but often the two kind intermingle within one image.

The method I use to test my hypotheses is to make a visual studies analysis of and interpret whether the images that appear regularly in scientific climate communication are limited by the visual regime or if they break free from its disciplining power by presenting themselves as something else, such as frames, backgrounds, or mere graphic design. Take the covers of the IPCC reports that are analysed in chapter 3; they are examples of how aesthetic images enfold the scientific images, and the significance of this is that these images does not seem to be limited to the visual regime of climate science. Instead, there are other principles that indicate that their role is supplementary.

The philosophical term for this supplementary or complementary function or position of the aesthetic expression is *parergon*.[6] Among the most common parergon in the climate change material are figures of terrestrial globes, glaciers, and the sea. Sometimes, these are *figuras* rather than iconic signs – as I argue – that they refer to their object through dissemblance rather than resemblance. "Dissamblant" is the analytical term for the opposite to pictorial resembling and I borrow it from French art historian Georges Didi-Huberman.[7] To take an example that I will come back to in chapter two; a terrestrial globe is not used in the background of a diagram to show how the Earth looks, but rather to signal that our small Earth is fragilely lonely in dark cold space, i.e. it is used to signal "environmental" and not geography. The reason why such an image returns over and over again is that it becomes a part of a productive pattern; we know the signs in the background even when we cannot articulate their meaning. The term "figura" indicates the evocative function of these signs

6 Jacques Derrida, *The Truth in Painting*, London, 1987.

7 Georges Didi-Huberman, *Fra Angelico: Dissemblance and figuration,* London, 1995.

and this makes it a useful concept for the analysis of visuality in the parergon material. I will mainly describe the recurring images of the sea and the terrestrial globe, because even though they show us a sea or a globe, this is not what they actually intend to communicate to us.

There are also other figuras within the visual culture of climate change, for example, the dark backgrounds onto which lighter figures are mounted (I argue, however, that the dark background is itself the figura). These figuras are an important part of the visual culture of climate change because they are incorporated into the scientific communication, but they elude the disciplining power of the visual regime thanks to their supplementary position. They are taken to be graphic design, but according to the conclusion of this thesis, they are really an integral part of the message. These figuras should not be looked upon as distinct images but rather as tools to direct our gaze beyond what is apparent on the surface of the image. Another aspect of visuality that will be touched upon in this thesis is the desire of scientists to visualize, illustrate, and decorate the scientific texts with images, because much of the climate communication is produced by the scientists or they are deeply involved in the production.

My theoretical resources come from aesthetics as well as Cultural Studies and I have a background in the natural sciences turning this thesis into an Environmental Humanities study even though the analysis of images must be described as Visual Studies. The conclusion of this thesis is that the shortcomings of communicating with purely scientific images is compensated for by the introduction of aesthetic images such as backgrounds, frames, covers, and additions that supplement what is otherwise limited by the visual regime of the climate sciences.

What is the problem with climate change?

There are many different kinds of problems associated with climate change. The most critical ones are consumer behaviour, lack of adequate policy decisions, and poor global agreements on emission rates, and then of course there are the actual physical effects of climate change such as melting sea ice and glaciers, droughts, heat waves, severe storms, and so on. The list of problems can go on, and my point here is that the problems of climate change are many and demanding, and I will add new problems to the list throughout this thesis. The analysis brings with it a critique of how the above-mentioned problems are articulated, represented, and communicated, and I claim that there are some aspects that have not been addressed in the discussion to date. This critique does not play down the need to deal with the already well-known problems, quite the contrary, but I will take a detour around the familiar terrain and raise questions and findings in a different light, at least as compared to the everyday political discourse on climate change. The final conclusion of my thesis is that science communication, to some extent, is able to compensate for its failures in ways that are visually rather eloquent. Still, any overall conclusion can only be that we are not doing enough to avoid the detrimental consequences of climate change.

I believe in climate change. But what has that to do with a critical analysis of the visual regime of climate sciences and the attendant communication problems? Several things. Climate change has the character of an existential subject matter; it has become a foundational outlook on the world. This is something I experience myself. It stems to some degree from the engagement I have had with this thesis, though I share an experience of changed outlook with many others. The impact climate change has had on popular culture and media coverage shows that it is becoming a fixed worldview. It is also a worldview of *becoming* in the philosophical meaning of the word. In other words, a worldview where we regard constant changes as the being of the world, rather than the permanence of the world as its true essence. This is what I mean with the world of becoming. The feeling that the world is in flux comes from a discourse that is influenced by the climate scientific findings.

The discourse surrounding climate change strongly influences what I, and you, perceive in "nature". It determines what we perceive as natural in contrast to anthropogenic, i.e. man-made. Every time I see my garden drenched in rain or a tree shaken by strong winds, I associate it with the predictions of the future, asking if the climate changed future already is here. This is a worldview, where I see the world, or nature, as influenced, or even created by mankind. That is also why the era we live in is called the Anthropocene and I will discuss how this is visually expressed in chapter two of this thesis.[8]

Some of my amateur weather observations might be attributed to climate change, while others are incidental, how could I know which is which? The problem of knowing that one knows is a philosophical problem. However, this must not lead to a failure in dealing with the actual problem. It might take some acceptance to see climate change in the world because it cannot be seen without the help of scientific records of historical changes to the climate. The recent *Encyclical Letter* written by Pope Francis can be seen as a sign of the general acceptance of scientific certainty of climate change. Pope Francis urges us to protect our common home and to "seek a sustainable and integral development, for we *know* that things can change", and he calls for the abandonment of "[o]bstructionist attitudes, even on the part of believers"![9] This contribution of the Pope to climate communication is not a sign of failure of climate communication, but proof of the strength that climate change has as a discourse in our time. I see this as an ethical frame to climate communication, and it has been called a "powerful, poetic call for collective action and major socio-cultural change", by sociologists of environmental science.[10]

Still, the critics of climate change communication are many, for example,

8 The Anthropocene as a concept was introduced into the climate scientific discourse by Paul J. Crutzen in 2002 with the article "Geology of Mankind" in *Nature* and has since then been a key concept to describe and understand the world after the industrialization.

9 w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html, (my italics).

10 Brulle et al., "The Pope's fateful vision of hope for society and the planet," *Nature Clim. Change* 5, no. 10 2015.

the Climate Outreach Information Network (COIN). They write in a short report from 2015 that the "IPCC is failing in its role of presenting facts about climate change to policy makers … [and] that this role reflects an outdated model of how science is incorporated into society".[11] Paradoxically, the criticism of the "outdated model" is recurrent. Everyone seems to agree on this, and still, science communication seems to be stuck with it. COIN recommends that the Intergovernmental Panel of Climate Change (IPCC) should tell stories about real people and bring climate science to life. I hesitate to agree with COIN's conclusions and I would say that one of the strongest stories told about climate change is that we are failing to communicate it.

The phenomenology of climate change

Effects such as long drought in California and the greater occurrence of strong storms are plausible attributed to climate change. Still, we cannot see the climate changing in everyday life. The daily changes we experience in the atmosphere are weather, and it is difficult to attribute most experience of weather or observation of seasonal temperature to long-term climate change, even though there are exceptions. The development of the climate models indicates that it will be possible to predict seasonal events like El Niño in advance in the future, but predictions of short-term change depend more on the current state of the atmosphere rather than on long-term changes on a global scale. The long-term effects cannot be seen in the current weather because they are very small on a day-to-day basis and are masked by everyday weather. Weather is the coming 10 days; climate is the mean of the last 30 years. Thus, the climate models must become much more detailed before the changes we experience during the seasons can be predicted. There is a divide between what the climate sciences claim and what is phenomenologically accessible to us. Still, we know less about the present climate than the future, according to the latest Assessment Report

11 Climate Outreach Information Network, "Science & Stories : Bringing the IPCC to Life," ed. Adam Corner and Christel van Eck (www.climateoutrech.org.uk) 2015

from the IPCC, because we can be sure that certain amounts of carbon dioxide will be emitted into the atmosphere.[12] Thus it is possible to predict which climate futures might be actualized depending on which paths toward the future we take. These paths are called Representative Concentration Pathways (RCPs) in Assessment Report 5 (AR5), and they are "[s]cenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover."[13] Thus, the four different RCPs represent four possible futures given the political, economic, and social choices that humankind makes. However, the AR5 glossary nuances the choice of words and writes that "[t]he word representative signifies that each RCP provides only one of many possible scenarios that would lead to the specific radiative forcing characteristics. The term pathway emphasizes that not only the long-term concentration levels are of interest, but also the trajectory taken over time to reach that outcome."[14] What the glossary is saying is that there is no finale, that it is impossible to actually say what a final state will look like, and above all, the world is in a state of infinite becoming. It is the path toward the future that is of interest, not the future itself, as the future is always beyond the present. In that respect, it would be better to focus on the present when we make choices, asking, "What can we do *now*?"

The point I want to make is that it is almost necessary to have a conviction of the factuality of climate change in order to get a feeling of change and to see it in the world. It is like the familiar gestalt image of the duck-rabbit, if you believe you see a rabbit, then you see a rabbit. If you believe you see a duck, you see a duck. But, as Errol Morris points out about the problem with documentary photography and its relation to what it depicts, "[o]ur beliefs do not determine what is true or false. They do not determine objective reality. But they can determine what we 'see'."[15] However, the scientific legitimacy of climate change can also be a

12 IPCC, AR5, WG1 p. 958.

13 ibid. p. 1461.

14 ibid. Glossary.

15 Errol Morris, *Believing Is Seeing: Observations on the Mysteries of Photography*, New York, 2014. p. 84.

phenomenological problem because any actual event could be deceiving. We must to some extent disregard what we experience in the world of weather and take the science as factual, and then also embrace a feeling for the world. If we manage to do this, then the world becomes even more interesting because the climate sciences contain absorbing predictions about our future and realize that what we do in the world today determines the future.

From *Science and Technology Studies*, we have learned that "for the world to become knowable, is must become a laboratory", as Bruno Latour formulates it in his well-known study "Circulating References" in *Pandora´s Hope* where he follows botanists and pedologists doing fieldwork in Boa Vista, Brazil. The problem with climate change is that we performed the big experiment without being aware of it until we realized that we are in the middle of it. If we trace the scientific graphs upstream to find their source, we will find ourselves in the laboratory called "The Anthropocene". Toward the end of Latour´s "photo-philosophical montage", he asks us to compare a map with the actual place where the soil samples were collected, labelled, and organised to become an image-map. His claim is that we will find no resemblance between the map and mapped area, and that this is only a problem if we "have taken science for a realist painting, imagining that it made an exact copy of the world."[16] Neither art nor science gives us the world out there, and we will not find total resemblance between map and mapped area, but we must realize that we are dealing with a "constructed world".[17] The *Science and Technology Studies* approach to images is suitable to show how the scientific graphs, diagrams, and maps are constructs rather than copied from nature. But, we already know that. The challenge for the climate sciences is to represent the physical world that is a construct of the human, not only the science used to describe this world. It is difficult to grasp this and to accept that both constructs also are changing over time.

For me, the climate sciences operate with an object that is immensely fascinating. It is a world bound to change beyond human comprehension,

16 Bruno Latour, *Pandora's Hope : Essays on the Reality of Science Studies*, Cambridge, 1999. p. 78.

17 ibid., p. 79.

and this might explain the desire and need of climate communicators to use additional aesthetic images. The IPCC states that "warming will continue beyond 2100" in all RCPs, "heat will penetrate from the surface to the deep ocean" and affect the ocean's circulation, and the "sea level will continue to rise". Even if we stop pouring out greenhouse gases today, "most aspects of climate change will persist for many centuries".[18] Still, the change that is taking place is not experientially accessible to us; its effect is either in the future or on a scale too grand for humans to perceive, and those processes taking place on the human scale are still inaccessible to us due to their character. Think about an ecosystem, a lake or a forest – the change is taking place there as it is taking place everywhere, and we might detect something different from last year if we seek the symptoms of a changing world in this ecosystem. However, nothing will be a sign of change for anyone who does not believe in climate change, not even the most violent weather event in a hundred years, because it does happen at least every hundred years. In a nutshell, this is the phenomenological problem, and I argue that the climate scientific worldview that underpins the IPCC reports lacks a corresponding visual manifestation that does not come in conflict with the visual regime of the climate sciences. The actual visual regime is initially characterized in next section and then exemplified and analyzed in chapter two and three while the final conclusion will be that a different visual regime possibly could bridge the gap between scientific findings and human experiences of nature.

The visual culture of climate change as empirical material

Admittedly, one of the biggest challenges during this thesis project has been to gather a consistent body of material. There is no lack of interesting material, quite the contrary, the problem is to choose, present, and analyze a representative material from the vast amount of material that is available. I thus divide my empirical material into that which is conditioned by the visual regime of the climate sciences and that which is representative of the visual culture of climate change in general. The visual material that is

18 IPCC, AR5, WG1, p. vii.

conditioned by the visual regime is much less known by the general public than is the visual culture of climate change. This is necessarily the case because the visual culture of climate change is precisely that culture that is disseminated through the news and the Internet, while the "proper" scientific climate communication has a quite small outreach in comparison. Nevertheless, the scientific climate communication is often produced as outreach material for the sciences in the first place. I would guess that scientific climate communication appears peculiar because few people consume it, and this points to one of the problems with climate change communication. Most people will get their knowledge of climate change from news reporting, broadcast documentaries, and popular culture, and not from scientific climate communication. It is from these popular sources that the visual culture is spread; however, many of the images come from scientific climate communication, but these have often lost their references to the original literature. It is difficult to find the way from a news article back to the scientific article or report because there are usually no detailed references.

Visual cultures tend to be sprawling and need to be delimited in order to be manageable. Visual cultures go beyond the visual, and they are not limited to the things we see on screens, images in books, articles, on the Internet, documentaries, moving illustrations, or visualizations. It is also about how people talk, think, and write about images, and it also involves the knowledge that facilitates the reading of images and the prejudices that can lead to misinterpretations. According to Gillian Rose, the "use of the term 'visual culture' refers to the plethora of ways in which the visual is part of social life" and even if climate communication is part of the social life of only a few people the message takes different routes as it makes its way to the general public to become part of the visual culture.[19]

The method that I deploy to approach the visual material is a diving into work and frame. The tool that I use for this operation is the concept of parergon from *The Truth in Painting* by Jacques Derrida, who takes his starting point in Immanuel Kant´s *Critique of Judgement* when describing

19 Gillian Rose, *Visual Methodologies : An Introduction to Researching with Visual Materials*, London, 2012. p. 4.

how to tell the aesthetic motif from its decorative frame. Kant takes the frame into account and holds it to be either a beautiful form that enhances the motif of the painting, or a charming addition that attracts the attention of the audience toward the outside of the painting instead of toward the actual aesthetic work that is inside the frame.[20] *Parergon* is the frame around the artworks, which are called *ergon* and is Greek for work. However, in the context of this thesis, the ergon is the scientific illustration, table, graph, map, or curve in my analysis, and not the artistic work that Kant singles out. On the contrary, I find the aesthetic material in the parergon that supplements the scientific image. Ergon and parergon are flipped when it comes to where we find the aesthetic material I have gathered, but the Derridean analysis is still fully applicable. Furthermore, it creates a much-needed perspective on climate communication.

Also the space where the visual material is presented is approached with this methodology, for example, the actual visualization dome, the book page, or the exhibition space. The way in which images are presented is part of their visuality and productively supplementary. This means that we cannot separate the presentation form from the visual material actually being presented but must acknowledge their mutual dependence. *Visual material* implies that there is a visual empirical material that allows itself to be cut from a context in order to be presented and analysed. Certainly, I do cut out still images from films, reports, books, and web pages and paste them onto the pages here, but this is for pragmatic reasons because it is difficult to follow the analysis of images that are not shown. A still from a film, or an illustration from a scientific article, becomes much different when taken from its former context. There is little that can be done about that other than to ask the reader to remember that both the form and the content is part of any message. They cannot be separated without changing what meaning is interpreted from them.

20 Jacques Derrida, *The Truth in Painting*, London, 1987.

Climate art

In an article in *The Guardian*, the journalist Andres Simms explains why action on climate change needs the arts, and he does so with references to Bertolt Brecht.[21] The famous Brechtian quotation is that "[a]rt is not a mirror to reflect reality, but a hammer with which to shape it", and this would be the reason why artists should engage in climate change communication, according to Simms. The argument is that perhaps art can succeed where other forms of climate change communication have failed. Simms writes that there always have been those who think that didactic art is bad art but that it isn´t necessarily so, according to his reasoning. I guess that the anxiety to become didactic to some extent explains why climate change has been a dry area for the arts and led to uncontroversial artworks that fail to incite change in the world. This state of affairs is now changing, according to Simms, who writes devotedly about the ambitious Cape Farewell project where artists visit the remote Artic Cape Farewell to witness the climate effects already manifest as inspiration for artistic work of their own.[22] Notwithstanding his seeming enthusiasm, Simms brings to the debate a critique of a climatically engaged culture as non-existent with an allusion to the Aristotelian *horror vacui* when saying, "climate action abhors a cultural vacuum" as the Greek expression could translate into "nature abhors vacuum". I interpret that Simms means that there is a natural artistic willingness to grapple with things and aspect that others shun from. The description of the arts as a hammer is popular among the artists engaged in climate art, and they share this conviction with many of the communicators of climate change who hope that art and culture can do that which the sciences are purportedly failing to do, namely, influencing people to change their behaviour and politicians to make better decisions.

However, the visual analysis in this thesis is not directed toward *artistic* works, as Simms article is. Still, it must be said that it is easy to find art with a purpose in scientific context in the UN climate context, for example,

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21 Andrew Simms, "Why climate action needs the art," *The Guardian*, 03 June 2015.

22 www.capefarewell.com

the United Nations Framework Convention on Climate Change (UNFCCC) photo contests, climate photo of the week, and the well-known artists exhibiting at the Conference of the Parties (COP) meetings. This expose at least two things: a strong belief in the power of images, and a strategic use of artistic or cultural expressions to perform outreach. Almost all the photographs submitted to these contests and exhibitions express the urgent message that behavioural change is needed or provide examples of how change is possible by showing images of successful projects in the developing world. The recurrent figures and characteristic configurations that I find among the finalists are not the typical polar bears and smoking chimneys, which have been the signature of climate change since the 1990s. The polar bear "became part of the symbolic repertoire of climate change images" thanks to NGO campaigns according to Julie Doyle who makes a pertinent analysis of the visual culture of climate change in his article "Picturing the Clima(c)tic".[23]

Interestingly, the UNFCCC contest photographs shown on their website often depict people working with their hands or people from poorer parts of the world building new climate smart industrial facilities, such as windmills and bio-gas installations. Theses are images of human activity, changing the world to a better place, hopeful photographs. My observation is that the overall repertoire of the motifs in climate communication and climate art, however, has been dominated by images of pristine environments like glaciers and melting sea ice, industrial chimneys, drought-ridden landscapes, and flooded coastal areas, with a noteworthy lack of human presence in these images.

Climate art is not an established concept but could be seen as part of eco-art, which exhibits similarities to climate art in that it often has an urgent message. When I write "climate art" I pragmatically mean art that either are produced with the intention of calling attention to climate change or are perceived by their audiences as dealing with climate change – and thus the definition totally rests on the context or the reception of the material. Many forums, mainly on the Internet, have been created for

23 Julie Doyle, "Picturing the Clima(c)tic: Greenpeace and the Representational Politics of Climate Change Communication," *Science as Culture* 16, no. 2 2007.

those who want to show their artworks or promote exhibitions, and there are also governmental and intergovernmental initiatives to encourage art that aims to promote climate change awareness through art and culture.[24] The objectives of climate communication and climate art are often the same, for example, the organization *Art Works for Change* describes how they are creating exhibitions that "address critical social and environmental issues" to "promote awareness, provoke dialogue, and inspire action", i.e., to do what many of the scientific climate visualization projects also aim to do.[25] *Imagine 2020* is a European Union (EU) project with "ten European performing arts venues and festivals who support artistic work that explores causes and effects of climate change".[26] Their objective is to spread awareness among the artistic community, which in turn will provoke change within the cultural sector, which in turn will spread to the general public. I would say that there is view that art and culture can be vessels to spread the scientific message. Further, there are research institutes that hire artists or use art to communicate and illustrate their results. The Stockholm Resilience Centre, for example, regularly arranges art exhibitions and events; one of the latest was music for coral reefs called *In Tune for the World's Coral Reefs*. The initiators explains the relationship between music and coral reefs: "It goes without saying that music cannot save the world's coral reefs, but history is replete with examples of how music can act as a force for change."[27] From my perspective is seems as art is perceived as an instrument for communication. Climate art has often a similar message as the scientific climate communication, though somewhat different form, and with same agenda in the end.

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24 See following sites for examples: artclimatechange.org/exhibitions/, climarte.org, www.capefarewell.com/about.html, www.resurgence.org/education/climate-change/art-climate-change.html, www.climatechangeeducation.org/tv.html, earthvisioninstitute.org, art.350.org

25 www.artworksforchange.org

26 www.imagine2020.eu

27 www.stockholmresilience.org/21/art--science/news-archive/art-and-science/11-11-2013-in-tune-for-the-worlds-coral-reefs.html

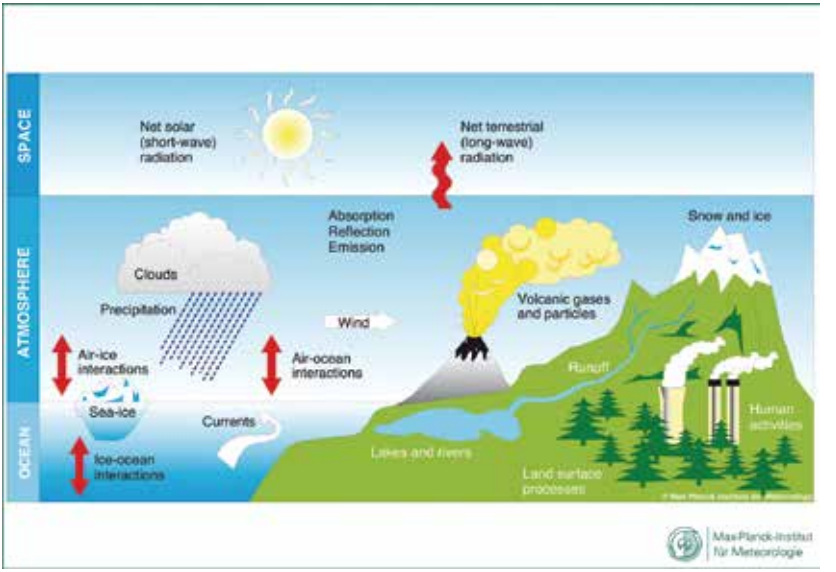

Figure 1. An illustration of the four components (cryosphere, ocean, land surface, and atmosphere) of the climate system and how they interact. From the Max Planck Institute for Meteorology (MPI-M) in Hamburg. www.mpimet.mpg.de/en/kommunikation/mediathek/bilder-grafiken.html

Limitation of the empirical material

It has been almost ten years since the documentary *An Inconvenient Truth* was screened for the first time in 2006, and most of the material in this thesis is from the period of 2006 to 2015. The film changed the discursive landscape because it made climate change an urgent topic, and the imagery from the documentary is still vivid for many. Al Gore, the creator of the film, showed that it is possible to use scientific images to tell a story to influence people. However, it was not mainly the graphs and diagrams that became effective, but rather, how they were presented with Al Gore as a guide through the violent weather events of the world. The visual culture of climate change has not changed much during these past ten years, and the same goes for scientific climate communications, i.e., the graphs, diagrams, and maps.

Figure 1 is a scientific illustration with a pedagogical purpose that is rather typical of the visual regime of the climate sciences. These kinds of illustrations are almost always used when the complexity of climate is to be communicated. The particular image below comes from MPI-M in Hamburg and is freely available for downloading. It is intended as pedagogical and illustrative material to be used by anyone: journalists, students or interested laymen. This would be an example of the main material if I were to write a thesis covering scientific climate illustrations, but my focus is on that which surrounds this kind of image, how illustrations relate to the text they illustrate, and what kinds of images that supplement these images. Fortunately, the visual culture of climate change goes beyond illustrations such as this and I allow myself to gather many images that come from different forms of presentations. In addition, I conducted interviews with representatives from the IPCC and researchers working with both visualization and climate science. Furthermore, there are articles and pamphlets about visualizations and communication that is telling of how scientific communication perceive and value images as illustrations. These texts are sometimes as important for my analysis as the images themselves. Much has been written in the last few years about climate communicate climate, including reports, funding applications, marketing material, popularizations of climate science, guidelines on how

to produce persuasive images, journal articles, and textbooks.. However, I would say that the most important material for my analysis comes from the backgrounds and the framings of climate change images and not from the actual motifs or messages of the climate images. It is in this supplementary visual material that I find the recurring figures that I analyse.

The venues I have visited several times are the Worldview project at Norrköping Visualizing Centre (which was produced by the Centre for Climate Science and Policy Research (CSPR) from Linköping University), and the Deutsche Klimarechenzentrum (DKRZ) and the adjoining Max-Planck Institute Meteorology (MPI-M) in Hamburg. However, most of the material for this thesis has been accessed via the Internet and broadcast television. Much of the scientific communication today is produced for on-line viewing. For example, different topical climate layers added to Google Earth (www.google.com/landing/cop15), National Aeronautics and Space Administrations (NASA) Global Climate Change site (climate.nasa.gov), and the Canadian Collaborative for Advanced Landscape Planning (calp.forestry.ubc.ca) all have many accessible climate projects. Some of the climate change visualizations produced within these projects are shown in small portable domes, big theatre planetariums, within video-games, or in projection rooms that are specially designed for the task of showing digitally produced images of the future based on massive amounts of data. Undeniably, there are few who actually go to see the material in these immersive settings, at least in comparison to how many partake of them through the news or documentaries. Such secondary displays of the images have a greater tendency to spread throughout the general population, but these scientific images then often lose parts of their scientific characteristics, for example, references to scale, accompanying text, and all the meta-data on which scientific images depend to be functional. All the visual material I have gathered comes from or appears to be connected to the climate sciences, but it is also visual material that looks rather different from but is presented in conjunction to scientific images.

Hypotheses

1. There are limitations on how climate scientific images can be shown within the scientific boundaries that I refer to as the visual regime of the climate sciences.
2. Crucial aspects of climate change become unrepresentable within this visual regime.
3. Aesthetic images are supplemented in the *parergon* position to compensate for what the scientific *ergon* fails to represent.

Research questions

First and foremost, this thesis is about the role images play in forming our understanding of climate change. One of my initial observations is that climate communication is described as failing to produce this understanding within the scientific visual discourse, especially among the public. However, when the communication is studied as part of a broader visual culture, much more than only scientific images becomes relevant as the empirical material, and the failure of climate communication is no longer as obvious. Because I have found that aesthetic images are prevalent within climate communication in conjunction with scientific images, I hypothesize that they are more or less consciously introduced to make up for what the scientific images fail to do. The aim of this thesis is to contribute to the understanding of how communication of something invisible and distant in the future can be achieved by adding other images in addition to the pedagogical and scientific images that are most often used. However, this calls for a reformulation of the most common research questions that aim to answer the overall question "What is the problem with climate communication?", which I identify as the motivating concern in much of the on-going research in the field.

Disposition

Next follows the theory and method section and then an expansion of the question "What is the problem with climate communication?" as it is answered in relevant previous research. Most scholars seem to think that something is wrong with climate communication, but they disagree on what the problem really is. Chapter 2 is "The Dark Background", which describes and analyses the use of dark backgrounds in climate change communication in general, both in text and in images. This chapter establishes the ontology that comes with the climate sciences through these recurrent backgrounds. Chapter 3 is "The Double Recurrence of the Sea" where this use of water images in both climate visualization and the visual culture of climate change is investigated. Chapter 4 presents the "Conclusions: Artistic expression and climate change" that can be drawn from the preceding chapters.

Theory and method

The focus of the analysis in this thesis is primarily directed toward that which can be called visuality and secondly toward the sign or figure that is apparent in the image. The term "visuality" is used in this thesis to denote much of that which comes with the experience of seeing images or visualizations. A set of theoretical tools that is applicable to visuality is therefore necessary, and the field of visual studies provides such tools. Visual studies is my theoretical belonging, and the material I analyze is a visual culture; however, I call part of this culture a "visual regime" to single it out from the broader material.

Visuality is the less obvious side of the visual culture of climate change. I would say that visuality, as a material, is somewhat amorphous, and it slips away from attempts to define its precise boundaries. Hal Foster sees visuality as the totality of vision in a specific context and as something that is bound to the beholder of the vision. Foster defines visuality as that which happens between visual perception and what the beholder is able to see and comprehend; it is the "datum of vision and its discursive determinations

[as] a difference […] [in] how we are able, allowed, or made to see, and how we see this seeing or the unseen therein".[28] In other words, visuality is a theoretical approach to understanding how we access the world and it is beyond what we perceive with only our sight. This means that that which we do not directly apprehend because we miss it out of habit or convention can be part of visuality, and visuality becomes rather formless and fluid. What Foster is also saying is that seeing is something that is so natural to us that we take for granted that we see the same things that everyone else sees; however, seeing is not transcendent, but is instead habituated by the social, the historical, and the ideological, and this is core concept in the visual studies.

The French art historian George Didi-Huberman structures his analysis of visuality around "dissemblance" in opposition to the traditional iconographic analysis of signs and figures commonly seen in art history discourses. This is a critique of the "tradition of the didacticism of images," which also, as I see it, could be aimed at science communication, which is based on the observation that we most often assume that any image that looks like something necessarily refers to the object it looks like.[29] Didi-Huberman targets the interpretation of 14th-century religious frescos created by Fra Angelico to argue that a lack of "realism" is not necessarily a sign of an inability to depict realistically, but is instead the result of different ways of painting, and this is obvious from an art historical perspective. This can be used as an argument for the climate sciences to open up the visual regime for other kinds of images that can add multiplicity to the repertoire of possible images. Normally the lack of resemblance or clear relationship between sign and object becomes a weakness, but it might well be that dissemblance is necessary because many aspects of the climate system cannot be depicted in a way that makes them recognizable to us.

Many of these unrecognizable aspects are virtual. That is if we use the Deleuzean and Proustean meaning of the term virtual. These pedagogically challenging aspects are not actual and manifest; they are intensive rather

28 Hal Foster, 'Preface' in H Foster (ed.) *Vision and Visuality*, Seattle, 1988.

29 Georges Didi-Huberman, *Fra Aangelico : Dissemblance and figuration*, trans. Todd J. M., The University of Chicago Press, Chicago, 1995.

than extensive because they lack extension in space and are instead only potentialities and risks or known unknowns. I argue that there is also a tradition of didacticism of images within the natural sciences where an image that shows a resemblance with a thing is assumed to be a depiction of that thing. However, this tradition, or convention, of the visual regime becomes an obstacle because pictorial resemblance between object and image often is impossible. I use the term "visual regime" similarly to a "scopic regime", just for a much narrower realm. The material I consider belonging to this visual regime has its very own characteristics. Still, it is clear that the visual regime of the climate sciences is related to the modern scopic regime. One aspect is what art historian Martin Jay write forth about this modern scopic regime of "Cartesian perspectivism", namely that it privileges the "illusion of homogeneous three-dimensional space seen with a God´s-eye-view from afar".[30] This is also is a characteristic of one kind of climate visualization which is produced with software developed for video game visualization. I am thinking of the landscape visualizations that show effects of climate change in the form of sea-level rise, drought or storm surges, they are prevalent and characteristic of the regime I single out.

David Kim uses the term "visual regime" in his analysis of the globe images and ideas and also how a planetary gaze is fostered. The popular image of Planet Earth in dark space is used as a homogenized site that can harbour the complexity of the world that otherwise is incommensurable. It does not matter from how far away the images of Earth is taken, no matter of the distance of the Earth the image always claim to show us our whole world and the nothingness surrounding it makes a perfect image of a world without any outside, because it seems obvious that humans are confined to this small dot in space. Kim argues that "the aesthetics of the globe [...] invite a heterogeneous set of emotions and thoughts" but becomes a super-image that tells us about human responsibility at the same time at it builds on reductionist problem presentation. This hypocrisy is made possible by an "epistemic violence" where differential judgments are

30 Martin Jay, "Scopic regimes of modernity" in *Vision and Visuality*, ed. Hal Foster, Seattle, 1988.

replaced by wholesome approaches. The analysis discerns the metaphors, literal images and what is associated with this globe image and then approaches it as one visual regime that has its own rules of formation in a wider visual culture. Visibility as well as what becomes invisible due to ideology is determined by this regime. Kim´s analytical concept informs the approach of this thesis where my visual regime is the climate scientific.[31]

Another scholar who explicitly uses "visual regime" is the Dutch media researcher Nanna Verhoeff, who understands a visual "regime as a set of conditions considered valid at a certain time, under which usages of things are taken for granted as normal and legitimate", with reference to Martin Jay's scopic regime.[32] I understand the visual regime of the climate sciences to be the conditions that limit what can be shown in the ergonal position in climate communication. These conditions constantly change over time, and the period that I primarily study is 2006 (and the premiere of *An Inconvenient Truth*) up until 2015. The visual regime of the climate sciences will overlap with much of the visual regime of the natural sciences and the visual culture of climate change taps into it and uses its scientific images in popularized form.

I see two tendencies in the images and the adjoining texts that I have chosen for my empirical material. The first tendency is the constraining of how they present scientific findings and facts. The second tendency is more interesting because it seems to break the spell of the first. This tendency is the poetic openness that exists next to the constrained images. This is because while most scientific images and texts are visually edited to comply with the expectations of the visual regime, there are still many expressions that provide us with fantastic images of a coming world. It is my hypothesis that the visuality in the parergon position escapes the grip of the visual regime that privileges the denotative images in the ergon position. This is partly because the visuality that surrounds the ergon images is considered decoration or "mere" graphic design and can therefore have ambiguous meanings. I observe that many images in this parergon position operate

31 David D. Kim, "The Visual Regime of the Globe: Revaluing Invisibility in Global Modernity," *Transit 7*, no. 1 2011.

32 Nanna Verhoeff, *Mobile Screens: The Visual Regime of Navigation*, Amsterdam, 2012.

on the level of dissemblance rather than through resemblance, and I argue that these images in practice compensate for the failure to communicate climate change that is caused by the limitations of the visual regime. The visual regime upholds the visual conventions in the field. However, there is a level of artistic freedom that can be found outside the bounds of the visual regime.

The French philosopher Jacques Derrida's *The Truth in Painting* unfolds the meanings of parergon in relation to ergon. Derrida develops his parergon discussion from Immanuel Kant´s *Critique of Judgement*. Kant does not write much explicitly about the parergon because his purpose is to separate the artwork (ergon) from its surrounding frame (parergon). Kant writes that "what is called ornamentation (parerga), i.e. what is only an adjunct, and not an intrinsic constituent in the complete representation of the object, in augmenting the delight of taste does so only by means of its form", and he continues with some examples.[33] It can be "the frames of pictures or the drapery on statues, or the colonnades of palaces." The conclusion is that "if the ornamentation does not itself enter into the composition of the beautiful form—if it is introduced like a gold frame merely to win approval for the picture by means of its charm—it is then called finery and takes away from the genuine beauty." Kant seems to be satisfied with determining the parergon to be either ornamentation that harmonizes with the work or mere finery, such as a gilded frame, that is added to charm the beholder and take beauty away from the main work.[34]

Kant's focus is on the work itself, and even if the parergon can augment the ergon for Kant, it is more complex for Derrida, who gives the parergon a more supplementary relation to the ergon, which actually needs the parergon to compensate for what it lacks. According to Derrida, the supplement contributes to the ergon, and he writes that "[w]hat constitutes them as parerga is not simply their exteriority as a surplus, it is the internal structural link which rivets them to the lack on the interior of the ergon", and thereby connects inside and outside instead of separating them. Derrida concludes that "[w]ithout this lack, the ergon would have no need

33 Immanuel Kant, *Critique of the Power of Judgment*, §14
34 ibid.

of a parergon", and I ask a similar question of my material. Why does ambiguous visuality surround the scientific images of climate change, what is it that the denotative images lack such that the aesthetic visual material in the parergon position is needed? There are many visual aspects in the visual communication of climate change that are not motivated by the text they accompany; however, it is clear that they play an important role in getting the message across. Derrida reminds us that parergon also means "exceptional", "strange", and "extraordinary" besides just "frame". I would say that this is what climate communication needs to evoke, and it might be fitting to do this from a supplementary position.[35]

Intellectual historian Martin Jay states in *Downcast Eyes* that Derrida showed that the integrity of a work of art "always is polluted by its framing contexts", so there can be no pure work but that can neither be a representation of truth through mimesis in an unproblematic way.[36] There is always an intermingling going on, connecting the ergon to the world. In the well known text "Scopic Regime of Modernity" he also points out that the scientific demands on the content of the motif have a long history. Jay begins this account with *De Pictura*, from 1435, by the Italian painter and writer on painting Leon Battista Alberti. *De Pictura* showed how the three-dimensionality of the external world is rationally rendered in two dimensions on the canvas, giving the illusion of depth. Jay writes, "Cartesian perspectivalism was thus in league with a scientific world view [...of] a mathematically regular spatio-temporal order filled with natural objects that could only be observed from without by the dispassionate eye of the neutral researcher", and thus there are similarities to the scientific image in the ergon position, which also needs the supplementary to make any evocative message come across.[37] The ergonal is produced and interpreted as dispassionate according to scientific claims and demands. This explain the need for supplementary aesthetic paregonal images that contribute to what the scientific image lacks, namely, ambiguity,

35 Derrida, *The Truth in Painting*, pp. 59-60.

36 Martin Jay, *Downcast Eyes : The denigration of vision in twentieth century French thought*, p. 516.

37 Martin Jay, "Scopic regimes of modernity" in *Vision and Visuality*, ed. Hal Foster, Seattle, 1988.

uncertainty, passion, the unknown, and all those aspects that are "unpresentable" under the visual regime that is studied in this thesis.[38]

French philosopher Gilles Deleuze's philosophy of the virtual returns on occasion in the analysis of this thesis. The significance of Deleuze's philosophy of the virtual comes from the fundamental difference between a virtual reality and the real virtuality. Virtual reality is often used to describe different immersive presentation forms that aim to represent the outside world within black boxes, on screens, or in domes when used in climate communication. They are all heavily afflicted with the thinking that the outside world can be faithfully simulated in these immersive environments, and they often strive to perfect techniques to accomplish this imitation. I claim that some of the problems with climate communication are well exemplified by this lust for the technological perfection of simulations, and I argue that thinking in the real virtuality is a more pedagogically productive way to think about climate change than are the virtual realities usually used to communicate it. The real virtuality stands in stark contrast to virtual reality even though the two are lexically similar – change the place of virtual(ity) and real(ity) and you go from the one to the other – but in philosophy the two seldom meet. Slavoj Žižek is one proponent for this either-or attitude, and in *Organs without Bodies* he writes, "Virtual Reality in itself is a rather miserable idea: that of imitating reality, of reproducing its experience in an artificial medium", and this parallels the stance I take through the theory I choose to apply to immersive climate visualizations. Žižek appoints Deleuze to be the philosopher of the real virtual in opposition to virtual reality and encourages us to embrace the reality of the virtual because it "stands for the reality of the Virtual as such, for its real effects and consequences". One could argue that Žižek submits to the dichotomy of real verses artificial and therefore upholds, rather than dismantles, the inside-outside thinking going on here.[39]

Deleuze presents the philosophy of the virtual in several books, and I rely on *Bergsonism* from 1966 and to some extent on Derrida's two Cinema books, which are also "Bergsonian" according to Deleuze. Virtuality as I

38 I am using Jean-Francois Lyotard`s concept of the unpresentable from *The Inhuman : Reflections on Time*.

39 Slavoj Žižek, *Organs without Bodies*, New York, 2004, p. 3.

use it here begins with the French philosopher Henri Bergson and with the contemporary French writer Marcel Proust, who provides Deleuze with the definition, "real without being actual, ideal without being abstract" from *Remembrance of Things Past*, which becomes a philosophy in itself in *Bergsonism* and other books by Deleuze. Bergson is important for Deleuze, and Bergson seems to have gained topicality as a philosopher in times of change because his process thinking of the world goes beyond reductionist approaches to the human while remaining materialistic.

Žižek's critique is contemporaneous with the promotion of virtual reality as a presentation form. The technology seems to be continuously evolving and the future promises even more, according to virtual reality's proponents, and this is unmistakable in the popular scientific discourse of climate change communication. Admittedly, the virtual, as in real virtuality, is not an easily comprehensible concept because it demands a lot of the reader of its philosophy, and I would say that it is telling that the literature that has anything to do with virtual and reality is either full of references to Deleuze, Bergson, and Proust or does not mention them at all. For this thesis, the heuristic value of keeping them apart is that I claim that one of the problems of scientific climate change communication is that it often wants to present the real virtuality within virtual realities, which are manifestations of the Cartesian perspectivism *par excellence*, and therefore such communication fails.

French art historian George Didi-Huberman presents a quite similar concept of the virtual as Deleuze's, but Didi-Huberman becomes easier to apply because he makes it operational in his analysis of actual paintings. For him, the virtual image arises as the event when a beholder meets the image as pure visuality, and this image contains not only the central image but also all the things around it. Didi-Huberman advises us to stop speaking only of "the subject of a painting, or of what is imitated in it" because it is only then that it will be possible to see what virtualities unfold within and around an image. I would say that he productively differs in his hands-on view of the virtual in comparison to Deleuze who would denounce this as a vain attempt to reach that which is not really reachable but is nevertheless fully real. Didi-Huberman is using the word virtual as a concept meant to "suggest how the regime of the visual tends to loosen

our grip on the 'normal' (let's say rather: habitually adopted) conditions of visible knowledge", the normal being denotatively figurative images while the virtual images have other qualities such as vagueness.[40]

When it comes to the visual culture of climate change, I understand that there is hope that the supplementary visuality used in junction with scientific graphs, maps, and tables can do this – that this supplement will make us loosen up to see beyond what it is possible to see in the proper scientific images. According to Didi-Huberman, the virtual images have the "strength of a multiple deployment", meaning that they evoke meaning beyond the univocal and point to constellations of significance, and I argue similarly that climate communication needs to achieve such a state in order to do pictorial justice to the changing world.[41] That is why this type of virtual images can provide a needed complement to the typical images normally presented in virtual reality.

The Deleuzean way of thinking is probably well known to most scholars within visual studies, but it is doubtless unfamiliar to most in the natural sciences. However, there is much evocative thinking within the climate sciences that lends itself to thought-provoking philosophy, for example, the previously unthinkable tipping points like the shutdown of the North Atlantic Drift. I argue that the Deleuzean philosophy resembles the natural scientific understanding that there are singular system points from which there is no return and that human activity has an effect on geological scales of both space and time that are rapidly moving us to those points. For me, Deleuze is a natural philosopher of change who can be read in juxtaposition to the IPCC reports, which challenge us to realize that "[c]hanges in [climate] systems and structures may call for new ways of thinking", and both are inspirational resources to embrace.[42] I argue that we need philosophical resources to understand the fact that forces within climate systems are far greater than humanity's – even if humanity has triggered these forces – and now it might lie beyond human possibility to prevent them or to understand the world that will come with them, let alone

40 Georges Didi-Huberman, *Fra Angelico*, Chicago, 1995, p. 1.

41 Georges Didi-Huberman, *Confronting Images*, Pennsylvania, 2009, p. 18.

42 IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*, 2012.

represent them within the prevailing visual regime.

The French philosopher Francois Lyotard describes limitations for what is presentable in the essay "Representation, Presentation, Unpresentable" translated to English and published 1988. It is not about climate change but instead how some things become unpresentable and for Lyotard the "unpresentable is what is the object of an Idea, and for which one cannot show (present) an example, a case, even a symbol", for example the idea of good, the instant and in general the absolute.[43] I would like to add change in itself to this list. For Lyotard, the presentation limitations do not come from a lack of technology instead he argues that we our losing the possibilities to present the vague and indeterminate because photography has outrivaled painting as a primary representational practice in society. Photography is automated to a high degree and takes away the recognition process that the painter necessarily must master. Lyotard does not write about climate communication, but the relevance of this argument for the analysis of climate change communication is that diametrically opposed arguments are frequently used. For example, scholar of climate and landscape visualization Stephen Sheppard is arguing for technological perfection when he writes that "realistic landscape visualisations" are the most promising means to produce the engagement and behavioural change that is necessary to meet the challenges of climate change.[44] Sheppard is definitely not alone, but he is one of the best examples of this position, and he adds that the emerging virtual reality technologies are especially attractive for communicating climate change. Lyotard, on the other hand, can be used to make the contrasting argument when he writes, "[w]hen the point is to try to present that there is something that is not presentable, you have to make the presentation suffer", because the painter understands that there are no absolute symbols and figures that signifies the unpresentable and a difficult detour through imagination of the beholder is therefore necessary. If we apply this to climate communication, then the solution is not to make perfectly crisp realistic representations, at least not when the referent is not a thing that can easily be depicted, but instead

43 Jean-Francois Lyotard, *The Inhuman : Reflections on Time,* Stanford, 1991.

44 Stephen R. J. Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour", 2005.

leave the simple idea that there are "stable symbols".[45] I argue that it is very often something other than a thing that is referred to in climate change communication, and it is more often a correlation, interaction, bifurcation point, uncertainty, or risk that is being referred to and these things could be called unpresentable. Lyotard claims that the indeterminate in photography will be "lost because it cannot be forecast", in other words, technology cannot be pre-set to capture something fundamentally intangible such as uncertainty or risk. According to Lyotard, indeterminacy could also not be forecasted in the world the painter represented, but the less than "perfect" painting remained open for interpretation and imagination. Indeterminate or vague photographs can be found in the visual culture of climate change and they are considered aesthetic here. They often productively supplement the scientific image that are limited by the visual regime. So it seems that the analysis of the unpresentable applies to the ergonal material and less to the parergonal which goes beyond the confines of the visual regime.

The French philosopher Gaston Bachelard sees scientific progress as a poetic production because scientific findings change those who think them. In other words, Bachelard understands "poetic" in its etymological meaning where a poetic image is a "making" of an idea. It is mainly scientific thought after Einstein that he finds mind altering because such thought complements the Newtonian and Cartesian way of thinking with an alternative. Thus, when Bachelard writes non-Newtonian or non-Cartesian, it is not in opposition but as an expansion of thought from habituated thinking. Scientific thinking is changing the subject, and science is also always changing.

The scientific images are as much about the making of an idea as they are about the transmission of formal knowledge from a Bachelardian perspective. This is a view on knowledge where it "is like an alternating current oscillating between" known and knowledge, according to Mary McAllester Jones who writes on Bachelard's thoughts in between science and the humanities. McAllester Jones argues that there was no conflict between this poetic approach and a strict natural science for Bachelard

45 Lyotard, *The Inhuman : Reflections on Time*, p. 125

because he was philosopher, scientist, and poet at the same time.[46] There seem to be many non-conflicting combinations in the Bachelardian thinking, and his analysis of imagination applies to both textual and visual images. Nonetheless, it is mainly literary poetic images that are analysed in Bachelard's many books on the subject, but they do not exclude the image in the visual arts. There is a production of tension between realism and reality in Bachelard's thoughts. Reality exists even though we construct it. Realism, on the other hand, is the idea that the world exists totally independent of the subject, and this is an idea that is shown to be flawed by the modern sciences and should therefore be abandoned, according to McAllester Jones´reading of Bachelard and I agree. One could say that Bachelard provides the sciences with the epistemology that he considers them to be missing, and he embraces the idea that "[s]cience in effect creates philosophy", but this means that "[p]hilosophy must therefore modify its language if it is to reflect the subtlety and movement of contemporary thought."[47]

Bachelard divides imagination into formal and material, and both are at work in most images because images express both form and matter, but it is matter as such as it is experienced through the material imagination that is the focus of his analysis. According to Bachelard in the introduction to *Water and Dreams*, aestheticians have given form too much importance, probably because form seems to give rise to individuality. He also argues that matter itself, as well as that which lies beyond the surface of matter, can give rise to feelings. Through meditation, or reverie of matter, the world opens up to us and we see how "black flowers bloom in matter's darkness", meaning that beyond the superficially apparent lies another world of signification where mind and matter are deeply intertwined, and this is where he takes his readers to understand.[48] Bachelard regards the sciences as fostering a philosophical relationship to the world in which the sciences are challenging the perceptions that we commonly have of the world. This, combined with his analysis of material imagination, where

46 Mary M. Jones, *Gaston Bachelard, Subversive Humanist,* Madison, 1991. p. 16.

47 Gaston Bachelard, *The New Scientific Spirit,* Boston 1984. p. 3.

48 Gaston Bachelard, *Water and Dreams: An Essay on the Imagination of Matter.* trans. Edith R. Farrell, Dallas, 1999. p. 2.

bodily shared experiences of matter beyond form, makes it applicable to the material that I have gathered. Material imagination offers explanation to why some of the supplementary material seems to evoke what the ergonal material fail to communicate. Bachelards embracing of the possibility offered by the material in itself to think beyond obvious figures and symbols as an exit from the unpresentable in my application of the concepts. Hence, Bachelard becomes an important thinker in the analysis of this thesis.

Why The Drowning World?

The inspiration for the title of this thesis comes from the science fiction writer J. G. Ballard's book, *The Drowned World*, but I preferred the title in present tense; drowning instead of already drowned. Ballard's post-apocalyptic book was published in 1962. This coincided with Rachel Carson's *Silent Spring*, but Ballard's book was neither intended nor received as "environmental". Carson's book was described as an eye-opener for many people and evoked a strong, sympathetic public reaction.[49] The book appeals to our imagination when it opens the first chapter with a description of a fictional ongoing catastrophe due to the emission of chemicals into the atmosphere and connects this to a supposedly shared experience of fading, disappearing, bird-song, "[t]he birds, […] where had they gone?"[50] It is a brilliant combination of science and imagination that uses literary means to make the reader see what otherwise is invisible to the naked eye. Imagination is the ability to make imagination within our minds and this is what science communication needs to become affective. With Carson science and the imaginary blend into each other even when it is not apparent at first. Evocation of imagination isn't triggered by what happen at the focal point of the text but rather on the sides and in the literary form. Carson uses a description of water to evoke a feeling of how everything is

49 Zuoyue Wang, "Responding to Silent Spring: Scientists, Popular Science Communication, and Environmental Policy in the Kennedy Years," *Science Communication 19*, no. 2 1997.

50 Rachel Carson, *Silent Spring,* Boston, 2002.

interconnected in the physical world, as we would say today. She writes about the flow of water across the surface, soil, and rocky ground. What she conjures is not only the passage of water from rain to ground water, but also all the pores and cracks where water penetrates into and down to a dark sub-surface sea far below. She sucks the reader underground to see the world from the inside.

> "Seldom if ever does nature operate in closed and separate compartments; and she (nature) has not done so in distributing the earth´s water supply. Rain falling on the land, settles down through pores and cracks in soil and rock, penetrating deeper and deeper until eventually it reaches a zone where all the pores of the rock are filled with water, a dark, subsurface sea, rising under hills, sinking beneath valleys. This ground-water is always on the move…" [51]

Rachel Carson is most known for *Silent Spring*, but she has also written three books about the sea. Carson describes how there had been a change in how we perceive the sea, from a place of abyssal calmness to a "place of movement and change". With her books, she showed how the ocean is not a vast and eternal space, but is a place heavily affected by human activity. Carson is part of a long tradition of writers, philosophers, and artists who use the sea to say something about the world beyond what we usually see from our land-based perspective.

Ballard's book *The Drowned World* presents the reader with a wet, hot, steaming world. The book begins in a hotel suite at the London Hotel Ritz after a series of solar storms and "the succession of gigantic geophysical upheavals which had transformed the Earth's climate" in such a way that the Hotel Ritz is the last house standing by the lagoon where London used to be – but Ballard does not at all attribute the change of climate to humans. In the 1960s, a celestial cause for such a climate was more intriguing, nevertheless, "[a]ll over the world, mean temperatures rose by a few degrees each year", and the planetary effects that follow in the book sound familiar to those climatic realities projected due to anthropogenic climate change, only pushed all the way to the end. Kerans, who we follow,

51 ibid., "Chapter: Surface Waters and Underground Seas".

wades through a jungle in the last sentence toward a eschatological place, "he left the lagoon and entered the jungle again, within a few days was completely lost, following the lagoons southward through the increasing rain and heat, attacked by alligators and giant bats, a second Adam searching for the forgotten paradises of the reborn Sun", and a total back to nature.[52] Kerans sinks into deep time as he cuts loose from the last pieces of what remains of society. It is a gradual loss of civilazation, which is replaced by violence. Memories from ancient times resurges in the mind of Kerans who isn´t sure if he is loosing his mind or if the memories are really are his. I would call them virtual memories and the story connect the human mind to the matter of the world in violent way.

Cultural theorist Malcolm Miles analyses *The Drowned World* in his book *Eco Aesthetics* (2014) where he notes the lack of human involvement in the changing climate and writes appreciatingly about Ballard's "radically other, uncaring Nature" that offers no hope of any Gaia nonsense.[53] I would say that Ballard also presents to us a future where only a few degrees change in mean temperature sends civilisation on a "descent into deep time" and where one cause has not just one effect, but instead has multiple, cascading effects.[54] The book is bathed in a mythical primordial soup where our bloodstream carries virtual memories from an archaeo-psychic past, all mixed with pseudo-scientific concepts that trigger the imagination. The inhabitants of this drowned world can only travel by boat, canoe, or rafts, but the water also has an active role in moving around silt and topsoil, turning the remaining land into meandering deltas. The physical world is totally deterritorialised and smoothed out as all roads and most infrastructures are underwater, and violence becomes the main characteristic of social life. Everything is soaked in water, from the minds of the people to the place where they wait out the apocalypse that is quickly closing in. But it is not the end of the world that is coming, and the second Adam is stumbling through the wetlands toward the sun that is burning his eyes.

52 Rachel Carson, *The Sea Around Us,* New York, 1951.

53 Malcolm Miles, *Eco-Aesthetics : Art, Literature and Architecture in a Period of Climate Change*, New Dehli, 2014.

54 J.G. Ballard, *The Drowned World,* New York, 1962. "Chapter two: The Coming of the Iguanas."

It is the return of a lost world. Scenes that remind of *The Drowned World* can be found in the visual culture of climate change, which is full of iconic places being submerged and of watery immersions. However, they are not so miserable – instead many images in the visual culture of climate change tend to be hopeful. I appreciate Ballard´s much darker thoughts. It is often said that we need a climate story of technological and political progress to inspire to action and my guess is that could be a motive to do hopeful images of the future. Sometimes, I would like to see somewhat gloomier stories and appreciate Timothy Morton who exclaims that "utopian eco-language turns me off [as it] is far too affirmative", sometimes I feel the same, especially when far too much optimism is put on technological future quick fixes.[55] The physical science basis of climate change is the opposite to affirmative, it is harsh and yet fascinating as it tells us about climate futures that are difficult to grasp. Still, it is possible to embrace the fact that we know that we don´t know and begin to rethink the world. This could be a way to "upgrade of our ontological tools", which Morton argues that we have to do in order to be able to adapt to a changing and unpredictable world.[56] He argues that there has been a change of mind and we are becoming able to think of the world as a whole and this makes the changing world intelligible to us. This aspect of the discourse is particularly interesting from the perspective of this thesis. I argue that the scientific images are not really able to equip us with the complex thinking ability that is needed to grasp the changes of the world.

55 Timothy Morton, *The Ecological Thought*, Cambridge, 2010, p. 15.

56 Timothy Morton, *Hyperobjects : Philosophy and Ecology After the End of the World*, Minneapolis, 2013, p. 111.

Research background: three fallacies

This research background is structured around three fallacies of how the problem of climate change communication is articulated in the scientific literature and then a more general section "Humanities and social sciences on climate communication" where perspectives closer to the visual studies field is discussed. The fallacies are the pedagogical, representational, and the technological. I claim that they lead to different kinds of false questions when the overall question is: *What is the problem with climate change communication?*

This general question comes with much of the climate communication studies today, but it is often phrased differently. The argument I put forward here – that climate communications are fraught with false questions – is the exploratory starting point of this thesis. The analytical approach to previous research is inspired by Gilles Deleuze's book Bergsonism. Deleuze's interpretation of Henri Bergson's philosophy provides tools to rephrase problems of difference in degree and kind when the fallacies themselves come from the social and cultural mindset. Deleuze writes, "[w]e are wrong to believe that the true and the false can only be brought to bear on solutions, that they only begin with solutions", and this demands that we realize that many problems are ready-mades that must be reformulated in order to be answered in a productive way.[57]

The two most widespread ideas of what the problem of climate communication is are 1) that the effects of climate change lie in the future, and 2) that the cause of climate change is invisible, and therefore challenging to communicate.[58] A very characteristic articulation of the second problem is that climate change is "a particularly challenging case of environmental communication because its main cause, greenhouse gas emissions, is invisible", as Stephen Sheppard formulates it. Yet, I observe that many scientific communication challenges seem to have succeeded even when the cause was invisible. Take the banning of ozon depleting chlorofluorocarbons as a similar environmental problem that was resolved.

57 Gilles Deleuze, *Bergsonism*, New York, 1988. p. 15.

58 S. R. J. Sheppard, *Visualizing Climate Change : A guide to visual communication of climate change and developing local solutions.* London, 2012.

It was global problem caused by an invisible gas that needed a political solution. I would say that the invisibility of carbon dioxide should not be the reason for the lack of public engagement and policy change. The source of carbon dioxide should be most tangible to most people driving their car or taking a holiday trip by plane. I will return to the other most commonly mentioned communication problem, that the effects of climate change lie in the future but first, the current image of climate communication is ambiguous. Communication researcher Susan Moser stated in 2010, with a tone of finality, "[m]edia practices have improved and public awareness – at least in many developed countries – is reaching saturation levels", but in retrospect I would say that she was wrong as climate is markedly more present today.[59] Still, the fundamental change in behaviour and decision making has not happened…or has it? Moser attributes the lack of action to the varying impacts that modern media practices have had on different groups, that the message works only for some groups. I am sceptical about the pessimistic story that is told about this communication, but I agree with Moser that the public discourse is drenched in climate change.

The pedagogical fallacy

Climate change communication has mainly been framed as a pedagogical undertaking where the mission is to answer how the natural facts should be transmitted to the public and politicians for them to take necessary action and to make the right policy decisions. There are numerous such studies and articles belonging to Public Understanding of Science and Technology and related research fields. They share a somewhat positivist approach to knowledge and presume that all of their questions can eventually be answered. There are also more critical pedagogical approaches that will be referred to, but they are also often afflicted with a similar pedagogical fallacy. This fallacy is to posit a fault, either with the sender of the message or with the receiver of the message, within the same model of

59 Susanne C. Moser, "Communicating climate change: history, challenges, process and future directions," *Wiley Interdisciplinary Reviews: Climate Change* 1, no. 1 2010.

communication. Supposedly, this model, with a "mechanistic exchange of information (the speech) between a messenger and a receiver", has been abandoned within communication studies.[60] However, the sender-receiver model seems to linger with us still, and arguing for its abandonment has so far been in vain.

The main problem with the model, as I see it, is that "receivers" are described as either scientifically illiterate or non-engaged in order to explain the failure of communication. Climate change, like many other scientific and social challenges, involves everybody, and the cause cannot afford a blaming of "the receivers". The critique of how communicators of science in general view the lay public is not new. As early as 20 years ago, science studies researcher Brian Wynne criticized science institutions for being unaware of how people reflexively negotiate knowledge. Wynne writes, "[r]eflexive institutions would be needed to place science-public interactions on a more constructive footing", this critique was aimed at science communication in general and not climate communication in particular but is applicable to it today.[61] Also British professor Birgitte Nerlich writes about climate and the models that Wynne criticises and refers to him when saying, "[m]essages are seldom transmitted in a linear fashion from those who know to those who have deficit knowledge", in line with how I approach this problem.[62] In addition, Nerlich argues that the physical and social reality of climate change is highly complex to understand, and the communication of it and any science communication of climate will thereby be of even greater complexity. Wynne's critique of public understanding of science models is mainly that sender-receiver models imply a rather passive receiver instead of an active agent. This becomes particularly pertinent in climate change communication because one of the aims of the communication is to produce an active agent who starts making smart climate decisions. Nerlich maps the scientific literature

60 ibid., p. 37.

61 For an overview and discussion on different communication theories and models, see Janette Webb, "Climate change and society: The chimera of behaviour change technologies," in *Sociology,* 2012.

62 Brian Wynne, "Public uptake of science: a case for institutional reflexivity," *Public Understanding of Science* 2, no. 4, 1993.

of climate communication and identifies three recurring aspects for meaningful engagement: understanding, emotion, and behaviour. I add arrows between them to arrive at the model that I interpret to be the most prevalent one: understanding --> emotion --> behaviour. This becomes a flowchart where the arrows symbolize one-directional processes, and this corresponds to many of the climate communication strategies that I analyse. This model is described, and also prescribed, along with many others, by Stephen Sheppard in *Visualizing Climate Change* from 2012.[63] However, this idea is flawed when viewed from a cultural studies analytical point of view and I will return to why below.

Admittedly, Sheppard does present alternatives and he discusses many different means to create behavioural change, engagement, and knowledge. Still, the expectation of how climate knowledge should be used by the "receivers" fundamentally diverges from how the models actually construct the receiver. First, these receivers are passive, then emotionally engaged, and finally physically active in making the right decision. I would say that the models construct everybody – be it a citizen, community, or the general public – as something that is being filled with knowledge. These bodies are then infused with emotions, which motivate them to do the right thing. Nerlich categorises them as a conduit model of communication that "does not work."[64]

Linguist Michael J. Reddy identified the use of *conduit* metaphors in the 1970s when corpus analysis showed how the construction of English sentences frequently implies that words *contain* thoughts. The term conduit is more often used for a water channel and is here used to say that it is one-directional sender-receiver moder of communication. Reddy doesn't argue that messages can be transmitted as a fluid, on the contrary and he doesn't say that the conduit model works but shows how the idea of language as a conduit always was construction in language. Reddy writes, "[t]he conduit metaphor – would now lead us to the bizarre assertion that words have 'insides' and 'outsides'", that the form of language

63 Sheppard, *Visualizing Climate Change : A guide to visual communication of climate change and developing local solutions*.

64 Nerlich et al., "Theory and language of climate change communication," *Wiley Interdisciplinary Reviews: Climate Change* 1, no. 1 2010.

would contain ideas that can be moved from one person to another.[65] The thing is that this was not a model for how communication should be done, but rather, it was an analysis of how (English) language users are led to think that words are containers for thoughts by the way metaphors and figurative language is used. It was a critique of a model rather than recommendations on how to communicate. Of course, the identification of the model and the following critique has left us with almost the same language that the model criticized; language does not change that quickly, and English still leads its user to think that words contain thoughts. Reddy's analysis provides us with arguments for why it is necessary to study how communication is done and not only by which words are used or what the intention behind the words might be. I would say that the same goes for images, symbols, and figures – it is not only what they say but also how they say it.

It is difficult to find outspoken proponents for a simple one-directional sender-receiver model like the conduit model of communication. This does not mean, though, that science communicators have totally have left this manner of thinking behind. In fact, I question that the transmission models are abandoned at all when I look at scientific presentations that target the public. A hypothesis of mine is that the introduction of aesthetic images among scientific images is compensation for a failing transmission communication. Aesthetic images are allowed in conjunction with scientific images – often in backgrounds, as frames, or on the covers. If this hypothesis holds true, this means that climate change communicators already go beyond boundaries – boundaries that they only seemingly uphold through guidelines and communication strategies. Take the IPCC communication strategy as an example of this. This strategy describes who is allowed to talk as a representative of the IPCC and how one should talk, and it describes in detail how the process is organized for going from a cited article to advice for policymakers. The strategy does not demand popularization of content, and that is only logical because it is not the general public that is the receiver of the message, but policymakers.

65 Michael J Reddy, "The conduit metaphor: A case of frame conflict in our language about language," *Metaphor and thought,* 1979: p. 288.

Nevertheless, it is still an example of a balancing act between the science, which is always complex, and the ambition to deliver applicable advice to governments, who are expected to change policies. The strategy states, among other things, in its *Summary for Policymakers (SPM)* that "authors should be aware of the need to produce clear, comprehensible texts and graphics that support the key findings in the report". [66] This is also what one first finds when reading through the SPM where texts and the graphics are clear and comprehensible, as intended, but a closer reading reveals the summaries to be less straightforward.

In a discourse analysis of the text in the SPM from 2007, language professor Kjersti Fløttum and linguist Trine Dahl find that there are many contrasting voices present even though the SPM aims for consensus. The SPM is a guide for presenting climate science to policymakers because scientists seldom talk with one voice. However, Fløttum and Dahl show how uncertainty is produced and then conveyed to the readers through the use of qualifying words, such as "but" and "nevertheless", in between scientific statements. Here is one example: "[p]eer-reviewed estimates of the social cost of carbon in 2005 average US$12 per tonne of CO2, *but* the range from 100 estimates is large (–$3 to $95/tCO2). This is due in large part to differences in assumptions regarding climate sensitivity, response lags…" [67] The word "but" introduces uncertainty because it sets different sources against each other, or as in this case, introduces a number of factors that destabilize the preceding estimation. The result is that the text as a whole implies more uncertainty than each source would otherwise show. It is the way that sources are presented together and not the sources themselves that does this. I see something similar when aesthetic images appear in conjunction with scientific graphs, maps, and tables in the broader scope of this thesis but the aesthetic images add complexity rather than introduce uncertainty to the whole. When uncertainties are introduced into the IPCC summary discourse with the use of qualifying words, complexity is added to the visual culture of climate change just as

66 *Communication Strategy* decided at IPCC 35th Session, 6-9 June 2012, Geneva, Switzerland. www.ipcc.ch/meetings/session35/IAC_CommunicationStrategy.pdf

67 Nerlich et al., "Theory and language of climate change communication." The authors are quoting IPCC, SPM, 2007, (my italics).

aesthetic images are added to scientific images. It should also be noted that Fløttum and Dahl criticise the deficit communication model, a model that suggests that the receiver of a scientific message could be filled up with the knowledge he or she is missing. Fløttum and Dahl identify a movement away from these models even though "calls for better science communication still often carry a flavour of the deficit model".[68] Few – if anyone – propose that the deficit model would be a good way to do communication; the really interesting question is why so many find it necessary to reject it.

The representational fallacy

There are variations concerning the representational fallacy, but I would say that the most fundamental question is whether or not it would be possible, in principle, to actually and finally capture change with a representation. Scientific representation through visualization is committed to the task of producing images that present the world as it is. However, the future remains open and is always in a state of becoming. Stephen Sheppard's guidebook *Visualizing Climate Change* is representative of both the most common problems in climate science communication and their proposed solutions. Sheppard advises climate communicators to make use of beautiful, realistic and picturesque visualizations of future landscapes to transfer knowledge and engage audiences through emotions and thereby facilitate changes in behaviour. There is a temporal thinking here, but it is brought about through representations of (future) space, i.e., the beautiful and realistic landscape images. The realistic images of how a given neighbourhood or region might become flooded by an imaginary storm surge is supposed to give the audience knowledge of how life will be in the future, and this is intended to change behaviour to such a degree that this worst case scenario can be avoided. So goes one of the most common arguments. Sheppard writes:

68 Reddy, "The conduit metaphor: A case of frame conflict in our language about language."

> "In particular, realistic landscape visualisations may offer special advantages in rapidly advancing peoples' awareness of climate change and possibly affecting behaviour and policy, by bringing certain possible consequences of climate change home to people in a compelling manner".[69]

I would argue that this problem is temporal rather than spatial. The future is not accessible to us through representation of space, and it never will be. Yet, it is almost always depicted through spatial representations. I argue that visualizations that show time and process are better if the aim is to promote different behaviours vis-à-vis the future climate. There are art works that shows that it is possible to do differently and it will be discussed briefly in the concluding chapter, but the major parts of ambitious visualizations that I have seen are bound to the idea that science should represent something that really exists in the physical world. However, the aspects that are crucial to present in communicating climate change does not yet exist, and thus it does not readily lend itself to scientific representations.

Communication researcher Sophie Nicholson-Cole has written "a critique on the use of images for visual communication" in which she analyses interviewees' experiences of climate change "futurescapes", and such a study object can be seen as an application of Sheppard's advice.[70] The problems she identifies are mismatches between visualization and audience, and her advice is to tune the images to the audience's background and knowledge. She reminds the reader that one set of images will never work for all audiences; her overall aim is not to find the solution to how influence through visualizations can be made as powerful as possible, but to find the ethical boundaries for what should be done. Nicholsson-Cole means:

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69 Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour."

70 Sophie A. Nicholson-Cole, "Representing climate change futures: a critique on the use of images for visual communication," *Computers, Environment and Urban Systems* 29, no. 3 2005.

> "[b]ecause of the great potential for using visualisations to motivate and engage people with issues like climate change [...we must] remain aware of the ethical and methodological issues associated with using computer-generated visualisations."[71]

This concern is an expression of the strong belief in the power of the image – that an image is worth a thousand words, as the saying goes – and that images can be dangerous if used carelessly. I am hesitant to agree, and I see this as an overly enthusiastic belief in the power of representation. Nicholsson-Cole argues that climate images potentially trigger strong emotions in the observers and can leave "the audience desensitised with a sense of 'issue fatigue' or leading to feelings of powerlessness to do anything to reduce the causes of climate change".[72] Nevertheless, the futurescapes are still only visualizations of space, which is the main problem with climate change visualizations, as they then often fails to present change, risk and uncertainty. The visual regime of climate science is predisposed to show space instead of time, and the result is that the imagery fails to account for the complexity of thinking in process and time, which is necessary to grasp climate change and its coming effects. A more recent article by Schroth et al focuses "on recognizable representations of local impacts within an interactive game environment" as visual alternatives to iconic motifs such as polar bears.[73] The main question that is raised is whether 3D imagery and virtual gaming can be used to change behaviour and spread knowledge about climate change. This approach is supposed to be different from both one-way communications, i.e. the sender-receiver model, as well as more complex communication and it acknowledges that any message is subject to the interpretation of the receiver.

Schroth et al takes the list of problems for climate visualizations in Moser's article – which was cited at the beginning of this chapter – and writes that "[a]t least three of the temporal and visibility challenges Moser identifies could be addressed through climate change visualizations and

71 ibid., p. 256.

72 ibid., p. 261.

73 Schroth et al., "Visual Climate Change Communication: From Iconography to Locally Framed 3D Visualization."

future scenarios in an interactive game environment".[74] Schroth argues that a video-game can give the player access to time in a collapsed form because it is possible to travel through decades of virtual time and see the result of previous choices made in the game. This goes for good and bad choices, either those that result in mitigation of the effects or those in which a lack of action leads to the full consequence of climate change. Still, the conclusion of the video-game study is that it is scientifically and technically challenging to bring "the realities of climate change to the local community level through images". Depending on how we articulate the question, this can either be viewed as a mismatch between image and audience or as a much more general problem of representation.

I argue that "realistic images" of a future landscape are difficult to make home-like for any given audience. Any given locale is only home-like to those living there, and this demands that every visualization or video-game be adapted to every local audience if realism is sought after. Another problem, which is paradoxical in nature, is that the places that we expect to change the most are thought to change to such a degree that they will not appear home-like at all – they will be unrecognizable. The fallacy is to neglect that there are aspect of climate change that are unrepresentable (Lyotard) with the kind of images that are used in science communication today. Schroth recapitulates that video-games can contribute to the overall change of leadership and governance in the "ecosystem of change" that must come about if we are to make any attempt at mitigating climate change.[75]

The image in figure 2 comes from a communication projects that also aimed at studying how its audience receives climate change communication. The most interesting question, though, is why these kinds of images are used at all in a high-tech 3D visualization. I argue this is symptomatic of the representational fallacy that I propose to underlie climate communication research in many cases. The answer to why this particular is used is that high-tech immersive environments have the same limits for what can be shown in more traditional forms of presentation due to the

74 ibid.
75 ibid.

Figure 2. CSPR WorldView climate visualization project in Norrköping Visualization Centre.

visual regime. The photograph is taken from a climate visualization project in the Norrköping Visualization Centre. We see how emissions are represented with different heights for each nation. This is but one example of how a visual regime limits the ways in which climate change is presented because this and many other sequences in this visualization could well have been shown on a flat screen. Victoria Wibeck, who is affiliated to the centre from where the project stems writes that there are limitations to what can be visualized, and they fear that there is a risk that this will affect the story being told, "[o]ne potential trap of ICT-based visualization presentations is that the storyline might be formed by what is possible to visualize", and I agree and would even add that our thinking is limited by what can be shown with images.[76]

These limitations, whether we choose to call them discourses, boundary work, or conventions, make the full complexity of climate science unpresentable. In the anthology *Image Politics of Climate Change* it is claimed that the effects of climate change are un-imaginable even though there are examples of successful scientific visualizations. Schneider et al writes that even if they can be visualized, "[s]ome findings are so vast and huge – they contradict all experiences we have about the world today; in fact they are unimaginable", and this frames the problem as representational even though that term is not used.[77]

The technological fallacy

The *State of Climate Visualization* report from CSPR states that "there is great potential for future development of visualization tools" when it comes to produce science as well as communicating the scientific results.[78] The reason to why advanced presentation technology should be used is that it can "feature the invisible", for example gas emissions and future

76 Victoria Wibeck, "Enhancing learning, communication and public engagement about climate change – some lessons from recent literature," *Environmental Education Research* 2013.

77 Birgit Schneider and Thomas Nocke, *Image Politics of Climate Change: Visualizations, Imaginations, Documentations.* Bielefeld, 2014. p. 13.

78 Neset, et al., *State of Climate Visualization.* Linköping, 2009. p. 19.

scenarios and the authors write that visualization tools provide new approaches. I would say that the report voices a widespread belief that the technological development will provide solutions to the proclaimed communication problem of climate change. However, the reasons to invest in new technology for the presentation of the climatic futures seems also to be driven by the same motives as in rest of society, namely, a desire for cool tech.

Sociologist John Urry writes about the drawbacks with ICT and climate mitigations as the technology is energy-intensive and how the on-line life often isn't an alternative to travel or meeting face-to-face but often the opposite, connectedness drives consumption.[79] Urry is sceptical to technological fixes of the climate, like so many other, but he is also sceptic about how environmentally friendly ICT is. I would say that it is a hallmark for climate change communication to put the trust in new communication technology, however, this technology could also part of the problem; media technologies are not necessarily green just because the message is green. Maxwell and Miller show precisely how dirty media technology is, and they argue that green-washing of media is achieved with media, thinking that "[p]erhaps the obsession with immediacy and interactivity via networks induces an ignorance of the intergenerational effects of consumption, inhibiting our awareness of the long-term harm to workers and the environment."[80] They continue and ask rhetorically if the constant connectedness to the Internet could "actively diminishing our ethical ability to dwell on interconnections between the present and future, between media and the Earth."[81] Of course, ICT doesn't have to be either harmful or enlightening for our feeling of belonging in the world, feeling for the world and knowing about the world. Still, the critical analysis of ICT are needed to curb the enthusiasm of the many proponents of visualization as *the* solution and turn attention to perceptions produced by the technology and how it makes us act in the world. Interactive media doesn't necessitate that anyone is activated in making changes outside the sphere of for example virtual reality. Though, Maxwell and Miller ask

79 John Urry, *Climate Change and Society*, Cambridge, 2011. pp. 143-44.
80 Richard Maxwell and Toby Miller, *Greening the media,* New York, 2012.
81 ibid. p. 4.

rhetorically whether the "constant connectedness [is] actively diminishing our ethical ability to dwell on interconnections between the present and future, between media and the Earth" and their answer is simple – it does.[82]

The report mentioned above on the current state of climate visualization was written in connection with the start-up of the Worldview project (CSPR) at the Norrköping Visualization Centre where they produce visualizations from scientific data. The report provides a good introduction to the field because the different chapters offer technological clarifications as well as critical analyses. What I appreciated most about the report is its introductory description of the challenge for climate change visualization, namely, "visualization of abstract, multiparameter, time-dependant data as well as on linkages between and intra-linkages within natural systems, such as interactions between climate and the biological systems, between natural systems and policies and measures".[83] This is a succinct formulation of the problem that counter the tendency to reduce it such that the cause of climate change is made invisible and its effects set in the future, which is similar to the above problem description but misses the complexity of the challenge of climate change as well as the complexity of communicating.

Thomas Nocke is a co-editor of a newly published anthology where he also contributes with a chapter on the use of visualization in the research of climate change. His chapter was written with an insight into the technology of present-day visualization, but it also has critical perspectives. Nocke has a background in computer science and graphics, and such a background seems almost necessary to thoroughly understand current research in the field. The software and the hardware technology for making data visible are constantly developing, and this makes it difficult to follow for outsiders. Nocke's chapter takes an insider's perspective and presents the standard visualization techniques and tools and discusses how they are used and approached by the researchers who are using them. I recognize much of the problems he describes from my own fieldwork among researchers who develop and apply the same tools that he discusses. Nocke writes, "[p]roblems for climate researchers arise from the complexity of

82 Richard Maxwell and Toby Miller, *Greening the media,* New York, 2012.
83 Neset et al, *State of Climate Visualization*, Norrköping.

most visualization software tools", and this notion is supported by the researchers that I met. Hence, Nocke concludes his chapter with a call for more development of "easy-to-use" interfaces.[84] One of the informants I met, Jochem Marotzke, questioned whether this would ever be achieved because his experience from working with this the last 20 years was that the "promise was never fulfilled". The promise of user-friendly software has never materialised, he complained, because the developers of cutting-edge tools always present new things, which turns the learning curve into a Sisyphean task for users of the tools. This does not affect the relevance of Nocke's knowledgeable contribution, but it adds another user perspective to the usefulness of the software.

Humanities and social sciences on climate communication

Climate visualizations are also analysed by humanities scholars and they seems to deliver conclusions that diverge from the ones mentioned in this section so far. Take eco-film critic Sean Cubitt who identifies a critical difference between how data visualizations and fiction films resolve temporal problems. Cubitt explains to some extent why climate visualizations often look the way they do. When a fiction film resolves narrative challenges of a temporal nature, it isn't forced to explain how it is possible. Instead, it offers what Cubitt calls an open gesture; time-travel is possible in fiction, and the audience will accept it if the narrative is persuasive, i.e. if it is a good story. This has more to do with a suspension of disbelief than to actually proving that time travel is possible. The situation is much different for the scientific visualization where proof of time-travel must be presented and that makes story-telling much harder. Cubitt observes that "[a]ll data visualizations tend toward spatial solutions for the problems raised by time" and this is interesting, because it means that a space, for example a landscape will be shown as it changes to

84 Thomas Nocke, "Images for data analysis," in *Image Politics of Climate Change: Visualizations, Imaginations, Documentations*, ed. Birgit Schneider and Thomas Nocke, Transcript Verlag, Bielefeld, 2014.

represent time travel in data visualizations.[85]

Even if the Worldview project discussed above aims to use "new narratives", it will not be possible for them to offer any "open gesture" that only hint at the things they are discussing. Instead, everything must be shown somehow. When a phenomenon lacks corporeality in the physical world, then it is shown with for example a pictogram, in ways that often disturbs the storytelling. The mantra in this visual regime is that "seeing is believing", the audience must be able to see the "truth" to believe it.[86] But what if there is nothing to see, nothing to show, because the multiplicity of information blows away every dimension we are habitually used to dealing with? I would argue that a strong belief in technological solutions to the problem of communicating climate change is a problem in itself; the efficiency of communication does not solely depend on the ability to produce "realistic" images. Nevertheless, that is how the problem is most often tackled.

Media theorist Julie Doyle undertakes a visaul discourse analysis of the Greenpeace climate campaigns from the early 1990s to the 2000s. Doyle is an observant describer of the general problem of making climate change visible, and she provides a pertinent visual analysis of the Greenpeace material.[87] I would call her work a visual studies analysis, not only because of the references to Roland Barthes' *Camera Lucida*, but also because of the focus on the visual rhetoric and not just the textual discourse. Her chapter was published in the journal *Science as Culture* in 2007, and it is still relevant to read because environmental campaign material apparently has not changed that much and the historical perspective is relevant.

Another critic of the role of media is George Lakoff, and he approaches

85 Sean Cubitt, "Everybody knows this nowhere: data visualization and ecocritizicism " in *Ecocinema Theory and Practice*, ed. S. Rust, S. Monani, and S. Cubitt, Taylor & Francis, New York, 2012.

86 Edward Morris and Susannah Sayler discussed the problems with "seeing is believing" in "The pensive photograph as agent: What can non-illustrative images do to galvanize public support for climate change action? ," in *Image Politics of Climate Change: Visualizations, Imaginations, Documentations*, ed. B. Schneider and T. Nocke, Transcript Verlag, Bielefeld, 2014.

87 Doyle, "Picturing the Clima(c)tic: Greenpeace and the Representational Politics of Climate Change Communication."

the topic as a cognitive-linguist. He claims in the article "Why it Matters How We Frame the Environment" that we lack the neural frames for making climate change meaningful, and he proposes that a production of new frames is both possible and necessary.[88] Lakoff argues that our mind is evolutionary developed to "run a body" but scientific communication is designed without this in mind, due to a the legacy of Enlightenment, and thereby becomes too abstract to reach out in meaningful way. We actually lack of the proper ideas in order to understand the changing world. Lakoff writes that we suffer from hypo-cognition and we feel seperated from nature because of this. I would say that the parergonal visuality that I present in this thesis could be a kind of remedy for hypo-cognition as it, to some extent, escapes the confines of the visual regime that privileges the mind and gives its audience a more haptic experience.

Birgitte Nerlich and Rusi Jaspal have written several relevant articles about climate and weather in the media. In one their latest articles, they analyze extreme weather and how human experiences of guilt, compassion, vulnerability, courage, and so on are expressed and mediated through images. They identify a recurrent recommendation to avoid images of helplessness and defencelessness so as not to induce deflection strategies among consumers of media. However, "the images that are used to accompany even relatively matter of fact reporting on an IPCC report on extreme weather and climate change seem to convey just these emotions, and may subtly undermine these avoidance efforts", and Nerlich and Jaspal argue that the accompanying images in the media are undermining scientific communication strategies.[89] I will argue for the opposite, namely, that a contemplation of how the world of becoming is fostered by the news media and some IPCC images. Excluding our different arguments, I agree on the dire relevance of studying the broader visual culture of climate change so as to understand how public understanding of climate change is produced – looking at science communication is not enough.

Anthropologist Mark Nuttall has done much of his research in the

88 George Lakoff, "Why it Matters How We Frame the Environment," *Environmental Communication* 4, no. 1 2010.

89 Brigitte Nerlich and Rusi Jaspal, "Images of Extreme Weather: Symbolising Human Responses to Climate Change," *Science as Culture* 23, no. 2 2013.

Arctic regions, and he asks in the article "Tipping Points and the Human World: Living with Change and Thinking about the Future" whether it is possible at all to make images of the future that are meaningful for any audience. This fundamental questioning applies to futures beyond tipping-points, and these future scenarios are what must be avoided because they are irrevocable and singular events. This makes Nuttall's questioning relevant for all climate communication because it introduces questions of human capabilities to understand the world. Nuttall argues for the production of proper anticipation in order to adapt to what is not yet known in a changing world, and he refers to his own observation of Inuit people and their lives in a hostile and changing environment. Nutall writes, "[a]nticipation is about perceiving the world, relating to it, moving around in it, making sense of it, thinking about what to expect from it, and what possibilities exist that one can gain from", and this anticipation is a way of envisioning the future in a productive way.[90] I interpret Nutall as arguing for less manifest predictions of the future as alternative to the scenarios we are used to see where the future will be 2 degrees, 4 degrees, 6 degrees or 8 degrees catastrophically warmer when in fact the future never will be fixed. A productive anticipation has more to do with an ability to imagine how the world is constantly changing and how we inhabit this world and I would say that such anticipation is far more effective for any individual human in a changing world. The natural scientific scenarios need to be supplemented with human imagination.

The anthropological approach can also be found outside anthropology where visuality is sometimes studied in a broad sense. Saffron O´Neill and Mike Hulme show how meaning is produced through "icons" in the media. They write, "[m]ore effective climate change communication approaches are needed which allow individuals to engage meaningfully with climate change".[91] However, they stick to the conventional problem formulation that the challenge of climate change communication is that the cause is invisible and the effects lie in a distant future. In addition, they

90 Mark Nuttall, "Tipping Points and the Human World: Living with Change and Thinking about the Future."

91 Saffron J. O'Neill and Mike Hulme, "An iconic approach for representing climate change," *Global Environmental Change* 19, no. 4 2009.

accept a communication model where efficiency depends on cognitive understanding of the factual issue coming before effective engagement, which I consider too simple. However, O´Neill and Hulme contribute with a distinction between the depiction of an icon and an actual icon and take the much-used polar bear as an example, "a particular image of a drowning polar bear is not an icon (it is a representation of the icon)", and this distinction is important because it is sometimes disregarded. O´Neill and Hulme, conclude their article with a fairly well-known result; images of "icons" close to home are more affective than those from more distant places, and the polar bear has lost its relevance as an icon.[92]

Relevance and topicality

Climate change is happening now, and even though "warming of the climate system is unequivocal" according to the fifth round of IPCC reports, there is a lack of action.[93] This is often articulated as a problem of getting climate science through to both politicians and the general public. Many of the projects I follow aim to produce visualizations that are compelling, realistic, and convincing. Often the problem of inaction is approached by showing how climate change will affect local communities, or major cities.

The IPCC report on management of weather risks from 2012 maintains that "[l]ittle evaluation has been done of visualization projects, therefore leaving a gap in understanding of how to most effectively communicate future risks of extreme events".[94] Thus there is an awareness even within the IPCC about the problem with communication. The report on extreme weather cited above contains a short section on the need for timely and effective risk communication and how cultural and social factors must be taken into consideration. The report does not say how this could be done,

92 ibid.

93 IPCC, AR 5, WG1. p.4

94 IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*, 2012. p. 302.

only that "[a]mong individual stakeholders and groups, perceptions of risk are driven by psychological and cultural factors, values, and beliefs".[95] It is my ambition to address climate change communication, not to finally answer how it should be done, but to bring an *Environmental Humanities* perspective to the table.

95 Ibid., p. 17.

The Dark Background

This chapter will describe some aspects of the scientific thinking about climate ontology – how the climate is wired according to the sciences – and compare it to the images that are produced with the purpose of communicating climate scientific findings. I argue that there seems to be a gap between scientific climate thinking and the actual images used to convey it, at least when it comes to the communication that targets the public. I find that this communication often has a overly pedagogical ambitions and that this reduces the haunting strength of scientific descriptions of the world's future climates, turning them into a rather boring subject. On the other hand, every time I visit the website of the journal *Nature Climate Change*, where much of the latest findings are presented, I find intriguing discoveries about our world and what is happening to it. Take the editorial titled "The Little Boy and his Changing Faces" in the October 2015 issue of the journal as an example, it begins, "[a]ll systems are go, with the much-anticipated *El Niño* event underway." The editorial is about the 2014 El Niño prediction when the somewhat mysterious global phenomenon was thought to start but did not. Besides presenting up-to-date figures on the expected event, we are also told, "Peruvian fishermen are directly affected as anchovy stocks (a key fishery for the country) are reduced under these conditions […and, the] term *El Niño* (the little boy or 'Child Jesus') was actually coined by fishermen of the region as warmer waters and reduced stocks have historically been observed after Christmas." [96] The coming event is expected to be of Godzilla strength and on par with the event of 1997.

96 Editorial, "The little boy and his changing faces," *Nature Clim. Change* 5, no. 9 2015.

The image on the following page is used to show the similarity between the preconditions of 1997 and 2015, saying that is likely that the little boy will become the Godzilla it was then, or even worse (fig.3). I find the text and the image suggestive, and the two worlds in the image appear like the eyeballs of a coming Godzilla looking at me. The short editorial tells me about fishermen in Peru, it describes how climate affects the economies and lives of people, it explains the name of the event and decorates it with religious as well as popular cultural references, it gives an update on the science and data of the phenomenon, and it supplements these descriptions with a scientific image that compare historical data with the present situation. This is a multifaceted storyline of the world told on just a couple of pages with only one image – the sciences are telling stories that are based on facts that are haunting and combined with references to popular culture that are well known.

I would argue that these true stories are of a cosmological character; they show us how the community of climate scientists imagine that the world is wired based on observations, experimentation, model making, predictions, and so on. However, the word "cosmology" is often used to say that something is metaphysical, spiritual, or even religious. It is sometimes easier to use the term "ontology", in the meaning "nature of being" in very broad sense, or just worldview. Surprisingly, there are few articles and books written explicitly about philosophical ontological perspectives on climate. At least this is the case if I compare it with the interest that, for example, continental philosophers and theoreticians like Isabelle Stengers, Manuel DeLanda, Karen Barad or Michel Serres have put into mathematics, architecture, quantum physics, or biology, to mention a few sciences that draw attention and seem to inspire both philosophers and artists. I am not saying that we have a lack of philosophical thinking about climate change, as I consider much of the proper physical sciences-based articles and the whole IPCC project to be a philosophical endeavor in addition to being about meteorology, oceanography, glaciology, and so on. There is a book series that produce ethics, aesthetics, and epistemologies about climate, the *Critical Climate Change* book series is an example of radical philosophy where eloquently stirring texts are

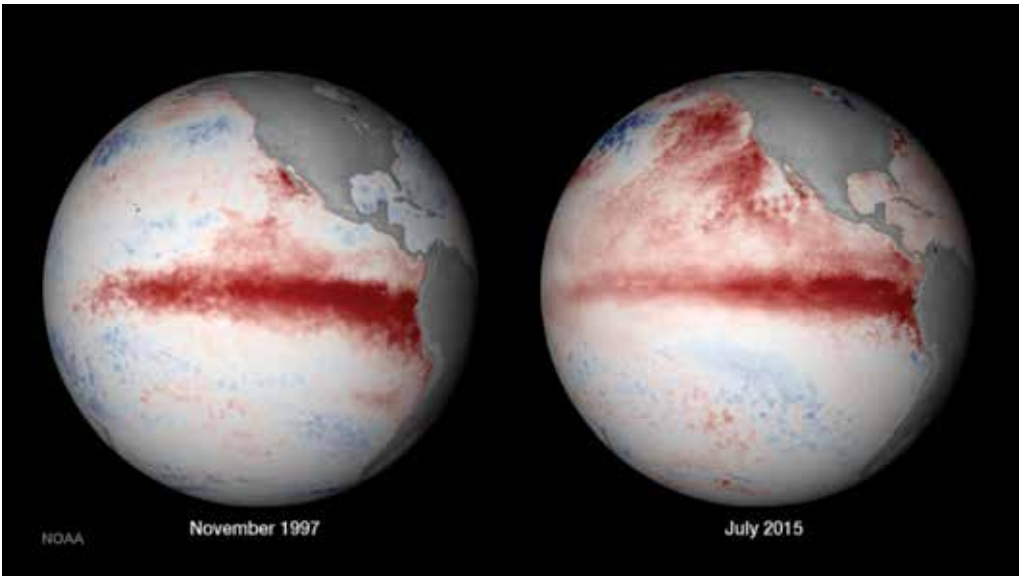

Figure 3. Comparison of sea temperature in 1997 and 2015. Similarities imply that there could be a El Niño of the same disastrous magnitude again. The title of the article in Nature Climate Change is "The little boy and his changing faces". These are the eyes of the boy becoming Godzilla.

published open access.[97] Still, I agree with Sarah Cornell and Jennifer Parker who write from a critical realism perspective that the "lack of ontological renewal of the basic presuppositions of the science is likely to be a major factor in the difficulties ESS now confronts in linking with the human sciences" and who talk about the link between philosophy and climate sciences.[98] ESS is an abbreviation for earth system sciences, and the authors argue that the natural sciences have succeeded in joining up the different parts to arrive at the climate system as a whole, and thus they now ask for an explicit "world view" that fits these complex models. I interpret this as meaning that the coupling of land surface, atmosphere, cryosphere, and ocean systems in climate models is accomplished at the price of failing to renew the ontological thinking and that this has resulted in a system that cannot include knowledge about culture, society, and human influences as part of the planet. Their text is from 2010, and one could argue that the IPCC is producing a model of the complex Earth system as a whole in its latest report. IPCC writes, "understanding of the climate system results from combining observations, theoretical studies of feedback processes and model simulations [… and the models in the AR5] enable the attribution of detected changes to human influences in more climate system components".[99] However, there is still a difference to achieving the holistic thinking that Cornell and Parker call for because holism requires including the human in the model, and there is no explicit philosophical ontology within the reports that show us how this can be achieved scientifically. It is difficult enough to grasp human thinking let alone make models of it that could be coupled to into climate models.

I guess that if that were possible, i.e. if the climate models could include the human condition in its entirety, then there would be no need for making different scenarios because we would know exactly which path we were walking on towards the future. I also suspect that the omission of humans in physical science-based images is a sign of the nuisance of

97 openhumanitiespress.org/critical-climate-change.html

98 Sarah Cornell and Jenneth Parker, "Critical realist interdisciplinarity," in *Interdisciplinarity and Climate Change : Transforming knowledge and practice for our global future*, ed. Roy Bhaskar et al., Routledge, New York., 2010. p. 30.

99 IPCC, AR5, WG1, p. 60.

including the human. For good and bad, human's have a free will, and Hans Joachim Schellnhuber points out that "Earth Systems development is heavily underdetermined and cannot be foreseen, in principle" precisely because of the human will. This will be discussed further in the section "The human factor" below. No matter what, I would guess that many climate scientists believe that we are heading toward a dark future – given the use of dark backgrounds in much of their imagery – but the problem that I write about is that the complex and awe-inspiring ontology of climate lacks the scientific images that could encompass it, at least within the visual regime of the climate sciences. Still, the dark background stands in a supplementary relationship to the main scientific message and offers some relief to the anxious scientific illustration. I will present different kinds of dark backgrounds from several sources and make the claim that its prevalence can be explained as an aesthetic parergon to the scientific ergonal image. To begin with, I will present a beautiful example of mixing science communication and video gaming.

Future Delta

The climate change videogame *Future Delta 2.0* from the Centre for Advanced Landscape Planning (CALP) and University of British Columbia begins in a dystopian future landscape where the citizens and politicians have failed to address the issue of climate change adequately, and society has therefore "been affected by sea-level rise, storm surges, heat waves, and fires, and communities are facing food shortages, high prices, and increased traffic and pollution".[100] The videogame is based on science – the choices the players can make are realistic and the effects of these choices are correlated with CALP's research on climate change. The action in the videogame takes place in the area where CALP is located, and they research the effects of climate change on this delta area. In other words, this is a very involved form of science communication.

The *Future Delta* videogame seems to be an application of the advice

100 futuredelta2.ca/about-future-delta

Figure 4. From the climate change video-game *Future Delta 2.0*.

that Stephen Sheppard, who is director of CALP, gives in the *Visualizing Climate Change* guidebook from 2012, and the image on the next page (fig. 4) is an example of what I mean by the recurrent "dark background" in the visual culture of climate change. The scene contains a literally dark background, in the form of dark skies, onto which events stick out due to their lighter colours. We see the man who watches his car being lost to the flooding and a fire that consumes the woods. I would deem this to be an apocalyptic scene to shed light on effects that appear distant and unlikely from the everyday perspectives of most people. The combination of several predicted risks for the future into this montage is saying that this is what we would imagine if all the bad things happened at once in a doomsday scenario. I find that this rhetoric is common in the visual culture of climate change. Future worst-case scenarios are handy when arguing that we need to do things differently today, and this motivates the production of scenarios or RCPs in the first place. RCPs are the kind of scenarios used in the AR5 reports, they "should be considered plausible and illustrative" and include many economical and demographic components to become representative of plausible future.[101]

The scene in the video game (fig. 4) will unfold if climate model values are set to reflect the business-as-usual attitude of today and we do nothing about it. The future looks dark from today's perspective if we fail to address climate change adequately. This is one reason why I say that the background to the climate sciences is a "dark canvas", or a dark background. We can see the IPCC predictions of worst-case scenario effects present in the above scene, all of which the player of the videogame must try to avoid. The events are coded into the game, and something similar goes for the events in the physical world. The effects of climate change are virtually already real; the only thing they lack is the actuality that will be given to them in time, i.e. if the process that leads to climate change is fuelled with more climate gases these changes will inevitably come about as actual events. Seen from this philosophical vantage point, which also corresponds to the climate scientific vantage point, it is only a question of postponing the events, and this is where the significant differences lie between the

101 IPCC, AR5, WG1, p. 79.

videogame and the world it aspires to represent, at least according to the climate sciences. The game is based on code, but it is produced in the opposite direction to the climate models that predict the events portrayed in the game. Climate scientist are constantly adding climate data into the supercomputers that run the climate models because the world exhibits unknown variations in relevant parameters that could tell us about the future climate, while the game is highly limited by its coding. The real virtuality of the physical world is a creative principle – the world is produced by a series of events – while the code that produces the virtual reality of the game lacks real virtuality. The player cannot actually create anything, but can only chose from a preset number of choices.

This is also the philosophical difference between the possible and the virtual. The Deleuzian virtual "does not have to be realized; and the rules of actualization are not those of resemblance and limitation, but those of difference and divergence and of creation", while what is possible operates within given limitations.[102] The player has a limited number of possibilities to choose from, while the real world is not limited but will proceed to express itself in creative ways that humans experience as events in time. The code in the videogame is written to create the dystopia of the game and to fit the predicted future, and this is the opposite of climate models where predictions come from the data and the future cannot be pinpointed – "Global climate models can only offer an imprecise view of the future", as the director of the German Climate Computing Center (DKRZ) puts it.[103] The videogame rapidly progresses towards its predetermined dystopic future as the player passes ten turning points where choices have to be made, "each one marking the 10-year period and collapsing time within seconds to make future consequences immediately visible", according to Olaf Schroth, one of the researchers engaged in the production of the game.[104] The videogame makes possible large leaps in time, and I argue that the potentiality of gaming could be the way it allows one to experience the

102 Deleuze, *Bergsonism*, p. 97.

103 Thomas Ludwig, "25 Years of the German Climate Computing Center (DKRZ)," Hamburg, 2012. p. 36.

104 Schroth et al., "Visual Climate Change Communication: From Iconography to Locally Framed 3D Visualization," p. 420.

simultaneity of different times, and not the visual 3D-rendered dystopic future.

There are four RCPs in the latest IPCC reports, ranging from doing nothing to beneficial development, but still "each of the RCPs should provide a plausible and internally consistent description of the future", according to the special edition about the construction of these new types of scenarios that comes with the fifth set of IPCC reports.[105] Thus, even though the four RCPs narrate very different kinds of futures, they are all plausible and scientifically consistent. We can turn to the videogame to gain some analytical distance and see how narration can work on a reader, an audience, or a video gamer.

It takes a quite a lot of suspension of disbelief to achieve an immersion into the four scientifically possible futures. However, when such immersion is achieved, it might be possible to gain a feeling of the real virtuality of the world in which the possible different outcomes depend on what we do today. French film semiotician Christian Metz argues that the suspension of disbelief is done by the filmgoer, or the player of the videogame in this case, and this depends more on the willingness of the gamer than the realism of the game. Metz argues, "[i]t is understood that the audience is not duped by the diegetic illusion, it knows that the screen presents no more than a fiction", and the audience just needs the right reasons to let themselves be immersed in the spectacle they are watching.[106] Nevertheless, the experience of throwing oneself toward a virtual future, letting the immersion happen, can be based on science that is told in a way that convinces the audience to suspend their innate disbelief in visualizations. The potentiality of using videogames as a communication tool for climate knowledge is not to transmit depictions of the future but is instead the experience of the ability to make choices here and now and to live in several different times simultaneously. It is extremely rare that an audience mistakes the visualization of, say, a landscape for the true landscape. Metz's analysis from *The Imaginary Signifier* is widely known and recognized within visual studies, but his analysis appears to be unknown to the projects

105 van Vuuren et al., "The representative concentration pathways: an overview," *Climatic Change,* 109, no. 1-2 2011.

106 Christian Metz, *The Imaginary Signifier,* London, 1982.

that I follow. My impression is that there are few scholars from the humanities within these projects. I guess this explains to some extent why only some problems are articulated and why some questions are overlooked that would normally be voiced by cultural studies, artistic research, or philosophy.

The another promising aspect of the *Future Delta 2.0* game and similar projects, as I see it, is that there are different kinds of "game over" scenarios, even if limited to a finite number. Nevertheless, there is an incongruity between the complex predictions made in, for example, the IPCC reports and the visualizations of the future that science communication embraces and that the videogame displays. The IPCC states that "[t]he term climate projection tacitly implies these uncertainties and dependencies" and emphasizes that the readers must accept that the future is not known and cannot be known no matter how much research goes into it.[107] The IPCC reports express some humbleness when it comes to the power of prediction. Even as the quality and quantity of data improve and the power of the supercomputers constantly increases with the demand for faster processors to run the evolving climate models, the future remains open. This is yet one aspect of the dark background of climate futures. Another aspect is how the climate ontology is described as having an underside to what is phenomenologically accessible to us here and now. The accessible parts are either as weather or through measurements and computing of big amounts of data. A *Nature* review article discusses if it is possible to predict critical transitions in climate systems, which could be tipping points or other abrupt changes. There is no doubt about the existence of tipping points in the climate systems, for these researchers, and they are calling forth a view on climate where things are happening beyond the apparent. There is support from studies of different complex systems that a kind of quivering can precede irreversible transition and they write, "data suggest that certain climatic shifts and epileptic seizures may be presaged by flickering", evoking the image of a hidden malignant process inside the system that we don't fully understand when they juxtapose climate change and a epileptic

107 IPCC, AR 5, WG1 p. 1034.

seizure.[108] These two systems, climate and human mind, behave similarly when being on the brink of chaos toward a new state of functioning. The authors also give an ecological example of similar behaviour when comparing it to a grass area being grazed that suddenly exhibits vegetation patchiness; the distribution and the size of vegetation-free spots can signal near-transition state of the system. Just a little more forcing on the system in the form of more grazers will result is total desert as the tipping point is reached. Many ecosystem and the climate system will behave like this to external forcing due to continues emission of climate gases. I interpret that the authors are introducing suspicions, and maybe anxiety, into human´s relationship to the world, saying that observations like a delayed winter or high summer temperatures could be signs of a catastrophe to come. We will experience of flickering between seasons, or asking if northern Europe summers will be like the Mediterranean in the future or if the Gulf Stream will shut down and result in Arctic conditions. The forces that are let loose was always there, they are still hidden in the dark and we are waiting for them to bring big change.

Gilles Deleuze uses a dark background in *The Fold* to illustrate a way of thinking that has similarities to what I find when talking to researchers working with climate models and their visualizations. Painters like Tintoretto and Caravaggio replaces the white chalk primer on the canvas with a thick dark painted background that in its nuances harbours deep shadows. Deleuze describes how "[t]hings jump out of the background, colors spring from the common base that attests to their obscure nature, figures are defined by their covering more than their contour".[109] The light and dark does not stand in opposition to each other, in Deleuze analysis, on the contrary. The dark backgrounds that I find are a new regime of light and sign of a philosophising where the becoming world is threatening. Take the image of the Gulf Stream (fig. 5) as a example a dark background where beautiful colours spring forth stronger due to the black base. These kinds of images are recurrent in the visual culture of climate change and they are aesthetically appealing today. I find them in scientific report and

108 Scheffer et al., "Early-warning signals for critical transitions," *Nature* 461, no. 7260, 2009.

109 Gilles Deleuze, *The Fold : Leibniz and the Baroque,* New York, 2006. p. 35.

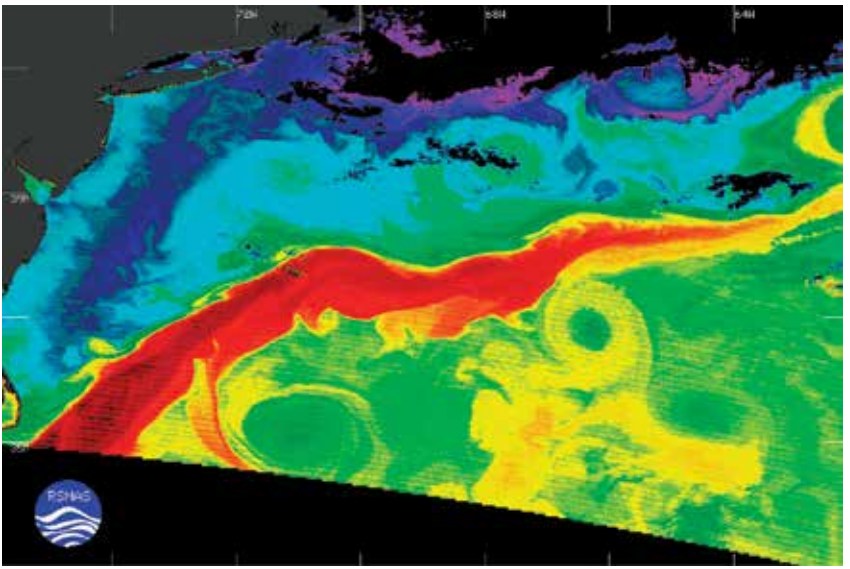

Figure 5. Temperature of the Gulf Stream. Credit: The sea surface temperature image was created at the University of Miami using the 11- and 12-micron bands, by Bob Evans, Peter Minnett, and co-workers. visibleearth.nasa.gov

articles, science communication and documentaries.

For me, the future apocalypse becomes a background particularly to the video- game Future Delta; it dramatizes the everyday situations that the player is confronted with in the game. However, it is not actually the drama of the apocalypse that is central, but what kind of worldview the presence of a dark background carries with it. For Deleuze, the presence of thick red-brown background of the 16th Italien chiaroscuro paintings makes "clarity comes of obscurity and endlessly is plunging back into it" but it also reflected the scientific thinking of its day.[110] I argue that we can understand the use of dark backgrounds in visual culture of climate change with this analysis of analogies between artistic expression and scientific thought in mind. It is simultaneously an expression of how the science imagine the ontology of climate systems as a whole and it is also a reason to listen to the climate science. Naturally, science becomes so much more important when the advice is given as a way to avoid the apocalypse that awaits us in the future. Because, this is a rhetorical device to create a feeling of urgency, but, of course, such a future is plausible and thus it really is urgent that many things are changed in order to avoid it. And again, this is more than an effective visual rhetorical device (fig. 5); it is also a visual expression of the thinking of ontology that otherwise is lacking in scientific images – there are few illustrations within the visual regime of the climate sciences that show the dynamic scientific thinking of the world.

The dark ontology of climate change

Critical realist Roy Baskar describes the ontology of climate change and emphasizes that the nonactualized possibilities must also be included in our description of reality. Baskar writes that we have "to think of reality in terms of at least three domains, the domains of the real, the actual and the empirical, with the real encompassing the actual and the empirical, but also including nonactualized possibilities or powers".[111] I would rather use

110 Gilles Deleuze, *The Fold*, New York 2006, p. 102.

111 Roy Bhaskar, "Contexts of interdisciplinarity Interdisciplinarity and climate change," in *Interdisciplinarity and Climate Change : Transforming knowledge and practice for our global future*, ed. Roy Bhaskar et al (London and New York: Routledge 2010).

"the virtual" with reference to Deleuze to denote the non-actualized or unmanifest so as to avoid thinking in negation. The non-actualised or unmanifest are also the creative power of the system, but the negative prefix takes that away. Still. Baskar et al is writing a philosophy of climate that is rare. Nevertheless, I would say that the images in *Interdisciplinarity adn Climate Change* foster an understanding of the world as univocal and compartmentalized, opposite to what it aims to convey. The few images are all very similar to figure 1 in the first chapter of this thesis besides a few diagrams and flowcharts. I consider it problematic to use too illustrative images when aiming to produce understanding that goes beyond insulated causality. I propose that we embrace the dark instead of the much too illustrative images. The illustrative etymologically come from the Latin verb *illustrare* – to light up – and it doesn't fully succeed.

I observe that many of the images used in climate communication are telling the story of how the data are harvested from the physical world rather than showing the actual outcome of the data. These data come from satellite monitoring of forests, glaciers, deserts, or oceans and can include temperature, salinity, chlorophyll levels, and so on. It include not only measurements or current weather, but also historical data from ice-core sampling or dendrochronology, that is, tree-ring dating. It is obvious that the significant data that make up the basis for climate science are not directly accessible to us without special instruments, and most historical data are in a proxy relationship with climate change. In other words, these historical data are secondary in relation to historical changes in the environment. They are the signs we read in peats, sediments, fossils, old artifacts in museum or even old literary sources and artworks and the can tells us something about historical change. What I am saying is that climate data are generated through long chains of interpretation.

The world is a big puzzle, and we do not know the final picture that will be result when the puzzle is put together. Metaphorically speaking, many suspect that the motif is constantly changing during the arduous task of building the puzzle because future climate is virtually emergent and not yet actualized, still, it is fully real if we stay with the Deleuzean thinking that I propose. Furthermore, future effects are always dependent on many factors rather than a single cause that can be pinpointed, and thus the

effects are not accessible either. Only a few changes over time can actually be seen here and now without instruments, like the cut tree where differences between growing seasons can be measured in the width of tree-rings, giving wooden furniture a sensuality of time, and this is one occasion when change becomes perceptible to both the hands and eyes. Most data, however, come from places we cannot access or perceive. This becomes an inverted variant of a Platonist luminous world where the truth resides within the dark and moving material background of the world instead of emanating from any ideal higher realm.

The film-stills in figure 6 are from a sequence in the DKRZ marketing video "High Performance for Climate Research". The sequence is an example of how the gathering and production of data makes better images than the actual outcome of the data, which often becomes a diagram or a bluish to reddish map of the world. In this and similar communication videos, relevant data come from the depth of the ocean and the long ice cores from inland ice sheets. Professor of film Sean Cubitt writes that "numbers are not intrinsically photogenic" to stress the need to make visualizations because the data themselves evoke almost nothing. It is only when the climate data are turned into visualizations that we can see the trends that otherwise are invisible to us. It takes a lot of skill and time to read the data on their own, and visuality is a device that speeds up the reading in time of urgency. However, the faster reading that is made possible through images also makes it a populist venture as it tries to mobilize *a people,* according to Cubitt who writes, "[d]ata visualisation aims to mobilise demand in the people by translating the empirical data of experts into visually legible symbols for the mass population".[112] Cubitt´s argument is that the visualization operates on an affective level when presented with images that strive for photographic realism. The visual culture of climate change is full of images that show the practices of the climate sciences. Maybe the aim is to produce authority and legitimacy. Then again, there is another side to it, namely the difficulty to make the many nested and interrelated causes visual and persuasive because the data

112 Cubitt, "Everybody knows this is nowhere: data visualization and ecocritizicism ".

Figure 6. Still frames from the DKRZ marketing video "High Performance for Climate Research".

Figure 7. Still frames from the DKRZ marketing video "High Performance for Climate Research".

describing these relationships usually refer to rather abstract findings that come from theoretical models running in supercomputers. It is difficult to make "visually legible symbols" of them and then reach out to a "mass population" but that is the aim.[113]

By changing space we change our Nature

The images in figure 7 suggests that the numbers belong to another space in the world. The researchers behind the screen "touch" data, and the data seem to ripple under their human digits. We see the waves under their fingers that produce a pattern referring to the sea. This kind of blurring image, where the background ripples or one object becomes another, is recurrent in images intended for lay audiences. However, this particular sequence epitomizes my observation that images of the production of data make better images than the actual data. It would be incorrect to suggest that data are actually being shown here because the numbers shown on the screen are arbitrary. Nonetheless, the image says something about the visual culture of climate change and shows that numbers can be photogenic after all, however, the numbers are not scientific. They are decor and Cubitt's claim that "numbers aren't intrinsically photogenic" is still valid. In addition. it is not the numbers themselves but the veil they make up that is appealing. The veil of numbers becomes a kind of *sfumato*, which is Italian for "smoke".

The technique of sfumato is to subtly mix colours and tone to make them blend into each other and produce a somewhat hazy appearance, or "in the words of Leonardo da Vinci 'without lines or borders, in the manner of smoke'", according to art historian Diogo Qeiros-Conde who writes, "[t]he painting appears as an undulating sea of shadows. It displays hidden dynamics that create the visual effect of an unstable figure that looks alive."[114] The sea-like shadows contribute to the illusion of reality in the painting, and this is also why the technique has been suggested to be an ancestor to virtual reality. Cami Nelson compares the virtual artwork

113 Cubitt, "Everybody knows this is nowhere".

114 Diogo Queiros-Conde, "The Turbulent Structure of Sfumato within Mona Lisa," *Leonardo* 37, no. 3 2004.

Osmose by Charlotte Davies to da Vinci's invention of sfumato. The *Osmose* is one of the most known virtual reality artworks, the experience of it is described by Oliver Grau like being a "diver, solitary and weightless, the interactor first glides out of a grid of Cartesian coordinates into the virtual scenarios: a boundless oceanic abyss, shimmering swathes of opaque clouds, passing softly glowing dewdrops and translucent swarms of computer-generated insects, into the dense undergrowth of a dark forest."[115] Leonardo da Vinci was sceptical about the ability of linear perspective to create an illusion of "representing the reality as accurately as possible", according to Nelson. The sfumato was added to the "scientific" linear perspective to add what it lacked, namely dynamism and porosity of boundaries among objects, and this technique is used by Charlotte Davies in the *Osmose*. There is a similar blurring of lines between the virtual reality experience and the experience of the lived body, and this creates ambiguity and indeterminacy to complement the Cartesian perspectivism, i.e. the somewhat stale illusion offered by linear perspective alone. The sfumato is parergonal to the motif to bring it the movement and life that it lacks. The interactive artwork *Osmose* offers a full immersion into a world that is navigated as if it were underwater. Immersions into virtual realities are recurrently compared to being immersed in water, suggesting that we can take a plunge into a different medium to experience the world anew or the future of our world. I regard the many climate change communication projects that use immersive environments to give its audience an outside perspective on the world by sinking down, or being immersed, in visual and audial stimuli. Charlotte Davies artwork makes explicit what these projects want to achieve. Davis describes how "Osmose is an immersive virtual environment utilizing a head-mounted display and motion tracking of breath and balance. As in the scuba diver´s practice of buoyancy control one breathes in to float upwards, breaths out to fall, and leans gently to change direction". [116] In the video that presents *Osmose* we see how an immersant robe on the equipment that connects her to virtual reality technology that makes the artwork possible (fig. 8).

115 Oliver Grau, *Virtual Art: from illusion to immersion*, Cambridge, 2003. p. 193.
116 www.youtube.com/user/Immersence/about


... by changing space
by leaving the space of one's visual sensibilities
one enters into communication
with a space that is poetically renovating...
For we do not change Man: we change our Nature
Gaston Bachelard
The Poetics of Space. 1964

Figure 8. Six still frames from Char Davies video that presents *Osmose* on the Youtube channel *Immersence*. Official site for the art work.

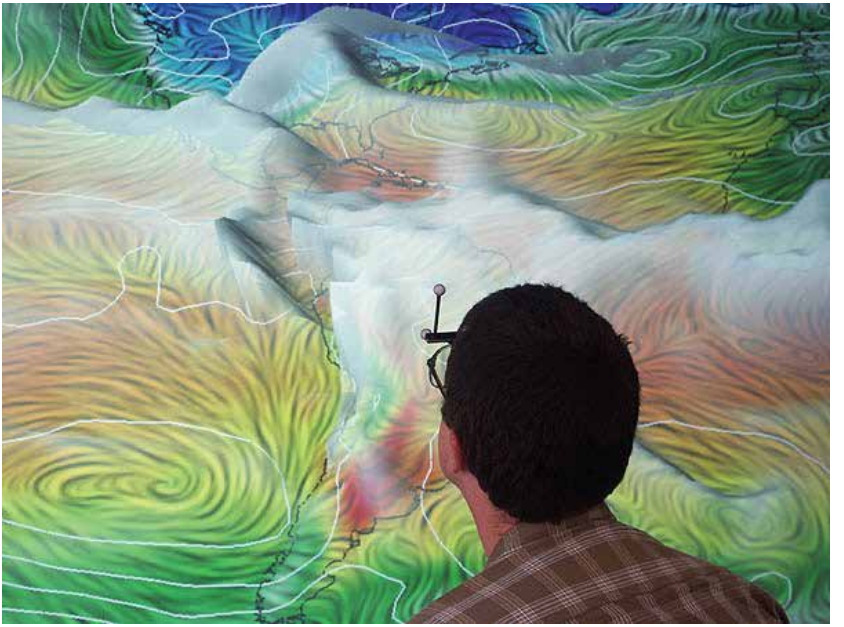

Figure 9. The Powerwall.at DKRZ.

The immersant puts on a helmet, the background turns blue, and bubbles appear over the image to make sure that the visual sea-metaphor is clear and Davies cites Gaston Bachelard "… by changing space, by leaving the space of one usual sensibilities, one enter into communication with space that is physically innovating… For we do not change place, we change our Nature." The reference to Bachelard is justified, not just for Davies beautiful artwork, but also for how virtual reality is infused with expectations of changing nature; our perception of nature and then the nature of the world. *Osmose* predates the other examples of virtual reality that I refer to as the use of virtual reality for climate change communication hypes later but Char Davies articulates what I find to be important in the Worldview, CALP and DKRZ immersive communication projects. *Osmose* is playful and appear to be a test ground for the artist to study if it is possible to our change nature, i.e. our ways of perceiving the world. However, the science communication projects mentioned above aims to change nature out-there, mitigate climate change and adapt society to coming effects of the changes. Davies also presents the underlying data within the virtual reality world to show the immersant the connection between image and world out-there. Breathing data is shown in Osmose but Davies also let the immersant dive into texts by Gaston Bachelard, showing her roots in poetics and philosophical thought.

The sfumato of numbers in front of the climate researchers in the image in figure 7 is not only an illustration of data from the invisible world of climate change but also an illustration of immersion into data in the virtual reality in a similar way as Davies shows breathing data. The video sequence suggests that we can see the invisible of the world within virtual reality in a haptic way. It is not only through just looking with our eyes, but it is also a bodily experiencing of it, stretching our hands out to feel the otherwise intangible world and moving around in it. But then, what is *it*? I argue that the aspects that the producers of the veil of numbers want to make accessible to the an imagined immersant is the real virtual, that which resides as potentiality in the climate system, that which risks being abruptly changed, that which is uncertain, and that which cannot be seen.

The researcher in the image in figure 9 is using polarizing glasses to be immersed in a map-like landscape where something invisible is made

palpable. He can also use a short stick that is connected to the visualization setup to grab the image, zoom in, turn it, or to poke the virtual world. I do not know what the mountainous shadows that cover the abstract landscape are referring to. It is neither something that I have knowledge about nor any everyday experience of, but it is clearly something that I would not be able to see with my bare eyes. In most cases, the climate sciences want to make visual correlations between parameters in the climate systems that do not have any actual objects that can be made visual – the things that are represented are abstract and produced by climate models. Nevertheless, the image above tells us a lot about how researchers imagine how the abstract aspects of the world can be visualized. I would say that it shows how the climate scientists think of the world rather than showing the world of physical reality.

The integral theorist Sean Esbjörn-Hargens describes the ontology of climate change and claims that climate change is something that escapes the binary of real and not real. His argument is that there is a gap between how we habitually operate with the world and the ontology of climate change, "it was very real but not real in the way that we typically think (or feel) about 'things out there' in the external world."[117] Esbjörn-Hargens further argues that the failure of the Conference of Parties meeting in Copenhagen (COP 15) showed that it is not enough to agree that climate change is real if we reduce it to one singular thing when it in fact is a "multiple object". It will be different things depending on how it is described, and climate change "is actually a complex set of phenomena that cannot easily be reduced to a single independent object".[118] His reason to avoid describing climate change as a singular object is pragmatic, i.e., it is political. According to Esbjörn-Hargens' argument, if climate change is reduced to one thing, as it was during the COP 15 meeting, it will be difficult to successfully mobilize, coordinate, and respond to the urgent situation we are in. It is far better, he argues, to agree that climate change will be different things depending on one's vantage point or methodological approach. I agree with his conclusion, but suggest that there is more to the

117 Sean Esbjörn-Hargens, "An ontology of climate change," *Journal of Integral Theory and Practice* 5, no. 1 2010: p. 143.

118 ibid., p. 148.

way he describes climate as a multifaceted object. Different sciences will enact such an object as different things depending on how the object is described but philosopher Esbjörn-Hargens sounds much like the natural scientists Snyder et al when they write, the "Earth's climate system hosts a myriad of nested and coupled sub-systems, functioning at various temporal and spatial scales".[119] Unfortunately, there seems to be few philosophers, who go into the climate sciences to do philosophy over it. I argue that the challenge of representing climate change comes both from the problem of political representations of it, as Esbjörn-Hargens claims, but also from the complexity of climate change itself as described by Snyder et al above. This challenge would need to the elucidated from more than the natural scientific perspective.

Many climate scientists do describe the world of climate change as unfolding in progressive events that are not given but are becoming. These changes are still obscured, and we cannot see these events until they actually occur. Trends of change are drowned out in the background noise of natural variability. Even major events can disappear into the background noise, for example, the massive eruption of aerosols from the Icelandic volcano Eyjafjallajökull into troposphere that was "undetectable amidst the chaotic weather noise in the atmosphere".[120] It is not surprising, then, that it is difficult to make plausible the risk of future events due to small changes in the climate data when even major events pass by unnoticed in the climate records. It becomes challenging to communicate change when the anthropogenic component drowns in natural variability and it risks "blurring" the image, nevertheless, climate change is not one clear-cut phenomena that easily can be depicted.

In the introduction to the *State of Climate Visualization* report these difficulties are described, the editors write that the challenges are to make "scientific visualization[s] of complex interlinkages between numerous phenomena in nature as well as in society, interrelations across vertical scales over time, substantial uncertainty of feedback mechanisms and often

119 Mastrandrea Snyder and Stephen H. Schneider, "The complex dynamics of the climate system: Constrains on our knowledge, policy implications and the necessity of systems thinking."

120 IPCC, AR 5, WG1, p. 692

massive numerical representation of scientific results", and thus they pinpoint the fundamental problem for any virtual reality rendering of climate change.[121] Even if the Worldview project that is presented in the report aims to use "new narratives", it does not seem possible for them to use the narrative tools of fiction because they must refer to science. I would say that their mantra is that "seeing is believing" and that the audience must be able to see the things to believe them, but what if there is nothing to see, nothing to show?[122] However, the visualization problem, as I see it, is that virtual realities are mostly apt to represent measurable properties like length, height, and weight, in other words, spatial representations of other spaces and that is one reason to why landscape visualizations as a means to communicate climate change becomes the answer to the communication challenge. Sea level rise or the effect of flooding shows the effect of climate change in a visual mode most people can relate to, namely as landscape picture. The landscape picture sucks the audience into the scientific findings. Nonetheless, all of the challenges listed in the above-mentioned report are intensive properties and do not automatically fit into spatial representations. They are not "things" with essential properties that can be measured and put into the three-dimensional world of virtual reality. Instead, they constitute the multiplicity that explains how and why the climate is changing.

The challenge is clearly to find ways to present the world beyond its manifest objects, both because poor visualization takes agency from the audience but also because much of the climate communication that I have seen does not capture the invisible nested mechanisms that cause climate change, i.e. the potentialities that reside in the background. Climate change is not something to be found "out there", but rather it is a potentiality that will be actualized in time. An event waiting to happen is a real virtuality, but as soon as it has happened it has lost its virtuality and is an actuality. I consider the intrinsic forces of the climate system that have not yet caused change to the climate to be of a virtual nature. This means that they are intangible and often also counterintuitive. Our common-

121 Neset et al, *State of Climate Visualization,* p. 5.

122 Morris and Sayler, "The pensive photograph as agent: What can non-illustrative images do to galvanize public support for climate change action?"

sense understanding of how one event causes one effect must be complemented with the understanding that one event can lead to many things, sometimes apparently disproportionately and sometimes leading to irreversible phase-shifts in the whole system. Something new can suddenly be the result of old business-as-usual behaviour as tipping-points are finally crossed, and the differential processes in these systems can be described as real virtual *events*. According to the French philosopher Gilles Deleuze, "the virtual […] creates its own lines of actualization in positive acts […and] it is difference that is primary in the process of actualization", and I would say that this thinking can be applied to the idea of abrupt climate change as it is described by the IPCC.[123]

In the IPCC *Climate Change: Physical Science Basis 2013* report, it is stated that researchers have found abruptly changed behaviour in the Arctic sea ice model "accompanied by an irreversible bifurcation to a new stable, annually ice-free state."[124] Notice that the bifurcation is not found in the Arctic Sea but in the data model of it, which is where science can detect it. The massive amount of data for this model is described as an "ocean of data" by the director of the Potsdam Institute for Climate Impact Research Hans Joachim Schellnhuber as he discusses hindrances and promoters to understanding a world whose "planetary machinery […] defies the power of standard scientific analysis".[125] Schellnhuber describes how the world is composed of innumerable parts and pieces that are heterogeneous and how the forces that drive various processes are fundamentally different from what the sciences are best suited to study, namely simple, linear, and deterministic processes. Non-linearity pervades the world and all its parts, and it is defined as a disproportionality in cause-effect relationships. A small push against a system can have a huge effect, and the opposite is just as likely and a major force can have infinitesimal effects, at least to begin with. The climate sciences are characterized by thinking beyond "great cognitive barriers" but have difficulty to communicate such thinking.

123 Deleuze, *Bergsonism*, p. 97.

124 IPCC, AR5, WG1, p. 1118

125 Hans Joachim John Schellnhuber, "Coping with Earth system complexity and irregularity," in *Challenges of a changing earth* (Springer, 2002), p. 151.

In addition, Schellnhuber deems indeterminacy the "unpleasant companion to false and true Earth System managers for all eternity", and he contends that it will be impossible to predict system behaviour on global scale.[126]

The human factor

Numerous measurements are currently being conducted to determine Earth's climatic history as well to predict its possible climatic futures. Which future it will be depends on how our societies develop and what choices people make, but this "human factor" makes prediction very difficult, if not impossible. It is somewhat paradoxical that it is the human that has caused the situation we now are in, the Anthropocene, and that has produced all the knowledge we have of this world, but it is also the human as a factor in the climate models that increases their complexity to a level that makes the outcome virtually indeterminate. As mentioned before, Hans Joachim Schellnhuber attributes the problem to human volition and concludes, "Earth Systems development is heavily underdetermined and cannot be foreseen, in principle", due to the "human factor".[127] In the same spirit, it is stated by the IPCC that "[p]redicting socioeconomic development is arguably even more difficult than predicting the evolution of a physical system."[128] Nonetheless, the climate sciences are putting enormous effort into predicting the future. Metaphorically speaking, it is not surprising then that humans are often left out of the image of climate change, but this is also what I literally find in the scientific images of climate change. However, climate documentaries and news about climate are different because they are not restricted in the same way, and they are part of the visual culture of climate change that have an internal visual logic that includes humans in their images. The below image is an example of the above exclusion and it tells us something about how the climate sciences approach and see the world and the involvement of humans.

126 ibid.
127 ibid.
128 IPCC, AR5, WG1, p. 1036.

Figure 10 show the first spread of a brochure that celebrates the 25th anniversary of the German Climate Computing Center, DKRZ, in Hamburg. They store climate data for the worldwide community of climate researchers and run climate models on their supercomputers. I have visited them twice to learn about how data are processed to become visualizations because they also have a division for the development of software applications for visualization. Here, they also research the possibilities to make climate data visible.

On the left-hand image of the spread in figure 10 we see two individuals standing on a plateau in an icy landscape. For me, their role is to function as a reference to the scale of the ice formations around them and to play the role of being marooned as they look out into the landscape. They are spectators to a world that really does not care about humans at all. The changing world appears as vast and silent, but still inaudibly hostile in this spread. When I see this spread I recall testimony that climate artists Morris and Sayler offer us in their art. They also write poignantly about their own shock in realizing this when going to places where climate change is already occurring, "The shock was the indifference of nature […] the silence in these places, not the noise."[129] Morris and Sayler claim that any climate *drama* that is played out comes from us. As I see it, we have to believe in climate change before any image at all becomes affective and any audience must want to feel the world before anything will happen in a meeting with any image of the world, and it is only then that images of climate change will make any sense. If we apply this to the image above, we see the two figures, and we might try to imagine how they feel being there. A feeling of the extreme and grand nature might be aroused in us when we imagine being there. Their and our own smallness becomes apparent compared to the surroundings, and the world might seem terrifying to us. Morris and Sayler identify two general artistic strategies to use photography to actually give voice to the silent indifference of nature. The first is to dramatize the landscape to evoke feelings of myth, and the second is to confess to feelings of incomprehension, loss of scale, and panic. They attribute the two

129 Morris and Sayler, *The pensive photograph as an agent: What can non-illustrative images do to galvanize public support for climate change action?*, Bielefeld, 2014.

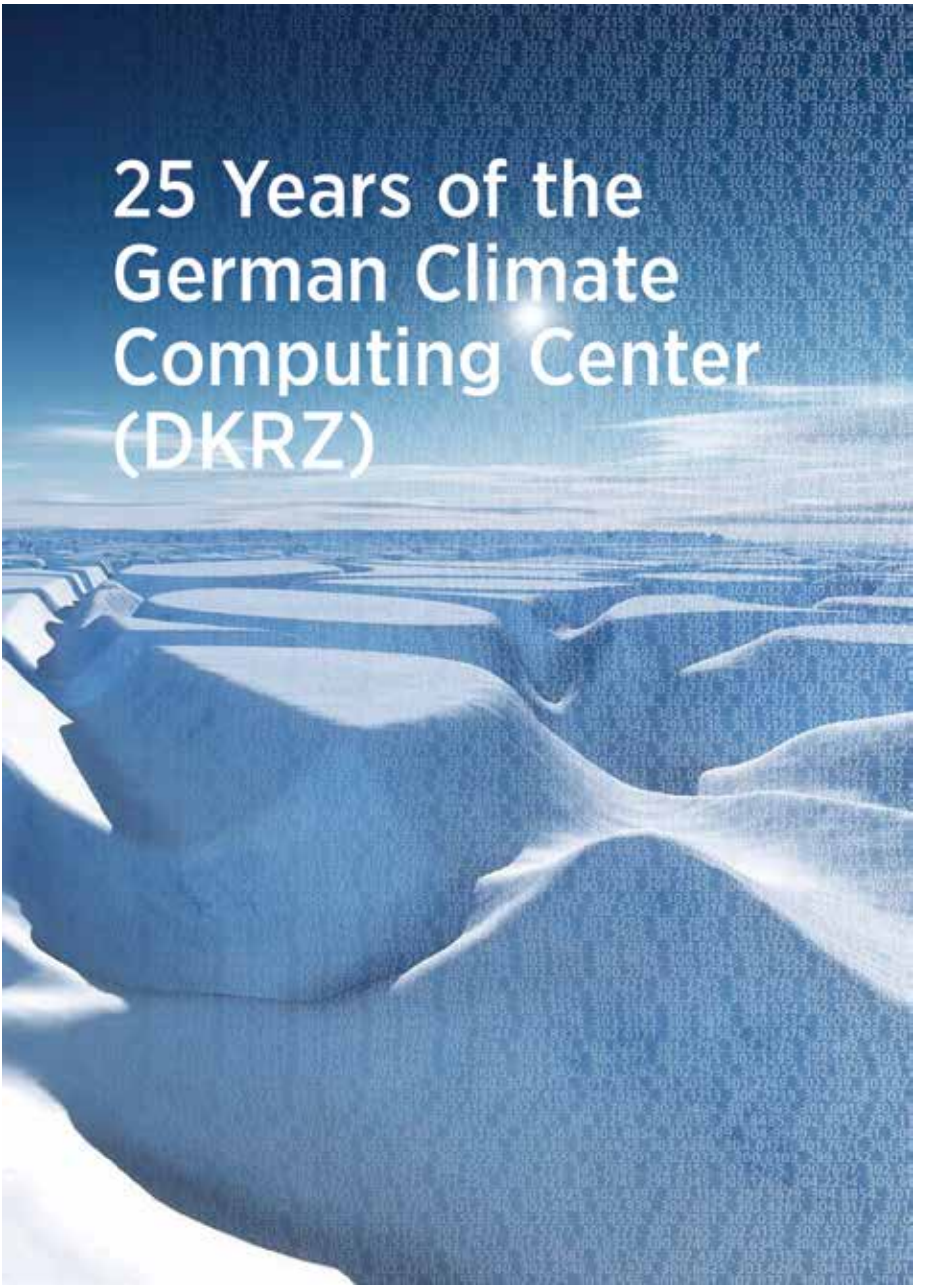

Figure 10. The opening spread of the "25 Years of the German Climate Computing Center" brochure. Note that the right side of the spread is veiled with numbers, fading out to the left, invisible over the humans.

strategies to the heritage of the landscape photographer Ansell Adams, and the above image would definitely fit in with his body of work. These kinds of aesthetic images are recurrent in the visual culture of climate change and we can place it into a traditional landscape-painting genre. As we move toward the right-hand image of the spread, we see numbers all over, or maybe behind, the landscape surface. If we look a little bit closer, the numbers appear to come from the measurement of something. It looks almost like a puzzle, a complicated assemblage of small (data) pieces.

When I met Thomas Stocker, who is co-chair of the IPCC Work Group 1, I asked what he thought the numbers were in figure 10. He came to the conclusion that they are more or less incidental and have nothing or little to do with the actual landscape. Of course, this image is constructed by putting a series of numbers over the image, but it is an image of how the climate sciences conceptualize the world, that data can be generated from the world and that this will help unravel things that are invisible to the naked eye. I showed the same image to oceanographer Jochem Marotzke at the MPI-M in Hamburg, who is one of the main authors in the same workgroup that Stocker chairs, and I asked if this is an image of change. He answered, "The change isn't there, it is just climate, (…) you would need change, this is a static image". Marotzke guessed that that the image is from Greenland and said, "Greenland's ice sheets are a big topic in research and a very spectacular part of the climate system, so in that sense, I can see climate there (in the picture)." Marotzke identifies the numbers as historical carbon dioxide concentrations, but this is not climate. He is overall sceptical to the ability to visualize climate change. He said, "To characterize climate change you have to come to grips with a very abstract phenomenon […] and perceptions can be incredibly misleading and deceiving", and then he mentioned things that we do experience: disasters and large-scale floods, things that only happened every 100 years are now happening every 10 years. These events are powerful experiences, but they are misleading and deceiving because the question of whether they are due to climate change or not cannot be answered. Extreme events are by definition rare events and therefore hard to characterize statistically, thus both our experiences from the world and the analysis of climate data involve uncertainty. He told me that he is engaged in an on-going

discussion with a colleague on how to make climate change more tangible by taking people on journeys to places where it is happening. The critical question is where to go in order to see it before it has already happened, and he told me about professors who also mistake naturally occurring events for climate-induced events. There is a chaotic factor at play that sometimes leads to unexpected and deceptive phenomena. The question of where to go still lacks a final answer to him.

I would say that the above spread doesn't depict such a place to visit, still, it show us where change take place. I would argue that this is an everywhere and nowhere place. The spread above is made up from two different images where the spine of the book makes a hinge for the two. The two images complement and depend on each other as they show two layers of the same landscape, one human and one intrinsically non-human where numbers shines forth. The numbers do not signify an inherent code in nature, but instead signify the material flow that is inherent to the *world of becoming* where there are no essences but only processes, movements and flows. Subtle ripples are created by the repetition of the numbers. However, the numbers come from computers and not from nature, as Stocker explained to me during our meeting. The right-hand image can be seen as the promise of what supercomputing can do, but I would also say that the ripples created by the *repetition* of differing seven-digit numbers are more important than the actual numbers themselves. They create a vague tension between the calm surface of the landscape and threatening change that looms over the horizon. The landscape is tranquil and pristine, but at the same time it shows where the unexpected and indeterminate reside, in other words, that which is in becoming something else. Climate is always in becoming, constantly changing, it always was, but never this fast before. Still we cannot see it.

The dark side of the landscape

In his study of historical English landscape paintings, John Barrell concludes *The Dark Side of the Landscape* by stating that the painter John Constable "reduces all labourers to serfs, but that in the very same act he

presents them involved in an enviable, and almost relaxed relationship with the natural world", which would then allow the landscape painting to remain a contemplative motif ignoring "the fact that the basis of this social harmony is social division". [130] The paintings discussed by Barrell are not "peopled" even though there are people depicted in them. Even if the landscapes are realistically painted, it is not realistic to depict people smiling while working given the social conditions they worked under; the smiles and naturalness of the work helped to depict labouring men who were at peace with their setting. However, it was considered they would spoil the contemplative potential of the landscape. Barrell gives plenty of examples of paintings where the workers are placed in the shadow of a tree or similar dark area of the landscape painting. Barrell´s analysis might also apply to the image above where we see to humans standing in an Arctic landscape. I would say that the scientific workers in the arctic landscape above have already spoiled the landscape, not with their presence but through the creation of the Anthropocene that will change all landscapes and we all know that when engaging with the report from where the photograph comes. The two humans cast long shadows into the landscape and their almost spectral presence in the image remind us that anthropogenic influence will be felt even when humans are not physically there. With or without humans, landscape photography and landscape visualizations that strive toward realism are popular among climate communicators and we must ask why. W. J. T. Mitchell argues that "Landscape is a cultural medium that has a double role with respect to something like ideology", since the landscape naturalizes both a cultural and social construction.[131] When we see landscape photography or visualization we are presented with an artificial world as if it were given and inevitable, and it will define the beholders relationship to the world as seeing sites. It produces a rather passive beholder of the world, however, the ideology of the landscape as given and natural, is imprinted in us through interpellation. The above photograph might play a somewhat different role as it to some extent lost its "naturalness" in the human-reshaped world. The humans present in the

130 John Barrell, *The Dark Side of the Landscape: The Rural Poor in English Painting 1730-1840*, Cambridge, 1983. p. 164.

131 W.J.T. Mitchell, *Landscape and Power*, Chicago, 2002.

to indicate activity and everything is obviously interconnected as wires lead out from all of the units and disappear into the floor under us. My guide on the tour informs me that it is very popular to take photos of the blinking lights, and he encourages me to do the same.

These supercomputers are black boxes both in the literal sense as well as that described by Bruno Latour. His concept of a "black box" is used when one wants to say that we know what goes into a scientific practice, institution or instrument and we know what comes out, but we do not how it is processed within the system. Latour first introduced the black box concept in his influential book *Science in Action* in 1987, and he borrowed the term from cybernetics and writes, "The word black box is used by cyberneticians whenever a piece of machinery or a set of commands is too complex."[132] The black box is closed from the beginning, but following the people doing the actual science can open it. It is obviously difficult to open up the supercomputer to see into it and the electron movements in a silicon chip doesn't really say anything to an observer about what is being processed. However, that is not the interesting problem here. There are other reasons to way the climate supercomputer is closed to observation and even the researchers working with them admit their own limitations to fully understand the computational processes that result in a scientific finding about climate futures. My guide explains to me how the climate models are processed with high resolution and over long time periods within the High Performance Computer, or supercomputer, and the simulations can run for weeks or even months. The researchers will extract small pieces of data by writing them out to disk, and they will feed the extracted variables into specialized software for analysis and visualization.

Only a small part of the data is analyzed and visualized while the big bulk of data will stay within the supercomputer as it practically impossible to write everything out to disc for analysis, it is too much to handle and that is why supercomputers are used in the first place. Data runs fastest in the dark as one of the researchers puts it and one does not fully know what happens inside. If the climate model running in the supercomputer is fed with erroneous data, its outcome can evolve into repetitive patterns or

132 Bruno Latour, *Science in Action*, Cambridge, 1987, p.2.

photograph are probably there to make measurements in the ice to quantity the damage that human activity has had on the world. This is probably how we interpret their presence on the ice, no matter whether this is their mission or not. Besides this, the image is also akin to the romantic sublime where the painting wants to induce the feeling of overwhelming grandeur. In this reception the human figures are contemplating a vast landscape but takes control over it through conceptualization, signalled with the numbers behind or within the Arctic landscape.

Supercomputers

The images below show two rather common images of supercomputing. These are the most popular kinds of images of supercomputing, and I would argue that they are used to represent the idea of "data" instead of images of the actual data. I find many similar images in brochures and other marketing material as well as in newspapers and television. The images seem to convey something that the numbers stored inside are unable to convey on their own (fig. 11 and 12). Cubitt argued that the urgency of climate change makes numbers inefficient, and his argument suggests that images are a much more efficient way to communicate climate change. Nevertheless, I would say that this does not explain the use of images of the outside of supercomputers instead of showing the inside numbers. There is something else going on here. The long rows of containers stacked with processors, disks, and tapes create images with a strong linear perspective and feeling of depth, they pull the viewer towards the vanishing point. The supercomputers I have seen have always been "black boxes", situated away from humans in the basements of research facilities or in data centres in remote places. Figure 12 shows data storage where twelve robots operate the loading and unloading of magnetic tapes in the service of researchers from around the world who want to access the data outputs from the climate models. Both the supercomputer and storage facility are located in the attic of the DKRZ in Hamburg. The supercomputer room is heated by so much data processing that it is unbearable to remain there for any length of time. Small lights are blinking

Figure 11. One of the supercomputers at DKRZ which rum climate models.

Figure 12. The data storage of climate data avt DKRZ where 12 robots services reserachers from the whole world, picking up magnetic tapes for reading and distribution of data.

inverted values. Thus when the poles are warmer than the equator it is probably a sign of a problem with the data going into the supercomputer. Sometimes, when more parameters are added or the resolution is increased, the simulations become more complex and suddenly the model can behave very differently. "If there is a feature that you don't understand, or have seen before [...] it can be that the model is screwing up", explains Röber. Any such error will be obvious to "the knowledgeable oceanographer", he assures. But of course, it can also be an unexpected prediction in the model that also could unfold as an actual event in the climate system. However, the writing out of small parts of the variables from the supercomputer is done regularly to run quality control tests on the model in addition to analyses. Röber states that "if your model runs for a day, or a week, or a month, then you want to know in-between whether it is running correctly or not." For these tests, data are extracted to produce simple visualizations to see if it running chaotically or soundly. It is actually in the middle of running the simulations that most research is done, and Röber describes how visualizations are used to both verify and explore the data being extracted. This seems to be one of the few times when visualizations are actually used to *do* research as opposed to just present it. This process is called exploratory visualization, and Röber explains how the relationships between different variables extracted from the model can be compared and visualized in the programme to see what will happen: "You can really dive into the data to look around and see what is in there". He shows me how he chooses the variables of salinity and water density and assigns them values typically found around Antarctica. Suddenly I can see how salty and very dense water moves slowly around the icy continent. For researchers this is all about exploring the data by comparing variables and unknown relationships on the bottom of the ocean, and when diving into the data I find it difficult to tell the ocean of data from the real ocean out there. Many of the answers to the climatic future reside dormant within the model running in the supercomputer until someone writes the data out and dives in to the right place. The massive number of variables makes it a virtual ocean of data; its depth appears to be unknown because data run fastest in the dark interior, which leads to unknown depths.

One of the researchers at the MPI-M said, "The problem with the very

advanced system that they have (at DKRZ) is that it isn't so fast and simple". The researcher touched upon a key problem in computation of climate models, the more detailed they get, the slower the models become to write out. An advanced model with many parameters and high-resolution can run within the supercomputer, but the transfer of the data to disc is the rate-limiting step. We cannot expect to fully see what the models predict because the data are processed faster than they can be written out. This particular example is called the input/output bottleneck and is caused by transmission of data doesn't match the speed of the processors and the memory capacity of the discs. The analogy of a bottleneck makes it sound as if it where a physical problem, we can imagine how the data are pressed into the neck of the bottle and slowed down, but the problem is more temporal than spatial in the climate model example. If high-performance computing is going to be used to predict the future in a way that is relevant to local conditions, it must to be fed with very high-resolution data. The finer the data gets, the longer time it takes to run the simulation and the greater the bottleneck when writing out the results, and if the process takes long enough the results might not be ready before the predicted future is already upon us.

The Planetary Boundary Trefoil

This section analyses a symbol published in a feature article in *Nature* in 2009.[133] I have chosen to call the symbol the Planetary Boundary Trefoil, and I will explain why later. However, the symbol is only the starting point for a larger discussion on how some kinds of images are used to indicate that there are invisible forces within the climate system that might exhibit emergent properties, i.e. they might unfold in violent and unforeseen ways. These images, like the symbol discussed below, can be seen as maps to an unknown landscape of forces threatening to express themselves as extreme events and eventually lead to long-term detrimental conditions

133 Rockström et al. "A safe operating space for humanity", *Nature Feature* 461, 2009.

for human and societal development. It is a visual *boundary work*. Boundary work is otherwise a central analytical concept within early *Science and Technology Studies*. The concept was introduced by Thomas Gieryn in the 1980s when he showed how the "sciences" kept the "non-sciences" at bay by demarcating the domain of science through boundary work.[134] We see a different kind of boundary work here, but there are also similarities. I will discuss the politics as well as the scientific content of three published articles, the first appearing in 2009[135]. The second was the in-depth article[136] from the same year, and the third was a follow-up article published in 2015[137]. Here is the first version of the planetary boundary trefoil (fig. 13).

The planetary boundary trefoil is designed to indicate which ecosystemic boundaries must not be crossed in order to avoid leaving Holocene-like living conditions. The Holocene was the 11,700 year geological era that preceded the one we are in now. The Holocene was an environmentally relatively stabile period that was beneficial for human development. The Anthropocene era on the other hand, which we are in the beginning of now, is described as the opposite of the Holocene, and the symbol above warns us about the pending risks ahead in this new era. The consequences and identified risks are caused by human activity, both historical and present, and these can have a negative influence on future possibilities for human existence. Take, for example, the monsoon system as part of the overall climate system. When its threshold is crossed due to anthropogenic climate change, it "could shift into a new state […] with deleterious or potentially even disastrous consequences for humans", and the same goes for ocean acidification, chemical pollution, and biodiversity loss on a massive scale.[138] The Anthropocene, or the era of humankind, could really become the opposite of its name. The narrative surrounding the

134 Thomas F. Gieryn, "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists," *American Sociological Review* 48, no. 6 1983.

135 Rockström, "A safe operating space for humanity".

136 Rockström et al., "Planetary boundaries: exploring the safe operating space for humanity," *Ecology and Society* 14, no. 2 2009.

137 Steffen et al., "Planetary boundaries: Guiding human development on a changing planet," *Science* 2015.

138 Rockström, "A safe operating space for humanity".

atmosphere to be used as fertilizers with the percentage of global land cover converted to cropland, and it turns all nine boundaries into a comprehensible sign operating on multiple time-scales. The phosphorus influx to the oceans can increase ten-fold during 1000 years before oceans will become anoxic, while species-loss already has turned into a mass-extinction 100- to 1000-fold greater compared to background loss. In the follow-up article in 2015, the trefoil operates on even more scales and levels. For example, the biodiversity loss is described at both gene and species level, but it then becomes too complex to be fitted into one symbol. I will return to this later.

Three boundaries are crossed in the 2009 version, we see them as radiating red out of "the safe operating space" for terrestrial humanity. Two are already on astronomical levels as they visually transgress Earth's spatial extension, while the third remains within Earthly levels. We must leave the scientific reading of the symbol as a diagram in order to understand what it hints at. All of the boundaries radiate from the centre of a map where Panama is the origin, or maybe it is the core of the world. The globe is made transparent to also show the backside of the world. Australia and Indonesia are shown as shadows to the left of South America, and the Horn of Africa to the left of West Africa. This symbol allows us to literally and metaphorically see through the world, and Panama has nothing to do with the choice of origin. There are a number of variants of the planetary boundary trefoil, and the terrestrial globe seems to turn arbitrarily around its axis. Still, they all share the trefoil character over an image of the terrestrial globe. They belong to the same visual culture where the emphasis is on all places rather than any particular place. The symbol is universal and applies to all places and to everyone. From the article, it seems that the future threat lies within and in the relations between ecosystems and is therefore invisible to un-aided human perception. However, the symbol makes it visible in a similar way that the threat of radiation becomes visible through the sign called the radiation trefoil.

Figure 14 shows the reason to why I call figure 13 for the planetary boundary trefoil. The crossed boundaries in fig 13 are marked in red and make up a trefoil, similar to the radiation trefoil. However, whereas radiation is local to places, the danger signalled by the planetary boundary

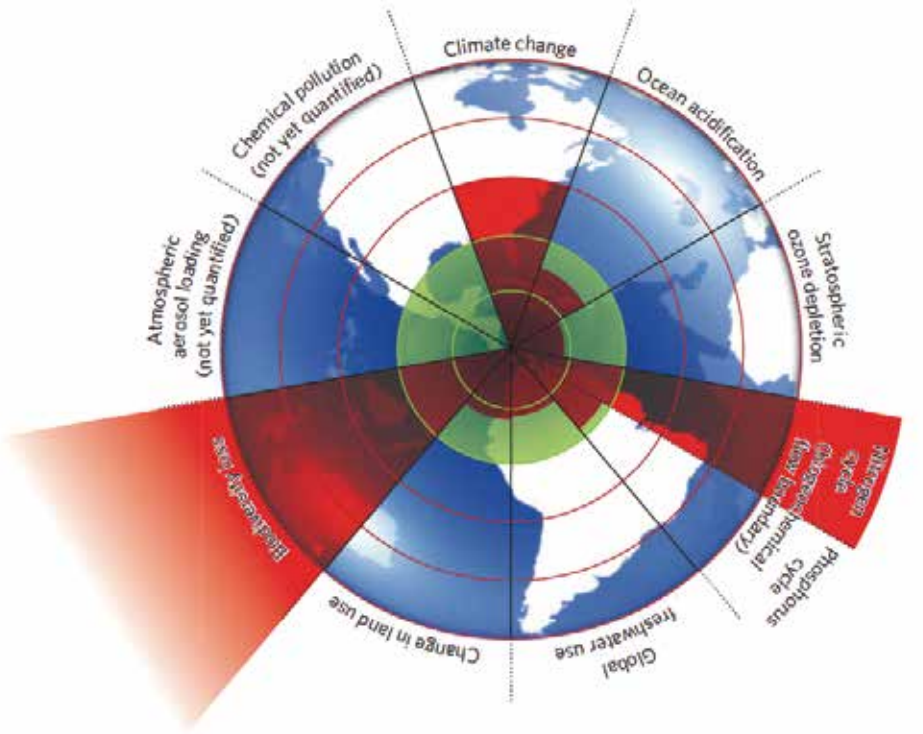

Figure 13. The *Planetary Boundary Trefoil* from the feature article "A safe operating space for humanity" in *Nature* ,2009.

Figure 14 The radiation trefoil.

Anthropocene sounds more like an imminent apocalypse than the age for humans. But, of course, the apocalypse is a recurrent theme in human culture, and our fascination of a world without us might say something about our human outlook onto the world. Joanna Zylinska finds that there is an equivocality in the form of narcissism, saying that "[t]here is no doubt something narcissistic about this enquiry into the instability of the human, inevitably conducted by a human subject".[139] Humans are spellbound by a world without us out of fascination with our creative power to destroy. Zylinska goes on to suggest that we should work toward a more welcoming and hospitable narcissism with reference to Jacques Derrida. It is not necessary to drive others to extinction out of love of self, especially because we are totally dependent on the *other*. It is *we*, because of our possibility for reflection, who have the obligation to think about how we can act ethically in relation to the other.

The planetary boundary trefoil is a diagram turned into a stop sign at the end of the Anthropocene path, or rather nine different roads toward the same dead end. "Don't go there!" is the outspoken political message. Each boundary is a rough estimation containing uncertainty and knowledge gaps, according the text, but the boundaries "lay the groundwork for shifting our approach to governance and management, away from the essentially sectoral analyses of limits to growth aimed at minimizing negative externalities".[140] The authors hope that politics will turn from a focus on economic growth to awareness of the effects that human activity have on future conditions for human development. The planetary boundary trefoil is a combination of nine values on different scales rendered as a polar area diagram, i.e. a bar chart in the form of a pie, and then placed over a schematic terrestrial globe to become a political communication tool. If each boundary was represented with a conventional bar and placed side-by-side, we would have recognized it as a diagram, of course, but it would have lost is affective imagery. I would argue that its successful circulation comes from its combining of different kinds of boundaries. For example, it juxtaposes the amount of gaseous nitrogen removed from the

139 Joanna Zylinska, *Minimal Ethics for the Anthropocene*, Ann Arbor, 2014, p. 62.

140 Rockström et al., "Planetary boundaries: exploring the safe operating space for humanity," *Ecology and Society,* 14, no. 2, 2009.

trefoil is harder to avoid. It comes from everywhere, and there is nowhere to escape it. There is no outside of the Anthropocene world, how could there be, as humans we are stuck within our world. It is in this respect that the symbol is a boundary work, it points out the boundary that we cannot transgress, the limits of habitable living conditions. The planetary boundary trefoil wants to induce a feeling of present danger through the use of an inverted symbol that links it to Chernobyl and Fukushima. There are similarities between the meltdown of a nuclear plant and passing of tipping points like the shutdown of the thermohaline circulations of the oceans or the monsoon system or the melting of the Siberian tundra. The similarity emerges when compared as singular events. This singular event can be described as a virtuality that becomes actualized in a process of differentiation, it springs forth in an act of creative differentiation and irreversibly changes the milieu in which it occurs. The world in which the threatening force was virtual no longer exists because the event has happened and become actual, there is no going back, just ask the citizen of the abandoned city of Pripyat next to Chernobyl and most people living within a radius of 20 km from Fukushima when they can go home again. Their hometowns no longer exist as homes; they have been turned into a radioactive area and the time it will take for anyone to make them home again is geological rather than human. Something similar goes for tipping points in ecological systems; once they are crossed, there is no going back, at least not on any human time scales. The results for passing tipping points will be loss of homes, loss of belongings, and an explosion of migration of people across the globe in search of a world to house them. This is already what is happening to inhabitants on low-lying islands like Tuvalu, and there are already climate refugees around the world from droughts and conflicts over resources.

I would argue that the terrestrial globe in the background of the trefoil illustrates no scientific information that comes from the accompanying text. However, the globe is a vital addition to get the message across. A relationship that is not obvious at first emerges between the diagram and the globe through Jacques Derrida´s explication of the parergon in *The Truth in Painting*. The added globe is the "supplement outside the work"

and it can be seen as a sign of lacking cognitive frames.[141] I argue that the background globe is added because the "senders" consider it necessary to frame the message so that the "receivers" are guided to interpret the urgency. Much has been written about frames, from actual frames of artworks to the rhetorical analysis of framing in text. I prefer the Derridean analysis when picking apart the polar area diagram from the terrestrial globe while still recognizing their strong interdependence.

My identification of the globe as a frame comes from the observation that it is one of the most recurring figures in the visual culture of climate change, but also that it is simultaneously redundant and totally necessary in the planetary boundary trefoil. From reading Derrida, the globe is like the clothes of a statue, it "inscribes something which comes as an extra, exterior to the proper field but whose transcendent exteriority comes to play, abut onto, brush against, rub, press against the limit itself and intervene in the inside only to the extent that the inside is lacking."[142] The body of the statue would be the polar area diagram, i.e. ergon, and what the inside is lacking is to become representative of the world. It becomes politically representative through the symbolism that the trefoil gains through the parergonal globe. The diagram does not function as a symbol without the parergon, the globe, which in itself is redundant to the content of the diagram. We will immediately interpret the planetary boundary trefoil as an "environmental" symbol and maybe even as a stop sign thanks to its similarity to the traffic sign, and I propose that the text that it illustrates is subordinate. The text in the article only discusses the boundaries indicated by the bars, thus the globe is supplementary in the visual manifestation and it is an aesthetic choice and not a scientific need compared to the content of the text. If we do read the text, then the globe is totally unnecessary, but we do not need to read the text if we see the trefoil, and the trefoil actually says it more evocatively than the text does – *don't go there, don't come here*.

In figure 15 we see the equivalent symbol from the 2015 article that illustrates the same boundaries used in the article from 2009. However,

141 Jacques Derrida, *The Truth in Painting*.
142 ibid., p. 56.

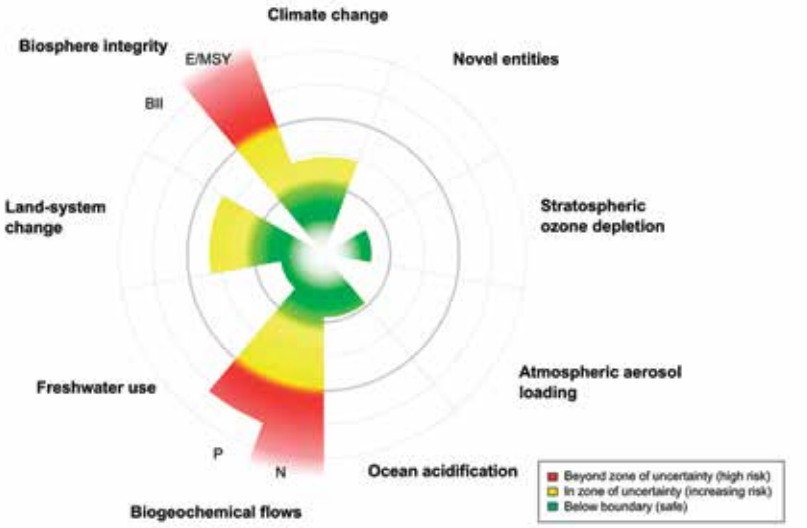

Figure 15. Polar area diagram used in the Science article "Planetary boundaries: Guiding human development on a changing planet" from 2015. A variant on the planetary boundary trefoil from 2009 (fig. 16) has become an important symbol, almost a trademark, for the Stockholm Resilience Centre. They write on their homepage that the "2009 and 2015 illustrations are free to use in publications, scientific or otherwise, describing the planetary boundaries concept." The symbol has gained an outreach that few scientific images do, and the authors know the value of this. Scientific communication needs a good package.

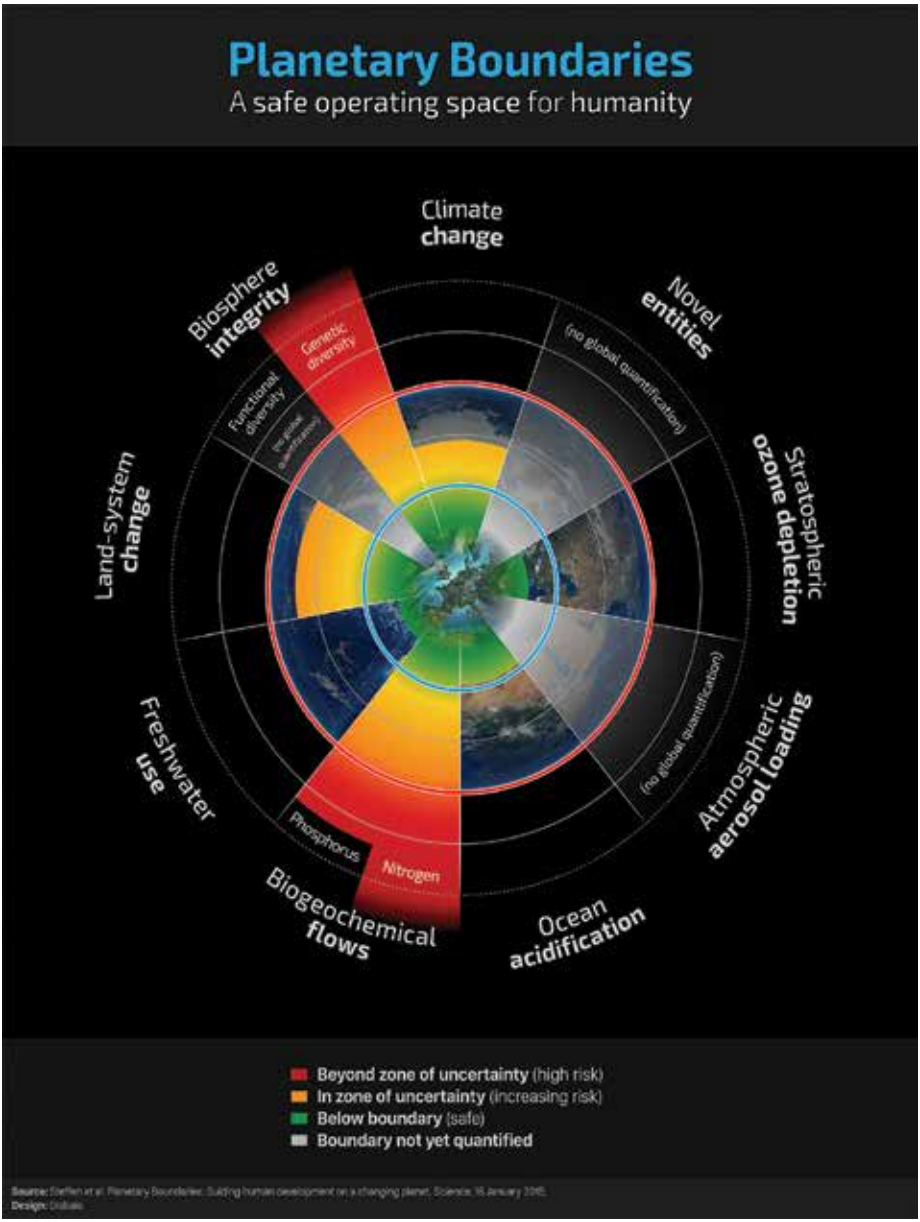

Figure. 16. www.stockholmresilience.org/21/research/research-programmes/planetary-boundaries.html

the visual appearance of the figure has changed. The trefoil, if there still is one, is made out of three question marks, and the globe is gone. I would say that this diagram is no longer the political communication tool it was. The planetary boundary analysis now operates on the sub-global scale as opposed to the global-scale boundaries in the earlier articles, according to the article. However, this is not shown in the diagram but only explained in the text. The diagram is changed because the authors have adjusted it to account for the risk that sub-global processes will push the planetary state over the boundary through positive feedbacks or other emergent events. If we see the globe, it is only an after-image from the earlier diagram, but then again, much of the messages in the visual culture of climate change are after-images. We see the globe also because it has entered into our thinking, according to the authors, and they write that they see "[t]he rise of 'the Planetary' as a relevant level of complex system understanding", which was not the case in 2009.[143] Similar discussions can be found in the IPCC choice of cover images in 2007 and 2013 for the physical science basis reports, according to co-head of IPCC, WG1, Thomas Stocker.

The introduction of question marks to the trefoil is a strong accentuation of the uncertainty that accompanies predictions of the future as well as planetary boundaries. The symbol has thereby become more scientific because it now accounts for the knowledge gaps, but it has also lost the evocative character its predecessor had. A legend is added to spell out the meaning of the colours. Seemingly, the legend was not necessary in the first figure. It is clear from the article that the science has progressed, but judged as a communication tool it appears unfortunate that the uncertainty is greater than it was six years earlier. The authors point out two boundaries that are critical and could push these systems into an unwanted state on their own, and they write that "climate change and biosphere integrity are highly integrated, emergent system level phenomena that are connected to all of the other PBs [planetary boundaries]".[144]

By 2015 the concept of the planetary boundary had entered into the

143 Steffen et al., "Planetary boundaries: Guiding human development on a changing planet," *Science* 2015.

144 ibid.

discourse of climate change, and this analysis has become well known since it was first introduced in 2009. It has been criticized by some scholars, acclaimed by many others, picked up by NGOs, and become a major component of the political discussion. The globe is deleted in the above image and thus the boundaries are less "limited" to the planetary and three question markers are added with one of them marking "novel entities".

The Double Recurrence of the Sea

This chapter will first show how images of the sea are recurrent in the visual regime of the climate sciences as well as the in visual culture of climate change. Then the chapter continues with the second occurence of the sea where climate images are modulated onto the ocean, i.e. images are shown in immersive environments like virtual reality. This second occurence is primarily found in scientific communication, i.e. governed by the visual regime. I argue that this recurrence of the sea is a double sea-scaping where the audience is led to see the world in endless change, in flux. This double sea-scaping is a visual manifestation of the worldview of climate change, meaning an "attitude, both an everyday attitude and an academic perspective, that gives a higher value to the meaning of phenomena than to their material presence; the word thus points to a worldview that always wants to go 'beyond' (or 'below') that which is 'physical'", in a quest for feeling of presence in a changing world. [145] I argue that it is a manifestation of panta rei metaphysics. It is thinking of a world where everything is in flux. Panta rei was supposedly first exclaimed by Heraclitus of Ephesus (c. 535 – c. 475 BC) and translates to "everything flows".

I observe that the sea repeatedly returns in images that are said to show climate change. We often see images of flooded cities and drowned landscapes in news articles that are discussing climate change, and I find them in scientific climate communication as well. These sea images are also often used in general discussions and not those explicitly about the risk of future flooding or sea level rise. One might argue that it is only natural to use images of the sea because flooding and sea level rise are predicted effects

145 Hans Ulrich Gumbrecht, *Production of Presence : What meaning cannot convey,* Stanford, 2004. p. xiv.

of climate change, and the effects are likely to become more frequent and more severe in the future. The latest IPCC report states that changes in the water cycle will be associated with extreme weather, including "[s]evere thunderstorms, associated with large hail, high winds, and tornadoes", and these will lead to flooding and heavy precipitation, while some parts of the world will be much dryer for the same reason.[146] It is safe to say that water in different forms is part of all climate causes *and* effects, but this only partly explains the ubiquity of sea images. There are other reasons for using such images in climate communication beside the scientific predictions, and I argue that sea images are recurrent because they are thought to evoke a feeling of change and to create a connection to nature. The lack of connections to nature is often used as a way to explain why climate change is too abstract of a phenomenon; supposedly we have lost the sensitivity to experience the contingent effects that are already becoming manifest. The scholar in French literature Julien Knebusch claims that "Western societies have progressively dissolved their ancestral link to climate […and] it has been possible to observe a deterioration of sensitivity to meteorology [sic] and climate".[147] This somewhat sceptical view on humans' attention to our surroundings might be refuted by those who note a rising attention to weather, if that is what Knebusch means with meteorology. Birgitte Nerlich and Rusi Jaspal point out that "[e]xtreme weather events have been increasingly in the news, accompanied by images" of flooding.[148] Admittedly, there is a fundamental difference between being interested in images of weather, like watching the weather forecast, and having the "ancestral link to climate", which Knebusch mourns the loss of.

Climate and weather are two different things; climate is an abstraction constructed retrospectively across the last 30 years of observations of actual weather. I argue that climate visualizations impel us to leap forward in time to imagine how catastrophic things will be given the present, yet almost

146 IPCC, AR5, WG1, p. 1087.

147 Meterology and climate are different entities, so I am guessing that Knebusch just means weather. Julien Knebusch, "Art and climate (change) perception: Outline of a phenomenology of climate," *Sustainability: A new frontier for the arts and cultures* 2008.

148 Nerlich and Jaspal, "Images of Extreme Weather: Symbolising Human Responses to Climate Change."

undetectable, trajectory of change. This forward loop wants to conjure the highly subjective feeling that "I am the seed of change", and this applies for good and bad futures. The trajectory of change is still only showing a relatively small deflection from historical weather patterns, and Nerlich and Jaspal recognize that "the process of unpicking signal from noise in weather data is extremely difficult". However, they identify images of flooding as the most common image to interface of symbolic and the documentary image of climate change effects, undoing the extremely difficult challenge to signify the small climate signal. Flooding is both the perfect symbolic image of climate change and at the same time one of the most plausible effect and a popular subject to make documentaries."[149]

I would argue that almost every scholar would agree that climate change is difficult to communicate no matter how the problem is described, and some would say this is due to the invisible cause and others would say it is because the effects lie in the future. I claim that it is not hopeless and that the communication is actually taking place, for example, through the sea-scaping that I will describe in this chapter. In other words, I agree with Nerlich and Jaspal´s conclusions but will take the visual analysis further, claiming that the feeling of tangibility in water images is an important aspect. This could be an additional answer to why images of flooding are popular climate change images.

I am not the only one to have identified water as a means to make the climate abstraction tangible. James Bunn writes, "The river flows through us and helps to shape us. If we want to understand climate change, and if we want to contribute to a re-balancing, we must understand these physical realities."[150] Bunn gives water a somewhat mysterious double role, both as the element that forms life on Earth and as the most important constituent of the climate system that must be brought back into balance. He also recognizes water as our cognitive access point to the intangible mechanisms of the climate system Bunn is, of course, not the first to make water an interface to the somewhat metaphysical; however, few make water the

149 ibid.

150 James H. Bunn, "The Physical Reality of Water Shapes," in *Impasses of the Post-Global: Theory in the Era of Climate Change,* ed. Henry Sussman (Open Humanities Press, 2012).

connector between humans and the intangibilities of the climatically changing world like he does. Bunn's analysis is more esoterically philosophical than phenomenological or ethnographic as he gives voice to the special quality that water has been given through history, though few have seen the tactile quality as a means of communication in this context. The thing that I argue that he is missing is that "enwaterment", as Italian film theoretician Adriano D´Aloia calls it, is already happening in climate communication and I will return to enwaterment later on in the analysis.[151]

It might be difficult to actually prove that sea images give any of the feelings that Bunn associates with them.[152] However, that is not the issue here; it is what we culturally attribute to water that matters because that explains why it is recurrent in the visual culture of climate change. I find that sea images in art history and literature are thought to conjure a number of things for the museumgoer or reader of literature. Kant writes that we gladly call the "hurricanes with the devastation they leave behind, the boundless ocean set into a rage, a lofty waterfall on a mighty river" sublime because they overwhelm us and encourage us to "measure ourselves against the apparent all-powerfulness of nature". [153] For Kant and the art historian, the sublime is not a thing out there, but an experience of an encounter "between consciousness and the world", as Stephen Levine puts it, thus the sublime will therefore also be dependent on artistic representations, and those change over time.[154] In the Romantic era, the ocean was a source of sublime feelings due to its vastness, depth, and threat of wrecking every vessel that dared to sail upon it. Christian iconography has depicted the sea as a place of evil and a "[m]atter that takes everything

151 Adriano D'Aloia, "Cinematic Enwaterment: Drowning bodies in the contemporary film experience," in *Emergent Encounters in Film Theory: Intersections between Psychoanalysis and Philosophy* (Kings College, London, 2009).

152 Even the ambitious visualization projects that produce impressive climate communication admit that it is difficult to prove the effect of images, and Sheppard et al write that "[v]ery little hard evidence exists on behavioural impacts of landscape visualisation either during exposure to the visualisation material or afterwards". Sheppard et al., "Can visualization save the world?", Digital Design in Landscape Architecture 2008.

153 Immanuel Kant, *Critique of the Power of Judgment*. § 28.

154 Steven Z. Levine, "Seascapes of the Sublime: Vernet, Monet, and the Oceanic Feeling," *New Literary History* vol. 16, no. 2, 1985.

back into itself", according Hans Blumenberg, who writes the aesthetic history of the *Shipwreck with Spectator*.[155] It is clear that the different manifestations of the sea have played important roles in Western culture and not least in Christianity. Noah builds the ark to save animals and his family to repopulate the world after it's temporary drowning. The whale swallows Jonah only for him to be rescued from the sea, and we cannot forget how the Red Sea is divided by Moses to save his people and then drown the pursuing army. Water was also the *line of flight* for the newborn Moses who was placed in a small ark and thereby saved from the king's order of drowning. The river deterritorialized power relations to let Moses live and become the seed of a *people to come*.

I find poetic expressions in the most rigid scientific reports and I would say that there often seems to be a climate scientist poet who wants to open up the dark cosmos through the parergonal. Or to use Deleuze, a "poet […] who lets loose molecular populations in hopes that this will sow the seeds of, or even engender, the people to come, that these populations will pass into a *people to come*, open a cosmos", because I argue that the scientific facts are unable to do this on their own.[156] Water is used as poetic images to smooth out the striated landscape we are accustomed to and open up the landscape for events that couldn't happen there otherwise. Indeed, the sea often has a liminal character – it acts as a border between worlds. Under the surface lurks the unknown. The physical plunge into water can symbolize an important change for the "immersant", going from one being into another through a water rite. Baptism might come easiest to our minds, as all Christians are familiar with it, but what is its meaning? Carl G Jung asks in *The Theory of Psychoanalysis* why the child is sprinkled with water during baptism into the Christian community, and he answers that we must gather the whole history of rituals from all of mankind's memory of relevant traditions in order to understand this ceremony. In order to understand ours rites of water, "all the reminiscences of folklore, the superstitious practices must be remembered" and the importance of water

155 Hans Blumenberg, *Storm with Spectator*, Cambridge, 1997.

156 Gilles Deleuze and Felix Guattari, *A Thousand Plateaus : Capitalism and schizophrenia,* Minneapolis, 1987. p. 345.

in Western thought is palpable also outside psychoanalysis and religion.[157] It is not only as the liminal other-world that the ocean has attracted writers and artists. Art historian Steven Levine writes that Monet's depiction of the seascape rocks of Belle-Ile-en-Mer in France offered the possibility to capture change, or the flux of nature, and the painting's "deathly immobilization of change" could render "the unseeable into the seen".[158] Levine describes the desire that Monet and other seascape artists felt when seeking to paint the oceanic feelings they experienced at the Atlantic shores of the small island of Belle-Ile-en-Mer. They proclaimed that they kept painting the seascape because it always eluded the materiality of the painting, turning it into a project that would never be finished. To finish this project would have resulted in the extinction of desire, but the changing seas are always new and impelled the artists to continue with the same motif. When it comes to climate visualizations, I would say that there is something poignant about the ocean, which could explain the desire to use it in visualizations in the first place, in a similar way as it have attracted artists through art history. But I would also argue that the ever more "realistic" visualization of the world never fulfills the promise of the perfected illusion. Still, I would say that the present day climate scientists perceive the physical world more and more like the Romantic painters related to the ocean, as elusively changing and always avoiding representational capture, and the scientific desire to visualize the world is therefore not extinguished. Not only the ocean but also the whole world is conceived as ever-changing, at least when the world as it is presented in the climate change communication.

Immersive environments are the second recurrence of the sea in climate visualizations, and such environments submerse the audience in audio-visual impressions to persuade them of the facts of the climate sciences through realistic visualizations. The more realistic the better, as the argument goes in the discourse of science communication. But we must not forget that the rhetoric of realism is first and foremost an aesthetic choice that has little to do with the accuracy or relevance of science.

157 Carl G. Jung, *The Theory of Psyconanalysis,* New York, 1915. p. 63.

158 Levine, "Seascapes of the Sublime: Vernet, Monet, and the Oceanic Feeling."

Timothy Morton argues against using virtual reality in environmental communication, and his critique is applicable to climate visualization. When the visualizations are claimed to be really realistic, when they are implied to be true to nature and they suggest to their audience that "[t]his environment is real" and thereby silently says, "do not think that there is an aesthetic framework here", then science has become an aesthetic material and should be analyzed as such, according to Morton.[159]

One could say that I explore the sea images in the visual culture of climate change because they are there to see. The sea images do not only show fluid water but also sometimes gaseous and often solid water – flowing water in oceans and rivers, the clouds in the sky, and the frozen water in glaciers, snow, and sea ice. I argue that the sea images often construct an outlook on the world rather than tell us something about any ocean or sea. When looking out onto the ocean, land becomes a seemingly fixed point, and it is from land that we observe the sea. Only rarely do we see land from the sea, because "man is a terrestrial, a groundling", according to the German political philosopher Carl Schmitt who points to the philosophic-political implications of this in his work *Land and Sea* from 1954. Man "lives, moves and walks on the firmly-grounded Earth", and Schmitt writes about the political history of the absent vantage point from the sea. Schmitt argues that we miss the importance of the sea throughout the history of civilisation and that this blind eye comes from our material human condition as "groundlings". The planet should not even be called Earth, according to Schmitt, who claims that "[t]he terrestrial onlooker finds it hard to understand that the continental space could be perceived with a distinctly maritime eye", still, he claims that we should call the planet "our sea".[160] Schmitt´s outlook have parallels in the history of sea images, namely the French Romantic historian Jules Michelet who composed one of the most eloquent and in-depth combinations of science and the sea when he described what the sea means to man in *La Meer* from 1861:

159 Timothy Morton, *Ecology without Nature*, p. 35.
160 Carl Schmitt, *Land and Sea,* p. 50.

> "For all terrestrial animals, water is the non-respirable element, the ever heaving but inevitably asphyxiating enemy; the fatal and eternal barrier between the two worlds. We need not, all things being considered, be at all surprised, if that immense mass of waters which we call the sea, dark and inscrutable in its immense depths, ever and always impresses the human mind with a vague and resistless awe."[161]

I would say that the 19th-century historian Michelet writes a natural history of the seas at the same time as he makes the sea the barrier between our living world and death. His grand history of the sea turns the sea into our *other-world* and not just the threat of death as it is described in this passage. Michelet´s prose makes us see where our conceptions of the sea come from, though, Schmitt´s political history of the sea is more contemporary and I would say that he even is articulating the idea inherent in an image which would not be created until almost two decades later, and then quickly gained iconic status as "The Blue Marble".

The Blue Marble

The Blue Marble is a designation given to Earth as a result of seeing it from space, it made the sea visible to humans from a totally new perspective (fig. 17). Earth became the small blue marble in dark cold space thanks to space travels that would culminate in the Apollo 17 mission in 1972 when the "last picture of our planet [was] taken by a human being from space", as Al Gore writes when explaining the importance of the many photographs called Blue Marbles.[162] Gore calls it the "last picture" to dramatize it, it might be more justified to call it the latest picture taken by human but he uses it to evoke a feeling of urgency to save the planet. It is often claimed that the distant vantage point made us see the world anew; it was brown and grey and suddenly turned blue, thanks to the space images. The German cultural critic Diedrich Diederichsen says, "Viewed from down

161 Jules Michelet, *The Sea (La Meer)*. New York, 1861.

162 Al Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*, New York, 2006.

here on the surface, the color of earth was brown, green, even black - it was of dark color. Then all of a sudden, the earth was blue".[163] Diederichsen argues that there was a fundamental shift of vantage point, from the ground to the outside in space. There might be good reasons that appoint this image a transformative point in the history of perception of the world. In addition, it can be regarded as a wish for the power of images. I argue that the use of the Blue Marble also signal a hope that images can change the world, when used as covers to for example *The Economics of Climate Change: The Stern Review* and the IPCC report *Climate Change 2007: Physical Science Basis*, then the image is used to remind us that it is possible to change perspective on the world, and maybe behaviour in the world. The Blue Marble is claimed to have caused a mental interiorization of planetary smallness – turning our head toward Earth from space did something to us, and Diederichsen claims that "this turning of the gaze back towards Earth signified a change of direction: the expansion-geared, outwards-directed frontier imaginary folding back on itself, in a 180 degrees turn. Ever since, we have been living in this period of interiorization".[164]

The Blue Marble is not only used to signify our fragile home from a stellar perspective, but it also signals the need for an ecological perspective, because oikos means "home", and the blue marble in dark space is all we have. This blue marble is actually turning bluer every year as the white polar ice caps are melting into blue water, and Al Gore asks, "What does it mean to us to look at a vast expanse of open water, at top of the world, that used to be – but is no longer – covered by ice?" His only answer is that it means "serious planetary effects".[165] While Gore asks the question from a physical science perspective, I ask the question from a visual studies perspective, but also I argue that the image of the "vast expanse of open water" signifies "serious planetary effects", the bluer the worse. I would say that it isn't a coincident as Earth against dark space is one of the most re-

163 Ana Teixeira Pinto, "The Whole Earth: In Conversation with Diedrich Diederichsen and Anselm Franke", 2013.

164 ibid.

165 Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It.*

Figure 17. This is the "original" blue marble taken 7 December 1972 on the Apollo 17 voyage. The image has the register number AS17-148-22727 and it is downloaded from spaceflight.nasa.gov/gallery/images/apollo/apollo17/html/as17-148-22727.html where they celebrate it like this: "This outstanding trans-lunar coast photograph extends from the Mediterranean Sea area to the Antarctica south polar ice cap. This is the first time the Apollo trajectory made it possible to photograph the south polar ice cap. Note the heavy cloud cover in the Southern Hemisphere. Almost the entire coastline of Africa is clearly visible..."

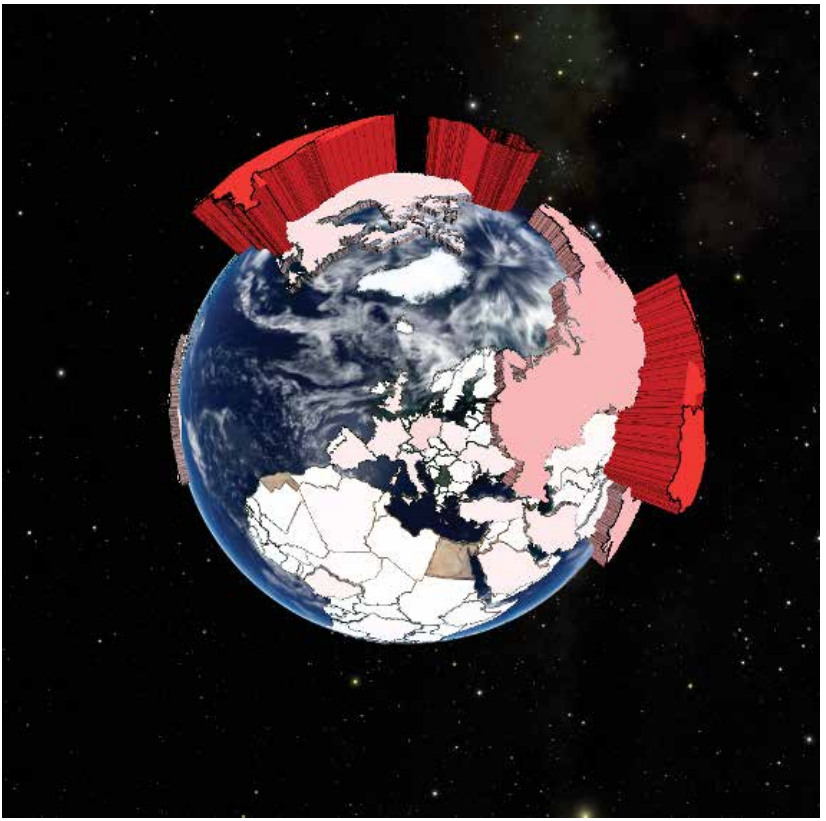

Figure 18. Still frame from a visualization shown in a portable dome, produced by CSPR. This is also a blue marble - planet Earth in dark space - though the Earth is totally digitally produced, it is the "same" image. The differences between the "original" to the left (fig. 17) is therefore noteworthy. I am not thinking of the boarders between countries that shows that this image is a political tool, nor the statistical bars showing emissions but the bright stars that has been added in the background. The stars creates depth in the image which is catchy in an immersive environment where Earth also spins in space. Stars cannot be seen in the left image but we culturally expect stars in the night heaven around us. There is also a likeness between the two that is interesting. Most modern Blue Marbles are produced from thousands of digital satellite photographs and those are choosen to create a cloud free planet. However, clouds are sweeping this digital planet as it used to communicate climate.

current configurations in the visual culture of climate change. Al Gore even claims it to be the most common picture of Earth, and he writes that "as matter of fact 99 times out of 100, when you see a picture of Earth, this is the picture you are seeing", in the book An Inconvenient Truth from 2006.[166] The professor of English Ulrike Heise writes that there is no doubt that the Blue Marble was the most influential image of world connectedness. This image signals that politics and science are intertwined and environmental movements uses it to remind the public that environmental solutions involve science and politics when using these kinds of space images, and this "in spite of their technological— indeed, to some extent, military—origin", and thereby neglecting any opposition between environmental engagement and military technological development. Heise means that it is stripped from its history to signal delicacy and unity instead of space race and war, she writes that it looks "like a precious jewel in a case of velvet, the planet here appears as single entity, united, limited, and delicately beautiful", against a dark background.[167] See the next spread for the "original" NASA photograph (fig. 17).

The roundness of the globe is often presented to us via images from outer space, but of course, the knowledge that Earth is round does not come from space travels and in addition, the exploration of Earth from above has a longer history than satellites have. Art historian Barbara Maria Stafford writes a history over scientific travellers where she presents some of the balloon voyagers that precede the modern satellite monitoring of the planet. Stafford describes how the scientists experienced the world from above and recites from their notebooks and diaries in her beautiful book *Voyage Into Substance*. Stafford does not only account for aerial travels but all kinds of scientific travels from mid 18th to mid 19th century, and she writes, "The scientific explorer-artist-writers, in trying to break from the limits of solipsism, custom, and habits of representation, strained to be extra-referential [...which] gives these accounts their special flavour of authenticity", i.e. the artistic and literary qualities that comes with the

166 Steffen et al., "Planetary boundaries: Guiding human development on a changing planet."

167 Ulrike Heise, *Sense of Place and Sense of Planet : The Environmental Imagination of the Global: The Environmental Imagination of the Global* New York, 2008. p. 22.

scientific presentation produces a feeling of presence in the world for the reader. Stafford describe how the first scientific aerial voyages change the perception of the amazed ballooner Thomas Baldwin in 1784, "The balloon descent produced analogous prospects that quickly drew the attention downward, away from a rectilinear horizon […and] at an altitude of one mile, the sea (red in colour) 'suddenly' presented itself, and circular landscapes of distant countries filled the eye", showing that the change of perception wasn't dependent on space travel but probably has a longer history.[168] Still, we have a clear image of our home in space as seen from space and this is a key image in the visual culture of climate change.

Figure 18 is a variant of the Blue Marble turned into a bar chart. This visualization is used to compare the total emission of climate gases for all countries. It can be changed to show emissions per capita, total emissions over time, and so on. In the end, this is a bar chart made more visually attractive than the conventional chart, only more difficult to interpret. Its mission is something other than just a representation of statistics, and I would argue that it tries to create connections between statistics and the planet as "home". In the search to be different from the conventional forms of scientific presentation, the image of the globe has become emblematic among public science communication images. It borrows its form from the image that "became a powerful symbol for the global environment movement", as Ulrike Heine writes.[169] One somewhat overlooked aspect of the Blue Marble is that it comes with a dark background, and the planet protrudes against dark space. The particular image was taken on a rare occasion, in the words of Al Gore, "when the Earth and the Sun and the Moon are positioned along a straight line". The photographer took the image with the sun behind the spacecraft, "So the Earth, instead of being partly shrouded in darkness, appears fully illuminated", nevertheless, the dark background is still there.[170] The Blue Marble isn't the only sea-image

168 Barbara M. Stafford, *Voyage Into Substance: Art, Science, Nature, and the Illustrated Travel Account, 1760-1840*, 1984. p. 418.

169 Morton, *The Ecological Thought*, p. 24.

170 Ulrike Heine, "How Photography Matters: On Producing Meaning in Photobooks on Climate Change," in *Image Politics of Climate Change: Visualizations, Imaginations, Documentations*, Transcript Verlag, Bielefeld, 2014.

in the visual culture of climate change. There are many other climatic images that are presenting the sea to make us see the change in the world.

Seascaping

When the sea is used in climate communication, it seldom refers to a particular ocean, it is anonymous and unexplained, it is just there. Then, art historian Abigail Susik sees changes in what the ocean beckons in contemporary photography compared to the tradition of art history. The sea is no longer only an evoker of sublime emotions, but it has become an eco-political trope. Susik writes that the ocean in contemporary documentary photographs is unfolding and "establishes a unique breed of social response that is more about calling attention to a general malaise of ambiguity than spelling out any specific political message", and I would say that the ocean thereby is somewhat less vast today then it used to be.[171] We still perceive it is as immense as the pollution of the ocean to a large extent is invisible to us, but we know, Susik argues, that we think about the invisible pollution when we see the ocean in photographs. The photographs of the ocean can be used as a vessel to express the invisible change in the environment to the audience, if Susik´s analysis is correct. Susik means that the ocean has become a zone of both horror and pleasure functioning as a self-reflexive matrix, and she compares it to the Freudian concept of the uncanny. Besides using water as trope or metaphor, I would say that water is a pictorial element that is applicable to almost any landscape, be it suburbia or farmland, any -scape is dramatized by being turned into a "seascape". However, I will begin the image analysis with a sea image where water is pictorially absent but still evoked through visual semblance. We sometimes must disregard the denotative to see what images convey through connotation.

171 Abigail Susik, "Convergence Zone: The Aesthetics and Politics of the Ocean in Contemporary Art and Photography," *Drain* 9, no. 1 (2012).

certain ideas and certain meanings […which always] involves a kind of comprehending where the meaning is represented as a property of the object illustrated", meaning that the images are symptomatic of a way of perceiving, and this way of perceiving could be considered a thought collective.[172] With reference to C. P. Snow, we can also say that images belong to one out of two cultures that are mutually un-interested in each other, or we can turn to Thomas Kuhn's paradigms of thinking to explain how choices of images are necessarily blind. Kuhn writes that differences between sciences are unavoidable because different sciences have "their incommensurable ways of seeing the world and of practicing science in it. Observation and experience can and must drastically restrict the range of admissible scientific belief, else there would be no science." [173] I conclude from the material I have been studying that there is a strong consensus on how to represent the world visually among climate scientists, making me defining it as a visual regime. Though, the example on the previous spread slips the restrains thanks to its parergonal position as cover. (fig.19)

This cover image differs from the many graphs, tables, round polar maps, and small elliptical world maps inside the report when these images are compared based on how they represent the world. However, the images on the inside and the outside of the report are actually more than just different. They complement each other by showing that representation of the same referent is possible through different kinds of images. The cover image shows us the curving forms and lines that belong to a landscape that is not immediately recognizable, while the inside images are very distinct and seek to establish clear links to their outside referents. It could have been that the images were *just* different, but they are *more than* different as they are representing the *same* things in the changing world, at least according to the motivation written by Stocker. The images inside the report are all illustrating their accompanying text, while the outside cover image illustrates the whole content of the inside and seems to belong to a different visual regime. Two images can be found in a pedagogical textbox in the FAQ section of the report that corresponds to what the cover images

172 Ludwig Fleck, *Genesis and Development of a Scientific Fact*, Chicago, 1979, p. 137.

173 Thomas S Kuhn, *The Structure of Scientific Revolutions*, Chicago, 2012. p. 4.

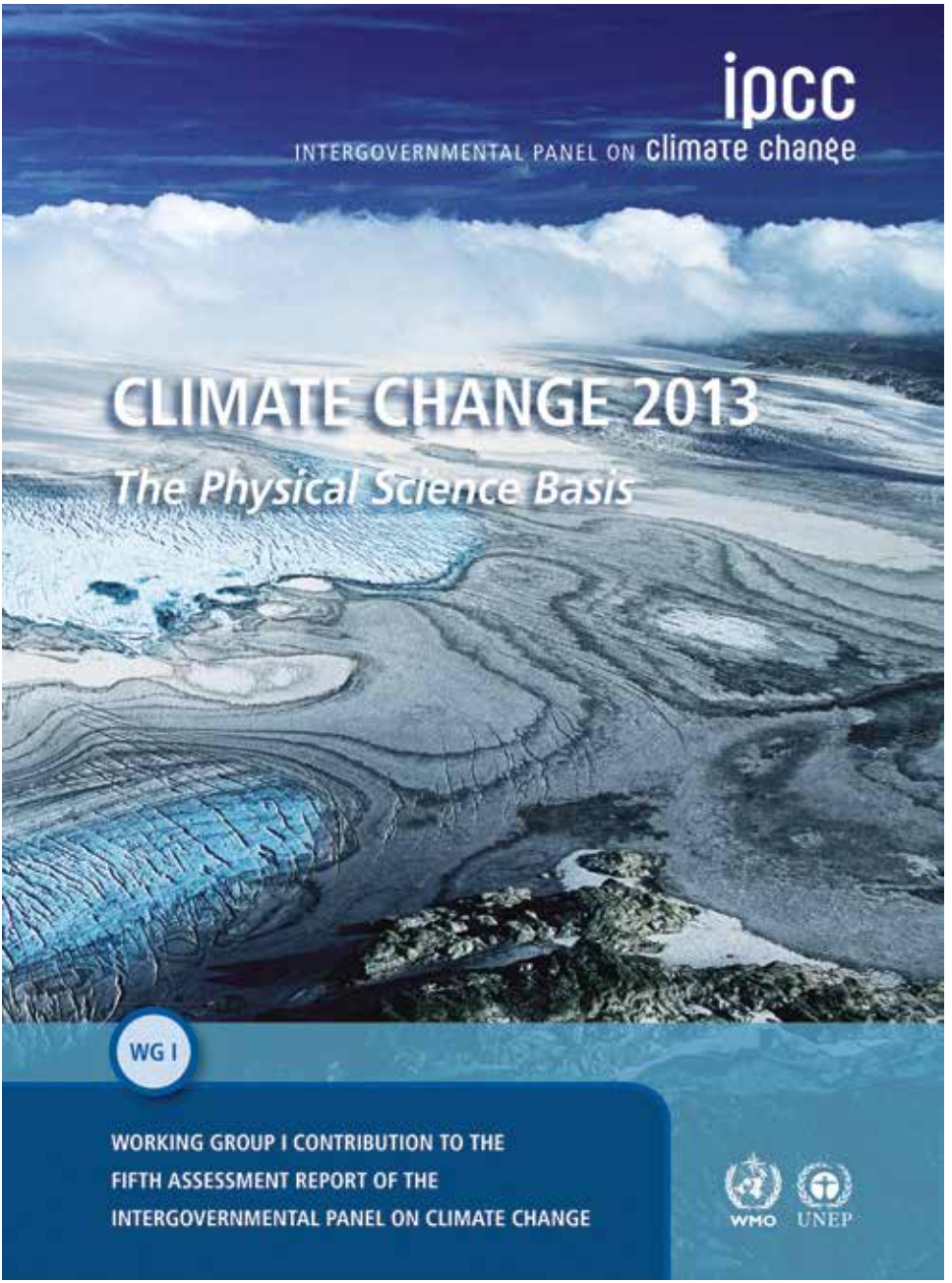
ipcc
INTERGOVERNMENTAL PANEL ON climate change
CLIMATE CHANGE 2013
The Physical Science Basis
WG I
WORKING GROUP I CONTRIBUTION TO THE
FIFTH ASSESSMENT REPORT OF THE
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO
UNEP

Figure 19. The cover image on the IPCC, AR 5, WG1 report *Climate Change 2013: The physical Science Basis*. The original photo for the cover was taken by French artistic photographer Yann Arthus Bertrand and shows the Norwegian Folgefonna Glacier at an angle from above. The horizon is heavily clouded, and there are mountain ridges in the foreground. The blue glacier stretches out onto a grey landscape where the darker lines make the photography look like a map with height lines. However, these lines are made up from moraine ridges that have been pushed up by the advancing and then receding glaciers. This is an aerial photograph that might make us hesitant as to what it shows, its denotation isn´t obvious for the lay viewer. To some extent is also lingers between being a fictitious landscape and being a photograph of an existing landscape. The lingering that we might experience as viewers, not exactly knowing what it depicts, gives the image pensive qualities. Determinacy disqualify it for use within the report. The visual regime of the climate science demands images that are clear and univocal. (Permission to reproduce given by IPCC, WG1, Technical Support Unit, Bern, Pauline Midgley)

The double recurrence of the sea

"Although not seen in this image…"

The image on the previous spread (fig. 19) comes from the cover of *Climate Change 2013: Physical Sciences Basis Report.* The image is originally a photograph taken by French artistic photographer Yann Arthrus Bertrand who seems to be especially popular among IPCC communicators for his work. Bertrand´s aerial photographs have been exhibited in many IPCC contexts. Nevertheless, it is not the artistic qualities that interests me first but the motivation for its parergonal use in science communication. Thomas Stocker, co-chair for IPCC WG1 and the working group wrote the motivation:

> The selected cover image incorporates three key climate system components that are part of the assessment of IPCC WGI in the AR5, namely the atmosphere, land surface, and the cryosphere. *Although not seen in this image,* the Folgefonna Glacier drains into the Hardangerfjorden and the Sørfjorden fjords, providing a direct coupling with a fourth major climate system component, i.e., the ocean. The selection of a high latitude Northern Hemisphere image puts the focus on the latitudinal zone within which some of the largest observed and projected changes in temperature and precipitation have been assessed in the WGI AR5 report. The image also prominently includes clouds and related cloud processes in the atmosphere, anther focus of the WGI in AR5. The image thus brings together many elements of the IPCC WGI AR5 assessment. (my italics)

This short text is a rare case where it is articulated why a particular image was used in science communication. I have observed that the actual choices of images normally are not motivated even though there are general pedagogical recommendations for climate communicators and specific protocols for IPCC representatives. Still, there seems to be a lack of words to talk about images in any other way than the natural scientific within the dominant visual regime, and this makes the choice of images almost invisible, it will appear to be the "natural" choice. This disciplinary belonging can be referred to as "thought collectives" with reference to Ludwig Fleck's work *The Genesis of a Scientific Fact* from 1935 where scientific images are described as "ideograms, or graphic representations of

depicts, namely changes in cryosphere and its connection to the other parts of the climate system. The difference between the cover image and the textbox images are indicative of the disparity between parergonal images and scientific images that belong to the visual regime of the climate sciences (fig. 20 and 21).

The pedagogical figurative image (fig. 20) and the graph (fig. 21) are from a summarizing textbox that illustrates "Changes in the Cryosphere" in chapter four "Observations: Cryosphere" in IPCC, AR5, WG1. The first image (fig. 20) is not the most common type in the report, which would be a graph or a simplified globe showing temperature, precipitation, ocean pH, sea-level rise, and so on. Nevertheless, the image is demonstrative of the visual regime of the climate sciences in general. These images are constructed with the intention of saying the same things as the associated text, and there is little interpretive space for the reader of the image to add meaning. This lexico-visuality, i.e. visuality in which images are combined with text, is used to limit alternative readings. I argue that the illustrative images should only amplify the message of the text. In my analysis, the term "illustrative" describes this relationship. It is a relationship between text and image, where the two make up a two-modality montage with corresponding meanings. I interpret the "illustrative" in the visual regime context thus to be limiting; an illustrative image is showing less than what the associated text says. Ideally the textual meaning will be mirrored and magnified in the pictorial meaning without adding any new meaning, it will just say the same thing in a more accessible form. I would say that most scientific communicators perceive images as easier to understand than text in general is.

Roland Barthes argues in *The Rhetoric of the Image* that "[w]e are still, and more than ever, a civilisation of writing" and that communication without words belonged to illiterate societies.[174] I would say that this can be applied to understand the visual regime here, as well as the broader natural scientific visual regime. Because, at the same time as it seems to love to communicate with images, it never do it without an explanatory

174 Roland Barthes, "Rhetoric of the Image," in *Image - Music - Text*, ed. Stephen Heath, New York, 1977.

text, or the opposite, letting the visual communication simply be an illustration of the text. Barthes goes on to claim that there is a hierarchy between textual and pictorial expressions where words have higher value than images. Nevertheless, virtually all of the climate scientists I have met with to discuss the scientific use of visualisations celebrate images as a communication tool seem to submit to the adage that "a picture is worth a thousand words". For me, this would be an empty celebration considering the actual use of images. It appears that the images most common in the visual regime of the climate sciences are only expected to express what the thousand words written down in the accompanying text already says.

Barthes' analysis in *Rhetoric of the Image* dissects an advertisment, whereas I analyse science communication, but there are similarities between these two types of communication. Both advertisement and science communication have a clear intentional message, and Barthes writes that "the signifieds of the advertising message are formed *a priori* by certain attributes of the product and these signifieds have to be transmitted as clearly as possible". I would say that the same goes for science communication which wants images to *denote* only what is already stated in the text, while advertising gains it strength from the *connotative*, saying something more than the text, something that arises from the projective power of the reader. The reader of a advertising text or image add meaning to the denotative message while the scientific images are intentionally prohibited from saying more than the text they illustrate. The text should carry all the scientific descriptions, discussions, and conclusions while the images only serve to illustrate the text. However, there is no image that only denotes without also connoting. This is unavoidable, but, as Barthes writes, "in every society various techniques are developed intended to fix the floating chain of signifieds in such a way as to counter the terror of uncertain signs", and the climate sciences follow certain practices that contribute to the constructing of what I call the visual regime of climate science. The scientific society, if you like, will only accept some kinds of visual expression to communicate in the ergon position and figure 21 is such an acceptable illustration.

The two images from the textbox in the IPCC report are similar to each other, but they seem to have different ends even if placed next to each

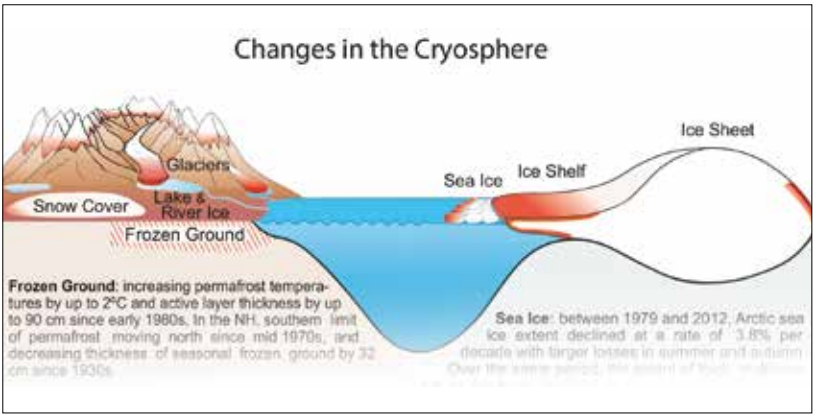

Figure 20. This is the upper image in an explanation textbox in the IPCC, AR5 , WG1 report. It shows the mechanistic relationship between glacier, sea ice and ice sheet in order to make the below image easier to interpret. This is a typical pedagogical textbook illustration.

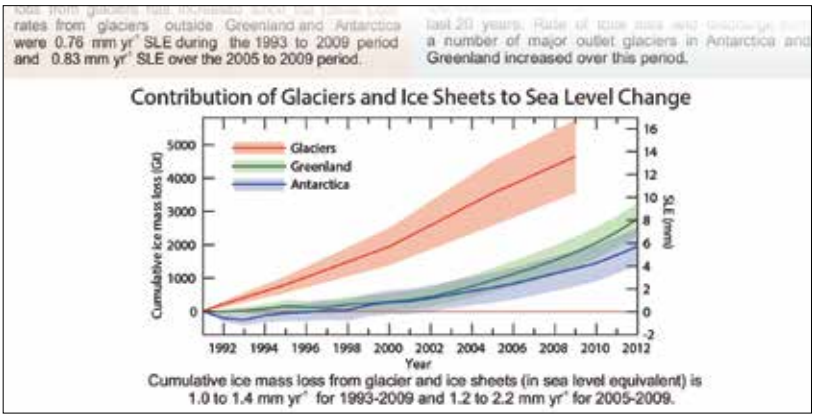

Figure 21. This graph shows what and how much contribution to sea-level rise that comes from the cryosphere and the image complies to the visual regime of climate science. The intermingling of text and images is characteristic.

other. The first image explains cryosphere mechanisms that are valid for all times, or at least as long as glaciers and sea ice exist, while the graph below it describes the direction and speed of contribution from melting ice to sea-level rise from 1992 to 2012. The first image (fig. 20) shows what everyone needs to know in order to understand the second, the first is intended to educate someone who knows little of the cryosphere and the second is much more difficult to interpret. The second (fig. 21) points out the changes taking place in the system that was described in the first. Nevertheless, the first image is a bit peculiar because I wonder what reader would make it to page 367 of the report without already having a fundamental knowledge of glaciers' relationships to the sea. Though, it makes it possible for the lay reader to pick up the report and start reading in the middle. The reports could become a traveller´s guidebook to the changing world.

The cover image´s message is not obvious, and it definitely operates outside the communication model that is otherwise dominant in which knowledge must precedes arousal of emotion, which then is supposed to lead to behaviour change. The cover of the IPCC report is not an illustrative image at all if we submit to the analysis of the artist duo Morris and Sayler. They write about the problem of illustrating climate change, and they promote the pensive image as an alternative or complement to the illustrative. They might agree that the cover is a pensive image as it fits into their definition of pensive; it has the quality of un-fixedness, it eludes determination and thereby opens up for interpretation in ways that the illustrative image aims to avoid. Their analysis is critical to its use and write that "[t]here is something deceptive about the illustrative image when it comes to climate change", and argue that illustrative "climatic" images are claiming an evidentiary relationship to their objects. They mean that these images only purpotedly show the evidence of "climate crimes", as if it was possible to attribute a cause for a coming effect. The problem of "climate crimes" is that any effect cannot be photographed just yet because it is only virtual and its is far from obvious who the criminal is, probably all of us.[175]

175 Morris and Sayler, "The pensive photograph as agent: What can non-illustrative images do to galvanize public support for climate change action?"

I would say that the scientific illustrative image is apt to show causal relationships, it can easily be done and there are plenty of such images within the visual regime of the climate science, such as images of chemical reactions and flow charts where systems are described. However, the climate systems as a whole cannot be described with isolated causal relationships but makes up a highly complex whole that eludes representation with illustrations. Because, the illustrative image depends on unambiguity so as to offer only one possible meaning, while climate always seems to be more than one thing – and often non-things – that cannot be represented, which is similar to the argument made by Barthes. The analysis that Morris and Sayler performs takes the photograph as its study object, while my analysis is about illustrative images that mostly are not photographs but are diagrams, maps, and so on. This leads to somewhat different conclusions, although the main critique is quite similar. Morris and Sayler propose that the pensive image is an alternative that could be introduced to climate communication. Pensive images are less contextualized, have zones of indeterminate figuration, strive less for fixed meaning and are more open toward the viewer which allow for more than one truth to unfold.[176] Whereas, I suggest that this has already happened in the margins of the illustrative, i.e. in the parergonal material of the scientific images.

The cover image is far from illustrative according to the given definition; rather, it is supplementary in that it adds meaning to the report. This is relevant because the cover image offers us *supplementary* ways of presenting with images, it is additive to the images inside the report that are totally determined by the visual regime. That is also why I regard this as a successful cover. For Stocker, the cover image (fig. 19) does not primarily express change, uncertainty, or complexity; instead, it presents a particular viewpoint. Stocker explains to me that the choice of image must be seen in the light of the previous report from 2007 where they used a Blue Marble as the cover image. I have not found any written rationale for that choice, but Stocker recalls that the motive was to signal that technology made it possible to make global predictions and that land surface,

176 ibid.

cryosphere, atmosphere, and ocean could finally all be integrated into one climate system in the climate models. The Blue Marble cover would then signify that the climate sciences could describe climate as a whole. The intended signal, if I understand Stocker correctly, would be that the climate models had become stable and robust enough to encompass the whole Earth. This could be compared to the present cover which, following the same logic, signals to the reader that the climate models used now can make predictions on a regional level because the resolution has increased since the last set of assessment reports. My guess that is that any of the intended signals are readable only by scientists familiar with the climate model development. Both cover images *show* the physical Earth, but these images are also supposed to *signify* the digital climate model of Earth, as each choice is motivated by the development of climate models. This show how the meaning of any image is not definite, not for aesthetic images and not for scientific images, and this is the given starting point for any analysis of visual culture. I argue that the parergonal surfaces, like the covers, offer an aesthetic playground for science to be expressed in other ways than the scientific, not only for communicative reason but also for the pleasure of those who understand the intended message. Seemingly, the "message" of the cover images can be much more convoluted than how the images inside the report operate, and I would argue that they appear to be riddles rather than illustrations. Clearly they have an aesthetic function on the whole, they are playful rather than serious in tone.

I saw the ocean when I first looked at the report *Climate Change 2013: The physical science basis*; however, it is not an ocean and I admitted this to Stocker when I first met him. He took the opportunity to explain how the scientifically trained eye will decode the landforms made by the moving glacier and hence know what the motif is, what the image depicts. The thing is that I still see the ocean when I look at the cover, even though I know that the "ocean" is only present in the marks made by moving ice and runoff water that drains into the fjords that enter the ocean. He tells me that "the ocean is implicitly in it". It is obvious that this image has a totally different role compared with the images inside the report because it is allowed to operate with other means – it gains power from what is missing rather than what is shown. It could be a compound image if we

follow Gaston Bachelards analysis of imagination, "linger and dwell in all these images, and then let each slip slowly into each other, you will come to know the extraordinary delights of these […] images that at one and the same time serve differing demands".[177] The image can evoke multiple meanings and precisely this vagueness and indetermination is producing multiple meanings, which is wanted for, at least from the perspective I argue for here.

This is but one example of how the ocean, the sea, or the river is implicitly or explicitly present in many climate change images, even if the outspoken message has nothing to do with the ocean. "We thought it (the image) was aesthetically appealing, it is something that makes you curious, […] as your visit proves", Stocker says about the cover, "it shows a system that is actually a physical system, it shows the interactions, atmosphere, water cycle, ice, land surface, and the ice that will discharge into the ocean". Stocker means that this is an illustration, after all. Of course, this depends on how we define illustration, and there could certainly be different types of illustrations.

It is my observation that the relationship between this cover and the inside images follows a pattern in climate change communication in which aesthetic images supplement scientific images in a beneficial relationship. In the interview with co-chair Stocker we discussed if and why the climate sciences need art, and I would say that Stocker is convinced that aesthetic images are needed to effectively transmit scientific messages to the public. There is no conflict between science and art as a means of presentation for him as a representative of the IPCC. Above all, he motivates the cover image for its aesthetic qualities and its ability to evoke emotions and not for its direct scientific usefulness as clarification or illustration. Stocker's motivation is closer to the use of the pensive image that Morris and Sayler advocate than how I regard the illustrative images inside the report. I observe that these aesthetic pensive images have a tendency to return in-between, wrapped around, behind, or over scientific images of climate change. They do not appear as separate images but as suggestive backgrounds or decorative frames that have a supplementary relationship

177 Mary McAllester Jones, *Gaston Bachelard, Subversive Humanist*. p. 109.

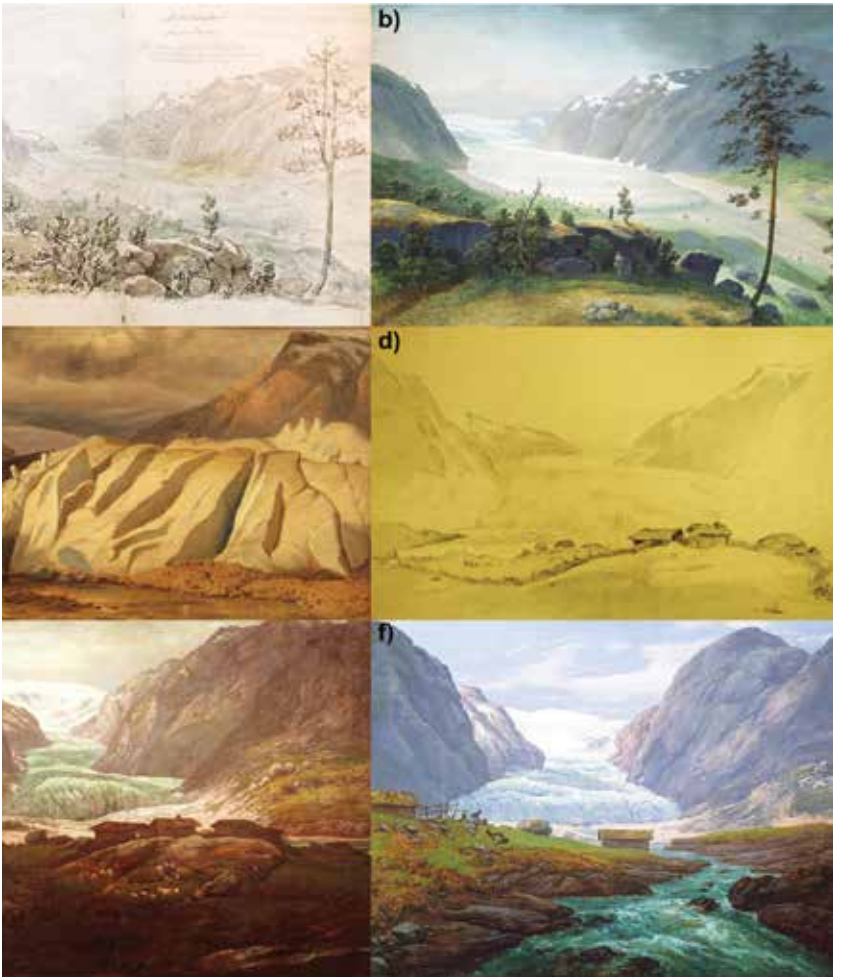

Figure 22. "Iconography" of the Nigard glaciers from Nussbaumer's article cited in IPCC AR5 WG1. A (1822) and B (1822/1834) were painted by Danish/Norwegian landscape painter Johannes Flintoe. C (1830) and D (1839) were by Norwegian landscape and marine painter Knud Baade. E (1839/1844) and F (1839/1847) were by the Norwegian romantic painter Johan Christian Dahl. G (1845) was by French mine engineer Joseph Durocher.

to the scientific image. Such images are present in scientific reports, marketing material, and documentaries about climate change, but its inclusion is seldom motivated. The interesting question is what it does to our reading of the scientific images when they are framed with an aesthetic décor and what does the inclusion of such material contribute with?

Barthes poses the question, "Does the image duplicate certain of the information given in the text by a phenomenon of redundancy or does the text add fresh information to the image?" He answers that the relation between illustrative image and text can be either *anchorage* or *relay*. Put simply, the two textbox images above (fig. 20 an 21) from the inside of the IPCC report are anchored because the text associated with the images limits "the projective power of the image", while the cover image relays meaning because it stands in a "complementary relationship" to what it illustrates.[178] The question, then, is whether the inside text is about the Folgefonna Glacier. Of course not – the Folgefonna Glacier is a "sea image" that is presented to its audience to help them feel the flowing change of the world. The image follows the pattern where the referent depicted in the sea image is kept anonymous, it could be any glacier, and it was not even clear to me that it *was* a glacier.

The Folgefonna Glacier *is* mentioned within the report, though in a footnote. The footnote refers to an article that is fascinating for anyone interested in the role of art in science. It is speculation on my part, but I suspect that this article was part of the inspiration that led to the choice of image for the report's cover. The article – "Historical glacier fluctuations of Jostedalsbreen and Folgefonna (southern Norway) reassessed by new pictorial and written evidence" – uses "data" from artworks to feed it into the climate models. The article by Nussbaum et al compiles hundreds of historical "drawings, paintings, sketches, engravings, photographs, chronicles, topographic maps, reliefs" that precede the scientific records of the extension and movement of Folgefonna and two other Norwegian glaciers. The historical material describes the glaciers' outlet onto the surrounding landscape, which provided sufficiently dramatic scenery to

178 Barthes, "Rhetoric of the Image."

attract painters and other artists to the remoteness of the glaciers.[179] The scientific aim of the article was to map the "evolution of the two ice caps over the last centuries" by compiling images where a retreat in glacier length marks the end of the Little Ice Age in the Scandinavian countries. The same material could also be included when writing the Scandinavian history of romantic landscape painting in the 19th century! The scientific empirical material that allowed the authors to determine the end of the Little Ice Age in Scandinavia is actually a veritable art history collection.

Nussbaumer writes that "[g]laciers are sensitive indicators of past climate and thus valuable sources of climate history", but the problem is that there is a lack of scientific records for glaciers. However, there is "[a] wealth of different historical sources [...that] allows reconstruction of glacier length variations" over the past three hundred years. The first source for the Nigardsbreen Glacier that Nussbaumer refers to is from 1735, and this "piece of written information reveals that the glacier was 'only a stone's throw away from the farm'".[180] What is fascinating about the empirical data in this article is that on their own, they are nothing more than works of art – but as soon as a geographer collects them, organizes them chronologically, and determines the glacier length from them, they gain value as pieces of evidence for the glacier equilibrium-line altitude. The present-day landscape provides us with two data points, namely the present length of the glacier and a moraine ridge that was pushed out at the glacier's maximum length. All of the data points in between come from the artworks and the scientific records. The use of art history accounts of glacier extension not only contributes with data, it also shows the nature of much of the data used to describe historical climate proxy data. When scientists measure the rings of old trees or the occurrence of pollen in marshes, they approach these signs in similar ways as Nussbaumer approaches the artworks in her study. Collecting documents, making measurements and interpreting signs to compile a history of a place and contextualizing it see the whole world, the big picture.

179 Nussbaumer et al., "Historical glacier fluctuations of Jostedalsbreen and Folgefonna (southern Norway) reassessed by new pictorial and written evidence," *The Holocene* 21, no. 3 2011.

180 ibid.

Grosse Aletsch-See

In my discussion with Tomas Stocker, I ask if he considers it to be difficult to make images of change. The simple argument is that a photographic image does not show change in comparison to video or film. He shows me two images that hang on the wall just next to us. The two images are very different from each other. The first is a map of Switzerland from 20,000 years ago when it was covered by ice, and the second image was made by a designer to illustrate an article about human adaptation to warming that Stocker wrote for the *Sonntagszeitung* in 2006. The article was called "Wie überleben wir bis zum Jahr 2106?", and Stocker was invited to write on the subject from the perspective of climate change. The question was what Switzerland would look like in a hundred years. The illustration (fig. 23) was commissioned by the newspaper to complement the text, and the illustration is not scientific, according to Stocker, but it does express change. The scene is hot red, and a tropical canopy forms a frame in front of the motif. The reader of the article becomes an onlooker *in* a nature that appears to be alien to Switzerland. Our position when viewing the image is framed by the leaves and branches in front of us. From our viewpoint, we are looking at future people going into the haze; almost everyone depicted is oriented toward the new-born sea upon which several boats are sailing. The sea comes from the melting water of the Grosse Aletsch Glacier, which is no more. The leafy frame is an eco-mimetic device used to produce a feeling of presence in nature. Echoing the words of Timothy Morton, I would argue that this is the ambience of the image, it has a "sense of a circumambient, or surrounding, world" that lulls us, and, paradoxically, the future catastrophe becomes enjoyable. The girl that leans forward from the canopy frame looks at us with an alluring smile; she brings charm to the already positive image of life in the climatically changed future. The main story of the scene depicted above is that the "Grosse Aletsch-See" will be created when the Aletsch glaciers melt. The glacier is the biggest in Switzerland today, and the image might sweep Swiss people through time and evoke a more fundamental understanding of the process of warming we are all experiencing. The image takes the viewer who understands the meaning of the title on a journey in time

Figure 23. Mathias Bader drew this illustration for the article "Wie überleben wir bis zum Jahr 2106?" published in Sonntagszeitung, 31. December 2006 written by Stocker and two authors from other fields of expertise.

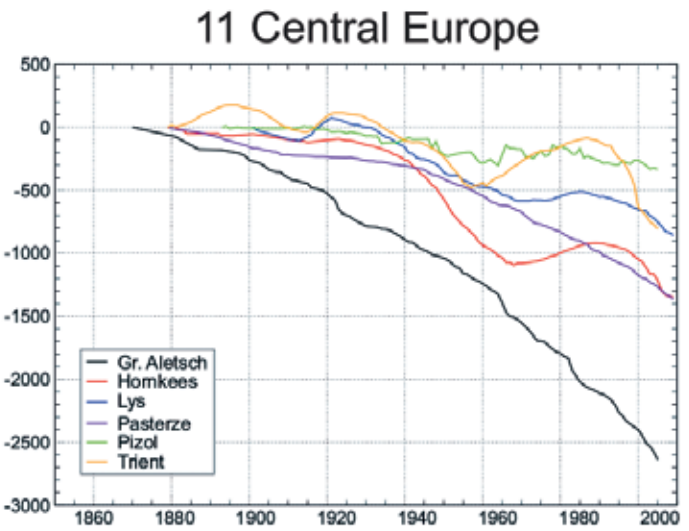

Figure 24. Graph in IPCC, AR5, WG1, p. 339 showing the decline of glaciers in Central Europe and Grosse Aletsch Glacier is one of them.

rather than space. The image suggests that significant events are taking place right here and now that will lead to a situation where the entire glacier is gone. What was once an alpine environment has been turned into a Mediterranean-like resort. Such a scenario can to some extent be backed by science, and it has been estimated that "the area of the glaciers in the regions will shrink by 70% to 90% by the end of the century" in an overall situation where "the world's glaciers are out of balance with the present climate and thus committed to losing considerable mass in the future, even without further changes in climate".[181] There is also an image of Aletsch glacier loss in the IPCC report. I would argue that the graph in the IPCC graph speaks clearly about the effects of climate change, and it is fairly easy to see where we are heading given the historical shrinkage of the glacier since 1870. (fig. 24) The Grosse Aletsch Glacier has receded by more than 2500 metres over the past 150 years, and the rate of shrinkage appears to be growing faster every year rather than slowing down. We can consider the drawing (fig. 23) of the lake framed by a canopy of trees to be a much needed dramatization of climate science. It present scientific findings with a very different story, while the second (fig. 24) is limited by the visual regime of the climate sciences.

The recommendation - sea-level rise, flooding, or drought

Let us take a step back to Stephen Sheppard who advises his readers to use images of water to make climate change more tangible. Sheppard et al write that because both carbon dioxide and even the source of carbon dioxide itself is effectively invisible, communicating the effects of increased carbon dioxide levels requires "quite tangible visual or landscape-related effects of climate change, such as sea-level rise, flooding, or drought".[182] The starting point for Sheppard is that "[c]omputer visualization of landscapes in three or four dimensions constitutes a 'crystal ball' capable

181 Farinotti et al., "Future glacier evolution and impact on the runoff regime in the catchments of Alpine reservoirs: The Aletsch area, Switzerland," *Dams and Reservoirs under Changing Challenges,* 2011.

182 Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour."

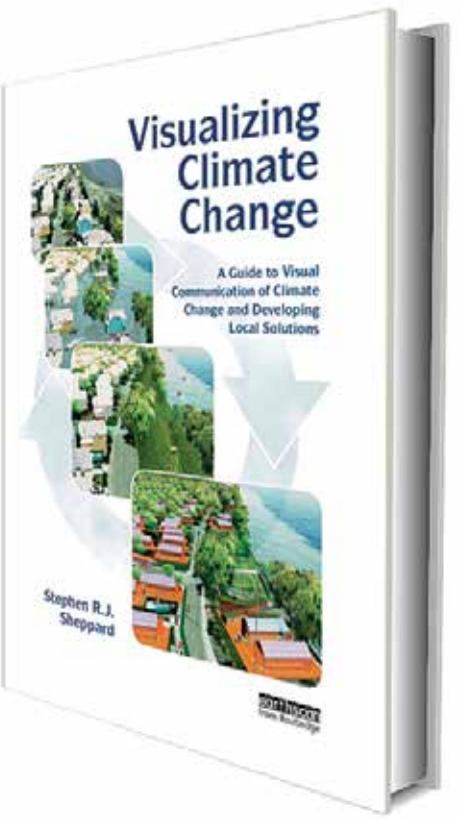

Figure 25. Cover of *Visualizing Climate Change* from 2012 by Stephen Sheppard

of showing us views into the future". I would say that the metaphor of a "crystal ball" is indicative of a strong belief in the power of the image among many scientists in the field. Sheppard recommends that visualizations must be used with care and that the "crystal ball gazers" should be informed by a code of ethics so as to avoid misuse of this powerful tool.[183] He is not implying that science needs magic to produce reliable scenarios for the future. The real magical effect is in the method of presenting the scenarios and the new insights offered to the audience. I would say that the visualizations discussed so far in this thesis conform to a rhetoric of authenticity. Furthermore, I would say that the ethics that come with the visualization are not written down nor explicitly communicated, instead, they are integral to the aesthetics of the visualizations.

The images analysed in this section were produced by David Flanders at the University of British Columbia and are frequently used in Sheppard's articles and on the CALP homepage, which is where the videogame *Future Delta* that was analysed in the previous chapter comes from. I first saw these images on the cover to Sheppard's guidebook *Visualizing Climate Change* (fig. 25). I would categorize them as Barthesian *anchored* images when appearing on the cover, where the textual context guides "interpretation, constituting a kind of vise which holds the connoted meanings from proliferating."[184] Any additional meaning that could come from reader's interpretation is controlled by the sender. This is a sender that appears to feel "responsibility – in the face of the projective power of pictures – for the use of the message", as Barthes puts it. Note though, the existence of a sender does not automatically give rise to a receiver of the intended message. Things happen on the way between the two that overthrows the model in the first place. However, the aspect that I really ponder upon is what happens to the reader who accepts that these images let us gaze into the future, regardless of whether the intended message is taken at face value or not. It would appear that images such as these are exemplary of how climate change should be communicated to laymen

183 Sheppard, "Guidance for crystal ball gazers: developing a code of ethics for landscape visualization," *Landscape and Urban Planning* 54, no. 1–4 2001.

184 Barthes, *Rhetorics of the Image*, p. 156.

given these particular scenarios recurrence in articles, books, and the webpages from CALP. Supposedly, they show the tangible effects of climate change instead of its invisible cause, but I question if this is quite the "message" that reaches its audience. I argue that seeing the world as landscape is the main message. Here, landscape means a selected and framed part of the world. The landscape will also position the viewer in specific relation to world-turned-into-landscape, and the frame stretches into the room of the viewer, framing us in the world.

The images that I discuss in this section (fig. 26, 27, 28, 29, 30, 31) make us see the outside world as a landscape and, in this climate context, dependent on man as opposed to only on nature, from which man come but is disconnected from through the development of civilization. Sheppard argues that the landscape image is only the medium for a message that informs the audience of future climate effects, but I would argue that the images produce an outlook on the world as landscape. Admittedly, there are similar arguments to mine used by the producers of the images. The following images represent four possible worlds and offer "pictorial storylines of the future for a South Delta community."[185] The first image represents the present state (fig. 26).

The shoreline is not pressing directly onto the backyards in the present-day image, but it will, which is what the following images will show. The following scenarios present different worlds, and they are produced to make the audience choose which world they want for the future, as if the audience was in the position to choose. I guess that the large majority of any audience would choose the "green" alternative, or the least bad pathway in the latest IPCC report, because most often there is only one alternative that allows for sustainable development. The reason why I have selected these particular images to interpret their meaning from my perspective is that they are exemplary of how scenarios like these are thought to communicate the idea of climate change to an audience. The communication model that I have criticized above is associated with these scenarios and the images in this section satisfactorily demonstrate the pedagogical thought that often comes with scenario-making in the climate context,

185 Sheppard, *Visualizing climate change.*

Figure 26. This is Sheppard's 2010 South Delta, visually representing present actual conditions to be compared with future scenarios. (Image by David Flanders, UBC-CALP)

Figure 27. South Delta in 2100 if business as usual is not replaced by new policies. (Image by David Flanders, UBC-CALP)

how to communicate the scenarios and what effect they are thought to have on the audience. The image in figure 27 shows the same scene in 2100 if nothing is done, i.e. business-as-usual.

Scientific images of the future are often devoid of humans, as was discussed in the section "The human factor" in the previous chapter. However, in the image in figure 27 we find two persons who are salvaging belongings from their homes, or maybe they are looters? I will return to "the man on the street" in a discussion on Hurricane Katrina later on. We cannot tell if the drowning of the street is caused by a storm surge – and the ocean will return to more normal levels – or if this is the supposed "new normal" in 2100. It is most probably due to global sea level rise combined with the ocean finally breaching any remaining natural barriers due to an extreme weather event. No matter what the cause, the calamity that has caused the depicted situation is surprisingly absent. It is as if everyone that lived there just vanished, except for the marooned man on the broken roof throwing things over to a raft and the man in the small boat a little ways up the street. The houses are still clean, no seaweed has been tossed up on the roofs, and no mould is growing on the walls. Somewhat paradoxically, the effects of sea level rise seem to be hidden under water. The two human figures do not change the feeling that this is a scene where humans have just left for some unfathomable reason. The deep despair that must pervade such a situation is not reflected in the scene. Sheppard writes, "[d]epicting personally relevant environments, such as local and recognizable neighbourhoods […] familiar landscapes tend to be associated with stronger and more positive affective responses […because] people seem most affected by personal implications of climate change".[186] Comparing the images and the text cited in the book, I would say that there is a balancing act going on here. The effect that evocative images might have should be harnessed to work in favour of promoting behaviour that will help mitigate climate change. Sheppard, among many other scholars, celebrates the effect that the fiction film *The Day after Tomorrow* had on public awareness and engagement in climate change. However, "the failure

186 Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour," p. 646.

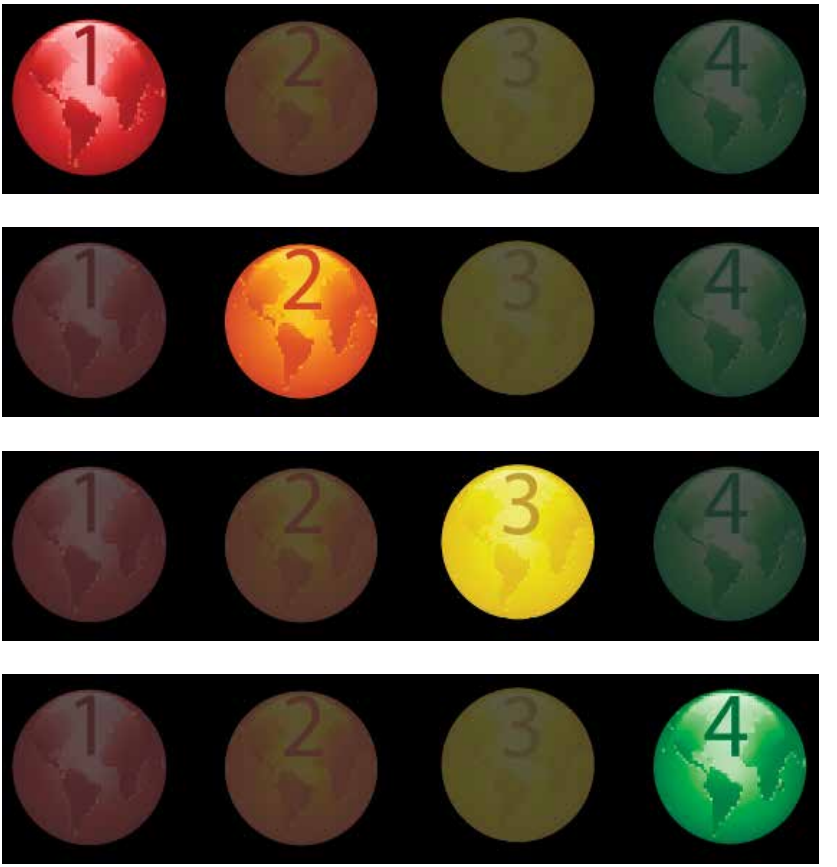

Figure 28. Markers to the four options in the form of traffic light. (Image by David Flanders, UBC-CALP)

to distinguish fact from fiction amid the high realism, led to low credibility of the film itself, making inferences for more scientifically based visualization difficult to draw."[187] I wonder, where is the human distress if this is a realistic visualization of what can be expected from the above scenario? It seems that climate communication loses one of the key ingredients for building a dramatic story when striving for universality, namely the humans that the audience might identify with. Instead, the Blue Marble returns as a red traffic light, shown in figure 28. The red, orange, yellow and green light comes juxtaposed with the different scenarios in Visualizing Climate Change and it is my interpretation that they are used as traffic signals - red for stop, orange and yellow might mean think again or beware and the green definitely means go![188] But is it really necessary to include a red stop sign to signal that the present-day business-as-usual attitude leads to the societal shipwreck depicted in the above image? One would think that the image of the flooded street would be clear enough. I would say that this shows how the author mistrusts the reader to make own interpretation. Barthes´ *The Rhetoric of the Image* take as its aim to analyse whether images functions because we perceive them as imitation, as the Latin root of image suggests, or what other ways that images gain meaning. The starting point is a pasta advertisement from Panzani, showing pasta, tomatoes, onion, and cheese in mesh net, making up a colourful blend of red, white and green. Barthes´ semiotic analysis shows that meaning is produced on several levels, not only through recognition of the depicted ingredients. The text in the photo as well as the colours are important as they make the viewer interpret things that are not obvious at first, but comes from association and connotation. This can readily be applied to many of the images that I present here as also they often are images with text inside or comes with a texts with they illustrate.

As described above, the principle relationship between image and text can either be anchorage or relay in Barthes' analysis of the rhetoric of images. The red traffic light is a Barthesian anchorage of the scenery being depicted because it limits our interpretation of it. I argued above that the

187 ibid, p. 642.
188 Sheppard, *Visualizing Climate Change*.

cover image of the IPCC report relayed new additional meaning to its text, whereas the traffic light anchor means only to "stop" because everyone who sees this image will be familiar with a traffic light. The scenarios discussed here always come as illustrations of a text, but my point here is that traffic signal symbolism is a form of text to the image the drowned street. Thereby, I argue that the red light only stops the reader of the image from engaging in the interpretation of image's many other possible meanings – the image becomes over-determined and loses rather than gains meaning. Each pictorial storyline assumes that the South Delta community is representative of the rest of the world because what happens to the sea level in South Delta is dependent on what happens in rest of the world. The pedagogical assumption is that those who live there will best understand the pictorial storylines and that they will affectively recognize the flood-prone street as "home". The communication strategy is to use "home" as an imaginary microcosm for the rest of the world, and the full message would then only be accessible to the very few people who live in that micro-cosmos. The doing-nothing scenario will eventually result in a storm surge that drowns someone's "home". It seems as though encouraging action among individuals is thought to be the solution to global responsibility taking, abstract as this concept might be.

The encouragement of responsibility might very well be based on the facts behind the plausible effects of climate change, but I argue that the ocean surge that drowns someone's "home" plays on both more corporeal and mythical strings than Sheppard admits. He "underscores the need of accurate recognition", together with relevant facts, to be able to relate to the images. I would say that images can have one apparent meaning while carrying something more, I am not convinced at all that recognition of a physical place is what is at work here. The similarity between the image and someone's home does not hit me, and most of us seeing an image of a drowning world are not struck by any illusion of "home" underwater because we don't live there. Still, I think it works, just not like that, not through recognition, but through the sea as agent that we almost all have experiences of, both as a threat and a pleasure. The image works through our bodily and cultural recognition rather that through its nature-likeness. According to Hans Blumenberg's analysis *Shipwreck with Spectator*, the

Figure 29. Wall adaptation to the world in 2100. Same street as figure 27 but the effects have been temporarily counteracted, still the even longer term effects will make the water flow over the wall. (Image by David Flanders, UBC-CALP)

Figure 30. Efficient development the world in 2100 will prevent the flooding of the South Delta area. This represent a combination of technical adaptations and some reductions of emissions. (Image by David Flanders, UBC-CALP)

ocean has long had a cultural association with shipwrecks, and a voyage at sea has been a metaphor for how humans live their lives in art, literature, and philosophy throughout Western history. When viewing the images in Sheppard's book, we become philosophers contemplating suburbia being "shipwrecked" as the sea level rises, and, supposedly, the storyline will be even more evocative for those who actually live there today, *in that blue house on that nice street*.

Nonetheless, the truly realistic visualizations of anyone's home are not yet obtainable at the scale needed to address the majority of those who are implicated in causing climate change. Undeniably, there are such projects going on. The VisAdapt project delivers recommendation on how Nordic homeowners should build, renovate, or refit their properties to prepare for predicted changes in local climate. Admittedly, this project aims for adaptation of infrastructure rather than reduction of emissions. Still, the aim of this web-based visualization tool is "to increase understanding of the potential effects of climate change", which is an aim shared by all those involved in climate communication. Alas, they do not deliver dramatic images of the effects on my house, but instead provide a Google maps image annotated with text that describes the general effect in the area. It takes some imagination to make any of the above images "hit home". [189]

Still, I believe, this is where the potential lies in these pictorial storylines, because all of them fit better as different actualizations of the sea-faring metaphor than as realistic visualizations of climate change effects. We are led to imagine a future where we would look back on what we should have done to avoid the wrecking the "ship" that we all sail. This forcing of imagination brings forth the philosopher, and "[i]n reflection, the spectator surpasses himself: becoming the transcendental spectator" and not a specific spectator identifying his house at risk.[190] In addition to the imaginary time-travel, I would say that it takes a kind of transcendental gazing to accept that there are three or four scenarios that we should visit before making up our mind of what to do today. Furthermore, we must also consider that numerous combinations of the scenarios are plausible,

189 www.cspr.se/forskning/visadapt-intro/1.601981/VisAdaptflyer141107_B_web.pdf

190 Hans Blumenberg, *Shipwreck with Spectator,* Cambridge, 1997. p. 61.

not only the red, orange, yellow, or green road ahead, but rather a rainbow that risks being smeared brown. As I see, we need the hopeful images, and the threatening ones, all the plausible scenarios, in order to have a feeling of where what we should aim for but we will not arrive at a world that looks like this image or scenario. It will be combinations of what was predicted, some totally unexpected aspects will be added, and turn into a mixture that doesn´t resemble any of the "options" we are provided with here.

I would say that that is what would need to be represented if we are to be realistic about the future scenarios. Obviously, this risks preventing the audience from feeling that the scientific predictions are conceivable at all because the suspension of disbelief demands that a coherent story is told, and there is not one story to tell. There are two adapt-to-risk approaches for the South Delta community. (fig. 29 and 30)

This adaptation storyline presumes business as usual, except for building higher levees. The wall will protect homes from being flooded, but nothing is done about the cause of change and the wall will only delay the coming drowning as sea levels continue to rise. This scenario with the dike embankment is marked in orange in a "traffic light" image. Interestingly, this relatively short delay of catastrophe is not indicated in the image. The ocean will continue to rise, and I ask, where is the virtual wrath that waits for its time to come? The orange traffic light is not really enough to evoke the sense of riskiness of this approach to what is coming (fig. 28).

The most prominent addition to the image for this approach is the catamaran with a futuristic rig. It looks like the sail is covered by solar panels, as are all the roofs of the houses. Solar panels are an eco-signal, add them to a roof and it will be perceived as environmentally friendly, in a similar way as water can be added to a familiar landscape or cityscape to signal catastrophe. Furthermore, it is relatively simple to change one roof cladding to another in the digital graphic environment where the visualizations are created, just exchange all rooftop surfaces for the typical white-grid on a grey background of a solar panel. There are also other features that are changed compared to the previous story lines, for example, the small pond for run-off water that replaces one of the houses. The sender seems to say that the efficient development world is superficial

because only the surfaces of the infrastructure have changed. It is different with the green future, called *deep sustainability*, where global and local society has changed entirely. (fig. 30)

The high-tech sailing boat is replaced with birds, and society seems to be more sunken into the greenery. There is a community garden, and I guess that all of the conventional houses are replaced with houses that sit on platforms that allow them to float up when storm surges drown the area. This deep sustainability represent a re-thinking of how societal infrastructure relates to changes in nature. The production of alternative scenarios is done to emphasise the need to make choices, both on political and societal as well as individual levels. The sea-level rise in these images corresponds to how much the rise is reduced compared to doing nothing; and sea level rise is the perfect indicator of the state of the world, connecting the street to the world as whole.

It is easy to grasp what sea level rise does to a landscape; however, these images do not relay meaning of what such a rise really means to society. The sea surface is calm in every frame, but it is a bit absurd to think that it will be a smooth rise, leaving everything intact as the sea level climbs over levees and embankments. Still, the images are invitations, or maybe desperate cries, from science to society to imagine the effects of today's political and economical decisions. In *The Gay Science*, Nietzsche calls out "Get on the Ships!...There is another world to discover – and more than one! On to the ships, you philosophers!", and this is echoed in this science communication´s call for the need for new imaginaries of the world.[191]

According to Blumenberg, this particular Nietzsche aphorism was written after a sea voyage that Nietzsche undertook in order to better understand the Epicurean philosopher Lucretius, who pointed out that there is a difference between standing ashore looking at the toil of others in distress and embarking on a ship to place oneself in the position of the distressed. In other words, Nietzsche left the ivory tower of the philosopher to enter the violence and turbulence of the world. However, the weather was calm and Nietzsche's voyage was without incident. Blumenberg means that he was neither in the position of the philosopher on the safe beach

191 Friedrich Nietzsche, *The Gay Science,* Cambridge, 2001. 289th aphorism.

Figure 31. Deep sustainability in 2100. The whole society has developed into sustainability and the threat of the ocean is avoided. (Image by David Flanders, UBC-CALP)

nor in the position of the shipwreck. The spectator, or philosopher, gains an outlook to the world thanks to the shipwreck in the distance and not necessarily being on-board the wrecking ship. If we transfer this to the ambitions to show the climatically changed future, then I would say that the usage of sea images seeks to translate between the audience and the world. However, one must take care to find the critical distance lest one drowns the audience with sea images, which often is the case when immersing the audience in images and sound to persuade them of the flux in the world.

I would guess that all of the scenes described will only be affective enough when we already are too close to the catastrophe to be able to actually do anything about it. It is a risk that the experience of the sea from our safe distance to the future is too distant to make these images affective. Blumenberg argues that it is kind of ironic that philosophical contemplation only comes from the "metaphysically exaggerated distance from earthly disasters", saying that this kind of knowledge demands distance and therefore makes it impossible for the poetic to triumph over the reflection that is needed today to realize the magnitude of the problem.[192] The existential aesthetic attitude could thereby remain un-actualized, i.e. virtual, until it is too late to actually deal with climate change.

Visualization and power

We do not really need to artificially produce realistic images of storm surges and the drowning of a world because we already saw first hand the effects that Hurricane Katrina had on to the streets of Louisiana. The visualizations should present an everyday experience of how it might be in the future, but it seems that actual events corresponding to those visualized in the scenarios in the previous section (fig. 26-31) are much more violent. I remember the first news images I saw from Louisiana after Katrina – they were fly-by images taken from helicopters showing people marooned on their roofs or gathered in the Superdome, and the people on the streets

192 Hans Blumenberg, *Shipwreck with spectator: paradigm of a metaphor for existence*, Studies in contemporary German social thought Cambridge, Mass., 1997. p. 32.

who were labelled looters rather than victims. The "real" human experience from the streets was not covered until much later. It seems difficult to actually transmit realistic images, and I note that almost all climate visualizations of landscape have a birds-eye perspective. The spectator position was a fly-by rather than the street view that most people have on the world whether we drive our car, take the bus or train, or walk the street. Still, Sheppard writes that "realistic landscape visualisations may offer special advantages in rapidly advancing peoples' awareness of climate change and possibly affecting behaviour and policy, by bringing certain possible consequences of climate change home to people in a compelling manner."[193] The images should not only be compelling, but also be dramatic, and this can be created with 3D presentation, according to Sheppard. In the perfect visualizations, people should recognize the places shown as "home". Landscape should therefore be shown with a human perspective in mind so as to better mimic how the outside world is experienced. Nevertheless, none of the above images of the four scenarios in the previous section have an everyday perspective, which would be walking on the street, driving a car, or looking out from a window. Instead, these images are typically scientific in that they show calm water where it would have been possible to produce the dramatic imagery that Sheppard suggests has a special ability to produce public engagement with landscape visualizations.

Julian Knebusch reminds us of something important from a vantage point informed by art history, "landscape does not exist in nature without the eye which grasps an expanse of land as landscape".[194] Her main argument is that the relationship between climate and weather is similar to the way landscape is related to nature. Landscape is a projection onto nature; it is there but is brought into being, by the viewer. Knebusch means that also climate needs a viewer in order to be perceived as such, I would say that weather needs a massive scientific apparatus to become climate. However, while Sheppard points to the influence that landscape has on us,

193 Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour", p. 637.

194 Julian Knebusch, "Art and climate (change) perception: Outline of a phenomenology of climate", p. 5.

Knebusch argues that landscape exists thanks to us, *we* make *it*. Exactly what the perceiving subject is projecting depends on history, culture, and so on. The famous art historian Kenneth Clark saw this in the development of landscape paintings and he writes in *Landscape into Art* (1949) that "Landscape painting marks the stages in our conception of nature". Accordingly, landscape was only possible to paint as result of the development since the Middle Ages, there is no such thing as a landscape until someone perceives it as such.[195] I would say that the scenario images (fig. 26-31) "do" landscapes of the world, but we should change "landscape" from a noun to verb. Visualizations of a countryside or a forest are not images of a landscape, but rather are images that are "landscaping" us. The images makes us perceive the outside as landscape, i.e. something that we are part and parcel of, there is no nature "out there" but only something that humans are the co-creator of.

Such an analysis is similar to that proposed by W. J. T. Mitchell in *Landscape and Power*, which is to "think of landscape, not as an object to be seen or a text to be read, but as a process by which social and subjective identities are formed". Mitchell argues that landscape is particularly effective as a medium for communication of identities and ideologies simply because it does not appear to be a medium of values but "as if nature were imprinting and encoding its essential structures on our perceptual apparatuses", i.e. today we experience landscape images as free from value and this is bound to conceptions in our time. Mitchell shows how "Landscape is a cultural medium that has a double role with respect to something like ideology" as it not only makes our cultural and social conception appear natural to us, it also interpellates the beholder to conceive his or her relation to a place be inevitable given.[196] I adhere to this analysis and suggest that its application to climate visualization through landscape would reveal that the stylistic value of the images is concealed by realism as style, as if nature perfectly reflected itself. This conceals the ideology that the natural science can represent nature "as it is". Mitchell also suggests that the reason why "we place a special value on

195 Kenneth Clark, *Landscape into Art,* London, 1949. p. 1.
196 Mitchell. *Landscape and Power*.

landscapes with lakes and reflecting pools" – the reflection in the water's surface would be an indication that natural perception is possible, just look at the image. The reflection in the water surface supposedly shows how the world is represented as if the images just mirrored the world. Except, this suppression of style or genre would be strongest as rhetoric in scientific, topographical illustrations, according to Mitchell; however, and I would add the actual recurrence of lakes and pools in scientific climate communication images.

Genuinely, I think that Sheppard is aiming to "landscape" (verb) his audience rather than to show the landscape as "it really is" out in the real world. Furthermore, given his recapitulation that "[c]ognitively effective landscape visualisation might focus on augmenting reality to make the invisible visible, making the abstract tangible, collapsing long time scales into short periods, and easily switching between different scales", it is not a farfetched interpretation that the image of landscape is primarily used to change the viewing subject more than to show the outside world.[197] I would say that landscape images as well as seascape images and all the other scapes – icescapes, dendroscapes, underwaterscapes, and so on – begin to make sense if their articulated intention is to change our understanding of the world rather than actually show us the world. The many examples of images of seascapes that show us nameless seas rather than a particular sea also make sense, and they foster an aesthetic *panta rei* relationship to the world rather than a purely scientific or mechanistic relationship.

A sea image that does not include land in the horizon becomes almost impossible to place identify – the image could be taken from any beach in the world or from any point out in the ocean. My interpretation is that such images are thought to carry transcendental qualities, i.e. something that goes beyond the particularity of most things we engage with on an everyday basis. Rachel Carson is famous for her ability to combine science and poetic language, and she writes in the *The Edge of the Sea* that when "Looking out over the cove I felt a strong sense of interchangeability of land and sea in this marginal world of the shore […] an awareness of the

197 Sheppard, "Landscape visualisation and climate change: the potential for influencing perceptions and behaviour," p. 645.

past and of the continuing flow of time, obliterating much that had gone before, as the sea had that morning washed away the tracks of the bird".[198] In this way, she conjures her shoreline position when talking to us, making us see the sea as a medium for feeling how life evolves as time goes on. This is all about the production of outlooks to the world and making the reader believe in the writer, it is an authenticating device. The writer becomes a witness of the world, as she takes us there when we read her lines. Climate visualization offers us a similar feeling of presence in nature. Critic of ecocriticism Timothy Morton argues that this "nature writing" is creating an ambience, which "denotes a sense of a circumambient, or surrounding, world", and the circumambient "suggests something material and physical, though somewhat intangible, as if space itself had a material aspect", concluded through his ecomimesis analysis.[199] This literary analysis aims to show how a deceptive feeling of presence in nature is produced through text. Morton especially targets ecologically engaged texts to do away with green superficiality.

The scenario images (fig. 26-31) in the previous section are not especially evocative of climate change – there is not a lot of dynamic activity depicted in them, there is not much drama on the streets, expect from the man on the roof, and the ocean is calm, almost tranquil. However, the images might work anyway. And if they do, then their effect would likely be through ecomimesis. It is through the ambience of landscape rather than a "realistic visualization" of nature that a viewer engages. This does not occur through the intended scientific message, but through the framing of the message. I argue that the four frames above, and many scientific images like them, actually achieve their objective, which is to engage their audience in the facts of climate change, but it is not with the facts, but how they are presented and the ocean is recurrent in these presentations.

Abigail Susik's analysis of the recurrence of the ocean in contemporary photography makes it conceivable that the ocean has the effect of a "reversal of the extremely common process of disavowal or repression that occurs in our daily lives regarding our consciousness of ecological issues". Susik

198 Rachel Carson, *The Edge of the Sea*, 1998. p. 6.
199 Timothy Morton, *Ecology without Nature*, p. 33.

recognizes the historical use and reception of the ocean in art, but she argues that something else happens for the contemporary museumgoer when seeing the ocean in photography. She writes that the "ocean repeatedly regurgitates and resurfaces what most of modern society has been attempting to repress for some time now", which is an apt description of the vast continent of garbage currently floating in the Pacific. Many people know that a giant swirling mass of micro-plastic is circulating "out there" even when we cannot see it, neither when we visit the seashore nor in contemporary artistic photographs of the ocean. Today, the image of the ocean mobilizes our feeling of guilt toward the environment at large; the images do not show plastic waste or oil spills. This is not necessary – it is what threatens to surface from the depths that is stirring us.

Immersion

Edward R. Tufte is famous and celebrated for his books on how information can be visualized. He opens the book *Envisioning Information* from 1990 with a formulation of a similar problem to the one that I am addressing in this thesis. He writes that the "world is complex, dynamic, multidimensional; the paper is static, flat," and then he asks, "How are we to represent the rich visual world of experience and measurement on mere flatland?" His book is full of beautiful examples where the conflict between the complexity of the world and the obvious flatness of paper is solved with exemplary graphic design. Tufte borrows the name – Escaping Flatlands – of the first chapter from the science fiction classic *Flatland: A Romance of Many Dimensions* from 1884 by Edwin A. Abbott. [200] Today, up-to-date climate communicators embrace digitally produced 3D visualizations instead of the flatness of paper, and this might be logical because it has been some 25 years since Tufte wrote his books. We expect a development of presentation technology, and the impressive advances in recent years have made flatlands of paper appear futile. However, sometimes it seems as if the focus on technology overrides the focus on motif that Tufte presents in his books.

200 Edward Tufte, *Envisioning Information,* Cheshire, 1990.

The surrounding of the images have evolved and this section will approach the immersion presentation technology as parergonal to the ergonal main message. One must keep in mind that the Derridean parergonal translates to frame, but it is the frame that gives the motif the meaning it would otherwise lack. Derrida emphasized the frame and how it interplays with the work, whereas Kant sought to cut the frame away so that one can better focus on the work itself, as if there could be a work isolated from its surrounding. I would say that the motifs of climate visualizations do not provide their audience the kinds of aesthetic experiences that have a transformative potential, but the settings in which these images are shown are often impressive. The parergon totally dominates the ergon, and maybe, if Kant were to perform a visual studies analysis he would dismiss the presentation form as schmuck (finery) to win approval for the scientific image by means of its charming frame. Then, we would miss the extra meaning that the surrounding carries with it, which is not always obvious at first. I argue that this is even more important for many of the climate scientific images here; as it is in the supplementary visuality that aesthetic playfulness is allowed. Immersion is a playful and lustful experience even though the message often is cataclysmic end of the world.

The idea that immersion is an especially apt form of presentation of big data has been widely recurrent for the past 20 years or so, at least since the big rise of virtual reality in the 1990s. One of the most elaborated forms of immersion for scientific use that I have come across is the *Allosphere* in Santa Barbara, California.[201] They aim to both do research on big data and perform science outreach through a full sphere that allows total immersion of the body. The sphere is a "perfect anechoic space, sound waves aren't reflected in any of its surfaces, yielding a neutral or dead space from an acoustic perspective"; it is a space that seems to eliminate itself.[202] The immersants stand on a gangplank between "two hemispheres constructed of perforated aluminum designed to be optically opaque and acoustically transparent."[203]

201 www.allosphere.ucsb.edu

202 Amatriain et al., "The allosphere: Immersive multimedia for scientific discovery and artistic exploration," *IEEE MultiMedia*, no. 2 2009: p. 64.

203 Kuchera-Morin et al., "Immersive full-surround multi-user system design".

Figure 32. Image from the article "Immersive full-surround multi-user system design" showing how immersants are standing on a gang-plank in an almost total spherical visualization surface in the Allosphere.

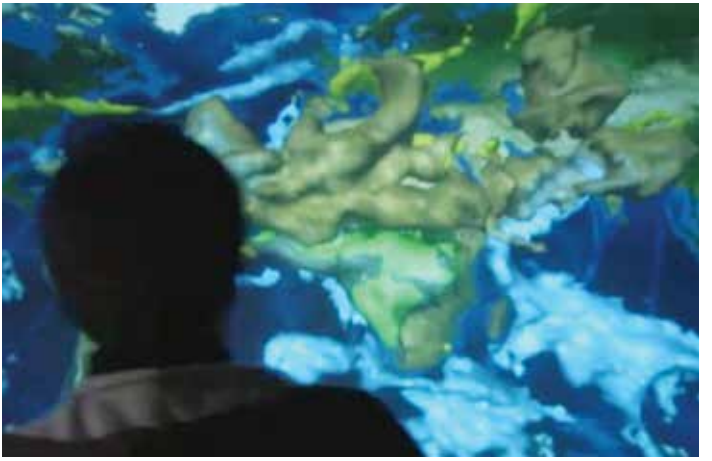

Figure 33. The Powerwall at the DKRZ, Hamburg. Special glasses produce a three-dimensional image that facilitates immersion.

The image in figure 32 was presented in a recent article on the development of the Allosphere, and they should be considered as marketing images of the potential of the facility, because I cannot find any research or outreach activities that motivate the immersive experience of a world map. [204] I take it that these images are thought to be more logical for anyone who is not into research projects about new atomic bonds or the artistic research projects in the Allosphere, which seems to have several extremely interesting projects.[205] Since, a full world map within a perfect immersive environment, surrounding the audience totally, becomes paradoxical because it is impossible to zoom in without loosing the full immersion into the world. The whole world can only be seen when standing in the "sweet spot" in the middle of the gangplank, and as soon as you physically move toward the screen you will lose the experience of being in the middle of a stereoscopic visualization. And you can only zoom in by traveling through space; if you want to see Venice in the Allosphere, then you have to "fly" there and thereby lose the full Gods-eye perspective where everything can be seen at once, which would the special feature of the world map in the Allosphere (fig. 32). Intriguingly, the ambitions to do full immersion – letting the audience stand on a gangplank in the sweet spot of technologically perfected experience – reveals the impossibility of seeing everything in detail at the same time. You have to choose, and choice means an awareness of the need of critical distance from a given place in space. This is thwarted when striving for full immersion, because, the essential aim of all immersive environments is to extinguish the perceptible aspects of the technology that make the immersions possible. Marshall McLuhan's famous adage absurdly as it might sound, is that the fish in water cannot know anything about water; the "[o]ne thing about which fish know exactly nothing is water, since they have no anti-environment which would enable them to perceive the element they live in."[206] This notion can be used to point out the danger of making the technological apparatus of climate visualization invisible, but it could also

204 Edward R. Tufte, *Envisioning Information*.

205 www.allosphere.ucsb.edu/research.php

206 Marschall McLuhan, *War and Peace in the Global Village*, New York, 1968. p. 175.

be that immersion is our possibility for an anti-environment that fish have no embracing relationship to, as the otherworld of fish (air) is only death to them. The Latin *immergere* is the etymological root for immersion and can be translated into "to dip, plunge, put under the surface of a liquid", and this definition fits well with the hopes that climate visualisations have.[207] One of the immersive environments I have experienced is the PowerWall at DKRZ in Hamburg (fig. 33).

The technical researcher Michael Boettinger puts on glasses to enhance the illusion of 3D, and the setup tracks his bodily movements and adjusts the projected image on the wall to the turning of his head. Boettinger is a developer of visualization at the DKRZ, and I ask him about the use of full-immersive environments in other projects where the aim is to totally surround the immersant. He explains that this is often unsuitable when doing climate research because the immersion into the ocean or atmosphere would leave the researcher lost without reference points, floating around without a feeling for scale or orientation. Then the immersant will have difficulty knowing what is up and down and will simply get lost. By concluding that we need to know where we are to know what we see, Boettinger argues for a distance to the visualization; a full body immersion would collapse the necessary gap. Timothy Morton dismisses virtual reality on the whole for environmental communication on epistemological grounds because "it becomes impossible to count on an idea of 'distance'", and we feel that we can't achieve a critical purchase, but are instead about to be dissolved into a psychotic aquarium of hallucinatory un-being."[208] Morton attributes a contemporary general loss of distance and feeling of being lost to the idea that there is no outside of the environment, it is a kind of panic attack to the magnitude of for example climate change but also other environmental problems that are fundamentally global.

However, we have never had an outside from where to neutrally observe the environment, and that is finally seeping in according to Morton. There is no anti-environment to go to in order to finally see the environment from the outside. That is precisely what many promoters of virtual reality

207 Oxford English Dictionary Online.

208 Timothy Morton, *Ecology without Nature*, p. 26.

in climate visualizations wish for, to produce an anti-environment, but Morton claims that the technology is only furthering the realisation of a total loss of vantage point, or anti-environment. He says that virtual reality is the symptom of the problem, rather than its solution; the aims of the technology only appear to explain why it is appealing for environmental communication to use, while only reproducing a feeling of being lost in space. Morton is not alone in seeing virtual reality as an aquarium or a virtual microcosm that we can dive into without the risk of getting lost.

Niklas Röber is also working at the DKRZ with the development of new technology for climate visualization, and he shows me how to approach the massive amount of data that is produced in the supercomputers running the climate models. The outcomes can be almost any kind of connection between observed or predicted parameters at any place or time. The challenge is to find the relevant correlations in the enormous quantity of data, and the way to do it is to "dive into data", according to Röber. He shows me exploratory visualizations where "you can dive into data and look for what is in there." When I ask him how one dives into data, Röber tells me how a number of variables in a gigantic dataset are chosen, in this case water density and temperature for currents around Antarctica, and then rendered into visual expressions. The invisibility of the numbers are turned into graphics that show how cold and dense water flows very slowly due to a lack of kinetic energy and high salinity. Then we turn to a map of Antarctica where some areas are indicated with red; this is where we can find water within the previously defined parameter ranges. Röber says that this way you learn about your data, and everything comes from the simulations that depend in turn on a given climate model that runs in the supercomputer. Small parts of the data are extracted and visualized while the simulation is running. He shows me how the ocean surface is bent down due to the dense water, and he says that this is something that can be measured in reality by oceanographers.

It is a challenge for me to tell the simulation of the world from the world outside when talking to someone who spends his time developing software for visualization of climate change, it is convincing. What he is showing me is what all of the visualization projects want to achieve, namely a feeling of exploration of the unknown in "real time", with the feeling of suddenly

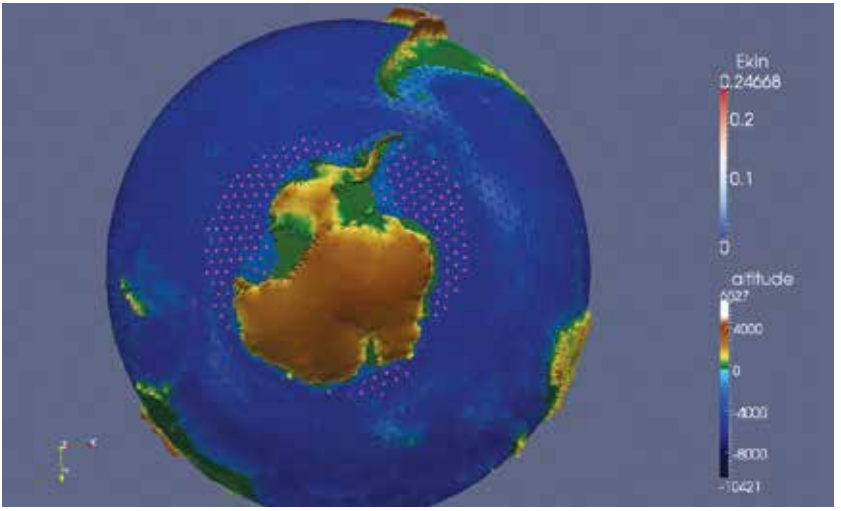

Figure 34. Exploratory visualization developed at DKRZ. Image produced by Niklas Röber.

being there, in the ocean and understanding. I was able to see things I have never seen before thanks to my guide through his enthusiasm and knowledge of both data visualization and climate. It seems that even though he is lost in the data it is in a very productive way and he knows the difference between reality and climate model (fig. 34).

The same technology is mainly used to promote climate awareness among laymen, and the discourse is to embrace as much "reality" as possible. The rhetoric that often comes with costly projects to produce immersive environments is that they can be used for both research and public outreach. Still, it seems as though the technology is mainly used for public outreach. And again, Morton claims that it is the loss of reference points that is the allure of the technology because it parallels the ecological panic we experience. The feeling of loss of understanding in the world is actually reproduced by the nauseating experience in the virtual reality dome. Thus, the perfect machine for producing the illusion of reality is really reproducing loss and Morton writes:

> Ecological culture is supposed to be soft and organic, old-fashioned and kitschy, while technoculture is hard, cool, and electronic. But there are surprising connections between the imminent ecological catastrophe and the emergence of virtual reality. The connections concern not content but form, and they open up questions of epistemology – how can we know that we know, and how can we verify what we know? Both virtual reality and the ecological panic are about immersive experiences in which our usual reference point, or illusion of one, has been lost. *Old ways of thinking, we tell ourselves, are not to be trusted.*[209] (my italics)

It seems difficult to take the critique of virtual reality much further, but Morton has a point and it is only reasonable to ask again, why do we want the perfect illusion of reality? Morton would consider the lost gap between illusion and reality an ethical problem and claim that "[w]e are losing touch with a nonexistent measuring stick" and it is that very same measuring stick that much of public climate communication seeks to provide. The Norrköping Visualization Centre hosted the World View

209 Timothy Morton, *Ecology with Nature*, p. 26.

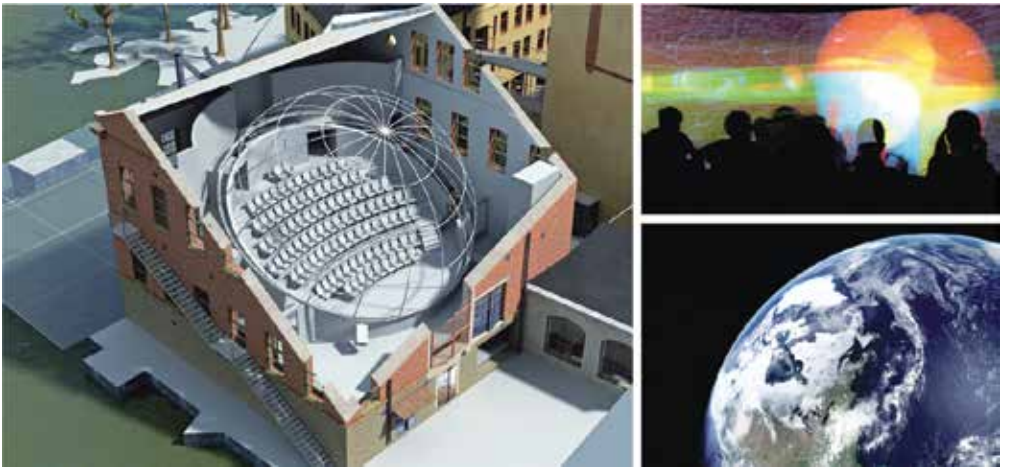

Figure 35. The original caption to these images says, "With a capacity of 100 visitors, the dome theatre of the Norrköping Visualisation Centre will provide an environment for border-crossing presentations – an audio-visual surround experience affecting both the mind and senses, while responsibly raising societal focus in concern toward the world we share and climate change". The three images come as one in the pamphlet from where the text also comes. Source: Worldview – New ways of visualizing climate change. www.cspr.se

project presented by the CSPR a few years ago. The World View project aimed at an "audio-visual surround experience affecting both the mind and senses, while responsibly raising societal focus in concern toward the world we share and climate change", and thereby conflating pathos and ethos as I see it.[210] Timothy Morton criticizes this kind of environmental virtual reality show where the audiences "are being asked to bathe in the environing ocean of our surroundings as a means to having a better ethical stance toward species and ecosystems", arguing that it is better to acknowledge and seek creative differences than likenesses. [211] It is also an argument for the need of a critical distance to what is shown, not being beguiled by technological brilliance, and it is a critique of the form of presentations that want to drown us in stimuli to persuade us that this is the world. But we must ask, which world? The recurrence of *The Blue Marble* is unmistakable here; spheres that connote worlds or planets, either our planet or other planets (Saturn?), are present in all three images (fig. 35). Planet Earth is transposed into the dome sphere, it fits into it and the audience fits into the sphere. The technological promises are many, and I would say that these promises are fulfilled through investments in state-of-art virtual reality technology to produce immersive visualizations. It is as though a new world becomes possible through the new experiences that the dome theatre provides. In the retrospective article written a few years later, the immersive properties are downplayed and there is a disappointment with what this form of presentation actually contributed. I would say that they had two key elements in the presentation besides the immersion: digitally designed landscape visualizations and a "climate expert […] who guided the audience through the presentation".[212] Both were motivated by aims of producing scientific legitimacy. The landscape visualizations were produced from scientific data, and the climate expert was affiliated with either Linköping University or the Swedish Meteorological and Hydrological Institute. However, the audience expected that the visualization would capitalize on the immersive possibilities in the dome,

210 Flyer from CSPR, World View - New ways of visualizing climate change.

211 Timothy Morton, *Ecology with Natur*e, p. 167.

212 Wibeck et al., "Communicating Climate Change through ICT-Based Visualization: Towards an Analytical Framework," *Sustainability* 5, no. 11 2013.

and they complained about the "quality of the projection", which I also experienced.[213] It takes more to "affect both the mind and senses" of the audience because most of them are familiar with many different techniques for three-dimensional screening from cinema, IMAX, and similar shows.[214] Nevertheless, there is one sequence that was immersive in the sense that it surrounded the audience and affected more than one sense. This was a rapidly moving whirlwind of newspaper articles that created a tornado around the audience sitting in the eye of the storm. I recall the guide describing the risk that the climate change message would drown in the "media noise", explaining how we, or rather the general public, are drowning in media messages.

The whirlwind might be an illustration of this media noise, but it is also an expression of the anxiety that science communicators have about their possibility to reach out. Instead of creating "border crossing" experiences with new narratives, as they write that they aim to do, they produce an immersive experience of anxiety, and the audience described how the whirlwind caused nausea. Michel Serres compares "[n]oise and nausea" and equates nausea to the nautical, "noise and the nautical, noise and navy belong to the same family. We mustn't be surprised." Nausea comes from the Latin from "ship" and the seasickness that arises from an incongruity between the balance organ in the ear and what is observed by the eyes. When agreement between these senses is disrupted, we experience nausea. For Serres, nausea is an opening to the internal interactions, the entanglements of connections, and the relations within the world. However, we were always lost in the world, and the unity of being is mere surface, "a global unity, all the same, remains scarcely accessible. We lose the particular; we've lost the world."[215]

It might be that the experiences of nausea give access to the multiple, but the visualization sequence seems simply to be used for the sake of using the technique rather than as a narrative or visuality to produce experiences for the audience. Naturally, I would say, the visualization as a whole did not tell the story they wanted, and the narrative was limited to what *could*

213 ibid.

214 Flyer from CSPR, "World View - New ways of visualizing climate change".

215 Michel Serres, *Genesis*, p. 3.

be presented. Researchers affiliated with the CSPR identify this by acknowledging that "[o]ne potential trap of ICT-based visualization presentations is that the storyline may be formed by what is possible to visualize."[216] A different approach could have been to embrace the feeling of being lost in the world, but that would not be wanted because science communication also aims to produce legitimacy. There are other means to immerse the audience than only the technological, for example, pictorial submersion instead of immersion of the audience. Next section will discuss how images of submersion is used in documentaries. I see also this as sea images, i.e. images of water that wants to induce a feeling of change in the viewer, though the mechanism is different. The French philosopher Gaston Bachelard has described this mechanism and it is called material imagination.

The true eye of the earth is water

Bachelard writes that "[t]he true eye of the earth is water" in *Water and Dreams* from 1942. He gives ample examples where water is used by poets and writers and observes that there is an "endless exchange of the visible for vision itself takes place", i.e. water is used as a poetic image to make vision visible to us.[217] Reflections in water works as illustration of the myth of representation, which is that photography simply reflect the world. The water reflection can naturalize such myth - just look at the water mirror!

However, Bachelard also provide us with another reading of water in sea images and that is submersion of bodies in images through the analysis of material imagination. There is a slight difference between immersion and submersion even though they have the Latin *merger* as their common etymological root. Immersion is the plunging or dipping into something, not necessarily water and it has been used in the above chapter to refer to being dipped into audio-visuality like virtual reality presentations. Whereas submersion normally refers to being underwater and in the following images we see water in images but we aren´t totally surrounded by images

216 Wibeck et al., "Communicating Climate Change through ICT-Based Visualization: Towards an Analytical Framework," *Sustainability* 5, no. 11 2013. p. 4769

217 Gaston Bachelard, *Water and Dreams: An Essay on the Imagination of Matter*, Dallas, 1999. pp. 31-32.

Figure 36. James Balog´s feet in icy water, or Jim as he is called in the climate documentary *Chasing Ice*. Jim, the photographer, is the one who is chasing ice. This is his project and he has a crew of people that makes his project possible. However, his body is a mediator between the hostile Arctic environment and the viewer who sees the documentary at home. Any viewer will feel how cold this water is and identify with Jim, his pain is ours. These kinds of images where Jim´s body becomes a projection screen for our feelings and thoughts are recurrent through the documentary and together with impressive imagery of massive glacier collapses it becomes evocative for the audience.

and sound.

Bachelard argues that images or "voices of water are hardly metaphoric at all; that the language of the waters is a direct poetic reality" for the viewer or reader, through a shared material imagination of water. I will take this as a starting point for the analysis of sea images in two documentaries. The Italian scholar in film studies Adriano D'Aloia applies Gaston Bachelard's analysis of human material imagination and shows how the depiction of water is used to produce narrative immersion through bodily recognition. D'Aloia sees the increased occurrence of these submersions in times of integrity loss for the film experience that is attributed to the increase in mobile devices on which many people now watch films instead of going to the movie theatre. He shows that immersion can be achieved with other means than with big screens, which is hardly a new finding within film studies. The significant observation is that water is used as an experiential figure to evoke immersion through a pre-linguist modality because we have "a primordial sense of liquid or fluid [---] we have all a 'hydro-knowledge' of things", and we therefore all familiar with the feeling of water in many forms. However, water has been there since the beginning of cinema to visually give meaning and matter to human dreams and needs. The "cinema enwaters both the filmgoer-body and the film-body in the same imaginative, materialised substance", water translates between the image on screen and the audience and it is just more common today.[218]

I will apply this enwatering analysis to the climate documentary *Chasing Ice* from 2012 by Jeff Orlowsky combined with a reading of the story on several levels of signification (fig. 36). Because, the climate documentary *Chasing Ice* has several sequences that produce a feeling and understanding of climate change that are different from the typical climate communication that we have become perhaps too familiar with, it plays on our familiarity with water where it creates a "dual participation of desire and fear" in images.

Chasing Ice starts with a number of short excerpts from American news

218 Adriano D'Aloia, "Cinematic Enwaterment: Drowning bodies in the contemporary film experience."

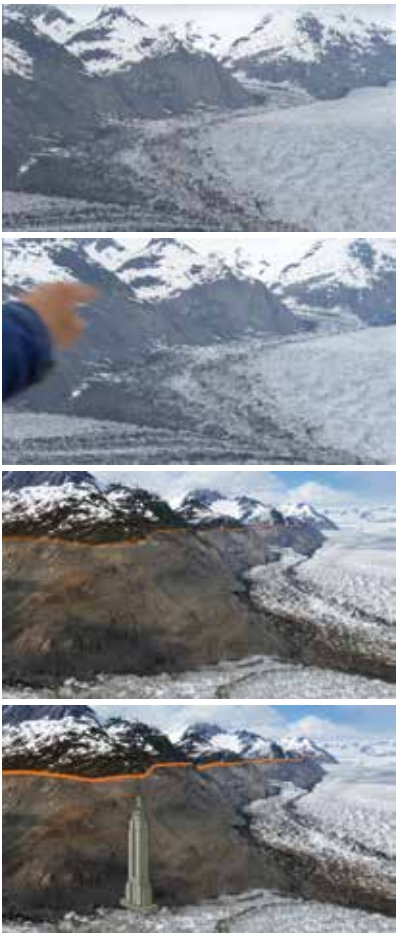

Figure 37. The climate documentary *Chasing Ice* presents several kinds of illustrations to give the viewer a feeling of the rapid changes that is taking place in the cryosphere right now; graphs, diagrams, time-lapse from the last years and comparison of photography from older documentary material with present-day photographs. The above short sequence is a comparison of the highest mark made by the glacier and todays receding low edge. The Chrysler Building is mounted on present-day level order to show the magnitude of the shrinkage and the iconic building doesn´t reach the orange line drawn to show the historical height of the glacier. A combination of the familiar and impressible building is juxtaposed to the "damage" caused by human activity to the cryosphere.

reporting showing agitated and frustrated debates over the factuality of climate change. The documentary takes the problem that climate communication is claimed to be afflicted with as its starting point. It sounds like something like this. Sceptics say that no matter if it is cooler than normal or hotter than normal it is always proof of global warming. Their criticism is based on the logic that even if it is impossible to prove that climate change is false, that cannot be a sufficient proof that climate change is true. Although, even if *Chasing Ice* starts with this recollection of public failures and the phenomenological problem with everyday experience and climate change, it does so only to be an example of how outreach is possible and I would say that it is conjuring our material imagination through the body of James Balog, who is the initiator, narrator and main character on screen. The film was nominated for an Oscar for its music and it has won several awards. It has been celebrated for how it tells the story about climate effects in novel ways compared to how the story is typically told. It becomes a captivating documentary partly due to the combination of time-lapse photography of melting glaciers with a narrative of grand adventure. *Chasing Ice* shows several variants of the "receding glacier time-lapse" which have been extensively used in climate documentaries the last years (fig. 37). These time-lapse images are often visually appealing as the retreat of a big glacier is a mighty sight and the speeding up of time makes the giants movements visible to us. Photojournalist Gary Braasch is sceptical to this imagery that focus on effects which the audience cannot do anything about, he writes that "the public has seen endless smokestacks, blazing suns, and polar bears; astounding time-lapse images of clouds, storms, and glaciers", in the article *Climate change: Is seeing believing*?[219] Braasch argues, as do climate communication scholars O´Neill et al, that these images provide the public with understanding of the effect though they induce a feeling of disempowerment. They come to the conclusion that it is difficult to do both things at the same time. O´Neill et al conclude that their study of representation of climate changes in current media "reveals a somewhat

219 Gary Braasch, "Climate change: Is seeing believing?," *Bulletin of the Atomic Scientists* 69, no. 6 2013.

Figure 38. Human standing on ice mountain in the beginning of *Chasing Ice*, we presume that it is Jim given the voice-over.

Figure 39. Two humans walking along a melt-water river. The camera follows the water stream.

Figure 40. Jim sits in his tent and is bandaging his knee which is causing him pain and risks rapid worsening from stress of walking the ice.

bleak situation", but I find the study questionable.[220] They used 40 images, taken from news media and categorized it into themes like impact, pollution, evidence, and people. The most "efficacious images" were those showing mitigation choices that are accessible to the public, i.e. solar panels, home isolation and electrical cars. The choice of images was based in solely on the motifs and then the images were shown out of original context.

I would argue that this is problematic as these images always come with text and a context. Take the melting glaciers and the adventure in *Chasing Ice* as an example of that, because it is only the most obvious levels for reading the images in this documentary. There are actually other levels of expression that bring home the main message. The first obvious level is the motif of the discernible figures of *man and ice*, and the second is the history we connect to this configuration of *man and ice* – it is relatively easy to see the motif and then interpret the history that comes with it. However, this documentary is not only about chasing melting glaciers but also about the chasing body of the acclaimed National Geographic photographer James Balog, also known as Jim. His body makes us sympathize with that which cannot be perceived with our five senses. The story is, as Jim says, "*within* the ice somehow" and I would argue that the understanding of climate change effects goes *through* his body. Jim's feet, hands, and knees have a central role in the story of the inner-life of ice. In the beginning of the documentary we see Jim standing on a mountain of ice above sheets of ice drifting toward the ocean to be melted. (fig. 38) Jim is our witness to the changes that are occuring in places that most of the audience will never visit. I presume that it is Jim that we see here, but it does not matter if it is him or someone else, it is the imagery that is created that is telling the story on this level. No matter who it is, the figure becomes the spectator and natural philosopher that Blumenberg identifies in *Shipwreck with Spectator*.[221] The spectator is not passive when contemplating the distress of others in the wrecking ship; he is philosophising. This wreck is a metaphor for the outside world, and the spectator is relatively safe and

220 O'Neill et al., "On the use of imagery for climate change engagement," *Global Environmental Change* 23, no. 2 2013.

221 Hans Blumenberg, *Shipwreck with Spectator*.

can therefore philosophise over others' misery. Blumenberg finds this contemplating subject in artworks, literary works, and philosophy from Lucretius onwards. I would add that many of the motifs of Arctic explorers that we find from 19th-century artworks also show examples of this imagery. However, this is the almost too obvious story of this documentary. Jim, the adventurer, is connected to earlier explorers depicted in the Artic and then exhibited in museums; this familiar trope makes him recognizable to us as such an explorer. It is the same story told about Nansen, Amundsen, Nordenskjold, and André when they were mapping the ever-smaller *Terra Incognita.* They had left Nordic homeports for adventure and fame but found uncaring relentless nature; many paid with their lives in the effort to bring home new maps. Today there are really no uncharted territories out there, at least not in the way it was then. Nonetheless, we still don't truly know the Arctic and that is why Jim has to go there again, and he will also suffer. It is neither the extension of land nor fluctuations of glaciers and sea-ice that is unknown to us, but the inner dynamics of glaciers. However, it will not be a map of the extension of the cryosphere that tells us where we are heading, it instead will be a map of risks and potentialities, and Jim will make us aware of the pains, cracks, holes, and tensions that could be leading to collapse. Despite his trials, the adventurer comes home at last, bringing with him the digital memory card of the biggest breakup of a glacier ever caught on film. This well-known sequence is the cathartic moment that gave the documentary the perfect selling point.

From the sequence with the man on the mountain of ice we will be presented images where the camera moves and zooms in and out to go beyond the discernible visual aspects of the landscape. I see this transmuting visuality in other climate change productions as well, take the cover of the IPCC, AR5, WG1 report as one example (fig. 19). Both are mapmakings beyond scales of space and time where recognizable figures transform into non-figurations, or dissemblances. Images go from being depictions of things we recognize to becoming visuality that no longer resembles things we recognize in order to induce feelings of the unpresentable in us, namely hidden potentiality in the climate system, or real virtualities. The transformations, or translations, go from extensions in space to intensities; this happens throughout the entire *Chasing Ice* documentary.

Back to Jim on the ice mountain, which gradually loses its elevation compared to the ground as the camera moves over Jim. The clear imagery with Jim against the Arctic scenery changes as the camera moves past and looks down on the iceberg, which melts into to the slush of ice when the horizon is lost. Dripping drops become rivers of melting water that cut holes in the ice surface. Images of water, both still and flowing, are inserted between sections of narratives of human strife, loss, and risk. We see how blue melting water cuts into the white glaciers in a meandering movement, and soon the water disappears as the cut goes deeper and deeper and the curve moves away from the camera. There is something enthralling with this cut into the glaciers; it is both a beautiful form and a threat as we have been told that the melting water is a lubricant that makes the glacier move faster toward the calving front where it breaks off icebergs into the ocean. The dripping water lubricates the glacier and it slides faster downhill, and this affects the whole balance of the glacier with possibly global implications.

The cut into the glaciers is not only a lubrication valve down to its bottom but also a threatening abyss for those walking the glacier's edge. Anyone slipping into to the depth would be forever lost, ending up as grease between bedrock and glacier a thousand meters below. Next we see an adventurer's tent against nuances of blue. (fig. 40) The tent becomes a scene that perfectly fits Jim's body. The inside of this tent is the new ground; the narrative needs this compartmentalization to be able to display the human details of this story. Jim sits inside and roles bandages over his aching knees; he has, and I quote his doctor, "right sided medial compartment arthritis with partial to full thickness cartilage loss", in other words, the toil and tear from walking the glacier in search for images have taken their toll.[222] Our philosopher is hurting from inflammation in the knee and a damaged meniscus, a very human condition but impractical for an adventurer in the Arctic, yet still evocative of our sympathy for him. We feel for Jim, while he feels for the glaciers. The pain of the ice world is his personal pain and thus ours as well. Blumenberg points out that the philosopher always risks that there is a reversal in the relationship between

222 www.regenexx.com/2012/11/knee-stem-cell-injections-help-a-mountaineerp-hotographers-return-to-chasing-ice/

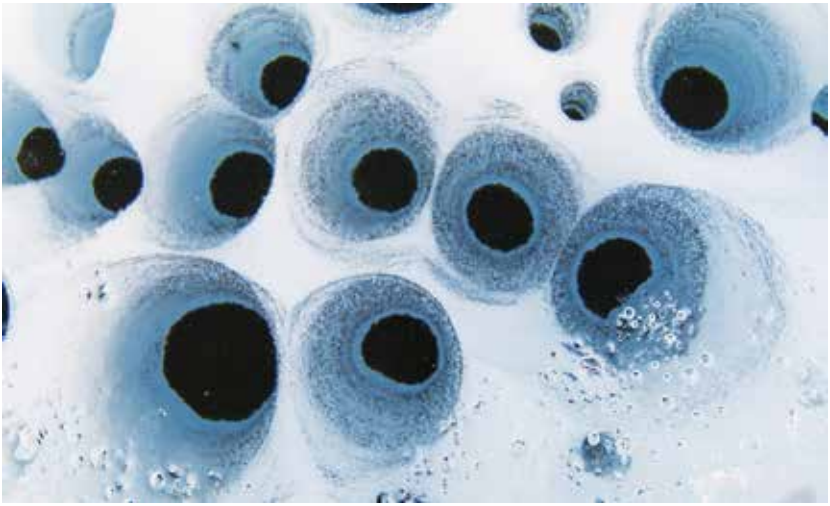

Figure 41. These are melt water-filled holes in the Greenland ice. The melting is caused by cryoconite which is soot and other dark particles that harnesses the warmth from sun. *Chasing Ice* shows many different kind of ice and water images, often in long sequences. This image is shown with other close-ups of similar formations, together they become montages that allow the voice-over to describe climate change effects in the Arctic while the viewer contemplates the world. Thereby becoming the kind of natural philosopher that Hans Blumenberg claims to the a recurrent figure in the history of art, literature and philosophy.

spectator subject and wrecked object; suddenly the spectator is in the distressed position of the shipwreck, but that is only on one level of the story being told. We can imagine the broken meniscus when we feel with Jim. His wife has told us earlier in the documentary how the whole mission is jeopardized by the risk of major injury caused by his stubborn streak, and we know that his knee can break at any time. We are provided with a map of pain and risk.

The next sequence shows three men walking in a hole-filled icescape, and it appears rotten. We do not know if Jim is in the group of men, if he is still striving through this ice, which is as rotten as his knees. The identification of a landscape in pain and Jim in pain comes from a simple visual juxtaposition; the bad kneecaps and the rotting ice cap follow each other as sequences in the documentary, but the two will also be paired by Jim's voice-over telling us about both ice and knees on the brink of collapse. The many holes in the surface are caused by cryoconite, which sounds much like a medical diagnosis. However, this is in no way a new phenomenon but a part of glacier life. Nordenskjold first observed them on his expedition to Greenland looking for an ice-free inland area in 1870. Nordenskjold writes that the cryoconite holes, made it "therefore impossible not to stumble into them at every moment, which was the more annoying as it happened just when the foot was stretched for a step forward, and the traveller was precipitated to the ground with his foot fastened in a hole three feet in depth."[223]

The frame with black cryoconite holes (fig. 41) is almost a medical image of the symptom of the disease that the glacier is suffering from. The cryoconite holes are caused by soot accumulation that attracts heat, which bores through the surface of the white ice. The black is a mixture of carbon soot, organic matter, and sometimes silt. The combination of fluid water, mineral, and organic material makes it a relatively hospitable milieu for algae in an otherwise extremely harsh environment. But these places for life are the sign of decaying glaciers according to Jim who says "ice is the canary in the coal mine", and the holes signal that the cryoconite is killing

223 A. E. Nordenskiöld, "Nordenskiöld on the Inland Ice of Greenland," *Science* 2, no. 44, 1883.

climate *change* but are part of the natural life of glaciers. Still, they induce in us a reflection over the beauty that is being lost as almost all glaciers in the world are retreating toward a final nothing. This bright image of bluish and whitish is actually quite vague when it comes to what it could depict. Is it an aerial photo of a landscape or a macro photo of that which lies just in front of Jim's feet? Is that a footprint or a lake that we see down there to the left? Of course, it is neither; it does not depict anything at all, but it is a much-used *figura* that is dissembling its virtual referent. Meaning that their referent is something that lacks actuality, it is the potentiality of climate change rather than a thing that physically can be found out there. These images are open to interpretation, and once we believe in climate change we will see such change everywhere.

Our senses are not fully reliable when it comes to climate change, but we *do* believe it when we see it through Jim's camera lens and feel it through his body. Jim has just scooped up the cryoconite from the cold water, and the gesture of pulling out from the cold water is also the last sequence before a new chapter opens in the documentary; we have gone full circle from the distant spectator overlooking the landscape to the experience of the material itself. News reporting and documentaries have much in common when it comes to making their audience know and feel for climate change. We are familiar with images of flooded areas from news media, including places we recognize from actually have being there or "iconic" places underwater. Hurricane Katrina hitting New Orleans in 2005 produced an immense amount of news images of a city drowning. Hurricane Sandy had a similar media effect after it hit New York in 2012. Arguably, the images of these unpredictable events are very different from the scientific images of possible future events. One might object to the comparison by saying that sea level rise is a slow process that engulfs low-lying coastlines slowly whereas storms are violent and sudden. Except, as the IPCC report on extreme weather states, "It is very likely that mean sea level rise will contribute to upward trends in extreme coastal high water levels in the future".[226] The two are complementary, we will see sea levels

226 IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*: p. 15.

the canary. However, the latest assessment by the IPCC is that the black carbon has it largest impact on global climate when suspended in the atmosphere as aerosols. The holes we see play a smaller role in glacier balance other than the importance they have for the visual expression in this documentary. Cryoconite holes look like the injury that climate change has on glaciers, and they become linked to Jim's arthritis through visual juxtaposition. The holes of the rotting ice turn scenic as the camera moves closer; it is as if we are looking into the void of the ocean below the ice. The ice seems to be a thin shell over the very dark and deep ocean below, and the ice surrounds the holes forming figures against this dark background. Jim picks up the black goo in the holes to reveal it as mud of black carbon, organic matter, and silt. The figure of ice and the ocean as background is reversed. The black is suddenly the thing, but it also a thing that is sticky and cold and causes pain to his hands. (fig. 42) Jim tries to wash of the mud in the muddy water, and the distinction between white and black is dissolved into dirt. This act of washing his hands in water triggers our material imagination. Bachelard writes that the "coolness which is felt while washing one´s hands at a stream reaches out, expands, and takes hold of all of nature" when discussing water images that becomes "poetic climate".[224] It is a poetic trick to show the hands going into the cold water. This pull us into the poem, the artwork, or the film, and the trick is based on the universal human experience of water that triggers a material imagination in us. We all know how it feels to stick those hands into that muddy cold water; we have all done it and that creates an experience of being Jim. James Bunn writes, "We are truly connected to water in peculiar ways, but the work of hands in solvent water makes the difference."[225]

I propose, here inspired by French art historian George Didi-Huberman, that the melting induced by the cryoconite forms figures that appear to us as an indexical sign. They evoke the impression that they are the footprints of the invisible monster of climate change, a linkage to our own carbon footprint. Humankind is the invisible monster, and this is our trace left behind. We now know that the cryoconite holes are not the result of

224 Gaston Bachelard, *Water and Dreams*, pp. 31-32.

225 James H. Bunn, "The Physical Reality of Water Shapes,"

Figure 42. We have just seen Jim try to wash away cryoconite from his hands before this moment when Jim pulls his hands from the ice cold water.

rise, but the damage will be incurred in conjunction with extreme weather, and we can expect a "likely increase in tropical cyclone maximum wind speed". [227] One reason for why science communicators are advised to avoid connecting extreme weather to climate change is that any individual event cannot be attributed to climate change. This makes it risky to use news images from spectacular weather events to show the effects of climate change; there is no simple causal relationship between them even if the frequency of storms and their magnitude will be affected in time. However, climate *is* weather, though it is defined as the mean weather over 30 years, and above all, climate change effects will be actualized as extreme weather in the future. The images that we see in the news from extreme weather events fulfil the demands of those such as Sheppard that the climate change visualizations needed to produce engagement and behavioural change must be dramatic, realistic landscapes shown from the human perspective and that occur in familiar places and tell a story. It might be problematic to use news media images and claim that they are images of the future, but any comparison between the visualization that science communicators produce and any image that the typical reporter-in-the-storm news feature reveals the scientific image to be insufficient, it does not do the job.

What is interesting in many documentaries is how non-figurative visuality is deployed to present the unpresentable, for example tipping points. I find visuality that operate on a different level that the representational, which is necessary, at least if Mark Nuttall´s analysis of tipping-points is accurate. Nuttall argues that the world past a tipping-point is changed beyond our experiential horizon, the world might not be recognisable, and he writes that "to gaze into a world beyond the tipping point, therefore, is to be confronted with something outside our collective experience".[228] Figure 43 shows six images from the documentary *Tipping Points*. I find the images in the sequence to make up a small circuit that involves what I would call a Deleuzean crystal image. Such an image creates a fleeting moment, not by showing time-lapse images or diagrams, but through the creation of image circuits that unfolds to give an intense

227 ibid.

228 Nuttall, "Tipping Points and the Human World: Living with Change and Thinking about the Future."

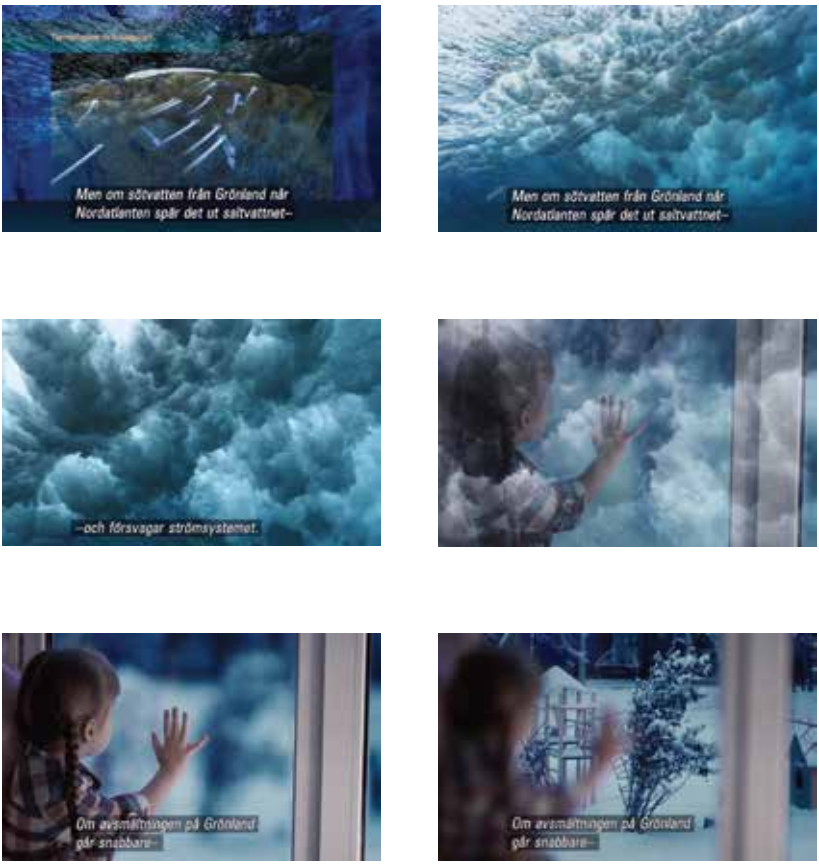

Figure 43. These three frames are from the first minutes of *Year of the Storm* produced by National Geographic (Koughan, 2011).

feeling of time. The first image in this circuit is a pedagogical illustration of how water flows to create the Gulf Stream. We recognize this type of illustration from textbooks and science communication contexts. It is typical in the sense that it is composed of a pictorial background onto to which arrows and text are added. The arrows in the illustration indicate how a part of the flowing water of the North Atlantic thermohaline circulation, or the Gulf Stream hits Greenland and warms its coasts. The, Gulf Stream moves warm water from the tip of Florida, along the North American east coast, and then toward the northern parts of Europe. Heat is transported to give Iceland and Scandinavia a mild climate despite their high latitudes. The warm water cools here and becomes denser, which causes it to sink, and this gives the circulation its return movement. However, the fresh water from melting glaciers in combination with more precipitation is weakening this drive. A voice-over explains that the forces that create the circulation are a multiplicity, and as such the circulation has a bifurcation point beyond which it will finally shut down. Exactly where this point is cannot be predicted, but the reality of its existence does not seem to be questioned. Nevertheless, I would say that this sequence of frames is not a presentation of the risk of Gulf Stream collapse but an appeal to imagine what the consequences for humans would be of such an event. The comprehensible and clear illustration is blurred from behind, and we are soon submerged as waves hit an edge of ice and underwater swells grow stronger until the illustration disappears.

Sunlight penetrates through the surface swells. The dark underside looks like clouds in a stormy heaven, which is not a coincidence but comes from an aesthetic choice common to climate documentaries. Aesthetic images are used to present what cannot be represented with scientific images like the illustration described above. The sequence of images continues with a young girl stretching her hand toward a windowpane. This is an image with two sides, one actual and one virtual, but it is not the girl and her reflection in the window but her still hand touching the after-images of the underwater swells. A girl looking out through a window from what is supposedly her home as the image transforms into wave swirls under the glacier's edge. This sequence does not have the same movement as Deleuze uses in his examples where present how film time is reflected in a mirror

of the past to create a circuit of images that carries both the actual and virtual image. Nevertheless, this crystal image of the girl at the window envelops two realities, the child's reality and the real virtuality of the bifurcation point in the Gulf Stream, "the real object is reflected in a mirror-image as in the virtual object which, from its side and simultaneously, envelops or reflects the real: there is 'coalescence' between the two."[229] This crystal image shows a world with two sides. Both are real, but the side with the child touching the windowpane is spatial while the side with the wave swells expressing the threat of collapse is temporal. Semiologist James Bunn writes in the anthology *Impasses of the Post-Global; Theory in the Era of Climate Change*, "Water seems most tangible and yet still elusive as it slips through your fingers in a wash, lovely to touch but impossible to hold, while it trickles to its lowest level."[230] His contribution "The Physical Reality of Water Shapes" advices to use water in climate communication, because the actual role of water in ecosystems and social systems, and the philosophical analysis of water forms. "We are truly connected to water in peculiar ways, but the work of hands in solvent water makes the difference." The next image in the sequence is almost redundant; everything is already told, and the camera zooms away from the child to show her snow-covered playground. The voice over says, "If melting on Greenland goes any faster… This is a gazing into the future, the season is winter, but it is also the virtual future in a world without the Gulf Stream where winter reigns. There are actually other ocean circulations, or rather, the Gulf Stream is only one part of the global circulation of water masses, but this one is particularly important because it provides the conditions that make it possible to inhabit the global North, which also is the rich part of the world that has contributed mostly to climate change historically. The child is also a symbol for that way of life and an indication of whom this circuit of images addresses.

229 Gilles Deleuze, *Cinema 2*, p. 68.

230 James H. Bunn, "The Physical Reality of Water Shapes," in *Impasses of the Post-Global: Theory in the Era of Climate Change* ed. Henry Sussman (Open Humanities Press, 2012).

Conclusions: Artistic expression and climate change

This concluding chapter will begin with a description of a possible turning point when it comes to the challenges posed by climate change. I will discuss some of the achievements in Paris in 2015, which resulted in the first global climate agreement (the expired Kyoto protocol was not global in its reach). I will then present two artworks that where exhibited during the Paris meeting, and these are used here as artistic illustrations of the conclusions in this thesis.

Going back to the Kyoto protocol, the United States never ratified that agreement, Canada withdrew from it, and many countries did not sign the second round of commitments. Thus, the new agreement from Paris appears to be a great success even though the commitments are voluntary and are actually insufficient to achieve what it aims to accomplish. Many climate scientists say that the Paris agreement demands more than most people realize, bur still it is not enough. I wonder if the politicians who signed it understand the urgency of the task they are taking on. The agreement, when followed through, necessitates a rethinking of how things are done in society on many levels. It will be interesting to follow the changes in discourse that should come with this agreement, but right now this is beyond the scope of this thesis. In retrospect, it appears that the increased presence of climate in the media over the last four or five years led to this turning point, but only the future will tell if the agreement really will be such an important point in the history of climate change politics.

I never perceived climate communication on the whole as inefficient, and the new climate agreement can be seen as an indication of the success of climate communication. Of course, there have also been substantial

advances made by the climate sciences in understanding the world during this short period, and there have been numerous actual changes detected in the physical world due to climate change in recent years. These effects have had a significant impact because they offer proof that climate change is occurring now, and the IPCC reports have sharpened their formulation of how certain it is that human activity is affecting the world's climate. Nevertheless, I still regard the purist scientific communication on its own as insufficient to communicate climate change to the general public. It needs a frame that makes the communication evocative, and I would say that the discourse provides such a frame. The changes in discourse, where climate change has become more certain than before, facilitate the interpretation of scientific findings in a way that is believable for the general public. Still, the scientific climate images are never just a scientific graph, diagram, or observation but are always supplemented by stories, tropes, and figuras that dramatize new findings.

A telling example of how stories of the world become believable through the use of framing is the feature article "Reaching peak emissions" published online in the journal *Nature Climate Change* during the COP21 negotiations. In that paper, Jackson et al argue that we now have seen a peak in the amount of carbon dioxide emissions, meaning that the trend of ever greater emissions has ended, writing that "rapid growth in global CO2 emissions from fossil fuels and industry ceased in the past two years, despite continued economic growth", and this is the first time we have seen economic growth and decreased emissions at the same time.[231] Using the peak as a thought image is helpful to get the hopeful message through. Such a peak has previously been used to describe how oil production has passed the point where it is no longer increasing but is now decreasing, and many people are familiar with this environmentally positive message. The same thought image is a threat to the oil industry and oil producing countries, and the decline of oil production will change global power relations. There is still no consensus over whether peak oil has been reached or not, and the year of peak oil has been calculated to be sometime between

231 Jackson et al., "Reaching peak emissions," Nature Clim. Change advance online publication 2015.

2004 and 2030 depending on the source. The peak must be considered to be a thought image, or as Bailey et al write, the rhetorical uses of peak oil are examples of "spatial representation[s] of environmental and social problems", in a similar fashion as I present the sea as a figura that signal change in the world.[232] The image of a peak is powerful because it can house the complexities of the problem in one place – the mountain peak – but it does even more in that it removes certain possibilities from the consideration of future scenarios.

In this thesis, I have raised the problem of how to best present the unknown future. The IPCC, and many others, attempt to solve the problem of the openness of the future with scenarios of different kinds. For some reason, this most often involves four plausible scenarios where one is always business as usual. The four scenarios, or RCPs in the latest IPCC assessment report, represent different directions for where the world is heading, but the peak points in one direction – though it is not fixed, it does points downward. But, of course, only the future will tell whether this is correct or not – though it seems as this could be an upcoming rhetorical image in the visual culture of climate change. I would suggest that the identification of the peak in emissions was also used as a motivation for the politicians negotiating in Paris because the article was presented during the negotiations. It is likely that the journal wanted to spur good decision-making by telling the politicians that they have been doing something right and that it is possible to change the course of the world through good policy making. *Nature Climate Change* complemented the peak carbon dioxide article with a climate graph that is not a hockey stick that only goes up and up, but instead culminates and turns slightly downwards, and it would not surprise me if this is an indication that we are seeing a change in the visual figures that are being used to describe where we are heading. The IPCC had already changed their overall rhetoric prior to COP21, and they went from talking about the physically destined dystopia to a focus on the positive changes in the political sphere that might lead away from such a dystopian future. This change has been

232 Bailey et al., "Some things old, some things new: The spatial representations and politics of change of the peak oil relocalisation movement", *Geology*, 2010.

criticised by many in the scientific community in the aftermath of the Paris negotiations because the agreement is viewed as impossible from a purely scientific perspective. The 1.5-degree goal might already be lost. This does not mean that the temperature has already risen by 1.5 degrees but that the historical emissions are enough to reach this point because the processes that cause temperature rise are, to some extent, self-propelled, and it will take time to turn things around again. My conclusion, from the philosophical approach of this thesis, is that the world is virtually 1.5 degrees warmer, and this will unfold as an actuality if drastic measures are not taken. Furthermore, emissions at the present level of accumulation, as Jackson et al write, "[are] deep into the territory that scientists expect would prompt catastrophic, irreversible climate changes".[233] The Paris agreement must be revised to become more progressive in order to avoid catastrophe. It has been clear from before the negotiations that the voluntary reductions are not enough, and the agreement states and "emphasizing with serious concern the urgent need to address the significant gap" between what has been agreed upon by the states and that which is necessary to achieve in order to reach the goal of keeping the temperature rise well below 2 degrees. It would be necessary to decarbonize the world's societies more or less immediately to limit the temperature to 1.5 degrees, which is the goal, although the agreement says "well below 2 degrees".[234] Island nations pushed for such a goal and succeeded, but it is an entirely different question as whether this is even possible and if these low-lying islands can be saved. NASA reports that 2015 had a global mean temperature that was 0.87 degree Celsius above the means over the period 1880-1899, and the warmest 15 years recorded since then occurred during the last 16 years. The trend is strong and moving steadily upwards.[235]

However, even if temperature and sea-level rise are well documented and threaten to drown low-lying islands, some islands can physically adapt to changing conditions on time-scales that are rather short, i.e. human time-scales. It seems that many of these islands are relocating due to sea level rise and some islands are growing. Kench et al writes in *Geology* that "there

233 Jackson et al., "Reaching peak emissions."
234 unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf
235 www.giss.nasa.gov/research/news/20160120/

is no evidence of heightened erosion over the past half-century as sea-level rise accelerated. They write that reef islands in Funafuti continually adjust their size, shape, and position in response to variations in boundary conditions, including storms and sediment supply as well as sea level."[236] These coral islands have increased in size as the sea level has risen. Gravel, sand, and coral debris have moved from one side to the other and new material is added from the sea, and "island accretion has occurred through generation of new gravel deposits during cyclonic events".[237] Thus, while some islands have decreased in size, the majority have slightly changed position and quite a few have even expanded during the last 60 years as the sea level has risen some 30 cm in the tropical Pacific Ocean. Fascinatingly, sea level rise is not uniform over the planet. This heterogeneity in sea-level rise takes something away from the ocean as the universal measuring stick of actual change, which is how I interpret that the ocean as a whole has been used in the scientific communication of climate change. Even if the storms are more severe in the Funafuti area – they come more often and the effects are worse due the sea level rise – many islands are growing. What must not be forgotten, however, is that there are humans living quite densely on some of these islands, and the consequences of sea-level rise for these societies can be devastating. We are truly living in a world of becoming where even islands are moving, and this undermines the land as the solid outlook onto the world of change as described in the analysis of Hans Blumenberg where the changing world can be seen as a shipwreck at sea that the philosophizing spectator on land contemplates from a safe distance.[238] Our world will adapt to the changing atmospheric conditions caused by human emissions, and we are witnessing some of those adaptations now. These will be dramatic events for our societies and for us humans living in them. The world is on the move, and it will be a rough ride for humanity.

The COP meetings are political rather than scientific, and the French President François Hollande´s speech to the negotiators at COP 21

236 Kench et al., "Coral islands defy sea-level rise over the past century: Records from a central Pacific atoll," *Geology* 43, no. 6 2015.

237 ibid.

238 Hans Blumenberg, *Shipwreck with Spectator.*

embodies this when he declares, "History is written by those who commit, not those who calculate".[239] We can interpret this to mean that science is not enough to change the world; it also takes political decisions and commitment to meet the challenges that we face. However, this would be a little unfair to "those who calculate" because they are the ones who have given us the rather spectacular scenarios of the future, and the scientific IPCC reports present us with possible future worlds that are quite stirring. Maybe President Hollande is talking about the economists who are calculating the cost of decarbonizing our societies. Still, according to the IPCC the calculated economic costs of mitigation are relatively cheap because they are costs that "correspond to an annualized reduction of consumption growth by 0.04 to 0.14 percentage points over" the coming century to 2100.[240] So far, the political leadership has been lacking, not the science or the economic analyses of the costs of mitigation.

Still, there has been a change in how we perceive the world, and climate communication has certainly contributed to this change of discourse. I will now conclude my analysis by presenting two artworks that were exhibited during COP 21. My argument is that these artworks foster an aesthetic relationship to the world that is supplementary to the political negotiations. I perceive them to be forms of productive visual communication that represent good examples for scientific climate communicators to learn from.

The fostering of an aesthetic relationship to the world

The cultural programme ArtCOP21 from the Paris meeting argues that art and culture are "an opportunity like no other to promote […] other ways of understanding the complexity of the climate challenge through a multitude of creative and innovative approaches", and this gives artistic and cultural expression a supplementary function to the science of climate

239 Tollefson et al., "Nations approve historic global climate accord", *Nature* 528, 315-316, 17 December 2015 online.

240 IPCC, AR5, WG3, p. 16.

change.[241] However, the role of art in this specific context should probably been seen as complementing and commenting on the political process of the meeting rather than the science that makes up the basis for the negotiations to begin with, and it is stated in the programme that "culture is involved in the political agenda", and this is true now more than ever before.[242] According to the ArtCOP21, the reason why culture is so important is that the actual conference is "practically inaccessible for the uninitiated" for technical reasons. The terrorist attacks that took place in Paris the weeks preceding the conference made the conference even more closed to outsiders, and the planned demonstrations were cancelled for security reasons. Exactly how this affected the reception of the artworks presented here is difficult to say. My interest comes from the observation that they are good examples to show that climate art is more than just the funny, sarcastic, or ironic images of polar bears on melting ice or the planet Earth on fire that have become so common on-line and in various campaigns from different NGOs. Furthermore, I chose these artworks because they can be used to illustrate the conclusions of this thesis by showing that it is possible to communicate complexity, fragility, care, exposure, and uncertainty with images and installations. To some extent they manage to do what the scientific images fail to do.

The Danish sculptor Olafur Eliasson is a world-famous artist who makes artworks that often deal with environmental issues. They are not necessarily environmental in the meaning of environmentally friendly, but I would say that they are environing their beholders through installations that produce a feeling of presence in nature. *Icewatch Paris* is such an artwork.[243] It consists of twelve large ice blocks arranged in the form of a clock in the middle of the city, and it lets the visitor lay their hands on glacier ice and to see the melting water drip away. A very similar installation, more or less the same, was presented in Copenhagen during the failed COP15 meeting in 2009. I guess that the title of the two works - Icewatch Paris and the installation in Copenhagen - also has two meanings, both a "clock" (a

241 "ArtCOP21: Cultural Calendar - Climate Festival - Paris 2015", (www.artcop21.com2015).

242 ibid.

243 www.artists4climate.com/en/

Figure 44. *Icewatch Paris* by Olafur Eliasson and Minik Rosing was exhibited in front of Place du Pantheon during COP 21.

watch) made of ice and "to watch" (to look at) melting ice, and together they say that we are looking at a physical doomsday clock. The world will be drowned when the clock strike twelve, i.e. when the Greenland ice has completely melted. Most visitors will be more or less familiar with the reference to the doomsday clock that the Bulletin of the Atomic Scientists presented in 1947 as a response to the threat of nuclear weapons. That clock was recently again set to three minutes to twelve due to modernization of nuclear weapons, but also "unchecked climate change".[244] Icewatch combines the idea of imminent danger of the end of the world with a possibility for the visitors to touch the thing that it is all about. I argue that ice often is used to show what could be called "the essentials" of climate change. Ice is a major component of the problem because the polar caps are melting, but it also shows us the process on a timescale that we can relate to when picking up a piece of ice or laying our hands on ice to feel it melt into water and trickle through our fingers.

The blocks came from a fjord outside Nuuk, Greenland, and were picked up when floating in the sea and then transported to Paris in refrigerated containers.[245] The artwork has a good message, except from one aspect, namely the environmental if we understand the word as it is used in the term "environmentally friendly". Eliasson argues that the blocks were floating freely and were not taken from the actual glacier from where they came in the first place. I would say that this is rather hollow rhetoric because the real problem is not the removing of the ice but why they were calved into the ocean in the first place. The melting of glaciers and sea-ice is caused by warmer climate that comes from emissions of carbon dioxide. It is impossible to perform a life-cycle analysis of this artwork because we would have to calculate the emissions of carbon dioxide caused by its production and set this against how much the artwork will mitigate climate change through the effect it has on its audience. The problem is not to measure the emissions that the artwork produces, which I am guessing is fairly easy. Instead, it is the effect the artwork has on its visitors, both in its physical place and through the media, that is impossible

244 thebulletin.org/three-minutes-and-counting7938
245 icewatchparis.com

to measure. The effect of climate communication on behaviour has not been successfully studied in any project, as far as I know, and artworks are much different from controlled studies where the reception of a message can be analyzed. Furthermore, it has been my argument throughout this thesis that communication of a complex issue like climate change cannot be expected to be transmitted from sender to receiver, so the "amount" of knowledge transmitted cannot be measured. This is simply a false question, and that is why I apply aesthetic analysis as a tool to understand climate communication. If we approach the artwork from an aesthetic perspective, then I would say that the transportation of 80 tonnes of ice from Greenland and the need for refrigeration for the entire journey takes something away that this artwork wants to evoke. It is not consistent with its aim anymore. Or is it? Perhaps the demand on efficiency is the wrong expectation to have from an artwork. I experience something like mourning when I speculate on the cost for the production of the artwork. I mourn the emission of carbon dioxide and feel bad for nature, asking why the climate has to suffer for the sake of art. And is that not exactly what I should feel in relation to all emissions in the world? The artwork conjures this in me and it is part of my meeting with the artwork, and maybe that is the whole idea of the piece.

Eliasson says in an interview that he "hopes [this] work of art can actually bridge the gap between the data, the scientists, the politicians and heads of state and how normal people feel", and I think it is well suited to do that.[246] This thesis has been all about broadening the perspective on climate communication to avoid reducing it to one message that is sent from a sender to a receiving general public or a given audience. Communication does not work that way, and the transmission model of communication has been abandoned, at least from the visual studies perspective that I apply here, although it often appears that many climate communicators still believe in such one-directional transmission. However, that is only if one looks at isolated "messages" because scientific communication always has a context, or many contexts. We now live in a

246 www.reuters.com/article/us-climatechange-summit-ice-idUSKBN0TM1VR20151203#2bXvZQxi4kb05v2E.97

time when the scientific message of climate change is surrounded by much dramatization. New findings in the physical science of climate change are often presented in the media as something quite dramatic, such as the accelerated melting of glaciers or the detection of new tipping-points in the climate system. I would therefore say that there is an onto-dramatization going on. *Icewatch* is one way to dramatize the message from the climate sciences. Putting a warm hand on the sculpture will immediately show how something as cold and hard as glacier ice can be turned into water, and this unusually warm December made the melting go even faster. I would say that this artwork is a communication project. Much scientific climate communication is produced with the intention to foster scientific literacy, but this artwork fosters an aesthetic relationship to climate change as we learn to bemoan the melting ice.

Another of the artists displaying work at the COP 21 meeting in Paris is Gideon Mendel with his ongoing project *Drowning World*. Mendel is 1 of 30 artists whose works were exhibited and sold at a charity auction by Christie's during the conference to sponsor projects that fight desertification in Africa, Asia, and South America. Mendel's work seems to be particularly useful in the UN context; his work has reappeared as the Photo of the Week many times and is highlighted on different websites. I would say that his project is representative of "climate art", and the photographs were shown "in famous locations of Paris, creating a contrast between the outdoor site of the exhibition and the theme of the photographs taken in 10 countries over the past eight years."[247]

Gideon Mendel writes on his website, "Drowning World is my attempt to explore the effects of climate change in an intimate way, taking us beyond faceless statistics and into the individual experiences of its victims", and I would say that he manages to do precisely that.[248] Mendel focuses on individual humans and lets us meet them face-to-face, which is in contrast to the scientific visualization depicting future scenarios that are almost always devoid of humans or only show anonymous, faceless humans. Through the photograph in figure 45, we are invited to imagine the feeling

247 www.artcop21.com/events/8521/

248 gideonmendel.com/submerged-portraits/

Figure 45. This photograph in the *Drowning World* series shows Victor and Hope America from Nigeria and was taken in November of 2012 by Gideon Mendel.

of standing in deep water and probably having lost much of your belongings to the storm surge or flooding. Obviously, these are experiences that most COP visitors will not experience but will recognize from media reports of people affected by flooding. The connection between the bodily sensation of how it would feel to stand in water and the distant images of what climate victims are experiencing makes this an evocative exhibition for the policy-makers who decide (at least to some extent) the future of distant people, both in time and space. The calm water that submerges those who are affected by climate change invites us to a meditation-like pondering of how they feel. A rough sea or a violent storm surge would have given the image another mood, but the calm water invites the audience to take a moment to stop and think with them. For me, the *Drowning World* series, of which only one photograph is shown here, is Bachelardian in that it operates on the level of material imagination. We know the feeling of being in water and we automatically share this feeling with those depicted; we can almost feel that we are there with them, and that makes this is a poetic image.

It seems clear to me that there are interesting differences between the scientific visualizations produced to promote understanding and to change behaviour and the two artworks described here. These artworks are climate art, and they represent the complex effects of climate change without simplification. We are forced to, or enticed to, interpret the meaning of the artworks, and we are engaged in what we see. Visualizations seldom achieve this because they are limited by the visual regime, and this is one of the main arguments in this thesis. The *Drowning World* series of photographs is documentary in nature and shows events that have already have happened instead of scenarios of what might happen in the future. In other words, instead of focusing on the possible effect in the future, they focus on the present and the effects that climate change is having on real people with names. These photographs are staged to some extent, and Mendel probably asked the couple to stand in front of their home and look into the camera. Aesthetic choices have been when it comes to lighting, composition, and things that might have been removed from the frame to make those standing in the water stand out as the absolute centre of attention. What I am saying is that these images have their genre specificity,

and thus they are also limited by unarticulated rules just as the scientific images are. The rules for the artistic images are probably ephemeral in comparison to the visual regime of the climate sciences, but both have their limitations. However, the visual regime seems to comprise a rather static set of rules given the permanence of how the images look over time. There is little playfulness when it comes to scientific images. Other values are much more important, including authority, readability, and, most importantly, convention. To some extent the scientific images lose some of their ability to present new thoughts. Mendel writes that "[t]he flood is an ancient metaphor, found within the myths and legends of many cultures", and it can therefore be used today as a representation for "an overwhelming, destructive force that renders humanity powerless in its wake and leaves us seeking refuge". I surely agree with this sentiment.[249] My thesis has aimed to show that images of the sea play a similar role in the parergonal position of scientific climate communication. The overwhelming and destructive force of the sea or the flood is also the force to change; the sea image is the image of change. The image of the sea is therefore added to complement what the scientific image is lacking, otherwise such change would not be representable within the visual regime of the climate sciences.

249 gideonmendel.com/submerged-portraits/

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A challenging question today is how to understand and act on climate change. Previous analyses of the public outreach of the climate sciences have concluded that the urgent communication of climate is inadequate. It is foremost the invisibility of carbon dioxide and the lack of a tangible relationship between current emissions and future effects that have been seen as the main challenge to visually represent. *The Drowning World* questions how the communication problem is articulated, and the analysis focuses on the supplementary images that come with this scientific communication, including cover images to reports, backgrounds to diagrams, or graphic design elements. The conclusion is that even if the scientific images might fail to communicate the complexity of the climate issue, the supplementary images, and the way the story of our changing world is told, manage to bring a feeling of change with them. Images of water are especially recurring, as are projects that use immersive environments like virtual reality, and these representations compete for attention in the media noise of modern society, a world that "drowns" the viewers in auditory and visual stimuli. Thus there are many reasons for the title of this thesis – *The Drowning World*.

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