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Wildfire growth modelling can facilitate the work of emergency services – but currently not in Sweden

Because of the wildfires causing damages amounting to hundreds of millions euro in recent years in Sweden, the Swedish Civil Contingencies Agency reported the need to increase the emergency preparedness for complex events such as wildfires. Wildfire growth modelling can strengthen the societal resilience to wildfires. However, the guidelines outlining the collection of the necessary spatial data currently do not exist in Sweden. Are data sets already available sufficient for wildfire growth modelling?

In order to understand how the growth of a raging wildfire can be modelled it is important to introduce two concepts describing a *fire*. Firstly, a fire is not as different to water as you might think. Figuratively speaking that is. Water is commonly referred to as a *body of water*. This body consists of a constellation of water molecules. Similarly, a fire is a constellation of flames. Secondly, a common misconception is that a fire *spreads*. A fire cannot spread. Instead, it *grows* when new flames are added to its body. Every flame constantly transfers energy in all directions, just like a radiator in your home, meaning the fire heats surrounding matter. Eventually, *pyrolysis* (i.e. the process in which matter decomposes into fire fuel) starts. Subsequently, the fire grows when ignition of the newly released fuel takes place. In contrast, a fire reduces in size when flames go extinct. Hence, the fire may appear to be spreading when in fact it is growing in one direction while decreasing in size in another. Continuous ignitions of new flames happen as long as a mixture composition of fuel, oxygen and heat remains balanced.

A wildfire is an uncontrolled fire that grows in vegetated areas. Since the amount of oxygen and pyrolysable matter in nature is almost inexhaustible, a wildfire has the potential to grow indefinitely. The rate at which the wildfire grows is controlled by environmental factors that describe the terrain, ground cover and weather of the area where the wildfire exists. Data sets containing this spatial information are currently available in Sweden. The *spatial resolution* (i.e. resolution of the area represented by a single value in a data set; denoted as the length of one side of a squared pixel) of these data sets is adequate to allow for wildfire growth modelling either as it is or after a resolution increasing process. Likewise, the *temporal resolution* (i.e. sampling rate; update frequency) of the terrain and weather information is sufficient. However, the ground cover information has a current planned update interval of five years meaning it cannot reflect variations (e.g. droughts; harvests; storms) in nature. In fact, its temporal resolution does not even reflect natural variations during the growing season. Therefore, the sampling rate of the ground cover data must increase before modelling of wildfire growth can be used in Sweden to strengthen the societal resilience to wildfires.

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