

## Can MSG help us to determine where to place solar cells in the Netherlands?

New methods of obtaining renewable energy are constantly being improved and developed. One of the major renewable energy components are solar cells. Solar cells make use of incoming radiation from the Sun and convert this radiation into electricity. However it can be hard to determine where to place these solar cells based on measurements made on the ground (in-situ measurements). The reason why it's hard to determine where to put solar cells is due to the fact that in-situ measurements don't cover the entire area of interest. They only measure incoming solar radiation at one specific point. These measurements can be interpolated to create a map of an entire area or country to guess what the incoming radiation is at locations that do not have an in-situ measurement station. Figure 1: A) shows how this has previously been done using a Thin Plate Splines (TPS) interpolation method. This maps gives a good and clear overview of the pattern that can be observed in the Netherlands when looking at global radiation from the Sun. However the TPS method doesn't give a lot of information about patterns that can occur in between these measurement stations. Therefore different interpolation methods with different input data could be used. In this research satellite images from Meteosat Second Generation (MSG) are used as an input next to the in-situ measurements. Different interpolation and combination methods are used to improve the quality of the maps. Especially Kriging with External Drift (KED) showed potential when using interpolation. In this interpolation method the in-situ measurements were used as main input to perform the interpolation. The in-situ measurement also correct the values found in the satellite image. The satellite image itself is used to explain the trend/pattern in between the in-situ measurements.

### Results

The results showed that all interpolation methods can be used to create maps of monthly averages and long term yearly averages. All interpolations returned correct values at the in-situ measurement locations when using a cross-validation. However TPS did not show any patterns in between the in-situ measurements. Kriging performed significantly better than TPS on a daily time interval. TPS returned errors up to 25% while Kriging errors did not pass 5% in most cases on a cross-validation. This is caused due to the fact that TPS cannot capture the big variation in incoming global radiation on a daily scale. Besides the errors on the in-situ measurement locations TPS does not use the satellite image to explain or account for the variation in between the measurements. Kriging does make use of this and can therefore return a map with more details and correct values (see figure 1: B).

### Conclusion

For interpolation of global radiation in the Netherlands Kriging would be a better interpolation method to use (especially on a daily time scale) due to the possibility of using a satellite image to explain the trend in between the in-situ measurements. The in-situ measurements make sure that the values are corrected so that the range of the values is trustworthy. With output maps showing both the correct values and local variation, better estimations can be made where to put solar cells or where radiation is higher for models and predictions.

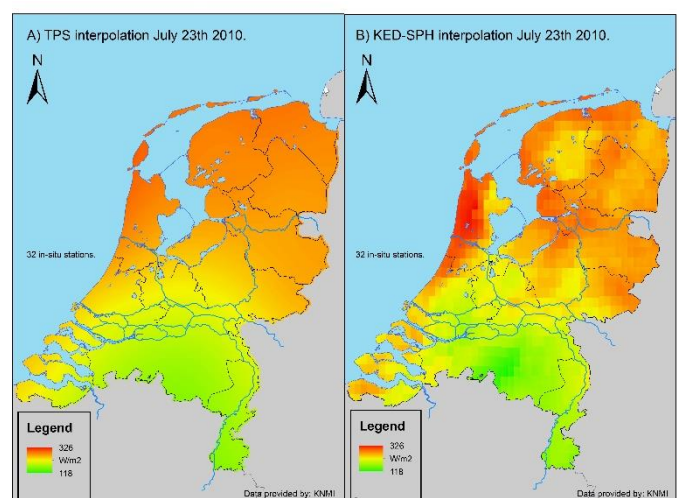


Figure 1: A) Interpolation using TPS, B) Interpolation using KED-SPH.