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Spatial error characteristics for operational day ahead solar irradiance forecasts

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Accurate solar energy production forecasts reduce the need for reserve power kept in the electricity grid management. This results in reduced costs of the renewable energy supply and – in case of using conventional reserve power – in reduced environmental impacts of conventional power production.

It is expected, that according to weather patterns the reliability of solar energy forecasts has a spatial dependence. Therefore, the question how accurate and reliable solar energy production forecasts can be on the intra-day and day-ahead forecast horizon, probably has also a spatial dependent component. Solar energy specific weather forecasts need to provide mainly global and direct irradiances, together with temperature, wind speed, rain and snow. The latter meteorological parameters are of less importance and therefore neglected in this study.

The available ground measurement network for direct irradiances is extremely sparse, in Europe and Northern Africa there are up to 10 stations working at maximum in public networks. This is not sufficient for any spatial analysis. For global irradiances the situation is much better, but also there the representativeness error of ground measurements gets larger than a typical satellite observation's error once there is a distance above 50 km from the next ground measurement station.

Therefore, Meteosat Second Generation based observations have been used as reference for the verification of nowadays numerical weather prediction capabilities at the ECMWF with respect to global and direct irradiance forecasts. They allow the spatially distributed analysis of forecast accuracies and even the assessment of spatial correlations of forecast errors.

This is valuable input for energy system modelers in principle, providing insight into questions related to power plant operations, electricity grid management on the distribution and transmission net operator's level and the electricity market.