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Assessing regional reanalysis data sets for planning small-scale renewable energy systems

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An accurate resource availability estimation is vital for proper location, sizing and economic viability of renewable energy plants. Large photovoltaic (PV) and wind installations undergo a long and exhaustive planning process that would imply unacceptably high costs for developers of small-scale installations. In a context of abolition of feed-in tariffs, electricity feed-in restricted by grid capacity constraints and storage systems being commercialized at lower costs, the acquisition of high quality solar radiation and wind speed data becomes important also for planners of small scale installations. These data allow the characterization of short-term and inter-annual variability of the resources availability. Global reanalysis data sets provide long time series of these variables with temporal resolutions that can be as high as one hour and at no cost for the final user. However, due to the coarse spatial resolution and relatively low accuracy these products only provide an inferior alternative for data retrieval compared to e.g. satellite derived radiation data sets or advanced interpolation methods for wind speed data. The COSMO-REA6 and COSMOS-REA2 regional reanalysis overcome this limitation by increasing the resolution of the reanalysis to six and two kilometres respectively. The accuracy of these data sets for variables with high relevancy for meteorology, such as rainfall, has been assessed with satisfactory results but an independent evaluation for variables relevant for renewable energy generation has not been performed yet. This work presents an assessment of the variables of these data sets that have been made available to the public until November 2017. This assessment is performed for the area of the federal state of Bavaria in Germany and whole Czech Republic using data of the Bavarian agro-meteorological network and the Czech Hydrometeorological Institute. Accuracy indicators are calculated for horizontal global radiation or cloud coverage (depending on data availability from the weather stations) and wind speeds at 10 meters height. While there are important differences between weather stations and cloud coverage data, the results for wind speeds and global solar irradiance are satisfactory for most of the locations. For certain locations widely used indicators such as the Pearson's correlation coefficient reach values above 0.8 for wind speeds and above 0.9 for global solar irradiance and the mean biased error is consistently lower than 10 W/m2 and can be as low as 0.3 W/m2 for the irradiance data and is, with a few exceptions, lower than 2 m/s in Germany and lower than 1 m/s in the Czech Republic for wind speed data. A total of eight indicators for the hourly data in the period between 1995 and 2015 are calculated, presented, discussed and compared against international literature dealing with data accuracy for solar irradiance and wind speed data sets.

Keywords: renewable energy, regional reanalysis, COSMO-REA, solar radiation, wind speed