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Simulation of long term renewable energy feed-in for European power system studies

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Renewable energies already play a remarkable role in Europe as of today.
It is expected that wind and solar amongst other renewables will contribute strongly to the future European energy generation.
However, wind and solar generation facilities have due to the weather dependent nature of their resources highly fluctuating feed-in profiles. To overcome the mismatch between energy demand and generation it is important to study and understand the generation patterns and balancing potentials.

The goal of the current work is to investigate how the feed-in time series from different renewable sources like on- and offshore wind, photovoltaic, solar thermal, wave, hydro, geothermal and biomass power and combination of them look like in an European power supply system . The work is part of the RESTORE 2050 project (BMU) that investigates the requirements for cross-country grid extensions, usage of storage technologies and capacities, the development of new balancing technologies and the conceptual design of the future energy market which is suitable for high generation percentages of solar and wind.

High temporally and spatially resolved long term weather data from COSMO-EU, MERRA and Meteosat (MFG/MSG) satellite data has been used to simulate feed-in from several types of renewable energy sources on a 7 x 7 km grid covering Europe. For wind speeds MERRA reanalysis data has been statistically downscaled to account for orography.
Generation was aggregated on the country level and production patterns and their variations in time of different resources were investigated for the years ranging from 2002 to 2012.

In a first step the quality of the simulated feed in time series has been investigated by comparison to real observations of wind power and PV generation. Furthermore, some sensitivity studies with respect to underlying assumptions like spatial distribution of wind and PV capacities, the chosen hub-height and wind power curve have been done and will be presented.

While daily and seasonal patterns in general stay similar, the total feed-in can vary by more than 25 % from year to year for certain resources in a region. It is shown that the overall annual resource of wind and PV power for entire Europe is considerably less variable. The seasonal correlation of wind and PV will be presented and the consequence on reduced storage needs.