Geophysical Research Abstracts
Vol. 19, EGU2017-2116, 2017
EGU General Assembly 2017
© Author(s) 2016. CC Attribution 3.0 License.

The Impact of Strong Climate Change on Inter-state Balancing in a Fully-renewable Simplified European Electricity System

Jan Wohland (1,2) and Dirk Witthaut (1,2)

(1) Research Center Jülich, Institute of Energy and Climate Research - Systems Analysis and Technology Evaluation, Jülich,
(2) Institute for Theoretical Physics, University of Cologne, Cologne

Electricity systems with a high penetration of renewables are strongly affected by weather patterns. Due to the variability of the climate system, a substantial fraction of energy supply needs to be provided by dispatchable power plants even if the consumption is on average balanced by renewables (e.g. Rodriguez et al. [2014]). In an interconnected system like the European electricity grid, benefits can arise from balancing generation mismatches spatially as long as overproduction in one region coincides with lack of generation in another region. These benefits might change as the climate changes and we thus investigate alterations of correlations between wind timeseries and Backup energy requirements.

Our analysis is based on a five member model-ensemble from the EUROCORDEX initiative and we focus on onshore wind energy. We use the highest temporal (3h) and spatial (0.11°) resolution available to capture the intermittent and spatially diverse nature of renewable generation. In view of inter-model spread and other uncertainties, we use the strong climate change scenario rcp8.5 in order to obtain a high signal-to-noise ratio. We argue that rcp8.5 is best suited to reveal interesting interactions between climate change and renewable electricity system despite the fact that is in contradiction to the UNFCCC temperature goals (e.g. Schleussner et al. [2016]).

We report spatially inhomogeneous alterations of correlations. In particular, we find increasing correlations between central and northern European states and decreasing correlations at the south-western and south-eastern margins of Europe. This hints to a lowering of balancing potentials within central and northern Europe due to climate change. A possible explanation might be associated to polar amplification and increasing frequencies of blocking events (Coumou [2015]).

Moreover, we compute wind energy generation using a single-turbine model and a semi-random deployment procedure as developed in Monforti et al. [2016]. In combination with ENTSO-E load data and validated solar generation timeseries from Renewable Ninja (Pfenninger and Staffell [2016]), we calculate backup energy needs in Europe and analyze the potential of cooperation between countries to lower them. We find increases in European backup energy needs throughout the 21st century which are robust across the 5 climate models considered.