

# Effects of climate variability and climate change on wind power integration into power systems

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Intermittence associated with the very nature of renewable energy sources determines a fundamentally new class of problems related to account for climatic and meteorological characteristics when planning the development of energy systems. That leads to a need for a detailed study of the temporal and spatial variability of the renewable energy climate factors. Particularly, the wind speed is known to be significantly influenced both by the climate change and the multidecadal natural variability while a gap in understanding details of these processes still exists for many regions around the world.

The presented work was aimed to investigate the long-term dynamics of the wind speed field across the Northern Eurasia looking for options to facilitate wind power integration into the existing power systems. The latest generation climate datasets were validated against direct measurements data and used for further calculations. A detailed analysis considering the spatial structure of the wind speed fields has been fulfilled with consecutive evaluation of the long-term wind power potential dynamics.

The representative samples of the climate data were established to be utilized as inputs into the energy models. An approach has been proposed towards optimizing working conditions of the wind power units taking an advantage of the wind speed spatial features found before. It has been shown that proper accounting for the wind variability allows for a noticeable increase of an average wind power capacity utilization. The most pronounced effects on wind power integration is reached for the episodes of very high and very low speed values.

A forecast approach has been developed to assess a combined effects of the energy load evolution and the long-term wind speed changes on the power systems. The main fundamental challenges and opportunities have been identified in integration of the wind power considering the Northern Eurasia macro-region and taking into account the climate change impacts under realistic assumptions.

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