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Simulation of long-term variability of wind power production in the Czech Republic

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The long-term (interannual to interdecadal) variability of wind power is generally of smaller magnitude than its short-term weather-driven fluctuations. However, it still has important practical implications as the deviations from long-term average (or even long-term trends) can strongly affect the wind farm cash flow and profitability. They must be carefully taken into account while processing a wind resource assessment or while evaluating the wind farm performance.

To make the long-term assessment easy and user friendly, the "wind indices" can be calculated, that are used to estimate the average deviation of a wind power plant's energy yield from its long-term annual mean. For instance, the BDB index is calculated for single months and refers to one of 25 wind-index-regions in Germany. However, if these data are based on wind or wind power measurements, that are not consistent (homogeneous) in long-term – which is rather the rule than the exception – then it can lead to incorrect results.

The more robust approach is using the reanalysis as a long-term reference standard. These low-resolution data can be downscaled by MCP-methods to simulate the long-term wind conditions at individual site. This approach was applied to simulate the wind and wind power conditions in the Czech Republic during last decades using geostrophic wind derived from NCEP/NCAR reanalysis. A comparison showed that the real wind power production in Czech Republic during past years was approximately in agreement with this simulation, with the exception of months strongly affected by wind turbine icing. In a long-term view, no significant trend was found. Also the multiannual oscillations were rather insignificant, with slight exception of sites, where the wind power rose is highly concentrated towards western directions – this is probably result of NAO variations.