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UK-wide wind power resource: Extremes and variability

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The sensitivity of the Great Britain (GB) power grid to atmospheric variability is expected to rise markedly over the coming decades as generation from wind (and other renewables) increases. Extreme wind power generation events can be characterised by either persistent low (or high) wind power output, or by rapid changes in wind power output. The latter is caused by wind power ramping (where small changes in wind speed induce large changes in wind power output) and by very high winds inducing turbine shut down.

Determining reliable statistics of extreme wind power generation events using surface weather observations or directly from power system data is problematic due to the spatiotemporal inhomogeneity and short time scales inherent to such data. In contrast, reanalysis datasets combine observations with state-of-the-art numerical weather prediction models to provide a global set of spatially and temporally consistent near-surface wind estimates over several decades. Here, we first assess the degree to which a commonly used reanalysis dataset can represent the observed variability in near-surface wind speeds over the last three decades at a range of spatial and temporal scales. After evaluation and statistical correction, this data is used to provide novel insights into the frequency and duration of extreme wind power generation events across GB. The way in which these extreme events propagate between different regions of GB is also discussed.

This research is being used to inform the GB power system operator about the statistics of extreme wind power generation events and provides the foundation for new research into the predictability of these events, as well as new research into the impacts of climate variability on power systems.