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Applications of two-dimensional multifractal fractional Brownian motion to mesoscale wind power generation and synthetic climate change

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We investigate the impact of synthetic climate change on the backup infrastructure of a simplified highly-renewable European electricity network. We conjecture that climate change affects the wind-speed distributions across the European continent, and simulate the continental wind-speeds by using a 2-dimensional stochastic meso-scale turbulence model, which is based on fractional Brownian motion and multifractal cascade processes. The considered parameters of the model are the turbulent integral scale, the large-scale fluctuation strength, the turbulent intermittency parameter, and the Hurst coefficient. For the turbulent integral scale and the large-scale fluctuation strength, we observe a significant increase in required backup infrastructure with increasing parameter values. For variations of the intermittency parameter and the Hurst coefficient only a negligible change in required infrastructure is observed.