Stability of power grid concerning tropical cyclones: Increasing resilience by protecting critical lines

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Power grids are characterized by multistability. For power grids, the strongly ongoing transition to distributed renewable energy sources leads to a proliferation of dynamical actors. The desynchronization of a few or even one of those would likely result in a substantial blackout. Thus, the dynamical stability of the synchronous state has become a leading topic in power grid research, in particular for rather strong perturbations where traditional linearization-based concepts are not appropriate. First, we discuss the concept of basin stability and its estimation even in high-dimensional systems. Considering the vulnerability of power grids against extreme wind loads and, consequently, increasing its robustness to withstand these events is of great importance. Here, we combine a detailed model of the climatic drivers of extreme events, and a cascadable model of the transmission network to provide a holistic co-evolution model to consider wind-induced failures of transmission lines in the Texan electrical network. The proposed modelling approach coulda tool so far missing to effectively strengthen the power grids against future hurricane risks even under limited knowledge.