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A Stochastic Generator of Global Monthly Wind Energy with Tukey g-and-h Autoregressive Processes

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Quantifying the uncertainty of wind energy potential from climate models is a very time-consuming task and requires a considerable amount of computational resources. A statistical model trained on a small set of runs can act as a stochastic approximation of the original climate model, and be used to assess the uncertainty considerably faster than by resorting to the original climate model for additional runs. While Gaussian models have been widely employed as means to approximate climate simulations, the Gaussianity assumption is not suitable for winds at policy-relevant time scales, i.e., sub-annual. We propose a trans-Gaussian model for monthly wind speed that relies on an autoregressive structure with Tukey g-and-h transformation, a flexible new class that can separately model skewness and tail behavior. This temporal structure is integrated into a multi-step spectral framework that is able to account for global nonstationarities across land/ocean boundaries, as well as across mountain ranges. Inference can be achieved by balancing memory storage and distributed computation for a data set of 220 million points.

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