On wind speed pattern and energy potential in China

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To achieve sustainable socioeconomic development as part of the global community, China has set ambitious goals for developing wind power within its national energy security framework. Existing wind power density maps in China present some knowledge gaps (e.g., lack of spatiotemporal resolution/characteristics and estimates at the height of a typical wind turbine). To address them, we combine the advantages of large network of wind speed observations (2430 meteorological stations; 2006–2015) and the grid-based method in order to create the spatiotemporal distributions of wind resource at the hub height. We found that the spatiotemporal variability of wind resources in China is apparent. Nationally, the annual mean wind speed and wind power density are 4.09 m s^{-1} and 164.1 W m^{-2}, respectively. Spatially, Northeast China has the highest wind potential with annual mean wind speed and power density 4.64ms^{-1} and 204W m^{-2}, while South China has the lowest wind potential annual mean wind speed and power density 3.55 m s^{-1} and 97.4 W m^{-2}. Temporally, the wind resources over the entire China are higher in the cold season (spring and winter with peaks in April) than those in the warm season (summer and autumn with bottoms in August). Specifically, the wind power output in "Three North" region (including Northeast China, North China and Northwest China) in the cold season is 1.4 times higher than that in the warm season. Some coastal regions in East China have relatively high wind power density (> 500 W m^{-2}) and small seasonal variations. These findings should help decision-makers to identify the areas suitable for utilizing wind energy, and optimizing power generation and transmission across the grid for better system performance.