Spatio-temporal Variations of Winds in Boundary Layer: Relations to Wind Energy Potential over India

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Efficient extraction of power from winds depends heavily on its spatial as well as temporal variations. This is primarily due to a near-linear response of the generated power to wind speed within the cut-in to cut-off speeds. Thus, estimation of wind energy potential heavily depends on the three-dimensional spatial and temporal variations of wind speeds. Often reanalysis data sets and numerical model simulations are used to estimate potential and real-time forecast of wind energy. In this study, we use station data sets and high-resolution reanalysis products to understand the vertical and diurnal variations of wind speed over several locations of India. We show that the temporal variations of wind speed in the reanalysis data sets is far from that observed. Moreover, we show distinct spatial patterns in the vertical variations of wind speed which can be used to design turbine heights for extraction of wind energy.