

Beneficial role of diurnal smoothing for grid integration of wind power

Worldwide renewable installations are growing exponentially in the electricity mix. In a renewable-rich electricity grid, meeting continuously changing demand with weather-dependent intermittent renewable generation is highly complicated. Aggregating wind generation from sites with different diurnal cycles can reduce the variability of hourly generation ("diurnal smoothing") (Figure 1A). Our work, for the first time, quantifies the implications of variation in the diurnal cycle of wind speed on renewable energy integration and smoothing. The timing of the daily ("diurnal") wind cycle maximum is

heterogeneous, yet the broad-scale patterns recur year after year (Figure 1C). The diurnal smoothing achieved at shorter distances is comparable to the geographical smoothing benefit achieved from sites with larger separation distances but similar phases (Figure 1B).

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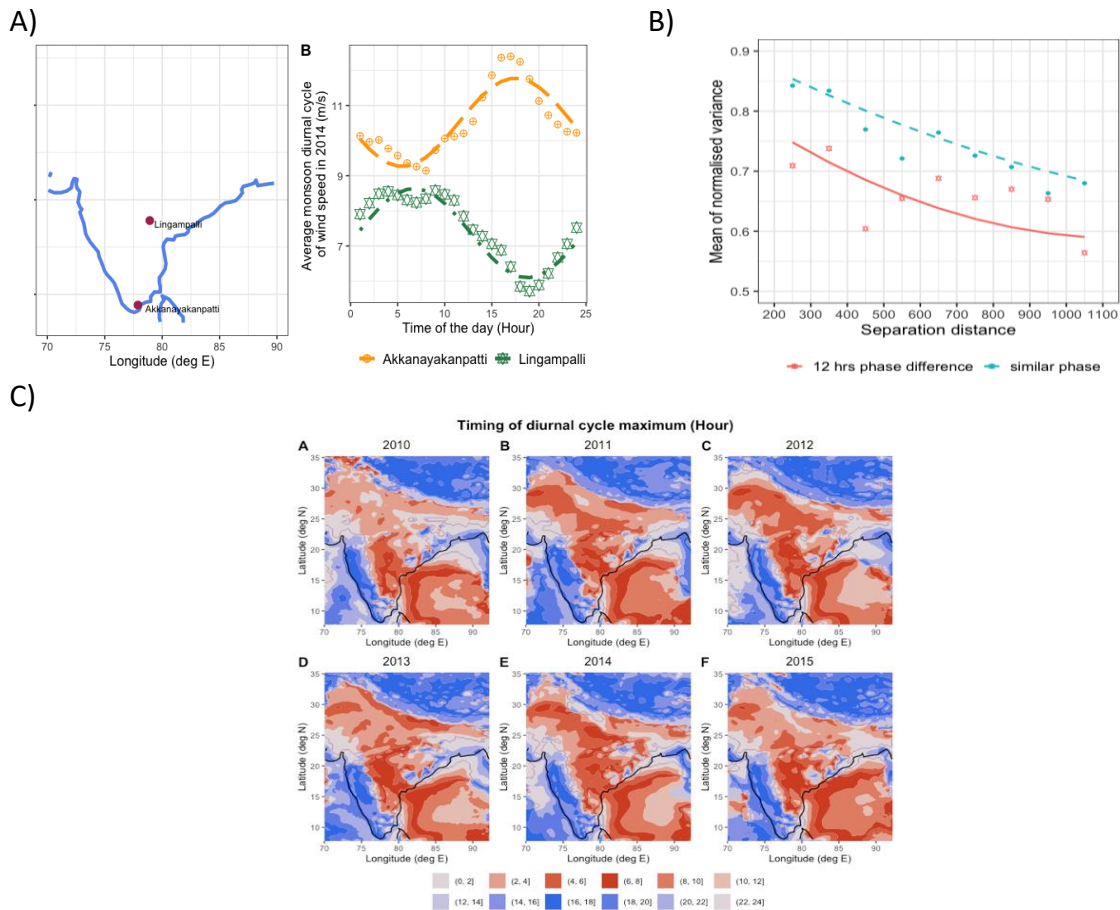


Figure 1 (A) Location of wind monitoring station (NIWE): Akkanayakanpatti and Lingampalli; and Average monsoon diurnal pattern of wind speed (year 2014); The difference in diurnal phase angle between these locations is approximately 12 hours. **(B)** The mean of normalized variance of hourly aggregate generation from a large ensemble of randomly chosen pairs of sites, plotted against their separation distance. **(C)** The timing of the wind daily ("diurnal") cycle maximum (year 2010 to 2015);