

Quantifying the Reduction in Solar Generation Variability through Interconnected PV (SEI-3)



A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

Collection and analysis of over 1 year of observed power production data from 50 utility-scale solar plants in the state of Gujarat shows that interconnecting as few as 12 photovoltaic (PV) plants achieves the majority of the reduction of variability.

Significance and Impact:

This is the first analysis of geographic smoothing of solar PV using actual generation data at high time resolution from utility-scale PV plants.

Research Details:

- We used geographic correlation and Fourier transform estimates of the power spectral density (PSD) to characterize the observed variability of operating solar PV plants as a function of time scale.
- Interconnecting 20 Gujarat plants reduces fluctuations at frequencies corresponding to 6 hours and 1 hour by 23% and 45%, respectively. Half of this smoothing can be obtained by connecting two plants; the point of diminishing returns occurs at 10–12 plants.

Publication: K. Klima and J. Apt, Geographic smoothing of solar PV: Results from Gujarat. *Environ. Res. Lett.* **10** (2015) 104001.
DOI: 10.1088/1748-9326/10/10/104001

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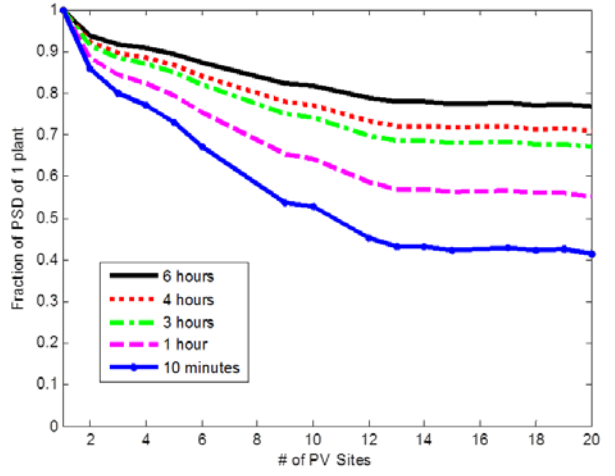


Fig. 1. Fraction of the spectrum of a single plant retained vs number of interconnected solar plants normalized at $f=1/24$ hours at different time scales.

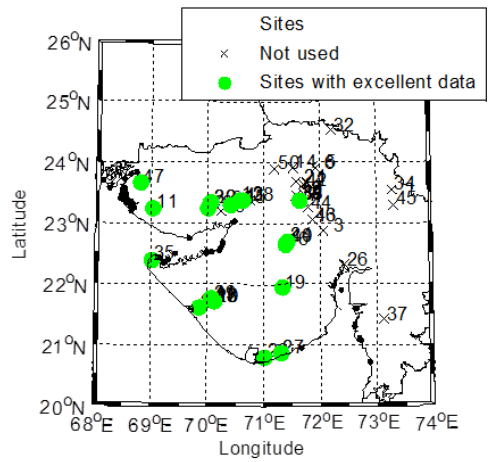


Fig. 2. A map of Gujarat showing the sites with excellent data.