



A methodology for evaluating the spatial variability of the wind energy resources: application to assess the potential contribution of wind energy to baseload power

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We propose a method for analyzing the potential contribution of wind energy resources to stable (baseload) within a region. The method uses principal component analysis (PCA) for analyzing spatiotemporal balancing of wind energy resources and then assesses optimal wind farm location, to reduce power fluctuations. The ability of different wind turbines, alone or interconnected, to provide stable (baseload) power is ultimately evaluated at selected locations. The method was tested in the southern Iberian Peninsula, including offshore areas. We used hourly wind energy estimates for 2009 from the WRF mesoscale model at 3 km spatial resolution. First, the results show the existence of valuable spatial balancing patterns within the study region, but with a marked seasonality. The most important balancing patterns were discovered in the eastern area and near the Strait of Gibraltar. The various patterns were found to result from the interaction of mesoscale zonal flow and the complex topography of the region. Second, the results indicate that optimal allocation and interconnection of wind farms across the region, by taking advantage of the aforementioned spatial balancing patterns, can substantially reduce wind power output fluctuations. In some cases, this optimal allocation provides stable (baseload) power.