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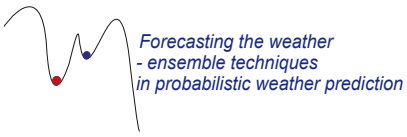

Intra-Hour Forecasting with a Total Sky Imager at the UC San Diego Solar Energy Testbed

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A method for intra-hour, sub-kilometer irradiance forecasting using a ground-based sky imager at the University of California, San Diego is presented. Sky images taken every 30 seconds were processed to determine sky cover using a clear sky library and sunshine parameter. Cloud motion vectors were generated by cross-correlating two consecutive sky images. Cloud locations up to five minutes ahead were forecast by advection of a two-dimensional cloud map that was generated from the coordinate-transformed sky cover. Cloud shadows at the surface were estimated using the cloud map. Cloud forecasts were compared to measurements from a network of six pyranometer ground stations spread out over an area of 2 km2.

The large cloud variability in the coastal environment is near impossible to be captured deterministically with satellites or numerical weather prediction (NWP). The use of sky imagery to assess the solar resource for solar energy applications shows potential for augmenting the spatial and temporal resolution provided by satellite and NWP. Most of the time, only short (5 to 20 minute) deterministic forecast horizons are feasible using a single TSI at the San Diego site due to low clouds limiting horizontal extent of the sky imager field of view.

Despite shortcomings of the sky imager, cloud shadows in the outer regions are correctly nowcast 76% of the time. Cloud-advection-versus-persistence errors were found to be a universal metric to compare forecast performance; for 30-sec forecast a 50-60% reduction in forecast error compared to persistence was found.