An irradiance probabilistic prediction system based on WRF-Solar EPS and the analog ensemble

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The WRF-Solar Ensemble Prediction System (WRF-Solar EPS) and a calibration method, the analog ensemble (AnEn), are used in this study to generate calibrated gridded ensemble forecasts of solar irradiance over the contiguous United States (CONUS). Global horizontal irradiance (GHI) and Direct Normal Irradiance (DNI) retrievals, based on geostationary satellites from the National Solar Radiation Database (NSRDB) are used for both calibrating and verifying the day-ahead GHI predictions. A 10-member ensemble of WRF-Solar EPS is run in a re-forecast mode to generate day-ahead GHI predictions for three years (2016-2018). The WRF-Solar EPS ensemble probabilistic forecasts rely on stochastic perturbations introduced on a set of variables relevant to solar irradiance predictions. On the other hand, the AnEn is used to calibrate the GHI predictions at each grid point independently using NSRDB as the "ground truth." The first two years of the ensemble are used as the training dataset, and the last year is used to evaluate the ensemble's performance. A set of deterministic WRF-Solar re-forecasts during the same three-year period is used to quantify the added value of the WRF-Solar EPS ensemble. Performance evaluations of deterministic and probabilistic attributes are carried out over the whole CONUS, by season, and by forecast lead times. The results demonstrate that using the AnEn calibrated ensemble forecast from WRF-Solar EPS contributes to improving the overall quality of the GHI predictions with respect to an AnEn calibrated system based only on the deterministic run of WRF-Solar. In fact, the calibrated WRF-Solar EPS's mean exhibits a lower bias (about 16% less for GHI) and RMSE (about 4% less for GHI) than the calibrated deterministic WRF-Solar. Moreover, using the ensemble mean and spread as predictors for the AnEn allows a more effective calibration than using only deterministic values.