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Post-processing numerical weather prediction ensembles for probabilistic solar irradiance forecasting

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In order to enable the transition towards renewable energy sources, probabilistic energy forecasting is of critical importance for incorporating volatile power sources such as solar energy into the electrical grid. Solar energy forecasting methods often aim to provide probabilistic predictions of solar irradiance. In particular, many hybrid approaches combine physical information from numerical weather prediction models with statistical methods. Even though the physical models can provide useful information at intra-day and day-ahead forecast horizons, ensemble weather forecasts from multiple model runs are often not calibrated and show systematic biases. We propose a post-processing model for ensemble weather predictions of solar irradiance at temporal resolutions between 30 minutes and 6 hours. The proposed models provide probabilistic forecasts in the form of a censored logistic probability distribution for lead times up to 5 days and are evaluated in two case studies covering distinct physical models, geographical regions, temporal resolutions, and types of solar irradiance. We find that post-processing consistently and significantly improves the forecast performance of the ensemble predictions for lead times up to at least 48 hours and is well able to correct the systematic lack of calibration.