

Probabilistic Cloud Optimized Day-Ahead Forecasting System Based on WRF-Solar

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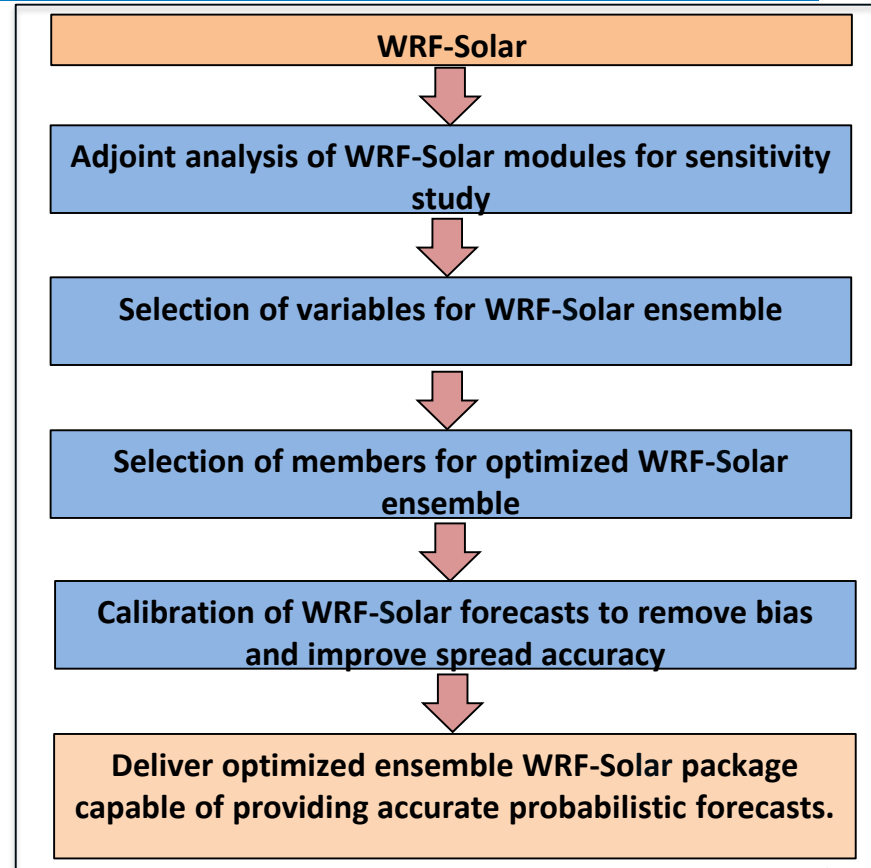
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Approach

- Identify variables that significantly influence the formation and dissipation of clouds and solar radiation through an **adjoint analysis** of WRF-Solar modules that influence cloud processes.
- Consolidate the variables identified in step (a) to develop the **WRF-Solar ensemble** forecasting system.
- **Calibrate the WRF-Solar ensemble system** using measurements to ensure that the forecasts' trajectories are unbiased and provide accurate estimates of forecast uncertainties under a wide range of meteorological regimes.
- **Demonstrate the improvements** delivered by the probabilistic forecasts for the regions and locations identified by Topic Area 1.
- Develop and deliver an **open-source probabilistic WRF-Solar system** for the solar energy community.



Adjoint Sensitivity Analysis Framework

Phase 1

Produce FARMS TI/Adj codes by TAF

Phase 2

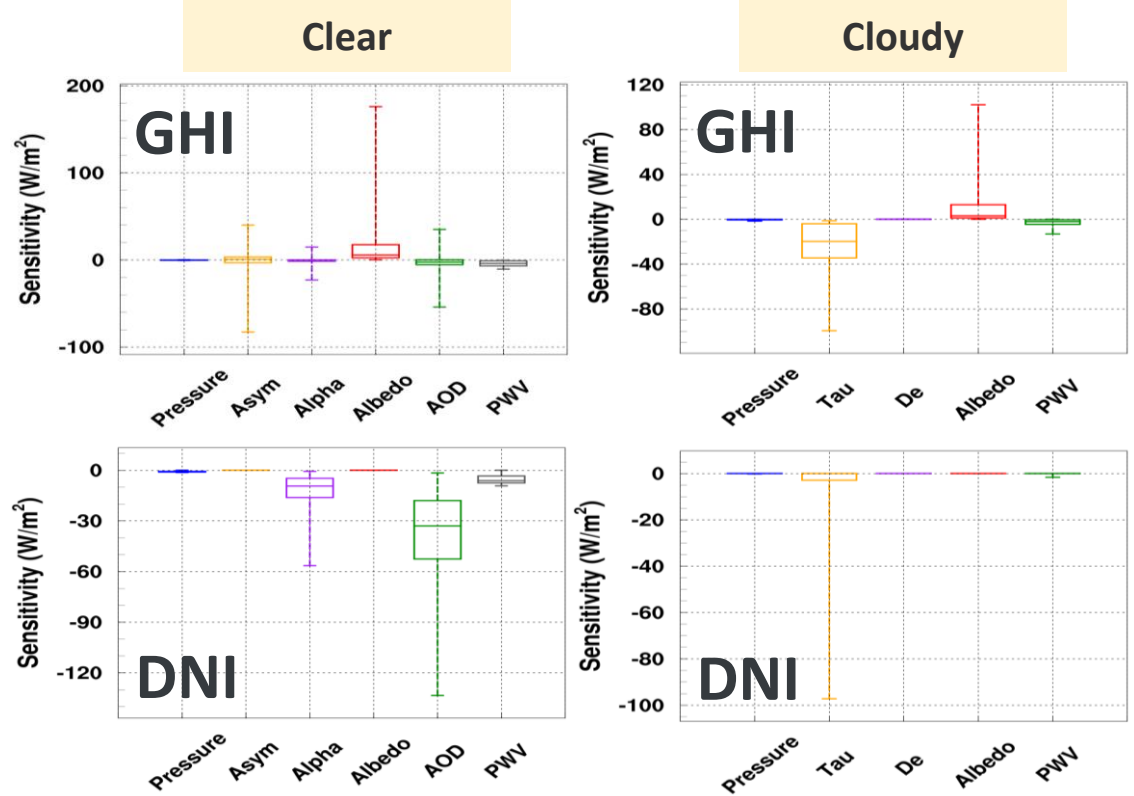
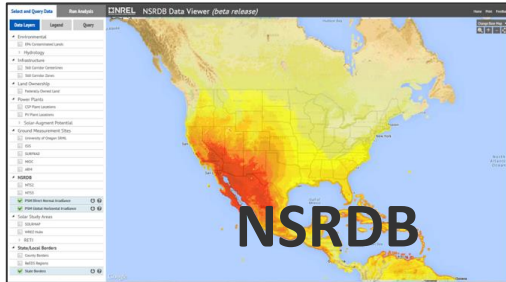
Linearity test and TI/Adj test

Phase 3

Probability distribution from NSRDB

Phase 4

Scenario analysis

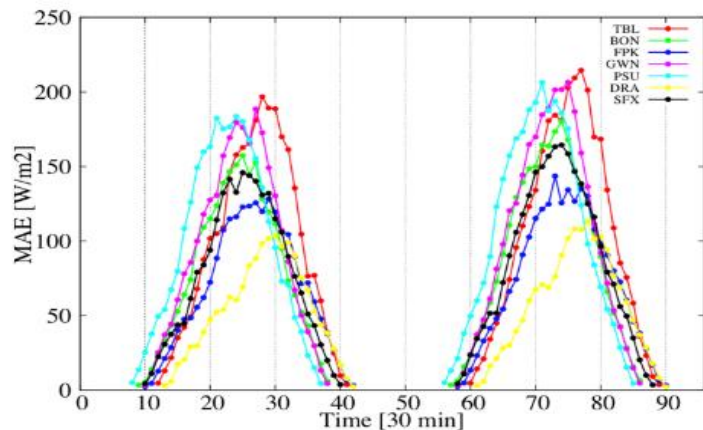


Normalized sensitivity of GHI and DNI with respect to model variables (12,150 clear-sky and 6750 cloudy-sky cases)

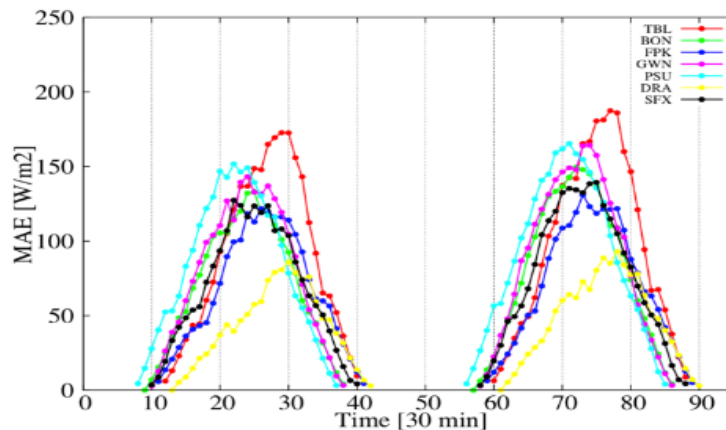
WRF-Solar Modeling: Baseline

WRF-Solar baseline case evaluation (1-yr, 9km resolution, RAP analysis for initial and boundary conditions)

MAE of GHI compared with SURFRAD



MAE of GHI compared with NSRDB



- Automatic process of WRF-Solar runs has been developed on NREL HPC (Eagle system).
- WRF-Solar simulations for day-ahead forecasts were run for 2017 covering CONUS.
- The 1-yr simulations of WRF-Solar were evaluated using SURFRAD and NSRDB data.

NSRDB and SURFRAD errors characteristics are similar with NSRDB comparison demonstrating smaller errors indicating that the NSRDB can be used for model evaluation.

Thank you

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