A Comparison of Advection-Based and Machine Learning PV Forecasts for Puerto Rico Forecasting

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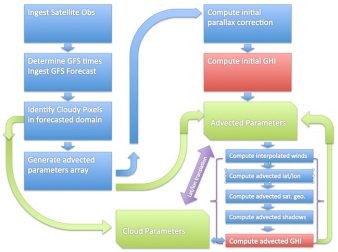
Power infrastructure for Puerto Rico fragile after tropical storm/hurricane

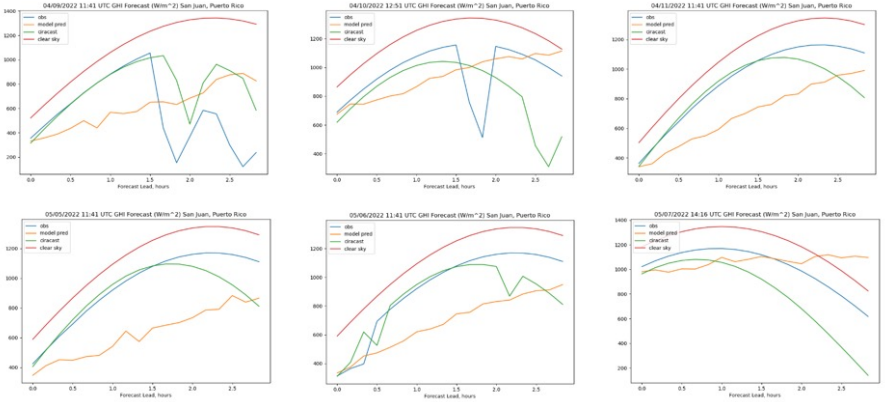
Considerable outages after Hurricane Maria, impact on disaster response, healthcare sector, and emergency communications

Idea: distributed solar to generate power, replacing central power grid and power line with more resilient dispersed photovoltaic (PV) generation

Solar needs: nearcasts of cloud shadow to prevent damage or outages in power due to cloudiness

Goal: 1-3 hour high turnaround solar forecast for Puerto Rico





Satellite advection forecast – CIRACast – uses satellite observations in concert with NWP winds to 'push' cloud groups forward in time. Benefits – fast, accurate current cloud locations, ability for advanced radiative transfer models for GHI calculations. Limitations: advection for stationary and sheared clouds – cloud motion outside of wind-driven model.

Machine learning – 'extremely random trees' model. Similar to random forest. Was developed as an extension to random forest. Randomly selects the best feature for splitting the node and uses the whole training.

Approach – perform random trees forecast using GHI information from satellite forecast, compare to computed GHI foreacast from CIRACast.

- The extra trees model works best for up to 1-hour forecasts. By the three-hour mark, clouds are being overpredicted over the west part of the island regardless of where the clouds are actually supposed to be.
- CIRACast does a much better job at catching solar ramps, while the ET model just assumes that GHI increases linearly over time, even when the forecasts start later in the morning.
- The ET Model could work better at predicting the warmer months (April to October) than the "colder" months (December to March).
- Limitations: five days of training data not enough.
- Future work: Climatology, better validation, optimization techniques.

CIRA Connecting Models and Observations

Colorado State University