Renewable Power Forecasting, Modeling, and Analysis at U. Arizona

Renewables forecasts from 1 minute to 8 days

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We create weather and power forecasts for over 2.7 GW of solar and wind power plants, analyze renewable power and load data from the Southwest, and develop open source software to model PV systems. Our work reduces the cost of integrating renewables into the power grid and helps utilities keep the power grid reliable.

Renewables forecasts from 1 minute to 8 days

We combine high resolution weather models, satellite images, and real time sensor data to create weather and forecasts from minutes to days ahead. Forecasts are updated every 5 minutes 24/7/365.

Local challenges include:
- Mountains + moisture + heating = storms
- Unreliable initialization data from Mexico
- Extreme planetary boundary layer heights
- Rapidly changing land/surface characteristics

Weather and power forecasts perform well in the Southwest U.S. See forecasting.arizona.edu/wrf for model output.

High resolution weather modeling

8 day forecasts from a 1.8 km resolution weather model (WRF) configured to perform well in the Southwest U.S. See atmo.arizona.edu/wrf for model output.

Optimal interpolation of satellite and ground data

1 minute to 4 hour forecasts using satellite and ground data.
- Combine data from geostationary satellite images and ground irradiance measurements from sensors and PV cells.
- Optimal interpolation enables accurate but sparse ground data to improve the irradiance estimate over a large area (in this case, Tucson).
- Optimal interpolation reduces root mean square error (RMSE) by up to 50% and nearly eliminates mean bias error (MBE).

Utility scale renewables in the Southwest

The Southwest Variable Energy Resource Initiative (SVERI) is a collaboration of 8 utility companies in the Southwest. SVERI and UA collaborate to analyze solar and wind data.

SVERIload, net load, and projected 2027 net load

SVERI, SRP, and APS

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PVLIB Python: An open source library for PV modeling and forecasting

PVLIB Python is an open source software library that provides a set of extensively tested and documented functions and classes for modeling photovoltaic energy systems. Learn more at pvlib-python.readthedocs.io and contribute to the library at github.com/pvlib/pvlib-python

Background

Sponsors and partners

The SVERI utilities