The Solar Forecast Arbiter enables reproducible irradiance, power, and net load forecast analysis

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Highlights

- **Web user interface, HTTP API, and python analysis package support many use cases.**
- **Workflow promotes clear communication of forecast attributes and analysis criteria.**
- **Supports DOE SETO Solar Forecasting 2 teams and the broader forecast community.**
- **Open source code allows users to inspect all layers of the software stack.**
- **Operational forecast trials with anonymity.**
- **Users retain full control of their data.**
- **Includes basic support for wind power.**

Summary

Integrating large amounts of solar into electric grids requires that forecast users, providers, and researchers can accurately communicate the strengths and limitations of forecasts. The Solar Forecast Arbiter establishes an evaluation framework that streamlines these communications. The framework workflow and its open source code promote efficient, transparent, reproducible analyses.

Get started by visiting solarforecastarbiter.org

Abstract

The Solar Forecast Arbiter is an open source platform for impartial, repeatable, and auditable evaluations of solar irradiance, solar power, and net-load forecasts. With a recent 1.0 release, the Solar Forecast Arbiter is a production-quality tool for both industry and researchers.

Solar Forecast Arbiter users define forecast and observation metadata, upload data, and then create analysis reports. This workflow prevents uncertainty about exactly what is analyzed and the open source code allows users to fully understand how the data is analyzed.

The Solar Forecast Arbiter provides quality-controlled reference irradiance and power data from a selection of networks and ISO/RTOs. It also provides understandable reference forecasts based on NOAA models and persistence. These features allow users to easily compare their forecasts to meaningful references using high-quality data.

Data privacy is a core feature of the platform. User uploaded data is private by default, but users may choose to grant other users the ability to see or modify their data. For example, a utility may create metadata to describe a power plant, upload generation data, and then share the data with several forecast vendors. These vendors can upload forecasts for the power plant and share them with the utility but not with each other. The participants can then create analysis reports for the data.

The Solar Forecast Arbiter supports operational forecast trials that allow forecast users and vendors to efficiently and fairly compare forecast performance. Participants no longer need to set up custom systems for every new trial. As a neutral 3rd party, the Solar Forecast Arbiter ensures that metrics are accurately calculated and that incumbent forecasters do not have an advantage.

The Solar Forecast Arbiter also supports the research community under the DOE Solar Forecasting 2 program. Our team has consulted with the other Solar Forecasting 2 project teams to develop detailed evaluation plans that will help all stakeholders understand the relative merits of the forecasts under conditions relevant to industry. Working with the project teams, we implement these evaluation plans using the Solar Forecast Arbiter features discussed above. This improves the transparency, fairness, and relevance of the forecast analyses.

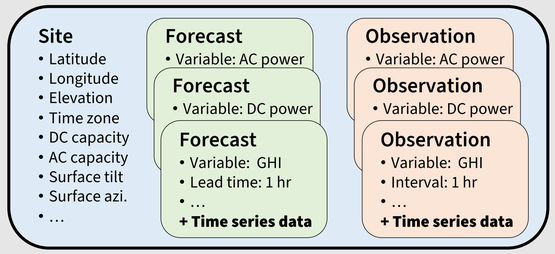
Finally, we will discuss plans for the future of the Solar Forecast Arbiter, including modifications to better support wind power forecast analysis.

The Solar Forecast Arbiter is funded under the DOE Solar Forecasting 2 program.

Solar Forecast Arbiter workflow promotes clear communication of forecast attributes and analysis criteria

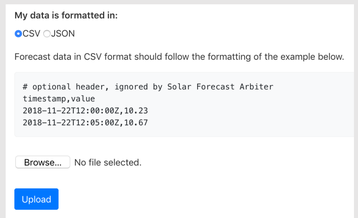
Step 1. Define site, observation, and forecast metadata

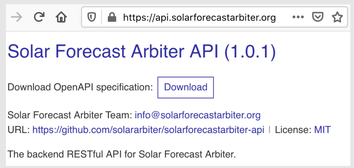
All time series data is associated with fully specified metadata objects.



Step 2. Upload time series data

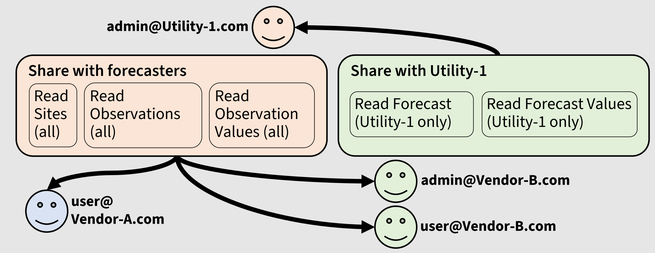
Use the dashboard forms or the RESTful HTTP API to upload and download data in CSV or JSON.





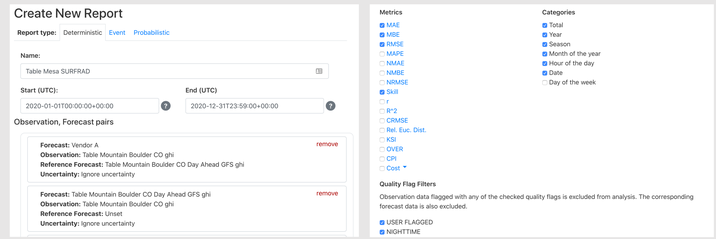
Step 3 (optional). Grant access to your data

Role-based access control provides detailed administration of data sharing with clients/vendors.



Step 4. Run analysis report

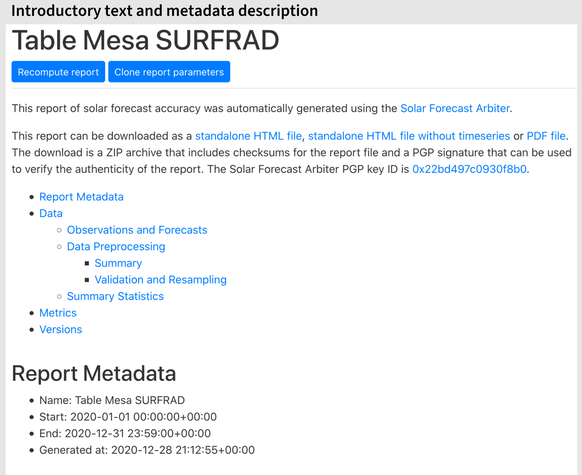
Specify start/end, forecast/observation pairs, reference forecasts, metrics, and filters.



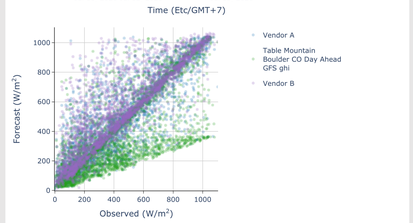
Standardized analysis reports communicate forecast performance

These screenshots show samples of the standardized analysis reports. Reports may be downloaded in HTML and PDF formats. Metadata, processed time series, and metrics may be downloaded for inspection or further processing as CSV or JSON files.

Introductory text and metadata description



Interactive time series and scatter plots



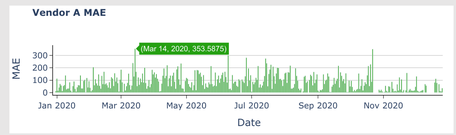
Data validation and filtering results

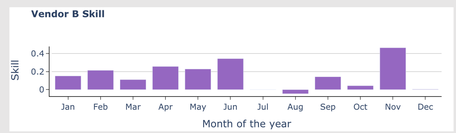
Aligned Pair	Table Mountain Boulder CO Day Ahead GFS ghi	Table Mountain Boulder CO Current Day NAM ghi	Table Mountain Boulder CO Intraday HRRR ghi	Table Mountain Boulder CO Intraday RAP ghi
Observation	Table Mountain Boulder CO ghi	Table Mountain Boulder CO ghi	Table Mountain Boulder CO ghi	Table Mountain Boulder CO ghi
NIGHTTIME OR USER FLAGGED OR ISNAN	4760	4760	4760	4760
TOTAL DISCARD AFTER RESAMPLE	4760	4760	4760	4760

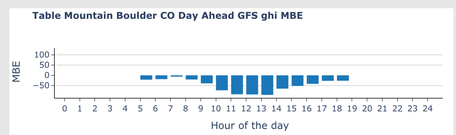
Table of metrics for total analysis period

Forecast	MAE	MBE	RMSE	Skill
Vendor A	91.3	16.7	147	0.238
Table Mountain Boulder CO Day Ahead GFS ghi	122	-56.3	193	nan
Vendor B	97.1	77.4	160	0.169

Interactive graphics for each metric for each category







Solar Forecast Arbiter architecture

Dashboard

The web-based graphical user interface for the Solar Forecast Arbiter framework. Includes forms for exchanging data with the API and requesting analyses. Leverages the Core library to create visualizations for uploaded data and reports. github.com/SolarArbiter/solarforecastarbiter-dashboard

API

An HTTP REST API for exchanging data with the Solar Forecast Arbiter, including user authentication and database interaction. Manages a queue of tasks to be performed by workers. github.com/SolarArbiter/solarforecastarbiter-api/

Core

Python library that contains code for data structures, data acquisition, data validation and filtering, error metrics, and visualization. github.com/SolarArbiter/solarforecastarbiter-core/

Data flow between components of the Solar Forecast Arbiter