



**NY Power
Authority**

NYISO Spring '23 Economic Conference Load Forecasting Task Force Meeting

Advanced Solar & Load Forecasting Operations Project

June 12, 2023

Advanced Solar and Load Forecasting

Project Purpose

- **Project Goal**

- Deploy networked Sky Imagers at locations across NYS to obtain advanced short term solar and load forecasting and building load management
- Incorporate into NCAR numerical weather-based forecasting systems, and deploy these across the state, with focus on selected regions
- Evaluate benefits to system and utility operations for solar integration, load forecasting and building load control

Advanced Solar and Load Forecasting

Project Team/Funder(s) & Roles

- NYPA - lead, direction, guidance, & field logistics
- EPRI - subcontracts, accuracy against benchmarks, tech transfer
- Nat'l Center for Atmospheric Research (NCAR) - lead implementation WRF-Solar model for NYS, blending algorithms for GHI & Utility scale PV forecasts
- Brookhaven Nat'l Lab - lead deployment sky imagers, solar nowcasting, data validation
- SUNY Albany- installed Albany sky imagers (8), NYS Mesonet dataset, meteorological analysis, calibration
- Advisor(s):
 - NYSERDA – Grant funding via Smart Grid PON in 2018 (\$750 K)
 - NYISO
 - Central Hudson

Advanced Solar and Load Forecasting

Improvements to Solar Forecasting w/respective duration

Nowcasting

Need to control variability for grid stability via real-time decisions

1min 30 min

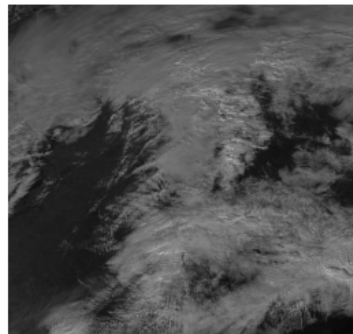


Ground-based imagers, sensor networks, and misc. "big data" solar input

Intra-day

Carry reserves and dispatch resources to meet load

6 hours

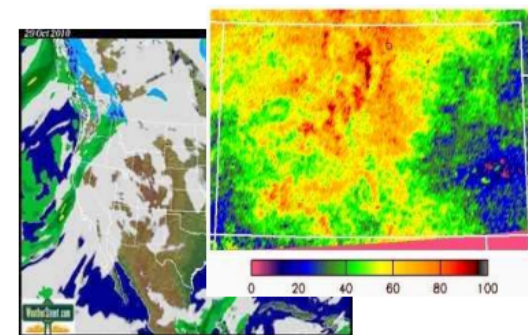


Satellite imagery

Day(s) Ahead

Need for daily trading to minimize energy costs

24+hours



Numerical Weather Prediction (NWP) Modeling

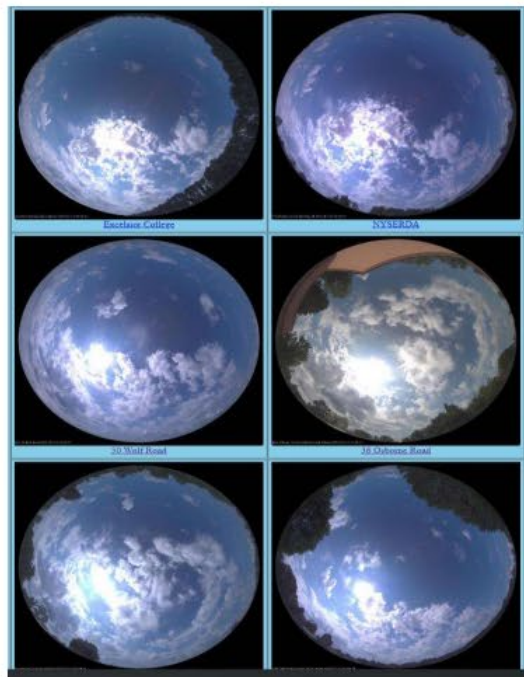
Advanced Solar and Load Forecasting In-Field Sky Imager Deployment (BNL – UAlbany)



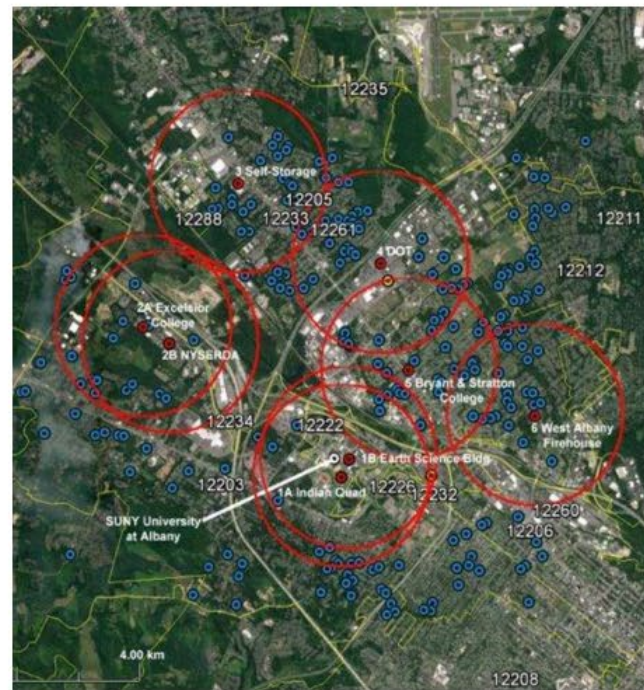
Advanced Solar and Load Forecasting In-Field Sky Imager Deployment – Method 1

BNL Solar NowCasting System (Solar Irradiance)

(a) Sky images

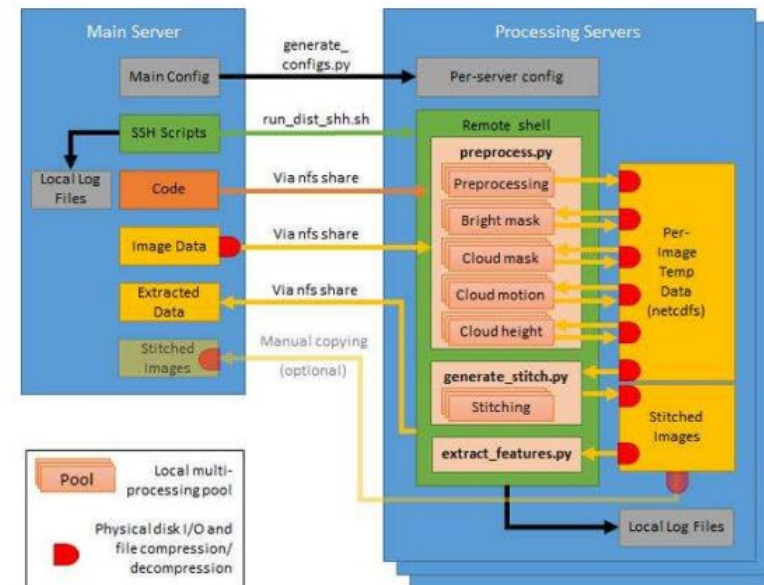


(b) Albany imager network



Red = cameras

(c) Code flowchart



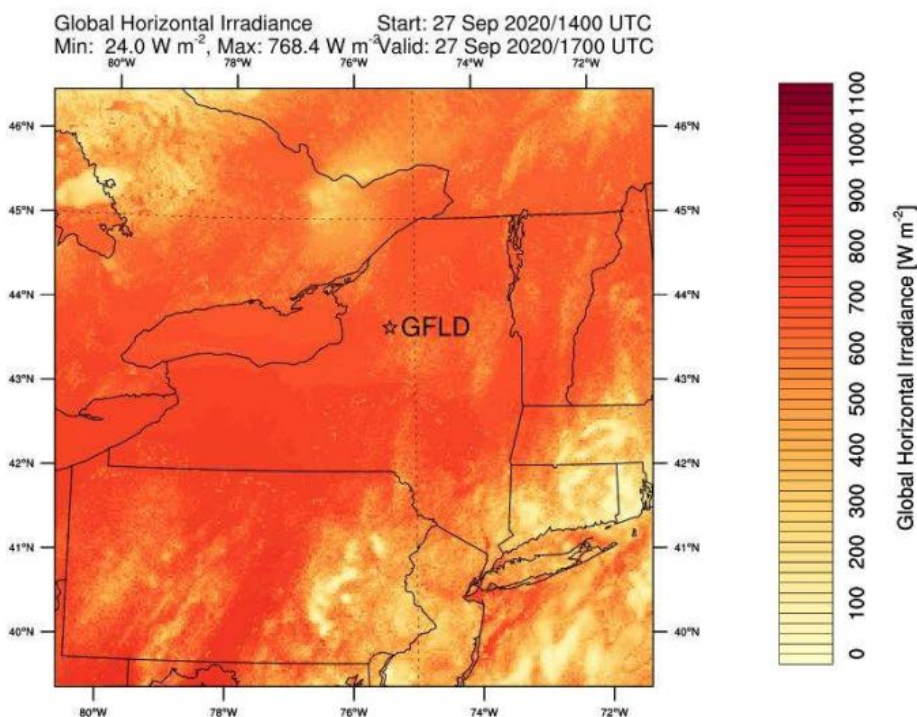
Advanced Solar and Load Forecasting Forecast Model Development – Method 2

- Key Features of the Forecast Study
 - Develop forecast models (relevant timescales to utility & ISO operations)
 - Validated forecasts (delivered ‘live’ forecasts for 1-year (May ‘21 – Apr ‘22))
 - Evaluated forecasts (against measurements & ref. forecasts from commercially available forecasts)

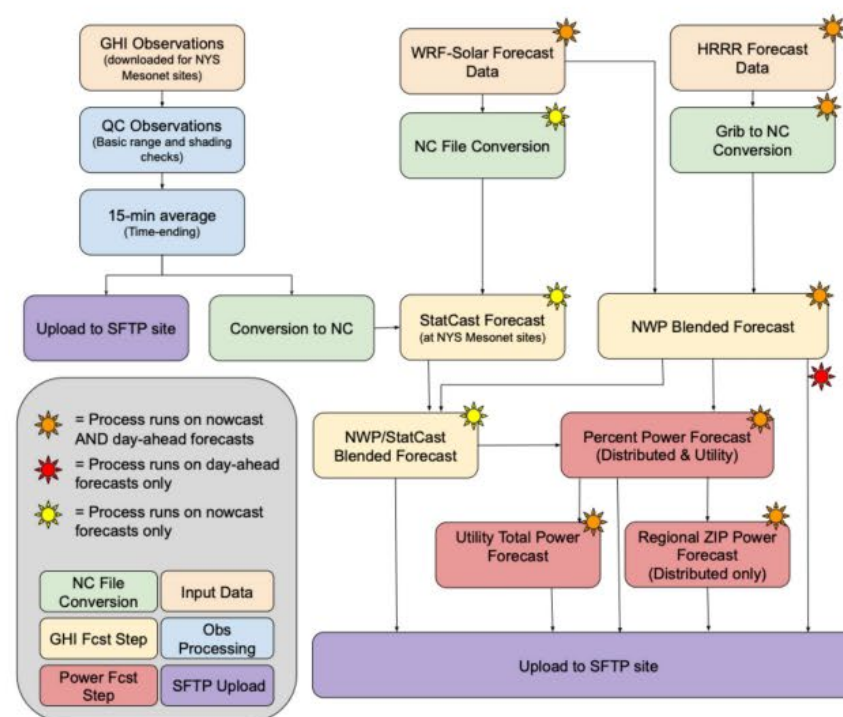
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NCAR NY SolarCast Forecast (Irradiance & Power)

(a) Forecast domain



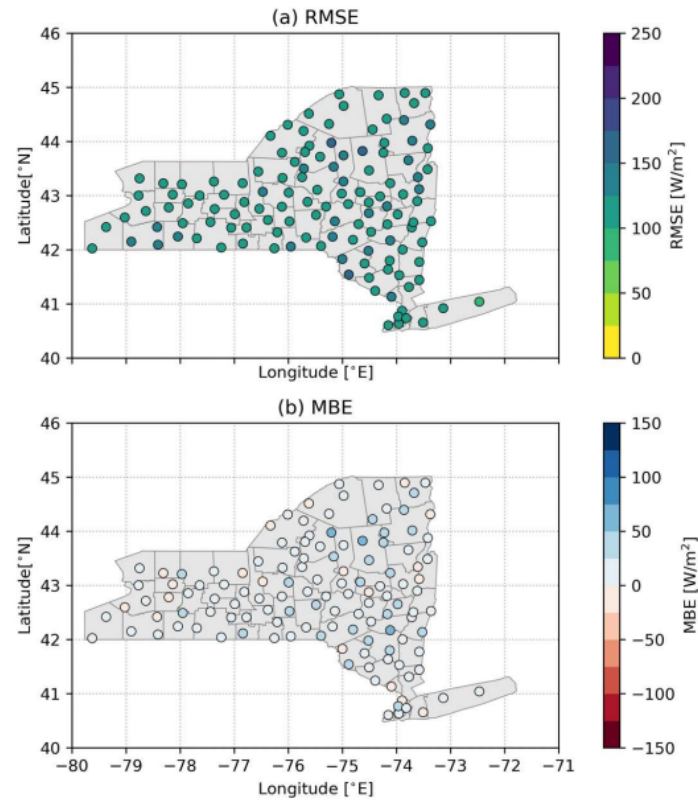
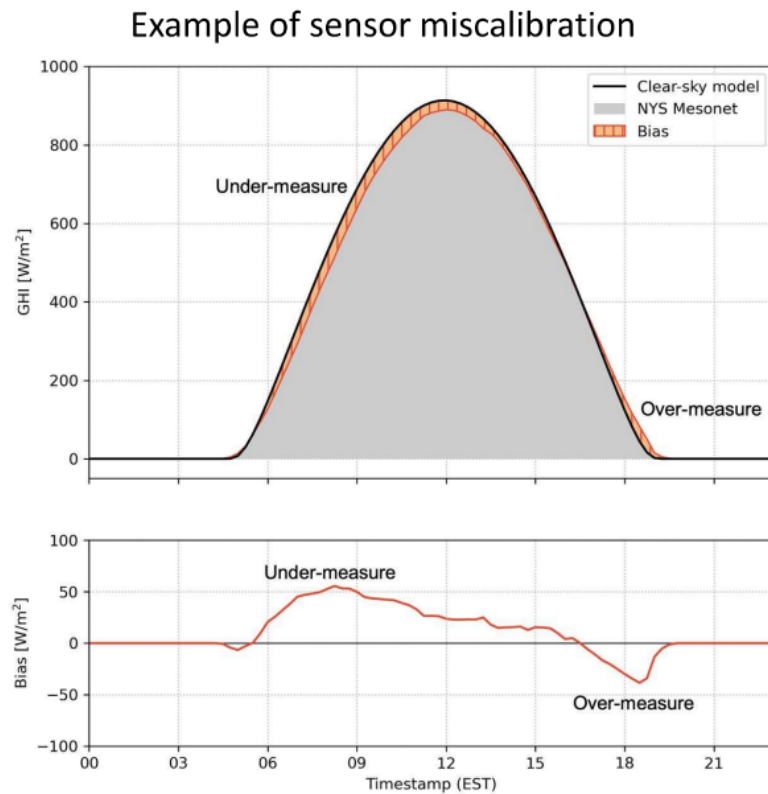
(b) Method flowchart



Approached via: Numerical Weather prediction, Sensors, & Machine Learning

Advanced Solar and Load Forecasting Takeaways from Method 2 Findings:

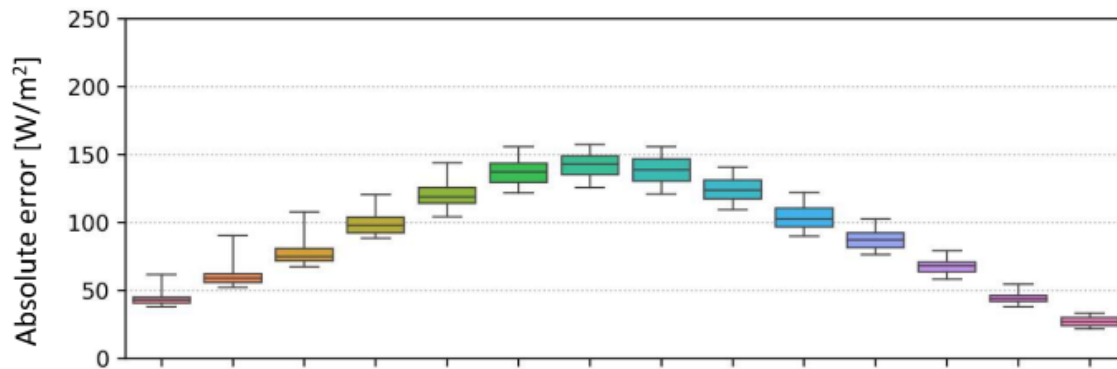
Takeaway #1: Sensor data quality impacts forecast accuracy



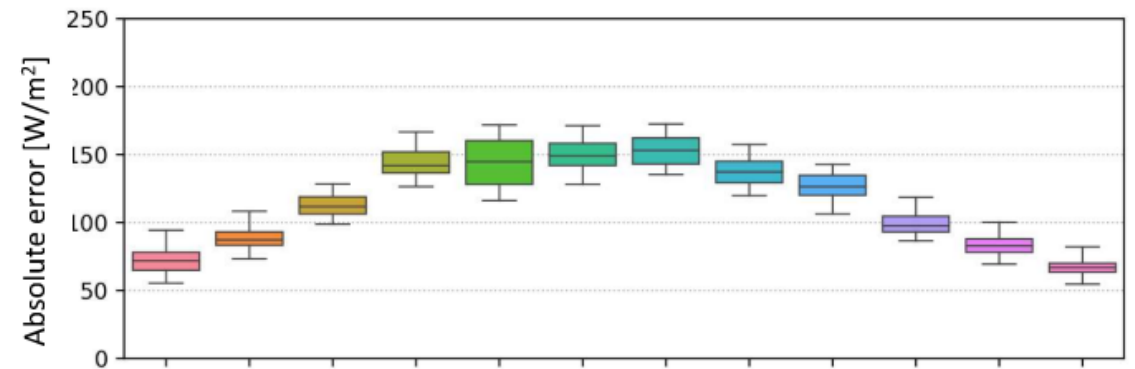
Advanced Solar and Load Forecasting Takeaways (continued...)

#2 – Forecast accuracy varies by time of day & season

(a) Errors by hour of day



(b) Errors by month of year



#3 – Importance of forecast inputs vary (allow model to select inputs based on forecast accuracy)

#4 – Research based tools perform well compared to existing commercial tools

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Solar Forecasting Roadmap Findings ...

Pathways for Forecast Deployment

- Commercialization as a Product
- Incorporation of Research by a Forecast Provider
- Public Deployment
- Private Deployment by End User

	Commercialization	Incorporate Research	Public Deployment	Private Deployment
Cost to forecast provider	Medium	Low	High	Medium
Cost to forecast consumers	High	High	Low	Low
Public benefit	Medium	Medium	High	Low
Time to deployment	Medium	Medium	Long	Medium
Scalability	High	High	High	Low

Advanced Solar and Load Forecasting Roadmap Findings cont'd & Lessons Learned

- Instrumentation reliability & maintenance critical for data accuracy
- Data collection & data streams, continuous, avoid interruptions
- Computational requirements are large, strategize methods
- Attention to Network bandwidth (both from sites and to system operators), can you deliver the forecast if complex

Advanced Solar and Load Forecasting

In Summary ...

- **Sky Imager Network:** developed method to site imagers, stitch imagery, produced nowcasts for 0 -10 minutes out, 18 mos. data obtained, forecasts revealed improvement compared w/persistence based
- **Modeling Systems –WRF Solar:** Gridded forecasts of global horizontal irradiance (GHI) & other meteorological parameters at 3 kM grid spacing, 15 min. output across NYS at both nowcasting (0-6 H) & day-ahead times. Python scripts developed to enable future leveraging deployment for NYS
- **Modeling Systems- Blended Forecast:** Predict clearness index for single point using meteorological observations – leads to GHI calc for day-ahead which is a blend of WRF-solar & High-Resolution Rapid Refresh (HRRR)
- **Solar Power Forecast:** Power generation forecasts were provided giving % power output for PV asset. Methodology produced gridded forecasts of % power on 3 kM horizontal spacing at 15 min. output across NYS at both nowcasting & day-ahead times. % Power forecasts are configured for selected utility scale solar plants
- **Integration into Operations:** Aligned methods w/power system operations, particularly NYISO. Data streams were setup discovering potential challenges, le. Network bandwidth
- **Forecast Evaluation:** Forecasts were validated and shown to perform expectedly, they were able to provide the basis for further commercialization. Comparable accuracy to existing reference forecasts

Questions ??

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