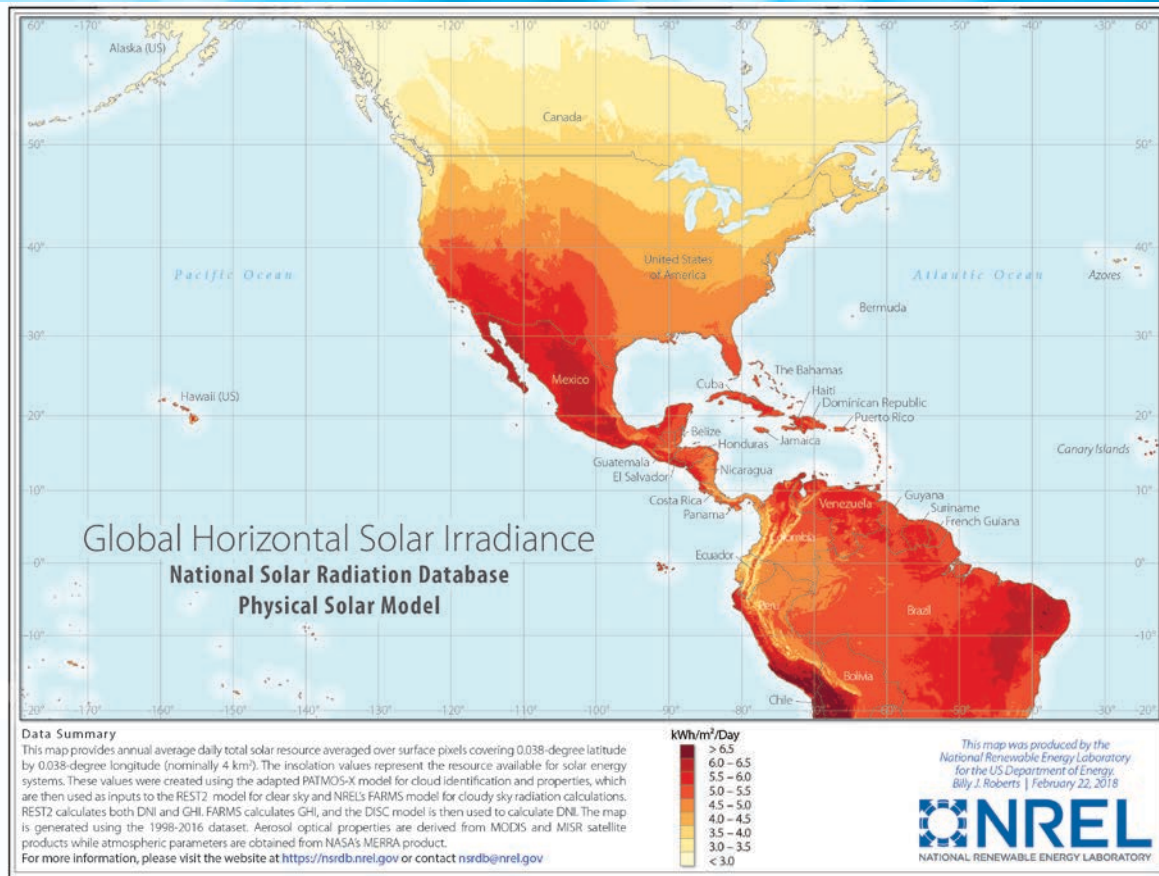


Improving the Accuracy of the National Solar Radiation Database (NSRDB) Using High-Resolution Data



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100th AMS Annual Meeting, January 12–16, 2020, Boston,
Massachusetts

Solar Resource Assessment

Support the U.S. Department of Energy (DOE) Solar Energy Technology Office to reduce the costs of solar deployment and financing by improving accuracy in solar resource measurement and modeling.

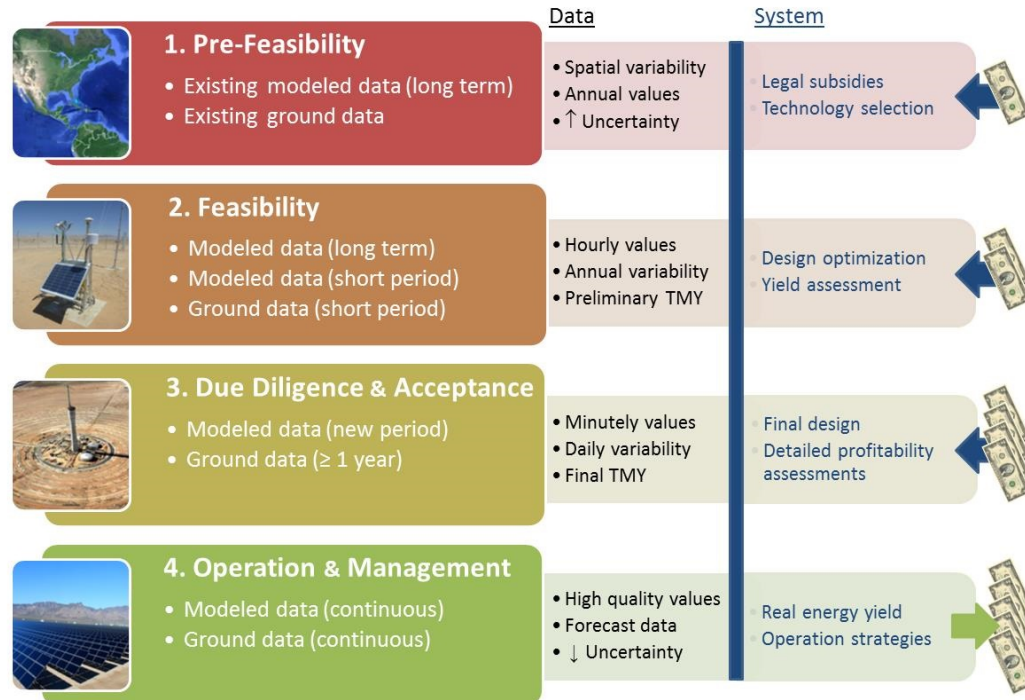
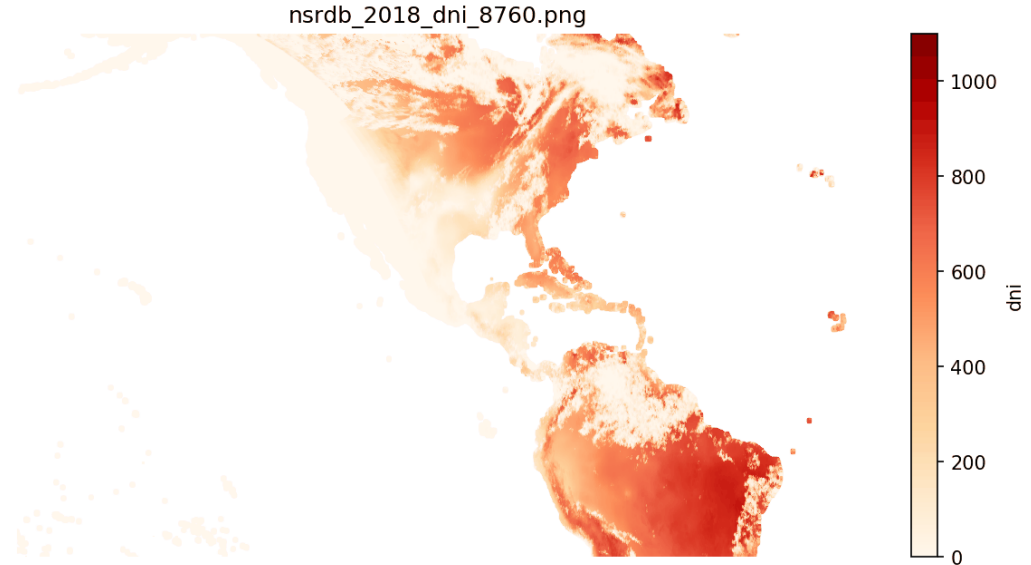


Figure from <https://www.nrel.gov/docs/fy18osti/68886.pdf>

National Solar Radiation Database Project

- Develop state-of-the-art models and create high-quality long-term solar resource data for the United States and distribute it via the **National Solar Radiation Database (NSRDB)**

Satellite-based irradiance modeling

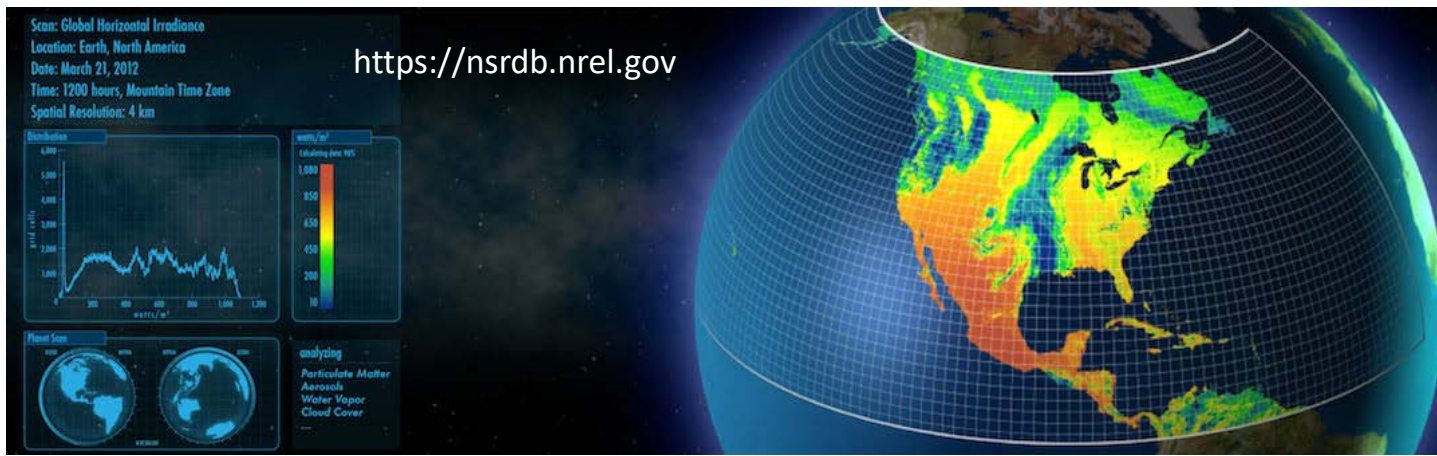


NSRDB:

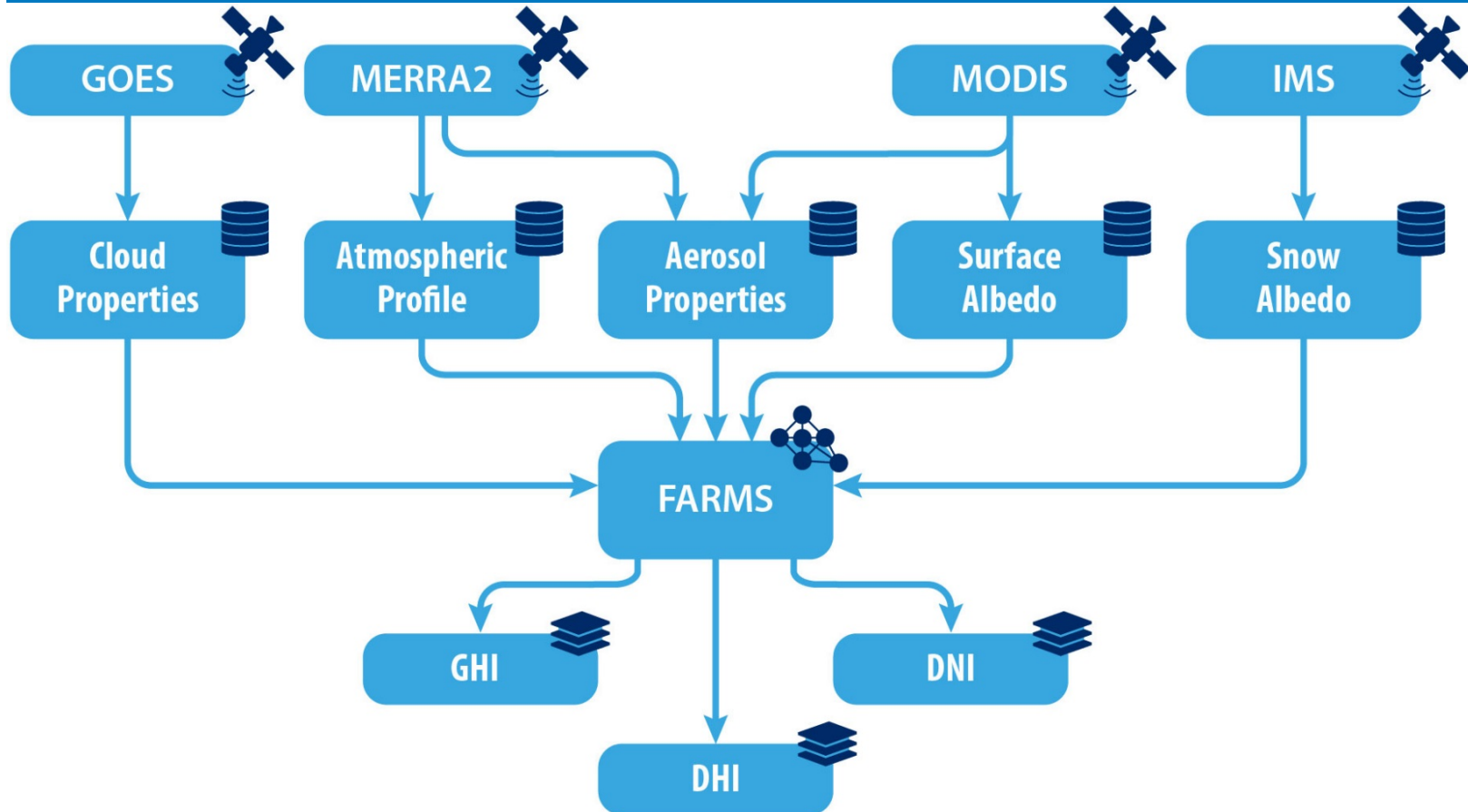
<http://nsrdb.nrel.gov>

What Does the National Solar Radiation Database Provide?

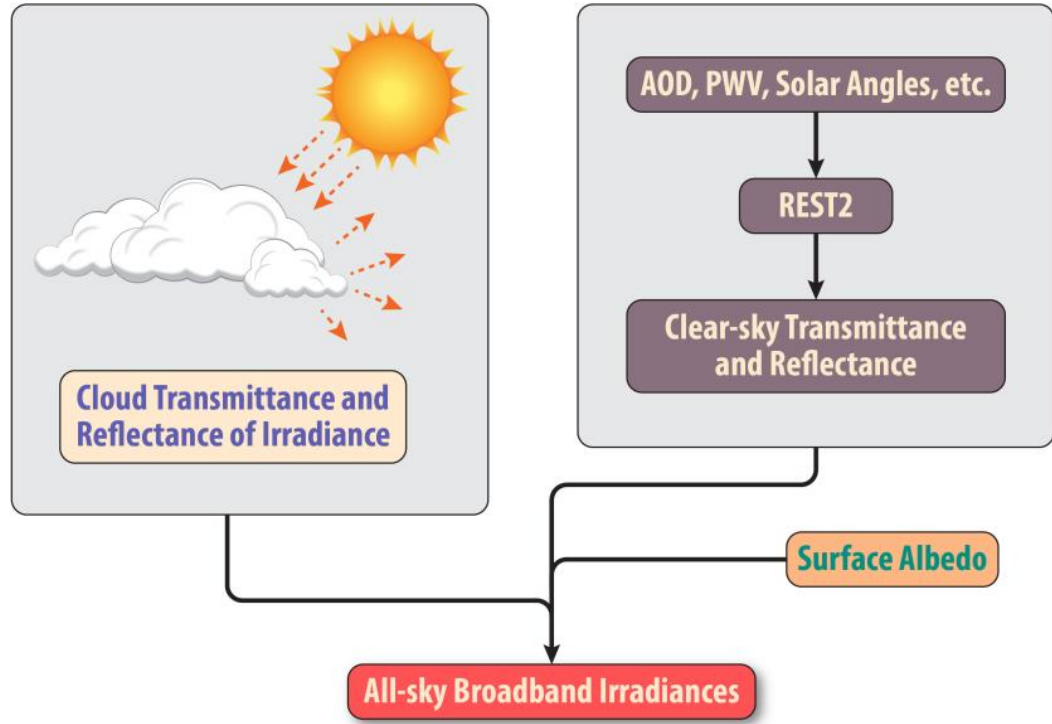
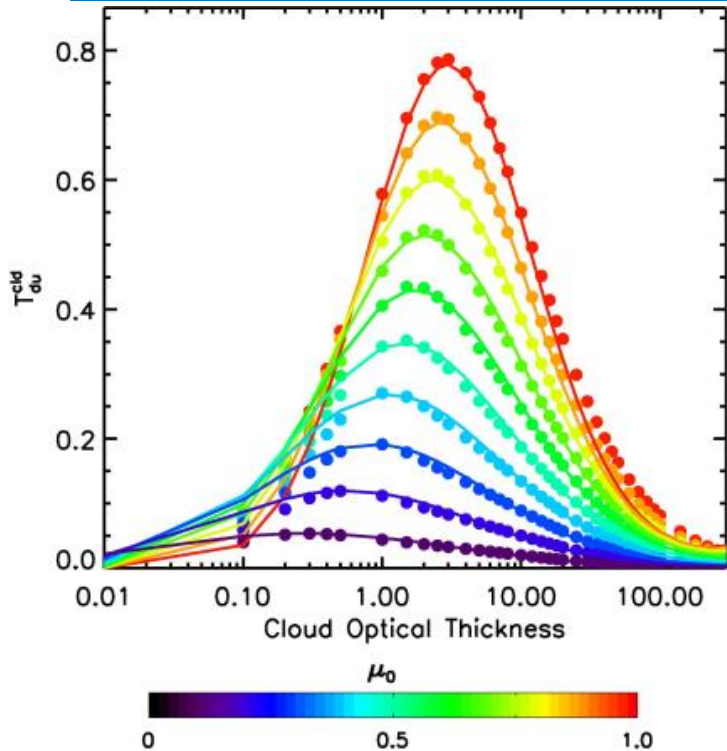
- The NSRDB seeks to advance our knowledge of solar radiation and its applications for renewable energy and beyond.
- The NSRDB provides a serially complete database of solar irradiance and meteorological information across the United States and in an increasing number of international locations.
- The NSRDB provides **21 years** (+ typical meteorological year) of half-hourly data at a 4-km by 4-km spatial resolution. Five-minute 2-km data are also available from 2018.
- The NSRDB uses a physics-based model, the Physical Solar Model (**PSM**).



National Solar Radiation Database: Physical Solar Model Workflow



Fast All-Sky Radiation Model for Solar Applications (FARMS)



Cloud transmittances can be parameterized as exponential functions of cloud optical thickness and solar zenith angles.

Validation of 2018 High-Resolution National Solar Radiation Database Data

Validation criteria:

1. Solar zenith angles must be less than 80° .
2. Irradiance must be greater than zero for both GHI and direct normal irradiance.
3. Data records with missing values from the surface measurements will be excluded from both the surface measurements and NSRDB data sets.

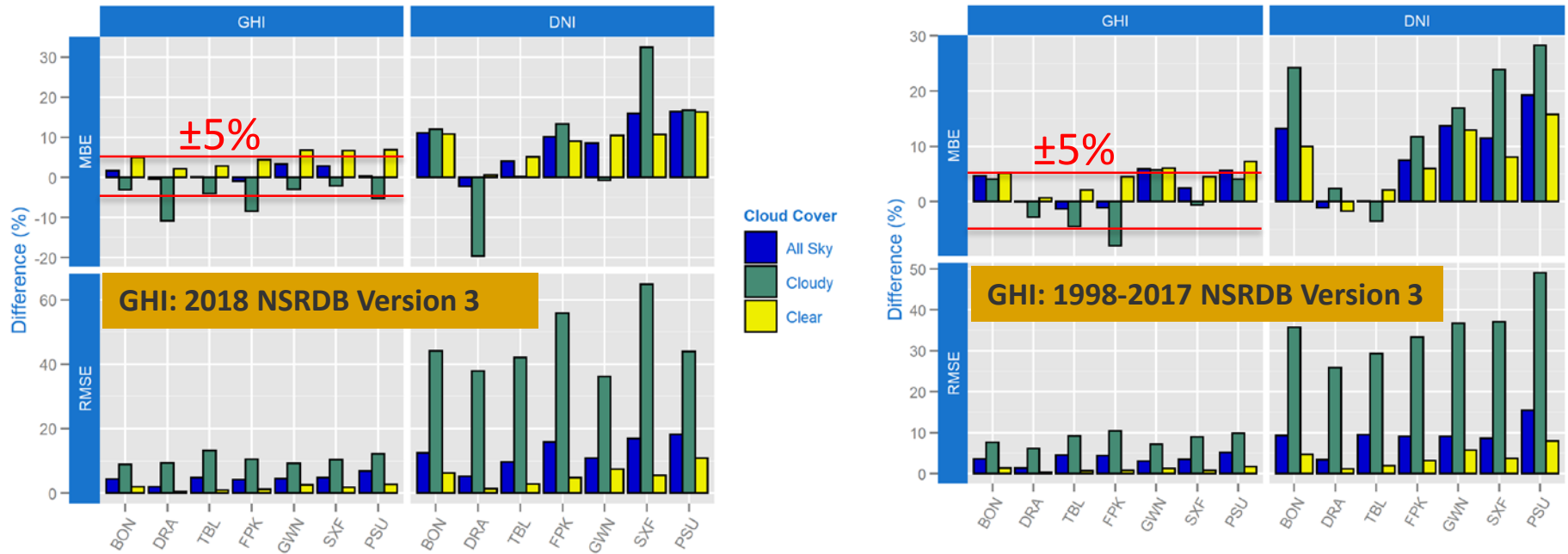
Clear and cloudy Identification:

1. Cloud types from the satellite data were used to determine sky conditions.

Time averaging:

1. Time averages of the ground measurement (5 minutes)
2. Take half before and half after of the averaging time.

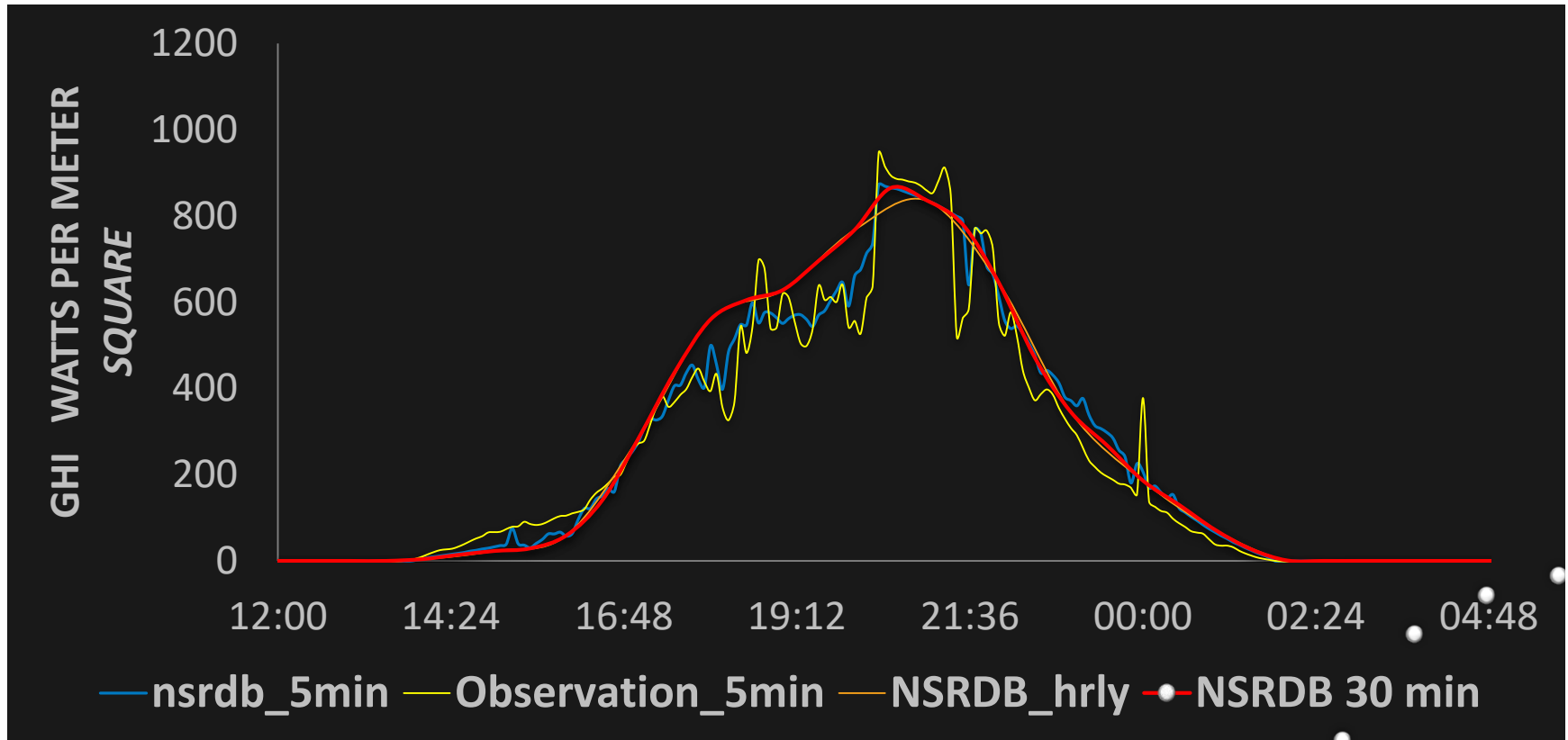
Cont. Validation of 2018 High-Resolution National Solar Radiation Database Data



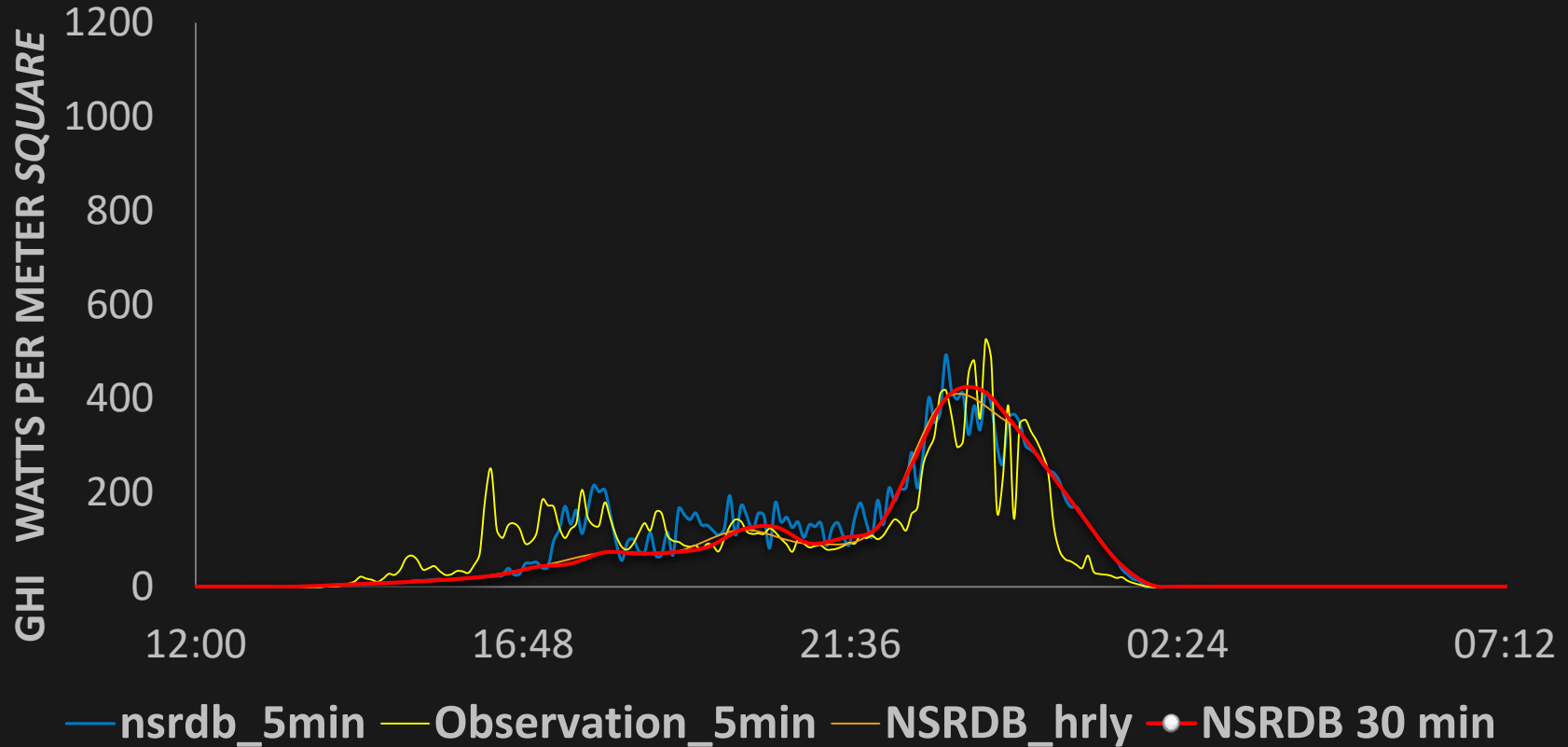
Difference between the two versions:

- 2018 NSRDB data are every 5 min and 2-km by 2-km and new satellite: Geostationary Operational Environmental Satellite 16 (GOES-16)
- 1998–2017 NSRDB data are every 30 min and 4-km by 4-km

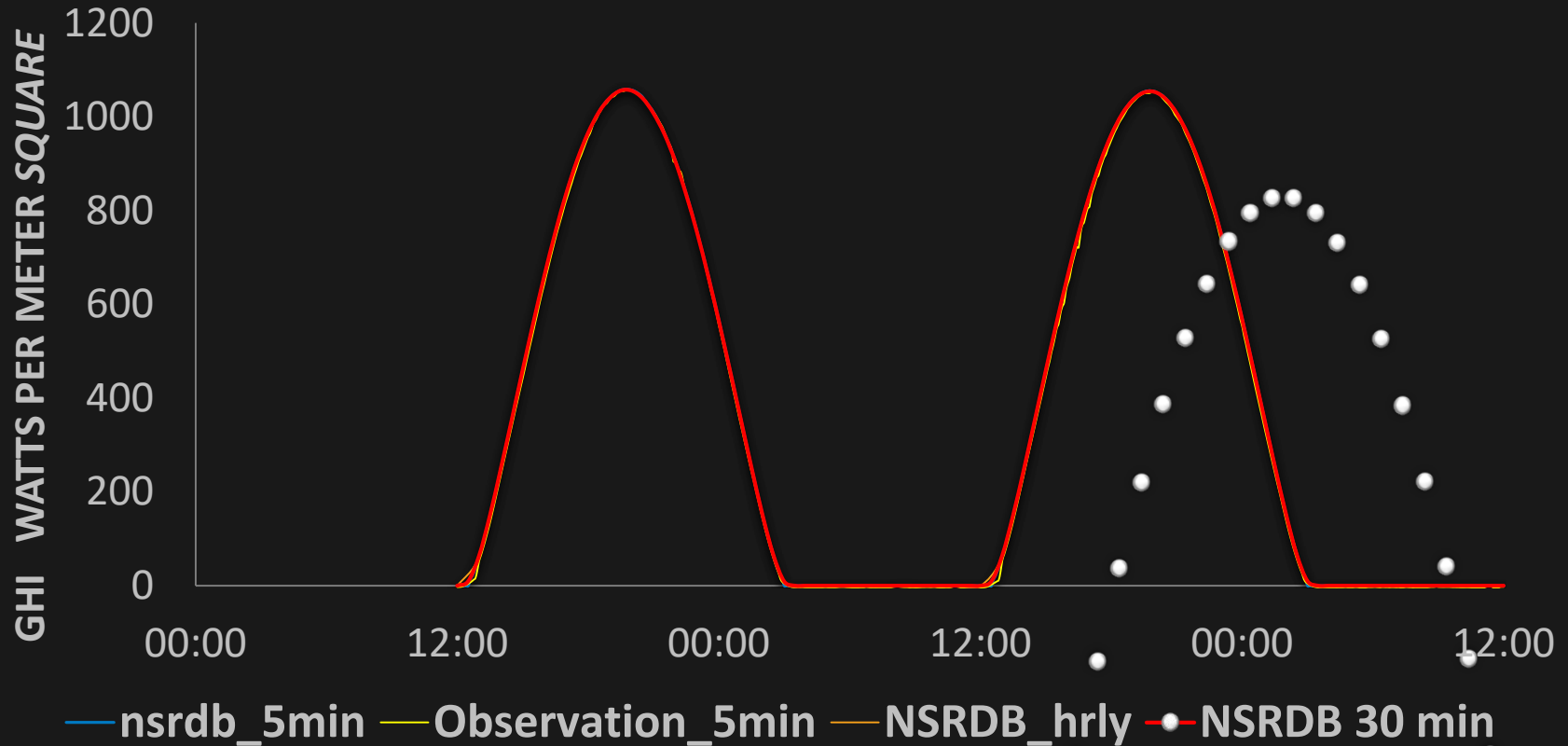
Desert Rock: March 20, 2018



Desert Rock: March 22, 2018



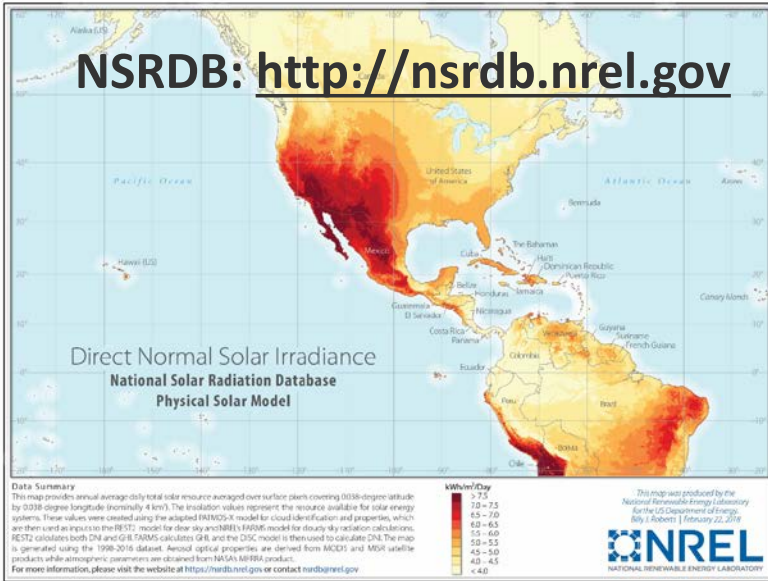
Desert Rock: June 19–20, 2018



Conclusion and Future Work

- High-resolution cloud properties at 2-km resolution are available from 2018 for GOES-16.
- The solar radiation calculated using GOES-16 cloud properties is of high accuracy when compared with ground measurements.
- The variability and ramps in solar radiation are better observed using the GOES-16 data.
- The solar radiation estimates are highly accurate in clear-sky situations, indicating that the aerosol optical depths from Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) are of high quality.
- The 5-minute data are available from AWS, whereas 21 years of 4-km, 30-minute data are available from the NSRDB website and through API downloads.
- Spectral data are also available for download from the NSRDB website.
- Future efforts will focus on representing partly cloudy situations using 500-m satellite data to estimate cloud fraction.

NSRDB: <http://nsrdb.nrel.gov>



Thank You!

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