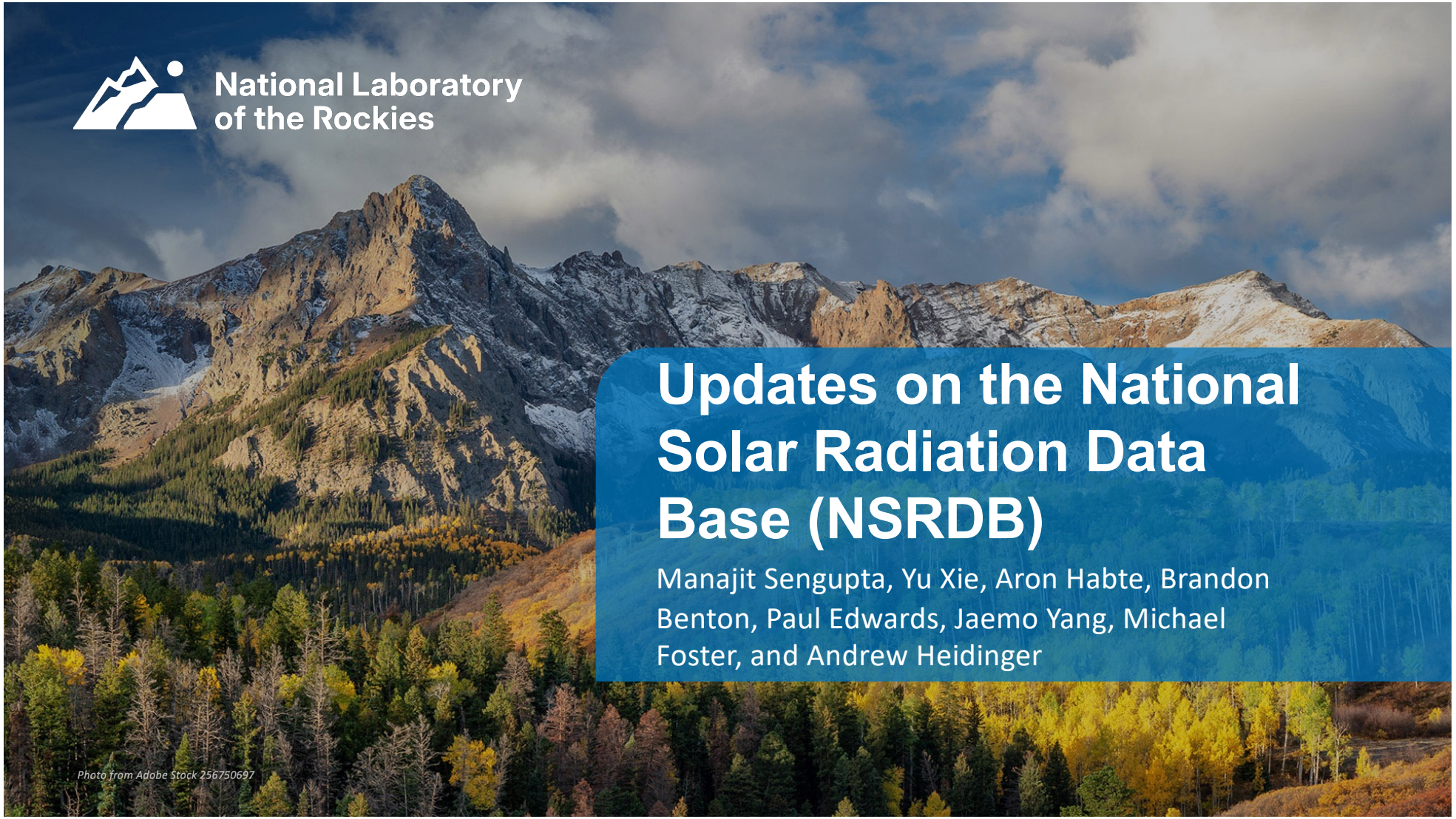
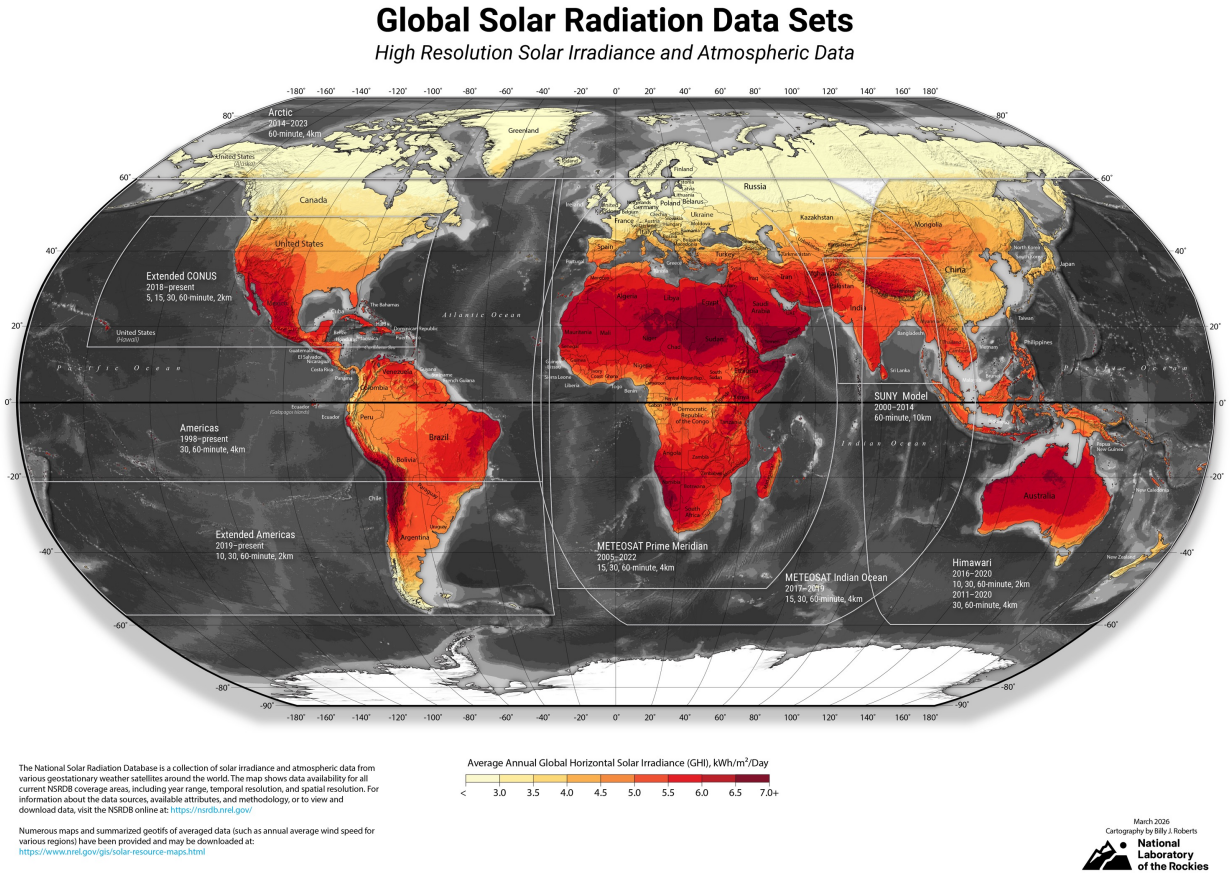


Updates on the National Solar Radiation Data Base (NSRDB)

Manajit Sengupta, Yu Xie, Aron Habte, Brandon Benton, Paul Edwards, Jaemo Yang, Michael Foster, and Andrew Heidinger

The National Solar Radiation Data Base (NSRDB)

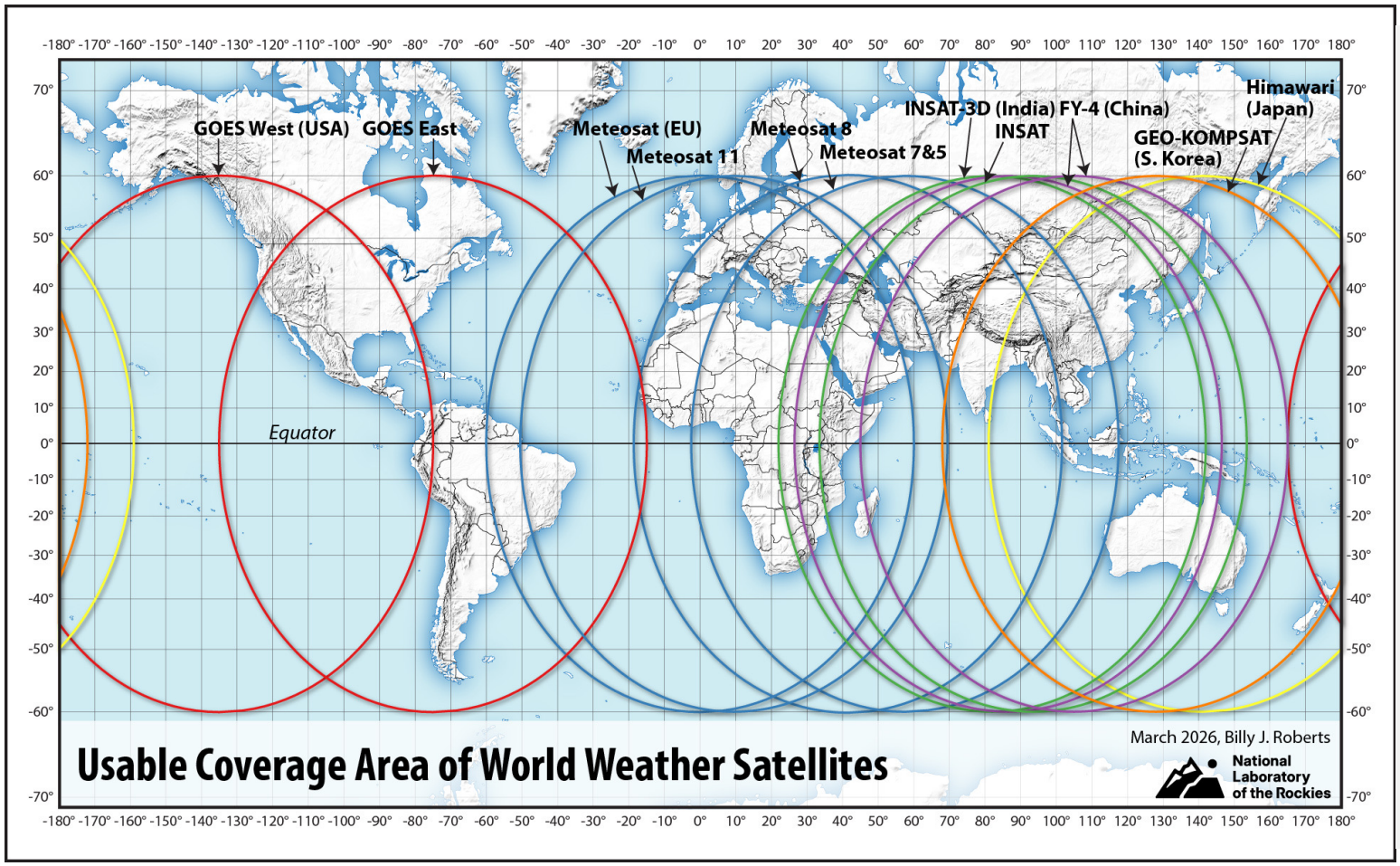


The National Solar Radiation Database is a collection of solar irradiance and atmospheric data from various geostationary weather satellites around the world. The map shows data availability for all current NSRDB coverage areas, including year range, temporal resolution, and spatial resolution. For information about the data sources, available attributes, and methodology, or to view and download data, visit the NSRDB online at: https://nsrdb.nrel.gov/

Numerous maps and summarized geotifs of averaged data (such as annual average wind speed for various regions) have been provided and may be downloaded at: https://www.nrel.gov/gis/solar-resource-maps.html

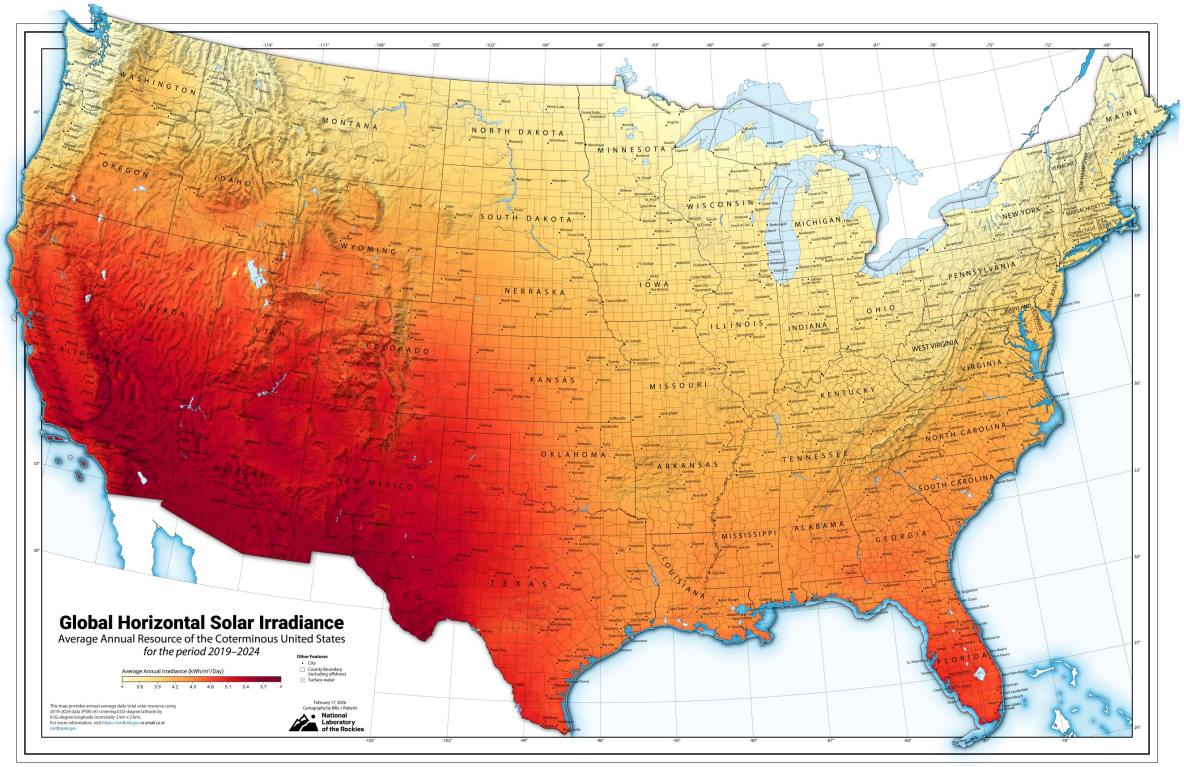
- Public-open data for solar radiation.
- Supports over 400,000 active users.
- Based on the physical solar model (**PSM v4**) with satellite observations.
- Cloud retrievals input into FARMS to compute all-sky solar radiation.

Advantages of PSM



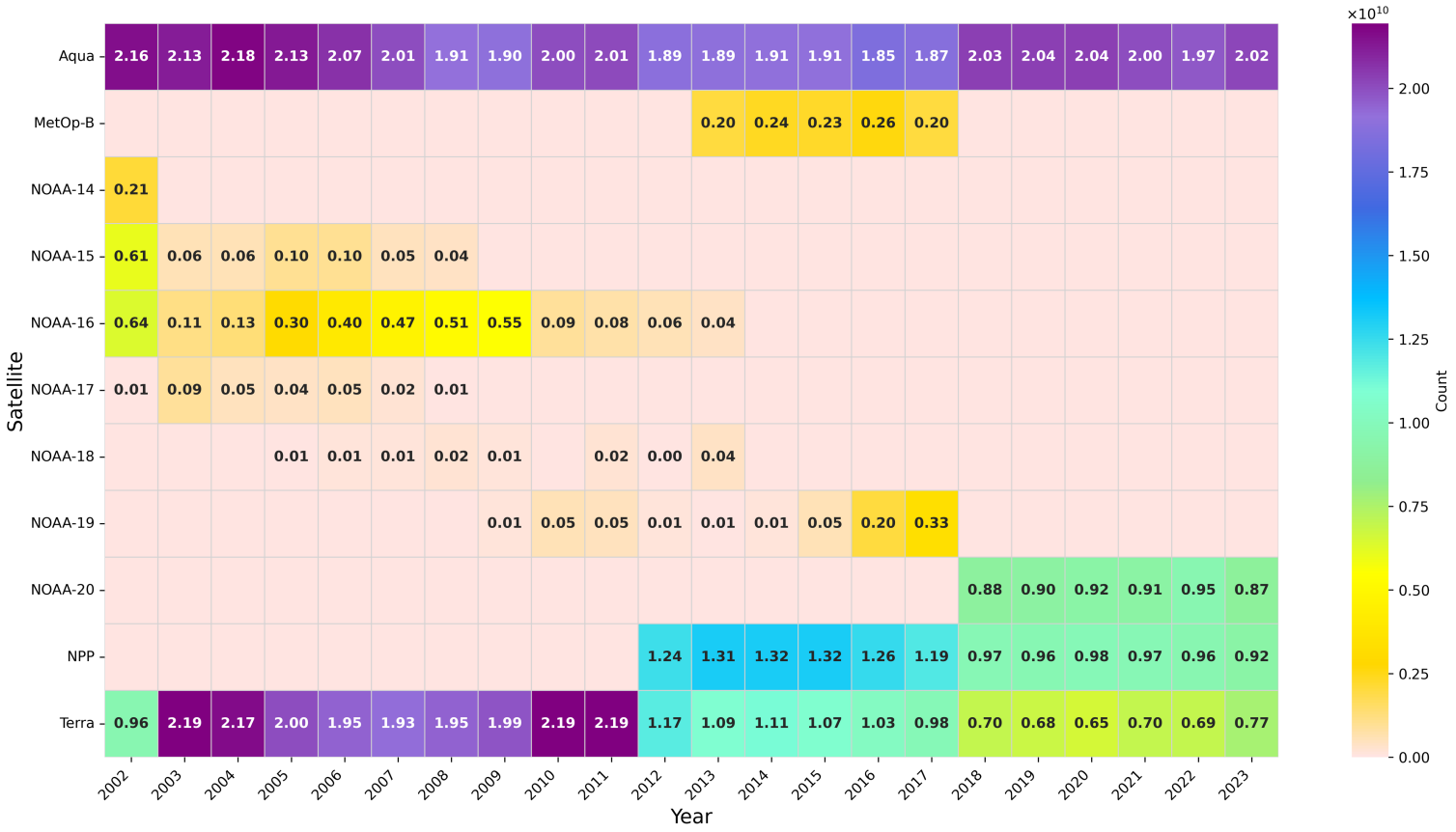
- Consistent performance for satellites and regions using PSM.
- Limited surface data constrain AI-based models.
- Integrated multi-source framework allows for continuous improvements.

Updates in PSM v4



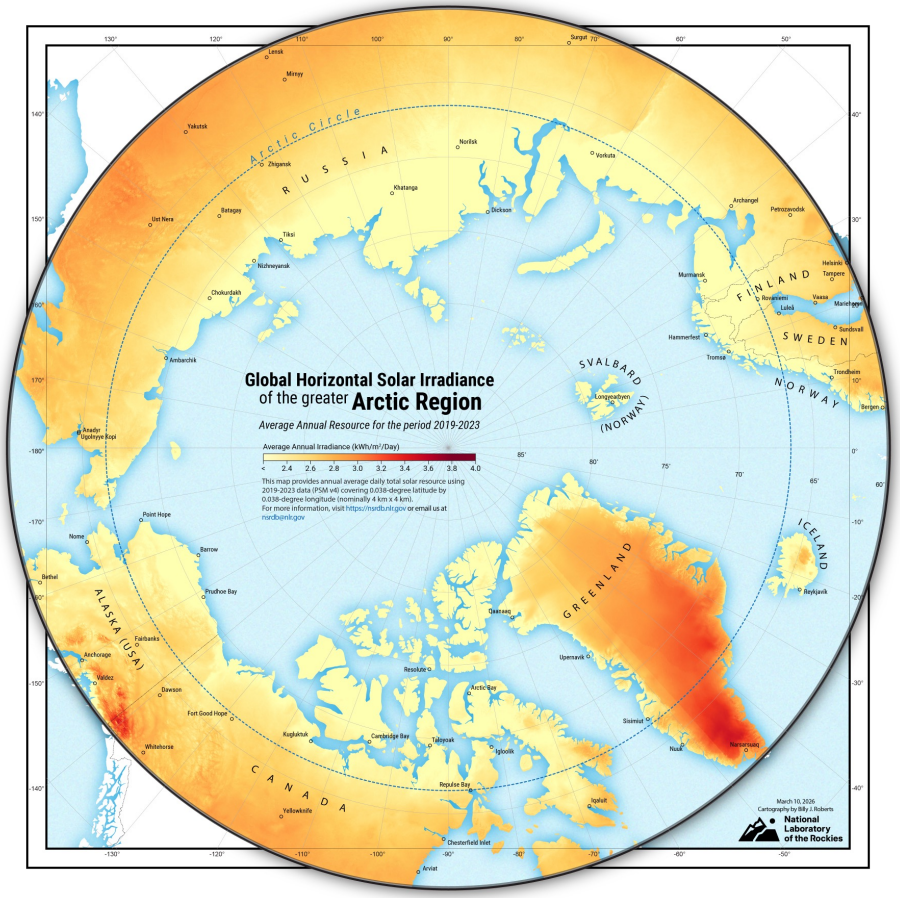
- Parallax correction for cloud location, cloud shading and remapping.
- Gap-filling of missing cloud properties.
- New algorithm for snow-albedo based on surface temperature.
- Spectral mismatch factors for common PV technologies.
- Use FARMS-DNI for DNI data.

Satellite data for NSRDB Polar



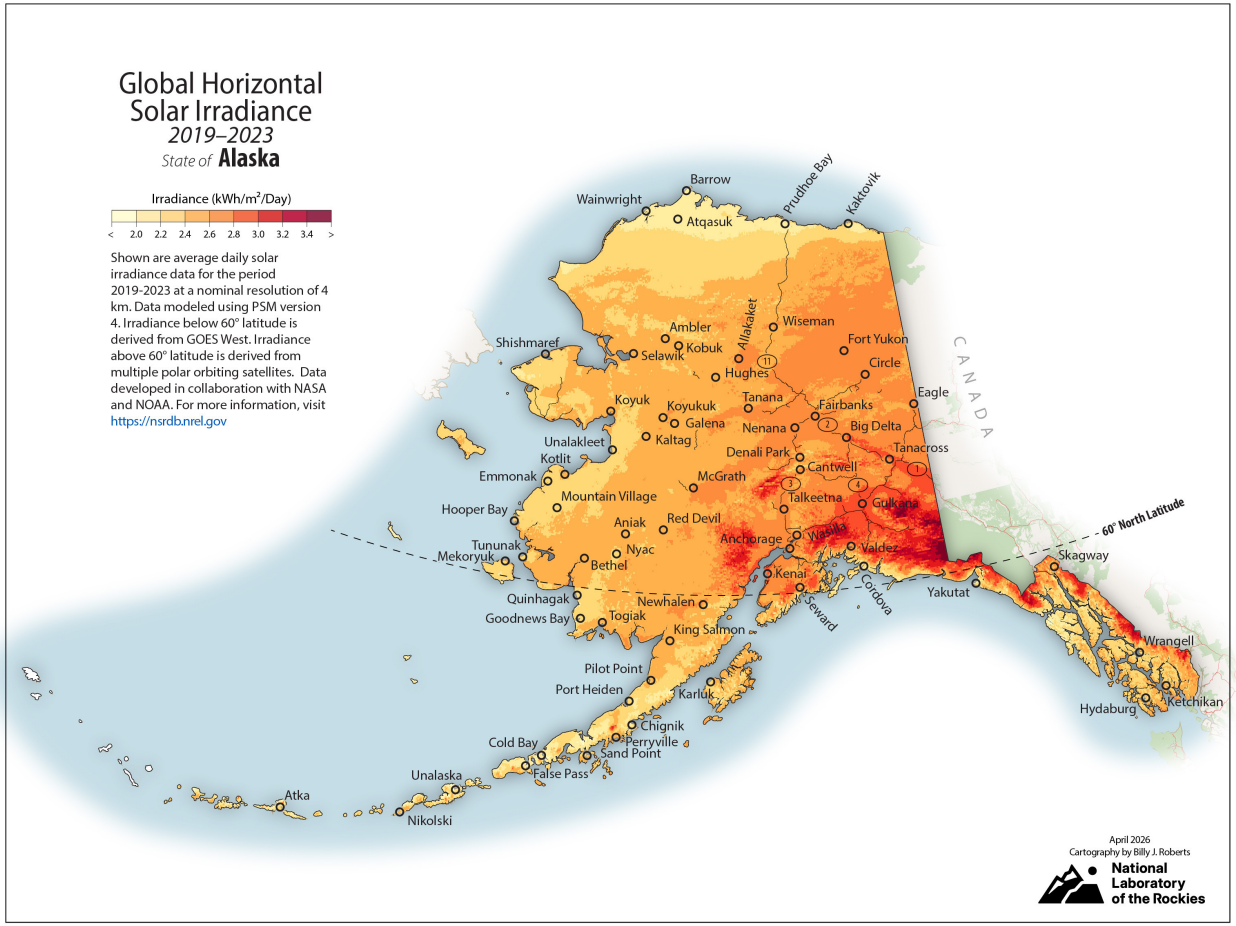
- GEO satellites lack coverage in high-latitude regions.
- Polar-orbiting satellites have more frequent observations in Arctic.
- Constellations of polar satellites provide continuous Arctic data.

NSRDB Polar data (2002-2023)



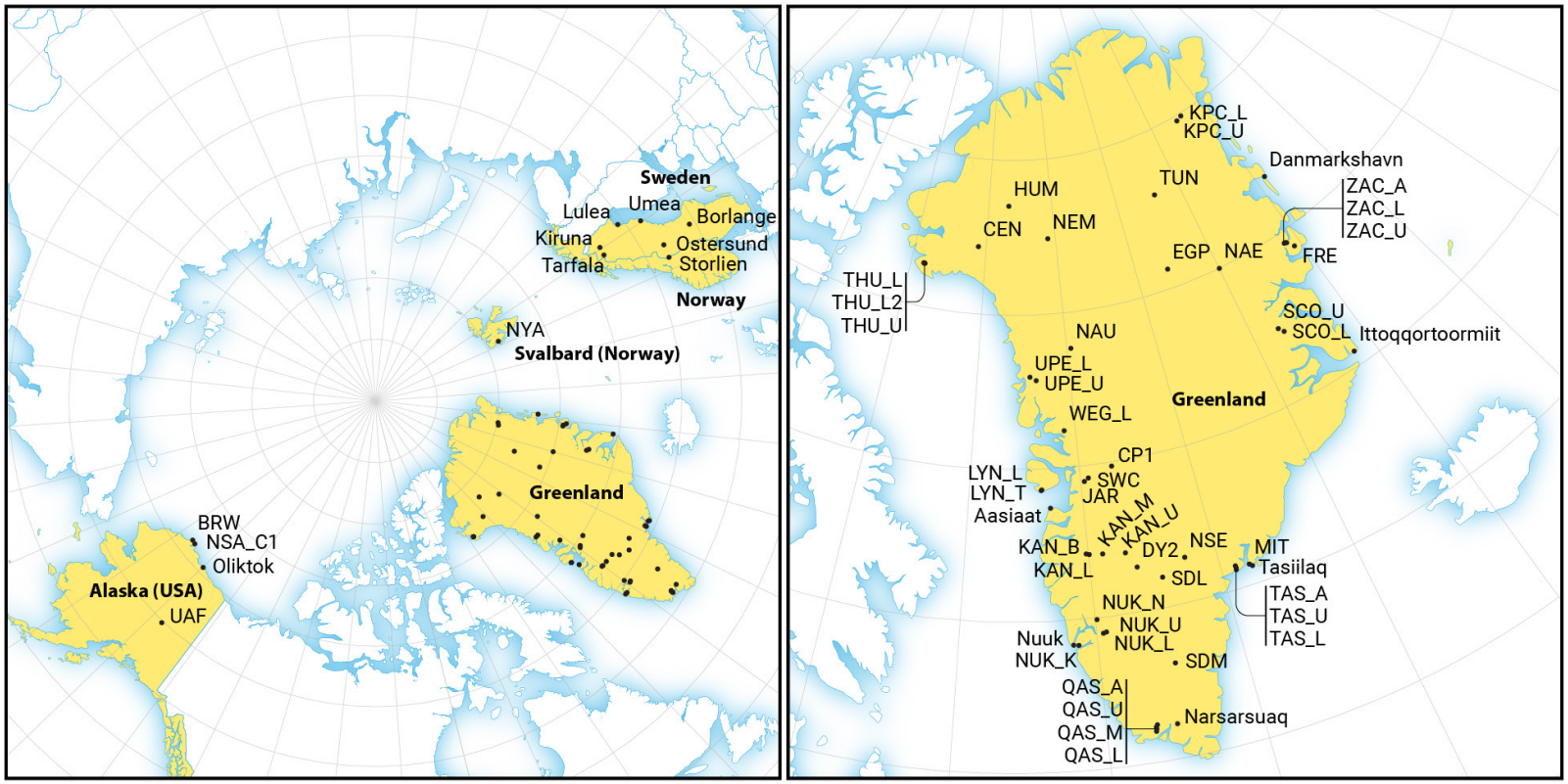
- The hourly, 4 km resolution NSRDB Polar data are developed for the entire Arctic region.
- The data for 2013-2023 were made publicly available in September 2025.
- Data for 2002-2012 and 2024-2025 will be made available by September 2026.
- Specific Arctic regions show significant solar potential.
- High-pressure system dominates Greenland and causes high solar radiation.

NSRDB Polar data for Alaska



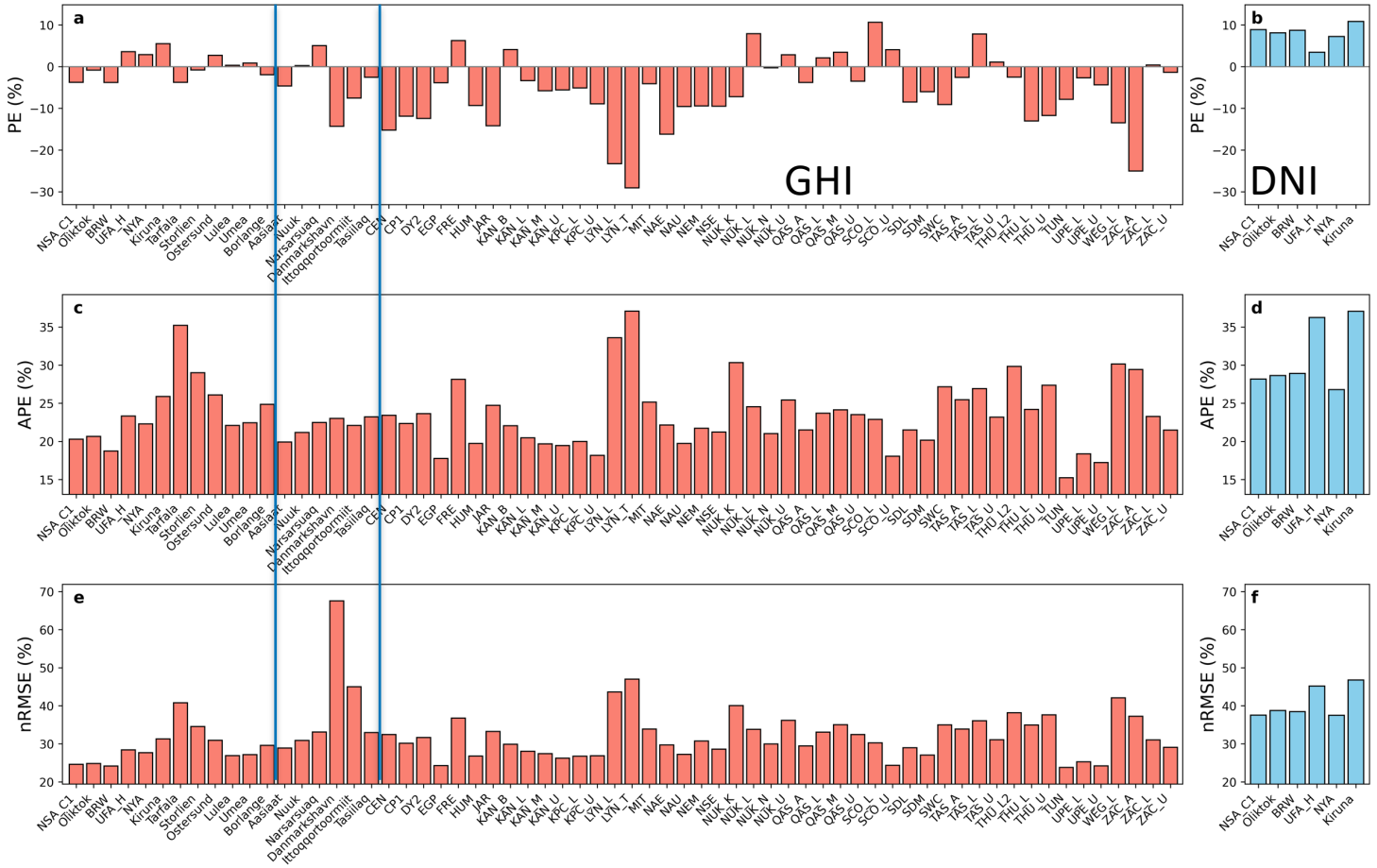
- Full coverage of Alaska based on **NSRDB Polar data** (north of 60º N) and the **CONUS data** (south of 60º N).
- Smooth transition around 60º N
- NSRDB Polar data are consistent with GEO-based solar radiation.

Validation data for NSRDB Polar



- 12 non-Greenland sites.
- 6 Greenland sites from DMI and 46 Greenland sites from PROMICE.

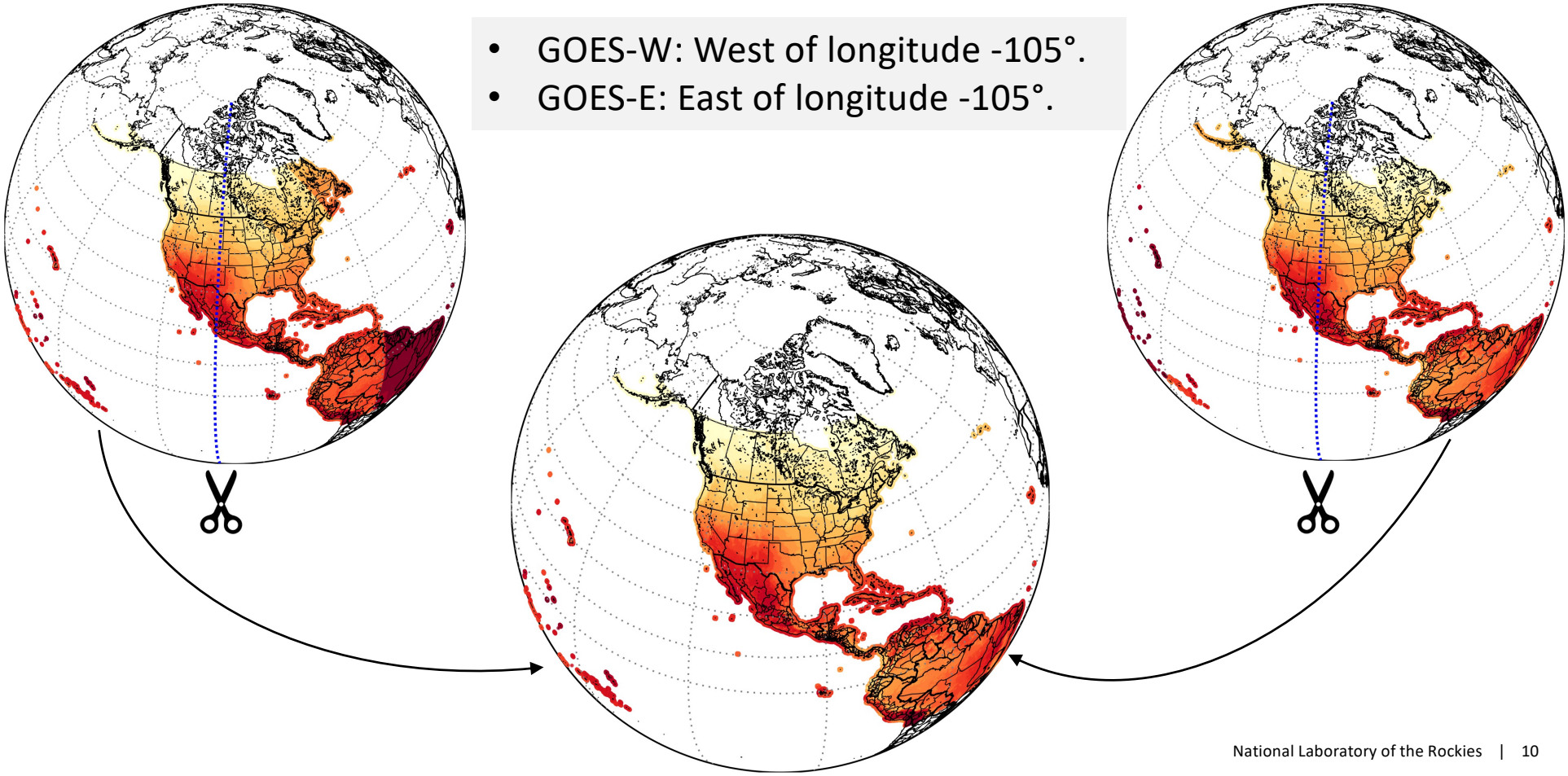
Validation of NSRDB Polar



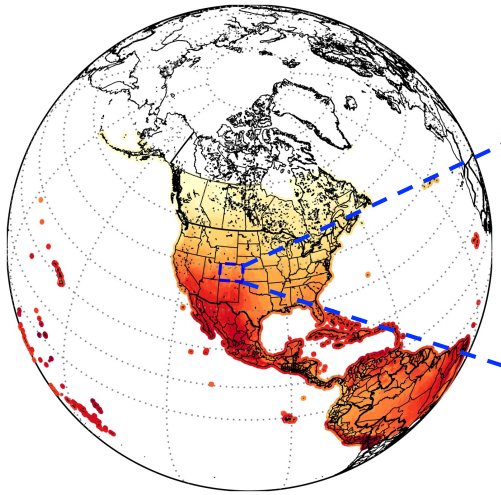
- **Non-Greenland sites (left columns):** the accuracy of NSRDB Polar is comparable to the CONUS data.
- **Greenland (mid and right columns):** systematic underestimation of GHI.

The current strategy for blending GOES data

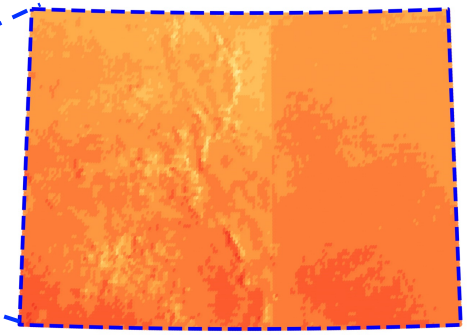
- GOES-W: West of longitude -105°.
- GOES-E: East of longitude -105°.



Data using new blending algorithm

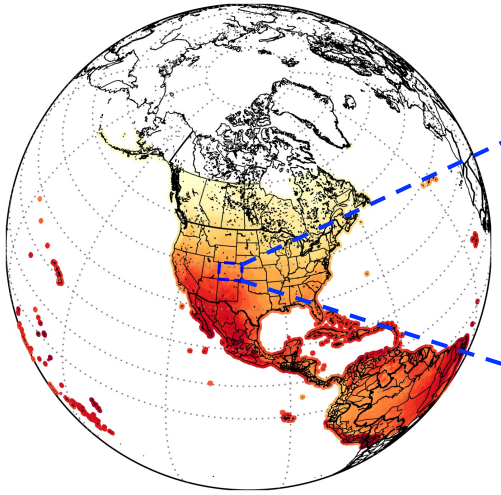


Current NSRDB

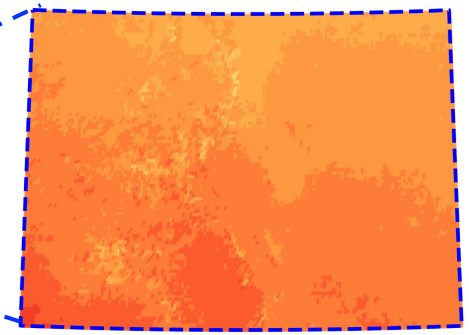


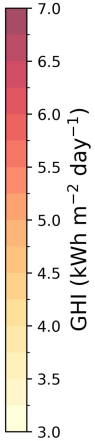
- A boundary seam in the current NSRDB where GOES-W and GOES-E data are merged.
- Variation in satellite calibration and viewing angles.

- A strong dependance of bias on scattering angle.
- A new blending model reduces the bias in the data.



New Data





Future work

- Updates on models and input data.
- Inclusion of precipitation
- NSRDB Polar data for 2002-2025.

- Cloud fraction in the computation.
- Apply the new blending model.
- Application of AI to improve early morning and later afternoon cloud properties and solar radiation.

https://nsrdb.nlr.gov