TEMPO Near UV Aerosol Algorithm (TEMPOAER)

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TEMPO DART Team Meeting
University of Iowa
Iowa, City
June 15-18, 2026

TEMPO UV Aerosol Algorithm (TEMPOAER) Version 1.1.2

- Development Team : Omar Torres (NASA/GSFC), Changwoo Ahn (ADNET), Hiren Jethva (MSU)
- Heritage: N7 & EP TOMS, Aura OMI, DSCOVR EPIC, S5P TROPOMI, and PACE OCI
- TEMPOAER V 1.1.0 delivered to SAO for test runs within the TEMPO production lines.

- **Input data :**
  -TEMPO L1B radiance and irradiance measurements
  -Radiative Transfer Look-up Tables

  Ancillary data:
  - Level-2 GOES-19 ABI Aerosol/Cloud Mask CONUS (ACMC)
  - Near UV Monthly surface Lambert equivalent reflectivity climatologies
  - Hourly averaged GEOS Composition Forecast CO
  - OMI-based monthly single scattering albedo climatology (for ACAOD product)
  - CALIOP Aerosol Layer Height Climatology (back-up info when O2B ALH retrieval not available)

- **Intended products:**
  - UV Aerosol Index (UVAI) (354/388 and 340/388 pairs)
  - Collocated GOES ABI Aerosol/Cloud Mask
  - O2B Aerosol Layer Height & AOD at 680 nm
  - Aerosol Optical Depth (AOD) at 354, 388 and 500 nm
  - Single Scattering Albedo (SSA) at 354, 388 nm
  - ACAOD, AOD over clouds at 354, 388 nm, 500 nm
  - Aerosol-corrected Cloud Optical Depth (COD)

- Output file format : NetCDF with global/field–level attributes (9 hourly granules per scan)
- L2 file size (compressed) : about (80) Mb (720 MB per scan)

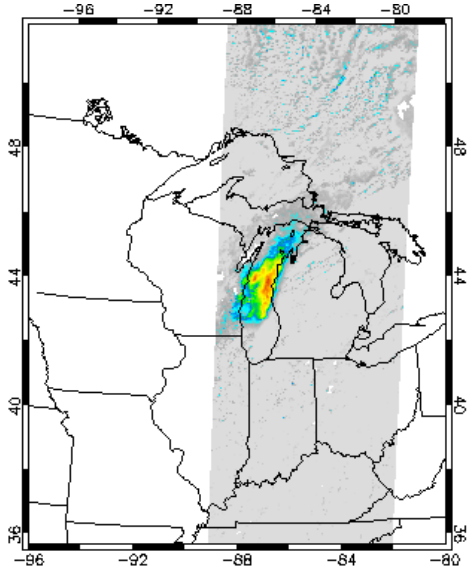
Preliminary Calibration: UV Aerosol Index Considerations

1. Ratio of the 354/388 nm reflectances approaches 1.0 close to 1.0 over bright clouds.
2. Over absorbing-aerosol free areas or bright clouds, UVAI be close to 0 +/- 0.5
3. Compare the performances of the ratio against the reflectance 388 of TEMPO with those from OMI, EPIC, TROPOMI and PACE-OCI.
4. Find appropriate adjustment factors for 340 nm and 354 nm through heuristic approaches.

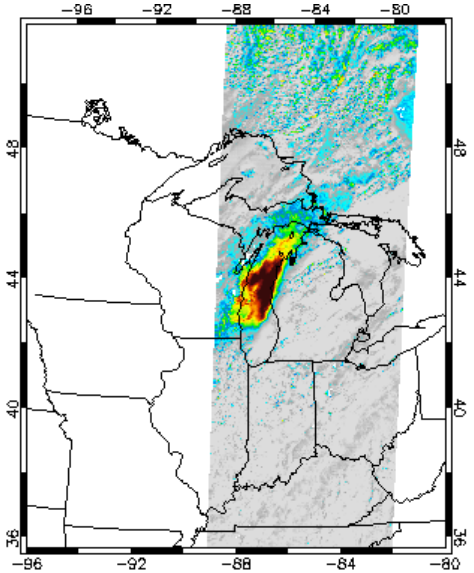
Comparisons of TEMPO UVAI to TROPOMI, EPIC, and PACE UVAI products were carried out.

TEMPOAER UVAI for June 19, 2024 (20:31:26 UTC)

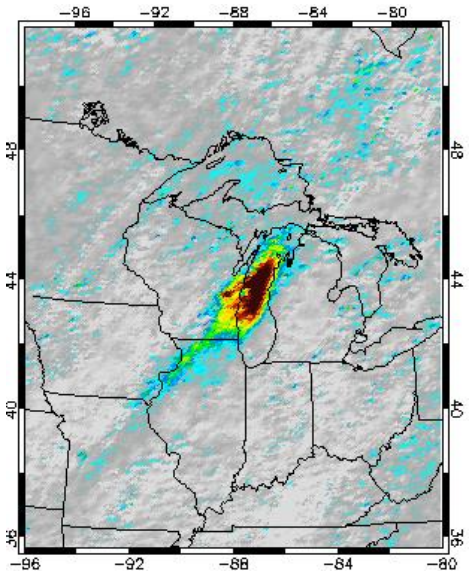
TEMPO UVAI_354/388

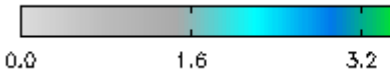


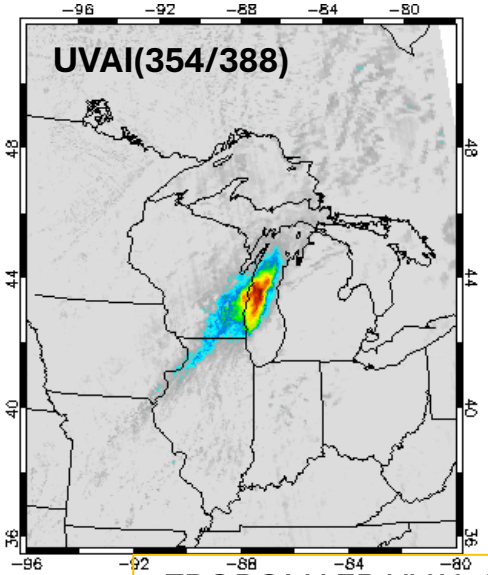
TEMPO UVAI_340/388

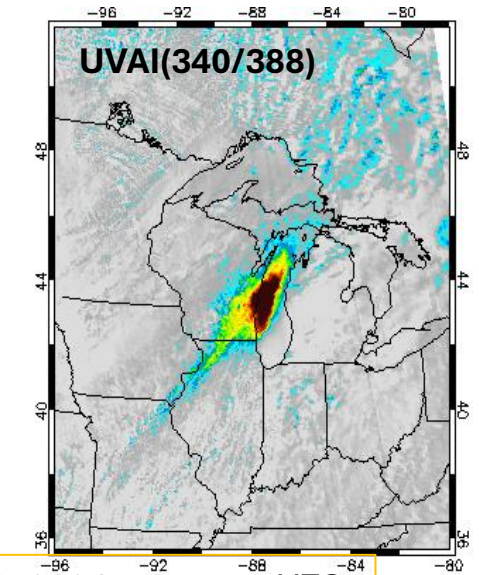


EPIC_340/388
19:56:05 UTC





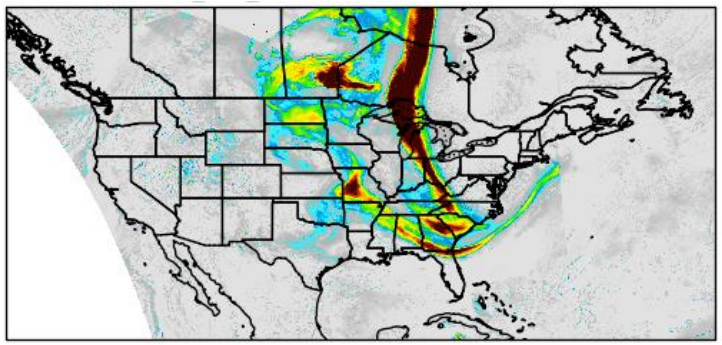


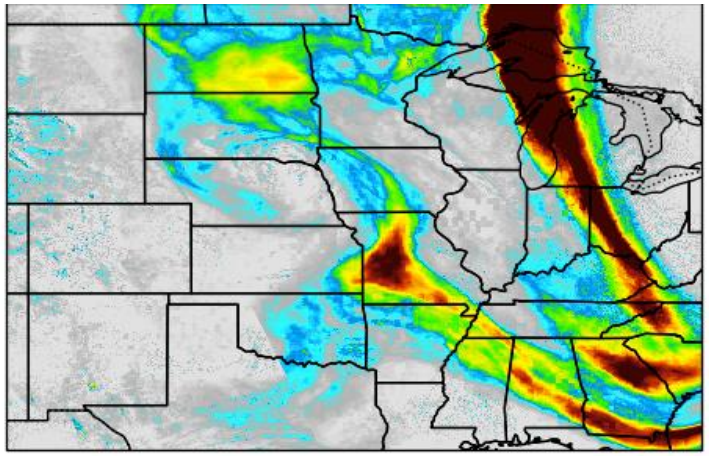


TROPOMAER UVAI, June 19, 2024, 19:15:17 UTC

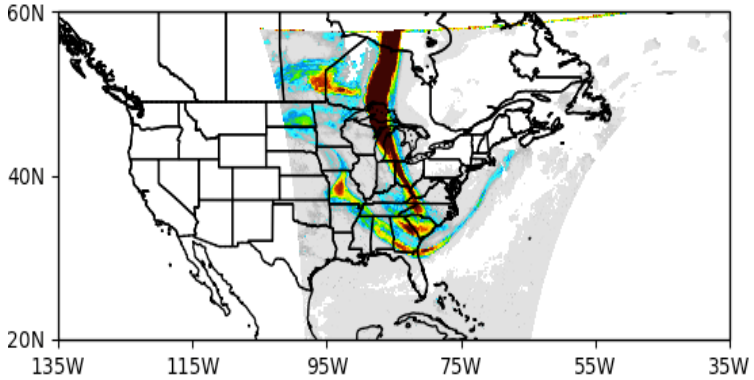
PACE-OCI and TEMPO analysis

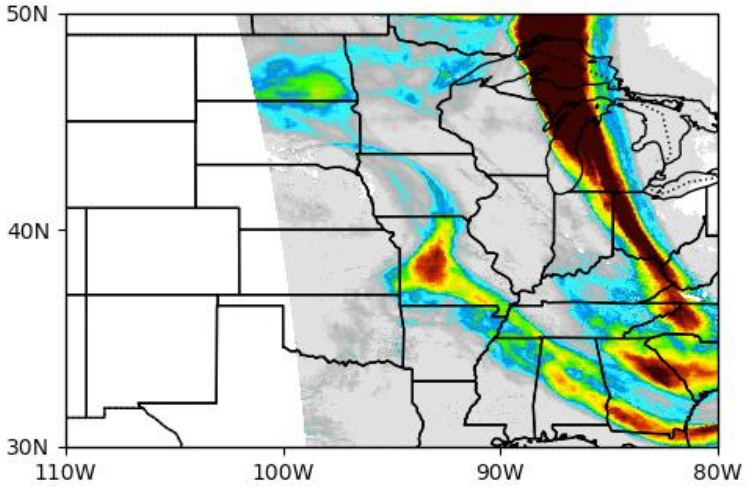
PACE_OCI UVAI for May 31, 2025
06:59:07 ~ 19:50:57 UTC



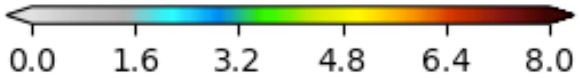


TEMPO UVAI for May 31, 2025
18:14:57 ~ 18:45:19 UTC





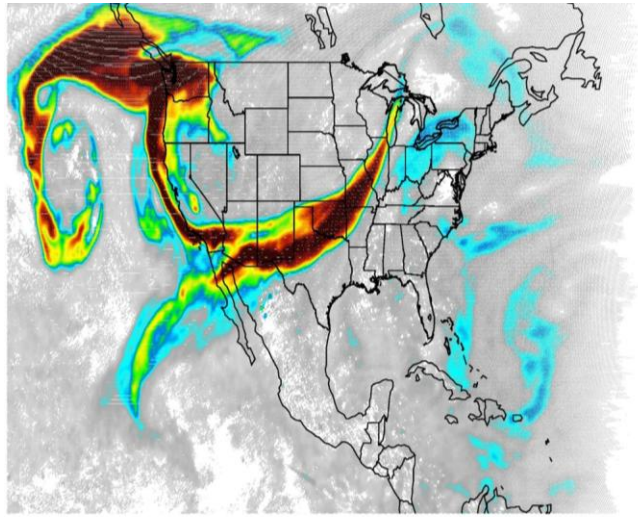
354/388 UVAI

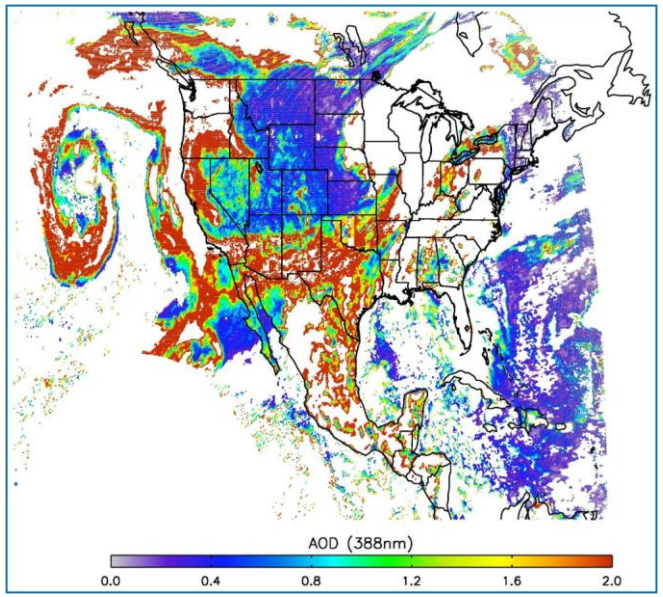


These considerations led to 6% and 2% adjustments to TEMPO measured radiances 340 and 354 nm respectively.

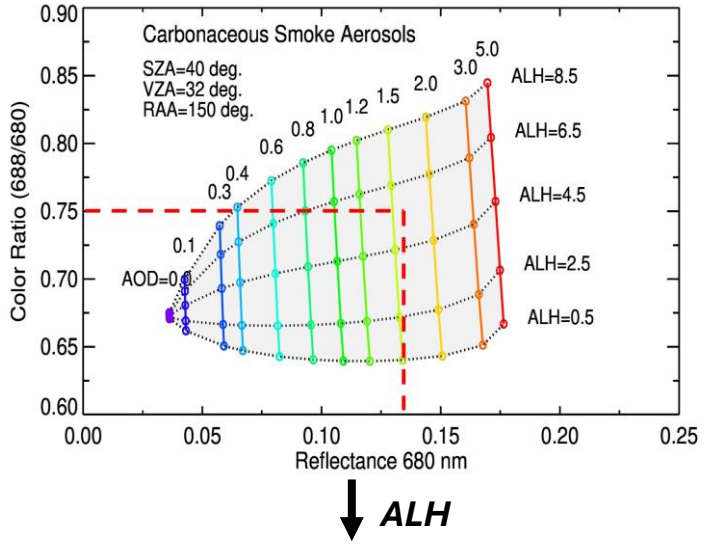
A DSCOVR/EPIC-based TEMPO UV Aerosol Retrieval Algorithm

September 12, 2020

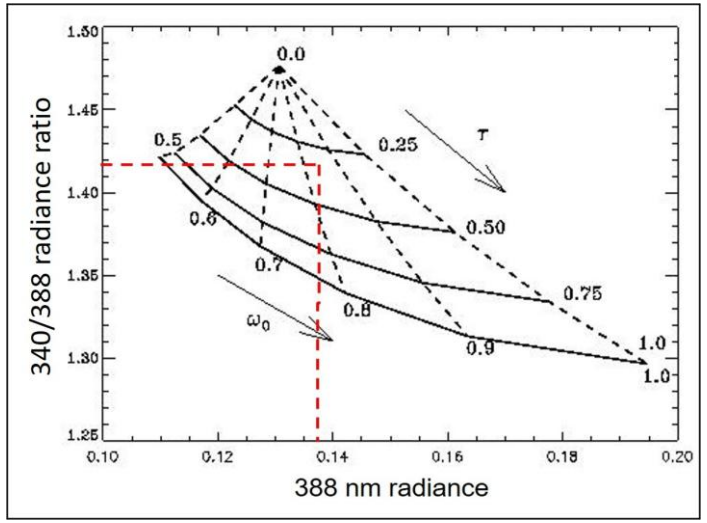




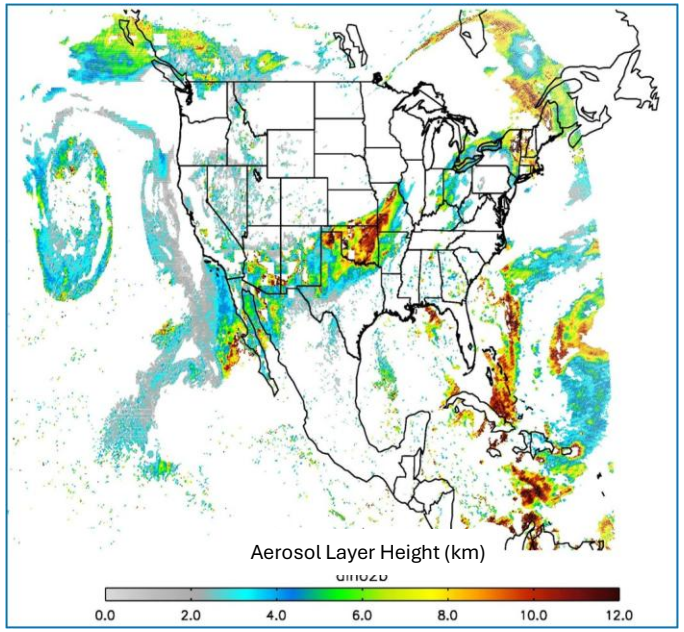
680,688 nm pair is used to simultaneously retrieve ALH nm 680 nm AOD (Xu, et al., 2019)

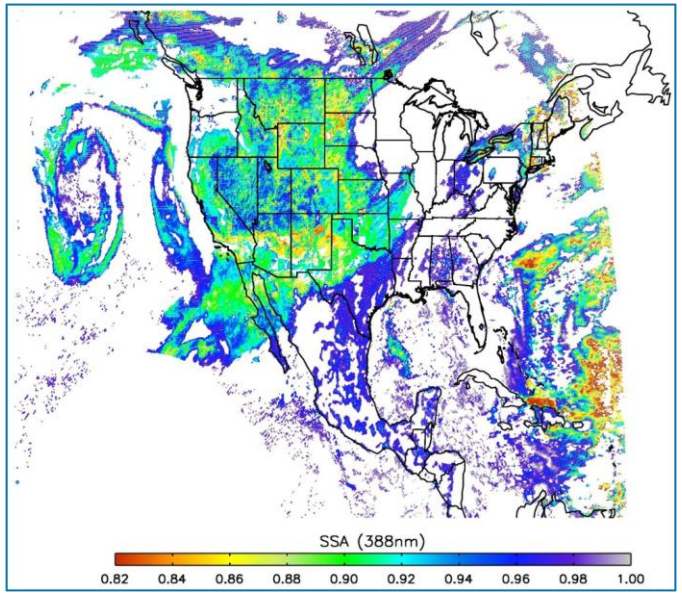


ALH

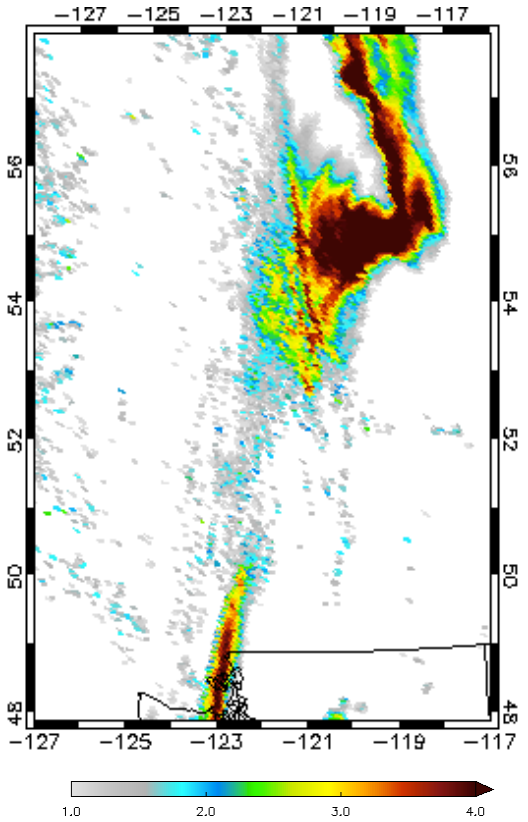


340,388 nm pair is used to simultaneously retrieve 388 nm AOD and SSA

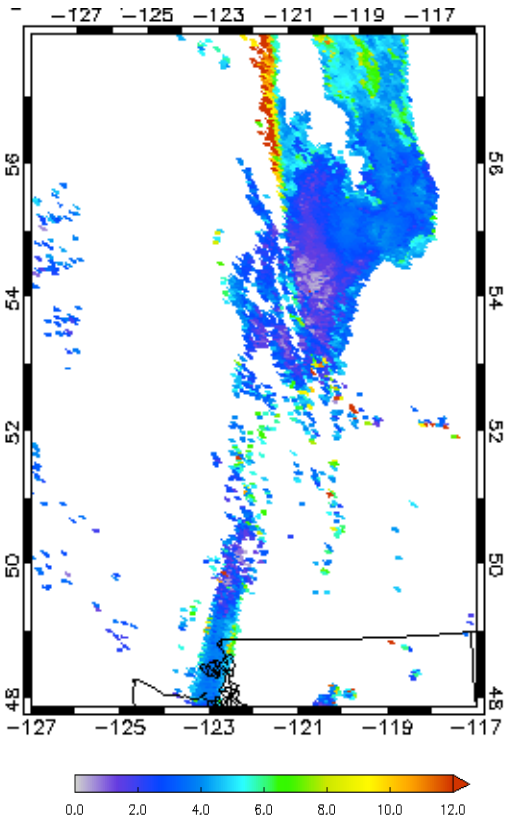




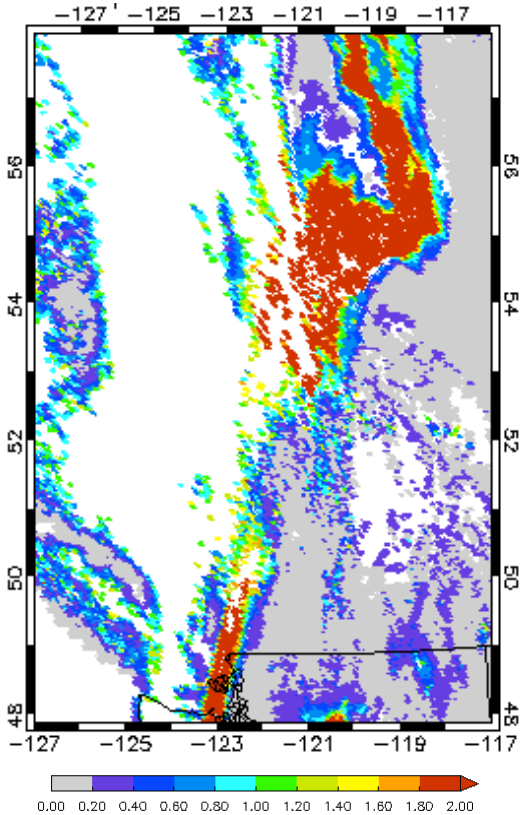
Sample TEMPOAER Retrievals on September 17, 2025



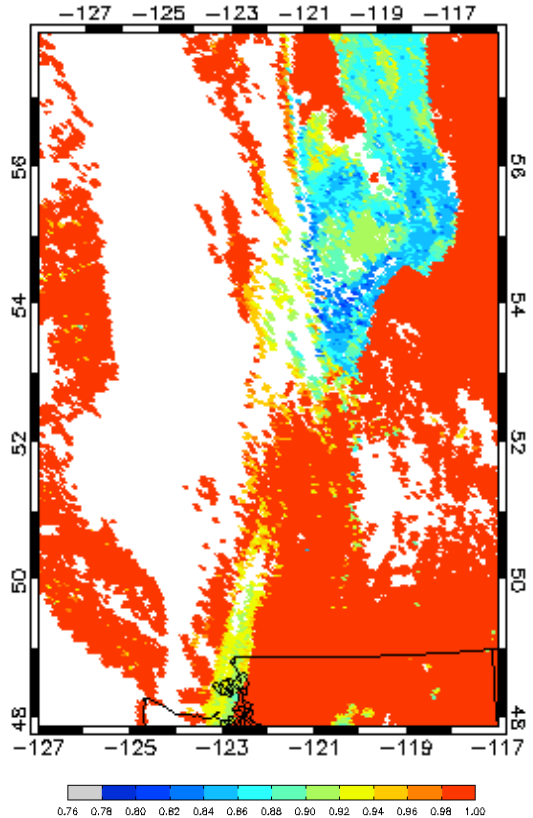
UVAI



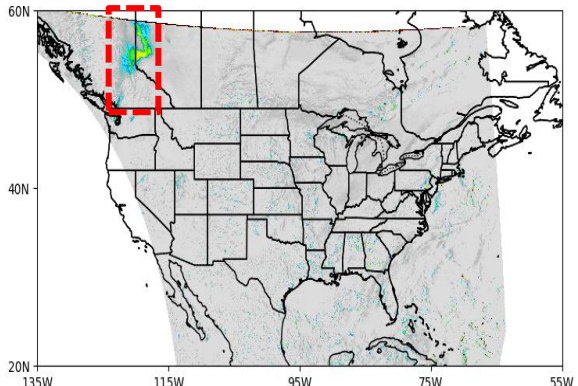
O2B ALH (Km)



AOD (388 nm)



SSA (388 nm)

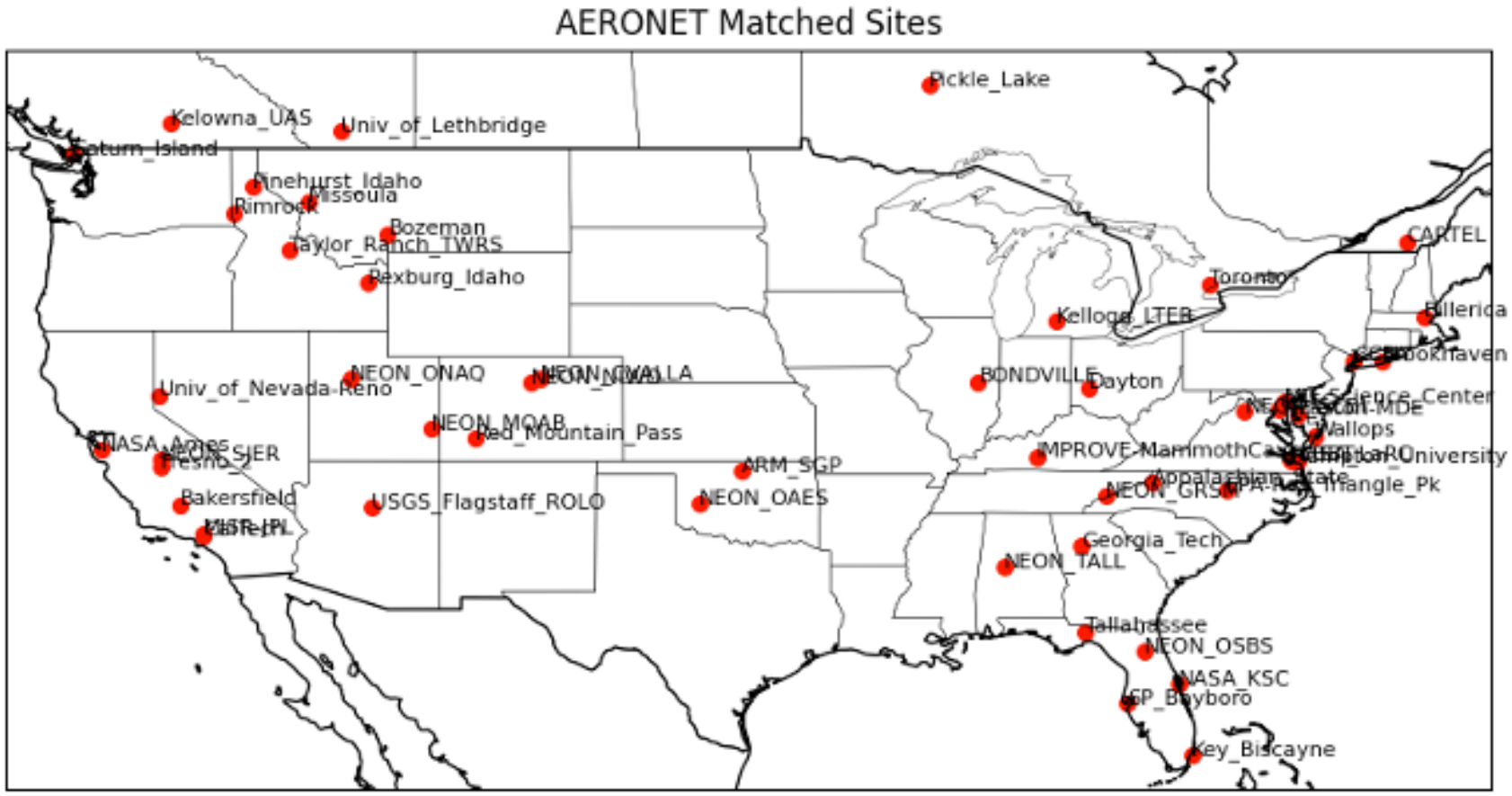


- 20250917T224238Z_S013G07
- 20250917T224915Z_S013G08
- 20250917T225552Z_S013G09

TEMPOAER 388 nm AOD Product Evaluation

Comparison with AERONET Level 1.5 AOD on Sept. 17&19, 2025

52 Aeronet Sites

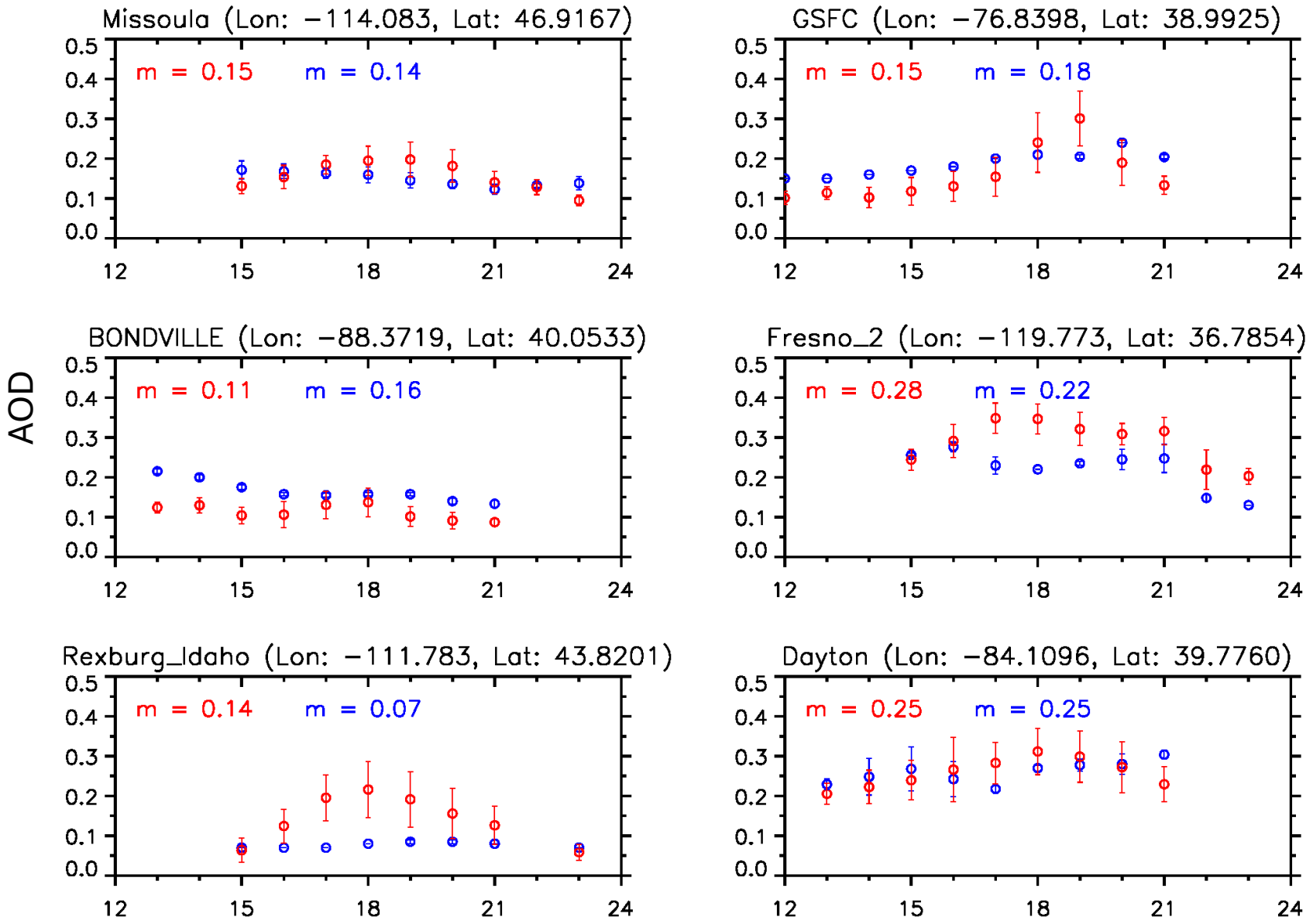


A preliminary quantitative evaluation of this calibration exercise is carried out by comparing TEMPOAER retrieved AOD to ground-based AERONET measurements at multiple sites.

Diurnal variation of matchup AODs for Sept 17 & 19, 2025

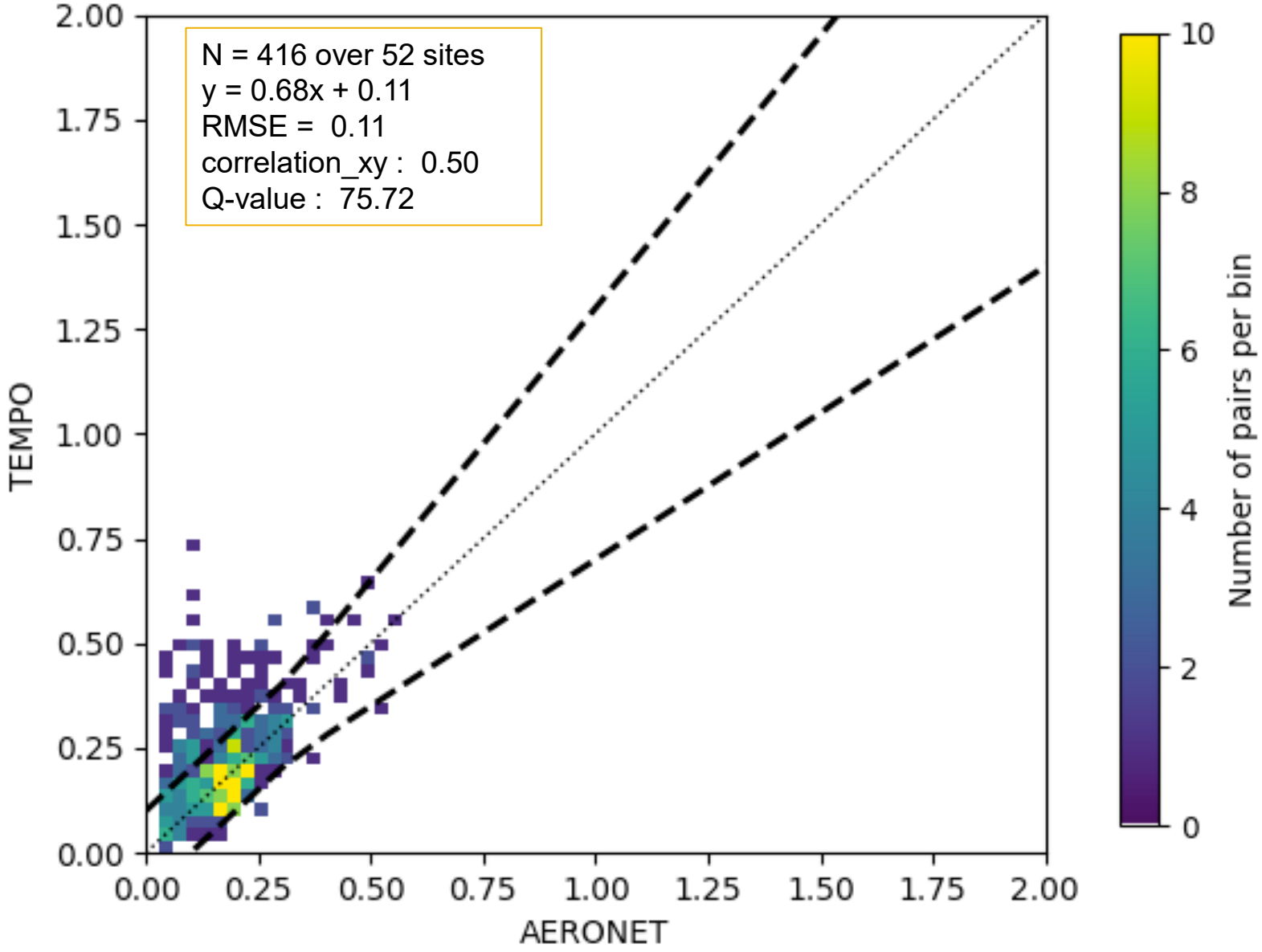
- 10 km radius and ±10 min windows

- TEMPO
- AERONET



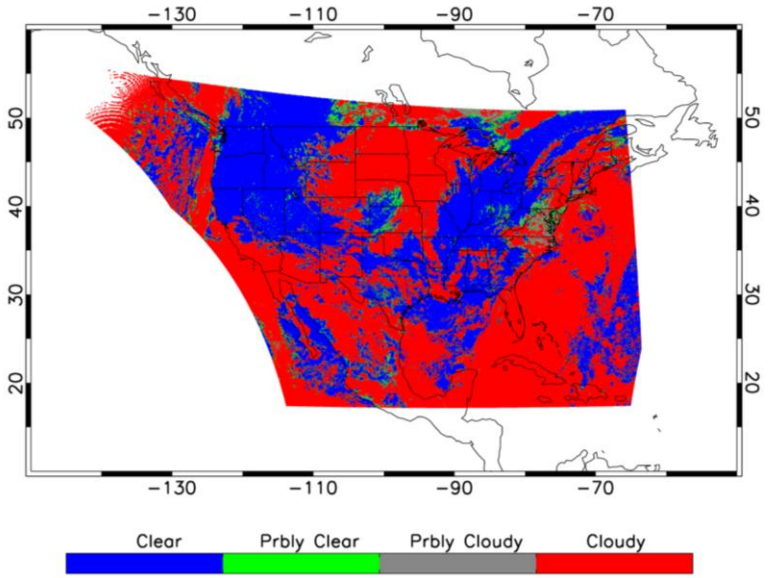
Mostly non-absorbing aerosols

Scatter Density Plot of Hourly-Averaged AOD comparison (TEMPO vs AERONET) for Sept 17 & 19, 2025

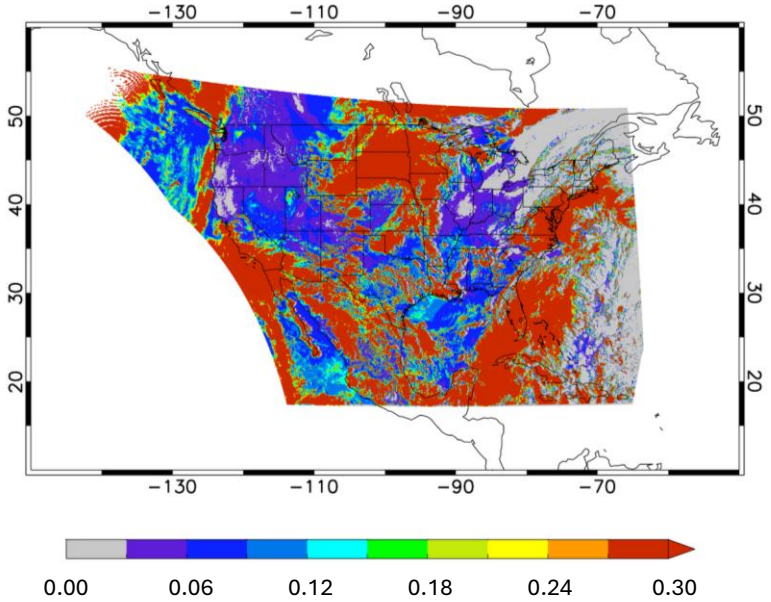


Current work: Minimizing sub-pixel cloud contamination

TEMPO/GOES-ABI Collocation for cloud screening (Sept 17, 2025, S013 : 22 UTC)



Cloud Mask



LER 388

Summary

-A beta-version of the TEMPO near UV aerosol algorithm has been developed.

-TEMPOAER V 1.1.0 was recently delivered for testing at SAO's TEMPO computer facilities.

-Initial evaluation results indicate that after minor calibration adjustments at near UV channels, TEMPO UVAI calculations are consistent with those reported by other operational UV-capable sensors.

-First evaluation of TEMPO aerosol optical depth retrievals shows consistency with AERONET measurements at multiple locations.

-Work on the development of a cloud mask using GOES-ABI fine spatial resolution observations is currently underway.