

Smoke Detection from UV sensors



NOAA

National Satellite and
Information Service

Center for Satellite Applications and Research

Pubu Ciren^{1,2} and Shobha Kondragunta²

¹STC@NOAA | ²NOAA/NESDIS/STAR

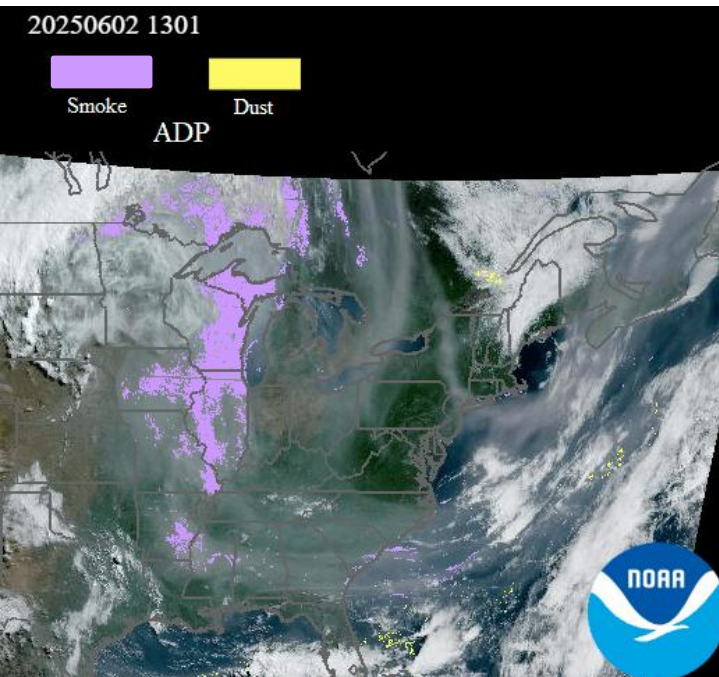
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CEOS AC/VC | June 1-4, 2026 | Leiden, the Netherlands

Smoke detection and quantification enhanced by UV observations...

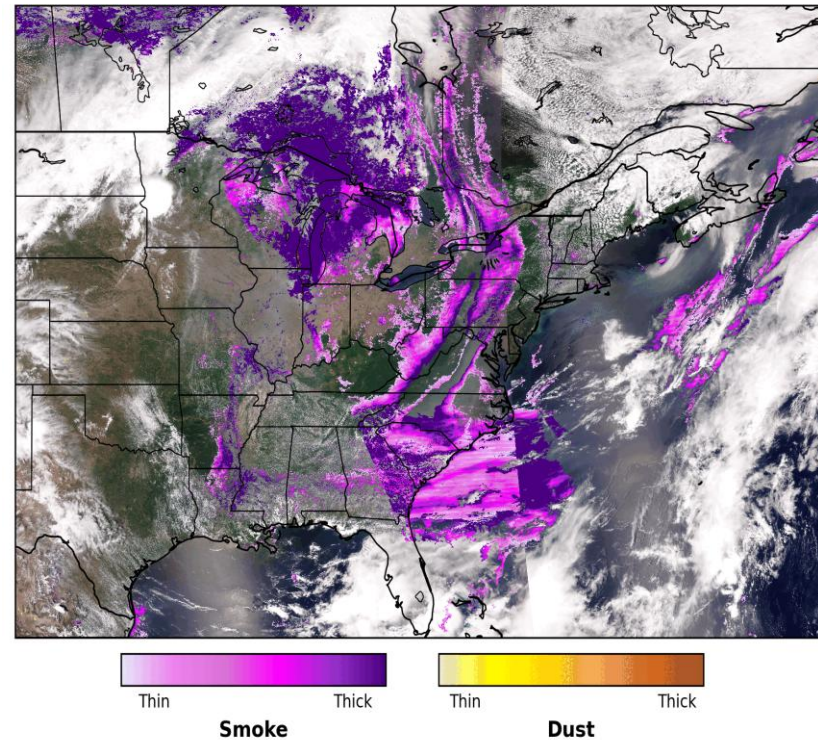
Visible-IR

GOES-R ABI Smoke



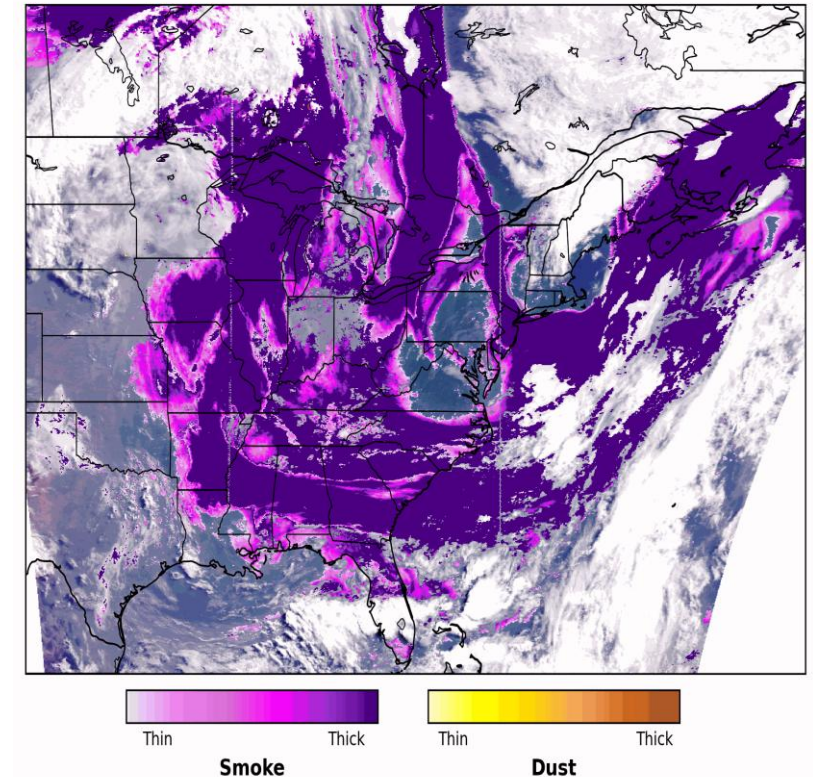
Deep Blue-IR

JPSS VIIRS Smoke



UV-Deep Blue-IR Hybrid

GOES-R ABI+TEMPO Smoke



NOAA TEMPO-ABI Hybrid Aerosol Detection Algorithm

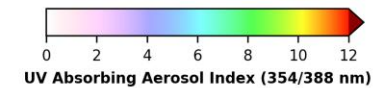
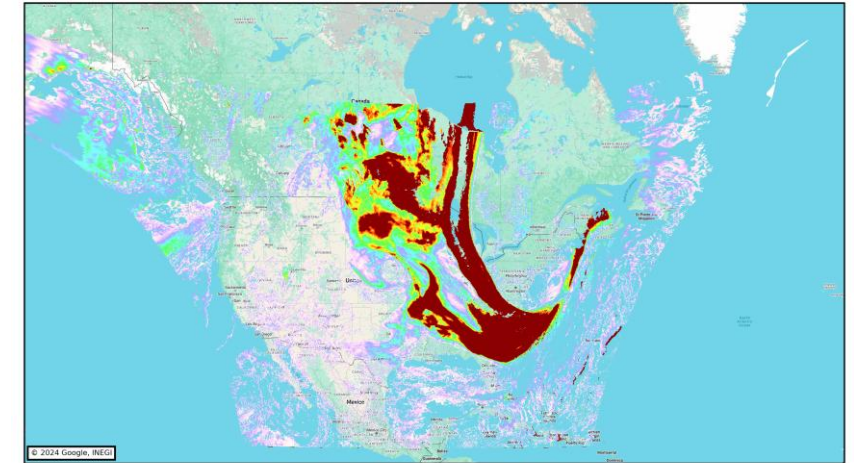
- Hybrid approach for smoke and dust detection.
- TEMPO+ABI synergy (East and West, dual view).
- **Cloud screening:** Remapped cloud mask from ABI
- **Cloud/Snow-ice Callback:** Identifies high UV AAI values over clouds and snow-ice
- **Outputs**
 - Smoke/Dust mask
 - UV AAI (354/388 nm)
 - Visible AAI (412/440 nm)

Absorbing Aerosol Index

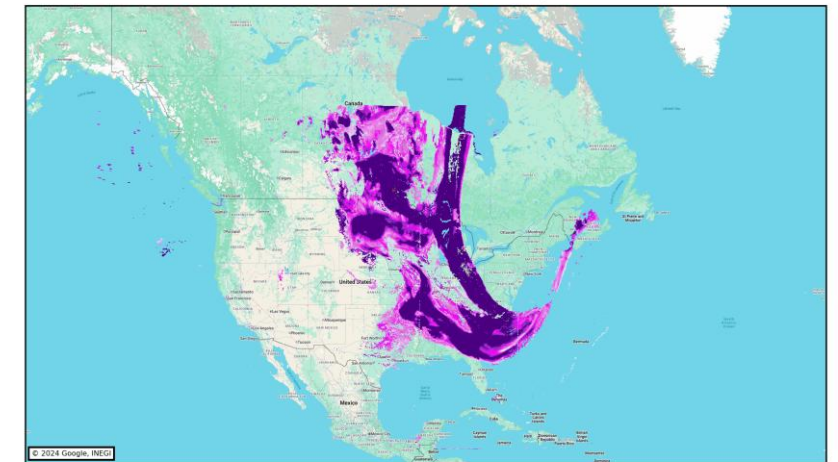
TEMPO: Visible AAI = $-100[\log_{10}(R_{412}/R_{440}) - \log_{10}(R'_{412}/R'_{440})]$
UV AAI = $-100[\log_{10}(R_{354}/R_{388}) - \log_{10}(R'_{354}/R'_{388})]$

ABI/GXI: **Dust Smoke Discrimination Index**
DSDI = $-10[\log_{10}(R_{412}/R_{2250})]$

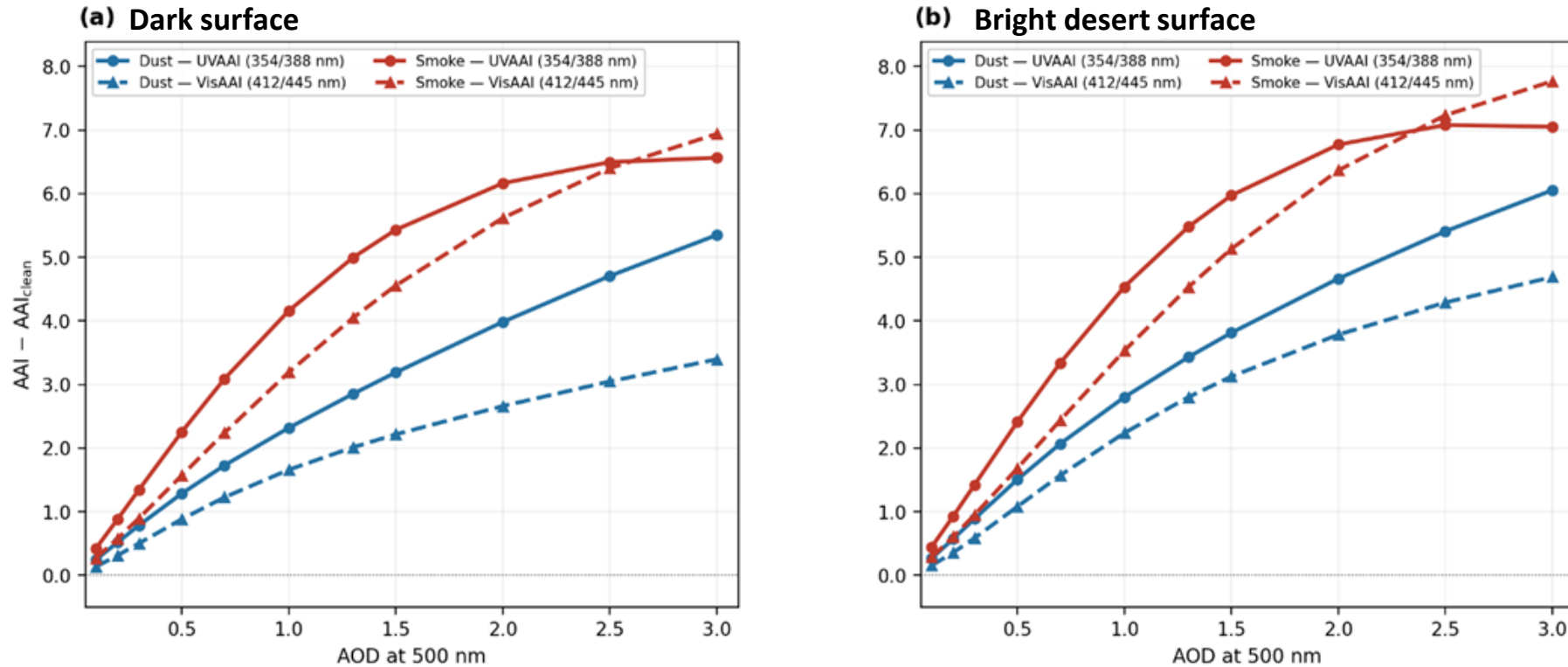
TEMPO UV AAI Scan: 14 31 May 2025 22:14-23:08 UTC



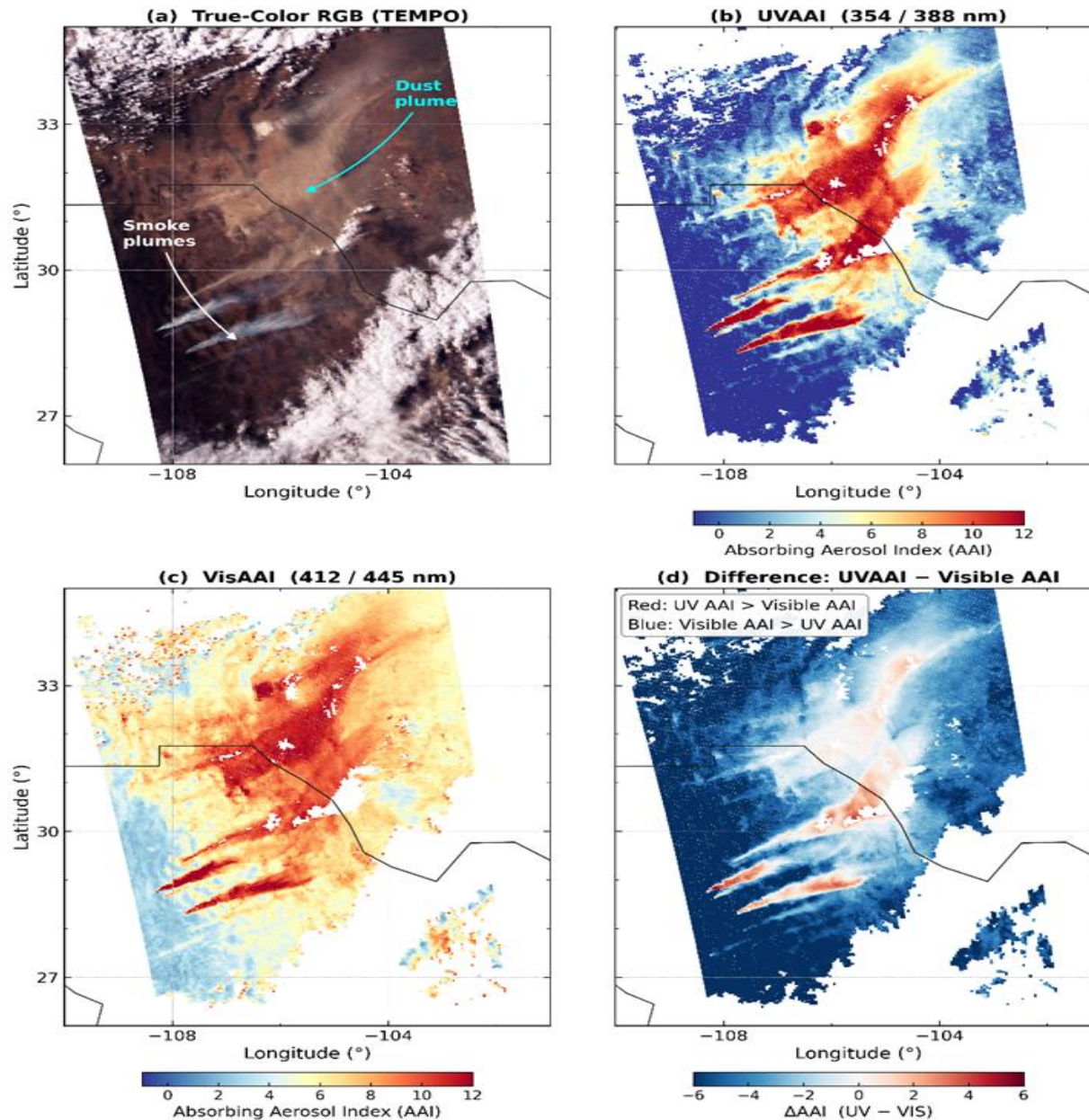
TEMPO-ABI (G19) ADP Scan: 14 31 May 2025 22:14-23:08 UTC



Advantage of UV AAI (Simulations)



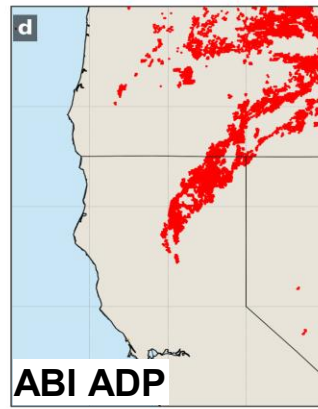
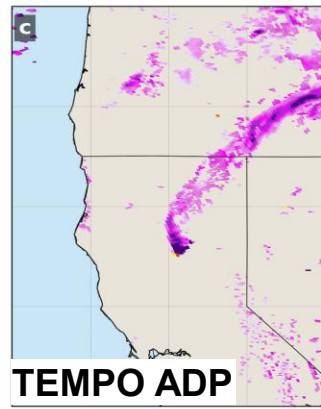
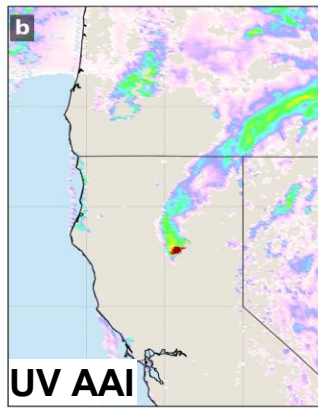
Over both dark and bright surface, UV AAI provides consistently higher sensitivity than VIS AAI for smoke aerosol for AOD <2.5.



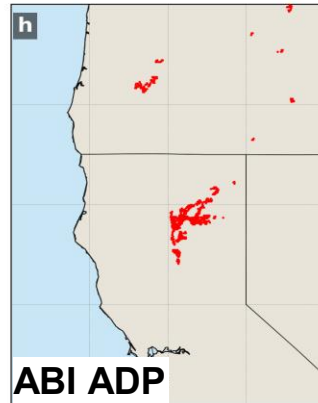
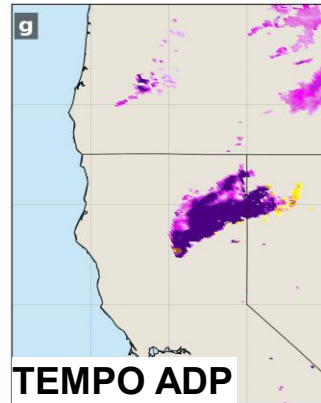
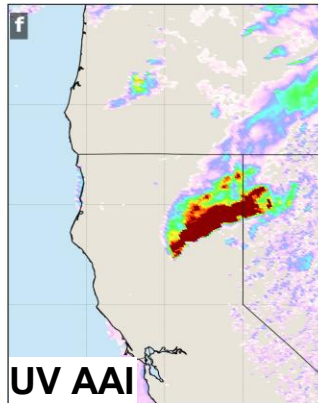
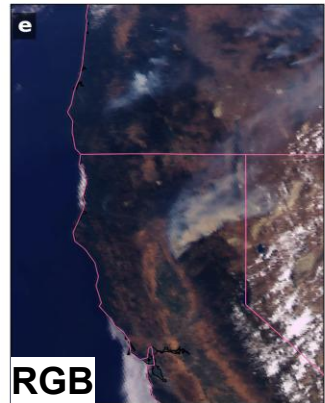
Advantage of UV AAI (Observations)

- Greater contrast aerosol-laden vs. clear-sky regions
- Near-zero background values
- Substantially elevated signals over aerosol plumes.

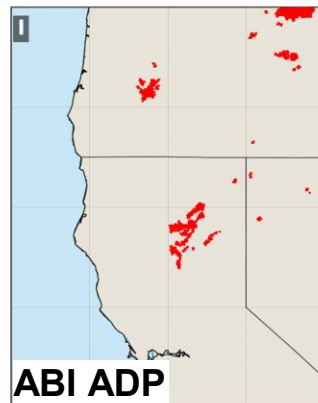
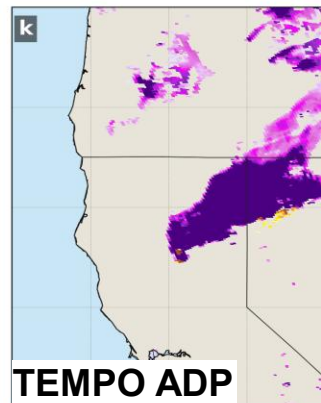
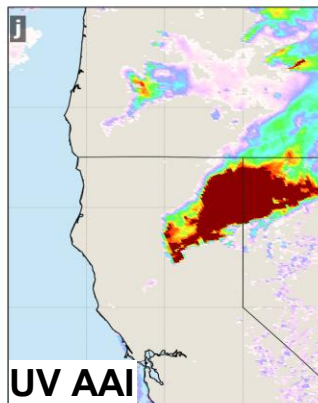
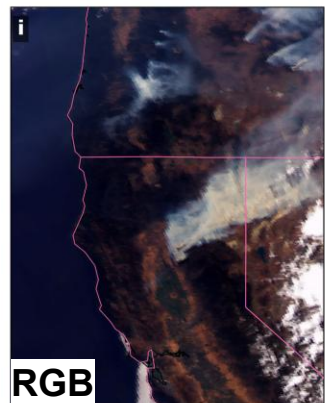
Park fire, CA, July 25, 2024



TEMPO Scan 8, 15:51 UTC

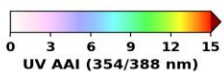


TEMPO Scan 12, 19:51 UTC



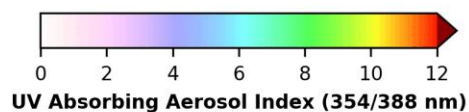
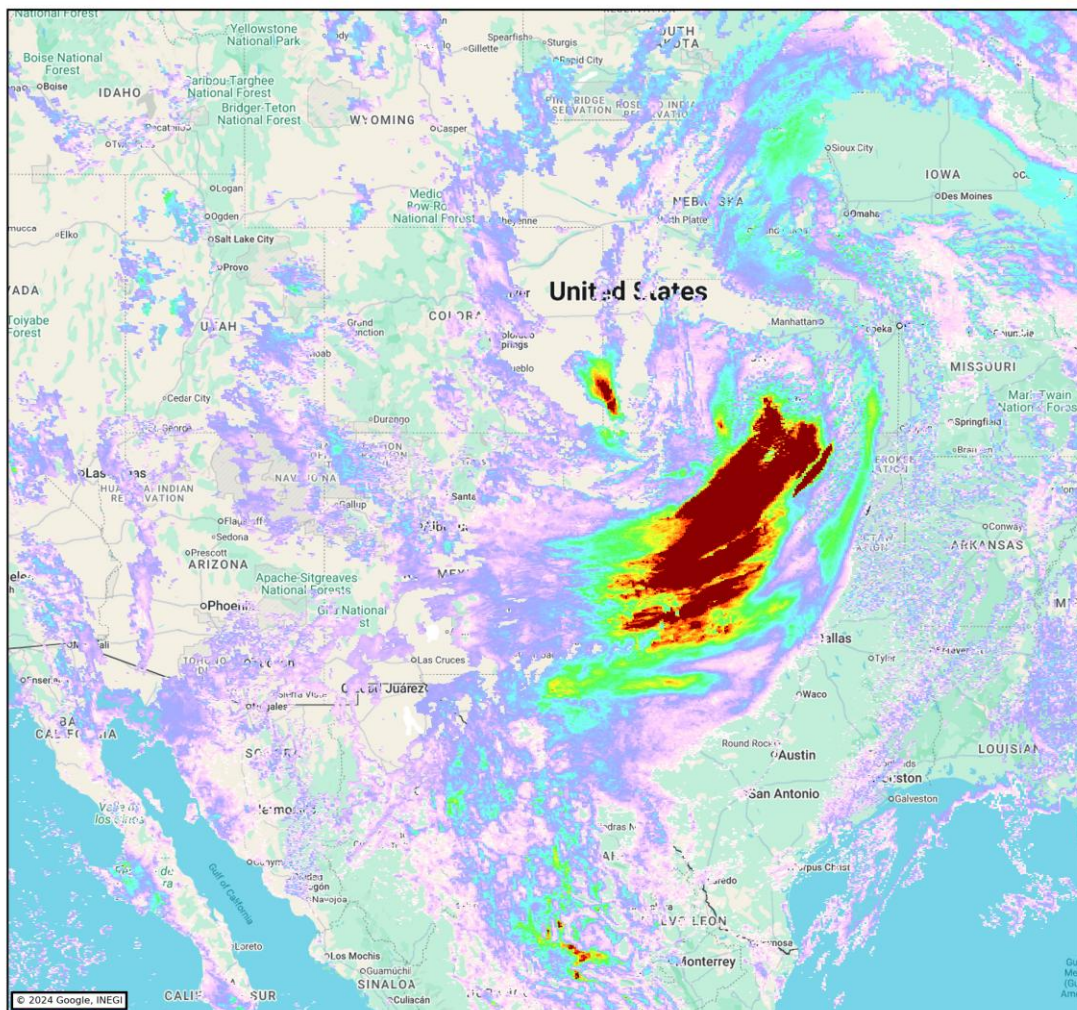
TEMPO Scan 15, 22:51 UTC

Park fire started on July 24, 2024 and burned through ~430,000 acres in 64 days. Extreme heat and dry conditions led to the start of the fire when a car engine stuck on grass was revved.

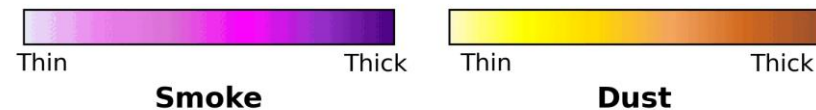
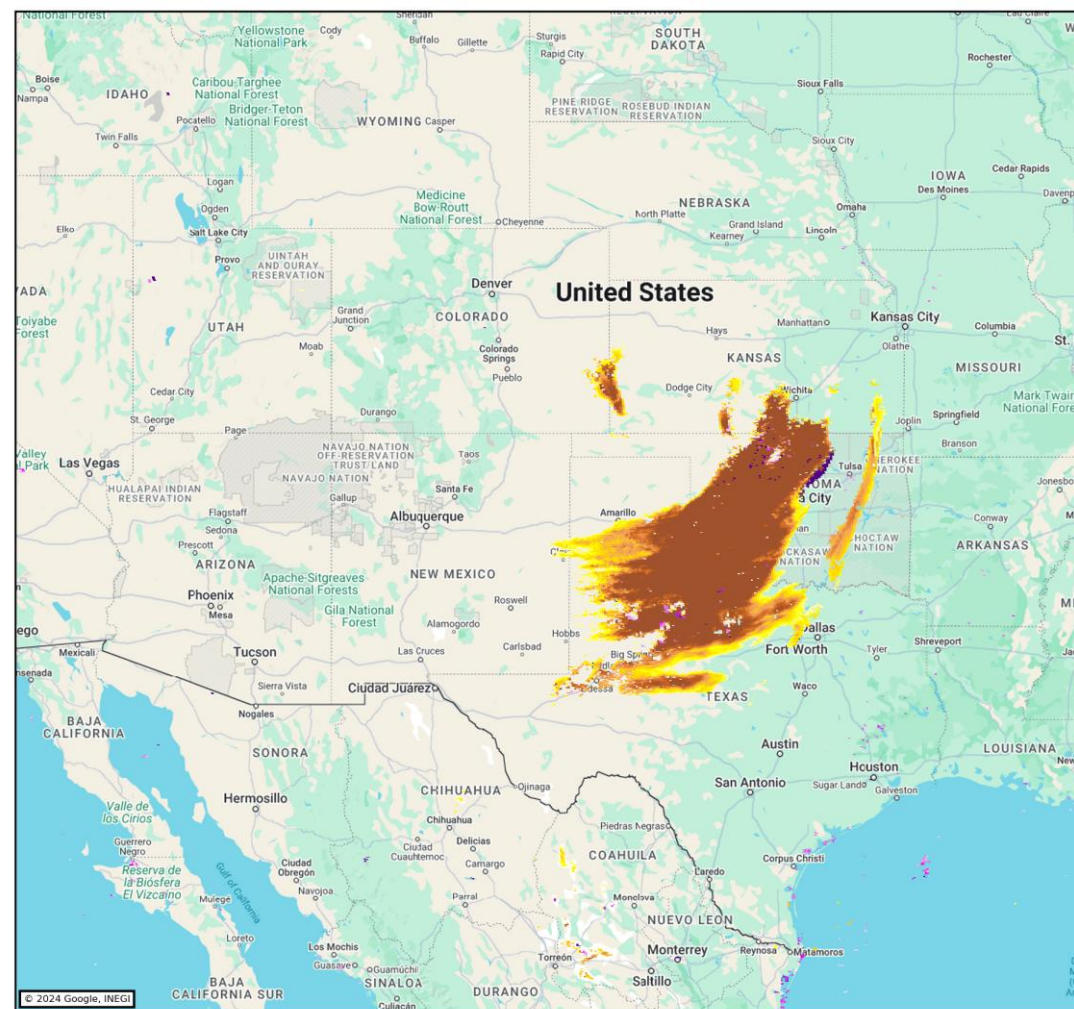


Case Study: Dust Outbreak Over New Mexico (03/14/25)

TEMPO UV AAI Scan: 10 14 Mar 2025 19:18-20:11 UTC



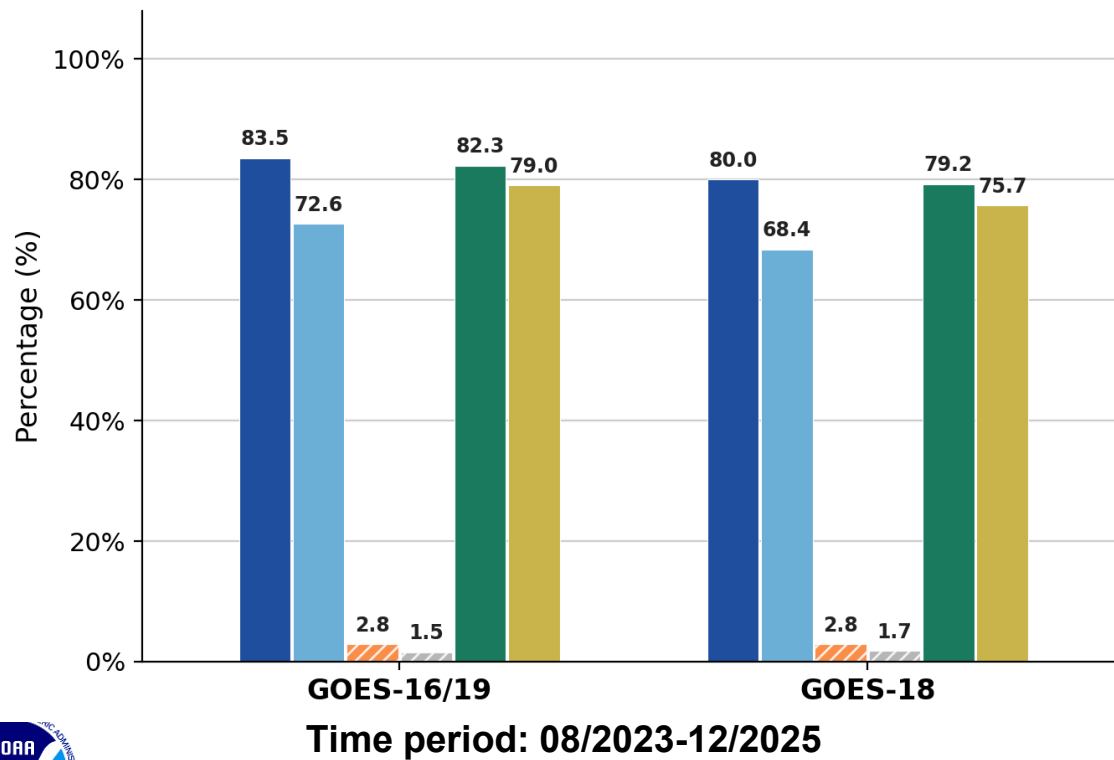
TEMPO-ABI (G16) ADP Scan: 10 14 Mar 2025 19:18-20:11 UTC



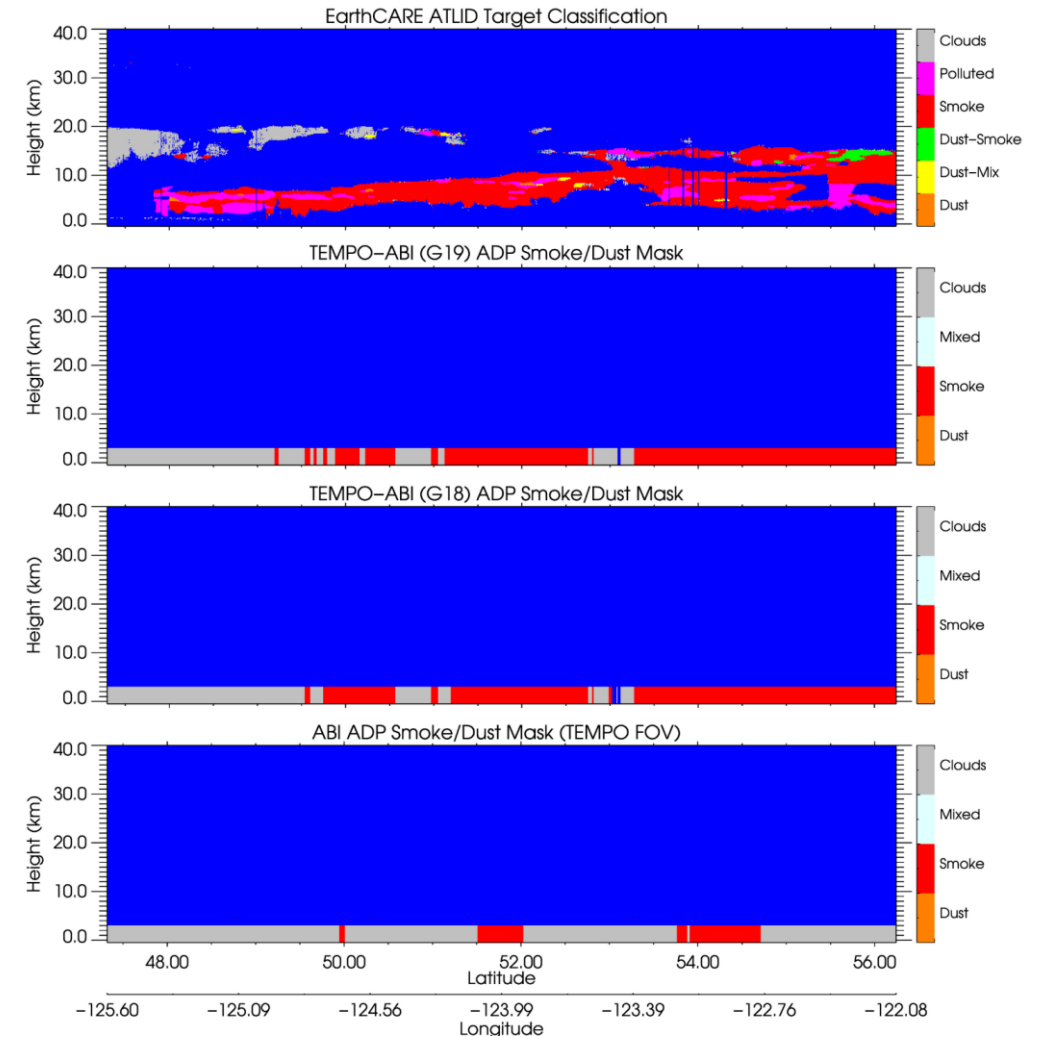
AERONET: Ground-Based Reference

■ Hit rate - TEMPO-ABI ADP ■ FAR - TEMPO-ABI ADP ■ PC - TEMPO-ABI ADP
 ■ Hit rate - ABI ADP ■ FAR - ABI ADP ■ PC - ABI ADP

Smoke detection



EarthCARE ATLID: Space-Borne Reference



Summary

- Sensors with UV wavelengths optimal for smoke detection
 - Strong signal, large separation from background.
 - Potential for overcloud detection capability
- Known Issues
 - False smoke over bright surfaces (White Sands, Great Salt Lake).
 - Occasional false detections over large cloud shadows (early/late evening).