Modeling and observations for fire and smoke events in 2023: A brief introduction of new satellite data

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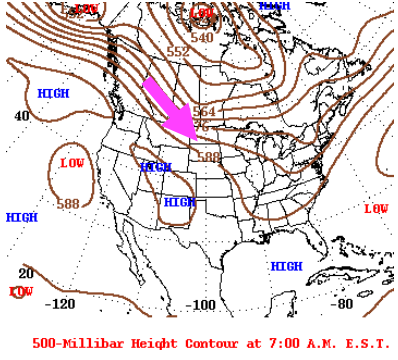
NASA GMAO (GEOS-FP & GEOS-CF)
Naval Research Lab (NAPPS team)
Many stakeholders who participated FireAQ weekly briefing this summer

Models

http://fireaq.uiowa.edu for weekly briefing of FireAQ this summer

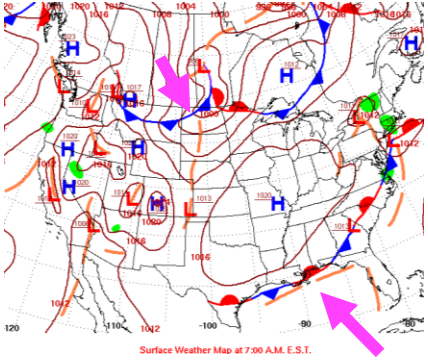
Air Quality Reflection: Wednesday August 16, 2023

500 hPa Contours



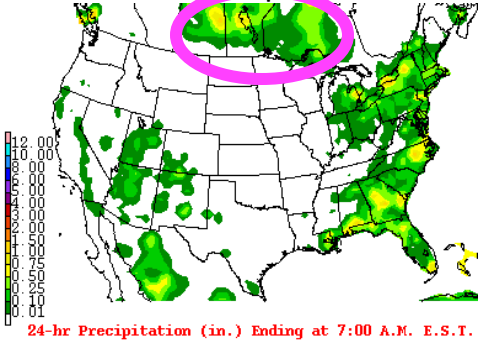
500-Millibar Height Contour at 7:00 A.M. E.S.T.

Surface Weather



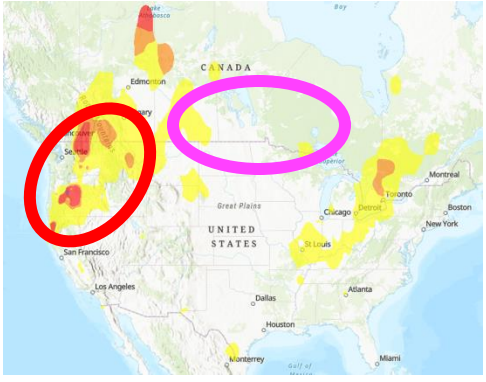
Surface Weather Map at 7:00 A.M. E.S.T.

Precipitation

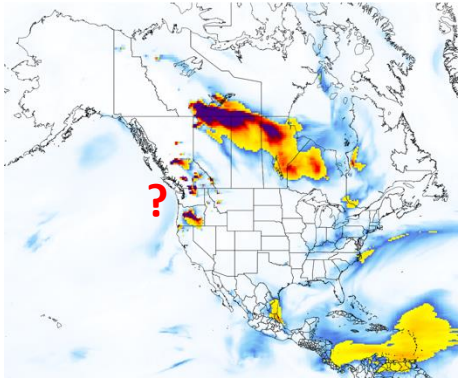


24-hr Precipitation (in.) Ending at 7:00 A.M. E.S.T.

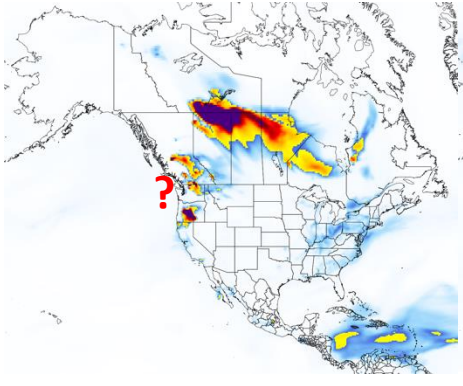
AirNow AQI



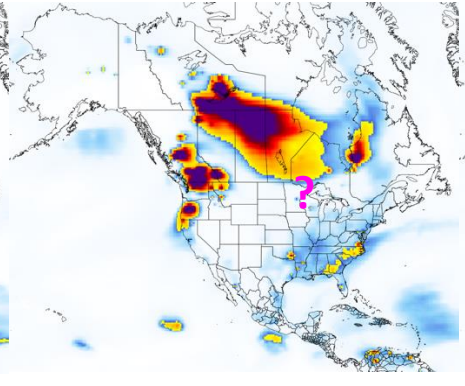
GEOS-FP



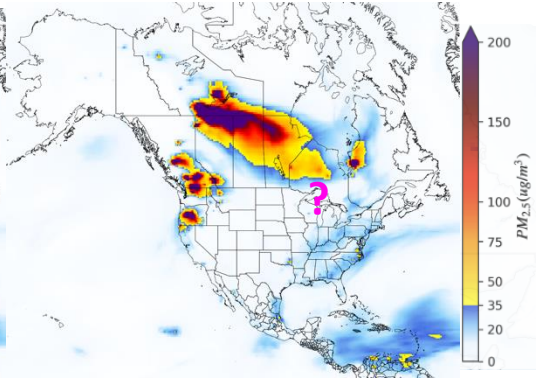
GEOS-CF



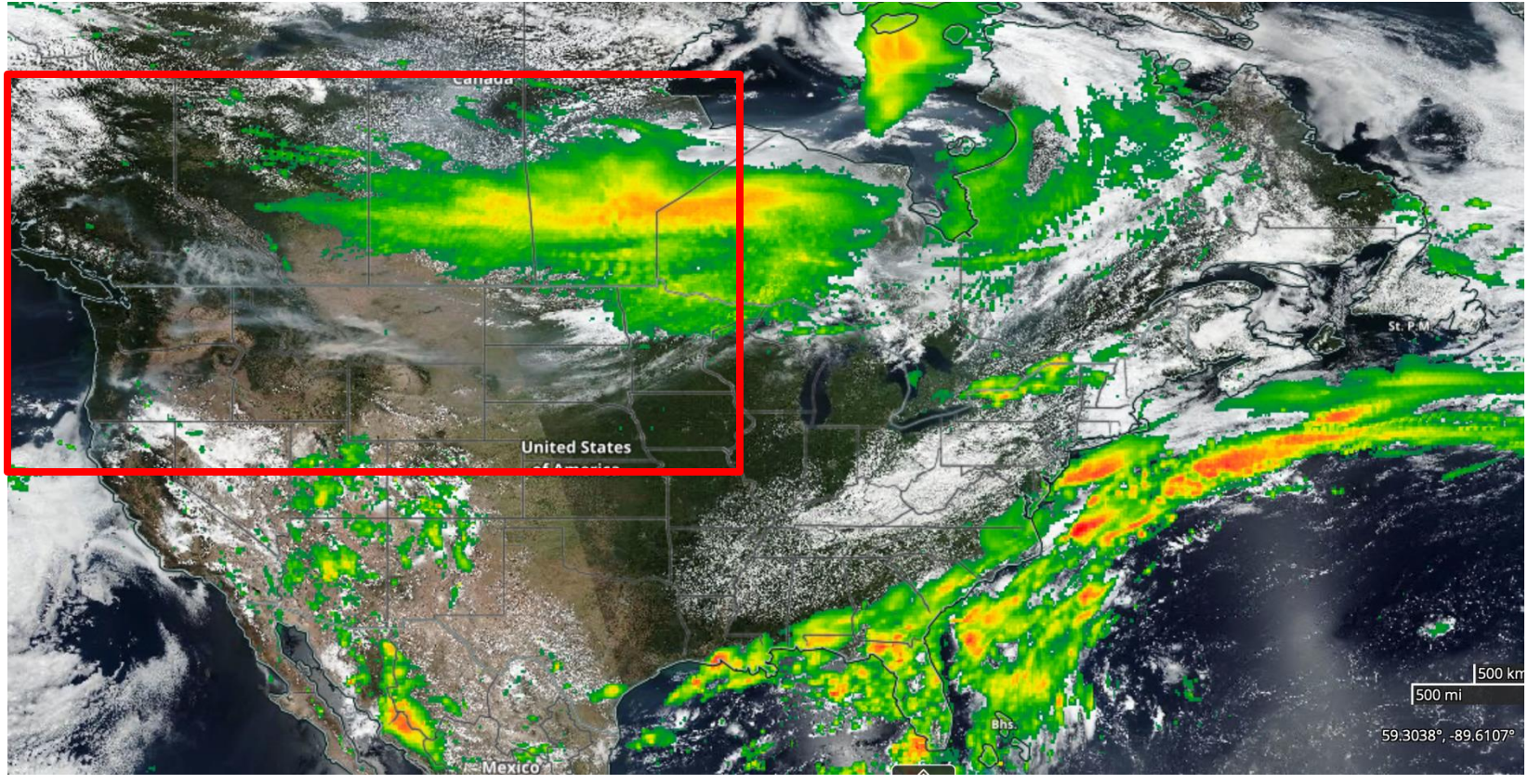
NAAPS



Ensemble



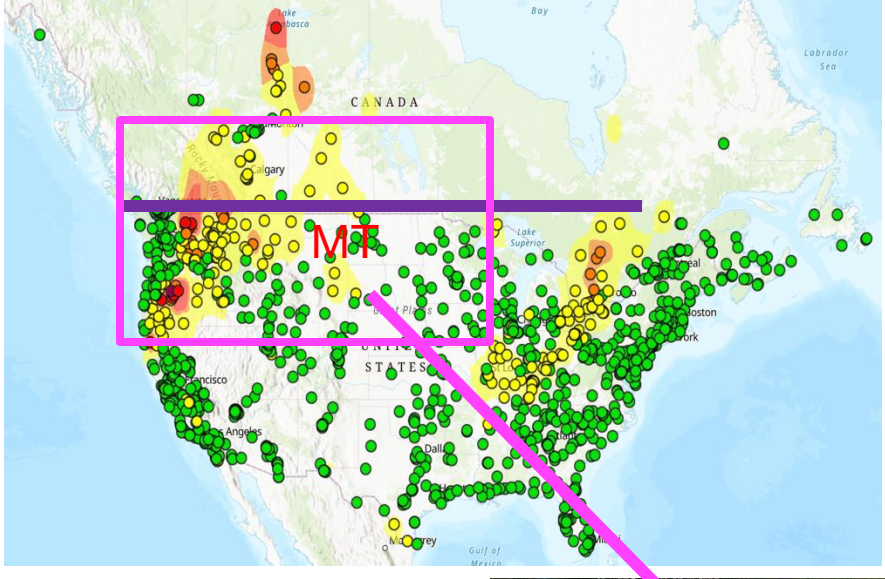
GPM, 16 August 2023

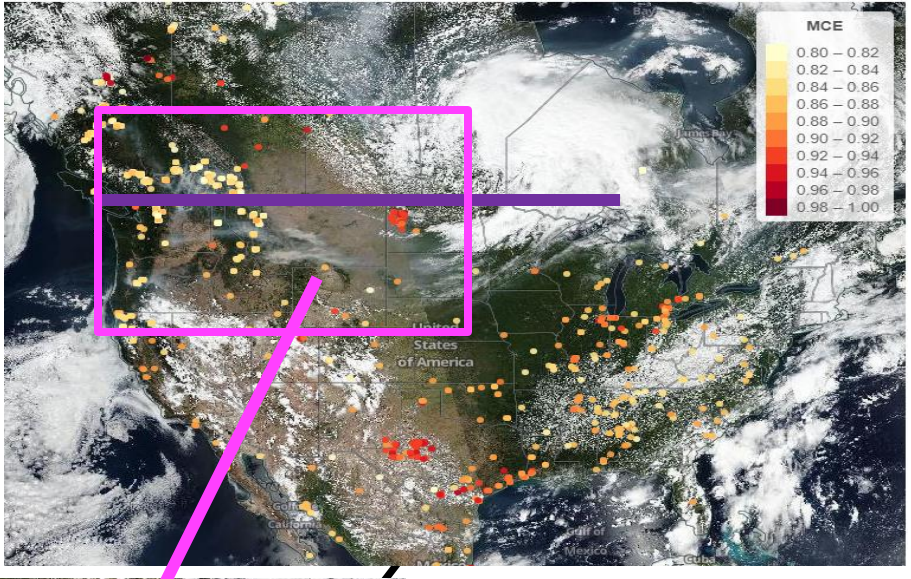


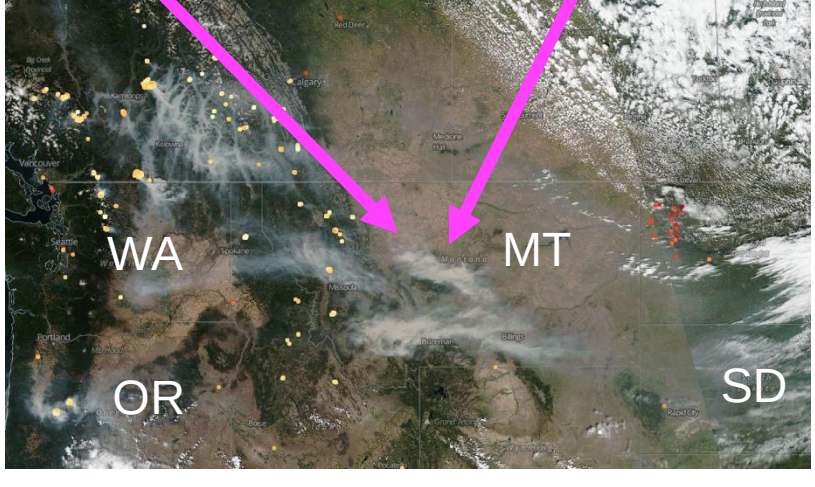
NASA WorldView

Observations

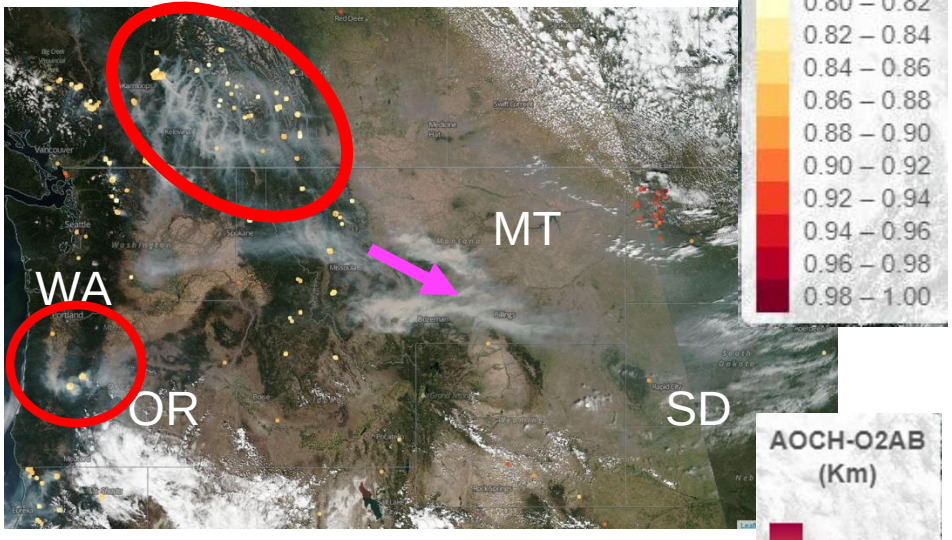
http://fireaq.uiowa.edu for weekly briefing of FireAQ this summer

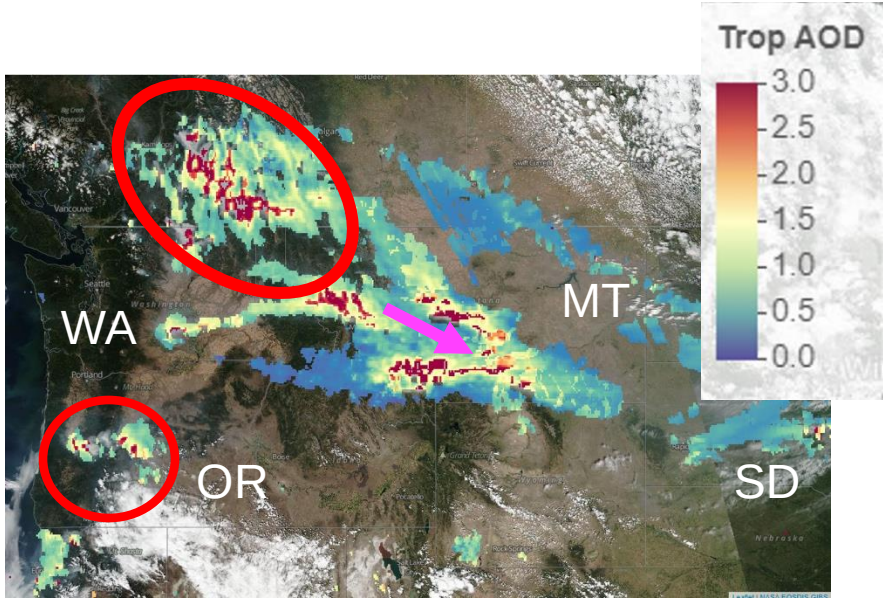


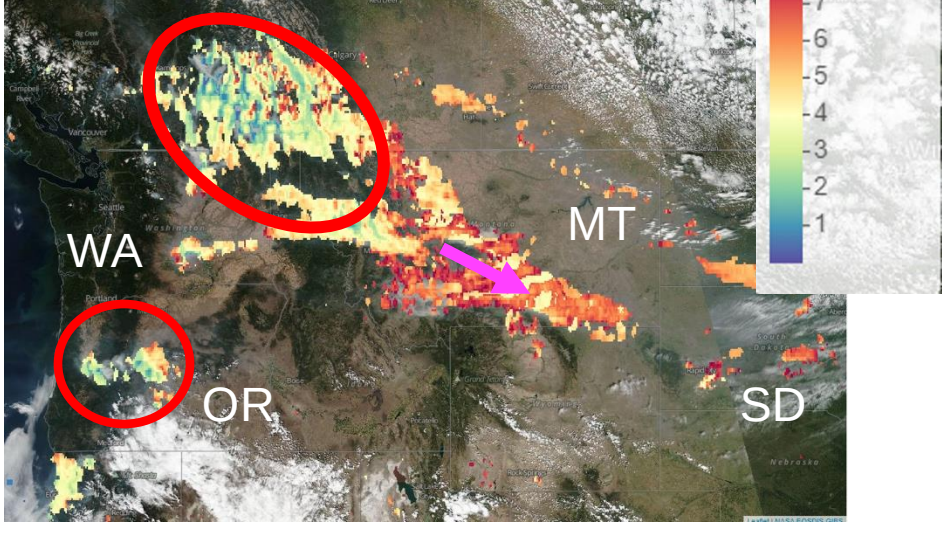




FILDA2 MCE


MCE
0.80 – 0.82
0.82 – 0.84
0.84 – 0.86
0.86 – 0.88
0.88 – 0.90
0.90 – 0.92
0.92 – 0.94
0.94 – 0.96
0.96 – 0.98
0.98 – 1.00
WA
OR
MT
SD


Trop AOD
3.0
2.5
2.0
1.5
1.0
0.5
0.0
WA
OR
MT
SD


AOCH-O2AB
(Km)
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6
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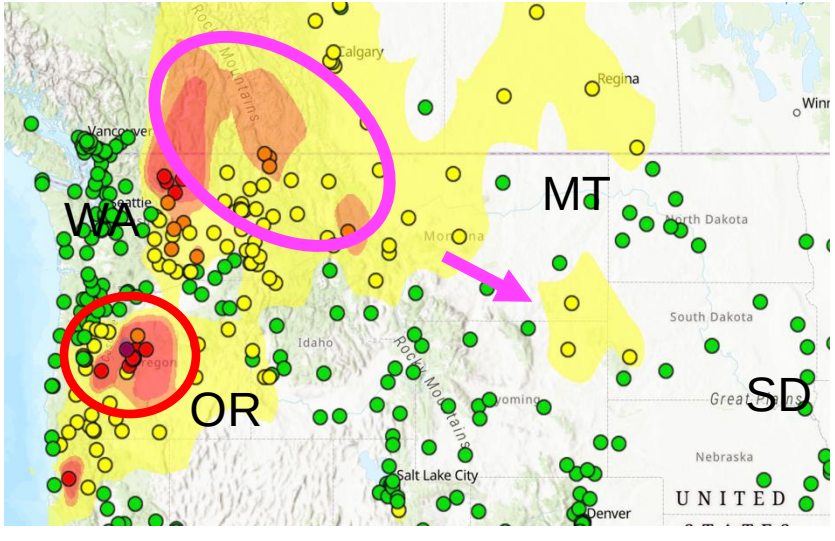
WA
OR
MT
SD


WA
OR
MT
SD
Calgary
Regina
Vancouver
Seattle
Montana
North Dakota
South Dakota
Idaho
Wyoming
Nebraska
Salt Lake City
Denver
UNITED

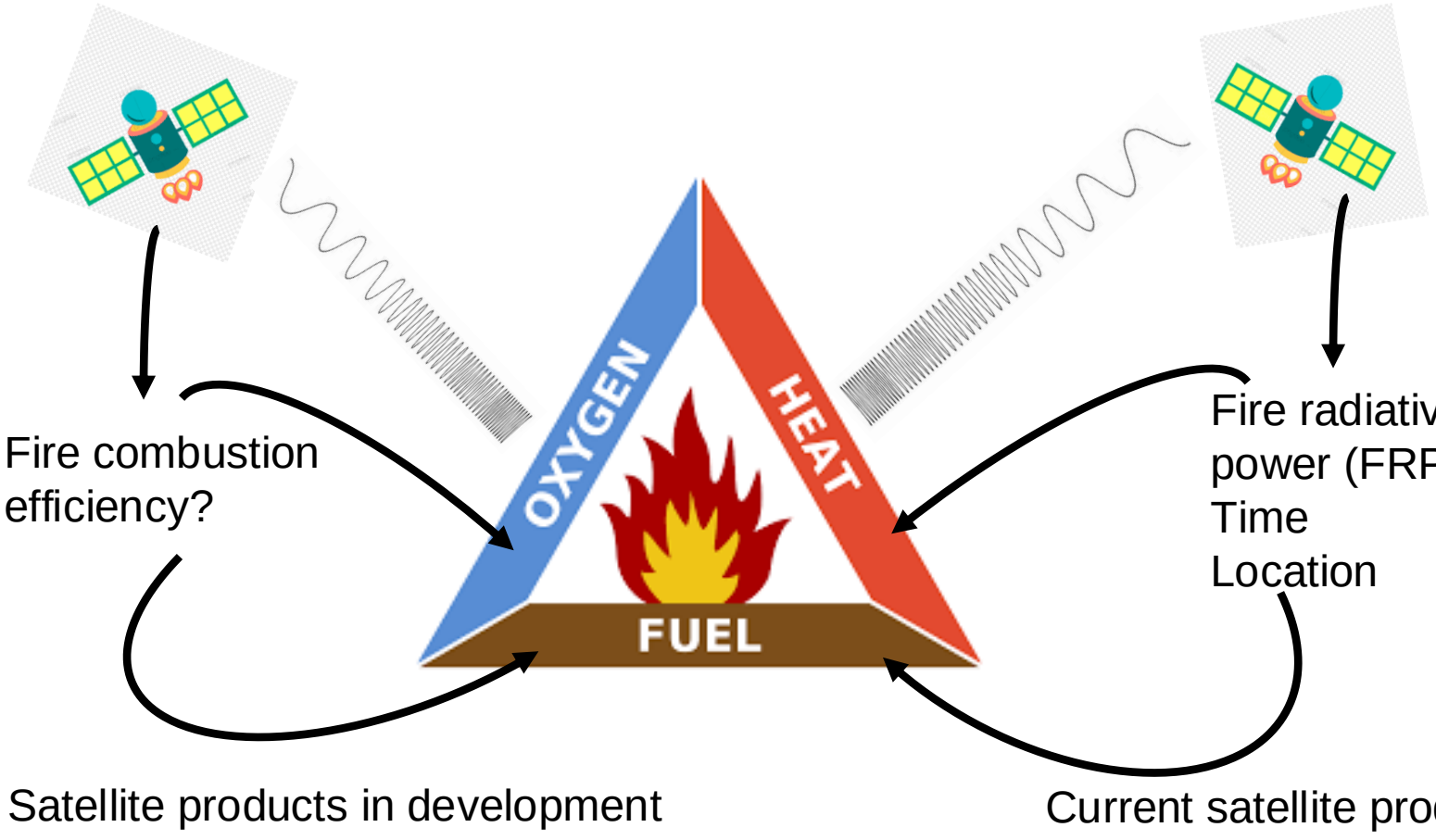
Three Points

- **All models are wrong; some are useful (at sometimes and some places)**

- **Observations, especially new observations, lead the way for improving models**
  - **Fire Modified Combustion Efficiency, aka, CO2/[CO+CO2]**
  - **Aerosol Optical Centroid Height (AOCH)**
  - **Night-time observations**

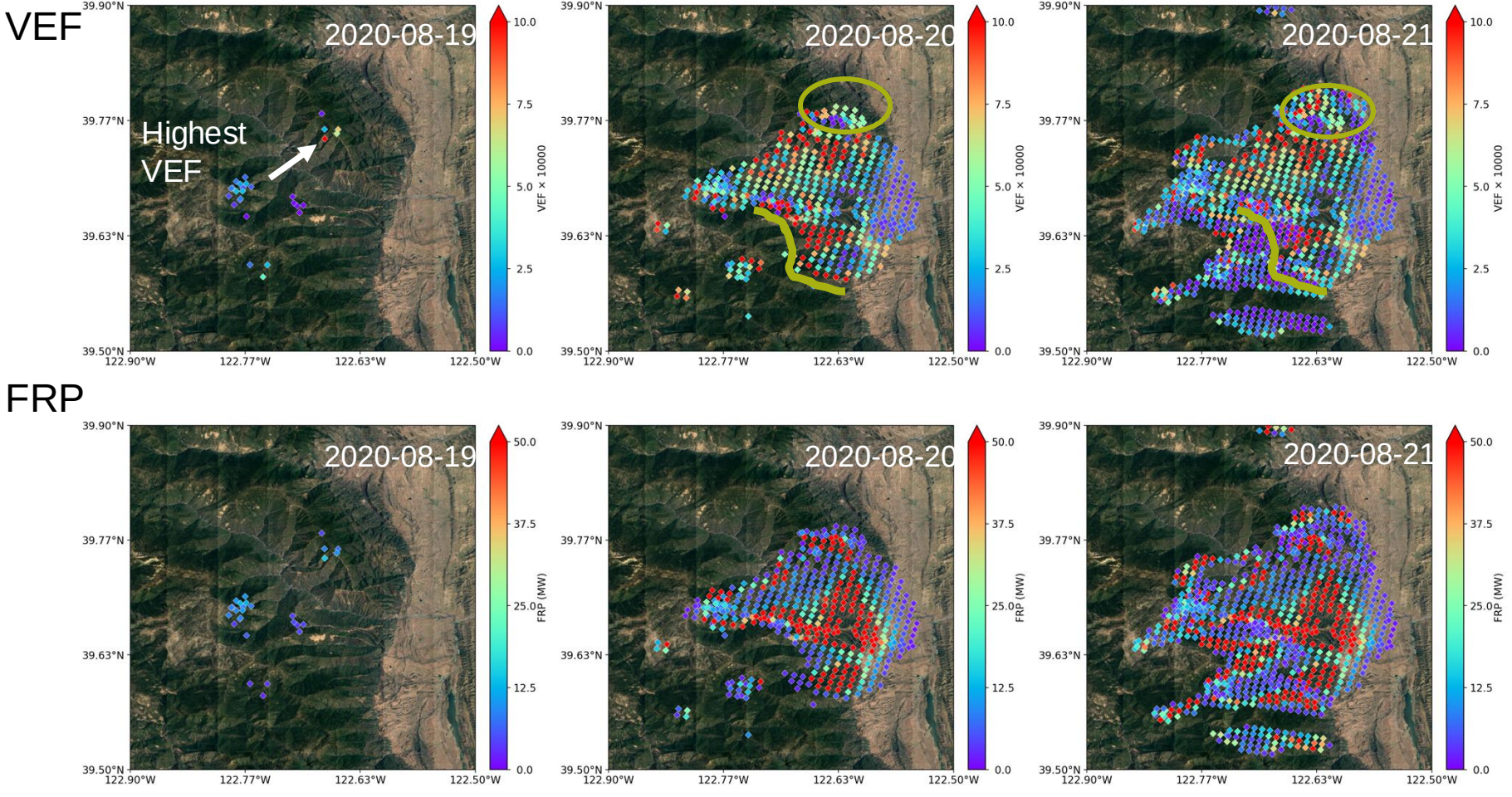
- **Observations have limitations**
  - **Can not forecast!**
  - **Data assimilation and AI/ML are not a trivial task, but applications require timely alert or advisory of air quality and health.**
  - **Aerosol vertical profile, not yet?**

Three elements of fires:
can their interaction be revealed from space?



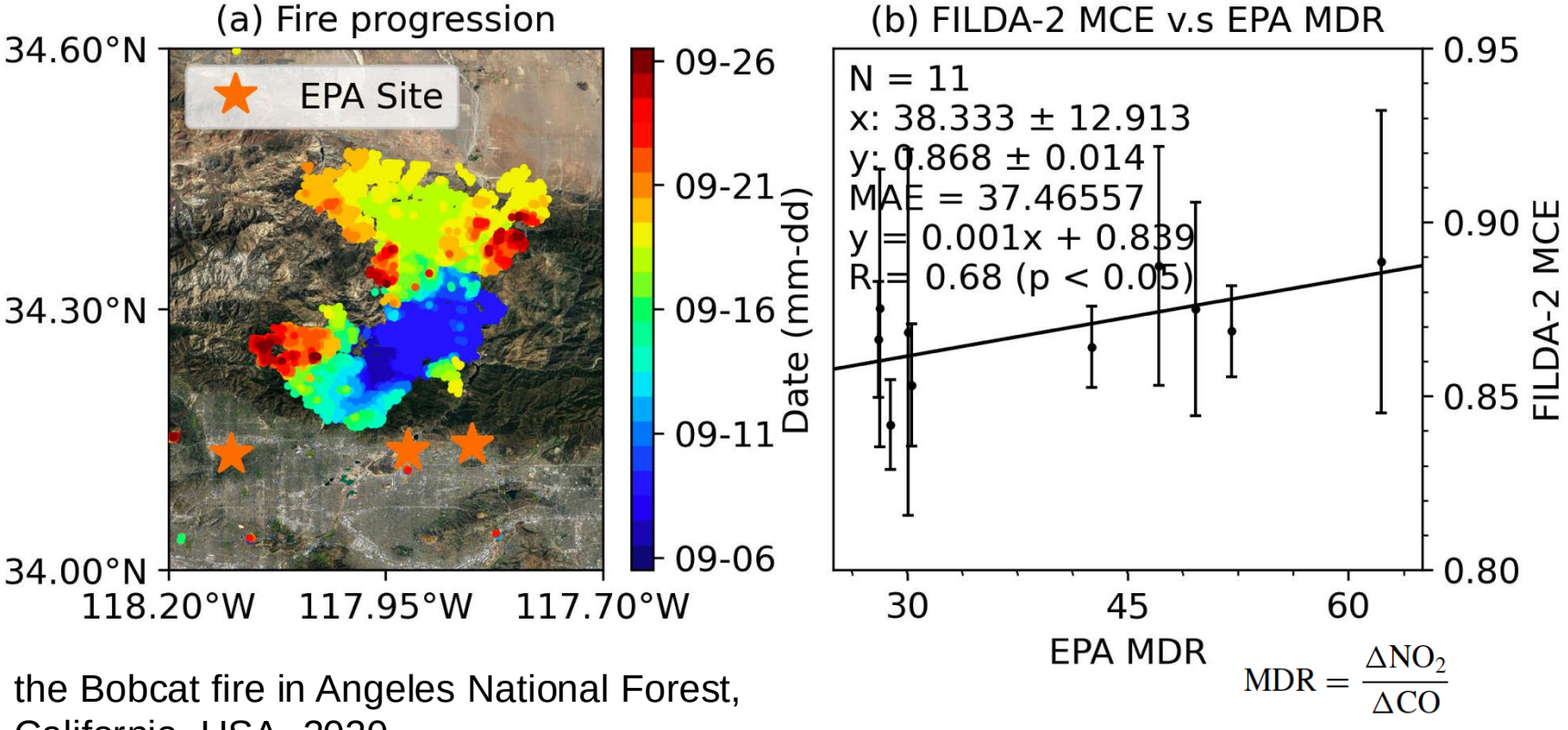
VEF has the potential to better predict fire growth

High VEF -> flaming → predicting movement of fire lines



What is left after fire lines is the smoldering fires

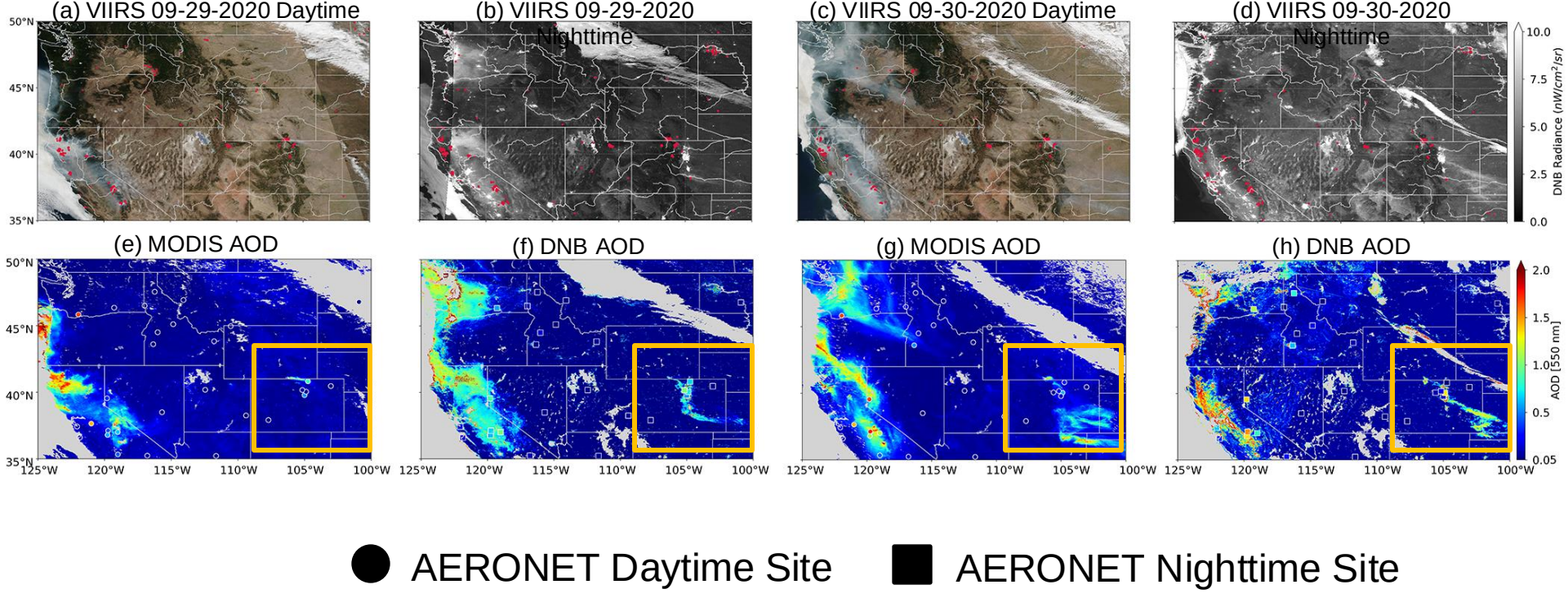
Further (indirect) validation



the Bobcat fire in Angeles National Forest, California, USA, 2020

Case Study

2020 Fire case – Day and Night AOD Map

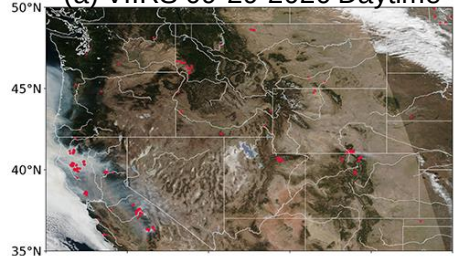


● AERONET Daytime Site ■ AERONET Nighttime Site

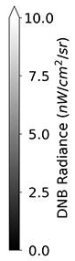
Case Study

2020 Fire case – Day and Night AOD Map

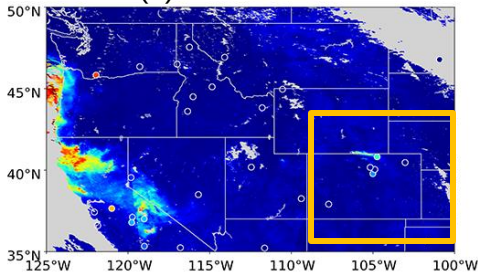
(a) VIIRS 09-29-2020 Daytime



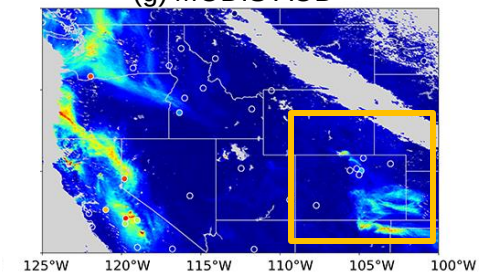
(c) VIIRS 09-30-2020 Daytime

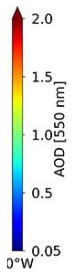


(e) MODIS AOD



(g) MODIS AOD





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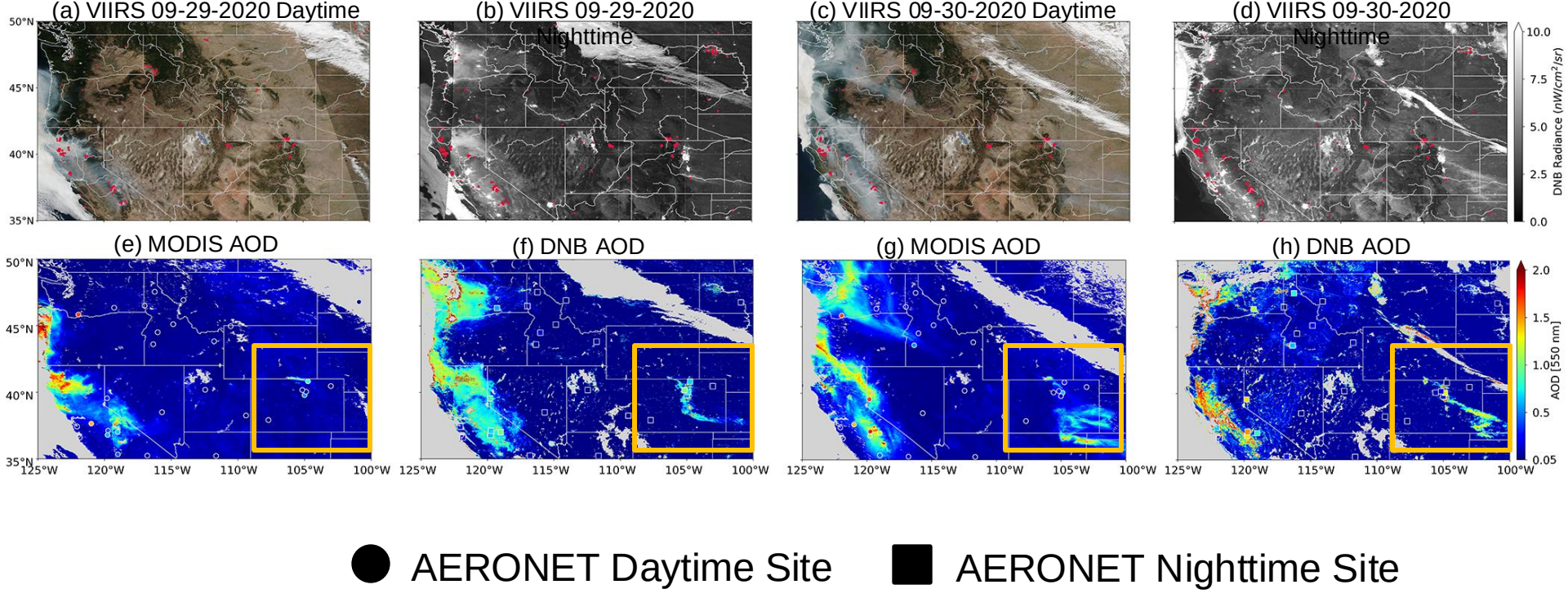

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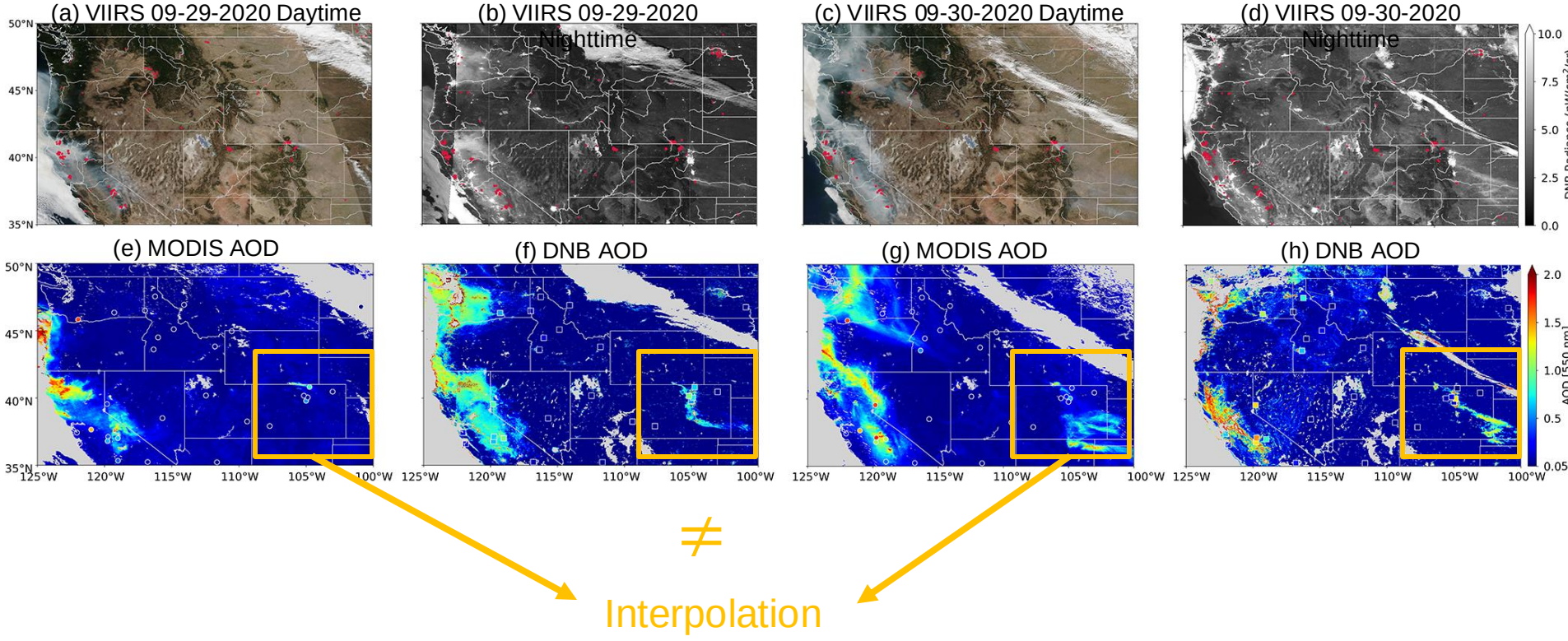

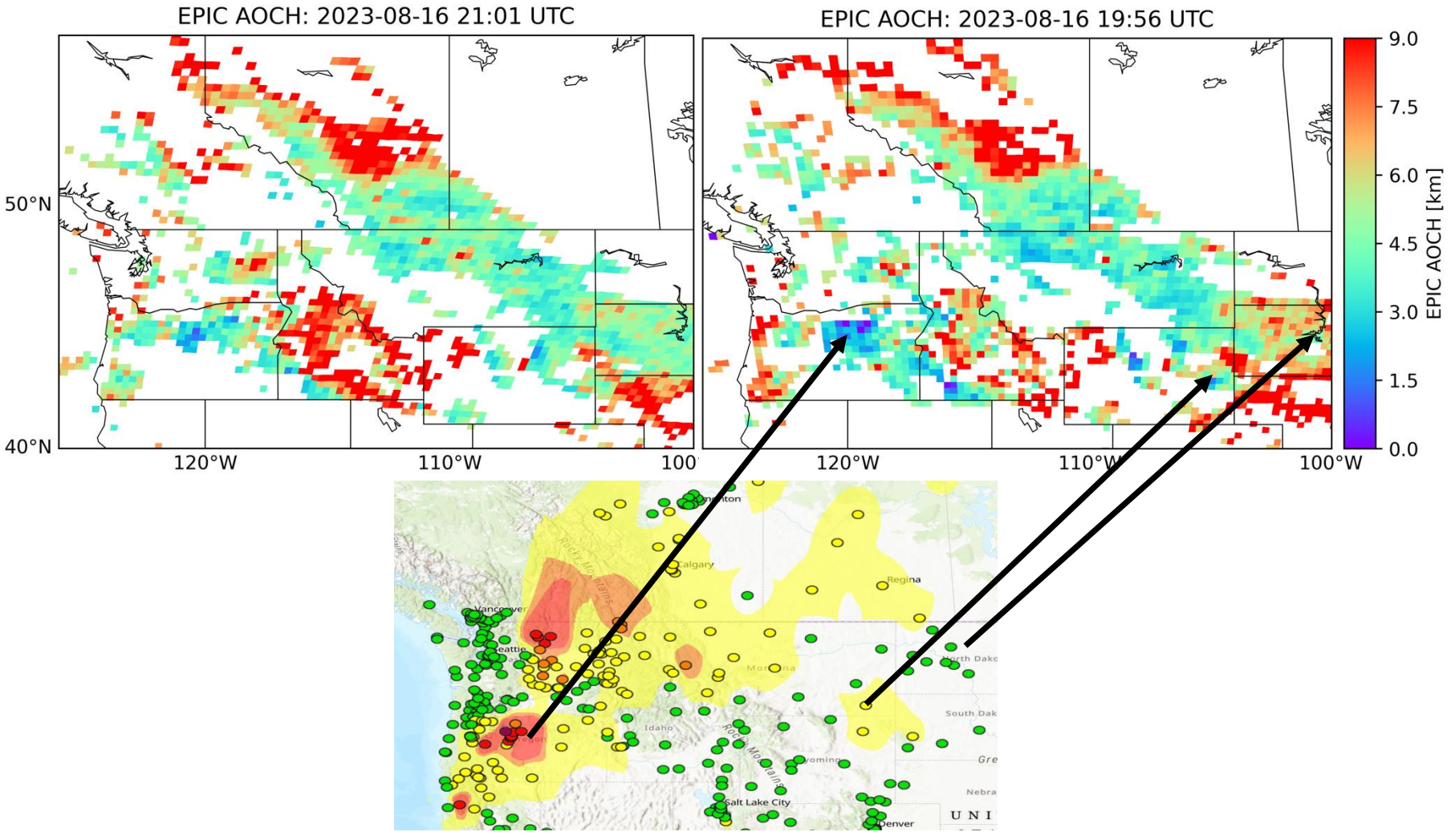
EPIC AOCH: 2023-08-16 21:01 UTC
EPIC AOCH: 2023-08-16 19:56 UTC
50°N
40°N
120°W
110°W
100°W
9.0
7.5
6.0
4.5
3.0
1.5
0.0
EPIC AOCH [km]
Calgary
Regina
Vancouver
Seattle
Idaho
Salt Lake City
Denver