

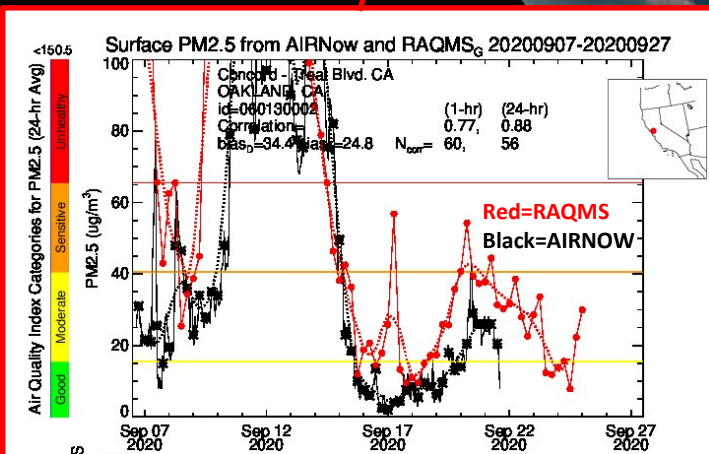
FRP (MW)



PM<sub>2.5</sub> (μg/m<sup>3</sup>)



- ▼ GOES-16 Layers
- ▼ GOES-17 Layers
- ▼ VIIRS Layers (SNPP)
- ▼ VIIRS Layers (NOAA-20)
- ▼ PM2.5 Layers
- ▼ Labels Layer
- + Boundaries Layer
- + Labels Layer

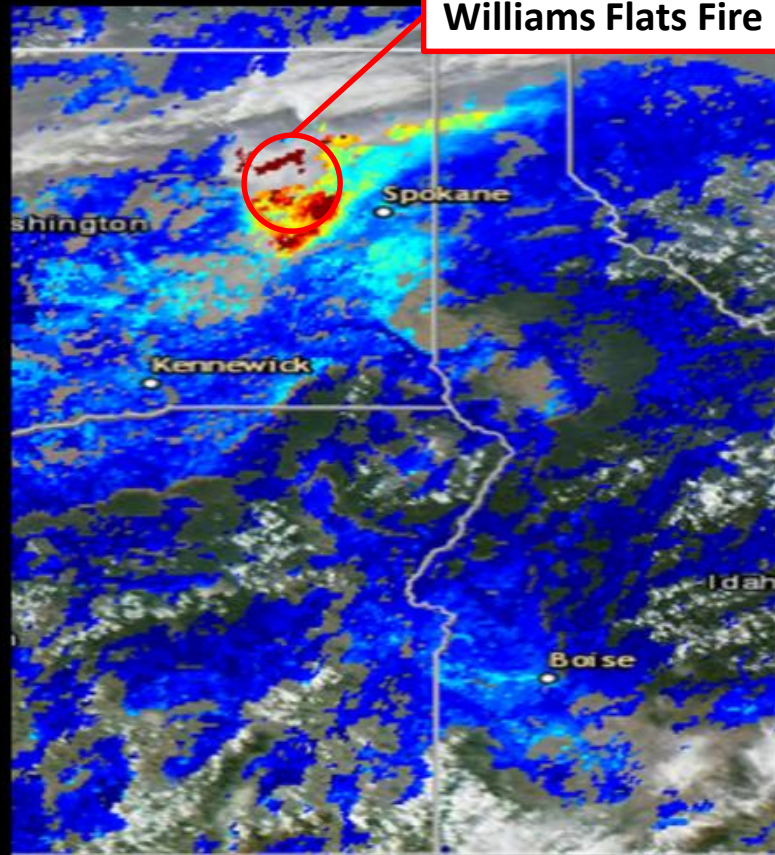


What satellite observations are available (current and future capabilities)? Assimilation of satellite measurements.



# GOES ABI Aerosol Optical Depth (AOD) and WRF-Chem Fire Radiative Power (FRP) Experiments, August 03, 2019

GOES-17 ABI AOD (23:51Z 20190803)

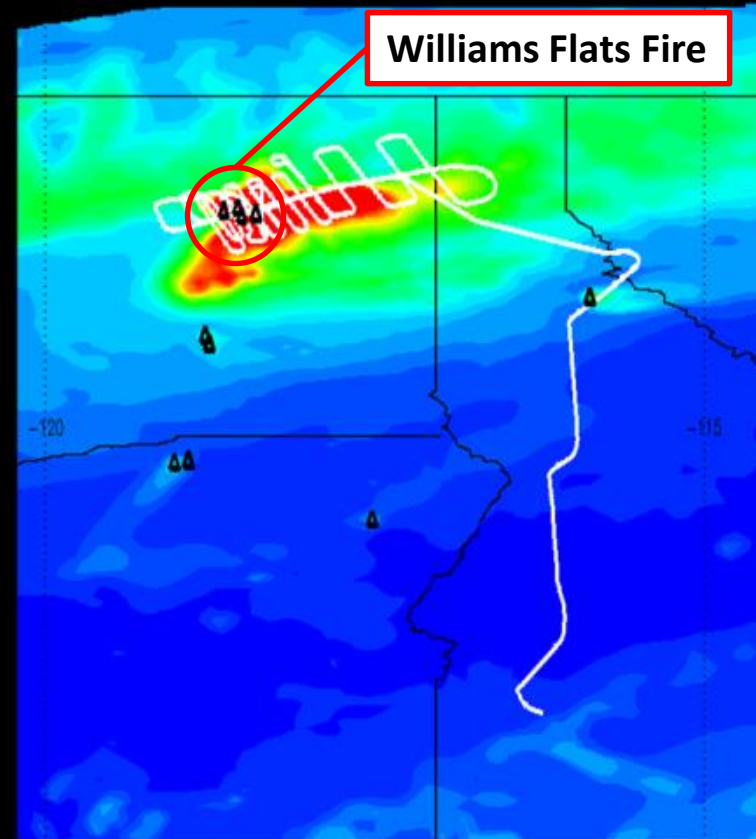


Williams Flats Fire

 **AerosolWatch**  
Every 10 minutes...

NO DATA 0.0 0.2 0.4 0.6 0.8 1.0

WRF-Chem FRP AOD (00Z 20190804)

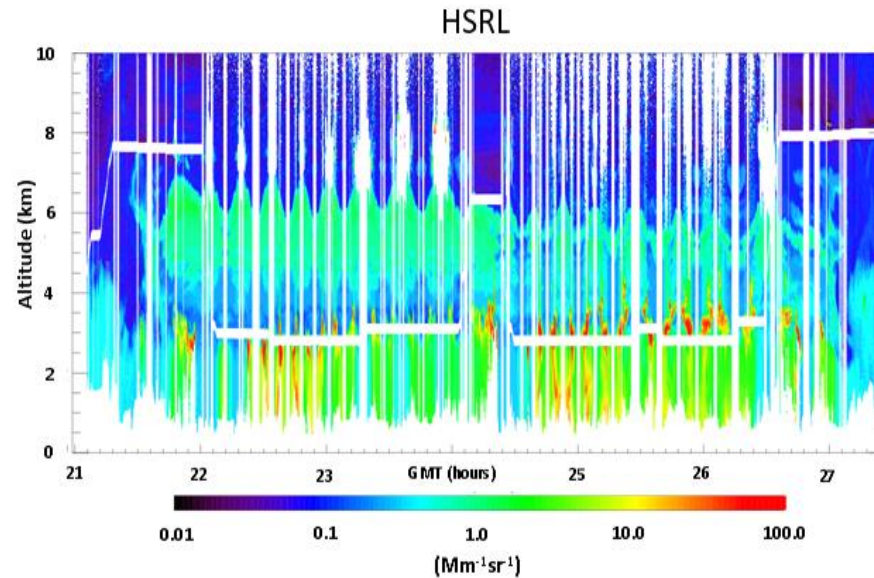


Williams Flats Fire

  
0.0 0.2 0.4 0.6 0.8 1.0  
AOD

- ☐ Use of 5-minute ABI FRP for wildfire emissions and injection heights following approach VIIRS in HRRR-Smoke
- ☐ High resolution (8km) WRF-Chem FRP based aerosol AOD forecasts are in good agreement with ABI

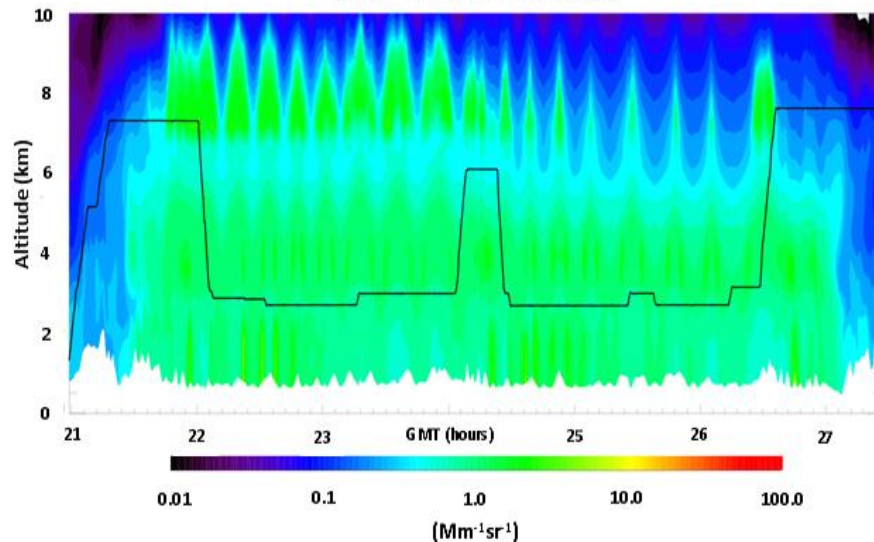
# FIREX-AQ High Spectral Resolution Lidar (HSRL) and WRF-Chem Control and FRP Experiments, August 03, 2019



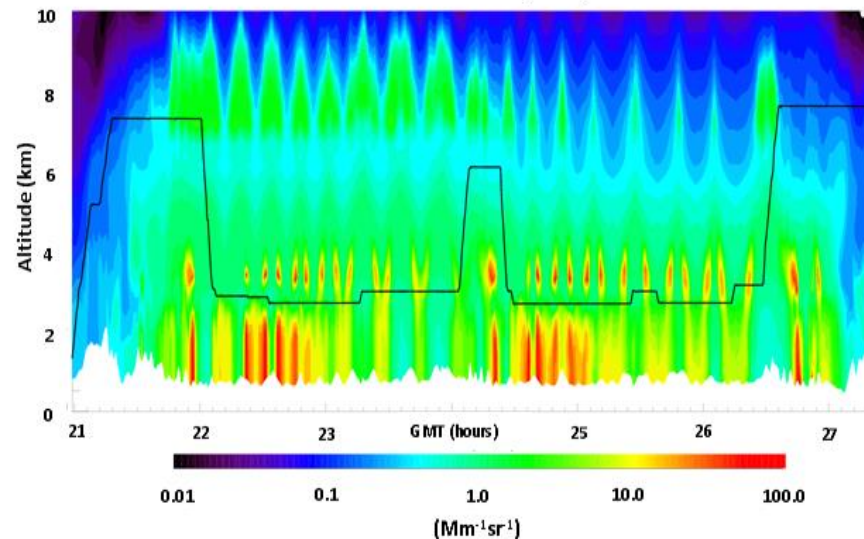
FIREX-AQ HSRL  
John Hair (NASA LaRC)

- ☐ Use of 5-minute ABI FRP for wildfire emissions and injection heights following approach VIIRS in HRRR-Smoke
- ☐ Significant improvement in predicted aerosol backscatter and injection heights

WRF-Chem (Control)

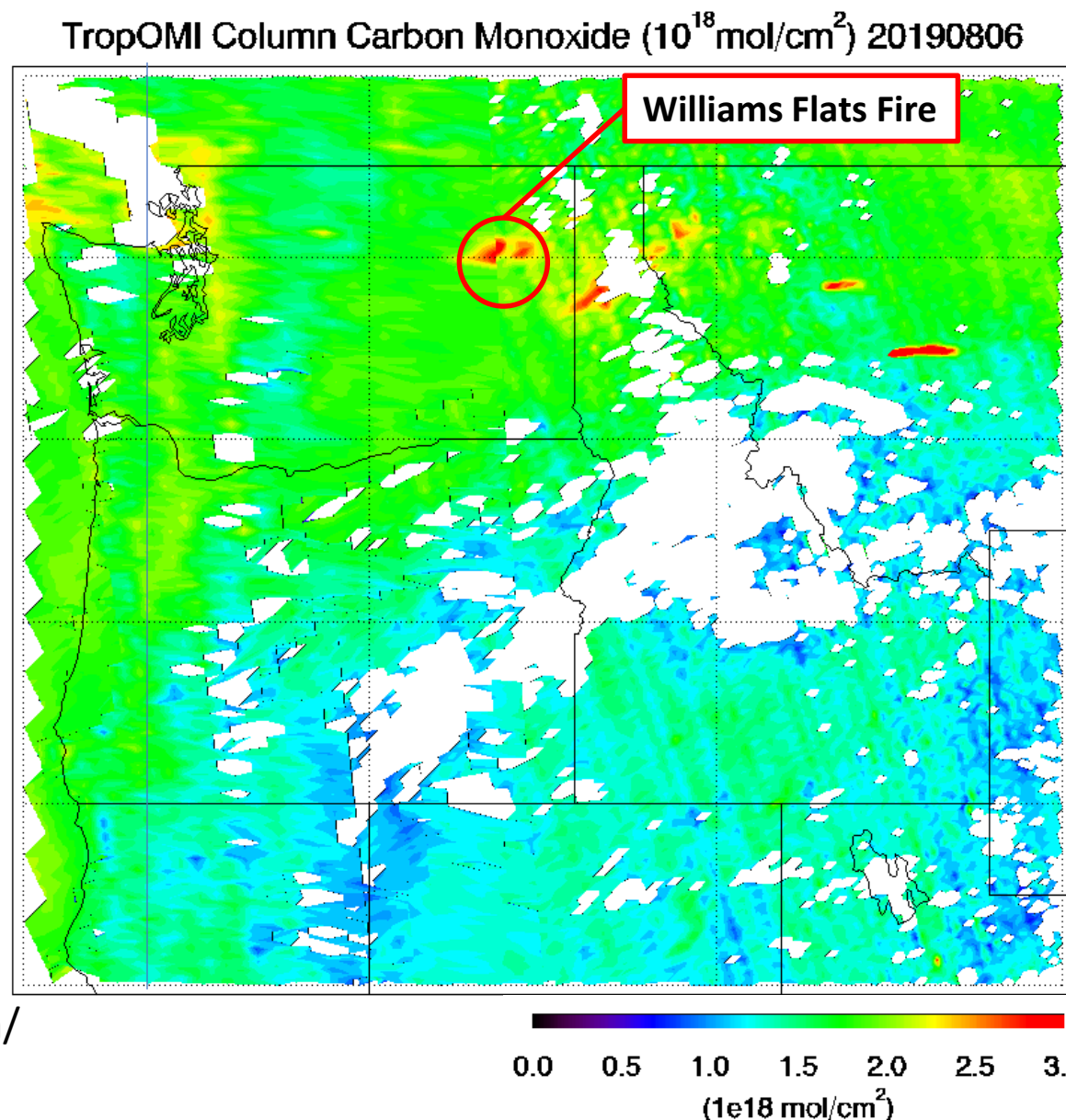
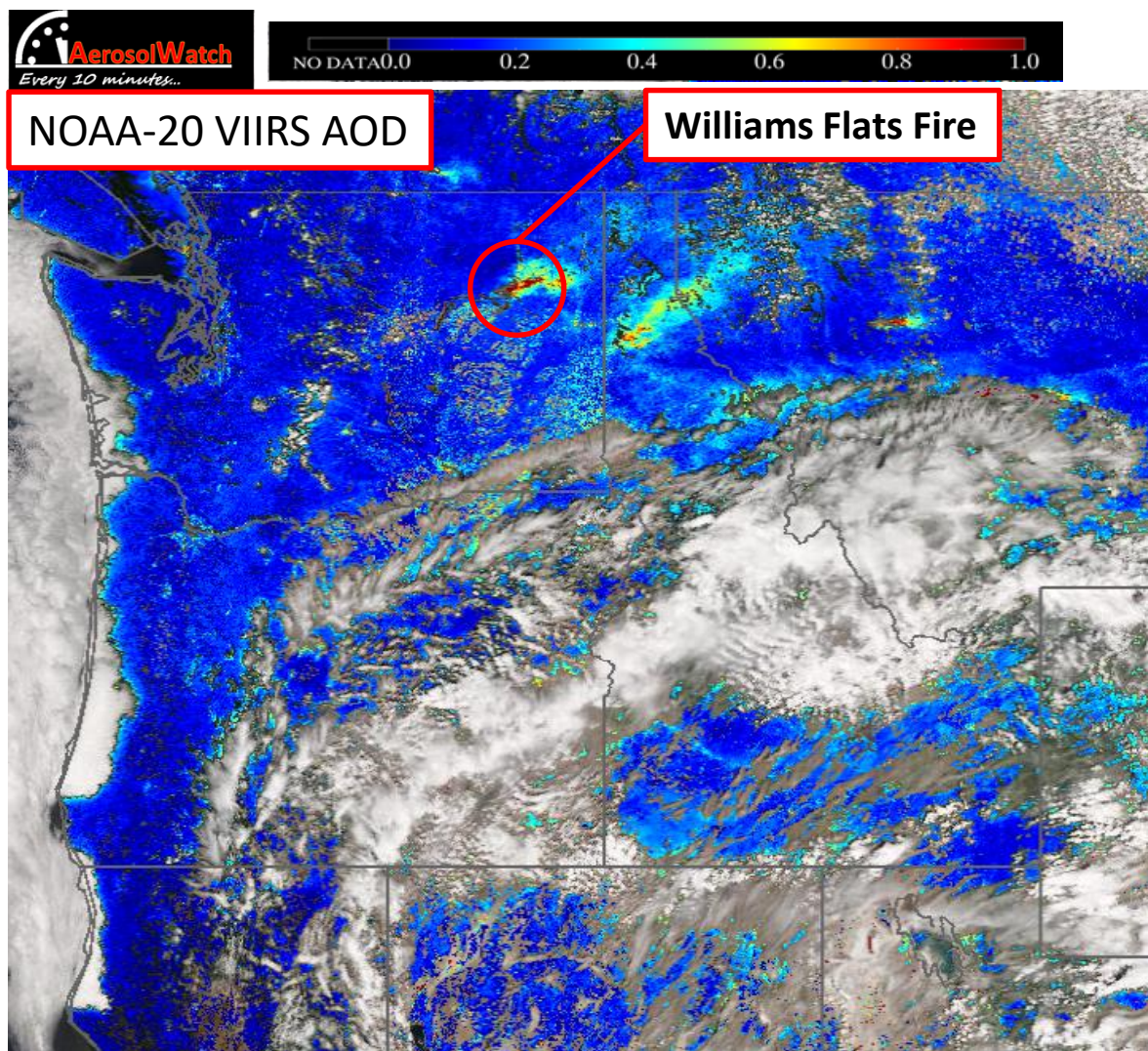


WRF-Chem (FRP)





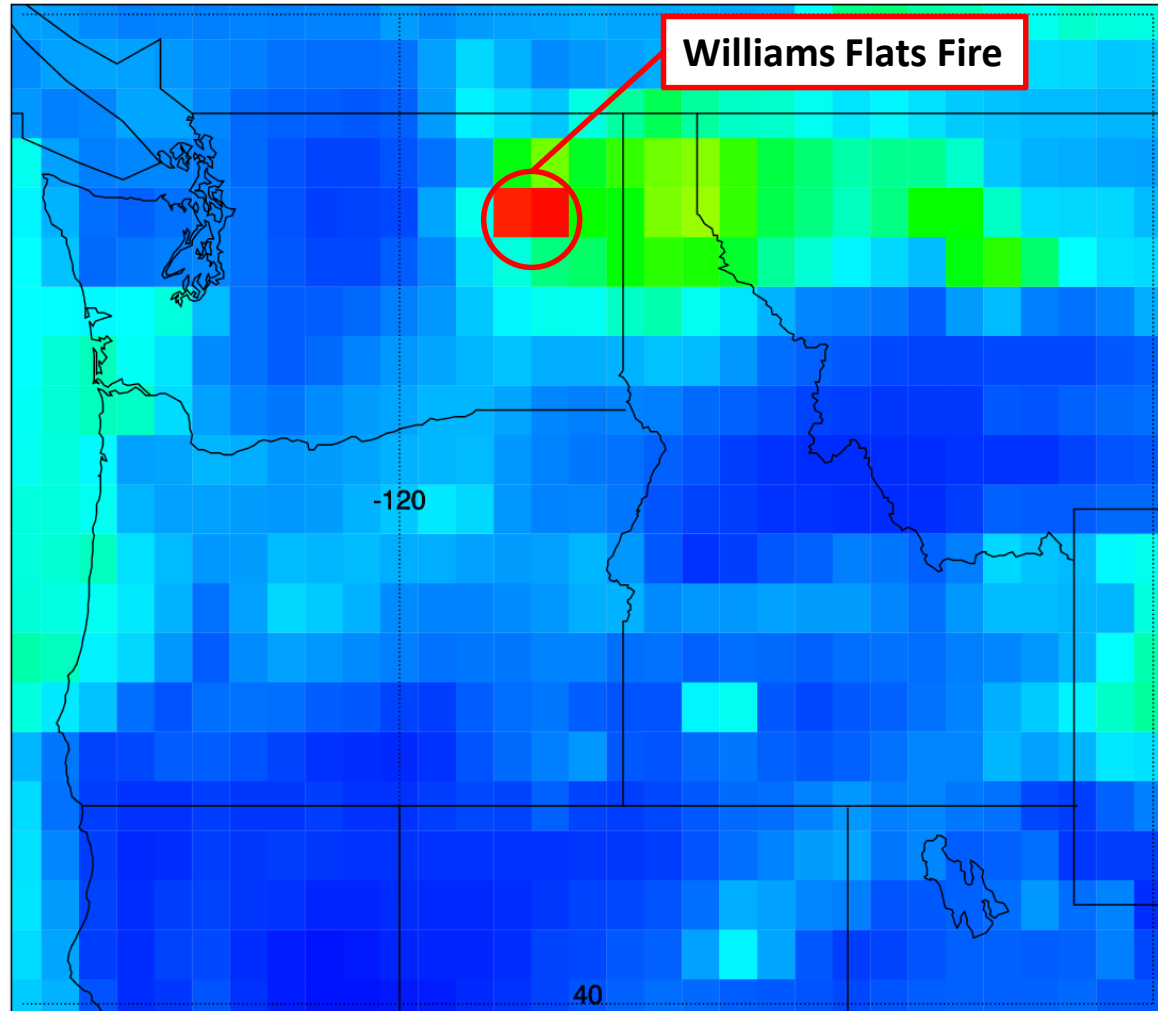
# NOAA-20 VIIRS Aerosol Optical Depth (AOD) and TROPOMI Carbon Monoxide (CO) August 06, 2019



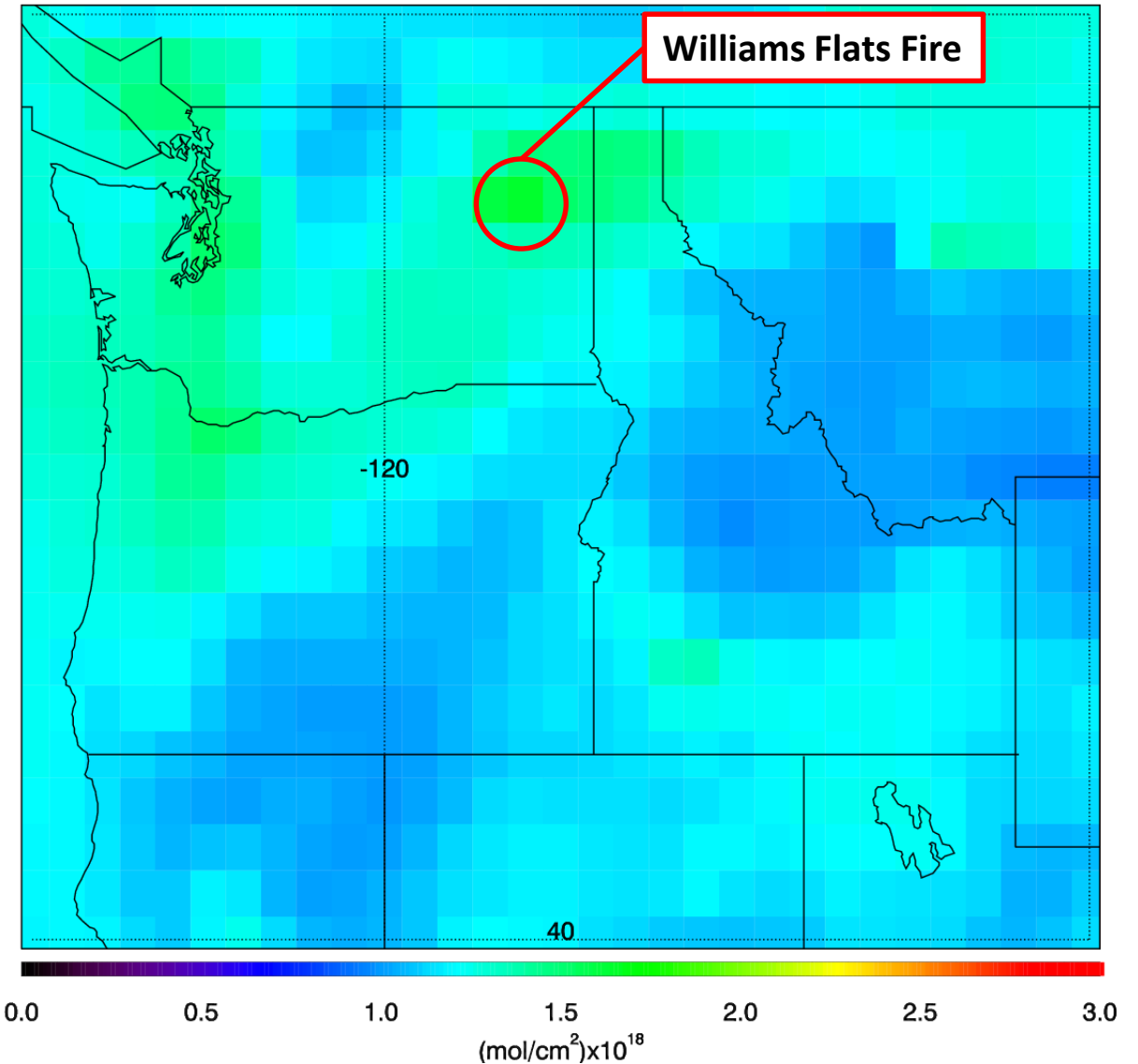
<https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/>

# NOAA UFS-RAQMS Aerosol Optical Depth (AOD) and Carbon Monoxide Forecast 21Z August 06, 2019

AOD FIREX-AQ  
(O3.PSAS.NGAC.C192.GSI.NO2.20190806)



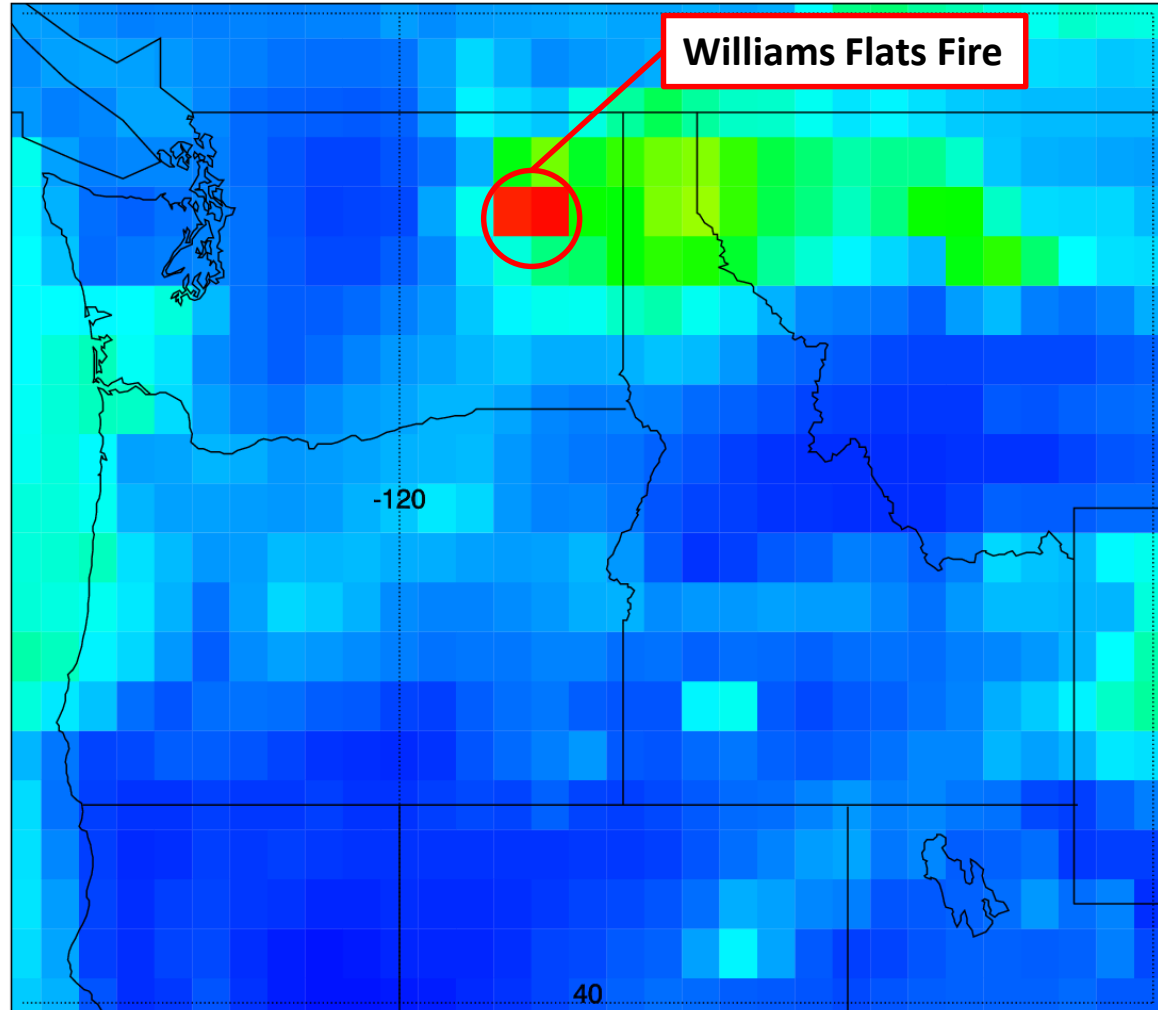
CO Column (mol/cm<sup>2</sup>) FIREX-AQ  
(O3.PSAS.NGAC.C192.GSI.NO2.20190806)



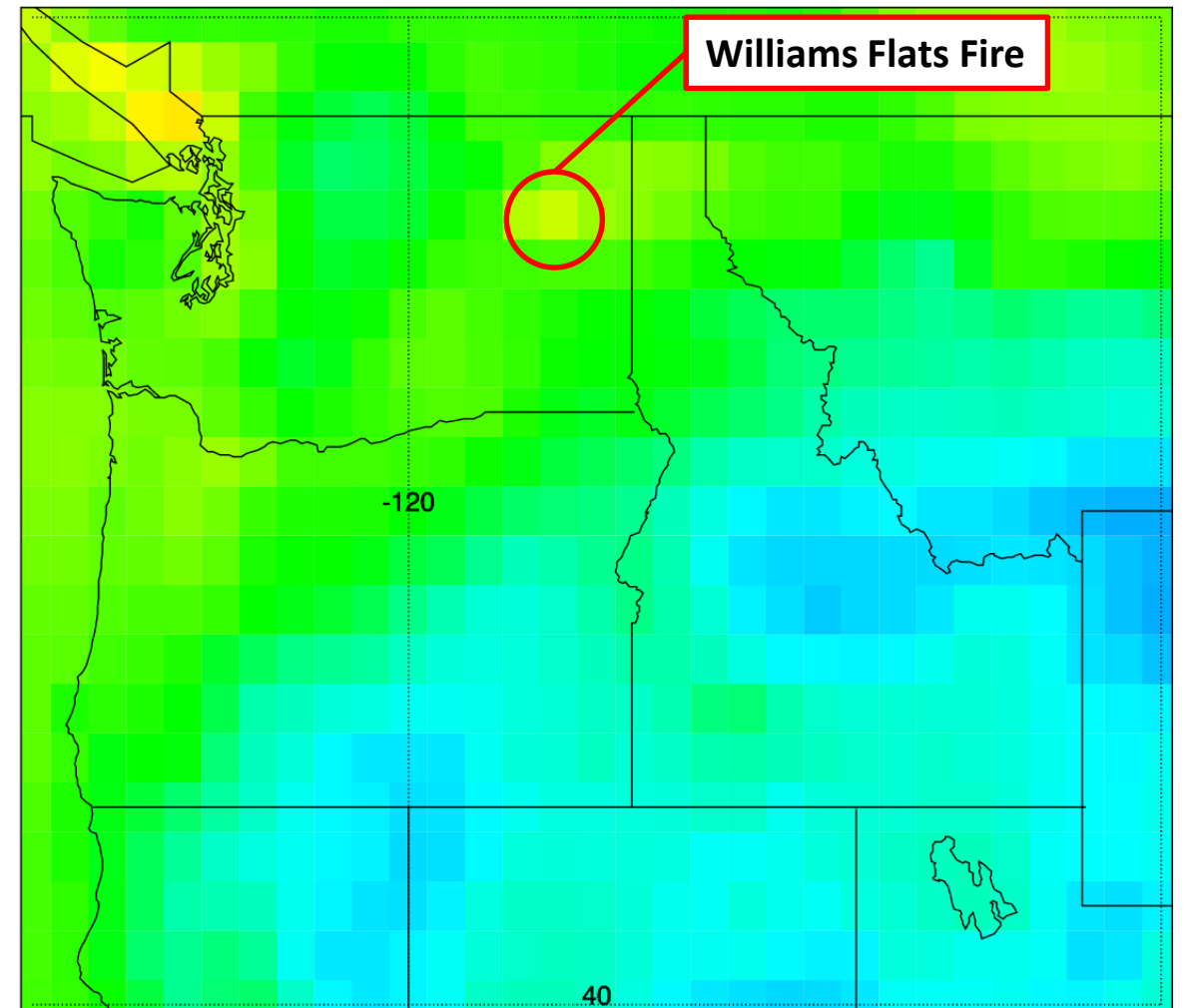
# NOAA UFS-RAQMS Aerosol Optical Depth (AOD) and Carbon Monoxide (TROPOMI Data Assimilation) 21Z August 06, 2019

AOD FIREX-AQ  
(O3.PSAS.NGAC.C192.GSI.NO2.20190806)

CO Column (mol/cm<sup>2</sup>) FIREX-AQ  
(O3.PSAS.NGAC.C192.GSI.CO.20190806)



0.0 0.2 0.4 0.6 0.8 1.0



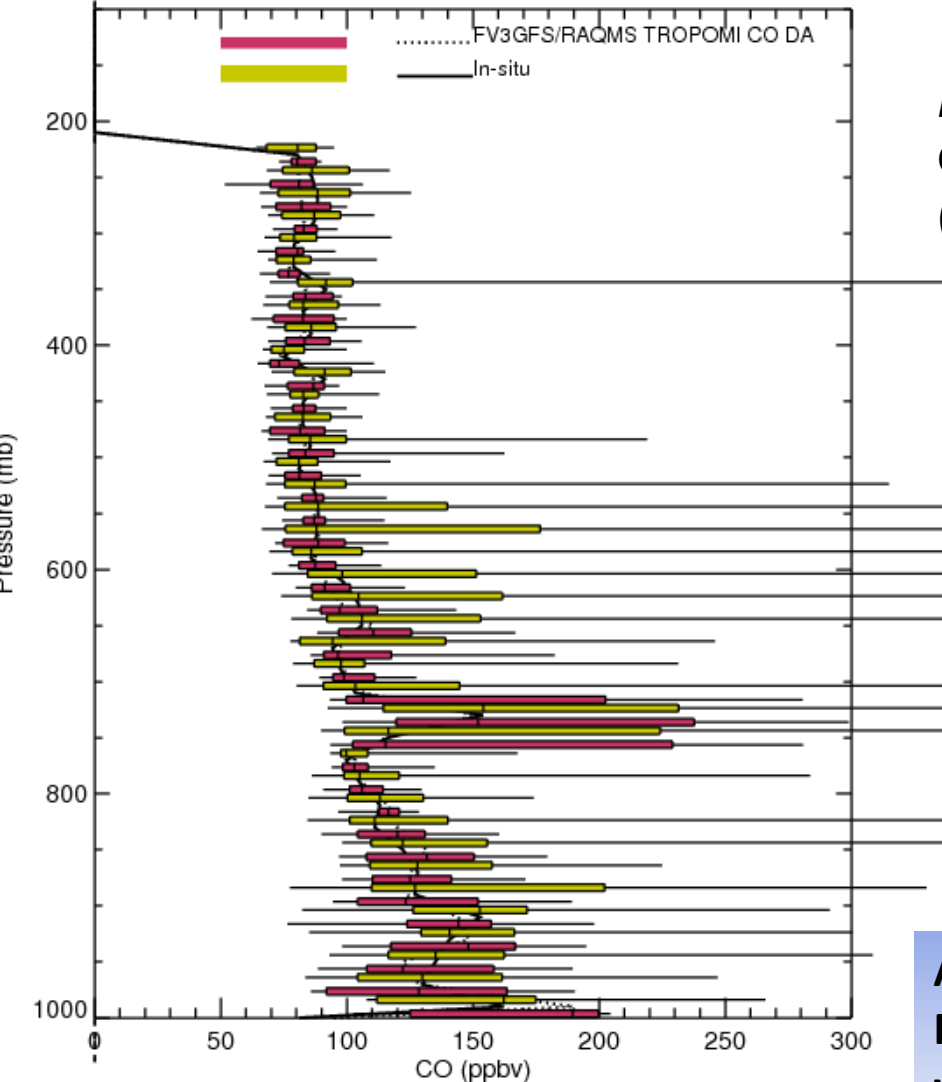
0.0 0.5 1.0 1.5 2.0 2.5 3.0

(mol/cm<sup>2</sup>)x10<sup>18</sup>



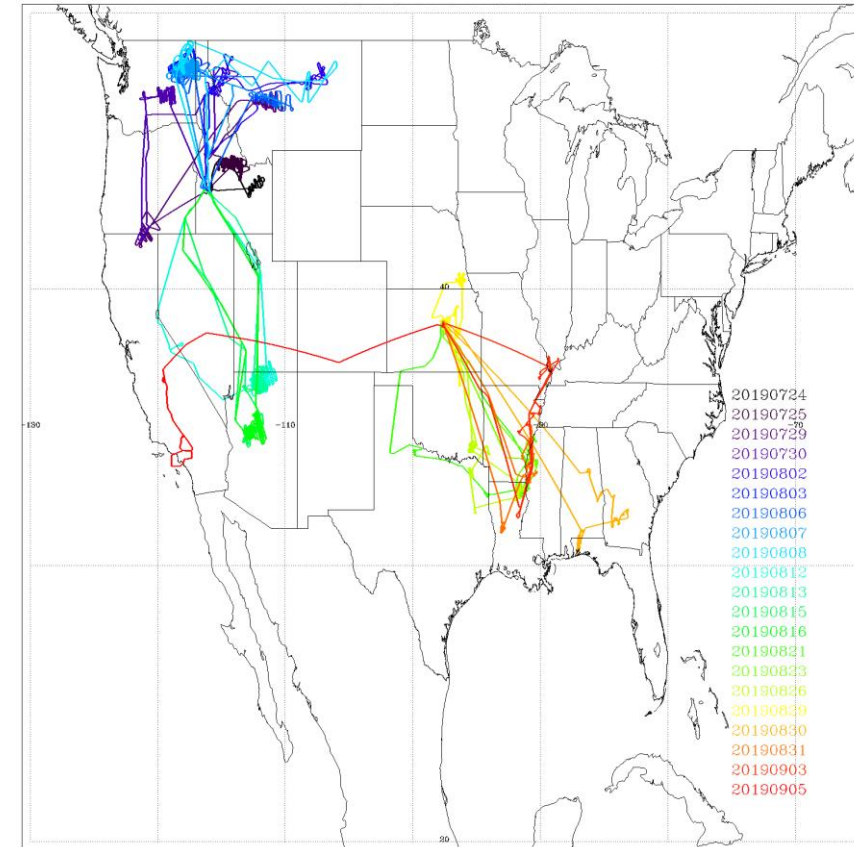
# FIREX-AQ insitu CO and UFS-RAQMS TROPOMI CO Data Assimilation Experiments, FIREX-AQ 2019

FV3GFS/RAQMS TROPOMI CO DA (0.5x0.5)/Insitu CO (Diskin)  
(07/24-09/05 FIREX-AQ Flight)



*Insitu* CO from  
Glen Diskin  
(NASA/LaRC)

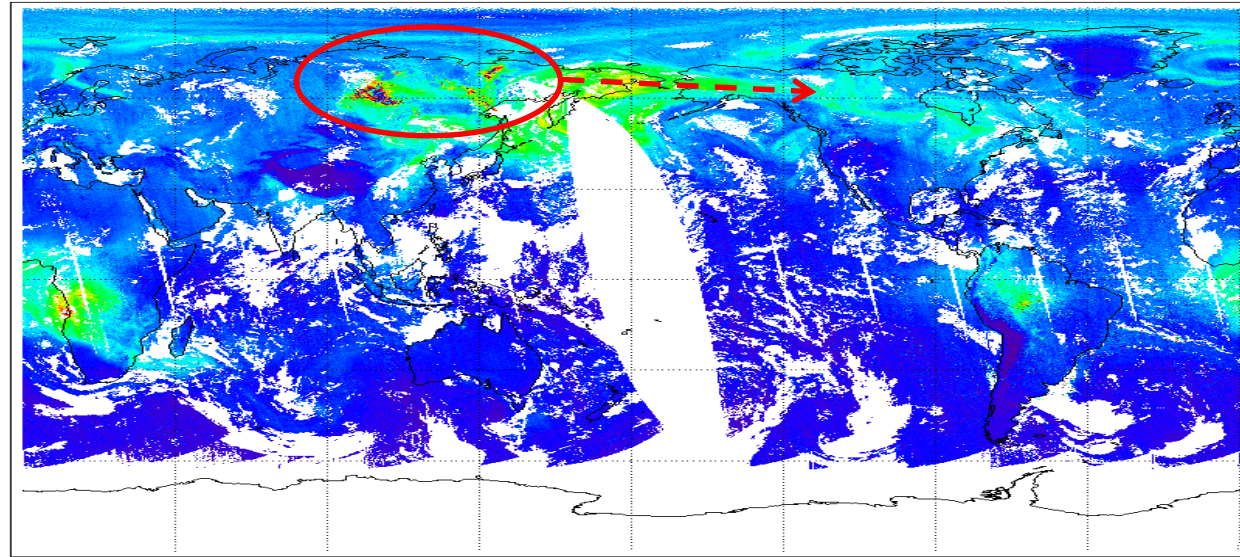
FIREX-AQ DC8 Flight Tracks



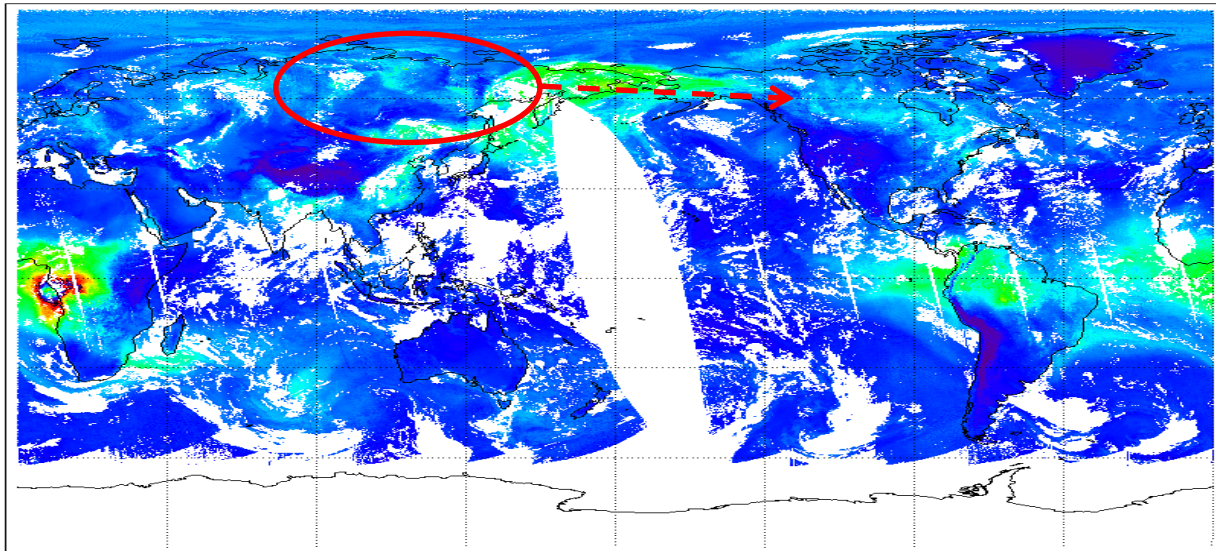
**Assimilation of TROPOMI CO column leads to significant improvements in UFS-RAQMS CO analysis (reduced bias, improved representation of variance within wildfire plumes) and very good agreement with *insitu* CO measurements**

# Long-range transport of wildfires can influence regional air quality

TROPOMI Column CO (August 06, 2019)

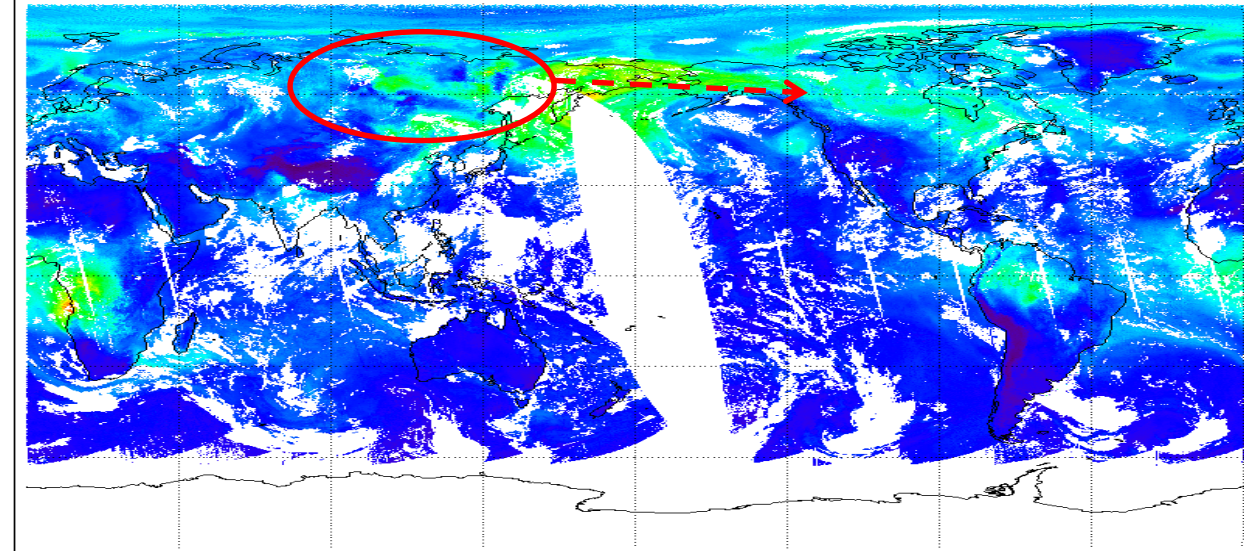


UFS-RAQMS (Control)



0 1 2 3 4 5 6  
( $10^{18}$  mol/cm<sup>2</sup>)

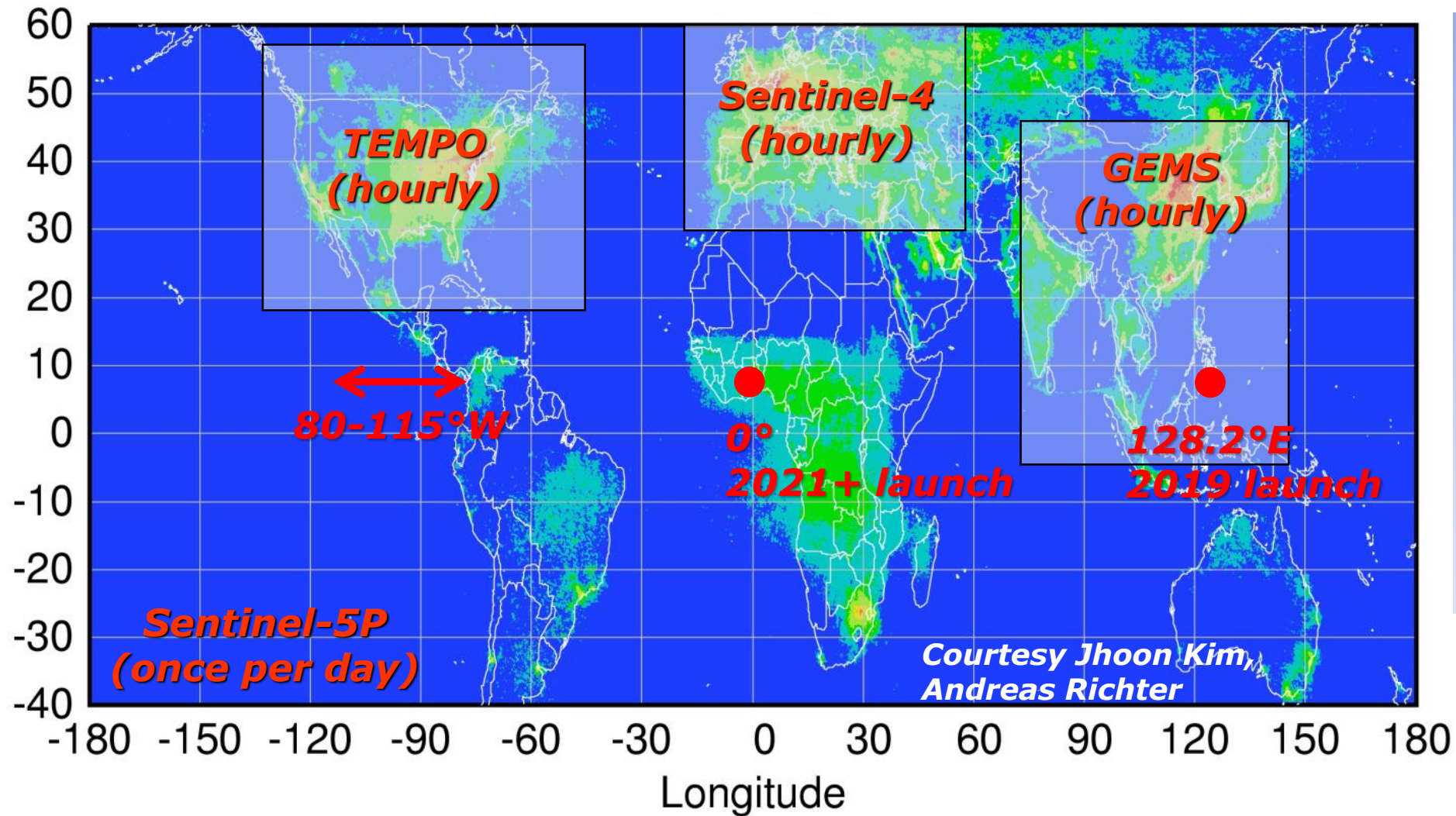
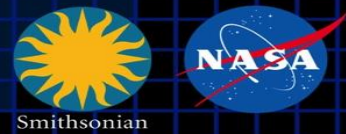
UFS-RAQMS (TROPOMI DA)







# Future: Global GEO/LEO pollution monitoring constellation



- The suite of  $\text{NO}_2$ ,  $\text{H}_2\text{CO}$ ,  $\text{C}_2\text{H}_2\text{O}_2$ ,  $\text{O}_3$ ,  $\text{H}_2\text{O}$ , and aerosol measurements from TEMPO will help constrain secondary formation of VOCs and ozone.
- TEMPO (GEMS) trace-gas retrievals will complement ABI (AHI) fire detection and aerosol measurements.

## Summary for discussion:

**The new Geostationary imagers (ABI/AHI) are comparable to MODIS and VIIRS Polar orbiting satellites:** These new sensors provide new temporal information regarding the day-time evolution of wildfire emissions (through FRP) and aerosol loading (through AOD) that can be used to constrain regional air quality forecast models.

**The new TROPOMI UV/NIR instrument provides high-resolution trace gas retrievals:** This new sensor provides high resolution information about wildfire chemistry through retrievals of CO, HCO, and NO<sub>2</sub> that can be used to constrain global air quality forecast models.

**Sentinel-5P follows NOAA-20 by only 5 minutes:** This allows combined use of TROPOMI, VIIRS, CrIS, and OMPS retrievals for cloud clearing and multi spectral (UV/NIR/TIR) of O<sub>3</sub> and CO with improved sensitivity to boundary layer concentrations that are critical for wildfire air quality impacts.

**The next generation of UV/VIS Geostationary sensors (TEMPO/GEMS/Sentinel-4) will be comparable to TROPOMI:** Combined, these new LEO and GEO satellites will provide unprecedented monitoring of global pollution, including wildfires.

**A hyperspectral GEO infrared sounder similar to CrIS or IASI** would allow hourly multi-spectral (UV/TIR) of O<sub>3</sub> with improved sensitivity to boundary layer concentrations that are critical for wildfire air quality impacts.