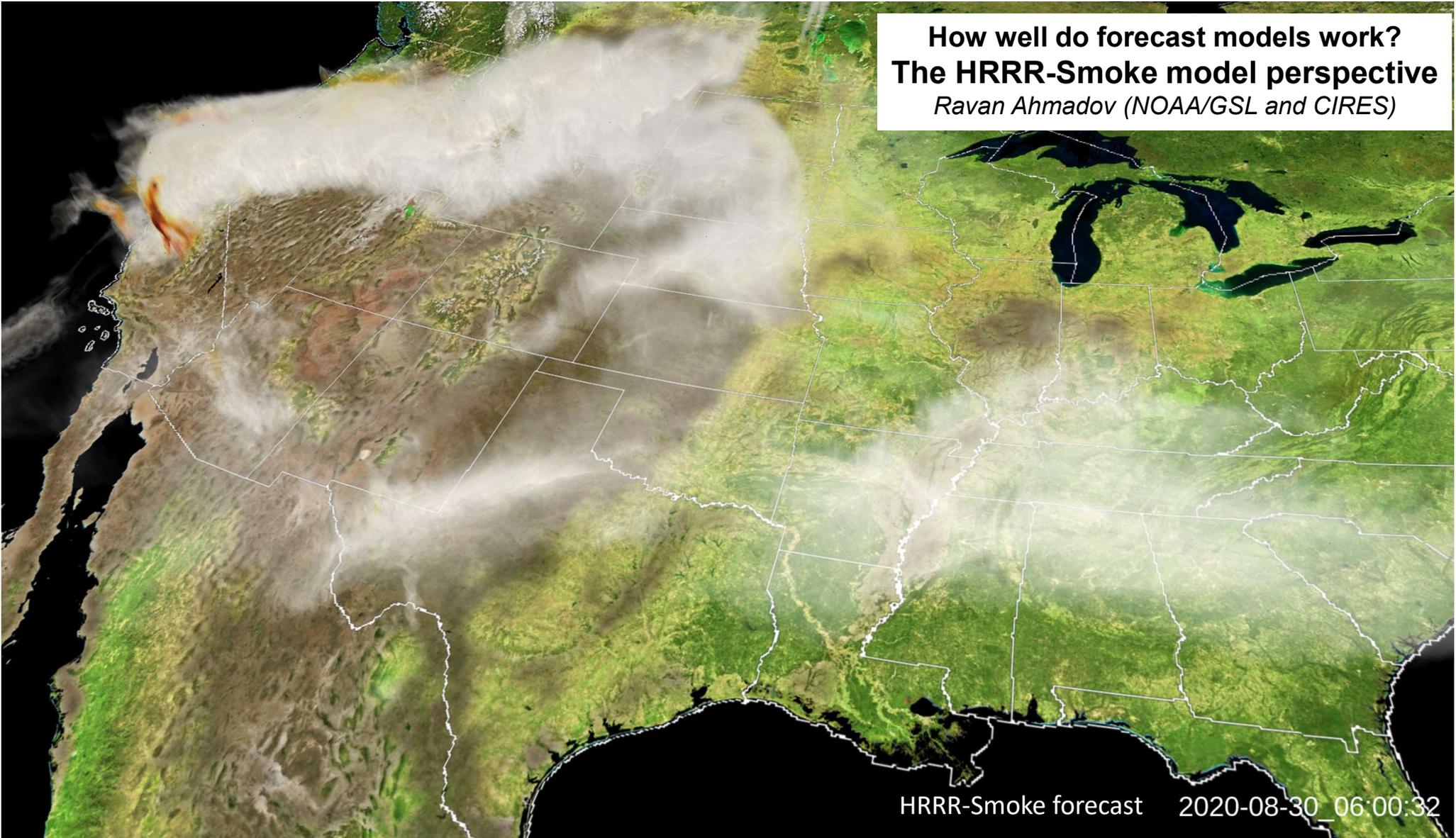


**How well do forecast models work?**  
**The HRRR-Smoke model perspective**  
*Ravan Ahmadov (NOAA/GSL and CIRES)*

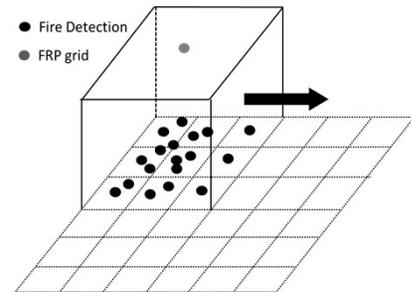


# Ingesting the real-time satellite fire radiative power data to the HRRR-Smoke model

The high-resolution **fire radiative power (FRP)** data from two **VIIRS** and two **MODIS** satellites are processed and mapped onto the HRRR-Smoke grid.

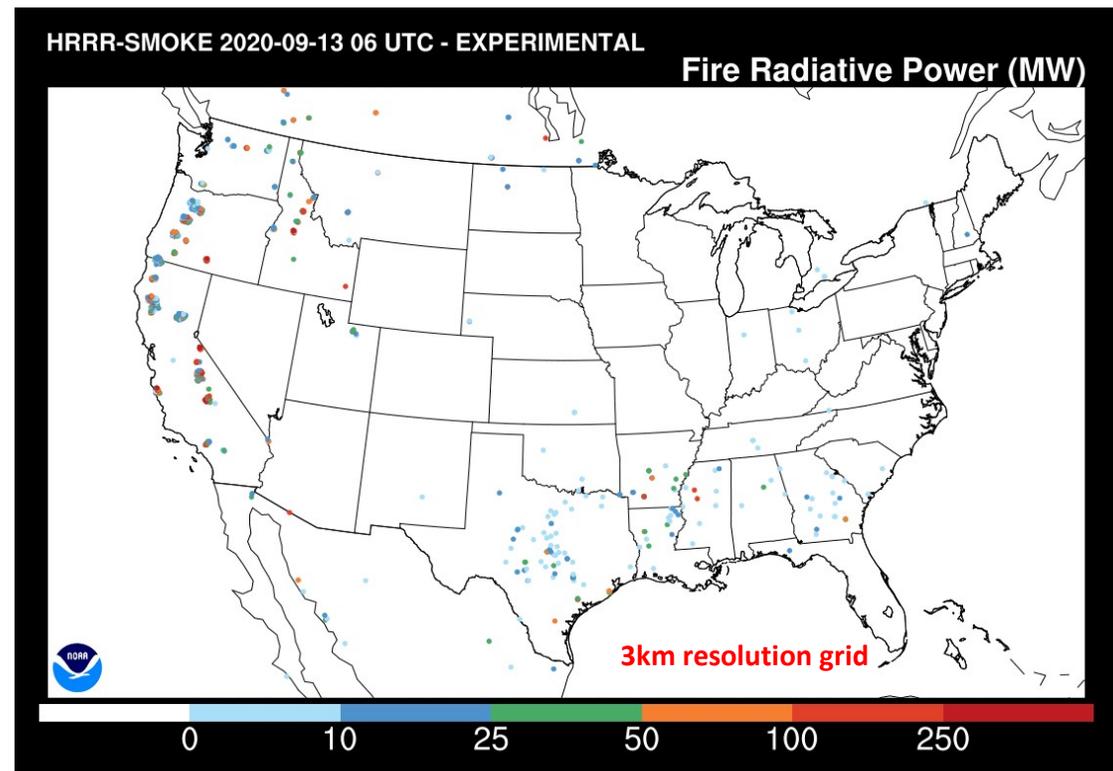


Fire emissions are estimated as follows:  
 $FRE = FRP \times \text{time (fire duration)}$   
Smoke emission  $\sim (FRE \times EF)$



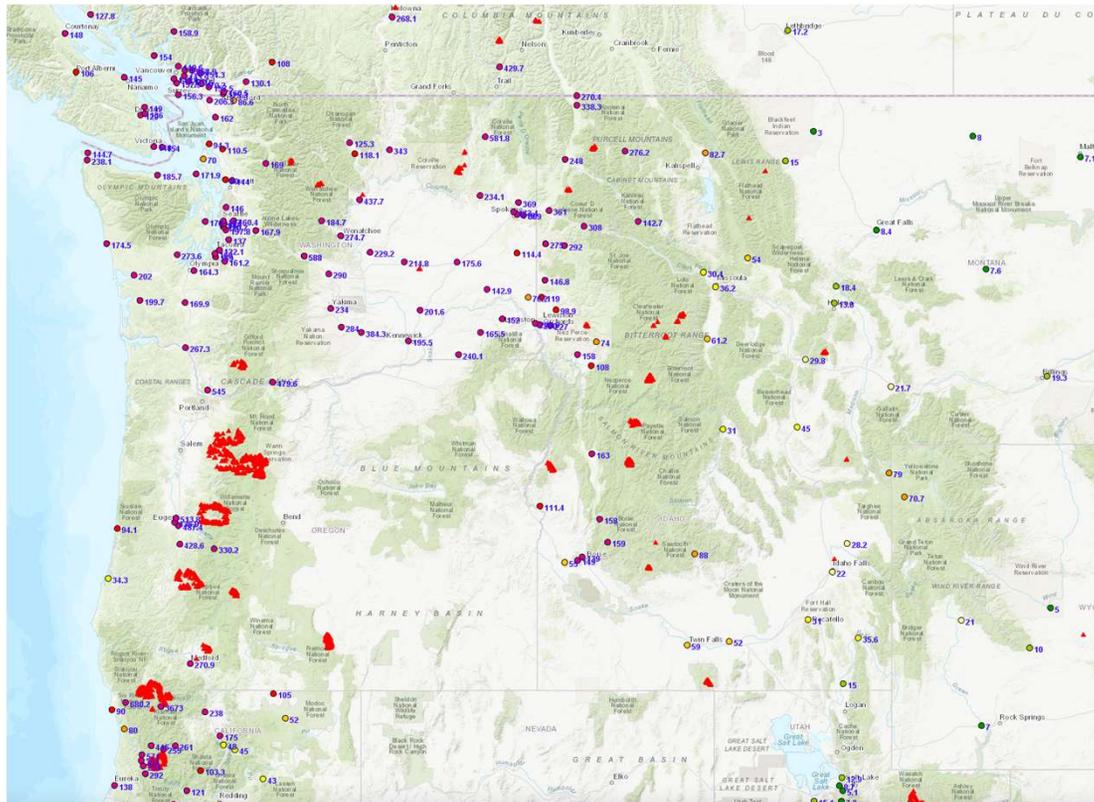
**Every hour** a new forecast starts by ingesting the satellite FRP data from previous 24 hours. HRRR-Smoke forecasts 3D smoke distribution up to 48 hours into the future.

Averaged satellite FRP data (24 hours) mapped over 3x3km HRRR CONUS grid pixels for September 13, 2020

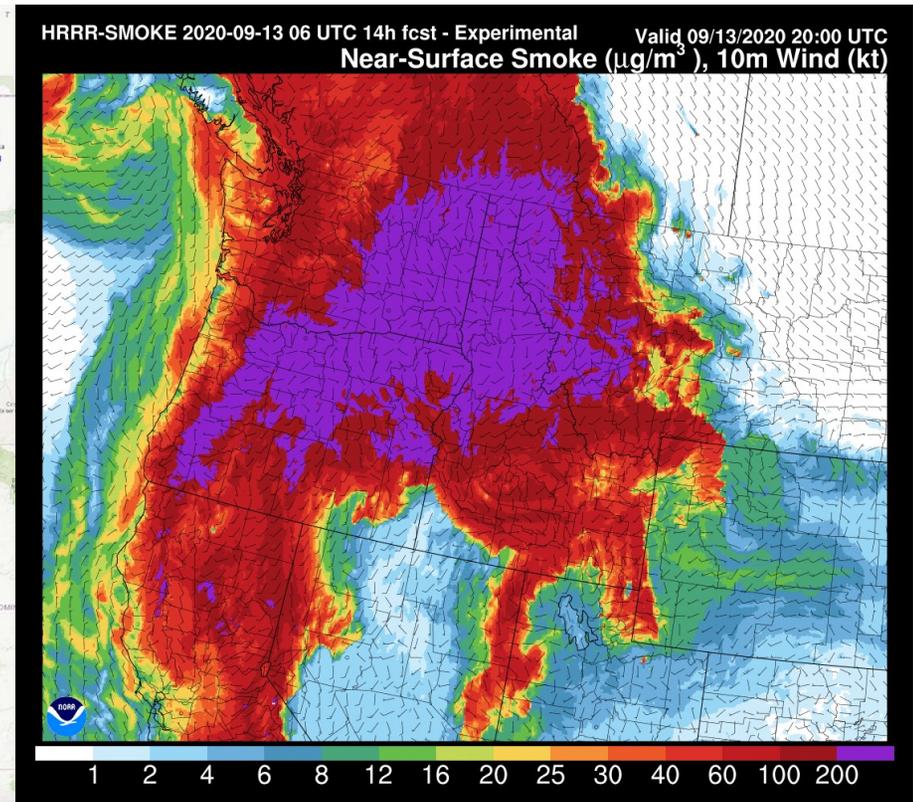


# Forecasting the extreme smoke pollution episodes this summer

PM<sub>2.5</sub> concentrations (AirNow), 1pm PDT, 09/13/2020

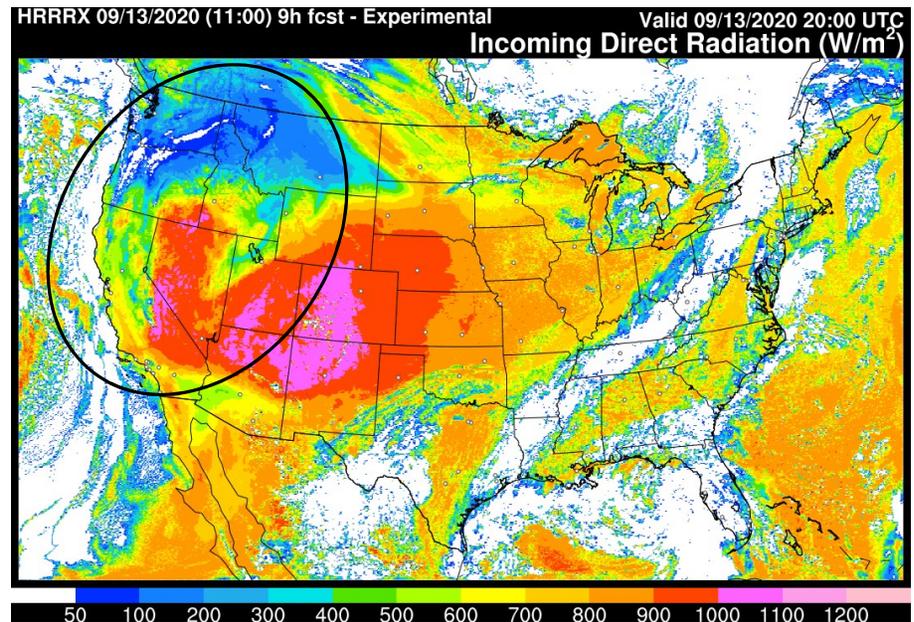
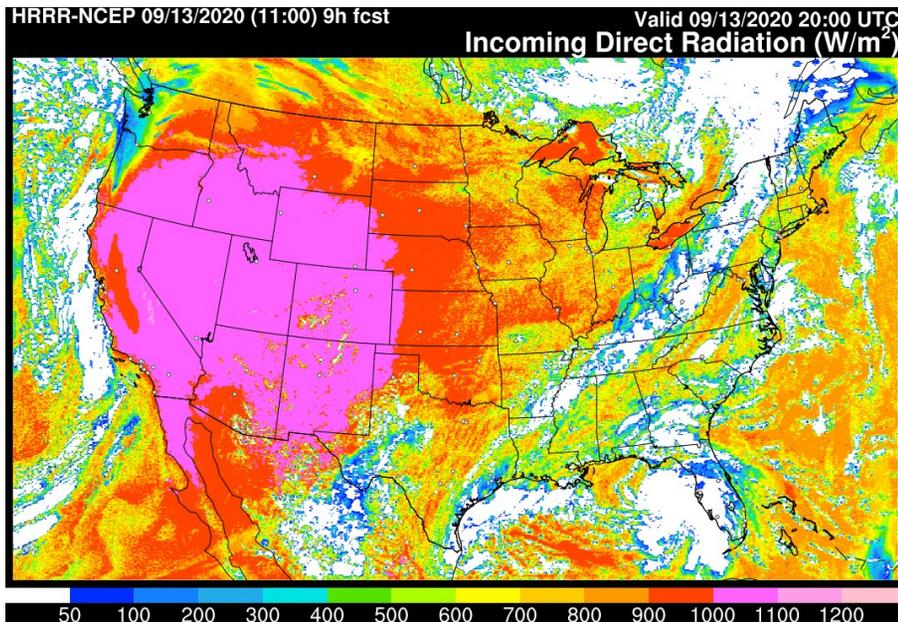


Smoke forecast by HRRR-Smoke



The PM<sub>2.5</sub> concentrations reached hazardous levels in many urban areas!

# Significant reduction in the solar radiation due to dense smoke *Implications for weather, solar energy production and visibility*



Hazy skies in Seattle, WA

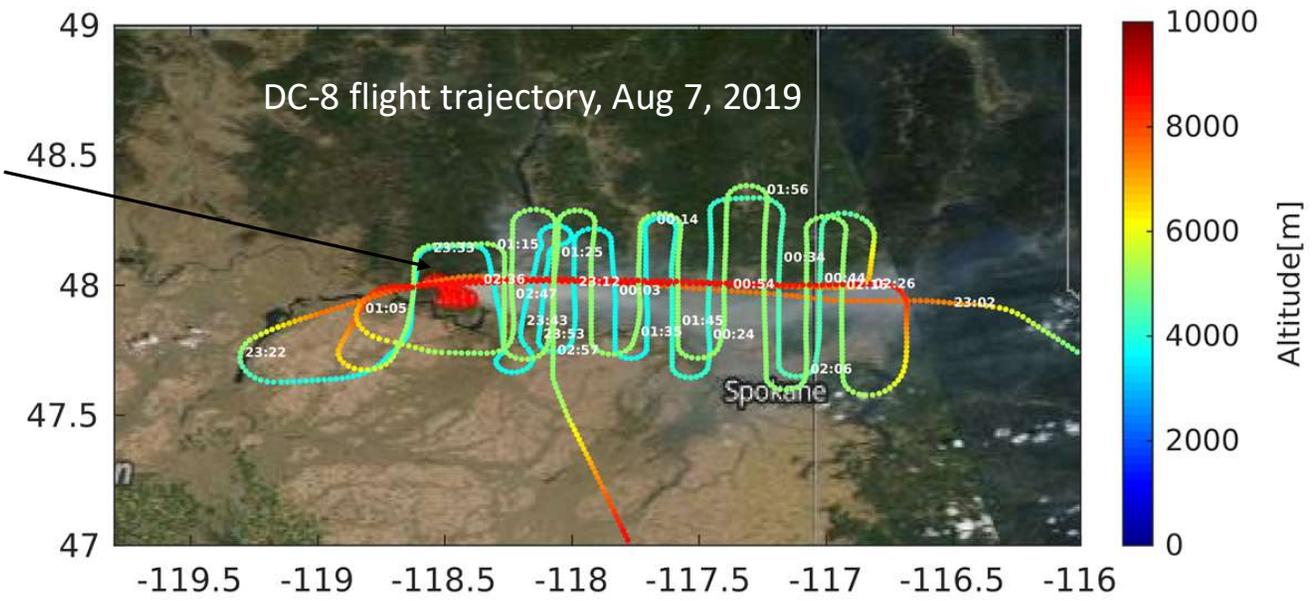


A thick smoke remains over Seattle on Sept. 13, 2020. (Photo courtesy: SuperClick Photography) <https://komonews.com>

Sampling of the smoke plume from the Williams Flats fire by the DC-8 aircraft during FIREX-AQ



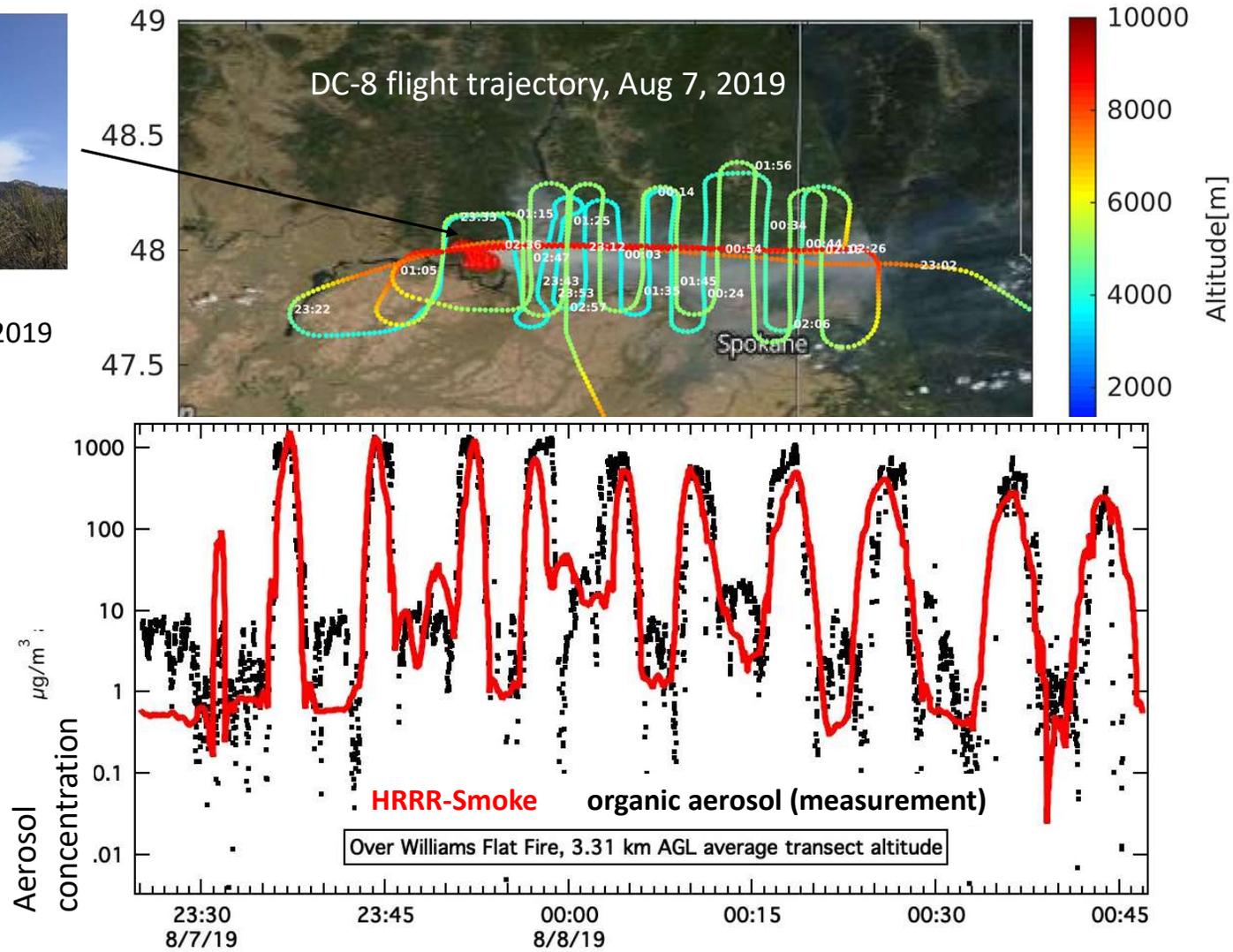
Williams Flats fire  
Started on August 2, 2019



The measurements from FIREX-AQ and other field campaigns are vital to evaluate and improve the smoke forecast models.

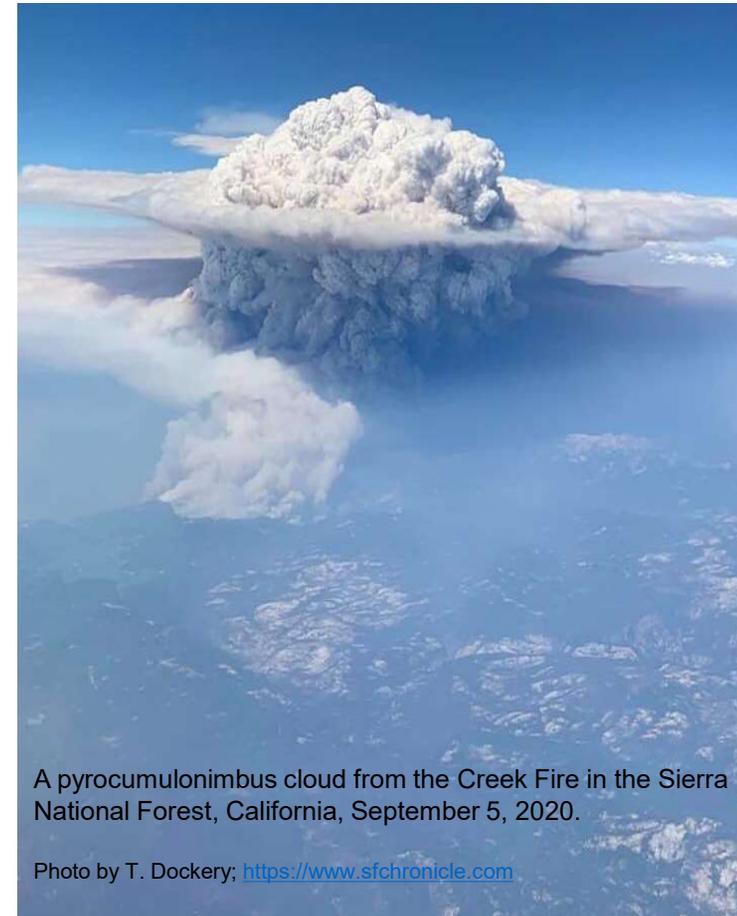


Williams Flats fire  
Started on August 2, 2019



## Concluding remarks

- The satellite fire detections and FRP data provide invaluable information to estimate the fire emissions and size in real time at high spatial resolution, which are ingested to air quality and smoke forecast models.
- Coupled meteorology-chemistry (e.g. HRRR-Smoke) models allow forecasting the impact of smoke on weather and visibility.
- There are a number of challenges in forecasting the smoke concentrations accurately, e.g. predicting the fire behavior, smoldering vs. flaming emissions, fire plume rise and smoke chemistry.
- There is a great need to develop next-generation smoke forecast models for fine-scale (~km) applications to simulate better the effects of complex terrain. These models should include the aerosol and ozone chemistry, aerosol-meteorology interactions, also assimilation of in-situ and remote sensing atmospheric composition measurements.



A pyrocumulonimbus cloud from the Creek Fire in the Sierra National Forest, California, September 5, 2020.

Photo by T. Dockery; <https://www.sfchronicle.com>