

Forecasting the Impact of Smoke from Mt McMurray Fires on U.S. Air Quality using S-NPP VIIRS Aerosol Products

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Operational Air Quality Forecasting

- State, local, and tribal agencies issue **air quality forecasts** to protect the public from the adverse health effects of criteria pollutants
 - 43 states plus Washington, DC
 - O_3 , $PM_{2.5}$, PM_{10} most commonly forecasted pollutants
 - Based on EPA's color coded Air Quality Index (AQI)
 - Forecasts typically issued by mid-afternoon (~3 PM) for next day; some agencies do morning updates
 - Forecasts available on state and local websites and EPA's AirNow national website (<http://www.airnow.gov/>)



Wildfire Smoke is a Problem for PM_{2.5} Forecasts

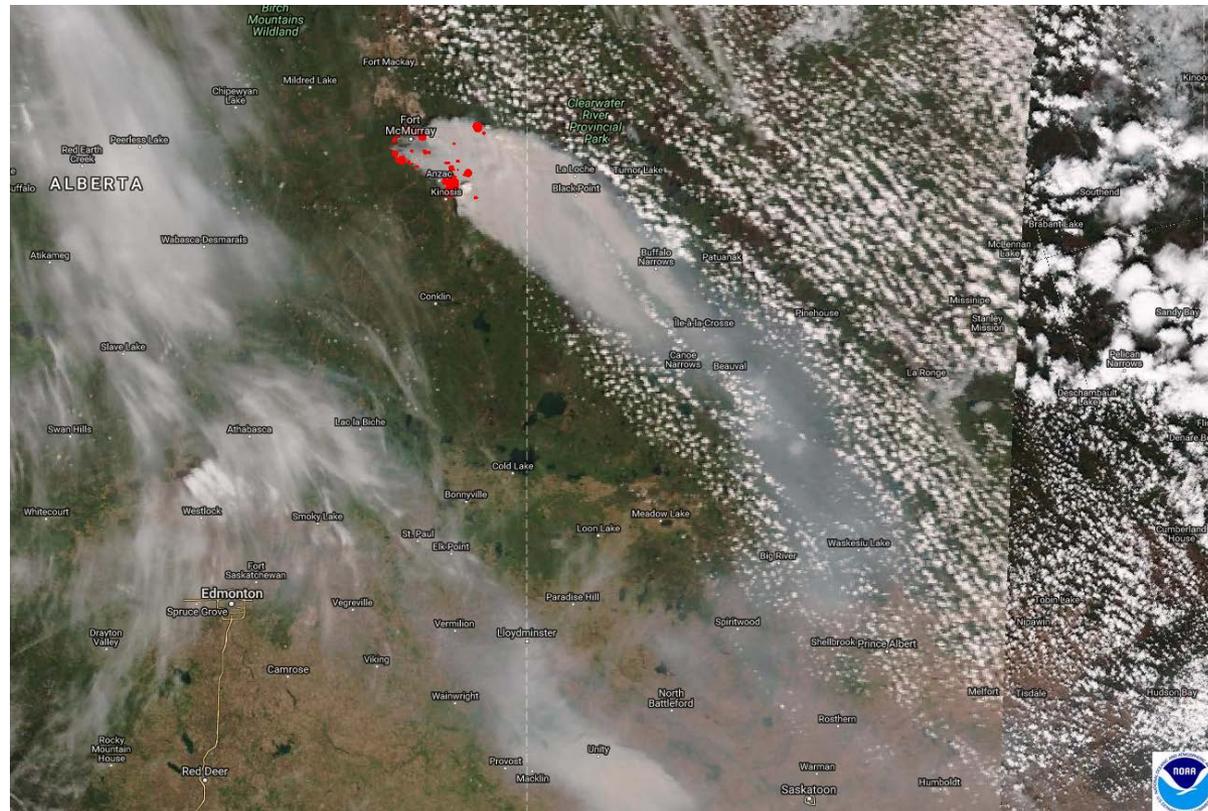
- PM_{2.5} is a mixture of solid and liquid particles with aerodynamic diameters $\leq 2.5 \mu\text{m}$
- Smoke from major wildfires can be transported long distances, sometimes 100s of km downwind
- If smoke mixes to surface, it can impact local PM_{2.5} conditions
 - Can cause exceedance of daily **National Ambient Air Quality Standard (NAAQS): $35 \mu\text{g}/\text{m}^3$ (24-hr)**
 - Observed Code Orange or higher PM_{2.5} corresponds to exceedance of NAAQS
 - Forecasted Code Orange or higher PM_{2.5}: **Air Quality Alert (AQA)** issued

Very Difficult to Forecast Impacts of Smoke

- Forecasters have variety of tools they use as guidance to prepare $PM_{2.5}$ forecasts, but **none** are skillful in case of transported smoke
- **Climatology**: smoke events are rare for most locations
- **Persistence**: can't account for first day of smoke event (but can be useful for multi-day smoke events)
- **Numerical $PM_{2.5}$ models**: don't include transported smoke in boundary conditions
- So forecasters turn to **satellite aerosol products** to track smoke plumes and predict whether smoke will mix to surface

Case Study: Fort McMurray Fire, May 2016

- Ft McMurray fire began May 1, 2016
 - Burned for more than 1 month
 - Consumed > 600,000 hectares
 - Forced evacuation of > 88,000 residents from city in early May

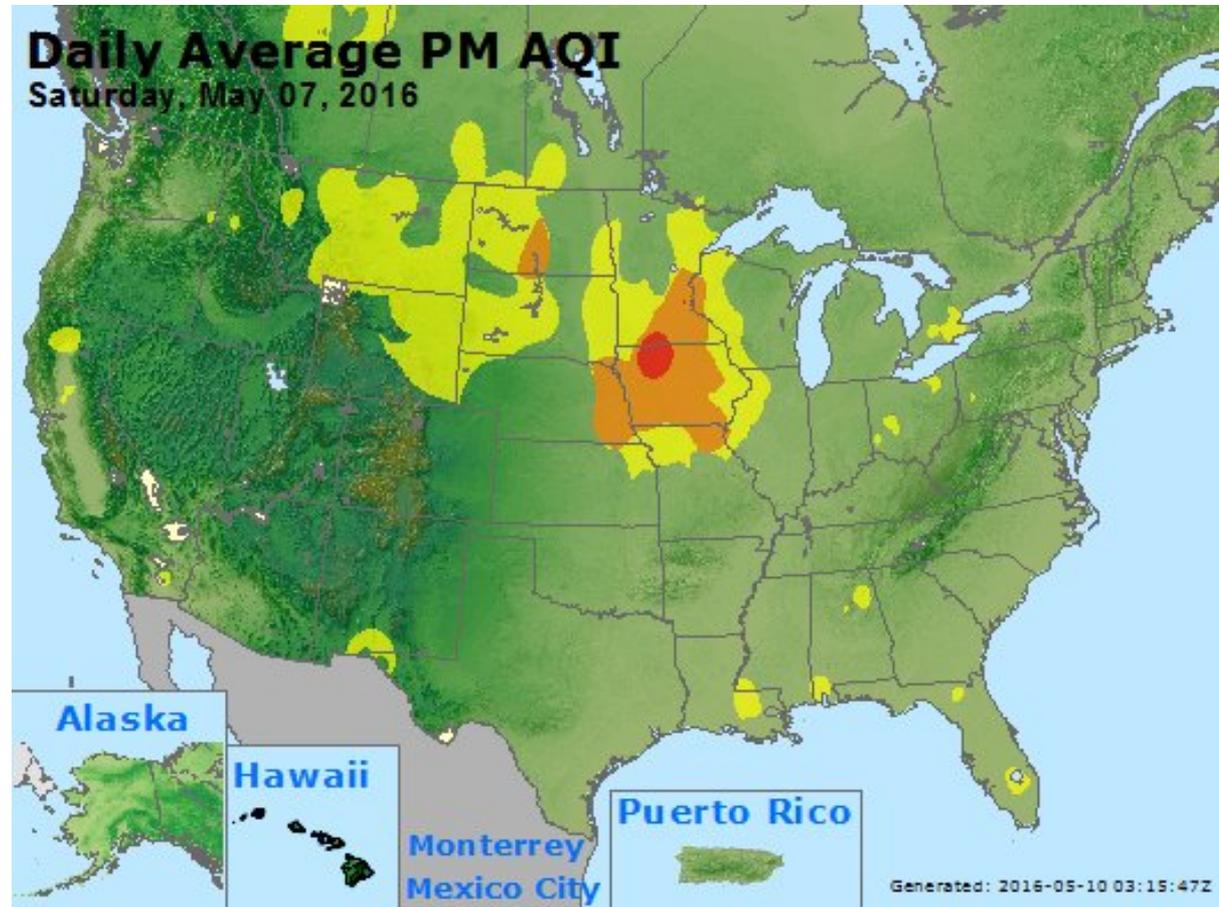


VIIRS RGB and FRP
May 6, 2016

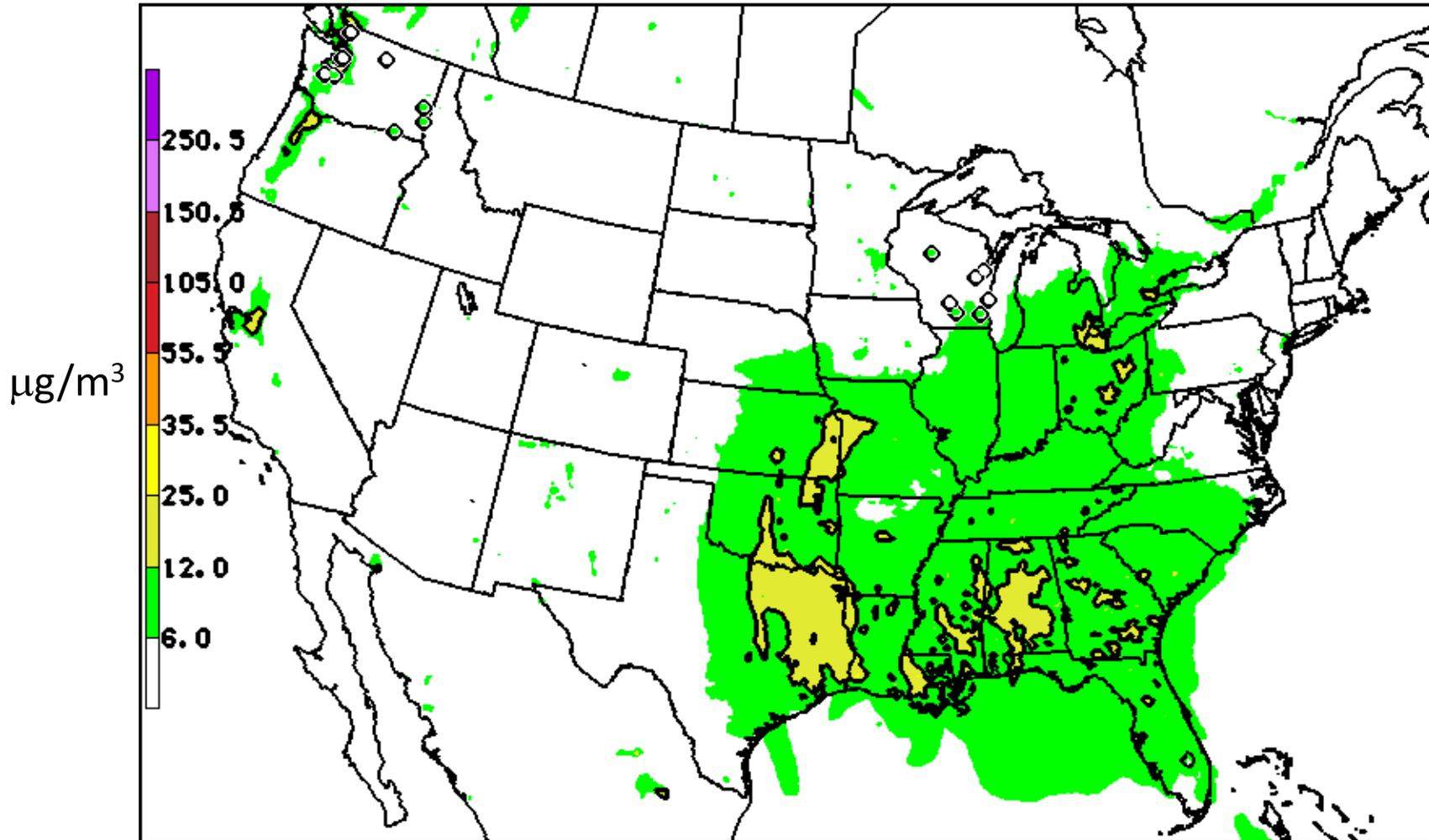
Smoke Transported to Northern Plains, May 7

- Smoke from Ft McMurray fire traveled to N. Plains states and caused widespread exceedances of PM_{2.5} NAAQS on May 7
- Event only lasted one day – PM_{2.5} dropped to Code Yellow on May 8

Good	0 to 50
Moderate	51 to 100
Unhealthy for Sensitive Groups	101 to 150
Unhealthy	151 to 200
Very Unhealthy	201 to 300
Hazardous	301 to 500



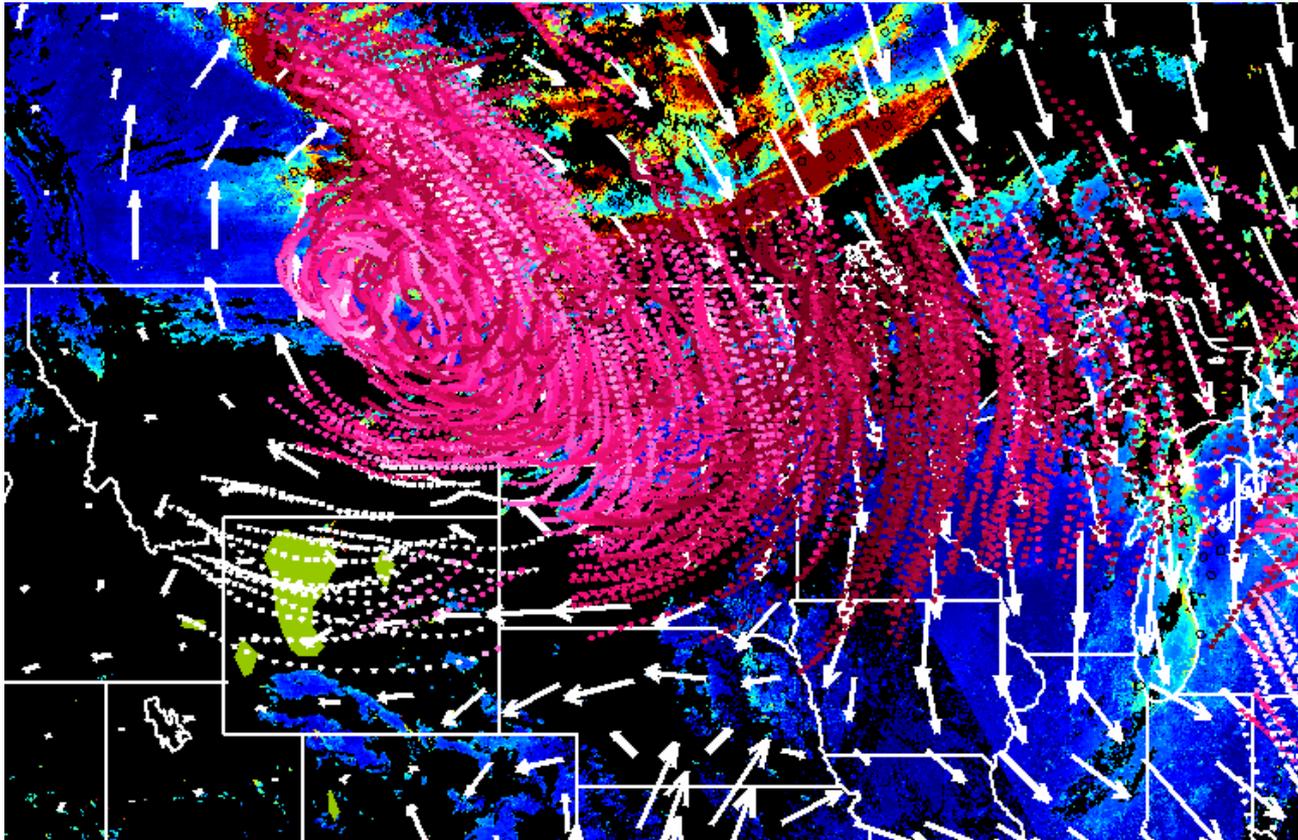
Operational PM_{2.5} Model Did Not Predict Smoke Impacts



PROD DAY1 PMX24 0 20160507 12Z CYC-

Best Forecast Tool is 48-Hr Forward Trajectories

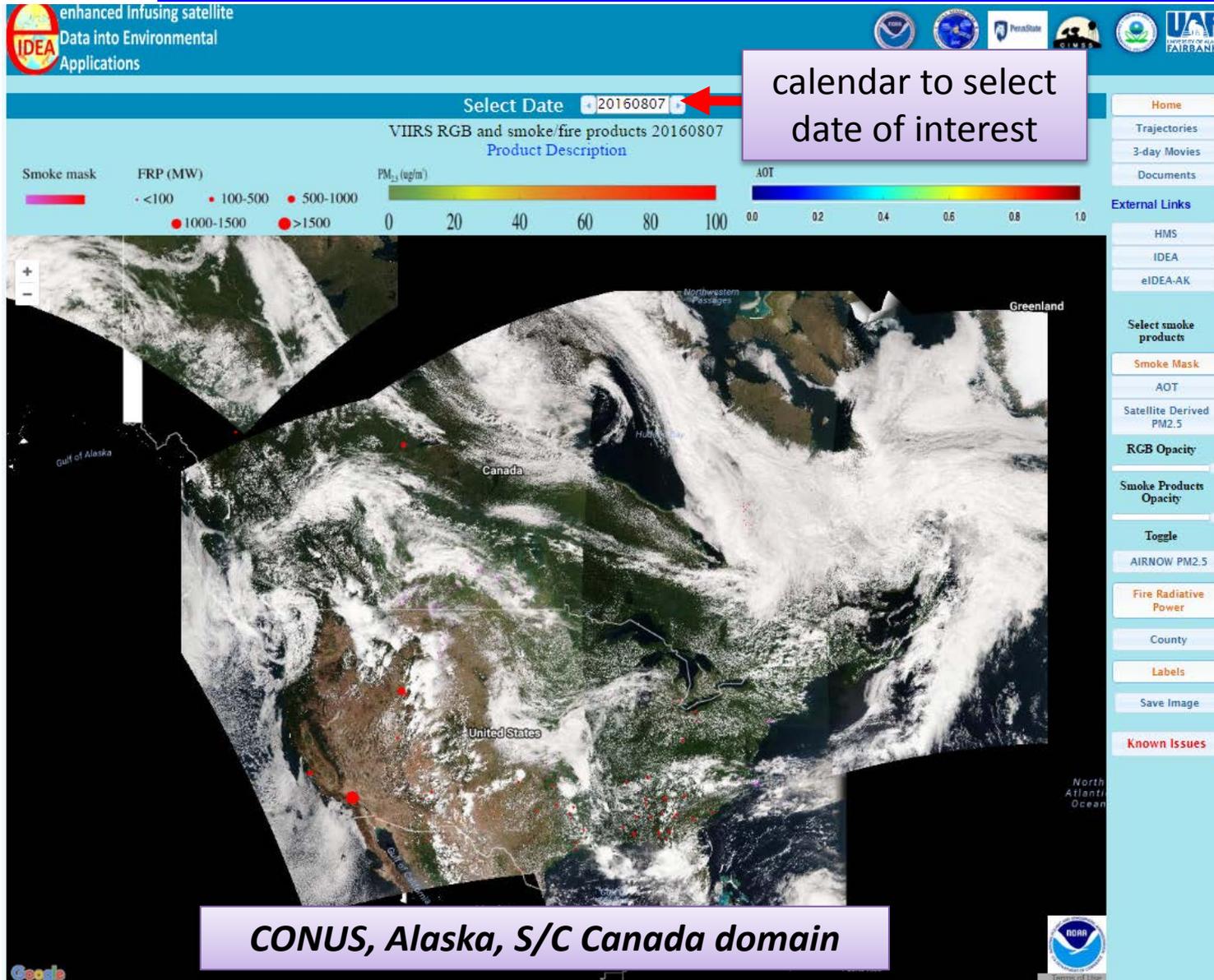
- Static example of 48-hr trajectories initiated at 12 UTC May 6
- Trajectories originated at areas of high observed AOT (> 0.4)
- Magenta/pink lines indicate transport of smoke S/SW into Plains states, remaining near the surface



Trajectory at
15 UTC
May 7, 2016

eIDEA: New 1-Stop Fire and Smoke Imagery

<http://www.star.nesdis.noaa.gov/smcd/spb/aq/eidea/>



calendar to select date of interest

animations and external links

main product overlay buttons

Importance of VIIRS Aerosol Products for Forecasting Impacts of Transported Smoke

- **VIIRS RGB and AOD** essential for identifying smoke plume transport upwind
 - Gives forecasters a heads-up when smoke may be heading toward forecast area
 - Use in conjunction with **surface PM_{2.5} measurements** to determine when smoke is impacting surface air quality
- **48-hour aerosol trajectories** critical tool for identifying when smoke will reach surface in forecast area
 - No other forecast tools can predict when transported smoke will move into forecast area and mix to surface
- New **eIDEA** website designed for operational users