EE’s: Impacts of Wildfire Smoke on Summertime Air Quality in Utah

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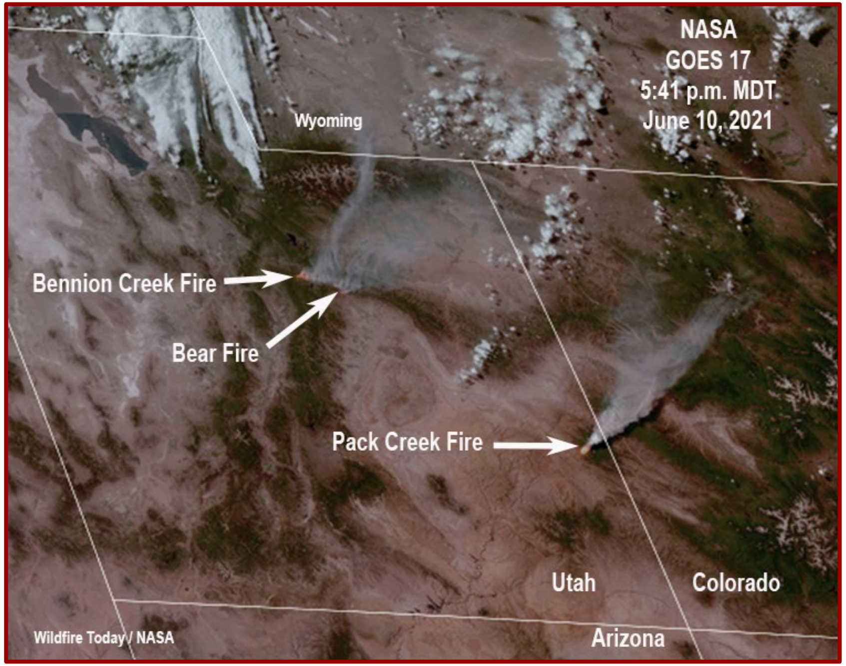
Wildfires and Air Quality

- Wildfires inject significant amounts of particulate matter, CO, NOx, as well as VOCs into lower to mid-levels of the atmosphere, depending on plume height/fire radiative power.
- Smoke plume is transported and dispersed by the prevailing winds
  - Convective updraft of fire and meso/local scale flows dominate transport in the short term
  - Large scale/synoptic winds dominate transport over longer distances and time scales
- Photochemistry within transported smoke plume alters the composition over time
- Large sources of WF smoke transported along Wasatch Front often originate from CA, OR, or WA not Utah.

Prevailing W to E flow generally advects Utah sourced WF smoke to the E, avoiding SLC



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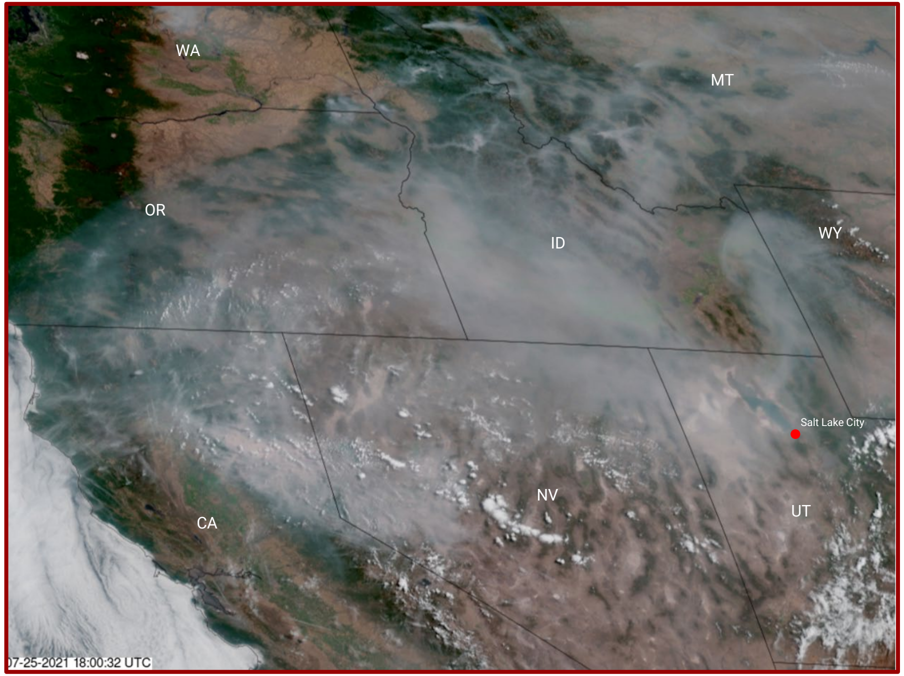
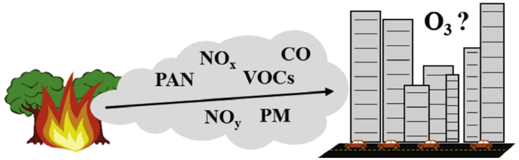
Wildfires and Air Quality

- Smoke plume ages, primary pollutants contribute to the formation of secondary pollutants such as O3
  - Enhancement of O3 downwind of wildfires (McClure and Jaffe, 2018):
    - Plume age
    - Smoke composition
    - Aerosol optical depth (dense smoke attenuates solar radiation)
    - Meteorology/transport dynamics
  - Plume emissions mix with urban emissions creating new photochemical reactions (Jaffe et al., 2012)
- Elevated PM2.5 concentrations marks wildfire smoke with delayed formation of O3 after plume arrives (1-2 days)
- Enhanced ground-level O3 > 10 ppbv for the western US due to wildfires (Jaffe et al., 2008; Jaffe and Wigdner 2012, Lu et al., 2016)





(McClure and Jaffe, 2018)

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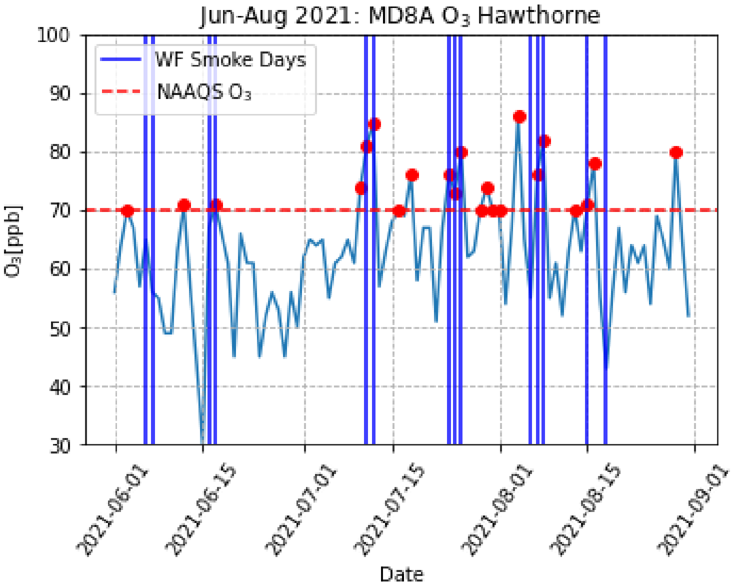
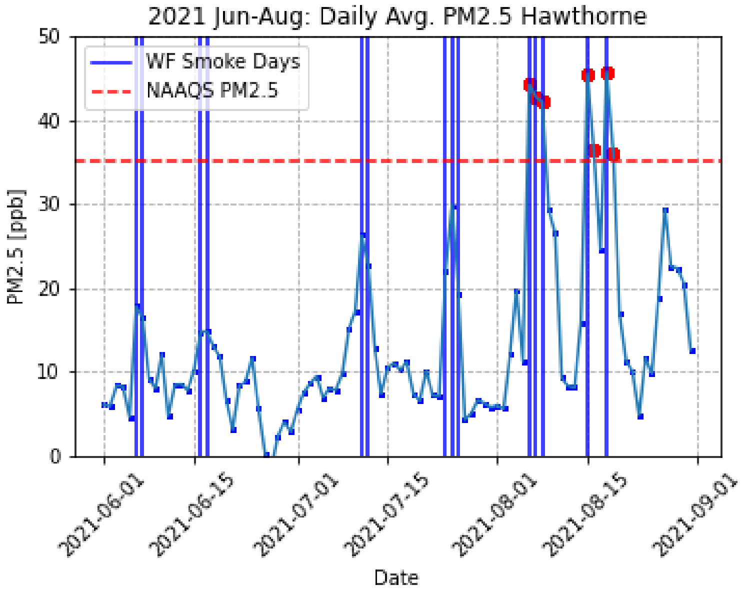
Wildfire Smoke Impacted Days SL Valley 2021

MD8A O3 at Hawthorne



Daily Avg. PM2.5 at Hawthorne



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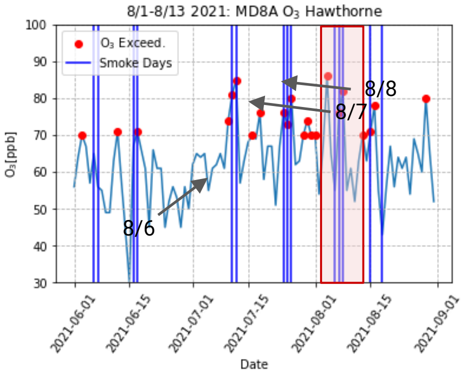
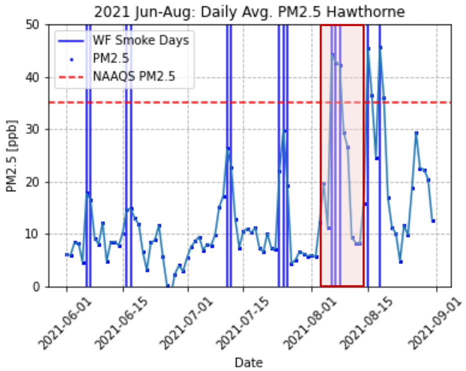
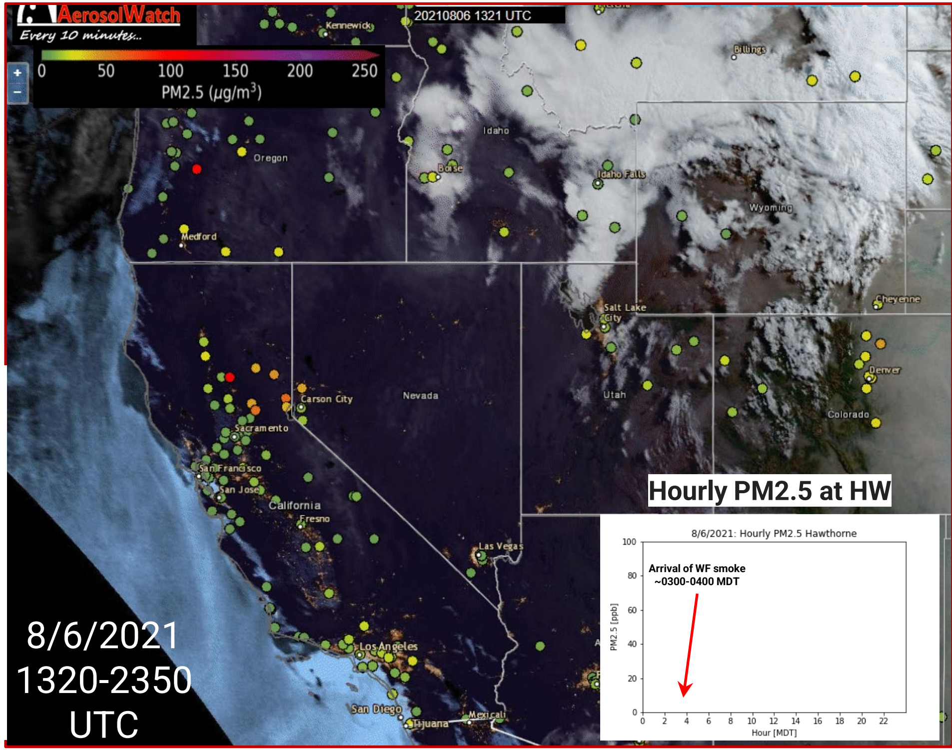
Wildfire smoke days → Vertical blue lines

Wildfire Smoke Impacted Days

- Long-range WF smoke transport from Dixie, Monument, and River Complex Fires among others…
- Three WF smoke impacted days 8/6-8/8 with increased PM2.5
- O3 exceedance for 8/7 and 8/8 not on 8/6 (smoke arrival day). O3 enhancement lag.







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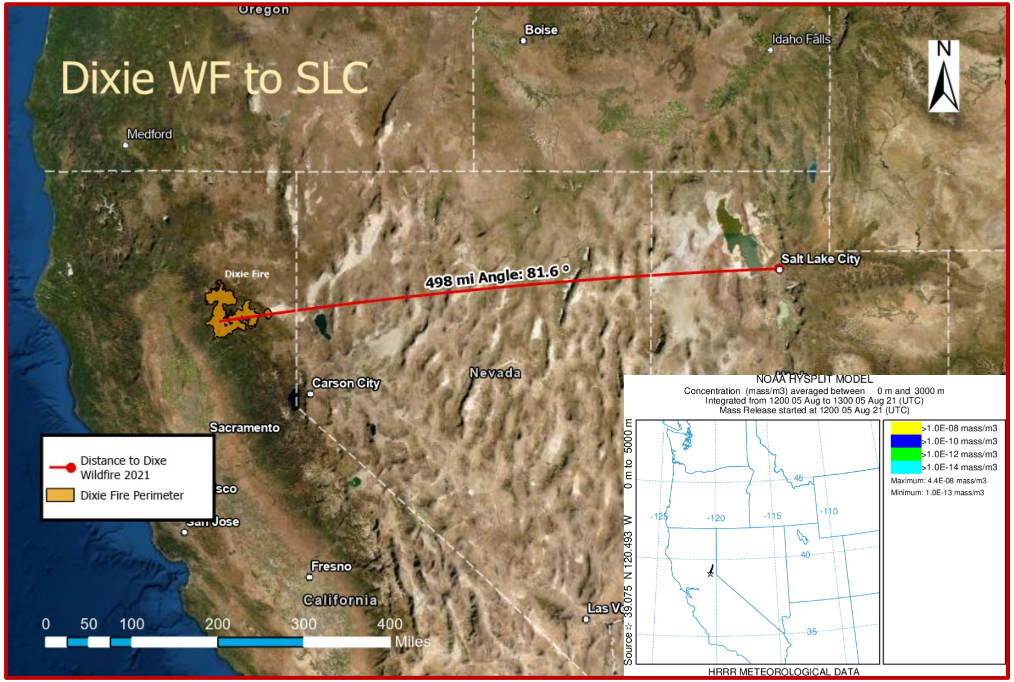
Linking O3 Exceptional Event to Wildfire

- Correlation between arrival of WF smoke and elevated O3 but… Correlation is not causation!
- Showing a clear causal relationship between long range WF smoke and enhanced O3 needs a robust analysis:
    - **Q/D < 100** (***fire emissions/distance***) requires additional evidence to show WF smoke is directly linked to O3 exceedance
    - Q calculation methods **1.)** aggregated emissions from all fires or **2.)** emissions from single fire. Q/D was **>100** or **<100** for **1** and **2**, respectively, for 8/6-8/8/2021.
- Potential additional analysis:
    - Trajectory/dispersion modeling (NOAA Hysplit)
    - Photochemical modeling for source apportionment
    - Near real-time modeling possible in future could alleviate some of this pressure



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