MGIS Capstone Project Proposal:

Impacts of the 2020 California Wildfires on Atmospheric Pollution at Selected Air Force Bases

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Introduction

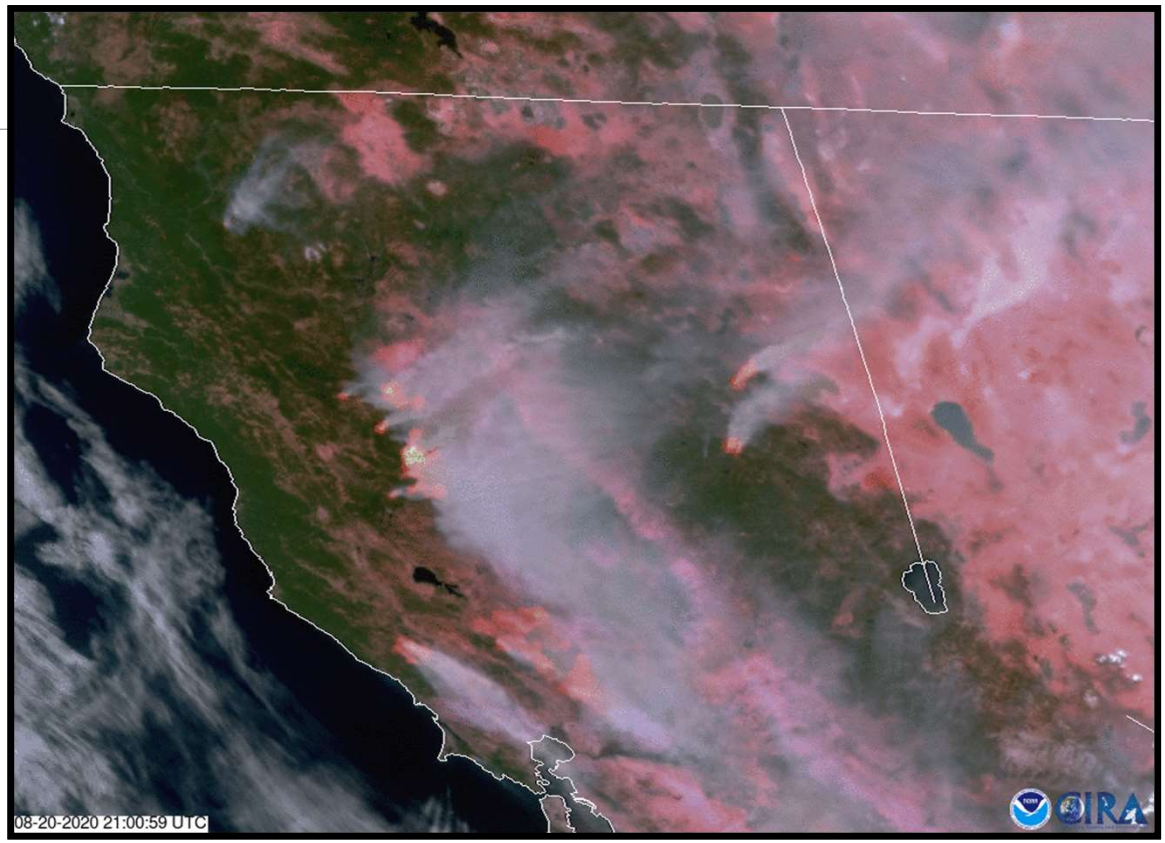
- About Me
- Background
- Objectives
- Study Area
- Data
- Methodology
- Expected Results

About Me

- I live in Las Vegas, NV with my Husband and our fur baby
- Air Force
- MQ-9 Pilot
  - California Wildfire Mission
- Future Professional Goals
  - USAF Academy
  - Other non-military

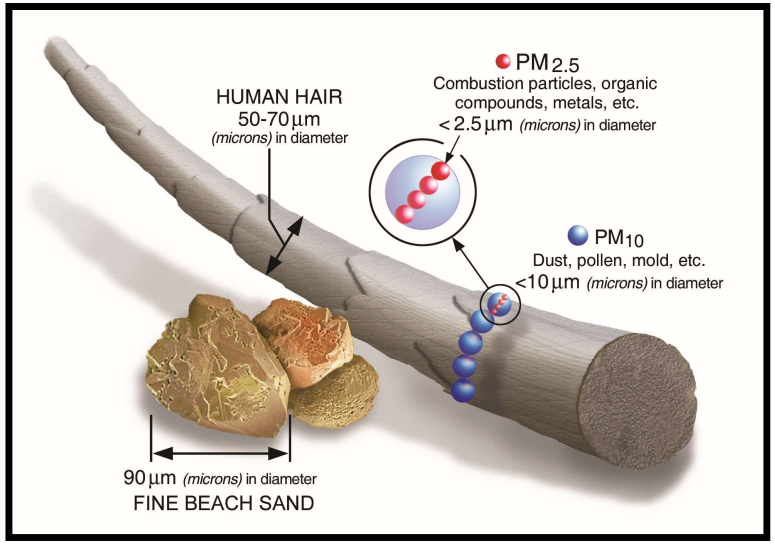
Background: Fires

- 2020 was the largest wildfire season ever recorded in California
  - 9,299 fires/ 4,197,628 acres burned
  - 10,488 structures destroyed
  - 31 deaths
  - >$2.059 billion
  - August Complex Fire is largest EVER on record 1,032,649 acres, 935 structures, 1 death
- Large amounts of smoke and other particulate matter released into the atmosphere
  - How far did the smoke travel?
  - Are smoke particles still present even after visual dissipation?



Background: PM2.5

- Particulate Matter (PM) 2.5
  - Fine inhalable particles, with diameters <2.5 microns
- PM2.5 Health Effects
  - nonfatal heart attacks
  - irregular heartbeat
  - aggravated asthma
  - decreased lung function
  - coughing or difficulty breathing
- PM2.5 & Military Readiness
  - Health effects on the young and healthy
  - No in-depth studies about atmospheric pollution & military readiness



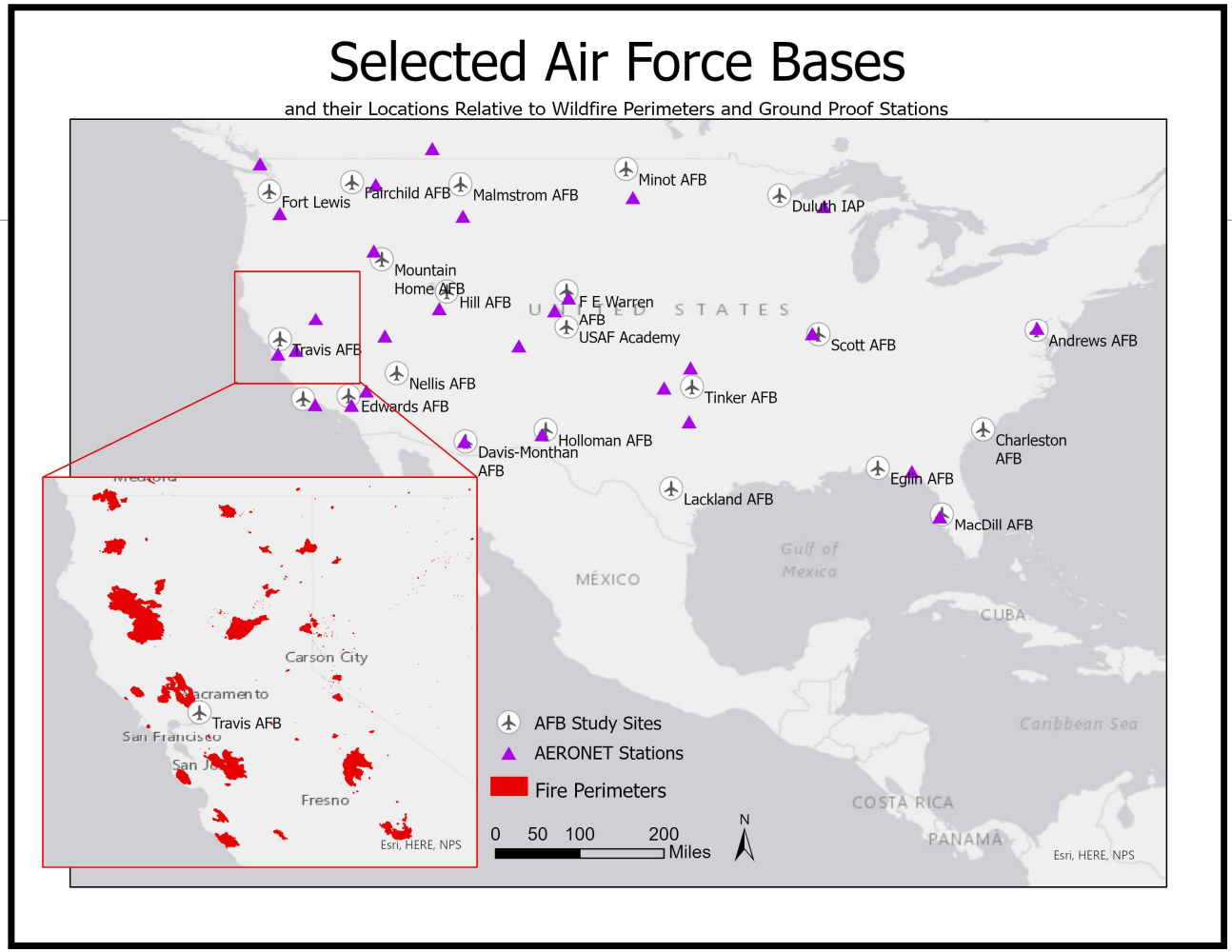
EPA Standards for PM2.5

- EPA regulatory standards for safe PM2.5 levels
  - 24-hours: 35 µg/m^3
  - Annual: Primary: 12 µg/m^3, Secondary: 15 µg/m^3
- For 2004–2009, on days exceeding regulatory PM2.5 standards, wildfires contributed an average of 71.3 % of total PM2.5 concentration
- Scientists predict increased fire activity in future→ We must be prepared for increased levels of PM2.5 and mitigate their effects

Objectives

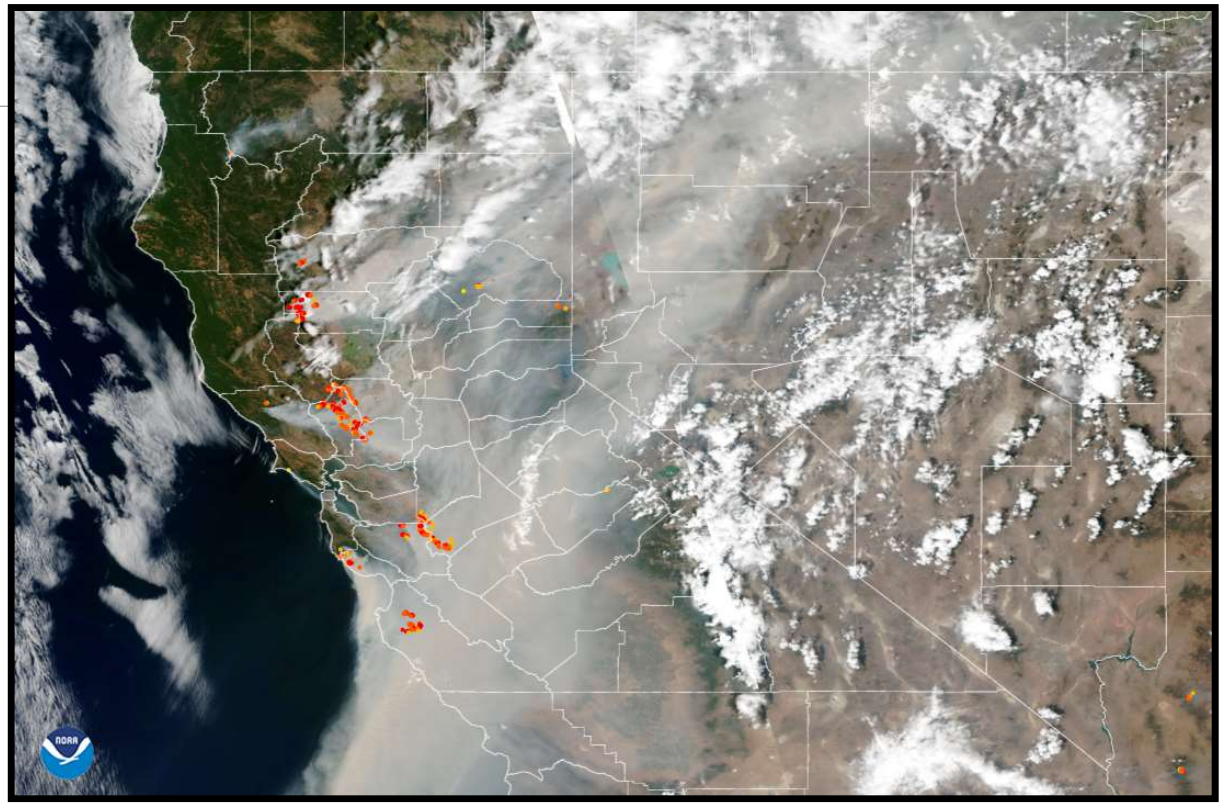
- Determine air quality change at selected Air Force Bases as a result of the 2020 CA wildfires
  - Show level of PM2.5 increase and reach of smoke even after visible smoke dispersion
  - Determine how many and which bases exceeded EPA standards and on how many days
  - Visualize the 5-year average PM2.5 levels
- Highlight the possible impacts of increased PM2.5 on health and military readiness

Study Area


Selected Air Force Bases
and their Locations Relative to Wildfire Perimeters and Ground Proof Stations
Fort Lewis
Fairchild AFB
Malmstrom AFB
Minot AFB
Duluth IAP
Mountain Home AFB
Hill AFB
F E Warren AFB
USAF Academy
Scott AFB
Andrews AFB
Travis AFB
Nellis AFB
Edwards AFB
Tinker AFB
Holloman AFB
Davis-Monthan AFB
Charleston AFB
Eglin AFB
Lackland AFB
MacDill AFB
Gulf of Mexico
MÉXICO
CUBA
Caribbean Sea
COSTA RICA
PANAMA
Carson City
Sacramento
Travis AFB
San Francisco
San Jose
Fresno
Esri, HERE, NPS
AFB Study Sites
AERONET Stations
Fire Perimeters
0 50 100 200
Miles
N
Esri, HERE, NPS

Satellite Data

- Visible Infrared Imaging Radiometer Suite (VIIRS) Satellite imagery
  - Available since 2012
  - Deep Blue Aerosol Optical Thickness
  - Deep Blue Aerosol Angstrom Exponent
    - Dust vs. Smoke

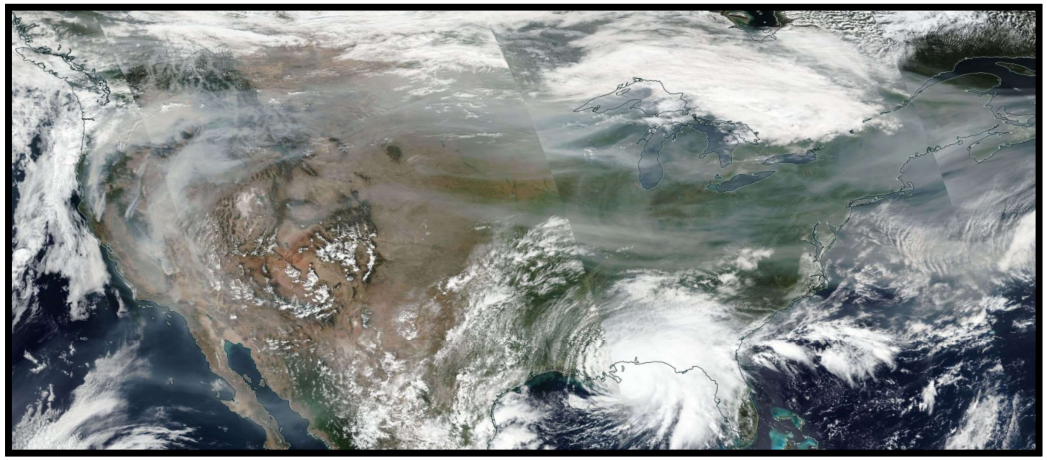


August 19, 2020

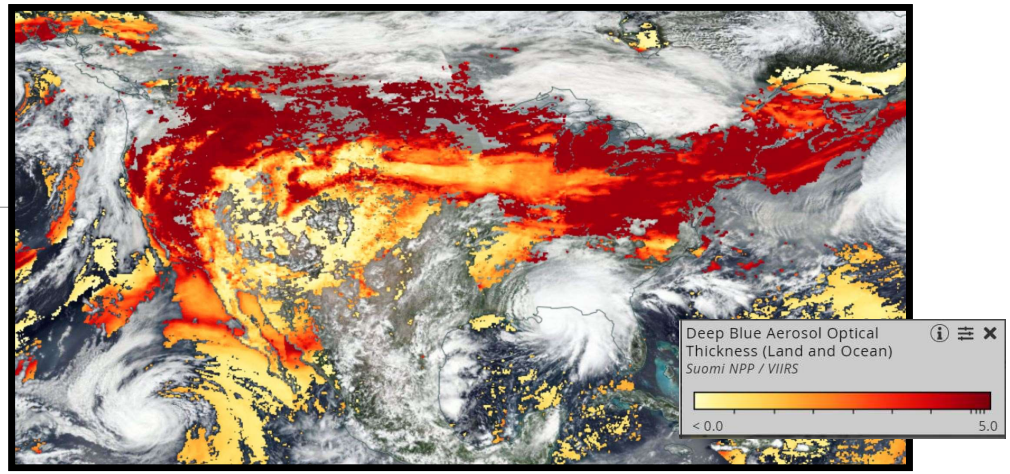
WorldView Display of VIIRS Imagery

September 15, 2020

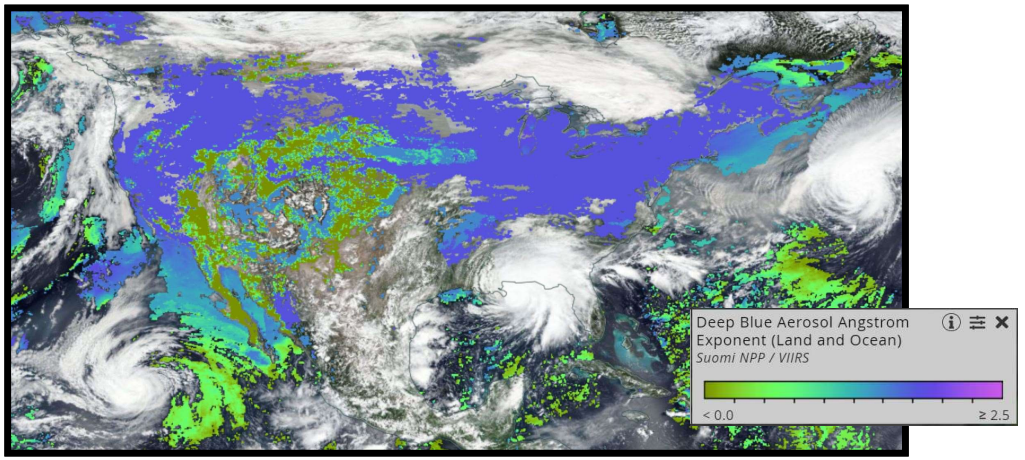
REAL COLOR IMAGE



DEEP BLUE AEROSOL OPTICAL THICKNESS

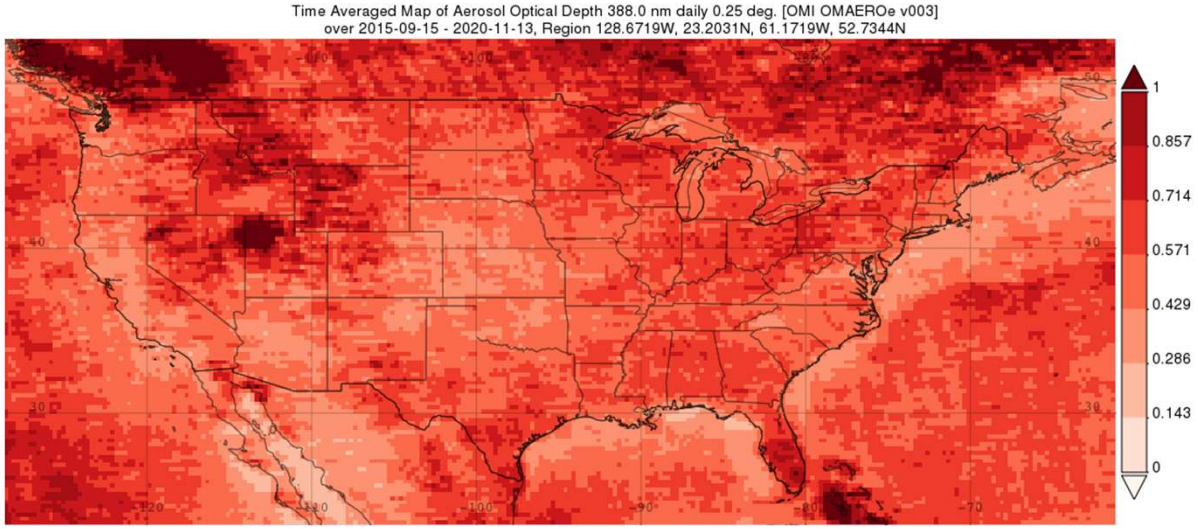


DEEP BLUE AEROSOL ANGSTROM EXPONENT

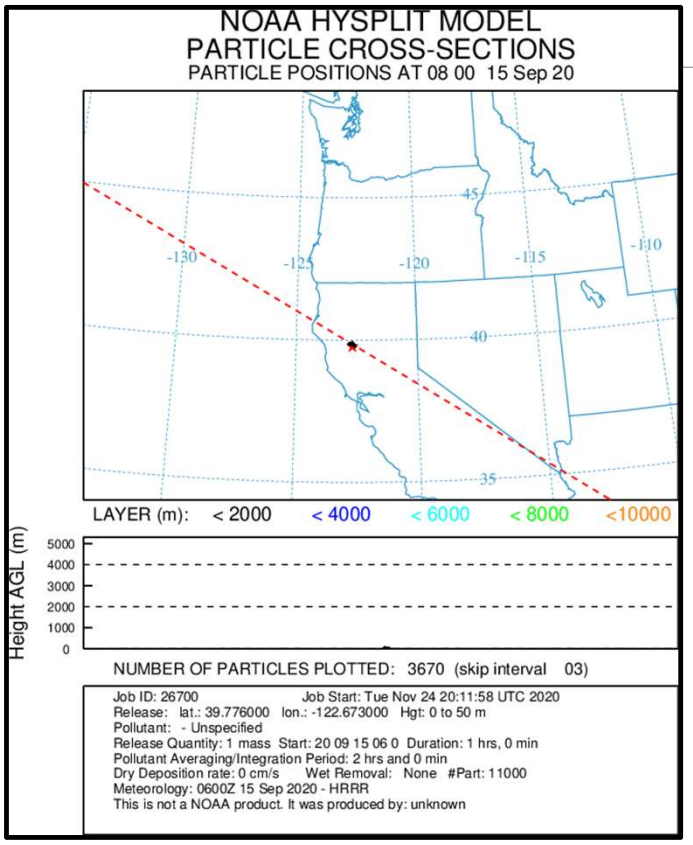


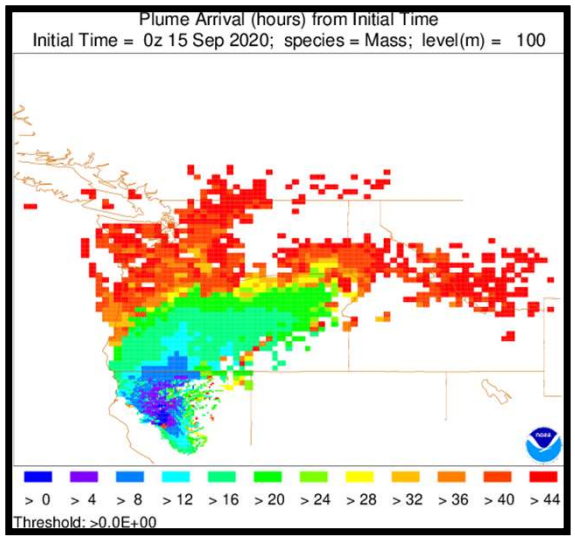
Methodology

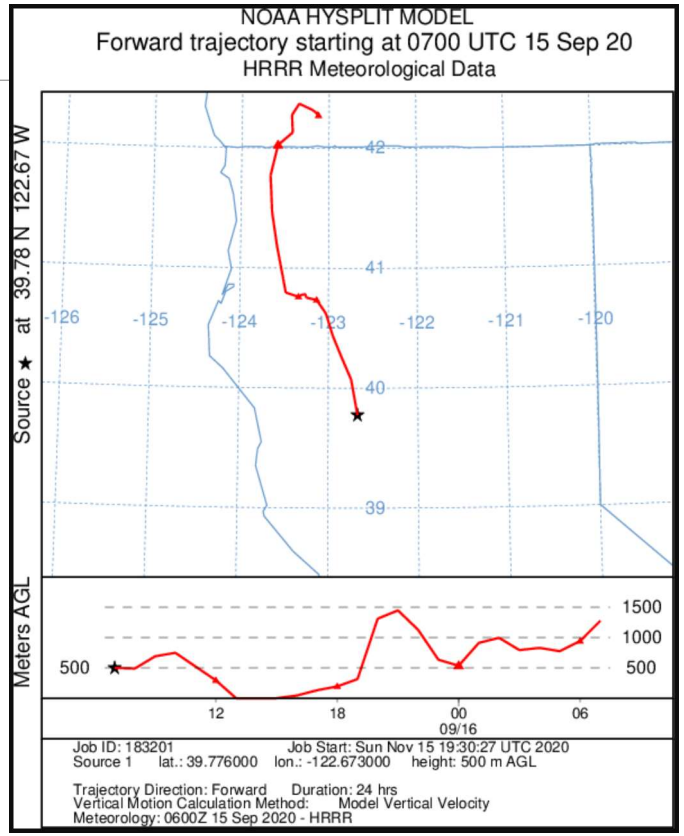
- Create a 5-year time-series map of PM2.5 levels at each pixel over the selected Air Force Bases using VIIRS data
  - Analysis will be done in R
  - Example: Giovanni with OMI data
- HYSPLIT Transport and Dispersion Modeling



HYSPLIT Numerical Modeling

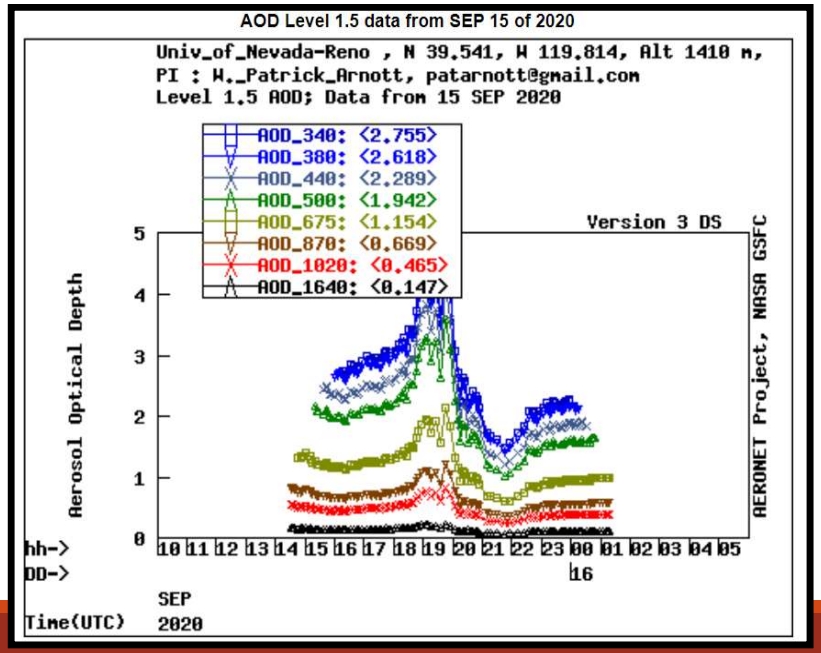


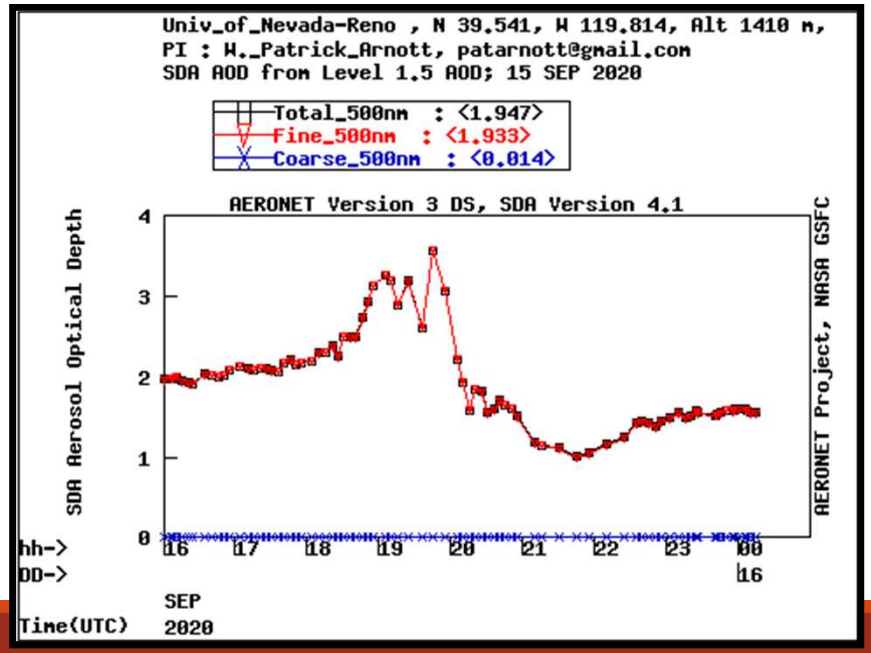




Ground Proof

- AErosol RObotic NETwork (AERONET)
  - Sun photometer measurements are used to calculate the AOD
  - Angstrom exponent used to differentiate between fine and course particles





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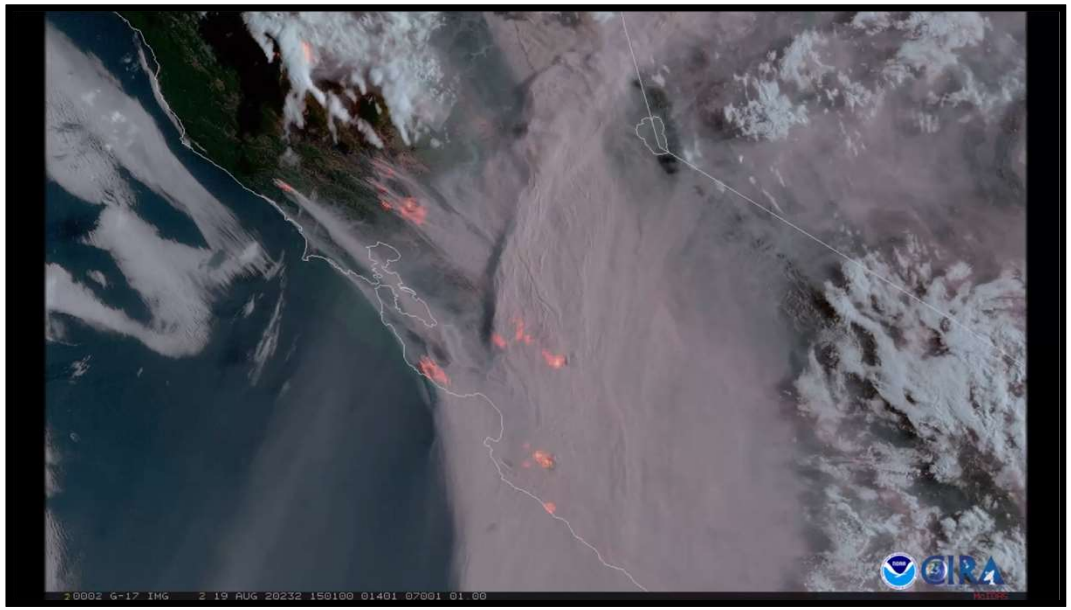
Expected Results

- PM2.5 increases above standards on peak fire days
  - Timeline of Fires: July - Nov
- Ideally the average PM2.5 level will not be above EPA safe level



GOES-R Video: August 19, 2020