Tracing 2020 Wildfires in Western U.S.

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I. Introduction

- 2020 had a notably long fire season in the Western U.S., with future models predicting an increase in this trend (Wilmot et al., 2021). Herein, Colorado aerosol data was used in combination with wind trajectory software to quantify the source region of smoke.
- The goal of this research was to detect the sources of select large emissions, potentially serving to test the efficacy and development of air quality forecasts.
- This research was inspired by the work of Ph.D. student Kai Wilmot, who is working on models to predict air quality. The model development contributes to the safety of public health.

II. Methods

- Steamboat Springs, Colorado's Storm Peak Lab facilitates the use of a TSI 3563 nephelometer, measuring aerosol light scattering year-round.
- This instrument separates light through a color splitter by range of wavelength, followed by a dichromic filter to reflect a specific wavelength. The TSI 3563 model detects scattering at wavelengths of 450 nm (blue), 550 nm (green), and 700 nm (blue). The specified wavelength is finally amplified by a photomultiplier (PM) tube (US Department of Commerce, 2005)
- Aerosol scattering data at 700 nm was plotted in R computer language (Figure 2), allowing for quantification of wildfires.
- After identifying a high aerosol event of interest—on August 12th and September 16th, the NOAA Hysplit Trajectory Model was used identify the source region.
- MODIS historical fire detection software was utilized to compare the trajectory findings to documented fires.

III. Results

- Aerosol light scattering data was successfully plotted with R computer language.
- The source region of two large aerosol scattering events on August 12 and September 16 were identified with Hypslit to be from Colorado and Idaho, respectively (Figure 3).
- Comparison analysis with MODIS fire detection showed large fires at Pine Gulch fire in Colorado, and Badger fire in Idaho

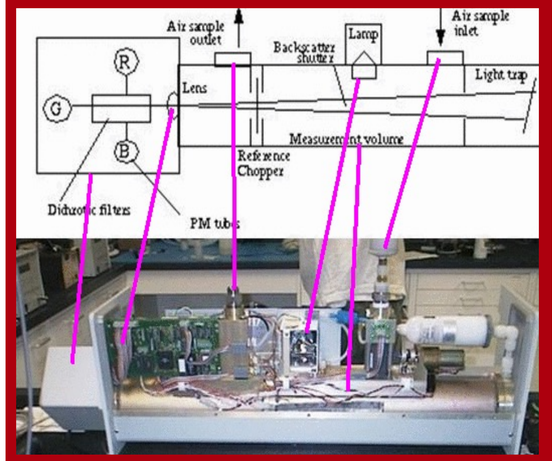


Figure 1. Nephelometer
Instrument used to determine aerosol lights scattering

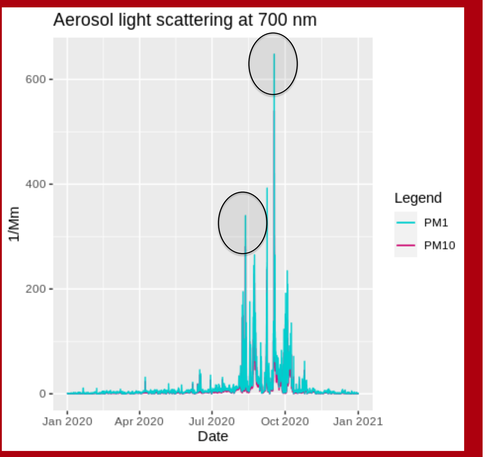
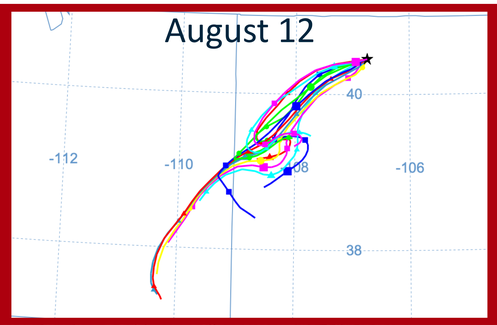


Figure 2. Aerosol light scattering values
Values shown for 2020



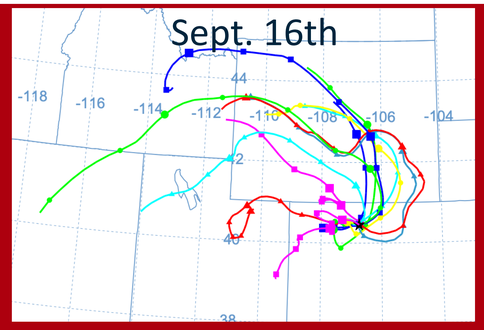


Figure 3. Wind back trajectories from Hysplit (top) and large fire incidences from MODIS (bottom)
High aerosol scattering values on August 12th and September 16th was estimated to be a result of wildfires in Pine Gulch in Colorado and Badger in Idaho, respectively.

IV. Conclusions

- High aerosol emission dates were quantified though aerosol light scattering data obtained at Storm Peak Lab
- Select dates on August 12th and September 16th were applied to NOAA wind trajectory software, 'Hysplit Trajectory Model'.
- These wind motions were analyzed and found to be originating from Colorado for the event on August 12, and southern Idaho on September 16th.
- MODIS fire detection data was utilized to observe large fire incident data.
- MODIS maps were compared with the wind plots in order to verify the fires came from the estimations and fit the intensity of the fires.
- In the future, these findings should be analyzed further to determine whether they may be beneficial for developing air quality models.

V. References

Wilmot, T. Y., Hallar, A. G., Lin, J. C., & Mallia, D. V. (2021). Expanding number of Western US urban centers face declining summertime air quality due to enhanced wildland fire activity. *Environmental Research Letters*, *16*(5), 054036. https://doi.org/10.1088/1748-9326/abf966

US Department of Commerce, N. O. A. A. (2005, October 1). *ESRL global Monitoring Laboratory - Global radiation and aerosols*. GML. https://gml.noaa.gov/aero/instrumentation/neph_desc.html.

Qiu, J., Tan, W., Zhao, G., Yu, Y., & Zhao, C. (2021). New correction method for the scattering coefficient measurements of a three-wavelength nephelometer. *Atmospheric Measurement Techniques*, *14*(7), 4879–4891. https://doi.org/10.5194/amt-14-4879-2021

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