

## Background



Fig.1 wildfire areas in the US

- ❖ Since the 1970s, wildfires greater than 1,000 acres have doubled on average, due to the rapid development of high-risk wildfire areas in the US. (Cleetus & Mulik, 2014).
- ❖ The environment gets affected by the chemicals released to the atmosphere in fire smoke, which can induce changes at the local or global scale, depending on their magnitude.
- ❖ Emitted nitrogen compounds include nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), peroxyacyl nitrates (PANs), nitrous acid (HONO), particulate nitrate (pNO<sub>3</sub>), isocyanic acid (HNCO), hydrogen cyanide (HCN), Ammonia (NH<sub>3</sub>) and over 44 nitrogen-containing volatile organic compounds.
- ❖ In this study we focus on four of the main reactive N (Nr) species (Nr = NO<sub>x</sub>, PANs, pNO<sub>3</sub>, HNO<sub>2</sub>) which besides being harmful to the environment, it can also be harmful to human health.
- ❖ According to the Center for Disease Control and Prevention (CDC), exposure to smoke has been associated with “thousands of deaths annually” besides “increasing respiratory and cardiovascular hospitalizations, emergency department visits; medication dispensations for asthma, bronchitis, chest pain, chronic obstructive pulmonary disease, and respiratory infections; and medical visits for lung illnesses”.
- ❖ Therefore, Quantifying the output of nitrogen species from wildfires smoke can help us understand the impact on air quality, as well as short-term and long-term consequences on the environment and human health.

## Methods

- ❖ To investigate the emissions of N species from wildfires, I use data from the FIREX-AQ mission (summer 2019).
- ❖ The NASA DC-8 aircraft, a flying laboratory, was deployed from around July 24 to September 05, 2019 from Boise, ID and Salina, KS
- ❖ The modified combustion efficiency (MCE), an indicator of combustion efficiency, was derived from CO and CO<sub>2</sub> measurements. High MCE indicates flaming combustion (high burning temperatures), and low MCE indicate smoldering combustion (low burning temperatures).
- ❖ From this dataset, I focused on the 07/25 fire to look at the temporal variability of N species in the smoke. I kept the 07/25, 07/29 and 07/30 fires to investigate the relation between each N species concentration and MCE.

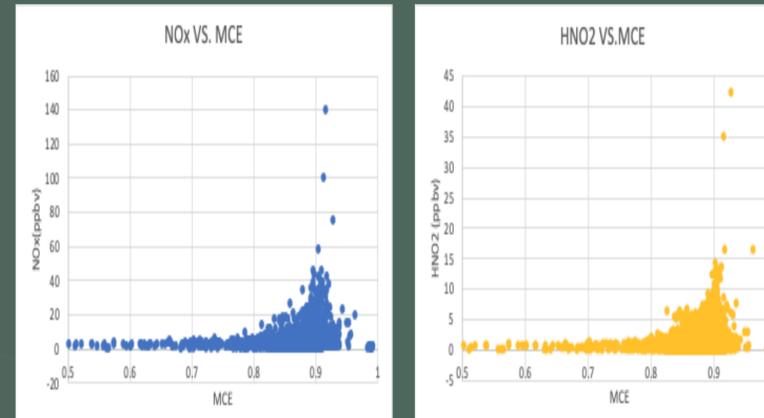
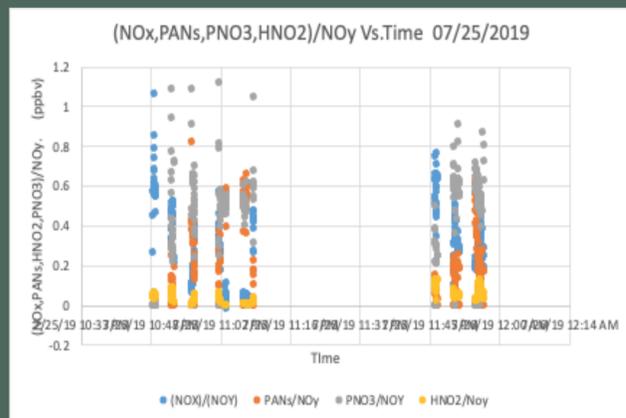
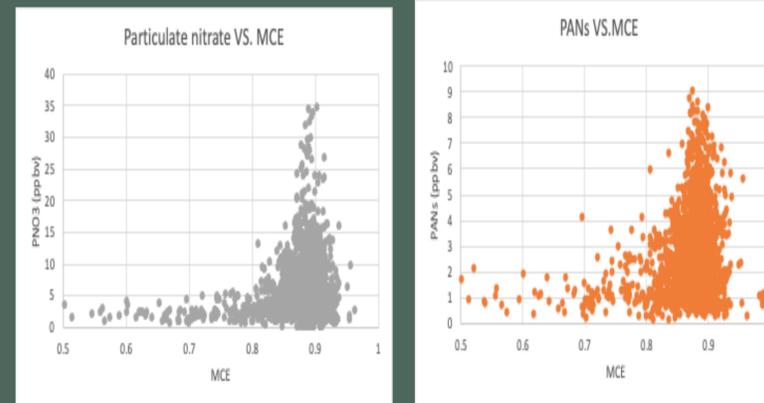
## Questions

- How are the Nr concentrations evolving with smoke aging
- How are these Nr emissions correlated with MCE

## Results



Fig.2 flying laboratory mab (FIREX-AQ)



## Discussion

- ❖ The proportion of each N compound to the sum of nitrogen species evolves with time.
- ❖ The proportion of NO<sub>x</sub> is higher at the beginning of the smoke plume.
- ❖ The proportion of PANs increases slowly with time with aging of the smoke plume.
- ❖ pNO<sub>3</sub> is increasing very fast after the first transect in the smoke.
- ❖ There is very little HNO<sub>2</sub> in the smoke because it probably already reacted away.
- ❖ At higher MCE (higher burning temperature), there is a higher output of Nr species, which will also affect air quality more.

## Conclusions

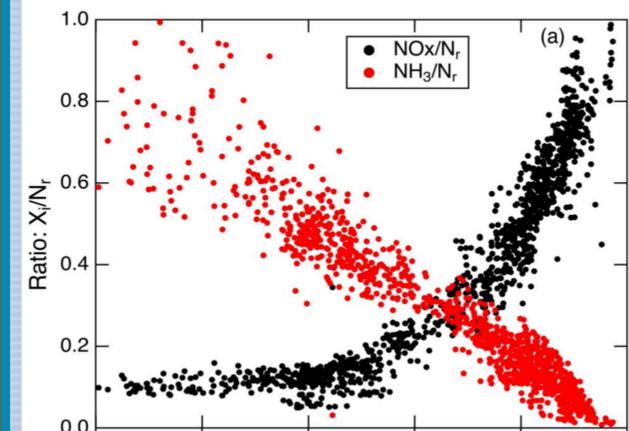


Fig. 3 Roberts and al. 2020

- ❖ Nitrogenous gases can be detrimental to the environment, impacting the air quality which can translate to human respiratory health deterioration.
- ❖ MCE is directly correlated with Nitrogenous gases release, with higher Nr emissions at higher MCE.
- ❖ However, to prove it with certainty, data from more wildfires is needed. That way each wildfire's MCE value can be analyzed along with their Nitrogen gas output and to see if all data show the same result as Roberts and al. (2020) which is the next step in this investigation.

## References

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## Acknowledgements

Thank you to Dr. Ilann Bourgeois for providing guidance and assistance throughout this project. RECCS Program is funded by the National Science Foundation (grant number EAR 1757930).