M.S. Defense Announcement
Julieta Juncosa Calahorrano
Tuesday, August 25 at 2:00 p.m.

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August 25, 2020
2:00 p.m.

Defense
Virtually (see below for Teams meeting link)

Post Defense Meeting
Virtually

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Daytime Evolution of Oxidized Reactive Nitrogen in Western U.S. Wildfire Smoke Plumes: *In situ* and Satellite Observations

The Western Wildfire Experiment for Cloud Chemistry, Aerosol Absorption, and Nitrogen (WE-CAN) deployed the NSF/NCAR C-130 aircraft in summer 2018 across the western U.S. to sample wildfire smoke during its first day of atmospheric evolution. We present a summary of a subset of oxidized nitrogen species (NO_y) in plumes sampled in a pseudo-lagrangian fashion. Emissions of nitrogen oxides (NO_x = NO + NO_2) and nitrous acid (HONO) are rapidly converted to more oxidized forms. Within 4 hours, ~86% of the measured NO_y (ΣNO_y) is in the form of peroxy acyl nitrates (PANs) (~37%), particulate nitrate (pNO_3) (~26%) and gas-phase organic nitrates (~23%). The average *e*-folding time and distance for NO_x are ~90 minutes and ~40 km, respectively. Nearly no enhancements in nitric acid (HNO_3) were observed in plumes sampled in a pseudo-lagrangian fashion, implying HNO_3-limited ammonium nitrate (NH_4NO_3) formation, with one notable exception that we highlight as a case study. We also summarize the observed partitioning of ΣNO_y in all the smoke-impacted samples intercepted during WE-CAN. In the smoke-impacted samples intercepted below 3 km above sea level (ASL), HNO_3 is the dominant form of ΣNO_y and its relative contribution increases with smoke age. Above 3 km ASL, the contributions of PANs and pNO_3 to ΣNO_y increase with altitude. WE-CAN also sampled smoke from multiple fires mixed with anthropogenic emissions over the California Central Valley. We distinguish samples where anthropogenic NO_x emissions appear to lead to an increase in NO_x abundances by a factor of 4 and contribute to additional PAN formation.

We utilize data from the Cross-Track Infrared Sounder (CrIS) on the Suomi National Polar- orbiting Partnership (Suomi-NPP) satellite, which continues the thermal infrared PAN satellite record established by the Tropospheric Emission Spectrometer (TES) onboard the Aura satellite. CrIS provides improved spatial resolution, allowing for improved analysis opportunities. Here we present an analysis of CrIS PAN retrievals over the western US during the summer 2018 wildfire season. The analysis period coincides with WE-CAN. CrIS is capable of detecting PAN and CO enhancements from smoke

plumes sampled during WE-CAN, especially those that became active before the satellite overpass or burned for several days (*e.g.,* Carr Fire, Mendocino Complex Fire). The analysis show that ~40 - 70% of PAN over the western U.S. can be attributed to smoke from wildfires. The contribution of smoke from wildfires to free tropospheric PAN generally increases with latitude. We calculate PAN excess mixing ratios normalized by CO (NEMRs) in fresh smoke plumes from fires and follow the evolution as these plumes are transported several hours to days downwind. This analysis shows that elevated PAN within smoke plumes can be detected several states downwind from the fire source. The combination of high CrIS spatial resolution and favorable background conditions on 13 September 2018 permits detecting chemical changes within the Pole Creek smoke plume in Utah. In this plume, CrIS PAN NEMRs increase from < 1% to 3.5% within 3 - 4 hours of physical aging. These results are within the range observed in fresh plumes sampled during WE-CAN, where PAN NEMRs increased from 1.5% to 4% within 4 hours of physical aging.