M.S. Defense Announcement
Andrey Marsavin
Thursday, October 19, at 11:00 am

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October 19, 2023
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Defense
CIRA Commons or Teams

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Jeffrey Collett (Advisor)
Emily Fischer
Megan Willis (Chemistry)

Summertime ozone production at Carlsbad Caverns National Park, New Mexico: influence of oil and natural gas development

Southeastern New Mexico's Carlsbad Caverns National Park (CAVE) has increasingly seen summer ground-level ozone (O3) levels surpassing the US Environmental Protection Agency's National Ambient Air Quality Standard (NAAQS) of 70 parts per billion by volume (ppbv). The park is located in the western part of the Permian oil and natural gas (O&G) basin, where production rates have more than tripled in the last decade. We investigate O3–precursor relationships by constraining a zero-dimensional (0-D) model to an hourly NOx and speciated volatile organic compound (VOC) data set collected at CAVE during the summer of 2019. O&G-related VOCs dominated the calculated VOC reactivity with hydroxyl radicals (OH) on days when O3 concentrations were primarily controlled by local photochemistry. Radical budget analysis showed that NOx levels were high enough to impose VOC sensitivity on O3 formation in the morning hours, while subsequent NOx loss through dilution and photochemical consumption led to NOx-sensitive conditions in the afternoon. Daily maximum O3 was most sensitive to NOx, but still responded to reductions in O&G-related VOCs, such that a combined 20% reduction in both precursor groups was approximately 40% more effective at lowering O3 than a 20% reduction in NOx alone. The model could not reproduce a 5-day high O3 episode when constrained to observed NOx and primary VOCs, likely due to influence from O3 production during long-range transport from regional O&G basins as indicated by back-trajectory analysis, low i/n-pentane ratios consistent with O&G emissions, increased concentrations of secondary VOCs, and extensive oxidation of emitted NOx. Constraining the model with observed total oxidized reactive nitrogen (NOy), approximating NOx at the time of emission, greatly improves model-observation agreement during this episode, reaffirming NOx-sensitive conditions in photochemically aged air masses.