Understanding the Impact of Biomass Burning on Ozone Conditions in the Arctic

A. McClure-Begley[1,2], S. Crepinsek[1,3], I. Petropavlovskikh[1,2], A.Y.[1,2], T. Uttal[3], S.T.[4], A. Jefferson[1,2] and D. Helmig[5]

[1]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309; 303-497-6823, E-mail: Audra.mcclure@noaa.gov
[2]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305
[3]NOAA Earth System Research Laboratory, Physical Sciences Division (PSD), Boulder, CO 80305
[4]National Center for Atmospheric Research (NCAR), Boulder, CO 80307
[5]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309

Tropospheric ozone (O_3) is an atmospheric species formed by the reaction of precursor species [NO_x, carbon monoxide (CO), volatile organic compounds (VOC's)] in the presence of ultraviolet radiation and drives complex interactions which can result in impacts on atmospheric conditions in the Arctic. As an important greenhouse gas, O_3 has a significant influence on the photochemical characteristics, oxidation capacity, and radiative forcing of the atmosphere and at high levels has negative impacts on public health and overall ecosystem functioning. In the Arctic, tropospheric O_3 has variable characteristics in time and space. The Arctic O_3 conditions are strongly influenced by seasonal destruction events, Arctic haze, transport of pollution from Asia and influence from precursor compounds released from wildfires. Surface O_3 measurements have been made in the Arctic since 1973 (Barrow, Alaska) and have expanded spatially and temporally since. This study analyzes the relative impact of biomass burning on surface O_3 conditions from six Arctic measurement locations. The meteorological and chemical conditions of the atmosphere are examined to help explain variation in the Arctic surface O_3 conditions. Co-located measurements of meteorological conditions, carbon monoxide, and aerosol optical depth are used to understand the dominant sources of pollution, pollutant composition, and the interactions due to meteorological conditions that result in anomalies in the observed O_3 mixing ratios. However, there is still a need for additional information and measurements of chemical tracers to help discern the contributions of different pollutant sources to O_3 conditions. NOAA Hypslit back-trajectory analysis, satellite imagery, smoke verification models, and NCAR Community Earth System Model are used to interpret observations as a result of the limited geographical and temporal coverage of measurements required for attribution of pollution sources. Characterization of O_3 conditions is essential for understanding the spatial and temporal variation and behavior of O_3 as it relates to climate change in the Arctic.

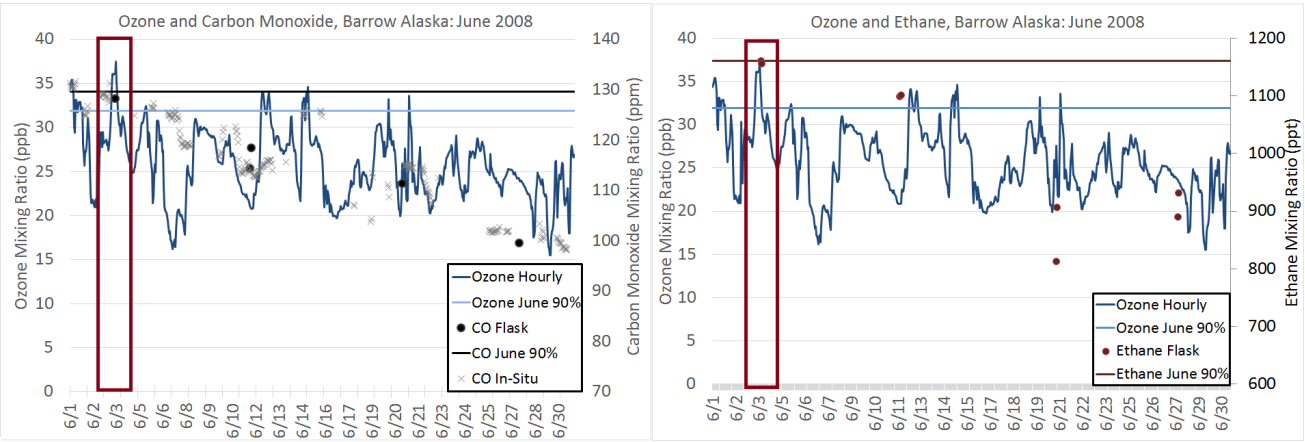

Figure 1. A case study of high O_3 measured from Barrow, Alaska on June 3, 2008 demonstrates the importance of co-located measurements, such as ethane (C_2H_6) and CO, for understanding the influence of biomass burning on ground-level O_3 conditions. Elevated CO, C_2H_6, and O_3 provide insight to investigate the high ozone episode further with model, satellite, and back-trajectory analysis.