3.149 The Influence of Biomass Burning on the Arctic: Pan-Arctic FTIR Observations and Model Results.

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Abstract:

Transport of biomass burning emissions into the Arctic can cause episodic enhancements of multiple trace gas species. We present a multi-year time series of the total columns of carbon monoxide (CO), hydrogen cyanide (HCN), and ethane (C_2H_6) measured using Fourier Transform Infrared (FTIR) solar absorption spectroscopy at six high-latitude sites: Eureka, Nunavut; Ny Alesund, Norway; Thule, Greenland; Kiruna, Sweden; Poker Flat, Alaska; and St. Petersburg, Russia, and at three mid-latitude sites; Zugspitze, Germany; Jungfraujoch, Switzerland; and Toronto, Ontario. For each site, the inter-annual trends and seasonal variabilities of the CO total column time series are determined and enhancements above ambient levels are used to identify possible wildfire pollution events. Correlations of HCN and C_2H_6 with CO, back-trajectories from HYSPLIT and FLEXPART, and fire locations from the Moderate Resolution Spectroradiometer (MODIS) confirm the detections and identify the source regions. The GEOS-Chem chemical transport model is run in tagged mode to determine the relative contributions to the observed enhancements from continental-scale biomass burning source regions.

Exceptional emissions of CO, HCN, C_2H_6, and ammonia (NH_3) from the 2017 North American wildfires were measured at Eureka and Thule, indicating that wildfires may be a major source of NH_3 in the summertime high Arctic. The enhancement ratios of the long-lived species HCN and C_2H_6 are found to be comparable between sites, but for NH_3, the enhancement ratios are strongly dependent on the transport patterns of the smoke plumes. Satellite measurements of NH_3 from the Infrared Atmospheric Sounding Instrument (IASI) and Cross-track Infrared Sounder (CrIS) are used to examine the spatial and temporal variabilities of NH_3. Comparisons to a high-resolution (0.25° x 0.3125°) nested run of GEOS-Chem using emissions from the Global Fire Assimilation System (GFAS) are performed to evaluate the emission inventories and assess the long-range transport of NH_3 to the high Arctic.