Ozone in the remote troposphere: long-range transport and non-fossil sources

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Abstract:

Air pollutants have impacts on climate change, ecosystems, and regional air quality. So-called short-lived climate pollutants (SLCPs) include aerosol particulate matter, tropospheric ozone and methane. These compounds have impacts on climate through affecting the atmospheric radiative balance, are harmful to human health at the surface, but are also sufficiently short-lived that strategies to reduce their emissions and secondary sources may deliver rapid short-term co-benefits to climate and public health, compared with expected longer-timescale responses to efforts to mitigate CO_2. In this talk, I will present recent work focused on improving understanding of sources, processing and impacts of the pollutant tropospheric ozone in two remote regions of the planet.

Rapid changes to and complex interactions within the Arctic environment due to climate change and socio-economic drivers mean that there is an urgent requirement to improve understanding of sources of Arctic SLCPs. Previous studies have identified significant deficiencies in the skill of atmospheric chemistry and climate models in simulating Arctic distributions of air pollutants, which are sourced from long-range import of pollution from lower latitudes as well as local sources in the Arctic itself. Improved quantification of the relative contributions of different pollutant sources in the Arctic atmosphere, and their impacts is needed to provide a sound scientific basis for sustainable solutions and adaptive strategies. I will show new results that investigate drivers of model variability in simulating tropospheric ozone and its precursors in the high latitude troposphere. We use results from multi-model inter-comparison experiments, an ensemble of single model perturbation experiments, and observations from aircraft to shed light on possible drivers of model bias and inter-model variability in Arctic SLCPs.

Finally, I will switch focus to the Amazon and present recent analysis using a long-term dataset from the Ozone Monitoring Instrument (OMI) on board the Aura satellite platform to detect changes and trends in biomass burning influence on atmospheric NO_2 and ozone over the Amazon basin over the period 2005 to 2015. We demonstrate a potential role for a shift in the balance between deforestation fire activity and savannah and agricultural burning in changing the magnitude and distribution of NO_2 and ozone over the Amazon region.

Overall, I will highlight the power of combining satellite instruments, aircraft platforms and models to improve understanding of the complexities controlling this key secondary global air pollutant.