3.081 Influences on spring and summer-time tropospheric ozone in Western Siberia and the Russian Arctic: a model and satellite analysis.

Early Career Scientist

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Abstract:

High latitudes have warmed disproportionately relative to mid-latitudes. This warming is predominantly controlled by radiative forcing from well-mixed greenhouse gases, amplified by efficient Arctic climate feedbacks. However, warming from changes in short-lived climate pollutants (SLCPs), such as tropospheric ozone precursors and aerosols, also contribute to Arctic warming. Arctic SLCP abundances are controlled by long-range transport from mid-latitudes, and by local sources within the Arctic. At present, high latitude emissions of SLCPs and ozone precursors are poorly quantified, particularly in Russia, where there is a paucity of in-situ observations. A full understanding of the impact of SLCPs on the Arctic is partly hampered by poor knowledge of processes controlling SLCPs in northern Siberia, which is home to large sources of anthropogenic and natural emissions. This region is also a key route for import of SLCPs to the Arctic lower troposphere from northern Europe and Asia.

In this study we use the regional chemistry transport model WRF-Chem, in conjunction with observations from ground sites and the Ozone Monitoring Instrument (OMI) satellite instrument, to evaluate processes controlling the regional ozone distribution during the Western Siberian spring and summer. Model sensitivity simulations are used to assess the influence of different ozone sources and sink processes in the region. We assess the influence of NO_x source sectors on ozone over Siberia and the Russian Artic, including comparison between anthropogenic sources and wildfires. Model comparisons with OMI NO_2 observations are used to highlight potential emission biases in the region. We also assess the sensitivity of Siberian ozone to uncertainties in simulating dry deposition, specifically with regard to parameters controlling ozone uptake to Boreal vegetation – an important ozone sink in the region. Our study provides insight into the relative importance of anthropogenic emissions compared with natural biosphere processes in controlling Siberian tropospheric ozone.