Geophysical Research Abstracts
Vol. 17, EGU2015-11855, 2015
EGU General Assembly 2015

Transport of tropospheric ozone and precursors to the Arctic: lessons from a multi-model evaluation using aircraft, satellite and surface data

Steve Arnold (1), Sarah Monks (1), Louisa Emmons (2), Kathy Law (3), David Ridley (4), Solene Turquety (5), Simone Tilmes (2), Jennie Thomas (3), Alex Rap (1), Idir Bouarar (3), Johannes Flemming (6), Vincent Huijnen (7), Jinqui Mao (8), Bryan Duncan (9), Stephen Steenrod (9), Joakim Langner (10), and Yoann Long (5)

(1) University of Leeds, Institute for Climate and Atmospheric Science, School of Earth and Environment, Leeds, United Kingdom (s.arnold@see.leeds.ac.uk), (2) Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, Colorado, USA, (3) UPMC Univ. Paris 06; Université Versailles St-Quentin, CNRS/INSU, UMR8190, Paris, France, (4) Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA, (5) Laboratoire de Météorologie Dynamique, IPSL, CNRS, UMR8539, 91128 Palaiseau Cedex, France, (6) ECMWF, Reading, UK, (7) Royal Netherlands Meteorological Institute (KNMI), De Bilt, the Netherlands, (8) Program in Atmospheric and Oceanic Sciences, Princeton University and Geophysical Fluid Dynamics Laboratory/National Oceanic and Atmospheric Administration, Princeton, New Jersey, USA., (9) NASA Goddard Space Flight Center, Greenbelt, MD, USA, (10) Swedish Meteorological and Hydrological Institute, 60176 Norrköping, Sweden

Changes in abundances of short-lived climate pollutants such as tropospheric ozone and aerosol may have contributed significantly to observed rapid Arctic warming in recent decades. Ozone in the Arctic troposphere is influenced by long-range transport of polluted air from Europe, Asia and N. America, and in summer from boreal wildfires. Our understanding of how different sources contribute to Arctic tropospheric ozone is limited, and is reliant on sparse observations and models of atmospheric transport and chemistry. In particular, our confidence in future high latitude tropospheric ozone response to projected changes in mid-latitude emissions, and subsequent climate impacts, is informed by the ability of models to accurately simulate poleward export from source regions, long-range transport to high latitudes, and photochemical transformation of ozone and its precursors during such events.

We will present an overview of recent results from the evaluation of simulated distributions of ozone and its precursors in the Arctic troposphere from 10 chemical transport models, using an extensive suite of in-situ aircraft data, and data from surface stations and satellites. The models show substantial variability in their ability to simulate abundances of key ozone precursor species throughout the depth of the Arctic troposphere, with implications for in-situ ozone photochemical production and loss. Using results from synthetic model tracer experiments, we separate the impacts of inter-model differences in transport and chemical processes in driving inter-model variability in high-latitude ozone precursor sensitivities to different anthropogenic and biomass burning source regions. We will also highlight the importance of simulated vertical export from source regions for the high latitude tropospheric ozone budget and ozone radiaitive effects. Finally, we discuss some important chemical uncertainties in simulating Arctic tropospheric ozone response to mid-latitude emissions and subsequent climate impacts, including interactions between stratospheric ozone import and in-situ ozone production.