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Evaluation of impacts of short-lived pollutant transport to the Arctic in chemical-transport models: The POLARCAT Model Intercomparison Project (POLMIP)

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The Arctic has warmed rapidly in the past few decades compared with observed global-mean temperature increases. Recent calculations suggest that changes in short-lived pollutants such as ozone and aerosol may have contributed significantly to this warming. Arctic tropospheric budgets of short-lived pollutants are impacted significantly by long-range transport of gases and aerosols from Europe, Asia and N. America, and in summer by boreal wildfires. Previous assessments based on limited observations at the surface, have demonstrated that chemistry-transport models have highly variable and generally poor skill in reproducing short-lived pollutant concentrations in the Arctic. This suggests a significant limitation in the ability of climate models to predict Arctic and hemispheric climate response to changes in mid-latitude emissions.

The recent International Polar Year activities during Spring and Summer 2008 have yielded a wealth of new observations from aircraft, satellites and surface stations of tropospheric chemical constituents. The POLARCAT Model Intercomparison Project has been established to exploit these observations to evaluate a series of 10 state-of-the-art global and regional atmospheric chemical transport models (CTMs) from several international groups. We will present preliminary findings from this model intercomparison exercise, evaluating the ability of the models to capture transport of mid-latitude and boreal fire emissions to the Arctic, their chemical processing and impacts on Arctic pollutant budgets. We will demonstrate the sensitivity of modelled Arctic pollutant enhancements to different model treatments for boreal fire emissions, chemical processes, stratospheric influence and wet deposition. The new observations allow unprecedented evaluation of controls on spring and summer tropospheric ozone across the range of models. We will investigate modelled Arctic reactive nitrogen, VOC and radical budgets, and stratospheric influence on the tropospheric ozone budget. Processes will be identified that require improved representation in climate models, to ensure realistic response of Arctic tropospheric ozone, and hence Arctic radiative response, to mid-latitude emission changes.