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Investigating long-range transport of pollution to the Arctic troposphere using aircraft observations and a global chemical transport model

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Surface temperatures in the Arctic have increased more than in any other region over the past few decades. A better understanding of the processes governing this warming, including the role of short-lived greenhouse gases, is therefore urgently required. During summer 2008, the POLARCAT campaign aimed to collect an extensive gas-phase and aerosol dataset within the Arctic troposphere, which will aid the evaluation of our understanding of oxidant photochemistry and aerosol processing in the region.

Previous comparisons of global chemical transport models have shown that they exhibit large variability in their Arctic chemical budgets, indicating that the processes controlling Arctic tropospheric composition are not well understood or represented within models. Here, we will use new trace-gas observations from the French ATR and German DLR Falcon aircraft during the POLARCAT experiment to evaluate the ability of a global chemical transport model (TOMCAT) to simulate the summertime transport of pollutants to the Arctic, and their impact on oxidant budgets. In particular, we aim to quantify the impact of anthropogenic and biomass burning sources on the Arctic tropospheric ozone budget.

Initial results show that the model underestimates observed concentrations of CO which has led to a re-evaluation of the different sources of CO to the region. Model performance in the Arctic is highly sensitive to the treatment of boreal biomass burning emissions. Boreal biomass burning plumes were sampled frequently over the course of the campaign therefore accurate representation of emission injection heights and fire locations is essential. Model CO is improved with real-time satellite derived daily biomass burning emissions, however large uncertainties in these emissions result in large variability in the Arctic CO budget. We will also present results on the ability of the model to capture pollution transport pathways to the Arctic and contributions to the oxidant and NOy budgets from different sources.