Geophysical Research Abstracts
Vol. 13, EGU2011-9078, 2011
EGU General Assembly 2011

Reconstructing ozone chemistry from Asian wild fires using models, satellite and aircraft measurements during the ARCTAS campaign

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We use O3 and CO satellite measurements from the Tropospheric Emission Spectrometer (TES), simulations from the Real-time Air Quality Modeling System (RAQMS) and aircraft data from the NASA DC8 aircraft to characterize the chemical and dynamical evolution of Asian wildfire plumes during the spring ARCTAS campaign 2008. On the 19th of April, NASA DC8 Differential Absorption Lidar (DIAL) observed two biomass burning plumes originating from North-Western Asia (Kazakhstan) and South-Eastern Asia (Thailand) which were transported eastward over the Pacific reaching North America in 10 to 12 days. Using both TES observations and RAQMS chemical analyses, we track the wildfire plumes from their source to the ARCTAS DC8 platform. Comparison between satellite ozone and CO measurements and model results show consistency when the TES averaging kernel and constraint vector are applied to the model. However, RAQMS CO simulations suggest that TES observations do not capture the full range of CO variability in the plume due to low sensitivity. In both plumes, exchanges between the stratosphere and the troposphere tend to be the major factor influencing O3 concentrations. However, fire emissions of ozone precursors increase photochemical ozone production, particularly in the Thailand wildfire plume. Analysis shows that the Kazakhstan plume is responsible for increases of O3 and CO concentrations up to 8.5 ppbv and 50 ppbv in the lower troposphere, and the Thailand plume is responsible for increases of O3 and CO concentrations up to 10 ppbv and 70 ppbv in the upper troposphere.