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Analysis of the Wildfires in Alaska and Canada in Summer 2004: Source Estimates and the Impact on Air Chemistry and Composition

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The total acres burned in Alaska in summer 2004 have surpassed the previous record set in 1957, making this the worst year for Alaskan fires on record. The fires in Alaska and Canada impacted air chemistry and the composition of airmasses not only over North America, but also over other parts of the globe. Observations of CO from the Measurements of Pollution in the Troposphere (MOPITT) remote-sensing instrument show that plumes from these fires were spread all across North America and carried eastwards over the Atlantic into Europe, influencing the region of the ICARTT campaign. In order to understand the impact of these wildfires on atmospheric chemistry and composition, it is important to have good estimates of their emissions. We present in this paper a top-down approach to quantify the fire emissions of carbon monoxide (CO) by using observations from MOPITT in combination with data assimilation and an optimal estimation inverse model. The global chemistry transport model MOZART (Model for Ozone and Related Chemical Tracers) is used as the forward model. Our method differs from other top-down techniques in that we apply data assimilation outside the region of the fires to define the boundary conditions and the transport into that region. Various sensitivity studies will be presented such as the influence of the inversion to emission height. We evaluate the a posteriori emission estimates by comparison with independent observations (e.g. aircraft observations from the ICARTT campaign) and point out the impact these fires had on CO and ozone levels in the Northern Hemisphere.