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A case study of pyro-convection using transport model and remote sensing data

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Abstract. Summer 2004 saw severe forest fires in Alaska and the Yukon Territory that were mostly triggered by lightning strikes. The area burned (>2.7×10^6 ha) in the year 2004 was the highest on record to date in Alaska. Pollutant emissions from the fires lead to violation of federal standards for air quality in Fairbanks.

This paper studies deep convection events that occurred in the burning regions at the end of June 2004. The convection was likely enhanced by the strong forest fire activity (so-called pyro-convection) and penetrated into the lower stratosphere, up to about 3 km above the tropopause. Emissions from the fires did not only perturb the UT/LS locally, but also regionally. POAM data at the approximate location of Edmonton (53.5° N, 113.5° W) show that the UT/LS aerosol extinction was enhanced by a factor of 4 relative to unperturbed conditions. Simulations with the particle dispersion model FLEXPART with the deep convective transport scheme turned on showed transport of forest fire emissions into the stratosphere, in qualitatively good agreement with the enhancements seen in the POAM data. A corresponding simulation with the deep convection scheme turned off did not result in such deep vertical transport. Lidar measurements at Wisconsin on 30 June also show the presence of substantial aerosol loading in the UT/LS, up to about 13 km. In fact, the FLEXPART results suggest that this aerosol plume originated from the Yukon Territory on 25 June.

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