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Source identification of short-lived air pollutants in the Arctic using statistical analysis of measurement data and particle dispersion model output

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Abstract. As a part of the IPY project POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate Chemistry, Aerosols and Transport), this paper studies the sources of equivalent black carbon (EBC), sulphate, light-scattering aerosols and ozone measured at the Arctic stations Zeppelin, Alert, Barrow and Summit during the years 2000–2007. These species are important pollutants and climate forcing agents, and sulphate and EBC are main components of Arctic haze. To determine where these substances originate, the measurement data were combined with calculations using FLEXPART, a Lagrangian particle dispersion model. The climatology of atmospheric transport from surrounding regions on a twenty-day time scale modelled by FLEXPART shows that the stations Zeppelin, Alert and Barrow are highly sensitive to surface emissions in the Arctic and to emissions in high-latitude Eurasia in winter. Emission sensitivities over southern Asia and southern North America are small throughout the year. The high-altitude station Summit is an order of magnitude less sensitive to surface emissions in the Arctic whereas emissions in the southern parts of the Northern Hemisphere continents are more influential relative to the other stations. Our results show that for EBC and sulphate measured at Zeppelin, Alert and Barrow, northern Eurasia is the dominant source region. For sulphate, Eastern Europe and the metal smelting industry in Norilsk are particularly important. For EBC, boreal forest fires also contribute in summer. No evidence for any substantial contribution to EBC from sources in southern Asia is found. European air masses are associated with low ozone concentrations in winter due to titration by nitric oxides, but are associated with high ozone concentrations in summer due to photochemical ozone formation. There is also a strong influence of ozone depletion events in the Arctic boundary layer on measured ozone concentrations in spring and summer. These results will be useful for developing emission reduction

strategies for the Arctic.

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