A model- and satellite-based assessment of the aerosol distribution over the Arctic

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The Arctic region experiences enhanced aerosol concentrations in winter and spring (the so-called "Arctic Haze"), which are mostly due to the transport of particles from mid northern latitude sources. Boreal fires also contribute to the Arctic aerosol loadings in summer. It has been suggested that the aerosols deposited on the snow affect the snow absorption and thus the surface albedo and evaporation rate. Besides, the presence of aerosols in the Arctic atmosphere has implications for the regional circulation patterns and the hydrological cycle. However, until now, Arctic haze studies still suffer from a lack of in-situ regional and continuous aerosol monitoring. In addition, current satellite observations cannot be used to retrieve tropospheric aerosol loadings over snow- or ice-covered surfaces. The goal of this study is to show that additional insights about the Arctic aerosol loading, origins and the associated processes can be obtained from using conjointly atmospheric chemistry and transport models and satellite observations over mid latitudes of the northern Hemisphere. Assimilation of the POLDER aerosol products into the LMDz-INCA global model show that typical seasonal variations of the aerosol optical thickness in the Arctic as well as the winter-spring peak measured in Longyearbyen (15°E, 78°N) in 2003 are captured (while the a priori model does not reproduce them). Using the global chemical transport model (GEOS-Chem) together with multi-satellite products (POLDER and MODIS aerosol products, MOPITT CO products) we show that the 2003 Russian fires contribute to 16-33% to the spring and summer monthly mean aerosol optical thickness averaged north of 75°N and to 40-56% to the mass of absorbing particles deposited. They contribute to more than 30% of the aerosol optical thickness during the days of Arctic haze events in spring and summer.