

Frost flowers as the main source of sea salt aerosol in winter at Antarctica: A trajectory study of year-round sea salt aerosol record over 25 years at Neumayer, Antarctica

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Abstract

Sea ice is the main source of sea salt aerosol instead of open water in coastal Antarctica in winter. Frost flowers which grow on the surface of newly-formed sea ice are considered to contribute to the generation of sea salt aerosol. However, the exact mechanism of the release of sea salt from frost flowers is unknown. Here we present the results from meteorological backward trajectory studies of sea salt aerosol samples collected at Neumayer Air Chemistry Observatory, Antarctica since 1983. Cluster analysis of trajectories shows that the trajectories arrived at Neumayer have both Antarctic continental and marine influences. Two major pathways can be seen from trajectory analysis: one is from the continent southeasterly from Neumayer, the other from the Weddell sea. Both pathways often carried more sea salt aerosols if they travelled along the coastline near Neumayer before arriving, accompanied by wide opening of polynyas near coast. Contact times of an air parcel with sea ice, potential frost flower area (PFF) [Kaleschke et al., 2004] and open water area were calculated along each trajectory. The seasonal cycle of sea salt concentration correlates well with that of PFF-contact time, reaching maximum in winter. Sea ice extent, which shows similar seasonal cycle as sea ice-contact time, shifts its maximum several months later than that of sea salt. It implicates that sea salt aerosol flux is not necessarily correlated with ice extent, rather with frost flowers.