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A lagrangian backward trajectory model for the sea salt aerosol production and transport in the coastal antarctic regions

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Sea salt aerosol (SSA) is produced from open sea water via wave breaking and bubble bursting processes. Recent studies have indicated that in the sea ice covered polar regions sea ice is the main source of SSA in winter. However, the production mechanism of SSA over sea ice is still an unsolved problem. In this study we try to investigate the SSA production and transport processes in the coastal regions of Antarctica with a Lagrangian backward trajectory model, together with year-round aerosol measurements from coastal stations Neumayer, Syowa, and Dumont d'Urville. Based on sea ice remote sensing data and atmospheric reanalysis data, the model calculates along each backward trajectory the emission, deposition, and transport of SSA in accumulation and coarse modes respectively. Dry deposition velocities and a constant boundary layer depth are assumed. Summer SSA data from the three stations are used to validate the model which is in turn applied to explore the possible production mechanisms of SSA in winter. The model study shows the importance of both local production and long range transport. The variability of measured and modeled summer SSA data from the three measurement sites has correlation coefficient up to 0.3 with the significance level higher than 99 %. Moreover, the model can reconstruct half of the inter-annual linear variability of SSA at Neumayer from 1983 to 2007 in summer. Best correlation is found between measured and modeled daily data in winter at Neumayer when we multiply polynya area covered by thin ice with square of wind velocity and use this item as SSA production flux. This study suggests that thin ice covered area and wind velocity are important factors of SSA production in winter in the coast regions of Antarctica.