Important contributions of sea-salt aerosols to atmospheric bromine cycle in the Antarctic coasts

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Polar sunrise activates reactive bromine (BrO_x) cycle on the Antarctic coasts. BrO_x chemistry relates to depletion of O_3 and Hg in polar regions. To elucidate atmospheric sea-salt and halogen chemisty in the Antarctic coasts, we made sampling of aerosols, blowing snow, and snowfall at Syowa Station, Antarctica from 2004 – 2006 (JARE45-47). Water soluble constituents were determined with an ion chromatograph in our laboratory. Earlier studies have indicated "blowing snow" as a source of atmospheric BrO_x. However, surface O_3 depletion and BrO enhancement occurs rarely under blowing snow conditions at Syowa Station, Antarctica. Therefore, trigger processes for BrO_x activation other than the heterogeneous reactions on blowing snow particles must be considered. Results of this study show that enhancement of sea-salt aerosols (SSA) and heterogeneous reactions on SSA are the main key processes for atmospheric BrO_x cycle activation. Blowing snow had Br^- enrichment, in contrast to strong Br^- depletion in SSA. In-situ aerosol measurements and satellite BrO measurements demonstrated clearly that a BrO plume appeared simultaneously in SSA enhancement near the surface. Results show that surface O_3 depletion at Syowa Station occurred in aerosol enhancement because of SSA dispersion during the polar sunrise. Amounts of depleted Br- from SSA were matched well to the tropospheric vertical column density of BrO and BrO_x concentrations found in earlier work. Our results indicate direct evidence that SSA enhancement by strong winds engenders activation of atmospheric BrO_x cycles via heterogeneous reactions on SSA.