北海道全域の季節積雪中ブラックカーボン分布
Black carbon distribution in seasonal snowpack in Hokkaido, Japan

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In February and March 2016, whole layer snow samples were obtained at 62 locations in Hokkaido, Japan. To identify the black carbon (BC) distribution in seasonal snowpack in Hokkaido for the first time, we carried out elemental carbon (EC) measurements for all the snow samples, using the thermal optical method (DRI Model 2001A with IMPROVE protocol: https://www.env.go.jp/air/osen/pm/ca/120419/manual-4.pdf), after the following filtration treatments were completed. The filter treatments were conducted in the following order, respectively: carrying out the first filtrations with the membrane filters (Mixed cellulose ester, Toyo Roshi Co. Ltd.) in the pore size of 0.8 μm; removing carbonate on the filters with 2N HCl in the heated glass beakers; conducting the second filtrations to quarts fiber filters (2500QAT-UP, Pallflex Products Corp.) after melting the membrane filters out with acetone; rinsing the filters with ultrapure water to remove the calcium chloride, which can be formed on the chemical reactions with the hydrochloric acid above. The elemental carbon (EC) measurements were conducted three times on the same filter at different locations. To determine the snow accumulation periods during the beginning of snow accumulation and the snow sampling timing at each sampling site, snow depth data in Hokkaido University, which was observed under the Joint Research Program of Institute of Low Temperature Science with Okayama University and Meteorological Research Institute and kindly provided from them, and that from AMeDAS data (http://www.data.jma.go.jp/obd/stats/etrn/index.php) in the vicinity of the sampling sites were used. The BC related data such as deposition, surface mass concentrations, etc., from NASA’s MERRA-2 reanalysis data (https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/) were also analyzed to compare the BC distribution patterns to the measured EC ones.

The observed EC mass concentrations in snowpack in Hokkaido were in the range of 3.3 to 104.1 ppbw. The highest EC mass concentration was measured at Mashike Town near the western coast of Hokkaido though the standard deviation of the EC masses on the filter at this site was larger. In general, EC mass concentrations were relatively higher along or near the Japan Sea side and the Hidaka region. On the other hand, the calculated total EC deposition in Hidaka region was low. The calculated daily mean EC deposition flux also showed similar results. The fluxes were calculated from the EC mass concentration, snow water equivalent of the samples, and the estimated snow accumulation period (see above). These imply that lower snow accumulations in Hidaka region probably made the mass concentration higher. The calculated non sea-salt sulfate (nss-sulfate) deposition fluxes, for which the sulfate ion data were obtained from the same snow samples, were consistent with the EC deposition ones. This indicated that the pattern of EC distribution is likely explained by the main contribution of trans-boundary transports of anthropogenic aerosols from the Eurasian continent in the winter season.

The total BC deposition pattern calculated for the time period during January and March in 2016 from the MERRA-2 data was also consistent with the EC deposition pattern though the time period was not exactly the same as the time periods of snow samples.

キーワード：ブラックカーボン、雪、エアロゾル、日本、北海道、沈着
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