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EFFECTS OF BLACK CARBON ON THE CLIMATE OF THE ARCTIC - CURRENT STUDIES AND FUTURE PLANNING -

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Black carbon (BC) particles strongly absorbs solar visible radiation and heats the atmosphere. They deposit on snow and ice and contribute to the warming of the Arctic. BC also acts as ice nuclei (IN) and thus can influence the phases of clouds in the Arctic. However, the effects of BC on the climate of the Arctic are highly uncertain and we are conducting BC studies as a part of the GRENE Project closely following the science needs identified by the AMAP assessment report (2011); 1) to improve the accuracy of measurements of BC, 2) to continue efforts to resolve and standardize monitoring methods and protocols for BC, 3) to characterize BC deposition processes and sources of deposited BC through routine measurements of BC and tracer species in snow at locations near long term monitoring sites, and 4) to undertake process studies for characterizing aerosol removal processes during transport.

In order to measure BC mass concentration (MBC) in the Arctic, we installed COSMOS instruments at Ny-Alesund in Spitzbergen and in Barrow in Alaska in 2012. COSMOS is a filter-based photometer to measure BC with an accuracy of 10%. BC showed a seasonal maximum in winter and spring at these sites with the BC at Barrow higher than that at Ny-Alesund by about a factor 2.

Wet deposition is a major loss process of BC during transport from mid-latitudes to the Arctic and in the Arctic. Wet deposition of BC can be characterized by the measurement of BC in falling snow and rain together with the ambient MB data. Snow and rain samples have been collected at these sites for 1-2 years. We successfully developed a system to accurately measure size distributions of BC in water. We are applying this technique to the analysis of the collected snow and rain samples. We plan to characterize wet deposition of BC in the Arctic by comparing the measurements of BC wet deposition at mid-latitudes.

We have developed a sophisticated regional scale model and are developing global model to study microphysical properties of aerosol and their distributions. The measurements made at the mid-latitudes and in the Arctic are used to validate the models. Then the validated models will be used to estimate radiative forcing of aerosols, including BC in the Arctic.