Evaluation of wet deposition process of black carbon in WRF/Chem model during MIRAI Arctic research cruise over high-latitude regions in 2016

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Black carbon, which is known as a component of PM2.5, can change the Earth’ s albedo by changing the color of ice and snow via deposition into the surface, and the impact of BC on the climate change seems to be larger at high-latitude regions than that at the rest of the world. The amount of local anthropogenic source at high-latitude regions is relatively small, and the precise assessment of 1) impact of local source such as biomass burning, ship emissions, gas flares, 2) amount of transport from mid-latitude regions such as Asia, and 3) the removal process during the long-range transport, are quite important for the estimation of climate change in Arctic region.

To tackle on this issue, we had conducted model simulations over the Pan-Arctic region using a regional chemical transport model (WRF-Chem version 3.8.1). The initial and lateral boundary conditions for the meteorology and chemical species were taken from NCEP-GFS and MOZART-4, respectively. RACM and GOCART modules were used for the gaseous and aerosol chemistry, with a slightly modification to include OH dependency for the aging and in-cloud wet deposition of BC process based on Liu et al. (2011). Anthropogenic emissions were based on EDGAR 4.2, and the biomass burning were based on the near-real-time version of FINN for each day. A pyro-convection process was also considered for the estimation of vertical profiles of biomass burning emissions. Biogenic emissions of VOCs were estimated by MEGAN 2.1 which is included in the model to use the meteorology and radiation calculated in the model for each time step. Calculated period was from August to October in 2016.

Meteorological field was compared with the observational data from the ship-based observation on R/V Mirai at the Arctic Ocean and Bering Sea. Model generally succeeded to reproduce the temporal variations of meteorological field such as the passage of low pressure systems, though the model tens to underestimate the amount of precipitation. BC concentration in rainwater was also compared with the observed samples during the cruise, and it was found that the model tends to overestimate especially for snowing period.

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