Estimation of the transport pathways of black carbon aerosols emitted from Siberian fire in 2016

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Black carbon aerosol (BC) emitted from incomplete combustion processes such as fossil fuel and biomass burning. BC is recognized as one of a factor affecting the climate change by IPCC. We try to understand the dynamics of atmospheric BC to elucidate the changes in the arctic climate and environment. We have to identify the sources and pathways of BC observed in the arctic region to make a correct estimate. Accordingly, as a trial, we inferred transport pathways of BC emitted by forest fires over Siberia from ship-based observation and model simulations with regional mask.
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. To estimate the impact of Siberian fire on the concentration of BC, we have conducted two calculations (full emission and without biomass burning emission over Siberia) from August to October in 2016.
Model simulation results were compared with the observational data from the ship-based observation on R/V Mirai at the Arctic Ocean and Bering Sea. The model generally captured the variation of BC concentration in arctic region. High contribution of Siberian biomass burning was suggested especially in late September through the sensitivity analyses.

Keywords: Black Carbon, Chemical Transport, Arctic, Forest Fire, Model Simulation

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