5.023 Impacts of atmospheric and aerosol processes on black carbon concentrations in the Arctic.

Presenting Author:
Knut von Salzen, Environment and Climate Change Canada,
knut.vonsalzen@canada.ca

Co-Authors:
Rashed Mahmood, University of Victoria
Mark G. Flanner, University of Michigan
Maria Sand, Center for International Climate and Environmental Research
Joakim Langner, Swedish Meteorological and Hydrological Institute
Hailong Wang, Pacific Northwest National Laboratory
Lin Huang, Environment and Climate Change Canada

Abstract:

This study quantifies black carbon (BC) processes in three global climate models and one chemistry transport model, with focus on the seasonality of BC transport, emissions, wet and dry deposition in the Arctic. In the models, transport of BC to the Arctic from lower latitudes is the major BC source for this region. Arctic emissions are very small. All models simulated a similar annual cycle of BC transport from lower latitudes to the Arctic, with maximum transport occurring in July. Substantial differences were found in simulated BC burdens and vertical distributions, with CanAM (NorESM) producing the strongest (weakest) seasonal cycle. CanAM also has the shortest annual mean residence time for BC in the Arctic followed by SMHI-MATCH, CESM and NorESM. Overall, considerable differences in wet deposition efficiencies in the models exist and are a leading cause of differences in simulated BC burdens. Results from model sensitivity experiments indicate that convective scavenging outside Arctic reduces the mean altitude of BC residing in the Arctic, making it more susceptible to scavenging by stratiform (layer) clouds in the Arctic. Consequently, scavenging of BC in convective clouds outside the Arctic acts to substantially increase the overall efficiency of BC wet deposition in the Arctic, which leads to low BC burdens and a more pronounced seasonal cycle compared to simulations without convective BC scavenging. In contrast, the simulated seasonality of BC concentrations in the upper troposphere is only weakly influenced by wet deposition in stratiform clouds whereas lower tropospheric concentrations are highly sensitive.