Geophysical Research Abstracts
Vol. 18, EGU2016-2382, 2016
EGU General Assembly 2016

Effect of Wegener-Bergeron-Findeisen Process to Black Carbon Simulation

Ling Qi (1), Qinbin Li (1,2,3), Cenlin He (1,2), Xin Wang (4), and Jianping Huang (4)

(1) Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, CA, USA, (2) Joint Institute for Regional Earth System Science and Engineering, University of California, Los Angeles, CA, USA, (3) Jet Propulsion Laboratory, California Institute of Technology, CA 91109, USA, (4) Key Laboratory for Semi-Arid Climate Change of the Ministry of Education, College of Atmospheric Sciences, Lanzhou University, Lanzhou, China

We systematically investigated the effect of Wegener-Bergeron-Findeisen (WBF) process to black carbon (BC) simulation by a global 3D chemical transport model GEOS-Chem constrained by measurements of BC scavenging efficiencies, concentration in air, deposition fluxes, concentration in snow and washout ratios. Including effect of WBF process reduces the annual mean BC scavenging efficiencies (the ratio of BC in cloud droplets to total BC) at all altitudes by 43-76% in the Arctic. For mid latitude BC scavenging efficiencies decrease by 8-22%, 23-39%, and 41-50% in lower (0-2 km), middle (2-5 km) and upper troposphere (5-10 km), respectively. Simulated BC in air in the Arctic and at mid altitude ($\sim$4 km) in mid latitude increases by $\sim$40%, and the discrepancy reduces from -65% to -30%. Simulated median BC in snow decreases from 25.7 to 22.4 ng g^{-1}, by 15% in mid latitude and increases from 8.7 to 11.0 ng g^{-1}, by 26% in the Arctic and the comparison with observations improves. The model overestimates washout ratios (ratio of BC in fresh snow/rain to BC in surface air) at most of the sites by up to a factor of 165. With effect of WBF process included, the discrepancy decreases to a factor of 72. The simulated BC burden increases from 0.22 to 0.35 mg m^{-2} yr^{-1} when effect of WBF process is included, partly explains the scaled up of BC burden in Bond et al., 2013. Moreover, burden above 5 km increases from 22% to 27% when WBF process is included, indicating a higher forcing efficiency. We also found that BC simulation is insensitive to the temperature criteria between mixed phase clouds and ice clouds. The simulated BC burden is the same when the temperature is set as -15˚C and -25˚C. This study also suggests that more observations are needed to better distinguish riming dominated and WBF dominated conditions and better parameterize BC scavenging efficiency under the two conditions.