Geophysical Research Abstracts
Vol. 18, EGU2016-13510, 2016
EGU General Assembly 2016

Parametric uncertainties in global model simulations of black carbon column mass concentration

Hana Pearce, Lindsay Lee, Carly Reddington, Ken Carslaw, and Graham Mann
Institute for Climate and Atmospheric Science, University of Leeds, University of Leeds, United Kingdom (h.c.pearce1@leeds.ac.uk)

Previous studies have deduced that the annual mean direct radiative forcing from black carbon (BC) aerosol may regionally be up to 5 W m^{-2} larger than expected due to underestimation of global atmospheric BC absorption in models. We have identified the magnitude and important sources of parametric uncertainty in simulations of BC column mass concentration from a global aerosol microphysics model (GLOMAP-Mode). A variance-based uncertainty analysis of 28 parameters has been performed, based on statistical emulators trained on model output from GLOMAP-Mode. This is the largest number of uncertain model parameters to be considered in a BC uncertainty analysis to date and covers primary aerosol emissions, microphysical processes and structural parameters related to the aerosol size distribution.

We will present several recommendations for further research to improve the fidelity of simulated BC. In brief, we find that the standard deviation around the simulated mean annual BC column mass concentration varies globally between 2.5 x 10^{-9} g cm^{-2} in remote marine regions and 1.25 x 10^{-6} g cm^{-2} near emission sources due to parameter uncertainty Between 60 and 90% of the variance over source regions is due to uncertainty associated with primary BC emission fluxes, including biomass burning, fossil fuel and biofuel emissions. While the contributions to BC column uncertainty from microphysical processes, for example those related to dry and wet deposition, are increased over remote regions, we find that emissions still make an important contribution in these areas. It is likely, however, that the importance of structural model error, i.e. differences between models, is greater than parametric uncertainty. We have extended our analysis to emulate vertical BC profiles at several locations in the mid-Pacific Ocean and identify the parameters contributing to uncertainty in the vertical distribution of black carbon at these locations. We will present preliminary comparisons of emulated BC vertical profiles from the AeroCom multi-model ensemble and Hiaper Pole-to-Pole (HIPPO) observations.