Geophysical Research Abstracts
Vol. 14, EGU2012-12682-1, 2012
EGU General Assembly 2012

Constraints from vertically-resolved aircraft observations on aerosol processes in climate models

Z. Kipling (1), P. Stier (1), J. P. Schwarz (2,3), D. W. Fahey (2,3), J. R. Spackman (2,3), and C. E. Johnson (4)

(1) Atmospheric, Oceanic and Planetary Physics, Department of Physics, University of Oxford, Oxford, United Kingdom, (2) Co-operative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, USA, (3) Chemical Sciences Division, Earth System Research Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado, USA, (4) Met Office Hadley Centre, Exeter, United Kingdom

Current climate models are increasingly including detailed aerosol schemes to capture both the direct and indirect effects of aerosol on climate. Evaluation of these schemes is dependent upon the available observational data. Airborne observations from flight campaigns can provide valuable data about the vertical distribution of aerosol that is difficult to obtain from satellite or ground-based platforms. Such measurements are localised in space and time however, which suggests that appropriate initialisation and sampling of the model may be important to achieve a meaningful comparison.

Using single-particle soot-photometer (SP2) observations from the HIPPO aircraft campaigns over the Pacific, we discuss and evaluate the impact of model initialisation and sampling choices on the match with black carbon aerosol simulated by the HadGEM3-UKCA and ECHAM5-HAM models. We then use these comparisons to evaluate two particular elements of these aerosol models: sensitivity to the choice and implementation of biomass-burning emissions, and scavenging by convective precipitation.

In the default setup of both models, biomass-burning emissions are taken as monthly means from the GFED2 inventory, which does not extend beyond 2008, preventing the use of correct-year emissions for the HIPPO campaigns. The newer GFED3.1 extends through 2010, covering the period of the first three campaigns, substantially revises the total carbon emitted, and provides data at a higher time resolution. We show large changes in the comparison with observations using the newer inventory, but almost no change from high-time-resolution emissions (at least in the remote regions sampled by HIPPO).

Vertically-resolved aircraft observations are particularly useful for evaluating those aerosol processes which affect the vertical profile of aerosol. In particular, convection plays a major role in vertical transport above the boundary layer, and scavenging by convective precipitation can thus be expected to control the amount of aerosol reaching the upper troposphere. We demonstrate the importance of this effect in getting a realistic vertical distribution of aerosol in both models, and attempt to quantify the impact this has in turn on estimates of radiative forcing and cloud condensation nuclei (CCN) concentrations.