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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Understanding the contributions of aerosol properties and parameterization discrepancies to droplet number variability in a Global Climate Model" *by* R. Morales Betancourt and A. Nenes

Anonymous Referee #1

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This paper attempts to disentangle the role of various aerosol properties (aitken, accumulation and coarse mode number, size and hygroscopicity) in the anthropogenic change in droplet number concentrations. The sensitivity of droplet concentration to aerosol properties is central to estimates of the indirect aerosol effect (IAE), which is arguably the single most uncertain forcing of modern climate change. As such, the paper addresses an important question, namely which aerosol properties are most influential for droplet number concentration and ultimately the IAE.

The so-called adjoint method is used for individual inspection of the sensitivity to ten properties of the aerosol size distribution and composition, and this is done for two versions of two frequently used droplet activation schemes. All four droplet activation schemes produce a global mean AIE of about -2 Wm-2 in the NCAR CAM5.1 model, the difference between them being so small that it is in itself not really worth investigating. However, it should still be of interest to the aerosol-cloud-climate research community which aerosol properties are driving the anthropogenic changes in droplet concentrations, and to what extent those properties are the same in different parameterization schemes.

I therefore find the paper worthy of publication in ACP, but ask that the authors go through the manuscript to clean up the English and correct for typos. In its current form, the manuscript seems a little "sloppy". For example, it was not clear to me why the figures and tables did not include the results from the ARG scheme, only the ARGalpha and FN schemes. The notation used is also not consistent (ARG and ARGalpha are used interchangeably), and Table 2 has the same entry twice. In summary, proper proof-reading is what is missing to make this manuscript publishable.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 31479, 2013.