Droplet number prediction uncertainties from CCN: an integrated assessment using observations and a global adkoint model
By Moore, et al. (Atmos. Chem. Phys. Discuss., 12, 20483–20517, 2012)

General Comments

Aerosol effect on climate remains one of the largest uncertainties in projecting future climate change. This work uses a global adjoint model together with observations to investigate the droplet number uncertainties associated with CCN uncertainties. This work is relevant to the scope of Atmos. Chem. Phys. I have a few general comments and a number of specific comments that the authors need to address. There are many places in the paper where the discussion and explanation need to be clarified.

General Comments

- The title. This study does not "predict" droplet number, but diagnose (calculate) it from aerosol (CCN) number and size and updraft. There are no other sources and sinks for the droplet number. I would suggest changing the title to "Droplet number uncertainties associated with CCN: an assessment using observations and a global adjoint model"
- This study aims to quantify the uncertainty of droplet number from CCN number uncertainty in observation estimations by using ΔNd/Nd = $(\frac{\P N_d}{\P N_a})$(Na/Nd)(ΔNccn/Nccn). However, it is unclear if the Na from the model is the same thing as Nccn from the individual observation? Or Na has the same sensitivity to Nd as CCN?

Specific Comments

1. Abstract. There are many sentences which are unclear to me. "Published CCN closure prediction uncertainties" is awkward. Change to "Published CCN closure uncertainties". "CCN-active aerosol number concentrations" is awkward. Change to "number concentrations of aerosols which are active as CCN". "most of the anthropogenic indirect forcing is concentrated over the continents". How do you know that? The objective of this study is to quantify the droplet number uncertainty from CCN uncertainty. However there are no quantitative numbers given for droplet number uncertainty in the abstract.
2. P20487. L10-13. Please explain the reason of reduced uncertainty of Nd compared to CCN.
3. The title of section 2.1 "CCN prediction uncertainty measurements" is awkward. Change to "CCN uncertainties due to mixing state and composition in the measurements".

4. P20490. L1-2. The statement is not generally true for large-scale models. Many large-scale models are now predicting the aerosol mixing state, composition and size distribution.
5. P20490. L22-24. This sentence is confusing. "Most studies tend toward *overprediction* with the external mixing…*lower*…than…internal mixing"
6. P20491. L19. "offline parameterization" of what?
7. P20492. L14. What do you mean "analytical precision"?
8. P20493. L2. "observations" of what?
9. P20493. Section 3.1, first paragraph. What is the size range of Na? Is Na the number for all aerosols predicted in the model? Are Na and Nd concentrations at surface? What is Smax? How do you derive the global geometric mean aerosol concentration?
10. P20494. L15. "inflection point of the sigmoidal fit function". This is unclear to me.
11. P20495. L17. "moisture flux (e.g., liquid water content)". Chang "liquid water content" to "water vapor mixing ratio".
12. P20496. L8. I don't know how you get 1/12*Nd when A=0.5 in Equation 1.
13. P20496. L25. It is confusing "simplified forms of Kohler theory".