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Interactive comment on "Aerosol direct radiative effects over the northwest Atlantic, northwest Pacific, and North Indian Oceans: estimates based on in-situ chemical and optical measurements and chemical transport modeling" *by* T. S. Bates et al.

Anonymous Referee #1

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Review of "Aerosol direct radiative effects over the northwest Atlantic, northwest Pacific, and North Indian Oceans: estimates based on in-situ chemical and optical measurements and chemical transport modelling. By Bates et al.

This 187 page manuscript describes in unrelenting detail the aerosol measurements from 3 recent and major field campaigns to improve the aerosol shortwave direct forcing and other optical calculations using chemical transport models. The synthesis of the large measurement data base allowed for the improved characterization of the aerosol

mixing states, hygroscopic growth and optical properties.

I was, quite frankly, at a loss in knowing how to proceed with reviewing this tome. It has been compiled by an excellent group of authors who are very familiar with the scientific issues related to aerosols and their direct radiative forcing. They cover all the bases, include a good literature review, point out uncertainties and errors, and discuss approaches in improving the radiative calculations. I recommend that the paper be published as is with the exception of a few minor comments given below. It is an excellent resource of up to date information that I hope all students engaged in aerosol research will use to appreciate the great challenges that exist in obtaining closure and good estimates of aerosol radiative forcing. I found no serious flaws and I will refrain from criticizing on the style and organization since this is not a convectional paper. Naturally a paper of this length tends to lose focus, but here again I believe the authors were more interested in presenting a comprehensive analysis rather than emphasizing one or two new findings, which is acceptable in this case. It is a shame that in a paper of such length that the issue of the indirect forcing was not confronted. In spite of all the uncertainties and problems associated with direct forcing, as was spelled out in detail in this paper, it still pales in comparison to the issues that face the aerosol-climate community in narrowing the uncertainty with the indirect effect. I shutter to think what the length of such a paper might be.

A few minor comments that should be addressed:

1. How would the authors recommend detailing with the hysteresis effect in the relative humidity on the size of the aerosols? Is it not important to know the recrystallization relative humidity so that the dry branch of the hysteresis curve can be followed if the ambient humidities become low enough? Also their water uptake is limited to RH $<$ 90% by the measurements. How did they extrapolate to RH = 100% in their model?

2. On page 220, Line 11-12. It is stated that the SSA is 1.0 but then for submicrometer aerosols the value would be expected to be even larger. How can it be larger than 1.0?

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3. Can the authors tell us what errors are made if we assume that all the fine mode aerosols are anthropogenic? Of course the answer will depend on location but they can compute this for the 3 regions studied. This is of some interest since this is often a necessary assumption when using satellite remote sensing to deduce the anthropogenic component.

4. In Section 4.2.4 an e-folding time of 1.6 days for hydrophilic conversion is assumed. Where does this time scale come from? Is it justified?

5. Page 234, line 13. “Dust was treated as a soluble component”. Dust is not a soluble substance. This sentence should be clarified.

6. Page 241, line 2-3. Why, in NIO, was the STEM dust burden half of MOZART in spite being a factor of 64 smaller in emissions?

7. Can you comment on the differences in numerical diffusion, both vertical and horizontal, between the CTMs? This has some bearing on comparing transport properties and results.

8. Page 243, Line 1. “session” should be “season”?

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 175, 2006.