

Interactive comment on “Uncertainty analysis for estimates of the first indirect aerosol effect” by Y. Chen and J. E. Penner

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We thank Anonymous Referee #1 for many useful comments and suggestions. We will incorporate the corrections and modifications in the revised version.

- As for general comments

A paragraph has been inserted to section 4 ‘Conclusions and discussions’ between paragraph 3 and 4. The paragraph is shown as follows:

‘We note that the uncertainty of the first indirect effect was based on the model and the criteria used in this study. If a different radiative transfer model was used, or other choices of criteria such as model resolution, cloud overlap scheme, and the aerosol mixing scheme were selected, the estimated uncertainty would probably be different.’

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- As for specific comments

(1) The aerosols are treated as an internal mixture. A sentence of has been added after 'black carbon(BC).' as follows: 'The aerosols are assumed to be internally mixed.'

(2) The meteorological data are from the assimilated data by NASA Data Assimilation Office (DAO). The time resolution of this data set is 6 hour. The original data were developed at (1 degree * 1 degree), but this is averaged up to (5 degrees * 4 degrees). Vertically there are 26 levels.

(3) This assumption is not well justified, but the use of didfferent model results have commonly been used to assess the uncertainty(e.g. IPCC,2005). This is now stated explicitly.

(4) We already did the MIN_MA case and will include the results and discussions on this case in the revised version. Briefly, the global mean forcing of MIN_MA case is - 2.39 W/m², which is larger than the reference case. This is reasonable since the cloud droplet number concentration (Nd) is more sensitive to aerosol number concentration (Na) when Na is small. The MIN_MA case has much lower pre-industrial aerosol number concentration so that the effect of anthropogenic effect is larger.

(5) This distribution refers to the aerosol size distribution. Since we assumed the aerosols are internally mixed, they all have the same size distribution. This is now changed in the text.

(6) In this case, the change of PI aerosol size distribution only applies to continental aerosols.

(7) In the base case, the 3-D LWC value is from a parameterization based on the RH values from the DAO meteorological field. For the perturbation case, the model calculated LWP and satellite retrieved LWP' are used to calculate 3-D LWC': $LWC'(x,y,z)=LWP'(x,y)/LWP(x,y)*LWC(x,y,z)$. This is now added to revised paper.

(8) Because in most stratiform clouds, LWC increases with the altitude, this sentence

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partially explains why modeled effective radius is smaller than retrieved value. But tests show this difference is not large enough to fully explain it. This is now added to revised paper.

(9) This sentence has been deleted.

(10) A sentence has been added here at line 15: 'This can be also seen from the parcel model simulation. Fig B1 shows after a certain limit of aerosol number concentration, the activated cloud droplet number decreases with Na.'

(11) See (3)

(12) A sentence has been added to paragraph 2 at line 13: 'This is consistent with the result by Platnick and Twomey (1994), which says that the cloud susceptibility (defined as the increase in albedo resulting from the addition of one cloud droplet per cubic centimeter as cloud liquid water content remains constant) is larger when the air is cleaner.'

- As for technical corrections

(a) Done.

(b) Done.

(c) Done.

(d) Here the LWP means the integration of LWC in each model level, so it is a 3-D quantity. We have added this explanation.

(e) The droplet concentrations are LWC-weighted in-cloud droplet number in each column sate change.

(f) Done.

(g) Done.

(h) '3-D' has been corrected to be '2-D'.

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(i) Done.

(j) Done.

(k) Done.

(l) Done.

(m) The colors do not mean anything.

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