

## ***Interactive comment on “Constraining the total aerosol indirect effect in the LMDZ and ECHAM4 GCMs using MODIS satellite data” by J. Quaas et al.***

### **Anonymous Referee #2**

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#### General comments:

The subject of the paper, reduction of the uncertainty in anthropogenic forcing of climate by constraining the GCM parameterizations of aerosol indirect effect to match the satellite data, is novel and relevant to the scope of ACP. The title clearly reflects the contents of the paper and the scientific methods used in the paper are well described. Overall, the paper is well structured and easy to read.

However, the rationale for the main assumption of the article that determines the conclusions reached in the paper necessitates further clarification (see Specific comments

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below).

Specific comments:

It is quite plausible to assume that CDR-AI relationship can be influenced by joint aerosol indirect effects (i.e., cloud albedo and lifetime). However, the rationale for adjusting coefficients for CDNC-AODFM relationships simulated by LMDZ and ECHAM4 to match that observed over the ocean by MODIS is not clear from the article. How this relationship will work over the continents where according to Fig. 3 the highest negative forcing is observed? If coefficients in BL95 formula are reduced so to match CDNC observed over the ocean, for the same aerosol mass concentration would not this cause reduction in cloud drop number over the land? If so, should not we expect to see the uniform reduction of CDNC number concentration, and hence the reduction in negative forcing over the continents? From Figure 3 it seems that the global annual mean radiative forcing was reduced mainly due to reduced forcing over the continents (Fig. 3c,d). Perhaps this is particularly true for the East Asia where ECHAM4 simulated strong negative forcing changed to positive after CDNC coefficient adjustment (Fig. 3b,d).

Will CDNC adjustments using CDNC-AODFM graphs still be realistic if the fine model AOD is not predicted correctly? Model simulated fine mode AOD for present-day conditions is not shown in the paper, therefore can not be compared to AOD derived from MODIS (Fig. 1a). However, Figure 4a,b show that with the adjusted parameterization the annual mean fine-mode AOD predicted by LMDZ is somewhat higher (particularly in the North Atlantic) compared to MODIS, while ECHAM4 predictions are considerably lower. In addition ECHAM4 displays no significant variations over the oceans.

It would be very helpful for the reviewer if the article showed how CDNC simulated by both models prior and after the coefficient adjustment compares with the annual mean CDNC derived from MODIS.

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