

## ***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 #1**

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In this paper, the authors use satellite observations to better constrain the relationship between aerosol concentration and cloud droplet number concentration that is used in two GCM to assess the indirect aerosol forcing. The satellite-derived relationship indicates a lower influence of aerosols on the cloud microphysics than in the original parameterization so that the corrected estimates of aerosol indirect effects are notably smaller than the original. However, there are still significant differences between the two estimates, which shows, if necessary, that such estimates are still rather uncertain.

This paper is an original study that is useful to the community. It is clear and well

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presented. It should be published after accounting for the few remarks below:

The satellite constrain that is used is the statistical mean relationship between aerosol optical depth of the fine mode for the atmospheric column and the droplet number concentration. There is a fairly direct relationship between aerosol optical depth and the satellite measurement (with some assumptions on the aerosol model). On the other hand, the relationship between the satellite measurement and the droplet number concentration is highly indirect. To the first order, the measurement is sensitive to the cloud optical depth. The spectral signature gives some indication on the droplet radius in the upper part of the cloud (not the very cloud top, see S. Platnick, JGR, 2000). Thus, a significant fraction of the MODIS variability in Fig 2b may be the result of this uncertainty. This should be mentioned and discussed in the paper.

In Figure 3, the units should be stated ( $\text{Wm}^{-2}$  ?). Why the use of an exponential scale ? Is there an explanation for the apparent small scale variation in the LMDz results, and broader scale in the ECHAM results ?

Fig 4 (b and c). State that the units are percents. It could be useful to show the maps of AOTFM for MODIS, that are used in the paper to derive the constrain on the model parameterization.

Figure 5: State that the units are percents. It could be useful to provide the same field (ie low cloud fraction) derived from MODIS. There are some white spots over the Sahara that, I believe, correspond to nill cloud cover and should be black instead. Why the exponential scale for figure 5cd ?

P 9671, line 4: Please define “forward and inverse simulations of global climate change”

In the discussion section, it is said that LMDz does not include the direct aerosol effect, while ECHAM estimate is on the order of  $0.1 \text{ Wm}^{-2}$ . How does this value compare to the observations. Isn't it rather small ?

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