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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Combined observational and modeling based study of the aerosol indirect effect" *by* T. Storelvmo et al.

Anonymous Referee #1

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The paper presents relationships between aerosol and cloud properties derived from MODIS satellite data for the purpose of detection of the indirect aerosol effect. These statistical relationships are compared to such derived from a GCM simulation. The use of statistical relationships of satellite retrieved quantities to improve process understanding and model parameterizations is very promising and thus the paper warrants publication in ACP. However, I have some comments regarding the statistical method used: The basic assumption is that although cloud properties as LWP (liquid water path), COD (cloud optical depth) and CER (cloud effective radius) are controlled by a multitude of processes the impact of aerosols is in evidence in the data. Figure 2 displays a scattergram showing the (rather poor) correlation between aerosol optical depth (AOD) and CER based on MODIS and on model data. It is quite obvious ac-

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cording to Fig 2 that low AOD values do not correlate with CER and that the correlation between AOD and CER is not linear. Linearity between the AOD and CER, COD or LWP cannot necessarily be expected from theory. Thus, the linear regression coefficients may not be physically meaningful and the assumption of linear correlation may understate the relationship. (similar arguments apply to Figs 3-9).

Minor comments:

- Page 3759/13: Suppression of rain may result in both an increase of LWP and/or an increase in cloud coverage. - The statement on page 3761 “Quaas et al used MODIS data..” is contrary to the sentence “A novelty in this study is the use of MODIS”. - Chapter 2: Simulations are driven by climatological SST. How many years was the model integrated. Wouldn’t it be better to simulate the same years when MODIS data are available? - Please, mention in chapter 3 which years of MODIS were used for analysis. Did you use daily mean values or satellite overpass mean? Are MODIS data interpolated on model grid? (they should). - Are satellite retrieved AODs lower than 0.05 accurate and should such low values be used to calculate correlation coefficients? - Chapter 4.2: Quality of MODIS retrieved AOD is lower over land than over the ocean and in particular low over bright surfaces as over deserts or snow-covered regions. These uncertainties should be addressed when discussing regional aerosol properties. - Page 3768: Please, compare findings of your analysis to that by Krueger and Grassl, GRL, 2004. - Page 3770 Kerguelen: The model simulates stronger indirect aerosol effect. Because this effect shows saturation for higher aerosol load, the fact that background aerosol is underestimated may cause this model bias. - Figs 2-7 are due to the many data points difficult to read; think about a better representation (frequency of occurrence, pdf). - Fig 12 a: Please, change the longitudinal representation.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 3757, 2006.

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