Atmos. Chem. Phys. Discuss., 8, S10386–S10391, 2009
www.atmos-chem-phys-discuss.net/8/S10386/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "A six year satellite-based assessment of the regional variations in aerosol indirect effects" *by* T. A. Jones et al.

Anonymous Referee #1

Received and published: 13 January 2009

This paper makes useful observations about the interaction of aerosols, clouds and prevalent meteorological conditions, extending previous correlative analysis of aerosol and cloud properties using satellite data. This research adds to an already large body of work that adopts this approach. It is valuable in its inclusion of meteorological variables in the analysis and the 6-year length of the study period. There are however some significant shortcomings with respect to written English and grammar, and the referencing of previous research in this field. If the comments below are fully addressed this paper will make a worthy contribution to aerosol research.

General Comments

This paper reads as if it has not been proof read. In many sentences there are gram-

matical errors, mixed tenses or simply sentences that make no sense. I give a few examples below but the whole paper needs to be checked thoroughly for grammatical mistakes. Page 20350 Line 1: Since aerosols act as cloud condensation nuclei (CCN) for cloud water droplets, changes in aerosol concentrations HAVE significant impacts on the corresponding cloud properties. Page 20355 Line 8: Anthropogenic aerosol from pollution sources are located nearly year-round in the Bay of Bengal (BB) OFF the east COAST of China.

Much recent research including some referenced in this paper has highlighted the limitations of using satellite data for this type of study given the large spatial and temporal variations in aerosol composition and loading and cloud properties, and the need to refine our analysis methods to capture these variations. These limitations need to be discussed in the paper. References include: Feingold et al, 2001, Analysis of Smoke Impact on Clouds in Brazilian Biomass Burning Regions: An Extension of Twomeys Approach, JGR. Feingold et al, 2003, First Measurement of the Twomey Indirect Effect using Ground-Based Remote Sensors, GRL. Bulgin et al (2008), 2008, Regional and Seasonal Variations of the Twomey Indirect Effect as Observed by the ATSR-2 Satellite Instrument, GRL.

Another major limitation of this type of research is correlating aerosol and cloud measurements when the two retrievals are not coincident. This issue is discussed in papers including Bulgin et al (above), and Breon et al, 2002, Aerosol Effect on Cloud Droplet Size Monitored from Satellite, Science. This must be addressed in this research.

There are a number of key references omitted in this work that adopt a similar approach, trying to quantify the aerosol indirect effect over a specific region for a given time period, in some cases focusing on different aerosol types. These should be acknowledged within the introduction. Examples include Breon et al (above), Bulgin et al (above) and Matheson et al, 2005, Aerosol and Cloud Property Relationships for Summertime Stratiform Clouds in the Northeastern Atlantic from Advanced Very High Resolution Radiometer Observations, JGR.

ACPD

8, S10386–S10391, 2009

Interactive Comment

In a number of cases acronyms are used that have not been expanded previously, or expanded after the first instance of their use. They need to be expanded the first time they are used.

The individual case study days are very important to this research as they enable the processes occurring in each region to be examined in more detail. It may be useful to plot the variables shown in figures 2-5 for the individual case studies depending on the frequency at which the data is available to see how they directly relate to one another.

Specific Comments

Page 20350 Line 19: In the Arabian Sea, the six-year mean anthropogenic + dust AIE is -0.4Wm-2 and is greatest during the summer months ($<$-2.0 Wm-2) during which dust aerosol is greatest, significant concentrations of anthropogenic aerosols are present, and upward vertical motion is also present providing a favourable environment for cloud formation. This figure (0.4 Wm-2) is not the same as the sum of the six-year mean anthropogenic and dust IE in table one. This statement is also misleading, as dust does not typically act as good cloud condensation nuclei, a point you made in line 25. It is however implyed here that it is a reason for the high AIE, and indeed table one shows that the dust AIE component is much greater than the anthropogenic one. Can this be explained?

Page 20351 Line 6: Not all biomass-burning aerosol is anthropogenic there is also a significant wildfire component.

Page 20351 Line 18: Here a description of small mode aerosols is introduced. Usually this size range is referred to as the fine mode fraction or nucleation/accumulation modes. Small and fine as a description of aerosol mode are interchanged throughout the paper and some consistency in terminology would be preferred.

Page 20352 Line 15: Aerosol indirect effects are shown to be strongly dependent on the aerosol size distribution not referred to here eg. Duesk et al, 2006. Size Matters

ACPD

8, S10386–S10391, 2009

Interactive Comment

More than Chemistry for Cloud-Nucleating Ability of Aerosol Particles, Science.

Page 20355 Line 5: Dust concentrations are also high in the northeast Atlantic in DJF although the transport method is different from that in summer months.

Page 20355 Line 8: Aerosol concentrations in the northwest Atlantic have been shown to vary significantly with season - Bulgin et al, 2008, Quinn and Bates, 2003, North American, Asian, and Indian haze: Similar Regional Impacts on Climate? GRL.

Page 20357 Line 3: What altitude ranges can the two cloud layers be identified within?

Page 20257 Line 25: Which regions have mainly optically thin clouds and at what time of the year? It is stated that the relationship between COT and cloud effective radius may break down in this case. How does this affect the conclusions drawn later in the paper?

Page 20358 Line 21: What is the minimum number of clear-sky pixels needed in a given region to calculate AOT? In line 25 it is stated that an AOT value can still be derived with a fractional cloudiness of 0.95. I would suggest that a lower threshold would be more appropriate to increase the amount of data available and reduce the potential for retrievals to be affected by aerosols absorbing water in the highly humid environment in close proximity to clouds (an effect detailed elsewhere in the paper). To have a threshold as high as 0.95 exhibits far too great a confidence in the cloudmask retrieval algorithm being correct especially in the presence of dust.

Page 20358 Line 28: How much greater is the uncertainty in the FMF?

Page 20359 Line 19: Which components of biomass burning aerosol absorb in the UV that are not also present in industrial aerosol emissions?

Page 20360 Line 4: What is the altitude range of the 17 levels?

Page 20360 Line 15: No mention of the variability in either meteorological data or aerosol data is made here. Aerosol indirect effects are dependent on processes hap-

ACPD

8, S10386–S10391, 2009

pening on much shorter temporal scales than a month. Variability could be included as error bars on the time series figures.

Page 20360 Line 26: How is each retrieval classified is a single observation taken to be anthropogenic, sea salt or dust depending on its FMF?

Page 20361 Line 10: How are these large uncertainties taken into account in the following analysis?

Page 20362 Line 6: does not appear to be defined in the text.

Page 20365 Line 14: Monthly averaged cloud top pressure ranges between 824hPa in the Bay of Bengal to as HIGH as 853hPa in the southern Atlantic. The cloud altitude is lower but CTP is higher.

Page 20365 Line 27: Is N rather than Rc used only for BB and EA? If so, what is the reasoning behind this and what impact does this have on the AIE calculation?

Page 20366 Line 25: However, the total AOT in both regions is low (tau=0.11) indicating that the aerosols that are present are very effective CCN. This statement implies that aerosol ability to act as CCN determines the aerosol optical depth retrieved in non-cloudy pixels. If that is the case then the basis of this research is void as the AOT in cloud-free pixels cannot be directly related to neighbouring cloudy pixel properties, as this suggests that the cloud alters aerosol properties rather than the aerosol impacting cloud microphysics.

Page 20367 Line 17: What altitude is this elevated aerosol at?

Page 20371 Line 13: This reads as if vertical velocities are near zero in the ITCZ which is characterised by convective uplift.

Page 20372 Line 19: Chemical composition of the dust and the potential for dust to obtain a hygroscopic coating are also important factors not mentioned here.

Page 20377 Line 14: A large body of research indicates the impact of aerosols on

ACPD

8, S10386–S10391, 2009

long-lived stratocumulus sheets, which could be mentioned here.

Page 20377 Line 27: What conclusions can be drawn from this? When hygroscopic aerosol is present, is the AIE more dependent on that than on other meteorological factors? This is an interesting observation and should be expanded.

Table 2: It would be useful to include the aerosol height from MISR for comparison with CTP in this table.

Figure 2: A correlation scale is given on the second y-axis but nothing seems to be plotted in relation to this. Also, is AOT for all aerosols or only the FMF?

Figures 5: No error bars are given in these figures.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20349, 2008.