Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-449-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Unveiling aerosol-cloud interactions Part 2: Minimizing the effects of aerosol swelling and wet scavenging in ECHAM6-HAM2 for comparison to satellite data" *by* David Neubauer et al.

Anonymous Referee #2

Received and published: 31 July 2017

This work looks at different factors that can affect the AI-LWP relationship, from measurement issues such as aerosol humidification to differences in how models represent aerosol and cloud processes. The authors find that model processes, such as wet scavenging, the use of prognostic drizzle and the representation of cloud processing of aerosol can have a significant effect on the AI-LWP susceptibility. They suggest that the susceptibility of LWP to dry aerosol properties is a better way to compare models to observations, as long as the satellite observations are sampled in a way that can reduce the impact of aerosol humidification. They go on to note that the differences

between the MODIS and AATSR relationships mean that current satellite relationships are problematic for use constraining the strength of aerosol-cloud interactions in global models.

The subject of this paper would be of interest to the readers of Atmospheric Chemistry and Physics, looking at observational constraints on aerosol indirect effects in global climate models. It provides an useful comparison between model and satellite relationships and I think that with a few minor changes/clarifications it would be suitable for publication.

Minor points

P1L23: This is a very long sentence and the meaning is not quite clear

P3L22: While vertical information is nice to have, other studies suggest that it may not be required to achieve s good proxy for CCN, both Stier (2016) and Gryspeerdt et al., (2017) find that AI is a good proxy for CCN (or is able to diagnose PD-PI CDNC changes), despite being vertically integrated.

P3L29: linearly

P4L29: Presumably this is for the model, as the MODIS LWP/CDNC can only be calculated in daylight for observations

P5L26: The MODIS aerosol retrieval is not performed poleward of 60 degrees anyway

P7L9: While it may be true that the sensitivities are of a similar magnitude, if the AI perturbation has a different magnitude to the AOD perturbation, these two relationships will diagnose different changes in albedo. Just because the relationships are a similar magnitude does not mean they are interchangeable.

P8L15: 'is an aerosol-climate model ... only the aerosol-climate model part is used.' - At the moment this sentences does not say much, is it missing something?

P9L25: Cloud top pressures less than 500hPa - how are these selected from the model, is a satellite simulator used?

P10L30: Is this use of Re as a proxy for precipitation dependent on the cloud parametrisation? Is it known if the ECHAM parametrisation is theoretically capable of this kind of behaviour?

P11L10: Presumably this influence of cloud processing could be checked within the model? Or if the effect is known, it could be stated more strongly.

P11L14: I am not sure I understand the reasoning here (and this is an important point) as to why AODdry is a better proxy than AIdry? AODdry is less sensitive to aerosol size than AIdry, but aerosol activation is quite sensitive to aerosol size.

P11L27: Although the meteorological regimes are a good way to look at this, the split by humidity regimes may also confound different cloud or aerosol types. Maps of these sensitivities might be useful (at the authors' discretion)

P11L31: The AI-CDNC relationship is mainly looking at aerosol activation - does wet scavenging really affect this, or is the change in the relationship in precipitating scenes indicative of differing aerosol types/cloud updraughts?

P12L2: based on Fig. 4a, I would have said that the regime variability in ECHAM using AIdry is similar, or even larger than the satellite products.

P12L19: Is there a way of checking if sampling is the issue here? Are there some situations where MODIS/AATSR refuse to retrieve cloud/aerosol properties?

P12L30: Does alpha not depend on the cloud properties to some extent (if not these retrieved ones), when computing the fluxes from CERES broad-band radiances? Perhaps this is not a significant issue?

P13L25: Fig. 7a shows drizzle water path, rather than LWP

P13L29: This is not true for all relationships (e.g. Gryspeerdt et al., 2017). This might just mean that the AI-LWP relationship is not a good proxy for the strength of the

aerosol influence on LWP.

P14L16: Could these regions be drawn on the maps (perhaps in fig 1)

P15L1: Could these ERFaci values be compared with values determined from the model (PD-PI simulations)?

P16L20: See earlier comment about model vs. satellite variability (P12L3)

References

Gryspeerdt, E. et al. (2017), Constraining the instantaneous aerosol influence on cloud albedo, Proc. Natl. Acad. Sci. USA, 114(19), 4899–4904, doi:10.1073/pnas.1617765114.

Stier, P. (2016), Limitations of passive remote sensing to constrain global cloud condensation nuclei, Atmos. Chem. Phys., 16(10), 6595–6607, doi:10.5194/acp-16-6595-2016.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-449, 2017.