

## ***Interactive comment on “The contribution of extratropical cyclones to observed cloud–aerosol relationships” by B. S. Grandey et al.***

**Anonymous Referee #2**

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The study investigates the relationship between aerosol optical depth (AOD), cloud fraction (CF), cloud top height (CTH) and strength of extratropical cyclones. AOD has previously been found to correlate well with both CF and CTH. However, there is still an ongoing debate as to whether this correlation represents a physical process (a true aerosol-cloud interaction) or if it is simply symptomatic of other processes (e.g. large scale or local meteorology), or retrieval biases in the satellite products used to obtain estimates of these variables. The underlying question motivating this study is: can relationships between aerosol and cloud related properties be simply explained by the relative vorticity of extratropical cyclones. The rationale is that extratropical cyclones may drive both high AOD, CF and CTH values and the correlation observed between these variables can then simply be due to cyclone activity.

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Overall, the manuscript is well written, easy to follow and will be of significant interest to the readers of ACP. I do however have some comments that I think the authors need to discuss before I recommend the paper of publication.

Major comments:

1) In the conclusions, the authors state that large scale synoptic conditions are not the driver of observed CTH and AOD relationships but can explain a fraction of the CF and AOD correlation. These conclusions are therefore rather inconclusive in some way. When reporting a null-result like this, how certain can you be that your method would capture a relationship if there was one? I think some acknowledgment of this fact would be in place.

2) In relation to comment 1), I miss a discussion on the uncertainties of the re-analysis product. All atmospheric state variables will include some degree of uncertainty. How could this uncertainty affect the null result? Also, what is the time lag between the MODIS overpass and the time of the analysis product? The temporal resolution of the ERA-Interim data is every 6 hours so in some regions there could be a significant temporal difference between the re-analysis and the satellite overpass? A discussion regarding this would benefit the paper I think.

3) Having read Grandey et al. (2011) it is easier to follow the Method section of the paper. But perhaps you could be a bit more detailed in the description of the method so that paper is more easily followed without looking up that paper? I got stuck a few times on the gridding methodology.

4) I think the authors need to acknowledge that the approach can only be used in the mid-latitudes. So even if the cyclone activity could explain the observed relationship, it could not explain the correlation in the sub-tropics and the tropics, where the correlation between AOD, CF, and CTH have been found to be high as well? That we have to use different plausible mechanism (meteorology, satellite biases, etc.) to discard the perhaps true aerosol-cloud interaction, at different parts of the globe I think is a bit

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troublesome. Perhaps it is not a problem since the paper does not report cyclone activity as a major explanatory factor of the observed correlations, but still, perhaps you can discuss the implications of this a bit more.

5) Of the amount of original data used (2002-2007), how much is left after processing and the storm-centric approach? There must be some limitation to the number of cyclones passing during the period of study and the number of matching MODIS overpasses as well? Is it really 5 years of continuous data used in the paper?

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