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Comment

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

Anonymous Referee #1

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This study investigates the relationship between satellite-retrieved aerosol optical depth (AOD) and cloud properties, namely cloud fraction (CF) and cloud top height (CTH). Previous studies have found a relation between e.g. satellite-retrieved AOD and CF as well as with CTH, which could be either due to retrieval artifacts, co-variation between AOD, cloud fraction and other meteorological variables (such as wind speed) or genuine aerosol-cloud interactions. More precisely, the authors examine if there is an influence of the strength of extratropical cyclones, and the location relative to the storm center, on the relation between AOD and CF/CTH. As a measure of extratropical cyclone strength and structure, the 850 hPa relative vorticity from ECMWF re-analysis is used.

The manuscript is in general well-written and the topic should be of high interest for

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ACP readers. Although the conclusion of the study is more or less a “non-finding” - there is no strong relation between the strength of the relative vorticity, AOD, CF and CTH – I still think the results are worth publishing, as they give further insights into the reasons behind the observed correlation between AOD and CF/CTH. However, there are a few clarifications, especially regarding the method, that need to be done before the manuscript is ready for publication.

General comments:

- Title: I find the title imprecise. Maybe something like “The contribution of *the strength and structure* of extratropical cyclones to observed cloud–aerosol relationships” would be better?

- Abstract: Similar as the title. Shouldn't it be something more like “it seems plausible to hypothesise that *the strength and structure* of extratropical cyclones may drive relationships between cloud-related properties and AOD”?

- Introduction, p. 11974, line 2: It would be nice to clarify already here that you are looking at CF and CTH as cloud variables.

- Introduction, p. 11974, lines: 5-7: I think the motivation to this question could be a bit clearer. Why would the position relative to the storm centre be important? Because of the wind velocity? But the (local) cloud cover, and other cloud properties are not really governed by the wind speed? Why 850 hPa relative vorticity? “Many studies have shown that extratropical cyclones and fronts are major drivers of large-scale cloud-related properties.” How good is the (re-analyzed) relative vorticity as an indicator of extratropical cyclones and fronts?

- Method, p. 11974, line 20-22: Did you do any filtering of the 850 hPa relative vorticity to remove weak, stationary or short-lived features?

- Method, p. 11974, line 23: storm-centric gridding methodology. Could be worthwhile to say a few more words about the method (so that you don't have to look up Grandey

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et al., 2011).

- Method, p. 11975, lines: 18-20: Same here, a bit more explanation of the storm track regriding would be nice (so you don't have to look up Grandey et al., 2011).

- Method, p. 11976, lines 3-8: Why $1 \times 10^{-5} \text{ s}^{-1}$ bins? If I understand things correctly, this "shuffling" will pair an AOD with a CF or CTH from a different grid box and/or time point, but with a similar relative vorticity? I think this should be clarified.

- Method, general: What is the time resolution of the data? How are the MODIS and ERA-Interim data matched in time?

- Results, p. 11977, lines 11-16: Isn't the decrease also due to (strong) precipitation?

- Results, p. 11979, lines 3-9: Isn't it a bit odd that relative vorticity and CF are so poorly correlated? Does this really show that vorticity is a good variable to use as a measure of extra-tropical storm (cloud) characteristics?

- Results, p. 11979, lines 10-13: The dependency of CF and AOD on storm strength is however weak, especially for AOD. I think this should be acknowledged.

- Results, p. 11981, lines 5-7: "They provide further support or the conclusion that the simplified description of the large-scale synoptics can explain relationships between AOD and fc." To me, it looks like large-scale synoptics (or rather relative vorticity) cannot explain the relationship between AOD and CF.

- Conclusions, p. 11985, lines 22-23: "This suggests that large-scale synoptic conditions in the mid-latitudes are not a major driver of Ttop-AOD relationships." This is a rather strong statement. It assumes that relative vorticity is a good indicator of the large-scale synoptic conditions.

Minor comments:

- P. 11977, line 20: "This storm-centric enhancement..." The enhancement is not really storm-centric, is it?

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- P. 11978, line 5: I suggest changing “They are similar to those for the NA. . .” to “The results are similar to those obtained for the NA. . .”

- P. 11979, line 22: I suggest changing “. . . is very slightly smaller” to “. . . is only slightly smaller”.

- P. 11981, lines 14-15: “Relatively cold cloud..” should probably be “Relatively cold clouds. . .”?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 11971, 2013.

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