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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Meridional distribution of aerosol optical thickness over the tropical Atlantic Ocean" *by* P. Kishcha et al.

Anonymous Referee #2

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Review of Meridional distribution of aerosol optical thickness over the tropical Atlantic Ocean by P. Kishcha et al.

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Summary This paper seeks to characterize the distribution of aerosols (chiefly smoke and dust aerosols) and their coincidence with cloud coverage in the Atlantic. The author carries out a statistical study spanning roughly 10 years of satellite observations (MODIS, MISR, TRMM, detectors) and aerosol modeling (GEOS-5). The study focuses on comparing aerosol optical depths, cloud fractions and total rain amounts in the northern (0 to ∼30N) and southern (0 to ∼30S) hemisphere sectors and points out the

difference.

While I see the subject in general of interest, the work presented is very limited and it does no contribute anything new. The paper shows interesting coincidences between the presence of aerosols and cloud properties but there is no discussion or hypothesis presented on why this happens or whether they are just covariant parameters with an undelaying driving factor (for example, synoptic).

Methodologically, this study is weak in that a large source of the datasets use is the Giovanni NASA interface. This is not a science quality data base and should not be used for the kind of analysis presented here. In addition, there are some procedural deficiencies in the data analysis that need to be considered and have not been made clear in the text. I recommend to reject the paper in the present form . I suggest the author to resubmit after addressing the structural concerns about the topic and methodologies used.

Major comments

There are two main concerns with this analysis: One is methodological. There are datasets used in this analysis which are of borderline scientific quality. Specifically, the use of data downloaded from the Giovanni NASA portal should be used with extreme care, particularly in the subject of aerosol-cloud interactions. While Giovanni provides a handy way to obtain and plot data, it does not deliver all the information needed to judge the quality of data in use (see more details below). So, while Giovanni may provide images acceptable for use in a publication (such a general view of AOD or Cloud Fraction distribution in the Atlantic basin), the L3 data provided by the same portal is not suitable for the application proposed here. Specifically, causal relationships between aerosol and clouds need to be studied in the context of meteorological influence that can cause covariance of aerosol and clouds parameters. This work does not appear to make any consideration of such influence. A number of studies have already pointed out biases that can confound the observation of aerosol-clouds relationship (Mauger

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and Norris, 2007). Furthermore recently , Goren and Rosenfled (2014) listed in section 2 a number of reasons (with references) why cloud Fraction and aerosol optical depth may or may not correlate. None of the effects can be discerned with the data set used and original MODIS level 3 and level 2 data sets are needed for such analysis.

Second is conceptual. : What is the main science question addressed here? While the introduction implies that this work is important for aerosol-cloud interaction studies, there is no case being made for the importance of an N and S hemispheric asymmetry in cloud fraction and aerosol concentrations. How this asymmetry relates to the indirect effects listed in the same introduction? In addition, the lack of discussion or explanations throughout the text of features observed, reduces this whole work to a correlation study. Paper points out coincidences but no elaboration.

Line by Line Comments Abstract: The opening paragraph should state why this study is important. The fact that there is an asymmetry observed needs to be accompanied of a hypothesis or a physical reason of why it is of interest to study this phenomenon.

For clarity it would be useful to list in one sentence the data and tools use from MODIS, MISR and TRMM and MERRAAerol.

Page 23311 . Line 20-26. This sentence is not clear. What does it mean that the " Southern Hemisphere contributed to the formation of noticeable meridional aerosol asymmetry"?

Pages 23311 . Line 26 to P 233112 line 4. This is statement is not quite correct and mostly applicable to land satellite observations. Over the ocean, both MODIS and MISR are able to provide qualitative aerosol identification that well suffice for a general study presented here.

P 233112 line 17 to 25. It is not clear why the asymmetry pointed out is important. While the previous paragraph lists several possible effects, it is not clear what effect or what mechanism this study will address. The mere study of aerosol distribution with

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respect to cloud fraction does not necessarily can help to understand the phenomena listed in the previous paragraph.

P 23313 , line 25. State the MISR algorithm version and data level used in the analysis. Line 23315. line 1-5. 1) This is the first time that TRMM data is mentioned. Since it is a dataset well used in this paper, it should be mentioned in the abstract 2) Giovanni is NOT a reliable source of scientific quality data. While the Giovanni interface is a handy tool for the creation of quicklooks and general assessment of data sets, it does not have datasets of research quality level. There are mutliple reasons: a) data versions are not updated regularly b) downloaded data from Giovanni does not include a number of quality flags and checks that are available in the original Level 3 data. Issues such as formulae used for averages, weights used on the average, time of the day when the observation was made, propagation of the quality flag from the original L2 to the L3 are not properly explained or not included in the data displayed in the interface. Specifically and by own experience of this reviewer, the MODIS CF reported by Giovanni is vey buggy with a tendency to report high cloud fraction in dusty areas because the cloud algorithm interprets the high reflectance of heavy dust as a cloud. This is a defect of the original MODIS algorithm cloud detection method and it is propagated to all products downstream. Because this failure to properly detect clouds in heavy aerosol loading envirnments, the aerosol MODIS group choose to create their own cloud mask algorithm (and used in the aerosol algorithm) .

P23315 Line 10, replace "demonstrated" with "shows"

Sections 4.2 and 4.3 . Both sections are limited to describe the listed figures but there is no explanations offered for the coincidences (or anti-coincidences) noted. Is there an indirect effect or are these co-varying parameters?

Section 4. There is description of Figure 4a but there is nothing said about figures 4b and 4c. Please add text or remove the figures altogether.

P 23317 , line 22-25. This is a generalization that is not quite correct.

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P23321 , l15-16. What is the justification of this statement? Wet removal can be an important reason too and I do not see why it should be ignored. P23321 , lines 25-30. What data was used to generate the plots in figures 10? it is not indicated.

P23322, lines 1-4. Why the increase in rainfall is attributed to heavy convection? Shallow Cu are abundant in this area too so it is not clear why they are not considered.

Goren,T , Rosenfeld,D. Decomposing aerosol cloud radiative effects into cloud cover, liquid water path and Twomey components in marine stratocumulus, Atmospheric Research, Volume 138, 1 March 2014, Pages 378-393, ISSN 0169-8095, http://dx.doi.org/10.1016/j.atmosres.2013.12.008. Mauger, G. S., and J. R. Norris (2007), Meteorological bias in satellite estimates of aerosol-cloud relationships, Geophys. Res. Lett., 34, L16824, doi:10.1029/2007GL029952.

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