

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-129

Anonymous Referee #1

Referee comment on "Investigating the impact of Saharan dust aerosols on analyses and forecasts of African easterly waves by constraining aerosol effects in radiance data assimilation" by Dustin Francis Phillip Grogan et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-129-RC1>, 2021

GENERAL COMMENTS:

This paper explores the impact of assimilating dust information into a numerical weather prediction system. The focus is on summertime northern Africa, where dust has been shown to affect the African easterly jet and the development of African easterly waves that can eventually serve as seedlings for tropical cyclones over the downstream Atlantic.

The assimilation of aerosol information is still not fully realised in most NWP systems and I thus welcome studies that explore potential impacts as this one. Overall I find the experimental design and outcome of this paper interesting and relevant for the readership of ACP, but the presentation of the results is not as clear and convincing as should be. The reference to relevant literature is a little thin, many figures are only superficially described and some important background information is missing. I therefore propose that major revisions are needed before I can recommend this work for final publication in ACP. Details are given below.

MAJOR COMMENTS:

- Title: I am not sure that this is an optimal title for this work. The second part reads quite complicated and technical and I doubt people will really understand what that means. The first bit is fine but you leave out the aspect of TC genesis. You mention data assimilation but not forecasting. How about the following: Effects of Saharan dust

assimilation on the analyses and forecasts of African easterly waves and Atlantic tropical cyclogenesis?

- **Abstract:** The first paragraph reads well but the second is mostly a repetition of the first and should be omitted. Instead you should much better explain your experimental design (take information from aerosol model NGAC for the assimilation, change of initial condition but not of forecast model, comparison to satellite data). I would also explain that your results are consistent with qualitative arguments of baroclinic and barotropic instability.
- **Literature:** Your introduction is relatively thin on references to relevant work. I would ask you to do a more thorough research and include more references. A few that come to my mind include Benedetti et al. (2018, ACP, overview paper for aerosol prediction), Knippertz and Todd (2010, JGR, dust and AEWs), Jones et al. (2003, JCLI, AEW and dust transport), Karyampudi et al. (1999, BAMS, Saharan air layer), Pope et al. (2016, GRL, dust data assimilation), Schwendike & Jones (2010, QJ, AEW merging and TC cyclogenesis), ...
- **Methodology:** Your dust information come from NGAC and you only mention this in passing. I see that you are giving references here but this information is so essential for understanding the present paper that you need to give a summary here. How does this model work? What data is assimilated? How good is it? You need to justify your approach much better!
In addition the radiative impact will depend a lot on the chosen optical properties. What is used here? How sensitive are the results to this? In the infrared the sensitivities can be quite large, as shown in a recent paper by Claudia di Bagio and co-authors!
- **Introduction:** In addition to more literature, your introduction should elaborate a clear hypothesis to test. There is a lot of literature on the link dust-radiation-temperature-wind-AEWs-TCs including mechanisms of barotropic and baroclinic instability. The way the paper is written now, this link comes really late. I would bring this to the very front and cast it as a hypothesis you are testing. This would make the paper much more interesting to read and easier to understand. Doing this, you could even hypothesize that only the forecast of TCs that form from northern vortices will be strongly affected by including dust, as the southern ones are too far away from the plumes. Harvey is a nice example, where the contribution of the northern vortex "wins"! You should stress this aspect more!
- **Balance between sections 3 and 4:** The description of results in section 3 is in places too short and superficial. Some aspects are then picked up again in section 4. I would merge these two for a better storyline. Make sure each panel of each plot is discussed in the paper. If not discussed, it can be omitted.
- **Conclusions:** If you follow my advice on formulating a clear hypothesis, you can use the conclusion section to explain to what extent you find that hypothesis confirmed. You should also clearly articulate what we have learned from this study we didn't know before or in other words what is the innovation? Compare your results to those of other studies! Remind the reader of your very special methodology of taking dust from a model to assimilate into another model to change initial conditions to then make forecasts using a dust climatology. This is not straightforward and limits the interpretation of the results.

MINOR COMMENTS:

- General: Your geographical descriptions are often imprecise. What you call North Africa, I would call West Africa in some cases. What you call the southern Sahara, I would call the Sahel etc. Please check throughout and try to be consistent with common terminology.
- General: Throughout the paper you very often use the word "circulation". Very often it is not clear what exactly this refers to. Are these horizontal circulations, overturning circulations?? What is "the peak of a circulation"? Be more precise in the description of features.
- Abbreviations: Make sure you define all at first use and then use abbreviation only. Don't define them, if not used again.
- Tense: You sometimes jump between present and past tense. I would use present tense as much as possible when you are describing results and past tense only where you refer to historical events.
- L92: affected
- L99: through data assimilation.
- L199 and elsewhere: please write blueish or cold colors, reddish or warm colors etc.
- L200: This is confusing. The monsoon flow is southwesterly. You are showing that the westerly component accelerates but if the southerly decelerated, the total wind would not change. Please be clear or analyse both components.
- L201: Again confusing. I would call a positive change in an easterly flow deceleration not acceleration?!?
- P8: I would explain the temperature first, then wind, as the latter is the consequence of the former.
- L221: why modulus??
- P12: The IASI data should be introduced in the method section. What exactly you do with them, is somewhat unclear to me. You need to describe this much better and discuss the results more clearly. Maybe good to show Gert, too, for contrast?!
- L313: better "the authors" to avoid repetition.
- Caption Fig. 1: Too short, more details here or reference to text.
- 2: Plot in one panel, add dates.
- 3: Labels too small (also others!); mark vertical levels of panels b and d in a and c; mark domains of a and c in b and d; state in caption what data were used for this.
- 4: Is this just the absolute value? Why?
- 5: Use "UTC" rather than "Z". Say that this is 2017 (also in others!).
- 9: As stated above, this is hard to understand and needs more explanation.