

## ***Interactive comment on “Synoptic-scale controls of fog and low clouds in the Namib Desert” by Hendrik Andersen et al.***

### **Anonymous Referee #1**

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Review of "Synoptic-scale controls of fog and low clouds in the Namib Desert" by Andersen et al.

Using a 14-year period of reanalysis grids and backward trajectories, this study examines the impact of large-scale dynamics and thermodynamics on fog and low clouds (FLCs) over Namib. Specifically, the authors' focus on two seasons when different FLC types are observed due to different synoptic-scale regimes. A main finding is that the mean sea level pressure (MSLP) field differs notably between clear and FLC days. To this end, the authors' use a statistical model and MSLP fields to provide skillful prediction of FLCs up to one day in advance. A new conceptual model of the two different FLC regimes is developed to summarize findings and aid in future studies related to FLCs over Namib. In general, the scientific purpose is justified, the findings are im-

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portant, and the paper is well-written; however, I do have concerns about some of the methods used. Overall, I think that the results are interesting and worthy of publication, and at this stage I suggest acceptance subject to major revisions.

Major/general comments: 1. Use of MSLP, 2 m temperature, and 10 m winds to characterize synoptic-scale conditions This study relies on the assumption that near-surface (boundary layer) meteorological variables – specifically MSLP, 2 m temperature, and 10 m horizontal wind components – are representative of the large-scale dynamics. While this assumption may be justified over the ocean, it is likely not justified over land, and especially where topography is pronounced. The authors' do acknowledge this sentiment (P7, L11-13); however, I think that this consideration is more important than they suggest. In fact, the authors' even cite two different papers on P7, L6-7 that suggest that "In the Namib Desert, thermally and topographically induced local wind systems within the boundary layer modulate these synoptic air-flow patterns, and the significance of the induced diurnal oscillations can exceed that of the synoptic scale". To this end, the authors' should also examine the aforementioned dynamic and thermodynamic variables at other (isobaric) levels (e.g., 925 hPa and 850 hPa) because i) the assumption of a standard atmosphere will be required for fewer locations (compared to estimating MSLP) and ii) the influence of local terrain will be suppressed at more locations. While the main conclusions of this study should not change notably, it will be interesting to see how much the PCA and statistical model results differ when using e.g., 925 hPa or 850 hPa fields. These results should be of interest to both the research and operational forecasting communities. Moreover, the impact of using the isobaric fields should be included in the context of Sections 3.1, 3.2, and 3.3: whether considering these isobaric fields is important when relating synoptic-scale meteorology to FLC occurrence.

Minor/specific comments: 1. P1, L7: When you say "significantly", do you mean in the statistical sense? If so, please specify this. If not, please choose different wording.

2. P3, L14: Please provide the retrieval wavelength(s) of the SEVIRI data used in this

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study.

3. P3, L20-21: Why use these criteria? Are they following a previous study?
4. P4, L9: Which “different pressure levels” are used?
5. P5, L3-4: What is the justification for using 0.5 deg rather than 0.25 deg ERA5 grids?
6. P5, L13-15: Please provide references for the PCA method.
7. P5, L19: What is the reasoning for remapping the wind fields to a 2 deg grid?
8. P5, L19-20: Please explain why the temporal – rather than the spatial – anomalies are used. Was care taken to ensure that this 14-year period is not anomalous in some way? A 14-year sample is likely not long enough to capture some of the climatological signals at a given location. I would think that spatial anomalies would be more appropriate.
9. P5, L25-26: Please make it explicitly clear that the statistical model in this study will use spatial patterns of pressure fields.
10. P6, L19-20: What is the percentage of data availability?
11. P6, L22: I do not understand why 0.25 deg grids are used for the statistical model and coarser grids are used for other portions of the analysis. Please explain.
12. P6, L29: For readers who may be unfamiliar with the St. Helena High and the southern African continental high, please provide references. Also, is the St. Helena High over the ocean? Please add some detail here.
13. P7, L9: Do you mean thermal stability?
14. P8, L4: To which trough are you referring? This is the first time that a trough is mentioned.
15. P8, L4: “Z500 on FLC days” – please refer to the panel to help the reader.

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16. P9, L2: Do you mean significant at the 0.01 level?
17. P9, L8-9: I am not sure that I understand this explanation of the dry slot. Is it possible that TCWV is reduced simply because at low levels water vapor is condensed into liquid water as FLCs form? Examining vertical profiles of TCWV may help clarify.
18. P9, L10-11: The strongest positive 2 m temperature anomalies are shifted west of the strongest positive TCWV anomalies. Can you explain why this pattern is observed?
19. P9, L11-12 & L21; P10, L2-3: These statements about greenhouse warming are a bit speculative and should be fleshed out with additional discussion/analysis/evidence. Is it possible to look at vertical profiles of heat fluxes/heating rates?
20. P9, L28: Please provide a citation for this statement.
21. P10, Fig. 3: I recommend making the contours of significant differences a different color because at present they are difficult to discern from the country boundaries.
22. P10, L3-4: Analysis of vertical profiles may help clarify and substantiate this claim.
23. P11, L7-11: Please reference Fig. 3 here.
24. P14, Fig. 6 panel b: Are you able to say something about the offshore Q anomalies in AMJ? Why do we see the positive Q anomalies increase in height farther away from the shoreline?
25. P15, Fig. 7: Can you estimate the absolute value of the pressure where the backtrajectories are initialized (25 hPa above ground level)? This will help the reader understand how much the parcels are traversing in the vertical.
26. P16, L3: The material in this paragraph does not seem to fit with the other material in this section. Perhaps improve the connection, create a new section and flesh out, or add to a different section.
27. P20, L3: Relative humidity or specific humidity?

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Grammatical/wording recommendations: 1. P14, L15: Please change “along all those backtrajectories” to “along all of the backtrajectories”.

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