Review of the paper doi.org/10.5194/egusphere-2025-5816: Synoptic and regional-scale meteorological controls of stratus altitude in the Namib Desert

This manuscript examines synoptic control on the formation of fog and low clouds over the western margin of the South African continent. The authors address this study by setting a spatial analysis to prove that the dipole high-pressure system between the Atlantic and the continent is the main mechanism controlling the land-to-sea wind circulation and boundary layer height. The manuscript is well written and well structured, with scientifically sound argumentation. The analysis, although descriptive, delves into synoptic causes of the difference between low stratus and land fog through a combination of reanalysis data and a case study. There are some minor comments in the supplement that need to be addressed before being considered for publication.

Abstract

- The abstract introduces the synoptic scale problem well. However, it lacks results, being difficult to evaluate.

Introduction

- Line 26: 'fog precipitacion' means fog and precipitation or fog deposition?
- Line 28: the austral summer is from late December to late March, and September is even winter. September to March is the transition between late winter and late summer.
- Line 30: The northeasterly surface wind is related to fog if fog/low stratus comes from the southwest (Atlantic)?
- Line 35: SON is spring, not summer. Summer is JFM. Please correct.
- Line 55: This is an austral summer! Which contradicts the other one mentioned in lines 28 and 35.
- Figure 1. Please set the coordinates for the MODIS image to be easily compared to the ERA5 synoptic patterns

Data

- Line 99-101: Does this algorithm filter by mid-clouds? Because I understand that fog with a cloud base of 200 m might be warmer than a cloud with a cloud base of 500 m.
- Line 105-109: It is well-known that ERA5 products are not representative of observations in the southern hemisphere, especially in relation to surface fluxes, where observations are scarce. Do you have any idea of how valid surface fluxes from ERA5 are to be included in the analysis?
- Line 122: there is a latex missing input, '?'

Methods

- Line 138: 'fog precipitacion measurements' means fog collection measurements? Through a standard fog collector or a cylindrical one? If so, how do you deal with potential dew that the fog collector can register? This is quite relevant, since low-cloud days might be misinterpreted as fog days if the collector is measuring dew rather than fog.

- I would expect a figure or table showing the simple logistic regression skill described in 3.2.

Results and discussion

- The analysis is very descriptive, which is good when non-understood processes are found. However, overall, I missed some relational analysis that would have reinforced the results and supported the hypothesis. For example, the main hypothesis is that seasonal and interseasonal variability in the two marine and continental high-pressure systems influences the thermally driven land-sea circulation and MBL capping when fog and LC occur. I would expect, for example, to see how much (statistical metrics) pressure changes are related to wind circulation or MBL height, to evaluate if it is a mechanism (high correlation) that is controlling FLC or fog, or it is just a modulator (low correlation).

- Figure 4 shows the vertical structure of MBL over the study area where CM and GB stations are located. The cyan line shows the BLH. However, when I see the thermal or humidity structure shown in 4a, b,d and e, the BLH is not in agreement with the T and q vertical structure. What I mean is that maximum dT/dz or dq/dz is located, for example, at Fig 4a around 950 hPa (14.5°E, over the CM station), while the BLH line is at 1000. Same in figure 4b, where the BLH line decays over the CM station, where dT/dz is two levels higher.

- This is probably because BLH in ERA5 is calculated using the Rib (bulk Richardson number), which does not well represent BLH over the CM station. This might be leading to incorrect interpretations, even though max dT/dz or dq/dz shows that the MBL is lower under fog than under low cloud.

- My suggestion here is to recalculate the BLH using the maximum dtheta/dz (potential temperature) to have a consistent BLH line with the inversion observed in Fig 4a to d. Also, some vertical profiles of theta and q next to vertical cross section would be useful to quantify BLH and structure.

- Another element that could be included in the analysis is the inversion layer strength. For example, Espinoza et al. (2024) (https://doi.org/10.1016/j.atmosres.2024.107533) demonstrate that thermal inversion is a key synoptic mechanisms that control FLC formation, using the Low Tropospheric Stability (LTS) parameter to quantify thermal inversion. Using ERA5 data, it is easy to compute thermal differences between two levels to characterise, in time and space, the strength of the thermal inversion, which is likely higher under fog than in LC situations.

- Figures 4, 7: I suggest changing the colour palette used to represent temperature and specific humidity to a more nature-related colour. For example, ‘coolwarm’ to temperature and ‘Blues’ to specific humidity. ‘viridis’ is ok for pressure, but it is confusing to see viridis for every variable. In that way, it would be easy to see the black wind arrow that, for example, in Fig. 7h, is extremely hard to see.

- Figures 4, 7: it has to be mentioned that vertical wind has been exaggerated to represent the vector since horizontal wind (u,v) is usually one order of magnitude higher than the vertical one.

Conclusions

- To reinforce conclusion bullet n° 3, the authors could include an analysis of the rate of change of MBL (dh/dt) relative to changes in the continental pressure system, which will likely show a stronger correlation under fog than in LC situations.

- Figure 10, which, to my understanding, summarises processes described in section 4.1, should be located there. It is odd to see a figure in the conclusions. Especially if it is a physical interpretation of processes described in section 4.1.