

Interactive comment on “The life cycle of nocturnal low-level clouds over southern West Africa analysed using high-resolution simulations” by Bianca Adler et al.

Anonymous Referee #2

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Review of “The life cycle of nocturnal low-level clouds over southern West Africa analysed using high-resolution simulations” by Bianca Adler, Norbert Kalthoff, and Leonard Gantner

Summary

This is a very well written study using high-resolution simulations with the COSMO model to investigate the processes that govern the evolution of low-level clouds in southern West Africa. The authors identify three processes, namely cooling of the atmosphere due to horizontal advection, gravity waves inducing vertical cold air advection, and enhanced convergence upstream of cloud formation triggering new clouds. The authors are careful to stress that these results consider a single case study and do

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not all agree with previous studies for the same region, but use a thorough discussion of previous work in other regions to illustrate that these processes may well be relevant for low-level cloud formation in southern West Africa.

Brief verdict

I have no concerns with the scientific quality of this paper and believe the arguments and results are well presented. I have a list of comments that mostly regard confusing turns of phrases and a few points where the authors can add further clarification. I therefore recommend this paper be accepted with (very) minor corrections.

Specific comments

Title: To me, “life cycle” suggests the study of individual cloud elements from their origin to their decay, which is not what is covered in this paper. I would prefer “evolution”, as it is more appropriate for a population of clouds. (Also title for section 3).

p.2 line 11: “a lot of effort is still needed” – At this point, the authors have not yet indicated why so much effort has gone into studying nocturnal low-level clouds over southern West Africa. One or two sentences regarding the motivation (weather? Climate?) should be introduced here.

p.2 line 20: “This results could then be used to optimize measurement strategy for the field campaign” – Since the field campaign has now taken place, the authors should rephrase this (assuming that their results have helped inform the strategy).

p.2 line 22-25: This is a nice way to distinguish this paper from previous studies.

p.2 line 32: “horizontal grid spacing of around 500 m” – has the COSMO model been verified and evaluated at this resolution? Perhaps not for southern West Africa, but one or two references covering COSMO at 500m would be useful here.

p.3 line 10: “sensitivity tests show” – Do you have a reference for this?

p.3 line 13-14: “online trajectory module” – At this point, could you add an additional

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sentence stating the purpose of this module for your work. What are you hoping to learn from these trajectories?

p.3 line 15-21: This is a useful paragraph building the reader's confidence in the simulation.

p.3 line 26: "we choose the night from 3 to 4 August for analysis" – This is slightly confusing, as in line 19 it says "the simulated conditions on a specific day do not necessarily agree with the observations". So are these dates relevant? Perhaps the authors could clarify for the reader again that these dates refer to the model simulation (unless the authors can confirm that also based on observations, these are appropriate days for their study).

p.4 line 3: "we accumulate the liquid water content" – so this is liquid water path?

p.4 line 3-4: Is 15-minute output sufficient to study the temporal evolution of low-level clouds, when individual cloud elements likely don't last more than 30 minutes? This is more a comment on using "life cycle".

p.4 line 6: "cloud-free" – Can the authors confirm there is no ice cloud aloft?

p.4 line 11: "clouds... are more intense" – what does this mean? That the clouds have higher LWC?

p.4 line 12: "very similar" – in this sentence structure, I would suggest "remarkably similar".

p.4 line 17, 19: "the processes", "the different budget terms" – Could you please be more specific. Which budgets matter for your study? Which processes can be expected to affect the atmospheric conditions?

Title of section 4.1 "Before the onset..."

p.5 line 6: "meridional averaging" – is this not domain averaging, i.e. over the SAVE box?

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p.5 line 11-23: Does the front differ much in structure in the 500m simulation for the single case study?

p.5 line 30: "once the front has passed SAVE" – please specify at what time, especially referring to figure 3.

p.5 line 32: "weak horizontal dry air advection" – how significant (important) is this? It seems rather patchy in figure 3.

p.6 line 4-5: "gravity waves... Fig(6)" – Please clarify in the main text how the gravity waves can be identified in figure 6. Presumably it's the wavelike pattern of the trajectories?

p.6 line 5: "broken band-like structures" – this is not obvious from the figures referenced.

Title of section 4.3 "Intensification" – in what sense? Thicker clouds? Higher LWC? I don't know how to interpret an "intense cloud".

p.6 line 17: "thick" – geometrically? Optically? Occurs also on p.7 lines 5 and 6.

p.6 line 19: "respectively" – this could refer to "phases 0 and 1" in this sentence structure. Perhaps best to disentangle the sentence to say "in the clouds is continuously cooled by vertical advection and below the clouds by horizontal advection" (or something similar/better).

p.6 line 22-23: "mean upward motion" – (perhaps obvious) what causes the mean upward motion?

p. 6 line 26: "intensity" – see earlier comment.

p.7 line 6 and line 11: "spread", "retreat" – how does this happen? Do new clouds form? Do clouds propagate or advect with the flow? Do clouds grow?

p.7 line 27-28: "this simulation" – which simulation? The COSMO 500m simulation of

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the current paper, or the Schuster et al. (2013) simulation?

p.7 line 32: “this process has not been reported before” – Anywhere? Or just for this particular region in southern West Africa?

p.8 line 7: Specify that Schuster et al. (2013) used simulations and Van der Linden et al. (2015) used observations.

p.8 line 9: “latter” – I’m not sure which process is referred to here, perhaps rephrase the sentence so that “latter” does not need to be used.

p.8 line 32-33: “In the opinion of the authors” – Who? Grams et al.? Please rephrase.

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