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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The vertical Structure and spatial Variability of lower tropospheric Water Vapor and Clouds in the Trades" *by* Ann Kristin Naumann and Christoph Kiemle

Anonymous Referee #3

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Review of "The vertical Structure and spatial Variability of lower tropospheric Water Vapor and Clouds in the Trades" (acp-2019-1015) by A.K. Naumann and C. Kiemle

Synopsis

The present study investigates the variability of water vapor and clouds in the tropical Atlantic. The manuscript is mainly a model validation, i.e., it focuses on the comparison of observations with simulations that have different grid spacings. The authors found that the variability of water vapor is generally well represented by the simulations with little differences between the various model resolutions, whereas the simulated cloud field shows a stark dependence on model resolution.

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Discussion paper

Overall comments

Overall, I think this study is appropriate for publication in ACP. I do not see any major flaws. The approach is sound, the results are sound, and, with a few exceptions detailed below, follow from the evidence. I do think, though, that the whole manuscript reads a little bit tedious; in other words, the clarity of the writing could be improved. Sometimes I feel like the authors make things more complicated than they really are. Examples are given in the specific comments below.

Specific comments

- I like that the authors make an effort to quantify uncertainty in the WVP measurements. This is really helpful in assessing potential model biases.

- I think that the entire case study (Section 3) could be removed without diluting the main points of the manuscript. The results aggregated over Dec. 2013 show a similar story, and the case study is not necessary to understand the aggregated results.

- I am still unclear what “spanning the moisture space" really means. Is it just the ordering of all individual profiles with respect to their WVP? Also, it is not fully clear to me what the “stretched moisture space” accomplishes.

- It seems like the WALES instrument has some issues with sensing water vapor in cloudy/very moist areas that HAMPS does not have. What’s the reason for using WALES in conduction with HAMPS instead of HAMPS alone?

- How is the "cloud layer" defined?

- How are the model fields subsampled? Are model soundings drawn from under a virtual flight track?

- Text-figure mismatch hinders readability: For the multi-panel figures like. Fig. 5, the authors first describe panel b), then c) and d), and lastly a). Making the text and figure panel order consistent would improve clarity.

- paragraph beginning on line 183: I can't quite relate the text here to Fig. 3. Also, I'm not sure what Fig. 3 is supposed to explain.

- l. 252: "standard deviation of qv": How do you compute the standard deviation, in space or in time?

- l. 275: "...but is still included in the range of uncertainty given by the observations." âĂŤ data from LEM 300m seem to fall outside the range estimated by WALES.

- l. 325: "a moist model bias at the inversion" âĂŤ I think what's going on is that the simulated inversion is too high. This is equivalent to what you write but more intuitive when looking at the figure.

- l. 352: I find the sentence construction "A too high low-cloud fraction" difficult to follow, because is has words that are the exact opposite of each other. . .I suggest rephrasing.

- l. 410-411: "In both seasons the model tends to smooth the moisture gradient at the inversion too much, . . ." âĂŤ I'd say the more important bias is that the moist layer is too deep, or in other words, the inversion is too high in the models.

Technicalities, typos, etc.

l. 106/107: "and only in 34 % of all lidar profiles are more than half of the data points valid below this height" l. 123: What is the 12-s grid? I don't think this has been mentioned before.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-1015, 2019.