Comment on acp-2022-505

Farahnaz Khosrawi (Editor)

Editor comment on "Vertical structure of the lower-stratospheric moist bias in the ERA5 reanalysis and its connection to mixing processes" by Konstantin Krüger et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-505-EC1, 2022

I agree with the referees that this is in excellent study. While waiting for the second referees comment I also had a look at the manuscript and have a bunch of rather technical comments which I would like the authors to consider when they do the revision.

Generally comment:

I would suggest to write throughout the manuscript "moist bias" instead of just "bias" and "jet stream" instead of just "jet".

Specific comments:

P1, L10: What kind of errors/uncertainties does this cause? Regarding e.g weather, does it affect predictions for cloud formation and/or precipitation? Can you give an example?

P1, L13: Mention here also how many campaigns were preformed.

P1, L14: The number of 31000 humidity profiles is impressive, However, could you also provide the time resolution of the data?

P1, L21: Add here "(O_3)" after ozone and "(H_2O)" after water vapour to introduce the abbreviations that are used then in the next line.

P1, L26: I would add after positive impact "i.e. more accurate" since I think that will be the outcome positive impact of a lower moist bias on the forecasts.

P1, L20: See my comment on P1, L13. That is why I suggest to mention above already that several campaigns have been performed. Otherwise writing here "During one campaign" is rather confusing.

P2, L29ff: This paragraph is rather confusing. I would suggest to revise it. Start with describing the general vertical distribution of H_2O (high in in the troposphere, low in the stratosphere) and then discuss the gradient and the exchange between troposphere and stratosphere. The vertical distribution of H_2O is not only dynamically driven, also the chemical sources and sinks of H_2O play a role.

P2, L56: co-loacted cold bias. Where exactly is this bias located? Also in the stratosphere?

Or in the atmospheric layer below (troposphere) or above (mesosphere)?

P3, L65: "for" is not correct here. Do you mean "from" different radiosonde types (thus two types of radiosondes show the opposing vertical structure) or do you mean "by comparing to two different radiosonde types"?

P3, L65ff: I would suggest to rephrase the sentence and to start with what Woiwode et al. compare with and then what the result is.

P3, L71ff: This sentence/paragraph is also rather confusing and should be improved. Numerical diffusion is something that affects Euler models, especially if a rather course grid is used, thus naming in this sentence the "semi-Lagrangian" is a bit confusing. Further, two my knowledge not the ECMWF model itself is Lagrangian, its rather one of the schemes used in the model that is semi-Lagrangian. You actually name it, it is the advection scheme. So it should read rather "the semi-Lagrangian advection scheme used in the ECMWF model".

P3, L79: highest altitude □ give an approximate altitude.

P3, L82: The reference of Hegglin et al. (2009) is not correct here. In that study ACE data has been used which is a solar occultation instrument and not a microwave sounder. I think the Hegglin reference you meant here is the paper where the H2O climatologies are compared (Hegglin et al., 2013, JGR). Also here additionally some of the WAVAS-II comparison papers should be cited (e.g. Lossow et al., (2017, 2018), Khosrawi et al. (2018), Read et al. (2022), see WAVAS special issue https://acp.copernicus.org/articles/special_issue830.html although I am not sure if one of the studies explicitly mentions the problem with the vertical resolution of the microwave sounders.

P4, L101: Not clear what you mean here with air mass classes.

P4, L113: Rephrase. Not the wavelengths itself consist of online channels. Rather the observations at these wavelengths are separated into the/by the channels".

P4, L116: The wavelength ranges have been optimized?

P4, L116: Also here rephrase the sentences. Generally, the whole paragraph should be revised.

P5, L155: This sentence is also rather confusing. Better to write "parts of the HALO flight tracks of all research flights where DIAL observations where obtained."

P8, L186: T639? Is there something missing? Usually the T gives the horizontal resolution and the L the number of levels.

P8, L192: You mean you do here the conversion from sigma coordinates to pressure coordinates?

P9, L210: "respectively" not correct here, either it should read "...and the lapse rate, respectively" or if you mean the vertical temperature gradient is equal to the lapse rate then it should read "The vertical temperature gradient, i.e. the lapse rate".

P9, L211: provide the unit in the text (and based on the ACP style it should read k m-1.

P13, Figure 5: Could you add a panel showing the bias in percent?

P14, L303: Can you also add the mean bias in percent?

P23, L439, L440 and 455: "Highest altitude" □ Give here an approximate altitude.

Last but not least, the original referee 2 who unfortunately could not submit a report, but thinks your study is excellent, asked why you did not use any in-situ data that was obtained during the campaigns?

Technical corrections:

P1, L14: data set □ observations

P1, L15: add "of moisture" so that it reads "vertical gradients of moisture"

P1, L22: small □ smaller (?), since you use "higher" before it should read here rather "smaller". Otherwise you could write "high" and "small".

P2, L32: a layer □ the layer

P3, L92: from WALES? Please add.

P4, L124: a DIAL □ the DIAL

P5, L126: Not clear. Leakage of what?

P5, L140: coverage □ resolution

P5, L144: delete "instrumented" and add "aircraft" after HALO

P5, L157: Beyond this □ However (or Additionally)

P5, L157: are □ were

P8, L185: in 2016 □ since 2016 (?)

P8, L187: with □ of the

P8, L189: one 1 hour intervals □ with a time resolution of 1 h

P9, L229: a typical location □ the typical location

P10, L242: Rephrase sentence so that it reads "gives some example values for the bias for certain moisture observations"?

P11, Table 2 caption: Add "Some" so that it reads "Some example values" and add "according" or "respective" before "computed".

P11, L251: introduced □ provided

P11, L260: lower □ smaller (?)

P11, L263: add comma after model and Eq(3).

P12, Figure 4 caption: Write "On the panels are the……….superimposed".

P14, L312: add "the" or "a" before bias.

P14, L312: compared □ compared to

P15, L326: replace "=" by "i.e."

P19, L372: illustrated □ shown

P23, L461: delete "the" before Dyroff et al.