Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., author comment AC1
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Reply on RC1

Marc Prange et al.

Author comment on "Are elevated moist layers a blind spot for hyperspectral infrared sounders? A model study" by Marc Prange et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-48-AC1, 2021

Dear Anonymous Referee #1,

we thank you for your comments. In the following we address each comment individually:

Referee Question:

Since the performance of EML retrieval is heavily relying on the additional information from temperature profile, the temperature averaging kernel results should also be shown.

Answer:

A key finding is indeed the reliance of the EML retrieval on the added temperature information. Hence, we agree that showing the temperature averaging kernels is beneficial (Figure 1). We think that it is sufficient to add them to the appendix of the paper since they do not appear as essential as the water vapor averaging kernels for the main train of thought in section 4. However, we will make sure to reference the appendix figure in that section.

Referee Question:

Moreover, if temperature retrieval is not performed, instead, reanalysis or forecast temperature profiles are used, will the EML retrieval be improved more?
On the additional temperature information, does the retrieval need the detailed vertical structure of temperature or is a smoothed "truth" temperature profile enough?

Answer:

We try to answer these two questions simultaneously. In Fig. 4 of the manuscript, we pick a particularly large error in our a priori temperature assumption to qualitatively demonstrate its effect on the water vapor retrieval. In practice, reanalysis or forecast products are expected to be much less biased and to be a somewhat smoothed version of the true temperature profile, similar to what Anonymous Referee #1 suggests in their second question. This indeed denotes another interesting testcase, which we tried to implement with a new retrieval run, the results of which are shown in Figure 2 of the Supplement. Here, the a priori temperature profile is set to be the true profile without the temperature inversion features and the temperature profile retrieval is omitted. The effect

on the water vapor retrieval is that the retrieved EML is overly pronounced and in a slightly wrong altitude. Note that the assumed temperature a priori is highly idealized in this example. Forecasts or reanalysis temperature data would be expected to be more error prone. We set up another testcase that only deviates from the previous one by a constant 3 K bias (Figure 3). The result is that the water vapor retrieval does not converge properly (canceled after 20 steps) and errors grow much larger. To avoid having the water vapor retrieval attempt to compensate for temperature errors, it is necessary to simultaneously retrieve the temperature profile. We conclude that missed fine temperature structures deteriorate the EML retrieval but do not yield an EML blindspot, as we also try to convey in the manuscript.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2021-48/amt-2021-48-AC1-supplement.pdf