

Atmos. Meas. Tech. Discuss., author comment AC2
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Reply on RC2

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-AC2>, 2021

Dear anonymous referee #3,

we thank you for laying out your major concerns with our paper. In the following, we want to address the raised points individually.

Referee comment:

The fact that water vapor information from hyperpectral sounder measurements is dependent on a-priori knowledge of surface and air temperature is a well established fact.

Response:

While this appears to be insufficiently communicated in the paper, we are well aware of the fact that we are not introducing a new idea to the field by finding that the water vapor retrieval is reliant on the knowledge of surface and air temperature. We agree with the referee that this generally is a well established fact. However, our finding is not of such general nature, but instead applied to a very specific and to our knowledge novel use case, namely an Elevated Moist Layer (EML). In this context, we believe it is not at all obvious, how the EML retrieval is affected by temperature errors due to the strong temperature inversion features associated with the EML. In the light of the poor retrieval results of Stevens et al. (2017) for an EML case, we view our assessment of the temperature error effect for this specific case as a valuable insight, although in the end it does not appear to be the driving effect for the severely underestimated EML found by Stevens et al. (2017).

Referee comment:

I see no reference to any of the excellent papers on IR information content from either the retrieval or data assimilation communities, whether for AIRS, CrIS or IASI. Except for Rodgers, the authors communicate no awareness of any of the operational or research algorithms successfully retrieving mid-tropospheric moisture across the globe on a daily basis. Not to mention the excellent studies on channel selection, error estimation, a-priori selection and least squares fitting.

Response:

We do cite IR retrieval literature and use their results as a premise to motivate our study. We cite Schneider and Hase (2011) and Borger et al. (2018) to raise the point that temperature induced errors are among the highest error sources for lower and mid tropospheric water vapor retrievals. We also cite Lacour et al. (2012) as the predecessor study of Stevens et al. (2017) and deploy their spectral setup to better put our results into context. However, we should have made it more clear in the text that there is a wider literature on hyperspectral IR retrieval in general and will amend that in the revised text. For example, we see the point of referencing more performance evaluation studies of operational or research algorithms that derive water vapor profiles from IASI or AIRS, such as Chazette et al. (2014) or Divarkarla et al. (2006). But we want to cite only those papers that are either directly relevant for this paper or important landmarks. If the reviewer thinks that a particular paper in these two categories is missing, then please suggest it.

Referee comment:

Who is your target audience?

Response:

The aim of our study is not to introduce new insights on retrieval methodology, but rather to investigate to what degree it is possible to retrieve layered moisture features in the troposphere based on established retrieval techniques with IASI. Hence, our target audience is less the retrieval and data assimilation community, but rather the community interested in exploiting satellite data for measurement campaign or climatology purposes with particular focus on the vertical humidity structure. We currently try to convey this in our introduction by mostly referencing literature that puts EMLs into a meteorological context. However, we can see that the current length and somewhat fundamental nature of the retrieval method section may raise unintended expectations for the reader. We could see that a more concise retrieval method section would be sufficient and beneficial for the story we want to tell. Any other suggestions for communicating our target audience clearer are of course welcome.

Referee Comment:

Except for responding to Stevens et al. 2017 (which I haven't read, but the authors stated in their motivation throughout), I am not convinced this paper has scientific merit.

Response:

With the exception of Calbet et al. (2006), which we will discuss in the revised version of the article, we are not aware of any study other than Stevens et al. (2017) that has addressed the subject of our paper, namely to what extent the retrieval from these instruments is able to faithfully characterise layered moisture structures, in particular EMLs. Typically, examples given in the retrieval literature are for rather smooth profiles, and resolution metrics are theoretical (resulting from OEM analysis), but not put to a practical test (e.g. Lerner et al., 2002). Any suggestion of studies that we might have missed that deal with this would be highly appreciated.

We should more clearly communicate the scientific added value of our finding that EMLs appear possible to retrieve. Rather than focus on pointing out that our results oppose the finding of Stevens et al. (2017), we will further elaborate on the added value of being able to investigate these features in their atmospheric environment based on satellite data.

References:

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