

Review of Schneider et al

November 29, 2023

This article describes the possible added value of assimilating water vapor isotopic observations from the IASI satellite instrument in addition to assimilating humidity and temperature observations. To do so, observing system simulation experiments are performed with synthetic IASI observations. The main result is that there is a significant improvement in the case of extreme rainfall, due to the property of the isotopic composition to deviate from its usual relationship with humidity in strong convective conditions.

I have already reviewed previous versions of this manuscript submitted elsewhere, and this version is significantly improved relative to the previous versions. In particular, the added value of this article relative to previous studies, argued in lines 73-87, is very convincing.

The article is overall well written and illustrated. I have several comments.

1 Major comments

- l 19 and discussion in the text on the added value of δD during “strong latent heating events”: are IASI observations of good quality or frequent during the strong latent heating events, that are probably associated with cloudy conditions? We the impact of clouds on the retrieval quality considered when creating the synthetic IASI dataset? Maybe a few words could be added on this in the methods section? And possibly discussion section?
- Section 4.3 and fig 6: I’m not sure the link with the previous sections is clearly explained. I thought about this link and this is how I understand it: most of the time, δD and q are correlated, so the added value of assimilating $q + \delta D$ relative to q is small. But for strong latent heating events, δD deviates from its usual relationship with q , so this is where the added value of assimilating $q + \delta D$ relative to q is the largest. Is this what the reader is supposed to understand? If so, maybe this should be explained more clearly, rather than letting the reader elaborate his/her own conclusion. If I misunderstood, then clarify as well.
- The results from Fig 3 to 6 were stratified by Q2: at which altitude?). Is there any reason for choosing to stratify by Q2 rather than precipitation rate or by ω at 500hPa, which are variables that are more commonly used in the community to stratify observations? Would the results be the same if they were stratified by e.g. precipitation?
- I understand that δD allows to identify “strong latent heating events”. In analyses, OLR observations are routinely assimilated. They are cheap and with excellent spatio-temporal coverage. I expect that OLR observations are very relevant to identify “strong latent heating events”. Do we expect any skill improvement when assimilating δD in addition to q , T , OLR?

2 Minor comments

- l 19: “most important”: be more specific: e.g. needed due to the low skill? Or important for societal implications?
- l 24: “heating or latent heat consumption” -> “heating/cooling”, for simplicity and coherence with the previous line.
- l 25: “impacting on” -> “impacting”
- l 164: “but we do not ... variables.” -> “but that are not assimilated .”

- l 181: “calculation data of continuous” -> “calculation, continuous”
- l 241: “with significant we mean...” -> Write a full sentence outside of the brackets: “By significant, we mean...”
- “as already achieved by” -> “relative to that achieved by”
- l 257-259: clarify that although it provides information, the skill improvement is small.
- l 291: “almost not”: why almost not? Why not completely not? In absence of any assimilation, don’t we expect no relationship at all?
- l 292: “this uncertainties” -> “the uncertainties”
- Fig 3: recall which altitude this is. Same fig 4 and 5.
- l 380: “under which... analyses” -> “where the impact on the analyses is largest.”
- l 386: “here used model IsoGSM” -> “IsoGSM model used here”
- l 391: “different highly resolving models” -> “convection-permitting models”?
- l 390-397: I’m not sure I understand the point of this paragraph: what is expected to have the largest impact on the analyses: the assimilation of real IASI δD , or the increased resolution? And is there any link between these two sources of possible improvement? If so, clarify. Regarding the impact of resolution on analyses, I suspect that there is already an extensive body of literature on this, maybe some papers could be cited?
- l 410: I didn’t understand this sentence. Replace the sentence between brackets by just “the skill is improved by less than 10%”?