Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-379-RC5, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison of RO tropopause height based on different tropopause determination methods" *by* Ziyan Liu et al.

Anonymous Referee #2

Received and published: 11 February 2020

** General comments

The manuscript under review, "Comparison of RO tropopause height based on different tropopause determination methods" by Liu et al., uses a tropopause definition tailored towards the radio occultation (RO) measurement technique–taking advantage of bending angle information which is very close to "pure" RO observations–and compares the resulting tropopause characteristics to the widely used temperature lapse rate definition of the thermal tropopause.

The paper analyzes data from two satellite missions, FY3C and Metop, and compares to collocated ECMWF analysis data using both methods and for two specific seasons. Compared are also the differences between the two missions.

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It makes sense to base global tropopause monitoring by RO on such a bending angle-based definition, because for RO the bending angle is the more natural parameter choice compared to temperature, and less contaminated by retrieval details. It is then of great value to see how this definition compares to the common WMO definition. Also, RO is a good choice for global tropopause monitoring due to its properties.

I have two major concerns to be addressed before I would consider the study ready for publication:

* Using RO data from two missions introduces a complication to this study. I see two issues here: First, I think it would help the paper to keep its focus on the comparison of the two tropopause determination methods, instead of also comparing two missions. Secondly, and more importantly, the data of these missions are from two different processing centers and I suppose that they are not consistently processed. Metop data are processed by ROMSAF, and information about the processing of FY3C is missing in the paper. It has been shown in the literature that only for the same processor and processing version profiles from different RO missions can be mixed together. Applying the tropopause determination algorithms on inconsistently processed profiles will most probably result in a systematic bias. I would strongly recommend to only use data from one processing to avoid this additional complication, or to first validate that no bias is introduced.

* Lewis 2009 showed comparisons of bending angle-based tropopauses to lapse rate tropopauses latitudinally resolved, and included comparisons to collocated radiosondes. Schmidt et al. 2010 used 8 years of RO data from various missions and ECMWF analysis data and showed latitudinally and seasonally resolved differences between bending angle- and dry temperature-based tropopauses. They also compared differences in tropopause height trends between these methods.

Apart from the comparison between FY3C and Metop (see above), I am not sure how the new findings of this study in light of the existing ones can be summarized. I think

the main results and conclusions of this study need to be discussed in more detail, going beyond the existing results. If the main findings are the differences between Metop and FY3C, then the different processing needs to be addressed (see above), and some attempt to explain those differences need to be made. If the focus stays on the difference between LRT and BAT, the details of Figs. 11 and 12 are worth to be looked at in more detail and additional work should be performed to understand these differences better (with the existing work as background).

** Specific comments

* The global map plots (Figs. 3, 5, 7, 8) are hard to read for several reasons. For the difference plots (bottom row), please use a diverging color scale so that one can distinguish positive and negative values. Secondly, the resolution of the bitmaps is too low. And thirdly, I do not understand where the white stripes pattern in these plots comes from? They do not represent the RO event distribution, and seem to be related to the underlying map. I find these patterns quite distracting.

* The paper needs heavy editing with respect to English language. I am (obviously) not a native speaker myself, and strongly recommend to use an English proofreading service.

* You write that you use "ECMWF reanalysis data"; I guess you actually use ECMWF operational analysis data?

* In Fig. 6, and also Fig. 4, the presented bias structures of Metop and FY3C are very different. Do you have an explanation for this? I think this is quite surprising, and I would guess that this is related to the different data processings (see above). Largest differences can be found in mid latitudes, where the occurrence of double tropopauses make the detection of the first tropopause more demanding. If the paper keeps the comparison between the two missions, these differences need to be discussed and analyzed in more detail (e.g. single profile comparisons, and so on). As shown in a number of publications, RO measurements from different missions can be usually com-

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bined as long as they are processed consistently, such systematic differences between two missions are therefore surprising to the reader and need explanation.

** Minor comments and technical corrections

* p.1 l30: "variation trend"? Probably you mean "trend in tropopause height"?

* p.2 l33: "direct sounding technic" => "in-situ measurements"

* p.3 l65: "Bending angle profile is level-1 data but dry temperature profile is level-2 data, and thus we only discuss the tropopause height (TPH)" I do not understand this sentence.

* Fig. 1: "Temperature" is misspelled.

* p.6 l117: GPS, BDS: Introduce acronyms

* p.6, l121: "Wegner" => "Wegener"

* p.6, l124: Which processing is used?

* p.7 l141-142: Supposing that these are ECMWF operational analysis, are these numbers correct? To my knowledge analysis resolution close to the surface is better than the stated 200 m, and at 20 km it should be around 400 m (and not 300 m), but I might be wrong.

* p.7 l144: "bias regulation": Not sure what this means. Maybe "bias characteristics"? This term occurs several times in the manuscript.

* p.7 l149: "spatial interval with" => "spatial distance to"

* p.8 l169: "opposite trend" => "opposite behavior" ("trend" is misleading).

* p.9 l176: "totally different": This is overstated, I think they look overall quite similar.

* p.12 l215: "bias trends": No trends involved here.

* p.12 l216: "RMSE trend": No trends involved here.

* p.13 l238: "variation trends": No trends involved here.

* Figs. 11, 12: "Summer" and "Winter" are ambiguous. Please use "DJF" and "JJA".

* p.15 l252: "To detect the global tropopause" => "To detect the global tropopause with RO"

* p.16 l262: No trend involved here.

* p.16 l262: "availability" is not the correct word. Maybe "reliability" or "usability"?

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