Response to reviewers – "Moisture transport axes: a unifying definition for monsoon air streams, atmospheric rivers, and warm moist intrusions"

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We thank Franziska Aemisegger and the anonymous reviewer for reviewing the revised manuscript. We are happy to read that we were generally able to satisfy the reviewers and thank for pointing out some remaining issues. Our point-by-point response appears below in blue.

Reviewer 1 (F. Aemisegger)

L 70 can you find a smoother way to lead over from the literature review to the data and methods section. The end of the intro is a bit abrupt.

Thanks for pointing this out. We agree that the transition was a bit abrupt. We have considered several options to smooth the transition by appending a sentence or two to the end of the introduction, like a final summing up and concluding of the literature review or a table-of-contents sentence, but in the end decided against these options. We feel that a conclusion would merely constitute a repetition of what we pointed out before and we generally find table-of-content sentences/paragraphs to be redundant.

To still smooth the transition somewhat, we changed the beginning of the data subsection, which now reads "We detect moisture transport axes in 3-hourly ERA5 reanalysis [...]". By taking up the phrase "moisture transport axes" from the previous sentence, we now provide a bit more continuity and a smoother transition.

code availability the jet axis detection algorithm is available in the dynlib, but adaptations are necessary to use it for moisture transport axes. Could these changes be documented in the supplementary, or the adapted code for moisture transport axes be made available?

Thanks for pointing out this missing bit of information. In fact, no adaptations of the algorithms are required. We now state this explicitly in the revised code availability statement: "The jet detection algorithm is used as published, no adaptations to the algorithm are required beyond setting the appropriate threshold."

Reviewer 2

General remark I am still not fully convinced that a single global threshold is the best approach. I agree with the arguments in the response letter that removing —IVT— could result in peaks in the gradient field that are not associated with significant moisture content but would still be identified as moisture transport axes. I believe that if the Kivt parameter were to vary with latitude, following, e.g., the smoothed IVT zonal profile, it would provide a more accurate representation of moisture transport in mid- and high-latitudes. (lines numbers in the manuscript with tracked changes)

We realise that this is a choice where we will not be able to avoid some disagreement among readers and reviewers, irrespective of our choice. We have followed the performance of the algorithm for more than two years now in the weekly chart discussions at our department and we genuinely believe that the variant we propose in the manuscript is the most generically useful one (in the extratropics, see discussion in the supplement.)

Having said that, we invite the reviewer to test his/her ideas and maybe suggest an improved definition for the feature. With the acceptance of the manuscript we will also publish the detections described in the

supplement, where we normalise the magnitude of the input IVT by the time and zonal average TCWV. This approach is equivalent to a latitudinally-varying K_{ivt}-threshold, so this might be an interesting dataset for the reviewer to consider.

l.16 I believe the last comma is not needed, i.e., it should read 'mid-latitudes and polar regions'

True, it is a serial comma and thus optional—but it is a valid choice to have it there. We consistently use the serial comma in the manuscript (including the title) and thus opt to keep it.

l.39 'the concept of atmospheric rivers'

We agree with the suggested edit and adapted accordingly.

l.202, 271 I would recommend not using the word 'detections' in those captions. I like your old subtitle of Section 5 better (Moisture transport axes in polar regions/midlatitudes and their relation to...)

We agree, the word "detections" makes the titles appear more technical than appropriate. We thus replace "detections" by "moisture transport axes" in the titles of sections 4-6.

l.219-222 This part should be made clearer and perhaps shorter, e.g., 'Not all fronts, however, are associated with moisture transport axes (e.g., warm fronts south of South Africa in Fig. 2c,d). Thus, the co-occurrence of fronts and moisture transport axes may define frontal moist baroclinicity - a metric that combines relative humidity and the isentropic slope, effectively describing fronts (S&S2018)."

Thanks for suggesting a more elegant phrasing for what we wanted to express there. We agree with the suggestion and changed the wording accordingly.

l.371-374 'attribution' of what? also, the word attribution is used 3 times in one sentence

This sentence is meant generically, i.e., the attribution of any given variable. We rephrased to make this clearer ("Compared to atmospheric rivers, moisture transport axes offer a more structure-based definition, at the cost of making it less straightforward to relate moisture transport axes to, for example, poleward vapour transport or precipitation.") and adapted the following sentence to avoid the repetition of "attribution".

l.399 'our approach allows (us) to unify atmospheric rivers'. Please bring 'us' back to the phrase.

Fine for us, we re-added "us".