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Comment on wcd-2021-12

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Community comment on "The interaction of tropical and extratropical air masses controlling East Asian summer monsoon progression" by Ambrogio Volonté et al., Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2021-12-CC1>, 2021

I have a primary concern about this manuscript, which is how the authors define a front and use the term "front" throughout the manuscript.

1. The authors use a definition of a front developed by Li et al. (2019). However, in neither Li et al. (2019) nor in the present manuscript is the suitability of this quantity assessed. Such a critical assessment in relation to previous definitions of fronts, in general, and the Mei-Yu front, specifically, needs to be carried out.

For example, at the most general, quite a few other studies have examined automated frontal detection methods, but that prior knowledge is not discussed in this manuscript as it would pertain to justifying the authors' choices in the present manuscript. Some examples include Hewson (1998), Berry et al. (2011), Schemm et al. (2018), Thomas and Schultz (2019a,b), and Catto and Raveh-Rubin (2019). The readers would benefit from a detailed discussion of the advantages and disadvantages of various approaches of automated frontal detection and a justification for these specific choices by the authors. Specifically, the following items need to be discussed.

2. Choice of theta-e. In atmospheric dynamics literature (e.g., Hoskins and Bretherton 1972), fronts are defined by the horizontal gradients in density (expressed through temperature changes). However, the present manuscript uses theta-e, which is a function of temperature and moisture. Thomas and Schultz (2019a,b) have discussed the implications of choosing theta-e over a temperature-based quantity (such as potential temperature). See in particular, Table 2 of Thomas and Schultz (2019b), which presents the advantages and disadvantages of using potential temperature versus theta-e. In the present manuscript, however, the authors did not justify their choice of theta-e over other thermodynamic quantities that would not be affected by moisture. Indeed, Yang et al. (2015) write, "mei-yu rainbands typically consist of a much stronger moisture gradient than temperature gradient". This statement (and others can be found in other articles, as well) is why a more clear definition of "front" is needed in this manuscript.

3. More specifically, what is the context for the choice of theta-e in terms of the Mei-Yu front? The discussion of the previous literature on Mei-Yu frontal identification is limited. Although theta-e is a useful diagnostic in some studies, in others, it is not appropriate. In fact, Chen et al. (2003) argued the following:

“As the mechanism for frontogenesis was almost unrelated to baroclinity in our mei-yu front case, traditional definitions of front and frontogenesis in terms of horizontal temperature gradient become inappropriate.”

In Wang et al. (2016), because the thermodynamic boundary and the wind-field boundary were often not collocated, the authors diagnosed the wind field (through the vorticity equation) and frontogenesis field (using theta-e) separately.

That agreement on how to diagnose the Mei-Yu front is not apparent from just a small sampling of the literature raises the issue of the appropriateness of the frontal diagnostic used in the present manuscript. Thus, this previous literature raises the issue of how cleanly the airstream boundaries line up (or don't line up, as the case may be) with gradients in the thermodynamic fields. How do the authors reconcile their picture of the Mei-Yu front that is smooth and simple compared to the previous literature on this topic?

4. Choice of meridional gradient. As detailed in their Table 1b, Thomas and Schultz (2019b) showed studies have used the full gradient of temperature as a frontal diagnostic (e.g., Sanders and Hoffman 2002; Spensberger and Sprenger 2018; Thomas and Schultz 2019a,b). The choice of only using the meridional gradient rather than the full gradient is an unusual one. In neither Li et al. (2019) nor in the present manuscript is the use of only part of the full gradient discussed. Given that the Mei-Yu front may not be purely oriented in a west-east orientation on any given weather map, the authors would not be capturing the full magnitude of the front by only using the meridional gradient. This choice needs to be better justified in the manuscript.

5. In summary, by designation of the front as the meridional gradient of theta-e, the authors obtain results that are overly smooth compared to previous literature that describes the complexity of the Mei-Yu front. Therefore, statements such as those below need to be better qualified.

“The EASM front neatly separates tropical and extratropical air masses” (line 2).

“The Mei Yu stage is distinguished by an especially clear inter- action between tropical and mid-latitude air masses converging at the EASM front” (lines 11–12).

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