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Geoscientific Model Development Discussions

Interactive comment on "Image Processing Based Atmospheric River Tracking Method Version 1 (IPART-1)" *by* Guangzhi Xu et al.

Anonymous Referee #2

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Interactive comment on "Image Processing Based Atmospheric River Tracking Method Version 1 (IPART-1)" by Guangzhi XU et al.

General comments: In this paper, the authors propose a novel automated detection method for Atmospheric Rivers (ARs), which addresses several research gaps among many AR detection methods. First, this AR detection method is threshold-free, which make it easier to detect AR in a warming climate or based on different data sources. However, some demonstration of the applications of this method under the climate change or in different data source should be provided to show the advantage of threshold-free characteristics. Second, a novel method is proposed to identify the AR axis, which is significant in calculating the spatial metric of ARs, such as length and width. While, more examples should be provided to assess the performance of this

AR axis identification method. For example, applications in ARs with varying shapes, orientation and curvature. Third, Hausdorff distance is a good evaluation of the closeness of two AR slices in tracking the AR life cycle, while the 1200 km criterion seems arbitrary. I would suggest to provide more detail of the selection criteria selection. In summary, the AR detection algorithm proposed here is novel and this manuscript is deserved to be published once all the comments are addressed.

Major comments:

Line 153-154: Please clarify when the 800 km threshold is applied and when the 2000 km is applied. How is the genesis stage of strong ARs defined?

Line 153: Why the ARs with too large area or too large length need to be eliminated? Please provide more examples to demonstrate why the large scale ARs do not conform to the definition of AR. The existence of large scale ARs wound have different reasons, for example two ARs are merged mistakenly and become a large scale AR. It is not appropriated to eliminate them directly.

Line 160: The AR candidate which is similar to circular region (e.g., when TC occur) will be discarded by this criterion. While, when TC occupies a small partition of the AR candidate (the concurrence of TC and AR), it is hard to be discarded by this criterion.

Line 168-169: Whether the tropical moisture need to be considered or not is a controversial topic in the AR study. Usually, the AR is defined as a mid-latitude phenomenon, while the impact of tropical moisture to the mid-latitude climate is not neglectable (Knippertz et al., 2013; Lu et al., 2013). Discarding the ARs whose centroids are within the 23N-23S may discard the genesis stage of an AR event, since the enhanced moisture transport often start from the tropics. So, what kind of tropical AR need to be discarded is deserved to be further considered.

Section 2.2 geometric considerations: Several geometric criteria applied here seem arbitrary. The sensitivity test from different geometric criteria should be conducted, especially for the relaxed 800 km length requirement, maximum length and maximum area, isoperimetric quotient and latitudinal range. It will be better to demonstrate how these criteria are selected and what kind of preliminary AR are discarded by these criteria.

Section 2.3 finding AR axis: This is a very novel method in identifying the AR axis, and it is believed that it has a very good performance in AR with complex shape, orientation and curvature. While, more examples should be provided to demonstrate its good performance in different situations, especially when ARs have varying shape, large curvature, or concurrent with TC or EC.

Figure 2: At the end of AR axis, why it no longer exists over the center of AR pathway anymore (marked by red box in Figure 1)?

Section 2.4: The Hausdorff distance measurement is an efficient method in assessing the closeness of two AR slices, while the reason why 1200 km is selected as the criterion should be further justified.

Line 278-283: From the histogram of occurrence and the box plot of mean IVT (Figure 5e), we can observe that the IVT85% method detect more ARs but with lower IVT intensity. From my experience, the reason would be that the 100 kg/m/s is too low to detect a lot of weak ARs near the polar region. So, in the comparison of different detection methods (THR, constant IVT thresholding method, and percentile method), the AR frequency maps are suggested to be provided, which can help to further explore the difference of spatial distribution among the ARs detected by different methods, and the region preference of different methods.

Figure 5: To be honest, it is hard to justify which result is better for the two examples marked by red box in Figure 2, THR or IVT85%. The ARs detected by THR (green contour) have two peaks, and the IVT85% divide them into two ARs (black dash contour). We can not say that the result of THR is better. Maybe the two peaks are controlled by different systems and should be diagnosed separately.

Line 344-348: How to prove that the low IVT mean for large size ARs is not due to the inclusion of weaker systems?

Minor comments:

Line 60-65: Another AR axis identification method is proposed in (Pan & Lu, 2019), which can fit smooth curve for ARs with varying shape, orientation and curvature. It will be a good reference here.

Line 247: The "constant IVT threshold approach" should be adjusted to the "constant IVT anomaly threshold approach" to distinguish from the real constant IVT threshold approachs (e.g., Sellars et al., 2017).

Reference: Knippertz, P., Wernli, H., & Gläser, G. (2013). A global climatology of tropical moisture exports. Journal of Climate, 26(10), 3031–3045. https://doi.org/10.1175/JCLI-D-12-00401.1 Lu, M., Lall, U., Schwartz, A., & Kwon, H. (2013). Precipitation predictability associated with tropical moisture exports and circulation patterns for a major flood in France in 1995. Water Resources Research, 49(10), 6381–6392. https://doi.org/10.1002/wrcr.20512 Pan, M., & Lu, M. (2019). A Novel Atmospheric River Identification Algorithm. Water Resources Research, 55(7), 6069–6087. https://doi.org/10.1029/2018WR024407 Sellars, S. L., Kawzenuk, B., Nguyen, P., Ralph, F. M., & Sorooshian, S. (2017). Genesis, Pathways, and Terminations of Intense Global Water Vapor Transport in Association with Large-Scale Climate Patterns. Geophysical Research Letters, 44(24), 12,465-12,475. https://doi.org/10.1002/2017GL075495

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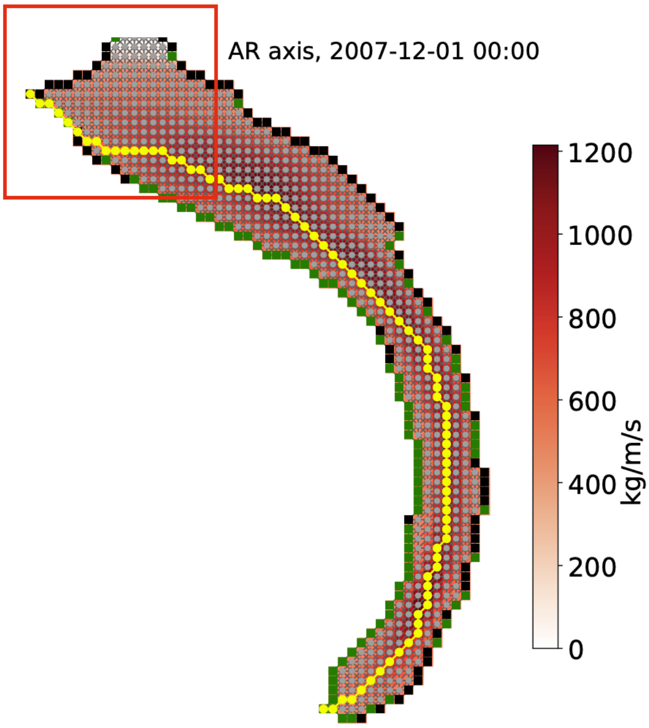

Fig. 1. AR axis generation

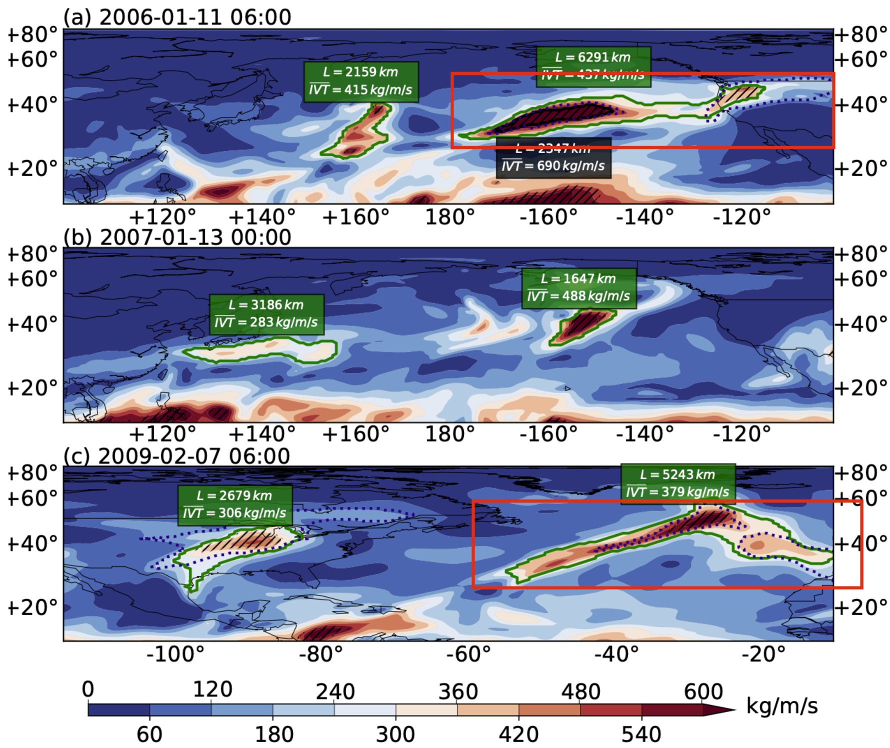

Fig. 2. AR algorithms comparison