

Interactive comment on “The Life Cycle of Upper-Level Troughs and Ridges: A Novel Detection Method, Climatologies and Lagrangian Characteristics” by Sebastian Schemm and Michael Sprenger

Anonymous Referee #3

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This is an interesting and well written paper. It describes a new method for tracking troughs and ridges based on curvature of geopotential height contours. The tracking algorithm features important tools, allowing to find the major axis and lifetime of the systems. After reviewing the tracking algorithm the authors present climatology of the detection frequency and axis orientation. The authors then use the unique capabilities of the tracking algorithm to analyse two important open questions: the effect of ENSO on extratropical weather systems and the Pacific midwinter minimum. Finally, the authors demonstrate the usefulness of the described tracking tool in a Lagrangian

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analysis, by tracking air parcels from trough and ridges identified regions using the LAGRANTO algorithm. The described tool is very useful and definitely worth publication following some modifications as described below.

Major comments:

1. As one of the most important skills of this tracking algorithm is finding the axis of the system, and a lot of the analysis is based on it, more effort should be invested in explaining the notation of cyclonic and anticyclonic tilt, what are the factors controlling the axis orientation and the effect of the axis orientation on the life cycle of the system and it's interaction with lower-level systems. A cartoon demonstrating these concepts might be helpful.
2. In the introduction, more attention should be given to explain the open questions addressed in this work (ENSO, midwinter minimum), and how these questions might be addressed using tracking algorithms.
3. Choosing 500 hPa as the main level in which the analysis is done is reasonable, but the authors should add a figure describing the performance of the algorithm as a function of tracking level to give a more general representation.
4. The effect of ENSO and the midwinter suppression on the number of eddies is crucial in understanding their overall effect. Although it is challenging to measure as it appears differently depending on the tracking algorithm and the parameter that is tracked. Therefore, the effect of ENSO and the midwinter suppression on the number of tracked eddies as found by the described algorithm should be shown (either in figures 5 and 6 or as additional figures).
5. One of the most commonly used Lagrangian methods is creating composites based on the tracking data. Using this algorithm in order to make composites might be even more useful as the algorithm finds the region associated with the systems, and improved composites can be made. Adding a composite analysis of some field might be

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very interesting (for example, a composite of the vertical velocity can be made and later compared to the more complicated analysis using LAGRANTO).

6. The analysis shown in figure 7 is confusing. These eddies are, to a good approximation, a closed system and therefore mass (and PV) conserving. Looking at the total vertical movement of parcels does not necessarily mean much and the conclusion that vertical processes play a small role in the dynamics might be incorrect. Previous papers (e.g., Booth et al., 2015; Tamarin-Brodsky and Hadas, 2019) have shown (as in figure 8), that there is a small section of rapidly ascending air and a larger section of moderately descending air.

Minor comments:

1. Figure 1 can be reduced to 3 subfigures, combining subfigure b-c and e-f and describe the system's age in the text.

2. The use of the phrase "low- (high-) pressure system" (e.g., page 4, line 24) is confusing in this context, as it is mostly used to refer to low-level cyclones (anticyclones).

3. The climatology calculations that led to the colours and contours in figure 3 should be better explained.

4. Page 11, line 32 to page 12, line 2: These results have been discussed before in the context of extratropical storms, both in simulations (Booth et al., 2015), and observations (Tamarin-Brodsky and Hadas, 2019). A reference should be made.

Typos

1. Page 3, line 17: "The trough and ridge identification algorithm is based on...". Perhaps use "The trough and ridge identification are done on..."

2. Page 4, line 20: Number is unclear.

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