

## **“Stratospheric intrusion depth and its effect on surface cyclogenesis: An idealized PV inversion experiment”**

**Authors:** Barnes, Ndarana, Sprenger, and Landman

**Recommendation:** Minor Revision

### **Overview:**

In this study, the authors perform a series of idealized experiments in which they invert QGPV anomalies of various sizes, shapes, and vertical depths for their associated horizontal circulations. These circulations are then used to identify QGPV configurations that are likely to be more influential on surface cyclogenesis. The authors have done well to address my prior comments on the manuscript. At the moment, the large share of my comments are textual in nature, and offered to help improve the clarity and precision of the discussion. I have certainly found the results to be interesting, and believe that the manuscript will be ready for publication after a round of minor revision.

### **Minor, Specific, and Typographical Comments:**

#### *1. Introduction*

L22: Rather than “down to”, consider “drawn from” as a potential substitution in the text.

L26: I think the ending of this sentence is a bit unclear. Is this sentence referring to the ideas of PV invertibility or quasi-geostrophic theory? Consider a revision that improves the clarity of this sentence.

L49: The first two sentences of this paragraph are a bit redundant. Consider a revision to streamline the text a bit more.

L52–54: I find this particular sentence to be a bit vague and confusing. Could it be rewritten for improved clarity? I view this sentence to be important for setting the stage for the forthcoming analyses.

L59: I am still not sure why it should be expected that the effect should be different in the Southern Hemisphere versus the Northern Hemisphere, especially in an idealized environment. Consider corroborating the relevance of this statement more or simply keep the focus of the study on systematically examining the characteristics of these intrusions from an idealized perspective.

#### *2. Methodology*

L181: Consider revising the text to read as, “...is comprised of...”, for greater clarity.

Overall: I love the table to summarize the various experiments – a great resource while evaluating the results.

### 3. Results

L212–213: I view this as a bit of a “chicken or the egg” type of description. I’m not sure I’m comfortable with saying that COLs are generated by stratospheric intrusions of high PV, since they *are* stratospheric intrusions of high PV. The generating mechanism, then, is what *causes* the intrusion. Consider a revision to the text accordingly.

L216: I believe the figure reference should be to Fig. 6b in this line, rather than Fig. 7b. Figure references appear to be off by 1 in many instances after this point in the manuscript.

L221: This quantity should be negative since we’re in the Southern Hemisphere.

L224: Consider referencing any specific figures from this prior work that may help direct the reader to better verify this connection.

L239: I find the figure references to be unconventional. Consider using a more standard a,b,c,d,e,etc. label for panels rather than mixing numbers and letters multiple times (i.e., avoid 7b2 and stick with 7a, 7b, etc.).

L292: For additional clarity, it may be worthwhile to emphasize that this text refers to the austral summer.

L330: At the same time, the reduced tropospheric static stability in the high tropopause case can also allow for the circulation induced by the upper-level PV anomaly to penetrate to lower altitudes. I wonder if this is why you still see an effect of a lowered surface relative vorticity in Fig. 10 for the high tropopause cases, but its muted due to the competing effects between the penetration depth of the circulation and the height of the anomaly?

L341–342: These two sentences are a bit repetitive, could one be deleted for improved concision.

L369: This is largely semantics, but I view the use of the word, “intensity” throughout the manuscript to be a bit confusing. Namely, when I see intensity I instantly think “magnitude”, but here the discussion refers to radial depth. Consider reviewing the text in the manuscript to improve the precision with which these changes to the PV anomalies are described. For example, in L380, “magnitude intensity” are the same words, from my perspective. Could it be possible to just keep reference to intensity in terms of anomaly magnitude and use radial depth or vertical depth to refer to changes in the anomaly’s geometry?

L424–425: I believe this sentence refers to the wider PV anomaly, correct? If so, consider a revision to the sentence clarifying this point.

L434: Typo: One “shallower” should be removed from this sentence.

L438–441: Consider providing a physical explanation for this (i.e., the horizontal scale of the surface pressure distribution is larger for the broader anomalies, and thus the pressure gradient does not necessarily get much stronger as you increase the radial width of the anomaly).

#### *4. Discussion and Conclusions*

L478: Consider emphasizing that you are referring to the height above ground level in this sentence to promote further clarity.

L516: Consider adding the word, “environment”, after baroclinic in this sentence.

#### *Figures and Tables:*

Fig. 8: I remain a bit confused as to what the difference between minimum relative vorticity and minimum cross-sectional relative vorticity is. Could this difference be more clearly identified within the body of the text before this first figure is introduced? Apologies if it is described earlier in the text and I missed it.