

Stratospheric intrusion depth and its effect on surface cyclogenetic forcing: An idealized PV inversion experiment

by Barnes et al.

The manuscript improved during the last revision. However, I still do have suggestions to improve the manuscript. I think after this round of minor revisions the manuscript might be ready for publication.

Penetration depth

The authors argue in Experiment 2 in LL454 that a lower tropopause results in an increased static stability leading to increased rotation (decreasing negative vorticity) around the anomaly. However, the penetration depth H of an anomaly varies inversely with the ambient static stability N around an anomaly (e.g. Martin 2013):

$$H = f L/N \text{ with } L \text{ the horizontal scale of the anomaly.} \quad (1)$$

I would ask the authors to insert potential temperature contours especially into Fig9 and Fig14 to confirm their argument and solve this contradiction. I would expect to see a lower static stability in cases with lower tropopause height since the cyclonic flow is stronger on the surface.

In Experiment 5 the penetration depth nicely varies with horizontal scale as expected following equation (1). I recommend to include the well-known concept of penetrations depth into the discussion of both, experiment 2 and 5.

Specific and technical corrections

L13: high PV (large negative PV) -> remove information about negative PV anomalies in abstract or mention focus on southern hemisphere.. otherwise confusing

L22: add that after fact: is the fact **that** PV

L60: Bierly confirmed/showed

L128-L130: piecewise PV inversion is no methodology of solving equation (1), but more an extended approach thanks to the additive behaviour of PV anomalies. Furthermore the different techniques studied by Davis 1992 are only necessary for PV inversion under nonlinear balance (since the equations are nonlinear) and not quasi-geostrophic balance. Under quasi-geostrophic balance the flow fields from different piecewise inversion are additive and do not depend on the different approaches suggested by Davis 1992. I hence suggest to remove this paragraph.

L140: remove „using a piecewise numerical approach“

L157: define AGL the first time using it

Eq5: $x-x_i \rightarrow x-x_{pos}$

L419: systemic -> systematic?

L519: lesser -> less

L551: ie. By -> i.e. by

L573: ie. That -> i.e. that

L607: result -> results

L609: why although? there is no contradiction, is it?

LL610: The authors state that „The larger magnitude relative vorticities induced by thinner intrusions are the result of the circulation with lower velocity being confined to a smaller horizontal region around the anomaly.“ However, from Fig14 I identify larger magnitude in relative vorticity for broad intrusions.. the rel. vorticity is more negative for broad intrusions and hence the cyclonic circulation is stronger. Please clarify! Especially in L638 the authors write „Enhanced surface cyclonic rotation is also induced by the broader PV anomaly with increases in the surface relative vorticity. “ and contradict themselves.

L670: ie. -> i.e.

L704: I would not state key finding, since all results are not knew but nice to have summarized in one study.

L715: remove of before with

References

Martin, Jonathan E. *Mid-latitude atmospheric dynamics: a first course*. John Wiley & Sons, 2013.