



EGUsphere, referee comment RC1
<https://doi.org/10.5194/egusphere-2022-1038-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on egusphere-2022-1038

Anonymous Referee #1

Referee comment on "Midlatitude Static Stability Alteration with Southern Hemisphere Blocking Onsets" by Li Dong et al., EGUsphere,
<https://doi.org/10.5194/egusphere-2022-1038-RC1>, 2022

This work studies the static stability evolutions during blocking onset. Reanalysis data is used to study 20 selected Southern Hemispheric blocking events during 1986-2008. The work finds 30% of the anticyclonic PV anomaly attributed to weak static stability. This weak static stability is primarily attributed to horizontal advection and vertical stretching.

The perspective from static stability is new and interesting. However, I have more than major reservations as follows. I suggest giving authors plenty of time (preferably no deadline) to undergo more-than-major revision.

Major comments

1. Figure 14: The static stability tendency budget is not closed. The difference is large and systematic. This cannot be explained by finite differencing (line 301). This cannot be compared with the difference seen in Teubler and Riemer (2016, their Fig. 6), which is much smaller and not systematic. This unclosed budget largely damages my confidence in the results.

Advection by rotational wind is suspicious because 32S 135W in Fig 12b shows positive tendency, but northerly should bring low static stability at that latitude (no matter JJA or DJF, Fig 7).

2. Different roles of static stability (low PV, high Eady growth rate) are confusingly presented (or not clearly distinguished). This makes the main finding unclear. Below is my understanding:

[Low PV] A detection criteria of blocking is low PV at the center of anticyclone. Low static stability at the center of anticyclone will help a system detected as blocking. This point is supported by Figure 11 and others.

[High Eady growth rate] Low static stability upstream can give high Eady growth rate and favors baroclinic eddies that maintain the blocking (line 358). This point is not supported by any figures. In fact, Figure 9 goes against this conjecture by showing high static stability upstream. I suggest largely cutting mentions of this conjecture (Lines 24-39, 321-322, 331, 351-365) and clearly saying that Figure 9 goes against this. Please also revise the title (avoid the word "preconditioning"), and rephrase line 14 and 348 (at least remove the word "upstream"), in order not to confuse with the unsupported/rejected conjecture.

3. My challenge to the low PV idea concerns the relevance of extreme weather conditions. It seems to me that blocking leads to extreme weather conditions (line 17) because of its wind anomaly, not static stability anomaly. In this sense, static stability will be relevant only if there is conversion to/from wind anomaly (or absolute vorticity). Is there such conversion (stretching term)? Or static stability and absolute vorticity are both doing their own thing without interaction?

4. Overall, description of results is not so balanced, not so scientific, and not so insightful. Some examples below:

Line 316-317: "Fig. 12(f)... positive values poleward side." It might be unfair to highlight these positive values, which are much much weaker than the negative values equatorward.

Line 210: "lower left"->"southwest"? Also line 268 and 270.

Line 161: "became a cut-off low IPV anomaly on the following day." The cut-off low anomaly might be referring to 50S 155W on 23 July (Fig 2d). Not sure if aforementioned understanding is right but this cut-off low measures less than 10 degrees in diameter and lasts only one day. Also, "cut-off" in anomaly field is not quite noteworthy (compared to cut-off in absolute field). Pointing to these fine details might not provide much insights.

5. Please focus on the role of static stability in giving low PV, by removing off-focus

discussions. Examples below:

Equations 1-3: I don't see the need to introduce sigma. You can directly introduce $\partial\theta/\partial p$, and use that in place of sigma.

Many figures: Rather than outlining the block-onset region as the wind reversal region, please try to highlight the low-PV region (e.g., where you detect PV anomaly).

6. A few previous papers are misinterpreted.

Line 123: Pelly and Hoskins (2003) were based on reversal of absolute field, not anomaly-based. I suggest removing the citation here.

Line 63-66: "The injection of diabatically processed anticyclonic PV is usually interpreted as the direct effect of latent heat release..." I suspect this is a misinterpretation of previous studies, at least of Teubler and Riemer (2016).

7. Figure 12: After closing the budget (comment 1), if panels b,d,e continue to be highly (anti-)correlated, please do a bit more discussion. I think horizontal convergence (panel e) correlates with sinking (panel d) because 300 mb is slightly below tropopause, so air is squeezed downward when it converges. Sinking correlates with equatorward motion (panel b) because air tends to move along isentropic surface, which is tilted in such way.

Having the dominate terms counteracting with each other does complicate the picture. Would it be better to use isentropic coordinate? - Also because it is low static stability on isentropic coordinate that helps low isentropic PV.

8. Fig 8f and 10c: Why zero lines differ in the two figures? Because of pressure coordinate vs. isentropic coordinate? Perhaps both should use isentropic coordinate (320K). Also Fig 9f vs 11c.

9. Figure 10abd: Why as low as -120%? Does the sign change? If the sign changes, it is perhaps infinitely more important than stability changes.

10. Figure 10abc: At 30S 160W, both panel b and c show >40%, why panel a is <80%, not >96% ($1.4 \times 1.4 = 1.96$)? Is mean(IPV) not equal to mean(vort)*mean(sta)? If

numbers are confirmed to be correct, please add an explanation in caption.

11. Line 240: What does "long-term mean" mean? Since there is a great seasonal cycle (e.g., in static stability, Fig 7), would be good to use one season.

12. Table 1: Most case is in JJA or May or September, except case 16 is in March. I suggest removing case 16.

Minor comments

13. Line 18: For blocking and extreme weather, it might help to cite Kautz et al. [doi:10.5194/wcd-3-305-2022], a review article at WCD.

14. Line 58: Hauser et al. [doi:10.5194/wcd-2022-44] also confirmed the importance of divergent outflow aloft. It might help to cite that as well. Please also comment (e.g., on line 343, 349) whether their study agree or disagree with yours.

15. Line 66-72: The mentions of WCB, PRE and ET do not tie well to the paper. They only connect to latent heat release, but not blocking. Perhaps simply remove them all.

16. Line 130: "screened these blocking cases against PV-anomaly based blocking criteria." Please give more details how that is done.

17. Table 1: If composite is done by overlapping the blocking centers (line 176), then table 1 should list the center, rather than the west boundary.

18. Line 166: The definition of block-onset region should be moved earlier, because it is already used in Figure 1. You may also include the definition in figure caption. (Also see comment 5 for suggested modification on definition.)

19. Figure 2 caption: Is contour interval 0.5 PVU instead of 1.0? Probably you don't need to say it in caption. Though you do need to mention the unit of PVU.

20. Line 168: Instead of "blocking center", please say 60S.

21. Figure 4: Please add tick labels for x-axis to show the scale.

22. Line 185: "originated from subtropics" - How do you see this?

23. Figure 6: Please modify the color scale so that white is 0.

24. Figure 12b: Vectors at high latitude are not parallel to contour. Maybe this is a map projection issue (one degree longitude measures different length at different latitude). Please either fix it, or add an explanation in caption.

25. Figure 12d: Upward motion not shown? Please mention in caption.

26. Line 353,354: "Rossy"->"Rossby", "amply"->"amplify"? (Actually, I suggest removing the paragraph in comment 2.)