

Weather Clim. Dynam. Discuss., referee comment RC2  
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## Comment on wcd-2022-44

Anonymous Referee #2

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Referee comment on "Towards a holistic understanding of blocked regime dynamics through a combination of complementary diagnostic perspectives" by Seraphine Hauser et al., Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2022-44-RC2>, 2022

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This work is a case study that aims to get a holistic view of different dynamics of blocking. This is a very important and meaningful direction to work on. Three perspectives (Eulerian, quasi-Lagrangian and Lagrangian) are used. The case study highlights the importance of moist processes (warm conveyor belt), which drive divergent outflow aloft and PV tendency.

The paper is well written overall.  
It will likely be well suited for publication after addressing the following comments (and more importantly, comments from the other reviewer):

(Reviewer 1 raised excellent points and I try not to repeat what they said.)

### Major comments

1. Title: I think the main selling point of this study is that it gives a holistic view of different dynamics of blocking. The three perspectives (Eulerian, quasi-Lagrangian and Lagrangian) are not as attractive. Consider revising the title.

I am also unsure about the word "unifying" in the title. The three perspectives are presented (metaphorically) like three separate dishes, not as one. "Unify" might not be the appropriate word.

2. The Eulerian perspective seems to be inferior, because it "misses the processes associated with the development of PVAs advected into the region" (line 379). Does it

have any advantage over the other perspectives?

3. I think this work lays out very good foundation where different proposed dynamics of blocking can be compared together. Right now, the direct latent heat release, indirect moist effect through divergent outflow and selective absorption (Yamazaki and Itoh, 2009) are considered. Many other proposed mechanisms, like the well-known eddy-straining idea (Shutts 1983), does not seem to be sufficiently discussed in results. Would be good to explicitly discuss them in results.

4. This work considers blocking from the perspective of weather regimes. I could be biased against weather regimes, but I feel like the perspective of weather regimes here brings few benefits but more burden. For example, amplification to the secondary ridge over the US East Coast might be confused with the block (line 360).

Maybe it is too much to ask you to give up on weather regime and redo the analysis, or to give up the phrase "blocking dynamics" and instead say "regime dynamics". But I still think it takes up too much words and figures, and some of them can be moved to appendix/supplement, as it is not the key or a selling point.

5. The quasi-Lagrangian analysis might be able to explain why the block becomes strong and large, but not why it is stationary. Stationarity is also a key aspect to create extreme weather events. Dynamics to make a block stationary should at least be included as one of the future directions.

6. Line 242: The amplitude metric is spatial integral of  $q'$  over the area A. Since the threshold of  $q'$  is not zero but -0.8 PVU (line 229), would it be better to choose the amplitude metric instead to be the spatial integral of  $(q'+0.8)$  over the area A? In this way, whether marginal points cross the threshold or not would not make a big difference.

Minor comments

7. Section 4.1: Related to reviewer 1 major point 2, when separately considering the cyclonic and anticyclonic anomalies, please say that the main cyclonic part of the regime pattern does not contribute to obstructing the westerly flow (Figure 2).

8. Line 163: "eddy flux convergence may change PVAs locally but may neither generate new nor amplify existing PVAs in a globally averaged sense. Furthermore, eddy flux convergence may not change the area-integrated amplitude of PVAs that are defined by a boundary at which  $q'=0$ " I'm not sure about if these statements are true.

9. Line 642: "we are able to close our  $q'$  budget...". But this requires taking Delta-A from observed area change? If so, is this "cheating"? Around line 260, you should briefly say that Bnd is taking from observed area change (not just in appendix).

10. Fig. 11: How is the effect of splitting/merging events on PVA quantified? Does this require knowing the observed area change?

11. Line 10: "All three perspectives highlight the importance of moist processes..." Does the Eulerian perspective highlight the importance of moist processes?

12. Line 355: There no Fig. 6d. Please fix the typo.

13. Line 554: "... the quasi-Lagrangian perspective reveals an amplitude strengthening of the main PVA over Europe by the merging of further PVAs..." This statement in section 5 (synopsis) don't seem to be supported in section 4.2 (quasi-Lagrangian perspective), especially Figure 11 finds merging and splitting to have \*weakening\* effect.