Weather Clim. Dynam. Discuss., referee comment RC2
https://doi.org/10.5194/wcd-2022-59-RC2, 2023

Comment on wcd-2022-59

Anonymous Referee #2

Referee comment on "Transient anticyclonic eddies and their relationship to atmospheric block persistence" by Charlie C. Suitters et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2022-59-RC2, 2023

Review of "Transient Anticyclonic Eddies and Their Relationship to Atmospheric Block Persistence" by Charlie C. Suitters, and coauthors

The authors investigate the relationship between block persistence and synoptic-eddy (especially anticyclonic anticyclone) characteristics based on the traditional eddy-feedback mechanism originally proposed by the famous paper Shutts (1983). The authors applied a cyclone-tracking method to the synoptic anticyclones that interact withã□□blocking, and discovered that i) longer blocks interact with more anticyclonic transients than less persistent blocks and ii) there is little relationship between the strength of the anticyclonic eddy and the blocking longevity except winter. In the manuscript, the authors comprehensively reviewed the blocking maintenance mechanism based on the eddy feedback mechanism and the results obtained here support importance of the eddy feedback mechanism. Also, the authors quantify the eddy feedback mechanism from both the Eulerian and Lagrangian perspectives. This paper include a lot of novel topics on the blocking mechanism and can develop the traditional eddy feedback mechanism from 1980s.

The reviewer evaluates that the manuscript is suitable for the journal Weather and Climate Dynamics that has the scopes on midlatitude dynamics, in which blocking and synoptic eddies are essential, though I also have a major comment about the correspondence between the anticyclone tracking used in this study and the Lagrangian tracking ways commonly used in previous studies. Then, the reviewer would suggest the paper is in a category of major revision. Specific comments are below.

Major comments

The authors define the anticyclonic eddies as positive anomaly from the zonal and temporal means, which seems different from typical cyclone tracking and particle tracking methods used in many studies. I think although the Lagrangian tracking used in this study is valuable to understand the eddy characteristics, but also think that many Lagrangian tracking schemes focus on the absolute (raw) fields (values) rather than their anomaly fields. Yamazaki and Itoh (2013a) mention in their paper that (raw) low PV supply is important for the blocking maintenance, and their Lagrangian tracking was done by raw (unfiltered) wind fields. More recent papers by Pfahl et al. (2015) or Yamamoto et al.

(2021) which adopted the Lagrangian analysis into the blocking formation and maintenance mechanisms monitored (raw) PV values of tracked air parcels. Here, my question is that if you define the eddy intensity (strength) as a raw value (say, PV) in Figs. 7-9, does your conclusion that "there is a less clear relationship between block persistence and the strength of the AC eddies that it absorbs" change? For example, could you trace the mean column-averaged value of raw PV of 150-500 hPa (Schwierz et al. 2004) at or within an AC eddy? In addition, I think that Z anomaly as the eddy strength can be changed if latitudinal position of the eddy varies. In such perspective, I am wondering how are the track distributions of ACs that interact with blocking? To check the distributions and/or the statistics of the AC tracks may be helpful on your conclusion. The results by Yamamoto et al. (2021) might be useful.

Other specific comments

1. Related to the major comment, could you show the trajectory statistics of synoptic cyclones? Since sometimes a Berggren-type blocking where there are several isolated anticyclonic or cyclonic vortices within the blocking region (e.g., Luo 2005) can exist.
2. How do you obtain "u" and "v" in Figs. 7 and 8? If those values are Eulerian-based (raw) winds which are the interpolated wind values at the AC centers from the ERA5 gridded data, to what extent are those values different from the Lagrangian speeds of ACs obtained by your tracking method?
3. Several previous papers may be useful for the introduction part:
- Zhu et al. (2007) investigated the statistics between the synoptic cyclone activity and the Aleutian low intensity.
- Okajima et al. (2021) proposed a new detection method for anticyclonic and cyclonic eddies based on curvature.
- Shi and Nakamura (2021) proposed a blocking detection index based on the Rossby wave breaking.

Minor comments:

- L193-194: Why are the climatological frequencies different (16% vs 30%)?
- The term "standard error": Is it "standard deviation"?
- L325 and L335: the abbreviation "SAM" is used before "Selective Absorption Mechanism"

Refereces:

- Luo, D., 2005: A Barotropic Envelope Rossby Soliton Model for Block–Eddy Interaction. Part I: Effect of Topography, J. Atmos. Sci., https://doi.org/10.1175/1186.1.
- Okajima, S., et al, 2021: Cyclonic and anticyclonic contributions to atmospheric energetics, Sci. Rep., https://doi.org/10.1038/s41598-021-92548-7.
- Shi, N., and H. Nakamura, 2021: A New Detection Scheme of Wave-Breaking Events with Blocking Flow Configurations, J. Clim., DOI: 10.1175/JCLI-D-20-0037.1.
- Yamamoto, A., et al., 2021: Oceanic moisture sources contributing to wintertime Euro-Atlantic blocking, Weather Clim. Dynam., https://doi.org/10.5194/wcd-2-819-2021.
- Zhu. X., et al., 2007: A Synoptic Analysis of the Interannual Variability of Winter Cyclone Activity in the Aleutian Low Region, J. Clim., DOI: 10.1175/JCLI4077.1.