**Responses to Second Round of Reviewer Feedback, and Community Comment by Dehai Luo, for Suitters et al. (2022)**

Here, we respond to the second round of reviewer feedback. We also respond to the community comment posted by Dehai Luo (page 8 onwards). Our responses are in blue text, with figures labelled by Fig. AR1, AR2, etc. ("Author Response").

**Reviewer #1**

Main comment:
- Lines 349-350: Why not defining sectors that change with seasons to be better adapted to the blocking main occurrence areas (like, for example, in Davini and D'Andrea, 2020)?

Thank you for this comment – this is something we did consider earlier on in the process of completing this study. We chose to define our sectors in such a way as to combine large blocking frequencies and the potential for large-scale impacts. Understanding the dynamics of blocking in areas where blocks are more likely to cause substantial hazards is arguably more useful than doing the same analysis where blocks are less impactful (though of course, our method could be applied anywhere). With these considerations in mind, we settled on the ATL and PAC sectors as shown in Fig. 2 in the paper. In the ATL sector, the climatological blocking frequency maximum in the Euro-Atlantic region is within, or very near to, the ATL sector for all four seasons. Therefore, results here are largely independent on the exact position of the ATL domain.

We concede that the same cannot quite be said for blocking in the North Pacific-North American region. The climatological blocking maximum is comfortably inside the PAC domain in DJF, MAM and SON (c.f. Fig. 2). Thus, moving the domain in these three seasons would, like in the ATL, have little bearing on the main conclusions of our work. However, the positioning of our PAC domain means that in summer, some of the highest block frequency contour is outside our region of analysis. The PAC domain was therefore designed to be a compromise between getting as much of the maximum

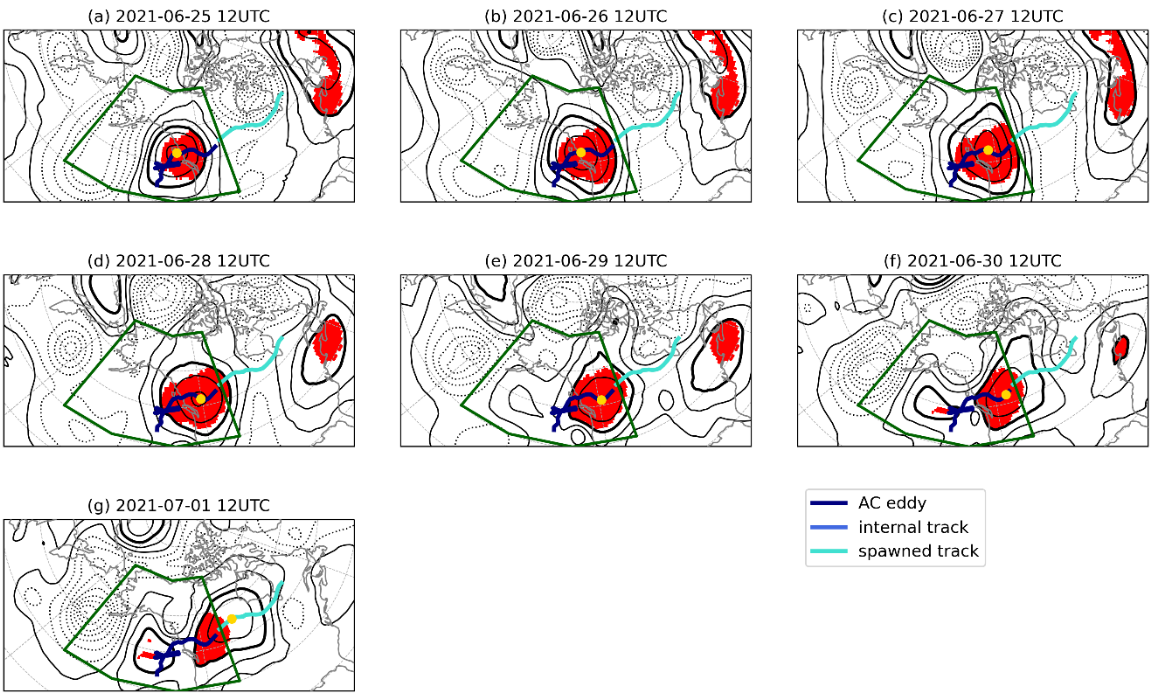


***Figure AR1.*** *As in Fig. 3 in the main text, but for the extreme Canadian heatwave in June 2021. The PAC domain, as used in our study, is shown by the green box; shifting the domain westwards to align with the JJA climatological maximum block frequency would result in this event not being considered in our analysis.*

blocking frequency all year-round, while also ensuring that the blocks we analyse have the potential to bring impacts to populous areas. If the PAC domain was shifted westwards in JJA to overlap with the whole blocking frequency maximum at this time of year, the blocks we would have investigated would have been less impactful since they would have mostly been over the ocean. However, keeping the PAC domain fixed for all four seasons still allows us to include impactful blocking events in this region, even in summer, for example the extreme Canadian heatwave in June 2021 (see Fig. AR1). A PAC domain more aligned with the seasonal JJA maximum would have not captured the dynamics of this blocking event. See also the response to the main comment from Reviewer #2 below for a more in-depth analysis of the effects of moving the PAC and ATL domains.

In addition to the explanation already present in Sect. 2.3 in the text outlining our choice for the PAC and ATL domains, an additional sentence has been added summarising the above: <u>"For example, the PAC domain as defined in this study is able to capture the dynamics of the severe North American heatwave in June 2021, which would not be the case if the domain was positioned closer towards the climatological summer blocking frequency maximum."</u>

Minor comments:
- Lines 196-198: I think that the authors should replace the word "block" by "sector block" to avoid any confusion with the Scandinavian blocking present to the east of the area. Indeed, the area blocked and block intensity are computed only within the ATL sector. These metrics do not take into account the grid points that are part of the Scandinavian blocking but that are outside the ATL area.

Thank you for this suggestion. Minor changes have been made in this paragraph (changing "block" to "sector block") to distinguish between the blocked points in the ATL domain, and the blocked points outside the domain (Scandinavia) like you point out.

- Line 202: It should say "The arrival of the first AC into the sector is associated with the sharp increase in sector block area…". Indeed, on 27/02/2011, the AC eddy and the Scandinavian block had not merged yet as shown in Fig. 3c.

Thank you – this has been amended in the text.

- Line 274-275: except for DJF PAC sector blocks.

Thank you for pointing this out. The text has been amended account for this (the text already mentions this further on, so this sentence has been clarified).

- Line 277-278: the strengthening starts one day before entering sector block.

This is correct. An additional clause has been added to this sentence stating that some strengthening also occurs one day before entering the block, like you suggest.

- Line 320: What does "here" refer to? I find this paragraph a bit confusing as it starts with the weakening and slowing of the eddies and finishes talking about change in eddy intensity when they enter the sector block.

We appreciate that this sentence was not clear, and the paragraph was talking about both eddy speed and intensity, which was confusing to the reader. The sentence containing "here" has been removed, and this paragraph has been split into two to make a clear distinction between the discussion about the weakening and slowing, and another separate paragraph about the intensity.

- Lines 336-337: Within the framework of this theory, how do the authors explain that some AC eddies pass through the block or are spawned by the block?

“Spawned” and “through” eddies are interesting but have not been given much attention in the paper, since we are only interested in the interactions of AC eddies in terms of block persistence. To our knowledge, we are not aware of any work where AC eddies emerge from a block and propagate downstream. We have seen a few cases in our dataset where these “spawned” or “through” AC eddies then go on to interact with another block downstream, so these eddies certainly require further investigation – a comment on this has been added to the Conclusions section: “…Furthermore, our results have also highlighted the existence of two further types of AC eddies, namely those that pass through the block, and those that are spawned by the block and propagate downstream. These types of AC eddies require further investigation, particularly as it is possible that they can go on to interact with another block event downstream…”. In terms of explaining them theoretically, we hypothesise that these types of eddies are the result of eddy straining, when incoming eddies split into a northward and poleward branch. This splitting of eddies inside of blocks could result in only one eddy vortex merging with the main block, with the other component continuing to propagate downstream. Investigation of these eddies is out of scope for this study but as mentioned above, would be interesting to look at in future.

- Line 340: This sentence is a bit too assertive. In winter and autumn, there is a difference in the intensity of the AC in the ATL sector between the shortest and longest blocks

Thank you for pointing this out. We meant this in the sense that AC eddy intensity only has an impact on block persistence in some seasons in the ATL, not in all times of year like in the PAC sector. This has been clarified in the text.

- Line 383: It is not that clear: in DJF in ATL sector, eddies intensify after entering the 25% shortest blocks. It is also true in JJA in PAC sector.

We have added the word “generally” to this sentence to suggest that this is not always the case, as you rightly point out.

Typos:
- Line 108: “produce” instead of “proudce”
- Line 246: correlation of 0.71
- Line 374: “... relationship between block persistence...”. Between is missing.
- Line 381: citation in parenthesis
- Line 382: remove “is”

Thank you for kindly pointing out these typos, we have corrected them in the text.

**Reviewer #2**

Comment:
After reading your revised manuscript in L426-428 ("When the PAC domain is shifted ... (Fig. 9a)"), I am concerned a possible discrepancy between the sentence in L160-162 ("Further sensitivity tests were performed ... did not change"). I am wondering that if the ATL and PAC domains are shifted westward or eastward for all the seasons, how will the results change? I'd like to know how are sensitive the eddy feedback effects to the relative positions to the storm tracks in each season and each region (ATL and PAC).

Thank you for pointing out this inconsistency in the text, and we agree that this idea is something that warrants further investigation. The sensitivity of our results to the position of the ATL and PAC domains have been explored further, by shifting both domains to the east and the west by 30 degrees, and producing the same plots as Figs. 7, 8, 9 in the main text. These will be discussed in more detail below. Table AR1 shows the coordinates of the shifted domains. It is worth highlighting that by shifting the domains in this way, in most cases different blocking centres would be analysed (e.g. Urals in the ATL east shift domain), and therefore we would be able to conclude less about Pacific and Euro-Atlantic blocking, which is the main focus of the study.

***Table AR1.*** *Details of the ATL and PAC regions used when testing the sensitivity of our results to the positioning of the domains.*

| Domain | Coordinates | Notes |
|---|---|---|
| ATL (west shift) | 60°W-0°E, 45-75°N | Positioned almost exclusively over the North Atlantic; Greenland blocking would be wholly within this domain. |
| ATL | 30°W-30°E, 45-75°N | As used in the paper. Focused on the broad DJF climatological blocking maximum over NE Atlantic and NW Europe (Fig. 5a), but also covers regions of large year-round blocking frequency. |
| ATL (east shift) | 0-60°E, 45-75°N | The focus for this domain would be a mixture of Scandinavian and Ural blocking. Ural blocking is not included in the ATL domain in the paper, but as shown in Fig. 5, there is another climatological blocking maximum here, year-round. |
| PAC (west shift) | 160°E-80°W, 40-70°N | The JJA blocking maximum in the North Pacific is covered better in this domain. |
| PAC | 170-110°W, 40-70°N | As used in the paper. Centred on the DJF North Pacific blocking maximum (Fig. 5a), but also positioned to consider blocks with the potential to cause large societal impacts by overlapping with some of continental North America (see also response to Reviewer #1 above). |
| PAC (east shift) | 140-80°W, 40-70°N | More blocks that impact North America are covered, but coincide with very low block frequencies in JJA. |

Relationship between Number of AC Eddies and Block Persistence, with Shifted Domains

*ATL (west shift), Figs. AR2a, c, e:* Very similar correlations between the number of AC eddies (N), block area (A), and block persistence (P) are found in DJF when the ATL domain is shifted to the west compared to the ATL domain in the paper (Fig. 7a). In JJA however, corr(N,P) in the west-shifted ATL domain is half of that in the ATL domain, and corr(N,A) is not statistically significant. This perhaps suggests that for summer oceanic Atlantic/Greenland blocking, the number of AC eddies is not very important for determining block persistence. This can also be derived from Fig. AR2e, where the mean number of AC eddies for JJA blocks is broadly the same for all persistences.

*PAC (west shift), Figs. AR2b, d, f:* Corr(N,P) and corr(P,A) are almost identical to those in the PAC domain in the paper in both DJF and JJA (Fig. 7b, d). Corr(N,A) is larger in the west-shifted PAC domain. Mean AC eddies per block are also broadly similar to those in the centred-PAC.

*ATL (east shift), Figs. AR3a, c, e:* Again, the relationships between N, P, and A in the east-shifted ATL domain are strong. In JJA, the relationships are smaller but again fairly similar to those in the ATL domain, and unlike when shifted west, the mean number of AC eddies in blocks does increase more noticeably as P increases.

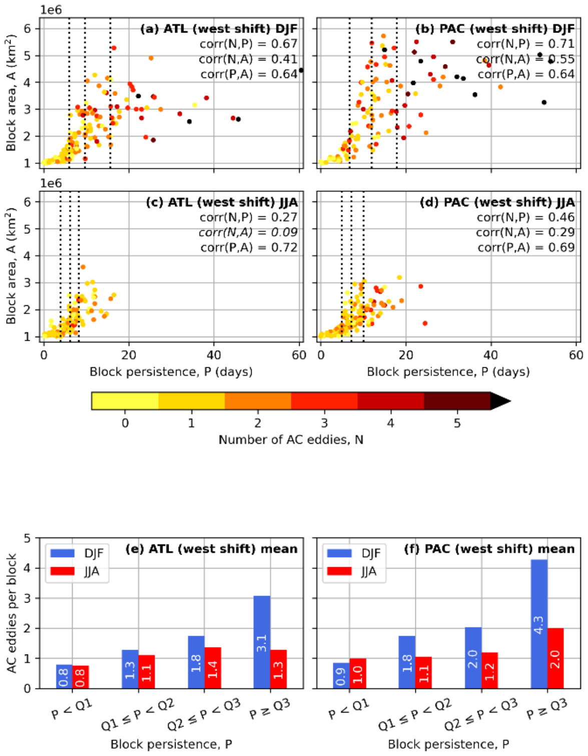


***Figure AR2.*** *As in Fig. 7 in the main text, but for the west-shifted domains. Statistically insignificant correlations are depicted by italic font.*

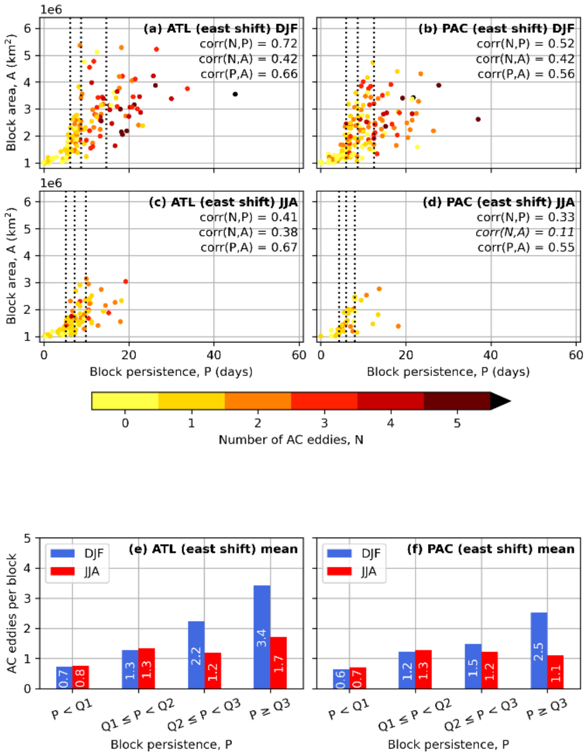


***Figure AR3.*** *As in Fig. AR2, but for the east-shifted domains. Statistically insignificant correlations are depicted by italic font.*

*PAC (east shift), Figs. AR3b, d, f:* Corr(N,P) in DJF is slightly lower in the east-shifted PAC domain, compared to the one used in the paper, but mean number of AC eddies per block still increases as block persistence increases, just to a lesser extent. Correlations in JJA are all smaller than what is found in the actual PAC region (and corr(N,A) is statistically insignificant) – this is due to the low climatological blocking frequency over continental North America and thus low sample size.

Relationship between AC Eddy Strength and Block Persistence, with Shifted Domains

*DJF ATL (west shift) and PAC (west shift), Fig. AR4:* When the domains are shifted to the west, broadly the same relationships present themselves as the conclusions in the text. The intensification of the AC eddies once inside the blocks is slightly larger in both west-shifted domains than the original (especially in the west-shifted PAC), however AC eddies contributing to the longest blocks still intensify more than those contributing to shorter blocks. AC eddy speed before/during/after blocking in both west-shifted domains is also qualitatively similar to that in the original PAC and ATL domains.

*JJA ATL (west shift) and PAC (west shift), Fig. AR5:* Results for the west-shifted ATL domain for AC eddy strength and speed are almost identical to those presented in the main text for the original ATL domain. The west-shifted PAC domain now also displays results that are consistent with the ATL domain – and this is already mentioned in the Discussion section of the main text, so is not discussed further here.

*DJF ATL (east shift) and PAC (east shift), Fig. AR6:* Findings from the east-shifted ATL domain are qualitatively similar to those in the original ATL domain. However, when the PAC domain is shifted to the east, there is no statistically significant different in the strength of the AC eddies that contribute to the longest and shortest blocks. We note however that this east-shifted PAC domain is cutting off part of the climatological blocking maximum, so certain events may only partially being captured by this domain.

_JJA ATL (east shift) and PAC (east shift), Fig. AR7:_ AC eddy speed is still consistent with the results for the original ATL and PAC domains. However, AC eddy intensity for the east-shifted ATL domain now demonstrates similar behaviour than in DJF (i.e. stronger eddies result in longer blocks), which was not the case in the original ATL domain. This east-shifted domain is however to the east of the Atlantic JJA blocking frequency maximum, so it is again possible that different block dynamics are being investigated when shifting the domain to the east, rather than in the original ATL domain. AC eddies contributing to east-shifted PAC blocks show no relationship between strength and block persistence, however the low climatological blocking frequency here means caution must be given while interpreting this result.

Summary of Shifting the Domains

We appreciate this was a useful exercise to undertake, and again thank the reviewer for suggesting we investigate this. Broadly speaking, we conclude that our results are fairly insensitive to the

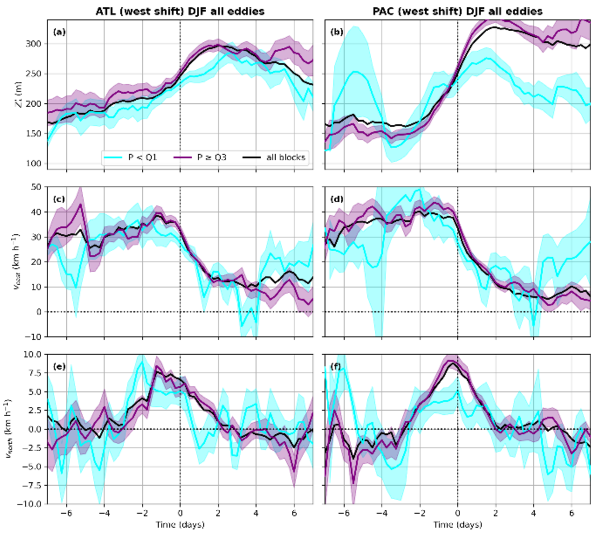


***Figure AR4.*** *As in Fig. 8 in the main text, but for the west-shifted domains in DJF.*

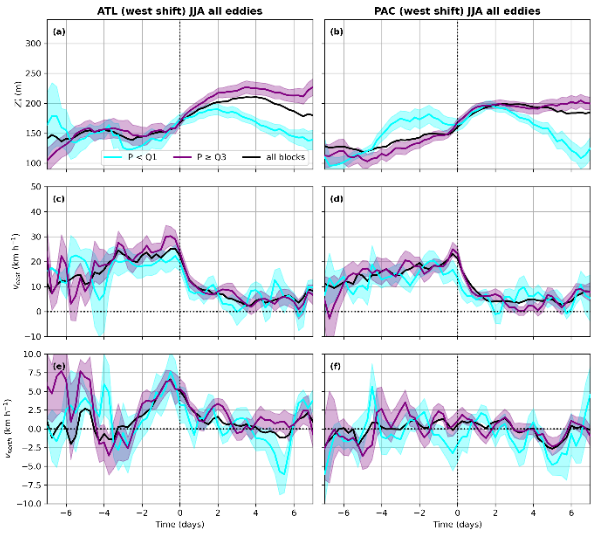


***Figure AR5.*** *As in Fig. 9 in the main text, but for the west-shifted domains in JJA.*

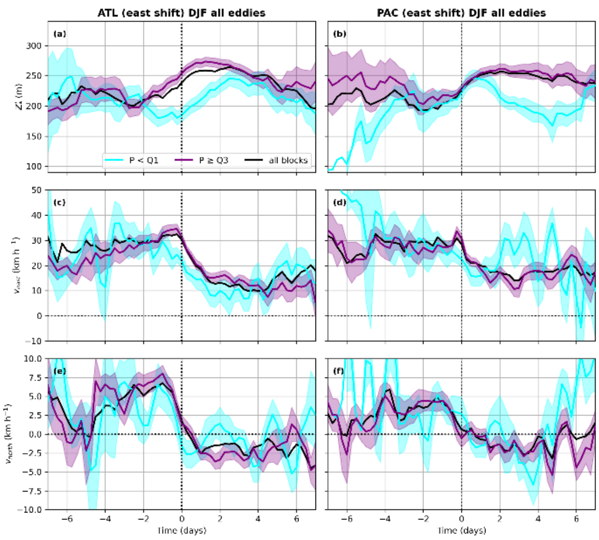


***Figure AR6.*** *As in Fig. 8 in the main text, but for the east-shifted domains in DJF.*

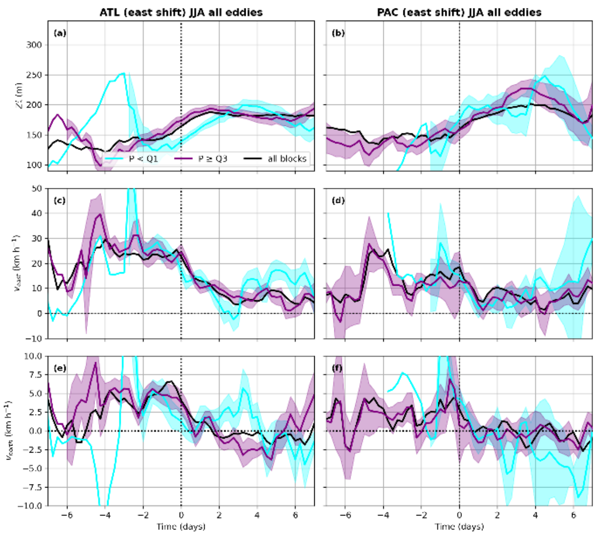


***Figure AR7.*** *As in Fig. 9 in the main text, but for the east-shifted domains in JJA.*

positioning of our ATL and PAC domains, provided that climatological blocking frequencies are relatively high within them. Therefore, if we were purely looking at the dynamics (without considering the potential impacts), moving the PAC domain in JJA in particular to align more with the seasonal blocking maximum would yield similar results. Furthermore, as previously mentioned in the text, and in response to Reviewer #1, we positioned the original ATL and PAC domains to give us an insight into the block events that have the potential to cause considerable impacts to society (the west-shifted PAC domain is almost entirely in the ocean, so these blocks would not cause as many impacts as those in the original). Thus, we will keep the ATL and PAC domains as they are in the original text. We will however clarify the contradiction relating to the domains in the text saying that "Further sensitivity tests were performed ... did not change". We will remove this sentence, and in the Discussion section we add a further comment about how results being potentially clearer if domains are located to align more with climatological maxima: "Clearer relationships between AC eddy strength and block persistence could be produced when the PAC (and to a lesser extent, the ATL domain) are aligned more with the seasonal climatological block frequency maxima, however the results presented here are still important since the blocks analysed have the potential to cause more impacts than those e.g. over the Pacific Ocean. The methodology presented here can be applied robustly anywhere, provided that climatological block frequency is relatively high."

Other minor comments:

- L212-213 and L280: I am wondering that what do you specify the "upstream forcing" here? I feel usually the upstream forcing corresponds to eddy-feedback or incoming Rossby-wave (lower frequency) one but they tend to reinforce blocking rather than dissipate and advect downstream?

We appreciate there may be confusion in using this phrase. We have adapted the sentences in the text to remove the phrase "upstream forcing" and simply state that larger, stronger blocks take longer to advect downstream or dissipate.

- The reviewer prefers to avoid using the term "observe" or "observation" except for actual observation, for example, launching a radiosonde, measuring temperature, etc. I would like to ask please consider rewording those terms, if possible.

Thank you for this suggestion; we have changed "observed" to a more appropriate word where necessary (the "observed" in the very first sentence of the Introduction has been kept since it concerns weather conditions at the surface).

**Response to Dehai Luo's Community Comment**

More recently, I have read a manuscript "Transient anticyclonic eddies and their relationship to atmospheric blocking persistence". I found that this manuscript is interesting, but this study is a phenomenological one, which cannot identify the causal relationship between transient anticyclonic eddies and blocking persistence. Because this study is in my research domain and the relation between blocking and transient synoptic eddies has been examined in my group before many years, below I give some comments on this manuscript to help the authors understand how transient eddies reinforce and maintain blocking and how intensified blocking deforms transient eddies.

We thank Dehai Luo for taking interest in our work and taking the time to leave thorough suggestions for further understanding of block-eddy interactions, and we apologise for the late response. Responses to the numbered points are addressed below:

1) In the daily geopotential height field of a blocking flow, the synoptic-scale anticyclonic (cyclonic) eddies are often seen to be intensified and shifted northward (southward) during the blocking growth and maintenance episodes (Berggren et al. 1949). Such an eddy deformation is also referred to as eddy straining or cyclonic wave breaking (CWB). Thus, many investigators inferred that eddy straining or CWB leads to blocking onset. Based on this, they also concluded that persistent eddy straining or persistent CWB leads to persistent blocking. In fact, the relationship between transient eddies and blocking is a chicken-egg problem. Thus, one cannot examine the causal relationship between the blocking persistence and transient anticyclonic eddies only using the identification method. However, this issue can be solved by a nonlinear theoretical model that considers a blocking as a nonlinear initial value issue of the blocking interacting with synoptic-scale eddies. The relationship between blocking and transient synoptic-scale eddies and what determines the persistence of atmospheric blocking has been widely examined in a nonlinear multi-scale interaction (NMI) model and has been clearly clarified (Luo et al. 2005, 2014, 2019).
Thank you for pointing us to these references, as they provide a different perspective on the relationship between block persistence and anticyclonic (AC) synoptic eddies. The work of Luo et al. (2005, 2014, 2019) considers this relation in an idealised model world, whereas our paper here concerns a climatological study using real-world data. While we do not necessarily test for exactly the same mechanisms that are highlighted in Luo's work, we believe that our climatological study is complementary to Luo's findings. The climatological effectiveness of the eddy-block matching (EBM) mechanism, in particular, is something we cannot quite ascertain in our study since we are not looking at the background vorticity field. However, we appreciate that this could potentially be an important process and as such, we have now addressed this in some introductory remarks in the text ("…This concept is expanded further in Luo et al. (2005, 2014, 2019) using the Eddy-Block Matching (EBM) mechanism theory. In the EBM mechanism, the two-way relationship between blocks and synoptic-scale eddies is explained via eddy vorticity forcing (EVF). If the background EVF is favourable for block amplification, the block feeds back onto the eddies to strengthen them and the background EVF, which further amplifies the block, and so on").

2) The mutual relationship between the blocking and synoptic-scale eddies has been examined in Luo (2005). It is found that the blocking and synoptic-scale eddies are dependent each other. Because of the feedback of the intensified blocking on the pre-existing synoptic-scale eddies prior to entering the blocking region, the pre-existing synoptic-scale eddies may slow down and

undergo a north-south straining, which are dominated by deformed eddies with meridional tripoles.

We understand that the AC eddies and blocks have a symbiotic relationship, and we believe the text already discusses this. We have found that the AC eddies act to strengthen and enlarge the block (Fig. 4 in the updated manuscript), while the blocks act to attract the eddies and move them in a northward direction (Fig. 8e-f, 9e-f). The northward movement of the eddies (in addition to being due to the attraction and ridge-building as already mentioned in the text) could also represent the northward component of the meridional eddy straining. The strengthening of the AC eddies that is observed, particularly in the PAC domain, in the ~3 days before entering the block (Fig. 8b, 9b) could be a sign of the block acting the strengthen the upstream eddies as well, agreeing with the theory from Luo (2005). A comment addressing this possibility has been included in the text in Sect. 5.2: "In the PAC region, the intensification is stronger for DJF eddies (nearly 100 m) and begins at around day -3. It is possible that this could be a sign that the block is acting to strengthen the upstream AC eddies, consistent with the EBM mechanism (Luo, 2005). However, it could also potentially because the PAC region is slightly to the east of the North Pacific climatological blocking maximum…"

3) Atmospheric blocking persistence has been first investigated by Yeh (1949), who found that atmospheric blocking tends to be long-lived in high latitudes. Luo et al. (2019) found from the NMI model that when the north-south gradient (PVy) of background potential vorticity is smaller, atmospheric blocking tends to be more persistent. Note that PVy is a modified $\beta_{\circ}$ When the background westerly wind or meridional temperature gradient is weaker or the latitude is higher, PVy is smaller. In this case, the blocking system has weaker energy dispersion and stronger nonlinearity so that the blocking can be more persistent. Thus, the persistence of atmospheric blocking is mainly determined by the background condition (i.e., the magnitude of PVy), rather than synoptic-scale eddies, even though synoptic-scale eddies have different phase speeds under different background conditions. As also noted by Luo et al (2019), the eddy forcing induced by pre-existing synoptic-scale eddies prior to entering the initial blocking is more persistent as PVy is smaller. In this case, atmospheric blocking can be more persistent due to persistent eddy forcing by pre-existing synoptic eddies prior to entering the initial blocking.

The background $PV_y$, as mentioned in Luo et al. (2019), is typically smaller at higher latitudes, explaining why blocks are more persistent here. However, by fixing our ATL and PAC domains in our study, we are largely taking out the effects of differing background PV in determining block persistence. A weaker background circulation is present in both domains in the summer (which can be inferred from the plots of $\overline{Z_*}$ in Fig. 1), meaning the background $PV_y$ is also weaker in summer. Therefore, one would expect from the NMI model that summer blocks are more persistent than winter ones (when $PV_y$ in the midlatitudes is much stronger). However, we find that blocks are actually least persistent in summer, and most persistent in winter, which contradicts the theory from the NMI model. Therefore, we do not think that the magnitude of the background circulation is an important factor in driving block persistence in our study, and instead conclude that, to first order, block persistence is related in many cases (but not all) by the number of incoming AC eddies (Fig. 7).

4) The interaction between transient eddies and blocking satisfies the symbiotic relation noted by Cai and Mak (1990). The onset and intensification of atmospheric blocking not only depends on the spatial structure of pre-existing synoptic-scale eddies prior to entering the initial blocking, but also the deformation of pre-existing synoptic-scale eddies depends on the intensification of atmospheric blocking. Thus, the blocking and synoptic-scale eddies are coupled together and

dependent each other. For an given initial blocking, the initial blocking can be amplified into a typical blocking if pre-existing synoptic-scale eddies ($\psi_1'$) prior to entering the initial blocking satisfy $\frac{\partial q}{\partial t} \cong -\nabla \cdot (\mathbf{v}_1' q_1')_P$ (Luo et al. 2014), where $q$ is the PV anomaly of the initial blocking, $\mathbf{v}_1' = (-\frac{\partial \psi_1'}{\partial y}, \frac{\partial \psi_1'}{\partial x})$ and $q_1' = \nabla^2 \psi_1'$. In other words, when the eddy forcing $-\nabla \cdot (\mathbf{v}_1' q_1')_P$ has the same spatial structure as the PV anomaly $q$ of the initial blocking, a typical blocking can form from this initial blocking under the eddy forcing. When the initial blocking is intensified (Fig. 4a of Luo et al. 2014), the feedback of intensified blocking can cause the deformation of preexisting synoptic-scale eddies. In this case, deformed eddies ($\psi_2'$) are produced. The daily synoptic-scale eddy field during the blocking episode can be represented by $\psi' = \psi_1' + \psi_2'$ . Because $\psi_2'$ includes the amplitude of the intensified blocking, the synoptic-scale eddies in the daily synoptic-scale eddy field ($\psi' = \psi_1' + \psi_2'$) are inevitably intensified, split into two branches and slowed down with the growth of blocking (Fig. 4b of Luo et al. 2014). This case corresponds to eddy straining. In the daily total field (the sum of mean flow, blocking part and $\psi' = \psi_1' + \psi_2'$) of the blocking flow, anticyclonic (cyclonic) eddies are intensified and shifted northward with the blocking growth (Fig. A2), which corresponds to CWB (Fig. 4c of Luo et al. 2014). When the blocking is more persistent (Luo et al. 2019), more transient anticyclonic eddies are seen due to the persistent feedback of blocking because there is a symbiotic relationship between the blocking and anticyclonic eddies (Fig. 4c of Luo et al. 2014). This does not imply that persistent blocking is produced by more anticyclonic eddies.
We thank you for pointing out that there is a positive feedback between the blocks and eddies. After the first round of reviewer comments, we explained this in the Discussion section of the updated manuscript in terms of the Selective Absorption Mechanism (SAM; Yamazaki and Itoh, 2013), though appreciate that a similar argument could also be made through the EBM mechanism. We have added the EBM mechanism suggestion to the discussion of the PAC results, as highlighted above.

5) The authors concluded that blocks can be maintained through repeated absorption of anticyclonic eddies. In fact, blocking events do not always occur, but synoptic scale anticyclonic eddies can often be seen. Why some anticyclonic eddies can be absorbed into the blocking, but others cannot. The authors should answer under what condition the anticyclonic eddies can be absorbed into the blocking to maintain it. This problem is easily explained in terms of $\frac{\partial q}{\partial t} \cong -\nabla \cdot (\mathbf{v}_1' q_1')_P$ because only some of synoptic-scale eddies can meet this condition. When the preexisting synoptic-scale eddies ($\psi_1'$) drive the onset and intensification of blocking ($q$), the feedback of blocking can cause the deformation of preexisting synoptic-scale eddies to result in the repeated absorption of anticyclonic (cyclonic) eddies by the blocking (Fig. A2 or Fig. 4c of Luo et al. 2014). When the blocking has longer lifetime, there are inevitably more anticyclonic (cyclonic) eddies within the blocking regions. Thus, persistent blocking can often occur together with more anticyclonic (cyclonic) eddies. But, this cannot lead us to conclude that more anticyclonic (cyclonic) eddies lead to persistent blocking.
We do not consider the AC eddies that do not interact with blocks, as one of our main goals was to examine the climatological relationship between AC eddy-block interactions and how these interactions determine block persistence. Upstream AC eddies that do not interact with an already-present block were therefore out of scope for this study. As our study only selects those AC eddies that do interact with blocks, while neglecting those that don't, we can say with confidence how these AC eddies may lead to more persistent blocking in support of our hypothesis (see again Fig. 7).

I suggest that the authors should read the following references to improve the understanding of how the blocking and synoptic-scale eddies interact and what leads to the persistence of atmospheric blocking.

References:

Berggren, R., Bolin, B. and C.-G., Rossby, 1949: An aerological study of zonal motion, its perturbations and break-down. Tellus, 1, 14–37.

Cai, M and M. Mak, 1990: Symbiotic relation between planetary and synoptic-Scale waves. J. Atmos. Sci., 47, 2953–2968

Luo, D., 2005: A barotropic envelope Rossby soliton model for block-eddy interaction. Part III: Wavenumber conservation theorems for isolated blocks and deformed eddies, J. Atmos. Sci., 62, 3839-3859

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Thank you for pointing us to these references for further background reading. We have added the references of Luo to our introduction. We also reference the Yamazaki and Itoh (2013) paper, mentioned in our response to point (4).

Yamazaki, A. and Itoh, H., 2013. Vortex–vortex interactions for the maintenance of blocking. Part I: The selective absorption mechanism and a case study. Journal of the Atmospheric Sciences, 70(3), pp.725-742.