

Editor comments

We appreciate the editors and reviewer comments, suggestions and questions to improve our manuscript. Please find below the point-by-point responses to each comment. Original comments are shown in black, our responses in blue and lines added to the text are shown in purple.

Public justification (visible to the public if the article is accepted and published):

Thank you to the authors and the referees for their contributions. In light of the follow up referee reports (two in time ones and one I chased up below) I can recommend an "publish subject to minor corrections". All referees found some further writing issues (I seem to have found the most), and there are quite a few of them, and I'd like to see it once more. I don't anticipate the changes taking too long to do.

Thank you again for submitting to EGU OS.

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Referee 3 ([JM edit] I removed one minor comment that the referee was not overly attached to):

(L559-581), the authors use "translational speed" to describe  $c$ , whereas Klocker and Abernathy (2014), and others, use phase speed for this term. For clarity, I suggest that phase speed is used instead, even if a caveat needs to be added about the interpretation of the speed derived from tracking eddy features (closed SSH contours) as being equivalent to a phase speed.

We changed translational speed to phase speed when discussing equation 21, but kept translational speed when referring to the tracking algorithm. We also added the following line to the manuscript: L575-576: We note that the translational speeds are close to but not necessarily equal to the phase speed in equation 21.

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Edits from JM:

line 2: suggest "actual", "observed", "diagnosed" mixing or similar (no descriptor leaves ambiguity)  
Changed accordingly.

line 6: "OSCAR" not expanded and is inconsistent with how "POP" is. Either do both or neither (I don't know the default preference for formatting for the journal; the former is safer, although I personally don't care that much in an abstract)  
Changed accordingly.

line 51: "TEM" acronym unnecessary because it is not used (or at least I didn't see it)  
TEM acronym has been removed.

line 64: current descriptor for "Eulerian" reminds me of this joke comment with mathematicians/physicists that "a tensor is something that transforms like a tensor"... "Eulerian" here really means "relative to a fixed geographical location" or similar, and saying that would also mirror the descriptor for "Lagrangian" giving a better balance to the text  
Changed accordingly.

line 114: move OSCAR acronym definition from line 157 up here (out of order at the moment, acronym used before being defined)  
Changed accordingly.

line 121: probably a comma after "diffusivity" (phrase a bit of a mouthful)  
[Comma added.](#)

line 122: probably a comma after "products" (as above)  
[Comma added.](#)

line 134, 139: reference formatting, should have brackets (`\citep` in LaTeX)  
[Changed accordingly.](#)

line 146, 152, 160: formatting of fractions inconsistent with other occurrences, choose one  
[Changed accordingly.](#)

line 191: this bothered me previously also, but what is meant is something like "indices  $i$  and  $j$  both run over the zonal (1) and meridional (2) directions" or similar. As written this could mean  $i = 1$  and  $j = 2$  and is unnecessarily ambiguous.  
[Changed as suggested.](#)

line 201: can remove ", as derived by Davis (1987)."  
[Changed accordingly.](#)

line 206: dollar signs around  $x$  and  $y$ , "...THE SUBSCRIPT  $r(\tau)$  indicates...", "...AND  $t_E$  is the time..."  
[Changed accordingly.](#)

line 213, 214: "...time closeR to about 100km and 30 days (Ballarotta et al., 2019), and SHOULD IN THOSE INSTANCES BE REGARDED AS A COARSE-GRAINED VELOCITY."  
[Changed accordingly.](#)

line 216: "...with aN HOURLY TEMPORAL RESOLUTION, the time..."  
[Changed accordingly.](#)

line 223: full stop at the end of sentence missing  
[Added.](#)

line 238: remove first "the", "indicated" -> "seen"  
[Changed accordingly.](#)

eq 18: not sure what this is saying because of formatting, because  $t \rightarrow \infty$  would lead to blow up of the denominator as written unless the nominator vanishes, so please clarify  
[Changed](#)

eq 18: missing a full stop  
[Full stop added.](#)

eq 19: would suggest having " $\lambda_{1,2}$ " rather than using a slash  
[Changed accordingly.](#)

line 257: "and" -> "where" (because it is not really a separate clause)  
[Changed accordingly.](#)

line 259: either "(cf. Haigh et al 2020)" as `\citep[cf.]{Haigh-et-al20}` or whatever the bibtex key is, or (cf. `\citealt{Haigh-et-al20}`) probably, then add ", AND  $\lambda_1$  is the...", because  $\lambda_1$  here does not follow from equation 20

Changed accordingly.

line 289: bracket after Fig 3a not closed

Changed as requested.

line 291: don't think the "respectively" is needed

Removed.

line 323: this bothered me last time and I forgot why, and it is because  $\kappa_{xy,yx}$  is messy and also inconsistent with the figures (e.g. Fig 5). The tensor is symmetric by construction so the off-diagonal terms are equal right? Would just suggest writing "In contrast, the OFF-DIAGONAL COMPONENT  $\kappa_{xy} = \kappa_{yx}$  shows..." Can then remove all relevant "yx" bits in the subscripts on the affected  $\kappa$ s (which reduces clutter)

xx were removed after first mention of  $k_{xy}=k_{yx}$ .

line 324: "...observations, THE LATTER EXHIBITING negative..."

Changed as requested.

line 331: comma after  $\kappa_{xx}$  unnecessary

Comma removed.

line 334 to 339: subscripts of all  $\kappa$  (if including line 323 change, then don't need this

Changed as requested.

line 350, 363, 380, 381, 382: the "yx" subscript on the kappa

Changed as requested.

right column of fig 7: should be  $\kappa_{yy}^{\text{corr}}$  not  $\kappa_{xx}^{\text{corr}}$  in figure right?

Corrected.

middle of fig 9: don't need the "yx" subscript (it's not consistent even within the figure!)

Done for Figs. 5,6 and 9.

line 503, 519: nitpicking, minus sign should be surrounded by dollar signs (otherwise it's a short dash as formatted here)

Minus sign surrounded by dollar signs to ensure Latex math-environment

line 564: punctuation, "...Klocker et al (2012a), Klocker and Abernathey (2014), AND Griesel et al (2015)" (would personally have the last Oxford comma, but ultimately don't care)

Changed appropriately.

eq 21: probably want a comma

Comma implemented.

line 635: not sure what is going on here, should have a need paragraph with indentation?

Corrected.

bibliography: Inconsistent formatting (e.g. capital letters of article titles inconsistent). Probably could leave this to copyeditors (I personally don't but that's me).

We are not sure which specific references in the bibliography the editor is referring to here. We have made sure that small and capital letters are given as in the original citation. We kindly ask the editor to either be more specific with the required changes or we hope this issue is going to be resolved during the typesetting process.

Additional private note (visible to authors and reviewers only):

Please also acknowledge referees where appropriate.

Was added to the acknowledgements section.

#### Reviewer 1:

I would like to thank the authors for addressing my concerns and I do not have any major comments, just a few editorial remarks (line numbers refer to the diff version) which the authors may or may not consider before the publication. I list these below, and suggest a prompt publication.

L40 this is true, but actually in climate models it is both the ocean and the atmospheric resolution that is needed to get the upwelling right (and even then it is not guaranteed. I think this is stated in the Small et al. paper that the authors cite, as well as in e.g.

<https://www.nature.com/articles/s41612-022-00264-4>).

We have added the requested information, however did not cite the paper as we do not consider the tropical Atlantic in our study.

L115 one bracket within bracket case seems to have remained.

We apologize for the inconvenience. Bracket within bracket case has been removed.

L635-L640 (Fig 10.) Do the authors believe the estimates of minor axis diffusivities are robust? Or is it possible that the major axis errors dominate the system such that the minor axis oscillates close to 0? I guess the authors used the time averaged mean velocity here, and I wonder how sensitive the computation is to the averaging period? Perhaps it would be possible to get a more well behaved estimate by tuning the averaging period. I don't think the authors need necessarily to test this, but perhaps a comment at the end of the 645-640 paragraph would be nice, at the moment the reader is left wondering what to think of the minor axis results.

We have added the following lines to the manuscript: This may depend on the temporal averaging interval used for the mean flow, which is one year in our case. The values of major and minor axis components might change if a longer averaging interval is used.

L560-L580 There is a recent paper by Sterl et al

<https://journals.ametsoc.org/view/journals/phoc/54/5/JPO-D-23-0142.1.xml> that might be of interest, they provide an alternative for eq. 21 and also seem to discuss the eddy decorrelation timescales.

We have added the following lines to the manuscript:

581-584: We note that mixing suppression in the zonal direction due to the mainly zonally oriented topographic background PV gradient might also be relevant here, a mechanism that was recently discussed by Sterl et al. 2024.