

The responses to the reviewers have been detailed in our public responses to their comments. In particular, we have made the following changes, with line numbers referring to the resubmitted manuscript:

1. Revised lines 24--56 of the Introduction in order to better clarify the relation of this method to others, addressing a concern of Reviewer 1
2. Removed several more technical paragraphs from the Introduction in order to address a comment made by Reviewer 2
3. Discussed further the physical reasoning for modeling geostrophic turbulence as a stochastic process, lines 72--84 of the Introduction, in response to a question by Reviewer 1
4. Modified the discussion of the sample eddy, lines 670--683, in response to a question from Reviewer 1
5. Added additional physical discussion of the cyclone/anticyclone asymmetry, lines 924--931, in response to a question from Reviewer 1
6. Corrected some typos, and added minor clarifications throughout, including those brought up by the reviewers
7. Made minor changes to notation (e.g. swapping underscore stars for overbars, renaming ν to ξ , renaming ν to ν)
8. Added several new average and meta-data quantities to the dataset, and to the list in Table A1
9. Improved and simplified the definition of our significance parameter. This has led to a number of text changes in Section 4.6, and a new version of figure 14, but no noticeable changes to the other plots. The reason for this change is explained on lines 860--865.
10. Reduced the number of figures by one by absorbing the previous figure 15 into the right column of the new figure 12, and adding a comparable column in figure 13.