We thank Referee #2 for its important and helpful comments. The revised text has been improved using most of them. Here is our specific responses to these comments:

C1: Authors used 1/9° - every two days velocity fields as a high-resolution setup. I do not believe that this resolution is precise enough to study the impact of fine-scale circulation on connectivity estimates. Most of the operational ocean models used in bio-physical modelling studies are characterized by daily velocity fields with a higher resolution (e.g.,1/12° in Ser-Giacomi et al., 2020, Assis et al., 2022, Legrand et al., 2022). As such, it questions the utilisation of a theoretical ocean circulation model. Moreover, I wonder if 1°resolution is too coarse for a 3000 km * 2000 km domain. In this setup, it results on a domain of approximately 30 *20 velocity field grid cells, with stations which are only separated by ~ 4-5 grid cells (e.g., stations 10-11, 11-8). Why not considering a 2- or5-times coarser setup rather than a ~ 10-times?

R1: We agree with the reviewer that a model-grid resolution of 1/9° would be insufficient to capture the full strength of mesoscale and submesoscale flows. This is why the model integration that we used was performed on a 1/54° grid, with a resolution finer than high-resolution operational models. We make the distinction here between the resolution used to integrate the model, and the effective resolution after model integration. A previous analysis has shown that the effective resolution is 1/9° (see Levy et al 2012 for justification). This is always the case with HR models, that the effective resolution is less than the grid resolution. Thus, because we work in offline mode, we used the outputs at effective resolution, i.e., at 1/9°. We explain this in the data section.
- *Lévy, M. et al. Grid degradation of submesoscale resolving ocean models: Benefits for offline passive tracer transport. Ocean Modelling 48, 1–9 (2012).*

We also agree that 1° is coarse for this domain as it corresponds to 20x30 grid cells. Our intention is to be as close as possible to the resolution of coarse resolution Ocean General Circulation Models that are generally used for this exercise, which is rather 2°. A resolution of 0.5° would not be coarse enough as it would retain too much of the mesoscale variability since it is close to the radius of most eddies in this region. Thus the choice of 1° is a compromise, but appears sufficient as it captures the large-scale circulation in the domain, and the different relevant parts of the domain are well distinguished at this resolution, i.e., the two gyres and the main jet.

C2: The stations are implemented in relation to flow features and model domain. I wonder how this impacts the results. Consequently, how are the results sensitive to a random implementation of stations?

R2: We thank the reviewer for raising this point, which was also raised by reviewer 1. We have expanded the discussion in the paper to justify our approach. There are two aspects to this question. One is the sensitivity of the results to the exact location of the station, in the vicinity of the station. Since there might have been some ambiguity in the meaning of “station” which could have been understood as a single precise location, we now use the word “site” instead of “station” throughout the paper. By sites, we mean small circular regions of 1° radius. This radius corresponds to the largest size of mesoscale eddies. By deploying 100 000 particles at each site, spread at different locations within the site (both on the horizontal and on the vertical), and also at different times, we are able to provide statistical estimates which are reliable at the scale of each site. The second question concerns how different parts of the model domain are connected with one another. To address that, we have considered 16 sites, located in key areas of the model domain, but indeed with some degree of arbitrariness in their exact position. There are 4 key areas in the domain, which are: the subpolar gyre, the subtropical gyre, the jets, and the quieter regions between the jets. To reduce the arbitrariness in the exact position of the sites, we have positioned several sites in each of the key regions. This is now better explained in the text.

C3: Results depicting the transit times between stations (section 3.2.1 to section 3.2.3 and Figure 5 to Figure 8) are only made on a station subset (e.g. station-pairs 1-15 and 10-12 for section 3.2.1 and Figure 5). As such, how are the results sensitive to this station subset? Are the results similar when considering all the possible stations together?

R3: In general, the results are likely to be sensitive to the subset of stations considered, especially if the stations are located in different regions of the study area. The results on transit times will depend on the specific pair of stations considered, as well as the characteristics of the water masses and currents between these stations. If the subset of stations being considered has different characteristics than the rest of the stations, the results may not be representative of the overall transit times between all stations.
Briefly, the selection of stations is based on the particular behavior of the flow in the mentioned regions. For instance, using stations 1 and 15 helps to understand particle transport along the basin diagonal from the subpolar gyre to the subtropical gyre. On the other hand, using stations 10-12 helps to understand the dispersion of particles along the strong jets.

C4: The Betweenness 2.2.4 Methods section is imprecise and muddled, and the results brought on make no sense. The authors mixed up between “betweenness centrality”, anode/edge measure, and “betweenness”, a link/vertices measure. Moreover, they have not specified how aij is computed to obtain betweenness results in section 3.3.1. Because of that, the comparison between betweenness value computed with the Costa et al., 2017 weight transformation and without is meaningless. Please consider rethinking all this section with a correct use of betweenness centrality measure.

R4: The section on betweenness centrality has been thoroughly revised and improved (Please see sections: 2.2.5 and 3.3 Betweenness centrality). The main objective of this paper is to assess the impact of the OGCM resolution and vertical turbulence on the analysis of connectivity in oceanic flows. In addition to this objective, the concept of betweenness was used as a way to investigate the connection between various stations or sites.

In short, we add that betweenness centrality is a way to quantify the importance of a node in a network by measuring how many shortest paths between any two nodes in the network pass through that node. By calculating the betweenness of each node, we can identify the most important locations for water transport in the ocean. Therefore, by comparing the betweenness centrality obtained from different OGCM resolutions, we can simply assess how well the models represent the true connectivity patterns in the ocean, and identify areas for model improvement.