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Interactive comment on "Dynamical Connections between Large Marine Ecosystems of Austral South America based on numerical simulations" *by* Karen Guihou et al.

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Response to Referee # 2

The manuscript analyses Eulerian transports and Lagrangian pathways between ecosystem regions on either side of southern South America. It is not my region of expertise, but from the past research described in the manuscript, it seems that previously there has been only limited observations and modelling work focused on this region. Therefore it appears that the results will fill a gap in the regional oceanographic knowledge and are worth publishing, after addressing the below comments.

1. **Figure 1: It's not clear what the extent of the LMEs are from this map, can you add shading or an outline to show how large they are?**
The extent of the HLME and PLME are defined in Heileman et al., 2009a/b, and the southern portions are basically bounded by the Cape Horn Current and Malvinas Current. We did not wish to outline the LMEs in figure 1 to prevent it from becoming too busy, but the references to these papers have been given in the revised manuscript.

2. **line 35-36, "The large-scale circulation of the HLME includes the broad eastward flowing West Wind Drift at 43S. This is a very outdated view of the Pacific Ocean circulation. See Chaigneau and Pizarro 2005 for updated terminology. The term "West Wind Drift" is no longer used by physical oceanographers, and the flow in the south-east Pacific covers the breadth**

of the gyre rather than being concentrated at 43S, as suggested here.
Corrected (page 2, line 34)
The HLME is a prototypical eastern boundary upwelling system that extends from northern Peru to southern Chile in the South Pacific Ocean (see Heileman et al., 2009 for a detailed description), where it is adjacent to the PLME (Fig. 1). The HLME can be separated in two meridional sub-regions, marked by the Subtropical Front, at 35 - 40S (Chaigneau and Pizarro, 2005). About 65% of the area of HLME corresponds to the northern region, and is under the influence of the Humboldt Current System and coastal upwelling from 4S to 40S. South of 45°S the HLME is mostly under the influence of downwelling-favorable (poleward) winds and the poleward flowing Cape Horn Current (CHC, Strub et al., 1998) along the shelf break of the Southern Chilean Shelf (SCHS, 40 - 55S), a region with a complex fjord system. Further south, the shelf widens onto The Cape Horn Shelf region (CHS), marking the northern boundary of the Drake Passage.

3. **line 42: "In this region". It's not clear what region you mean by this. I assume you are talking about the CHS, since that was mentioned in the last sentence. But since this is the start of a new paragraph, I wonder if you could be talking about the whole of the HLME again? But in the last paragraph you said that extended north to 4S, where the westerlies are definitely not strong. Please clarify.**
   The text has been clarified in the revised version.

4. **line 42-44, "the main flow patterns are from the Pacific towards the Atlantic", this sentence needs a reference.**
   The reference was included in the revised version (Combes and Matano; 2014).

5. **lines 48-53: "Recent observational records with unprecedented spatial and temporal resolution in Drake Passage yielded an absolute ACC transport of 173.3+-8.9Sv" etc. I am not sure how this level of detail is relevant, since**

your model transports are only measuring very close to the continent and in the upper ocean layers.
Corrected. Lines 48-53 have been deleted in the revised version.

6. **model description at line 96: State how long the spinup is before the 27 years used here.**
   The spin-up span 15 years, 10 years for the parent model and 5 additional years for the parent/child configuration. It was followed by a 34-year integration (1979–2012; Combes and Matano, 2014b). The text has been modified accordingly in the revised version.

7. **line 120: What do you do with particles at the surface? Do you parameterize vertical motion within the surface mixed layer at all?**
   Particles are advected by the 3D simulated currents, meaning that surface particles are allowed to upwell/downwell if there is a vertical velocity component.

8. **there are so many acronyms used throughout the text for place names that are very difficult to follow and remember. E.g. line 135-137 ("Only a branch of this strong current, deflected between the PS and BB enters into the ME and flows along the Southern slope before joining the northwards flowing MC further north.") is ridiculous! I suggest spelling out some of the less familiar or less used terms, such as SCHS, CHS, SPS, MIS, BB, PS throughout the manuscript.**
   The manuscript has been modified spelling out some of the less frequently used terms (i.e, BB, ME).

9. **Line 139: "vertically integrated up to 200-m deep". I think you mean integrated DOWN to 200m deep?**
   Yes. Corrected.

10. **Section 3.1: It would be good to provide some discussion here of how**

these transports compare with observations where possible. You listed so many transport values in the introduction where it wasn't obvious why the reader needed to know at that point. Move them here instead to validate you model circulation.
The only existing measurements of transport (to the best of our knowledge) are close to the Drake Passage. In this section we focus on the mean transport on the shelf, for which we do not have observations. The best we can do is to compare our results with indirect transport estimates (Brun et al, 2019) or previous numerical studies (Palma et al, 2008; Combes and Matano, 2018).

11. **Line 175: I don't see what the point of these climatological Lagrangian experiments is. Why use a 1/12deg model if you don't include the mesoscale variability in your Lagrangian pathways? Past studies have shown that pathways are completely changed if you include the mesoscale variability. Later on you release at many different times and then average all of the subsequent trajectories to obtain an average picture of the pathways. Therefore I don't see what this initial analysis adds, since it is incorrect to leave out the time-varying flow. Alternatively, you could clearly state that this section is just to see what impact the mean flow, with no mescoscale variability, has on the pathways, and then later do a quantitative comparison of advection by the mean flow and advection by the complete time-varying velocity field. You say here that you want to "qualitatively investigate" the pathways, but including the mesoscale variability will actually give a different (correct) qualitative picture.**
Following the reviewer's advice, we re-write Lines 175 and 214 (Lines 172 and 213 in the revised manuscript)

    Line 175
    Two sets of Lagrangian experiments using Ariane were conducted to investigate the fate of HLME and PLME waters. The first set was intended to explore the

impact of the mean flow and employs the CMM's climatological velocity fields. Initially particles were released on all shelf grid points onshore from the 200-m isobath (see green areas in figures 3 a, 4a and 5 a), at the surface, 50m and 100m depths, and followed during 90 days.
Line 214
The second group employed monthly averaged currents from CMM and monthly releases to better quantify the effect of mesoscale and long-term variability on the pathway of particles flowing through the northern Drake Passage. Particles were released on all grid points from 0 to 200m at 68.1W (Cape Horn), from the coast (at 55.7S) to 58.5S, and tracked during one year. This simulation was repeated monthly from 1980 to 2005, that is 321 simulations of 365 days each.

12. **Line 217: What is the impact of only using monthly resolution velocity fields on your results?**
Putman and He (2013) used HYCOM model outputs to explore resolution effects on particle tracking experiments in the North Atlantic: Comparison with oceanographic drifters released in the Gulf Stream System indicated that daily snapshots better represented the real trajectories while 30-day averages tended to under-predict speeds (although not direction). Numerical experiments of particle dispersal also indicated a bias towards higher cross-shelf transport when using low resolution model outputs. Overall, however, their results were very dependent on particle release location and the associated dynamical characteristics of the regional ocean circulation (i.e., releases in the South Atlantic Bight were scarcely affected by temporal resolution). In this regard, it is important to note that our geographical area differs from the one analyzed in Putman and He (2013). The SCHS is very narrow and located on an eastern boundary while the PS is extremely wide, is bounded by a very stable western boundary current and is forced by large tides (not included in HYCOM) and steady westerly winds. Altimetry analysis has shown that this is a region (particularly the shelf) of very

low eddy variability [see for example and Goñi et al, (2008), their Fig. 9 for the PS and Meredith (2016), his Fig.2, for the entire region]. Some of the drawbacks of poor sampling can be alleviated with multiple releases and long term tracking (Putman and He, 2013). The release of particles every 30 days (not just a single day) the long-term span of our tracking experiments and the ensemble average of the results (Fig. 6) ensures a more robust interpretation of particle dispersion between the HLME and the PLME. Therefore, although we expect some influence of high frequency input on our preliminary particle tracking results, the only way to properly asses and quantify this effect would be to perform a dedicated series of experiments, something that is beyond the scope of our study. A paragraph on these matters was included in page 12, line 242 of the revised manuscript.