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Interactive comment on "Antarctic Circumpolar Transport and the Southern Mode: a model investigation of interannual to decadal time scales" *by* C. W. Hughes et al.

Anonymous Referee #2

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One strategy for estimating Antarctic Circumpolar Current transport variability is to look at pressure variability along the Antarctic continent. In earlier papers, the lead author of this manuscript has pointed out that ACC variability displays a stronger and less noisy signal along the Antarctic continent than it does along the northern continental shelves that bound the ACC. This manuscript extends this earlier work to longer time periods, using 50-year simulation at 0.25 degree resolution and a 20-year simulation at 1/12 degree resolution. The objectives are to evaluate whether at long time scales, the presence of baroclinic effects alters the transport variability. Results show that the Southern Mode remains important even on long time scales, although on longer time scales they do see evidence for a surface intensification of the flow, associated either

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with baroclinic effects or with barotropic flow on the shallow continental shelf.

The manuscript is for the most part well-written, and it addresses a timely topic with relevance to the interpetation of extended GRACE and altimeter records and interpretation of longer in situ bottom pressure records that are now becoming available. However, there are a few places where the manuscript could provide clearer information for readers, and I would recommend revisions prior to publication.

p. 2086. lines 14-16. Abstract. The end of the abstract is not easily interpreted. I would recommend rewriting the sentence that says, "The role of density variations results in a sea-level signal, which, although reflecting tranpsort changes at all time scales, has a ratio of sea level to transport which becomes larger at longer time scales." This may need to be split into two sentences in order to clarify the meaning for readers.

p. 2086. line 21. In lieu of “errors”, the text should probably say “uncertainties”.

p. 2090. line 1. Clearer discussion of the definition differences between transport anomaly T’ and depth-integrated transport anomaly psi’ would be helpful. On first reading, I had trouble deciphering whether this was a discussion of depth-integrated psi’ (with psi’ perhaps being equivalent to T’) or whether ψ' itself was the depth-integrated transport anomaly.

p. 2090. lines 6-7. “... the current always flow at the same effective average value of f”. This sentence should be rewritten for clarity. Most readers familiar with GFD are likely to be able to decipher this eventually, but the text appears to imply that f stands for “flow” rather than the latitude-dependent Coriolis parameter.

p. 2090. lines 9-28. I think that if you were giving a seminar on this material, you would probably want to show a schematic diagram illustrating the differences in geostrophic currents for deep and shallow parts of the continental slope. Similarly, readers of this manuscript would probably benefit from a schematic meridional section showing where pressure is calculated.

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p. 2090 line 24. “lower part of the slope” would be clearer as “deeper part of the slope”

p. 2090 line 25. “upper part of the slope” would be clearer as “shallower part of the slope”.

p. 2092. line 26. “which is as high as is possible with these correlation coefficients.” Please clarify the calculation needed to reach this conclusion.

Figure 2 (top panel). The numbers 85in the legend.

Figure 3. For power spectral density and phase, it would be good to show uncertainties. The calculation for the two gain estimates doesn’t seem to be explained. If one represents a regressed on b and the other represents b regressed on a, I would have thought they would have reciprocal relationships. Or have they been readjusted to have the same values?

Figure 4. What are the statistical uncertainties in these regressions? I’m not sure of the reason to show regression of p on transport as well as regression of transport on p. A more usual approach is to use weighted orthogonal regression, which is able to take into account the separate uncertainties of p and transport to produce a single robust estimate of the regression coefficients.

Figure 6. What are the statistical uncertainties for these spectra? Do the different cases differ by more than their formal statistical uncertainties?

Interactive comment on Ocean Sci. Discuss., 10, 2085, 2013.