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Interactive comment on "Dissipation of the energy imparted by mid-latitude storms in the Southern Ocean" *by* J. Jouanno et al.

Anonymous Referee #1

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This manuscript addresses the fate of energy (mostly near-inertial energy) imparted by Southern Ocean storms and its effect on the Southern Ocean overturning circulation using a suite of semi-idealized high-resolution ocean models. The numerical experiments designed by the authors are suitable to address this important topic. Although the results on near-inertial energy generation, propagation and dissipation are somewhat expected, its effect on Southern Ocean overturning circulation is new. Furthermore, I haven't seen sensitivity studies of near-inertial energy budget to model numerics at such high resolutions before. Therefore I think this manuscript will make a useful and necessary contribution to this topic. I have some comments for the authors to consider, but most of my comments are minor in nature.

1. The manuscript talks about "energy imparted by mid-latitude storms". Well, it is not strictly correct. The synoptic winds associated with mid-latitude storms not only

generate near-inertial waves via time-varying wind stress, but also contribute significantly to the time-mean wind stress at mid-latitudes via the nonlinear dependence of wind stress on the wind. For example, Zhai et al. (JPO, 2012) showed that when the synoptic winds are included in the stress calculation, the wind power input to the ocean general circulation can increase by as much as 70%.

2. Recently, Rath et al. (JGR, 2013) found that accounting for the ocean-surface-velocity dependence of the wind stress leads to a large reduction of wind-induced near-inertial energy of approximately 40% in their 1/10 degree Southern Ocean model. This relative wind damping effect seems to be a very important way of dissipating near-inertial energy in the ocean. When you force your model directly with wind stress that knows nothing about the surface ocean currents, this relative wind damping effect is absent. I think this issue should at least be discussed, given that this manuscript is about energy dissipation.

3. line 19-20 on page 3. Should be "2000 km long" and "3000 km wide".

4. line 26 on page 3 and in many other places in the manuscript. It should be "3x104".

5. The last sentence on page 3 needs to be rephrased. It is not clear to me what you want to say here.

6. In the model configuration section on page 4, there is no information about the existence of the background wind forcing without storms at all. It should not be left completely in the appendix.

7. line 21 on page 4. Brackets are needed for "2012".

8. page 6. (2) also includes diffusive energy transport in the vertical direction, not just energy dissipation?

9. line 12 on page 7. The average KE exceeds......, but the caption of Fig. 6a says "EKE"?

10. line 1 on page 9. What is WKB stretched CW and CCW? Need to explain it or at least point the readers to the appendix.

11. line 21-22 on page 9. Why does the storm lead to strengthening of the eastward current?

12. line 25 on page 9. The Coriolis force is perpendicular to the current, and therefore should not do any work?

13. line 17 on page 10. The authors should check what these papers say before citing them here.

14. line 21 on page 10. You need to explain how the strength of the storm activity is varied seasonally here, or at least point the readers to the appendix.

15. line 31 on page 10. Again, why does the mean KE increase in response to the storms?

16. line 7 on page 11. How do you define the mixed layer?

17. line 23 on page 13. The effective frequency should be "$f+\zeta/2$", according to Kunze (JPO, 1985)?

18. line 12 on page 17. Should be "easy comparison".

19. line 22 on page 17. I assume that changes in air-sea fluxes are due to the feedback term in surface heat flux forcing? If so, need to say it.

20. lines 13-14 on page 19. It is not clear to me why you conclude that your results are noticeably different from the previous two studies, since your results also show that the majority of energy imparted by the storms is dissipated within the top 200 m.

21. line 18 on page 19. What is that part of wind work that is not near-inertial wind work? Wind energy input to the surface Ekman currents?

22. Figure 5. Three different color maps are used. Is this necessary? Why is 17 days

after the passage of the storm is chosen? Is it to give enough time for the near-inertial waves to reach the base of the anticyclonic eddy?

23. Figure 8. a) and b) are plotted differently (one on log scale and one not), which makes it hard to compare them quantitatively. In the caption for c), the symbol "< >" appears messed up on my printed-out version.

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