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Interactive comment on "Dynamics of turbulent western boundary currents at low latitude in a shallow water model" *by* C. Q. C. Akuetevi and A. Wirth

Anonymous Referee #2

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I reviewed a previous version of this manuscript that was ultimately rejected. This version is much more focused and readable. The English has improved and some of the more confusing aspects of the original manuscript have been removed or clarified. I think the present manuscript presents some interesting results and makes a few good points and could be published after a bit of revision.

Major comments:

1. Time step: The reviewers of the original manuscript questioned the short time step used here (90 s—five times shorter than that required by the CFL condition) and this issue has has never been fully resolved. The authors state that the "intermittent, rapid

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and violent" bursts "asks for a short time-step," but it's not clear from the manuscript why this is so. It seems unlikely that the bursts could violate the advective CFL condition, as this would require unphysically large velocities (on the order of 14 m/s). In the responses to the previous set of reviews, the authors state that they used such a short time step because they wanted the flow to be well resolved in time as well as space; they should add a comment to this effect in the present manuscript.

2. Scales of motion: The previous reviewers had issues with the definitions of the length scales used in section 4.4 and the present manuscript does not resolve them completely. One issue is that the scales appear to be defined using the full (i.e., fluctuating + mean) fields, rather than the fluctuating fields. For example, the kinetic energy used in defining lamda_1 appears to be the total kinetic energy rather than the turbulent kinetic energy. This seems strange considering that these scales are supposed to characterize the scales of the turbulence, not the mean flow. Defining the scales in terms of the fluctuating quantities would alleviate the problem noted below equation (13): "the above scales are not useful for analyzing time-independent flow." If they were defined in terms of fluctuating quantities, the scales would simply become undetermined for steady flow rather than oscillating between zero and infinity as do the solutions in eq (13).

Minor comments:

1. Page 2462, Line 2: "is" should be "are".

2. Page 2463, Line 6: insert "the" between "in" and "form".

3. Page 2463, Line 9: delete "While".

4. Page 2463, Line 18: Replace "permit to represent the" with "permit representation of".

5. Page 2463, Line 23: Replace "were performed" with "have been performed previously".

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6. Page 2464, Lines 13 & 14: Insert commas after "Indeed" and "knowledge". Remove comma after "current".

7. Page 2465, Line 20: Replace "These numbers" with "The values of these parameters".

8. Page 2466, Line 15: Replace "It" with "This".

9. Page 2488, Line 14: What is meant here by "scheme"?

10. Page 2469, Line 4: Insert a comma after "experiments".

11. Page 2469, Line 9: Replace "spacial" with "spatial".

12. Page 2470, Line 23: Remove comma following "demonstrates".

13. Page 2470, Line 26: The comment "One has to mention that in the literature eddy or ring are often used interchangeably to denote the same object." can be replaced with the parenthetical comment "(In the literature, eddy and ring are often used interchangeably.)"

14. Page 2471, Line 25: "strongly spatially localized" rather than "strong spatially localized".

15. Page 2472, Line 2: "dynamics" rather than "dynamic".

16. Page 2472, Line 7: Be more specific about what is meant by "the dynamics in the viscous sub-layer is not laminar".

17. Page 2472, Lines 10-15: The fact that T1 and T2 are numerically similar does not indicate that "there is only a feeble dependence on latitude," as this agreement could simply be a consequence of the mean value theorem for integrals. If T(y) is the fraction of bursts as a function of latitude, then T1 = T(1000 km) and T2 is the average of T(y) over a range of latitudes containing y = 1000 km. The mean value theorem states that the mean value of T(y) over an interval is achieved as the point value of T(y) for some

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point in the interval. Thus, the agreement between T1 and T2 could simply be due to a fortuitous choice of the latitude used to evaluate T1. It would be more convincing to show a plot of T(y) as a function of latitude, or at least state that T(y) is nearly constant.

18. Page 2473, Line 6: Delete "Using".

19. Page 2473, Line 8: Delete "which".

20. Page 2473, Line 16: Do not indent this line.

21. Page 2473, Line 18: Start a new paragraph after "gradients."

22. Page 2473, Line 21: Do not indent.

23. Page 2474, Line 9: Replace "when" with "through".

24. Page 2474, Line 19: Remove comma after "plateau".

25. Page 2475, Line 21: Replace "state a time" with "state, the time".

26. Page 2476, Line 13: The term "advective boundary layer" might confuse the reader into thinking you're talking about an inertial boundary layer. A better term might be "turbulent boundary layer."

27. Page 2478, last line through beginning of next page: It would be easier to follow if the description started at high viscosity and proceeded downwards to lower viscosity; otherwise the comment "once the viscosity drops below values ..." is confusing.

28. Table 1: "extent" rather than "extend".

29. Figures 3 & 4: Since lambda_1 diverges over a large fraction of the domain, it would be clearer to plot the inverse of lambda_1. It might make more sense to frame the entire discussion of length scales in terms of their inverses (i.e., wavenumbers) since turbulence is often discuss in wavenumber space.

30. Figure 5: Consider changing the color scheme of the lines; they are currently difficult to distinguish.

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