Nonlin. Processes Geophys. Discuss.,
https://doi.org/10.5194/npg-2017-63-RC2, 2017

Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Trajectory encounter volume as a diagnostic of mixing potential in fluid flows: connection to diffusivity" *by* Irina I. Rypina et al.

Anonymous Referee #2

Received and published: 26 November 2017

The manuscript presents an extension of a previous work (Rypina and Pratt, 2017), relating the 'trajectory encounter volume' , V, defined there to the 'effective diffusivity' in an ocean flow.

The manuscript presents interesting developments that would merit publication in NPG. Nevertheless, there are a few points the authors should revise before I can recommend publication:

- The authors compute V by assuming trajectories behave as random walks, which is the main assumption behind the concept of 'effective diffusivity' , k. This gives an expression (in 2d only implicit) for V in terms of k. Then V is computed in a real flow, and

the formula is used to plot k. There is a step to close the logic here, and it is to compare the k obtained in this way with the one obtained in other approaches aiming also at identifying k from data. I understand that this may be difficult, in particular because, even as shown in this paper, the 'effective diffusivity' concept is far from appropriate in many situations, and in those in which it works, only at very long times. But in my opinion something should be said al least for the regions in which the diffusivity approach seems consistent. If not a full comparison with other results, at least some discussion beyond the simple consistency with the diffusivities of Okubo (1971) for mesoscale spatial scales.

- The random walk theory is developed for a circular (in 2d) area around the focus trajectory. But in the application to the ocean the authors consider a region with R= 0.3 degrees. This is something like a rectangle or trapezoid (on the sphere) and its size in kilometers will change when the focal trajectory changes latitude. Could you explain more clearly which is the region you actually use when computing numerically V, and its relationship with the circular region of the theory?

- In several places of the paper a 'fit' of the data to Eq. 38 is mentioned. Please state more clearly if this fit is only used to asses the validity of the diffusivity assumptions or if it is even used to estimate k (the most direct estimation, instead, would not use the temporal fit, but just the value of V at time T).

- The description of figure 3 in lines 363-367 seems to have some error (red and black curves are mentioned which do not appear in the figure, and also the mentioned order 'core, periphery and outside' should be probably 'core, outside and periphery'.

- The relative motion of two random walks is just another random walk of double diffusivity. But for fluid trajectories, absolute dispersion and relative dispersion may be quite different. In fact there is a most interesting regime of 'nonlocal transport' for relative dispersion before the asymptotic diffusion regime is reached. I think something should be commented on thee different time regimes in relation with the very long times needed to observe consistently the diffusive regime for relative dispersion.

- Please use consistently either \delta x or L in the developments of Sect. 2.

- The quality of the figures is quite low, which is specially important for Fig. 3.

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