

Nonlin. Processes Geophys. Discuss., referee comment RC1  
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## **Comment on npg-2022-1**

Anonymous Referee #1

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Referee comment on "Rigid Sets and Coherent Sets in Realistic Ocean Flows" by Florian Feppon and Pierre Lermusiaux, Nonlin. Processes Geophys. Discuss.,  
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This paper studies how to extract Lagrangian Coherent sets from velocity fields. Another one. The paper has two parts: the first is devoted to extract rigid sets based on a diffeomorphism criterion, and the second is oriented to compute coherent sets with operator methods. The authors insist in the novelty of both methodologies, but this is not clear all along the paper. There are already so many new methods to study LCS/rigid sets that the focus should be in the applications (even more if NPG is for applications in Geophysics): discuss the advantages of the new method in a particular oceanic example, focus on the physical processes it can describe better than previous methodologies, and stress the computational benefits of using this particular method. What scientists working in ocean dynamics can learn using this "new" methodology?

I have not seen all this in this manuscript. The paper is difficult to follow, it has too much mathematical discussion (but without any proof), and it has two independent parts with their own definitions and numerical results. Maybe a single scheme with all the theory together in the beginning and then numerics would be better. Moreover, the novelty of the methods when applied to a realistic oceanic velocity field is not clear. The discussion of the results for the Palau Island region is vague. I think the paper (which of course has interesting material, very professional and with potential interest) could be largely improve if the authors reduce the mathematical discussion and enlarge the physical meaning (comparing with the obtained with other methodologies) of their results.