Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2020-83-SC3, 2020

Ocean Science
Discussions

Interactive comment on "Sensitive dependence of trajectories on tracer seeding positions – coherent structures in German Bight surface drift simulations" *by* Ulrich Callies

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Received and published: 21 December 2020

Ulrich,

Thanks for considering my comment and planning to revise the paper to avoid suggesting that attraction implies convergence in general. Perhaps you can consider exchanging the use of "convergence" for "attraction" throughout the manuscript. For example, in the abstract where you mention: " A corresponding spread of backward simulations implies convergence in the forward passage of time." In this sentence, "attraction" instead of "convergence" would be correct.

Regarding attraction implying convergence in your study in particular, I would like to clarify a few points:

1) I did notice the FDLD computations, apparently only compared to one set of FTLE, while the paper describes other FTLE. Perhaps you can clarify if FDLD always coincides with FTLE in your study.

2) Note that an advantage of the method I suggested in my previous comment is that the sampling of along-path divergence happens along the same trajectories used to compute LCS. You mention you use the same "pixels" (caption of Fig. 1), it is unclear if you are using the same trajectories. In backward time and near attracting FTLE, small differences in initial positions may cause large differences in trajectories, as the title of your paper suggests. It, therefore, becomes unclear how the two sets of trajectories compare, although I would not be surprised if the results hold either way.

3) By quantifying along-path divergence one can arrive at one of two conclusions:

a) Divergence is negligible

b) Divergence is not negligible.

Concluding that FTLE is due to convergence just because option b) is true would overlook the possibility that attraction, at least in part, originates from confluence.

Here are a few thoughts along those lines:

In geophysical flows, it is possible, perhaps even likely, that when b) holds, then attracting LCS are due to the effect of both confluence and convergence—especially at time and space scales above a few days and the deformation radius, respectively. Consequently, there is a need to quantify individual contributions. Note that in figure 1, the FTLE and FDLD do have a remarkable resemblance, but there are also some locations where intense FTLE coincides with negligible or positive FDLD.

What does it mean that FTLE magnitude is often about two or three times larger than

FDLD (both are 1/hour)? (This is often the case when FTLE ridges and negative FDLD coincide).

Is it possible that the strain from confluence induces the ageostrophic circulation that FDLD detects? Note that the FDLD may be a localized consequence of confluence, e.g., see the schematic in figure 3 of https://www.nature.com/articles/s41467-019-10883-w Are FDLD ridges collocated to FTLE? How well do FTLE and FDLD ridges intersect in space and time?

These are all just possibilities that, in my view, need consideration before concluding with certainty that in your study, attraction implies convergence. I hope to have demonstrated that the correlation between FDLD and FTLE does not necessarily implicate FTLE causation by FDLD.

Thanks again, and best regards, Rodrigo.

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