Interactive comment on "Numerical integrators for Lagrangian oceanography" *by* Tor Nordam and Rodrigo Duran

Tor Nordam and Rodrigo Duran

tor.nordam@sintef.no

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Dear Anonymous Reviewer #2,

Thank you for your encouraging comments. Below, we address the suggested changes to our manuscript.

Major comments

> 1) Section 4.1: All three data sets have the same constant temporal resolution of 1 hour. Since of of the key advantages of the proposed time-varying

> integrators is to better treat temporal discontinuities in the sampled flow field, I'm wondering if varying temporal resolutions might have an impact on the analysis as well? Some clarification, either in section 4 or 5 would help here, or possibly even an additional test case with a known analytical solution and different temporal resolutions could be used to highlight this (something akin to 3.2, but comparing fixed / time-varying / special-purpose integrators).

There is indeed an effect of temporal resolution. We did some tests initially, but these were not included in the manuscript. While we would have to double check to be sure, the improvement seen for the special-purpose integrators is probably smaller for datasets with coarser temporal resolution. The reason is the relative importance of crossing discontinuities in the time dimension relative to the spatial dimensions. This is discussed in lines 429-437, when discussing the different spatial resolutions.

It is certainly possible to downsample the datasets to for example 3 hours or 6 hours timesteps, and re-run the simulations. This will make the paper a bit longer, but it might also make the paper more generally relevant. We will need some time to run the simulations and include the results in the paper.

Any further comments on this point by the reviewer are most welcome.

> 2) Section 4.4: "We used only the surface layer of the data sets", but then 3D spline interpolators are used. Are the experiments considering 2-dimensional trajectories or 3-dimensional ones? Please clarify.

Time is the third dimension used in the interpolator. This is mentioned in lines 368/369, but we will make this more clear earlier in section 4, in line with our reply to comments by Reviewer 1. We will add the following after line 300:

"We have chosen to consider two-dimensional (horizontal) transport only, using the surface layer of the modelled current data. The current velocity field is interpolated in three dimensions (two spatial dimensions plus time), using the same degree of interpolation in all three dimensions."

> 3) Section 5.: "Number of evaluations of the right-hand side was chosen as a measure of work, as it is more objective than the runtime of the simulation" is almost immediately followed by "We note that higher-order interpolation is more computationally costly than lower order interpolation." While both statements are correct in their own context, they seem a little contradictory here. A small clarification could help clarify this. Moreover, while I agree that the number of evaluations is an important metric to evaluate the efficiency of different numerical integrators, the overall time-to-solution is often the final metric in practice. The final paragraph of 5.2 hints at this, but I'm left wondering if a graph plotting error vs. run-time could be used to highlight the points here more clearly?

We will change the second sentence, to read

"We note, however, that higher-order interpolation is more computationally costly to evaluate than lower-order, and thus the same number of evaluations will take longer when using an interpolator of higher degree."

We can also add a version of figure 4 using run-time on the horizontal axis, as an appendix.

> 4) Section 6: "The most striking conclusion from the results presented above," This reads more like a continuation of the discussion above, rather than a conclusion in its own right. Maybe re-structure a little to independently re-state the objective and key findings of the paper, as is to some extend done later in the section?
>
> <div align="center">C3</div>

We will rephrase the start of this section.

Minor comments

> * Link to data sets strictcly requires 'https://' in the URL. Please adjust footnote on p.12.

Ok.

> * The code repository on github is very neat (much appreciated!), but I could not find the Jupyter notebooks mentioned in the text. (In case I just missed them, maybe a link in the README in the repo would help people find them quickly?)

The notebooks are indeed missing. Our apologies. We will make sure the repo is complete, and create a "release" with its own DOI that can be cited, prior to submitting the final manuscript.