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Comment on gmd-2021-233

Anonymous Referee #2

Referee comment on "LAPS v1.0.0: Lagrangian Advection of Particles at Sea, a Matlab program to simulate the displacement of particles in the ocean" by Maxime Mouyen et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-233-RC2>, 2021

In this paper the authors present LAPS, a Matlab program to simulate Lagrangian advection of particles under the influence of oceanic circulation, gravity and, optionally, wave action. The simulation time stepping is fixed to 15 minutes and particle injection can either be fixed, gradual or both, with input data restricted to ECCO2 velocity and Stokes velocity fields for wave action drift. The paper presents a range of validation experiments, highlighting the impact of the Stokes drift and particle sinking features of the code on the simulation results, while highlighting the ease of use of LAPS throughout.

Unfortunately, however, beyond the introduction of a new software implementation, no distinctly novel features are presented and little discussion is provided on the challenges and trade-offs in developing Lagrangian particle tracking software. A further lack of direct comparison to existing software frameworks makes it hard to assess LAPS' role in the existing ecosystem of Lagrangian oceanography tools. No discussion is provided on the choice of interpolation schemes or the lack of parallelism in the software framework that seems to underpin the overall low number of particles used throughout the validation experiments.

More detailed comments on individual sections of the paper:

- p 2, l. 27; Only a single link to and overview to alternative software packages. A brief comparison of major differences to other software packages that points out major differences explicitly would be preferable over a link to a general review paper.

- p. 3, l. 63: "Note that the program does not support parallel computing." Given the fairly low number of particles cited for runtime evaluation later in the paper that seems like a

pretty substantial limitation. Putting the responsibility on the user to split the input files goes very much against the "ease of use" argument that seems to underpin this paper.

- p. 7, Table 2: There is little useful information conveyed in this table beyond the obvious "more particles take more time". A more detailed breakdown of single-core performance of individual components (eg. tracking vs. no tracking, I/O overheads or normalised runtime per particle) could help make this more relevant to the paper.

- p. 8, l. 152: This seems to imply linear temporal interpolation, and bi/tri-linear spatial interpolation. It would be good to explicitly mention the interpolation schemes used and possibly give a brief rationale for the implemented choices over other methods, such as cubic or spline interpolation.

- p. 9, Figure 3: It is unclear to me what this figure adds to the paper, since no explanation or discussion of the particular cases is provided.

- p. 10, Figure 4 and line 180: "Given the area covered by the global ocean, we consider that the standard deviations obtained with LAPS are reasonable." On what grounds is that based? Are there any other metrics that could strengthen this argument?

- p. 13, l. 206: "The simulation cannot account for all processes". While there are some similarities between the simulation and the observations, and matching the full pattern is clearly challenging, I feel that a more detailed discussion and potential investigation of causes would improve this section significantly. For example, the April simulation seems to spread further south than the observations; or the July simulation seems to stick closer to the coast line than observations. Are these discrepancies purely limitations of the spatial resolution of the velocity data, or could numerical artefacts and implementation details play a role here? In addition, a visual illustration of the starting condition might also help to make the experiment setup more accessible to the reader.

- p. 16, l. 270; "A variety of factors, such as plastic density, shape, particle size, biofouling, waves, are controlling the sinking of particles." One of the potential application areas of Lagrangian particle models, such as LAPS, is exploring new models and mechanisms to account for such processes. Future plans for extension, or a discussion on the ease with which such extension could be added to a model could add value to the paper, either here or in the final evaluation section.