

Geosci. Model Dev. Discuss., referee comment RC3
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Comment on gmd-2021-400

Anonymous Referee #3

Referee comment on "ROMSPath v1.0: offline particle tracking for the Regional Ocean Modeling System (ROMS)" by Elias J. Hunter et al., Geosci. Model Dev. Discuss.,
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This manuscript describes the ROMSpath particle tracking code, which results from modifications to the LTRANS particle tracking code to improve the functionality and efficiency of the model. The main changes from LTRANS are to run directly on the ROMS circulation model grid, to allow particles to move between nested grids, to separate the time stepping for advection and turbulence, and to correct an error in the coding of the turbulence random walk. LTRANS has been used widely with ROMS for years, and the changes made in creating ROMSpath will only increase the utility and accessibility of the particle tracking code.

The changes to the code that are reported here are all sensible and clearly explained. The effects of the changes on the model output are illustrated with examples from a study of larval transport along the east coast of the U.S. and Delaware Bay. While this project motivated the changes that were made to the code, it's not necessarily the most effective means for demonstrating the improvements. It would have been more informative to illustrate the results with simpler, idealized examples that are more easily diagnosed and transferrable to other applications. For example, the improvements in performance from splitting the advective and turbulence time steps will clearly provide model speed-up, but it'd be helpful to provide guidance on how much speedup users can expect for typical simulation parameters. Similarly, it is not surprising that using higher resolution grids will increase the resolved dispersion of particles, but it'd be useful to provide more context on how the increase in dispersion with nested grids compares with theoretical expectations. The examples with initially vertically uniform particle distribution illustrate how particle dispersion depends on having the random walk algorithm coded correctly, but I am left wondering whether the clustering of particles near the pycnocline in the ROMSpath case has a physical basis due to flow characteristics or is instead some residual error (that is nevertheless a big improvement on the LTRANS result). Among the stated aims are to "improve the model's efficiency, accuracy, and generality" [47-48], so that end, it would enhance the presentation to provide more generalizable examples of how these code updates improve the model.

Some additional, specific comments are provided with line numbers in brackets.

[11] is “OPT” a commonly used acronym? It’s unfamiliar, and quick search did not turn up other instances of it. The added confusion to readers with creating a new acronym does not seem to be worth the savings in keystrokes or ink.

[22] Perhaps note in the abstract that the manuscript provides examples of the how the improvements affect the performance of the code?

[41] “that calculate particle trajectories for a variety of applications” can be deleted.

[45] “It is not uncommon for users to modify OPT models to add novel processes for individual studies. Here, we describe alterations and additions to an existing OPT code, the Lagrangian TRANSPORT model (LTRANS), to add specific larval behaviour and improve the model’s efficiency, accuracy and generality.” These statements seem contradictory. If most users add their own processes and you are adding your own specific behavior, how does that improve generality? Please clarify.

[195] is the Stokes drift necessarily output at the same times as the ROMS fields?

[232] Do the details of the Doppio implementation on data assimilation and nudging matter for ROMSpath? If not, suggest removing for clarity.

[245] Similar to the previous comment, it's not clear if the details on the time stepping are important for ROMSpath (e.g., recommended output interval) or specific to the goals of this science project. For this manuscript the focus should be on the former, and the latter would be more appropriate for a manuscript reporting on the scientific results.

[331] As with OPT, "CM" is unnecessary, and is more a source of confusion than clarity.

[334] "LTRANS OTP fails to reproduce the off-shelf transport" Why is that? What aspect of the code modifications led to this improvement?

[Fig 4] It's confusing to have the center of mass line on all 3 plots since the rest of the info in each panel is just a snapshot in time, whereas the line represents the trajectory over time. It's also hard to distinguish the center of mass lines from the dots. Suggest removing the center of mass lines since, as noted in the text, it is not a particularly good metric as the particles get strained out.

[353] Why does decreasing the advective time step mitigate the clustering problem in LTRANS?

[354] "numeric[al] efficiency...tens of thousands of particles" It'd be worth quantifying the speedup in efficiency gained by splitting the turbulence and advection steps, assuming an appropriate ratio for them. Presumably it depends on how computationally expensive the advection and turbulence calculations are? Does it depend on the number of particles, or just become more noticeable with increasing numbers of particles?

[Fig 5] As mentioned above, ROMSPath also appears to have clustering near the turbulence minimum, but much less so. If LTRANS were run with the correction to the sign error in the code, would it give a result similar to ROMSPath, or are there other factors contributing to the difference?

[393] "wave swell was onshore during this time period" Isn't swell usually onshore, and increasingly so as it approaches the coast? Perhaps the idea is that the wave direction was aligned with main axis of the estuary?