

Review #2

We appreciate the reviewer's careful and thoughtful comments and have made extensive edits to address these, which are tagged and marked in blue within the revised text, the attached gives detail responses

The manuscript presents the new capabilities of the particle-tracking model OceanTracker and compares its performance with two other models, OpenDrift and Parcels. It also explains the design choices behind the model's structure and features and illustrates these through examples.

General comments:

- a. The introduction should more clearly and concisely introduce the previous version of OceanTracker (including the hydrodynamic models it supported, as stated in the abstract) and explicitly state that this manuscript presents and evaluates the new version of the model.
 - Added text to intro which specially notes the aspects new in this version of the code as also suggested by reviewer A, see multiple A1 in the introduction.
- b. The manuscript would benefit from additional references throughout. A few specific places where references are needed are noted below, but this is a broader recommendation for the entire text.
 - Have added references (A15 line 151, B6 line 151, B7 line 160, A10 line 355, A15 line 15) plus others
- c. A thorough proofread is recommended, as there are numerous typos. I have listed the ones I noticed below, but I might have missed some.
 - Have taken the suggestion of a profession proofread.

Specific comments:

1. *line 62: Although fewer particle tracking tools exist for structured grids, a few are available. For example PyLag (<https://pylag.readthedocs.io/en/latest/>)*
 - Added reference to PyLag (B1 line 70)
2. Figure 1: Please add color bars for panels 1b, 1c, and 1d. Also specify the time elapsed before the snapshots were taken. Clarify the meaning of the crosses shown on the maps.

- Have added colour bars and explicitly indicated crosses as a grid release in caption (B2 line 51)
“In the upper figures, the crosses in the upper left are the locations of a grid particle release, while the black polygon is the area covered by a polygon release. The crosses near the middle of the plots are locations of two point releases.”
3. *section 1.1: It would help to include a brief description of the particle tracking setup used in Figure 1 (e.g., study area location, simulation duration).*
 - Add release rates and numbers to subsection, see multiple in Fig. caption and text body (B3’s line 110ff)
 4. *line 96-97: Clarify whether this value refers to the average number of particles per cell over the full simulation period.*
 - Add comment on the average of 300 particles per cell out of 5 million total (B4 line 119)
“The two points in the lower plots of \ref{fig:examples} each released 5000 particles every 10 min., giving 5.7 million particles by the end of the 4 day run. This resulted in an average of 500 particles being counted within each grid cell to create the heat maps”
 5. *line 100: Rewrite as "some of **the new** Ocean Tracker **0.5** features" to explicitly refer to the new version.*
 - Edited as suggested (B5 line 125)
“This section highlights some \edit{B5} of the new features of \OT v0.5 } that minimise user effort and its physics.”
 6. *line 132-133: specify "**vertical** dispersion" and remove "3D" in "vertical turbulent viscosity". Also clarify whether vertical dispersion is an addition to horizontal dispersion already available in earlier versions of OceanTracker.*
 - have clarified that using vertical turbulence profiles for random walk is new to this version, plus added references (B6 line 151ff)
“As in the earlier version of \OT, random walk can be incorporated using constant turbulent eddy viscosities in both the horizontal and vertical directions. Optionally in the new version,} if vertical turbulent viscosity profiles are available in a 3D hydrodynamic model, the profiles are interpolated to calculate the size of the vertical random walk. This requires the inclusion of an additional vertical velocity that is equal to the vertical gradient of the turbulent viscosity \edit{B6}{\citep{visser1998using,thorpe2005turbulent}}.”
 7. *line 140-142: Add appropriate references.*
 - cited equations in lynch, B7 line 160
“cite{lynch2014particles} equations 5.5 and 5.6.”

8. *line 154: Correct the phrase “adding addition.”*
 - Edited “adding additional”, (B8 line 177)
9. *line 177: Correct “example”*
 - Edited at B9
10. *paragraph lines 180-189: Incorrect figure is cited; please revise.*
 - Changed at multiple (B10 line 204ff)
11. *line 188: Clarify how users are expected to know which classes must be explicitly provided.*
 - Add comment on minimum requirement of a reader and release group, changes at multiple (B11 line 211)

“To run \OT a user must add at least a reader class and one release group class. In addition, they must set the name of the folder where output will be written to (see \frefs{fig:code-param-example}{a}).”
12. *Figure 3: Figure 3: The separation of dispersion and RK advection appears inconsistent with lines 136–137, which state that the random walk is applied to each RK sub-step rather than as a separate displacement.*
 - Yes this does appear confusing, the size of the random walk as a velocity is only calculated once per full step as in figure, but this additional velocity is applied at each sub-step to move particles, clarified and modified figure to indicate computation of total velocity modifiers. (B12 line 151)

“This dispersion velocity modifier is calculated once for each full time step and added to the hydrodynamic model's velocity at each Runge-Kutta (RK) sub-step, see \fref{fig:CP} and \sref{sec:vel_mods}.”
13. *Caption of Figure 4: YAML configuration files are not mentioned anywhere in the text; a brief explanation should be added.*
 - YAML format now referenced at (B13 line 58) and abstract A2
14. *Minor edits fixed*
 - Line 207: Correct “their a new location”
 - Line 219: Fix spacing.
 - Line 239: Correct “manages they appropriately.”
 - Line 246: Correct “can different types.”
 - Line 248: Fix punctuation.
 - Changed order as suggested, - *Line 250-260: Consider reversing the order of the “custom particle properties” and “core particle properties” paragraphs. The current order feels confusing because the text returns to custom properties afterward.*
15. *Line 288: Explain why 24 hydrodynamic model time steps were chosen.*

- Have added comment noting why 24 (B16 line 321)
“This default number of steps balances reducing wall time, by reading in multiple time steps at the same time, while only requiring of 100s of megabytes of computer RAM for each buffered hindcast variable. The user can reduce this buffer size if RAM is limited.”
16. Line 294-295: This information should be introduced earlier in the introduction.
- Moved to introduction as suggested
17. Line 303-304: The sentence is unclear; please rewrite and add a reference describing the method.
- Rewritten and expanded at (B18 line 342)
“Vertical interpolation to the position of each particle is also linear between the layers of the hydrodynamic model and between time steps. The one exception to linear vertical interpolation is the water velocity within the seabed layer. Here, vertical interpolation is based on a logarithmic layer, ensuring that particles near the seabed experience a more realistic velocity profile than the linear variation in higher layers \cite{lynch2014particles}”
18. Line 378-385: Is there no downside to this method?
- Noted that it means OT is not using the native hydro model grid, but an approximation of it (B19 line 422)
“Though vertical interpolation means particle motions are not strictly a result of velocities of the native hydrodynamic model grid, but rather an approximation of those velocities.”
19. Minor edits done to fix
- Line 402: Fix spacing.
 - Line 403: Fix spacing.
 - Line 454: Fix spacing.
 - Line 497: this is a conclusion of the paper so may not have been noted in a prior publication? Added a reference (B20 line 586)