

## ***Interactive comment on “Variational assimilation of Lagrangian trajectories in the Mediterranean ocean Forecasting System” by J. A. U. Nilsson et al.***

### **Anonymous Referee #1**

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### **1 General Comments**

This manuscript describes some experiments where Lagrangian observations from drifters are assimilated in the MFS 3D-Var. The work provides a demonstration on how drifter observations improve the near-surface and intermediate waters circulation, the SSH fields in proximity of the drifter observations, without jeopardizing the quality of temperature and salinity fields. The assimilation is tested within a 4-month period.

The scientific approach is simple and effective. The work is well, clearly and synthetically presented in the manuscript, it is suitable for the Ocean Science readership, and

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interestingly introduces original results on the use of drifter trajectory data, which are usually not assimilated in current operational analysis systems. The results are encouraging and the near-surface current improvements are promising for search and rescue operations. I found the scientific significance and quality high, and the presentation quality good.

I recommend the manuscript for publication in Ocean Science, after a few corrections are considered, in order to improve the manuscript readability.

## 2 Specific Comments

- The description of the assimilation method misses the specification about the assumption for the vertical location of the Lagrangian observations (both drifters and Argo), namely for the model-equivalent calculation: are drifter positions compared to 0m-15m vertical mean values or assumed to be nominally located at 15 m? The authors should specify this point; similarly for Argo trajectory data: model-equivalents are vertical interpolations to the nominal parking depth of 350 m?
- The manuscript will improve in readability if the Lagrangian trajectory observation operator is explicitly included (Equations 6 to 8 of Nilsson et al. 2011). I suggest the Authors to briefly recall the operator in an Appendix.
- When the observational error is introduced in the text, it is not clear which values has and why. Please reformulate the sentence in page 2507 line 18-21 “The Argos positioning...respectively”, which is not very clear to me. I understand that observational accuracy is estimated to be 1 Km and between 250 m and 1 Km for drifter and Argo positions, respectively. Then, page 2508 line 6, the observational error is assumed to be 5 Km, from which I understand that the

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representativeness error is assumed to be dominant and approximately equal to 4.9 Km, since  $5km = \sqrt{instrumental^2 + representativeness^2}$  ). Is this correct? Did the authors find the results very sensitive to the total observational error? Please speculate a bit more on the observational error assignment.

- Discussion about the IP gyre depth rise (P2513, line 26-onward): I suggest the authors to highlight “more explicitly” the fact that also the use of the drifter trajectory assimilation (experiment SURF vs CTRL) contributes to slightly decrease the gyre depth and make it closer to observational estimates, proving again the benefit of near-surface trajectory assimilation on intermediate circulation.

### 3 Technical and Typo Corrections

- p2507, first sentence, perhaps the authors meant “In this Section” instead of “In this study”;
- p2509L17, p2510L1: Please remove brackets from the sentences.
- Check carefully all the instances of singular 3rd person verbs (e.g. in page 2513 line 5 “...assimilation of Argo float trajectories HAS”; line7 “appears”; line 20 “varies”; line 22 “seems”; p. 2520 Figure 1 Caption : “... while the dashed line marks”)
- Page 2512 Sect. 4.3 line 18: “Here, it is investigated if the assimilation”
- Page 2512, line 23: “of the order”; line 25: “drifter assimilation”. Please reformulate the sentence between lines 22 and 25, which does not sound very nice.
- Table 2, Caption: “[...] Near-drifter (as defined in the text) SLA RMS misfits [...]”

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- Figures 2, 4, 5, Caption: Please explicit the temporal frequency of the black markers (daily) for improving the figures readability.

#### 4 References

Nillson et al., 2011: On the assessment of Argo float trajectory assimilation in the Mediterranean Forecasting System, Ocean Dynamics.

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Interactive comment on Ocean Sci. Discuss., 8, 2503, 2011.

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