

Interactive comment on “The ECMWF operational ensemble reanalysis-analysis system for ocean and sea-ice: a description of the system and assessment” by Hao Zuo et al.

Anonymous Referee #2

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General comments

The authors present the last release of the ECMWF reanalysis and real-time analysis system, e.g. the OCEAN5 system. They describe both the reanalysis part, ORAS5, and the OCEAN5-Real Time systems. Description is focused on upgrades of all the different OCEAN5's components compared to the previous reanalysis ORA5. This paper gives a detailed and full comprehensive description including initial conditions set up, assimilation, models choices, different observations data sets used along the historical period and ensemble generation. Numerous experiments have been performed to assess the choice of the SST and SIC in the assimilation framework, to perform twin

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experiments with in situ datasets, to update the quality control of in situ data, to generate and assess the off-line bias correction ensemble estimation, to produce OSEs with in-situ network and to measure the impact of different sources of data sets. This valuable paper, likely to become the reference publication for the OCEAN5 system, is well written and this manuscript contains material that deserves to be published with minor revisions listed below.

Specific comments

1 – Introduction

P.2 L. 3: The primary purpose of ORAs also could be initialization/verification of long-term prediction such as decadal or climatic projection.

P2. L.23-24: Funding item should be put in acknowledgement to my point of view; or mention the support in the text as well.

2 - The ORAS5 system

2.1 - Ocean-sea ice model and data assimilation

P.3 L.11 : Bernard et al. 2006 should be cited as Barnier et al. 2006

P.4 Table 1 : - What is the + TKE mixing in partial ice cover meaning? - ERA-Interim is replaced by IFS in 2015, for sake of continuity is there any plans to re-run ORAS with ERA-Interim on 2016-2018 time slots? Is the small increase in RMSE in Figure 16 could also be related to this transition?

2.2 Model initialization and forcing fields

Figure 2: it would be highly valuable to add the spread in the salt content.

P.6 Table 2: “Sali. Capping” refers to salinity bias correction? It should be mentioned in the caption or in the text.

2.2.2 - Forcing, SST and SIC

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P7 L.12-13: is the value of SSS relaxation term has then the same representative time scale of 12 days?

P8 L10: We would read "... prior to 2008 comes from HadISST2.1 ..."

P9: The choice of SST products is truly justified in terms of temporal consistencies, what about the spatial patterns, where are the main differences prior 2018 between OSTIA and HadISSTv2?

P.9 L12-P.10 L1-4: It is difficult to understand that changing the source of sea ice concentration data in the assimilation has such a big impact on sea ice thickness. Either the source of the impact is coming from the Hadley SIC itself; either the control of the ice volume through the assimilation of SIC has changed between experiments. Further explanations are needed.

2.2 Assimilation of in-situ observations

2.3.2 – Quality control of in-situ data

The improvement with pair-check verification looks pretty weak, how much? and from Figure 7 hardly noticeable. A zoom in the Northern Atlantic with changes in the color bar will be appreciated or this Figure can be withdrawn. How many isolated salinity profiles has been rejected? Are these profiles located in key areas?

2.3.3 – Bias correction scheme

Figs8 and 9: It is surprising that an ensemble mean (set up of ORAS5) give larger biases than a single realization (set up in ORAP5). Part 2.3.1 also showed that model bias is reduced with EN.4 compared to EN.3. Is it then possible that these systematic larger biases come from different periods used to estimate these biases correction?

2.4 – Assimilation of satellite altimeter sea-level anomalies

P.16 L.2-3: Is cutting the assimilation of the SLA at 50° latitude doesn't bring others issues such as artificial and abrupt changes in the circulations? Is there any ramp to

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smooth this cut off for instance? Is the MDT still assimilated in these shelves and polar areas?

P.18 L14-15: then how the steric component in the GMSL is estimated prior 1993?

Figure 12: BGE acronym should be informed in the text before figure's citation.

Figure 13: We should read : . . . The specified BGE standard deviation. . .

2.5 – Ensemble generation

P.19 L14-15: net precipitation refers to what?

P.19 L.23: From Figure 12 . . . The salinity and temperature are under-dispersive . . . to my point of view

3 - The OCEAN5 Real-time analysis system

P.22 : YMD should be informed in the text.

4 – Assessment of ORAS5

4.1 – OSE

Clear and informative part which regionally characterizes the importance of in situ network.

4.2 – Sensitivity experiments

Table 5: It is not clear from the Table 5 in which sensitivities experiments the assimilation of in situ data set is activated. From the text, we understand that this assimilation is switched on in the O5-NoAlt and O5-NoBias experiments but it should be specified in the text, idem for the assimilation of SIC.

4.3 – Verification in observation space

Figure 16: It is surprising to notice that the impact (improvement) of the SST nudging is increasing from the year 2008, is it likely due to the change from HadISST to OSTIA

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but why?

4.4 – Verification of ocean essential climate variables

4..4.1 – SST Figure 19: remove the ‘sosstst’ title.

4..4.2 – Sea level

P.32 L.24: “. . .reasonably well. . .” Figure 22 b): We understand the same color bar is used for the Figure 21 but contours are hardly noticeable in this ratio.

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