Ocean Science
Discussions

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Interactive comment on "Impacts of mean dynamic topography on a regional ocean assimilation system" *by* C. Yan et al.

Anonymous Referee #2

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The manuscript describes and explains the impact of different MDT used for assimilating altimetry data in a data assimilation system covering the Pacific and Indian Oceans, concluding that using a long-term mean SSH calculated from an assimilative experiment with the assimilation of hydrographic profiles provides better results.

I found the article well written, clear and concise, and I believe the topic is of interest for the data assimilation community, especially because data assimilation procedures require an MDT consistent with the analysis system itself, which is usually neglected when gravimetry derived MDTs are built. However, I found in my opinion a major weakness in the experimental design, therefore I recommend the manuscript for publication only after having fixed the issue (see below).

General points

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Interactive Discussion

Discussion Paper

I believe the way the authors use the Rio et al. (2009) MDT, so called MDTOBS, is not correct or at least unfair. In facts, the MDT is defined as the elevation of the mean sea surface with respect to the Geoid. The Geoid is the gravitational equi-potential surface: it is defined for less than a reference height, i.e. a reference height for the Geoid (e.g. its spatial average) cannot be unambiguously determined. The authors use the Rio et al. 2009 MDT as it is, and it shows an offset of 0.80 m with respect to MDTMOD, MDTTS. This offset is completely artificial and should be removed before using MDTOBS, for instance imposing that the weighted spatial mean of MDTOBS is the same of MDTTS, i.e. subtracting 0.78 m in every point from MDTOBS and then using it. It is important to note that the Rio et al. (2009) MDT is defined without any constraint on the global mean, its global mean being in facts a meaningless number. Neglecting this, the authors use an MDT with an unrealistic offset. Being the offset positive, as the authors explain well, the data assimilation system quickly adjusts to the MDT, the sea level rises and there is subsequent temperature increase. I believe that this is an artifact. Temperature RMSE of up to 10 degrees Celsius are not realistic. I recommend the authors to adjust the MDTOBS in order to cancel the artificial offset and rerun the experiment. I expect results qualitatively similar but quantitatively very different. The way E_MDTOBS experiment is designed at the moment does not allow any strong conclusion on the performance of MDTOBS wrt MDTTS. By construction E_MDTOBS has too negative skills, and conclusions cannot robustly be drown.

Specific points

P1085L15: Not only to avoid the need for an uncertain Geoid: by construction the satellite measures the distance from sea surface to satellite, which in turns, by knowing the ellipsoid, gives distance between sea surface and ellipsoid, regardless of any underlying Geoid.

P1086L19: Interesting to specify the coupling method (bulk formula?)

P1087L5: Interesting to specify how Equation (1) is solved (iteratively? Analytical local

solutions?)

P1088L7 and later: Please specify which version of ENSEMBLES is used (EN3v1, v2 ??) and which version of AVISO is used. For the latter, please note that the last version defines SLA as anomaly w.r.t to 1993-2012, while previous versions w.r.t. 1993-1999. So it is important that authors specify the version and the period with respect to which anomalies are computed, because it is relevant for the MDT estimation.

P1088L14: Since in data assimilation usually along-track SLAs are assimilated, rather than mapped SLAs, the authors should justify this choice.

P1090L27: where the "Argo observations" used for verification (Figures 3 and 5) come from? Is it a special dataset? Objective analyses?

P1092L22: please explain what do you mean for "independent observations that were not assimilated": which observations are you talking about? How many?

Technical points

P1084L1: "An ocean DATA assimilation"

P1087L14: I believe A should be defined as the "ensemble anomaly" or "difference between ensemble members and the ensemble mean", NOT as just an ensemble.

P1089L6: "distribution" ? Maybe simply "maps" sounds better

P1092L12 "whether the"

P1093L22: change "regardless" to "for both"

P1094L13: "assimilation-run-derived" => "assimilation-derived"

P1094L23: "assimilation run"

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