Ocean Science
Discussions

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Interactive comment on "Data assimilation of SMOS observations into the Mercator Ocean operational system: focus on the Nino 2015 event" *by* Benoît Tranchant et al.

Anonymous Referee #2

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The paper discusses the impact of the assimilation of SMOS data on the Mercator Ocean model.

The uptake of SMOS data in the scientific community and the ocean modelling community is relatively slow due to many unique challenges associated to remote sensed salinity observations.

Therefore such paper comparing the model results with and without assimilation of SMOS data is quite important and timely. The presented study is well planned and executed and followed by an independent validation.

My major critique points are the following 2:

A. The description of the data assimilation scheme is rather confusing, partially due to the fact that two different schemes are used together (3D-var for the bias and the reduced order Kalman Filter). Having two clearly distinct sections (one KF section and one 3D-Var) and for each of these section the relevant subsection (model error covariance, observational error covariance,...) would already clarify a lot.

B. The interpretation of the results is a rather superficial. The discussion on why the model has a salinity bias relative to in situ observations should be substantially improved. Also did the authors check of a possible degradation in other model variables (besides salinity) due to the assimilation of SMOS data?

In addition, the overall quality of the figures should be significantly improved. The font-size is really small and the text is barely readable on a print-out (especially on Figure 18). As a rule of thumb, the font-size of the figure after embedding it in the document should be roughly the same font size as the text. Also the text labels should not overlap with other text (Figure 18). Labels on figure 15 are blurry and also very hard to read (probably JPEG compression artifacts; vector image formats like EPS or PDF provide a much better quality).

Therefore I recommend major revision before publication in Ocean Science.

Specific comments:

page 5, line 27: "The localization of the error covariance is performed assuming a zero-covariance beyond a distance defined as twice the local spatial correlation scale"

How is the local spatial correlation scale determined? Is it derived from the ensemble and does it vary then for every model grid point?

page 6, line 9: "...where x is the in-situ bias to estimate, B is the background error covariance of the 3D bias, d is the innovation vector (it is the mean innovation over 1 month on a $1°\times1°$ grid between 0 and 10 meters depth and the mean is symbolized by <>)"

Why are only near-surface in situ values used? If the in situ data are assumed to be biased at the surface, should one not also expect a bias at depth?

Figure 4, panel b: What is the negative anomaly at 20°S and 120°W?

section 2.3.4 "SSS observation error". It seems that the same SSS observation error is used in the 3D-var scheme and the reduced-order KF despite the fact they use different background-error covariance and different time scales. Should the representativity error not be quite different if one uses different time-scales (bias versus instantaneous field)?

page 10, line 10: "A reinforcement of the TIWs (the slope is steeper)..." Do you mean a reinforcement (related to amplitude and energy) or acceleration (related to speed)? Also in a Hovmöller-Diagram, one plots space in the x-axis and time in the y-axis. The slope is thus the *inverse* of the speed. Figure 15 seems indeed to show that the slope get less steep in the second half of 2015. Please provide a discussion about why we see a change in the propagation speed and quantify the changes that you are seeing.

page 11 and Figure 17: The impact of the SMOS SSS assimilation seems to depend on the latitude. The impact at latitudes lower than 5°N (or 5°S) seem to be consistently higher than near the equator. Why?

Minor comments:

page 6, line 14: "Spatial correlations in B are modeled by means of an anisotropic Gaussian recursive filter." Please provide the equations on how this filter is built.

page 6, line 18: in the definition of d_\xi why is \xi transposed?

page 6, line 25: "The Fig. 4 shows the SSS bias (ξ term of the Eq. 1). The patterns are different than the model bias (Fig. 4) and often of opposite sign but have the same magnitude..." Should that not be "Fig. 5" showing the SSS bias?

Figure 4: Please add a color-bar on Figure 4.

General comment about citation: "Following (Desroziers et al., 2005),..." should be "Following Desroziers et al. (2005),...". Please correct also other similar citation issues.

Salinity is sometimes expressed in PSS (practical salinity scale), for example page 8, line 18 and sometimes in psu (practical salinity unit), for example page 9, line 16. Please make use of the same unit.

page 8, line 26: "Fig. 9 shows the mean and standard deviation of the daily ?? [sic] or monthly differences between the (analyzed) SSS for REF and SMOSexp simulations compared to the SMOS SSS observations (non-debiased). Statistics are computed over the year 2015 for the Tropical Pacific Ocean." Daily or monthly?

page 10, line 6: "At the equator, there is an acceleration of the Warm Water Pool migration towards the east (Fig.14c) which helps the ocean-atmosphere coupling and thus the triggering of El Niño.". This is not so clear to see from the figure. Can you give the start and end latitude of the Warm Water Pool migration?

Hoevmuller -> Hovmöller (or Hovmoeller)

define acronym TIW

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