Ocean Science

Discussions

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Interactive comment on "Assimilation of SST data in the POSEIDON system using the SOSSTA statistical-dynamical observation operator" *by* Gerasimos Korres et al.

Anonymous Referee #2

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General comments

This article addresses a very specific problem for model - observation comparison of satellite SST. This question is of primary importance when assimilating skin/sub skin satellite SST to produce ocean analysis and forecasts, but also for model evaluation.

This article presents and evaluates a quite complex but promising observation operator allowing the computation of the equivalent of a satellite skin and/or sub skin SST observation from an OGCM simulation. The estimation of the skin/subskin SST is based on statistical analysis using a 1D turbulence model. Today, most of OGCM do not have a vertical resolution that allows representing skin / sub skin temperature, the first ver-

tical level thickness being in the order of a meter or 50 cm. The differences between the foundation, skin, sub skin and model first level temperature can be larger than 1°C under certain atmospheric conditions and this prevents an efficient assimilation of the satellite SST observation if just compared with the 1st vertical model level temperature.

An offline evaluation is first done comparing SEVIRI SST innovations computed using the 1st model temperature and the SOSSTA observation operator in the Aegean region. A better fit to the observations is obtained with SOSSTA, especially in summer when the diurnal cycle is larger, showing the benefit of the use of the SOSSTA operator versus the 1st OGCM level temperature.

Then experiments using the SOSSTA operator to assimilate SEVIRI skin SST in the Aegean region are presented.

The article is well written. The offline validation approach and the implementation in a data assimilation framework is well exposed. The analysis of the results is clear and goes from the validation of the assimilation process itself to the physical analysis of the region of interest, ie the Aegean Sea.

The originality of the SOSSTA observation operator compared to other approaches used today should be exposed.

The weakness of this article lies in the evaluation of the SOSSTA observation operator in the data assimilation framework. Comparison is made with simulations assimilating or not SEVIRI SST daily, considering weekly assimilation window. The comparison shows a very significant improvement of the analysis and forecasts, not only restricted to the additionally "observed" variable (the SEVIRI SST) but also the SSH and the full integrated temperature profile. As mentioned in the text, it is not possible to identify the improvements brought by the daily assimilation of SST, the use of SEVIRI SST with high spatial resolution or the use of an improved SST observation operator.

An additional experiment, with SEVIRI daily skin SST assimilated using for example

the first level model temperature as for the offline validation, is required to evaluate properly the improvement from the SOSSTA observation operator itself.

The use of sigma "model" also strongly limit the area where skin SST is assimilated due to too thick 1st layer but this point is well explained and taking into account when analyzing the results.

I would recommend a major revision before publication to overcome the lack of a proper evaluation of the SOSSTA observation operator itself in a data assimilation context.

Specific comments

- l. 63 : define explicitly the term "innovation" as it is appears for the first time in the paper here.

2.1 GOTM simulations

- 3 settings for learning: explain the physical differences that are expected to bring significantly different responses when using the operator.

2.2 CCA

- L. 124: Can you briefly justify why you choose to have a dependency of the transformation M to the wind and insolation.

3.3 Observational datasets

- L. 194: Can you give more precise description on the area where the foundation SST is not assimilated due to the thickness of the first layer?

- L. 204: the SEVIRI skin SST observations are assimilated keeping the original spatial resolution, ie 4.5km?

4.1 Offline evaluation

- Recall that the evaluation is done with the 3h frequency SEVIRI data as mentioned before l.201.

- L.296 and figure 2: The seasonal variability of the improvements due to the use of the SOSSTA seems to be counterintuitive: in winter the 1st level and skin SST may not differ as strongly as in summer with large heat fluxes and low wind conditions. Could you discuss this point?

- L.306: do you have any physical explanation for the better performance of the v2 obs operator version compared to the 3 others?

4.2 Online evaluation

Does the assessment still done with the 3h SEVERI SST?

- L344: ii) What do you mean by "on the days where no other observations are assimilated"? What is the consequence? Is the innovations for the different datasets are computed at the time of the observations (FGAT)?

- L.345: iii) . . .higher than 200. Is it a value computed over the week for a model grid cell / analysis point?

- L.349: what is the most stringent criteria in eliminating the number of assimilated observations?

- L.362: missing reference

- p.14: Table 3: Even if the SEVIRI data are not assimilated in the CTRL experiment, you still can diagnose the misfit to the analysis that can have a value lower than the innovation due to the multi-obs / multivariate properties of the DA system.

- P.19: Figure 7: the color bar is too large to highlight the improvements in most of the domain.

Technical corrections

- The reference to the figure numbers is wrong all along the text.

- The axis labels on the figures are most of the time too small. (fig. 16,. . .)

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