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Ocean Science Discussions

Interactive comment on "Using Canonical Correlation Analysis to produce dynamically-based highly-efficient statistical observation operators" *by* Eric Jansen et al.

Anonymous Referee #2

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GENERAL COMMENTS This paper essentially present a method to assimilate satellite SSTs using canonical correlation analysis (CCA); a statistical technique that permits to construct an appropriate observation operator to project the state variables of a numerical model onto observed variables. In this case the method is used to correctly assimilate measurements (satellite skin sea surface temperatures) which are not included in the set of those simulated by the model (the temperature of the first model layer) but which are physically linked to them. Based on a previous paper of Pimentel et al (2018) a 1D model (GOTM) is used to simulate high-resolution temperature profiles from which it is possible to extract temperature at the model levels (the state variable of the model) and "observed" temperatures at the sub-skin level. The skin temperature

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is obtained, from the sub-skin temperature, using the Fairall 1996. CCA OO is based on these simulate data rather than on real measurements.

Considering that skin temperature measurements are very rare, the idea to build a matchup dataset using a specialized model is quite interesting and represents a good compromise between the two extremes of using only very few in situ data or assimilate satellite skin or sub-skin SSTs as if the they were bulk SSTs.

The validation is based on the evaluation of ability of SOSSTA in reproducing the GOTM derived skin and sub-skin temperatures (fig. 3). SOSSTA is presented in what appears to be the companion paper of this paper still submitted to Ocean Sciences by the same authors. Probably, the author should better clarify the relation between the two papers, and rather than merging the two, indicate in some way that they are part I and II of a single subject.

One last, more general comment is about the fact that implications for the diurnal cycle are well discussed in the paper also in relation with satellite data in section 4 but geostationary satellite, and SEVIRI in particular, are never mentioned while they should represent an interesting source of information for the assessment of the proposed assimilation procedure. However Seviri SSTs are distributed as subskin-sst. This is clearly declared in the MSG SST reprocessing ATBD v1.1, 31/5/2016 Algorithm Theoretical Basis: “Since the coefficient of the SST algorithm are established using in-situ measurements, the retrieved SST is considered to be the sub-skin SST. One could apply a -0.17C (Donlon et al., 2002) to get the skin SST. However this offset is only a very rough conversion term valid at largescale for wind speed exceeding 6 m/sec.” (osi-saf v1.1, 31/5/2016). If this sentence is correct one should verify if IR SSTs are to be considered skin or sub-skin SSTs.

Donlon, C. J., Minnett, P. J., Gentemann, C., Nightingale, T. J., Barton, I. J., Ward, B., and Murray, M. J. (2002). Toward improved and validation of satellite and sea surface and skin temperature and measurements and for climate and research. Journal of

Climate, 15:353–359.

Overall I would say that it is a good paper that deserves to be published on Ocean Sciences doing some minor revisions as suggested in this review.

SPECIFIC COMMENTS:

Page 5, section 4 Use case: satellite SST, The authors write: “Although diurnal variability is included to some extent (Marullo et al., 2014), the vertical resolution of the OGCMs is still insufficient to fully resolve the variability of the skin and subskin ocean temperature”, To resolve Skin a sub-skin is only matter of resolution or some more physics is still needed?

Page 5 section 4.1: “The top 75 m of the water column is resolved using 122 vertical layers with fine resolution near the surface and gradually becoming coarser with depth. The uppermost 1 m contains a total of 21 layers, with the highest level at 1.5 cm depth”. Considering that 1.5 cm is not enough to resolve the skin and sub-skin can the author justify the choice of 122 vertical levels with the highest level at 1.5 cm depth? Is this due to computation capabilities or, for some numerical or physical reason, it makes no sense to use higher resolutions?

Page 6 section 4.2: “Under certain conditions the ocean skin may even cool down below the bulk temperature. “. “certain conditions” are related to latent heat loss.

Page 10, section 5, lines 7-8. “This can be explained by the cool-skin effect that is included in GOTM and which plays a role also at nighttime”. Here you can cite figure 4 of Donlon et al 2002 (see reference above),

Section 6, Discussion. The skill of CCA OO respect to some other method is measured using GOTM as a reference. As I already noted in the general comments this choice is, in some sense, obliged by the scarcity of in situ skin or sub-skin SST measurements. But, what about the possibility to use meteosat data as a reference?

Bulk SSTs at about 20 cm of depth are routinely measured by drifters. Drifter SSTs

are used to continuously assess the validity of satellite SST products, distributed by agencies or the Copernicus Marine Service (CMEMS). Can the proposed CCA OO method also contribute to adjust drifter SSTs to skin or sub-skin temperature making more correct the comparison with the satellite estimates?

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