Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2018-132-AC1, 2019

Interactive comment on "A multiscale ocean data assimilation approach combining spatial and spectral localisation" *by* Ann-Sophie Tissier et al.

Ann-Sophie Tissier et al.

ann-sophie.tissier@univ-grenoble-alpes.fr

Received and published: 21 February 2019

We thank referee #1 for his/her careful reading of the manuscript and for his/her appreciation for the work done in the paper. Comments are reproduced in bold italic to ease the reading. Text changes in the manuscript are in italics.

Answer to general comments

This paper presents a multiscale data assimilation method to take into account both large and small scales oceanic processes in an ocean operational system by spectral and spatial localisations. The paper is globally well written: most of the technical part is clear and the results are convincing.

Printer-friendly version

Discussion paper

My main questions are about the spectral transformation: 1) why the spherical harmonics transformation has been chosen? What is the strengths of this transformation compared to other spectral transformations?

Yes, we agree with the reviewer that this point was not sufficiently explained in the paper. The following paragraph has been added in section 3.2 to better justify the choice of spherical harmonics to separate scales :

"The use of spherical harmonics is not the most natural way to separate scales for fields that do not extend over the whole sphere. In principle, it would for instance be better to use the eigenfunctions of the Laplacian operator defined for the model domain. They would account for the land barriers and would display a better relation to the system dynamics. However, they would also be much more expensive to compute than the spherical harmonics, and would need to be stored and then loaded each time they are needed to separate scales. This is why we preferred using spherical harmonics in this study : they make the method numerically efficient and they are sufficient to obtain a relevant spectral decomposition of the input signal."

2) It seems that after the spectral transformation, each term (corresponding to a given wavelength of a spherical harmonic) has particularly a statistical sense, I just wonder if it also always has a physical interpretation, i.e. corresponds to an oceanic process at a specific scale. Even if so, do they really correspond to the scales observed in the data ?

Yes, they would have a clear interpretation if the domain extended over the whole sphere. As explained above (in the paragraph now included in the paper), they are used here as an efficient practical way to separate scales.

3) It is not clear to me how the observation error standard deviation along each spherical harmonics is obtained in the twin experiment. More importantly, how it can be obtained in realistic case?

In the twin experiment, the observation error standard deviation along each spherical harmonics is obtained by transforming (i) the innovation vector and (ii) the misfit with respect to the true state, and by computing the RMS difference between these two transformed vectors. This sentence has been included in the paper in section 3.3.2 to improve the explanation :
"It is then possible to evaluate the standard deviation of the observational error in the spectral domain by transforming (i) the innovation vector and (ii) the misfit with respect to the true state, and by computing the RMS difference between these two transformed vectors. More explicitly, this is done by computing the RMS between (. . .)"

In a realistic case, the above method can directly be transposed by simulating observational error in model results, and by transforming the difference between the perturbed and unperturbed data. The standard deviation of the result is then an estimate of the observation error standard deviation along each spherical harmonics. The following sentence has been added in section 3.3.2 to clarify this point. *"In a realistic case, the above method can directly be transposed by simulating observational error in model results, and by transforming the difference between the perturbed and unperturbed data. The standard deviation of the result is then an estimate of the observation error standard deviation along each spherical harmonics."*

Answer to minor questions or remarks

Minor questions or remarks :
1) In Fig. 7, why small difference exists between the black and the green curves

before the critical scale while almost no difference between the blue and the black curves after the critical scale?

The analysis increment obtained with the spatial localisation can recreate a large scale field. This impacts the large scale of the total analysis increment. On the contrary, the analysis increment resulting from the spectral localisation will only impact the result obtained for the large scales, because the scales have been treated separately by the spectral localisation. The residual field may contain a small amount of large scales that have not been treated by spectral localisation. Thus, green and black curves before the critical scale (large scales) can be more different than blue and black curves after this critical scale (residual scales).

2) many small spelling mistakes, please check

We did our best to check the manuscript again, but the manuscript has not been revised by a native English speaker.

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-132, 2018.