

Author's response to Anonymous Referee #2 Comments on 'On the resolutions of ocean altimetry maps'

Anonymous Referee (AR#2): This paper: "On the resolutions of ocean altimetry maps" uses spectral coherence between SSH maps and along-track and tide gauge SSH measurements. The calculations seem correct and the figures are interesting, but to me, this approach is complicated because it combines together the resolution of the maps and the lengthscales of the processes being imaged. For example, in the equatorial region they estimate spatial resolution at 800km, far bigger than the altimeter track spacing.

Chelton, a co-author on this paper, has done a lot of work on evaluating sampling from satellite observations of both SSH and wind (Schlax, et al., 2001), and has examined the transfer function of linear mappings (Schlax and Chelton 1992). The latter paper focuses on the effects of the mapping as a smoother of the original field, examining the resolution of the mapping independently from the length scales of the mapped fields. A similar approach could be used here, taking out the correlation of the underlying fields to focus on the smoothing done by the mapping.

This is what I expected from the analysis, and I feel that the differences should be discussed and the results presented here put in context as a combination of two effects.

I would also like to request that the authors please also address why they do not compute decorrelations in physical space and time instead of coherence. This would allow the preservation of spatial structure that is removed by the stationarity assumption built into the coherence calculation, including the averaging over large regions to get adequate coherence statistics. Since only a decorrelation distance is reported, the sacrifices needed to be able to make the coherence calculation do not seem necessary, and a region-by-region decorrelation scale could have been reported. This would still have mostly represented the scale of the SSH field, not the mapping, but it would be simpler to compute, report, and understand.

references:

Sampling errors in wind fields constructed from single and tandem scatterometer datasets. J. Atmos. Oceanic Tech., 18, 1014-1036, 2001. (Schlax, M. G., D. B. Chelton, and M. H. Freilich.)

Schlax, M. G. and D. B. Chelton, 1992: Frequency domain diagnostics for linear smoothers. J. Amer. Stat. Assoc., 87, 1070-1081.

Author's Response:

We would like to thank the Anonymous Referee #2 for taking time to read our manuscript and for providing comments. The referee pointed out 2 main concerns:

- An approach based on transfer function (Schlax and Chelton 1992) should have been done and discussed
- A calculation in physical space should have been undertaken (a region-by-region decorrelation scale could have been reported)

Following the study by Dufau et al. (2016), who estimated the along-track resolution using spectral approach, we have made the choice to pursue the investigation of the maps resolution also using spectral approach. We agree with the reviewer's comment stating that an approach based on the estimation of the transfer function could have been undertaken and discussed. Hence, we propose to extent our analysis and compare our estimation of the effective resolution with the methods based on the transfer function for the estimation of the resolution capabilities. A paragraph is added in the Appendix A to discuss about the difference between the two approaches, as well as other approach such as the spectral magnitude ratio.

More importantly, following the comment made by referee #3, we redefined the effective resolution based on the Noise to Signal spectral ratio (PSD mapping error / PSD_along_track), which is more robust than the spectral coherence. This ratio (PSD mapping error / PSD_along_track) verifies both the phase and the amplitude consistency between the two signals considered, whereas the spectral coherence focuses only on the phase consistency. The main conclusions of the paper are unchanged. We also illustrate that this change of definition has a weak impact on the results since the signal amplitude is globally optimal at the wavelength where the phase becomes incoherent. In response to reviewer #3, several test cases based on Observing System Simulation Experiment have been conducted and are freely available and interactively repeatable here: <https://mybinder.org/v2/gh/mballaro/notebook.git/master> (under the analysis_OSSE_NATL60 folder). They are also available at the end of the response to referee #3. These test cases show that the Magnitude squared coherence and Ratio PSD error/PSD along-track are in good agreements, meaning the phase consistency is the dominant factor controlling the "quality" of the DUACS maps.

The spectral coherence estimates the correlation for each specific wavelength. The correlation in physical space is hence the integral of the spectral coherence. Computing the correlation in physical space would hence give strong value since the large-scale signal is globally well mapped in the DUACS system.