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Potential for temporal aliasing in satellite-derived SSS measurements

Nadya Vinogradova and Rui Ponte
AER, Inc., Lexington, MA, United States (nadya@aer.com)

Two salinity remote sensing satellite mission, SMOS and Aquarius/SAC-D, are intended to provide global mapping of sea surface salinity (SSS) fields over the next few years. To obtain global coverage and to minimize instrument errors, ocean products are provided as temporal and spatial averages of the satellite salinity retrievals —typically monthly means on ∼150-200 km grids. One issue of relevance for the satellite-derived products is the potential for temporal aliasing of short scale fluctuations into the climate (monthly-averaged) values of interest. With orbit repeat cycles of 7 and 10 days for Aquarius and SMOS respectively, variability at periods shorter than the Nyquist periods of 14 and 20 days will alias into longer periods. Thus, the question arises as to whether potential aliasing error is large enough to affect the accuracy of 0.2 psu that is quoted for the final satellite salinity products.

To assess potential aliasing in satellite salinity records, we analyze global SSS numerical estimates that resolve variability down to daily periods and also compare the results with those based on a few available in situ measurements. The numerical estimates are based on HYCOM output from a global, eddy-resolving, high-resolution model run constrained to a variety of ocean data sets. For comparison, we also use daily salinity series collected at several in situ stations from the TAO (Tropical Atmosphere Ocean) moorings provided by NOAA/PMEL. Based on the HYCOM daily time series, over many oceanic regions, a significant part of the total salinity variability is contributed by rapid fluctuations at periods aliased in the satellite retrievals. Estimates of the implicit aliasing error are derived, suggesting that removal of aliased signals, if possible, could reduce errors in monthly mean salinity estimates by as much as 0.05 psu on average and >0.1 psu in some coastal, tropical, and western boundary current regions. In some cases, the in situ data analysis shows that the impact of rapid variability on monthly SSS values can be even higher than that estimated based on HYCOM solution. Some differences could be attributed to short-scale spatial structures (fronts, eddies) removed by the spatial averaging of the HYCOM fields onto 1-degree grid to be comparable to typical satellite salinity resolution. However, at some stations rapid variability based on in situ data exceeds that computed based on full high-resolution (1/12 degree) HYCOM fields, suggesting that the aliasing errors based on model output could be an underestimate.