A blending algorithm using SST data to improve SMOS SSS maps

Data fusion is a process for combining two, or more, sources of information to improve the representation of a given system. In a recent paper, data fusion has been used to remove noise from SMOS sea surface salinity (SSS) products, by fusing SMOS data with sea surface temperature (SST) fields.

Our approach is justified by the correspondence between the singularity exponents of SSS and SST. The singularity exponent is a non-dimensional measure of the regularity or irregularity of a field in a given point. The value of the singularity exponent increases with the smoothness of a field. The correspondence between the singularity exponents of SST and SSS implies the existence of a local functional dependence between these two variables. This correspondence can be illustrated using data of a numerical simulation (OFES, Ocean General Circulation Model for the Earth Simulator).

Figure 1 shows two conditioned histograms. The one in the top illustrates the histogram of SSS conditioned by each given value of SST. The conditioned histogram looks like a superposition of narrow lines. It indicates that, while strong local SSS-SST correlations exist, these relations do change from one region to the other. On the contrary, the conditioned histogram of SSS singularity exponents conditioned by the value of the singularity exponents of SST indicates that a unique correlation exists all over the world ocean. In fact, the slope of the maximum probability line is close to one, indicating an almost perfect identity between the singularity exponents of SST and SSS.

The correspondence of the singularity exponents reveal that **a local relationship between the gradients of SST and SSS exists**. However, as the functional relation between the two gradients is under-determined, additional constraints are required. In Umbert et al. (2013), a scalar relationship is supposed, leading to a rather simple fusion algorithm.

Figure 2 shows the standard deviation of the difference between various SMOS SSS products and in situ SSS values retrieved from Argo profiles. The top map corresponds to the Level 3 binned product. The average standard deviation of the differences is about 0.53. The middle map corresponds to the Level 3 Optimal Interpolation product. In this case, the average standard deviation is 0.26. Finally, the bottom map corresponds to the Level 4 Fusion product built using SST maps from OSTIA (Operational Sea Surface Temperature and Sea Ice Analysis). The average standard deviation is 0.21, illustrating the improvements lead by our data fusion approach.

Despite of the drawbacks of the strong simplifications used in our algorithm, considerable improvements in the quality of the SSS maps derived from SMOS data are obtained.

Details of the algorithm (being used to create the current version of the BEC Level 4 SSS product) can be found in M. Umbert et al. (2013), New blending algorithm to synergize ocean variables: The case of SMOS sea surface salinity maps, *Remote Sensing of Environment* (DOI:10.1016/j.rse.2013.09.018).

Marta Umbert