Adaptive tuning of observational errors in the forthcoming Copernicus Marine Service global ocean monitoring and forecasting real-time system

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Brief description of the method

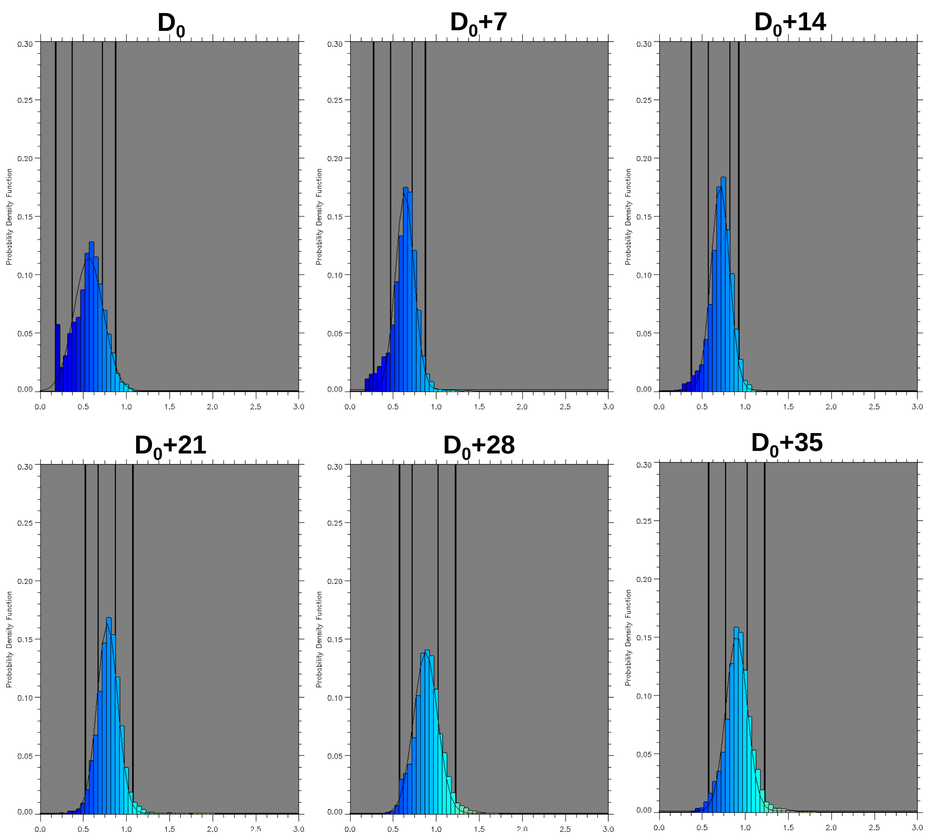
The prescription of observation errors in the assimilation systems is often too approximate. For this reason, we started at Mercator Ocean, to develop and adapt diagnostic proposed by Desroziers in 2005. This diagnostic consists in the computation of a ratio which is a function of observation errors, innovations and residuals. It helps to identify inconsistency on the specified observation errors. The objective of this diagnostic is to improve the error specification by tuning an adaptive weight coefficient acting on the error of each assimilated observation. The objective of this diagnostic is to improve the error specification by tuning **an adaptive weight coefficient α** acting on the error of each assimilated observation. Either for SLA or SST, we improve the performances of the system using this adaptive tuning. It allows us to have more realistic and evolutive observations errors maps which can provide valuable support to space agencies.

$$\text{ratio} = \frac{E\,[\,\text{residual (innovation)}^T\,]}{\alpha\, R}$$

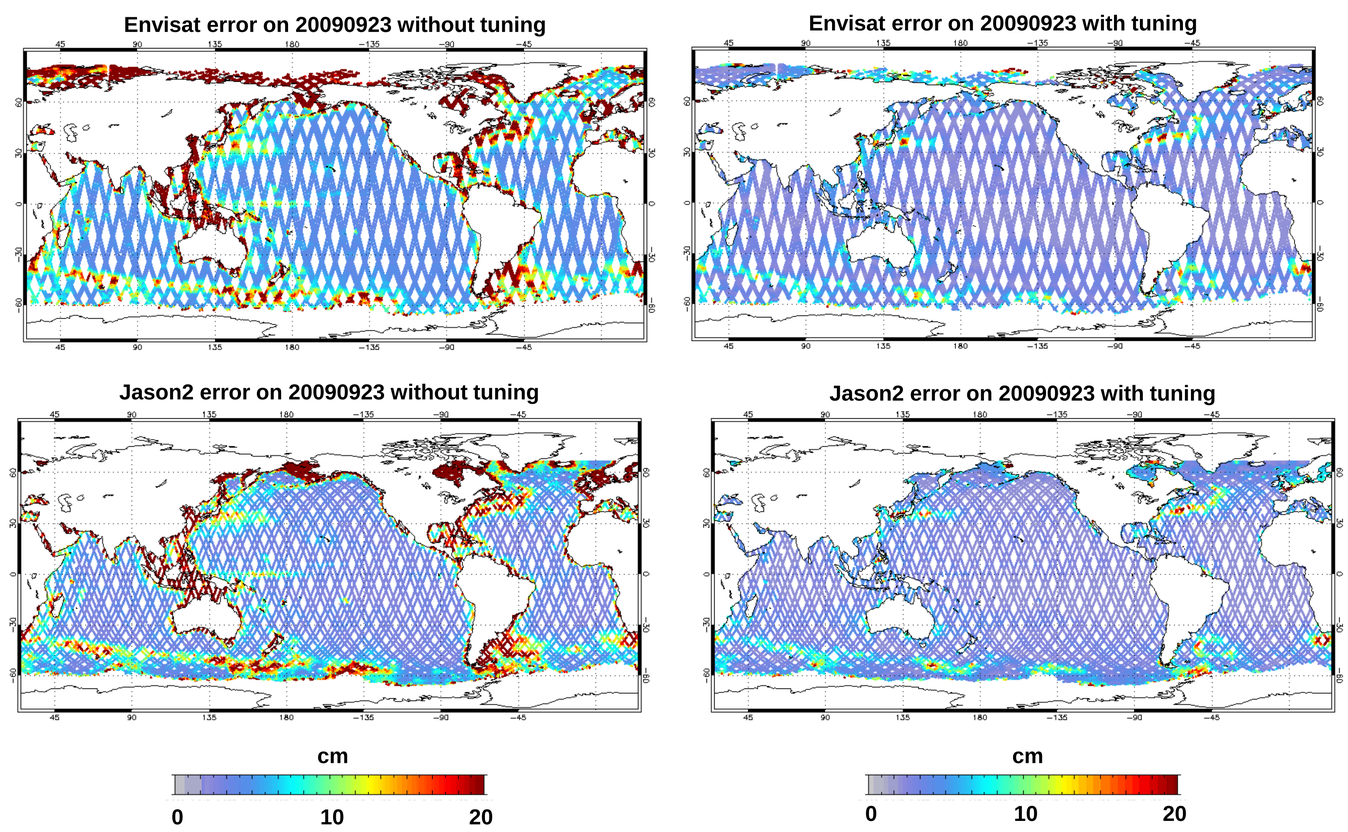
- Ideally, ratio=1
- ratio < 1 => obs. error overestimated
- ratio > 1 => obs. error underestimated

Adaptive tuning of SLA observation error

The *a priori* prescribed observation error is globally greatly reduced. The median value of the error changed from 5cm to 2.5cm in a few assimilation cycles and allows for better results.

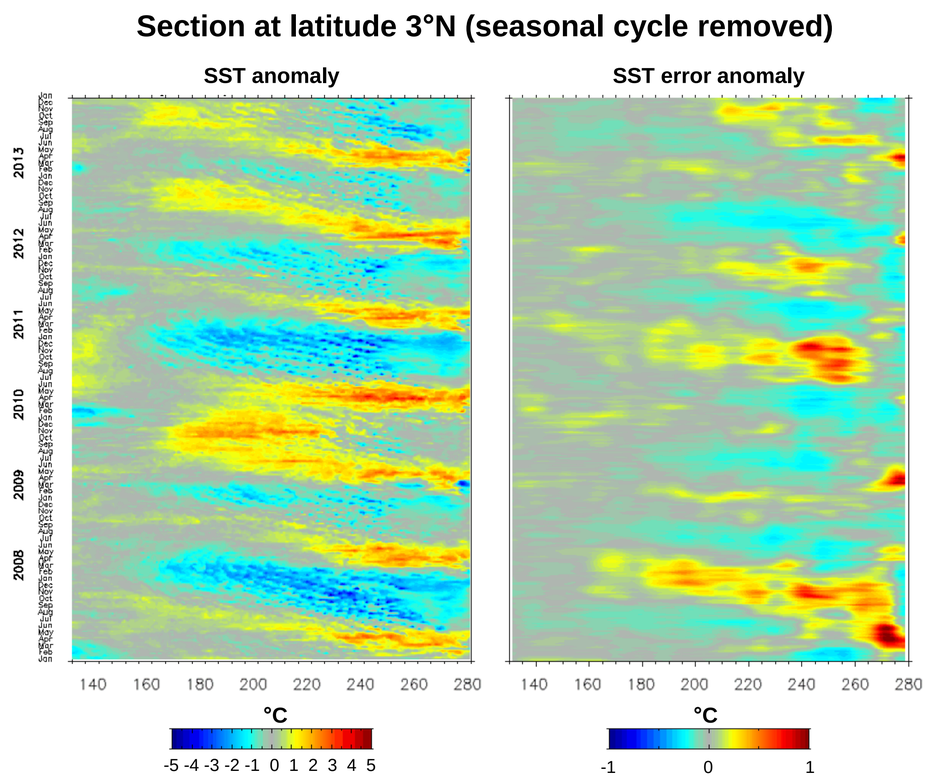


Evolution of the pdf of the ratio for Envisat satellite



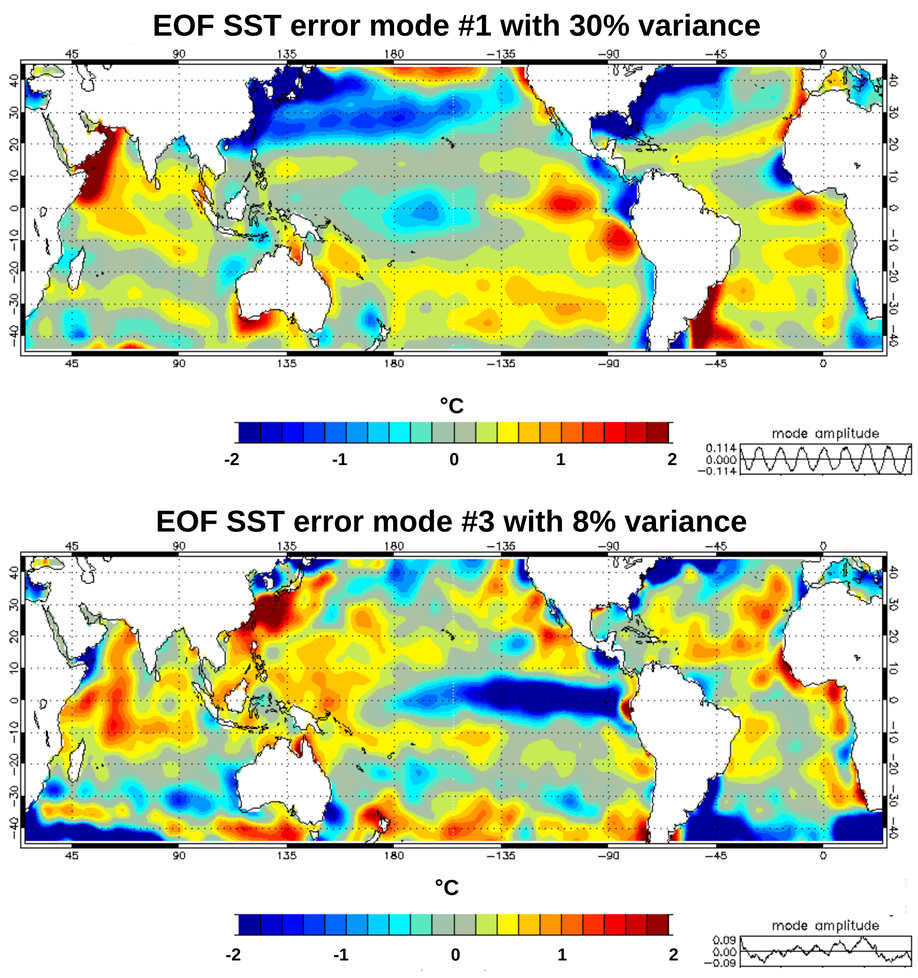
Adaptive tuning of SST observation error

For the SST, we added the constrain to maintain the median value of the error to 0.4°C. The spatial distribution of the SST error follows the model physics and atmospheric forcing.



The SST anomalies in the equatorial Pacific clearly show the propagation westwards of TIW in the second half of the year. This is more pronounced during episodes of La Nina (late 2007 and 2010-2011).

The error anomalies estimated by "Desroziers method" show that the error increases when these TIWs are more marked. When model SST and OSTIA SST are smoother, the error decreases.



Mode 1 is associated to the seasonal cycle.
Mode 3 is associated to the interannual signal ((La Nina → El Nino).

The SST error adapts both to the seasonal and interannual fluctuations.

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