Reducing altimetry small-scales errors to access (sub)mesoscale dynamic

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Abstract

The purpose of along-track spatial filtering applied to Sea Level Anomalies currently distributed through AVISO and MYOCEAN is two-fold: (1) removing the non-oceanic small-scales signals (error, noise) and (2) keeping ocean dynamics that can be monitored by the satellite constellation. If it is suited for computing afterwards maps of SLA over the global ocean, it is clearly too radical for applications focused on (sub)mesoscale dynamics. We revisit the along-track filtering applied to SLA by using spectral analysis to determine the mesoscale capability of 12. This paper focuses on the small-scales errors contained in SLA and on the spectral slope estimation. A new specification of filtering cut-off length to reduce these errors and access (sub)mesoscale dynamics is detailed as well as an estimation of the remaining error to be prescribed in data assimilation systems that will use this new data.

A new along-track spatial filtering on high level SLA

The global MyOcean AVISO along-track SLA are filtered differently with latitude (210km near Equator, until 55km at high lat) linked to the ability of Topex/Poseidon mission to capture mesoscale structures, (le Traon and Dibarboure 1999).

To provide higher resolution along-track SLA to MyOcean and DUACS users, the future generation of high-level SLA (March 2014) will be filtered taking into account the mesoscale capability computed for the Jason-2 1hz SLA (Figure 4) but first with a unique cut-off length of 65km.

At low latitudes, it will change drastically the content of SLA profiles as cut-off lengths will be reduced from more than 100km in this region (Figure 5).

Future products will provide higher resolution SLA profiles below 30° in latitude (Figures 6a and 6b) and a noise reduction at latitude higher than 40° (Figure 6c).

Additional meso-scale dynamics will be added at low latitudes (Figure 7b), future products will follow original energy until a length scale of 80km approx. In the Gulf Stream area (Figure 7a), less impacted by this filtering change, future products will nevertheless give access to smaller scales.

Residual Error in altimeter high-level SLA (for modelers)

Instead of a constant value, data assimilation systems should a map of SLA observation errors. For users of non-filtered SLA : a map of the 1hz estimated white noise (Figure 2). For users of future DUACS SLA : a map of the remaining error level after filtering is estimated (Figure 8).

In addition to these maps, a dependency to the coastal distance (+ 1 cm rms from 60 to 10 km) have to be added. Ideally, these error maps should be estimated separately for each altimeter and for different periods of the year to follow error change with time.

Future products will be available in March 2014 both in RT (MyOcean V4 release) and OT (DUACS reanalysis). More details on these products, see * SSALTO/DUACS: The Reprocessing of the 20 Years of Data is On Going * (Pujol et al) and * SSalts/DUACS: The Jason1 / Altika unexpected handover * Faugere et al.

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Aims: a map of remaining altimeter SLA noise after a 65km spatial filtering (cm rms)

Figure 5: Change in cut-off lengths [km] in spatial filtering with future SLA product (future values – current values)

Figure 6: along-track SLA profiles along track 122 (Atlantic area) over 3 sections

Figure 7: Mean wavenumber Spectra

Figure 8: Map of remaining altimeter SLA noise after a 65km spatial filtering (cm rms)

Figure 2: Noise Level in 1Hz Jason-2 SLA estimated from mean wavenumber spectra over 2011 in 1°x1° boxes (cm rms)

Figure 3: Spectral slope (with opposite sign) estimated in different mesoscale band using SLA. Mean Spectra computed over 70°-20°N. a) between 320 and 100km, b) between 100 and 250km, c) and d) being estimated after theoretical noise removal.

Figure 4: Mean wavenumber spectra in the mesoscale band, between two wavenumbers k1 and k2, the spectral slope is estimated by a least squares regression. At high wavenumbers, between k=20km and k=4k=20km, the noise level is estimated as the mean value of energy in this band.