~ On the resolution of ocean altimetry maps ~

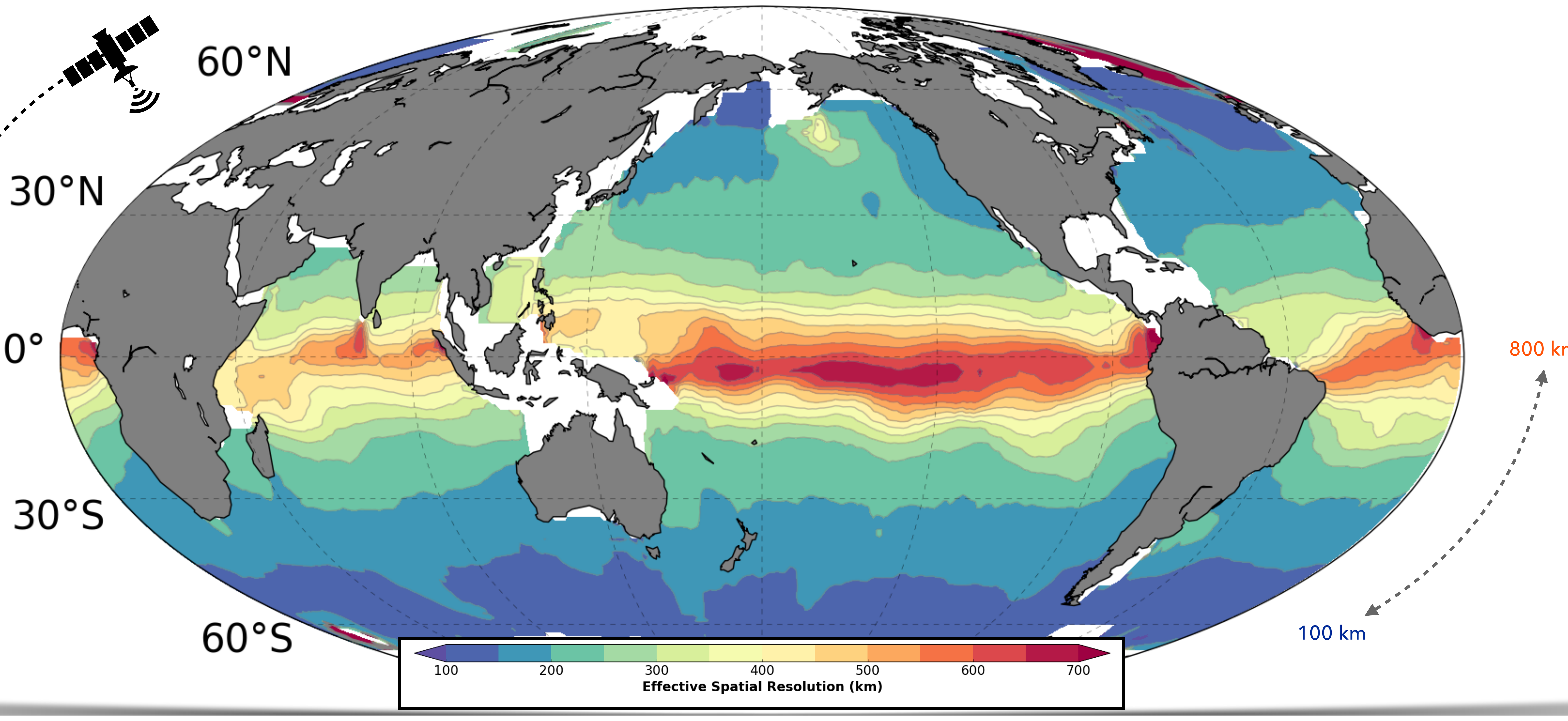
by the DUACS Team

2018 Ocean Surface Topography Science Team Meeting

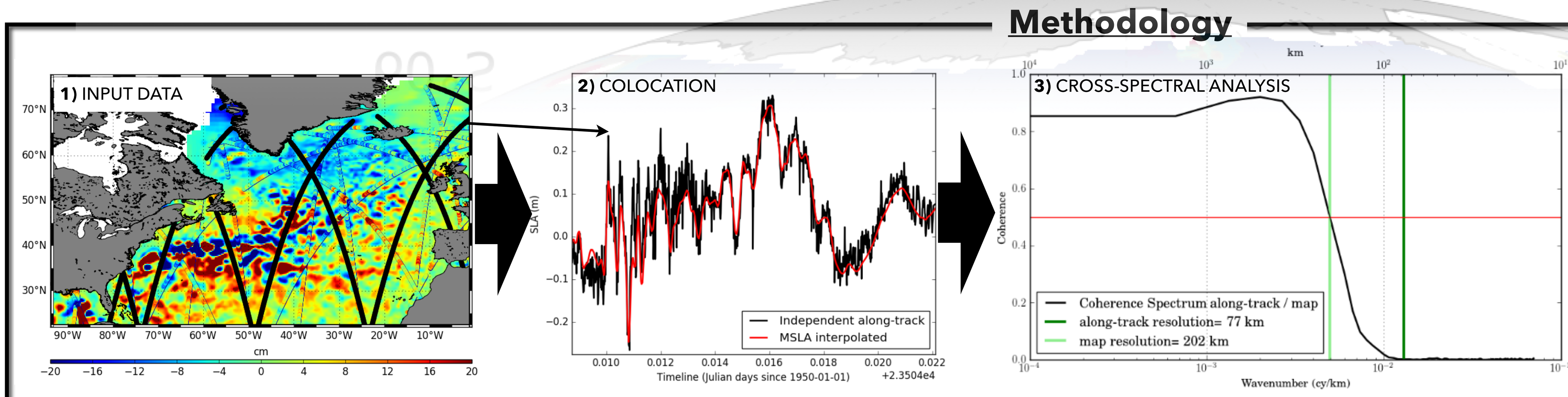
CONTEXT

The **DUACS** system produces multi-mission **altimetry sea level global and regional maps** that serve oceanographic applications, climate forecasting centers, geophysics and biology communities. These maps are constructed from **optimal interpolation** of along-track altimetric observations and are provided on a global 1/4°x 1/4° (longitude x latitude) and daily resolution framework through the Copernicus - Marine environment monitoring service (http://marine.copernicus.eu/). Yet, the **dynamical content of these maps is not ensured to have a full 1/4° spatial and 1-day resolution**, due to the filtering property of the optimal interpolation. *We here present an assessment of the effective resolution of the DUACS global maps*.

DUACS-DT2018 MAP RESOLUTION in km



Methodology

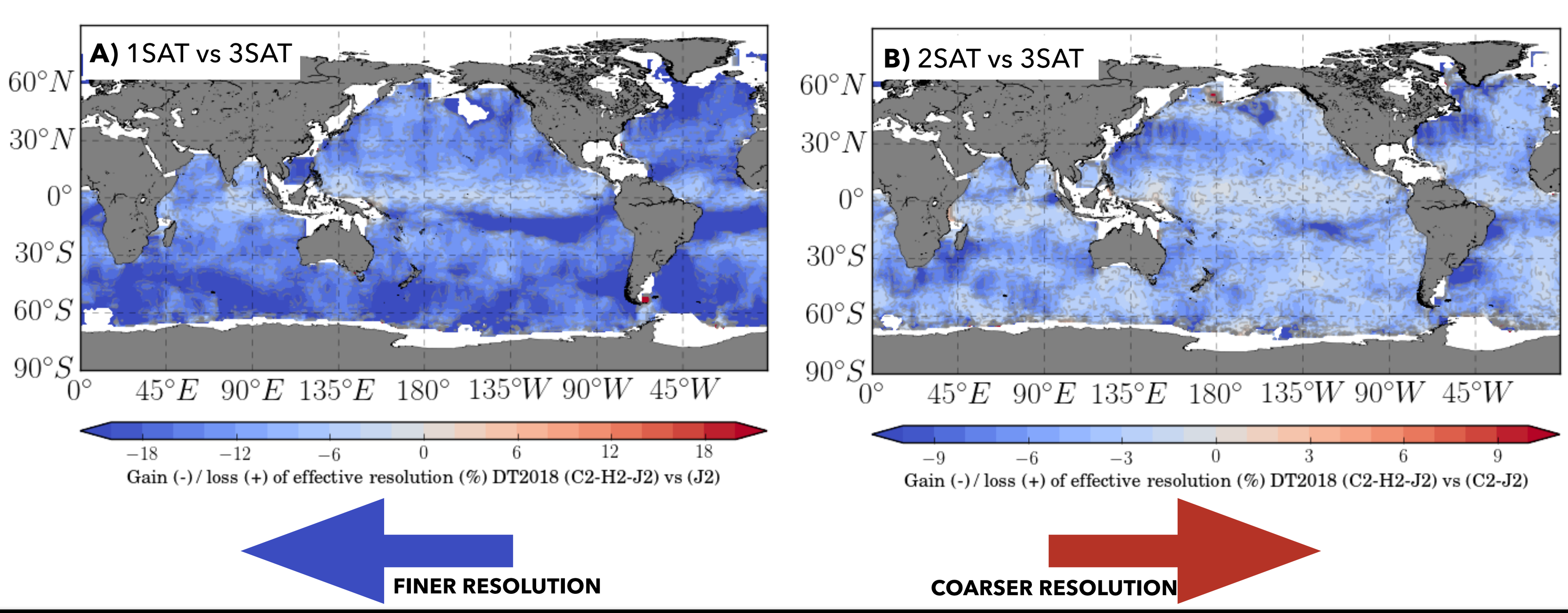


1) Input data selection: **gridded SLA** (color) and **independent along-track** (black track line)

2) Colocation : gridded data are **interpolated** onto the independent along-track

3) Cross-spectral analysis: **magnitude square coherence (MSC)** computation in 10°x10° lonxlat boxes from the power spectral densities and cross spectral densities. Prior to spectral computation, signals are detrended and we applied a Hanning window. **The effective resolution is then given by the wavelength where the MSC is 0.5.**

Impact varying satellite constellation



Several studies showed that at least two altimeters are required to accurately map the SSH mesoscale structures (Le Traon and Dibarboure 1999; Ducet et al. 2000; Pujol and Larnicol 2005; Dibarboure et al. 2011) and up to four altimeters are required for Near-Real-Time products (Pascual et al. 2006). **The present study reinforces these findings and quantifies the increased resolution capability with the number of satellite**. The resolution becomes significantly **finer (> 20%)** from maps constructed with **one** altimeter **to** maps constructed with **three** altimeters (Fig. A)). The resolution capability increased **~10-20%** at regional scale from **two to three** altimeters merging (Fig. B)).

Le Traon, P.Y.; Dibarboure, G. Mesoscale mapping capabilities from multiple altimeter missions. J. Atmos. Ocean. Technol., 16, 1208–1223, 1999

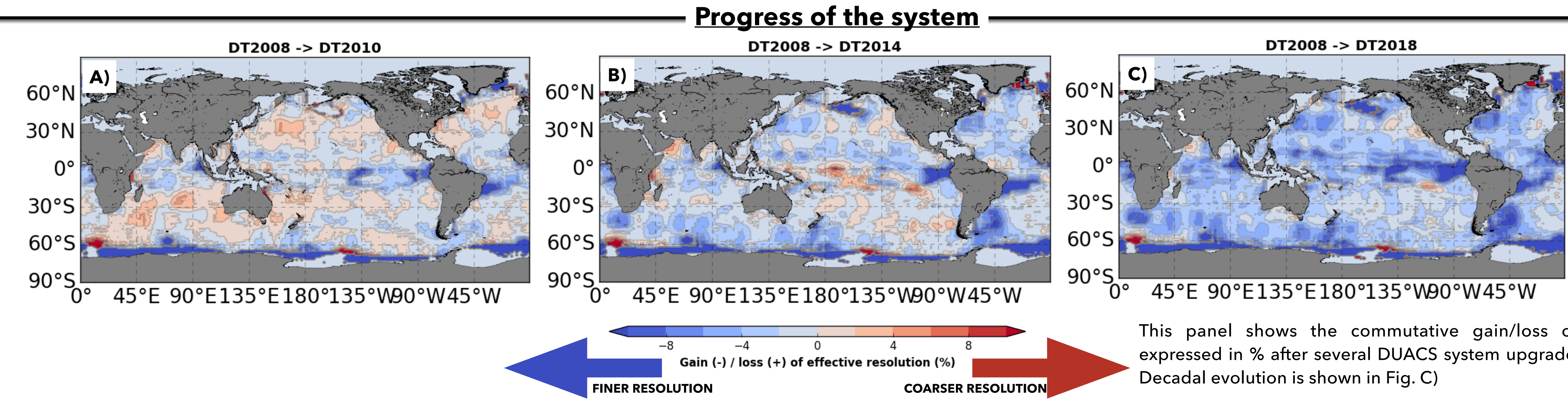
Ducet, N., Le Traon, P-Y, and Reverdin G.: Global high-resolution mapping of ocean circulation from TOPEX/Poseidon and ERS-1 and-2, Journal Of Geophysical Research-oceans , 105(C8), 19477-19498, doi:10.1029/2000JC900063, 2000

Pujol, M. I., & Larnicol, G. 2005. Mediterranean Sea eddy kinetic energy variability from 11 years of altimetric data. Journal of marine systems, 58 (3-4), 121–142

Pascual, A., Y. Faugere, G. Larnicol, and P.-Y. Le Traon, 2006:Improved description of the ocean mesoscale variability by combining four satellite altimeters.Geophys. Res. Lett.,33,L02611, doi:10.1029/2005GL024633

G. Dibarboure, M.-I. Pujol, F. Briol, P. Y. Le Traon, G. Larnicol, N. Picot, F. Mertz & M. Ablain (2011) Jason-2 in DUACS: Updated System Description, First Tandem Results and Impact on Processing and Products, Marine Geodesy, 34:3-4, 214-241, DOI: 10.1080/01490419.2011.584826

Progress of the system



This panel shows the commutative gain/loss of resolution expressed in % after several DUACS system upgrade since 2008. Decadal evolution is shown in Fig. C)

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This study investigates the **resolving capabilities of the DUACS gridded products** delivered through the CMEMS catalogue. Our method is based on the **spectral coherence** and is similar to the approach proposed by Yale et al. (1995) or Smith (2015) to estimate along-track resolution. While altimeter **along-track resolves scales in the order of few tens** of kilometers (e.g., Dussurget et al., 2011, Dufau et al. 2016), we found that the merging of these along-track data into continuous maps in time and space leads to effective resolution ranging from ~800km wavelength at the Equator to 100km wavelength at high latitude. Considering that eddies radius characteristic can be estimated as one-fourth of the wavelength, it means that ~25km radius structures are properly resolved in the maps at high latitude and ~200km radius structures are resolved in the Equatorial band. This diagnostic also confirms the **increase of resolving capabilities in the DUACS maps with the number of altimeter** and illustrates the cumulative gain/loss of resolution between successive DUACS system generations since 2008. The gridded product **resolution becomes** globally **finer** (mean global gain of 10% since 2008, regional resolution gain > 10%) **upgrade after upgrade** (*Ballarotta et al. : On the effective resolution ocean altimetry maps, in prep)*

Dufau,C., Orsztynowicz, M., Dibarboure, G., Morrow, R. and P.-Y. Le Traon: Mesoscale resolution capability of altimetry: present and future, J. Geophys. Res., Oceans, 121 (7), pp. 4910-4927, doi: 10.1002/2015JC010904, 2016

Dussurget, R., Birol, F., Morrow, R. and P. De Mey: Fine Resolution Altimetry Data for a Regional Application in the Bay of Biscay, Marine Geodesy, 34:3-4, 447-476, doi: 10.1080/01490419.2011.584835, 2011

Yale, M.M., Sandwell, D.T., and W.H.F. Smith: Comparison of along-track resolution of stacked Geosat, ERS-1 and Topex satellite altimeters, Journal of Geophysical Research, 100 (B8):15117–15127, doi: 10.1029/95JB01308, 1995

Smith, W.H.F. : Resolution of Seamount Geoid Anomalies Achieved by the SARAL/AltiKa and Envisat RA2 Satellite Radar Altimeters, Marine Geodesy, 38,644-671, doi: 10.1080/01490419.2015.1014950, 2015