



Evaluation of CTOH new along-track tidal constants database for dealiasing coastal altimetry over the North-West European continental shelf

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Motivations

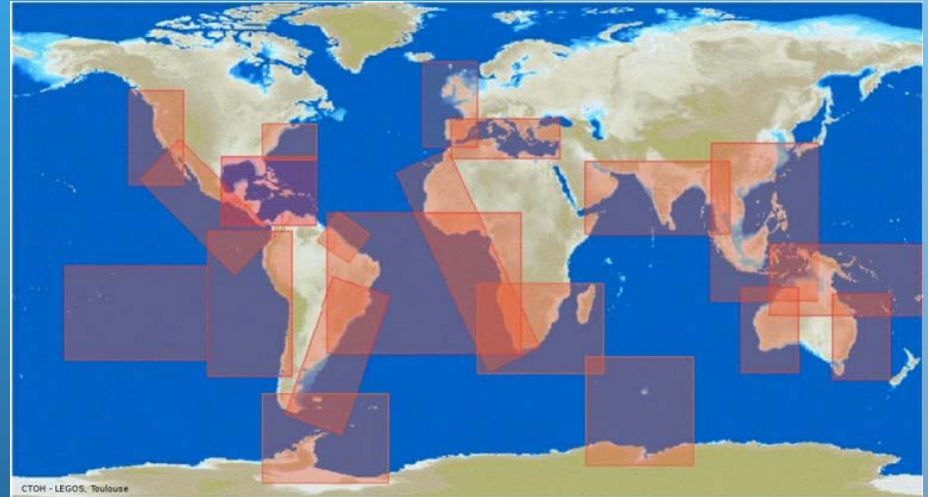
- Tidal observations are needed/useful for
 - Ocean tides direct mapping (e.g. Ray *et al.*)
 - Model assessment (e.g. Shum *et al.* this session)
 - Data assimilation (e.g. Carrère *et al.* this session)
 - Model OBC forcing (e.g. Lyard *et al.*)
- Assess the potential use of tidal constants for dealiasing coastal/shelf altimetry
 - residual errors in tidal model over shelves ($o(20\text{cm})$) imply residual errors on SLA over coastal and shelf seas
 - Is there an improvement when applying a harmonic prediction using tidal constants instead of a model?

CTOH coastal databases

- CTOH data centre provides the community with SLA over 20 coastal and shelves seas, with a specific processing accounting for altimeter usual limitations and shortcomings (X-TRACK)

<http://ctoh.legos.obs-mip.fr/products/coastal-products/coastal-products-1/sla-1hz>

- Since a couple of months, CTOH also provides the 'tidalist' community with large collection of tidal constants estimates over these 20 coastal and shelves seas



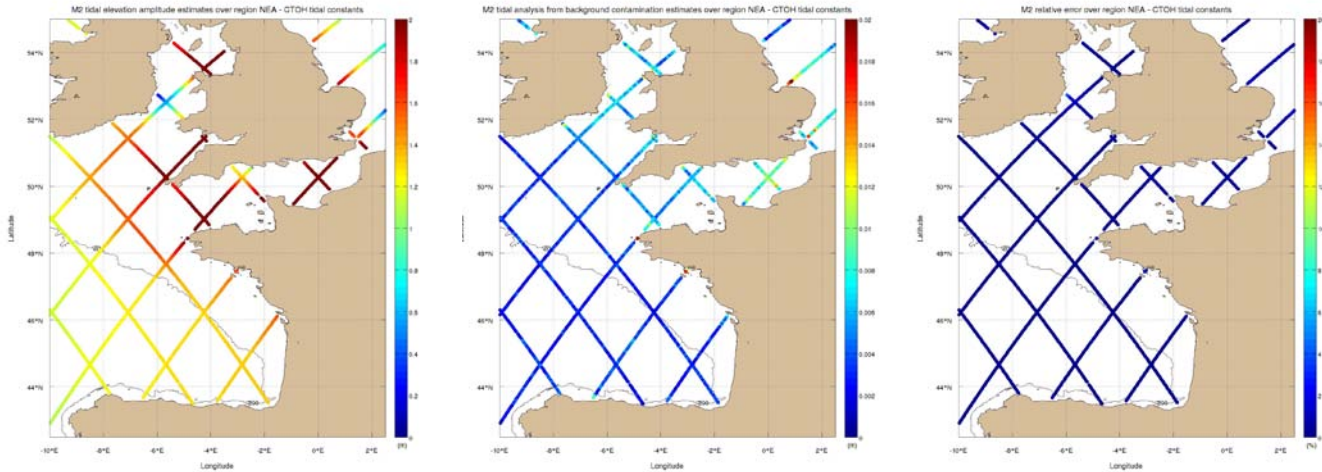
CTOH along-track tidal constants product details

<http://ctoh.legos.obs-mip.fr/products/coastal-products/coastal-products-1/tidal-constants>

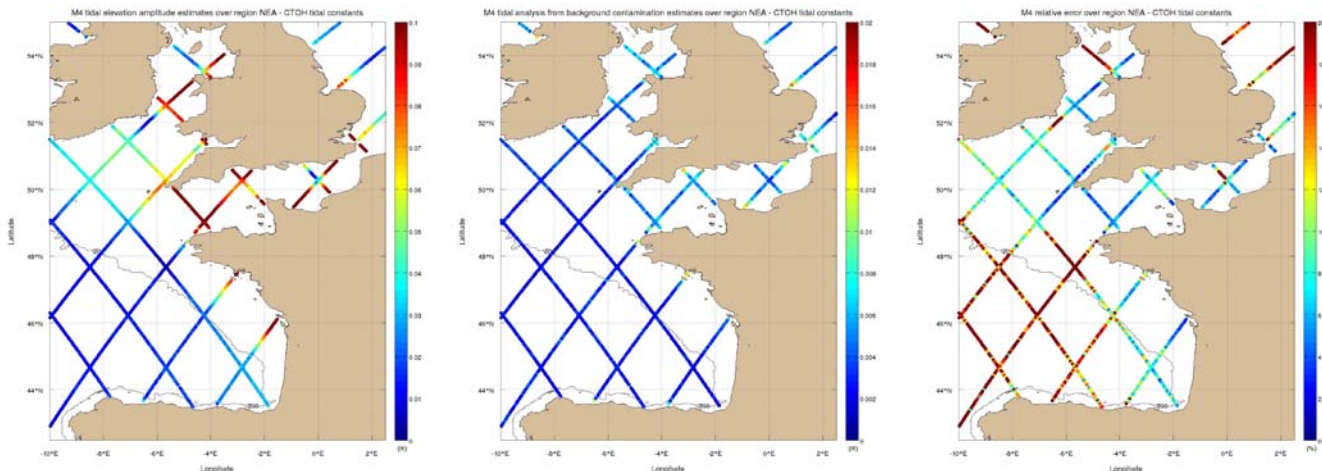
- 20 areas (coastal and shelf seas), more on demand
- Harmonic analysis of long-term coastal SLA
 - Full corrected X-TRACK SLA, excepted for ocean tides
 - Remove/restore a prior estimate (FES2004)
 - TP+J1+J2 times series greater than 300 cycles
 - TPN+J1N time series greater than 50 cycles (used for this study only but not distributed by CTOH yet)
- contains: tidal elevation amplitude, phase lag and error estimates (based on non tidal signal contamination) for a large spectrum:
 - 73 constituents for TP+J1+J2, including non linear and secondary constituents
 - 22 constituents for TPN+J1N

Product overview over Euro. shelf

M2



M4



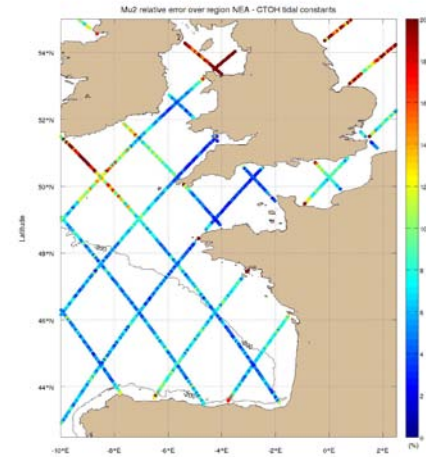
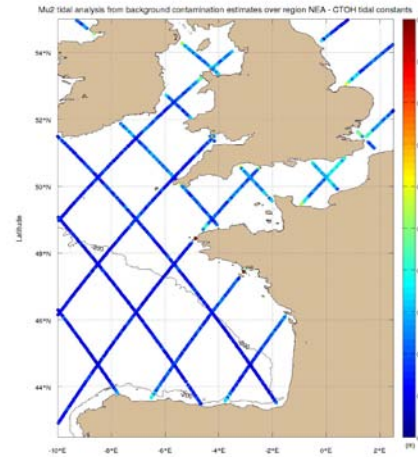
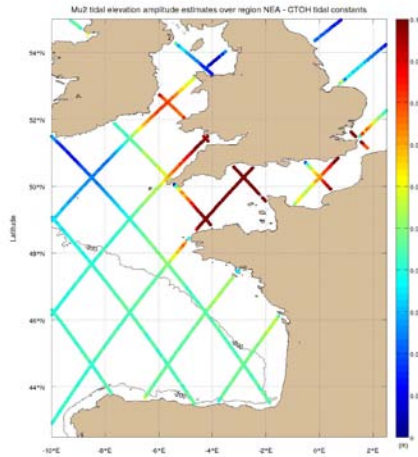
Amplitude (m)

Error (m)

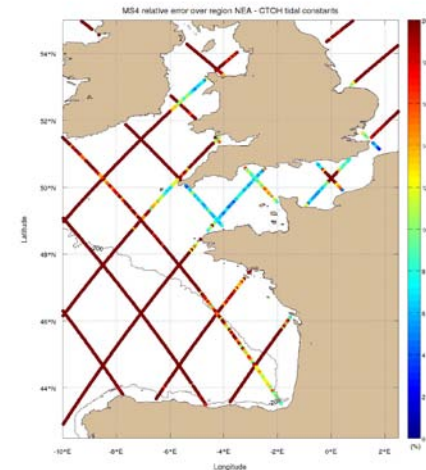
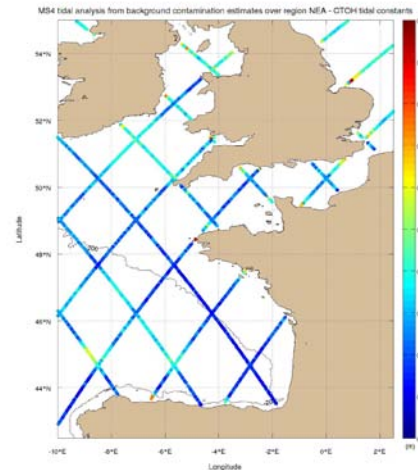
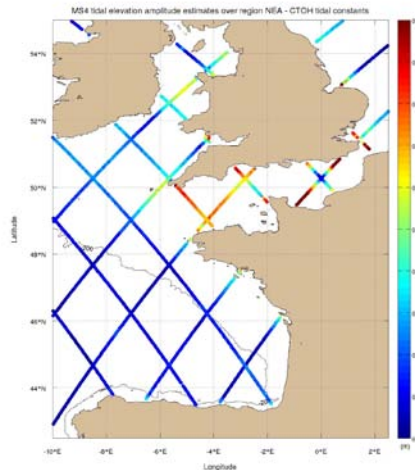
Relative error (%)

Product overview over Euro. shelf

μ_2



MS_4



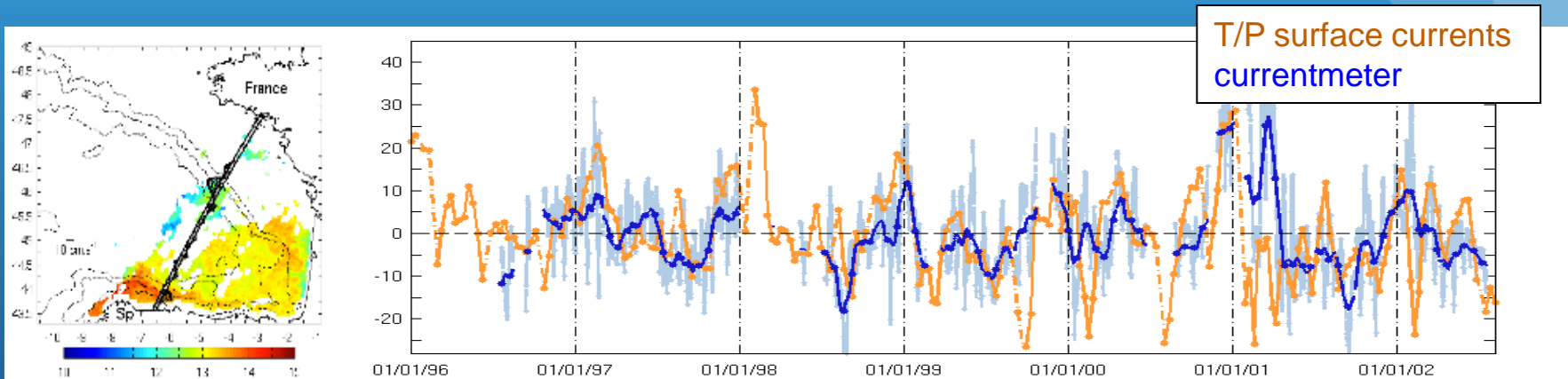
Amplitude (m)

Error (m)

Relative error (%)

Motivations

- Observing river density currents, wind-driven circulation, residual tidal currents... with altimetry remains challenging: residual errors in tidal model over shelves imply residual errors on SLA over coastal and shelf seas



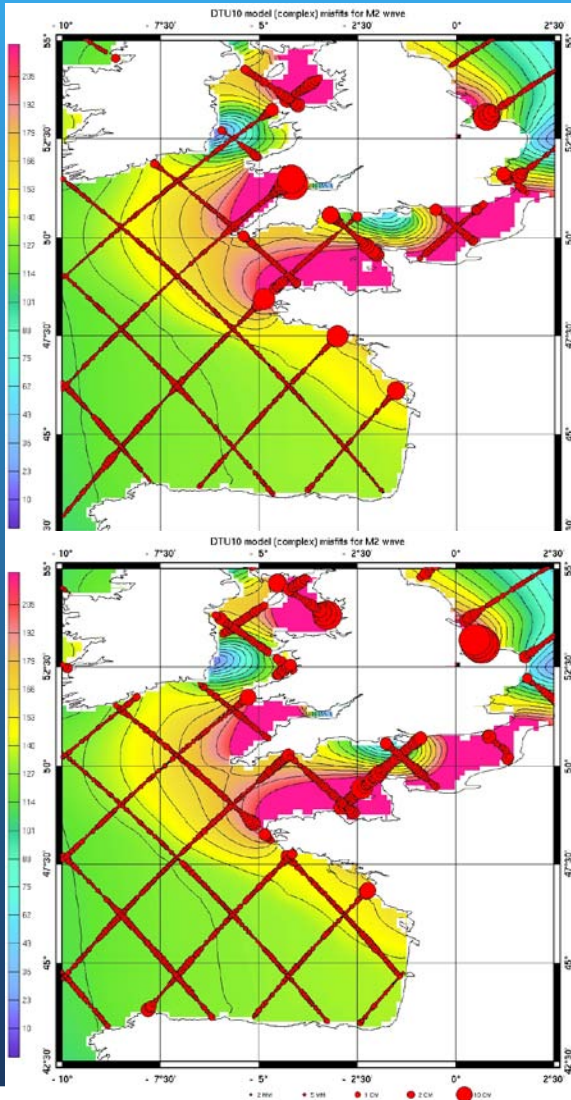
Le Hénaff et al., (2011) Characterizing the Navidad Current interannual variability using coastal altimetry

- Can the brand new CTOH tidal constants database provides valuable inputs for setting up an empirical tidal correction over the NW European shelf?

Methodology

- Tidal constants product assessment with respect to existing tidal models over the NW European shelf
- Coastal SLA variance reduction applying an empirical tidal correction and GOT4.7 tidal correction
- Coastal SLA time series comparisons to tide gauges measurements

Data assessment: M2 tide



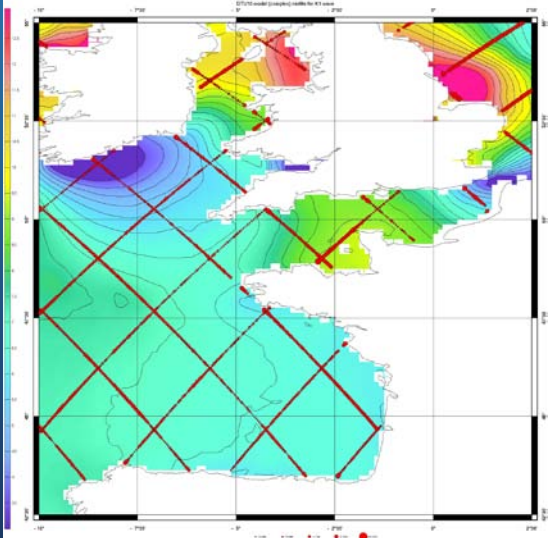
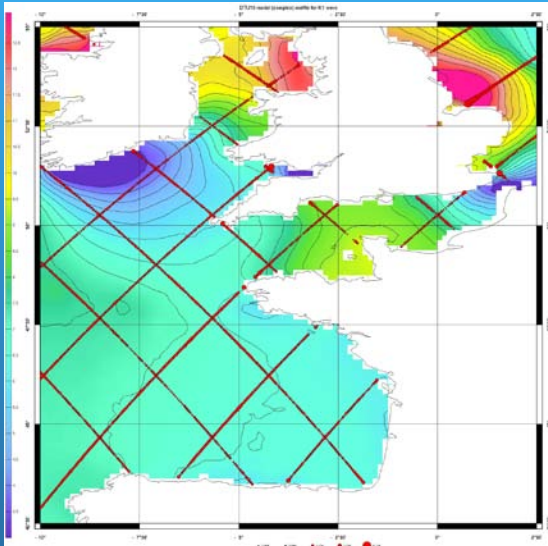
FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.4 +/- 3.0	0.3 +/- 2.9	0.3 +/- 2.0	0.2 +/- 2.0	0.2 +/- 1.2

Reference orbit: complex misfits to models (cm)

FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.6 +/- 3.5	0.4 +/- 3.2	0.3 +/- 2.0	0.1 +/- 3.3	0.2 +/- 1.3

Interleaved orbit: complex misfits to models (cm)

Data assessment: K1 tide



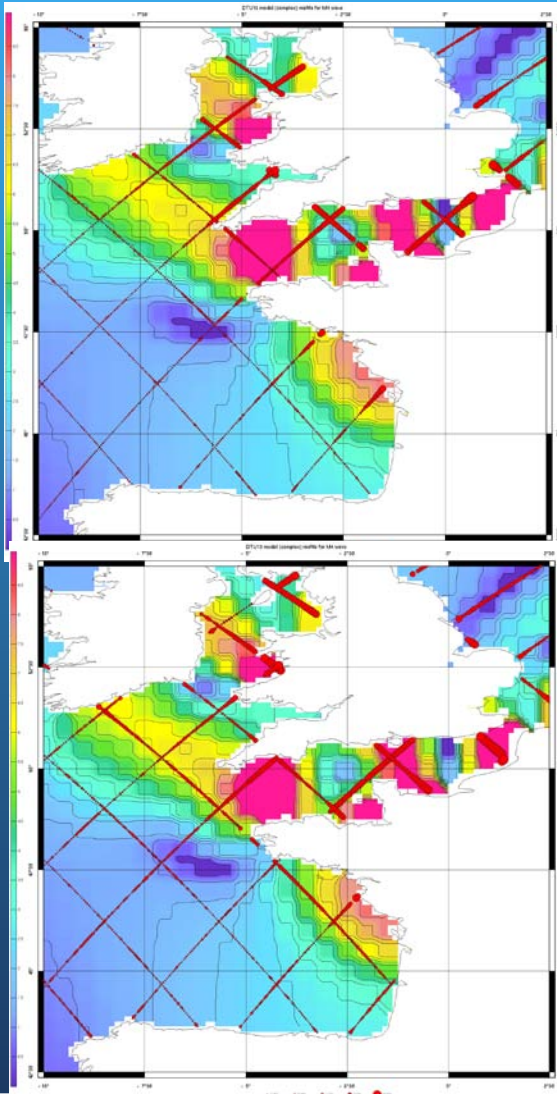
FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.8 +/- 0.7	0.8 +/- 0.7	0.8 +/- 0.6	0.3 +/- 0.7	0.8 +/- 0.6

Reference orbit: complex misfits to models (cm)

FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.7 +/- 1.1	0.8 +/- 0.7	0.8 +/- 1.0	0.4 +/- 1.1	0.8 +/- 1.0

Interleaved orbit: complex misfits to models (cm)

Data assessment: M4 tide



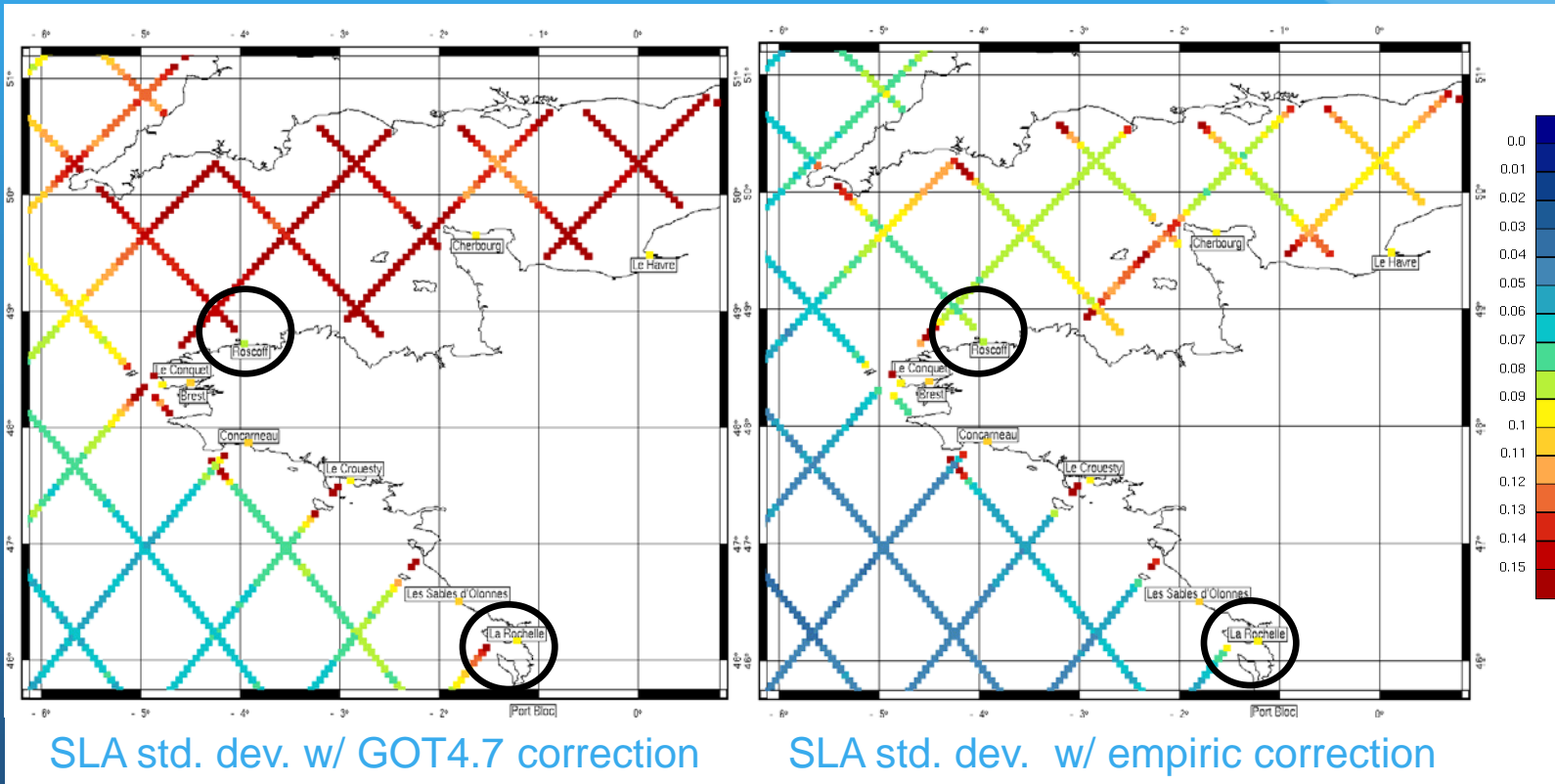
FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.1 +/- 2.4	0.1 +/- 1.2	0.1 +/- 1.2	0.2 +/- 1.2	0.0 +/- 1.1

Reference orbit: complex misfits to models (cm)

FES2004	GOT4.7	DTU10	COMAPI	FES2012
0.1 +/- 3.0	0.2 +/- 1.7	0.1 +/- 1.7	0 +/- 1.2	0.1 +/- 1.4

Interleaved orbit: complex misfits to models (cm)

SLA standard deviation

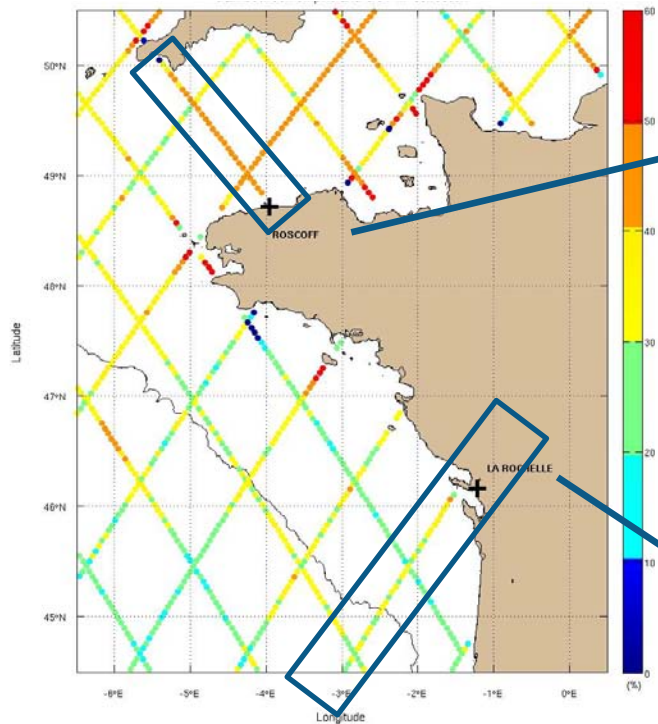


Tide gauges sea level provided by SONEL (France) and Puertos del Estado (Spain) and processed consistently

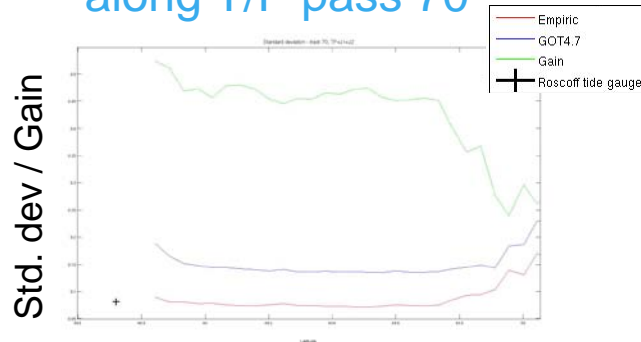
- SLA standard deviation is dominated by a shelf-block pattern when applying GOT4.7 tide correction
- Coastal features emerge when applying the empirical tide correction

SLA standard deviation reduction

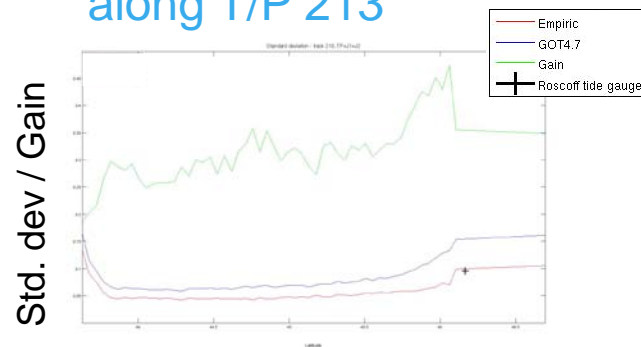
Gain (%) in std. dev reduction



along T/P pass 70

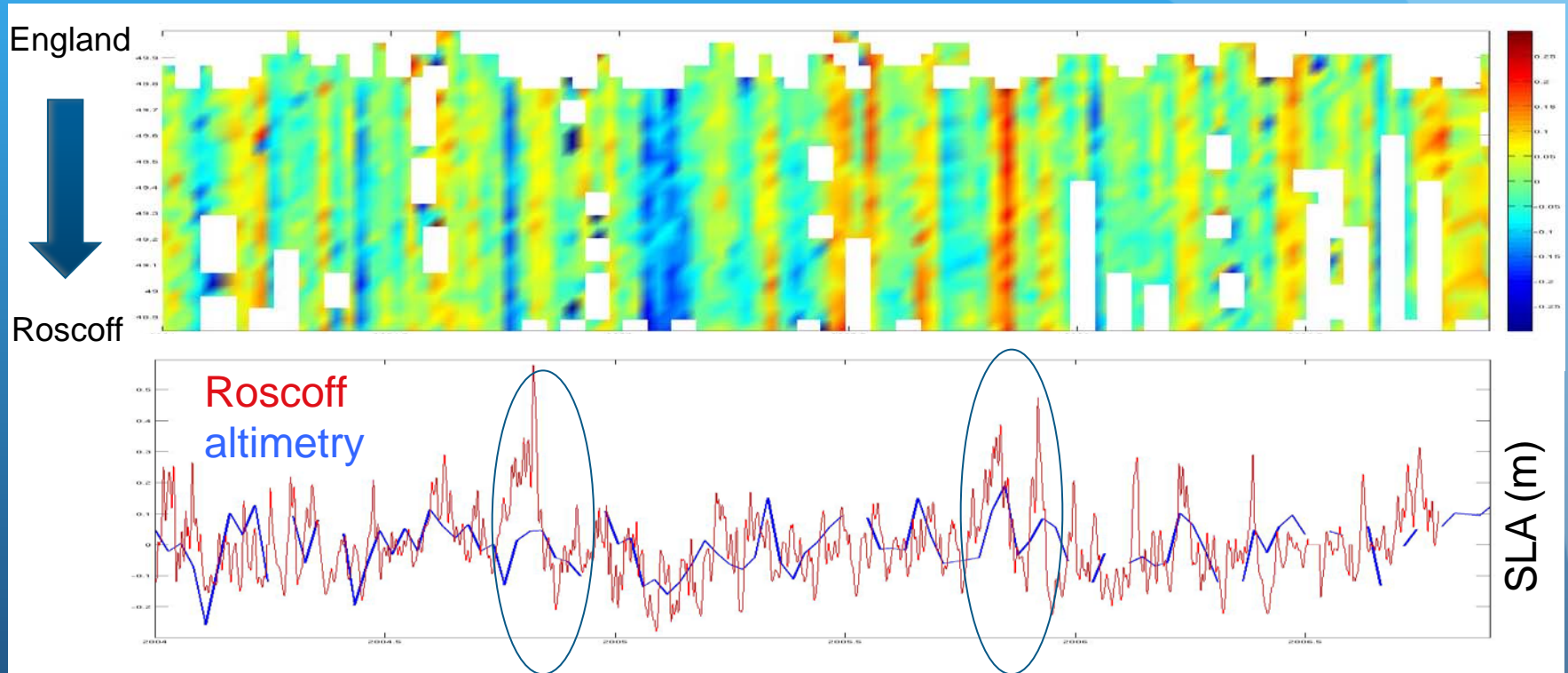


along T/P 213



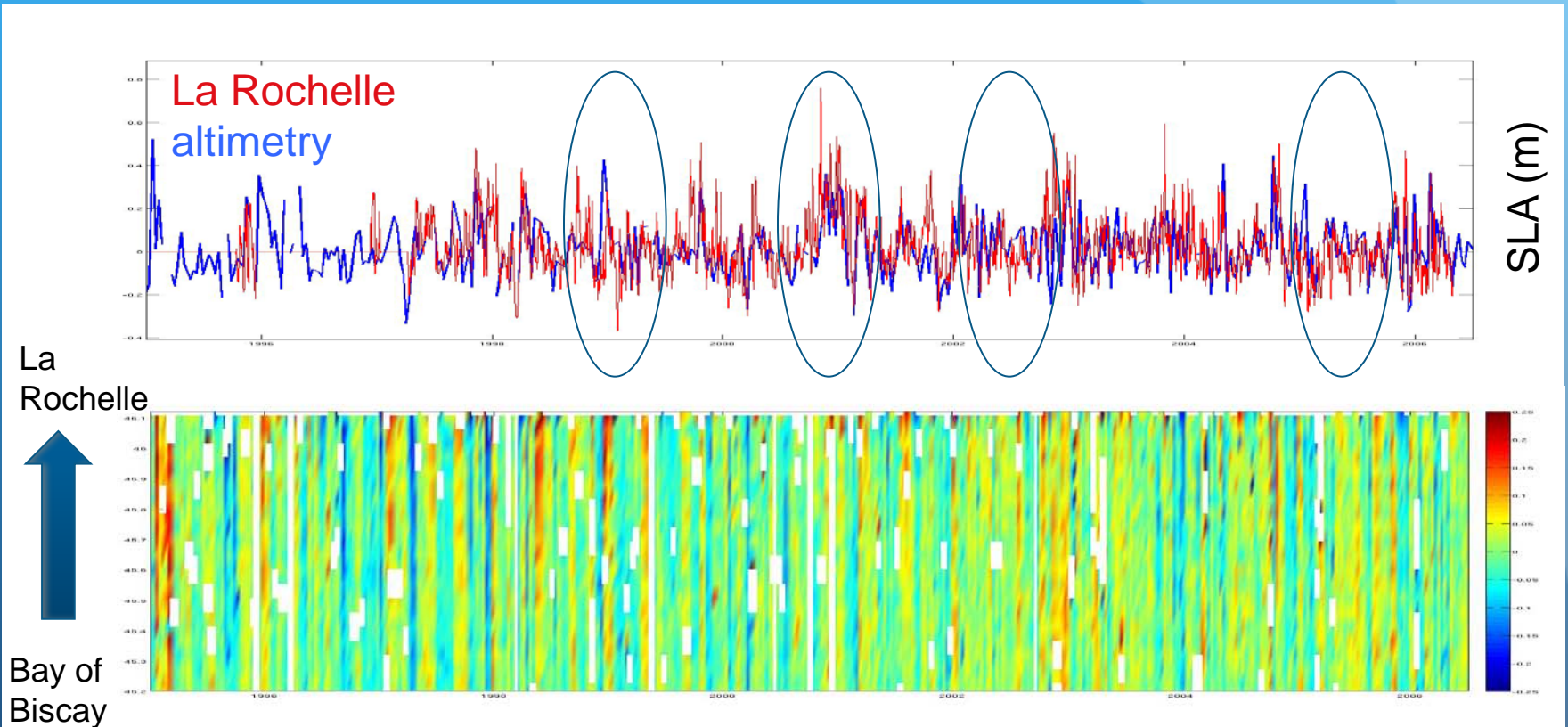
- Overall gain in std. dev. reduction when applying the empirical correction
- SLA applying empirical correction become more consistent with tide gauges in terms of std. dev.
- Are time series good enough for studying local dynamics?

SLA comparisons at Roscoff



- SLA time series exhibit qualitative agreement at infra seasonal time scales
- Short-term extreme events are not well reproduced, probably wind-induced

SLA comparisons at La Rochelle



- SLA time series exhibit qualitative agreement at infra seasonal time scales
- Short-term extreme events are not well reproduced, probably wind-induced
- Some SLA overestimation

Summary & perspectives

- CTOH data centre releases tidal constants and error estimates over 20 coastal and shelves seas

<http://ctoh.legos.obs-mip.fr/products/coastal-products/coastal-products-1/tidal-constants>

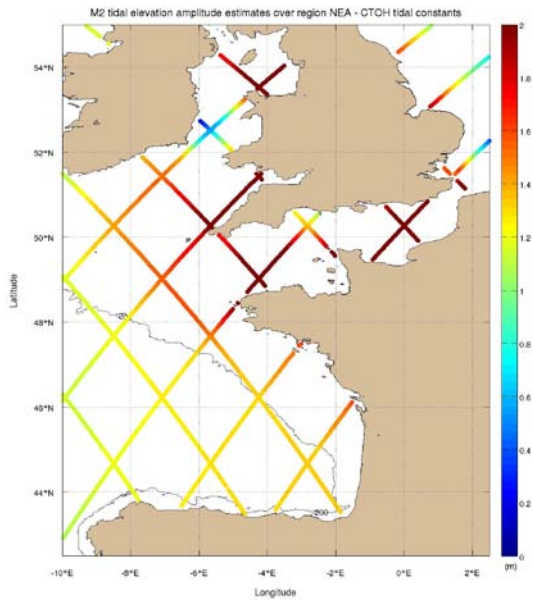
- As a particular application, this tidal constants database has been used for dealiasing X-TRACK coastal SLA over the NW European shelf, using a harmonic prediction as tidal correction
- Preliminary comparisons shows statistical and qualitative agreement with respect to tide gauges sea level measurements
- Lots of work still remains
 - Update tide gauges time series and use currentmeters time series for a quantitative assessment of this dataset for dynamics studies
 - Identify time scales observable and quantify residual errors
 - Characterize coastal currents variability and transports
- Proposed collaboration with V. Kourafalou's team (RSMAS) within OSTST current call

Thanks for attention

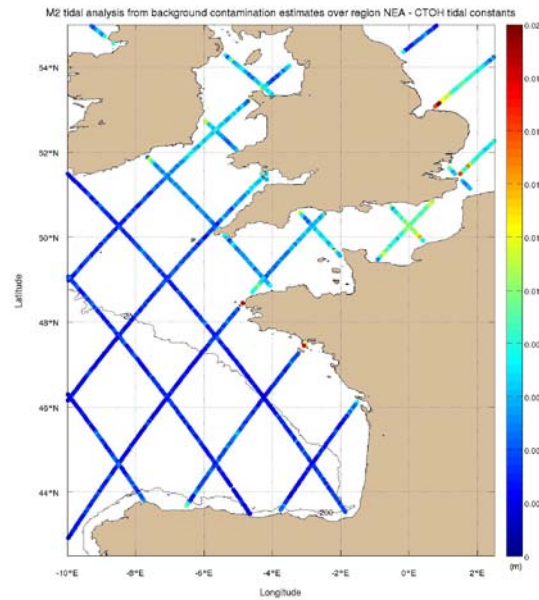
NW European shelf dynamics

- Strong influence of tides
- Wind circulation
- Navidad current
- Autumn current
- River plume density current
- Tidal residual currents

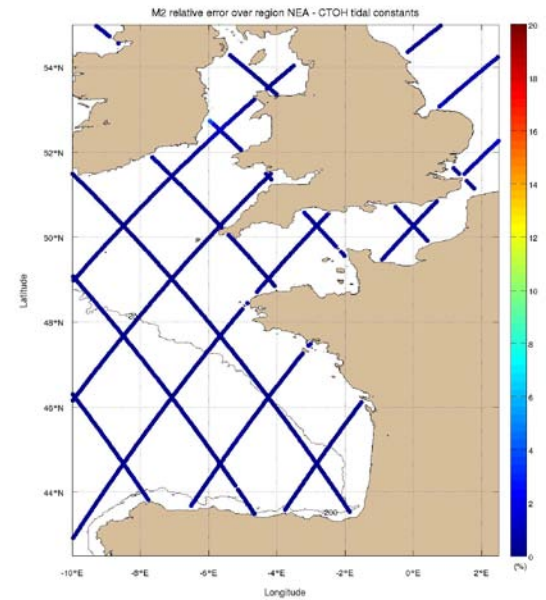
M2 tides over NW Euro. shelf



Amplitude (m)



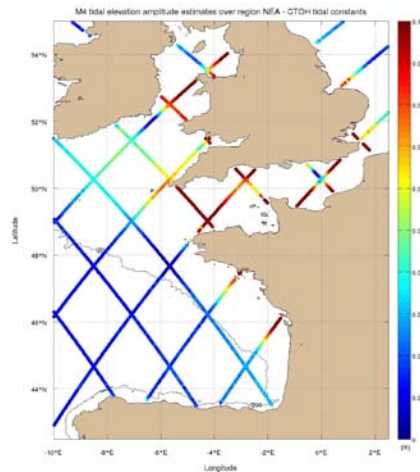
Error (m)



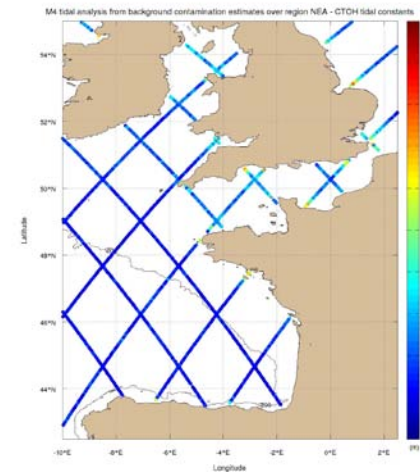
Relative error (%)

M4 tides over Euro. shelf

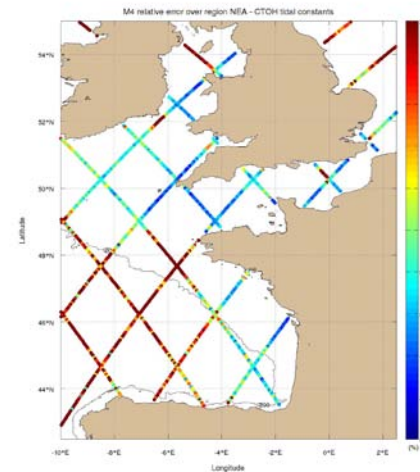
Reference orbit



Amplitude (m)

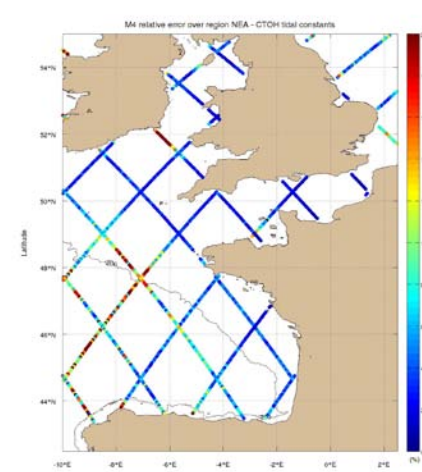
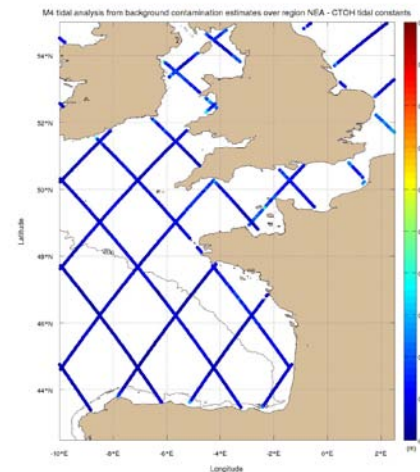
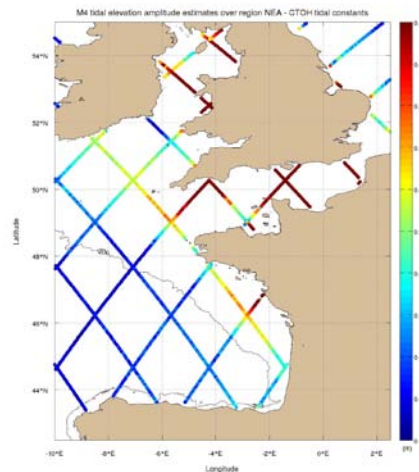


Error (m)



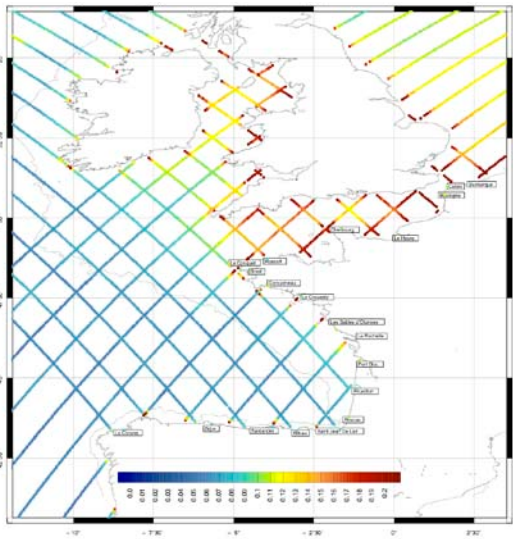
Relative error (%)

Interleaved orbit

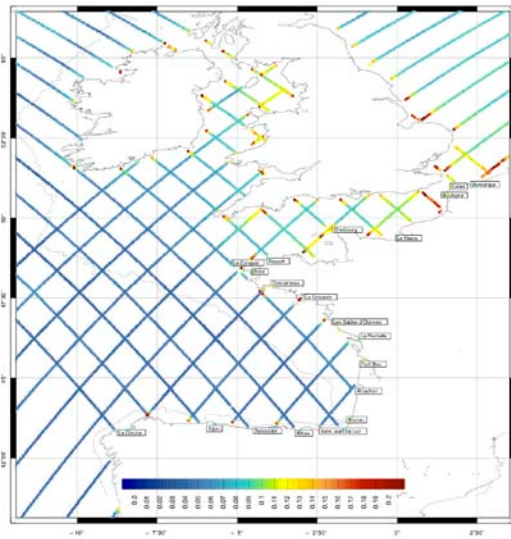


Dealiasing altimetry

Standard deviation of X-TRACK SLA (cm)



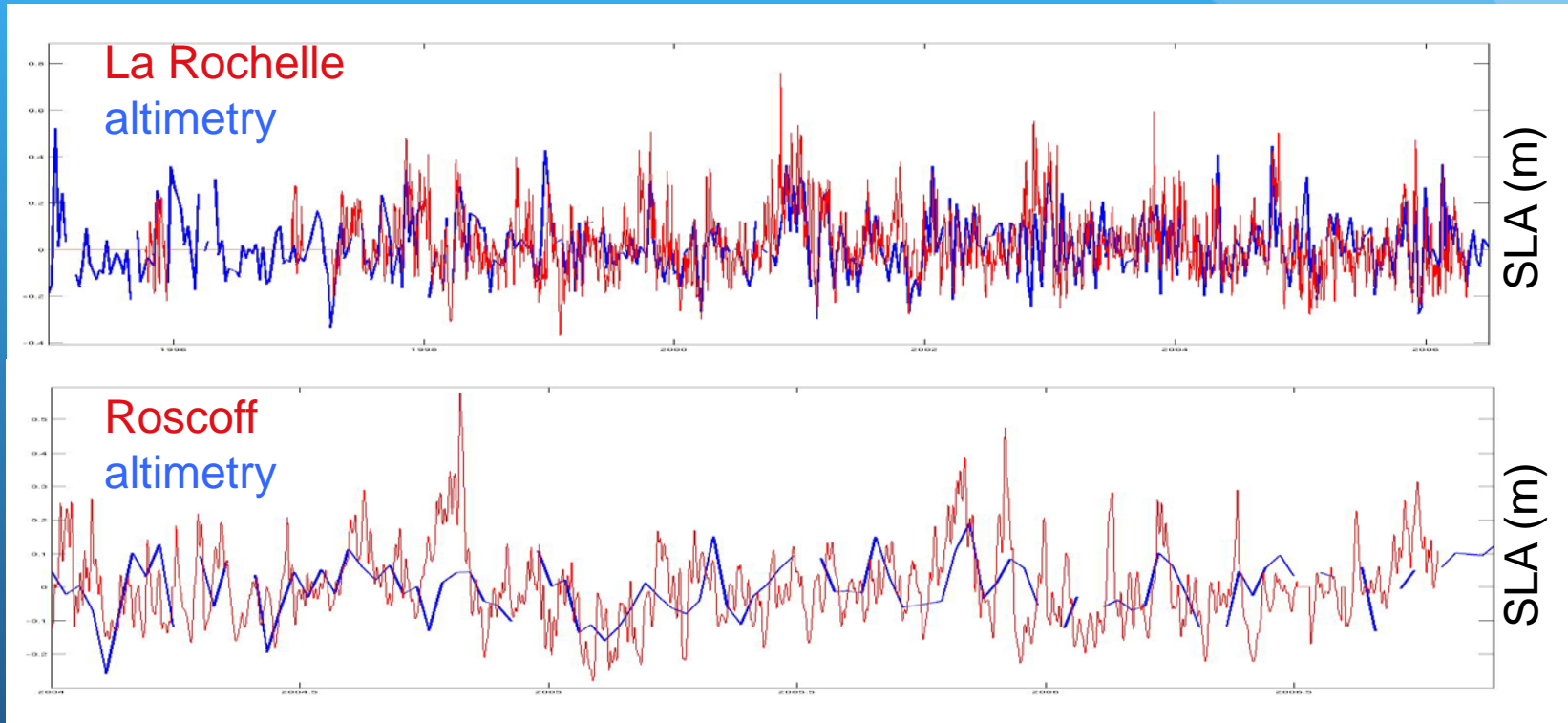
w/ GOT4.7 tide correction



w/ empiric tide correction

Tide gauges provided by SONEL (France) and Puertos del Estado (Spain) and processed consistently

SLA comparisons at tide gauges



- preliminary comparisons of SLA time series exhibit qualitative agreement at infra seasonal time scales
- short-term extreme events are not well reproduced, probably wind-induced
- some altimeter SLA overestimation