CTOH ALTIMETER DATA SERVICE

APPLICATIONS BASED ON REGIONAL ALTIMETER PRODUCTS

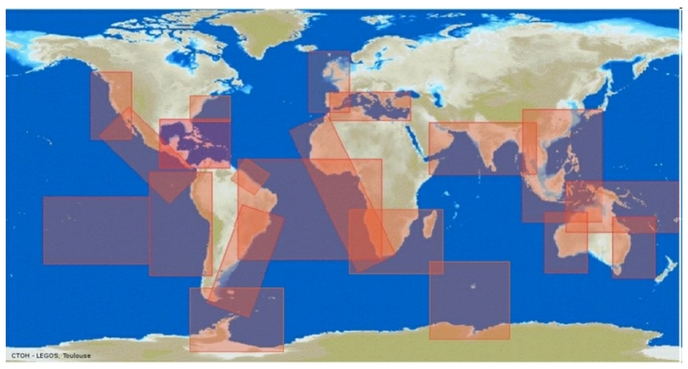
C. Delebecque, R. Dussurget, F. Birol, L. Roblou,
R. Morrow, S. Fleury, F. Niño, B. Picinbono

Established in 1989, the **Center for Topographic studies of the Oceans and Hydrosphere (CTOH)** is a french national observation service dedicated to satellite altimetry. Its main objective of the CTOH is to develop and maintain altimetric data bases with homogeneous, up-to-date corrections for the long term monitoring of sea level, lake and river levels, and the cryosphere for climate studies. The CTOH aids scientific users in the development of new altimetric products and applications.

CTOH Coastal Products – What's new in 2011 ?

The CTOH computes and distributes specific, coastal along-track sea level anomalies (SLA) using its **X-TRACK**[1] processor for all precise altimeter missions : Topex/Poseidon (TP), Jason-1 (J1) , Jason-2 (J2), Topex + Jason-1 + Jason-2 combined, Jason-1 interleaved (J1N), Topex/Poseidon interleaved (TPN), Geosat Follow on (GFO) and Envisat. Using the latest corrections available in the CTOH database, CTOH computes a coastally-adapted Sea Surface Height (SSH) along the satellites ground-track for each cycle. Additionnal geophysical corrections are applied accounting for the aliasing of tides and short-term atmospheric effects in the SSH measurements. The Mean Sea Surface (MSSH) is computed at each point, based on the mission period currently available, and subtracted from the corrected SSH in order to form the SLA. The SLA are finally projected onto a reference track

1Hz SLA coastal product



J1N and TPN correspond to interleaved missions

	J1	J1N	J2	TP	TPN	TP+J1	TPN+J1N	TP+J1+J2	Envisat	GFO
AFRIQUE	●	●	●	●	●	●		●		
AMAZONE	●	●	●	●	●	●		●		
BIGBEN	●	●	●	●	●	●		●		
CALIFORNIA	●	●	●	●	●	●		●		
CHINASEA	●	●	●	●	●	●		●	●	●
DRAKE	●	●	●	●	●	●		●		
EAC	●	●	●	●	●	●		●		
GoM	●	●	●	●	●	●		●		
GOMMAB	●	●	●	●	●	●		●	●	
HUMBOLDT	●	●	●	●	●	●		●		
KERGUELEN	●	●	●	●	●	●		●		
MEDSEA	●	●	●	●	●	●		●	●	●
NEA	●	●	●	●	●	●		●	●	●
NINDIAN	●	●	●	●	●	●		●	●	●
OREGON	●	●	●	●	●	●		●		
PACIFICSUD	●	●	●	●	●	●		●		
PATAGONIA	●	●	●	●	●	●		●	●	●
SALOMON	●	●	●	●	●	●		●	●	
SOUTHAFRICA	●	●	●	●	●	●		●		
WAUSTRALIA	●	●	●	●	●	●		●		

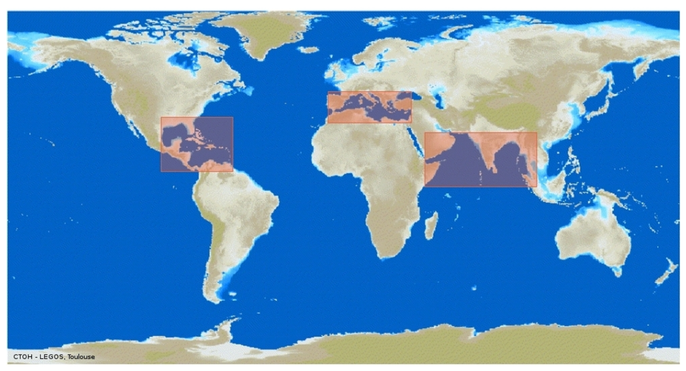
Table 1: Availability of SLA data by mission and by region

- 20 regions available
- Frequent data reprocessing/ updates
- Netcdf files contain ready-to-use SLA and geophysical corrections (DAC and tides) separately.
- New variable: distance to the nearest coast by Eric Leuliette (NOAA / Lab for Satellite Altimetry).

➔ Web site: http://ctoh.legos.obs-mip.fr/products/coastal-products/
- Details on corrections applied, data processing ...
- Access to some regional diagnostics: maps of rms, percentage of data available, minimum and maximum values.

➔ Data request: mailto:// ctoh_products@legos.obs-mip.fr
http://ctoh.legos.obs-mip.fr/products/coastal-products/coastal-registration-form

High Frequency SLA experimental product [2]



- 3 regions available as demo.
- Starting from 10 Hz (T/P), 20 Hz (Jason-1& Jason-2) measurements provided in standard GDRs and interpolating 1Hz geophysical corrections at 10 Hz/20Hz times.
- Using X-TRACK data processing.

➔ Firsts results on Mediterranean Sea :
- Consistency with 1Hz data but better resolution
- Higher data availability close to the coast (~some kilometers)
- Higher noise level in raw HF SLA
- But an adapted spatial filter (here 24km) leads to similar correlation as 1Hz SLA

➔ Very promising results

➔ Further analysis and validation upcoming

➔ Expertise support for CNES PISTACH project

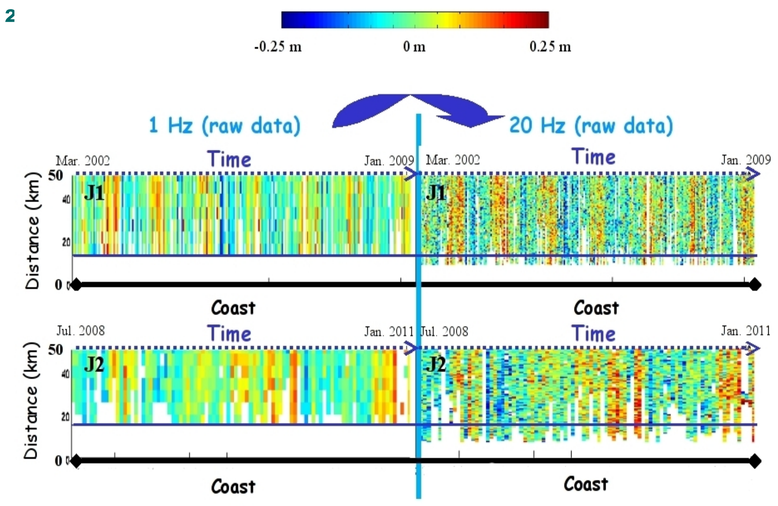


Fig. 1. Comparison of available SLA between 1Hz and 20 Hz data for Jason-1 (upper level) and Jason-2 (lower level), track 146.

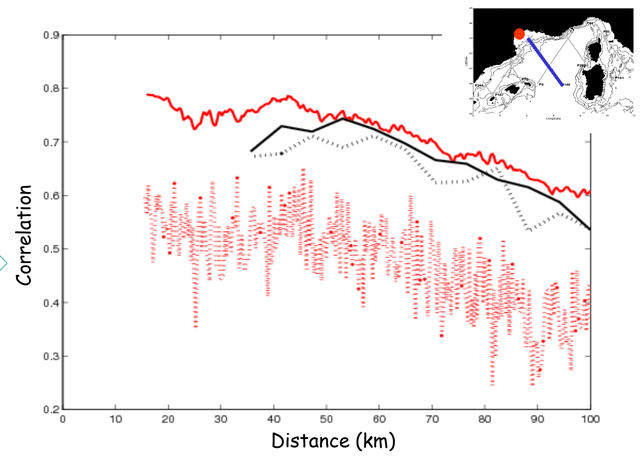


Fig. 2. Correlation between SLA raw data (solid line) and tide-gauge of Sète and between spatially filtered about 24 km (dashed line)and tide-gauge, for 1Hz SLA (in black) and 20Hz SLA (in red), for Jason-1, track 146.

Application : Multi-mission mapping of 1Hz SLA for fine-scale mesoscale studies in the Bay of Biscay [4]

New mapping methodology [3]

- 1Hz alongtrack SLA from **X-TRACK**[1]
- Period : *2002-2005* → 4 missions
- Grid resolution:
  - regional configuration : 1/6° weekly
  - coastal zooms also: 1/10° & 1/16°
- Different decorrelation scales tested:
  - •a) fixed (*55* to *95*km)
  - •b) variable (*wavelet analysis* of local scales)

Low resolution maps (AVISO) + high resolution increment from X-TRACK (see below).

Fig. 3. Methodology: example for 8th March 2003.

Regional variability according to the decorrelation scale used:

Regional averages	Fixed scale (55 km)	Varying scales	AVISO DT-MSLA Upd	Surface drifters[5]
RMS(SLA)	4.39 cm	4.36 cm	4.25cm	
EKE	59 $cm^2.s^{-2}$	34 $cm^2.s^{-2}$	15 $cm^2.s^{-2}$	69 $cm^2.s^{-2}$

- RMS and EKE increase when decorrelation scale decrease... but "*trackiness*" effect also[4].

Validation of fine-scale surface currents

- Surface current anomalies derived from new OI analysis
- Slope current (Fig.R4)
  - ➔*Comparison against currentmeter data (Fig. 4 for location)*:
  Better intensities & flow anisotropy (Fig. 5)
  Energetic errors, located in time (subsampling problems)
- Offshore : lagrangian statistics (Fig. 6)
  - ➔*Comparison against subsurface drifters:*
  Reduction of RMS dev. to drifter velocities (48h filt.)
  - ➔*Front detection from SST & FSLE*[4]
  Submesoscale filaments and fronts detected east of 4°W

Example of analysis produced

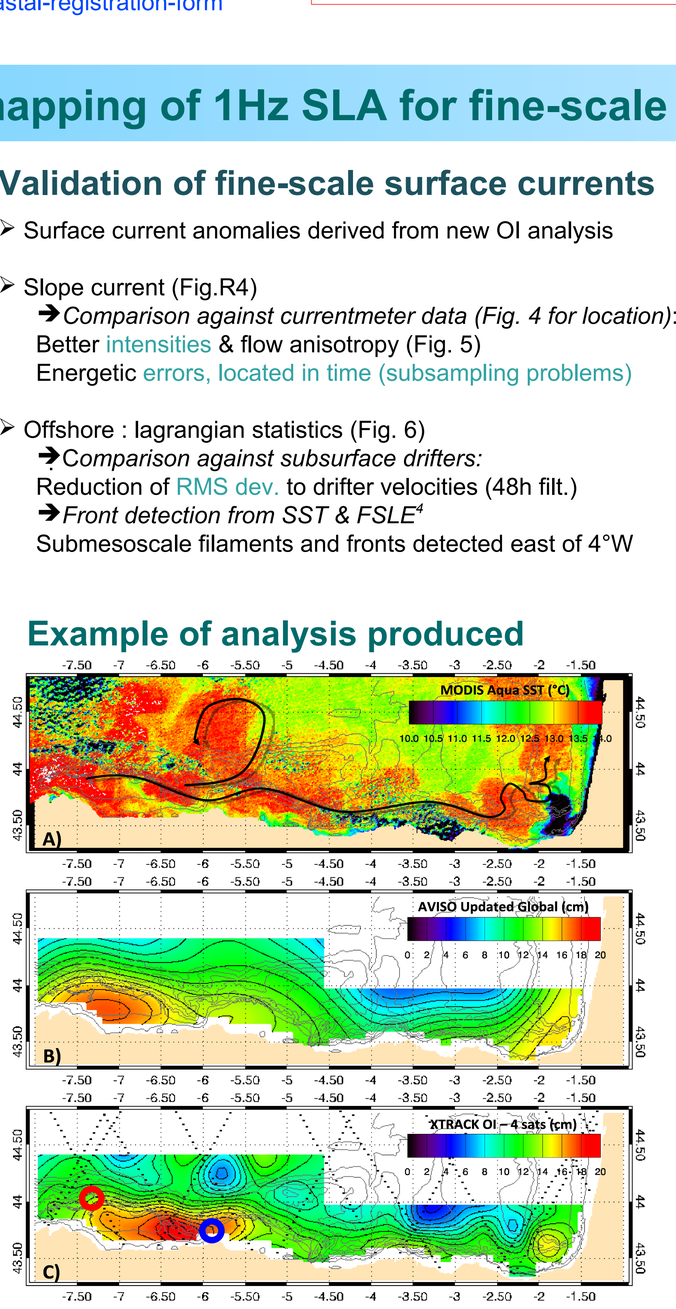


Fig. 4. Upper panel) MODIS SST image. Middle panel) AVISO DT-MSLA *Upd* data. Lower panel) 55km resolution mapping – 1/16°. Bathymetry & T/P + GFO tground tracks overlaid. 1/16°grid, 55km scales.

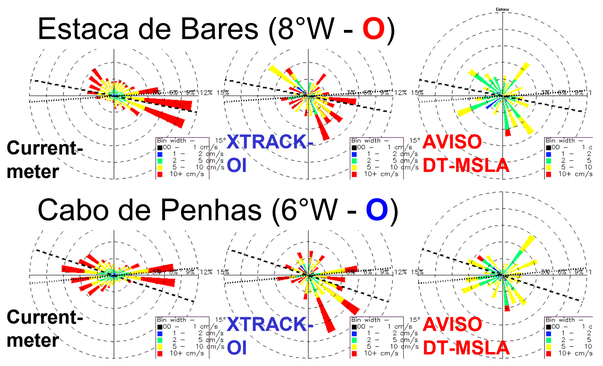


Fig. 5. Validation of geostrophic currents anomalies (*GCA*) at Estaca de Bares (upper panel) and Cabo de Penhas (lower panel). Dotted line : local gradient; Dashed line : large scale gradient (>50km)

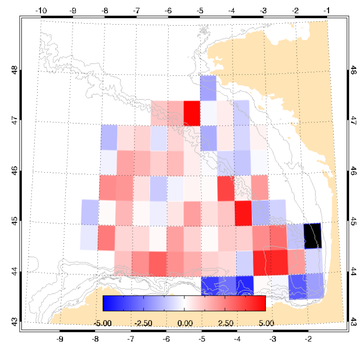


Fig. 6: RMS (AVISO – drifter) – RMS (fine scale OI – drifter) :
- Red: fine scale mapping closer to obs
- Blue: AVISO closer to obs

Conclusions & Perspectives

- **Impact of using different decorrelation scales analysed**
- **More realistic regional statistics (EKE and RMS levels)**
- **Current amplitudes and anisotropy in better agreement with in-situ observations**
- **Smaller scale structures represented (Slope current, small to larger scale eddies & fronts), in agreement with information provided by satellite imagery**
- **Subsampling errors** also detected

➔ Such dataset has a great potential for ***studying mesoscale to submesoscale transition in coastal areas but needs to work with efficient error estimation.***

References

(1) Roblou et al., 2011. Coastal Altimetry, Springer Berlin Heidelberg
(2) Birol et al., 2011. Presented @ 5th Coastal Altimetry workshop – San Diego, 2011.
(3) Dussurget et al, 2011. Mar.Geod. Vol 34 (3-4).
(4) Dussurget et al, 2011. Presented @ 5th Coastal Altimetry workshop – San Diego, 2011.
(5) Charria et al., 2011, submitted to JMS