



Altimetry data for regional applications: the CTOH database

A review of CTOH coastal products and scientific impact

N. Fuller¹, F. Birol¹, F. Niño¹, F. Lyard², S. Fleury¹ and D. Allain².

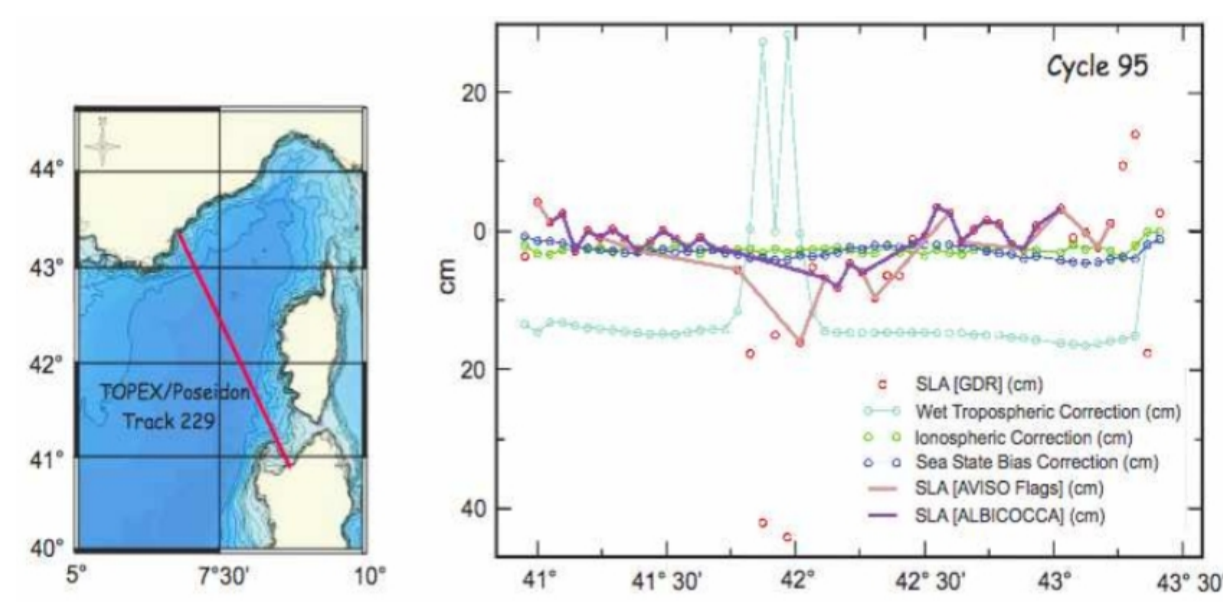
¹CTOH/LEGOS, ²CNRS/LEGOS, 14 Av. E. Belin, 31400 Toulouse, France

Since the early developments done in the framework of the Albicocca project (TOSCA/CNES; Vignudelli et al., 2005), the CTOH tool dedicated to the reprocessing of coastal altimetry data has evolved into a pre-operational software called X-TRACK. X-TRACK processes GDR altimetric data on a regional basis in order to enhance both quality and completeness of altimeter datasets. Before it shifts into a more operational phase we make a short review of the regional products available at CTOH, of their scientific impact and give three examples of cutting-edge research using either the 1Hz SLA or the tidal constants computed by X-TRACK.

X-TRACK processing

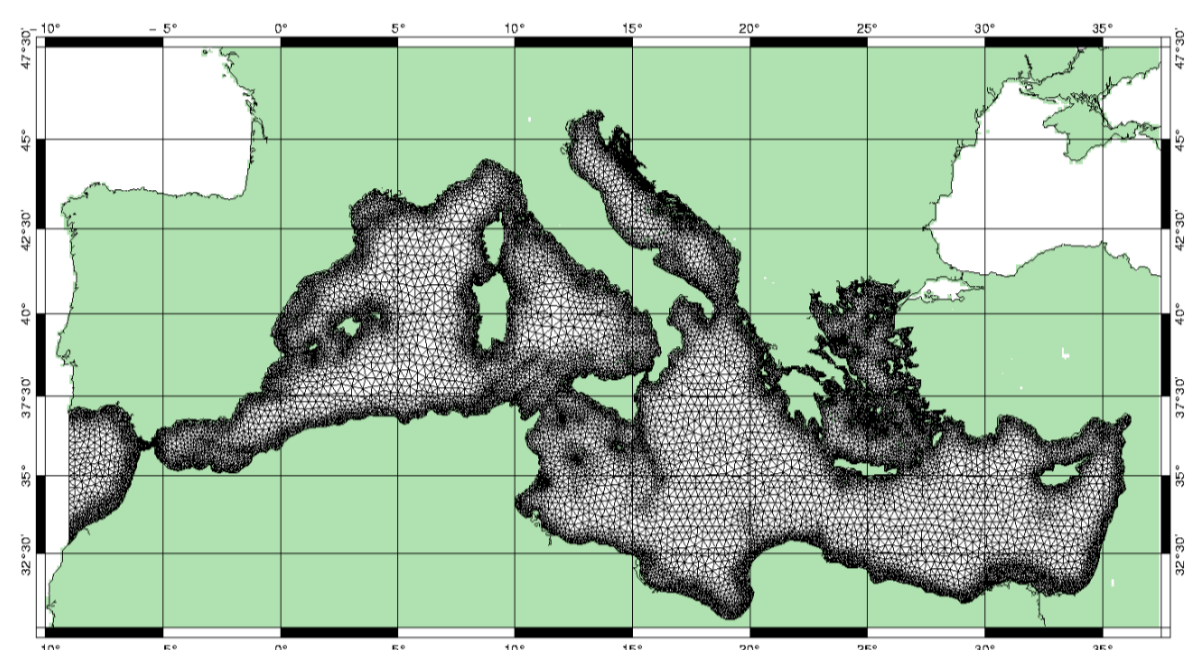
DATA EDITING

To compute the alongtrack SSH values, X-TRACK revisits the edition of the main environmental corrections: wet and dry troposphere, ionosphere, sea state bias, using regional criteria. Corrections are also filtered "alongtrack" and properly reconstructed from valid neighbours with Bezier curves. Finally, because of the land contamination of the onboard radiometer near the coast, the extrapolation of the wet and dry tropospheric corrections to the coast using splines insures a better completeness in coastal areas than the original corrections.



DE-ALIASING

X-TRACK uses a Dynamic Atmospheric Correction (DAC) computed as the combination of high-frequency elevations from Mog2D/T-UGOm 2D model (Carrère and Lyard 2003) plus low-frequency elevations from inverted barometer law (using ECMWF products). A regional version of Mog2D/T-UGOm is available for the Mediterranean Sea



MSSH

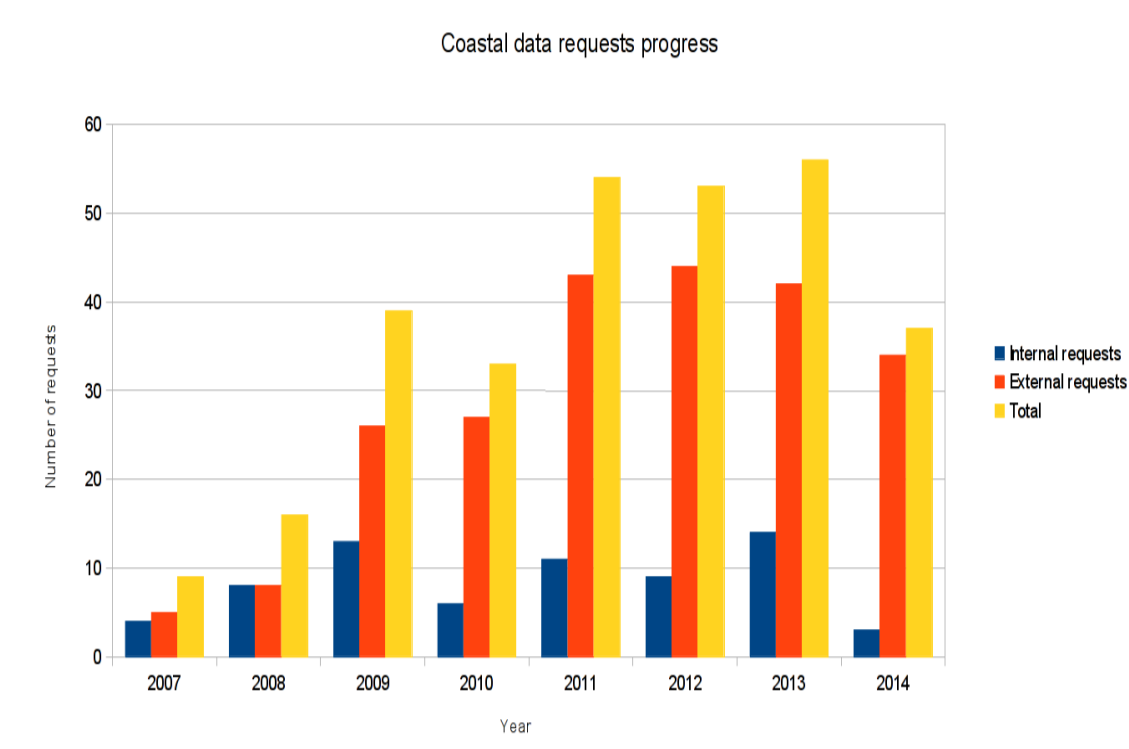
A precise mean sea surface is then computed by inversion of the original SSH data in order to obtain SLA time series at reference points along the nominal track.

Users

STATISTICS

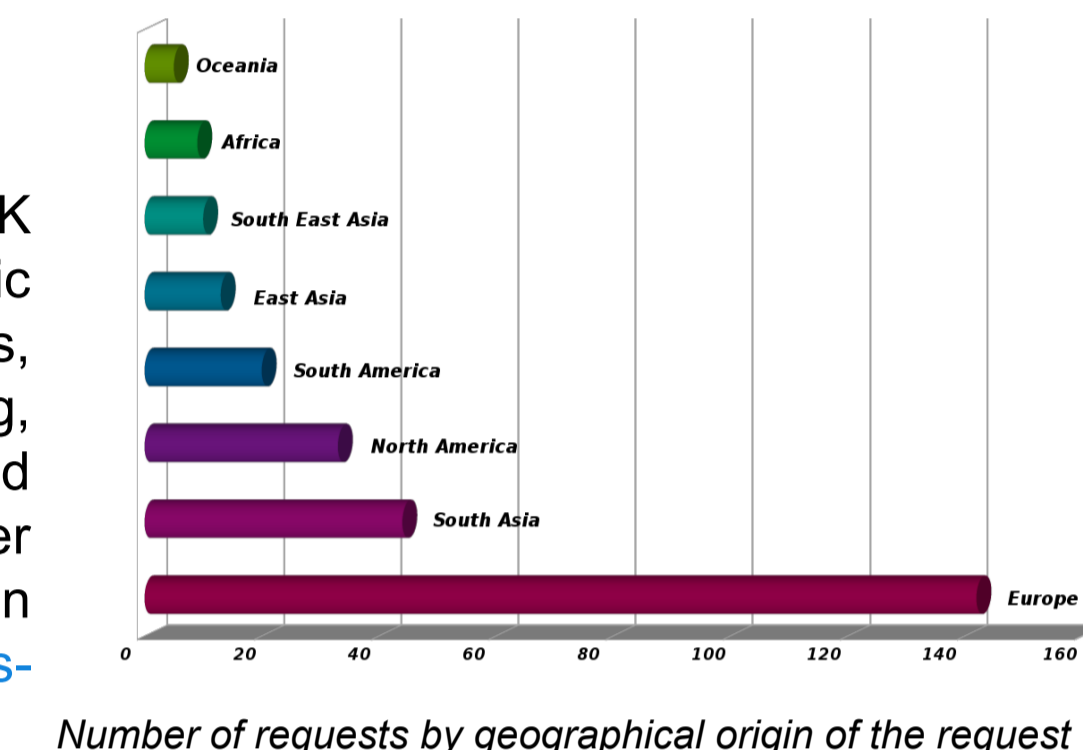
Since 2007, X-TRACK regional data are available from the CTOH website (<http://ctoh.legos.obs-mip.fr/products/coastal-products>). With a simple form one can ask for 1Hz SLA or tidal constants for a list of 23 regions available. The number of request has been growing up to about 50 request/year (2014 is not complete on the graph). Regional 1Hz SLA remain the principal product asked by users.

Europe is the first user worldwide of X-TRACK products. However, more and more requests are coming from new industrialized countries (India, Mexico, Indonesia, Argentina...)



APPLICATIONS

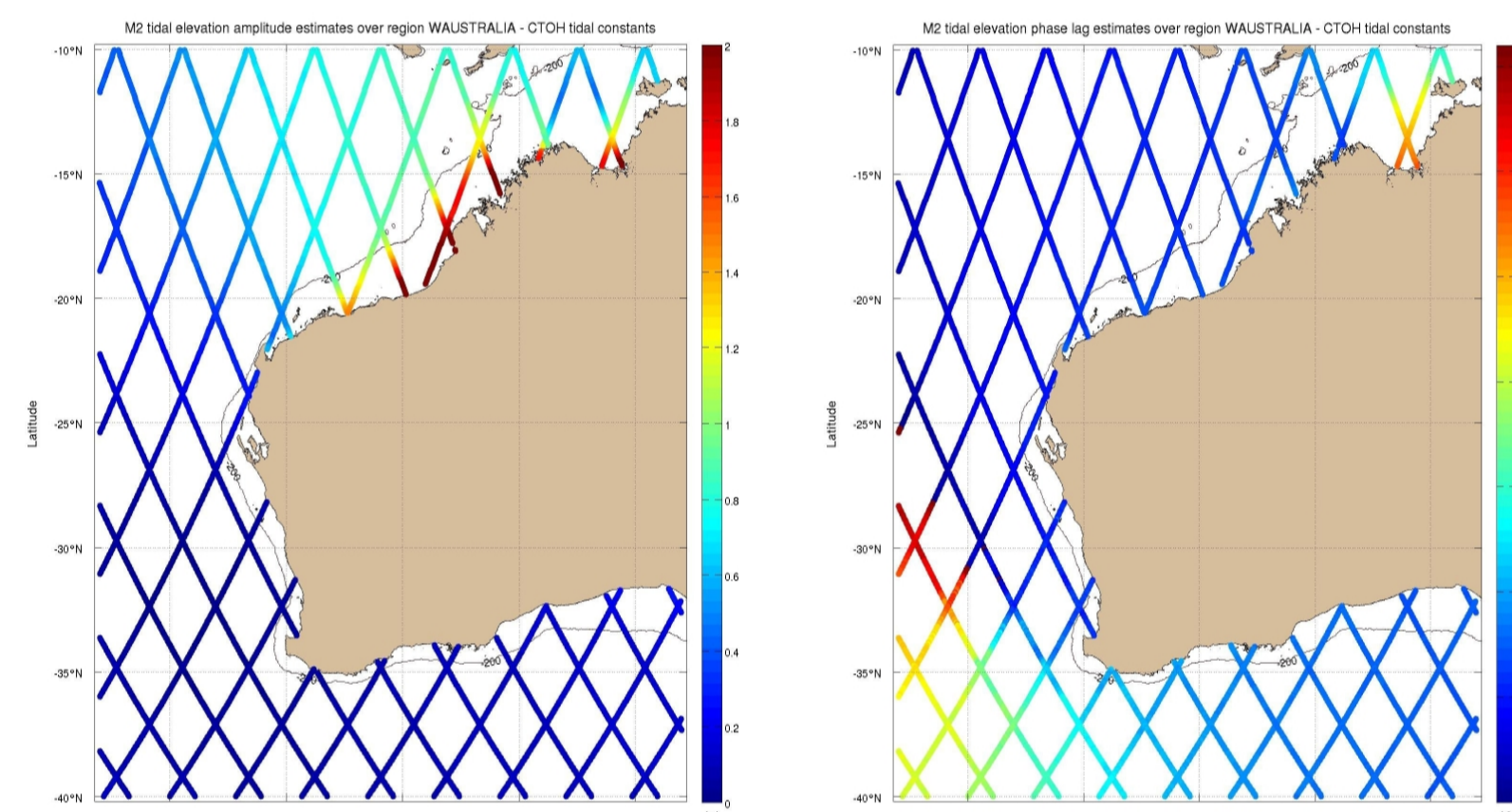
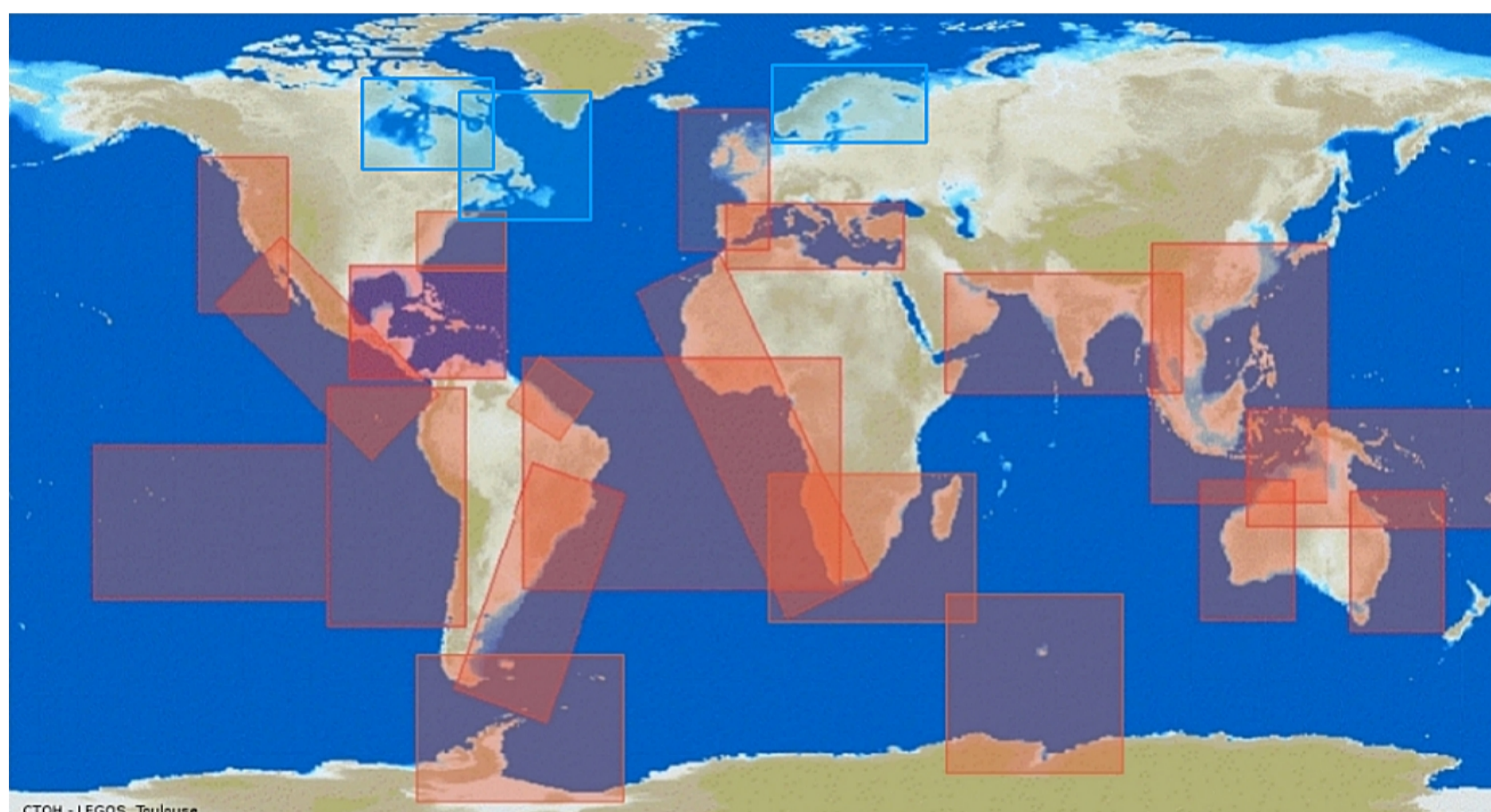
Many research studies have now been done with X-TRACK regional products. They concern a wide range of scientific applications: coastal ocean circulation, mesoscale dynamics, model validation, tides, development of new altimeter processing, ... It significantly helps us to understand the strength and limitations of coastal altimetry and to prepare for future altimeter missions as SWOT. A list of publications, classified by region, can be found on the CTOH website: <http://ctoh.legos.obs-mip.fr/products/coastal-products/references/references>



Products available

SLA / MSSH

X-TRACK products are distributed in the netcdf format. SLA files hold alongtrack SLA data together with MSSH, FES2012 tide, Dynamic Atmospheric Corrections and distance to coast parameters (DAC and Tidal corrections are applied to SLA but provided for specific applications). Users can both retrieve filtered and non-filtered data (spatial filter of ~40km alongtrack). The MSSH is an average from time series of the corrected sea level values (it is then consistent with the SLA time series), interpolated on a reference nominal ground track with equally sampled points.



Amplitude and phase for tidal constituent M2 in West Australian region. These maps of quality control are systematically computed for all constituents; they are available on the CTOH website.

TIDAL CONSTANTS

The tidal constants database is computed using the SLA time series processed by X-TRACK (fully corrected except for tides), taking advantage of the TOPEX-Poseidon, Jason-1 and Jason-2 long time series. It provides tidal experts and coastal modelers with amplitude, phase lags and accuracy estimates for a wide spectrum of tidal constituents (M2, S2, N2, O1, K1, M4), every 6-7 km along the satellite ground tracks. FES2012 global tidal model has been validated using this tidal constants database. It has also been used for constraining T-UGOm model (ex-MOG2D) at open ocean boundaries.

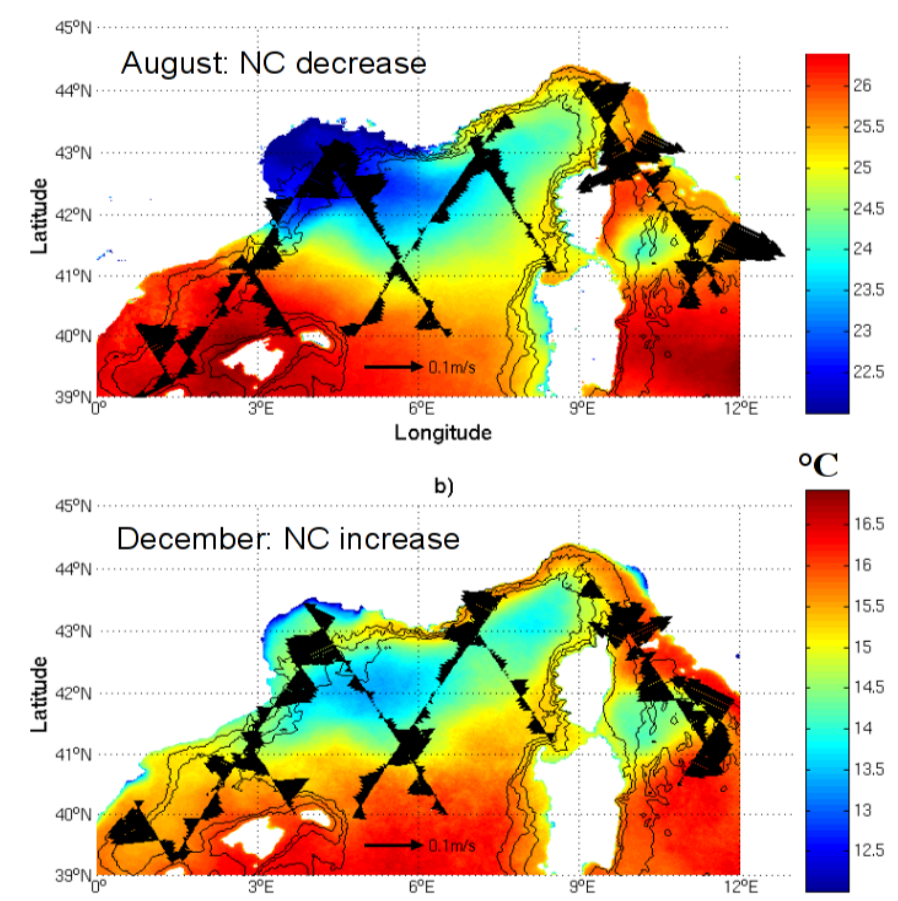
X-TRACK: a multi-mission product

Availability of X-TRACK products for each region :

Regions	TP+31+32	TP+31+32+1	RA2
ADEN/PEDSEA			
AFRICA			
AMAZONIA			
BALTIC			
BIOBEN			
CALIFORNIA			
CASPIAN			
CHILE			
CHINA/SEA			
DRAKE			
EGAC			
GOM			
GOMMAB			
HAMBOLIT			
IBERIAN			
KORCOR/JELEN			
MAREKOSTRUM			
MEDSEA			
NEA			
NORWEGIAN			
OREGON			
PACIFIC/SEA			
PATAGONIA			
PERSIAN			
REDSEA			
SALOMON			
SOUTH/AFRICA			
VALENTIA			
WALUSTRALIA			

NEW IN 2014
→ 3 new regions validated: Hudson, Labrador sea, and Norwegian coast (world map blue rectangles)
→ Time series extended to June 2013
→ Distribution by AVISO+ is underway

Recent scientific studies : 3 examples

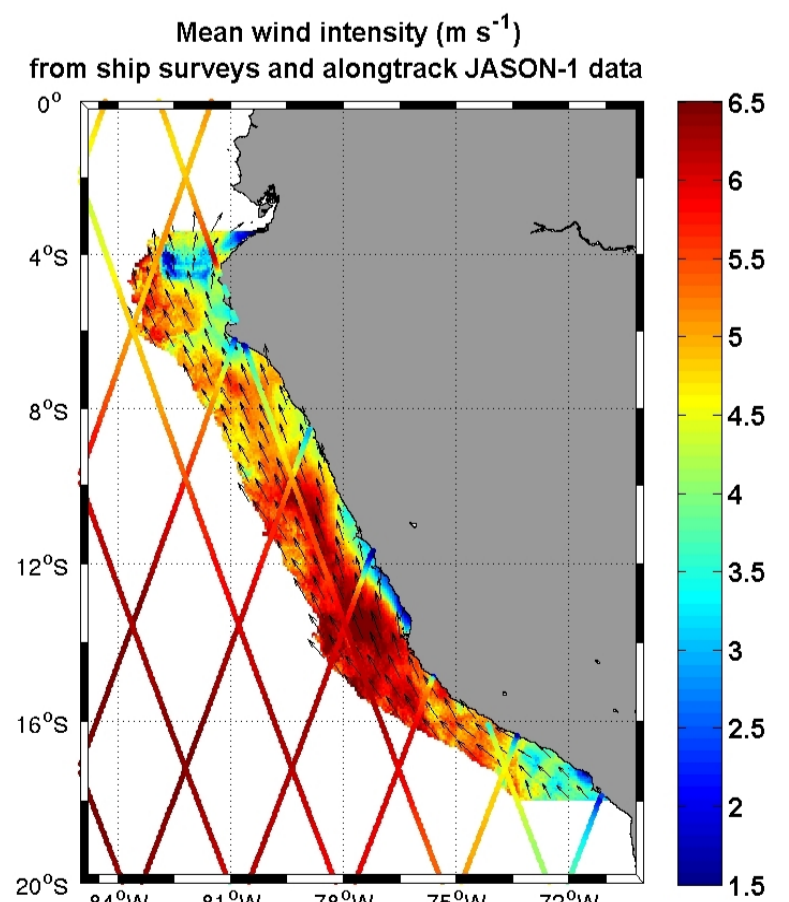


Aspect of the variability of the Northern Current observed by satellite altimetry – complementarity with high resolution model (F. Birol et al.)

This example shows how satellite altimetry, despite its limited spatial resolution, can be a key component in the study of currents in coastal regions. Geostrophic velocity anomalies are computed from 15 years of T/P and Jason-1 data (X-TRACK 1Hz SLA). They are compared to the Sea Surface Temperature (SST) and to in-situ currents. Symphonie ocean circulation model (Marsaleix et al., 2006) with a high resolution configuration (0,8 to 3km) is also used (Birol et al; CoastAlt Workshop). The complementarity of these data provide a deepened knowledge of the regional circulation of the study area. The inter-comparison between altimetry and model over the period 1993-2012 reveals very interesting aspects of the coastal current system, in particular the low frequency variations of the Northern Current flowing along the continental shelf, as well as associated mesoscale eddies.

Characteristics of the wind drop-off along the Peruvian coast from satellite altimeter derived wind data and historical in-situ observations. See the poster by A. Chaigneau et al. (CoastAlt Workshop)

In this study the authors are using the alongtrack satellite altimeter data from CTOH to derive wind data at ~6km resolution (jason-1) along the near coastal strip along the Peruvian coast. They combine these data with the historical data acquired by ~70 repeated ship surveys and compare their results with the scatterometers gridded wind products. The spatial structure and temporal variability of the wind regime in the near coastal region as well as their potential impact on the upwelling are discussed.



Coastal Altimetry: Its Potential for Very High Resolution Tide Modelling in the Gulf of Guinea (R. Onguene et al. CoastAlt Workshop)

Tidal constants provided by CTOH are used to validate a tidal wave propagation model (based on T-UGOm) in the Gulf of Guinea, including the Cameroon Estuary. The authors compare their model and altimetry for a number of tidal harmonic constituents and also with tide gauge observations (GLOSS database), located in SONARA harbour, LAGOS, and SAO TOME. Their model shows good agreement with the altimetric tidal estimations (see Figure). After validation, model results show that the Cameroon Estuary is not resonant for the semi-diurnal or diurnal waves. The tide amplification depends more on the funnel effect created by the shape of the coastline and on the small water depths.

New web portal and future plans



<http://www.aviso.altimetry.fr/en/data/products/sea-surface-height-products/regional/x-track-sla.html>

AVISO+ www.aviso.altimetry.fr

Opened in February 2014, AVISO+ is the new reference web portal for altimetry. It combines expertise of both AVISO/CNES operational service and LEGOS/CTOH research service to give access to a wide range of altimetry products: ocean, coast, hydrology and ice. X-TRACK SLA is already available for the combined Topex/Jason1/Jason2 missions (see also the poster *Online Data Extraction Service for coastal studies* by V. Rosmorduc et al.). Other products will be committed to AVISO+ in the near future. Meanwhile, they are available from our website: <http://ctoh.legos.obs-mip.fr/>. Contact: ctoh_products@legos.obs-mip.fr

Future developments

Different types of new developments/evolutions are underway:

- A complete reprocessing of X-TRACK products: extension of different regions to include all the coastal areas, the altimetry corrections and editing procedure revisited, new missions included (SARAL/AltiKa & ERS-2).
- New regional products: monthly climatologies, cross-track velocities, time series of current characteristics, ...