

# COASTAL AND INLAND ALTIMETRY SESSION SUMMARY

OSTST 2009 – Seattle – 22-24 June

# Coastal and Inland Altimetry session

- ▣ *28 abstracts received !*
- ▣ **Result of the ongoing effort to structure the community:**
  - Coastal Altimetry workshops in Silver Spring (Feb08) and Pisa (Nov08)
  - Hydrology from Space Meetings (Toulouse03, Geneva07)
  - COASTALT/ESA and PISTACH/CNES initiatives
  
- ▣ **COASTAL:**
  - 18 abstracts received → 4 oral pres. + 14 posters*
  
- ▣ **INLAND:**
  - 8 abstracts received → 2 oral pres. + 6 posters*
  
- ▣ **INSTRUMENT:**
  - 2 abstracts → 1 oral pres. + 1 poster*

# Coastal and Inland Altimetry session

## Oral Programme (Tuesday 23/06/09)

### ▣ *COASTAL*

- 4:30 Florence Birol: CTOH regional altimetry products: Example of applications
- 4:40 Ananda Pascual: Synergy between glider and coastal altimetry: Case study in the Balearic Sea
- 4:50 Graham Quartly: Singular reflections on the Golfo della Botte
- 5:00 Tracy Haack: High-resolution models of wet-troposphere path delay fields in coastal regions

### ▣ *INLAND*

- 5:10 Franck Mercier: The PISTACH project for Hydrology: project status, products and early results
- 5:20 Stephane Calmant/ Ana Emilia Souza: Validation of JASON-2 over the Amazon basin rivers

### ▣ *INSTRUMENT*

- 5:30 Jean-Damien Desjonqueres: POSEIDON Diode/DEM coupling mode

### ▣ *SUMMARY OF POSTER PRESENTATIONS 5:40*

### ▣ *DISCUSSION 5:50*

# Coastal and Inland Altimetry session

## Poster Programme

### ▣ *COASTAL (1/2)*

Paolo Cipollini: Advances in Coastal Altimetry: the COASTALT project

William (Bill) Emery: Improved altimetric retrievals in the coastal zone

Hui Feng: Exploiting ocean altimeter data in the Gulf of Maine and Middle Atlantic Bight region

Joana Fernandes: GNSS derived path delay, a method to obtain the wet tropospheric correction for coastal altimetry

Guoqi Han: Mean dynamical topography and surface circulation off Atlantic Canada

Florent Lyard: Robust methods for high accuracy tidal modelling in coastal and shelf seas

Juan Jose Martinez-Benjamin: Operational monitoring level at Barcelona and l'Estartit harbours

# Coastal and Inland Altimetry session

## Poster Programme

### ▣ *COASTAL (2/2)*

Franck Mercier: The PISTACH project for coastal altimetry: status, products and early results

Anne-Charlotte Peter: Thermal impact of the coastal waves in the coastal African upwelling areas

Laurent Roblou: The contribution of improved altimetry to a study of NW Mediterranean sea coastal dynamics

Simon Ruiz: Merging altimetry and glider data to estimate vertical motion in the upper ocean

Y. Tony Song: Strait And Inter-Ocean Transport Estimation Using Altimetry SSH And Gravimetry OBP

Alexandre Kurapov: Assimilation of along-track altimeter SSH into a coastal ocean model

Javier Zavala-Garay: Development of an operational analysis /forecast system for the Mid Atlantic Bight.

# Coastal and Inland Altimetry session

## Poster Programme

### ▣ *INLAND*

Charon Birkett: Performance of the Jason-2/OSTM instrument over inland waters

Marie-Claude Gennero: Water level on rivers & lakes using Jason-2 altimetry data

Jinyun Guo: Correlation of El Niño and water level variations of Hulun Lake monitored with TOPEX/POSEIDON

Hyongki Lee: Assessment of retracked Jason-2 measurements over Louisiana wetland

Frederique Seyler: Cross-comparison of Jason2 data with ENVISAT RA2 and ICESAT data over Amazon basin

Stéphane Calmant: JASON-2 IGDRs for flood alert in the Amazon basin

# Coastal and Inland Altimetry session

## Poster Programme

### ▣ *INSTRUMENT*

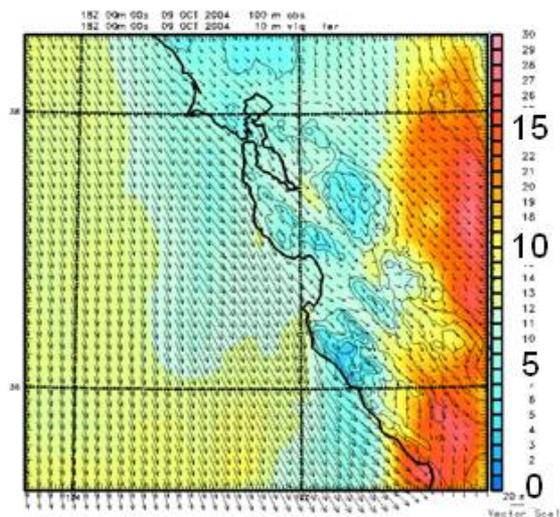
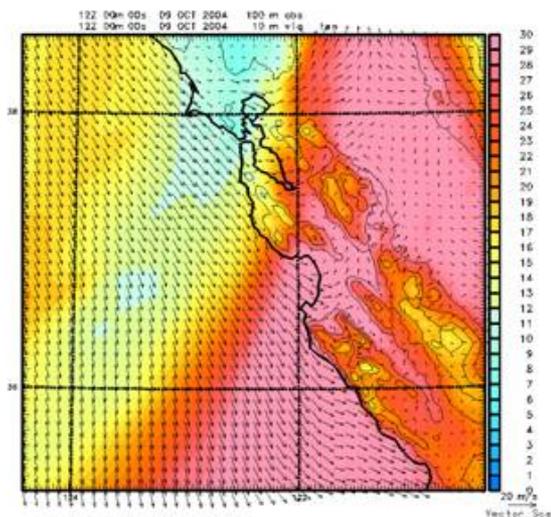
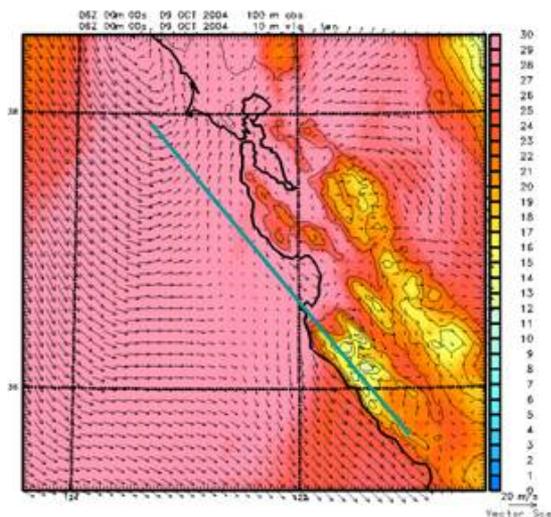
Nathalie Steunou: AltiKa: a new concept of altimeter for the SARAL mission

# Coastal and Inland Altimetry session

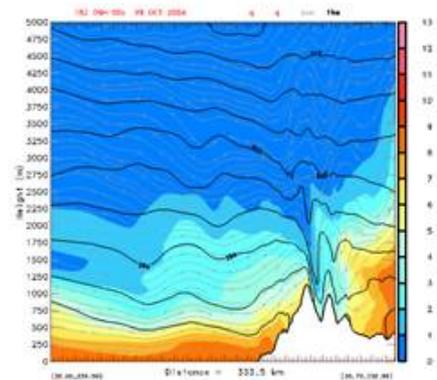
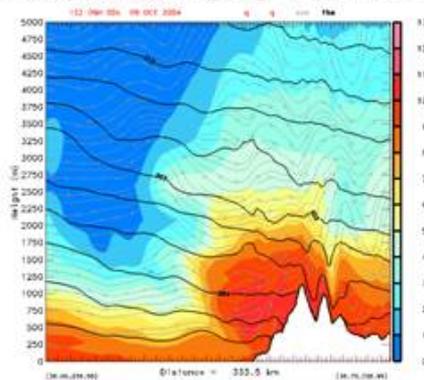
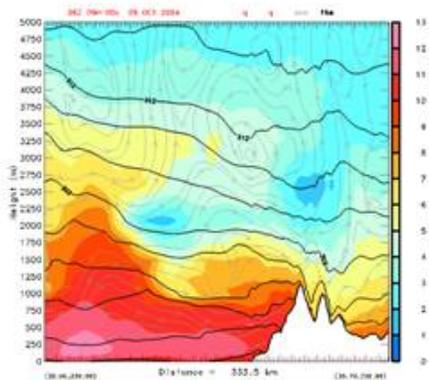


## COAMPS Water Vapor Forecasts 9 Oct 2009 6-18 UTC

IWVP ( $\text{kg m}^{-2}$ )  $\rightarrow$  Path Delay (cm)



Water Vapor ( $\text{g kg}^{-1}$ ) & Theta (K)





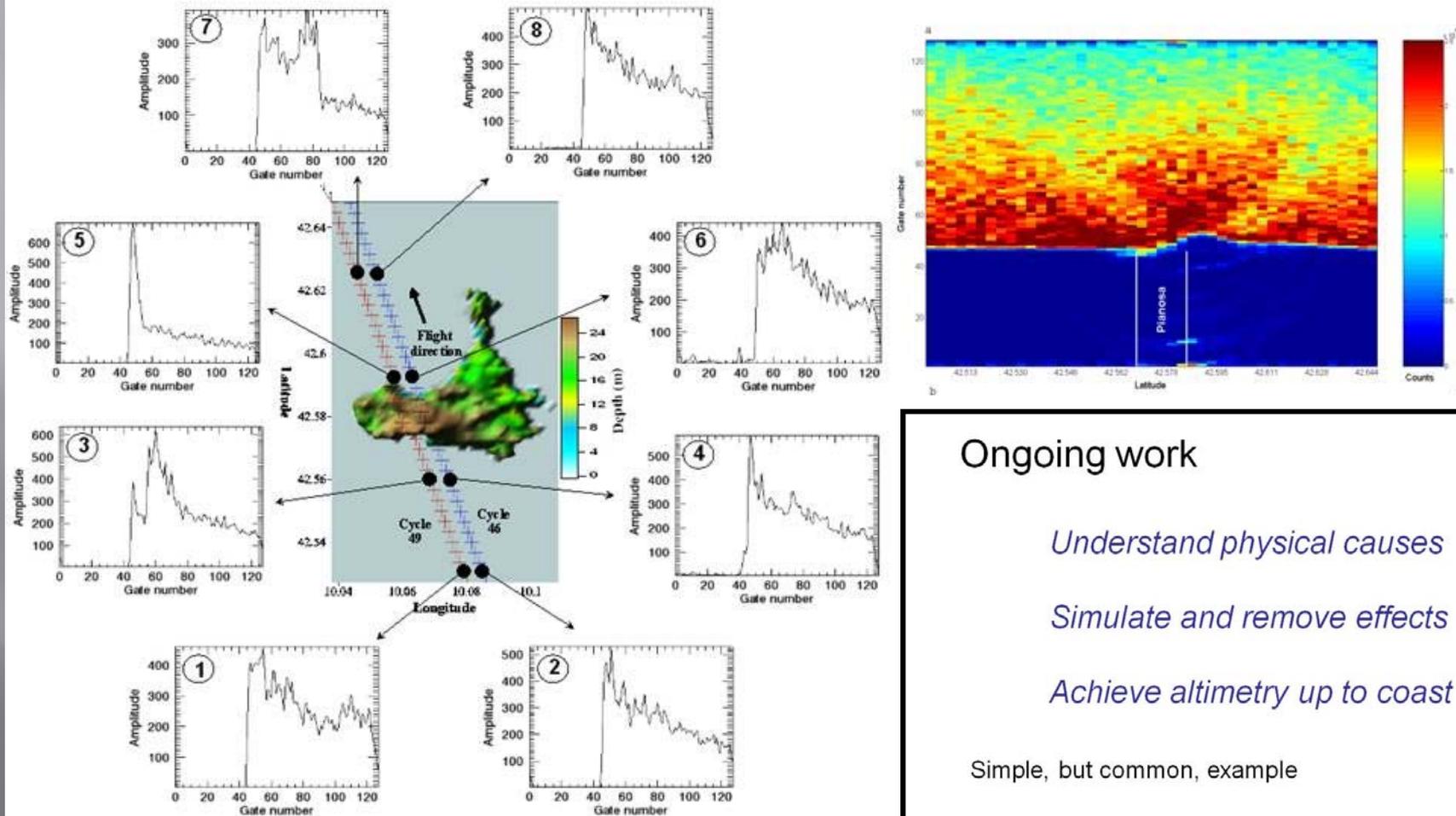
# Coastal and Inland Altimetry session

## Wet Tropo Correction

- ▣ **Global « Coastal » corrections now exist:**
  - S. Brown :→ to be included in the GDR ?
  - 2 WTC in the PISTACH products (+ 1 for Hydro)
  
- ▣ **Development of regional corrections:**
  - GNSS based corrections (Fernandes)
  
- ▣ **Improvement of Regional Atmospheric models**
  - →to retrieve high space/time variability (Haack)

# Coastal and Inland Altimetry session

## Waveform analysis



### Ongoing work

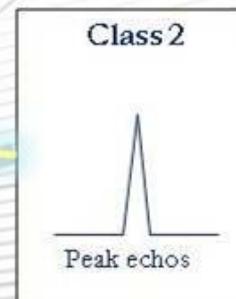
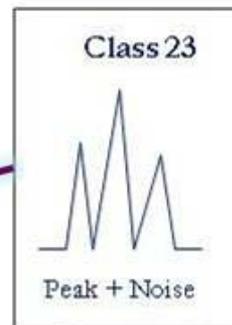
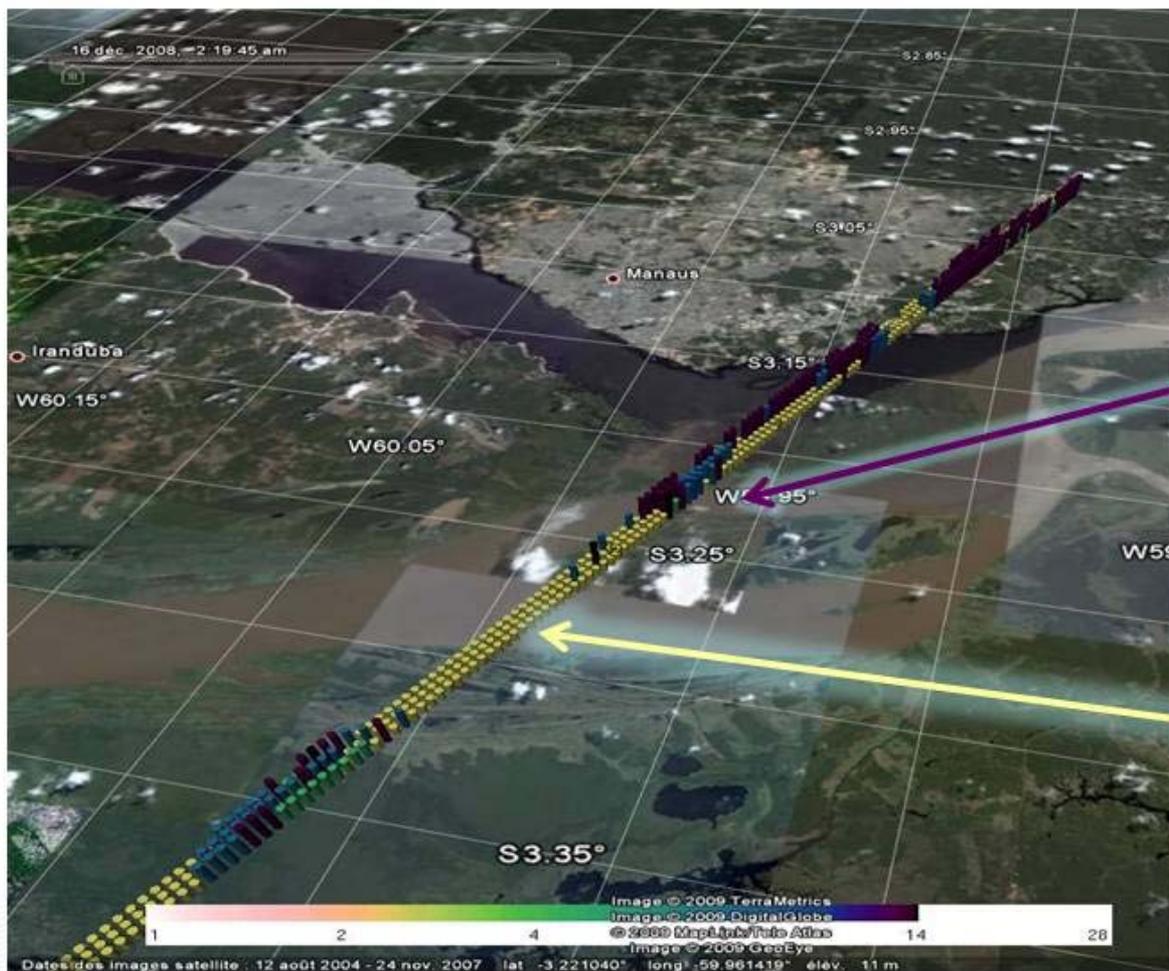
- Understand physical causes*
- Simulate and remove effects*
- Achieve altimetry up to coast*

Simple, but common, example

# Coastal and Inland Altimetry session



## WF Classification: Amazon (Manaus)



# Coastal and Inland Altimetry session

## Waveform Analysis/Retracking

- ▣ **A (The) key issue for inland and near shore altimetry:**
  - Significant effort in PISTACH and COASTALT projects
  - Local and regional studies also develop retracking strategies (posters by Emery, Lee)
- **Still a lot of work to do on retracking....**
  - But feasible with Jason-2 data since waveforms are acquired almost everywhere ! (not the case for Jason-1)

# Coastal and Inland Altimetry session

## Other corrections

### ▣ Tides, atmospheric loading, ...:

- Regional solutions exist (FES, GOT, MOG2D, T-UGO, Webtide...). Local solutions too!
- See presentation/Poster: Birol, Roblou, Lyard, Feng ...
- How to compile/merge these solutions inside a global altimetry product?

# Coastal and Inland Altimetry session



## Data distribution:



<http://www.legos.obs-mip.fr/en/observations/ctoh/COTIER>

PRODUCTS: Centre de Topographie des Océans et de l'Hydrosphère  
Responsable Edition: Yves Méraud      Webmaster: Renaud Chouxart

Along track Sea Level Anomalies

Along track data

- SLA
- Currents
- Surface current
- Coastal products
- CTOH products HOME
- CTOH HOME

Data available via ftp



## Conclusion



- ✓ Ongoing project: other applications under analysis
- ✓ Strong connection with different scientific groups/projects
- ✓ The feedback we get from CTOH coastal data users for marginal/coastal applications helps us:
  - to understand the users needs
  - to identify the problems to solve
  - to analyze the potential applications and/or limitations
- ✓ If you have new corrections or scientific applications you want to test, do not hesitate to contact us!!!

HF and regional products can be provided for other c  
[ctoh\\_products@legos.obs-mip.fr](mailto:ctoh_products@legos.obs-mip.fr)

[ctoh\\_products@legos.obs-mip.fr](mailto:ctoh_products@legos.obs-mip.fr)

# Coastal and Inland Altimetry session



## Conclusion

- The **PISTACH products** include **several** new **state of the art** corrections and geophysical information: retracking, wet tropo, geoid, DEM, surface classification ....20Hz sampling
- V1.0 products are freely available since **cycle 1, in NRT.**
- **Validation & Evaluation** during next months. They will provide us feedback for improving future versions.
- A **light** version of the products is under reach more easily non-expert users
- **Possible evolution of the prototype** T/P, AltiKa ?
- **Feedback, comments, questions:**
  - [Claire.Dufau@cls.fr](mailto:Claire.Dufau@cls.fr) (Coastal I)
  - [Franck.Mercier@cls.fr](mailto:Franck.Mercier@cls.fr) (Hydro



## High-resolution & coastal coverage

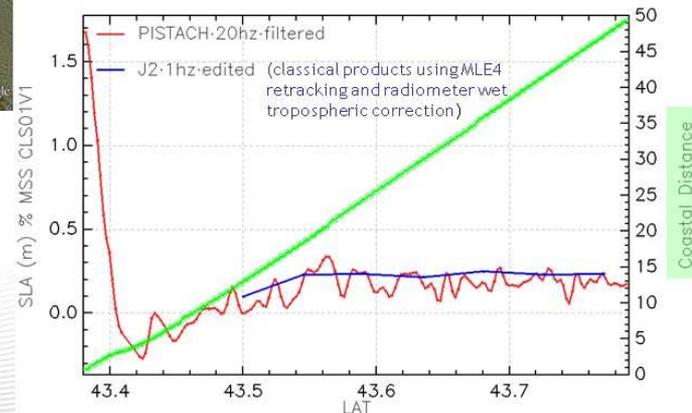
2/22



Using Jason2-PISTACH 20Hz fields provide a better spatial coverage and a higher resolution in the coastal ocean

Cycle 24

SLA Jason 2 PISTACH vs SLA Jason2



some noise still remains to be filtered on PISTACH SLA

# Coastal and Inland Altimetry session

## Products available

### ▣ **Dedicated processings/products:**

- CTOH (LEGOS): post-processing (editing, ...)
- PISTACH (CNES): JASON-2, pre-processing (retracking, Wet, SSB, local/global corrections ...) → IGDR-like products in NRT, available on FTP
- COASTALT (ESA): Envisat, pre-processing (retracking, corrections, ....) → soon

### ❖ **It's up to users to use these products (+feedback) and make good science !**

- « InSitu Calval »: Birkett, Seyler, Calmant
- Regional/local studies/applications: Pascual, Ruiz, Feng, Peter, Han, Song, Kurapov, Zaval-Garay, Gennero

# Coastal and Inland Altimetry session

## Summary & Future Work

- Gliders are useful platforms for exploring limitations of coastal altimetry.
- New methodology and data processing in the velocity computation improves the altimetry-glider comparisons.
- The impact of using HF along track altimetric data is tremendous in the coastal zone (correlation = 0.97, error variance = 5%).
- **Future work:**
  - Dedicated mean dynamic topography
  - Multi-sensor approach experiments
  - Data assimilation into numerical models to better understand coastal and mesoscale dynamics (collaboration with J. Zavala - Univ. Rutgers).

# OSTST 2009 SEATTLE, WASHINGTON June 23

## Coastal and Inland Altimetry

Poster

J.J. Martinez-Benjamin  
et al.

**Operational monitoring Sea level by CGPS in the Barcelona and l'Estartit harbours**

Juan Jose Martinez-Benjamin<sup>1</sup>, Miquel Angel Ortiz Castellon<sup>1</sup>, Ernest Bosch<sup>1</sup>, Assumpcio Termens<sup>1</sup>, Marina Martinez<sup>2</sup>, Xavier Martinez de Oses<sup>3</sup>, Begoña Perez Gomez<sup>4</sup>, Francesc Prost<sup>5</sup>, Xavier Mart

(1) Technical University of Catalonia (UPC), Dpt. Geotechnical Engineering and Geosciences, ETSECCPB, IECCORAE, Institut d'Estudis Espacials de Catalunya/Centre de Recerca de l'Aeronautica i de l'Espai, Barcelona, Spain  
 (2) Technical University of Catalonia (UPC), Dpt. Navigation, Robotics and Engineering, FND, Barcelona, Spain  
 (3) Institut Cartografic de Catalunya (ICC), Barcelona, Spain  
 (4) Puertos del Estado (PE), Madrid, Spain  
 (5) Port de Barcelona, Spain

**Abstract**  
 A description of the actual operational infrastructure at Barcelona and l'Estartit harbours is presented. The main objective is the implementation of these harbours as a precise geosic areas for sea level monitoring and altimeter calibration for radar and airborne systems. Laser altimetry in the coastal areas.

At the Barcelona harbour there is a CGPS with a radar tide gauge from Puertos del Estado and a GPS belonging to Puerto de Barcelona, receiver Leica Geosystems GRX1200 GG Pro and antenna AX 102 GG. A precise leveling has been made by the Cartographic Institute of Catalonia, ICC. Bathymetric campaigns have been made.

The instrumentation of sea level measurements has been improved by providing the Barcelona site with a radar tide gauge Datamar 3000C device and a Thales Navigation Internet-Enabled GPS Continuous Geosic Reference Station (CGRS) with a choke ring antenna, located at the ES-525 of the Technical University of Catalonia, UPC. It is intended that the overall system will constitute a CGPS Station of the ERSAS and TGA networks. A radar tide gauge MIRCOS from Puertos del Estado is also located inside the harbour.

**1 - Cape of Begur calibration site**

The tide gauge of l'Estartit is a traditional floating gauge placed 18 years ago and has an accuracy of ± 2 mm. Since 1995, the l'Estartit tide gauge has been co-located with geosic techniques (GPS measurements of XU, Military Network, and XGA, Levelling Network) and it is tied to the SPGC (Integrated Geosic Positioning System of Catalonia) project of the Institut Cartografic de Catalunya (ICC).

In 2005, due to the work for the expansion of the harbour, the tide gauge had to be moved. Before the work started, appropriate GPS measurements were carried out in order to ensure the connection of the tide gauge data. During October 2005, and May 2006, the tide gauge was inactive and it has been moved on to a new location inside the harbour.

In June 2008, new GPS and leveling measures have been done in order to tie the new location into SPGC project and to co-locate old data respect the new one.

A significant contribution has been made related to TopoPosidon and Jason-1 calibration campaigns, direct and indirect, in March 1999, October 2000 and July 2002 near Cape of Begur.

Although l'Estartit does not have a GPS permanent station, it is possible to build a virtual one from the service "CATNET web" of the ICC. "CATNET web" is a data distribution system of a virtual GPS permanent station via web. From the coordinates where you want to place the virtual station, the time interval and the measurement rate, the system generates a FUNEX file under the requested conditions.

code : type of data, longitude, latitude, at special height  
 314094002 : XU/KCAT2006; 3.2067322; 42.0535326; 50.851  
 314094002 : RTKAT2006; 3.2067322; 42.0535326; 50.851  
 314094002 : RTKAT2006; 3.2060021; 42.0535314; 50.481  
 314094064 : XU/RTKAT2006; 3.2064734; 42.0535306; 50.664  
 314094064 : XU/RTKAT2006; 3.2064734; 42.0535309; 50.677

**CGPS - Barcelona Harbour - Technical University of Catalonia UPC  
 - Cartographic Institute of Catalonia - Puertos del Estado**

At the UPC there is a CGPS, an Ashtech Internet-Enabled Geosic Reference Station (IGRS) from Thales Navigation, with an Ashtech choke ring antenna dome margin, and a meteorological station DAVID PR22.

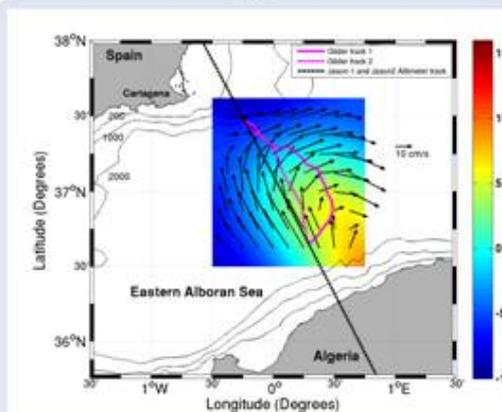
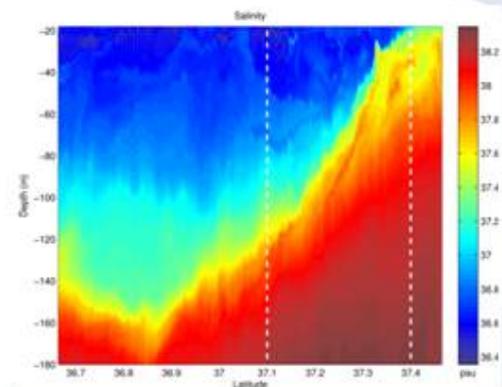
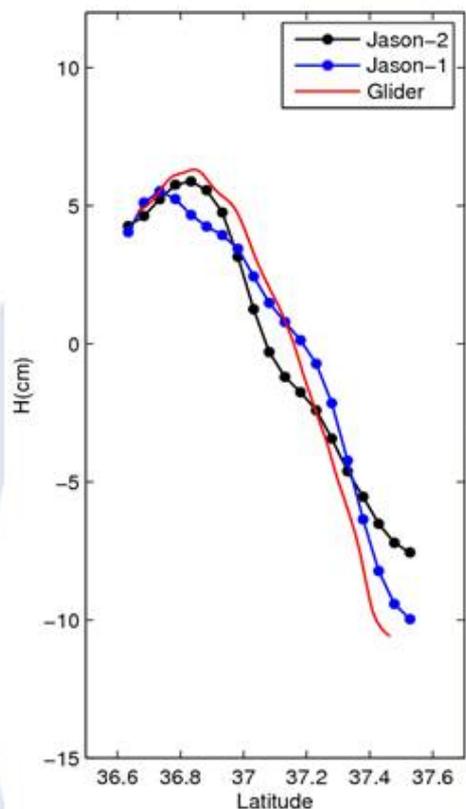
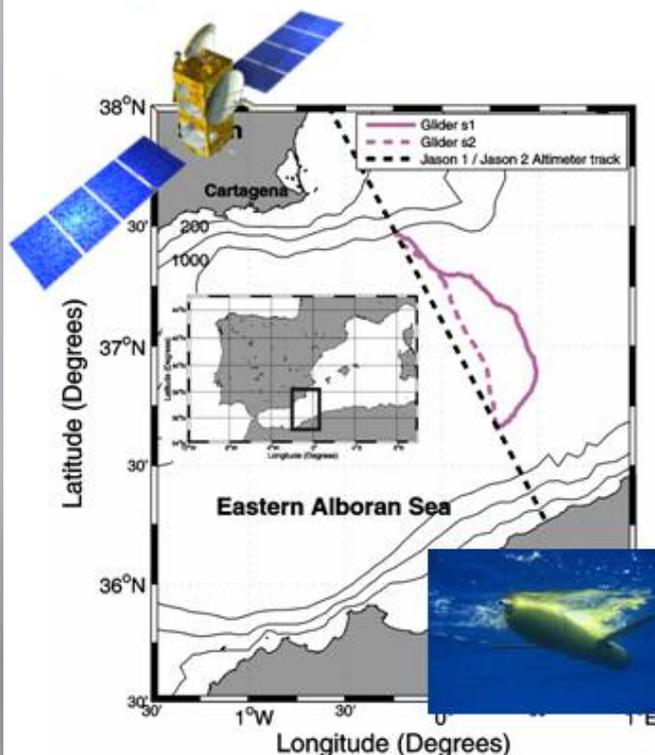
**2. Sea Level Monitoring by Airborne LIDAR**

The airborne calibration campaign with a Paroscientia P48 (ICC) carrying an Optech Laser ALTM-3025 (ICC) was made on June 15, 2007, overflying l'Estartit harbour (about 8 km wide by 50 km long) and looping with a circular orbit radius of about 800 m. The validation of this new technology LIDAR may be useful to fill coastal areas where satellite radar altimeters do not measuring due to the large footprint and the resulting gaps of about 25-40 km within the coastline. Measurements with a GPS buoy were made during the experience and a GPS reference station was installed in Arguacava. A DGM of l'Estartit Harbour was also determined by the first results from the campaign. On October 15, 2007, another LIDAR campaign was made of night with a Cassini Caravan 200R.

OSTST Meeting      Seattle, Washington, USA      June 22-24, 2009

## Vertical motion in the upper ocean from glider and altimetry data

Simon Ruiz, Anan da Pascual, Batolome Garau, Isabelle Pujol; Joaquin Tintore (GRL, June 16, accepted)



Western Mediterranean,  
Data from glider, Jason 1  
and Jason 2

DH from glider and ADT  
from Jason-1 & Jason-2  
tandem mission  
( $r > 0.97$ , rms differences  
< 1.6 cm).

Vertical section from glider  
(top) and reconstructed DH  
field from glider and  
altimetry at 75 m depth  
(bottom).

# Assimilation of Along-Track Altimeter SSH into a Coastal Ocean Prediction Model

A. Kurapov, G. Egbert, J.S. Allen, P. T. Strub (Oregon State U.)

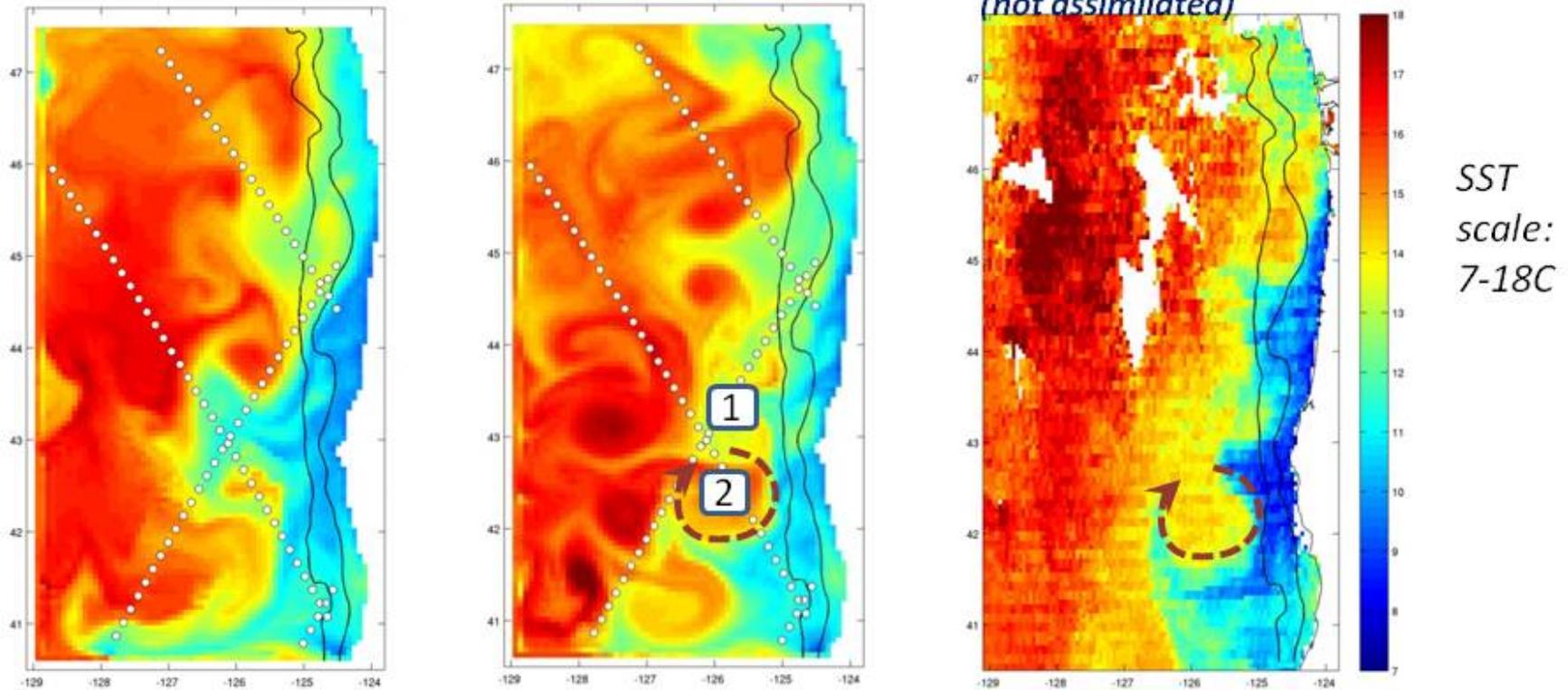
SST Fields from Model (left, middle) and Satellite (right) – July 24, 2008

prior (free-run) model

model after SSH assim.

GOES daily composite

(not assimilated)



1: extent of separation at 43-44N is reduced; 2: eddy is formed; both effects are consistent with GOES SST

Assimilation of alongtrack SSH altimetry, using a multivariate variational approach, improves prediction of SST – compare SST on left (no SSH assimilation) and middle (SSH assimilation) to right (SST that was not assimilated). Will increased data from interleaved orbits improve the fields further?

# Coastal and Inland Altimetry session

## Conclusion

### ▣ Coastal and Inland Altimetry: increasing interest

- Promising good performances of Jason-2, even in NRT
- Dedicated altimetry products/solutions already exist
  - **Use them !**
- Improvements still necessary/possible (retracking, DEM tracking mode...)

*Third Coastal Altimetry Workshop (Roma, Sept 2009)*