On the use of altimeter products in coastal ocean

In prospect of the Jason-2 mission launching in June 2008, CLS is preparing a new altimeter data processing dedicated to coastal seas and continental hydrology. As the improvements planned for these new products should agree with user expectancy, this survey aims at gathering your feedback or your needs in altimeter products for your activities in coastal oceanography. You will find a detailed description of altimeter products in annex. We thank you to spend some of your time to answer our questions. Please do not hesitate to contact us if you require any additional information

Best regards,

For the CLS project team PISTACH
(**P**rototype **I**nnovant de **S**ystème de
Traitement pour les **A**pplications
Côtières et l'**H**ydrologie)

Claire.Dufau@cls.fr, responsible “definition of users’ needs”
Franck.Mercier@cls.fr, project leader

Please check/circle all that apply and fill if necessary.

You !

- Identity (optional):……
- Do you work in :
  - Operational Oceanography : ……..……..…(project name)
  - Research in Oceanography : …….(lab. name)
  - A private company
- How do you study the coastal ocean?
  - With in-situ measurements: …….…….....
    ……...
  - With remote sensing: ……
    ……..
  - With 2D modelling: ……..…… (model name)
  - With 3D modelling: ……. …… (model name)
  - With data assimilation : ……..…….……(scheme)
  - Other:……...
- Have you already used altimeter products for your studies?
  - No
  - Yes. What kind of altimeter data have you used (GDR, CorrSSH, SLA, SSHA…) ? Did they suit your need? If not, what kind of problem or limitation did you encounter ?

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« Your » coastal sea

- What part of the coastal ocean do you study? (several answers are possible)
  - Seashore
  - Continental shelf
  - Shelf Break
  - Deep Ocean in the vicinity of the shelf break.
- How far is « your » coastal ocean from the shoreline (because this distance changes from one location to another)?
  - 0-50km
  - 50-100km
  - 100-200km
  - Other: …….
- What are the specificities of « your » coastal ocean?

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Your investigation in coastal ocean processes

- On which physical value do you mainly focus?
  - Temperature
  - Salinity
  - Horizontal velocities
  - Surface elevation
  - Other:……

- What physical processes do you examine in particular?
  - Not particularly one
  - 3D circulation over the continental shelves
  - River plumes
  - Slope currents (position)
  - Slope currents (their interaction with shelf dynamics)
  - Slope currents (instabilities)
  - Density currents over the bottom
  - Upwelling/downwelling
  - Internal waves
  - Tide
  - Tidal currents
  - Storm surges
  - Other:……

- What kind of physical processes studied might exhibit a significant pattern in sea surface elevation? What are their space-time characteristics and localization?

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An altimeter product dedicated to coastal ocean

- For what purpose such new altimeter products could help you?
  - Modelling/validation
  - Modelling/assimilation
  - Analysis of ocean processes
  - Other: ……

- What physical content would you like to find in an altimeter product in the coastal area?
  - Sea Level Anomaly (SLA)
  - Sea Level Anomaly corrected from High-Frequency signals (*)
  - Absolute Dynamic Topography ADT (=MDT+SLA)
  - Sea Surface Height SSH (=geoïd+MDT+SLA)
  - Sea surface states

(*) Altimeter data is corrected from the HF response of the ocean when it is used alone to look at the ocean dynamics. In fact, periodicity of satellite does not permit to sample correctly HF signals which are sub-sampled and then appear at lower frequencies than they should do. This is called "aliasing "of HF into LF.

- What kinds of product seem to be the most interesting for you?
  - Record of altimeter data and corrections to apply (Geophysical Data Record)
  - Along-track SSH uniformly corrected for every mission + correction applied
  - Along-track SLA and ADT validated and cross-calibrated between missions
  - 2D Gridded products (map)

- What kinds of data validation and quality control do you need?
  - Raw data not validated
  - Validated data (erroneous data removed)
  - Data with global quality flags
  - Data with quality flag for specific criteria
    Which ones? ……..
- Do you need any complementary information?

- HF fields used to correct altimeter data
- Atmospheric corrections
- Geophysical corrections (tide, load effect)
- Instrumental corrections
- Other: ……

- What along-track time sampling do you need?
  - Full resolution (20 Hz) : 1 observation every 0.5 km
  - Current resolution (1Hz) : 1 observation every 6 km
  - Other: ……

- Do you need a Mean Dynamic Topography (MDT) for the coastal ocean?
  - Yes
  - No
  - I don't know

- Do you need other remote-sensing data for your coastal studies?
  - SAR (for ice)
  - MERIS (chlorophyll, suspended matter)
  - Other: ……..

- Do you need altimeter data both in coastal ocean and in Open Ocean?
  - No
  - Yes: Do you need coherency and continuity between these two products?
    - Yes,
    - No
    - I don't know

- Do you need altimeter data in several coastal locations?
  - No
  - Yes: Do you need coherency between them?
    - Yes,
    - No
    - I don't know

- If you work on data assimilation in a coastal model, what kind of data are you interested in?
  - SLA
  - ADT
  - I don't know yet

- Have you already been faced with questions of physical contents when using altimeter data with a model:
  - No
  - Yes. Which ones? (Reference level, steric effect, mean signal, etc.) ……..
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Data format and distribution

- What data format do you prefer to manipulate?
  - NetCdf
  - ASCII
  - Binary
  - Other: ……..

- How do/will you read and use altimeter data?
  - With your own tool
  - With IDL
  - With Matlab
  - With an altimetry toolbox
  - Other: ……..

- What delivery mode seems to be easier for you?
  - DVD
  - FTP
  - OpenDAP
  - Live Access Server
  - Other:……

- How often do you need the altimeter dataset to be updated?
  - daily
  - weekly
  - monthly
  - 2 to 4 times per year
  - following mission cycles
  - Other:……

- Do you need offline or real time data sets (accuracy vs fast delivery)? Which class of data delivery delay and accuracy would best suit your needs?
  - Offline data (months between measurement and final product, best accuracy)
  - Near real time data (days between measurement and final product, good accuracy)
  - Real time data (less than one day between measurement and final product, poor accuracy)

Free remarks:

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THANK YOU !!

Annex: Altimeter products

The principle of altimetry

Altimeters on board of Earth Observation satellites measure the distance between the sea surface and the satellite. Using a positioning system, the altitude of the satellite is known and the Sea Surface Height (referenced to an ellipsoid) can be deduced from the measure. SSH is composed of a variable oceanic part, the Absolute Dynamic Topography ADT, and of a geophysical constant the Geoid. These latter deals with the position of the ocean at rest. Its small scales are not known with enough accuracy to permit the separation of the two components of the SSH. Consequently, SSH is decomposed into a Mean Sea Surface MSS and a Sea Level Anomaly SLA which takes into account the variation of height around the MSS due to the variability of the ocean currents (eddies, mean sea level change, tides, …).

$$SSH = MSS + SLA \quad = Geoid + ADT$$

The MSS contains then both the Geoid and the permanent part of the ADT called the Mean Dynamic Topography MDT which deals with the stationary part of the ocean currents. Its knowledge permits to bypass the Geoid to study the ADT of the ocean:

$$ADT = MDT + SLA$$

The spatial coverage and time-sampling

Measure is made along-track during the satellite revolution around the Earth. Satellite orbit is repetitive: satellites always fly over the same locations with a fixed periodicity. The choice between spatial coverage and time-sampling at each location results from a compromise. For example, Jason satellite covers the Earth in only 10 days but with 314 km between its tracks near Equator whereas Envisat takes more time (35) days to pass over the same location with only 80 km between its track near Equator. These time-space resolutions constitute clearly a limiting factor for studying the coastal area with only altimeter data. Nevertheless, they can be useful for validation/assimilation in modelling or combination with other observations.

Available products

Several levels of altimeter products are delivered.
Level 0 corresponds to raw telemetry data received from Space
Level 1 corresponds to positioned and timed telemetry data. They are expresses in physical units and qualified.
Level 2 deals with level 1 data associated with the corrections to apply for overcoming measurement errors (instrumental, due to signal propagation in the Atmosphere, perturbation by the sea surface states) and geophysical processes (tides, load effect,…). Level 2 data are given along-track separately for each mission. They are also called Geophysical Data Records (GDR)
Level 3 data come from a data processing chain including multi-mission calibration and validation. Only data respecting quality flags are kept. Physical value SLA, SSH, ADT are performed along-track for each mission.
Level 4 data refer to gridded products multi-mission intercalibrated.

For more details or explanation on altimetry principle, please consult the following website:
http://www.altimetry.info/ made by CLS for ESA and CNES.