An overview of recent progress in Coastal Altimetry and its synergies with modeling

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The Coastal Altimetry Community

• Coastal Altimetry Workshops (CAW) since 2008

– Large community: 100+

– COASTALT-SWT mailing list

– Several technical sessions + applications

– Reports to Ocean Surface Topography Science Team (OSTST)

• A Community Science Review

– Techniques, new datasets, applications

– Recommendations (internal / external)

• Interaction with coastal oceanographers, modelers, in situ scientists
Highlights from CAW-10 in Florence

• 73 abstracts, 35 orals, 38 posters, **118 participants, 28 countries**
• Synergy with coastal and regional modelling featured prominently
  – dedicated ARCOM session
• Data access and user support are crucial
  – High-resolution along-track should be made more accessible to non experts, with well-documented manuals in user-oriented formats.
• Need to improve MSS, MDT, better bathymetry, and studies on how to exploit the higher resolution
Highlights- waveforms and retracking

- Precision and reliability of high-resolution data in the coastal zone steadily increasing (better retracking)

Examples of fitted waveforms from BP, ALES and MLE4

Peng and Deng

With a new retracker for Brown-peaky waveform
Highlights- waveforms and retracking

- Precision and reliability of high-resolution data in the coastal zone steadily increasing (better retracking)

![Graph showing waveforms and retracking examples from BP, ALES, and MLE4](image)
Highlights- waveforms and retracking

- Precision and reliability of high-resolution data in the coastal zone steadily increasing (better retracking)
- Retracked data available from a number of sources (new COSTA dataset from DGFI-TUM, PEACHI datasets from CNES/CLS)
- High-Resolution data allow observation of new signals, such as internal solitary waves;

Examples of fitted waveforms from BP, ALES and MLE

Peng and Deng

With a new retracker for Brown-peaky waveform
Highlights - Corrections

• Further advances are expected from improvements in atmospheric corrections, geophysical corrections and Mean Sea Surface (MSS)

• Wet tropo correction and tides are always improving (examples: GPD+, FES2014) but remain main source of errors in coastal zone

• MSS is also an important source of errors in the retrieval of the sea surface height anomalies. Particularly for new untracked missions

Handoko, Fernandes and Lazaro
Highlights - Performance and Cal/Val

- SAR processing (Sentinel 3 and Cryosat-2 in some areas) offers much improvement but still work in progress.

Sentinel-3 Validation Team meeting feedback (*R.Scharoo*)

- Caspian Sea and Great Lakes to be included in Marine as well as Land product
- New L2 in June revision: SAMOSA 2.5, MSS CNES-CLS15, MSS DTU15, FES2014b tide model, sigma0 attenuation applied, netCDF compression
- Future enhancements: specialized distance-to-coast, dedicated L1 for sea-ice and land, GPD+, improved rain flag
- Reprocess all data with next baseline (produce L1A, L1B-s) in April
- Reprocess all data (including prior to June ‘16) in Summer 2017
Highlights - Performance and Cal/Val

• SAR processing (Sentinel 3 and Cryosat-2 in some areas) offers much improvement but still work in progress.

• Focus on Sentinel-3 coastal approach (*M. Raynal*)

Measurement available as a function of the **coastal distance** and the **coastal approach angle**

➢ Close to the coast, the number of available measurement is higher in SARM compared to the classical measurement mode
Highlights - Performance and Cal/Val

- SAR processing (Sentinel 3 and Cryosat-2 in some areas) offers much improvement but still work in progress.
- Focus on Sentinel-3 coastal approach (M. Raynal).
- The very small scales of ocean dynamics, i.e. those at the high resolution offered by the SAR and SARin modes, need to be investigated further.
Highlights - Performance and Cal/Val

- SAR processing (Sentinel 3 and Cryosat-2 in some areas) offers much improvement but still work in progress.
- Focus on Sentinel-3 coastal approach (*M. Raynal*)
- The very small scales of ocean dynamics, i.e. those at the high resolution offered by the SAR and SARin modes, need to be investigated further
- Absolute calibration requires a very well defined datum, as it is the case for the Corsica site.
Synergy with modeling, ARCOM

After 2015 first ARCOM pilot event, we want to

✓ Pursue to **arouse interest for altimetry** within the coastal modeling community trough 2 events :
  ✓ ARCOM17’a :During CAW10
  ✓ ARCOM17’b: During the 5th ICM COSS-TT (today)

✓ Guide the modeling community in the uptake of **coastal/HR altimetry**
  ✓ Improve products information and access
  ✓ Establish concrete links
1st ARCOM session during CAW10

• 8 oral presentations, 4 posters
• Three different thematics:
  – Data products for modelling systems (1)
  – Sea level processes in regional and coastal seas (6)
  – Altimeter Data Assimilation (5)
• Main outcomes
  – Request of high-level products, easier to use
  – More visibility for altimetry products dedicated to COSS
  – Focus to be done on the COSS dynamics
1) Need of higher-level products

Products vary today in ease of use. Need help from expert altimetrist

Request:
- 20 Hz level 2 with limited set of recommended and documented defaults ("not only ingredients but also recipes")
- 20 Hz level 3 (ready-to-test) enriched with corrections (tides, DAC, ...)
- No need of level-4 (gridded product)
- Unity/consistency in multi-sat products and formats
- Community tools in support of applications

2) COSS Dynamics

- Growing interest in submesoscale – unifying coastal and open ocean communities
- IB and DAC are different dynamics – should be separated
- Using altimeter data in conjunction with tide gauges is not obvious
3) Visibility for altimetry products dedicated to COSS

- Wiki or User Forum: expert help for novice users
- Demonstrate value-added by comprehensive use
- Encourage greater focus on sea level in model analysis
- Identify coastal regimes/processes (river plumes, fronts, internal waves, estuaries) potentially informed by altimetry
Coastal/High-Resolution datasets

- List drafted in 2015 during the ARCOM-pilot workshop
- Updated in November 2016 by Cipollini et al., Surv. Geophys., 2017

Available on to [http://www.coastalt.eu/community#datasets](http://www.coastalt.eu/community#datasets)

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<th>ID</th>
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<td>PISTACH</td>
<td>CLS CNES</td>
<td>j2</td>
<td>L2</td>
<td>20 Hz</td>
<td>Global</td>
<td>AVISO+</td>
<td>Experimental Jason-2 products for Hydrology and Coastal studies with specific processing. Will be discontinued at the end of 2016 in favour of PEACHI</td>
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<tr>
<td>PEACHI</td>
<td>CLS CNES</td>
<td>sa, (j2 to be added soon)</td>
<td>L2</td>
<td>40 Hz</td>
<td>Global</td>
<td>AVISO+ / ODES</td>
<td>Experimental SARAL/AltiKa products including dedicated retracking and corrections leading to more accurate products for coastal zones, hydrology and ice. From 2017 expected to generate also j2 products</td>
</tr>
<tr>
<td>XTRACK</td>
<td>LEGOS-CTOH</td>
<td>tx, j1, j2, gfo, en (sa to be added soon)</td>
<td>L2, L3</td>
<td>1 Hz (20Hz (test))</td>
<td>23 regions covering the whole coastal ocean</td>
<td>CTOH AVISO+ / ODES</td>
<td>Specific processing using improved data screening and latest corrections available</td>
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<tr>
<td>ALES</td>
<td>NOC</td>
<td>j2, n1, (j1, j3 to be added soon)</td>
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<td>Global, &lt;50 km from coast</td>
<td>PODAAC</td>
<td>Experimental products from the ALES processor included in SGDR-type files alongside the standard products and corrections.</td>
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<td>SARvatore</td>
<td>ESA-ESRIN</td>
<td>c2 (SAR only)</td>
<td>L2</td>
<td>20 Hz</td>
<td>SAR mode regions</td>
<td>ESA GPOD</td>
<td>On-demand Processing service for the CryoSat-2 SAR mode data where the user can configure some processing parameters to meet specific requirements (for instance for the coastal zone)</td>
</tr>
<tr>
<td>COP</td>
<td>ESA</td>
<td>c2 (LRM/PLRM)</td>
<td>L2</td>
<td>20 Hz</td>
<td>Global</td>
<td>ESA</td>
<td>Global products for CryoSat-2 from an Ocean processor (output is in PLRM over the SAR mode regions) - but no specific coastal processing</td>
</tr>
<tr>
<td>COSTA</td>
<td>DGFI-TUM</td>
<td>e2, en (j1,j2,e1 to be added soon)</td>
<td>L3</td>
<td>1 Hz (20 Hz)</td>
<td>Mediterranean and North Sea</td>
<td>PANGAEA</td>
<td>Dedicated coastal altimetry sea level measurements based on enhanced ALES retracker</td>
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« Coastal Altimetry »

= where land contamination of altimeter and radiometer footprints

(a question of distance to the shore)

credits: www.coastalt.eu
Coastal Modeling

= the transition between shoreline and deep-ocean including the continental shelf

Marked by **Energetic processes**: waves, tides, storm surges, eddies, filaments

**HF dynamics** (atmosphere, tides)

With complex hydrodynamical features of **small scale** (low Rossby radius)

**Exchanges** area between the shelf and the open ocean (slope currents)

- a question of ocean processes
- Including the shelf region (bathymetry)
Coastal Altimetry vs. Coastal Modeling

✓ Limitation <30km from the shore
  ➢ Overstep those limitations <30km
  ➢ Increase the spatial resolution

✓ Large distance to the shore o(100km)
✓ Various scales of ocean processes
  ➢ Can use altimetry data and not only “coastal”
For this ARCOM session

• No detail today on Altimetry processing
  – still available online on the 4th COSS-TT ICM website if needed
• Altimetry datasets information (COSTA, PEACHI, DUACS-HR, X-TRACK)
  – 3 posters available in the corridor
• Examples of altimetry use in coastal regions from the CAW-10
• Focusing the discussion on :
  ➢ What physical processes have a **signature in Sea Level** in the coastal ocean you’re modeling?
  ➢ Do you have the **information you need to begin**, or to **improve**, your **use of altimetry data**? If not, what do you need - more knowledge about processing, access to data, examples of their usefulness, or other?