

Coastal Altimetry: the 1-km Challenge

a short summary of the 9th Coastal Altimetry Workshop

Paolo Cipollini, National Oceanography Centre, UK

Organizing committee: J. Benveniste (ESA), H. Bonekamp (EUMETSAT), P. Cipollini (NOC), L. Miller (NOAA), N. Picot (CNES), T. Strub (OSU), D. Vandemark (UNH), S. Vignudelli (CNR)

Session Chairs: O.B. Andersen (DTU), F. Birol (LEGOS), M. Cancet (Noveltis), J. Fernandes (U Porto), J. Hausman (JPL), K. Ichikawa (Kyushu U), L. Fenoglio (TUD), C. Martin-Puig (NOAA), A. Pascual (IMEDEA), M. Saraceno (U Buenos Aires), R. Scharroo (EUMETSAT), W.H.F. Smith (NOAA), P. Thibaut (CLS), J. Wilkin (Rutgers U).

plus the many scientists who contributed papers, posters & animated discussions

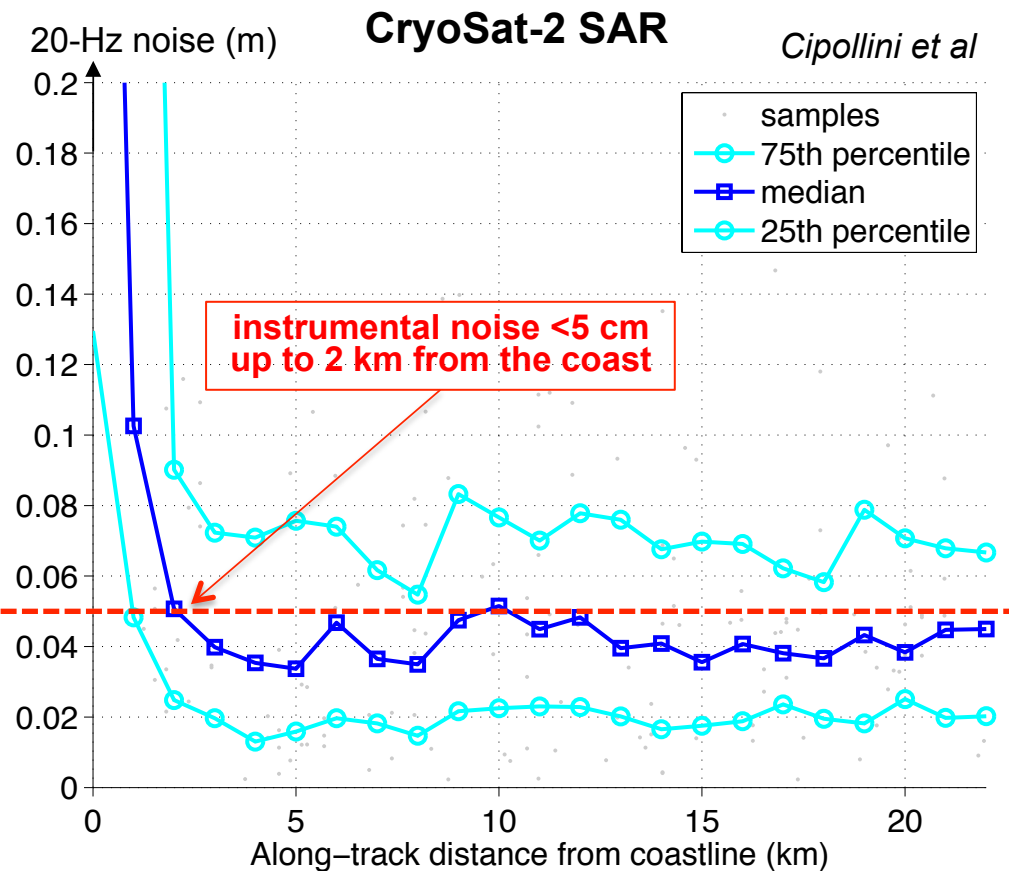
Coastal altimetry is increasingly relevant for altimetry as a whole

...and at both ends of the spectrum

This is made possible by a number of advancements

Advances in processing

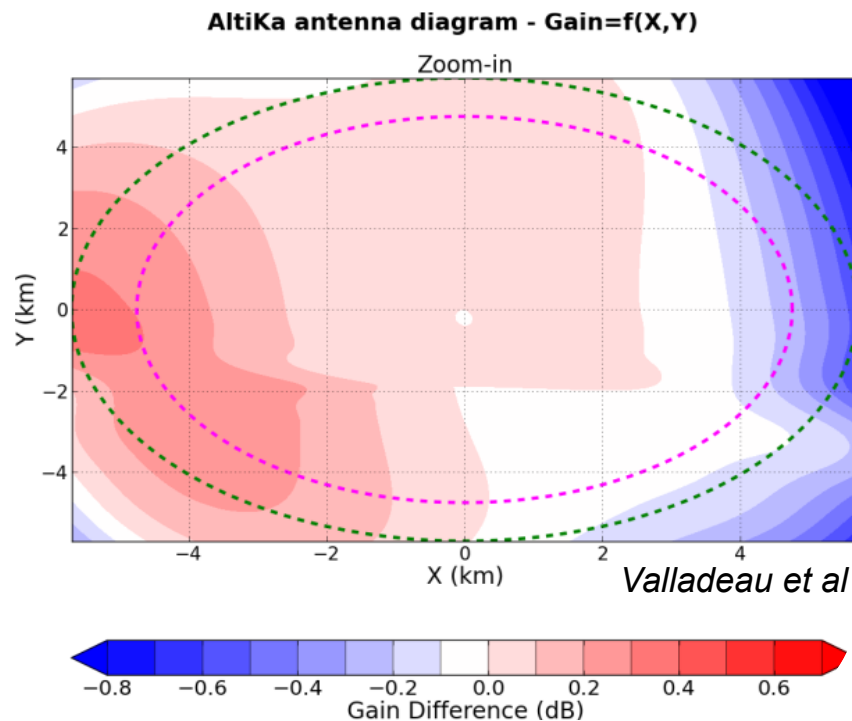
- SAR altimetry is maturing
 - particularly valuable in coastal zone (higher resolution, higher SNR, reduced impact of land/bright targets) as clearly demonstrated by CryoSat-2
 - will be global (with all coasts) with Sentinel-3
- AltiKa working extremely well
 - PEACHI project has introduced many improvements in processing
- Advances in retracking
 - For LRM: ALES (NOC, on PODAAC), DCORE (CLS)
 - For SAR: SAMOSA Coastal (ESRIN), convolution-based retracker (TUDarmstadt)



Data from "Brighton Box" (South UK)
processed by GPOD @ ESRIN

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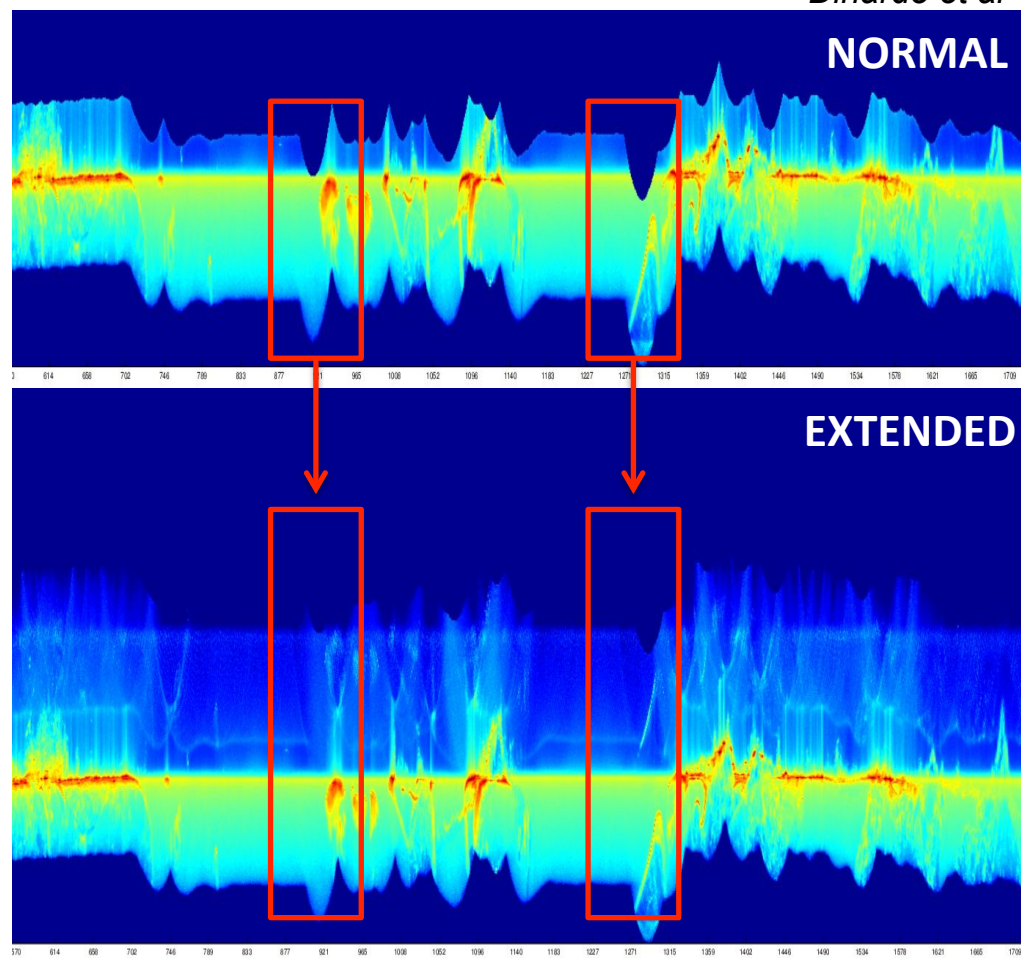
AltiKa antenna pattern compensation

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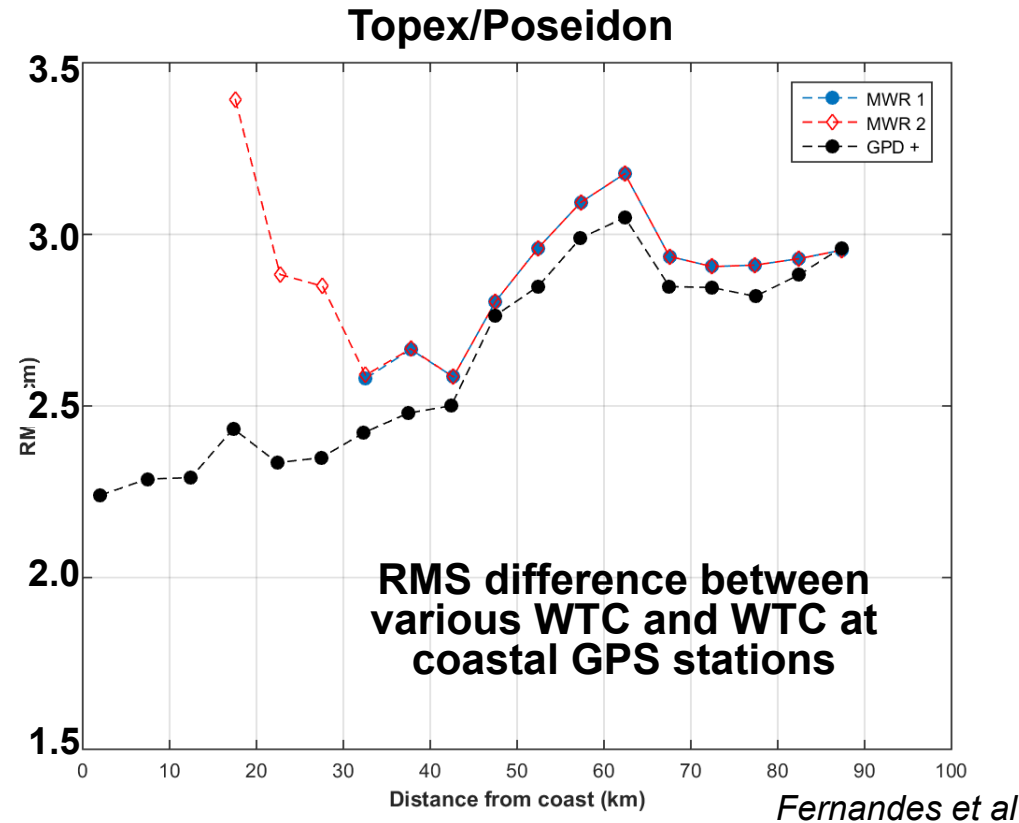
Extended range window for SAMOSA Coastal

Dinardo et al



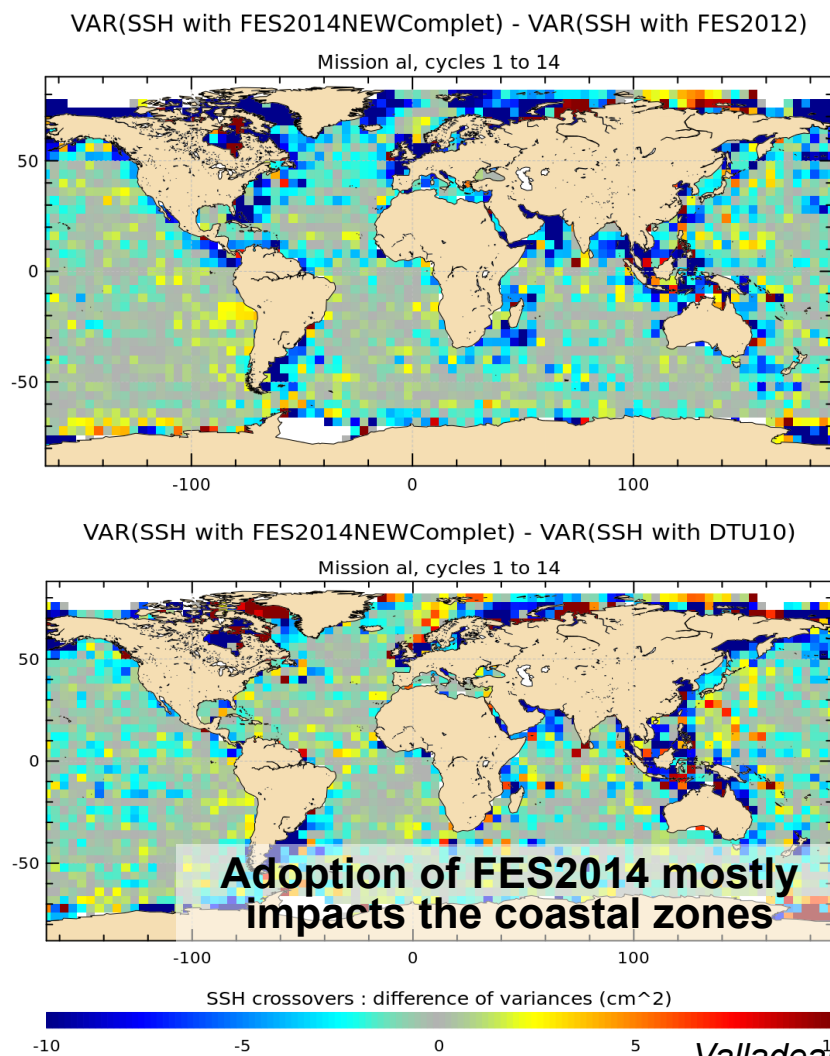
Advances in corrections & MSS

- Wet Tropo: GPD+ (UPorto)
 - from Alt MWR, ~700 GNSS stations, imaging MWR
 - available globally for 8 missions, great improvement at the coast, significant impact on regional sea level trends
- tides continue to improve and remain crucial
 - and many applications will need regional tidal models
- New MSS models with coastal improvements



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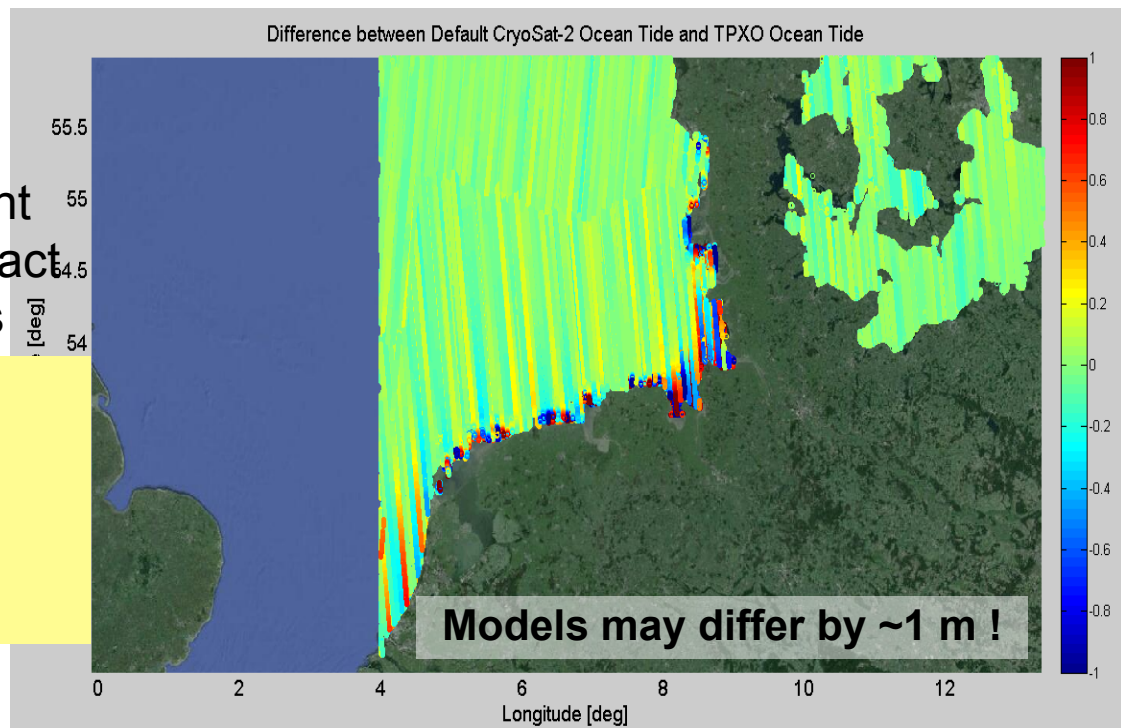


Valladeau et al

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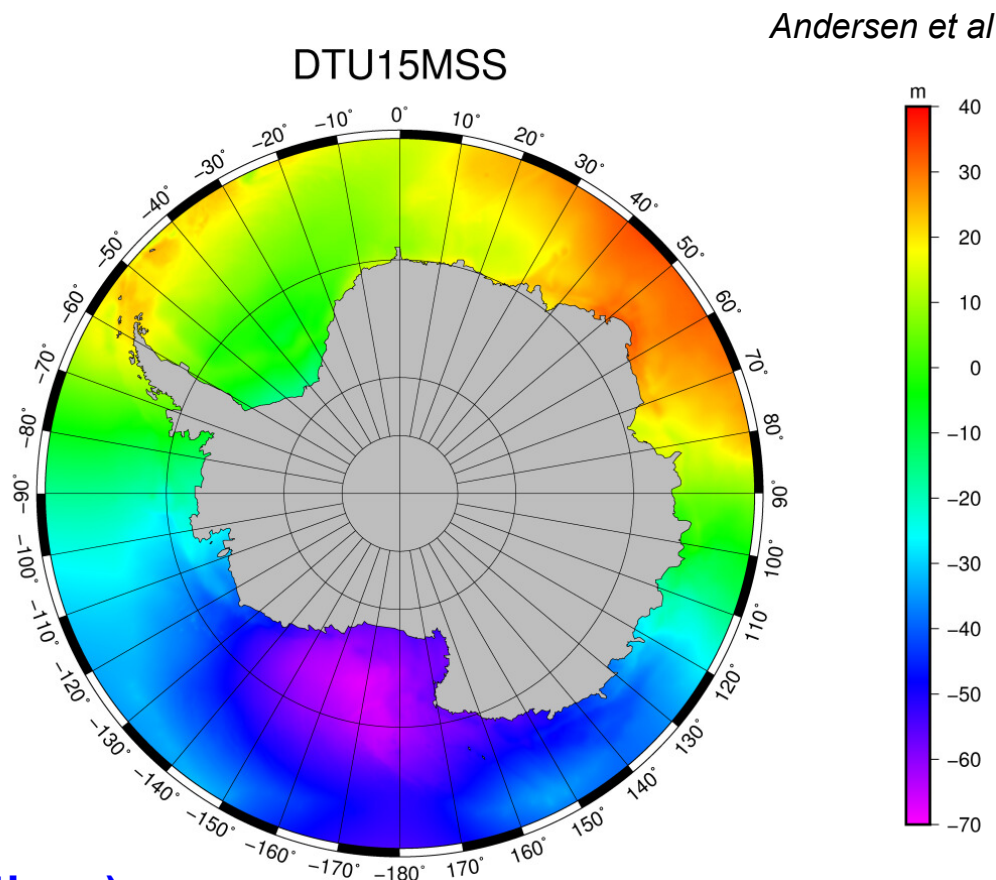
Dinardo et al



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- **New MSS models with coastal improvements**

Some applications just require Total Water Level (independent on corrections)



Many datasets are now available

Table (with links) at <http://www.coastalt.eu/community>

| ID | Produced by | Missions | Product level | Posting rate | Coverage | Download from |
|-----------|-------------------------------|---|--------------------|------------------------|------------------------------|--------------------------|
| AVISO | CLS CNES | e1,tx,e2, en, j1, j2, c2 (LRM/ PRLM), sa | L2, L3 also L4 | 1 Hz | Global + european regions | AVISO+ |
| CMEMS | CLS CNES | e1,tx,e2, en, j1, j2, c2 (LRM/ PRLM), sa | L3 L3 for assim | 1 Hz | Global + european regions | marine.cope rnicus.eu |
| PISTACH | CLS CNES | j2 | L2 | 20 Hz | Global | AVISO+ |
| PEACHI | CLS CNES | sa | L2 | 40 Hz | Global | AVISO+ |
| XTRACK | LEGOS- CTOH | tx, j1, j2, gfo, en | L2, L3 | 1 Hz 20Hz (test) | 23 regions | CTOH AVISO+ |
| RADS | EUMETSAT, NOAA, TUDelft | gs, e1, tx, pn, e2, gfo, j1, n1, j2, c2, sa | | 1 Hz | Global | TUDelft |
| ALES | NOC | j2, n1 (coming) | | 20 Hz | Global, <50 km from coast | PODAAC |
| SARvatore | ESA-ESRIN | c2 (SAR only) | | 20 Hz | SAR mode regions | ESA GPOD |
| COP | ESA | c2 (LRM/PLRM) | L2 | 20 Hz | Global | ESA |

Presented at
the workshop

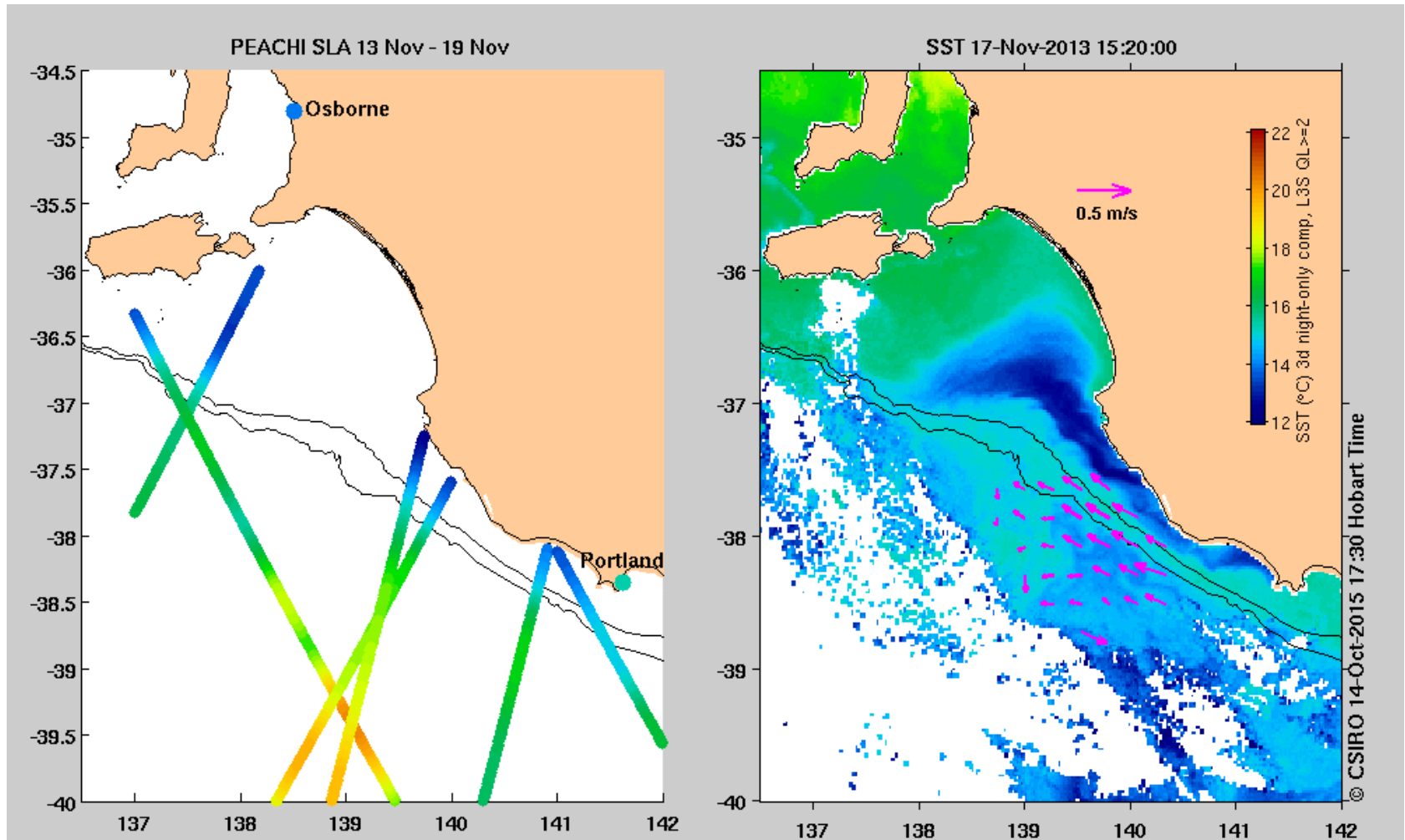


Applications reflect evolution of altimetry

- Initially designed for **meso- to large-scale**
 - and extremely successful in that
- Now moving to the **short/fast end**...
 - regional/coastal dynamics
 - submesoscales
- ...but also to the **very long/slow end**
 - climate scales
 - mean sea level

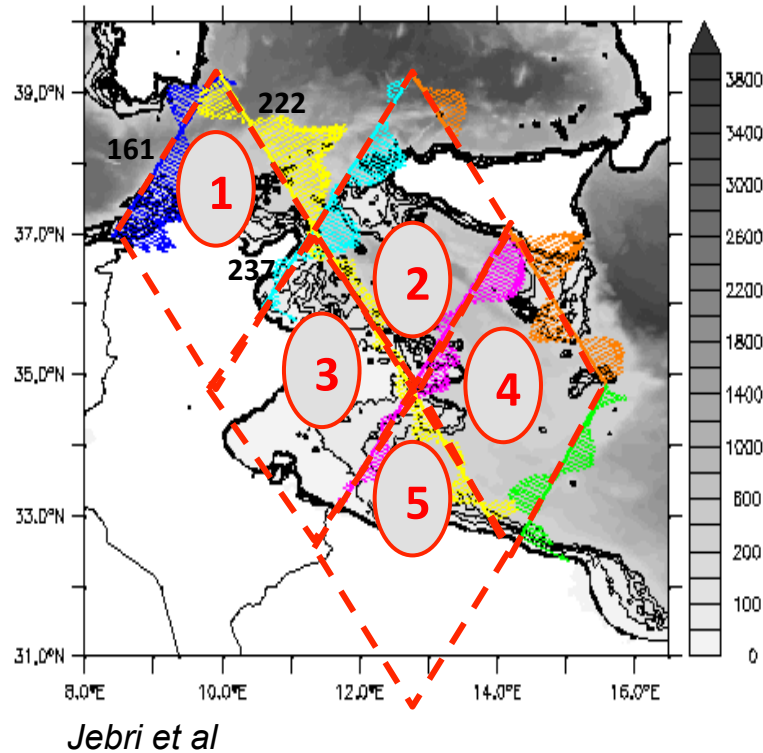
The short/fast end

Cahill et al Upwelling setdown along SE Australia captured by AltiKa

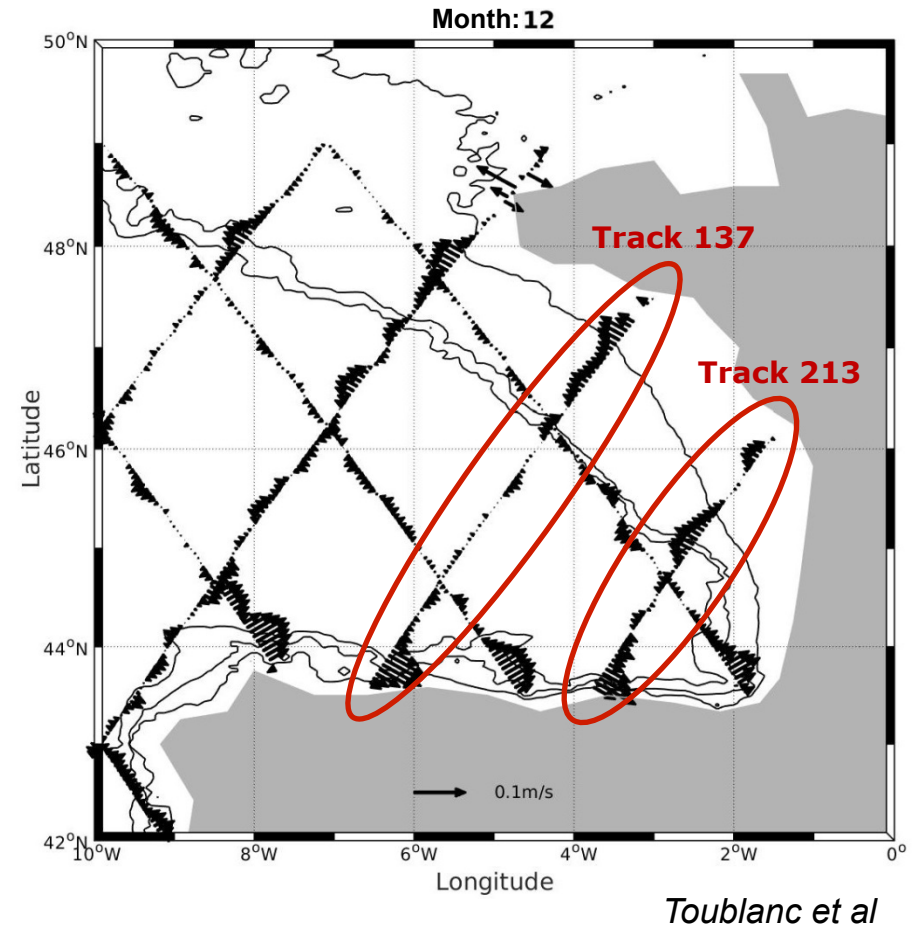


The short/fast end

Volume Transports in the Straits of Sicily



Shelf and slope circulation in Bay of Biscay



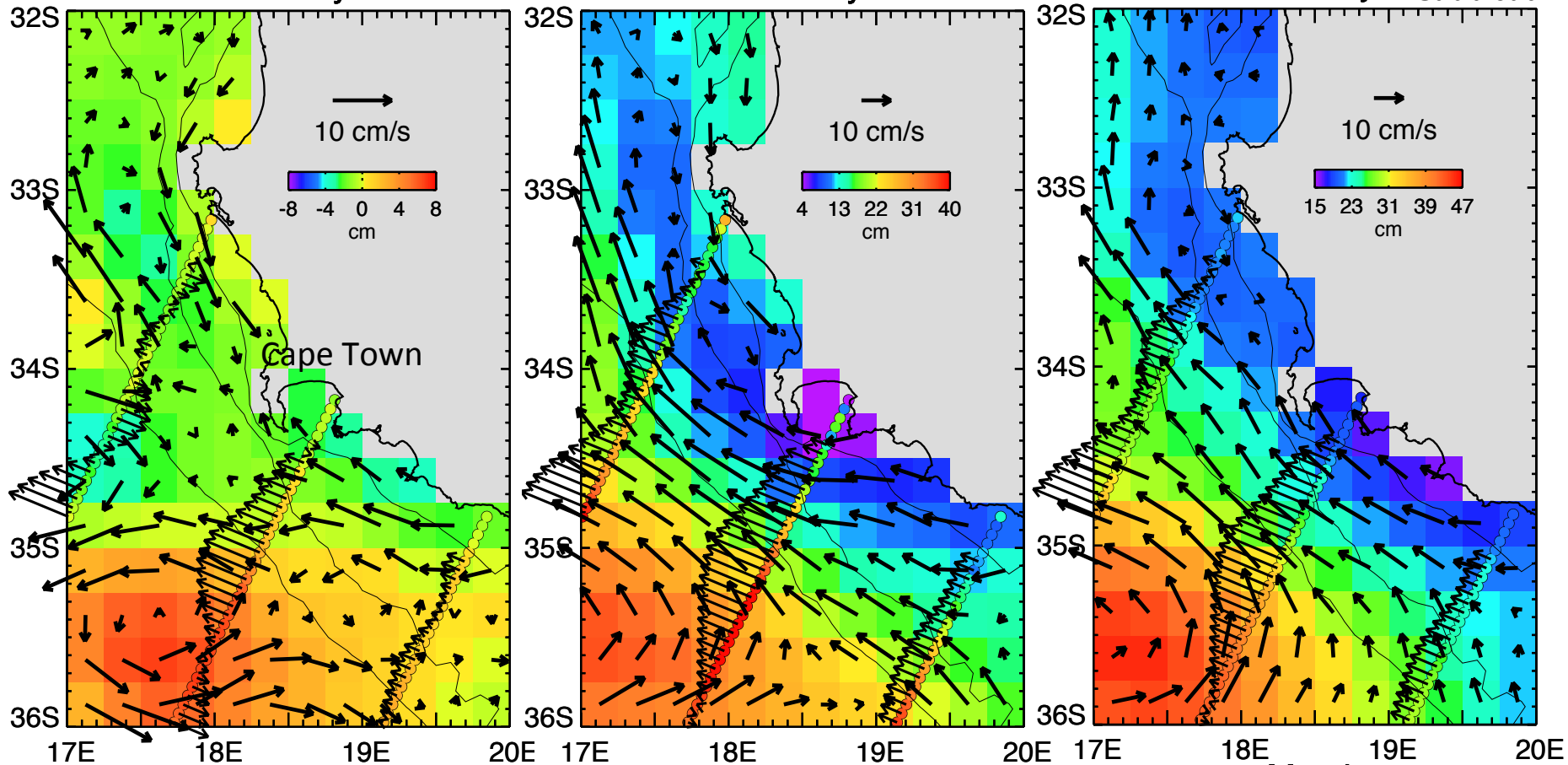
The short/fast end

Coastal Currents in the Benguela area – a SWOT Testbed?

SLA – 6 Years
January

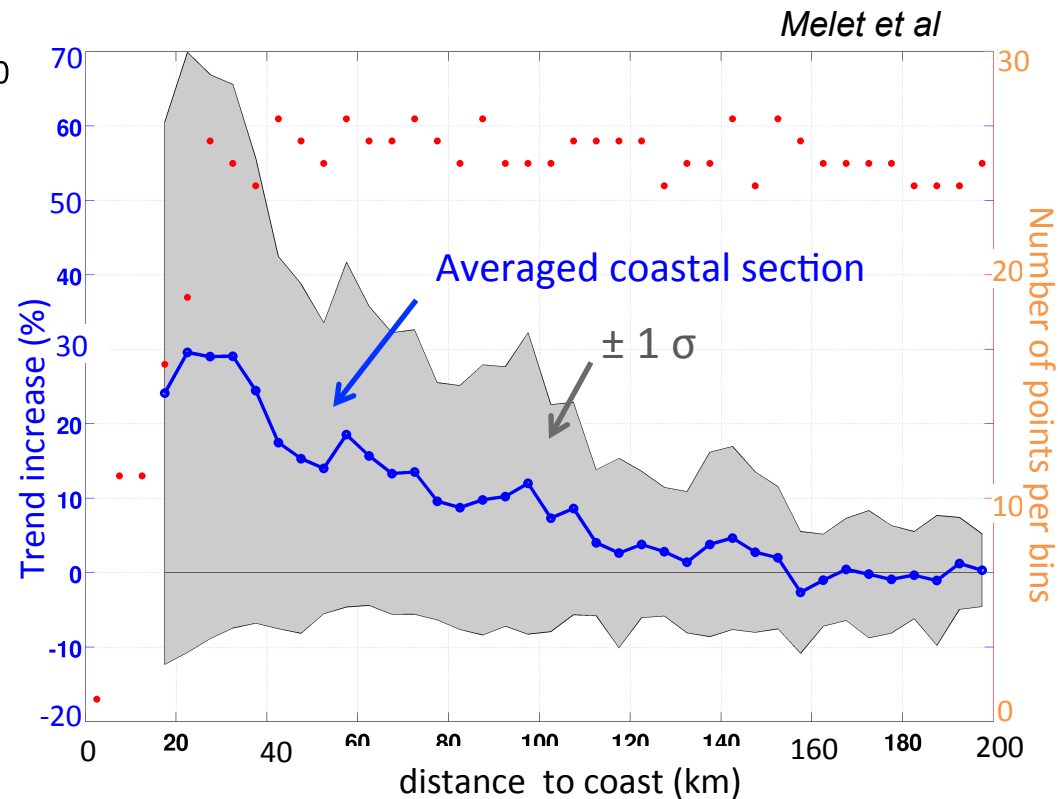
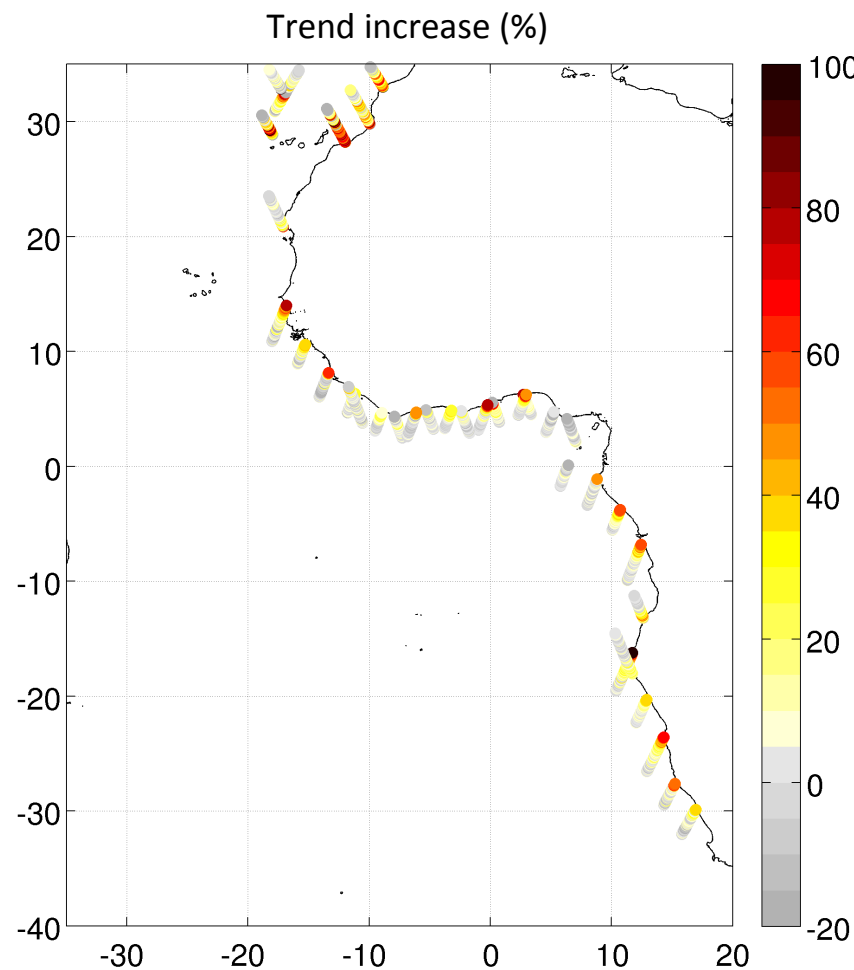
6-Yrs ADT – CNES
January

6-Yr ADT – DTU
January *Strub et al*



The long/slow end

► **Coastal sections** : 1993-2012 trend CTOH/XTRACK



**Faster sea level rise onshore (+20-30%)
Robust for coastal sections**

Synergies with NASA SLCT



Keynote by Eric Lindstrom calling for closer collaboration between sea level change community and coastal altimetry community

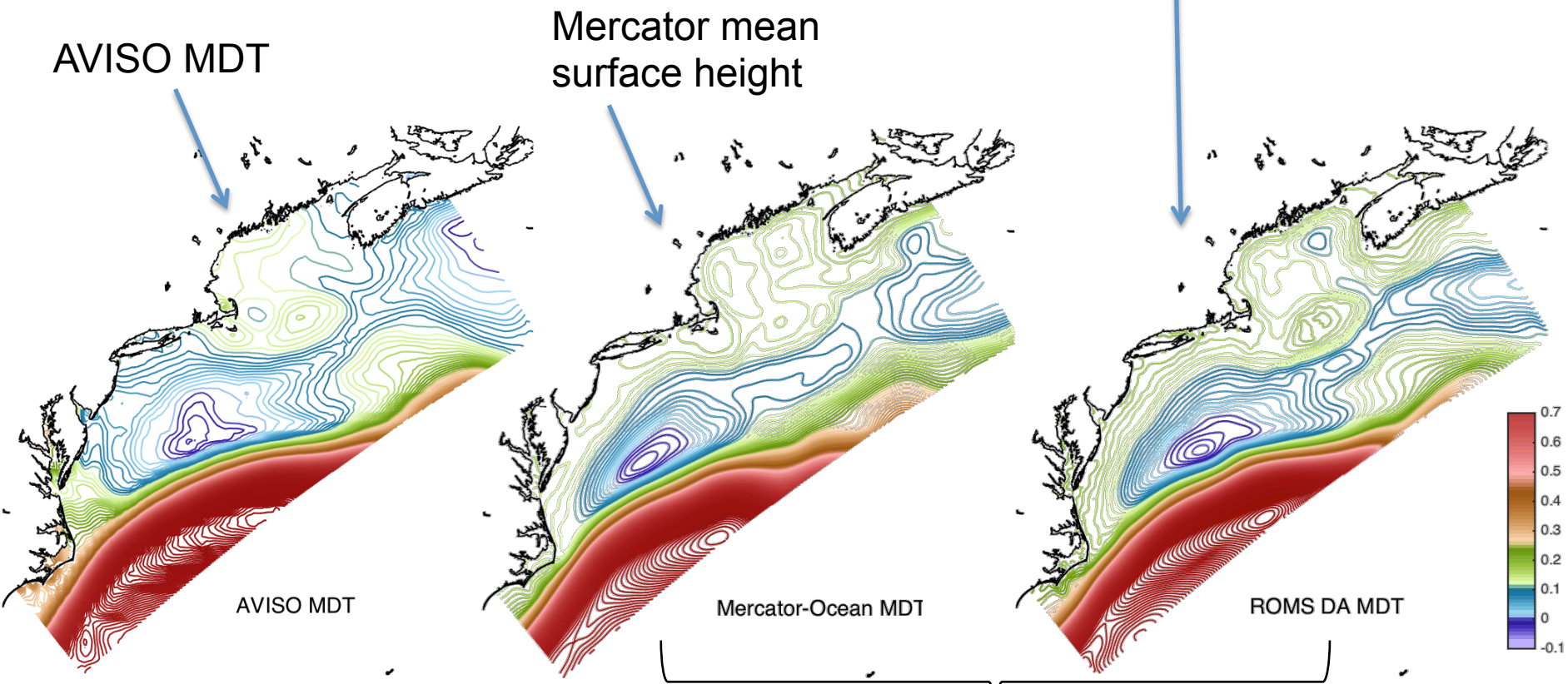
Synergies with the modelling community

ARCOM workshop of GODAE COSS-TT in September (Dufau/Wilkin)

- Presented coastal altimetry concepts to coastal modelers/data assimilators
 - MSS/geoid, MDT, geophysical corrections, sampling patterns, re-tracking, signal/noise
- Emphasized “*know your corrections*” to match altimeter data relevant to coastal dynamics
- Example application: observation impact in coastal variational Data Assimilation

To have ADT suitable for coastal oceanography, especially data assimilation, we need MDT accurate to the coast

Regional model after 4DVAR DA on climatological CTD, velocity & wind stress



John Wilkin, Rutgers

ROMS MDT matched to Mercator sea level datum in open ocean

Some (self-?) recommendations

Themes that arose at ARCOM, and echoed at CAW-9:

- (i) coastal oceanographers remain **unaware** of the valid uses of altimetry in shallow waters and close to the coast, and
- (ii) the **apparent complexity of choices** amongst the many coastal products puts novices off!

1 Need for a “portal” (CoastAlt Wiki?) to summarize and document the various products available, data access points, and examples uses.

2 At ARCOM it was suggested that a “decision tree” guide (flow chart) would help with data selection be offered.

3 Desire for a “multi-mission along-track coastal AVISO” with default choices that presents data to oceanographers in a common format for use in integrated analyses, to overcome activation energy of first use of coastal altimetry

Conclusions - and a challenge

- Coastal altimetry has increasing relevance because of:
 - technical know-how of altimeter processing
 - sampling of smaller scales
 - coastal impacts – also of climate-scale changes (MSL)
- **The “1-km challenge”:**
 - **in the coast:** can we capture the dynamics up to 1 km from the coast? and Sea Level (also over long scales) up to 1 km from the coast? (yes!)
 - **over open ocean:** spectra show us we cannot resolve 1 km, but how do we use the increased resolution & accuracy?

And finally, how we best integrate this information with other data and models?

23 talks over 7 sessions → all to go on www.coastalt.eu/community

1 keynote

2 poster sessions

83 participants

15 countries, 6 continents

