PEACHI
Prototype for Expertise on AltiKa for Coastal Hydrology and Ice

N. Picot, A. Guillot, G. Valladeau, P. Thibaut

Motivations for coastal activities

- Coastal area is a region of high variability
  -> need to use as much as flight and in-situ data as possible

- SARAL will complement the current virtual constellation (JA2, CY), knowing that the phasing of 2 satellites is not optimal

- The use of the Ka-band frequency will supply more accurate measurements -> improvement of the spatial and vertical resolution

- Among SARAL/AltiKa main scientific goals is the study of coastal dynamic processes (small or medium scale phenomena)
  -> anticipate many downstream applications (SWOT mission)

- Several projects on-going to increase the use of altimeter data in the coastal area (CoastAlt, PISTACH)

Main Objectives

- Realization of a prototype for analyzing and improving dedicated processings relative to the SARAL mission
- Analyse and validation of the existing algorithms before their application in the operationnal products
- New algorithms and parameters implemented during the exploitation phase
- The prototype will also be able to extract parameters to be provided to expert scientists
- Complementarity/continuity with the altimeter products provided in the open ocean

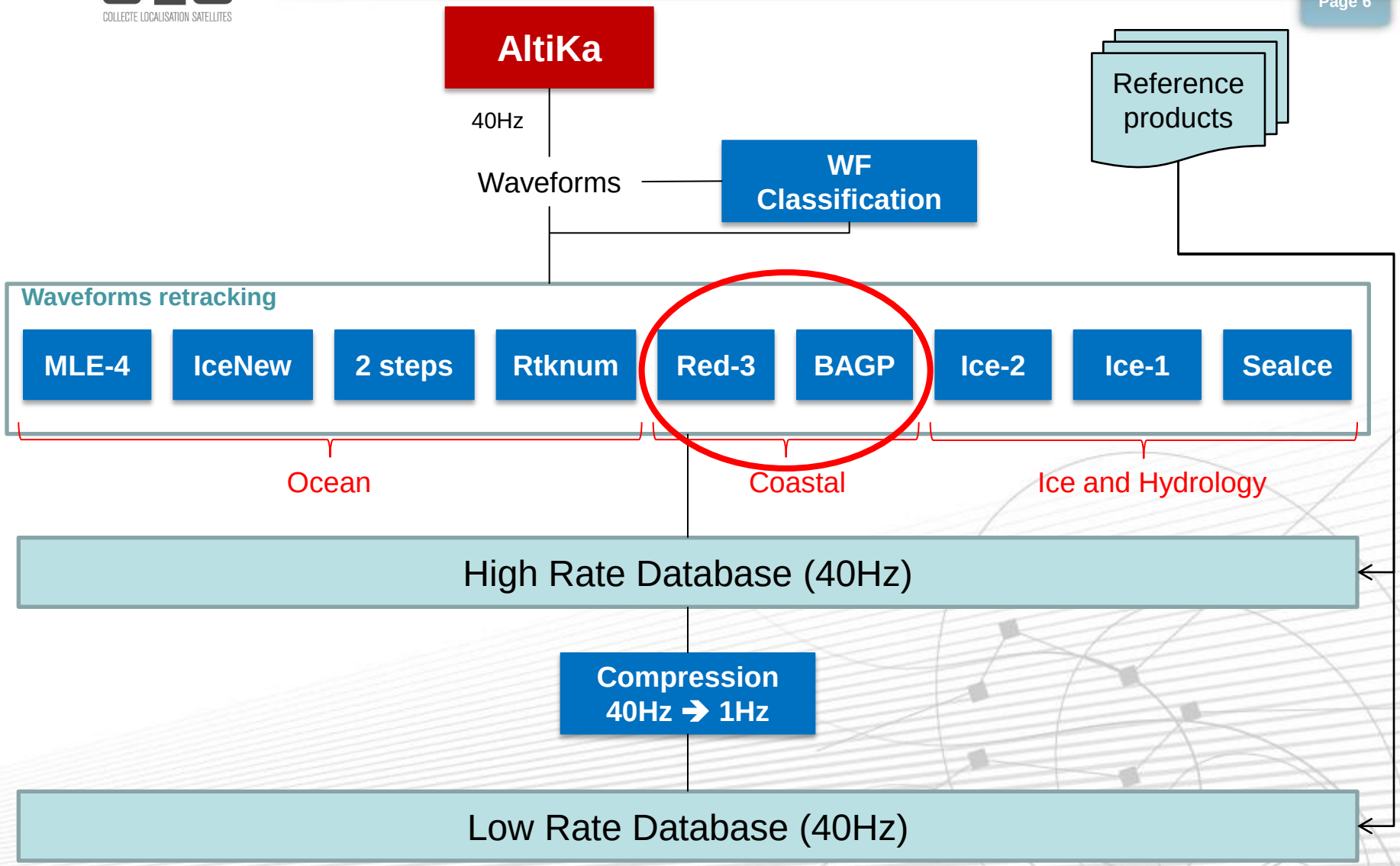
State of the art

- Available data in the prototype from S-GDR AltiKa products: cycle 1 and part of cycle 2
- Operationnal processing for retracking, radiometer, tide and MSS
- Dedicated algorithms: - new low-pass filtering to compute the 1Hz data
  - computation of new troposphere corrections from ECMWF 3D vertical fields of temperature and humidity
  - additional geophysical corrections: FES 2012, DTU MSS, MDT 2013, …
  - additional instrument corrections: SSB coupled with WW3 or with 40 Hz SWH values, …
- Prototype routinely performed to provide expert scientists the most up-to-date improvements on the ground processing for Ka-band studies

Presentation outline

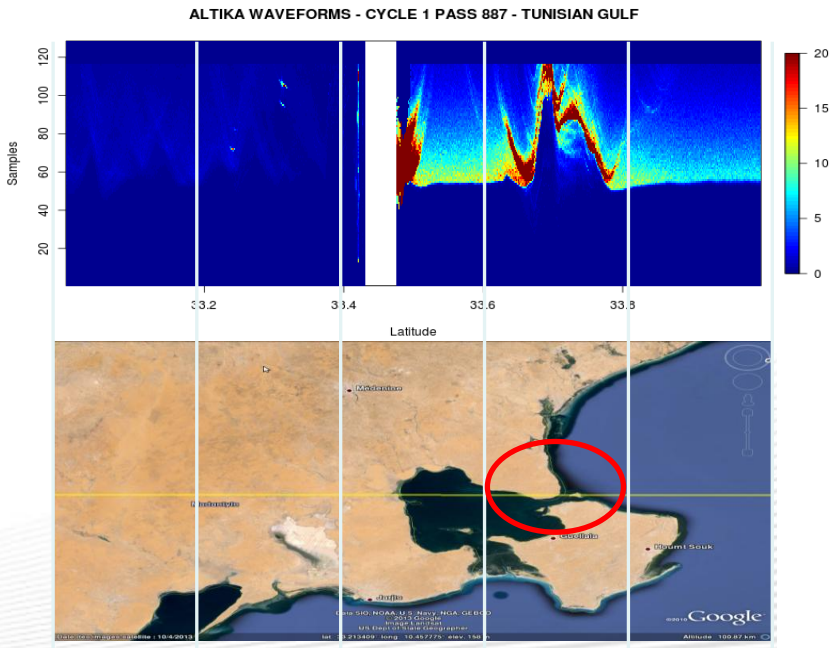
- AltiKa waveforms over coastal edges
- Radiometer coastal performances
- Additional geophysical correcton: FES 2012 tide model

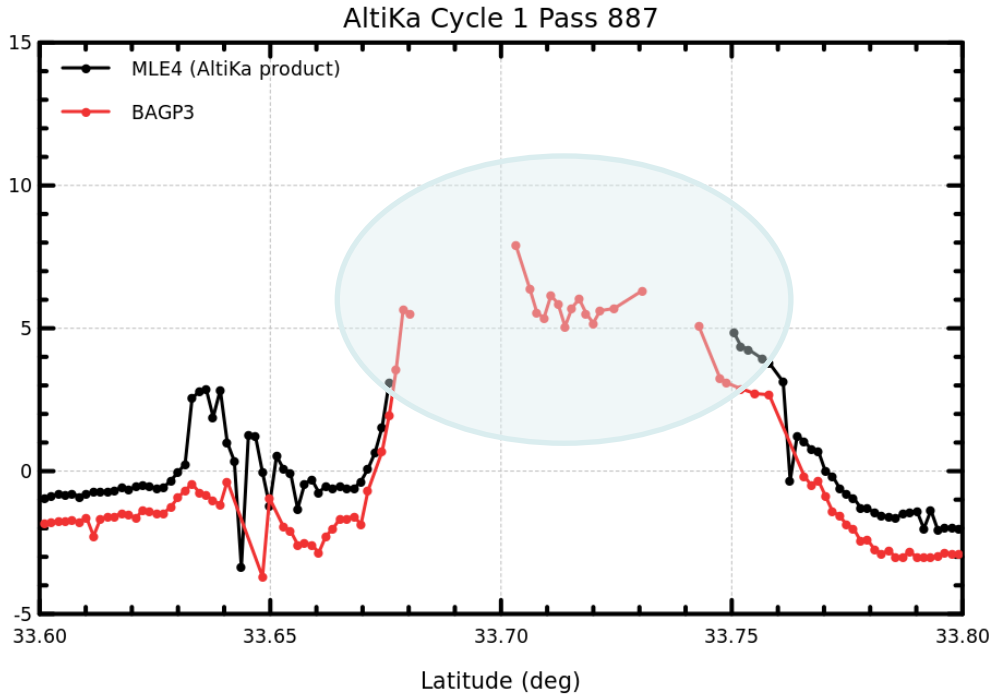
The PEACHI retracking process



AltiKa waveforms over coastal edges

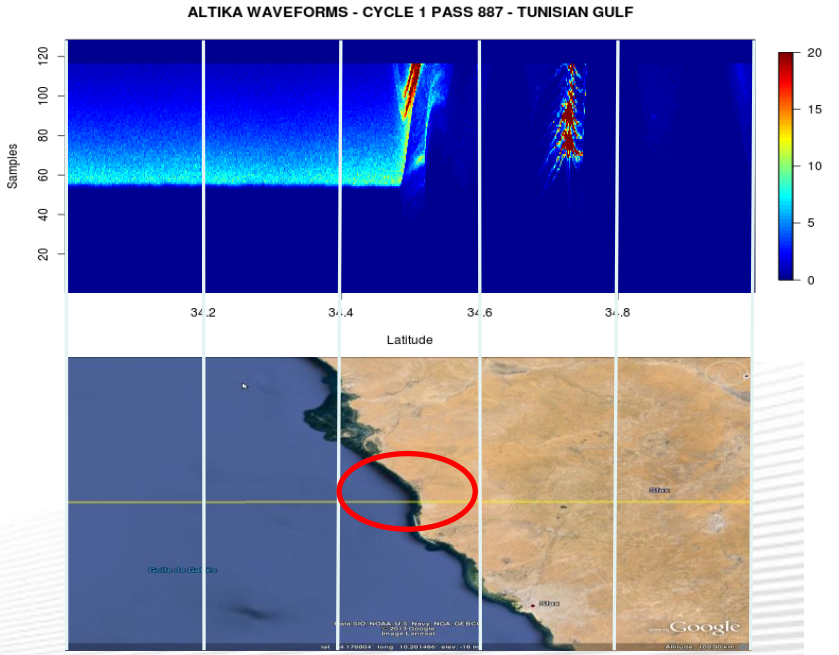
- Example for Cycle 1/Pass 887 (acsending pass) in EDP mode for the Tunisian gulf (leaving coast)
- Good retrieval of the transition between the Tunisian Gulf and the Mediterranean Sea
- + 16 points considering BAGP algorithm
  -> 2400 m spatial coverage in addition

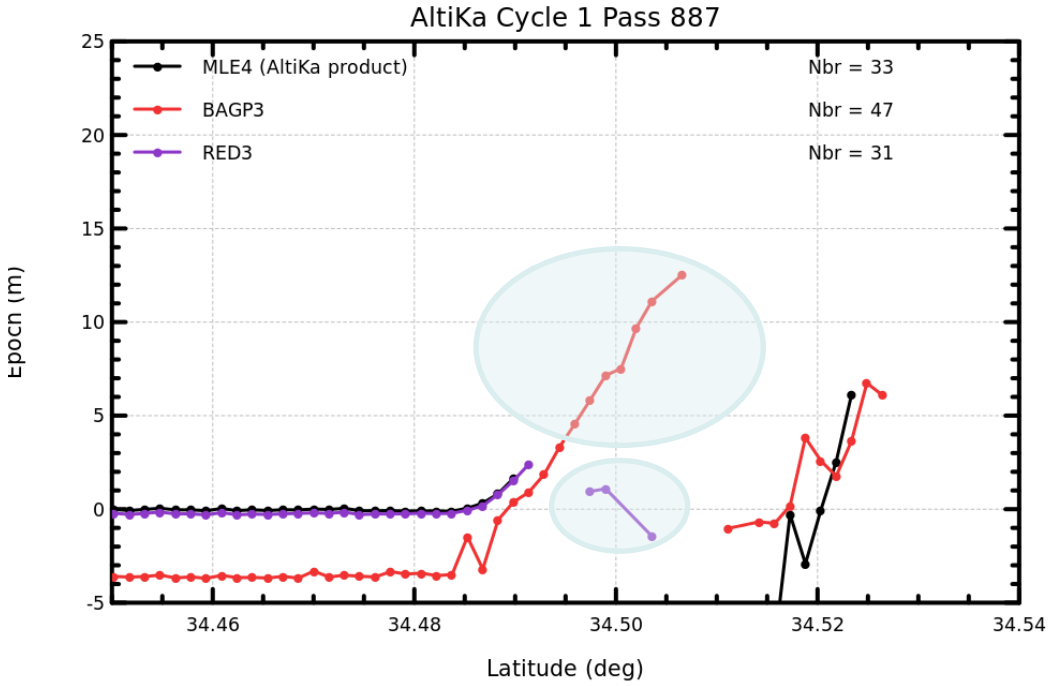




AltiKa waveforms over coastal edges

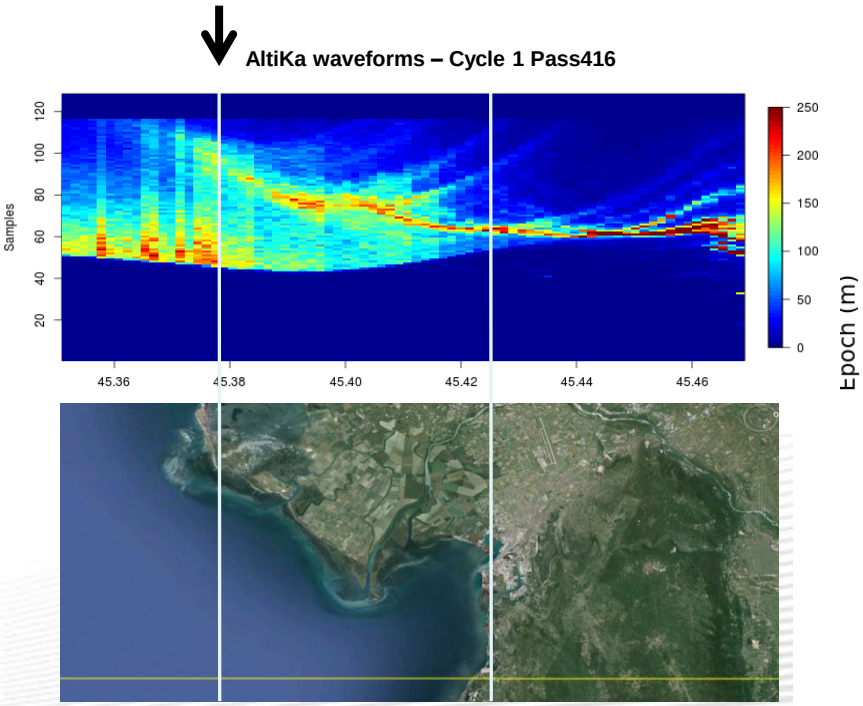
- Example for Cycle 1/Pass 887 (acsending pass) in EDP mode for the Tunisian gulf (approching coast)
- Again, + 14 points with BAGP algorithm close to the coast
- Expected waveform classification for better results with Red-3 algorithm

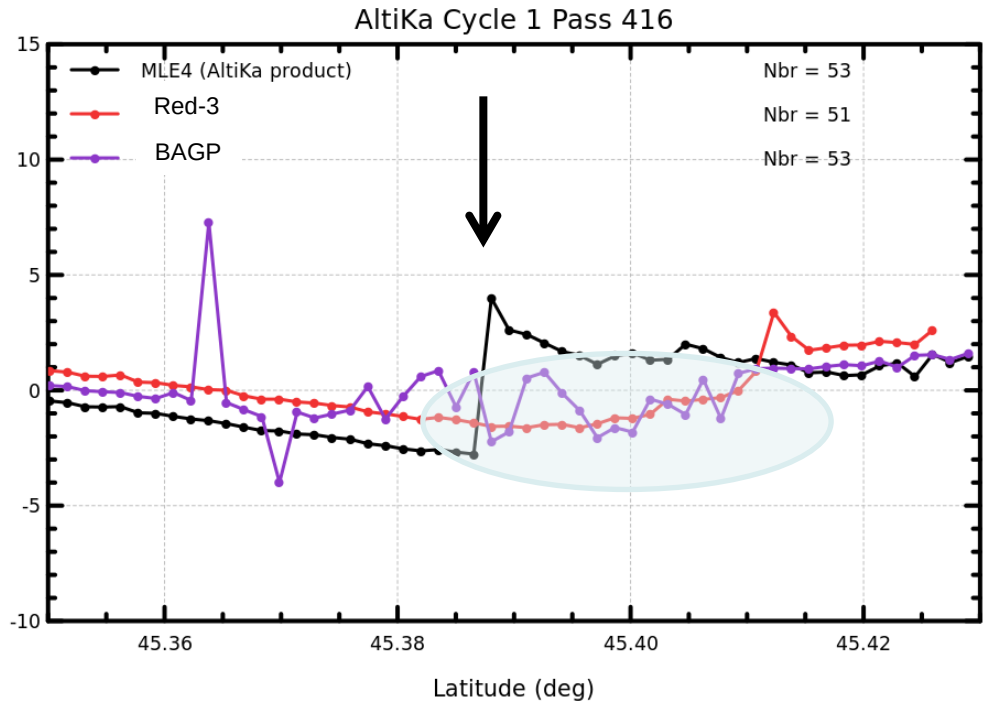




AltiKa waveforms over coastal edges

- Example for Cycle 1/Pass 416 (close to 887) in median tracker mode close to Slovenia (approching coast)
- Continuity is ensured between open ocean and coastal waveforms thanks to BAGP and Red-3 coastal retrackings
- Better retracking of the AltiKa waveform with Red-3





AltiKa waveforms over coastal edges

- **Conclusions on retracking algorithms:**

➢ First results about the BAGP retracking algorithm display very good behaviour

➢ Concerning Red-3, even with early good results, the waveform classification is expected to be further studied and compared to MLE4 and BAGP retrackers

➢ On-going studies are performed on the global performance of coastal retracking algorithms over coastal areas

➔ Providing the best settings for each algorithm and thus improve the AltiKa ground processing

Radiometer coastal performances

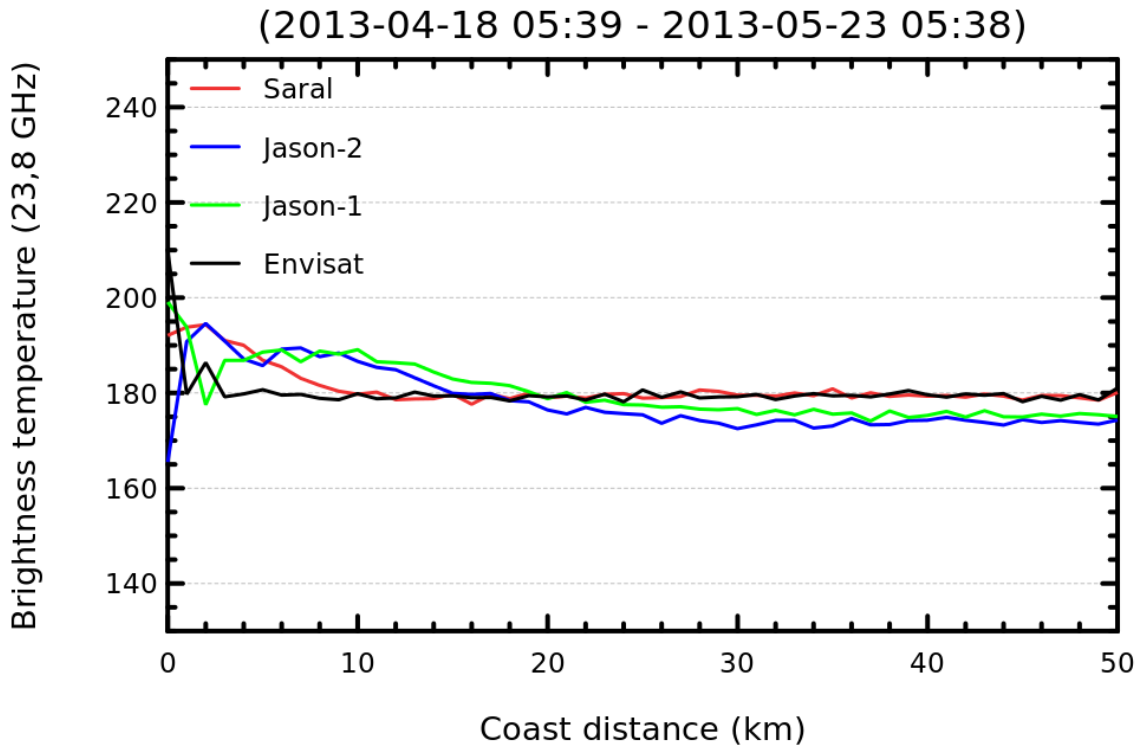
- Radiometers: large contrast between ocean (170 K) and land (280 K) brightness temperatures -> contamination on coastal measurements depending on spatial resolution
- Spatial resolution results from the combination of the antenna directivity (-3 dB width) of various radiometers computed from the antenna patterns
- AltiKa radiometer has the finest resolution

	Envisat	JMR	AMR	AltiKa
23,8 GHZ	17 km	36 km	25 km	12 km
Channel 2	25 km	22 km	12 km	8 km

Radiometer coastal performances

- Expected performances for AltiKa are confirmed by the measurements: brightness temperatures are free from contamination up to 10 km from the coast

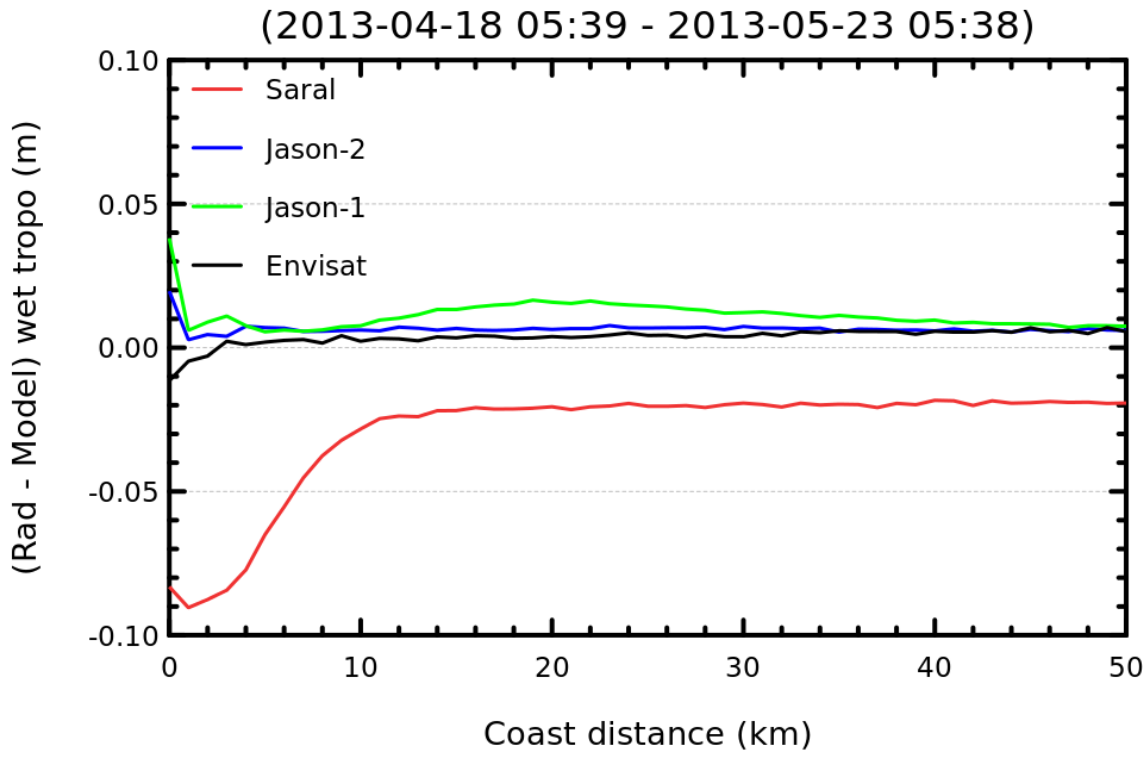
- On Envisat/MWR, last valid ocean TB is extrapolated



Radiometer coastal performances

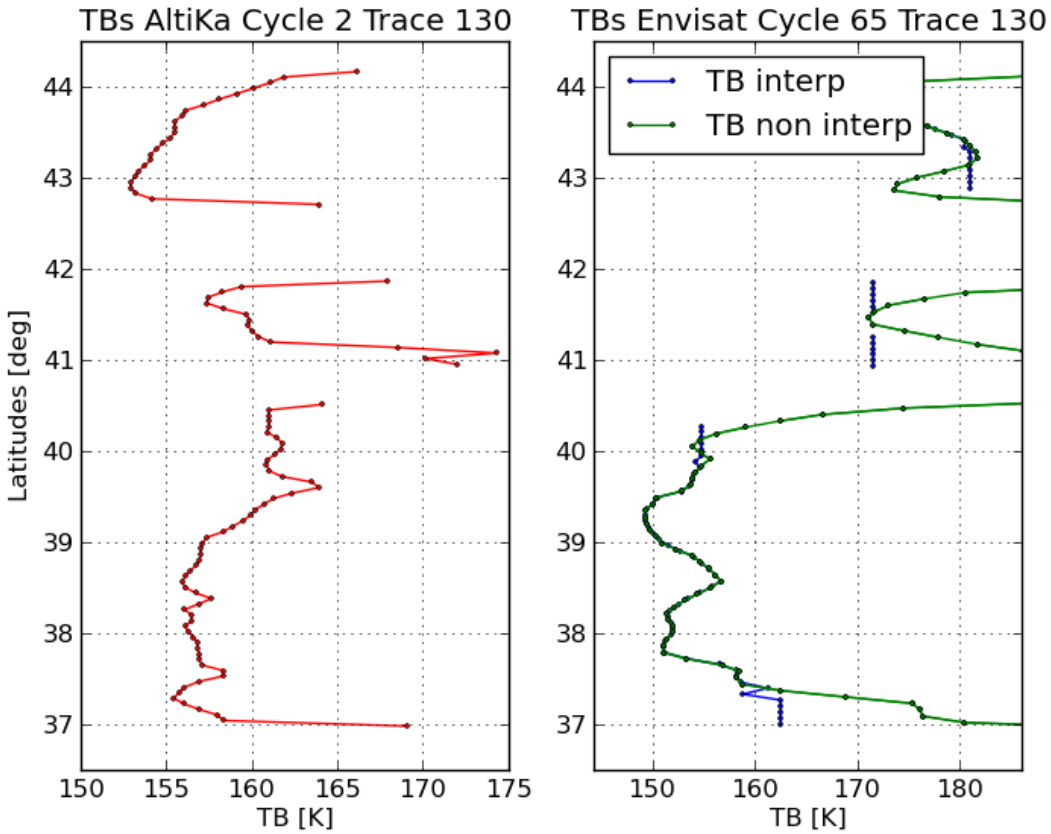
- So far, no dedicated processing is applied on coastal approach for AltiKa radiometer: the wet troposphere correction shows no contamination up to 10 km from the coast

- On J2/AMR, S. Brown (2010) coastal algorithm is applied



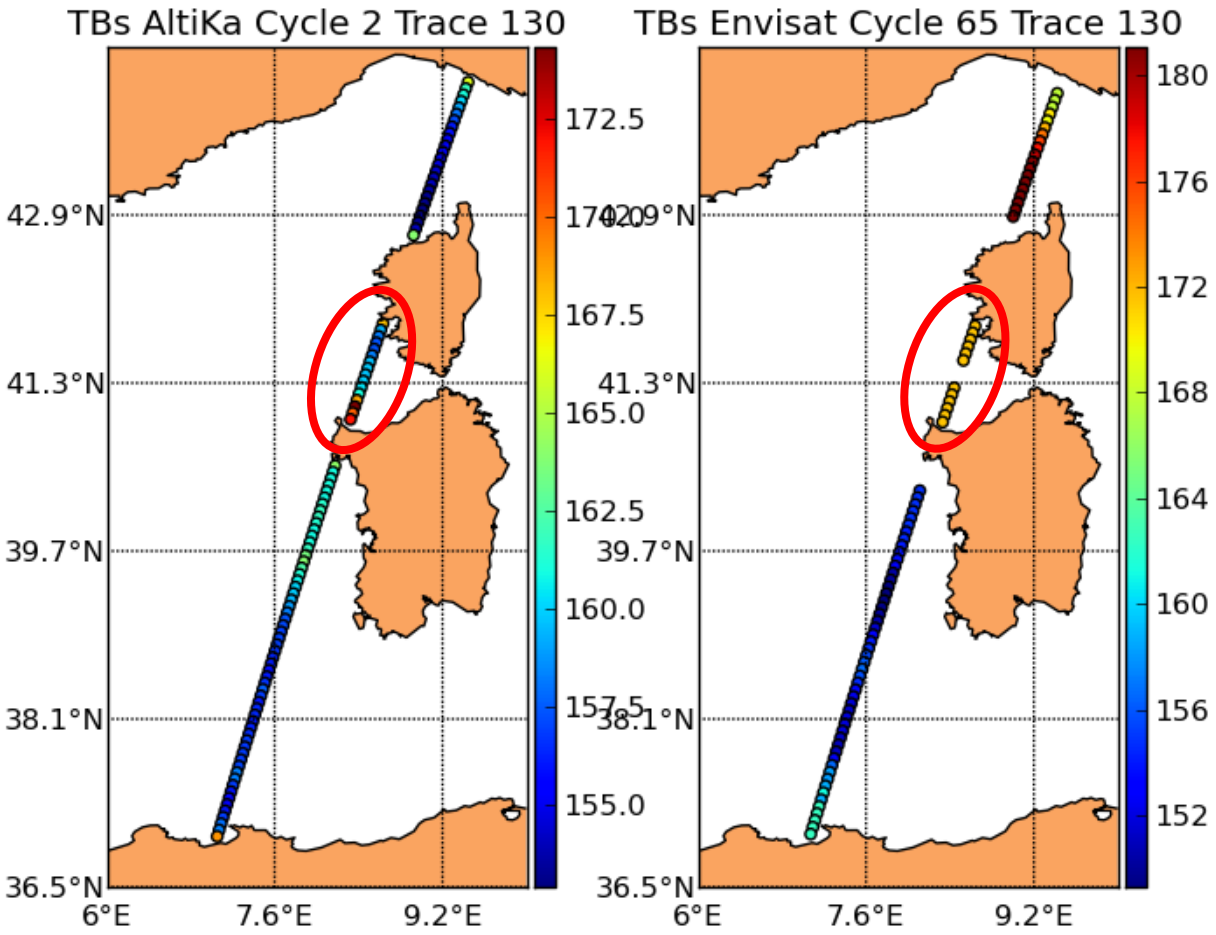
Radiometer coastal performances

- Impact of the extrapolation processing on Envisat brightness temperature
- Considered as a good alternative to the contamination in the lack of a L2 processing dedicated to coastal approach



Radiometer coastal performances

- Comparing to Envisat, AltiKa radiometer displays a large number of measurements in coastal areas
- Moreover, no threshold appears on along-track interpolated brightness temperatures



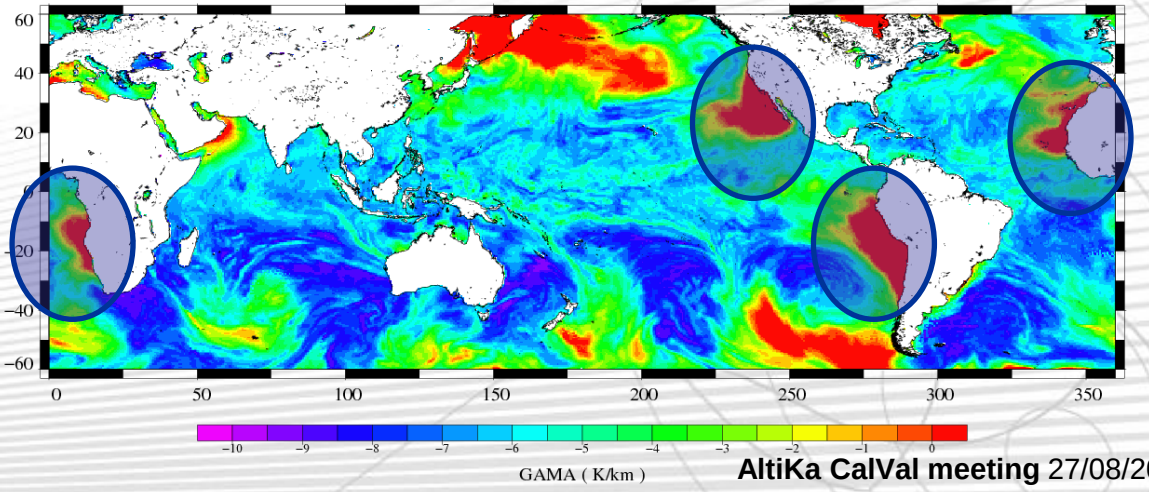
Radiometer coastal performances

- **Conclusions:** Very good performances of AltiKa radiometer on coastal approach up to 10 km

- Additionnal features: The classical approach uses brightness temperatures for the 2 radiometer channels and Sig0 for the altimeter

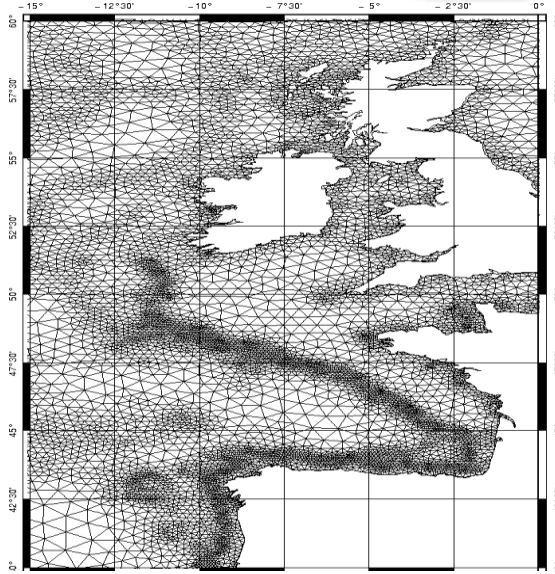
  - In the frame of PEACHI, **2 additionnal parameters** are used as inputs for the inversion as proposed by Obligis, 2009:
    - **SST:** to compensate from the lack of a surface channel (18,7 GHz)
    - **Gamma:** to indicate a possible inversion of the temperature decrease with the altitude

➔Expected better performances on global ocean and especially near the coast on upwelling areas

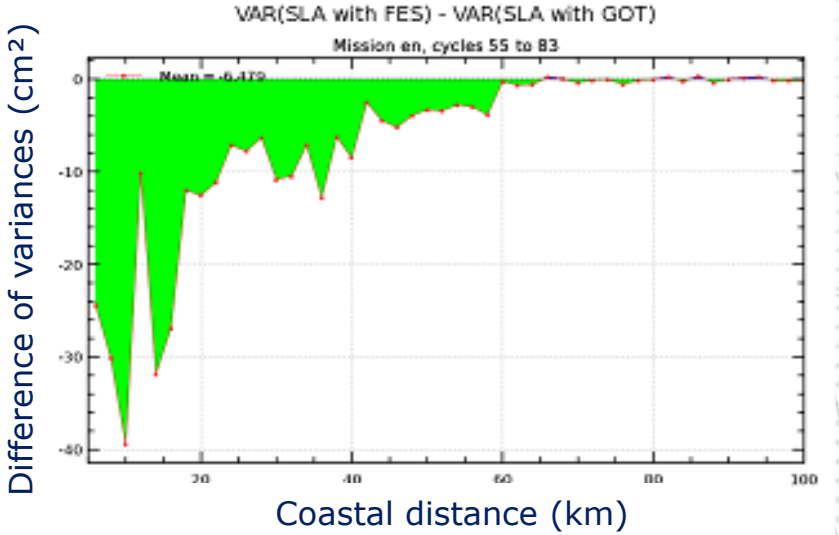


FES 2012 tide model

- FES2012 is based on T-UGO model
- A new global high resolution mesh has been generated from this bathymetry and starting from FES2004 mesh. The strategy followed was to:
- Keep or improve FES2004 coastal resolution (5-7 km in P2)
- Locally resample FES2004 coastlines (Antarctic, Baltic sea …)
- Increase mesh resolution above bathymetry slopes (ridges, continental shelves)

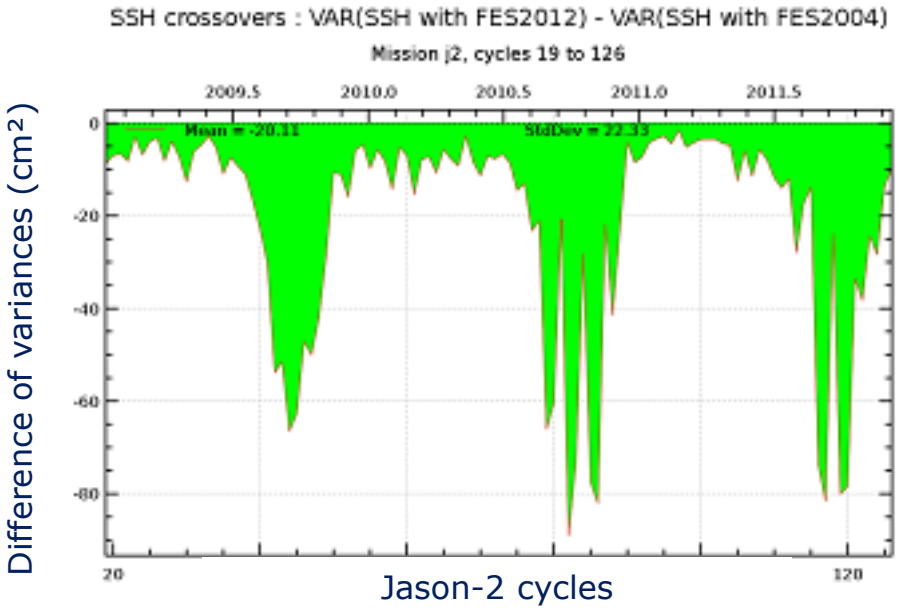


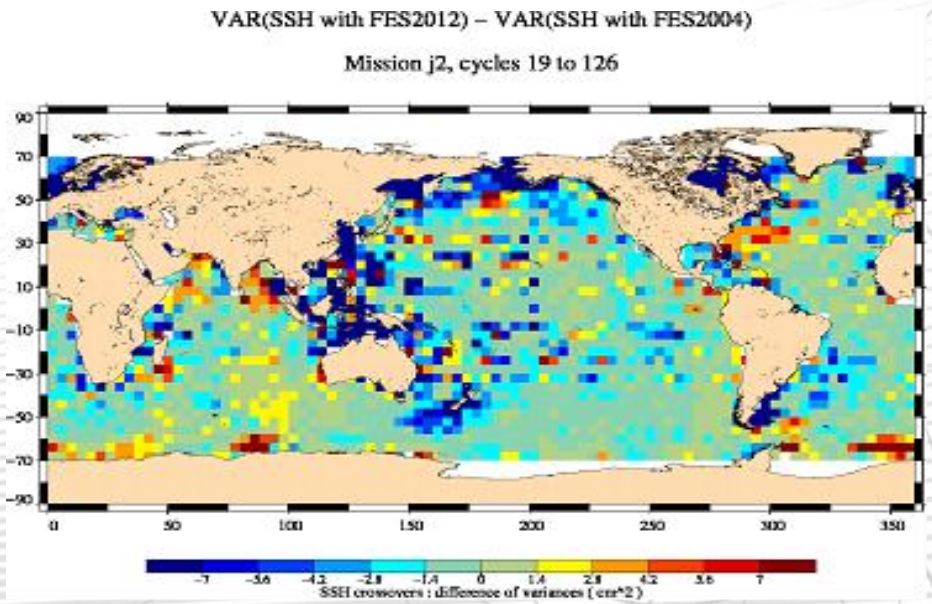
- Along coastal areas, FES models tend to reduce the variance and thus improve the altimeter SLA comparing to other tide models



FES 2012 tide model

- Comparing both FES tide models:
  - Difference of variances display that the new FES2012 tide model globally improve the SSH (compared to FES04 tide model currently computed in AltiKa products)
  - The map of the difference of variances display strong improvements in coastal areas more than open ocean (difference locally greater than 7 cm²)





Conclusion

- AltiKa is working well in coastal areas, data quality appears nominal close to the coast

- In the frame of the PEACHI project, retracking algorithms and radiometer wet troposphere correction among others will be further investigated to provide users the best solutions

- PEACHI will help us testing new solutions, this prototype is much more flexible than PISTACH one's

- Validation/comparison: - comparison with different datasets provided by expert scientists

  - comparison with products provided by PISTACH and COASTALT projects

  - comparison with the CY2 SAR retracked data

Futures on ground processing improvements

- Computation of the MLE3 algorithm to be compared to the MLE4 retracking algorithm
- L2 radiometer algorithm dedicated to coastal areas and based on the Shannon Brown algorithm
- Analyses on both wind and attenuation with Remko's results
- Estimate of the SSH in the Arctic Sea (related to the ESA phase 2 CCI project)
- New tide models: - new release of the FES model (expected mid 2014)
  - DTU13 tide model
  - TPXO8
  - ETO11a

Thank you for your attention !