7th COASTAL ALTIMETRY WORKSHOP

7–8 October 2013 | Boulder, CO, USA

Summaries and conclusions

Session 1 Summary Ka-band Altimetry

First results from SARAL/AltiKa analyses are extremely encouraging. Complementary and reasonably consistent results seen in talks by Picot et al., Nino et al., and Scharroo et al..

HIGHLIGHTS:

- The radar performance is proving to be nominal – meaning reduced range and SWH noise and finer spatial resolution in comparison to Jason-series altimeters
- Data provision (OGDR->IGDR) to users has been quick, efficient and successful
- DIODE tracker + ALtiKa allow data closer to the coast (*O*(3 km))
- Atmospheric attenuation issues at Ka appear to be limited, more work will quantify
- CTOH showing an objective coastal flagging applied to AltiKa (EOF, clustering)

OVERALL ISSUES:

- Range bias of ~6 cm wrt T/P-Jason still to be resolved
- A more precise SSB model helps to improve SSHA data

COASTAL ISSUES (see also retracking session):

- Geophysical noise and/or geophys. corrections dominate SSHA noise 15 km and shoreward, thus spatial resolution and range noise gains from Ka-band not yet realized
- FIner coastal wet tropo correction still to be built and implemented in GDR
- Ka-band 40 Hz data rate may provide some coastal benefits in improving corrections, flagging, region specific data gains, etc.. but work required

RECOMMENDATION: Coastal data refinement, assessment and applications are clearly warranted using ALtiKa

CAW-7

Applications of Coastal Altimetry

Storm surge:

TWLE (Total Water Level Envelope) estimate of sea level including dynamics associated with atmospheric forcing and ocean tide. Potential data for coastal inundation due to storm surge.

Vignudelli – monitoring of flooding in Venice using observations from the Acqua Alta oceanographic platform referenced to the same datum as altimeter TWLE.

Scharroo, for John Lillibridge – short time scale of surge event ~ 10 hours. Hurricane Sandy surge in NYC captured only by HY-2A

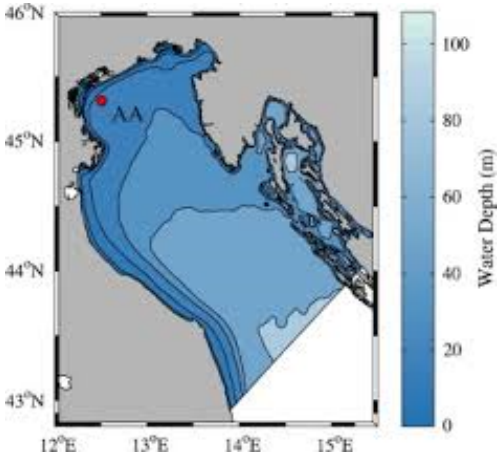
Comparisons of altimeter-derived across-track geostrophic velocity to direct current observations:

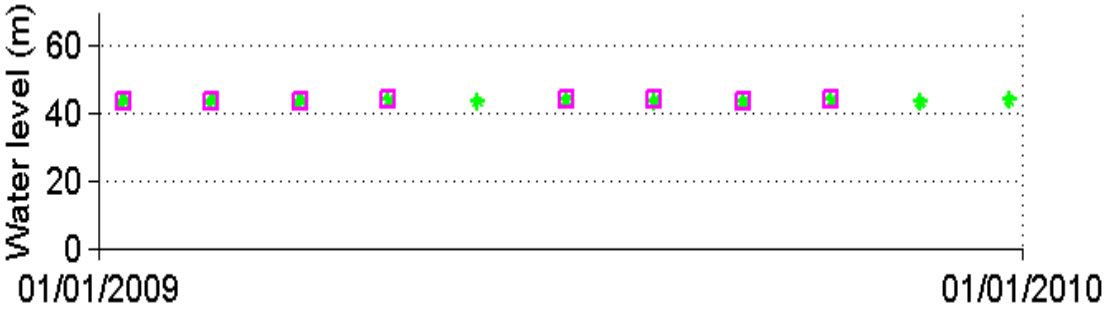
Cahill – Great Barrier Reef comparisons to HF-radar (WERA) mesoscale variability inside EAC

Feng – Gulf of Maine comparisons to long-term current-meter deployments in passages and coastal current

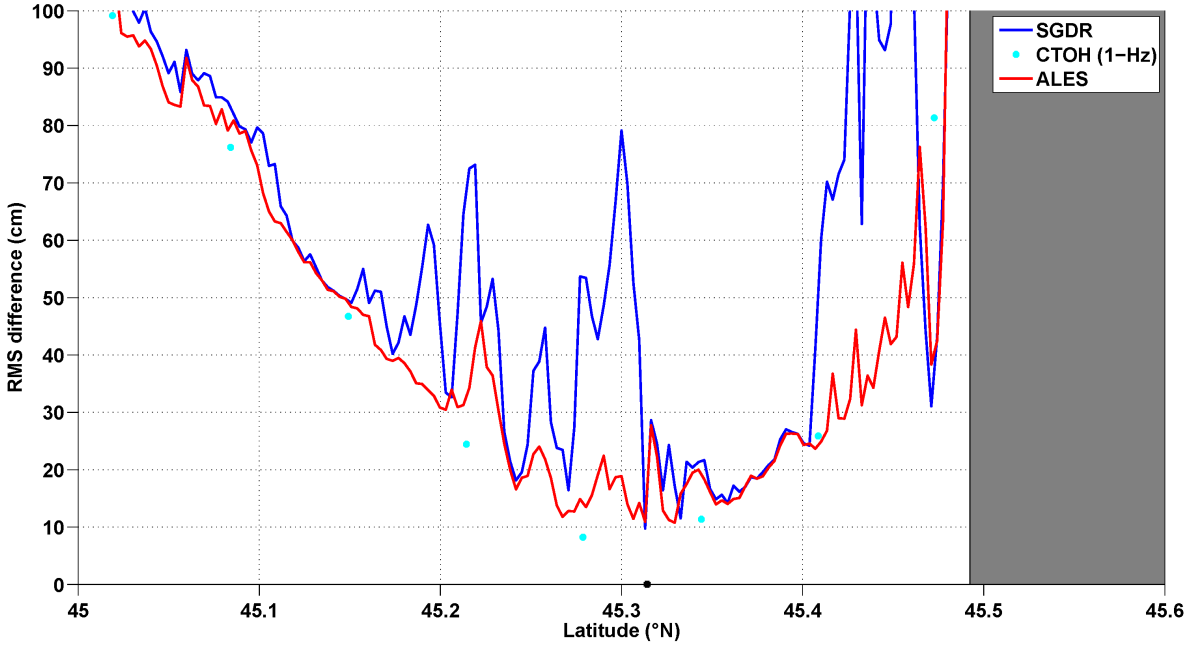
Stefano Vignudelli – Multi-mission coastal altimetry around Venice

Altimeter/tide gauge comparisons are typically RELATIVE. Here there is an ABSOLUTE calibration, i.e. closing the altimetric height budget using absolute references (WGS84 ellipsoid) without removing biases by hand.

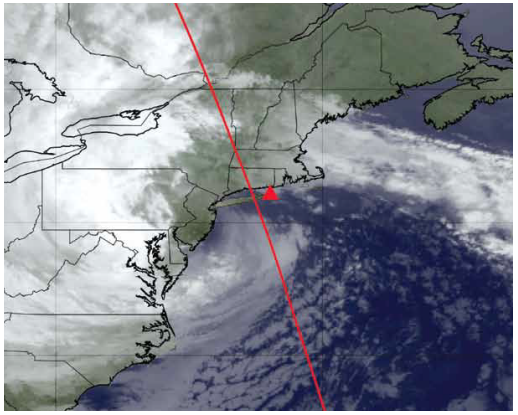


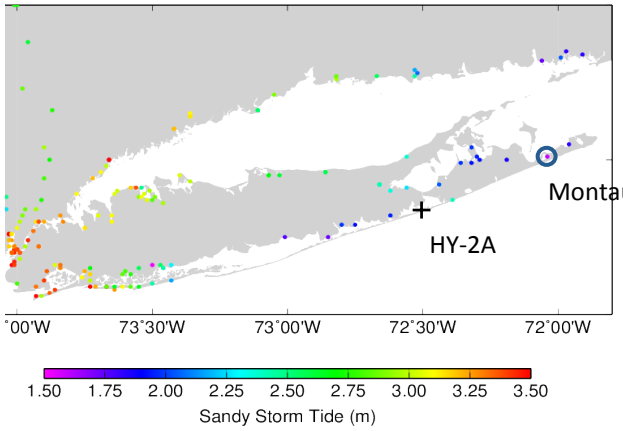


Both referred to absolute level (ellipsoid or geoid)



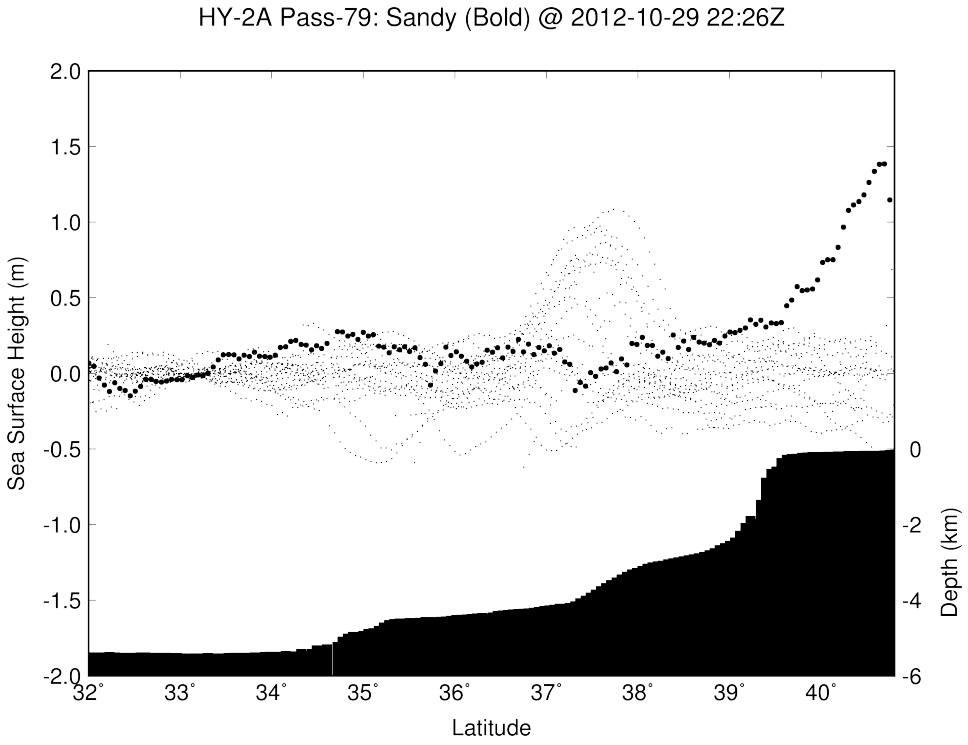
Absolute RMS difference between “Acqua Alta” TG and Env 543 for 3 altimetric datasets

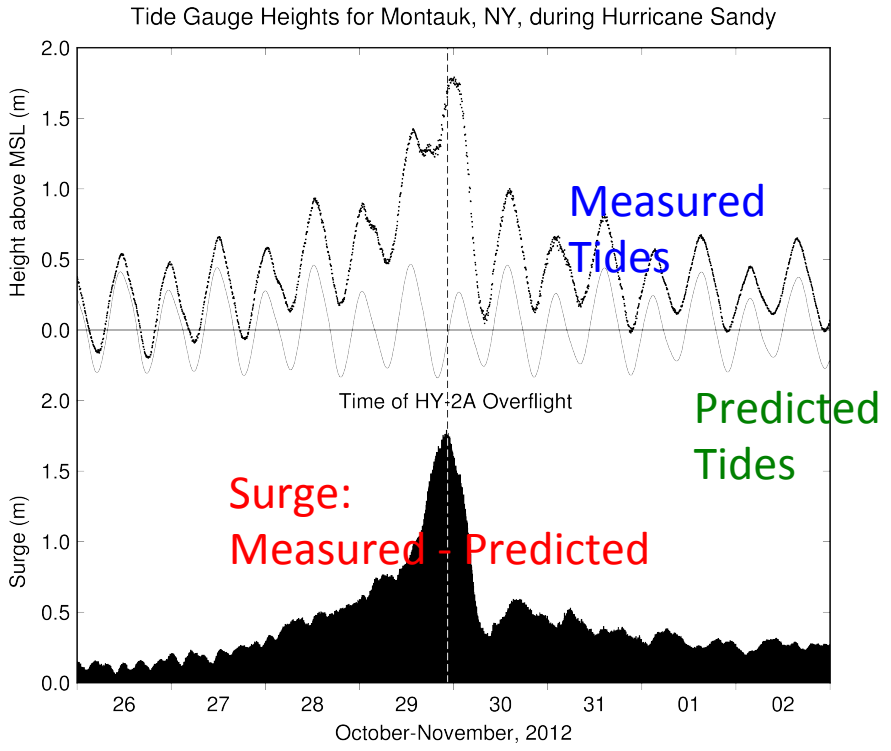


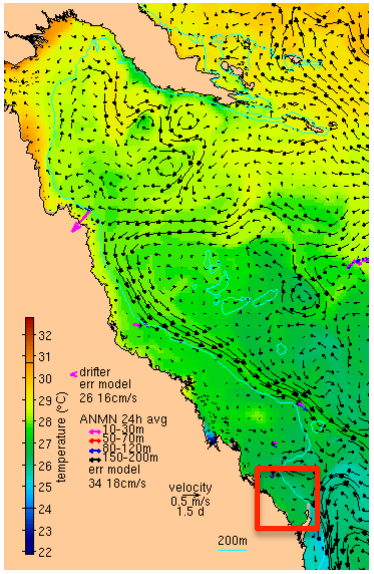


John Lillibridge -
Hurricane Sandy storm surge

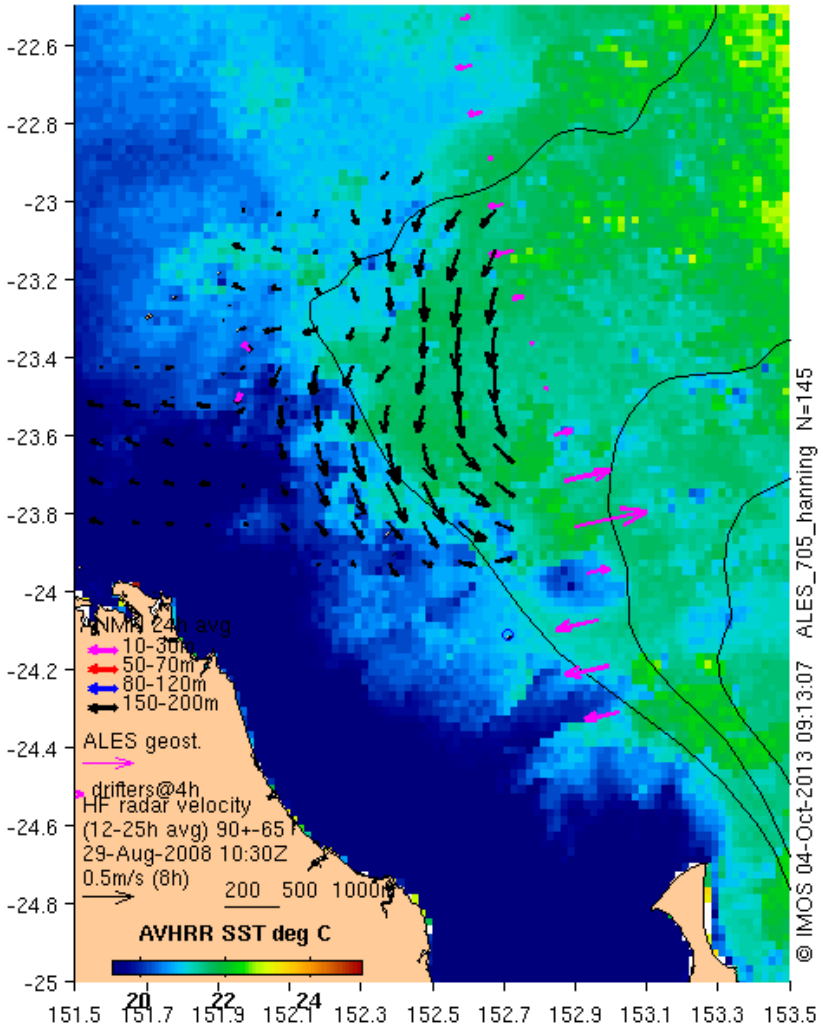
HY-2A only altimeter to capture surge < 12 hr duration







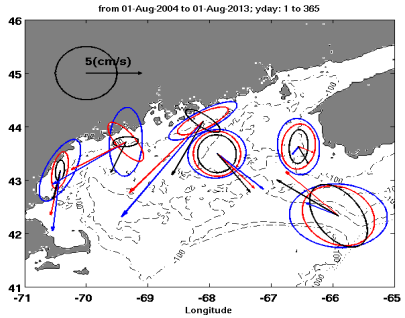
Madeleine Cahill - Ocean Currents Near Heron Island, Great Barrier Reef, as Observed Using Altimetry and HF Radar

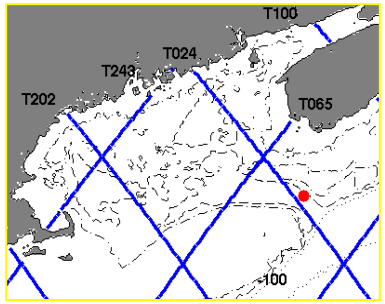


It is possible to be able to accurately identify small O(50km) oceanographic features when their presence is backed up by other observations

There is too much noise even in 4s averages to be able to reliably get velocity from an altimeter track yet

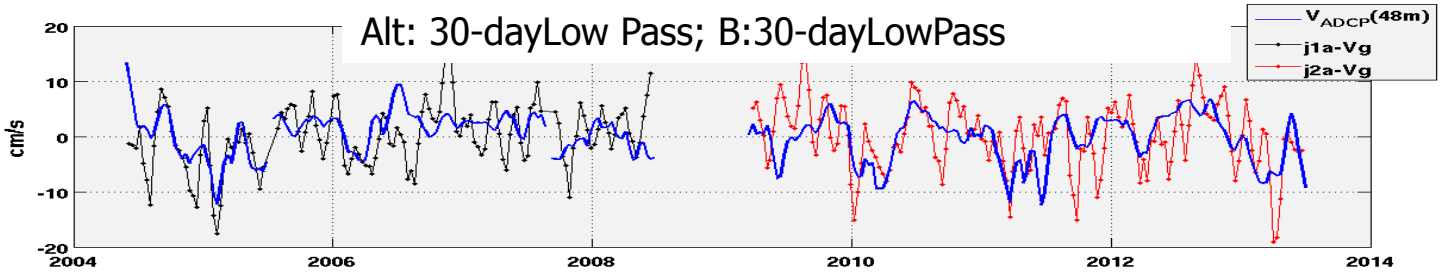
Hui Feng –
Ocean circulation observed by altimetry on the northwest Atlantic shelf and the Gulf of Maine

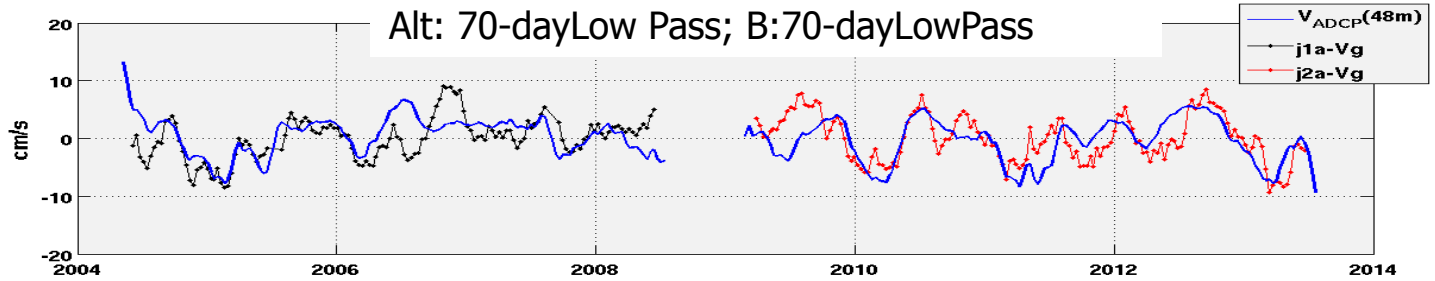




Geostrophic current correlation of 0.58 and difference RMSE of 3.3 cm/s for >70 day LP

Some discrepancies in altimeter-based and in-situ Vg most likely related to aliasing M2 tide





Applications of Coastal Altimetry

Summary Group Discussion Points and Posters

- Several posters described attempts to resolve both SLA and currents along tracks that extend into the 10 km next to the coast.
- Examples include the use of along-track data in the North Sea and Baltic Sea, as well as next to the coast of South Africa inshore of the Agulhas Current.
- There is a common interest in
  - best tracking methods and corrections in this nearshore region
  - methods for calculating geostrophic currents with least filtering
  - the need for MSS and/or MDT that include realistic small scale structure due to mean currents, bathymetry and the geoid in order to estimate absolute heights and currents

Applications of Coastal Altimetry

Summary Group Discussion Points and Posters

- Following the oral presentations, there was an extended discussion of the way in which altimeter data can be used for more operational and applied uses.
- The time delay in processing and repeat interval can make it somewhat problematic to use in real time for events with short forecast time scales such as storm surges and tsunamis, search and rescue and hazardous spills.
- This same problem will be true for future altimeters such as SWOT, with increased spatial resolution but no improvement in temporal sampling intervals (5 days or more).

Applications of Coastal Altimetry

How can altimetry be used to address real-time applications

- Data assimilation for nowcasting uses altimeter data from the recent past to improve forecasts for the next several days. This follows the conceptual approach used for atmospheric forecasts and analysis.
- Similar to dynamical models, there are statistical models that make use of prior altimeter (and other) data to produce nowcasts and forecasts based on data which are more readily available in real time (e.g. tide gauges, coastal radars, moorings, etc.).
- Statistical methods can project in situ observations spatially based on the long time record of 2-D altimeter data. For example, this is being done in the North Sea and Baltic Sea.

Applications of Coastal Altimetry

Summary Group Discussion Points and Posters

- High resolution altimeter data increase our understanding of the physics and structure of ocean circulation features on smaller scales than previously possible
  - storm surge and other phenomena with short temporal scales
  - mesoscale features that do not presently appear in models
- Will be even more true for SWOT observing scales much smaller than we can presently resolve (and likely significantly ageostrophic)
- Improved understanding of these features can be incorporated into the dynamical and statistical models.

Hurricane Sandy storm surge flooding the World Trade Center construction site

Session 4 Retracking SUMMARY

- Session 4 included four presentations on the issue of retracking of conventional (LRM) and reduced SAR waveforms.

- New LRM retracking techniques are strongly driven by the new experiences obtained by processing SAR and reduced SAR waveforms. CryoSat-2 has been instrumental in reviving the interest in improvement of retracking techniques. SARAL data is also providing new insights with a reduced footprint size and a much lower noise. Ka band will help us to better understand LRM Ku band processing.

- Various new techniques are being studied to cope with the impact of land in the footprint onto the waveform.
  - Detection of perturbations in waveforms gets more attention
  - Adaptive leading edge retrackers can avoid or reduce the impact of land contamination on the estimation of range and significant wave height. Attention should be given on the impact on the bias (range and SWH) and on the SSB
  - Reduced SAR techniques show that such contamination can also be avoided while creating the reduced SAR waveform.

- Retrieval of geophysical parameters from SAR requires more study
  - The retrieval of backscatter from SAR mode data may require more work. Differences between SAR mode sigma0 and reduced SAR sigma0 can be significant
  - The effect of significant wave height and wind on range retrieval (sea state bias) for SAR mode data requires more study. Comparison between CryoSat-2 LRM and SAR mode data at crossing tracks could be used effectively for this study.

Session 4 Retracking RECOMMENDATIONS

- * The coastal altimetry community recognises the large contributions of CryoSat-2 to the understanding of altimetry in the coastal regions. CryoSat-2 is/will be instrumental in the study of remaining questions regarding the transition from LRM to SAR altimetry. We hence recommend that CryoSat-2 data will be made available to tackle long-standing issues like the recovery of low wave heights, sea state bias in SAR mode, and many others.

Coastal Altimetry – SAR Processing Summary

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Coastal Altimetry Workshop 7

October 8, 2013

Francois Boy, Phil Callahan, Robert Cullen

SAR Processing Summary

- Basic processing, retracking of SARM is converging
  - Explore issues of resolution, coherence. Covered in several talks: 80 Hz data; Fourier aliasing; coherence – resolution vs incoherent averaging, noise
  - Understand Doppler aliasing for 9 kHz PRF on Jason-CS
  - Processing can be done to specific ground points; could be especially useful for inland water
  - Pursue improved methods for LRM, P-LRM, and SAR such as reduced WF or leading edge
- Need more users, feedback on full year of CNES SAR product
  - In examining Agulhas current, it was found that ~50% of the velocity came from structures smaller than 50 km
  - It should be remembered that there are still limits on the cross-track resolution of ~8 km, so utility of data, results can be scene dependent
- Sea State Bias model is still needed. What additional data are needed to derive the model?
- What is the process for changing the SAR mask for CryoSat-2 ?
  - Several suggestions for possible changes – Asc/Des pass change; new area(s); but are many considerations – continuity, annual cycles, SSB
- Recommendation for all SARM on Sentinel-3 is technically accepted, but issue of cost (data volume) needs to be worked out
- Assess user desire for same products from Jason-CS as Sentinel-3

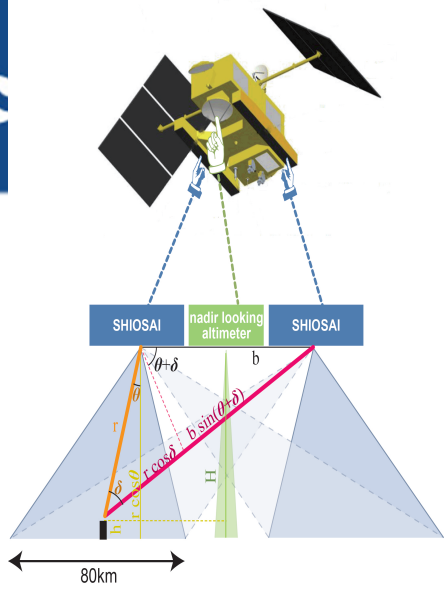
Session 6: New data and Cal/Val

- Florence Birol:
  - Improvement of altimetry data for coastal dynamics, coastal circulation etc., using high sampling rate, extrapolation for missing corrections, filtering, better tide corrections.
- Charles Troupin:
  - Mean SLA maps over Med using eddy kinetic energy, variational analysis, gliders, HF-radr and drifters,
- Pascal Bonnefond:
  - Analysis of calibration of several altimetry missions close to the coast (AltiKa, HY-2, Cryosat-2, Jason, etc.) using Corsica.
- Martin Saraceno
  - Investigation of annual cycles , extreme events, and trends in sea level by gridded satellite altimetry and tide gauges in islands and continental regions.

SUMMARY: need more data along alt tracks, and more direct involvement by physical oceanographers in the validation.

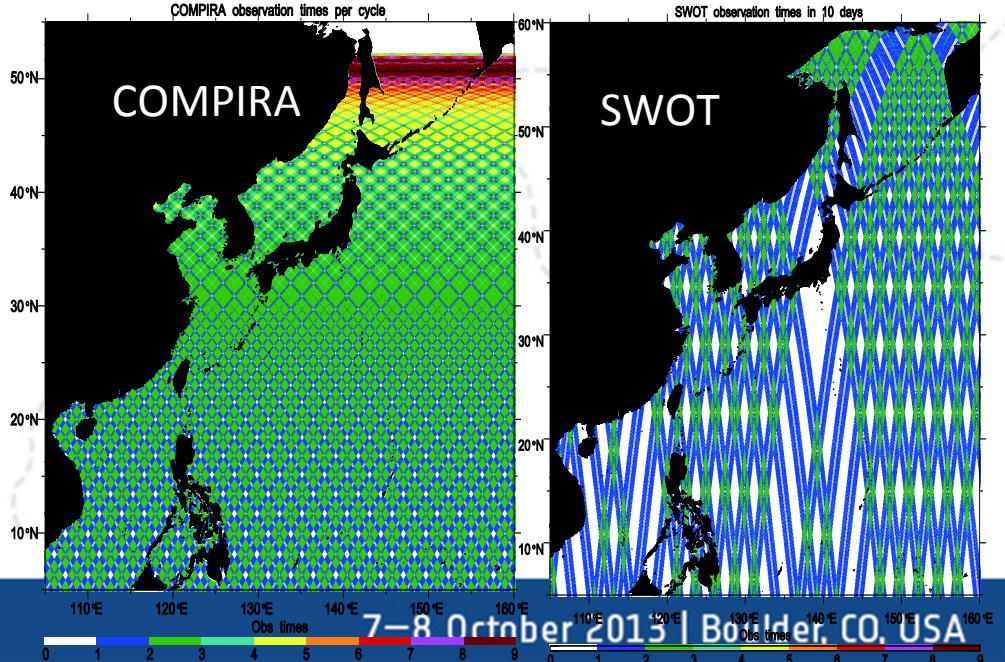
Suggestion: perhaps a special issue of an oceanographic/geodesy journal?

Session 7: Future Missions



- JAXA's COMPIRA mission
  - Another wide swath altimeter
    - X-band ALT to avoid losses due to rain
  - 80x2 km swaths with 5km resolution
  - To be launched in **2019-2020**
  - Now in Phase A
    - to be proceeded to Phase B in 2014
- Less spatial resolution, but more frequent observations than SWOT
  - Like T/P & ERS-1, combination of SWOT & COMPIRA results in the best

Data coverage in 10 d



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Conclusions

Still a hot topic!

- 100+ participants (130+ registered)
- lively discussion
- lots of cross-fertilization with open-ocean altimetry
- Exciting times: SAR getting mature by the day, Ka-band incredibly promising, and we still learn new things on the LRM reprocessing!

Next

- Presentations go online
  - send us posters too
- www.coastalt.eu/community
  - tell me if you want to be on COASTALT-SWT mailing list and your are not yet
- Next year: probably in Germany! watch this space

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