Ocean Surface Topography Science Team Meeting (OSTST)
October 23-27, 2017

"The 25th Anniversary of TOPEX/Poseidon"

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Science I: Climate data records for understanding the causes of global and regional sea level variability and change

Session chairs: Ben Hamlington, Benoit Meyssignac

7 orals, 10 posters

Presentations

- Primary Topics:
  - Global mean sea level – trends and acceleration
  - Coastal vs. Open Ocean Sea Level
  - Impact of internal variability on global and regional sea level

- **Further understanding the global mean sea level record over the satellite era**, Chris Watson
- **Understanding the Acceleration of Sea Level Rise During the Altimeter Era**, Steve Nerem
- **Impact of Pacific Ocean Variability on Global Mean Sea Level**, Se-Hyeon Cheon
- **Sea Level Monitoring in the coastal zone: impact of retracking and correction choices**, Paolo Cipollini
- **Evidence of coastal sea level changes along the east coast of United States associated with the Florida Current transport and heat content using satellite altimetry and hydrographic observations**, Ricardo Domingues
- **Wave climate observed from satellites: trends and inter-annual**, Justin Stopa
- **Comparison of coastal and open ocean sea level trends**, Yingli Zhu

Summary

- Evidence is emerging of an acceleration in global mean sea level.
  - Importance of accounting for drift in TOPEX A associated with the Cal1 mode was highlighted.
  - Correction has significant impact on rate and acceleration.
  - With careful consideration of variability contributing to GMSL time series, may be possible to extract a significant acceleration.
- Several talks and posters discussed the relationship between internal variability (seasonal to decadal) and regional sea level change on a range of timescales.
  - Impact can be on the order of several cm, serving to exacerbate long-term sea level rise at the coast.
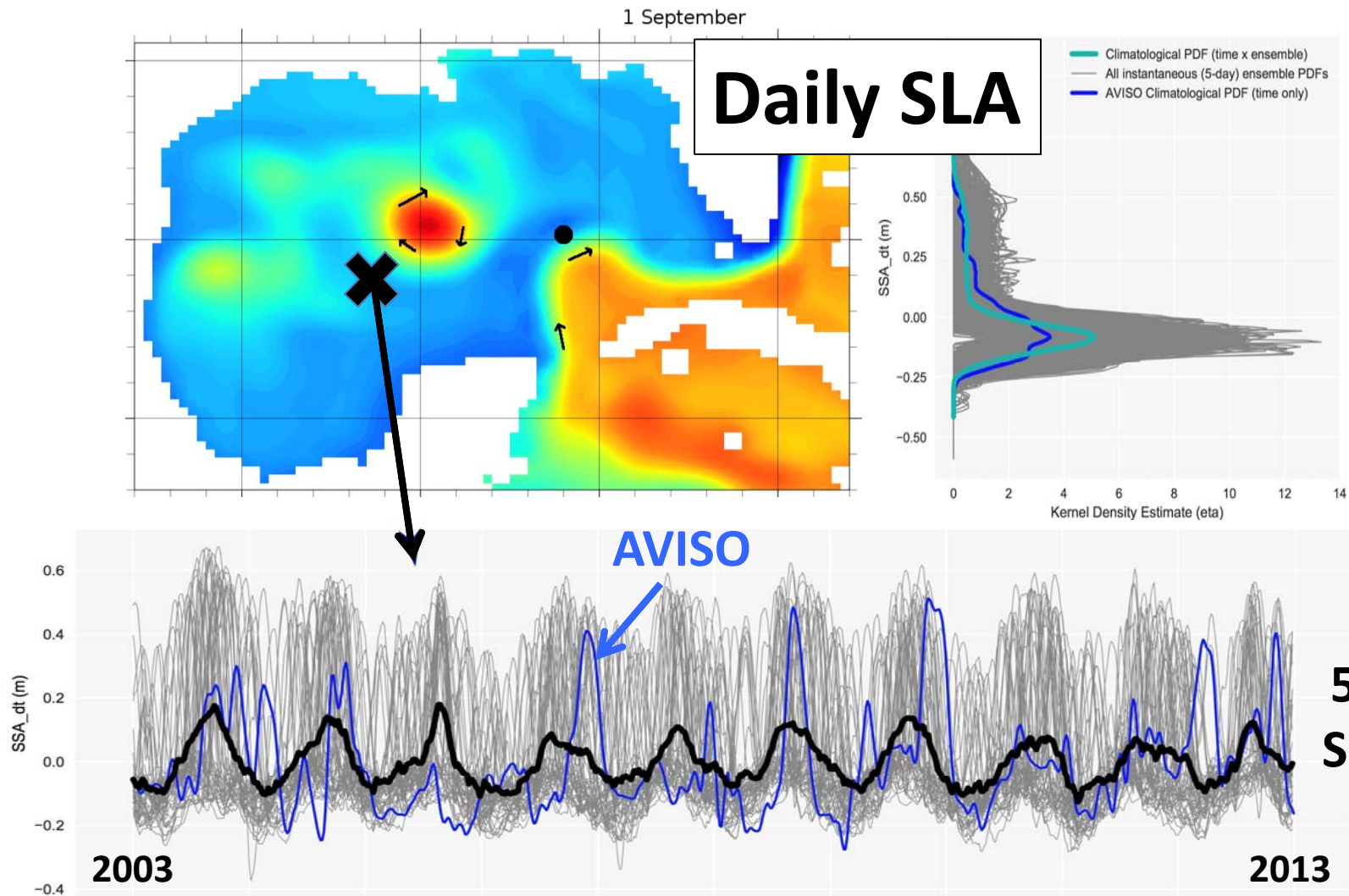
Summary

- Focus on coastal sea level and connection between open ocean and coast.
    - Discussed as a topic of high importance, needing further investigation.
    - Impact of re-tracking and correction choices was demonstrated, yielding rates of sea level rise comparable to those measured at tide gauges.
    - Open-ocean climate variability was shown to have a large influence on coastal sea level in the SE United States,.
    - Trends computed from tide gauges and nearby altimetry data were compared, showing good agreement in some locations and poor agreement in others → possibly owing to coastal ocean dynamics.
    - Satellite altimeter and SAR data was used to examine trends and interannual variability in the wave climate and the importance in the context to coastal sea level/sea state was discussed.

Science II: Large Scale Ocean Circulation Variability and Change:

Research covered the North Pacific, Tropical Indian Ocean, North and South Atlantic and the Southern Ocean.
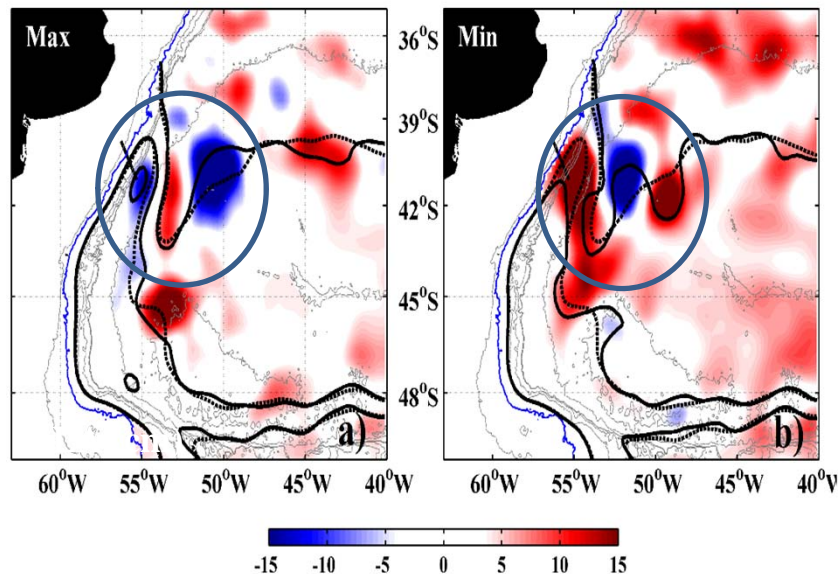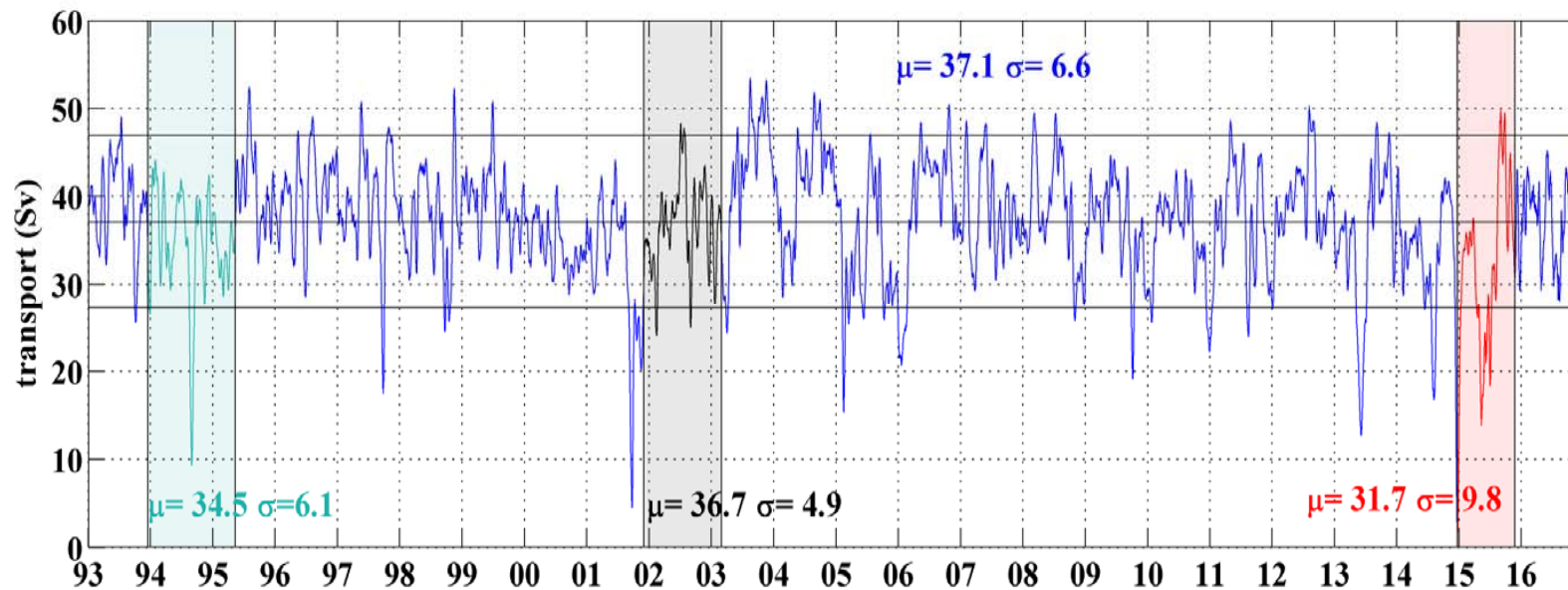
1. Altimetry has become crucial for extending moored time series to investigate boundary current variability beyond what is available from in situ data. (Artana, Beal, Saraceno, Ferrari, Hosmay, Goes, Dong)

2. Global Altimetry measurements along with models and advanced statistics allow us to examine both forced and intrinsic ocean variability and its potential role in climate (Punduff, Leroux, Bulusu, Melice, Anderson, Qiu, Haykal, Artana)

3. Altimetry is also being used to investigate of coupled ocean-atmosphere variability (Han, Thompson)

Daily SLA

Leroux et al (poster)

50-MEMBER SIMULATION

AVISO

2003   2013

1 September

Climatological PDF (time x ensemble)
All instantaneous (5-day) ensemble PDFs
AVISO Climatological PDF (time only)

The ocean variability is partly chaotic (up to decadal timescales)
Ensemble simulations help distinguish chaos from forced variability
Observed timeseries are randomly picked among many possible evolutions

μ= 37.1 σ= 6.6

μ= 34.5 σ=6.1

μ= 36.7 σ= 4.9

μ= 31.7 σ= 9.8

Max

Min

a)

b)

Transport time series from Look up table method
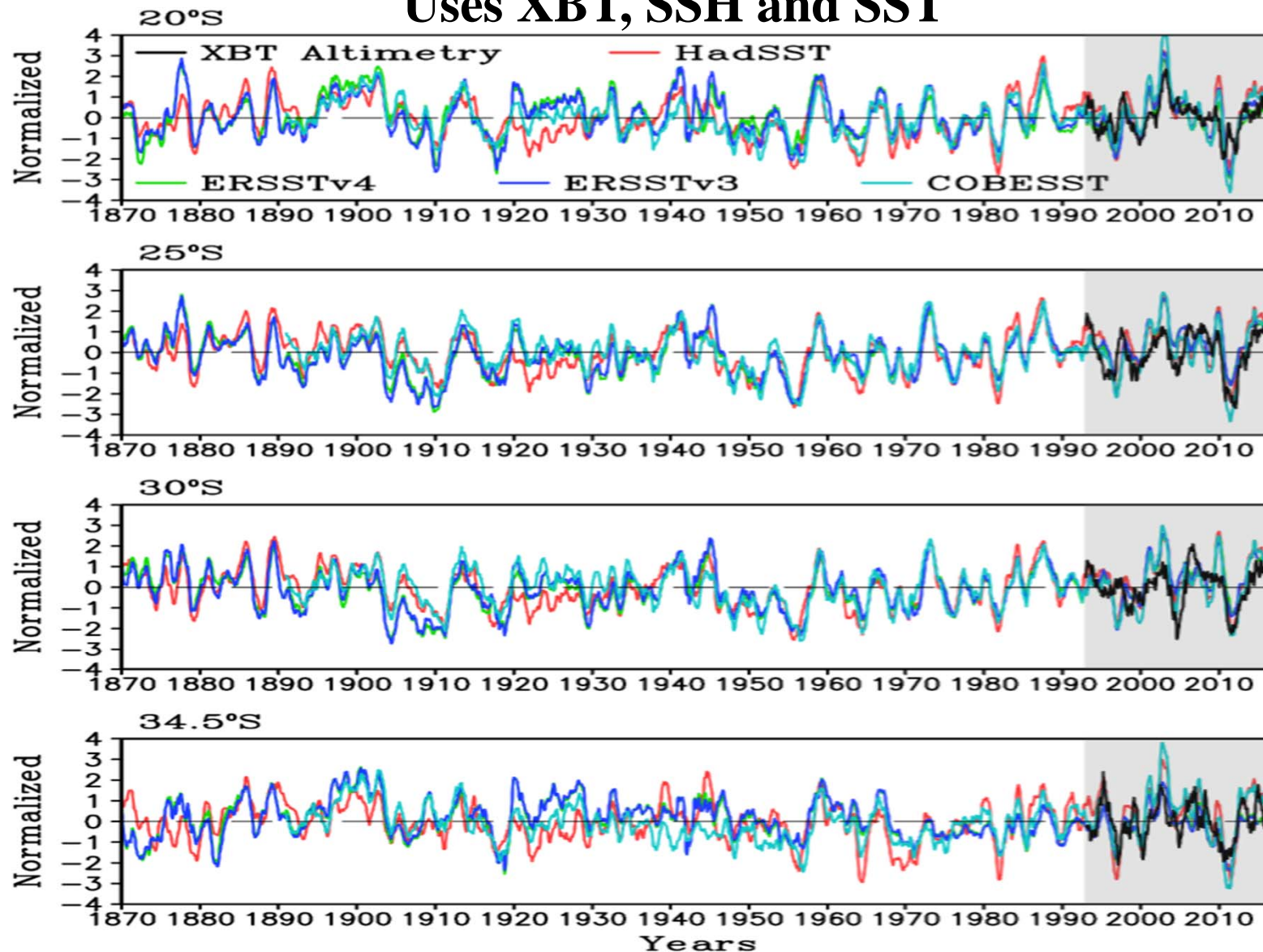**mean: 37.1 ± 2.6 Sv, std: 6.6 ± 1 Sv**
Study circulation and origins associated with extreme events:

- **Transport maxima ← cyclonic anomalies that propagate from the south above 4000m isobath.**
- **Transport minima ← large positive sea level anomalies shed by the BC overshoot.**

Reconstruction of a century-long SAMOC timeseries.
Lopez, Goni and Dong
Uses XBT, SSH and SST

Mesoscale and sub-mesoscale oceanography

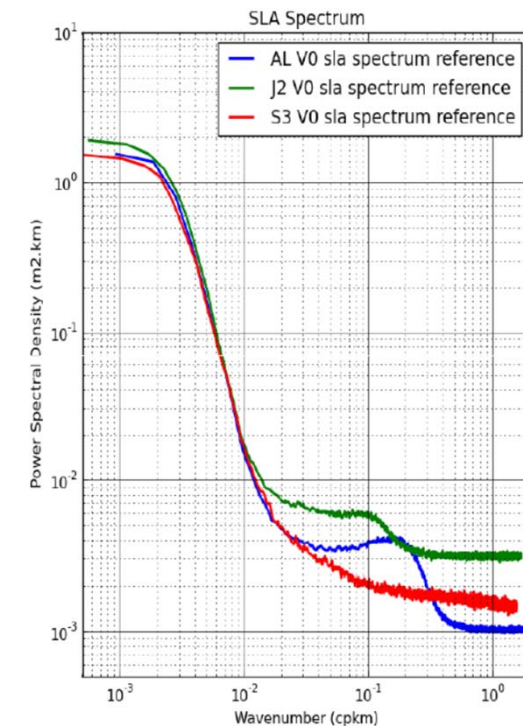7 oral presentations and 29 posters

- **Mesoscale dynamics observed with altimetry**
- **Altimetric wavenumber spectra**
- **Mesoscale detection, mapping, and reconstruction techniques for small scales**
- **New mesoscale SSH and surface current products & model evaluation**
- **Biogeochemisty applications**
- **Future missions : SWOT & surface currents**

Mesoscale and sub-mesoscale oceanography discussion points …

As we move to resolving smaller alongtrack spatial scales …

- What have we learned about the mesoscale ocean dynamics from the increased spatial resolution of Saral & SAR altimeters?

- Most mesoscale studies presented use the gridded MSLA maps
- Some studies on alongtrack wavenumber spectra (3 posters)
- Some studies use the alongtrack SSH gradients to better detect ocean fronts (eg Chambers poster)

SLA Spectrum

AL V0 sla spectrum reference
J2 V0 sla spectrum reference
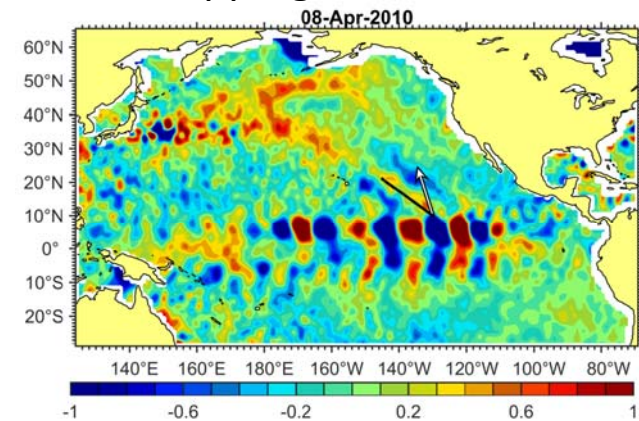S3 V0 sla spectrum reference

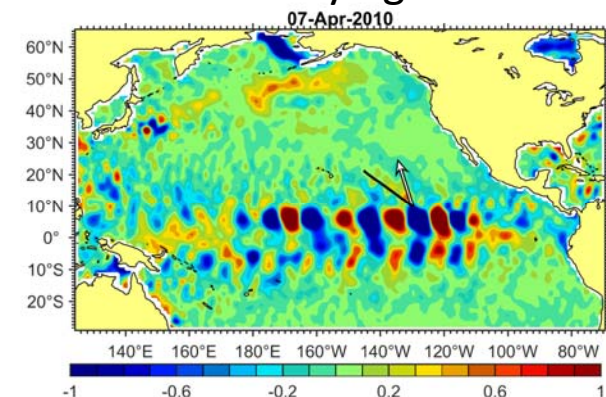# Mesoscale and sub-mesoscale oceanography discussion points ...

As we move to resolving smaller alongtrack spatial scales ...

- How should we construct our future gridded HR-SSH products? Statistical interpolation, dynamical interpolation, full data assimilation ?

- - T. Farrar – AVISO maps with latitudinal-varying temporal decorrelations - losing barotropic Rossby wave signal at mid-latitudes – > revise temporal decorrelation scales?

- A. Amores - Only 25% of Med Sea eddies can be detected with today's altimetric sampling and OI mapping ... many different small-scale mapping techniques being explored for today's alongtrack data

Remapping with dt = 17.5d

Standard AVISO maps – varying dt

Barotropic Rossby waves, Farrar talk

Mesoscale and sub-mesoscale oceanography discussion points …

As we move to resolving smaller alongtrack spatial scales …

- How do we separate small-scale balanced dynamics from internal waves and internal tides in HR alongtrack and SWOT data?

=> Different statistical techniques being explored to estimate these signals from models and in-situ (ADCP or glider) data – Helmholtz decompositions, structure functions, different covariance structure, …
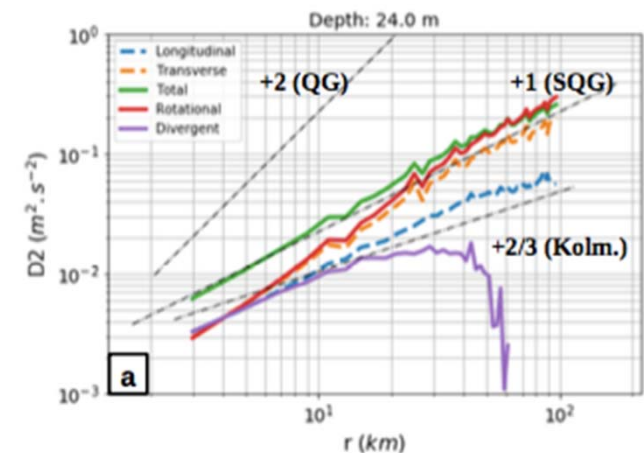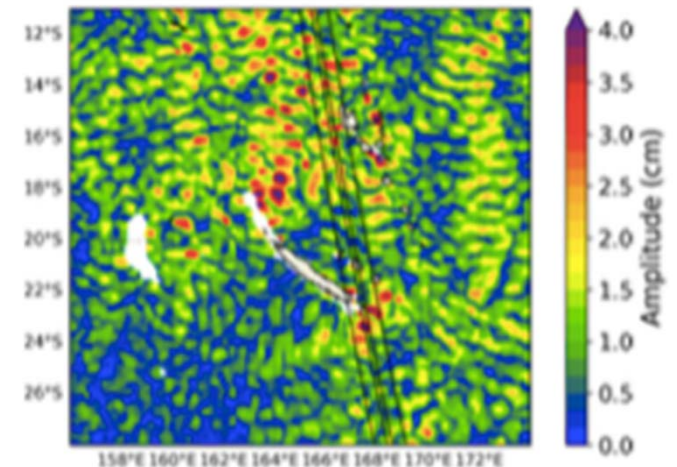
Structure functions from ADCP, Serrazin poster

OST Miami 2017   Science IV – Hydrology / Cryosphere
Science applications versus data processing and performance of onboard instruments

Jason-3
- Some initial data losses in both open and closed loop modes, but otherwise performing well.
- Data losses are now minimized via the enhanced DEM (cycle 58/pass160)
  There is further scope for DEM improvements. Would assist operational programs
  if DEM uploads could be more frequent.

Sentinel-3A
- Performing well, especially SAR mode which is allowing surface acquisitions much nearer to
  the river banks/lake coastlines. <u>Early cycles 001-004 required for SARAL mergers</u>.

Sentinel-6/Jason-CS
- Requesting clarification on the use of SAR mode over continents.
  Global mask? Hydrological requests?
- SAR implementation in the Jason series will enhance operational services
  Constellation of three SAR altimeters (Sen-3A, Sen-3B, Sen-6) may open up new science and applied
science programs.

ICESat-2 (launch 2018)
- New opportunities for enhanced along track resolutions, and spatial coverage.
  Inter-mission cross-calibration, and field campaign opportunities

- Hydrology recognizes enhanced signal processing techniques (e.g. FF-SAR, retracking), and fully
supports any cal/val projects, and the need for additional research efforts.

OST Miami 2017   Science IV – Hydrology / Cryosphere

More and more groups are looking to SARIn Mode from CryoSat:

- This mode is particularly relevant to detect icebergs and characterize their associated freeboard, representing a new potential source of operational application.
- This mode can be exploited to process high-resolution swath elevations over ice sheet and Glaciers. The existing approaches are already mature over land ice and should be tested /refined over the ocean.

Sentinel-3, CryoSat and Altika show very consistent results over Antarticta ice sheet (Vostok Lake) . SAR is more promising than LRM but would require some processing refinements.

Any future Topography Polar mission should have Ka-Ku band capabilities to retrieve snow-depth over sea-ice and better assess the impact of radar penetration in the snow pack.