Ongoing monitoring of absolute bias from the Australian In-Situ Calibration Sites:

Bass Strait and Storm Bay

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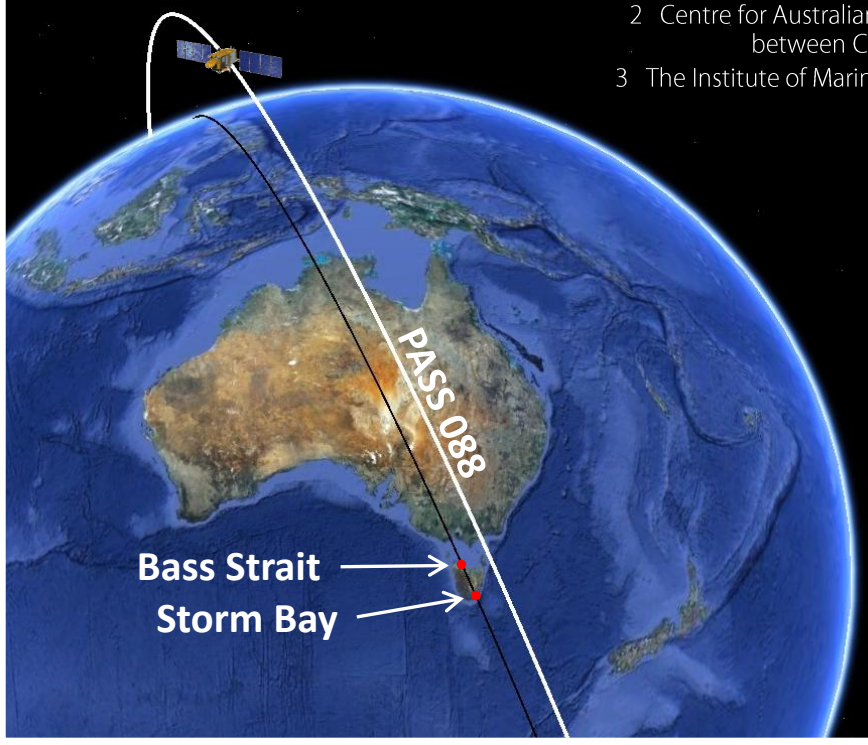

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Ocean Surface Topography Science Team Meeting

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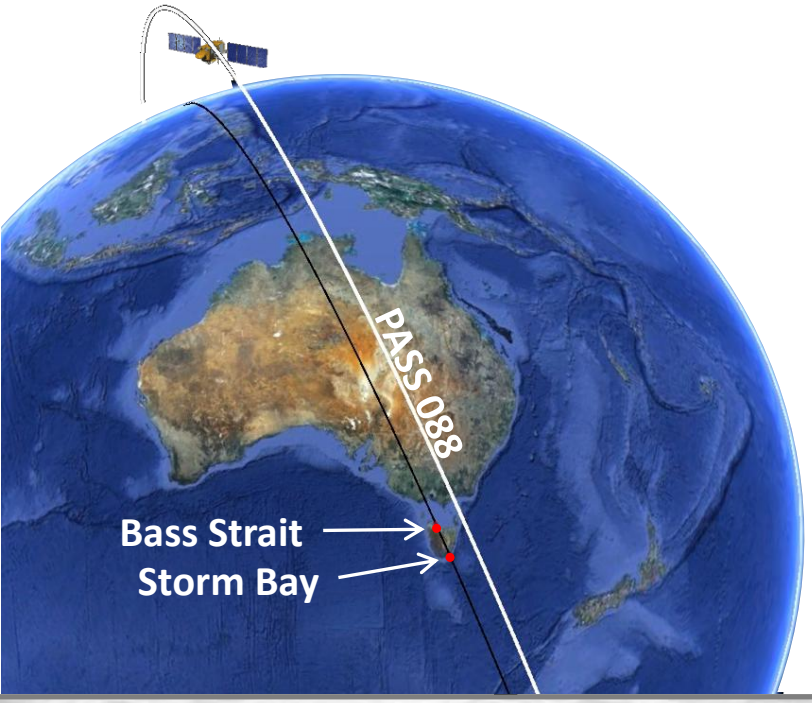
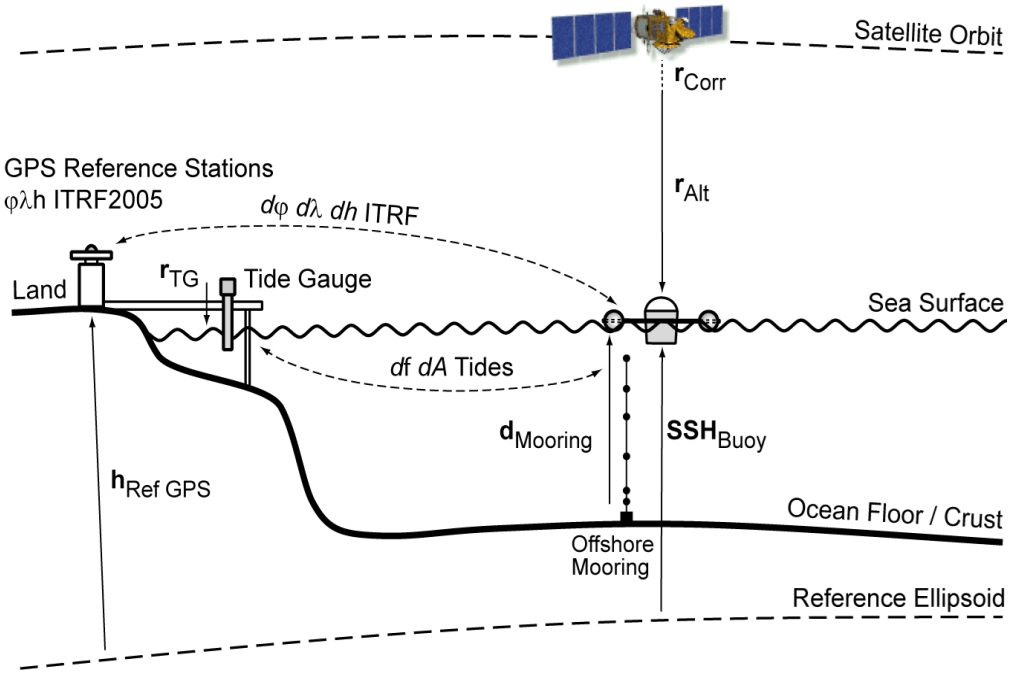
Boulder, Colorado

Review

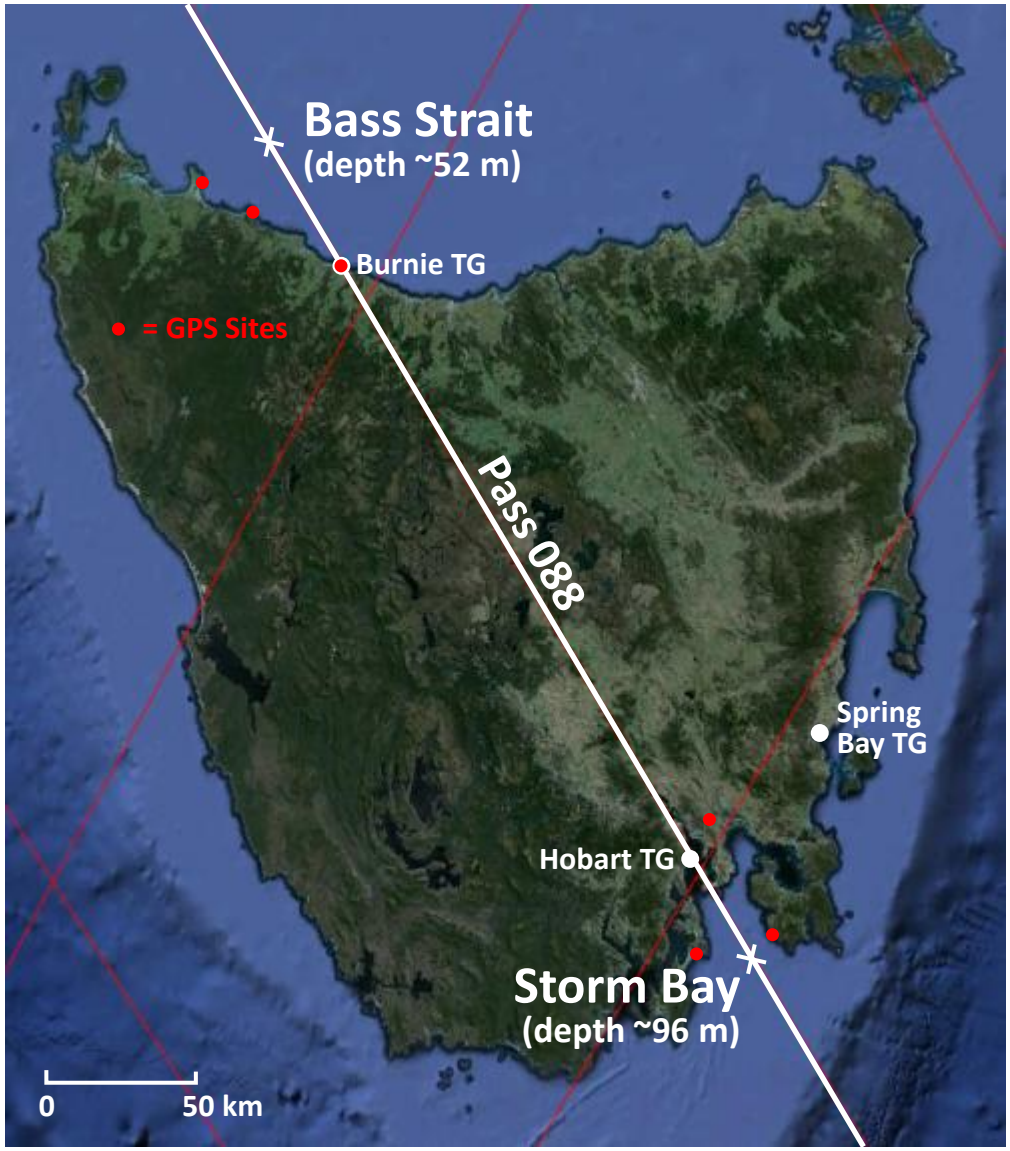
- **Primary site located in Bass Strait (40° 39'S, 145° 36'E) on decending pass 088. Contributed to the SWT/OSTST since launch of TOPEX/Poseidon.**
- **Geometric approach – *In situ* SSH determined at a comparison point through combination of GPS buoys, ocean moorings and TG observations.**
- **We present updated absolute bias results and briefly draw attention to our bias drift work (poster).**



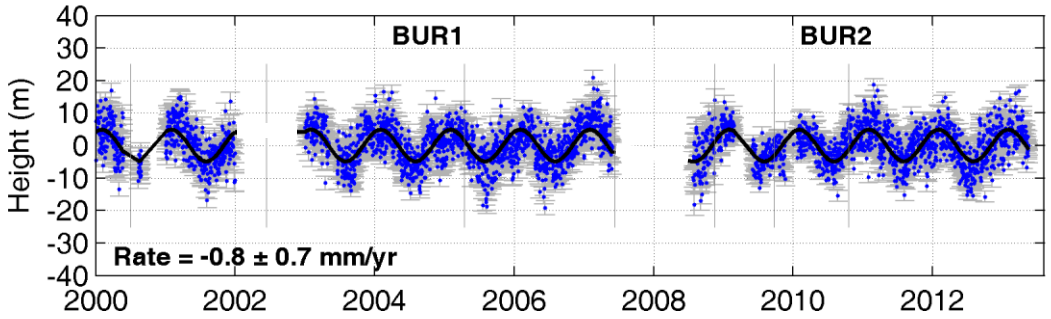


Instrumentation: TG and CGPS

- **Bass Strait site:**
  - Burnie TG (part of the ABSLMP)
  - BUR1/2 and RHPT CGPS sites
  - An additional 2 GPS sites are used episodically to further support GPS buoy processing.
- **Storm Bay site:**
  - Spring Bay TG (part of the ABSLMP)
  - Hobart TG (local port operated)
  - HOB2 CGPS
  - An additional 2 GPS sites as per Bass Strait.

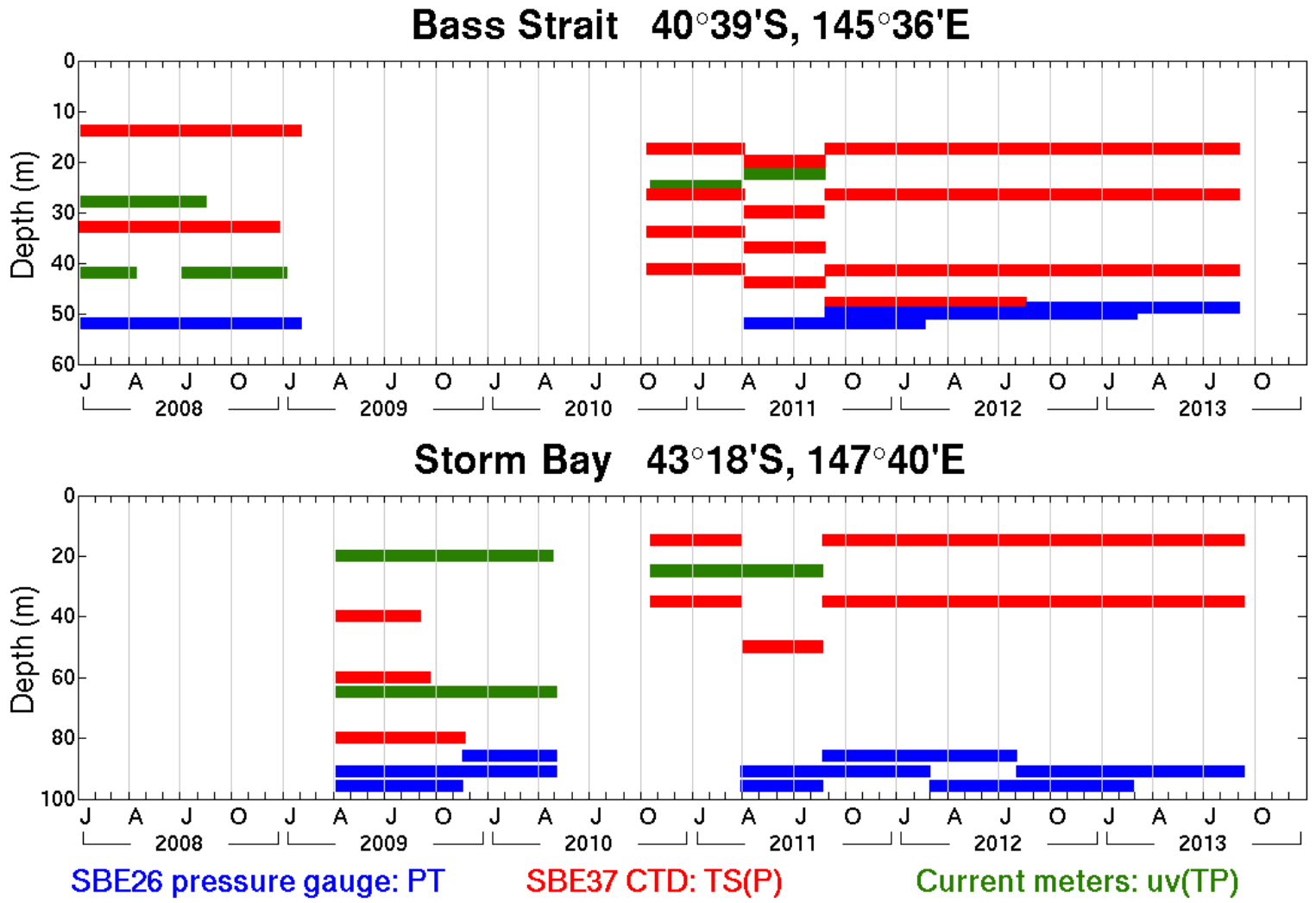


Instrumentation: GPS

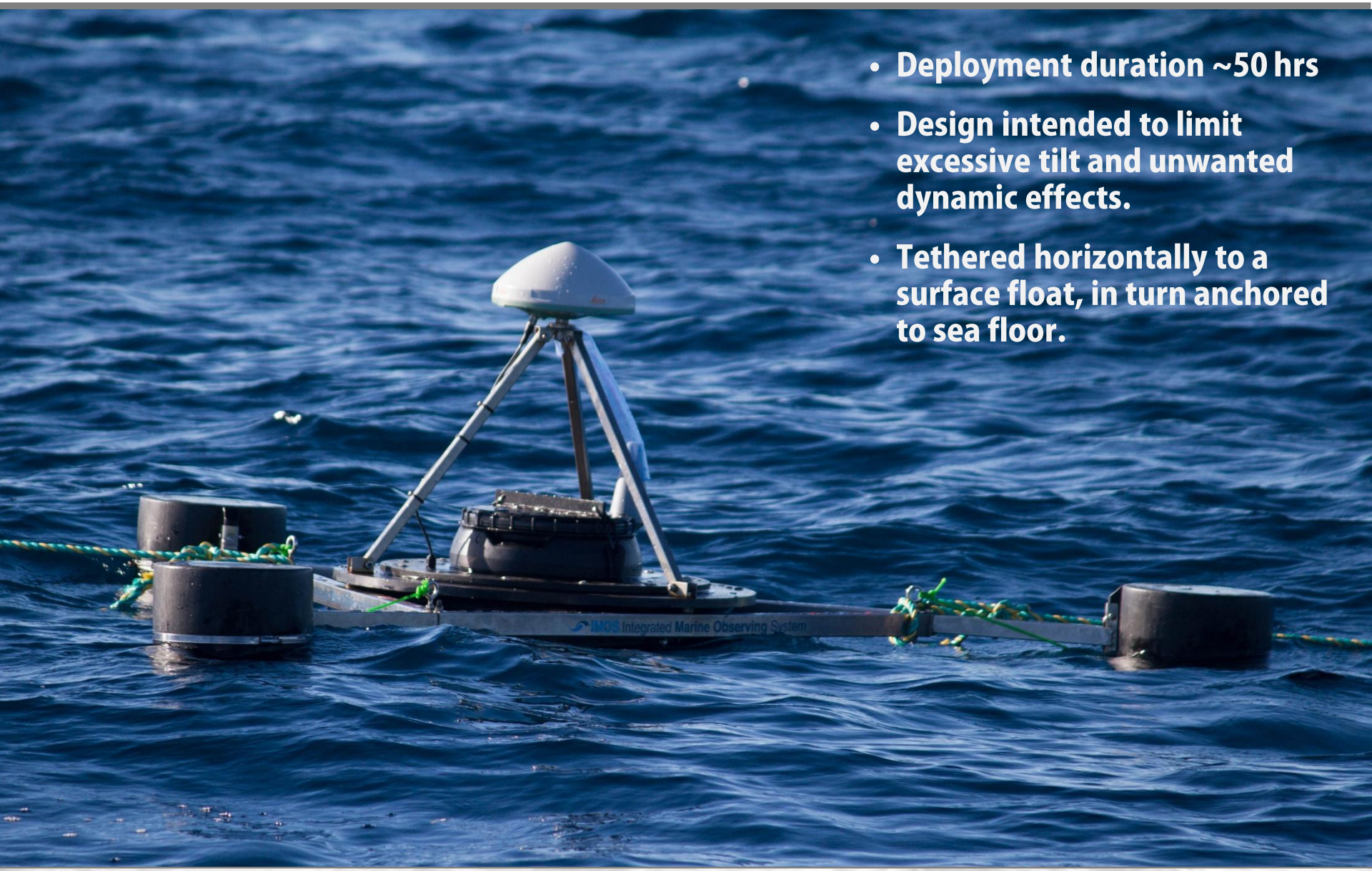


- **BUR1/2 record suggesting marginal subsidence in latest GPS solution.**
- **RMS of each GPS height time series ~6-7 mm.**

Instrumentation: Ocean Moorings



GPS Buoy Deployments (UTAS Mk IV)



- Deployment duration ~50 hrs
- Design intended to limit excessive tilt and unwanted dynamic effects.
- Tethered horizontally to a surface float, in turn anchored to sea floor.

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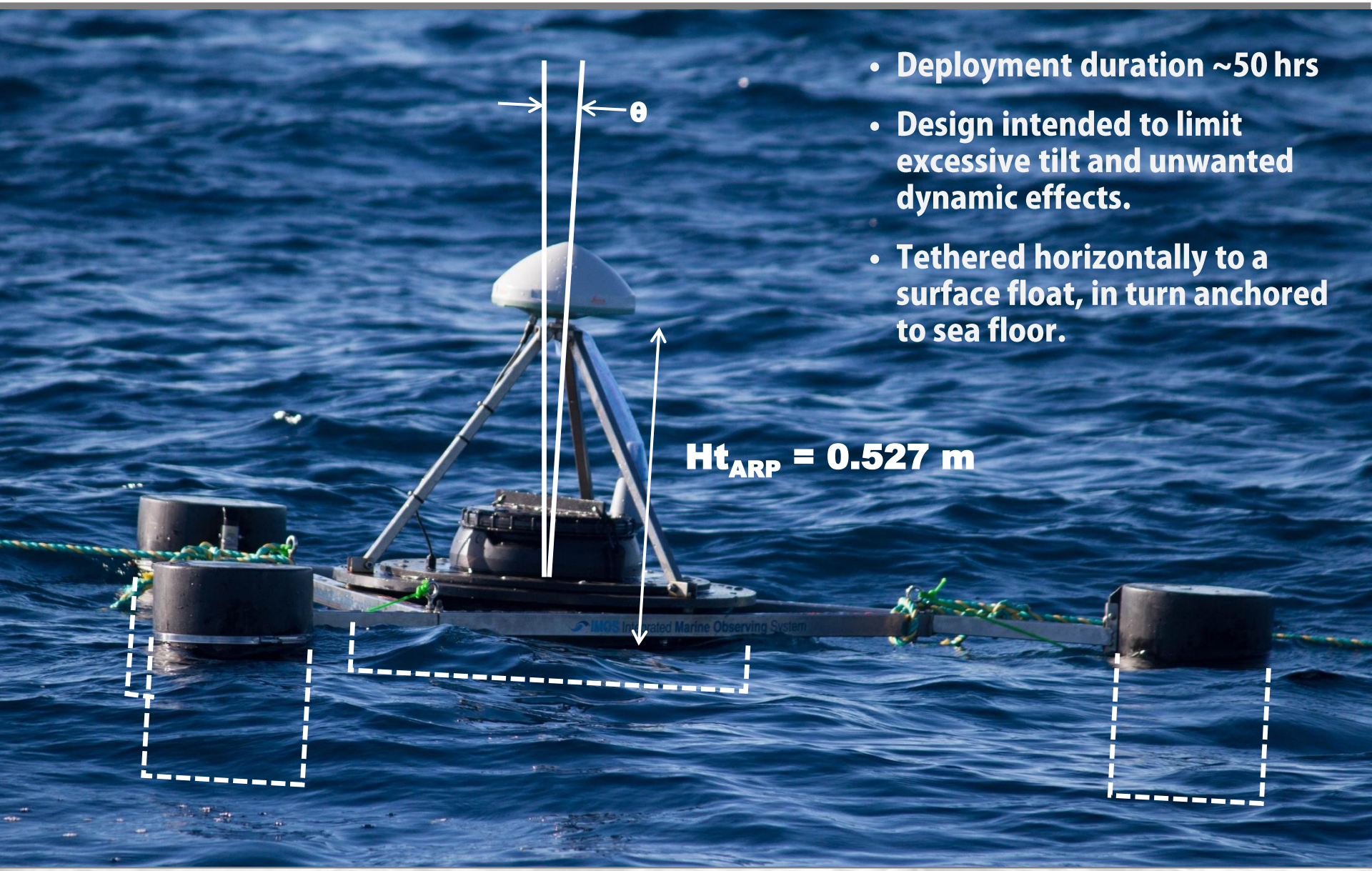

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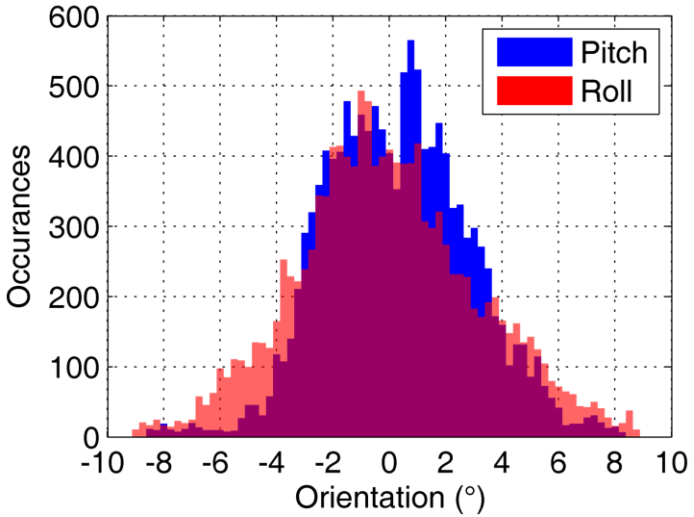
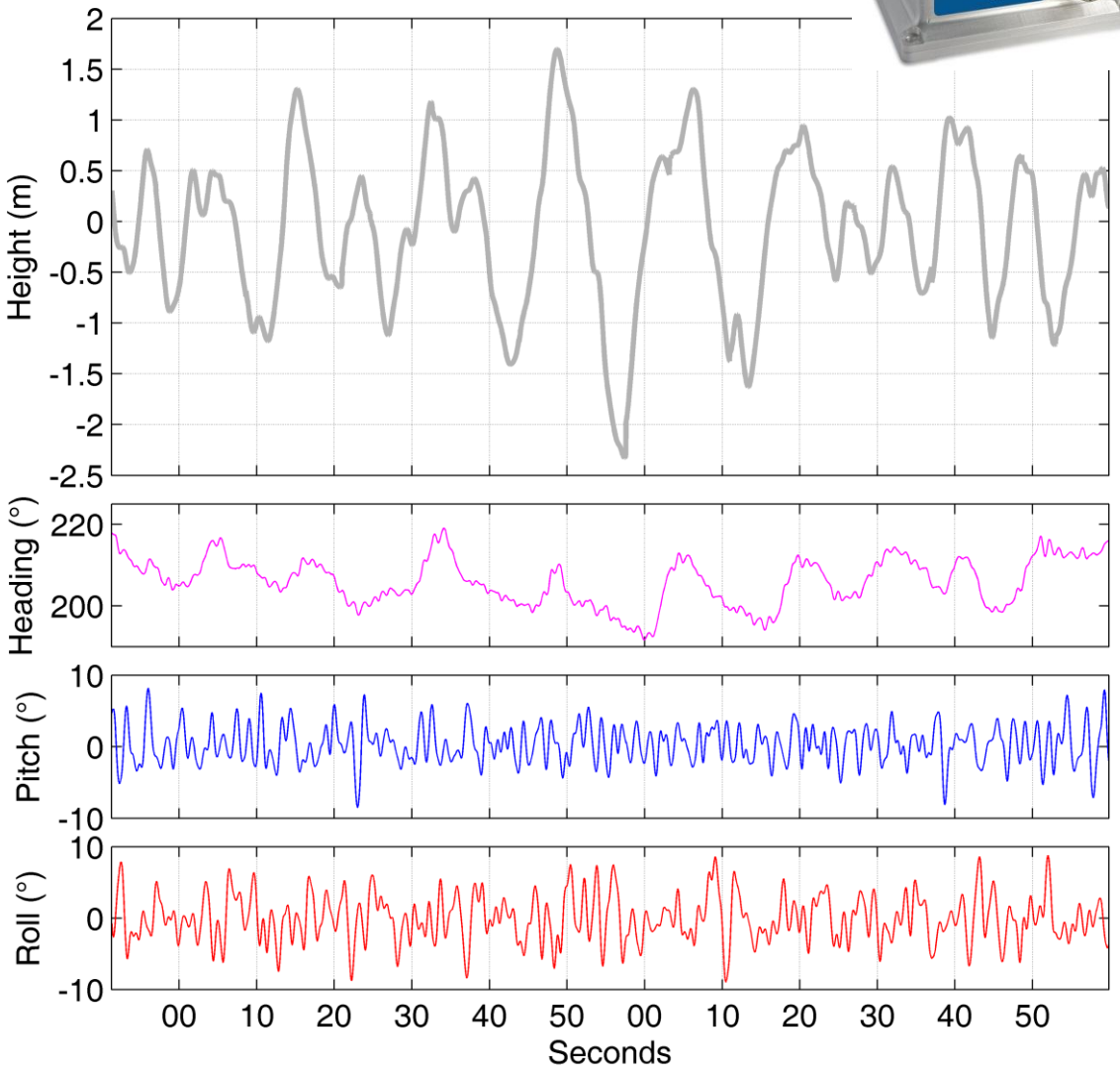
- Design intended to limit excessive tilt and unwanted dynamic effects.
- Tethered horizontally to a surface float, in turn anchored to sea floor.

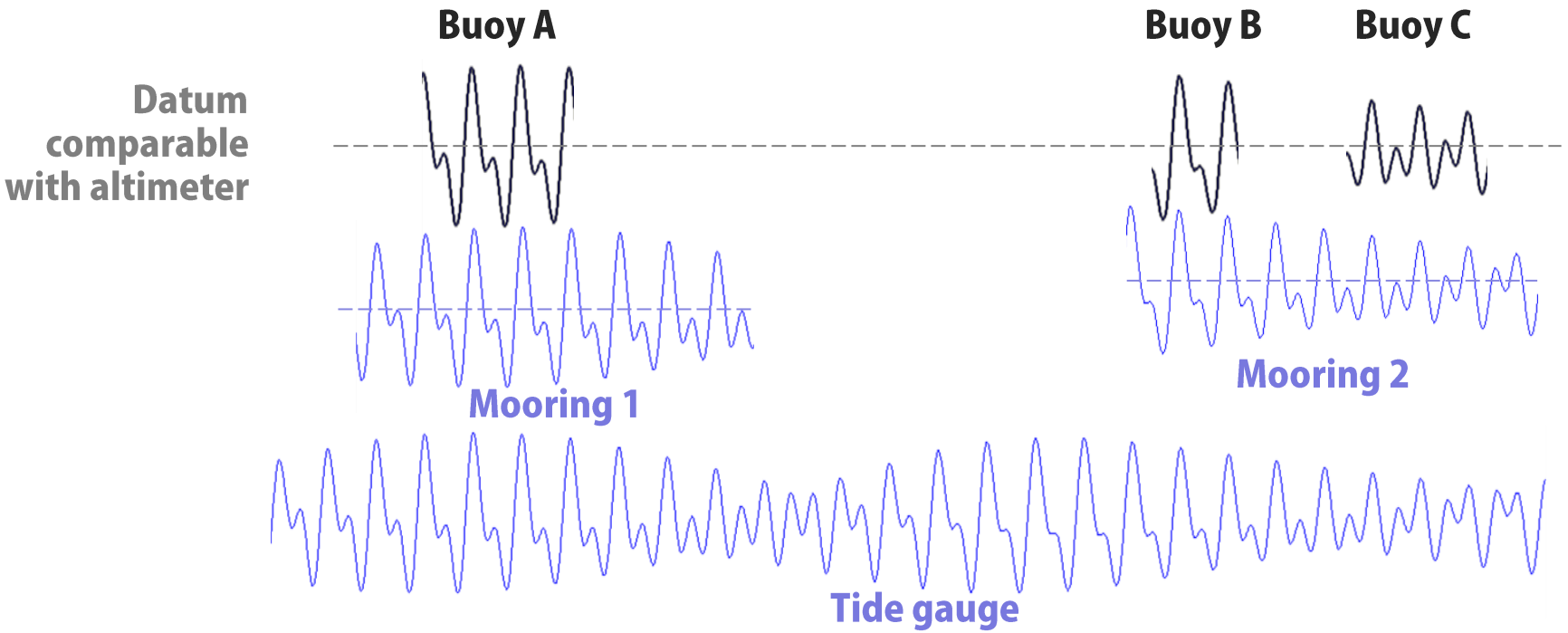
GPS+INS Buoy Solutions

- **Buoy deployments have included a trial of a combined GPS / INS unit (Novatel SPAN CPT).**
- **Orientation data during a rougher than average deployment shows the buoy remains within ±5° in pitch and roll.**





In Situ SSH Determination



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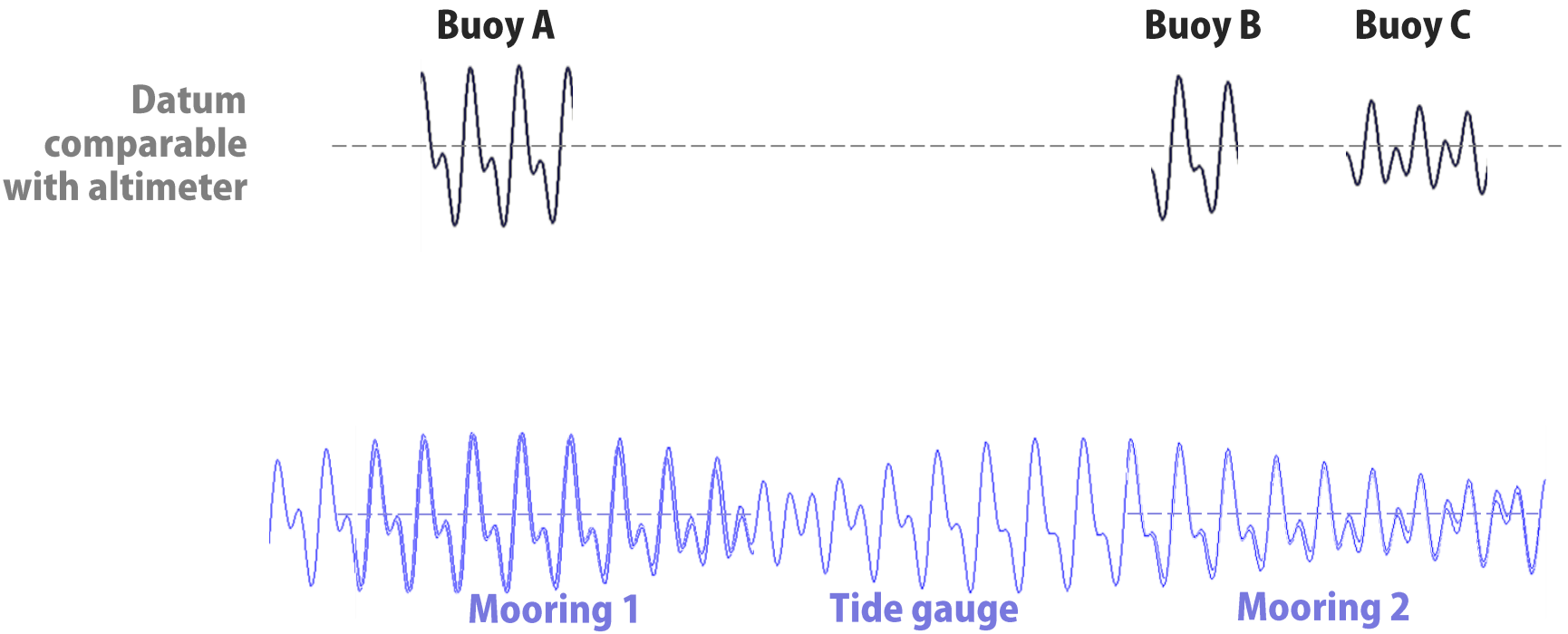
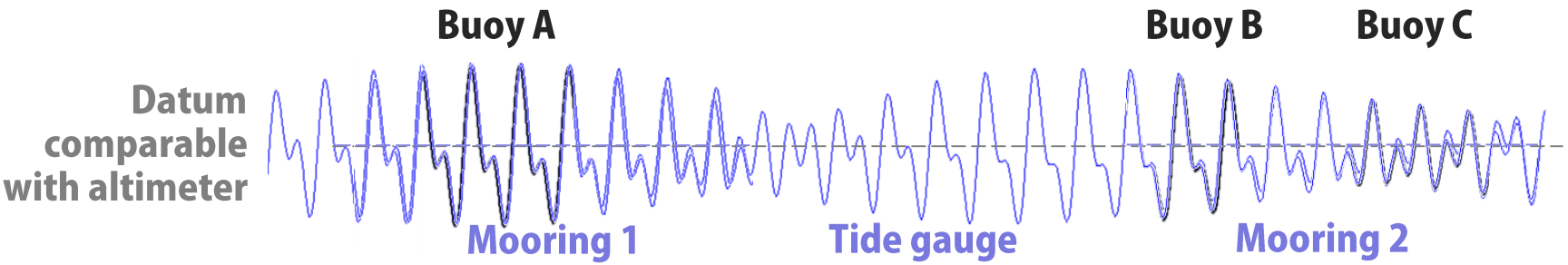


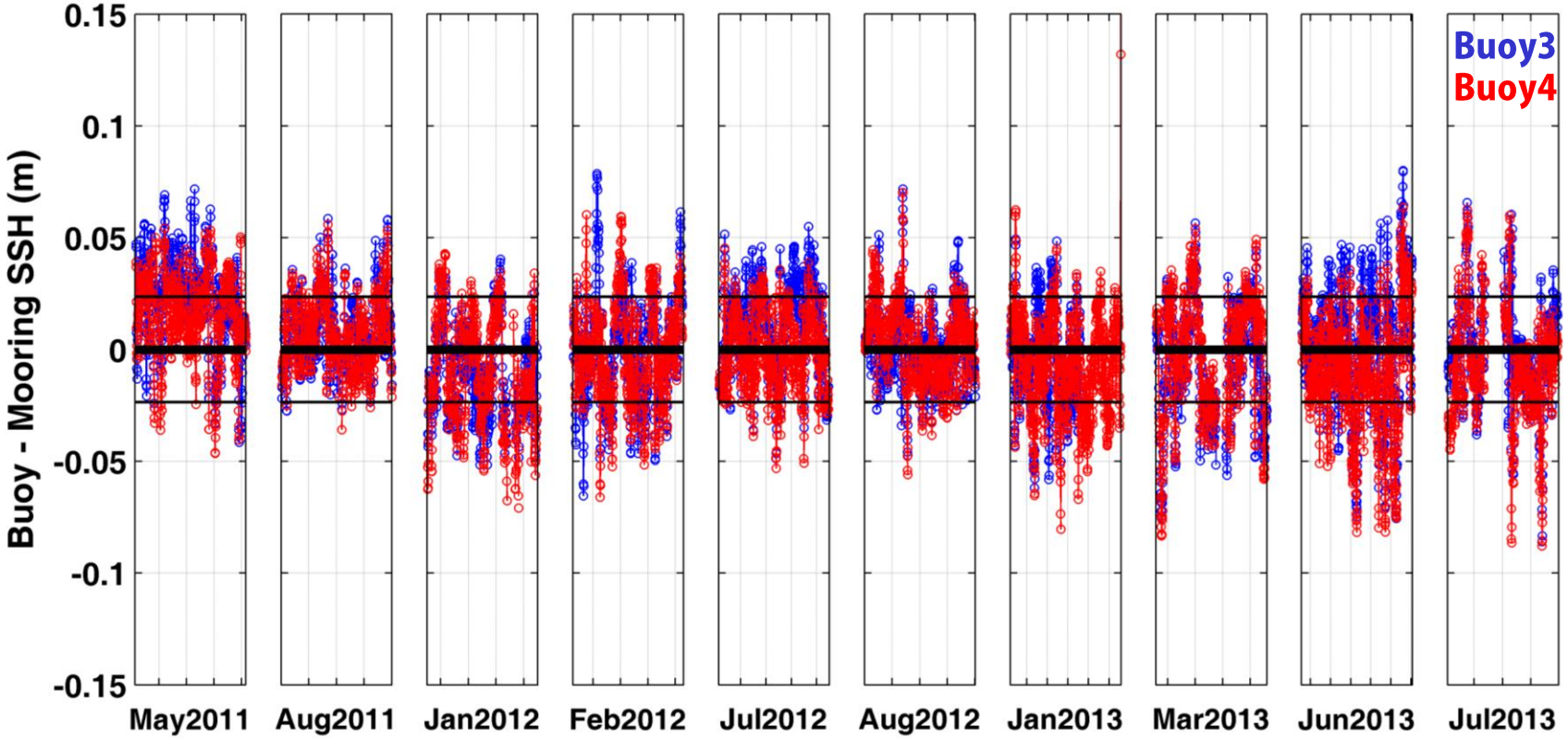
1) **Determine mooring to TG offsets using a harmonic analysis of time series differences (dominated by M2, Amp = 0.126 m). RMS of the non-tidal residual, (mooring – tide gauge) is 22 mm (reduces to 20 mm when differential effect of air pressure is considered).**

In Situ SSH Determination



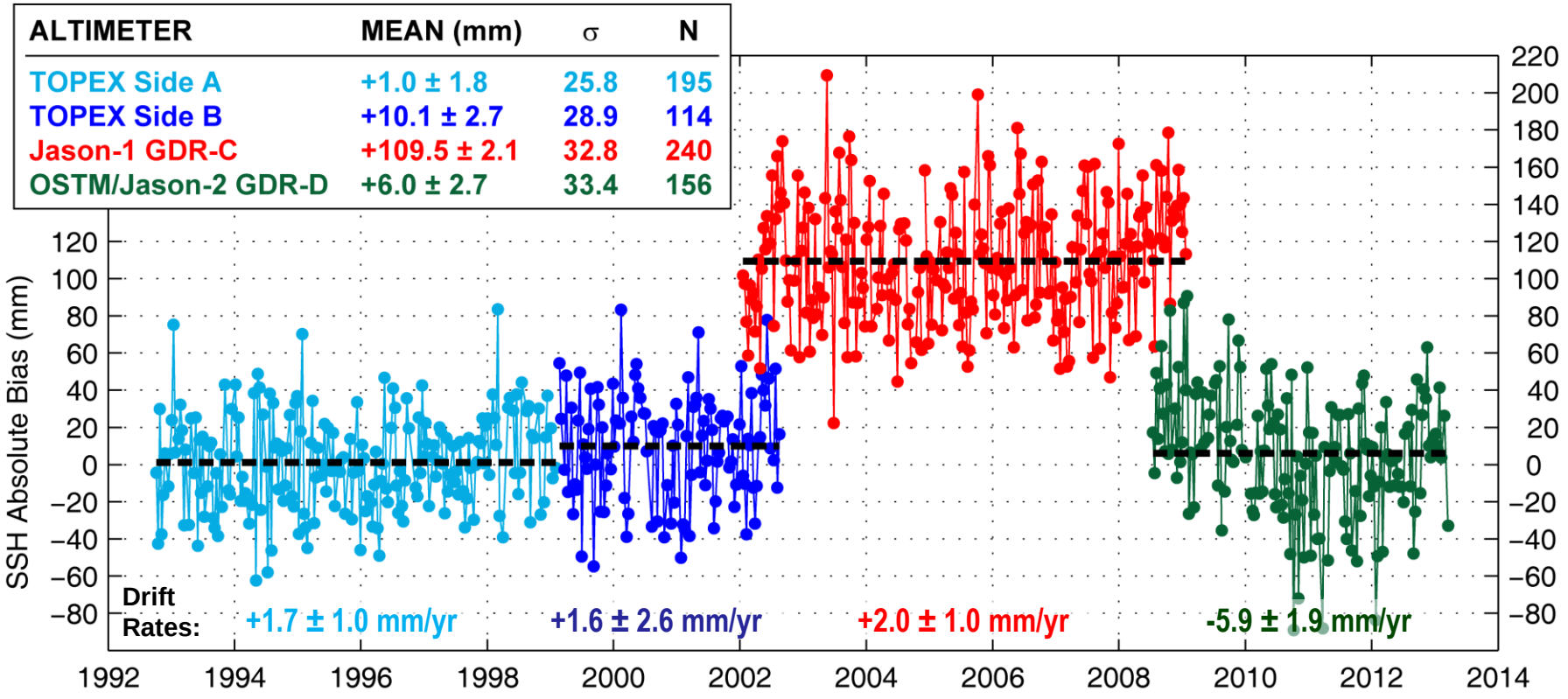
1) **Determine mooring to TG offsets using a harmonic analysis of time series differences (dominated by M2, Amp = 0.126 m). RMS of the non-tidal residual, (mooring – tide gauge) is 22 mm (reduces to 20 mm when differential effect of air pressure is considered).**
2) **Define the datum using multiple GPS deployments (min of 2 per 6 month mooring deployment).**

Results: Buoys v Mooring



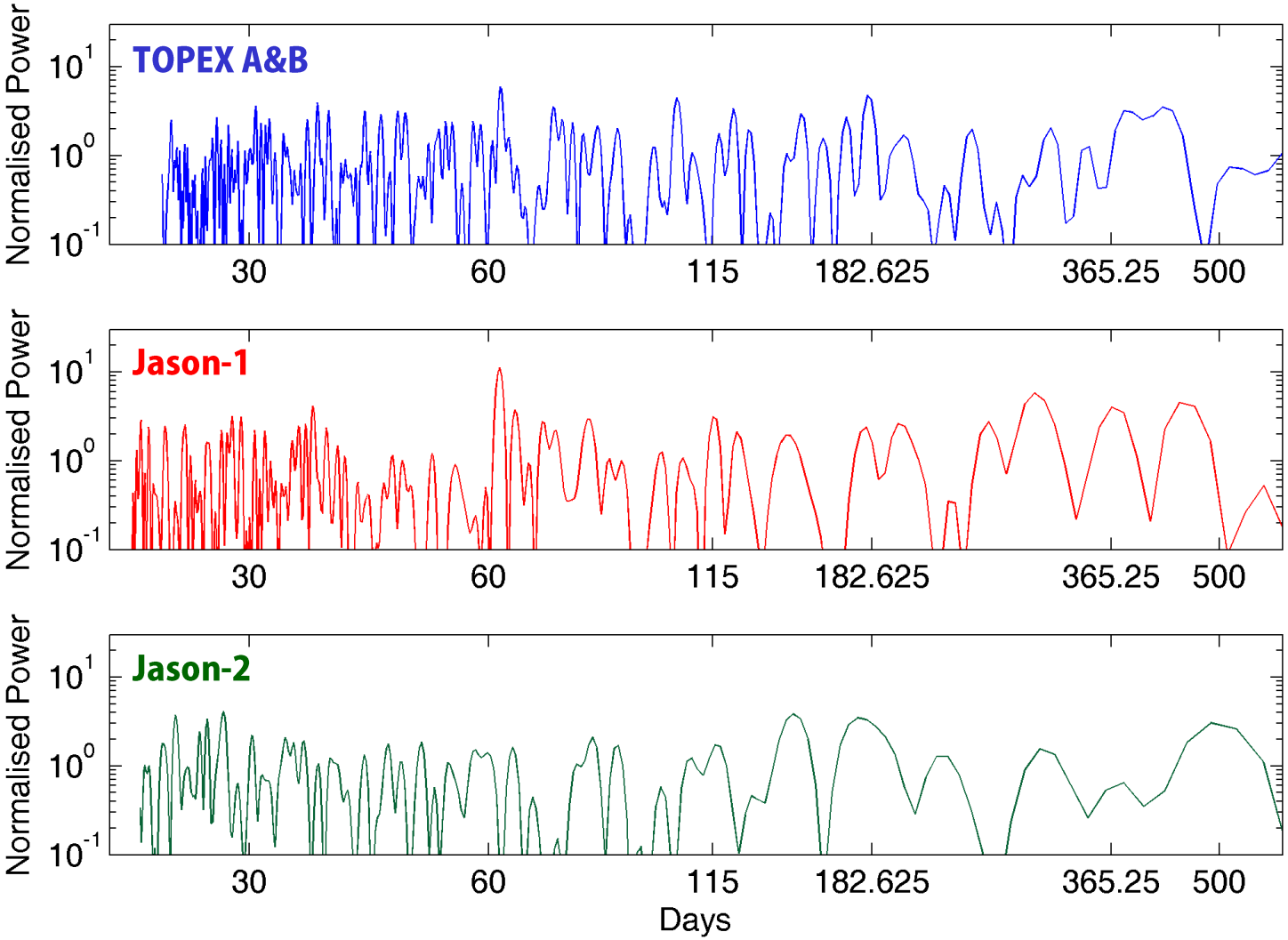
- Typically < 5 mm agreement between differences observed with Buoy 3 and Buoy 4.
- Residual time series (filtered buoy SSH – mooring SSH) shows RMS of 23 mm.
- Larger excursions are likely GPS artefacts given they typically correlate well with times of poorest GPS constellation coverage.

Results: Absolute Bias

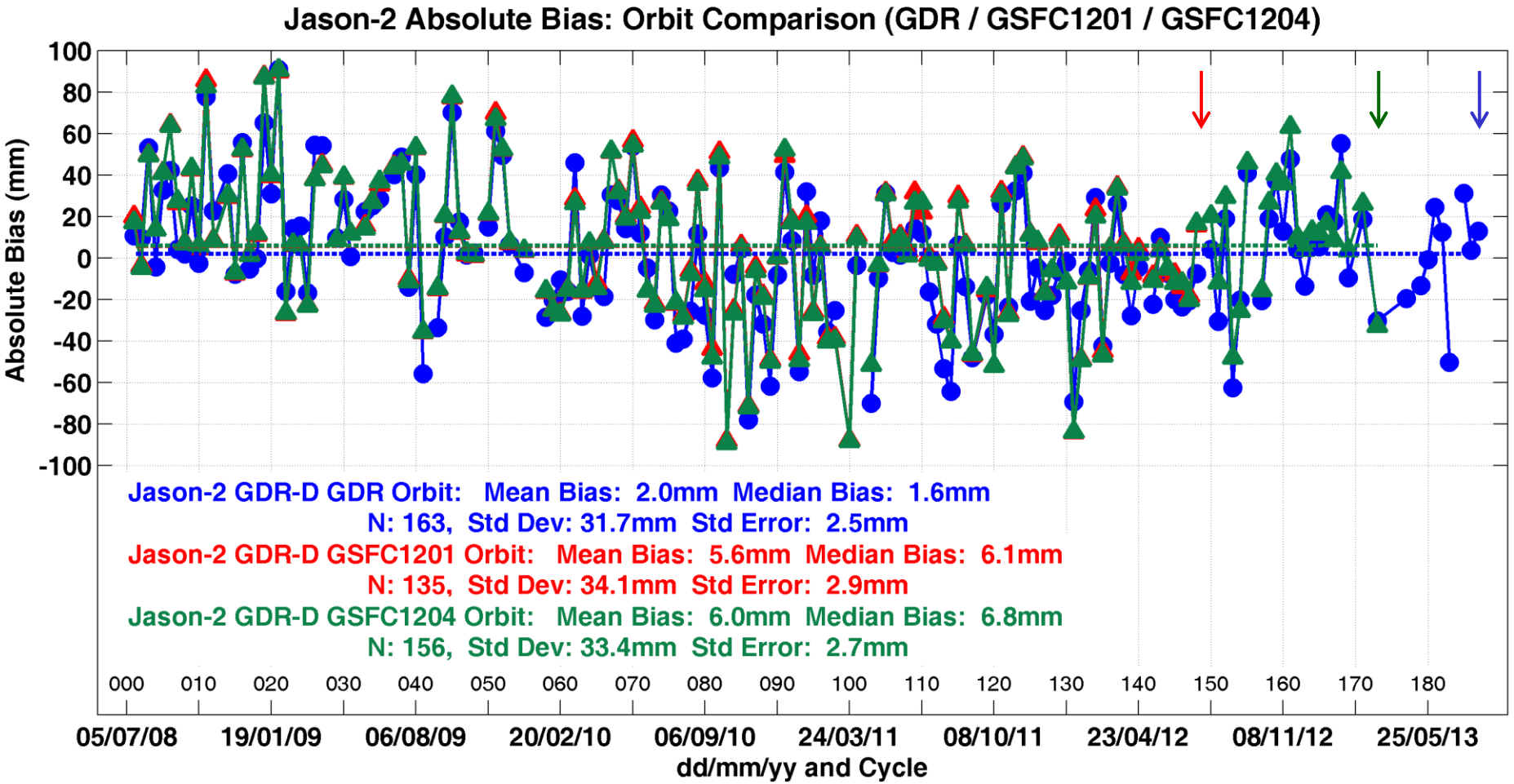


- Jason-1 GDR-C + GSFC1204 orbits, Jason-2 GDR-D + GSFC1204 orbits.
- Pole tide issue resolved (now using crust only component, scaled from GDR value).
- The large negative trend in Jason-2 is slowing, unlikely to be TG/VLM related.

Results: Bias Spectra



Results: Jason-2 Orbit Comparisons



- **Marginal increases in bias when using GSFC1201 or GSFC1204 orbits.**
- **(Note slightly different data durations).**
- **Anomalous trend seems to cease towards end of 2010.**

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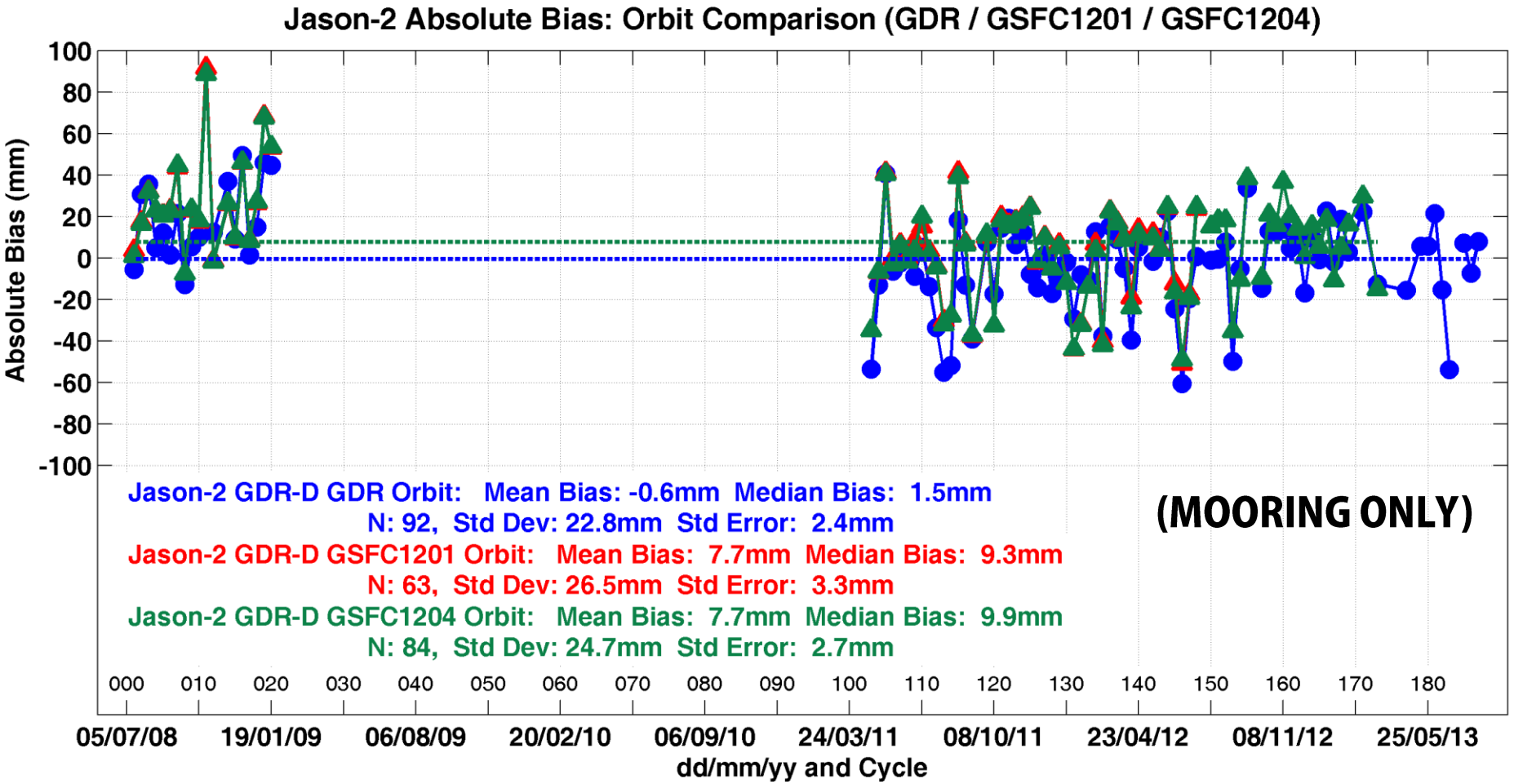

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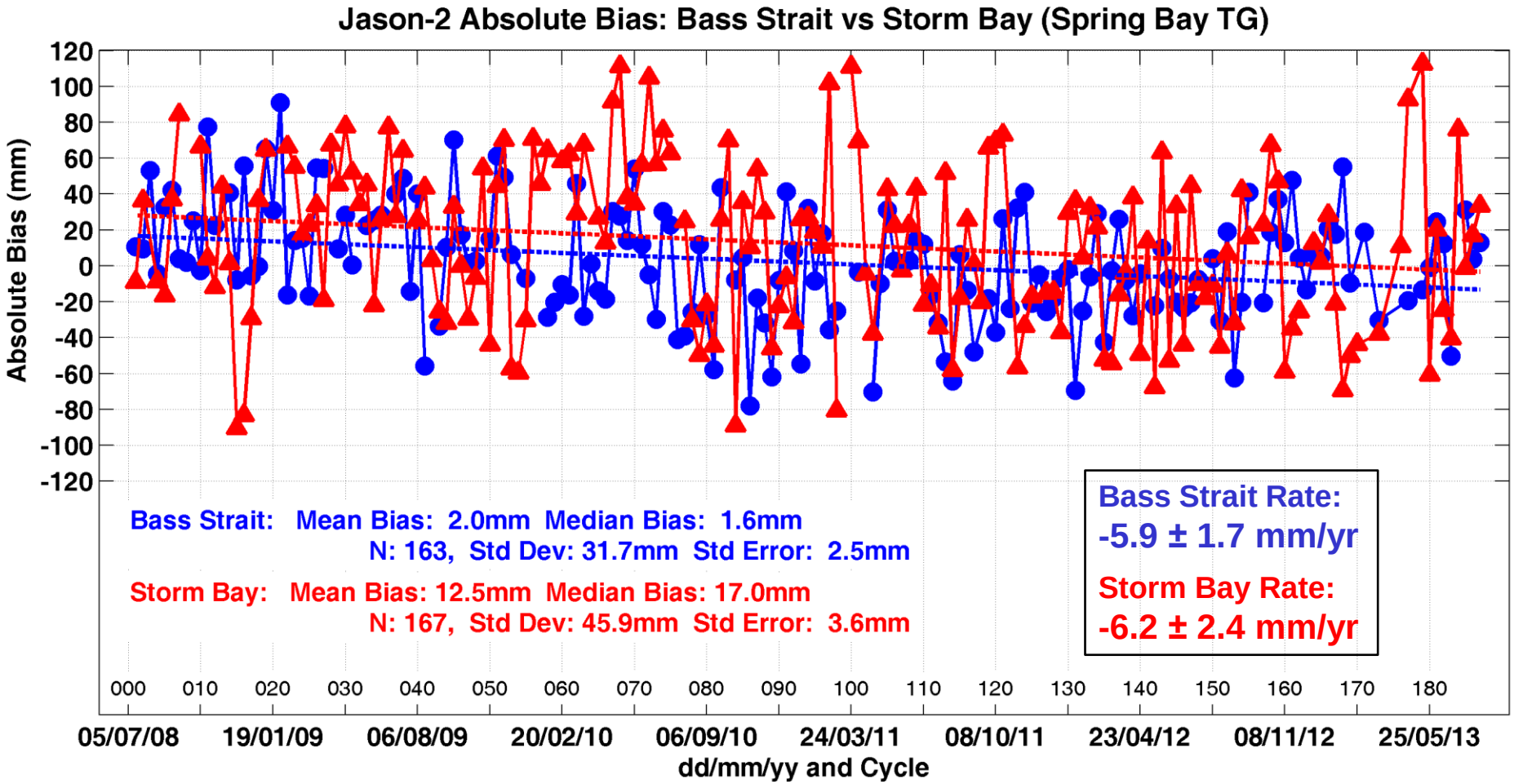
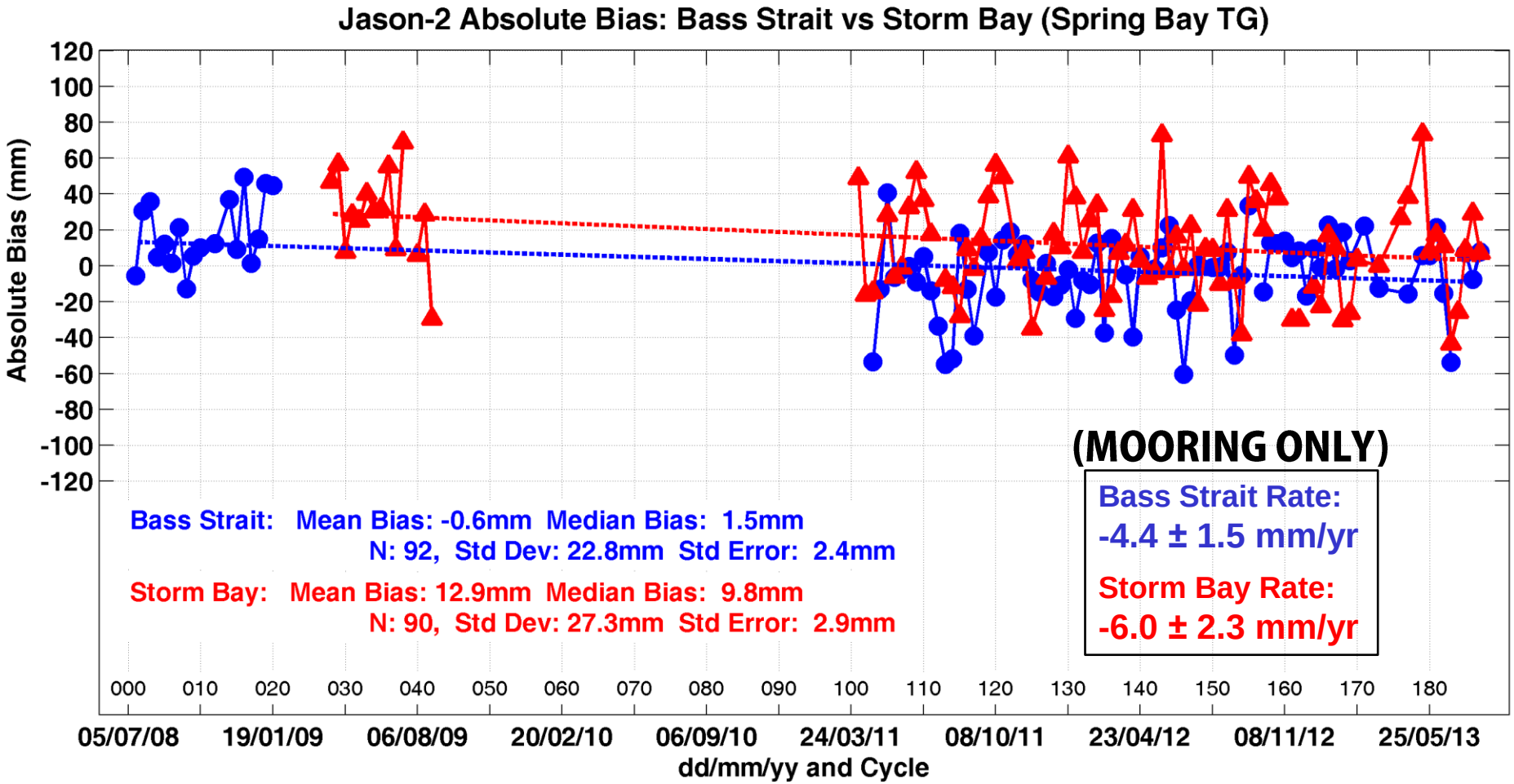
Results: Bass Strait v Storm Bay (GDR-D)



- Comparable rate observed at Storm Bay using the transformed Spring Bay TG time series.
- Increased noise at Storm Bay attributed primarily to TG location.
- Absolute bias at Storm Bay marginally higher – needs further work.

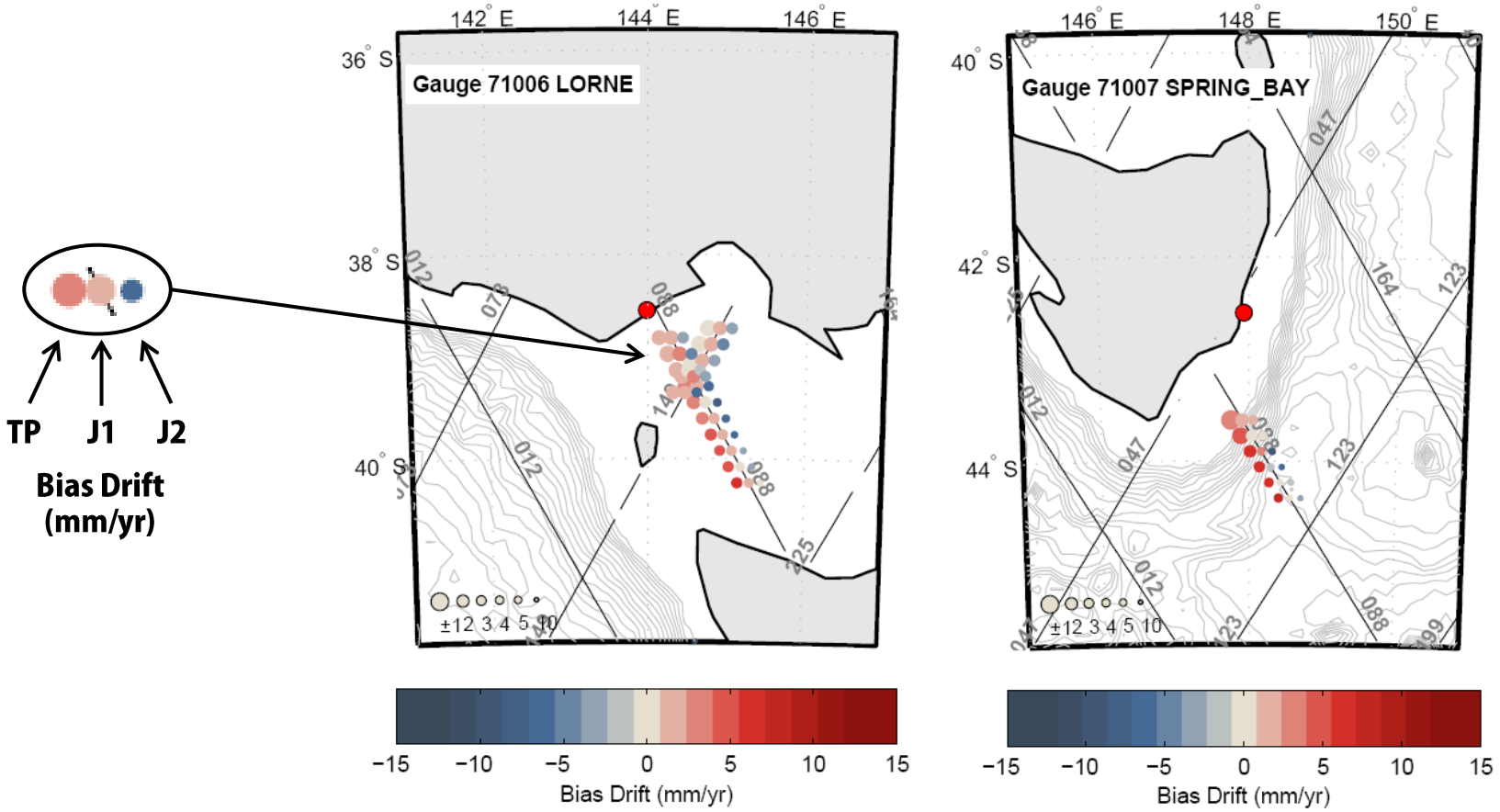
Results: Bass Strait v Storm Bay (GDR-D)



- **Mooring only rates comparable despite different data periods.**
- **Storm Bay mooring time series marginally more noisy c.f. Bass Strait, in part driven by water depth (~52 m vs ~96 m respectively), and sparser instrumentation.**

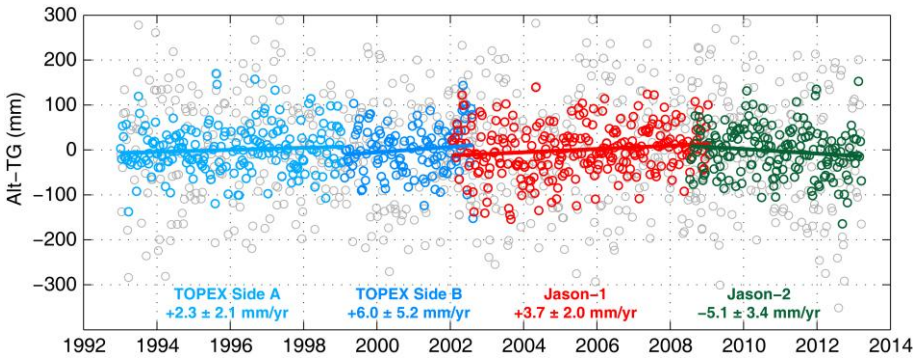
Bias Drift at nearby TGs

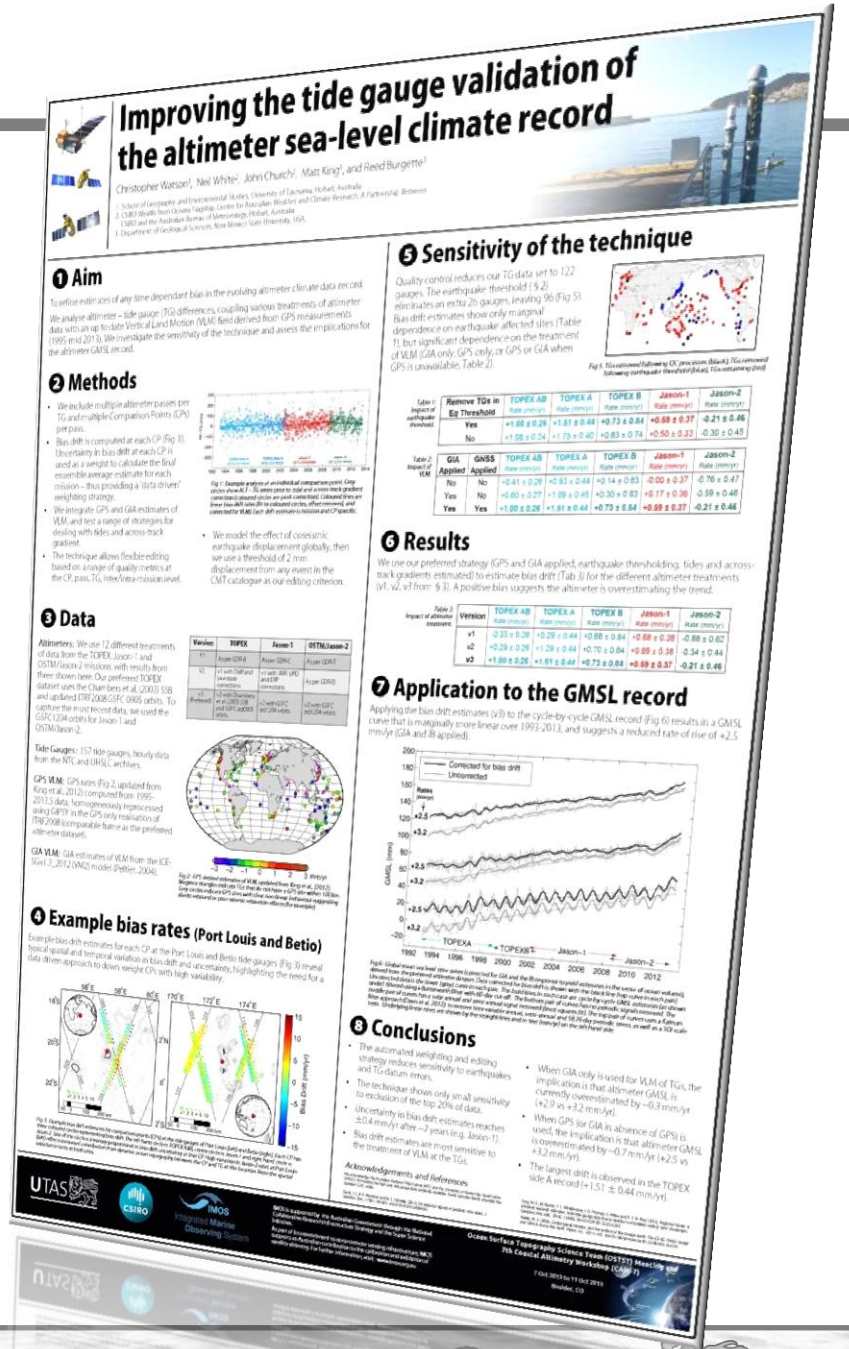
- As part of our global bias drift work, we compute bias drift for a series of comparison points (CPs) along passes close to TGs, CPs separated by 20 km.
- TGs *Lorne* and *Spring Bay* are also on Pass 088 and show similarly anomalous drift rates for Jason-2 (likewise for pass 149 for *Lorne*, and 225 for *Burnie*).



Bias Drift Poster

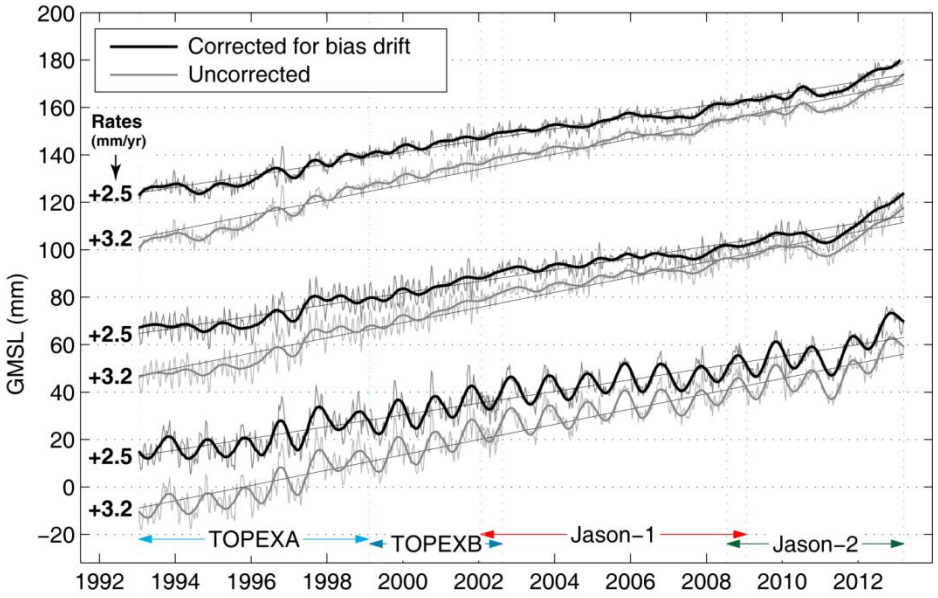
- **Aims to refine estimates of time variable bias in the climate record.**
- **Assess sensitivity to various altimeter data treatments, and to the method itself.**
- **Multiple altimeter passes per TG, and multiple comparison points per pass.**
- **New estimates of VLM 1995 – 2013.5 (updated from King et al. GRL 2012).**

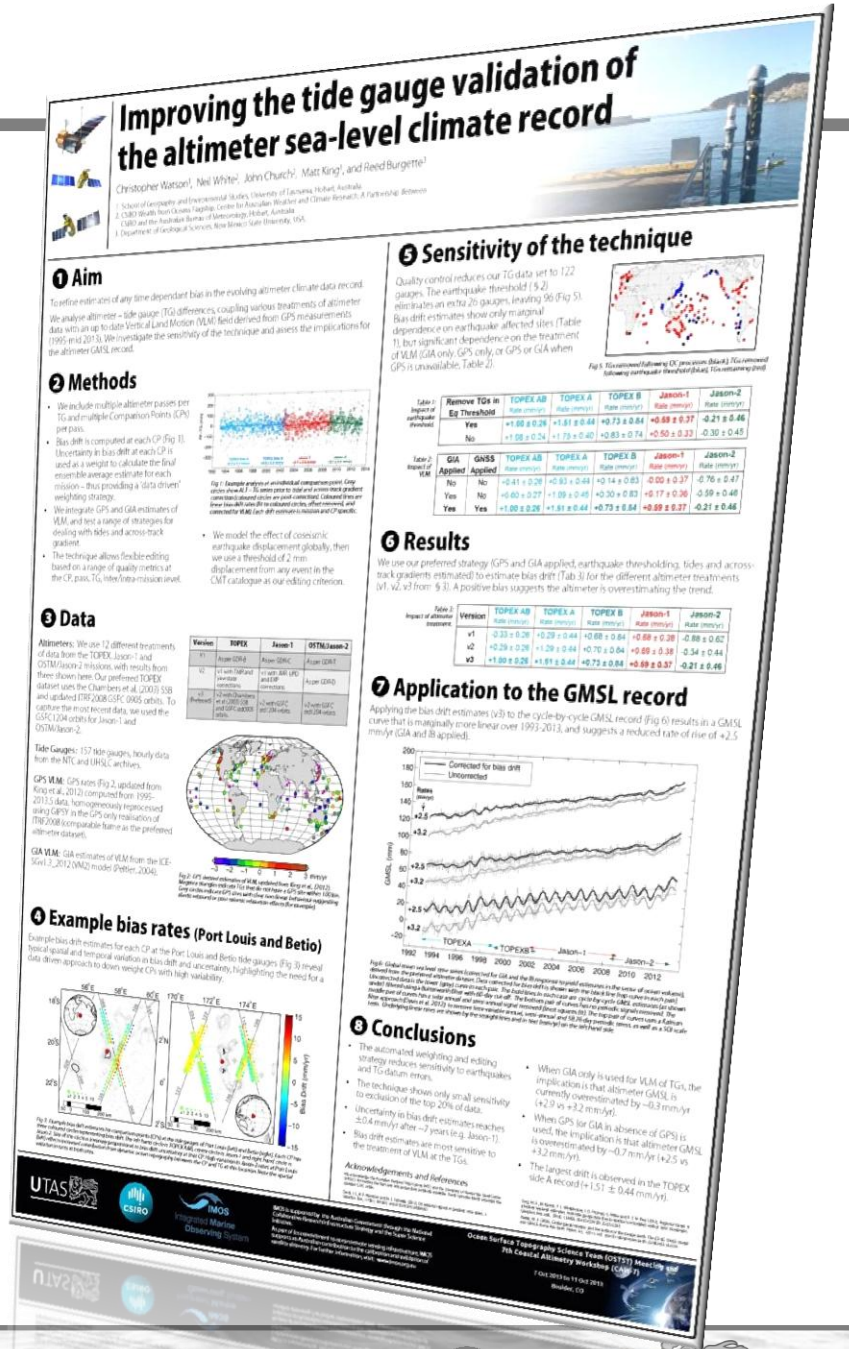




Bias Drift Poster

- **Results show significant dependence of bias drift estimates on VLM, with the largest effect for TOPEX A and B.**
- **Application of the drift estimates to the GMSL record produces a marginally more linear time series, and suggests a downward revision in the rate (from +3.2 to +2.5 mm/yr, GIA+IB corrected).**
- **Come and see the poster!**





Conclusions…

Data	Cycles	N	Mean Bias ± Std Error
Jason-1 GDR-C			
GDR Orbits, enc JMR	001-259	234	+115.6 ± 2.1 mm
GSFC0905 Orbits, enc JMR	"	"	+112.9 ± 2.2 mm
GSFC1204 Orbits, enc JMR	"	"	+109.5 ± 2.1 mm
OSTM/Jason-2 GDR-D			
GDR Orbits	001-187	163	+2.0 ± 2.5 mm
GSFC1201 Orbits	001-149	135	+5.6 ± 2.9 mm
GSFC1204 Orbits	001-173	156	+6.0 ± 2.9 mm

- **Jason-2 GDR-D absolute bias not significantly different from zero.**
- **However –regional coherence in anomalous drift remains puzzling.**
- **Storm Bay biases (and drift) consistent with those from Bass Strait.**
- **Recall that non-time averaging systematic error contributions likely dictate that the "absolute" error is 10-15 mm for these estimates.**

Questions?

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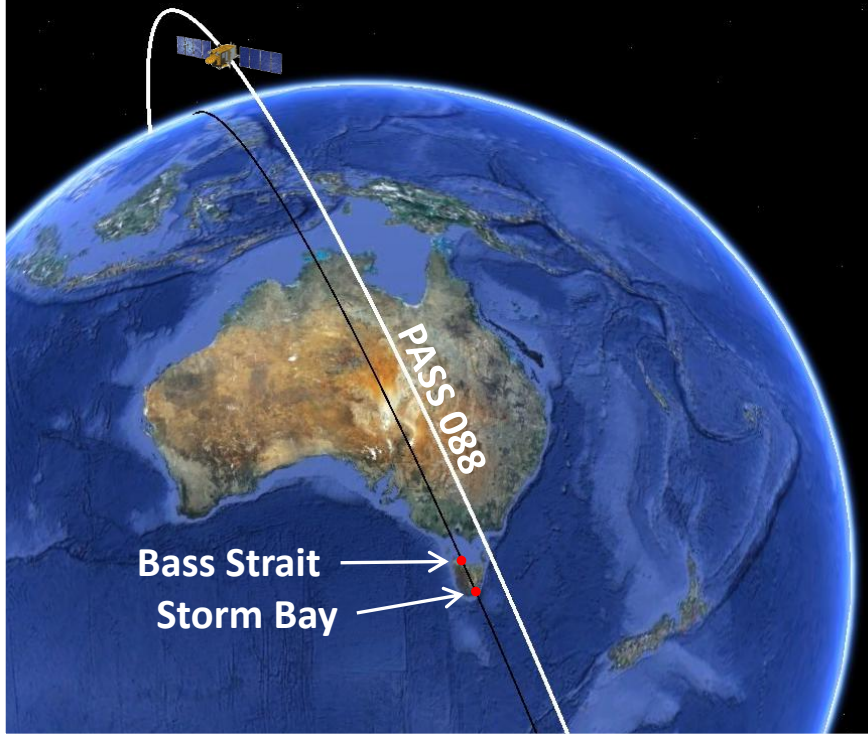

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