Altimeter absolute bias estimates from Bass Strait, Australia

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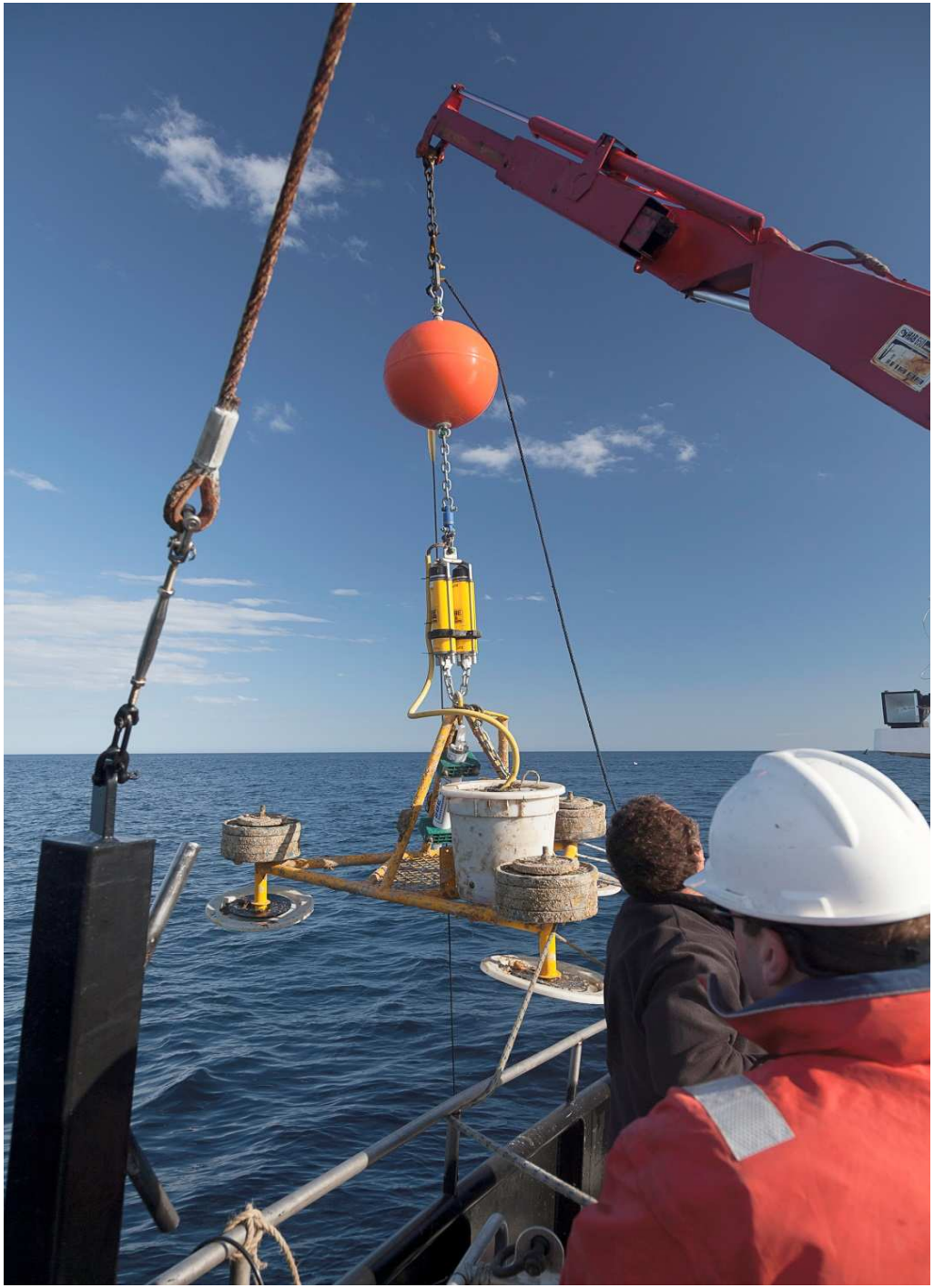

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Australian Cal/Val Overview

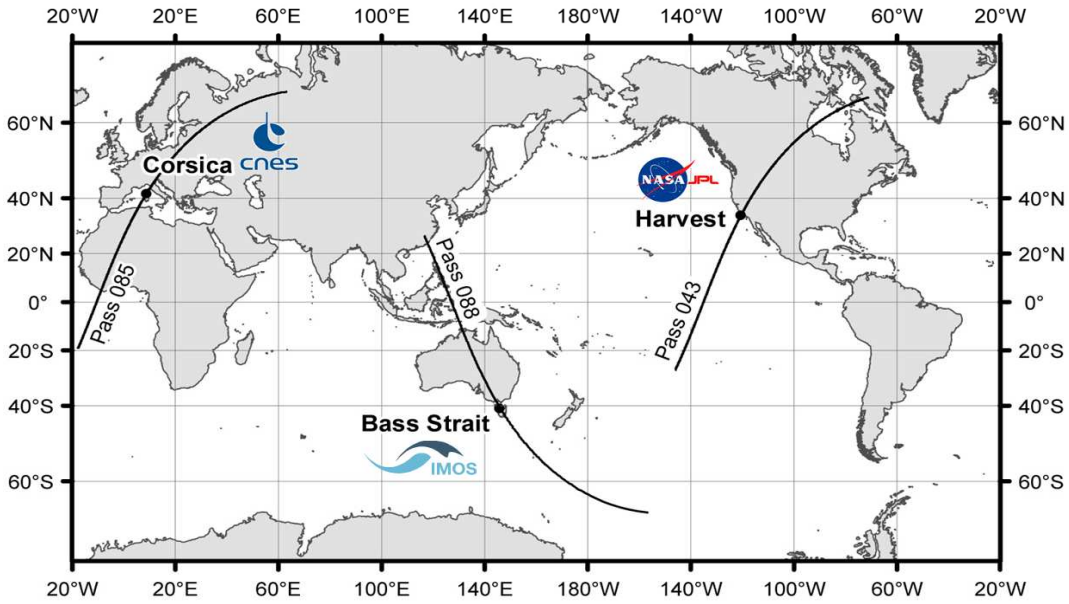
Bias Drift (see poster)**:**

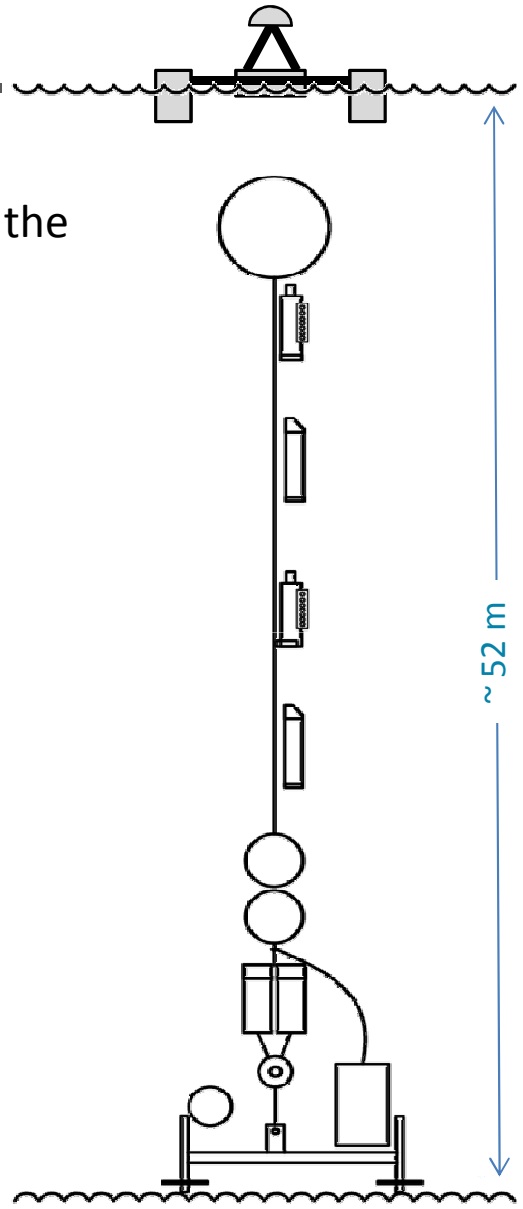
Global analysis of altimeter v tide gauges: advocates for a reduction in the GMSL rate from ~3.2 to ~2.6-2.9 mm/yr (Watson et al., 2015).

Absolute Bias (this talk)**:**

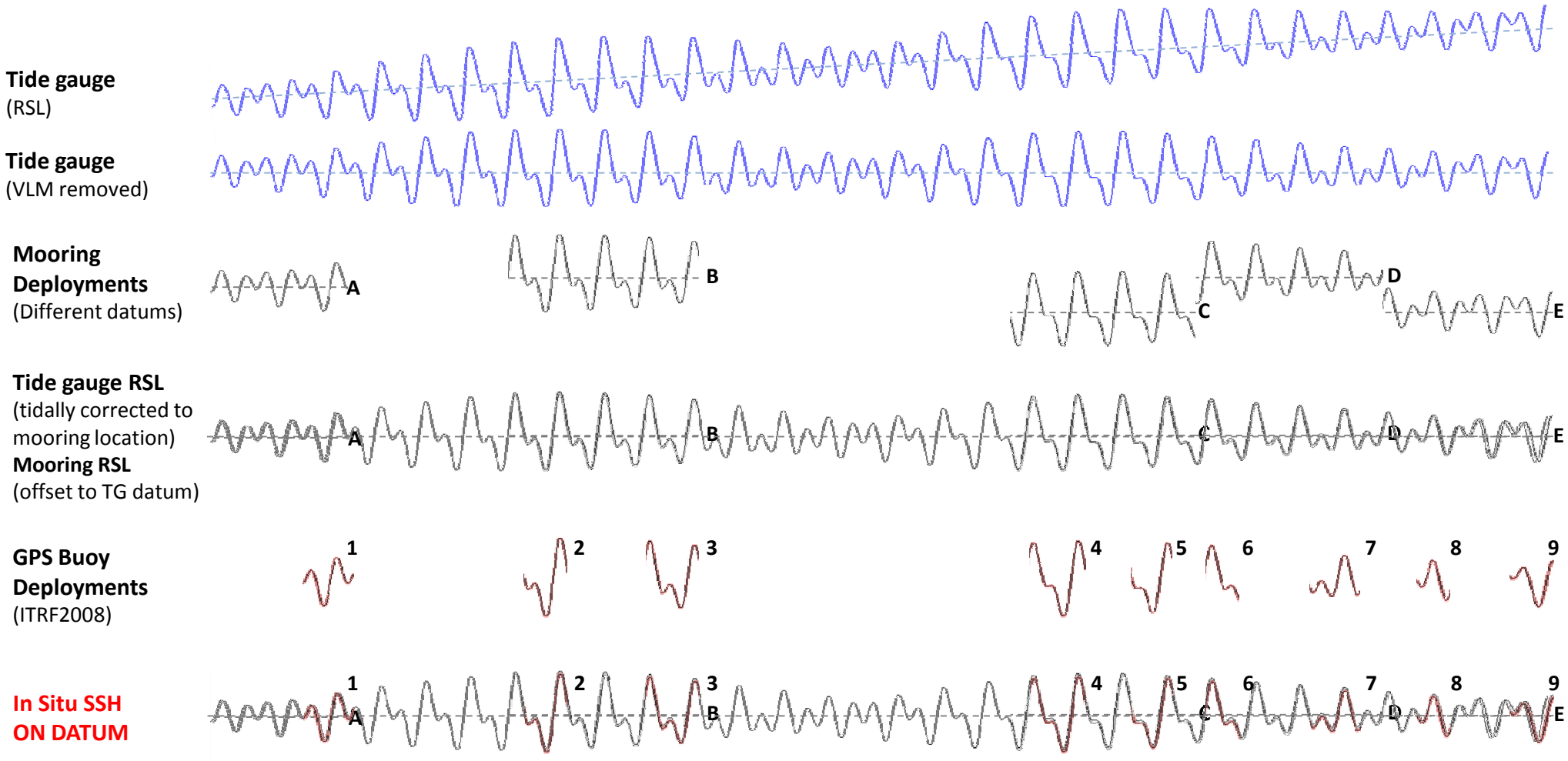
Bass Strait and Storm Bay sites, altimeter v in situ SSH.

In situ SSH = tide gauge + moored T/S/P sensors + GPS buoys

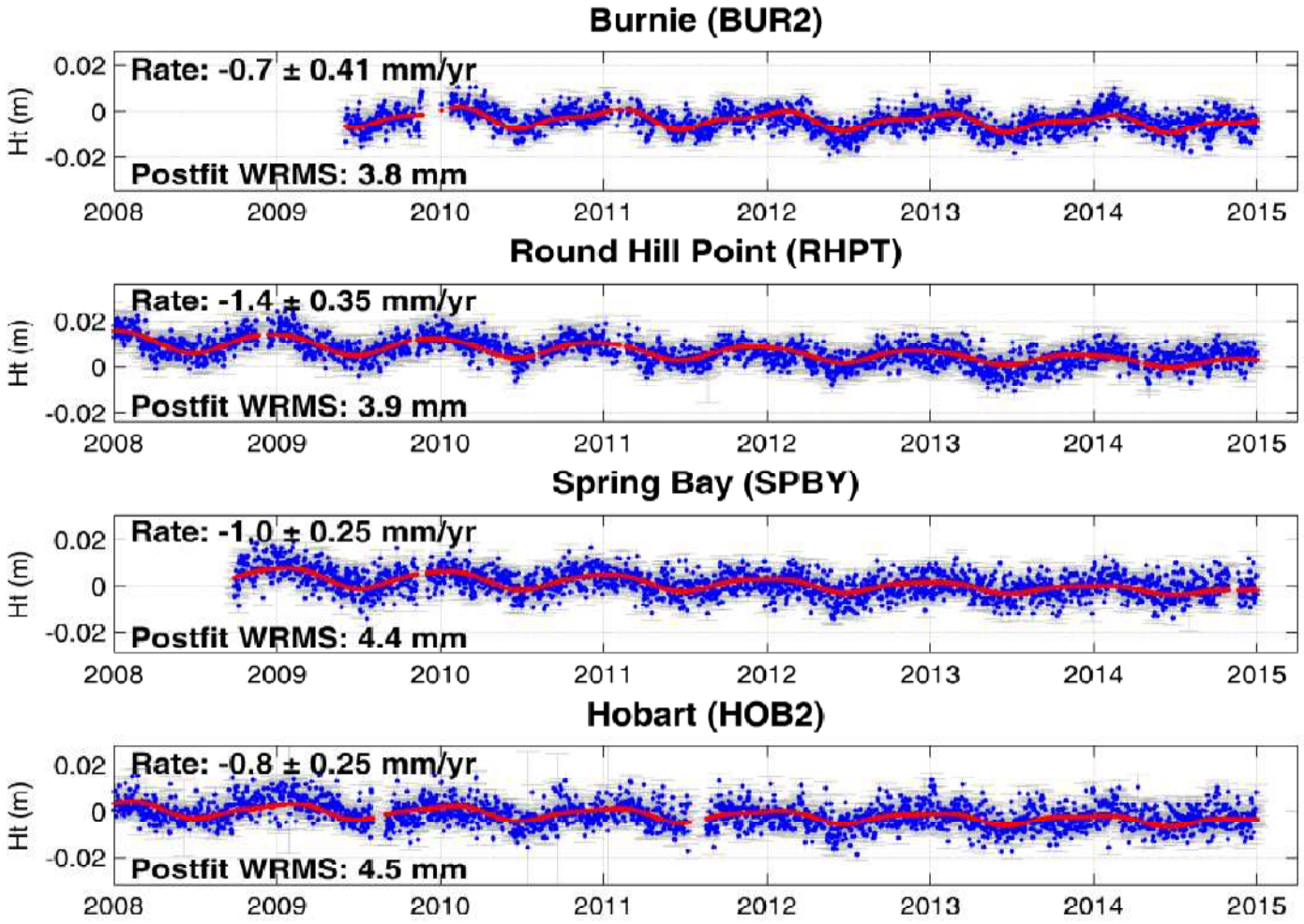




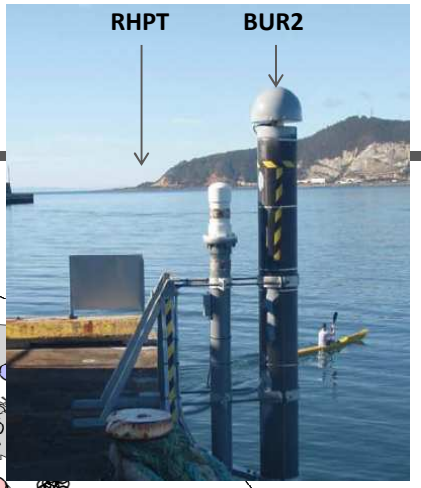
In Situ SSH Generation

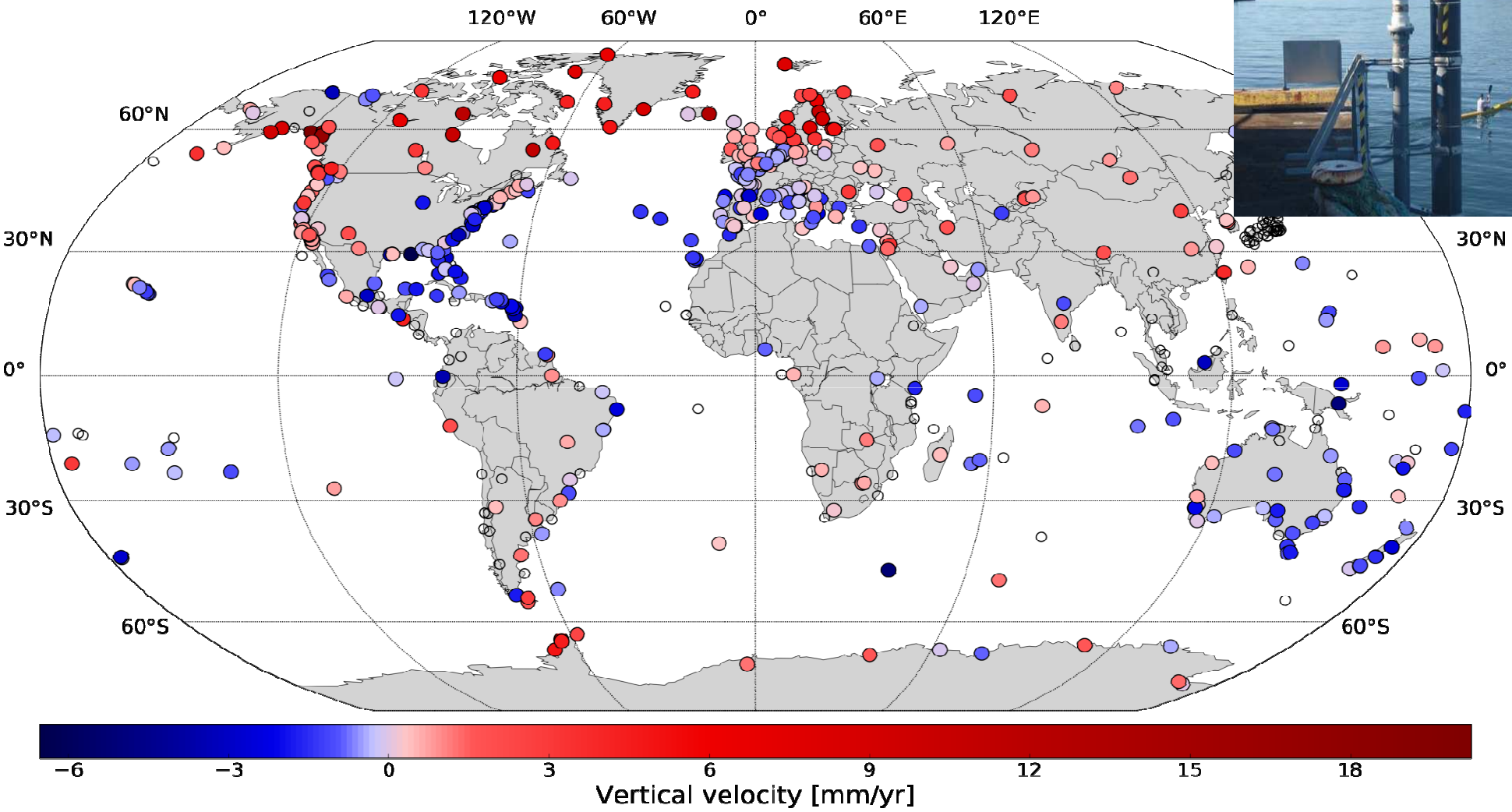


Vertical Land Motion



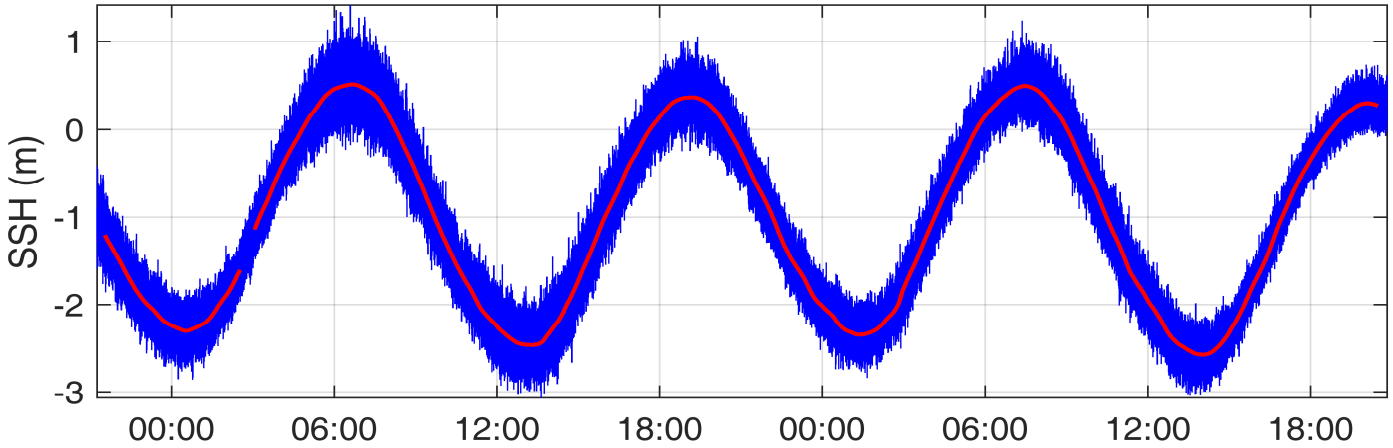
Vertical Land Motion





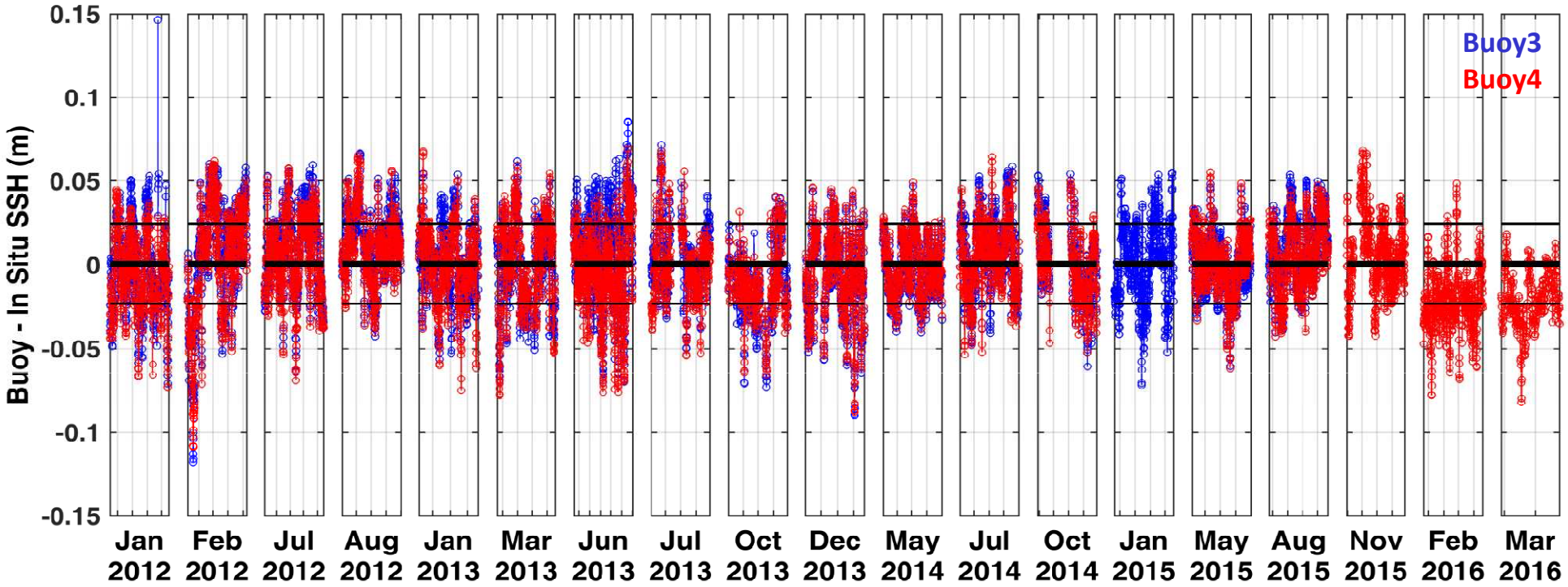
(Courtesy ULR / Alvaro Santamaría-Gómez)

GPS Buoy Processing



- **Still utilising a lightweight, portable buoy design.**
- **Antenna height ~550 mm above water level.**
- **Buoys now separated during deployment, with one at the historical CP and the other at the S3A CP (7 km separation).**

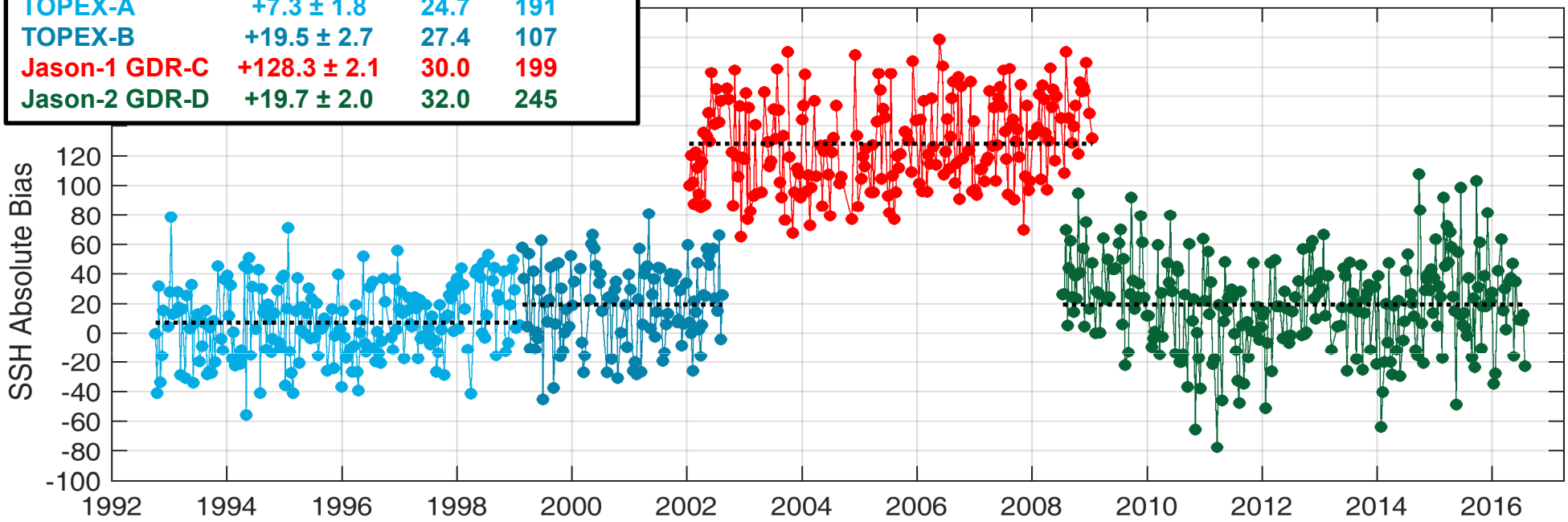
Buoy SSH - In Situ SSH



- Episodic GPS buoy SSH defines the absolute datum of the in situ record
- Two buoys (red, blue) typically deployed at any one time
- Standard deviation of this series ~24 mm (mean offset removed in Figure)

Absolute Bias at Bass Strait (TG)

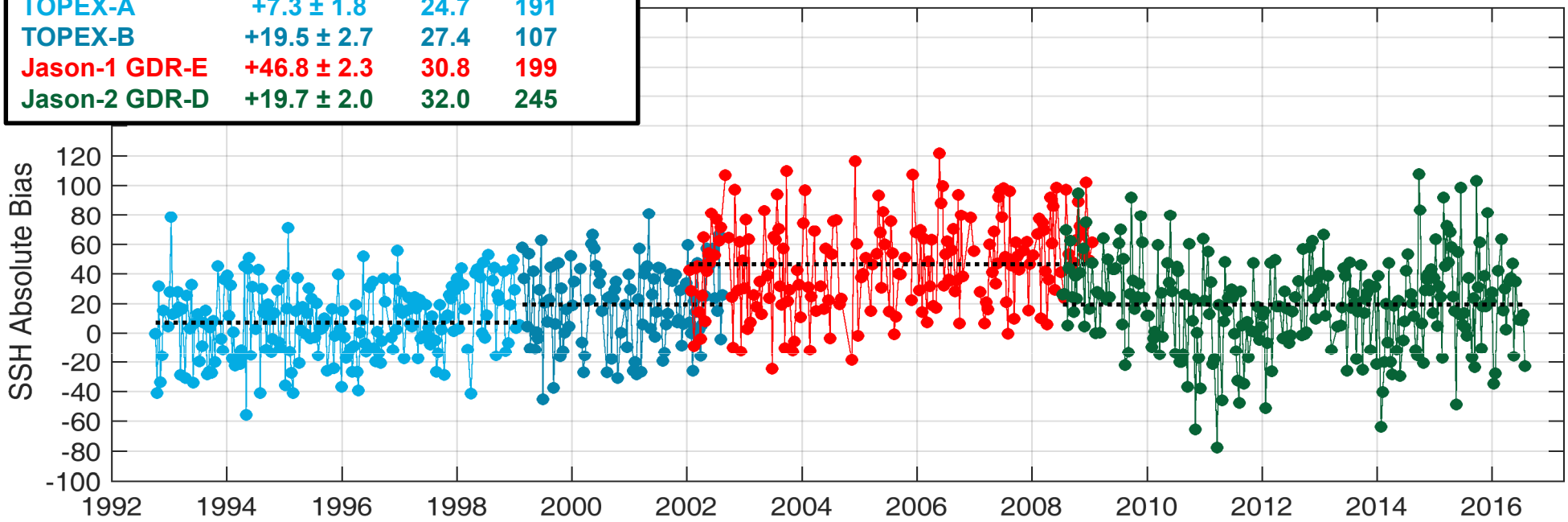
ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	+7.3 ± 1.8	24.7	191
TOPEX-B	+19.5 ± 2.7	27.4	107
Jason-1 GDR-C	+128.3 ± 2.1	30.0	199
Jason-2 GDR-D	+19.7 ± 2.0	32.0	245



- TOPEX result dependent on VLM applied at TG (0.4 mm/yr over 20y = 8 mm)
- Jason-1 GDR-C high…
- Systematic structure evident in Jason-2…

Absolute Bias at Bass Strait (TG)

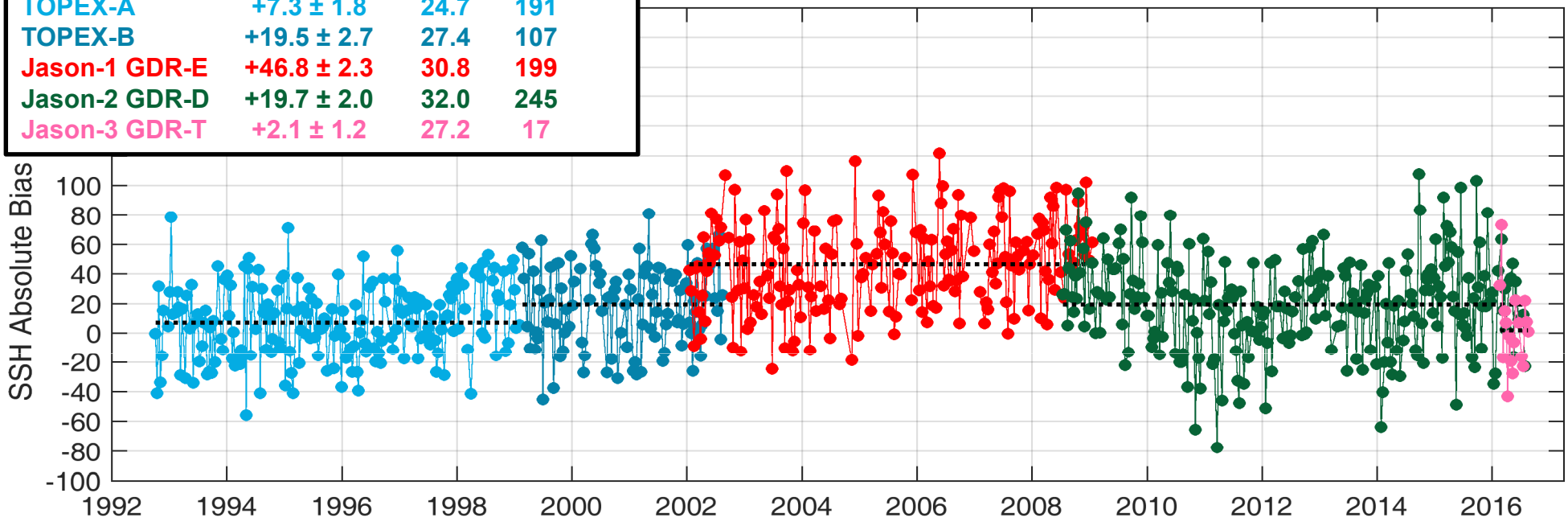
ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	+7.3 ± 1.8	24.7	191
TOPEX-B	+19.5 ± 2.7	27.4	107
Jason-1 GDR-E	+46.8 ± 2.3	30.8	199
Jason-2 GDR-D	+19.7 ± 2.0	32.0	245



- **Switch to Jason-1 GDR-E lowers our bias, but still high (5 cm).**
- **Note Jason-1 high over each formation flight period.**

Absolute Bias at Bass Strait (TG)

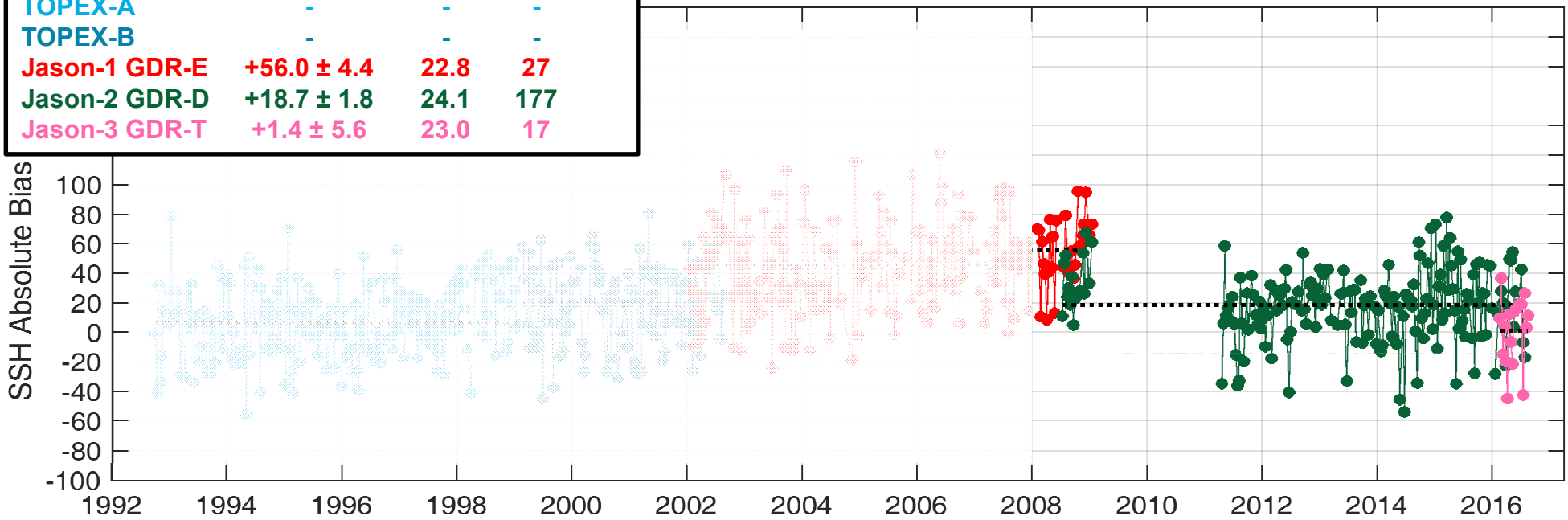
ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	+7.3 ± 1.8	24.7	191
TOPEX-B	+19.5 ± 2.7	27.4	107
Jason-1 GDR-E	+46.8 ± 2.3	30.8	199
Jason-2 GDR-D	+19.7 ± 2.0	32.0	245
Jason-3 GDR-T	+2.1 ± 1.2	27.2	17



- **Absolute bias for Jason-3 GDR-T ~2 cm lower than Jason-2 GDR-D.**

Absolute Bias at Bass Strait (Mooring)

ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	-	-	-
TOPEX-B	-	-	-
Jason-1 GDR-E	+56.0 ± 4.4	22.8	27
Jason-2 GDR-D	+18.7 ± 1.8	24.1	177
Jason-3 GDR-T	+1.4 ± 5.6	23.0	17



- **Reduced noise against the in situ mooring data.**
- **Temporally correlated signal in Jason-2 still evident.**
- **Standard deviation for both series ~24 mm.**

Absolute Bias at Bass Strait (Mooring)

ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	-	-	-
TOPEX-B	-	-	-
Jason-1 GDR-E	-	-	-
Jason-2 GDR-D	+18.7 ± 1.8	24.1	177
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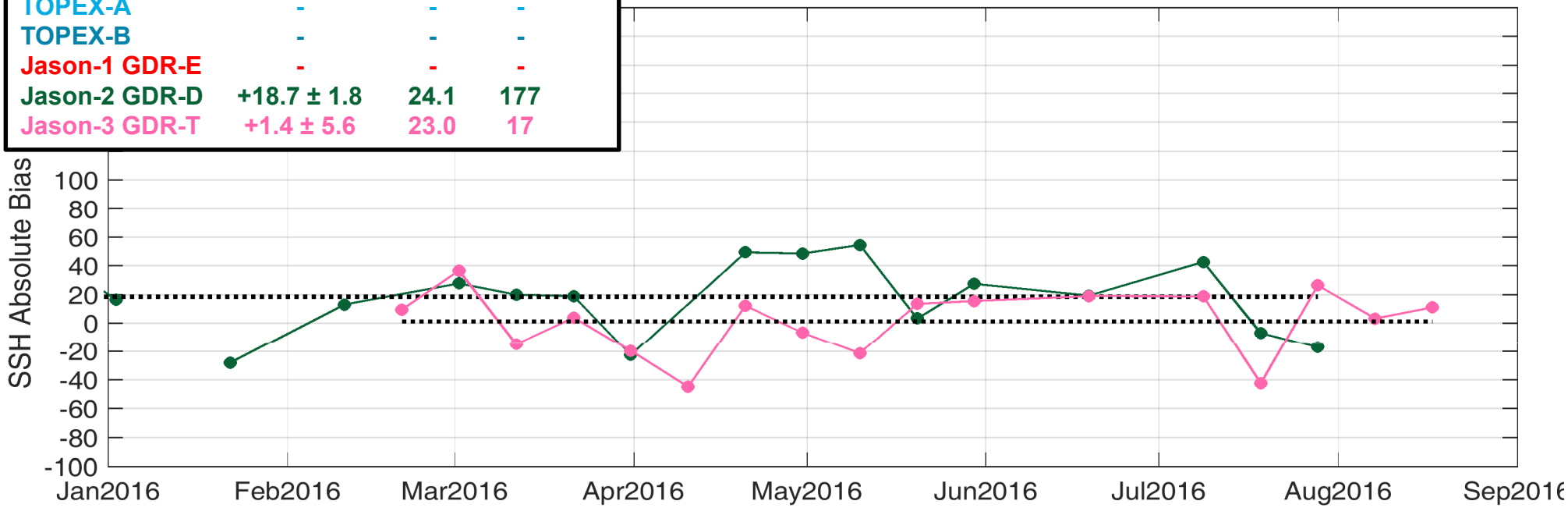
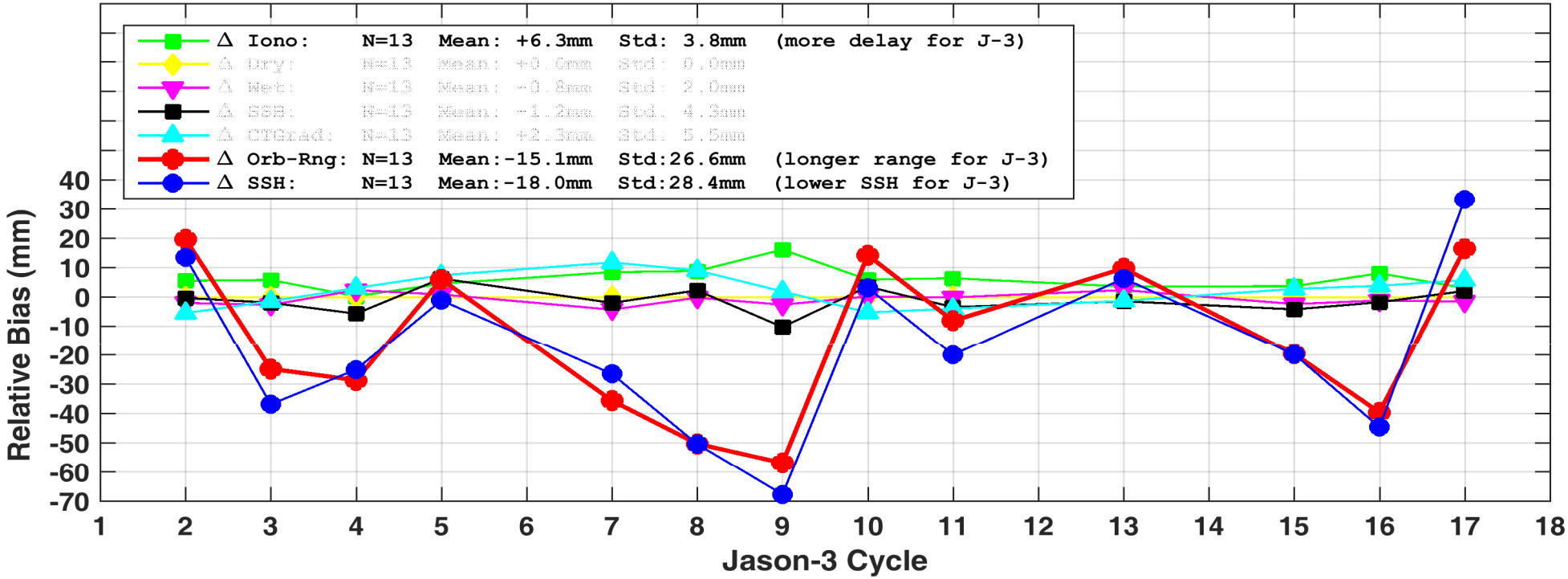
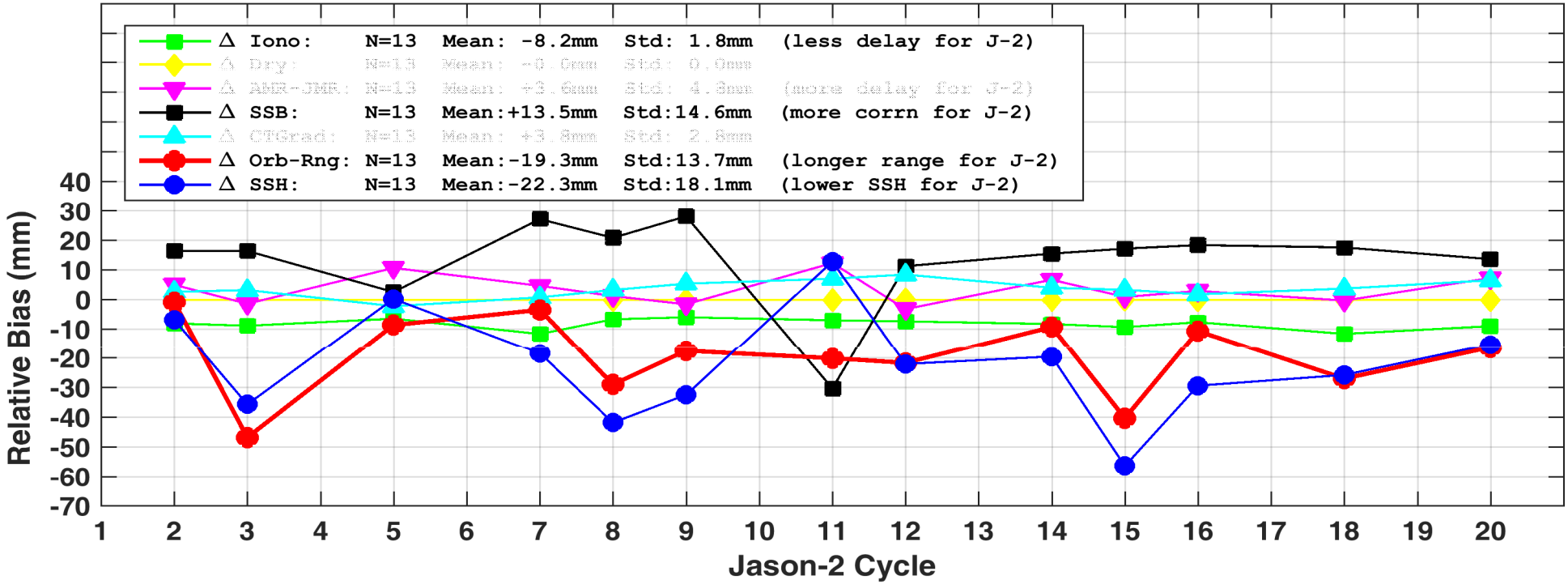


- **Formation flight period shows J3 GDR-T ~2 cm lower than J2 GDR-D.**

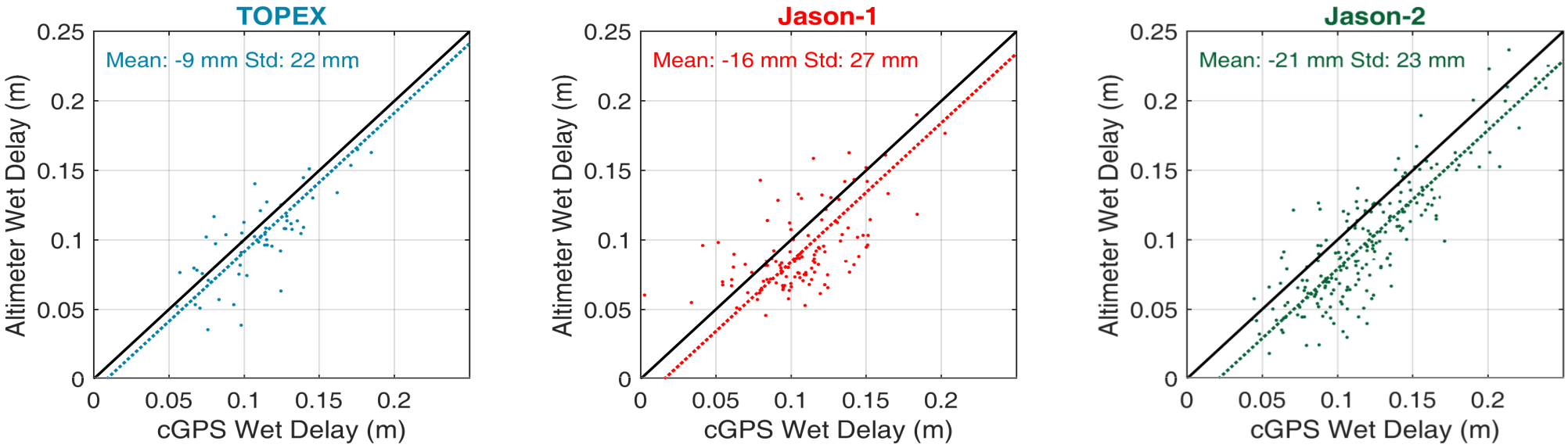
Relative Bias: J3 GDRT – J2 GDRD



Relative Bias: J2 GDRD – J1 GDRE

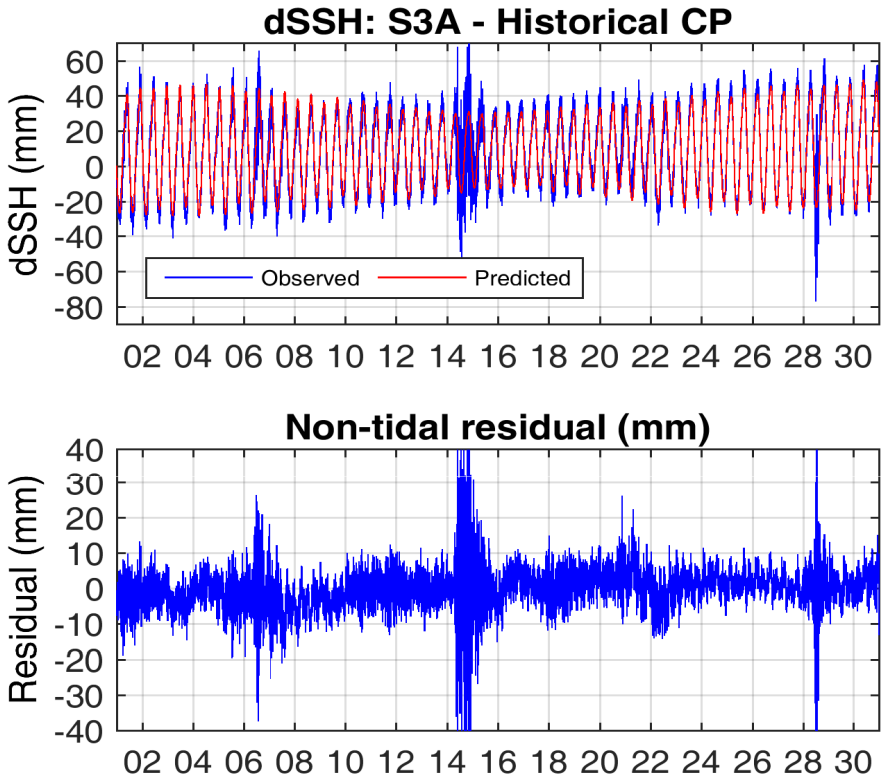


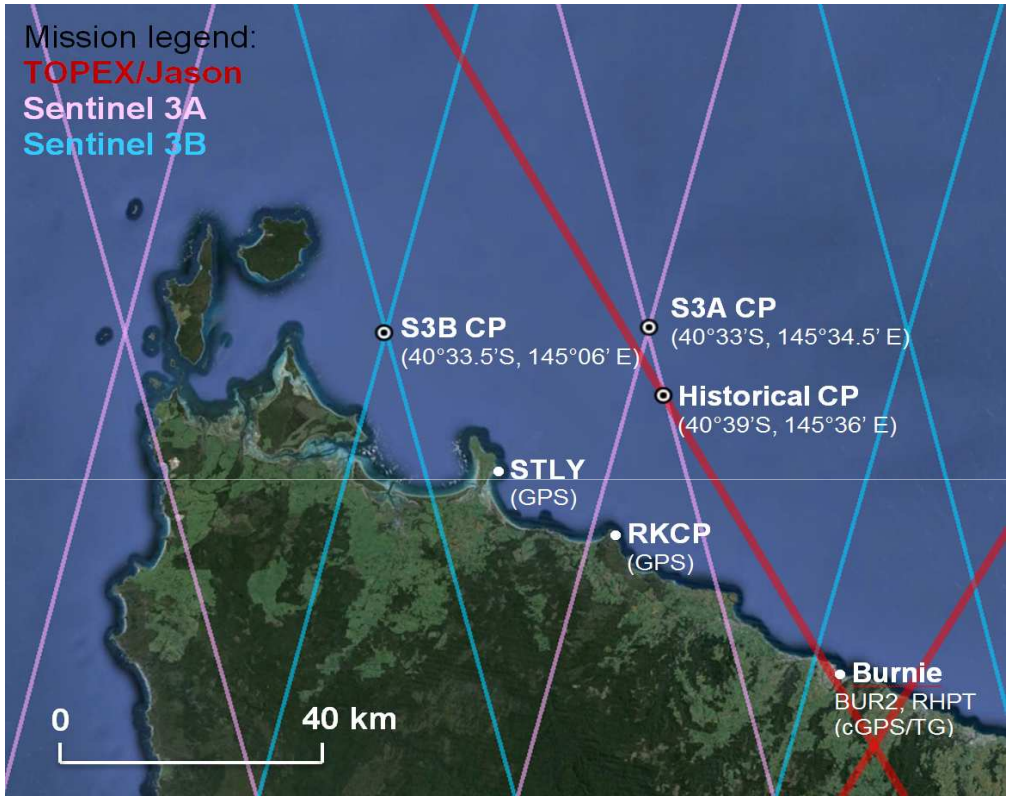
Wet Delay: Altimeter – cGPS @ TG



- **Altimeter data here is extrapolated linearly from the CP to the GPS (~53 km) located at the TG (GPS: BUR1, BUR2).**
- **Difference is consistently negative implying GPS measuring drier / altimeter wetter.**
- **If you believe the GPS, the absolute bias moves closer to 0 in each case (and ~ -2 cm for Jason-3).**
- **BUT – variability here seems too high. Further investigation of the GPS series is required.**

Other Missions at Bass Strait





- **First data from our S3A CP just recovered. S3A site ~7 km from our Jason-series historical CP. SSH difference typically within ±5 cm, dominated by tides.**
- **First mooring for our S3B CP just deployed. See poster by Legresy et al…**

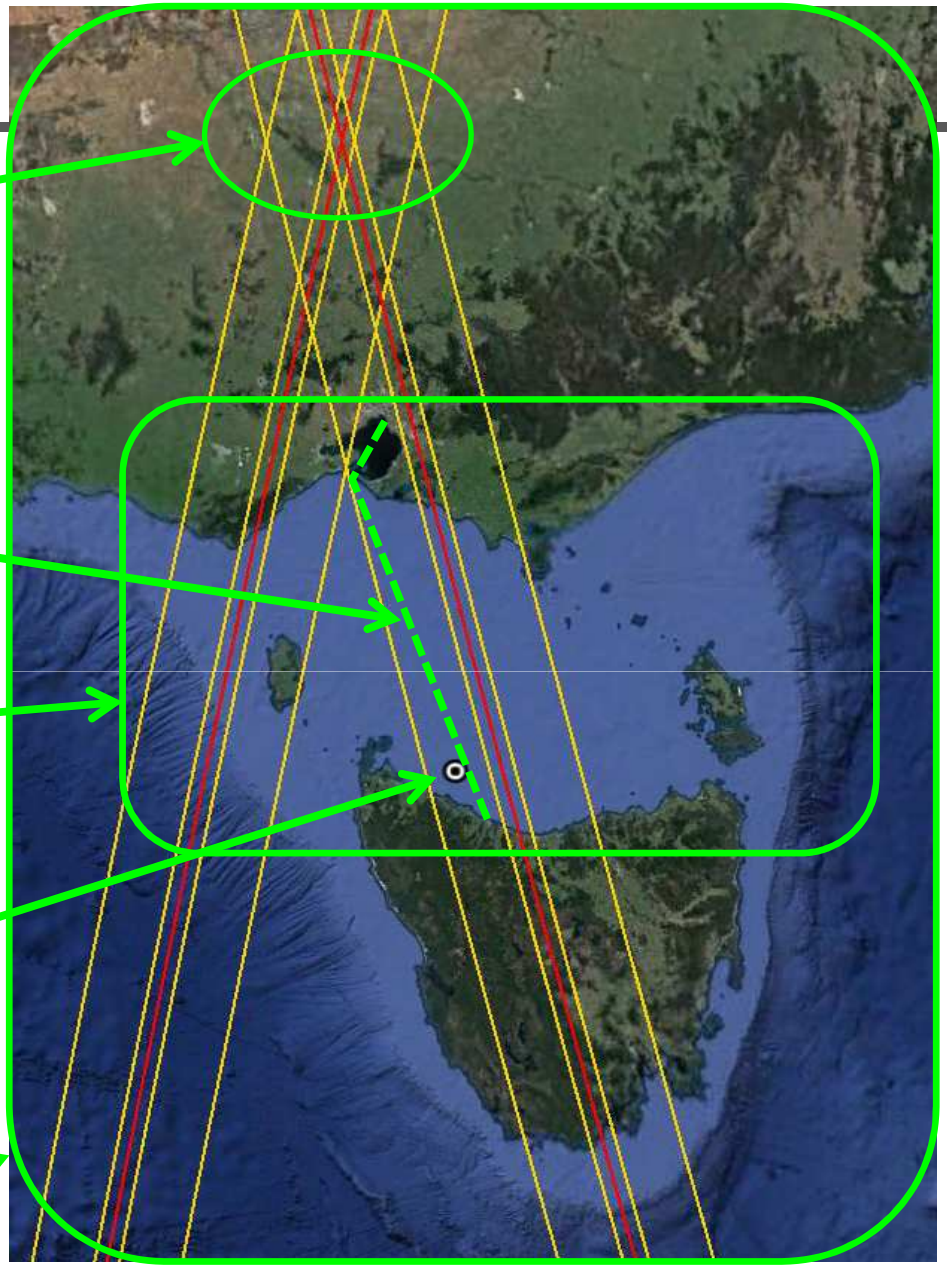
SWOT Opportunities

Possible inland corner cube array?

2 x Ferries, 2 x cargo ships, each crossing (320 km) once per day. Underway T/S, SSH? obs

Bass Strait historical and S3A/B CPs -> shallow moorings

Within the model domain of the ACCESS met model (1 km res)



Conclusions

Mission	Cycles	Absolute Bias	Stdev [TG(Mooring)]
TOPEX-A	1 -> 235	+07 mm	25 mm
TOPEX-B	236 -> 365	+19 mm	27 mm
Jason-1 GDR-E	1 -> 259	+47 mm	31 mm
Jason-2 GDR-D	1 -> 298	+19 mm	32 (24) mm
Jason-3 GDR-T	1 -> 17	+01 mm	27 (23) mm

* Solutions adopt VLM of -0.8 mm/yr at the tide gauge

1. **Jason-3 GDR-T performing well at Bass Strait. Absolute bias ~ 2 cm lower than Jason-2 GDR-D and insignificantly different from zero.**
2. **Jason-1 GDR-E remains high. Investigating iono and SSB differences, problems with in situ data are considered unlikely.**
3. **GPS wet delay appears dryer than the radiometer for all missions at Bass Strait. Effect would be to lower absolute bias estimates by 1-2 cm, but further investigation required.**
4. **Non-time averaging systematic errors are likely to be order ~ 15 mm.**

Questions?

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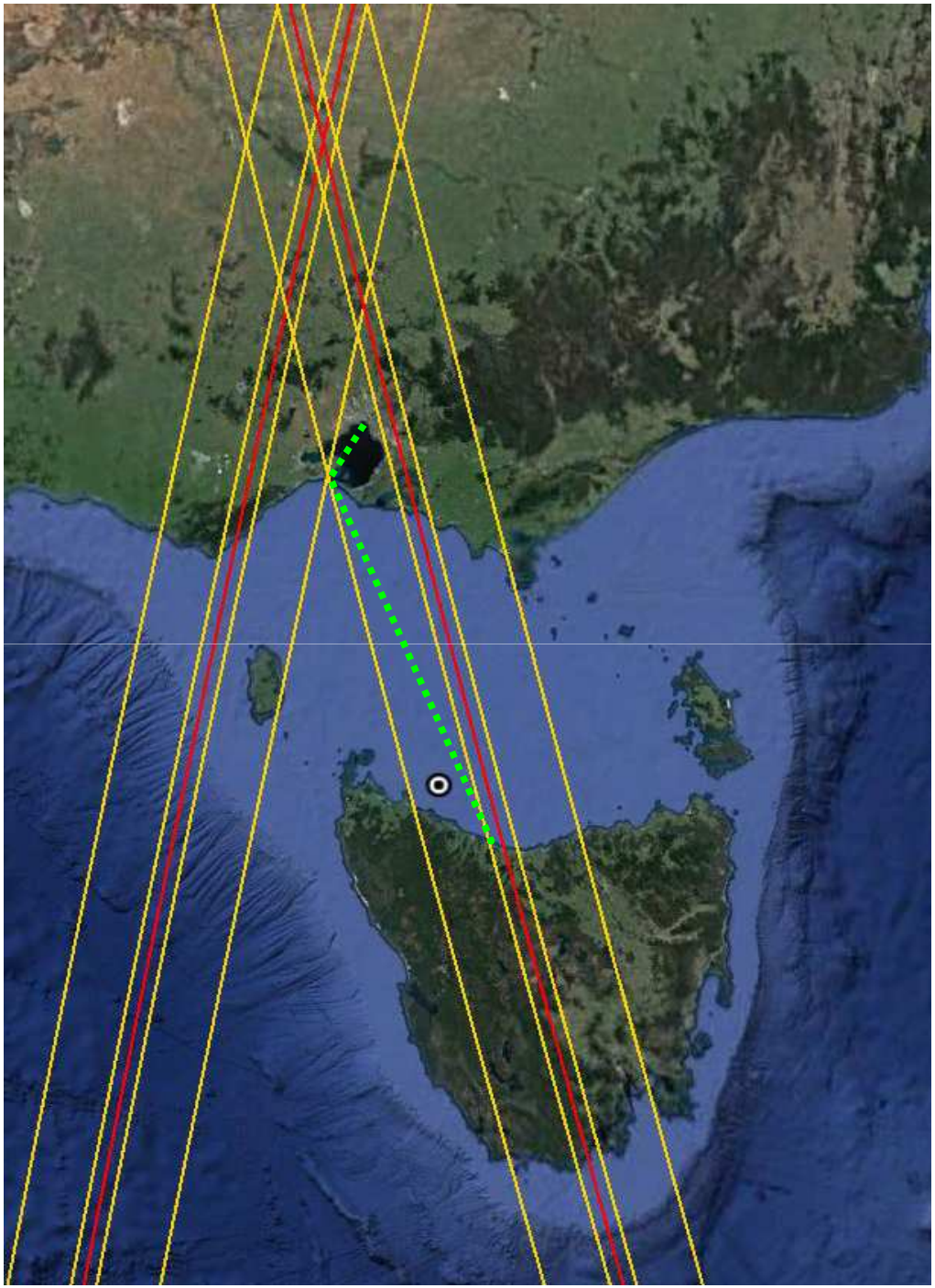

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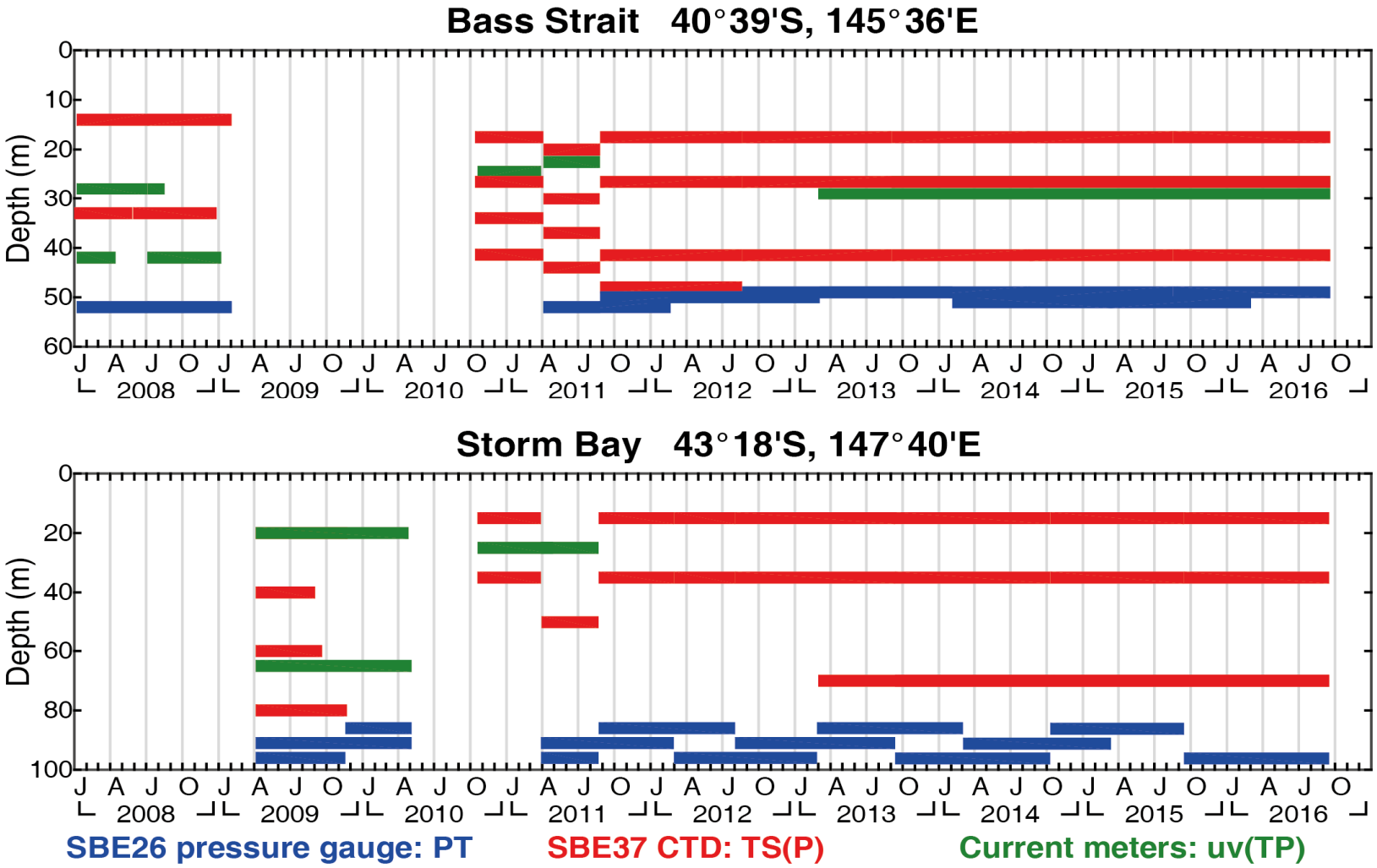
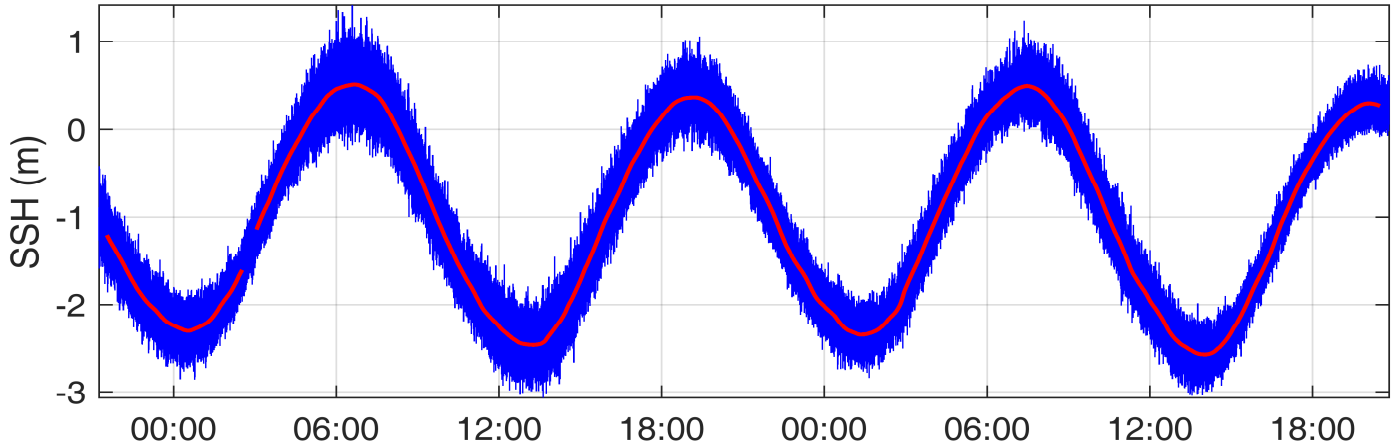
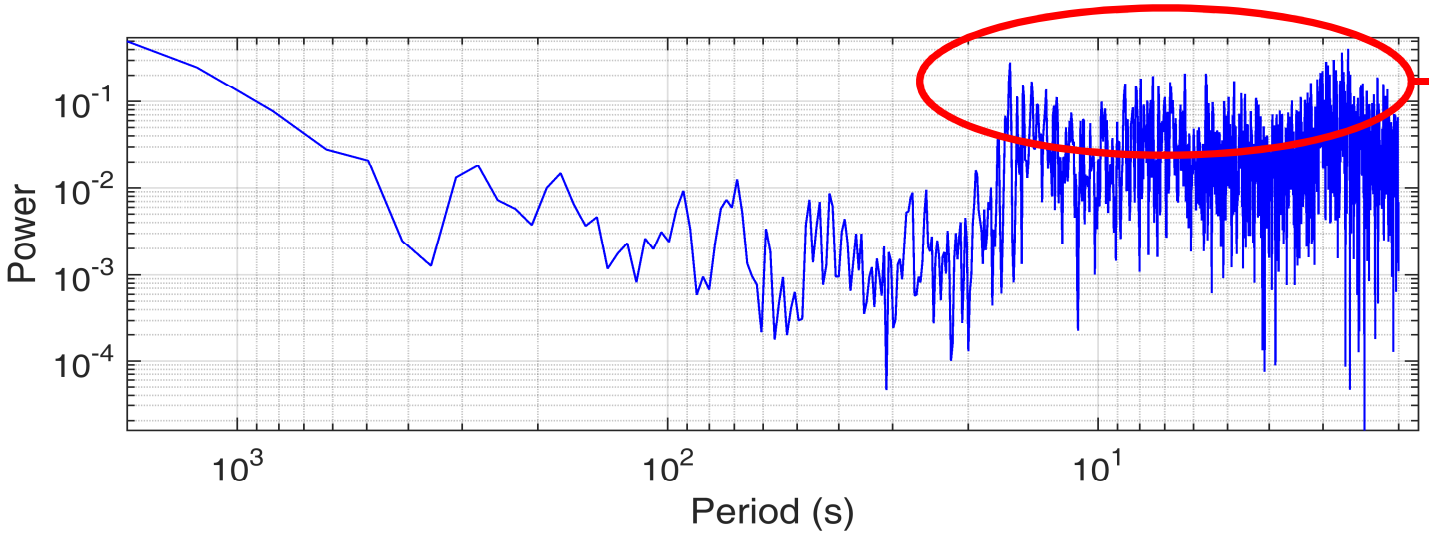
Spares

Mooring Inventory



GPS Buoy Processing





Wind wave and swell energy - period 3-14 s