Updated altimeter absolute bias results from Bass Strait, Australia

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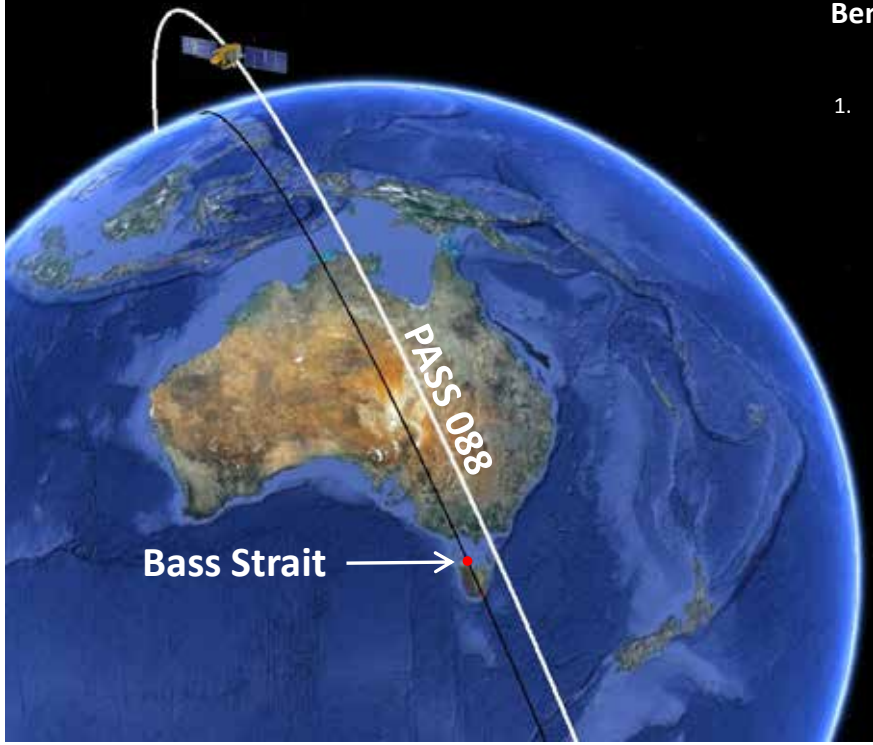

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Ocean Surface Topography Science Team Meeting

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Method Update:

Tide gauge
(RSL)

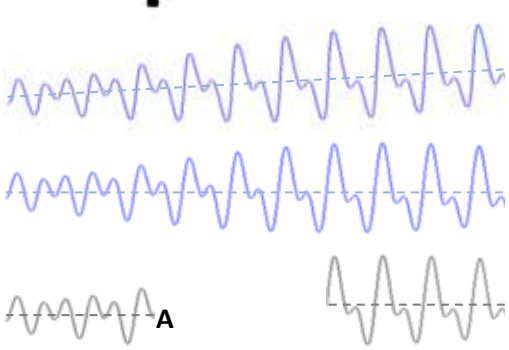
Tide gauge
(VLM removed)

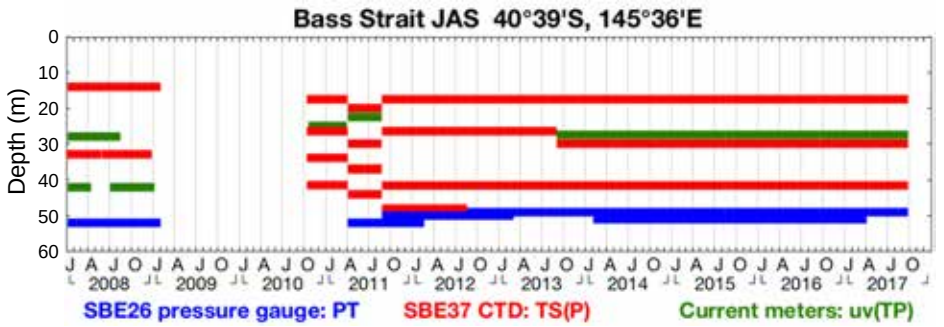
Mooring Deployments
(Different datums)

Tide gauge RSL
(tidally corrected to mooring location)
Mooring RSL
(offset to TG datum)

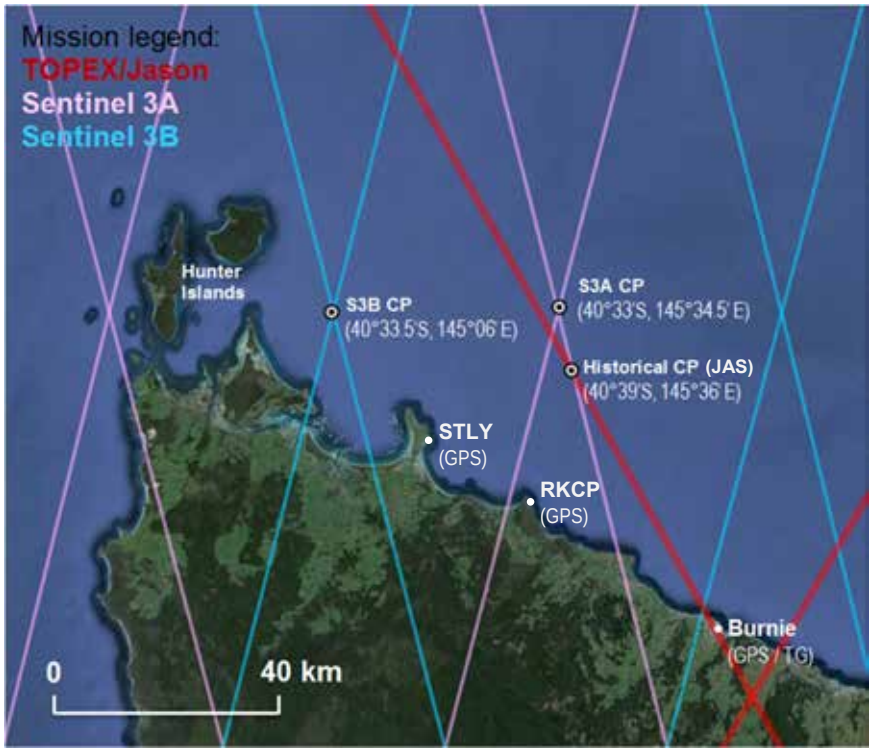
GPS Buoy Deployments
(ITRF2008)

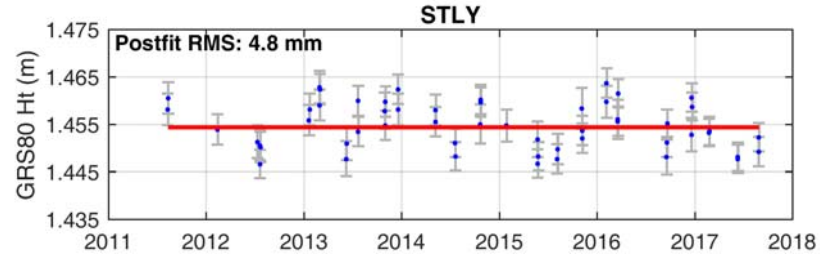
In Situ SSH ON DATUM

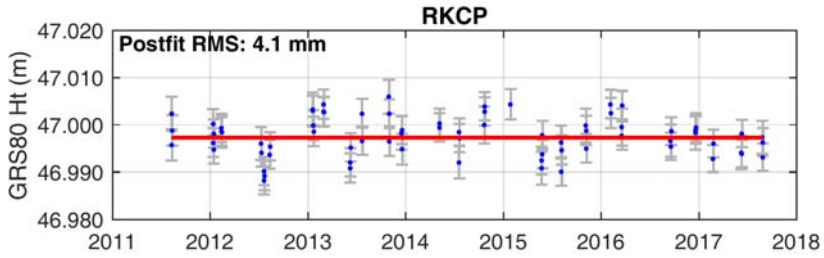


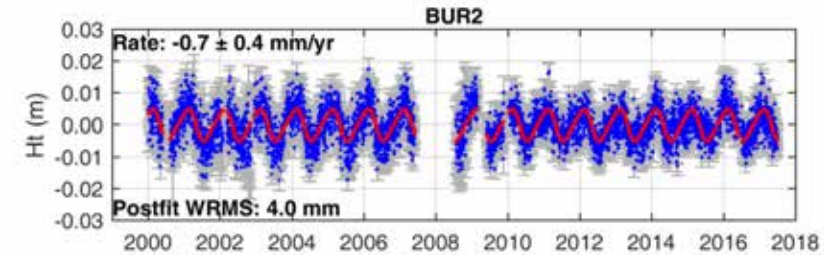


GPS Datum (ITRF2008):



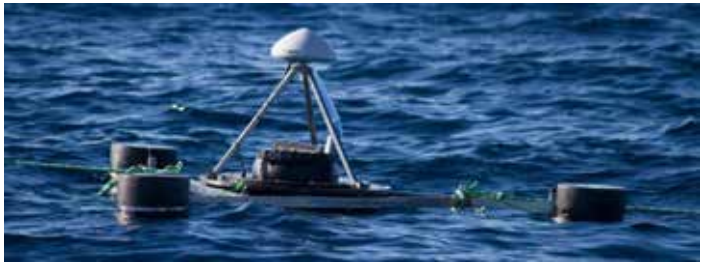


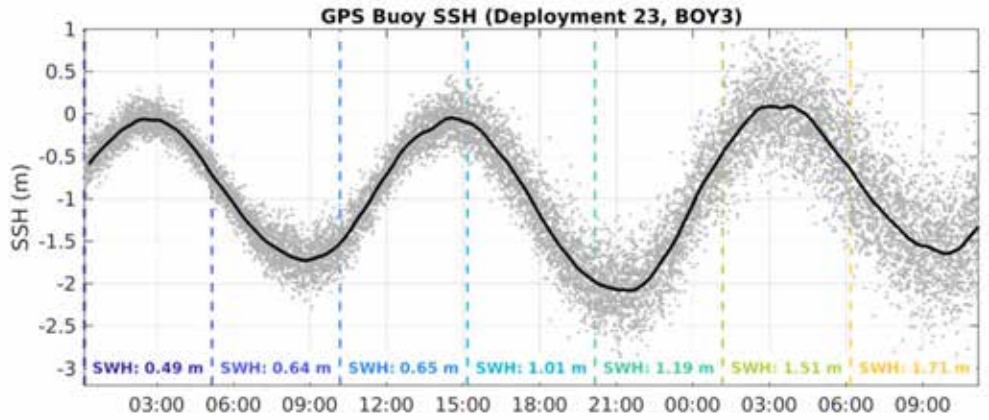


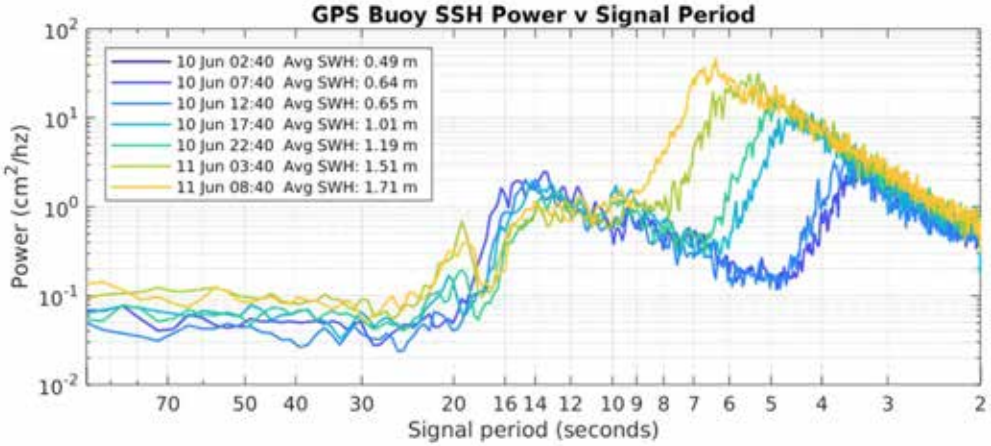


In situ SSH:

- Buoy deployments typically ~48 hours duration, typical SWH ~0.75 m.
- 1 Hz GPS data have been completely reprocessed (Track) in a network solution with reference sites at Stanley (~29 km) and Rocky Cape (~25 km).
- Example power spectra evidence wind waves (~3-4 secs) to swell (~12-14 secs).

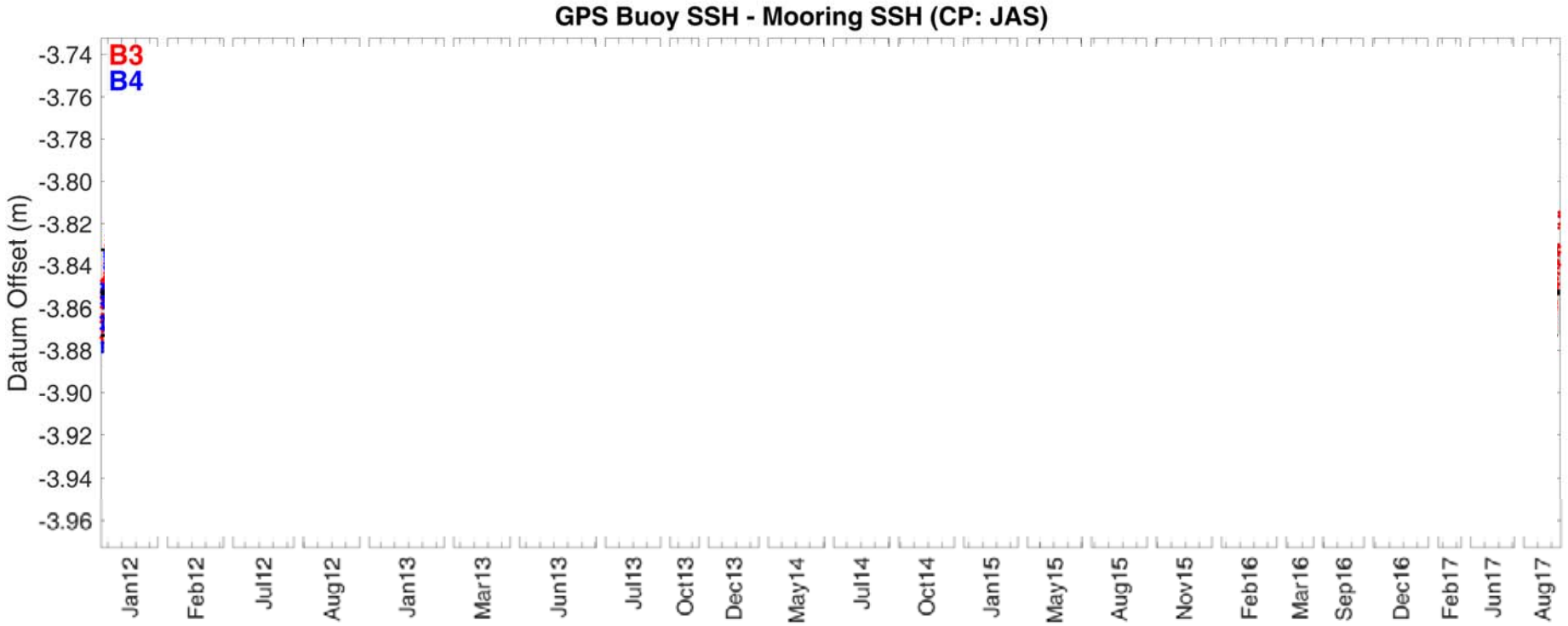




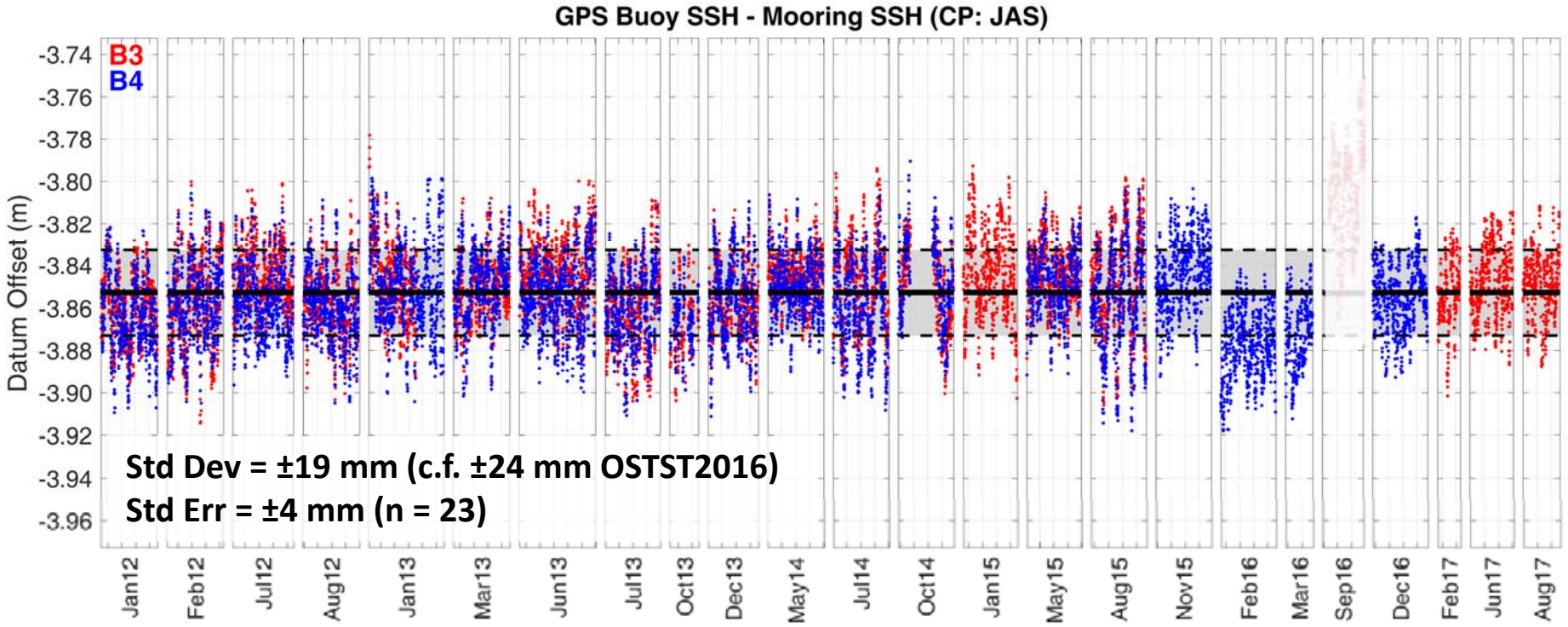


Datum Determination (Buoy-Mooring):

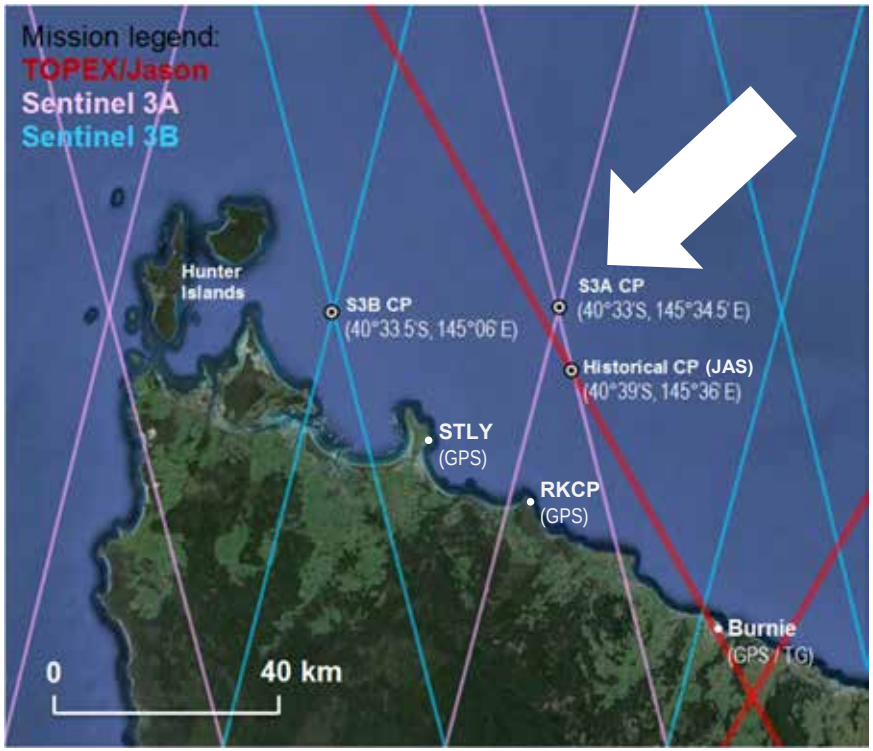
- Buoy – mooring yields the mooring datum offset with noise contributions from both sensors.

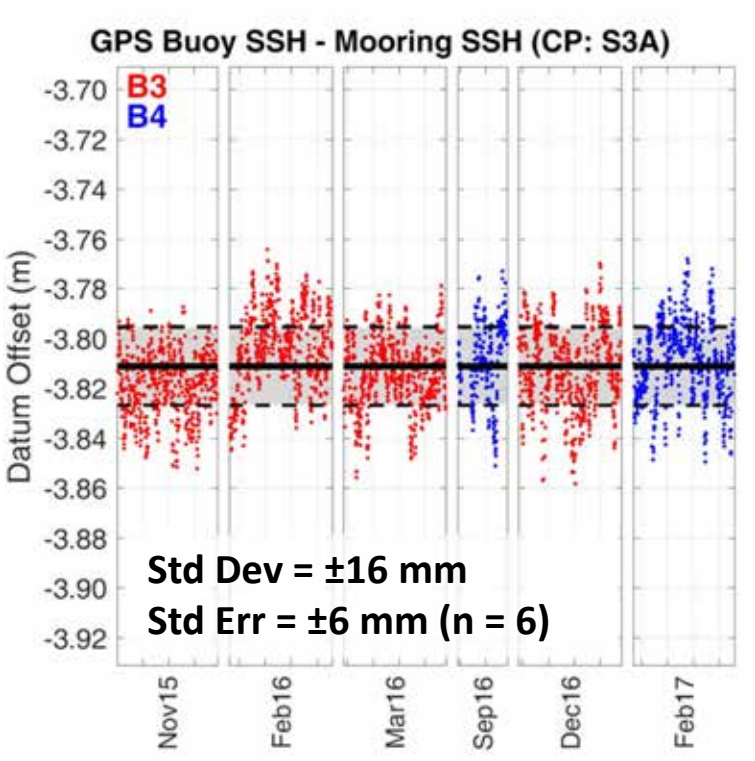


Datum Determination (Buoy-Mooring):



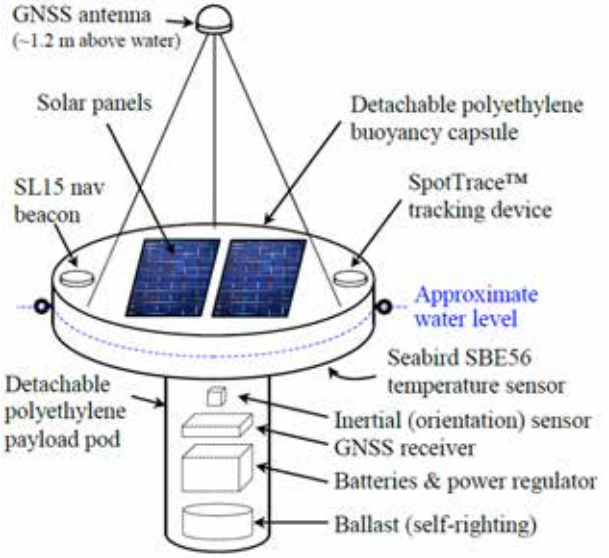
Datum Determination (Buoy - S3A Mooring):

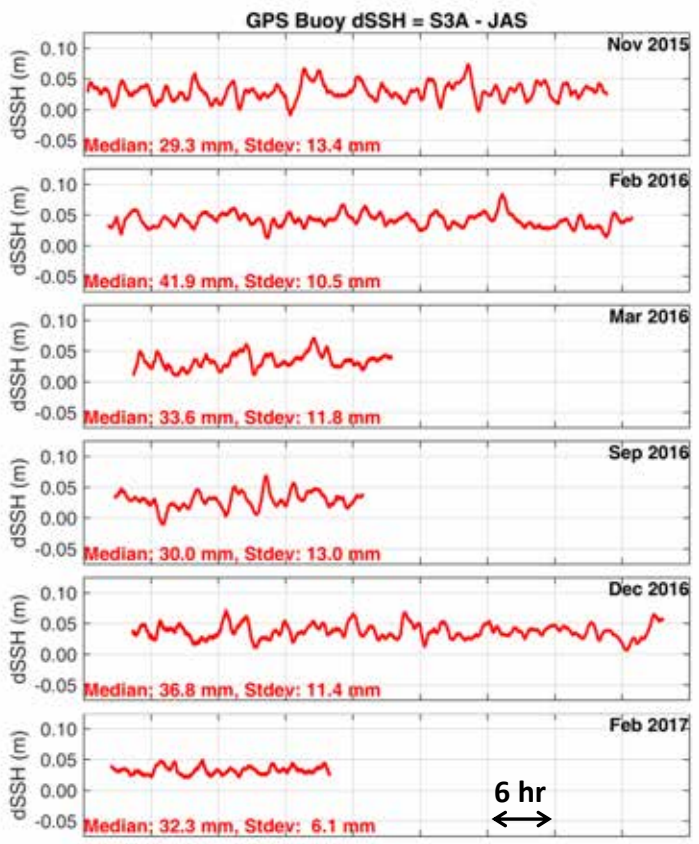




dSSH S3A – JAS from GPS buoys:

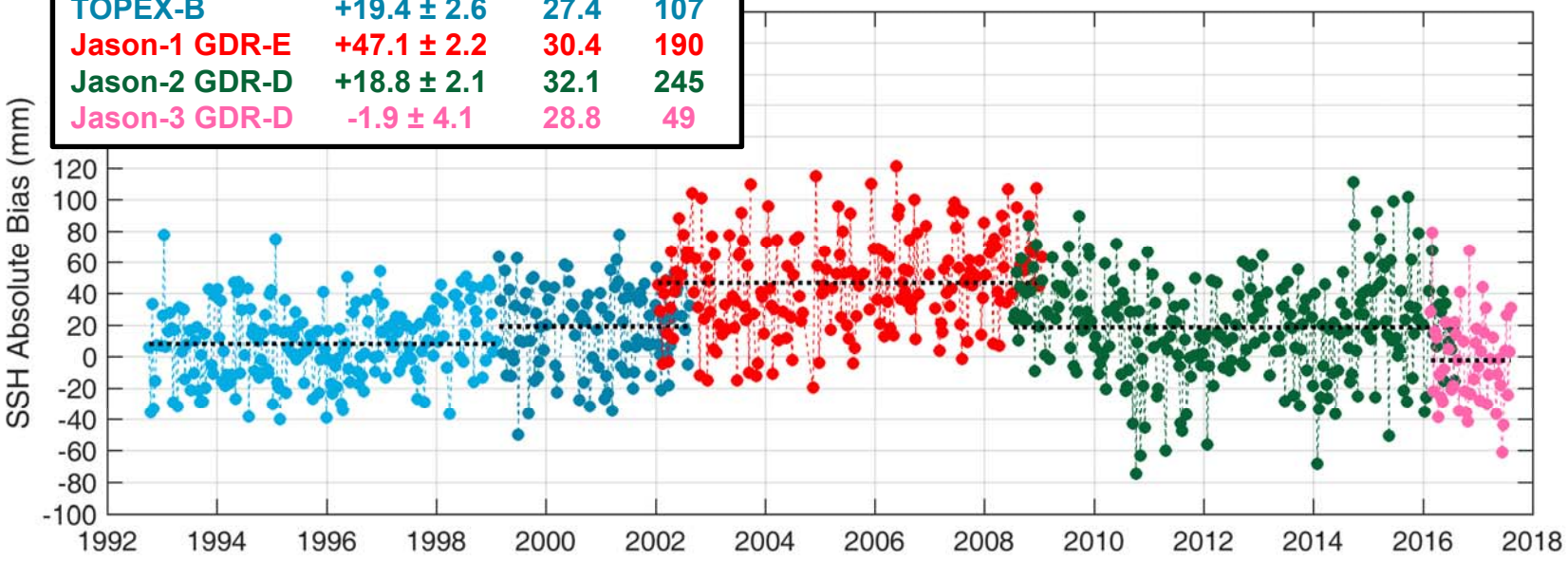
- S3A and JAS buoy deployment sites separated by ~9 km.
- What precision can be achieved in dSSH computed between contemporaneous buoy deployments (corrected for tidal difference computed from mooring data)?
- Standard deviation ranges between 6-13 mm over 6 deployments (9 km separation).
- Ongoing area of investigation given implications for e.g. SWOT cal/val.





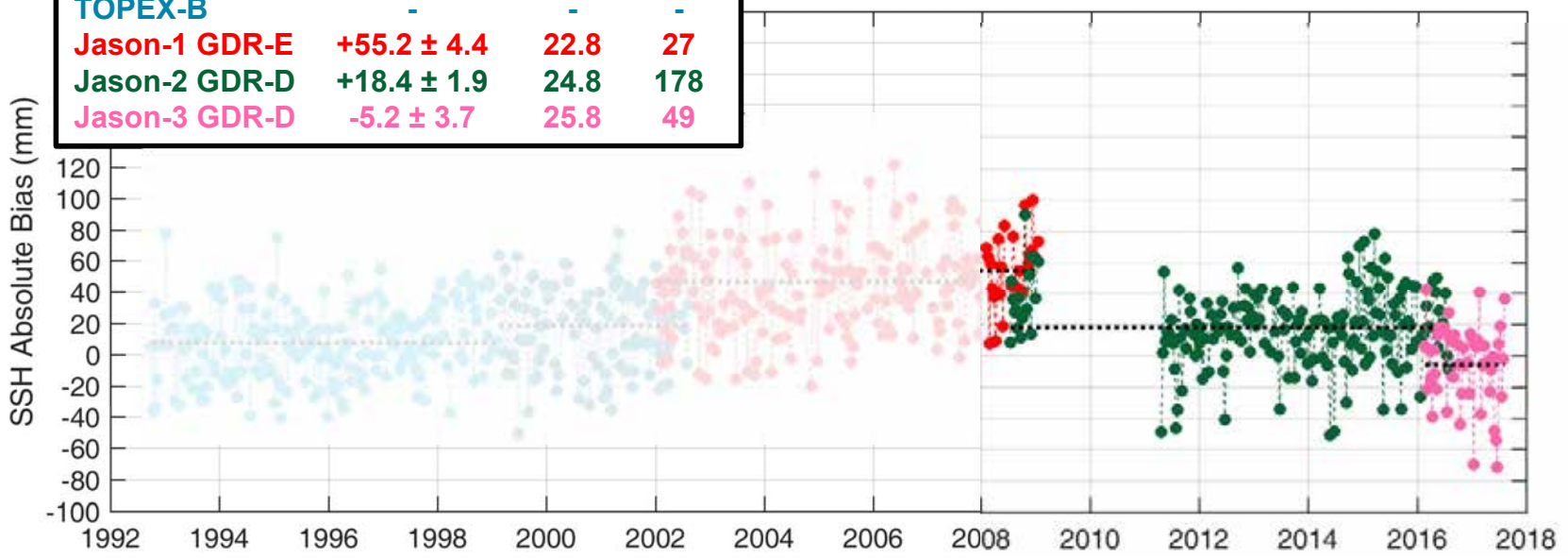
Absolute Bias at Bass Strait (vs TG)

ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	+8.4 ± 1.7	23.7	191
TOPEX-B	+19.4 ± 2.6	27.4	107
Jason-1 GDR-E	+47.1 ± 2.2	30.4	190
Jason-2 GDR-D	+18.8 ± 2.1	32.1	245
Jason-3 GDR-D	-1.9 ± 4.1	28.8	49

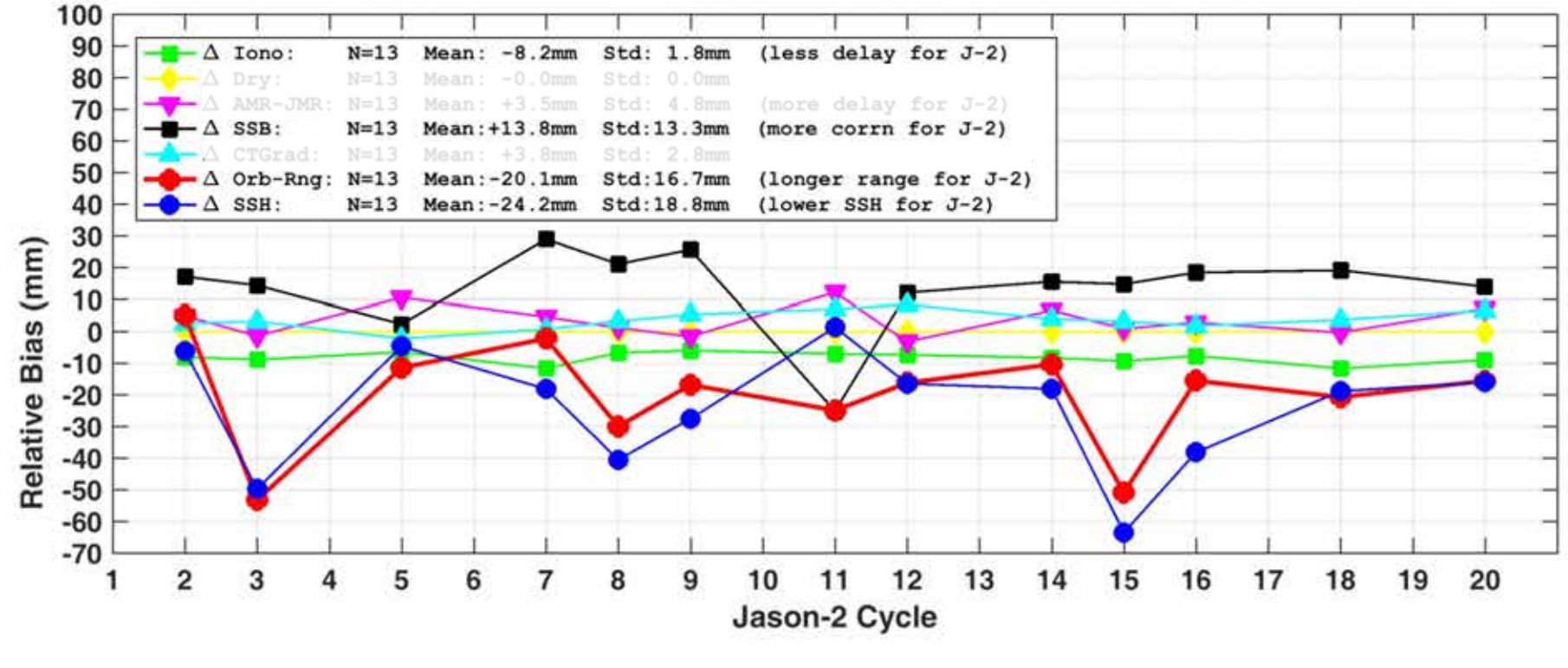


Absolute Bias at Bass Strait (vs Mooring)

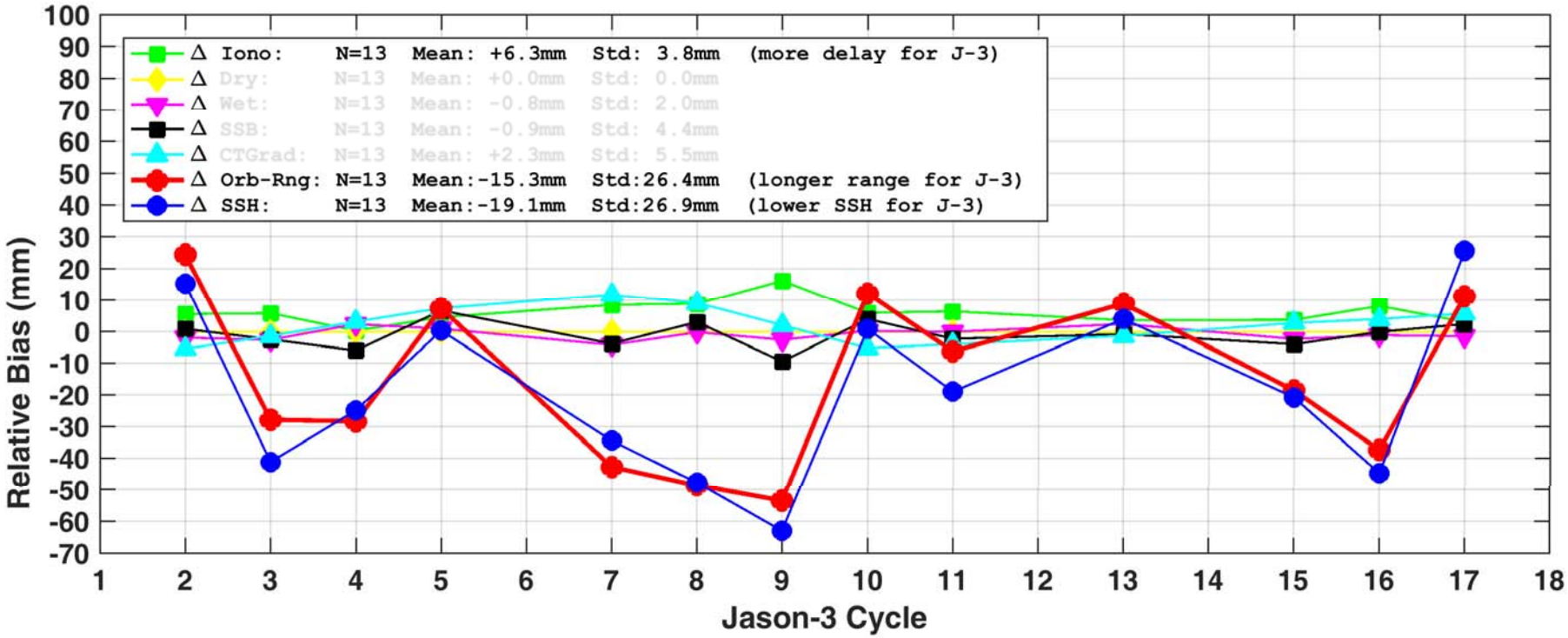
ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	-	-	-
TOPEX-B	-	-	-
Jason-1 GDR-E	+55.2 ± 4.4	22.8	27
Jason-2 GDR-D	+18.4 ± 1.9	24.8	178
Jason-3 GDR-D	-5.2 ± 3.7	25.8	49



Relative Bias: J2 GDRD – J1 GDRE

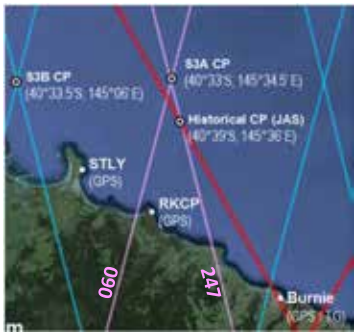


Relative Bias: J3 GDRD – J2 GDRD

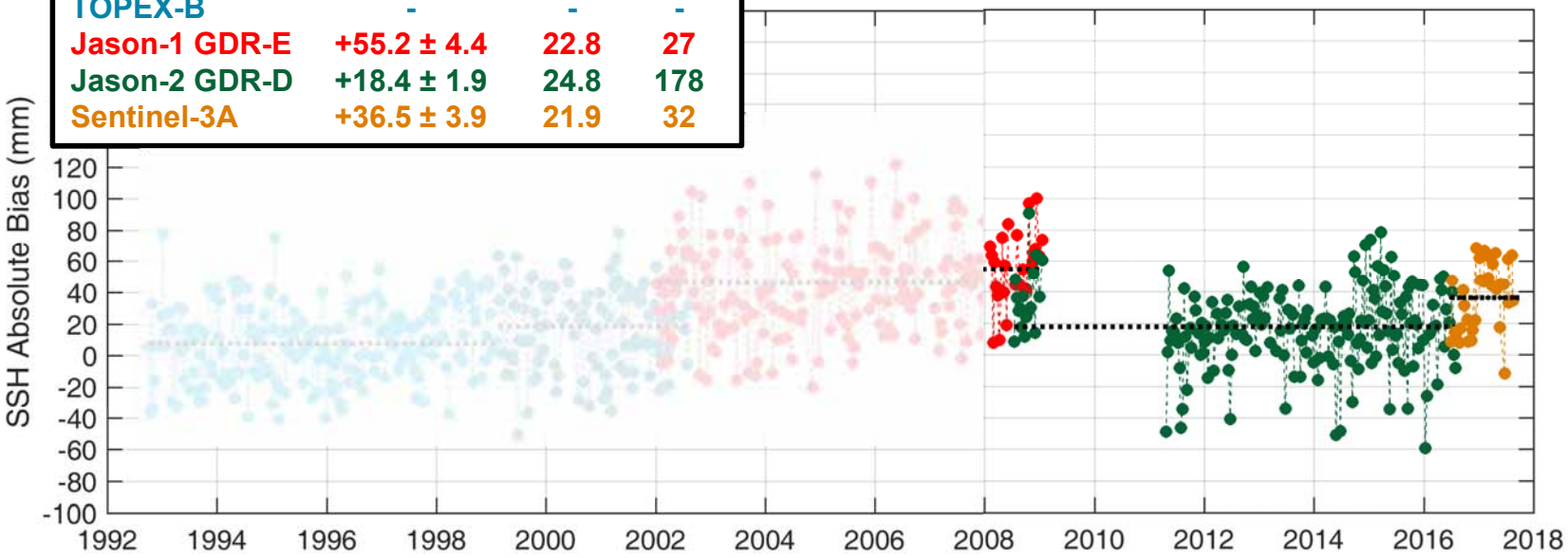


Absolute Bias at Bass Strait (vs Mooring)

- Sentinel-3A, 1 Hz, L2 Non Time Critical, Baseline 2.15 via RADS

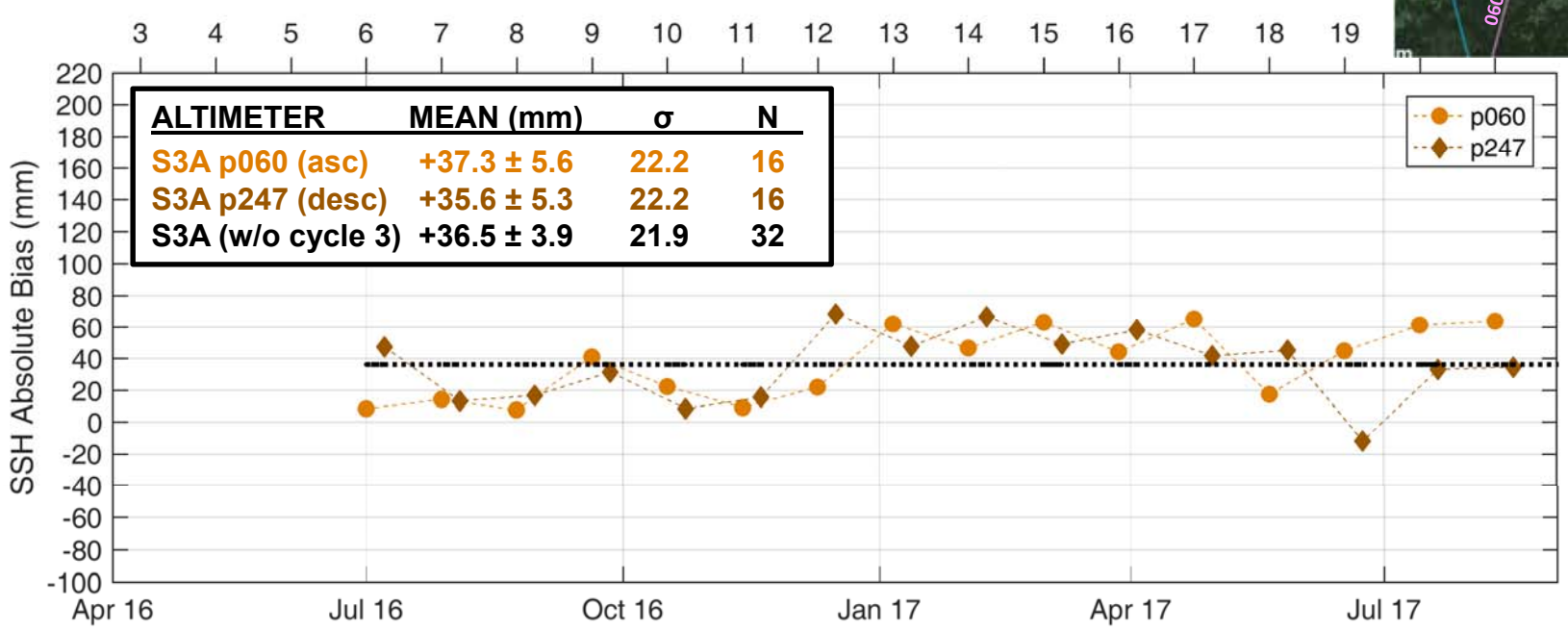


ALTIMETER	MEAN (mm)	σ	N
TOPEX-A	-	-	-
TOPEX-B	-	-	-
Jason-1 GDR-E	+55.2 ± 4.4	22.8	27
Jason-2 GDR-D	+18.4 ± 1.9	24.8	178
Sentinel-3A	+36.5 ± 3.9	21.9	32



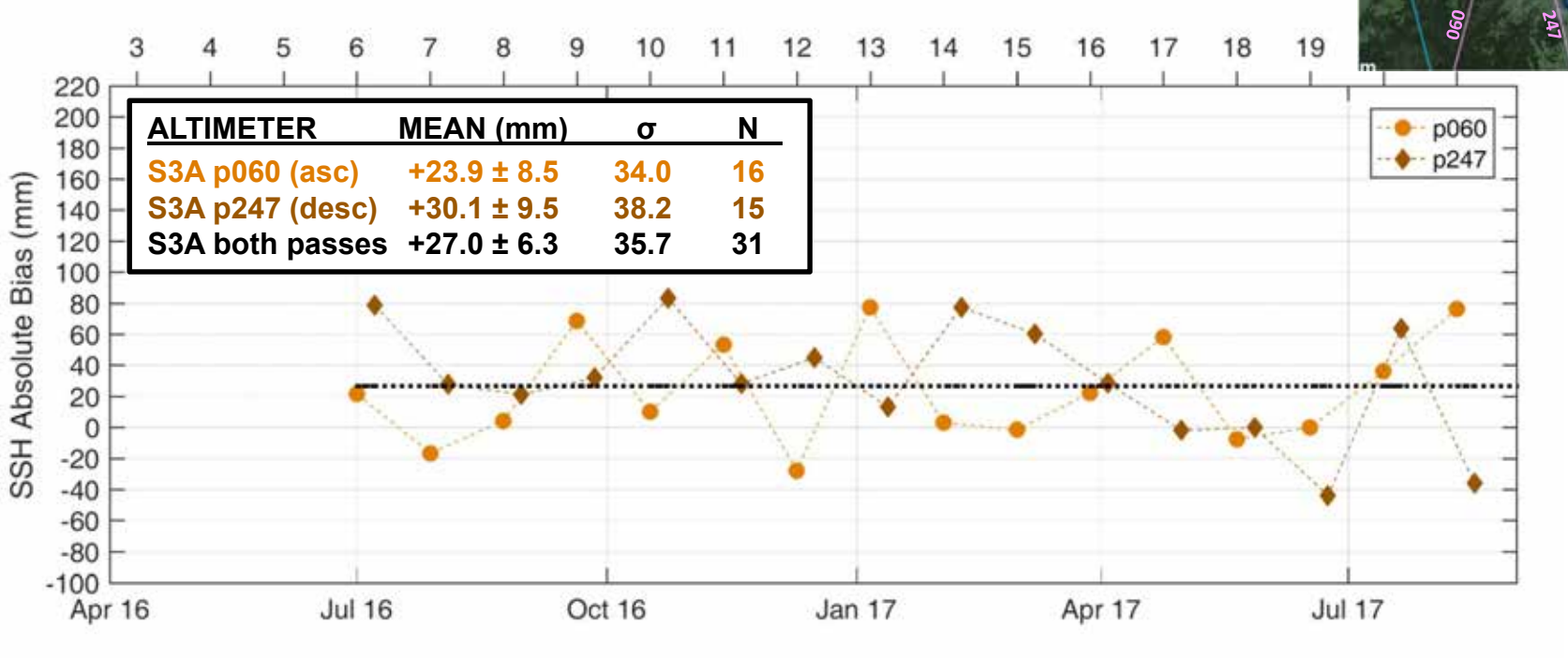
S3A Absolute Bias (SAR v Mooring)

- Insignificant difference between biases from p060 and p247



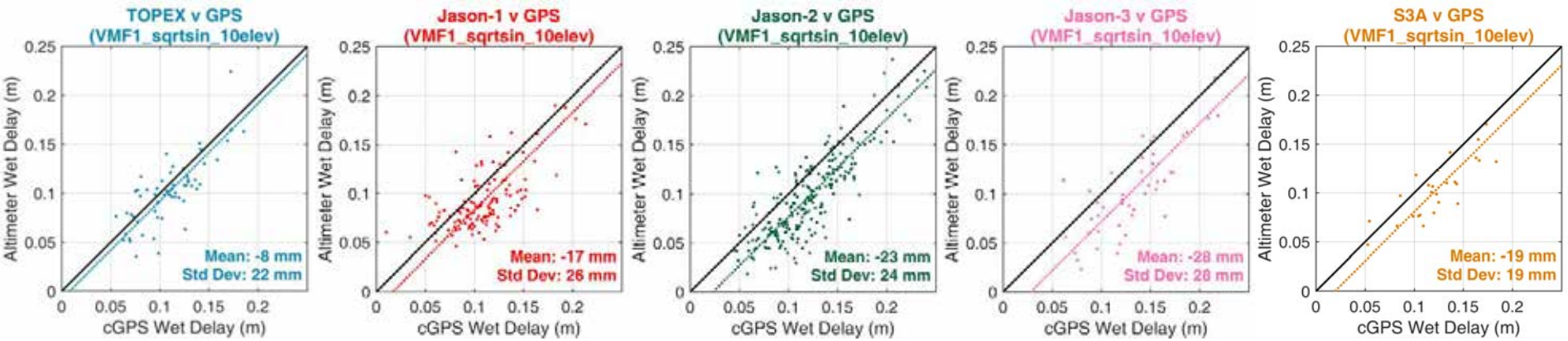
S3A Absolute Bias (PLRM v Mooring)

- ~10 mm difference in bias (PLRM lower)
- PLRM has higher (expected) variability (36 vs 22 mm)



ALTIMETER	MEAN (mm)	σ	N
S3A p060 (asc)	+23.9 ± 8.5	34.0	16
S3A p247 (desc)	+30.1 ± 9.5	38.2	15
S3A both passes	+27.0 ± 6.3	35.7	31

Wet Delay: Altimeter - cGPS @ TG



- **Altimeter data here are 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 (n=1), the absolute bias moves closer to zero for TP/J1/J2/S3A but more negative for Jason-3 (-3cm).**
- **Various tests undertaken to assess GPS variability (elev cutoff, elev weighting: sin, sqrtsin)**

Conclusions from Bass Strait

- Buoy reprocessing has achieved a homogeneous record that has updated and improved the Bass Strait datum:
  - Difference from OSTST 2016 is < 2 mm.
  - Overall scatter reduced from ±24 to ±19 mm.
- Actively pursuing development in marine GNSS SSH estimation – happy to collaborate.
- Jason-3 GDR-D is performing well at Bass Strait. Absolute bias is ~2 cm lower than Jason-2 GDR-D and insignificantly different from zero.
- Jason-1 GDR-E remains high. Unlikely to be related to in situ data.
- GPS wet delay appears dryer than the radiometer for all missions at Bass Strait.
  - Effect would be to lower bias estimates by 1-3 cm
  - Scatter remains relatively high (spurious?)
  - Currently assessing ACCESS model products

Mission	Cycles	Absolute Bias	Std Dev
TOPEX-A	1 -> 235	+8 mm	24 mm (TG)
TOPEX-B	236 -> 365	+19 mm	27 mm (TG)
Jason-1 GDR-E	1 -> 259	+47 mm	30 mm (TG)
Jason-2 GDR-D	1 -> 298	+19 mm **+18 mm**	32 mm (TG) **25 mm (Mooring)**
Jason-3 GDR-D	1 -> 55	-2 mm **-5 mm**	29 mm (TG) **26 mm (Mooring)**
S-3A SAR S-3A PLRM	6 -> 23 6 -> 23	**+36 mm** **+27 mm**	**22 mm (Mooring)** **36 mm (Mooring)**

* Solutions adopt VLM of -0.7 mm/yr at the tide gauge

Questions?

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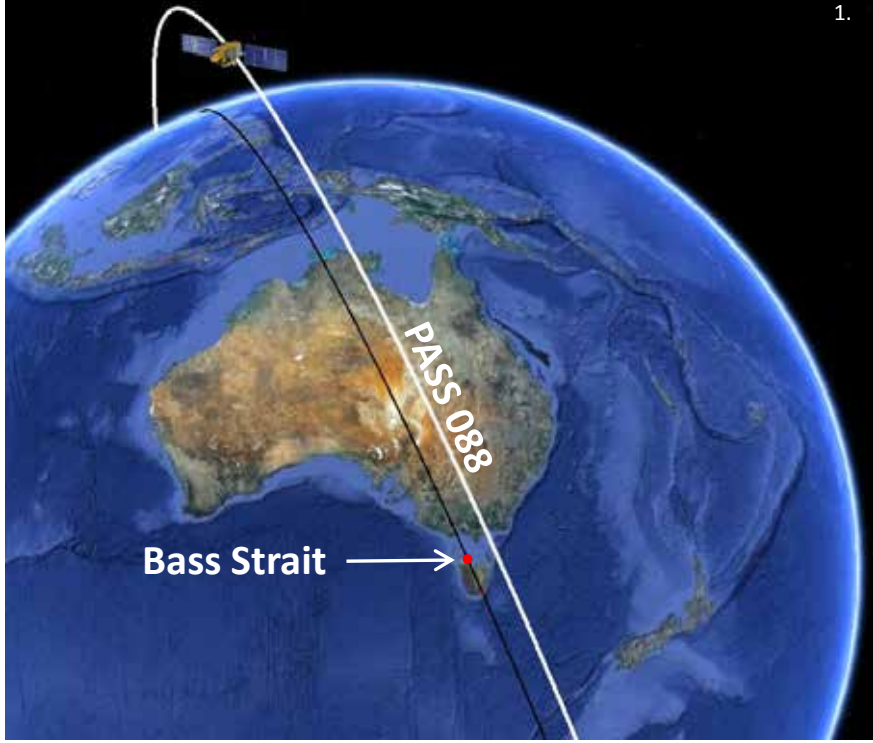

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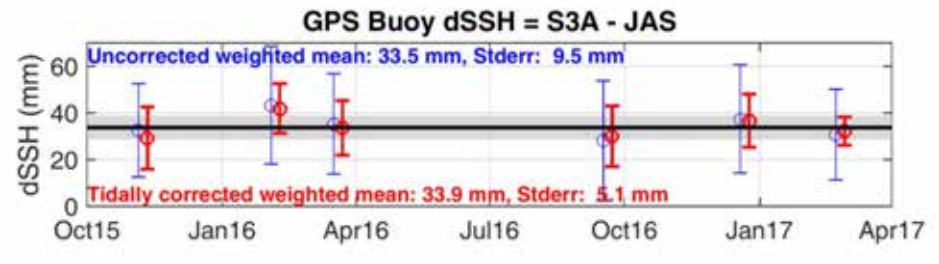
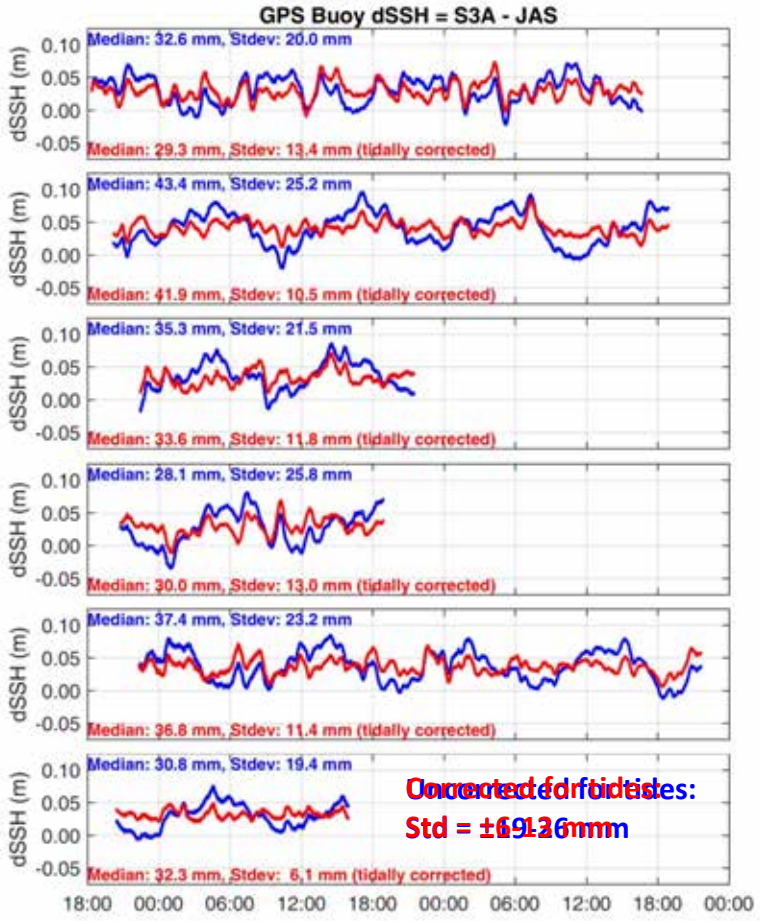
Spares

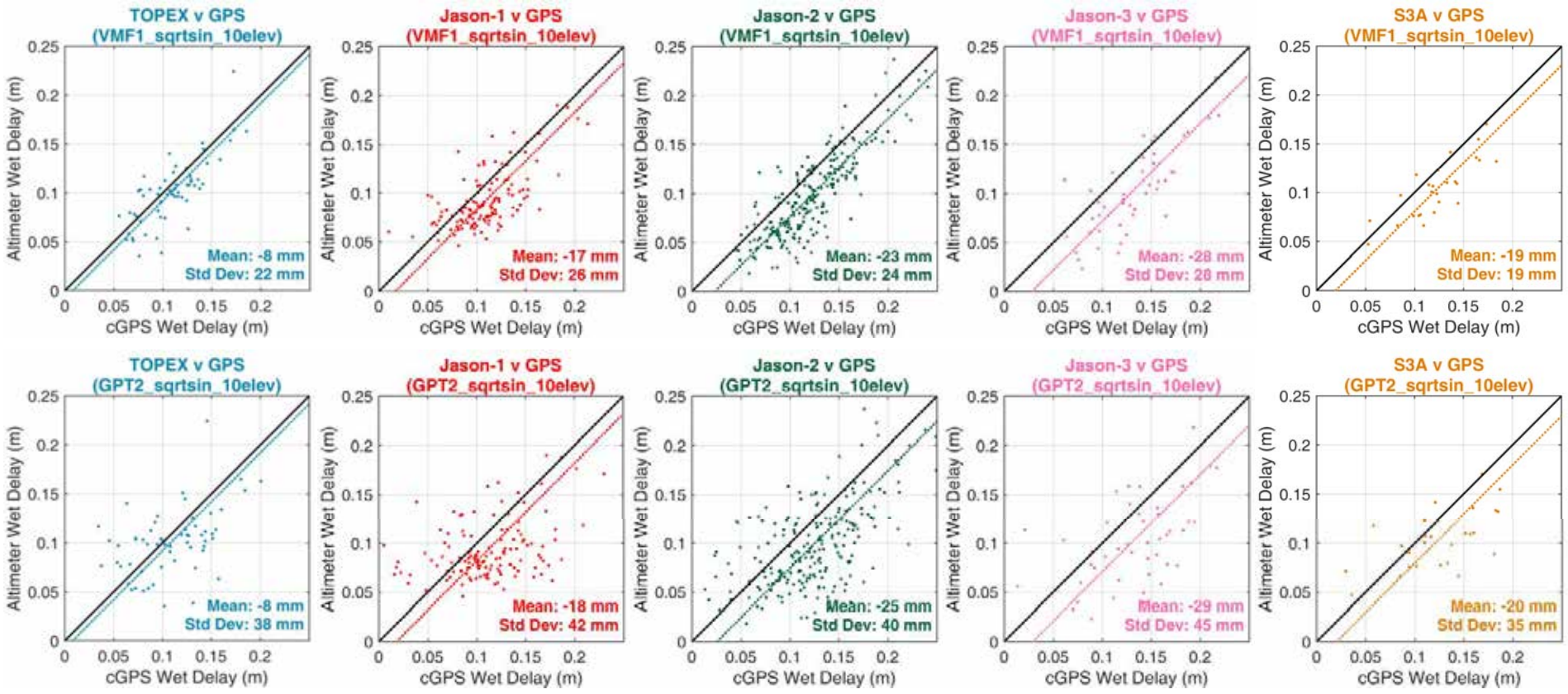
S3A – JASON Datum:

- S3A and JASON comparison points separated by ~9 km.
- Contemporaneous mooring deployments yield difference in tide…
- Contemporaneous GPS buoy deployments yield precise dSSH…





Altimeter – cGPS (VMF1, sqrtsin, 10° vs GPT2, sqrtsin, 10°)



Altimeter – cGPS (VMF1, sqrtsin, 10° vs VMF1, sin, 10°) Looks identical but is not!