In-Situ Calibration Results from Bass Strait

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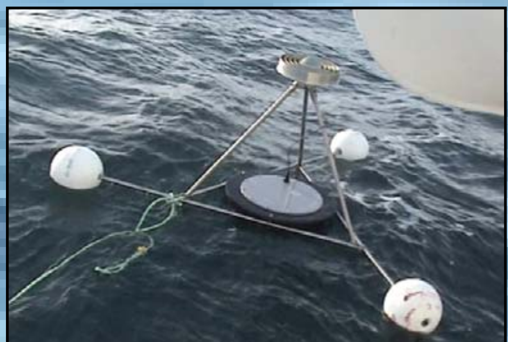

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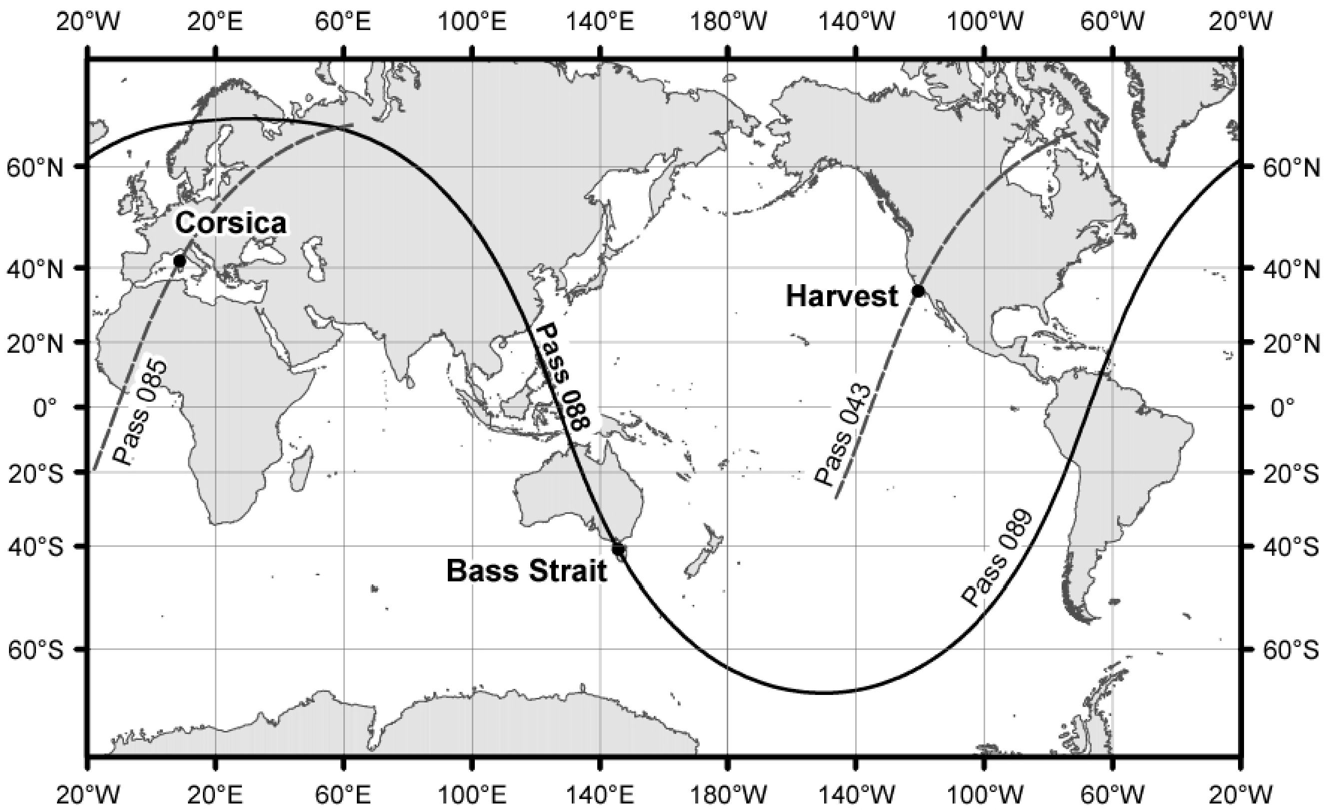
Jason-1 and Jason-2/OSTM OST Science Team

Updated Results
Nice OSTST Meeting
November 2008

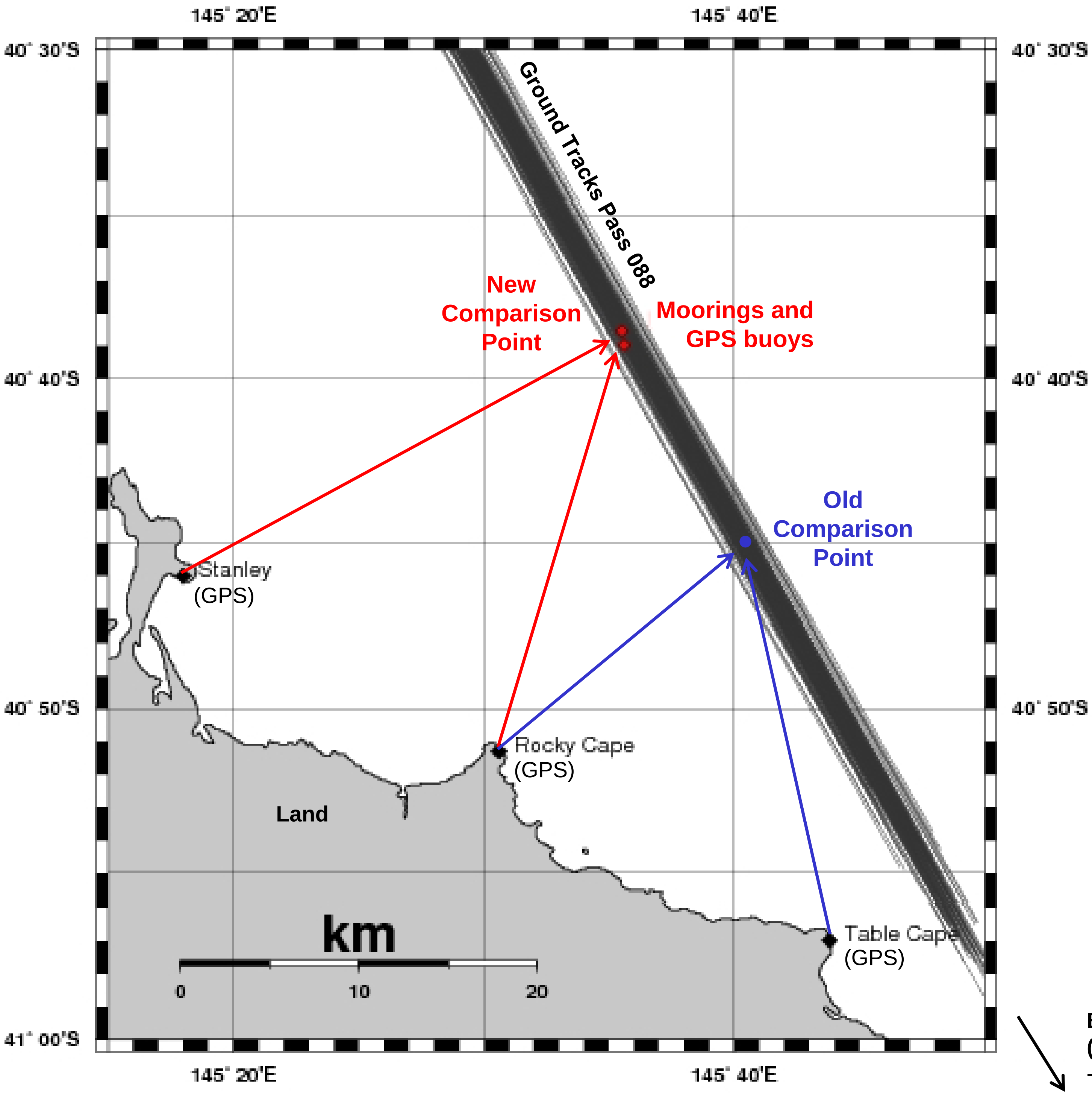
Overview

- Bass Strait is an absolute calibration site that adopts a purely geometric technique. The method is centred around the use of GPS buoys to define the datum of high precision ocean moorings.
- Mooring SSH also used to correct tide gauge SSH to the comparison point.
- Altimeter vs mooring SSH and tide gauge SSH to determine absolute bias.



What’s New?

1. New comparison point (moved further offshore to avoid land contamination of the radiometer).
2. New GPS buoy design (better tracking in dynamic conditions).
3. New tide gauge (as a result of gauge vs tug boat).
4. Two new CGPS sites (one replaces the GPS collocated with the tide gauge and the second is inland on bedrock).
5. New episodic GPS at Stanley to minimise baseline length to GPS buoys.
6. Three new ocean moorings (two consecutive six month deployments and one twelve month deployment spanning the previous two).
7. FTLRS campaign (assess benefit of additional southern hemisphere SLR).

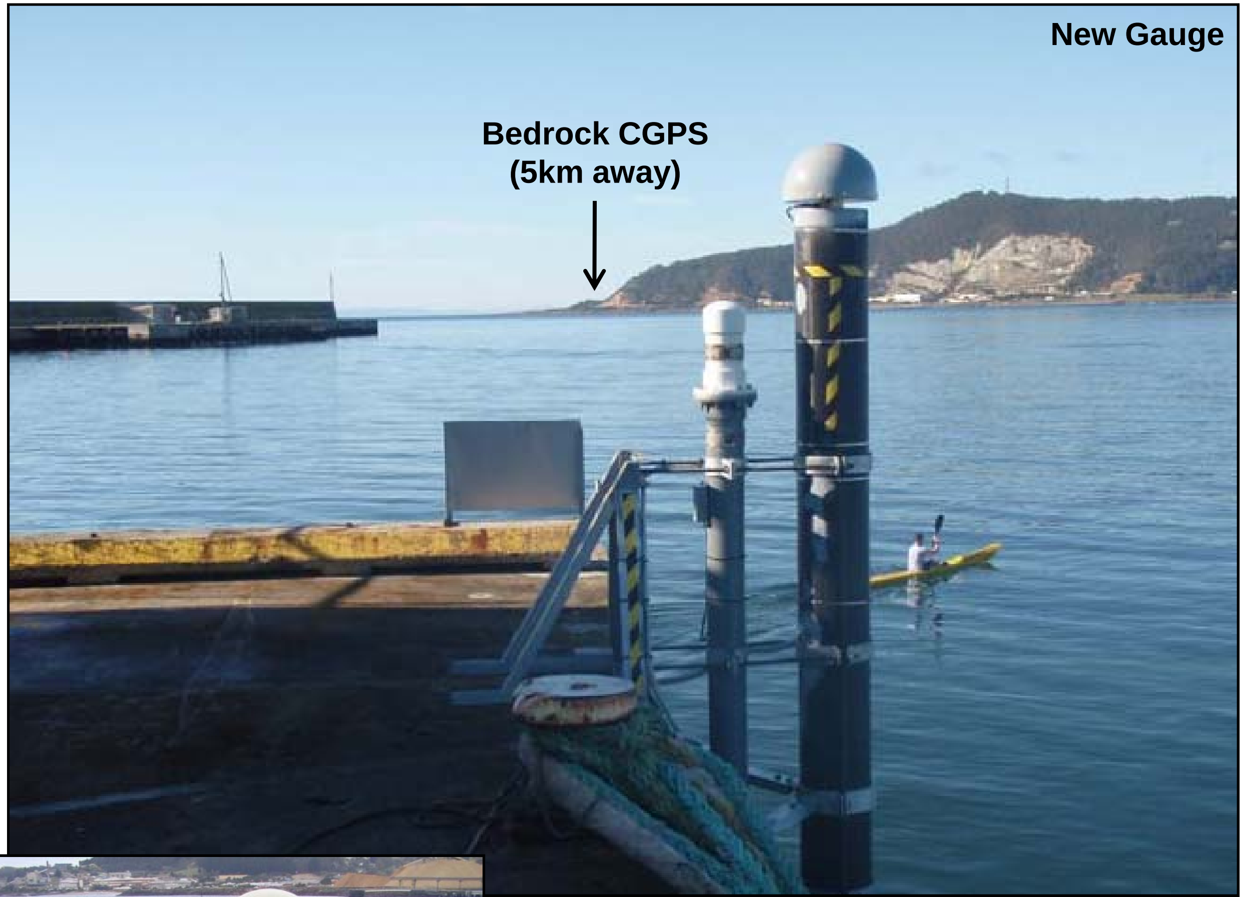


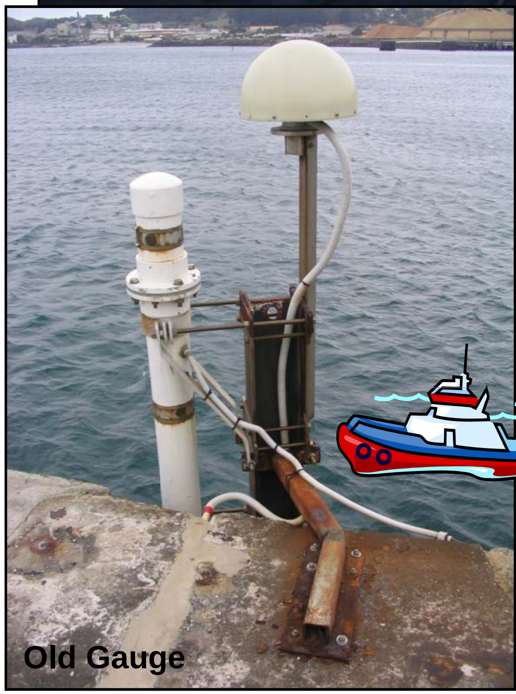
Burnie
(19km from Table Cape)
- Tide gauge
- CGPS x2
- FTLRS

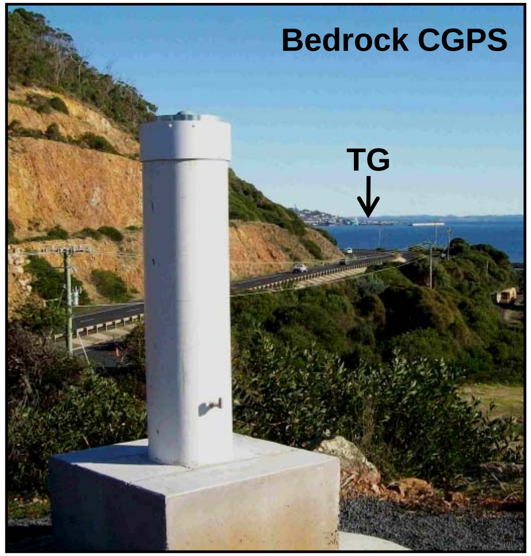
Instrumentation:

Tide Gauge

- Since the Hobart OSTST meeting, Burnie has a new tide gauge and co-located CGPS monument (BURN).
- The Burnie site had 11 years without incident, then 2 rogue tugboats within a year.
- Gauge is part of the Australian baseline array, provision for a radar gauge in 2009. Run by the Australian National Tidal Centre (NTC).
- Bedrock CGPS ~5km away at Round Hill (RHPT).







Ocean Moorings

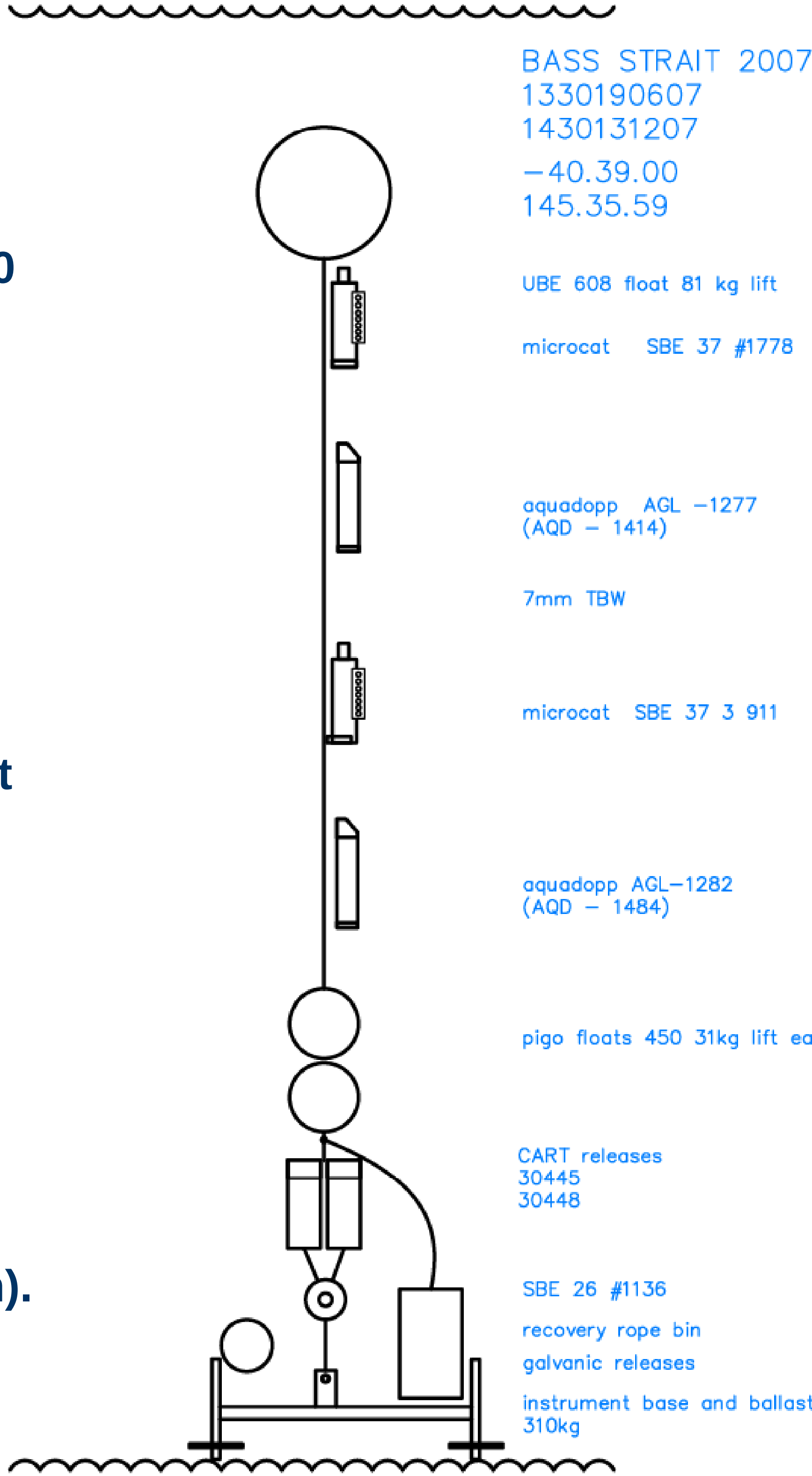
- Two ocean moorings deployed 07-Jan-2008 in ~50 m water depth (Mooring 1 and 2). On retrieval of Mooring 1, Mooring 3 was deployed.
  - Mooring 1: 6 Month deployment.
  - Mooring 2: 12 Month deployment.
  - Mooring 3: 6 Month deployment.

- Instrumentation includes high accuracy pressure gauges, Seabird TS meters and aquadopp current meters.

- Local atmospheric pressure determined using high resolution Australian LAPS model.

- Mooring 1 and first half of Mooring 2 coincides with FTLRS deployment.

- Mooring datum determined using episodic GPS buoy deployments (to continue over Nov/Dec/Jan).



Instrumentation:

GPS Buoys

- Moved on to Mk III wave rider buoy design. New design lifts antenna above water level whilst minimising tilt. Design prevents loss of lock caused by breaking waves as experienced with the Mk II design.
- Two buoys deployed at comparison point, tethered horizontally to anchored boat.
- Episodically deployments, each for 8 hours duration. Data at 1 Hz.
- Buoys used to solve for mooring datum, NOT purely for alt bias or geoid determination.

Instrumentation:

FTLRS

- Part of our NCRIS/AUSCOPE project has been to trial the FTLRS in Burnie during 2007/08.
- French and Australian Campaign ran from 01-Dec-2007 to 17-Apr-2008, observing a total of 660 over flights from 10 different satellites.
- Site was located in the city of Burnie, ~10km from the tide gauge site. FTLRS co-located with temporary GPS.
- Has been an important project to further build Australian SLR capability.
- Detailed analysis slow to start but now fully underway (see poster by Zhang et al).
- Aim is to assess the influence of an additional SLR site in this region.

Results:

Preview

1. Summary statistics – GPS buoy SSH / Mooring 1 SSH / Tide gauge SSH
2. Jason-1 GDR-B – cycles 001-232 (as supplied)
3. Jason-1 GDR-C – cycles 198-240 (as supplied)
4. Jason-1 GDR-B vs Jason-1 GDR-C – cycles 198-232 (as supplied)
   - Absolute biases, relative bias, differences in corrections
5. Jason-1 IGDR-C 238-251 vs Jason-2/OSTM IGDR-A 000-012
   - Absolute biases, relative bias, differences in corrections
6. GPS Buoys / Mooring 1 / Mooring 2 / Tide gauge / sea surface set up (investigate any improvement in our ability to transform the tide gauge SSH to the comparison point)
7. Mooring 2 vs Jason-1 / Jason-2 (improved datum and precision).
8. Altimeter data with Burnie FTLRS vs non-FTLRS orbits. What is the orbit error vs range error? Do we see geographically correlated effects?

Results:

GPS Buoy / Mooring / Tide Gauge

- Our reference frame is defined by daily global analyses of 2x40 station networks of CGPS stations in GAMIT software, with ITRF2005 realised using GLOBK and a well defined set of stabilisation sites. We consider this analysis state-of-the-art within GAMIT.
- Four GPS buoy deployments completed to define the datum of Mooring 1 (~8 hours each – 2 buoys deployed each time). Kinematic processing of 1 Hz buoy data in Track and Grafnav. Smoothed over a 20 minute time scale.

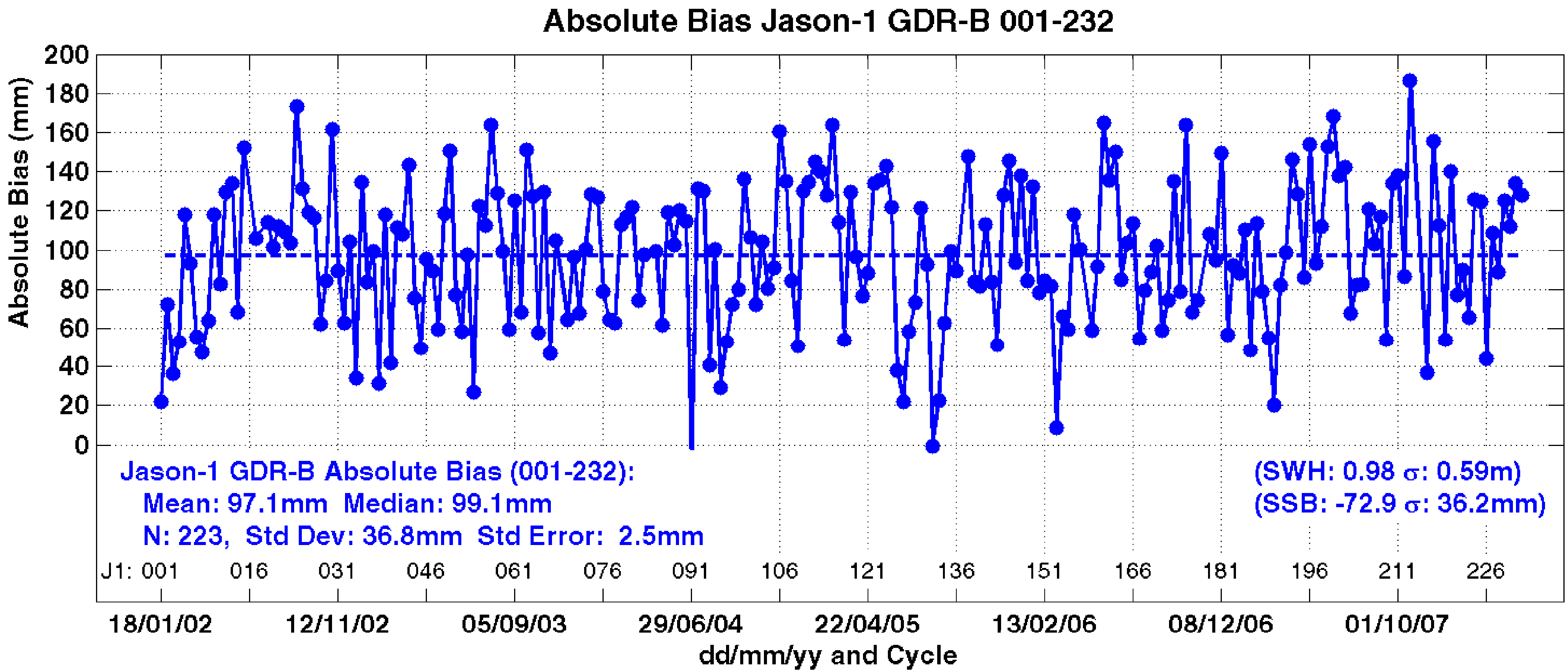
Results:

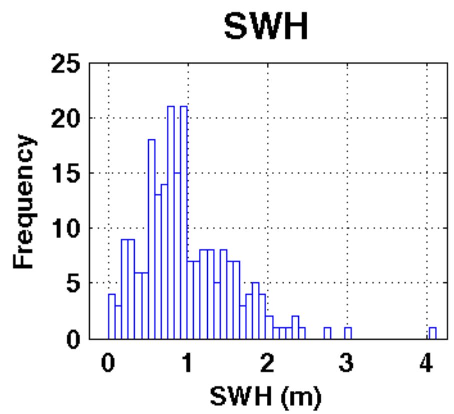
GPS Buoy / Mooring / Tide Gauge

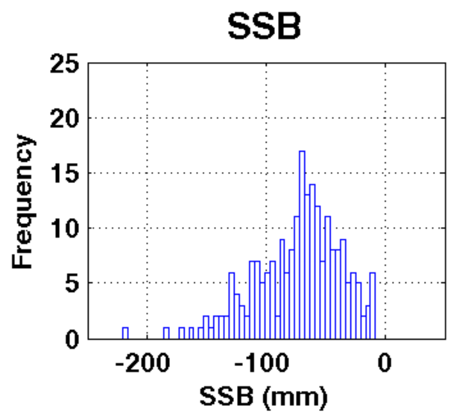
- **Between buoy comparison (B1 and B2 from 4 deployments):**
  - Mean (B2 SSH – B1 SSH) = 0.7 mm, std dev = 8 mm (average separation distance between buoys ~10 m).
- **“Average” buoy vs mooring 1 comparison:**
  - The mean of (buoySSH – mooringSSH) defines mooring datum, std dev = 22 mm. Assuming independent estimates each half hour, N = 56, std err = 3 mm.
- **Mooring 1 vs Tide Gauge:**
  - Std dev of difference is 91 mm, dominated by tidal differences at M2 (amp=115 mm) and N2 (amp=28 mm).
  - Non-tidal residual has std dev = 29 mm.

Results:

Jason-1 GDR-B cycles 001-232







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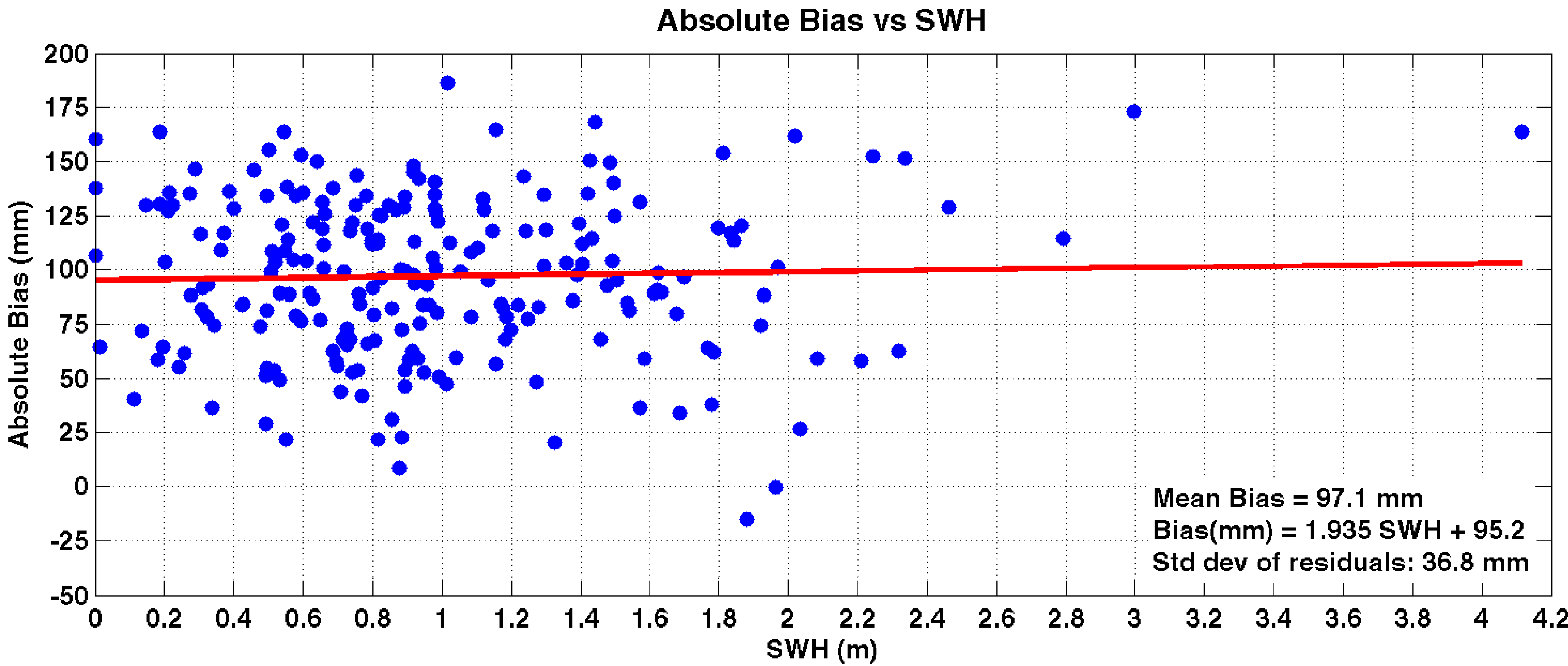

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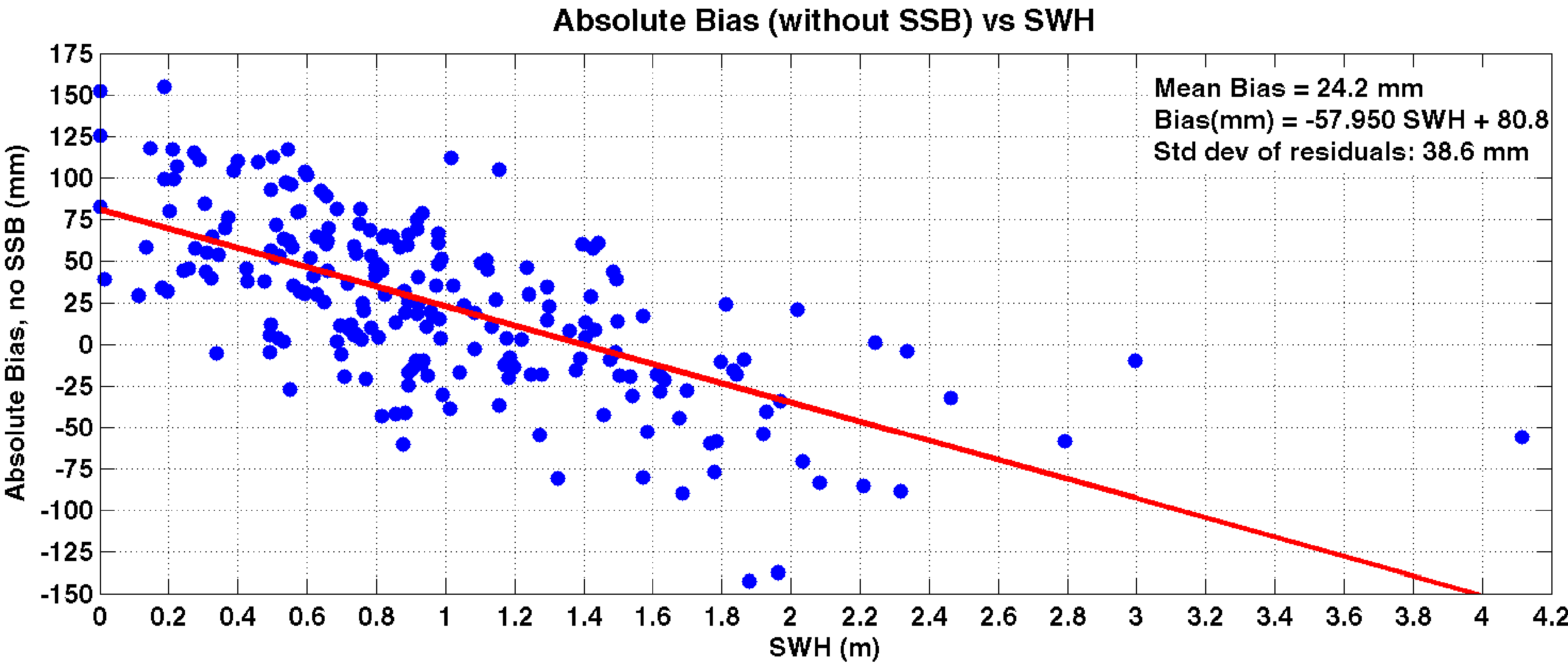
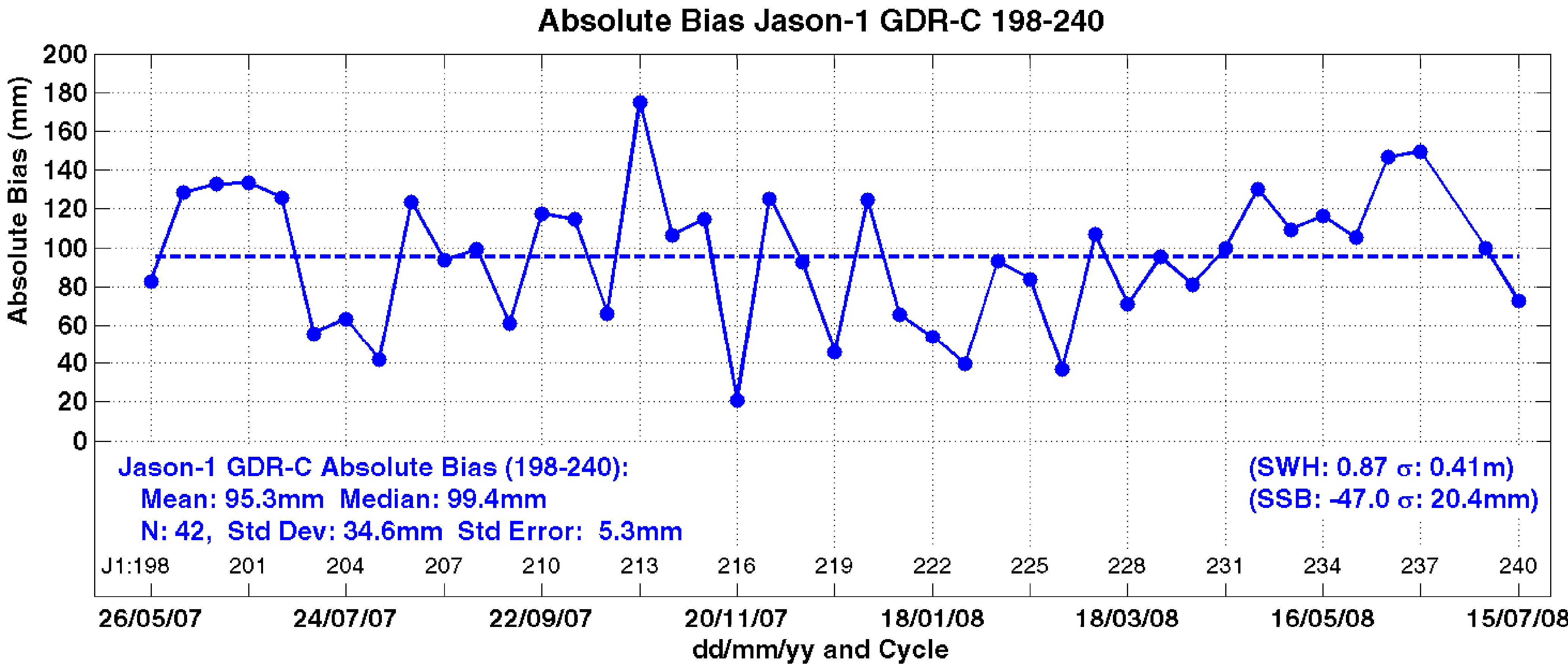
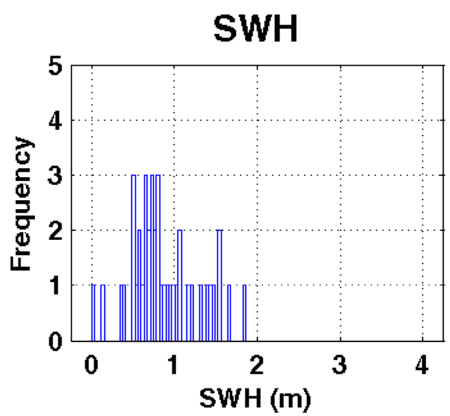
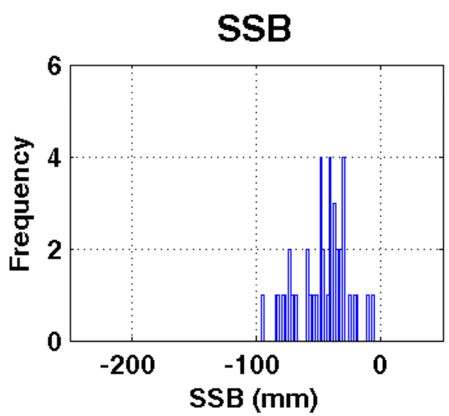


Results:

Jason-1 GDR-C cycles 198-240

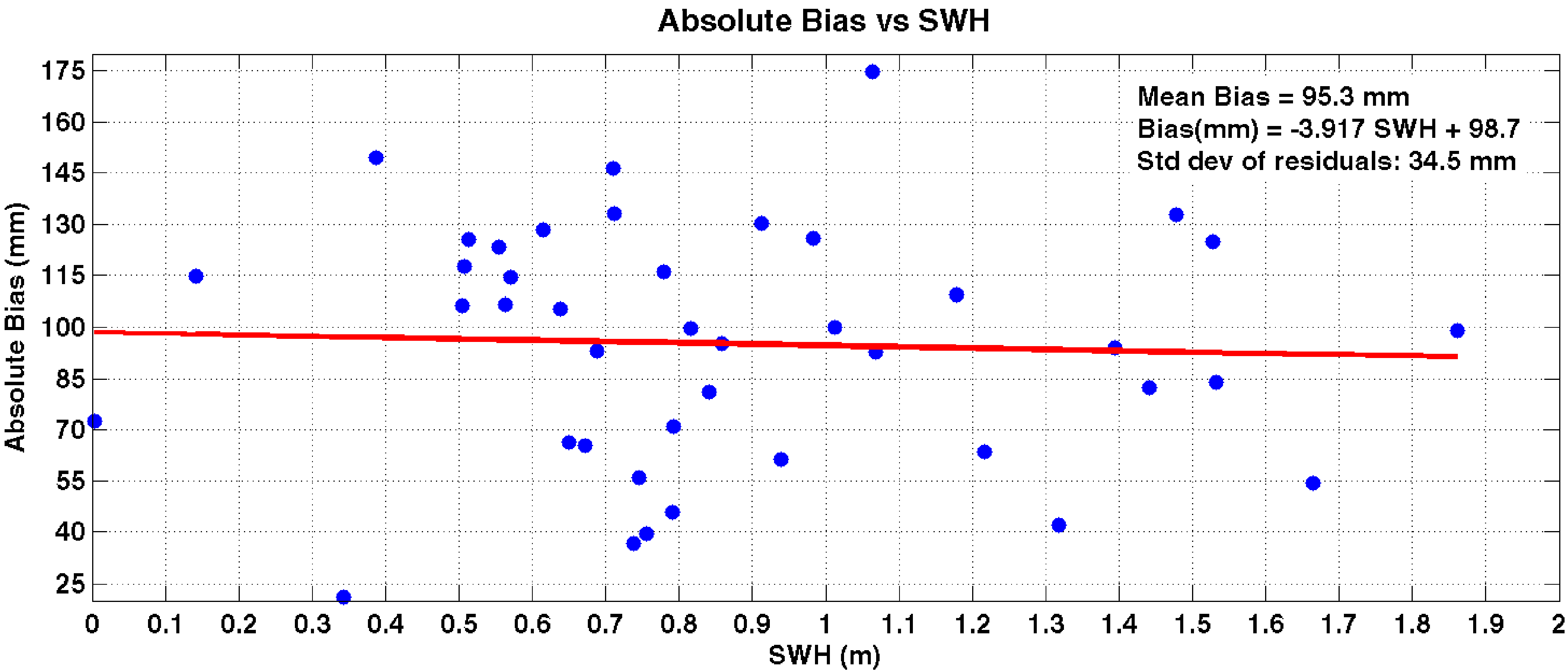






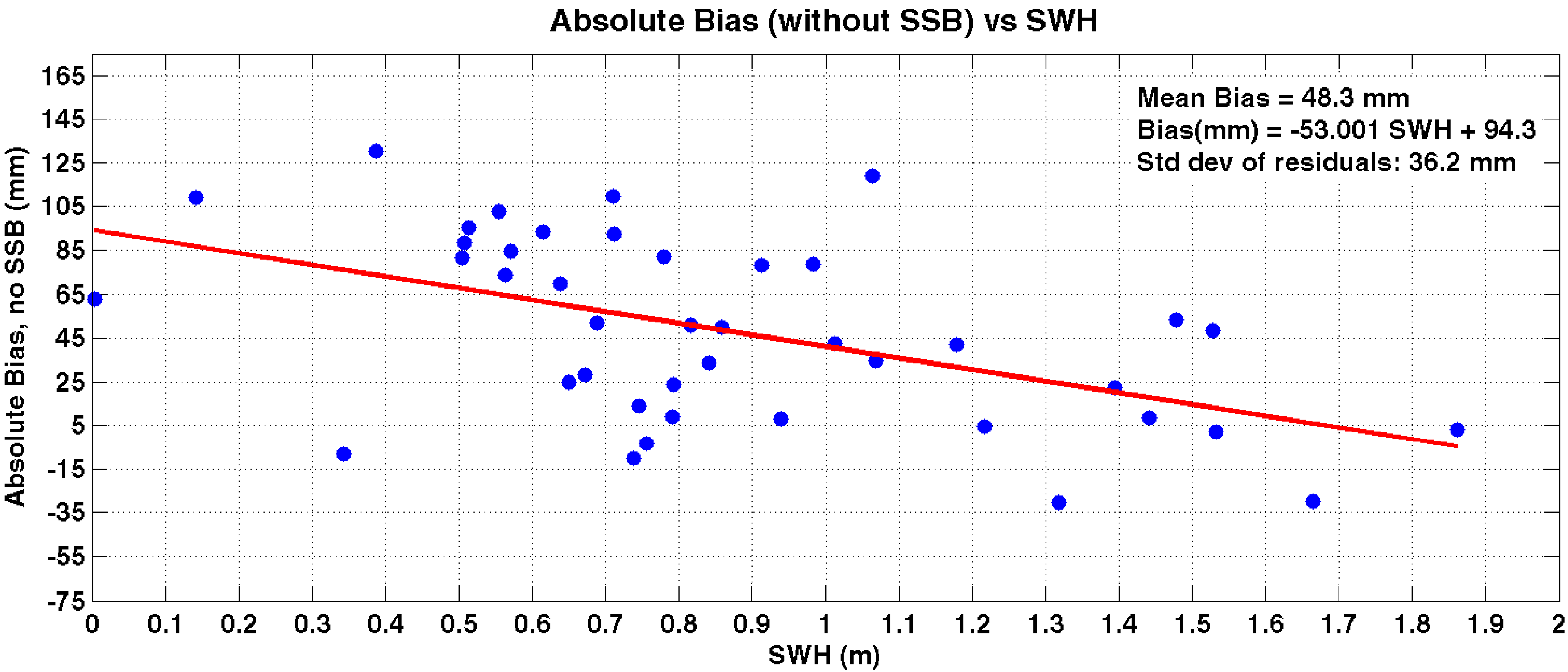
Results:

Jason-1 GDR-C cycles 198-240



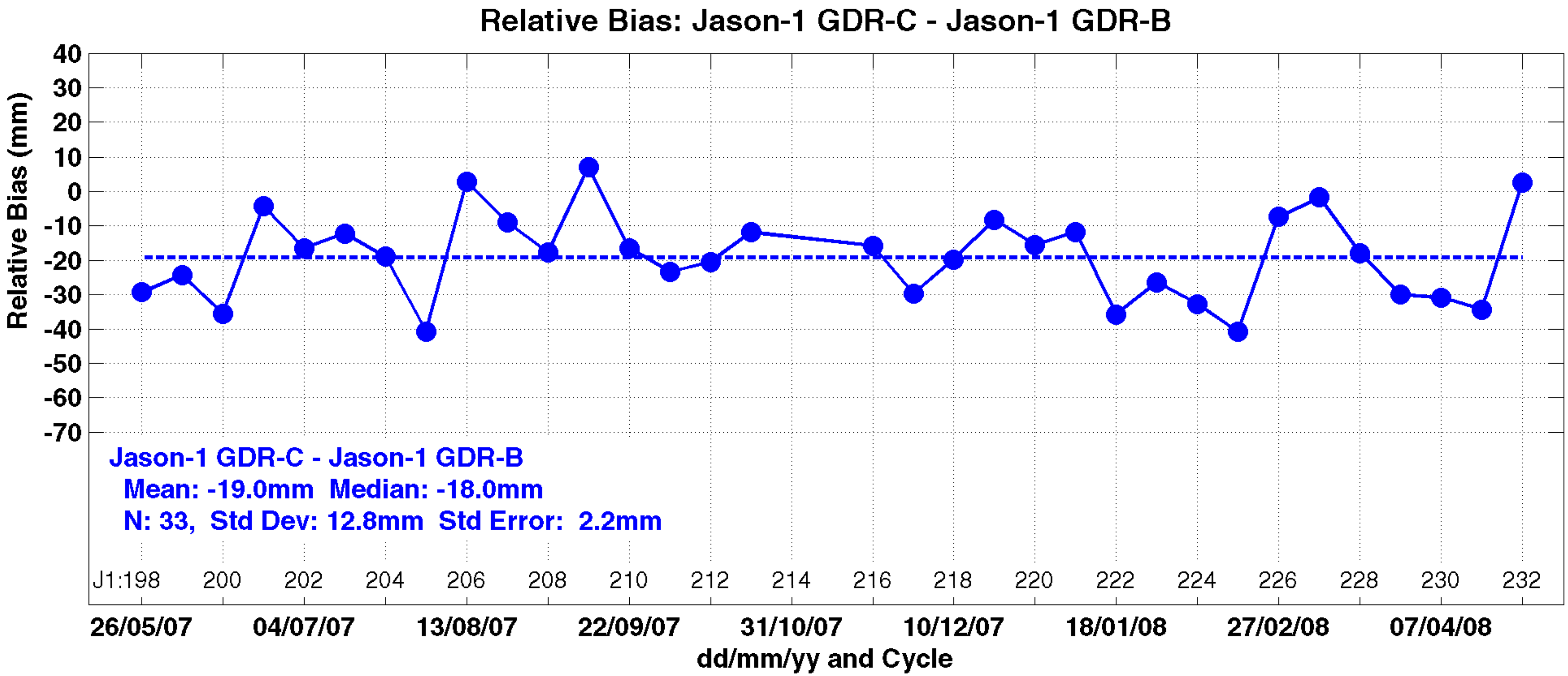
Results:

Jason-1 GDR-C cycles 198-240



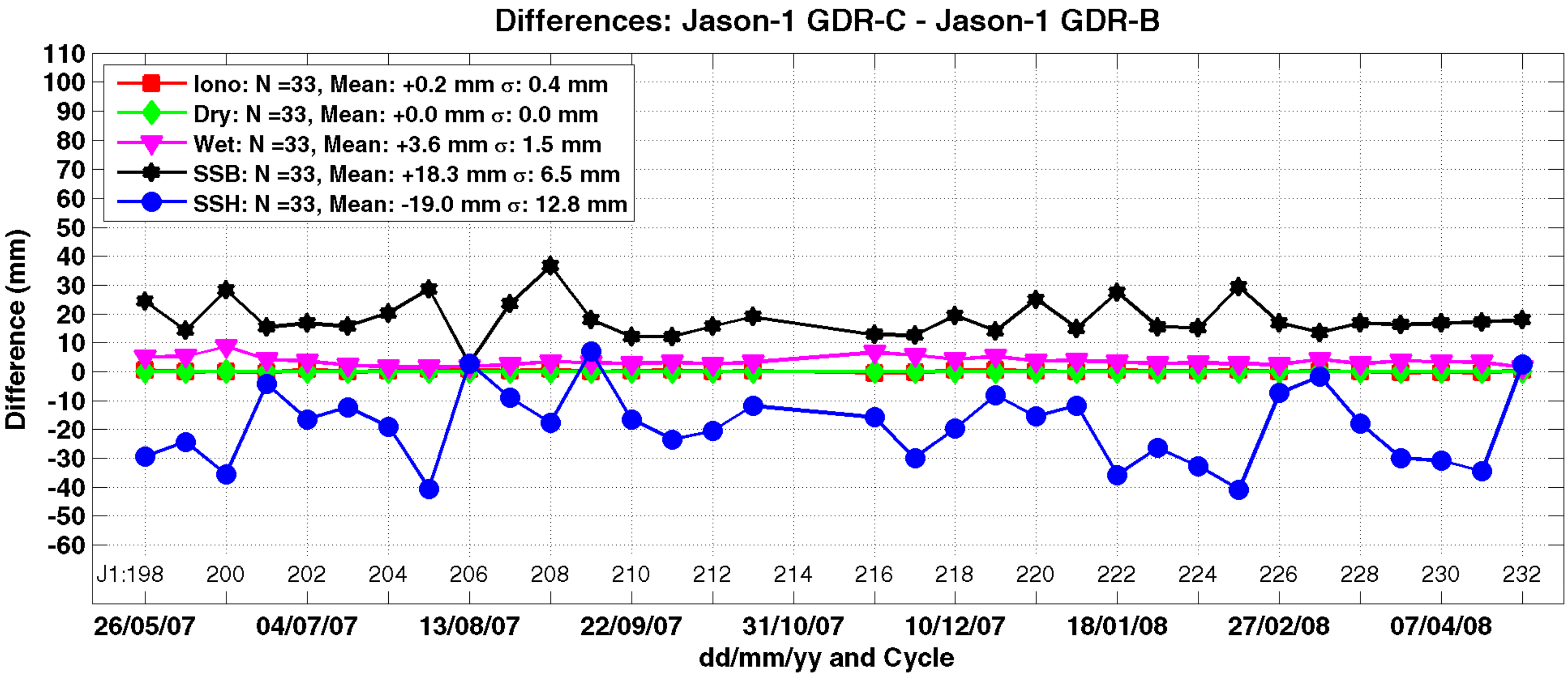
Results:

Jason-1 GDR-C vs Jason-1 GDR-B (198-232)



Results:

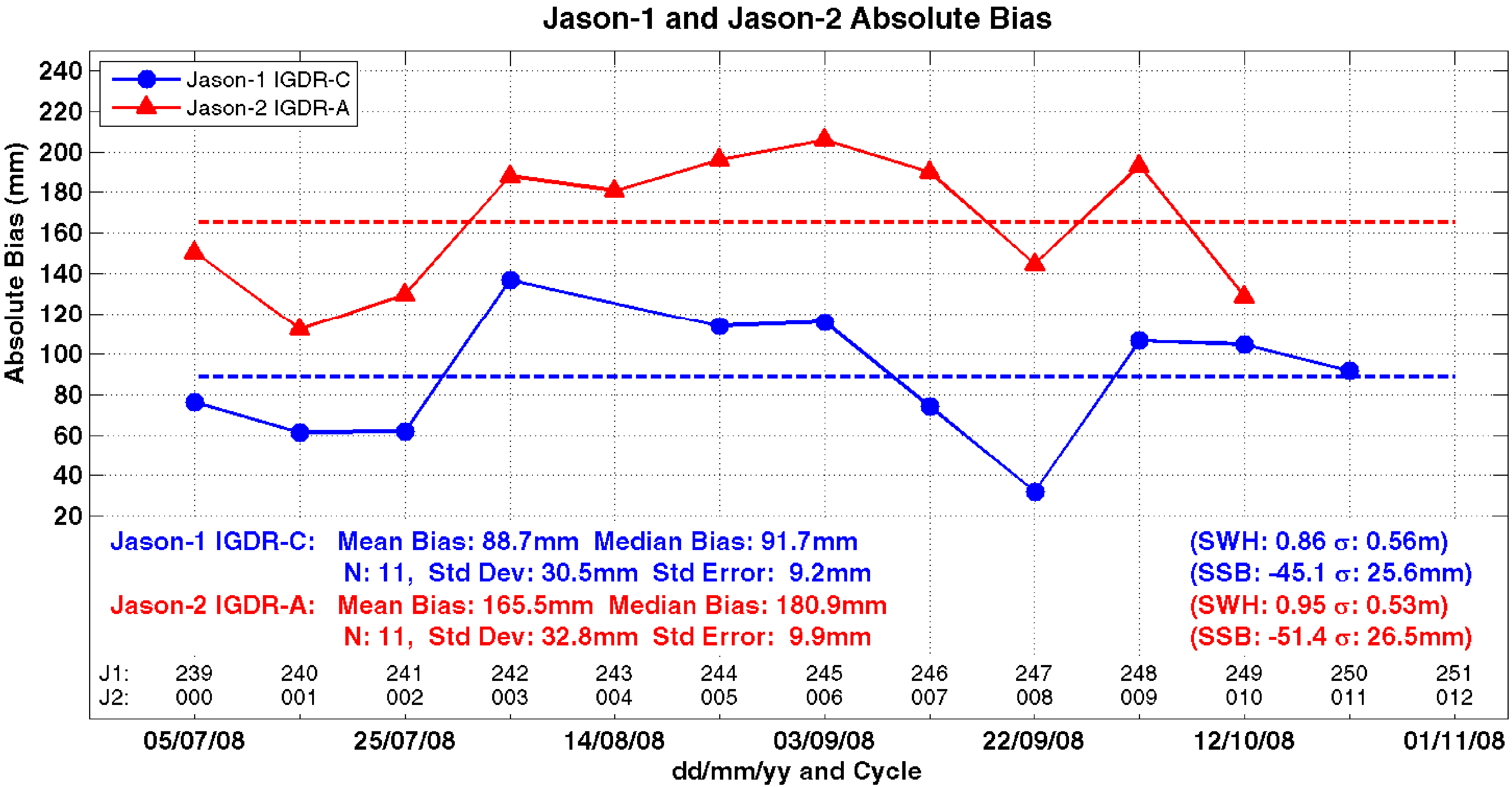
Jason-1 GDR-C vs Jason-1 GDR-B (198-232)



- Difference in corrections +(ve) = B-series correction is of greater magnitude (wetter, more electrons etc)
- Difference in SSH –(ve) = B-series SSH is higher than C-series SSH

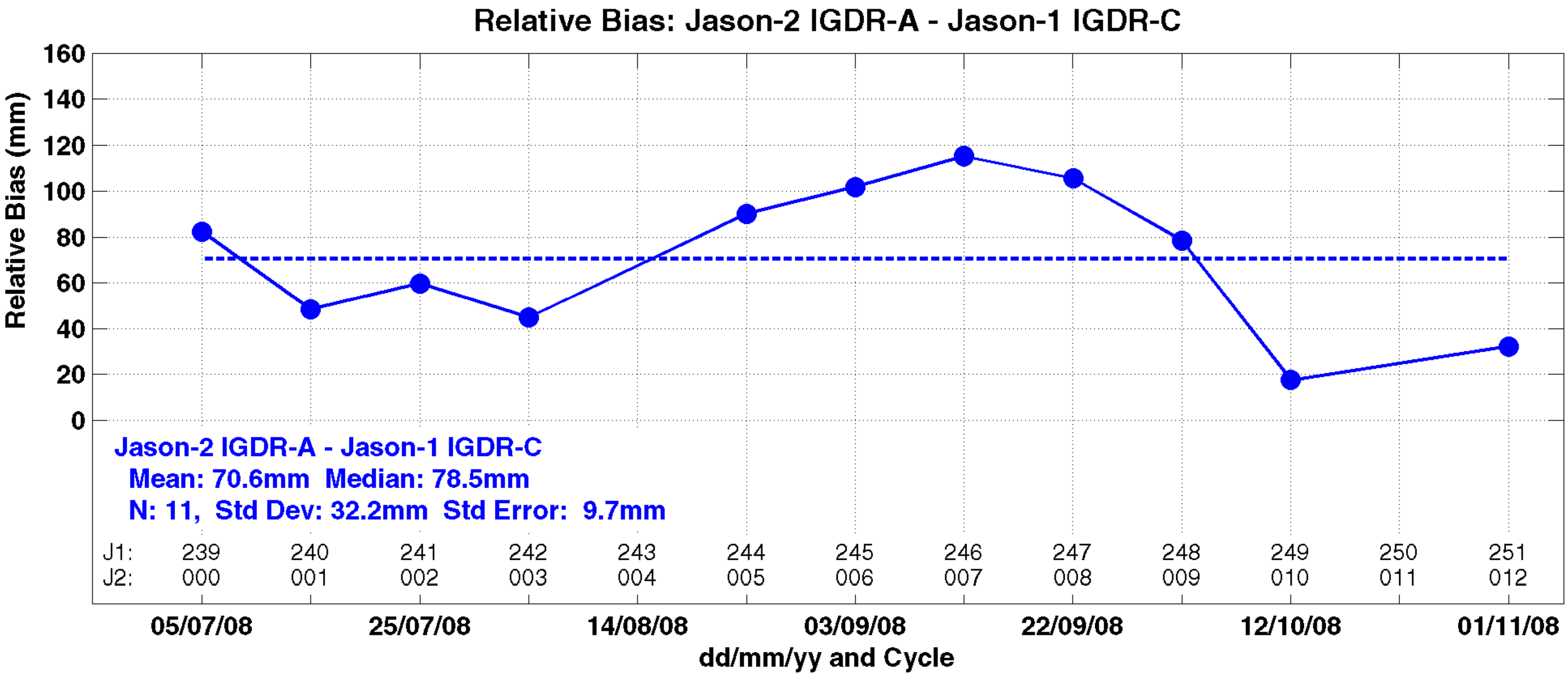
Results:

Jason-1 IGDR-C vs Jason-2 IGDR-A



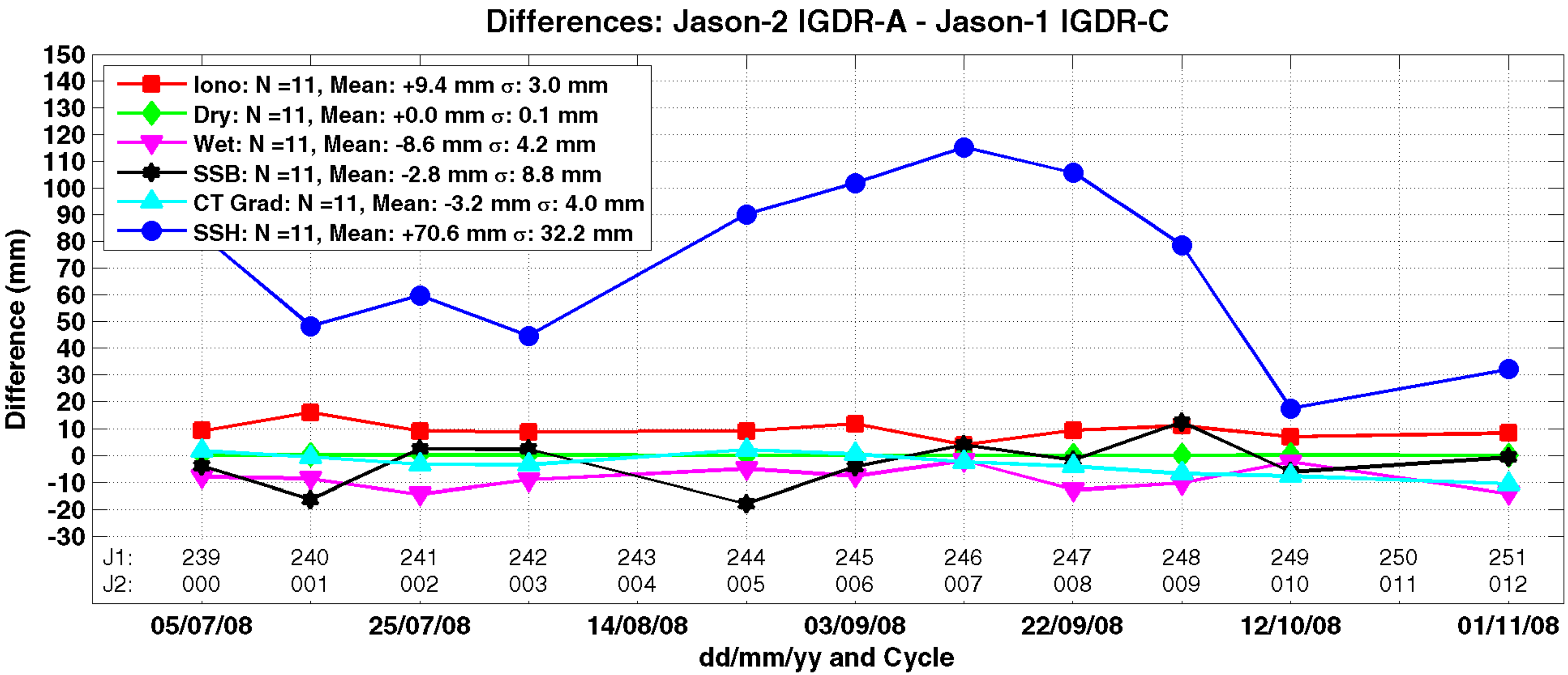
Results:

Jason-2 IGDR-A vs Jason-1 IGDR-C



Results:

Jason-2 IGDR-A vs Jason-1 IGDR-C



Iono Delay: Jason-2 has a bigger delay (opposite for Harvest)

Wet Delay: Jason-2 AMR is dryer than Jason-1 JMR (opposite for Harvest)

SSH: Jason-2 higher

Conclusions

Data	Cycles	N	Mean Bias ± Std Error
Jason-1 GDR-B	001-232	225	+96.8 ± 2.5 mm
Jason-1 GDR-C	198-240	42	+95.3 ± 5.3 mm
J1 GDR-C – J1 GDR-B	198-232	33	-19.0 ± 2.2 mm
J2 IGDR-A – J1 IGDR-C	000-012	11	+70.6 ± 9.7 mm
Jason-2 IGDR-A	000-010	11	+165.5 ± 9.9 mm

Tasks remaining:

1. **Investigate any improvement in our ability to transform the tide gauge SSH to the comparison point.**
2. **Incorporate Mooring 2, Mooring 3 and subsequent buoy deployments (moorings to be recovered early Feb 2009).**
3. **Investigate altimeter bias with and without Burnie FTLRS data used to determine orbits. Do we see geographically correlated effects?**

Questions?

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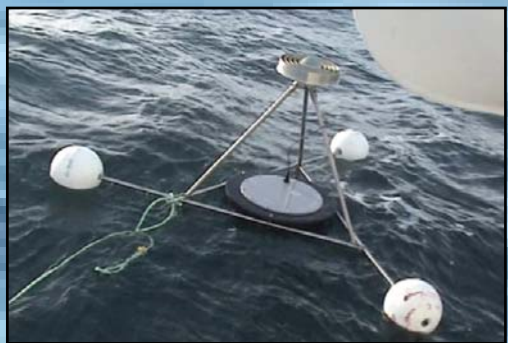

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