Updated Results from the In Situ Calibration Site in Bass Strait, Australia

Christopher Watson[1] , Neil White[2], John Church[2]
Reed Burgette[1], Paul Tregoning [3], Richard Coleman[4]

1 University of Tasmania (cwatson@utas.edu.au)
2 Centre for Australian Weather and Climate Research, A partnership between CSIRO and the Australian Bureau of Meteorology
3 The Australian National University
4 The Institute of Marine and Antarctic Studies, UTAS

IMOS
Integrated Marine Observing System

UTAS

CSIRO

ANU
THE AUSTRALIAN NATIONAL UNIVERSITY

IMAS

OSTM/Jason-2
OST Science Team Meeting

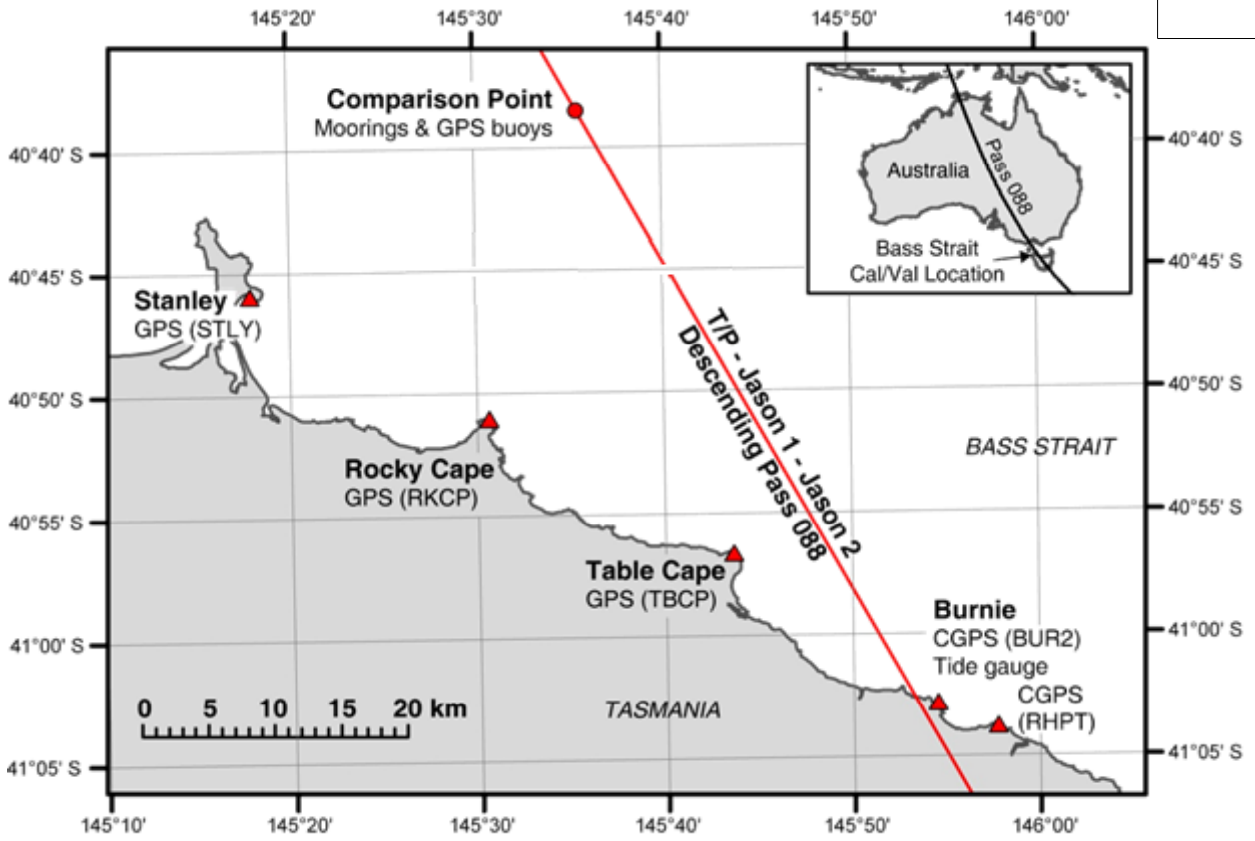
Updated Data Stream Presentation
San Diego OSTST Meeting
October 2011

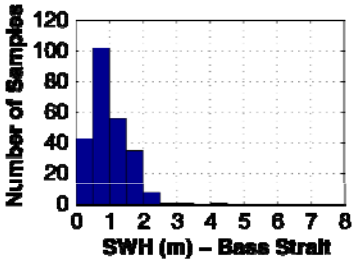
Methods Recap

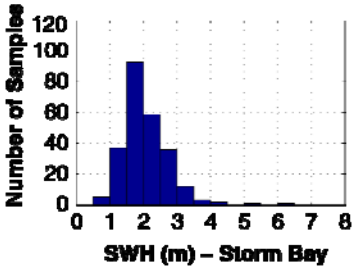
- Primary site is located on Pass 088 in Bass Strait. Contributing bias estimates to the SWT/OSTST since the launch of T/P.
- Secondary site along track in Storm Bay

Bass Strait

Storm Bay

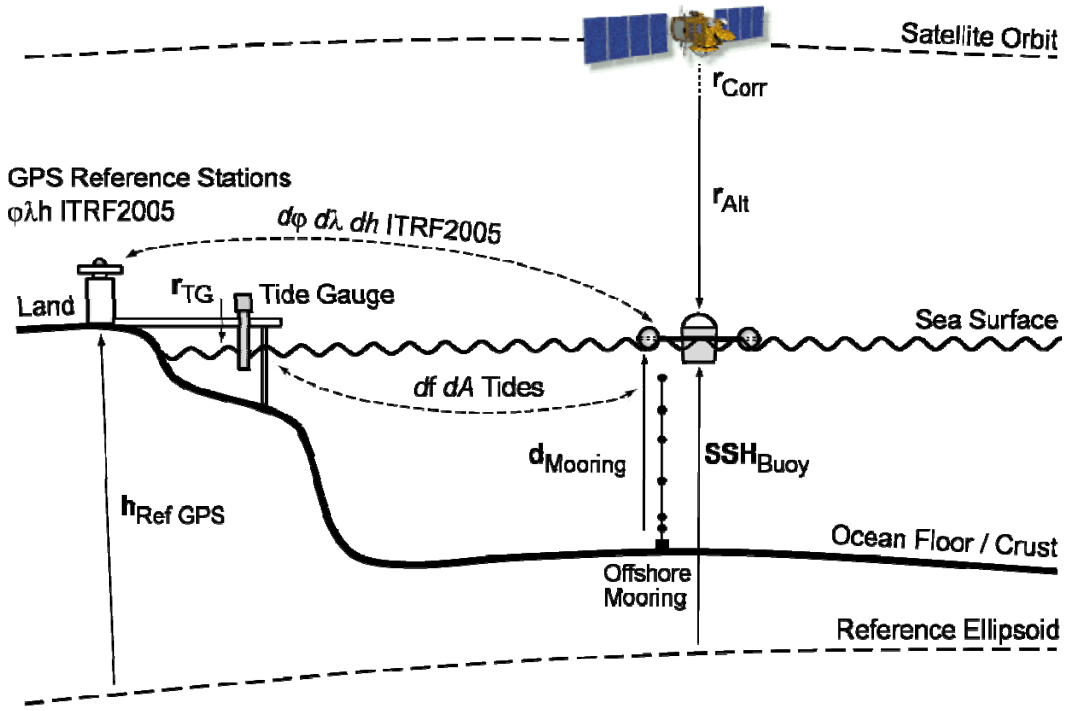






Methods Recap

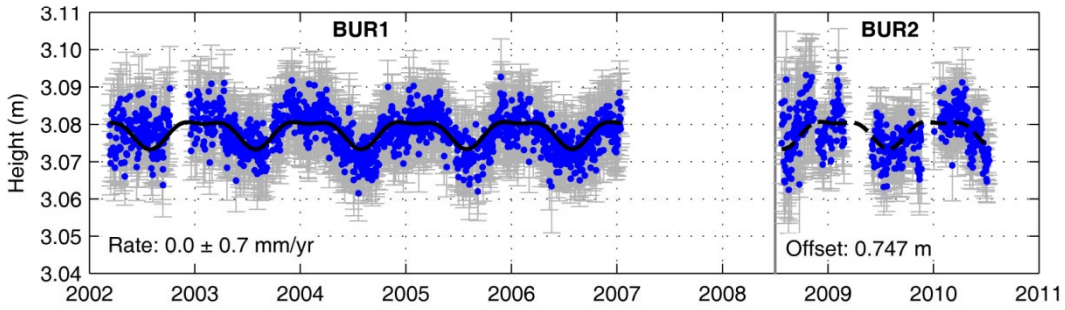
- We adopt a purely geometric technique for determination of absolute bias.
- The method is centred around the use of GPS buoys to define the datum of high precision ocean moorings.
- Outside of available mooring data, all available mooring SSH data are used to correct tide gauge SSH to the comparison point.



Instrumentation (Bass Strait):

Tide Gauge and CGPS

- Tide gauge part of the Australian baseline array, located in Burnie.
- Vertical velocity not significantly different from zero.
- CGPS time series shows a quasi-annual periodic signal (amplitude ~3-4 mm). Current investigations point towards this being dominated by a (spurious) GPS draconitic annual period (~351 days).



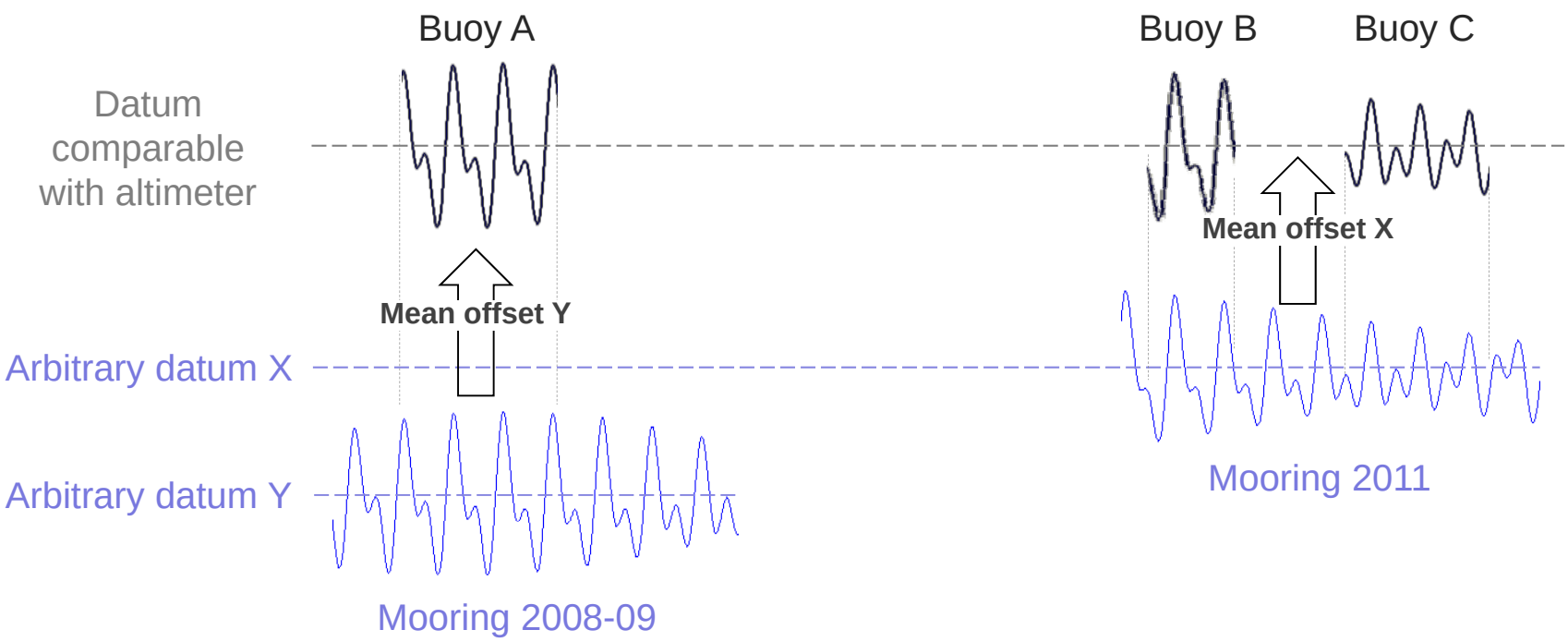
Watson et al. (2011)

BUR 2
CGPS at tide gauge

RHPT
Bedrock CGPS site (~5km)

Instrumentation:

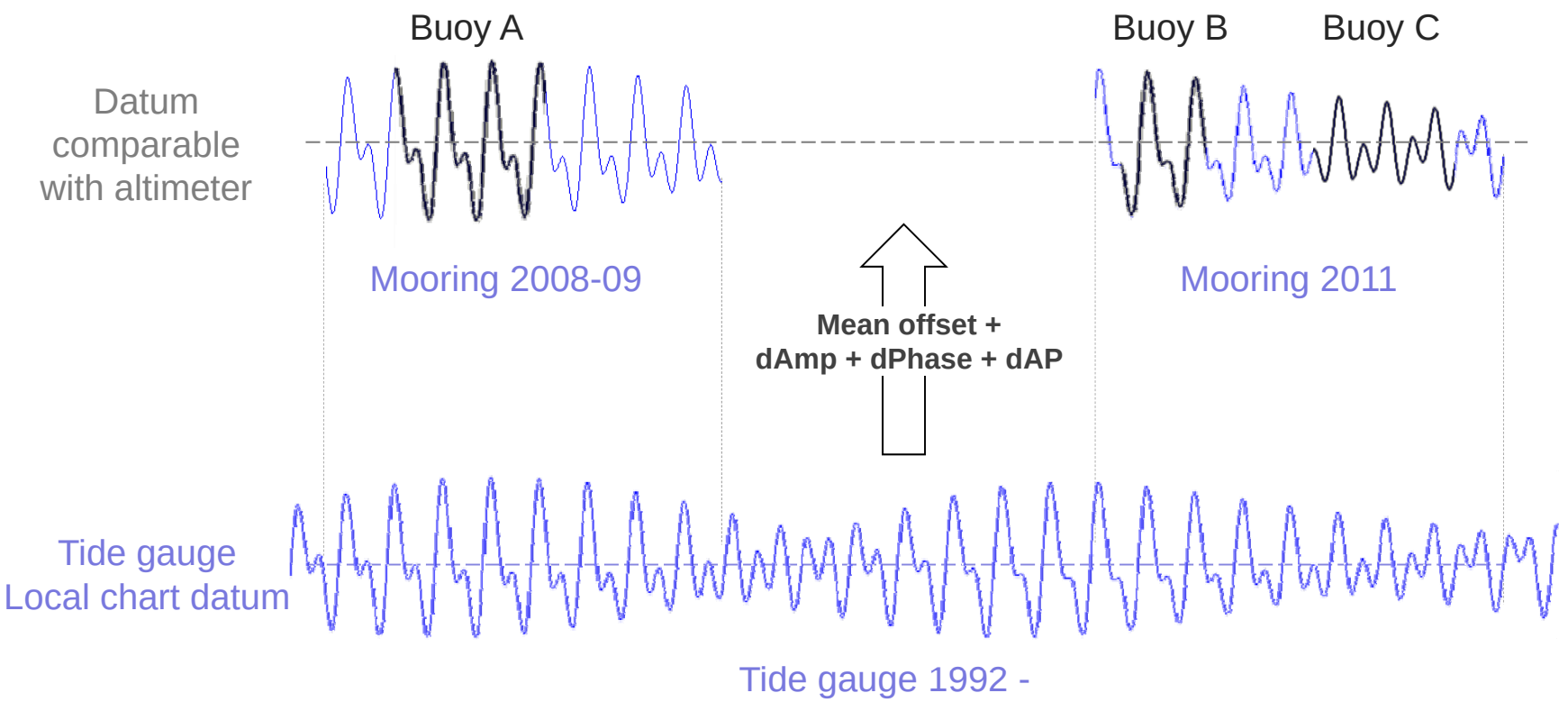
Ocean Moorings & GPS Buoys



- **Mooring 2008-09 shifted onto absolute datum using 8 GPS buoy deployments, each ~8 hr duration.**
- **Mooring 2011 shifted onto absolute datum using 2 ~50 hr buoy deployments.**

Instrumentation:

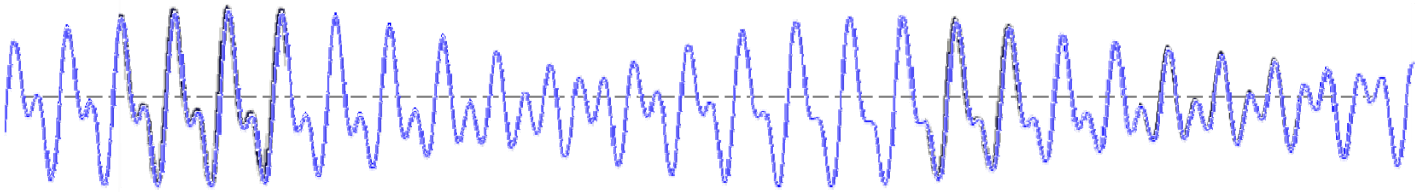
Ocean Moorings & GPS Buoys



Instrumentation:

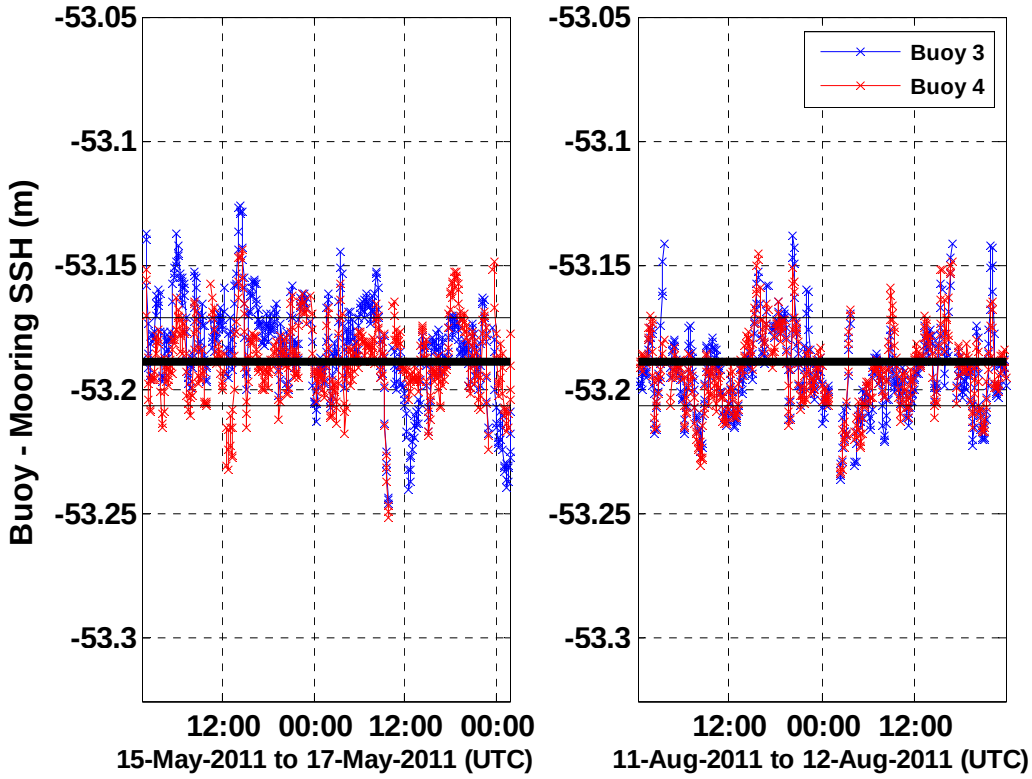
Ocean Moorings & GPS Buoys

Datum comparable with altimeter



- **Tidal difference between mooring and tide gauge is dominated by M2 (amp = 0.126 m, and N2 (amp = 0.030m).**
- **Non tidal differences are reduced by modelling the differential effect of the modelled air pressure between the mooring and tide gauge.**
- **The RMS of the final non tidal residual (mooring – tide gauge) is ~22 mm.**
- **The corrected tide gauge dataset enables us to compute cycle by cycle estimates of absolute bias.**

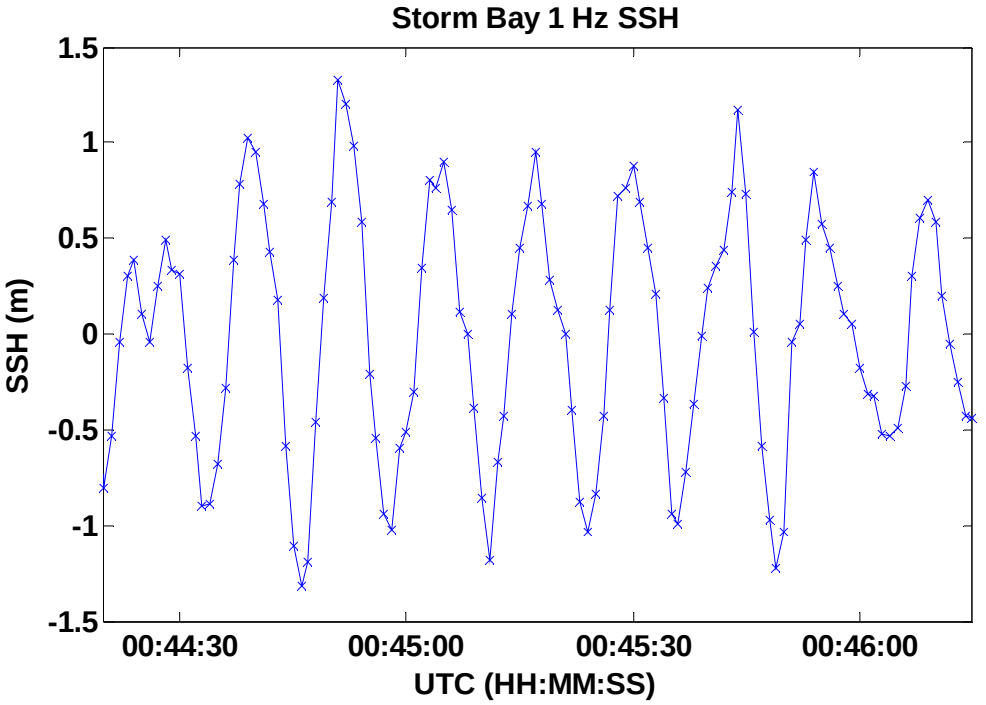
GPS Buoy vs Mooring SSH: Bass Strait

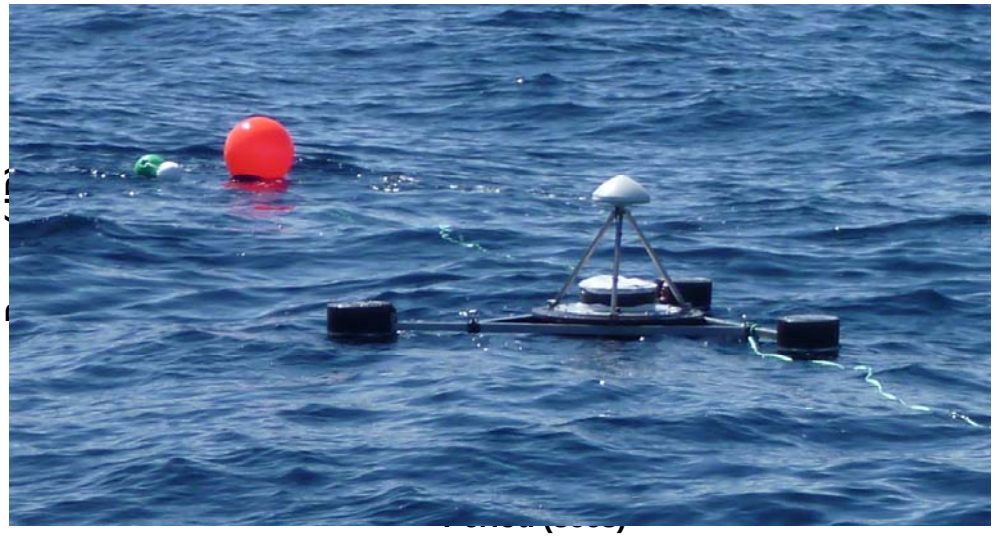


- 1 Hz GPS Buoy SSH time series is filtered prior to comparison with the mooring SSH (5 minute estimates).
- The residual time series (Buoy SSH – Mooring SSH) shows a typical RMS of ~18-20 mm.
- Conservative estimates of independence every 3 hours, yields a standard error about the mean of ~ 3 mm.

Example 1 Hz GPS Buoy Data

- Our current evolution in GPS buoy enables extended deployment for up to 3 days.
- Deployed in pairs, tethered individually via horizontal floating tethers attached to surface floats, which are then anchored to the sea floor.
- Deployment typically limited to relatively calm conditions (good results in up to ~3.5 m peak to trough waves at Storm Bay).
- Swell signals are readily extracted from 1 Hz data at both sites.



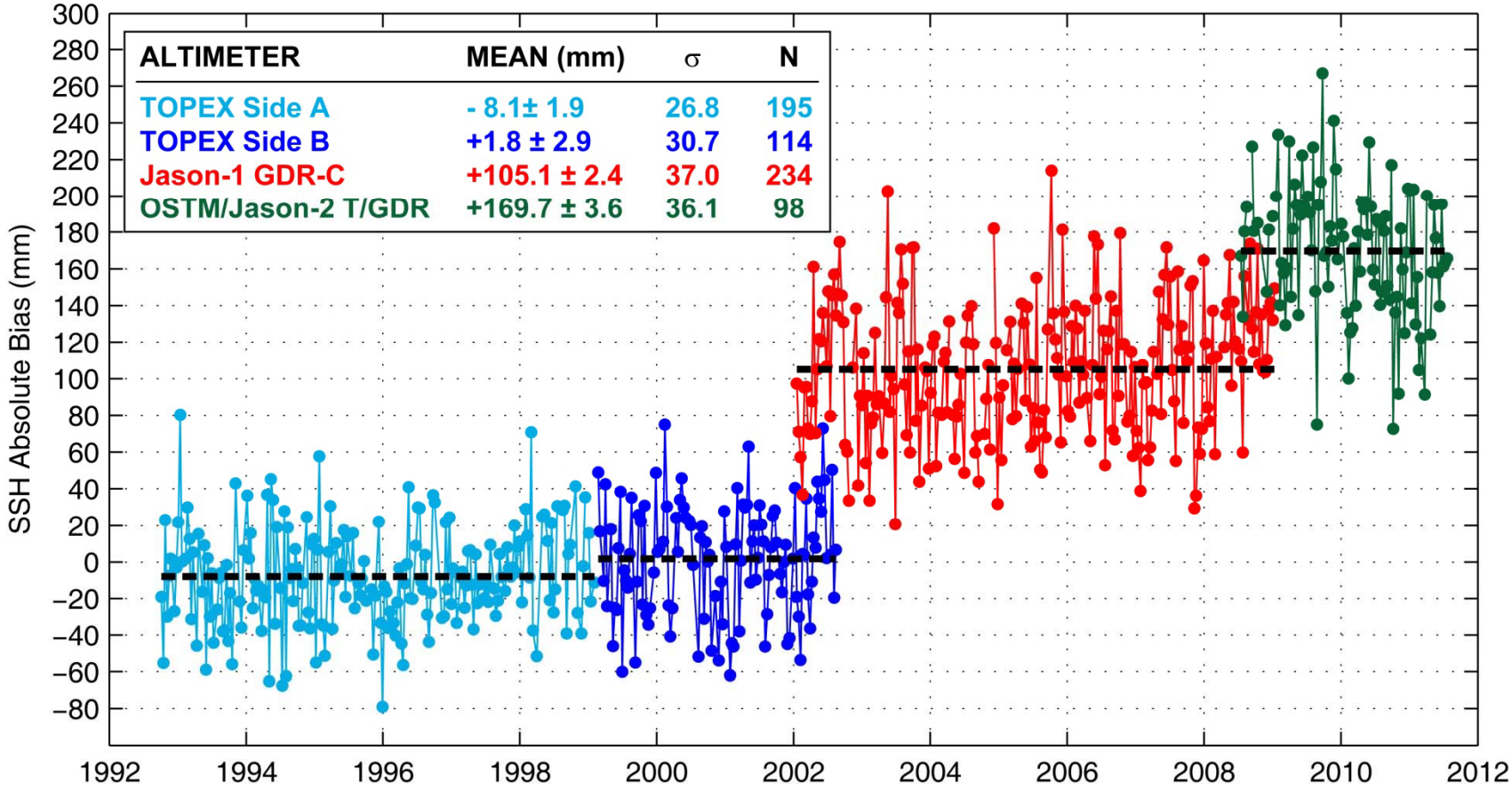


Results:

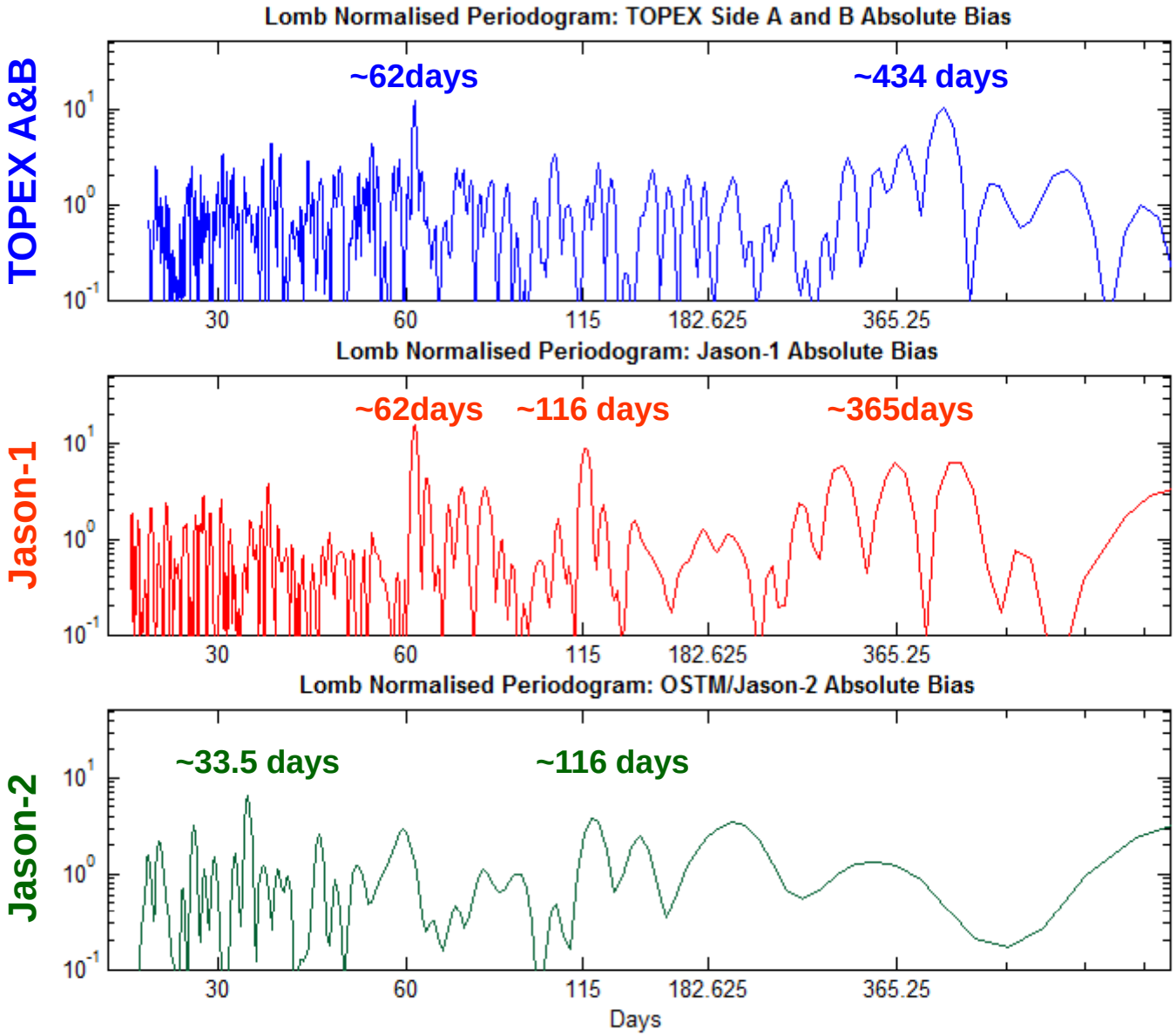
Preview

1. **TOPEX Side A and B, Jason-1 and OSTM/Jason-2**
   - All available cycles (OSTM/Jason-2 up to cycle 112)
   - **TOPEX**: GSFC orbits, corrected TMR, Chambers et al SSB.
   - **Jason-1**: GSFC orbits, enhanced JMR.
   - **OSTM/Jason-2**: GSFC orbits, enhanced AMR.

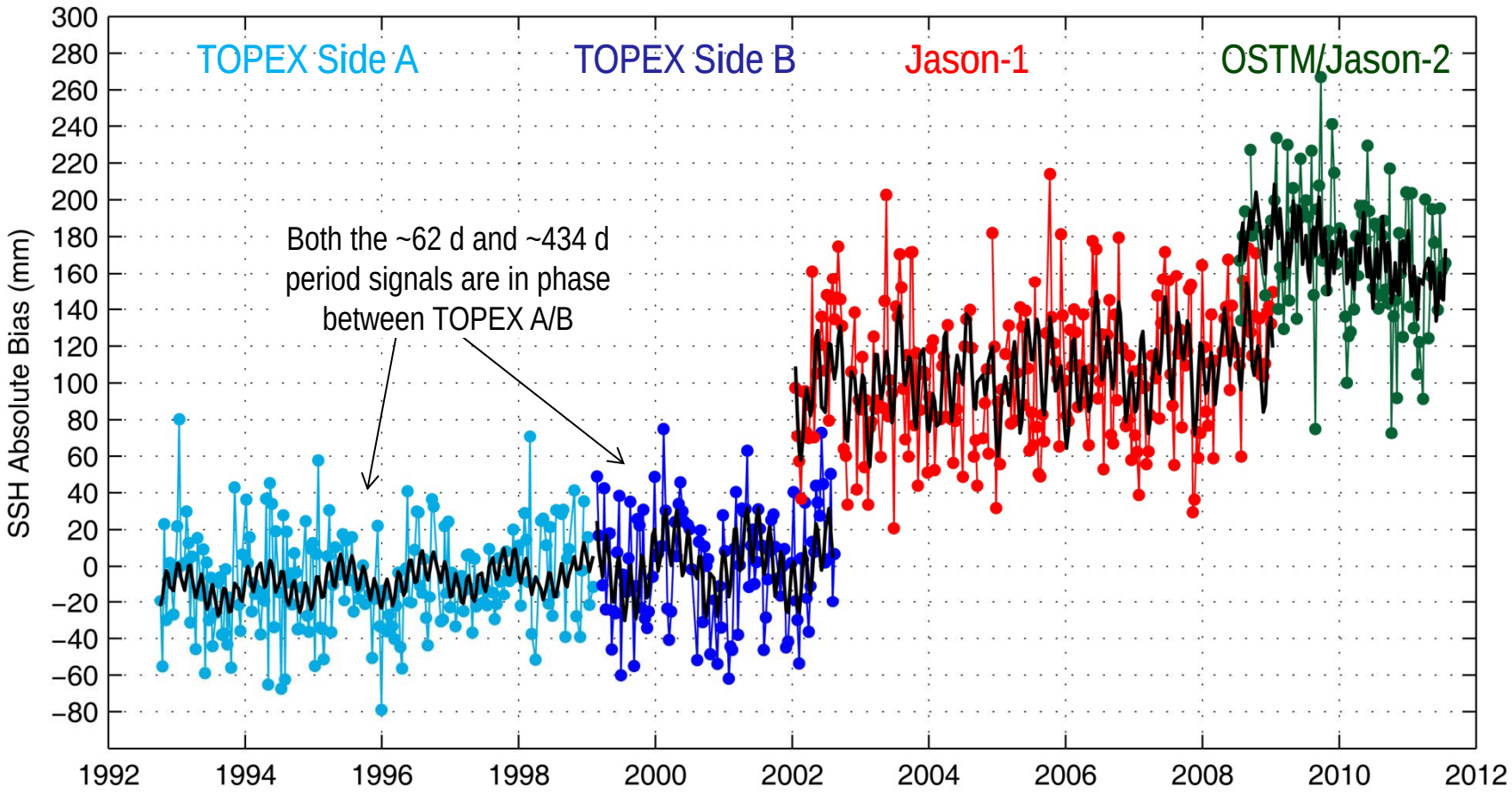
Bass Strait Absolute Bias Record



Absolute Bias Periodic Energy



Bass Strait Absolute Bias Record



	TOPEX Side A	TOPEX Side B	Jason-1	OSTM/Jason-2
Linear rate:	+1.8 ± 1.0 mm/y	+1.2 ± 2.6 mm/yr	+2.6 ± 1.0 mm/yr	-11 ± 4 mm/yr
Variance exp:	10 %	27 %	29 %	20 %
Residual RMS:	25 mm	26 mm	31 mm	32 mm
Periodic terms:	62d + 434d	62d + 434d	62d + 116d + 365d	34d + 116d

Results:

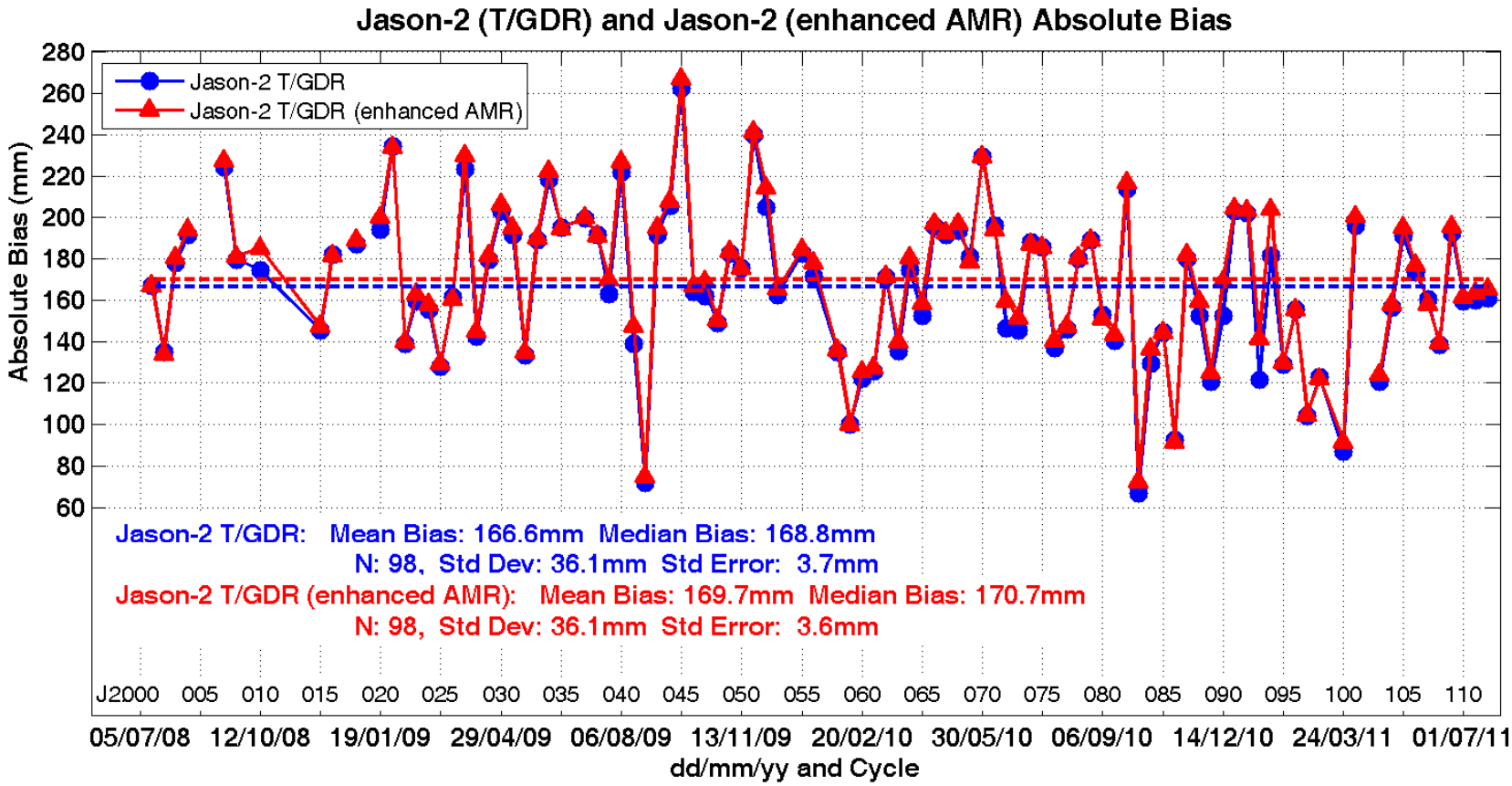
OSTM/Jason-2 Absolute Bias

2. OSTM/Jason-2

- Closer look at bias record cycles 001-112.
- Influence of T/GDR AMR vs enhanced AMR
- Influence of GSFC orbit vs GDR orbit

Results:

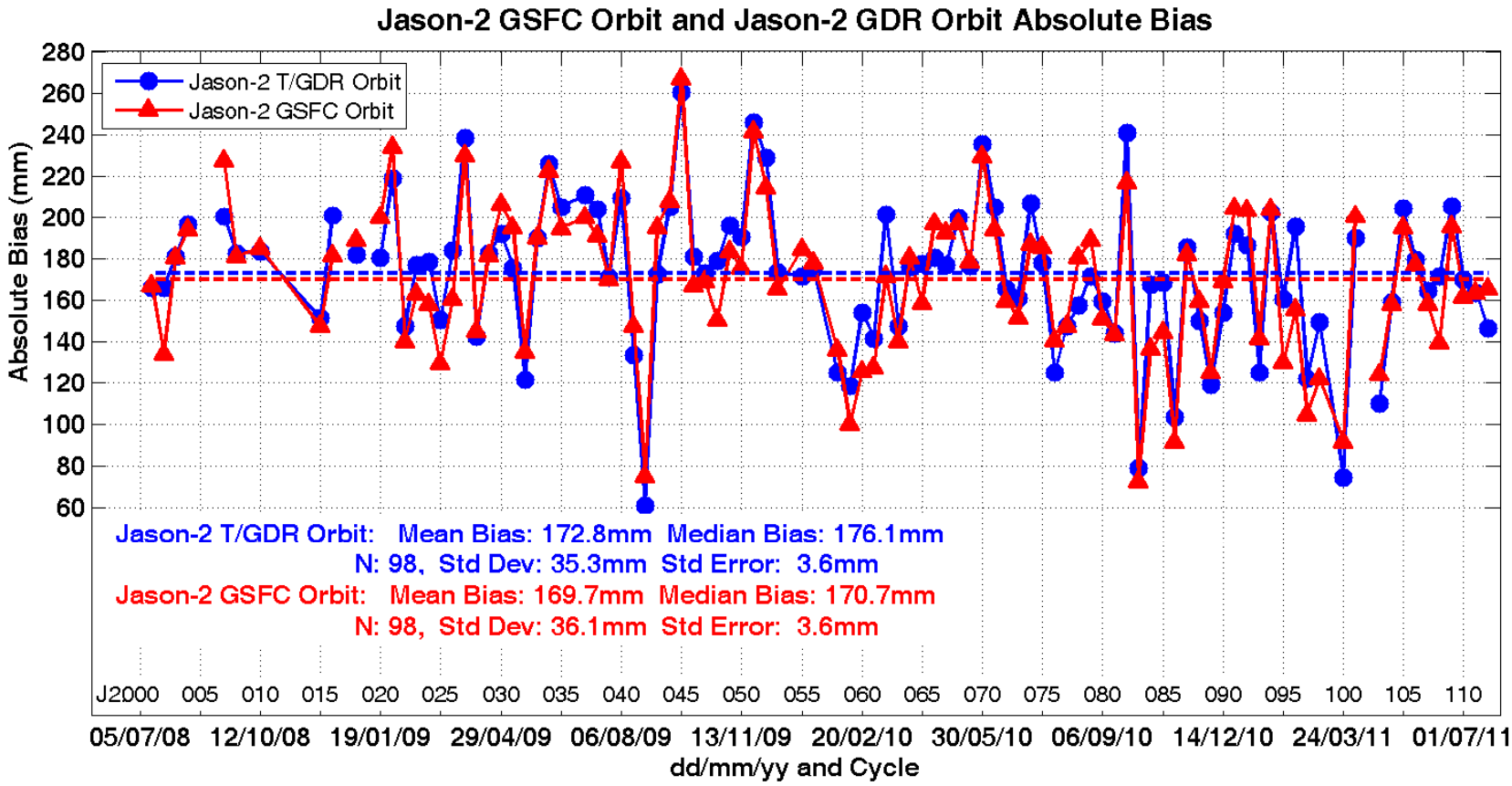
OSTM/Jason-2 Absolute Bias: Bass Strait



- **Using the enhanced AMR product increases the bias by 3.1 mm (standard deviation of the difference time series is 4.1 mm).**

Results:

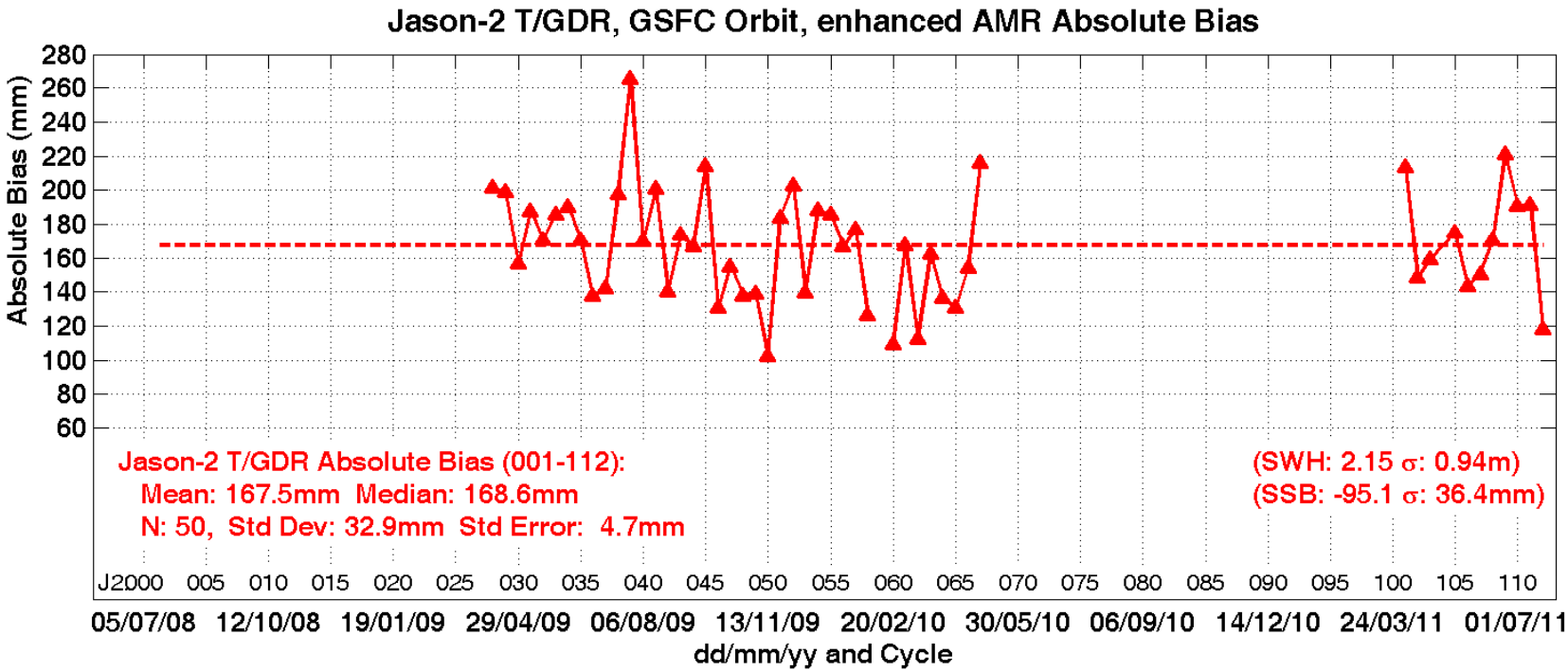
OSTM/Jason-2 Absolute Bias: Bass Strait



- **Using the T/GDR orbit over the GSFC orbit increases the bias by 2.1 mm (standard deviation of the difference 15.2 mm).**

Results:

OSTM/Jason-2 Absolute Bias: Storm Bay



- Preliminary bias estimates from Storm Bay, using the only available mooring data, show a comparable bias to Bass Strait (c.f 169.7 mm)
- Detailed comparison requires additional mooring data, ongoing analysis and refinement of datum.

Conclusions

Data	Cycles	N	Mean Bias ± Std Error
TOPEX Side A (GSFC Orbits, corrected TMR, Chambers SSB)	001-235	195	**- 8.1 ± 1.9 mm**
TOPEX Side B (GSFC Orbits, corrected TMR, Chambers SSB)	236-365	114	**+ 1.8 ± 2.9 mm**
Jason-1 GDR-C (GSFC Orbits, enhanced JMR)	001-259	234	**+105.1 ± 2.4 mm** Decrease by ~10 mm if using GDR JMR
OSTM/Jason-2 T/GDR (GSFC Orbits, enhanced AMR)	001-112	98	**+169.7 ± 3.6 mm** Decrease by 3.1 mm if using GDR AMR Increase by 2.1 mm if using GDR orbits

- **Recall that non-time averaging systematic error contributions likely dictate that the "absolute" error is ~15 mm for these estimates.**

Questions?

Christopher Watson[1] , Neil White[2], John Church[2]
Reed Burgette[1], Paul Tregoning [3], Richard Coleman[4]

1 University of Tasmania (cwatson@utas.edu.au)
2 Centre for Australian Weather and Climate Research, A partnership between CSIRO and the Australian Bureau of Meteorology
3 The Australian National University
4 The Institute of Marine and Antarctic Studies, UTAS

IMOS
Integrated Marine Observing System

UTAS

CSIRO

ANU
THE AUSTRALIAN NATIONAL UNIVERSITY

IMAS

OSTM/Jason-2
OST Science Team Meeting

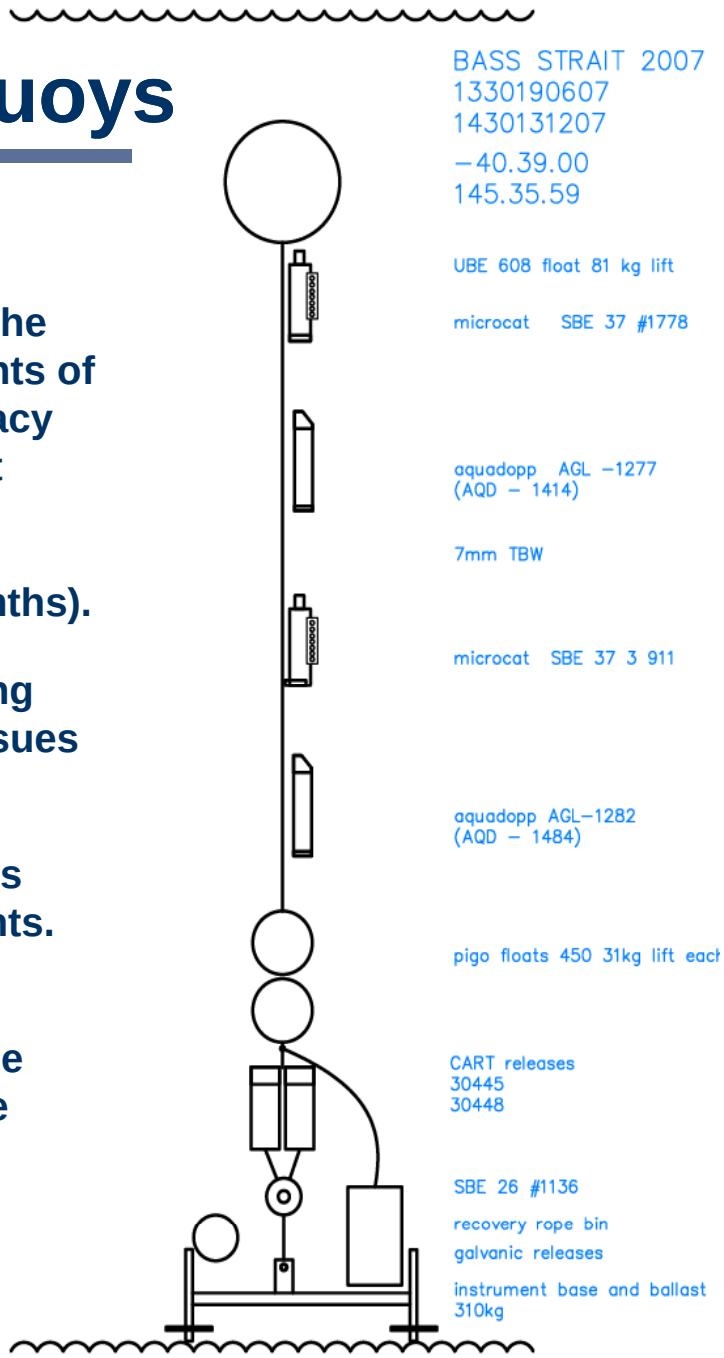
Updated Data Stream Presentation
San Diego OSTST Meeting
October 2011

Spares…

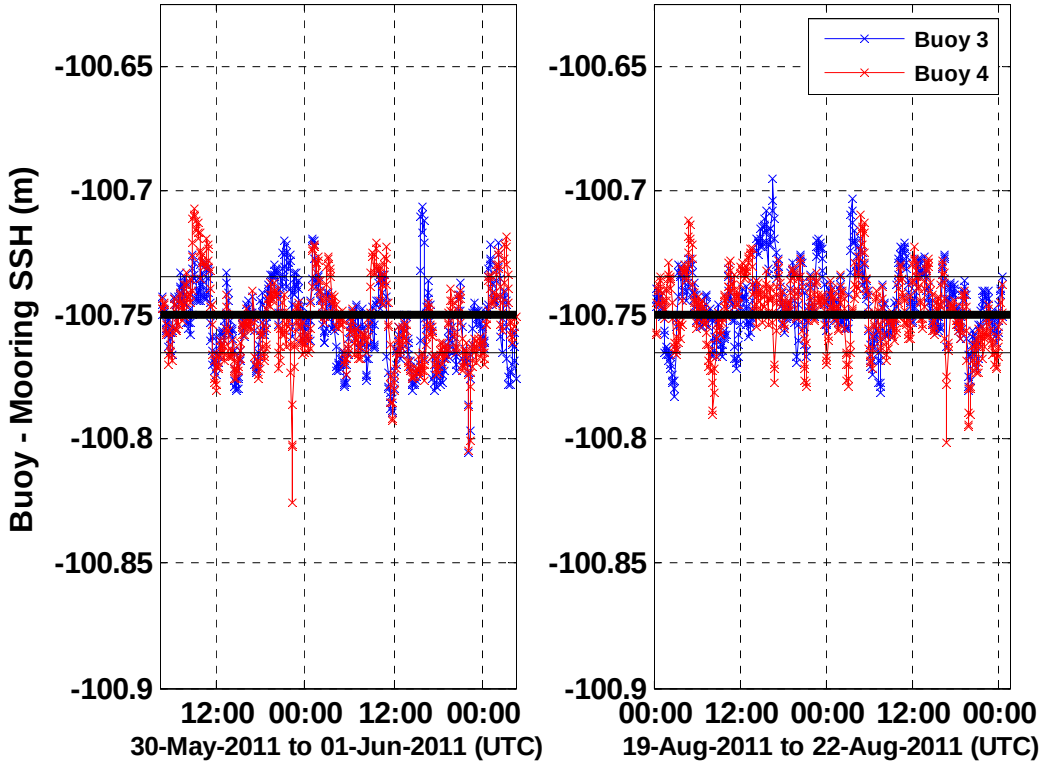
Instrumentation:

Ocean Moorings & GPS Buoys

- We derive a precise SSH time series, directly at the altimeter comparison point using two deployments of moored oceanographic instruments (high accuracy pressure gauges, Seabird TS meters and current meters).
- Mooring deployments 2008-09 (1 year), 2011 (6 mths).
- Unfortunately, 6 months of mooring data following the previous OSTST was lost due to technical issues with SBE26 pressure gauges.
- The datum of each mooring-derived SSH series is determined using episodic GPS buoy deployments. *(Datum shift = GPS SSH – Mooring SSH)*
- Outside the mooring deployment window, the tide gauge data can be tidally corrected to best fit the ensemble mooring series.



GPS Buoy vs Mooring SSH: Storm Bay



- Slight improvement in the precision at Storm Bay due to improved GPS network geometry.
- Note increased water depth at this site (~101 m vs ~53 m at Bass Strait).