First Marine Gravity field results from Jason-2 Long Repeat Orbit mission

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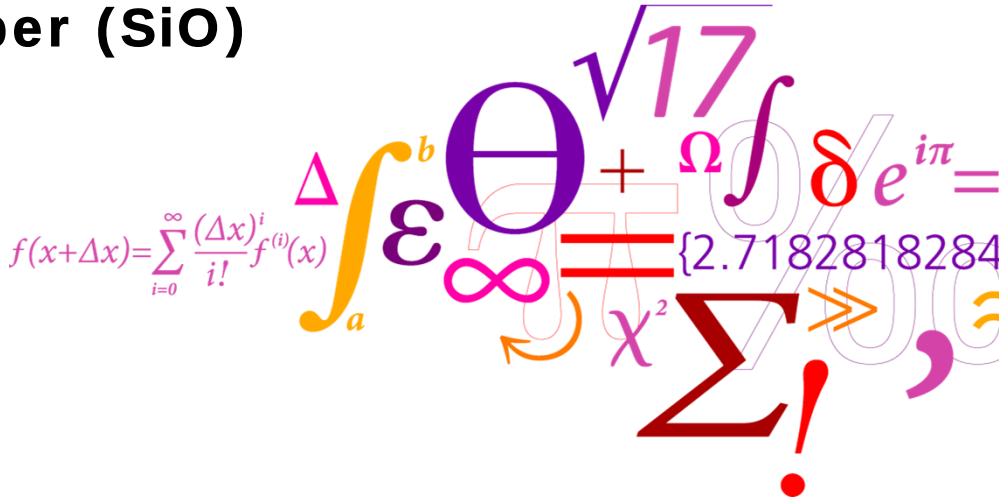


DTU Space
National Space Institute

Geodetic Missions investigated.

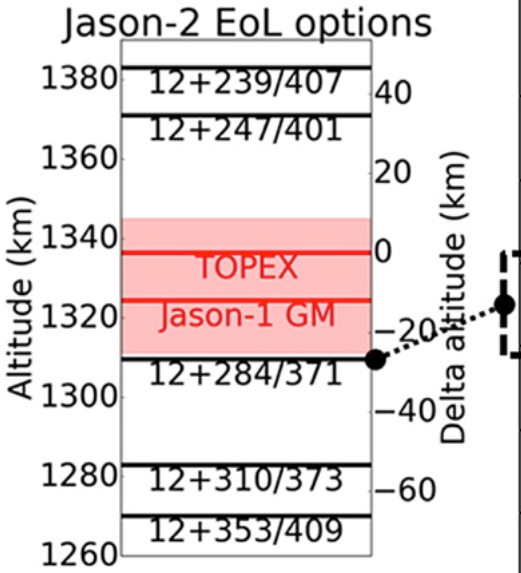
• JASON-1 EOL

- April 2012 – May 2013
- Jason-1 Extension-of-Life Scenario
- 1320 km orbit
- Low inclination (66º)
- 406 Days GM
- Track Spacing = 7.5 km

• JASON-2 LRO

- Initiated June 2017 –>
- 371 days cycle.

Investigating possible / optimal Jason-2 LRO orbits (G. Dibarboure)



				A	B	C	D	
Altitude (km)	Delta Altitude (km)	Number of Revs per day	Sub-cycles (days, negative is westard)	Mesocale sampling uniformity (Jason-2 EoL + Jason-3)	Geodetic sampling uniformity (Jason 2 EoL + Jason1 GM)	Overlap event uniformity	Satellite debris (collision risk)	Tentative Priority
1383.0	46.7	12+239/407	-2, 5, -17, -63, -172, 407	Excellent	Good	Very Good	Medium	3
1371.0	34.7	12+247/401	3, -5, 13, 138, 401	Very Good	Good	Excellent	Good	2
1309.5	-26.8	12+284/371	-4, 17, 81, 145, 371	Excellent	Very Good	Very Good	Very Good	1
1282.9	-53.4	12+310/373	-6, -77, -148, 373	Good	Very Good	Very Good	Very Good	2
1277.3	-59.0	12+322/381	-6, 13, -71, 155, 381	Good	Very Good	Very Good	Very Good	2
1270.0	-66.3	12+353/409	-7, 22, -73, 168, 409	Very Good	Medium	Excellent	Very Good	3

G. Dibarboure and R. Morrow, 2016: Value of the Jason-1 Geodetic Phase to Study Rapid Oceanic Changes and Importance for Defining a Jason-2 Geodetic Orbit. J. Atmos. Oceanic Technol., 33, 1913–1930, doi: 10.1175/JTECH-D-16-0015.1.

JASON-2 EOL Long Repeat orbit

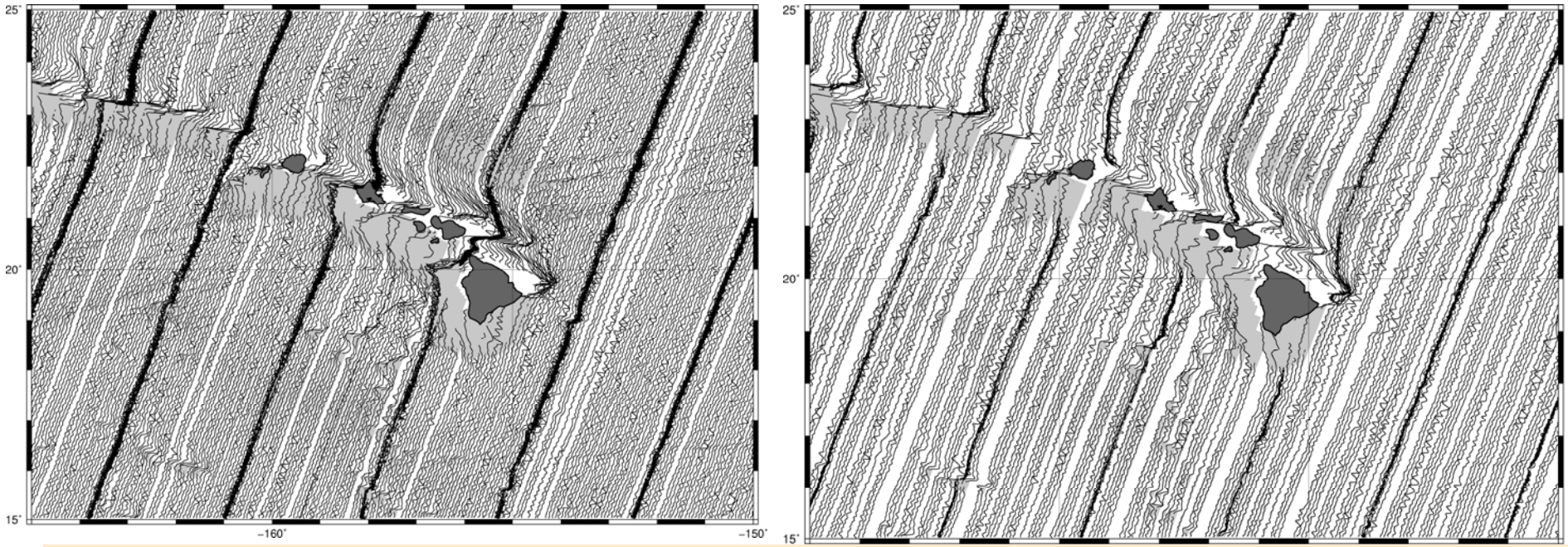
Altitude 1309 km (Jason-3 alt -27 km):

1. **It has a 17-day sub-cycle that is good for mesoscale monitoring because it blends well with the 10-day cycle of Jason-3.**
2. It has a 145-day sub-cycle and a 371-day repeat cycle that are good for geodesy: the final grid is close to the Jason-1 GM grid. If Jason-2 EoL was to die after only half the repeat cycle, it would still provide a coarser but globally homogeneous dataset for geodetic users.
3. It has a 4-day sub-cycle that is favorable for sea state applications (e.g. assimilation in operational wave models) and that blends well with Jason-3's 3-day sub-cycle.
4. It generates overlap events with Jason-3 that are well distributed at all time scales. There are no empty bins for the 10-day criterion, and only 3 empty bins for the 1-day criterion. This orbit yields a high probability of collecting an overlap sample in any region, season, and for any time difference.
5. **IT HAS A BENEFITIAL SUBCYCLE IN CASE OF EARLY FAILURE**

along-track sea surface slope over Hawaii

- JASON-1 (14 month)

JASON-2 (12 + 1 month)



Status:

Jason-2 completed first LRO cycle.

Several safeholds is visible but not critical due to orbit choice.

Entered second cycle since july 2018 with ground tracks shifted by 4 km.

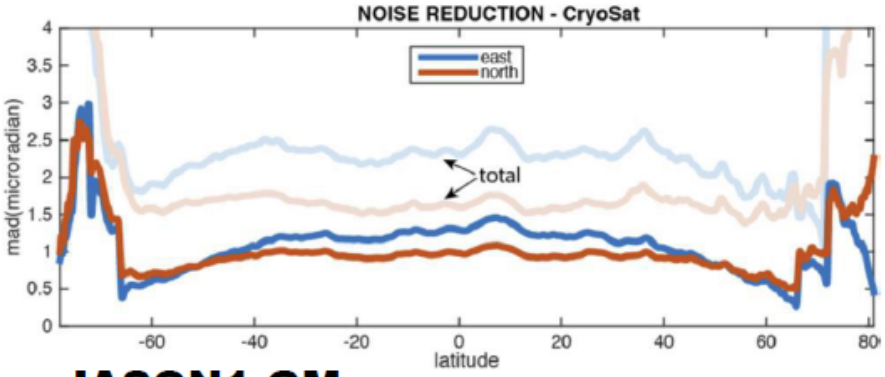
Jason-1

- Gravity noise reduction from Jason-1 GM is very good despite the short time series (4 times less than CS-2), thanks to the 66° orbit
- Greatest gravity improvement
  - at latitudes lower than 40°
  - in the east-west direction

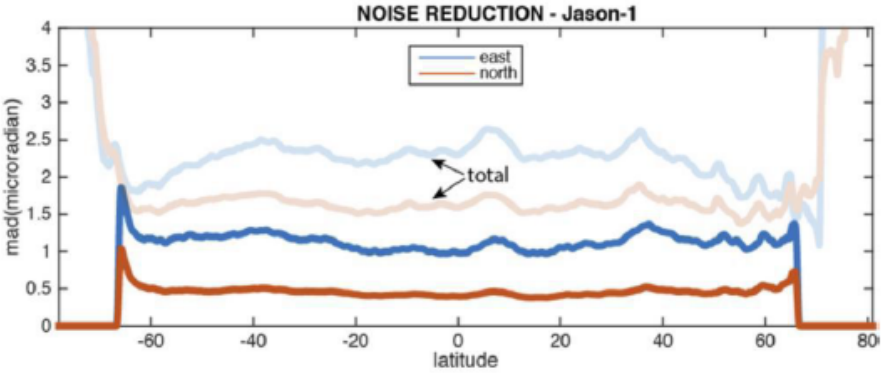
Jason-2

- Resolution of current gravity models is 12 km (6km features)
- Difficult to improve upon with CryoSat alone (8-km fixed grid) or AltiKa (uncontrolled drift)
- Jason-2 is the only mission that can yield a 4-km grid after 2 years (and a 2-km grid after 4-years)

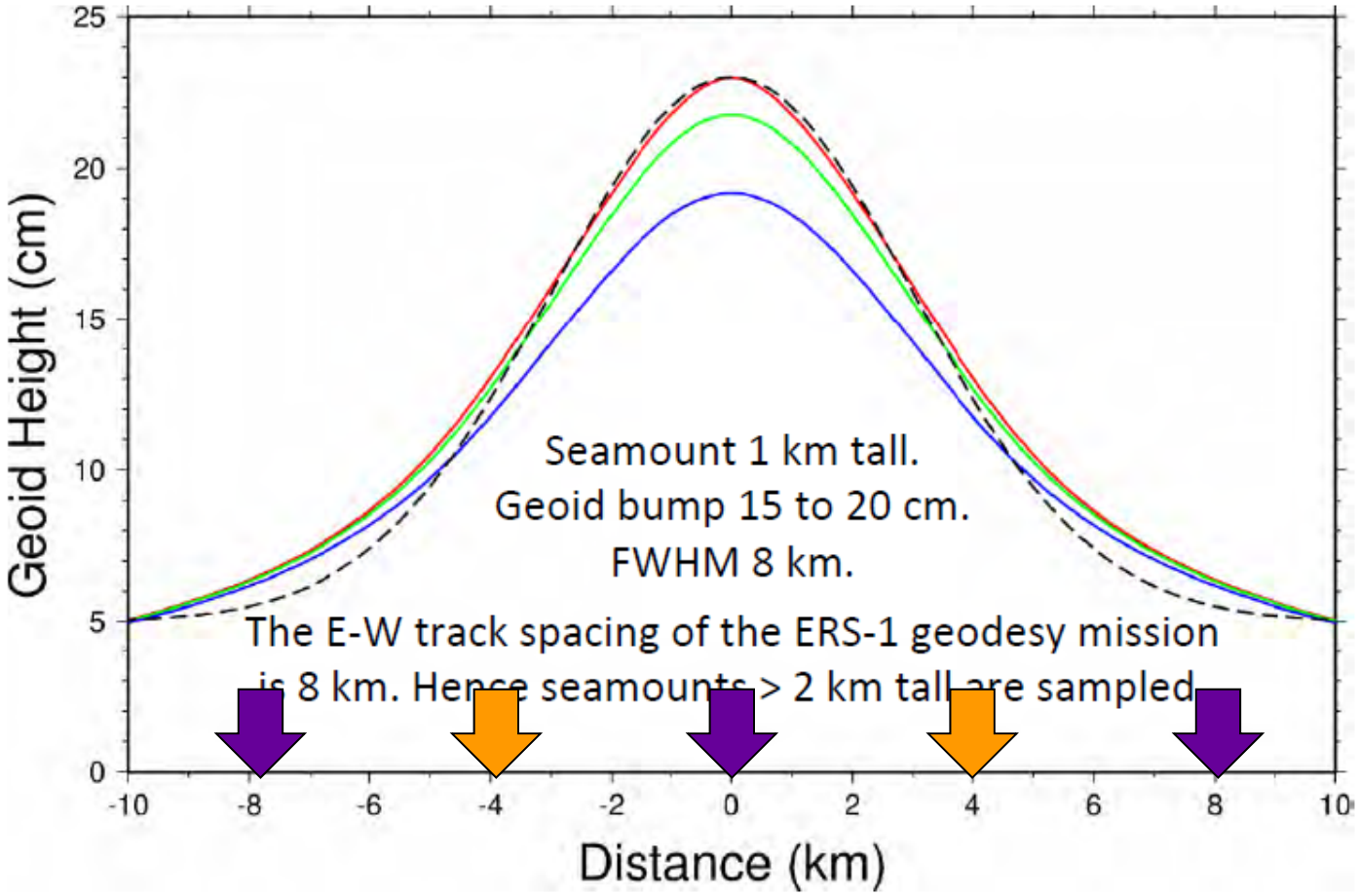
CRYOSAT-2



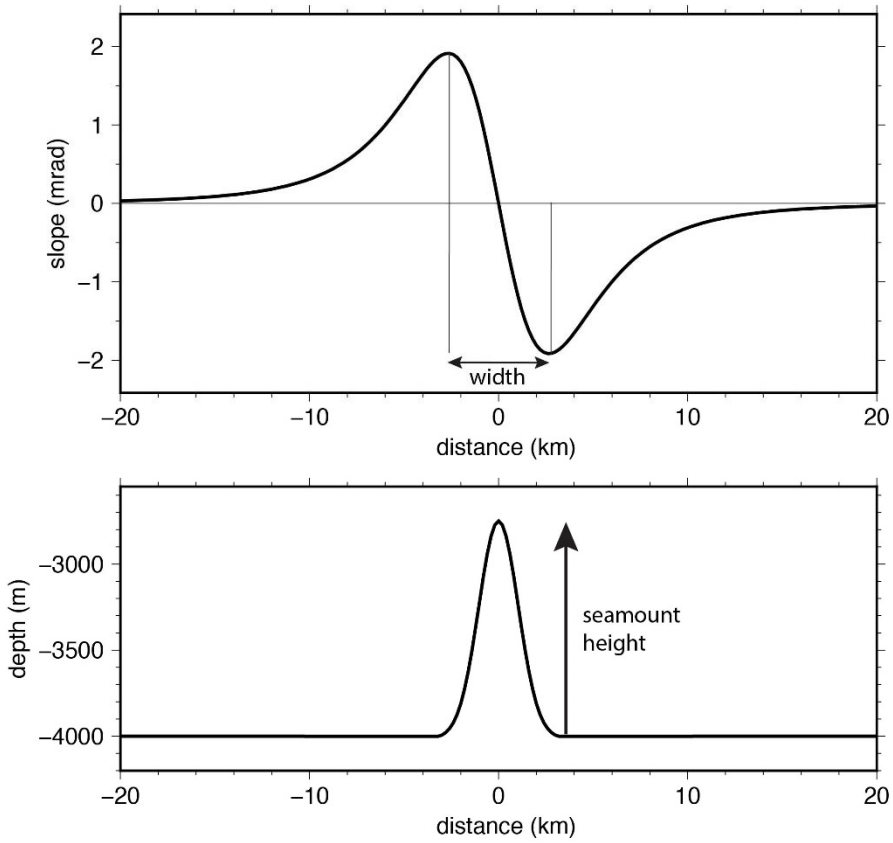
JASON1-GM



Mapping requires spatially dense ground tracks

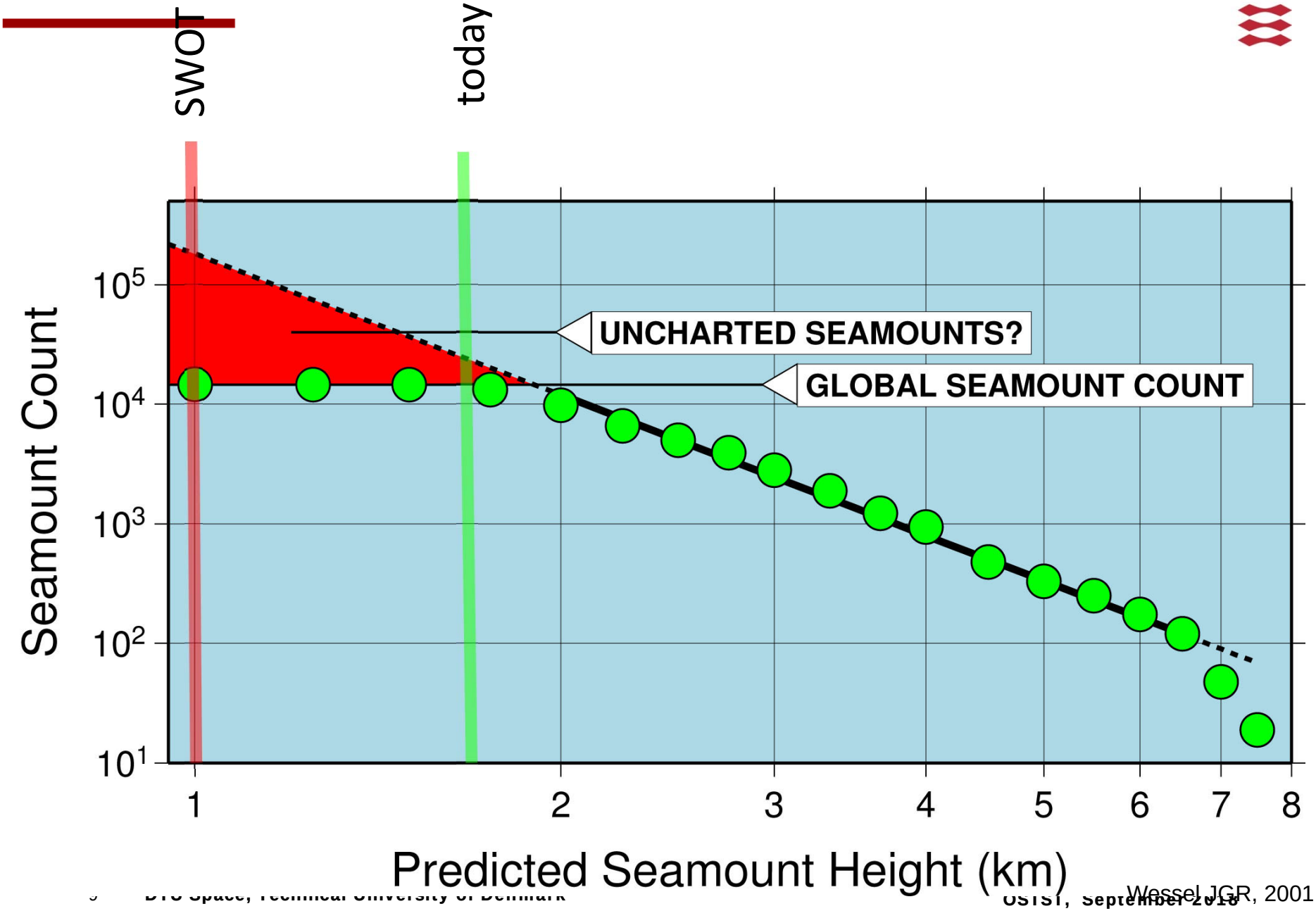


Signal of Gaussian Seamount



seamount		sea surface		
height (km)	radius (km)	slope (μrad)	width (km)	Δheight (mm)
1.00	**2.50**	**1.0**	**5.2**	**5.2**
1.25	3.13	1.9	5.3	10.1
1.50	**3.75**	**3.2**	**5.4**	**17.3**
2.00	5.00	7.3	5.6	40.9
2.50	6.25	13.3	5.7	75.8
3.00	7.50	21.7	5.8	125.9

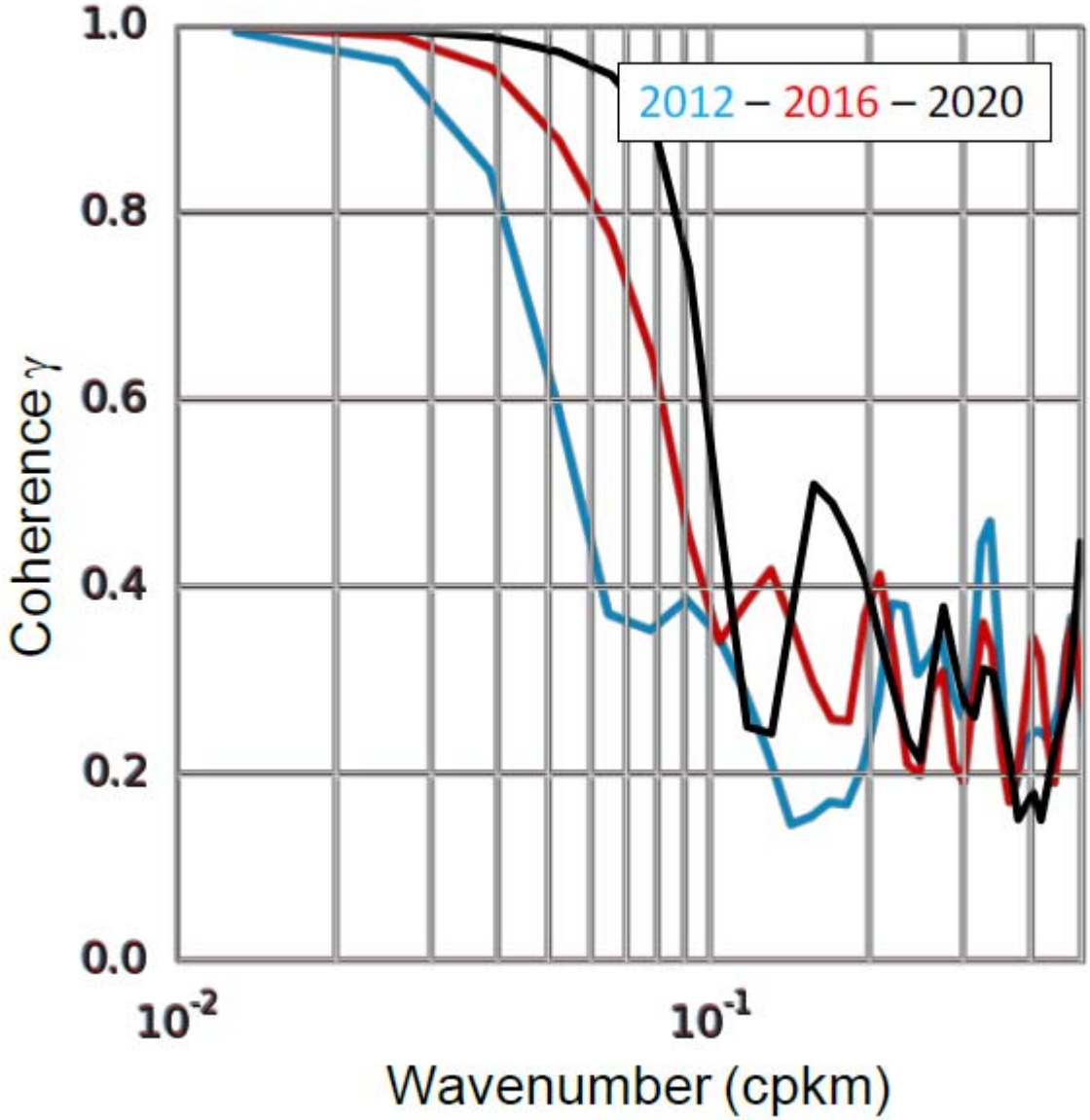
today



Wessel JGR, 2001

Importance of 4 year LRO (2 km)

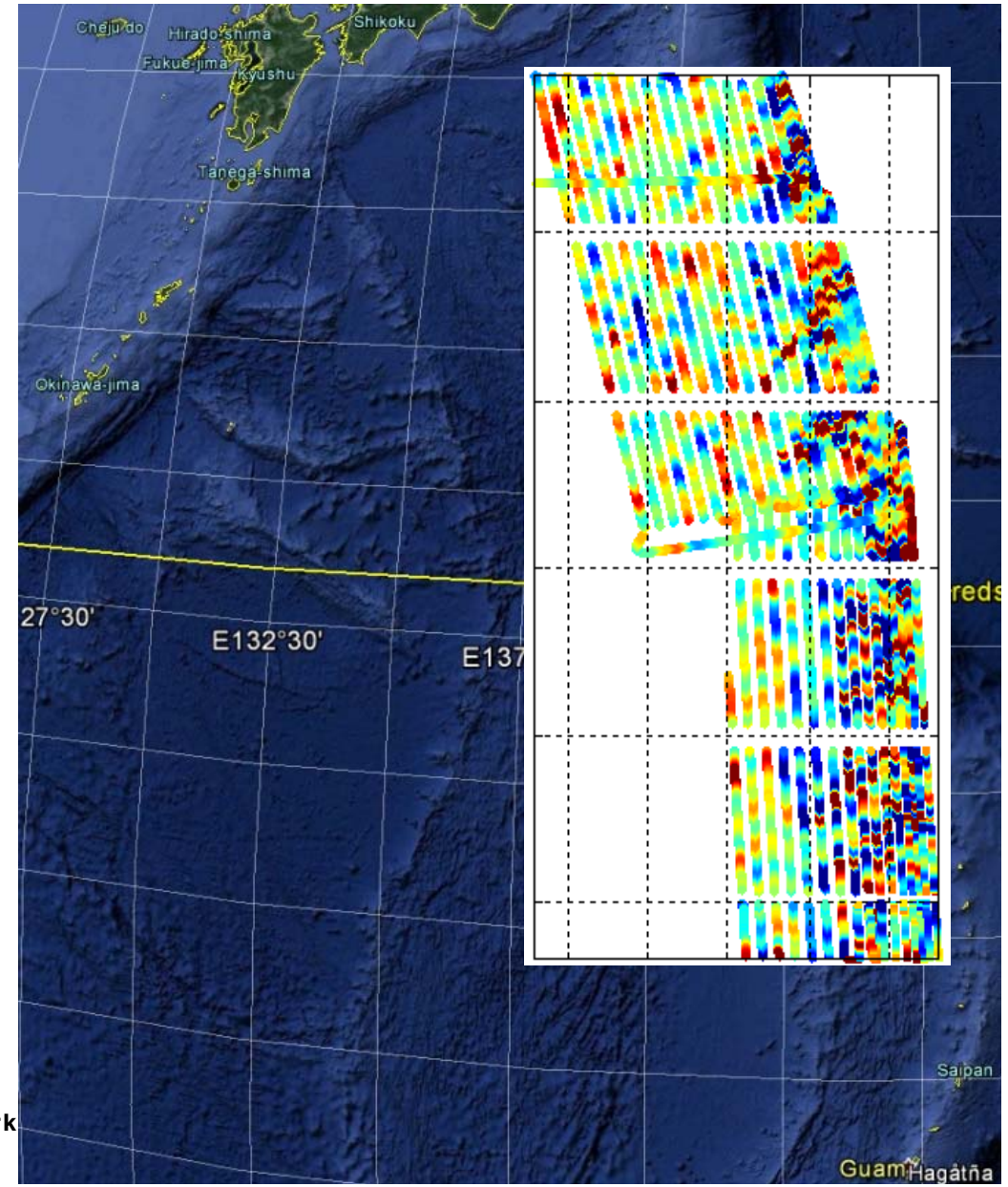
Will increase Resolution
to below10 km
⇒Resolve structures
smaller than 5 km
Typically being seamounts
Of 1 km size



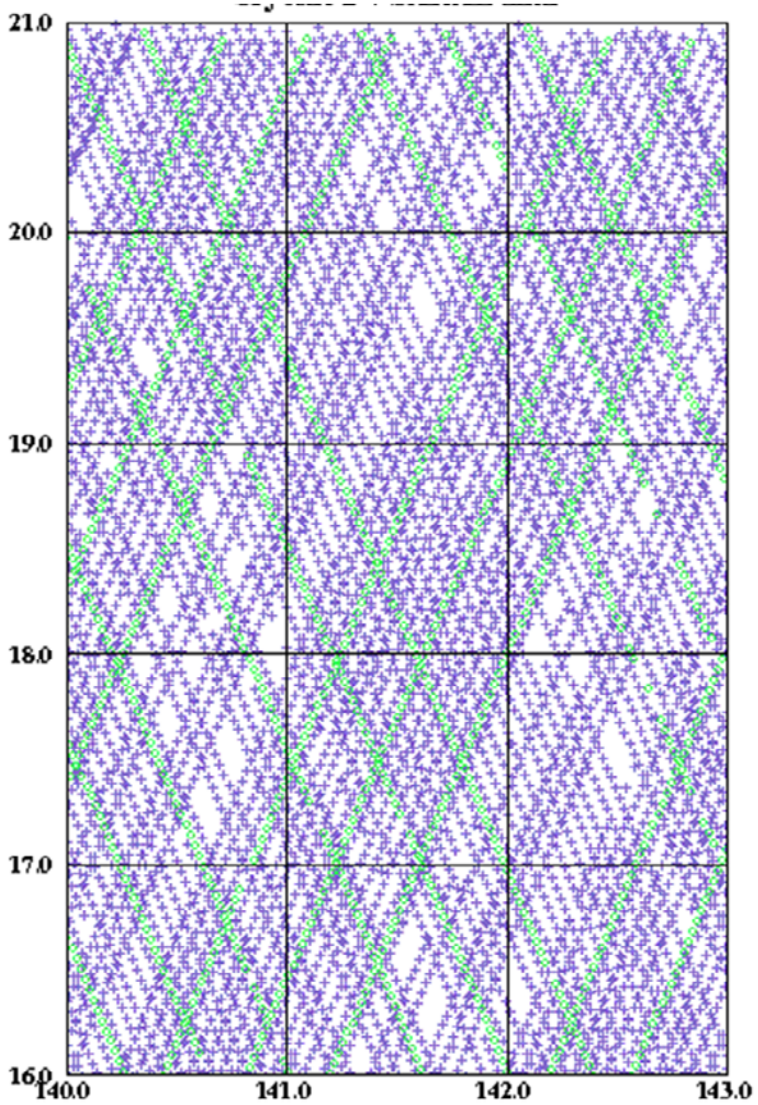
Range Precision (mm) and Data Volume of GM Altimeters at 20 Hz

Altimeter	Noise (mm) @ 2 m SWH	# at 20 Hz (10^6)
Geosat	57.0	517
ERS-1	61.8	442
CryoSat-2 LRM	43.7	2001
CryoSat-2 SAR	49.7	1010
Jason-1/2	43.0/43.0	402/344
Altika	29.0	847

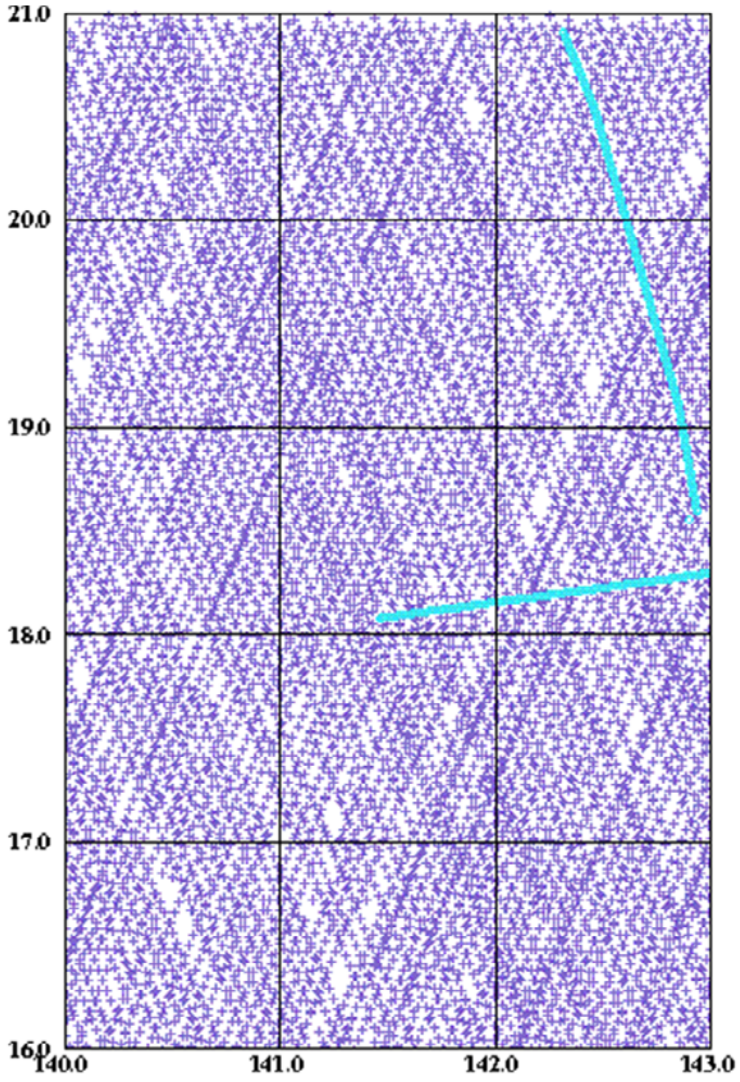
US Bowditch Survey near Guam



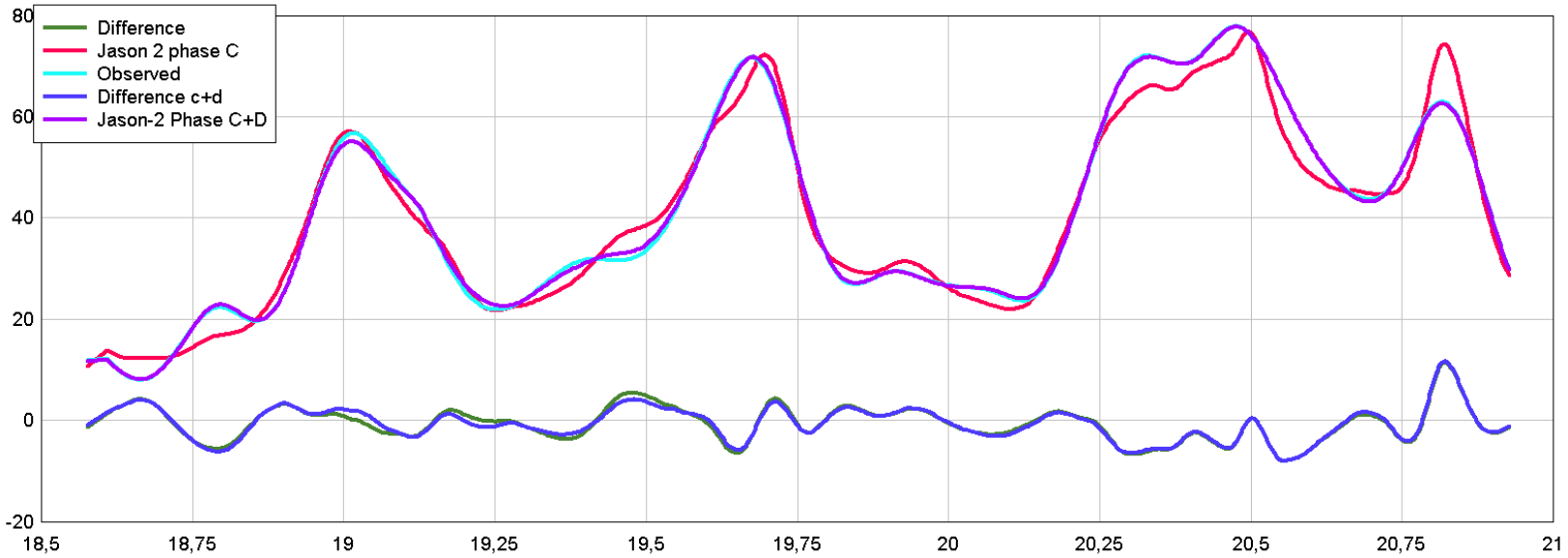
Guam Jason 2



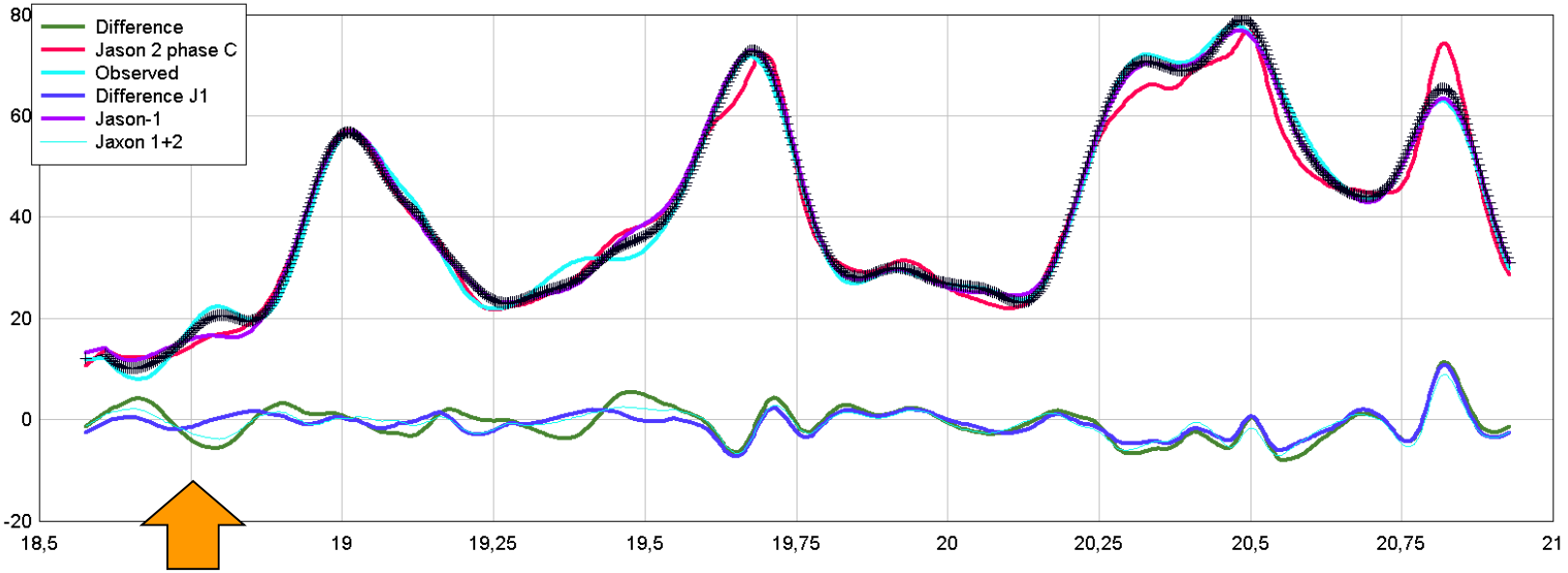
Jason 1 + Marine



Gravity from Jason 2 (LRO)



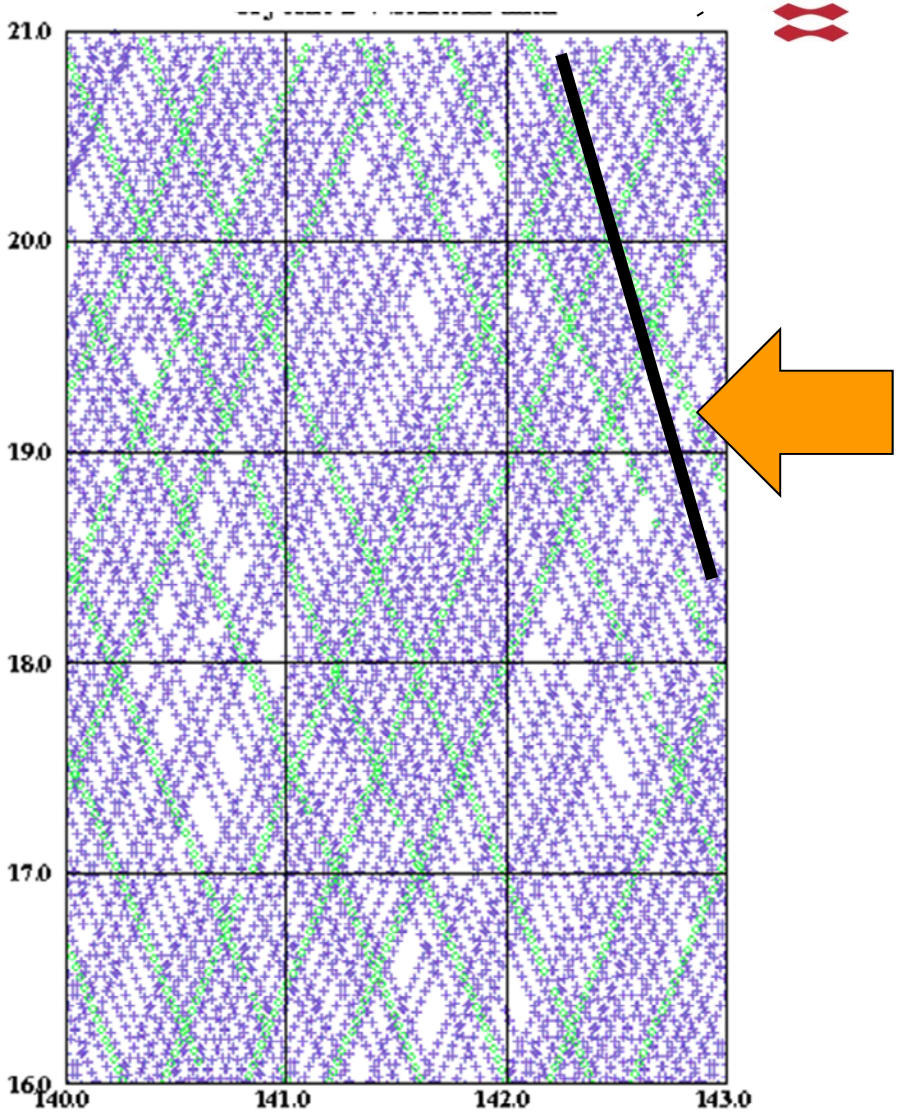
Combining with Jason 1



Comparison

	Std Diff
Jason 2 –LRO A	3.37
Jason 2 – LRO A+ 1month LRO B	3.25
Jason 1	2.55
Jason 1+2	2.52

Effect of J-2 LRO safehold mode



Summary

- First testing with Jason-2 LRO
- Data is of same quality as Jason-1 LRO
- Importance to continue mission
- Initial investigation saw effects of Safehold operations