Marine Gravity from the "First" two cycles of the Jason-2 LRO extension of Life mission

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Outline

Jason-2 Long Repeat Orbit choice

Impact of Safe-holds

Gravity field Modelling.

Jason-2 Extension of Life Orbit

Altitude 1309 km (-27 km rel to 1336 km nominal orbit
371 day repeat
4,17,81,145 days sub-cycles

Main argument for orbit choice (to optimize operational usage):

17-day sub-cycle is good for mesoscale monitoring because it blends well with the 10-day cycle of Jason-3.

The 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.

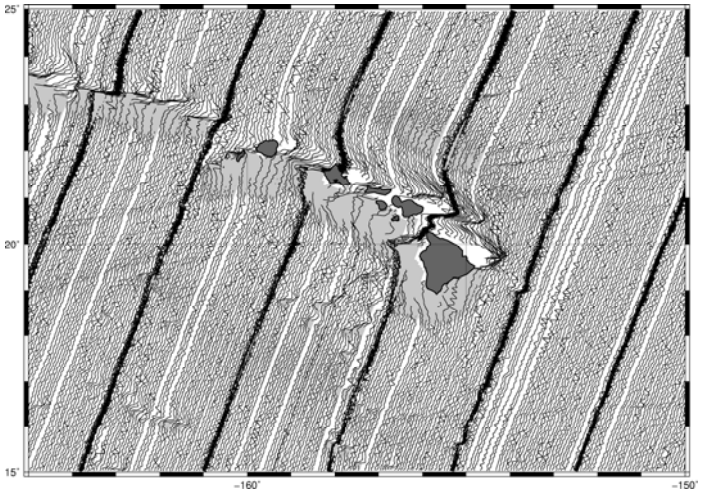
The 4-day sub-cycle that is favorable for sea state applications (e.g. assimilation in operational wave models) and that blends well with Jason-3's 3-day sub-cycle.

IT HAS A BENEFITIAL SUBCYCLE IN CASE OF EARLY FAILURE

Jason-2 LROs:

Start date	End date	Comments
11 May 2017	18 July 2018	371 days
18 July 2018	25 July 2018	Transition to LRO 2
25 July 2018	1 October 2019	431 days?

Jason-2 LRO-1 (371 days repeat)



Jason-1 (408 days repeat)

Plots courtesy of D. Sandwell

Jason-2 Safeholds:

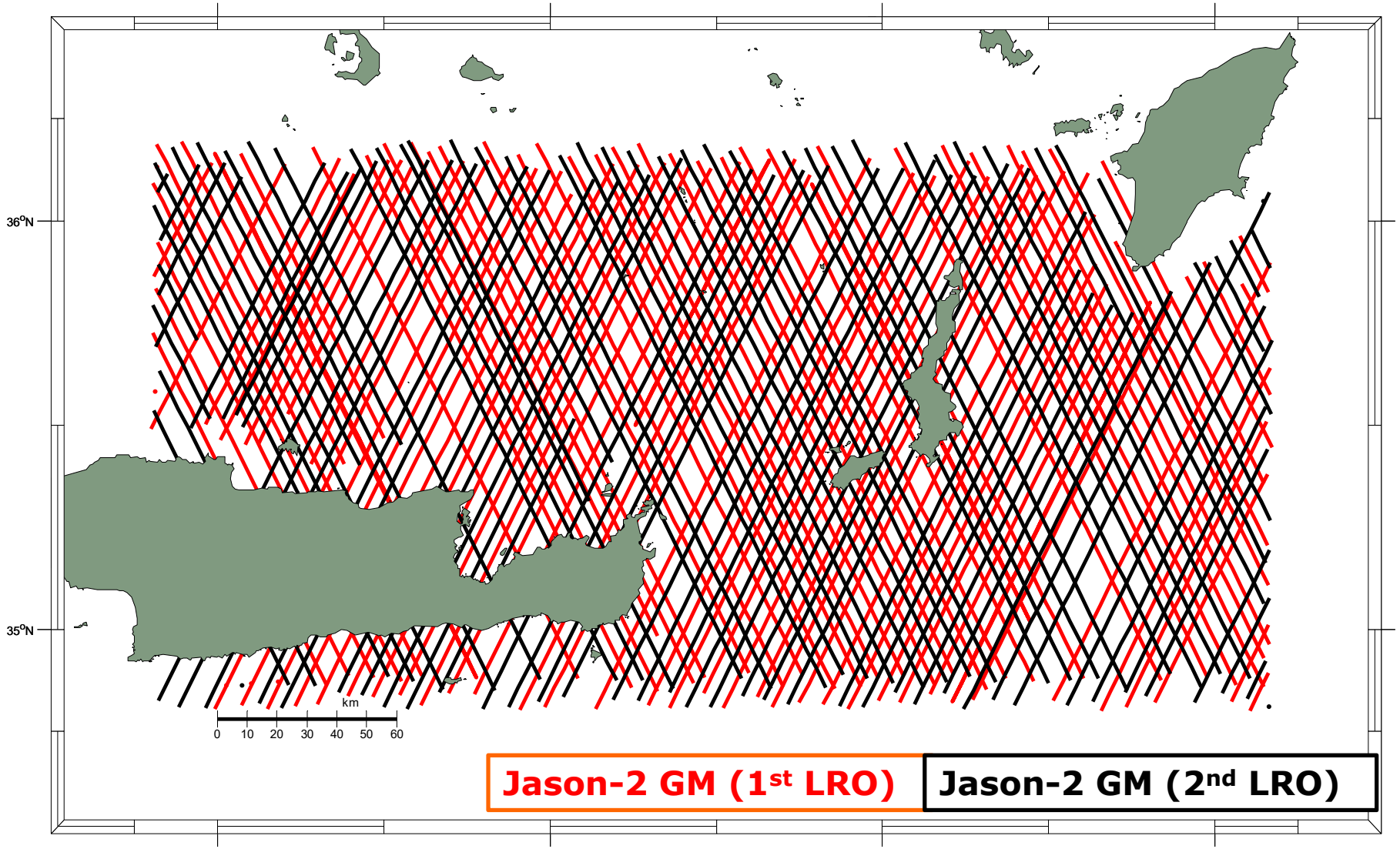
Start date	End date	Duration / Comments
17 May 2017	11 July 2017	Transition to LRO 1 (20 days)
14 Sept 2017	13 Oct 2017	31 days
20 Feb 2018	02 March 2013	10 days
18 July 2018	25 July 2018	Transition to LRO 2 (7 days)
19 Oct 2018	25 Oct 2018	6 days
26 Dec2018	07 Jan 2019	14 days
16 Feb 2019	28 May 2019	**100 days**
01 Oct 2019	**End of Mission**	

Late may 2018 Jason-2 was rewinded using sub-cycles (4,17,81,145 days sub-cycles), by 81 + 17 = 99 days.

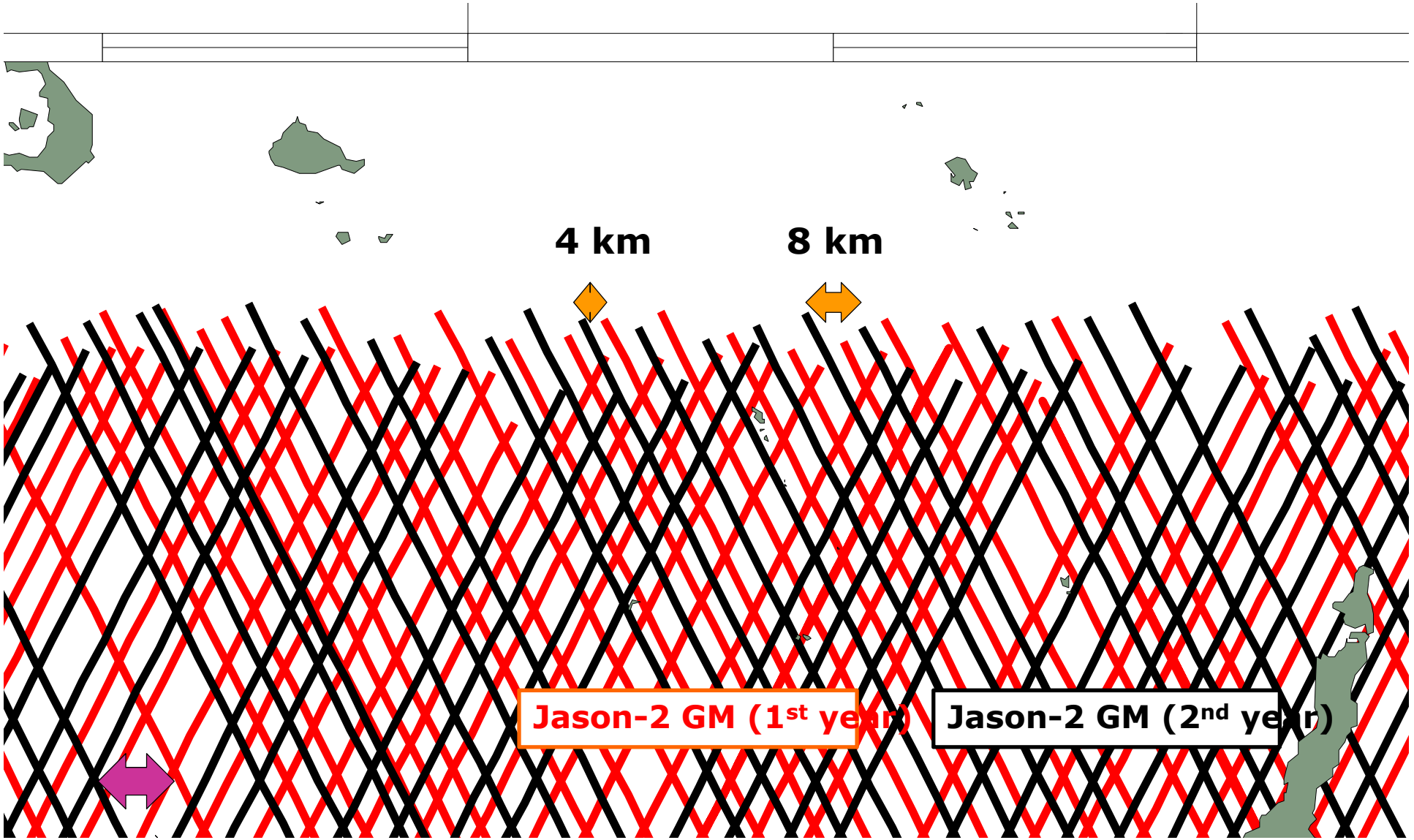
Completion: LRO-1 = (330 days out of 371) ~ 85 %

LRO-2 = (311 days out of 371) ~ 83 %

Jason-2 GM track distribution



Across-track distance:



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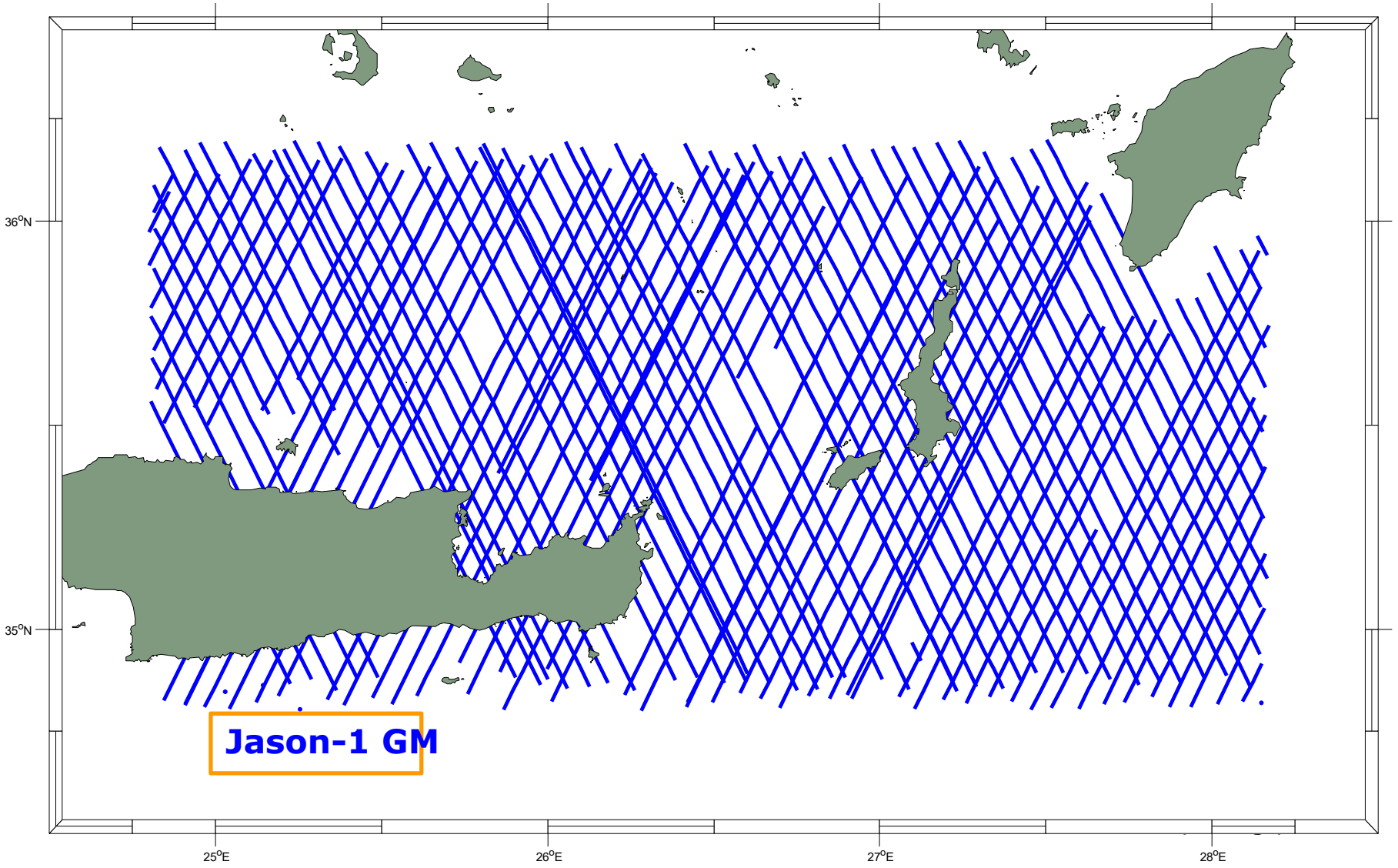
Jason 1 GM tracks



Range Precision (@ 20/40 Hz)

Altimeter	3-PAR @ 2 m
Geosat	88.0
ERS-1	93.6
Envisat	78.9
Jason-1/2	75.9
CryoSat-2 LRM	64.7
CryoSat-2 SAR	49.5
AltiKa	**34.3**

Key is RANGE PRECISION

More precise SSH =>

More accurate Gravity

ACCURACY is of less importance

$$\Delta g = L_{\Delta g}(T) = -\frac{\partial T}{\partial r} - 2\frac{T}{r} \approx -\frac{1}{\gamma}\left(\frac{\partial N}{\partial r} + 2\frac{N}{r}\right)$$

Relevant steps:

SSH/ΔSSH Interpolated onto grid

Gravity is computed using FFT

Filtering:

Interpolation / gridding

FFT (Enhance short wavelength).

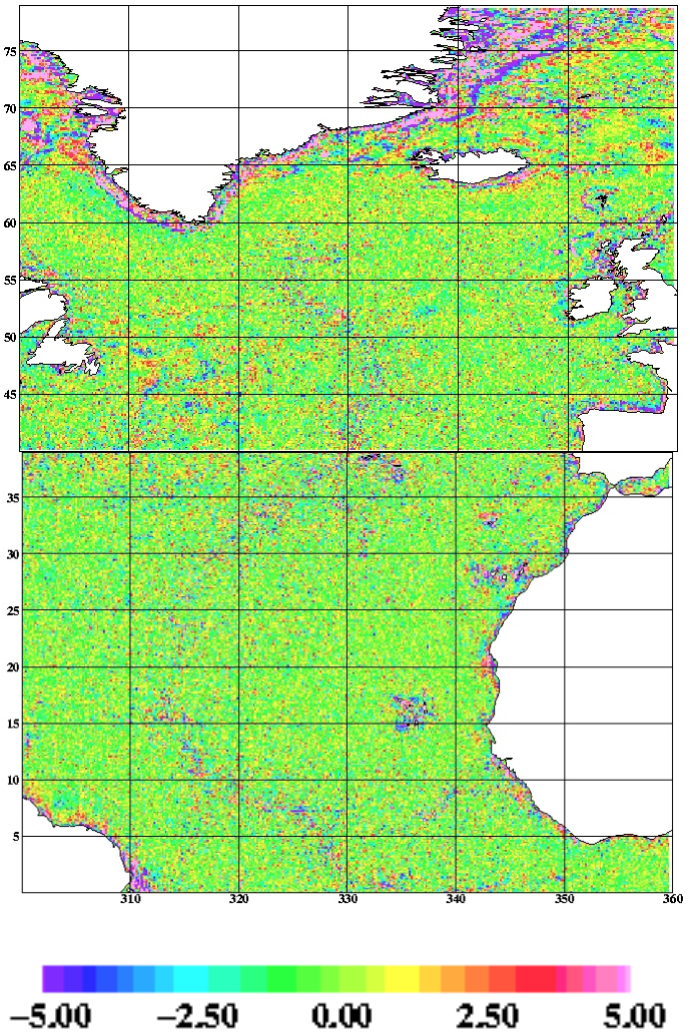
Spatial filtering

Half wavelength spatial filtering 5 km (DTU17).

Resolves increasingly more signal related to geophysical strutures

We get improvement from Adding more data……..

But we have NOT been able to Decrease spatial filtering (work in progress)



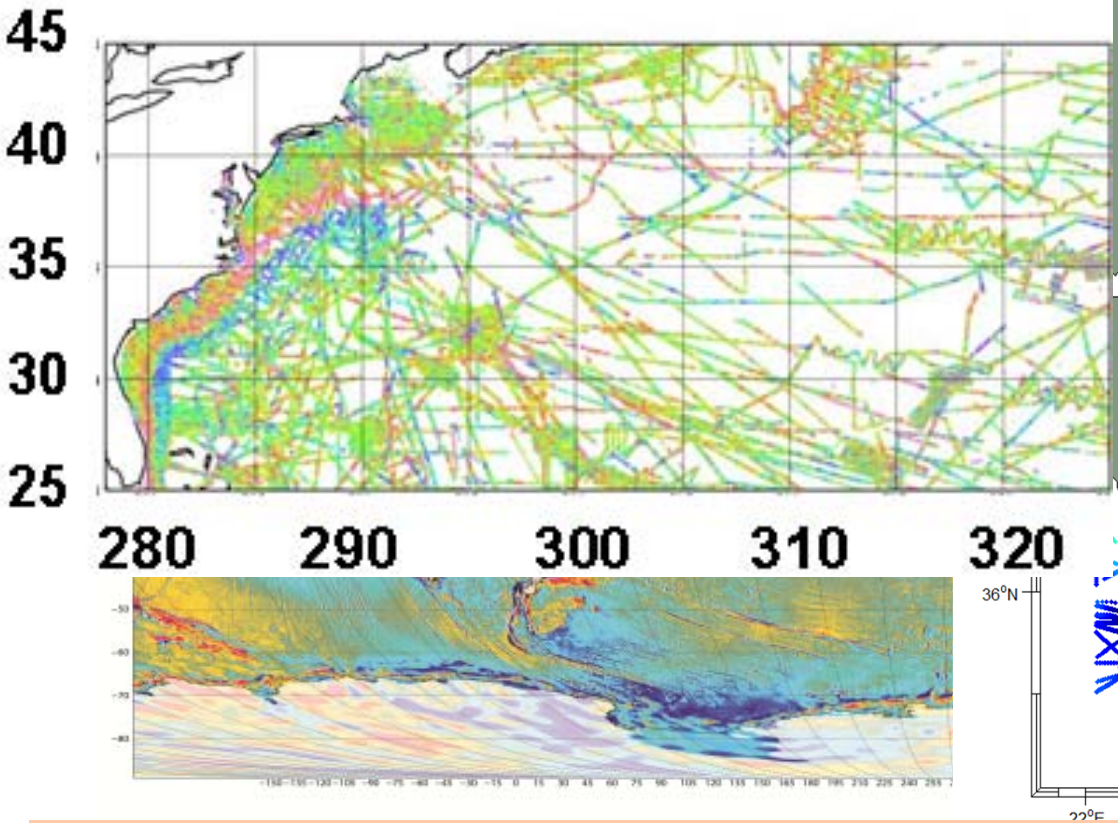
Illlustration

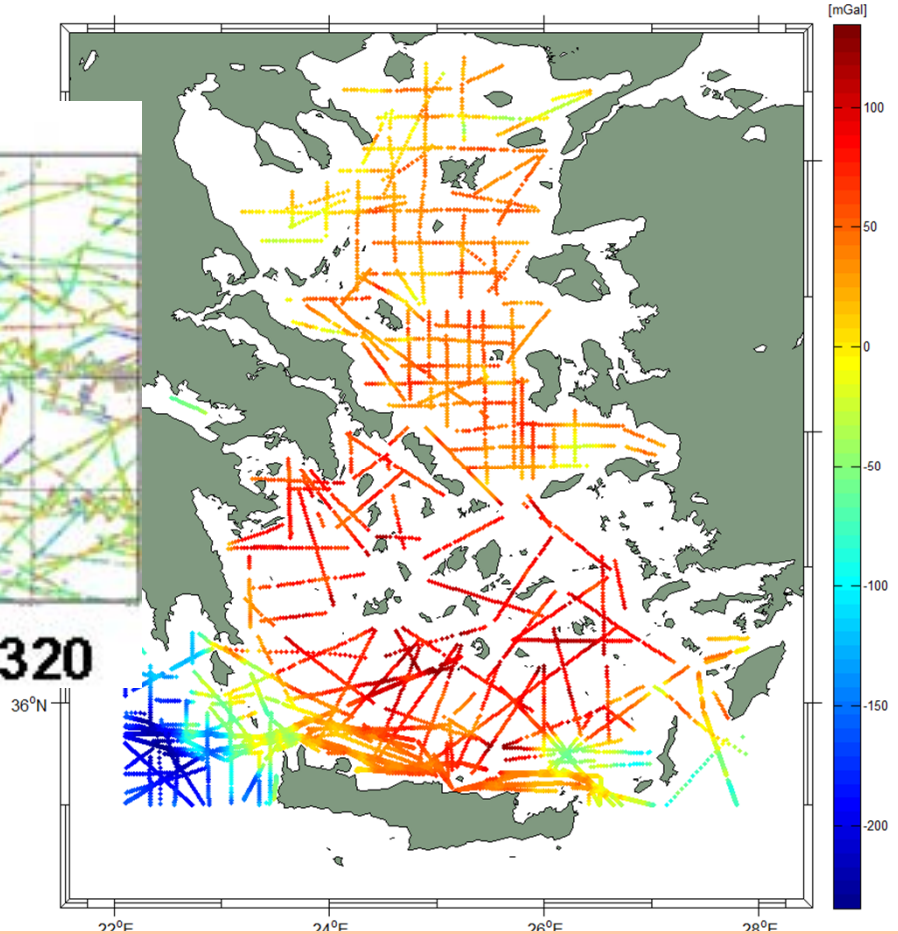
DTU15 – DTU10 where

HWL filtering from 6.5-5km

Test regions

NE Atlanti





Huge region (4000x6000 km:

1.4 mill NGA (< 2mGal accuracy)

Declassified data.

Small complex coastal region:

19456 Morelli+BGI obs (3-4 mGal)

Older marine data.

Aegean results:

Models	Mean	Std	Min	Max
EGM08	-0.70	7.05	-45.66	31.10
DTU17	-0.53	6.26	-45.67	29.07
PGM17	-1.01	6.71	-42.12	29.72

NW Atlantic:

Data	Std	Percent improvement
Jason-1 GM	2.76	
Jason-2 (1st year)	2.77	~-1 %
Jason-2 (2nd year)	2.78	~-1 %
Jason-2 (all)	**2.68**	**4%**
C2 only (8 years)	**2.66**	**5%**
SA only (3 years)	**2.67**	**4%**
Combinations:		
C2+SA+J1	**2.58**	**7%**
C2+SA+J2	**2.57**	**7%**

Unit: mGal

Summary.

- Impact of 2 cycle Jason-2 on gravity field modelling
- Problems due to Jason-2 safehold.
- Expect improvements (fine tuning filtering, retracking etc)
- Jason-2 LRO "orbit" is now taken (J-2 Graveyard).

- Future potential Jason-3 GM orbit must "start over".
- Important to rewind orbit to ensure spatial coverage.
- Important to initiate future GM as early as possible.

- Optimally FOUR interleaved LRO cycles could get 2 km resolution.

- SWOT will be a game changer