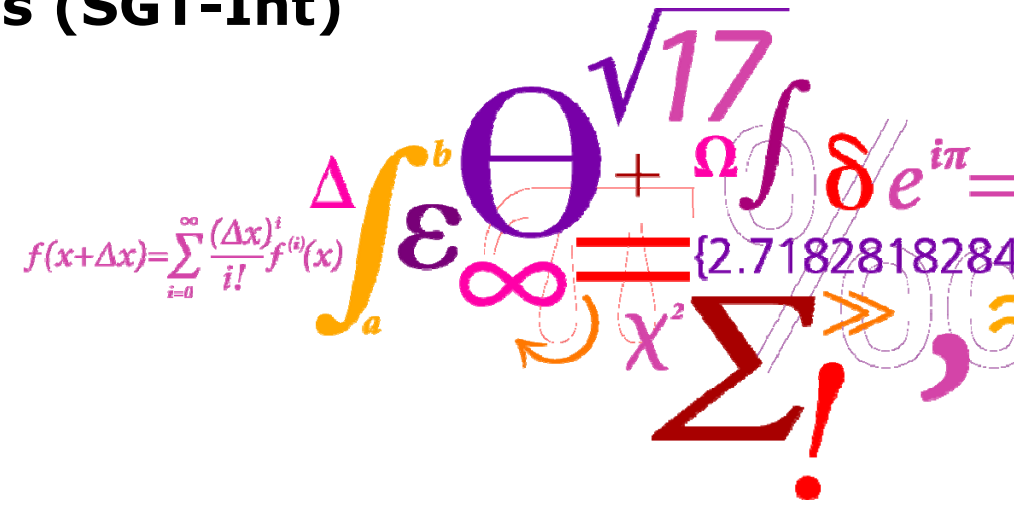
The DTU13 Global marine gravity field - first evaluation

Ole B. Andersen & Per Knudsen
Steve Kenyon, John K. Factor (NGA)
Simon Holmes (SGT-Int)



DTU Space
National Space Institute

Outline

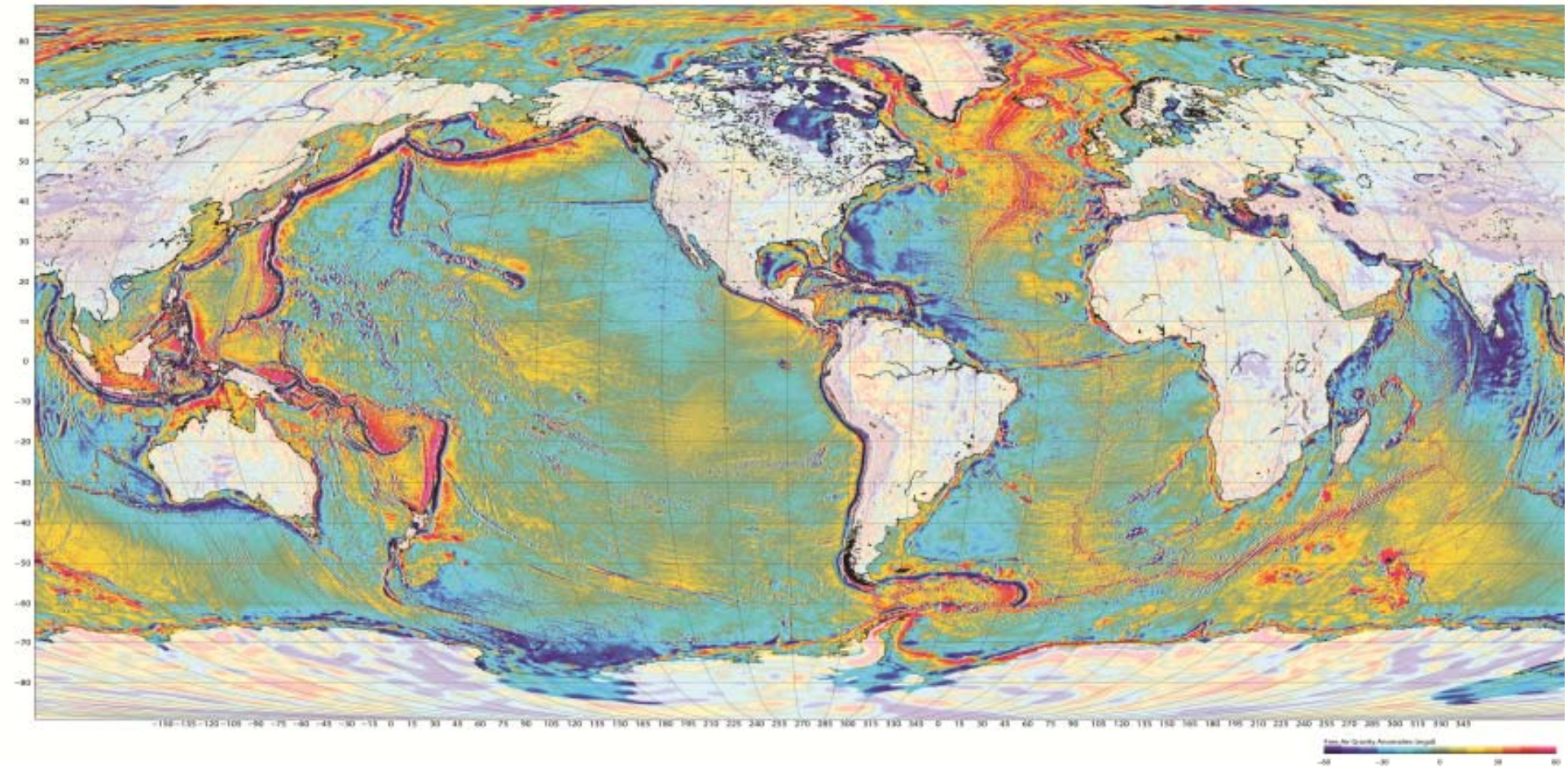
Steps towards DTU13

- **Introducing Cryosat-2 and Jason-1 GM**
- **LW residual SSH signal in EGM08/MDT (remove/restore)**
- **Cross-over adjustment**
- **Decreasing filtering (resolving finer scale signals)**

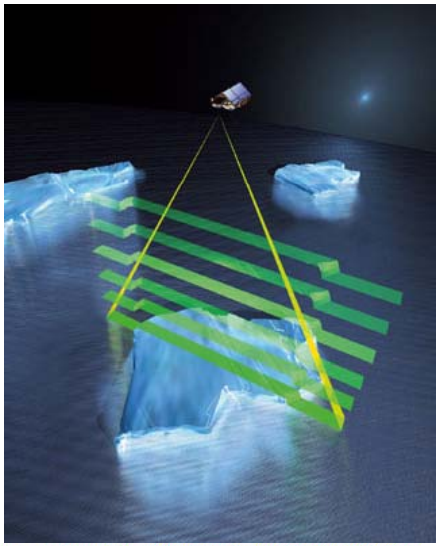
- **The Arctic Ocean – Completing global Coverage with C2**

- **Accuracy, Compasison with marine gravity**

DTU13 Free air global gravity is available

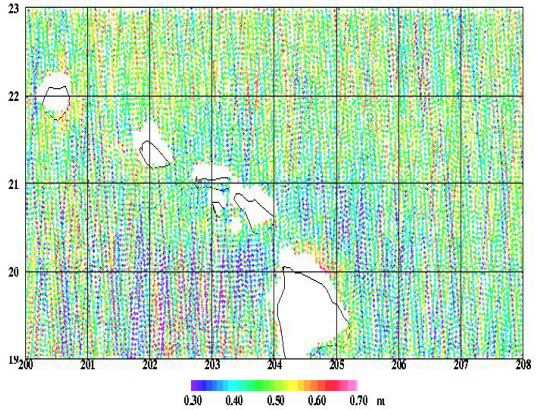


Two new "Geodetic" Missions



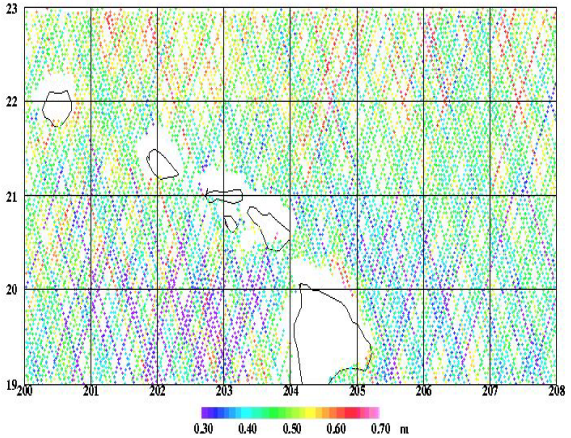
• CryoSat-2

- Cryosat-2 Launched April 2010.
- High Inclination (88º) – Covers most of the Arctic
- Completed 3 repeats of 369 days.
- Offers LRM, SAR and SAR-in altimetry.
- Track Spacing = 8 km
- Used 1 Hz data from RADS for DTU13



• JASON-1 EOL

- April 2012 – May 2013
- Jason-1 End-of-Life Scen
- Low inclination (66º)
- 406 Days GM
- Track Spacing = 7 km
- Use 1Hz RADS data

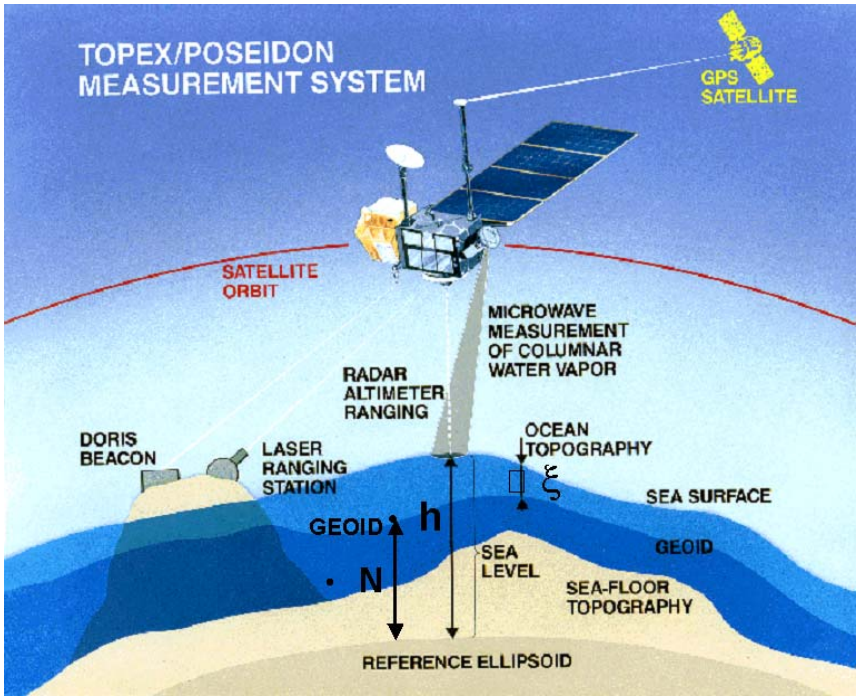


Gravity from Sea surface heights

With J1 (1.1Y) and C2 (3Y) we have 3 Times more GM data.

$$h = (N_{LW} + \Delta N) + MDT + h(t)$$

$$\Delta g = -\gamma \frac{\partial N}{\partial r} - 2\gamma \frac{N}{r}$$



Select Area-tile (process world in tiles)

Remove N_{LW} (EGM2008 d/o = 1960)

Remove MDT ($MDT_{DTU07/EGM2008}$ d/o=100)

Perform crossover adjust (”reduce” h(t))

Iterative (despiking /re-xover)

”Designed” collocation interpolate to a regular grid

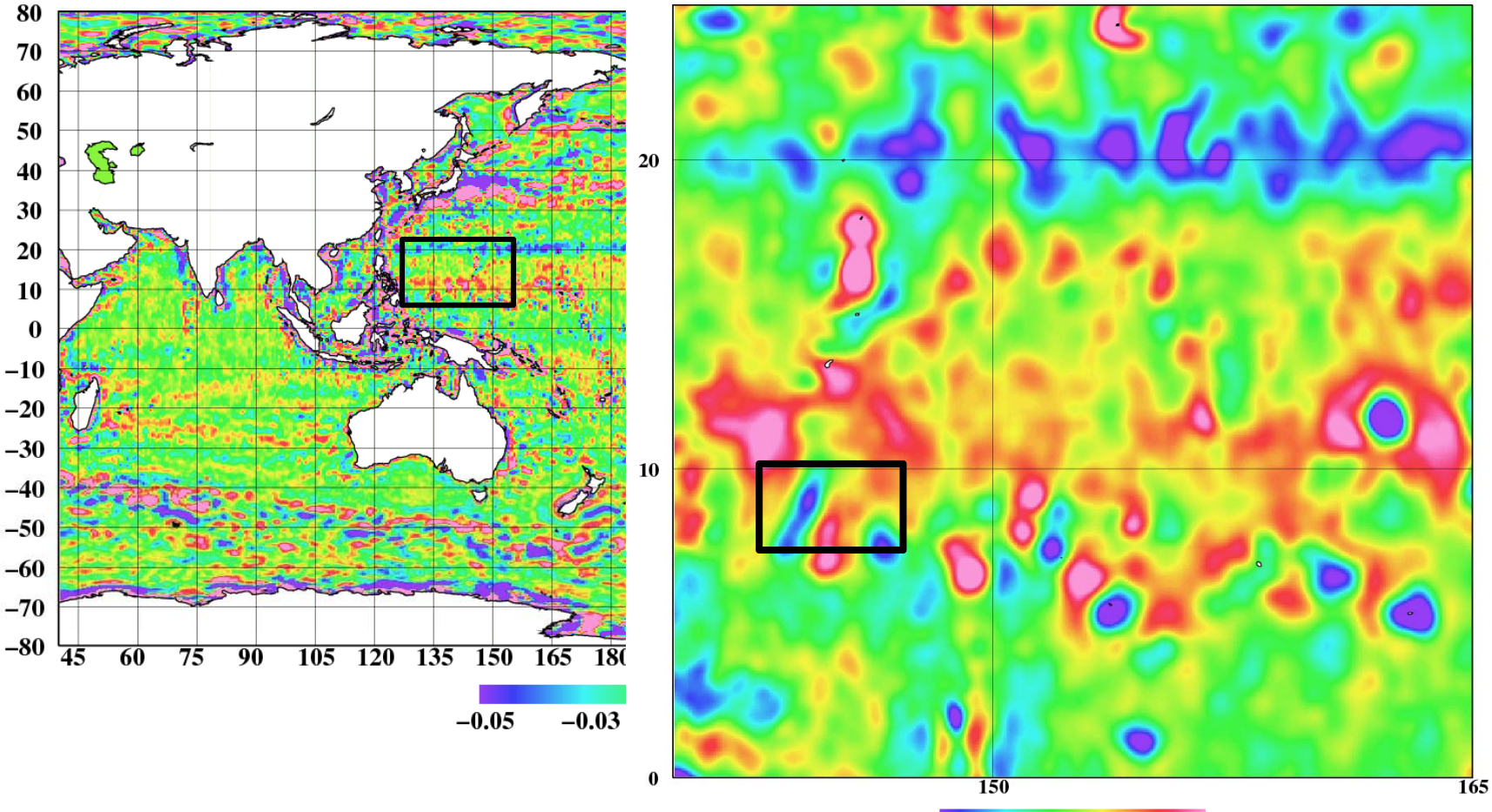
Convert ΔN to Δg using FFT

Restore EGM2008 gravity

NOTICE WE HAVE NOT USED GOCE MDT due to consistency issues

Deriving DTU13

Smaller tiles/regions (1º x 3º - process in 1.5º by 3.5º)
For x-over we assume "no ΔN" signal > 150 km



Introduced a remove/restore of "residual" wavelength (150-500 km)

Prior to x-over adjustment using ERM data.

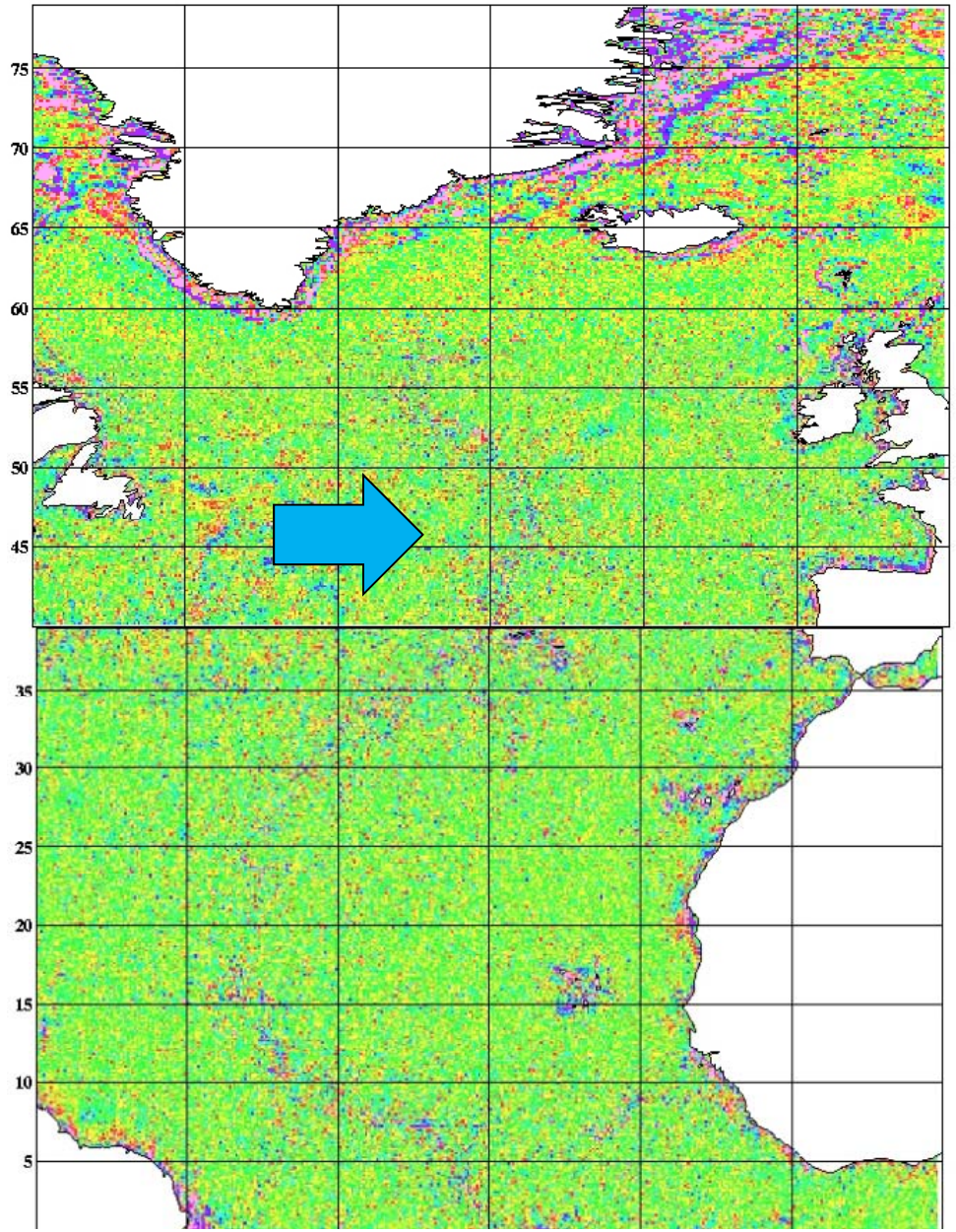
Deriving DTU13

Decrease spatial filtering from 9 km (DTU10) to 6.5 km (DTU13) half wl.

Resolves more signal related to geophysical Structures:

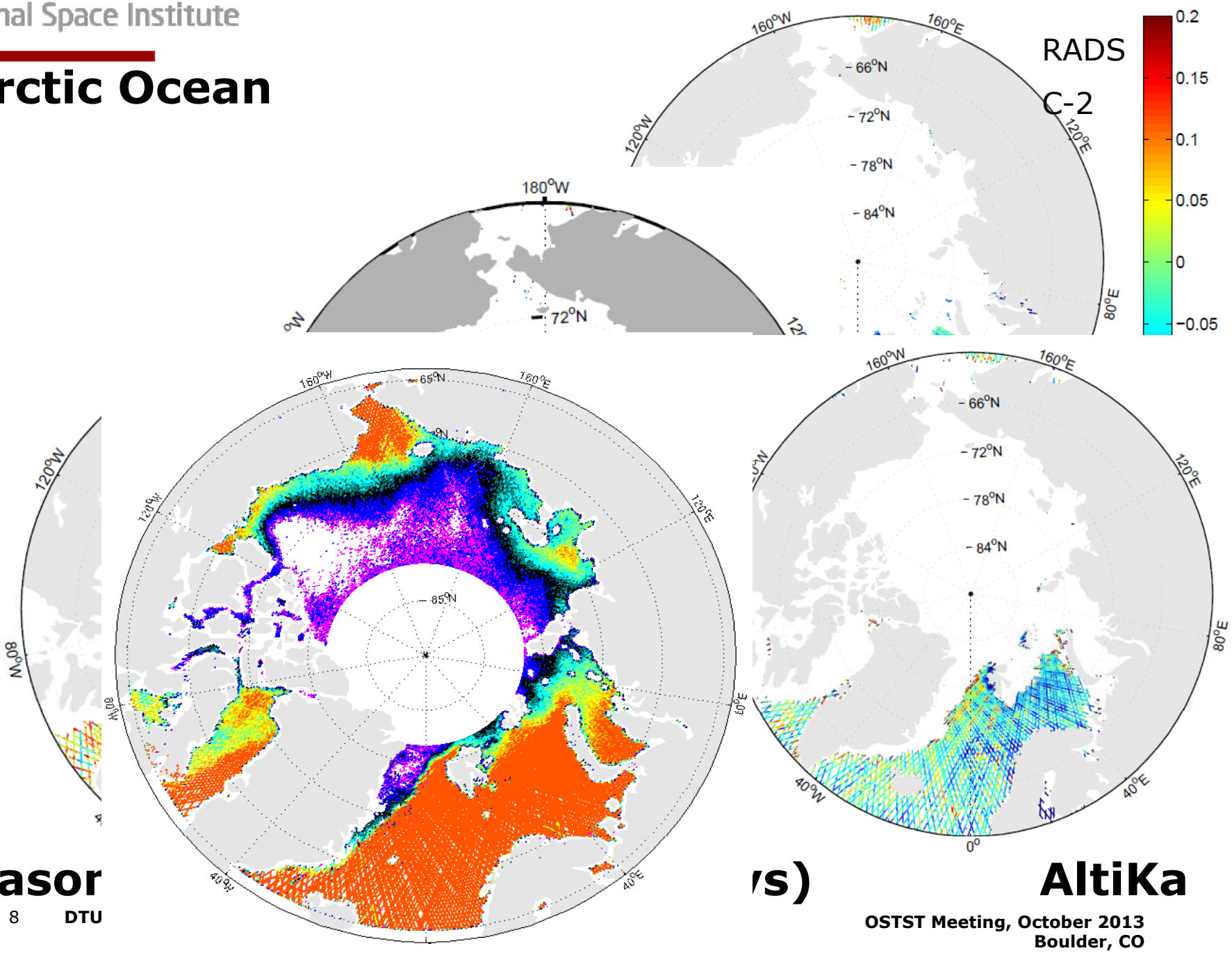
I.e. the Mid-Atlantic Spreading ridge.

Shows DTU10 – DTU13



DTU Space
National Space Institute

Arctic Ocean

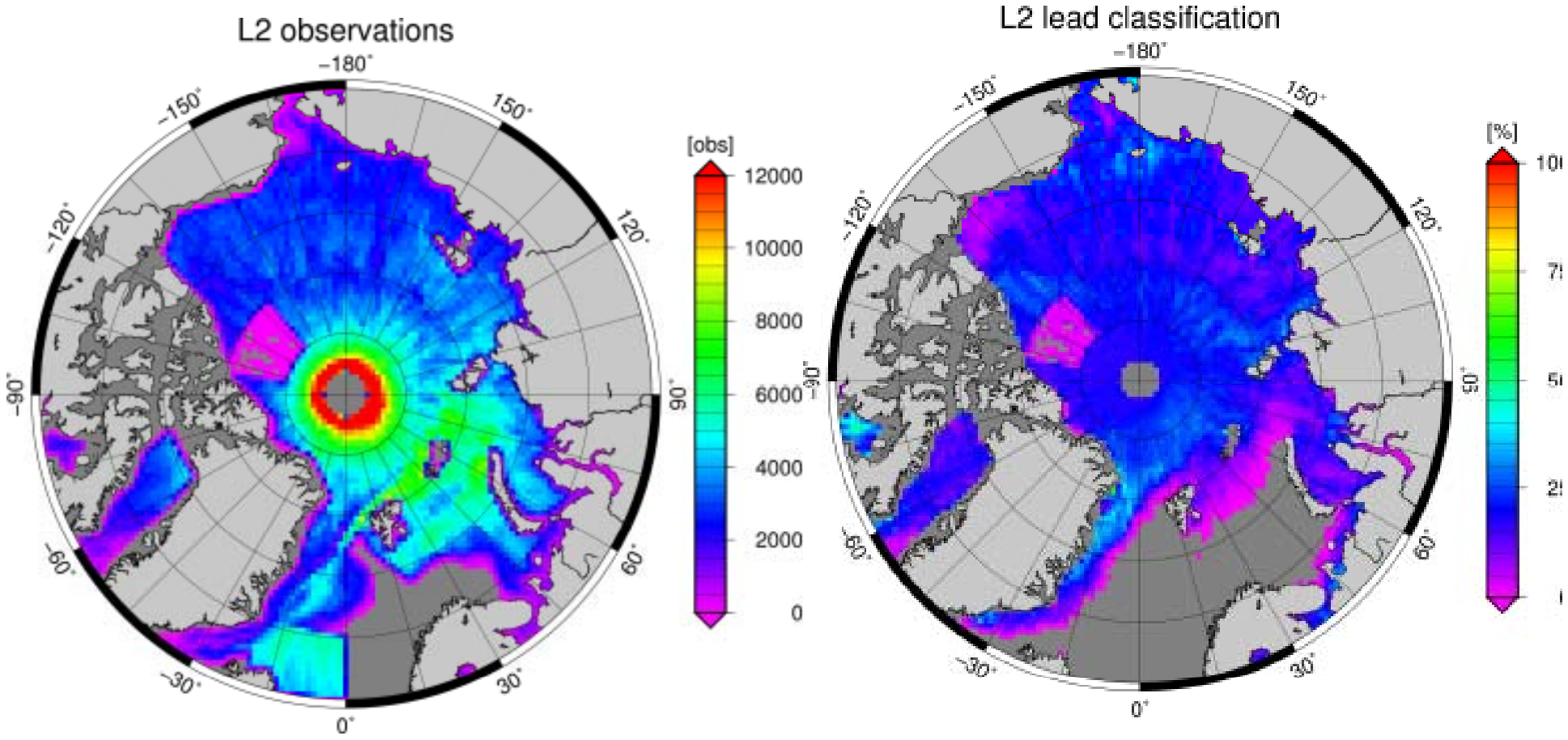


Jason

AltiKa

Cryosat-2 SAR DATA

Using 20 Hz L1B (2012)

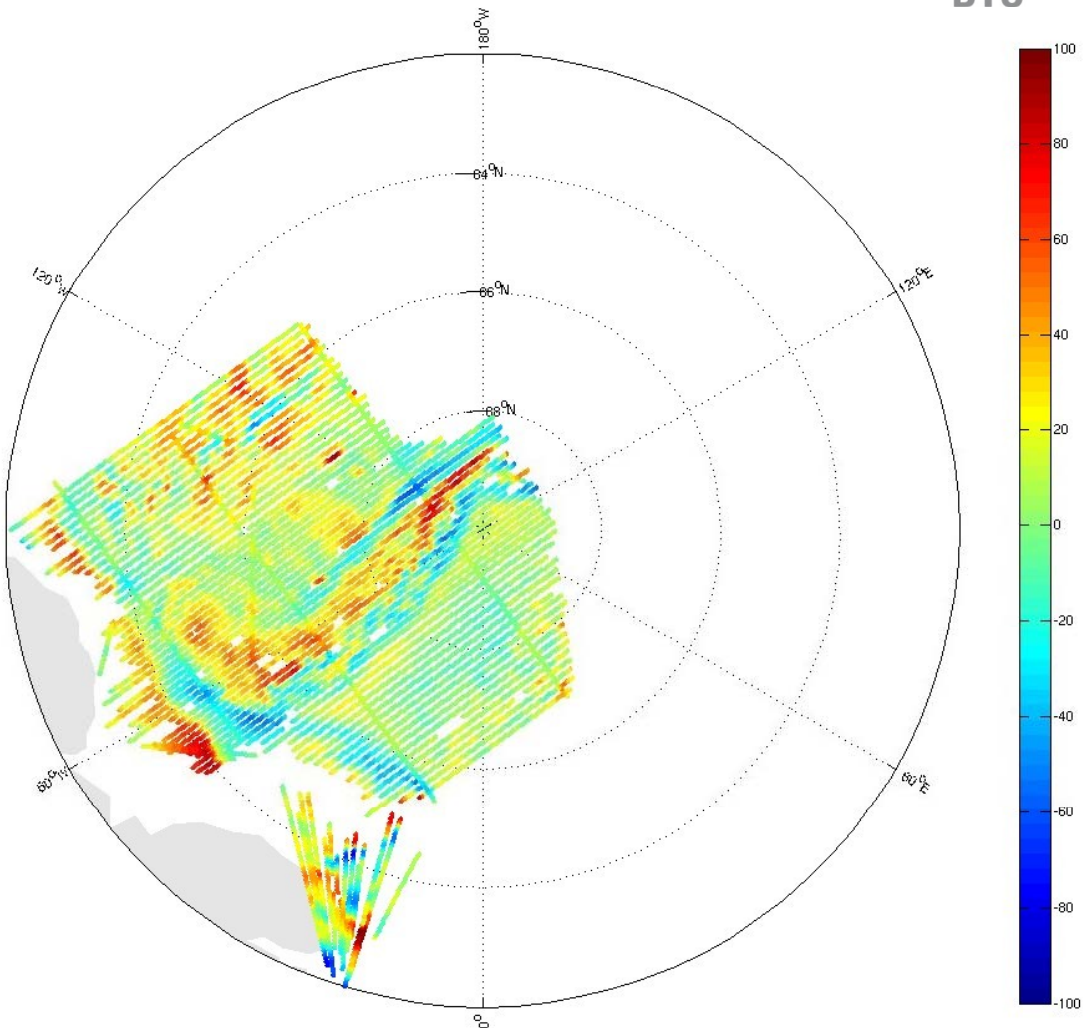


Processed all C-2 Lead data retracked using a Gaussian peak retracker.

Employ updated EGM08E (north of 70ºN) due to striation in EGM08

Comparison

LomGrav 2009 Airborne survey.

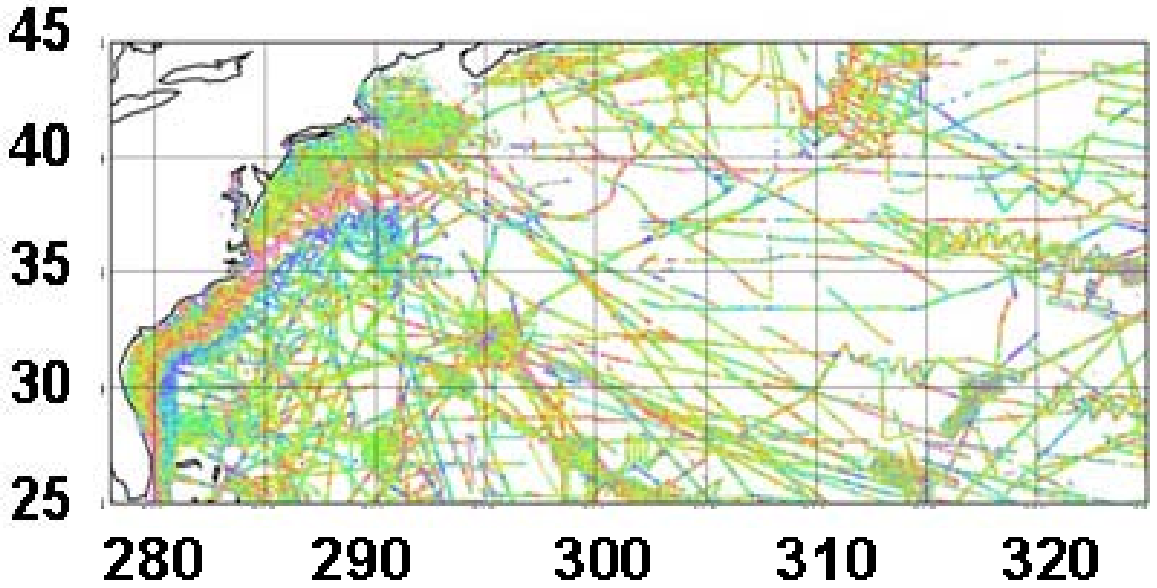


All mGal	DTU10	EGM08	EGM08E	DTU13
LomGrav 2009	8.78	9.82	4.74	4.45

DTU Space
National Space Institute

Comparisons NW Atlantic

Unclassified NGA marine gravity (Δ = 2mgal)



321.400 obs	Mean	Std Dev.	Max Dev
KMS02	0.44	**5.15**	49.38
DNSC08	**0.39**	**3.91**	**36.91**
DTU10	**0.39**	**3.88**	**36.89**
DTU13	**0.40**	**3.71**	**36.80**
SS V16.1	0.59	**4.88**	45.29
SS V18.1	0.41	**3.96**	36.99
SS V19.1	0.43	**3.93**	36.81
SS V21.1	0.41	**4.09**	38.20

Know Δg mprovement is bigger. ”the error is in the marine gravity data”

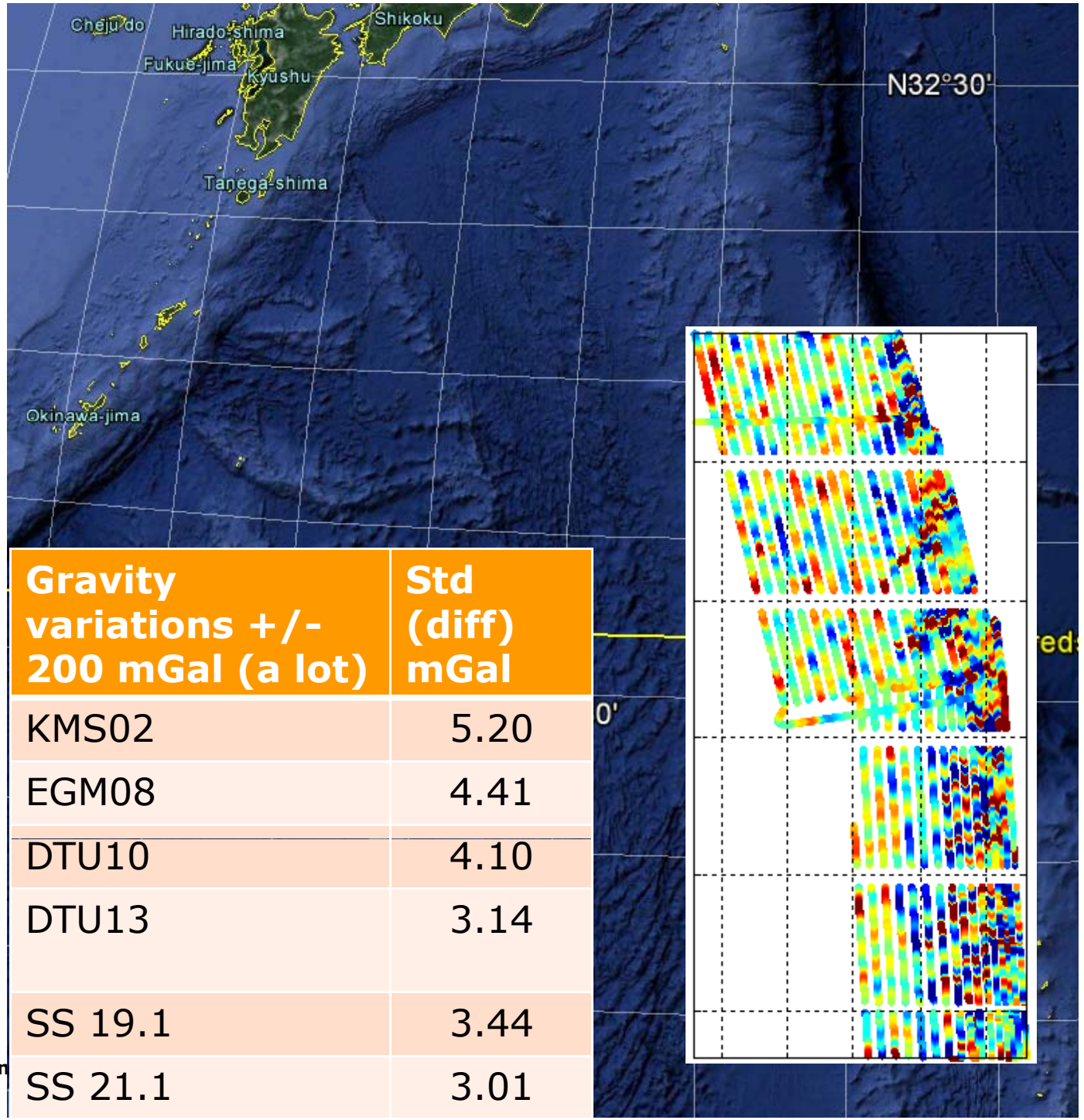
DTU Space
National Space Institute

Marine Test Area

USGS marine survey Onboard US Bowditch.

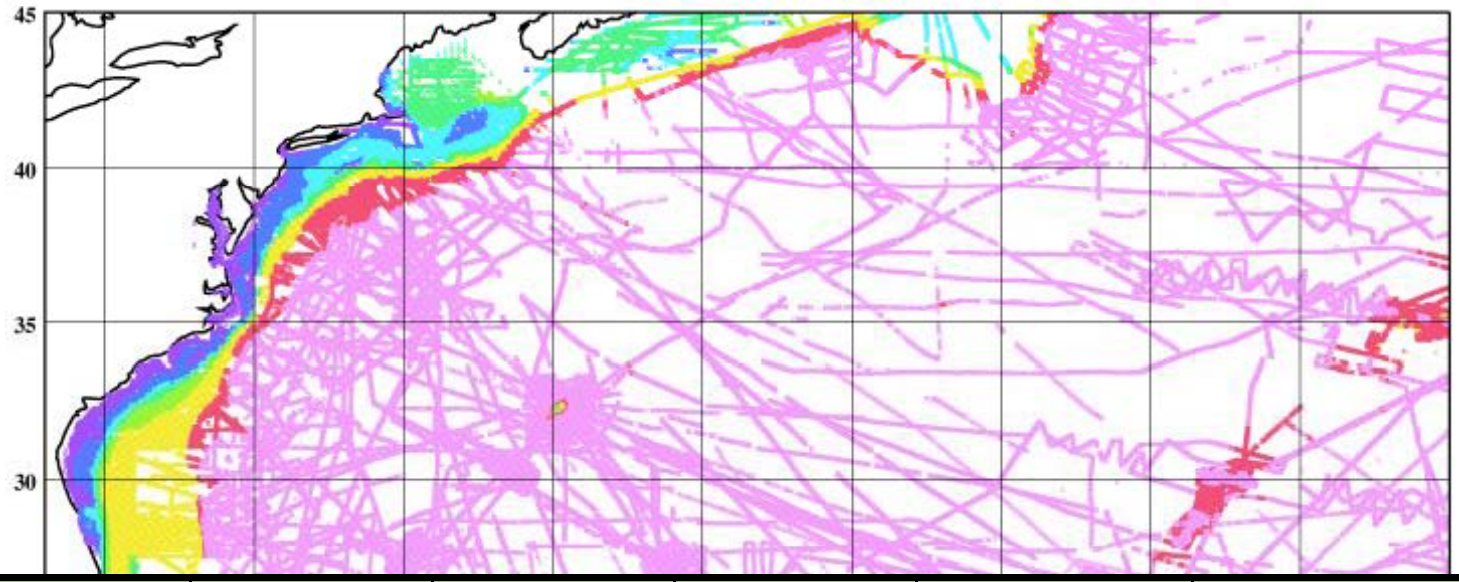
Crosses the
Marianer Trench
And nearby Plateau
2-9 km depth.

Total.
66291 obs.



Gravity variations +/- 200 mGal (a lot)	Std (diff) mGal
KMS02	5.20
EGM08	4.41
DTU10	4.10
DTU13	3.14
SS 19.1	3.44
SS 21.1	3.01

Coastal -> deep regions



All Regions has over 10.000 obs	Std KMS02	Std DTU10	**Std DTU13**	Std SS 18.1	Std SS 21.1
Purple (0-20 m Depth)	6.54	3.46	**2.97**	3.26	3.81
Dark Blue (20-50 m)	4.16	3.14	**2.79**	2.88	3.34
Light Blue (50-100 m)	4.06	3.83	**3.16**	3.26	3.61
Green (100-500 m)	5.74	4.89	**3.61**	4.98	4.69
Yellow (500-1000 m)	5.36	4.38	**4.17**	4.05	4.05
Red+Pink (1-5 km)	5.60	4.89	**4.23**	4.40	4.16

Summary

- **DTU13**
  - **Resolution: 1 minute by 1 minute (2 km by 2 km)**
  - **True global gravity field (90°S to 90°N)**

  Tripled the amount of Geodetic Mission Data.
  Improved x-over adjustment and shorter wavelength recovery.

  Still await ESA for retracking Cryosat-2 Baseline B=>DTU14.

- **Internet point of download (comming very soon):**
  FTP: ftp.space.dtu.dk/pub/DTU13
  WWW: www.space.dtu.dk

Contact Ole B. Andersen oa@space.dtu.dk