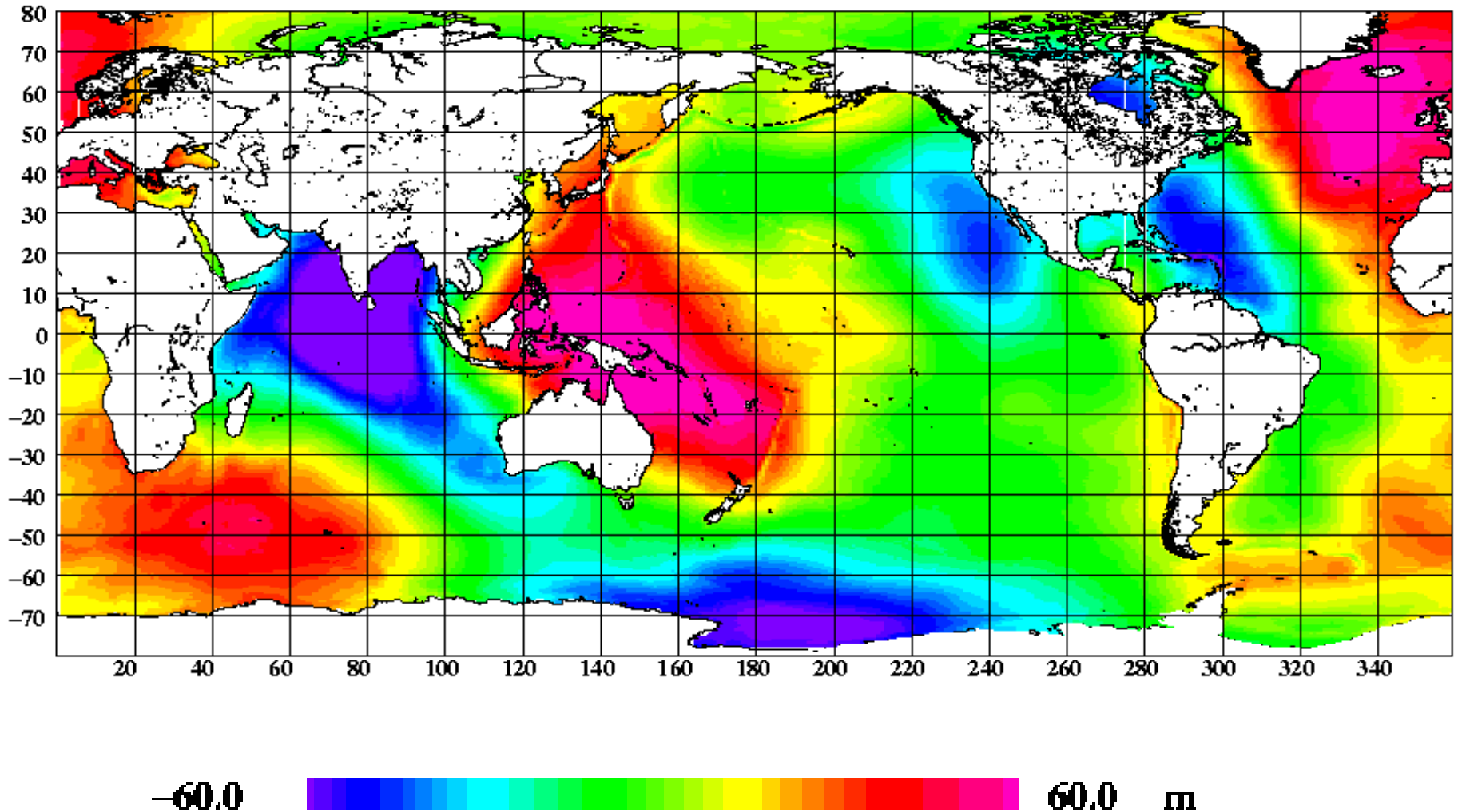# The DNSC08MSS global Mean Sea Surface

Ole B. Andersen and P. Knudsen (DTU-SPACE)

The DNSC08 Mean Sea Surface

- Notice: DNSC08MSS is identical to DNSC07MSS
- The DNSC08 Global Mean Sea Surface
- Adjusting different satellites together.
  - ERS-2 (8 years -> T/P+Jason 12 years)
  - ENVISAT onto ERS-2 (Arctic Ocean)
  - ICESAT onto ENVISAT onto ERS-2 (Arctic Ocean)
- Importance of an accurate MSS
- Inter-annual variability
- The DNSC08 Bathymetry

Model (Name)	T/P data Years	Resolution(min)
KMS04	9 (93-01)	2
CLS01	7 (93-99	2
GSFC00/00.1.	7 (93-99)	2
KMS01	7.5 (93-00)	2
NCU01	6 (93-98)	2
GSFC98	3 (93-95)	2
CLS-SHOM 98,	3 (93-95)	2
KMS98	3 (93-95)	3.75
CSR95	2 (93-94)	3.75
OSU95	1 (93-93)	5

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Want complete coverage in space and time"

"Get the best out of ERM (Variability averaged out) and GM (high spatial resolution)"

– First purely Geometrical MSS (CLS01 + KMS04 used geoid remove/restore)

– T/P, T/P TDM, ERS1 ERM+GM, ERS2 ERM, ENVISAT, Geosat GM, and GFO

– Total 12 years of data using T/P + Jason-1 as reference

– Based on NASA Pathfinder Data (ERM),

– Double-Retracked ERS-1 GM (Berry) + Retracked GEOSAT GM (Sandwell)

– ICESAT added in Arctic ocean betwen 90E-90W

– ArcGP Geoid "feathered" in at 86°N for global coverage (Extra/Inter-polating across pole)

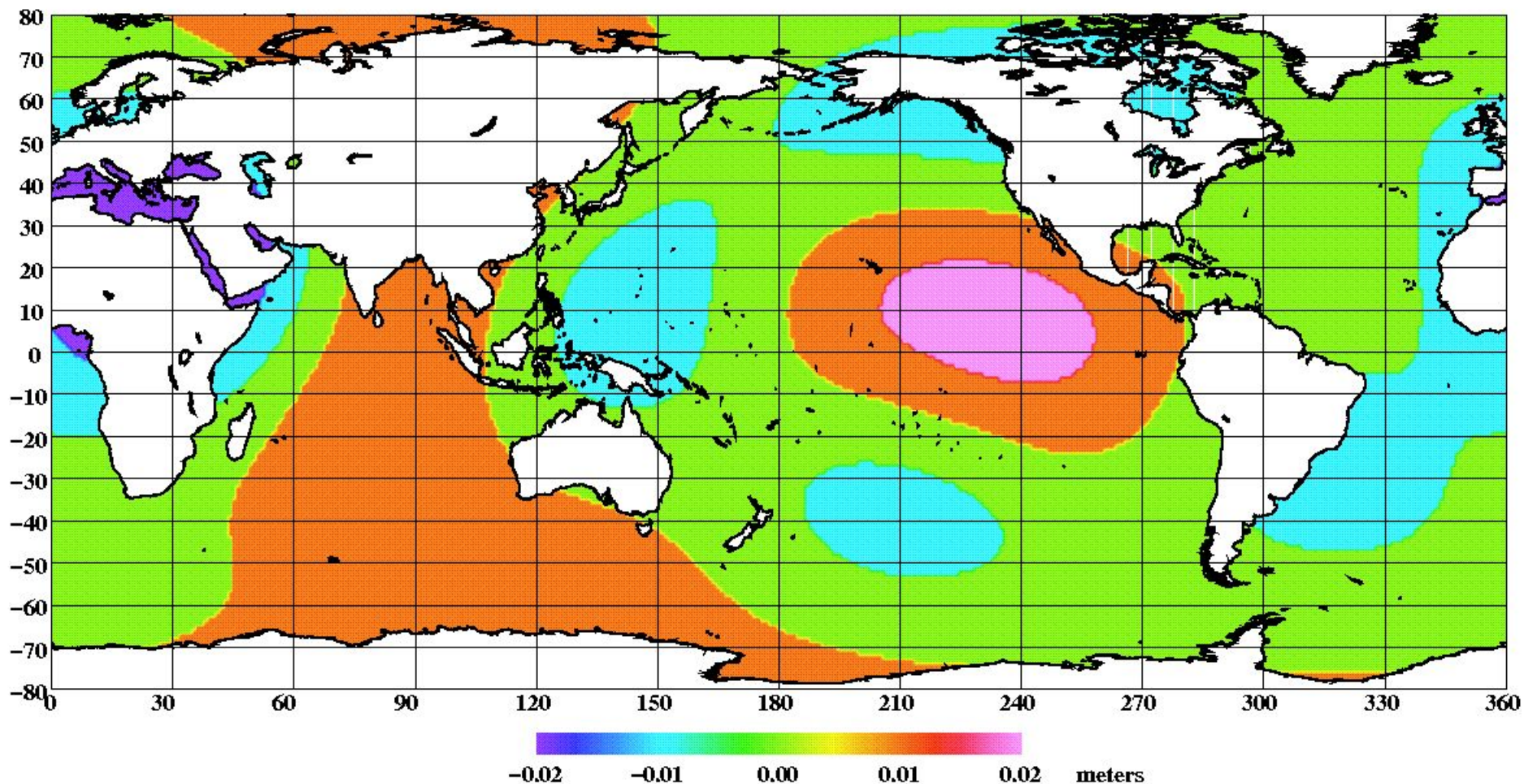– The MSS has been derived in the Mean Tide System

MSS = MDT + Geoid

TOPEX/POSEIDON MEASUREMENT SYSTEM

DANISH NATIONAL SPACE CENTER
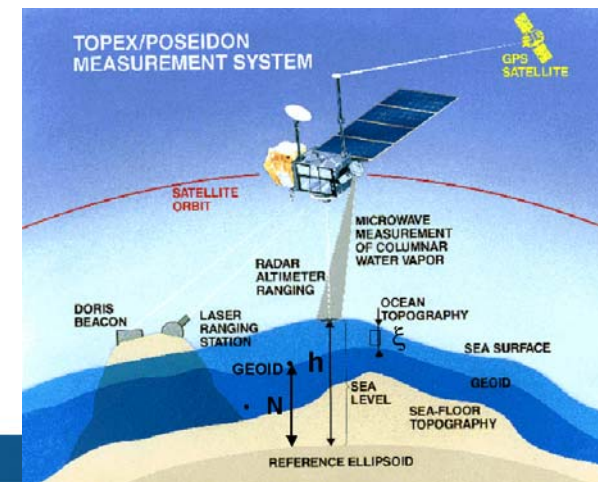
ERS-2 pathfinder globally adjusted to T/P (3 year mean)
ERS-2 8 year mean on T/P+JASON-1 12 year mean (Spharm degree and order 4)

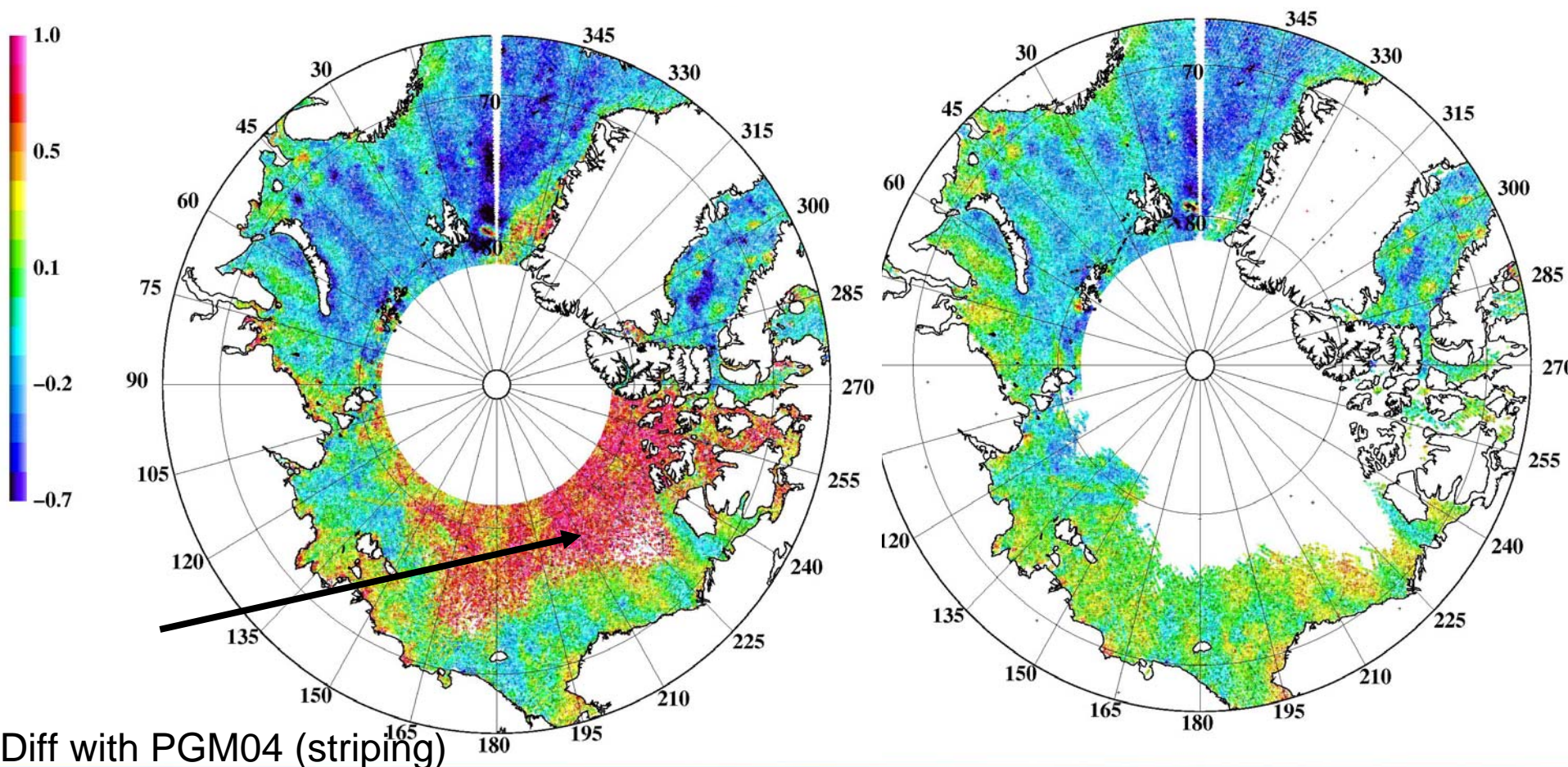**DANISH NATIONAL SPACE CENTER**

No icemask on pathfinder ERS-2 data.
Removing un-reliable data and adding in good Arctic Data from ENVISAT.

Diff with PGM04 (striping)

ICESAT (not trivial to use)

- 6 monthly datasets used (2B, 3B, 3D, 3E, 3F,3G)
- 40 Hz data analysed
- 3 point lowest level filter applied (max 2 m)
- Captures many leads in the Ice.

- Ocean tide correction substituted with GOT00
- Inverse barometer correction applied
- +/- 2 meters editing rel to PGM04

- Waves in open ocean causes biasing low (70 meters footprint).
- Only used in icecovered part of Arctic ocean
  - between 90E and 90W and latitude > 72N
  - Latitude > 80N (all longitudes)

- Seasonal effects corrected / Monthly skewness correction.
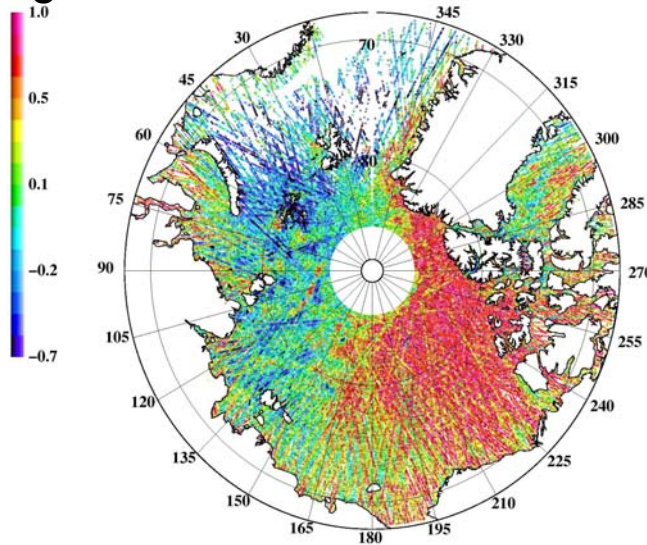
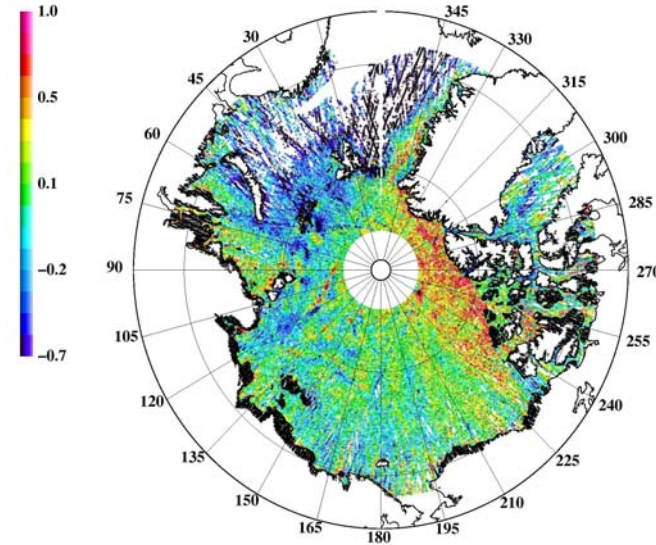ERS = 3 –10 km

GLAS ~65m

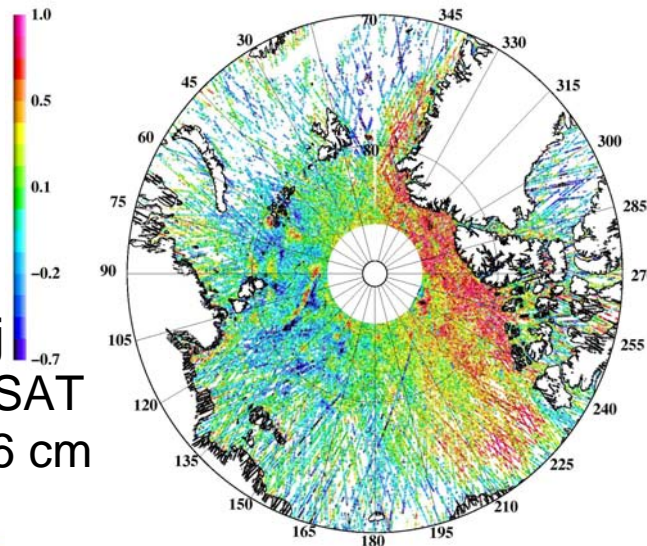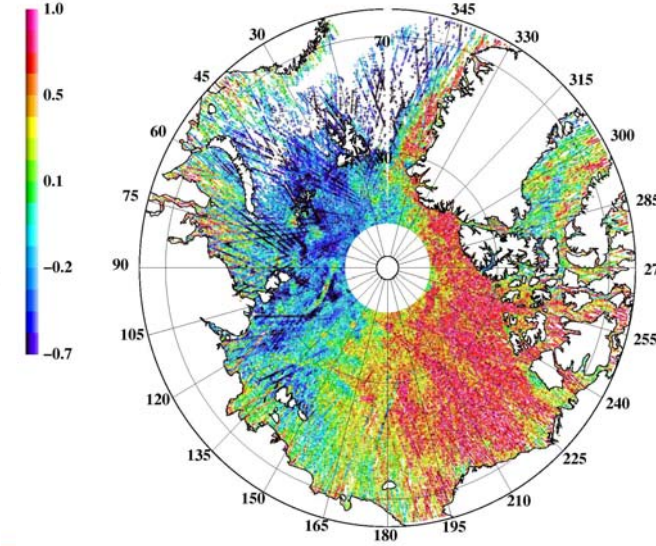**DANISH NATIONAL SPACE CENTER**
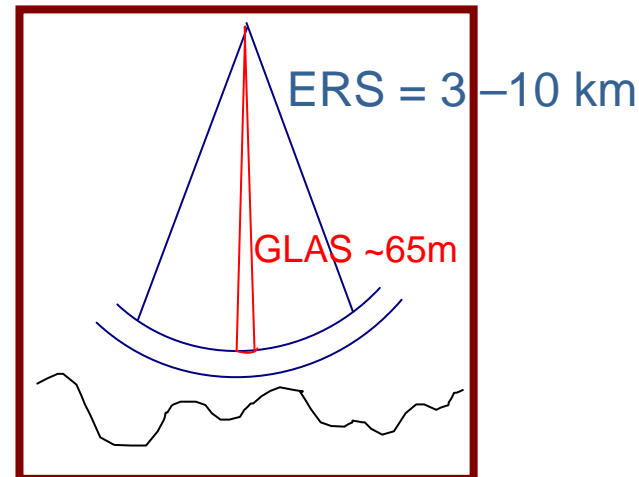
Diff with EGM04 geoid

2B

3B

3D
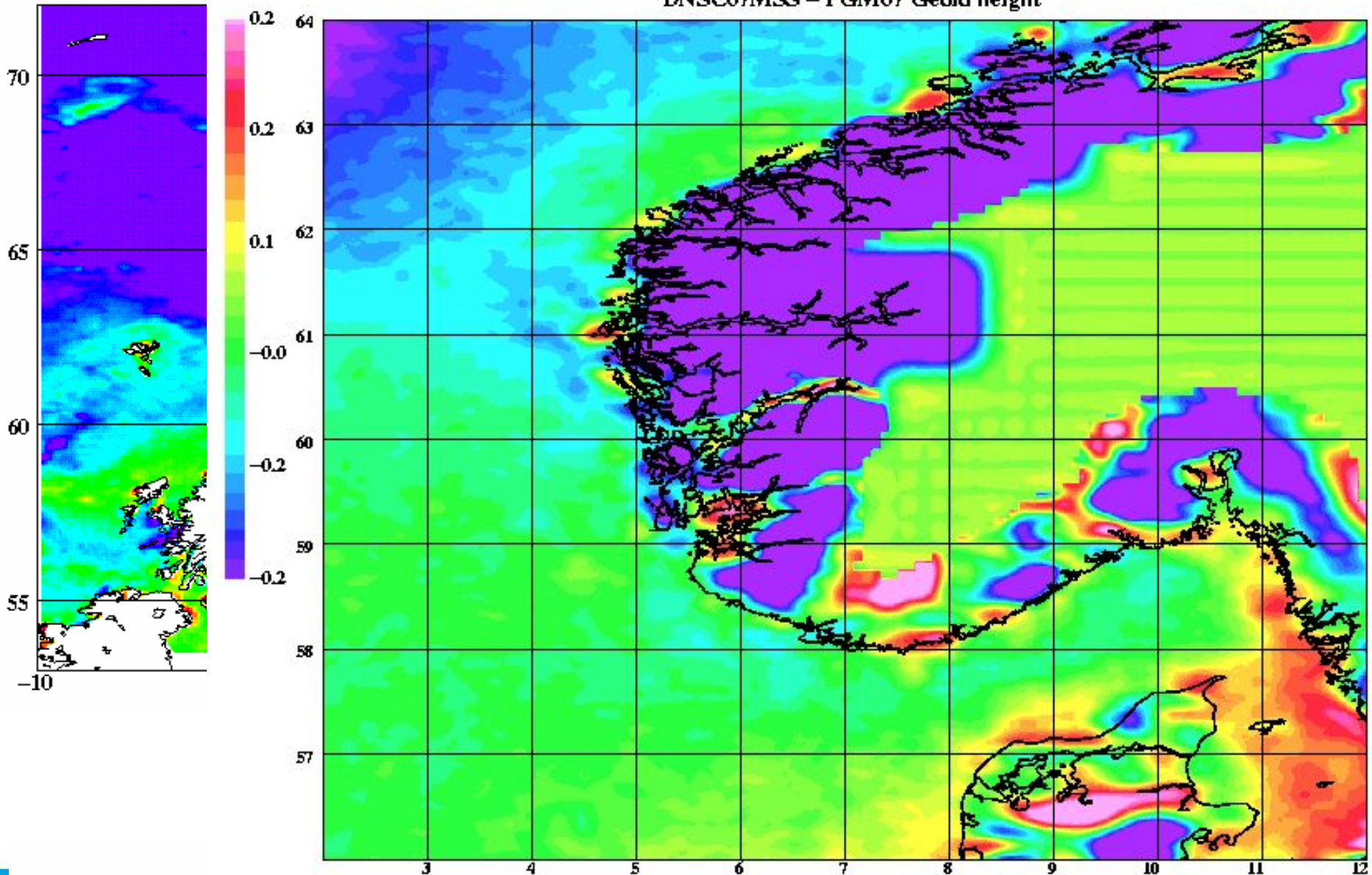
3E

Each month adj
to ERS-2/ENVISAT
-29, -13,-15, -36 cm

Having a good MSS and Geoid
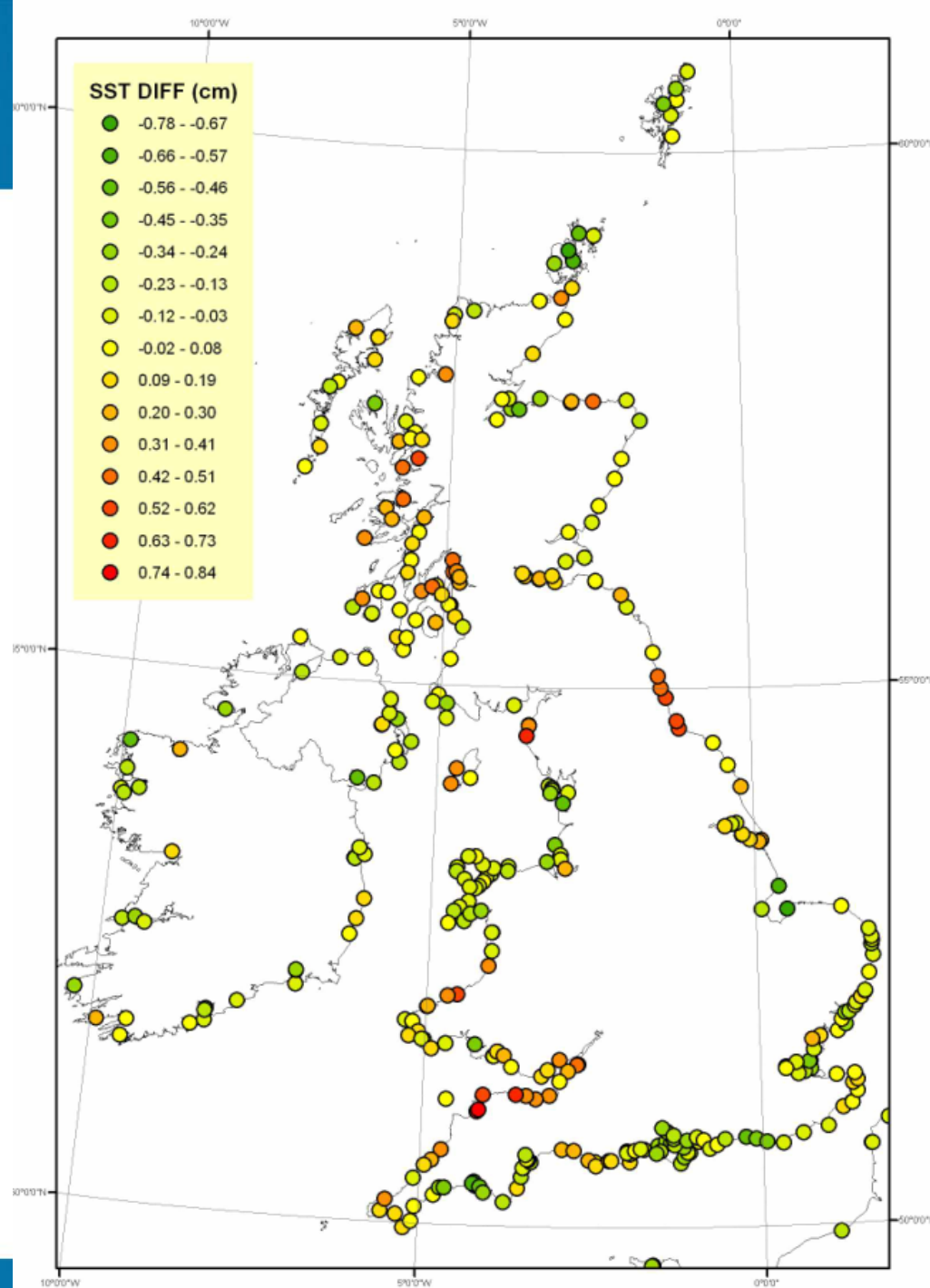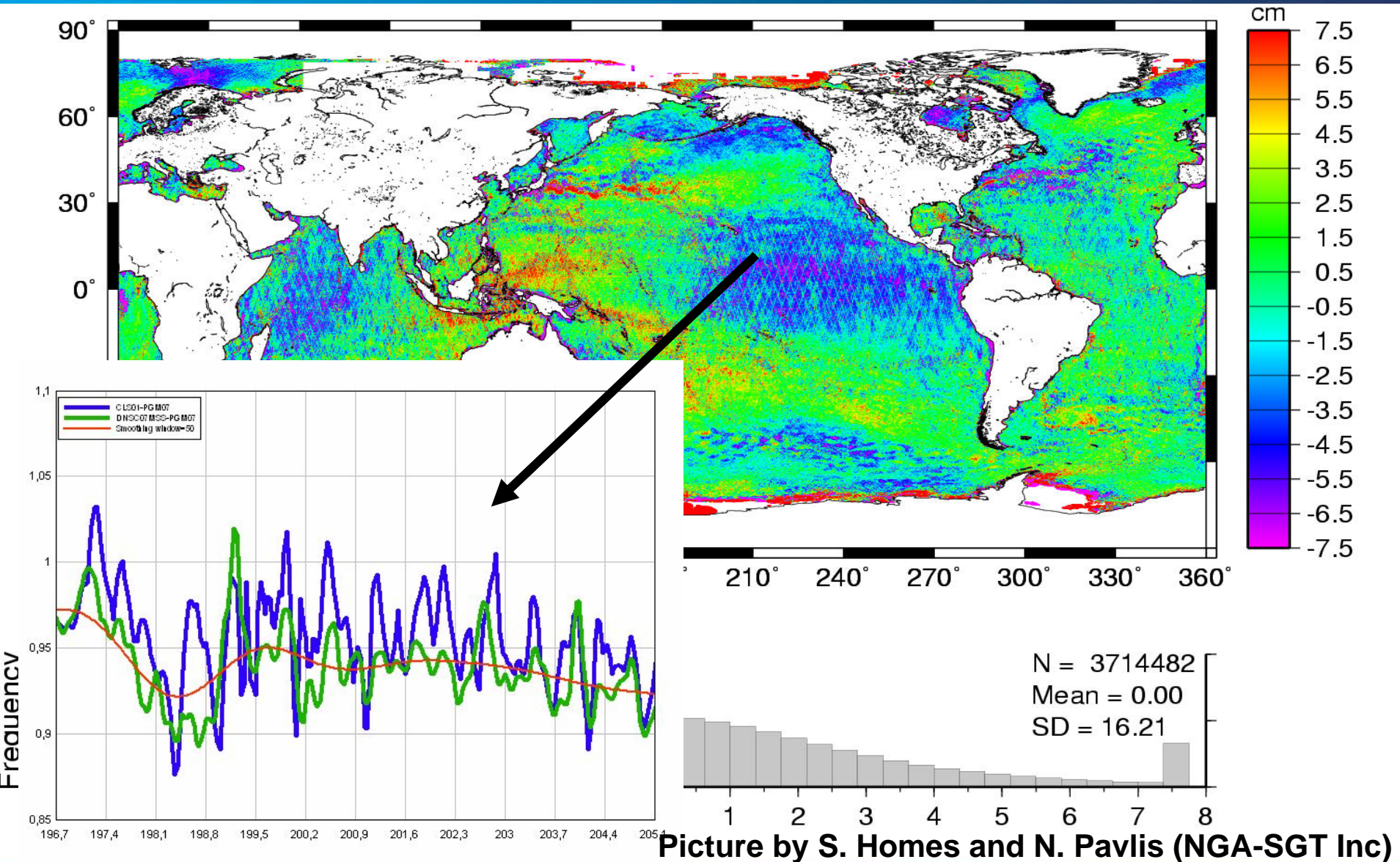

DNSC07MSS – PGM07 Geoid height

Evaluation

320 GPS measured Tide Gauges Around Britain

TG – DNSC08MSS

    Mean = 1.24 cm,

    Std = 6.8 cm

Comparison by
Marek Ziebart, UCL London,

SST DIFF (cm)

●	-0.78 – -0.67
●	-0.66 – -0.57
●	-0.56 – -0.46
●	-0.45 – -0.35
●	-0.34 – -0.24
●	-0.23 – -0.13
●	-0.12 – -0.03
●	-0.02 – 0.08
●	0.09 – 0.19
●	0.20 – 0.30
●	0.31 – 0.41
●	0.42 – 0.51
●	0.52 – 0.62
●	0.63 – 0.73
●	0.74 – 0.84

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Picture by S. Homes and N. Pavlis (NGA-SGT Inc)

- The mean sea surface, a linear sea level change (over the 12 years) and the annual cycle in sea level is modelled like:

$$h_{obs} = h_0 \quad + \quad h_1 t \quad + \quad h_2 \cos(\omega_{ann} t) + h_3 \sin(\omega_{ann} t) + e$$
where ω_{ann} is the frequency of the annual cycle.

- All residual altimetric observations for each year is averaged to calculate mean annual variariation

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Annual mean offsets relative to mean and sea level trend over the 1993-2004 period
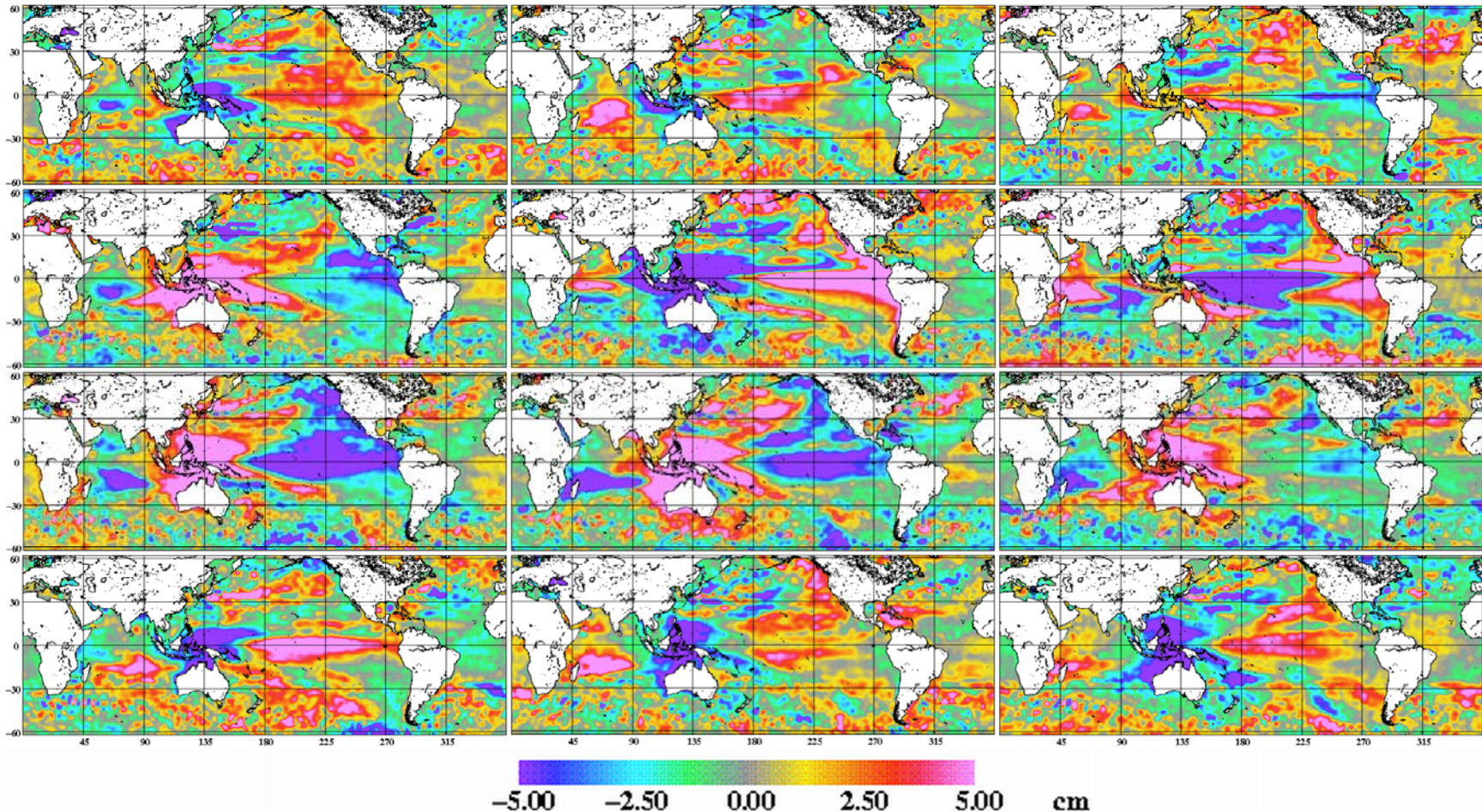
Assuming the geoid is stationary

Adjustments to the MDTs / MSS's for the inter-annual sea level variations is

$$\text{Geoid} = \text{MSS} - \text{MDT}, \quad G(\text{period1}) = G(\text{period2})$$

$$\text{MDT}(\text{period1}) = \text{MDT}(\text{period2}) + \Delta\text{MSS}(\text{period1}) - \Delta\text{MSS}(\text{period2})$$

EXAMPLE:

The OCCAM MDT model represent the period 1993-1995.

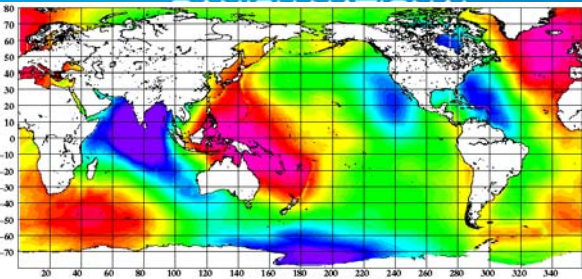OCCAM MDT representing the 1993-2001 period is then:

$$\text{OCCAM}(93\text{-}01) = \text{OCCAM}(93\text{-}95) + \Delta\text{DNSC08}(93\text{-}01) - \Delta\text{DNSC08}(93\text{-}95)$$

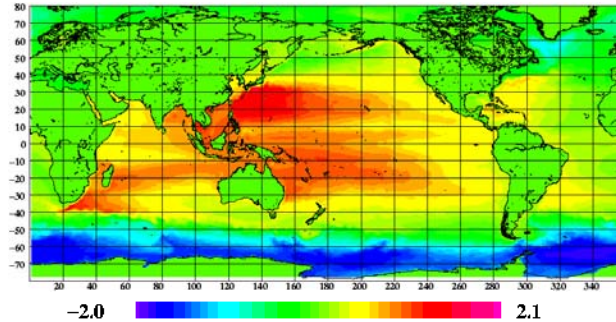**DNSC08MSS is provided with a program to perform this correction**
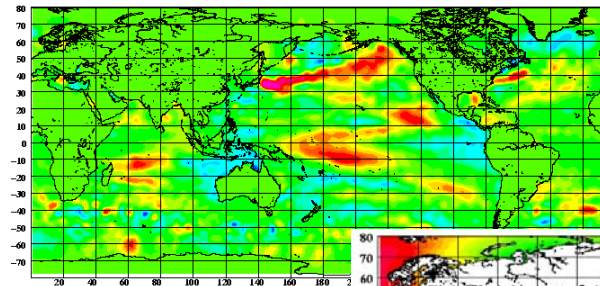
DNSC08 MSS
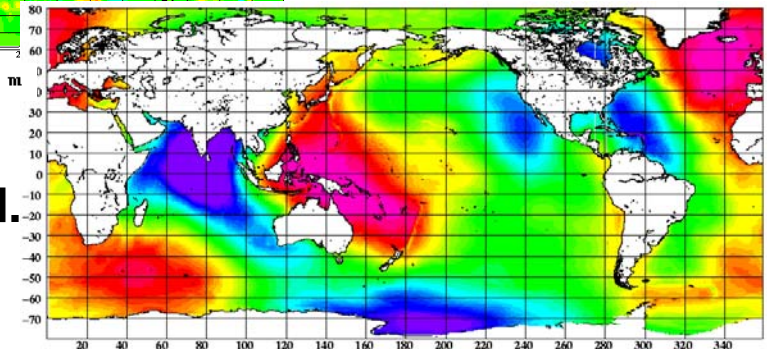

The OCCAM 93-95 MDT

The 93-95 -> 93-01 Interannual Sea Level Anomaly Correction.

DNSC08 MSS - OCCAM MDT synthetic geoid. Consistent inter-annual SLA modelling

Summary

- **DNSC08 Fields**
  - **Resolution: 1 minute by 1 minute (2 km by 2 km)**
  - **True global fields (90°S to 90°N)**

- **DNSC08MSS: ftp.spacecenter.dk/pub/MSS**
- **DNSC08ALL files: ftp.spacecenter.dk/pub/DNSC08 (all files)**
-                       **DVD: Contact oa@space.dtu.dk**

- **Consistent Products available:**
-
  - **Altimetric (geometrical) MSS   DNSC08-MSS**
  - **Altimetric derived Bathymetry DNSC08-BAT**
  - **Altimetric Marine Gravity field DNSC08-GRA**
  - **Mean Dynamic Topography   DNSC08-MDT**
  - **Products also available in Google Earth**