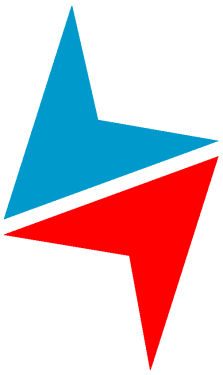

GOCINA

Geoid and Ocean Circulation in the North Atlantic

Contract EVG1-CT-2002-00077

Report on task 4.3

Description and comparison between selected mean sea surfaces in the GOCINA project

Date: 30 January 2004

Description and comparison between selected mean sea surfaces in the GOCINA project

Mean Sea Surfaces (hereafter called MSS) are by-products of satellite altimetry. Referenced to an Earth ellipsoid, they contain the geoid plus the mean dynamic ocean topography (MDT).
Mean sea surfaces are commonly used by geodesists and geophysicists to analyse geoid undulations, and studying crustal deformation, or Earth interior dynamics. Oceanographers using satellite altimetry can reference sea surface heights (hereafter called SSH) to the MSS. Due to the non perfect satellite positioning for repeat orbit missions, SSH are usually referenced to an MSS in order to reduce possible geoid cross-track artifacts.

The Delivery report D2.1 showed that the two mean sea surfaces KMS01 and CLS01 showed approximately equal accuracy. The data processing was therefore maintained at both KMS and CLS as independent approaches.

A new global mean sea surface, KMS03, has been calculated as a part of the GOCINA project. This surface is compared with the CLS01 mean sea surface in this deliverable.

	Mean sea surfaces
Selected	KMS03 (National survey and Cadastre) – Denmark CLS01 (Centre de Localisation d' Satellittes) – France
Other surfaces.	OSU95 (Ohio State University, Columby, USA) CSR98 (University of Austin, Texas, USA). KMS01 (National survey and Cadastre) – Denmark GSFC00 (Goddard Space Flight Center – Maryland, USA

Table 1. Mean sea surface models.

Both the KMS03 and the CLS01 mean sea surface is computed and delivered on a 2' grid oceanwide between latitude ±82° (KMS03) or –80° to 82° (CLS01). This resolution corresponds to 4 km at the Equator.

Section 2 below describes the mean sea surfaces. Section 3 presents the mean sea surfaces for the region of interest for the GOCINA project.

2. Mean sea surface Description.

Below a summary of the different data and processing applied to the individual mean sea surfaces.

KMS 03	T/P mean profile	ERS2 mean profile	T/P TDM	GFO	GEOSAT geodetic data	ERS-1 geodetic data
Selected time period	1993-2001 9 years (cycles 10-344)	1995-1999 74 cycles (cycles 1-74)	2002-2002 0.7 years (cycles 368-383)	2000-2001 0.7 years (cycles 368-383)	1985-1986 1.5 years (cycles 1-44)	1994-95 ERS-1 phase E ERS-1 phase G
Coverage	66°S-66°N	82°S-82°N	66°S-66°N	72°S-72°N	72°S-72°N	82°S-82°N
Groundtracks spacing	320 km	~80 km	320 km	150 km	~6 km	~8 km
Total of used points	used to reference GM data	ERS2 referenced to T/P data separately. DGM04 orbits combined with T/P to reference GM data	Referenced upon 9 years T/P+ERS MSS x-over corrected sea surface height used	Referenced upon 7 years T/P+ERS MSS x-over corrected sea surface height used	DEOS upgraded set used to resolve fine spatial scale signals x-over corrected sea surface heights used	Used to resolve fine spatial scale signals x-over corrected sea surface heights used

Table 2. Characteristics for the KMS03 mean sea surface.

CLS 01	T/P mean profile	ERS mean profile	GEOSAT mean profila	ERS-1 geodetic data
Selected time period	1993-1999 7 years (cycles 11-280)	1993-1999 5 years 64 cycles	1987-1988 2 years (cycles 1-44)	1994-95 - ERS-1 phase E - ERS-1 phase G
Coverage	66°S-66°N	82°S-82°N	72°S-72°N	82°S-82°N
Groundtracks spacing	320 km	~80 km	160 km	~8 km
Remarks	used to reference other data	referenced to T/P data.	old dataset less accurate correction	fine spatial resolution. each track adjusted to T/P mean profile

Table 3. Characteristics for the CLS01 mean sea surface.

Both mean sea surfaces are derived from different (but somewhat similar) subset of altimetry. The major difference is the fact that the CLS mean sea surface only uses finer scale geodetic mission altimetry from the ERS-1 satellite whereas KMS03 uses the older and GEOSAT geodetic mission altimetry.

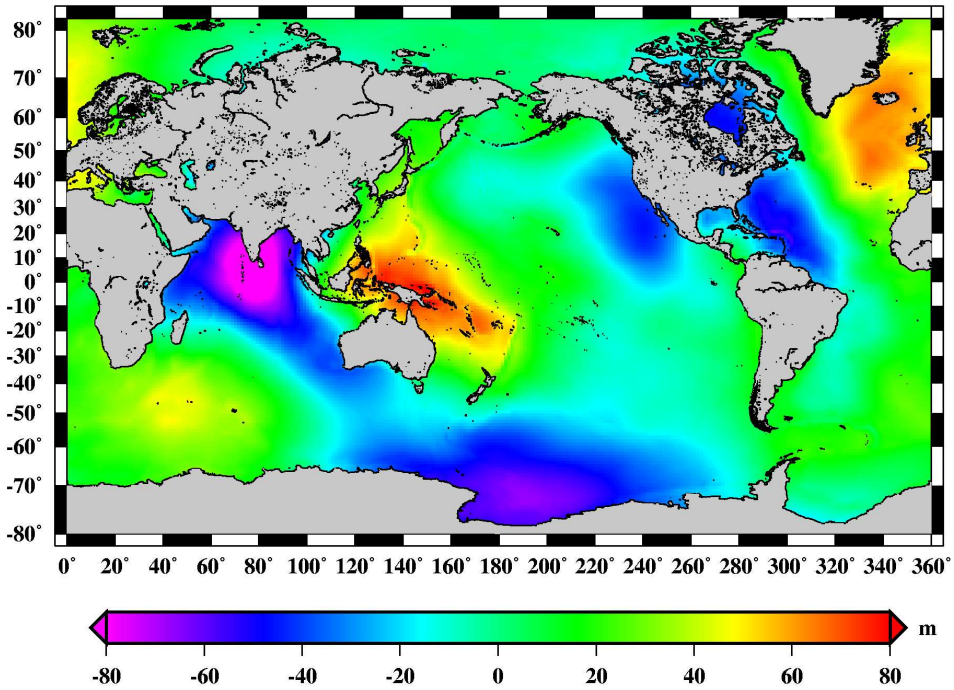

Figure 1: Global map of the MSS KMS03 (units in meter).

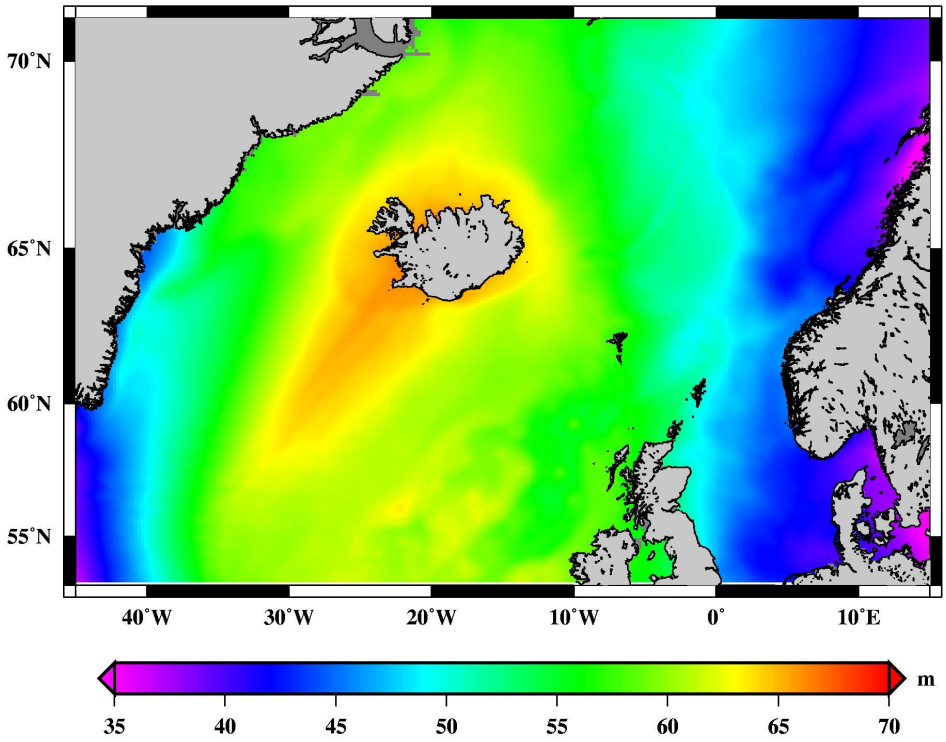

Figure 2: Map of the KMS03 MSS in the GOCINA area.

3. Comparison with GGM01EGM geoid in the GOCINA study region

A comparison for the GOCINA region between the MSS surfaces and GGM01EGM geoid model is given in table 4 and in figure 3 and 4. The GGM01EGM geoid is a hybrid between GGM01S (up to degree and order 95) and EGM96 to degree 360. No data over land are included.

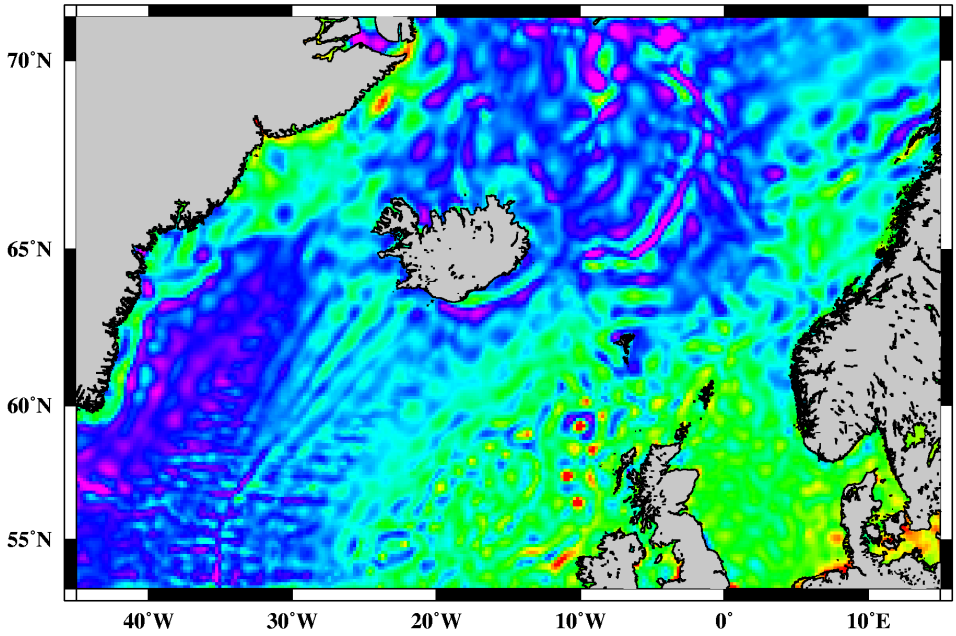

Figure 3. Differences between CLS01 mean sea surface and GGM01EGM geoid. Color scale same as figure 4.

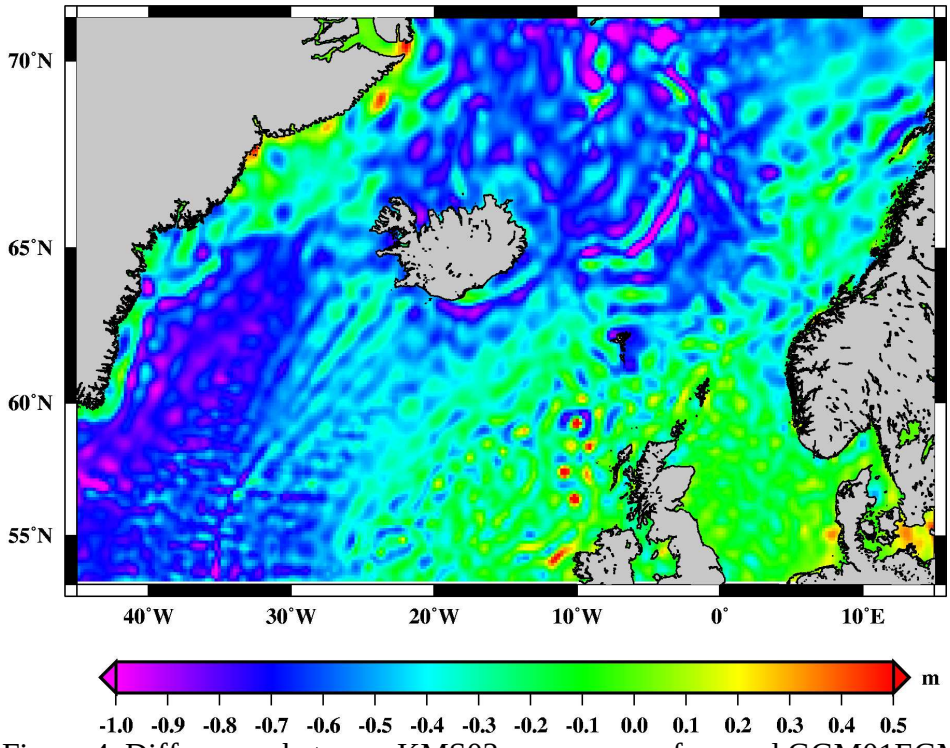

Figure 4. Differences between KMS03 mean sea surface and GGM01EGM geoid.

	Mean	Standard Deviation	Minimum	Maximum
KMS03-GGM01EGM	-0.37	0.29	-1.41	1.51
CLS01-GGM01EGM	-0.34	0.30	-1.37	1.88

Table 4. Mean difference, standard deviation, minimum and maximum of difference between the MSS models and the GGM01EGM geoid model. All values are in meters

4. Comparison between mean sea surfaces

The comparison for the GOCINA region between the KMS03 and the CLS01 mean sea surfaces is given in the table below.

	Mean	Standard Deviation	Minimum	Maximum
KMS03-CLS01	-0.02	0.05	-1.35	1.09

Table 5. Mean difference, standard deviation, minimum, and maximum of difference between the mean sea surface models. Values are in meters

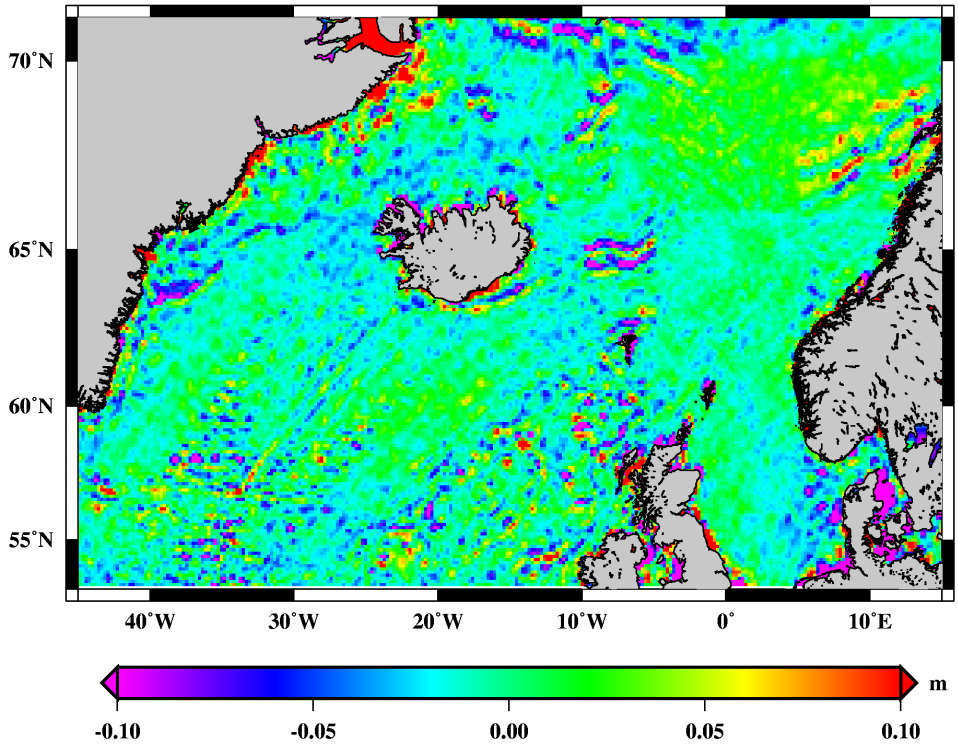

Figure 5. Differences between KMS03 and CLS01 mean sea surfaces (KMS minus CLS) in the GOCINA area.

5. Comparison between error files for different mean sea surfaces

For the two mean sea surfaces associated error files, with same resolution as the MSS, are indicating the quality of the surfaces. A comparison between the two error files is given in table 6.

	Mean	Standard Deviation	Minimum	Maximum
KMS03 err –CLS01 err	-0.26	5.20	-99.94	0.32

Table 6. Mean difference, standard deviation, minimum, and maximum of difference between the error files for the mean sea surface models KMS03 and CLS01. All values are in meters

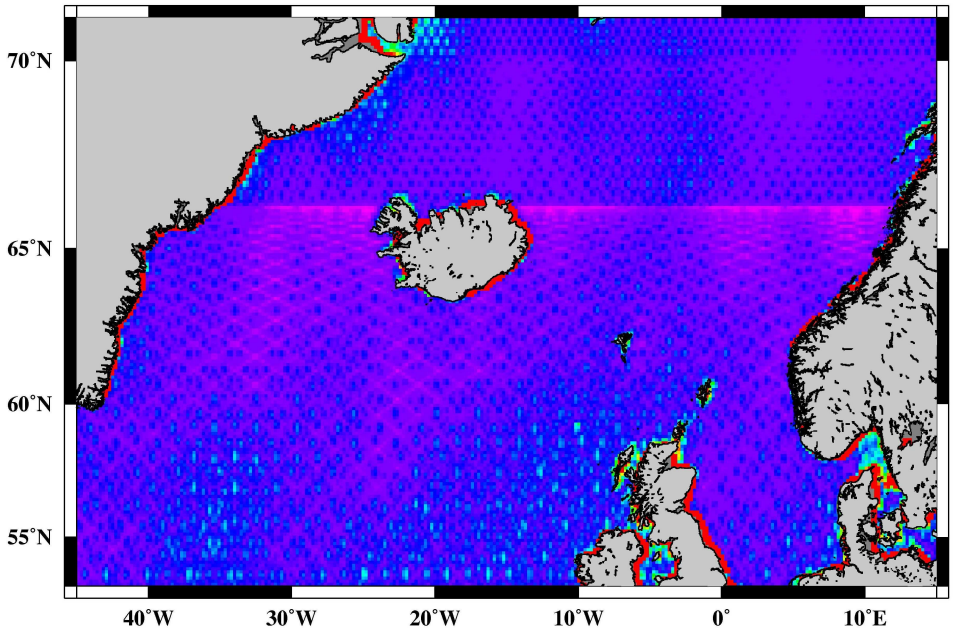

Figure 6: Map of the error file for the CLS01 MSS in the GOCINA area. Color scale same as figure 7.

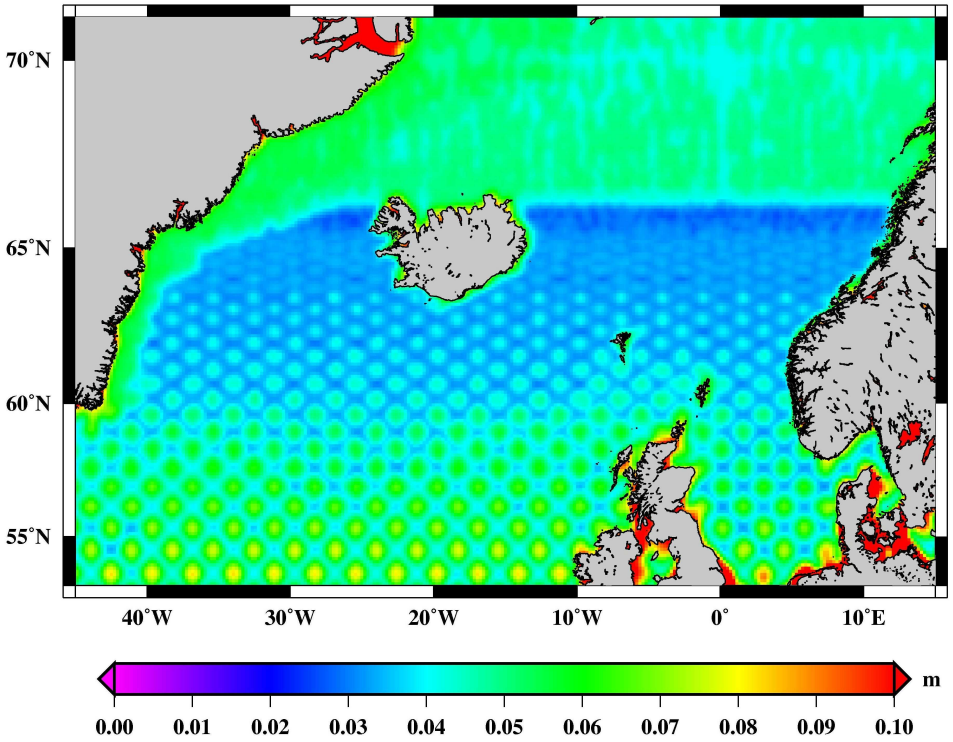

Figure 7: Map of the error file for the KMS03 MSS in the GOCINA area.

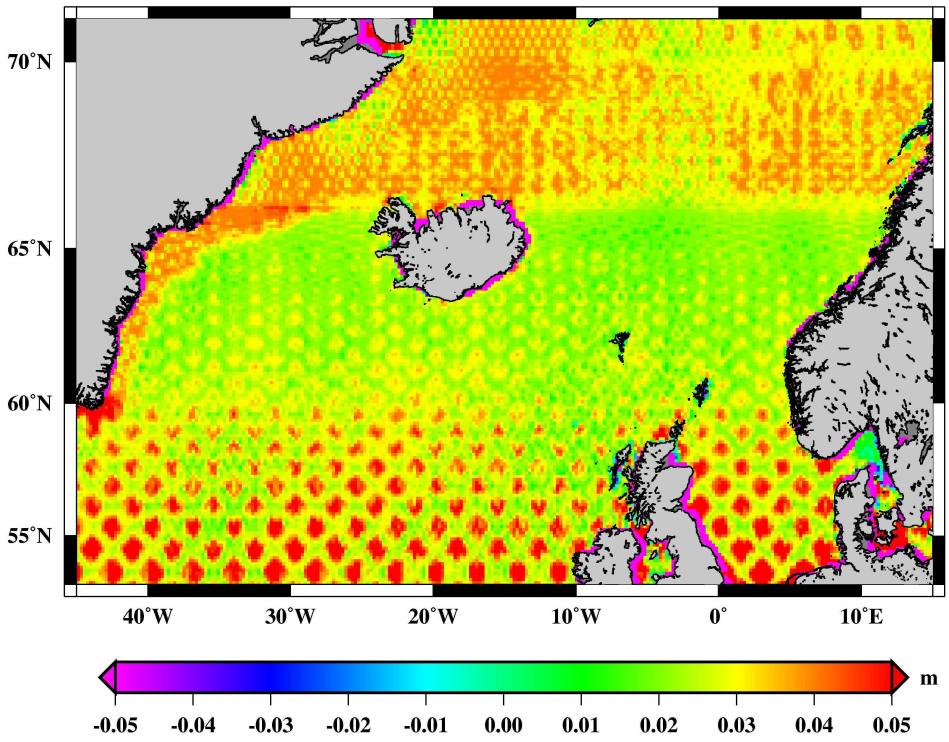

Figure 8. Difference between error files for KMS03 and CLS01 MSS (KMS minus CLS).

6. Data

ASCII grids of the mean sea surfaces used for this comparison are available at ftp://ftp.kms.dk/pub/GOCINA/OLD_FTP/MSSH