Report on the homogenized historical marine gravity data of the southern and eastern Baltic Sea

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Contents

1 Introduction

The BalMarGrav project, co-financed by the European Union Interreg Baltic Sea Region 2021-2027 program, aims to improve the insufficient mapping of the gravity field in marine areas of southern and eastern Baltic Sea. This task is very important due to the decision of the Baltic Sea Hydrographic Commission (BSHC) to implement a common height reference system called the Baltic Sea Chart Datum 2000 (BSCD2000), which is based on a geoid model determined using gravity measurements. A uniform datum in the Baltic Sea region will allow to improve satellite navigation on vessels, in particular, monitoring under-keel clearance, thereby optimizing their routes, reducing fuel consumption and pollution.

In 1956-1990 multiple marine gravity survey campaigns were conducted in the coastal areas of Germany, Poland, Lithuania, Latvia and Estonia, mainly with support of the research infrastructure of the Soviet Union. After becoming independent from the Soviet Union and the political transition of former Eastern Bloc countries, much of these data were forgotten or underutilized. Considering high cost and time-consumption of gravity measurements at sea following modern standards, an international network of experts from the Baltic Sea region has been built to reconcile and standardize historical marine gravity data within the BalMarGrav project.

Within the BaMarGrav project totally 15 sources of historical gravity data from the Nordic Geodetic Commission gravity database (the NKG/FAMOS/BalMarGrav gravity DB) have been examined, 4 of them did not exist in the database previously, and their addition to the database was the result of work conducted during the project. Historical sources were validated by 16 sources of the NKG/FAMOS/BalMarGrav gravity DB containing modern gravity data (2 of them, i.e. sources #314 and #621, are the results of the project). As a result of procedure of data recalculation to modern geodetic and gravimetric reference systems, mean free-air and Bouguer mean gravity anomalies together with uncertainties were determined on a grid of spatial resolution of 1.2' × 0.6' in the region from 13.7° E to 24.7° E and from 53.6° N to 58.6° N. The homogenized historical marine gravity data of the southern and eastern Baltic Sea has been implemented into the NKG/FAMOS/BalMarGrav gravity DB as a source #1000. The source #1000 under the licence "product_balmargrav" is available from the NKG/FAMOS/BalMarGrav gravity DB upon an e-mail request to Gabriel Strykowski (gs@space.dtu.dk).

2 Marine gravity data

Nowadays, most of the marine gravity measurements from the Balitc Sea region are stored in the NKG/FAMOS/BalMarGrav gravity DB, maintained by the DTU Space (an institute of the Technical University of Denmark).

2.1 Historical sources

Following historical gravity sources of the NKG/FAMOS/BalMarGrav gravity DB have been reviewed to develop a source #1000:

- #042 (1970-1972, 1975) – Agency of Climate Data (former Agency for Data Supply and Infrastructure - SDFI, Denmark);
- #381 (1969-1973) and #383 (1966-1968) – Federal Agency for Cartography and Geodesy (BKG, Germany);
- #319 (1971-1972) and #995 (1972) – Institute of Geodesy and Cartography (IGiK, Poland);
- #996 (1978-1979) and #997 (1976-1981) – Polish Geological Institute - National Research Institute (PGI-NRI, Poland);
- #372 (1968-1970) and #373 (1973-1974) – National Land Service under the Ministry of Environment (NLS, Lithuania);
- #338 (1969), #345 (1990) and #615 (1977-1979) – Latvian Geospatial Information Agency (LGIA, Latvia);
- #622 (1976) – Riga Technical University (RTU, Latvia);
- #618 (1966-1967) – Estonian Land Board (ELB, Estonia);
- #998 (1956) - National Land Survey of Finland/Finnish Geospatial Research Institute (NLS/FGI, Finland).

Years in which gravity measurements have been taken as well as the names of owners of sources are given in the brackets and after the hyphen, respectively. Sources #995, #996, #997 and #622 have been added to the NKG/FAMOS/BalMarGrav gravity DB as a result of the BalMarGrav project. All historical sources analyzed during the BalMarGrav project have been assigned in the database to the license called "all_balmargrav". Sources and procedures of data re-processing to modern reference systems were described in details in Wilde-Piórko et al. (2023a). The location of analyzed data is presented in Figure 1.

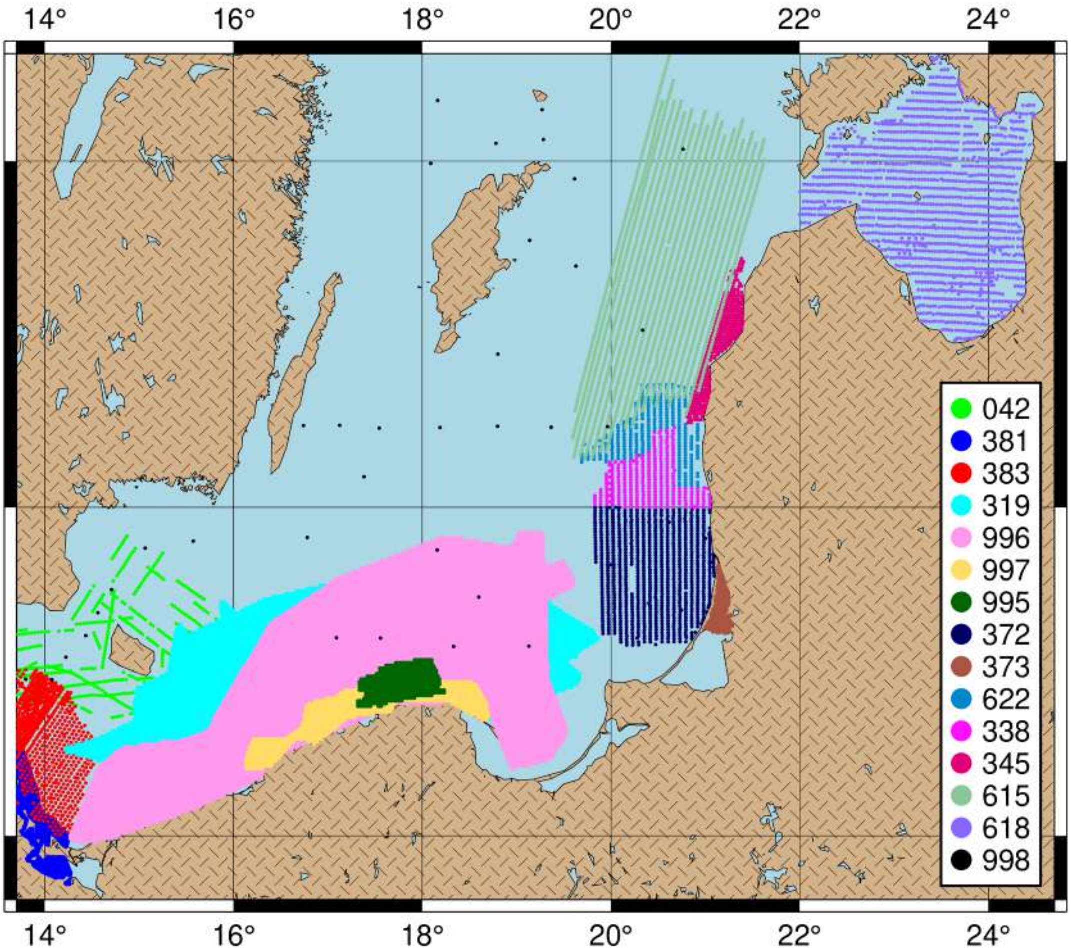

Figure 1: Historical sources of the NKG/FAMOS/BalMarGrav gravity DB examined during the BalMarGrav project

2.2 Validation sources

Following modern gravity sources of the NKG/FAMOS/BalMarGrav gravity DB have been used to validate the historical sources:

- #002 (2015), #003 (2015), #004 (2015), #005 (2015), #006 (2015), #007 (2016) and #012 (2017) – Technical University of Denmark (DTU, Denmark);
- #375 (2013), #377 (2015), #378 (2016), #379 (2017) and #380 (2018) – Federal Agency for Cartography and Geodesy (BKG, Germany) and GFZ German Research Centre for Geosciences (GFZ Potsdam, Germany);

- #312 (2019), #313 (2021) and #314 (2023) – Gdańsk University of Technology (GUT, Poland), Hydrographic Office of the Navy (HOPN, Poland) and Maritime University of Szczecin (MUS, Poland);
- #621 (2023) – Latvian Geospatial Information Agency (LGIA, Latvia) and Lantmäteriet (Sweden).

Years in which gravity measurements have been taken, as well as the names of the owners of sources are given in the brackets and after the hyphen, respectively. Sources #314 and #621 have been added to the NKG/FAMOS/BalMarGrav gravity DB as a result of the BalMarGrav project and they are described in details in Wilde-Piórko et al. (2023b). All sources used in validation procedure during the BalMarGrav project have been assigned in the database to the license called "all_balmargrav". The location of analyzed data is presented in Figure 2.

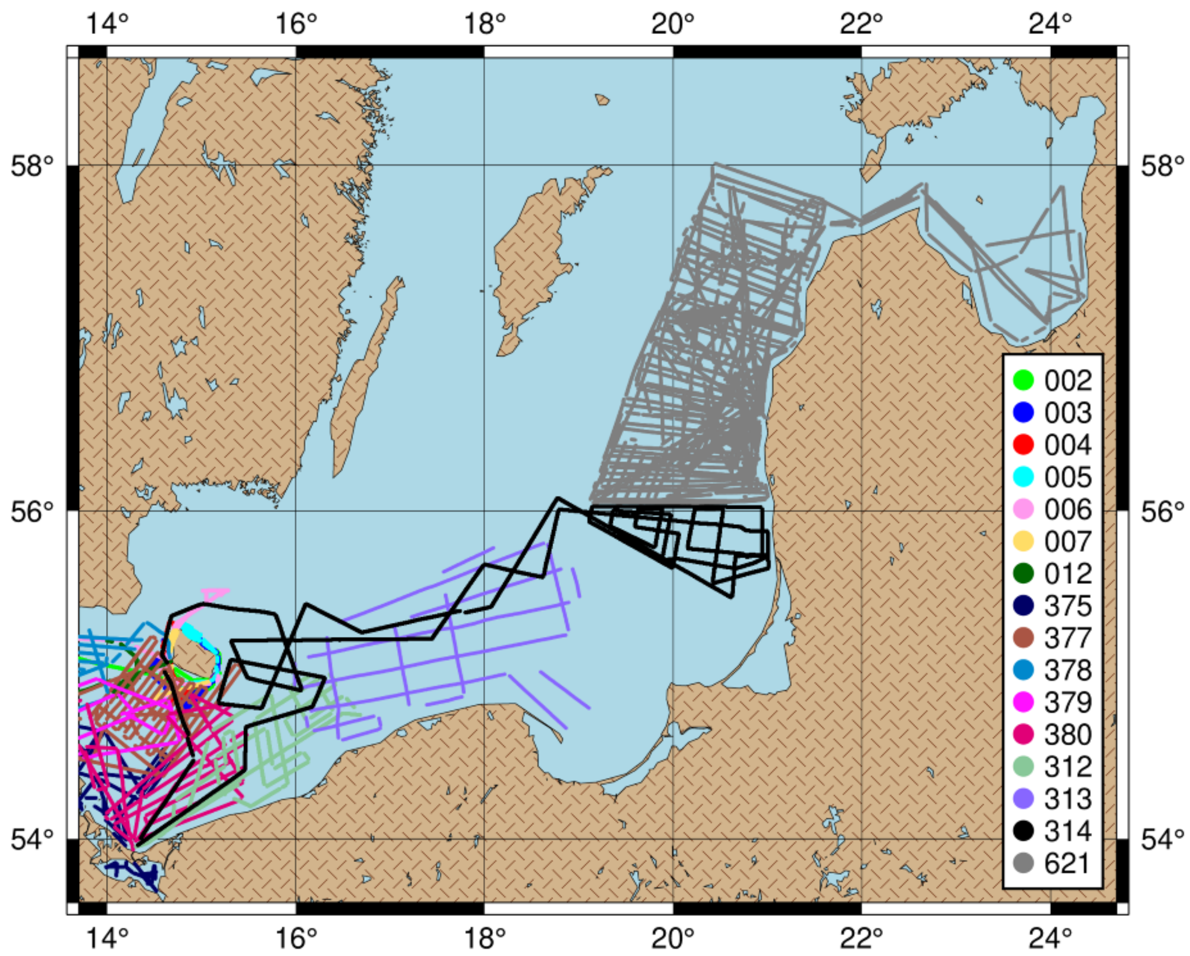

Figure 2: Sources of the NKG/FAMOS/BalMarGrav gravity DB used for validation of the historical marine gravity data

3 Homogenized historical marine gravity data

3.1 Preparation of data

The free-air gravity anomalies of historical and modern marine gravity data from the southern and eastern Baltic Sea have been preliminarly compared by Schwabe (2024) to inventory the data and its structure (e.g. profile data, point data, grid data) as well as to check individual and mutual consistence of the sources. Preliminary conclusions about the application of corrections or exclusion of same part of data have been formulated based on these results. Also, following guidelines have been drawn to select the appropriate historical marine gravity data for gridding:

1. When the area is covered by one source of historical marine gravity data, statistics of differences between Bouguer anomalies of historical and modern marine gravity data are calculated for this area and:
   - if std $<$ 2 mGal and max/min values $<$ 5 mGal, the dataset are used for gridding;
   - if std $>$ 2 mGal and max/min values $>$ 5 mGal, either this historical source is not used for gridding or an attempt is made to correct this data set by e.g. adding offset, removing bilinear trend.
2. When the area is covered by more than one source of historical marine gravity data, statistics of differences between Bouguer anomalies of historical and modern gravity data are calculated for each source for this area and:
   - either a source characterized by smallest values of std and min/max values are selected, or sources with comparable statistics (std $<$ 2 mGal and max/min values $<$ 5 mGal) are used for gridding.

The total topographic corrections (gravity disturbance with indirect term) have been calculated to determine statistics of differences between Bouguer anomalies of historical and modern marine gravity data. The 2" DEM/bathymetry BalMarGrav model was developed following the procedure:

- coastline was taken from the European Regional Map;
- in marine areas the EMODnet Digital Bathymetry model (DTM, 2022) was used with cells of height $<=$ 0 (other cells were assigned to zero);
- in land areas EuroDEM patched with MERIT model (EuroDEM, ver. 11/2023) was used with cells of height $>=$ 0 (other cells have been assigned to zero); some mining pits below -50 m were "filled up" (negligible local effect).

Computation of total topographic effects has been performed for points at the sea surface (DEM/bathymetry height $=$ 0) determined according to land surface (DEM/bathymetry height $>=$ 0) with density equal 2670 kg/m^3 for bedrock/land and 1007 kg/m^3 for water/ocean (according to the salinity map of the Baltic Sea). The integration radius of 166.7 km was assumed. Rectangular prism formula was applied up to ~300 m distance (5 times DEM/bathymetry resolution in latitudinal direction) and beyond it a tesseroid

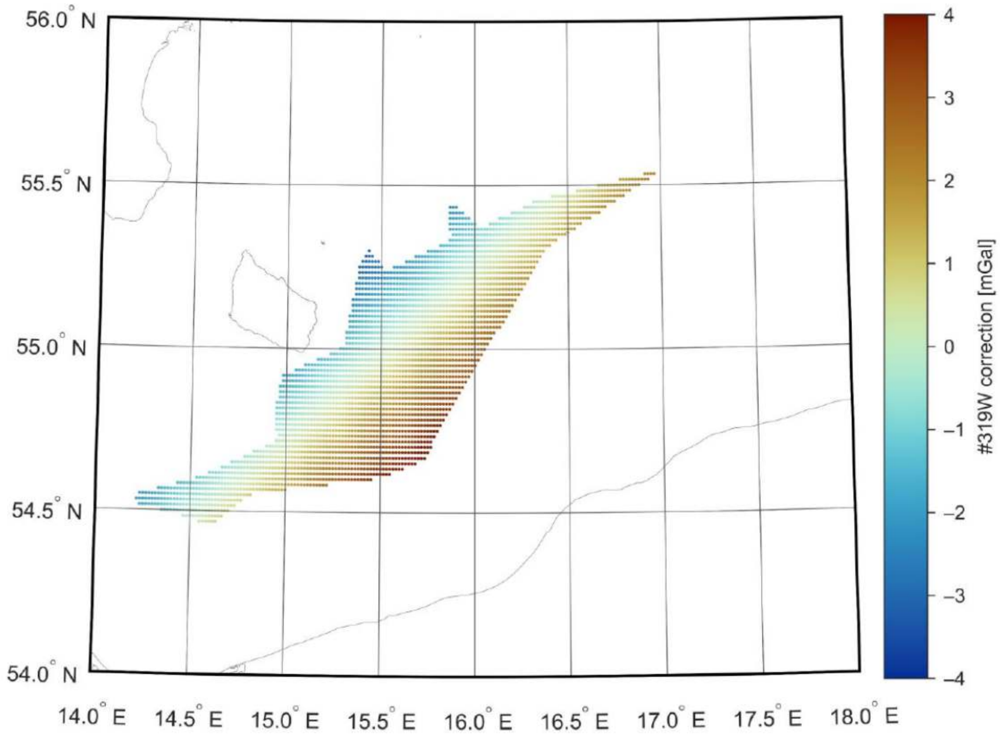

Figure 3: Correction values used for western part of the source #319 (Bouguer anomalies) (Varbla, 2024)

formula (Grombein et al., 2013) with a vertical subdivision of tesseroids (up to ∼11 km distance). The DEM/bathymetry geometry is assumed on the ellipsoid and the geoid is neglected.

For all historical and modern sources Bouguer anomalies have been recalculated by adding the total topographic corrections to the free-air gravity anomalies. Statistics of differences between each historical and modern sources have been calculated leading to conclusions that:

- only parts of the source #319 should be used, i.e. the ones which are outside the area covered by the source #996; western part of #319 (named #319w) was corrected with a tilted linear correction surface (Figure 3) and the eastern part of #319 (named #319e) was corrected by adding an offset of +1.7 mGal;
- the source #995 was corrected by adding an offset of +3.6 mGal;
- the source #996 was corrected by adding an offset of -0.7 mGal;
- the source #998 was not used for gridding because it consists of single points scattered around the whole analyzed area.

Table 1 shows statistics of differences between historical and modern gravity sources (Bouguer anomalies after correction) interpolated into a grid with spatial resolution of $1.2' \times 0.6'$ in the region from 13.7°E to 24.7°E and from 53.6°N to 58.6°N. Sources #319e,

#373 and #618 are not covered by modern gravity data gathered in the BalMarGrav project.

Table 1: Statistics of differences of Bouguer gravity anomalies obtained from the historical and modern gravity data

Histor.− Modern	No of points	Min [mGal]	Max [mGal]	Mean [mGal]	Std [mGal]	Min.r[a] [mGal]	Max.r[b] [mGal]	Med.[c] [mGal]	L1[d] [mGal]
042−002	510	-12.7	5.2	-3.1	3.48	-9.7	8.3	-2.5	3.34
042−003	542	-14.9	5.1	-3.1	4.40	-11.8	8.2	-1.5	2.93
042−004	367	-12.7	5.9	-1.7	2.99	-11.0	7.6	-1.6	2.89
042−005	267	-14.4	1.4	-3.6	3.46	-10.8	4.9	-2.5	2.94
042−006	508	-12.3	12.6	-1.9	4.31	-10.4	14.5	-2.0	3.27
042−007	270	-13.2	8.1	-2.3	3.74	-10.9	10.3	-2.2	3.74
042−012	275	-7.6	1.2	-2.6	1.72	-5.0	3.7	-2.4	1.86
042−314	800	-14.1	10.4	-2.1	5.47	-12.0	12.5	-0.8	5.90
042−377	1368	-10.0	4.8	-2.2	2.66	-7.8	7.0	-2.0	2.49
042−378	565	-9.9	9.6	-2.6	3.87	-7.4	12.2	-3.4	4.00
042−379	399	-8.6	5.2	-1.9	3.36	-6.7	7.1	-1.6	3.88
042−380	230	-7.6	6.2	-2.4	3.16	-5.2	8.5	-3.3	3.10
381−375	724	-2.2	3.3	0.2	0.75	-2.4	3.1	0.1	0.61
381−377	51	-0.9	2.9	1.1	0.69	-2.0	1.8	1.1	0.73
381−379	70	-0.7	2.3	0.7	0.62	-1.4	1.6	0.7	0.65
381−380	354	-3.3	3.6	0.3	1.00	-3.6	3.3	0.2	1.03
383−012	190	-2.7	5.4	0.9	2.11	-3.6	4.5	0.6	2.61
383−375	1438	-3.0	2.3	0.2	0.70	-3.2	2.2	0.2	0.62
383−377	1529	-4.8	3.2	-0.2	0.89	-4.6	3.4	-0.2	0.68
383−378	205	-6.0	2.6	-0.9	1.24	-5.2	3.4	-0.9	0.76
383−379	876	-5.3	3.2	-0.4	1.02	-4.9	3.6	-0.3	0.87
383−380	1327	-3.0	2.2	0.1	0.67	-3.1	2.1	0.2	0.53
319w−002	108	-11.0	6.3	-0.9	4.34	-10.0	7.3	-0.7	4.37
319w−003	96	-12.1	6.3	-1.3	4.32	-10.8	7.6	-1.6	5.12
319w−004	28	-13.8	-4.9	-7.5	2.45	-6.3	2.5	-6.4	1.02
319w−005	26	-12.2	-4.5	-6.9	2.27	-5.4	2.4	-5.7	1.09
319w−006	47	-9.6	-3.1	-5.9	1.77	-3.8	2.8	-5.1	1.48
319w−007	17	-8.0	-5.3	-6.5	0.66	-1.5	1.2	-6.4	0.49
319w−312	752	-4.9	5.8	0.0	1.91	-4.9	5.8	-0.1	2.05
319w−313	185	-5.0	4.8	-0.7	2.69	-4.2	5.6	-1.2	2.80
319w−314	1637	-7.3	9.1	-0.4	2.68	-6.9	9.4	-0.7	2.43
319w−375	136	-2.3	7.4	0.7	1.84	-3.0	6.7	0.2	1.47
319w−377	1042	-7.1	6.1	-0.3	1.97	-6.8	6.3	-0.6	1.79
319w−379	200	-6.1	4.0	0.0	2.38	-6.1	4.0	0.3	2.32
319w−380	842	-5.9	5.8	-0.4	2.05	-5.5	6.2	-0.7	1.91
996−312	3077	-3.2	3.4	-0.1	0.86	-3.1	3.5	-0.1	0.79
996−313	5216	-7.2	3.3	-0.7	1.32	-6.5	4.0	-0.6	1.11
996−314	2591	-8.5	4.2	-0.8	2.01	-7.7	5.1	-0.5	1.73
996−375	160	-3.2	9.4	1.0	1.91	-4.2	8.4	0.4	0.82

996–377	142	-1.7	4.6	1.2	1.30	-2.9	3.4	0.9	1.22
996–380	2217	-2.9	5.3	0.1	0.86	-3.0	5.2	0.1	0.68
997–312	33	-0.6	2.2	0.7	0.64	-1.4	1.5	0.6	0.47
997–313	757	-3.7	2.6	0.0	1.21	-3.6	2.6	0.0	1.22
995–313	436	-4.7	3.3	-0.0	1.48	-4.7	3.3	0.0	1.37
372–314	2029	-7.8	9.0	0.9	1.65	-8.7	8.1	0.9	1.43
622–621	2232	-4.0	3.3	0.1	0.72	-4.1	3.2	0.1	0.61
338–314	390	-2.2	7.9	1.5	1.90	-3.7	6.4	1.2	1.58
338–621	1604	-2.8	3.3	0.2	0.68	-3.0	3.1	0.2	0.58
345–621	1044	-3.3	4.9	0.1	0.97	-3.4	4.8	0.1	0.84
615–621	9584	-8.9	13.9	0.5	1.17	-9.5	13.4	0.5	1.08
998–012	27	-0.5	7.5	4.0	2.25	-4.5	3.5	4.4	1.50
998–313	37	-2.8	1.3	-0.4	0.87	-2.4	1.7	-0.3	0.93
998–314	14	-1.2	-0.8	-1.0	0.11	-0.2	0.2	-1.0	0.09
998–377	55	-1.7	7.4	1.5	2.06	-3.2	5.9	1.1	2.05
998–379	34	-1.6	5.7	0.7	1.54	-2.3	5.0	0.4	0.95

[a] Min.r – a smallest value of set after removing the mean value; [b] Max.r – a largest value of set after removing the mean value; [c] Med. – median of set; [d] L1 – L1 norm of set

3.2 Gridding procedure

Gridding of Bouguer anomalies of historical marine gravity data was done by least-squares collocation method (Varbla, 2024). The GO_CONS_GCF_2_DIR_R6 global geopotential model evaluated up to a degree order of 300 was used to remove and later restore the long-wavelength gravity signal. Covariances of residual gravity were determined by using the second-order Markov covariance model (signal variance of 55.97 mGal^2 and correlation length of 17.10 km) fitted to the empirical autocovariance curve (calculated in 5 km distance groups, Figure 4). Grid node value prediction was done by using 100 closest points to a grid node in each quadrant. Extrapolation was allowed up to 6 km from the nearest available data point.

Estimation of uncertainties of the historical gravity data were determined based on the reported values in original documentations and based on comparison with modern gravity data. These values ranged from 0.5 to 3.5 mGal (Table 2). Using uncertainties estimated based on comparison with modern gravity data, the least-squares collocation method provides slightly better results, i.e. better agreement with the validation data, than when uncertainties reported in original documentation were used. An exception was data from the Gulf of Riga, where 2.0 mGal assumed uncertainty causes too significant gravity field smoothing. In fact there are a few regions where agreement with validation data is better than reported in documentations. As a compromise, 1.0 mGal uncertainty was assumed for the source #618 for the final grid computation. The uncertainties used in final gridding are presented in Table 2.

Homogenized historical gravity data, a result of the gridding procedure, is shown in Figure 5 and their uncertainties in Figure. 6. It can be seen that uncertainties of homogenized

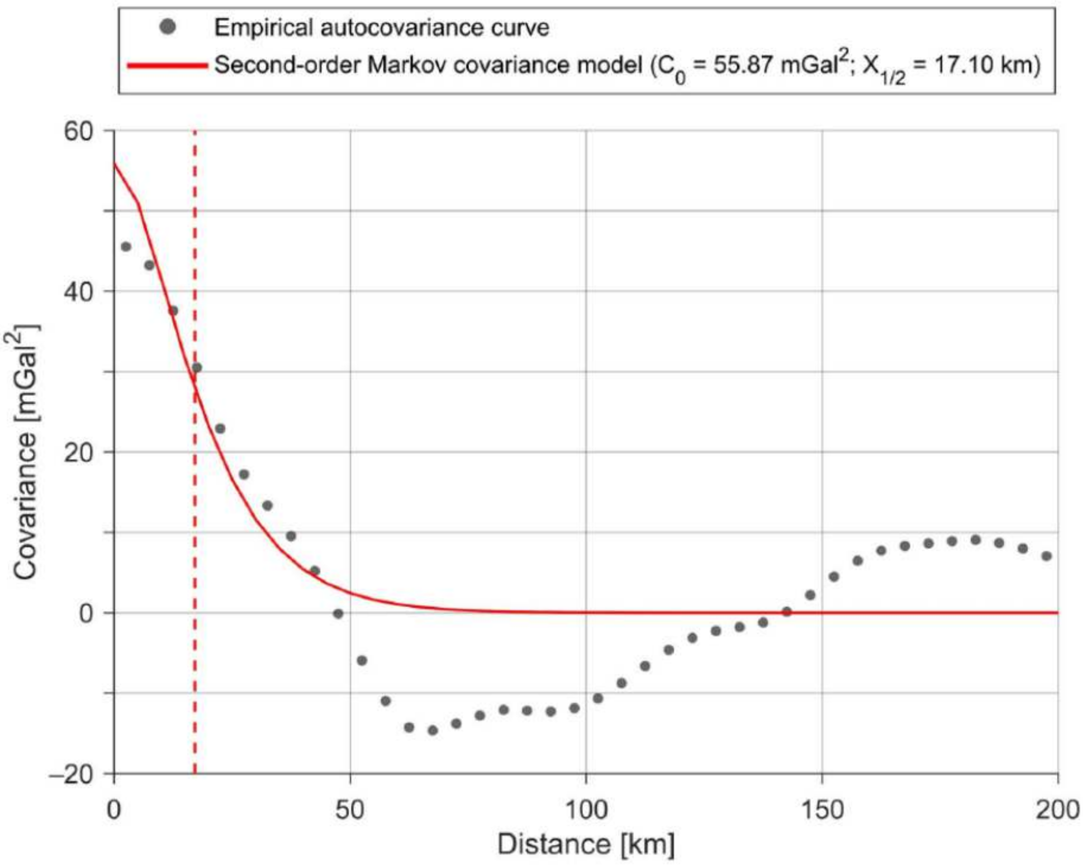

Figure 4: Empirical autocovariance curve of the residual gravity and fitted to it second order Markov covariance model (Varbla, 2024)

Table 2: Estimated uncertainties of the historical gravity sources

source number	reported in documentation [mGal]	comparison with modern data [mGal]	used in final gridding [mGal]
042	2.5	3.5	3.5
319	1.6	2.4	2.4
338	1.0	1.0	1.0
345	1.0	1.0	1.0
372	0.5	1.0	1.0
373	0.5	1.0	1.0
381	0.5	1.0	1.0
383	1.0	1.0	1.0
615	1.2	1.2	1.2
618	0.5	2.0	1.0
622	0.5	1.0	1.0
995	1.3	1.4	1.4
996	0.7	1.0	1.0
997	0.5	1.0	1.0

historical gravity data around the Bornholm island are much higher than those observed at other areas, so a decision has been made among the project partners to remove the source #042 from the final gridding data set. Figure 7 shows results of gridding without the source #042. A small problematic area still remains south of Bornholm, with highly scattered values of Bouguer anomalies (Figure 8). Data covered that region was removed from source #319w, and then the gridding procedure was repeated.

Gridded free-air anomalies were obtained by restoring the topographic corrections. Uncertainties are assumed to be equivalent to those calculated for Bouguer anomalies. Figures 9-11 show free-air and Bouguer anomalies of the homogenized historical marine gravity data together with their uncertainties.

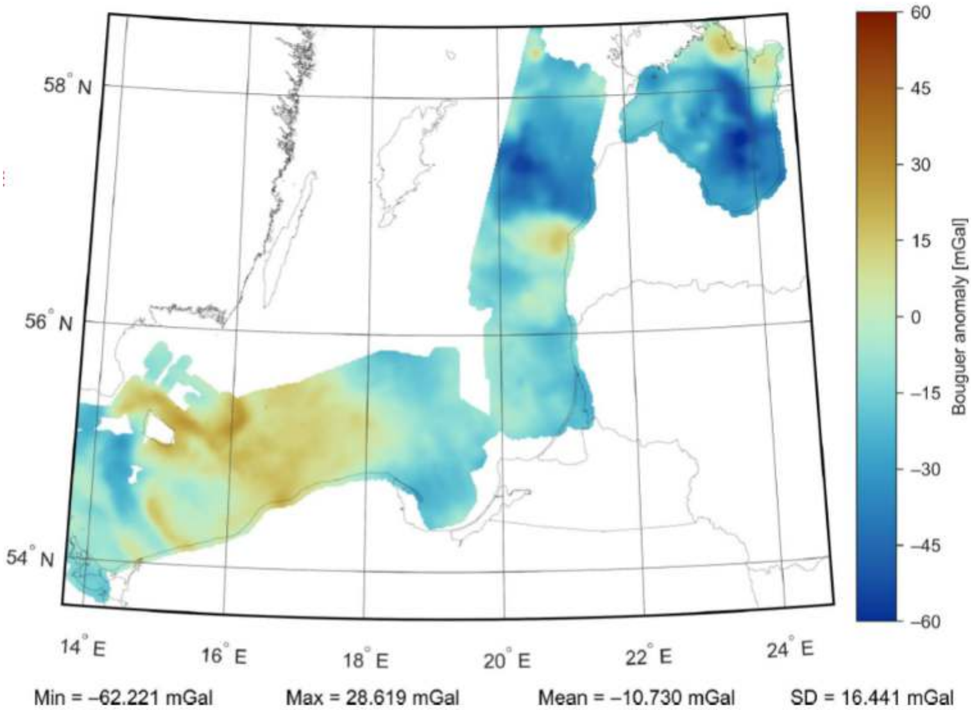

Figure 5: Preliminary result of the gridding procedure - homogenized historical gravity data (Varbla, 2024)

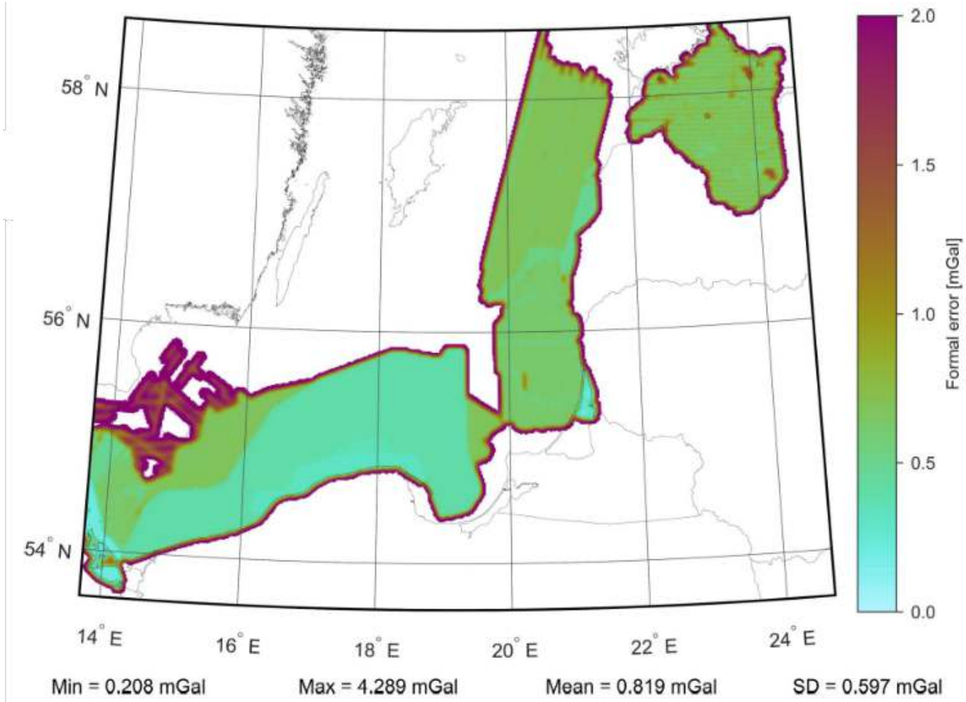

Figure 6: Preliminary uncertainties of the homogenized historical gravity data (Varbla, 2024)

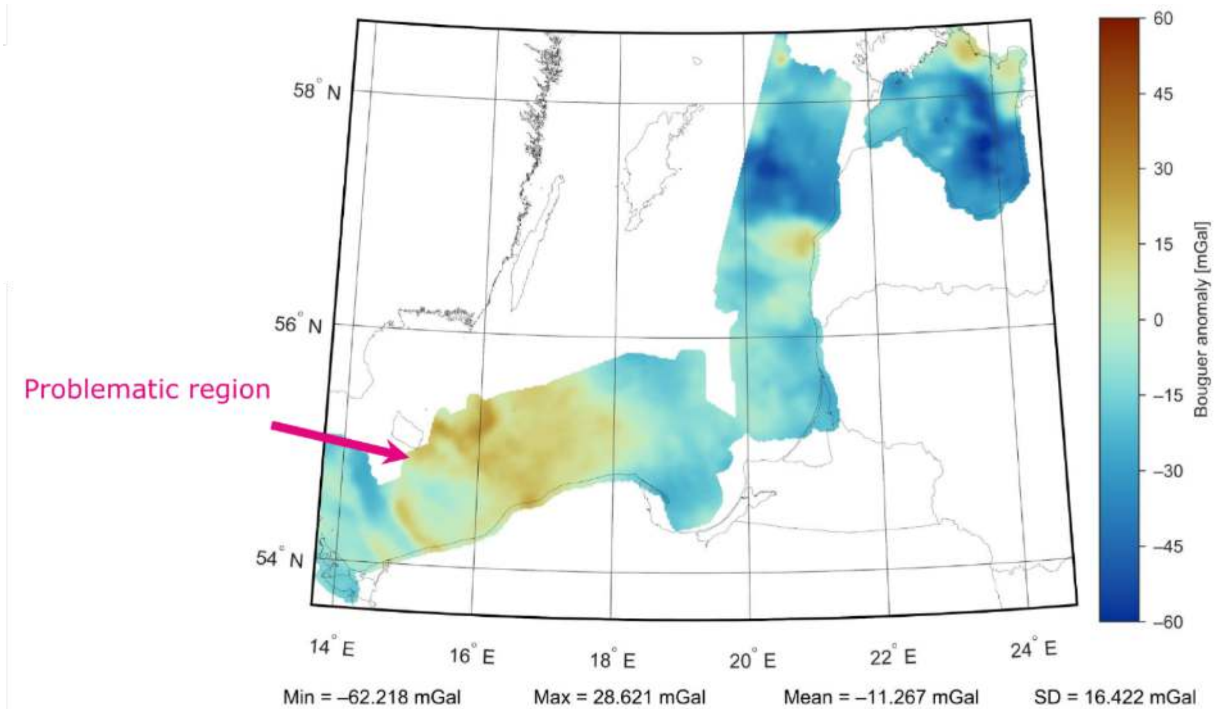

Figure 7: Final result of the gridding procedure without the source #042 with marked problematic area (Varbla, 2024)

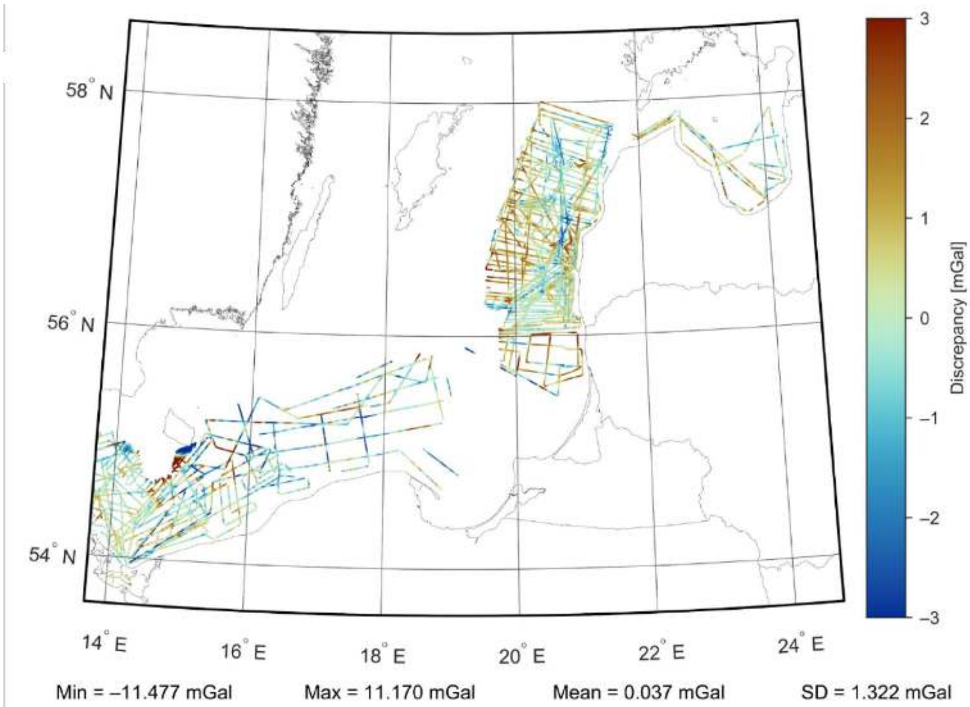

Figure 8: Differences between the final homogenized historical gravity data grid and modern gravity data (Varbla, 2024)

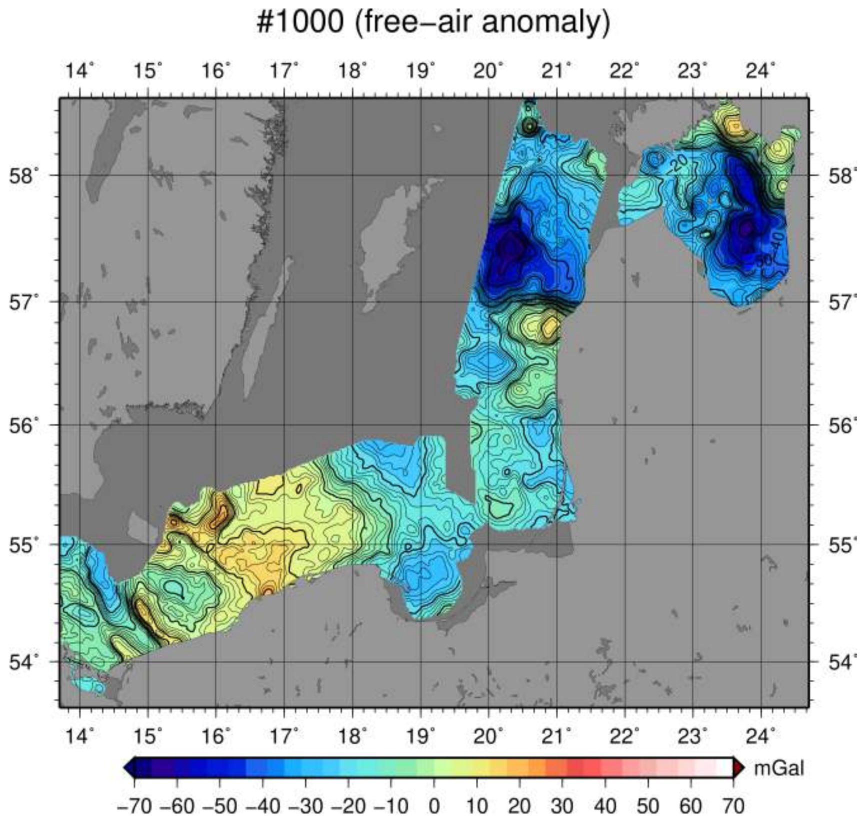

Figure 9: Final free-air gravity anomalies of the homogenized historical gravity data (Wilde-Piórko et al., 2024)

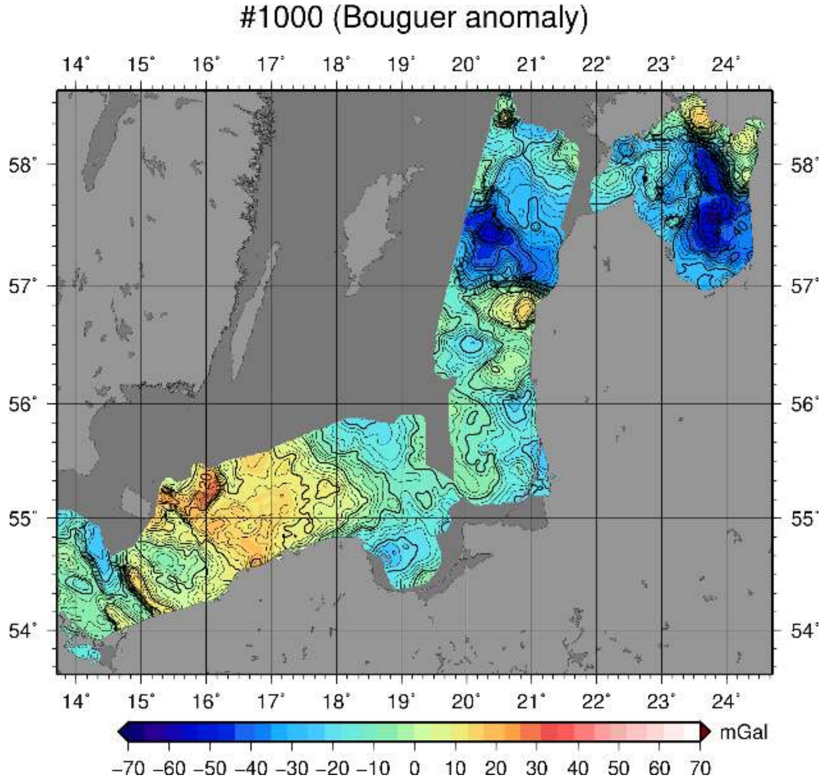

Figure 10: Final Bouguer gravity anomalies of the homogenized historical gravity data (Wilde-Piórko et al., 2024)

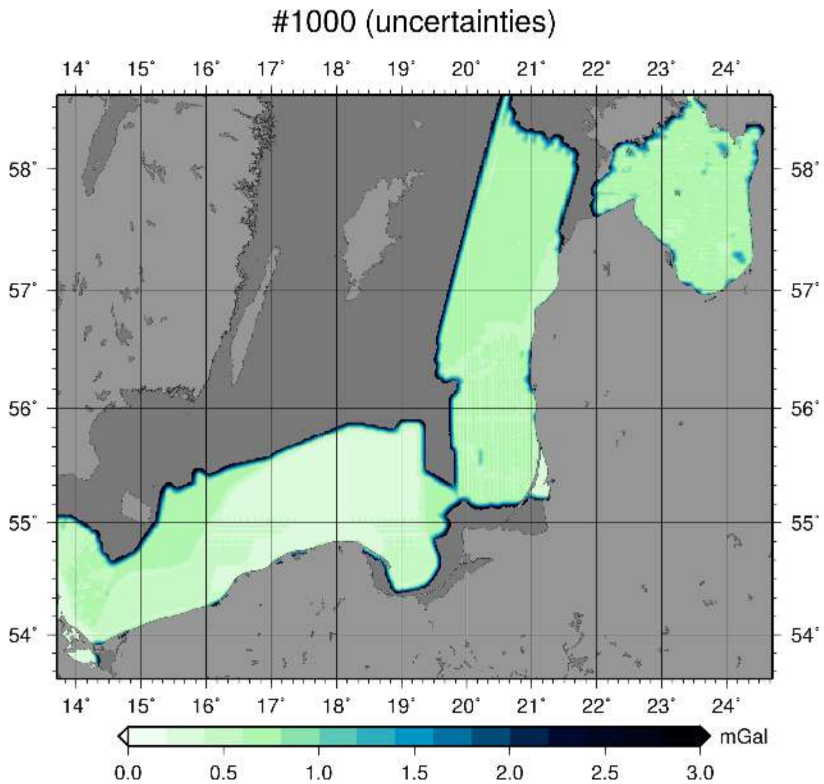

Figure 11: Final uncertainties of the homogenized historical free-air and Bouguer gravity anomalies (Wilde-Piórko et al., 2024)

4 Validation of homogenized historical marine gravity data

The developed homogenized historical free-air gravity anomalies were compared with regional FAMOS gravity anomalies models, global altimetric model and global geopotential models.

4.1 Regional gravity models

During the EU project "Finalising Survey for the Baltic Motorways of the Sea" (FAMOS Freja, 2014; FAMOS Odin, 2015) ran in 2014-2019 many modern shipborne gravity measurements at the Baltic Sea were conducted. These data together with other gravity data available at the Nordic Geodetic Commission gravity database are used to develop gravity anomalies models: BKG5A–BKG5D by the Federal Agency for Cartography and Geodesy, DTU1 by the Technical University of Denmark, LM9F by Lantmäteriet and TUT3 by the Tallinn University of Technology. The statistics of differences between the free-air gravity anomalies of each above models and the homogenized historical gravity free-air anomalies are shown in Table 3. Maps of those differences are shown in Figure 12-15.

Table 3: Statistics of differences between the homogenized historical free-air gravity anomalies (#1000) and the FAMOS regional models (BKG5A–BKG5D, DTU1, LM9F, TUT3), the altimetric model (DTU23), the global geopotential models (EGM2008, EIGEN-6C4)

Homogenized– Regional/Global	Min [mGal]	Max [mGal]	Mean [mGal]	STD [mGal]	Min.r[a] [mGal]	Max.r[b] [mGal]	Med.[c] [mGal]	L1[d] [mGal]
#1000–BKG5A	-8.1	11.8	-0.1	1.13	-8.0	12.0	-0.1	0.53
#1000–BKG5B	-8.1	12.1	-0.1	1.13	-7.9	12.2	-0.1	0.50
#1000–BKG5B	-8.1	12.1	-0.1	1.13	-7.9	12.2	-0.1	0.50
#1000–BKG5C	-8.6	11.8	-0.1	1.14	-8.5	11.9	-0.0	0.55
#1000–BKG5D	-8.5	12.0	-0.1	1.14	-8.4	12.1	-0.1	0.52
#1000–DTU1	-13.9	12.7	-1.1	1.32	-12.8	13.8	-1.0	0.42
#1000–LM9F	-8.6	13.2	-0.1	1.11	-8.5	13.3	-0.1	0.44
#1000–TUT3	-9.3	13.2	-0.2	1.11	-9.1	13.3	-0.1	0.43
#1000–DTU23	-7.7	9.6	-0.8	1.50	-6.9	10.4	-0.8	1.36
#1000–EGM2008	-12.8	10.7	-0.8	2.29	-12.0	11.5	-1.0	2.35
#1000–EIGEN6C4	-13.8	10.8	-0.8	2.01	-13.0	11.6	-0.9	1.77

[a] Min.r – a smallest value of set after removing the mean value; [b] Max.r – a largest value of set after removing the mean value; [c] Med. – median of set; [d] L1 – L1 norm of set

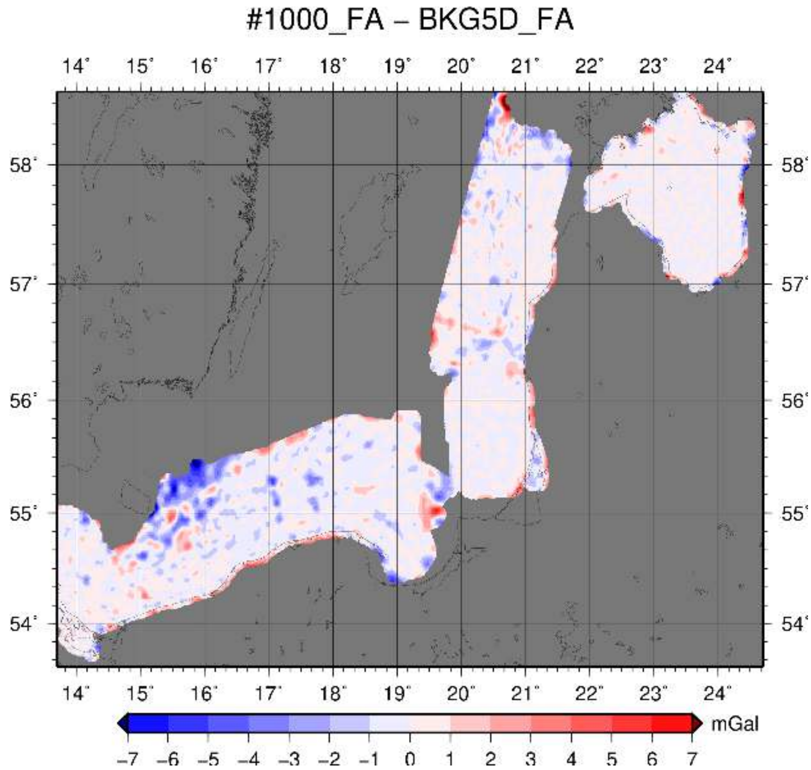

Figure 12: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the BKG5D mode

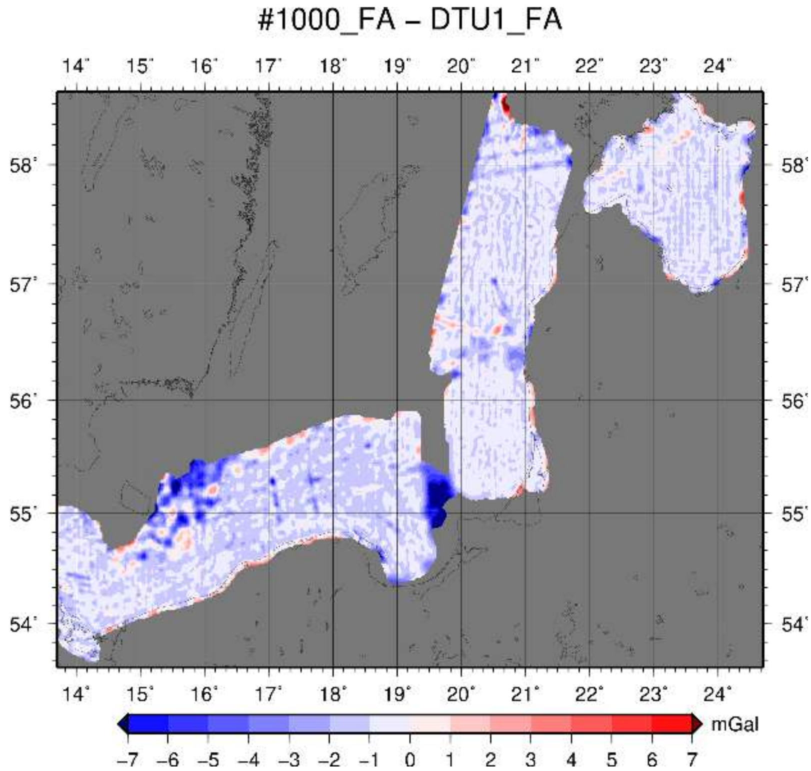

Figure 13: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the DTU1 model

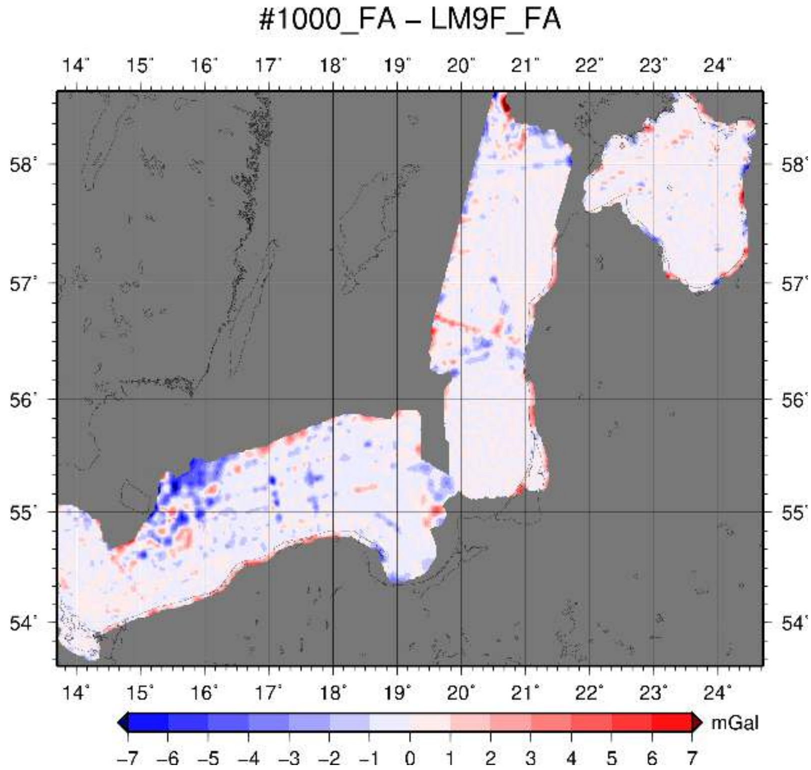

Figure 14: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the LM9F model

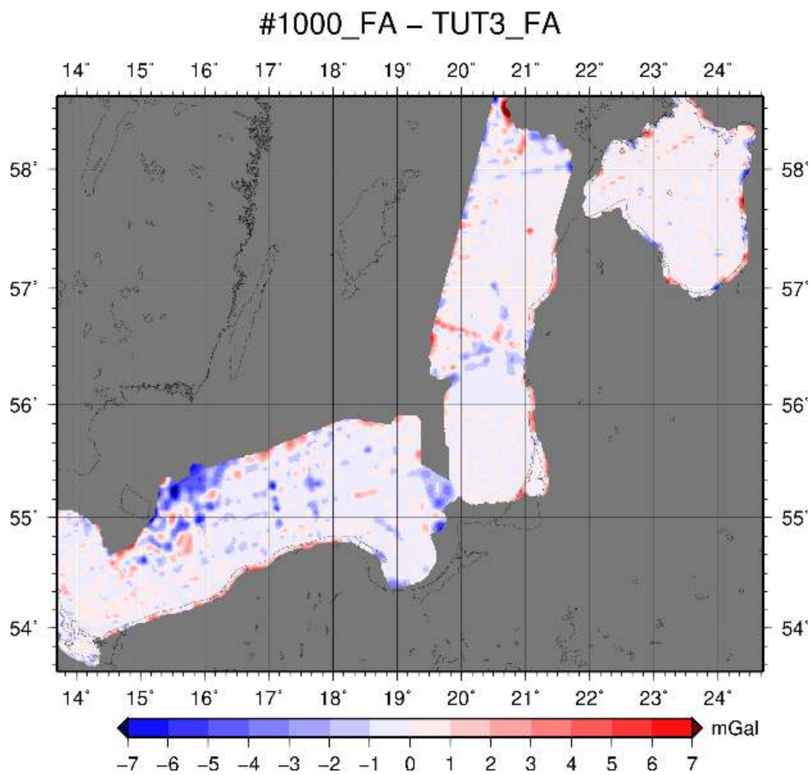

Figure 15: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the TUT3 model

4.2 Global altimetric model

The homogenized historical marine gravity data has also been compared with the preliminary global gravity anomalies model (DTU23) developed by the Technical University of Denmark (DTU) based on altimetric measurements. The DTU23 model is not yet published and it was kindly provided by its author for the purpose of this study. The statistics of differences of the free-air gravity anomalies resulted from the homogenized historical marine gravity data and the DTU23 altimetric model are shown in Table 3. The differences of anomalies were calculated for points which were offshore at a distance exceeding 10 km from the coastline (Figure 16).

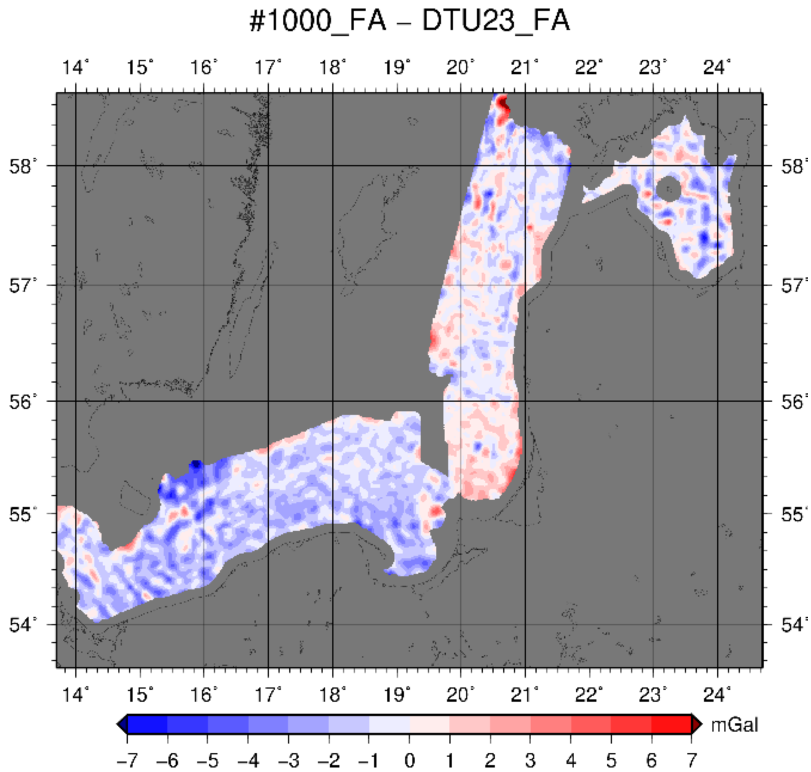

Figure 16: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the DTU23 altimetric model

4.3 Global geopotential models

Finally, the homogenized historical marine gravity data were compared with the global geopotential models: EGM2028 (Pavlis et al., 2012; Fullea et al., 2008) and EIGEN-6CN (Ince et al., 2019; Förste et al., 2014). The statistics of differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the global geopotential models are shown in Table 3 and their maps in Figure 17 and 18.

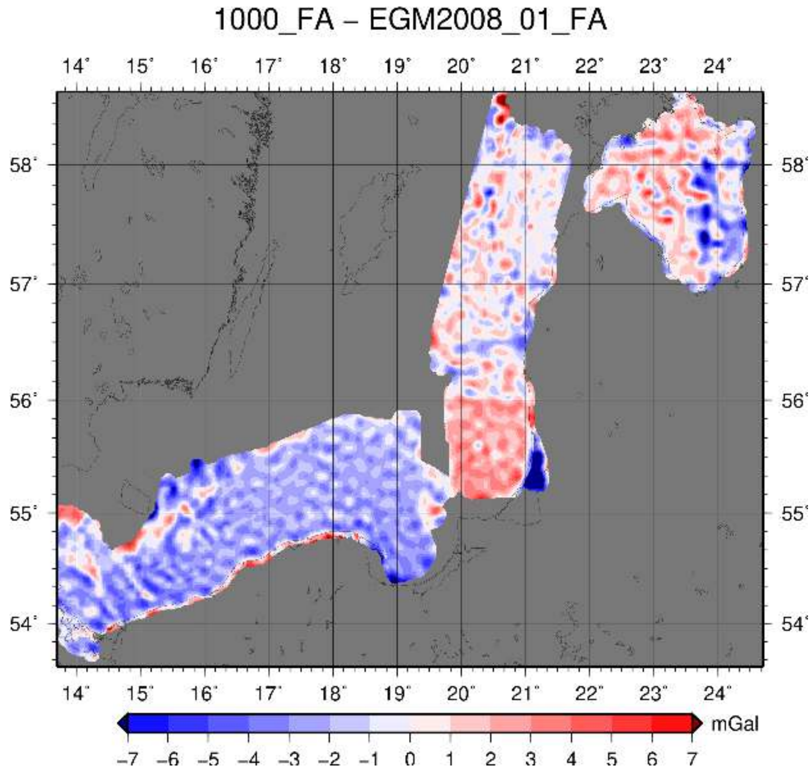

Figure 17: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the EGM2008 model

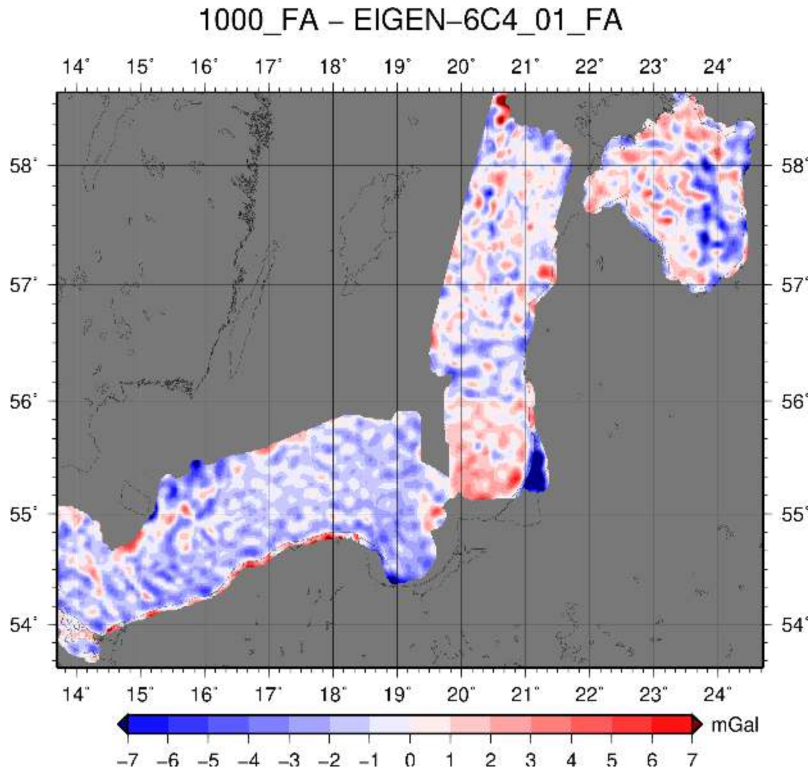

Figure 18: Differences of free-air gravity anomalies obtained from the homogenized historical marine gravity data and the EIGEN-6C4 model

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EuroDEM, version 11/2023. https://www.mapsforeurope.org/datasets/euro-dem. EuroDEM product is owned by all National Mapping and Cadastral Agencies above and collectively represented by © EuroGeographics. EuroDEM is infilled with SRTM open data, SRTM data is used with the kind permission of CIAT: https://srtm.csi.cgiar.org/. MERIT DEM is available for download at http://hydro.iis.u-tokyo.ac.jp/~yamadai/MERIT_DEM. MERIT data can be shared under "CC-BY-NC 4.0" or "ODbL 1.0" license. Please specify which license you'd like to follow. For Non-Commercial use, "CC-BY-NC 4.0" is recommended. For Commercial use, "ODbL 1.0" must be selected and you have to follow its open data policy (for example, if you create a flood hazard map using MERIT data and you'd like to provide a commercial service based on that, you have to make the hazard map publicly available under OdBL license).

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