Improving the Baltic Sea geoid model by marine gravity measurements in the FAMOS project

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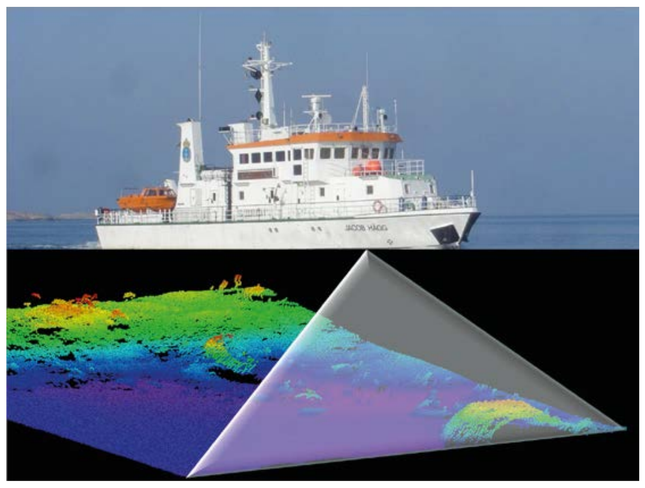
FAMOS – Finalising Surveys for the Baltic Motorways of the Sea

The main component of the FAMOS (Finalising Surveys for the Baltic Motorways of the Sea) project is to finalise hydrographic surveying in those areas of the Baltic Sea that are of interest for commercial shipping. More specifically, this means to finish the surveying of the CAT I /II areas in the BSHC-HELCOM harmonised re-survey scheme; see figure below.

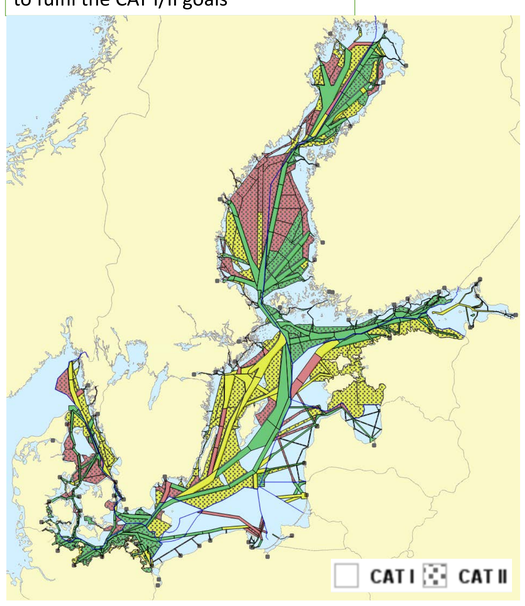
The FAMOS project is planned from 2014 to 2020.

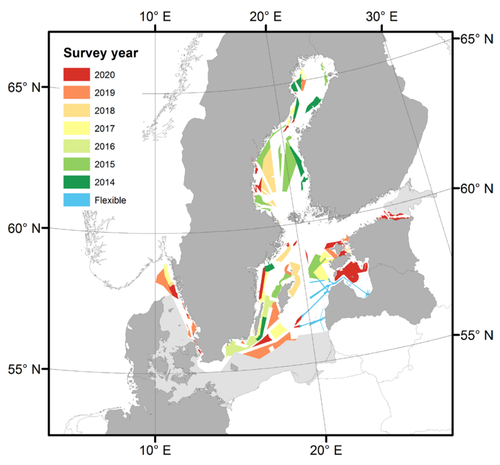


Example of a shipborne gravimeter: LC&R S-meter

The BSHC-HELCOM harmonized re-survey scheme

The main focus of FAMOS activity 1 is to fulfil the CAT I/II goals





FAMOS
FINALISING SURVEYS FOR THE BALTIC MOTORWAYS OF THE SEA

Harmonising vertical datum (activity 2 of FAMOS)

The main goal of activity 2 is to improve the geoid model over the Baltic Sea area,to provide an important basis for future offshore navigation.

This is also crucial for the on-going efforts of the the Chart Datum Working Group (CDWG) of the Baltic Sea Hydrographic Commission (BSHC) to introduce the European Vertical Reference System (EVRS) as chart datum in the Baltic Sea.

The activity partners include:

- Lantmäteriet, Sweden
- German Federal Agency for Cartography and Geodesy
- GFZ - German Research Centre for Geosciences
- Danish Technical University Space Institute

All participating Hydrographic Offices support the activity with their survey vessels.

Planned components of activity 2

a) Check the status quo regarding existing gravity data and the quality of presently available geoid models. Plan what data should be collected based on activity 1 survey plans.

b) Quality control of existing gravity data by means of collecting new, high-quality data on cross tracks during activity 1 field work.

c) Fill identified gaps in gravity database where possible during activity 1 field work.

d) Collect raw GNSS data to determine water surface and validate hydrodynamic models.

e) If possible, collect limited amounts of land gravity data in coastal areas to better tie marine measurements to land data.

f) Determine improved geoid(s), possibly using different methods in order to find methodology yielding best results in the Baltic Sea area.

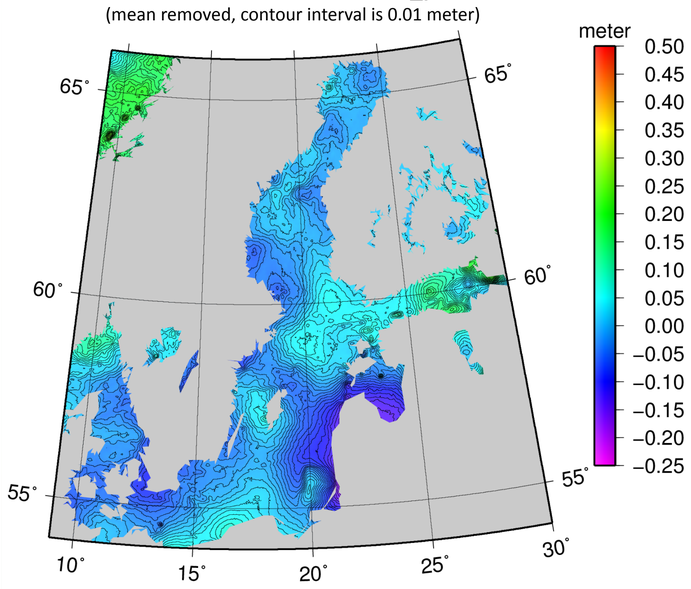
g) Validate new geoid(s) by means of gravity data and water level information from survey vessel GNSS positioning.

This will include marine gravity measurements by means of running a gravity meter onboard the survey vessels to collect additional gravity data on an opportunity basis during hydrographic surveys. This “piggy-back” concept of collecting gravity measurements has been successfully used by the Danish Technical University during Danish Geodata Agency surveys.

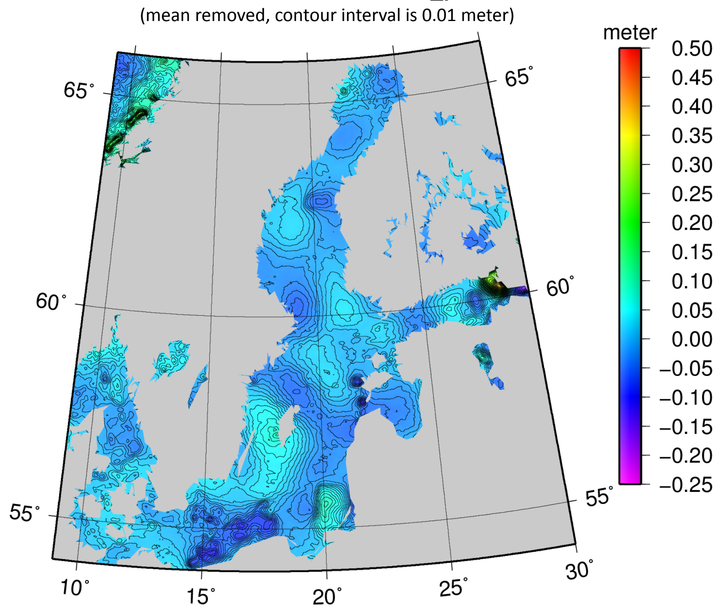
Differences between gravimetric geoid models in the Baltic Sea

- FAMOS activity 2 will focus on improving the gravimetric geoid model over the Baltic Sea, mainly by checking and updating the Baltic Sea gravity data set.
- To be practically useful, the gravimetric model has to be adapted to the relevant geodetic reference systems/frames along the coasts, but this is not part of FAMOS.
- The figures show the differences between NKG2004, EGG08, EGM2008 and one preliminary version of NKG2014.
- NKG2014_prel140828 has been computed using a thoroughly updated version of the NKG DB (v02, 2014-08-08) and the new GOCE/GRACE derived GO_CONS_GCF_2_DIR_R5. It is therefore believed to be the best model (but this remains to be proved).
- The differences between the models have a standard deviation between 5 to 10 cm in most of the Baltic Sea, but the differences become increasingly larger in the Gulf of Finland.
- However, it is still the case that these geoid models have much of the Baltic Sea gravity data in common, which means that many gravity errors will not show up in the comparisons.

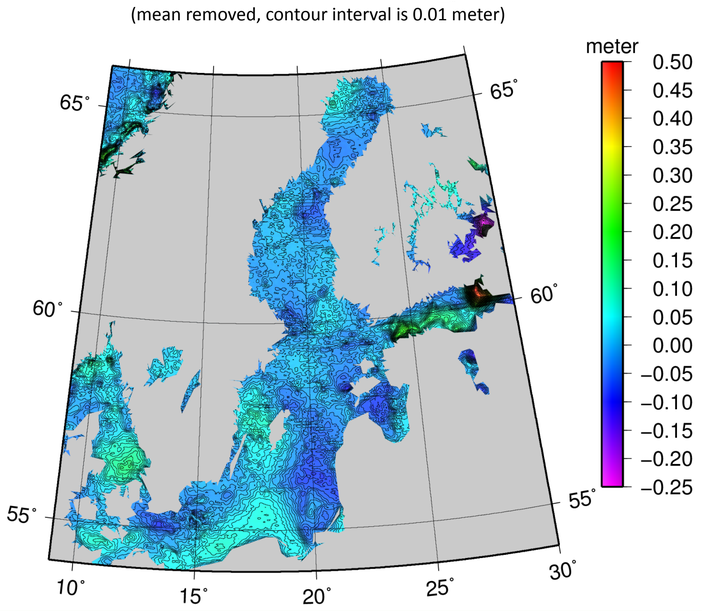
Difference NKG2004 and NKG2014_prel140828
(mean removed, contour interval is 0.01 meter)



Difference EGG08 and NKG2014_prel140828
(mean removed, contour interval is 0.01 meter)

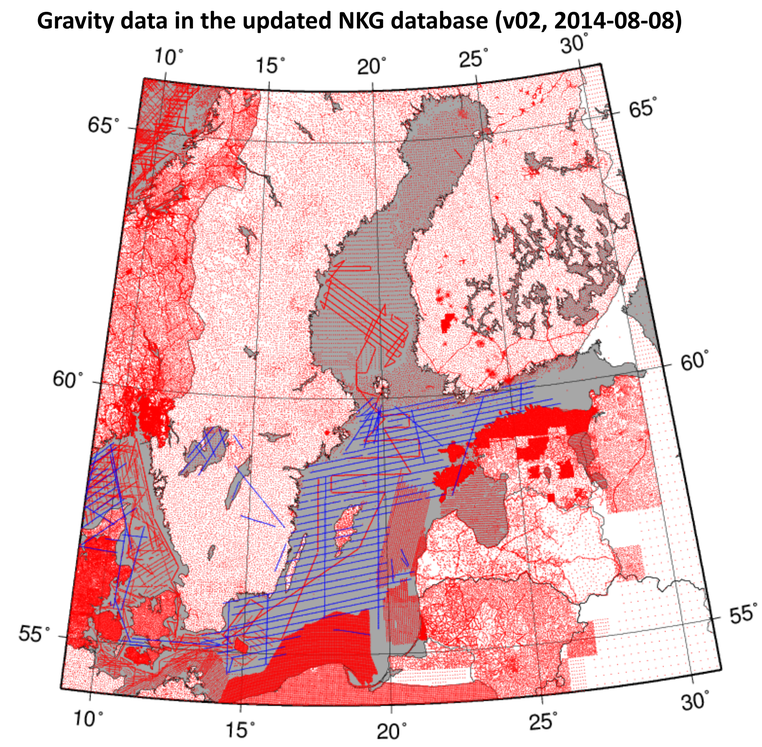


Difference EGM2008 and NKG2014_prel140828
(mean removed, contour interval is 0.01 meter)

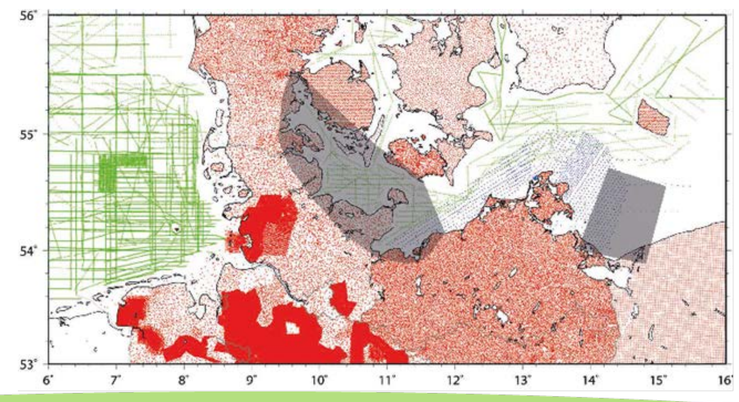


Presently available gravity data in the Baltic Sea

Gravity data in the updated NKG database (v02, 2014-08-08)



Gravity data in the BKG database



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