GOCE and Cryosat-2 for Dynamical Coastal Topography and Tide Gauge Unification

O. Andersen (1), P. Knudsen (1), K. Nilsen(1), C. Hughes(2), P. L. Woodworth(3), R. Bingham(4), G. Woppelman(5), M. Gravelle(5), L. Fenoglio-Marc(6). J. Kusche (6), M. Kern(7)

(1)Technical University of Denmark, DTU Space, 2800 Lyngby, Denmark. (2) University of Liverpool (3) University of Liverpool (NOC), (4) University of Bristol (5) LIENS University La Rochelle (6) University of Bonn, (7). ESA ESTEC

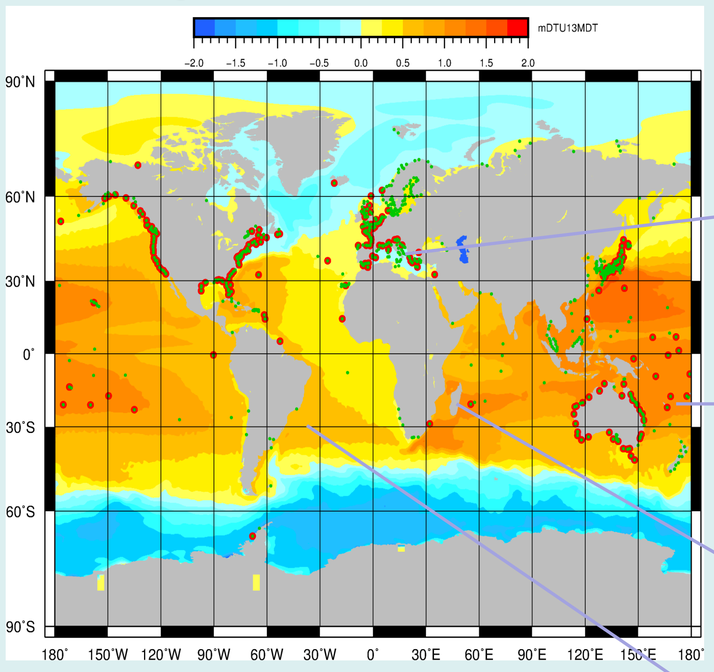
Introduction.

ESA is currently supporting a study on the investigation and using ocean levelling as a novel approach to the study of height system unification across the oceans taking the recent development in geoid accuracy from GOCE into account.

Objectives

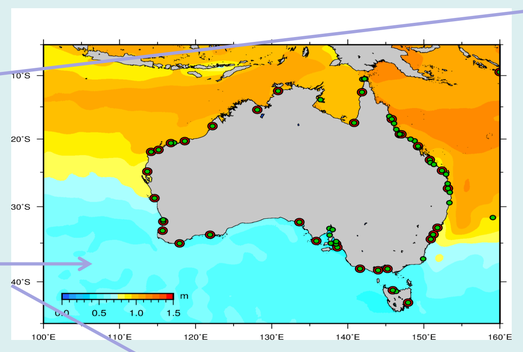
The objective of this activity is to perform a consolidated and improved understanding and modelling of coastal processes and physics responsible for sea level changes on various temporal/spatial scales and to test the use of a combination of GOCE and altimetry for studying of height system unification in well and sparsely surveyed regions as shown in the figure below (T. Gruber et al. GOCE+ HSU consortium) The study has been running since November 2015

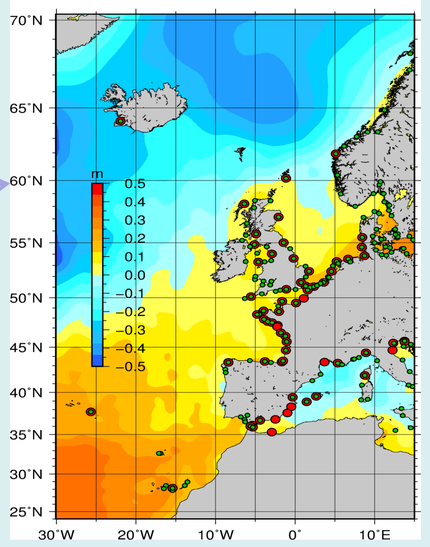
Test regions.



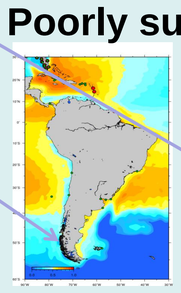
Dataset of tide gauge stations (green) and corresponding and GPS stations (red). The DTU13MDT is colored

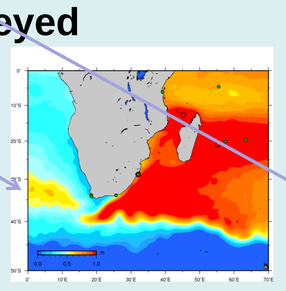
Well surveyed

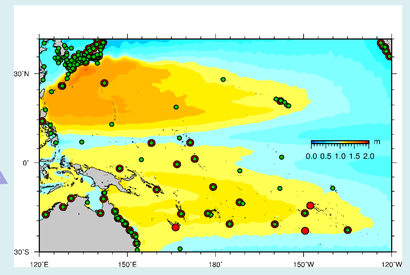




Poorly surveyed

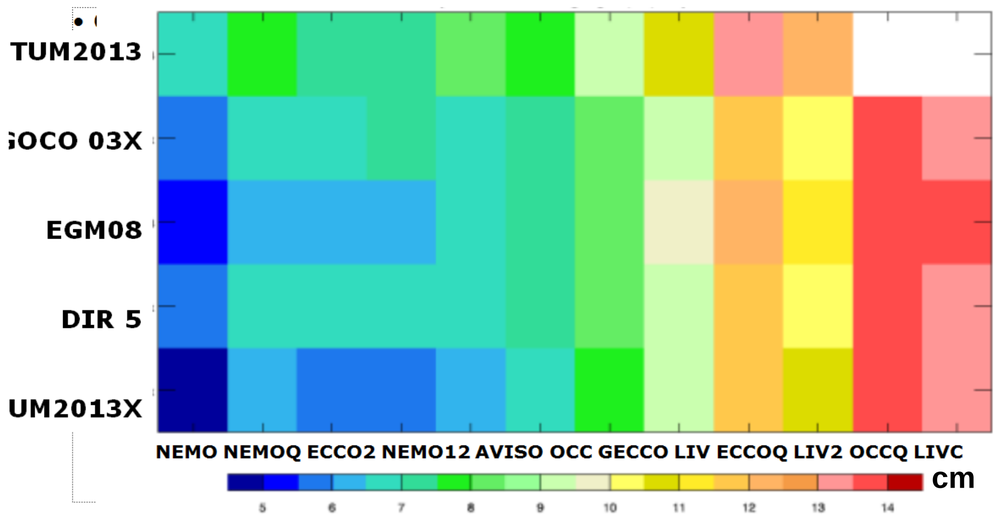




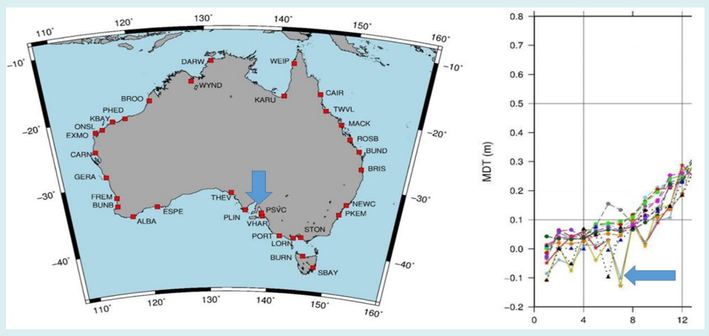


Evaluation of Mean Dynamic Topography profiles with tide Gauges and GOCE

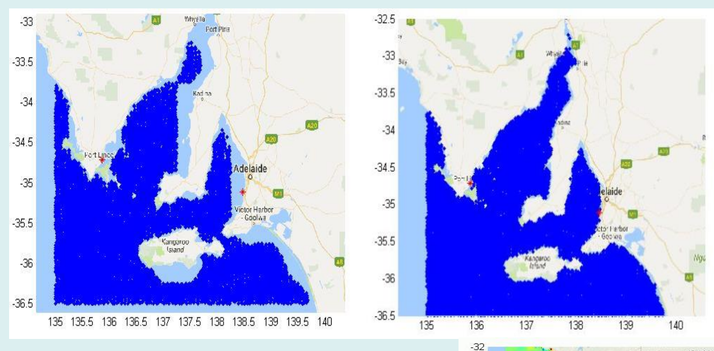
Comparison between Tide gauge GPS heights subtracted with recent geoid models and Ocean derived MDT and altimetric derived MDT shows high agreement
The compairison to the left (Chris Huges) are global compariosn with **113 tide** gauges in the SONEL network (se below).



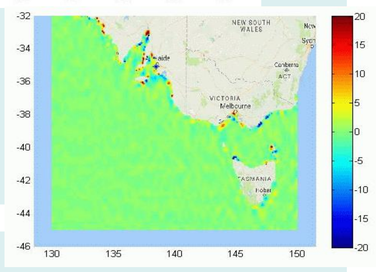
Recent MDT development



Comparison with Australian tide gauges indicated that the DTU13 was too low . This was found to be due to the coverage of the applied ocean tide model. Se below for FES2012 (left) and GOT4.10 (left) and FES2012 (right).

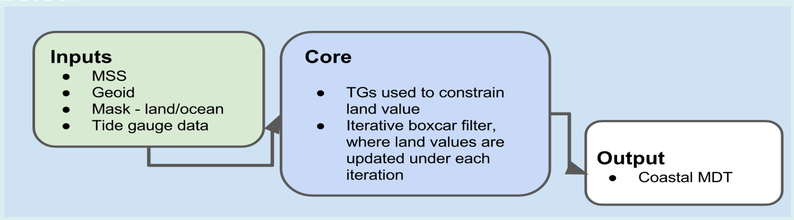


Upgrading the MSS using FES2012 based SSH solved the coastal issue



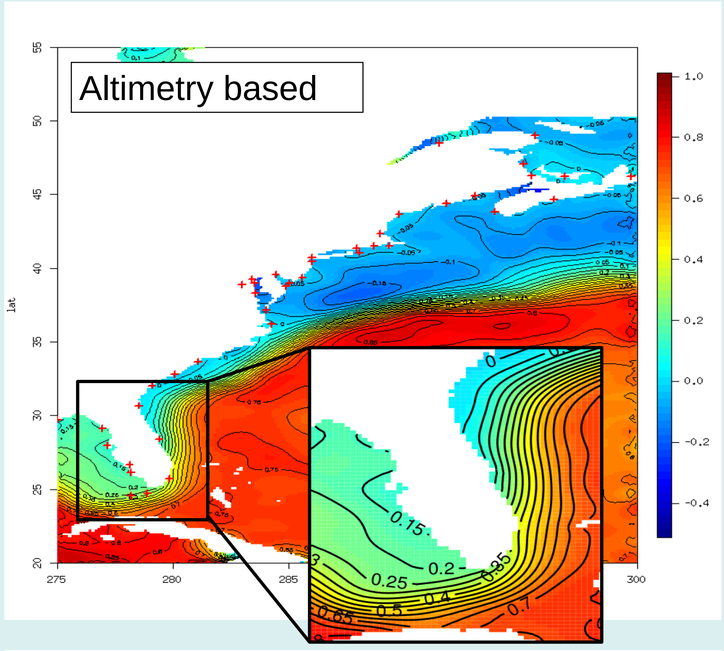
The GOCE++ approach to TG unification using altimetry and GOCE

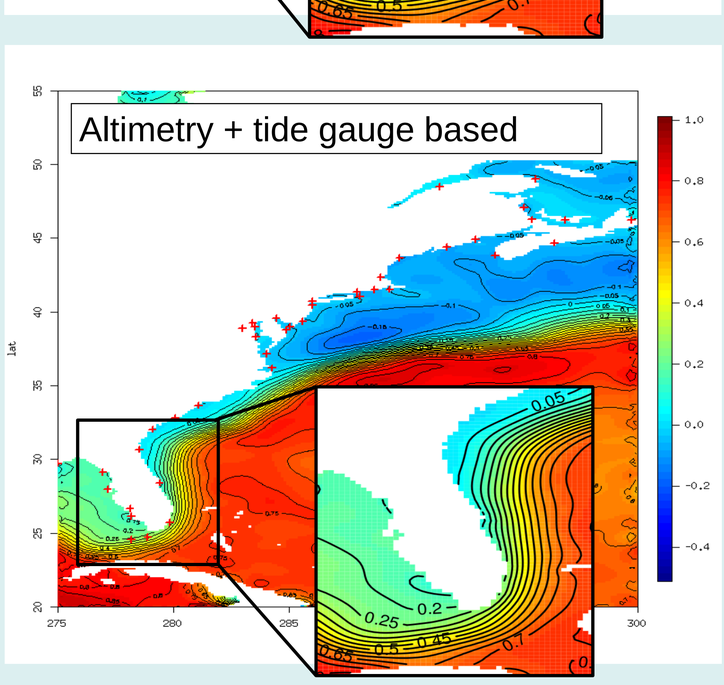
In the GOCE++ DYCOT project the software package ”coastMDT” has been developed to estimate the MDT in the coastal area. The approach is to use MDT estimates at tide gauges to constrain the values on land. The architecture of the software is described in the flow chart below

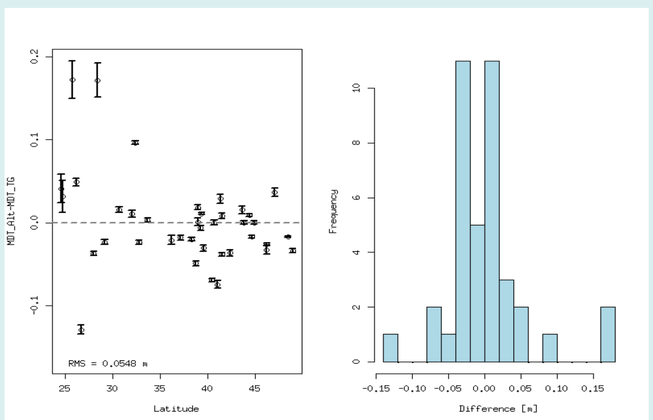


The software is implemented in the ”R” programing language (www.r-project.org). After testing the software will become freely available.

The plots to the left show estimates of the MDT for the East coast if the US. The red crosses are the positions of the tide gauges. In the lower plots the tide gauge information is included. The effect is especially pronounced along the coast of Florida, where the Gulf Stream is better represented. The plot below shows a comparison between the MDT estimates based on tide gauge and altimetry/GOCE.







SONEL Tide gauges and trends