The GOCE User Toolbox – GUT

An ESA effort to facilitate the use of GOCE Level-2 products

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Abstract

The GOCE User Toolbox GUT is a compilation of tools for the utilisation and analysis of GOCE Level-2 products. GUT supports applications in Geodesy, Oceanography and Solid Earth Physics. The GUT Tutorial provides information and guidance in how to use the toolbox for a variety of applications. GUT consists of a series of advanced computer routines that carry out the required computations. They may be used on Windows PCs, UNIX/Linux Workstations, and Mac. The toolbox is supported by The GUT Algorithm Description and User Guide and The GUT Install Guide. A set of a-priori data and models are made available as well.

Examples of Scientific Applications

- The Gravity field and steady-state Ocean Circulation Explorer (GOCE)
- Global unification of height systems
- Improved understanding of ocean circulation and energy distribution
- Gravity field map and improved global geoid models

The satellite and its instruments

Payload: Three-axis digital gravity gradiometer - multi-channel tracking (geoid, quality multi-channel GPS receiver with Antenna)

GOCE Use Case

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GUT is available at http://earth.esa.int/gut. The GUT package includes:
- The source package for building on UNIX/Linux/Mac
- Binary packages for Linux and Windows that include BratDisplay (v.2.0.0)
- The GUT Algorithm Description and User Guide (v1.2)
- The GUT Tutorial (Beta version)
- The GUT Install Guide (applicable to ALL packages).

The a-priori data package gut-apriori.zip is available as well.

GUT use GOCE data associated with the following GOCE-L2 products:
- EGM_GCF_2: Spherical harmonic series in IGCEM format
- EGM_GEO_2: Grid with geoid heights in Grid format
- EGM_GKE_2: Grid with gravity anomalies in Grid format
- EGM_GVE_2: Grid with east-west vertical deflections in Grid format
- EGM_GCV_2: Variance-covariance model file of the spherical harmonics coefficients

These products will be stored in XML format, except for the Variance-Covariance Matrix (Internal HPF VCM format). In addition GUT uses auxiliary data such as MSS and errors, MDT, DEM in NetCDF format (COARDS/CF standard).

GUT is a command line processor. Its output may be exported and visualised using the ESA Basic Radar Altimetry Toolbox BRAT (http://earth.esa.int/brat).

1. Background

The Gravity and Ocean Circulation Experiment - GOCE satellite mission is a new approach to provide detailed measurements of the Earth's gravity and geoid with unprecedented accuracy. Combining GOCE geoid models with satellite altimetric observations of the sea surface height substantial improvements in the modelling of the ocean circulation and transport are foreseen. No ocean circulation products are planned to be delivered as Level-2 products as part of the GOCE project so that a strong need exists for oceanographers, to further process the GOCE Level-2 geoid and merge it with Radar Altimetry. The primary requirement of oceanographers is to have access to a geoid and its error covariance at the highest spatial resolution and accuracy possible, although required resolution depends on application. For effective use of the geoid data, knowledge of the error covariance is mandatory. Within the ESA-supported GUT Specifications project, the user requirements for GUT associated with geodetic, oceanographic and solid earth applications were consolidated. For all applications the absolute resolution of the geoid is a key quantity to be computed is the mean dynamic topography which describes the shape of the Earth. Simultaneously the dynamic topography may be considered as a reference surface for the ocean circulation at the ocean surface. The key application of oceanography will benefit because the sea level slopes relative to the geopotential surface allows calculation of surface ocean currents on a global scale.

2. Computation of Geoid

GUT is a command line processor. Its output may be exported and visualised using the ESA Basic Radar Altimetry Toolbox BRAT (http://earth.esa.int/brat).

Example of GUT functionality:

- Computation of Geoid
- Change reference ellipsoid
- Filter (MSS-geoid) to obtain the Mean Dyn Topography

Input Data:
- EIGEN-GRACEGL4S Geoid
- EIGEN-GRACEGL4S error covariance matrix of SH coefficients
- Reference ellipsoid=GRIM
- Output Reference ellipsoid: TP

Output:
- Output Grid: regular, ½ resolution grid

Options:
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- Degree of expansion: 60

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