GOCE User Toolbox and Tutorial

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GUT contributors

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GUT developments

The GOCE User Toolbox has been developed through 3 ESA supported projects:

- GUTS developing user requirements and algorithm specifications,

  + trade-off studies on data processing, eg filtering,

- GUTS#2 developing GUT and Tutorials v.1,

  + software for GOCE error covariances,

- GUTS#3 developing GUT and Tutorials v.2,

  + study of geoid and MSS error covarances.

Input from the EU supported GOCINA and GOCINO projects.

User requirements

The toolbox supports the use of GOCE data in Geodetic, Oceanographic and Solid Earth studies.

Basic requirements:

- Computation of global, gridded geoid heights at a given, user-specified, degree and order of the spherical harmonic expansion (i.e., at a given spatial resolution)
- Computation of geoid heights at a given spatial resolution (i.e. specified degree and order of the spherical harmonic expansion) at a given point or list of points (e.g. unstructured grid, transect)

User requirements

Specific requirements for generation of MDT:

- Provision of a priori MSS, MDT and Geoid data on a grid
- Computation of a ‘GOCE’ MDT (MSS-GOCE geoid) at a given spatial resolution, on a given structured or unstructured grid
- Filtering of MSSH consistent with a specific harmonic degree geoid height field expansion.

What is GUT?

The GOCE User Toolbox is a compilation of tools for the utilisation and analysis of GOCE Level 2 products.

The GUT package includes:

- The source package for building on UNIX/Linux/Mac
- Binary packages for Linux and Windows that include BratDisplay
- The GUT Algorithm Description and User Guide
- The GUT Tutorial
- The GUT Install Guide (applicable to ALL packages).

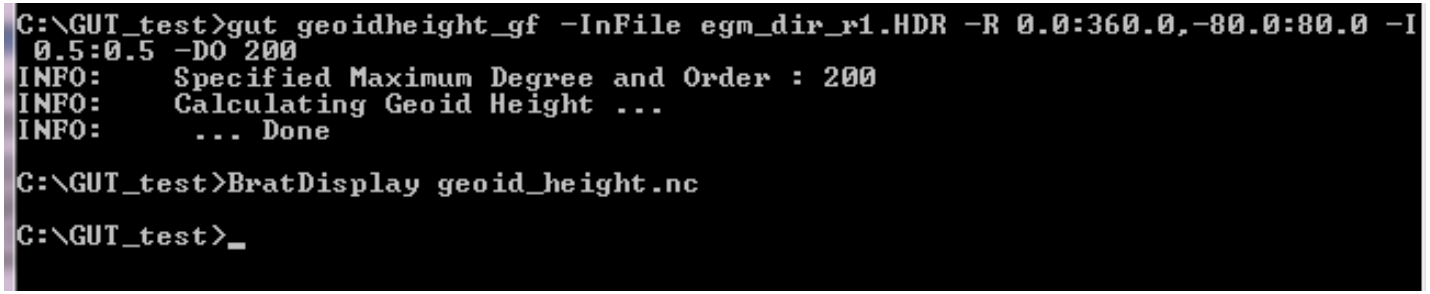
A set of a-priori data and models are made available as well.

What is GUT?

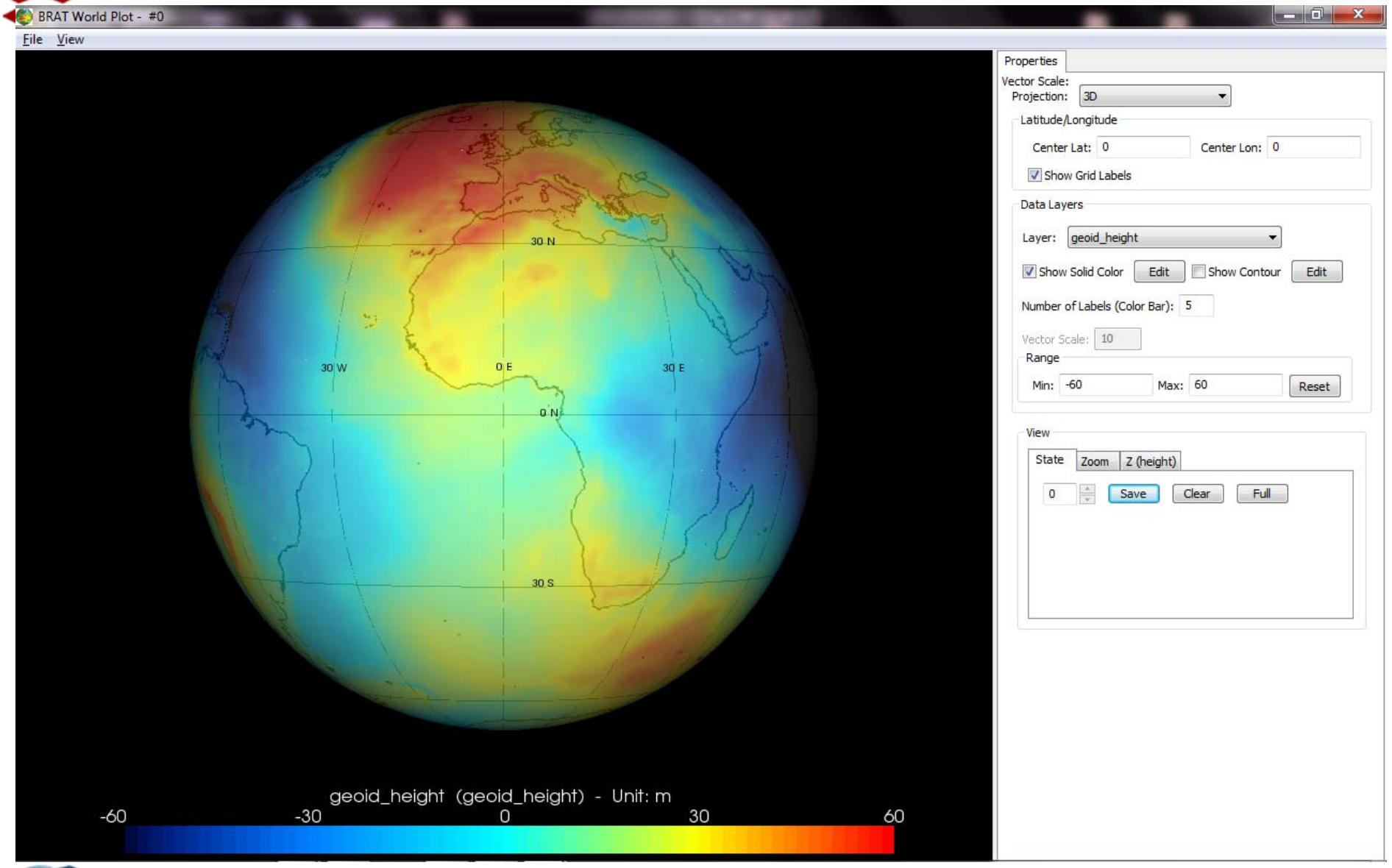
GUT is a command line processor :

C:\gut geoidheight_gf -InFile egm_dir_r1.HDR -R 0.0:360.0,-80.0:80.0 -I 0.125:0.125 -DO 200

C:\BratDisplay geoid_heights.nc

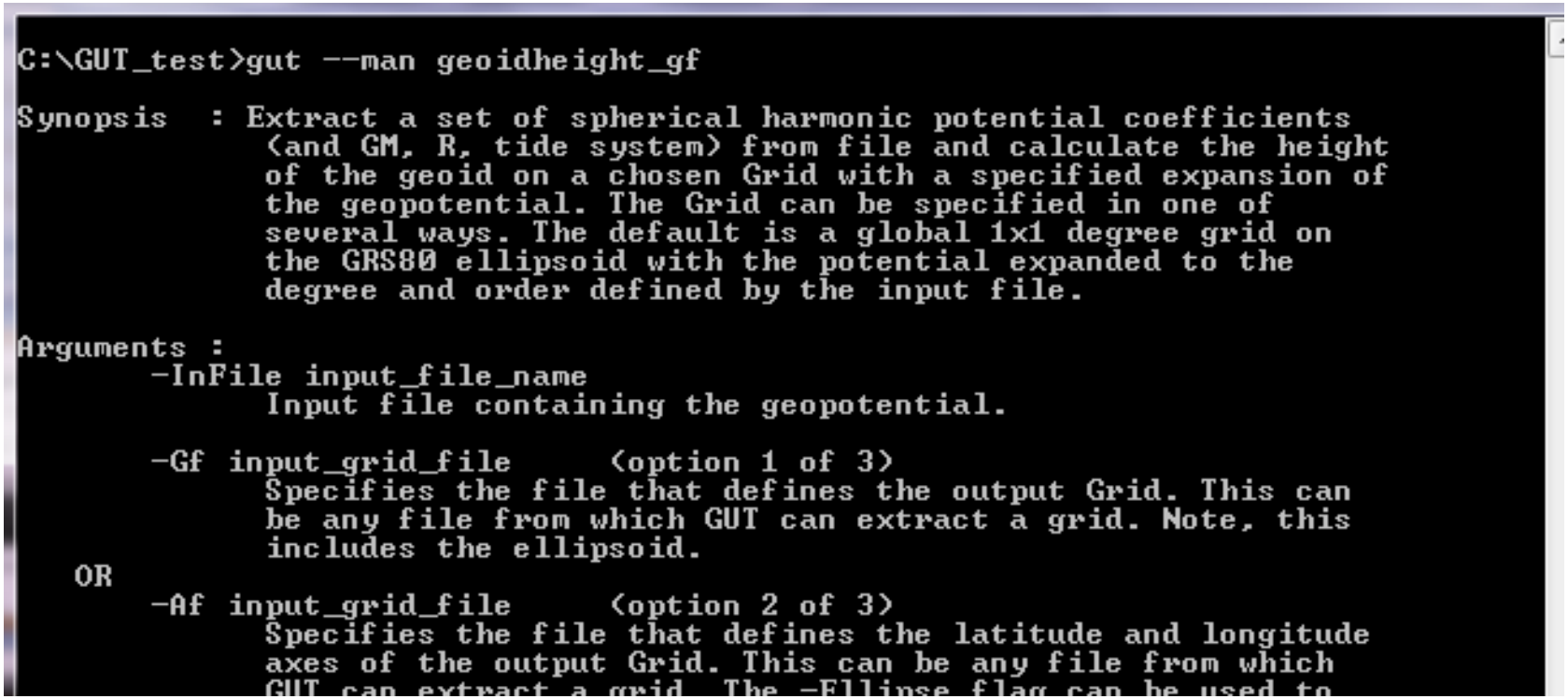


Meta data included in the xml/nc files


BRAT World Plot - #0
File View
30 N
30 W
0 E
30 E
0 N
30 S
geoid_height (geoid_height) - Unit: m
-60
-30
0
30
60
Properties
Vector Scale:
Projection: 3D
Latitude/Longitude
Center Lat: 0
Center Lon: 0
Show Grid Labels
Data Layers
Layer: geoid_height
Show Solid Color
Edit
Show Contour
Edit
Number of Labels (Color Bar): 5
Vector Scale: 10
Range
Min: -60
Max: 60
Reset
View
State
Zoom
Z (height)
0
Save
Clear
Full

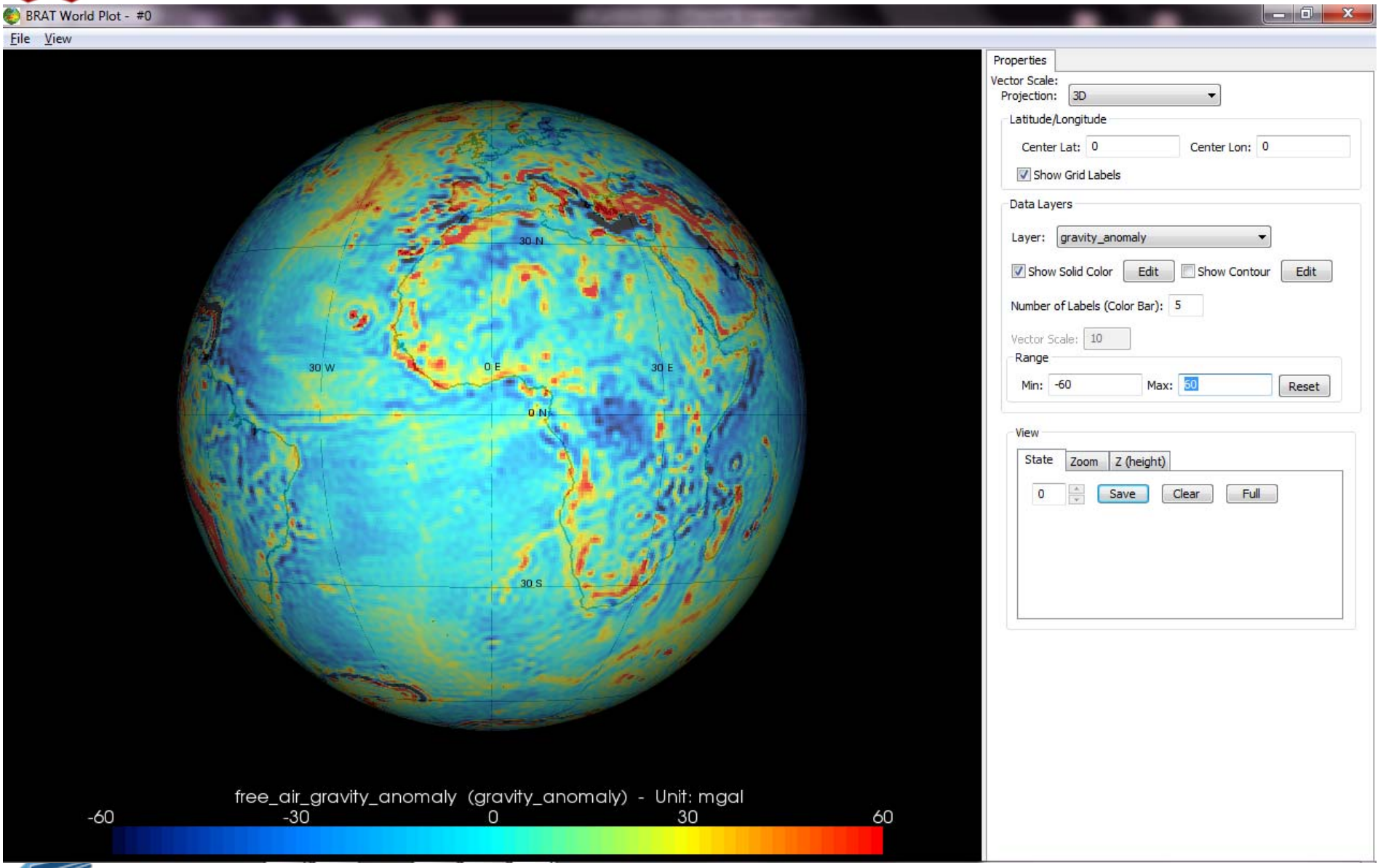
What is GUT?

GUT has help / man functionality

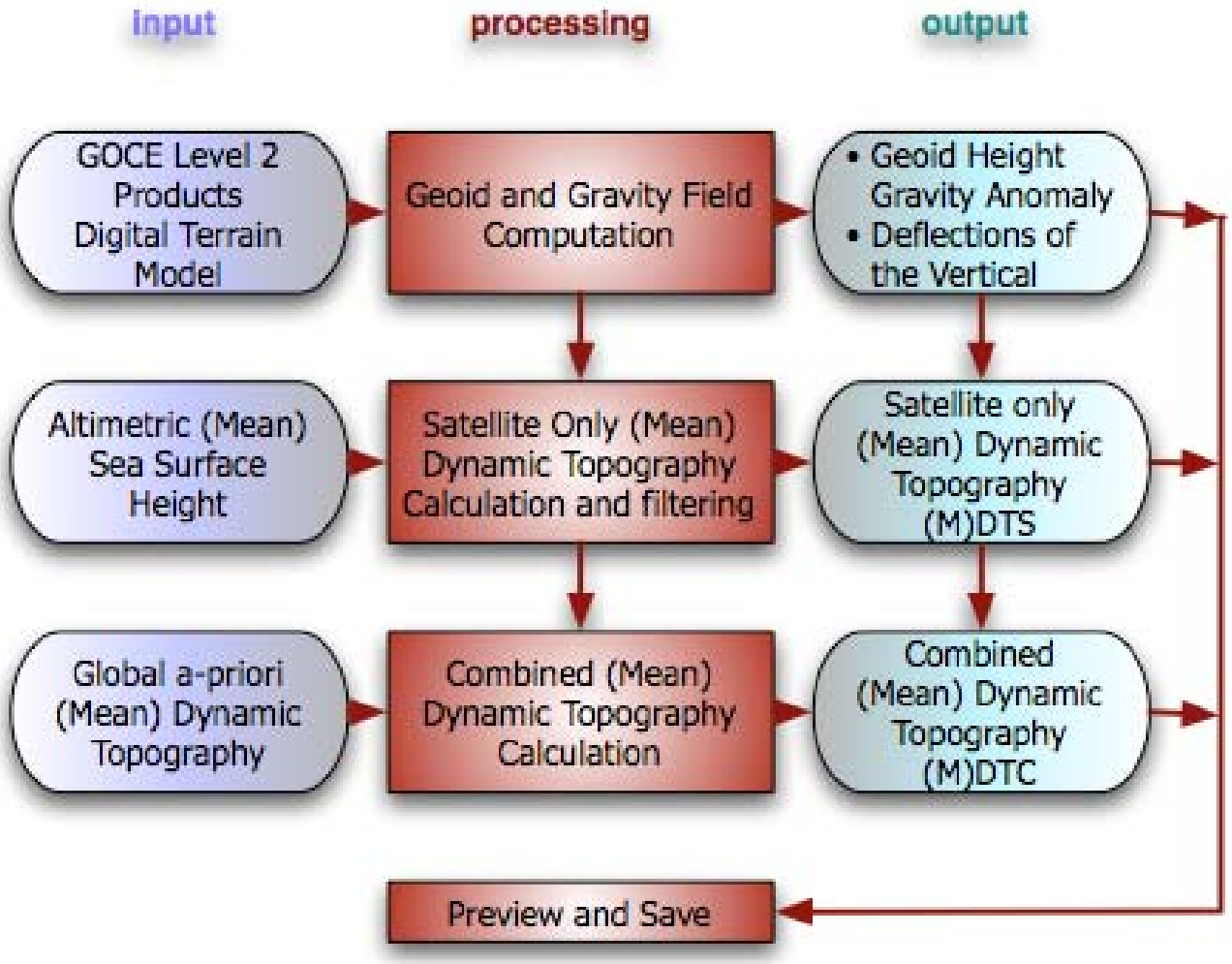


```
C:\GUT_test>gut --man geoidheight_gf

Synopsis  : Extract a set of spherical harmonic potential coefficients
            (and GM, R, tide system) from file and calculate the height
            of the geoid on a chosen Grid with a specified expansion of
            the geopotential. The Grid can be specified in one of
            several ways. The default is a global 1x1 degree grid on
            the GRS80 ellipsoid with the potential expanded to the
            degree and order defined by the input file.

Arguments :
      -InFile input_file_name
            Input file containing the geopotential.

      -Gf input_grid_file     (option 1 of 3)
            Specifies the file that defines the output Grid. This can
            be any file from which GUT can extract a grid. Note, this
            includes the ellipsoid.
   OR
      -Af input_grid_file     (option 2 of 3)
            Specifies the file that defines the latitude and longitude
            axes of the output Grid. This can be any file from which
            GUT can extract a grid. The -Ellipse flag can be used to
```

GUT may also compute gravity anomalies and deflections of the vertical


BRAT World Plot - #0
File View
30 N
30 W
0 E
30 E
0 N
30 S
free_air_gravity_anomaly (gravity_anomaly) - Unit: mgal
-60
-30
0
30
60
Properties
Vector Scale:
Projection: 3D
Latitude/Longitude
Center Lat: 0
Center Lon: 0
Show Grid Labels
Data Layers
Layer: gravity_anomaly
Show Solid Color
Edit
Show Contour
Edit
Number of Labels (Color Bar): 5
Vector Scale: 10
Range
Min: -60
Max: 60
Reset
View
State
Zoom
Z (height)
0
Save
Clear
Full

Workflows


input
processing
output
GOCE Level 2 Products Digital Terrain Model
Geoid and Gravity Field Computation
• Geoid Height Gravity Anomaly
• Deflections of the Vertical
Altimetric (Mean) Sea Surface Height
Satellite Only (Mean) Dynamic Topography Calculation and filtering
Satellite only (Mean) Dynamic Topography (M)DTS
Global a-priori (Mean) Dynamic Topography
Combined (Mean) Dynamic Topography Calculation
Combined (Mean) Dynamic Topography (M)DTC
Preview and Save

Computation of a MDT

Use the GUT workflow: spatialmdt_gf

-InShpFile EGM.HDR -InSshFile MSS.nc

-R 280.0:320.0,25.0:45.0 -I 0.125:0.125

-DO 240

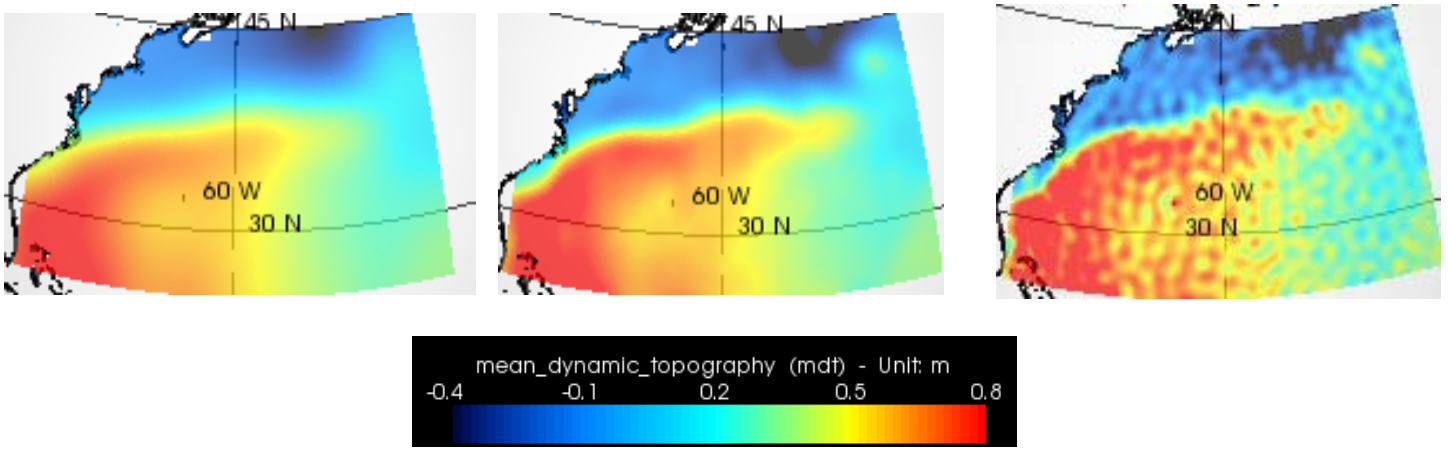
-Ftg 1.0

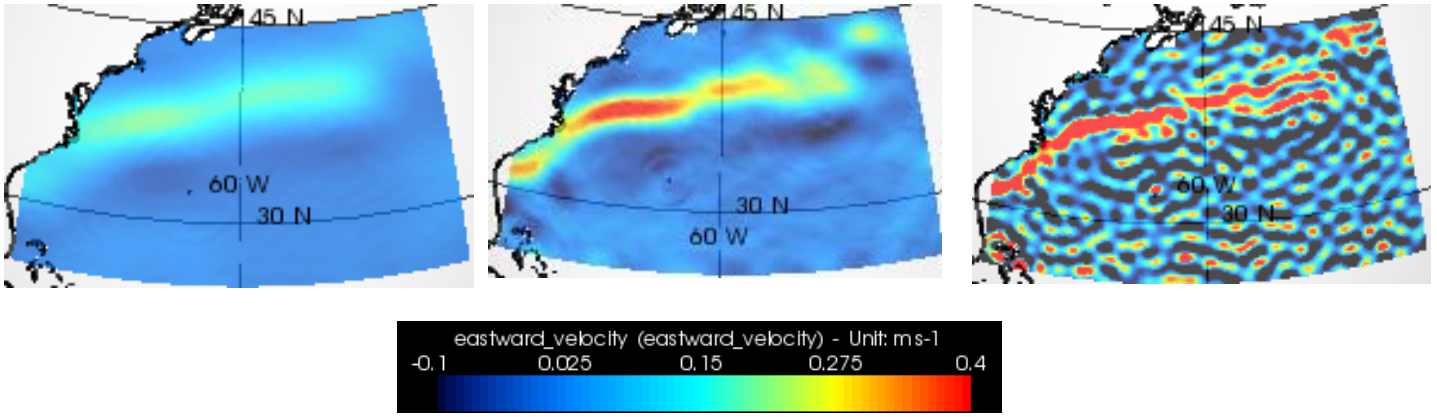
The workflow ensure consistency in

- Grids
- Reference frame
- Tidal system

Perform filtering considering a land mask using a user specified filter wrt type and width.

Demo: Filtering using 2.0, 1.0, and 0.5





Filter types

-F[filter_type] filter_scale

- -Fg: Gaussian with given Half-Width at Half-Maximum (HWHM = 1.1774 sigma)
- -Ftg : Truncated Gaussian (- at a radius of 3 sigma)
- -Fsc : Spherical Cap
- -Fhan : Hanning
- -Fham : Hamming
- -Fbox : Pill Box

Both isotropic and simple anisotropic.

Also Spectral filtering through spherical harmonic expansion.

Summary:

- GUT is an advanced professional package of functions that support R&D in the use of GOCE EGM data,
- Most required functionalities are implemented in GUT
- User testing and validation of software and GOCE EGM data are ongoing

- Still need to implement:
  - Error covariances
  - Use of gradients

Demo at the posters