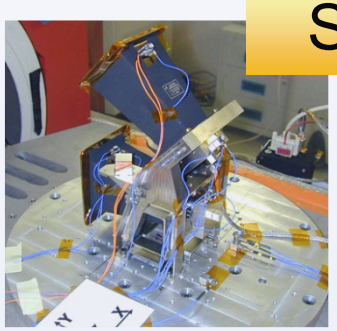
GOCE Data and Formats

GOCE PDGS Team:

Alberto Bigazzi, Björn Frommknecht, Marco Meloni, Loretta Mizzi.

GOCE Instruments and Products Overview

STR

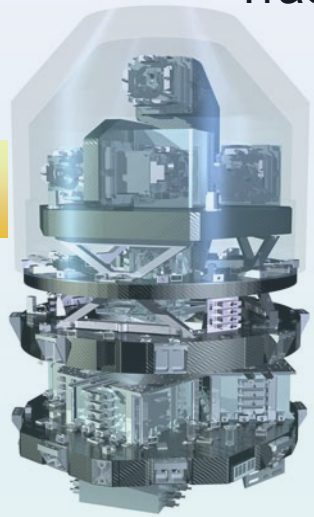


Star Tracker

SSTI

Satellite-to-Satellite Tracking Instrument

EGG



Electrostatic Gravity Gradiometer

Not Available

GOCE Telemetry

Extraction

Level-0 Products

Processing

Available to Users

Level-1b Products

Level-2 Products

Gravity Fields

GOCE

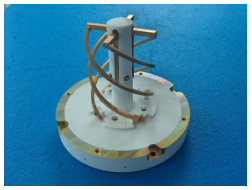
GOCE single access point

http://earth.esa.int/GOCE

- The GOCE portal is the single and comprehensive access point for all GOCE-related information, resources, **data access**, software, Mission News.
- V***isit us !!***
- *For any enquiry or request, send an e-mail to* ***eohelp@esa.int***

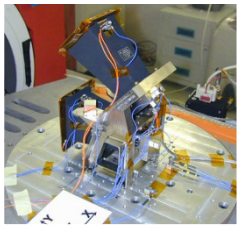
GOCE Data Levels and Available Products

EGG_NOM_1b



SST_NOM_1b

SST_RIN_1b



STR_VC2_1b

STR_VC3_1b

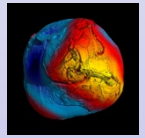
Level-1b

EGG_NOM_2

EGG_TRF_2

SST_PSO_2

SST_AUX_2



EGM_GOC_2

EGM_GVC_2

EGM_GCF_2

Level-2

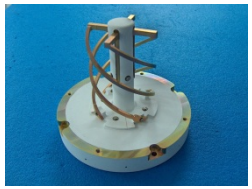
GOCE L1b Products

Orbit-wise products, dated.

EGG_NOM_1b

Nominal Gradiometer Instrument data. Internally calibrated (Accelerometers in linear regime and accelerations calibration)

Datation



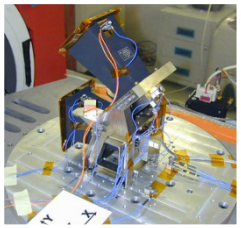
SST_NOM_1b

Nominal SSTI Instrument (GPS) data

SST_RIN_1b

Nominal SSTI Instrument (GPS) data in RINEX format

Angular Rates



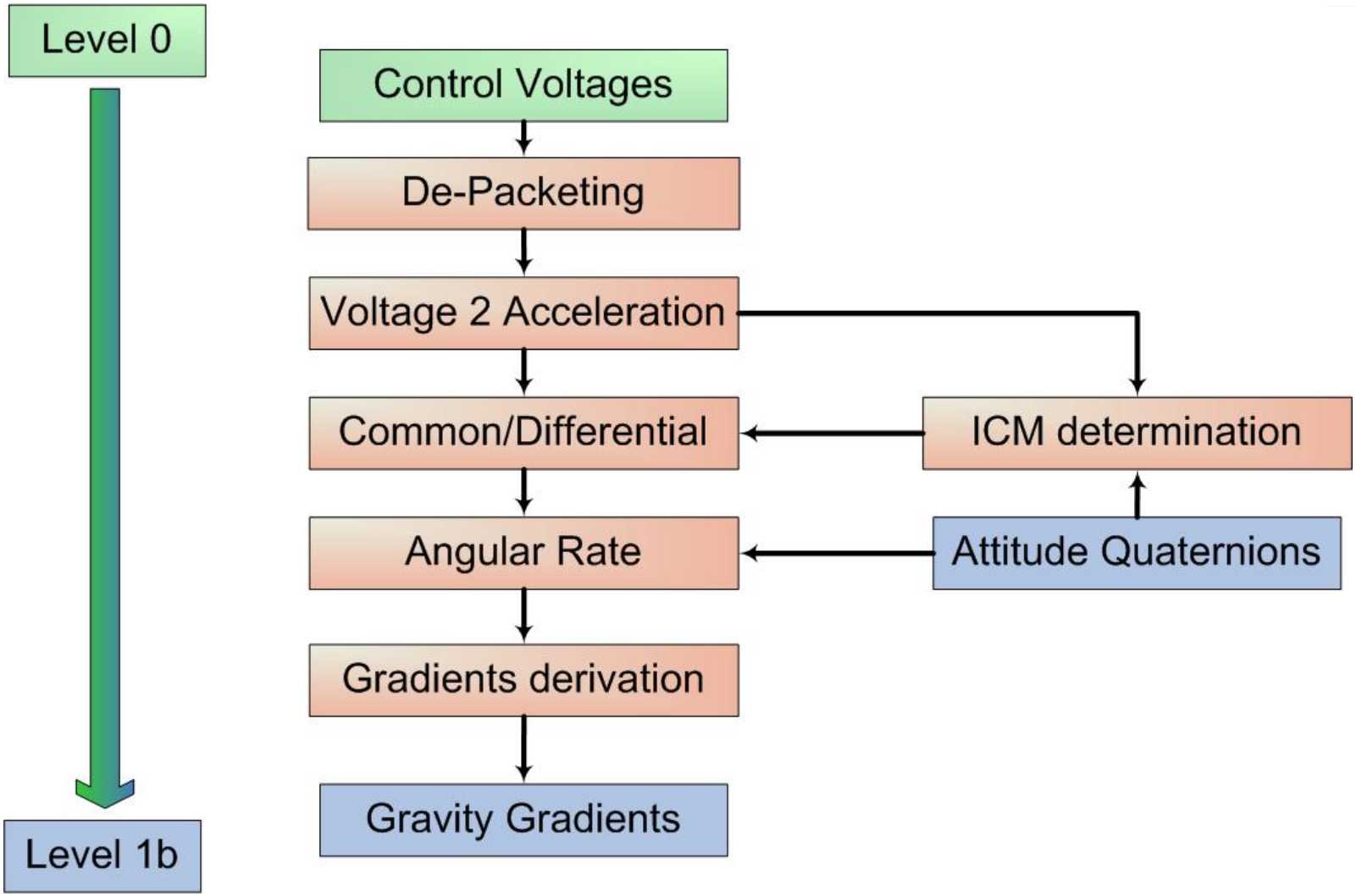
STR_VC2_1b

Star Tracker Data Virtual Ch #2

STR_VC3_1b

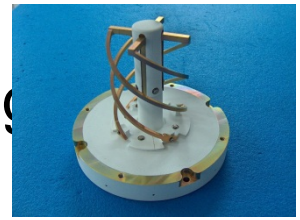
Star Tracker Data-Virtual Ch #3

Gradiometer processing



GOCE

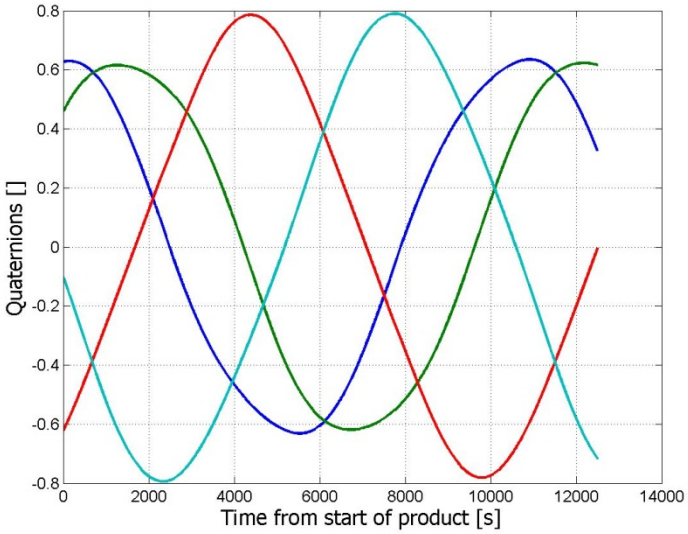
SSTI Data Processing

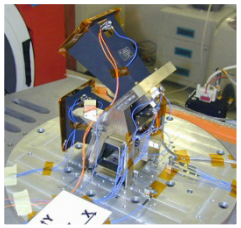


- Nominal product contains position solution using code observations (***SST_NOM_1b***)
- Conversion into engineering units
- Correction of phase and code observations for instrument specific effects (IFB and ICB)
- Corrected observations form RINEX product (***SST_RIN_1b***)
- Position solution used to derive correlation between OBT and GPS time
- In case of single frequency measurements effect of Ionosphere is corrected using Ionosphere maps

Star tracker processing

- Conversion into engineering units
- Transform datation from On Board Time to GPS time and UTC
- Correction for orbital relativistic aberration
  (annual relativistic aberration is corrected on-board)
- Resolve sign ambiguity to get continuous quaternion





GOCE

Products Documentation

Comprehensive GOCE Products documentation is available through the GOCE Portal.

All GOCE Dataset are fully described in the related Product Data Handbooks

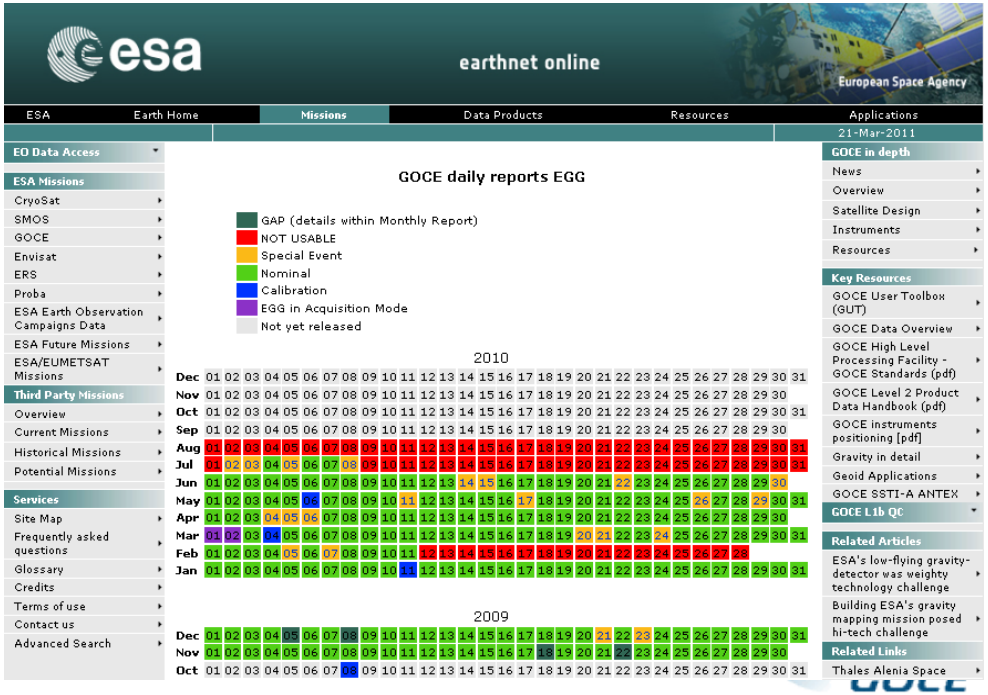
→ http://earth.esa.int/GOCE.

→ Key Resources

GOCE L1b Products Quality Control

- All L1b products delivered by ESA are quality-verified.
- Systematic data quality assessment is performed for:
  - Gradiometer Instrument (EGG),
  - Satellite-to-Satellite Tracking (SSTI),
  - Drag-Free and Attitude Control (DFACS),
  - Star Tracker (STR)

- Reporting on **EGG** and **SSTI** data quality (daily and Monthly), is made available through the ***GOCE Portal***.



GOCE Level-2 Products

GG's with corrections for temporal gravity variations and validated against external a-priori gravity data. In the gradiometer (GRF) and in the terrestrial reference frame (TRF/LNOF).

- Precise Science Orbits (PSO)
- Time variable gravity field due to non-tidal mass variations

- GOCE Gravity solution
- Variance/covariance matrices associated to the Gravity solutions
- Gravity Coefficients (ICGEM format)

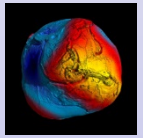
Level-2

EGG_NOM_2

EGG_TRF_2

SST_PSO_2

SST_AUX_2

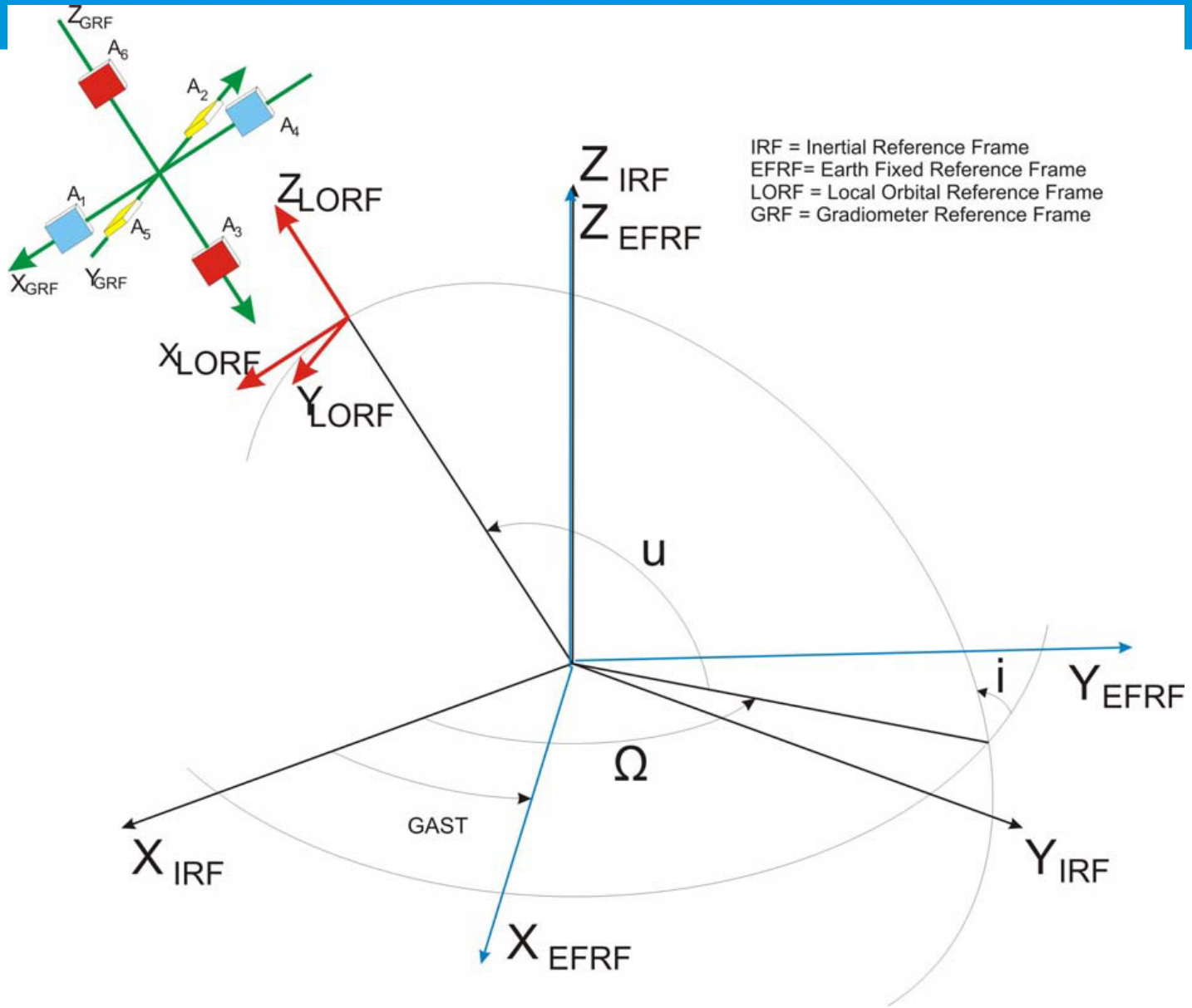


EGM_GOC_2

EGM_GVC_2

EGM_GCF_2

Main GOCE Reference Frames



See the GOCE Standards

or the

GLOCE L2 Products Handbook

All available through GOCE Website

earth.esa.int/GOCE

GOCE Data Release strategy

"Batch-wise" release with Quality Control on L1b → 2 Months

EGG NOM 1b

EGG NOM 2

"Real-time" release → Monthly

STR VC2/3 1b

SST NOM/RIN 1b

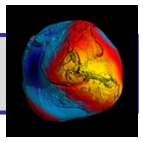
SST PSO 2

(latency ≈ 6w)

SST AUX 2

http://earth.esa.int/GOCE --> GOCE L1b QC

Gravity Field Releases - Yearly



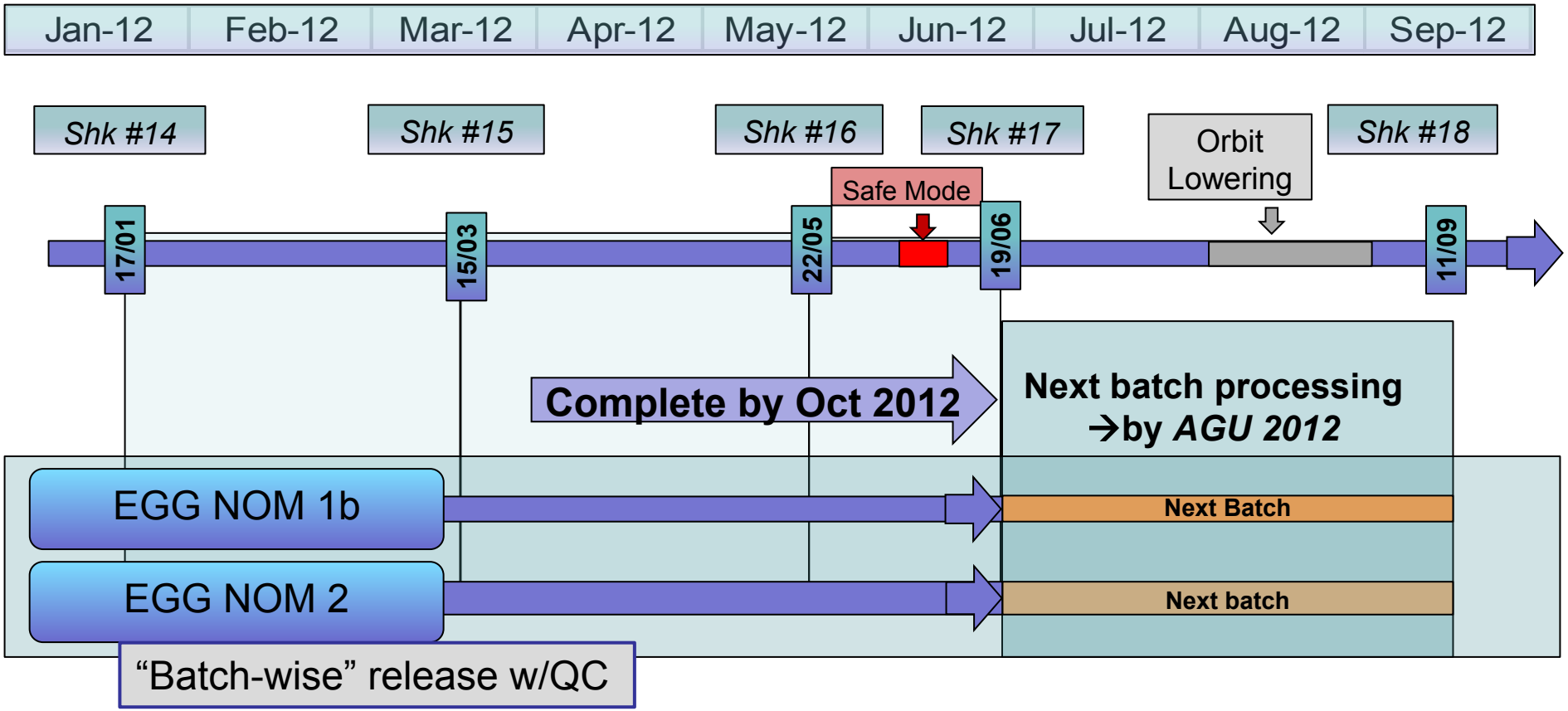
EGM_GOC_2

EGM_GVC_2
EGM_GCF_2

Third Generation released Nov 2011
Fourth Generation → 2013 (ahead of EGU).
Based on re-processed gradiometer data.
Fifth Generation all data, till end of Mission

GOCE

EGG L1b and L2 Release



GOCE Gravity Solutions

Three generations of GOCE global **Gravity solutions** have been distributed so far. The latest one was released on November 2011, based on the data available between November 2009 to June 2011.

Three different solutions are available, accounting for three different processing paradigms:

- Direct solution (**DIR**)
- Time-wise (**TIM**)
- Space-wise (**SPW**)

Latest available GOCE Gravity Solutions			
Model	**Data span**	**D/O**	**Main features**
SPW2	6 months	240	Pure GOCE; uses kinematic orbits & gradiometry
DIR3	12 months	240	Uses satellite-only normals + GOCE gradiometry
TIM3	12 months	250	Pure GOCE; uses kinematic orbits & gradiometry

ESA Data Policy

Access to GOCE data is **open and free of charge**

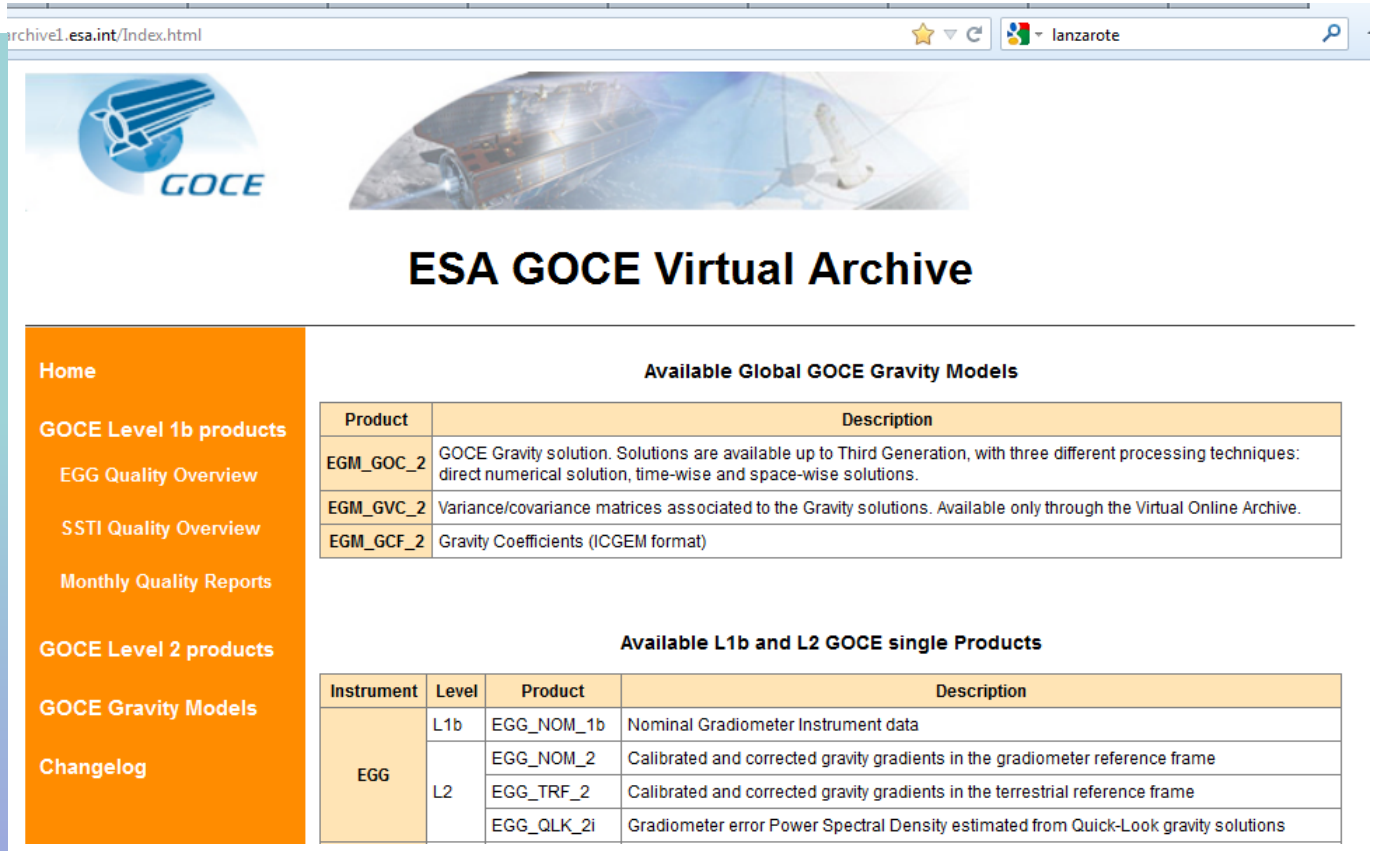
Users are requested to perform a **simple registration**

GOCE

The GOCE Virtual On-line Archive (VOA)

http://eo-virtual-archive1.esa.int/Index.html

- The GOCE Virtual On-line Archive (Cloud service)
- The most complete and updated data archive.
- Accessible through simple registration
- **Easy and fast** download



Obtaining data: User registration

http://eopi.esa.int/Registration

- Users shall perform a
- **"Fast Registration"** through ESA's PI Community portal.

- An account with ordering privileges shall be obtained in order to access the GOCE Virtual Online Archive

- Users may also contact the ESA's Help and Order Desk, ***EOHelp@esa.int***, for guidance on the registration process.

GOCE Gravity Field Model

Direct Solution - Third generation

Back

Home

GOCE Lev

EGG Qua

SSTI Qua

Monthly (

GOCE Lev

GOCE Gra

Changelo

Model Characteristics

GOCE Input Data:
- Gradients: EGG_NOM_2
- Orbits: SST_PKI (kinematic orbits)
- Attitude: EGG_IAQ_2C
- Data period: 20091101T000000-20110419T235959

The full list of input data to this direct-approach model is provided in the IHD file.

A-priori Information used:

A-priori gravity field for the processing of the GOCE gravity radients:
The GOCE-model 2nd realease from the direct approach GO_CONS_GCF_2_DIR_R2
up to degree/order 240

Processing Procedures:

The GOCE gravity gradients are processed without applying the calibration factors.
The observation equations are filtered with a 10-125 mHz bandpass filter, and subsequently "SGG" normal equations to d/o 240 are computed individually for the gradient components Txx, Tyy and Tzz.
The Txx, Tyy and Tzz SGG normal equations are accumulated with the relative weight 1.0
To overcome the numerical instability of the GOCE-SGG normal equations due to the polar gaps and to compensate for the poor sensitivity of the GOCE measurements in the low degrees the following stabilizations were applied:
1) The GOCE-SGG normal equation was fully combined with a GRACE normal equation. Details about this GRACE contribution are given below.
2) A spherical cap regularization in accordance to Metzler and Pail (2005) was iteratively computed to d/o 240 using the GRACE data mentioned below to d/o 130.
3) Additionally a Kaula regularization was applied to all coefficients beyond degree 200

Details of the GRACE contribution:

GRACE normal equations to d/o 160 for the period 24 February 2003 through 30 June 2009, based on the improved data editing and solution regularization procedure of the

GOCE Data Tools

- Goce Level-1b and Level-2 data are **plain-text xml**.
- They can be **processed** by user-written routines.
- Basic **tools** are made available through the GOCE website, free of charge

  → XML Parser, Matlab routines.

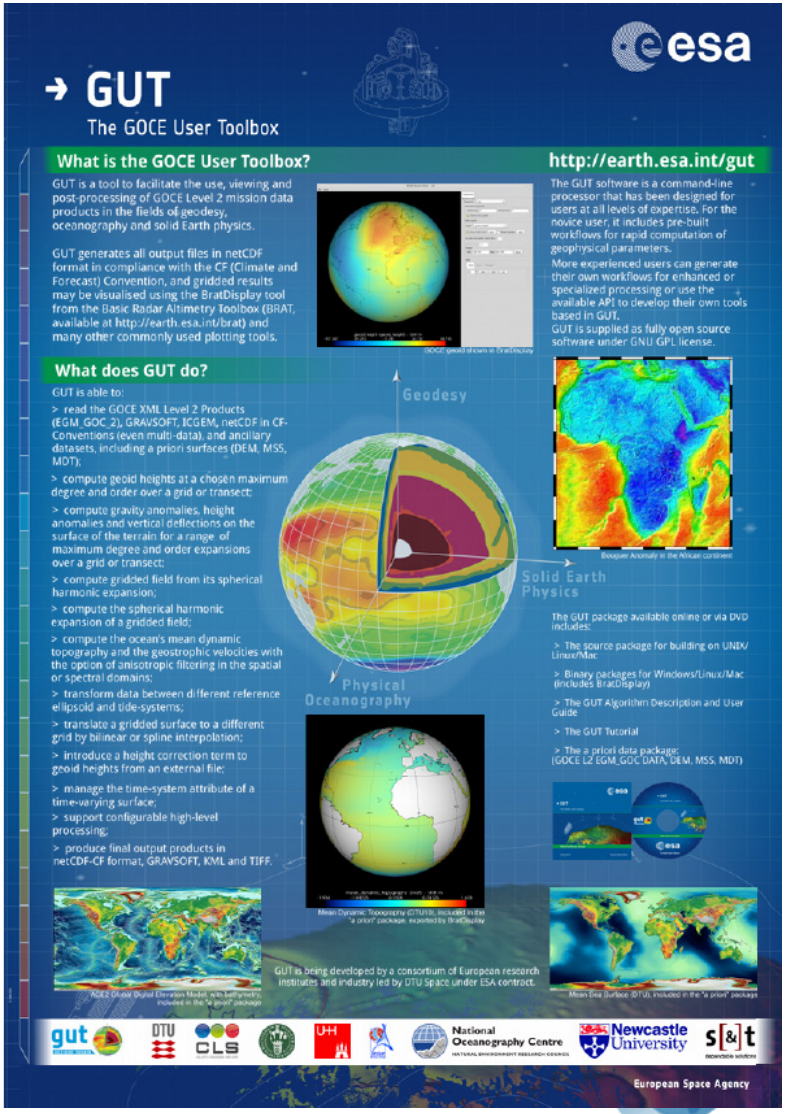
Besides these, **GUT (GOCE User Toolbox)** is a comprehensive application for Level-2 data, supporting applications in Geodesy, Oceanography and Solid Earth Physics.

GOCE

GUT: The GOCE User Toolbox

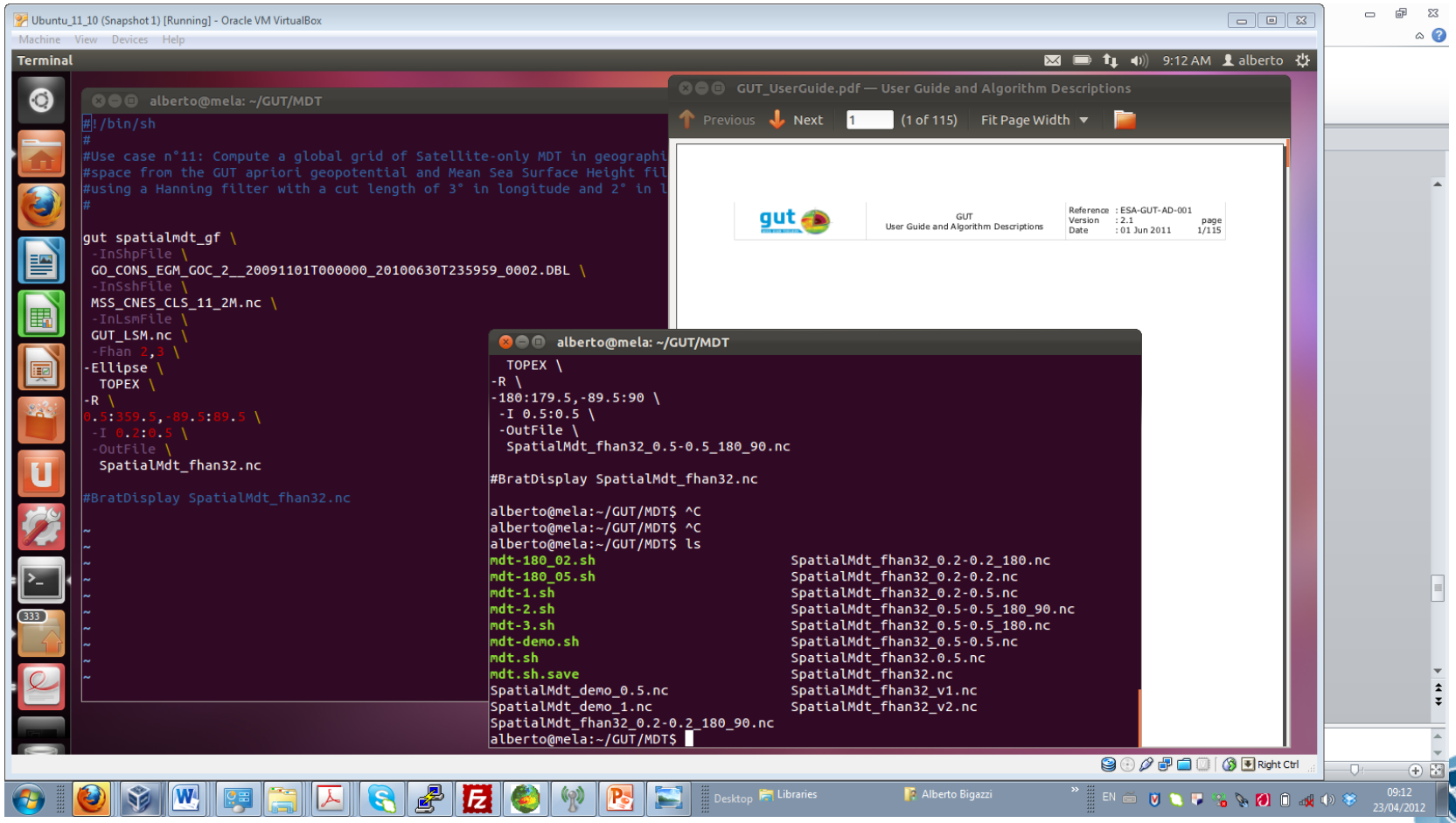
Release 2.1 includes **the third GOCE Gravity Field Solutions** (TIM and DIR) and the 2011 CNES-CLS Mean Sea Surface (in addition to DTU 2010 Mean Sea Surface).

It includes a tool for handling the GOCE **variance/covariance** matrices and for computing the Geoid height error variance and covariance functions.



GUT: The GOCE User Toolbox

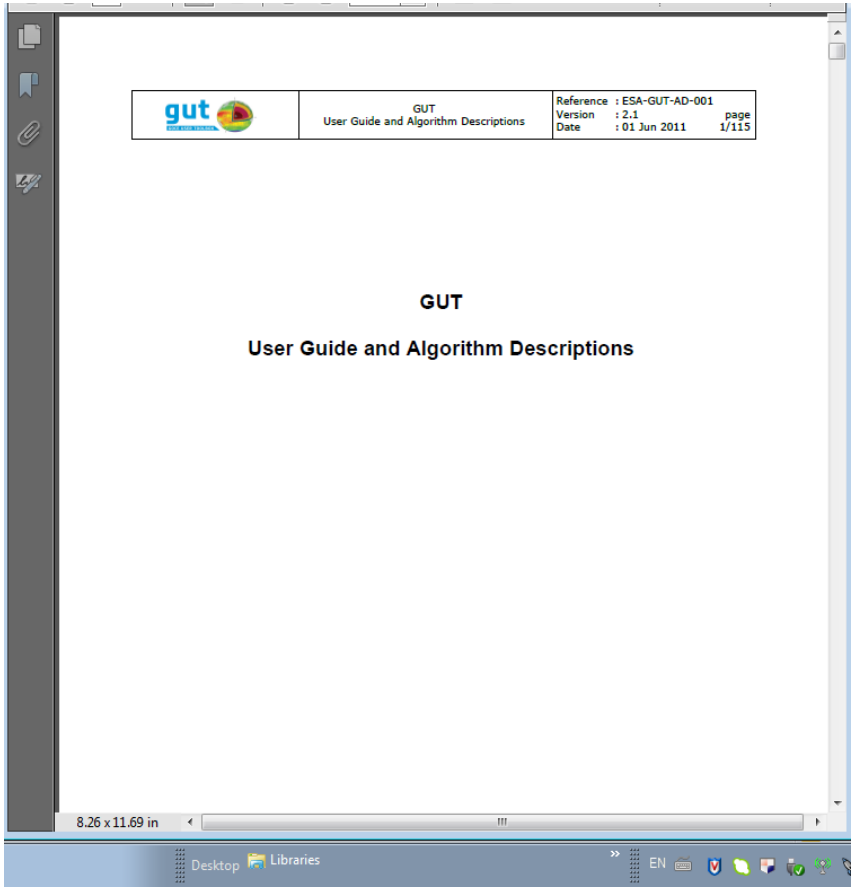
Multi-platform, cmd-oriented tool
Integrated with BRAT (Basic Radar Altimetry Toolbox)

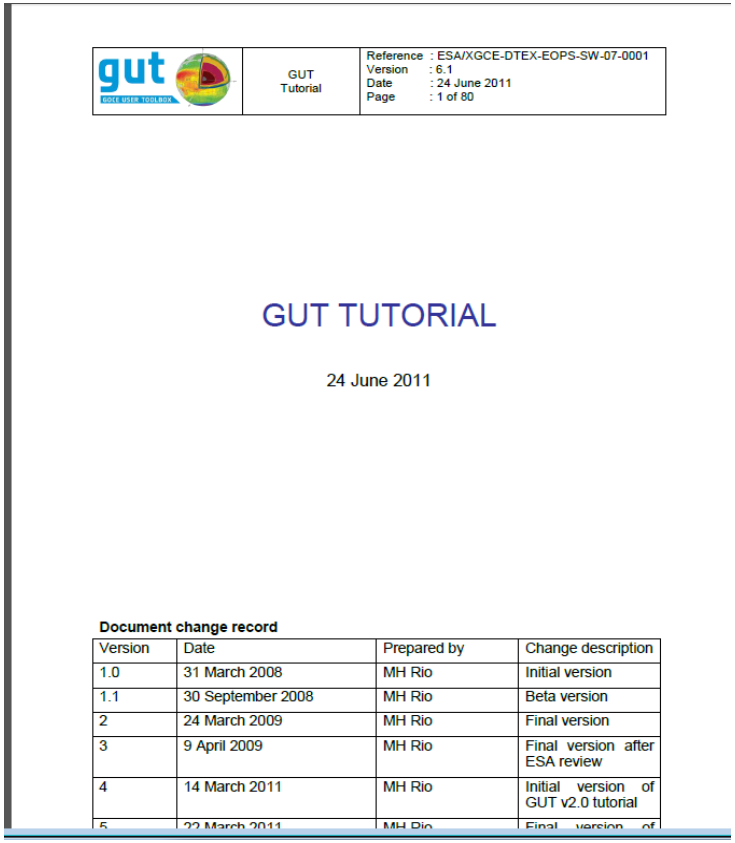


GOCE

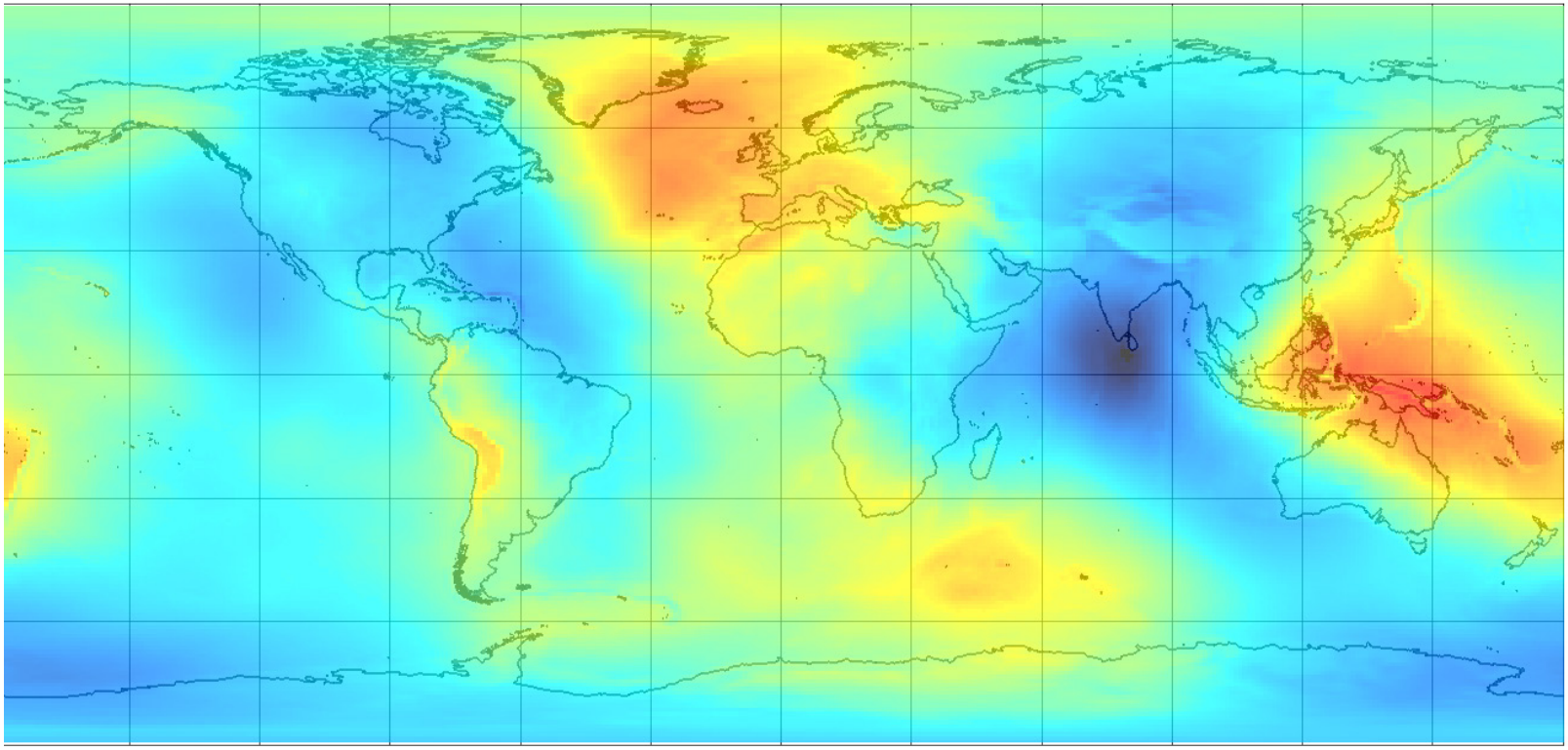
GUT: Main Documentation

- User Guide and Algoritm Description
- The GUT Tutorial





Sample GUT: Geoid heights

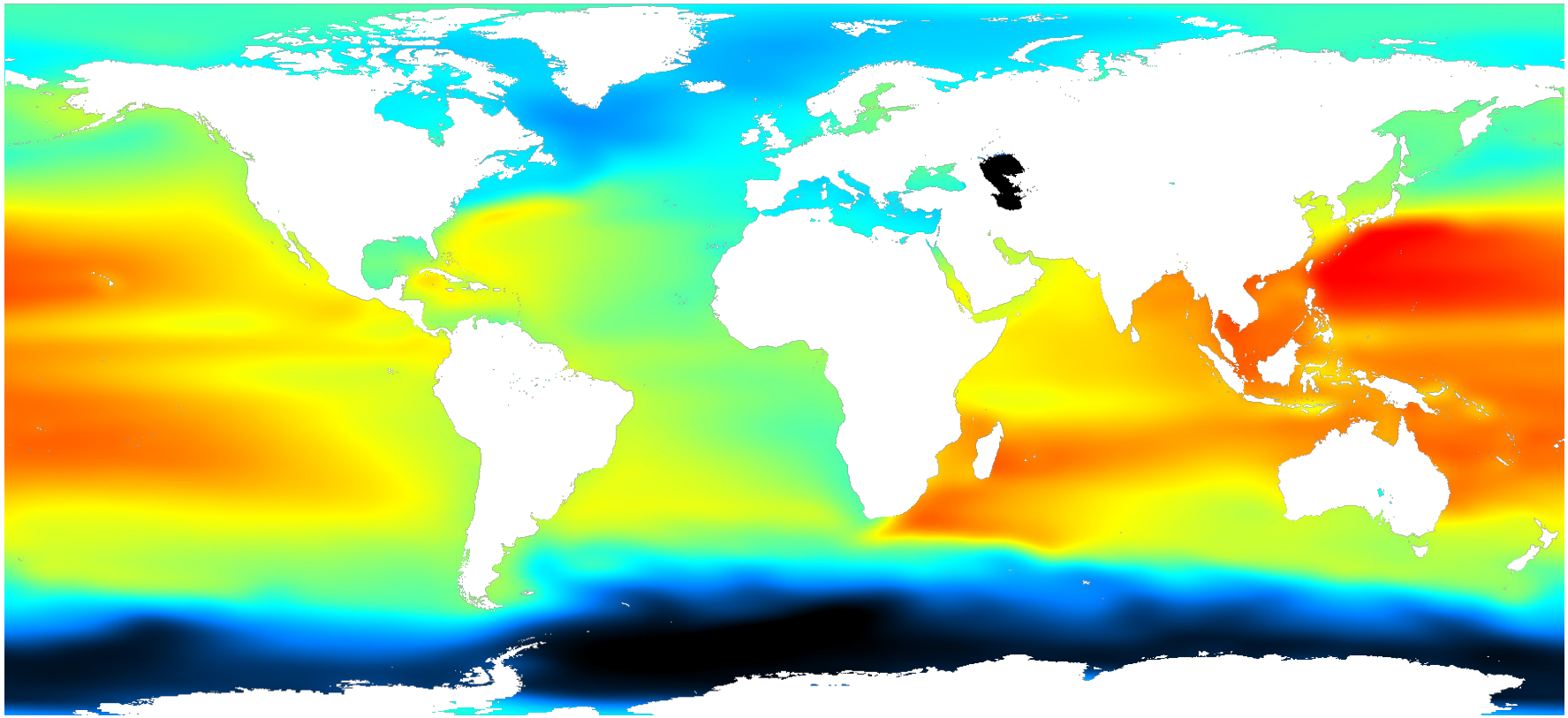


geoid_height (geoid_height) - Unit: m

-106.827 -59.0239 -11.2213 36.5813 84.3839

GOCE

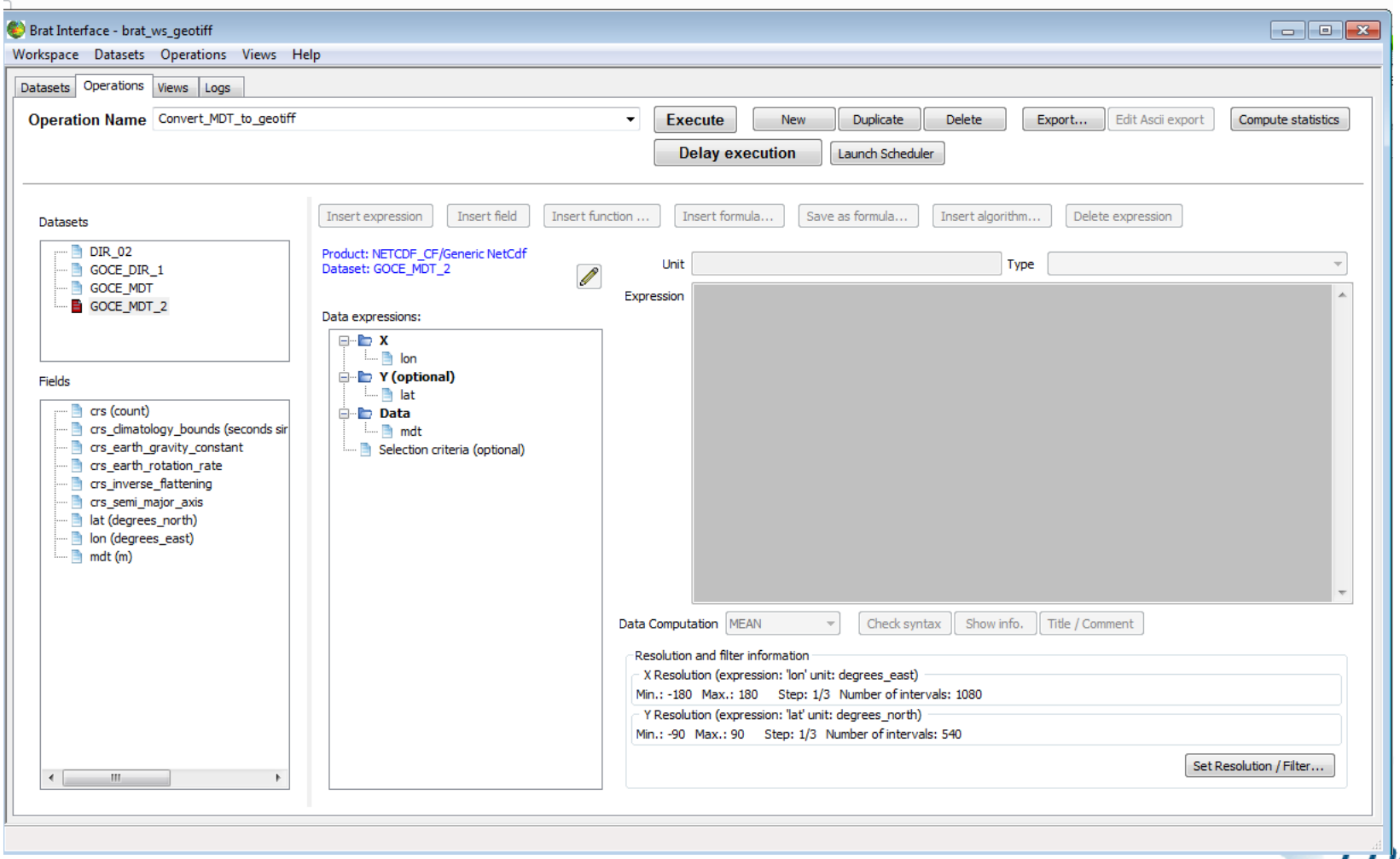
Sample GUT: Mean Dynamic Topography



GOCE

GUT and BRAT integration

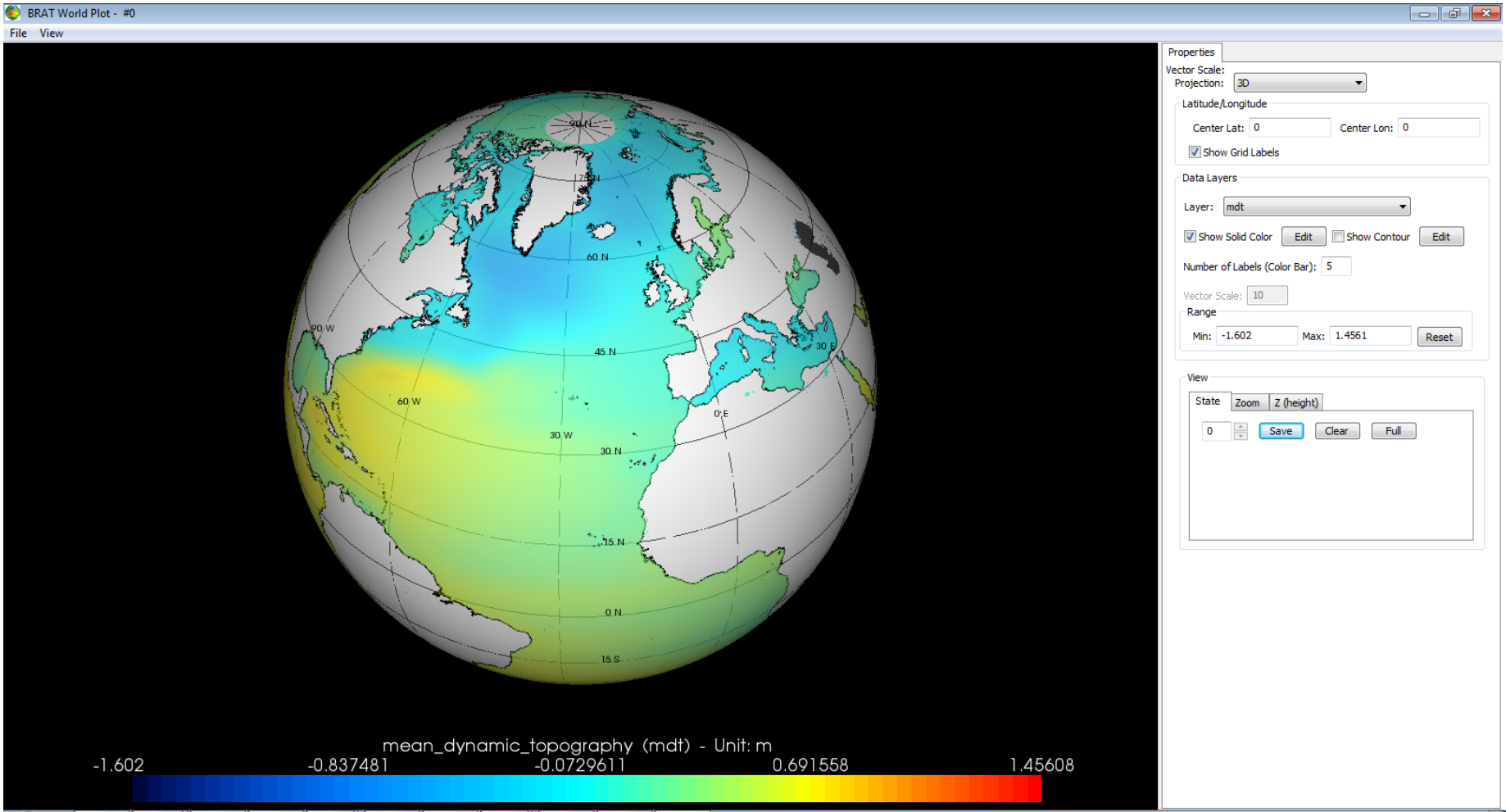
Multi-platform, cmd-oriented tool
Integrated with BRAT (Basic Radar Altimetry Toolbox)



GUT and BRAT integration

BRAT Display
NET CDF input data format

Output Tiff, Kml, etc..



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