Stabilisation with a Stabilisation experiences of invariants incorporating GOCE real data. Algorithms have been implemented on high performance computing platforms and have been tested successfully within the framework of comprehensive numerical simulation studies. The major objective analysis. Within the support programs GOCE-GRAND I and II, the methodological fundamentals were established to apply the invariants approach to gradiometer data. Most notably, in this context, the rotational invariants of the gravitational tensor avoids any orientation concerns. For this reason, the invariants representation constitutes an alternative and independent procedure for GOCE data reference frame of gravity field modeling is of prime importance. Hence, the orientation information quality strongly influences the accuracy of the entire analysis procedure. Gravity field recovery based on Commonly, GOCE gradiometry analysis relates the single gravitational gradients to the unknown gravity field parameters. For its application, the orientation of the gravitational tensor relative to the reference frame of gravity field modeling is of prime importance. Hence, the orientation information quality strongly influences the accuracy of the entire analysis procedure. Gravity field recovery based on

Launched on 17 March 2009, ESA’s Gravity field and steady-state Ocean Circulation Explorer (GOCE) will revolutionize our understanding of one of Earth’s most fundamental forces: gravity. GOCE gravity field determination by means of rotational invariants: first experiences

Invariant I₂, residuals, 02-Nov-2009, all GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₃, residuals, 02-Nov-2009, main diagonal GGs only (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₂, 02-Nov-2009, main diagonal GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₃, 02-Nov-2009, main diagonal GGs only (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₁, residuals, 02-Nov-2009, main diagonal GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₁, residuals, 02-Nov-2009, main diagonal GGs only (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₁, residuals, 02-Nov-2009, all GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₂, 02-Nov-2009, all GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Invariant I₃, 02-Nov-2009, all GGs (red solid line); forward modeled reference invariants, all GGs (green line)

Global map of the Invariant I² from 02-Nov-2009 to 31-Dec-2009, in E²

Time series of REAL GOCE gravity gradients EGG NOM and three invariants (in red) from 02-Nov-2009 to 02-Dec-2009

Stochastic model of invariants

The linearized invariant I₁:

\[ I₁ = \sum \partial \eta_i \partial \theta_r \partial \phi_t + \sum \partial \eta_i \partial \theta_r \partial \phi_t + \sum \partial \eta_i \partial \theta_r \partial \phi_t \]

Variance-covariance of invariant I₁:

\[ D(I₁) = \Delta V \Delta V^T \]

D(N) = the total GGs variance-covariance matrix; Neglecting correlations among GGs, D(I₁) simplifies to \[ D(I₁) = \Delta V \Delta V^T \]

Inserting \[ D(I₁) = \Delta V \Delta V^T \]

yielding \[ I₁ = \sum \Delta V \partial \eta \partial \phi \]

Determination of the GOCE Earth gravity field

Processing:

- Least-Squares solution
- Tailored parallel processing scheme
- High performance computing with OpenMP and MPI
- Stabilization with a priori information
- Optimal regularization

Real GOCE Observations:

- Invariants I₁ and I₂ derived from gravity gradients
- Reference model for invariant linearization OSU86F until degree/order 200.