The EGSIEM combination service: final results and further plans

Introduction

In the frame of the Horizon 2020 project European Gravity Service for Improved Emergency Management (EGSIEM, 2015-17) the prototyp of a scientific combination service for time-variable gravity fields has been installed at the Astronomical Institute of the University of Bern (AIUB). It provides consistent, reliable and validated monthly GRACE gravity fields that are combined on Normal Equation (NEQ) level from standardized NEQs of all associated Analysis Centers (ACs). While the EGSIEM standards on reference frame and Earth rotation guarantee consistency of the NEQs, the different ACs are free to use their specific processing approaches and the background force models and de-aliasing products of their choice. The latter is restored to use their specific processing approaches and the background force models and de-aliasing products. The strategy is developed to pair-wise combinations. In a second step relative weights are derived by VCE on solution level (middle) represent the different noise levels of the individual contributions, the final weights (bottom) are the monthly products of the empirical factors and the relative weights based on the different noise levels.

Combination strategy

The individual NEQs are first scaled empirically to contribute equally to pair-wise combinations. In a second step relative weights are derived iteratively by VCE on solution level (Jean et al., 2018). Finally these factors and weights are derived by VCE on solution level (middle) represent the different noise levels of the individual contributions, the final weights (bottom) are the monthly products of the empirical factors and the relative weights based on the different noise levels.

Test combinations 2006/07

In the frame of EGSIEM monthly gravity fields of two test years 2006 and 2007 were combined. For these two years contributions from four ACs were available:

- Astronomical Institute University of Bern (AIUB)
- Groupe de Recherche de Géodesie Spatiale (GRGS), Helmholz Centre Potsdam (GFZ), and Institute of Geodesy, Graz (ITSG).

Fig. 1: EGSIEM has installed three services related to temporal gravity field variations.

Fig. 2: Weights on solution level are derived iterative (top), the STD of the noise levels (smoothed by a 400km Gauss filter), weighted by the cosine of the latitude of the grid cells.

Quality control

For independent quality control anomalies are computed. They are defined as the residuals after removal of a best fitting trend and seasonal variations. Anomalies are either derived coefficient wise in the spherical harmonic domain or per grid cell of global grids in the spatial domain. In the latter case they may be evaluated over the ocean areas, where no short-periodic temporal mass variations are expected, to provide monthly estimates of the noise levels.

Fig. 3: Relative weights applied for the combination of the monthly NEQs.

- weights derived by VCE on solution level (middle) represent the different noise levels of the individual contributions, the final weights (bottom) are the monthly products of the empirical factors and the relative weights based on the different noise levels.

Fig. 4: Monthly quality control in the spatial domain of the ACs individual contributions, compared to the corresponding EGSIEM time-series and the combination. Shown is the RMS of anomalies over the ocean areas smoothed by a 400km Gauss filter. Weighted by the cosine of the latitude of the grid cells.

Fig. 5: Quality control in the spectral domain of the EGSIEM combination compared to the GRACE SDS time series. Shown is the RMS of degree amplitudes of anomalies, either including all orders (solid lines), or truncated at order 29 to focus on the signal dominated part of the spectrum (dashed).

Future plans: COST-G

The end of the EGSIEM project is not the end of the scientific combination service. It is being transformed into the International Combination Service for Time-variable Gravity field solutions (COST-G), the Product Center of the IGFS for time-variable gravity fields. It is envisaged to provide combined monthly fields of the whole GRACE mission period, taking into account the EGSIEM, the GRACE SDS RL06 and further time-series that pass the EGSIEM quality control (as soon as SDS RL06 becomes available).

Acknowledgment: This research was supported by the European Union’s Horizon 2020 research and innovation program under the grant agreement No. 637010. All views expressed are those of the authors and not of the Agency.

References:


Contact address

Astronomical Institute, University of Bern
Sidlerstrasse 5
3012 Bern (Switzerland)
ulrich.meyer@aiub.unibe.ch

Poster compiled by Ulrich Meyer, April 2016
Astronomical Institute, University of Bern, Switzerland
ulrich.meyer@aiub.unibe.ch

joint research project in the frame of the Horizon 2020 project European Gravity Service for Improved Emergency Management (EGSIEM, 2015-17) the prototype of a scientific combination service for time-variable gravity fields has been installed at the Astronomical Institute of the University of Bern (AIUB). It provides consistent, reliable and validated monthly GRACE gravity fields that are combined on Normal Equation (NEQ) level from standardized NEQs of all associated Analysis Centers (ACs). While the EGSIEM standards on reference frame and Earth rotation guarantee consistency of the NEQs, the different ACs are free to use their specific processing approaches and the background force models and de-aliasing products of their choice. The latter is restored to use their specific processing approaches and the background force models from standardized NEQs of all associated Analysis Centers (ACs).

Fig. 2: Weights on solution level are derived iterative (top), the STD of the noise levels (smoothed by a 400km Gauss filter), weighted by the cosine of the latitude of the grid cells.

Fig. 6: For quality control the noise level of the combined EGSIEM gravity fields are compared to the official GRACE SDS time series. Shown are anomalies, i.e. residuals after removal of trends and seasonal variations. Over the oceans the anomalies mainly represent noise.

Fig. 5: Quality control in the spectral domain of the EGSIEM combination compared to the GRACE SDS time series. Shown is the RMS of degree amplitudes of anomalies, either including all orders (solid lines), or truncated at order 29 to focus on the signal dominated part of the spectrum (dashed).

Future plans: COST-G

The end of the EGSIEM project is not the end of the scientific combination service. It is being transformed into the International Combination Service for Time-variable Gravity field solutions (COST-G), the Product Center of the IGFS for time-variable gravity fields. It is envisaged to provide combined monthly fields of the whole GRACE mission period, taking into account the EGSIEM, the GRACE SDS RL06 and further time-series that pass the EGSIEM quality control (as soon as SDS RL06 becomes available).

References:


Contact address

Astronomical Institute, University of Bern
Sidlerstrasse 5
3012 Bern (Switzerland)
ulrich.meyer@aiub.unibe.ch

joint research project in the frame of the Horizon 2020 project European Gravity Service for Improved Emergency Management (EGSIEM, 2015-17) the prototype of a scientific combination service for time-variable gravity fields has been installed at the Astronomical Institute of the University of Bern (AIUB). It provides consistent, reliable and validated monthly GRACE gravity fields that are combined on Normal Equation (NEQ) level from standardized NEQs of all associated Analysis Centers (ACs). While the EGSIEM standards on reference frame and Earth rotation guarantee consistency of the NEQs, the different ACs are free to use their specific processing approaches and the background force models and de-aliasing products of their choice. The latter is restored to use their specific processing approaches and the background force models from standardized NEQs of all associated Analysis Centers (ACs).