ON THE CURRENT STATUS OF THE COOPERATIVE RESEARCH PROJECT REAL DATA ANALYSIS GOCE (REAL GOCE)

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ABSTRACT

The goal of the current REAL GOCE project, which is funded throughout the years 2009 - 2012 by the Federal Ministry of Education and Research (BMBF) of Germany through the Geotechnologien Programme, is the complete implementation of a GOCE data processing chain and its application to the GOCE real data within the framework of a cooperative scientific analysis. In this paper we present an overview of the crucial scientific goals of REAL GOCE and the organizational structure of this project.

Key words: Gravity and Steady-State Ocean Circulation Explorer (GOCE), Living Planet Programme, Geotechnologien, Gravity field.

1. INTRODUCTION

The determination of the detailed structure of the Earth's gravity field is of vital importance e.g. for the exploration of dynamic processes in the Earth system and for the precise orbit prediction of satellites. The high demand for globally spread and highly accurate gravity data in research fields such as oceanography, geophysics, glaciology, and geodesy led the European Space Agency (ESA) to implement the satellite mission GOCE (Gravity and Steady-State Ocean Circulation Explorer) as the first core mission of the Living Planet Programme (cf. ESA 1999).

The purpose of GOCE, which was launched on March 17, 2009, is to deliver data that allows for a representation of the stationary component of the Earth's global gravity field with unprecedented accuracy. The mission goal concerning the geoid, for instance, is to achieve an accuracy of 1-2 cm at a resolution of at least 100 km. This goal can be reached by a combination of orbit determination by means of GPS satellites (the measurement principle is called Satellite-to-Satellite Tracking or SST in high-low mode) and with direct measurements of the second derivatives of the gravity potential (the technique is Satellite Gravity Gradiometry or SGG) at a very low altitude of approximately 250 km (i.e. GOCE is a low earth orbiter or LEO).

The key elements of a tailored GOCE data processing chain were already studied and implemented from 2001-2008 in the course of the national cooperative research projects GOCE GRAND (GOCE Gravitationsfeldanalyse Deutschland), which were jointly funded by the Federal Ministry of Education and Research of Germany (Bundesministerium für Bildung und Forschung, BMBF) and the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG). In the main focus of GOCE GRAND I (2001-2004) was the implementation of standard procedures for the analysis, processing, calibration, and validation of GOCE data and their combination with GRACE data (cf. the contributions in Flury, Rummel, Rothacher, Boedecker and Reigber, 2006). During GOCE GRAND II (2005-2008) research was mainly concerned with adaptations of the methods, algorithms, and software modules to the final configuration of the GOCE satellite and its instruments (cf. the contributions in Flechtner, Gruber, Güntner, Mandea, Rothacher, Schöne and Wickert, 2010).

The goal of the current BMBF-funded REAL GOCE project (granting period 1.6.2009 - 31.5.2012), which is currently coordinated at the Department of Theoretical Geodesy of the Institute of Geodesy and Geoinformation (IGG-TG) of the University of Bonn (Germany), is now the complete implementation of the GOCE data processing chain and its application to the GOCE real data within the framework of a cooperative scientific analysis. In this paper we present an overview of the crucial scientific goals of REAL GOCE and the organizational structure of this project.

References of this section:

ESA (1999) The Four Candidate Earth Explorer Core Missions. ESA Report SP-1233(1), Granada.

Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (2010) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271.

Flury J, Rummel R, Schreiber U, Rothacher M, Boedecker G, Reigber C (2006) Observation of the Earth System from Space. Springer, Berlin. ISBN 978-3540295204.

Proc. of '4th International GOCE User Workshop', Munich, Germany 31 March – 1 April 2011 (ESA SP-696, July 2011)

2. GENERAL GOALS AND STRUCTURE OF REAL GOCE

To realize the scientific goals of REAL GOCE in a joint venture, the project partners have defined their individual work packages according to a matrix as shown in Fig. 1. This matrix structures the thematic interconnections of these individual contributions.

The different rows within the matrix structure reflect the three main thematic focuses.

1. **GOCE gradient analysis and gravity field computation (first row):**
   GOCE gradient analysis aims at a continuous evaluation of the information content of the GOCE data, which is necessary for an ensuing optimal computation of the desired Earth gravity field models on the basis of calibrated GOCE measurements. In this context, five work packages (WP110 - WP150) were designed with the following particular goals:
   - Analysis of the characteristics and quality of the measured GOCE gravity gradients in the orbit system
   - Derivation of a GOCE gravity field model based on rotational invariants of the gravitational tensor (i.e., independent of observed GOCE orientation data)
   - Data-adaptive determination of the stochastic model of GOCE measurements
   - Determination of global GOCE–only gravity field solutions from in-situ measurements
   - Derivation of regionally refined gravity field models and their fusion to a global model
   - Study on the consideration of topographic and isostatic prior information as part of GOCE gravity field modeling
2. **GOCE validation (second row):**
   Besides the evaluation of the GOCE data, the independent validation of the calibrated measurements and of the various gravity field products will be of crucial importance in order to guarantee their reliability and accuracy. Two work packages (WP210 and WP210) deal with this topic in particular and have the following specific goals:
   - Detailed understanding of sensor-related systematic effects via application of independent validation procedures
   - External validation via computation of reference gravity gradients at the satellite's altitude from european terrestrial gravity data and evaluation of occuring differences
   - Internal validation via comparison of measured GOCE gravity gradients in satellite orbit cross-over points
   - Merging of the GOCE geoid with a numerical ocean circulation model for quantitative evaluation of the model accuracy
3. **GOCE combination (third row):**
   Combinations of GOCE data with available terrestrial gravity field data, altimetric data or GRACE data provide numerous opportunities for both improvements and further consistency assessments of the GOCE-only products. The final two work packages (WP310 and WP320) were designed to carry out the following tasks in particular:
   - Combination of GOCE data with external data for improvement of the spatial resolution (regional and global modeling)
   - Determination of a high-precision regional quasi-geoid model for Germany and Europe
   - Connection of regional, european and global height systems by means of quasi-geoid models

The columns represent the distinct spatial characteristics of the different approaches to GOCE data analysis, which are considered as cross-sectional research topics.

1. **Focus on orbital gradients (first column):**
   The analysis of the gravity gradient components in the orbit system aims at the full utilization especially of the high-frequency part of the information content of the GOCE data. Cross-over analyses, computation of reference gradients from terrestrial data (topography and geoid), and trace-wise comparisons of GOCE data with regional geoid models are also within this focus.
2. **Focus on regional gravity models (second column):**
   The focus is mainly on Europe, the Atlantic and Pacific ocean, as well as the transition zones from the rugged continental to smooth sea topography.
3. **Focus on global gravity models (third column):**
   Through the combination of GOCE-only global gravity field models with ocean circulation models, GRACE models, and terrestrial data, it is intended to assess the consistency of the information content.

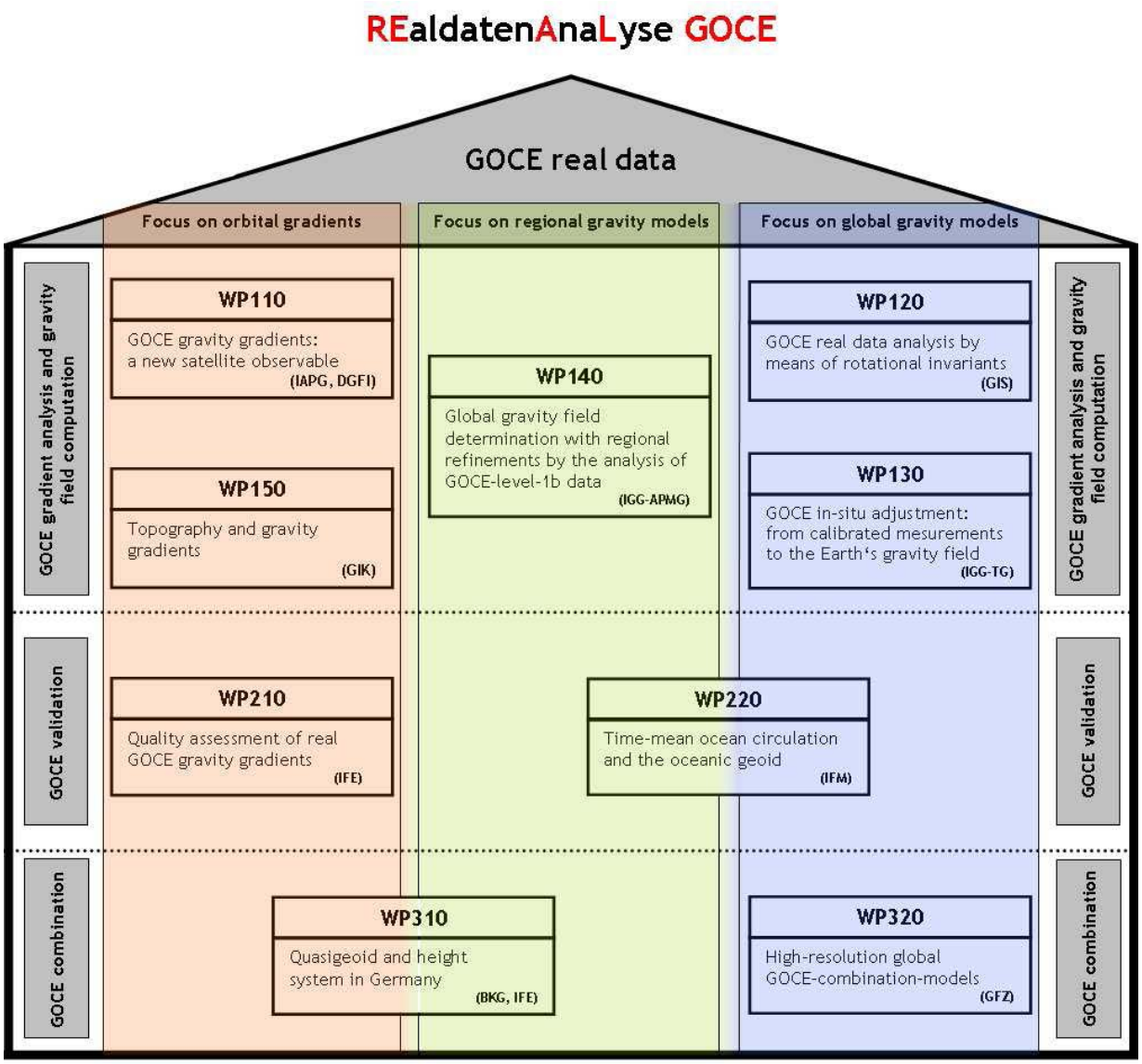

Figure 1. REAL GOCE comprises 9 work packages (WPs) with different spatial (orbital, regional, global) and thematic (gradient analysis and gravity field computation, validation, combination) focuses.

The participating national research institutions are:

1. Institute of Geodesy and Geoinformation, Department of Theoretical Geodesy (IGG-TG), University of Bonn
2. Institute of Geodesy and Geoinformation, Department of Astronomical, Physical and Mathematical Geodesy (IGG-APMG), University of Bonn
3. Federal Agency for Cartography and Geodesy (BKG), Frankfurt
4. Institute of Oceanography (IFM), University of Hamburg
5. Institute of Geodesy (IFE), Leibniz University Hannover
6. German Geodetic Research Institute (DGFI), Munich
7. Institute of Astronomical and Physical Geodesy (IAPG), Technical University Munich
8. Geodetic Institute (GIK), Karlsruhe Institute of Technology
9. Institute of Geodesy (GIS), University of Stuttgart
10. GFZ German Research Centre for Geosciences (GFZ), Helmholtz Centre Potsdam

3. CURRENT STATUS

In the following, we provide a list of contributions, which reflect the research activities of the REAL GOCE project partners (with currently 37 contributing scientists), in terms of written publications, oral and poster presentations throughout the period 1. June 2009 – 31. December 2010. These presentations were given at a wide range of meetings and conferences. Aside from national and international conferences with dedicated GOCE sessions, a number of project meetings directly devoted to REAL-GOCE were held so far:

- 1. REAL-GOCE project meeting: 22. September 2009 in Karlsruhe/Germany (30 participants)
- 2. REAL-GOCE project meeting: 15.-16. March 2010 in Munich/Germany (28 participants)
- 3. REAL-GOCE project meeting: 23.-24. September 2010 in Stuttgart/Germany (22 participants)
- Geotechnologien Status Seminar: 4. October 2010 in Bonn/Germany (51 participants)
- 4. REAL-GOCE project meeting: 30. March 2011 in Munich/Germany (25 participants)

3.1. Publications

1. Baur O, Cai J, Sneeuw N (2010) *Spectral approaches to solving the polar gap problem.* In: Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271. pp.242-254

2. Baur O, Sneeuw N, Cai J, Roth M (2010) *GOCE data analysis: realization of the invariants approach in a high performance computing environment.* In: Lacoste-Francis H (ed.) Proceedings of the ESA Living Planet Symposium. ESA Publication SP-686, ESA/ESTEC. ISBN 978-9292212506, ISSN 1609-042X

3. Brieden P, Müller J (2010) *Quality assessment of GOCE gradients.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.94-100

4. Brieden P, Müller J (2010) *Two methods for quality assessment of goce gradients.* In: Lacoste-Francis H (ed.) Proceedings of the ESA Living Planet Symposium. ESA Publication SP-686, ESA/ESTEC. ISBN 978-9292212506, ISSN 1609-042X

5. Brockmann JM, Kargoll B, Krasbutter I, Schuh W-D, Wermuth M (2010) *GOCE data analysis: from calibrated measurements to the global Earth gravity field.* In: Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271. pp.213-229

6. Brockmann JM, Schuh W-D (2010) *Fast variance component estimation in GOCE data processing.* In: Mertikas S (ed.) Gravity, Geoid and Earth Observation, IAG Symposia Vol. 135. Springer, Berlin. ISBN 978-3642106330. pp.185-193

7. Cai J, Baur O, Sneeuw N (2010) *GOCE gravity field determination by means of rotational invariants: first experiences.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.62-69.

8. Denker H, Barriot JP, Barzaghi R, Fairhead D, Forsberg R, Ihde J, Kenyeres A, Marti U, Sarrailh M, Tziavos IN (2009) *The development of the European gravimetric geoid model EGG07.* In: Sideris M (ed.) *Observing Our Changing Earth*, IAG Symposia, Vol. 133. Springer, Berlin. ISBN 978-3540854258. pp.177-186,

9. Flechtner F, Dahle C, Neumayer K-H, König R, Förste C (2010) *The release 04 CHAMP and GRACE EIGEN gravity field models.* In: Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271. pp.41-58

10. Grombein T, Seitz K, Heck B (2010a) *Untersuchungen zur effizienten Berechnung topographischer Effekte auf den Gradiententensor am Fallbeispiel der Satellitengradiometriemission GOCE.* KIT Scientific Reports 7547, KIT Scientific Publishing, Karlsruhe

11. Grombein T, Seitz K, Heck B (2010b) *Modelling topographic effects in GOCE gravity gradients.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.84-93

12. Ihde J, Wilmes H, Müller J, Denker H, Voigt C, Hosse M (2010) *Validation of satellite gravity field models by regional terrestrial data sets.* Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. pp.277-296

13. Krasbutter I, Brockmann JM, Kargoll B, Schuh W-D (2010) *Stochastic model refinements for GOCE gradiometry data.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space,

Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.70-76

14. Müller J, Jarecki F, Wolf I, Brieden P (2010) *Quality evaluation of GOCE gradients.* In: Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271. pp.265-276

15. Pail R, Goiginger H, Mayrhofer R, Schuh WD, Brockmann JM, Krasbutter I, Höck E, Fecher T (2010a) *Global gravity field model derived from orbit and gradiometry data applying the time-wise method.* In: Lacoste-Francis H (ed.) Proceedings of the ESA Living Planet Symposium. ESA Publication SP-686, ESA/ESTEC. ISBN 978-9292212506, ISSN 1609-042X

16. Pail R, Goiginger H, Schuh W-D, Höck E, Brockmann JM, Fecher T, Gruber T, Mayer-Gürr T, Kusche J, Jäggi A, Rieser D (2010b) *Combined satellite gravity field model GOCO01S derived from GOCE and GRACE.* Geophysical Research Letters, Jg. 37, EID L20314, American Geophysical Union. ISSN 0094-8276

17. Pail R, Bruinsma S, Migliaccio F, Förste C, Goiginger H, Schuh W-D, Höck E, Reguzzoni M, Brockmann JM, Abrikosov O, Veicherts M, Fecher T, Mayrhofer R, Krasbutter I, Sanso F, Tscherning CC (2010) *First GOCE gravity field models derived by three different approaches.* Journal of Geodesy (submitted in 2010, accepted)

18. Schuh W-D, Brockmann JM, Kargoll B, Krasbutter I, Pail R (2010) *Refinement of the stochastic model of GOCE scientific data and its effect on the in-situ gravity field solution.* In: Lacoste-Francis H (ed.) Proceedings of the ESA Living Planet Symposium. ESA Publication SP-686, ESA/ESTEC. ISBN (Online) 978-9292212506, ISSN 1609-042X

19. Schuh W-D, Brockmann JM, Kargoll B, Krasbutter I (2010) *Adaptive Optimization of GOCE Gravity Field Modeling.* In: Münster G, Wolf D, Kremer M (eds.) Proceedings of the NIC Symposium 2010, IAS Series, Nr. 3. Forschungszentrum Jülich. ISBN 978-3893366064, ISSN 1868-8489. pp.313-320

20. Shabanloui A, Schall J, Mayer-Gürr T, Eicker A, Kusche J, Kurtenbach E (2010) *Global gravity field determination with regional refinements by the analysis of GOCE level-1b data (GLOREGOCE).* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.77-83

21. Shako R, Förste C, Abrikosov O, Bruinsma S, Dahle C, Flechtner F, Neumayer H, Marty J-C (2010) *High-resoluton global gravity fields by combining GOCE, GRACE and terrestrial data. First results from the REAL GOCE project.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.112-117

22. Shako R, Förste C, Abrikosov O, Kusche J (2010) *GOCE and its use for a high-resolution global gravity combination model.* In: Flechtner F, Gruber T, Güntner A, Mandea M, Rothacher M, Schöne T, Wickert J (eds.) System Earth via Geodetic-Geophysical Space Techniques. Springer, Berlin. ISBN 978-3642102271. pp.231-242

23. Siegismund F, Köhl A, Stammer D (2010) *Inferring the mean dynamic topography by using GOCE geoid information in ocean state estimations.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.101-105

24. Voigt C, Denker H, Hirt C (2009) *Regional astrogeodetic validation of GPS/levelling data and quasigeoid models.* In: Sideris M (ed.) *Observing Our Changing Earth*, IAG Symposia, Vol. 133. Springer, Berlin. ISBN 978-3540854258. pp.177-186

25. Voigt C, Rülke A, Denker H, Ihde J, Liebsch G (2010) *Validation of GOCE products by terrestrial data sets in Germany.* In: Münch U, Dransch W (eds.) Observation of the System Earth from Space, Geotechnologien Science Report, Vol. 17, Koordinierungsbüro Geotechnologien, Potsdam. ISSN 1619-7399. pp.106-111

3.2. Talks and Posters

1. Agren J, Barzaghi R, Carrion D, Denker H, Grigoriadis VN, Kiamehr R, Sona G, Tscherning CC, Tziavos IN (poster) *Different geoid computation methods applied on a test dataset: results and considerations.* VII Hotine-Marussi Symposium, Rome/Italy, 6.-10.7.2009

2. Bouman J, Brieden P, Catastini G, Cesare S, Floberghagen R, Frommknecht B, Haagmans R, Kern M, Lamarre D, Müller J, Plank G, Rispens S, Stummer C, Tscherning CC, Veicherts M, Visser P (talk) *Overview of GOCE gradiometer Cal/Val activities.* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

3. Bouman J, Bosch W, Fuchs M, Grombein T, Gruber T, Heck B, Murböck M, Pail R, Rummel R, Schmidt M, Seitz K, Stummer C (talk) *GOCE gravity gradient analysis.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

4. Bouman J, Fiorot S, Fuchs M, Gruber T, Schrama E, Tscherning CC, Veicherts M, Visser P (poster) *GOCE level 2 gravity gradients.* AGU Fall Meeting 2010, San Francisco/USA 13.-17.12.2010

5. Brieden P, Müller J (talk) *Allan Varianz und der Bezug zur PSD.* Future Gravity Field Satellite Missions Meeting, Immenstaad/Germany, 2.12.2009

6. Brieden P, Müller J (talk) *Hannover SGG Cal/Val Methods.* ESA Calibration/-Validation (Cal/Val) Meeting, Frascati/Italy, 13.11.2009

7. Brieden P, Müller J, Jarecki F (talk) *Validierung von GOCE-Gradienten - Qualitätsreports.* Geodetic Week 2009, Karlsruhe/Germany, 23.9.2009

8. Brieden P, Müller J (talk) *WP210: Qualitätsbeurteilung gemessener GOCE-Gradienten.* 1. REAL-GOCE project meeting, Karlsruhe/Germany, 22.9.2009

9. Brieden P, Müller J (poster) *Two methods for the validation of GOCE gradients.* General Assembly of the European Geosciences Union, Vienna/Austria, 2.-7.5.2010

10. Brieden P, Müller J (poster) *Quality Assessment of GOCE Gradients.* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

11. Brieden P, Müller J (poster) *Quality Assessment of GOCE Gradients.* 4. GOCE-Cal/Val Projekttreffen, Bergen/Norway, 1.7.2010

12. Brieden P, Müller J (talk) *Wissenschaftlicher Bericht und Status von WP210: Qualitätsbeurteilung gemessener GOCE Gradienten.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 24.9.2010

13. Brieden P, Müller J (talk) *Quality assessment of GOCE gradients.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

14. Brieden P, Müller J (talk) *Kreuzungspunktanalyse als Validierungsmethode für GOCE Gravitationsgradienten.* Geodetic Week 2010, Cologne/Germany, 6.10.2010

15. Brieden P (talk) *Qualitätsbeurteilung von Gravitationsgradienten, der Messgröße der Schwerefeldsatellitenmission GOCE.* Seminar for doctoral students in the geodesy and geoinformatics program of the Leibniz University Hannover, 9.11.2010

16. Brockmann JM, Schuh W-D, Krasbutter I (talk) *WP6000: Gravity field determination with the time-wise approach (Tuning-Machine).* 18. GOCE-HPF project meeting, Munich/Germany, 17.3.2010

17. Brockmann JM, Schuh W-D, Krasbutter I (talk) *WP6000: Gravity field determination with the time-wise approach (Tuning-Machine).* 19. GOCE-HPF project meeting, Toulouse/France, 10.6.2010

18. Brockmann JM, Fecher T, Goiginger H, Höck E, Kargoll B, Krasbutter I, Mayerhofer R, Pail R, Schuh W-D (talk) *First gravity field derived with the time-wise approach.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

19. Brockmann JM, Baur O, Cai J, Eicker A, Krasbutter I, Kusche J, Mayer-Gürr T, Schall J, Schuh W-D, Shabanloui A, Sneeuw N (talk) *REAL GOCE – Gravity field determination from GOCE.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

20. Brockmann JM, Fecher T, Goiginger H, Höck E, Kargoll B, Krasbutter I, Mayerhofer R, Pail R, Schuh W-D (talk) *GOCE-only solution using the time-wise method.* Geodetic Week, Cologne/Germany, 6.10.2010

21. Brockmann JM, Schuh W-D, Krasbutter I (talk) *WP6000: Gravity field determination with the time-wise approach (Tuning-Machine).* 20. GOCE-HPF project meeting, Frascati/Italy, 21.10.2010

22. Cai J, Baur O, Sneeuw N (talk) *WP120: GOCE Realdatenauswertung unter Anwendung der Invariantendarstellung.* 2. REAL-GOCE project meeting, Munich/Germany, 15.3.2010

23. Cai J, Baur O, Sneeuw N (talk) *WP120: GOCE Realdatenauswertung unter Anwendung der Invariantendarstellung.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

24. Denker H (talk) *The European gravity and geoid project.* National Geodetic Survey (NGS/NOAA), Silver Spring/USA, 20.8.2009

25. Denker H, Voigt C (talk) *WP310: GOCE Cal/Val, Quasigeoid und Höhensysteme in Deutschland (Part 1).* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

26. Denker H, Voigt C (talk) *WP310: GOCE Cal/Val, Quasigeoid und Höhensysteme in Deutschland (Teil 1).* 3. REAL-GOCE project meeting, Stuttgart/Germany, 24.9.2010

27. Eicker A, Mayer-Gürr T, Kurtenbach E (talk) *Accurate GRACE solutions tailored to hydrological requirements.* IAG Symposium "'Geodesy for Planet Earth"', Buenos Aires/Argentina 31.8.-4.9.2009

28. Förste C, Shako R, Bruinsma S, Marty JC, Flechtner F, Dahle C, Neumayer H, Rülke A, Schäfer U, Liebsch G, Schirmer U, Ihde J, Denker H, Voigt C, Müller J (talk) *REAL-GOCE validation and combination.* Geotechnologien status seminar, Bonn/Germany, 4.10.2010

29. Förste C, Shako R, Flechtner F, Dahle C, Abrikosov O, Neumayer H, Barthelmes F, Bruinsma SL, Marty J, Balmino G, Biancale R (Poster) *A new combined global gravity field model including GOCE data from the collaboration of GFZ Potsdam and GRGS Toulouse.* AGU Fall Meeting, San Francisco/USA, 13.-17.12.2010

30. Fuchs M, Bouman J (talk) *WP110: GOCE-Gradientendarstellung in einem lokalen Bezugssystem.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

31. Fuchs M, Bouman J (talk) *GOCE-Gradientendarstellung in einem lokalen Bezugssystem.* Geodätische Woche, Köln, 6.10.2010

32. Fuchs M, Bouman J (talk) *Gravity gradients: effective MBW, contribution in LNOF, comparison with GOCE models.* 20. GOCE-HPF project meeting, Frascati/Italy, 21.10.2010

33. Fuchs M, Bouman J (poster) *GOCE gravity gradients in local frames.* AGU Fall Meeting 2010, San Francisco/USA, 13.-17.12.2010

34. Goiginger H, Hausleitner W, Höck E, Krauss S, Maier A, Pail R, Gruber T, Fecher T, Jäggi A, Mayer U, Schuh W-D, Brockmann JM, Kusche J, Eicker A (Poster) *The impact on a combined global gravity field model using simulated GOCE data.* General Assembly of the European Geosciences Union, Vienna/Austria, 2.-7.5.2010

35. Goiginger H, Rieser D, Mayer-Gürr T, Hausleitner W, Höck E, Krauss S, Maier A, Pail R, Gruber T, Fecher T, Albertella A, Jäggi A, Mayer U, Schuh W-D, Brockmann JM, Kusche J, Eicker A (poster) *Combined global gravity field model from space-based (and ground-based) data: GOCO01S.* AGU Fall Meeting, San Francisco/USA, 13.-17.12.2010

36. Grombein T, Seitz K, Heck B (talk) *WP150: Topographie und Schweregradienten.* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

37. Grombein T, Seitz K, Heck B (poster) *Spherical and ellipsoidal arrangement of the topography and its impact on gravity gradients in the GOCE mission.* General Assembly of the European Geosciences Union, Vienna/Austria, 2.-7.5.2010

38. Grombein T, Seitz K, Heck B (talk) *WP150: Topographie und Schweregradienten.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

39. Grombein T, Seitz K, Heck B (poster) *Modelling topographic effects in GOCE gravity gradients.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

40. Grombein T, Seitz K, Heck B (talk) *Einfluss von Dichteannahmen auf die Modellierung topographischer Effekte.* Geodetic Week 2010, Cologne/Germany, 6.10.2010

41. Krasbutter I (talk) *Dekorrelationsfilter und ihre Validierung am Beispiel von GOCE Messreihen.* Geodetic Week 2009, Karlsruhe/Germany, 23.9.2009

42. Krasbutter I (talk) *Filterdesign mit quadratischen Programmen am Beispiel der GOCE Messreihen.* Geodetic Integration Seminar at the Institute of Geodesy and Geoinformation, Bonn/Germany, 19.11.2009

43. Krasbutter I, Brockmann JM, Schuh W-D, Roese-Koerner L, Kargoll B (talk) *WP130: GOCE in-situ Ausgleichung: Von kalibrierten Messdaten zum Erdschwerefeld.* 2. REAL-GOCE project meeting, Munich/Germany, 15.3.2010

44. Krasbutter I, Brockmann JM, Schuh W-D, Kargoll B (talk) *WP130: GOCE in-situ Ausgleichung: Von kalibrierten Messdaten zum Erdschwerefeld.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

45. Krasbutter I, Brockmann JM, Kargoll B, Schuh W-D (poster) *Stochastic model refinements for GOCE gradiometry data.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

46. Krasbutter I, Schuh W-D, Brockmann JM, Kargoll B (talk) *Statistische Analyse der ersten GOCE Residuen.* Geodetic Week, Cologne/Germany, 6.10.2010

47. Mayer-Gürr T, Eicker A, Schall J (talk) *Regional high resolution geoid and mean sea surface topography determination by a combination of GOCE, GRACE and altimetry data.* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

48. Müller J (talk) *Die Physikalische Geodäsie als Kerndisziplin der Erdsystemforschung.* Geodätisches Kolloquium (Förderertag), Hannover/Germany, 17.11.2009

49. Müller J, Sneeuw N, Flechtner F (talk) *Future satellite gravity missions - activities in Germany.* Workshop "'Towards a Roadmap for Future Satellite Gravity Missions"', Graz/Austria, 30.9.2009

50. Müller J, Brieden P (talk) *WP210: Qualitätsbeurteilung gemessener GOCE-Gradienten.* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

51. Müller J, Brieden P (talk) *Hannover SGG Cal/Val methods.* 3. GOCE-Cal/Val synthesis project meeting, Munich/Germany, 19.3.2010

52. Müller J (talk) *Accelerometry in satellite gravimetry.* GOCE Summer School, Munich/Germany, 1.6.2010

53. Murböck M, Stummer C (talk) *WP110: GOCE gravity gradients: a new satellite observable.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

54. Murböck M, Fuchs M, Stummer C, Bouman J, Bosch W, Fecher T, Pail R (poster) *GOCE gravity gradients: a new satellite observable.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

55. Pail R, Goiginger H, Gruber T, Fecher T, Schuh W-D, Brockmann JM, Kusche J, Eicker A, Jäggi A, Hausleitner W, Höck E (poster) *Combined global gravity field models from GOCE data and complementary data types.* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

56. Pail R, Goiginger H, Mayrhofer R, Fecher T, Gruber T, Schuh W-D, Brockmann JM, Krasbutter I, Höck E (talk) *Global gravity field model derived from GOCE orbit and gradiometry data.* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

57. Pail R, Goiginger H, Schuh W-D, Höck E, Brockmann JM, Mayrhofer R, Fecher T, Krasbutter I (talk) *Global gravity field models from GOCE applying the time-wise method.* AGU Fall Meeting, San Francisco/USA, 15.12.2010

58. Roese-Koerner L (talk) *Quadratische Programmierung mit Ungleichungen als Restriktionen.* Geodetic Week 2009, Karlsruhe/Germany, 24.9.2009

59. Roese-Koerner L, Krasbutter I, Schuh WD (poster) *Constrained quadratic programming technique for data-adaptive design of decorrelation filters.* VII Hotine-Marussi Symposium, Rome/Italy, 6.-10.7.2009

60. Rülke A, Ihde J, Liebsch G, Schirmer U, Schäfer U (talk) *WP310: GOCE Cal/Val, Quasigeoid und Höhensysteme in Deutschland (Part 2).* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

61. Rülke A, Schäfer U, Liebsch G, Schirmer U, Ihde J (talk) *WP310: GOCE Cal/Val, Quasigeoid und Höhensysteme in Deutschland (Part 2).* 3. REAL-GOCE project meeting, Stuttgart/Germany, 24.9.2010

62. Schall J (talk) *WP140: Gravitationsfeldbestimmung aus GOCE Gradiometerbeobachtungen in GROOPS.* 2. REAL-GOCE project meeting, Munich/Germany, 15.3.2010

63. Schall J, Kusche J, Eicker A, Mayer-Gürr T (poster) *Optimized regional gravity field solutions from GOCE.* General Assembly of the European Geosciences Union, Vienna/Austria, 2.-7.5.2010

64. Schall J (talk) *WP140: (Regionale) Gravitationsfeldbestimmung aus GOCE Echtdaten.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

65. Schall J, Kusche J, Eicker A, Mayer-Gürr T (talk) *Optimierte regionale Gravitationsfeldmodelle aus GOCE Daten.* Geodetic Week 2010, Cologne/Germany, 5.-7.10.2010

66. Schuh W-D, Kargoll B (poster) *REAL GOCE: Ziele und Partner des BMBF-Verbundprojektes zur Auswertung der GOCE-Messdaten.* Geodetic Week 2009, Karlsruhe/Germany, 23.9.2009

67. Schuh W-D, Brockmann JM, Kargoll B, Krasbutter I (poster) *Adaptive Modeling of GOCE Gravity Field Modeling.* NIC Symposium 2010, Jülich/Germany, 24.-25.2.2010

68. Schuh W-D (talk) *Filtering of correlated data - stochastical considerations within GOCE data processing.* GOCE Summer School, Munich/Germany, 31.5.-4.6.2010

69. Schuh W-D, Brockmann JM, Kargoll B, Krasbutter I, Pail R (talk) *Refinement of the stochastic model of GOCE scientific data and its effect on the in-situ gravity field solution.* ESA Living Planet Symposium, Bergen/Norway, 29.6.2010

70. Schuh W-D, Kargoll B, Brockmann JM (talk) *Die Satellitenmission GOCE - Status und erste Schwerefeldlösungen.* GeoDarmstadt 2010, Darmstadt/Germany, 10.-13.10.2010

71. Schuh W-D, Brockmann JM, Kargoll B, Krasbutter I (poster) *Adaptive modeling of GOCE gravity field modeling.* GeoDarmstadt 2010, Darmstadt/Germany, 10.-13.10.2010

72. Sebera J, Bouman J, Bosch W (talk) *WP110: Satellite altimetry for GOCE validation.* 2. REAL-GOCE projekt meeting, Munich/Germany, 15.3.2010

73. Shabanloui A, Ilk KH (talk) *A new approach for pure Kinematical and reduced Kinematical determination of LEO orbit based on GNSS observations.* IAG Symposium "'Geodesy for Planet Earth"', Buenos Aires/Argentina, 31.8.-4.9.2009

74. Shabanloui A, Ilk KH (talk) *From pure kinematical to reduced kinematical LEO orbit determination.* Geodetic Week 2009, Karlsruhe/Germany, 23.9.2009

75. Shabanloui A, Ilk KH (poster) *Pure geometrical precise orbit determination of a LEO satellite based on carrier phase observations.* IAG Symposium "'Geodesy for Planet Earth"', Buenos Aires/Argentina, 31.8.-4.9.2009

76. Shabanloui A (talk) *WP140: Precise orbit determination.* 2. REAL-GOCE project meeting, Munich/Germany, 15.3.2010

77. Shabanloui A, Kusche J (poster) *How important is the dynamical information in determination of LEO orbits?* ESA Living Planet Symposium, Bergen/Norway, 28.6.-2.7.2010

78. Shabanloui A (talk) *WP140: Geometrical precise orbit determination (GPOD).* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

79. Shabanloui A, Schall J, Mayer-Gürr T, Eicker A, Kusche J, Kurtenbach E (poster) *Global gravity field determination with regional refinements by the analysis of GOCE level-1b data (GLOREGOCE).* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

80. Shabanloui A, Kusche J (talk) *Geometrical and kinematical precise orbit determination of GOCE.* Geodetic Week 2010, Cologne/Germany, 5.-7.10.2010

81. Shako R, Förste C (talk) *WP320: Hochauflösende globale GOCE-Kombinationsmodelle.* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

82. Shako R, Förste C (talk) *WP320: Hochauflösende globale GOCE-Kombinationsmodelle.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 24.9.2010

83. Shako R, Förste C, Abrikosov O, Bruinsma S, Dahle C, Flechtner F, Neumayer H, Marty J-C (poster) *High-resoluton global gravity fields by combining GOCE, GRACE and terrestrial data.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

84. Stammer D, Siegismund F (talk) *WP220: Der zeitliche Mittelwert der Ozeanzirkulation und das ozeanische Geoid.* 2. REAL-GOCE project meeting, Munich/Germany, 16.3.2010

85. Stammer D, Siegismund F (talk) *WP220: Der zeitliche Mittelwert der Ozeanzirkulation und das ozeanische Geoid.* 3. REAL-GOCE project meeting, Stuttgart/Germany, 23.9.2010

86. Stammer D (talk) *Sea level Change, oceanographic aspects. (Altimetry, GRACE, and Argo).* Workshop on "Gravity from Space" for OCEANS, LAND ICE, and SEA LEVEL RISE, Hamburg/Germany, 29.-30.9.2010

87. Stammer D, Müller J, Brieden P, Siegismund F, Köhl A (talk) *Quality assessment of GOCE data.* Geotechnologien Status Seminar, Bonn/Germany, 4.10.2010

88. Stummer C, Murböck M (talk) *WP110: GOCE gravity gradients: a new satellite observable.* 2. REAL-GOCE project meeting, Munich/Germany, 15.3.2010

89. Stummer C, Fecher T, Pail R, Rummel R, Gruber T (talk) *Alternative GOCE gradiometer processing - Wiener method for angular rate determination.* AGU Fall Meeting 2010, San Francisco/USA, 15.12.2010

90. Voigt C, Denker H (talk) *Regionales Validierungsexperiment mit astrogeodätischen Lotabweichungen in Deutschland.* Geodetic Week 2009, Karlsruhe/Germany, 23.9.2009

91. Voigt C, Denker H (poster) *Astrogeodetic vertical deflections in Germany for GOCE validation and calibration.* Second International Gravity Field Symposium, Fairbanks/USA, 20.-22.9.2010

92. Voigt C, Denker H (poster) *Validation of GOCE products by terrestrial data sets in Germany.* Geotechnolgien Status Seminar, Bonn/Germany, 4.10.2010

93. Yi W, Murböck M, Rummel R, Gruber T (poster) *Performance analysis of GOCE gradiometer measurements.* ESA Living Planet Symposium, Bergen/Norway, 30.6.2010