

Preface

Observing the Earth from space has undergone rapid developments in recent years and has a prominent position in geo-related scientific research today. Research satellites are indispensable tools for studying processes on the Earth's surface and within the System Earth. The view from space allows the observation of the entire planet uniformly in near-real-time. At the same time the resulting time series of measurements allow the detection and monitoring of changes in this very complex system.

Satellites like Challenging Mini-satellite Payload (CHAMP), Gravity Recovery and Climate Experiment (GRACE) and Gravity Field and steady state Ocean Circulation Explorer (GOCE) measure the gravity and magnetic fields of the Earth with unprecedented accuracy and resolution (in time and space) and provide the metrological basis for oceanography, climatology, glaciology, global change and geophysics in general. These missions have been—and continue to be—instrumental to establish a new segment of the Earth system science.

Based on these data it is possible to explore and monitor changes related to the Earth's surface, the boundary layer between atmosphere and solid Earth, oceans and ice shields. This boundary layer is our habitat and therefore in the focus of our interests. The Earth's surface is exposed to anthropogenic changes, to changes driven by Sun, Moon and planets, and to processes in the Earth system. The state parameters and their changes are best monitored from space. The theme "Observation of the System Earth from Space" offers comprehensive insights into a broad range of research topics relevant to geodesy, oceanography, atmosphere science (from meteorology to climatology), hydrology and glaciology, and to society as a whole.

The volume *Observation of the System Earth from Space-CHAMP, GRACE, GOCE and Future Missions* documents the third phase of the topic *Observation of the system Earth from space*. As opposed to the first two phases the range of topics was narrowed down to the projects *LOTSE-CHAMP/GRACE* (led by Frank Flechtner), *REAL GOCE* (led by Wolf-Dieter Schuh) and Future Gravity Field Satellite Missions (led by Nico Sneeuw). This structure is also mirrored by the table of contents in the volume.

Three seminars, the status seminars at the University of Bonn in October 2010 and at the University of Stuttgart in October 2011 and the final presentations at the GFZ, German Research Centre for Geosciences in Potsdam in May 2012 were

organized to keep track of the progress and to draw the conclusion of the work of the third funding phase, respectively. The advisory board thoroughly reviewed the progress at the status seminars in Bonn and in Stuttgart and made its recommendations for the completion of the work in two reports, which were made available to the involved scientists.

It is rather unusual—and as viewed from the outside—extraordinary that a *topic* of GEOTECHNOLOGIEN is funded over three phases and so for more than 10 years. The third phase could only be approved based on the very strong recommendation submitted by the international advisory committee consisting at that time of Alain Geiger, ETH, Zürich, Robert Weber, Technical University of Vienna, Suzanna Zerbin, University of Bologna, Kathrin A. Whaler, University of Edinburgh, and Gerhard Beutler from University of Bern (chair), on the occasion of the status seminar of phase 2 in Munich in November 2007. The recommendation in 2007 was based on the insights that

- the three space missions CHAMP, GRACE and GOCE would have a tremendous impact on the advance of Earth system science,
- the funding through GEOTECHNOLOGIEN was of paramount importance to create a strong, internationally competitive science community in Germany,
- a termination of funding in 2008 would have a devastating impact on Germany's standing in this important field of science. It was, in particular clear, that a termination would endanger the German participation in the GRACE follow on mission (GRACE-FO).

The advisory committee is convinced that the *Coordination Committee GEOTECHNOLOGIEN* made the right decision at its 22nd meeting on March 17, 2008, in Potsdam to approve the third phase of *Observation of the System Earth from Space* with the focus on the three space missions CHAMP, GRACE and GOCE. The reduced breadth of the project in the third phase allowed it to reduce the size advisory committee—Alain Geiger, Robert Weber and Gerhard Beutler (chair) accompanying the third phase.

Meanwhile, history has proven that the decision taken in 2008 was absolutely right:

- The GOCE satellite was successfully launched on March 17, 2009. The scientific exploitation of this mission proved to be a full success, not least thanks to the strong support of the third phase of the GEOTECHNOLOGIEN programme.
- After very long and at times tiresome negotiations, the German participation in the GRACE-FO mission, slated for launch in 2017, could be secured. Part of the work documented in the section *future gravity field missions* is related to GRACE-FO. It would have been close to impossible to achieve this participation without the strong support and standing of the united scientists documented by this volume.

The report we have in our hands now not only documents the outstanding work performed by German scientists in this last phase using the data of CHAMP, GRACE and GOCE, it also marks the end of the topic *Observation of the Earth from Space* within the GEOTECHNOLOGIEN programme.

A new chapter of Earth monitoring from space is about to begin with the launch of the US/German mission GRACE-FO. Let us hope that this new era—which must eventually be followed by a permanent monitoring of the Earth's gravity and magnetic fields—will be accompanied in Germany by a science programme to match that related to the exploitation of CHAMP, GRACE and GOCE. It will take dedication on the part of science and wisdom on the political side to invoke such a development in Germany.

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Observation of the System Earth from Space - CHAMP,
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