Preface

Our planet is currently experiencing substantial changes due to natural phenomena and direct or indirect human interactions. Observations from space are the only means to monitor and quantify these changes on a global and long-term perspective. Continuous time series of a large set of Earth system parameters are needed in order to better understand the processes causing these changes, as well as their interactions. This knowledge is needed to build comprehensive Earth system models used for analysis and prediction of the changing Earth. Geodesy and geophysics contribute to the understanding of system Earth through the observation of global parameter sets in space and time, such as tectonic motion, Earth surface deformation, sea level changes and gravity, magnetic and atmospheric fields.

In the framework of the German geoscience research and development programme GEOTECHNOLOGIEN, research projects related to the theme “Observing the Earth System from Space” have been funded within two consecutive phases since 2002, both covering 3 years. The projects address data analysis and model development using the satellite missions CHAMP, GRACE, GOCE and complementary ground or airborne observations. The results of the first phase projects have been published in the Springer book, titled “Observation of the Earth System from Space”, edited by Flury, Rummel, Reigber, Rothacher, Boedecker and Schreiber in 2006. The present book, titled “System Earth via Geodetic-Geophysical Space Techniques” summarizes in 40 scientific papers the results of eight coordinated research projects funded in the second phase of this programme (2005–2008). These projects partly represent a continuation of the first phase, while some new projects have been initiated. The book provides an overview of the main outcomes of this research. At the same time it should inspire future work in this field. The programme was funded by the German Federal Ministry of Education and Research (BMBF). The support of the GEOTECHNOLOGIEN programme by BMBF is gratefully acknowledged. All projects were carried out in close cooperation between universities and research institutes.

A total of eight coordinated projects have been carried out. Three of them address the processing of static and time variable gravity field models from CHAMP, GRACE and GOCE data including methods for validation (“Improved GRACE Level-1 and Level-2 Products and their Validation by Ocean Bottom Pressure”, “More accurate and faster available CHAMP and GRACE Gravity Fields for
the User Community” and “Gravity and steady-state Ocean Circulation Explorer GOCE”). The papers related to CHAMP and GRACE provide deeper insight into the sensors, the processing methods and the applied algorithms. Results of orbit and gravity field determination including validation are presented as well. As GOCE was not yet in orbit during the project period, the rationale of GOCE gravity gradient processing to static geoid solutions and their validation are described in several papers. Two out of the eight coordinated projects are related to applications of GRACE results, altimeter, GPS and other data for geophysical analyses (“Time-Variable Gravity and Surface Mass Processes: Validation, Processing and First Application of New Satellite Gravity Data”; “Sea Level Variations – Prospects from the Past to the Present”). The papers in these chapters focus on the use of geodetic observations for assessing variations in the global water cycle and the analysis of sea level variations derived from satellite altimetry and observations taken at GPS and tide gauge stations. The remaining three chapters address contributions to the Global Geodetic-Geodynamic Observing System (GGOS), the atmospheric sounding by the geodetic based GPS radio occultation technique with CHAMP and GRACE and the observation of the Earth’s magnetic field with CHAMP (“Integration of Space Geodetic Techniques as the Basis for a Global Geodetic-Geophysical Observing System – GGOS-D”, “Near-Real-Time Provision and Usage of Global Atmospheric Data from GRACE and CHAMP” and “The Earth’s Magnetic Field: At the CHAMP Satellite Epoch”). The articles in the GGOS section address the consistent processing of space-geodetic data, combination techniques and solutions for a global terrestrial reference frame. Results of atmospheric sounding using GPS radio occultation with CHAMP and GRACE are summarized in the subsequent chapter. Special focus is hereby given to the near-real time satellite data analysis, fundamental precondition for the application of the innovative GPS occultation data to improve global weather forecast. Finally, a review paper describes the progress made in magnetic field modelling during the CHAMP era.

In order to ensure high quality of the papers included in this book a review process was conducted before publication. The editors would like to thank all internal and external reviewers for their valuable contributions, which significantly helped to improve the quality of the book. The editors are indebted to all authors and to the publisher for the excellent cooperation when preparing this book. Sabine Lange and Anja Schlicht of the German GOCE project office at the Technische Universität München coordinated the editing process and the compilation of the book. The editors gratefully acknowledge their valuable support.

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