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Observation of the Earth System from Space

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Observation of the Earth System from Space

with 249 Figures and 54 Tables

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Preface

In the recent years, space-based observation methods have led to a substantially improved understanding of Earth system. Geodesy and geophysics are contributing to this development by measuring the temporal and spatial variations of the Earth's shape, gravity field, and magnetic field, as well as atmosphere density. In the frame of the German R&D programme GEOTECHNOLOGIEN, research projects have been launched in 2002 related to the satellite missions CHAMP, GRACE and ESA's planned mission GOCE, to complementary terrestrial and airborne sensor systems and to consistent and stable high-precision global reference systems for satellite and other techniques.

In the initial 3-year phase of the research programme (2002-2004), new gravity field models have been computed from CHAMP and GRACE data which outperform previous models in accuracy by up to two orders of magnitude for the long and medium wavelengths. A special highlight is the determination of seasonal gravity variations caused by changes in continental water masses. For GOCE, to be launched in 2006, new gravity field analysis methods are under development and integrated into the ESA processing system. 200,000 GPS radio occultation profiles, observed by CHAMP, have been processed on an operational basis. They represent new and excellent information on atmospheric refractivity, temperature and water vapor. These new developments require geodetic space techniques (such as VLBI, SLR, LLR, GPS) to be combined and synchronized as if being one global instrument. In this respect, foundations have been laid for a substantial improvement of the reference systems and products of the International Earth Rotation and Reference Systems Service (IERS). Sensor systems for airborne gravimetry have been integrated and tested, and a particularly development is a laser gyro dedicated to the measurement of the rotational degrees of freedom of the motion caused by earthquakes. A total sum of about 10 million Euros has been spent by the German Federal Ministry of Education and Research (BMBF) and the German Research Foundation (DFG). The projects were carried out in close cooperation between universities, research institutes, and small and medium sized enterprises.

In this book the results of the first programme phase are collected in 30 scientific papers related to the six core programmes of the theme “Observation of the Earth system from space”. The book provides an overview of the state-of-the-art of this research. At the same time it should provide inspiration for future work, since on many fields research is going on, and a number of projects will continue in the second programme phase. The editors are indebted to all authors and to the publisher for the excellent cooperation in the preparation of this book. The editing process and the compilation of the camera-ready manuscript were coordinated by J. Flury at the German GOCE project bureau at Technische Universität München. The support of the GEOTECHNOLOGIEN programme by BMBF and DFG is gratefully acknowledged as well as the continuous support by the GEOTECHNOLOGIEN coordination office.

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GEOTECHNOLOGIEN

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