This section is an outgrowth of the section *Earth Sciences* of the Transactions of the High Performance Computing Center 2004. Although the two articles published last year under this heading find their continuation in the present volume, it was thought to be useful to broaden the scope of the heading so that more singular topics can be included. The four articles that follow clearly indicate the necessity of the use of high performance computers in new fields of science, and also the spreading tendency of computing into fields which until now relied on other than numerical techniques.

The first article is a continuation of the work reported in the volume of last year. The investigation is concerned with a numerical study of the influence of viscous fluid forces on the wave propagation in porous media, as it is observed in many rocks, caused by a complex interaction between heterogeneous solids and viscous fluids. The work is carried out as a cooperative investigation of the Free University Berlin, Germany, the Stanford Rock Physics Lab., and Stanford University, USA. The numerical technique used is based on a displacement-stress rotated staggered finite-difference scheme, with which the elastodynamic wave equation is solved. The results enable the authors to compare effective elastic properties of dry and viscous fluid filled three-dimensional porous media. All three distinct coupling mechanisms of fluid-solid interactions can be studied: The inertial coupling, the Biot coupling, and the Squirt flow. The article describes the numerical method and summarizes the most recent results obtained with the method proposed.

The second contribution is in part also a continuation of previous work, originated at the university of Jena in Germany, and now continued together with the Department of Earth & Planetary Science of the University of California at Berkeley. So far a thermo-chemical model for the description of the evolution of the mantle of the earth, together with its numerical implementation were described. In the last year the model could substantially be improved: The temporal development of the radial viscosity profile caused by the cooling of the earth could be taken into account in a more accurate manner. Also, the laterally averaged heat flow and the time dependence of the
volume-averaged temperature used now compare better to other evolution models. With these and other improvements the dynamic model presented for the description of the evolution of the earth mantle is reported to generate a good self-consistent plateness of the oceanic lithosphere and a proper approximation of the thermal evolution as a function of time. The method of solution is based on a three-dimensional finite-element discretization of the system of differential equations describing convection in a compressional spherical shell. The results shown comprise the computed temperature distribution and creeping velocities for various depths and also the evolution of the laterally averaged surface heat flow among other data.

The third article is a new investigation of the Geodetic Department of Stuttgart University. The investigation is aimed at using data of geoscientific satellites to analyze the gravity field of the earth. Three satellites will be used to obtain the data required: The CHAMP (CHAllenging Minisatellite Payload), the GRACE (Gravity Recovery And Climate Experiment), and the GOCE (Gravity field and steady-state Ocean Circulation Explorer). It will be possible to determine the physical shape of the earth, spatial and temporal variations, global sea level variations, ocean circulation, ocean mass and heat transport, ice mass balance, the global water cycle, and other phenomena. The solution of the system of equations which has to be solved for such an analysis involves the determination of up to a hundred thousand unknown coefficients of an existing series expansion model, which can only be achieved with the aid of high performance computing. So far the work was concentrated on the CHAMP data, which were used in an existing analysis procedure, involving direct normal matrix inversion and other methods. First results of a comparison of two solution techniques implemented on the HLRS machines are reported.

The fourth article deals with a completely different subject: In the Institute of Technical Thermodynamics and Thermo-Chemical engineering at Stuttgart University a new approach is offered for the modeling of vapor-liquid equilibria of pure components and mixtures. It is proposed to enable a more reliable description and prediction of thermo-physical properties with the aid of molecular modeling and simulation. In the article new Lennard-Jones based molecular models for ethanol [SVH05], ammonia [SEV05], and water [Der05] were developed. It is reported, that the excellent agreement of the descriptive mode results for vapor-liquid equilibria confirm that reliable mixture properties can be obtained over a wide range of state points.