Preliminary Results of long-wavelength gravity field determination from dedicated gravity satellites

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Dedicated gravity satellite missions, whose main objective is to directly observe the Earth's gravity field from space, CHAMP (launched in July 2000) and GRACE (launched in March 2002) enabled us to detect temporal changes in the gravity field at long wavelengths. The analysis institutes responsible for the missions, GFZ (GeoForschungsZentrum Potsdam in Germany) and CSR (Center for Space Research, University of Texas at Austin in the U.S.A.) have been published several global gravity field models from CHAMP or GRACE and processed data of the satellites have been made partly available to those who join the approved research projects.

We have been doing research on international connection of national height datums and determination of the absolute geoid in view of improvement of the Japanese geodetic reference frame. For the realization of such objectives, it is essential to recover the gravity field with sufficient accuracy at long wavelengths. In that, the key issue is how to precisely determine the gravity field by High-Low Satellite-to-Satellite Tracking, which is employed in the CHAMP and GRACE missions. Shorter wavelength undulations in the static gravity field, aliasing by shorter period variations of the dynamic gravity field, and other errors associated with the H-L SST technology and its analysis methodology should affect the precision of the observation.

We are participating in a study group under the joint study entitled "Applications of Precise Satellite Positioning For Monitoring the Earth's Environment" funded by the Ministry of Education, Culture, Sports, Science and Technology. The group, headed by Y. Fukuda of Graduate School of Science, Kyoto University, has been studying basic design and feasibility of future gravity missions. In the orbit designing, it is important to carry out physically meaningful simulation study based on realistic signal/noise models for High-Low SST measurements in terms of gravity field recovery at long wavelengths.

We, therefore, have started a research on determination of the global gravity field from CHAMP processed orbit data and its temporal variability. GEODYN2/SOLVE software developed at Goddard Space Flight Center, NASA of the U.S.A. is used for gravity field recovery. Temporal variability is computed by inter-comparison among the resulting gravity models and published models by GFZ and CSR, for assessment of aliasing and other errors in High-Low SST methods. In addition, the resulting gravity models are compared with GPS/leveling derived geoid undulation data over Japan for evaluation of precision at long wavelengths.