Regional gravity field modeling from GRACE data for the vicinity of Japan - Secondary results

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The Japanese islands and their vicinity are located in a trench and island arc region in which four tectonic plates converge, producing substantial gravity and geoid undulations in a wide range of wavelengths. Because of the geometry of the islands and trenches, precise information on gravity in the surrounding oceans should be incorporated in detail, even if the geoid model is required to be accurate only over land. The Kuroshio Current, one of the western boundary currents, runs south of Japan, causing high sea surface variability. Oceanographers, also, highly demand a precision absolute geoid model in the vicinity of Japan to enhance the ocean dynamics study in this area.

The objective of this study is to precisely determine the gravity field at long wavelengths in the vicinity of Japan from data of the dedicated gravity satellite mission, GRACE, for reducing at such wavelengths the systematic errors of the latest gravimetric geoid model for Japan, JGEOID2004. The geoid model was developed under the use of a global geopotential model, EGM96, as the foundation, by combining land and marine gravity data with a global marine altimetric gravity model, KMS02. Comparison with a nation-wide net of GPS at benchmarks shows that the geoid model contains smooth errors at long wavelengths in a range of +/- 20 cm, presumably due to EGM96 errors.

In gravity field recovery, we employ the following approach. First, precise science orbits determined from on-board GPS positioning data are used for calibrating accelerometer data. Second, inter-satellite range-rate data between the twin GRACE satellites with the accelerometer data so calibrated are processed for recovering the gravity field globally and regionally in the target area, with respect to a latest combined global geopotential model determined from GRACE and terrestrial gravity data, GGM02C. In the analysis, we use an annual sinusoidal model for the temporal gravity changes derived by Goddard Space Flight Center, NASA of the United States (GSFC) from GRACE data analysis, and utilize an atmospheric geopotential variation model and a baroclinic ocean model with a hydrological discharge model for de-aliasing. We analyze one year of GRACE data for 2005 and discuss the improvement effects of the resulting gravity models at long wavelengths over JGEOID2004. GEODYN2/SOLVE software developed at GSFC is used for these procedures.