Satellite gravimetry and the study of the solid-fluid coupling dynamics of the Earth

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Earth's solid and fluid layers couple each other through the rotation of the Earth, the gravitational force, the electro-magnetic force and heat flow etc. For example, the inertial and electro-magnetic coupling at the core-mantle boundary (CMB) is a good example for this. Thanks for the resent development in the precise geodetic measurements such as VLBI, GPS and both the absolute and relative gravimeters, small ground displacement less than 1 cm in amplitude or small gravity change less than 1 micro Gal due to the tides or the sea surface height variations is actually detected. From these observation data, for example, parameters related to the coupling between the mantle and core at CMB is precisely determined.

Adding to these measurements, now a new observation tool has been available to us. It is the satellite gravimetry. On July 2000, ESA has succeeded in launching CHAMP (Challenging Mini-satellite Payload) stellite. Continuing this, as a joint mission between USA and German, GRACE (Gravity Recovery and Climate Experiment) satellite will be launched on this March. Moreover, it is planed by ESA to launch GOCE (Gravity field and Ocean Circulation Explorer) satellite in 2004. By analyzing the data obtained from these missions, it is expected to become possible to determine not only the static gravity field up to 200-250 in degree and order of the spherical harmonics with an accuracy of better than 1 milli Gal but also to detect their temporal variations. For the low degree harmonics, the observation accuracy is estimated as a level of 1 micro Gal.

The satellite gravimetry has a potential to revolutionary improve our knowledge on the Earth's coupling dynamics though the mass transportation on/inside the Earth. Uses of the data from the satellite gravity missions for the study of the Earth's coupling dynamics and some problems will be discussed in connection with the gravity measurements made on the ground especially from the point of view the observed gravity changes due to the effect of motions of the atmosphere and oceans.