Geophysical Research Abstracts,
Vol. 11, EGU2009-6925, 2009
EGU General Assembly 2009
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# Tidal Effects on GOCE Satellite Gravity Gradiometry

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**ABSTRACT**: The primary object of GOCE (Gravity field and steady-state Ocean Circulation Explorer) is the determination of the global static gravity field with uttermost precision and resolution, instead of its temporal variations. Hence, the effects of time-variation signals, which include tidal effects and other temporal effects, should be taken into account prior to the data reduction process. Direct astronomical tides, solid earth tides, ocean tides and pole tide, which are the principal contributors for the tidal part, are selected for simulation analysis. In this paper, their effects on the orbiting gravity gradiometry are calculated on a sphere at the altitude of GOCE spacecraft with respect to the local north-oriented reference frame, other than along the track of GOCE satellite, in order to ascertain the impact at the global level. The spatial distributions of the tidal effects are presented and the maximum and minimum values during an interval of 30 days are estimated. Besides, the power spectral density is evaluated to characterize the tide power signals and the influences are compared with the GOCE measurement error to find out whether the GOCE satellite possesses the competence to sense these impacts.

To correct the tidal effects on the GOCE gravity gradient, we calculate their action on the gradiometer, which are the second order derivatives of the tidal generating potential from July 15, 2000 to August 14, 2000, with the interval of 30 minutes. Each calculation point locates at the center of $1^{\circ}\times1^{\circ}$grid on a sphere at the height of 250 km, the average altitude of GOCE satellite. We plot the spatial distribution of the gravity gradient corrections and find out that, with time passing by, the direct astronomical tides and the solid earth tides move from east to west systematically. The transfiguration of ocean tides is complicated and the solid earth polar tide changes imperceptibly. The entire influence of the solid earth tides is lower than that of the direct astronomical tides, and greater than that of the ocean tides. The corrections for the pole tides are the smallest. By estimating the maximum and minimum values of the influence temporally and spatially, the simulation results demonstrate that the tides will affect the GOCE gradiometer signals at the level from $10^{-3}$E to $10^{-4}$E. That is, the temporal tidal corrections are generally below the GOCE gravity gradient error level. But the temporal signals cannot be totally ignored because they may be systematic and consistent to the GOCE gravity gradients.

**Keywords**: tidal effects, gravity gradient, GOCE

**Acknowledgements:** This research was jointly supported by the National Natural Science Foundation of China (No.40874002), the National 863 Program of China (Project No.2008AA12Z105), and the New Century Excellent Talents Plan of Ministry of Education, China (NCET-07-0635).