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Improvement of ocean loading correction for superconducting gravimeter data of GGP including Syowa Station, Antarctica, and the effect on fluid core resonance (FCR) parameters

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The free core nutation (FCN), also refered to as the nearly diurnal free wobble, is due to the pressure coupling between the liquid core and the solid mantle. The FCN enhances the resonance with the diurnal earth tide. Investigation of resonance parameters of FCR (eigenperiod, quality factor Q, and resonance strength) is essential for the Earth's deep interior dynamics and structure. The eigenperiod directly depends on the core-mantle boundary (CMB) ellipticity and on the mantle's inelasticity. The quality factor Q is a direct consequence of damping mechanisms inside the Earth (Sasao et al., 1980; Sasao and Wahr, 1981; Florsch and Hinderer, 2000).
For determining theseresonance parameters, the tidal gravimetric factor based on superconducting gravimeter (SG) data is used. We used the gravity data of 4 stations, from 1992 through 2002 at Syowa Station, from 1997 through 2007 at Strasbourg, from 1998 through 2007 at Metsahovi, from 2000 through 2006 at Sutherland, of the GGP Data Center. The tidal gravity parameters were determined using the BAYTAP-G software package (Ishiguro et al., 1981; Tamura et al., 1991).
In this study, we focused on the influence of ocean loading effect on precise estimation of FCN parameters. The global ocean tidal models, CSR4.0 (Eanes and Bettadpur, 1999), GOT99.2b (Ray, 1999), FES2004 (Lyard et al., 2006) and TPXO7.1 (Egbert and Erofeeva, 2002) models are tested. These models are accomodated to the GOTIC2 for ocean loading estimation program (Matsumoto et al. 2001).
The quality factor Q is dependent on the phase delay of the tidal waves, that means the imaginary part of gravimetric factor corrected for ocean loading effect is an important point for this inverse problem(Florsch and Hinderer, 2000). We present how much the accuracy of FCR parameters can be improved by adopting proper ocean models to each station (Le provost et al., 2001). For this work, we have applied minor waves for ocean loading correction (Matsumoto, 2003), and the ocean loading effect from other kinds of Green's functions based on an elastic Earth model (Francis and Dehant, 1987) and an inelastic Earth model (Okubo and Tsuji, 2001) was estimated. We show the dependency on these effect on accurate estimation of resonance parameters.
Because the gravity data from Syowa Station has much ocean loading effect, i.e. as a noise, the reduction of this effect is very important. We show how much the recent global ocean models (FES2004 and TPXO.7.1) can decrease the residual gravity and improve the accuracy of the FCR parameters.
Finally, we test the effect of the random error in the ocean loading calculation on the determination of the resonance parameters in the inverse problem. For this work, white noise s were added to the observed gravimetric delta factors when solving the non-linear least squares problems to see the stability of the solved resonance parameters.