# Secular Low-Degree Deformation of the Earth: GRACE versus GPS

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Last spring, Ogawa and Heki (2005a) estimated the velocity field expressed with degree 2 spherical harmonics and plate motion parameters simultaneously using worldwide GPS data, and compared the obtained parameters with those due to mass redistribution associated with post-glacial rebound (PGR), i.e. increase of P20 component due to slow uplift of the glaciated region, and change in P21 components due to TPW (true polar wander). Mitrovica et al. (2001) predicted that such degree 2 secular crustal deformations may reach 1mm/yr, well above the detection level with the current GPS site velocity accuracy. Last fall, Ogawa and Heki (2005b) estimated secular degree 2 deformation including P22 and compared them with the changes in degree 2 Stokes coefficients from GRACE. They showed that the P20 component in GPS site velocity was insignificant. They also showed that the P21 and P22 components were significant but different from the prediction. However they were consistent with the GRACE data to some extent, although the time span covered by GRACE is only 2 years.

Seasonal gravity changes due to change in terrestrial water storage in the Amazon basin have been detected in GRACE data (Tapley et al., 2004). In addition to seasonal changes, Tamisiea et al. (2005) detected secular mass decrease in GRACE data caused by the melting of mountain glacier in southeast Alaska. Davis et al. (2004) compared annual movements of GPS points in South America with gravity changes from GRACE, and concluded that large part of such displacements are caused by the changing mass in the terrestrial water storage. Here we try to compare secular deformation of the Earth in degrees higher than 2 between GPS and GRACE.

First we try to estimate annual and secular variations from GRACE monthly data set composed of monthly values of Stokes coefficients (up to degree 150), and investigate the relationship between degree and their amplitudes (i.e. Kaula rule of the time-varying part). We will also compare their amplitudes with their errors, and infer the limit of statistical significance of such changes in high degree/orders. Then such gravity changes can be converted into surface velocities using ratios between load Love numbers k+1 and h/l, so that we can compare them directly with velocities of worldwide GPS stations.