Geophysical Research Abstracts, Vol. 8, 08968, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08968

Azimuth-dependent Load Love Numbers from GPS and GRACE data

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When Farrell, in 1972, set up his theory on the deformation of the Earth by surface loads, he simply took a longitude-independent load and a radially symmetric Earth model. For various Earth models, different sets of load love numbers (LLN) have been derived, depending on the underlying center of frame. At that time, Farrell's assumption was more than sufficient so that even today geometric displacements (derived from space geodetic techniques) and relative geoid height changes (derived from GRACE) are related to equivalent load height column coefficients solely by degree-dependent LLN (although the load allows for azimuth dependence). With the longitude-dependent data of GPS (vertical and horizontal station motions) and monthly geopotential coefficients of GRACE, the above-mentioned assumption leads to a non-unique solution for low-degree LLN. The estimation of azimuth-dependent LLN would allow us to verify the correctness of the Love-Shida hypothesis for the spherically symmetric Earth model w.r.t. the real Earth. Thus we extended the model of LLN to azimuth-dependent components. This concept and results of some first tests will be presented. In fact, we were able to estimate a unique set of proportions between the h_{nm}, l_{nm}, and k_{nm} coefficients up to degree and order eleven, solely from synthetic GPS SOPAC and GRACE data. However, at present the contribution of lateral geometric displacement coefficients (derived from GPS station coordinate time series (SOPAC)) to the estimation of equivalent load height column coefficients seems to consist mainly of additional noise, due to the spatially incoherent pattern of seasonal lateral station displacements.