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Comparison of gravity changes from the Hsinchu superconducting gravimeter (T048) and GRACE: effects of low-degree gravity and local hydrology

Tzu-Yi Lien, Cheinway Hwang, and Ching-Chung Cheng

A superconducting gravimeter delivers point gravity measurements. Gravity changes from GRACE have limited spatial resolutions due to satellite altitude, measurement/correction noises and filtering. This paper compares gravity changes from the Hsinchu (HS) superconducting gravimeter (SG, T048) and GRACE. The HS SG station is near the Taiwan Strait which is about 120-160 km in width. Taiwan is an island at a largest width of 120 km, with the Pacific Ocean to its east. Thus, residual SG gravity changes at HS, obtained by removing the gravity effects due to solid earth tide, ocean tidal loading, atmospheric pressure, contain the local hydrological effect (first-order effect) and the effect due to phenomena at spatial resolutions beyond the local hydrological scale (second-order effect, at about a spherical harmonic expansion to degree 100). Various combinations of low-degree harmonics from GRACE and SLR are used to generate various second-order effects, which are then removed from SG gravity to produce first-order effects. Soil moisture and groundwater levels are used to model the firs-order effect for comparison with the SG-measured first-order effect. It is found (1) groundwater and soil moisture-derived first-order effects have a phase lag of about 60 days. (2) SLR-derived J2 coefficient delivers a better match of the second-order effect with SG measurements than GRACE-derived J2, (3) The nominal maximum harmonic expansion degree of 100 does not produce the best second-order effect. Several experimental computations of the first-order effect will be presented in the paper.