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A study on geocenter motions and load Love numbers using GPS and GRACE data

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Time variable geographical distribution of hydrology, atmosphere and oceanic masses changes the gravity field and geometrical shape of the Earth. Due to intricate relations among gravity changes, mass variation and displacement on the Earth's surface, geocenter motions and Earth's responses to the surface loads can be examined from Global Positioning System (GPS) displacement and Gravity Recovery and Climate Experiment (GRACE) geopotential data. We show our approach to estimate the center of mass (CM) coordinates (i.e. degree 1 terms) and load Love numbers, separately and simultaneously, given that GRACE measurements are based on a coordinate system centered on instantaneous CM and GPS time series are referred to a coordinate system with long-term CM origin (like ITRF) and that the elastic Earth responses are different to GRACE and GPS data. We rigorously examine the sensitivity of each component of 3D GPS displacements on determination of the geocenter motions to highlight the important roles of horizontal displacements in different continents on different components of the geocetner motions. We also examine various elastic Earth models with different layering, particularly within the upper crust. We present the results of monthly geocenter motions and the load Love numbers from the analysis of 10 years of time series from ∼2000 worldwide GPS stations.