Geophysical Research Abstracts
Vol. 21, EGU2019-9300, 2019
EGU General Assembly 2019

A possible reason for discrepancies of horizontal seasonal loading displacements between GNSS and GRACE: the visco-elasticity of the upper mantle

Lan Zhang (1), Wenke Sun (2), and He Tang (3)

(1) Key Laboratory of Computational Geodynamics, University of Chinese Academy of Sciences, China (zhanglan16@mails.ucas.ac.cn), (2) Key Laboratory of Computational Geodynamics, University of Chinese Academy of Sciences, China (sunw@ucas.ac.cn), (3) Key Laboratory of Computational Geodynamics, University of Chinese Academy of Sciences, China (tanghe2014@mails.ucas.ac.cn)

The seasonal hydrological effect is the main reason of global mass redistribution which causes seasonal loading deformation of the Earth surface. As two independent geodetic observations, GNSS and GRACE both can detect these seasonal signals from geometry and physical view, respectively. The displacements observed by GNSS and derived from GRACE are generally consistent in the vertical component while showing large discrepancies in the horizontal component. Most studies explained of these discrepancies for several reasons: 1) GRACE cannot detect a short-wavelength mass redistribution of the loading; 2) GNSS stations are influenced by thermal expansion of the monument and nearby bedrock (Yan et al. 2009); 3) the intrinsic inconsistency of degree-1 spherical harmonic coefficients of GRACE provided by Swenson et al. (2008) and calculated by GPS displacement filed (Chanard et al. 2017).

We consider that another possible reason causing these discrepancies may be the visco-elastic respond of the Earth instead of the pure elastic response to the seasonal loading. To verify it, we use daily GNSS time series and monthly GRACE data around Caspian sea to compare observed and model-predicted displacements in visco-elastic Earth model with a burgers rheology for the upper mantle (30-300km) and elastic parameters given by the preliminary reference Earth model. We use spatial-temporal analysis based on empirical orthogonal function to get the seasonal signals from GNSS-observed and GRACE-derived displacements, firstly. Then we adjust the viscosity parameters to achieve the consistency between GNSS observations and model results from GRACE. We evaluate the effect of the viscosity by comparing the phase shift and amplitude amplification between these two signals. This study tries to explain systematic discrepancies between two independent geodetic observations from a new geophysics perspective.