Recent crustal movements and deformations of the southeast of Russia as seen from continuous GNSS measurements

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The Far East geodynamic GNSS network was established in 2009-2010. It covers the southeast of Siberia and Sakhalin Island and consists of more than 15 continuously operating GPS/GLONASS stations. Its data along with observations stemming from IGS and other available GNSS networks were used to estimate the crustal velocity and deformation field of the investigated region before and after March 11, 2011 when the Great 2011 Tohoku earthquake struck the Pacific coast of northern Honshu, Japan and caused measurable coseismic displacements through Northeast Asia. The BERNESE 5.2 software was used for GNSS data processing. The ITRF2008 and ITRF2014 reference frames were adopted for data analysis. The calculated interseismic GNSS velocities indicate relative internal (between network sites) and external (with respect to the Eurasian tectonic plate) stability of continental part of the investigated region. The velocity boundary between Sakhalin Island and continent was discovered which possibly tells on their relation to different tectonic plates/microplates. The intense postseismic crustal displacements caused by the Great 2011 Tohoku earthquake have also been observing in the Russian southeast near the triple junction of Russia, China and North Korea national boundaries. The maximum observed cumulative postseismic displacements have already exceeded 70-80 mm (the corresponding coseismic shift is equal to ~50 mm). Afterslip or viscoelastic rebound models separately cannot reproduce properly all parts of the observed GNSS site position time series, however, viscoelastic approximation is working well on the time interval of 0.5-3 yrs after the mainshock. Two-layers viscoelastic model with Maxwell's viscosity of about $5 \cdot 10^{18}$ Pa·s adequately fits horizontal components of the observed postseismic displacements but fail to explain vertical component. The 2013 Okhotsk deep focus earthquake generated measurable coseismic displacements which were detected by Kamchatka and our GNSS network. The annual velocities of GNSS sites located in the northern part of Sakhalin Island demonstrate notable change after the mainshock of the Okhotsk deep earthquake which, probably, could be explained by the existence of notable postseismic mantle response.

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