

EGU2020-1373

<https://doi.org/10.5194/egusphere-egu2020-1373>

EGU General Assembly 2020

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Cross-comparing GPS and seismic data in advance and after great earthquakes

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With the accumulation of seismic and other geophysical data and update of methodologies, the accuracy and reliability of seismic risk assessment can be improved. In particular, the introduction of GPS observation data leads to better understanding of earthquake origins and sequences. For this, we cross-compare the pre- and post-seismic deformation of the 2011 Tohoku Mw9.1 earthquake in Japan, the 2010 off shore Maule Mw8.8 earthquake in Chile, the 2018 Kodiak Mw7.9 earthquake in the Gulf of Alaska, and the 2016 Kaikoura Mw7.8 earthquake in New Zealand derived from GPS observations with integral characteristics of the regional seismic regime, including the accumulated length of seismic sources derived from the catalogs of earthquake hypocenter parameters. We found that (a) the area on top the 2011 Tohoku mega-thrust keeps moving at speed of about 10 cm per year, (b) eventually, the 2016 Kaikoura unidirectional strike-slip resulted in the current position retreat nearby epicenter and steady increase on the opposite edge of its rupture zone, (c) the four cases show up different deformation vs seismicity correlation patterns in advance and after the catastrophic event, and (d) GPS data confirm the existence of intermittent long periods of regionally stable levels of seismic regime controlled by the Unified Scaling Law for Earthquakes that may switch as the result of mid- or even short-term bursts of activity associated with major catastrophic earthquakes.

The study supported from the RFBR Project No. 19-35-50059 "Study of pre- and post-seismic displacements in the areas of the strongest earthquakes in the world".