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Effects of the Earth's rotation on the dynamics of tsunami-like waves caused by deep-focus earthquakes

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Effects of the Earth's rotation on tsunami wave dynamics has repeatedly been discussed in the literature. Usually it was concluded that these effects are minor. Such a conclusion is easily explained. It is known from geophysical hydrodynamics that the Earth's rotation effects are significant for processes for which the spatial scale is comparable with the barotropic Rossby deformation radius Ro (∼2000 km) or exceeds it. Tsunami spatial scale Rts (∼100 km) is determined by the size of co-seismic deformations area which is normally much inferior to the Rossby radius. There are exceptions to this rule: mega-earthquakes with moment magnitude Mw>9.0 and strong deep-focus earthquakes. In both cases co-seismic deformations cover extensive area which size can be comparable with the Rossby radius. The aim of this study is to reveal effects of the Earth's rotation on waves generated by two deep-focus seismic events: the Okhotsk Sea earthquake on May 24, 2013 (Mw=8.3, h=611 km) and the Fiji earthquake on August 19, 2018 (Mw=8.2, h=580 km). Being completely hazard-less due to a few centimeter amplitude, these unusually long tsunami-like waves are of great interest from the viewpoint of geophysical hydrodynamics. Our method is based on comparison of results of numerical experiments performed with and without the Coriolis force. It was shown that in case of the 2013 Okhotsk Sea event the Earth's rotation has a large effect on the spatial distribution of the maximum amplitudes and wave forms (Rts/Ro=1.4). In particular, taking into account the Coriolis force we obtain nearly twofold increase of wave amplitude in some bays of Okhotsk Sea. The observed differences are mostly caused by Kelvin waves, which exist only in a rotating ocean. For the 2018 Fiji earthquake the Earth's rotation effect, because of the proximity of the equator, turned out to be smaller (Rts/Ro=0.22). However, even in this case the Coriolis force noticeably alters the leading wave amplitude and tsunami wave-forms.

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