



Variations of the VLF/LF signals during seismic activity in Japan in November 2016

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The measurements of the very low and low frequency (VLF/LF) signals at the Petropavlovsk-Kamchatsky and Yuzhno-Sakhalinsk stations were used for the analysis in connection with two underwater earthquakes which occurred near Japan in November 2016. The first earthquake with $M=6.1$ (depth 42 km) happened on 11 November. The second earthquake was recorded on 21 November with $M=6.9$ (depth 11 km) and had series of aftershocks with M up to 5.6 (USGS/NEIC). The significant negative nighttime amplitude anomalies were found for two sub-ionospheric paths: NWC-Petropavlovsk-Kamchatsky and JJY-Yuzhno-Sakhalinsk during about a week in case of the first earthquake. The anomalies of signal in the path JJY-Petropavlovsk-Kamchatsky were observed during 4-5 days before the second earthquake and during 3 days after it. Taking into account the possible influence of other factors which can produce perturbations in VLF/LF signals (geomagnetic storm, proton burst and the relativistic electron fluxes, as well as atmospheric parameters), also using control paths, we may conclude that observed anomalies very likely were caused by impending earthquakes.