

Source parameters of the 2004 Kaliningrad earthquakes

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Abstract

An analysis of source parameters of the two unexpected earthquakes from the Kaliningrad (Russia) area is presented. The earthquakes occurred on 21 September 2004 at 11:05:01 and 13:32:31 UT, respectively. The first event was located at the latitude $\varphi = 54.924^\circ\text{N}$ and the longitude $\lambda = 20.120^\circ\text{E}$, with a depth $h = 16$ km, and the second event at $\varphi = 54.876^\circ\text{N}$, $\lambda = 20.120^\circ\text{E}$ and $h = 20$ km.

Magnitudes M_w of the two events were very similar: 5.1 and 5.2. The magnitude values reported by various international data centers have been meaningfully different. The reason is the presence of high-frequency components in Z velocity component of the S wavefield. They were observed along the direction defined by two stations, BLEU in Sweden and SUW in Poland, located in opposite sides of the source. Along the direction perpendicular to it, the effects are relatively very small. The high-frequency waves are understood to mean components in the 6-8 Hz band for event 1 and 2-4 Hz for event 2. The effects in question are also clearly visible on displacement spectrograms. The magnitude values calculated at such stations from S -wave amplitudes or from seismic spectra are clearly overestimated and are close to 6. Therefore, we made a careful selection of channels in order to determine the spectral parameters and, on this basis, the source parameters.

The size of the source is relatively small, of about 2 km. The closest seismic station is at 100 source radii from the source. One can clearly see the effect of the TT zone which markedly reduces the seismic moment value for seismic stations laying on the opposite sides of the source. Both events have very similar spatial distributions of the source parameters: magnitude, seismic moment and radius.

Key words: seismic source parameters, seismic moment, seismic source radius, wavefield, 2004 Kaliningrad earthquakes.