



How can gravimeters improve recordings of earthquakes?

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Modern tidal gravimeters record relative global and local gravity variations with frequencies lower than 1 mHz. Typical broadband seismometers record velocities of displacement of the Earth's surface in a frequency range from 8.3 mHz to 50 Hz. The seismic band extends from 0.3 mHz and there are surface waves generated by large earthquakes, with frequencies from 1 to 6 mHz, penetrating the Earth's mantle up to a depth of 1000 km. These waves are very distorted in seismometer records but clearly detectible by gravimeters. In particular, the analysis of superconducting gravimeter recordings, characterized by sensitivity in the frequency domain at an order of nGal, gives a unique opportunity to study long-period surface waves, what previously was unattainable in data collected by seismometers. In this study, recordings of surface waves carried out by gravimeters and seismometers, located at the selected observatories in Europe and Africa have been analyzed.

The gravimeter and seismic data had been downloaded from IGETS (GFZ Potsdam), ORFEUS (Europe) and IRIS (USA) databases. Also recordings obtained during a national project carried out in Poland in December 2016 – May 2017 had been used. The collected tidal records were post-processed, i.e. filtered and deconvolved with the instrument transfer function (if exists), and tidal, barometric pressure and polar motion effects were removed. The collected seismic records were filtered, differentiated and deconvolved with the instrument transfer function to obtain a consistent database of earthquakes recorded by gravimeters and seismometers. Superconducting gravimeters have a much smaller dynamic range than seismometers, so it happens that in a case of significant earthquakes, recorded amplitudes exceed the dynamic registration range. Recordings of spring gravimeters require careful analyses due to their lower sensitivity and significant drift, which may affect the interpretation of long-period seismic waves. Therefore, the analyses of the magnitude and the epicentral distance of earthquakes for each location and instrument type due to the quality of recordings were carried out, in particular saturation of surface waves recorded by gravimeters was taken into account. On this basis, the formula defining the values of parameters of earthquakes useful in the analysis of surface waves recorded by tidal gravimeters was developed.

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