

Effects of the Earth's asymmetry on ${}_0S_0$ amplitude: predictions and observations after the 2004 Sumatra-Andaman earthquake

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The 2004 Sumatra-Andaman earthquake with a moment magnitude greater than 9 has strongly excited the low-frequency seismic modes, particularly the seismic mode ${}_0S_0$. ${}_0S_0$ is a radial fundamental spheroidal mode called “breathing mode” of the Earth that oscillates at a period of 20.5 minutes and that is associated with changes in the Earth's circumference. Amplitude measurements of ${}_0S_0$ at 11 Superconducting Gravimeters (SGs) sites reveal a clear latitude dependency of $\pm 2\%$ in deviation from the mean amplitude between the latitudes 80°N and 40°S . In a non-rotating spherically symmetric Earth's model (PREM-like model), ${}_0S_0$ amplitude is the same all over the Earth's surface. The Earth's rotation and ellipticity introduce a strong coupling of ${}_0S_0$ with the spheroidal harmonic degree two ${}_1S_2$, ${}_0S_2$ and ${}_2S_2$ modes through elliptic figure of the Earth and with the toroidal degree one ${}_1T_1$ and ${}_2T_1$ modes through the Coriolis force. The coupling effect through the rotation and ellipticity perturbs ${}_0S_0$ amplitude by introducing a latitude dependency with a maximum change of 1% between the equator and the pole. When we introduce the seismic lateral heterogeneities, ${}_0S_0$ strongly couples to ${}_0S_5$, and next to ${}_1S_2$, ${}_1S_3$, ${}_4S_2$, ${}_3S_2$ and ${}_0S_2$ also couple to ${}_0S_0$. In this case we observe both a latitude and longitude dependency of ${}_0S_0$ amplitude at the Earth's surface and ${}_0S_0$ amplitude is 2% higher at the pole than at the equator. The variation of ${}_0S_0$ amplitude as a function of latitude is therefore consistent between the theoretical predictions and the observations.