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Surface amplitude variations of the "breathing mode" of the Earth 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. The time-variation of the gravity field induced by the free-oscillations of the Earth after Sumatra event have been recorded by the Superconducting Gravimeters (SGs) of the Global Geodynamics Project (GGP). The high stability and low noise level of most SG records has enabled us to follow the time decay of ${}_0S_0$ amplitude till the second Sumatra event on March 28^{th} 2005. We obtained a value of 5513 ± 8 for ${}_0S_0$ quality factor from the weighted mean of 12 SG record estimates. Amplitude measurements of ${}_0S_0$ at 11 SG 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 depen-

dency of ${}_0S_0$ amplitude at the Earth's surface and ${}_0S_0$ amplitude is 2% higher at the pole than at the equator, which is much consistent with the observed variations. The amplitude deviation of ${}_0S_0$ reaches $\pm$ 2% while the calibration errors of SGs are usually less than 0.2%. This accuracy enables us to discuss on the validity of 3D seismic models and to put some constraints on the lateral heterogeneities of the mantle.