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The Sumatran earthquake of 2004, December 26th and the gravest modes

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The high quality of the GEOSCOPE and FDSN seismological broad-band stations contributes to the clear observation of seismic normal modes at frequencies lower than 1mHz and offers a good opportunity for studying the behaviour of these modes.

The interest of scientists for the gravest normal modes is due to the fact that they do contribute to a better knowledge of the density profile in the Earth, helping to constrain Earth's models. These modes have been clearly identified after some large recent events.

The M=9 Sumatran earthquake of December 2004 provides us with individual spectra which exhibit a clear splitting of the spheroidal modes 0S2 , 0S3 and 2S1, and a clear identification of each of the individual singlets, with a resolution never obtained in the past from broad-band seismometers records. The Q quality factors have been determined from the apparent decrease of the amplitude of each singlet with time, according to a well-suited technique (Roult & Clévédé 2000). The results are compared to the theoretical frequencies and Q quality factors computed for the PREM and 1066A models, taking into account both rotation and ellipticity effects of the Earth. The two observed datasets (frequencies and Q quality factors) exhibit a splitting on the observed values different from the predicted one. That seems to point out that some parameters such as density or attenuation used in the theoretical models do not explain the observations. A new dataset of frequencies and Q quality factors of the whole set of singlets of the gravest spheroidal modes is thus under construction. That dataset includes the five individual singlets of the 0S2 mode clearly identified on the spectra, the three singlets of the 2S1 mode recently observed for the first time by Rosat et al. (2003b), the 0S0 radial mode, and the seven individual singlets of the 0S3 mode.