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The signal of azimuthal anisotropy in the coupling of normal modes below 3.5 mHz – Evidence from the South Pole

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Significant coupling between fundamental spheroidal and toroidal modes (S-T coupling) below 3.5 mHz is generally considered to be mainly due to Earth's rotation. Coriolis force at the Earth's Pole becomes zero, thus rotational coupling should be very weak at QSPA, a permanent IRIS/USGS station located at the South Pole. However, our investigation shows that very strong S-T coupling are occasionally observed in the early period(less than 24 hours) following some large earthquakes. The typical example is significant coupling 0S11-0T12 at QSPA after the 2011/03/11 Mw=9.1 Tohuko earthquake of Japan, but the coupling is hardly identified at other Antarctic stations and at stations located along the great circle paths connecting QSPA and the epicenter, suggesting that the strong coupling at the South Pole is a local event. It is noted that non-rotational coupling 0S24-0T24, 0S25-0T25 and 0S26-0T26 are also found to be very strong at QSPA after some recent year large earthquakes. Our extensive observations suggest that the local azimuthal anisotropy may play a leading role in causing strong S-T coupling at QSPA. Our study proposed that the anisotropic S-T coupling between in the frequency band of 1.5∼3.5 mHz is more important than previously realized. The signal of anisotropic coupling may help us constrain the depth location of azimuthal anisotropy.