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The Earth's Hum Comes from the Sun

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It was established over a decade ago that the normal modes of the Earth are continuously excited at times without large earthquakes, but the sources of the 'seismic hum' have remained unresolved. In addition to the normal modes of the Earth, we show spectral lines in seismic data with frequencies which correspond closely to normal modes of the Sun. Moreover, the widths of the low-frequency lines in the seismic spectra are similar to those of solar modes and much narrower than those of the Earth's normal mode peaks. These seismic lines are highly coherent with magnetic fields measured on both the Geostationary Operations Environmental Satellite (GOES)-10 satellite and the Advanced Composition Explorer (ACE) spacecraft located at L1, 1.5 million km sunward of Earth suggesting that the solar modes are transmitted to the Earth by the interplanetary magnetic field and solar wind. The solar modes are split by multiples of a cycle/day and, surprisingly, by the 'quasi two-day' mode and other frequencies. Both the phase of the coherences and slight frequency offsets between seismic and geomagnetic data at observatories exclude the possibility that these effects are simply spurious responses of the seismometers to the geomagnetic field. We emphasize data from low-noise seismic observatories: Black Forest (BFO), Pinon Flat (PFO), Eskdalemuir (ESK) and Obninsk (OBN). Horizontal components of seismic velocity show higher coherences with the external (ACE) magnetic field than do the vertical components. This effect appears to be larger near the seismic torsional, or T-mode, frequencies.

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