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Modulation of seismic noises induced by tidal strains: results of continuous observations and possible physical mechanism

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We report results of continuous observations of modulation of endogenous seismic noises by tidal strains in the seismically active region of Kamchatka Peninsula. Sufficiently long-time averaging makes it possible to reliably single out modulation periods corresponding to individual tidal-strain components that are clearly distinct from approximate nearly-diurnal periodicity that could be attributed to other reasons. Main revealed features of the tide-induced modulations are pointed out, such as: stabilization of the modulation phase in the periods preceding strong earthquakes; much less stable modulation phase in the "calm" periods between earthquakes; often observed switching of the modulation phase to the opposite after the earthquake events; pronounced increase in the modulation depth at the tidal second-harmonic in the vicinity of the earthquake events. Striking difference between the level of the tidal strains $\sim 10^{(-8)}$ and the induced noise-modulation depth up several per cent indicates extremely high nonlinearity of rocks as compared with "usual" solid materials. We suggest a physical mechanism which can explain both the level and main qualitative features of such modulation. Important structural features of rocks that can explain their extremely high nonlinearity in the strain range typical of tidal deformation are pointed out.