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Water and air dynamics and the Earth crust microdeformations

in the land-ocean transition zone

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During several years the seismic fluctuations near the Sea of Japan shore were registered with the help of a laser strainmeter at the Marine Experimental Station of the V.I.Il'ichev Pacific Oceanological Institute. Additional measurements included sea level fluctuations (SLF), water temperature at several layers, air temperature and pressure, and wind velocity.

The possibility of tidal and internal wave effects on the earth crust microdeformations (MD) was discussed earlier [1], but corresponding mechanisms are not evident. Diurnal and semidiurnal periods are frequently seen in microdeformations, but not allways they display direct relation to the SLF. In most observations MD amplitudes at diurnal and semidiurnal periods are small comparative to the low frequency trends and have random phase shifts. It means that we deal with highly non-stationary and nonlinear processes.

Well defined zones of maximum energy in SLF in the range of 4h – 15 min have no correspondence in the MD spectra. Though in many MD records fluctuations with such periods, characteristic for internal gravitational waves (IW), are present, but their energy is smoothed in the MD spectra as a result of averaging in time.

Spectral analysis of air pressure and MD fluctuations shows, that their spectra are rather similar in the range of periods from several hours till minutes. It means that transfer of energy of strain in the Earth crust from low to high frequencies can follow the same law as in hydrodynamic inertial turbulence.

Two mechanisms are proposed to explain the possibility of internal tide and inertia-gravitational internal wave influence on the crust microdeformations in the land-ocean transition zone. The first mechanism is based on the results of IW observations [2] showing IW reflection from a steep shore. The second mechanism is related to the local shelf structure that leads to the possibility of forming standing internal waves with semidiurnal frequency in warm periods with typical water density stratification [3]. Numerical modeling is carried out to analyze the corresponding nonlinear IW generation and spectral analysis of observations is made using Hilbert-Huang method for non-stationary and nonlinear processes.

References

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