# First instrumental recognition of the Earth eigenmodes in radio frequency electromagnetic radiation

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At present time eigenmodes of the Earth and earthquakes-related long period oscillations are reliably registered by seismic and gravitational methods. A special term has been put forward for the definition of such oscillations, namely seismic — gravitational oscillations of the Earth [Linkov et al., 1989]. There have been determined the structure of oscillations spectrum with periods above one hour and delineated the regions of the most intensive Earth oscillations.

A new relevant geodynamic conception has been developed in the past several years. It states that "the mechanism of forced cyclic relative build-up and wandering of the Earth's core and mantle over the geological periods of time is a single and main mechanism controlling the plate tectonic and plume tectonic activity of the Earth" [Barkin, 2002; Barkin, Vilke, 2004]. The periods of free oscillations of the dynamic system (the elastic mantle — Earth's core) have been revealed to be as 3.47, 4.06 and 4.89 hours. An analysis of different experimental observations has demonstrated that the variations with periods from 1.497 to 24 hours are characteristic of all planetary processes.

New methods and technologies are employed to examine long period waves, with these methods being particularly based on the use of natural electromagnetic emission of the Earth. The present study is aimed at detecting some regularities of the Earth oscillations processes in the spectrum of the Earth's electromagnetic radiation (EMR). Experimental observations have been performed to reveal EMP oscillations frequencies already registered by seismic — gravitational methods and to finding new harmonics of oscillations. They have been carried out on the Ukrainian Antarctic Station (ö= 64º15?S, ë= 65º15′W) and at 3 sites in Ukraine (φ=50ºN, λ=35º51′E; φ=44º51′N, λ=34º58′E; φ=44º35′N, λ=33º39′E) during 2004—2009.

A three component EMR detector has been used to measure 1—100 Hz frequencies (at a level of 3dB) in a dynamic range of 1—20 nT. A quantity of pulses has been registered in time (*N*) unit exceeding the specified threshold. It is proportional to root-mean-square value of carrier frequency.

A method for revealing latent periodicity and Wavelet — analysis have been applied to mathematical processing, interpretation and visualization of results. An analysis of graphs from four stations demonstrates that the strong negative correlation is observed in some vicinity of characteristic frequencies of 0.15, 0.20, 0.21, 0.28, 0.2 MHz in periods from 10 to 90 min. The full spectrum of EMR oscillations from Antarctica and in Ukraine contains sufficient frequencies. Their analysis exhibits that the properties of a signal in the interval of 0— 250 min, including its frequency characteristic and duration, correspond to seismic-gravitational multiplets and to natural oscillations of the inner Earth's core with a period of about 200 min.

The periods have been also registered to be needed for explanation, for example, the Shuler period of 84.4 min. The oscillations with the Shuler period are expressed more intensively in Antarctica than in the middle latitudes of Ukraine. In Figure the time series data cover 1440 min, i. e. one day. The graphs of Wavelet decomposition are situated for Antarctica and Ukrainian on the right and left of the Figure respectively. The following periods of oscillations are observed: the eigenmodes of the core with the basic oscillations of ~14 hour (the 2$^{th}$ row of the graphs), the oscillations with a period of ~5 hour (the 3$^{th}$ row of the graphs), the variations in the synodic month duration, the oscillations of the inner core with a period of~3 hour 18 min (the 4$^{th}$ row of the graphs), the Shuler period ~84 min (the 5$^{th}$ row of the graphs). According to Petrova the oscillations with periods of 78 min (the 6$^{th}$ row of the graphs), 67 min (the 7$^{th}$ row of the graphs), and 54 min (the 8$^{th}$ row of the graphs) are main harmonics reliably registered in Ukraine. On the contrary, the amplitudes of these oscillations are negligible in Antarctica.

The above results indicate the existence of both inner and cosmic sources of oscillation processes in the Earth. The indicator of these global processes is background electromagnetic radiation. The paradigm of originating electromagnetic oscillations in the Earth implies that any eigenmodes of planet oscillations leads to change in the Earth deformation mode resulting in the generation of EMR. All frequencies of the mechanical eigenmodes in the Earth must be revealed in spectrum of electromagnetic radiation. Based on observations of Earth electromagnetic variations in Antarctica and Ukraine, it has been established that not only generally acknowledged seismic-gravitational oscillations but all planetary processes must additionally oscillate with periods of an hour range, for example, the Shuler period ($T$≈84 min), and with different daily periods from 14 days to 28 days which are not shown in the Figure).

In conclusion, for the first time our instrumental observations have recognized the frequencies of the Earth mechanical eigenmodes in the spectrum of its background electromagnetic radiation.

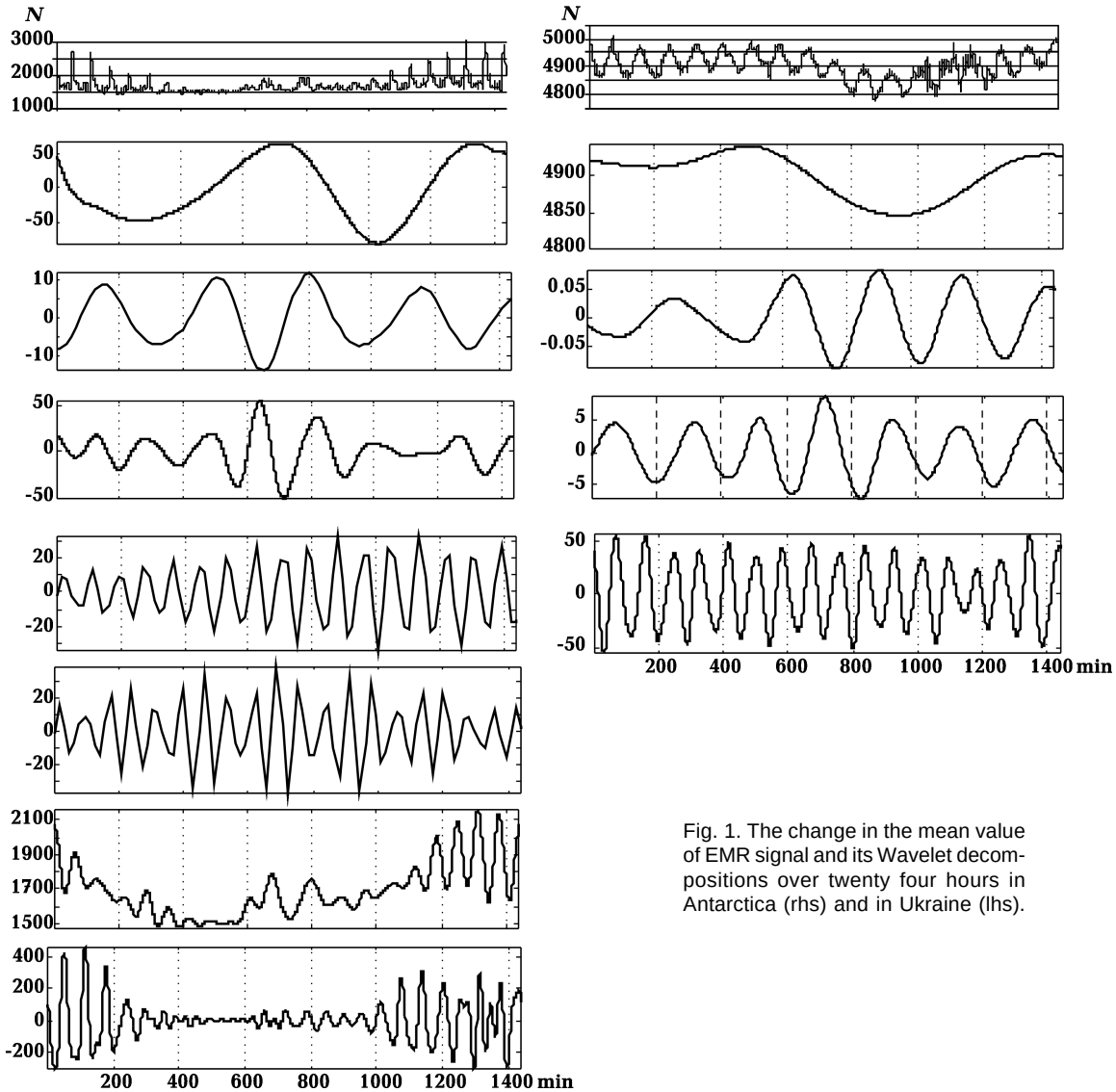


Fig. 1. The change in the mean value of EMR signal and its Wavelet decompositions over twenty four hours in Antarctica (rhs) and in Ukraine (lhs).

## References

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