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ULF electromagnetic waves connected with seismic hazards – observation methodology and instrumentation

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The ULF electromagnetic signals are often observed from days to hours before the earthquake. So, their occurrence can give with rather good precision the time of the impending earthquake. Also some conclusions about earthquake magnitude and the epicentral distance can be drawn from the amplitude of ULF precursory signals. Still to determine the location of the earthquake epicenter remains the most difficult task of earthquake prediction. Some advances to solve this task can be possible by studying the amplitude behavior of ULF signals in different points.

The possibility of estimation of earthquake source position in close region to epicenter may exist if we take into account the phase difference between lateral and crustal electromagnetic signals in a point of signal reception. For the distances comparable with skin depth in crust, the phase difference between two signals has to be noticeable because of big index of refraction in lower half space.

This peculiarity can be used for enhancing the signal-to-noise ratio by processing simultaneously the time-synchronous signals collected in different points. To realize this efficiently, there are two critical requirements to the observation system. First one relates to the very high dynamic range of the measured signals in ULF band – 120 dB and more. Second problem, mostly controlled by the first one, is data sampling synchronization quality. It is common to use GPS for the synchronization of numerous observation systems distributed across the given area, but a serious problem of false harmonics generation appears by this. In practice, a low cost commercial GPS receiver gives only 1-second time synchro-pulses, which in our case have to be split in order to get numerous samples per second to sample efficiently signal in ULF range. It is shown

that this process if incorrectly realized can give high enough level of false signals – up to 40 dB, what can completely distort the received signal. The design features of the automatic ULF observation system with large dynamic range and free from time mismatch necessary for continuous monitoring of earthquakes electromagnetic precursors are discussed and the example of its practical realization as well as first experimental results are presented.

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