TIME-SCALE PATTERN FEATURES IN THE NEUTRON MONITOR INTENSITY BEFORE EARTHQUAKES

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GOAL. In the present work, by studying the time-scale pattern features in the neutron monitor (NM) intensity, we intend to estimate the detectability of precursory phenomena for relatively weak earthquakes. The variations of scales in the temporal patterns have to be analyzed for several tens hours before events. Such approach will allow us to reveal emergence of precursory patterns in the different range of scales.

SHORT DESCRIPTION. The clear relation between the geodynamical processes in the Earth's lithosphere and corresponding ionosphere phenomena has been established in the last time. Underlying physics of the problem consists in the formation of high electrical potential for the stressed rock volume under pre-earthquake conditions. This surface potential for shallow earthquakes will generate corresponding changes in the ionosphere. The experimental researches of the correlations between strong local seismic activity and ionosphere responses have further shown that maximum perturbation was observed during pre-seismic periods for such earthquakes. The ionosphere perturbations are too weak in order to change the cosmic ray intensity. However, they can modulate the appropriate frequency or scale range of intensity. The specifications of the fine structure analysis have to be very carefully fitted. The best study of the non-stationary data with intermittent features, in which the time of occurrence of events is important to the description of the phenomenon, can be performed with computation of the local energy density of signal in the wavelet transform. It can be viewed as a microscope for looking into the time-scale signal characteristics.

COMPUTING is performed on this basis in the MATLAB environment [1]. The significance of this approach is obvious. The result is 2D surface (a counter plot) which displays the time on the horizontal and the scale on the vertical axes. It reveals how much each scale contributes at any given point in time, so evolution in the time is observable.

DATA of Kazakhstan National Data Center [2] were used for retrospective analysis of earthquakes. The events, - that occurred at distances up to 250 km from receiving place - (Almaty NM), - were chosen.

RESULTS. Previous reports have shown [3-5], that cosmic ray can be considered as an indicator of the local geodynamical environment. In the present work more detailed analyses in the new period 20061226 - 20091104 have been performed. To search for the time-scale variability of the NM intensity, 400-hours interval of the time series has been selected in the each event. Earthquake's time point corresponds to the middle point of this interval. We have focused on a small range of scales, from 1 hour to 9 hours and on 70 hours interval from the time series. The results are presented on Fig. 1 and Fig.2. The 2D counter plots display evolution of the different scales over selected intervals. The head line above each plot contains in consecutive order: earthquake date, coordinates, magnitudes (in epicentre/ in Almaty), azimuth direction and distance from Almaty, the earthquake moment - X. The appropriate color on the line below plots represents the local energy density of the according time-scale point.

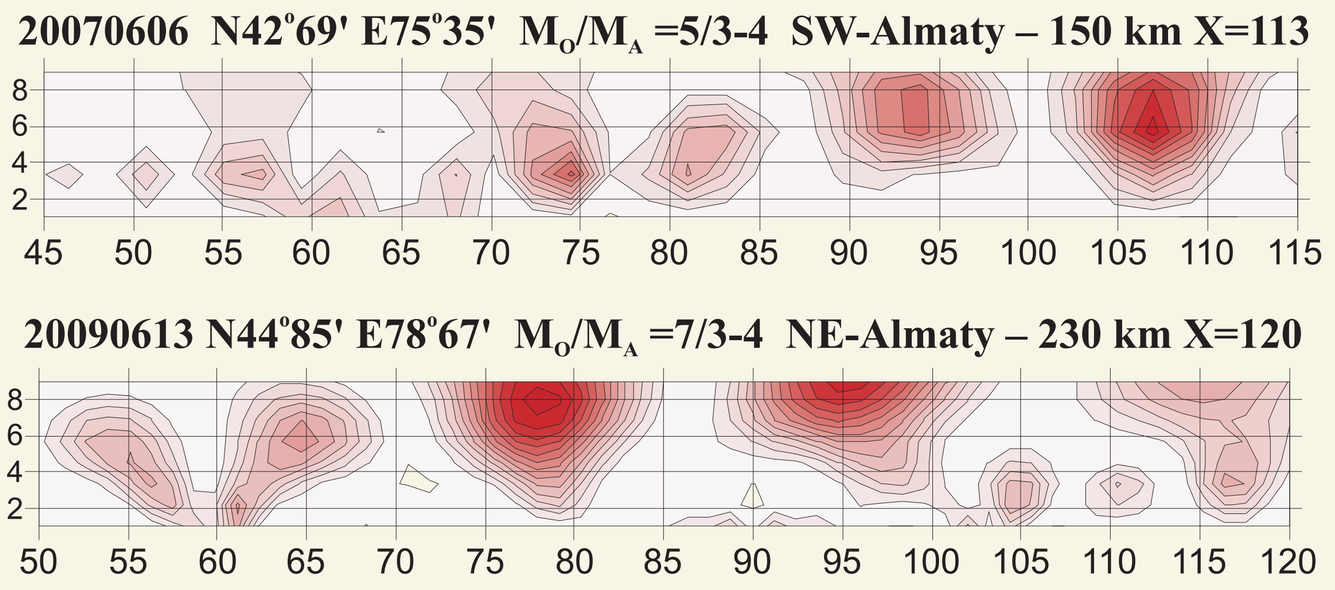

Figure 1. The results for two events with well-isolated time-scale pattern features in the NM intensity "before earthquakes".
It should be stressed that the second plot corresponds to the sum of superimposed intensities for three 3 earthquakes in the 40-minutes interval.

The wide range of results have been obtained for the different events. For the part of events, the clear time-scale evolution patterns have been obtained for the local energy density "before earthquakes", - (Fig. 1). On the other hand, there are some events with the more weak evolution patterns, - (Fig. 2), or without any such patterns. The average rate of events with the clear pattern of time-scale correlations is 0.60 ± 0.15.

It should be stressed that all experimental patterns have clear intermittent features. From our point of view this is very important result. Rearrangements of the Earth's lithosphere arising at pre-earthquake conditions correspond to complex non-stationary processes with fractal structures. The intermittent behavior of rock stresses dominate in such strong interactions between overlapping structures at many different scales. The ionosphere perturbations have to reflect these peculiarities and, therefore, have to have intermittency features at the corresponding scales.

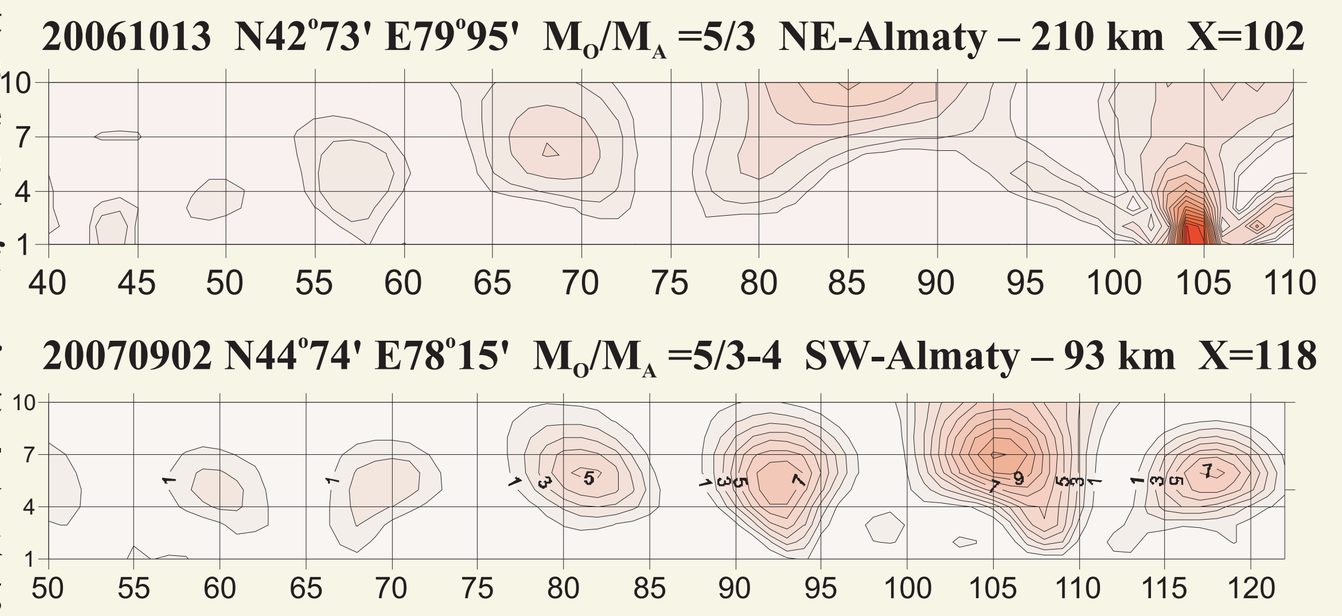

Figure 2. Two events with the more weak evolution patterns.

SUMMARY. In the substantial part of events with relatively weak magnitudes, the bright intermittent time-scale correlations, - at a small range of scales from 1 hour to 9 hours, - have been recognized in the NM intensity for several tens hours "before earthquakes". The average rate of such events with the clear pattern of time-scale correlations is 0.60 ± 0.15. The additional researches and understanding of the underlying problems are need.

References

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