Anomalous solar-diurnal variation of Cosmic Ray Neutron and Hard components intensity, cosmic phenomena and the problem of Earthquakes

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Abstract

It is shown that from all cosmophysical phenomena connected directly or indirectly with the strong destructive earthquakes(SDE), the process of the Earth's passage through the neutral current sheet of interplanetary magnetic field (IMF) is most powerful for their stimulation. To prove this statement, the results of the analysis of multiple histograms, the distribution of the Earth's passage through the neutral IMF sheets relative to the cases of SDE with the magnitude ≥6.0 are presented according to the data of 1958-1988.

According to the considered histograms the probability of the initiation of SDE is of cyclic character with a 11-year period.

The increase (a day before) and significant decrease of Solar-diurnal cosmic ray anisotropy (SDCRA) are demonstrated   according to the averaged data of Tokyo neutron monitor and Nagoya meson telescope.

I. Introduction. A lot of works (Shatashvili et al 1999, Sitinski 1989, Sobolev et al 1988, Sitinski 1990, Gokhberg et al 1998) deal with the search for extraterrestrial sources of creation of the conditions for the initiation of earthquakes. The authors of the work (Yu Zhen-dong, 1985) connect some of the SDEs with the flare of cosmic rays in the far regions of the Universe during the explosion of novae stars. One should mention the work of Asatrian et al 1997), showing that during the famous Spitak earthquake the hard component intensity of cosmic rays (CR) was increased by 100% in the stratoshpere over Erevan 30 minutes earlier before the earthquake. Prospects of the investigations of lunar CR variations at the expense of tide effects in the upper atmosphere are described in the review (Duggal, 1977) on the basis of the verifications of (Naskidashvili and Shatashvili 1977). The fact, that the particle flows recorded by neutron monitors are not only of solar-galactic but also of terrestrial origin, is justified in (Volodichev et al, 1997, Dunbar et al, 1992).

The work (Shatashvili et al 1999) gives a brief review of the results of most important investigations of a lot of authors not supposing that SDEs occur exclusively at the expense of physical-chemical processes inside the Earth, causing tectonic motion. Based on the analysis of the complex diagram, comparing the cases of A_n/A_μ ratio decrease (the amplitudes of diurnal variations of: A_n - neutron and A_μ - meson components of CR intensity), moments of the Earth's passage through the neutral IMF sheets, Forbush CR effects, moments of the New Moon and full Moon as well as lunar perigee and apogee, the authors (Shatashvili et al, 1999) came to the conclusion that SDEs   often take place in cases, when some of above-mentioned factors are superimposed.

2. Experimental Data and Methods of Investigation. As in the work of Shatashvili et al, 1999), we suppose that near-space phenomena, which, in principle, can stimulate SDEs, and generally speaking, can affect the terrestrial processes shoud be carried out , first of all, through the channels contaicting directly

with the Eart's magnetospheric surface. The physical processes occurring in the vicinity of the Earth's magnetosphere and propagating along its surface, reach the upper layer of atmosphere and interact with it. In our opinion, at the moment of the Earth's passage through the neutral IMF sheet, i.e. at the sharp change of IMF direction this interaction should affect the Earth's magnetosphere. Geoefficiency of this process have to be most appreciable, and it is supposed that this effect should not only reach the solid shell of the Earth but it should also cause tectonic shifts.

We have analyzed the data of the earthquakes (Dunbar et al, 1992) and IMF signs presented in (Mansurov, 1984) during 1958-1988. As initially we supposed that not each change of IMF sign near the Earth can be accompanied by the earthquake, as the conditions for the initiation of earthquakes are not always prepared, and the change of the IMF sign, in our opinion, can be considered only as a trigger mechanism, for plotting the corresponding diagram moments of the begining of SDEs with the magnitude more than 6 were taken as an origin. We have plotted a lot of histograms of frequency distribution case numbers of the moments of the Earth's passage through the neutral IMF sheet relative to the cases of earthquakes and Chree-diagrams of SDCRA amplitudes (Despotashvili et al, 1999). To plot Chree-diagrams the moments of SDE were taken as zero days. We plotted histograms step-by-step every year as well as every 4-5 year. They were plotted by two ways.

3. Results of the analysis. In Fig.1 the histograms of frequency distribution of case numbers of the moments of the Earth's passage through the neutral IMF sheets is presented as an example, relative to the moments of the origination of SDEs with the magnitude ≥ 6.0 during the period of observations of 1965-1969. Fig.1 shows histograms on the basis of the data of 1965-1969 according to the works of (Dunbar et al 1992, Mansurov 1984): case numbers (N) of the Earth's passage through the neutral IMF sheet, newrest of the two cases of the Earth's passage through the neutral IMF sheet before and after earthquake. "0" on the abscissa corresponds to the moment of earthquake, negative numbers "-1", "-2", etc. show the days corresponding to the moments of passage through the neutral IMF sheet before SDE, and positive numbers - the days after SDE

To reveal the cyclic character of the begining of SDEs with the cases of the Earth's passage through the neutral IMF sheet (e.g. with 11-year period), from the histograms of frequency distributions we chose the intervals of extreme values of the probability of the begining of SDEs. We took in percent the sum of case numbers of earthquakes a day before ("-1") and on the day of their begining ("0") from the total number of SDE during the whole considered year and then we constructed a plot of the changes of the relative values of case numbers of SDEs by years. The results of these calculations are presented in Figure 2. Figure 3 shows Chree diagrams of the first Fourier SDCRA harmonics amplitudes obtained according to the data of Kiel and Tokyo neutron monitors and Nagoya meson telescope for 1978 with connection of SDE cases.

Tentative analysis of Fig. 3 shows that in the region of relatively high CR energies (according to Tokyo and Nagoya stations) SDCRA amplitude increases a day before SDE.
We think that the Earth's passage through the boundaries of IMF sectors, heating of the upper atmosphere and in some special cases SDEs occur in complex and almost at the same rate. However, this conclusion is of purely tentative character.

The analysis of Fig. 1 and 2 show:
1. SDEs almost in 75% of the cases always take place a day before or on the day of the Earth's passage through the neutral IMF sheets.
2. According to the data of planetary observation analysis during 1958-1988 the tendency to 11-year cycle of SDEs is observed at the Earth's passage through the neutral IMF sheets.
3. As the time of appearance of neutral IMF sheets is not difficult to predict, the results of our analysis can be used for simulation of fore-runners of SDEs.
4. The symptoms exist that passage through the boundaries of IMF sectors and SDEs take place in complex, heating of the upper atmosphere and almost Synchronously.

The comparison of the results of calculations with the complex of cosmophysical phenomena followed by SDEs (Shatashvili, 1992), shows that the process of the Earth's passage through the neutral IMF sheets plays a very important role as a trigger mechanism in the creation of conditions and then in the begining of earthquakes with the magnitude ≥ 6.0.

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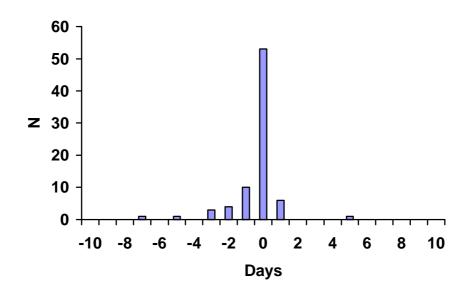

Figure 1: Histograms obtained according the data for 1965-1969. Case numbers (N) of the Earth's passage through the neutral IMF sheets, latests (of the two cases of the Earth's passages through the neutral IMF sheets before and after SDE) "0" - on the abscissa corresponds to the moment of earthquake, negative "-1", "-2", etc. are the days corresponding to the moments of passage through the neutral IMF sheets before SDE, and positive numbers - after SDE.
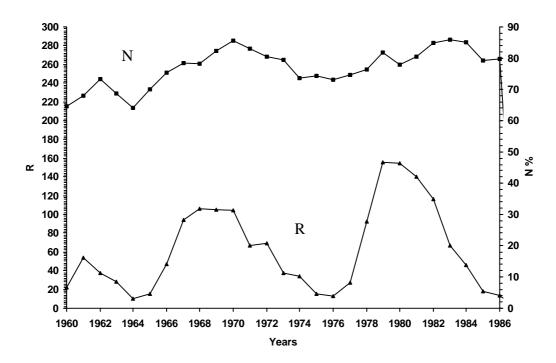
Figure 2: The diagrams of cyclic changes of the experimental values of N numbers of the passage through the neutral IMF sheets in percent near SDE moments by moving-average method (with the period of averaging - 5 years) during 1960-1988, and yearly average values of numbers of sun spots R in the period of 1960-1986
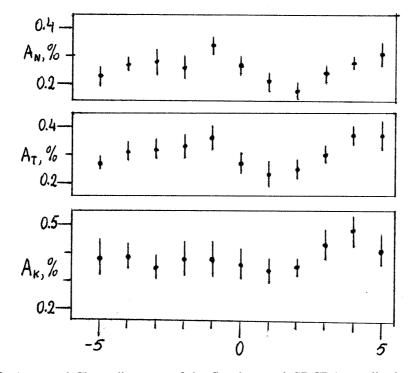

Figure 3: Averaged Chree diagrams of the first harmonicSDCRA amplitudes according to the data of Kiel (A_k) and Tokyo (A_T) neutron monitors and Nagoya (A_N) μ-meson telescope. The days of initiation of SDE is taken as zero days.