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Forecast of Space Weather on the Ground-Based Radiation Monitoring

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Abstract

It has been established that GCR intensity scintillations are associated with large-scale disturbances in the interplanetary magnetic field (“magnetic corks”). The magnetic corks separate the particle trajectories into “permitted” and “prohibited” ones that are manifested in the celestial sphere scintillations in cosmic rays. The method of *early diagnostics* of large-scale disturbances of the interplanetary magnetic field by GCR intensity *scintillation registration* is suggested.

1 Introduction:

The dynamics of GCR intensity scintillations is the most expressed during the decay of the large-scale magnetic field on the completion stage of the general magnetic field reversal of the Sun (Kozlov, 1992). This stage is accompanied by the growth of the number of shock waves, Forbush effects and index of their energy spectrum typical for the descending phase of the 11-year cycle. The scale- invariant character or “scaling” of cosmic ray scintillation dynamics during GCR intensity decreases of different scale is proved by monofractal dependence of the process correlation dimension with the obviously expressed plateau: $d_{GCR}(n)=2.5\pm 0.1$. The scaling of cosmic ray scintillation dynamics reflects the hierarhically self-similarity, i.e. fractal structure of GCR intensity decreases at the geoeffective phase of the 11-year cycle.

The detection of the low-dimensional attractor, i.e. partially determined chaos, in the chaotic dynamics of solar activity by the GCR scintillation index points to the ***principal*** possibility for the forecast of the periods of maximum sporadic activity of the Sun (Kozlov, 1999). Parametrization of GCR fluctuation dynamics makes possible to reveal the structure reconstruction of the heliospheric current sheet (HCS) manifesting in the change of recurrent (27 days) variation period of the scintillation index till 13±1 days and, further, to near-week period (T=4±1days) – ***activity wave***. In the process of HCS variation period decrease the formation of shock waves is possible with the similar interval of sequence (4±1 days) often accompanied by the GCR intensity decreases (Kozlov, 1999).

2 Results:

From January 1999 the suggested earlier diagnostic method of interplanetary field large-scale disturbances was realized in the real-time regime by using the global Internet network. 5-min neutron monitor data of Tixie Bay and Yakutsk stations were sent to the local IKFIA network. Pressure corrected data were treated in accordance with the suggested algorithm. The computation results of the discrete predictor P=±1 together with the initial hour-averaged data were entered into global computer Internet network with a step of 5-min (Figure).

The first predictor (P=±1) was registered on February 12, 1999. It is necessary the note that the predictor is already registered under comparatively disturbed conditions. The measurement data of February 12-13 are indicative of the development of the IMF disturbance initial phase, the velocity and density of solar wind plasma (the first maximum). In accordance with the results of retrospective analysis (Tugolukov and Kozlov, 1991) the extremely high values of solar wind parameters should be expected on the ***4±1 days*** (*activity wave*), i. e. on February 13-16 in this case. Really, the solar wind parameters which are typical for shocks (V≥600 km/s, the plasma density n≥20) were reached in 2 days, i. e. February 15 (the second maximum). On February 16 the low-frequency predictor (P= -1) was registered. Thereby, the forecast was prolonged for February 17-20. The third maximum was registered on February 18 (V≥700 km/s, the plasma density n≥20). The whole period are characterized by significant IMF parameter disturbances, Forbush effects of amplitude A≈5% and geomagnetic field disturbances. D_{st}-variation attained 150 nT. A short-term low-frequency predictor was registered from February 20 to 21 indicating to the weak increase of the activity from February 22 to 24 (V≤500 km/s, K_p=4). The second forecast signal P=+1 appeared on February 25. As it was expected, the strong solar wind disturbances (V≥600 km/s, the plasma density n≥20) and significant changes of IMF values and directions should be registered on February 26 – 1 March. Such disturbances were registered from February 28 to March 1, 1999 in fact. The low-frequency predictor of February 27 simply prolonged this forecast for February 28 - March 3 which is confirmed by in situ data and ground-based measurements. The analogous calculations were carried out on data of Yakutsk and Lomnitsky Stit stations. The results obtained by superposition of plots for different pairs of stations (Yakutsk-Tixie and Yakutsk–Lomnitsky Stit) are given in Figure. The results of different pairs of stations are successively supplement each other "registering" a thin structure of already known solar wind parameter variations in the *period marked by GCR predictors*. The structure of D_{st}-variation is also indicative of this fact depicted at bottom of Figure.

3 Conclusion:

The experiments on early diagnostics of large-scale solar wind disturbances in the *real-time* regime (with the entry into the Internet network: http://teor.ysn.ru/rswi/) have been out. The method of early diagnostics of large-scale disturbances of the interplanetary magnetic field by *GCR intensity scintillation* registration (by the *method of cross-correlation signals reception* of separated neutron monitors) has been suggested.

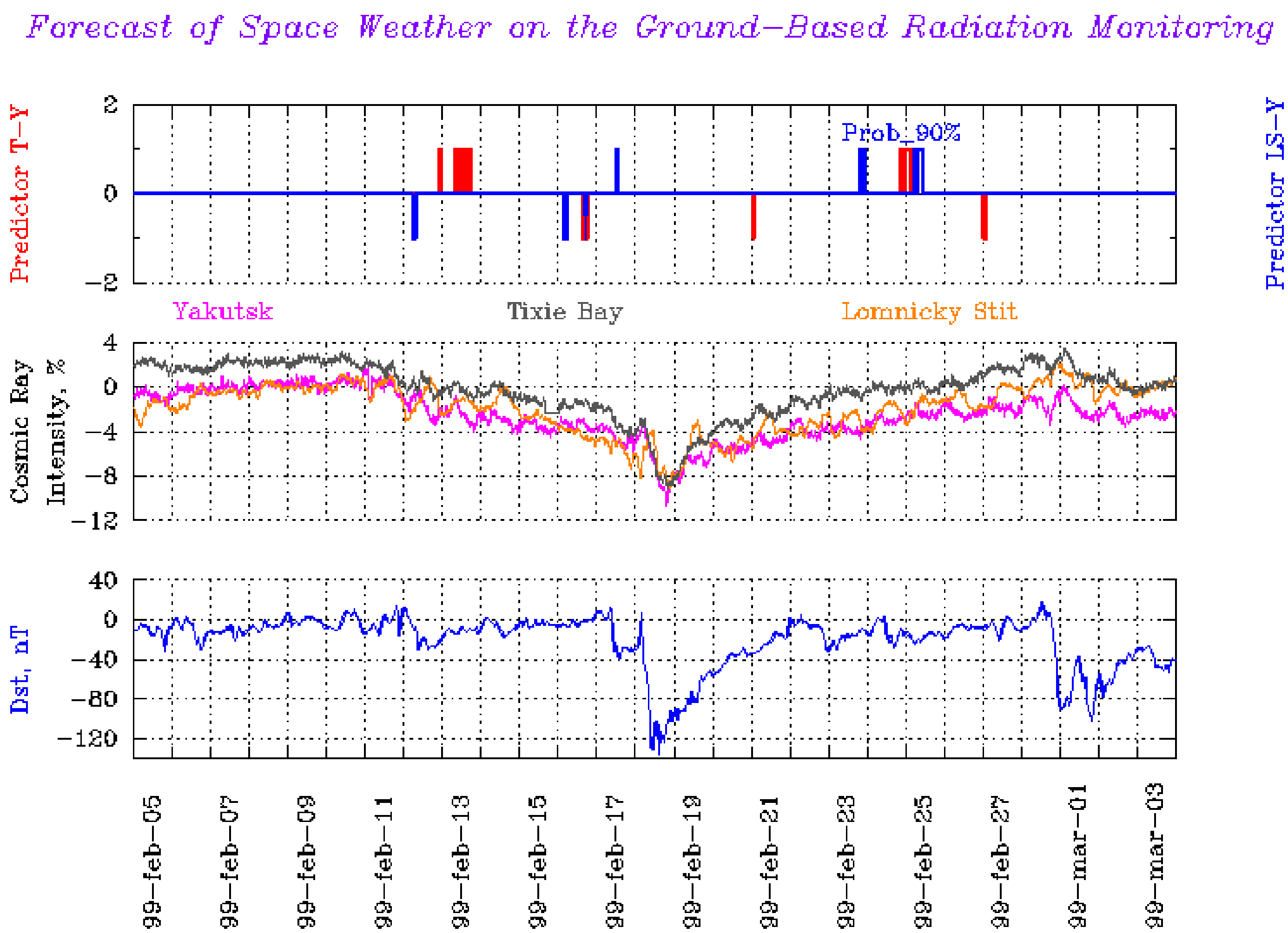
References

Kozlov V. I., Tugolykov N. N. 1992. Cosmic Ray Intensity Scintillations. Geomagnetism and Aeronomy. V. 32. N 3. P. 153 (in Russian).

Kozlov V. I. 1999. Scale Invariance of Cosmic Ray Fluctuation Dynamics at Geoeffective Solar Cycle Phases. Geomagnetism and Aeronomy. V. 39. N 1. P. 95 (in Russian).

Kozlov V. I. 1999. Estimation of Scaling Characteristics of Cosmic Ray Fluctuation Dynamics in a Solar Activity Cycle. Geomagnetism and Aeronomy. V. 39. N 1. P. 100 (in Russian).

Tugolukov N. N., Kozlov V. I. 1991. Connection of Cosmic Ray Scintillations with Parameters of Solar Wind. Geomagnetism and Aeronomy. V. 31. N 2. P. 715 (in Russian).



Early diagnostics of IMF "magnetic corks" (4 days advanced). Predictor P = +1: (high-frequency T=10-20 min component of GCR scintillation). Predictor P = -1: (low-frequency T>20 min component of GCR scintillation).