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The Structure of the Time-patterns of Geophysical Fields: Rhythms and Chaos

V. Smirnov (1), A. Ponomarev (2), Qian Jiadong (3), A. Cherepantsev (4)

(1) Physics Faculty of Moscow State University, Vorobievy Gory, Moscow, 119899, Russia, (vs60@ phys.msu.ru), (2) Institute of Physics of the Earth, Russian Academy of Sciences, Bol.Gruzinskaya 10, Moscow, 123810, Russia, (avp@ifz.ru), (3) Center for Analyses and Prediction, CEA, Beijing, China, (jdqian@sdb.csdi.ac.cn), (4) Taganrog State University Of Radioengineering, Tagnrog, 347922, Russia, (s6319a@itt.net.ru)

The investigation of the structure of time-patterns of geophysical fields in seismically active regions were carried out for volumetric strain, apparent resistivity, radon concentration, indoor leveling, water level. The structure is discussed in terms of rhythmic variations and chaotic component. The rhythms found to be governed by the various exogenous processes and controlled by such factors as the variations of temperature, atmospheric pressure, water consumption. Rhythmic variations are quasi-periodic and have time-depended amplitudes of cycles. The technique of linear co-spectral analysis and adaptive regression allows to design the statistical models for rhythmic component.

Chaotic component of studied time series can be interpreted as a mixture of observation random noise and the deterministic chaos. The technique for analysis of processes generated by the nonlinear dynamical system analysis allows us to estimate a degree of a determinacy of chaos. These estimations indicate that the observed chaotic variations in time series can be explained by changes concerning a small amount of non-linearly interrelated physical factors. It was shown that the studied time series are partitioned on two groups distinguished by their fractal dimension. The first group is characterized by values of dimension 1.5-1.9 and includes the fields, which directly or indirectly reflects deformation processes in the lithosphere. The processes of the second group have the different physical nature (electrical conductivity, the contents of a radon etc.) and are characterized by dimension 2.7-3.5. The large values of dimensions obtained in the latter case, apparently, show more composite and random system

behavior generating variation of these geophysical fields. The obtained results suggest a possibility of identifying the chaotic components of studied geophysical fields with processes going on in a dynamical system which is governed by the regularities of nonlinear dissipative systems with time-space deterministic chaos.

Obtained results can be used in the investigation of the nature of geophysical fields variations and by development of the methods and algorithms for identification of their prognostic anomalies.

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