

THE INVESTIGATION OF THE STRUCTURE OF THE SIGNAL OF GEOPHYSICAL AND ASTROPHYSICAL ORIGIN IN THE ELECTROMAGNETIC FIELD OF THE ATMOSPHERE BOUNDARY SURFACE LAYER

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ABSTRACT. There has been developed a program – analytical system for investigation the structure of the signal in the spectral and time ranges caused by geophysical processes. The main purpose of developing such system is – to investigate the structure of the signal in the spectral and time ranges, caused by geophysical and astrophysical magnetic field of the atmosphere boundary surface layer and to find under – noise periodical processes of geophysical nature. The analysis of the exposing efficiency in the time ranges of the components corresponding to the periods of the moon gravitational tides showed high efficiency of the eigen vectors, chosen according to the criterion MKK which provides very slight probably of the false alarm of omitting displayed signs at the level 10^{-4} .

Key words: an electrical field, a program – analytical system, moon tides.

Introduction

The main aim of the given investigation is connected with estimation of the mean value of the intensity amplitude of the electrical field vertical component of the atmosphere boundary surface layer at the frequencies of the moon tides. The task is done with methods of spectral estimation using great time series (years of continuous records) [1-6]. The main task of these investigations is a true discovering an effect of the moon tides on the electrical field of the atmosphere boundary surface layer.

The investigations are based on the experimental data of the ground of Vladimir State University and also of a number of stations which are provided with receiving and registration devices, developed in VSU. [7-8]

The results of the analysis of the possibilities of the spectral method of the investigations, including ones with an optimal recorder which allows to estimate the amplitude of the chosen spectral component, mean that the signal – to – noise ratio at the frequencies of moon tides is not enough for a true estimation of the influence of moon tides on the electrical field of the boundary surface layer.

To raise discovering of reliability of moon tides in the electrical field of the atmosphere boundary surface layer there has been developed a program analytical system of investigating the structure of signals in the spectral and time ranges caused by tide processes. The main purpose of

such system is to investigate the structures of the signals in the spectral and time ranges, caused by tide processes in the electrical field of the atmosphere boundary surface layer. Using the method of eigen vectors can raise considerably the selectivity of any known analysis method (a spectral one as well) because the latter ones will be used not to the whole time series but to its independent components, time series but to its independent components, including those which have no power dominating (moon tides). It is shown an efficiency of using eigen vectors of the covariance matrix for exposing complex periodical components of the time series including the case when such components have no power dominating in the time series (moon tides).

Program – analytical system for investigating the structures of the signals caused by moon tides in spectral and time ranges

To investigate time series of natural phenomena both the method of spectral analysis and the methods, based on the appearance of the signals in the bases of eigen vectors of the covariance matrix, are widely used. [9-11] Eigen matrix are completely determined with the covariance matrix of the time series and the analysis interval chosen by an investigator. Eigen vectors forms an orthorated basis and each of basis vectors forms its own properties of the investigated nature object. The analysis of the situation defines the thing that if the nature has some distinctive properties, they must be shown by the definite group of the basis vectors. As the basis of the eigen vectors is determined by the time series itself during the investigation but not by an investigators “arbitrariness”, there is some hope for the thing that in the eigen vectors there will be expressed the properties of the investigated objects “by themselves”.

Each of eigen vectors brings its own power contribution into the analyzed time series, which is determinate by the ratio of the eigen value of this vector to the sum of all the eigen values. So analyzing the structures of eigen, having the information about typical nature phenomena allows to reveal features of these typical phenomena without any dependence on the power contribution of the specific eigen vector into the investigated time series.

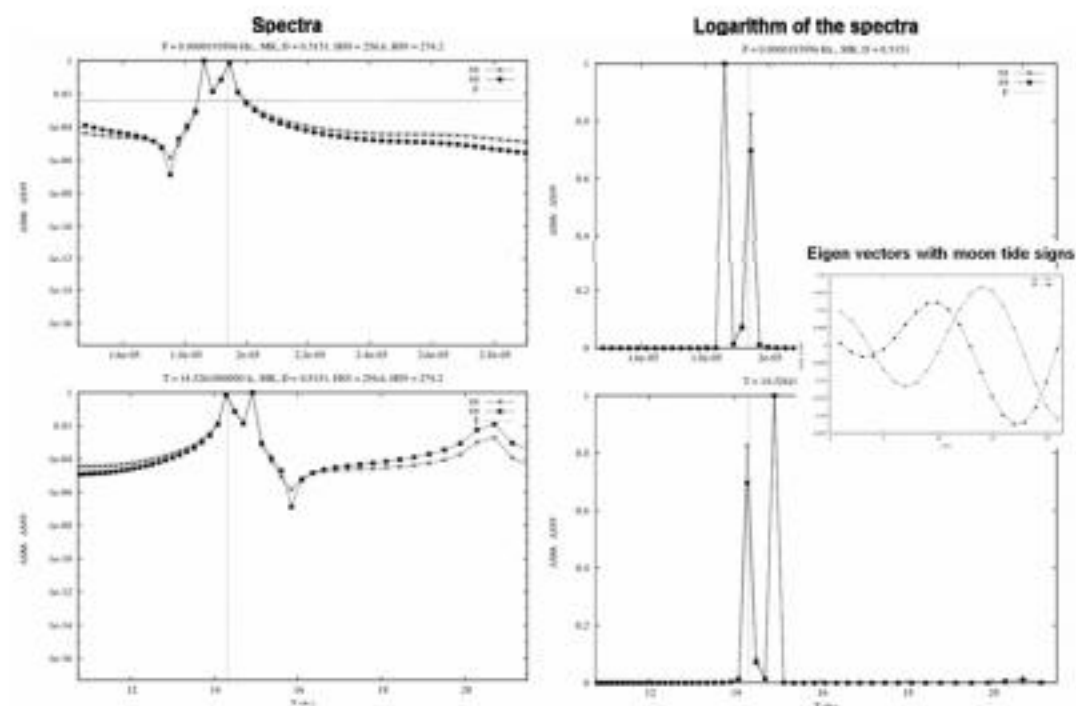


Figure 1: Amplitude spectra of eigen vectors, chosen according to the criteria of maximum correlation coefficient with a harmonic signal of tide frequency $2M_2$. Component E_z of the electrical field, VSU, 2003-2010

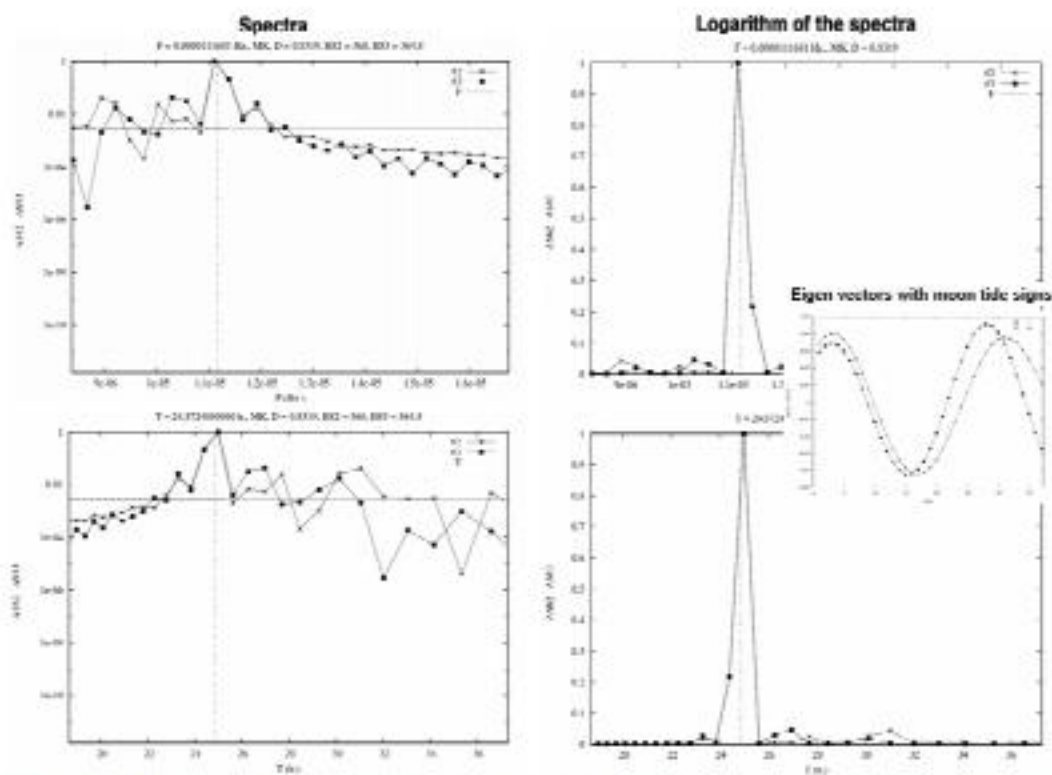


Figure 2: Amplitude spectra of eigen vectors, chosen according to the criteria of maximum correlation coefficient with a harmonic signal of tide frequency M_1 . Component E_z of the electrical field, Vozikovo, 1966-1995

The use of the method of eigen vectors doesn't eliminate using spectral analysis or some other methods, but they are used bearing no relation to the initial time series but in conformity with eigen vectors which are independent of each other each of them has its own conformation. Thus, using the method of eigen vectors can raise considerably the selectivity of any known method of analysis (including a spectral one) because the latter ones will be used not to the whole time series but to its independent components including to those ones which have no power dominating and they represent a "thin" structure of time

The example of the results received as result of the analysis of the time series with the purpose of discovering influence of moon tides on the electromagnetic field of the atmosphere boundary surface layer with PAK are shown at figures 1, 2.

The correlation coefficient (a median value) between the chosen CB and displaced sinusoid for component E2 for moon tides for the station with monitoring for dozens of years (Voyeikovo, Verhnyaya Dubrova, Dushety) is 0,78. For the stations with monitoring for a few years (VSU ground, Baikal, Obninsk) the median value of the correlation coefficient is 0,535. The signal - to - noise ratio (the ratio of the maximum value of the amplitude spectrum) at the chosen eigen vectors to it's mean value for component E2 for the stations with long time monitoring (Voyeikovo, Verhnyaya Dubrova, Dushety) is mean 267 and for the stations of VSU ground, Baikal and Obninsk is mean 179.

Conclusion

There has been developed a program – analytical system to investigate the structures of the signal in the spectral and time series caused by geophysical processes. The main purpose of the development of such system is to investigate the structures of the signals in the spectral and time series caused by geophysical processes in the electrical field of the atmosphere boundary surface layer.

The novelty of the developed method consists in the thing that the initial time series itself is not subjected to spectral analysis but its eigen vectors are, to which the time series is distributed which allows to use spectral analysis to some non-correlated components of the time series connected with the definite physical processes.

When exposing frequencies coinciding with the frequencies of tides the final frequencies coinciding with the frequencies of tides the final frequency of the coincidences of the tides the final frequency of the coincidences of the amplitude spectrum maxima of the chosen eigen vectors of the electrical and geomagnetic fields with the frequencies of tides was 99 per cent.

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