Irregular phenomena in the Earth Pole oscillation process and temporal variations of geopotential

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The observed irregular phenomena in the Earth Pole oscillation process are very variety. Basing on the results of simulation and the processing of high-precise series of the IERS observations it is extracted "irregular effects" in the Earth Pole oscillation process that are connected with within-annual variability of parameters of the main oscillation components. These phenomena indicated in the IERS data are the "abnormal" fluctuation of the Earth Pole coordinates which owing to changing of the geodynamical parameters gives negative result in interpolation and forecast of the first approximation mathematical model. It is submitted as essential interest the sharp changes in the oscillation phase in the middle of 1974 and in the end of 2005 - beginning of 2006 non-forecasting in the frames of the first approximation model. The trajectory of the Pole motion according to the IERS observation data and the theoretic interpolation curves on time interval of the Pole abnormal behavior in 2005-2006 are presented on Fig. 1.

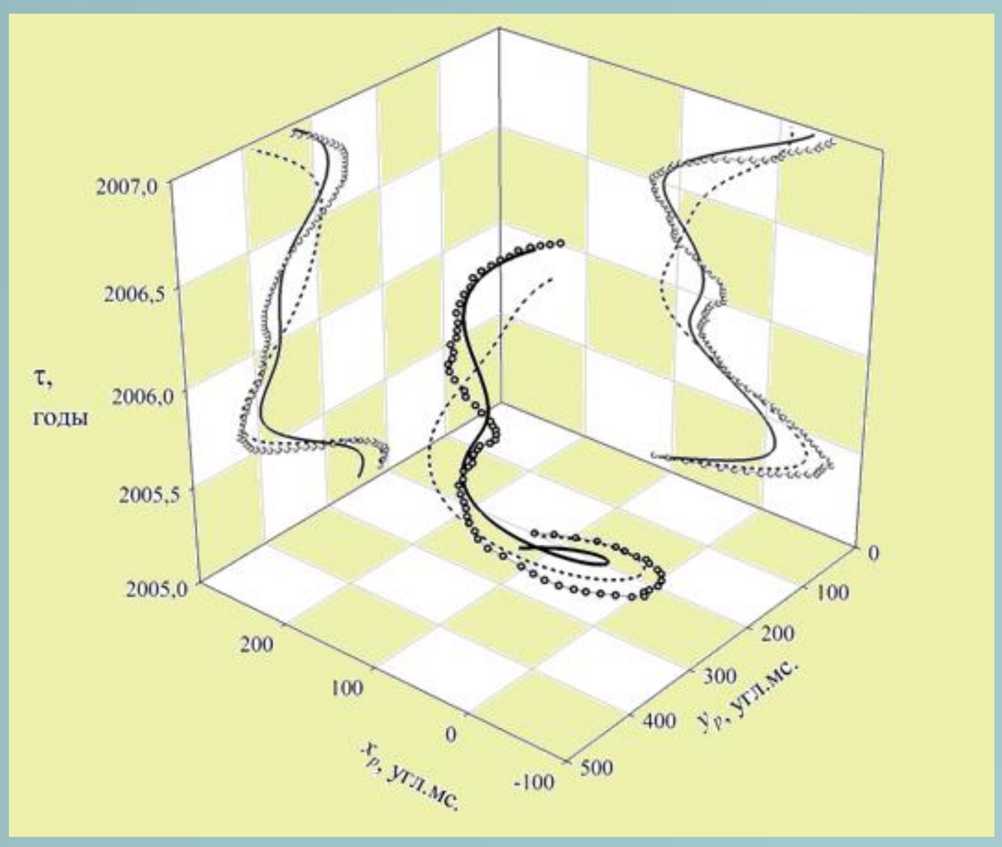

Fig. 1

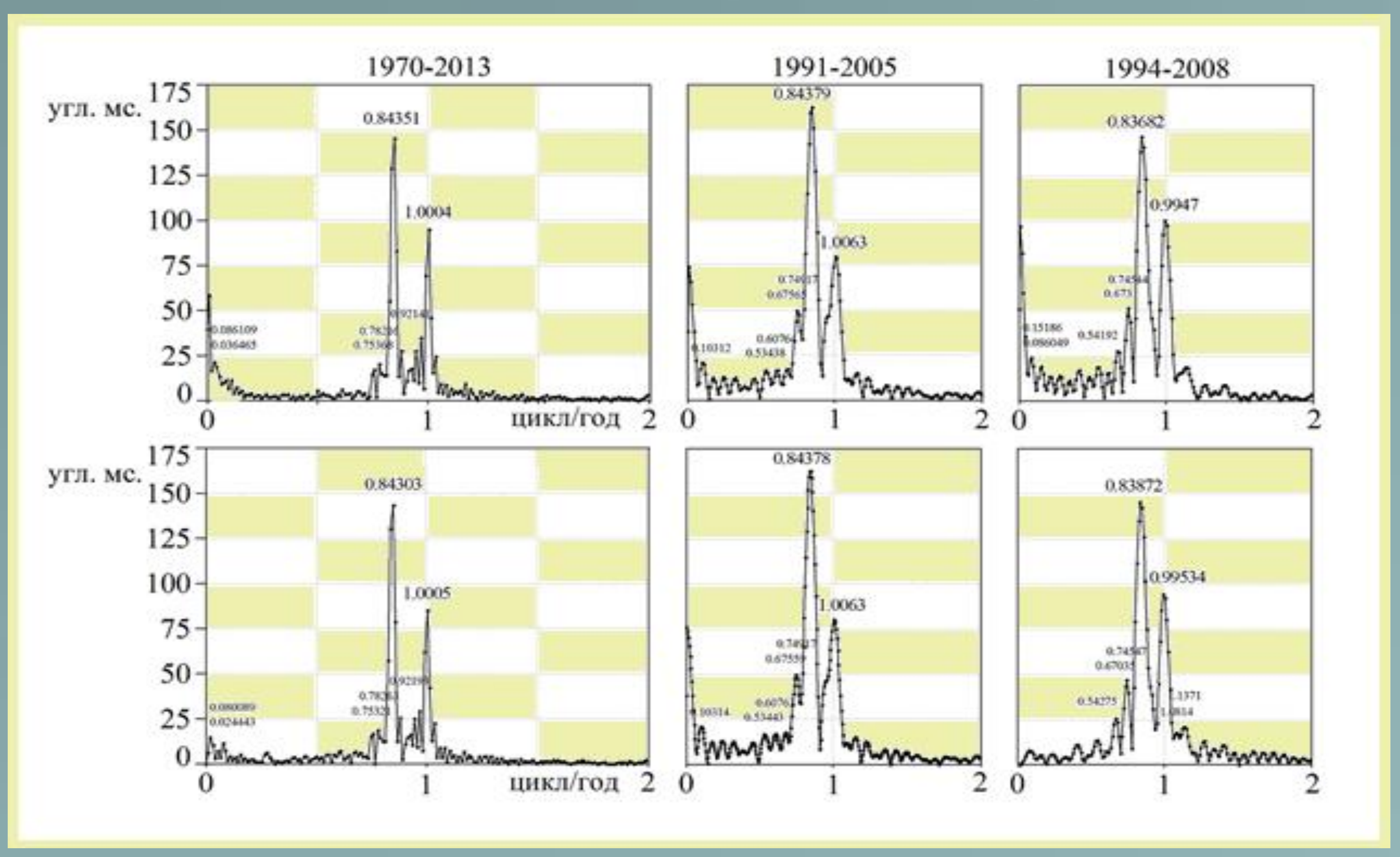

Fig. 2

As one can see from Fig. 2 the defined by the interpolation constant coefficients of the first approximation model - the amplitudes and the phases of Chandler and annual components both are subjected to essential variations. The Fig. presents the spectral density of power (SDP) of the IERS observation series of the Earth Pole coordinates (x, y) for three distinctive time intervals. The long time interval of the IERS data processing is used for definition of average values of Chandler and annual frequencies of the Pole coordinates. One of two crossing 15 years intervals excludes the moment of extreme phase fluctuation being in the end of 2005 - beginning of 2006. The comparison of the presented SDP plots shows that root-mean-square deviation of extrapolation of the Pole motion main model on time interval after abnormal phenomena of 2006 is increased considerably that corresponds to essential decreasing of the model precision.

Modelling of the Earth pole motion

The visual illustration of the Pole abnormal behavior effects and the extraction of some its singularities assume employment of non-stationary processes analysis methods. Personally, the use of wavelet analysis allows to extract the local singularities during common approximation. The graphic results of wavelet conversation of temporal series of the Pole coordinate x with the different parameters of Morle base wavelet function are presented on Fig. 3 (for coordinate y the deduction is the same). The 3D wavelet surface is represented by isogram loop that are the borders between the regions with different colors (from light-grey till black). For visualization of wavelet spectrum on a plane the wavelet surface is considered in projection with isograms. The spectrum of real Morle wavelet conversion with the parameters that gives the temporal localization of oscillations x is presented on top slot of Fig. 3a. Here it must be noted the appearing of "abnormal" extremes in the oscillation process being during considered moments of the Pole phase sharp fluctuations (the middle of 1974 and the end of 2005 - beginning of 2006). The spectrogram of Morle complex wavelet conversion with localization along scale dial is presented on bottom slot of Fig. 3a. This alternate of conversion shows the "abnormality" of amplitude modulation $a(t)$ of annual and Chandler components. The 3D alternate of spectrogram of complex wavelet conversion for visual estimation of relative value of considered fluctuation amplitude along the Pole main modulation motion is shown on Fig. 3b. One may see from Fig. 4a that availability of the Pole coordinate fluctuation in periods of 1974 and 2005-2006 reduces to short-time decrease of velocity of phase $d\psi/dt$ change (increase of period of the Pole rotation around its average location owing to moments when the velocity of phase change equals to zero) and lateral its considerable increase. The increase of frequency $d\psi/dt$ corresponds to decrease of period of the Pole rotation around its average location from usual value that is near to Chandler period (in "usual" years) till "abnormal" one that is comparable with annual period. The attempt to correct the frequencies of Chandler and annual oscillations on interval of interpolation (1994-2008) with the help of spectral analysis leads the decrease of forecast precision of the main model. The construction of numerical-analytical model of the Earth Pole oscillation that permits increase the precision of trajectory forecast in periods of considerable abnormalities is based on modern analysis of variations of the Earth gravitational field and the Earth rotation parameters.

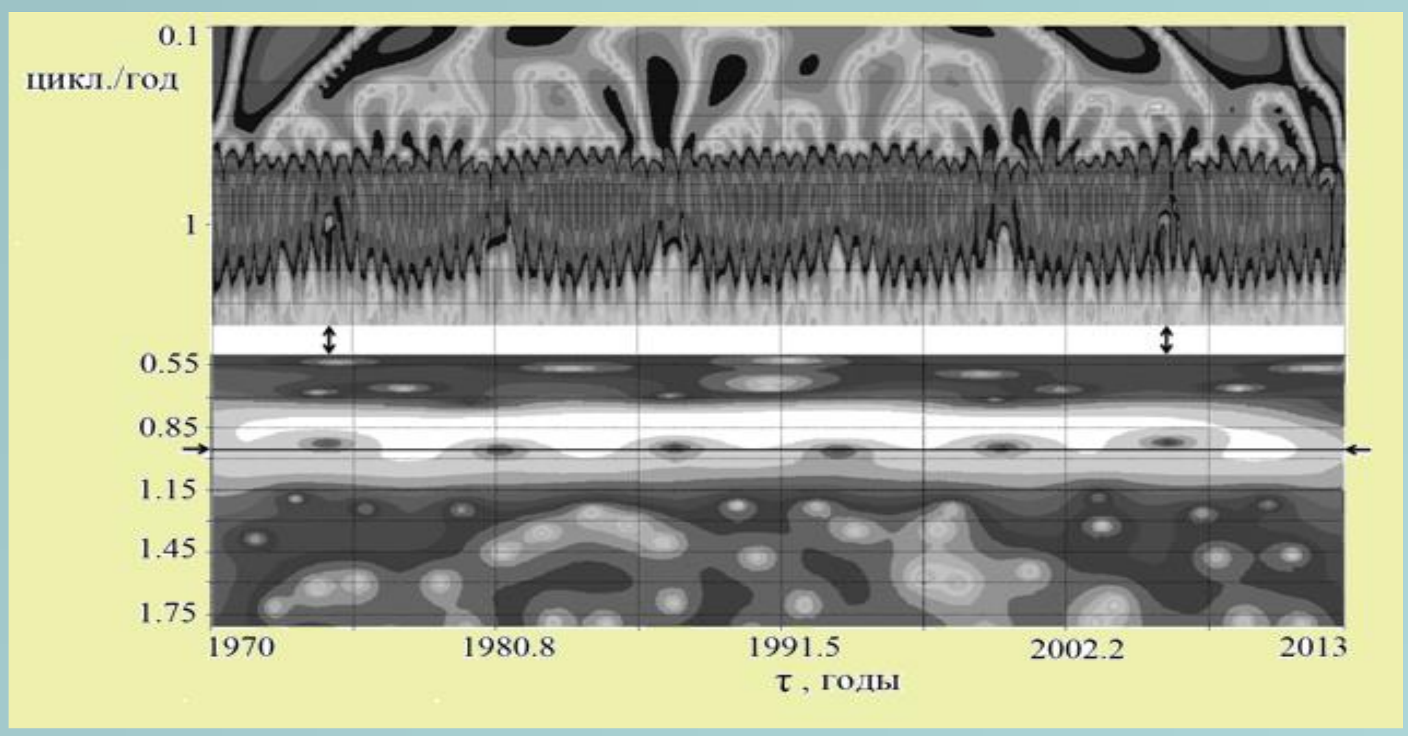

Fig. 3

The construction of numerical-analytical model of the Earth Pole oscillation that permits increase the precision of trajectory forecast in periods of considerable abnormalities is based on modern analysis of variations of the Earth gravitational field and the Earth rotation parameters. The parameters of main component of the Pole oscillations on the forecast interval are assumed to be equal its fixed values in the end of interpolation interval. Fig. 4 shows the plot of phase variation of the Earth Pole motion that constructed on the IERS observation data on time interval from 1970 till 2011 in the comparison with the variations of the Pole motion phase according to two models (the main one and the refined one) on time intervals from 1990 till 2011. The residuals between observed and calculated values of the phase are shown in the bottom of the plot. The precision of annual forecast of the refined model is higher than the forecast precision of main model during appearing of abnormal fluctuations in the Pole oscillation process. But the precision of main model is higher when Chandler and annual oscillation characteristics are stable. The comparable short period of the Pole stable behavior was observed from 2004 till the middle of 2005. The abnormal effects in the Pole oscillation process that are shown on Fig. 1-4 were observed during the remaining time. The average precisions of annual forecast of the Pole motion that is calculated by main and refined models are 1.66 *м*. and 1.50 *м*. correspondingly.

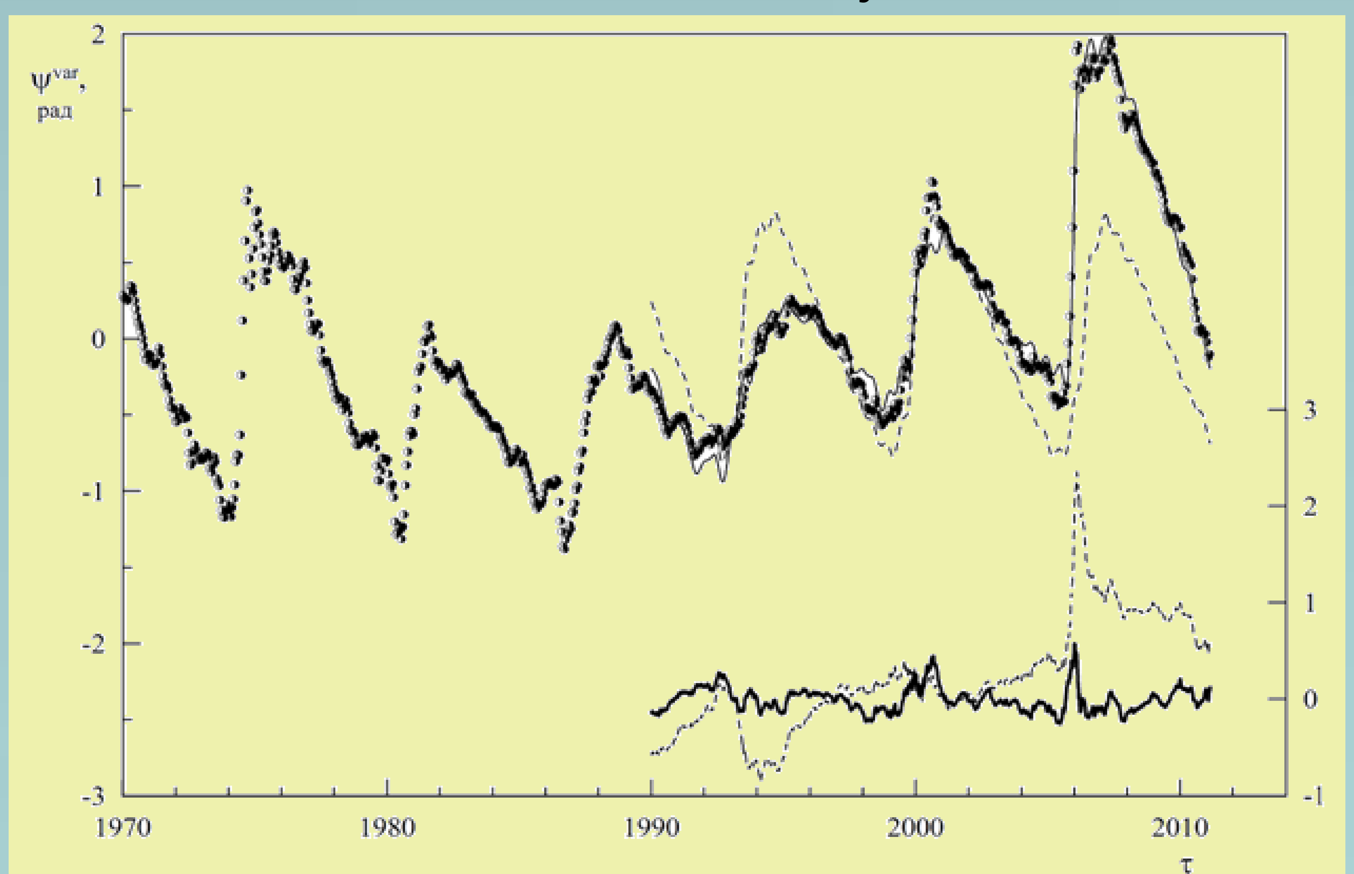

Fig. 4

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