DYNAMIC EFFECTS OF THE SPATIAL MOVEMENT OF THE EARTH-MOON SYSTEM IN THE EARTH'S POLE OSCILLATION

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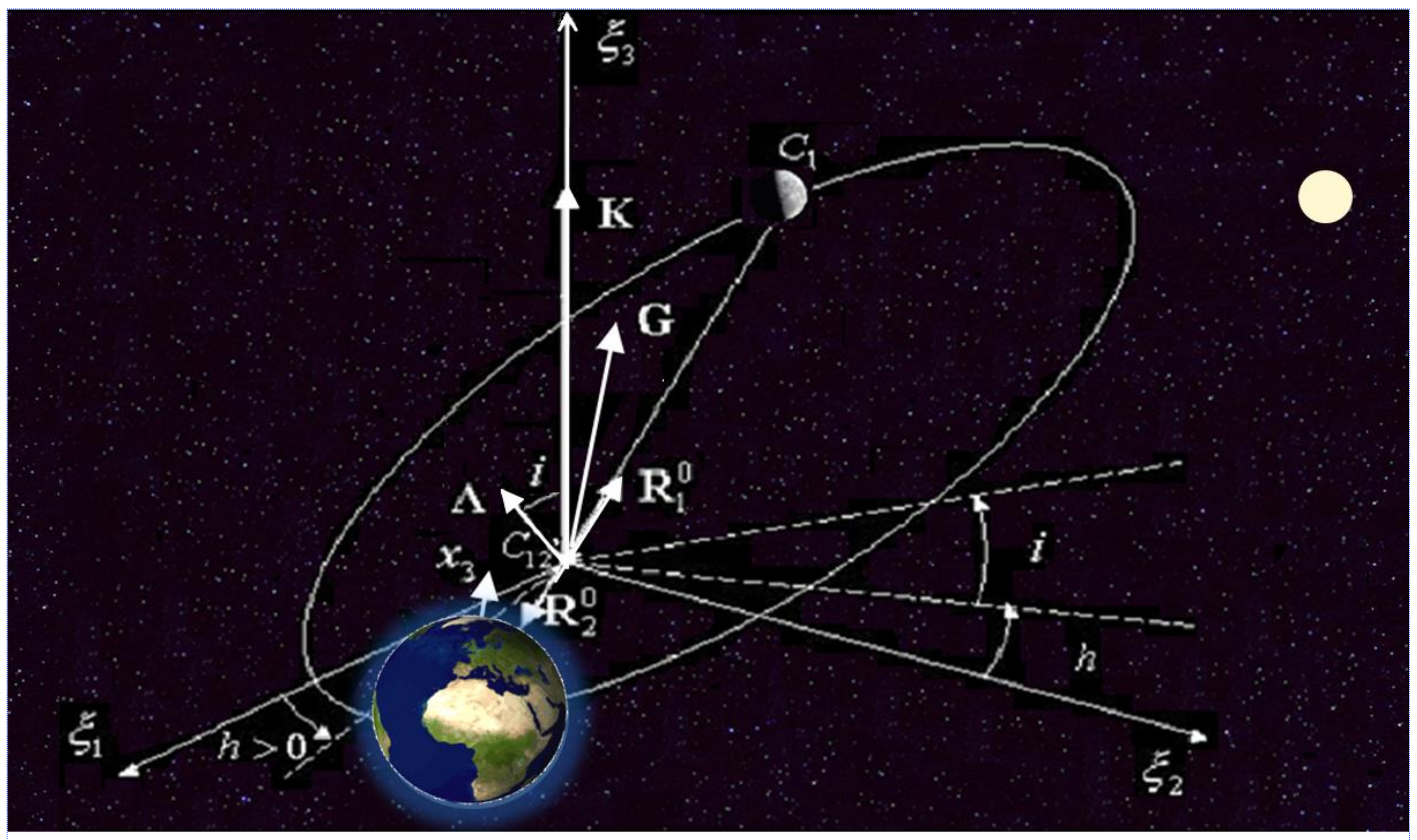
Abstract. On the basis of a numerical-analytical approach, the irregular effects of the oscillatory process of the Earth's pole, associated with changes in the Chandler and annual component, are investigated. An approach to the study of oscillatory processes in the motion of the Earth's pole is proposed on the basis of joint consideration of the Chandler and annual components of its motion. Within the framework of this approach, a transformation to a new coordinate system has been found, in which the in-phase motion of the pole and the precession of the lunar orbit are shown.



The statement of the dynamical problem on the Chandler component of the Earth pole oscillations under consideration is based on the spatial version of the deformable Earth–Moon system in the field of solar attraction.

1

Equations of motion of the Earth's pole

1. The two-frequency model with Chandler and annual components with constant coefficients

$$x_p = a_{ch}\cos w_{ch} + a_h \cos w_h + \Delta x_p,$$
$$y_p = a_{ch}\sin w_{ch} + a_h \sin w_h + \Delta y_p,$$

Chandler wobble Annual wobble

2. Additional terms to the main two-frequency model

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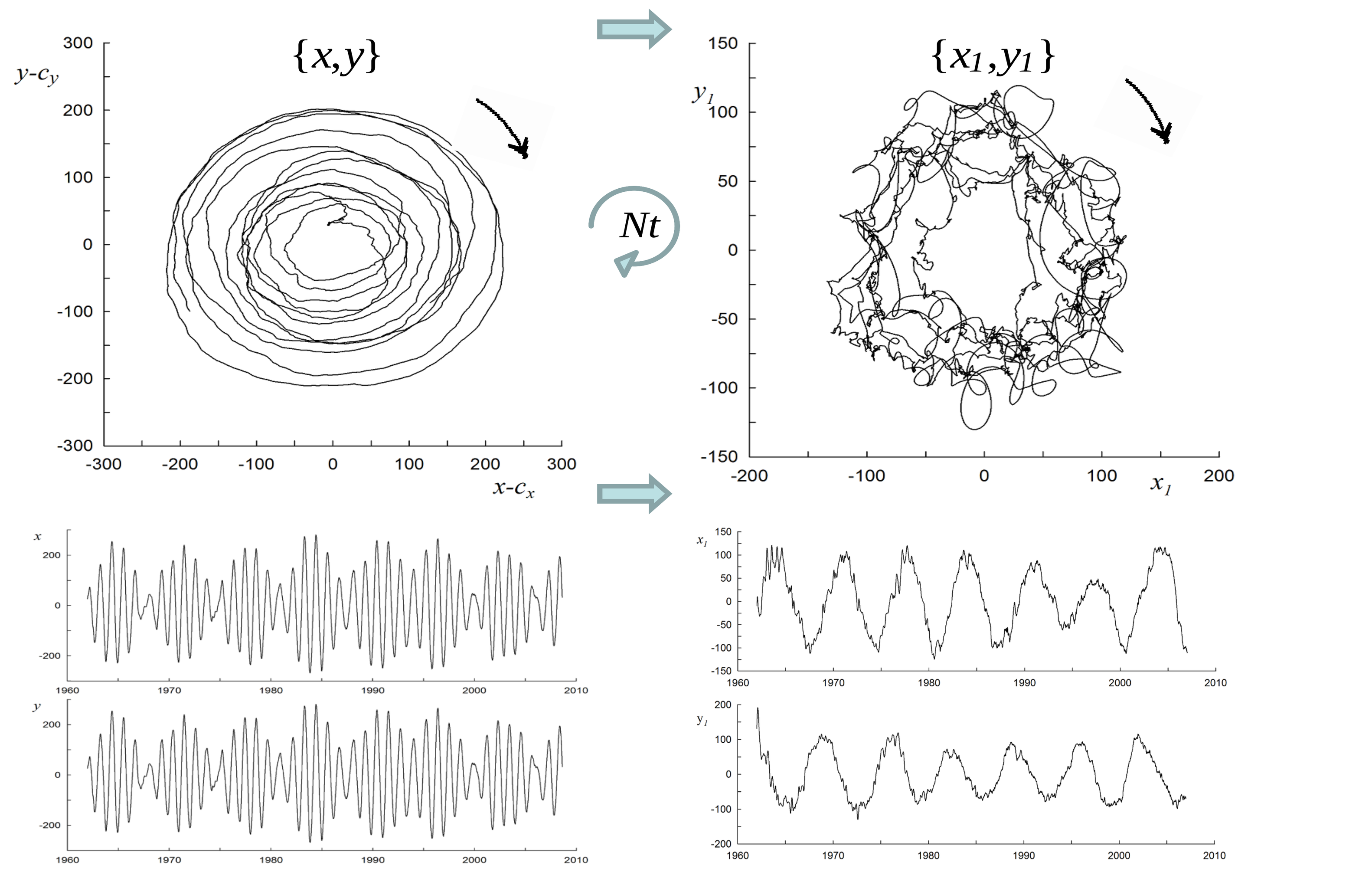
$$\Delta x_p = a^{+}_{ch/h}\cos(w_{ch/h}+h) + a^{-}_{ch/h}\cos(w_{ch/h}-h) + a^{+}_{1h}\cos(w_1+h) + a^{-}_{1h}\cos(w_1-h),$$
$$\Delta y_p = a^{+}_{ch/h}\sin(w_{ch/h}+h) + a^{-}_{ch/h}\sin(w_{ch/h}-h) + a^{+}_{1h}\sin(w_1+h) + a^{-}_{1h}\sin(w_1-h),$$

$$w_{ch/h} = \begin{cases} w_h, & \text{если} \quad a_h < a_{ch} \\ w_{ch}, & \text{если} \quad a_h > a_{ch} \end{cases}, \qquad w_1 = \begin{cases} w_{ch}, & \text{если} \quad a_h < a_{ch} \\ w_h, & \text{если} \quad a_h > a_{ch} \end{cases},$$

$$\dot{w}_{ch} = 2\pi(0.84 \div 0.85)\omega_*, \quad \dot{w}_h = 2\pi\omega_*, \quad \dot{h} = \frac{2\pi}{18.61}\omega_*.$$

2

Transformation of the pole's coordinates $\{x,y\} \longrightarrow \{x_1,y_1\}$



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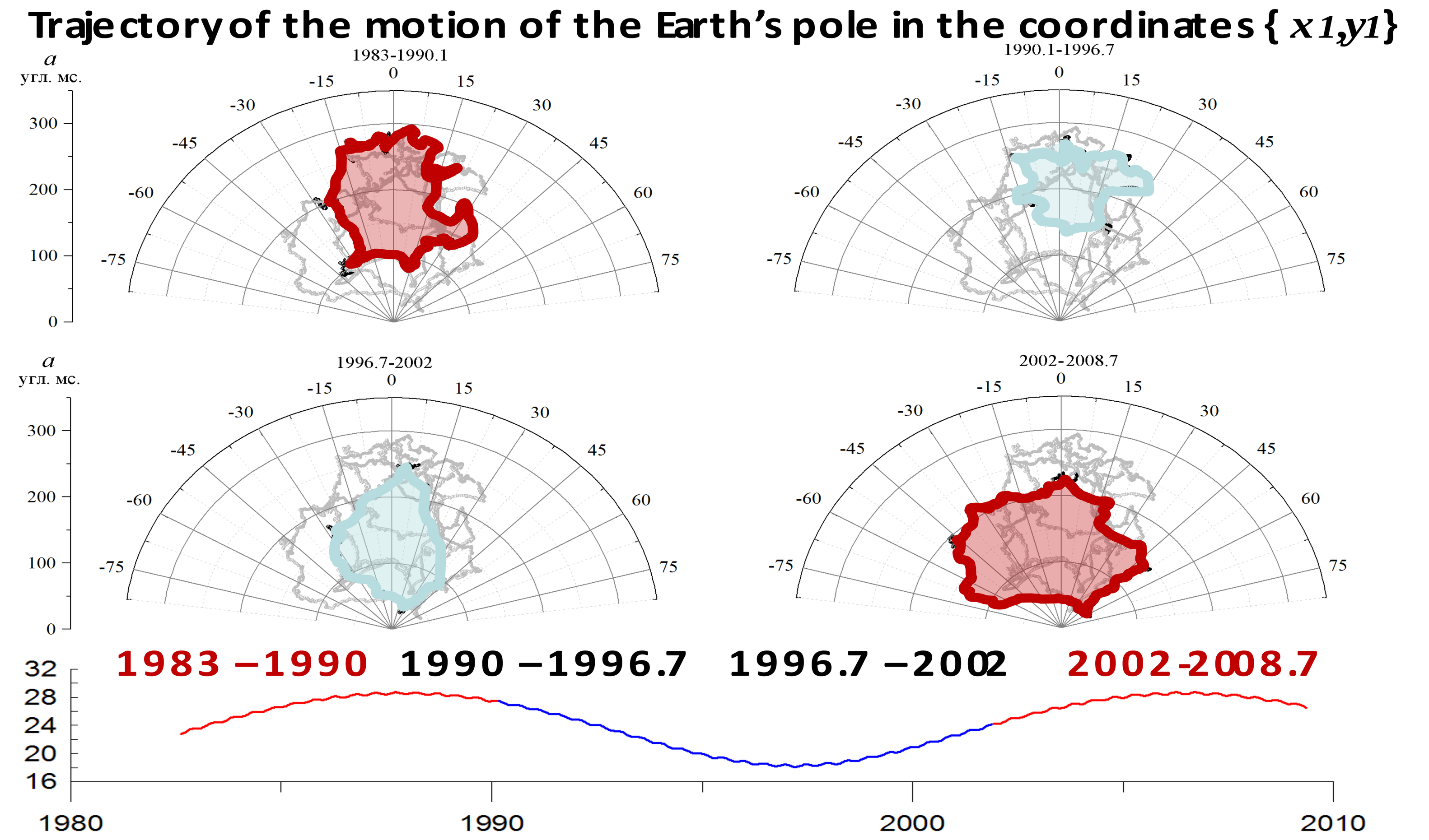
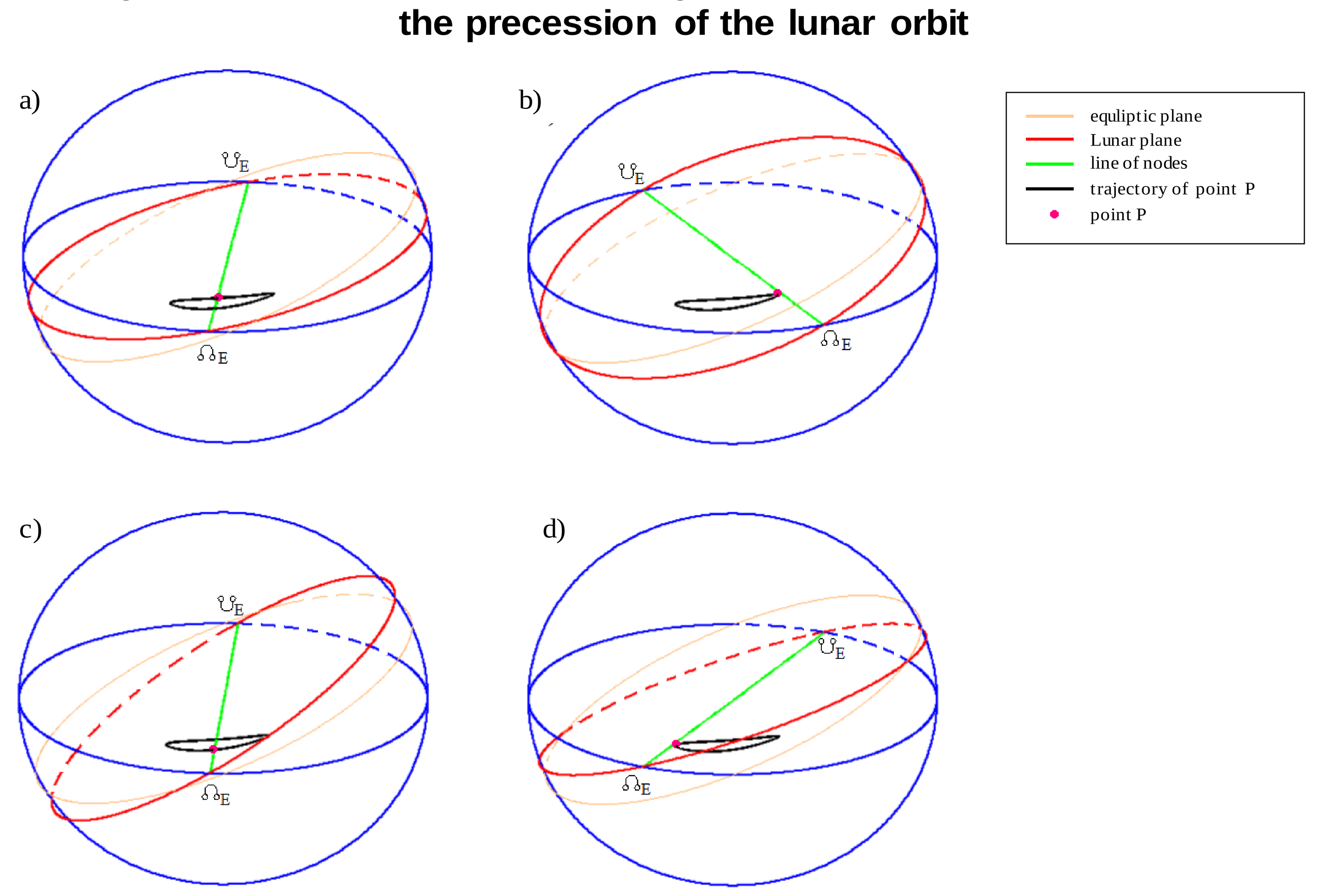
Trajectory of the motion of the Earth's pole in the coordinates $\{x_1,y_1\}$



The area bounded by the curve is smallest in a time interval close to the minimum of the inclination of the lunar orbit to the equator (1990.1–1996.7 and 1996.7–2002) and largest in a time interval in which the inclination is at a maximum (1983–1990.1 and 2002–2008.7)

4

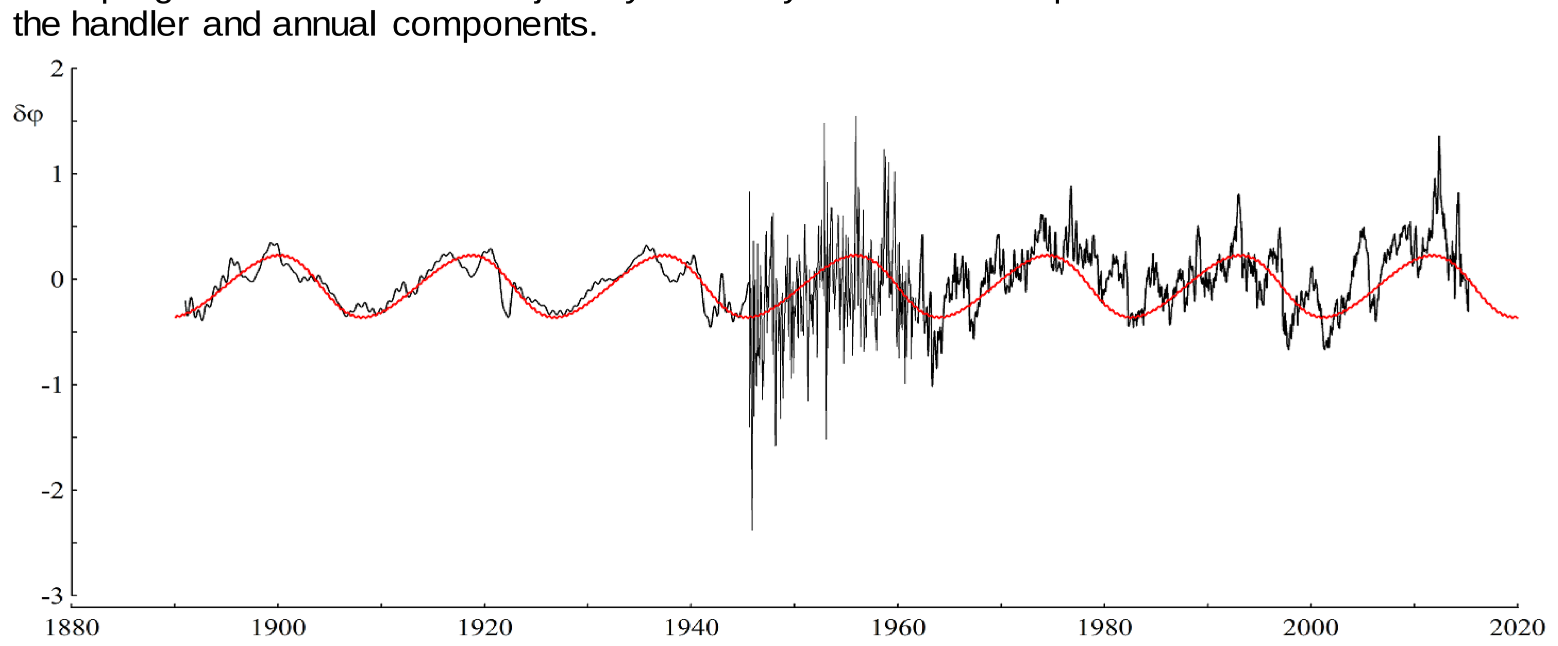
Synchronization of the oscillatory process of the Earth's pole and the precession of the lunar orbit



5

Variations of polar angle in the new coordinate system

We carry out a transition to another new frame (ξ, η) analogous to the first transformation, via successive shifts by a constant amount (centering of the trajectory) and rotation by the frequency inthe prograde direction. The trajectory in this system illustrates perturbations of the modulation of the handler and annual components.



It is shown that the significant impact into the variations of the basic pole oscillation components is given by the long-term perturbations from the lunar orbit. The analysis of these perturbations is held using the wavelet and Fourier transformations. On the long time interval it shows matching phases of the perturbed polar motion and the lunar orbit motion using the available series of observations C04 and C01 from the International Earth Rotation and Reference Systems Service. This feature can be used to refine the model of the forecasting the Earth pole oscillations. And taking into account these structural features of the oscillations the refined numerical-analytical model of the Earth pole motion is presented.

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