Dynamic modes in the model of neutral gas convection in the ionospheric F region under forced harmonic influence

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Numerical simulation methods are used to study the modes in the modified Lorentz dynamic system, which describe the distribution of the speed and temperature of convective rolls with thermophysical parameters of the neutral gas of the ionosphere F region under an external harmonic effect on the neutral gas temperature. The neutral gas model is built in the approximation the thermophysical parameters constant in a convective cell. During the model constructing, the effect of the geomagnetic field on the neutral component through interaction with ions and electrons wasn't considered. The external influence on the dynamic system is carried out by changing the parameters of the horizontal and vertical temperature distribution of the convective rolls.

This investigated dynamical system with given parameters and without external influence is in a state of equilibrium. However, when some threshold value of the external influence is reached, long-term transients occur between dynamic and static modes. Stable and unstable attractors are realized. The transition between them can be realized by the trigger switching mechanism. The duration of the transient process is understood as the ratio of the settling time of the dynamic mode or equilibrium state to the period of natural oscillations. This value depends on the chosen set of parameters and initial conditions and can vary from several tens to hundreds of thousands or more. Finding the durations dependence of the transient process establishment on the parameters is a separate task so it wasn't studied in this work.

In the present work, the phase portraits of the dynamics of the normalized velocity and temperature of convective rolls and the characteristic Fourier spectra are calculated. Stability maps of dynamic regimes are calculated. These maps allow determining the type of mode depending on the parameters of the dynamic system and external harmonic influence.