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Projection operators for the Rossby and Poincare waves in a beta-plane approximation

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Study of the wave structure variations of atmospheric parameters is a due to a solving of number practical problems associated with the weather and the state of the environment requires knowledge of the spectral characteristics of atmospheric waves. Modern methods, for identification of wave disturbances in the atmosphere, based on the harmonic analysis of observations. The success of these application is determined by the presence of sets of experimental data obtained in the long-term (over the period of the wave) of the atmosphere on a large number of independent observation stations. Currently, the system of observation in the atmosphere, both terrestrial and satellite, unevenly covers the surface of the Earth and, despite the length of observation, doesn't solve the problem of identification of waves.

Thus, the problem of identification wave disturbances conflicts fundamental difficulties, and solution needs in a new methods for the analysis of observations.

The work complete a procedure to construct a projection operators for large-scale waves in the atmosphere. Advantage of this method is the ability to identify type of wave and its characteristics only on the base of a time series of observations. It means that the problem of waves identification can be solved on the basis of only one station observations.

In the method assumed that the observed spatial and temporal structure of the atmosphere is determined by the superposition of different type waves. For each type of waves involved in this superposition, dispersion and polarization relations (between the components of the wave vector of the field) expect as known. Based on these assumptions, we can construct projection operators on the initial superposition state on the linear basis of vectors corresponding to the known type of atmospheric waves. The action of the design on the superposition state, which, in fact, is the result of observations, determine the amplitude and phase of the waves of a known type.

The idea to use the polarization relations for the classification of waves originated in radio physics in the works of A. A. Novikov. In the theory of the electromagnetic field polarization relations is traditionally included in the analysis of wave phenomena. In the theory of acoustic-gravity waves, projection operators were introduced in a works of S. B. Leble. The object of study is a four-dimentional vector (components of the velocity, pressure and temperature). Based on these assumptions, we can construct the projection operators for superposition state on the linear basis, corresponding to the well-known type of waves.

In this paper we consider procedure for construction of a projection operators for planetary Rossby and Poincare waves in the Earth's atmosphere in the approximation of the "beta-plane". In a result of work we constructed projection operators in this approximation for Poincare and Rossby waves. The tests for operators shown, that separation of the contribution of corresponding waves from source of the wave field is possible. Estimation accuracy of the operators and results of applying operators to the data TEC presented.