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Intra-seasonal oscillations as nonlinear planetary wave interactions

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In the last three decades some recurrent patterns have been found in different atmospheric data sets with periods 10-100 days which is now called intra-seasonal scale. The processes of this class have been discovered in rawindsonde time series of zonal wind, in the atmospheric angular momentum, atmospheric pressure, etc, both in the North and South Hemispheres. A number of comprehensive numerical models of the atmosphere has been developed, both deterministic and stochastic, reproducing to some extent known properties of intra-seasonal oscillations (IOs). But many aspects of them remain unexplained, for instance the reason of IOs in the North Hemisphere is supposed to be topography, and no reason is given for IOs in the South Hemisphere, there is no known way to predict the appearance of IOs, etc.

We propose a novel approach for description of IOs. Giving up the assumption that the process is dominated by a single mode and ground-atmosphere interaction is important, we suggest a model of IOs as intrinsic atmospheric phenomenon as related to a system of resonantly interacting triads of barotropic planetary waves that naturally have the period of desired order. We present classification of all resonant triads in meteorological significant domain, derive explicit formula for the period of energy oscillation among the modes in the triads and interpret main features of intra-seasonal oscillations in terms of isolated resonant triads of planetary waves. In the frame of this model many questions can be answered immediately, for instance: Why the period of "topographic" oscillation in North Hemisphere is given as 40 days by some researchers and 20-30 days - by other researchers? Why do the intra-seasonal oscillations are better observable in winter data? How do the tropical and mid-latitude oscillations interact? How to predict these recurrent features? and others. Baroclinic effects are not included in our model but can easily be included, if necessary.