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*On the dynamics of monsoon disturbances**

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ABSTRACT

The dynamics of the disturbances due to the instabilities of horizontally and vertically shearing mean monsoon flow have been studied. The necessary conditions for internal jet instability are satisfied, and a barotropic-baroclinic instability analysis of the observed zonal flow has shown that the fastest growing modes are mainly due to the barotropic instability of the upper level flow. The amplitude of the most unstable mode is confined to the barotropically unstable upper tropospheric levels and the primary energy conversion is from the zonal kinetic energy to the eddy kinetic energy. This may explain the occurrence of observed westward moving waves at 200 mb.

In an attempt to explain the formation of the monsoon depressions, the role of the CISK mechanism in conjunction with barotropic-baroclinic instability has been explored.

Instability analysis of vertically shearing zonal flows with prescribed vertical distribution functions for cumulus heating has shown that the horizontal scale, phase speed and structure of the most unstable mode depends upon the choice of the vertical heating distribution function. The horizontal scale of the most unstable mode is larger for those distribution functions that provide heating to the larger vertical depths of the atmosphere.

Instability analysis with the quasi-equilibrium assumption (QEA) of Arakawa and Schubert for parameterization of moist convection has shown that in a quiescent atmosphere the growth rate is a maximum for a perturbation of intermediate scale. The vertically integrated net heating is a maximum for the fastest growing mode. It has been shown that a two-layer model is not adequate for study of CISK with QFA parameterization of moist convection. For a two-layer model, the growth rates are infinite for the perturbations whose horizontal scales are proportional to the Rossby radius of deformation. In the presence of vertical shear, the cloud mass flux, as determined by QFA, becomes inversely proportional to the wavelength of the perturbation and the maximum growth rate occurs for the smallest scales.

A combined CISK-barotropic-baroclinic instability analysis of the observed monsoon flow has been performed using the quasi-equilibrium assumption for the parameterization of moist convection. The structure and energetics of the computed linear perturbations are in good agreement with the structure and energetics of the observed monsoon depressions. The results of this study suggest that CISK may provide the primary driving mechanism for the growth of monsoon depressions.

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