Title: The Effects of Latent Heat Release on the Waves with Ekman Pumping

Investigator:

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Significant Accomplishments to Date in FY-84:

(1) Two-level model: A slab-symmetric two-level model has been investigated with the presence of the lower boundary friction. The profile of the vertical motion is sinusoidal in the moist region, but exponentially decaying in the dry regions. The mass continuity constraint and the condition of the continuity of the normal component of the velocity at the interface between the moist region and the dry region are satisfied. The results are similar to the results of Charney and Eliassen (1964) but without their extremely large growth rates for some medium horizontal scale. The most favorable horizontal scale is the cumulus scale, but the most favorable doubling time is order of a day, and there exists a cut-off of the domain size of the moist region beyond which the system is stable. When the internal friction is included, the growth rates are reduced for most of the unstable mode, but the stability cut-off disappears.

(2) Three-level model: The corresponding three-level model has been investigated. The instability is sensitive to the ratio of the heating parameter in the upper layer to that in the lower layer and the corresponding static stability ratio. For the model without internal friction, the stability diagram with the heating ratio versus the domain size of the moist region shows that as the static stability ratio increases, the unstable spectrum increases for a given heating ratio. Depending on the parameters, the most favorable horizontal scale can range from the cumulus scale to synoptic scale. With the internal friction included, the stability cut-off disappears and two unstable modes appear for large domain size for some parameters.

Focus of Current Research Activities:

Currently, the problem of the effects of the latent heat release on the waves with both upper and lower boundary frictional effects is investigated.

Plans for FY-85:

The influence of the vertical shear of the basic wind in these models will be investigated. These investigations will shed some light on the method of solution to the problem of including the effect of Ekman pumping on the moist baroclinic waves in the model of Tang and Fichtl (1983).

List of Publications Prepared since June 1983:

Tang, C-M., and Fichtl, G. H., 1984: Non-quasigeostrophic effects in baroclinic waves with latent heat release. J. Atmos. Sci. 41 (in press).

References:

Charney, J. G., and Eliassen, A., 1964: On the growth of the hurricane depression. J. Atmos. Sci. 21, 68-75.

Tang, C-M., and Fichtl, G. H., 1983: The role of latent heat release in baroclinic waves — without β-effect. J. Atmos. Sci. 40, 53-72.