

TITLE: Utilization of Satellite Cloud Information to Diagnose the Energy State and Transformations in Extratropical Cyclones

PRINCIPAL INVESTIGATOR:

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SIGNIFICANT ACCOMPLISHMENTS IN FY-84:

The work during FY-84 has focused on two aspects of the project.

1. A study of the contribution of latent heat release to the synoptic scale vertical motions in our Jan. 9-11, 1975 extratropical cyclone case study was completed. Results indicate that early cyclone development was dominated by dry dynamical forcing. However, as the cyclone matured, the influence of latent heating became more significant. This influence appeared to be of two types, (1) the "direct" impact of heating causing a lowering of surface pressures, and (2) an "indirect" role in which the heating altered thermal and vorticity gradients and lead to subsequent increases in dry dynamical forcing.
2. The kinetic energy budget completed by Patricia Dare in her master's degree thesis was extended to include an available potential energy budget. Focusing on the eddy component of the budgets, results indicate that kinetic energy increased throughout the cyclone's development, with the increase being most pronounced after the onset of significant latent heat release. Latent heating played a strong role not only in generating available potential energy, but also in forcing baroclinic release of potential energy.

CURRENT FOCUS OF RESEARCH:

Our present focus is on further diagnoses of the role of latent heating in the January 1975 cyclone's evolution. This is being accomplished by solving the quasi-geostrophic height tendency equation separately for the vorticity advection, differential temperature advection, and latent heat forcing terms. We are especially interested in the relative importance of the latent heat forcing. In addition, comparison with observed height tendencies will indicate the extent to which non-quasigeostrophic processes are important.

PLANS FOR FY85:

As we enter the final year of the project, we plan to

- (1) complete the height tendency diagnosis,
- (2) complete the energy budget analyses, and
- (3) replicate our latent heat modification experiment using SESAME I conventional data and cloud images.

PUBLICATIONS PREPARED SINCE JUNE 1983:

Lin, S.-J., 1983: Utilization of Satellite Cloud Information to Improve the Estimation of Latent Heat Release. M.S. thesis, Dept. of Geosciences, Purdue University, West Lafayette, IN 47907.

Dare, P.M., and P.J. Smith, 1984: A comparison of observed and model energy balance for an extratropical cyclone system. Mon. Wea. Rev., 112, accepted for publication.

Smith, P.J., P.M. Dare, and S.-J. Lin, 1984: The impact of latent heat release on synoptic-scale vertical motions and the development of an extratropical cyclone system. Submitted to Mon. Wea. Rev.