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**TITLE:** Nonlinear Feedbacks Between Stratocumulus and Synoptic-Scale Systems

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## STRATEGY:

Widespread regions of low-level marine stratocumulus can affect tropospheric weather systems by perturbing the patterns of both radiative cooling and the vertical transports of sensible and latent heat. In turn, these systems control, in poorly understood ways, the cloud distribution. In our renewal proposal of June 15, 1992-June 14, 1995, we plan an observational, numerical, and theoretical study of this interaction that was initiated under NASA Grant NAG8-780. We shall relate northern hemisphere satellite-inferred and ground-based stratocumulus distributions to the amplitude and phase of stationary and traveling lower and mid-tropospheric synoptic-scale waves. At the same time, numerical models will be developed and used to study the implications of the stratocumulus-induced diabatic feedbacks. These results will be compared with the above observations. We ultimately seek a parameterization of these effects that could be incorporated into global climate models. We envision supporting two graduate students.

## PROGRESS DURING FY91:

We have collected wintertime and springtime stratocumulus observations for a number of 5-day periods. We find close correlations between the mean 850 and 500 mb trough positions and cloud over marine areas (Pavloski and Calkins, 1991). A linear study (Clark, 1991) of the radiatively-driven interaction between stratocumulus and synoptic-scale waves has been completed. Shallow surface-bound traveling waves are created that are strongly dependent on the phase relation between cloud and low-level flow. A nonlinear model (Kratz, 1992) is now under development that will permit a more detailed investigation of these interactions. Finally, a nonlinear study (Haack and Shirer, 1991) of the modification of the background flow by boundary layer roll vorticies has been revised for submission for publication.

## PLANS FOR FY92:

The observational study will be expanded to cover more cases and longer periods. Mean and transient components of the cloud distributions and the synoptic-scale wind and temperature fields will be related on a regional basis. The linear study initiated in FY91 will be extended to include cloud-driven interactions via synoptic-scale modulations of cloud-topped turbulent boundary layer sensible and latent heat transports. The nonlinear model will be used to investigate very simple scenarios of, and parameterizations for, diabatic feedbacks between cloud and large-scale flow.

## BIBLIOGRAPHY:

Clark, John H.E., 1991: Radiatively-induced interactions between low-level stratiform cloud and synoptic-scale motions, Mon. Weath. Rev., submitted for publication.

Haack, T. and H. N. Shirer, 1991: Mixed convective/dynamic roll vorticies and their effects on initial wind and temperature profiles, J. Atmos. Sci., submitted for publication.

Kratz, B., 1992: Stratocumulus modulated quasi-geostrophic flows, MS thesis, in preparation.

Pavloski, C. and J. Calkins, 1991: A stratocumulus cloud climatology, Undergraduate Special Project, Department of Meteorology, Penn State University.