TITLE: INVESTIGATION OF MESOSCALE PRE-CONVECTIVE FORCING MECHANISMS

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SIGNIFICANT ACCOMPLISHMENTS FY84:

A numerical mesoscale boundary layer model was installed and tested on the MSFC-ASD Perkin-Elmer computer system. A graphics driver utilizing the NCAR graphics package was also developed allowing cross-section and plan view depictions of model predictive fields. The boundary layer model output was also linked to ASD's general data management and analysis system MASS. Such a link allows direct comparison of model predictions with AVE-VAS ground truth data as well as potential comparison with VAS temperature and moisture fields.

The basic purpose of the current investigation was to diagnose the physical mechanisms leading to the development of an organized convective line during AVE-VAS IV (April 24, 1982). A data analysis was first made using the special rawinsonde network which showed a strong baroclinic zone developing in the region where convection was initiated (Figure 1). The observed wind field showed an easterly component developed in opposition to the synoptic flow producing convergence.

The numerical boundary layer model was used to diagnose the physical development of the above described thermal and flow fields. Two candidate physical mechanisms were examined: 1) topography and 2) cloud shading. The models were run in varying combinations including topography, without topography, with cloud shading, without cloud shading, etc.

The model results showed that while heated sloping topography alone did create a modest baroclinic zone and convergence values; cloud shading was apparently a stronger mechanism for producing a thermal field representative of observed conditions. Significant convergence values were associated with the cloud shading case which, based on sensitivity tests with a two-dimensional cloud model, could have sustained convection. Figure 2. shows the model predicted thermal and flow field for the case with cloud shading and topography which can be compared to observations in Figure 1.

CURRENT FOCUS OF RESEARCH

Present work is directed toward a three-dimensional simulation of the case outlined above to provide a clearer understanding of the organization of the convective line in terms of topography and cloud shading. Attention is also being directed toward the role of accelerations in the velocity field due to frictional reduction as the boundary layer stabilizes.

RECOMMENDATIONS FOR FUTURE RESEARCH

As shown in this study boundary layer forcing can play a major role in determining the pre-convective environment. A numerical model can assist in diagnosing this role; however, better parameterization is needed for cloud shading effects. Dynamic feed-back of latent heating is also required to extend model simulation into the convective phase. Additional evaluation of boundary layer forcing for other test cases is needed, especially nocturnal convection cases.

PUBLICATIONS:

R. T. McNider, G. Jedlovec, G. Wilson, 1984: Data analysis and model evaluation of the initiation of convection on 24 April 1982. Tenth Conference on Weather Forecasting and Analysis, AMS, Tampa, FL

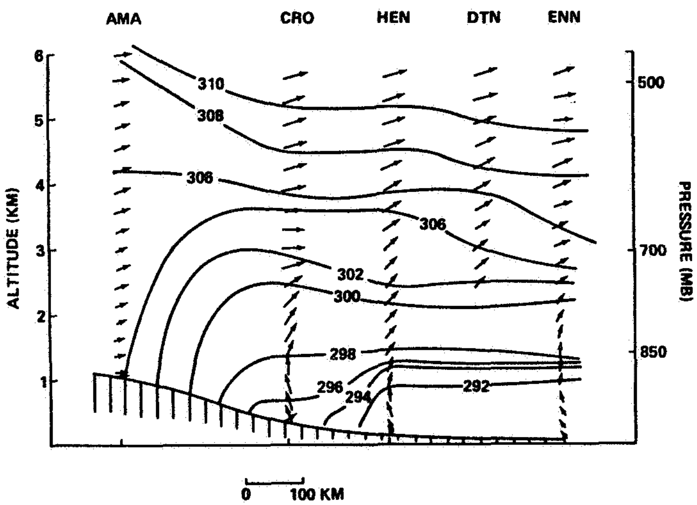

Figure 1. Cross-section analysis of potential temperature and horizontal winds. Cross-section runs from Amarillo along the Texas-Oklahoma border utilizing special network stations operating during AVE-VAS IV. Time is 2300Z. Contour interval is 2°K.

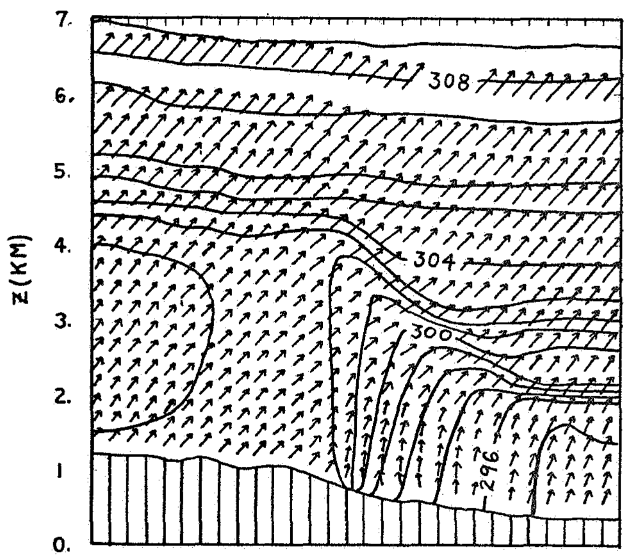

Figure 2. Cross-section of modeled temperature and winds employing cloud shading and topography as forcing functions. Time is 2000Z. Contour is 1°K.