Diagnostics from a 1-D Atmospheric Column

J. M. Flatley and G. Mace
The Pennsylvania State University
University Park, Pennsylvania

Various diagnostics were computed from an array of radiosondes during an intensive field operation arranged by the Department of Energy's Atmospheric Radiation Measurement (ARM) Program. The diagnostics were derived using objective analysis techniques applied to the radiosonde network data centered on the Cloud and Radiation Testbed (CART) site at Lamont, Oklahoma (Mace 1994).

In the current work, the apparent heat source (Q1) and apparent moisture sink (Q2) were computed (Yanai et al. 1973) and compared to the kinematic vertical velocity for both real data (i.e., objective analysis by applied radiosonde data) and the mesoscale analysis and prediction system (MAPS). Three different case studies, of various weather regimes, were examined from November 1994.

An example in which shallow convection occurred is shown by case 3 (06Z 05 Nov - 06Z 06 Nov 94). Upward vertical motion (Figure 1) associated with a cold front touched off precipitation between 11Z and 17Z (9 mm fell). The apparent heating (Q1), seen in Figure 2, reached a maximum between 10Z and 12Z (the incipient stage of the precipitation) and the apparent drying (Q2), seen in Figure 3, reached a maximum between 13Z and 16Z (during the main precipitation event).

The next phase of this research will be to extend the single column to the lowest l km of the atmosphere and to generate a precipitation estimate using the Q1 method (to compare with observations). Through comparison of the budget-derived precipitation estimate and the observed precipitation, the level of accuracy inherent in the data can be evaluated for processes relevant to atmospheric convection. The ultimate goal of this work will be the construction of data sets of cases by which objective analysis errors are below a critical threshold (Mace 1994) and are deemed useful for further diagnostics. These constructed data sets will then be exploited by validating the Integrated Cumulus Ensemble Turbulence (ICET) parameterization scheme currently being developed at Penn State.

Acknowledgments

I would like to thank my advisor, Dr. Jenni Evans for her guidance and suggestions. This research was supported under Department of Energy (DOE) Grant Number DE-FG02-94ER61773.

(a) J. L. Evans, W. Frank, and G. Young, personal commmunication.

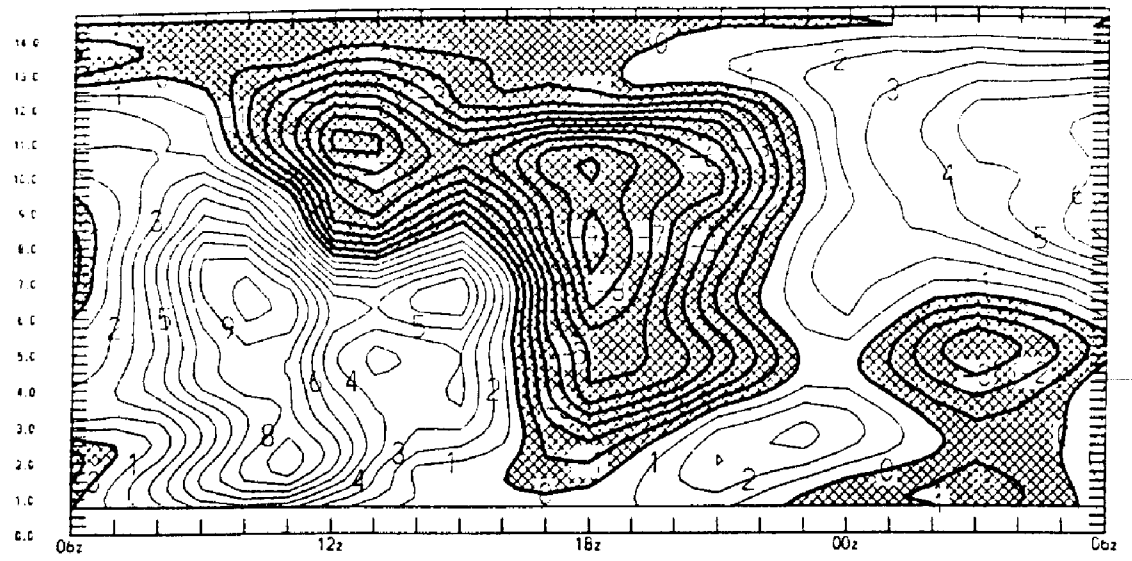

Figure 1. The kinematic vertical velocity at the CART site from 06Z 05 Nov - 06Z 06 Nov 1994.

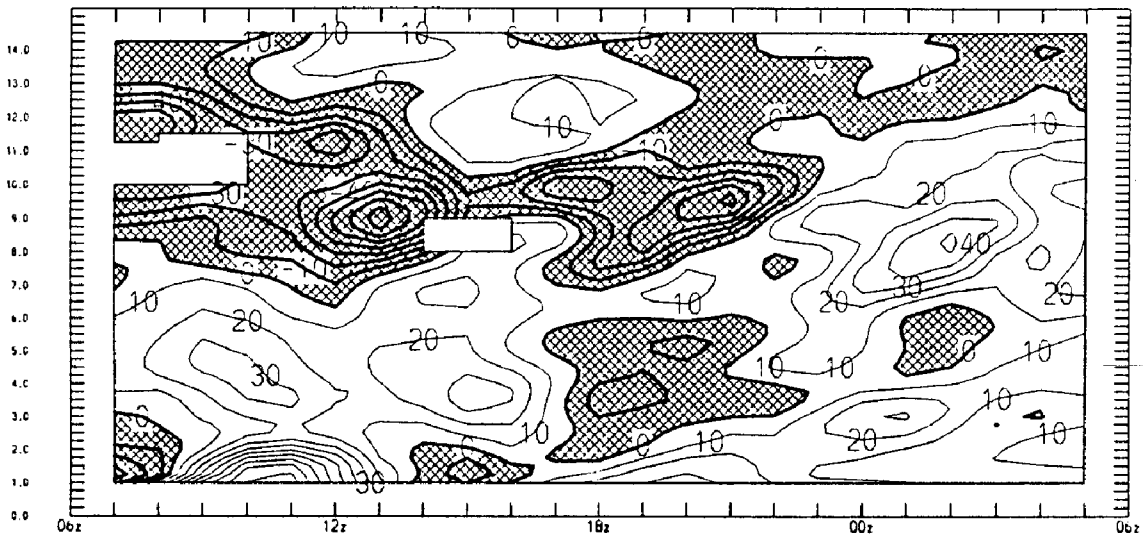

Figure 2. The apparent heat source (Q1) at the CART site from 06Z 05 Nov - 06Z 06 Nov 1994.

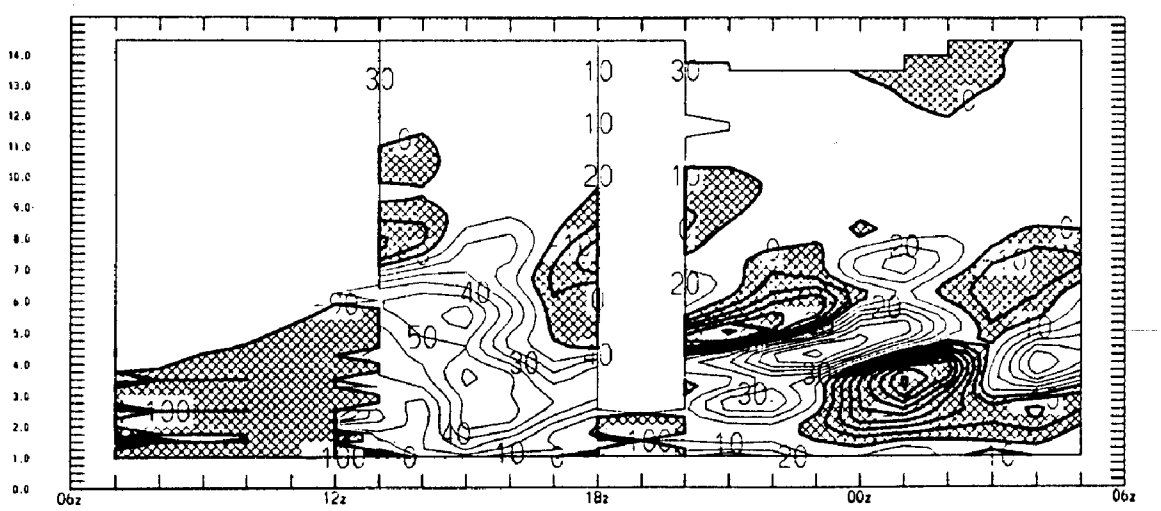

Figure 3. The apparent moisture sink (Q2) at the CART site from 06Z 05 Nov - 06Z 06 Nov 1994.

References

Mace, G. G. 1994. Development of large-scale diagnostic analysis techniques applicable to regional arrays of wind profilers and radiosondes. Ph.D. Thesis, The Pennsylvania State University, University Park, Pennsylvania.

Yanai, M., S. Esbensen, and J. Chu. 1973. Determination of bulk properties of tropical cloud clusters from large-scale heat and moisture budgets. *J. Atmos. Sci.*, **30**, 611-627.