TITLE: Cloud Scale Influences on Mesoscale Precipitation Patterns

RESEARCH INVESTIGATORS: Fred J. Kopp
USRA (Consultant)
South Dakota School of Mines
Rapid City, SD 57701
(605) 394-2291

Harold D. Orville
South Dakota School of Mines
Rapid City, SD 57701
(605) 394-2291

G. D. Emmitt (USRA)
Marshall Space Flight Center
Huntsville, AL 35812

SIGNIFICANT ACCOMPLISHMENTS FY84:

While a summer '83 visitor to the Marshall Space Flight Center a version of the Institute of Atmospheric Sciences' cloud model was brought up on the NASA computers. The model is a two dimensional, time dependent finite diffence grid model simulating atmospheric motions, potential temperature, water vapor, cloud liquid, cloud ice, rain and small hail. The nonlinear partial differential equations which make up the model are integrated on a 19 kilometer square grid with 200 meter spacing between grid points. Lateral boundary conditions are open allowing flow in and out of the model domain. The model is presently running on the Perkin Elmer 3250 and the IBM 4341.

A number of experiments have been run on two soundings taken on April 24, 1982 at Amarillo, Texas. The first sounding is from the morning and is very stable so little convection can be expected. Varing amounts of convergence are simulated to test the effects on cloud initiation and development. The second sounding taken three hours later at 1700Z is much warmer at the surface and much less stable. Runs made tested the effects of convergence on the convection; one case with divergence in the lower atmosphere was run.

The early morning sounding needed a convergence value of 10^{-4} per second before a cloud formed. The cloud became quite active during the simulation producing precipitation. Analysis of the results showed that the sounding changed during the simulation due to the convergence as well as diffusion effects. Results from the second sounding are more interesting. With this more unstable sounding, a cloud forms readily with no convergence. After a simulation of about 1.5 hours the cloud has formed precipitation and dissipated. With divergence of 2×10^{-5} a cloud forms but quickly dissipates with no precipitation falling to the ground. Convergence enhances the amount of precipitation in this case and the dynamics as well. The cloud is broader and the precipitation falls over a wider area.

FOCUS OF CURRENT RESEARCH ACTIVITIES:

During the summer of '84, more realistic convergence/divergence values will be taken from a mesoscale model which is being run to simulate the mesoscale dynamics on April 24, 1982. These more realistic values should result in a better simulation from the cloud model. Time varying values of convergence can be simulated to produce more realistic cloud dynamics. Graphics for the model will be brought up on the Perkin Elmer and hopefully the FR80. Comparisons with available observations will be made.

PLANS FOR FISCAL '85:

Additional cases could be run and quantitative predictions made of precipitation production under varying amounts of dynamic forcing. Eventually, near real time estimates of precipitation could be attempted using combined mesoscale and cloud scale models.

PUBLICATIONS:

Cloud Scale Influences on Mesoscale Precipitation Patterns. Report to NASA, 1983, 23p.