In this exercise, the student will use the idealized model CM1 to demonstrate the relationship between characteristics of the environmental wind shear and supercell evolution.

Suggested experiments

Conduct separate model experiments with environmental wind profiles characterized by 35 m s^{-1} of wind variation over a "quarter-circle" and then "straight-line" hodograph curve, and then comment on the:

(a) time for the initial cell to completely split, (b) symmetry of the resultant cells, (c) magnitude and cell-relative location of the maximum vertical vorticity at 7200 sec, and (d) orientation of the horizontal vorticity vectors relative to the gradient of potential temperature.

Model setup and other instructions

Installation, setup, and execution of this CM1 is fairly straightforward (see: http://www.mmm.ucar.edu/people/bryan/cm1/). A typical Linux workstation will be sufficient to execute this numerical model.

The preceding experiments assume a computational domain defined by:

`nx = ny = 120; nz = 40`

`dx = dy = 1000.; dz = 500.`

The "Weisman-Klemp" analytic sounding is used; the environmental winds are defined by namelist variable `iwnd`, and, as noted above, are characterized by a hodograph length of 35 m s^{-1}. These and other parameters are defined in *namelist.input* file (as can be obtained from http://web.ics.purdue.edu/~jtrapp/namelist.input.quarthodo and http://web.ics.purdue.edu/~jtrapp/namelist.input.straighthodo.

To allow for comparison with previous studies (e.g., Weisman and Rotunno 2000), this particular model setup assumes rain-only precipitation, via the "Kessler" microphysical parameterization scheme. Change the namelist variable `ptype` to 2, 3,4, or 5 to include the effects of ice microphysics.

The *namelist.input.straighthodo* file takes advantage of the CM1 option to introduce additional parameters. Here:

`var1` = vertical depth of linearly increasing unidirectional shear (m) (model variable **udep2**)

`var2` = value of (unidirectional) environmental wind at height **udep2** (m s^{-1}) (model variable **uconst2**)

These parameters were set in the source file *base.F* , in directory src (see http://web.ics.purdue.edu/~jtrapp/base.F for an example).

One software application that can be used to display the model output is NCL (see http://www.ncl.ucar.edu).

An example script can be obtained from http://web.ics.purdue.edu/~jtrapp/cmplot.ncl

The output (as a pdf file, by default) shows horizontal cross-sections, at two different levels, of: water vapor water mixing ratio and winds. vertical vorticity and winds, and perturbation potential temperature and winds.

A separate script

http://web.ics.purdue.edu/~jtrapp/cm1series.ncl

graphs a time series of maximum vertical velocity, maximum surface vertical vorticity, and maximum vertical vorticity at 3 km. The output is also a pdf file, by default.