AT 741 **Homework 3** **Spring 2008**

Tentative Due Date: Thursday, April 24th

Overview of Assignment

Your task for this homework will be to complete a dual-Doppler synthesis of a convective system and describe the resulting kinematic and microphysical structure of the storm. You will be working with CSU-CHILL and CSU-Pawnee (both S-band) radar data that was collected during the passage of a quasi-linear convective system on 2 August 2001. While the Pawnee radar is a non-polarimetric Doppler radar, CHILL has polarimetric capability and measured ZDR, RHOhv, LDR, and PHIdp. KDP was then diagnosed from PHIdp.

On the AT 741 web site, you will find the following files pertaining to this assignment:

- CHL20010802_020101.uf.gz (CHILL UF radar file)
- PAW_2aug01_0201.uf.gz (Pawnee UF radar file)
- reo_chill.inp (input REORDER file to interpolate CHILL data to a cartesian grid)
- reo_pawnee.inp (input REORDER file to interpolate Pawnee data to a cartesian grid)
- cedric_input.txt (input CEDRIC file to do dual-Doppler synthesis)
- at741_doppler.sh (script to run REORDER and CEDRIC)
- low level CHILL reflectivity PPI's at 01:54:54 and 02:06:53 UTC (to determine storm advection for the dual Doppler synthesis; ignore figure date stamps: images are from 2 August 2001)

There are several steps that must be completed in order to do the dual-Doppler synthesis.

A. Create sweep files from the Pawnee UF file

To break up the Pawnee UF file into individual sweep files (and to output the sweep files in the current directory), run the command "uf2swp CHL20010802_020101.uf .". There should be 21 sweep files for 21 different elevation angles. Do this only for the Pawnee dataset. Leave the CHILL UF file as it is. You will not be editing the CHILL dataset.

B. Clean and unfold the velocity data

This procedure is described in the SOLO handout. You will need to unfold velocities for the Pawnee radar only. The CHILL dataset has already been unfolded for you (the unfolded velocity field in the UF file is VT). Note that before you begin unfolding the Pawnee velocity, you may want to clean up the field by thresholding with NCP (NC in SOLO). Once you copy the velocity field (VR) to a new field (VT), run the command "threshold VT on NC below 0.25" on every sweep. Then despeckle the velocity field using the command "despeckle VT" at every sweep. That should help. When unfolding the Pawnee velocity field, note that the Nyquist velocity for the Pawnee radar is 26.4258 m/s.

C. Create a new Pawnee UF file containing the unfolded "VT" field

Use the script "swp2uf" to take the edited Pawnee sweep files and generate a new Pawnee UF file. This script uses the xltrsii translator and requires 3 inputs: input directory, radar name, and output directory (unless you want the UF file created in the current directory; then you do not need the third input). To create a new Pawnee UF file in the directory containing your edited sweep files, type: "swp2uf . PAWNEE ." at the command line. You should get a resulting file named something like "ufd.tape". Rename this file to "pawnee.uf". Also, rename the CHILL UF file to “chill.uf”.

D. Interpolate radar data to a cartesian grid (actually done in step E)

This will be accomplished using the REORDER software (documentation available at: http://radarmet.atmos.colostate.edu/radartools.html). REORDER uses input files to specify the location of the radar, the location of where to center the interpolated grid, the size and resolution of the domain, and how to weight the data surrounding a grid point. We didn’t cover this in class so just use the files provided on the web site: “reo_chill.inp” and “reo_pawnee.inp”. REORDER will generate a gridded file for each radar: chill.ced and pawnee.ced. Note - these .ced files won’t appear until after you set up the CEDRIC input file and run the script “at741_doppler.sh” in the next step.

E. Perform the dual Doppler synthesis

The NCAR CEDRIC software (Mohr, C. G., and L. J. Miller, 1983: CEDRIC — A software package for cartesian space editing, synthesis, and display of radar fields under interactive control in Preprints of 21st Conference on Radar Meteorology, pp. 559 –574, Am. Meteorol. Soc., Boston, Mass.) will be used to do the dual-Doppler synthesis.

CEDRIC has been setup to run from an input script “cedric_input.txt”. You must modify this text file to run the program properly. You will need to estimate the storm motion vector (angle and speed; angle is the direction from, not towards, so if the storm is moving towards the east for example, the storm motion angle is 270 degrees). The text file also requires you to interpolate the datasets to a specific time: choose 020330 UTC (hhmmss). Once the input file is set up, you can execute the REORDER and CEDRIC steps by typing “./at741_doppler.sh cedric_input.txt” at the command line.

After the script has finished, you should have 3 .ced files (chill.ced, pawnee.ced, and synthesis.ced) and 1 NETCDF file (synthesis.nc) in your directory (note – you can convert the chill.ced and pawnee.ced to NETCDF by using the command “ced2nc filename.ced” at the command line). You will also see a file “dualdop.input” which shows how the actual CEDRIC input file looks based on your input and the default settings.

F. Visualize the data

You can use available software to view the dual Doppler synthesis (will be posted on the class website with this assignment) or your own software. The radar group has a set of IDL routines to display NETCDF files in /usr/local/idl/cdf_radar. Start IDL and type “cdf_radar” at the command line. Also, 2 additional IDL programs are available for displaying the cdf data: “cdf_cappi_wnd1.pro” will plot CAPPI’s of reflectivity with wind vectors overlaid. “cdf_profile.pro” will calculate histograms and mean profiles of u,v,w, and dbz as a function of height and plot these quantities.

Specific tasks for this homework assignment:

1. Use SOLO to unfold the Pawnee velocity data and create a corrected UF file
2. Perform the dual-Doppler synthesis using REORDER and CEDRIC. When performing integrations with CEDRIC, choose downward integrations with a variational adjustment on w (reasons for this will be covered in class).
3. Present an analysis of the 2 August 2001 convective line, utilizing both polarimetric output from CHILL (you'll probably want to convert the chill.ced file to NETCDF) as well as reflectivity and kinematic output from the dual-Doppler synthesis. While the assignment is fairly open for interpretation, the main focus should be a discussion of overall storm structure (location of convection, intense downdrafts, updrafts, convergence, divergence, etc.). What is going on microphysically (any hail, supercooled raindrops aloft)? Include any plots you feel appropriate to describe your main points (hint: aside from other types of plots, a vertical cross section through the convection would be nice to see).
4. Please turn in only one writeup per group
   -do not turn in code
   -do not include plots or detailed discussion showing how you did steps 1 and 2. Your writeup should focus on analysis.

cedric_input.txt

Enter First cedric radar data file with best DBZ field

Enter other cedric radar data file

Enter output cedric file

Enter Grid Domain: xmin xmax xdelta

Enter Grid Domain: ymin ymax ydelta

Enter Grid Domain: zmin zmax zdelta

Enter time (hhmmss) to advect to

Enter Advection wind direction (deg) and speed (m/s)

Enter Name of Radial Velocity Variable of first radar

Enter Name of Radial Velocity Variable of second radar

Enter Dual Doppler Domain (likely the same as the grid): xmin xmax

Enter Dual Doppler Domain (likely the same as the grid): ymin ymax

Enter height grid domain above melt level: zmin zmax

Enter height grid domain below melt level: zmin zmax

Choose upward or downward integration: (U/D)

Do you want a variational adjustment on W (spread out the error): y/n