ATMO 352
Severe Weather and Mesoscale Forecasting

Laboratory #1

Section 502, Friday
01-19-07

Due: By beginning of next lab session (01-26-07)

Note on Collaboration:

Unlike exams, which must reflect your own individual effort, working toward solutions to problems in laboratory assignments can be a collaborative endeavor. Forecasting is typically a team effort so we encourage you to discuss the lab assignments with your neighbor. However, each student *must* write her/his own answer in her/his own words to each question. We will *not* accept verbatim copies of answers for any laboratory assignment.

Introduction:

The purpose of this laboratory assignment is to give you some experience in manipulating meteorological data in GARP (GEMPAK Analysis and Rendering Package). GARP can display meteorological observations of many sorts – surface METAR, upper-air radiosonde data, GOES satellite, WSR-88D radar, wind profiler data, and NLDN lightning data. GARP also displays a wide range of numerical model output variables in plan projection, time-height, vertical cross section and vertical profile mode. Available numerical weather models include the AVN, ETA, MRF, NGM, RUC, and ECMWF. We will learn more about these observations and numerical models as we progress through the class. GARP can zoom into regions of interest, plot animations of any model or observational data, overplot data (e.g., surface observations on satellite), allows many user options to customize look of plots, and allows saving of GIF files of created images. The flexibility of GARP is the reason that we will use it as a key learning and forecasting tool in ATMO 352 to supplement data this is also available on the Internet. For example, see a few useful links here - http://www.met.tamu.edu/class/atmo352/

Some basic instructions:

- *Starting GARP*: Just enter the command "garp" (case-sensitive) in a terminal window after logging into your UNIX account.

- *GARP User's Guide*: There is an online "User's Guide" that is available via the "Help" drop down menu in the upper right hand corner of GARP. Most information that you will need is available in "The Interface" link and subtopics below. You can also link directly here - http://weather.ou.edu/computing/gempak/garp/UserGuide.html. There is also a tutorial here - http://www.unidata.ucar.edu/packages/gempak/tutorial/garp.html

- *Selecting Data for Viewing*: Each of the ten icons beneath the drop down Menubar refers to different meteorological data types. If the data type is not obvious to you from the icon, just begin by placing the mouse over the icon. Just click on the data icon that you need and an image product menu will pop up. In this menu, select the data source, scale, product type, and available time as desired and needed. Note that not all of these options will be required for each plot. Just select from what GARP presents. There are other options not discussed here. Feel free to explore.

- *Data Animations*: In the image product menu discussed above, you can select multiple times for animations by using the *Ctrl* button when selecting available times. There are "VCR-like buttons" (located to right of data icons) for viewing and controlling the animation.

- *Over-plotting Data*: GARP can plot multiple data tops in the same frame. After making a plot (e.g., of surface METAR data), you can select a different data type (e.g., satellite data) and over plot onto the existing image. There are clear and reset buttons in Menubar above when you want to start over.

- *Zooming:* You can zoom into any image by left clicking on the image and then drag and drop the zoom box that automatically appears over the area of interest. You can return to the DEFAULT or other views by using the "Area" drop down menu.

- *Interrogating Data:* You can actually determine the date, time, latitude, longitude and raw value of any data source by moving the mouse along the data and viewing the data at the bottom of the display. This is useful for determining exact locations.

- *Saving GIF files*: Select "File" in the GARP Menubar and then enter name of file to save (e.g., surface.gif) and select apply. It will save it in the local directory where you ran GARP.

- *Subsequent GIF image Viewing, color editing, and printing*: Use the "xv" command in a UNIX terminal window to view the image. (Note: You may need to start a new terminal window if GARP is running in your only currently open window). For example, type "xv surface.gif" to view GIF image saved above. You should see your saved image. Right click on the image with your mouse and a menu will pop up. Before printing, we must change any expansive black GARP background to white so we don't waste printer ink. To do this in xv, select "Windows," and then "Color editor." Put the cursor on the black block in the colormap editing window. Using the RGB color dials, select (255,255,255) for (R,G,B) by rotating the dials all the way clockwise (this is white). Select close. Select print button using greyscale option. It should print on the HP Laserjet printer. If you want to save the changes, select "save" and then select GIF image type, greyshade, and input desired filename at the bottom. Note: there are other image viewing and editing software available on the UNIX machines. Feel free to use any software that you like to get the same job done.

- *Problems*: Sometimes GARP crashes. Just accept it with grace and start over (it's free software so we can't complain too much)! If GARP is not behaving well but is still running, try "Clear" and "Reset" buttons in the Menubar. This fixes most problems. If it doesn't, then quit GARP and start over.

Below are a few simple exercises to introduce you to GARP. We encourage you to explore GARP beyond this lab. The best way to learn is by doing. Please report any GARP or other UNIX computer problems in the LINUX lab (Rm 1201) immediately to Dr. Larry Carey (Rm 1110c), Mr. Kevin Viner (Rm 1013), or Mr. Neil Smith (Rm 1212).

Exercises: (30 total points)

NOTE: For all sub-questions, please provide the time (UTC) for each map that you are using.

1. **GOES Satellite Data: (6 points)**
   - **a.** (2 points) Using GARP, display the most recent GOES-12 (Geostationary Operational Environmental Satellite) infrared (IR) (4 km resolution) image. *Briefly* describe what you see over the contiguous United States (CONUS).
   - **b.** (1 point) Repeat a. with GOES-12 visible (VIS) (4 km) data.
   - **c.** (2 points) Create an animation or loop (about six hours) of GOES-12 visible data. Use the animation toolbar to loop back and forth through the image. Briefly describe any insight into current cloudiness conditions you get from looping the data.
   - **d.** (1 point) With your animation running, try zooming into a cloudy region. (First zoom into Texas and then zoom into west Texas until you see county boundaries). Briefly describe any further insight that you get from zooming and running your animation.

2. **WSR-88D Radar Composite Data: (5 points)**
   - **a.** (2 points) Using GARP, display an animation (e.g., about 1 hour) of WSR-88D (Weather Surveillance Radar – 1988 Doppler) radar reflectivity composite data at low-levels over the United States. Select LEVELIII data source, 1 km data scale, product n0r (reflectivity), and about six files to loop. Briefly describe what you see.
   - **b.** (2 points) Zoom into the same region of west Texas that you viewed with satellite above until you see county boundaries. Describe what you see in the animation over west Texas. What is the range of radar reflectivity (dBZ) associated with the precipitation system there?
   - **c.** (1 point) What WSR-88D (three letter identifiers) are viewing the precipitation of interest? Hint: You can plot radar identifiers using "Station Overlay - NEXRAD" and also radar range rings in the "Options" drop down menu.

3. **WSR-88D Individual Radar Data: (4 points)**
   - **a.** (2 points) You can plot radar reflectivity and Doppler velocity data (and other parameters such as precipitation accumulation) from individual WSR-88D radars (NIDS). Using the closest radar (use three letter identifier) from problem 2c

above to the precipitation of interest, plot radar reflectivity (N0R). Compare and contrast to what you saw above.

b. (2 points) From the same radar, plot the Doppler velocity (N0V) and describe what you see. Note: we learn more about this later.

4. Surface Meteorological Data (METAR) (7 points)

a. (2 points) Make an image of CONUS surface METAR data. Zoom into Texas. What range of temperatures do you see in Texas? Is there any cloud cover or weather in the state? If so, briefly summarize.

b. (1 point) Save a GIF image of your surface plot of Texas and print to hand in with write-up. Be sure to change the background color from black to white before plotting (see directions above).

c. (1 point) Over-plot the GOES-12 IR satellite data for this time over Texas. Does the satellite data agree with the surface observations? Explain.

d. (2 points) Zoom into College Station, Texas (CLL). What's the pressure, temperature, dewpoint, wind direction and magnitude and any cloud cover or weather over CLL? (Include units. Review station model if necessary!).

e. (1 point) Make a loop over about six hours for the CLL region of surface observations. Record how the temperature changed over the period.

5. Upper air radiosonde data (3 points)

a. (1 point) Make an image of the 500-mb pressure level meteorological data at a selected date and time.

b. (1 point) Zoom into Texas. Save the image as a GIF and make a plot to hand in.

c. (1 point) Record the 500-mb temperature, dewpoint, height, and wind magnitude and direction over Dallas Fort Worth Texas (FWD). Remember that you can plot locations of upper air stations.

6. Model data (5 points)

a. (2 points) Create an animation of the contoured height (m) of the 500-mb pressure level using the AVN numerical model using all available forecast times over the CONUS. Describe what you see – what pattern (troughs/ridges), how does it evolve?

b. (2 points) Over-plot the same for the ETA model, are the two models forecasting the same pattern and progression of the 500 mb surface during the overlap period (0-60 hrs)? Describe any differences in the forecasted height pattern.

c. (1 point) Make a printed copy of one of the overlaid 500 mb height plots (any interesting time up to 60 hrs) from the loop in b above. Hand in with writeup.