

Mesoscale Meteorology: Assignment #5

Due 28 March 2017

1. (15 pts) On Fig. 1, please isopleth 2-m dew point temperature ($^{\circ}\text{F}$, every 5°F from $20\text{-}70^{\circ}\text{F}$) in green and 2-m temperature ($^{\circ}\text{F}$, every 5°F from $40\text{-}75^{\circ}\text{F}$). Label each isopleth. From the analysis and other data on the figure, indicate a dryline and cold front using their typical symbols. Justify your answers.
2. (15 pts) On Fig. 2, please isopleth 2-m dew point temperature ($^{\circ}\text{F}$, every 2°F from $58\text{-}72^{\circ}\text{F}$) in green and 2-m temperature ($^{\circ}\text{F}$, only at 84°F , 86°F , and 88°F). Label each isopleth. From the analysis and other data on the figure, indicate a sea breeze front. Justify your answer.
3. Request KTLH (Tallahassee, FL) “Level III (Products) (ALL)” data for 21 June 2016 from 2100-2200 UTC from NCEI. Copy the Order ID in the e-mail notification, load the NOAA Weather and Climate Toolkit from Assignment 1, and enter the Order ID into the entry box under the NCEI/CLASS order tab and click on “List Files.” Zoom to the Florida panhandle in the background display window.
 - a. (5 pts) Create an animation of Base Reflectivity (0.5 elev angle) data between 2107-2153 UTC. Describe what you see and how it evolves with time.
 - b. (5 pts) Close the animation and load a single image: Correlation Coefficient (0.5 elev angle) at 2107 UTC. Uncheck the “Reset Zoom” box before doing so. What are the correlation coefficient values in association with the primary feature from (a)? What does this imply about the nature of scatters found along this feature?
 - c. (5 pts) Compare the location of the primary feature in (b) to that from question 2. (If it helps, you can add county borders and ASOS/AWOS locations to your plot by clicking on “Layers” on the left side of the plot window.) How closely do they match up? Describe locations where departures between the two are evident. Why might these departures exist?
4. (20 pts) For this question, you will be using the GrADS software to create model analysis-derived charts for fields related to the sea breeze. In instances where precise steps are not described below, please refer to Assignment 4 for the applicable details.

Start by going to <http://derecho.math.uwm.edu/classes/Meso/assignments/A5>. Use wget in the terminal to download each file from this directory. Open GrADS and open the control file that describes the data:

open nam.ctl

These data are valid at 0000 UTC 22 June 2016. We wish to create a vertical cross-section between 1000-900 hPa from $29.5\text{-}30.5^{\circ}\text{N}$ along 85°W . Thus, the desired display window is set as follows:

```
set lat ### ###  
set lon ###  
set lev ### ###
```

As before, ###s should be replaced with the desired numbers and western longitudes should be prefaced with negative signs. Since pressure does not vary linearly with height, we wish to have the vertical axis for this cross-section vary with $\ln p$. This is done as follows:

```
set zlog on
```

Set the display color to white and then clear the screen. We wish to plot three fields on our chart, in order: temperature (K, shaded), height anomaly from the 29.5-30.5°N mean height (m, black contours), and horizontal wind (kt, white barbs).

To display a shaded field, you must tell GrADS to plot a shaded plot:

```
set gxout shaded
```

After you display temperature (variable name: tmprsr, units: K), add a color bar to your chart by running the cbarn.gs script you downloaded:

```
run cbarn.gs
```

To display a contoured field after displaying a shaded field, you must tell GrADS to plot a contoured plot:

```
set gxout contour
```

You can specify a single color for the mean height contours (variable name: hgtprsr, units: m) as follows:

```
set ccolor #
```

The # should be replaced by the desired color. For a background color of white, 1 = black and 0 = white. Other color numbers: <http://cola.gmu.edu/grads/gadoc/16colors.html>. For a generic variable X, the anomaly from the mean over a given latitude band can be displayed as follows:

```
display X-ave(X,lat=###,lat=###)
```

As before, replace the ### with the appropriate values; the lowest of the two comes first.

To display barbs, you must tell GrADS to do so:

```
set gxout barb
```

You can specify a single color for the wind barbs as you did for the height contours above. Note that the wind variables ugrdprsr and vgrdprsr are in m/s.

Once your plot has been created, save it to an image file. Include the plot you created with your completed assignment. Describe your plot; what does it show?

5. (15 pts) Continuing in GrADS, start by clearing the screen. Set the level to a single value of 1000 hPa. We now wish to create a line plot of 1000-900 hPa layer-mean temperature (units: K) along 85°W from 29.5-30.5°N. This will help us consider the vertical circulation (in the y - z or y - p plane) associated with the sea breeze along 85°W at this day and time.

Just as the `ave()` function was used in #4 to compute the average along some latitude band, it can be used to compute and display the average between two levels; simply replace `lat=` with `lev=`. Note that the level closest to the surface comes first.

After displaying the field, label your axes:

`draw xlab _____`

`draw ylab _____`

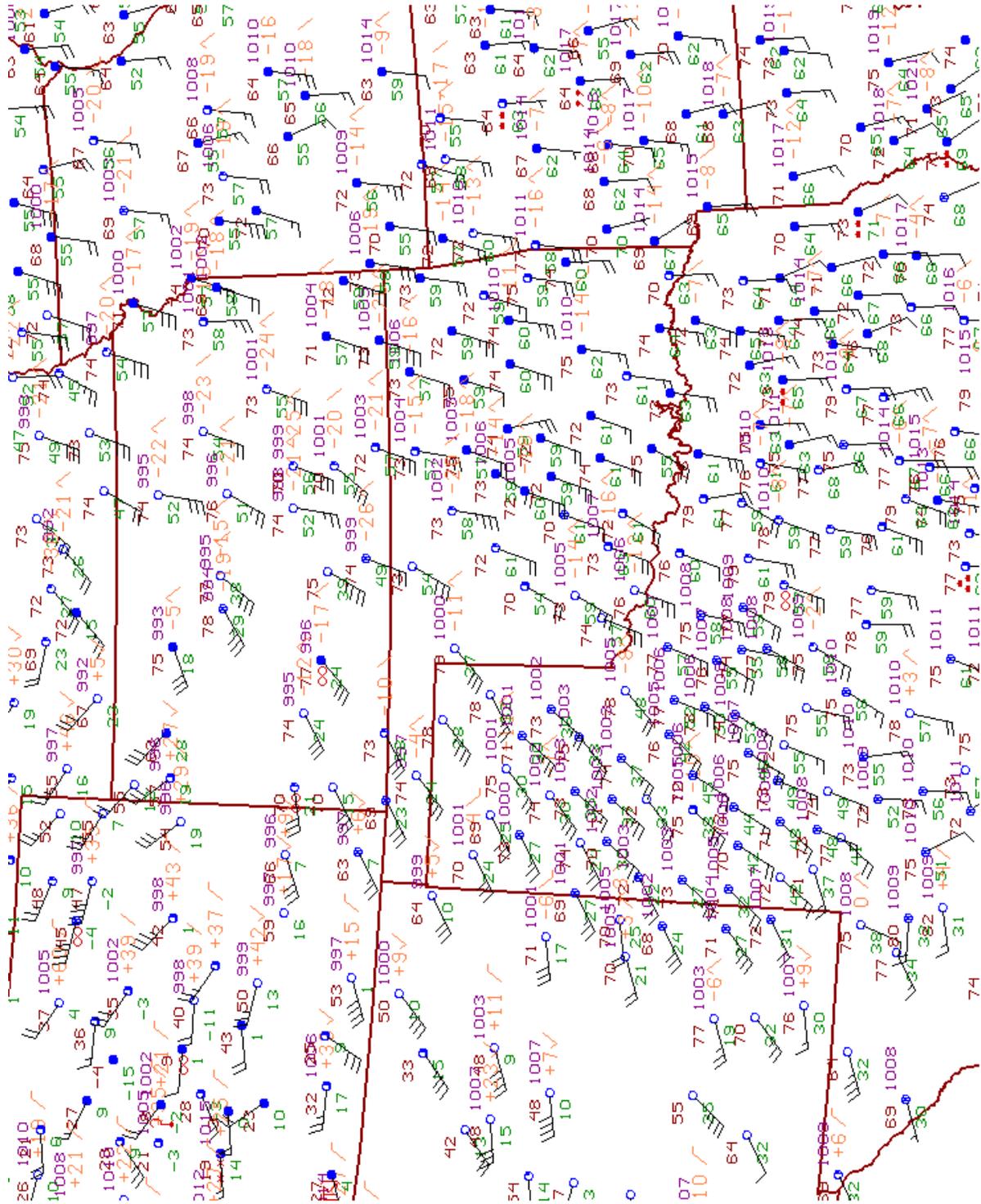
Here, the _____ are replaced by what you wish to label the axes. You are free to choose your labels for each axis, but please give units with the axis label where appropriate. Once your plot has been created, save it to an image file. Include the plot you created with your completed assignment.

Next, interpolate the values of 1000-900 hPa layer-mean temperature at 29.6°N and 30.4°N from your chart. Using the hypsometric equation, compute the 1000-900 hPa thickness at each point. Show all work. Assume that this thickness difference is found in equal parts on the top and bottom of the layer. How does your calculation compare to the latitudinal variation in height anomaly from the zonal mean plotted in your response to #4? Discuss.

6. (20 pts) Assume layer-mean temperature is equivalent to layer-mean virtual temperature. Based off of the interpolated layer-mean temperature values from #5, please compute the resulting change in circulation following the motion (in units of J kg^{-1} , which are equivalent to $\text{m}^2 \text{s}^{-2}$). Show all work, including units, and ensure your answer has correct sign.

Next, compute the perimeter of the vertical circulation. From your change in circulation and the perimeter of the vertical circulation, compute the resulting change in flow around the perimeter of the vertical circulation following the motion. Show all work. Assume that the flow is initially at rest (i.e., $v = 0 \text{ m s}^{-1}$). What is the average value of the inland-directed flow over this 1 h period? How far inland will an air parcel along this flow travel in 1 h?

Return to the radar data from #3. Along the radial extending due north-south from the radar, how far inland does this feature travel between 2107-2153 UTC? How does it compare to the circulation-derived answer above? Discuss potential reasons for disagreement between the two values; note that there are several potential culprits on both sides of the argument.



170306/1800 Sfc Southern Plains Plot

Figure 1: Station plots of 2-m temperature ($^{\circ}\text{F}$, red), 2-m dew point temperature ($^{\circ}\text{F}$, green), sea level pressure (hPa, purple), 10-m wind (kt, barbs), surface pressure tendency (orange in hPa*10), and cloud cover (circles, blue) valid at 1800 UTC 6 March 2017. Figure obtained from the West Texas Mesonet (<http://www.mesonet.ttu.edu/Tech/1-output/gempak.html>).

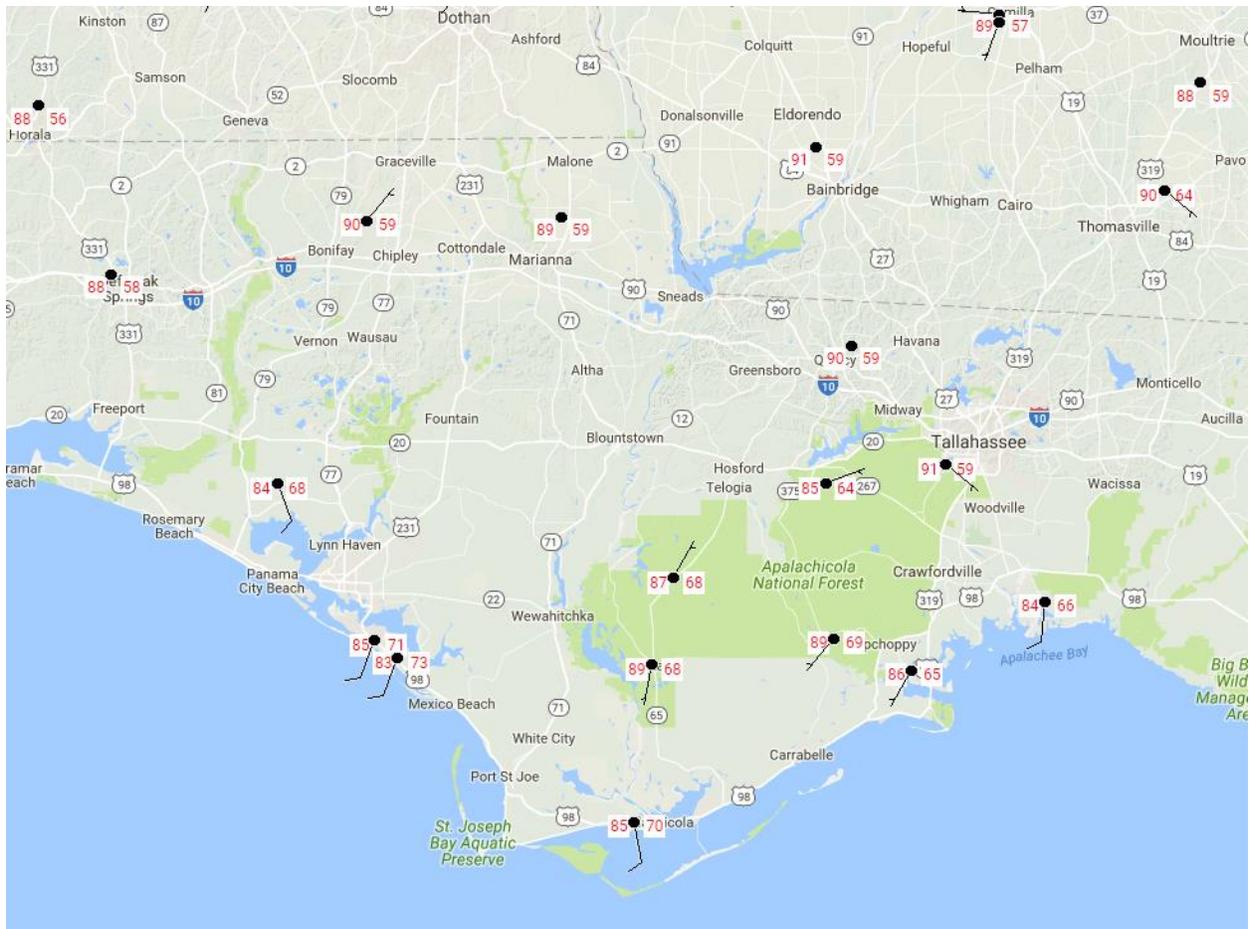


Figure 2: 2-m temperature (°F, value in left box for each station), 2-m dew point temperature (°F, value in right box for each station), and 10-m wind (kt, barbs) valid at 2100 UTC 21 June 2016. Data obtained from MesoWest (<http://mesowest.utah.edu/>).