**Part I (60 pts, 15 pts per map set):**

The Jupyter Notebook I’ve provided for this lab contains code for 4 different automated or “objective” analysis routines. Each block of code will load or analyze the data provided and plot it on a map. The four different analysis methods are:

Observation only methods:

1. 1-pass Cressman (1959) scheme.
2. 2-pass Barnes Analysis scheme (Koch et al. 1983)

Observation + NWP methods:

1. A 6-hour forecast from the 12-km North American Model
2. 2-pass Barnes Analysis scheme using the 6-hour NAM forecast as the first guess.

These analysis methods are shown on a 40-km grid that is centered over the U.S. and encompasses many of the same radiosonde data points you analyzed in our upper air analysis lab (only May 19, 2017 00 UTC.) In this lab, we’re going to look at some of the sensitivities of the various analysis schemes and compare these automated analysis methods to each other and the manual analyses you performed a few weeks ago. Should the weather behave next week, I also have a SPC forecaster (Roger Edwards, lead forecaster and hand analysis extraordinar) performing his own analysis for you to compare with.

For your assignment, you’ll need to recreate the various upper air analyses you made manually a few weeks ago, but using the automated methods instead. You’ll need to recreate your 850, 700, 500, and 300 maps. You’ll need to refresh yourself on the various contours we put on those maps (e.g., height contours, isotherms, isodrosotherms, height tendencies, constant lapse rate contours, isotachs, etc.).

I’ve provided much of the code and examples in the Jupyter Notebook I’ve provided to you.

There are a few things you’ll need to do to complete this lab:

1. Write a function that converts the NAM temperature and relative humidity grids into dew point so you can plot the 850-mb dewpoint contours. You’ll need to code up Clausius-Clapyeron or something similar to get this done. The NAM grids do not provide dew point at isobaric levels, so you’ll need to calculate this on your own.
2. Read up on the clabel() and contour() functions on Matplotlib so you can learn how to plot line contours on the maps. Making plots with multiple contours on it with contourf() can get quite messy. Contour() is just like contourf(), but there are some different arguments you’ll need to provide. Clabel() will label your contour lines. I’ve provided some examples of how contour() and clabel() work.

Once you have completed this you’ll be comparing twelve maps (three sets of maps) to one another. One set will be from the manual analyses we did a few weeks ago, the next set will use only observations (you choose either Barnes or Cressman analyses), and the final set will use NWP analyses somehow in the analysis (you choose). Visually put, these should be the 12 maps:

|  |  |  |  |
| --- | --- | --- | --- |
| **Pressure Level** | **Manual Analyses** | **OBS Only Analysis (1 or 2)** | **OBS + NWP Analysis (3 or 4)** |
| 850 mb |  |  |  |
| 700 mb |  |  |  |
| 500 mb |  |  |  |
| 300 mb |  |  |  |

Below is a sample map that illustrates what I’m looking for. I’m providing the code that made this map so you can see how it’s done (I did not include the dewpoint depression less than 5 ˚C areas due to space):

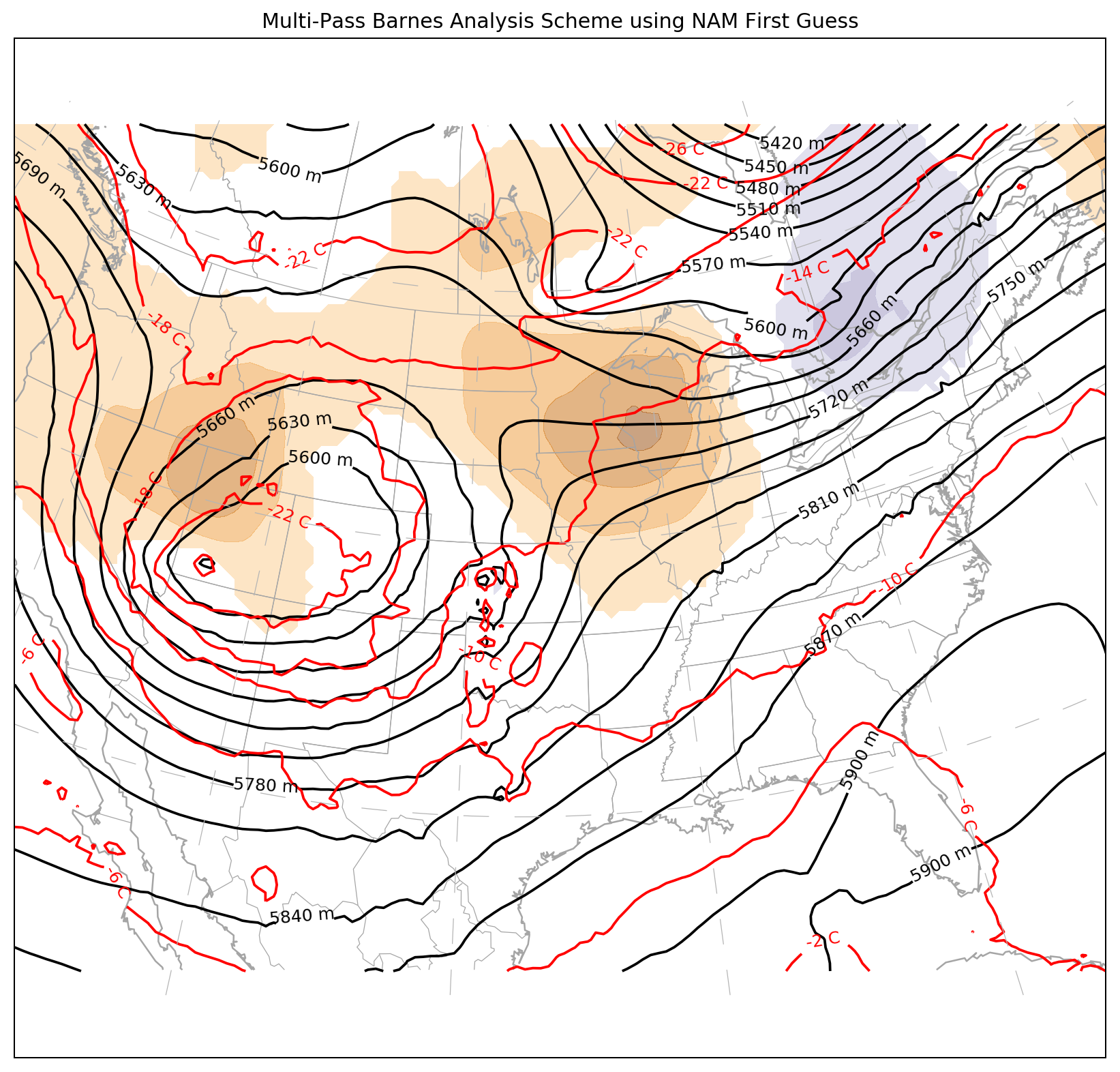


Figure . An example 500-mb chart showing the height contours (every 30 m, black), isotherms (every 4 ˚C, red), and height tendencies (purple – negative and orange – positive, starting at -30 m and 30 m, with every 30-m contoured). The analysis scheme used here is the Multi-Pass Barnes Analysis using the 6-hour forecast from the NAM as the first guess.

When you turn it in, include the 8 maps you created from the automated analyses. Include a key, perhaps similar to the one I’ve included in the caption above.

**Part II (25 pts):**

Write two paragraphs comparing the different analyses. What is different? What is similar? How do the automated methods compare to the manual analyses you did before? What differences do you think matter when trying to diagnose the current state of the atmosphere? Discuss this using meteorological terminology. Example question: Do the different analyses suggest the 850-mb front is either weakening or strengthening (frontolysis or frontogenesis)?

**No quiz next week. I’m tired of making them, so the 15 points normally going towards the quiz will be included in the lab.**