ATM 400: Synoptic Meteorology I
Lab #1: Plotting 250-hPa heights, isotachs, and ageostrophic winds with Python
Due: Wednesday, September 11

For your first lab assignment, you will be plotting maps of 250-hPa heights, isotachs, and ageostrophic winds using the NCEP–NCAR Reanalysis data set. The dates/times you will plot, from Superstorm 1993, are (in YYMMDD/HHMM):

930311/0000
930311/1200
930312/0000
930312/1200
930313/0000
930313/1200
930314/0000
930314/1200

To begin, copy the template Jupyter notebook from */kc11/kristen/ATM400/notebooks/Lab1.ipynb* into your */home/<userid>/atm400* directory. Open the template and <u>read it through carefully</u> before you begin to edit it (recall you can login to the JupyterLab at *https://ash.atmos.albany.edu:8000/user/<netid>/lab*). The template will produce a plot for each of the times above, <u>after you fill in</u> the *#FILL HERE* blanks correctly.

To help you to fill in the blanks, please consult the example plot posted on the class website (for contour and fill intervals) and the following example notebooks that Kevin and Ross went through in ATM 350: */spare11/atm350/common/apr11/04_GriddedDiagnostics_Frontogenesis-CFSR.ipynb*, */spare11/atm350/common/apr11/01_GriddedDiagnostics_TempAdvection-CFSR.ipynb*, and */spare11/atm350/common/apr11/03_GriddedDiagnostics_DivergenceIsotachs-CFSR.ipynb*.

Also helpful will be the following links to MetPy's diagnostic functions/meteorological calculations, units library, and example plots/code:

https://unidata.github.io/MetPy/latest/api/generated/metpy.calc.html
https://unidata.github.io/MetPy/latest/tutorials/unit_tutorial.html
https://unidata.github.io/python-gallery/examples/index.html

Note: I recommend you create separate folders in your *atm400* folder for each lab and **chmod** the folders so that others cannot access them before the labs are due. After class on the due date, however, please **un-chmod** the folders so that Evan may grade your code and plots.

Analysis questions:

1. The 250-hPa (i.e., jet-level) winds are often used as an approximation for the thermal wind. Why?

Using this approximation, where would $\vec{\nabla}T$ point over Buffalo, NY at 0000 UTC 14 March? Reason out your response using the thermal wind equation and the right hand rule. Please draw a sketch depicting appropriate arrows for the directions of $\vec{V}_T$ and $\vec{\nabla}T$ as part of your answer.

2. Following our in class discussion of Uccellini and Kocin (1987), locate a time/date and area where the circulations associated with two jet streaks overlap and constructively interfere to produce strong upward (or downward) motion. Carefully describe the geographical area of constructive interference and which quadrants of the jets overlap.

3. Discuss the differences in the pattern (i.e., direction, strength, divergence) of the ageostrophic winds in the exit regions of the jets located over the Gulf of Mexico and over northern New York/New England at 1200 UTC 13 March. Do the patterns match the theoretical picture we discussed in class? Why or why not?