AOSC 470/600
Homework #3 -- "OCTOBOMB" Python Graphics
DUE: FRIDAY 23 September 2016 (5 p.m.)

Following the manual analysis of one of the times for the 2010 Upper Midwest cyclone, we will follow up by creating some computer generated graphics using python. For this assignment, you will be using the same times as HW #1, with the assigned times are as follows:
26 October 2010, 00 UTC: Bagadia, Hansford, Seibert, Benish, Stratton
26 October 2010, 06 UTC: Bolt, Kahn, Vernon, Cavanagh, Thomas
26 October 2010, 12 UTC: Caron, Malloy, Vitelli, Junghenn
26 October 2010, 18 UTC: Clements, Murphy, Arcomano, Sengupta
27 October 2010, 00 UTC: Fowler, Rose, Beckley, Sharma

For the above times, you can find reanalysis data here:
/data/op/dkleist/aosc600/data/oct2010/cfsr/pgbhnl.gdas.yyyymmddhh.nc
or
/data/op/dkleist/aosc600/data/oct2010/narr/narr-a_221_yyyymmdd_hh00_000.nc

Here, yyyy = four digit year, mm = two digit month, dd = two digit day, and hh = two digit hour. These are two different reanalysis data sets (cfsr is global half degree data, narr is North American on the "221" grid). The files have different contents, so be sure to use ncview or ncdump before getting two far. Feel free to use either the narr or cfsr data.

Assignment: AOSC470 students, please complete two of the three graphics. For AOSC600 students, please complete all three of the following:

1. Plot 500 mb Height (color filled with associated color bar, 30m interval) and mean sea level pressure (contoured, 4 mb interval) on the same plot. The plot should be something along the lines of the Unisys ECMWF graphics:
   http://weather.unisys.com/ecmwf/ecmwf_500p_4panel.gif

   Hint: The pressure tendency graphic in the tutorial had color filling and contouring on the same graphic.

2. Plot the 500 mb absolute vorticity (color-filled with associated color bar) and 500 mb heights (contoured, 30m interval). For this, compute the relative vorticity from the wind field using the gradient routine in numpy (which will give you du/dx, du/dy, dv/dx, and dv/dy). Be sure to combine your computed relative vorticity with coriolis (note you have an array containing the latitude already). Please do this using the NARR data. Hints were sent via email. Feel free to compare your result with the contents of the CFSR data (ABSV_500hgt).

3. Plot one variable of your choosing to help identify where there may be a lower tropospheric frontal zone. Feel free to use temperature, potential temperature, water vapor, or gradients thereof.