SIO 217B Atmospheric and Climate Sciences II

Exercise #2

1. a) It is usually more convenient to use pressure rather than height as a vertical coordinate. Thus, instead of examining spatial variations in pressure at constant height (e.g., mean sea level), we will examine spatial variations in the height of a constant pressure surface (e.g., 1000 hPa). Write down an equation for calculating the geopotential height at which the pressure is 1000 hPa (i.e., Z_{1000}) in terms of SLP (hint: hypsometric equation). We also need to know the mean layer temperature $\langle T \rangle$ between Z_{1000} and mean sea level. Where SLP is less than 1000 hPa, Z_{1000} is less than 0 gpm and the 1000-hPa pressure surface fictitiously extends below sea level.

   b) Download the file containing SLP data for 1993 March 14 00Z and use it to calculate Z_{1000}, assuming for convenience a uniform temperature of 275 K for $\langle T \rangle$. Plot the calculated Z_{1000} in the domain 20-55°N, 230-310°E. A contour interval of 40 gpm (e.g., –40, 0, 40, etc. gpm) may be best. Check the correctness of your calculation by downloading Z_{1000} data for 1993 March 14 00Z and plotting it over your calculated Z_{1000} using a different color or line pattern. Due differing methods (particularly the use of uniform $\langle T \rangle$), we do not expect perfect correspondence, but there should be good agreement between the two datasets.

2. Plot downloaded Z_{1000} for 1993 March 14 00Z in the domain 20-55°N, 230-310°E. Over this, plot downloaded SLP for 1993 March 14 00Z using a different color or line pattern. Note the very close correspondence between regions of low SLP and low Z_{1000} and regions of high SLP and high Z_{1000}.