EAS372 Assignment 1 Due: Tues 29 Jan., 2013

Format: Please submit a tidy, organized report covering the exercise below. Report should be single-sided, double spaced with font size 12 pt. The page limit is **two**, not counting figures[1].

Task: Record a two week time series (two points per day) of (a) the 1000-500 hPa thickness (b) temperatures (T_{850}, T_{700}, T_{500}) at a Canadian radiosonde station[2]. Thickness can be obtained from the soundings (see course URLs) or (less accurately and more laboriously) by interpolating between contours on the CMC 500hPa analyses at 00Z and 12Z. Likewise, temperatures could be taken off the analyses, but it is simpler to grab all needed data off the sounding text data.

Let any given point in the thickness time series be labelled ΔZ_i ($i = 1...28$). Compute the mean value $\overline{\Delta Z}$ of your thickness time series, and form the series

$$q_i = \frac{1}{2} \left(\Delta Z_i - \overline{\Delta Z} \right) \ [\text{dam}] \tag{1}$$

(the factor of two corresponds to the relationship between changes in thickness and changes in mean layer temperature). Graph your time series q_i. Alongside, but with an arbitrary offset on the q-axis, plot the time series of the following (crudely-computed) layer mean temperature,

$$\langle T_i \rangle = \frac{1}{9} \left[2\, T_i^{(850)} + 3\, T_i^{(700)} + 4\, T_i^{(500)} \right] . \tag{2}$$

Explain the relationship you find between q_i and $\langle T_i \rangle$ by appeal to the hypsometric equation (Lackmann's Eqn. 1.37. You may safely ignore the difference betwen virtual and actual temperature in the cold, dry winter atmosphere; the gas constant for dry air $R_d = 287\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$ and with sufficient accuracy $g_0 = 9.81\,\text{m}\,\text{s}^{-2}$; $p_{low}/p_{up} = 1000/500$).

Comment: Note that we are using two different types of average in this exercise. The time average is denoted by the overbar, and the height average by the angle-brackets. You may find it helpful to add an arbitrary constant offset to your values of $\langle T_i \rangle$, e.g. the average value $\overline{\langle T_i \rangle}$.

[1] This upper limit should not be interpreted as meaning you *must* fill two pages. One will not necessarily score better for 2 pages than for 1.5 or 1.75.

[2] No more than two students to use the same station.

Organization of the data

The index i orders your data in time. Presumably it is easiest to perform the needed calculations in a spreadsheet, which might resemble Figure (1).

Table 1: Stony Plain sounding data organized for calculation.

i	Day	Time	Z_{500}	Z_{1000}	ΔZ	$q_i \equiv \frac{\Delta Z - \overline{\Delta Z}}{2}$	T_{850}	T_{700}	T_{500}	$\langle T_i \rangle$
1	10Jan/11	12Z	5420	321	5099		-19.5	-19.1	-32.3	-25.1
2	11Jan/11	00Z	5420	317	5103		-17.1	-19.3	-32.1	-24.5
3	11Jan/11	12Z	5400	300	5100		-16.5	-19.3	-32.5	-24.5
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28	23Jan/11	...								
Avg.					5100.7					