EAS270, "The Atmosphere" Assignment 1

Professor: J.D. Wilson Value: 10% Due 18 Oct., 2006

Instructions: **A maximum of two pages, including your graph, will be marked.** Your assignment need not be typed, but, tidiness and legibility will factor into your score. You may work with others, however you must hand in work that reflects your own reasoning and writing.

Daily cycle in the surface energy balance

The surface energy balance states that

$$Q^* = Q_H + Q_E + Q_G$$

where the sign convention for the fluxes has been defined in the powerpoint lecture file (note: evaporation rate $E = Q_E/L$, where $L = 2.5 \times 10^6$ J kg^{-1}). Table (1) provides an example of the daily cycle in the components of the energy balance (if you wish you may download a file 'flanagan.txt' containing these data from the course web site).

- plot each of the four fluxes with respect to time (all four on the same graph). You may use software of your choice; or hand plot the data on *proper* graph paper (which may be purchased at the UA bookstore). Be sure to label your axes, identify each plotting symbol, etc.
- give a brief interpretation[1]
- compute these 24 hour totals[2]
  - transfer of sensible heat to the atmosphere in [J m^{-2}]
  - transfer of latent heat to the atmosphere in [J m^{-2}]
  - transfer of water to the atmosphere expressed in [kg m^{-2}]
  - equivalent loss of stored soil liquid water expressed in [mm] (note: the conversion factor is the density of liquid water, i.e. 1000 kg m^{-3})

Don't forget that any written communication should be structured so as to have an identifiable Introduction, Main Body, and Conclusion.

T.A.'s office hours are Tues/Thurs 11-12 and 1-2 pm, and her email address is prozny@ualberta.ca (please pre-arrange a time to visit Tanya if you need some guidance).

[1] You are not required to research this topic beyond what has been covered in class. However if you wish to do some background reading, you may consult "Boundary Layer Climates" (2nd edition) by T.R. Oke, which is on reserve in Cameron Library (see especially Chapter 1 Section 3c, p20, titled 'Diurnal energy balance at an ideal site').

[2] This is done by summing up the product of each hourly estimate of the rate x 3600 sec.

Table 1: Daily cycle in hourly-averaged energy balance components over grassland in Alberta. 1 July 2003. (All fluxes in W m^{-2}; data courtesy of Dr. L. Flanagan; file flanagan.txt)

End time [MDT]	Q^*	Q_G	Q_H	Q_E
1	-77	-17	-117	23
2	-68	-17	-67	11
3	-38	-25	2	-2
4	-37	-29	2	-2
5	-31	-27	-5	-1
6	34	-19	-26	2
7	134	-4	3	72
8	262	13	42	136
9	312	28	60	212
10	438	31	99	272
11	518	45	162	315
12	632	65	213	316
13	633	68	208	339
14	595	61	200	347
15	563	54	167	337
16	347	34	73	278
17	311	28	53	230
18	209	13	-35	139
19	81	1	-52	111
20	-15	-5	-44	55
21	-62	-11	-103	23
22	-63	-14	-106	17
23	-62	-14	-77	12
0	-66	-15	-101	19