**Lab Assignment #1**

**ECE 597UU/697UU, Fall 2009**

(Posted on the course website on Thu, 5 Nov; due in class on Thu, 12 Nov)

## Estimation of the surface flux of sensible heat

The sensible heat flux at a height $z$ is defined as

$$H(z) = c_p \rho \langle w'(z) T'(z) \rangle, \tag{1}$$

where $\langle\rangle$ stands for "expected value of", $c_p$ is the specific heat of dry air at constant pressure, $\rho$ is the air density, and $w'(z) = w(z) - \langle w(z) \rangle$ and $T'(z) = T(z) - \langle T(z) \rangle$ are the fluctuations of vertical velocity and of temperature, respectively.

**Task 1:** Download the .mat file and the .m file from the Lab #1 webpage. The .mat file contains 24 hours of 5-Hz data of vertical velocity $w$ and of temperature $T$. The two time series were measured in Amherst on 15/16 September 2009 with an ultrasonic anemometer/thermometer ("sonic") about 1 m above ground level. The .m file contains a Matlab code that (a) loads the data file into the Matlab workspace, (b) performs some basic data processing to estimate the sensible heat flux $H$ at the level of the sonic, and (c) plots time series of $H$.

**Task 2:** "Transcribe" the Matlab code into a sequence of "textbook-style" mathematical equations (as opposed to Matlab code) embedded in explanatory text.

**Task 3:** Interpret the plots generated by the processing code that I provided. Consult Chapter 5 of Garratt, *The Atmospheric Boundary Layer* (1992). Compare the $H$ time series with that shown in Garratt's Figure 5.5 (p. 126). What is similar, what is different? Why?

**Task 4:** Refine the data processing such that you obtain a $H$ time series that has as little scatter as the one in Garratt's Figure 5.5. Explain!

**Grading:** The Lab #1 report will be graded according to the following criteria: (a) **readability**, conciseness and logical flow of the text, (b) neatness, clarity and correctness of **figures** including axis labels, choice of colors and symbols, and readability of the figure captions, (c) correctness and completeness of **mathematical equations** including the **verbal definitions** of the symbols in those equations, (d) qualitative and quantitative **understanding** of the measurements. – I will grade each of the four items on a scale from 5 (very bad) to 10 (excellent) and sum them up. A total of 20 is equivalent to a numerical grade of 50% (very bad), and a total of 40 is equivalent to a numerical grade of 100% (excellent).