Final Project Report

To be completed for
Meteorology 130 Boundary Layer Meteorology
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Due: May 19, 2008

The San Jose Urban Turbulence Project: Pilot Study 2008

Overview
The goal of this project is to analyze turbulence data collected on the roof of Duncan Hall during two days. The analysis will consist of calculating turbulence statistics and creating a final, written project report.

The final project report will be completed using student teams consisting of three students per team. Each team is required to independently process all data required, write programming scripts to perform needed calculations, plot the data for analysis and interpretation, interpret and analyze the data, and finally write up your results in a professional format report.

Data
There is one data set consisting of 10 Hz instantaneous values of $u$, $v$, $w$, $ts$, $q$, and $tc_e$ taken at the top the meteorological tower located on the northeast corner of the meteorological observation deck. where $u$ is the horizontal wind component in the east-west direction, $v$ is the horizontal wind component in the north-south direction, $w$ is the vertical velocity, $ts$ is the sonic temperature, $q$ is the absolute humidity, and $tc_e$ is thermocouple temperature. The data files are on the course website: http://www.met.sjsu.edu/~clements/met130_data/Final_project

Units: (also see datalogger program) $u$, $v$, $w = [m s^{-1}]$; $Ts = [^oC]$; $q = rhow2 [g m^{-3}]$; $tc_e = tce10 [^oC]$. Some variable name inconsistencies exist: $q = rhow2$ and $tc_e = tce10$.

Note: Typically the convention for $u$ and $v$ components is as follows: a positive $u$ represents a wind from the west while a negative $u$ represents wind from the east. The sonic anemometer that was used during this experiment is configured such that the +U represents east winds opposite from the standard convention. This also applies to the $v$ component. So to remedy this, you should convert the $u$ and $v$ data back to the original convention by simply multiply each series by -1. For more information refer to the RM Young 81000 sonic anemometer manual online here:

Part I.
From the data set collected during the experiment calculate the following turbulent statistics using a 30 min averaging period:

1. variances: \( u'^2 \), \( v'^2 \), \( w'^2 \), \( t_s'^2 \), \( q'^2 \), \( t_{ce}'^2 \)
2. TKE
3. friction velocity, \( u_* \)
4. momentum fluxes: \( \overline{u'w'} \) and \( \overline{v'w'} \)
5. heat and moisture fluxes: \( \overline{w'q'} \), \( \overline{w't_s'} \), \( \overline{w't_{ce}}' \)
6. Now, take your \( u \) and \( v \) components and calculate your conventional wind speed and wind direction. Average both to 5 min.
7. Finally, average all the instantaneous values to 1 Hz \((u,v,w,t_s,t_{ce},q)\).

Part II.
Now that you have calculated the necessary statistics, plot each one as a time series. Make sure your graphs are clear and labeled correctly. You should plot similar statistics on the same graph for comparison and analysis.

Here is an idea of how to layout and plot your results:

First plot your 1 sec averaged quantities for the entire period to pick out any interesting features during the period. Next, plot your variances for each variable. Maybe plot the wind variances on one graph and temperature variances on another graph. Next plot your TKE and \( u_* \) on one single. Plot your momentum fluxes on one graph, plot your sensible heat fluxes and latent heat flux on one graph. Finally, plot wind speed and wind direction to help you determine background wind conditions.

Part III.
Now that the plotting is complete, have a look over your plots. Look for interesting features in the time series. Begin writing what you see and describe the features in as much detail as possible. Try to discuss the nature of the turbulence measured. If needed, calculate other parameters to help in your analysis. Include any references you use to help in your analysis. Your report should include a description of the background ambient atmospheric conditions, the site location, any possible errors associated with the calculations, the order in which your calculations were made, and any assumptions used to calculate the fluxes.

Format:
The write-up should follow AMS format and the figures should be referred to correctly within the text. Maximum length is 20 pages, single space, including figures. Do not embed the figures into the document. Place them at the end of the document in proper order.

Finally, the report should indicate the amount of effort that went into the project from the team. To determine this, simply add up the total combined number of hours each team
member worked on this project. List only one number for the entire team (each team member’s total hours added together). Multiply this number by 150. Each team member has to sign the report where this total number is indicated. Typically, this would be on the cover page.