P 1.22 PRELIMINARY RESULTS OF A NEW LABORATORY EXERCISE TO STUDY MICROSCALE SPATIAL TEMPERATURE CHANGES ON A UNIVERSITY CAMPUS

Steven B. Newman*
Central Connecticut State University
New Britain, Connecticut 06050

1. INTRODUCTION

Microscale spatial changes in temperature have, traditionally, been very difficult to measure without expensive instrumentation. This has historically made it impossible to conduct such measurements within the confines of a laboratory exercise in the Introductory Meteorology curriculum. However, with the increasing availability of low cost, handheld, sensitive digital thermometers, it is now possible to produce highly accurate spatial analyses of small-scale temperature changes. On the Central Connecticut State University campus in New Britain, Connecticut, one finds a mix of park-like and urban concrete settings, as well as elevation changes which lend themselves well to such microscale temperature studies.

2. METHODOLOGY

Students were sent out, in teams of two, to 21 different points on the University campus. These points were distributed among athletic fields, roadsides with heavy traffic flow, and concrete and grassy areas amid the various campus buildings. The elevation of the campus varies, with high points at the northeastern and western ends (about 1 km apart), and low points at the campus center near Point 8. Figure 1 shows the CCSU campus, along with the 21 points where students made simultaneous temperature measurements with handheld digital thermometers/wind meters (see Figure 2). These particular instruments are available from various online vendors for around $40 each. The students returned to the lab and all readings were posted on the board at the front of the room. The students recorded the temperatures on a blank campus map and performed an isothermal analysis of the data using a contour interval of one degree Fahrenheit. The Fahrenheit scale was chosen as it is more sensitive to small scale changes than the Celsius scale. Students were asked to comment on the analysis and explain why the temperature pattern looked the way it did, based on the buildings and topography of the campus, along with the current weather conditions. Introductory lab instructions given to the students also included an explanation of the urban heat island effect along with the possible effects of elevation and wind.

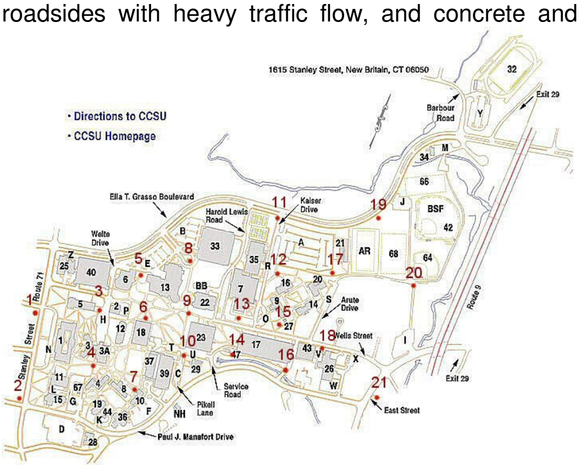

Figure 1. Map of CCSU Campus showing points (in red) where temperature measurements were made by student teams.

Figure 2. LaCrosse Technology EA-3010 handheld digital thermometer/wind meter used in this lab exercise. (Photo courtesy Lacrosse Technologies)

**Corresponding author address:* Dr. Steven B. Newman, Central Connecticut State University, Physics-Earth Sciences Department, New Britain, CT 06050; e-mail: newman@ccsu.edu

3. PRELIMINARY RESULTS

The exercise was conducted for the first time during the Spring, 2006 semester, in three sections of the Introductory Meteorology laboratory class. Weather conditions varied over the period during which the lab exercise was conducted. Two of the classes conducted the experiment during the mid-afternoon. The third conducted the experiment during the early evening. The results were striking in the temperature patterns that were revealed.

Figure 3 shows the results of the microscale temperature analysis of 25 April 2006. Note the distinct warm plume extending from the southern central edge of the campus, northward to the northern edge. This plume extends across the lowest elevation section of the CCSU campus. Weather conditions were cloudy with temperatures in the

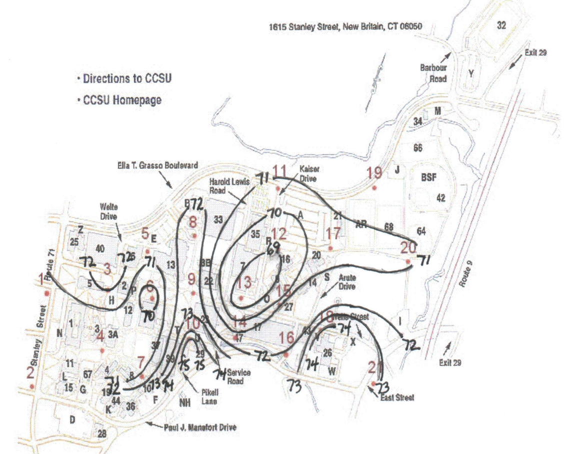

Figure 3. Microscale temperature analysis of the CCSU campus at approximately 2000 UTC on 25 April 2006.

upper 60s. Winds were predominantly from the southwest, with gusts of up to 32 mph during that time period. The southwesterly wind would appear to be the primary reason for the warm plume in the lower elevation portion of the campus. The plume is situated in an area of the campus that is between two larger buildings on either side. There are two large parking structures on either side of the plume, and, at the time of the measurements, a number of cars were entering and leaving the garage.

Figure 4 shows the microscale temperature analysis for 1 May 2006. Conditions during this sampling were much different than those of the previous week. The experiment was conducted near 2300 UTC. Skies were partly cloudy, the temperature was around 60°Fand the prevailing wind direction was from the east-northeast. The warmest part of the campus is found near Point 19, at the top of the hill just around the CCSU co-generation plant (a significant heat source). The prevailing wind has clearly carried some of that heat towards the central part of the campus, as reflected by the twin plumes of higher temperatures spreading toward the east and southeast from the powerhouse. The region of lower temperatures near the southwest portion of the campus may be associated with a large grass field, which would radiate heat more efficiently than the concrete and buildings around it.

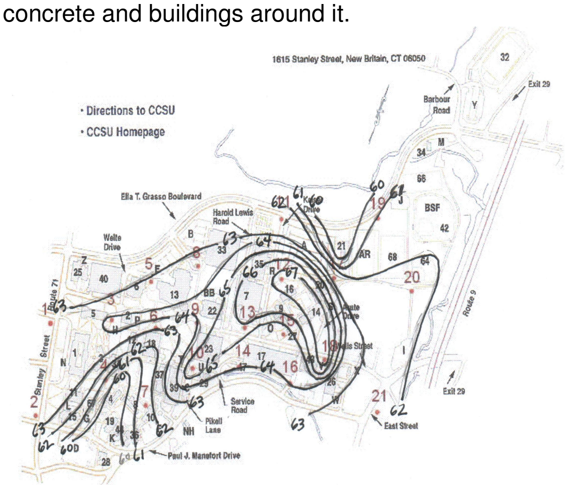

Figure 4. Microscale temperature analysis of the CCSU campus at approximately 2300 UTC on 1 May 2006.

4. FUTURE STUDIES

The exercise will be conducted on a regular basis each semester. During the Fall, 2006 semester, we asked the students to use the handheld device to measure wind direction and speed as well. We hope to be able to find relationships between the observed wind field and the observed temperature pattern. Initial results for the Fall semester seem to indicate that light winds do have an effect on the observed temperature pattern. More sophisticated weather instrumentation recently acquired will allow the students to also measure other meteorological variables at each data location. This will allow for more detailed data plots.

5. ACKNOWLEDGEMENTS

The author is grateful to Mr. Richard Roy, and Ms. Carol Ivers, whose students also participated in this experiment, and who provided additional data for the maps shown here.