

TALL TOWER INVESTIGATIONS OF MISSOURI WINDS

Progress report 3 – April 18th, 2007

Tower Instrumentation

The two towers being used for the project funded by Kansas City Power and Light are both operational. The first in Miami, MO was set up on 30th June 2006 and the second, at Raytown (Kansas City), on 25th July 2006. Both have operated since those dates with data being collected. The Raytown tower has a working cellphone modem which is allowing us to automatically download data each day. Significant icing affected the towers in mid-January leading to loss of data for a period and it is suspected that a limited amount of damage was sustained during this storm. However, due to the redundancy of the systems in place, good data continues to be collected at both sites.

Data

In the tables below are simple monthly means of wind speed recorded by each of the anemometers on each of the towers. For Miami we now have nine complete months of data, while for Raytown, eight complete months of data have been collected. However there were serious icing problems starting in mid-January 2007, and a more detailed evaluation (quality control) of the data is required before reliable results from that period are presented. For many instruments this was a more severe and prolonged event than that which occurred in November/December 2006. In January the freezing appeared to persist for longer, with one of the top level instruments at Raytown being frozen well in to February. This appears to have led to persistent problems and data loss on this channel. Unfortunately, there also appears to have been damage to Channel 3 on the Miami tower. By visual inspection it can be seen that the anemometer appears to be operating, so it is uncertain what the problem is. Most likely it is a wiring issue but the sensor would have to be examined to ascertain this.

Miami	Mean wind speed (m/s)								
Height (m)	Jul 2006	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007
67	5.3	5.2	5.2	6.3	6.4	6.8		6.4	7.5
68	5.0	5.0	5.3	6.2	5.7	6.7		6.5	7.4
96	6.0	5.8	5.8	7.1	7.2	7.7		n/a	n/a
97	5.7	5.6	5.8	6.9	6.5	7.6		7.1	8.2
114	6.3	6.1	6.0	7.4	7.5	8.2		7.2	8.6
115	6.5	6.3	6.4	7.8	7.2	8.6		7.6	9.1

Raytown	Mean wind speed (m/s)							
Height (m)	Aug 2006	Sep 2006	Oct 2006	Nov 2006	Dec 2006	Jan 2007	Feb 2007	Mar 2007
67	4.3	4.5	4.9	4.8	5.2		5.3	5.8
67	4.3	4.5	5.0	4.9	5.3		5.5	5.8
95	5.0	5.2	5.9	5.8	6.3		6.1	6.8

95	5.0	5.3	5.9	6.0	6.3		6.2	6.6
140	5.2	6.0	6.9	6.9	n/a		n/a	n/a
140	5.9	6.2	7.0	7.2	7.45		6.9	7.6

Data Analysis

We have now collected sufficient data to begin developing and testing analysis methods. A number of basic analyses are being conducted on the data on a month-by-month basis. At this time the following investigations are under way using the data collected so far. At this stage much of this work is devoted to establishing procedures for regular and reliable analysis and detailed study of the results has not been undertaken. We intend to produce a more detailed data report over the summer that will provide greater insight into the data and its uses.

1. *Diurnal variations*

Other than the mean wind one critical observation is how the wind varies with time of day and season. We have started looking at the diurnal variation in wind speed at each tower for each month. To date the variation of the wind with time of day observed is in line with expectations with higher winds seen in the evening and lower winds in the morning.

2. *Wind shear*

Excessive wind shear across the diameter of the turbine can create stresses on blades that can require a turbine to be shut down or else risk damaging it. Therefore knowledge of the shear pattern across turbine heights is of great interest to wind power generators. Using the tower observations frequency distribution of wind shear can be constructed. The variation of shear with season will be of interest, as will the identification of times of extreme shear. These may be associated with occurrences of the low level jet and this connection will be explored.

3. *Low-level jet identification*

One of the primary objectives of the project is the investigation of the characteristics of the low level jet in Missouri. By combining the tower observations with those from local wind profilers and with analyzed atmospheric wind fields from NOAA models we are developing an objective method of identifying low level jet occurrence from the tower observations. Once this is accomplished the times when observations affected by the presence of a jet can be separated from times when no jet is present, thereby allowing an assessment of the impact of the jet on the observed characteristics of the wind at tower height.

4. *Comparison of wind map with tower observations*

With the aim of assessing the accuracy of the wind map the idea is to compare the data gathered at the tower sites with that presented by the map for that location.

We do not yet have enough data to formally assess the accuracy of the wind map and even once an entire year of data has been gathered there is no guarantee that the year will not be anomalous. Therefore one would not expect the observed mean wind to match that of the wind map at that

point. However, by combining the data from the two towers in this project with others on other projects it is a simple matter to rank the towers by wind strength. When that is done with the data collected so far, the tower locations match the wind map for wind strength.

In the future we plan to compare the mean wind speeds and their distribution as parameterized using Wiebull factors. Directional information can also be compared as an indicator of the representativity of the annual climatology.