Miller, Debra

From: Larry Teahon <Larry_Teahon@cameco.com>
Sent: Tuesday, April 28, 2015 1:14 PM
To: Lancaster, Thomas
Cc: Doug Pavlick; Robert Tiensvold; Sabrina Fox; Larry McGonagle
Subject: MET Data RAI #2
Attachments: Table 2.5-14 Marsland MET Station Description Rev 1.pdf

Tom:

Letter dated November 19, 2014 stated that during NRC staff review of the MEA Technical Report it was identified that certain areas under the Meteorology Section needed additional information. Request for Additional Information (RAI) #2 requested the following;

1. The height above ground level that wind speed, wind direction, temperature and relative humidity measurements are made;
2. A drawing or photograph of the meteorological tower showing the instrumentation location relative to the tower lattice work, including the lengths of the booms;
3. An evaluation which would establish that the wind sensor electrical range limitation to 356 degrees azimuth does not affect meteorological data fidelity.

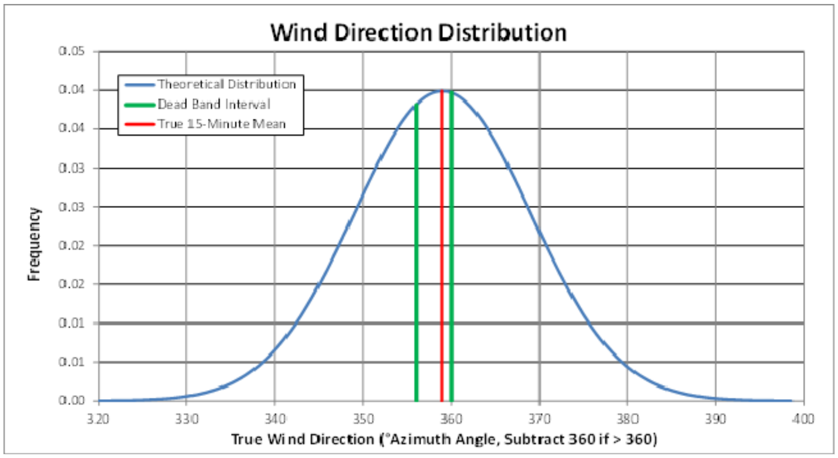
The following is CBO's response to this request:

1. The description of the height of the instrumentation above ground level was included in the calibration records located in Appendix B of the MEA Technical Report. For clarification, Table 2.5-14 (attached) has been revised to include these heights.

2. A photograph of the MEA MET station can be found in Appendix B on the cover page of the calibration report. The instruments are located on booms (1.5 meters in length) oriented into the prevailing wind direction at a minimum distance of two tower widths from the tower to preclude substantial influence of the tower upon measurements.

3. The most commonly used wind direction sensors employ a circular potentiometer to generate electrical signals that represent the azimuth angle (degrees counter-clockwise from North). Although the mechanical range of these sensors is 360°, the electrical range is necessarily restricted to less than 360°. The potentiometer cannot function without this "dead band" between the high and low resistance extremes. For the Met One 034B wind sensor, the dead band is 4°. Even though the wind vane is free to rotate continuously, the potentiometer only generates signals ranging from 0 to 356°. If the true instantaneous wind direction is greater than 356° but less than 360° the signal will indicate 356° (full-scale value), resulting in a negative bias for wind directions in the dead band.

   Probability theory can be used to analyze the expected degree of bias in recorded wind directions. While the maximum instantaneous bias would be -4° based on the above description (i.e., when the true wind direction is just below 360°), the maximum average bias during the data logging interval is much closer to zero. The reason is that the wind direction fluctuates naturally throughout the logging interval. This fluctuation is quantified as sigma theta. Typically, the logger scan rate is every 1 to 5 seconds but the scanned directions are vector averaged over each logging interval (e.g., 15 minutes or 1 hour). Only the averaged directions are recorded. Shown below are a typical dead band interval, hypothetical 15-minute mean wind direction of 359°, and overall data distribution during this logging interval based on a sigma theta of 10°.



In the northern Great Plains, typical 15-minute values for sigma theta range from 5° to 20° and higher. This means that even when the true 15-minute average wind direction falls within the instrument dead band, the instantaneous wind direction will statistically fall outside the dead band for most of the logging interval. During these times the sensor will indicate the correct wind direction (subject to instrument accuracy), thus lowering the overall average bias in the wind direction signal. Using the example graphed above, if the true 15-minute average is 359°, sigma theta is 10°, and wind directions are normally distributed, the sensor will read full scale less than 16% of the time. While at full scale, the expected average sensor error is -2.02°. Therefore, the average bias throughout the 15-minute interval is 0.16 x -2.02 = -0.32°.

Sigma theta is the standard deviation of the horizontal wind direction values scanned during the logging interval. Even when the 15-minute average wind direction falls outside the instrument dead band, some error may be introduced due to this standard deviation in wind directions. Higher sigma theta values will lead to lower peak errors, but with more dispersion as shown in the graphic below.

Regards,

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