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THE ENHANCEMENT OF QA/QC TESTS FOR WEST TEXAS MESONET WIND PARAMETERS

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1. INRODUCTION

The West Texas Mesonet (WTM) is monitoring the West Texas area with 45 automated surface observation sites (Figure 1) that provide 232,320 daily observations (Schroeder et al., 2005). Each observation includes information about 15 meteorological parameters and 10 agricultural parameters at temporal resolutions of 5 and 15 minutes, respectfully.

In order to extract suspicious and/or bad observations and improve the overall quality of the real time and/or archived dataset, an initial set of QA/QC tests were developed (Sonmez and Doggett, 2003) largely based on QA/QC tests applied for the Oklahoma Mesonet (Shafer et al., 1999). Modifications to these tests are still under consideration in hopes of improving the performance of each test for the WTM dataset.

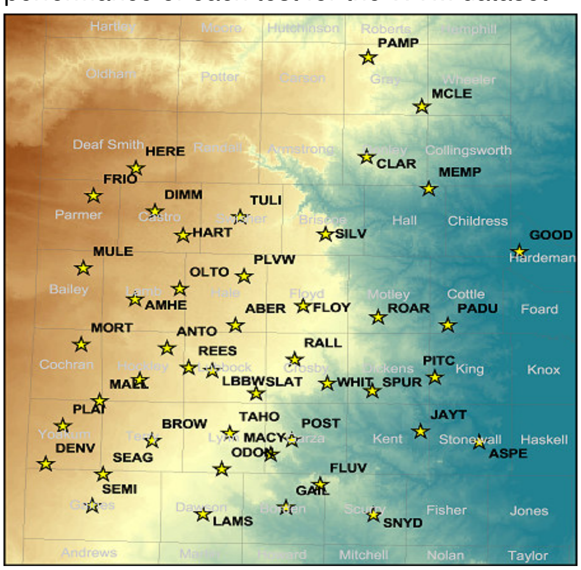

Figure 1. Location of the West Texas Mesonet sites with four letter site name identifies and corresponding county names.

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Applying the QA/QC tests to the 2002 dataset resulted in 4,307 flagged observations (~0.01% the total observations) of various parameters. The flagged observations are examined manually to confirm the level of authenticity of the observation. Additionally, analyses are applied for unflagged observations of various parameters. This process is conducted to verify the QA/QC process and seek improvements to the automated system. For instance, all of the unflagged 2002 wind speed (WS) observations from 2m are plotted versus their 10m counterpart in Figure 2. The plot indicates an expected band where WS measured at 10m is greater than the WS measured at 2m. On the other hand, some perturbations from the band take place at low wind speeds. These data points represent time periods where the 5 minute average WS measured at 2m is greater than the 5 minute average WS measured at 10m. In this study, the legitimacy of the wind observations at 2m and 10m, which falls in this perturbation region, is investigated to improve the QA/QC tests.

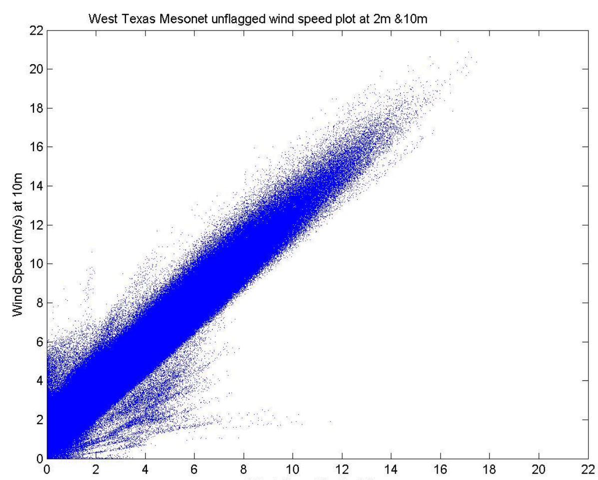

Figure 2. Scatter plot of unflagged 2m versus 10m wind speed measurements as observed by the WTM during 2002.

2. SENSOR SPECIFICATIONS

The WTM employs different sensors for the WS observations at 2m and 10m. Propeller type anemometers are used at 10m to measure both WS and wind direction (WD) while 3-cup anemometers are used for WS measurements at 2m. The sensor types and specifications are provided in Table 1.

Table 1. Sensor specifications for WS observations at 2m and 10m.

Sensor	Type	Range	Accuracy
10m WS	R.M. Young 05103 (propeller type)	1-60ms^{-1}	± 2%
10m WD	R.M. Young 05103 (propeller type)	O^{o}-355^{o}	3^{o}
2m WS	R.M. Young 03103 (3-cup vendor)	0.5-50ms^{-1}	± 2%

3. PRELIMINARY ANALYSIS

The 10m and 2m WS observations (9,004 in total) that took place in the perturbation region in Figure 2 are considered for further analysis. To better understanding the reasoning for such occurrences, some of the related variables are examined. For instance, the occurrence days (as Julian day) are plotted versus the occurrence frequency in Figure 3. The results indicate that 90.06% of the observations took place in the winter months (December, January and February), where December alone represented 82.51% of the total number of occurrences.

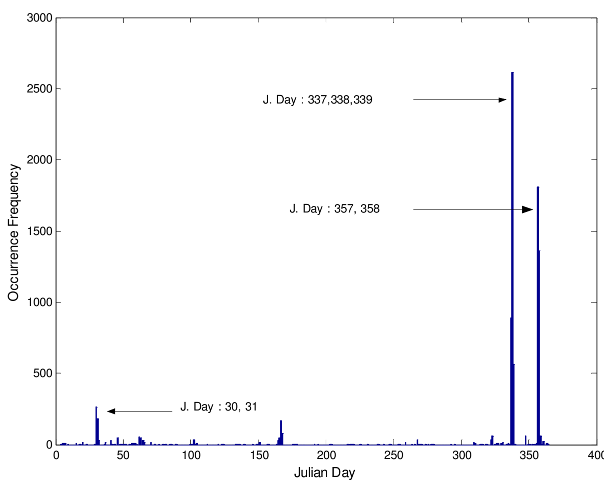

Figure 3. Occurrence days versus the occurrence frequency of the wind data in the perturbation zone.

Secondly, the wind observations in the perturbation region are analyzed with respect to site location. Sites with corresponding occurrence frequencies are plotted in Figure 4. The comparison of the occurrence frequencies and corresponding site locations in Figure 1 indicate that the sites with the highest occurrence frequencies are mainly located in the northern regions of the domain.

4. DATA PROCESSING

The higher concentration of the perturbation observations in winter months and in the northern mesonet sites implies a problem under certain weather conditions. For instance, freezing of the wind sensor is commonly observed when the temperature is around freezing and a sufficient amount of relative humidity is present. In such cases the wind instrument can become stuck and provides observations at (or around) a constant value.

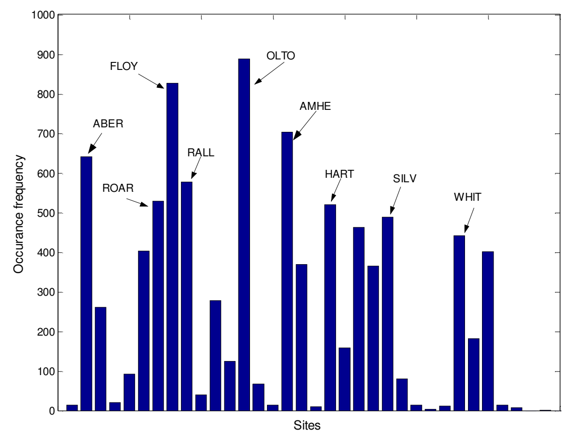

Figure 4. Distribution of the wind observations in the perturbation zone respect to observation sites.

Various parameters are considered for the same time period with the perturbations to determine a possible correlation. For instance, Figure 5 represents time histories of various parameters when a perturbation is observed. The relative humidity, WS difference between 2m and 10m, and temperature observations at 2m and 9m from site FLOY are plotted versus time. A clear jump on the difference between WS observations at 2m and 10m is observed between December 2nd at 12:45 (local time) and December 5th at 12:50. The reason for the change is a drastic decrease in the measured WS at 10m during the same time period rather than a significant change in WS at 2m (Figure 6).

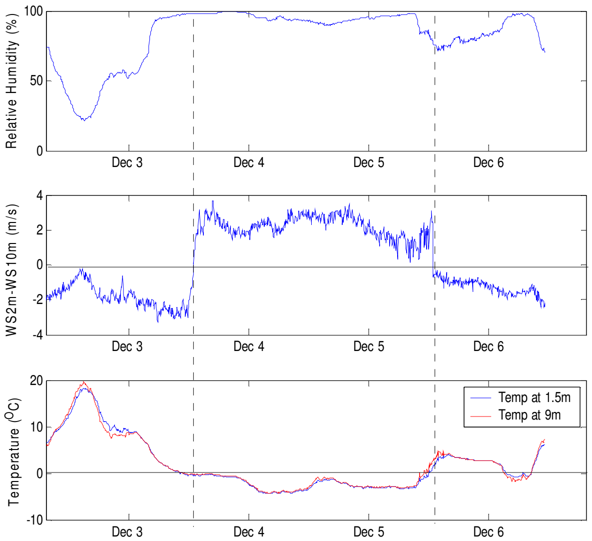

Figure 5. Time series of relative humidity, difference between WS observed at 2m and 10m, and temperature at 2m and 9m between December 2, 2005 at 7:20pm and December 6, 2005 at 6:20 for site FLOY.

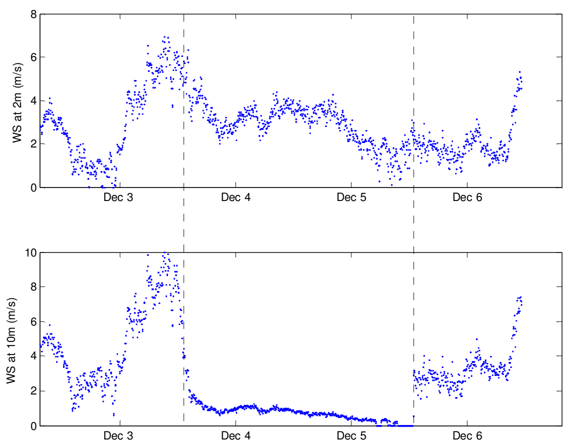

Figure 6. Time series of WS at 2m and 10m between December 2, 2005 at 7:20pm and December 6, 2005 at 6:20 for site FLOY.

Note in Figure 5 that the temperature parameter observations at 1.5m and 9m are below the freezing level during the period with a drastic reduction in WS at 10m. For the same time period, relative humidity is observed to be almost 100%. So, the presence of the high moisture and the temperature below the freezing level indicates that the wind sensor at 10m is partially frozen for the corresponding time period. Apparently, the wind sensor still functions but provides unrealistic observations with a small amount of variation. On the other hand, the WS sensor at 2m shows no sign of the problem in this case.

5. CONCLUSIONS

Various QA/QC tests and subtests provide different flag levels for the dataset obtained by the WTM depending on the legitimacy of the observations. The unflagged observations are also analyzed in order to improve these tests. For this purpose, the unflagged WS observations at 2m are plotted versus the WS observations at 10m.

Perturbations from the general tendency are observed for 2002 dataset where WS observations at 2m are larger than the WS observations at 10m. The analyses indicate that the majority of the perturbations are observed in winter months. In addition, the spatial analysis of the perturbations found a higher frequency occurring in the northern regions of WTM network.

Various parameters within the same time period with perturbations are analyzed. Among them, relative humidity and temperature at 1.5m and 9m are well correlated. The perturbations occurred during time periods of high relative humidity with temperatures at 1.5m and 9m below the freezing level. Review of the data and subsequent field observations revealed that the 10m wind sensor froze up first relative to the 2m sensor on many occasions.

Armed with this new information, the Like Instrument Test for QA/QC procedure is enhanced for WS at 2m and 10m. Even when the measured WS at 2m and/or 10m pass all of the other QA/QC tests, temperatures at 1.5m and 9m for the corresponding observation time is controlled. If one of these temperatures is below freezing, then the WS at 2m and/or 10m is flagged as suspicious for manual inspection.

6. REFERENCES

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