Thies first class advanced X anemometer pressure correction analysis

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INTRODUCTION

Wind speed measurements from anemometers are the highest standard for field measurements in the wind industry. IEC 61400-50-1 defines the classification procedure to characterize the anemometer performance in a range of environmental conditions. Thies Clima has two anemometers that are classified to IEC 61400-50-1: Thies X (4.3352.x0.4xx) and Thies 2 (4.3352.x0.000). The Thies X has computational capabilities that can actively manipulate the output signal and internally apply a pressure correction, that improves the air pressure sensitivity to achieve lower classification uncertainty compared to the Thies 2.

In this poster, UL Solutions examines the difference from applying the corrections in the sensor and in post processing. UL Solutions hopes to achieve the Thies X lower class number by applying the same pressure correction to a Thies 2.

METHODOLOGY

UL Solutions installed a Thies X at their Advance Wind Turbine Test Facility at West Texas A&M University since February 2024. The Thies X has a configurable analog output and various digital outputs. UL Solutions recorded the 1 second Modbus and pulse count outputs and used the standard wind speed transfer function. The table below outlines the outputs measured.

Output	Description
35013	Digital output of the wind speed, standard wind speed transfer function and pressure correction applied internal to the sensor. Output used in classification and best wind speed measurement to use
Pin1	Analog pulse output in dm/s, standard wind speed transfer function used and, pressure correction applied internal to the sensor
Frequency	Digital output of the optical reading of the anemometer (same output as a Thies 2)

Using the frequency output (equivalent to a Thies 2), UL Solutions applied the pressure correction in post processing and compared this output to 35013. UL Solutions also compared Pin1 to 35013 as they are intended to be equivalent outputs, just one is an analog signal and the other is digital. Comparing all the results from the same sensor will give the best indication of how well the post processing correction compares to the sensor's internal correction.

RESULTS

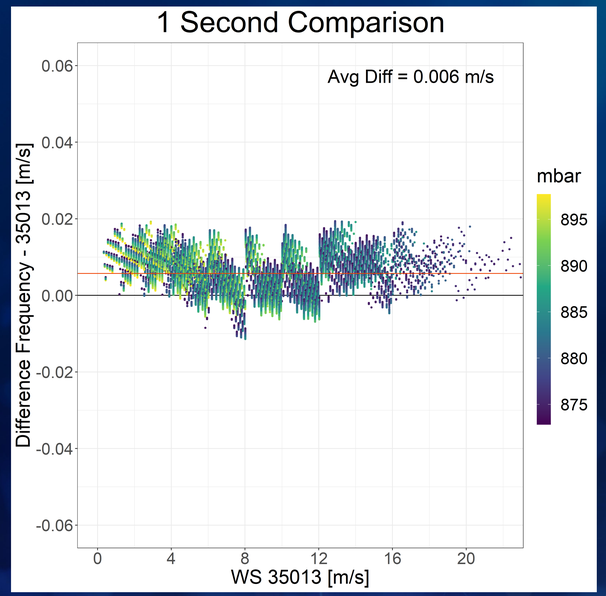
Frequency vs 35013

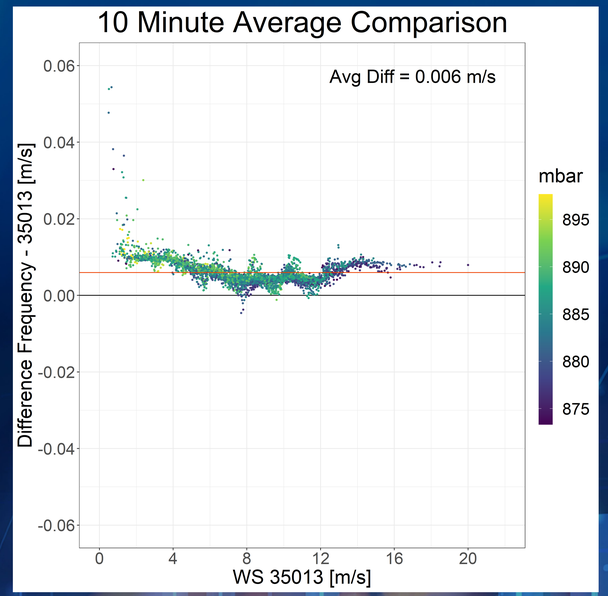
Post pressure correcting the frequency output vs 35013 results in an average difference of 0.006 m/s meaning over time these two measurements converge to being different by 0.006 m/s.

Pin1 vs 35013

Pin1 and 35013 are supposed to be equivalent and over time the average difference is 0 showing that this is true when collecting lots of data. Though at any specific time measurement, there is a variability in how different the measurement is. This is pronounced at in the 1 Hz data with differences ranging up to 2 m/s. At 10 minutes the differences is much smaller at a range of 0.01 m/s .

Post-correcting the Thies 2 anemometer with a pressure correction closely resembles the results from the better class Thies X anemometer





RESOURCE & TECH

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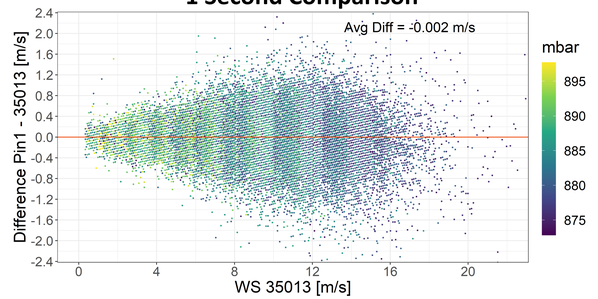
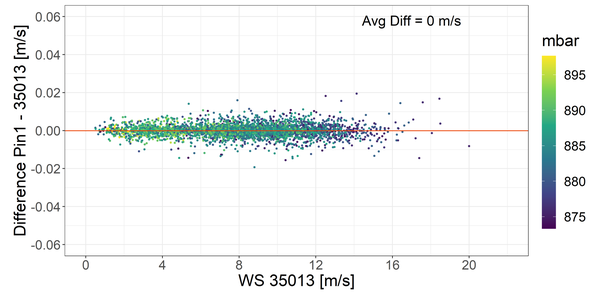
PIN1 VS 35013 COMPARISON

1 Second Comparison



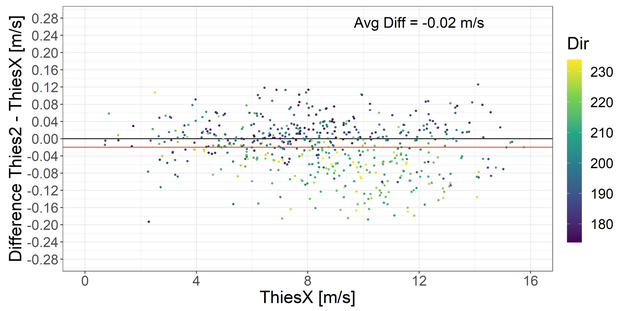
10 Minute Average Comparison



THIES X FREQUENCY OUTPUT VS THIES 2

The test site has a Thies 2 positioned at the same elevation (47.6 m and 47.2 m) and on opposite sides of a guyed lattice tower. The plot below compares the calibrated wind speed difference between a Thies 2 to the frequency output of the Thies X with no pressure correction applied. The dataset was filtered for shear between 0 and 0.2 and a small valid sector of 60° centered perpendicular to the booms.

Anemometer to anemometer variability is also low on average (0.02 m/s) but slightly higher than the pressure correction variability. This means the inherent sensor variability and mounting effects are larger than the differences observed due to internal vs post processing pressure correction.



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