NOAA Pacific Marine Environmental Laboratory
Ocean Climate Stations Project

TECHNICAL NOTE 5

Wind Speed Variability of Vaisala WXT520

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Introduction

Beginning in 2011, it was noted at PMEL that the wind speed sensors of some Vaisala WXT520 combination weather sensors were very erratic at higher wind speeds. Made aware of the issue, Vaisala was going to fix the problem in new instruments. A new sensor received in 2012 exhibited the same problems, with no immediate solution available from Vaisala. For this reason, and also due to the difficulty of calibrating the other sensors in the combination instrument, the WXT520 will no longer be deployed on OCS moorings.

Background

The Vaisala WXT520 is a combination weather instrument, with sensors for air temperature, relative humidity, barometric pressure, rainfall, wind speed and direction in one package. This instrument was first deployed on OCS moorings in 2009, for field testing. It was hoped that this package could be used as a low cost replacement for several other instruments on the buoys.

During pre-deployment wind speed checks at PMEL during the spring of 2011, several WXT520 sensors were noted to have erratic wind speed output. After extensive internal review of the testing set-up and method, a service request (#34636) was opened with Vaisala technical support in May of 2011, regarding the erratic wind data at high wind speeds. Eventually, the suspect sensors were returned to Vaisala for evaluation, and the problem was duplicated at their test facility in Finland.

By September of 2011, the Vaisala US offices had agreed to replace three of the malfunctioning PMEL-owned units with units that had been specially tested in a wind tunnel in Finland, and were known to function properly. These replacement sensors were deployed by OCS and EDD.

Notification was received by OCS in February 2012 that the service request was officially closed, while the Vaisala Engineering group had created ECR 3526 to follow through on the issue. Their internal testing was expect to take "a few months." A newly purchased WXT520 was received at PMEL in July 2012, and displayed the same erratic wind speed issue. Herb Winston, Senior Sales Manager at Vaisala Inc., was notified of the continuing problem, but he was unable to offer a solution.

Wind Speed Testing at PMEL

Using a wind tunnel, instruments to be deployed on PMEL moorings are compared to a Standard, which is an RM Young mechanical style anemometer. The Vaisala WXT520s are securely mounted to a mast inside the wind tunnel, with the ultrasonic wind sensor in the same horizontal and vertical planes as the Standard. A software program records both the sensor and Standard outputs over a range of wind speeds. A linear fit is calculated for the sensor data to the Standard, and difference statistics are calculated. Poor linear fits and large differences were the first indicators of a problem with the Vaisala wind sensor.

The plots below show the raw output of sensor S/N H9240001 during wind tunnel testing. On the left, the wind was incident from 0°. On the right, the sensor was rotated off North by 30°. When the wind is not coming directly from 0°, the readings at higher wind speeds stabilize. This was noted by Vaisala while addressing the initial service request.

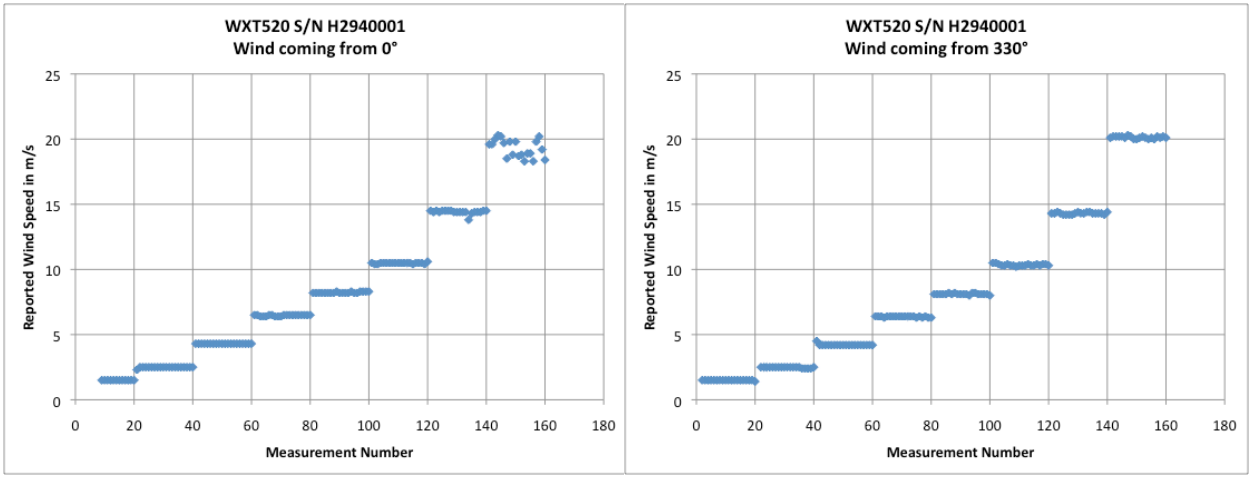

Figure 1: Vaisala WXT520 wind speed output as tested in a wind tunnel. Wind incident from 0° (left) and 330° (right).

Further testing was done to determine the angle either side of North at which the speed measurements become steady. On September 5, 2012, sensor S/N H2940001 was tested in the wind tunnel at a wind speed setting of 19.5m/s. Forty readings were logged at various angles.

Winds from the NW were found to be more erratic than from the NE. By 15° off N in either direction, the spread of wind speed readings fell within the accuracy specifications of the instrument (±3%). The speeds were more erratic at 10° than 5° on either side of North.

This sensor was previously checked at 30° on August 8, 2012, with no stability problems. No other directions were tested.

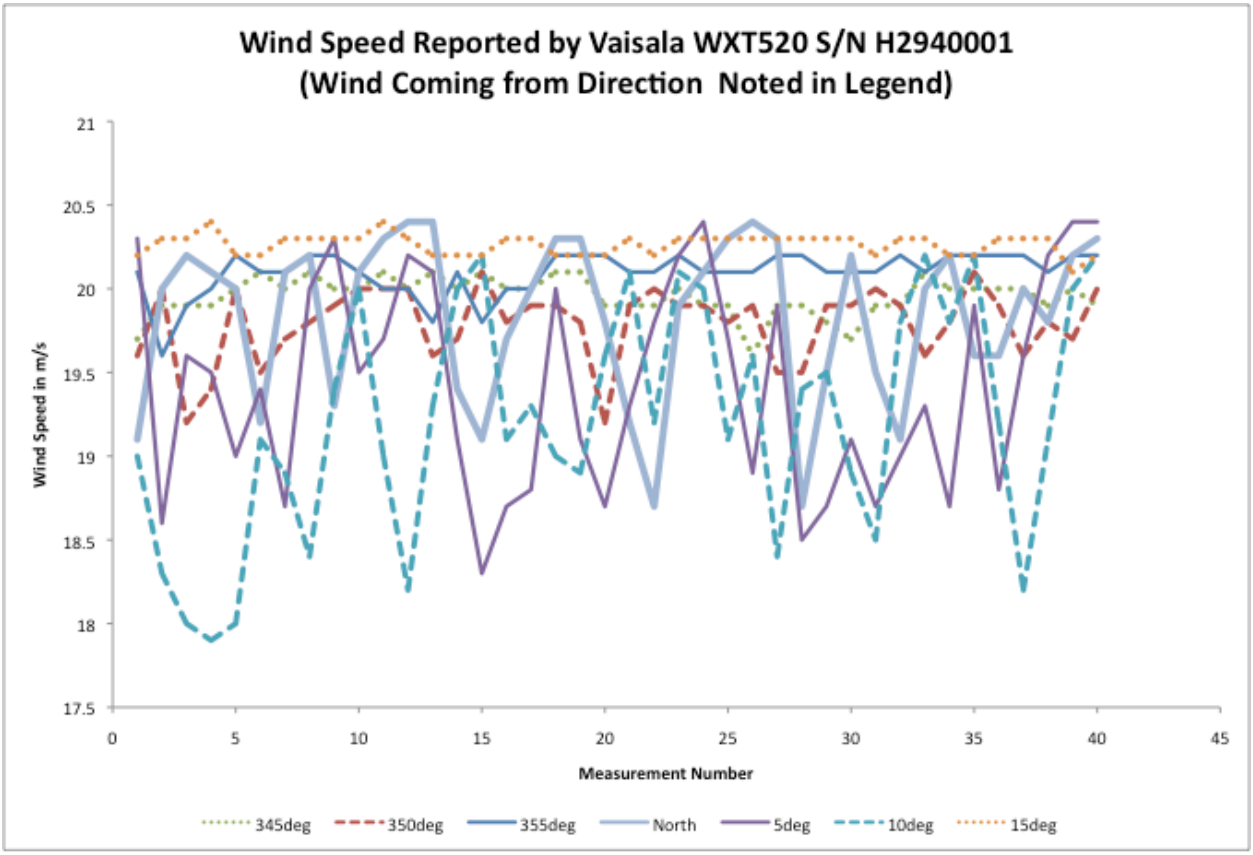

Figure 2: Vaisala wind speed readings at wind tunnel setting of 19.5m/s. Incident wind directions noted in legend.

	North	355°	350°	345°	5°	10°	15°
Min	18.7	19.6	19.2	19.6	18.3	17.9	20.1
Max	20.4	20.2	20.1	20.1	20.4	20.2	20.4
Spread	1.7	0.6	0.9	0.5	2.1	2.3	0.3

Table 1: Minimum and maximum wind speeds reported by WXT520 over 40 samples.

Recommendations

OCS moorings use redundant sensors for each meteorological measurement type, so that data loss due to sensor failure is mitigated. Data from these redundant sensors are most comparable, and easiest to substitute, if the same sensor is used for the duplicate system. Therefore, it does not seem practical to continue using the Vaisala WXT520. With the exception of BP and AT, the data do not compare well with the primary measurements. None of the sensors in the Vaisala can be calibrated, and the additional problems with high variability in wind speeds indicate this is not a reliable instrument for the quality of science expected on OCS moorings.

In August 2012, it was recommend that all future purchases of the Vaisala WXT520 be halted completely, until it could be guaranteed that a solution to the erratic wind speed readings has been found and implemented. Vaisala was notified of this decision.

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