NRG Heated Sensor Response Characteristics

Introduction

The NRG IceFree3 and Hybrid XT anemometer models were designed to measure wind speed in icing environments, and contain active heating. During the winter season, standard (unheated) anemometers will periodically slow or freeze, and measurements from the heated IceFree3 or Hybrid XT sensor become the primary resource assessment data source.
The operational characteristics of the heated sensor models differ from a standard cup anemometer, and these operational differences may be reflected in the collected measurements when using both heated and standard sensors in a particular wind assessment project. This application note discusses differences and provides a guidance on how to use data from the heated sensor when the standard anemometer is frozen.

Off axis response

The IceFree3 and Hybrid XT anemometer models share a similar head geometry and are more sensitive to the off-axis winds typically found in complex terrain than a standard cup anemometer such as the NRG 40C or NRG Class 1. Over speeding due to off-axis winds is generally difficult to quantify and a vertical propeller can be used to help characterize upslope winds during non-icing seasons.

Distance constant

The IceFree3 and Hybrid XT anemometer models have a longer distance constant than standard cup anemometers, which means they cannot respond to changes in wind speed as quickly as a standard cup anemometer. The distance constant is a measure of how much air must pass the sensor in order for the response to reach ~63.2% of a step increase.
A sensor with a longer distance constant results in a tendency for it to "under report" true wind speed when the wind is increasing and to "over report" true wind speed when the wind is decreasing. This is expected, and at non-complex sites with no significant upslope wind components, long-term averages for sensors with different distance constants will tend to converge.

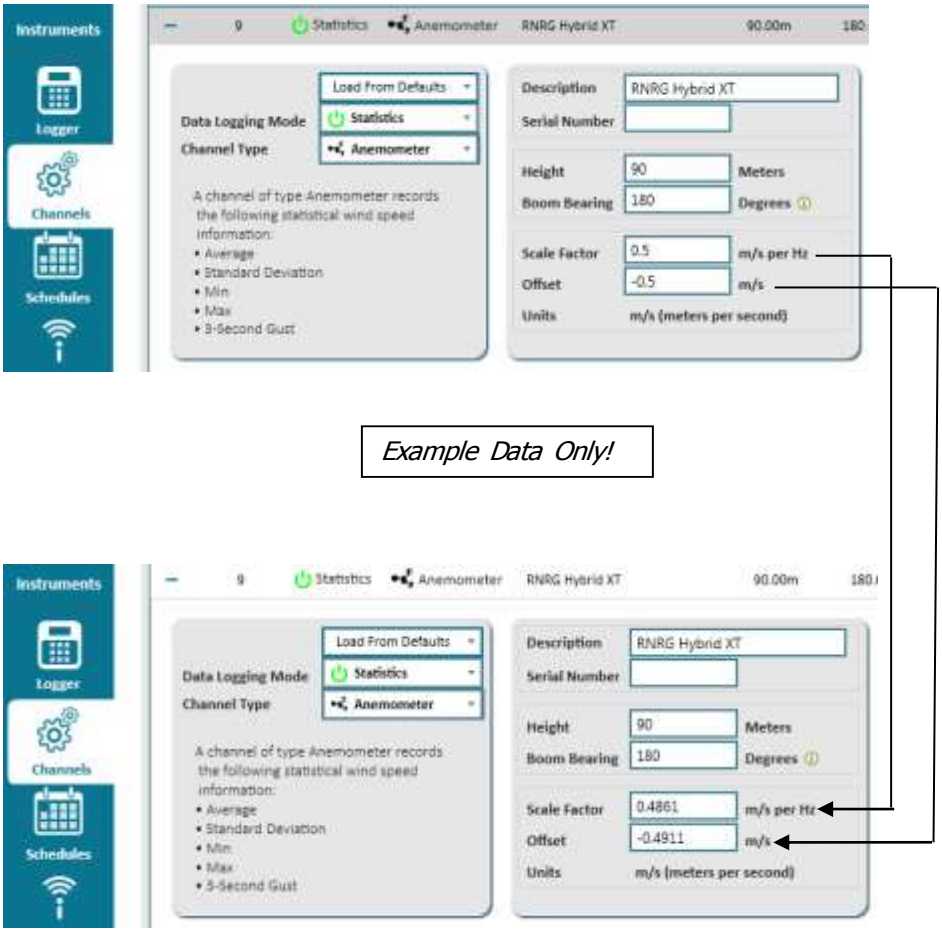
Interpreting data from NRG heated anemometers for wind assessment studies

Wind resource assessment studies utilizing an NRG heated sensor such as the IceFree3 or Hybrid XT benefit from the installation of a standard cup anemometer such as the NRG Class 1 at the same level as the heated anemometer. This anemometer pairing can be used to establish an in-situ correction between the unheated and heated sensors' measurements for the "non-icing" months (typically April-October in the Earth's Northern Hemisphere). The correction will compensate for response differences between the sensors at a particular site. Once determined, the correction can be applied to the IceFree3 or Hybrid XT so that measurements collected during the winter months are as continuous as possible with data collected from the unheated anemometer during the summer.
One simple correction method is to take the average wind speed for each sensor during non-icing months and create a ratio.

Correction coefficient = [long-term average NRG Class 1] / [long-term average Hybrid XT]

Hybrid XT average (m/s) = recorded Hybrid XT average (m/s) x Correction coefficient

There are additional methods to perform an in situ correction which would yield better results than the simple ratio. For example, the user can perform a linear regression of the Class 1 anemometer wind speed (m/s) against the Hybrid XT anemometer signal output (Hz) for the collected data intervals. This can be easily performed on exported data in Excel and other tools. The regression will provide a new slope and offset for the Hybrid XT anemometer which can optionally be plugged into the SymphoniePRO software.



Once the new slope and offset are applied in the SymphoniePRO Desktop Application, any exported measurement data will have those scaling values applied.