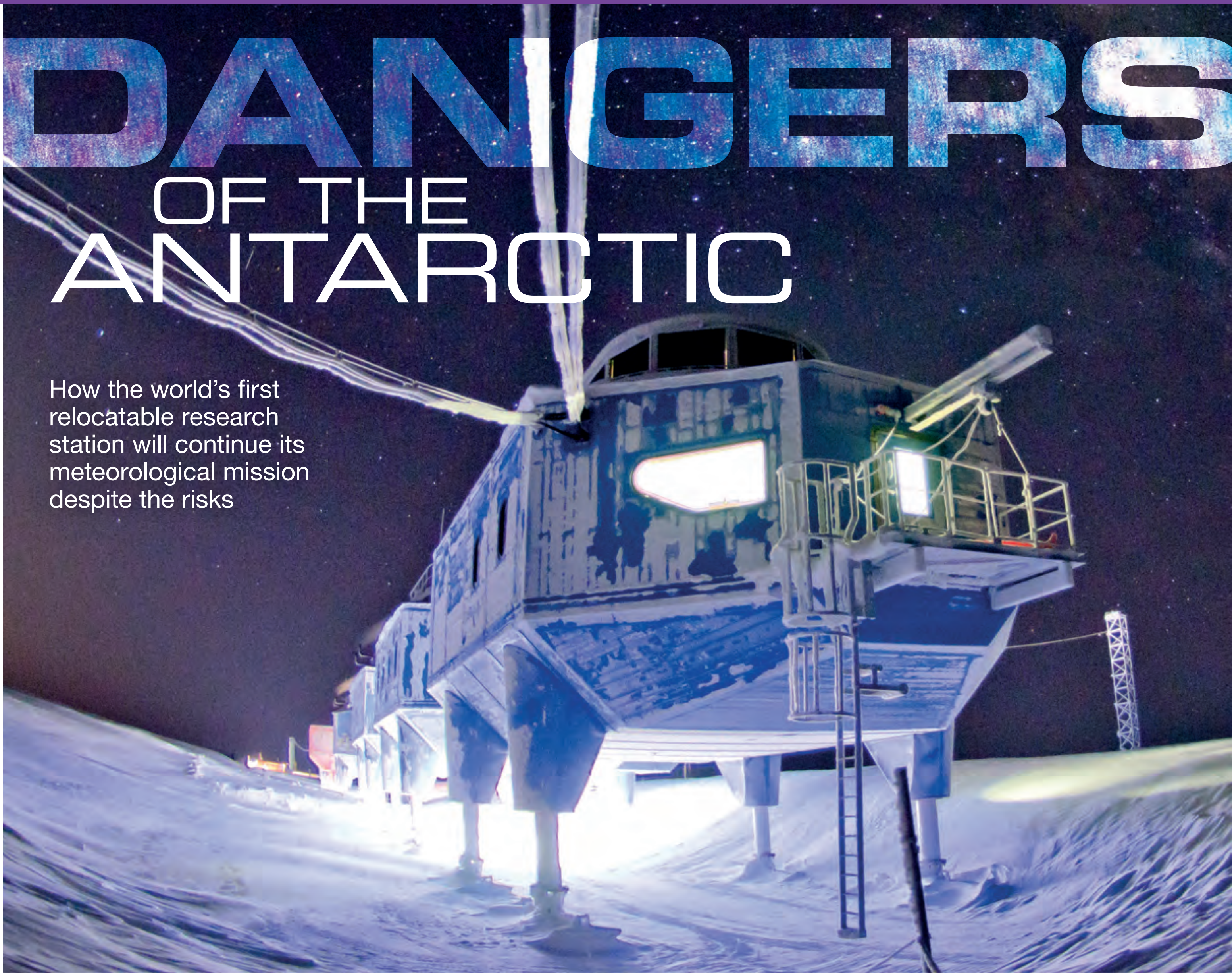
THE INTERNATIONAL REVIEW OF WEATHER, CLIMATE AND HYDROLOGY TECHNOLOGIES AND SERVICES

Meteorological Technology International



DANGERS OF THE ANTARCTIC

How the world's first relocatable research station will continue its meteorological mission despite the risks

MERCURY DEADLINE

Effective alternatives to mercury, how to maintain record homogeneity, and regional progress toward the switchover

WMO INTERVIEW

Dr Wenjian Zhang presents his vision on how the public sector should work more closely with private sector vendors

Helena Wingert, content marketing specialist, Lufft

NO LIMITS

A range of wind sensors has risen to the challenges posed by extreme weather conditions

Super-heated Ventus on Rustadfjell mountain, Norway

Weather can be merciless, and the places hit by the harshest conditions are often those most in need of monitoring. This is a real challenge for measurement technology, and to meet it meteorological sensors must be adapted to suit the conditions. One environmental measurement technology manufacturer, Lufft of Fellbach, near Stuttgart, Germany, has developed a wind sensor that works in extreme conditions.

MECHANICAL, ULTRASONIC AND LDA WIND SENSORS

Mechanical, ultrasonic and laser wind sensors all have limitations. In mechanical wind sensors, the measuring element (cups or vanes) produces a flow field disturbance. In the case of ultrasonic anemometers, this can be caused by the holder or housing construction. Only optical methods, such as the laser Doppler anemometer (LDA), enable a disturbance-free analysis of wind speeds but they are expensive and require particles in the air for measuring. Also, when watching mechanical wind sensors you will notice that they move slightly at all times, even under constant conditions. This is caused by inertia, making the measurement of short wind gusts impossible.

By contrast, ultrasonic wind sensors such as the Lufft Ventus-UMB have no moving parts that are subject to wear. The sensor detects wind directions and velocities up to 90m/s, with frequencies of up to 4Hz, and stays maintenance-free for long periods. Thanks to a built-in heater, it can measure wind speed and direction, even at -40°C.

Disturbances, which can be caused by the sensor fixtures, bars and the housing construction, are smoothed by the long distance over which the ultrasonic signal travels. At Lufft, every ultrasonic anemometer undergoes an adjustment process in the wind tunnel, to detect and correct all kinds of influences, eliminating any that interfere. The test results are recorded in a calibration protocol, which is included with delivery.[1]

Moreover, ultrasonic wind sensors have lifetimes of more than 20 years, making them more cost-efficient than mechanical systems. By selecting an ultrasonic sensor rather than a mechanical sensor, wind energy service providers, for example, can save up to US$1.9m over the course of servicing a single 100-turbine wind farm.[2]

Ventus stays ice-free even at -40°C

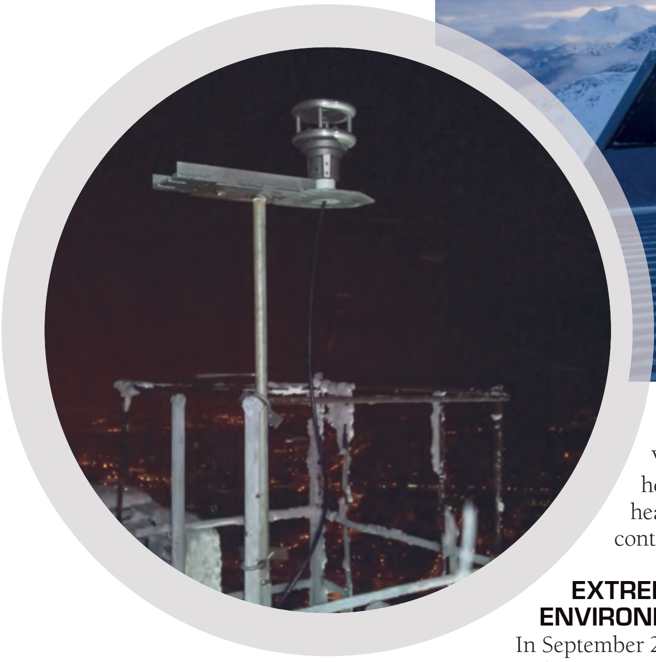
EXTREME COLD

At times of snowfall, low temperatures and high wind speed, technical equipment is invariably working at the limits of its capability.

Whistler Blackcomb Mountain is a popular ski region in British Columbia, Canada. At the end of 2012, Lufft USA, a subsidiary of Lufft of Germany, installed the first Ventus-UMB anemometer at the top of one of the mountain's main ski lifts. Since then, the sensor has produced accurate wind speed and direction data, even during storms. The region has an average annual snowfall of 11.9m and temperatures can drop to -20°C. To provide skiers and visitors with actual weather data, the lift operator's website shows up-to-date information on snowfall, temperatures and wind speeds, in addition to important avalanche information.

As soon as the Ventus ultrasound wind sensor was installed and running, a snowstorm front hit Whistler Mountain and much of the technical equipment installed

An ultrasound anemometer endures the snowstorms of Whistler Blackcomb Mountain, Canada



Ventus on top of Ostankino TV tower, Russia

there stopped functioning. The Ventus-UMB anemometer, however, with its integrated heating system, kept going and continued to send reliable data.[3]

EXTREME CORROSIVE ENVIRONMENT

In September 2014 a tender was launched to find wind sensors for the renewal and extension of the maritime monitoring network of Deutscher Wetterdienst (DWD), the German Meteorological Office. Based in Offenbach am Main, the DWD has exacting standards. It operates the largest national monitoring network in Germany, consisting of primary, secondary and maritime systems that regularly deliver weather data. The maritime network provides data that is vital to DWD weather forecasts.

The new wind sensors have replaced the old equipment, extending the existing monitoring network in terms of its maritime use. This network includes weather stations on DWD research vessels, in addition to those on commercial and government vessels.

The weather service had a number of strict exclusion criteria to consider when deciding who should supply the new wind sensors. The anemometers had to be very robust, with a closed housing. "Since the sensors are used exclusively in the maritime sector, they must be well protected against extreme weather conditions and bird attacks," explains Lufft sales manager Udo Kronmüller. "The Ventus-UMB consists of a seawater-resistant aluminum alloy, which is also used on ship propellers and has a closed housing design. Each year, a large proportion of the open measuring systems fails for this reason and gives rise to high repair costs."

The Ventus-UMB's closed housing design makes the sensor more prone to measurement uncertainties than an open housing design. To meet the DWD's requirements, Lufft checked and corrected many single measurement points. The DWD then used its own wind tunnel for further tests, before choosing the Ventus-UMB from among the short-listed sensors.

EXTREME HEIGHT, COLD AND FOG

The top of the 537m Ostankino TV tower in Moscow, the tallest freestanding building in the world until 1973, is dominated by Arctic temperatures, wind speeds of up to 42m/s and freezing fog. As almost all kinds of measurement instruments tend to be coated by a thick ice layer, the tower's operators sought out a more robust sensor model. They chose Ventus – in 2013, the first sensor was installed on the tower's spire. It has provided data ever since without interruption.[4] ▮

Mountain-top trials

In another project, launched in January 2016, the Norwegian airport systems integrator Avinor is testing a new Ventus model with an enhanced heating power of 240W. Two of the new models are already in the field, installed at the most extreme sites in Norway, where they are delivering reliable wind data. One is at the top of Kjølen mountain, close to Tromsø Airport, at a height of 2,600ft, where the average winter temperature is -5°C. The other is installed at the top of Rustadfjell mountain, near Bardufoss Airport. At 1,100ft, the site commonly experiences temperatures of -10°C in January. Both locations are very windy and experience numerous snow showers in winter. "The new sensors are much improved and stability is now as good as our users could wish," says Avinor system manager Sander Bjørn Hansen.

References

1) Hager, Helmut, What are the Advantages of Ultrasonic Wind Sensors, blog post, January 2017, http://bit.ly/2kfTFQW
2) Williamson, Erin, Lufft USA, Inc, Cost Benefit Analysis and Argument in Favour of Replacement of Mechanical Turbine Control Wind Sensors, white paper, March 2016, http://bit.ly/1Z9PSBV
3) Mörken, Christian, Reliable in ice and snow – Lufft Ultrasonic Anemometers Ventus-UM, blog post, February 2013, http://bit.ly/2khmoEV
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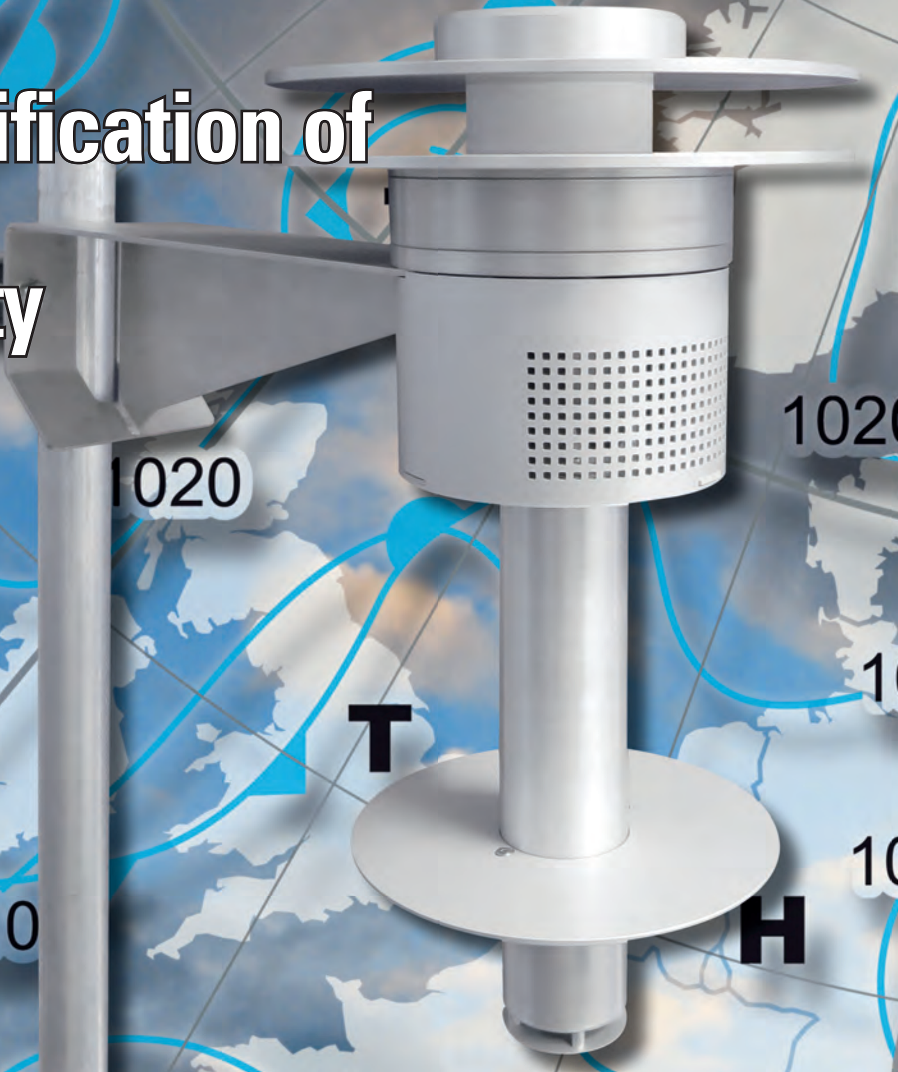
WS3000 Climate Reference Sensor

Calibration / Verification of
Air Temperature
Relative Humidity
Air Pressure



a passion for precision · passion pour la précision · pasión por la precisión · passione per la precisione · a pass

Traceable accuracy
Modular architecture
Drift-free sensing technologies
Excellent survivability under extreme conditions
Full-metal construction with ventilated air temperature / humidity measurements

Accuracy:

Temperature better than +/- 0.1°C
Relative Humidity better than +/- 2%
Air Pressure better than +/- 0.1 hPa
Solar Radiation better than 5% W/m²
(secondary standard)

Lufft

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