CAMPBELL SCIENTIFIC UPDATE

Second Quarter 2009 Vol. 20, Issue 2

USU Awards Honorary Doctorate to Bert Tanner *p. 2*

"...From the Perspective of the Customer" *p. 3*

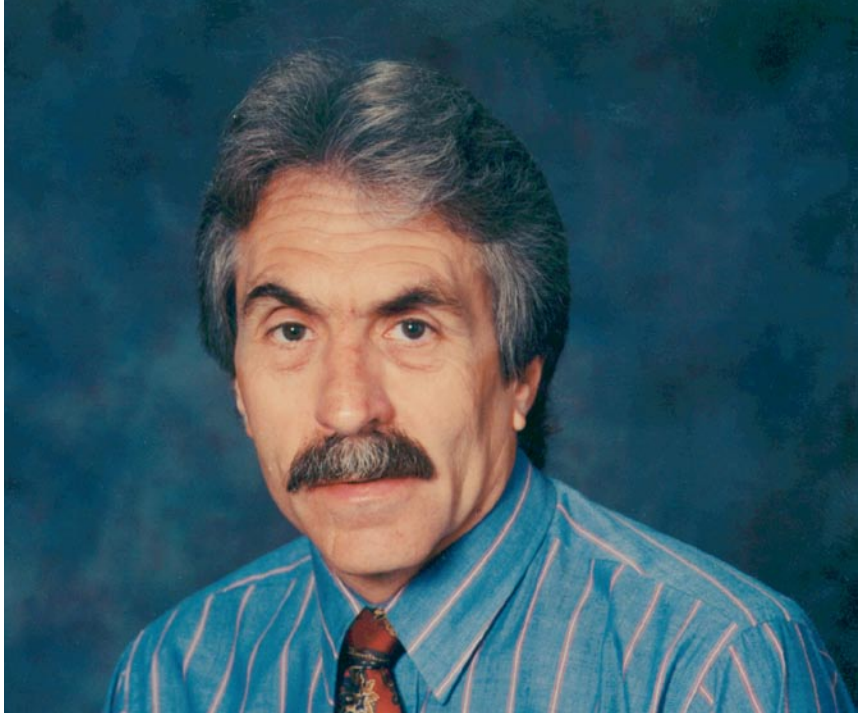
Featured Application: Fire Weather *p. 4*

VisualWeather 3.0 Released *p. 5*

New Compact Bubble Sensors *p. 5*

Meteorology for Aviation in Mexico *p. 6*

Monitoring Mixing Dynamics and Water Quality in Alaska *p. 7*



USU Awards Honorary Doctorate to Bert Tanner

Utah State University (USU) has awarded a posthumous doctorate to Bert Tanner at the spring graduation ceremony. Bert, our vice president of Marketing for 28 years, passed away in September 2008 after a battle with cancer.

Bert is being awarded this honor because of his contributions to various scientific fields over many years. His nomination received many letters of support and recommendation from all over the world. Below are some excerpts from the kind words sent by Bert's colleagues.

The PhD is a research degree requiring a contribution to the advancement of science. Without question, Bert has made this unique impact.

Edward Kanemasu
Director of Global Programs,
University of Georgia

He has worked shoulder to shoulder with research scientists to solve difficult measurement problems that have slowed progress in our discipline. I cannot think of a more fitting honor for a colleague who has contributed so much to our scientific community.

John Norman
University of Wisconsin

Bert Tanner has been a world leader and a great teacher and has contributed hugely to advances in our understanding of biosphere mechanics.

O.T. Denmead
CSIRO, Australia

The impact of Bert's contribution to environmental and global change science community has been phenomenal from local to global scales.

Joon Kim
Yonsei University, Seoul, Korea

Bert completed tens of PhD-equivalent research studies during his research career. He was a humble and gentle giant among instrumentation giants.

Rick Allen
University of Idaho

Bert's knowledge of physics and intuitive understanding of instrumentation and measurement requirements is well known around the world. His dedication to promoting the highest quality science and his willingness to contribute enormous time to train researchers has been a huge contribution to science.

George Thurtell
University of Guelph, Canada

Bert was a Certified Consulting Meteorologist with the American Meteorological Society (AMS) and has also been honored with an honorary PhD from the AMS and a fellowship in the American Society of Agronomy.

At Campbell Scientific, which benefited from decades of Bert's contributions, we are honored by our association with Bert and applaud USU's recognition of his many contributions by awarding him this honorary doctorate.

"...From the Perspective of the Customer"

Larry Shirk, Quality Assurance Manager

Over 20 years ago, while a student at Utah State University, I operated a wave solder machine for Campbell Scientific. This piece of equipment was used to flow solder onto the bottom of the assembled printed circuit boards in order to quickly form the solder joints and electrical connections. I learned quickly that the outcome of this process depended on my conscientiousness. The option was mine to either correct the defects or pass them on. It didn't take long to learn that the expectation was high and that perfection was an option. As challenging as this process was, I was able to measure and monitor my performance and gradually decrease the defects, while at the same time meeting my internal customers' expectations. I learned that quality was based upon the expectation of my customer.

Many years have passed and there have been many changes throughout the company, as any growing organization would experience. However, one thing has remained constant, and that is our vision of quality. At Campbell Scientific, quality is measured by the pride and satisfaction the customer feels when he makes his first measurements with his new equipment. That quality is reconfirmed year after year through collecting good measurements with that same equipment. Quality is also found in the voice of support on the phone when a customer contacts us for assistance concerning any issue, from orders to applications.

The opening statement of our quality policy states: "We at Campbell Scientific are committed to value oriented quality from the perspective of the customer." Clearly, you as the customer are the reason we are in business, and we are serious about your needs and the measurements you make.

Years ago, Paul Campbell, our company president, made a significant statement regarding quality at Campbell Scientific. He stated that if you perceive one instrument to be better than another, "then one of them isn't good enough." This philosophy has led to a strong and continual focus on quality from the perspective of the customer. We at Campbell Scientific place ourselves in the shoes of the customer often, ensuring that customer advocacy is ever-present throughout the company.

The value of our customer-focused quality system and culture is that it continuously strengthens itself as improvements are made and expectations are increased.

Campbell Scientific dataloggers have achieved impressive mean time between failure (MTBF) statistics. Simply stated, MTBF is total available operating time of units under warranty divided by the number of warranty returns during the same period. For example, the CR1000 is running currently around 800 years MTBF. If you purchase a datalogger today, your probability of no failure during the warranty period is 99.88%. Over the lifetime of this product Campbell

continued on page 8

CAMPBELL SCIENTIFIC UPDATE

Executive Editor	Neal Israelsen
Managing Editor	Lex Shakespear
Assistant Editors	Linda Worlton Patrick Burt Anthony Bodily
Contributors	Dana Worley Larry Shirk

Quality Policy

We at Campbell Scientific are committed to value oriented quality from the perspective of the customer.

- Quality of WORKMANSHIP and SERVICE are encouraged without adding unduly to cost.
- Quality is primarily dependent upon individual COMMITMENT and acceptance of responsibility by each employee for the quality of the products and services offered, both internal and external to the company.
- Efforts of continuous IMPROVEMENT focus on enhancement of product and process reliability and customer satisfaction.

Featured Application: Fire Weather

The arrival of warmer weather (at least in the Northern Hemisphere) brings with it the 2009 fire season. Many of us don't think about wildfires until we hear about them on the news. For others, however, it's their job to think about them all the time—how to prevent, manage, and fight them. Between nature- and human-ignited fires, there's certainly a lot to think about. On average over the last 10 years, 80,030 wildfires have burned 6,897,922 acres per year in the United States. These figures would be much higher if we were to include prescribed burns.

With weather being a major factor in both creating fire danger and spreading fires, the need for accurate weather measurements has made automated weather stations an important tool. Fire danger prediction involves many factors, including the topography of the land, current and recent weather, and the characteristics of wildfire fuels (e.g., wood, grass). All of these variables are used by National Fire Danger Rating System algorithms that estimate fire danger.

Permanent fire weather stations, such as our RAWS-P station, continuously monitor, record, and transmit meteorological data used by these algorithms. Standard measurements include precipitation, temperature, relative humidity, solar radiation, wind speed, and wind direction. Fuel moisture and temperature can easily be added. This rating system provides reliable information that helps make the public aware of danger and help land managers make decisions and prepare for possible fire scenarios.

Weather stations not only help us understand the potential for future fires, but they are a useful tool for fighting existing fires and monitoring prescribed burns. Precipitation, temperature, relative humidity, and especially wind can influence the speed at which fire spreads. The need for on-site weather measurements is met by portable stations, such as our RAWS-F station. These quick-deploy stations can be set up in 10 minutes or less without tools. The stations are preprogrammed, ready to output the weather parameters that are useful to firefighters.

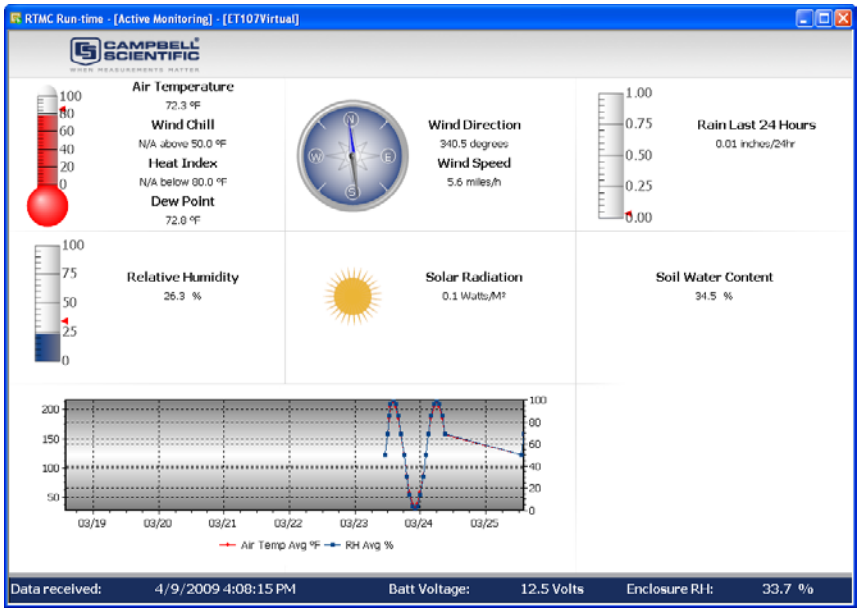
Radios can be integrated into both permanent and quick-deploy weather stations, making it possible for fire fighters to call the fire weather station via a hand-held radio and receive a verbal report of site conditions. Telemetry options include a GOES satellite transmitter for sending data to the National Interagency Fire Center (NIFC), in Boise, Idaho. NIFC is the wildland fire fighting support center for the United States.

Campbell Scientific weather stations have been used for years in fire-weather applications. In addition to offering permanent and quick-deploy stations, we offer retrofits for existing stations that use existing sensors and mounts, but swap out the data collection platform (DCP).

We also offer a duff moisture meter, the DMM600, for fast and accurate on-site duff moisture measurement—useful for planning prescribed burns. Our dataloggers can be used together with thermocouples and other sensors for researching wildfires and fire-protection equipment.

Contact us any time to talk to a fire-weather-station expert.

VisualWeather 3.0 Released



VisualWeather is our support software for preconfigured weather stations. Version 3.0, which began shipping March 31, 2009, adds support for the ET107 and the Toro T107. In addition, this version incorporates RTMC Pro* for creating its real-time displays and web-page-compatible graphics. These displays provide an even more polished, updated look for VisualWeather.

VisualWeather's standard reports can be generated monthly, weekly, or daily, or a date can be entered for custom reporting. The reports include:

Met station data

- Air temperature
- Solar radiation
- Relative humidity
- Rain fall
- Wind speed
- Wind rose
- Barometric pressure
- Soil water content
- Leaf wetness
- Snow depth
- Soil temperature
- Fuel moisture content

Datalogger health statistics

- Battery voltage
- Enclosure relative humidity

Calculated data

- Evapotranspiration
- Crop water needs
- Growing degree days
- Dew point
- Chill hours
- Wind chill
- Heat index

VisualWeather uses a database for storing data collected from weather stations. In version 3.0, we made report generation faster by updating this database. The first time VisualWeather 3.0 is started, it automatically imports the data from any version 2 of VisualWeather. (Data from version 1 is not compatible and will not import into version 3.)

Upgrade pricing is available. Contact a Campbell Scientific application engineer today to see if VisualWeather meets your weather station data collection and reporting needs.

**Note: The version of RTMC Pro incorporated into VisualWeather cannot be used outside of VisualWeather.*

New Compact Bubble Sensors

The new CS470 and CS471 are compact bubbler sensors manufactured by OTT. They are ideal for areas where submersed sensors can be damaged by corrosion, contamination, flood-related debris, lightning, or vandalism. These sensors have a pump that produces compressed air bubbles, whereas other bubblers use nitrogen tanks that need to be periodically exchanged. The elimination of tanks means less site visits, saving time and money.

The CS470 and CS471 determine liquid level by measuring the pressure required to force compressed-air bubbles through a submerged tube. A pressure transducer measures the tube pressure and the atmospheric pressure at the surface. This technique compensates for temperature effects and long-term drift in the transducer, producing a more accurate measurement.

The two models differ only in their accuracy. The CS470 is the standard accuracy version, providing an accuracy of ±0.02 ft. The CS471 is the high-accuracy version that can provide an accuracy of ±0.01 ft.

Six Airports in Mexico Get Weather Stations

Weather is, of course, a critical component of safe and efficient air travel. Pilots, navigators, air-traffic controllers, and maintenance technicians all need to know current conditions in order to do their job: move aircraft and passengers safely through the airways.

The Mexican Aerospace Navigation Service (SENEAM) is the agency responsible for providing meteorological data to airports in Mexico. To capture and make available to airports more of this critical weather data, SENEAM contracted with Disime, Campbell Scientific's representative in Mexico and a highly-qualified integrator and consultant, to install comprehensive weather stations at six airports.

In addition to standard weather conditions, the agency required visibility measurements, special runway visual range (RVR) calculations, and high-accuracy pressure sensors. Disime chose Campbell Scientific dataloggers for their ability to handle the large array of sensors and the complexity of data involved.

SENEAM wanted weather stations that generate high-quality data while still meeting a reasonable budget, and Disime was able to configure stations to match those needs using gear mostly available as standard products from Campbell Scientific. At each airport, the sensors are attached to a Campbell datalogger. (They first used the CR10X, then began using the CR850 when it became available.) The datalogger uses a VHF radio to broadcast the data to a PC. Disime set up the system software to display data that fits the customers' needs and the requirements of the International Civil Aviation Organization (ICAO).

Disime and SENEAM found that the Campbell systems were more affordable than similar products from other companies. Also, the maintenance and parts costs are low, and parts are readily available.

Disime is planning to use a similar system at a private airport for an upcoming project.

Monitoring Mixing Dynamics in Toolik Lake, Alaska

Toolik Lake is 130 miles south of Prudhoe Bay in northern Alaska. It is one of the main monitoring sites of the Arctic Long-Term Ecological Research (LTER) project and a site for studies led by Sally MacIntyre of the University of California investigating the linkages between hydrodynamics and ecosystem function. Both studies are funded by the U.S. National Science Foundation. Toolik Lake is classified as a dimictic lake, meaning a lake that undergoes two mixing periods—one in the spring and one in the fall. The lake is thermally stratified during the summer since the sun warms the upper layers. A thermocline (a layer with a rapid change in temperature) separates the warm upper layer with the cold deeper layers. The lake is ice-covered in winter.

Toolik Lake is a Global Lakes Ecological Observatory Network (GLEON) site. At present, there are 22 sites worldwide, with new members joining each year. The goal is for all sites to be instrumented with thermistor chains combined with meteorological stations, transmitting data in real time to a central computing facility. Ideally, oxygen will also be measured in real time at these sites.

In an effort to better understand Toolik Lake's mixing dynamics, a T-Chain (vertical series of temperature sensors, from Precision Measurement Engineering, Inc.) was installed in conjunction with a Campbell CR10X datalogger. The T-Chain and logger collect real-time, continuous temperature data at a series of depths, with an accuracy of plus or minus 0.01 deg C. The data from Toolik Lake during the summer of 2008 can be seen at www.icess.ucsb.edu/biogeo/toolik1/toolikRT.html, and will be updated again when data collection resumes in the summer of 2009.

For several reasons, researchers are interested in monitoring the thermal stratification in Toolik Lake, as well as its mixing dynamics. One reason is that the most dramatic climate change is anticipated in the Arctic region, and temperature data are required to document the changes.

Another reason is that winds create internal waves in stratified lakes. If the winds are strong enough relative to stratification, the internal waves will break and cause nutrients, regenerated in near-bottom waters, to mix vertically. If the quantity of nutrients mixed vertically in the lake is large enough, phytoplankton growth rates will increase. Thermal stratification measurements are essential in order to quantify the productivity of lakes and to predict how the productivity will change over time. The amplitude and shape of internal waves are evident when multi-depth, time-series temperature measurements have been made. Similarly, these measurements allow users to compute the coefficient of eddy diffusivity, a parameter indicative of the amount of turbulence in a lake and critical for computing nutrient flux.

A third reason is that scientists are interested in the mixing dynamics of lakes of different sizes and in different latitudes. Time-series temperature measurements, coupled with measurements of surface meteorology, allow scientists to decipher the different dynamics in lakes in different regions. This knowledge will allow greater prediction of the quality of inland waters under changing climate regimes and with changes in land use.

Researchers are also interested in time-series oxygen measurements paired with temperature measure-

continued on page 8

Calendar

May		
4-6	AWRA Spring Specialty Conference	Anchorage, AK
4-7	WindPower 2009	Chicago IL
13-16	ASES National Solar Conference	Buffalo, NY
17-21	ASCE/EWRI	Kansas City, MO
18-22	Great Lakes Research	Toledo, OH
18-21	National Hydrologic Warning Council	Vail, CO
June		
3-6	US Committee on Irrigation and Drainage	Reno, NV
14-17	International Bridge Conference	Pittsburgh, PA
14-17	WEDA 29	Tempe AZ
16-19	A&WMA	Detroit, MI
21-24	ASABE 2009	Reno, NV
July		
26-29	Fatigue Fracture 2009	Philadelphia, PA
27-30	WaterPower XVI	Spokane, WA
August		
1-5	APS Annual American Phytopathology	Portland. OR
2-7	94th ESA Annual Meeting	Albuquerque NM
16-20	StormCon	Anaheim CA
23-27	National Rural ITS Conference	Seaside, OR
September		
12-15	PCI National Bridge Conference	San Antonio, TX
21-23	Western Bridge Conference	Sacramento, CA
22-25	AEG	Lake Tahoe, CA
24-25	AWEA Wind Assessment Conference	
27-1	Dam Safety 2009	Hollywood FL
October		
04-07	Geothermal Energy Expo	Reno, NV
18-21	GSA 2009	Portland, OR
26-29	Oceans 2009 MTS/IEEE	Biloxi, MS
27-29	Automotive Testing	Novi, MI
27-29	Solar Power International	Anaheim, CA
28-30	NALMS	Hartford, CT
November		
1-5	ASA 2009 Annual Meeting	Pittsburgh, PA
1-5	CERF 2009	Portland, OR
9-12	45th AWRA Conference	Seattle, WA
December		
2-4	Irrigation Show 2009	San Antonio, TX
14-18	AGU	San Francisco, CA

Visit our web site for training class schedules and additional listings.

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER

Campbell Scientific, Inc.
815 West 1800 North
Logan UT 84321
435-753-2342

"...From the Perspective of the Customer"

continued from page 3

Scientific has shipped approximately 20,000 units and only experienced 60 warranty returns. That's 99.7% customer satisfaction. Every month a focused team of employees reviews in detail the issues that make up the deficiency between reality and perfection. As we determine the root causes of failures, we prevent recurring failures. We may never achieve 100% satisfaction, but it is still an option!

Twenty years ago, only 80% of all production units passed final testing. Three years ago the average passing rate was up to 97.5%, and today we are better than 99.0%. Can we maintain the trend? Sure we can! Why the confidence? It is simple. Campbell Scientific is, "…committed to value oriented quality from the perspective of the customer."

Monitoring Mixing Dynamics in Toolik Lake, Alaska

continued from page 5

ments. These measurements allow scientists to quantify the metabolism of a lake, that is, how much the phytoplankton and bacteria are growing. Changes in oxygen at different depths are also indicative of remineralization, the process which transforms organic matter to inorganic nutrients. In addition, time-series oxygen and temperature measurements are essential for determining how much of a lake is suitable for the growth and survival of fish. For example, with high loading of nutrients or insufficient mixing, oxygen depletion occurs at depth, causing a loss of habitat suitable for fish. This problem may be exacerbated by a changing climate.