July 31, 2017

Radiometrics Completes Delivery and Installation of *SkyCast* Atmospheric Wind and Thermodynamic Profilers to Taiwan Central Weather Bureau.

Radiometrics Corporation (Radiometrics) recently completed installation of a ***SkyCast***™ wind and thermodynamic profiler system (WTPS) and a separate RAPTOR® radar wind profiler (RWP) for The Republic of China (Taiwan) Central Weather Bureau (CWB).

Radiometrics installed the S*kyCast* WTPS on Dongsha Island, a remote outpost in the South China Sea. The system provides continuous profiles of wind speed/direction to 16 km, and temperature and humidity profiles to 10 km. The Taiwan National Forecast Center will use the *SkyCast* system to support severe weather prediction and to better understand annual monsoonal flows and tropical cyclones. A separate RWP installed at Taiwan's National Central University (NCU) will be used as a research, demonstration and maintenance system. The installations were in accordance with CWB's Strategic Plan for upgrading meteorological observation facilities and enhancing weather monitoring ability.

The *SkyCast* system on Dongsha Island includes a Stratospheric-Tropospheric, full beam steering (FBS-ST) RWP and an MP-3000A microwave profiling radiometer (MPR). The FBS-ST RWP and the MP-3000A MPR, along with integrated software tools, provide a complete wind and thermodynamic profiling system. This was Radiometrics' first WTPS delivered with a Stratospheric-Tropospheric class RWP.

Installation of the *SkyCast* system on Dongsha Island presented several challenges, including transport logistics, data communications, and civil works needed to ensure long-term reliability in a salt-air environment. Radiometrics, along with in-country partner Global Electronics Company, Ltd. (GECL), completed the difficult installation on-time and within budget. Radiometrics completed the smaller tropospheric (FBS-T) RWP installation at NCU prior to starting the Dongsha Island installation. The Dongsha Island and NCU sites are annotated on the map shown in Figure 1.

After installation and site acceptance, Radiometrics provided multi-day operator-level training on system maintenance and operations, as well as advanced training on data interpretation and operational applications. Radiometrics staff member and Certified Consulting Meteorologist Tim Wilfong led the advanced training at NCU.

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Figure 1. Installations Sites on Dongsha Island and NCU, Taoyuan City, Taiwan[1]

"Together, the radar and radiometer will allow us to better understand the dangerous weather that affects Taiwan," said CWB senior meteorological scientist Dr. Shih-Yun, Chou. CWB atmospheric scientists are already using the NCU radar to analyze the location, depth and evolution of the main island sea breezes, which play a key role in convection and heavy rains. The Dongsha Island *SkyCast* system is primarily used for atmospheric research and improved storm forecasting. The Dongsha Island RWP, shown in Figure 2, is currently configured to produce hourly profiles up to 16 km elevation.

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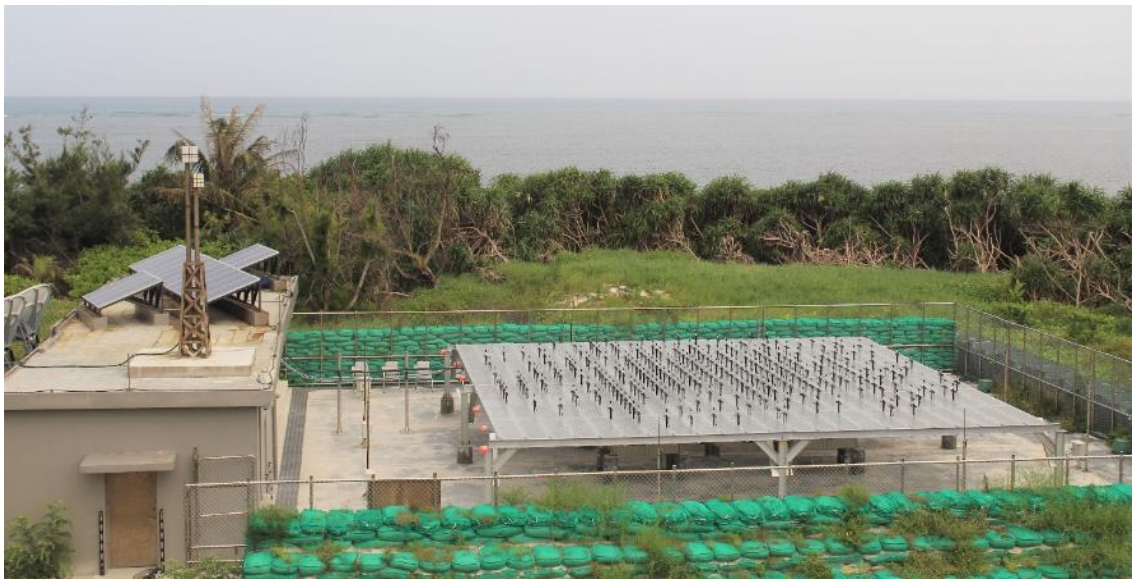

Figure 2 – RAPTOR Stratospheric-Tropospheric Radar Wind Profiler Installation on Dongsha Island

Measured wind data from the Dongsha Island RWP is shown in Figure 3; a Skew-T plot of thermodynamic profiles from the MP-3000A microwave radiometer installed on the island and concurrent RWP measured winds is shown in Figure 4.

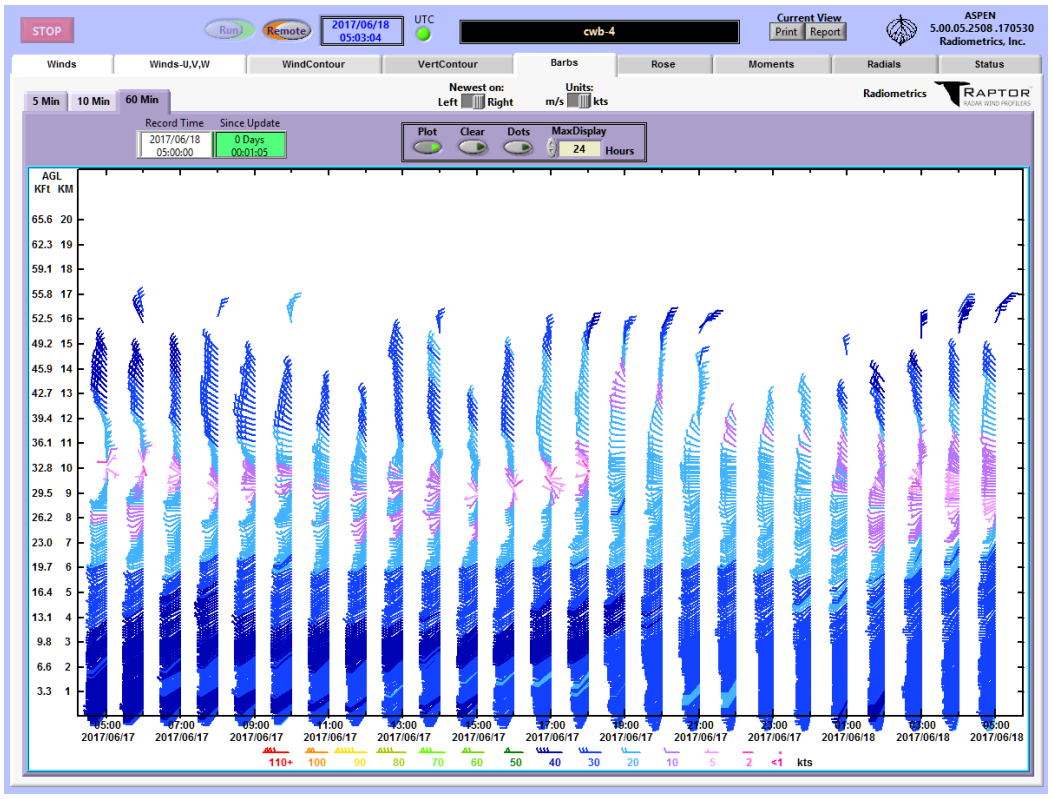

Figure 3 – Hourly Wind Profiles from Dongsha Island Radar Wind Profiler

"The Central Weather Bureau is a thorough and experienced customer," noted Radiometrics Program Manager Grant Beverage. "We are proud to be supporting their efforts to better understand and predict severe weather and, ultimately, help them save property and lives." Beverage added, "The customer well understood the challenges associated with this project, were very appreciative of our ability to deliver on time, and complete all Site Acceptance Tests (SATs) at both Dongsha Island and NCU according to schedule."

Remote visualization of both instrument health and data is important for CWB, and Radiometrics delivered powerful software tools to support this requirement. VizRCM software provides remote health status monitoring and basic wind data display for the RWP as shown in Figure X. VizMet-B provide browser-based remote control and monitoring for the radiometer system; a screen shot of the VizMet-B time-series display is shown in Figure X. Radiometrics also delivered RAOB software[2] for remote display of integrated winds and thermodynamic data in both time series and Skew-T formats.

About *SkyCast* Wind and Thermodynamic Profiler Systems

SkyCast is an integrated wind and thermodynamic profiling system (WTPS) that includes all needed instrumentation and feature-rich control, configuration and data display software tools. *SkyCast* utilizes advanced atmospheric remote sensing technologies to provide continuous boundary layer wind, temperature, vapor and liquid profiles, uniquely integrating remotely sensed observations from multiple instruments including the Radiometrics RAPTOR RWP, MP-3000A MPR, and optional Radiometrics Acoustic Wind Profiler (AWP or "sodar").

SkyCast WTPS provides key hyperlocal meteorological information within the Planetary Boundary Layer (PBL), from the surface to 3000 m AGL, or higher. The evolution and dynamics of PBL processes often drive the onset of mesoscale meteorological phenomena including high impact weather events. As such, the ability to monitor rapidly changing conditions in real-time is critical to assisting forecasters in providing timely and accurate weather information.

Radiometrics' RAPTOR family of Radar Wind Profilers provide unattended, real-time operational support for mission critical applications requiring high quality meteorological data products at high temporal resolution. The Full beam steering (FBS) radars use a unique phased-array antenna with

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2 Universal RAwinsonde OBservation program, www.roab.com

individual Yagi elements and solid-state phase shifters, and are scalable in size and power from Boundary Layer (BL) through Stratosphere-Troposphere (ST) systems. The FBS design incorporates a high-reliability digital transceiver, advanced signal processing, a wide range of displays for maintenance and meteorological data, non-proprietary data acquisition cards, and other Commercial-Off-The-Shelf (COTS) components. Full Health and Status (H&S) monitoring is incorporated throughout the system for quick diagnostics; all RAPTOR profilers are designed for "soft" or "graceful" degradation so that data is still collected even if there are internal hardware failures. By using real-time advanced signal processing algorithms, fully processed meteorological products are available both with high-resolution (e.g., at 6-minute report intervals) and simultaneous with lower resolution (e.g., at 60-minute report intervals).

The FBS feature allows for advanced beam steering options to improve data quality, avoid ground clutter, and even track the sun for antenna and receiver status tests. Due to design features of the antenna, as well as the design of other subsystems, the RAPTOR FBS can acquire data as low as 160 meters above the ground. RAPTOR radars are designed for 20+ year serviceable lifetime and for extreme environments, including wide temperature range, snow loading and high wind loading. Unlike lidars or sodars, radar wind profilers possess all weather capability. A chart of the different RWP models with measurement heights is shown in Table 1.

RAPTOR Model	Atmosphere Level	Typical Height	Frequency Band	Description
DBS-BL	Boundary Layer	3-4 km	900 – 1400 MHz	Upgrade for LAP®-3000[2]
FMC-BL		1-3 km	900 – 1400 MHz	Designed for shipboard installation
XBS-BL		3-4 km	900 – 1400 MHz	Lower cost; designed for trailer or static mount
VAD-BL		3-6 km	900 – 1400 MHz	High-performance stationary system
XBS-T	Troposphere	5-8 km	400 – 500 MHz	Lower cost; designed for trailer or static mount
FBS-T		5-8 km	400 – 500 MHz	Scalable antenna and transmitter
FBS-ST	Troposphere/ Stratosphere	16 km	400 – 500 MHz	Scalable antenna and transmitter
FBS-ST-EX		18 km	200 MHz	Scalable antenna and transmitter
FBS-MST		20 km	50 MHz	Scalable antenna and transmitter

Table 1: RAPTOR Radar Wind Profiler Models by Atmospheric Height

Radiometrics has delivered over 230 MP-3000A MPRs to customers worldwide for research and operational forecasting applications. The MP-3000A radiometers deliver optimum accuracy and reliability in a rugged, highly portable package. Patented hyperspectral receiver technology, rain effect mitigation, and advanced calibration technologies result in an instrument which is optimized for all-weather, all-sky performance. In recognition of the MP-3000A's superior performance and reliability, the Indian Air Force (IAF) selected the MP-3000A system for its 20-site national thermodynamic profiling network, and the Republic of Korea Air Force (ROKAF) selected the MP-3000A for an eight-site profiler network.

The MP-3000A is ideal for both permanent installations and portable use; the entire system, including tripod and optional azimuth positioner, weighs less than 50 kg, and can be installed in less than an hour. The MP-3000A provides profiles to 10 km height, with greatest accuracy in the Planetary Boundary Layer (PBL), where convective storms, fog, and winter storms occur, and where atmospheric data is most sparse. The MP-3000A MPR is shown in Figure 6.

Figure 6 – The MP-3000A Microwave Profiling Radiometer

Radiometrics had previously delivered SkyCast WTPS to customers in the United States, UAE, and Dubai. A trailer-mounted mobile SkyCast systems, one of two delivered to a U.S. public utility, is shown in Figure 7, while a boundary layer fixed airport installation is shown in Figure 8.

Figure 7 – Trailer-Mounted SkyCast WTPS

Figure 8 – Boundary layer SkyCast Airport installation

About Taiwan Central Weather Bureau: Headquartered in Taipei, the CWB (http://www.cwb.gov.tw) is responsible for forecasts and warnings with the goals of disaster prevention and mitigation and promotion of economic development. CWB's mission is to promote modernized meteorological observation,

develop refined meteorological forecasts, and provide diversified channels of information dissemination, and improve the quality of its meteorological services.

About Radiometrics: Radiometrics Corporation (www.radiometrics.com) is a privately held corporation based in Boulder, Colorado. The company has pioneered commercial ground-based atmospheric remote sensing systems for over three decades. With more than 300 microwave thermodynamic profilers, 200 acoustic wind profilers (sodars) and 35 boundary layer, tropospheric and stratospheric RAPTOR™ radar wind profilers in operation worldwide, the company is recognized as the world leader in ground-based atmospheric profiling solutions. Radiometrics offers software tools for network deployments, system monitoring, data display and analysis, as well as long-term support.