



# CARICOOS

## **CARICOOS Equipment: Standard Operating Procedures**

CARICOOS instructs all subcontractors and employees to follow industry best practices and manufacture guidelines where applicable, and to be prepared to provide documentation upon request.

Below are descriptions of the standard operating procedures for calibrating, validating, operating, and maintaining equipment within CARICOOS. A description of the inventory, shipping, and maintenance log requirements are also included on p.7.

### **WIND**

#### **1) WeatherFlow Coastal Mesonet Stations**

WeatherFlow owns and operates 13 Coastal Mesonet weather stations for CARICOOS. The standard measurements for these stations include surface winds (R.M. Young wind sensor), air temperature, and barometric pressure.

WeatherFlow Inc. calibrates, operates, and maintains the equipment in accordance with the manufacture's guidelines and/or industry standards, when available. The following specific sensors are included in the weather station:

##### *Surface Winds:*

R.M. Young aero-vane wind sensor, model number RMY 05133-58. WeatherFlow personnel use the operations and maintenance guidelines provided in the following manual:

[https://about.caricoos.org/wp-content/uploads/2022/01/rm\\_young\\_05103.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/rm_young_05103.pdf)

##### *Air Temperature*

Sensirion model SHT75 housed in a Stevenson radiation shield.

WeatherFlow personnel follow the operations and maintenance guidelines provided in the following manual:

[https://about.caricoos.org/wp-content/uploads/2022/01/Sensirion\\_Humidity\\_SHT7x\\_Datasheet\\_V5.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/Sensirion_Humidity_SHT7x_Datasheet_V5.pdf)

##### *Barometric Pressure*

Bosche barometric pressure transducer, model number BMP085/183. WeatherFlow personnel use the operations and maintenance guidelines provided in the following manual:

[https://about.caricoos.org/wp-content/uploads/2022/01/BOSCH\\_BMP085.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/BOSCH_BMP085.pdf)

## **2) WindNet Meteorological Stations**

Dr. Patricia Chardon-Maldonado operates and maintains one WindNet and four Davis land-based coastal weather stations for CARICOOS. CARICOOS and the University of Puerto Rico at Mayaguez staff provide operations and maintenance as recommended in the following manuals:

RM Young Wind Monitor - Model 05103

[https://about.caricoos.org/wp-content/uploads/2022/01/rm\\_young\\_05103.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/rm_young_05103.pdf)

RM Young Temperature Probe - Model 41342VC

<https://about.caricoos.org/wp-content/uploads/2022/01/rm41342V.pdf>

RM Young Relative Humidity/Temperature Probe - Model 41382VC

<https://about.caricoos.org/wp-content/uploads/2022/01/rm41382VC.pdf>

RM Young Barometric Pressure Sensor - Model 61302V [https://about.caricoos.org/wp-content/uploads/2022/01/rm\\_press\\_61302V-90.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/rm_press_61302V-90.pdf)

Davis Vantage Pro2

<https://about.caricoos.org/wp-content/uploads/2022/01/Davis-Vantage-Pro2-UserManual.pdf>

Davis Vantage Pro2 Console

[https://about.caricoos.org/wp-content/uploads/2022/01/Davis-Console\\_Manual.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/Davis-Console_Manual.pdf)

Davis Anemometer – Model 6410

<https://about.caricoos.org/wp-content/uploads/2022/01/Davis-Anemometer-User-manual.pdf>

## BUOYS

### 1) UMaine Meteorological and Oceanographic Data Buoys

The University of Maine operates and maintains 4 buoys for CARICOOS (PR1=Ponce; PR2=San Juan; PR3=Vieques; VI1=St. John, VI2=St. Thomas).

These buoys are serviced yearly and refurbished by its fabricators from the Physical Oceanography group of the U. of Maine led by Dr. Neal Pettigrew. The maintenance is scheduled to ensure it's timely completion before the hurricane season that officially begins June 1. UMaine and CARICOOS personnel service the following instruments annually following instrument manuals and guidelines:

#### Surface Winds:

The primary wind sensor on the CARICOOS buoys is the Gill Instruments UltraSonic wind sensor (WindSonic). The WindSonic is interfaced to the Campbell data logger for data collection and transmission. UMaine staff follows all operational guidelines as described in the Gill WindSonic manual:

[https://about.caricoos.org/wp-content/uploads/2022/01/gill\\_windsonic-manual.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/gill_windsonic-manual.pdf)

There is also a backup R.M. Young wind sensor (Marine Wind Monitor model 05106) on each buoy. These are serviced yearly by UMaine personnel in accordance with the operational guidelines for laboratory checks described in the Wind Monitor manual and Wind System Calibration manual:

<https://about.caricoos.org/wp-content/uploads/2022/01/rm05106-90%28J%29.pdf>

<https://about.caricoos.org/wp-content/uploads/2022/01/rm18860-90%28B%29.pdf>

#### Air Temperature:

Each buoy has a Campbell Scientific air temperature sensor (model 107) housed in a Campbell radiation shield as specified by the manufacturer. All operational guidelines as described in the Campbell air temperature manual are followed by UMaine personnel as part of the yearly maintenance: <https://about.caricoos.org/wp-content/uploads/2022/01/campbell107.pdf>

#### Barometric Pressure:

A Setra 270 barometric pressure transducer is installed in a vented housing on each buoy. These are serviced yearly by UMaine personnel in accordance with the

operational guidelines described in the pressure transducer manual:  
<https://about.caricoos.org/wp-content/uploads/2022/01/sertra270.pdf>

#### Directional Waves:

The primary directional wave sensor used on the CARICOOS buoys is the AXYS Technology Triaxys directional wave sensor. UMaine personnel service the sensors annually in accordance with the operational guidelines described in the TRIAXYS OEM Directional Wave Sensor User Manual (not found online; copy of manual obtained when instrument was procured). General information about the TRIAXYS wave sensor can be found at:

<https://about.caricoos.org/wp-content/uploads/2022/01/TRIAXYS-Sensor.pdf>

#### Ocean Temperature/Salinity:

Each buoy has a Seabird SBE37SM mounted at a depth of 1 meter. The University of Puerto Rico sends all recovered SBE37SM back to the manufacturer (Seabird) for recalibration yearly. A freshly calibrated instrument is provided by UPR for each buoy as part of the yearly servicing. All operational guidelines described in the following manual are followed by UPR/UMaine personnel during the yearly servicing:

[https://about.caricoos.org/wp-content/uploads/2022/01/SBE\\_37SM\\_rs232\\_039.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/SBE_37SM_rs232_039.pdf)

#### Ocean Currents:

Each buoy has a Nortek Aquadopp current profiler. All operational guidelines described in the Aquadopp Current Profiler User Guide are followed. If an instrument requires servicing, UPR returns the instrument to the manufacturer:

[https://about.caricoos.org/wp-content/uploads/2022/01/aquadopp-profiler\\_Users-Guide\\_86pgs.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/aquadopp-profiler_Users-Guide_86pgs.pdf)

## **2) Datawell Waverider Buoys**

CARICOOS operates one Waverider Buoy at Rincon and Arecibo. CARICOOS follows the standard operating procedures outline in the National Wave Plan (p. 31) and in the Datawell manual: [https://about.caricoos.org/wp-content/uploads/2022/01/datawell\\_waverider.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/datawell_waverider.pdf)

## **HIGH FREQUENCY RADAR (HFR)**

NOAA IOOS and the HFR Steering Team developed standard operating procedures for HFR. CARICOOS follows these guidelines: [https://about.caricoos.org/wp-content/uploads/2022/01/HF\\_radar\\_best.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/HF_radar_best.pdf)

Deployment & Maintenance of a High Frequency Radar for Ocean Surface Current Mapping: Best Practices, February 2008.

## **MAPCO2 BUOYS**

The buoy maintenance and instrument calibration operations are completed annually. Instrument calibration process is offered by NOAA, Pacific Marine Environmental Laboratory and assisted by CARICOOS. The MAPCO2 buoys include the following equipment:

### Infrared CO2 analyzer (LI-COR)

The analyzer is calibrated on a 3hr cycle using a reference CO2 gas mixture. The gas mixture is filled and calibrated at the World Meteorological Organization (WMO) central calibration laboratory at NOAA Earth Systems Research Laboratory in Boulder, Colorado. The description about how standard reference gases are filled is at: [https://about.caricoos.org/wp-content/uploads/2022/01/preparation\\_std\\_air\\_mix.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/preparation_std_air_mix.pdf)

Averaged data and standard deviations for each measurement are transmitted to PMEL daily.

### GPS module

GPS information is provided through iridium satellite data transmission system. Data and diagnostic information is transmitted directly to PMEL daily. The software user manual is provided by Battelle Memorial Institute at [https://about.caricoos.org/wp-content/uploads/2022/01/pco2\\_firmware\\_manual.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/pco2_firmware_manual.pdf)

### SBE16 Microcat

The SBE16 Microcat has temperature, salinity with fluorescence, turbidity and oxygen auxillary sensors. SeaBird provides calibrations and maintenance annually following these manuals:

*SBE16 plus:*

[https://about.caricoos.org/wp-content/uploads/2022/01/sbe\\_16plusV2.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/sbe_16plusV2.pdf)

*Dissolved Oxygen optode:*

[https://about.caricoos.org/wp-content/uploads/2022/01/sbe\\_DO63\\_010.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/sbe_DO63_010.pdf)

SAMI pH system:

The SAMI pH system is provided by Sunburst Sensors, LLC. The instrument is self-calibrated every cycle using an internal pH standard and operates following the manual:

[https://about.caricoos.org/wp-content/uploads/2022/01/phsensor\\_SAMI.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/phsensor_SAMI.pdf)

## **GLIDERS**

CARICOOS owns and operates one underwater glider, as well assist NOAA, Atlantic Oceanographic & Meteorological Laboratory (AOML), who owns and provides operations and data management for several gliders in the CARICOOS region (four as of November 2021). CARICOOS also provides field support to the gliders in the form of ship time for deployments and retrievals plus local students and crews in collaboration with AOML. The gliders measure vertical profiles of temperature and salinity.

AOML and CARICOOS personnel use the following guidelines and manuals to perform calibration, maintenance, and operations: Maintenance Guide:

[https://about.caricoos.org/wp-content/uploads/2022/01/Seaglider\\_Refurbishment\\_Maintenance\\_Guide.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/Seaglider_Refurbishment_Maintenance_Guide.pdf)

Calibration Procedures: [https://about.caricoos.org/wp-content/uploads/2022/01/Seagliders\\_Calibration\\_Procedures.pdf](https://about.caricoos.org/wp-content/uploads/2022/01/Seagliders_Calibration_Procedures.pdf)

## **DRIFTERS**

The NOAA, Atlantic Oceanographic & Meteorological Laboratory (AOML) owns and provides operations and data management for the Global Drifter Program surface drifters in the CARICOOS region. CARICOOS provides field support to the disposable drifters in the form of ship time for deployments, plus local students and crews in collaboration with AOML.

AOML uses the standard guide of David Griffin from NOAA's The Global Drifter Program for the deployment and design of CARICOOS drifters. Many of the documents can be found here: [http://www.aoml.noaa.gov/phod/dac/gdp\\_doc.php](http://www.aoml.noaa.gov/phod/dac/gdp_doc.php)

## **SURFRIDER WATER SAMPLING**

Surfrider trains volunteers to use Enterolert for detecting enterococci, using this IDEXX manual: <https://about.caricoos.org/wp-content/uploads/2022/01/Enterolert-Procedure-en.pdf>

Surfrider trains volunteers to use IDEXX Quanti-Tray\*/2000 to determine bacterial counts in 100mL water samples, using this manual: <https://about.caricoos.org/wp-content/uploads/2022/01/Quanti-tray-2000-procedure-en.pdf>

## **CARICOOS INVENTORY AND EQUIPMENT LOGS**

CARICOOS requires all subcontractors to keep logs, inventory, and maintenance records. Any maintenance details, shipments, and problems observed with the instruments during the deployment, or the yearly servicing period are included in the reports from the subcontractor to CARICOOS. This structure applies to the following subcontractors and associated assets:

- University of Maine: Meteorological and Oceanographic Data Buoys
- WeatherFlow: Mesonet Weather Stations
- Arecibo Datawell WaveRider Buoy

For equipment owned and operated by CARICOOS, the Property Office of the UPR at Mayaguez Oficina de Propiedad UPRM maintains inventories, maintenance details, and shipping logs: <http://www.uprm.edu/decadmi/propiedad/>

This structure applies to the following assets:

- WindNet Weather Stations
- Rincon Datawell WaveRider Buoy
- High Frequency Radar antennas

NOAA PMEL keeps a record of the equipment inventories, shipping logs, and instrument history logs for all equipment on the MAPCO2 buoy.

NOAA, Atlantic Oceanographic & Meteorological Laboratory (AOML) keeps a record of the equipment inventories, shipping logs, and instrument history logs for all gliders and drifters operating within CARICOOS.