

WeatherStation Weather Reporting Option User Guide

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Revision History

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1.00	Initial Production Release	MB, JS

TRADEMARKS

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PATENTS & INVENTIONS

The Wave Glider mechanism is patented under US Patent Number 7,371,136 and other patents pending. All aspects of the Wave Glider product have been developed at private expense by Liquid Robotics, Inc.

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Table of Contents

Preface	7
This Document	7
Chapter 1: WeatherStation Option Overview	9
Hardware Architecture	9
The Weather Sensor	9
The Logic Board	10
Software Architecture	10
On-Board Software	10
Shore-Side Software	10
Chapter 2: Planning to Use the WeatherStation Option	13
Weight	13
Power Budget	13
Operating Conditions	13
Software Setup	13
WGMS	13
Custom Software	14
Specifications	14
The Weather Sensor	14
The Mounting	14
Shipboard Controlling Logic	14
Chapter 3: Preparing the WeatherStation Option Hardware	17
Installing the WeatherStation Option	17
Precautions	17
Required Parts	17
Tools	17
Installation	18
Cutting a Turtle Deck Slot	18
Testing and Deploying the WeatherStation Option	19
Chapter 4: Working with Weather Reports in WGMS	21
Using the WGMS Dashboard	21
Viewing Weather Reports	21
Exporting Weather Reports From a Table	23
Turning the iPIB and Weather Sensor On or Off	23
Chapter 5: Developing Custom Weather Report Software	25
Using WGMS SOAP Functions	25
Entity Type Number and Column Names	25
Reading Entity Information in the WGMS Dashboard	26
Working Directly With the Wave Glider WeatherStation Option	27
Reading Weather Report Packets	27
Powering the Weather Sensor and iPIB On and Off	27

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Preface

The WeatherStation weather reporting option is one of a set of sensor options that Liquid Robotics, Inc. (LRI) provides for its Wave Glider ocean-going unmanned sensor platforms. The WeatherStation option adds a mast-mounted weather sensor to the Wave Glider's Command & Control (C&C) module. The option detects air temperature, barometric pressure, and true wind speed and direction.

A process running in the C&C module averages wind speed and direction over a period of time. At regular pre-set intervals it reports current air temperature, current barometric pressure, average true wind speed and direction, and wind gust speed since the last report. It uses the Wave Glider's Iridium satellite communications channel to make its reports. Operators shore-side can view the weather reports in the Wave Glider Management System (WGMS) console, where they appear in easily exportable table format.

A custom web application can retrieve weather reports directly from the WGMS database through SOAP calls. A custom application can also receive weather reports directly from the Iridium communications channel, bypassing WGMS completely.

This Document

This user guide provides information for people who may work with the WeatherStation option in different roles:

- **All readers** can read "WeatherStation Option Overview," which introduces the hardware and software in the WeatherStation option and explains some weather data concepts. It is a useful overview for anyone working with the WeatherStation option.
- **Mission planners** can read "Planning to Use the WeatherStation Option" to see how to integrate the WeatherStation option with other Wave Glider components. This section contains specification details for hardware and software and a short description of the work required to set up and use the option.
- **Wave Glider deployment teams** will find instructions in "Preparing the WeatherStation Option Hardware" for the preparation necessary to set up the WeatherStation option before Wave Glider deployment.
- **Shore-side operators and system administrators** should read "Working With Weather Reports In WGMS." It describes how to view weather reports in tabular form, how to export weather report data, and how to turn the WeatherStation sensor and iPIB board on or off on the Wave Glider.
- **Software developers** should read "Developing Custom Weather Report Software." It provides weather-report-specific details that a custom web application uses to work with WGMS-stored weather data via SOAP calls. It also provides necessary details for software that reads weather reports directly from a Wave Glider's Iridium packets without going through WGMS: the commands used to turn the WeatherStation sensor and iPIB board on and off, and packet formats for weather data.

You will find detailed information about Wave Glider mission planning, operation, and using the WGMS dashboard in "Wave Glider User Manual." System administrators will find more information about setting up and using WGMS in "Wave Glider System Administration." "Wave Glider Interface Control" provides details physical details of the Wave Glider as well as interface details for software developers.

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Chapter 1: WeatherStation Option Overview

The WeatherStation option includes hardware installed on a Wave Glider and software that runs both onboard the Wave Glider and shore-side on computers located on land or in a ship.

Hardware Architecture

The WeatherStation option adds a mast-mounted weather sensor to the mast deck of a Wave Glider. The sensor connects to the C&C module through a standard plug in the C&C dry box lid. The option uses the logic board present in the C&C dry box to run controlling software.

The Weather Sensor

The weather sensor, an Airmar WeatherStation Model PB200, sits on top of a one-meter carbon-fiber mast that contains an integrated data and power cable. The mast is mounted in one of the four mast positions available on a Wave Glider's mast deck; the data and power cable runs from the bottom of the mast under the turtle deck to plug into the C&C dry box lid.

The connection goes from there to the internal Personality Interface Board (iPIB) in the C&C dry box. The iPIB supplies power to the weather sensor and communicates with it to receive weather reports. The iPIB can power the weather sensor on or off.

The weather sensor has no moving parts, and contains multiple sensors within itself:

- An ultrasonic anemometer detects apparent wind speed and direction.
- A thermistor reads air temperature.
- A piezoresistive pressure sensor reads barometric pressure.
- Magnetoinductive XYZ sensors provide a tilt-compensated magnetic compass heading.
- A three-axis MEMS accelerometer provides pitch and roll angles.
- A Micro Electro-Mechanical Systems (MEMS) gyroscope provides rate of turn.
- A GPS receiver provides position (latitude and longitude), speed, course over ground, time, and date. The GPS receiver is augmented by WAAS and EGNOS for greater accuracy.

The weather sensor calculates true wind speed and direction from the apparent wind speed and direction that the anemometer provides. Apparent wind speed and direction are measured relative to the weather sensor, which will likely be in motion; true wind speed and direction are measured relative to a fixed point on the earth.

The weather sensor applies motion data such as heading, pitch and roll angles, speed over ground, and rate of turn to the relative wind speed and direction to calculate the true wind speed and direction.

The weather sensor reports weather conditions once a second to the iPIB, and reports GPS position, time, and date once every ten seconds.

The Logic Board

The logic necessary to read weather data, calculate average wind direction and speed, and transmit weather reports runs on the iPIB resident within the C&C dry box. The iPIB contains a CPU and RAM and communicates directly with the weather sensor and with the C&C controller. The C&C controller can turn the iPIB on and off and, through the iPIB, the weather sensor on and off.

Software Architecture

The WeatherStation option's software runs on-board the Wave Glider, where it receives and transmits weather reports, and shore-side, where it processes weather reports from the Wave Glider.

On-Board Software

A weather process running on the iPIB receives weather data from the weather sensor at one-second intervals, and GPS data at ten-second intervals. The weather process retains the latest air temperature, barometric pressure, and GPS location, date, and time. The process sums up wind direction values as they arrive, and also sums up wind speed values, keeping a tally of how many values are included in the sum. It also keeps a record of the highest wind speed reported.

Every 15 minutes the weather logic uses its summed wind direction and speed values and the value tally to calculate average wind direction and speed, then assembles a weather report that contains:

- The most recent air temperature in degrees Centigrade)
- The most recent barometric pressure in millibars
- The average true wind direction in degrees from true north
- The average true wind speed in knots
- The most recent GPS latitude, longitude, date, and time

The weather logic packetizes the weather report and submits the report to the C&C controller for transmission over the Wave Glider's Iridium communication channel (or, for local testing purposes, the XBee communication channel).

Once the weather report has been sent, the weather logic clears its wind speed, direction, and gust values and starts once again summing speed and direction and maintaining the maximum speed value.

Shore-Side Software

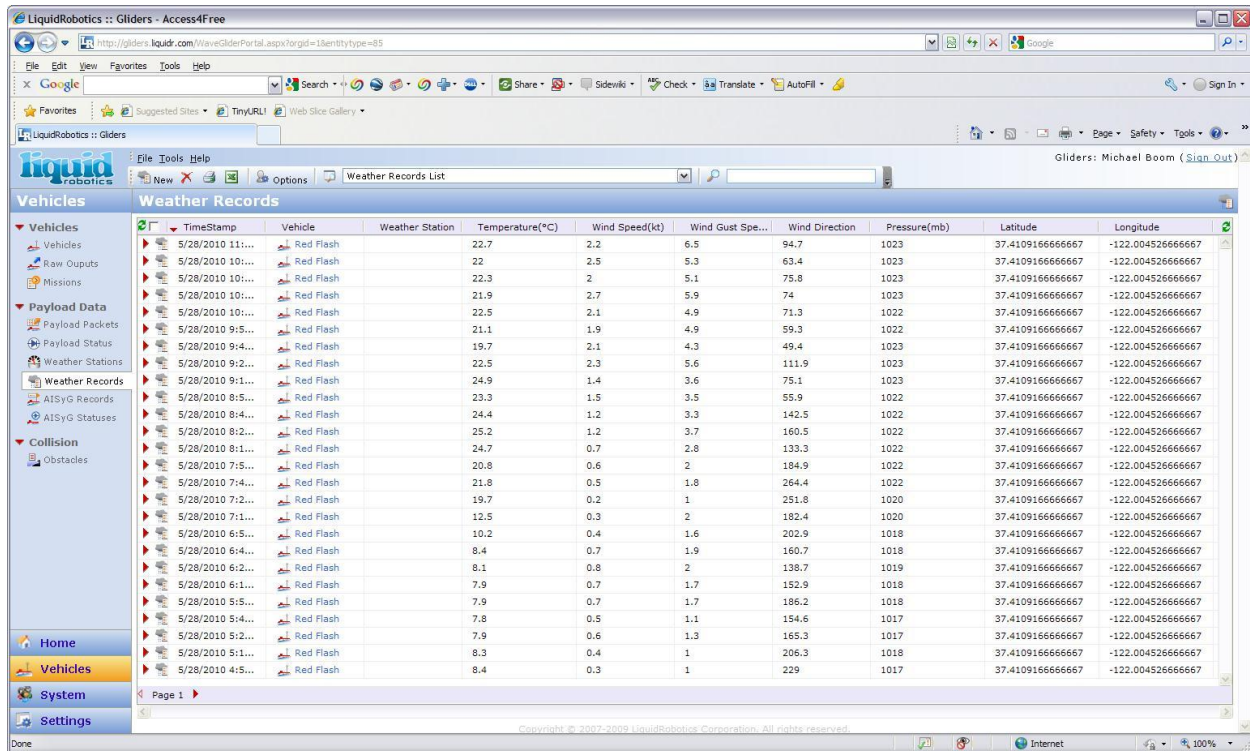
The Wave Glider Management System (WGMS) receives, stores, and displays weather reports from one or more Wave Gliders that have the WeatherStation option. Custom applications can retrieve weather reports directly from the WGMS database and may also receive weather reports directly from Wave Gliders via Iridium without going through WGMS.

WGMS

Weather reports come to WGMS as standard payload data via operations packets transmitted by Wave Gliders over Iridium or XBee channels. WGMS unpacks and decompresses the packets and reads the weather reports from a weather packet format (described later in this document). WGMS then stores the

weather reports in tables in the WGMS database. It also stores the original weather report packets in the database.

An operator uses the WGMS dashboard to view the weather reports, where they appear in tabular form listed in chronological order by reporting vessel. An operator can export weather reports in HTML format for import into Microsoft Excel or other spreadsheet programs.



The screenshot shows a web browser window displaying the LiquidRobotics WGMS dashboard. The dashboard has a sidebar with navigation links: Vehicles, Payload Data, AISyG Records, Collision, Home, Vehicles (highlighted), System, and Settings. The main content area is titled 'Weather Records List' and displays a table of weather reports for a vehicle named 'Red Flash'. The table has the following columns: TimeStamp, Vehicle, Weather Station, Temperature(°C), Wind Speed(kt), Wind Gust Spe..., Wind Direction, Pressure(mb), Latitude, and Longitude. The data is sorted chronologically from 5/28/2010 11:00:00 to 5/28/2010 4:50:00. The table shows various weather parameters for the 'Red Flash' vehicle, including temperature, wind speed, wind gust speed, wind direction, pressure, latitude, and longitude.

TimeStamp	Vehicle	Weather Station	Temperature(°C)	Wind Speed(kt)	Wind Gust Spe...	Wind Direction	Pressure(mb)	Latitude	Longitude
5/28/2010 11:00:00	Red Flash		22.7	2.2	6.5	94.7	1023	37.4109166666667	-122.004526666667
5/28/2010 10:00:00	Red Flash		22	2.5	5.3	63.4	1023	37.4109166666667	-122.004526666667
5/28/2010 10:00:00	Red Flash		22.3	2	5.1	75.8	1023	37.4109166666667	-122.004526666667
5/28/2010 10:00:00	Red Flash		21.9	2.7	5.9	74	1023	37.4109166666667	-122.004526666667
5/28/2010 10:00:00	Red Flash		22.5	2.1	4.9	71.3	1022	37.4109166666667	-122.004526666667
5/28/2010 9:50:00	Red Flash		21.1	1.9	4.9	59.3	1022	37.4109166666667	-122.004526666667
5/28/2010 9:40:00	Red Flash		19.7	2.1	4.3	49.4	1023	37.4109166666667	-122.004526666667
5/28/2010 9:20:00	Red Flash		22.5	2.3	5.6	111.9	1023	37.4109166666667	-122.004526666667
5/28/2010 9:10:00	Red Flash		24.9	1.4	3.6	75.1	1023	37.4109166666667	-122.004526666667
5/28/2010 8:50:00	Red Flash		23.3	1.5	3.5	55.9	1022	37.4109166666667	-122.004526666667
5/28/2010 8:40:00	Red Flash		24.4	1.2	3.3	142.5	1022	37.4109166666667	-122.004526666667
5/28/2010 8:20:00	Red Flash		25.2	1.2	3.7	160.5	1022	37.4109166666667	-122.004526666667
5/28/2010 8:10:00	Red Flash		24.7	0.7	2.8	133.3	1022	37.4109166666667	-122.004526666667
5/28/2010 7:50:00	Red Flash		20.8	0.6	2	184.9	1022	37.4109166666667	-122.004526666667
5/28/2010 7:40:00	Red Flash		21.8	0.5	1.8	264.4	1022	37.4109166666667	-122.004526666667
5/28/2010 7:20:00	Red Flash		19.7	0.2	1	251.8	1020	37.4109166666667	-122.004526666667
5/28/2010 7:10:00	Red Flash		12.5	0.3	2	182.4	1020	37.4109166666667	-122.004526666667
5/28/2010 6:50:00	Red Flash		10.2	0.4	1.6	202.9	1018	37.4109166666667	-122.004526666667
5/28/2010 6:40:00	Red Flash		8.4	0.7	1.9	160.7	1018	37.4109166666667	-122.004526666667
5/28/2010 6:20:00	Red Flash		8.1	0.8	2	138.7	1019	37.4109166666667	-122.004526666667
5/28/2010 6:10:00	Red Flash		7.9	0.7	1.7	152.9	1018	37.4109166666667	-122.004526666667
5/28/2010 5:50:00	Red Flash		7.9	0.7	1.7	186.2	1018	37.4109166666667	-122.004526666667
5/28/2010 5:40:00	Red Flash		7.8	0.5	1.1	154.6	1017	37.4109166666667	-122.004526666667
5/28/2010 5:20:00	Red Flash		7.9	0.6	1.3	165.3	1017	37.4109166666667	-122.004526666667
5/28/2010 5:10:00	Red Flash		8.3	0.4	1	206.3	1018	37.4109166666667	-122.004526666667
5/28/2010 4:50:00	Red Flash		8.4	0.3	1	229	1017	37.4109166666667	-122.004526666667

Figure 1. The WGMS Dashboard Displays Weather Reports in Tabular Form

Custom Web Applications

Developers can create custom web applications that have direct access to the WGMS database and the weather reports stored there. These applications can use SOAP calls from the WGMS SOAP API to retrieve weather reports and act on them as desired.

Custom Operations Software

Developers who wish to bypass WGMS completely can write their own software to receive weather report transmissions arriving via Iridium or XBee. The software is responsible for unpacking weather report packets, reading them, and then acting on the weather reports they contain.

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Chapter 2: Planning to Use the WeatherStation Option

When planning a Wave Glider mission that includes the WeatherStation option, there are some minimal physical operating conditions to consider and minimal software setup necessary. This chapter describes those considerations and provides hardware and software specifications.

Weight

The WeatherStation option adds a little less than one kilogram of weight (approximately two pounds) to the C&C module. A mission plan should include this extra weight and ensure that it does not take the total weight of the float over its maximum allowed weight.

Power Budget

The WeatherStation option draws two watts of power that must be planned to fit within the overall Wave Glider power budget including other sensors and payloads.

The weather sensor is off and draws no power until it is turned on through the WGMS dashboard or through a direct C&C controller command. It can be turned on or off at any time by shore-side operations.

Operating Conditions

The WeatherStation option meets or exceeds the Wave Glider's operating condition limits, so there are no special operating condition considerations for the WeatherStation option.

The weather sensor extends a meter above the Wave Glider, so it slightly increases the Wave Glider's visibility. It has a slender profile that doesn't catch much wind, so it has no effective sail effect on the Wave Glider.

Software Setup

The onboard WeatherStation option software needs no setup. It is already installed and runs when the Wave Glider is powered up.

WGMS

WGMS is installed to handle weather reports by default. There is no special configuration necessary.

WGMS operators need to have roles with appropriate permission to work with weather reports at different levels in the WGMS dashboard.

Custom Software

Creating a custom web application to work with weather data in the WGMS database or creating a custom application to work directly with weather report payload data from a Wave Glider is completely the responsibility of customer developers. LRI supplies complete information for the interfaces. Development time depends on the customer's software design and development team.

Specifications

These are the specifications for the the WeatherStation option components.

The Weather Sensor

The weather sensor is an Airmar PB200 WeatherStation. Its measuring capabilities:

- Wind speed range & resolution: 0 to 80 knots (0 to 92 mph), 0.1 knots (0.1 mph)
- Wind speed accuracy at 0-55° C (32-131° F) and no precipitation:
Low wind speeds: 0 to 10 knots, RMS error of 1 knot + 10% of reading
High wind speeds: 10 to 80 knots, RMS error of 2 knots or 5% RMS, whichever is greater
- Wind speed accuracy in wet conditions: 5 knots RMS
- Wind direction range & resolution: 0° to 360°, 0.1°
- Wind direction accuracy at 0-55° C (32-131° F) and no precipitation:
Low wind speeds: 4 to 10 knots, 5° RMS typical
High wind speeds: >10 knots, 2° RMS typical
- Wind direction accuracy in wet conditions: >8 knots RMS—8° RMS typical
- Air temperature range & resolution: -25° to 55° C (-13° to 131°F), 0.1°C (0.1° F)
- Air temperature accuracy: ±1° C (±1.8°F) at >4 knots of wind
- Barometric pressure range & resolution: 850 mbar to 1150 mbar, 0.1 mbar
- Barometric pressure accuracy: ±2 mbar
- GPS position accuracy: 3 m (10 ft) with WAAS/EGNOS (95% of the time, SA off)

The weather sensor works within a temperature range of -25° to 55° C (-13° F to 131° F).

The Mounting

The weather sensor is permanently attached to the top of a one-meter (3 ft.) carbon fiber mast with integrated power and data cable. The mast is attached to the Wave Glider's mast deck. The power and data cable plugs into the AUX2 plug in the C&C dry box lid.

Shipboard Controlling Logic

The WeatherStation option logic transmits weather reports every 15 minutes. Each report contains:

- Current temperature to 1/10 degree Centigrade accuracy
- Current barometric pressure to 1/10 millibar accuracy
- Average true wind speed to 1/10 knot accuracy, samples taken once per second over the averaging period
- Standard deviation of true wind speed to 1/10 knot accuracy
- Average true wind direction to 1/10 degree accuracy measured from true north
- Standard deviation of true wind direction to 1/10 degree accuracy
- Number of wind samples used to derive average wind speed and direction
- Current latitude and longitude
- Current date and time

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Chapter 3: Preparing the WeatherStation Option Hardware

Customers can order a Wave Glider set up for the WeatherStation option, or they can install the WeatherStation option on an existing Wave Glider. Both require the same basic set-up procedure. A Wave Glider not ordered with the option requires a slot cut into the turtle deck to accommodate the weather sensor mast.

This section describes both general set-up and the extra steps necessary to cut a slot in the turtle deck. It also provides notes about testing the WeatherStation option and deploying it on site.

Installing the WeatherStation Option

WeatherStation option installation is a relatively simple operation.

Precautions

Scratching the blue metal plate or the waterproof film above it on the WeatherStation sensor can damage it and affect its ability to sense weather conditions. Take care when handling the sensor.

It is best to install the sensor after the Wave Glider is transported to its deployment location so the weather sensor mast is not broken in transit.

Required Parts

You will need these parts to install the WeatherStation option:

- A Wave Glider, which includes a mast deck with four mounting positions and screws for each position
- A Mark 3 C&C dry box
- A turtle deck with a mast slot (already there if ordered from LRI, must be cut out if not ordered)
- The weather sensor mast assembly

Tools

You will require these tools and materials for general installation:

- A 4mm hex wrench
- A Phillips head screwdriver
- Loctite 243 Blue Threadlocker
- Silicone spray

If you are installing the option on a Wave Glider without a slotted turtle deck, you will require:

- A 1-inch diameter hole saw
- A band saw
- 220 sandpaper (optional)

Installation

To install the weather sensor mast assembly on a Wave Glider with a slotted turtle deck:

1. Note where the slot in the turtle deck lies. It should be at the front of the turtle deck over one of the four mounting locations on the mast deck beneath the turtle deck. That mounting location is where you will install the mast assembly.
2. Remove the turtle deck from the Wave Glider by unscrewing the six screws holding it in place using a Phillips screwdriver. Set the screws aside where you can find them later for reassembly.
3. If there are screws in the mast mounting location, remove them with a 4mm hex wrench and set them aside for later assembly.
4. Put a drop of Loctite 243 Blue Threadlocker on the threads of each mast mounting screw.
5. Place the base of the mast assembly on the mast mounting location.
6. Screw the three mast mounting screws into place snugly using a Phillips screwdriver. The mast should stand firm without wobbling at the base.
7. Use silicone spray to clean the metal contacts of the plug on the end of the mast assembly's cable.
8. Firmly plug the mast assembly cable into the AUX2 port on the Mark 3 C&C dry box lid.
9. Plug the mast assembly cable firmly into the AUX2 port.
10. Slide the turtle deck back into place on the Wave Glider top deck, putting the mast assembly in the turtle deck's slot.
11. Slide the turtle deck into place around the mast assembly.
12. Screw the turtle deck back into place using a Phillips screwdriver on the six screws set aside earlier. Use Loctite 243 Blue Threadlocker on the screws for longer Wave Glider missions.

Be sure to let the Loctite dry before putting the Wave Glider in the water.

Cutting a Turtle Deck Slot

If your Wave Glider does not have a turtle deck slot for the mast assembly, you can cut one:

1. Choose one of the four mast mounting locations on the mast deck for mounting the mast assembly. Closer to the center of the Wave Glider is better for stability unless you have something on the other side of the Wave Glider to balance the weather sensor.
2. Look for a small guide hole in the turtle deck that is located directly above mast mounting location when the turtle deck is in place and note its location.

3. Drill a hole one inch in diameter centered on the location of your chosen guide hole.
4. Use a band saw to cut a slot from the front of the turtle deck to the edges of the one-inch hole. The slot should be perpendicular to the front edge of the turtle deck.
5. If desired, smooth the rough edges of your cut using 220 sandpaper.

This completes the procedure.

Testing and Deploying the WeatherStation Option

A few notes about testing the WeatherStation option before the Wave Glider is deployed and about setting the WeatherStation option up for operation after deployment:

The weather sensor and the iPIB that controls it do not turn on when the Wave Glider powers up. You must turn them on remotely through shore-side operations (typically through the WGMS dashboard) as described later in this document.

The weather sensor will not report wind data unless the sensor is able to get a GPS fix, so when testing it may be necessary to take the Wave Glider (or at least its C&C dry box) outside with the weather sensor to get a GPS fix and wind readings.

The compass in the weather sensor was pre-calibrated at the factory. Because there is so little ferrous metal in a Wave Glider there is no need to recalibrate the compass.

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Chapter 4: Working with Weather Reports in WGMS

Wave Gliders equipped with the WeatherStation option regularly send weather reports back to shore-side operations. If operations are set up to use the Wave Glider Management System (WGMS), operators can use the WGMS dashboard to view and work with weather reports. This section describes how.

Using the WGMS Dashboard

You will find detailed instructions for using the WGMS dashboard in the “Wave Glider User Manual,” including instructions for connecting your web browser to WGMS and logging into the dashboard.

Once you have logged into the dashboard, the features available to you depend on your role and the permissions your role gives you within WGMS. Not every role can perform all of the actions described here. To view weather data through the WGMS console, you can have any role, including that of Guest. To perform more involved weather work, you must have a more advanced role such as Data Analyst, Master, System Administrator, or Root.

If your role does not have permission to perform actions described here, you may not see those actions available in the dashboard. For example, to turn a Wave Glider’s weather sensor on or off, or the iPIB board that controls the weather sensor on or off, you must have a role of Master, System Administrator, or Root.

Viewing Weather Reports

The WGMS dashboard displays weather reports in tables:

1. Click the “Vehicles” button at the bottom of the System Menus bar on the left of the dashboard. (If the bar is not visible, click “Show System Menus” below the Liquid Robotics logs in the upper left of the dashboard.)
2. Click “Weather Records” under Payload Data in the System Menus bar.
Weather records received by all Wave Gliders in the current organization appear in tabular form.

TimeStamp	Vehicle	Weather Station	Temperature(°C)	Wind Speed(kts)	Wind Gust Speed(kts)	Wind Direction	Pressure(mb)	Latitude	Longitude
5/28/2010 11:...	Red Flash		22.7	2.2	6.5	94.7	1023	37.4109166666667	-122.0045266666667
5/28/2010 10:...	Red Flash		22	2.5	5.3	63.4	1023	37.4109166666667	-122.0045266666667
5/28/2010 10:...	Red Flash		22.3	2	5.1	75.8	1023	37.4109166666667	-122.0045266666667
5/28/2010 10:...	Red Flash		21.9	2.7	5.9	74	1023	37.4109166666667	-122.0045266666667
5/28/2010 10:...	Red Flash		22.5	2.1	4.9	71.3	1022	37.4109166666667	-122.0045266666667
5/28/2010 9:5...	Red Flash		21.1	1.9	4.9	59.3	1022	37.4109166666667	-122.0045266666667
5/28/2010 9:4...	Red Flash		19.7	2.1	4.3	49.4	1023	37.4109166666667	-122.0045266666667
5/28/2010 9:2...	Red Flash		22.5	2.3	5.6	111.9	1023	37.4109166666667	-122.0045266666667
5/28/2010 9:1...	Red Flash		24.9	1.4	3.6	75.1	1023	37.4109166666667	-122.0045266666667
5/28/2010 8:5...	Red Flash		23.3	1.5	3.5	55.9	1022	37.4109166666667	-122.0045266666667
5/28/2010 8:4...	Red Flash		24.4	1.2	3.3	142.5	1022	37.4109166666667	-122.0045266666667
5/28/2010 8:2...	Red Flash		25.2	1.2	3.7	160.5	1022	37.4109166666667	-122.0045266666667
5/28/2010 8:1...	Red Flash		24.7	0.7	2.8	133.3	1022	37.4109166666667	-122.0045266666667
5/28/2010 7:5...	Red Flash		20.8	0.6	2	184.9	1022	37.4109166666667	-122.0045266666667
5/28/2010 7:4...	Red Flash		21.8	0.5	1.8	264.4	1022	37.4109166666667	-122.0045266666667
5/28/2010 7:2...	Red Flash		19.7	0.2	1	251.8	1020	37.4109166666667	-122.0045266666667
5/28/2010 7:1...	Red Flash		12.5	0.3	2	182.4	1020	37.4109166666667	-122.0045266666667
5/28/2010 6:5...	Red Flash		10.2	0.4	1.6	202.9	1018	37.4109166666667	-122.0045266666667
5/28/2010 6:4...	Red Flash		8.4	0.7	1.9	160.7	1018	37.4109166666667	-122.0045266666667
5/28/2010 6:2...	Red Flash		8.1	0.8	2	138.7	1019	37.4109166666667	-122.0045266666667
5/28/2010 6:1...	Red Flash		7.9	0.7	1.7	152.9	1018	37.4109166666667	-122.0045266666667
5/28/2010 5:5...	Red Flash		7.9	0.7	1.7	186.2	1018	37.4109166666667	-122.0045266666667
5/28/2010 5:4...	Red Flash		7.8	0.5	1.1	154.6	1017	37.4109166666667	-122.0045266666667
5/28/2010 5:2...	Red Flash		7.9	0.6	1.3	165.3	1017	37.4109166666667	-122.0045266666667
5/28/2010 5:1...	Red Flash		8.3	0.4	1	206.3	1018	37.4109166666667	-122.0045266666667
5/28/2010 4:5...	Red Flash		8.4	0.3	1	229	1017	37.4109166666667	-122.0045266666667

Figure 2. Weather Records Displayed in Tabular Form

- Click on any of the column headings to sort the list by the values in that column.
- Click on the icon at the beginning of a weather report line to see further details about the weather report.
- If the list is longer than one page, click the page arrows at the bottom left of the list to move from page to page.

Note that if you are logged into a WGMS system that is hosted by Liquid Robotics, WGMS receives weather reports from Weather Underground (wunderground.com) weather stations as well as from WeatherStation-equipped Wave Gliders. These stations are typically land based. WGMS polls them at regular intervals and adds their weather reports to the Wave Glider weather reports in the weather table.

The column headings list the types of data in each report:

- TimeStamp shows the date and time of each weather report.
- Vehicle shows the name of the reporting Wave Glider. This column is empty if the weather report comes from a weatherunderground.com weather station.
- Weather Station shows the name of the reporting Weather Underground weather station. This column is empty if the weather report comes from a Wave Glider.
- Temperature shows the air temperature at the time of report in degrees Centigrade.
- Wind Speed shows the average true wind speed in knots during the reporting interval.
- Wind Gust Speed shows the highest wind speed in knots during the reporting interval.
- Wind Direction shows the average true wind direction in degrees from true north during the reporting interval.
- Pressure shows the barometric pressure at the time of report in millibars.
- Latitude and Longitude show the Wave Glider's position at the time of the report.

Exporting Weather Reports From a Table

You can export weather reports from a table into an HTML file that any spreadsheet such as Microsoft Excel can read:

1. Click the Excel icon at the top left of the table to open the export dialog box.
2. Enter a file name and specify a folder if desired, then click Save.

The file contains all weather reports stored in the WGMS database for all the Wave Gliders in the current organization. It has an .xls extension so that it opens by default in Microsoft Excel.

Turning the iPIB and Weather Sensor On or Off

The weather sensor in a Wave Glider and the iPIB controlling the sensor must be turned on before the sensor can begin detecting weather conditions and making weather reports. Once the weather sensor is on, there may be times when you want to turn it off again—to conserve power, for example.

The iPIB and weather sensor do not turn on when the Wave Glider is powered up, so they must be turned on independently. The iPIB powers the weather sensor and may also power other C&C sensors such as the WeatherStation option. When you turn the iPIB on or off, it turns all connected sensors on or off with it.

To turn the iPIB on or off and the weather sensor with it:

1. In the WGMS dashboard Home page, choose the Wave Glider you want from the pull-down list below the Liquid Robotics logo in the upper left corner.
2. Click the “Set Parameter” button on the left side of the page to open the Set Parameter Command dialog box.
3. Choose “Internal Payload Power” from the “Select Parameter” pull-down list.
4. Enter explanatory text in the “Enter Reason” text box. The text will be stored with the command in the WGMS database and can help later to clarify why the command was issued.
5. Click the “Add” button. The internal payload power parameter appears in the bottom half of the dialog box.

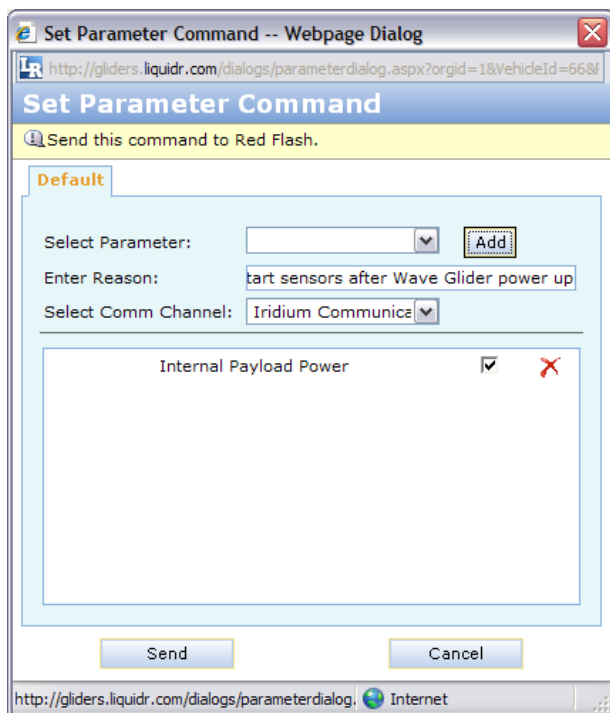


Figure 3. The Set Parameter displays the Internal Payload Power parameter set to turn on

6. If the check box after the parameter is checked, the parameter performs a power on. If the check box is unchecked, the parameter performs a power off. Set the check box for the option you want.
7. Click “Send” to send the command. WGMS will send the command to the Wave Glider the next time the Wave Glider checks for new commands.

Remember that all sensors connected to the iPIB power up or down with the iPIB.

Once the iPIB is on, you can turn the weather sensor on or off independently of the iPIB:

Use the same procedure as you would to turn the iPIB on or off, but use the parameter “Weather Station Power” instead of “Internal Payload Power.”

Note that if the iPIB is off, you cannot power up the weather sensor because the weather sensor gets its power from the iPIB.

Chapter 5: Developing Custom Weather Report Software

Developers can create their own custom software to work with weather reports from Wave Gliders. They can either get weather reports from the WGMS database through the WGMS SOAP API, or by they can handle weather reports directly as they come from the Wave Glider, bypassing WGMS completely.

Using WGMS SOAP Functions

A custom web application uses simple SOAP function calls to read and otherwise work with data in the WGMS database. “Wave Glider Interface Control Description” describes the WGMS SOAP functions in the section “Wave Glider Management System” under the heading “SOAP Envelopes.” It provides functional descriptions and lists arguments and returned data for each function.

Entity Type Number and Column Names

WGMS stores weather records as entities in the WGMS database. An entity is, in essence, a record, and its columns are the fields of the record. To work with the weather report entities through the SOAP calls, you need to know the entity type number and the names of the columns within each entity type.

Weather Reports

Weather Reports are weather report records stored in native WGMS format. Their default entity type number is 39, and they contain a number of columns used to store data fields from both Wave Glider weather reports and Weather Underground weather station reports. Some of the columns, such as the dew point and heat index columns, store data only for Weather Underground reports and aren’t used for Wave Glider reports.

The following columns store data for Wave Glider weather reports. Note that some of the columns, such as `pressure_in` and `pressure_string`, are derived from a reported value such as `pressure_mb`. WGMS makes its best effort to translate a received value such as pressure in millibars into pressure in inches and pressure expressed as a text string. These columns aren’t guaranteed to contain values, though.

Table 1. Weather Report Columns

Column Name	Contents
Latitude	The latitude of the vessel’s current position
Longitude	The longitude of the vessel’s current position
PayloadPacketId	The identification number of the payload packet in which the weather report was transmitted
pressure_mb	The current reported barometric pressure in millibars
pressure_string	The current reported barometric pressure expressed as a text string (translated by WGMS from <code>pressure_mb</code>)
pressure_in	The current reported barometric pressure in inches (translated by WGMS from <code>pressure_mb</code>)
temp_c	The current reported temperature in degrees Centigrade

Column Name	Contents
temperature_string	The current reported temperature expressed as a text string (translated by WGMS from temp_c)
temp_f	The current reported temperature in degrees Fahrenheit (translated by WGMS from temp_c)
TimeStamp	The universal time to the nearest second when the report was generated
VehicleID	The identification number of the Wave Glider that transmitted this weather report. This column is empty for Weather Underground reports.
WeatherDataFlags	A one-byte value reports on the validity of each type of weather data in this report. If a bit in the value is 1, the weather data of that type is valid; if the bit is 0, the data is invalid. The bits used are (from least significant to most significant): 0: temperature valid 1: barometric pressure valid 2: time valid 3: pressure valid 4: wind valid
WeatherDataVersion	Used internally by WGMS to provide the version number of the weather report type
WeatherReportID	The unique identification number of this weather report entity
wind_dir_std_dev	The standard deviation of the average true wind direction in degrees from true north
wind_degrees	The average true wind direction in degrees from true north
wind_gust_kmh	The speed in knots of the highest wind speed detected during the reporting period
wind_samples	The number of wind speed and direction pair values received over the reporting period and used to determine average true wind speed and direction
wind_speed_std_dev	The standard deviation of the true wind speed in knots
wind_kmh	The average true wind speed in knots (not kilometers/hr as the name implies)

Reading Entity Information in the WGMS Dashboard

The WGMS dashboard displays current entity type numbers and column names under Record Customization in the Settings page, which also allows changing their values. (This feature is available only to operators with the role of System Administrator or Root.)

To see what the current values are:

1. Click the Settings button in the left-side menu bar. (Click “Show Menus” if the bar is not visible.)
2. Click “Record Customization” in the left-side menu bar.
The panel displays different entity types. The Record Type column provides the entity type ID for each type.
3. Double-click on any of the entity rows to see what columns that entity contains.
The Record Edit dialog box appears.
4. Click Fields on the left side of the dialog box.
The Fields panel displays the field names and column names of the entity type.

Working Directly With the Wave Glider WeatherStation Option

Custom software working with weather reports outside of WGMS must understand the Iridium and XBee packets described in detail in “Wave Glider Interface Control Description.” The software reads weather reports contained within those packets and issues C&C commands through those packets.

Reading Weather Report Packets

A weather report payload packet contains the following data:

Table 2. Weather Report Packet Contents

Field Name	Bytes Used	Byte Index
Weather Data Version	2	0
Flags (see WeatherDataFlags column information in last section for details)	2	2
Temperature (in 1/10 degrees C)	2	4
Pressure (in millibars)	2	6
Latitude	4	8
Longitude	4	12
Average Wind Speed (in 1/10 knots)	2	16
Maximum Wind Speed (in 1/10 knots)	2	18
Standard Deviation for Wind Speed (in 1/10 knots)	2	20
Average Wind Direction (in 1/10 degrees from true north)	2	22
Standard Deviation for Wind Direction (in 1/10 degrees from true north)	2	24
Number of Wind Samples	2	26
Hour	1	28
Minute	1	29
Second	1	30
Day	1	31
Month	1	32
Year	2	33

Powering the Weather Sensor and iPIB On and Off

Custom software uses C&C commands to turn the weather sensor and the iPIB on or off. “Wave Glider Interface Control Description” describes the commands. The SetParameters command powers the weather sensor and iPIB up or down.

Use the field “Weather Station Power” to turn the weather sensor on or off; use the field “C&C Internal Payload Power” to turn the iPIB board on or off. Set the field value to 1 to turn the component on; set the field value to 0 to turn the component off.

Note that the iPIB powers the weather sensor. Turning the iPIB off automatically powers down the weather sensor. Turning the iPIB on automatically powers up the weather sensor. The weather sensor cannot be turned on while the iPIB is off.