

RiverSonde™

Non-Contact River Monitor

Model 100

Documentation



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2008-09-25

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1. Introduction

RiverSonde™ is a non-contact river monitor system by CODAR Ocean Sensors, Inc. It is based on the highly successful SeaSonde® technology used to monitor coastal ocean currents. SeaSonde is the only commercially available system for surface current measurements with a proven track record and stands at the forefront of current measurement technology for its precision and ease of use. RiverSonde builds on the foundation of SeaSonde technology, resulting in a river monitoring system with similar robustness, accuracy, and ease of use. RiverSonde continuously measures the velocity distribution on the surface of a river, a stream, or a channel. Using a UHF transceiver and antennas, RiverSonde records mean surface velocities and generates a velocity profile across the river. The user can employ these data along with known river cross-section (depth distribution) and river stage to calculate the total river discharge, i.e., the total volumetric flux of water passing the cross-section. RiverSonde is used by hydrologists, water resources researchers and managers, agricultural and irrigation engineers, wildlife managers, flood control, environmental protection and emergency response personnel—anyone who studies river flow properties and effects.

RiverSonde is a non-contact water surface velocity monitoring system installed on the bank of a river; it automatically gathers, processes, and stores surface velocity data. Using an interface computer, these data can be viewed in tables or graphs, and transferred for remote archiving and processing. A UHF transceiver and an antenna assembly are used to transmit periodic signals of known frequency and wavelength over the water's surface. The signal's waves resonate with the random waves on the water surface at half the radar wavelength. The phenomena of resonance and reinforcement of the reflected signal is known as Bragg scatter which can be precisely identified in the echo spectrum as "Bragg peaks." If the water is stationary, the two peaks of Bragg-resonated waves are symmetric to the center (zero-velocity) axis, and represent waves propagating towards and away from the antenna. If the surface water itself at each point seen by the radar is moving relative to the antenna, these Bragg peaks will be Doppler shifted and spread. The basic operational principle behind the RiverSonde for measuring surface velocity is based on the known, precise relation between the amount of Doppler shift of the Bragg peaks and the water surface velocity. Thus, determination of the Doppler shift gives rise to the measurement of surface water velocity relative—or radial—to the antenna. The processor computer converts the repeated measurements of Doppler shifts over the viewing area of the antenna to its mean water surface velocity. The details of hardware, software, operations and use of the RiverSonde system are described in this documentation.

1.1. Features

RiverSonde Measures Water Velocity

Measures, records and displays:

- Radial flow vectors and vector maps
- Cross-channel velocity profile
- Time series of mean water velocity

1. Introduction

Non-Contact

No part of the RiverSonde is in the water.

Automatic Operation

After set-up, RiverSonde runs automatically.

Remote Access

When connected to appropriate communication systems, data retrieval, system monitoring and control can be performed from any Internet-connected location using the provided interface computer.

Low Power

The power requirement of the RiverSonde system is less than 100 watts. Thus, the system can be powered by alternative energy sources.

1.2. Documentation

This document is an operational, reference and user's manual. It is intended for those who install and operate the RiverSonde, and those who use its data. The following chapters include:

System Description

Overview, hardware and software.

Installation

Preparation, siting, installation, first power-up and checkout.

Operation and Use

Normal power-up, selecting and connecting with the interface computer, system checkout, data display and data retrieval.

Reference

Data product descriptions, date and time code expansions, enclosure access.

2. System Description

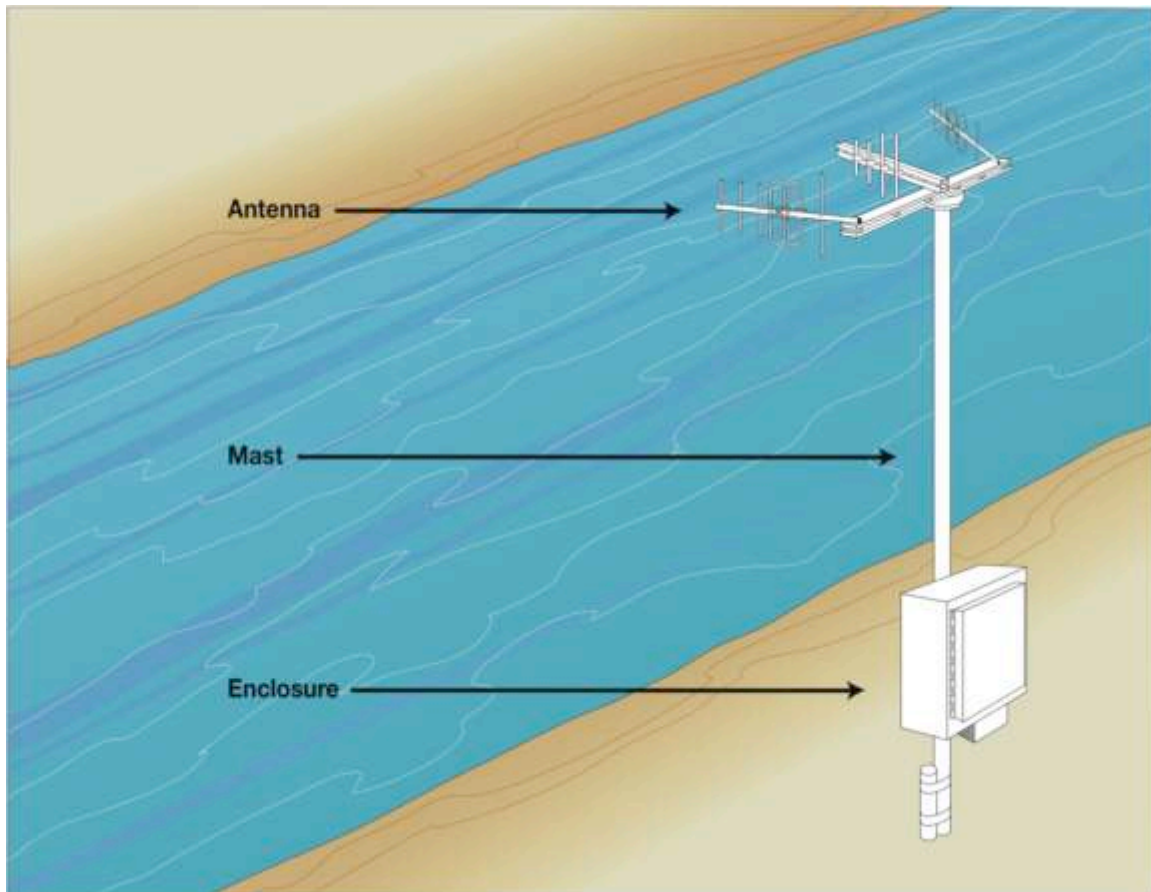
In This Chapter

Overview: general description of the RiverSonde, its parts and set-up.

Hardware Description: enclosure, transceiver, processor, power supply, antenna, mast and interface computer.

Software Description: *RSCommander* and *RSCoordinator*.

2.1. Overview



The RiverSonde is a hardware and software system designed to continuously monitor river surface velocity. The RiverSonde consists of an *antenna* and an electronics system. The electronics system is housed in an *enclosure*. The RiverSonde is erected on a river (or water channel) bank, with its antenna mounted on the top of a *mast*, and the enclosure attached to the mast. The center antenna element is pointed approximately perpendicular to the principal water flow direction. The center antenna transmits a signal that is reflected by random waves on the surface of moving water. Two side antennas pointing upstream and downstream, along with the center antenna, receive reflected signals that are passed on to a data processor. Knowing the frequency and wavelength of the

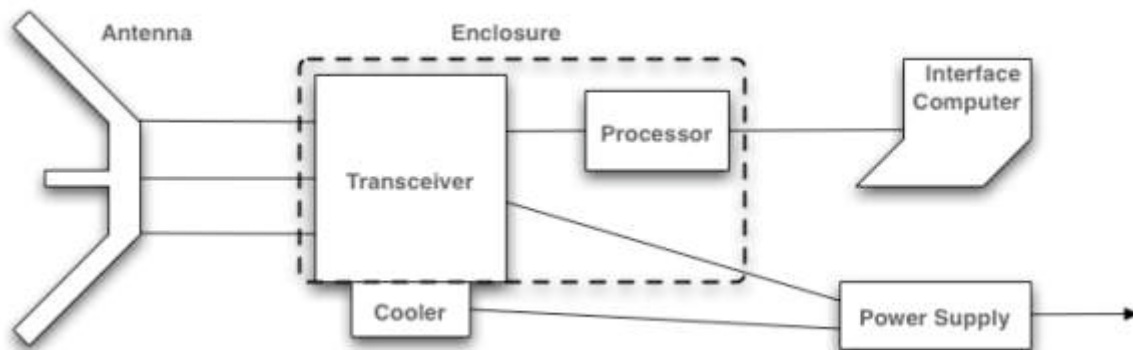
2. System Description

transmitting signals, RiverSonde calculates and records the radial surface velocity distribution on the processor.

The weather-resistant *enclosure* houses an electronic *transceiver* and *processor* computer. An *interface computer* is connected to the processor via a connector on the enclosure or an optional wireless network interface. The interface computer is used to configure the RiverSonde and access the data stored on the processor.

System Diagram

The diagram below shows the principal RiverSonde subsystems and their connections. A cable connects each antenna element (three total) to the transceiver via connectors on the enclosure. Inside the enclosure are the transceiver and processor, which share a data and power connection. A cooler is mounted outside the enclosure, maintaining the temperature inside the enclosure. The transceiver and processor are connected to a power supply. The interface computer is connected to the processor via a cable and connector on the enclosure.



2.2. Hardware Description

Enclosure



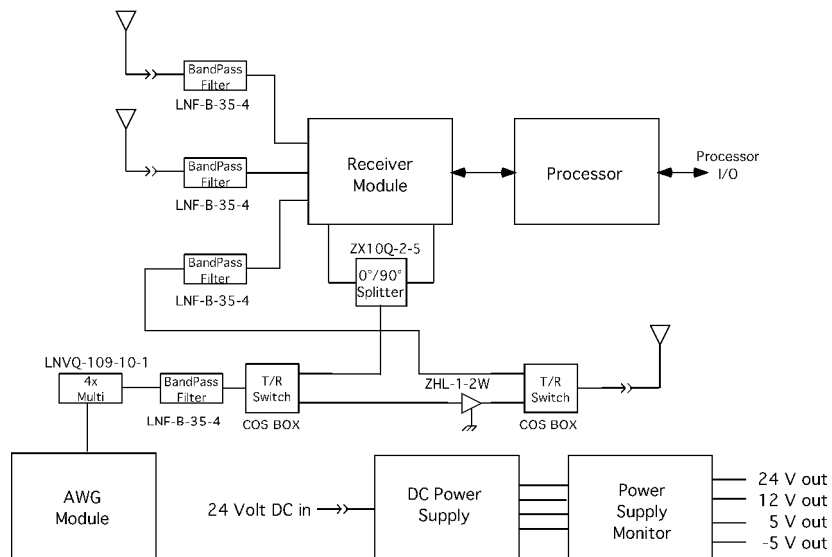
The enclosure provides weather-resistant protection for the transceiver and the processor. In addition, the enclosure is outfitted with a self-contained air conditioner that cools the enclosed electronics. A door with a weather-resistant seal allows access to the enclosed transceiver and processor. It has external connectors for power, communication and antenna signals. The enclosure is mounted to the antenna mast.

2. System Description

Transceiver



The transceiver generates and transmits the RiverSonde signal. It also receives and conditions the reflected signal. It communicates with the processor, receiving commands and forwarding received signal data. It sends measurement signals to and receives reflected signals from the antenna. The transceiver is housed in the enclosure. The photo above shows the transceiver electronics mounted in the enclosure. A schematic diagram of the transceiver is shown below.



Processor

The processor computer controls all aspects of RiverSonde operation. It runs system software that performs data acquisition, storage and processing. It controls other hardware functions and responds to requests for reports and plots. The processor also communicates with the external interface computer via an Ethernet connection or an optional wireless connection. The processor is housed in the enclosure.

Power Supply

External AC power (110 or 220 V) is used for normal operation. The power supply converts AC power to DC and conditions the DC power supplied to the electronics housed in the enclosure. A dual cable connects the power supply output to the transceiver and cooler at the enclosure.

Antenna and Mast



The antenna transmits signals from the transceiver to the river. It also receives reflected signals from the river. Each of the three antenna elements is connected to the transceiver by a cable. The antenna is mounted on top of a hollow fiberglass mast. The mast is secured on the ground with a user-provided post.

The antenna contains three elements. The center element transmits and receives the RiverSonde signal. The outer two elements receive the reflected signal, but do not transmit.

2. System Description

The mast provides elevation and support for the antenna. The mast also supports the enclosure.

Interface Computer



The interface computer is a portable computer, outside the enclosure, used to set up, configure and control the RiverSonde. It is also the user interface to the RiverSonde, communicating with the processor via the *RSCCommander* program. Use the interface computer to view and download data summaries, request plots and configure the RiverSonde. The interface computer communicates with the processor via a local wired Ethernet connection, an optional wireless connection, or an Internet connection.

If the processor is connected to a local- or wide-area TCP/IP network, the interface computer can be connected to the same network and communicate remotely with the processor.

2.3. Software Description

Overview

There are two main RiverSonde programs: *RSCCommander* and *RSCoordinator*. *RSCCommander* runs on the interface computer and is the user interface to the RiverSonde. *RSCoordinator* runs on the processor and performs most data acquisition and processing functions. It communicates with *RSCCommander* and performs functions requested via *RSCCommander*, such as data plotting. Ancillary programs run on the processor to control

the transceiver, gather raw data, transfer data to the interface computer, and perform supporting tasks.

Two other programs can be used to transfer data from and view data on the processor: *Fugu*, a file transfer program, and the *Safari* web browser.

Detailed instructions to operate the software are in Chapter 4, “Operation and Use.”

RSCommander

RSCommander is a program that runs on the interface computer. It communicates with the *RSCoordinator* program running on the processor, via a wired or optional wireless network connection. Use *RSCommander* to:

- Configure or reconfigure the RiverSonde.
- Browse, select and filter data set attributes.
- Export data set attributes to a file on the interface computer.
- Plot time series of average velocities.
- Plot velocity profiles for selected data sets stored on the processor.
- Plot radial velocity vector maps for selected data sets stored on the processor.
- View the time series, velocity profile, and radial velocity vector map plots of the most recent data set.

RSCoordinator

RSCoordinator is the main data processing program. It determines the direction of the reflected signals, estimates and filters radial vector information, calculates mean velocity vector fields and calculates each velocity in a profile.

Fugu

Fugu is a file transfer program. Use *Fugu* to list data files and transfer them from the processor to the interface computer.

Safari

Safari is a web browser. Use *Safari* to view plots of the most recent data set, list data files and transfer them (one at a time) from the processor to the interface computer.

3. Installation

In This Chapter

Preparation: site requirements and considerations, how to select a site and prepare for set-up.

Set-Up: how to install the RiverSonde hardware and make cable connections.

Initial Power-Up: how to apply electrical power to the system.

Communication Checkout: how to confirm that the interface computer communicates with the processor.

Configuration: how to configure the RiverSonde settings using the *RSCommander* program.

When reading this chapter, note that *Requirements* **must** be met in order for the RiverSonde to work properly.

Implementing *Recommendations* enhances RiverSonde performance, efficiency, accuracy, and/or ease of use. Recommendations are lower priority than requirements. Do not violate any requirement when following a recommendation.

3.1. Preparation

Successful RiverSonde operation depends on proper preparation. Read and understand the RiverSonde documentation. Select a site that meets all requirements. Locate and ensure the performance of required infrastructure.

This section describes requirements, recommendations and procedures to prepare for RiverSonde installation and operation.

Siting

River Features and Conditions Requirements

The river characteristics at the RiverSonde installation site must meet the following requirements.

River Width

10 to 300 meters

Current Speed

0.025 to 4.0 meters per second

Minimum Water Surface Roughness

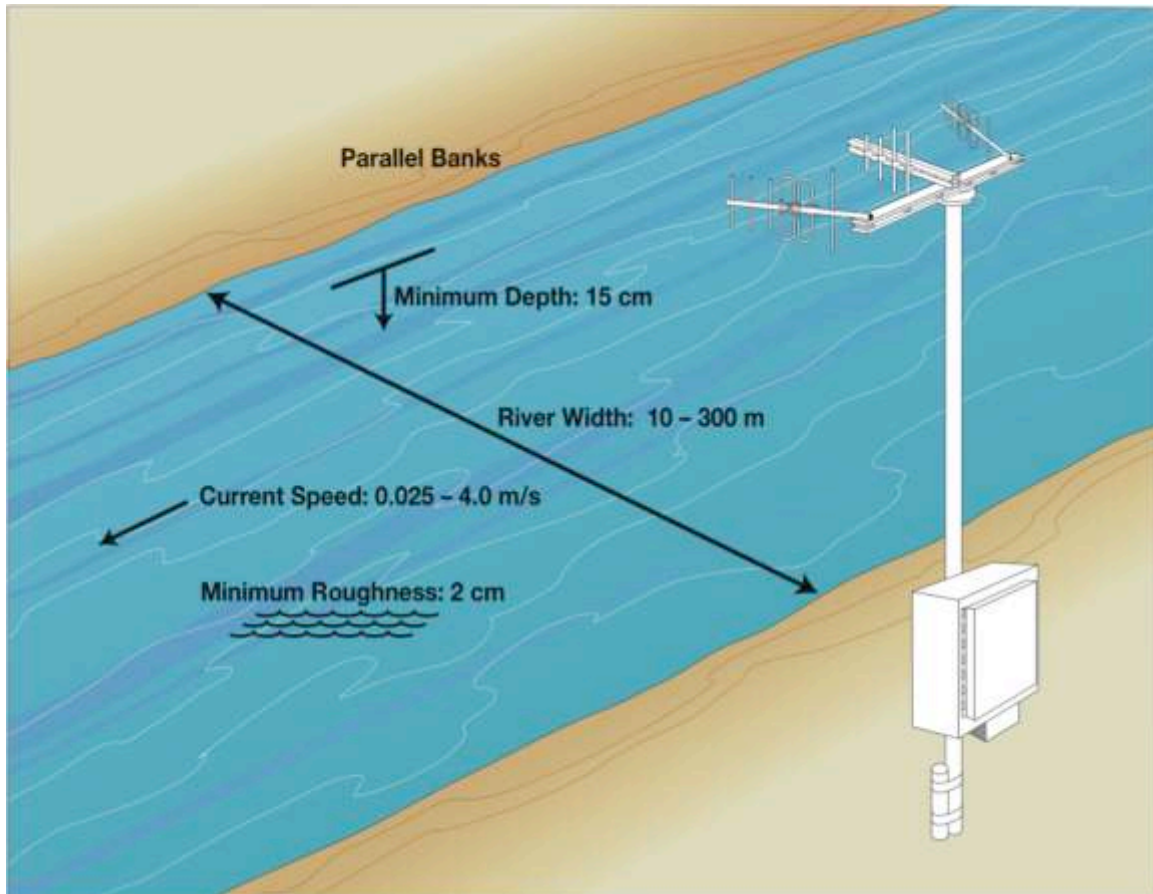
2 centimeters

Minimum Water Depth

15 centimeters

River Banks

Select a section of the river where the banks of the water channel are approximately straight and parallel. While river channels can be sinuous, the RiverSonde installation site should have a straight section for a distance equal to twice the river width (i.e., one river-width upstream and one river-width downstream). The diagram below summarizes the required river characteristics at the RiverSonde installation site.



Antenna Location and Positioning Requirements

The antenna location and position at the RiverSonde installation site must meet the following requirements.

Maximum Distance Between Antenna and Water Edge

20 meters

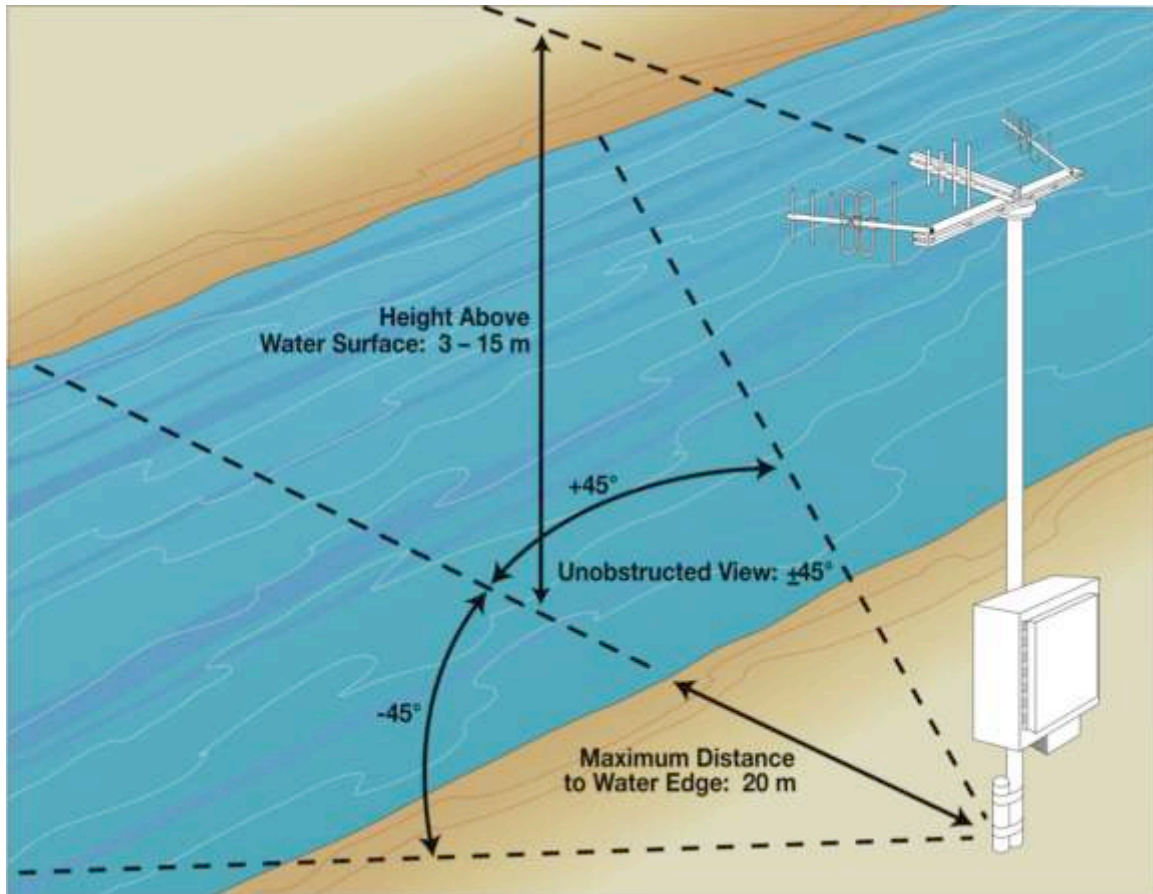
Antenna Height Above Water Surface

3 to 15 meters

3. Installation

Minimum Unobstructed View of Water

$\pm 45^\circ$ from direction of center antenna element. (Note: plants, trees, branches, fences, etc. between the antenna elements and water surface are obstructions.) The diagram below summarizes the required antenna location and position at the RiverSonde installation site.



Antenna Location and Positioning Recommendations

Locate the antenna as close to the water as possible, but account for future maximum water stage. The mast should never touch the water.

The antenna height above the water's surface should not exceed the distance between the mast and the water's edge.

Maximize the unobstructed view of the water from the antenna. A full view of the river ($\pm 90^\circ$) is ideal.

The antenna mast should be secured to an in-ground support post that is not taller than two meters above the ground. Stabilize the post by burying a portion of it or otherwise providing a firm foundation. Burying 1/3 of the support post is recommended. Stabilize the mast, if necessary, using nonmetallic guy ropes.

Enclosure Location and Position Requirements

The enclosure is normally mounted to the antenna mast with U-bolts. Other configurations are possible. Study your preferred location and decide on the best location and position for the enclosure.

Minimum External Cooling Fan Position and Clearance

The external cooling fan is located on the bottom of the enclosure. Position the fan so that it faces down, avoiding exposure to rain and debris. The area around the cooling fan must be kept clear. A minimum of 15 centimeters (6 inches) on all sides must be kept clear.

Enclosure Location

If the enclosure is not mounted to the antenna mast, it must be located on a secure solid support. The area around the enclosure must be kept clean and unobstructed.

Enclosure Position Recommendations

The enclosure should be mounted at a height for convenient access.

Security Recommendations

Consider the possibility that the RiverSonde may be tampered with, vandalized or stolen. Protective measures should be considered. The enclosure latch can be locked with a padlock. An additional secure enclosure or locating the enclosure in a secured building nearby may be desirable. Fencing may be a deterrent. Warning or informative signs may increase security. Consider routing cables underground or out of reach.

Infrastructure Requirements

Power

120 or 220 volts AC, 50 to 60 hertz, 100 watts minimum

Optional Remote Communication

Any standard TCP/IP network connection

Environment

Maximum Ambient Temperature During Operation

40 C (104°F)

Relative Humidity Inside Enclosure

5% to 95% noncondensing

Signal Broadcasting

Conform to regulations on UHF broadcasting in your locale.

Infrastructure Recommendations

Power

The power specification above is a *minimum* requirement. Additional power should be provided for other electrical devices or equipment on the same circuit.

Site Scouting, Analysis and Selection

The complexity of preparing for a RiverSonde deployment varies widely and depends on the candidate sites and the ease with which they are accessed. In all cases, the following tasks are performed. The order in which you perform the tasks depends on your particular situation. Think about the proposed site, and its ease of access. Plan accordingly.

Pre-Scouting Research

Identify the river to be measured and survey the general area where the measurement will be made. Get a detailed map and identify areas likely to meet the siting requirements.

Obtain information about the availability of infrastructure, i.e., power and communication. Assess the infrastructure's ability to meet RiverSonde requirements. Research existing water flow measurement sites; they may have the required infrastructure. Consider the implications of adding required infrastructure. If remote communication is desired, assess communication and/or computer network capabilities.

Assess the need for security. Do your candidate sites require security? Is there a history of theft or vandalism of other measurement equipment in the area? Is the area frequently visited? Will warning or informative signs increase security?

Site Scouting

Visit the sites identified in pre-scouting research. Prepare a list of site requirements and recommendations. Inspect the sites. Note each site's features and record each feature on the list. Record candidate antenna locations and "views," including measured or estimated angles between a cross-channel axis and any curved banks or view obstructions. Use a map and compass or GPS unit to determine and record the longitude, latitude and antenna pointing direction for each candidate antenna location. (If these are not available, you may estimate them using a map.) Survey and record infrastructure locations, facilities, and any security considerations.

Site Analysis

Analyze the site characteristics both while visiting the site and after site scouting is complete. Consider the following questions:

Do the river features and conditions meet requirements?

Can the antenna and enclosure be located in places that meet all requirements?

Which sites meet the most recommendations for best performance?

Which recommendations do they meet?

Does the site need additional security?

Are there any facilities that can enhance security? (For example, a locked structure for the enclosure.)

Does the site meet infrastructure requirements?

Will any special power or signal cable routing facilities (e.g., underground or overhead) be needed?

You may wish to perform a weighted analysis, giving more weight to requirements or recommendations that have greater importance to you.

Site Selection

After performing site research, scouting and analysis, select the sites that best meet requirements and recommendations.

Site Set-up Preparation

Review this manual. Collect and record the data described in the section, “Configuration,” later in this chapter. Gather all RiverSonde hardware and any tools required for installation.

3.2. Set-Up

Hardware Installation

Antenna Assembly and Installation

At the installation site, the user must supply and install a sturdy and stable mounting post, and metal clamps to fasten the antenna mast to the mounting post.

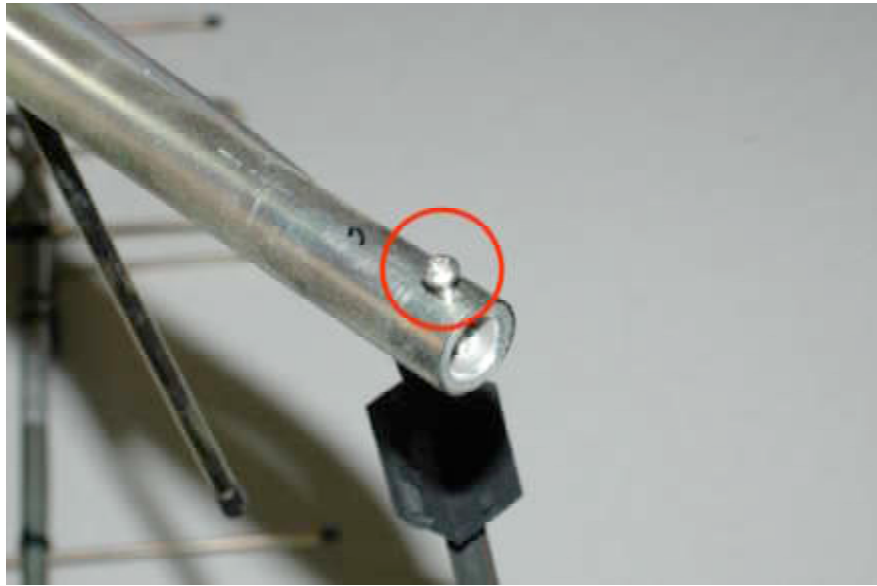
Install the mounting post at the antenna site. Stabilize the post by burying 1/3 of it or otherwise providing a stable foundation.

Assemble the antenna. Looking down from top, antennas are numbered 1-3 from left to right.

Unpack antennas #1, #2 & #3. Antennas #1 and #3 are marked on upper rearmost element. Antenna #2 is not marked and is a shorter antenna.

3. Installation

Remove antenna-locating screw from shaft for the #1 antenna.

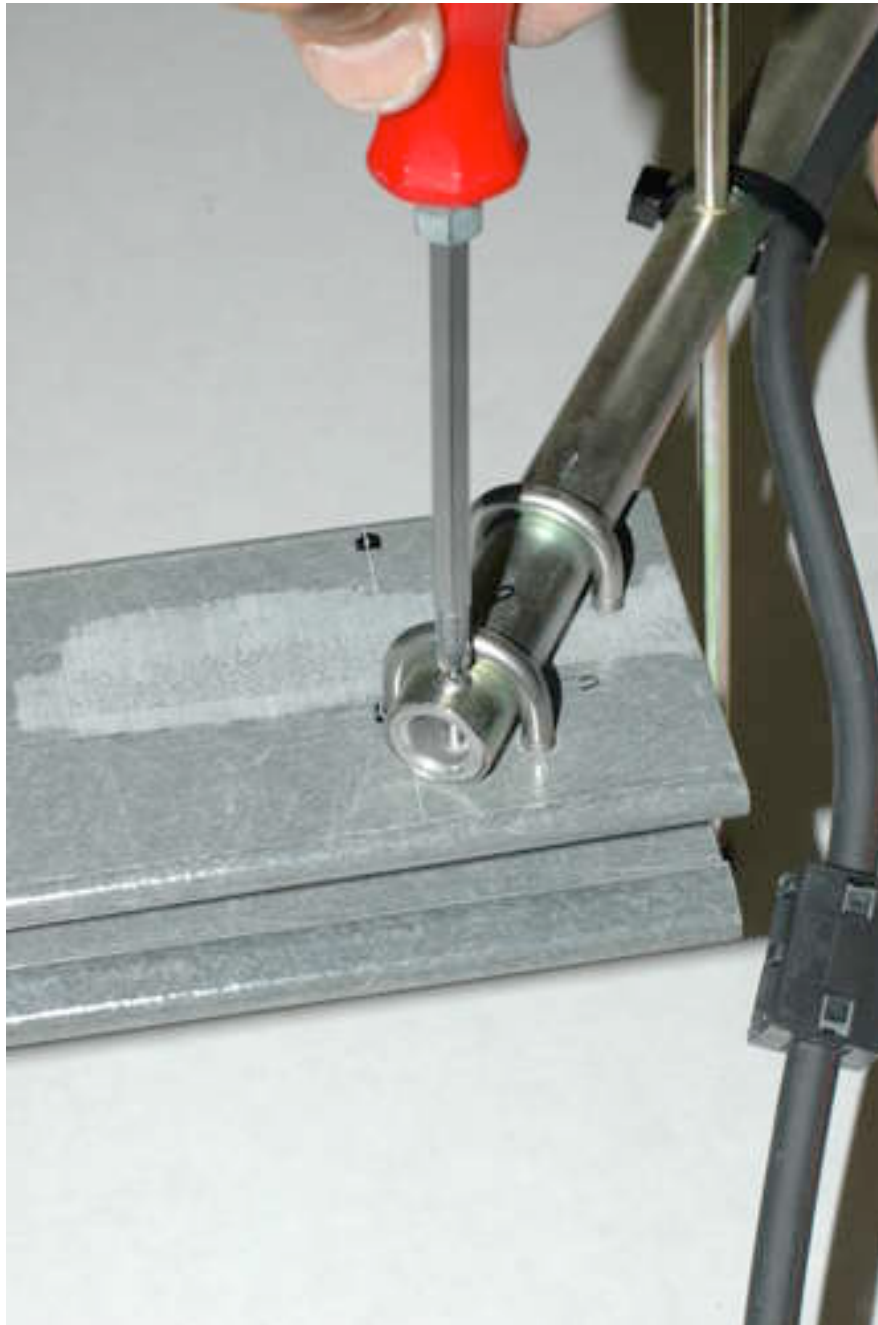


Loosen nuts on U-bolts.



Slide antenna under U-bolts, rotate antenna and align locating hole below screw hole.

Insert locating screw and tighten.

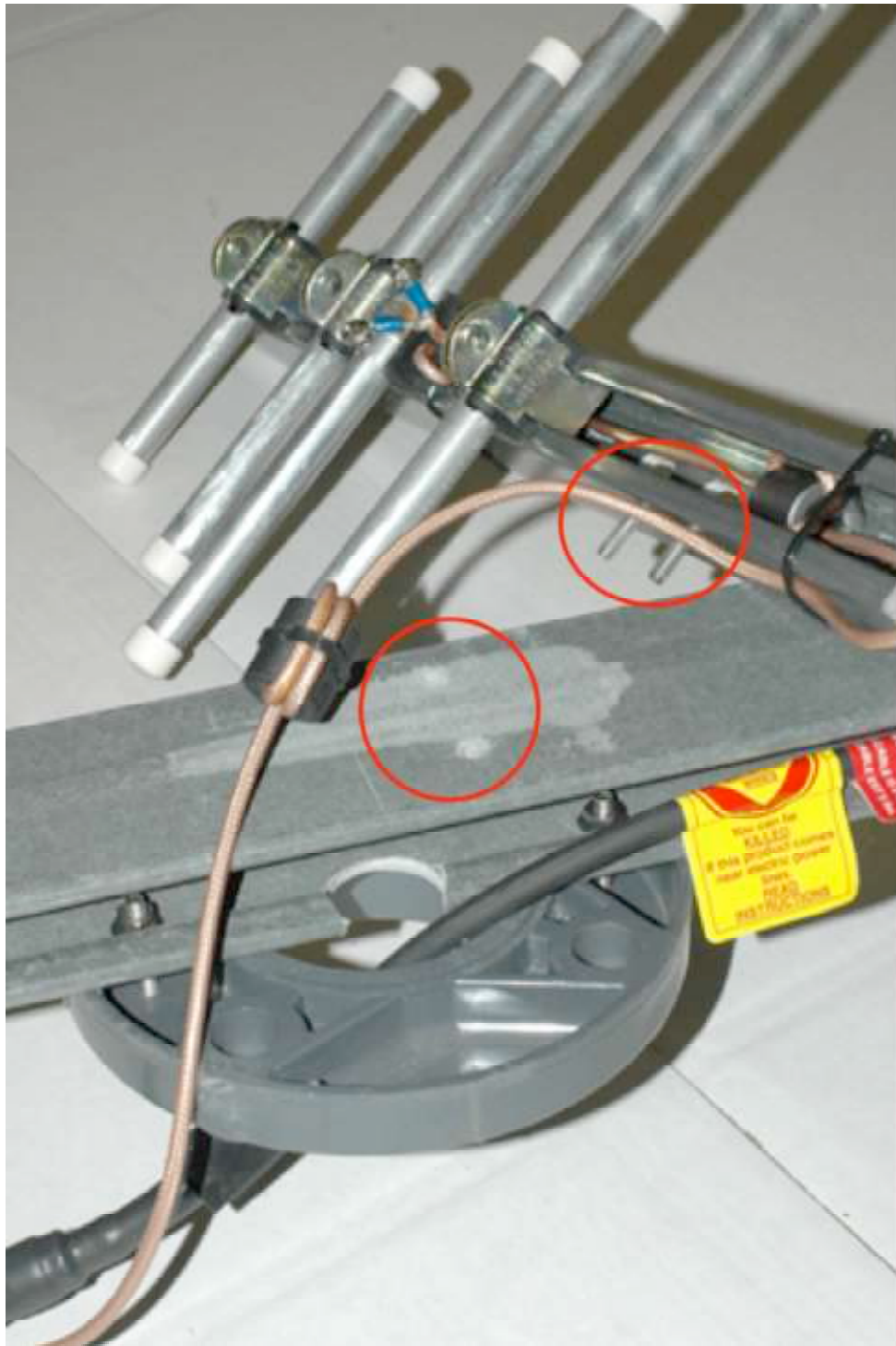


Tighten U-bolts.

Repeat all previous steps for #3 antenna.

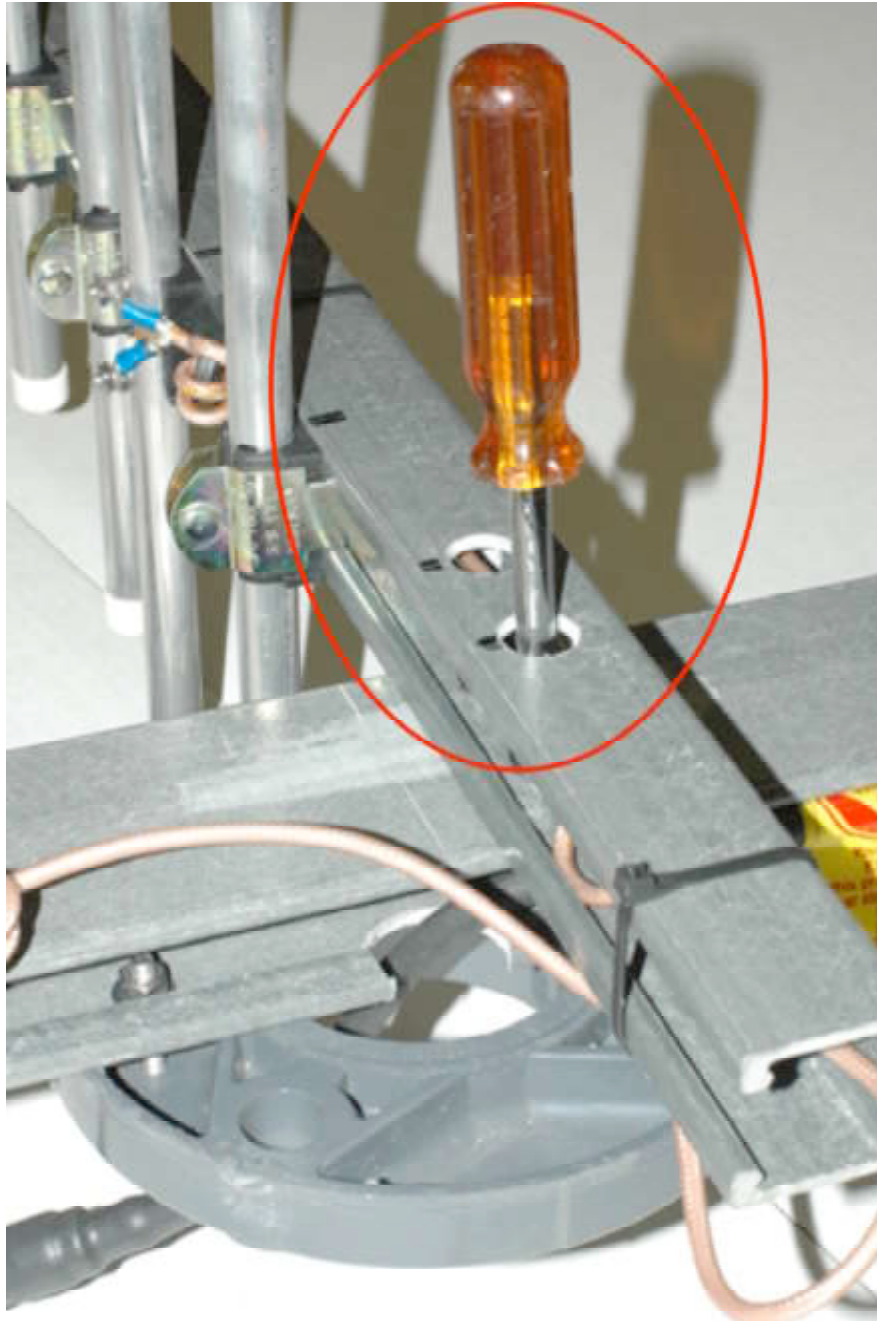
3. Installation

Remove nuts and washers (2 each) from mounting screws for center antenna (#2).



3. Installation

Attach center antenna to cross member, tighten nuts.

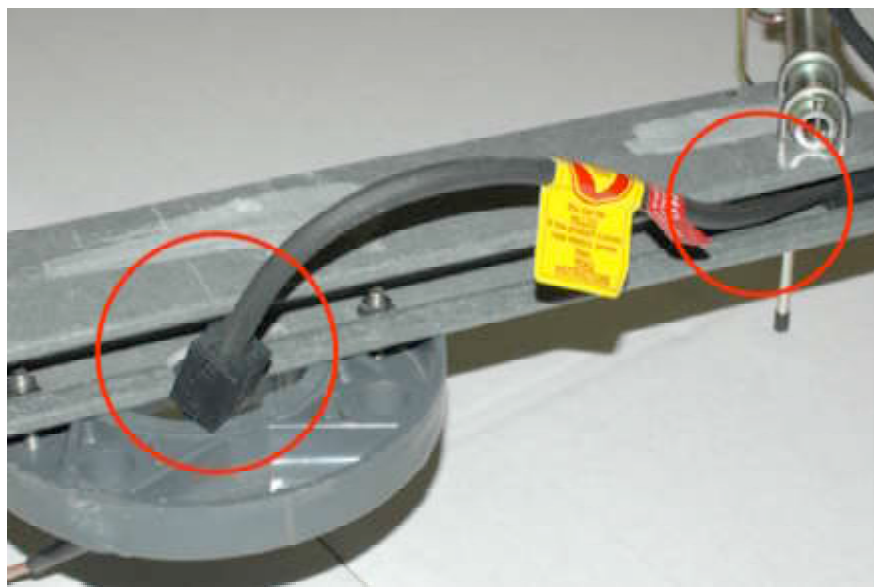


3. Installation

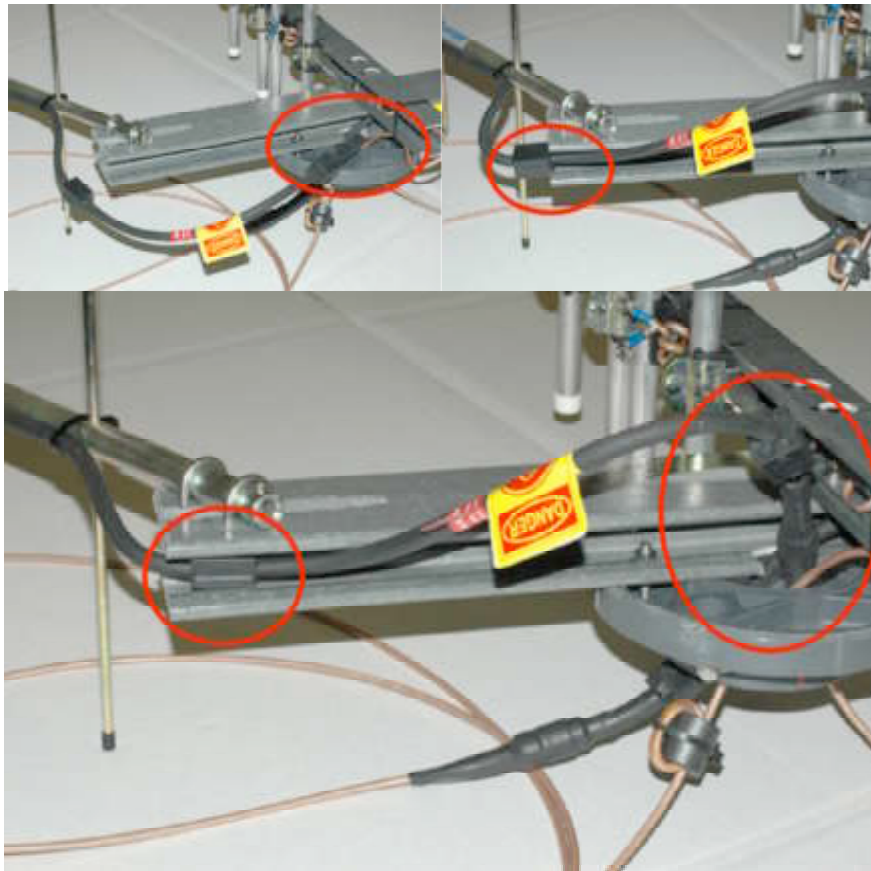
Feed the cable from the #3 antenna through slot in cross member so that ferrite bead slides into slot.



Feed the remaining cable from the #3 antenna under the center antenna rail and into the center hole of the flange.



Repeat the previous two steps for antenna #1.

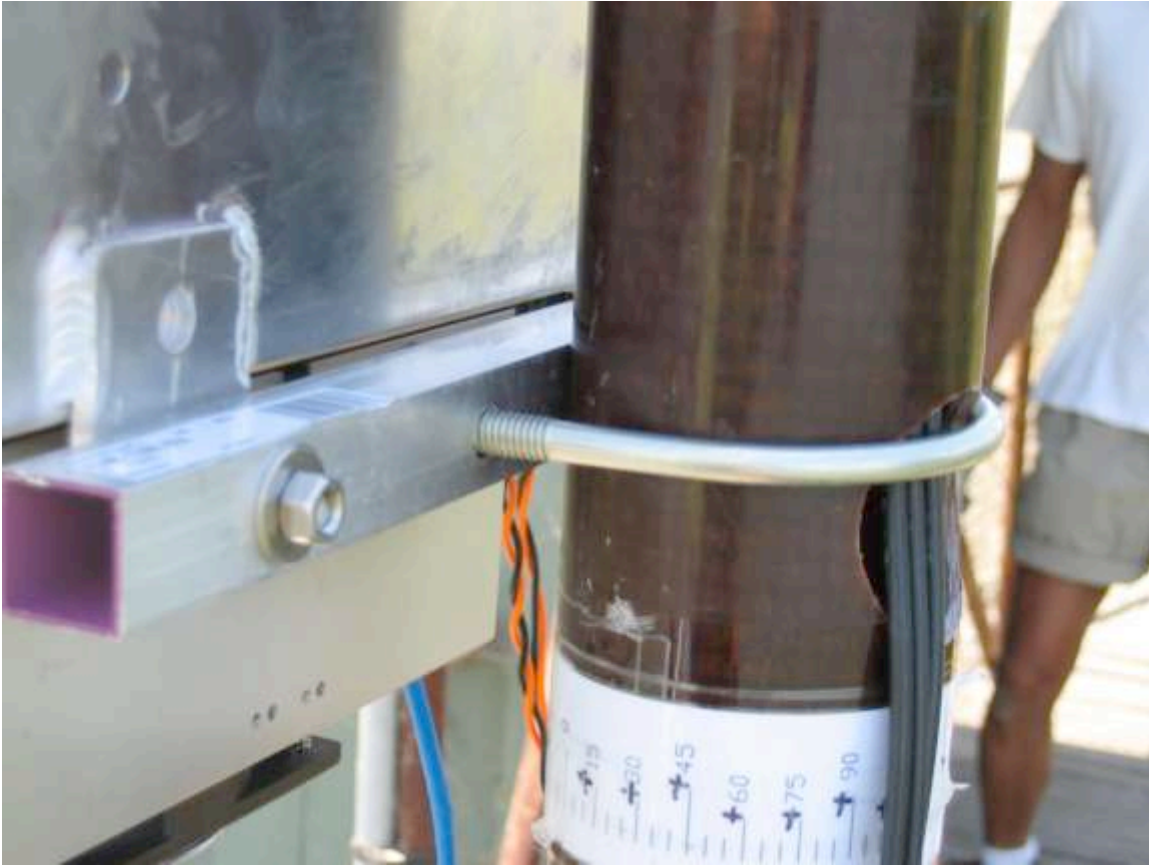


3. Installation

Feed the cable from the center antenna into the center hole of the flange.



There is a cable access hole in the lower end of the mast. Guide the antenna cables into the top of the hollow mast. Thread the cables through the lower cable access.



Mount the antenna to the top of the mast.

Secure the antenna to the mast with the set screw in the antenna-mounting flange.

Raise the mast and antenna.

Point the center antenna toward the river at a 90-degree angle to the main flow direction.

Secure the mast to the mounting post with strong metal clamps.

Enclosure Installation

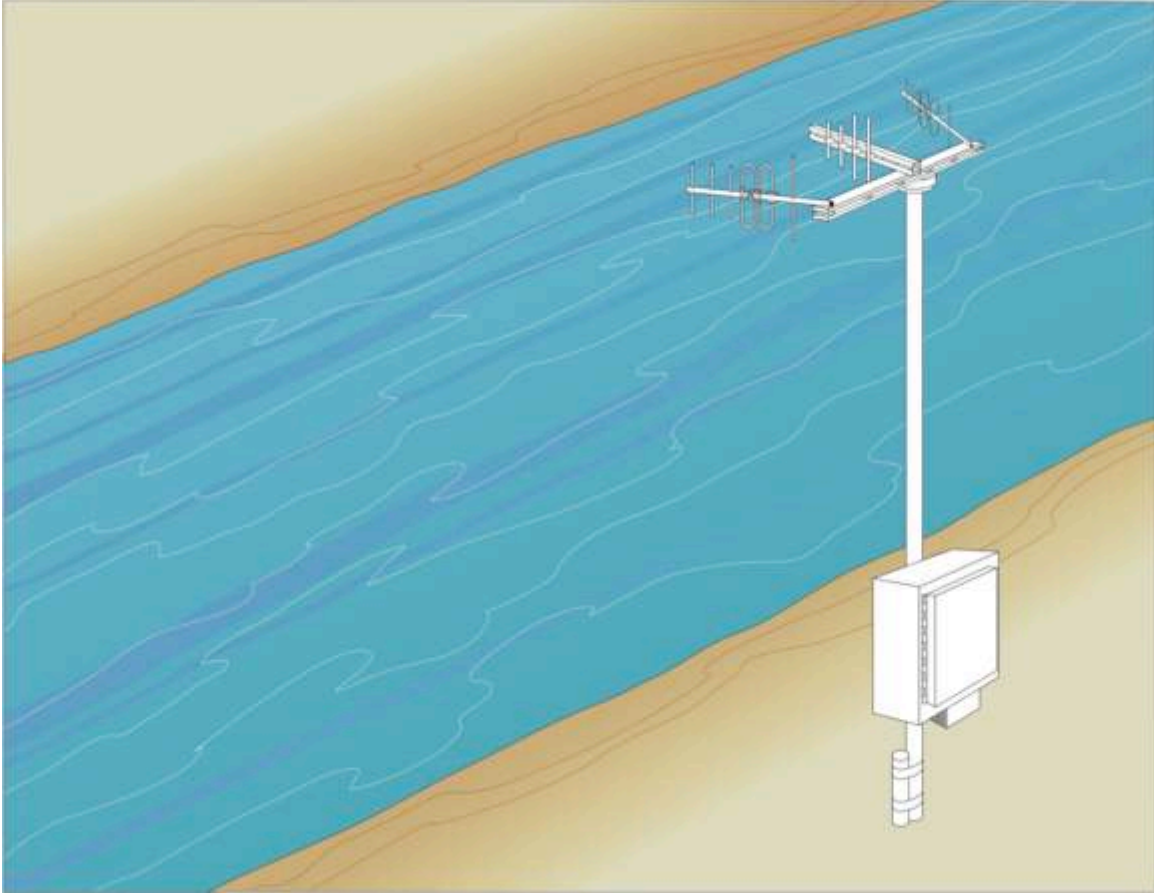
Two mounting brackets are attached to the enclosure. The enclosure is then positioned on the mast and fastened with two U-bolts. The photograph in the previous section shows the enclosure, mounting bracket and U-bolt arrangement.

Secure each mounting bracket to the flanges on the enclosure using two each: bolts, lock washers, flat washers and nuts. The mounting brackets are oriented across the width of the enclosure, i.e., parallel to the ground. Tighten the nuts and bolts with a wrench.

The enclosure is mounted to the antenna mast using two U-bolts. Position the enclosure as desired on the mast. The external fan faces down and must have 15 centimeters (6 inches) minimum clearance.

3. Installation

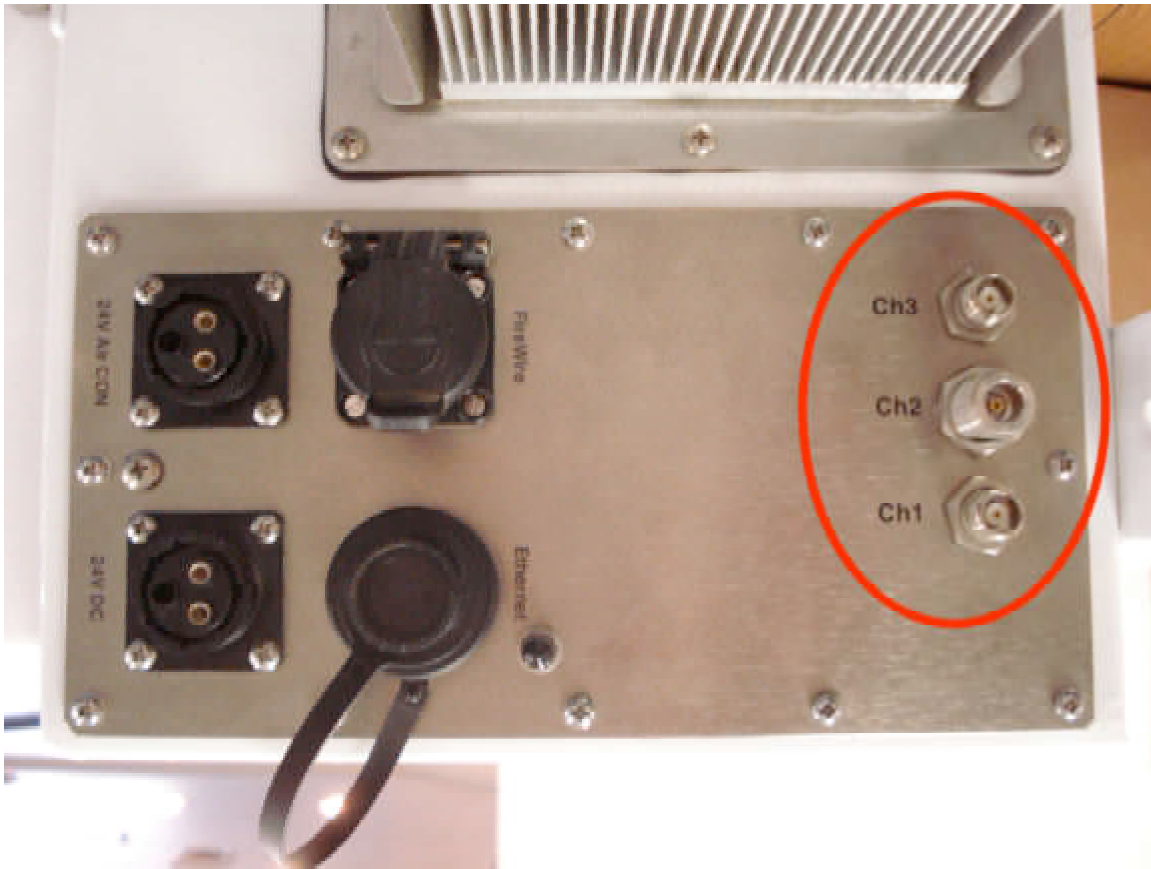
Place the lower U-bolt around the mast. Insert each end of the U-bolt in the mounting bracket holes. Place one washer and nut on each end of the U-bolt. Repeat for the upper U-bolt and mounting rail. Tighten all nuts with a wrench. The figure below shows a typical installation.



Hardware Connections

Antenna Connections

Connectors on the antenna cables and enclosure are labeled. Match each of the three antenna cable-side connector labels to the corresponding enclosure-side connector label. Connect each antenna cable to its connector on the enclosure.

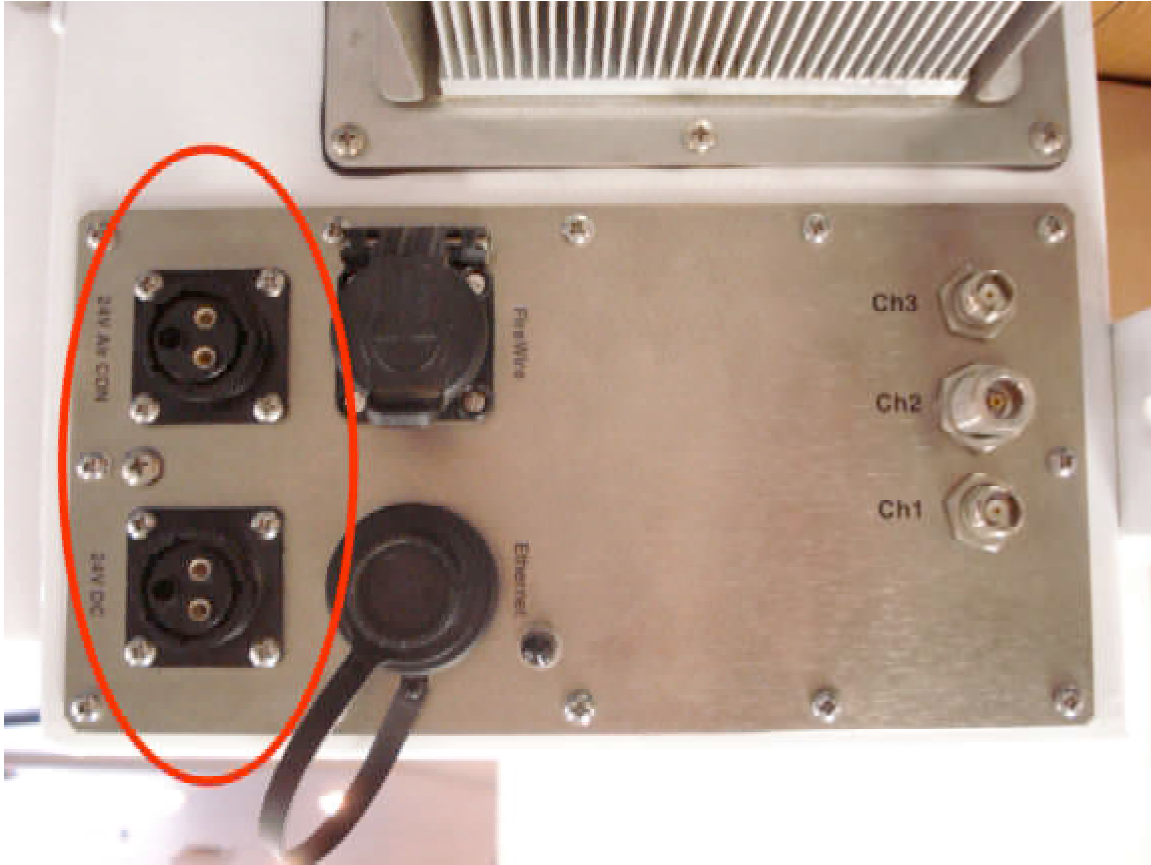


3. Installation

Power Connections

The power cable is a dual cable with a single connector at the power supply end and two connectors at the enclosure end.

Connect enclosure ends of the power cable to the power connectors on the enclosure.



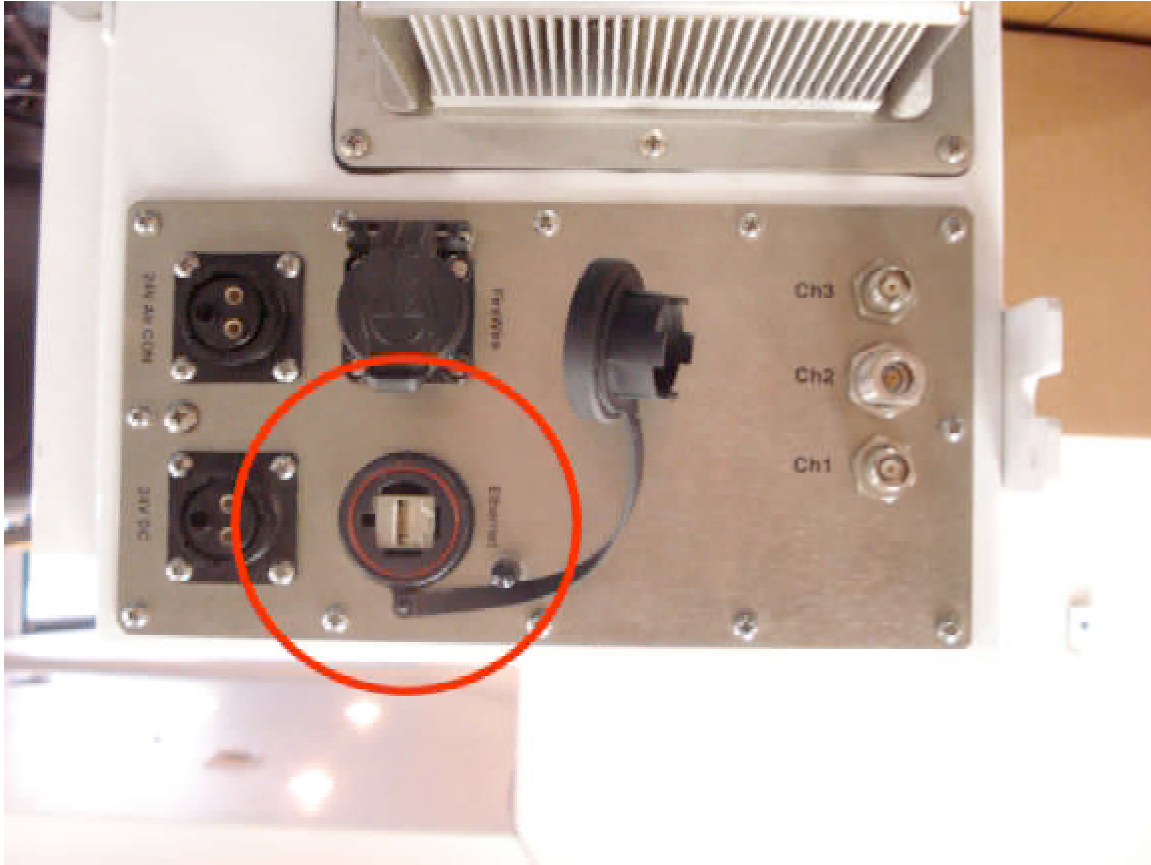
Place the power supply near the AC power source in a sheltered area.

Connect the power supply end of the power cable to the power supply.

Communication Connection

Wired Ethernet Connection

Connect an Ethernet cable (CAT5, CAT5e or CAT6 with an RJ45-style connector) to the enclosure.



Connect the opposite end of the Ethernet cable to the interface computer.

Optional Wireless Connection

Wireless connection is made automatically at power-up by placing the interface computer in the vicinity of the enclosure. No physical connection is required.

3.3. Initial Power-Up

Transceiver and Processor Power-Up

Make sure the power supply switch is in the off position.

Plug in the power cable to the AC electrical power source. Switch on the power supply. The transceiver and processor start automatically.

Interface Computer Power-Up

Press the power button on the interface computer to turn it on.

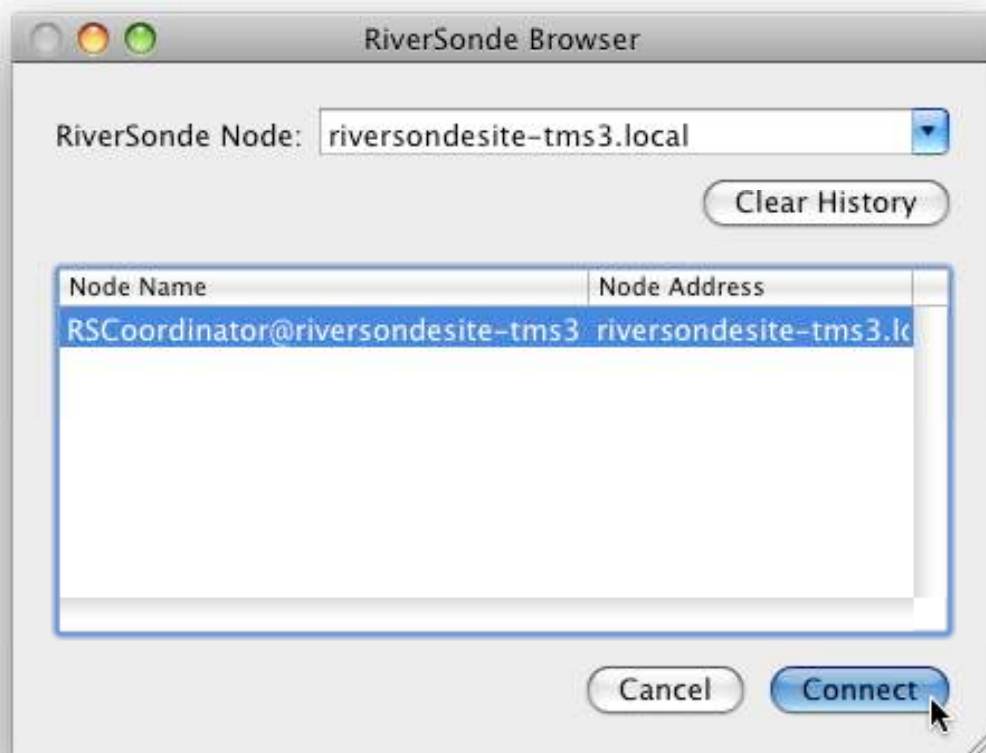
3. Installation

3.4. Communication Checkout

The first step of system checkout is to test the communication between the interface computer and the processor. At the bottom of the interface computer display, click the *RSCoordinator* icon on the Finder Dock to start *RSCoordinator*.



RSCoordinator displays the RiverSonde browser.



The browser lists the *RSCoordinator* that is running on the processor. If this is the case, communication is normal.

Select the desired node. (Typically, only one node is shown, the *RSCoordinator* at the local RiverSonde processor.)

Click the “Connect” button to establish communication with the processor. Connecting can take as long as two minutes. When connection is established, *RSCCommander* displays the Data Browser.

Data Browser for riversondesite-tms3.local

Display Time Zone: GMT

Display Columns

Date	UrMean (m/s)	UrStd (m/s)	VrMean (m/s)	VrStd (m/s)	MeanStd (m/s)	Num Vecs
2008-03-28 00:00	-0.306	0.042	0.006	0.014	0.037	1385
2008-03-28 00:05	-0.287	0.045	0.010	0.013	0.046	1770
2008-03-28 00:10	-0.259	0.038	0.008	0.012	0.054	1886
2008-03-28 00:15	-0.214	0.031	0.010	0.011	0.058	1784
2008-03-28 00:20	-0.175	0.026	0.014	0.012	0.064	1727
2008-03-28 00:25	-0.136	0.034	0.024	0.026	0.074	1659
2008-03-28 00:30	-0.098	0.042	0.041	0.054	0.083	1578
2008-03-28 00:35	-0.022	0.058	0.036	0.064	0.089	1554
2008-03-28 00:40	0.077	0.058	0.066	0.057	0.081	1498
2008-03-28 00:45	0.130	0.024	0.078	0.037	0.068	1575
2008-03-28 00:50	0.150	0.030	0.067	0.023	0.061	1667
2008-03-28 00:55	0.185	0.038	0.053	0.029	0.055	1786
2008-03-28 01:00	0.232	0.027	0.055	0.017	0.051	1831
2008-03-28 01:05	0.279	0.012	0.069	0.008	0.048	1878

1 records selected out of 290 total records

Export... Fetch All Records... Fetch Records...

Config RiverSonde... Config Latest Plots... Plot Time Series... Plot Profiles... Plot Radials...

3.5. Configuration

RSCCommander performs the initial RiverSonde configuration. Enter the requested data. Approximate data can be used, but it is better to be precise.

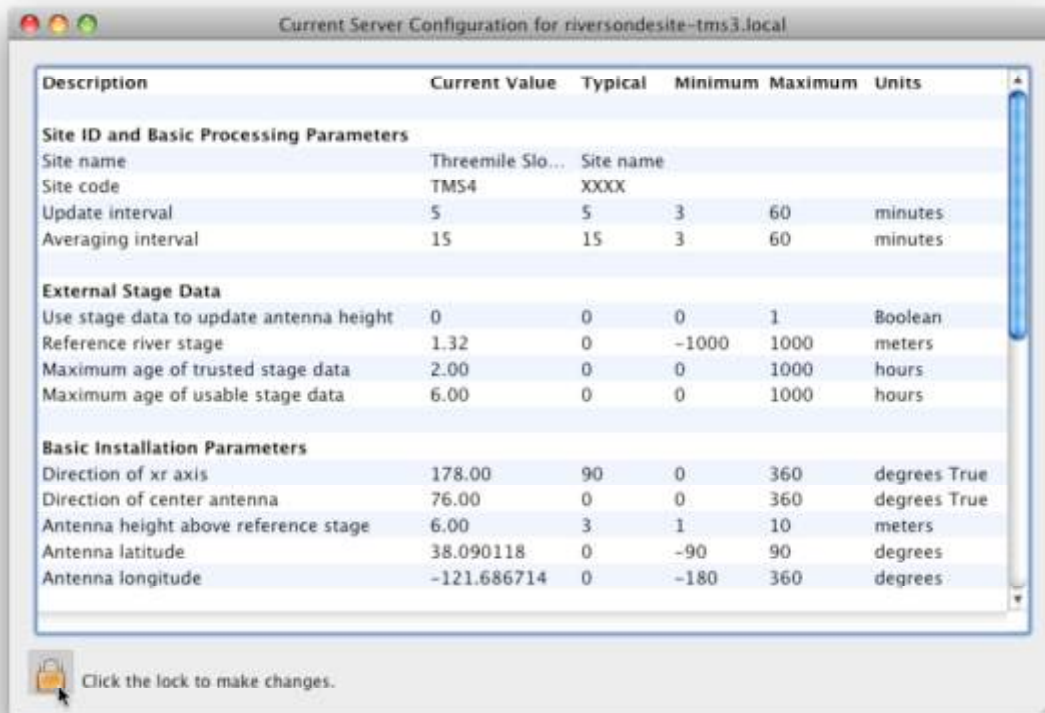
Some steps require authentication. The default administrator name and password are:

Name: codar

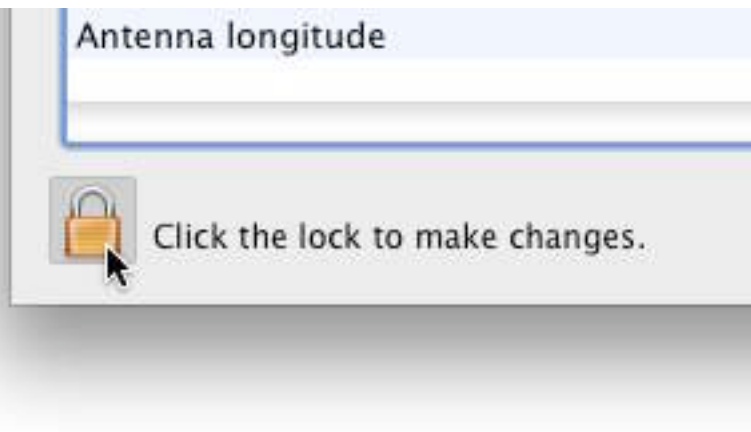
Password: tnes

3. Installation

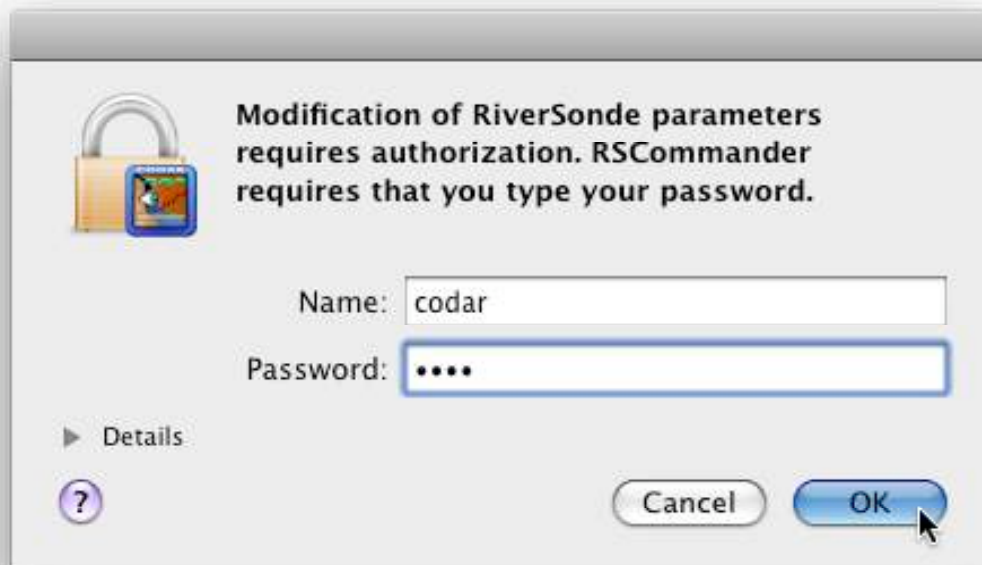
Click the “Config RiverSonde...” button on the Data Browser to initiate RiverSonde configuration. A Current Server Configuration window is displayed.



Click the lock to change the RiverSonde configuration.



A password dialog appears.



Enter the interface computer administrator name and password. Click “OK.”

The configuration parameter assistant starts. See “RiverSonde Configuration” in the “Set-up” section for complete documentation and description of RiverSonde configuration parameters.

A series of configuration dialogs appear. Enter the requested data in each dialog and click the “Next...” button to proceed through each step. Click the “Previous...” button to go back to a previous step and change or correct entries.

3. Installation

The first configuration dialog appears, site identification and basic data processing parameters.



New Server Configuration for pylon.local

Site identification and basic data processing parameters

Site Name: Text string

Site Code: 4-char code

Update interval: min

Averaging interval: min

“Site Name” is a short descriptive name for your site or location.

“Site Abbreviation” is a four-character code for the site. The code will appear in all associated data sets and file names. It is helpful to make this code uniquely descriptive of the RiverSonde site. Typically, use abbreviations of local area names. Examples of descriptive codes are: PLCR (Placerville), ZHNG (Zhengzhou) or 30MT (Thirty Milestone Tract).

Generic names and codes are easily confused. Try not to select codes like ABC1 and ABC2. (Which is 1? Is there some other identifier that better describes the site?) Naming a site after the river itself may be confusing. (What if there is more than one RiverSonde on the same river?)

“Update interval” is the time period, in minutes, between data display updates.

“Averaging interval” is the time, in minutes, over which data are averaged.

Click the “Next...” button to proceed to the parameters for externally supplied stage data dialog.

New Server Configuration for pylon.local

Parameters for externally-supplied stage data used to update height of antenna above water surface

☒ Use stage data to update antenna height

Reference river stage: 0.00 m

Maximum age of trusted stage data: 2.00 hours

Maximum age of usable stage data: 96.00 hours

Colors for data display using antenna height stage correction

Data with questionable stage correction: [Blue color box]

Data with discarded stage correction: [Blue color box]

Cancel Previous... Next...

Click the checkbox to use stage data to update the antenna height above the water surface. When “Use stage data to update antenna height” is enabled, user-supplied stage data are used in water velocity calculations and stage data age thresholds are applied. When “Use stage data to update antenna height” is disabled, the antenna height (entered in the basic installation parameters dialog) will be used, with no adjustments for stage. If you do not provide stage height data regularly, disable this item and click the “Next...” button to proceed to the next dialog.

“Reference river stage” is the river stage, in meters, at the time the antenna height above the water’s surface was measured. If the stage is unknown, enter 0 (zero).

“Maximum age of trusted stage data” is a time limit, in hours, after which stage data are deemed questionable. (Or they may be usable, but perhaps suspect enough to be flagged.) When stage data are older than the “trusted age,” they are flagged as “questionable.”

3. Installation

“Maximum age of usable stage data” is a time limit, in hours, after which stage data are deemed unusable. When stage data are older than the “usable age,” they are not used in water velocity calculations and are flagged as unusable.

“Colors for data display using antenna height stage correction” are used to set colors that indicate when stage data are questionable or unusable. Click on the colored rectangle to change the color of the displayed items.

Click the “Next...” button to proceed to the basic installation parameters dialog.

New Server Configuration for pylon.local

Basic installation parameters
Orientation of river channel and center antenna, location and height of antenna above reference stage

The diagram shows a river channel with a radar antenna at a reference stage. The antenna is labeled 'Radar' and has a red dot indicating its position. The river channel is labeled 'River'. The diagram includes labels for 'yr' (y-axis), 'xr' (x-axis), 'θr' (antenna orientation), 'θc' (river channel direction), 'lat' (latitude), 'lon' (longitude), and 'ht' (height).

River Channel Direction (θc): 191.00 deg T

Antenna Orientation (θr): 77.00 deg T

Antenna Height (ht): 6.50 m

Antenna Latitude (lat): 38.090000 deg (Positive North)

Antenna Longitude (lon): -121.680000 deg (Positive East)

Lat-Lon Display Format: ☒ D.dd ☐ D M.mm ☐ D M S.ss
Enter coordinates in D.dd, D M.mm, or D M S.ss format with optional N,S,E,W

Buttons: Cancel, Previous..., Next...

Directions and orientations are described in “degrees true” (deg T), that is, degrees clockwise from true north. This is not magnetic north; if using a compass, apply the appropriate declination correction for the location.

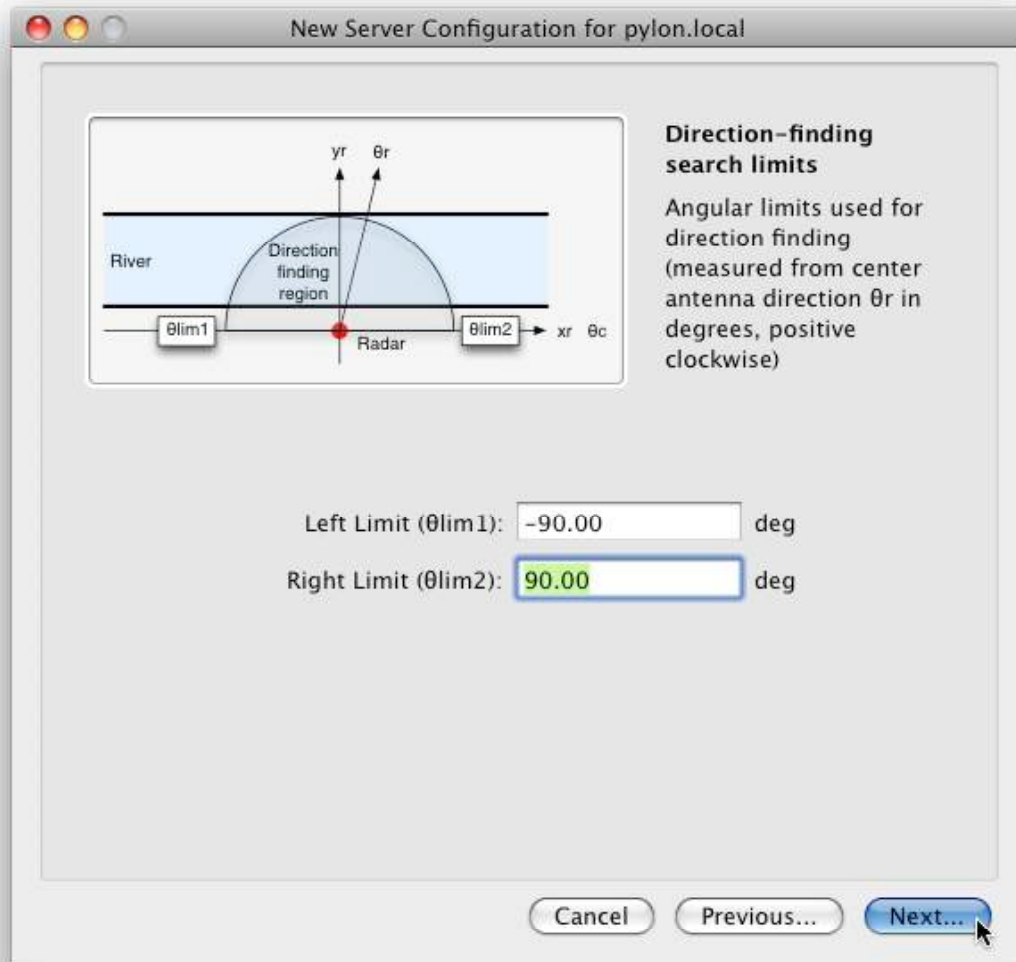
“River Channel Direction” is the direction, in degrees true, of the main flow to the right of the mast when facing the river.

“Antenna Orientation” is the pointing direction, in degrees true, of the center element of the antenna.

“Antenna Height” is the height, in meters, of the antenna above the water surface.

“Antenna Latitude” and “Antenna Longitude” are the geographic latitude and longitude of the antenna.

Click the “Next...” button to proceed to the direction-finding search limits dialog.



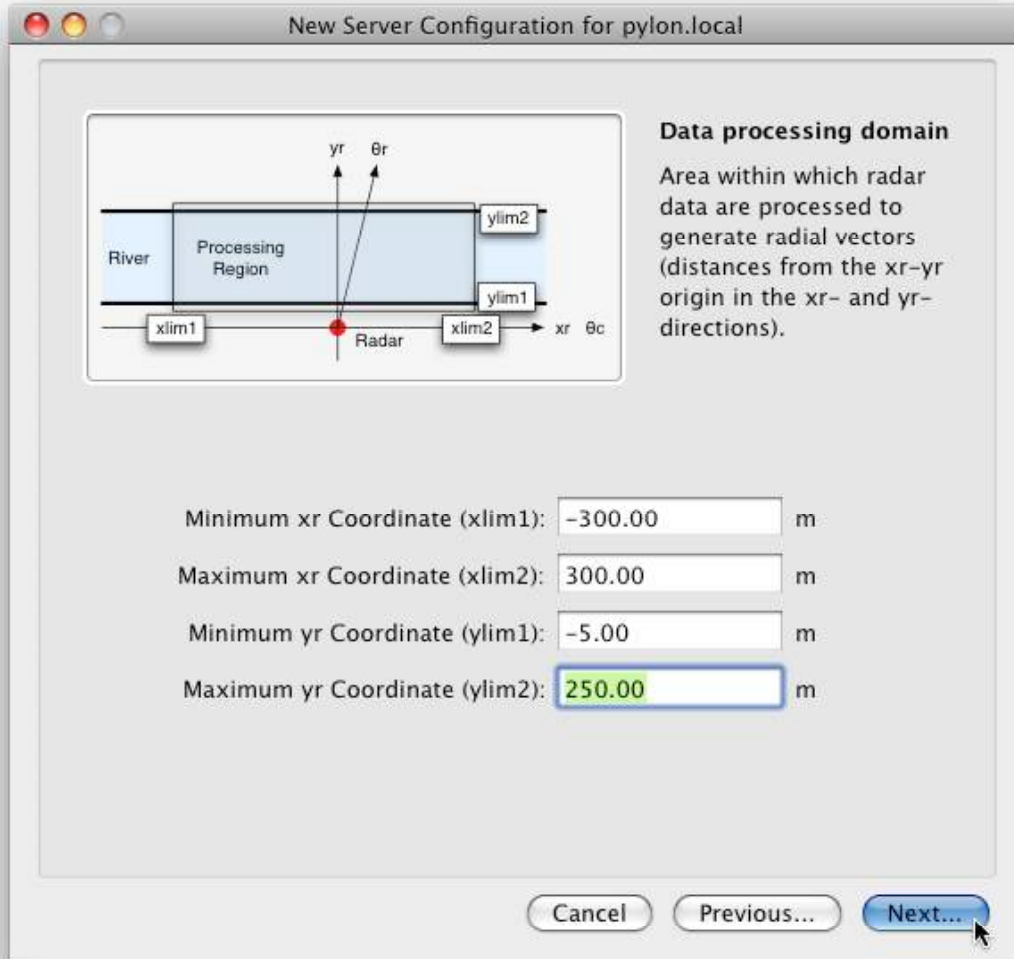
“Direction-finding search limits” are two angles over which the software calculates the direction of reflected signals. Angles are described as they are viewed facing the river from the mast and with respect to the center antenna direction, i.e., the direction at the antenna orientation angle, θ_r . Angles to the left of the center antenna direction are negative. In ideal circumstances (straight banks, unobstructed views, antenna oriented perpendicular to flow and near the bank), the angles are -90 degrees and +90 degrees. If the banks are curved or the view of the water is obstructed in any way, measure or estimate the angle between the center antenna direction and the view directions that include the river only.

“Left Limit” is the view angle, in degrees, to the left of the center antenna direction as you face the river.

3. Installation

“Right Limit” is the view angle, in degrees, to the right of the center antenna direction as you face the river.

Click the “Next...” button to proceed to the data processing domain dialog.



The dialog box is titled "New Server Configuration for pylon.local". It contains a diagram of the radar setup and a section for configuring the data processing domain.

Data processing domain
Area within which radar data are processed to generate radial vectors (distances from the x_r - y_r origin in the x_r - and y_r -directions).

The diagram shows a radar unit (red dot) on a riverbank. A rectangular "Processing Region" is defined by coordinates x_{lim1} , x_{lim2} , y_{lim1} , and y_{lim2} . The radar's field of view is indicated by angles θ_r and θ_c relative to the x_r axis.

Configuration fields:

- Minimum x_r Coordinate (x_{lim1}): -300.00 m
- Maximum x_r Coordinate (x_{lim2}): 300.00 m
- Minimum y_r Coordinate (y_{lim1}): -5.00 m
- Maximum y_r Coordinate (y_{lim2}): 250.00 m

Buttons: Cancel, Previous..., Next...

The “data processing domain” is a rectangular area within which the received signal data are processed to generate radial velocity vectors. Identify this rectangle and measure or estimate the distance of its edges from the base of the antenna mast. Coordinates are described as they are viewed facing the river from the mast. Coordinates to the left or behind the mast are negative.

“Minimum x_r Coordinate” is the smallest distance, in meters, between the mast and the left-hand edge of the rectangle.

“Maximum x_r Coordinate” is the smallest distance, in meters, between the mast and the right-hand edge of the rectangle.

“Minimum y_r Coordinate” is the smallest distance, in meters, between the mast and the near edge of the rectangle.

“Maximum yr Coordinate” is the smallest distance, in meters, between the mast and the far edge of the rectangle.

Click the “Next...” button to proceed to the limits for moving strip velocity profile estimation dialog.

Limits for moving-strip velocity profile estimation

Region with homogeneous river conditions used to estimate velocity profile (xr- and yr-distances and strip width).

Minimum xr Coordinate (xsmmin): -200.00 m

Maximum xr Coordinate (xsmax): 200.00 m

Minimum yr Coordinate (ysmin): 0.00 m

Maximum yr Coordinate (ysmax): 200.00 m

Strip width (ystrip): 5.00 m

Cancel Previous... Next...

RiverSonde generates velocity profiles by processing data from a “strips” of river area. The “limits for moving strip velocity estimation” describe a rectangular area that lies within the data processing domain set in the previous step, and a smaller width, which essentially sets the number of velocity data points across the river. The area within the limits should have homogeneous (essentially uniform) surface conditions. In particular, the surface roughness should be uniform. Coordinates are described as they are viewed facing the river from the mast. Coordinates to the left or behind the mast are negative.

“Minimum xr Coordinate” is the smallest distance, in meters, between the mast and the left-hand edge of the rectangle.

“Maximum xr Coordinate” is the smallest distance, in meters, between the mast and the right-hand edge of the rectangle.

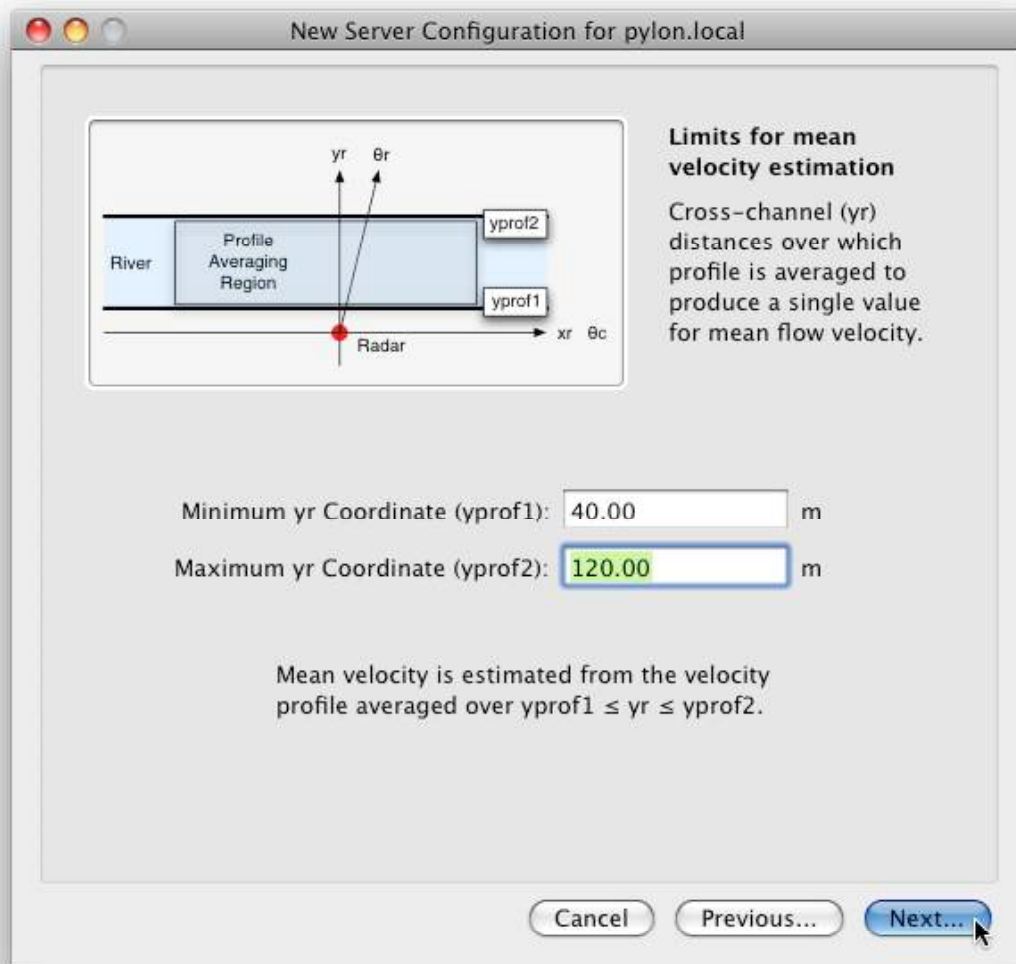
3. Installation

“Minimum yr Coordinate” is the smallest distance, in meters, between the mast and the near edge of the rectangle.

“Maximum yr Coordinate” is the smallest distance, in meters, between the mast and the far edge of the rectangle.

“Strip width” is the width, in meters, of each estimation strip. This is typically set to 1/40 of the yr width, i.e., $(y_{\text{max}} - y_{\text{min}})/40$ (allowing 40 velocity points across the river). The strip width should be within the range of 1 to 100 meters.

Click the “Next...” button to proceed to the limits for mean velocity estimation dialog.

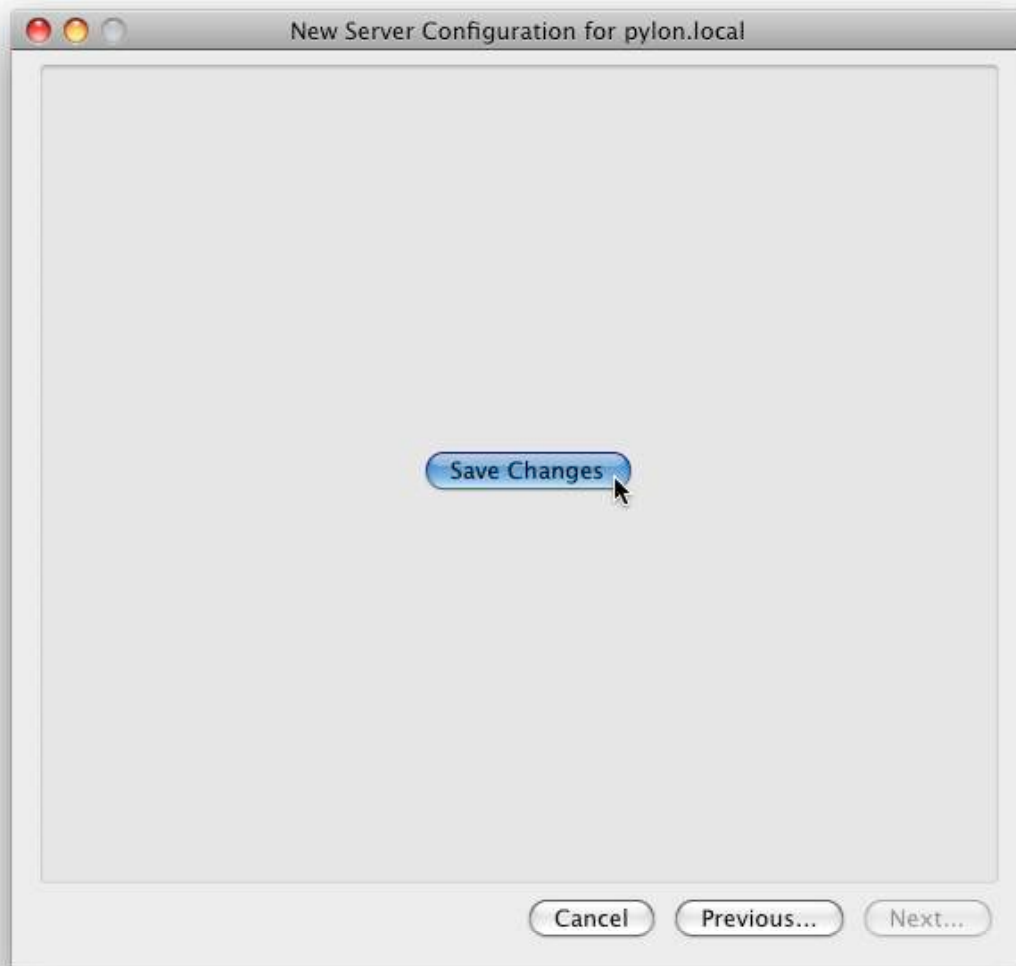


“Limits for mean velocity estimation” are near and far distances, in meters, over which the software computes a single mean velocity for the entire river. These limits should cover the typical main flow of the river.

“Minimum yr Coordinate” is the distance, in meters, between the mast and the near limit.

“Maximum yr Coordinate” is the distance, in meters, between the mast and the far limit.

Click the “Next...” button to proceed to the save dialog.



Click the “Save Changes” button to save configuration settings and changes. Enter the interface computer administrator name and password if prompted.

4. Operation and Use

In This Chapter

Overview: description of normal operation and use.

Power-Up: how to apply electrical power to the RiverSonde.

Checkout: how to confirm that the RiverSonde operates normally.

Software Use: user guide to *RSCCommander*, how to retrieve data from the processor, overview of *RSCoordinator*.

This chapter describes normal operation and use. The RiverSonde must be set up correctly, all connections made and the initial RiverSonde configuration complete, as described in “Set-up.” Many operations are similar to those performed during set-up.

4.1. Overview

Once the RiverSonde is set up and powered on, it operates automatically.

The RiverSonde makes periodic measurements and processes the measurement data.

Data files containing received signal spectral data, radial velocity vector components and statistics, cross-channel velocity distribution and mean velocity time series are created on the processor.

You can review data sets and generate data plots with the interface computer. The interface computer communicates with the processor locally via wired or optional wireless connection, or remotely via an Internet connection.

You can check RiverSonde status to identify potential problems or malfunctions.

4.2. Power-Up

Transceiver And Processor Power-Up

Plug in the power cable to the main AC power supply. The transceiver and processor start automatically. Power must remain on for the RiverSonde to make measurements, store data and provide data displays.

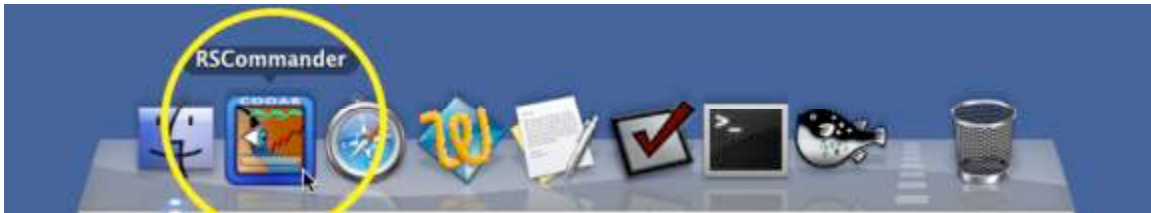
Interface Computer Power-Up

Press the power button on the interface computer to turn it on.

The *RSCCommander* program starts automatically.

Select RSCommander and Connect

If the RiverSonde Browser or Data Browser is not visible, click the *RSCommander* icon on the Finder Dock.



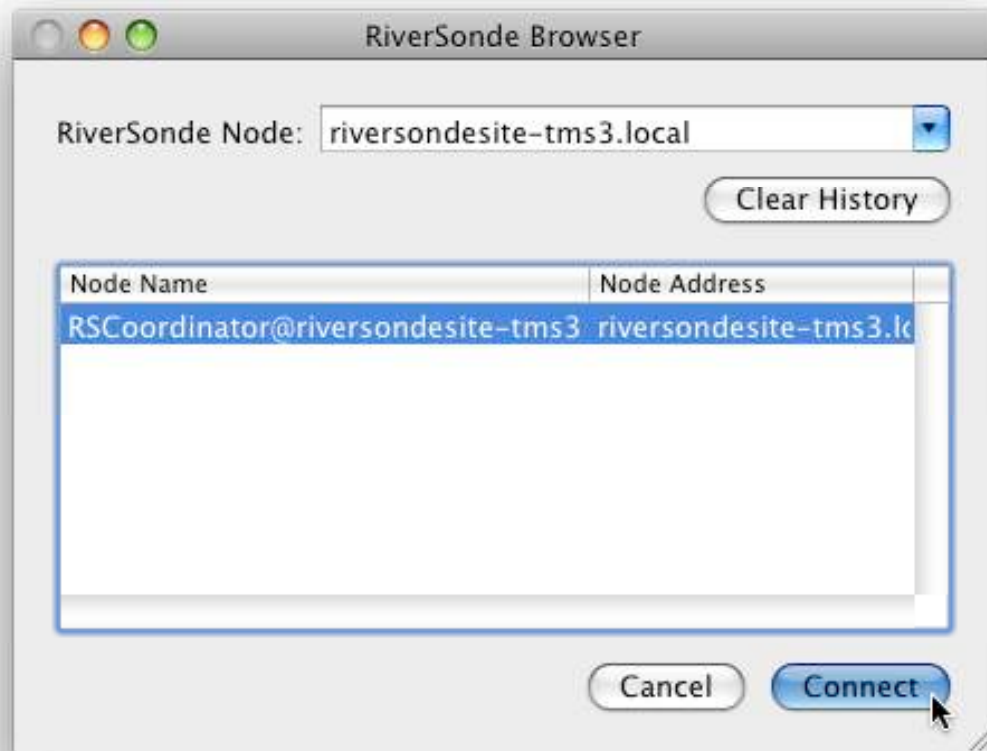
If *RSCommander* is not running, it starts and displays the RiverSonde Browser.

If *RSCommander* is running, you may not see the RiverSonde Browser. Select “Open RiverSonde Connection...” from the File menu ...



4. Operation and Use

... to display the RiverSonde Browser.



Select the desired node. (Typically, one node is shown, the *RSCoordinator* running on the local RiverSonde processor.) Click the “Connect” button to establish communication with the processor.

4.3. Checkout

Next, the RiverSonde functional checkout should be performed on the interface computer using the *RSCommander* program. Successful completion of the following steps indicates that the RiverSonde is running normally.

Start or select the *RSCommander* program.

Connect to the *RSCoordinator* program running on the processor.

The *RSCommander* Data Browser displays the data sets stored on the processor and their attributes. (The Data Browser is described in a later section.)

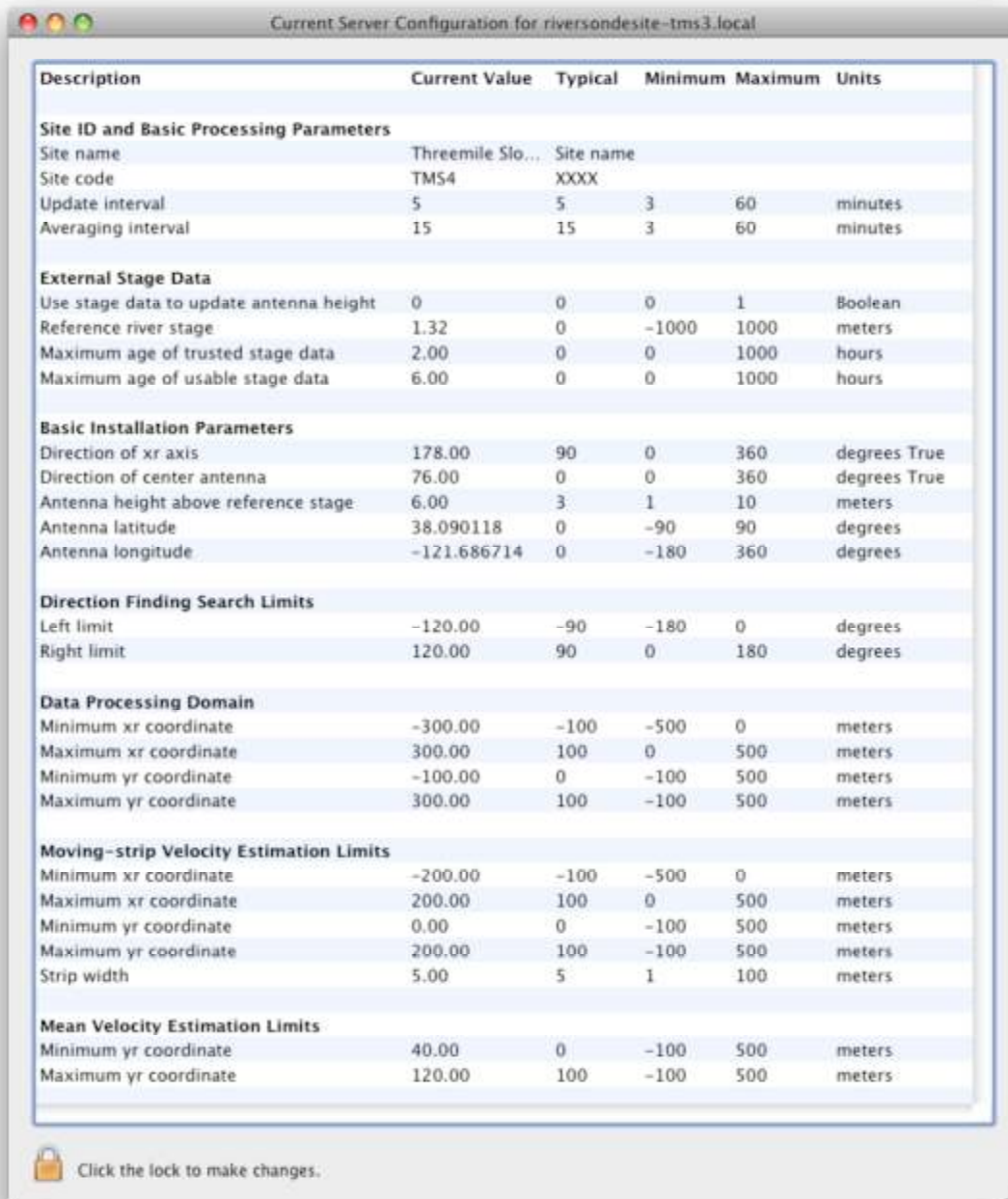
The screenshot shows the 'Data Browser for riversondesite-tms3.local' window. It features a 'Display Time Zone' dropdown set to 'GMT' and a 'Display Columns' dropdown. The main table displays data records with the following columns: Date, UrMean (m/s), UrStd (m/s), VrMean (m/s), VrStd (m/s), MeanStd (m/s), and Num Vecs. The table contains 15 rows of data, with the first row highlighted. Below the table, it indicates '1 records selected out of 290 total records'. At the bottom, there are buttons for 'Export...', 'Fetch All Records', 'Fetch Records...', 'Config RiverSonde...', 'Config Latest Plots...', 'Plot Time Series...', 'Plot Profiles...', and 'Plot Radials...'.

Date	UrMean (m/s)	UrStd (m/s)	VrMean (m/s)	VrStd (m/s)	MeanStd (m/s)	Num Vecs
2008-03-28 00:00	-0.306	0.042	0.006	0.014	0.037	1385
2008-03-28 00:05	-0.287	0.045	0.010	0.013	0.046	1770
2008-03-28 00:10	-0.259	0.038	0.008	0.012	0.054	1886
2008-03-28 00:15	-0.214	0.031	0.010	0.011	0.058	1784
2008-03-28 00:20	-0.175	0.026	0.014	0.012	0.064	1727
2008-03-28 00:25	-0.136	0.034	0.024	0.026	0.074	1659
2008-03-28 00:30	-0.098	0.042	0.041	0.054	0.083	1578
2008-03-28 00:35	-0.022	0.058	0.036	0.064	0.089	1554
2008-03-28 00:40	0.077	0.058	0.066	0.057	0.081	1498
2008-03-28 00:45	0.130	0.024	0.078	0.037	0.068	1575
2008-03-28 00:50	0.150	0.030	0.067	0.023	0.061	1667
2008-03-28 00:55	0.185	0.038	0.053	0.029	0.055	1786
2008-03-28 01:00	0.232	0.027	0.055	0.017	0.051	1831
2008-03-28 01:05	0.279	0.012	0.069	0.008	0.048	1878


If no data sets are listed, wait at least 15 minutes. If you set the averaging interval to a longer period during RiverSonde configuration, you must wait at least as long as the setting. After the wait, the first data set is listed.

4. Operation and Use

Click the “Config RiverSonde...” button to display the configuration parameters.

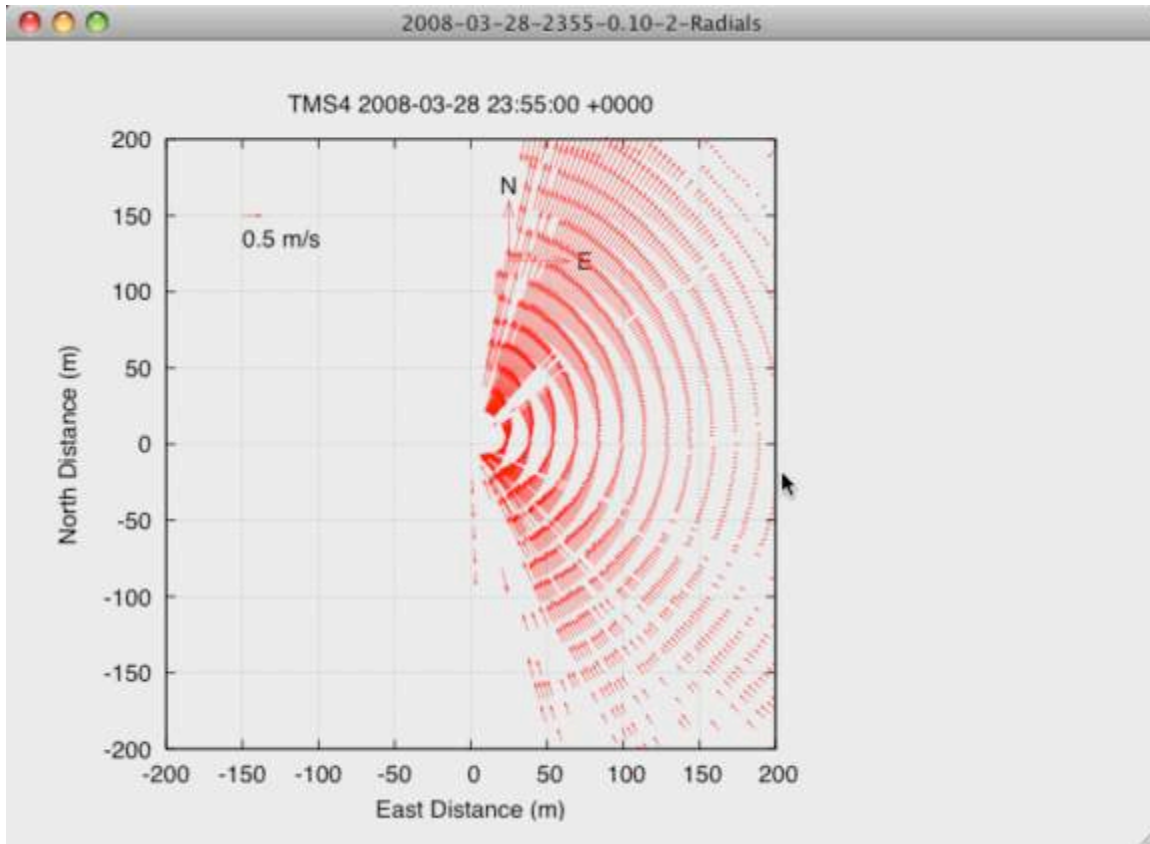


Description	Current Value	Typical	Minimum	Maximum	Units
Site ID and Basic Processing Parameters					
Site name	Threemile Slo...	Site name			
Site code	TMS4	XXXX			
Update interval	5	5	3	60	minutes
Averaging interval	15	15	3	60	minutes
External Stage Data					
Use stage data to update antenna height	0	0	0	1	Boolean
Reference river stage	1.32	0	-1000	1000	meters
Maximum age of trusted stage data	2.00	0	0	1000	hours
Maximum age of usable stage data	6.00	0	0	1000	hours
Basic Installation Parameters					
Direction of xr axis	178.00	90	0	360	degrees True
Direction of center antenna	76.00	0	0	360	degrees True
Antenna height above reference stage	6.00	3	1	10	meters
Antenna latitude	38.090118	0	-90	90	degrees
Antenna longitude	-121.686714	0	-180	360	degrees
Direction Finding Search Limits					
Left limit	-120.00	-90	-180	0	degrees
Right limit	120.00	90	0	180	degrees
Data Processing Domain					
Minimum xr coordinate	-300.00	-100	-500	0	meters
Maximum xr coordinate	300.00	100	0	500	meters
Minimum yr coordinate	-100.00	0	-100	500	meters
Maximum yr coordinate	300.00	100	-100	500	meters
Moving-strip Velocity Estimation Limits					
Minimum xr coordinate	-200.00	-100	-500	0	meters
Maximum xr coordinate	200.00	100	0	500	meters
Minimum yr coordinate	0.00	0	-100	500	meters
Maximum yr coordinate	200.00	100	-100	500	meters
Strip width	5.00	5	1	100	meters
Mean Velocity Estimation Limits					
Minimum yr coordinate	40.00	0	-100	500	meters
Maximum yr coordinate	120.00	100	-100	500	meters

 Click the lock to make changes.

Compare these to the expected values, for example, the values set during the initial RiverSonde configuration.

In the Data Browser, select the most recent data set. Click the “Plot Radials...” button to generate a plot of radial velocity distribution.



The radials plot shows arcs of radial velocity vectors. If good plots exist from the same site in the past, compare them with the most recent plot for consistency.

Successful completion of the preceding steps indicates that the RiverSonde is running normally.

4.4. Software Use

Overview

There are two main RiverSonde programs: *RSCommander* and *RSCoordinator*. *RSCommander* runs on the interface computer and is the user software interface to the RiverSonde. *RSCoordinator* runs on the processor and performs most data processing functions. It communicates with *RSCommander* and performs functions requested via *RSCommander*, such as data plotting. Other programs run on the processor to control the transceiver, gather raw data, transfer data to the interface computer, and perform supporting tasks. The *Fugu* file transfer program and the *Safari* web browser run on the interface computer and are used to transfer data files from the processor.

4. Operation and Use

RSCommander

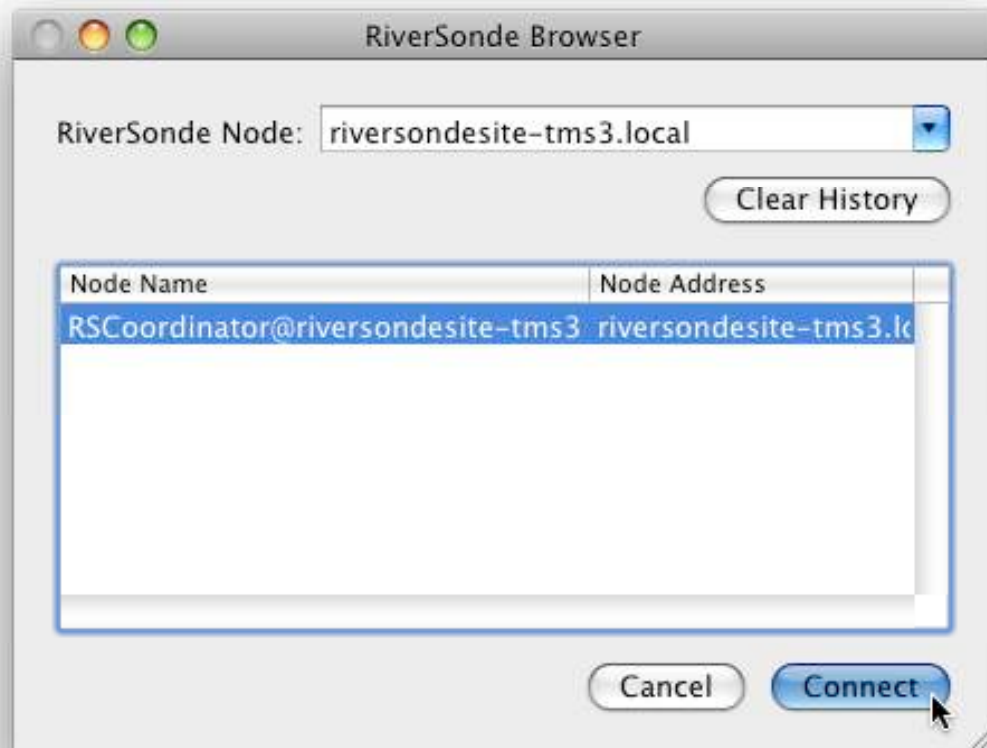
RSCommander is the main program that runs on the interface computer. It communicates with the *RSCoordinator* program running on the processor, via a wired or optional wireless network connection. *RSCommander* is used to:

- Browse, select and filter data set attributes.
- Export data set attributes to a file on the interface computer.
- Plot time series of average velocities.
- Plot velocity profiles for selected data sets stored on the processor.
- Plot radial velocity vector maps for selected data sets stored on the processor.
- View the time series, velocity profiles, radial velocity vector map plots of the most recent data set.
- Configure or reconfigure the RiverSonde.

Clicking a button and/or choosing a menu item initiates these functions.

***RSCommander* Start-Up**

RSCommander displays the RiverSonde Browser at start-up.



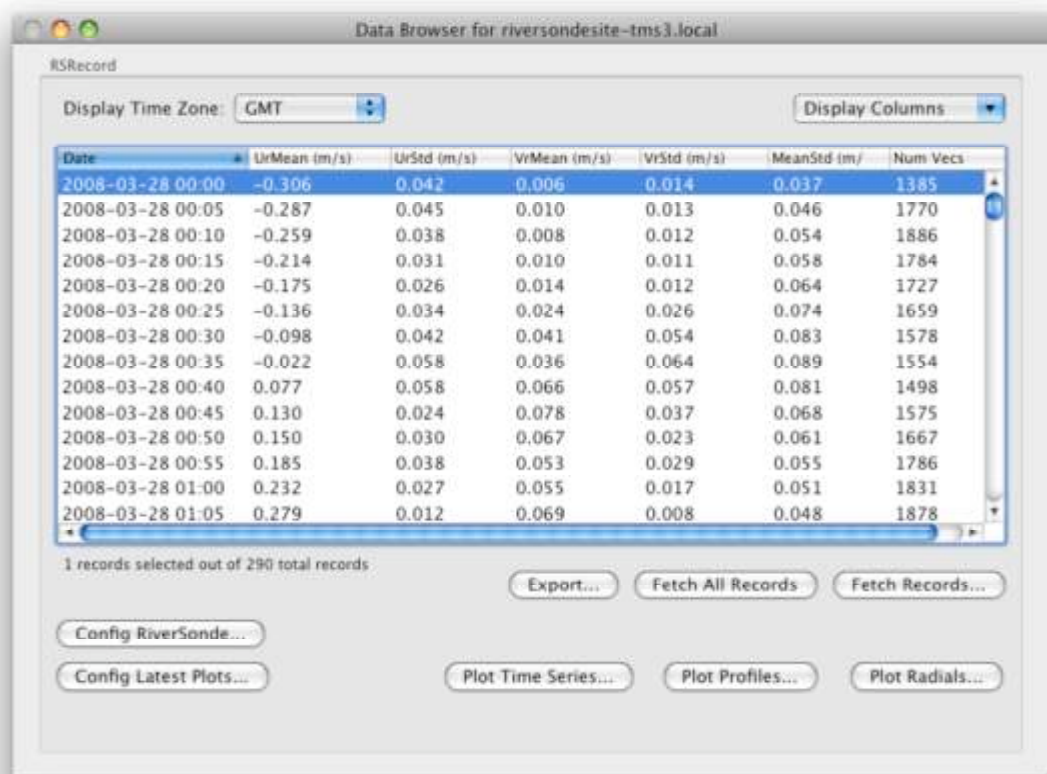
Select the desired node under “Node Name” and “Node Address”. Typically, one node—the local RiverSonde—is available.

The menu to the right of “RiverSonde Node:” holds a history of RiverSonde connections. Click the menu to choose a past connection.

Click the “Connect” button to connect to the selected node and display the Data Browser. Connecting can take as long as two minutes.

RSCommander Data Browser

Browse, sort and select data sets stored on the processor with the Data Browser.



The data shown in the browser are averages over the *averaging interval* set in the “Site identification and basic data processing parameters” configuration dialog. Typically, the averaging interval is 15 minutes. The times of the data sets shown in the browser correspond to the *update interval* set in the same configuration dialog. Typically, the update interval is 5 minutes. The times are set to fall on round-hour boundaries. That is, they contain even-hour times like 7:00 with subsequent times of 7:05, 7:10, etc. Any single entry in the browser shows the averaged data for the averaging interval centered on its time.

The main part of the browser is a table showing data set attributes. The attributes normally displayed are:

Date: the data set’s “averaging center” date and time.

4. Operation and Use

UrMean: the mean along-channel velocity for the data set.

UrStd: the standard deviation of the mean along-channel velocity for the data set.

VrMean: the cross-channel mean velocity for the data set.

VrStd: the standard deviation of the mean cross-channel velocity for the data set.

MeanStd: the mean standard deviation of the data set, a measure of the data set quality. Higher quality data have MeanStds closer to zero.

Num Vecs: the number of raw radial velocity vectors in the data set.

The following data are not measured by the RiverSonde, but can be imported from outside sources. If these data are available and imported, they can be included in the Data Browser window:

Stage: mean river stage (water level with respect to some known datum), if available.

Wind speed: mean wind speed, if available.

Wind: mean wind direction, if available.

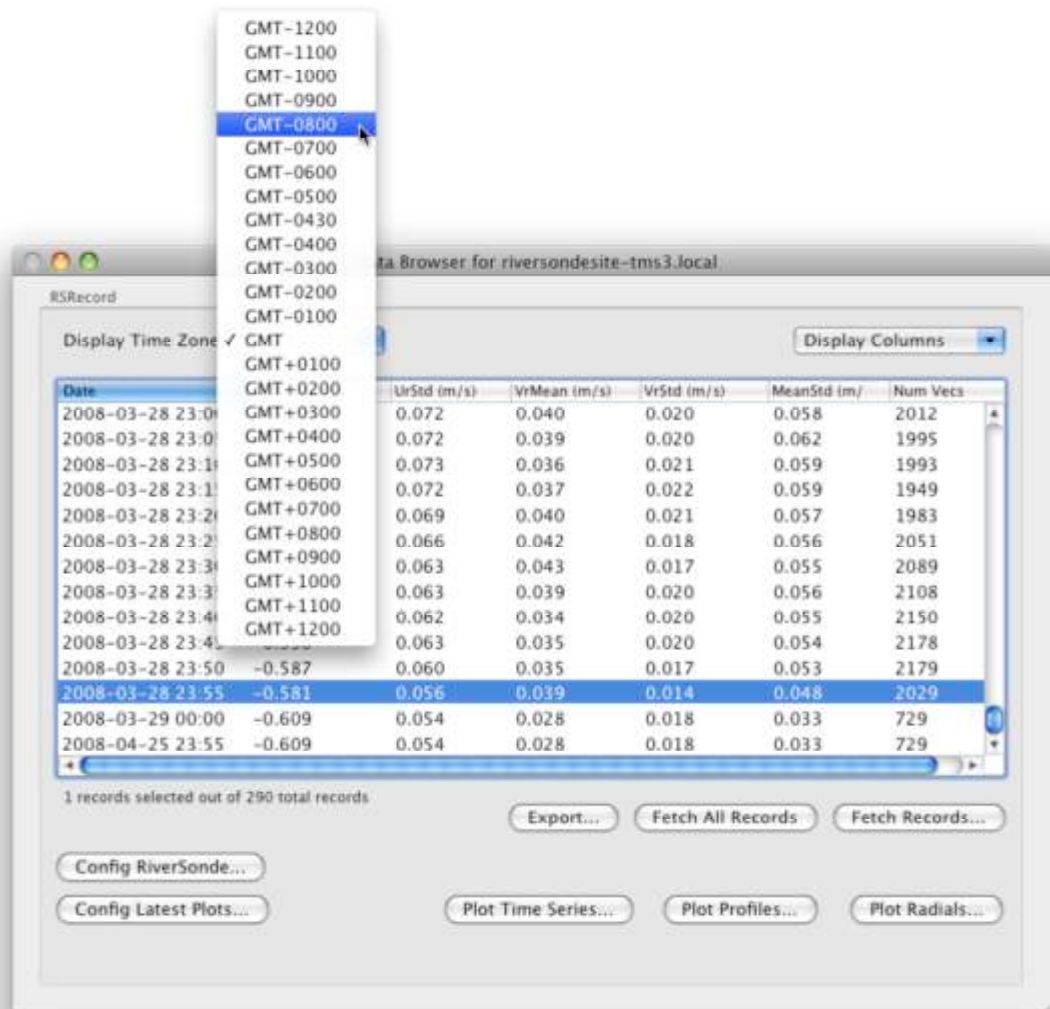
Discharge: mean discharge (volume per unit time), if available.

Configuring the Data Browser

The Data Browser can be configured to suit various needs:

Display Time Zone

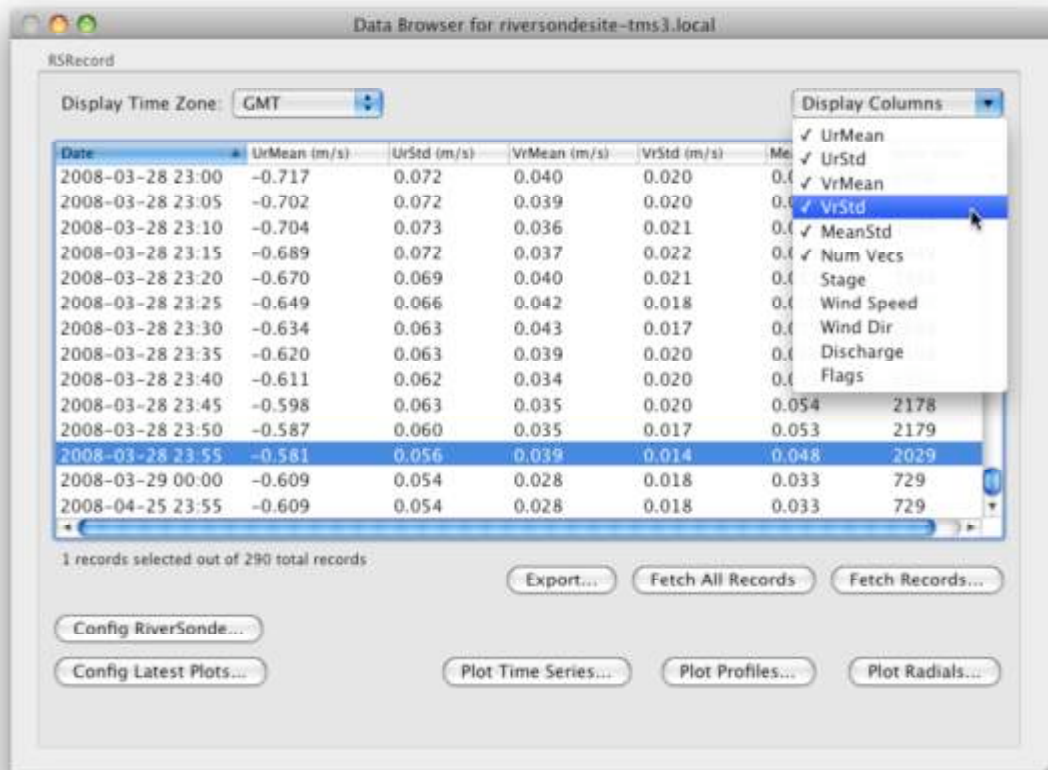
Click the menu next to “Display Time Zone” to display a time zone menu. Choose your preferred time zone.



4. Operation and Use

Display Columns

Click the “Display Columns” menu to choose which attribute columns are displayed in the Data Browser table.



Sort Data Sets by Attribute

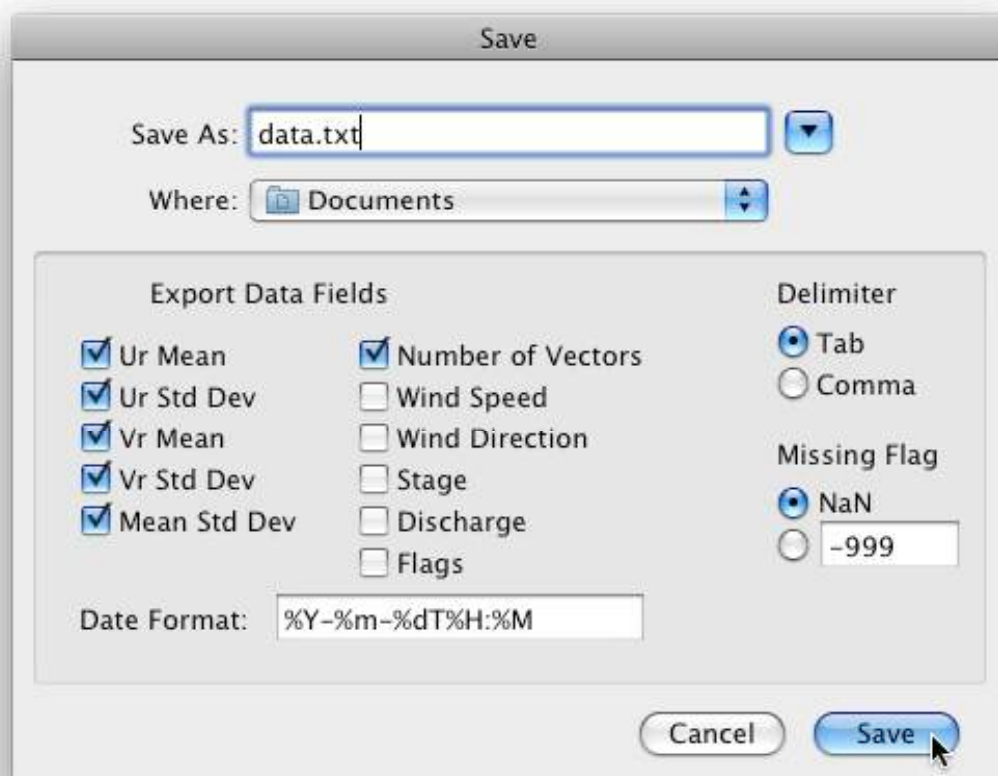
Click a column heading to sort the table. For example, clicking the “Date” column-heading sorts the table by date and time. The selected heading is highlighted. The small triangle on the right side of the column heading indicates ascending or descending sort order. Click the triangle to reverse the sort order. If the triangle “points up,” the column is sorted in ascending order. (Smaller numbers or earlier dates are listed before larger numbers or later dates.). If the triangle “points down,” the column is sorted in descending order.

Select Data Sets

Select data sets from the data attributes table with the trackpad or keyboard. Use normal Macintosh selection techniques. For example, click on an entry to select a single data set or shift-click to select a contiguous group of data sets or ⌘ -click to select discontinuous data sets.

Export Data Set Attributes

Click the “Export...” button to export attributes of all displayed data sets to a plain text file.



Data set attributes are single averages of each data set, not the raw data. See the section “Data Retrieval” for information on how to move raw data sets from the processor to the interface computer. Data set attributes are exported as they are displayed by the Data Browser, including sort order and “Fetch” filters.

Click the checkboxes under “Export Data Fields” to select the attributes you wish to export.

“Date Format” is a date and time formatting code. The default date format, “%Y-%m-%dT%H:%M”, exports dates that look like, “2006-08-25T16:05”¹. See “Date and Time Codes” in Chapter 5, “Reference,” for a list of codes and expansions.

Click a button under “Delimiter” to select a field delimiter (a character placed between each field that indicates the field boundary), either a tab or comma character.

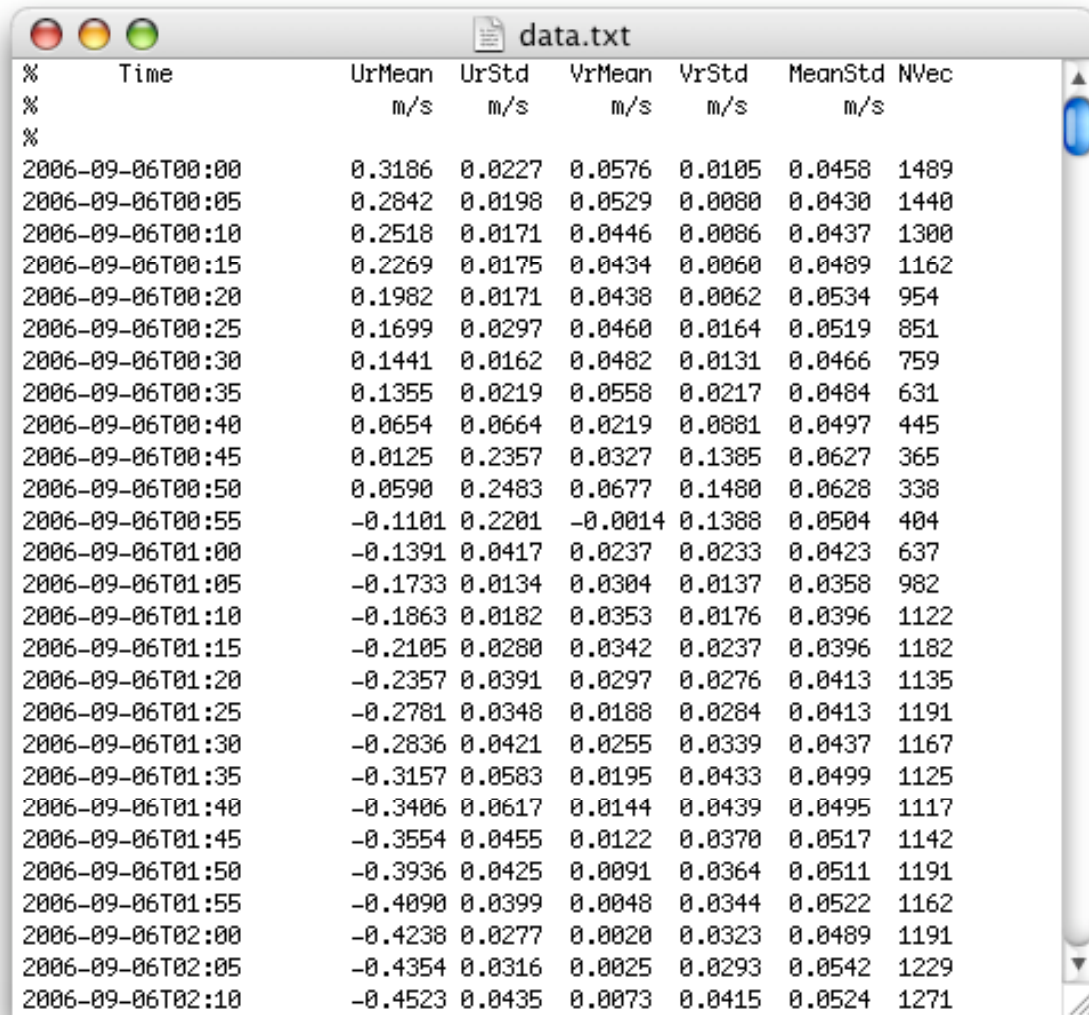
¹ This format is compliant with international standard ISO 8601, “Data elements and interchange formats – Information interchange – Representation of dates and times.”

4. Operation and Use

Click a button under “Missing Flag” to select how to indicate a missing field, either the string “NaN” or a user-supplied “out-of-bounds” number, such as -999.

Select a location for the export file and click the “Save” button to export the data to a file on the Interface Computer.

The example below shows part of an exported data set attributes file.



%	Time	UrMean	UrStd	VrMean	VrStd	MeanStd	NVec
%		m/s	m/s	m/s	m/s	m/s	
%							
	2006-09-06T00:00	0.3186	0.0227	0.0576	0.0105	0.0458	1489
	2006-09-06T00:05	0.2842	0.0198	0.0529	0.0080	0.0430	1440
	2006-09-06T00:10	0.2518	0.0171	0.0446	0.0086	0.0437	1300
	2006-09-06T00:15	0.2269	0.0175	0.0434	0.0060	0.0489	1162
	2006-09-06T00:20	0.1982	0.0171	0.0438	0.0062	0.0534	954
	2006-09-06T00:25	0.1699	0.0297	0.0460	0.0164	0.0519	851
	2006-09-06T00:30	0.1441	0.0162	0.0482	0.0131	0.0466	759
	2006-09-06T00:35	0.1355	0.0219	0.0558	0.0217	0.0484	631
	2006-09-06T00:40	0.0654	0.0664	0.0219	0.0881	0.0497	445
	2006-09-06T00:45	0.0125	0.2357	0.0327	0.1385	0.0627	365
	2006-09-06T00:50	0.0590	0.2483	0.0677	0.1480	0.0628	338
	2006-09-06T00:55	-0.1101	0.2201	-0.0014	0.1388	0.0504	404
	2006-09-06T01:00	-0.1391	0.0417	0.0237	0.0233	0.0423	637
	2006-09-06T01:05	-0.1733	0.0134	0.0304	0.0137	0.0358	982
	2006-09-06T01:10	-0.1863	0.0182	0.0353	0.0176	0.0396	1122
	2006-09-06T01:15	-0.2105	0.0280	0.0342	0.0237	0.0396	1182
	2006-09-06T01:20	-0.2357	0.0391	0.0297	0.0276	0.0413	1135
	2006-09-06T01:25	-0.2781	0.0348	0.0188	0.0284	0.0413	1191
	2006-09-06T01:30	-0.2836	0.0421	0.0255	0.0339	0.0437	1167
	2006-09-06T01:35	-0.3157	0.0583	0.0195	0.0433	0.0499	1125
	2006-09-06T01:40	-0.3406	0.0617	0.0144	0.0439	0.0495	1117
	2006-09-06T01:45	-0.3554	0.0455	0.0122	0.0370	0.0517	1142
	2006-09-06T01:50	-0.3936	0.0425	0.0091	0.0364	0.0511	1191
	2006-09-06T01:55	-0.4090	0.0399	0.0048	0.0344	0.0522	1162
	2006-09-06T02:00	-0.4238	0.0277	0.0020	0.0323	0.0489	1191
	2006-09-06T02:05	-0.4354	0.0316	0.0025	0.0293	0.0542	1229
	2006-09-06T02:10	-0.4523	0.0435	0.0073	0.0415	0.0524	1271

Fetch (Filter) Data Sets

Click the “Fetch Records...” button to filter data set attributes with specified criteria. Enter your selection criteria in the “Fetch Records” dialog.

Minimum Values	Fetch records in database satisfying:	Maximum Values
2008-03-27 08:00	<input checked="" type="checkbox"/> <= Date	<= <input checked="" type="checkbox"/> 2008-03-28 08:00
-0.50	<input type="checkbox"/> <= U Mean	<= <input type="checkbox"/> 0.25
0.00	<input type="checkbox"/> <= U Std Dev	<= <input type="checkbox"/> 0.04
0.00	<input type="checkbox"/> <= V Mean	<= <input type="checkbox"/> 0.50
0.00	<input type="checkbox"/> <= V Std Dev	<= <input type="checkbox"/> 0.25
0.00	<input type="checkbox"/> <= Mean Std Dev	<= <input type="checkbox"/> 0.25
500	<input checked="" type="checkbox"/> <= Number of Vectors	<= <input checked="" type="checkbox"/> 5000
0.00	<input type="checkbox"/> <= Stage	<= <input type="checkbox"/> 10.00
0.00	<input type="checkbox"/> <= Wind Speed	<= <input type="checkbox"/> 30.00
0.00	<input type="checkbox"/> <= Wind Direction	<= <input type="checkbox"/> 360.00
0.00	<input type="checkbox"/> <= Discharge	<= <input type="checkbox"/> 1000.00

☒ And ☐ Or

In the example above, data sets that were created between the dates shown AND that contain the number of vectors in the range shown are fetched.

The fields on the left side of the window are minimum values. The fields on the right side of the window are maximum values.

Select the checkbox next to a field to activate that criterion in your search. If both checkboxes for an item are selected, a finite range is used. If only a left-side checkbox is selected, all data that are greater than or equal to the specified value are returned. If only a right-side checkbox is selected, all data that are less than or equal to the specified value are returned. Combine selections to make precise searches.

Click the “And” or “Or” button to select how the search is performed. “And” is more stringent and returns data sets that each meet all the specified criteria. “Or” is less stringent and returns data sets that meet any of the specified criteria.

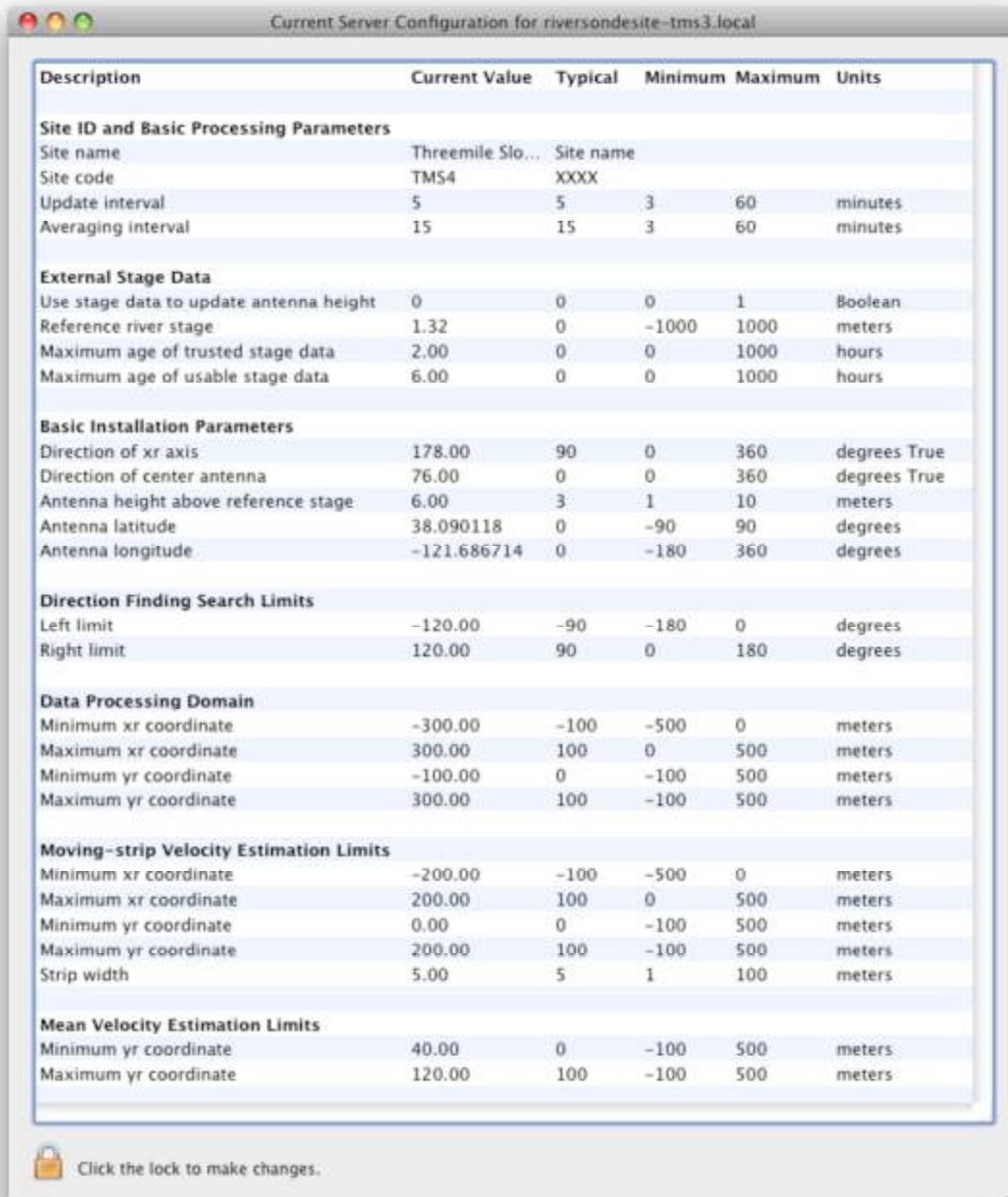
Click the “Fetch” button to display the data sets entries that meet the specified criteria.

Click the “Fetch All Records” button in the Data Browser window to display all data sets unfiltered.


4. Operation and Use

Configure the RiverSonde

Click the “Config RiverSonde...” button to display the RiverSonde configuration. The RiverSonde configuration can be set or re-set for a new operational setting or a new study site. See “RiverSonde Configuration” in the “Set-up” section for a description of configuration steps and parameters.



Description	Current Value	Typical	Minimum	Maximum	Units
Site ID and Basic Processing Parameters					
Site name	Threemile Slo...	Site name			
Site code	TMS4	XXXX			
Update interval	5	5	3	60	minutes
Averaging interval	15	15	3	60	minutes
External Stage Data					
Use stage data to update antenna height	0	0	0	1	Boolean
Reference river stage	1.32	0	-1000	1000	meters
Maximum age of trusted stage data	2.00	0	0	1000	hours
Maximum age of usable stage data	6.00	0	0	1000	hours
Basic Installation Parameters					
Direction of xr axis	178.00	90	0	360	degrees True
Direction of center antenna	76.00	0	0	360	degrees True
Antenna height above reference stage	6.00	3	1	10	meters
Antenna latitude	38.090118	0	-90	90	degrees
Antenna longitude	-121.686714	0	-180	360	degrees
Direction Finding Search Limits					
Left limit	-120.00	-90	-180	0	degrees
Right limit	120.00	90	0	180	degrees
Data Processing Domain					
Minimum xr coordinate	-300.00	-100	-500	0	meters
Maximum xr coordinate	300.00	100	0	500	meters
Minimum yr coordinate	-100.00	0	-100	500	meters
Maximum yr coordinate	300.00	100	-100	500	meters
Moving-strip Velocity Estimation Limits					
Minimum xr coordinate	-200.00	-100	-500	0	meters
Maximum xr coordinate	200.00	100	0	500	meters
Minimum yr coordinate	0.00	0	-100	500	meters
Maximum yr coordinate	200.00	100	-100	500	meters
Strip width	5.00	5	1	100	meters
Mean Velocity Estimation Limits					
Minimum yr coordinate	40.00	0	-100	500	meters
Maximum yr coordinate	120.00	100	-100	500	meters

 Click the lock to make changes.

Plot Velocity Time Series

Time series plots show along-channel and/or cross-channel velocities vs. date and time.

Click the “Plot Time Series...” button to plot a history of along- and/or cross-channel velocities. The “Options for Time Series Plot” dialog appears.

Options for Time Series Plot

Starting Time: 2008-03-25 00:00:00 +0000

Ending Time: 2008-03-28 00:00:00 +0000

Minimum Velocity: -1.00 m/s

Maximum Velocity: 1.00 m/s

☒ Along-Channel Velocity

☒ Standard Deviation

☒ Cross-Channel Velocity

☒ Standard Deviation

Directory: /tmp Choose...

☒ Open plot

Cancel Plot

Set and select time series plot ranges and display parameters. Options are saved between plots, so the next time “Plot Time Series...” is clicked, the saved options for the previous plot are displayed.

Enter or change values for “Starting Time” and “Ending Time” to set the time range of the plot.

Enter or change values for “Minimum Velocity” and “Maximum Velocity” to the velocity range of the plot.

Click the “Along-Channel Velocity” and/or “Cross-Channel Velocity” checkboxes to select or deselect plotting of the corresponding velocities.

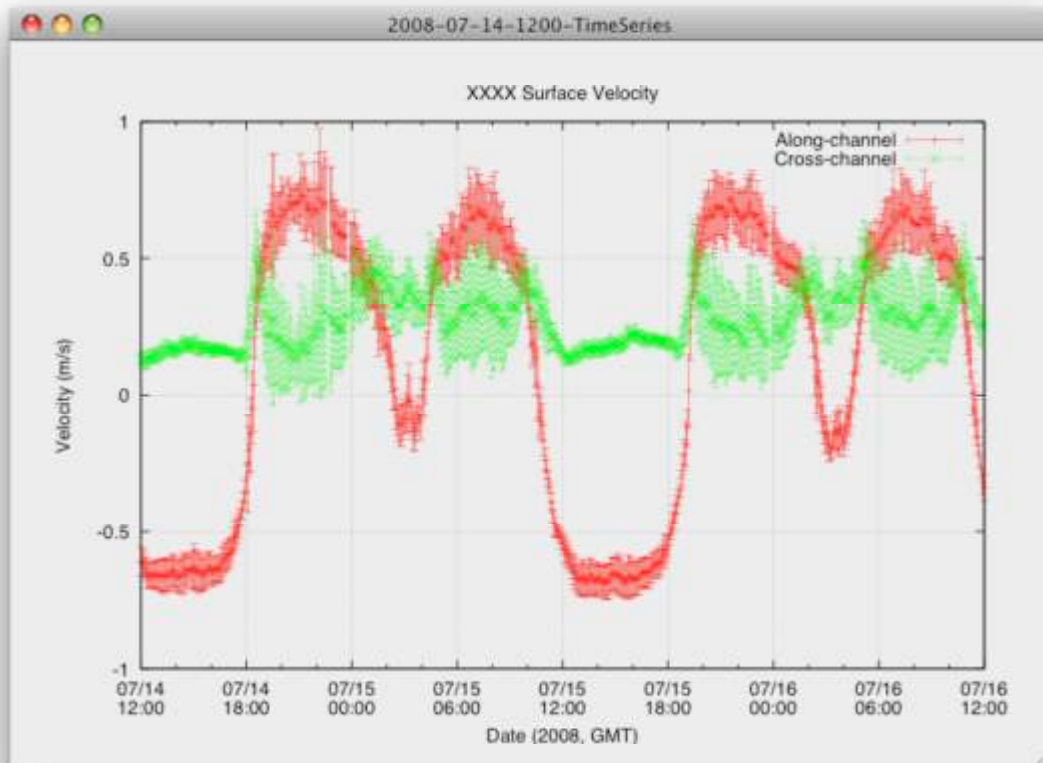
Click the “Standard Deviation” checkboxes to select or deselect the plotting of standard deviation error bars for the corresponding velocities.

4. Operation and Use

Enter a directory where the plot is written or click the “Choose...” button to select a directory. “/tmp” puts the plot in a temporary directory that is emptied regularly; enter /tmp to minimize storage or if you generate plots only for display on the interface computer.

Click the “Open plot” checkbox to select or deselect the display of the plot. Selecting “Open plot” opens the plot in the *RSCOMMANDER* program when the “Plot” button is clicked and saves a copy in the specified directory. Deselecting “Open plot” saves the plot in the specified directory when the “Plot” button is clicked.

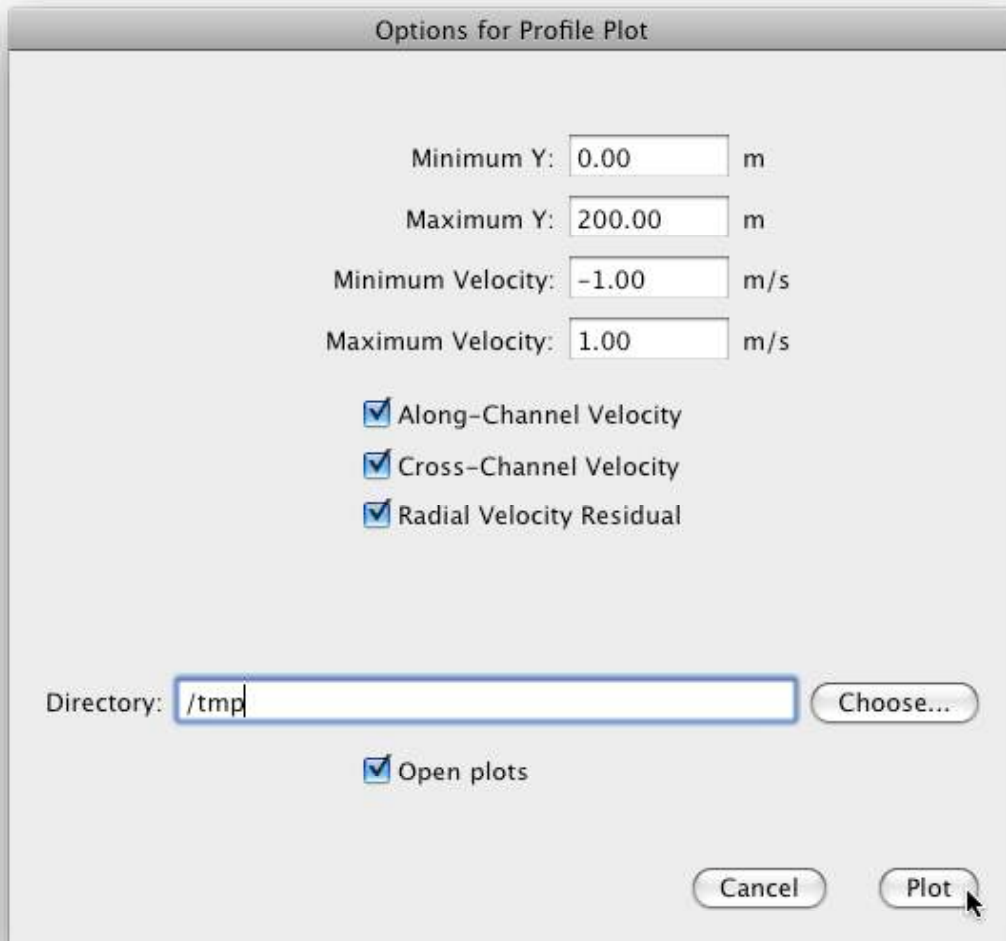
Click the “Plot” button to generate the Time Series Plot with the selected options.



Plot Velocity Profiles

Velocity profile plots show along-channel and/or cross-channel velocities vs. cross-channel distance.

Select one or more data sets and click the “Plot Profiles...” button to plot velocity profiles across the river. The “Options for Profile Plot” dialog appears.



The dialog box titled "Options for Profile Plot" contains the following controls:

- Minimum Y: m
- Maximum Y: m
- Minimum Velocity: m/s
- Maximum Velocity: m/s
- ☒ Along-Channel Velocity
- ☒ Cross-Channel Velocity
- ☒ Radial Velocity Residual
- Directory:
- ☒ Open plots
-

Set and select profile plot ranges and display parameters. Options are saved between plots, so the saved options for the previous plot are initially displayed.

Enter or change values for “Minimum Y” and “Maximum Y” to set the minimum and maximum cross-channel distance shown on the plot. Cross-channel distance is shown on the horizontal axis.

Enter or change values for “Minimum Velocity” and “Maximum Velocity” to set the velocity range of the plot. Velocity is shown on the vertical axis. Positive along-channel velocities are to the right of the antenna when facing the river. Positive cross-channel velocities are away from the antenna when facing the river.

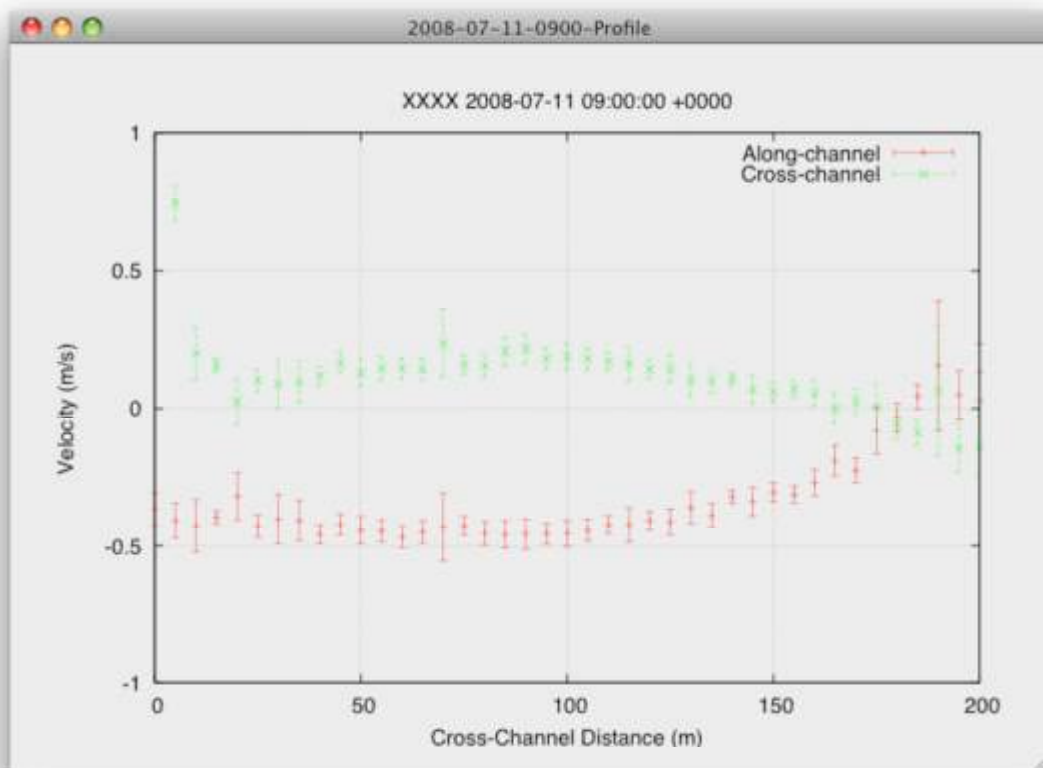
Click the “Along-Channel Velocity,” “Cross-Channel Velocity” and “Radial Velocity Residual” checkboxes to select or deselect the data to plot. “Radial Velocity Residual” is plotted as error bars on the associated along-channel and cross-channel velocity data.

4. Operation and Use

Enter a directory where the plot is written or click the “Choose...” button to select a directory.

Click the “Open plots” checkbox to select or deselect the display of the plots. Selecting “Open plots” opens the plots in the *RSCCommander* program when the “Plot” button is clicked and saves a copy in the specified directory. Deselecting “Open plot” saves the plots in the specified directory when the “Plot” button is clicked.

Click the “Plot” button to generate plots of the selected data sets and options.



Plot Radial Vectors

Radial vectors plots are maps of radial velocity vectors over the river surface.

Select one or more data sets and click the “Plot Radials...” button to plot radial vectors. The “Options for Radial Vectors Plot” dialog appears.

Options for Radial Vectors Plot

Minimum X: -200.00 m

Maximum X: 200.00 m

Minimum Y: -200.00 m

Maximum Y: 200.00 m

Minimum Number of Vectors: 2

Maximum Mean Std Dev: 0.10 m/s

Velocity Scale Factor: 25.00 m/(m/s)

☒ Rotate vectors to geographic coordinates

Directory: /tmp Choose...

☒ Open plots

Cancel Plot

Set and select radial vectors plot ranges and display parameters. Options are saved between plots, so the saved options for the previous plot are initially displayed.

Enter or change values for “Minimum X” and “Maximum X” to set the minimum and maximum along-channel or east-west distances, in meters, shown on the plot. Negative numbers are to the left of the antenna (facing the river) or westward (when “Rotate vectors to geographic coordinates” is selected; see below).

Enter or change values for “Minimum Y” and “Maximum Y” to set the minimum and maximum cross-channel or north-south distances, in meters, shown on the plot. Negative numbers are behind the antenna (facing the river) or southward (when “Rotate vectors to geographic coordinates” is selected; see below).

Enter or change “Minimum Number of Vectors” to set a lower limit to the number of raw vectors needed to generate a plotted average vector. If the number of raw vectors in a range cell is less than this setting, an average vector is not plotted.

4. Operation and Use

Enter or change “Maximum Mean Std Dev” to set a mean standard deviation threshold for which vectors are plotted. If a range cell mean standard deviation exceeds this setting, a vector is not plotted.

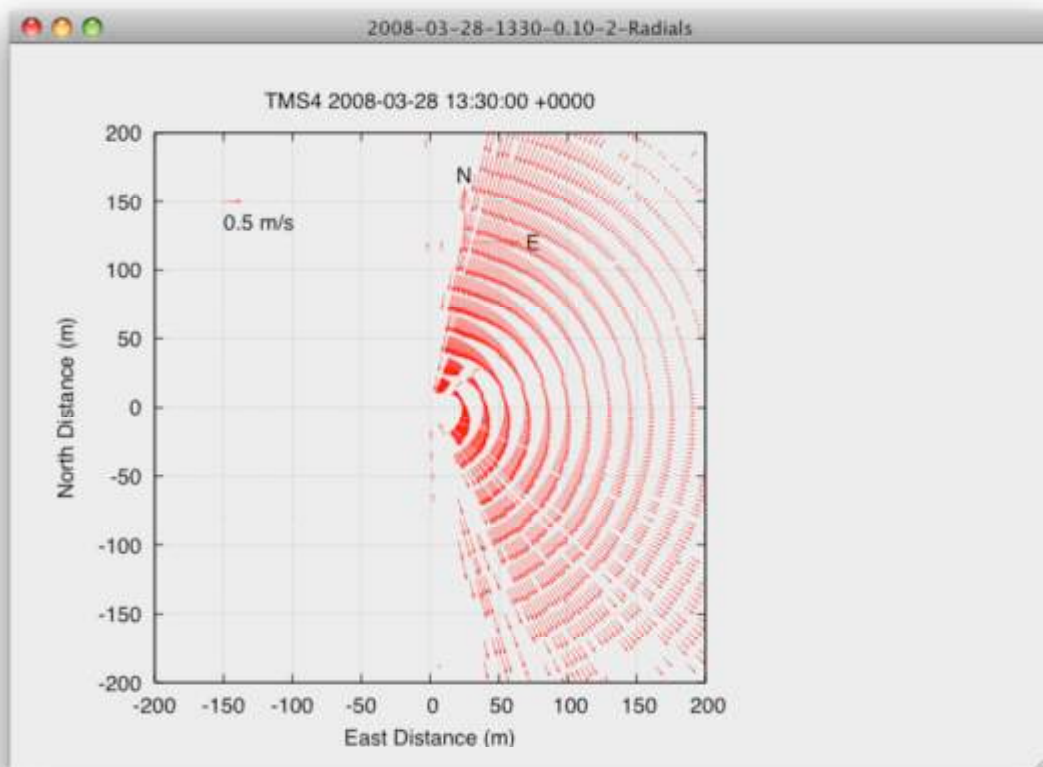
Enter or change “Velocity Scale Factor” to set a scale factor for the plotted velocity vectors. The vectors are scaled to the number of meters entered per m/s of velocity. A larger number plots longer vector arrows. Adjust this setting to minimize vector overlap on the plot.

Click the “Rotate vectors to geographic coordinates” checkbox to select or deselect plotting aligned with geographic coordinates. Selecting this puts north at the top of the plot, like a geographic map, and aligns the plot so that the horizontal (X) axis is east-west. Deselecting this orients the plot so that the horizontal (X) axis is the along-channel direction.

Enter a directory where the plot is written or click the “Choose...” button to select a directory.

Click the “Open plots” checkbox to select or deselect the display of the plot. Selecting “Open plots” opens the plot(s) in the *RSCommander* program when the “Plot” button is clicked and saves a copy in the specified directory. Deselecting “Open plot” saves the plot in the specified directory when the “Plot” button is clicked.

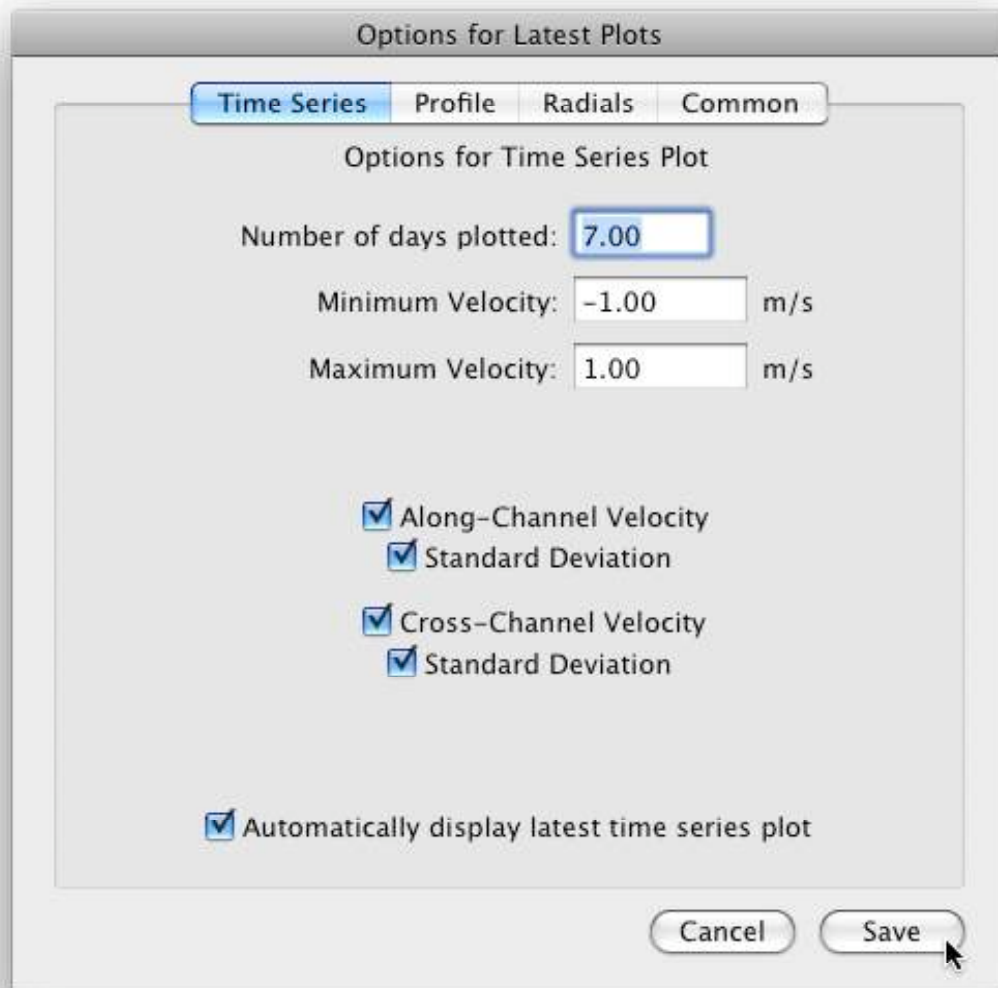
Click the “Plot” button to generate plots for the selected data sets and options.



Configure Latest Plots

“Latest plots” are time series, profile and radial plots of the most recent data set.

Click the “Config Latest Plots...” button to configure the latest plots display. This configuration also applies to the latest plots from the RiverSonde web server. The “Options for Latest Plots” dialog appears. The dialog has tabs for each plot type and a tab for options common to all plot types.



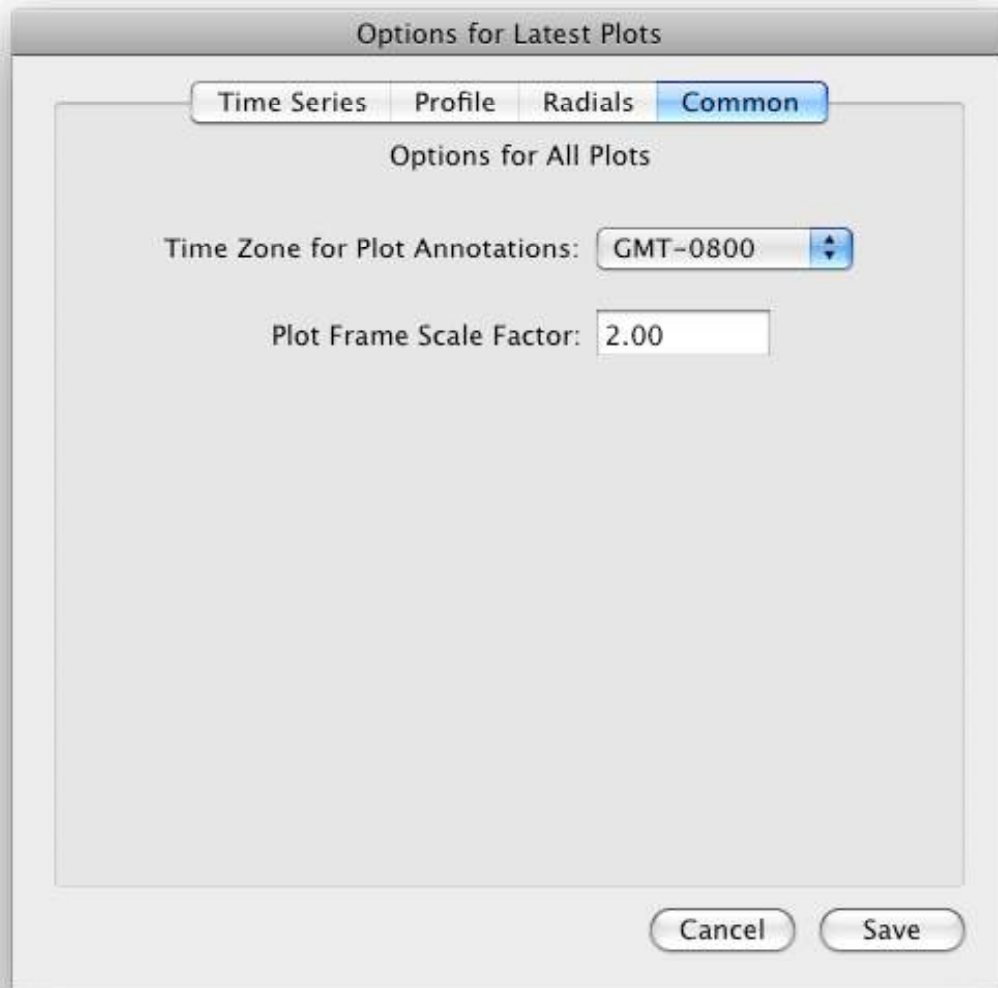
Click the “Time Series” tab. The “Options for Time Series Plot” dialog appears. The options are similar to those described in “Plot Velocity Time Series.”

The “Profile” and “Radial Plots” options are identical to those described in “Plot Velocity Profiles” and “Plot Radial Vectors.”

The “Automatically display latest (type of) plot” checkbox controls whether the latest plots are automatically transferred from the processor. Deselect this when network connections are slow or in other situations where the transfer is not desired.

4. Operation and Use

Click the “Common” tab to set options common to all plots.



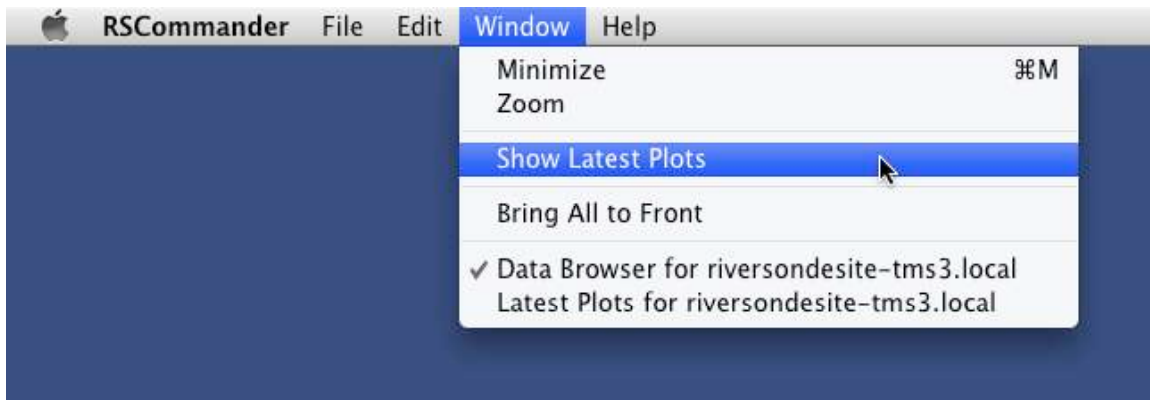
Choose a time zone from the “Time Zone for Plot Annotations” menu to set the time zone shown on plots.

“Plot Frame Scale Factor” sets the relative size of the latest plots window frame. Enter a factor between 1 and 3.

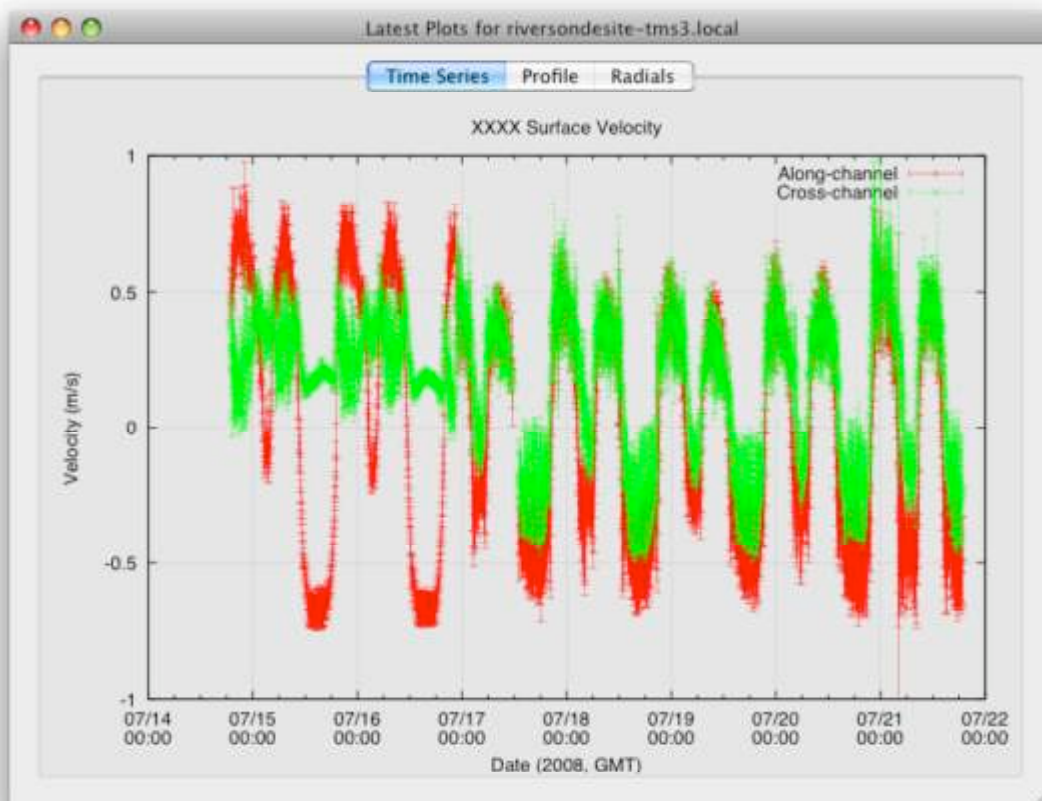
Click the “Save” button to save the options for the latest plots display.

Show Latest Plots

Choose “Show Latest Plots” from the Window menu.



The “Latest Plots” window is displayed.



The Latest Plots window has tabs for the latest time series, profiles and radial plots. Select a tab to see the corresponding plot.

Data Retrieval

Radials, profiles and data attributes are stored in files on the processor.

4. Operation and Use

Radials and profiles data files are retrieved using the interface computer and the *Fugu* file transfer program or the *Safari* web browser. *Fugu* is best for transferring many files.

Data attributes are filtered, sorted and saved to files using the interface computer and *RSCommander*.

Data are stored on the processor. Because the processor's storage space is limited, older data are automatically deleted when the processor's storage capacity is reached. Data must be retrieved and archived regularly if they are to be saved for later review or analysis. Data should be copied to the interface computer at least once per month. The data can then be archived on removable media or another computer system.

A data transfer account name and password provided. Use this name and password for data retrieval activities.

name: xfer

password: holm

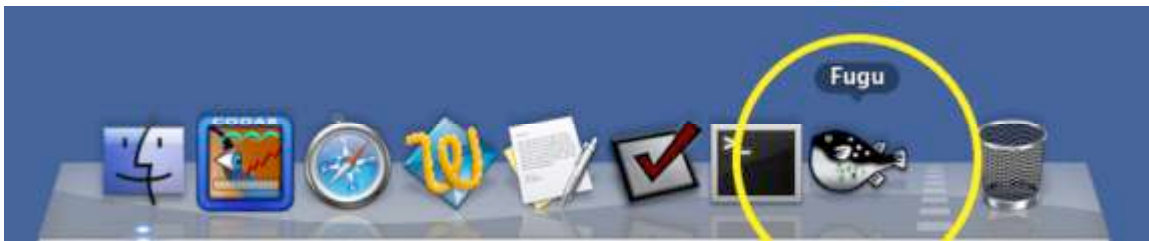
Data Location and Names

Data are stored in the processor's /Codar/RiverSonde/Archives directory. The main river data files are stored in the subdirectories "Radials" and "Profiles." Each subdirectory is organized by site code and date. File names include file type, site code, and date and time information.

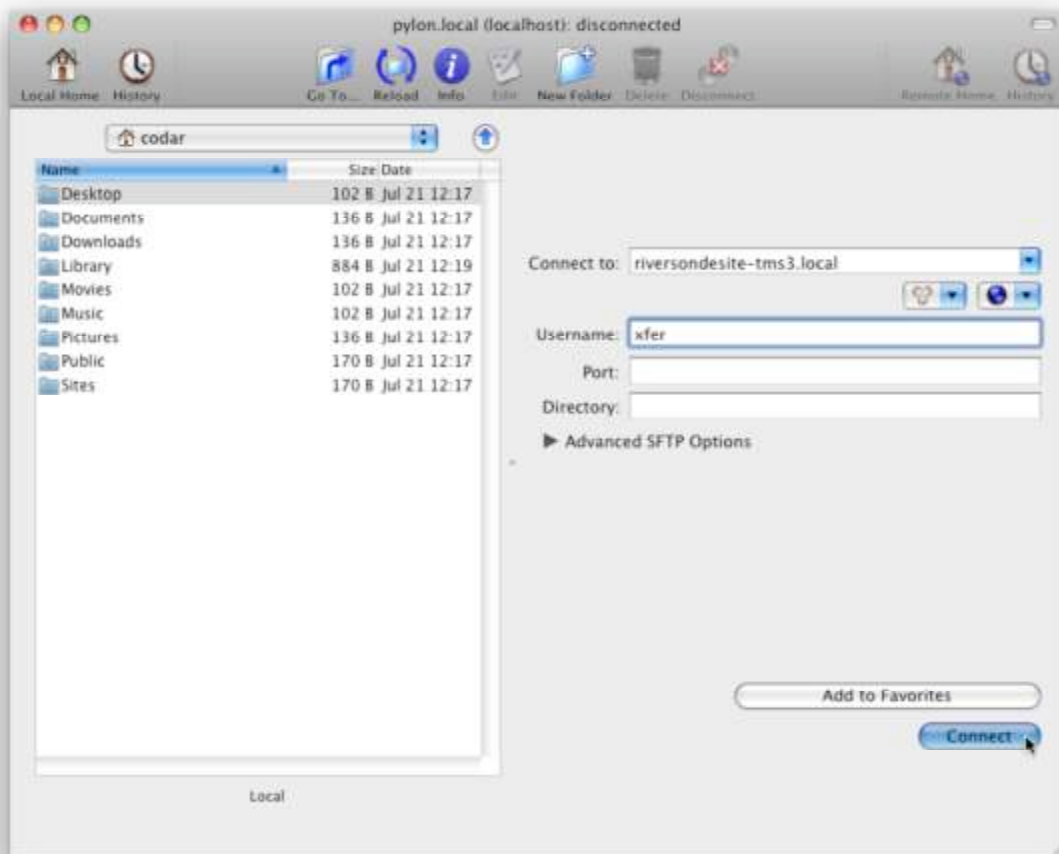
Data Retrieval with *Fugu*

Data retrieval with *Fugu* is the best for routine data retrieval and archiving. Many data files can be selected at one time and transferred.

Click the *Fugu* icon on the Finder Dock.



The *Fugu* window appears.



Enter the processor name, internet domain name or IP address in the “Connect to:” field.

Enter “xfer” in the Username field.

Click the “Connect” button.

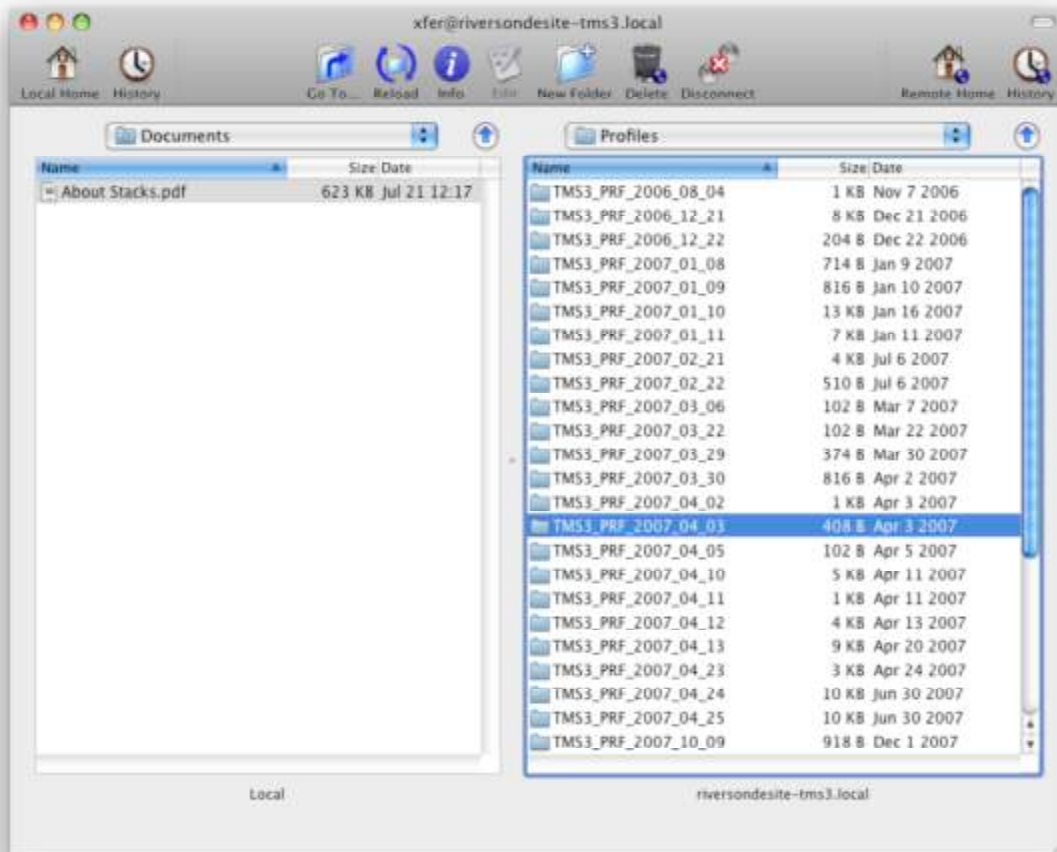
If this is the first time connecting to the processor, you might receive a warning about the processor’s authenticity and asked, “Are you sure you want to continue connecting?”

Click the “Continue” button.

Enter xfer’s password (holm) when prompted.

4. Operation and Use

Click the “Authenticate” button to connect to the processor.



Processor directories and files are listed in the right pane. Interface computer (“local”) directories and files are listed on the left.

Use the lists, menus and buttons to navigate to the desired processor directories. (Recall that data are archived in /Codar/Riversonde/Archives.) Select the desired processor directories and/or files.

Drag the selected items to the interface computer list. The items are copied to the interface computer. This may take several minutes.

Data File Retrieval with *Safari*

Safari is a web browser. Data retrieval with *Safari* is limited. Only one file at a time can be transferred. It may be preferred for obtaining data file lists or by those familiar with web browsers. Recent plots can be viewed with *Safari*.

Click the *Safari* icon on the Finder Dock. It connects to a web server running on the processor. You can enter the processor name, internet domain name or IP address in *Safari*’s Address field.

Enter the transfer name and password when prompted. The processor data directories are listed.



Click a link to navigate to data directories, view and sort data file and directory lists, view data file contents, view recent plots and retrieve individual data files.

5. Reference

In This Chapter

Data Products Description: plot types and formats, data file formats.

Importing External Data: how to import discharge, stage or wind data to RiverSonde data sets.

Date and Time Codes: list of codes and description of expansions.

5.1. Data Products Description

Plots

RiverSonde generates three different data plots:

Radials

A map of radial velocity vectors is plotted. The area surrounding the antenna is divided into a number of cells. A velocity vector is calculated for each cell. The radials plot shows the vector for each cell.

The RiverSonde can directly measure only the velocity component “radial” to the antenna from the signal reflected from the water, meaning those components pointing toward or away from the antenna. Data processing yields directions and distances from the antenna. Combining velocity, direction and distance information yields a field of velocity vectors pointing toward or away from the antenna. This vector field forms the basis for velocity profiles and average velocities shown in profile and time series plots.

Profiles

Along-channel and cross channel mean velocities (m/s) with radial velocity residual error bars vs. cross-channel distance (m) are plotted. The plot covers a single averaging interval centered at the time chosen.

Mean velocities and radial velocity residuals are calculated for a strip of water whose distances and widths are set in the RiverSonde configuration. The number of points plotted depends on the settings. Using the nomenclature in the “Limits for moving strip velocity estimation” configuration dialog, the number of points plotted is: $(ys_{max} - ys_{min})/ystrip$.

Time Series

Along-channel and cross-channel mean velocities (m/s) with standard deviation error bars vs. time are plotted.

Mean velocities and standard deviations are calculated over the averaging interval set in the RiverSonde configuration. Times are spaced over the update interval set in the RiverSonde configuration. The typical configuration displays 15-minute averages at 5-minute intervals.

Latest Plots

Time Series, Profile and Radials plots for the most recent time period are plotted. The data characteristics are the same as those described above.

Data Files

All data files start with a multiple-line header with information about format version, file type, data specification, manufacturer, site, time, geographic location, antenna bearing, measurement units, data processing parameters, data description and data format. Header lines start with a “%” character.

Data files contain data for the *averaging interval* set in the “Site identification and basic data processing parameters” configuration dialog. Typically, the averaging interval is 15 minutes. The interval is centered on the file’s time stamp. So, for the typical averaging interval of 15 minutes, the data spans 7.5 minutes (15/2) prior to and after the time stamp.

Radials Data File Format

Radials data are stored in Longitude-Latitude-UComponent-VComponent (LLUV) format for use with geographic information systems.

Each velocity vector for an averaging interval is characterized by these data:

Longitude (LOND): the geographic longitude of the vector. West of 0 degrees longitude is negative.

Latitude (LATD): the geographic latitude of the vector. South of the equator is negative.

U comp (VELU): the east-west vector component.

V comp (VELV): the north-south vector component.

Flag (FLAG): unused.

X Distance (XDST): the easting component of the distance from the vector to the antenna (i.e., the header item *%Origin*).

Y Distance (YDST): the northing component of the distance from the antenna to the vector.

Range (RNGE): the distance from the vector to the antenna.

Bearing (BEAR): the bearing direction of the vector from the antenna, clockwise from north.

Velocity (VELO): the vector magnitude.

Direction (HEAD): the vector direction, clockwise from north.

Std Dev (STDV): standard deviation of the data used to calculate the vector.

Number of Vectors (NVEC): the number of raw vectors used to calculate the vector.

Profiles Data File Format

Profiles data are stored in a format that is relative to the main channel flow direction. Note that U and V are not the same as for radial data.

Yr Distance (DSYR): the cross-channel distance from the near edge of the data processing domain. (I.e., the *Minimum y Coordinate (ylim1)* set in the “Data processing domain” configuration dialog.)

Ur comp (VLUR): the along-channel velocity component.

Vr comp (VLVR): the cross-channel velocity component.

Std Dev (STDV): the standard deviation of the data used to calculate the velocities.

5.2. Importing External Data

Discharge, stage and wind data can be imported to RiverSonde data sets. To import data, a data file is transferred to the processor. The *RSCoordinator* program reads the file and imports the data. Use Secure File Transfer Protocol (sftp) to transfer files. (E.g., use the *Fugu* program.) Use the data transfer username and password when transferring:

name: xfer

password: holm

Transferred files must be named one of the following:

discharge.txt

stage.txt

wind.txt

Each file must contain the data corresponding to the file name.

The format for each line in each of the files is a time, followed by one or two parameters:

discharge.txt:

time discharge [in m³/s]

stage.txt

time stage [in m]

wind.txt

time wind speed [in m/s] direction [in degrees true]

The time stamp must be in the following format: yyyy-mm-ddThh:mm:ss±hh:mm

“yyyy” is a four-digit year. “mm” is a two-digit month number, e.g., 07 for July. “dd” is a two digit day of the month. “T” is the letter T, which separates the date and time. “hh,” “mm,” “ss” are two-digit hour, minute and seconds, respectively. ±hh:mm is a two-digit hour and minute offset from GMT.

Discharge, stage and wind data can be in integer (e.g., “13”), floating-point (e.g., “27.2”) or exponential (e.g., “2.0E-1”) formats. Data may be enclosed in double quotes.

Times and data must be separated by “white space” (space(s) and/or tab(s)) and/or commas.

Lines beginning with #, % or ! characters are considered comments and ignored.

Use of stage data is subject to the RiverSonde “externally-supplied stage data” settings. See section 3.5, “Configuration,” for a full explanation.

Data files may contain more than one line of data.

Imported data times are rounded to the nearest minute. If you wish to associate external data times with RiverSonde data set times, the times in the data file must be the same (after rounding to the nearest minute, if applicable) as the update interval set in the site identification and basic data processing parameters configuration dialog. The RiverSonde data set times start at 00 minutes and are incremented by the update interval. For example, if the update interval is set to 5 minutes, the times on data sets starting at 07:00 would be: 07:00, 07:05, 07:10, etc. Imported data times not coinciding with RiverSonde data set times are displayed on a separate line, with the imported time and datum.

5.3. Date and Time Codes

Date and time codes can be used format times when exporting data set attributes. The default code, “%Y-%m-%dT%H:%M”, is recommended. Codes are expanded as follows:

- %A is replaced by national representation of the full weekday name.
- %a is replaced by national representation of the abbreviated weekday name.
- %B is replaced by national representation of the full month name.
- %b is replaced by national representation of the abbreviated month name.
- %C is replaced by (year / 100) as decimal number; single digits are preceded by a zero.
- %c is replaced by national representation of time and date.
- %D is equivalent to “%m/%d/%y”.
- %d is replaced by the day of the month as a decimal number (01-31).
- %e is replaced by the day of month as a decimal number (1-31); single digits are preceded by a blank.
- %F is equivalent to “%Y-%m-%d”.
- %G is replaced by a year as a decimal number with century. This year is the one that contains the greater part of the week (Monday as the first day of the week).
- %g is replaced by the same year as in “%G”, but as a decimal number without century (00-99).
- %H is replaced by the hour (24-hour clock) as a decimal number (00-23).
- %h the same as %b.
- %I is replaced by the hour (12-hour clock) as a decimal number (01-12).
- %j is replaced by the day of the year as a decimal number (001-366).

5. Reference

%k	is replaced by the hour (24-hour clock) as a decimal number (0-23); single digits are preceded by a blank.
%l	is replaced by the hour (12-hour clock) as a decimal number (1-12); single digits are preceded by a blank.
%M	is replaced by the minute as a decimal number (00-59).
%m	is replaced by the month as a decimal number (01-12).
%n	is replaced by a newline.
%p	is replaced by national representation of either "ante meridiem" or "post meridiem" as appropriate.
%R	is equivalent to "%H:%M".
%r	is equivalent to "%I:%M:%S %p".
%S	is replaced by the second as a decimal number (00-60).
%T	is equivalent to "%H:%M:%S".
%U	is replaced by the week number of the year (Sunday as the first day of the week) as a decimal number (00-53).
%u	is replaced by the weekday (Monday as the first day of the week) as a decimal number (1-7).
%V	is replaced by the week number of the year (Monday as the first day of the week) as a decimal number (01-53). If the week containing January 1 has four or more days in the new year, then it is week 1; otherwise it is the last week of the previous year, and the next week is week 1.
%v	is equivalent to "%e-%b-%Y".
%W	is replaced by the week number of the year (Monday as the first day of the week) as a decimal number (00-53).
%w	is replaced by the weekday (Sunday as the first day of the week) as a decimal number (0-6).
%X	is replaced by national representation of the time.
%x	is replaced by national representation of the date.
%Y	is replaced by the year with century as a decimal number.
%y	is replaced by the year without century as a decimal number (00-99).
%Z	is replaced by the time zone name.
%z	is replaced by the time zone offset from UTC; a leading plus sign stands for east of UTC, a minus sign for west of UTC, hours and minutes follow with two digits each and no delimiter between them (common form for RFC 822 date headers).
%+	is replaced by national representation of the date and time.
%%	is replaced by '%'.

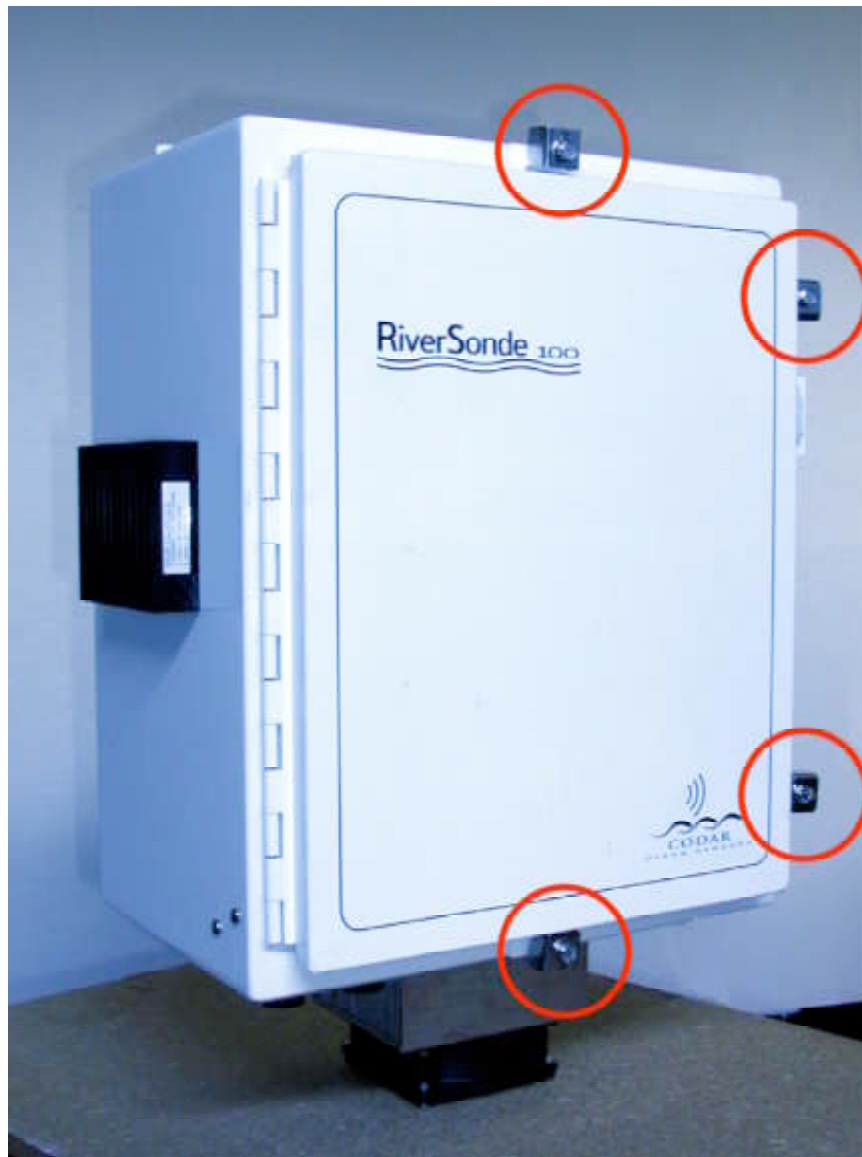
5.4. Enclosure Access

The enclosure can be opened for inspection, repair, replacement, cleaning or other tasks. This section describes how to open and close the enclosure.

The enclosure can be accessed without making any electrical disconnections.

Start by turning off the RiverSonde power.

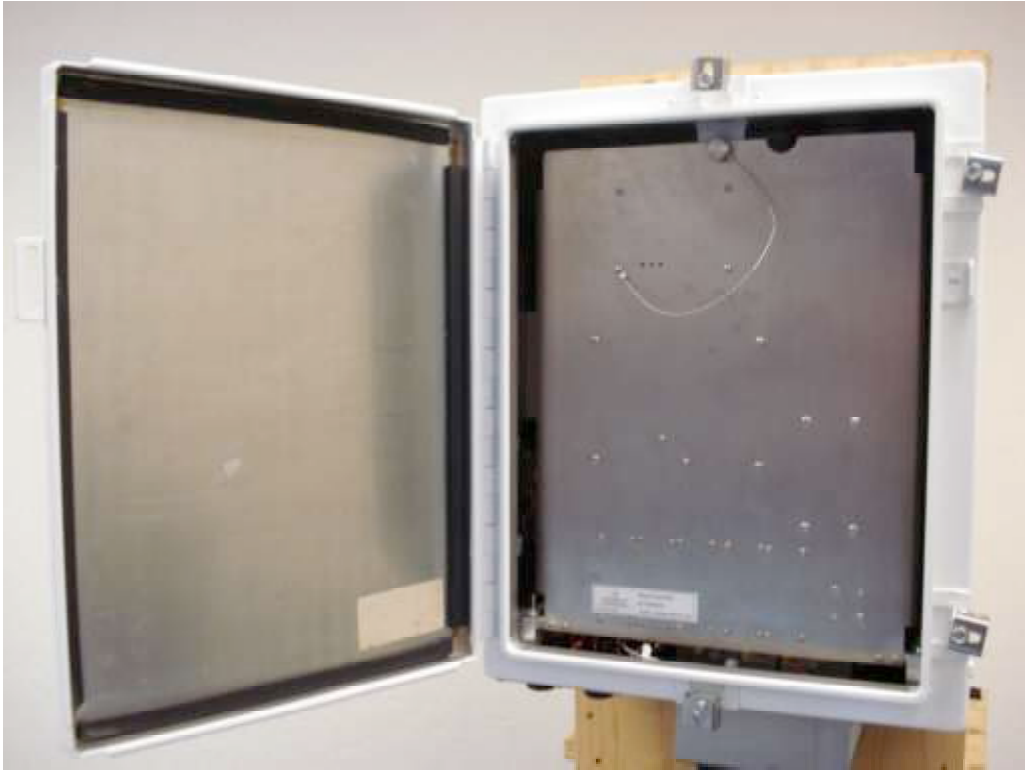
Loosen the screws on the four spring-loaded retainers that hold the door closed. Do not completely remove the screws; loosen them just enough to pull the spring-loaded retainers outward.



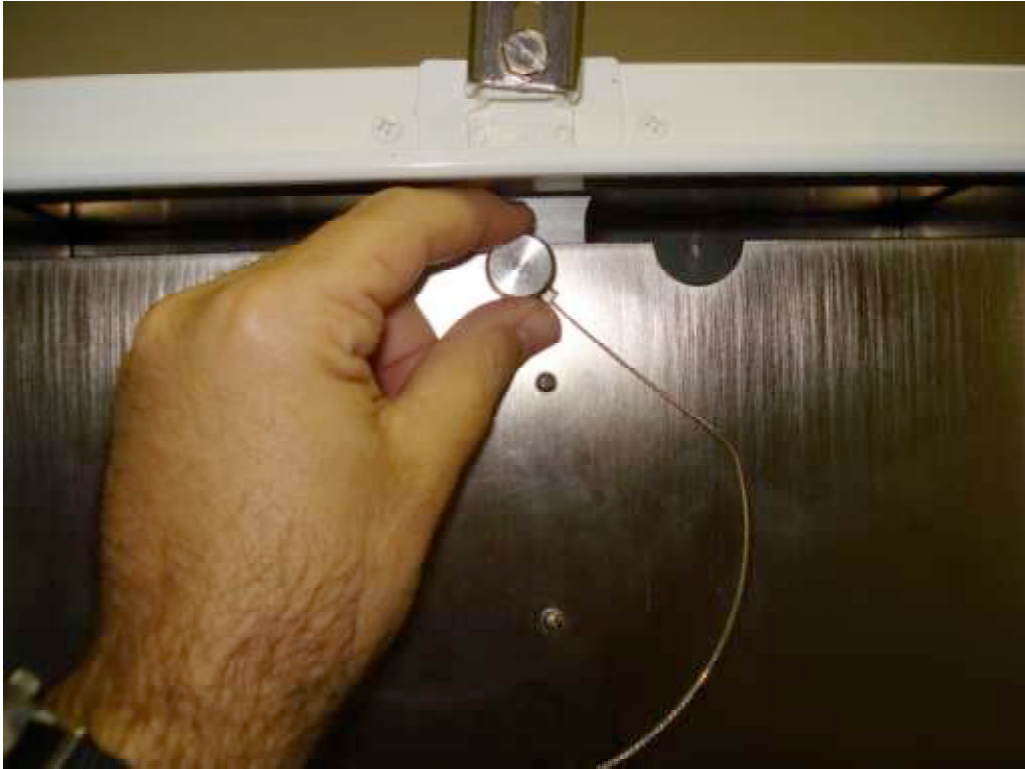
Pull each retainer outward (toward the face of the door), then slide the retainer away from the lip on the door's edge.

5. Reference

Open the door.



There is a retaining thumbscrew captured by a cable at the top of the bracket that holds the electronics. Remove the thumbscrew.



Carefully swing the bracket into its open position.

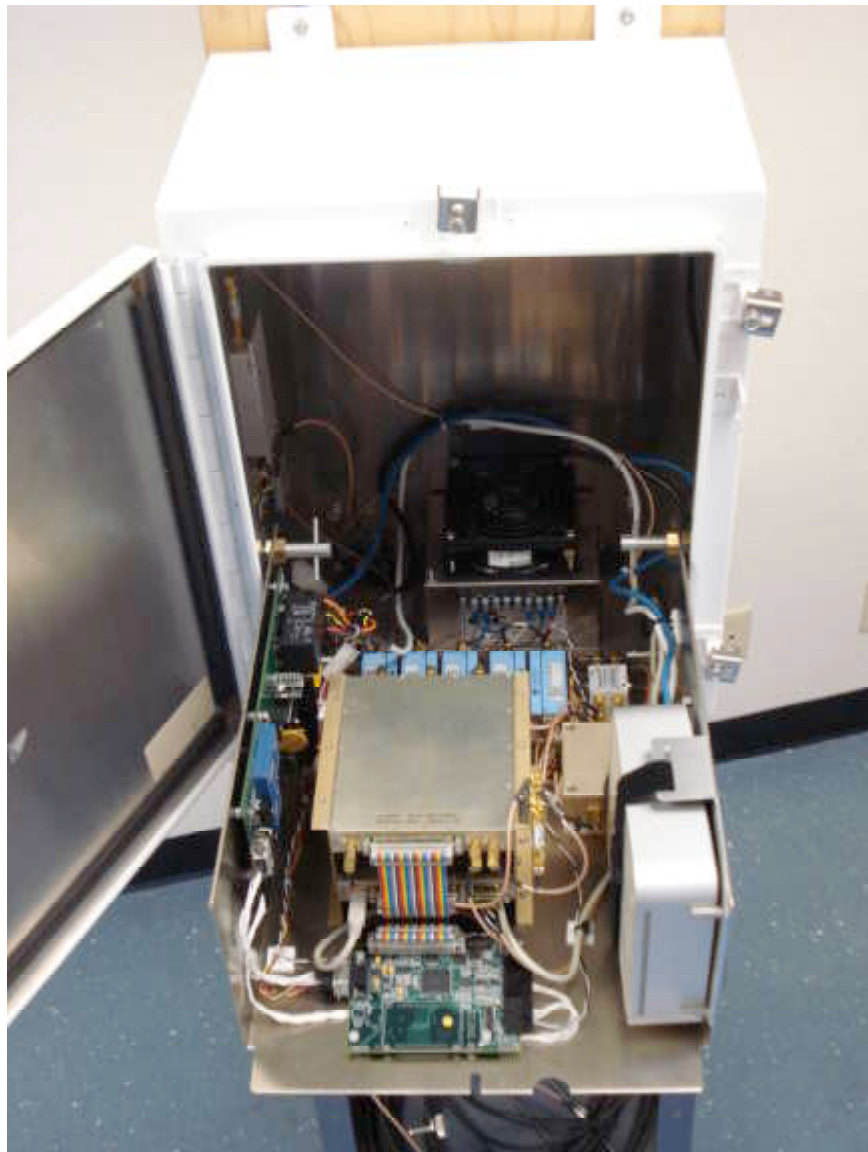


There are two spring plungers at the rear of the bracket (as you face the door). Rotate each spring plunger handle 90 degrees to extract the plunger.

5. Reference



Swing the bracket completely forward. The spring plungers rest against stops in the enclosure.



To close the enclosure, reverse the steps above. Be certain to:

- Retract and lock the spring plungers. Pull the handles toward the center of the enclosure to retract the plungers and rotate the handles 90 degrees to lock the plungers in place.
- Replace the retaining thumbscrew.
- Secure the door retainers. Slide them over the door lip and tighten the screws.

6. Glossary

AC

Abbreviation for alternating current. This type of electrical current alternates its amplitude and direction. It is commonly available in buildings and from large-scale electrical producers.

antenna

One or several conducting elements elevated on a mast that transmit and/or receive the radio signals.

Bragg scatter

The mechanism for scatter from water surface roughness from HF through UHF frequencies. This echo comes from waves half the wavelength, and has unique Doppler properties that allow precise calculation of the underlying flow velocity.

DC

Abbreviation for direct current. This type of electrical current flows in one direction only. Batteries commonly produce it. The RiverSonde power supply converts alternating current to direct current. Direct current powers the transceiver and processor.

Doppler shift

The change in the reflected radio wave frequency due to the velocity of the target/scatterer toward or away from the antenna. The Doppler relation between frequency shift and radial velocity is precisely known.

Ethernet

A widely implemented local-area network protocol. The processor and interface computer communicate using an Ethernet connection.

Finder Dock

Appears at the bottom of the interface computer screen. The Finder Dock contains icons for applications. Click an icon in the dock to open it.

HF

An abbreviation for high frequency. A radio frequency band in the range 3-300 MHz.

node

A computer communication connection point. Connect to a RiverSonde node using the RiverSonde Browser in *RSCommander*. A RiverSonde node has a *name*, usually containing “RSCoordinator,” and an *address*, the network address.

radial velocity vector

The component of the 2-dimensional surface water velocity vector that points toward/away from the radiating antenna.

stage

The height of a river, stream or water channel, measured with respect to a known datum.

TCP/IP

Abbreviation for “Transmission Control Protocol/Internet Protocol.” A computer communication protocol, used to transmit data over networks. TCP/IP is the basis for standard Internet protocols.

time zone

Region of the earth around which local time is measured. There are 24 standard time zones in the world, each offset from Greenwich Mean Time (GMT). Time zone offsets are negative to the west of the Greenwich (0°) longitude and positive to its east. For example, Pacific Standard Time in the United States of America is offset -8 hours from GMT.

transceiver

A device that is capable of both transmitting signals and receiving them.

UHF

An abbreviation for ultra-high frequency. A radio frequency band in the range 300-3000 MHz. RiverSonde's signals are in the UHF band.

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