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OFFICE OF SURFACE WATER TECHNICAL MEMORANDUM 2002.03

SUBJECT: Release of WinRiver Software (version 10.03) for Computing Streamflow from
Acoustic Profiler Data

The purpose of this memorandum is to announce the availability of WinRiver 10.03 for collecting and processing data collected with RD Instruments (RDI) acoustic profilers (Broadband, Rio Grande, Workhorse, and others). The WinRiver software was developed by RDI, in cooperation with the USGS, as a part of a Cooperative Research and Development Agreement (CRADA). The use of WinRiver software by USGS offices was announced in Office of Surface Water Technical Memorandum No. 2000.03.

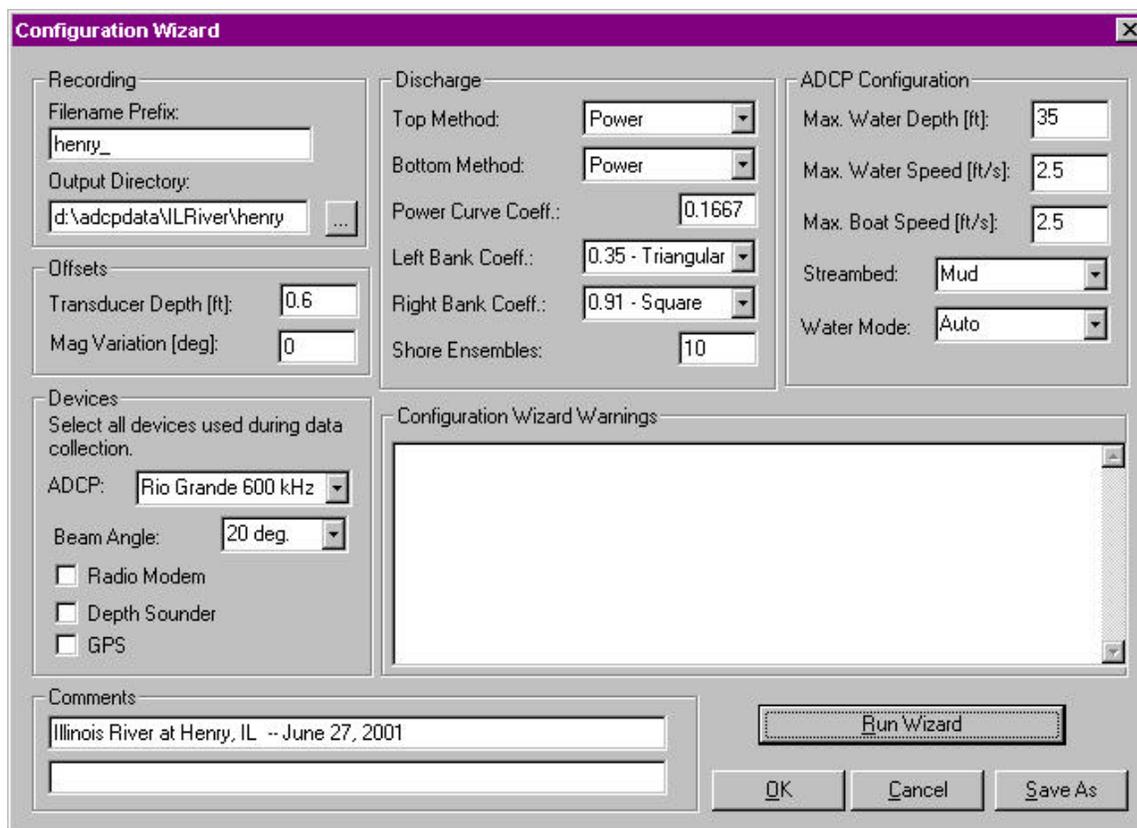
The WinRiver software continues to be updated and improved. Various new features are included in this release of WinRiver and many known problems have been fixed. Lists of new features, changes to existing features, and bugs fixed are provided in Attachment A. At least one known bug remains in WinRiver 10.03. Attachment B documents this bug, as well as two other bugs that appear to have been fixed. All USGS users who collect streamflow data must upgrade to WinRiver 10.03. The latest version of the software is available to USGS personnel who own and use ADCP's manufactured by RDI at <http://hydroacoustics.usgs.gov/downloads/setupex.exe>.

The following sections contain information about two major enhancements in WinRiver 10.03, the addition of a configuration wizard for configuring the ADCP and the addition of data-screening tools. In the following sections, italicized text refers to menu options or buttons in the WinRiver software.

Configuration Wizard

The configuration wizard is a tool that can be used to set up an ADCP for data collection. The goal of the configuration wizard is to guide the user through the ADCP setup process and reduce the need to remember all direct commands. The OSW hopes that the addition of this feature will minimize some of the common mistakes that occur when setting up ADCP's for discharge measurements.

The configuration wizard is invoked in Acquire mode by selecting *Configuration Wizard* under the *Settings* menu or by pressing Shift-F6. An example of the configuration wizard is shown below.



When the *Run Wizard* button is pressed, the wizard verifies that the required fields have been entered by the user and uses these values to generate a configuration file for the measurement. The appropriate direct commands are specified, based on rules supplied by the USGS to RD Instruments, including depth cell size, number of depth cells, ambiguity velocity, and water mode. The wizard also scales the chart properties accordingly based upon the entered values. Although the software has been tested and we are reasonably confident that the configuration wizard will work well, users always should check to make sure that the direct commands are appropriate. In particular, users should pay attention to the Configuration Wizard Warnings generated after running the wizard.

After running the configuration wizard, pressing *Save As* will save the configuration file as a WinRiver configuration file. Pressing *OK* will apply the wizard-generated settings to the currently loaded configuration file. The user then can select *Save* or *Save As* from the *File* menu to save the configuration file. After the configuration wizard window is closed, the configuration file settings created by the wizard can be viewed in the *Configuration Settings* window. The direct commands generated by the configuration wizard are listed under the *Commands* tab of the *Configuration Settings* window in the second column labeled Wizard Commands. Wizard Commands can override Fixed Commands and User Commands can override Wizard Commands.

Data Screening Tools

The capability of WinRiver 10.03 to screen data in software provides a better approach to processing data that should result in more accurate measurement of discharge. Previously all screening was done in the firmware of the ADCP. The new data-screening switches and threshold variables are found in the *Configuration Settings* window, under the *Processing* tab.

The first set of screening tools is for the acceptance or rejection of 3-beam solutions. In the past, users determined whether to allow 3-beam solutions using the EX command. This determination was an irreversible decision that applied to both water-track and bottom track data that had to be made before data collection. With this new screening tool all raw data can be collected by setting the EX command (EX10111) to accept 3-beam solutions (which is now the default in WinRiver) and then accepting or rejecting 3-beam solutions in WinRiver after the user reviews the data. Three-beam solutions often indicate that a fish or other object has interfered with one beam, which can cause the sound reflected by that object to contaminate the neighboring beams. Thus, simply throwing out the bad beam and accepting a 3-beam solution can cause errors in the measured velocity. In most situations, 3-beam solutions should be rejected and the default setting for water-track is to reject 3-beam solutions. The cause of 3-beam solutions in bottom-track data is different and it generally is acceptable to use 3-beam solutions for bottom tracking, and the default setting is to accept 3-beam solutions for bottom tracking.

The next set of screening tools allows the rejection of data in individual bins based on the error velocity and (or) vertical velocity in that bin. Ambiguity errors and areas of highly non-homogeneous flow cause high values in the error and vertical velocity magnitudes. Contour plots of the error or vertical velocity with the appropriate color scale can be used to identify data that obviously are different from the surrounding data. Likewise, time-series plots of the boat speed or water speed, and the stick ship-track plot, can show unreasonable spikes. Prior to the release of this version, no mechanism was available for removing data containing obvious ambiguity errors or data with high error velocities because of non-homogeneous flow. By appropriately setting the error and vertical velocity thresholds, WinRiver 10.03 will mark these data as invalid and compute discharge in these areas from neighboring valid data. By default, the thresholds are set very high, which for practical purposes turns off the screening. Reasonable values for the error velocity thresholds are a function of the standard deviation of the velocity measurement in a single bin, which is dependent on the frequency of the ADCP, the bin size, and the ambiguity velocity setting for mode 1 data. The objective of screening is to reject only the obviously bad data and because the errors are normally distributed, a threshold of 3 to 4 times the standard deviation of the velocity measurement is reasonable (see table 1).

Table 1. Reasonable error velocity thresholds.

[WM refers to the WM command used to set the water mode in RDI profilers. WS refers to the WS command used to set the depth cell size in RDI profilers.]

ADCP Frequency (kHz)	Water Mode [WM]	Depth Cell Size (m) [WS]	Standard Deviation ¹ (ft/sec)	Reasonable Error Velocity Threshold (ft/sec)
300	1	1.00	0.59	1.8
	5	0.20	0.03	0.1
	8	0.20	0.86	2.5
600	1	0.50	0.59	1.8
	5	0.10	0.03	0.1
	8	0.10	0.86	2.5
1200	1	0.25	0.59	1.8
	5	0.10	0.02	0.1
	8	0.10	0.81	2.5

¹ The standard deviation for mode 1 measurements shown in this table are computed assuming a mode 1 ambiguity velocity (WV) of 170 centimeters per second.

Setting the threshold for the vertical velocity is not as straightforward as the error velocity threshold. The vertical velocity threshold only should be used if the user has a reasonable knowledge of the vertical velocities in the measurement section and (or) observes patterns or banding in the vertical velocity contour plot. The vertical velocity threshold then can be set based on the user's judgment to remove obviously erroneous data.

The last screening tool allows users to apply a fish-detection algorithm in the WinRiver software. When using WinRiver, by default, a firmware fish detection algorithm is implemented by sending the direct command, WA50. However, in the WinRiver software users now can select different values for intensity amplitude for detecting and removing data that potentially are contaminated by echoes from fish. This feature has the advantage of collecting all the raw data and screening the data in post-processing rather than having the instrument reject the data based on the configuration setting.

Because screening data by use of these thresholds is a new feature, we expect that guidance regarding their use will change as we gain experience. Additional information regarding the use of thresholds will be made available through the OSW ADCP Web pages (<http://hydroacoustics.usgs.gov/>).

J. Michael Norris
Acting Chief, Office of Surface Water

Attachments (2)

SUPERCEDES OSW TECHNICAL MEMORANDUM NO. 2000.03

Distribution Code: A, B, FO, PO

Attachment A – Changes to WinRiver since release of version 10.01

Features Added

1. Implemented Configuration Wizard.
2. Added near-zone correction for backscatter.
3. Added features to go to a specific ensemble number (Ctrl-Home).
4. In User Options, a field on the Acquire Mode tab was added to enter Terminal Program path (like BBTalk, DumbTerm, or others).
5. Added menu item to execute a Terminal Program from within Acquire Mode.
6. Added F12 key shortcut to toggle display of Discharge History Tabular view.
7. Added F9 key shortcut to toggle display of Ensemble Header Tabular view.
8. Added F11 key shortcut to toggle display of Composite Tabular and Discharge Detail Tabular views.
9. On the Discharge History Tabular window all transects greater than $\pm 5\%$ from the average (based on Total Discharge) now have a red font color.
10. Added 3-beam solutions screening.
11. Added error velocity screening.
12. Added vertical velocity screening.
13. Added capability to screen out data contaminated by fish within with the acoustic beams.
14. Added “Q/Area” to Discharge History Tabular view.
15. Added “Go To Ensemble” feature.
16. Added F8 key shortcut to toggle left/right bank.
17. Added F2 key shortcut to set the Mean Flow Dir. as Projected Angle.
18. Added accelerator character keys in configuration window to allow easier navigation without a pointing device.
19. Subsectioning values are now saved to the configuration file so that when a file is loaded it automatically is subsectioned, if it previously had been subsectioned.
20. Show on status bar that data are averaged (right low corner).
21. Process control bar changes color when a transect has been subsectioned.
22. Generate a warning if $ws*wn < \text{measured depth}$.
23. Ship track plot is no longer frozen while not recording.
24. The user now can set a starting file number for raw data files.
25. CL0 now is added automatically to fixed commands when "===" is selected for break.
26. Added Reset button to reset configuration parameters back to *w.000 parameters.
27. Added checking COM1-COM256 instead of COM1-COM9.

Changes made to existing features

1. Changed behavior for the subsection. If the file is positioned at the end of the subsection and a new selection for “All Ensembles” is made, the file will be reset to the beginning and played to the end.
2. Changed order of the way units were displayed. First selection is “English” units.
3. Changed temperature display on the Standard Tabular view from °C to °F, if English units are selected.
4. Expert parameters in User Options are reset to defaults on exiting the program. Before they were saved to registry.
5. Changed the order of fixed commands to be alphabetical.
6. Changed default for cross-sectional area computation to “Parallel to Average Course”.
7. Changed description on Discharge Detail Tabular view from “Flow Speed” to “Q/Area”.
8. Changed “Shore Pings” to “Shore Ensembles”.
9. Changed default of EX10101 to EX10111 to allow software screening of 3-beam solutions
10. Changed behavior of Recent File Lists – in Playback mode, only rawdata files are shown, in Acquire mode, only configuration files.
11. Changed default maximum number of bins from 128 to 255.
12. Removed Resets page in Acquire mode.
13. Changed default value of shore ensembles to 10 (from 1).

Bugs Fixed

1. Fixed the problem with ASCII out repeating velocity values for invalid data.
2. Fixed problem with Win2K communications.
3. Fixed the problem with calculating backscatter for up-looking data.
4. Fixed problem with bin mapping (bin mapping also was implemented on the ship data, which were bin mapped by the instrument’s software).
5. Changed Depth Sounder scale factor range (Configuration Settings, DS/GPS tab) from 0 – 2 to 0.5 – 1.5. Allowing 0 as a valid entry had caused problems in WinRiver.
6. Fixed problem with displaying of the discharge column on Velocity Tabular view. The data were not averaged if averaging was selected.
7. Fixed the display of “DS Depth” on Navigation and Composite Tabular views.
8. Fixed the implementation of GPS Time Delay.
9. Fixed the problem where the last bin was calculated if the “Cut off bins above side-lobe” was selected and there were bad bins near the side-lobe.
10. Fixed display of fixed commands loaded from w.000 file.
11. Fixed saving of fixed commands to w.000 file (line feeds were missing).

12. Fixed magnetic variation correction for earth data.
13. Fixed the problem with marking below bottom for up-looking data.
14. Fixed problem with calculating average water speed for up-looking data.
15. Fixed some displays for up-looking data.
16. Fixed the problem with Boat Speed Time series view. When bottom reference was set to “none”, the Boat Speed Time series plot did not display the boat speed. If the user sets the bottom reference to “none” – WinRiver will display boat velocity data based on bottom track, providing it is available.
17. Fixed a problem with ASCII-out. If the bottom reference is set to “none” some parameters were still 0 (distance traveled, distance made good, etc.).
18. Fixed ASCII out option. When a user chooses to display velocity *As Received From ADCP*, the velocity now written to the ASCII-Out file is the velocity data as collected by the ADCP. For example, if a user collects data in beam coordinates, the Ascii-Out file created now will contain the radial velocities for each beam.
19. Fixed problem in plots; changing sections would not change tick marks properly.
20. Fixed problem with resetting values in the configuration settings dialog window. If you right clicked and set a new value in a variable, then right clicked to set a new value in another window, the first variable reverted to its original value.
21. Fixed problem when switching between Playback and Acquire configuration information was not saved automatically.
22. Fixed zoom feature, which would reset after each new ensemble.
23. Fixed the behavior of Configuration Settings property pages during Acquire (it use to gray out during Acquire).

Attachment B – Known/Possible Bugs with WinRiver Version 10.03

1. Some users have reported that WinRiver will sporadically enter into an infinite loop. We believe that this bug has been fixed. However, if anyone does experience this problem, please contact Kevin Oberg (kaoberg@usgs.gov) or Dave Mueller (dmueller@usgs.gov) to report the problem. The bug does not affect the computations and only is an occasional problem.
2. Some users have reported problems with printing color plots from WinRiver. The resulting plots were printed in gray scale even on color printers. For the present, the software has been set to default to a color plot (as opposed to a grayscale plot). This change seems to have fixed the problem for color printers at present. Again, if you observe more problems, please contact Kevin Oberg or Dave Mueller. In general, we suggest that users copy the plots of interest into a word-processing package, such as Microsoft Word, and print the plots from that package. This procedure usually eliminates any problems in printing, and it allows the user to adjust the size of the plots, etc.
3. The correction of the bug identified in Attachment A, Bugs Fixed, number 9 could result in some minor changes in discharge when transects are played back in version 10.03.