SonTek RiverSurveyor® M9 & S5

All New River Discharge Measurement System

Jan 2009

SonTek
YSI incorporated

What is new?

- New Doppler engine
- New transducer configurations
- New multiple frequency configurations
- New automated cell-size switching and signal processing
- New housings and power-communications modules
- New PC and mobile software
- New high-resolution GPS options
- New floating platform

New S5 & M9 Acoustic Doppler Profilers

- Significantly faster ping rates (3-4x) - robust and accurate measurements.
- Integrated multiple acoustic frequencies
- Integrated acoustic vertical beam transducers – for depth.
- Pulse-Coherent and Narrowband – transitions automatically.
- Internal recorder (8 Gb) - Discharge processing and data storage is done inside the ADP – not in software – faster sampling rates and no data lost to telemetry drops.
- Increased Processing Power for discharge calculations, real-time data quality checking, on-line summary tables, etc…
- Dramatically improved bottom tracking resolution and precision (3-4x more BT samples/second)

RiverSurveyor S5 & M9 Enhancements for the user

- Easier to use than ever – push-button setup, intuitive interface, limited programming.
- Cell-size, depth range, and sampling frequencies automatically adjust to changing river conditions for optimized performance.
- Superior ability for shallow-to-deep depth transitions – automatically
- Improved channel definition and area calculations with vertical beam
- More robust – higher sampling rates and real-time quality checking
- High-resolution GPS for bathymetric surveying and moving bottom

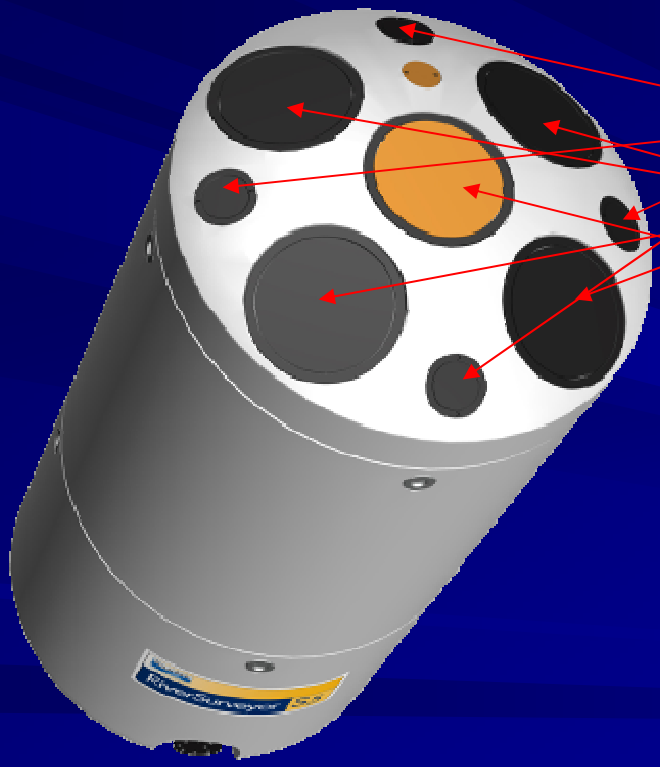
RiverSurveyor
"S5" Shallow range system

- 5 beams, dual frequency
  - 4 beam Janus for velocity (3.0Mhz)
  - 1 centered vertical beam (1.0 MHz)
- Velocity profiling range (0.06 m to 5.0 m*)
- Vertical beam range (0.2 – 15 m)
- Discharge Measurement Range
  - 0.3 to 5m referencing bottom tracking
  - 0.3 to 15 m referencing GPS
- 2.4" diameter transducer housing
  - Minimizes flow disturbance

** Maximum profiling range can vary depending on conditions*

RiverSurveyor

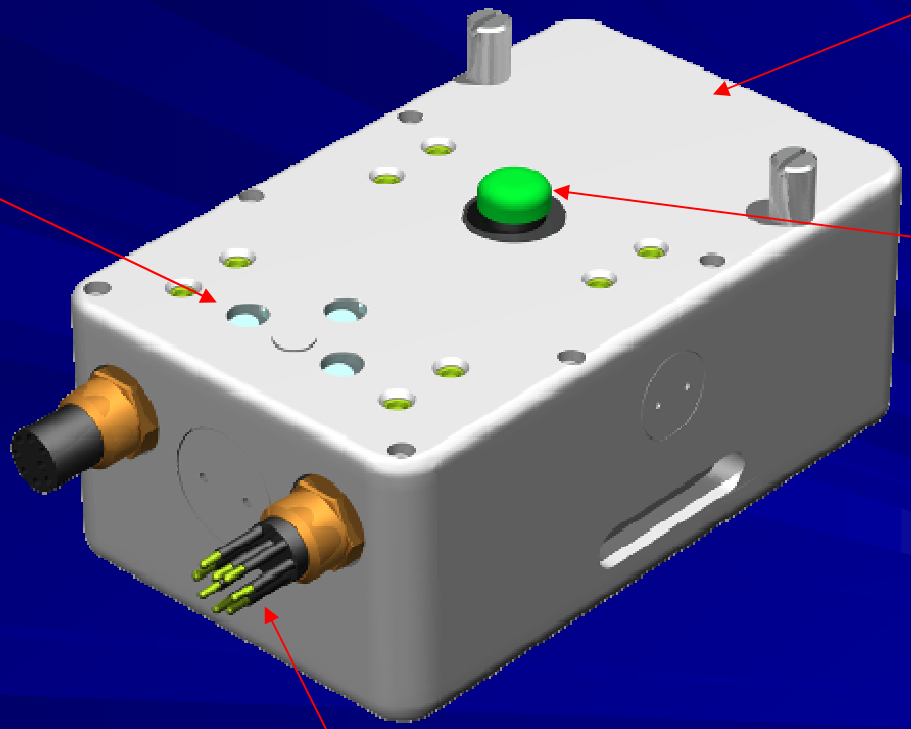
“M9” Mid-Range system



- 9 beams, tri-frequency, dual Janus array
  - 4 beam Janus for velocity (3.0Mhz)
  - 4 beam Janus for velocity (1.0 MHz)
  - 1 vertical beam (0.5 MHz)
- Velocity profiling range (0.06 m – 30.0 m*)
- Vertical beam range (80m)
- Discharge measurement range
  - 0.3 to 30m referencing bottom-track
  - 0.3 to 80 m referencing GPS

* Max profiling range can vary depending on conditions

Power & Communications Module (PCM)



Battery Compartment

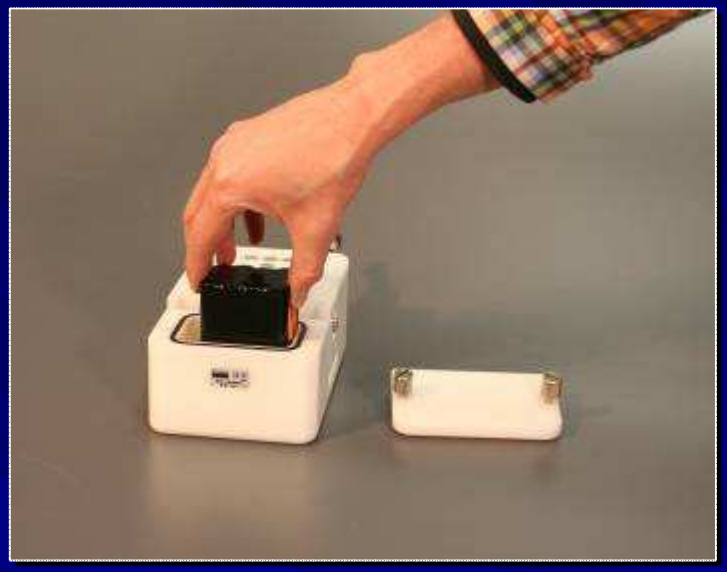
System/status lights

On/off button (w status light)

Connector to power/com cable or dummy plug

Connector to M9/S5

Power & Communications Module

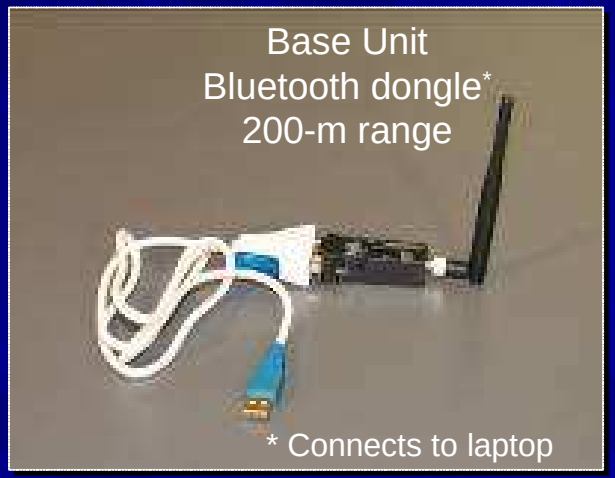


- Drop-in replaceable/rechargeable 18v battery packs
- Battery charger
- Bluetooth or FreeWave 900-Mhz Communications
- Internal antennas
- Wet-mate connections
- 10-m cable and AC power supply for direct reading and external power

Modules are fully independent of frequency and can be used with M9 or S5

Power and Communication Module (PCM) Telemetry Configurations

- Rover PCM and corresponding Base unit are matched and configured at factory
- No possibility for data drops – internal ADP calculations and processing

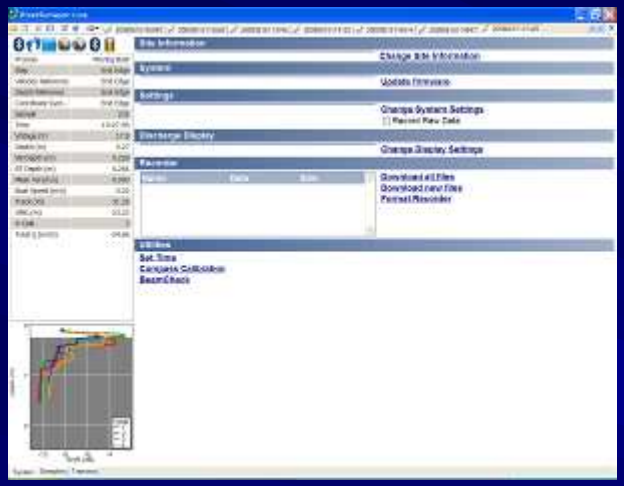


RiverSurveyor Live!
PC software

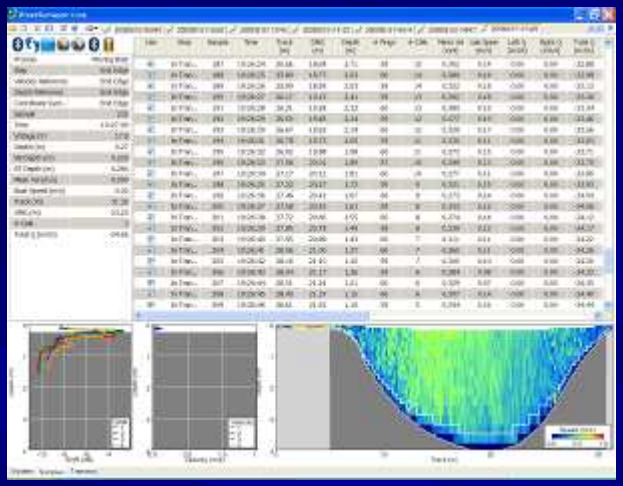
- All new look and simplified operation.
- Initial release supports moving-boat calculations.
- Subsequent release will support stationary.
- GIS shape files displayed in UTM coordinates.
- Automatic report and summary tables.
- MATLAB and ASCII export functions.
- Simultaneous velocity/depth reference display.

RiverSurveyor Live! Software

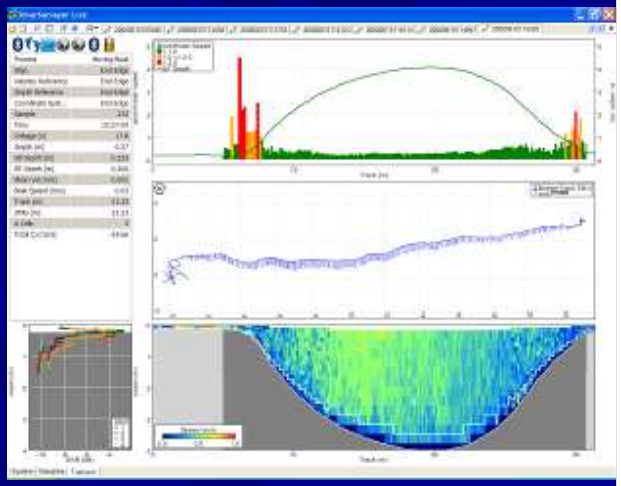
- 5 Primary Software Function Tabs:



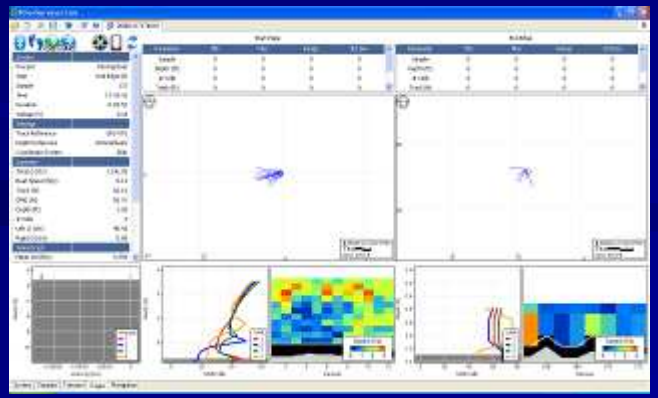
System Setup Tab



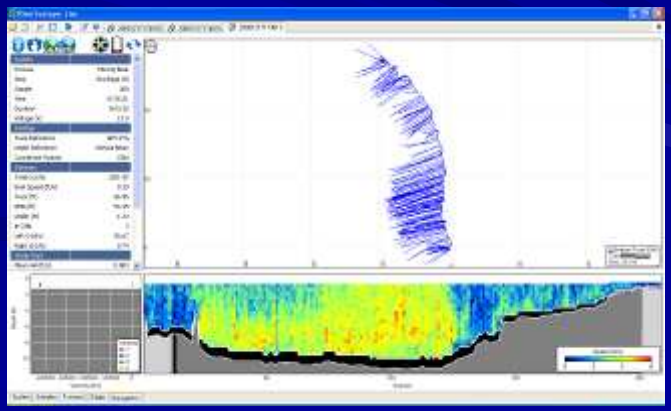
Samples Tab



Transect Tab



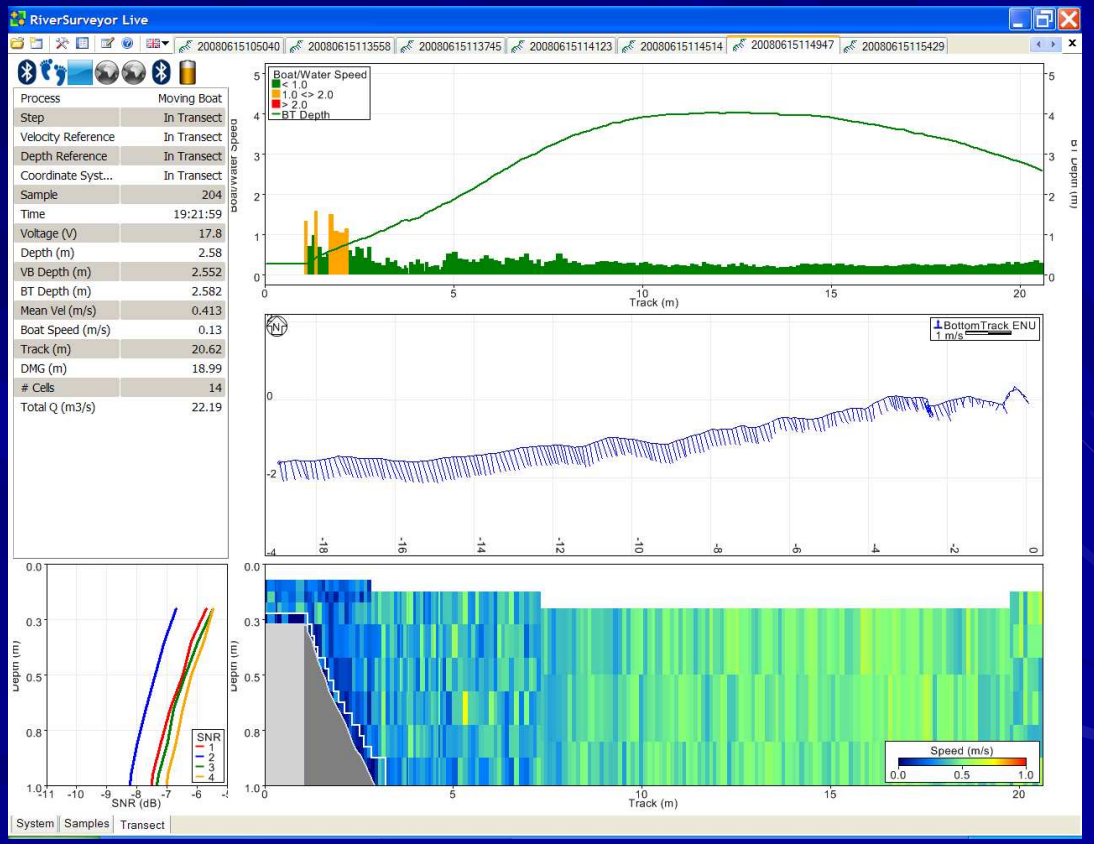
Edge Section Tab



Navigation Tab (GIS)

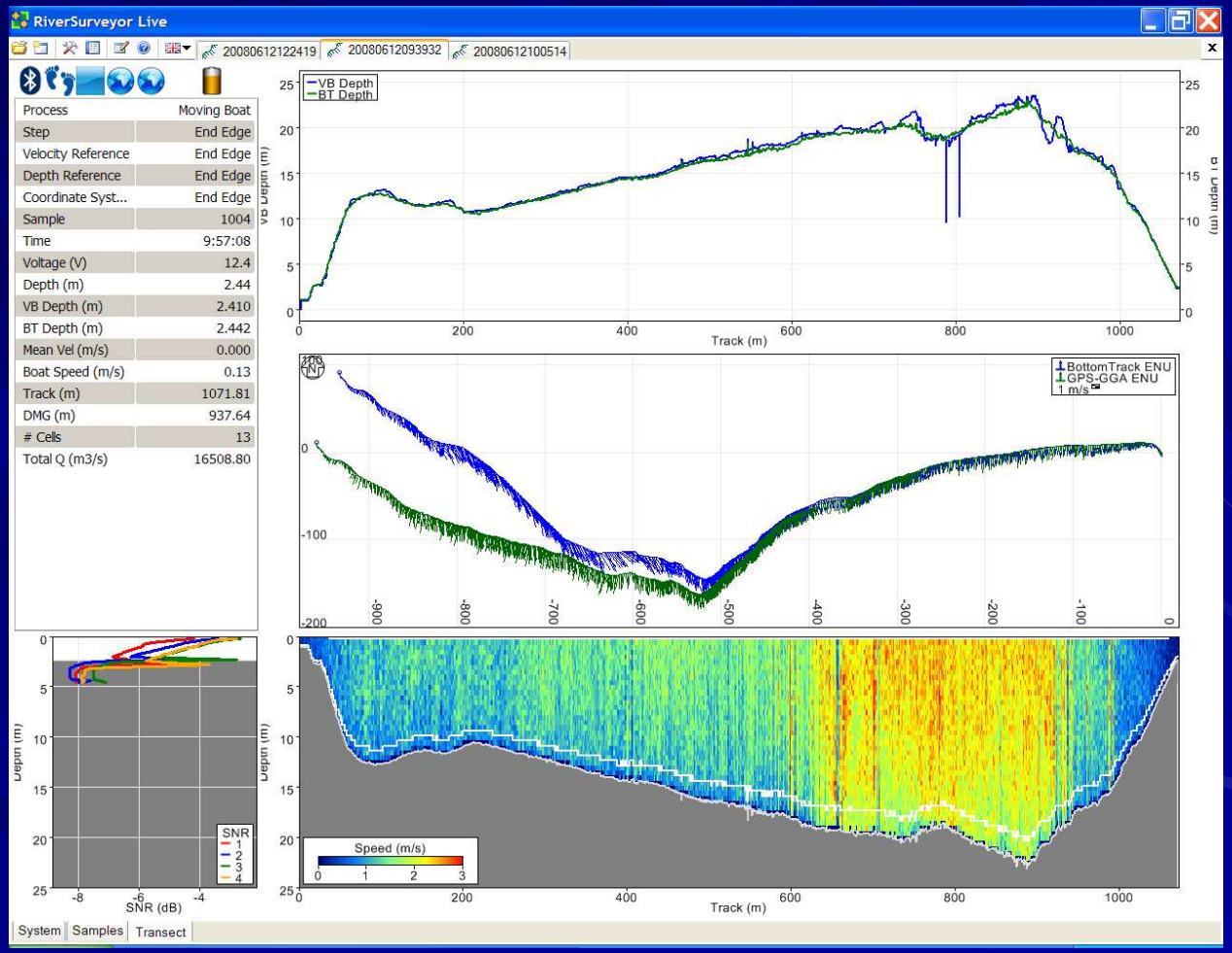
Live! Software – Full Auto Discharge Measurements

- Automatic velocity cell size adjustment – maximizes resolution in shallow depths and increases maximum depth range of system.
- Automatic adjustment between pulse-coherent and narrowband - optimizes overall performance.
- Automatic adjustment between high and low frequency acoustic transducers – optimizes overall performance and increase operational range.



RiverSurveyor Live!

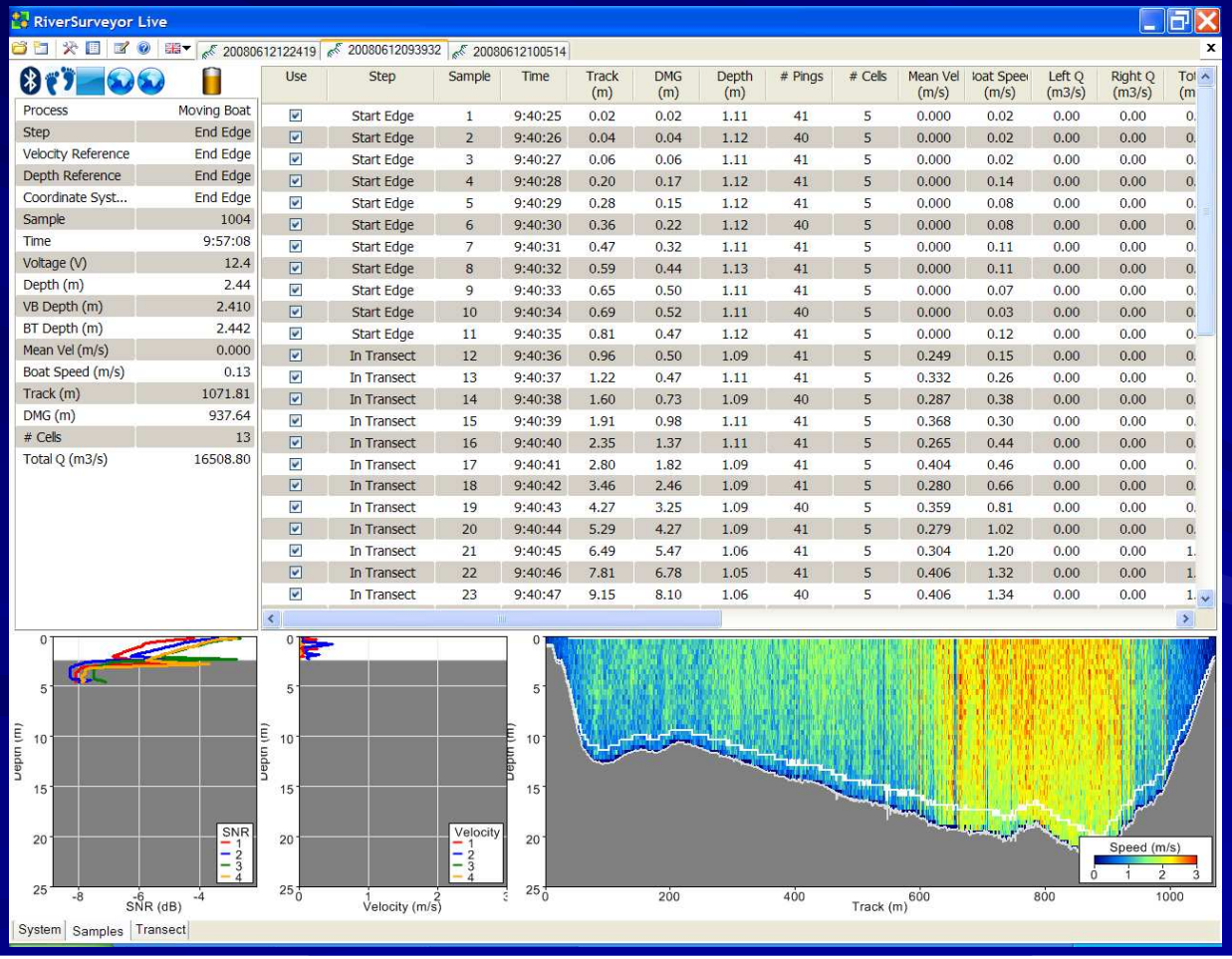
- M9 w/Bluetooth and RTK GPS
- RTK and BT Reference Track
- Vertical Beam and BT Depth plot
- Contour Plot Shows Transitions



Mississippi River

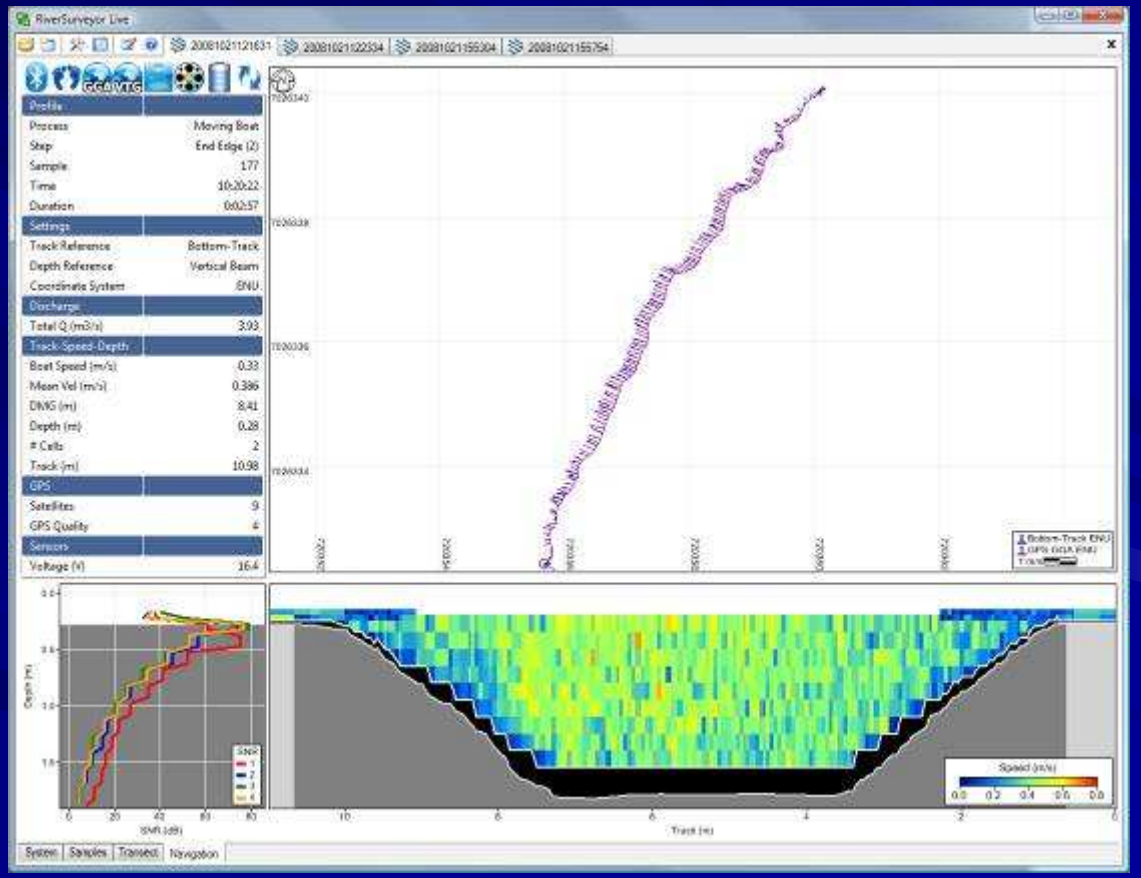
RiverSurveyor Live!

- Independent data sampling – every sample can stand on its own
- Start/End edge profiles differentiated from “Transect” profiles



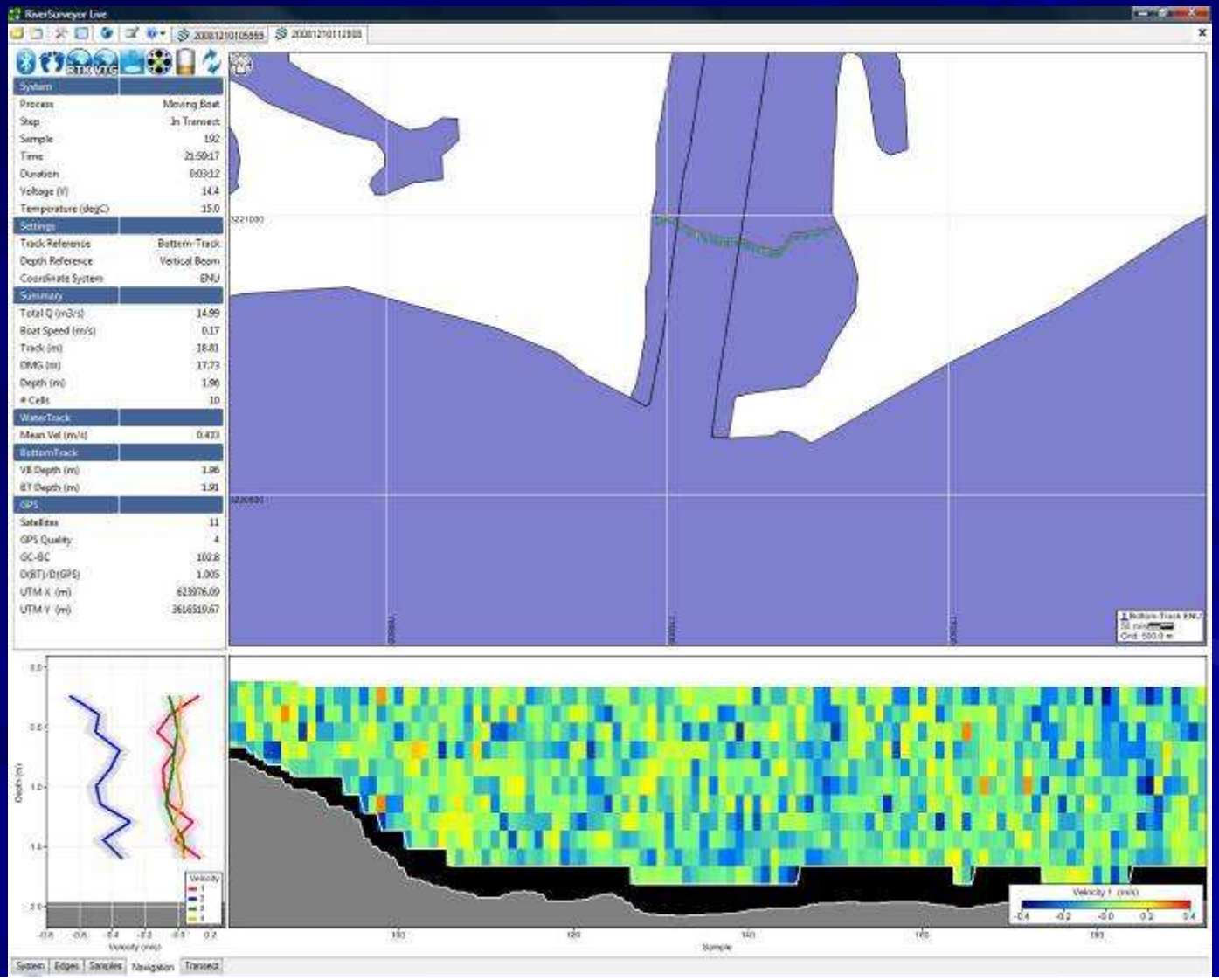
RiverSurveyor Live!

- Vertical bean enables superior channel definition vs 3 or 4 beam average
- This is most evident in trapezoidal canals

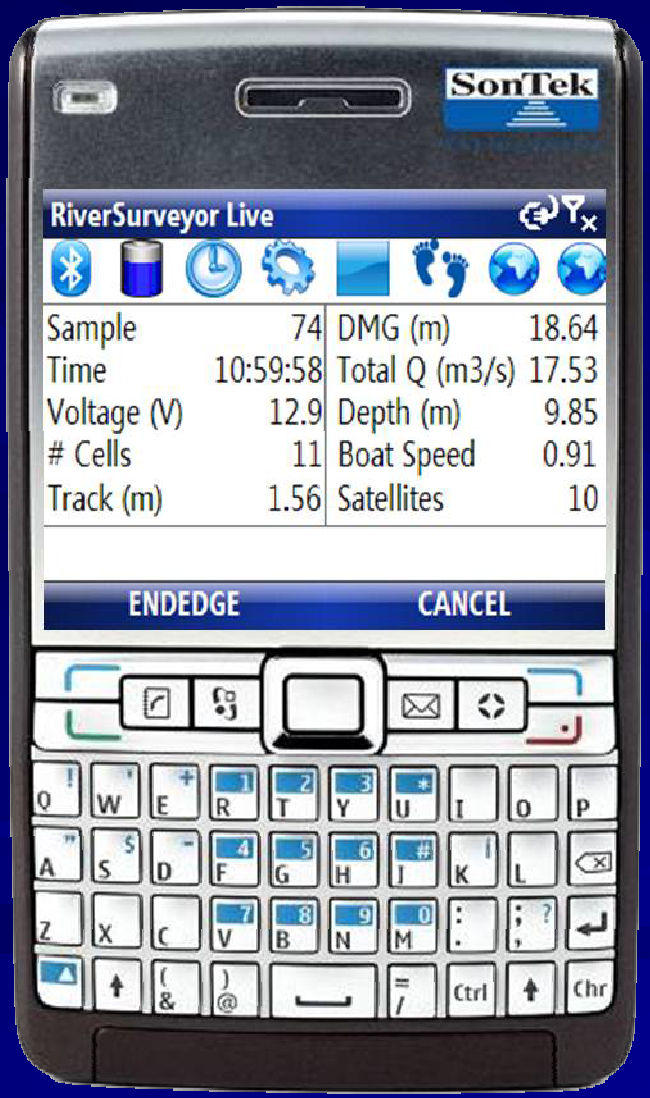


RiverSurveyor Live!

- GIS shape file automatically combined when using GPS



RiverSurveyor Live! Mobile Platform



- Windows Mobile
- Utilizes Motorola Q phone
- Bluetooth telemetry – 60m range
- Extremely easy and robust
- Complete calculation on the fly.
- QA checks during data collection.
- Motorola Q phone included with RiverSurveyor Bluetooth configurations sold in 2009

RiverSurveyor Live! Mobile Platform

Protective enclosure provided for adverse weather

Enables one person operation !

S5 and M9 GPS Options

1. Direct connect (customer supplied)
   - Sub-meter Accuracy required
   - 10-Hz update rate required
   - Accepts 10-Hz GGA and VTG data string (NEMA-182) via RS-232 output

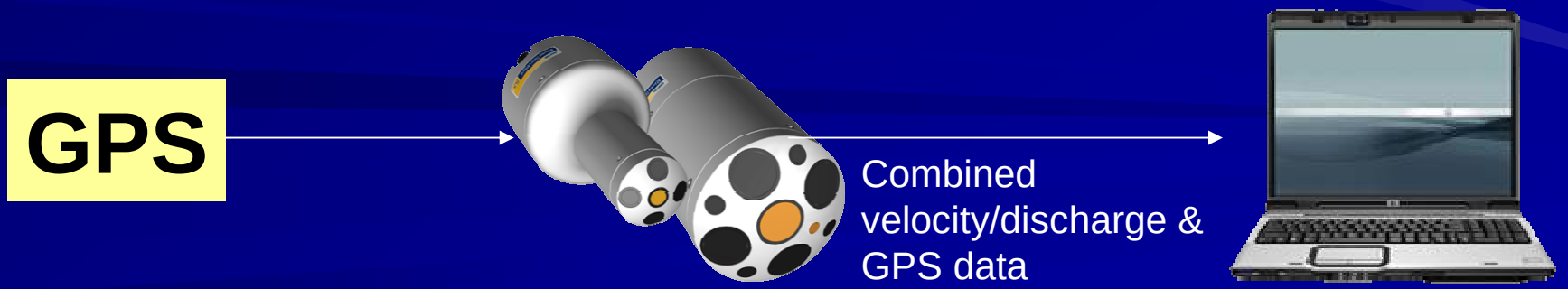
2. SonTek Differential (sub m accuracy)
   - GGA and VTG (NEMA 182) data strings
   - 10 Hz sample rate
   - Differential correction using WAAS, SBASS, or EGNOSS
   - GPS mounted inside rover PCM

3. SonTek RTK (0.03 m accuracy)
   - Includes SonTek RTK base-station PCM
   - GGA and VTG differential (sub-meter)
   - GGA RTK (0.03 m)
   - GPS mounted inside rover PCM and RTK base station PCM

S5 and M9 GPS Options

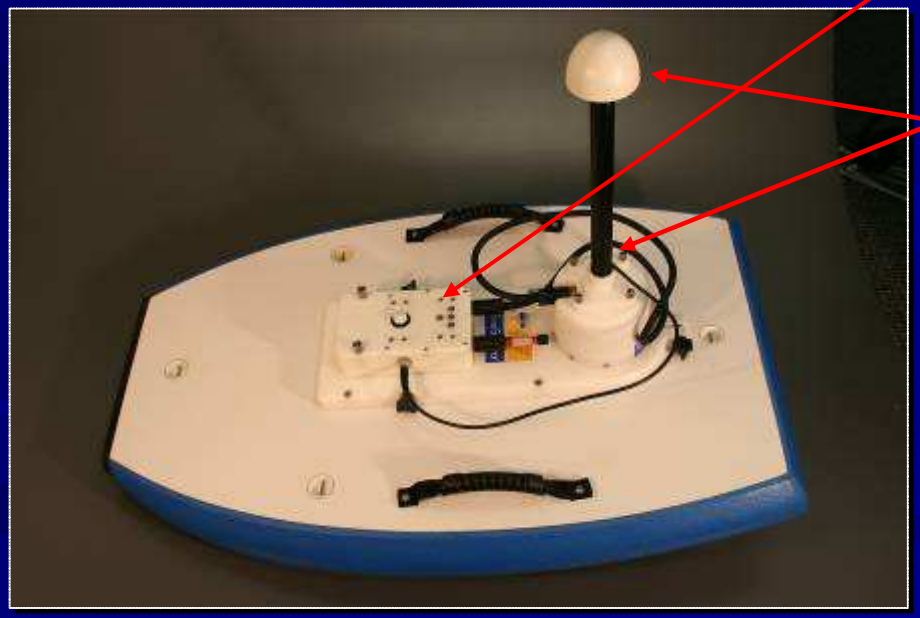
1. Direct connection

- GPS signals go directly into M9 or S5 (serial connector provided on power/communication cable)
- Single combined data string (GPS and ADP) is stored internally in M9/S5 memory and displayed on laptop.



S5 and M9 GPS Options

2. SonTek Differential Solution (referred to as VTG on brochure)



- GPS electronics are housed in rover PCM
- SonTek provides antenna, mount, cable, and pole that attaches to top of S5/M9 ADP housing
- Outputs VTG and GGA (NEMA 182) strings at 10 Hz
- Capable of sub m precision using WAAS, SBAAS, or EGNOSS differential corrections where available

S5 and M9 GPS Options

3. SonTek RTK (Real-time Kinematic) solution

GPS contained in rover PCM with additional radio link to RTK base station PCM.
1-mile range typical

- **Unique one-button setup**
- **Tripod does not require precise positioning**
- **0.03 m precision**
- **10-Hz sampling rate**
- **Removes moving-bed bias**
- **Useful in streams less than 1-m in width**

RTK Base station PCM, tripod, and radio telemetry

Internal SonTek RTK/DGPS

- Simple and cost-effective alternative to existing RTK based solutions.
- RTK provides improved performance over DGPS.
  - 300 second typical lock-time.
  - If RTK correction is lost system operates on differential based correction (for up to 45-minutes) and VTG.
  - Minimum channel widths of 1 meter are possible with increased precision.
  - Tentative plans for up to 20-hz output
- Internal GPS (rover) located in power/communication module connected to acoustic Doppler profiler.
  - Antenna is mounted on mast directly above ADP transducer
- Base-Station RTK PCM
  - High gain antenna
  - Tripod
  - Radio communication with ADP – 1 mile range line of sight
  - 18-volt rechargeable power supply
  - Water-proof housing

Floating platforms

OceanScience Tri-hull

SonTek Hydroboard

Applications

Mississippi flooding June 2008

100 year flood event

Applications

Mississippi flooding May 2008

Collaboration of: *Illinois State Water Survey*
University of Illinois
SonTek

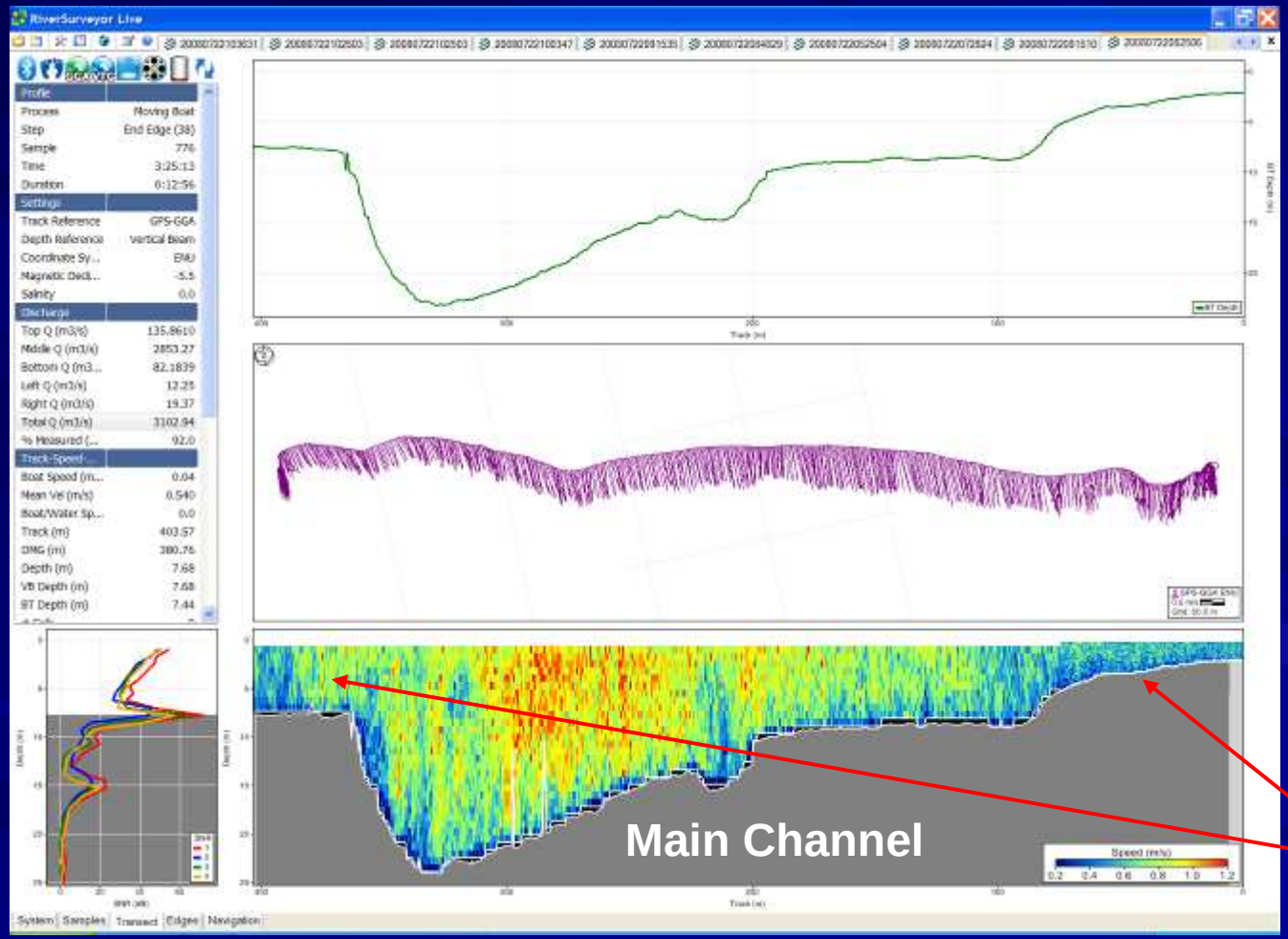
Applications

Mississippi flooding June 2008

SonTek's John Sloat sets up RTK base station in a cornfield

SonTek's Muthiah Radhakrishnan And ISW's Jim Slowikowski set up M9 and S5

Mississippi flooding June 2008



- First full flood measurement including flood plain
- RTK GPS used to account for moving bed bias
- Data still being evaluated by University of Illinois

Applications

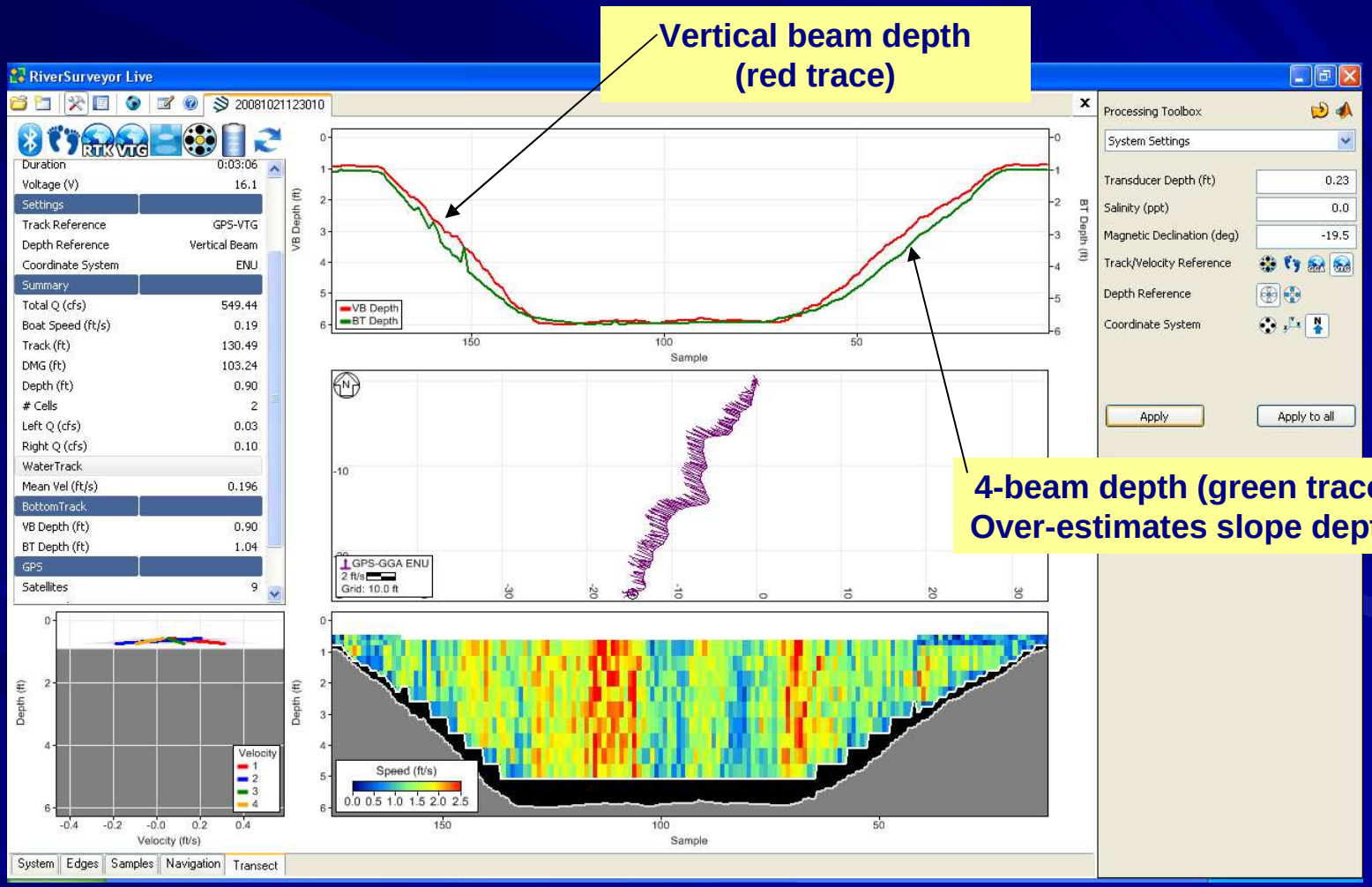
Imperial Irrigation District Canal measurements

Simple – Effortless - Accurate

- Data collected using mobile phone with Bluetooth connection.
- 1-person operation collecting discharge measurements.
- Data seamlessly collected from ADP, RTK-GPS, and Echo-Sounder.
- Vertical beam data shows “true” trapezoidal channel shape.

Applications

Imperial Irrigation District Canal measurements



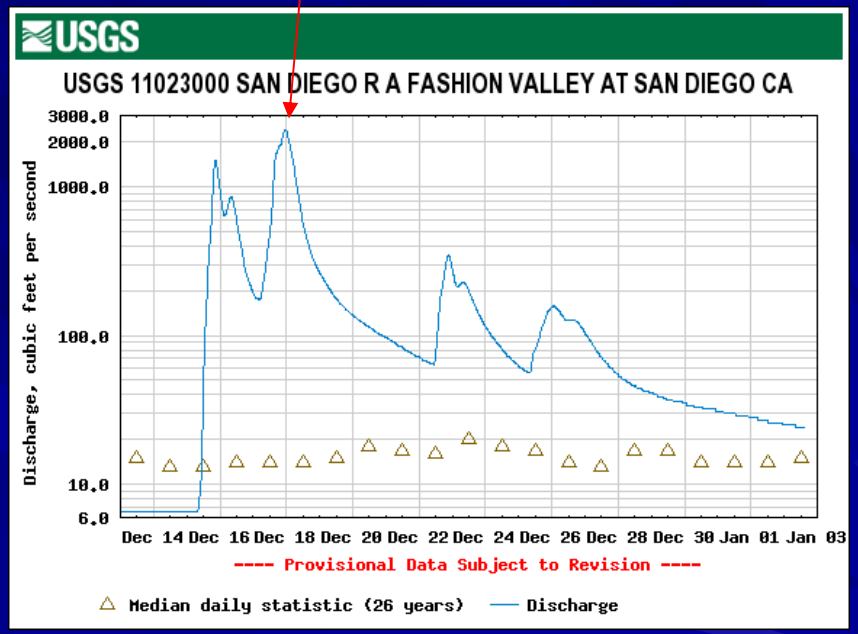
Applications

San Diego River Flooding at Fashion Valley

Dec 2008

San Diego River Flooding at Fashion Valley
Dec 2008

M9 measurements made Dec 17th flow rates at over 200 times normal values



San Diego River Flooding at Fashion Valley
Dec 2008

One man operation in the rain!
Vs . . . . . .

They only thing dry that day was the mobile phone!

San Diego River Flooding at Fashion Valley
Dec 2008

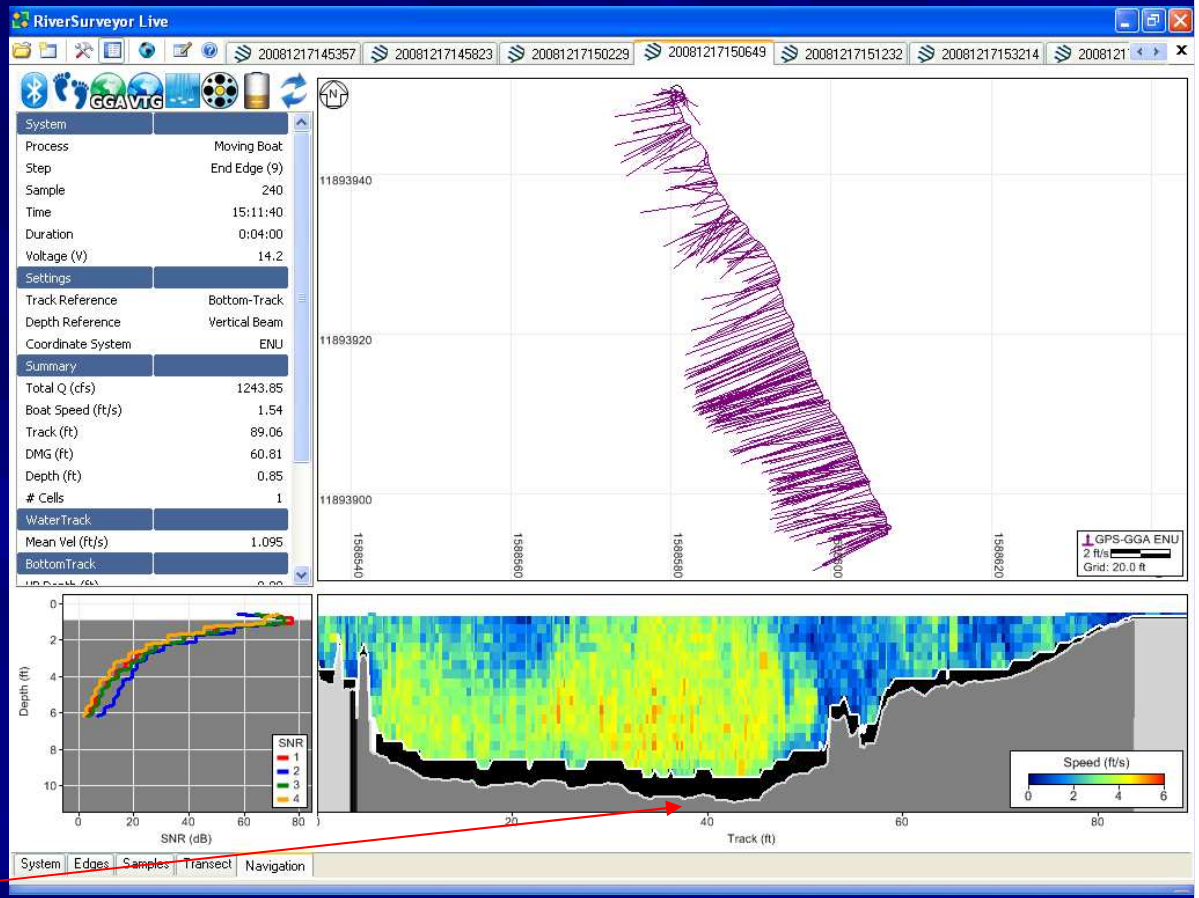
Traditional USGS Measurement

- "A" type reel
- Price "AA" mechanical meter
- 30-lb sounding weight
- .2/.8 Mid-Section Calculation

. . . . . No explanation required
But they were wishing they had an M9!

San Diego River Flooding at Fashion Valley
Dec 2008 – M9 Results

- GPS VTG, GPS-RTK and Bottom-Track data was collected simultaneously.
- Moving bed during flood – Bottom-track bias, not useful data.
- RTK-GPS not reliable due to tree canopy and minimum number of available satellites
- GPS VTG solution provided excellent results using limited satellite availability.
- Measurement depth range 0.25 cm – 4 m.
- Vertical beam measurements show true cross-section shape and area.



USGS Rating = 1,260 cfs
M9 measured discharge = 1,243 cfs

RiverSurveyor S5 and M9 Summary points

- Many new features – too numerous to cover all, especially in software
- Systems are much more robust and easy to use including one man operation
- Enhanced abilities in extreme flood events
- Vertical beam makes them surveying tools as well

SonTek
YSI incorporated