Field Measurements of Flow are the Foundation of Hydrology

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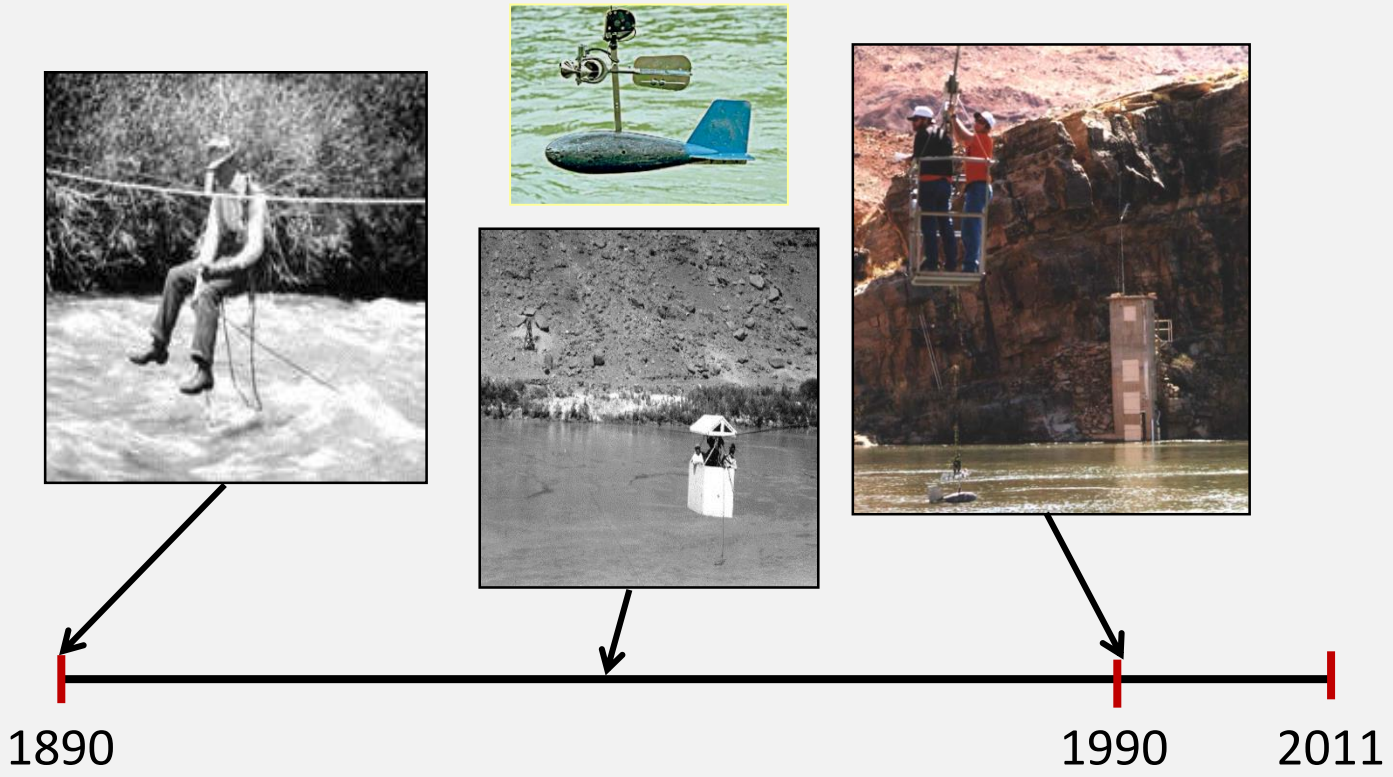
Field measurements of flow are used for:

- Determining discharge
- Developing flood recurrence intervals
- Development of regulations
- Regulatory compliance
- Habitat evaluation
- Calibration and validation of models
  - Flood and drought prediction
  - Habitat assessment
- Evaluating the effects of the climate and land use changes

Field measurements of streamflow are the foundation of hydrology.

Technology didn’t change for 100 years



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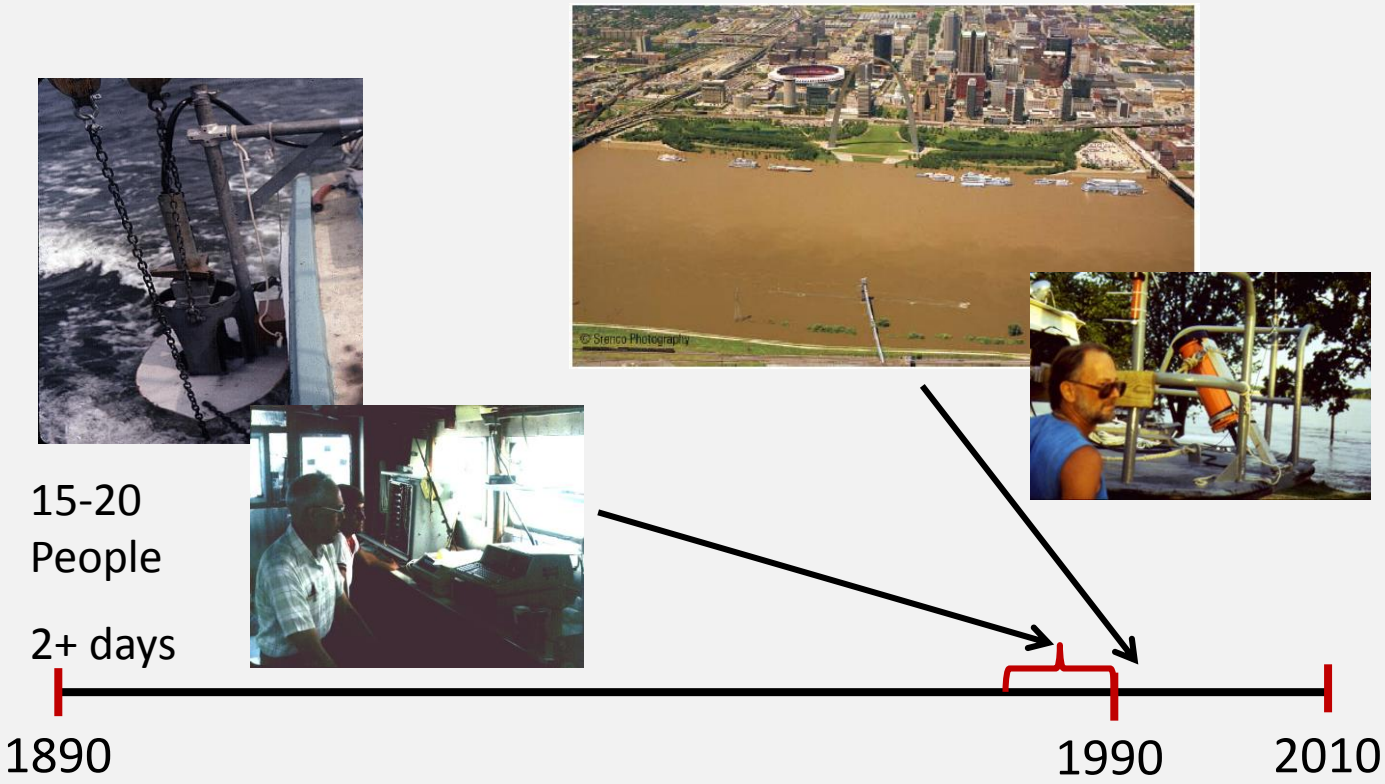
Then the era of acoustics began -- slowly



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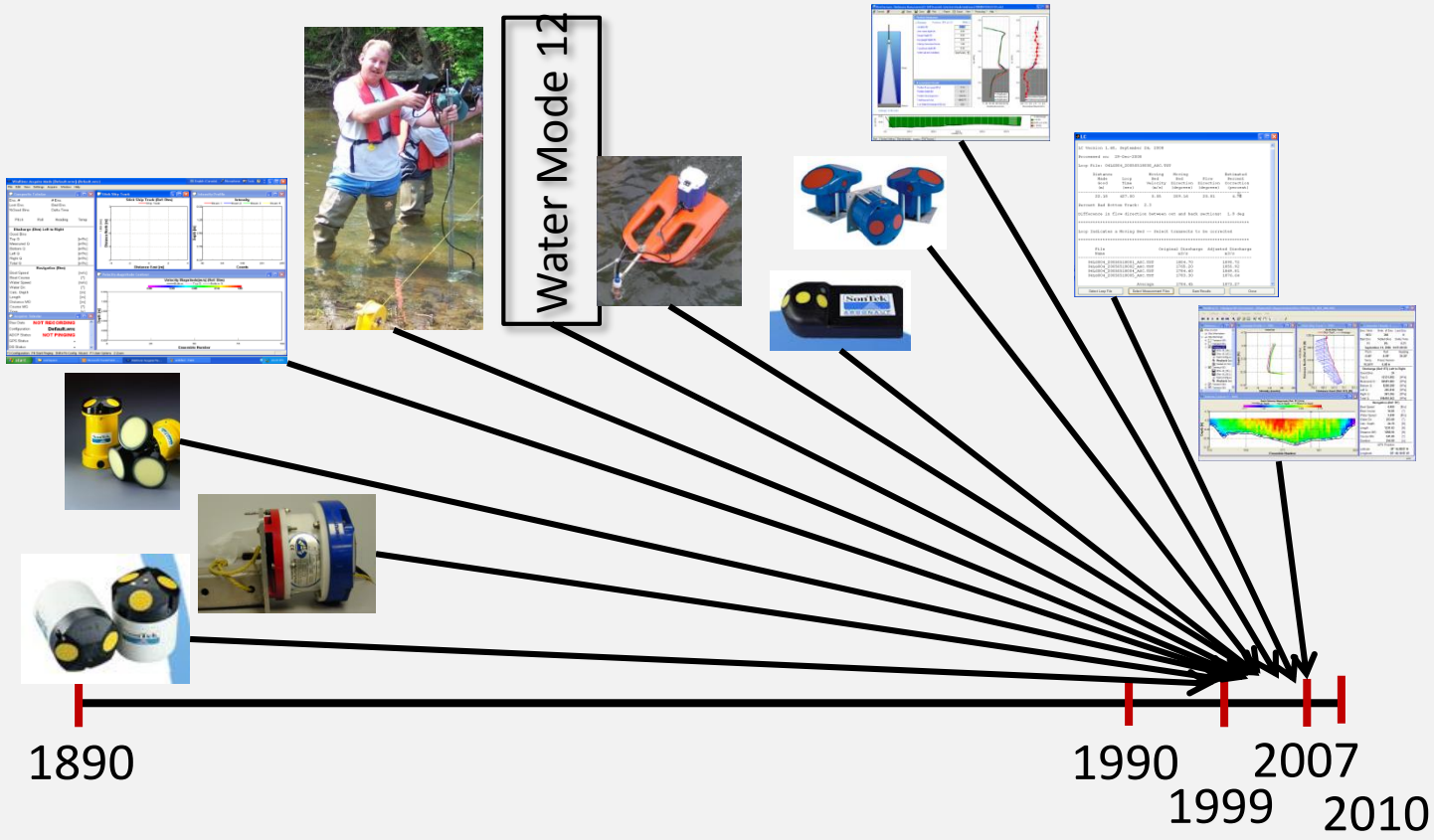
Acoustic Development Picked Up Pace (1999 - 2007)



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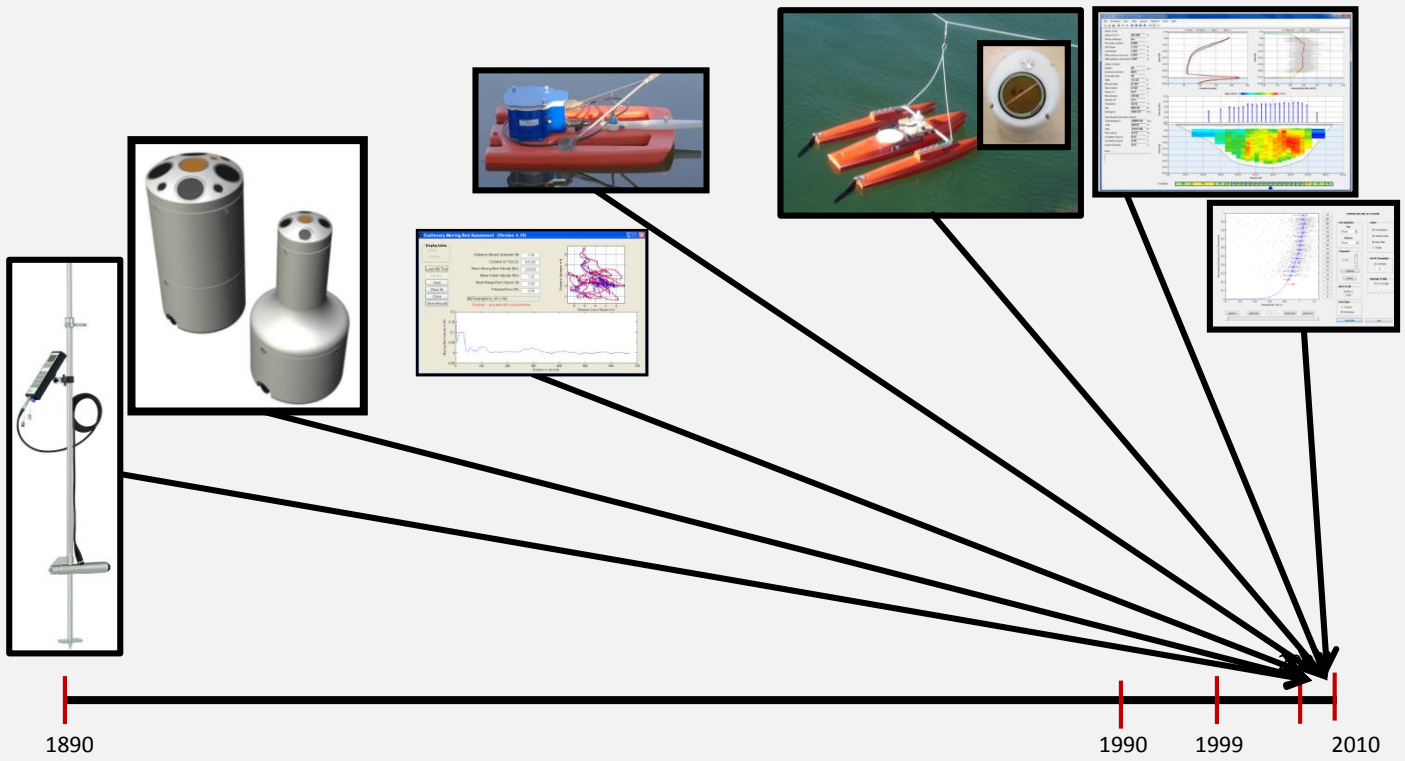
VERY Rapid Development (2007 – 2010)



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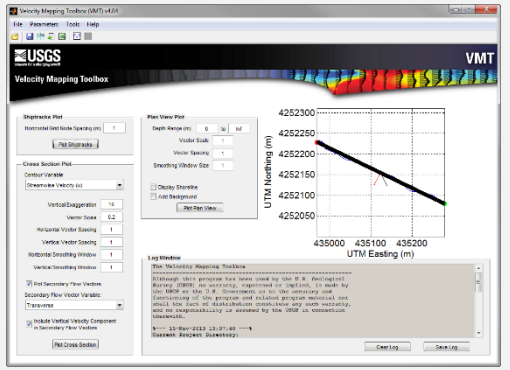
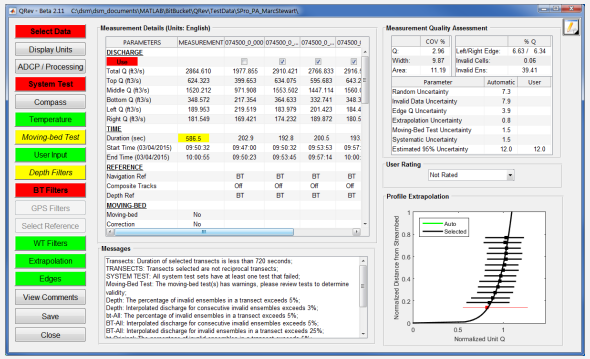
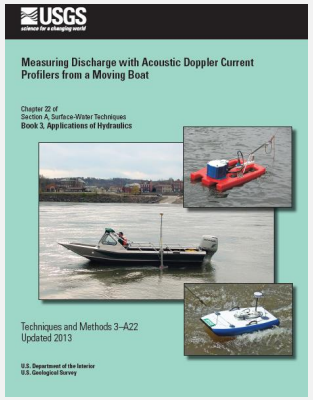
Since 2010

- Remote control boats
- GPS compasses
- RiverPro
- RioPro
- SonTek SL3G
- Velocity Mapping Toolbox (VMT)
- Index velocity software (Excel spreadsheets)
- RIVRS for index velocity under development
- QRev
- Updated Policy
- And More







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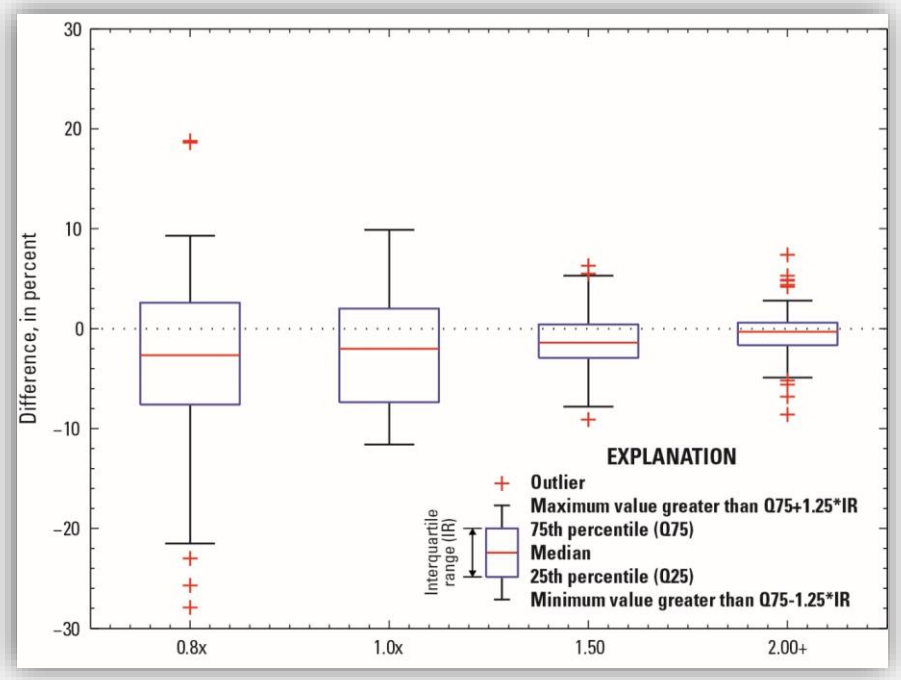
Ensuring a Solid Foundation

- Testing
- Comparing old with new
  - Would a change in technology create a change in rating curves?
- Collaboration with manufacturers
- Collaboration with international agencies
- Standard Policy and Procedures
- Training
- Smart software

Improved Instruments by Field Testing



- USGS began testing ADCP in 2008.
- Testing identified deficiencies – resulting in firmware and software changes
- By firmware 2.00+, **bias** almost completely eliminated, and **accuracy** has increased!

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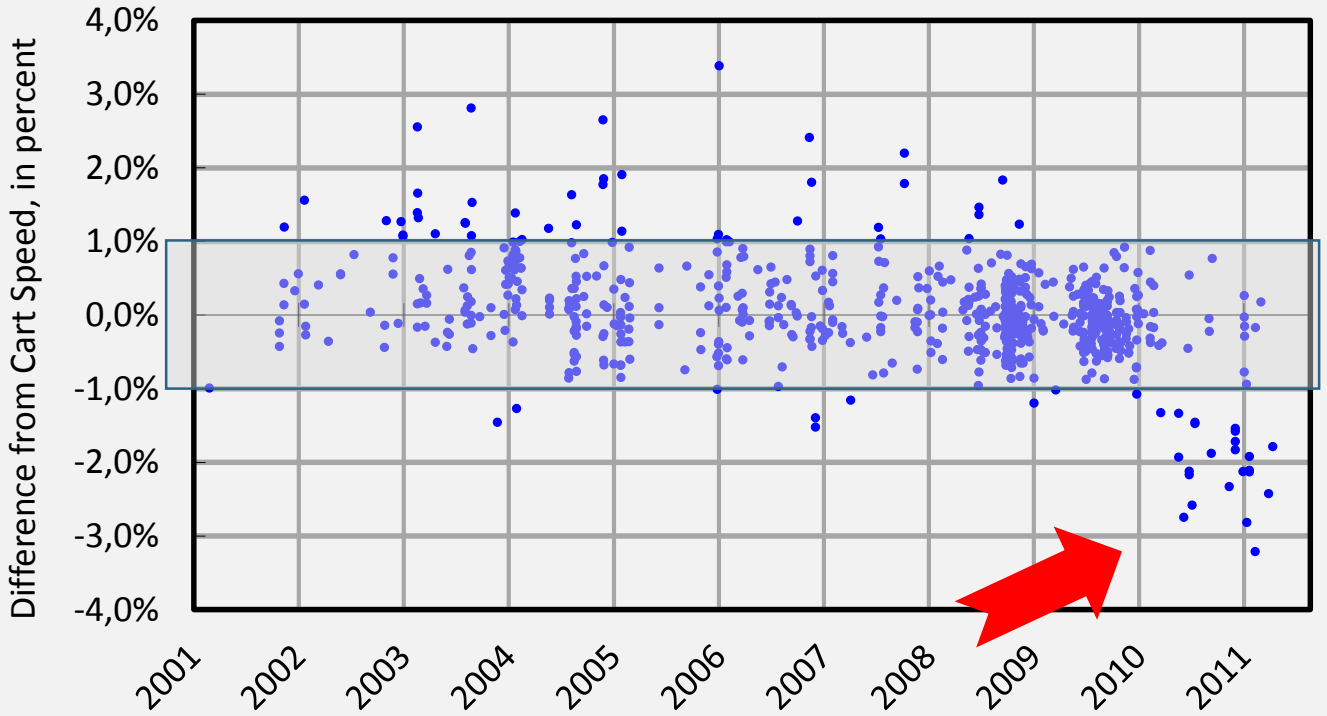
Implemented QA Programs



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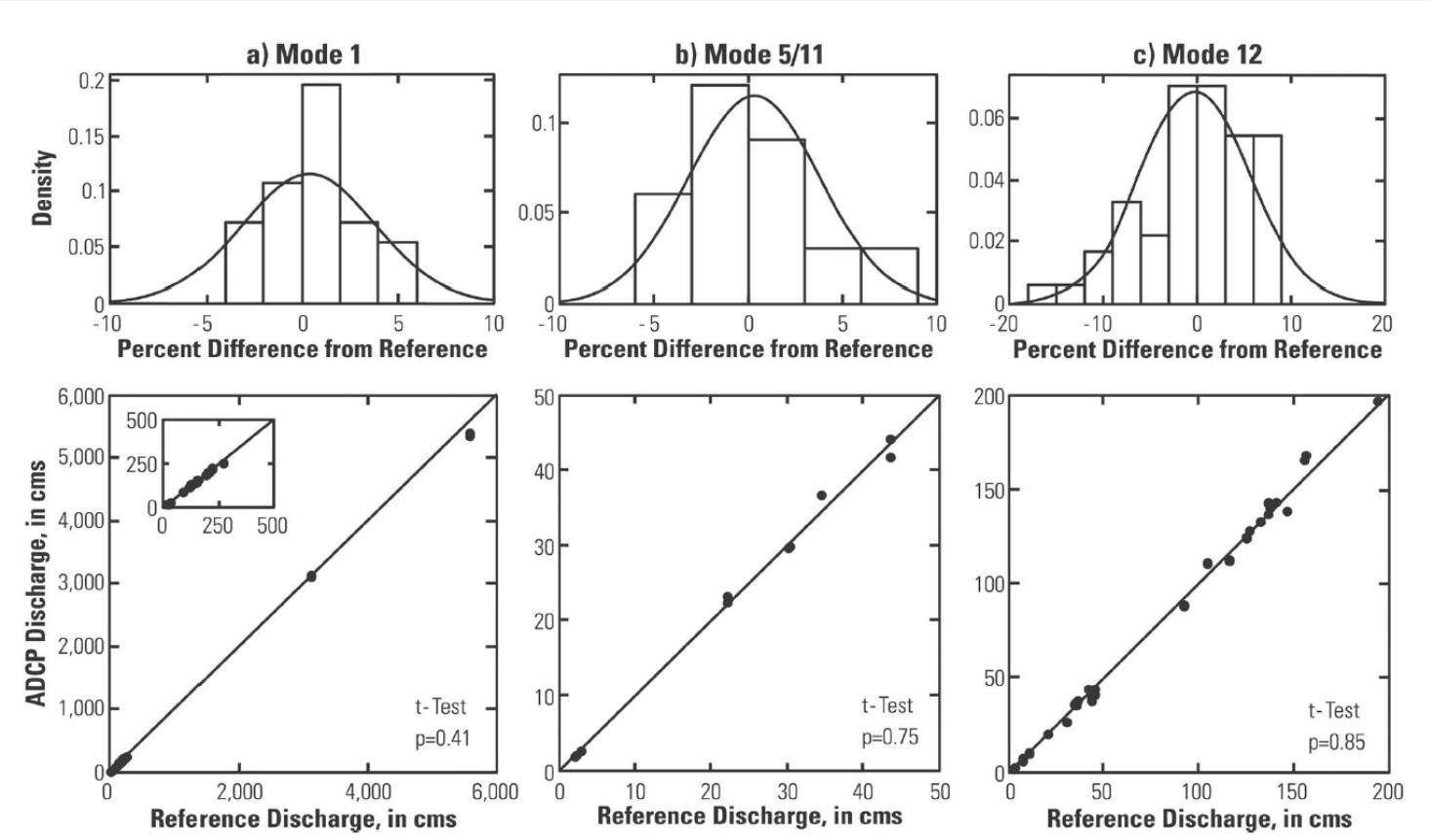
Field Comparisons

Rio Grande vs Price AA and stable ratings based on Price AA measurements



Collaboration is Important to Success

- Working with the manufacturers for win-win situations
  - They want to sell instruments and make a profit
  - We want reliable instruments that fit our needs
  - We both need to understand the others limitations
- International cooperation
  - Coordinate needs/desires back to manufacturer
  - Share testing and comparison data
  - Work together to identify and solve issues

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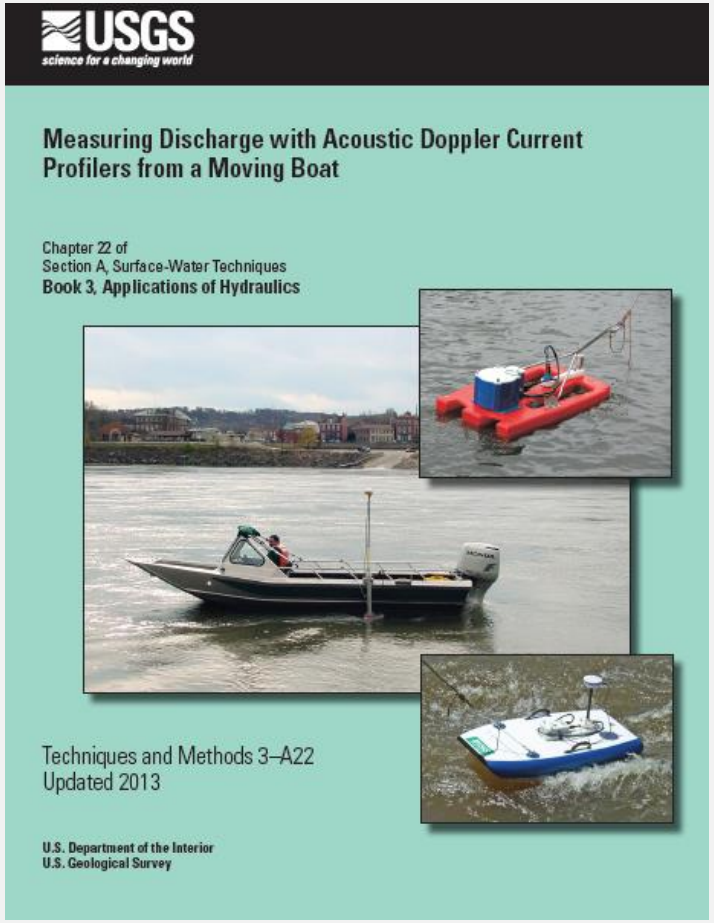
Standard Policy and Procedures

- Verify temperature readings
- System test
- Moving-bed test
- Compass calibration
- Number of transects
- Steps for collecting and processing data



Train the Users

- USGS trains more than 120 user's every year
  - 1 week training
  - Combination of online, classroom, and field data collection
- Technology changes
- Ongoing education
  - Webinars
  - Conferences
  - Short courses
- Measurement review by experienced users

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The Field Technicians Tools





The typical ADCP user will not be an ADCP expert!












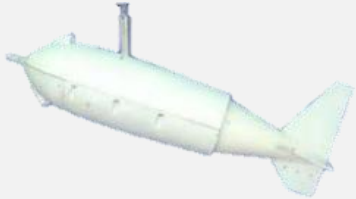


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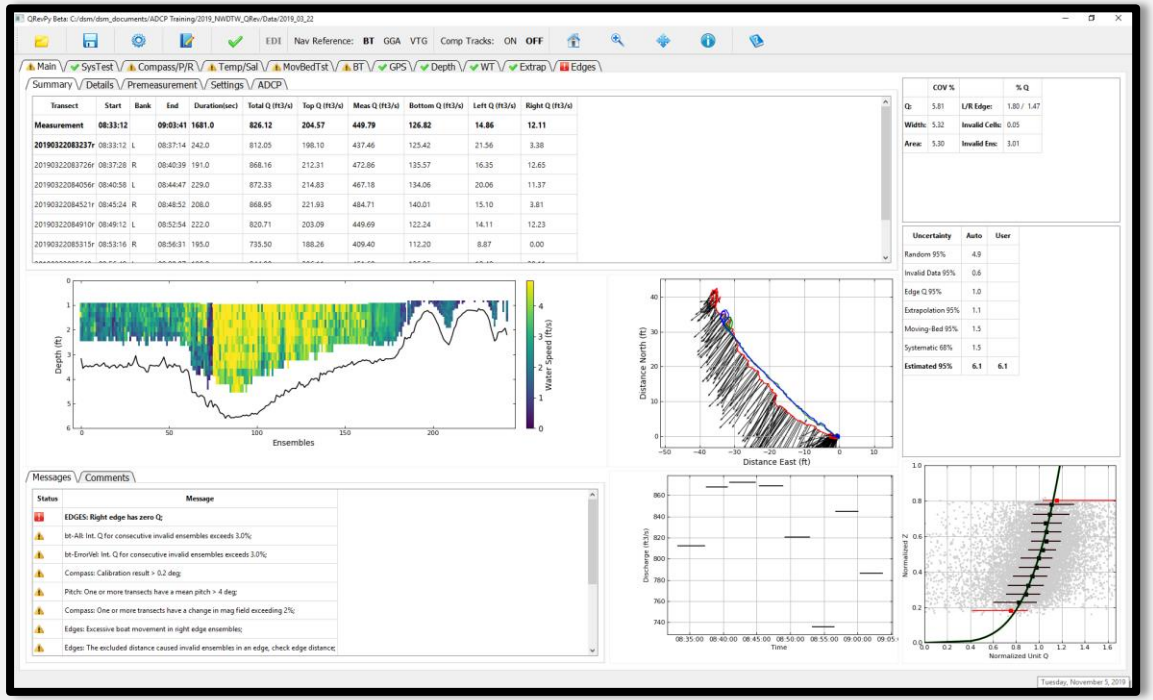
QRev – Goals & Requirements

- Process both SonTek and TRDI data
- Logical workflow
- Automated data quality review and feedback
- Consistent algorithms
- Use best available data
- Manual overrides
- Issue specific dialog windows
- Feedback to user on uncertainty
- Tablet friendly

Develop Standard Smart Qm Processing Software

QRev



- "Single most important development in hydroacoustics in the past 10 or more years." (Kevin Oberg)
- Improved efficiency of data review and processing
- Consistent methods, independent of ADCP manufacturer

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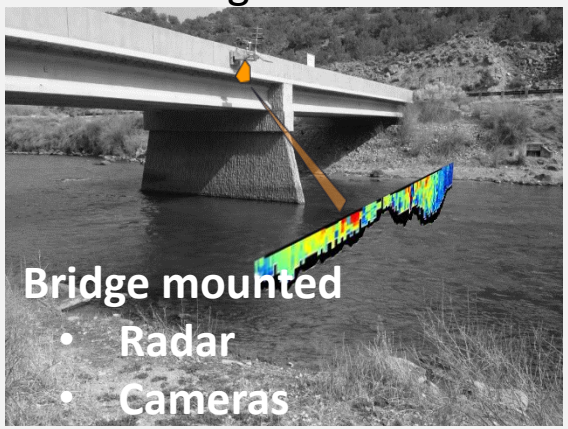
Practical and Specific Standards

"The great thing about standards is that there are so many to choose from."
(attributed to Rear Admiral Grace Hopper)

- Standards are needed to ensure consistent quality data
- Software can enforce procedures and standards
  - Workflow
  - Required tasks
  - Automated quality checks
  - Improved efficiency and accuracy
- Standard file format
  - Independent of manufacturer
  - Independent of instrument
  - Allow easily shareable data repositories
  - Allow broader use of data

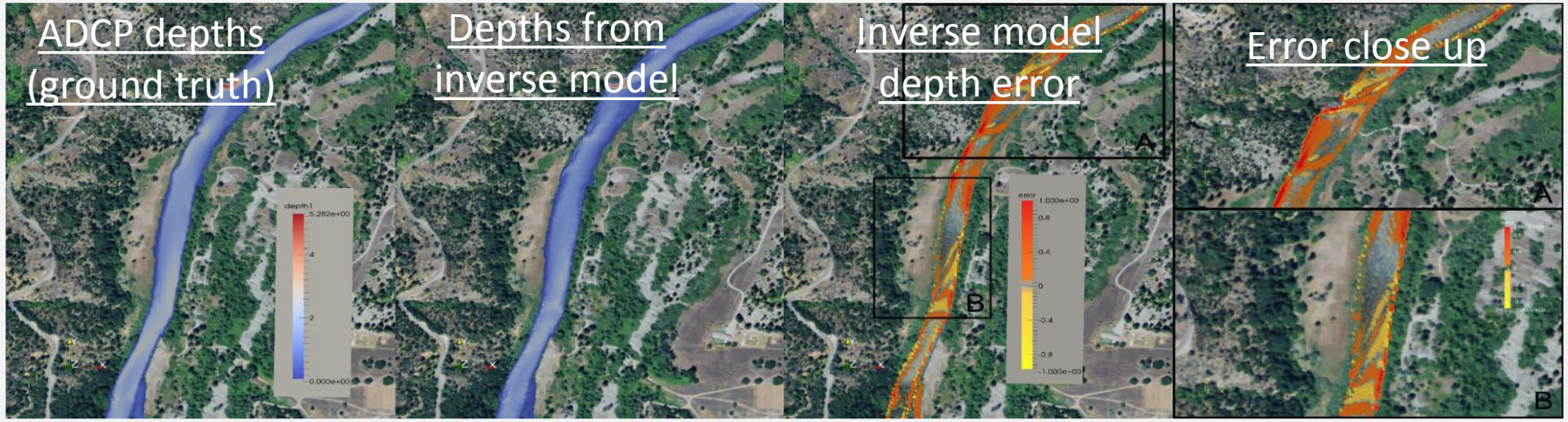
Future Technology Changes

- Remote Discharge Measurement Methods
  - Greater safety
  - Lower cost per site – more sites
  - Monitoring remote sites



- **Bridge mounted**
  - **Radar**
  - **Cameras**

- **UAS (Drones)**
  - **Radar**
  - **Cameras**



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Uncertainty: All data are not equal

- The uncertainty of a streamflow measurement varies
  - Environmental conditions
  - Technology
  - Procedures
  - User experience
  - Measurement location
  - Etc.
- Users of measurements need to be aware of uncertainty in the measurement.
- GOAL: Every measurement would have an uncertainty associated with it.
  - Uncertainty analyses are complex
  - Uncertainty estimates are often uncertain
  - Often the largest source of uncertainty is the part of the streamflow measurement that is estimated rather than measured.
  - Will users pay attention to and know how to deal with uncertainty?

Summary

- As technology changes we need to remember our **field measurements are the foundation** of nearly all aspects of hydrology.
- **Field technicians** are experts at hydrologic field data collection but are not necessarily experts in any or all instruments.
- **Smart software** that enforce standard procedures, apply standard processing algorithms, and provide automated data quality assessment and feedback to the user is important in maintaining high quality data.
- Success depends on **collaboration** between international agencies and manufacturers.

Discussion

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