Horizontal Acoustic Doppler Velocity Meters

"Side lookers"

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USGS

Acknowledgements:

- Scott Morlock (USGS, Indiana)
- RD Instruments
- Sontek/YSI Inc.
- Nortek AS

The use of brand names is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

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Acoustic Doppler Current Meters

ADVM's

- Two-beam systems (two main beams for 2D velocity measurement—system may have 2, 3, or 4 beams)
- Used in fixed deployments, typically to index mean-channel velocity

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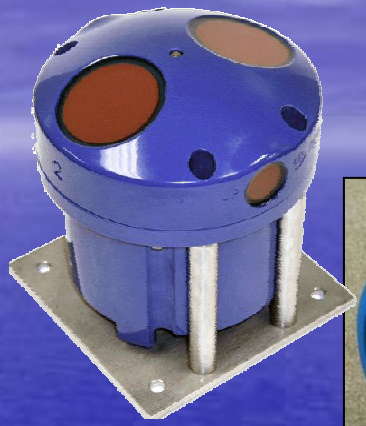
Side lookers

Sontek Argonaut SL



RDI ChannnelMaster

Nortek EasyQ

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Index-Velocity Profilers

56

17

33

28

301

- Argonaut-SL
- Argonaut-SW
- Argonaut XR/MD
- Argonaut-ADV
- Nortek EZQ

Numbers Updated September 2003

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Benefits:

- More accurate record

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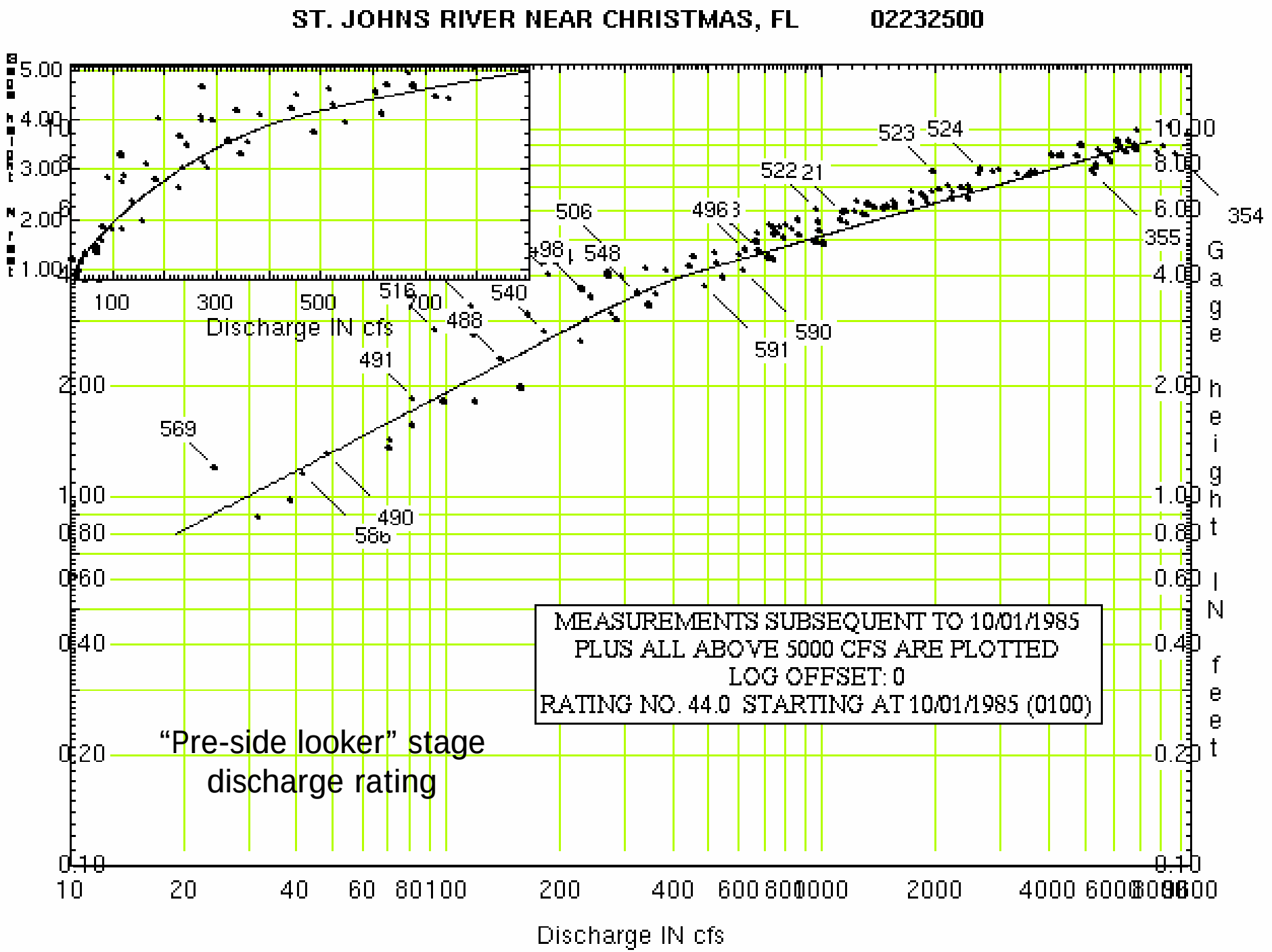
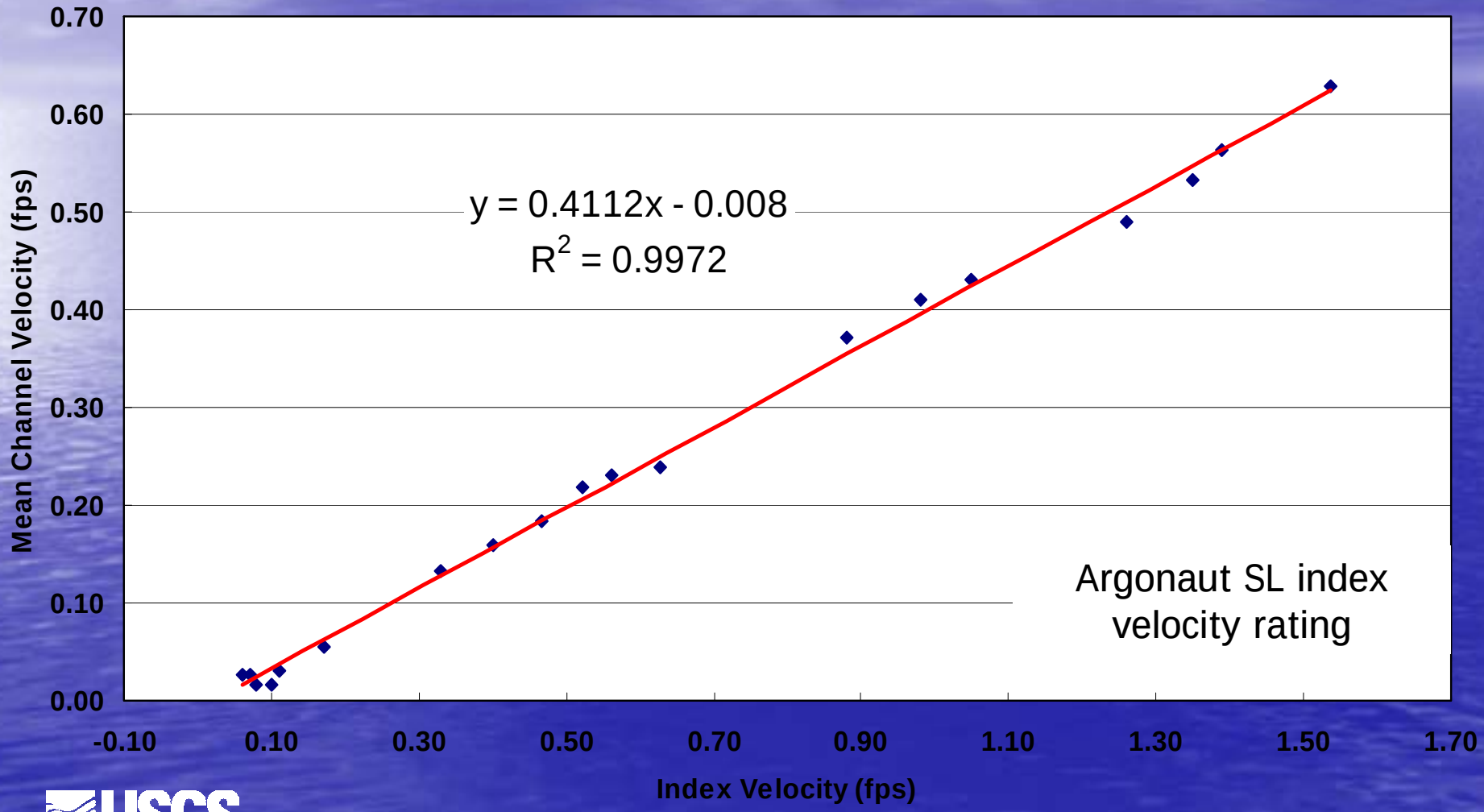

ST. JOHNS RIVER NEAR CHRISTMAS, FL 02232500
Gage height IN feet
Discharge IN cfs
MEASUREMENTS SUBSEQUENT TO 10/01/1985
PLUS ALL ABOVE 5000 CFS ARE PLOTTED
LOG OFFSET: 0
RATING NO. 44.0 STARTING AT 10/01/1985 (0100)
"Pre-side looker" stage discharge rating

St. Johns River near Christmas, FL
02232500
Rating #52



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Benefits:

- More accurate record
- Better science (model calibration, water quality studies, etc.)

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Example:

- Northern Indian River Lagoon (IRL) Feasiblilty Study to evaluate the effects of causeways on the IRL
- Two model comparison--

  St. Johns Water Management District

  U.S. Army Corps of Engineers

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Benefits:

- More accurate record
- Better science (model calibration, water quality studies, etc.)
- Cost (possible elimination of slope stations)

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- Potential for under ice

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Typical Florida installation

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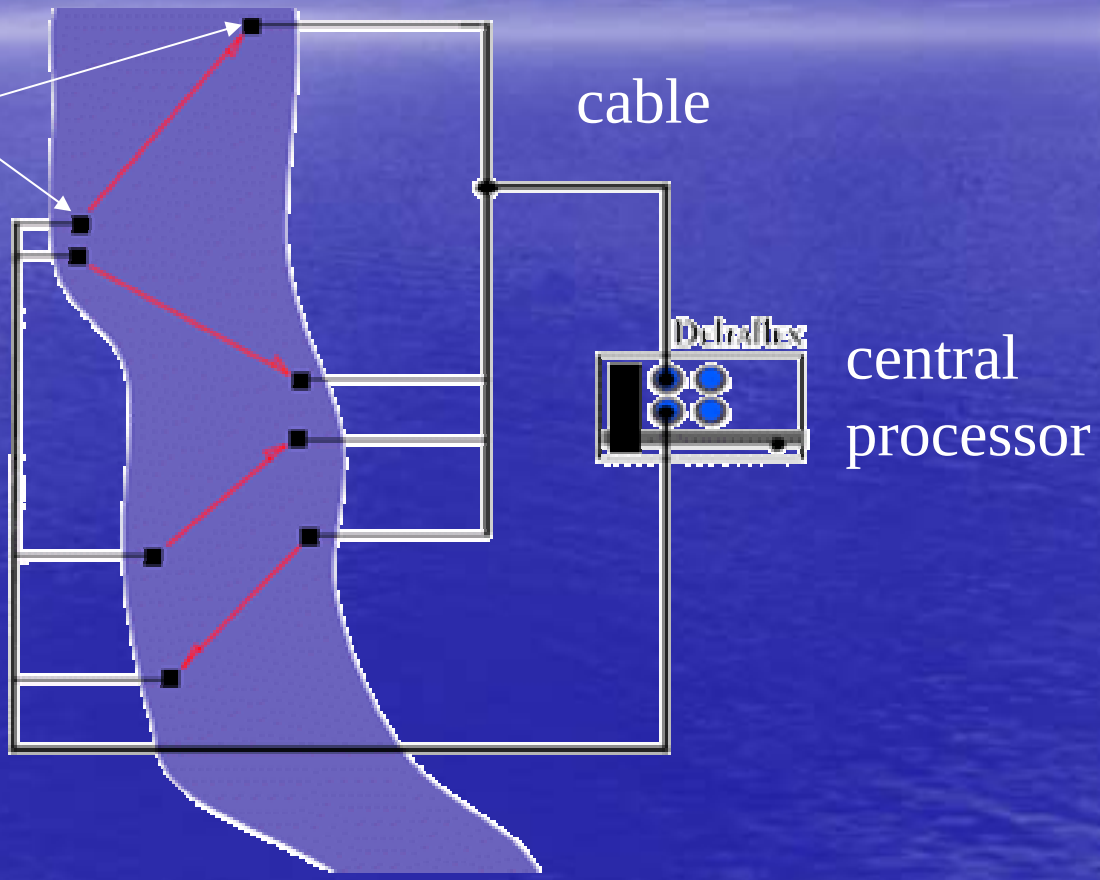
Benefits:

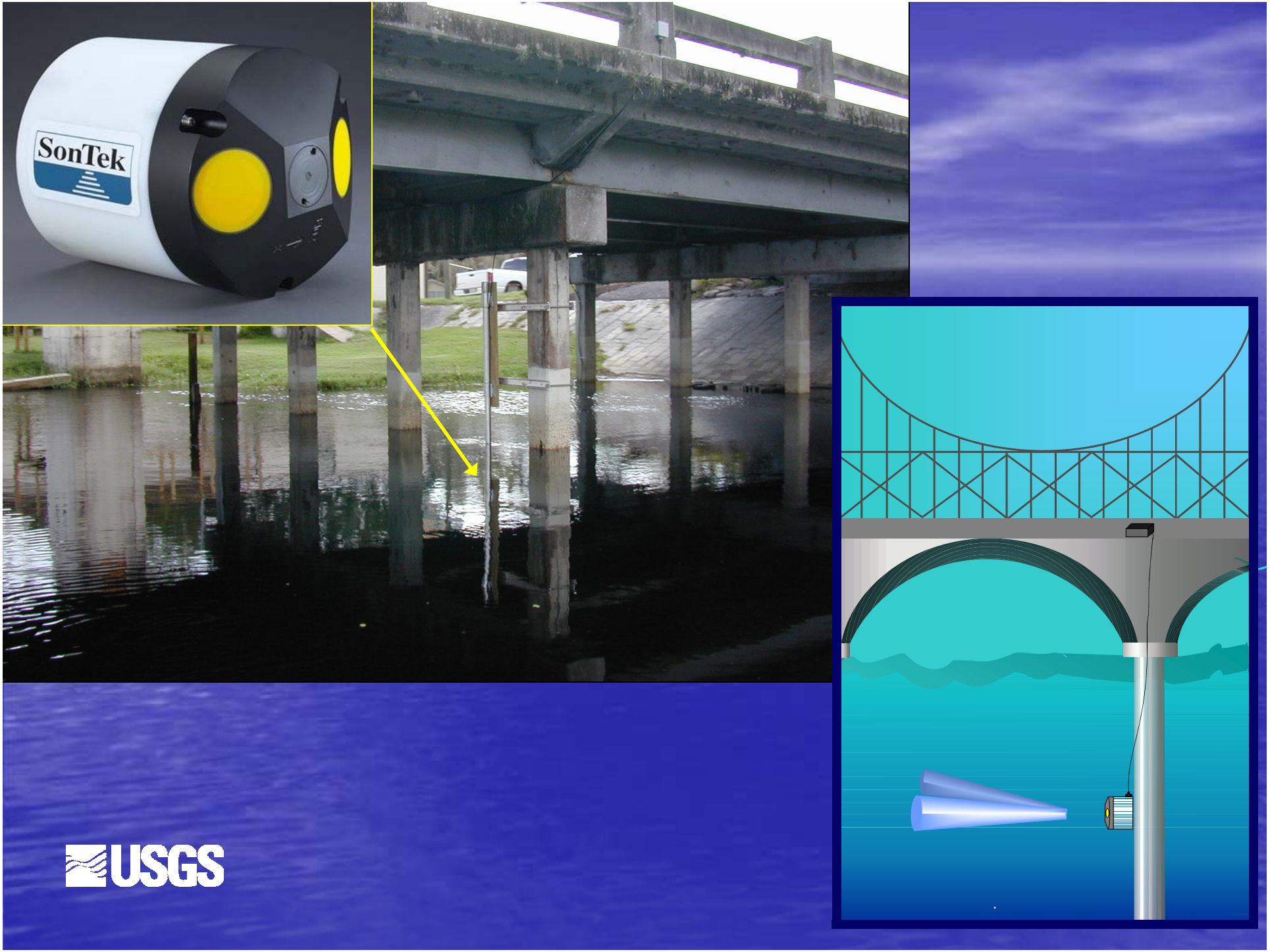
- More accurate record
- Better science (model calibration, water quality studies, etc.)
- Cost (possible elimination of slope stations)
- Potential for under ice
- No cross-channel cables (AVMs)

USGS

Typical multi-path AVM installation



USGS


SonTek
USGS

Benefits:

- More accurate record
- Better science (model calibration, water quality studies, etc.)
- Cost (possible elimination of slope stations)
- Potential for under ice
- No cross-channel cables (AVMs)
- Less frequent site visits (?)

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Some things to consider:

- Wake turbulence
- Boundaries/obstructions
- Noise
- Aspect ratio
- Averaging interval

Sample volume location

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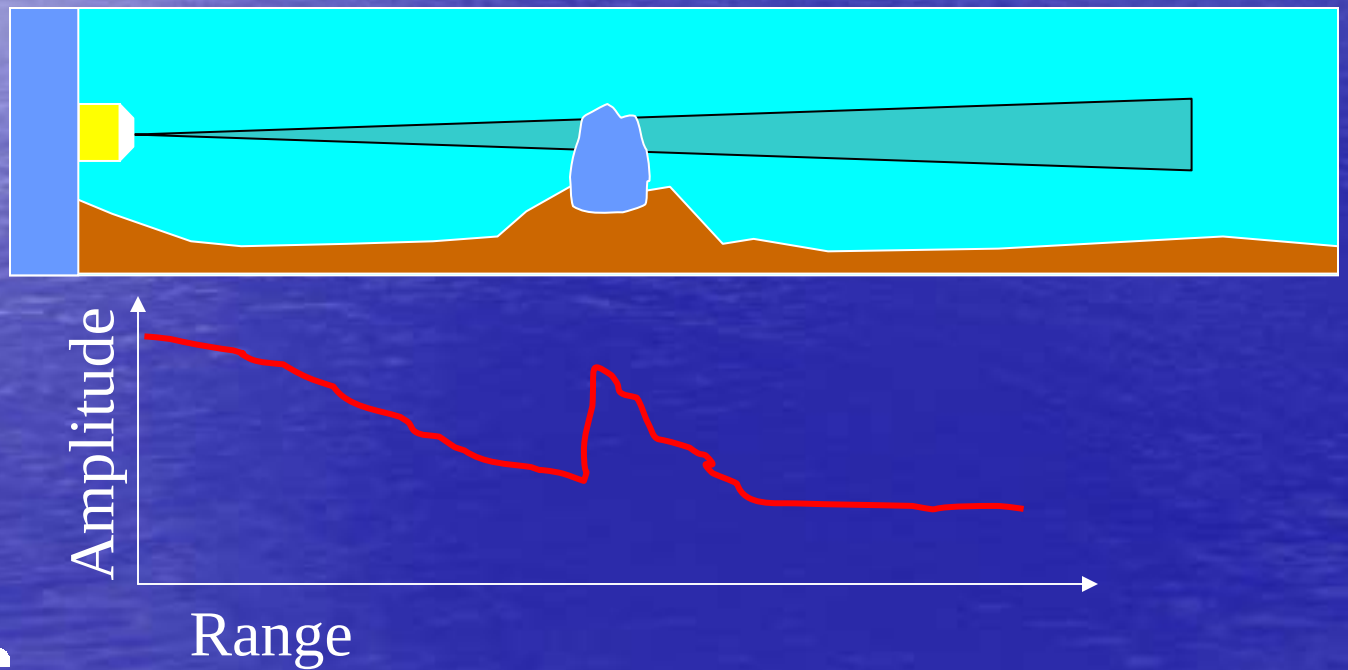
Beam Amplitude

Beam amplitude is a valuable tool. For example, beam amplitude plots can show the location of an object in a beam.



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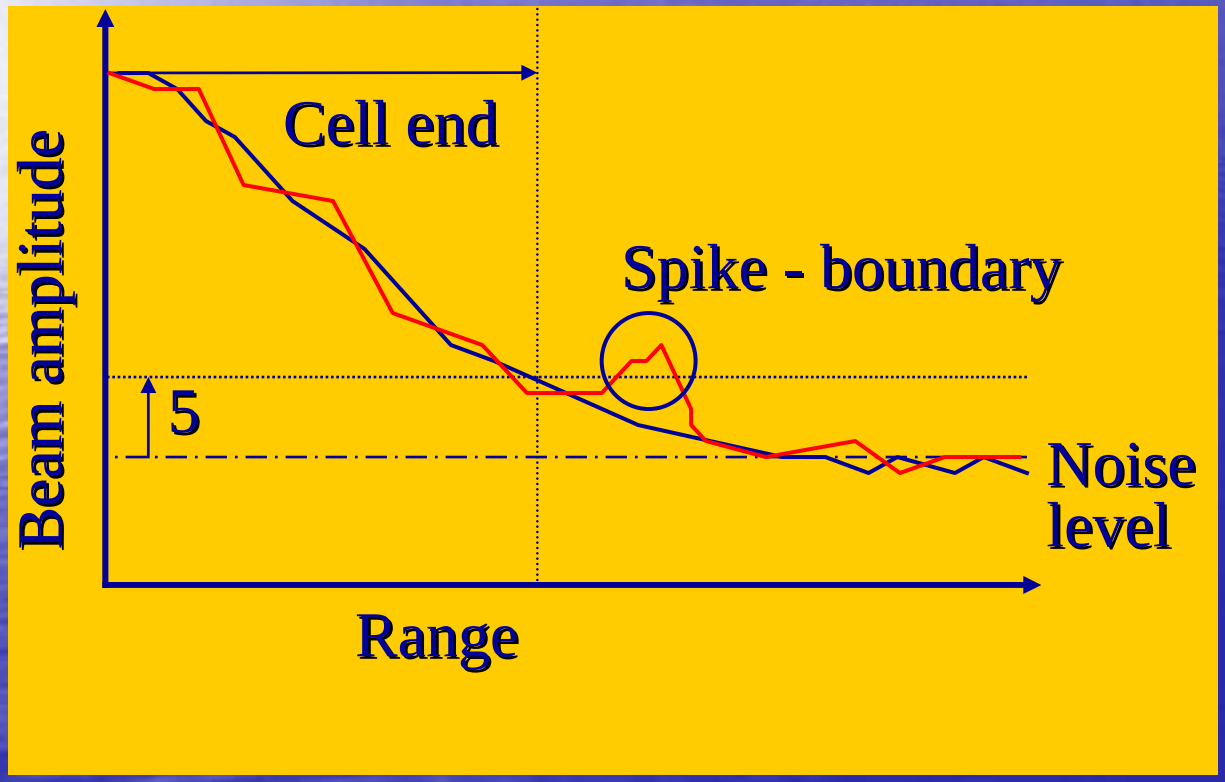
Example: noise level & boundary

Generalized beam amplitude plot

Amplitude in counts; 1 ct = 0.43 db



Set cell end so that:

- Amplitudes are 5 counts above instrument noise level
- Noise level can vary seasonally
- Cell clears boundaries

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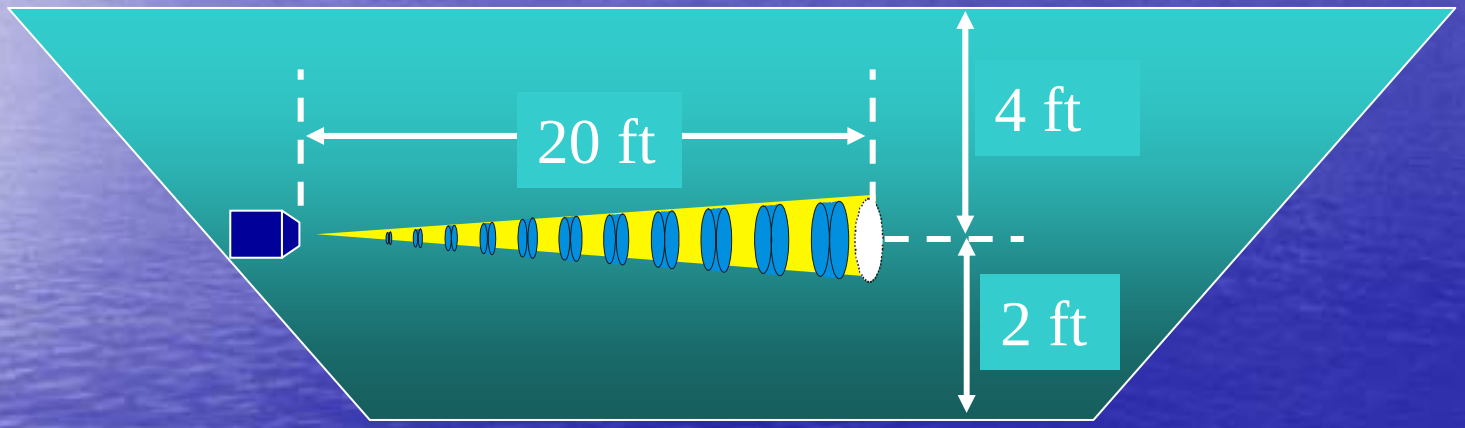
Aspect Ratio

A.R. = R/D



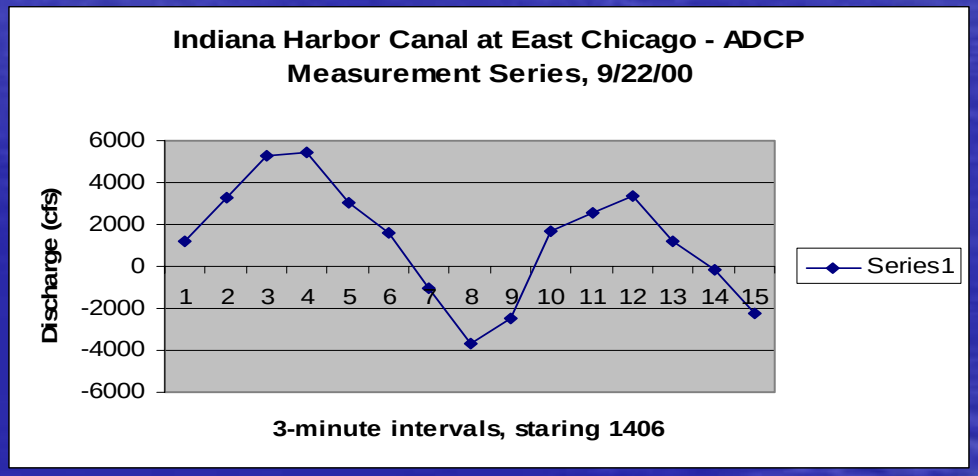
A.R. = 20/2 = 10

Averaging Interval

Unsteady flow

- Indiana Harbor Canal
- 15 minute sample interval
  - Dictated by telemetry
- 13.5 min. averaging interval
- Collecting data most of the time

Example of extreme variability



48-minute period

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Averaging Interval

Turbulence

- Kankakee River at Davis, Indiana
- Acceptable results at one minute, smoother data at 10 minutes

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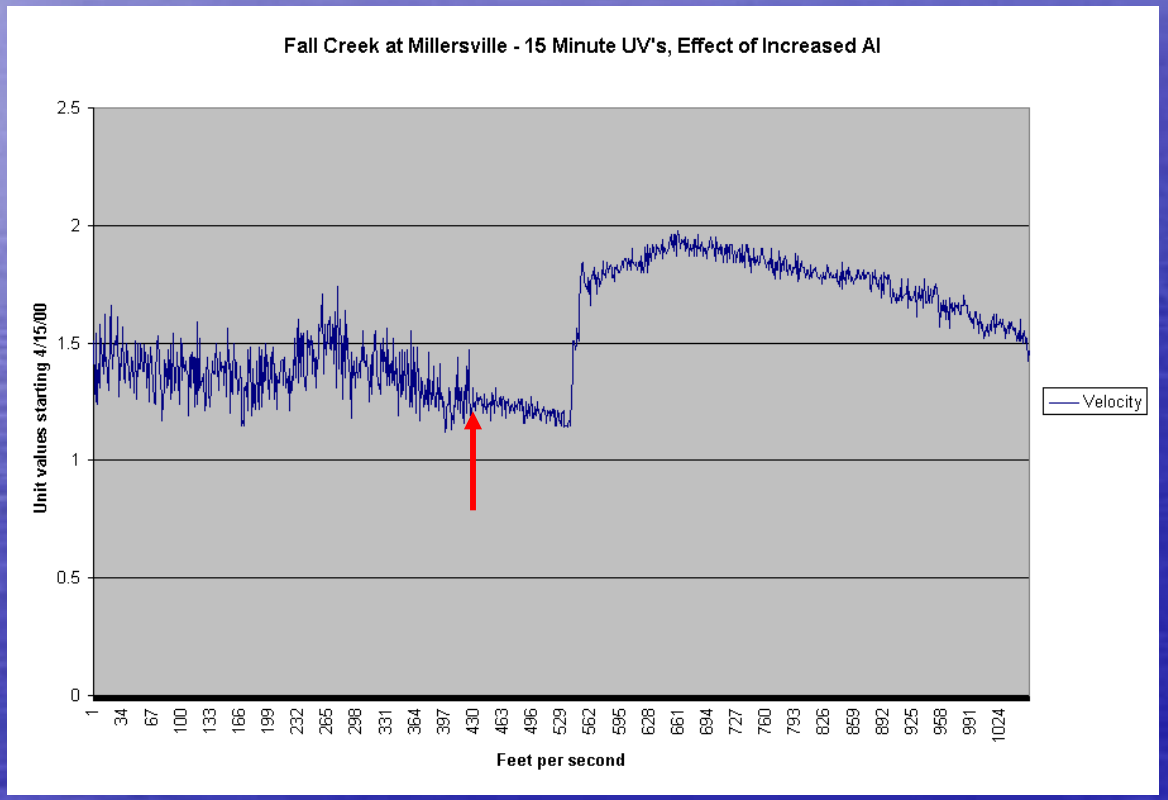
Averaging Interval

Smoothing the data

1 min. to 10 min. averaging interval



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Averaging Interval

A case for shorter intervals

- Power consumption
- Effect of a bias might be more evident – i.e. a boat is measured – than for long averaging intervals

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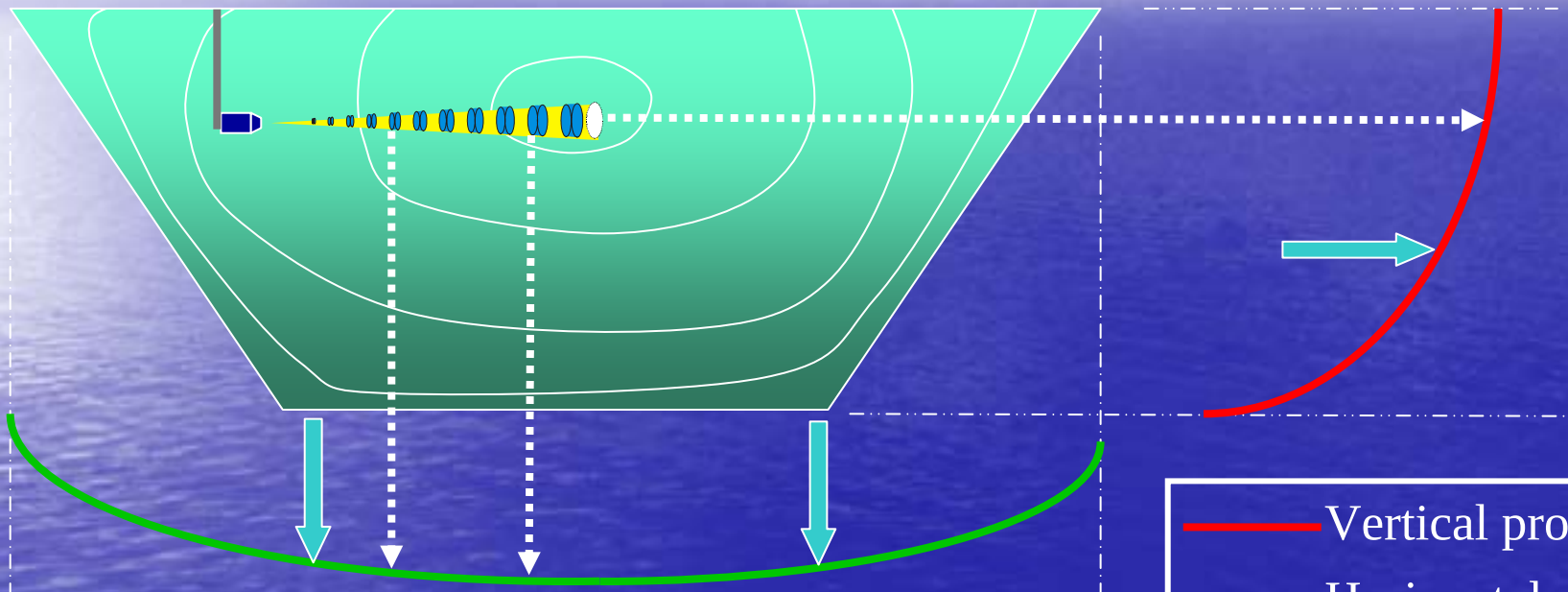
Keep in mind...



Vertical profile
Horizontal profile
Mean velocity
Sample volume

We are not sampling the mean velocity in the vertical or horizontal here.

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As flow/stage conditions change, velocity distributions can change dramatically.

In this illustration, flow in the overbank causes a shift in the horizontal and velocity distributions -- rising stage results in a shifted vertical-velocity distribution -- major factors in the relation of instrument to mean velocity.

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Mississippi District Mount

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Gage & Mount in Florida Bay

Photos courtesy of Eduardo Patino, USGS

Indiana Bridge Pier Mount

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California Argonaut Mount

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Model Comparison

	Available Frequencies	Maximum Range (m)	Number of Cells	Cost
Sontek	3000 kHz	8	5	--
	1500 kHz	22	5	--
	500 kHz	120	5	--
(SL ADP)	500 kHz	100	100	--
(SL ADP)	250 kHz	200	100	--
Nortek	2000 kHz	6-14	3	--
	1000 kHz	14-30	3	--
RDI	1200 kHz	20	128	--
	600 kHz	60-90	128	--
	300 kHz	200-300	128	--

"—" = Prices omitted at request of manufacturer

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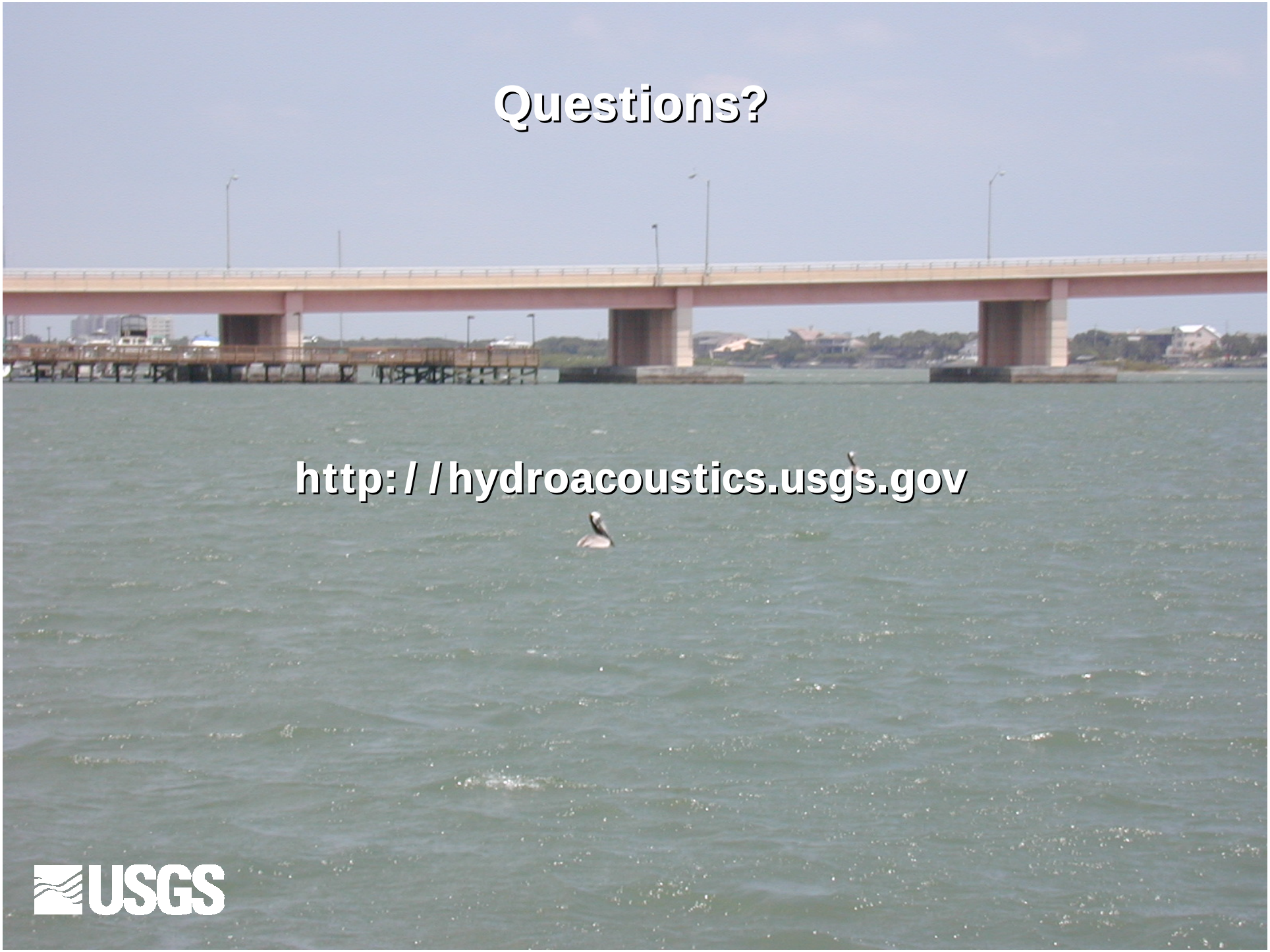
Questions?
http://hydroacoustics.usgs.gov
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