
Streamgaging of the Future
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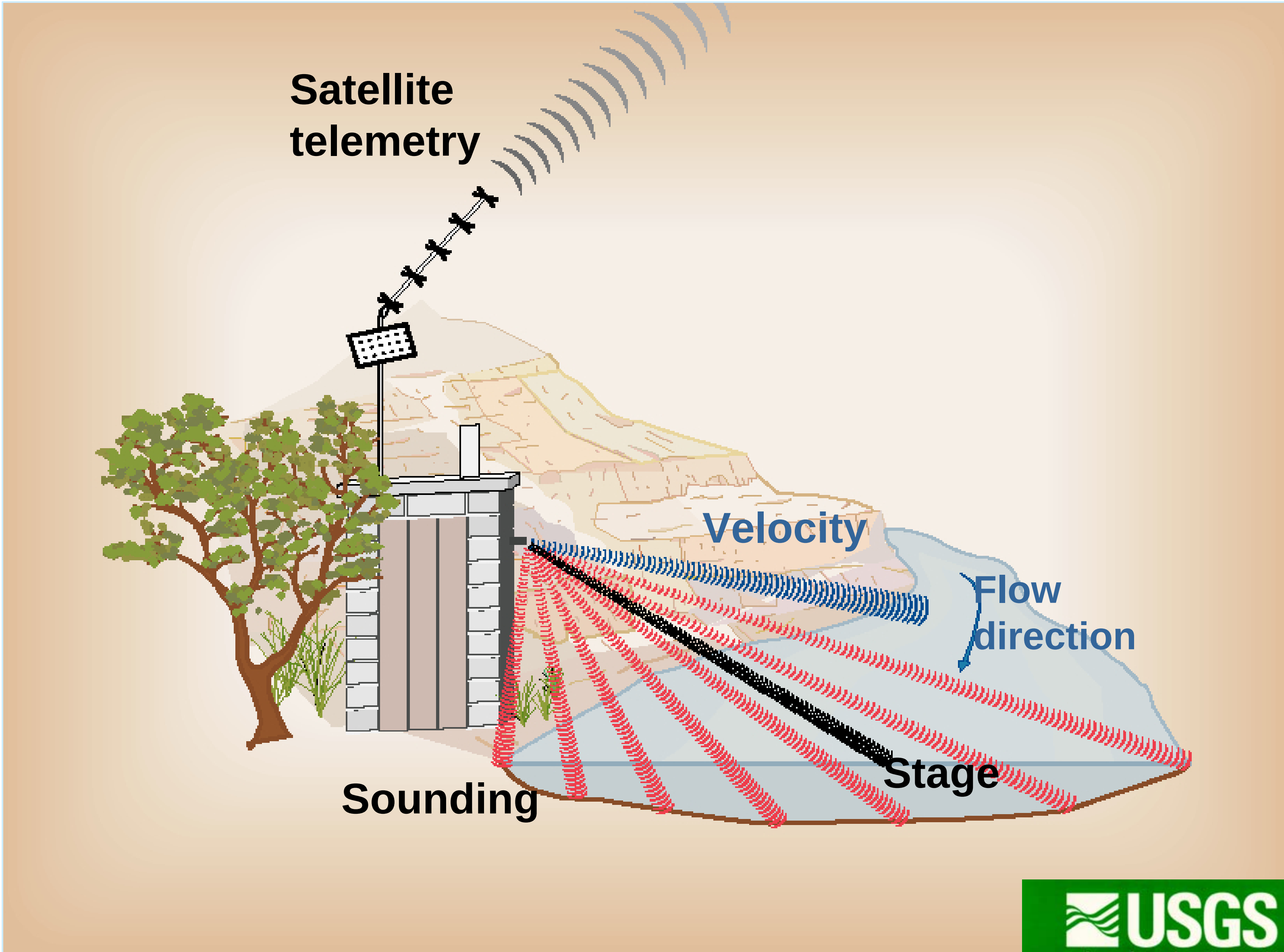
U.S. Geological Survey
USGS
science for a changing world

This is the Present…..

In the Future: Streamflow Data From Space

The Vision: Non-Contact Measurement of River Discharge



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Evaluation of Potential New Technologies

River Discharge:
Channel X-section
Velocity Distribution

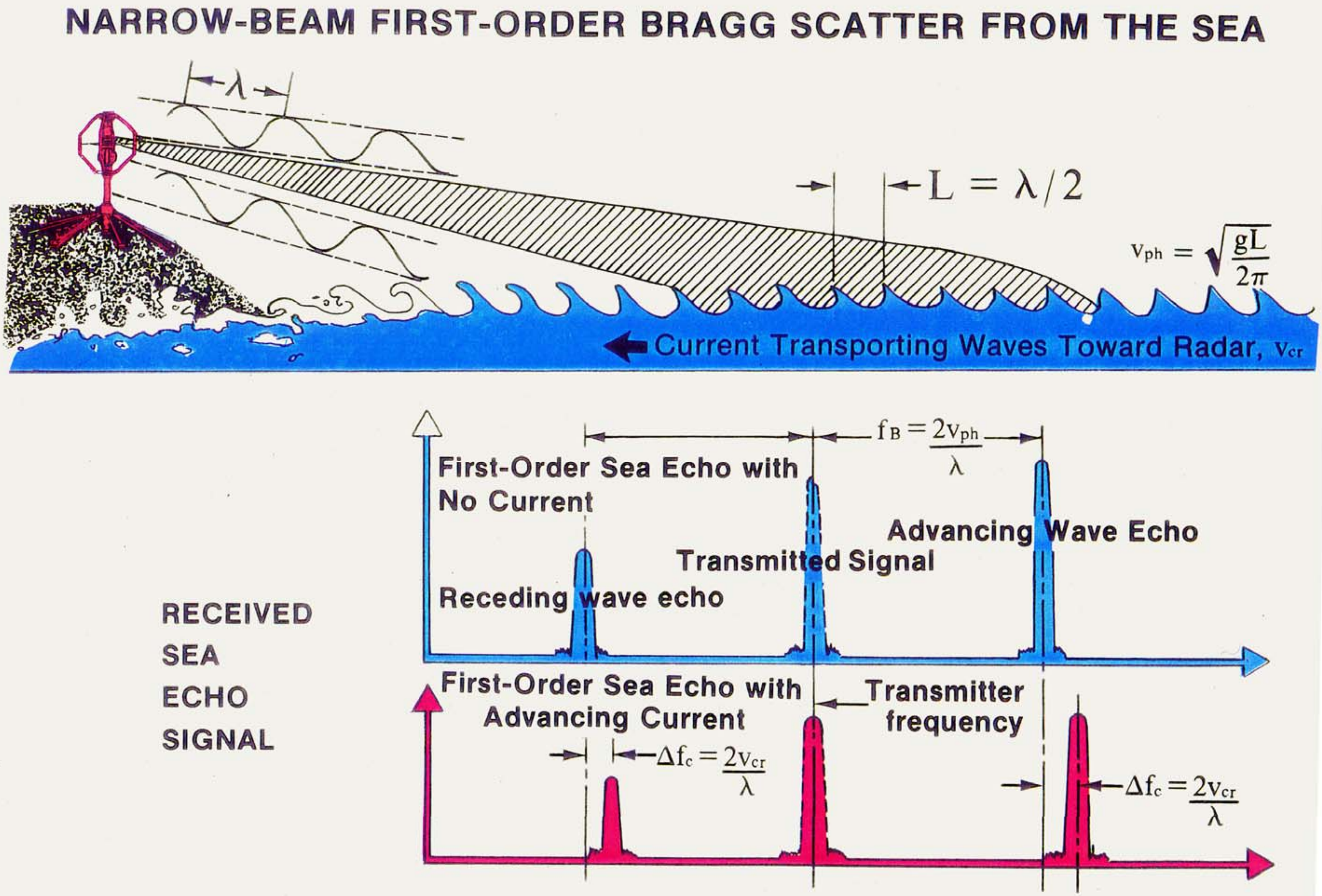
$$Q = \int_{\vec{A}} \vec{V} \bullet d\vec{A}$$

Notes:
1 = Field Tested
2 = Possible, but not tested
3 = Not Possible

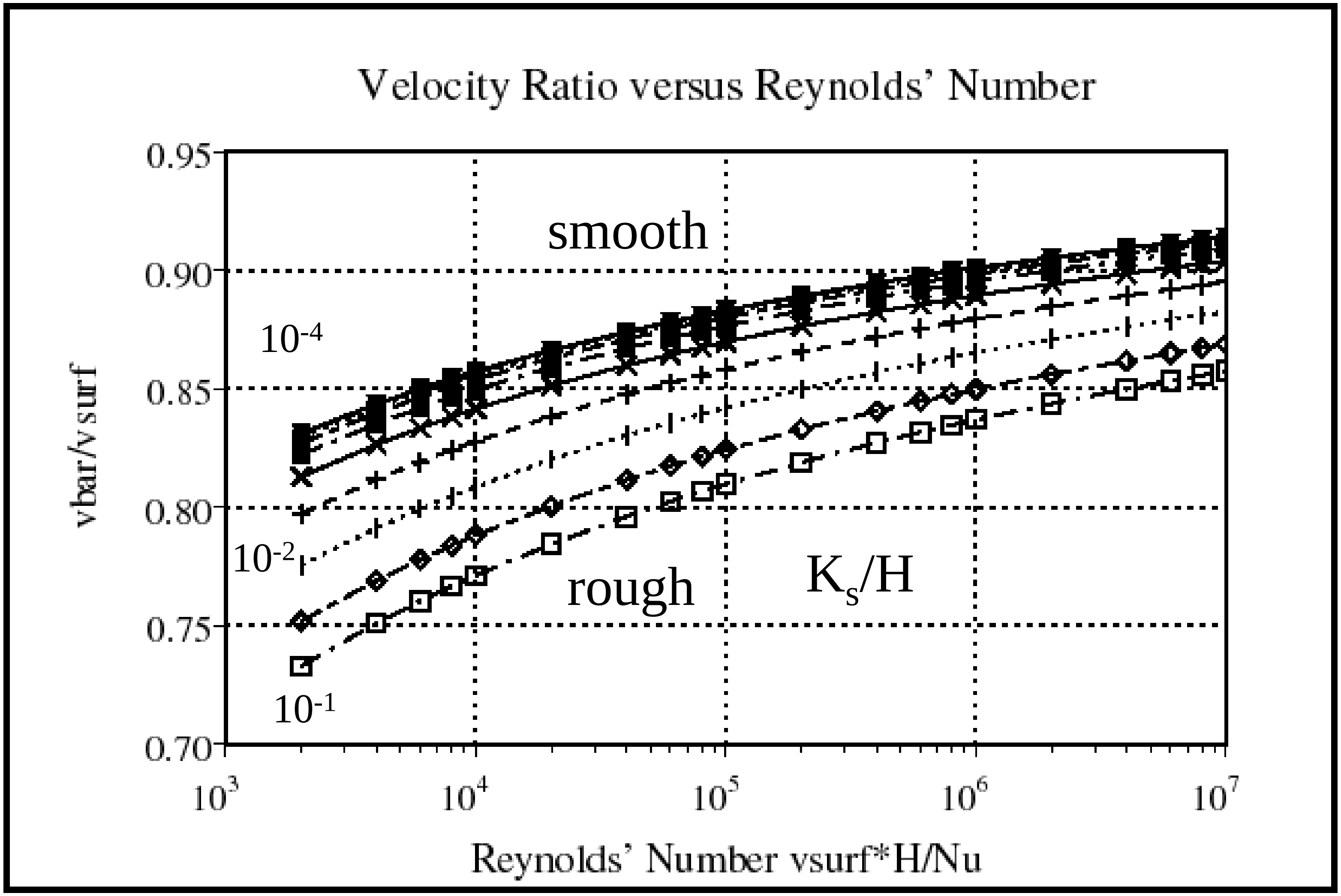
Without Contacting Water

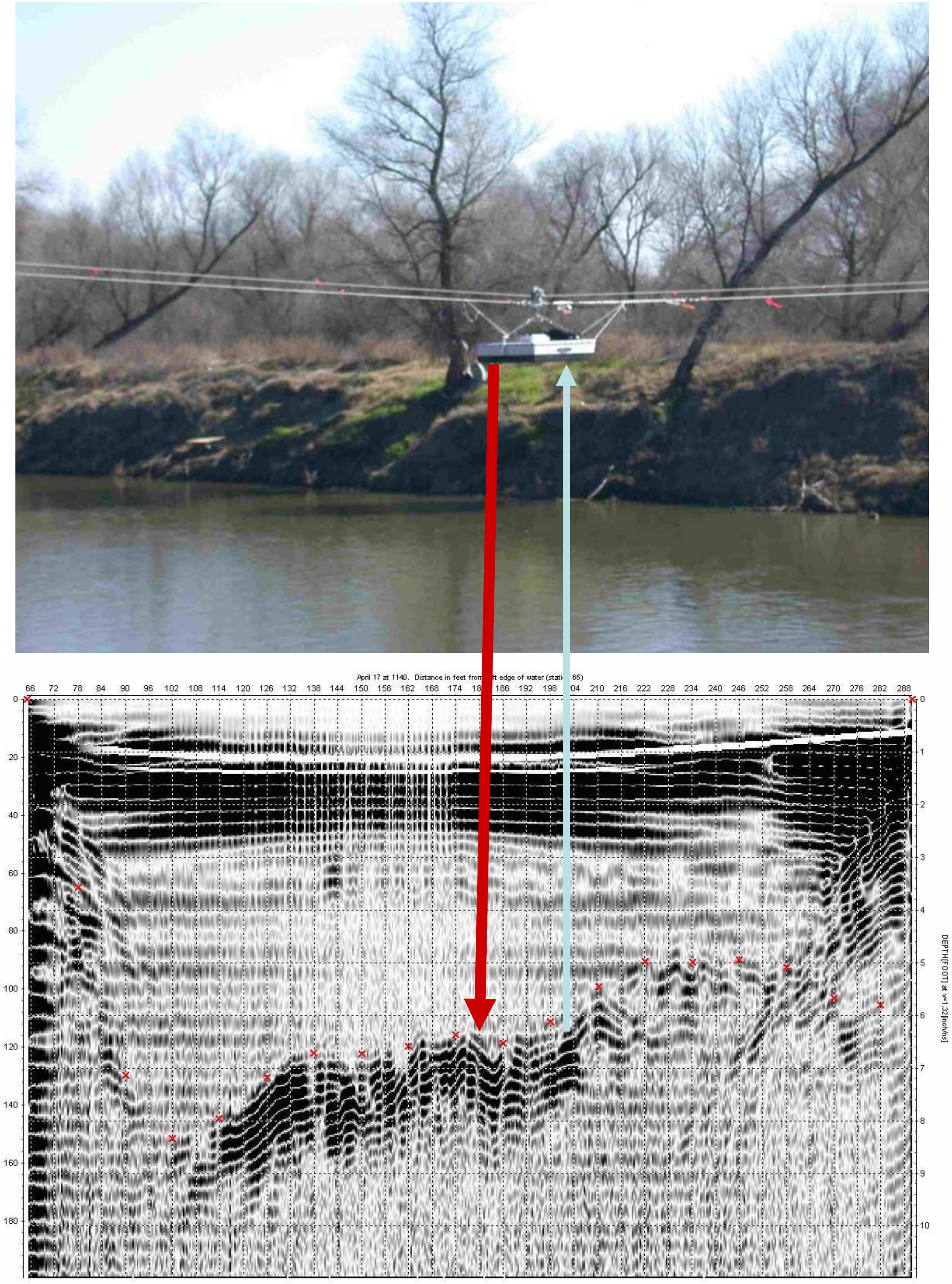
Technology	Stage	Water Depth	Mean Velocity	Surface Velocity
HF Radar	1	3	3	→ 1
LF Radar (GPR)	2	→ 1	2	3
Lasers	2	1*	2	2
Imaging (PIV)	2	3	3	2
Acoustics	1	3	2	2

Part 1: Surface Velocity



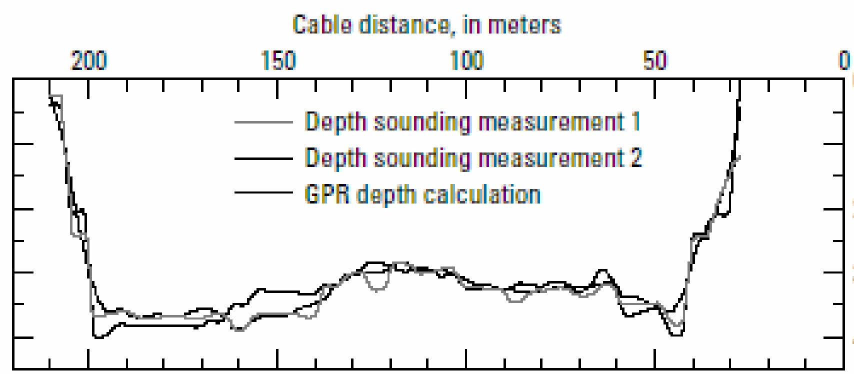
Conversion of Surface to Mean Velocity





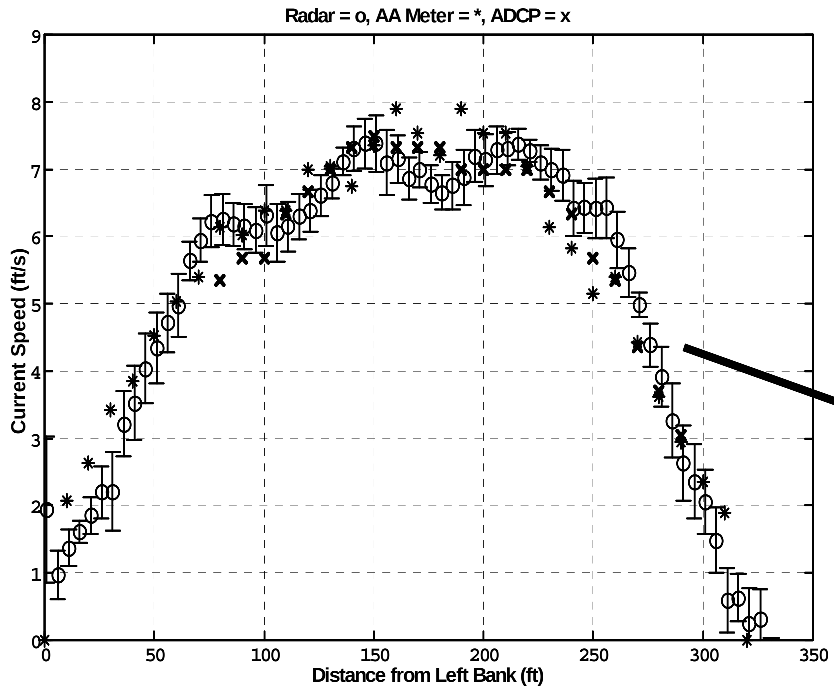
Part 2: Cross-section

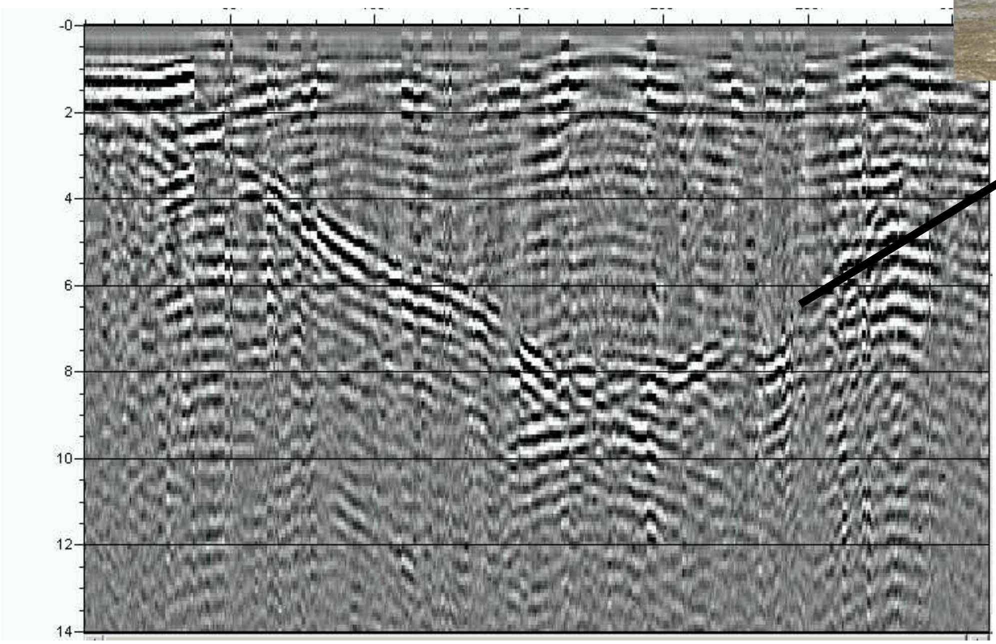
Ground Penetrating Radar Operational System;
100 MHz



San Joaquin River nr Vernalis, CA

May 2001
Cowlitz River, WA





We Learned:

You CAN measure Q from the air

2-3 m (10 ft) height 2-4 knots

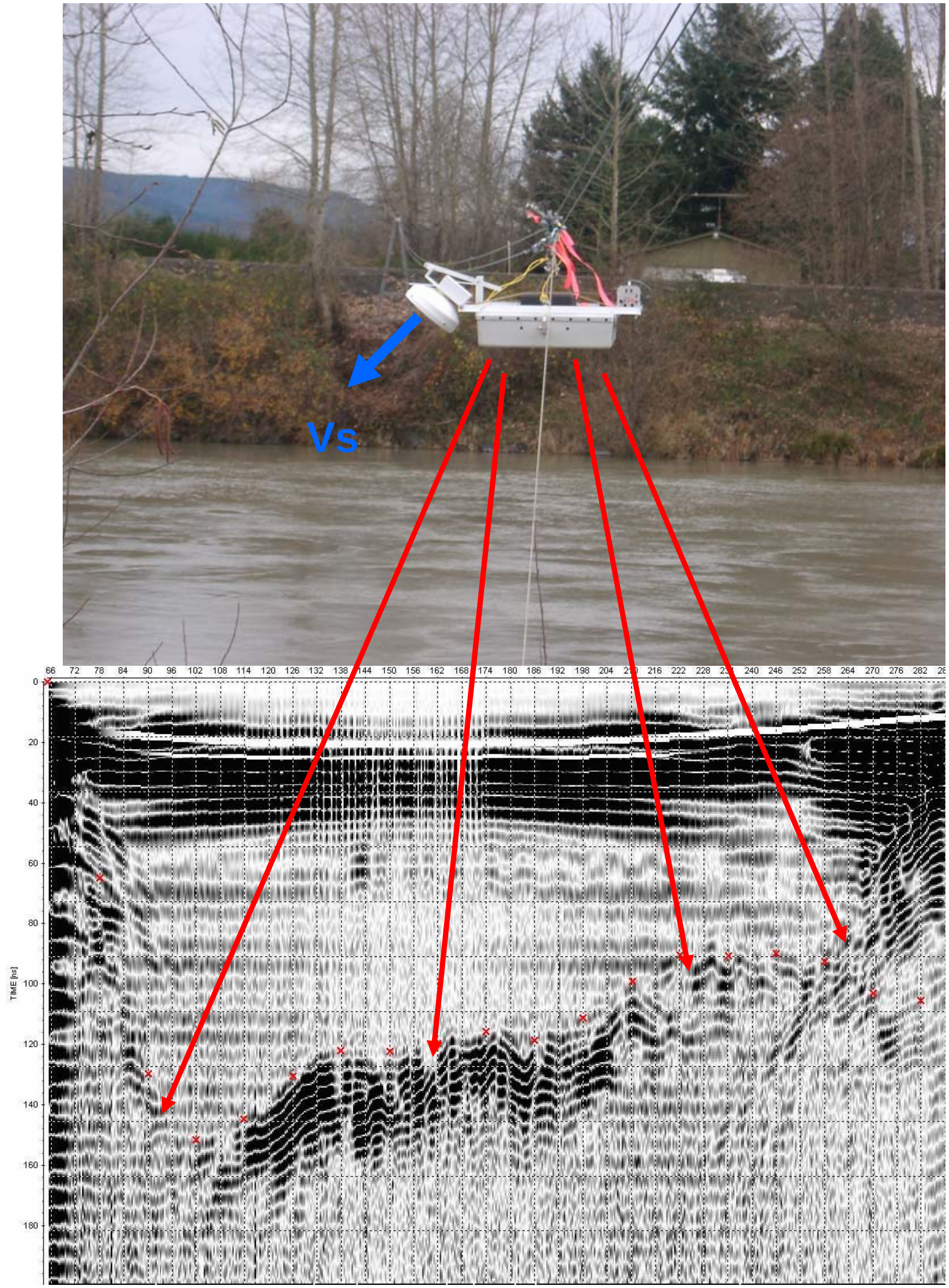
Testing RiverScat CW Radar

Nooksack River, WA Apr 2004

- USGS has 10 portable units available for use
- AA meter = 4.98 fps
- RiverScat = 5.02 fps (30 sec average)

This might be your next streamgaging station

- No rating curves
- Real-time
- Directly measuring

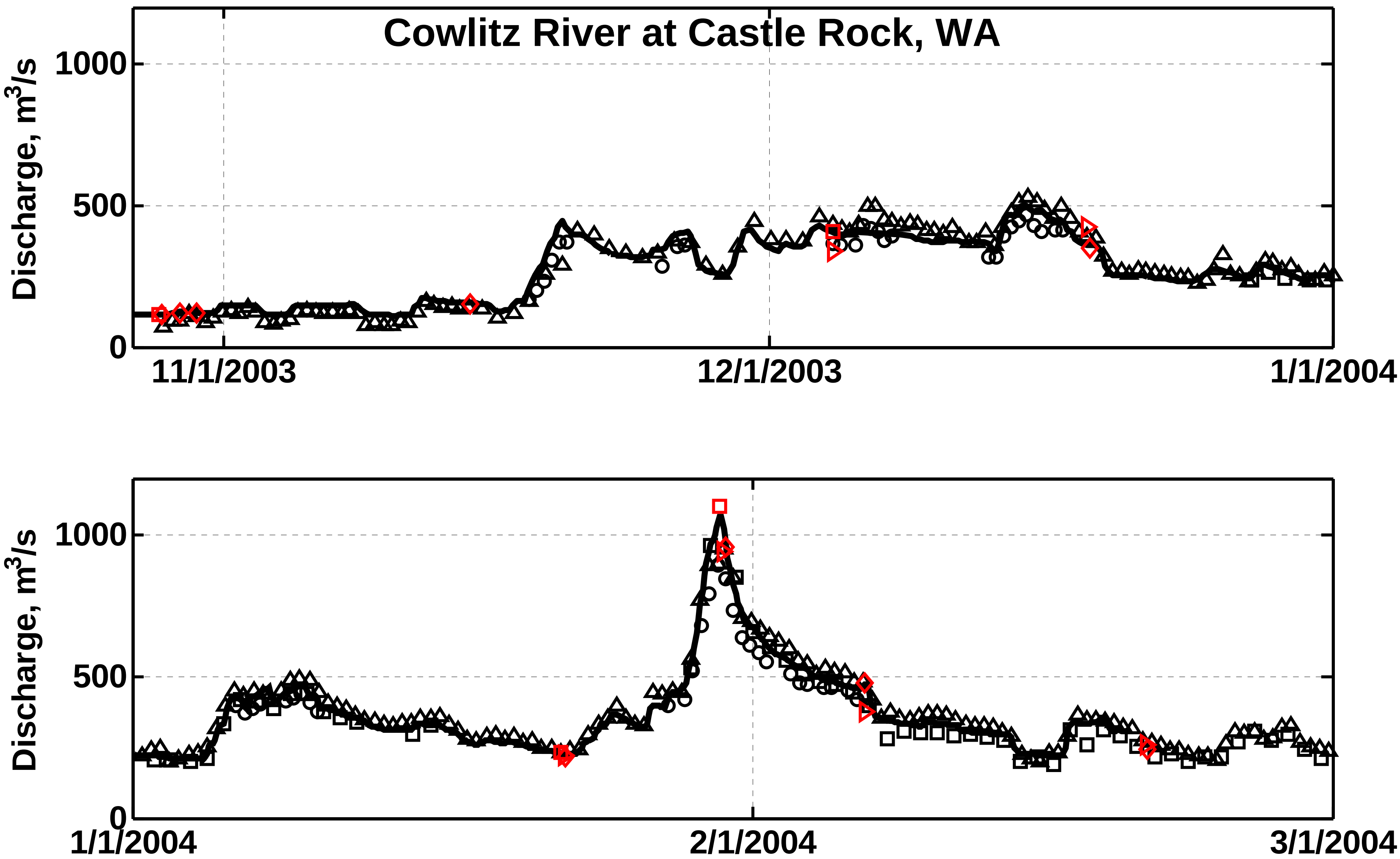


Cowlitz River, WA Experiments

To Collect Continuous Discharge Data for 4 Months

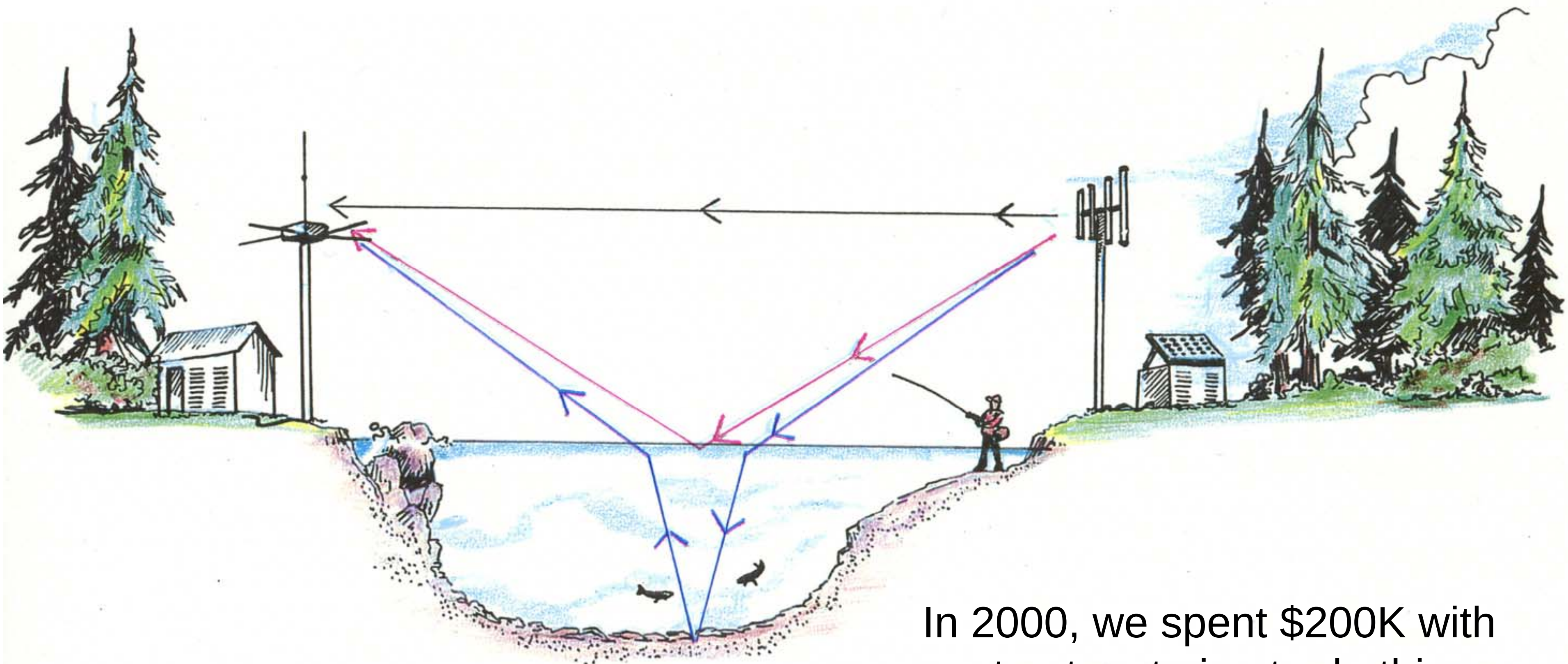

Applied Physics Lab
Univ of Washington
NSF-Supported
Continuous-wave radars
(24 GHz)


CODAR RiverSonde about
250 ft upstream of bridge
Univ of Washington RiverRad about
150 ft upstream of bridge
Univ of Washington
RiverScat, under bridge
Univ of Washington RiverScat
on GPR at cableway



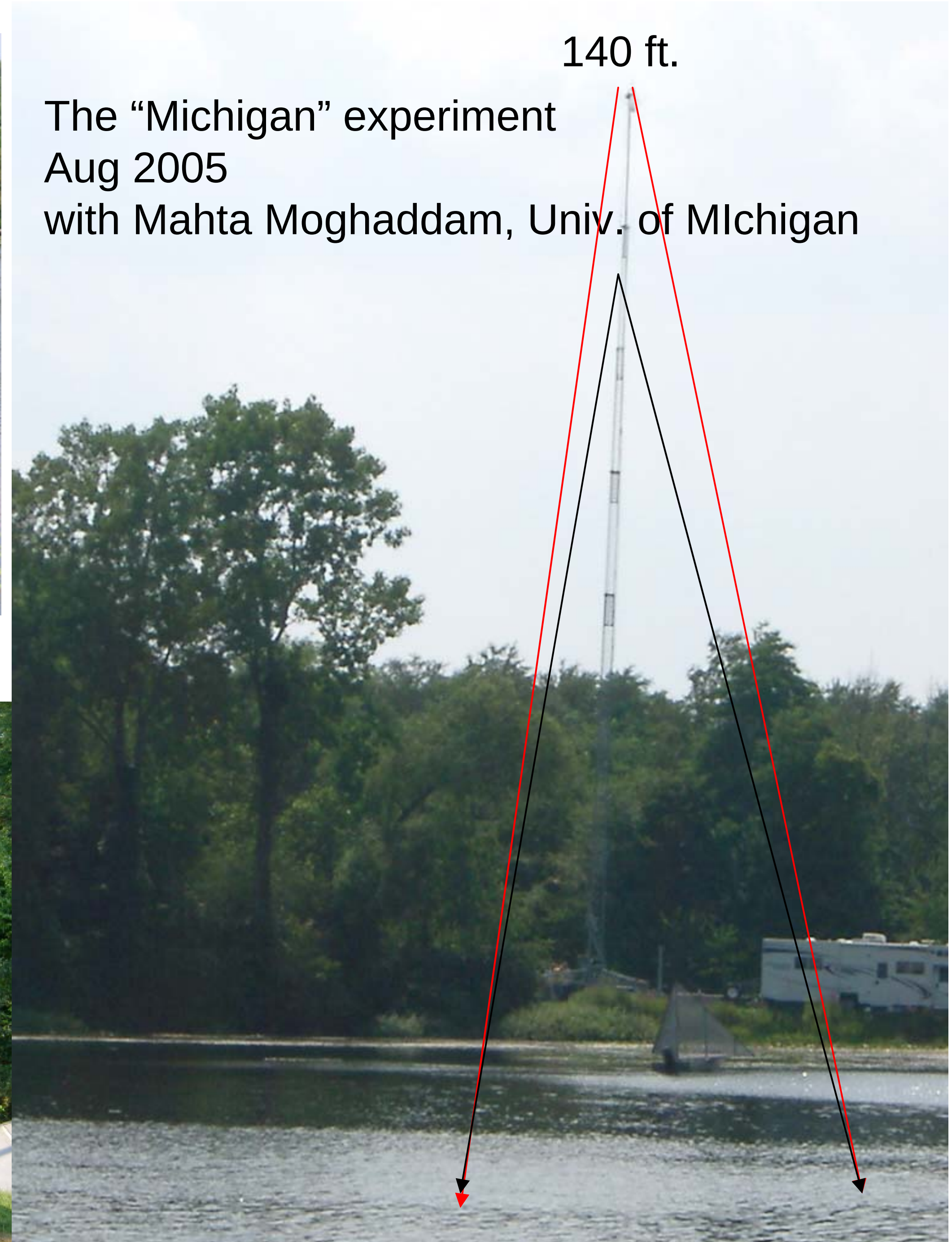
- Black squares and triangles are non-contact discharge values
- Red symbols are hydroacoustic and current meter discharge data
- Black line is gaging station record

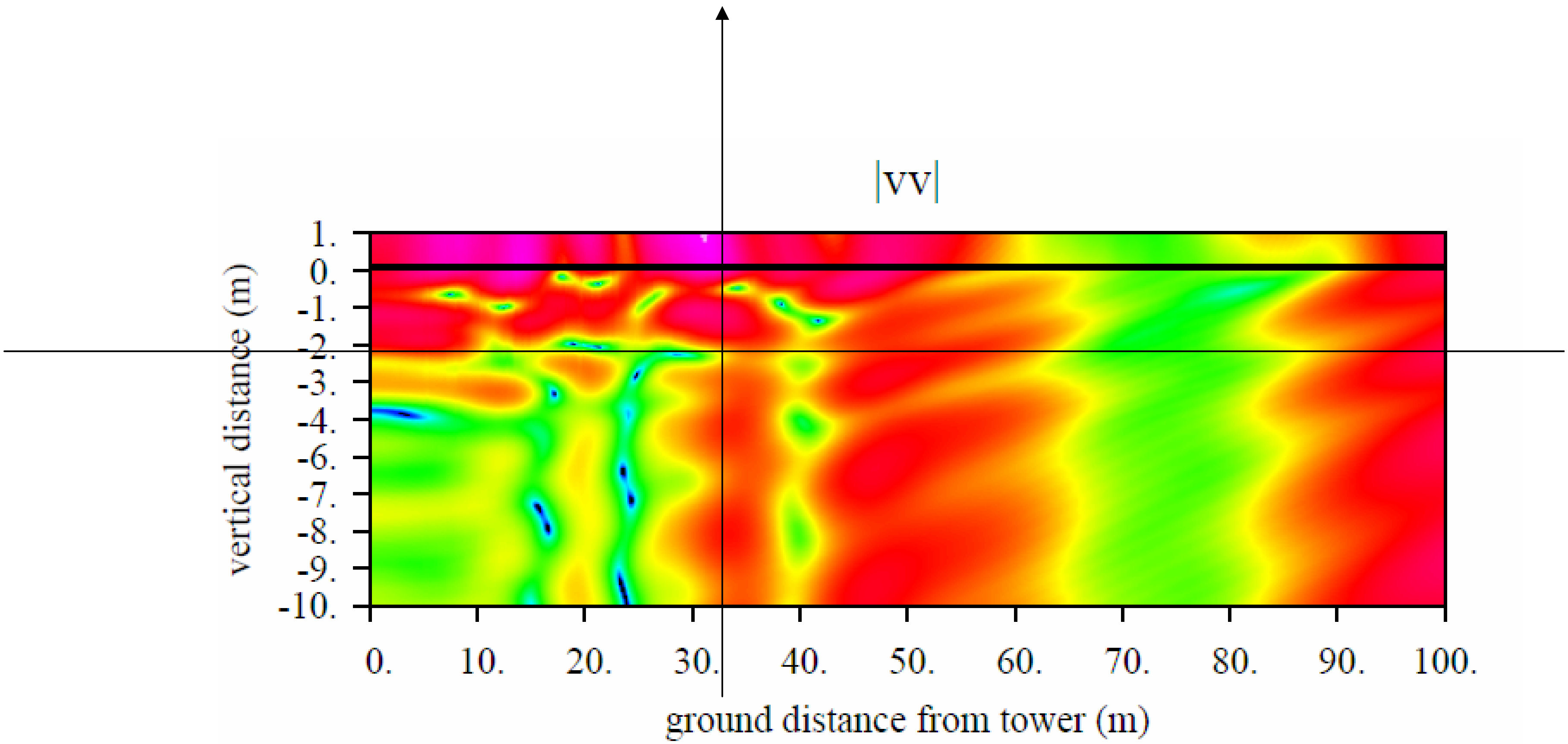
What We Still Want to Do
(but a very difficult science problem)



In 2000, we spent $200K with contractors trying to do this: complete failure

Figure 7. Sketch of the three strong transverse signals across the river. The direct signal th
reference for the delayed reflected signals from the river surface and bottom.


140 ft.
The “Michigan” experiment
Aug 2005
with Mahta Moghaddam, Univ. of MIchigan



Can see out ~ 30m f(power – milliwatts)

Welcome to the Future