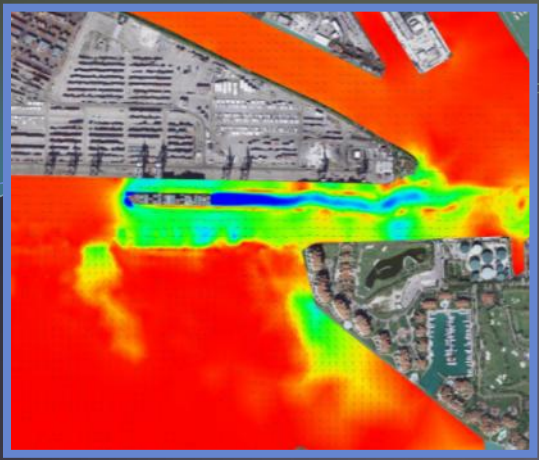


FSBPA

2011 National Conference for Beach Preservation Technology

Jacksonville, FL

SWAMPED

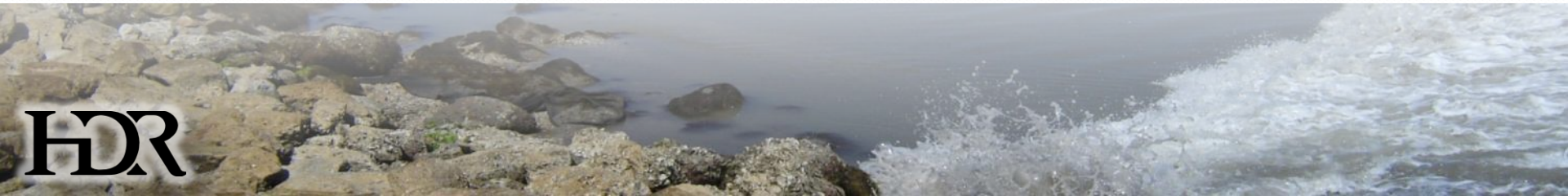
Passing Vessel Impacts for Shoreline Protection

Ronny McPherson

Wesley Dortch, P.E.

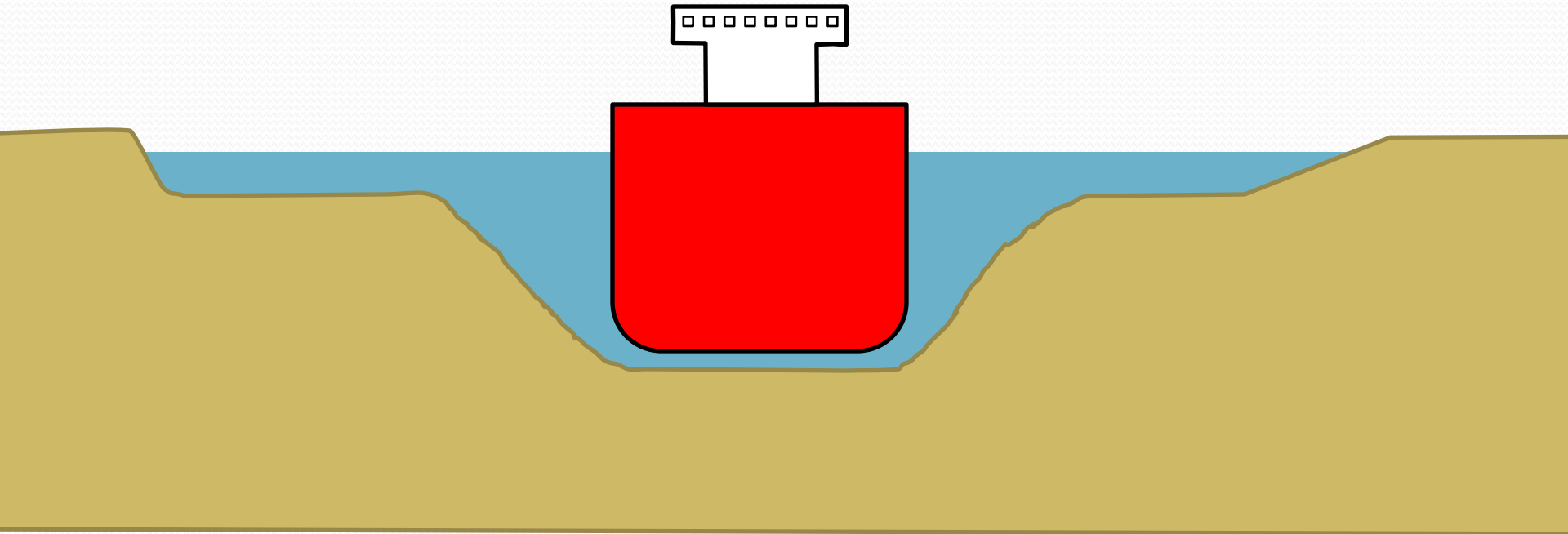
Swamped?

- Passing vessels can impart tremendous hydraulic effects (even miles away)
- Two main types of vessel effects
  - Primary Wave
  - Secondary Waves



Transverse Stern Wave (TSW)

- Primary Wave
- Long period
- Cause – Large displacement of Water



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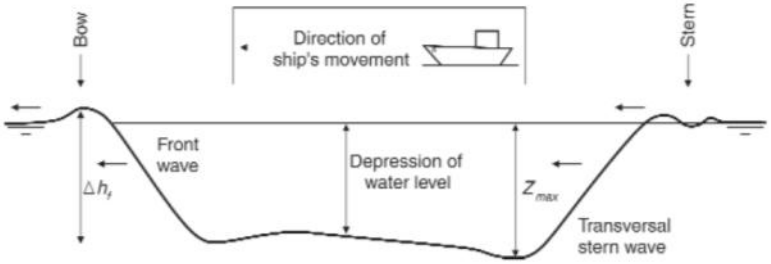


Ref: CUR 2007

Bank

Shallow

Channel

Increased Pressure

Decreased Pressure

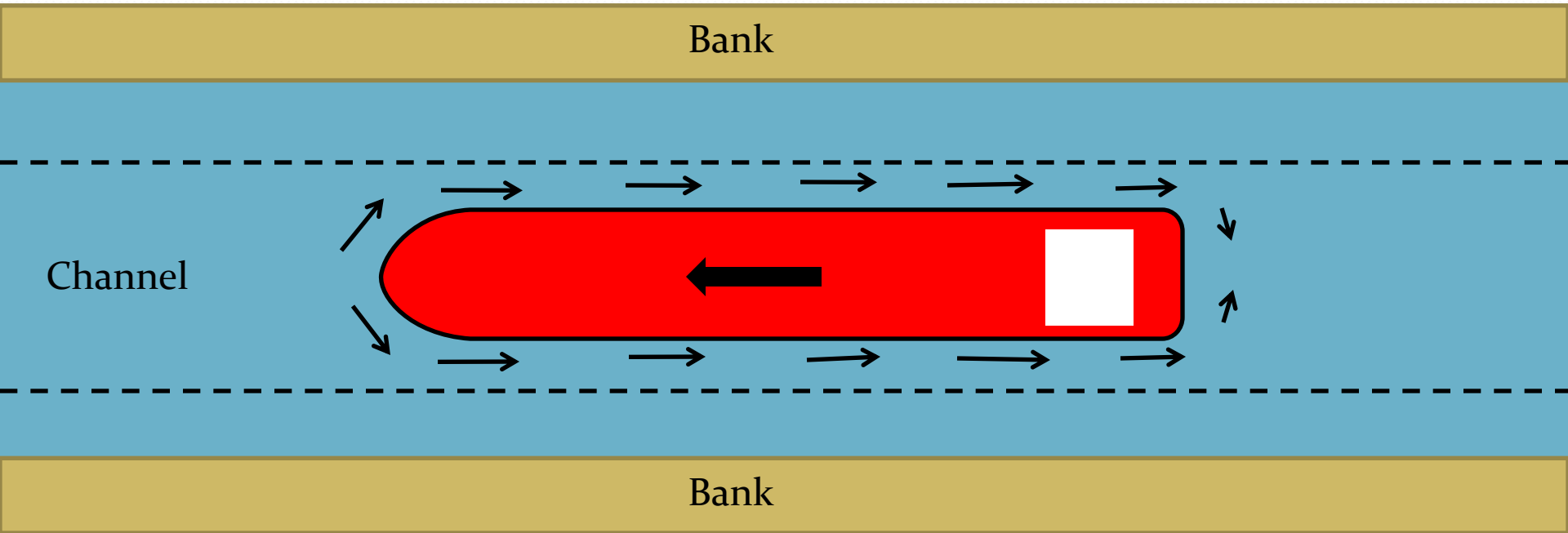
Shallow

Transverse Stern Wave (TSW)

- Drawdown and Surge

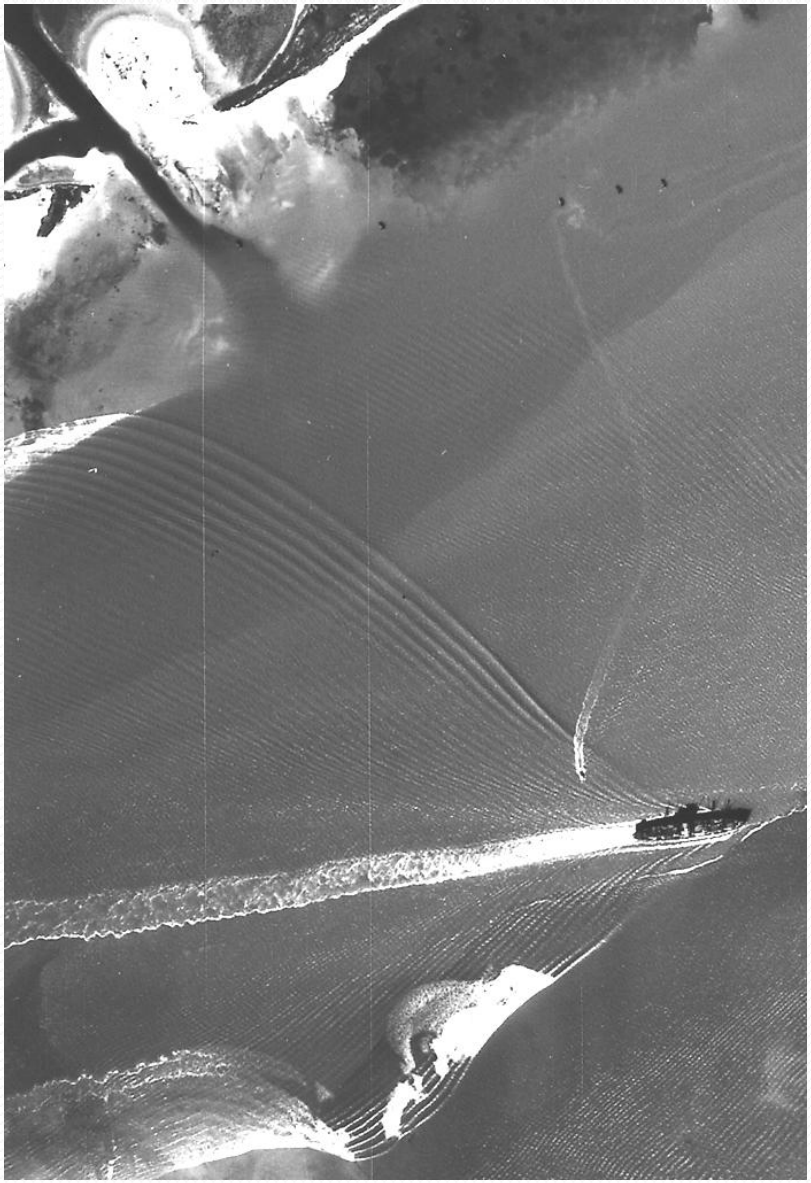
Return Current

- General near the ship
- Water displaced in front of the vessel returning to rear of the vessel (bow to stern)
- Not usually a concern for shoreline far from ship



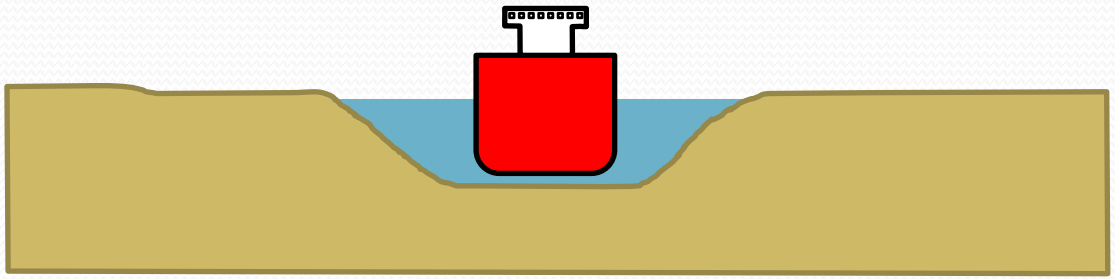
Divergent Wave

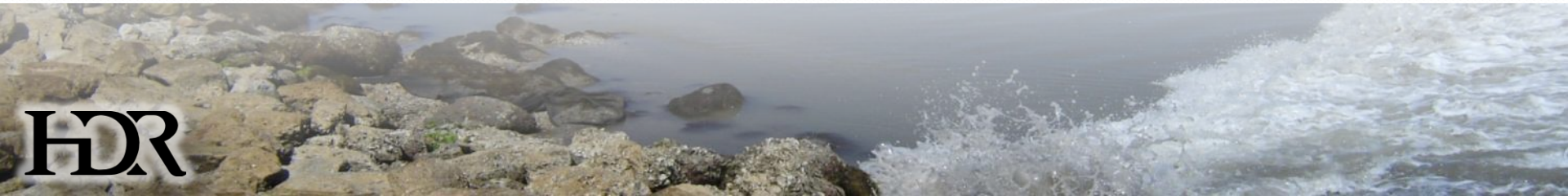
- Secondary Waves
- Short Period
- Commonly known as “wake”
- Smaller vessels can create significant wakes (ex. Tugs, Yachts not on plane)



The Well Studied Case

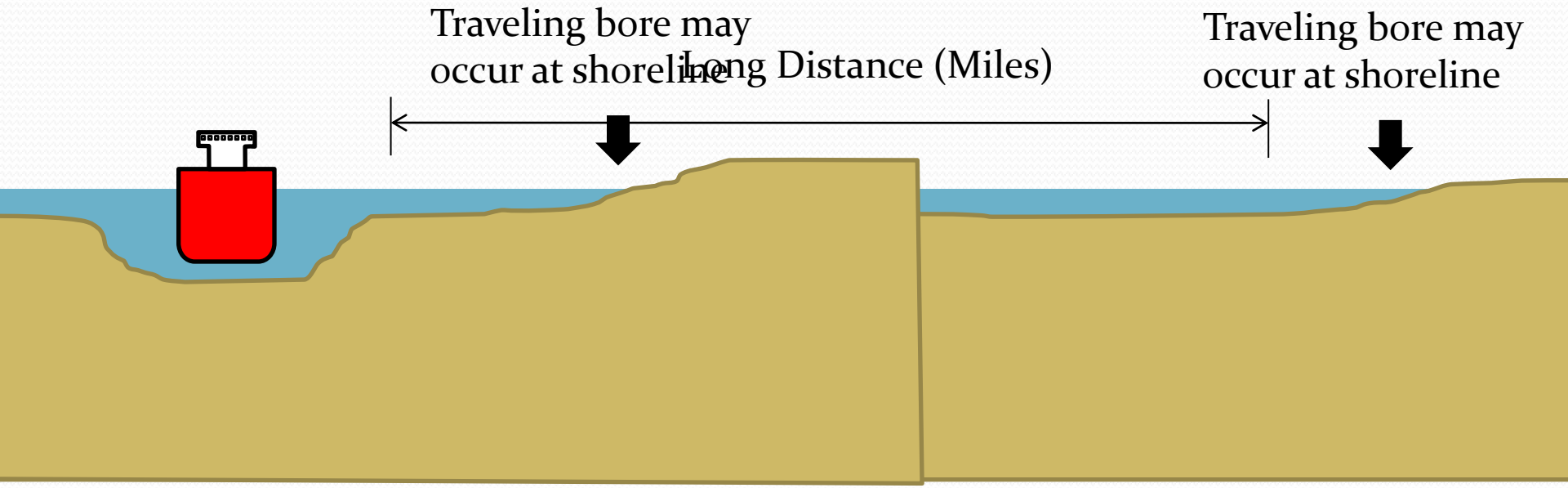
- Confined navigation channel
- Well developed analytical solutions
  - TSW
  - Return current
  - Divergent waves

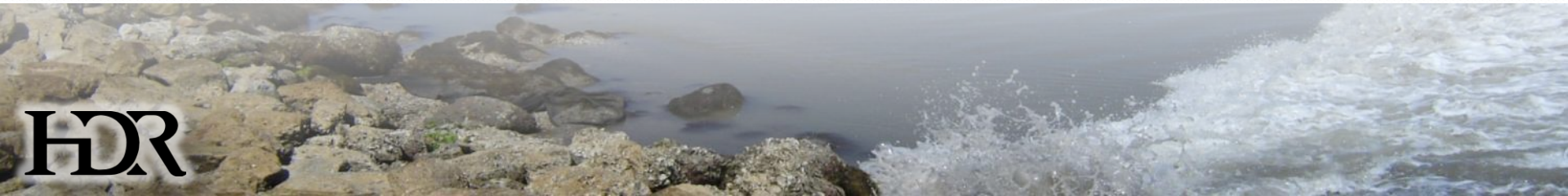




Not Well Understood Case

- Areas far from navigation channel affected



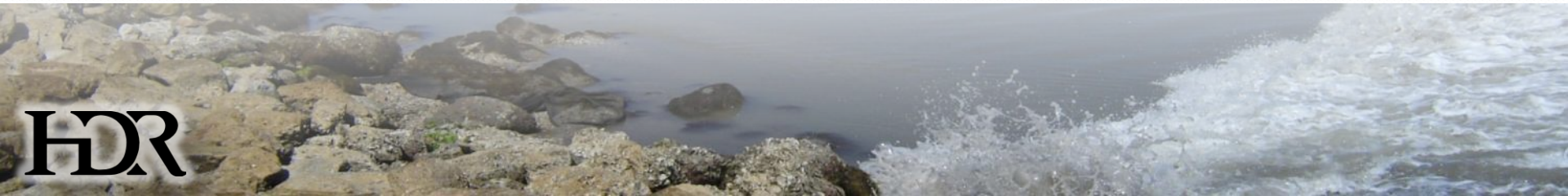


Not Well Understood Case

- Open body of water with navigation channel
- No analytical solution
- Too many parameters

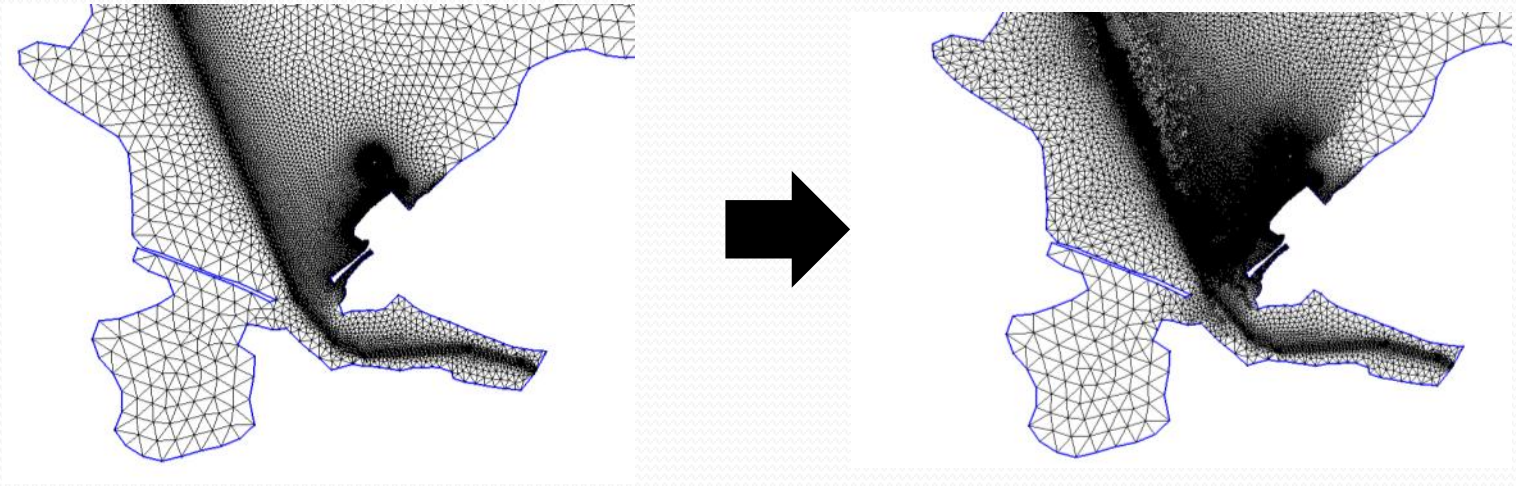
Shoreline Protection Design

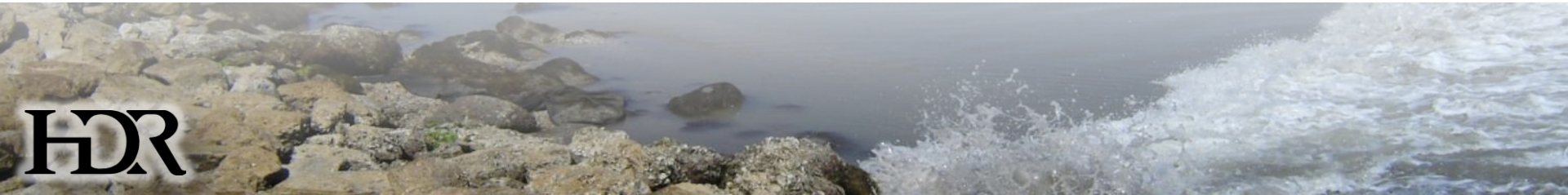
- Cause of bank erosions
- Cause of localized scour (pre or post construction)
- Additional element in shore protection design
  - Affect stability analysis
  - Affect shore protection design (toe width, toe height, etc.)
- How can this be quantified?



ADH Numerical Model

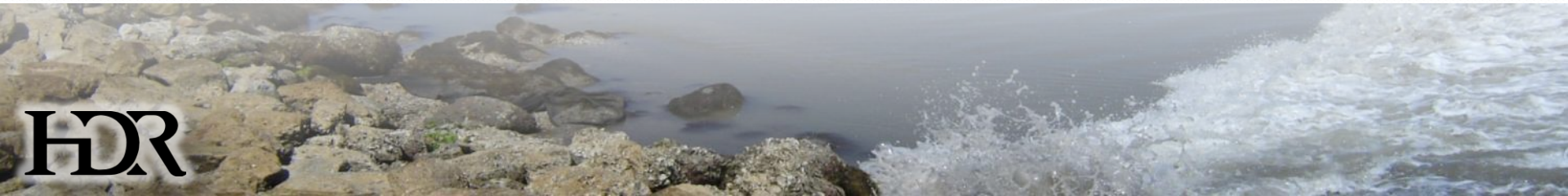
- ADaptive Hydraulics Modeling System
- Developed by the USACE
- Simulate multiple vessel movements



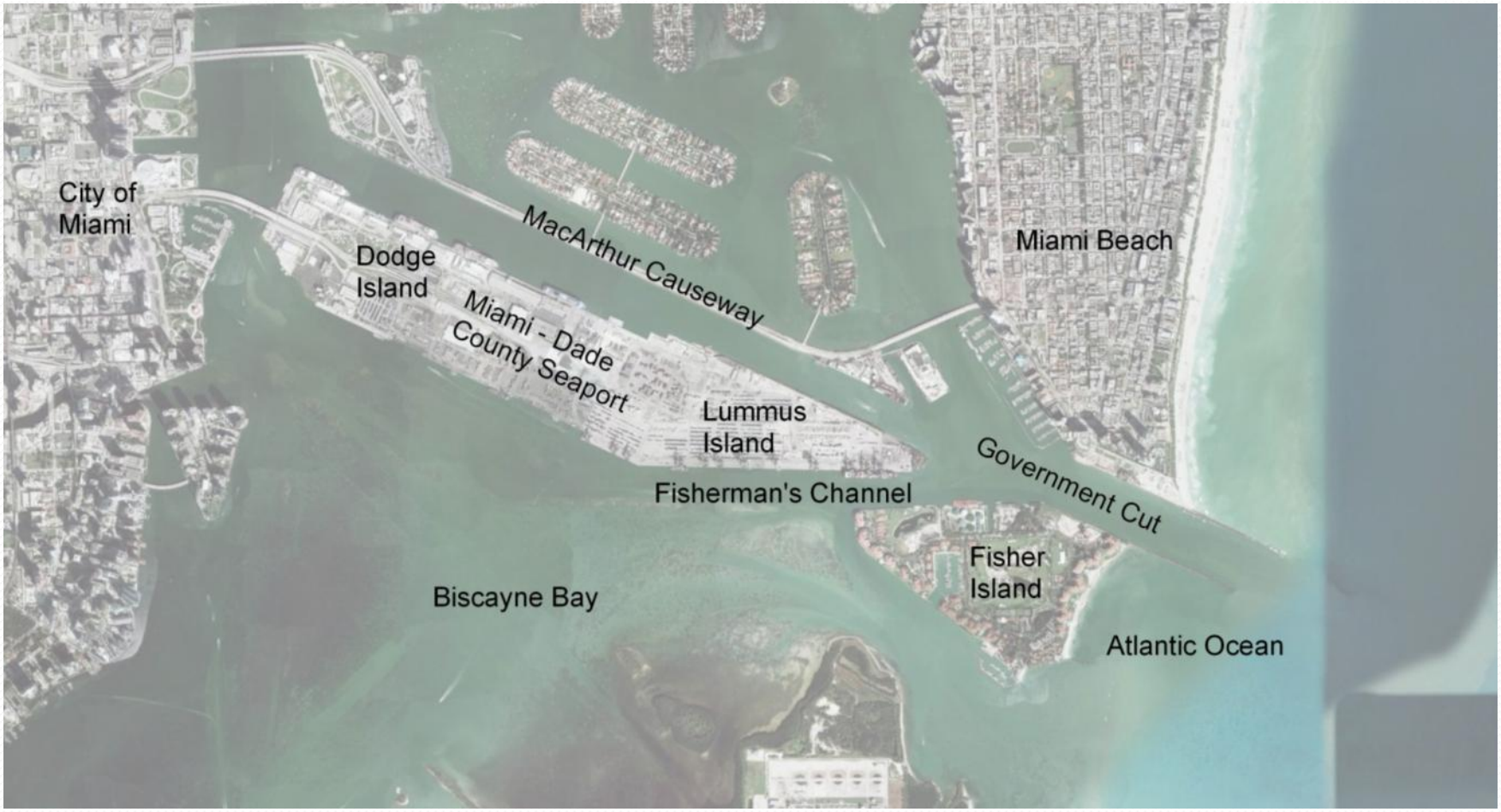


ADV Underwater Instrument

- Acoustic Doppler Velocimeter
  - Measures current velocity
  - Direction - 3 dimensions
  - Single point
- Sync with OBS (Optical backscatter device)
  - Measure turbidity
- Use to calculate forces directly at site
- Use to assist in numerical modeling



Case Study: Port of Miami

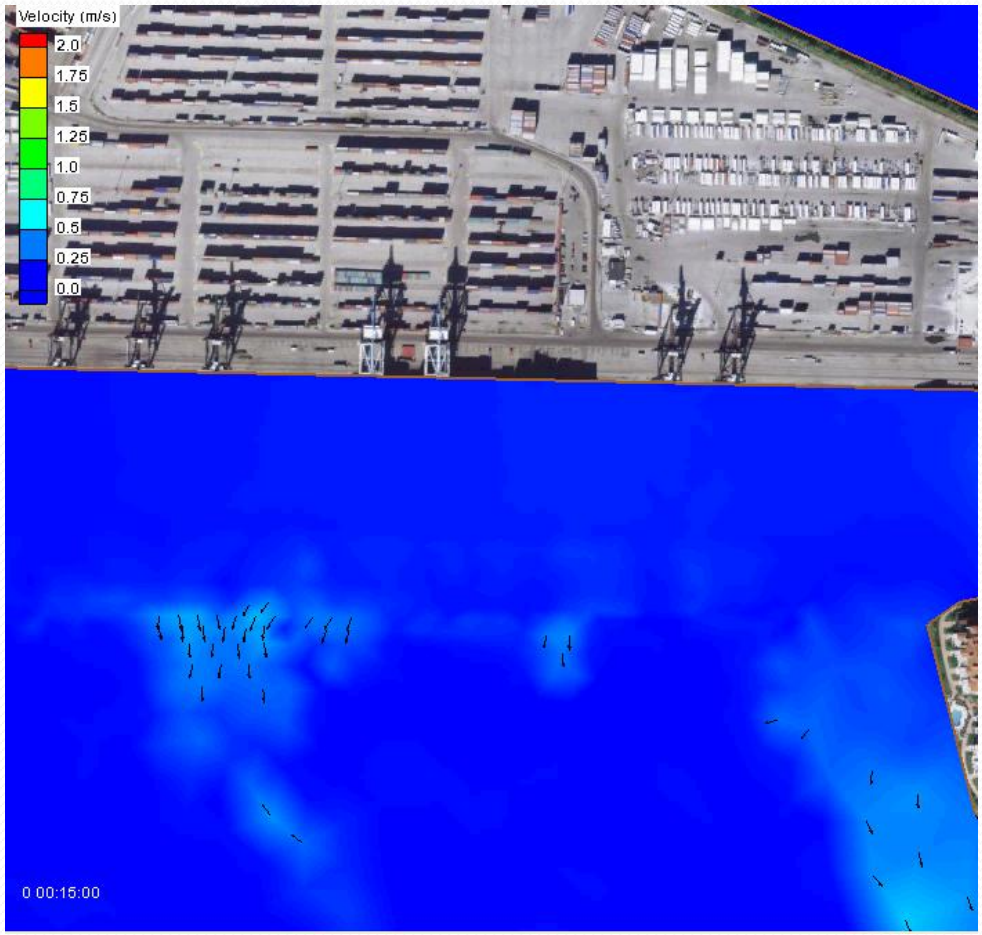


Port of Miami

- Increase size navigation channel
- Leads to increase ship size
- Not the “well studied” case

Port of Miami

- Used ADH model (not calibrated)
- Compared to analytical solution at constricted section of Fisherman's channel – good match

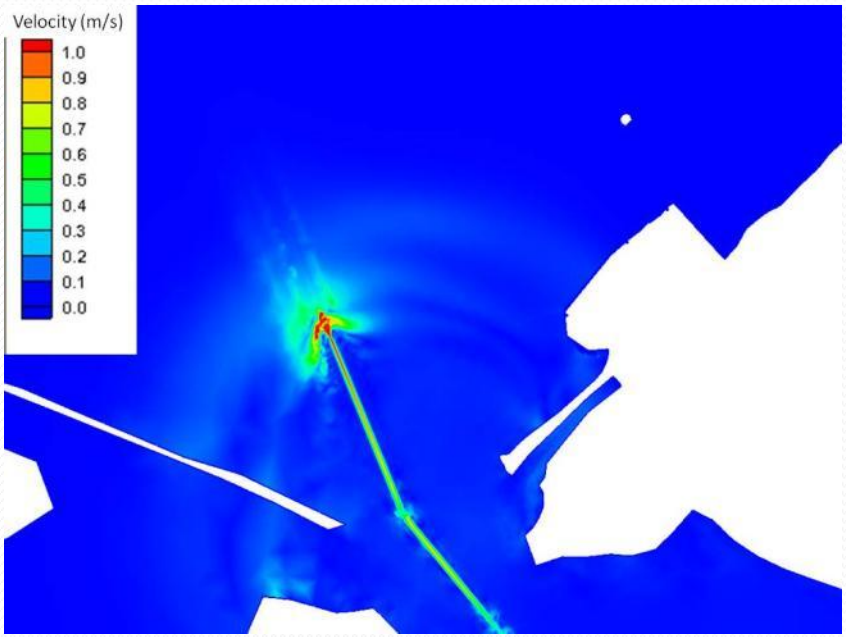


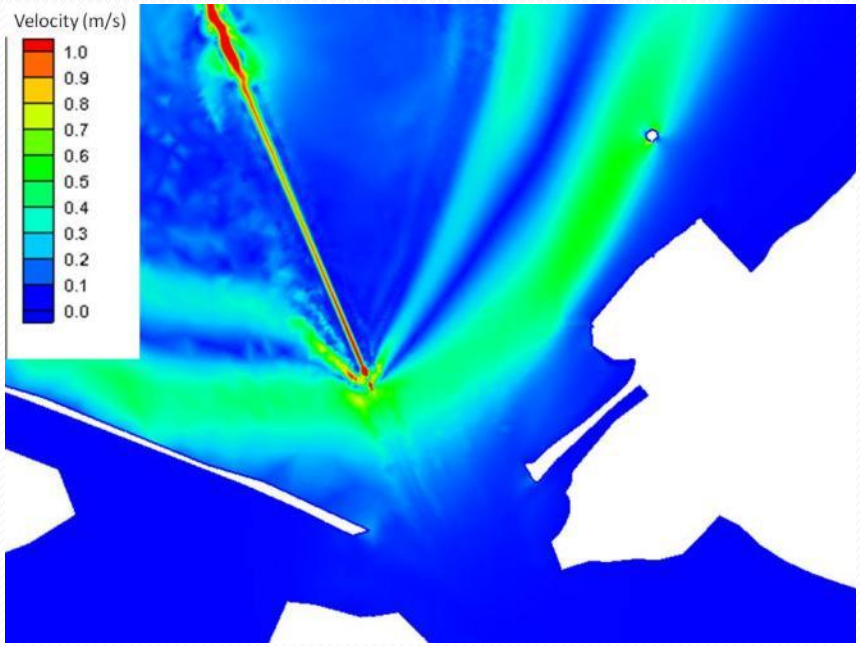
Case Study 2: Galveston Bay

- Project Location

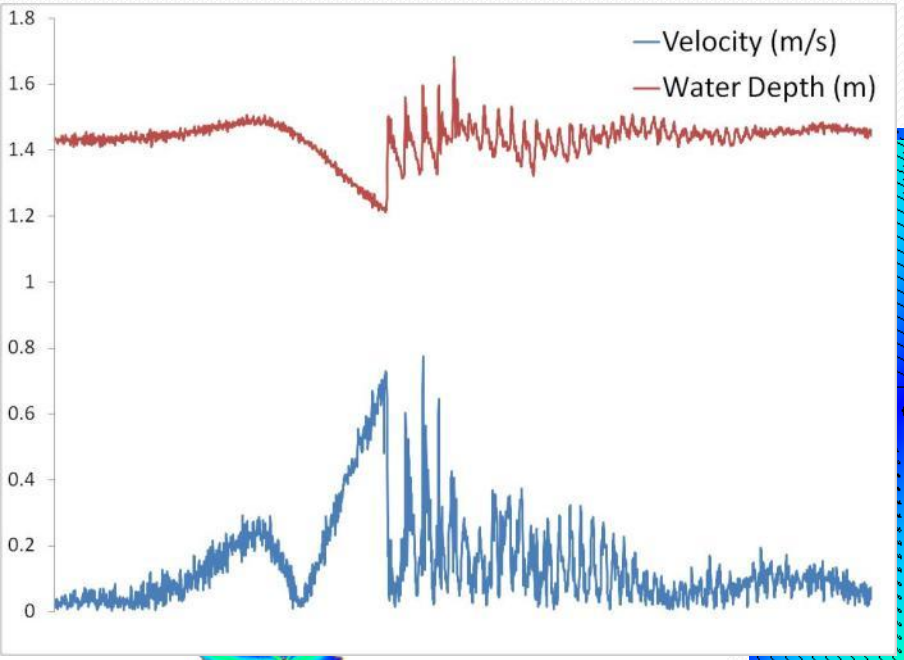
Galveston Bay

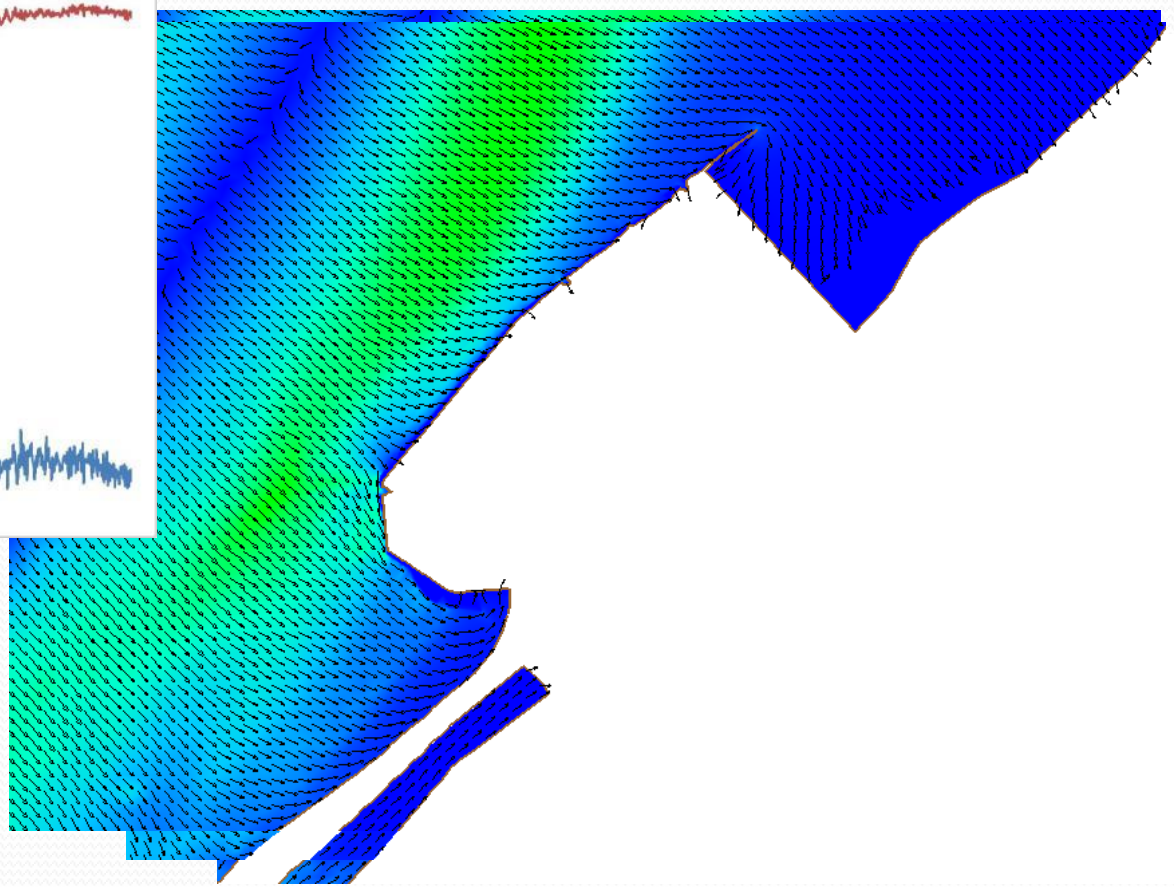
- Used ADH model (not calibrated)
- Compared to measured data from ADVs
- Good agreement

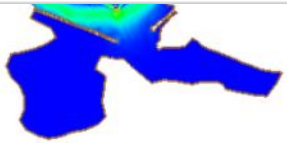


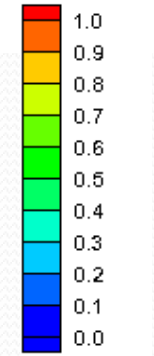


Galveston Bay





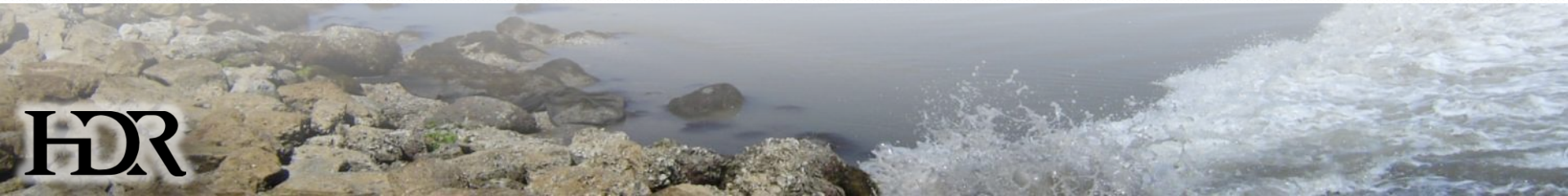




Galveston Bay

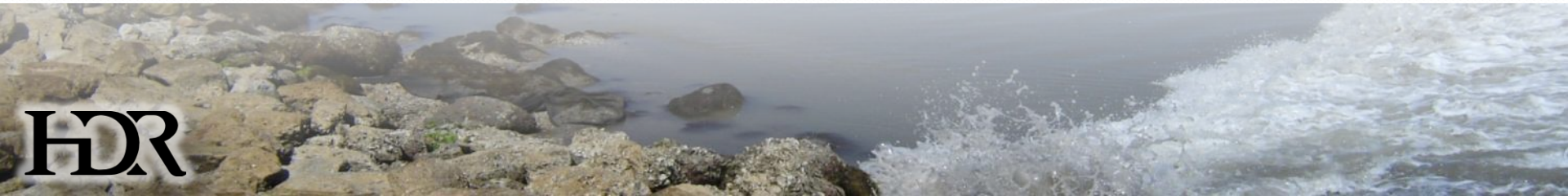
- Preliminary Results
  - Measurements based on 24 passing vessel events at 5 varying locations
  - Modeled results based on 2 ship types traveling both inbound and outbound (4 model runs)

Vessel Effect	Measured Minimum	Measured Maximum	Measured Averaged	Modeled
Current	1.4 ft/s	4.7 ft/s	2.9 ft/s	1.3 - 3.3ft/s
Transverse Stern Wave	0.4 ft	1.5 ft	0.9 ft	0.5 - 1.0 ft (Outbound) 0.1 ft (Inbound)

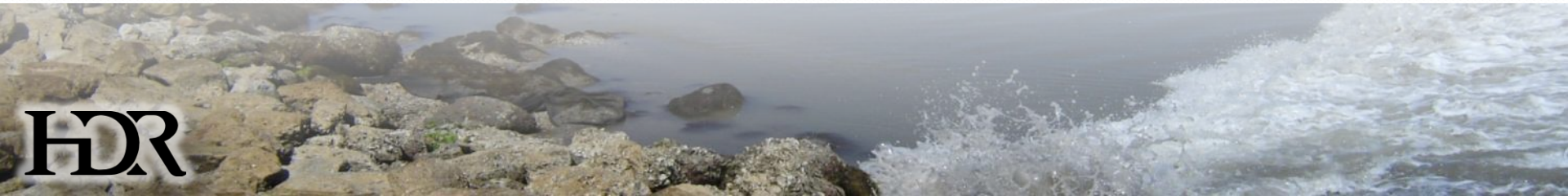


Conclusion

- Vessels can create large erosional forces on shorelines (even at a far distance)
- Technology can help reduce the uncertainty
  - ADH Numerical model
  - Field Measurements (ADV)
  - Use results to better quantify processes and adapt design to forces/scour



Thank You



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