

*Science, Service, Stewardship*



# **Objective Delineation of Untrawlable Areas in Alaska Bottom Trawl Surveys**

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# Advantages:

- Knowledgeable and Experienced Captains
- Experienced Crew (critical for gear maintenance and safety)
- Cost savings
- Flexibility
- Standardization of methods



So, what might effect the decision on trawlability?

### **Different vessels**

- Different echosounders/frequencies
- Different settings
- Vessel characteristics (e.g., pitch/roll)
- Noise sources

### **Different captains/crew**

- Bottom trawling experience (especially with survey gear)
- Net-mending experience

**Trawlable?**

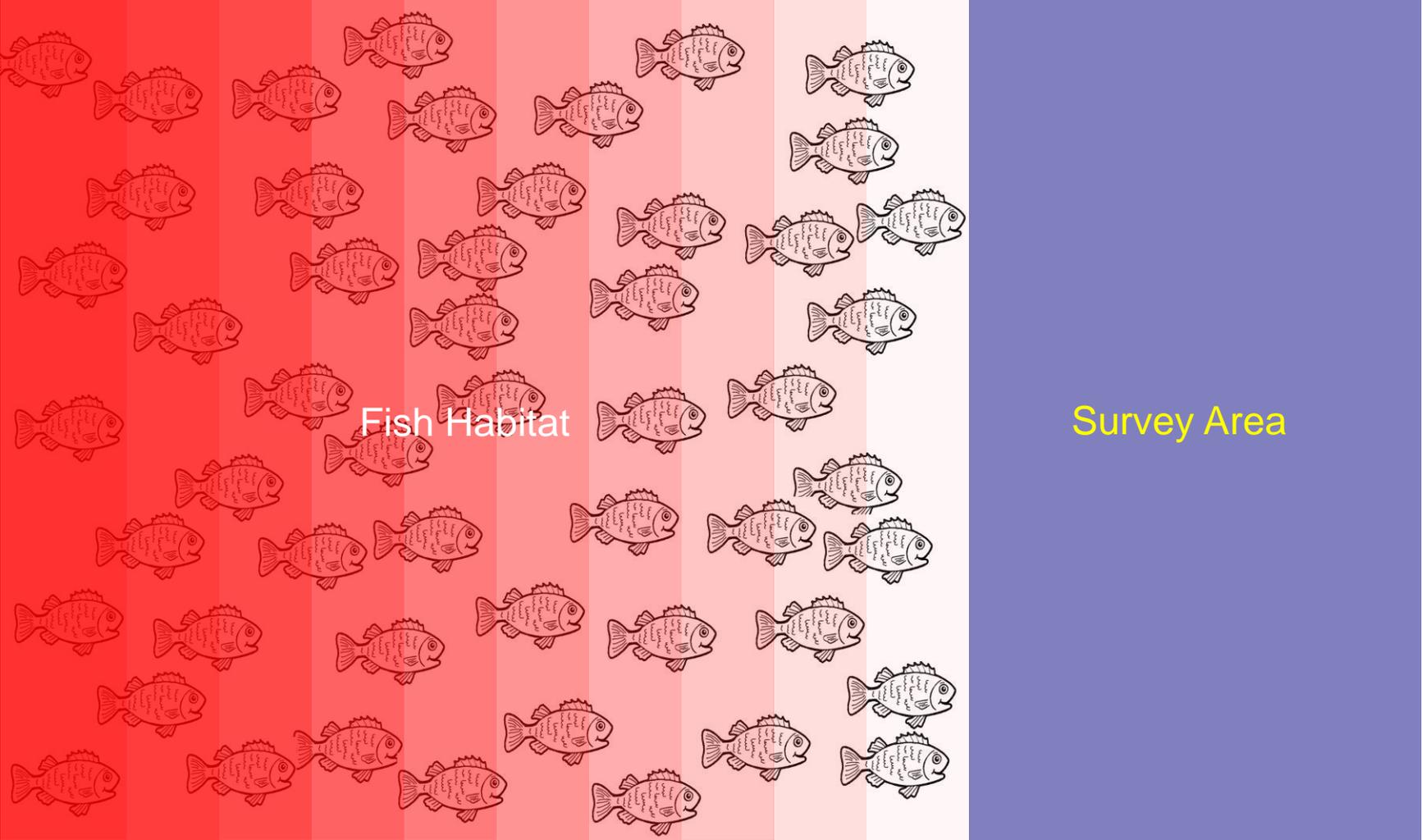
### **Recent experience**

- Recent gear damage
- Difficulty finding tow in stratum

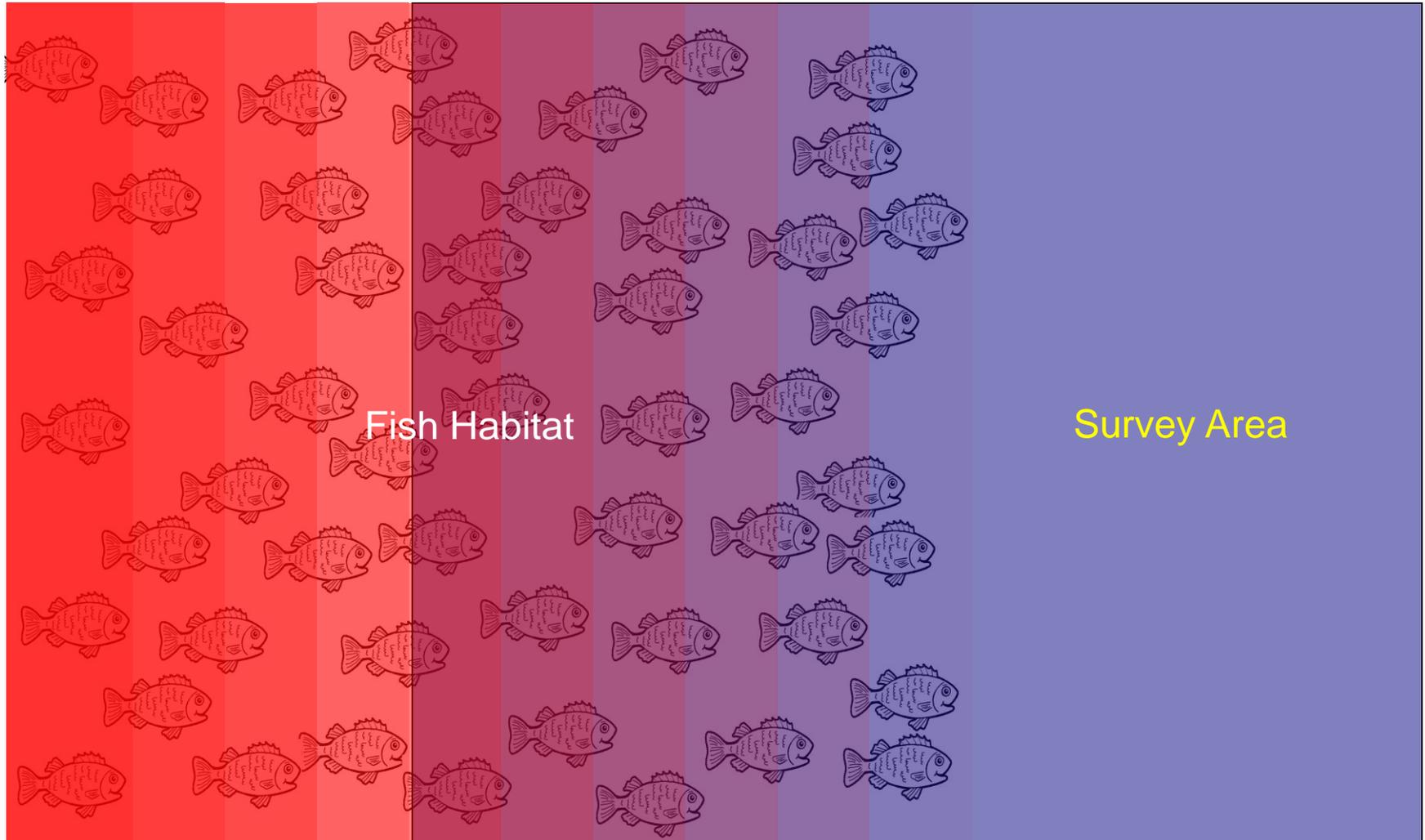
### **Current conditions**

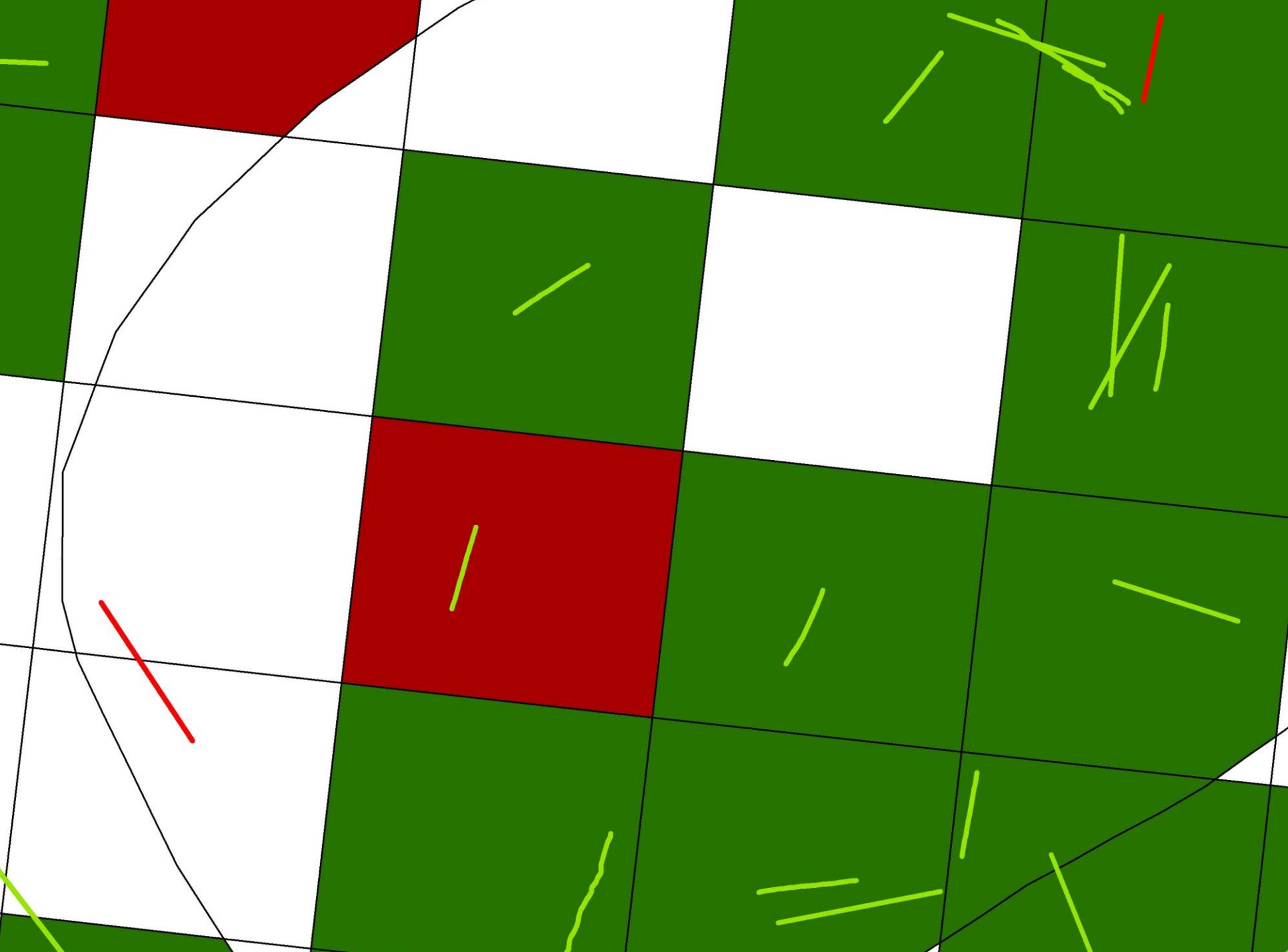
- Sea state
- Time of day
- Distance to next station

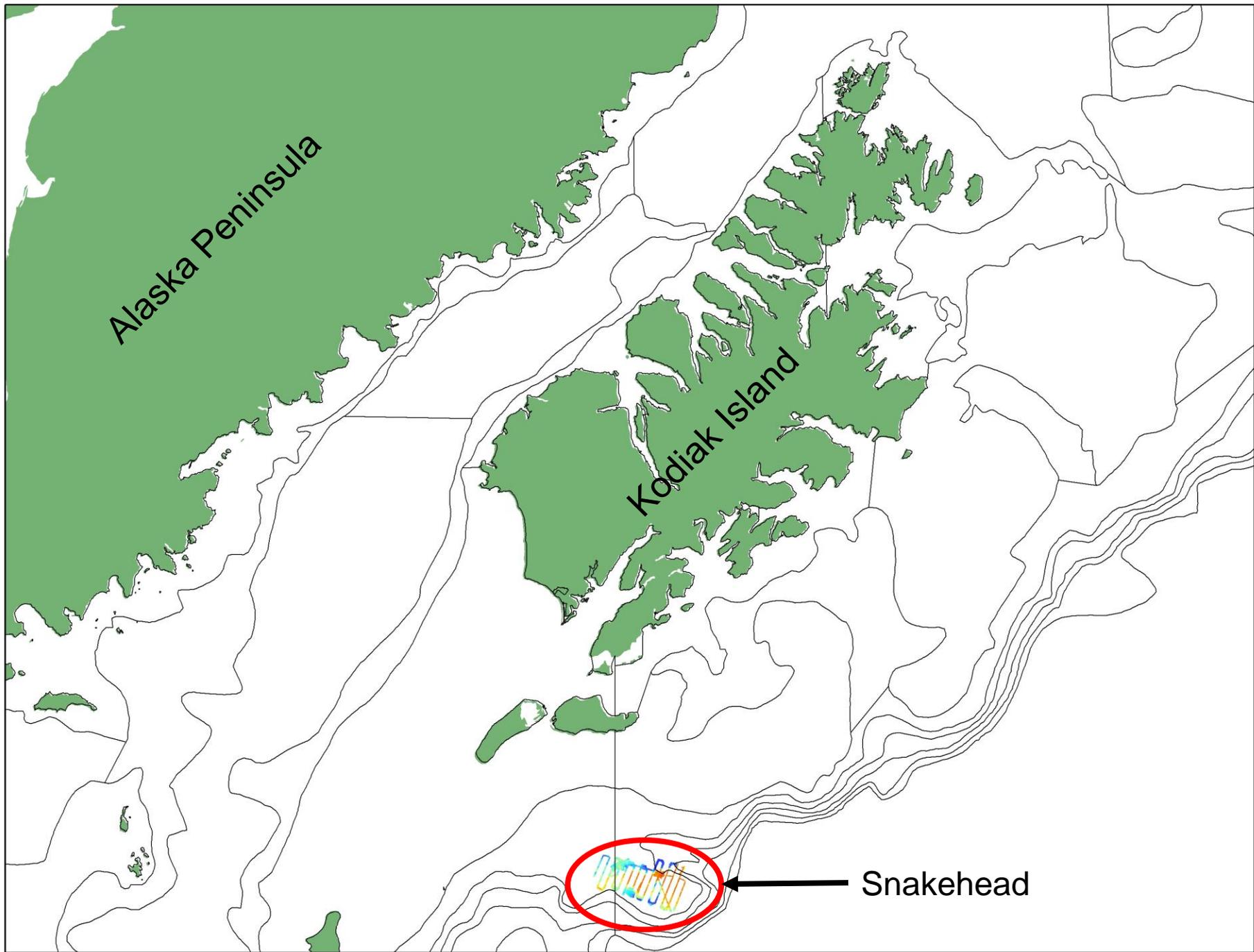
# Most Risk-Averse Captain



# Less Risk-Averse Captain







# Methods

## Oscar Dyson

### Multibeam data (Simrad ME-70)

- 31 beams
- 73-117 khz
- Pulse length 1.536 ms
- Athwartship coverage  $\pm$  65 degrees

### Split-beam data (EK-60)

- 5 frequencies (18, 38, 70, 120, 200 khz)
- 38 khz used for rockfish backscatter estimates
- 1 second ping rate
- 0.512 ms pulse length

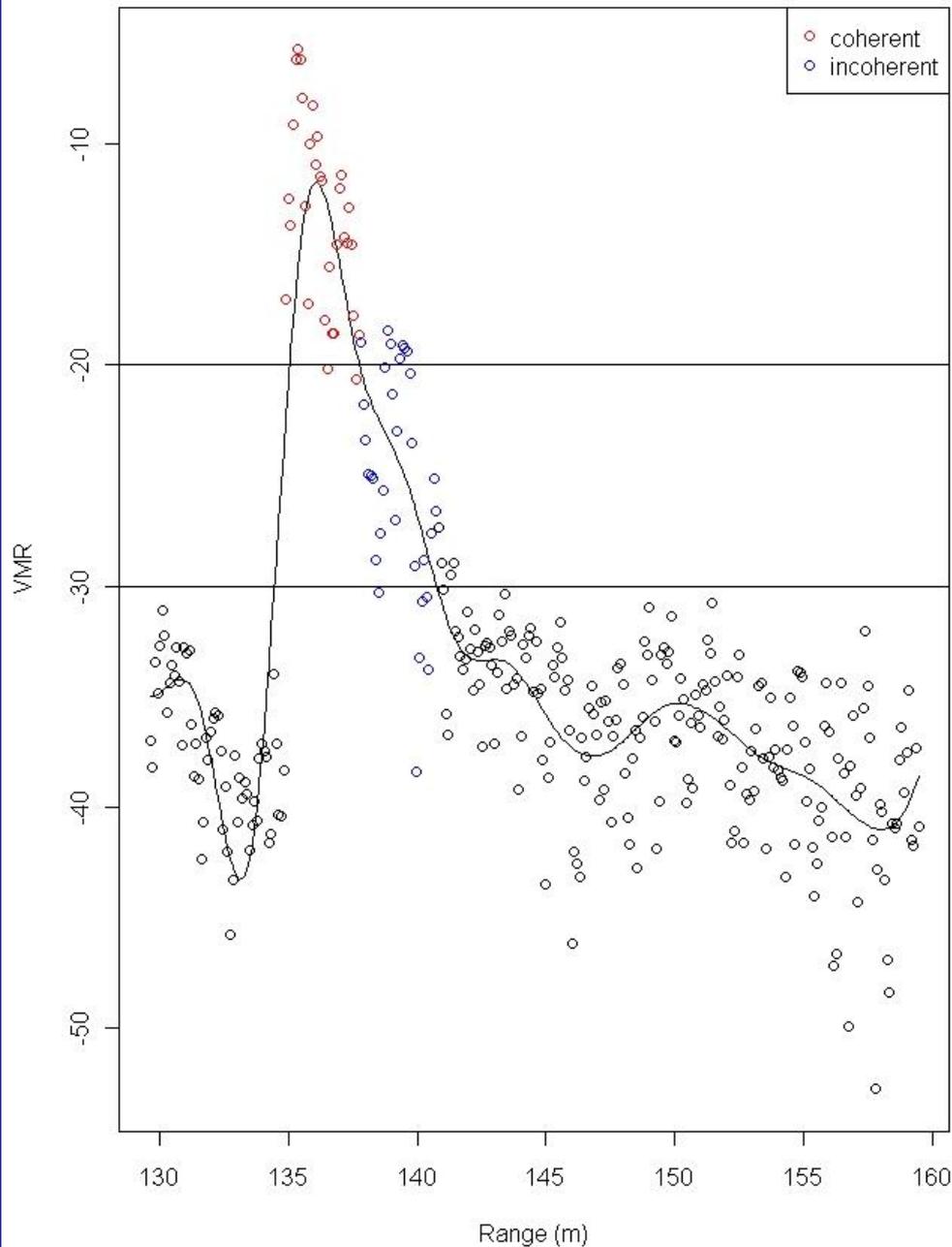
### ROV (Phantom DS4)

## Epic Explorer

Trawl

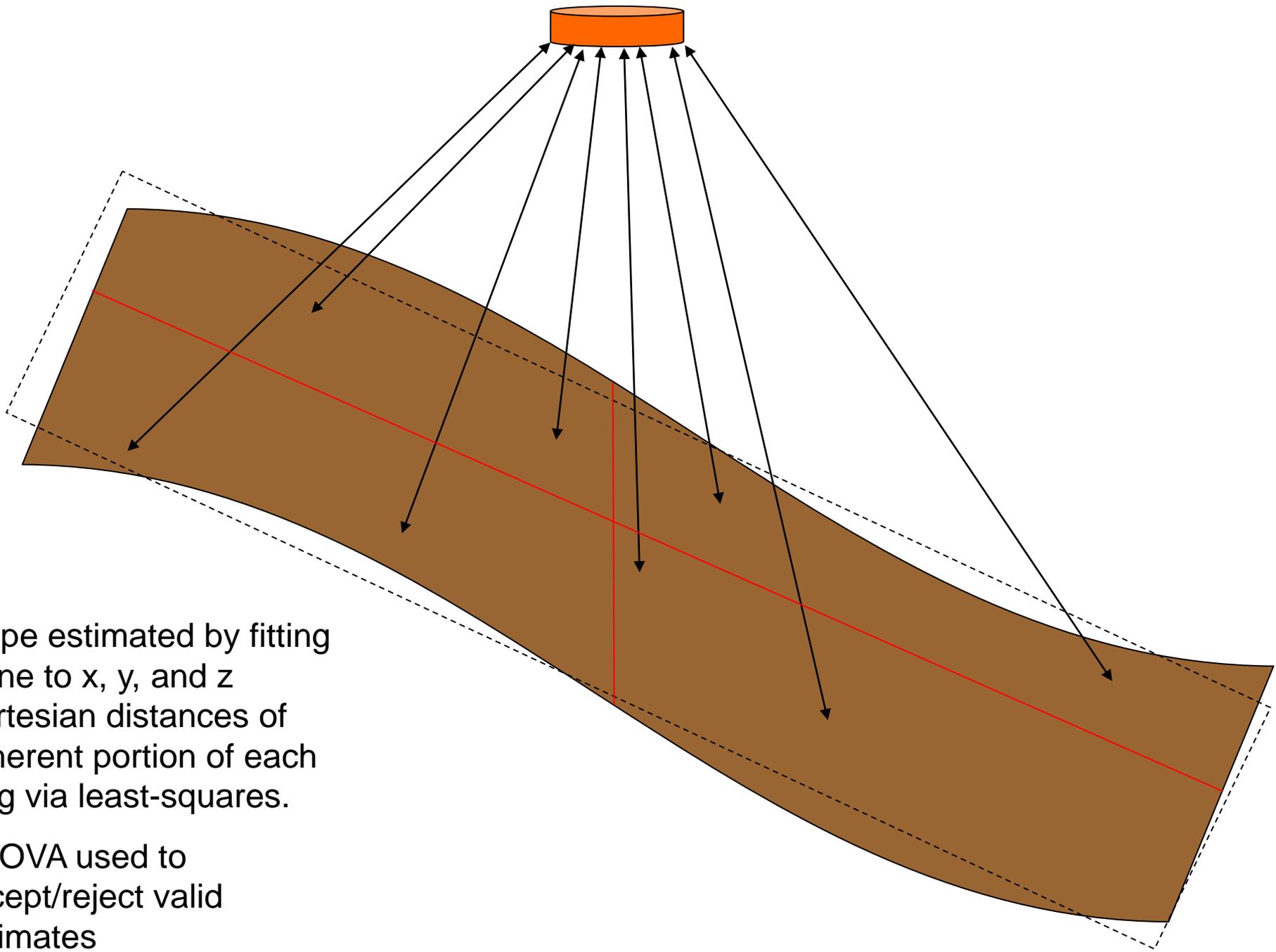
Drop camera

Split Beam data (ES-60)



Variance to mean ratio used to classify echo samples as coherent or incoherent for each set of pings (1 at each of five frequencies)

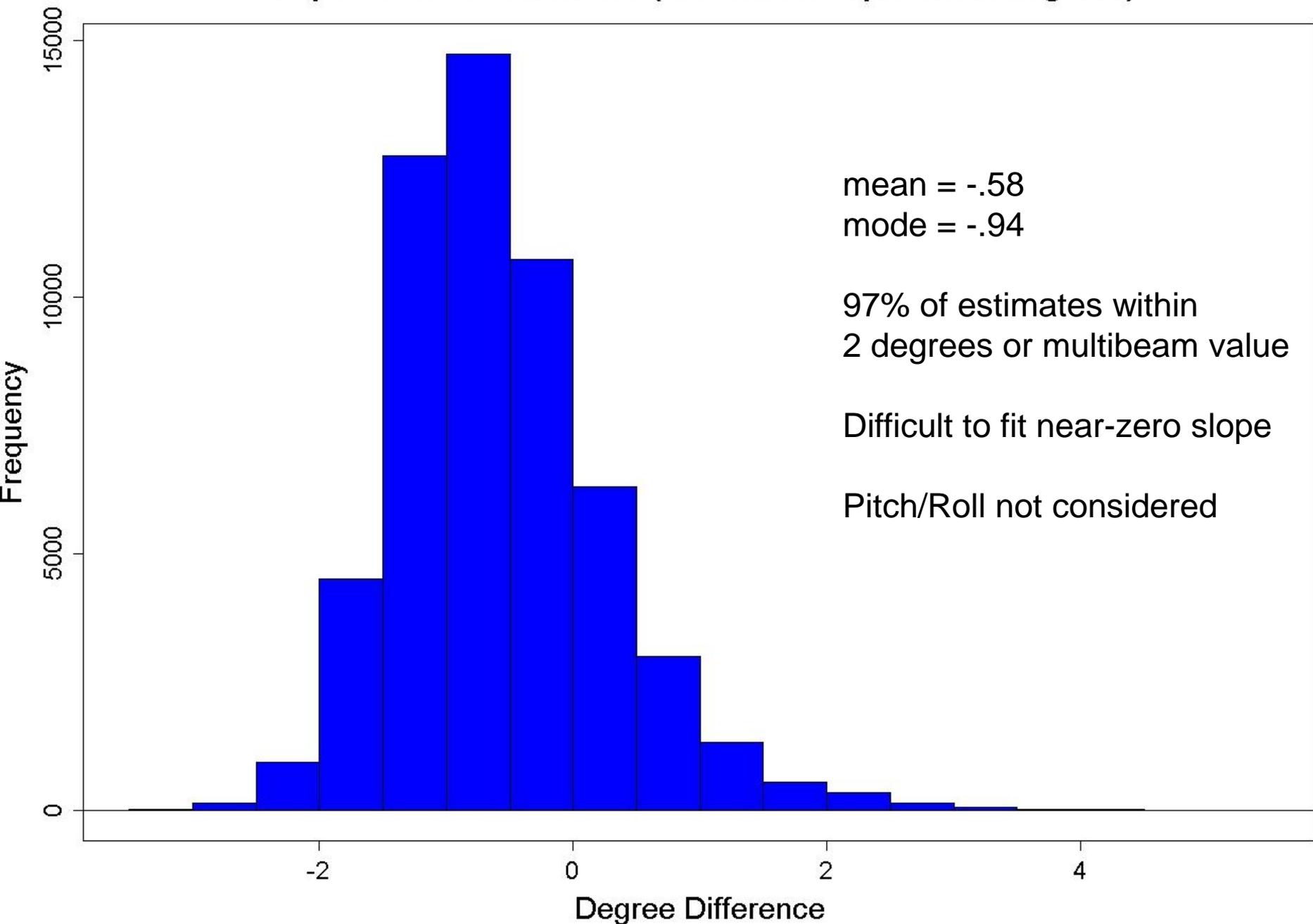
Coherent portion used to estimate slope



Slope estimated by fitting plane to x, y, and z Cartesian distances of coherent portion of each ping via least-squares.

ANOVA used to accept/reject valid estimates

# Slope Estimate Difference (multibeam - split beam degrees)



$$\overline{p_{i,f}} = \overline{p_{o_{i,f}}} e^{-2k_f^2 \overline{\rho_i^2} \cos^2 \phi_{i,f}}$$

where:

$p$  = seabed echo pressure ( $10^{\overline{Sv}/10}$  \* integration layer thickness)

$p_0$  = zero roughness echo amplitude

$k$  = acoustic wave number ( $2\pi / \lambda$ )

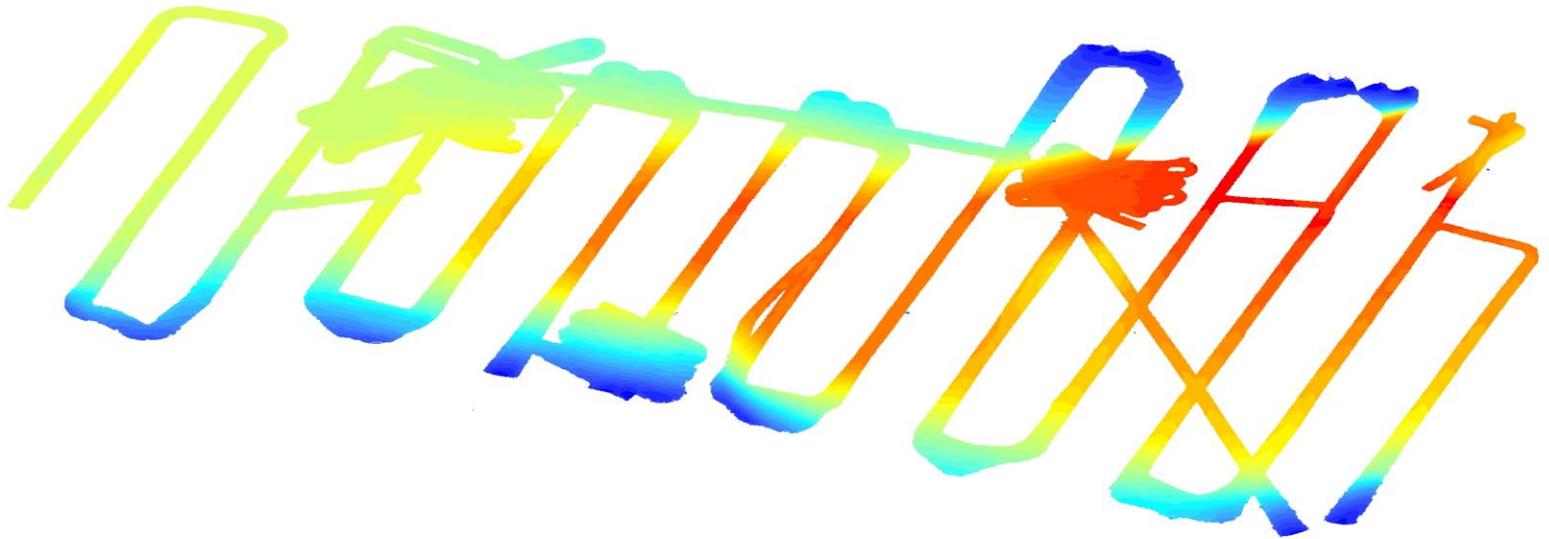
$\rho$  = rms roughness

$\phi$  = off normal incidence angle (slope)

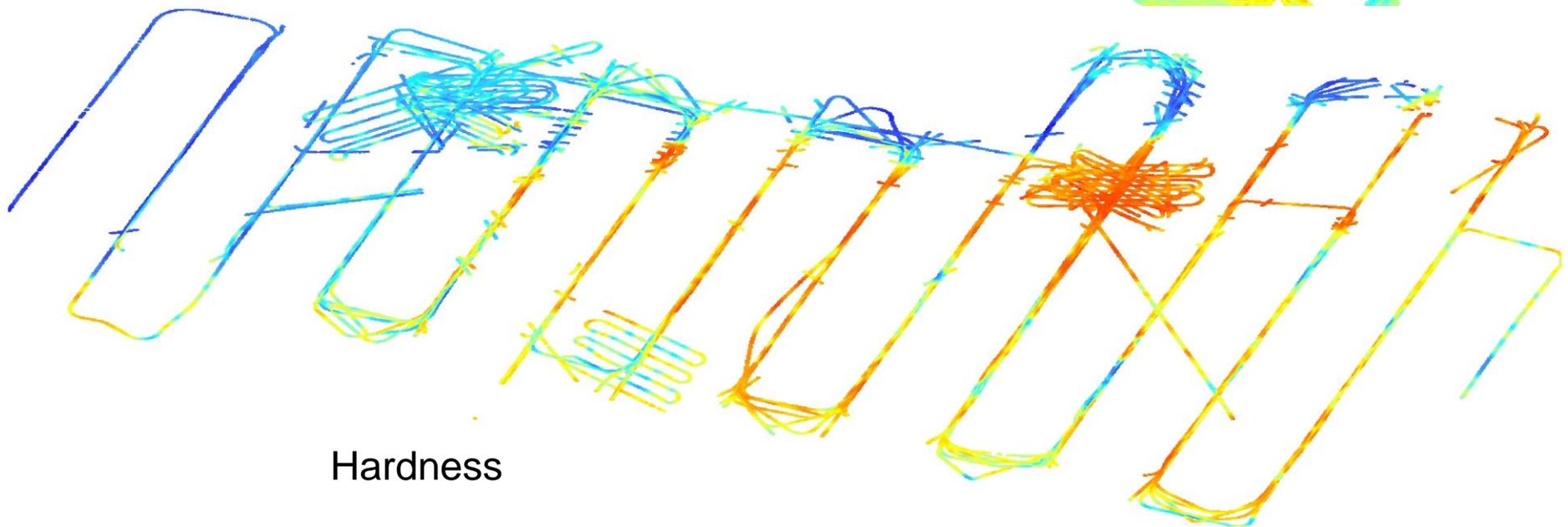
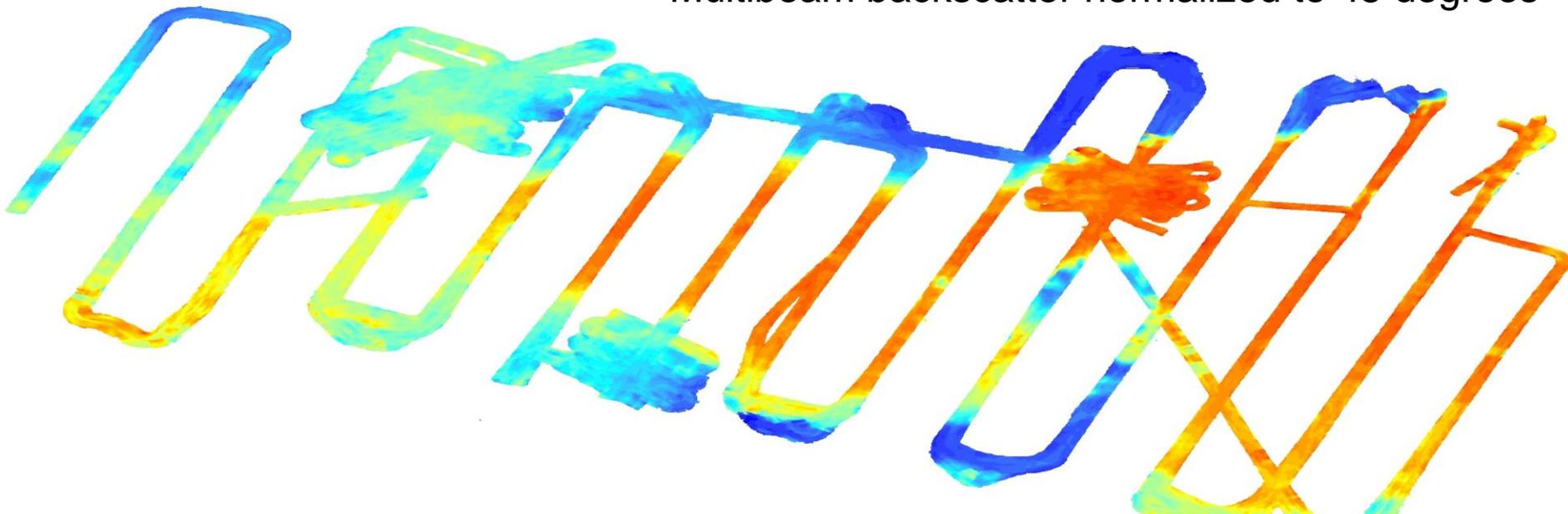
$i$  = 25 m interval

$f$  = frequency

# Snakehead Bathymetry - Multibeam

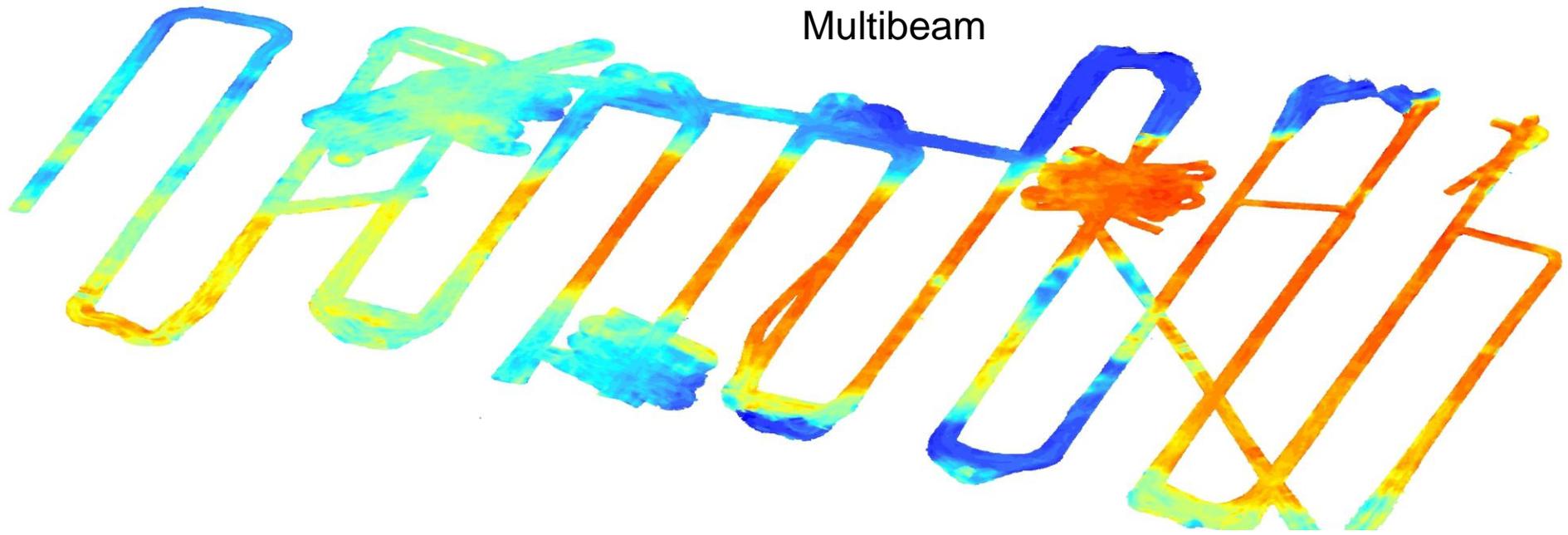


Multibeam backscatter normalized to 45 degrees

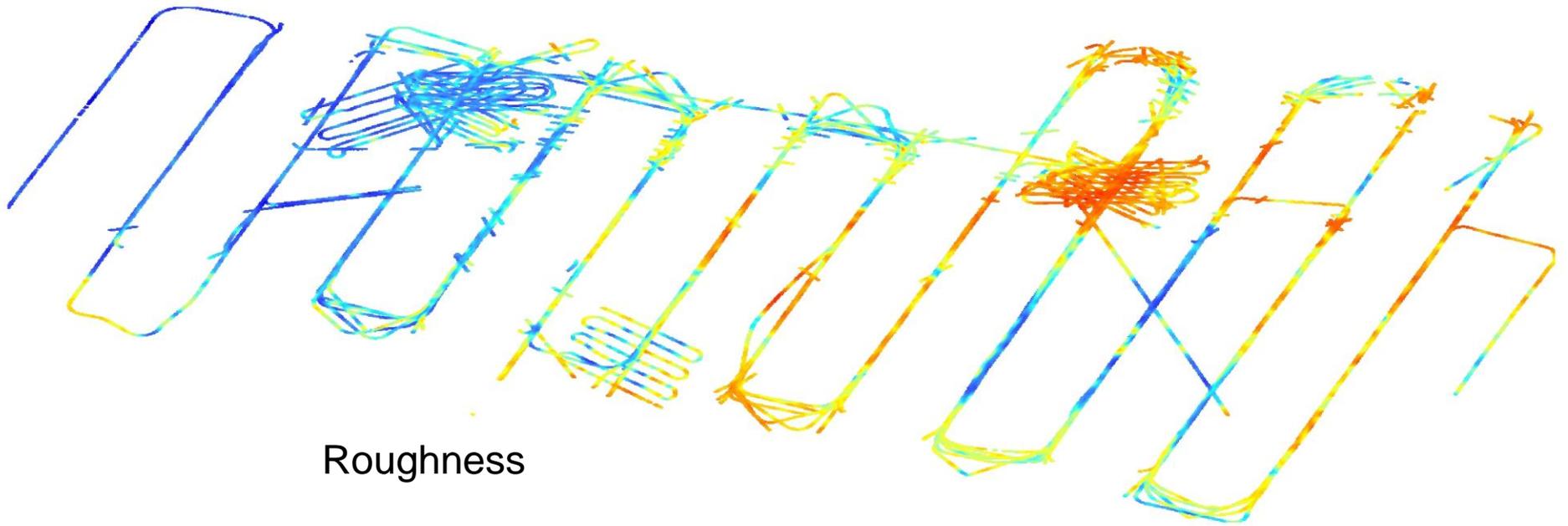


Hardness

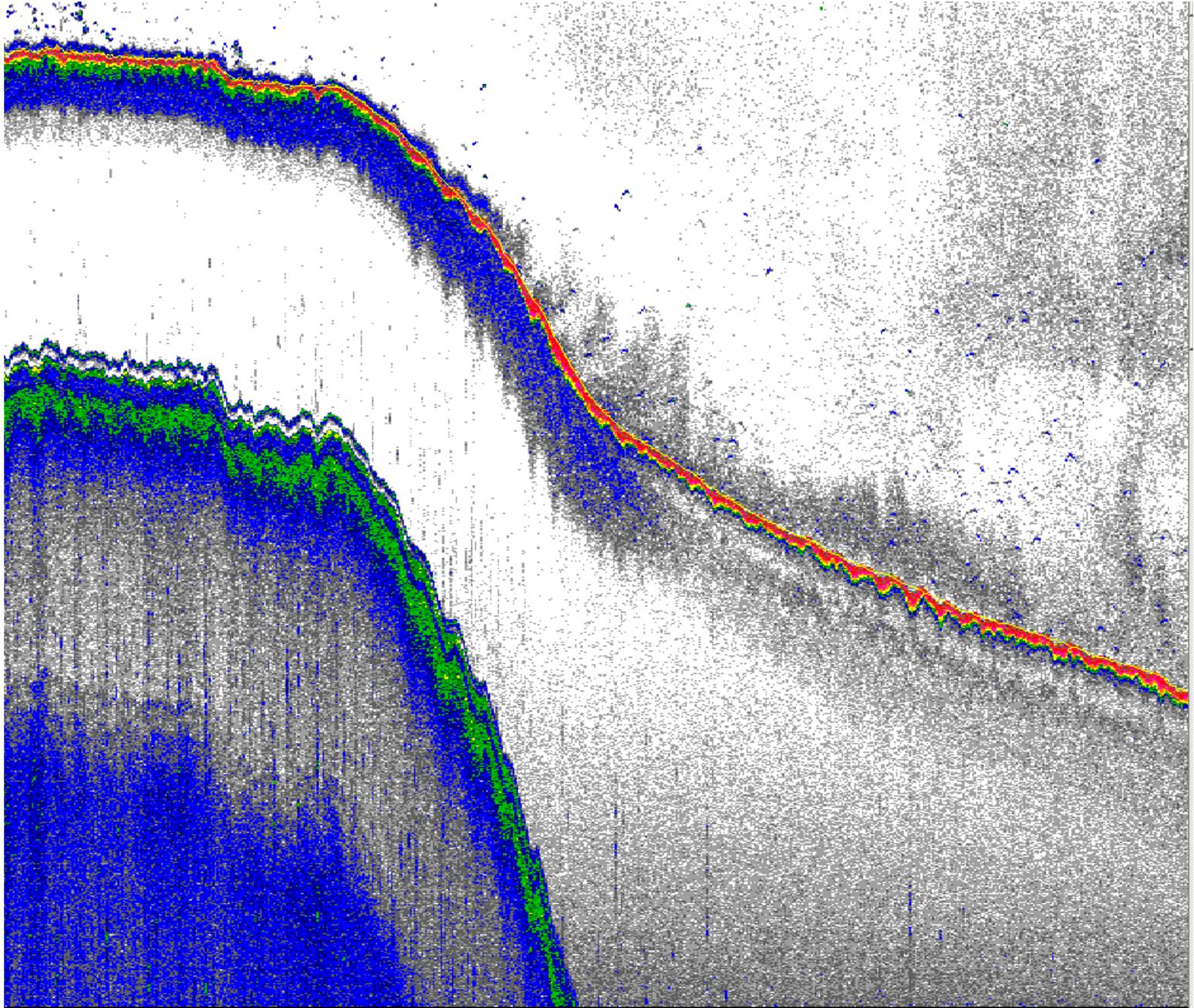
Multibeam

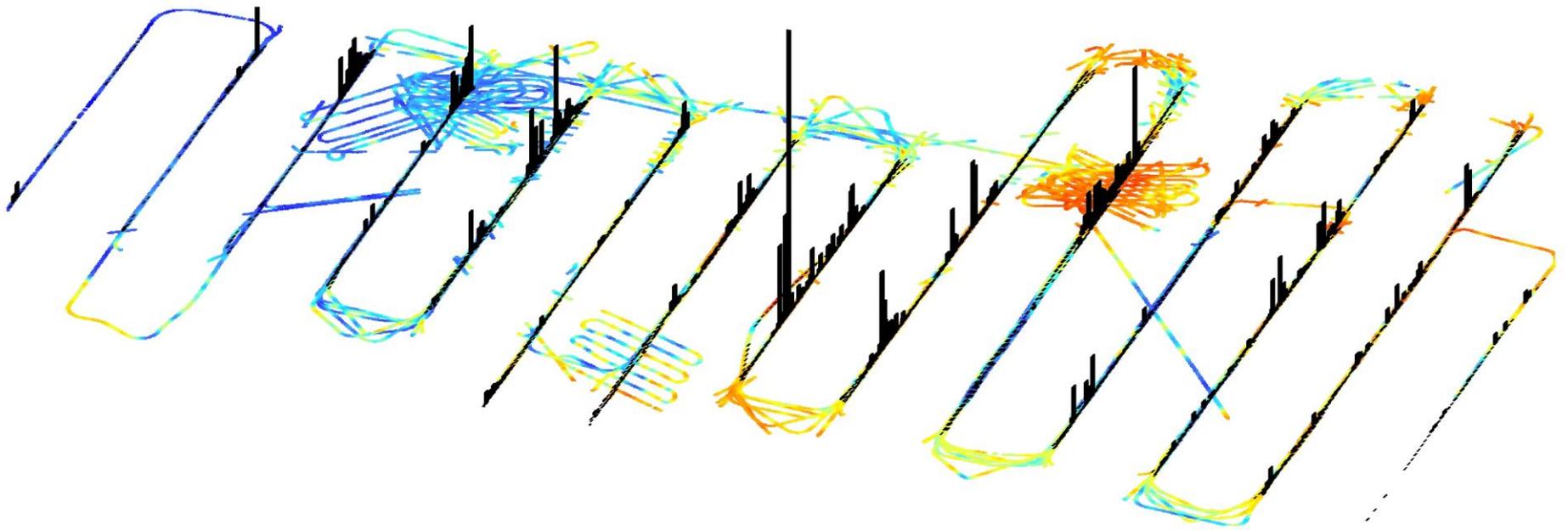


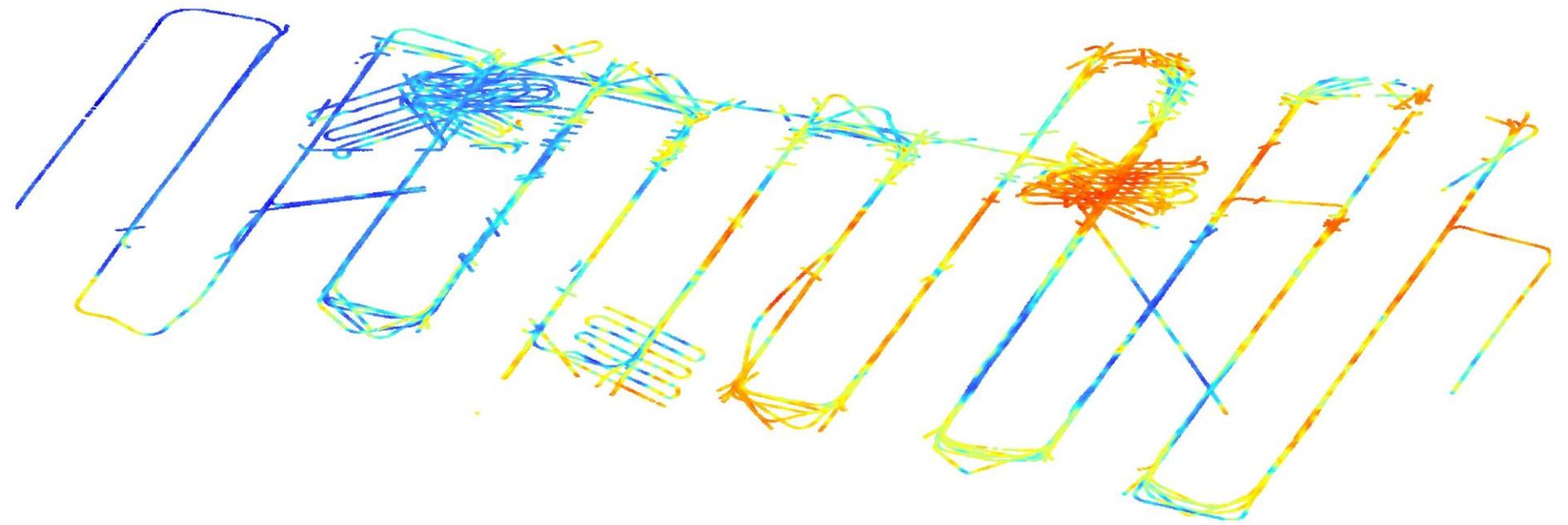
Roughness

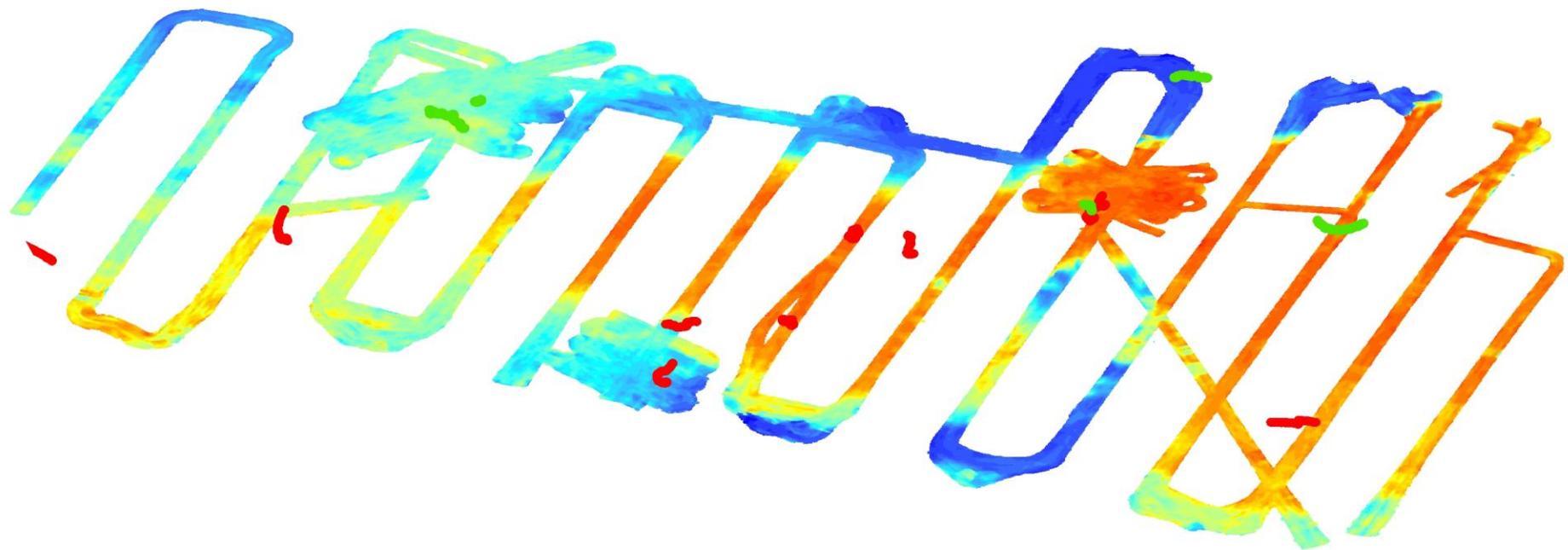


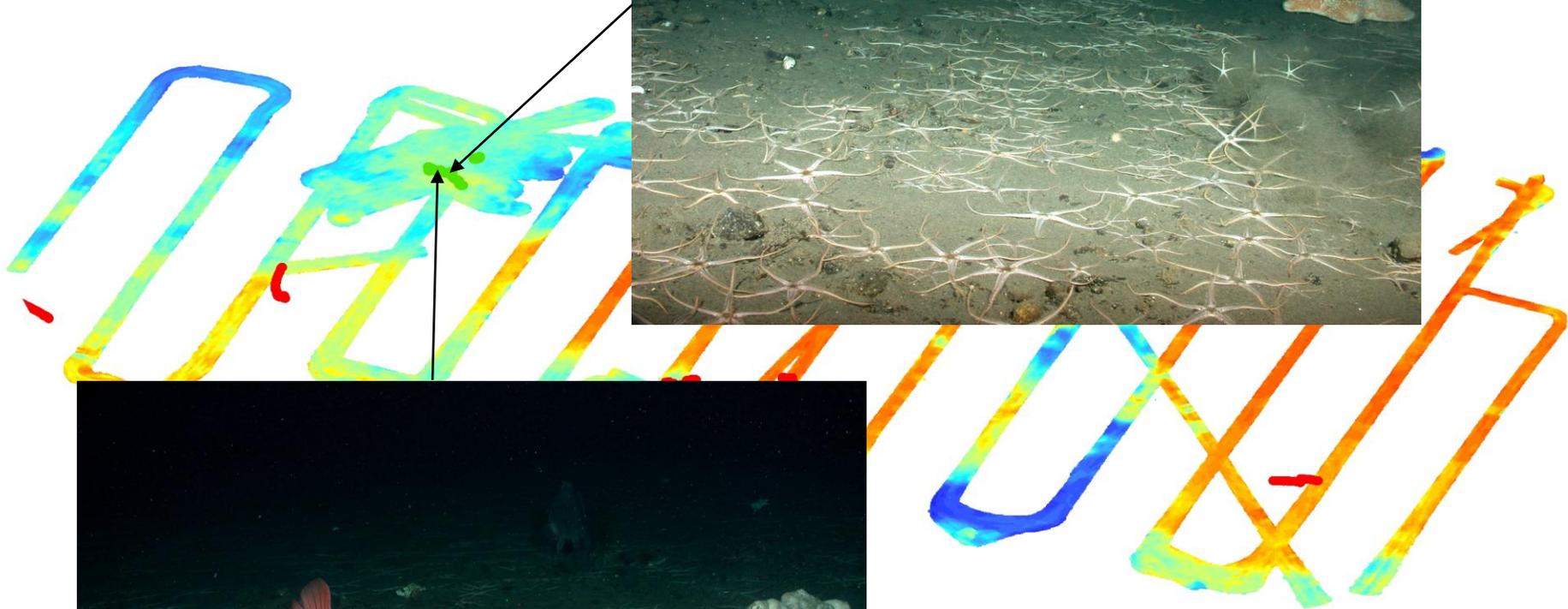
Noise at deeper depths – 200 khz

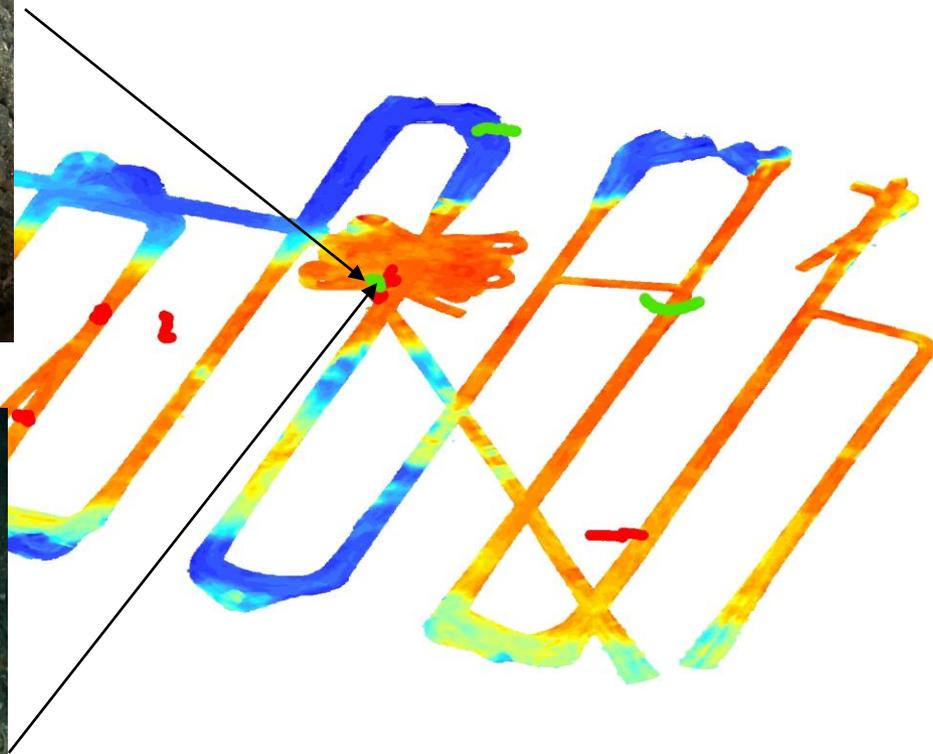












## Potential Barriers to Implementation on Chartered Survey Vessels:

- Multiple frequencies?
  - Plan to redo analysis with 2 frequencies (38 and 120 kHz) and compare results
- Must be able to do in essentially real time?
- Availability of heave/pitch/roll data?

## Special Thanks to:

NPRB

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