SHR-40f

Delta Bathymetry Mapping With Four Beam ADCPs:

Tradeoffs ,Tools, and Techniques

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Why Map Bathymetry?

- Navigation
- Pre or post dredge assessment
- Study fundamental processes
  - Bed-form mapping
  - Sediment transport
- Generate model inputs
- Predeployment reconnaissance

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Bathymetry Needs

Model Inputs; Garbage in, garbage out!

Potential users of improved bathymetry:

- Si3D
- RMA
- DSM2-CSDP
- REALM
- TRIM3D
- Contracted projects, e.g., Hydroqual

What does this list imply?

Huge variability in data requirements!

- Inputs range from DEMs to sparse cross sections

- Model runs range in scale from $O(10^2)$m to $O(10^5)$m !

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The Key Question:
What defines a good bathymetry survey?

- Accuracy of data points
  - Depth, position
- Density of data points
  - Multibeam standard?

balanced against…

- Survey Speed
  - Cost/Unit Area
- Survey Turnaround Time

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The Optimal Survey

An engineering geek might define a Survey Number (SN):

SN = m/n

m = amount of data collected

n = minimum amount of data needed for the target model(s) to capture driving physics

SN << 1 = bad model runs

SN >> 1 = wasted time/money

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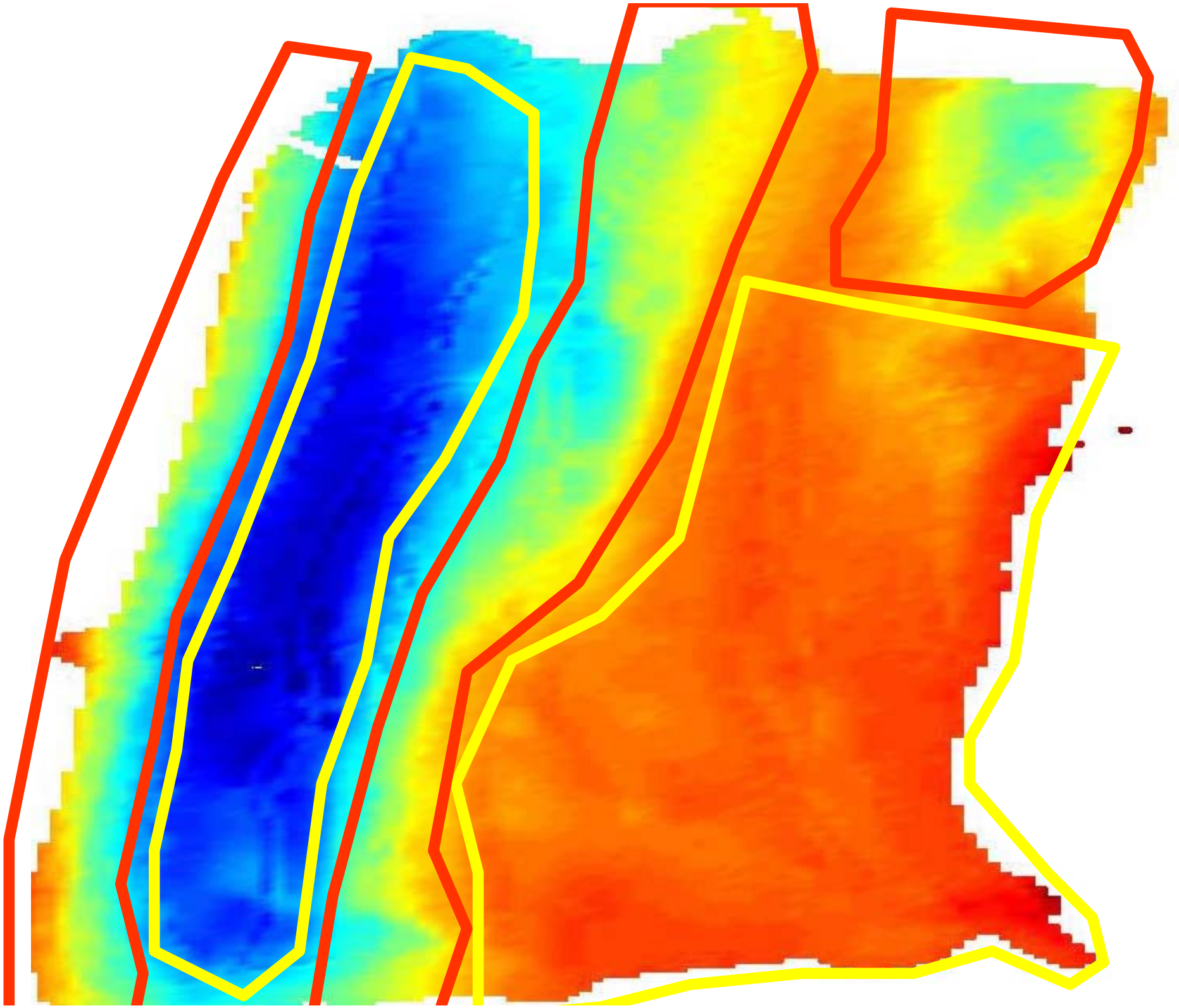

How do we optimize bathymetry collection?

This requires…

- Rapid turnaround between acquisition and survey processing/assessment
- Automatic data filtering
  - Scan by scan doesn't cut it!
  - Multi beam standard?
- Ability to navigate to pre-selected areas

Iterative data acquisition process

1. Rough primary survey (30%-50%)
   - Analyze to find areas of interest
2. Focused secondary survey (40%-60%)
   - Survey areas of interest (red boxes)
   - Reprocess and asses data
3. Quick tertiary survey to fill in last gaps (0%-10%)

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BathMapper

Developed to optimize iterative acquisition

Basics of the BathMapper system

- RDI ADCP provides depth and geometry data
  - Four independent depth measurements (40 deg square)
- Trimble Ag GPS provides position
- Matlab and LabView software for control and processing
  - Software timed acquisition
  - Real time navigation and ping processing
  - On-the-boat DEM generation

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BathMapper Software
Multithreading for software timed acquisition

- Each major process has its own thread and priority
  1. Instrument control
  2. Data processing / filtering
  3. Data storage
  4. Data visualization and navigation display
- Software timed acquisition
  - Data acquisition is timed by software calls (User sets data rate <5Hz)
  - More accurate synchronization of position and ping data
- Real-time filtering, navigation, and ping feedback
  - Real-time processing occurs during acquisition down time

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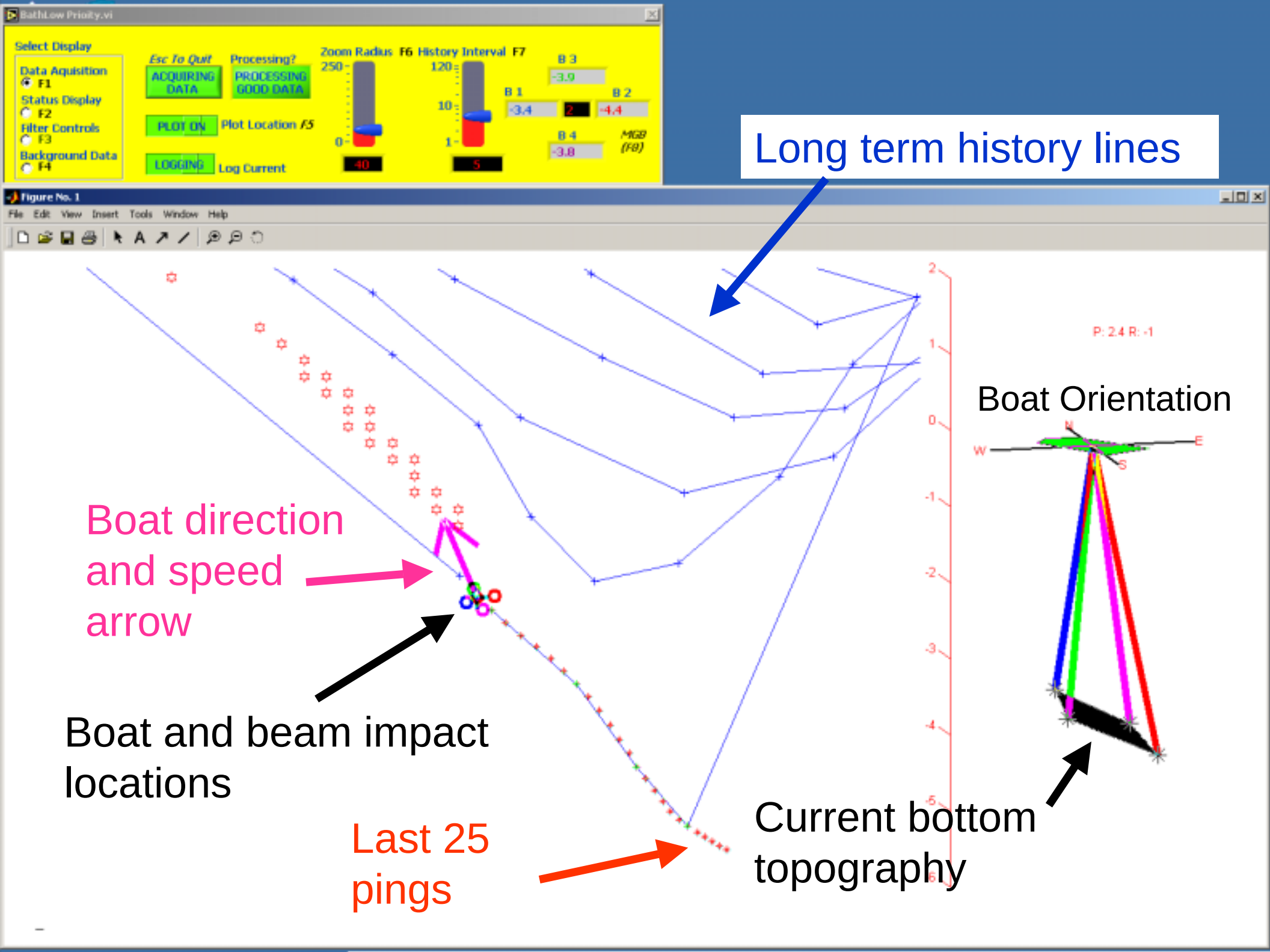
BathLow Priority.vi
Select Display
Data Aquisition
F1
Status Display
F2
Filter Controls
F3
Background Data
F4
Esc To Quit
ACQUIRING DATA
Processing?
PROCESSING GOOD DATA
PLOT ON
Plot Location F5
LOGGING
Log Current
Zoom Radius F6
250
0
40
History Interval F7
120
10
1
5
B 3
-3.9
B 1
-3.4
2
B 2
-4.4
B 4
-3.8
MGB (F8)
Long term history lines
Figure No. 1
File Edit View Insert Tools Window Help
Boat direction and speed arrow
Boat and beam impact locations
Last 25 pings
Current bottom topography
P: 2.4 R: -1
Boat Orientation
N
W
E
S

BathMapper Software
Rapid DEM generation and evaluation

- Automated DEM generation (1-5 minutes)
  - Assigns survey data to regular grid points
  - Determines wet and dry grid points
  - Interpolates to the empty wet grid points
- DEM evaluation
  - Distance from real data (m)
  - 2D Gradient (m/m)
  - Grad*Dist metric (m)
- Select and mark points for further aquisition

Change is important!

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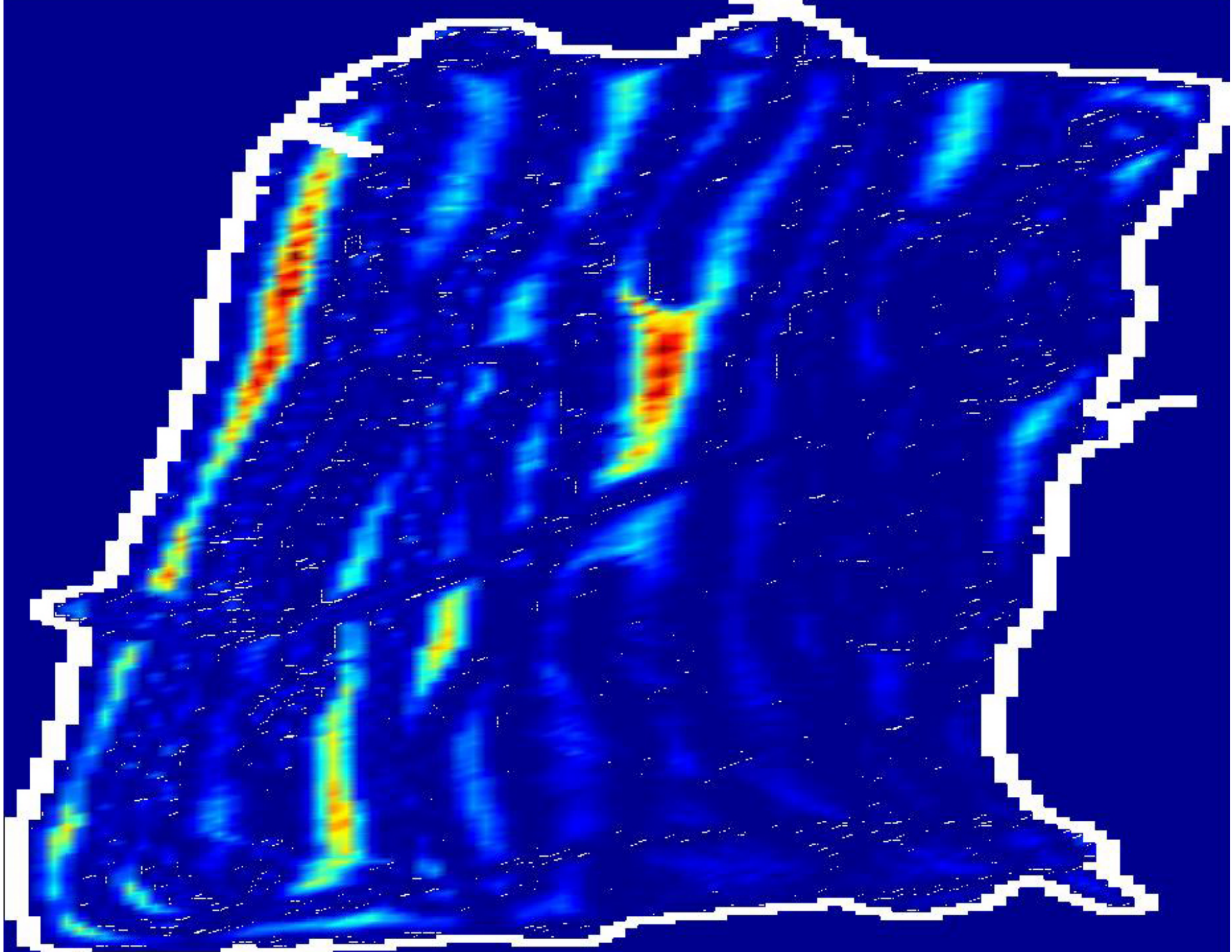

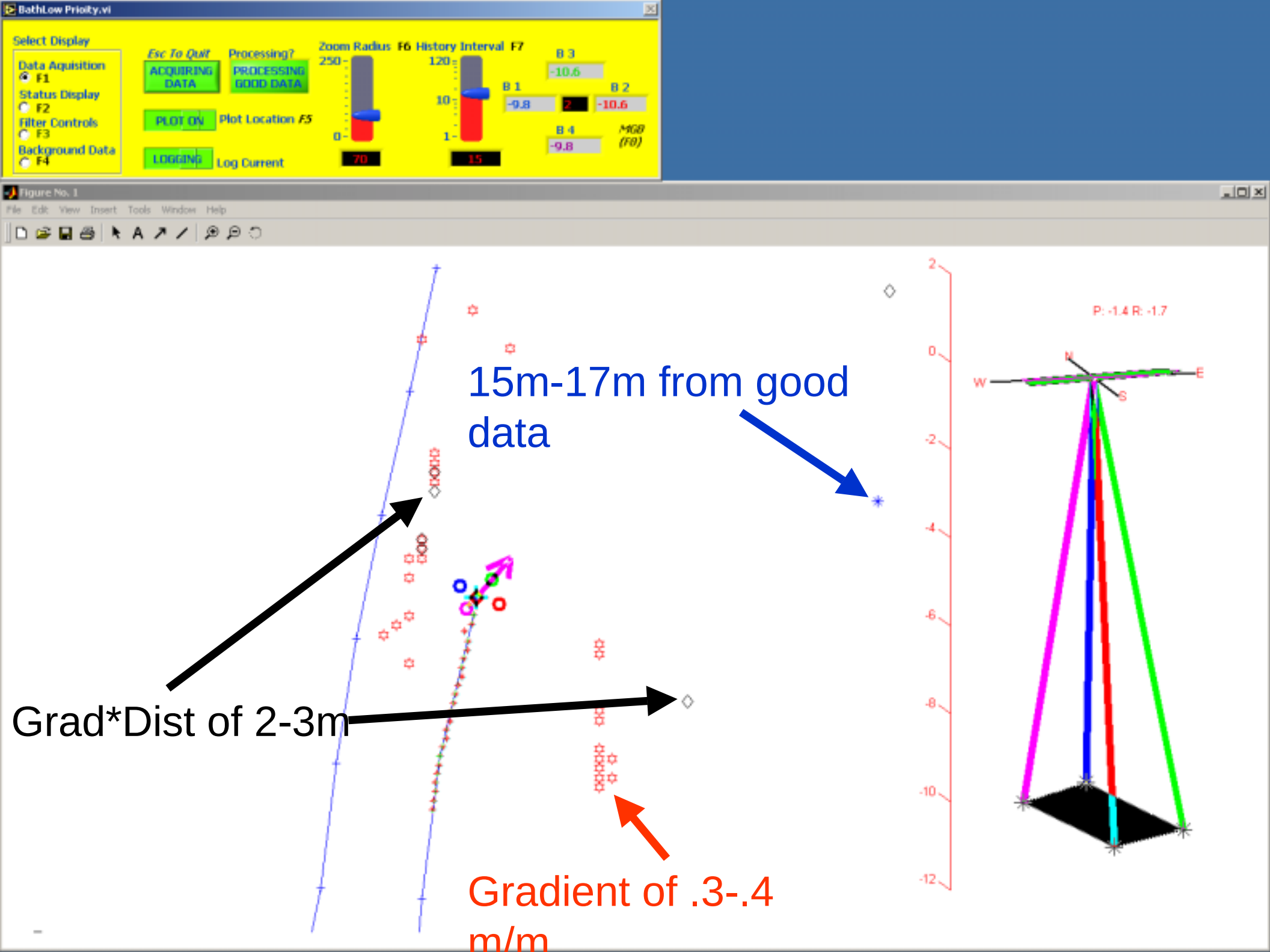
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PROCESSING GOOD DATA
PLOT ON
Plot Location F5
LOGGING
Log Current
Zoom Radius F6
250
0
70
History Interval F7
120
10
1
15
B 3
-10.6
B 1
-9.8
2
B 2
-10.6
B 4
-9.8
MGB (F8)
Figure No. 1
File Edit View Insert Tools Window Help
15m-17m from good data
Grad*Dist of 2-3m
Gradient of .3-.4 m/m
P: -1.4 R: -1.7
N
W
E
S
2
0
-2
-4
-6
-8
-10
-12

In the end…
(Lessons learned from BathMapper development)

- Ultimately, bathymetry collection is a means to an end (Accurate model runs, optimal instrument placement, etc.)
- No matter what tools you use, bathymetry acquisition can be optimized!
- An iterative acquisition approach is useful
- Consider the data interpolation when driving your boat!
- Use meaningful specifications for data acquisition (outcome based!)

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