Measurement Error and Bathymetric Uncertainty

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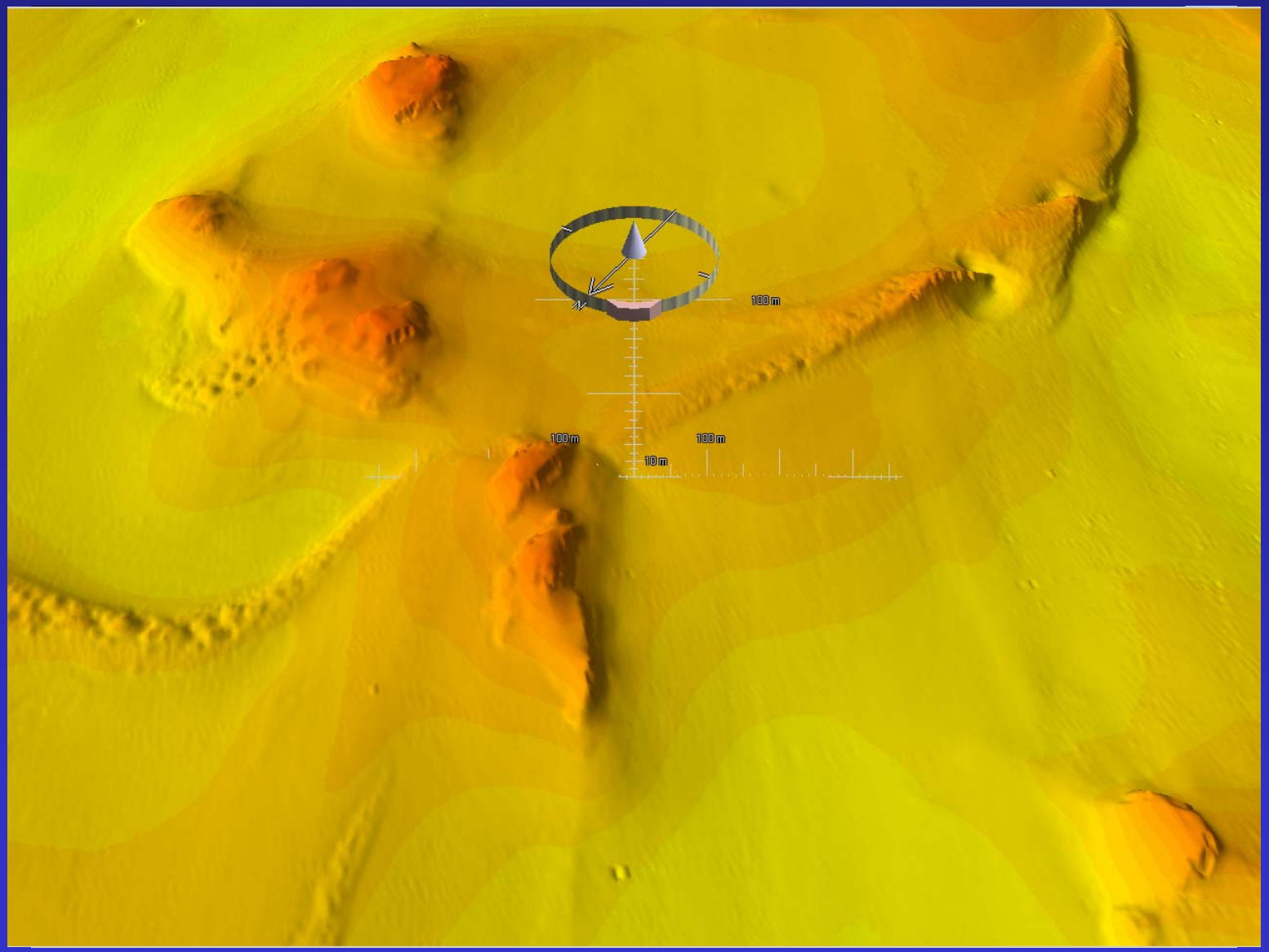
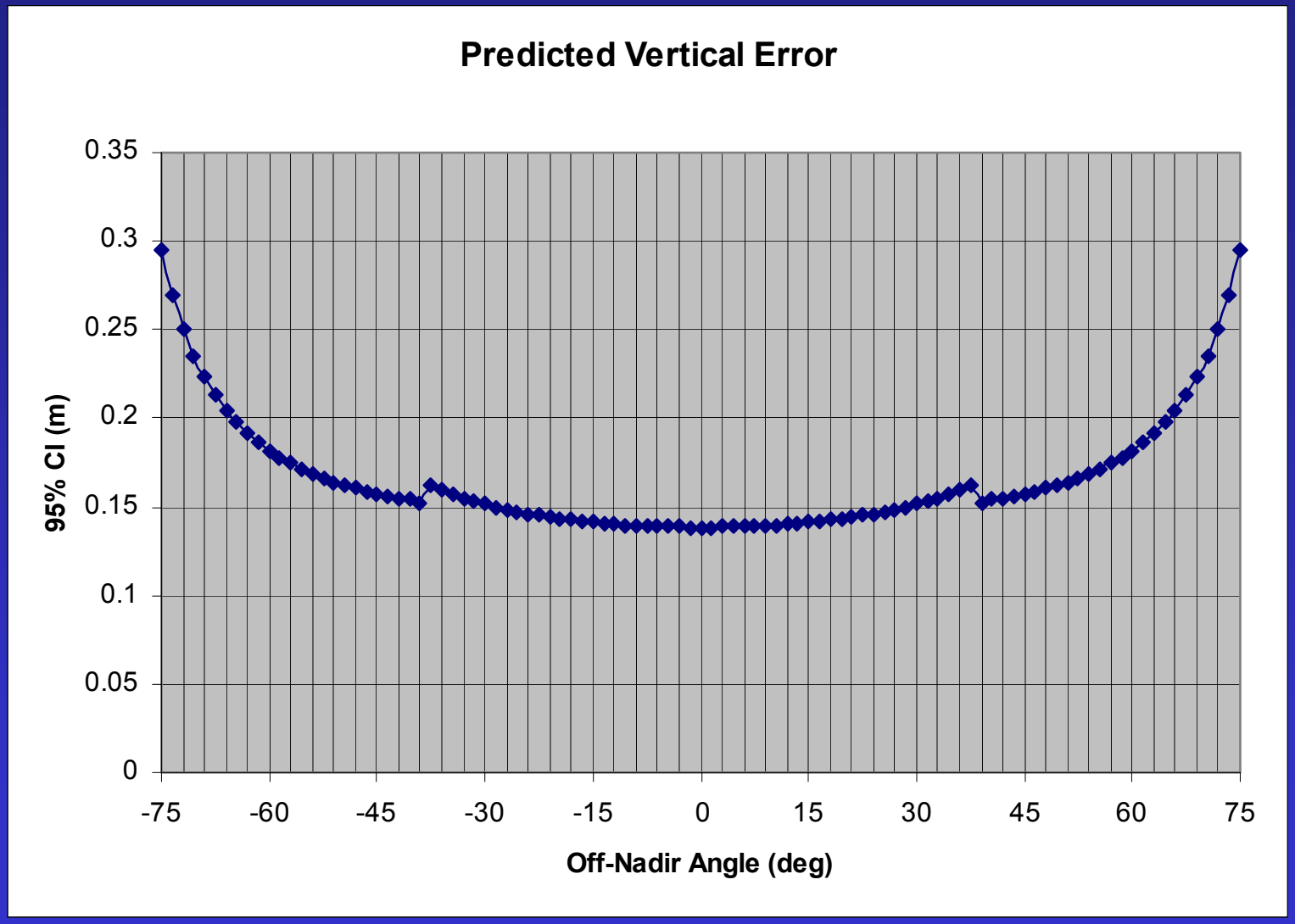
Bathymetric Uncertainty

- …with new surveys
  - How good are the instruments?
  - What are the error sources?
  - How do we use this information?

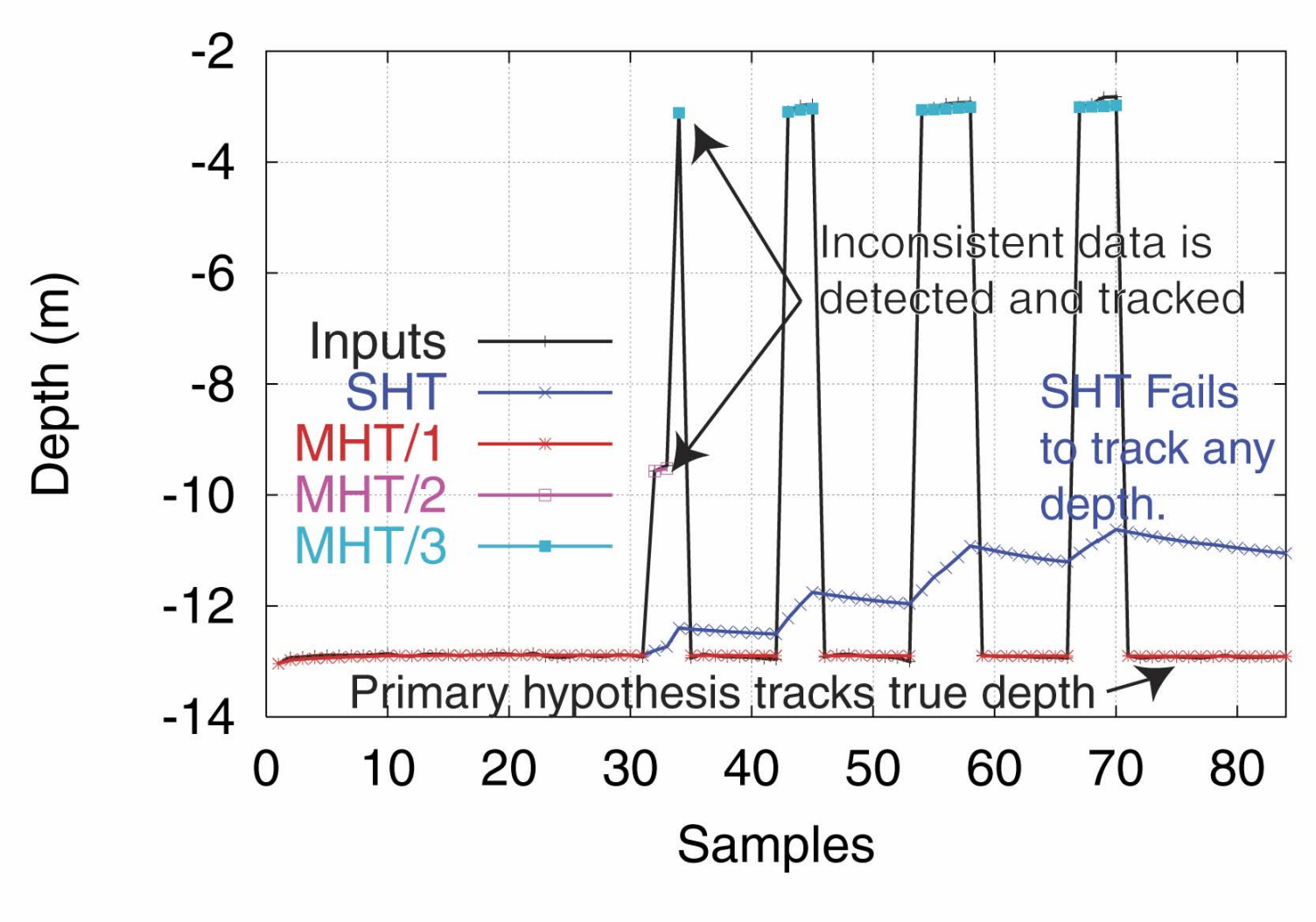
- … with historic/sparse surveys
  - How do we estimate the uncertainty?
  - What's changed between surveys?


100 m
100 m
100 m
10 m

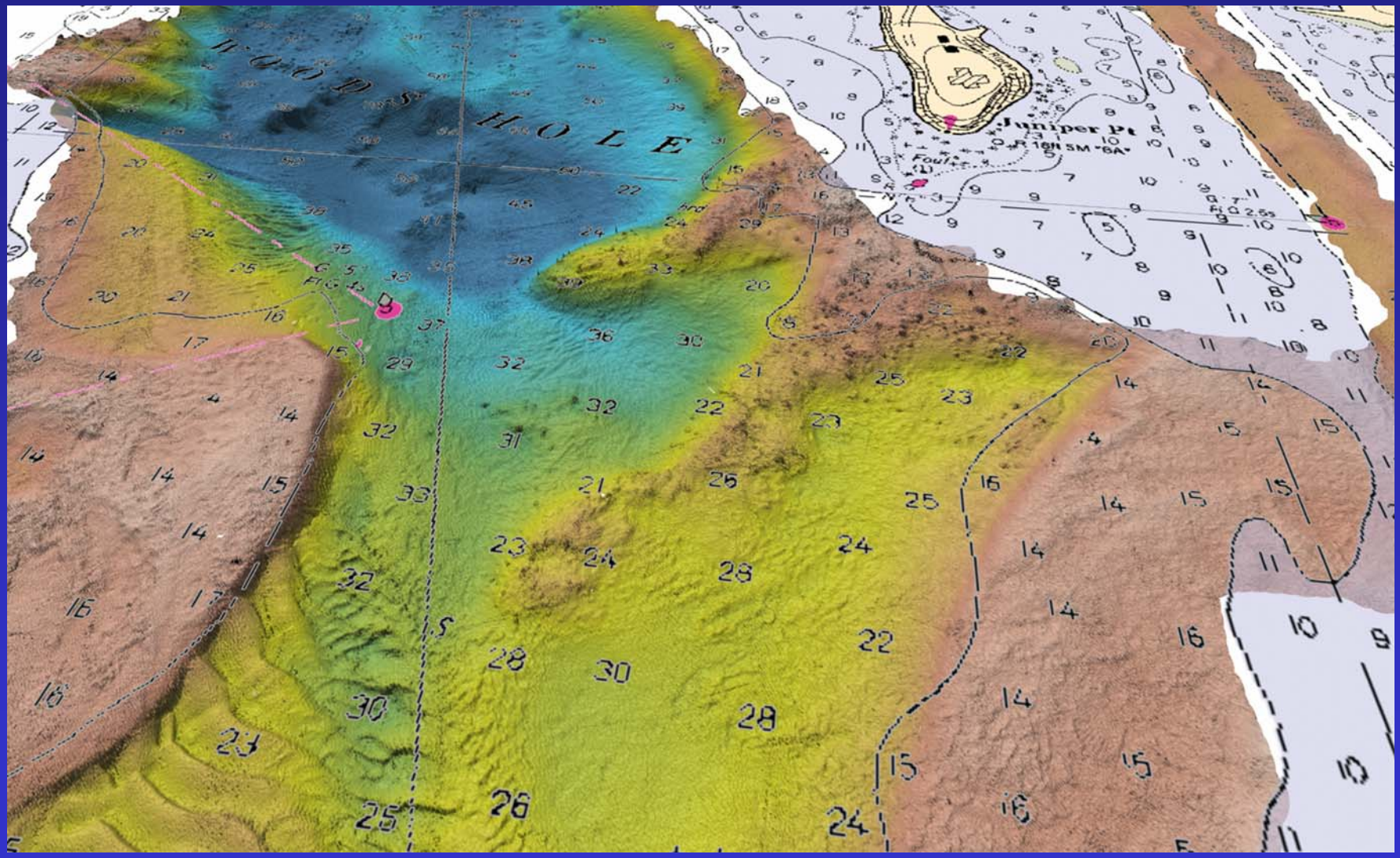
Model: Predicted Performance



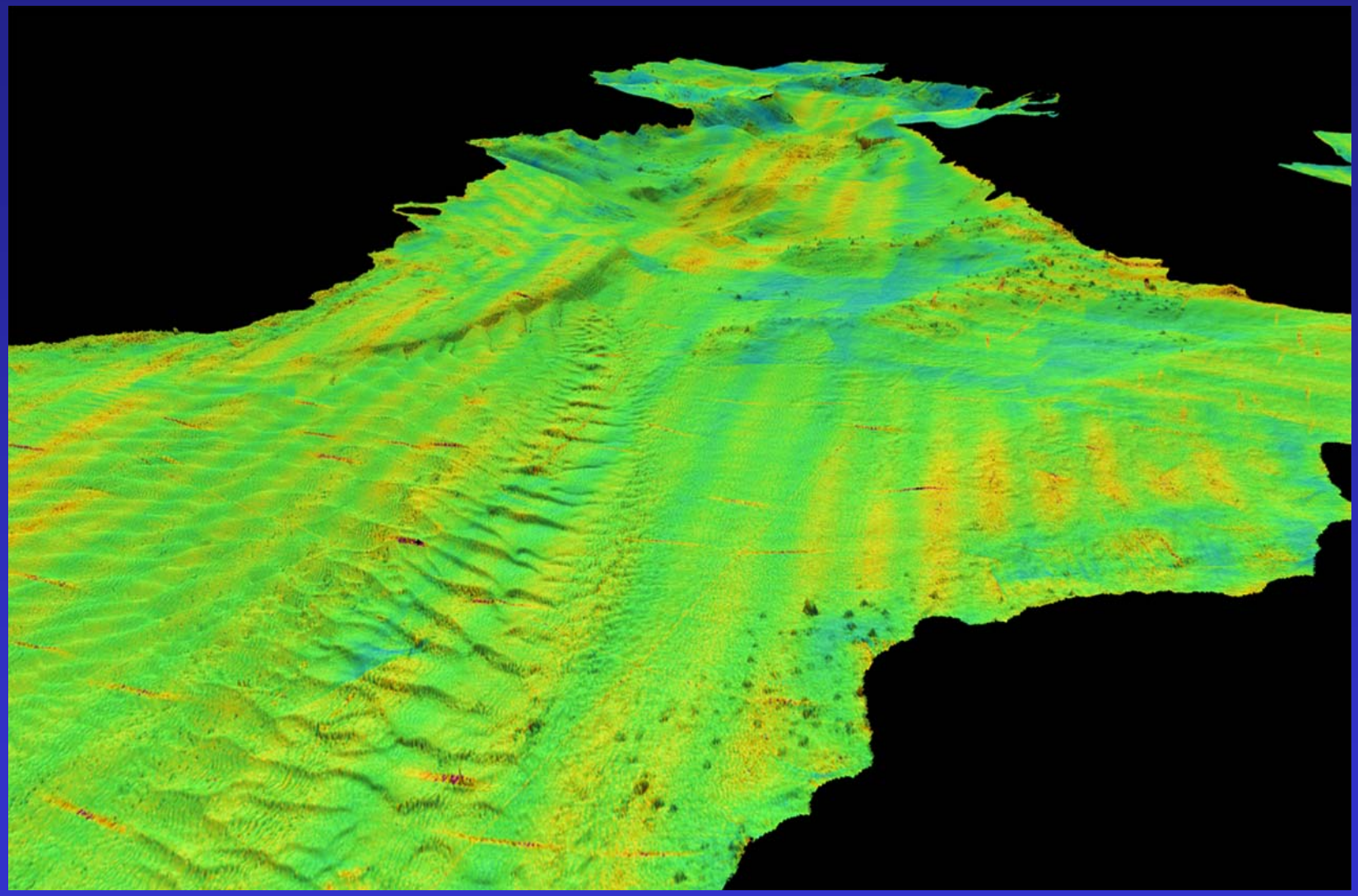
CUBE Data Tracking



Example: Wood's Hole, MA



Example: Wood's Hole, MA



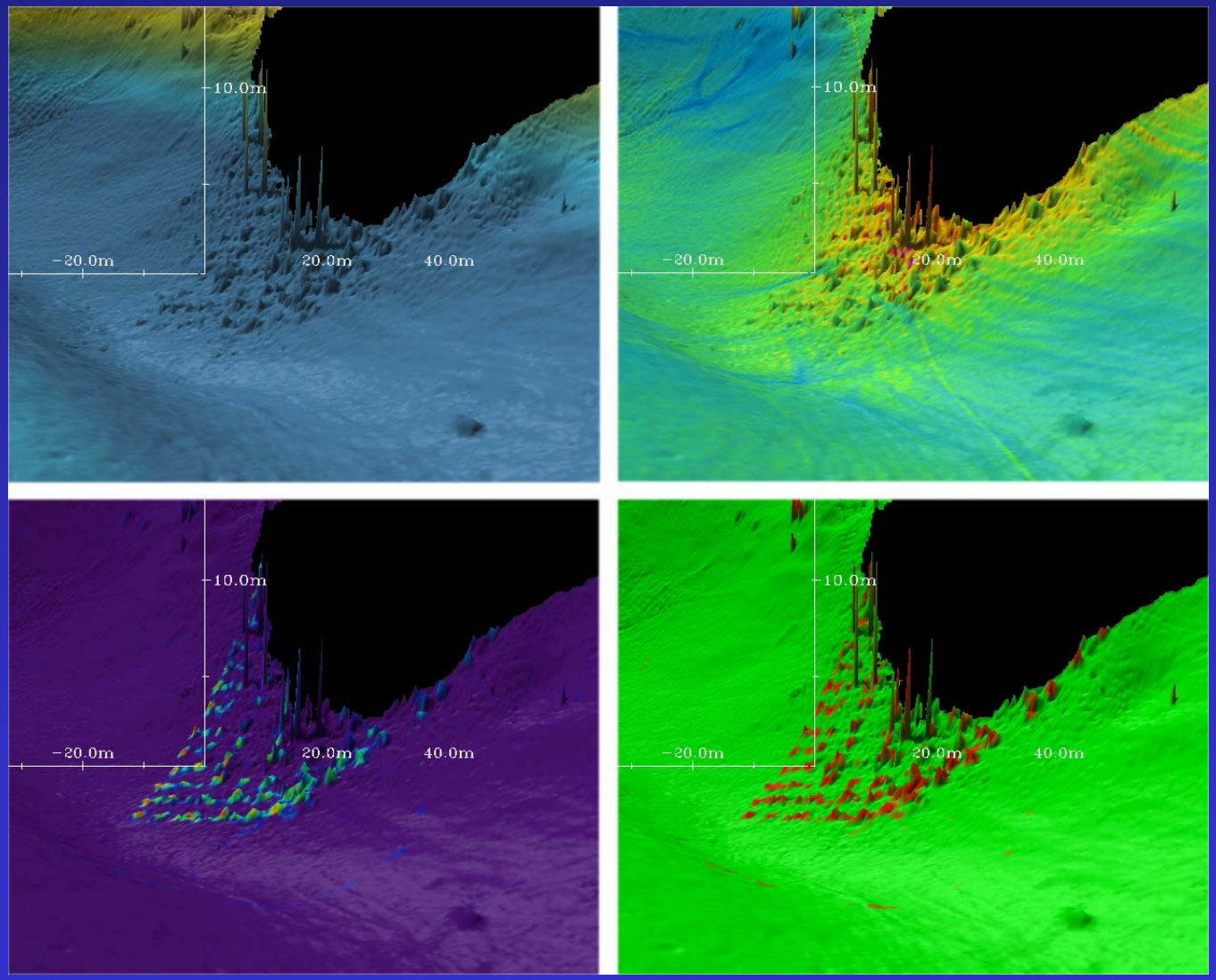
Output Surface Data

Depth Estimate

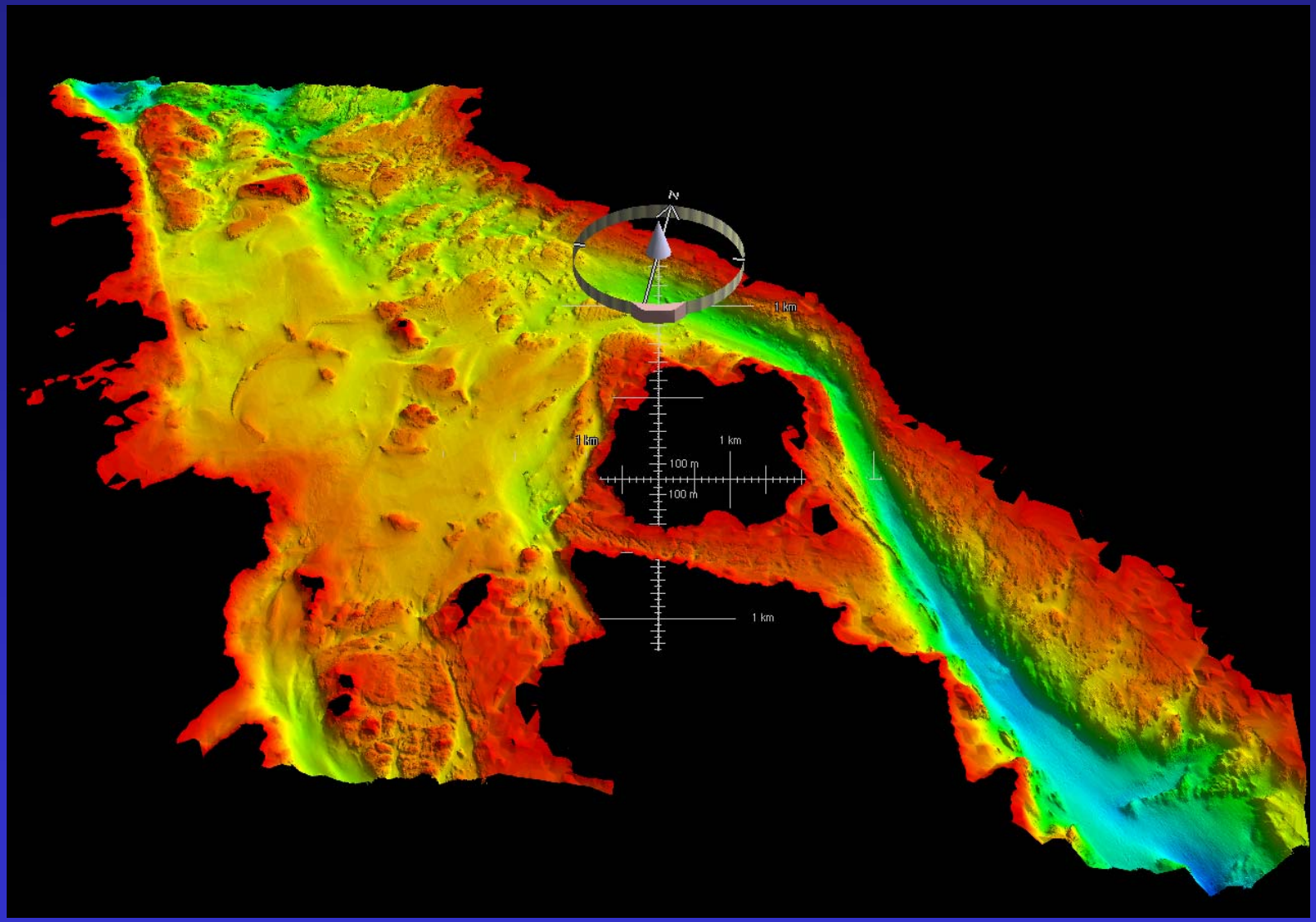
Uncertainty Estimate

Num. Hypotheses

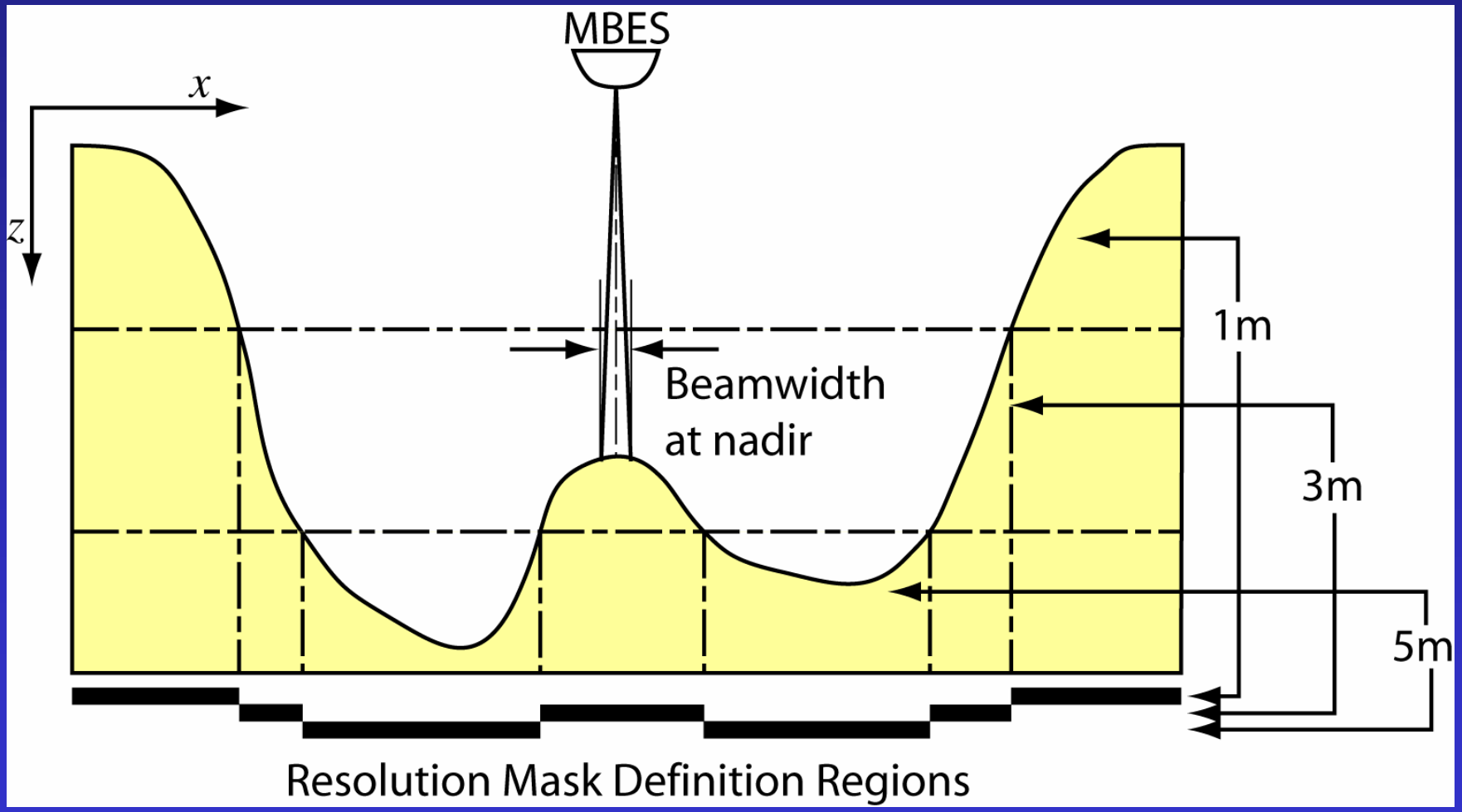
Hypothesis Strength



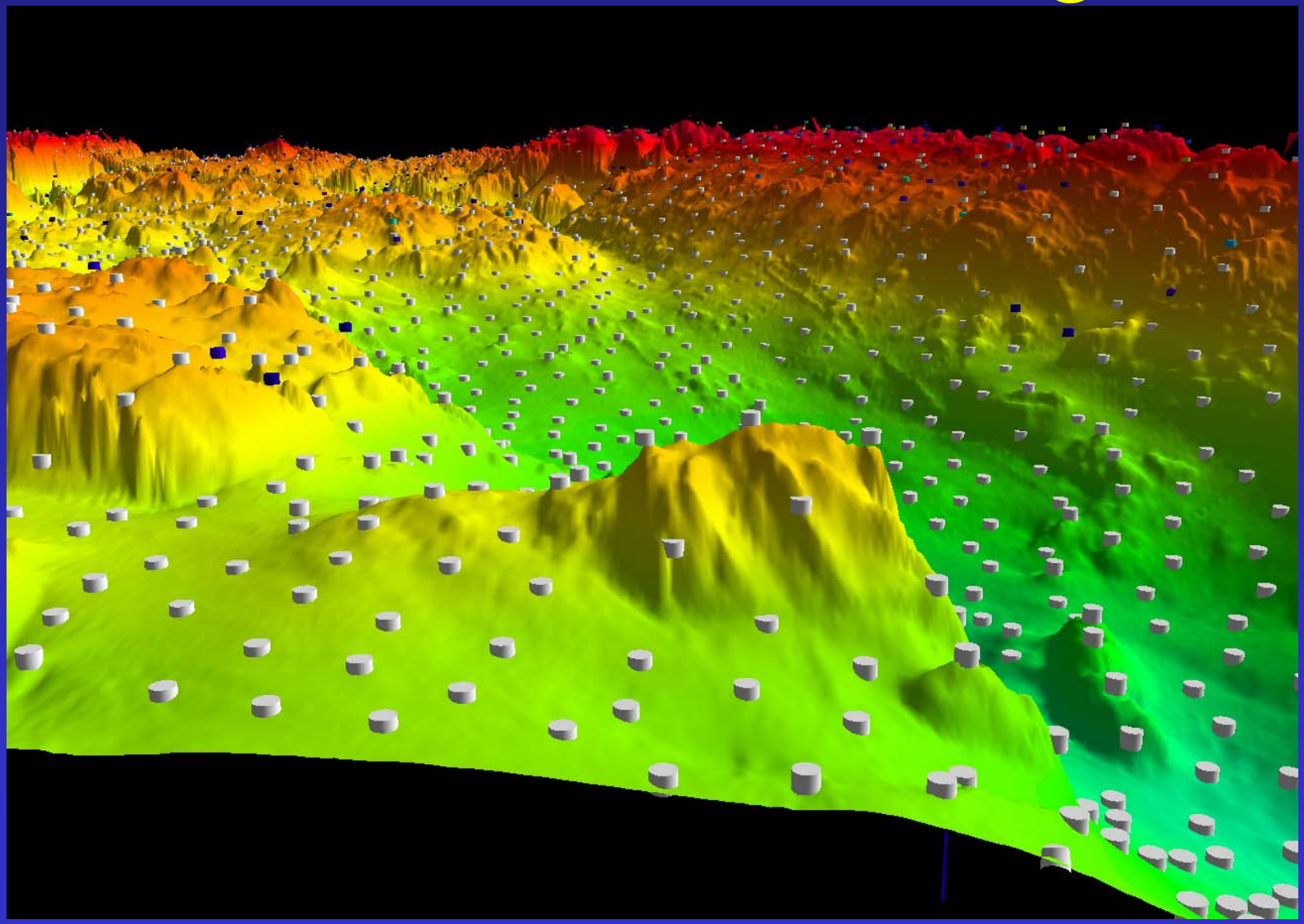
Snow Passage, AK



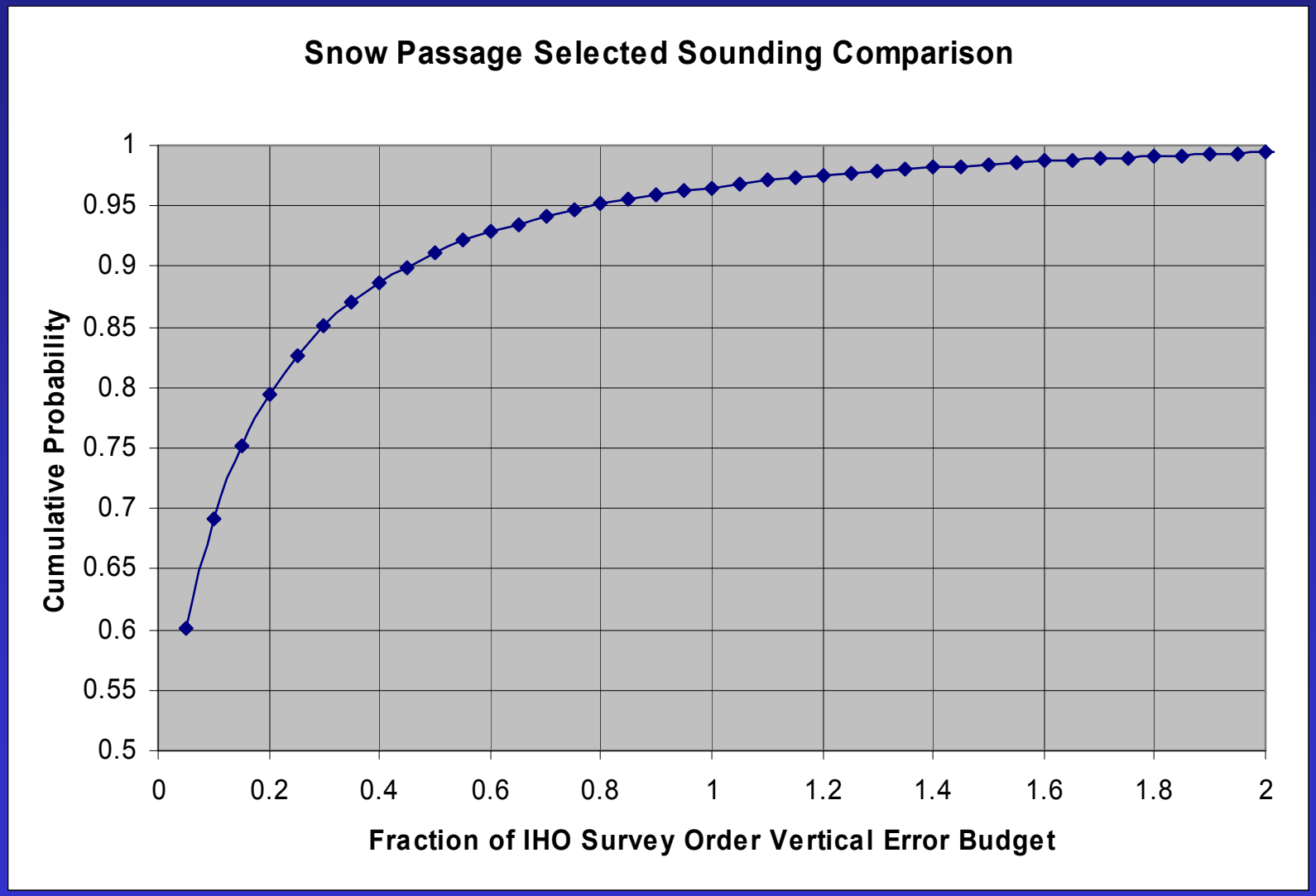
Multiple Resolutions



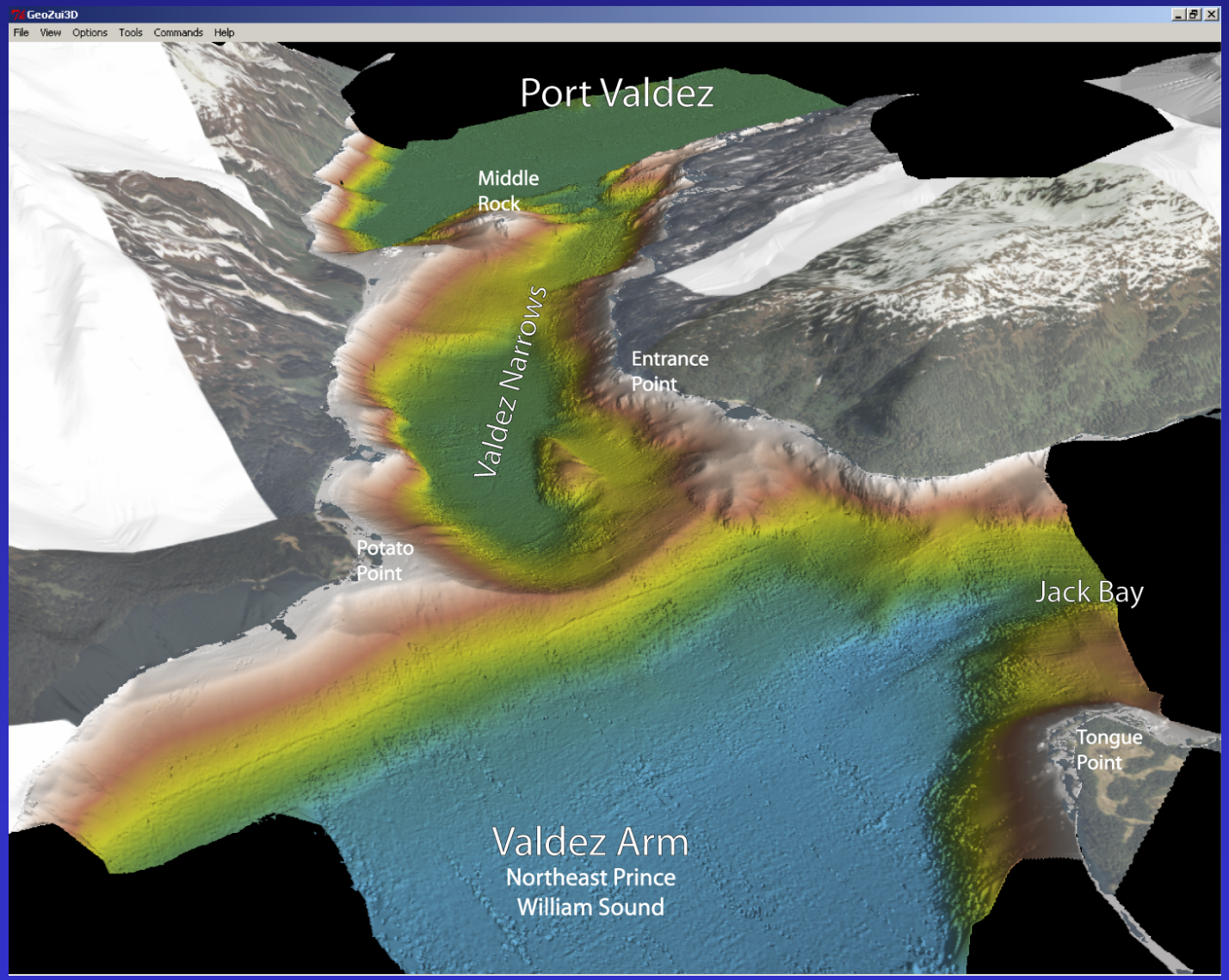
Smooth Sheet Soundings



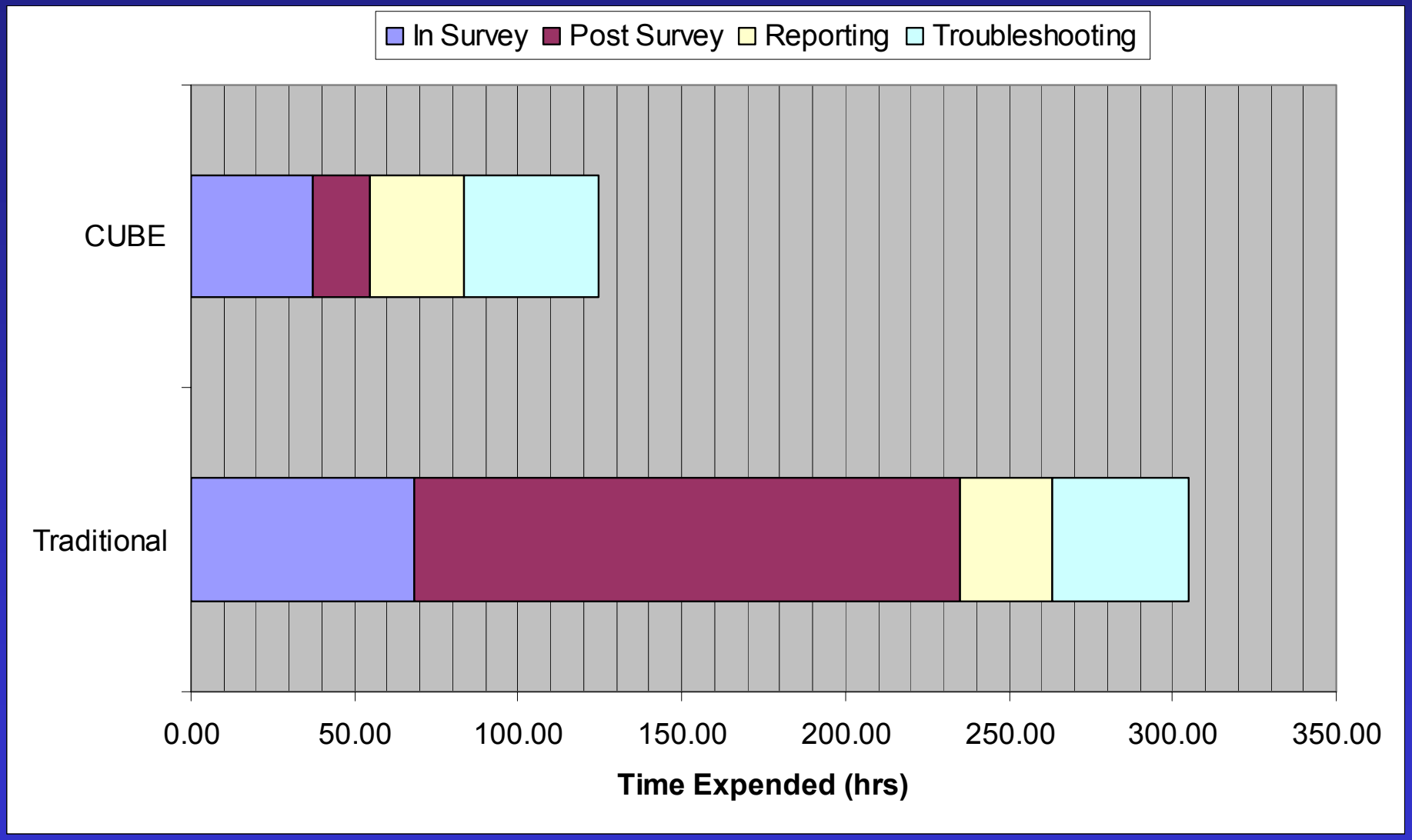
Snow Passage Comparison



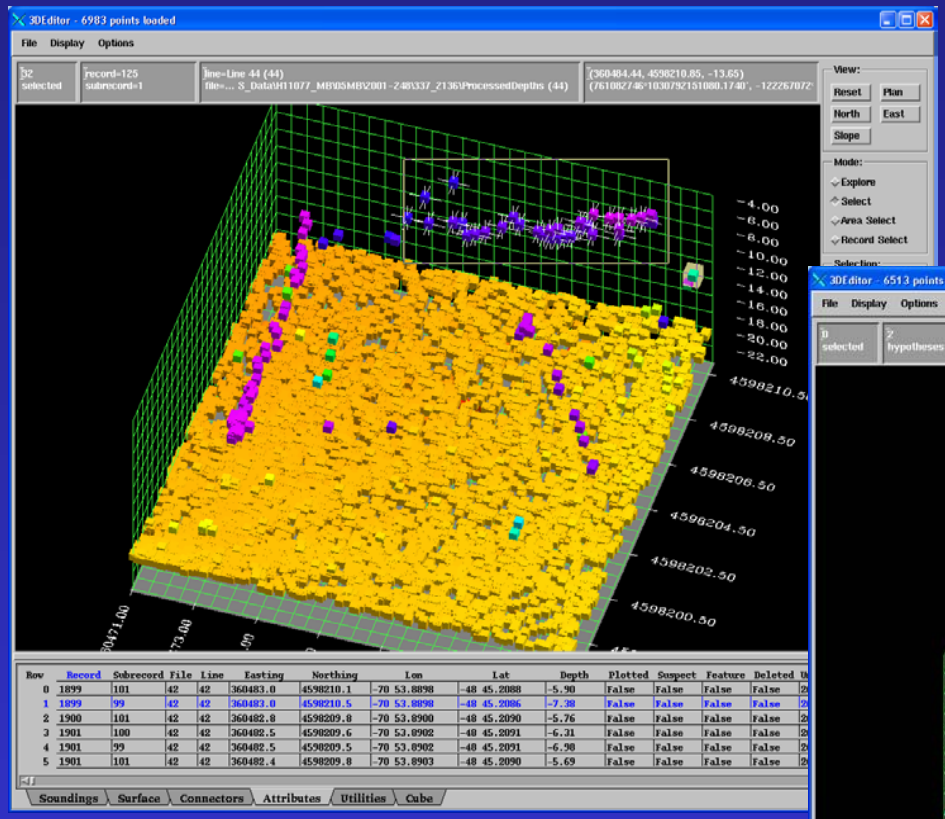
Valdez Narrows, AK



Total Time Comparison

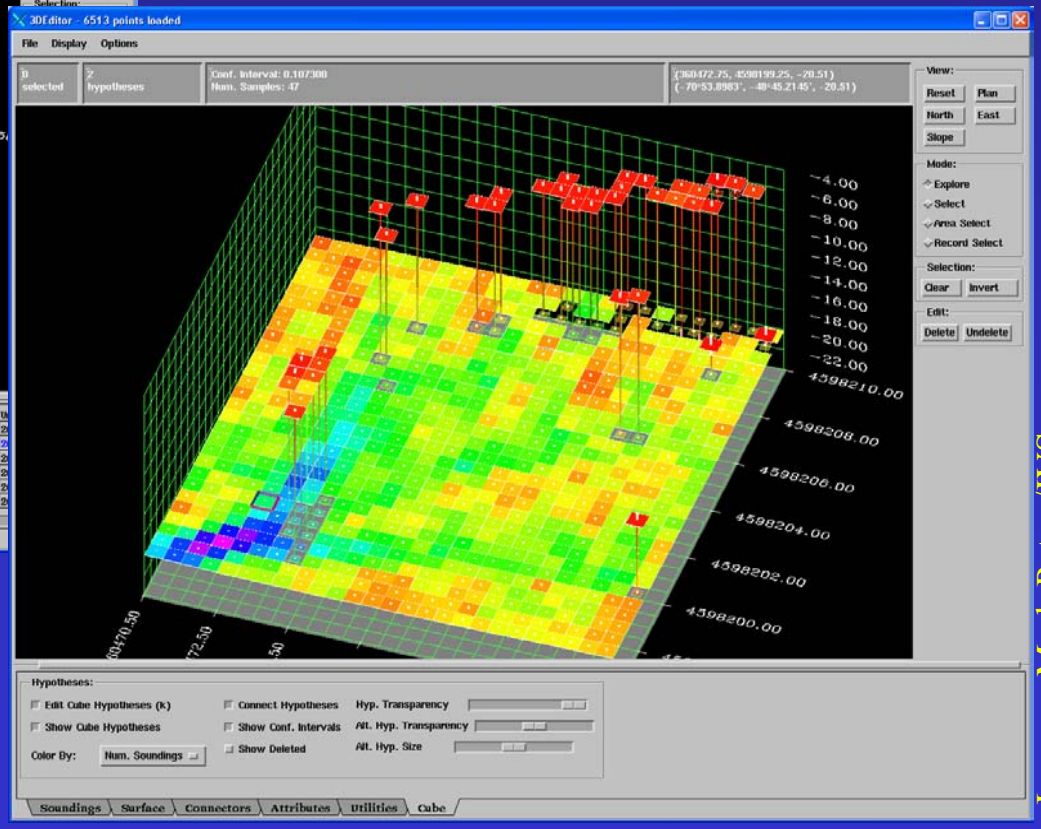


Transition Implementation



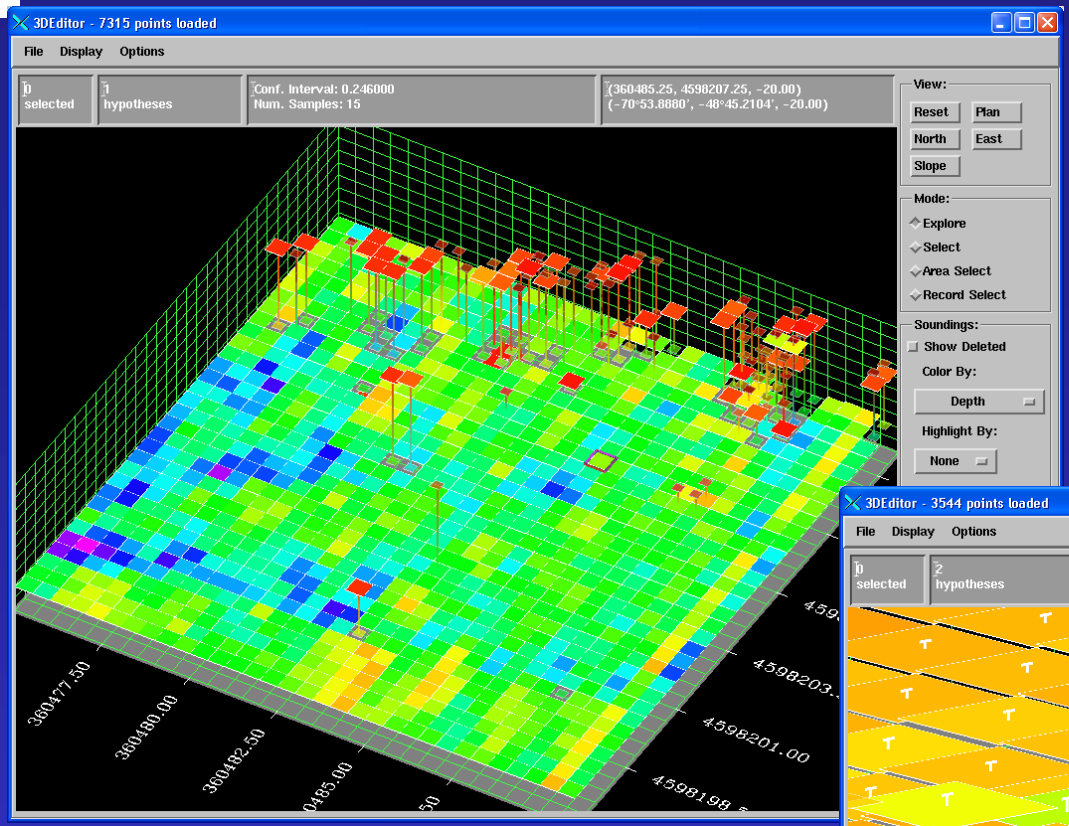
Examine points for problem solution (traditional)

Examine hypotheses for problem resolution

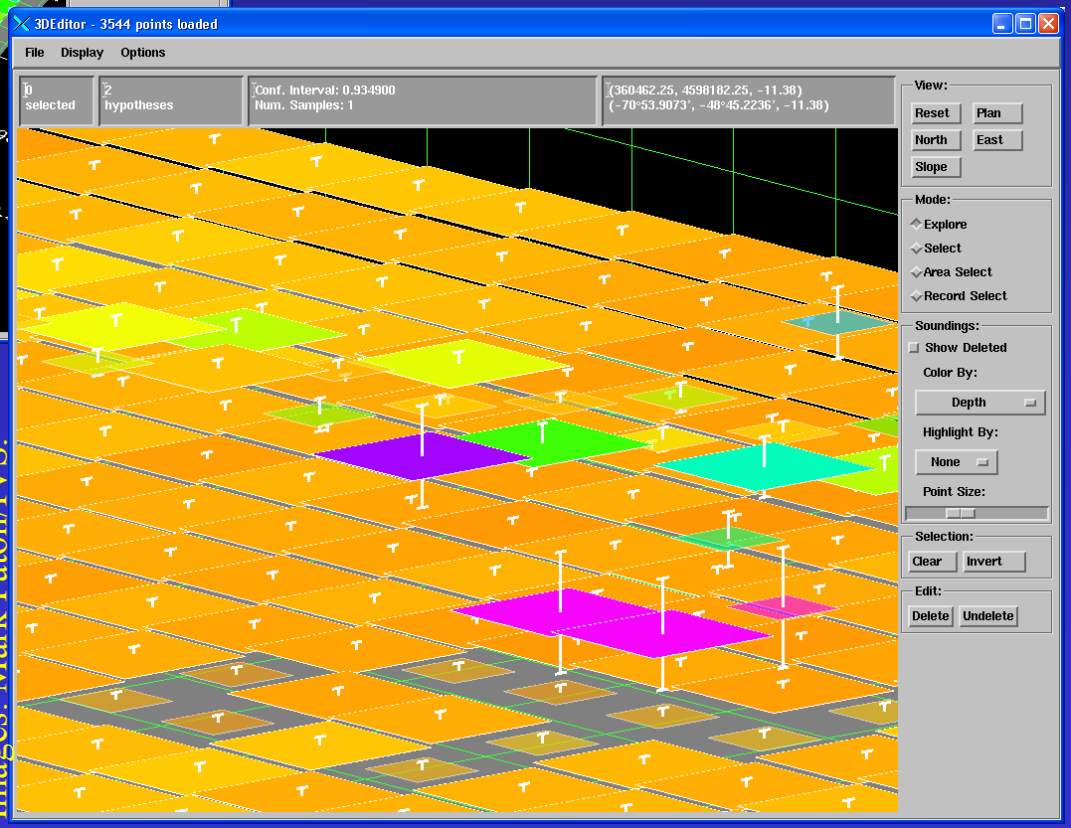


Images: Mark Paton/IVS.

Visualization of Uncertainty



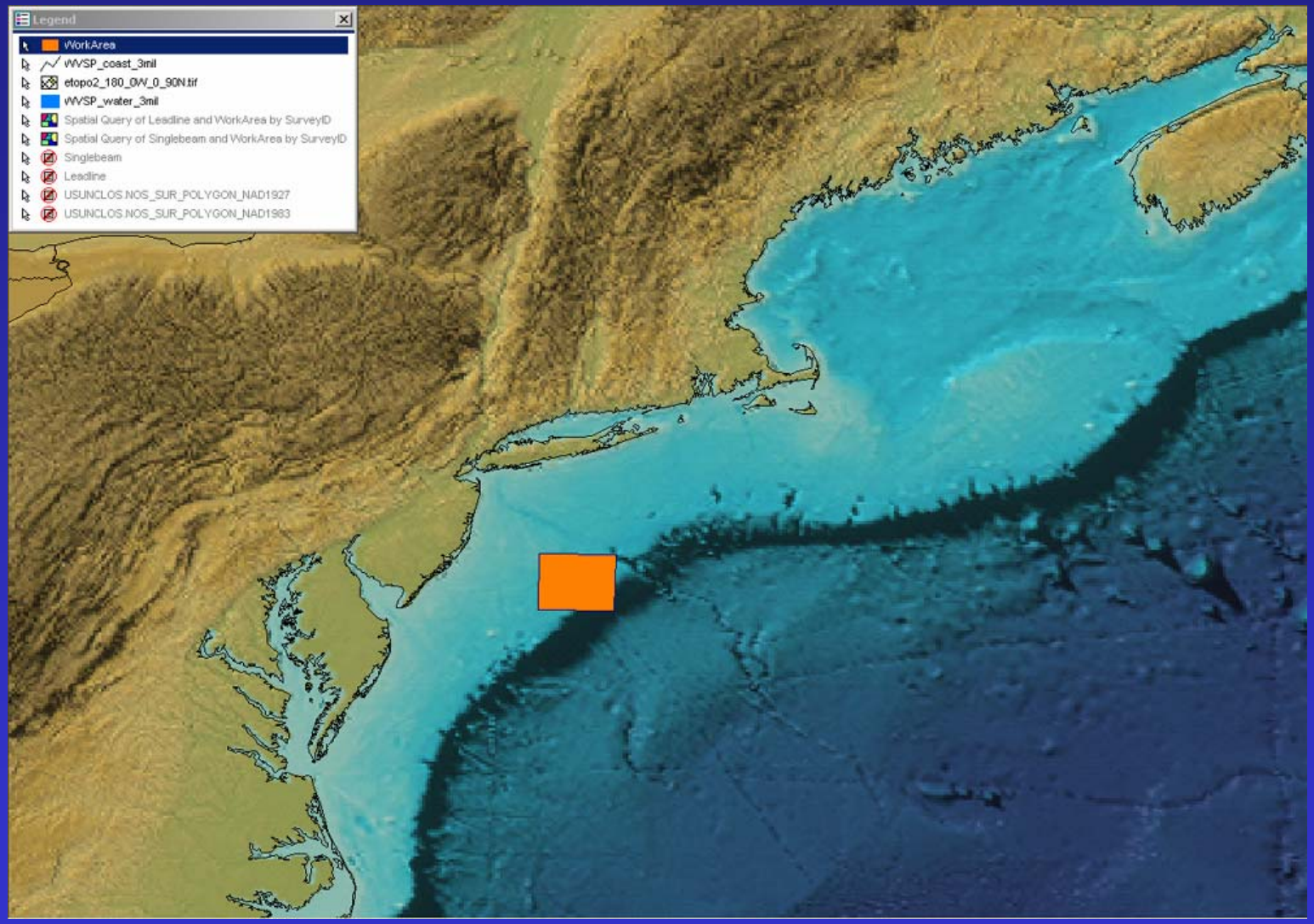
Color by confidence interval

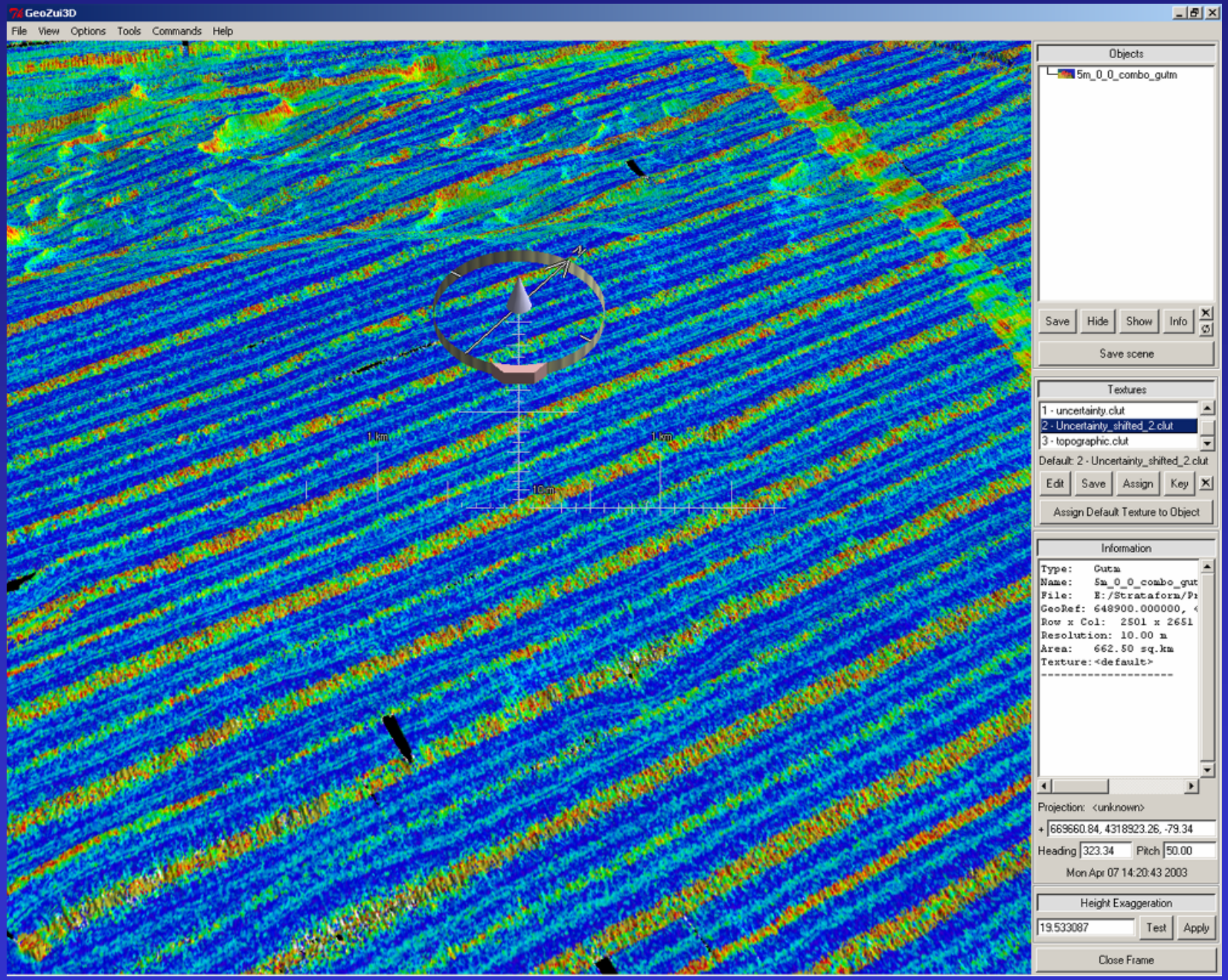


Color by sounding density

Images: Mark Paton/IVS.

Strataform Survey




GeoZui3D
File View Options Tools Commands Help
Objects
5m_0_0_combo_gutm
Save Hide Show Info
Save scene
Textures
1 - uncertainty.clut
2 - Uncertainty_shifted_2.clut
3 - topographic.clut
Default: 2 - Uncertainty_shifted_2.clut
Edit Save Assign Key
Assign Default Texture to Object
Information
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Projection: <unknown>
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Heading 323.34 Pitch 50.00
Mon Apr 07 14:20:43 2003
Height Exaggeration
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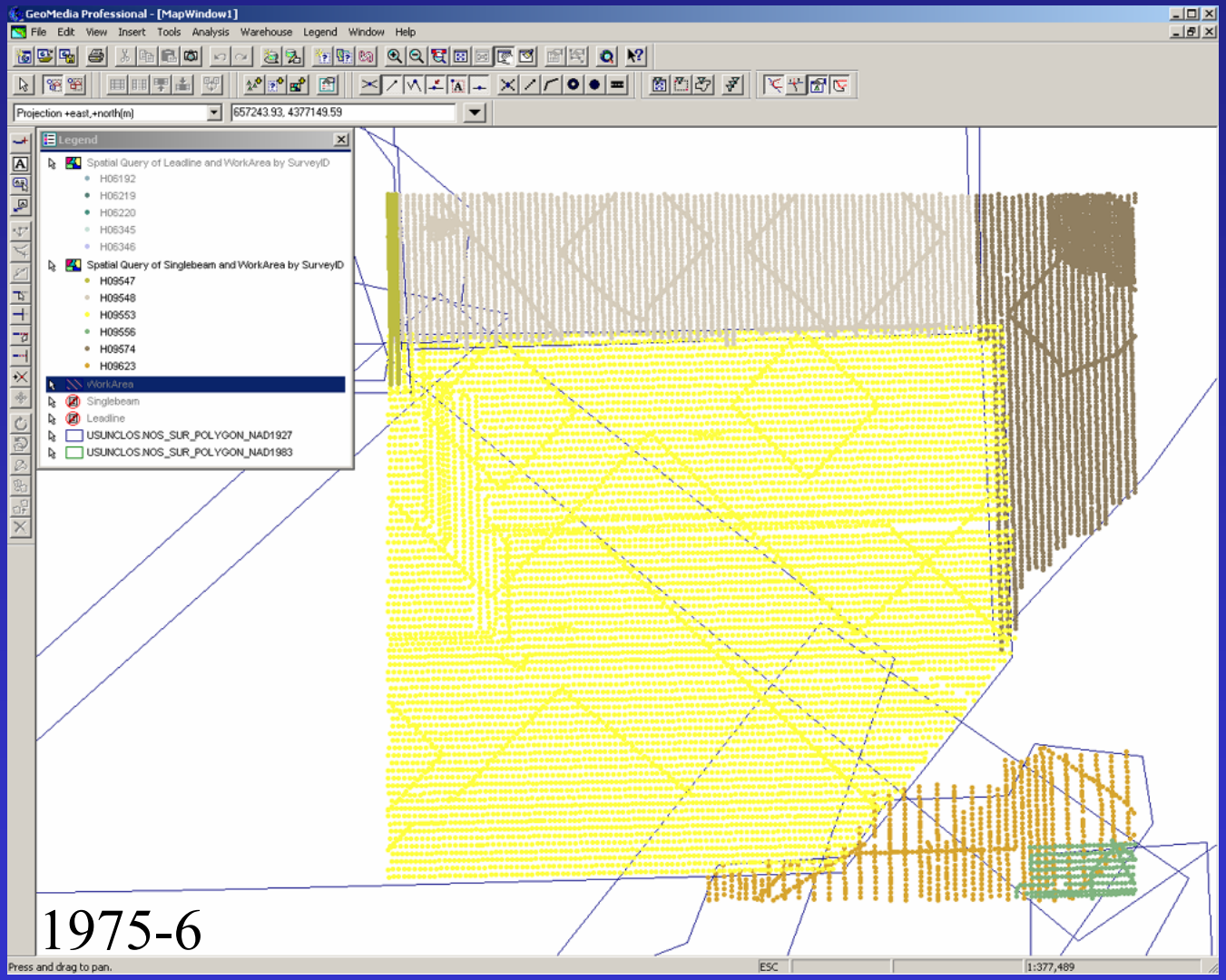
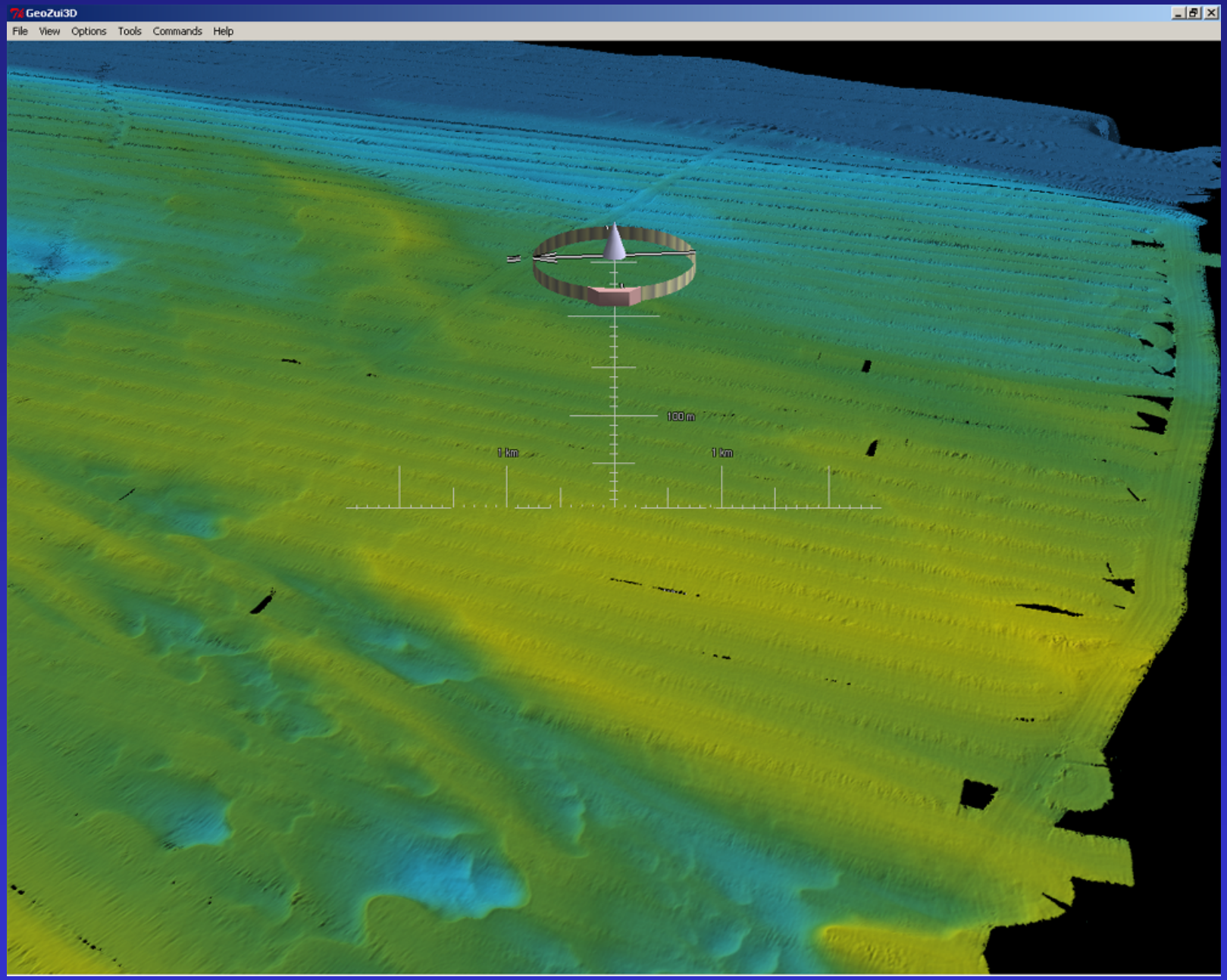
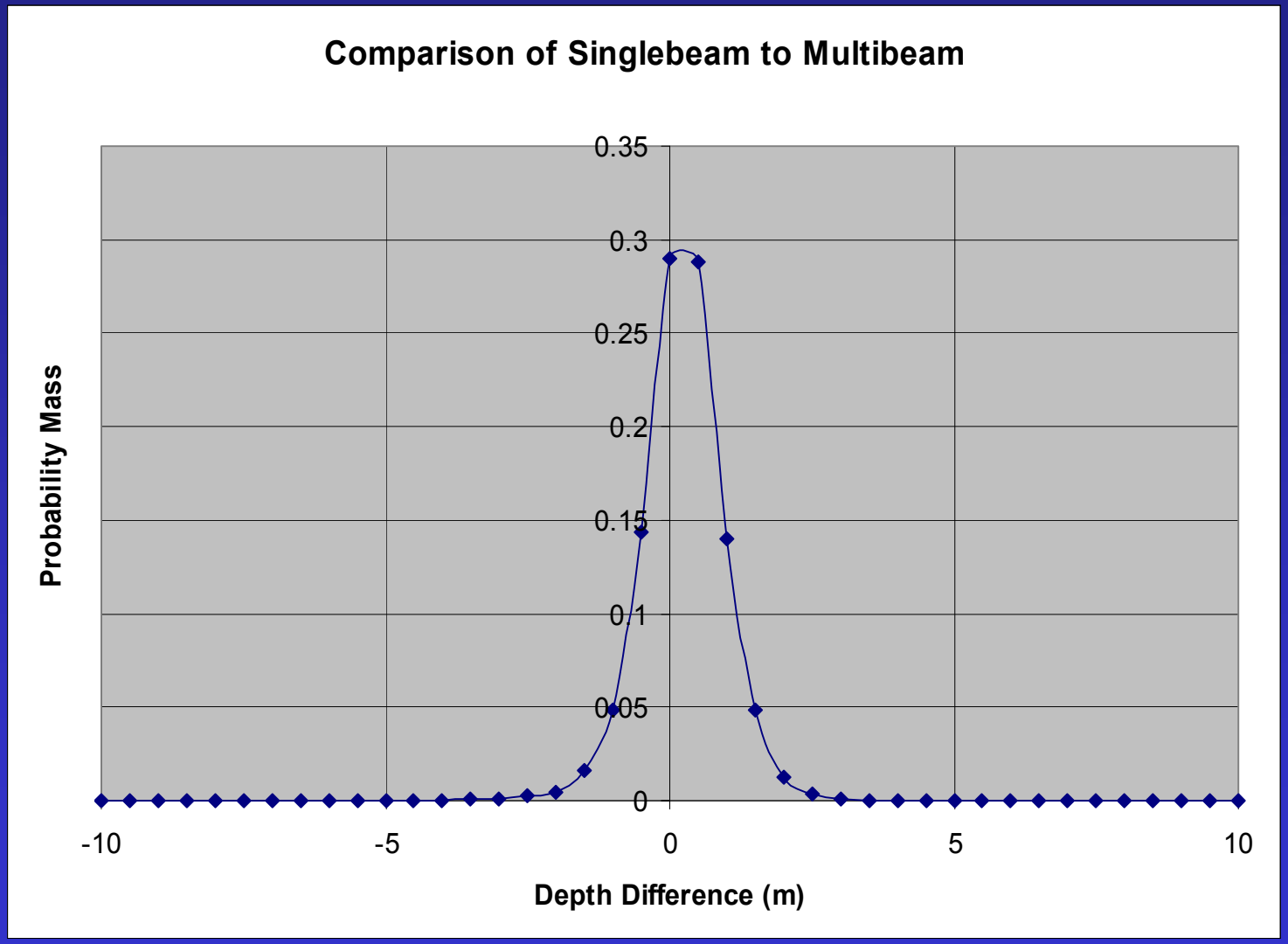
Close Frame
1 km
1 km
10 m

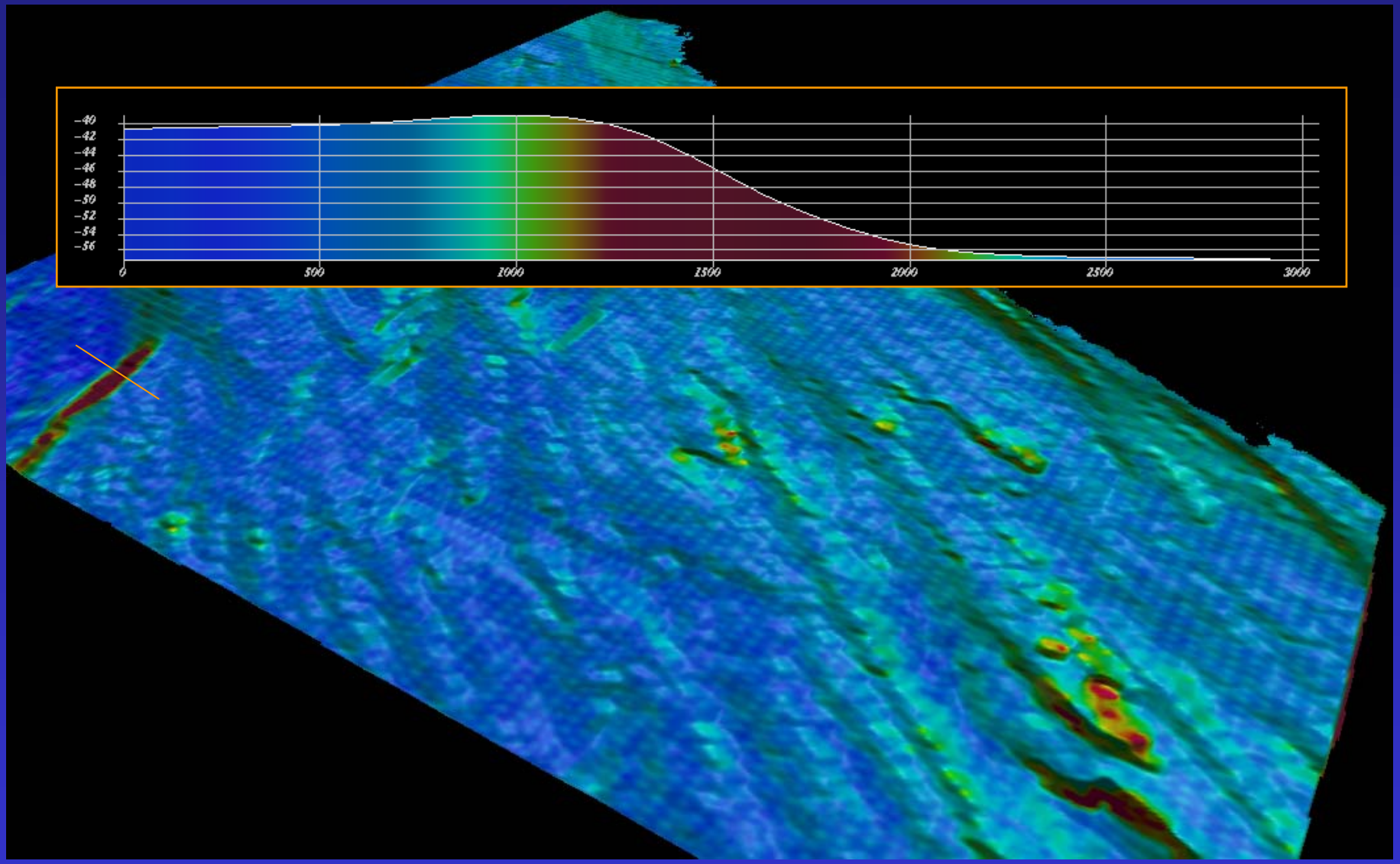
Historical NOS Surveys




GeoZui3D
File View Options Tools Commands Help
100 m
1 km
1 km

Singlebeam Comparisons




-40
-42
-44
-46
-48
-50
-52
-54
-56
0
500
1000
1500
2000
2500
3000

Summary

- Dense modern surveys
  - Hydrographically equivalent to hand process
  - Significantly faster than hand process
  - Extended for multi-resolution, algorithm reliability
  - Being transitioned to real-time and post-processing implementations
- Sparse historical surveys
  - Calibration against MBES where available, good for surveys of same vintage and methods
  - Sensitivity analysis via direct simulation Monte Carlo
  - Features offshore can be poorly defined by sparse data

New Avenues of Research

- ‘Child of CUBE’:
  - Real-time implementation for on-line survey analysis and uncertainty quantification
  - Smooth multi-resolution analysis with propagation of information
  - Data quality feedback through analysis of error patterns in resolved data
- Model Calibrations:
  - Comparison with historical datasets for variability
  - Methods for calibration from field ‘patch test’ data

Products

- Transition: CUBE is being implemented by:
  - IVS Fledermaus (http://www.ivs.unb.ca)
  - CARIS Ltd. (http://www.caris.com)
  - Kongsberg Simrad (http://www.kongsberg-simrad.com)
  - SAIC [MTG] (http://www.saic.com)
- Data products:
  - Bathymetry of the NJ shelf (coastal relief model)
  - Bathymetry & uncertainty of the Strataform NJ area
- Future Products:
  - Analysis of uncertainty in historic datasets
  - Visualization of uncertainty
- Papers:
  - "Automatic Statistical Processing of Multibeam Echosounder Data", B. Calder, Int. Hydro. Review, 4(1), 2003.
  - "Automatic Processing of High-Rate, High-Density Multibeam Echosounder Data", B. Calder and L. Mayer, G3 (http://www.agu.org/journals/gc/), DOI 10.1029/2002GC000486, 2003.