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Application of JPEG 2000 Wavelet Compression to Multibeam Echosounder Mid-water Acoustic Reflectivity Measurements

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Application of JPEG 2000 Wavelet Compression to Multibeam Echosounder Mid-water Acoustic Reflectivity Measurements

J. Beaudoin

Ocean Mapping Group

University of New Brunswick

Fredericton, NB

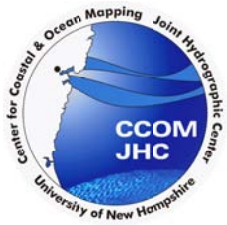
Now at

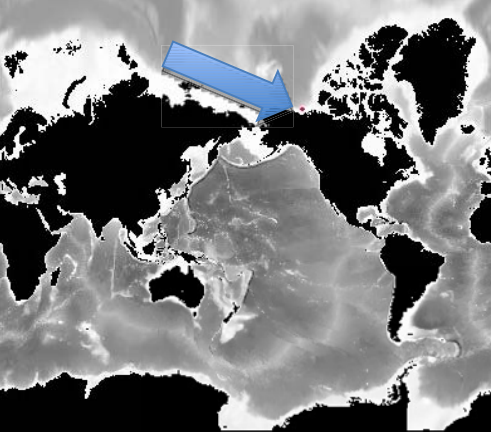
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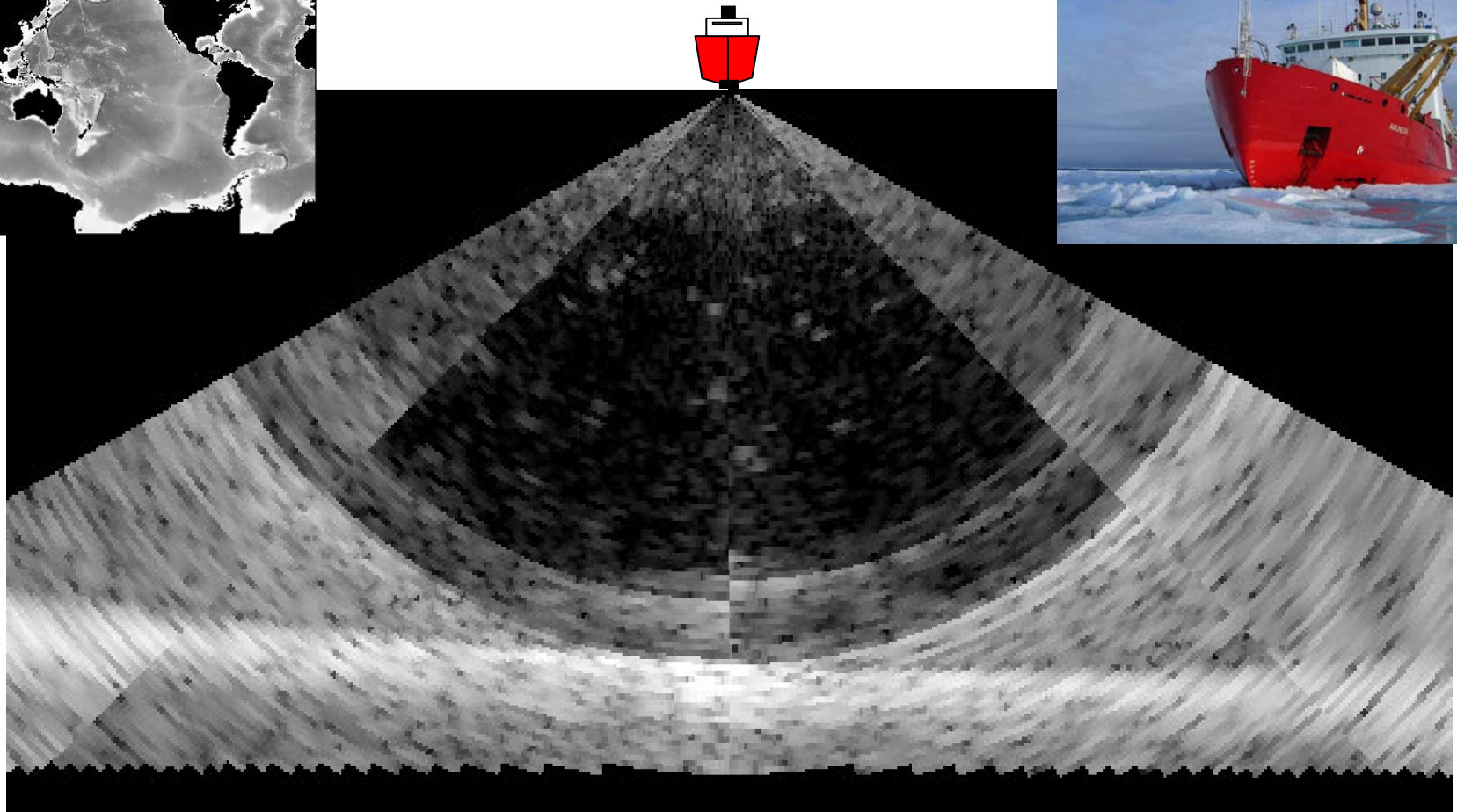
Durham, NH

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120 m



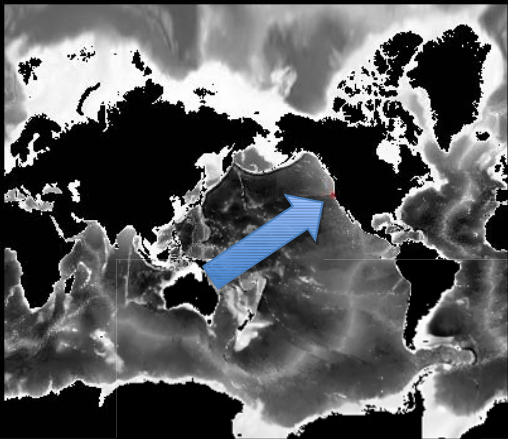
240 m

CCGS Amundsen – Mackenzie Shelf, 2009-10-01
EM302 30 kHz MBES (1.0°x2.0°)

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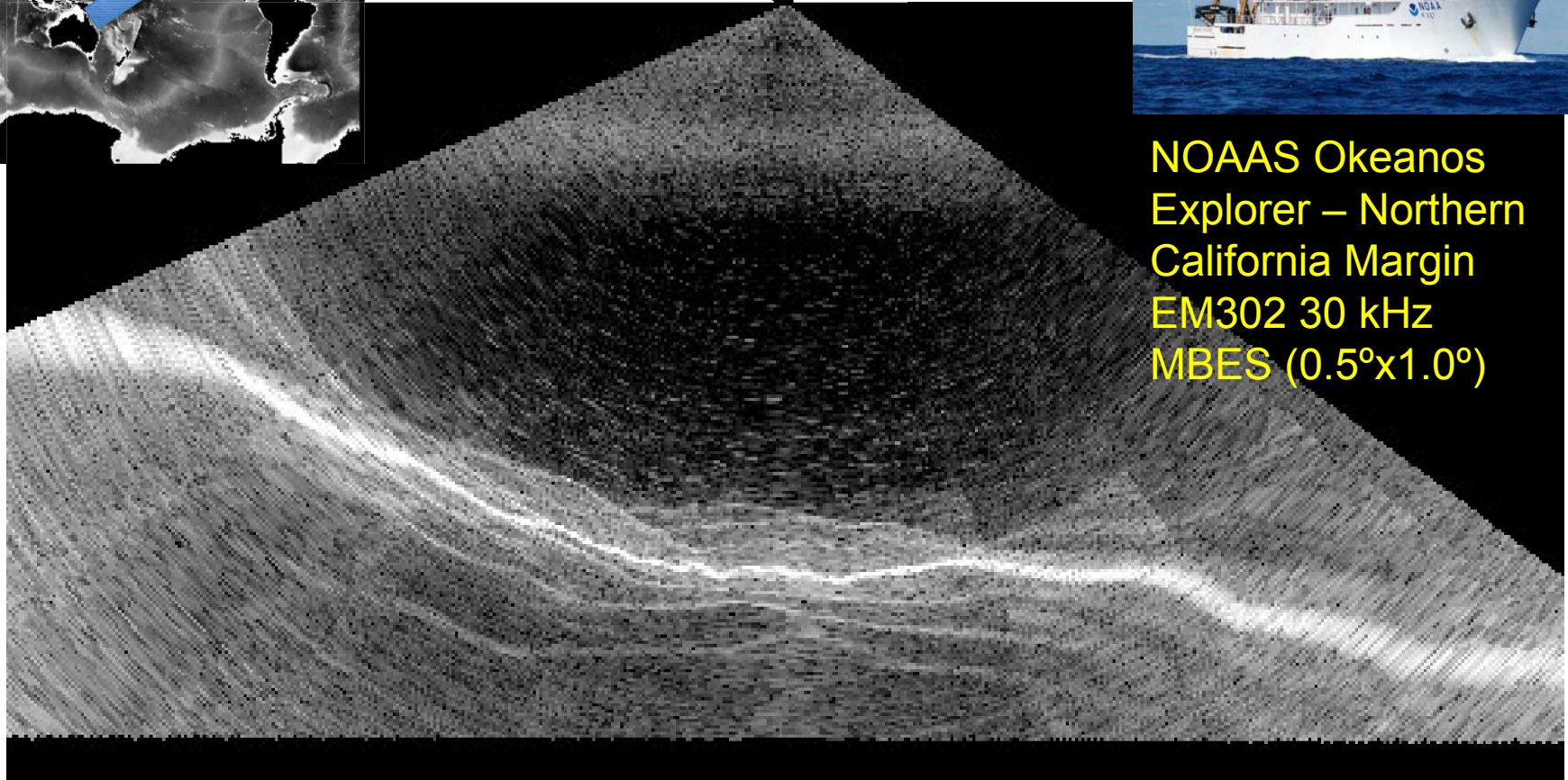
University of New Brunswick
CANADA





NOAAS Okeanos
Explorer – Northern
California Margin
EM302 30 kHz
MBES (0.5°x1.0°)

2,500 m



5,000 m

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J. V. Gardner, M. Malik, and S. Walker. Plume 1400 Meters High Discovered at the Seafloor off the Northern California Margin. Eos Trans. AGU, 90(32), 2009



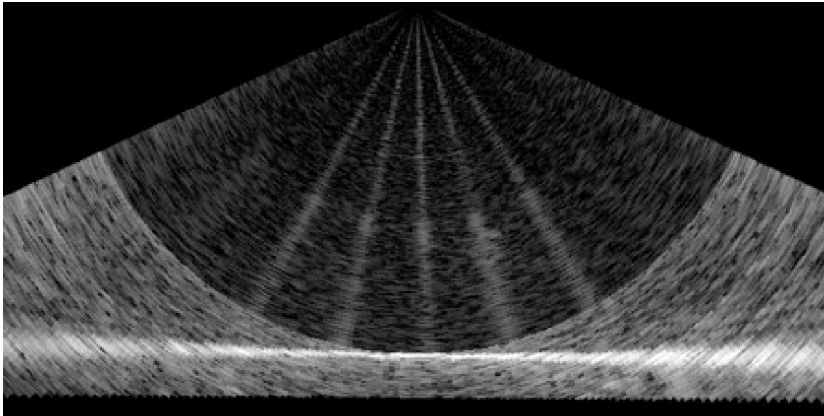


Data Storage Requirements



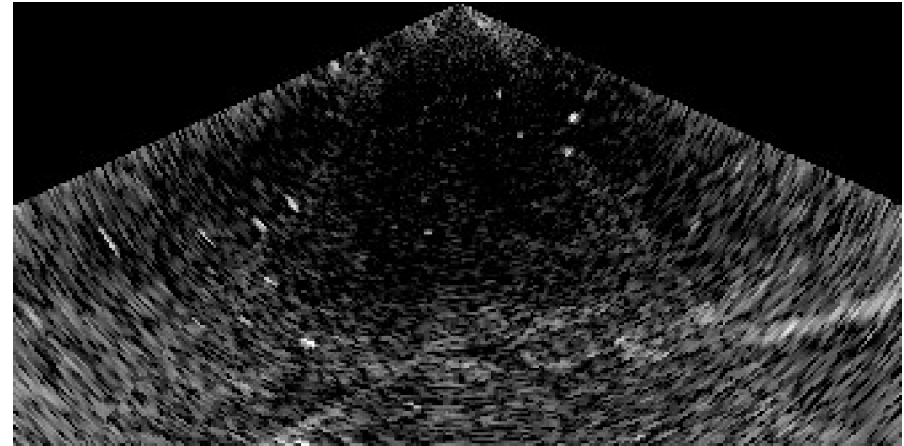
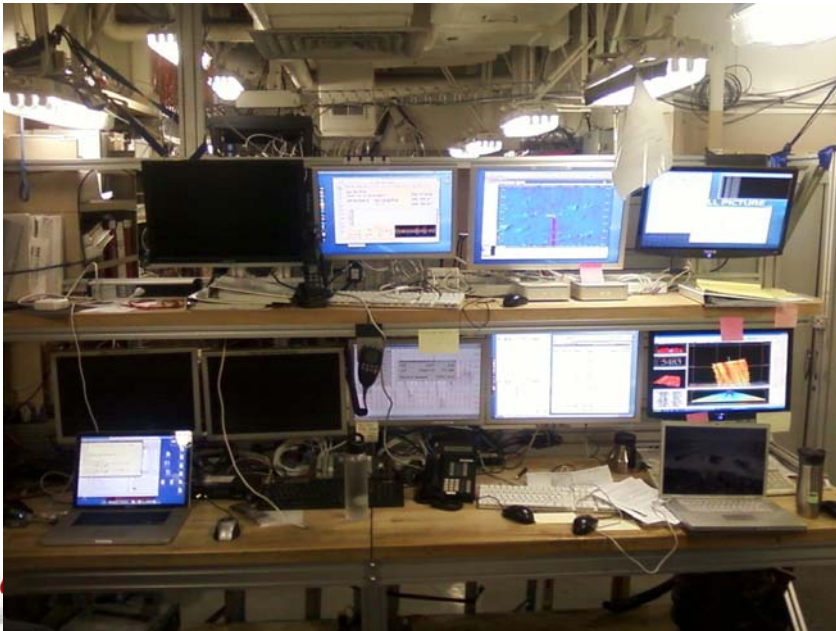
- Logging WC data increases file sizes:
 - CCGS Amundsen, 2009 field season
 - 135 days at sea, continuous MBES logging
 - “Regular” data: 860 GB (.all files)
 - Water column data: 783 GB (.wcd files)
- File size grows by factor of 2-8, depending on water depth and angular sector
- Some (most?) don’t bother logging WC, especially in shallow water





Recording “Interesting” Data only

How do you define “interesting”?





Solution?

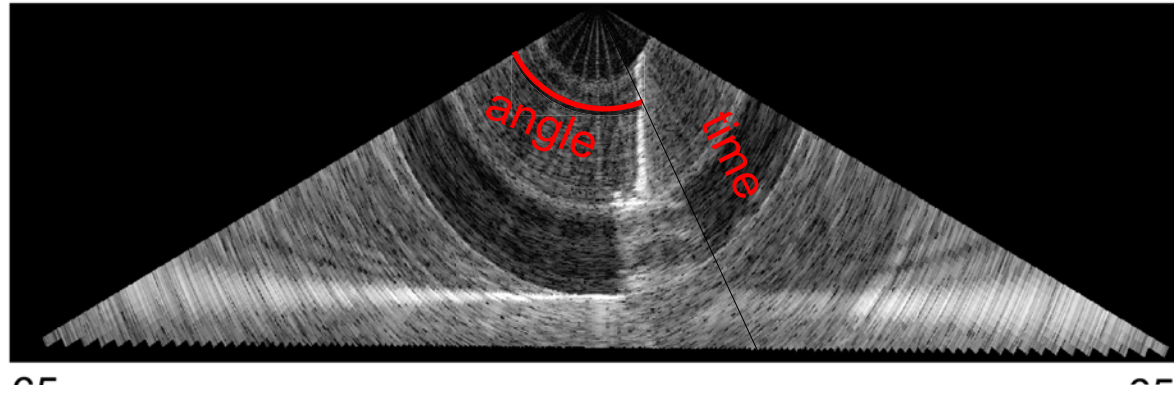
- Courtney (2008) applied JPEG2000 to seismic & sidescan and suggested use for MBES
- JPEG2000:
 - Discrete Wavelet Transform (DWT)
 - Lossless and Lossy methods available
- JasPer implementation of JPEG2000
 - Freely available open source library
 - Reasonably documented
 - Implemented in many open source applications

R. Courtney. Storage and dissemination of SEG Y data in JPEG2000 format. In Proc. Shallow Survey 2008, Oct2008.

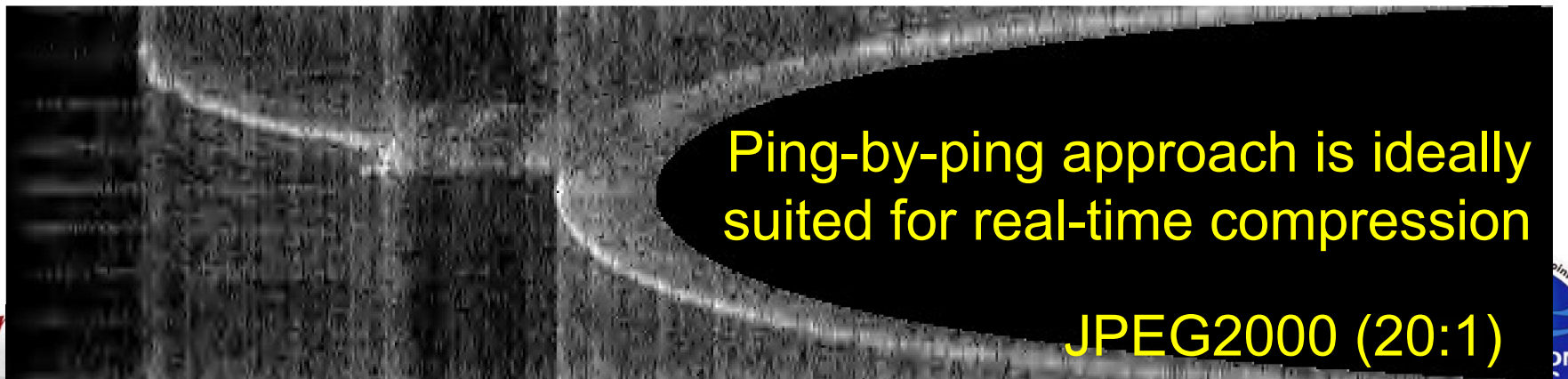
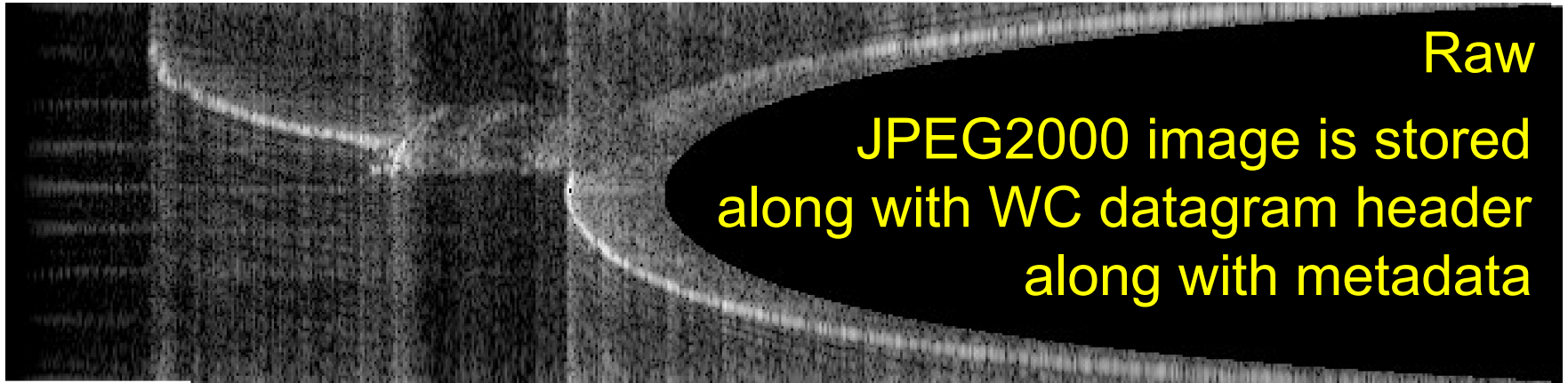


Implementation

time



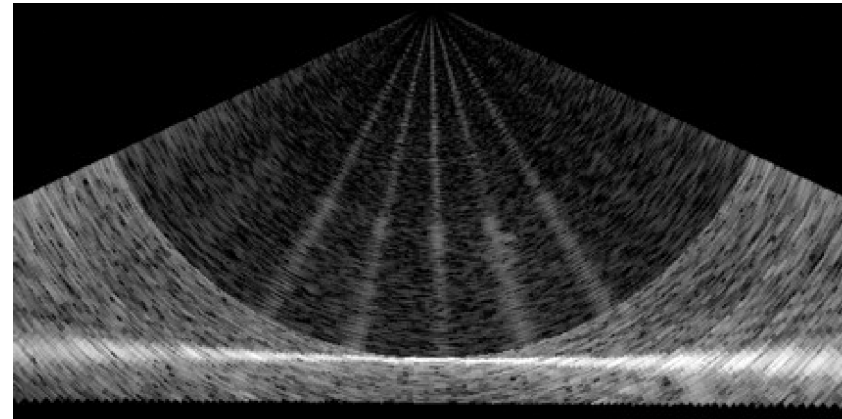
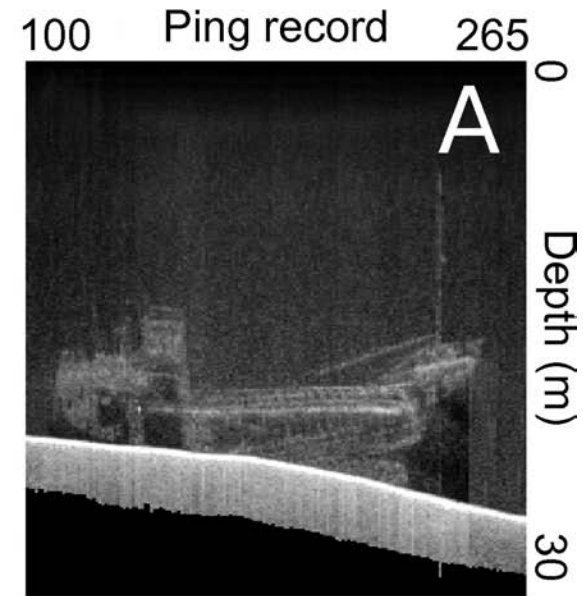
Beam/angle





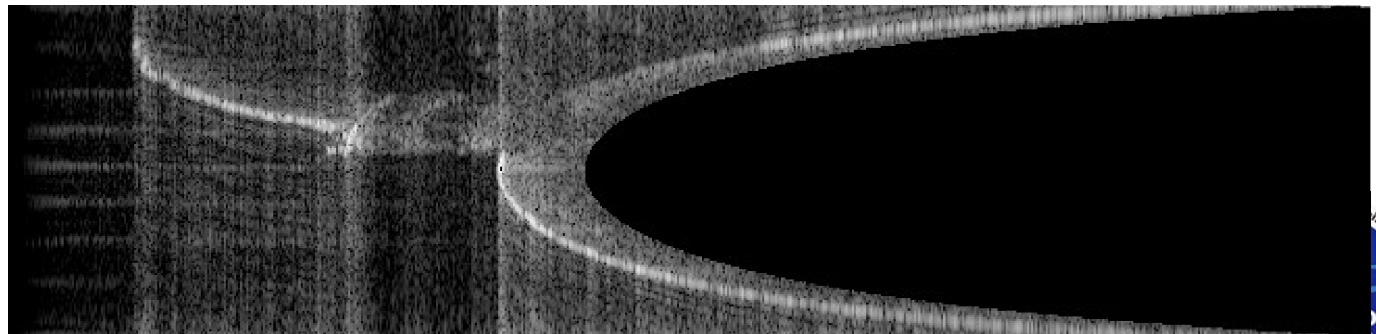
Evaluation

- MV G.B. Church, purposely sunk in 1991
- Mapped with EM3002 in 2006 (CCGS Otter Bay)
- 12 passes, only 1 pass fully imaged mast (1,064MB of data, 899MB of WC)
- Wreck imaged over 170 pings

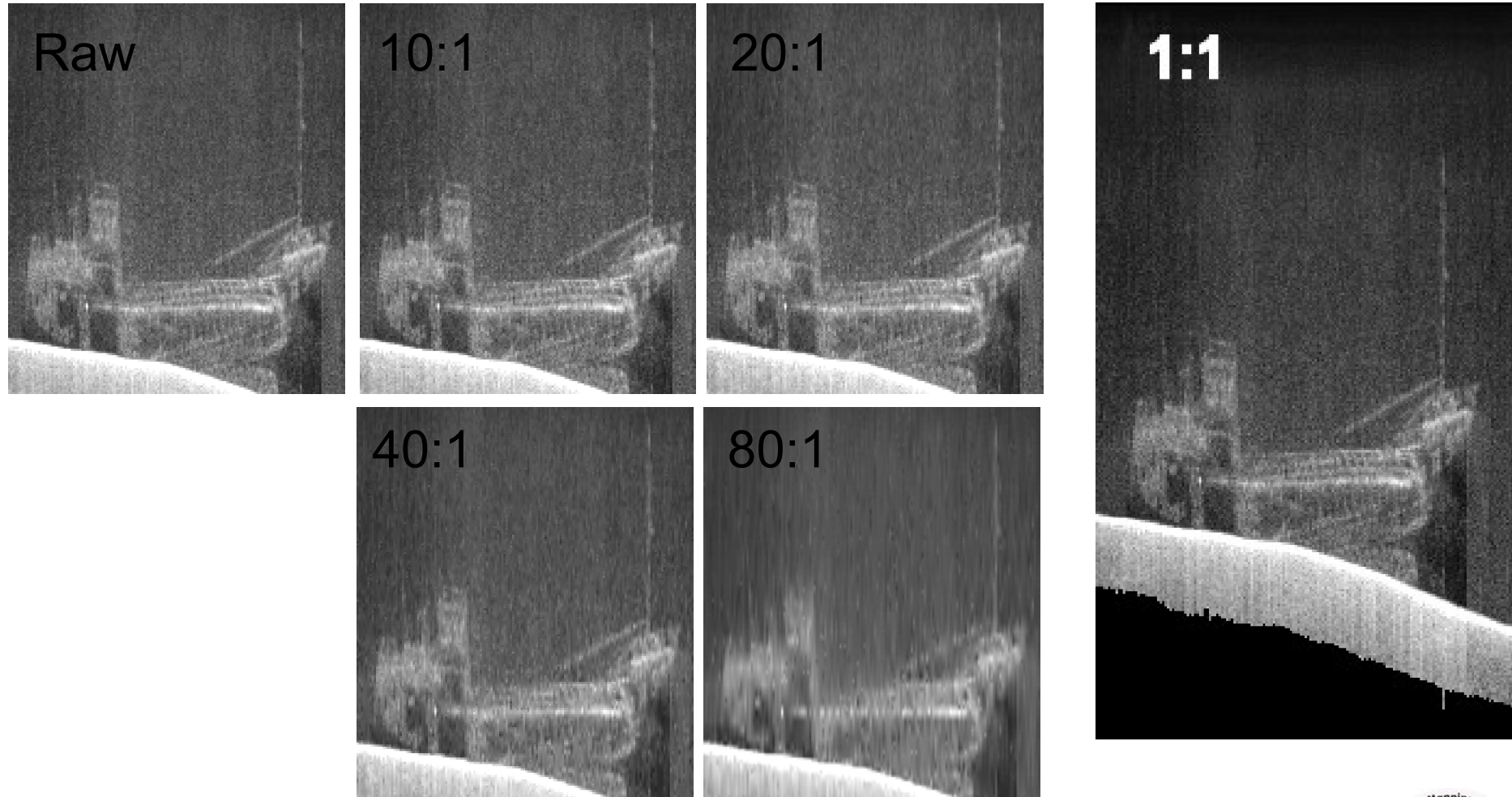


Results: Lossless Compression

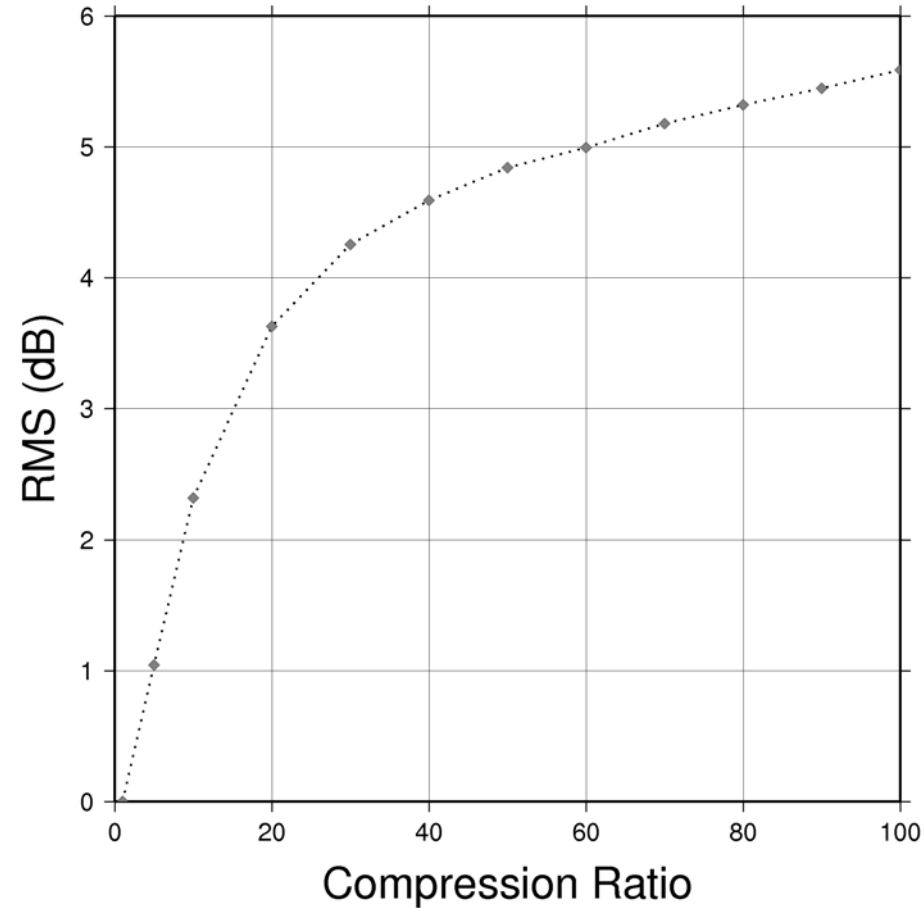
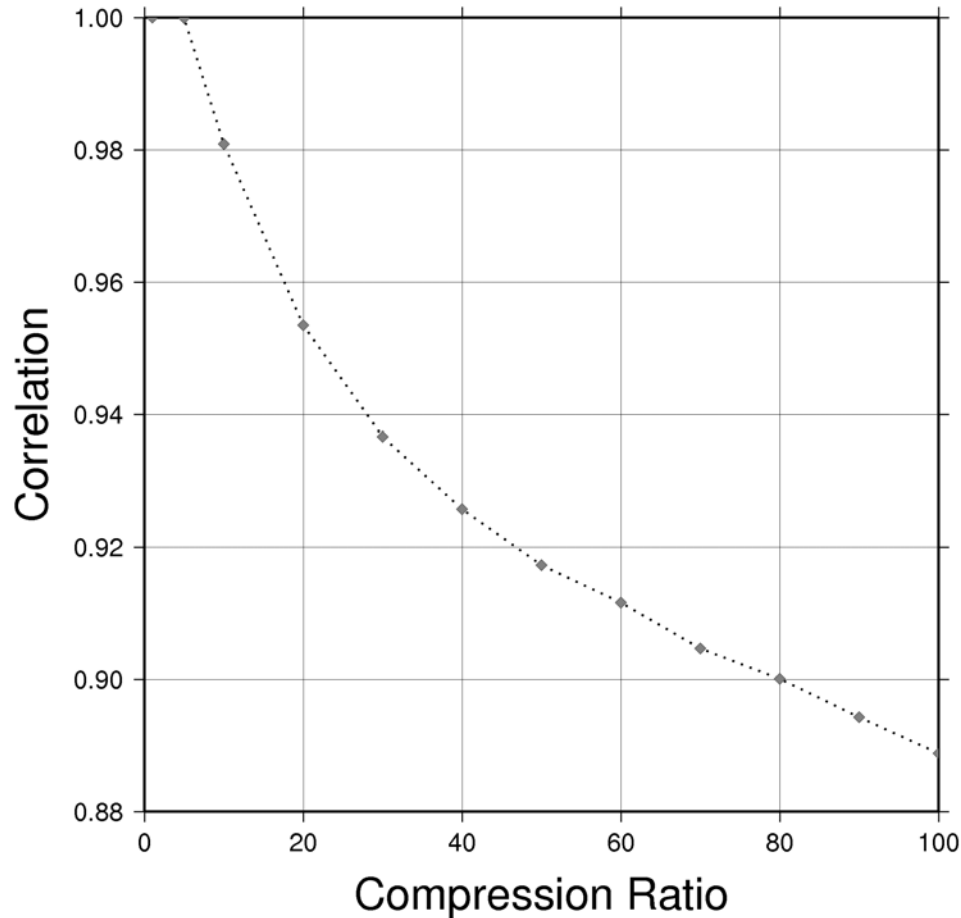
- Ratios 2.5:1 (raw image compared to JPEG2000)
- Effective ratio only 1.5:1 due to zero padding
- Still better than WinZip:
 - JPEG2000: packs down file size to 68%
 - Lempel-Ziv: packs down file size to 75%



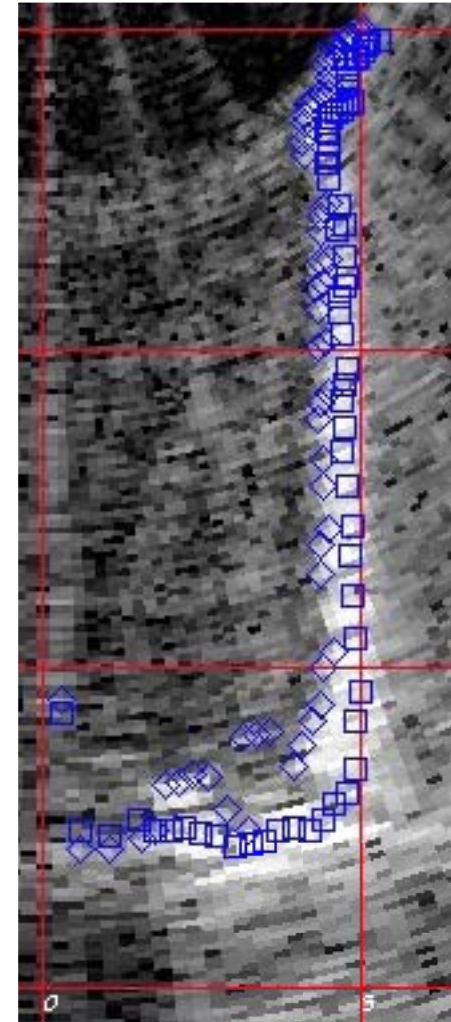
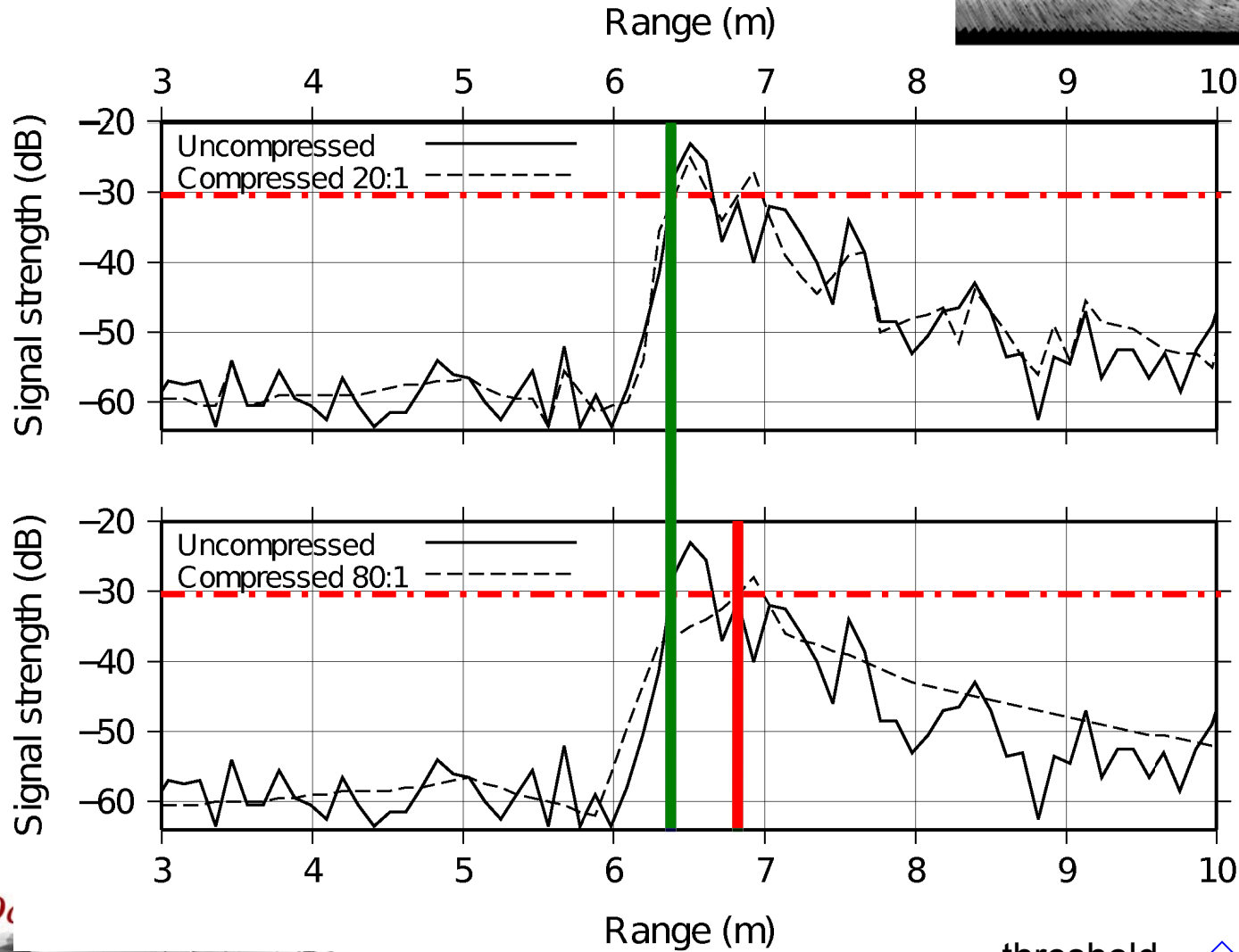
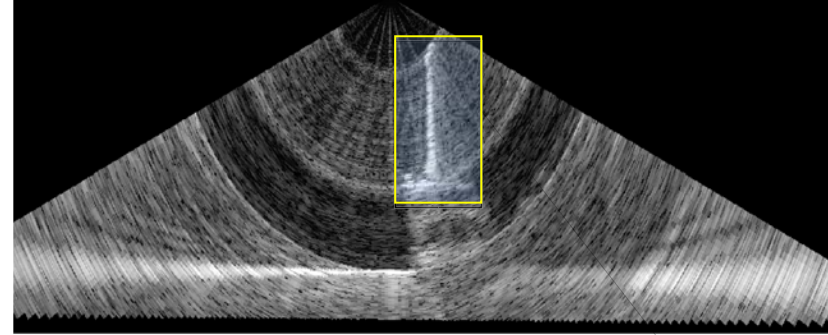
Results: Lossy Compression



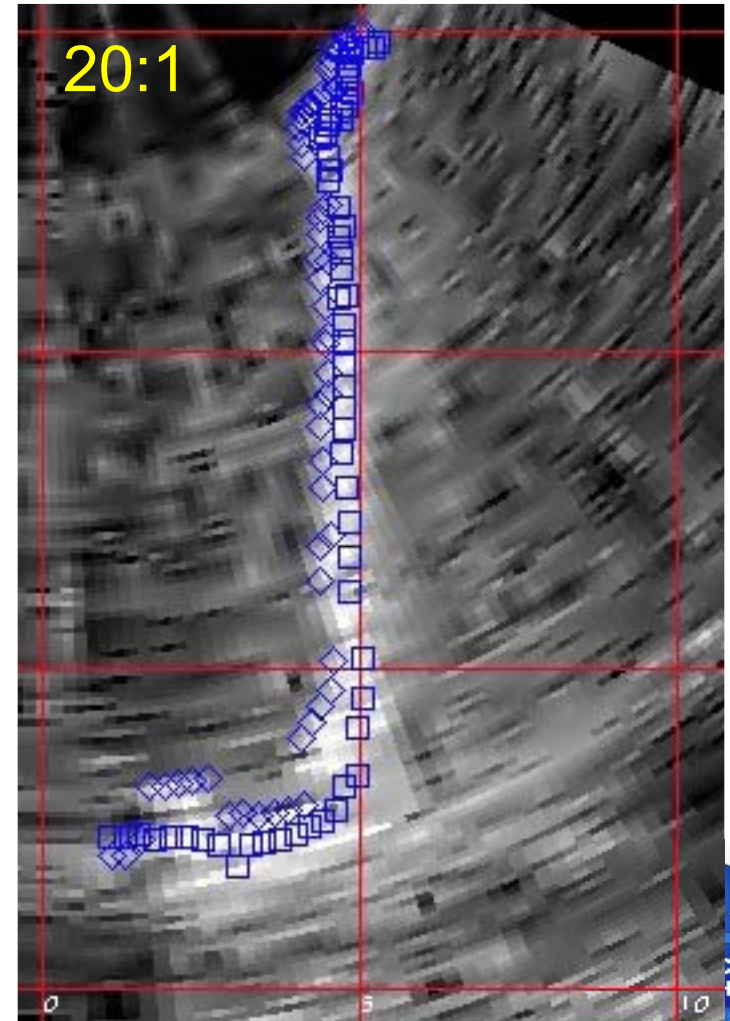
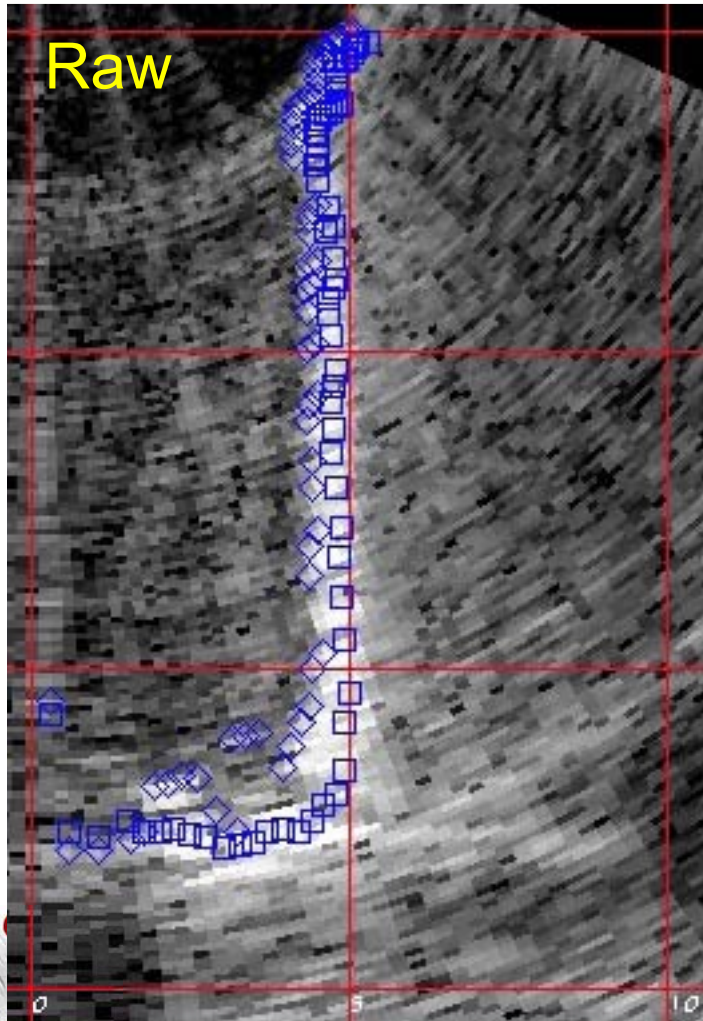
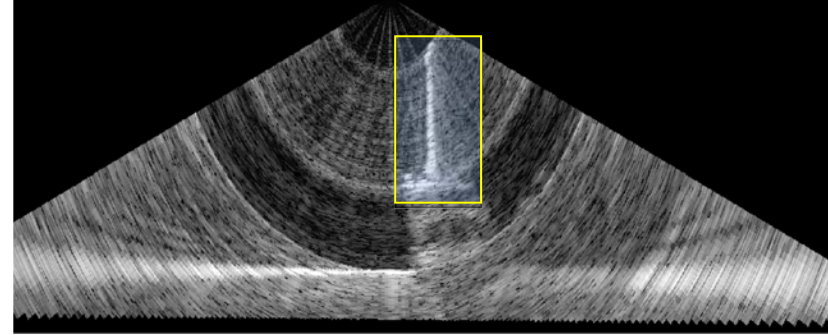
Quantifying Effects of Lossy Compression



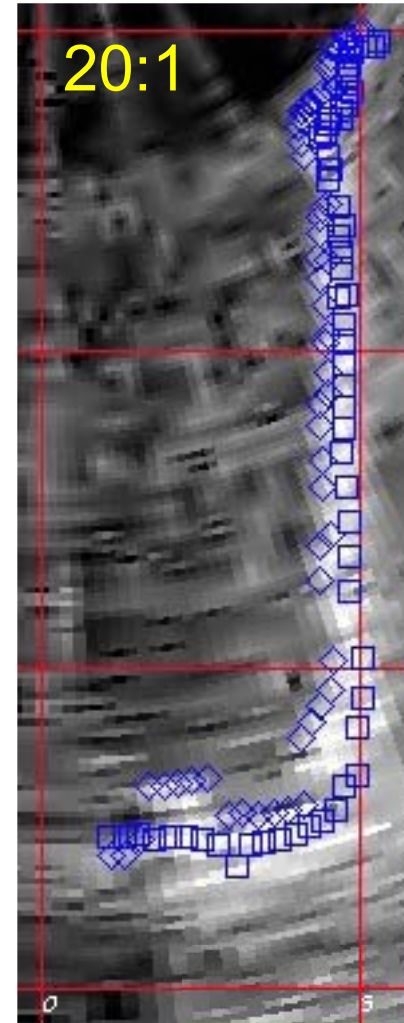
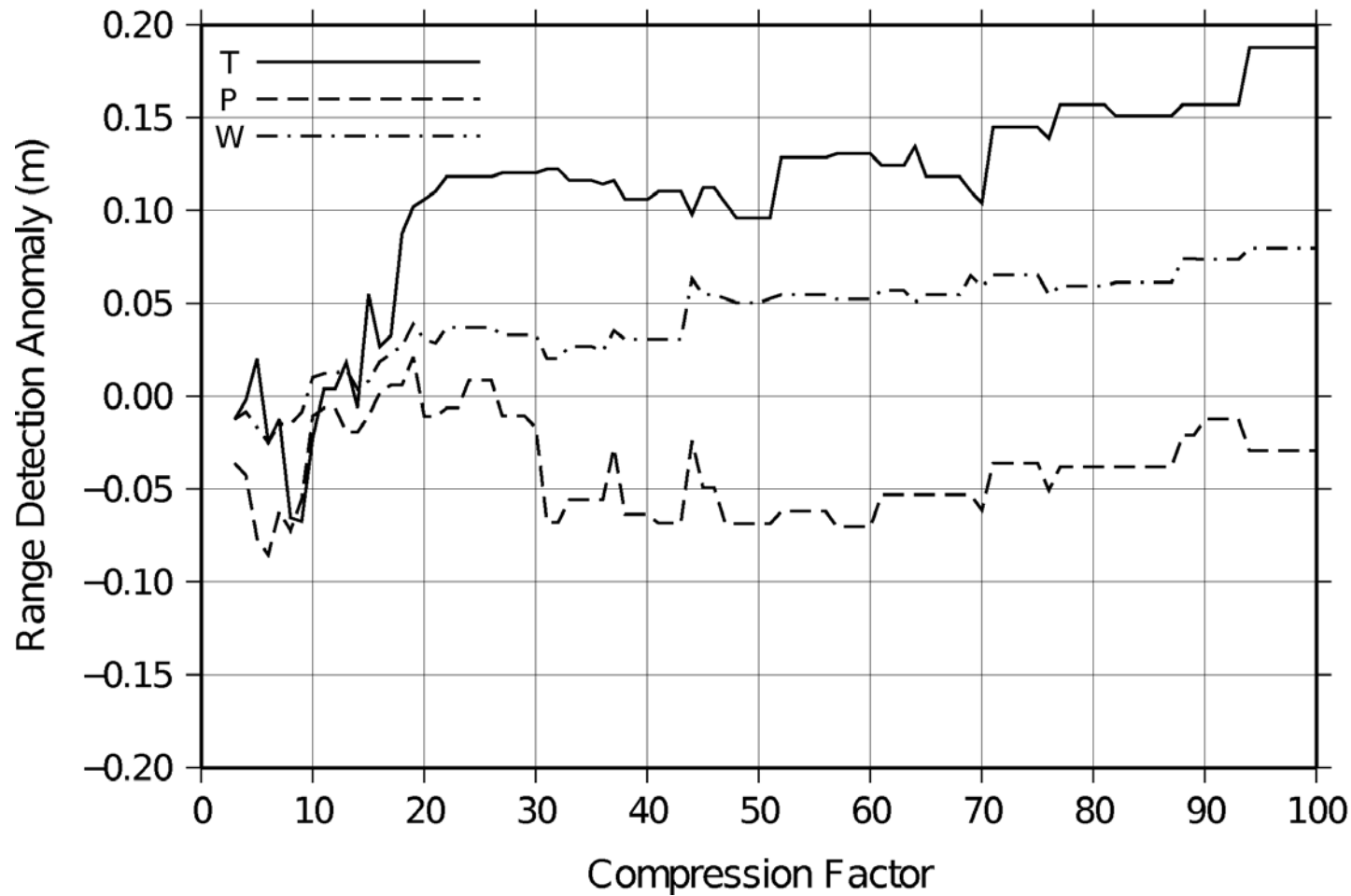
Wreck Measurement



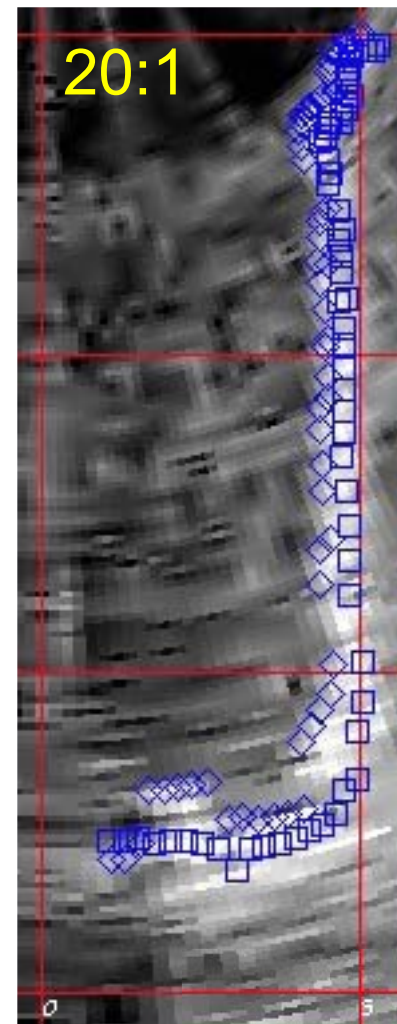
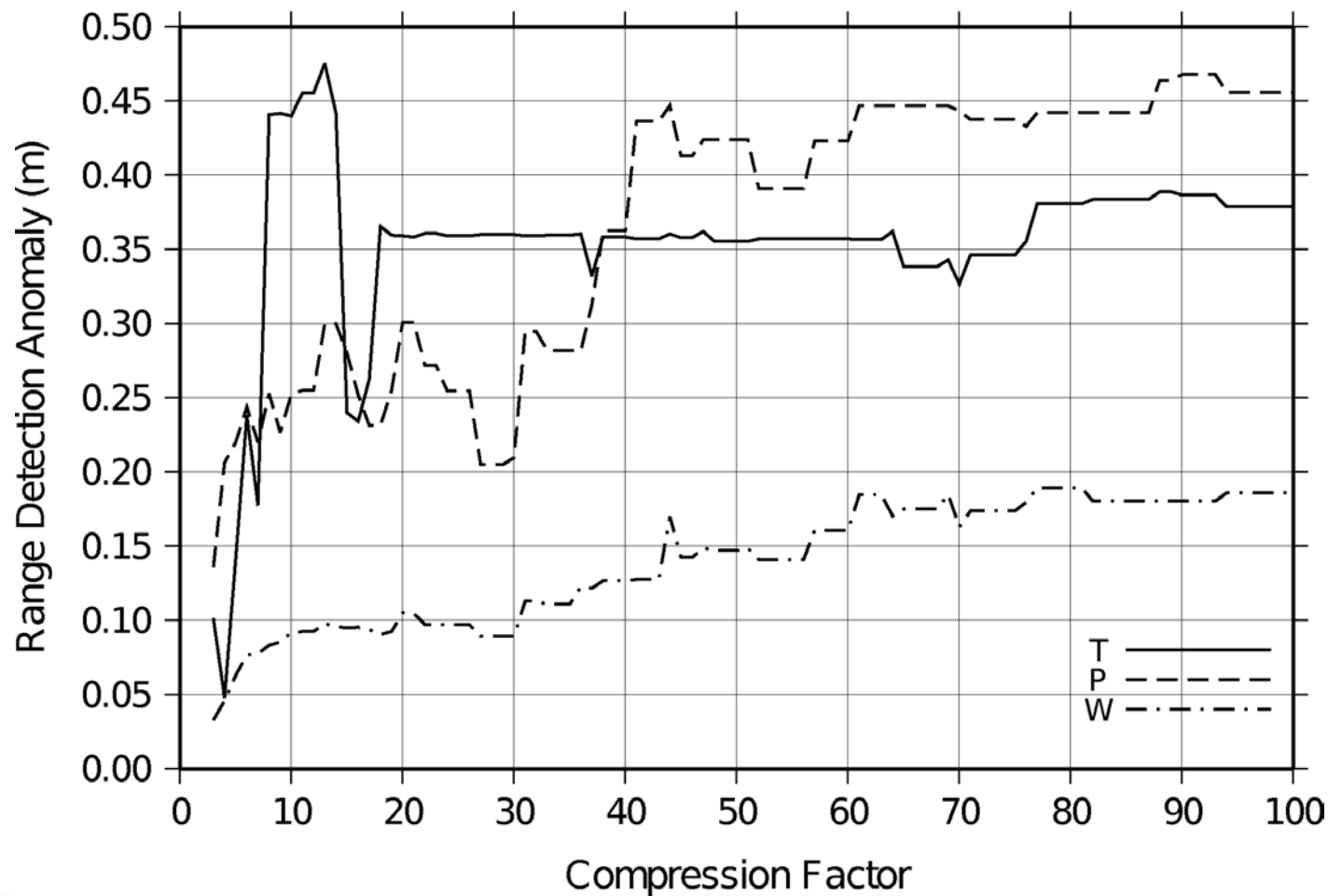
Wreck Measurement



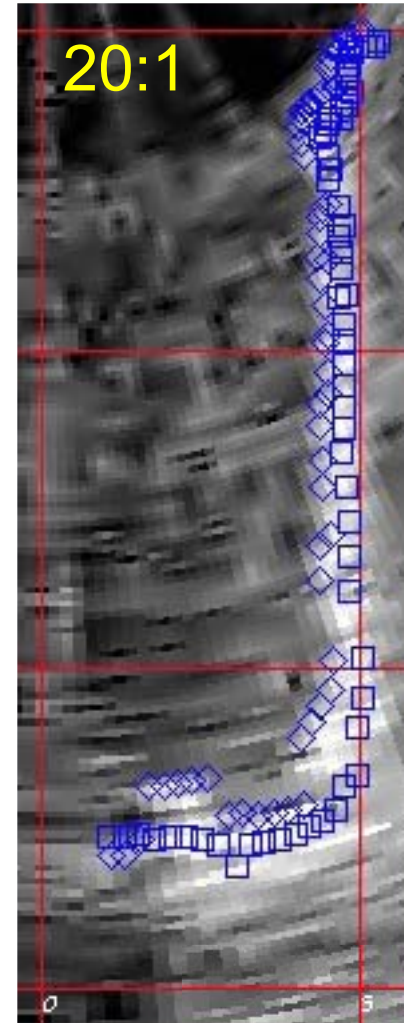
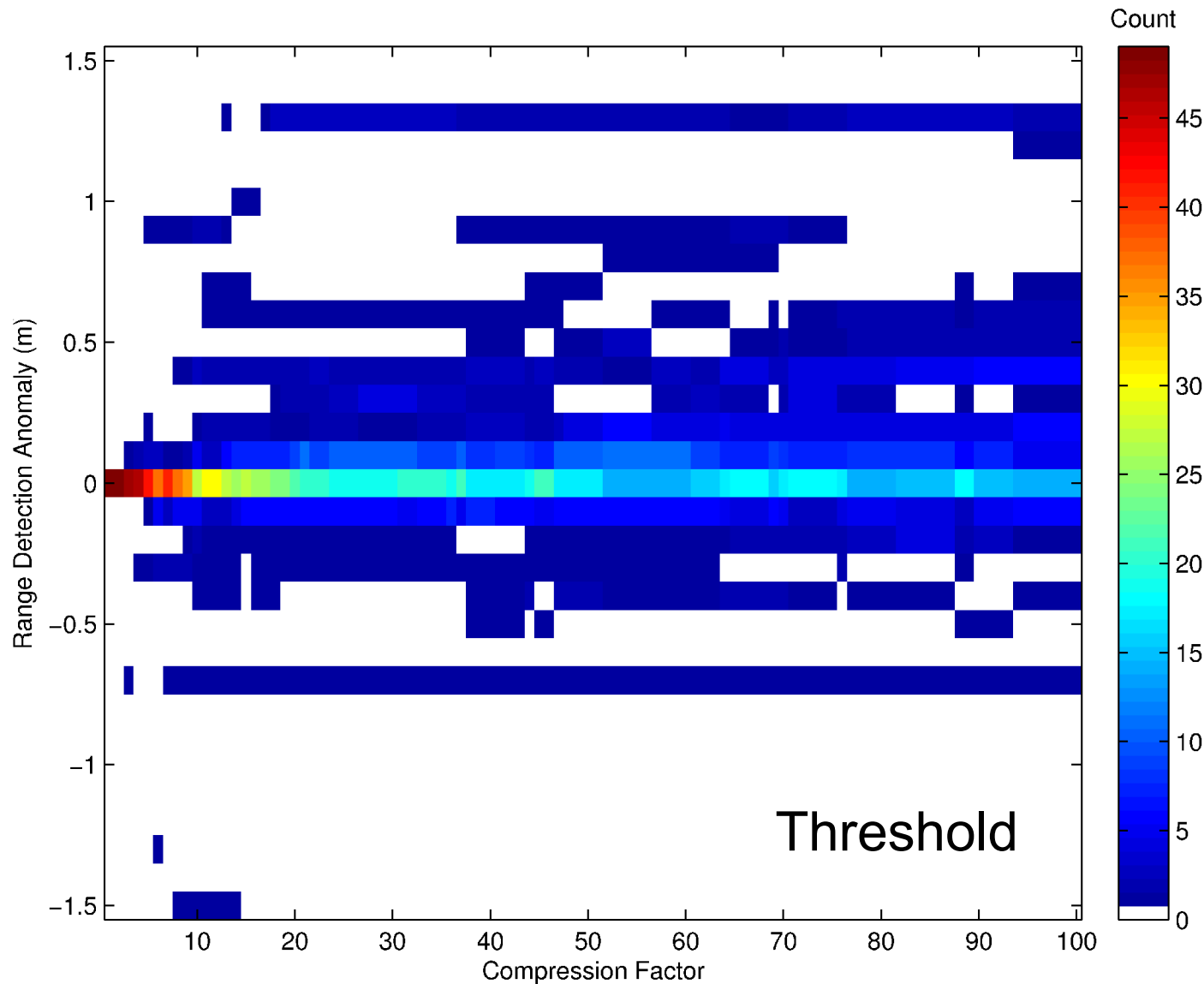
Mean Anomaly



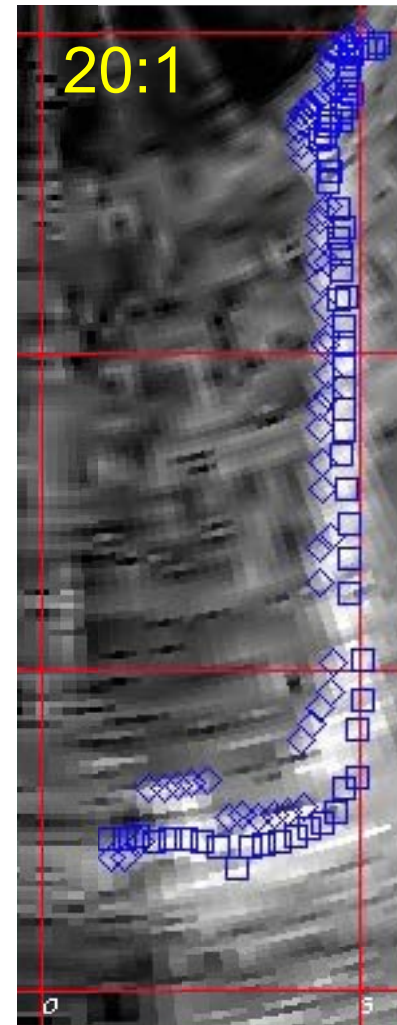
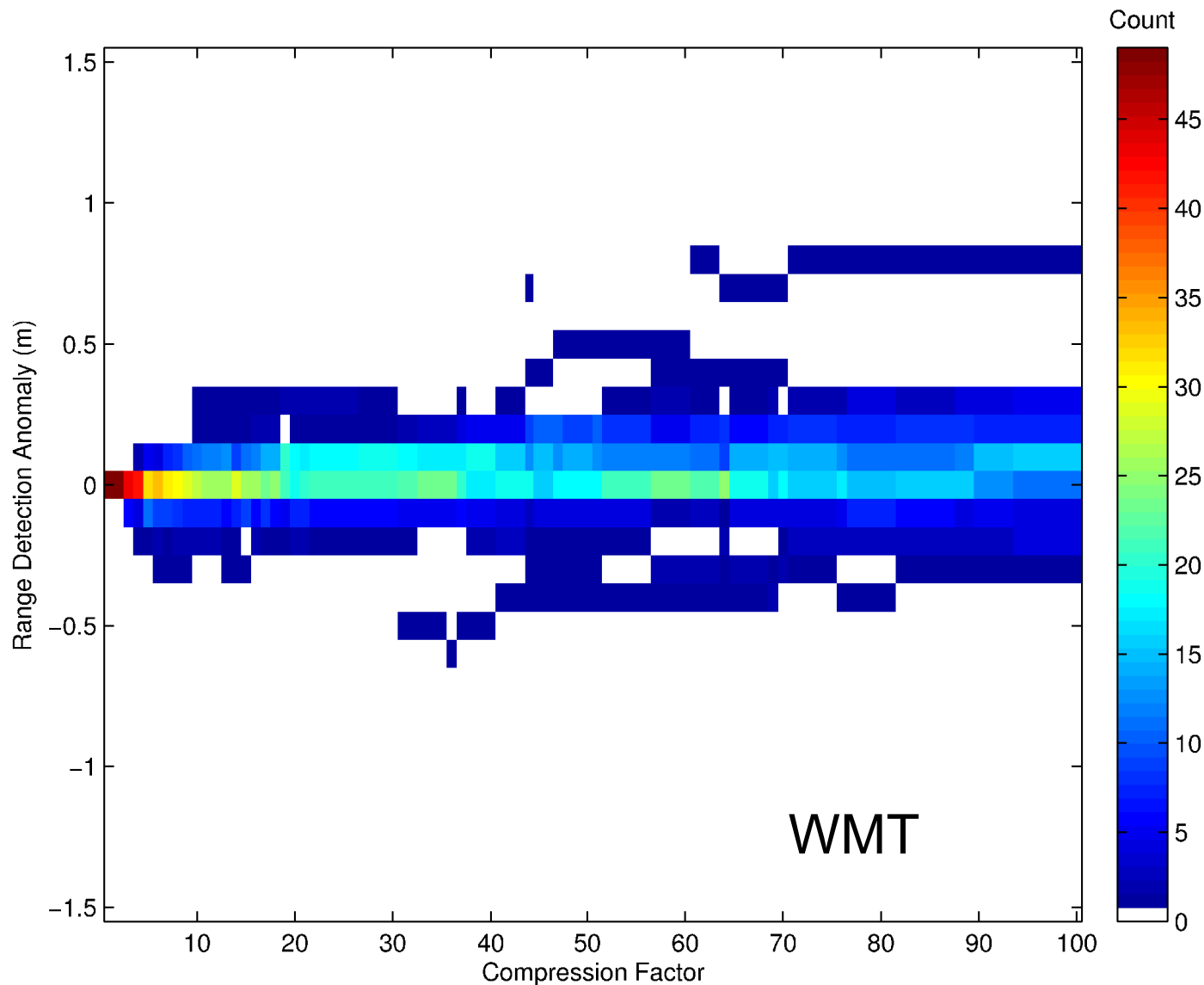
Anomaly Std. Deviation



Wreck Measurement Performance

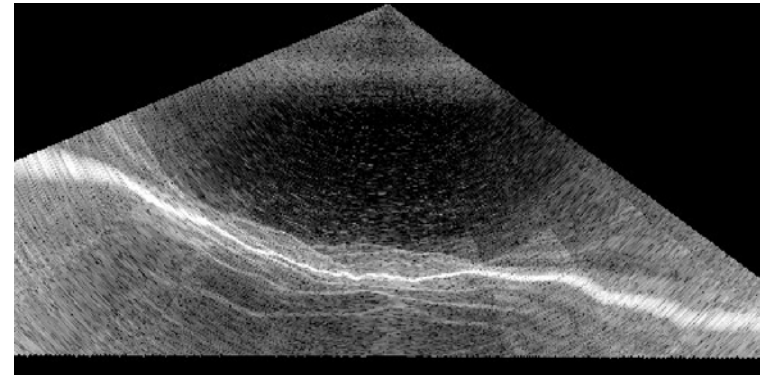


Wreck Measurement Performance



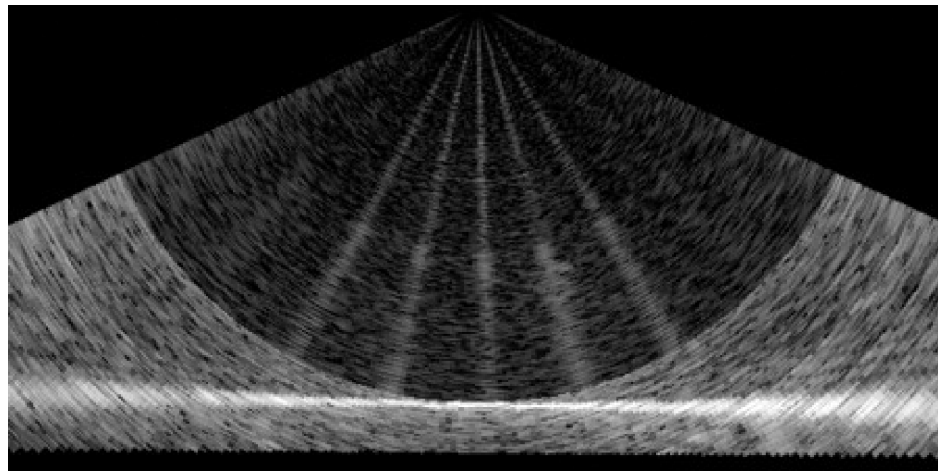
Conclusion

- JPEG 2000 compression easily applicable to MBES water column data
- Lossless:
 - ratios of 1.5:1 achievable
- Lossy:
 - 20:1 seems a good compromise for hydrographic purposes
 - Application specific metrics should be devised
- Compression enables discovery



Take Home Message?

- Lossy compression applied in real-time would allow for continuous WC recording in shallow water
 - Help fulfill hydrographic “detection” requirements
 - Provide invaluable contextual information for data cleaning



Acknowledgements

- ArcticNet NCE
- Sponsors of the OMG
- Officers and Crew of CCGS Otter Bay
- Robert Courtney, GSC (Atlantic)

Questions?

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