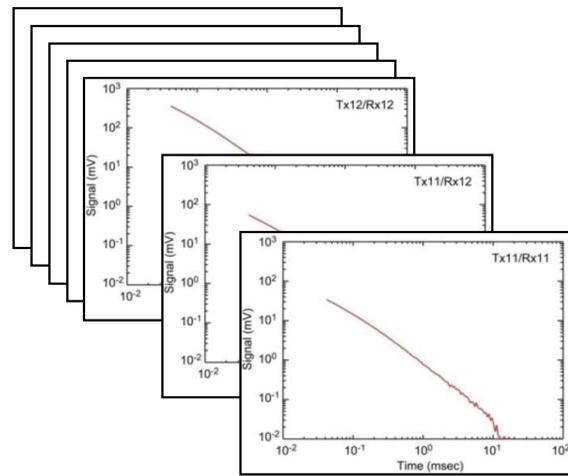


Are Cued AGC Surveys Necessary?



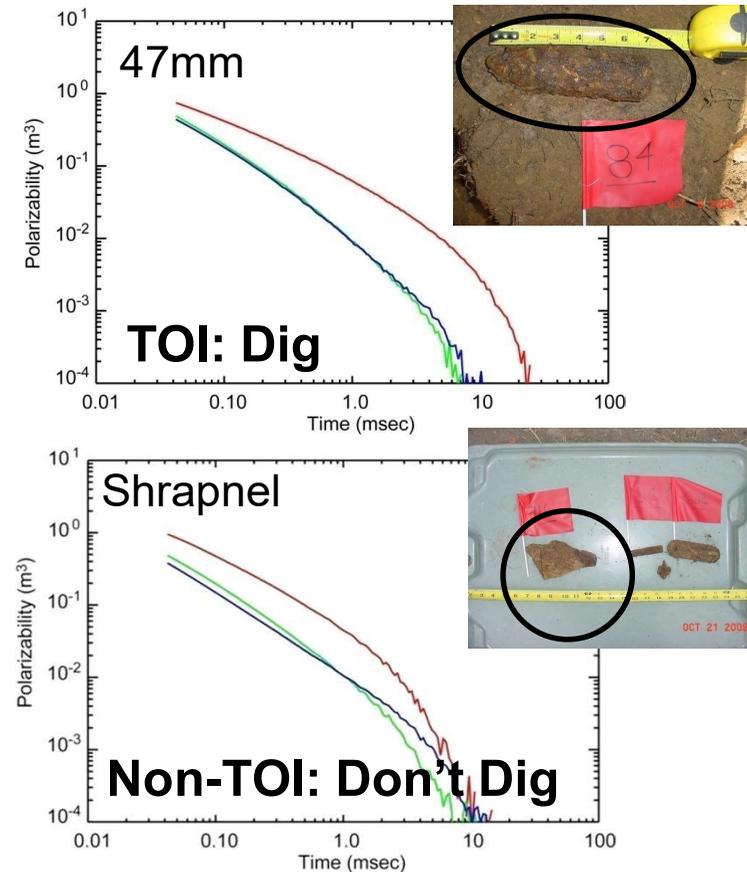
Advanced Geophysical Classification

- Use a dipole signal model and principal axis polarizabilities for distinguishing potential UXO from scrap



Data from different sensor/object geometries

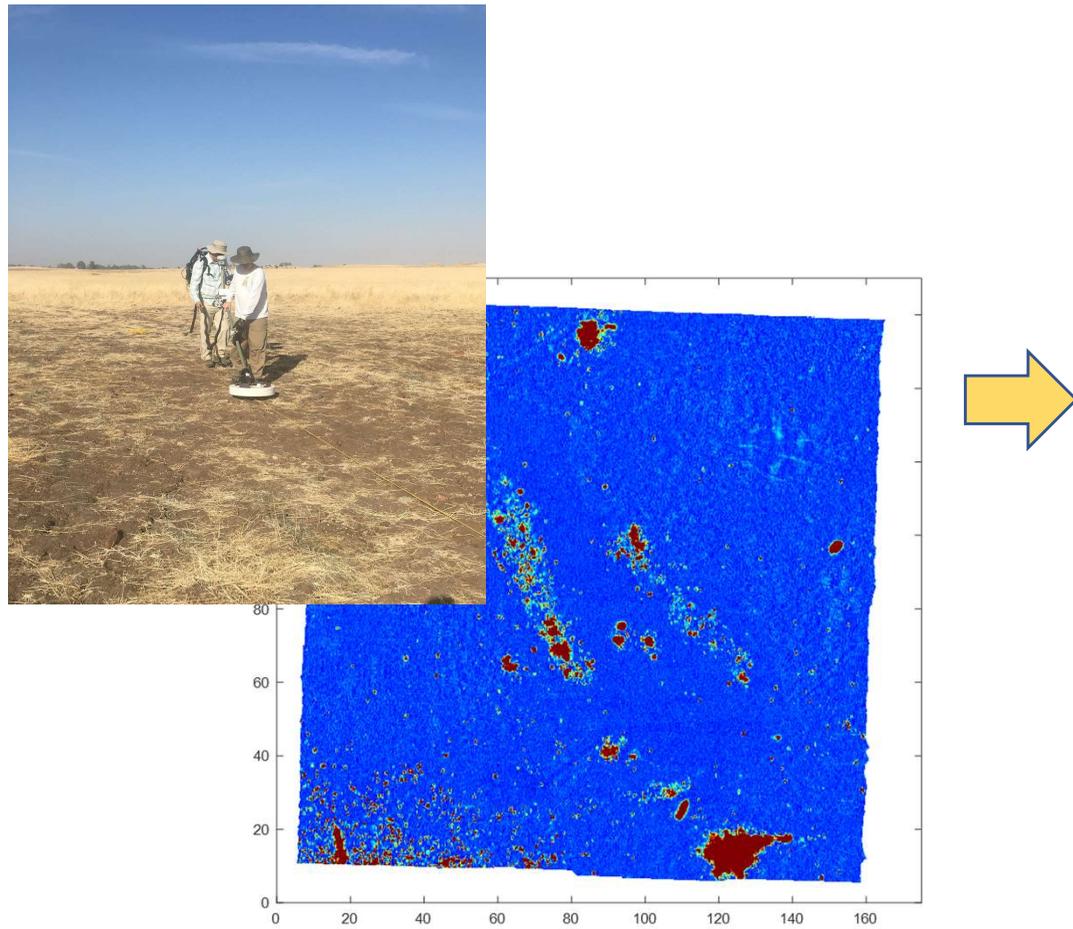
Inverse operation



Principal axis polarizabilities

Acquiring AGC Data: Two-Pass surveying

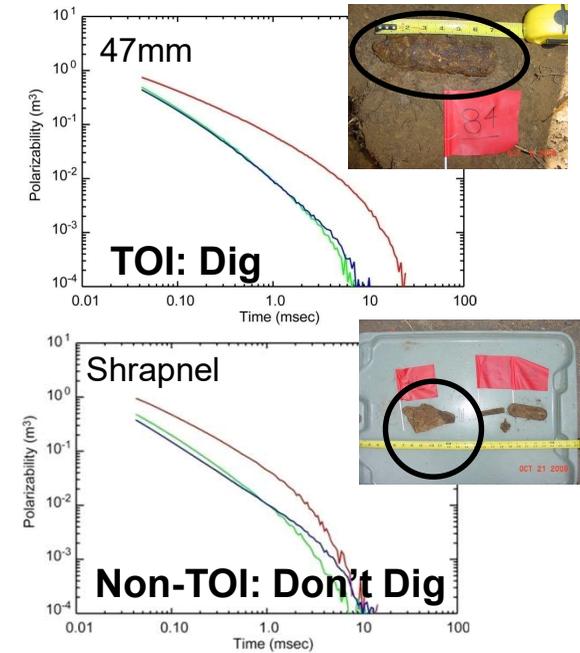
Detection Survey



Cued Survey

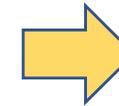
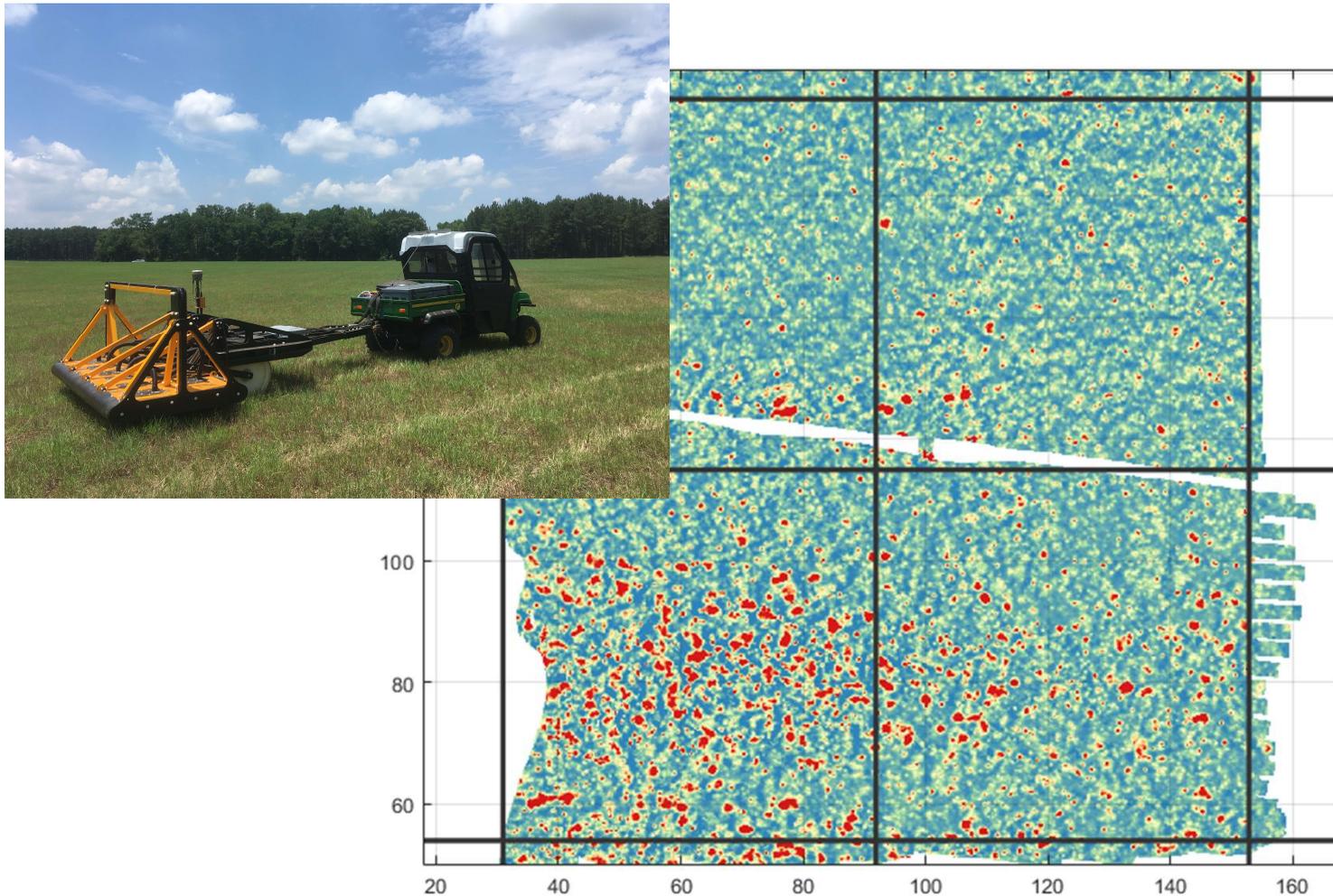


Classification

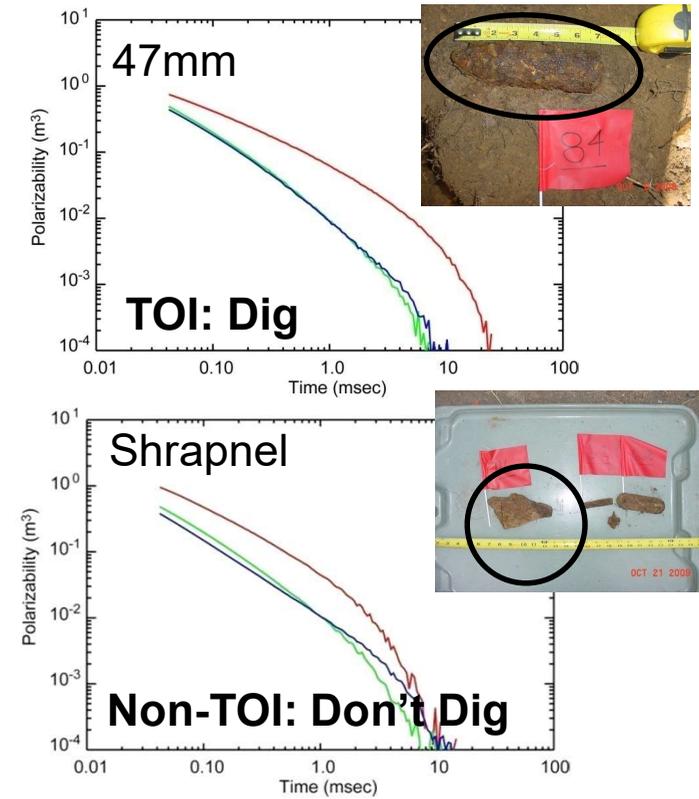


Acquiring AGC Data: One-Pass Surveys

Full Coverage, dynamic data



Classification



Systems Validated for One-Pass Classification

There are several instruments validated for One-Pass classification



One-Pass vs Two-Pass surveys: Cost Comparison

- Consider a hypothetical 110 acre site based on previous experience
- 125,000 non-redundant sources
- Costs:
 - Data acquisition:
 - mobilization
 - rental
 - survey labour/field crew
 - truck, UTV and GPS rental
 - Data processing and reporting

One-Pass vs Two-Pass surveys: Cost Comparison

One-Pass Survey

- Production rate = 3 acres/day
- Survey time: System assembly + IVS testing and initial IVS survey = 39 survey days
- 125,000 non-redundant sources
- Total Cost for Data acquisition, reporting and processing = **\$573K**



One-Pass vs Two-Pass surveys: Cost Comparison

Two-Pass Survey

Detection Survey

- UltraTEM 2Tx Screener array operated by two operators.
- Production rate = 6.5 acres/day
- Survey time: System assembly + IVS testing and initial IVS survey = 17 survey days
- 125,000 non-redundant sources

Cued Survey

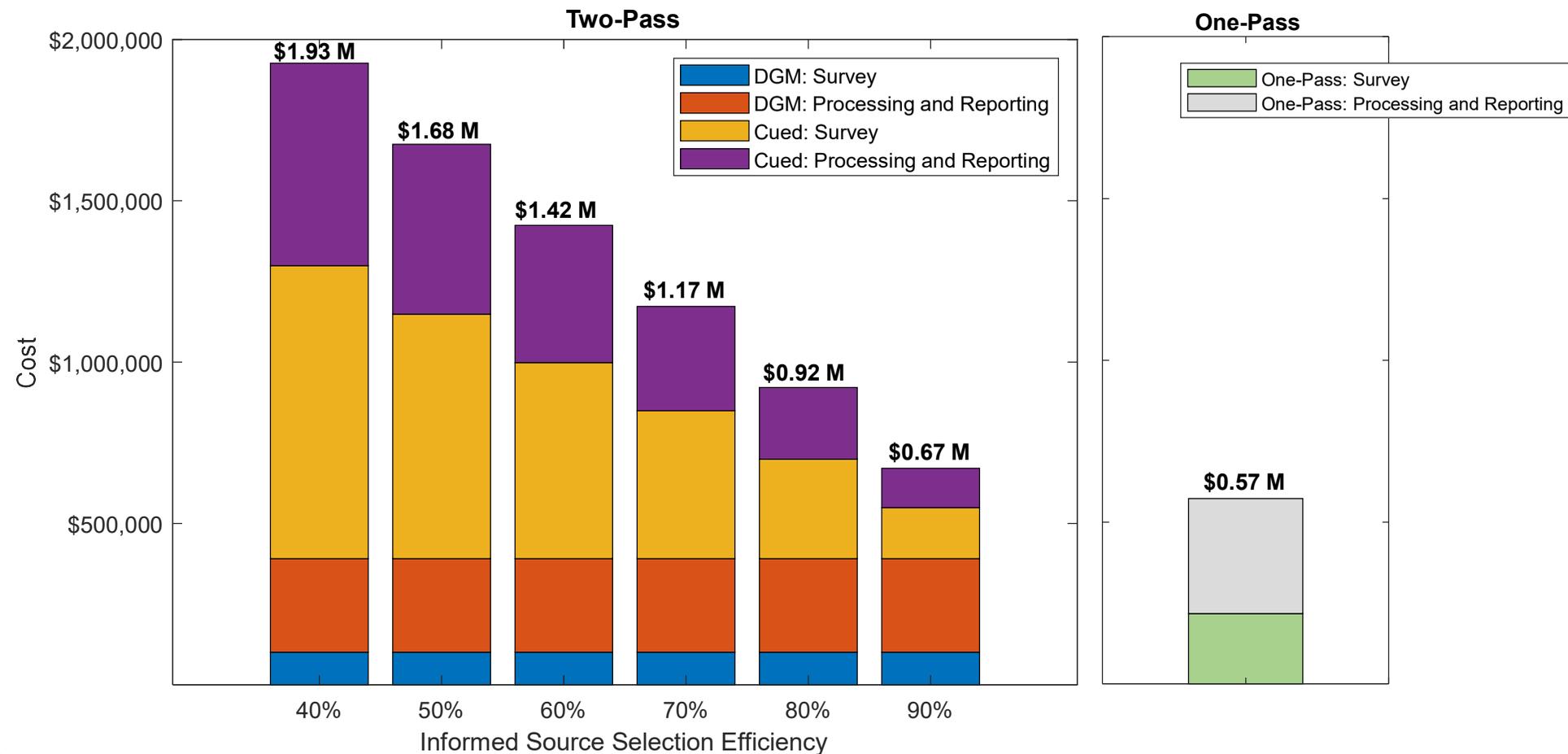
- MPV Man portable system operated by two operators. 3 Teams
- Production Rate: 250 targets/day per sensor
- Survey time: Assume 70% of sources can be screened - 52 days

Total Cost for Data acquisition, reporting and processing = **\$1,173K**



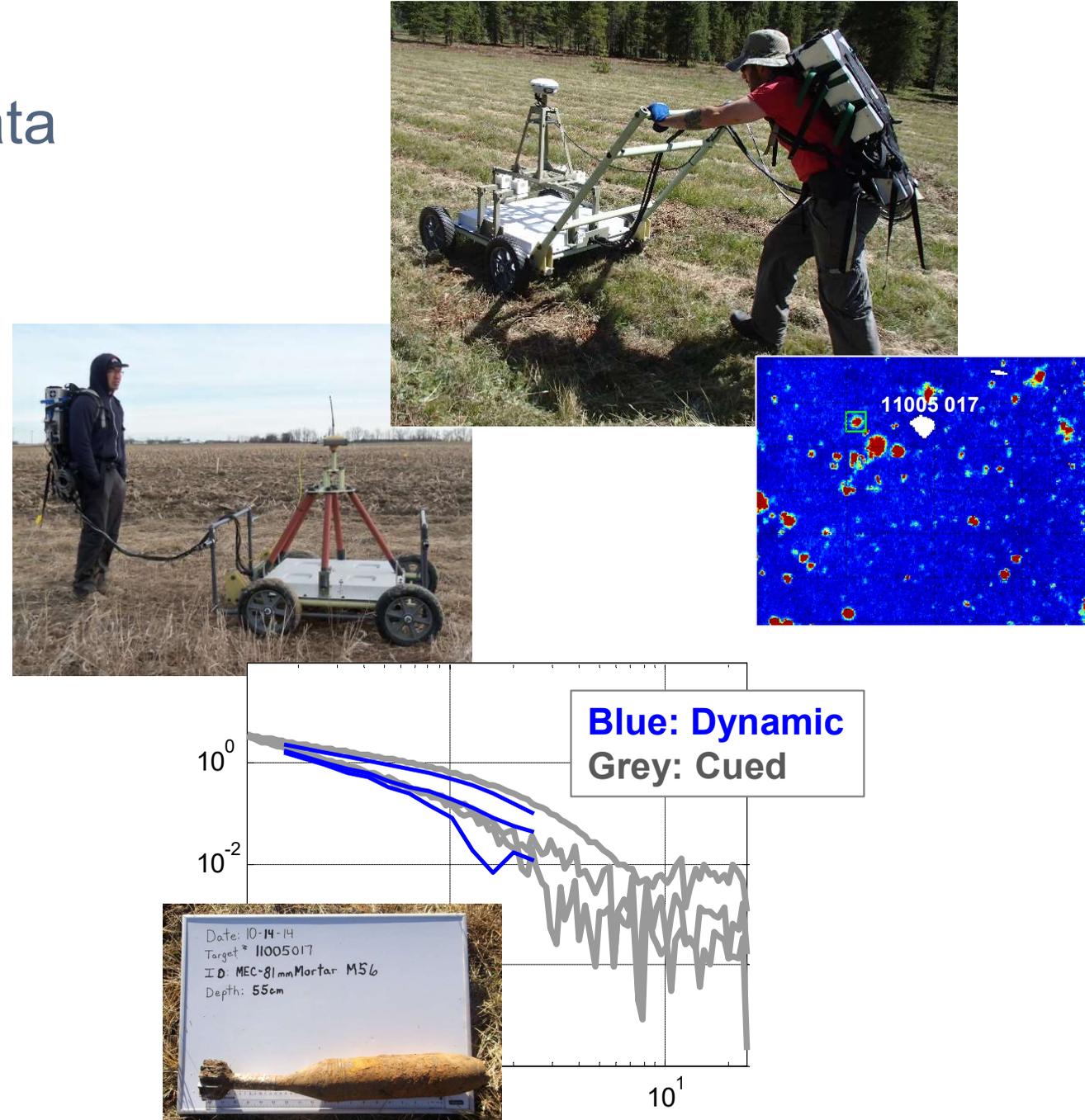
One-pass vs Two-pass surveys: Cost Comparison

- The cost of the cued survey will depend on the total number of cued measurements required.



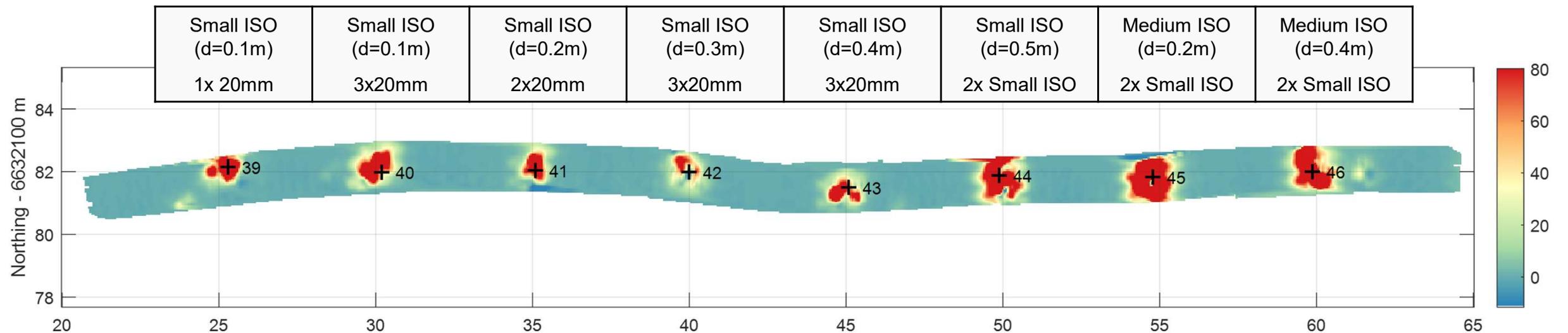
Comparing Static and Dynamic Data

- The number of digs required is directly linked to the accuracy of dipole polarizabilities estimation
- Key features of cued/static data acquisition:
 - Time to “stack” the data to increase SNR
 - Positioning requirement for accurate polarizability estimates is eliminated by having multi-static Rx/Tx with fixed geometry taking static measurements
 - Longer time windows possible



Comparing Static and Dynamic Data

- *Approach:* Collect data over complicated target scenarios in both dynamic, One-Pass mode, and cued mode
- Compare ability to recover polarizabilities

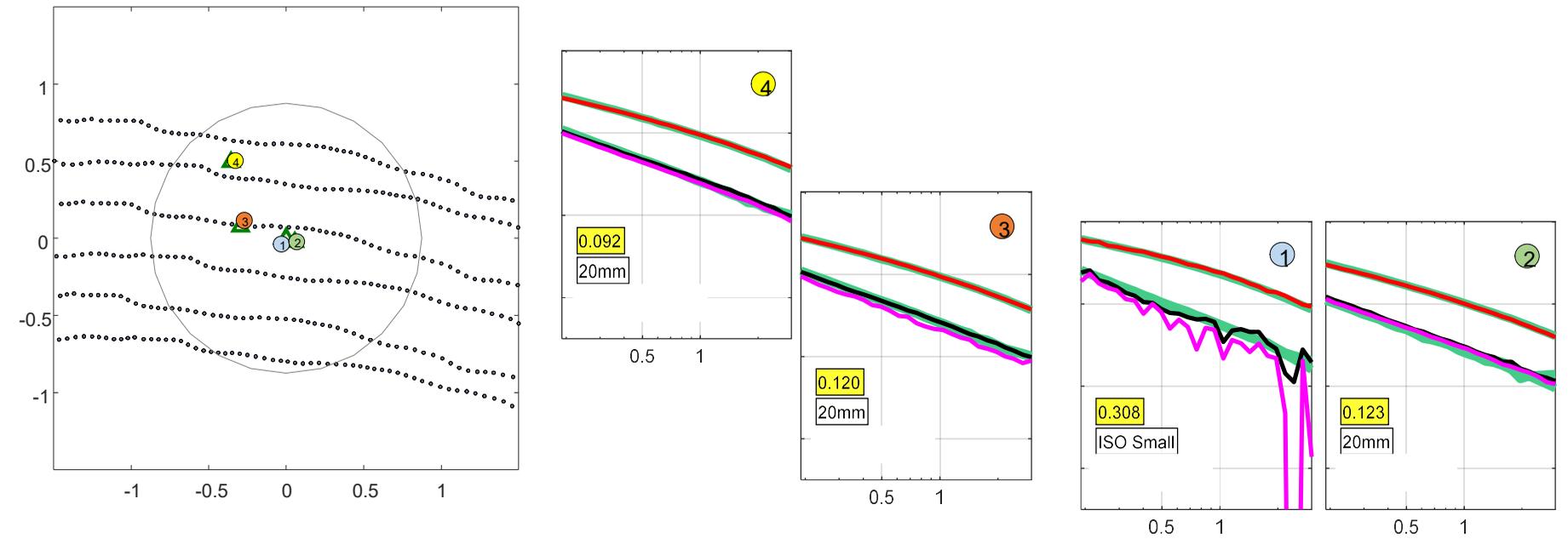


Small ISO (d=0.1m) 1x 20mm	Small ISO (d=0.1m) 3x20mm	Small ISO (d=0.2m) 2x20mm	Small ISO (d=0.3m) 3x20mm	Small ISO (d=0.4m) 3x20mm	Small ISO (d=0.5m) 2x Small ISO	Medium ISO (d=0.2m) 2x Small ISO	Medium ISO (d=0.4m) 2x Small ISO
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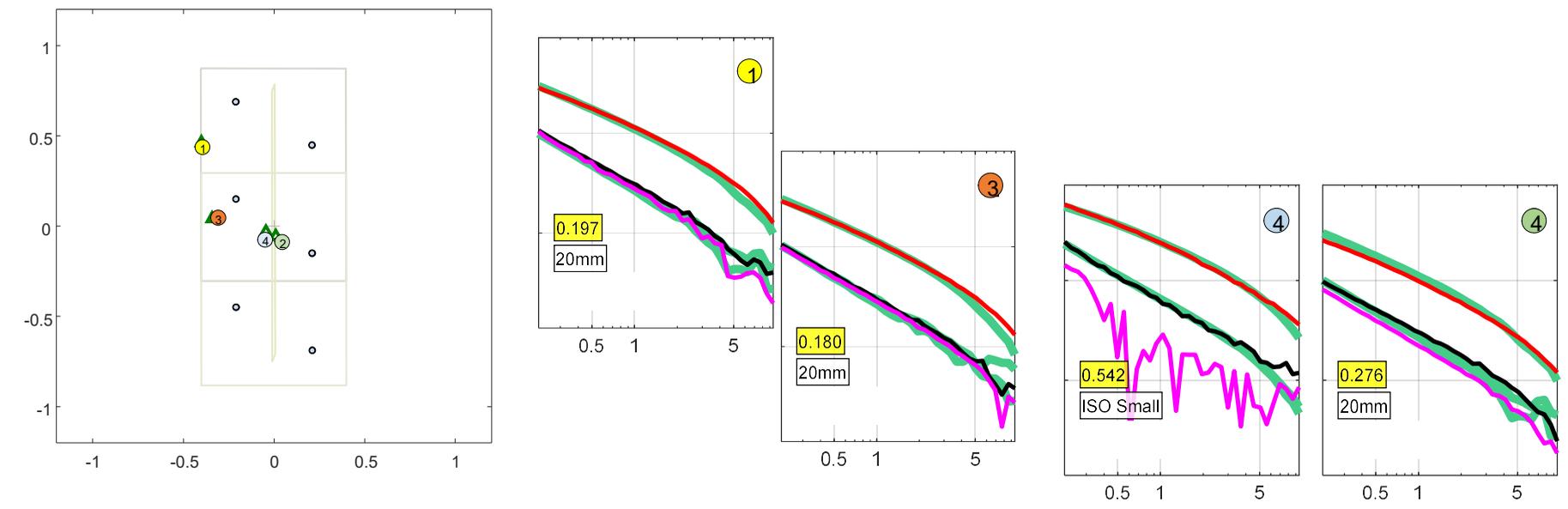
Small ISO (horizontal) at depth =0.3m

+
3 x 20mm on surface

Dynamic Data
(up to 2.99 ms)



Cued Data
(up to 9.5 ms)

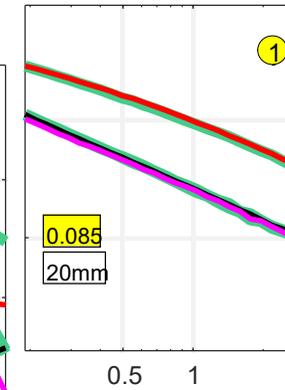
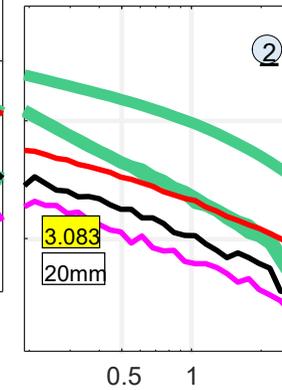
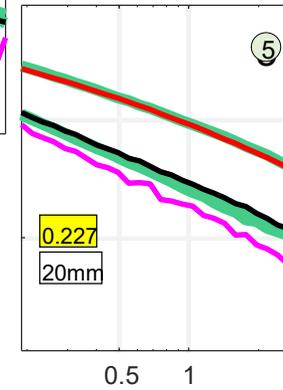
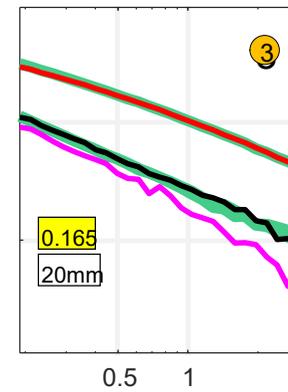
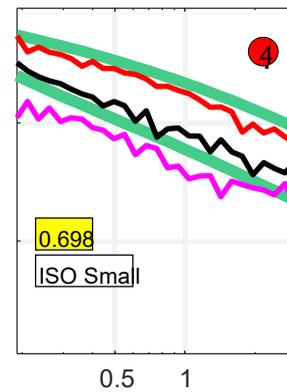
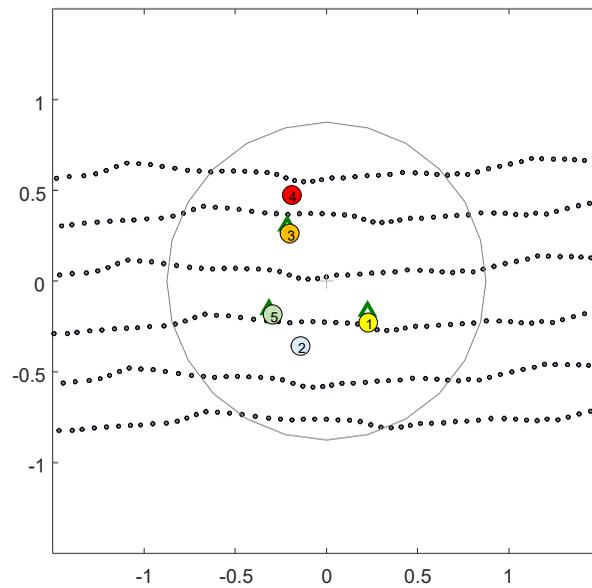


Small ISO (horizontal) d=0.4m

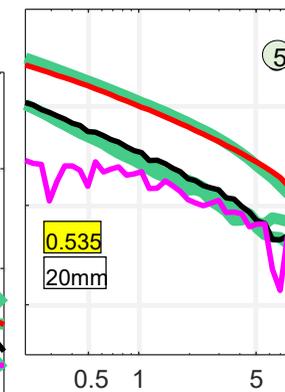
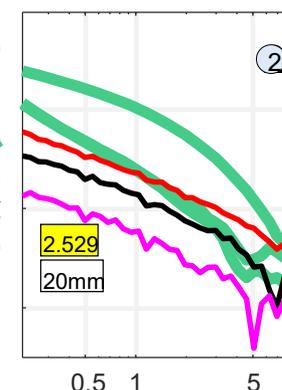
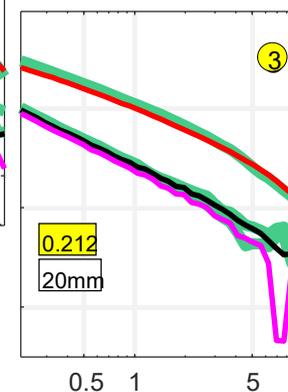
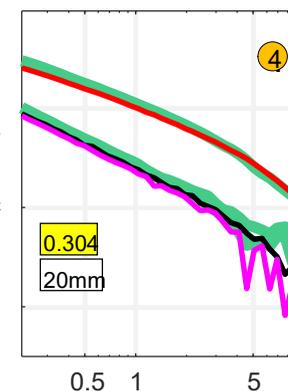
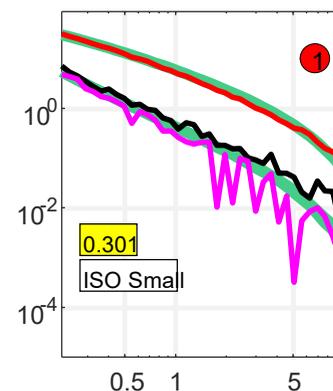
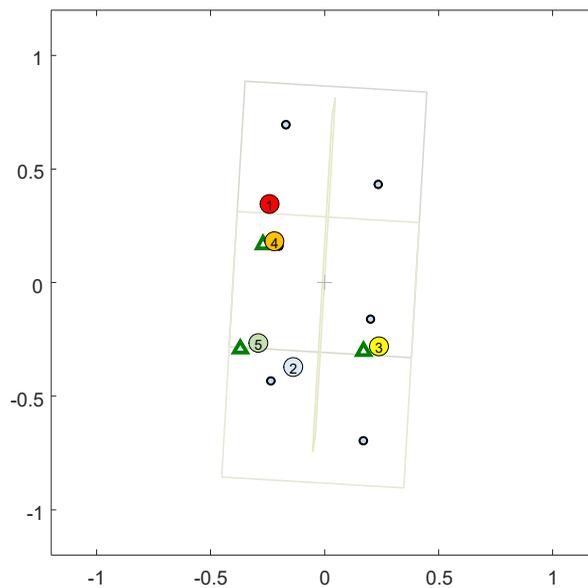
+

3 x 20mm's at surface

Dynamic Data (up to 2.99 ms)

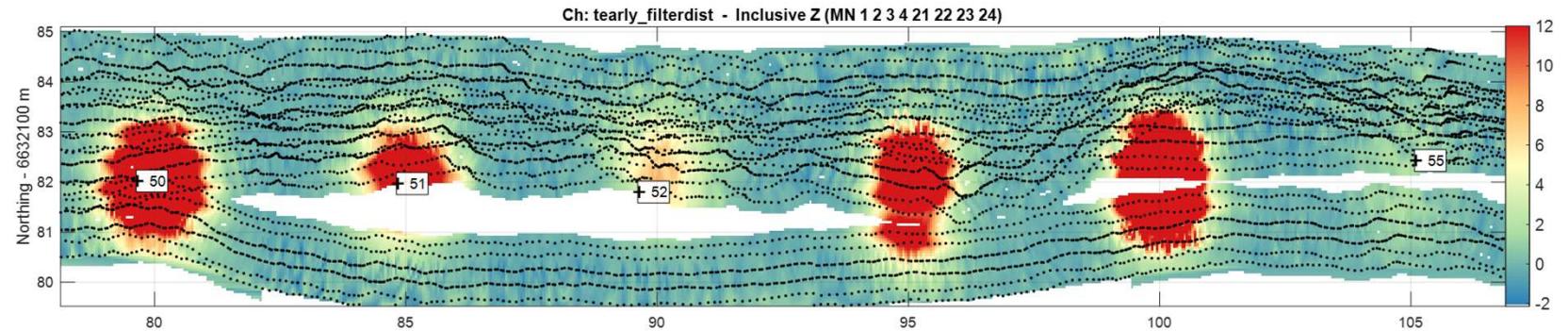


Cued Data (up to 9.5 ms)



Comparing Cued and Dynamic Data: Deep Targets

- Large ISO at various depths
- Similar performance



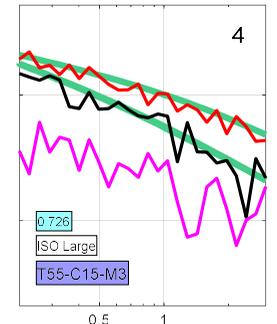
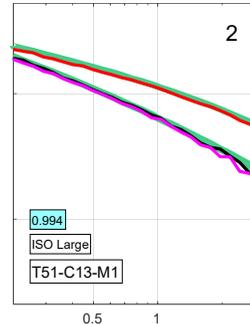
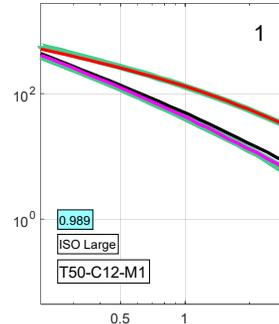
d = 0.6m

d = 0.9m

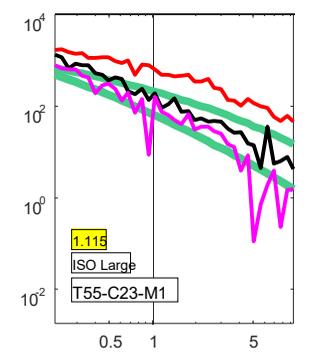
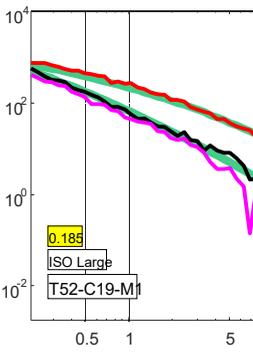
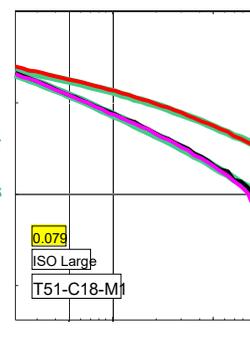
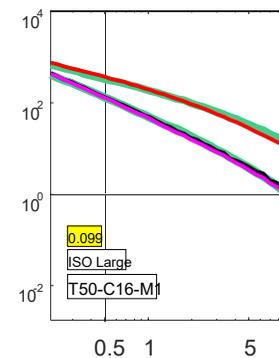
d = 1.2m

d = 1.5m

Dynamic Data
(up to 2.99 ms)



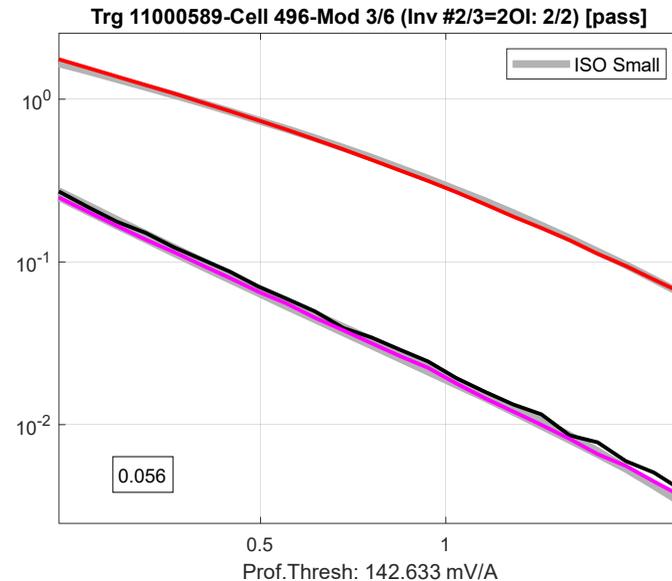
Cued Data
(up to 9.5 ms)



Cued Surveys: Extended Time Windows

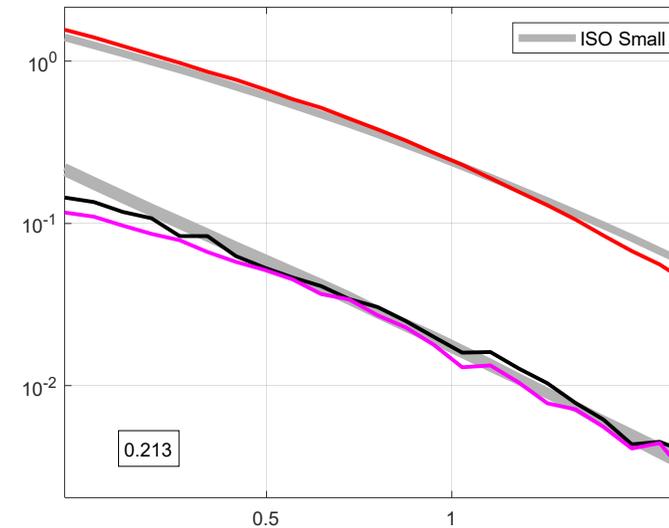
- At sites where a large percentage of non-TOI have similar decay as TOI, a longer time window may improve classification

Example from a recent project:



Small ISO:

- excellent match to library



Ubiquitous clutter:

- decent match to small ISO, must be dug in order to identify all ISOs
- Additional late time information would help eliminate these targets from the dig category

When Should We Use Two-Pass surveys?

Site-specific factors will determine use of Two-Pass surveys

- Conditions that are difficult for larger systems
 - Difficult terrain for larger systems
 - Small spaces to survey due to obstructions (some residential settings or between trees)
- Obstructions that lead to degraded positioning and/or poor coverage
- Sites where a large percentage of non-TOI have a similar polarizability decay behaviour as TOI within the One-Pass measurement window



Conclusions

- The elimination of the cued surveying phase can significantly reduce the geophysical survey time and cost versus a Two-Pass classification approach
- We demonstrated on complicated target scenarios that one pass classification data can perform similarly to cued data collection
- We suggest that One-Pass systems should be used whenever possible. However, we acknowledge that at sites where the terrain and obstacles make surveying with One-Pass instruments difficult or conditions significantly reduce the quality of dynamic data, a Two-Pass approach may be necessary