Technology Update

Iver McLeod, Project Manager- Maine DEP
John Jackson, Geophysicist- USACE EMCX

Goals for today:

- What is one pass classification?
  - Current status of technology
- What is DAGCAP?
- Quality updates->concerns from

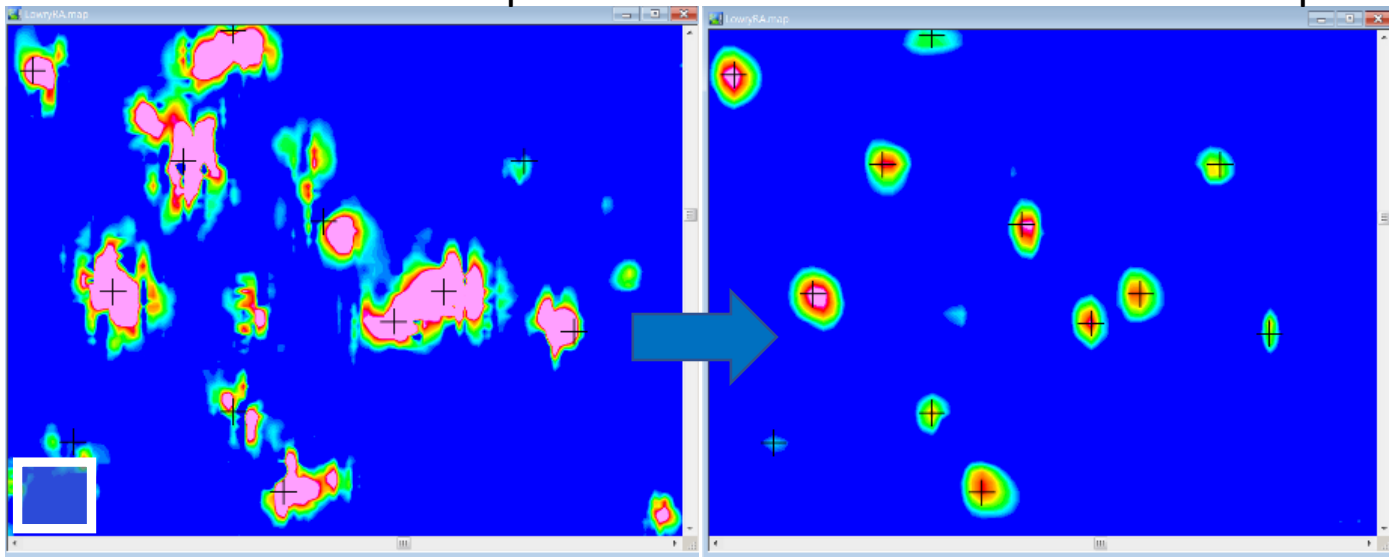
  MR QAPP Toolkit #1 & #2
- State Perspective
- Underwater munitions technology update

One Pass Classification: Invert everything (TOI)

- Invert a square meter of data every 10cm assuming a smallest TOI or larger piece of metal is present
- Resulting Map = How well inversion matches data

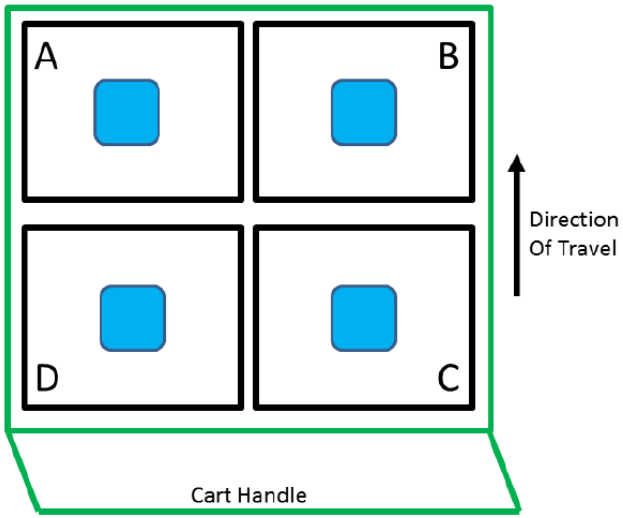
Peak Detection Map

Inversion Match Metric Map

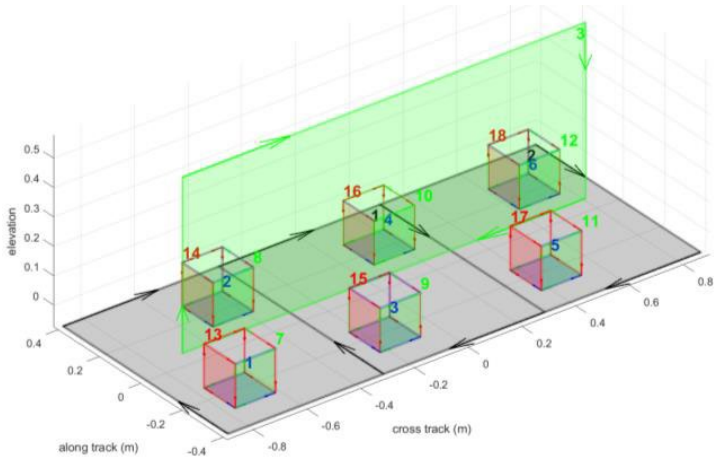


Receiver/Transmitter Schematic

MetalMapper 2x2



UltraTEM3Tx Portable



MetalMapper -Geometrics

- Demonstrated proof of concept and first commercially available instrument
- Not available for purchase anymore
- 1 contractor system, 1 gov system still accessible
- Not one-pass validated

MetalMapper 2x2- Geometrics

- Second commercially available instrument
- Validated for detection and cued
- Preferred purchase model, 2 available for rent
- Validated in all software
- Not one-pass validated

MPV- AcornSI

- Validated for detection and cued classification
- Sale and lease model
- Handful of instruments
- Can be processed in all software
- Not validated for one-pass

TEMTADS 2x2/TEMSENSE- NovaTEM

- TEMSENSE is newer version of TEMTADS 2x2
- Lease model
- Used on multiple sites during FY22/23
- Originally validated for dynamic detection/ISS and cued data collection
  - Hot off the press- approved for dynamic classification January 2023
- Can be processed in all software

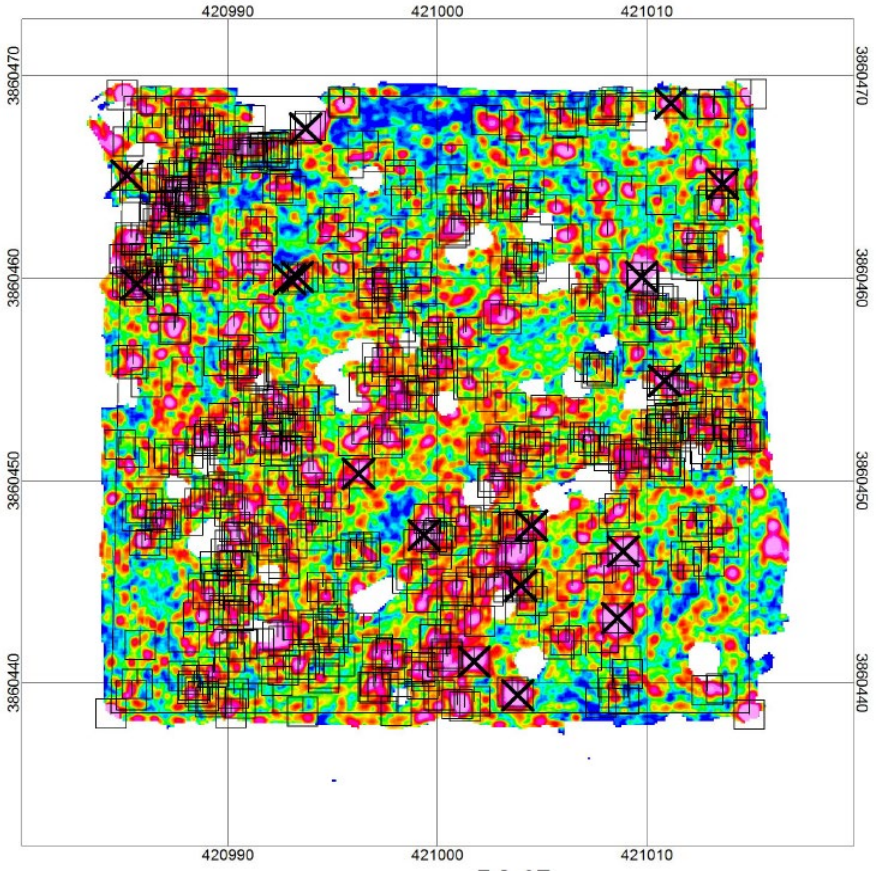
UltraTEM- Gap EOD

- Top left- UltraTEM Underwater
  - Currently in R&D (SERDP/ESTCP)
- Bottom left- UltraTEM Screener
  - Validated for detection/ISS
- Top Right- UltraTEM 3Tx Portable
  - Hot off the press- approved for one pass classification January 2023
- Bottom Right- UltraTEM Classifier
  - Validated for dynamic classification
- Classifier and screener actively utilized on multiple projects.
- Over a dozen instruments available
- Lease business model
- Must be processed with UXOLab (Classifier/Screener) or BT Field (Screener only)

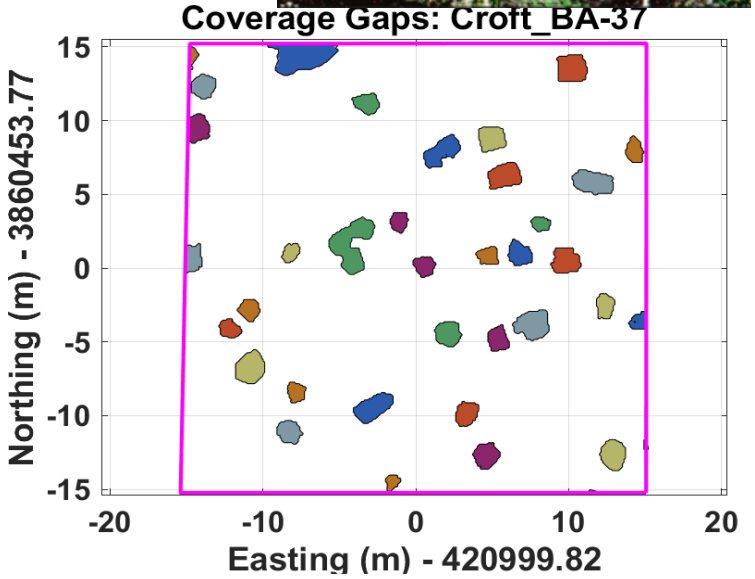
APEX- White River

- Validated for one pass dynamic classification
- Lease model
- Over two dozen instruments available
- Must use EMClass for processing
- Working with UXAnalyze to incorporate software routines

Croft Example- Density and Coverage



Detections- 609
TOI- 17
Coverage- 92%



*APEX: OnePass AGC by the Numbers (*contractor data*)*

30 – Commissioned APEX systems

18 – MMRP projects

11 – DAGCAP companies provided APEX rentals

4,118 – Successful APEX days in the field with no equipment failures

14 – Projects completed with ZERO equipment downtime

98.2% – Uptime over all 18 projects (98.9% uptime in 2022)

0.3 to over 1.0 – Acres per day production rate – similar to the EM61

>900 – acres collected with APEX and classified by WRT

90.2% – Clutter rejection based on over 630,000 anomalies classified

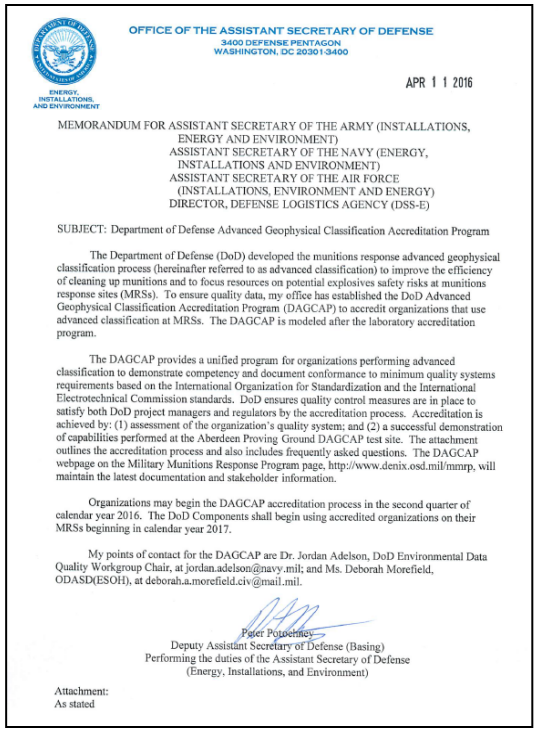
DAGCAP

DoD Advanced Geophysical Classification Accreditation Program

Environmental Data Quality Workgroup

- Develop and recommend policy related to sampling, testing, and quality assurance for environmental programs to eliminate redundancy, streamline programs, improve data quality, and promote data integrity.
- Coordinate the exchange of information among DoD components.
- Develop DoD issuances to implement environmental quality systems and promote cost effective government oversight.
- Implement and provide oversight of the DoD ELAP.

DoD Advanced Geophysical Classification Accreditation Program



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3400 DEFENSE PENTAGON
WASHINGTON, DC 20301-3400

ENERGY, INSTALLATIONS, AND ENVIRONMENT

APR 1 1 2016

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, DEFENSE LOGISTICS AGENCY (DSS-E)

SUBJECT: Department of Defense Advanced Geophysical Classification Accreditation Program

The Department of Defense (DoD) developed the munitions response advanced geophysical classification process (hereinafter referred to as advanced classification) to improve the efficiency of cleaning up munitions and to focus resources on potential explosives safety risks at munitions response sites (MRSs). To ensure quality data, my office has established the DoD Advanced Geophysical Classification Accreditation Program (DAGCAP) to accredit organizations that use advanced classification at MRSs. The DAGCAP is modeled after the laboratory accreditation program.

The DAGCAP provides a unified program for organizations performing advanced classification to demonstrate competency and document conformance to minimum quality systems requirements based on the International Organization for Standardization and the International Electrotechnical Commission standards. DoD ensures quality control measures are in place to satisfy both DoD project managers and regulators by the accreditation process. Accreditation is achieved by: (1) assessment of the organization's quality system; and (2) a successful demonstration of capabilities performed at the Aberdeen Proving Ground DAGCAP test site. The attachment outlines the accreditation process and also includes frequently asked questions. The DAGCAP webpage on the Military Munitions Response Program page, http://www.denix.osd.mil/mmrp, will maintain the latest documentation and stakeholder information.

Organizations may begin the DAGCAP accreditation process in the second quarter of calendar year 2016. The DoD Components shall begin using accredited organizations on their MRSs beginning in calendar year 2017.

My points of contact for the DAGCAP are Dr. Jordan Adelson, DoD Environmental Data Quality Workgroup Chair, at jordan.adelson@navy.mil; and Ms. Deborah Morefield, ODASD(ESOH), at deborah.a.morefield.civ@mail.mil.

Peter Potochney
Deputy Assistant Secretary of Defense (Basing)
Performing the duties of the Assistant Secretary of Defense
(Energy, Installations, and Environment)

Attachment:
As stated

- Started in 2016
- Program added to DoDI 4715.15 “Environmental Quality Systems”
- Quality Systems Requirements (QSR)
  - Based on ISO 17025 (updated from 2005->2017)
  - Establishes personnel skill requirements
  - Reporting requirements for QA failures
- Requirement to be accredited when performing AGC started 01 January 2017
- Two Accrediting Bodies (ABs)- A2LA & ANAB

http://www.denix.osd.mil/mmrp/advanced-geophysical-classification-accreditation-and-other-tools

DAGCAP Components and Status

Aberdeen Proving Ground/Accreditation

- 15 Geophysical Classification Organizations (GCOs) accredited
  - Strong mix of small and unrestricted companies.
  - Assessment of GCO Quality System
  - APG a pass/fail test (100% classification TOI/60% rejection of clutter)
- Biennial Reaccreditation
  - Assessment of Quality System
  - Pass/fail synthetic site test
    - Prevents need to return to APG
    - More or less mirrors failure rate seen at APG- that's a good thing!

Library/Data Management

- HDF5 Version 1 required on FY22 contracts and beyond
- Working on updating SOPs, QSR, and HDF5 verions

Geosoft/Seequent/Bentley- Oasis montaj

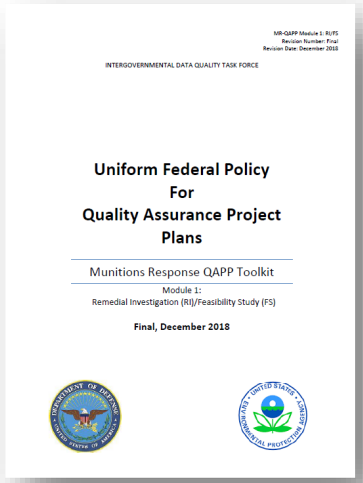
- Hardware/Software Validation

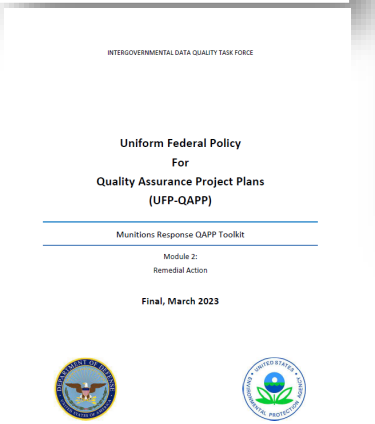
Quality Concerns

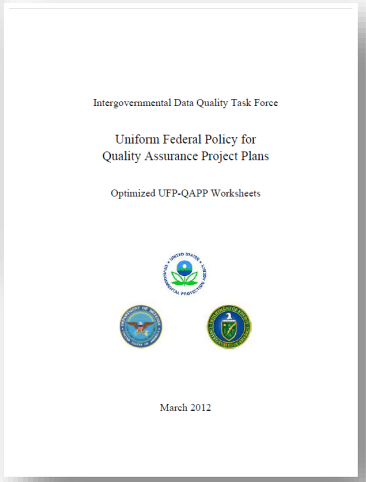
MR-QAPP Toolkits #1&#2

MR-QAPP Toolkits

- Both based on the Optimized UFP-QAPP Worksheets
- MR-QAPP Toolkit Module 1- RI/FS
- MR-QAPP Toolkit Module 2- RA
- Both follow similar paths-
  - Systematic Planning Process
  - SPP#1/2- gov/regulator planning sessions
  - Planned decision points
- Focuses on the data collection for geophysics and MEC investigation
  - Project teams need to add in other elements
- Provide a transparent path towards achieving project goal





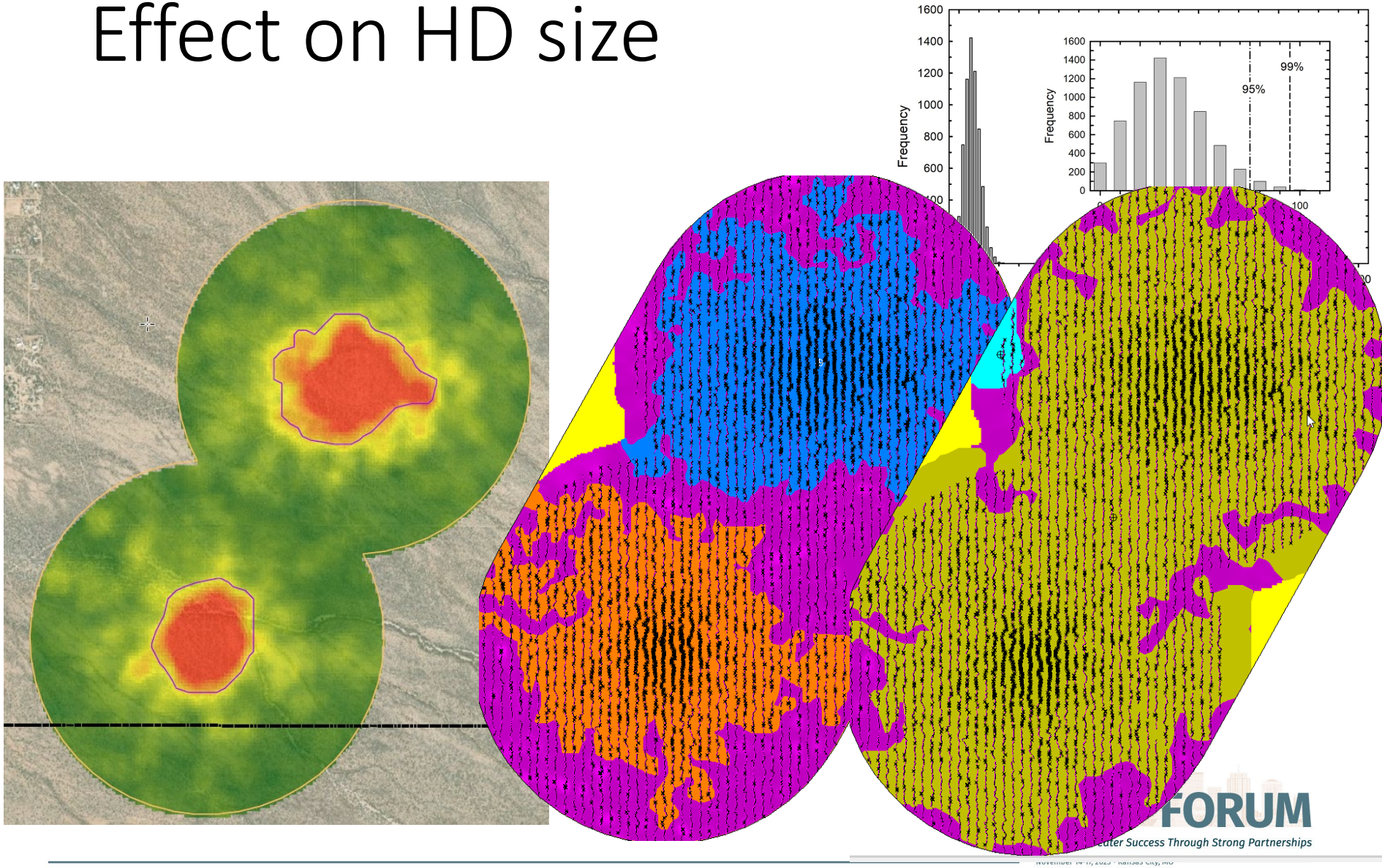


First the RI/FS

Critical RI/FS data quality and decision points

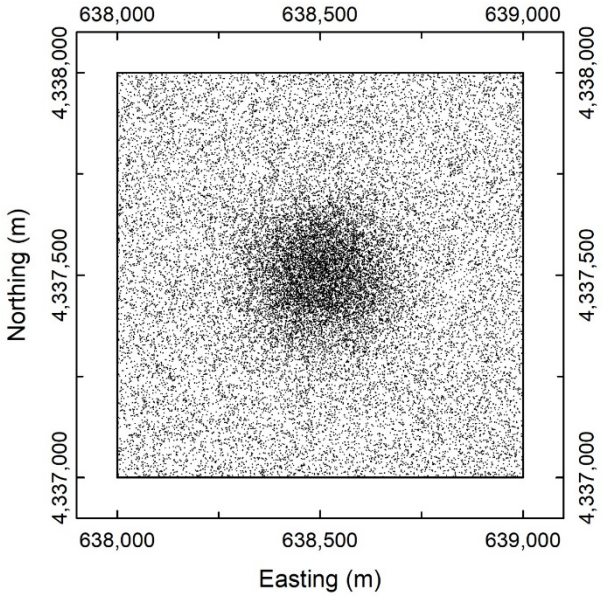
- What is an anomaly?
- Background anomaly density
- Critical density/average target area density
- Coverage
- Types of munitions
- Cost estimating

Effect on HD size



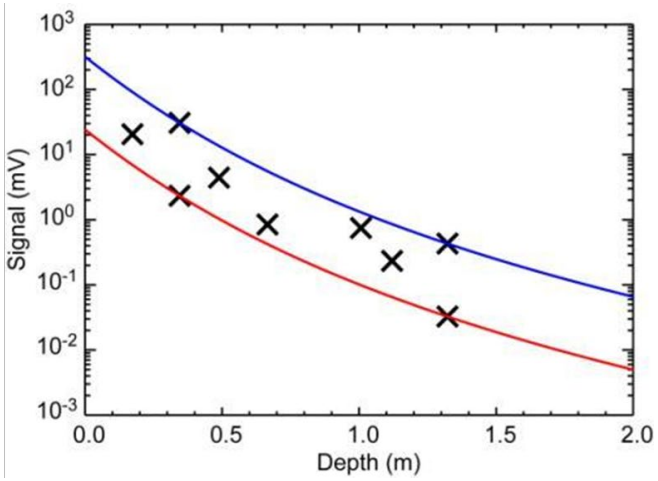
Kriging With Insufficient Transect Data

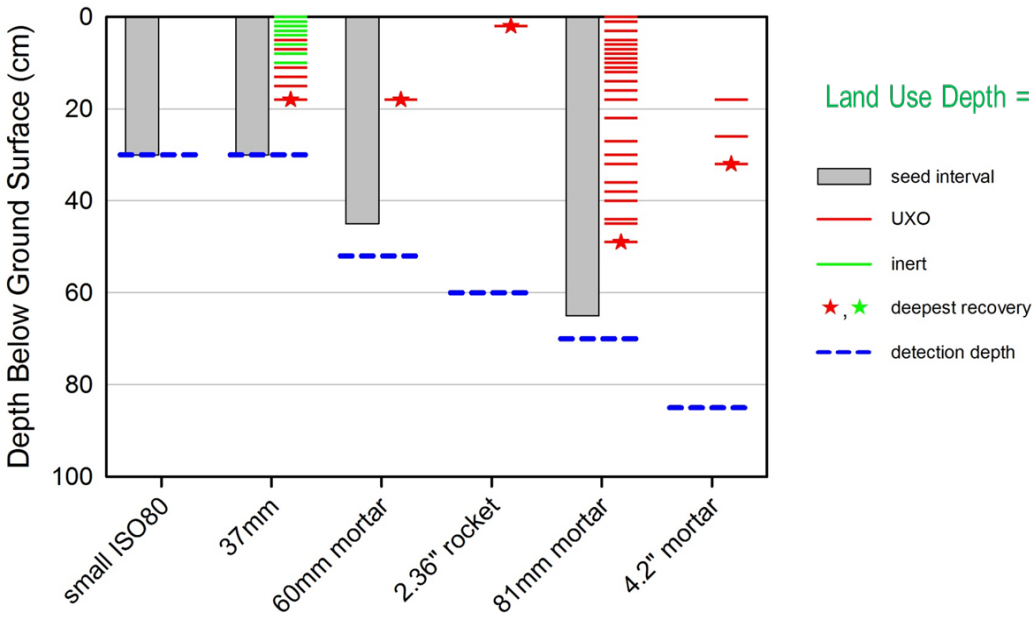
- How close do you need to be on extent, estimated anomaly count
- “the sample variogram does not provide any information for distance shorter than the minimum spacing between the sample data”

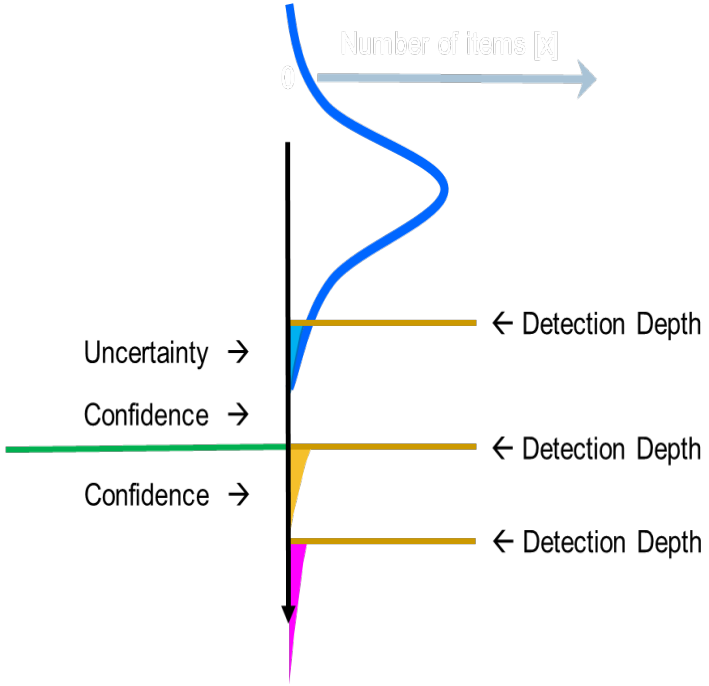


Spacing	Target Area/acres	Average Anomalies/ Acre	Total Anomalies
200 m	203	124	28444
100 m	113	247	27995
50 m	32	274	8992
Actual	42.5	200	8530

Vertical CSM concerns



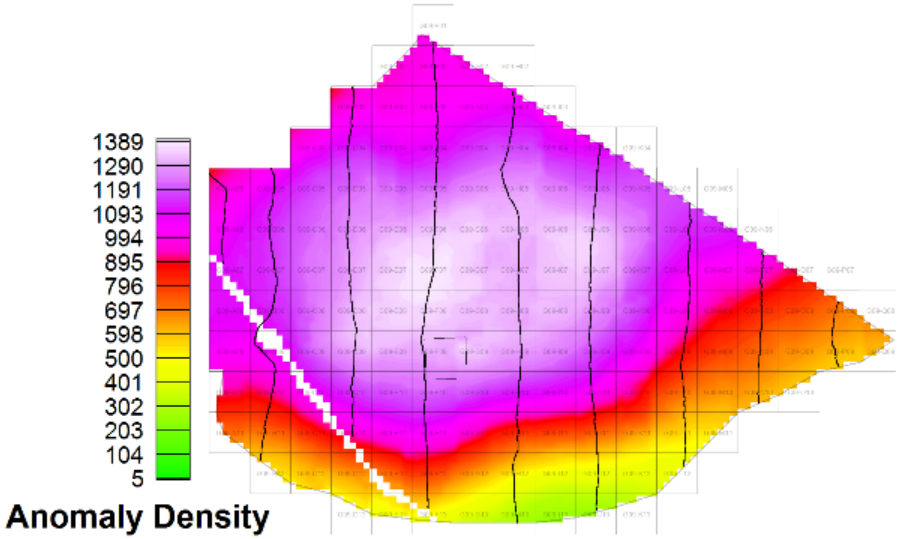




Using dynamic AGC transects to obtain a better anomaly density estimate.

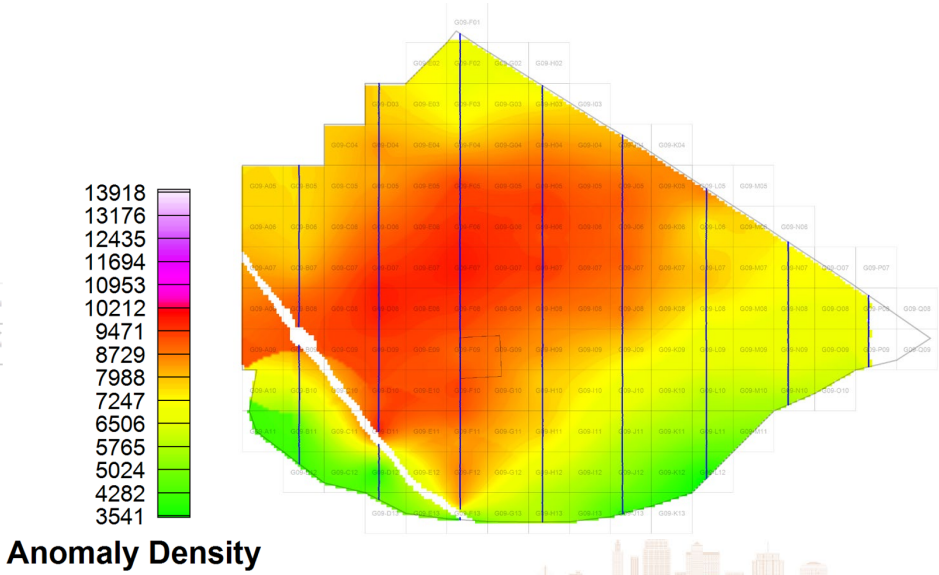
EM61

- Additional EM61 transects spaced appx. 200 ft. apart collected in Area 9 prior to anomaly reduction.
- 29,221 estimated targets, which is close to the 410-ft spaced transects from the RI (26,000).
- VSP density estimates are still 3-4x less than the actual EM61 anomaly density from the full coverage surveys of Grids 8 and 9.



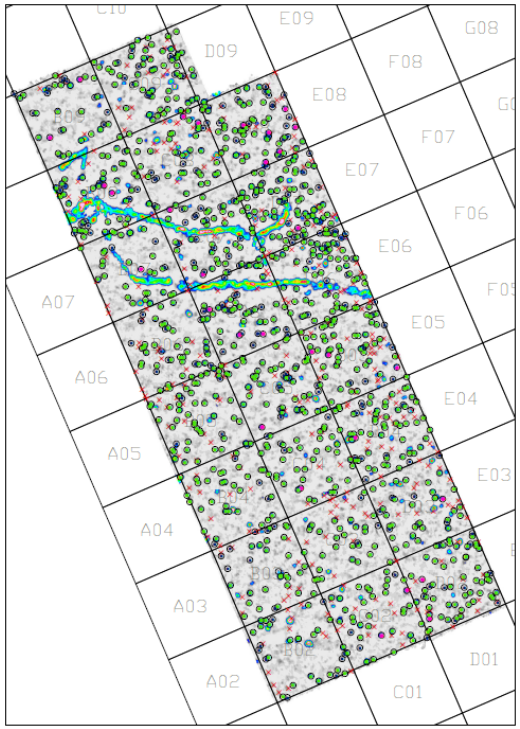
MM2x2

- 200-ft spaced AGC transects extracted from full coverage survey of Area 9.
- 218,004 estimated targets vs. 223,704 actual targets (2.5% difference)
- Estimated vs Actual targets is much closer than the EM61-based transects.



RA concerns

Limitations Of EM61- 100% Coverage Data



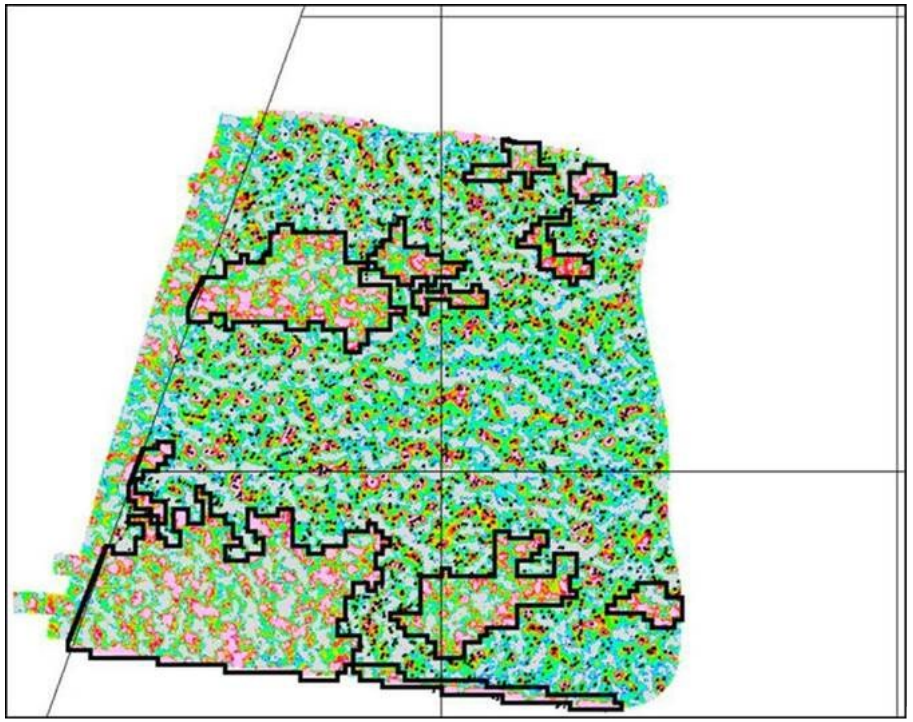
- 100% EM61 coverage 0.5m -vs- 0.75m lane spacing
- Lane spacing results in greater than 25% anomaly selection difference
- Not limited to just lane spacing! Processing procedure variations resulted in 50% increase in anomaly selections

Saturated Areas

- Saturated response areas (SRAs) are areas where geophysical methods cannot discern individual sources. There are two primary methods:

- Searching for, excavating, and documenting each detectable source via analog and following with dynamic AGC
- Dig and sift methods, identifying and documenting each recovered source, and following with dynamic AGC

How do we appropriately contract for these unknowns?!?!



Exception areas

•The ROD, AM, or PWS may exclude specific volumes of soil from requiring a search for the presence or absence of MEC. There are two general categories:

- Areas inaccessible to a search for MEC
- Accessible areas, or portions thereof, that are specifically excepted in the ROD from a search for MEC

•If there are no exception areas noted in the ROD, AM, or PWS, special consideration should be given to:

- Within or under tree root balls (this has been demonstrated)
- Under hedges and other landscaped features (ditto)
- Under fences and fence posts (ditto)
- Under roads and/or under roadbeds (property owner's decision)
- Under driveways and foundations (ditto)
- Under power transmission lines and power poles (sensor dependent)
- Steep, uneven, or unstable terrain (alternative & innovative approaches)

Defensibility

- AGC
  - All data, processing, and decisions are recorded and can be reviewed
  - Physics-based anomaly selection and classification
  - Decisions can be revised if new information emerges
  - Extensive demonstrations = well documented performance
- DGM
  - Digital record
  - Principled anomaly selection
  - Well documented performance
- Analog
  - No digital record of where the sensor visited, what signals were investigated, or why
  - Known to have poorer detection capability

Quality Concerns

- The obvious:
  - Coverage
  - Detection and classification ability
  - Repeatability, etc
- The not as obvious:
  - Critical density
  - Transect spacing during detailed characterization
  - Definition of anomaly
  - One pass classification decision points and data flow

Quality Concerns

- The not at all obvious:
  - Cost estimating for each phase of work
  - Exclusion zone minimization using AGC
  - How to QA/QC immense amounts of data
  - Leaving TOI in the ground from one phase into the next
- The should be obvious but we are not doing:
  - Communication pre-proposal
  - Communication with regulator

Going back to DAGCAP and quality:

- Huge improvement in quality
- Better root causes, corrections, and corrective actions
- Drastically reduced “lone rangers” making incorrect, indefensible decisions in the field
- Auditable record
  - Coverage, coverage, coverage
  - “Volume of soil” searched
- There are no longer “equipment availability” issues

Elephant in the room

- How do you compare work when the assumptions of quality of work have changed?
  - And how do you compare costs?
- Did we unintentionally create an uneven playing field? Quotes from industry:
  - “We bid projects differently depending on whether they’re DAGCAP or not.”
  - “We’ll use different subcontractors depending on whether they’re DAGCAP or not.”
  - “We’ll use one cost for EM61 and dig and another cost for EM61 and cue.”
  - “We’ll implement different QC procedures depending if it’s a DAGCAP project or not?”

MR TECHNOLOGY UPDATE

State Perspective

MR TECHNOLOGY UPDATE

State Perspective

Might just look a bit like…

Huh? What did he just say?

DAGCAP?

MRQAPP?

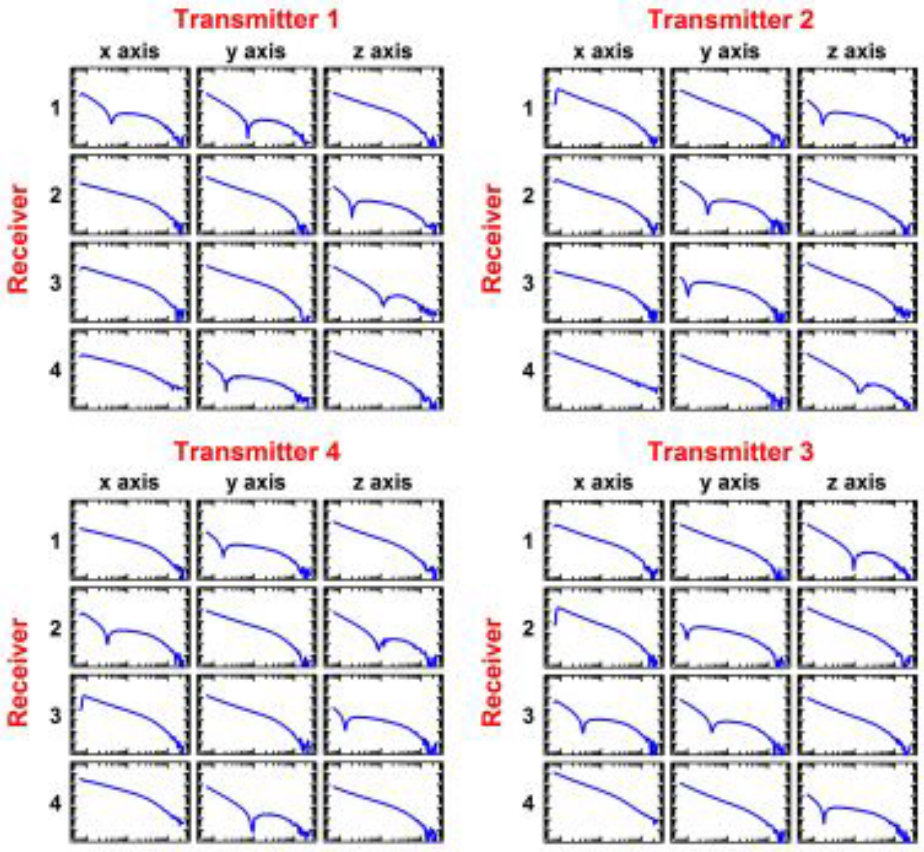
TOIs?

Cued?

Dynamic?

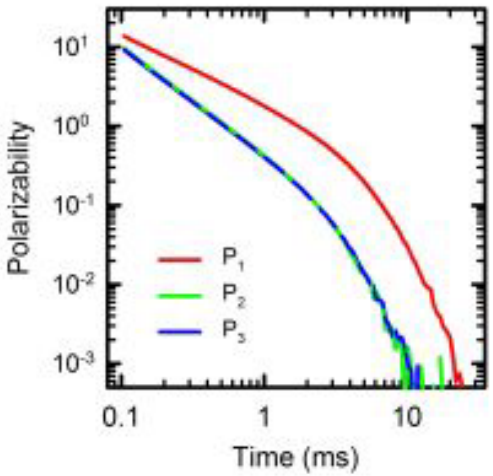
Inversions?

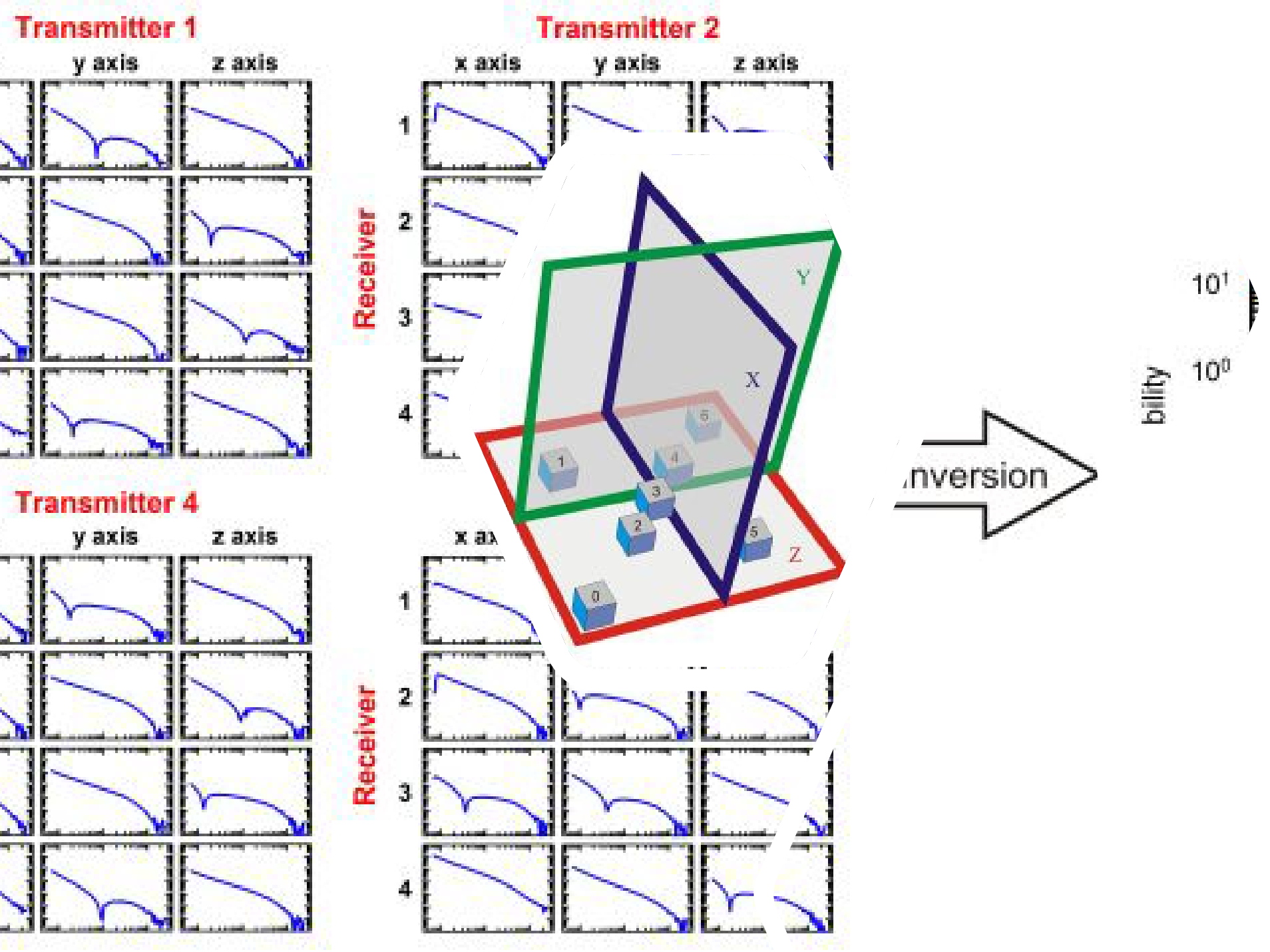
ISS?



Inversion

Principal axis Polarizabilities




Transmitter 1
y axis
z axis
Transmitter 2
x axis
y axis
z axis
Receiver
1
2
3
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Y
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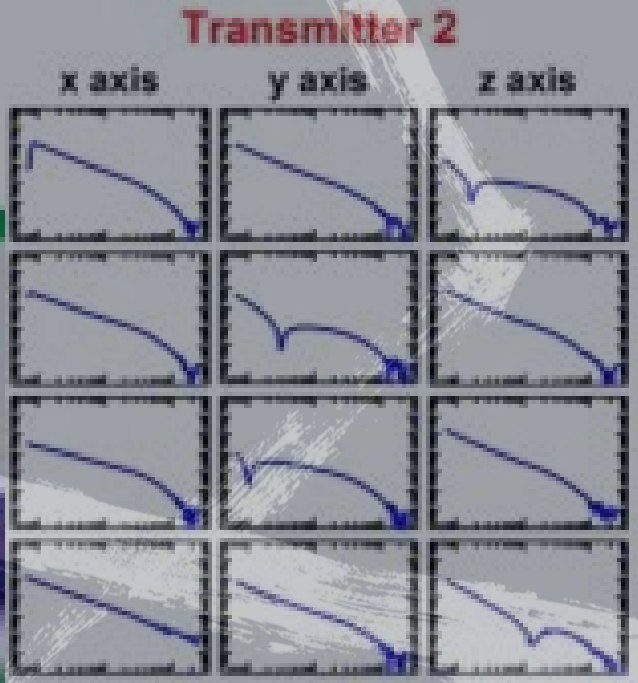
Transmitter 2
x axis
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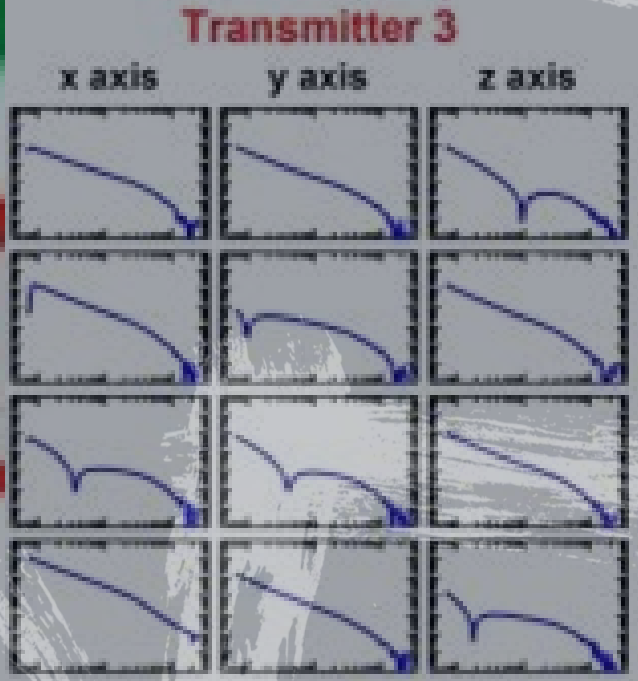
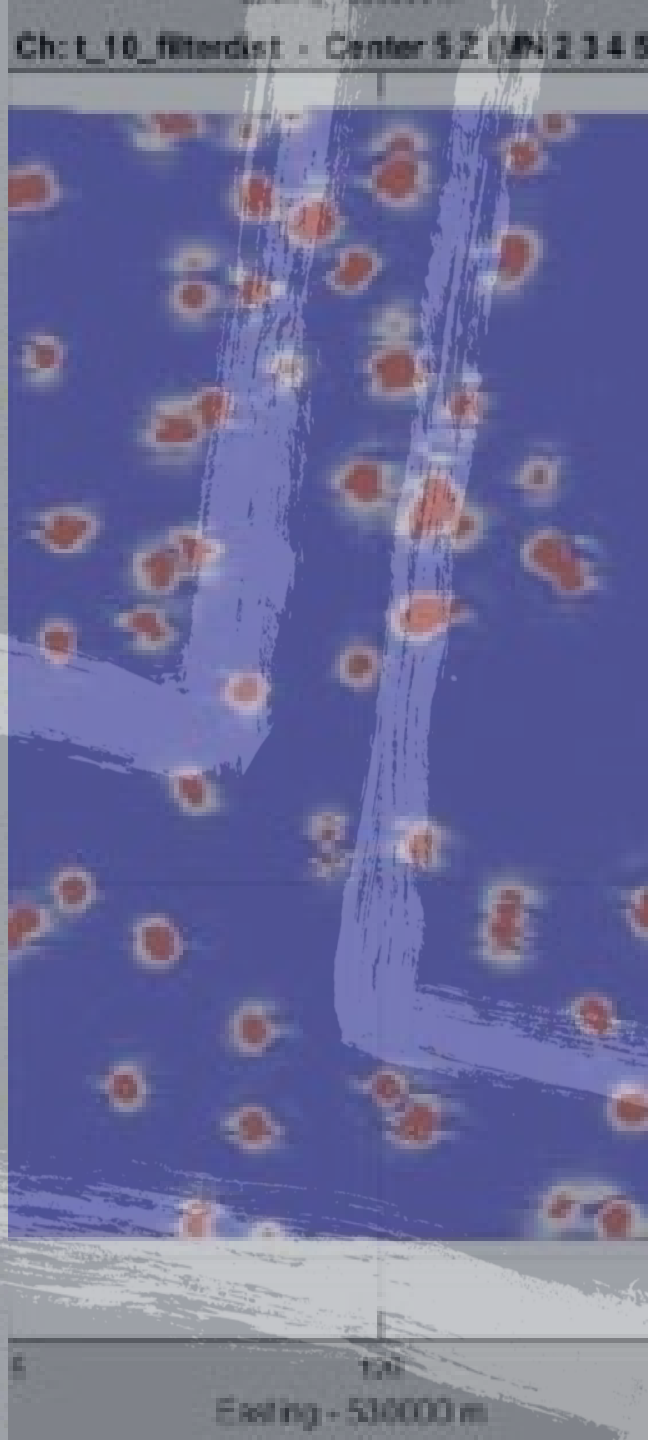

Transmitter 3
x axis
y axis
z axis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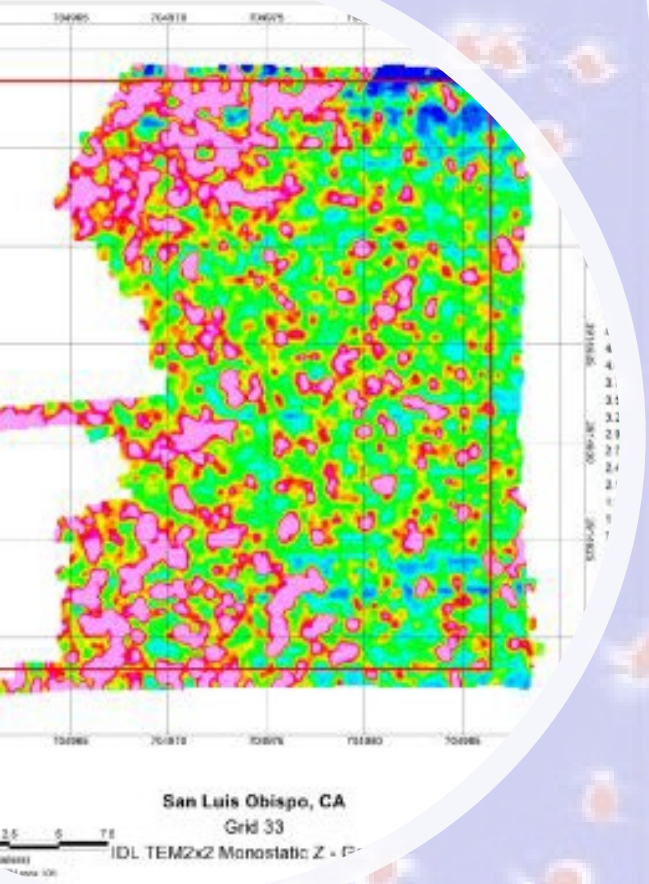
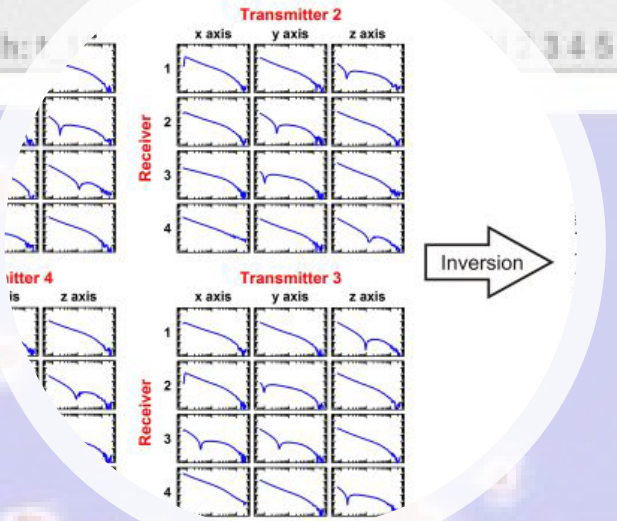
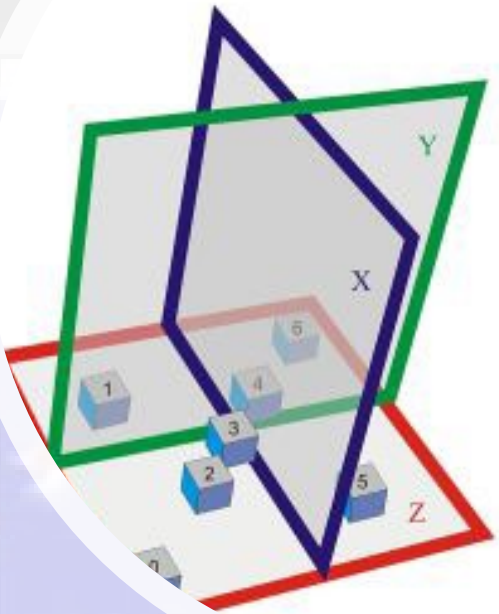
Easting - 536000 m


San Luis Obispo, CA
Grid 33


Transmitter 2
x axis
y axis
z axis
Receiver
Transmitter 3
Inversion


Y
X
Z

WHAAAAAT??

How do States get a handle on this?

- Don’t stress over the technical aspects (though your state may have staff experienced with geophysics used at chemical sites to locate USTs, utilities, drums, etc. AGC is more advanced but principles are the same)
- Focus on the quality systems just as we do at chemical sites (see Jeff and Jordan’s Data Quality presentation after this)

- Many resources available to help with the technical and quality systems:
  - ITRC documents and archived training (Clu-in.org)
  - DoD/EPA sponsored training
  - M2S2 webinars
  - ASTSWMO webinars
  - SERDP/ESTCP papers and webinars
  - Consultants who work with States
  - Munitions Response Dialogue state and EPA staff
  - USACE Center of Expertise

QUALITY SYSTEMS

- Munitions Response QAPP Toolkit
  - Based on based on requirements and guidance contained in the Uniform Federal Policy for Quality Assurance Project Plans (IDQTF, 2005) and makes use of the Optimized UFP-QAPP Worksheets (IDQTF, 2012).
  - Module 1 – RI/FS (2018, 2020 update)
  - Module 2 – Remedial Action (2023)
  - If you've used the UFP-QAPP at chemical sites the MR QAPP modules will look very familiar
- DAGCAP – DoD AGC Accreditation Program (2017)
  - uses two third-party accreditation bodies to provide a unified program for organizations to demonstrate competency and document conformance to requirements
  - Ensures contractors performing AGC meet stringent quality requirements
  - At least 15 organizations currently accredited under DAGCAP to perform AGC
- Resource: Quality Considerations for Multiple Aspects of Munitions Response Sites (ITRC, 2018)
- Jeff and Jordan will dive into this topic in the next session

Data Quality Considerations

- AGC has upped the game considerably in terms of data quality and response efficiency
  - Not usable in all terrains
  - May not be worth the added expense depending on the site
- High-quality products and performance standards are required for all geophysical surveys, including analog detection methods, digital geophysical mapping (DGM), and AGC. Detailed and documented QC/QA procedures are required for each of these geophysical technologies and should be expected in all MR projects, regardless of the selected technology. (ITRC, 2018)
- To effectively implement DQOs during a project's life cycle, qualitative and quantitative requirements and acceptance thresholds and limits for these requirements should be defined and documented. (defined during the systematic planning process) (ITRC, 2018)

Data Quality Considerations (cont.)

- DAGCAP has been a game changer for AGC work. But the requirements for quality systems and accreditation should be expanded to ALL aspects of MMRP, raising the bar for all projects and evening the playing field for all contractors.
  - Historical Records Review
  - CSM
  - Analog and DGM
- Uncertainty must be better defined/quantified in all phases of munitions response in order to better define/quantify our confidence in primary and secondary data - The confidence in the decision is only as good as the quality of the relevant evidence used to make the decision.
  - HRR (ITRC, 2003)
  - CSM (EM 200-1-12)

(Not so) RANDOM THOUGHTS

- One-Pass minimizes mobilizations! This is great for
  - Contractor – less work
  - DoD – less money
  - State – faster response
  - Property owner – Would ya get off my damn lawn already?
- AGC will screen out Munitions Debris but need MD data to determine nature & extent in RI
- High quality data from AGC can be negated by low quality HRR and CSM (uncertainty vs confidence)
- Need to very carefully consider SI conclusions.
  - Most were performed 15 years ago
  - What were quality considerations at that time?
  - SI conclusions that do not incorporate MD evidence often get used for MRSPP scoring which results in a low biased total EHE hazard rating

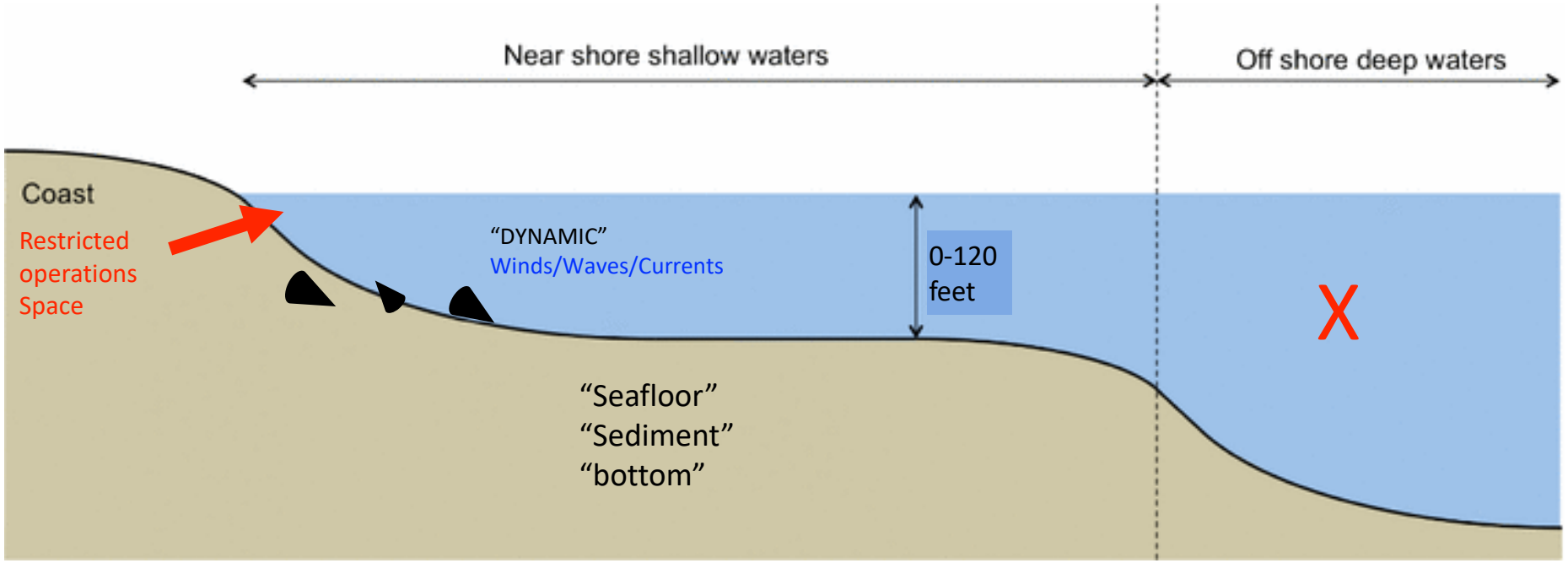
(Not so) RANDOM THOUGHTS

- RMM is not quantitative in the way that RAGS (Risk Assessment Guidance for Superfund) are but still requires high quality data/information for inputs
  - See RMM session
- UU/UE – Unrestricted Use/Unrestricted Exposure
  - May or may not be attainable but will definitely not be attainable without very high quality data
  - Need to consider data quality needs if determined up front that UU/UE not attainable at a site

Underwater update

The Targets, UXO(s), remain the same

The Marine Environment (Major Change)



New Terminology

- DCL — Detection, Classification, Localization
- AUV — Autonomous Undersea Vehicles (unmanned, untethered)
- UAV — Unmanned Aerial Vehicles (Drones)
- USV — Unmanned Sea-surface Vehicles (typically, Kayak-like)
- “Mobility” — Munition movement caused by natural forces
- ROV — Remotely operated vehicles (Both tethered/not)

General Operational Concept:

Reconnaissance followed by detailed DCL Surveys

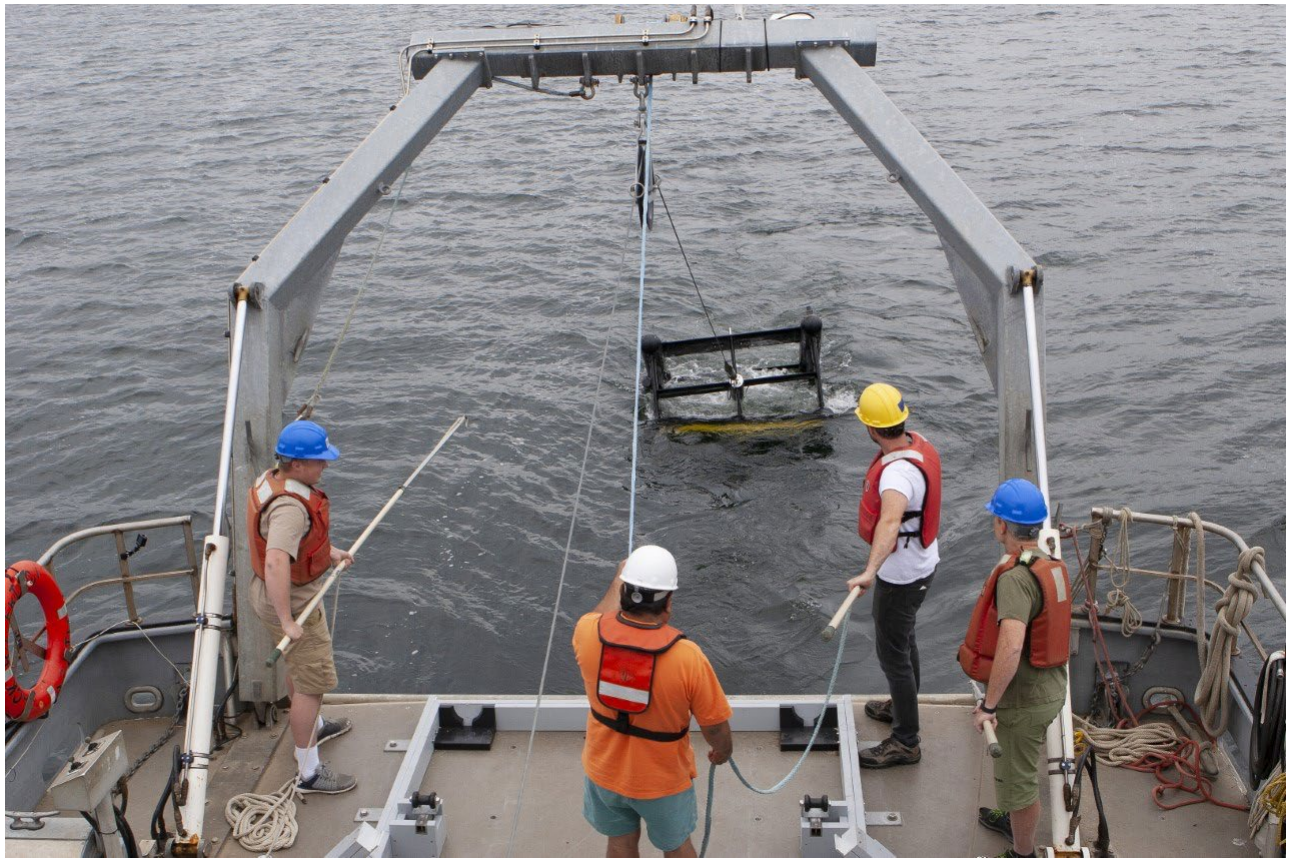
All Sensors can, and will be used

- 1—Acoustic
- 1—Electromagnetic Induction
- 2—Magnetometers
- 3—Optical

The Environment forces the use of multiple DCL Platforms

- Manned Surface Ships
- AUV’s
- USV’s
- ROV’s
- Robots

Acoustic Sensor; Towed behind a manned Surface Ship



Sequim Bay 2022

Electromagnetic Induction Sensor; towed behind a manned Surface Ship

Optical Sensor integrated into a Drone

Underwater Munitions

- Huge progress in technology over the past few years. But…
- Very challenging and often dangerous environment
  - Munitions mobility due to currents, wave action, erosion, etc.
  - Generally can’t work in rough seas
  - The environment forces the use of multiple DCL Platforms
  - Costs are orders of magnitude larger than faced by terrestrial remediation
- Accreditation is absolutely necessary but what does that look like?

Underwater Munitions

- Getting easier to Detect/Classify/Locate but remedial options still limited
  - Removal – obvious safety issues
  - BIP – problem when statute prohibits taking live rock or coral, bubble curtain to minimize impact not always viable
  - Cut and capture looks promising but needs more testing
  - “Manage in Place” - requires high quality data to understand what’s there and their behavior under dynamic conditions – not a real option currently

Questions?