SUB-BOTTOM PROFILING PROVIDES CRITICAL INFORMATION FOR UNDERSTANDING MUNITIONS BURIAL

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Outline

- Study Objective – Why is understanding sand thickness important at an underwater munitions site?
- Methodology – Sub-Bottom Profiler (SBP) Systems
  - Advantages and important considerations
  - Selected SBP system
- Sediment Thickness Survey Study Area - Vieques, PR
- Results
- Conclusions

Why is Understanding Sand Thickness Important?

- Burial is a significant factor in underwater munitions mobility
  - Munitions remain on top of hard bottom, partially bury in seagrass, and partially to fully bury in sand
  - In general, munitions tend to self-bury over time versus moving laterally in sandy, relatively shallow-water conditions
    - This is where beachgoers want to be!
  - Once buried, munitions tend to stay buried and may continue to bury deeper depending on water depth, sand and hard-bottom depth, wave/current conditions, sand grain size, and beach dynamics

Sub-Bottom Profiler (SBP) Systems

(A) Non-Parametric SBPs

Advantages

- High penetration depth (up to hundreds of feet)
- High vertical resolution
- Ability to operate at range of frequencies at one time (higher resolution seabed images)

Important Considerations

- Recommended fixed height is 15 – 24 ft above seafloor
- Low lateral resolution/wide footprint
- Potential impact on marine mammals
- Weight (impacts size of vessel necessary)

(B) Parametric SBPs

Advantages

- High lateral resolution/small footprint
- Lightweight (can be mounted to smaller vessels)
- Can operate in as little as 2 ft of water
- Lower potential impact on marine mammals

Important Considerations

- Up to three user-selected frequencies (reduced vertical resolution relative to non-parametric SBPs)
- Lower vertical penetration depth and resolution

Selected SBP System Configuration

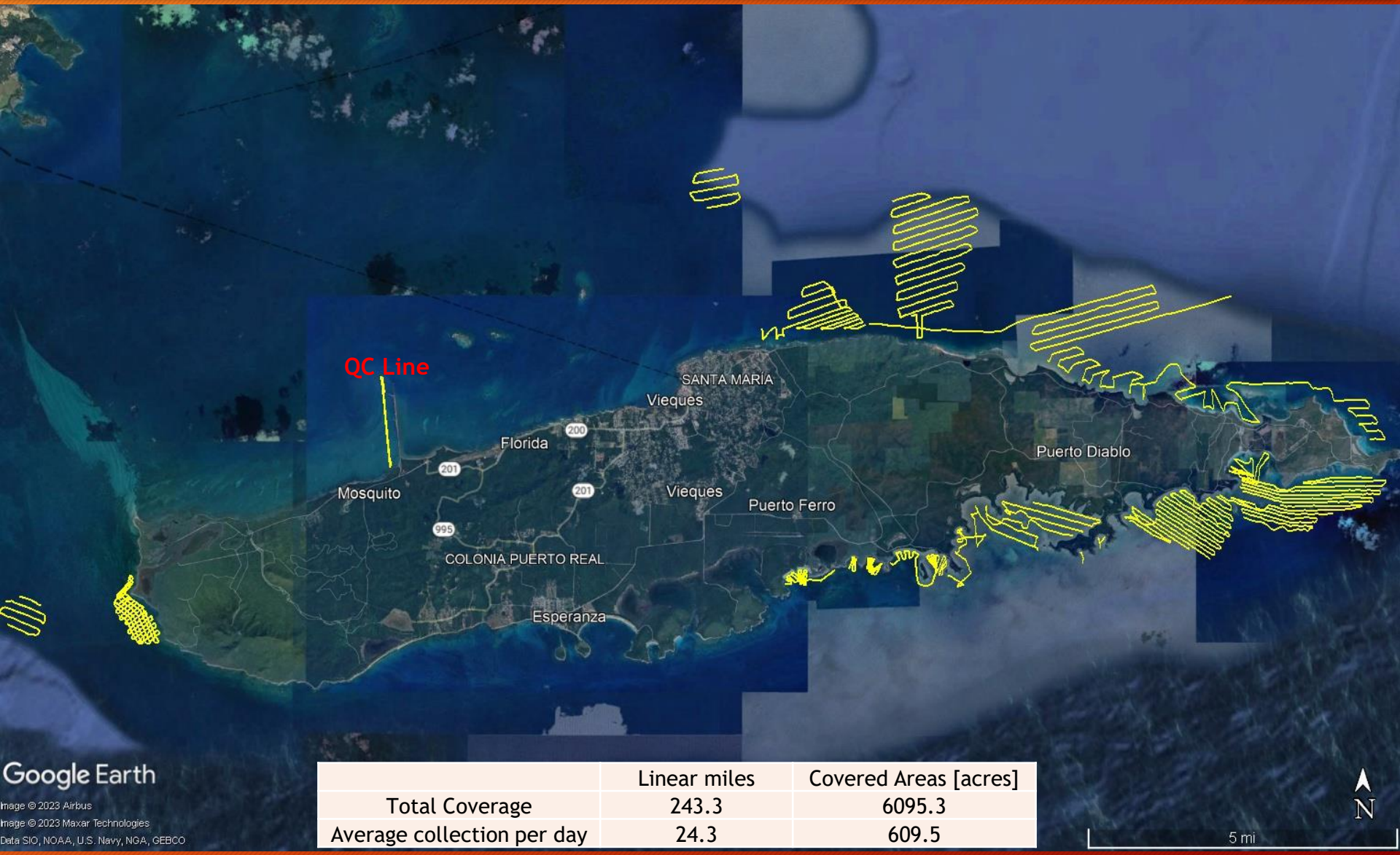
System Selected

- Innomar SES2000 parametric SBP system
  - Connected to Trimble R2 GPS unit with cm-level positioning accuracy
  - Mounted to 37’ Zodiac vessel

Setup

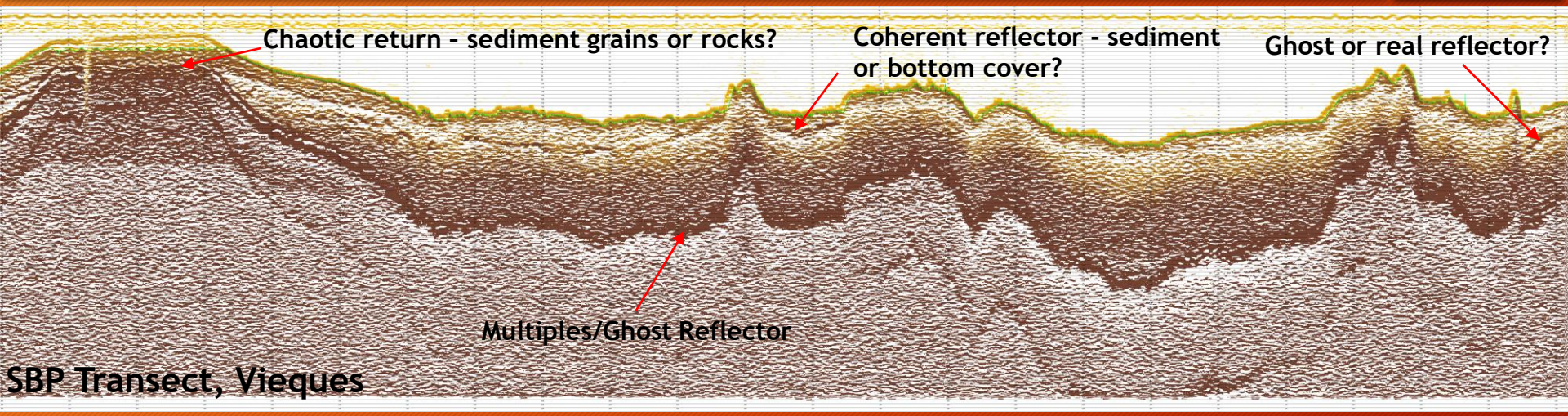
- Customized mounting bracket
- Initial QC tests to minimize impact on system data due to vessel engine and rough sea conditions
- Additional QC tests prior to collecting production data to identify optimum SBP pulse settings and vessel speed.

Study Area – Vieques Sediment Thickness Survey



	Linear miles	Covered Areas [acres]
Total Coverage	243.3	6095.3
Average collection per day	24.3	609.5

Interpretation Challenges



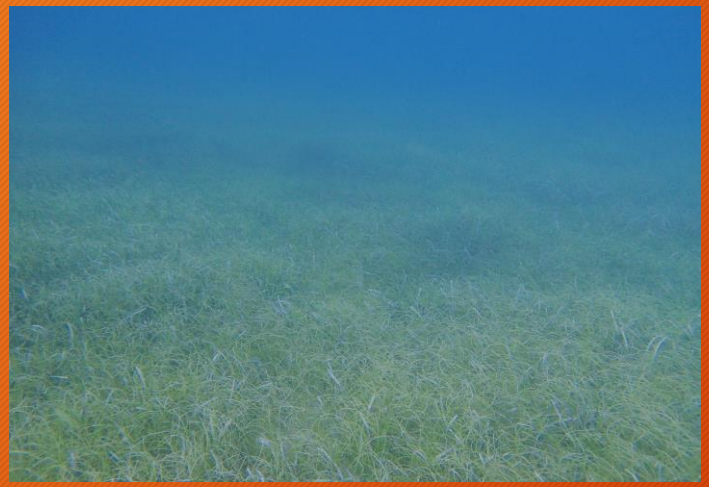
- Chaotic return/random reflection events – caused by real features such as very loose sand, irregular rock surfaces, highly variable bottom cover, etc.
- Coherent reflector/laterally continuous reflection events – caused by density contrast among laterally "homogeneous" media
- Multiples/ghost reflector – it mimics seabed configuration and is caused by reflection of acoustic signal between water surface and seabed; inherent to any seismic technology
- Ghost/real reflector – either a ghost (as described above) or a real feature

- In general, these interpretation challenges are resolved using other lines of evidence such as:
  - ground truthing
  - maps from other studies
  - boring (if possible)

Seafloor Bottom Types in Survey Area

Source: An Ecological Characterization of Marine Resources of Vieques, Puerto Rico (NOAA, 2010)

Survey Ground Truthing

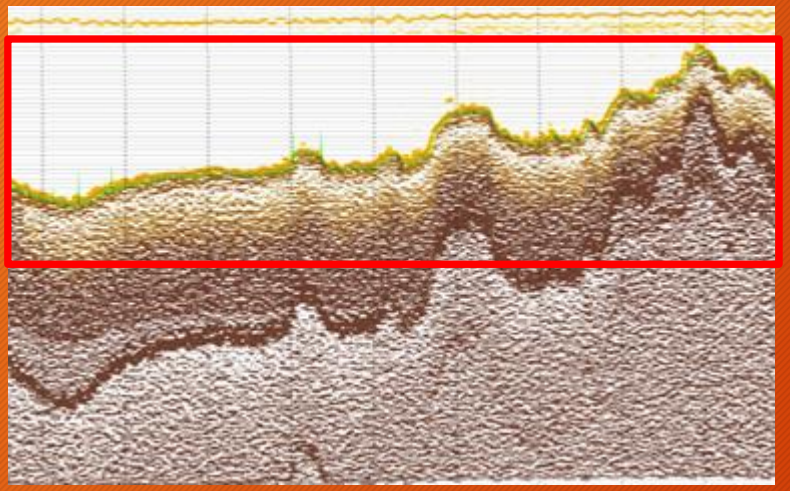


Scientific divers performing ground truthing of sub-bottom profiler results

Sub-bottom Profiles and Ground Truthing

Selected Ground Truthing Results

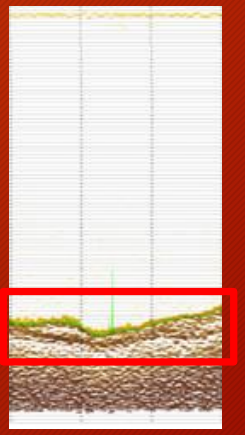
Coral Reef and Hardbottom



Sand and scattered rocks

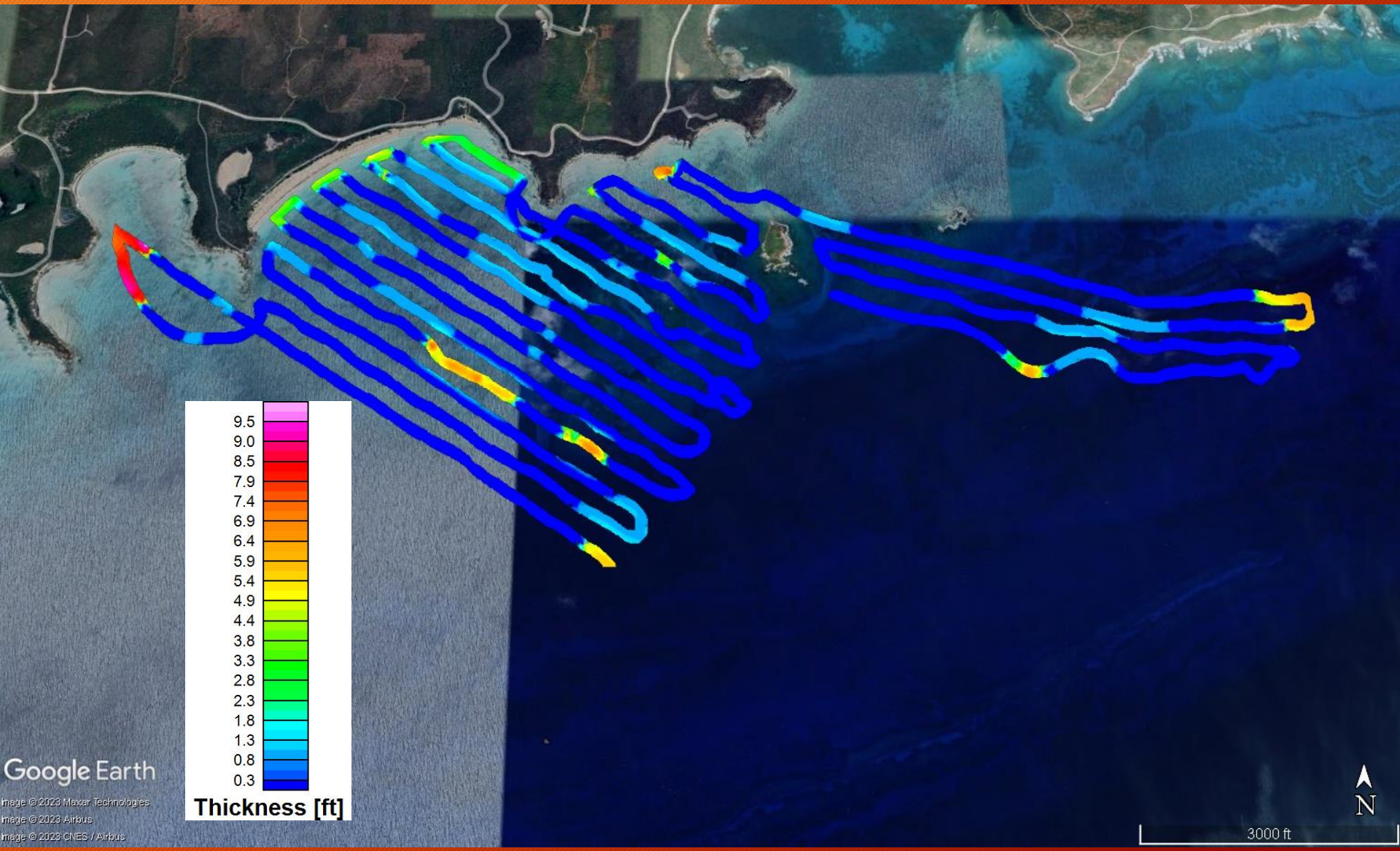
Sand

Dense Seagrass



Ground truthing helps confirm/refine SBP signature interpretation regarding different covers, sub-bottom structures, and thicknesses

Preliminary Sediment Thickness Results



Conclusions/Use

- Effective tool for helping to determine where and how deep munitions may bury
  - Will use data to generate a sediment thickness contour map of the offshore munitions site
- Survey results will be used, together with information gathered regarding munitions types and mobility, to enhance remedy decisions
- To improve data collection, quality, and interpretation:
  - Select the type of system based on site-specific conditions and needs
  - Perform setup and initial testing to optimize system/vessel settings and minimize data interference
  - Calibrate SBP data against other lines of evidence to ensure accurate interpretation of bottom and sub-bottom structures

Questions?