Progress Report on Comparisons of East China Sea Bottom Scattering Strengths at Low Frequency

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**Abstract:**

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ECS Bottom Scattering Strength Determinations

- **ASIAEX**
  - *Date*: August 2001
  - *Location*: 29°39'N 126°49'E
  - *Source Weight/Depth*: 1 kg/50 m
  - *Receiver Depth*: 5-90 m (30 element VLA)
  - *Geometry*: Monostatic reverberation

- **Navy Test #1**
  - *Date*: September 1998
  - *Location*: 28°30'N 126°00'E
  - *Source Weight/Depth*: 2 kg/50 m
  - *Receiver Depth*: 45 m (nominal) (64 element HLA)
  - *Geometry*: Bistatic reverberation

- **Navy Test #2**
  - *Date*: 1998
  - *Location*: 29°05'N 126°43'E
  - *Source Weight/Depth*: 0.8 kg/18 m
  - *Receiver Depth*: 27 m
  - *Geometry*: Monostatic reverberation
Bottom Scattering Strength Measurement Sites

ASIAEX
Navy #1
Navy #2
**Bottom Scattering Strength Estimation**

- **Method 1** (ASIAEX, Navy Test #2): Extract scattering strength from reverberation intensity
  - Scale reverberation level for source energy and 2-way transmission
  - Adjust for area contributing to instantaneous reverberation level

  **Issues/Assumptions:**
  - Source level known vs frequency & measurement range
  - Transmission known vs frequency & range

- **Method 2** (Navy Test #1): Compare bottom target strength & target strength of reference target
  - Compare energy scattered from near-bottom known target with energy scattered from bottom near target
  - Adjust bottom target strength for contributing area

  **Issues/Assumptions:**
  - Same transmission to target & bottom
  - Reference target strength known vs frequency

- Both methods typically assume scattering region homogeneity & isotropy
Passive Reflector Schematic

Subsurface Flotation (28" Dia.)

3" Dia. X 100' (30.5 m) Reinforced PVC Tube w/ Internal Wire Rope Strength Member

- Mid-Water Depth

Scuba Tank w/ Regulator

Glass Balls (17" Dia.)

Single Acoustic Release

1000 lb Anchor
Passive Reflector Target Strength

Theoretical Air Column
Target Strength @ 150'

Newport ATD
Measured Data
(Scaled)
Summary & Conclusions

- Three separate estimates of East China Sea low frequency integrated bottom scattering strength have been compared
  - Two measurements - ASIAEX & Navy test#2 - were made at closely spaced sites (56 km separation) using same method
    ▪ estimates agree closely
  - One measurement - Navy test#1 - was made at a removed site (140 km separation from ASIAEX) using different method
    ▪ estimates differ from ASIAEX & Navy test#2 results

- Several questions of physics are being probed, the interaction of which affect the interpretation of the scattering strength determinations
  - Source level range dependence expected
    ▪ Consequence of explosive source & nonlinear propagation characteristics
  - Monotonic decrease of scattering strength with range expected
    ▪ Consequence of high angle stripping & scattering strength grazing angle dependence
  - Maximum $f^3$ dependence of scattering strength expected
    ▪ Consequence of Born approximation scattering applied to sub-bottom scatterers
Plans

• Complete analysis of bottom scattering strength
  – Refine frequency dependency arguments
• Research sub-bottom characterizations for ASIAEX/Navy test#2 sites and for Navy test#1 site
• Undertake construction of scattering strength model