Bayesian Geoacoustic Inversion: Seabed Classification Workshop

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Austin TX
5–6 April 2011

Geoacoustic Inversion: Fundamental Issues

Goal: Automated general probabilistic inversion

Requirements:

- Unbiased PPD sampling → Detailed balance
- Parameterization consistent with data information → Trans-D inversion
- Data/theory error modeling (including covariance)
  → Empirical & hierarchical Bayesian
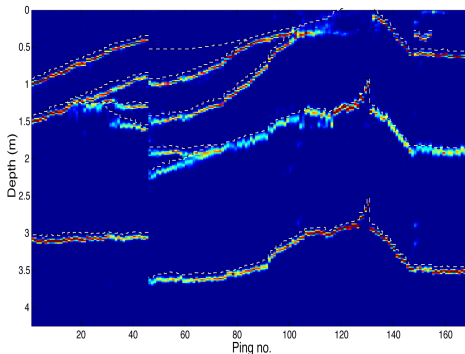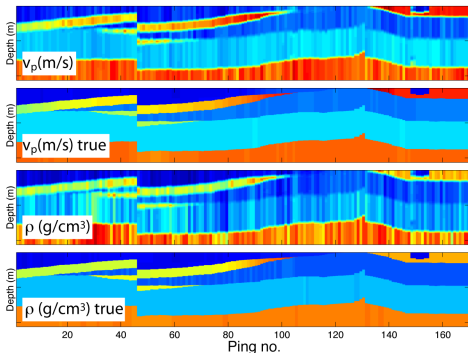
Inversion Algorithms:

- Parallel Trans-D Markov chains
- Sequential Monte Carlo for static and dynamic systems
- Interacting MCMC/SMC: Improve mixing & multi-mode sampling
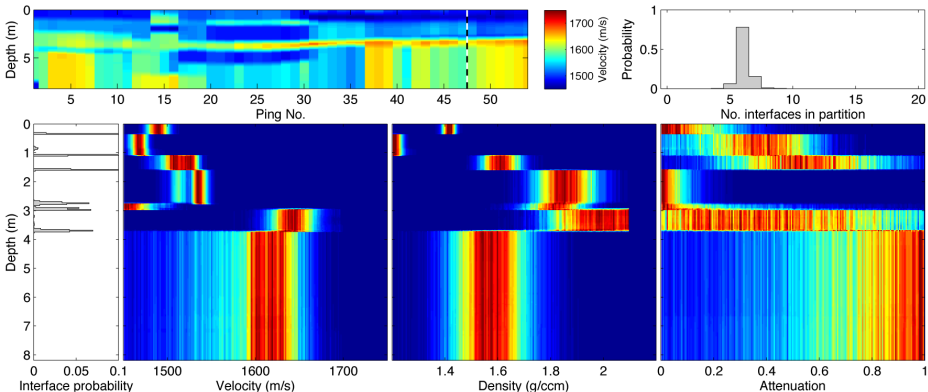- Partition modeling: Simple parameterizations for complex environments

Ship/AUV towed array (with Charles Holland)

Sequential trans-D inversion along tracks:

- Efficient inverion, adapts to enviroment (e.g., No. layers)
- Partition model captures general structure through ensembles

Simulation:

Ship/AUV towed array (with Charles Holland)

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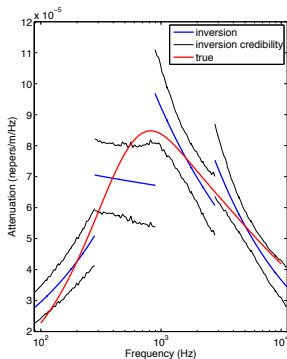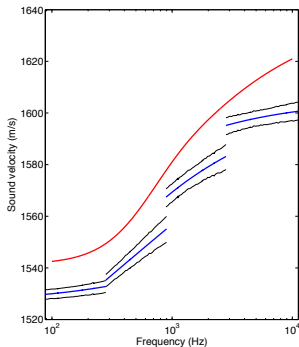- Partition model captures general structure through ensembles

Measured AUV data:

High bandwidth refl. coeff.: α_p / V_p Dispersion

- Reflection coefficient over large bandwidth: Kramers-Krönig for causality over 100-10,000 Hz)
- $\alpha = \kappa f^n$
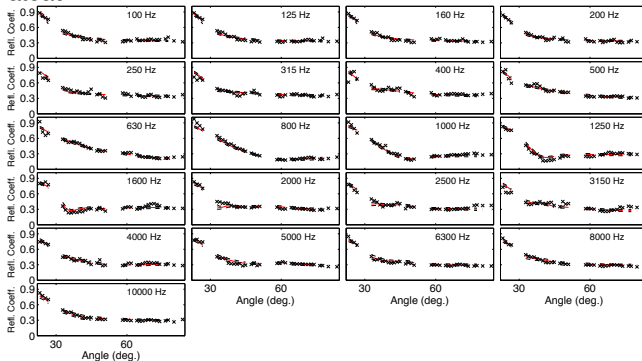- Layers pose challenge: thin layers, complicated α–f dependence

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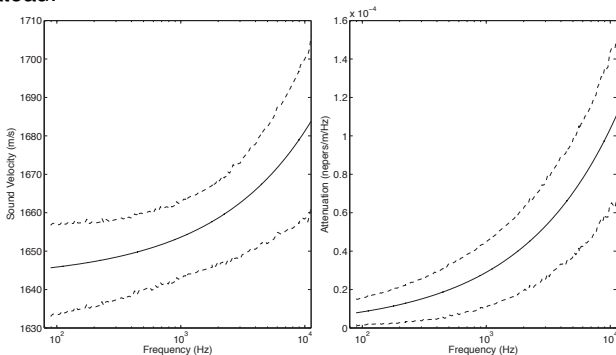- Layers pose challenge: thin layers, complicated α–f dependence

Malta Plateau:

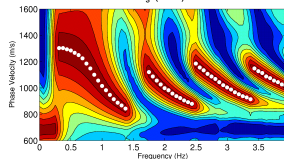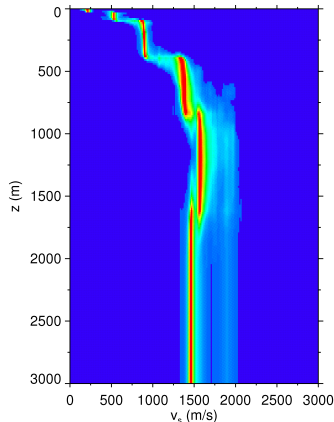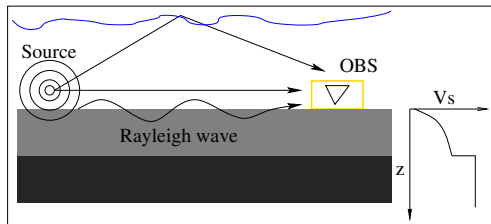# High bandwidth refl. coeff.: α_p / V_p Dispersion

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Malta Plateau:

Modal Dispersion: V_s Inversion

- OBS interface wave dispersion inversion for V_s profiles
- H/ph measurements of water borne mode dispersion for geoacoustic inversion
- Can invert for shear attenuation

Matched-field/TL Inversion

- Trans-D Bayesian inversion with hierarchical error modeling for VLA and/or towed array