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Acoustic Source

- Air gun (5 in^3 [also available 20 in^3]):

Source Level 165 to 175 dB/micro Pa

Calibration Hydrophone @ 1m

Frequency band 30 Hz to 500 Hz

<u>Advantages:</u>

a) Very sharp pulse, provide a very good source for modal analysis

b) Compact, mobile, easy to use

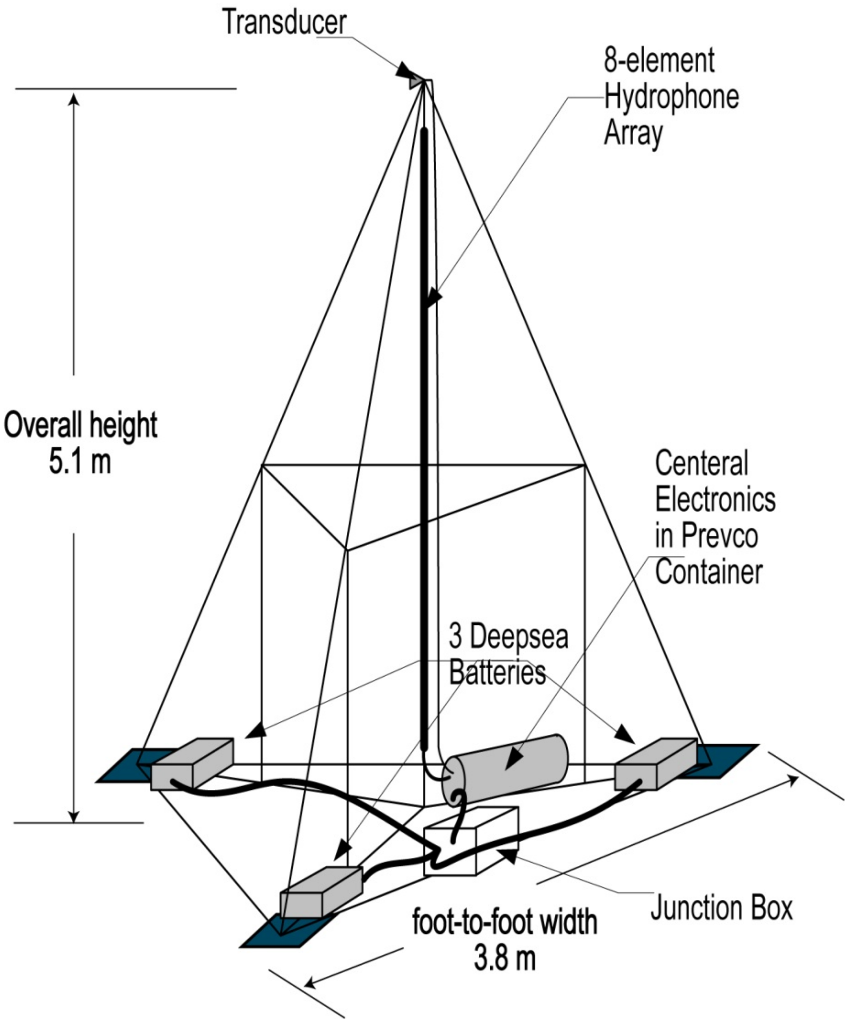
c) Available and calibrated already

<u>Disadvantage:</u>

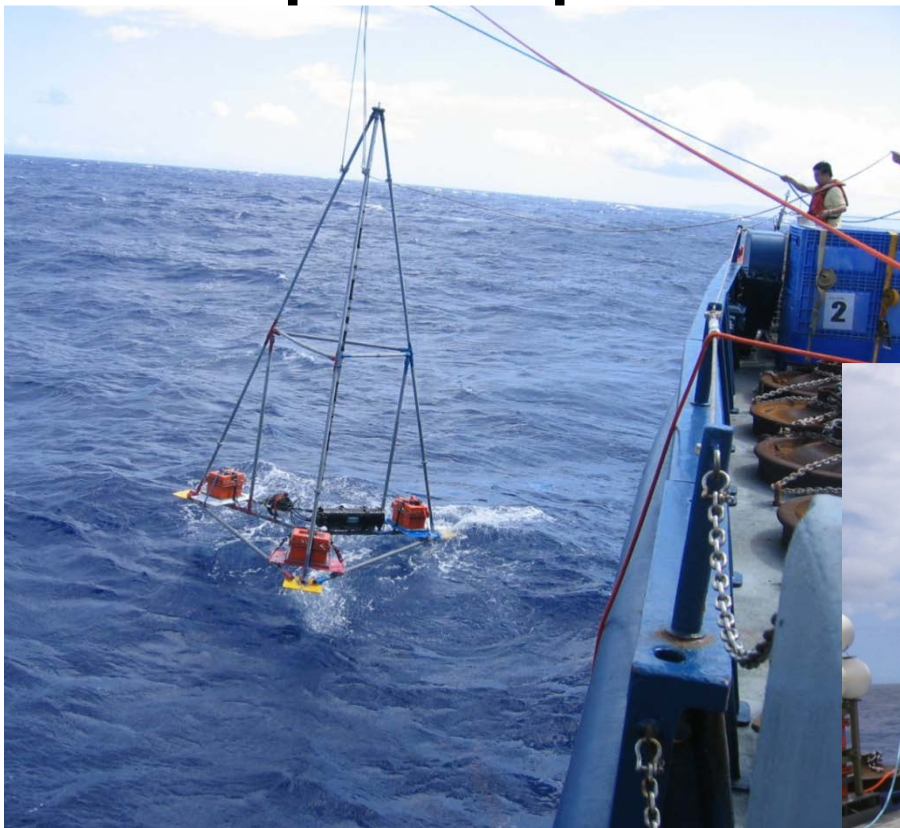
a) Need to apply for permit “soon” in advance to the experiment.

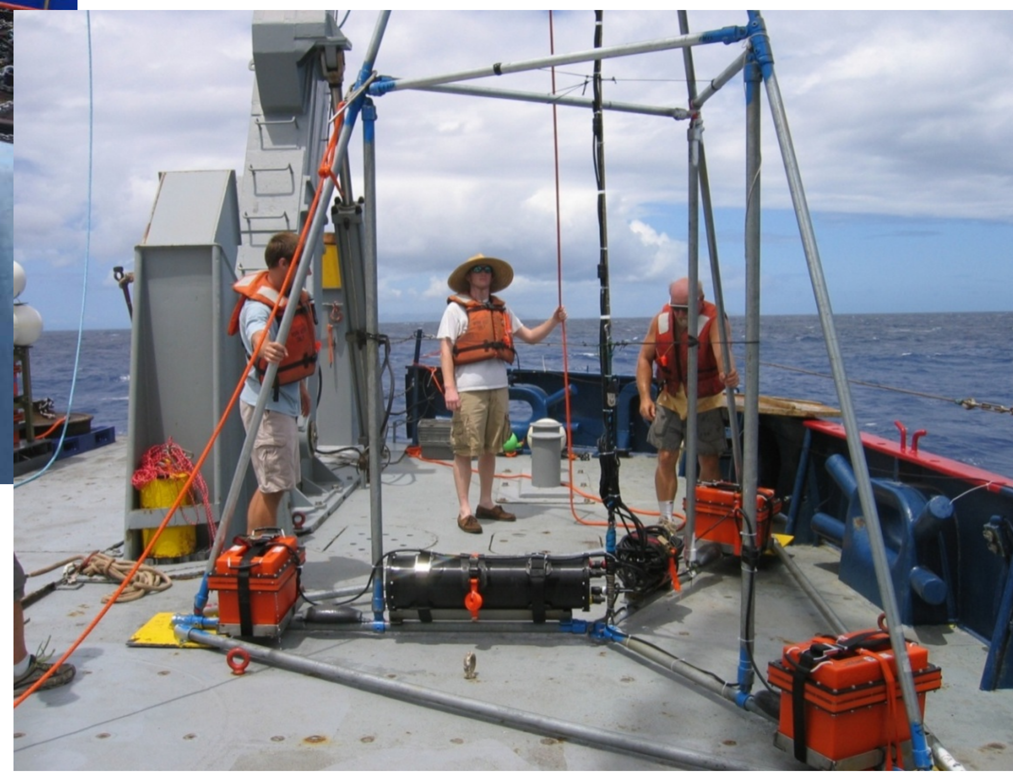
Tripod Acoustic Systems

- Tripod VLA:
  - Eight receiving elements
  - 80 kHz sampling frequency
  - ~50 hours of underwater lifetime
- Single Source
  - ITC3013 source near the top (~4 m from the sea floor)



Tripod operations during KAM08





Geo-acoustic parameter estimation using a multi-step inversion technique based on normal mode method

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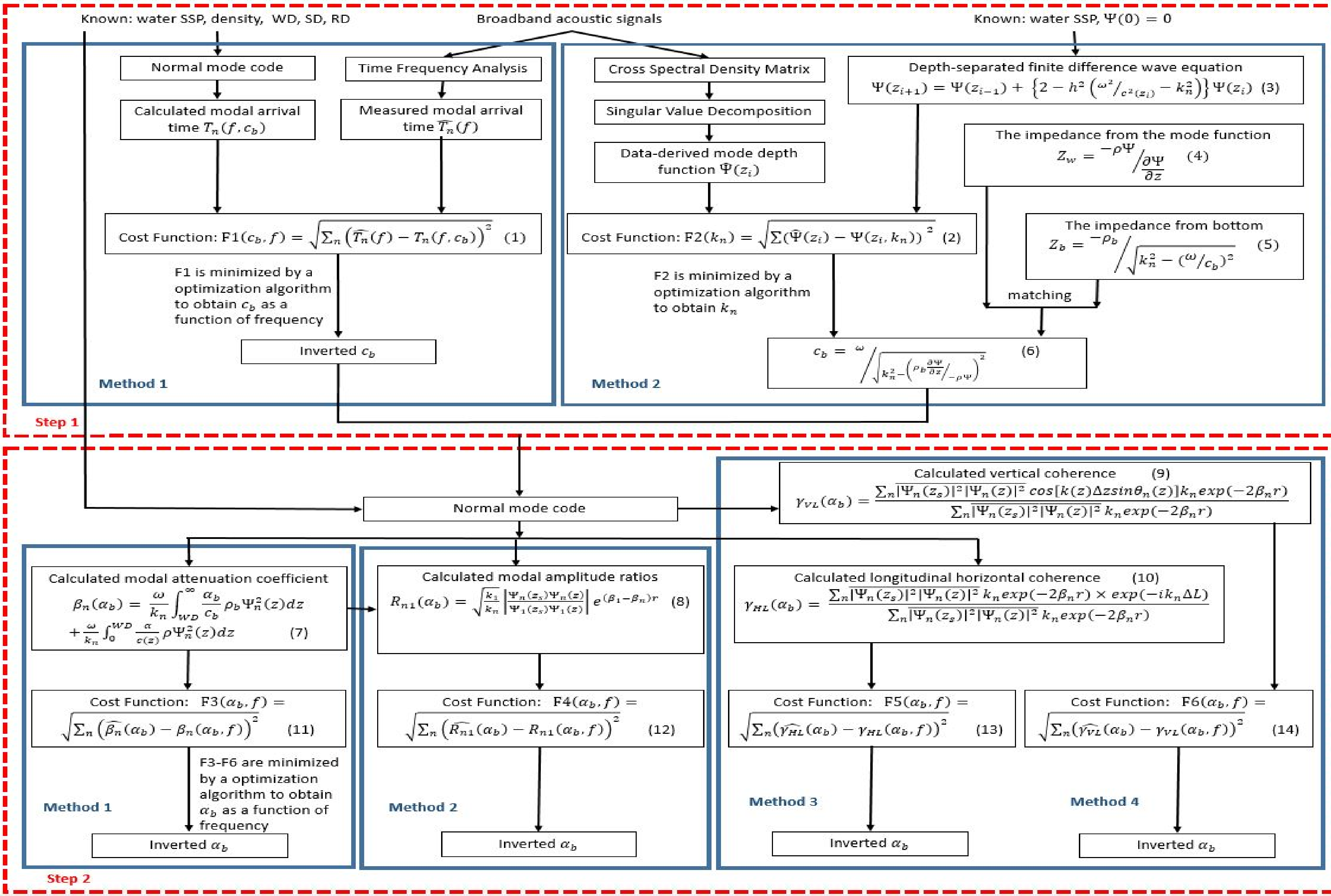
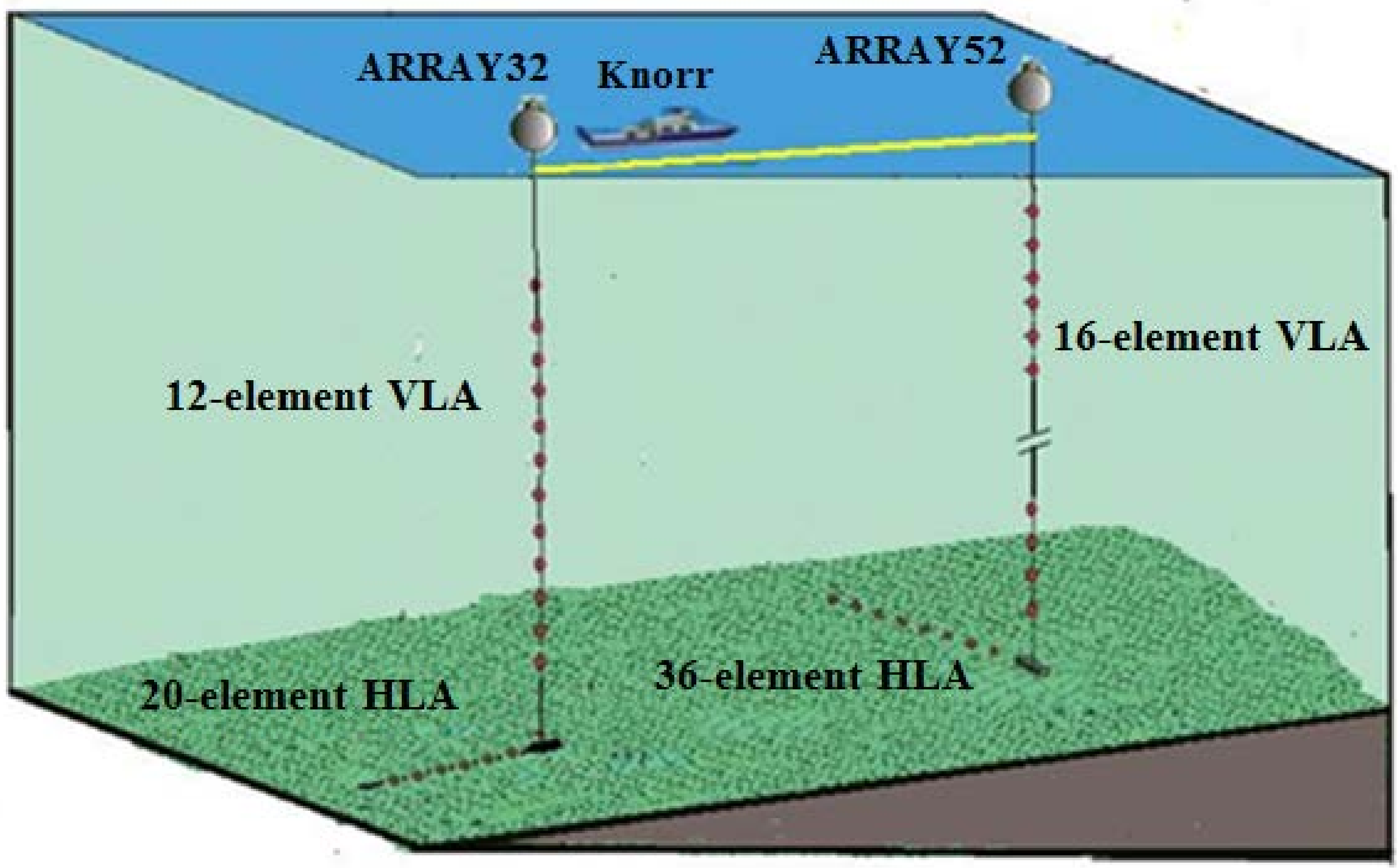
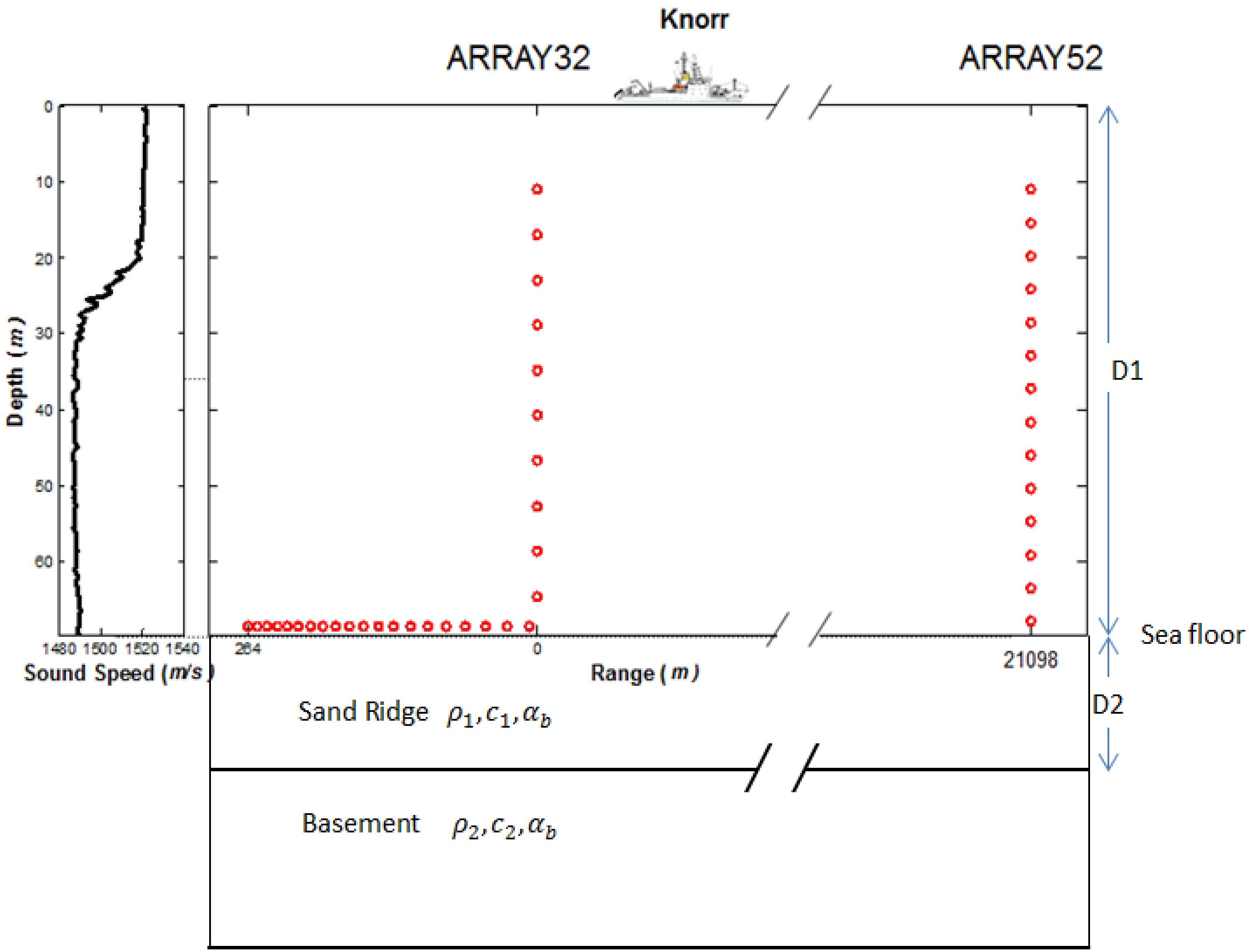


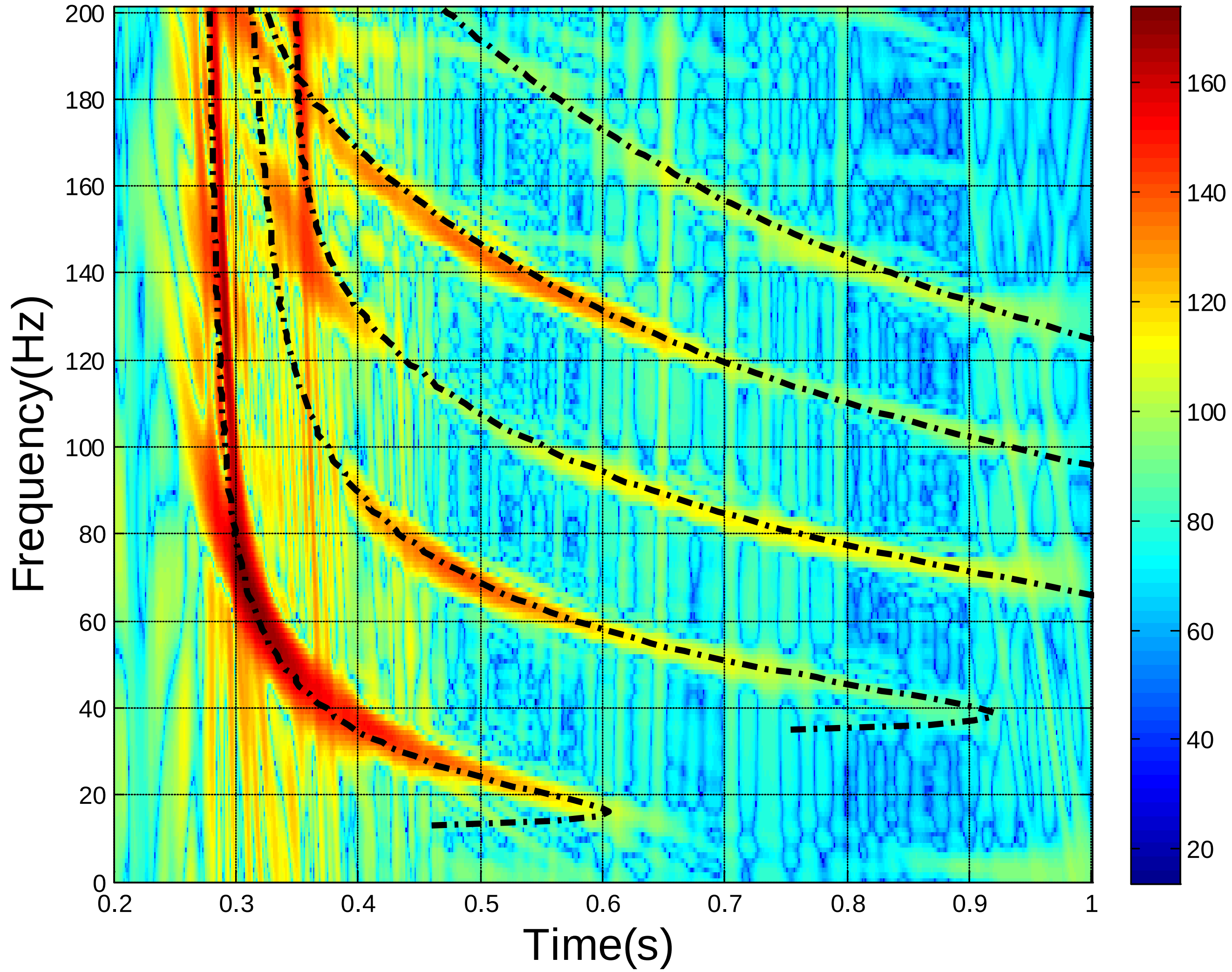
Experimental Description



Experimental Description



Data-model comparison of modal dispersion curves



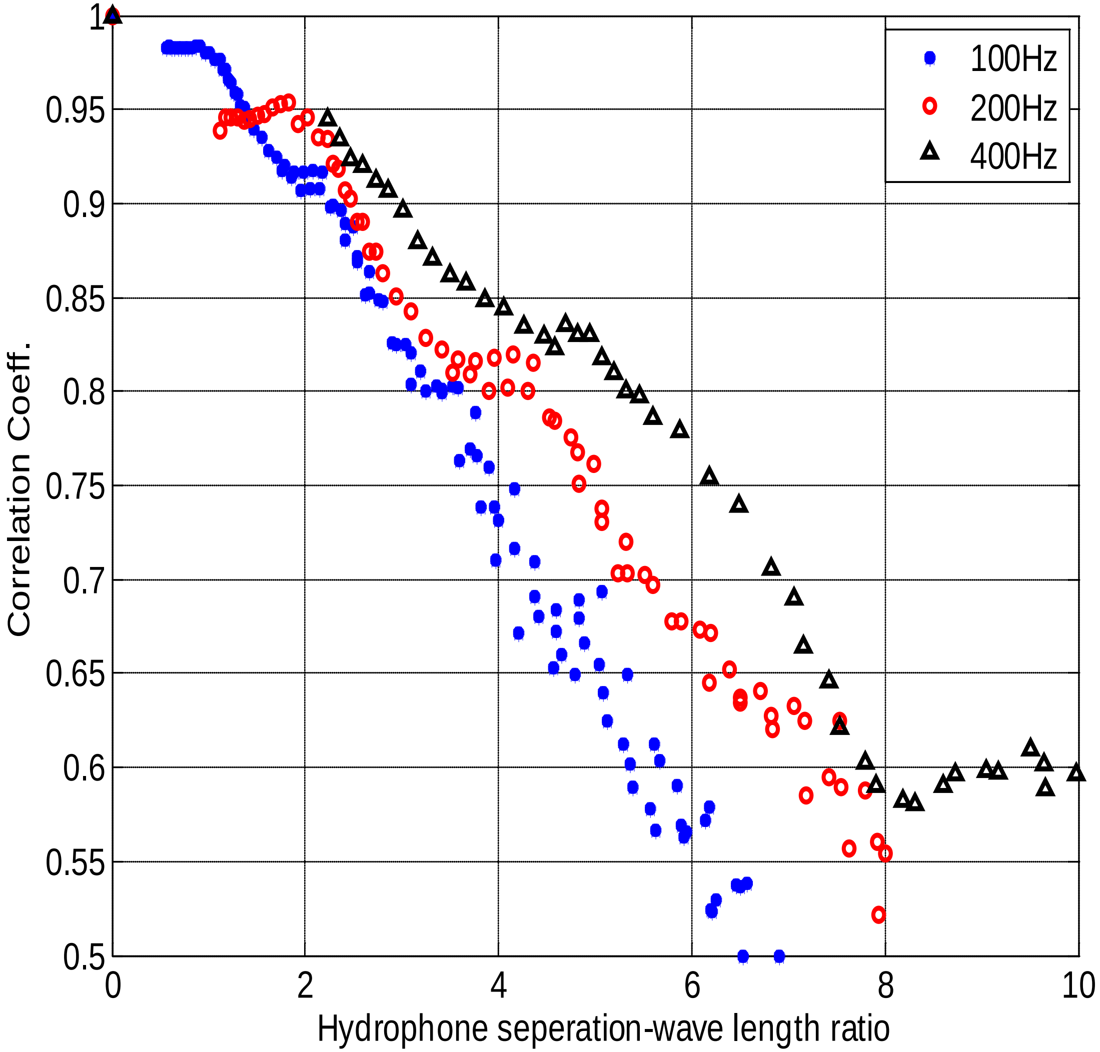
Seabed attenuation inversion using LHC

The experimental longitudinal horizontal coherence

$$\rho(\Delta T,\tau)=\frac{\int_{t}^{t+\Delta T} p_1(t)\,p_2\;(t-\tau)dt}{\sqrt{\int_{t}^{t+\Delta T} p_1{}^2(t)dt\times\int_{t}^{t+\Delta T} p_2{}^2(t)dt}} \tag{1}$$

Where $\tau = L/c$ is the time delay and ΔT is the integration time.

LHC as a function of hydrophone separation-wave length ratio



Seabed sound attenuation inversion using LHC

Using the normal mode expression for sound pressure generated by a harmonic point source, we obtain the mathematical expression in terms of normal modes for the theoretical normalized longitudinal horizontal coherence:

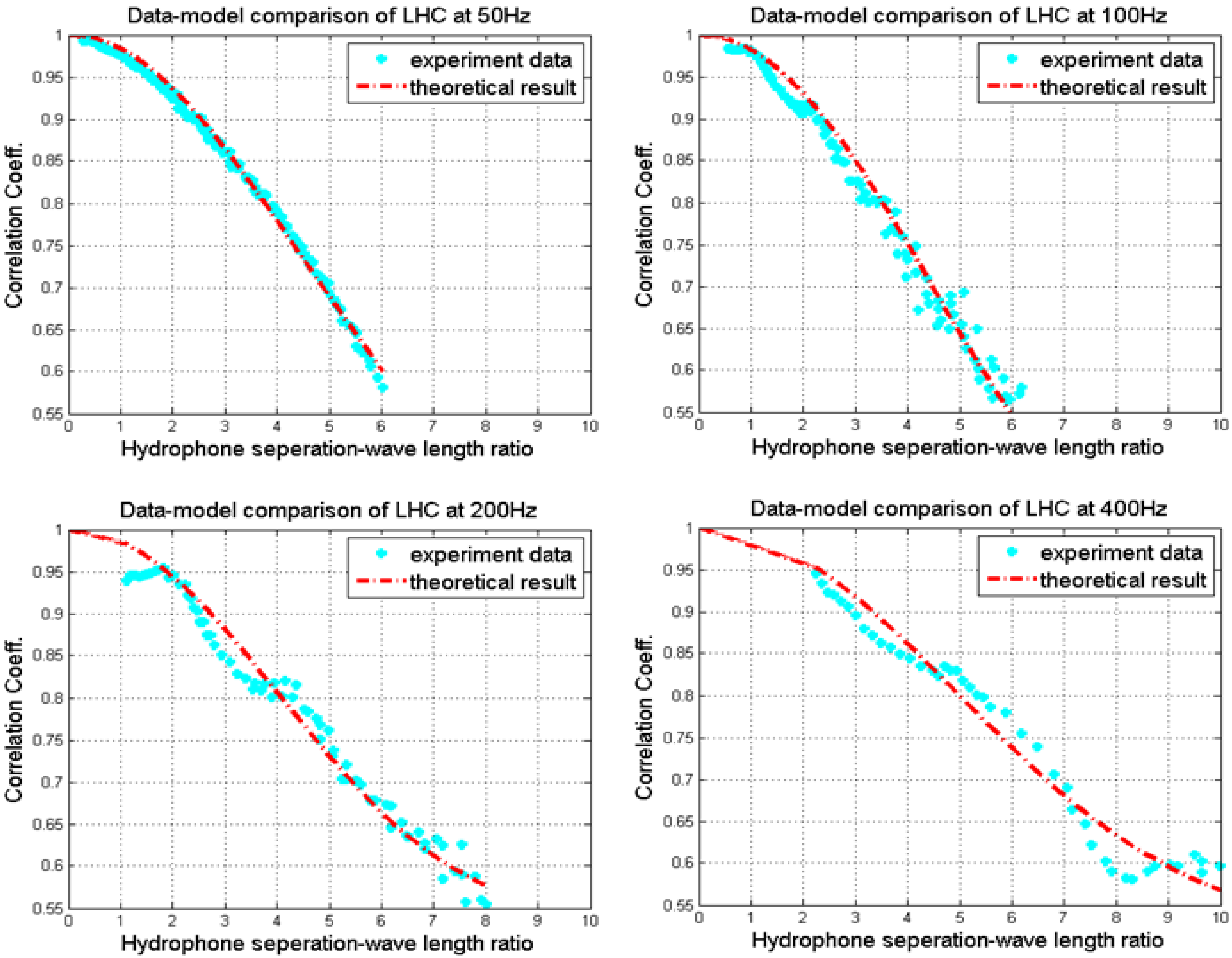
$$\gamma_{HL}(z_s, z, \Delta L, r) = \frac{\left| \sum_n \overline{|\Psi_n(z_s)|^2}\,\overline{|\Psi_n(z)|^2} k_n \exp(-2\beta_n r) \times \exp(-ik_n \Delta L) \right|}{\sum_n \overline{|\Psi_n(z_s)|^2}\,\overline{|\Psi_n(z)|^2} k_n \exp(-2\beta_n r)} \quad (2)$$

where, r is range, z_s is source depth, z is receiver depth, ΔL is the horizontal separations of the pair of hydrophones, Ψ_n is the mode depth function of the nth mode, k_n is the horizontal wave number of the nth mode, β_n is the modal attenuation coefficient, and S_n is the cycle distance of the nth mode. The square-average depth function can be calculated

$$\overline{\Psi_n(z)^2} = \frac{1}{S_n \sqrt{k^2(z)F(z) + k^2(z) - k_n^2}} \quad (3)$$

$$F(z) = 0.875 \left| \frac{1}{\pi f} \frac{dc(z)}{dz} \right|^{2/3} \quad (4)$$

[Zhou et al. 2004, JOE IEEE and Zhang & Jin 1987 JSV]



Data-model comparison of LHC at 50Hz
Data-model comparison of LHC at 100Hz
Data-model comparison of LHC at 200Hz
Data-model comparison of LHC at 400Hz
experiment data
theoretical result
Correlation Coeff.
Hydrophone seperation-wave length ratio
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0 1 2 3 4 5 6 7 8 9 10

Inverted bottom attenuation in SW06 area