Research motivation:
1. Effects of variable seabed on long-range propagation
   - Range-dependent (cross-province) context
   - Side: thin geoacoustic layers (shear).
2. Quantify uncertainty → sonar predictions & array processing.
   - Account for oceanographic variability in inversions.

Participation:
1. Main experiment: FFI-array (and data analysis).
2. Side: smaller-scale Arctic Shelf initiative (FFI to facilitate).
Experiment

- **Acoustic data:**
  - Towed source (LF tones): EF & 30° to 10 nmi.
  - Repeated runs: sampling effects, model verification.
  - Short-range (broadband).
- **Oceanographic:** along-track & moored-buoy profiles.
- **Geophysical:** seismic profiler, cores, (shear).
Prior & inferred information

Site survey

- Seismic reflection
- Profiling sonar (TOPAS PS018)
- Multibeam sonar (EM-710)
- Subbotom profiler (HUGIN-AUV)
- Gravity cores

Bayesian inference

FIG. 8. Marginal PPDs for: (a) Short-range outbound controlled-source data, (b) short-range outbound ship-noise data, (c) long-range outbound controlled-source data, and (d) long-range outbound ship-noise data.

[from Tollefsen and Dosso, JASA, 2008]
Inference method

• Bayesian framework
  – Likelihood for Gaussian-distributed errors; data error $C_d$ estimate, posterior analysis of residuals
  – Metropolis-Hastings sampling from PPD; heat-bath (Gibbs) sampling for source positions
  – Marginal posterior distributions and covariances.

• Model parameters:
  – $N$-layer $(c, \rho, \alpha)$ with gradients. Model selection via BIC.
  – extend to range-dependent context (segments).
  – variable oceanography via EOFs.

• Prior assumptions:
  – Wide (no-information) or narrow (prior-inversion) uniform bounds.

• Model parameter resolution: not assessed \textit{a priori}.
FFI-array

Specifications:
- Length 1032 m
- 63 hydrophones
- 10 Hz–2 kHz, 24-bit ADC
- 5 Tb memory
- 6 weeks endurance
- Depth rating 1000 m
- Acoustic link (status/control)
- Adjustable gain
- L-shape configuration TBD
Arctic Shelf

- Environmental data:
  - 50m to >400m depth
  - Bathy (mb) in general scarce
  - Legacy geoac data in select areas
  - Some additional seismic data.

- Ice conditions:
  - mid-Aug to mid-Sep window
  - yearly variations.

- Ship operations:
  - FFI Research Vessel (Ice cl. C)
  - Site survey
  - Combine with FFI-array expt.

[Vibrocore sites and physical properties, and distribution of Quaternary sediment from Solheim et al, 1990; bathymetric map from Solheim & Elverhøy, 1993]
David’s questions

- New about these measurements:
  - moving-source/fixed-array data in cross-province context (with high-resolution supporting information).
  - side: high-quality data set in Arctic Shelf environment.
- Latest expected technology:
  - state-of-the-art acoustic array (and Bayesian inference method).
- Collaboration:
  - Interactions with the SBCX team
  - Explore (informal) collaborations with ESL and UVic.
• EXTRA
NILUS bottom node

- Sensor nodes dropped onto the sea floor
- Modem in water column (increase range)
- Acoustic sensors:
  - DIFAR hydrophone or
  - 4 hydrophones in tetrahedron
    30.3 cm between h/ps in plane;
    top h/p 16.7 cm above centre
- Magnetic sensor (3-axial fluxgate)
- Local signal processing
  - Atmel AP7000 processor
- Tripod structure
- Flotation bag for easy recovery
- 10-day battery endurance (per 2011).
R/V H U SVERDRUP II

• 55-m length overall, 13m breadth, 5.5m draft, 1387GRT,
• Approx. 200 m² deck space, 10-ton A-frame, 3-ton crane, trawl winch, side winch, 150 m² wet and electronics labs.
• Echosounders: EA-600 SB, EM-710 MB, PS018 bottom profiling.
• HUGIN-1000 AUV; deck container, aft launch.
• 2x40 cu. in. airgun, Moving Vessel Profiler, ADCP.
• Berths for 15 scientists, 7 crew.
• Operates 11 months/yr, mainly mapping and survey tasks, external hire.
HUGIN 1000

Equipment (April 2011)
• Multibeam – KM EM2000 (200 kHz)
• Singlebeam – KM (300 kHz)
• Sidescan – EdgeTech 2200 (120 & 410 kHz)
• KM-HISAS-1030 (60-120 kHz)
• Subbottom Profiler – EdgeTech (2–16 kHz)
• Forward looking – BlueView (200 kHz)
• Oceanographic – FSI Micro CTD 2
• Methane sniffer – Contros HydroC
• ADCP, Optical camera, Navigation sensors.

1000 m depth rating, mobilization container, L:4.5m, ø75cm, sp:2-6 kts, 24 hrs@4 kts.

SBP – example (630m depth, 35 m height)