Loughborough
University

Anthropogenic noise measurements and impacts for assessment of the marine environment
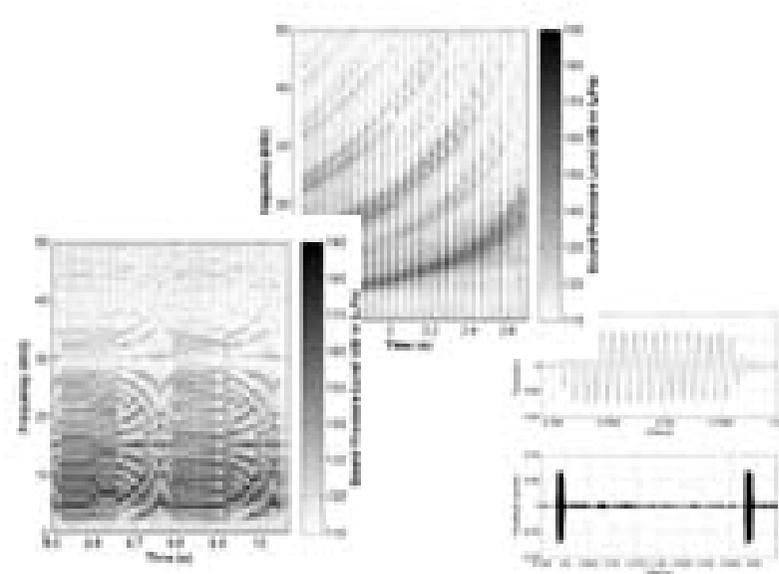
Paul Lepper

Underwater Acoustics Research
Applied Signal Processing Group
Loughborough University, Loughborough, UK.

Department of Electronic and Electrical Engineering
Underwater Acoustics Research Group

Applied Signal Processing Research Group
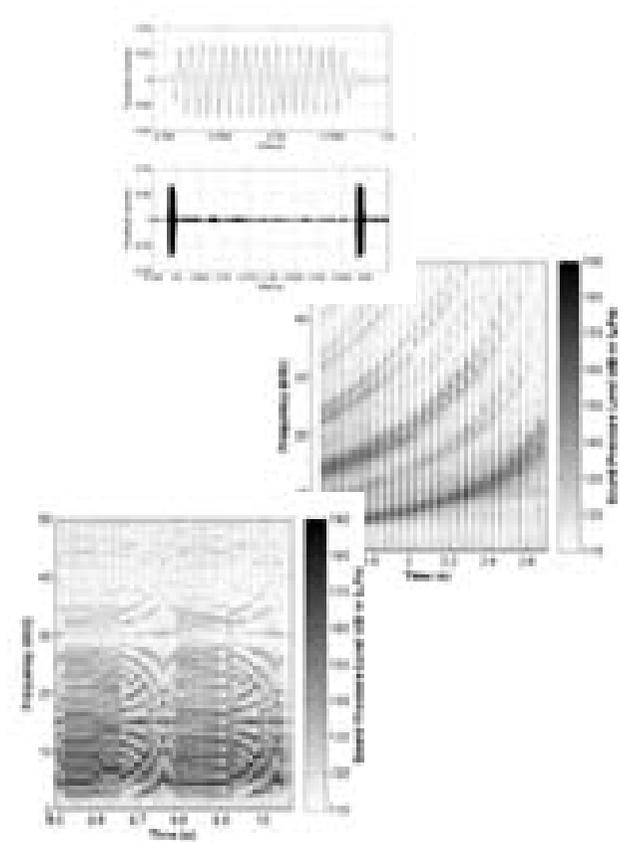
Outline

o In-situ measurement of commercial acoustic CAAD devices

o Noise measurements from a North Sea drilling operation

o Audiogram measurements of harbour porpoise

o Future work, Needs??

Department of Electronic and Electrical Engineering
Underwater Acoustics Research Group

Applied Signal Processing Research Group

Commercial Aquacultra Acoustic Devices (CAAD)

Loughborough University

Manufacturers

- AIRMAR   dB Plus II
- ACE AQUATEC   Silent Scrammer
- TERECOS   Type DSMS - 4
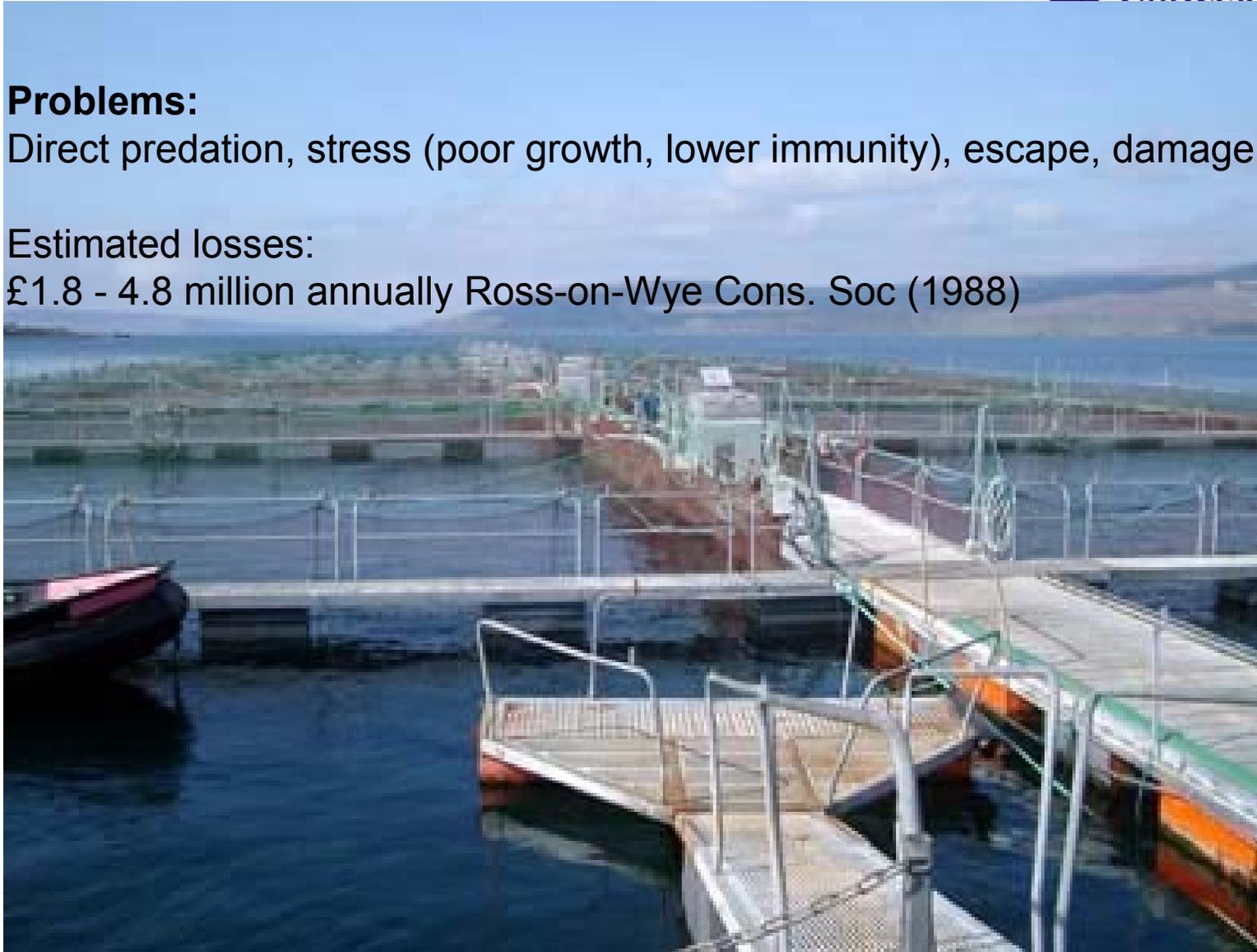
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Coastal fish farm

Problems:
Direct predation, stress (poor growth, lower immunity), escape, damage

Estimated losses:
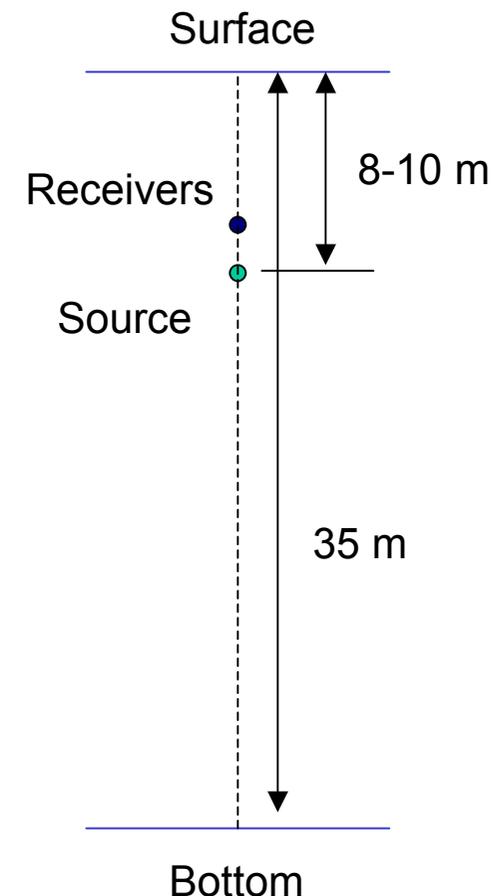£1.8 - 4.8 million annually Ross-on-Wye Cons. Soc (1988)

Measurement procedure

- 12.5mm & 25mm spherical omni-directional hydrophones
- 32 dB and 26 dB preamp gain (1 kHz HP)
- Recordings direct to lap-top hard-disk
- 160 kHz bandwidth (NI-6062E card)
- 12-bit resolution
- RACAL recorder (100 kHz bandwidth)

- Tidal depth variations
- CTD casts
- Bottom samples
- DGPS range estimates

- Fixed short range (<5m on axis measurements)
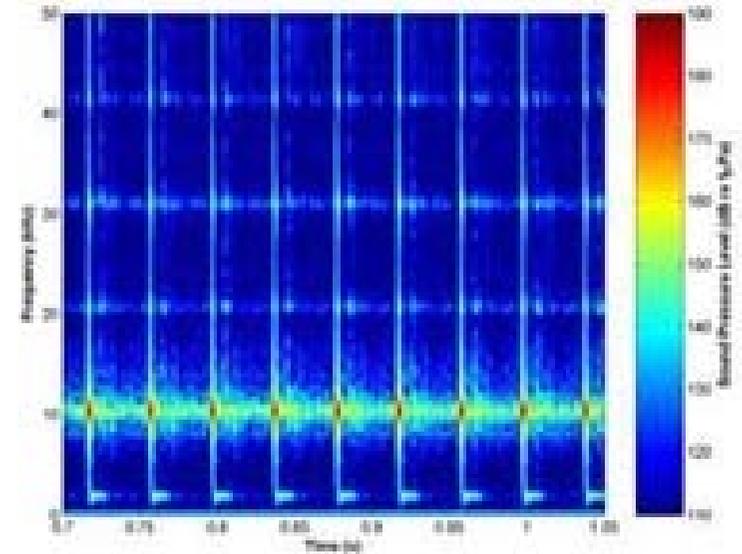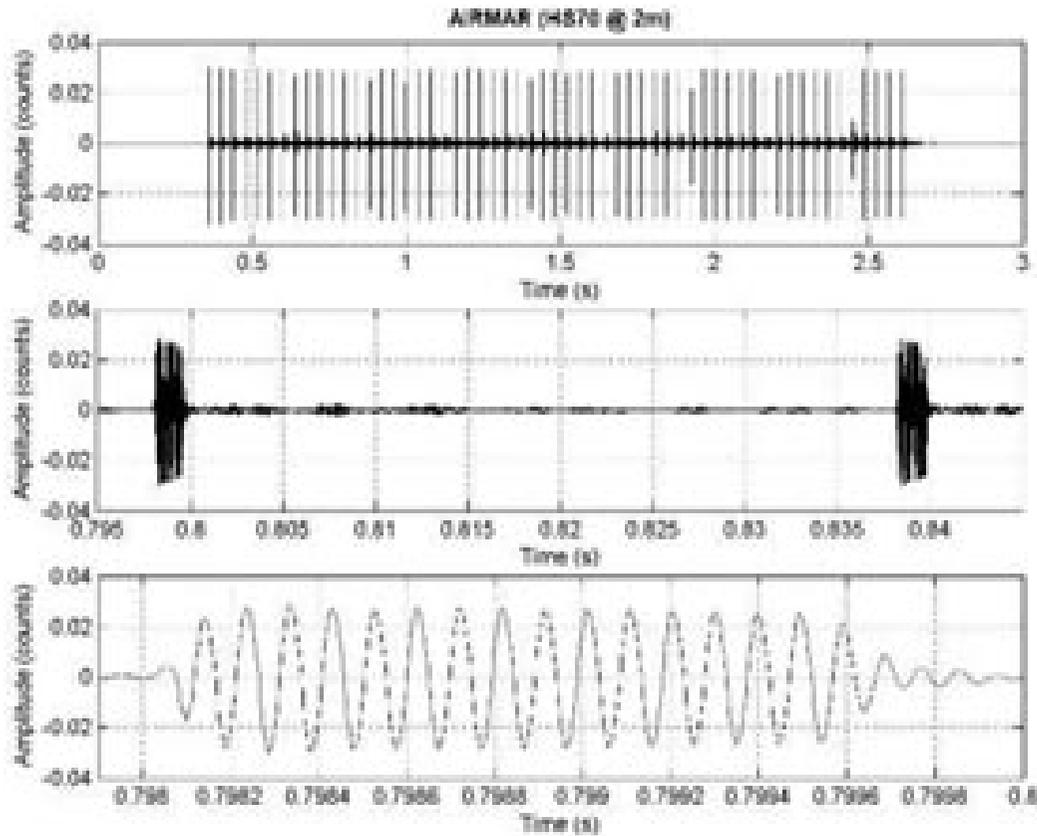- Medium (400m) & long range (2.5 & 4.5 km)

Surface

Receivers

Source

8-10 m

35 m

Bottom

AIRMAR (dB Plus II)

Transducer

Control System

Applied Signal Processing Research Group
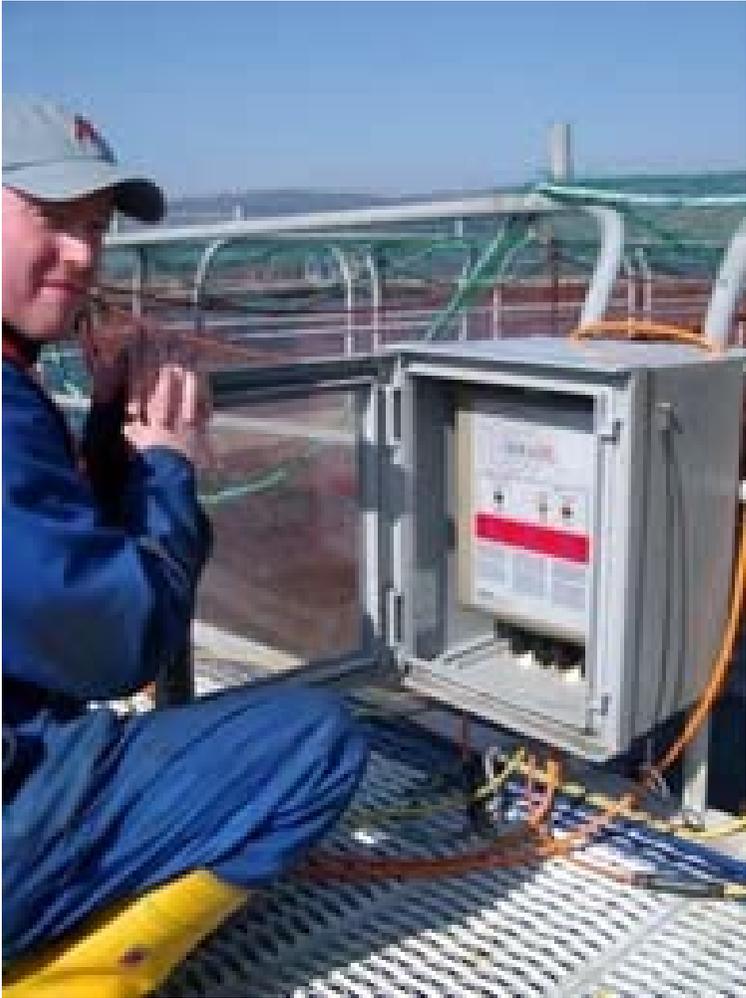
AIRMAR (dB Plus II)
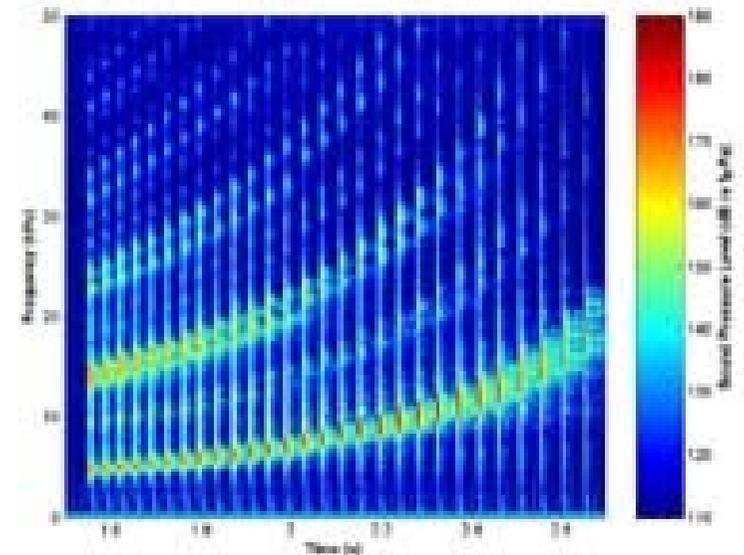
AIRMAR (dB Plus II)

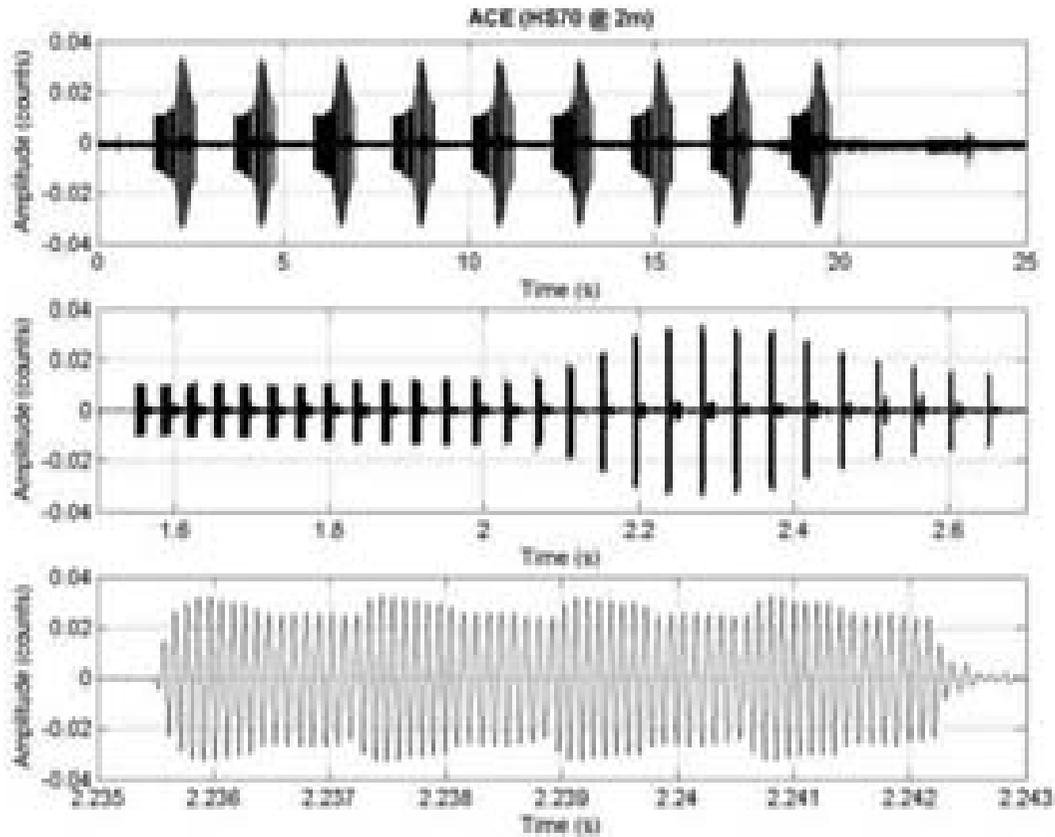*Applied Signal Processing Research Group*
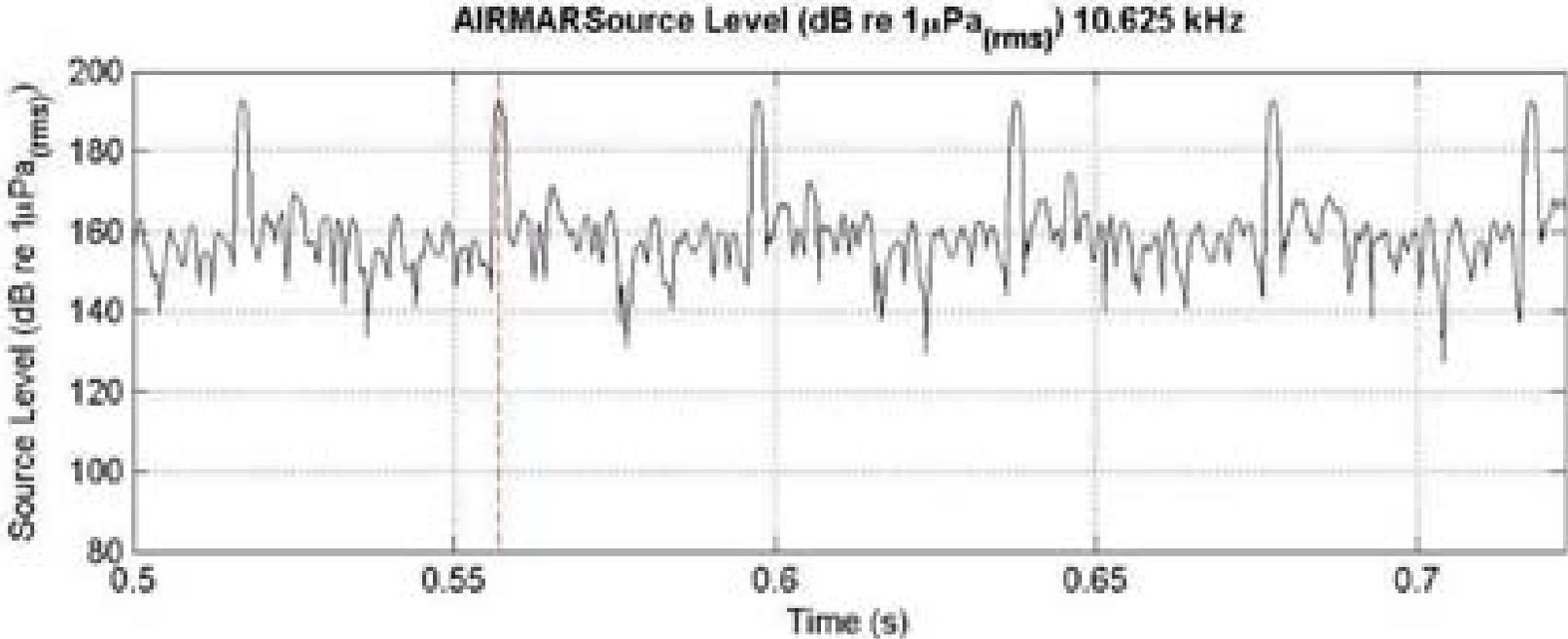
ACE AQUATEC (Silent Scrammer)

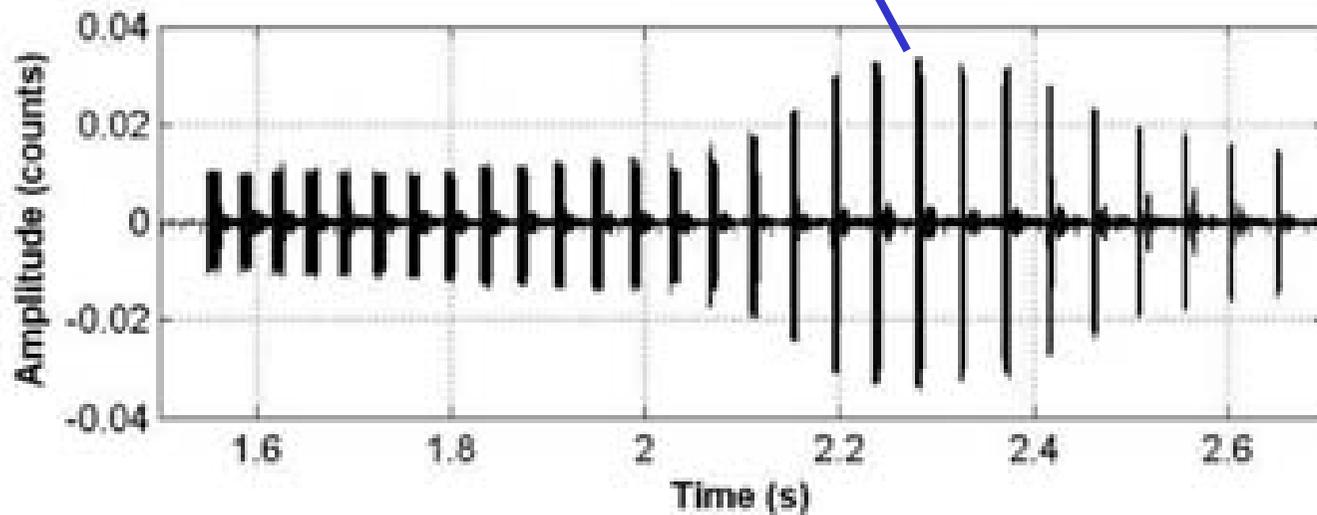Silent
Scrammer

Trigger
system

ACE AQUATEC (Silent Scrammer)

ACE AQUATEC (Silent Scrammer)

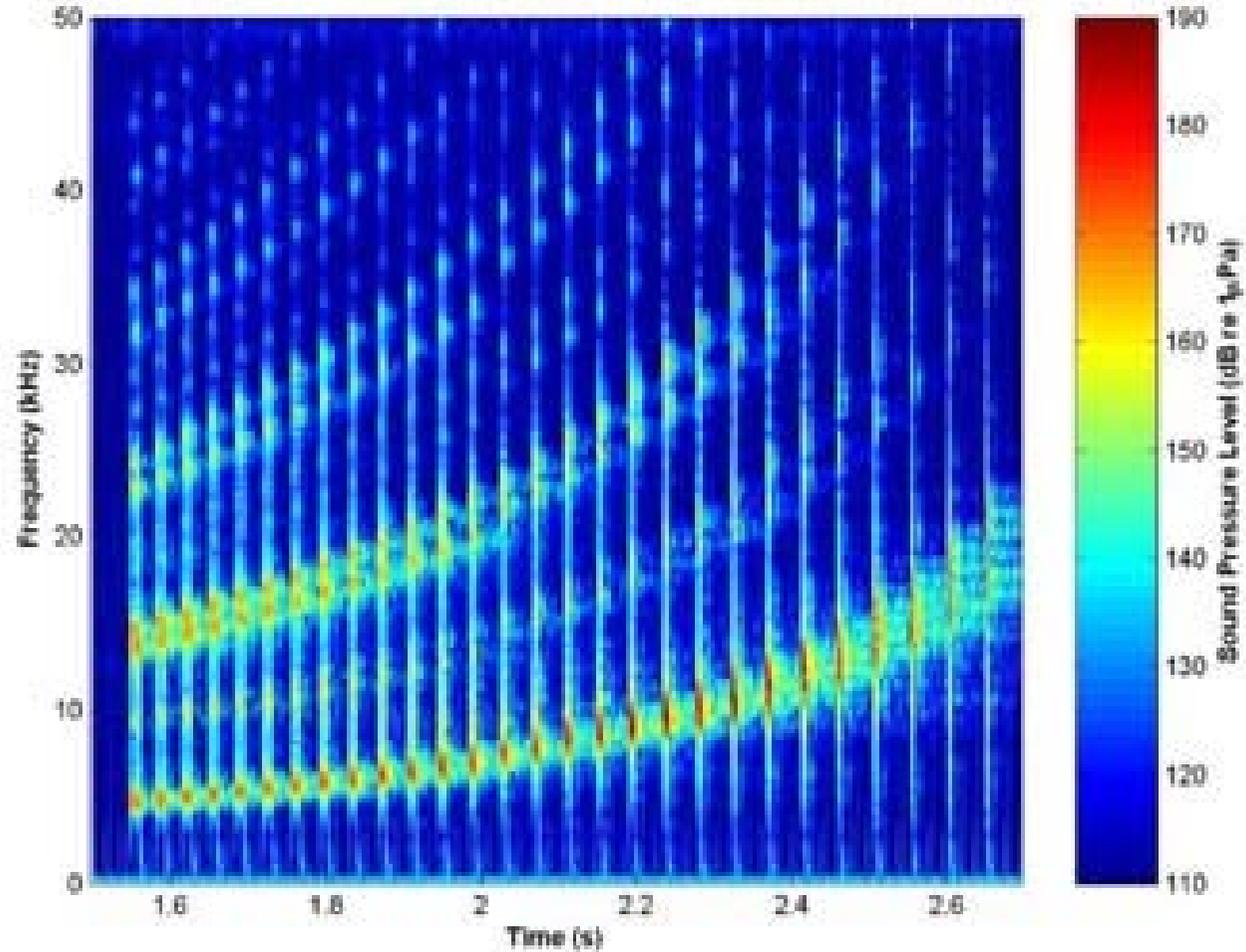Loughborough University
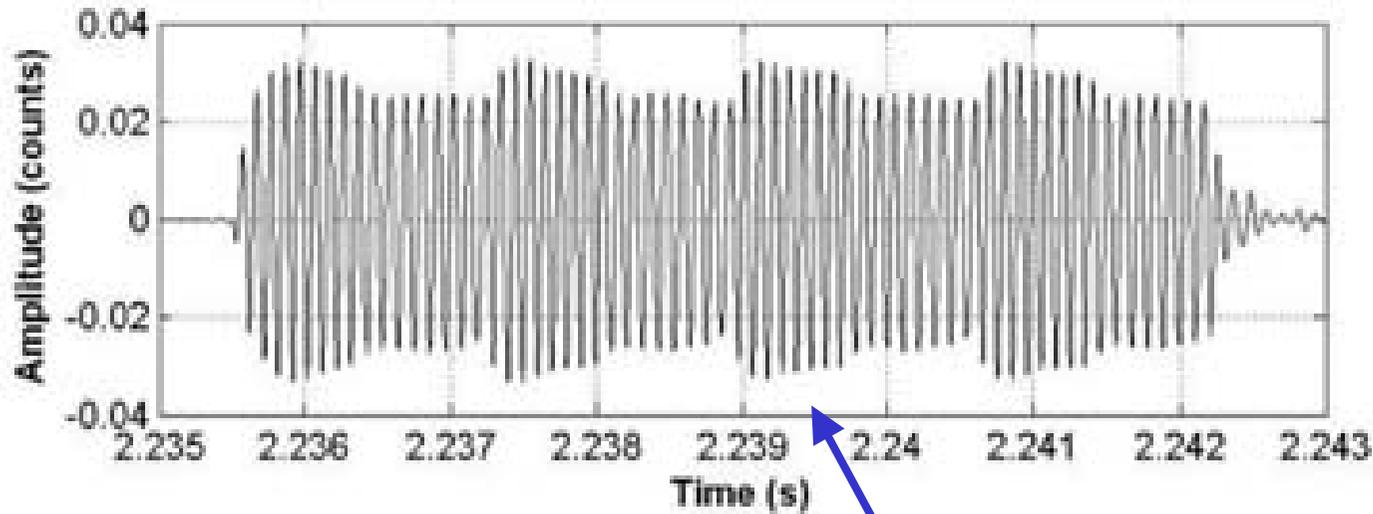
**Pulse No. 20
Peak level pulse**

**Complete
test sequence**

Pulse length
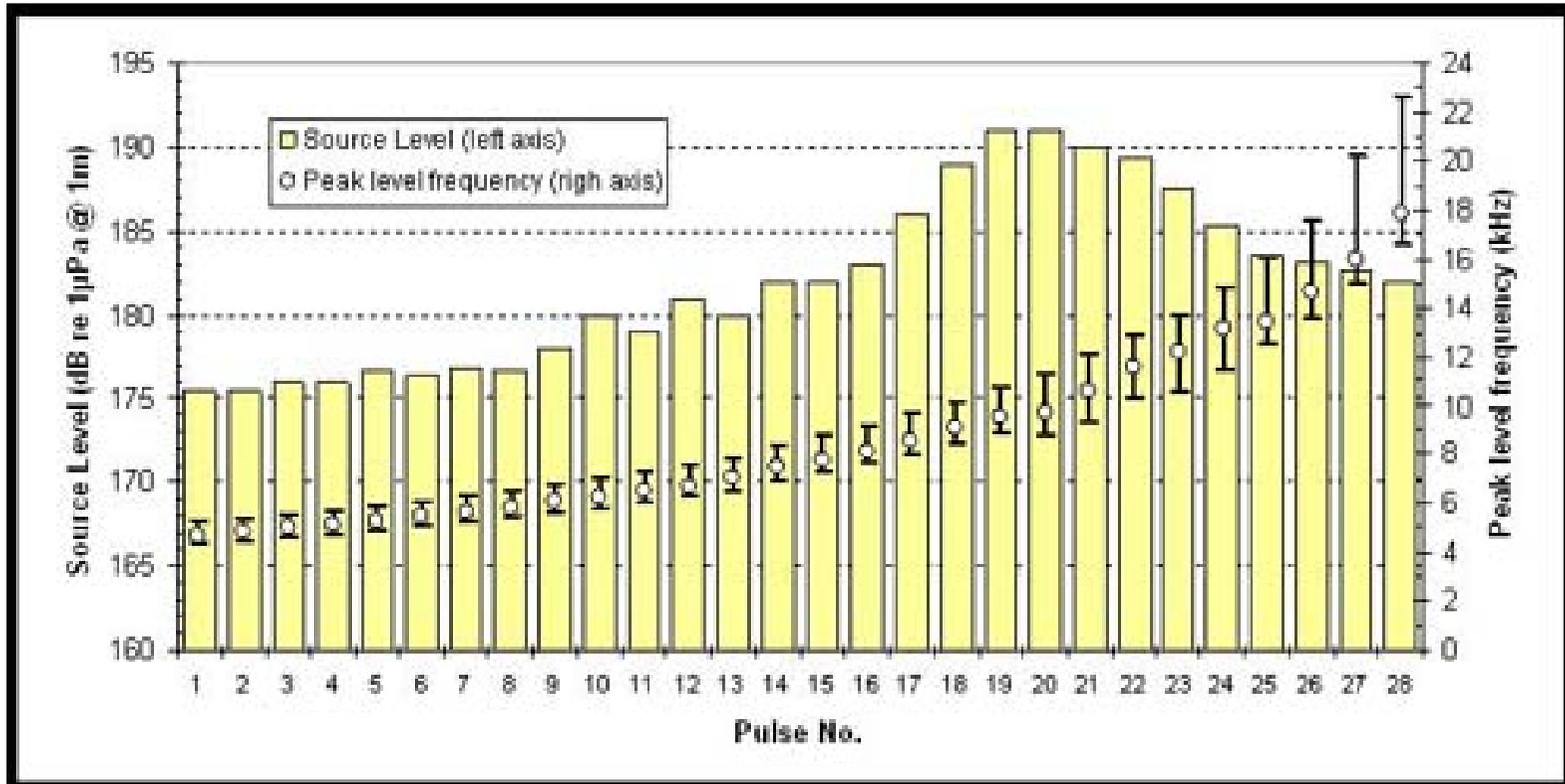(14 ms - 3.3ms)

Inter-pulse period
(33.2 ms - 48.5 ms)

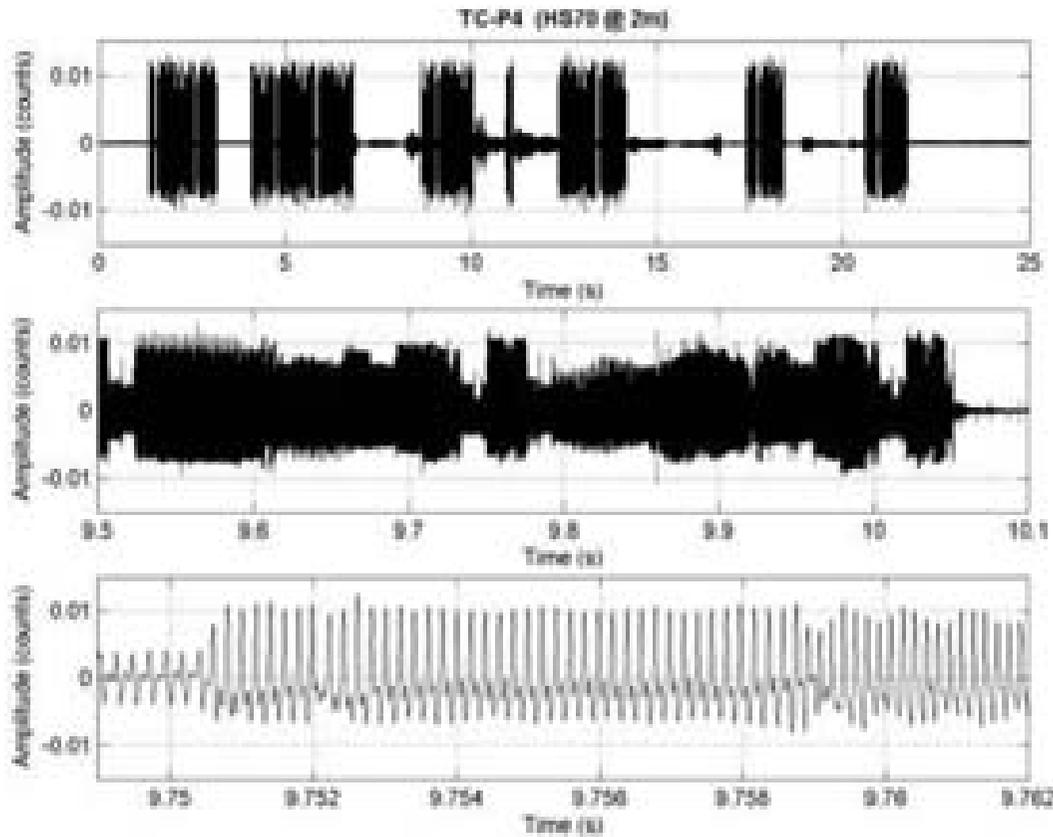# ACE AQUATEC (Silent Scrammer)

Test sequence spectral content

Maximum observed Source Level 191 (dB re 1uPa @ 1m) at 9.7 kHz

Applied Signal Processing Research Group
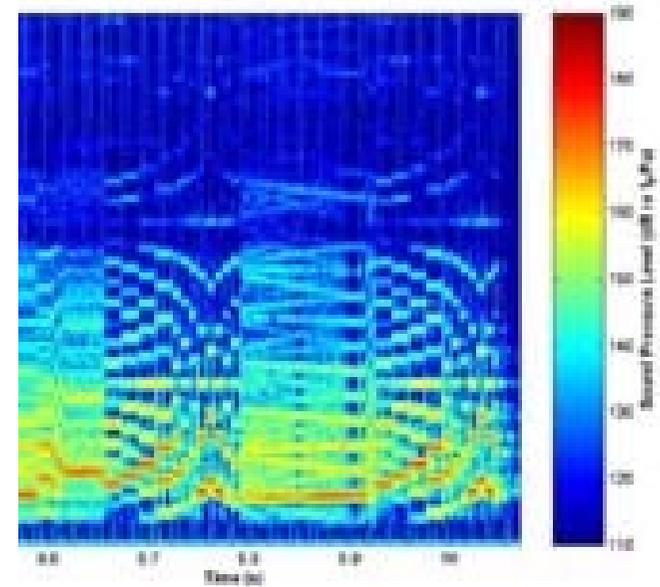
ACE AQUATEC (Silent Scrammer)

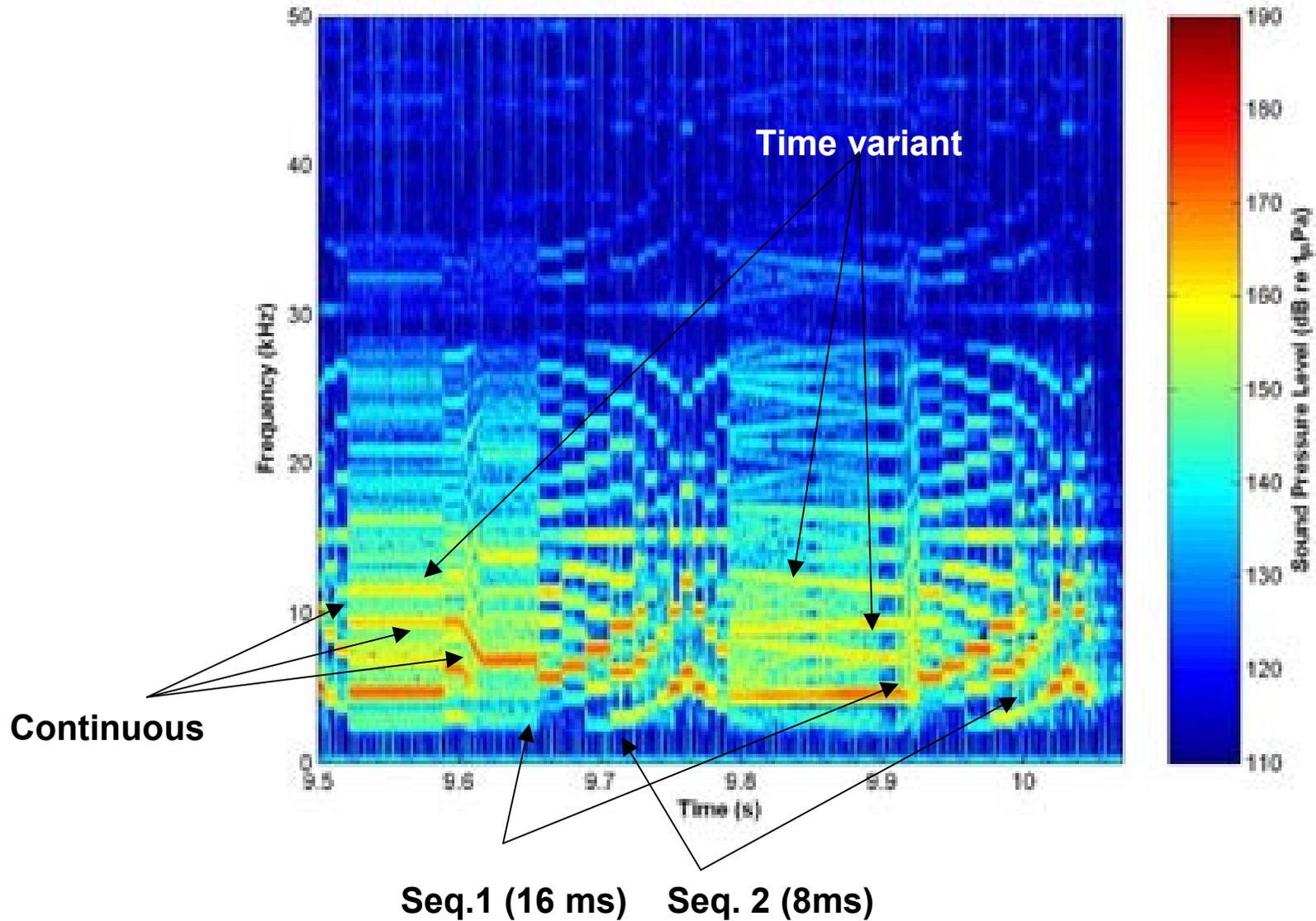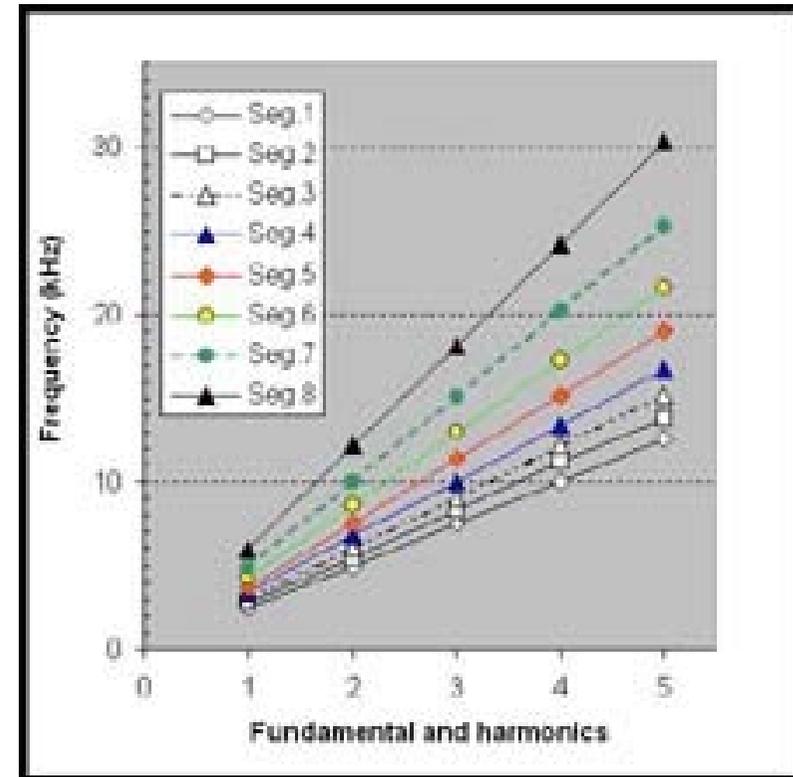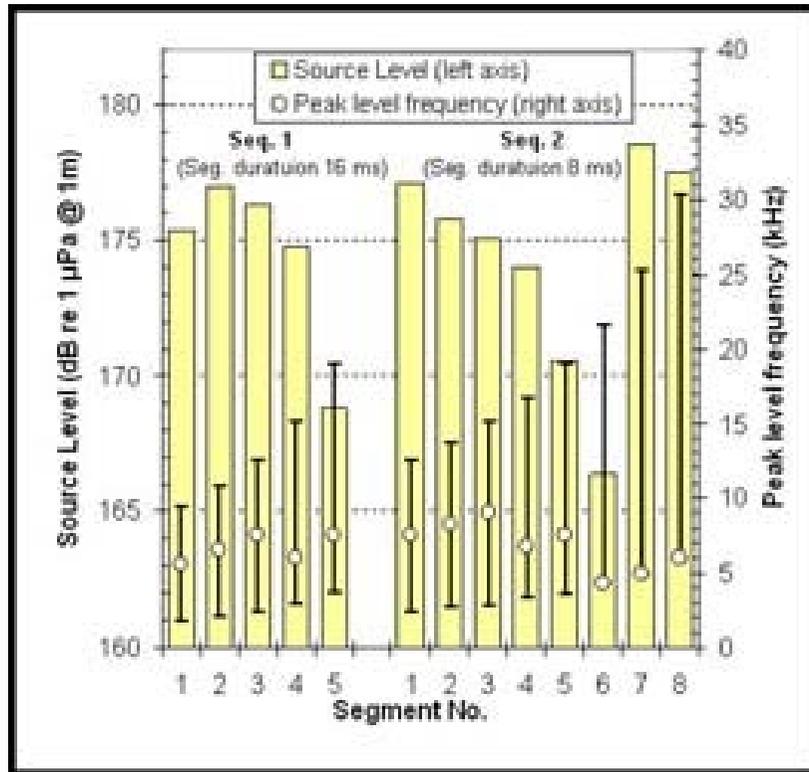Maximum observed Source Level 191 (dB re 1uPa @ 1m) at 9.7 kHz

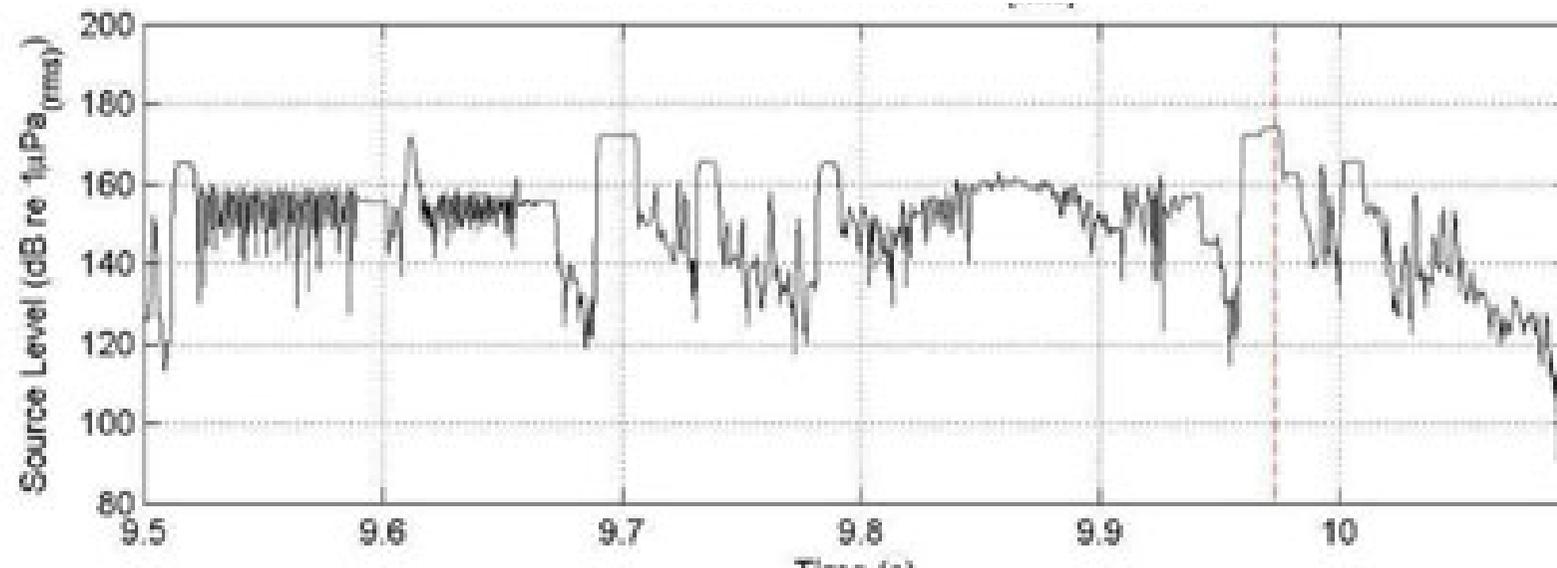# TERECOS (Type DSMS - 4)

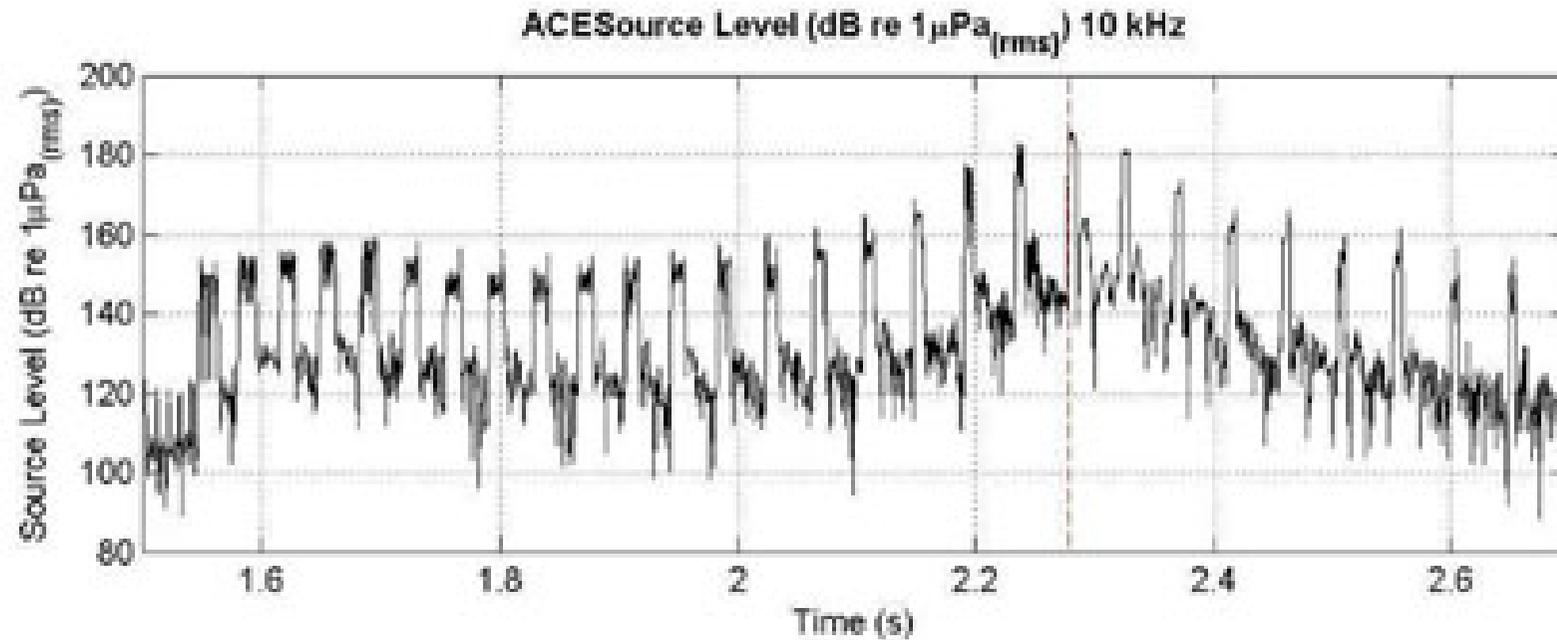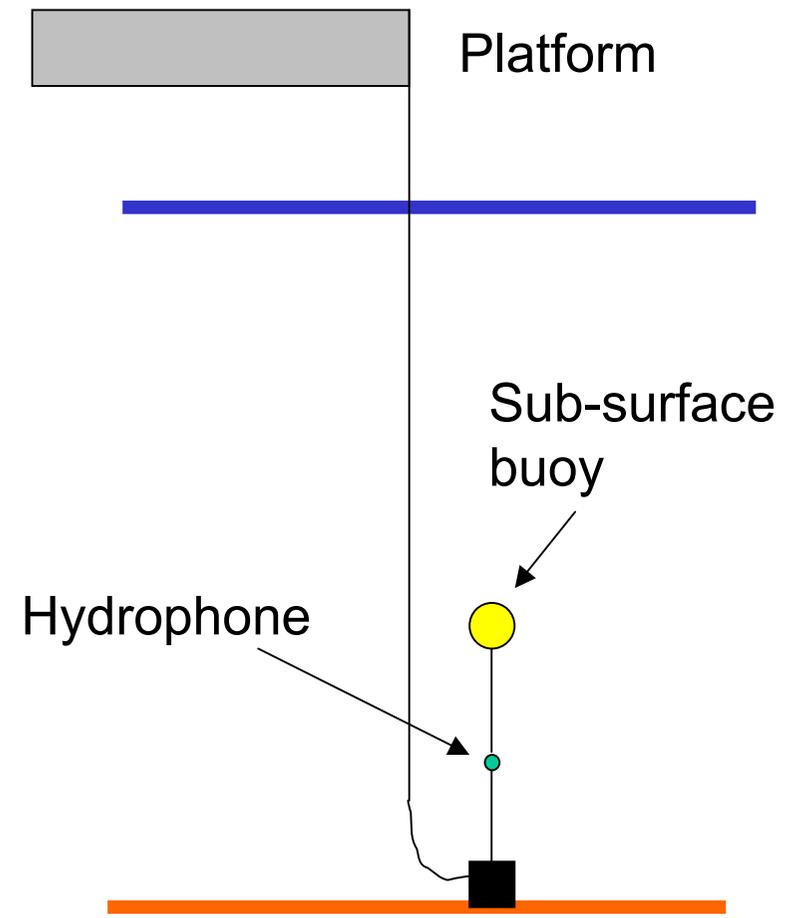Program 4 example
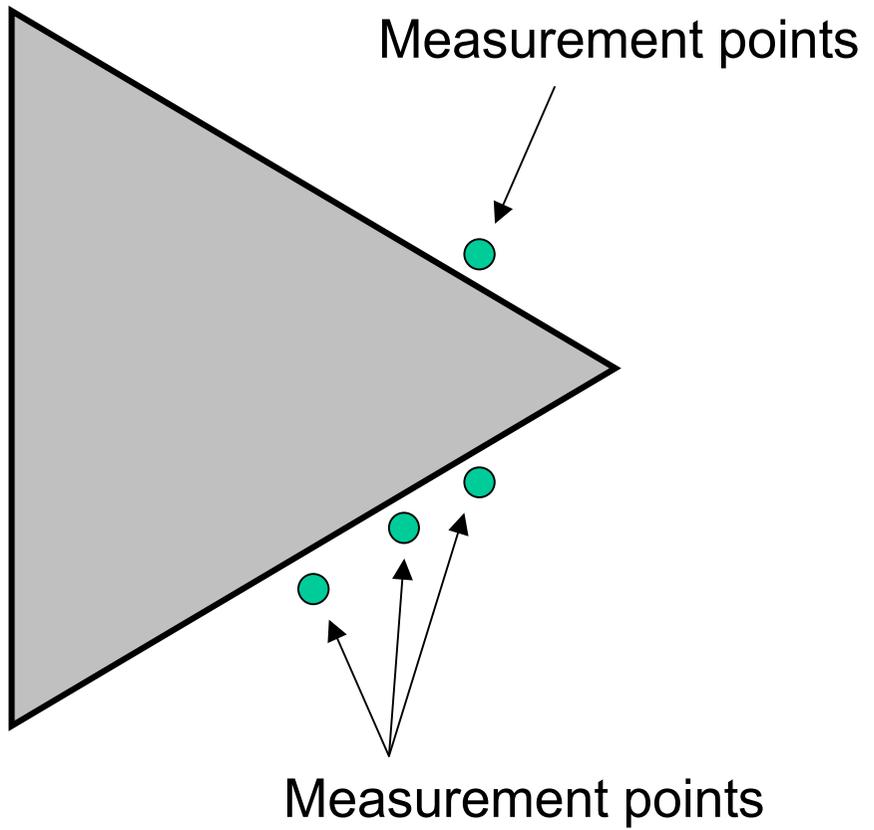
TERECOS (Type DSMS - 4)
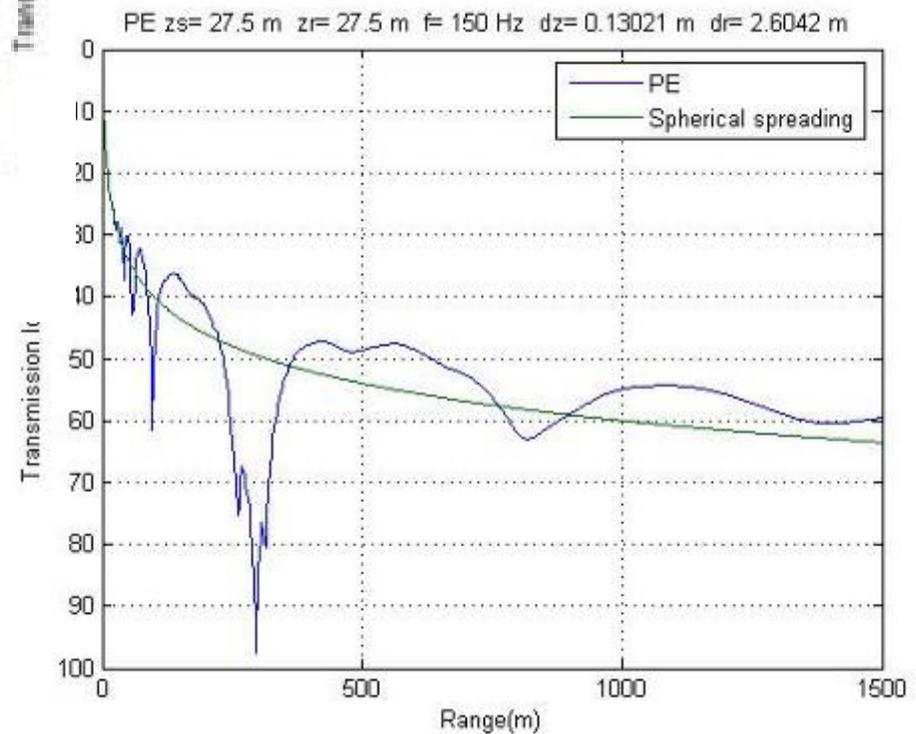
Program 4 example

TERECOS (Type DSMS - 4)
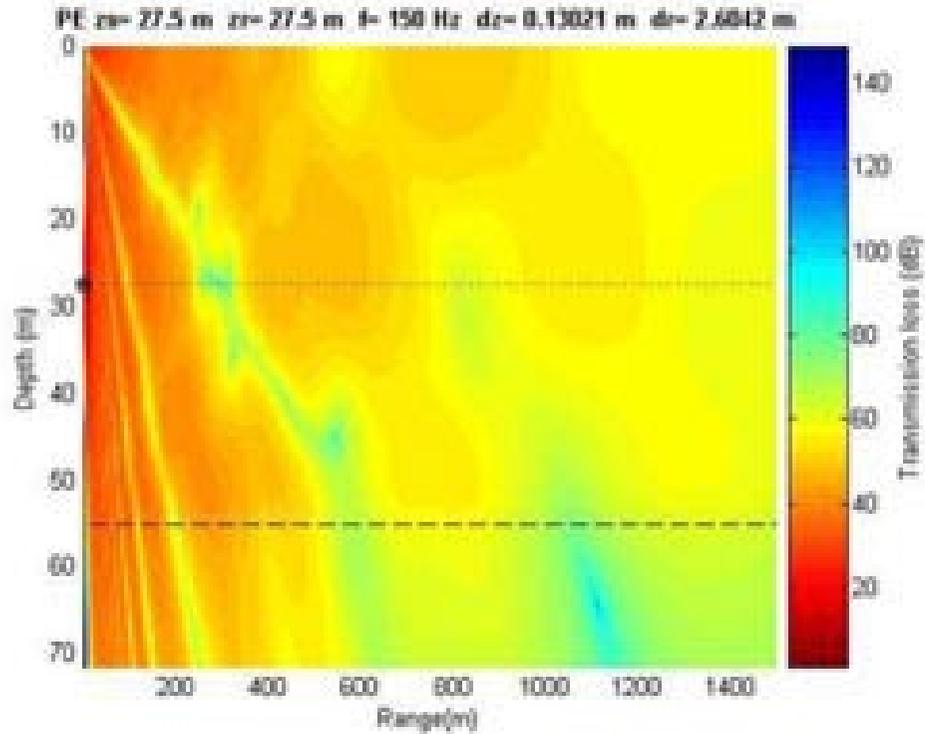
Sequence 1 & 2 maximum Source Level

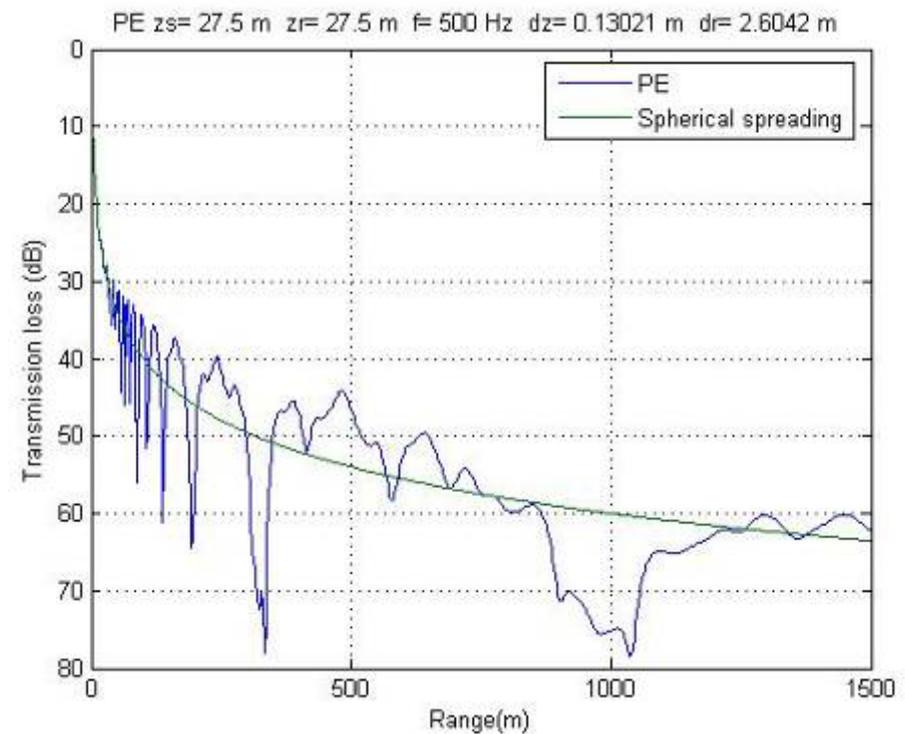# Peak level duty cycle

In-situ noise assessment
offshore drilling operation

Measurement points

Measurement points

Platform

Sub-surface buoy

Hydrophone

Propagation prediction (150 Hz)

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Propagation prediction (500 Hz)

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Propagation prediction (880 Hz)

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The Harbour Porpoise

Loughborough University

100 μ sec
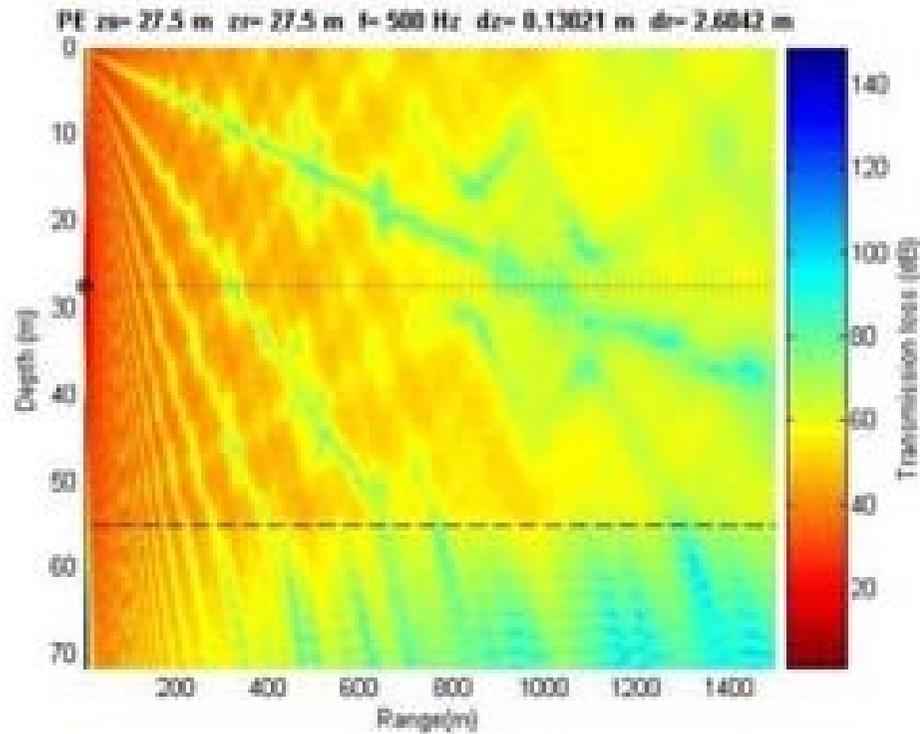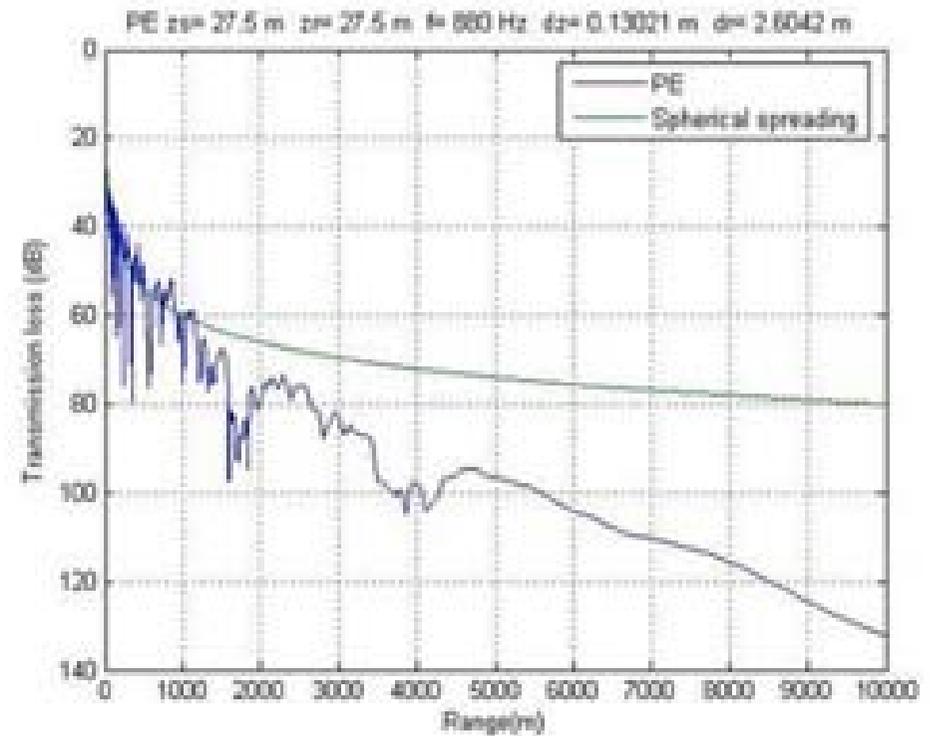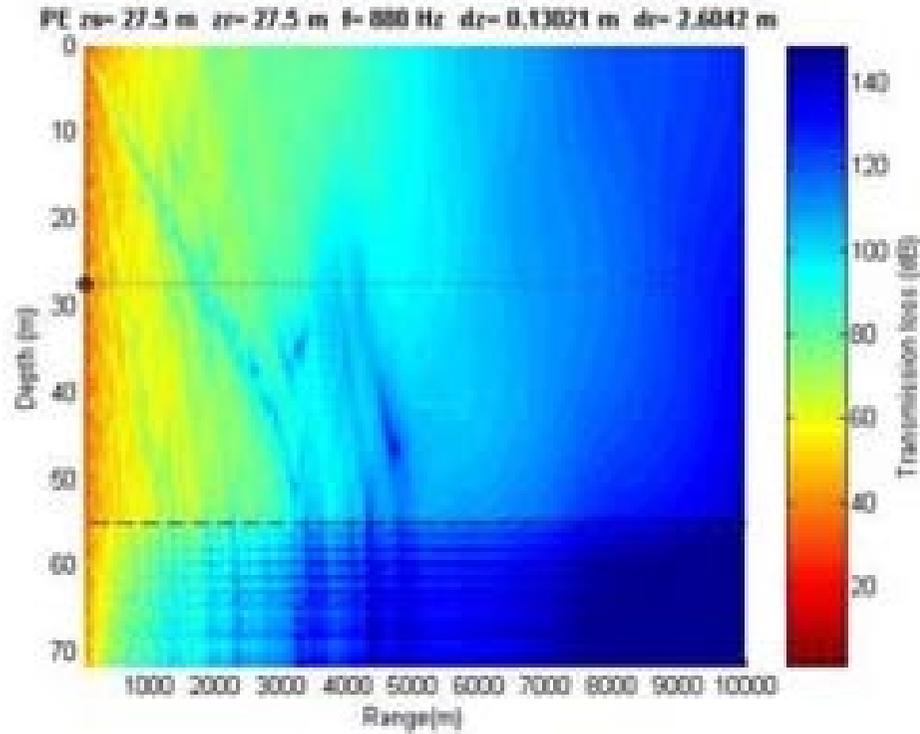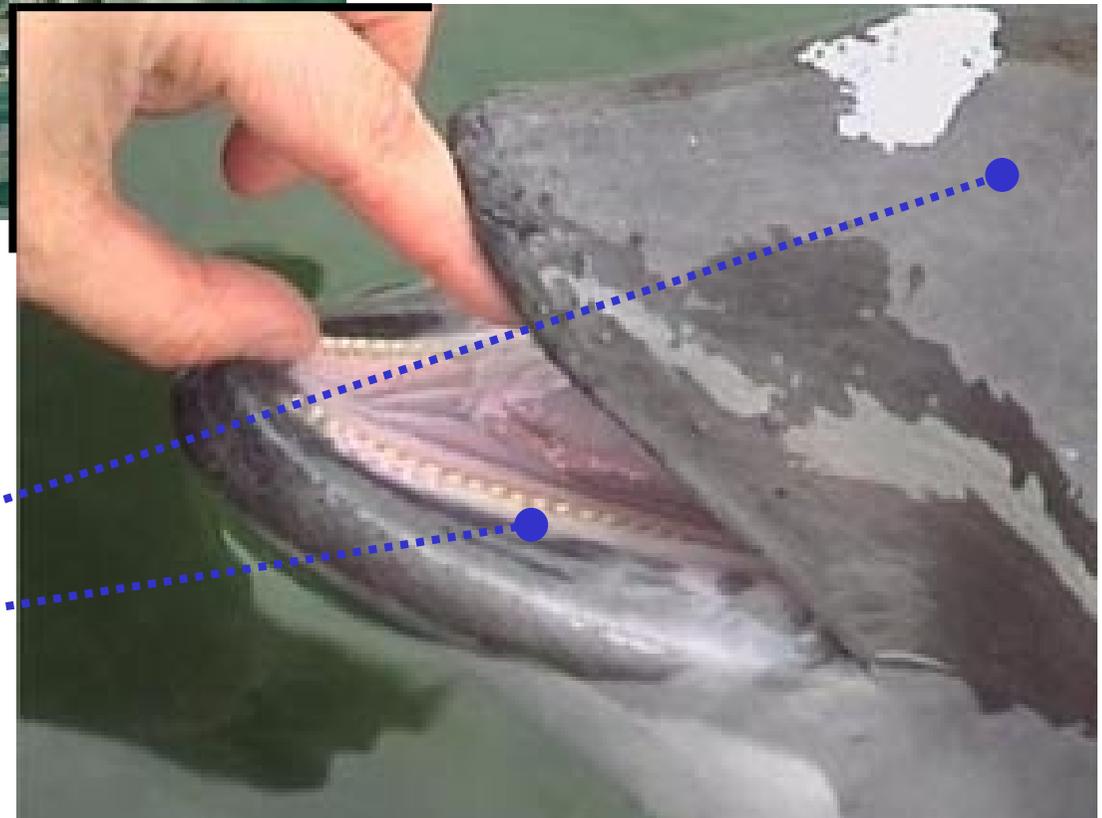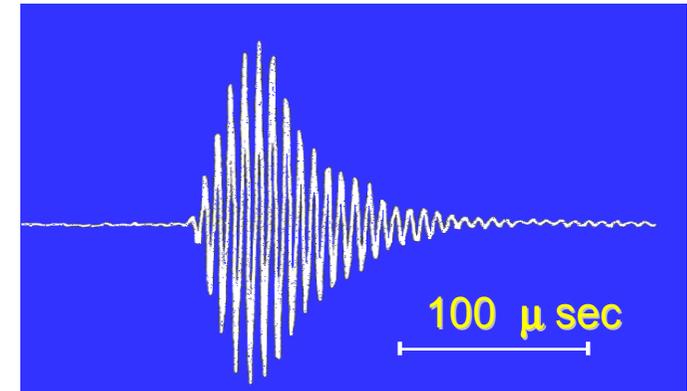
ACTIVE SONAR

Transmit path via 'Melon'

Echo reception via lower jaw

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Hearing response of harbour porpoise

Environmental impacts of off-shore windmills / drilling and marine construction

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ABR measurements

Porpoise start position at poolside

Underwater station with monitoring hydrophone

Baffle-boards

Transmitting transducers hydrophones

ABR measurements

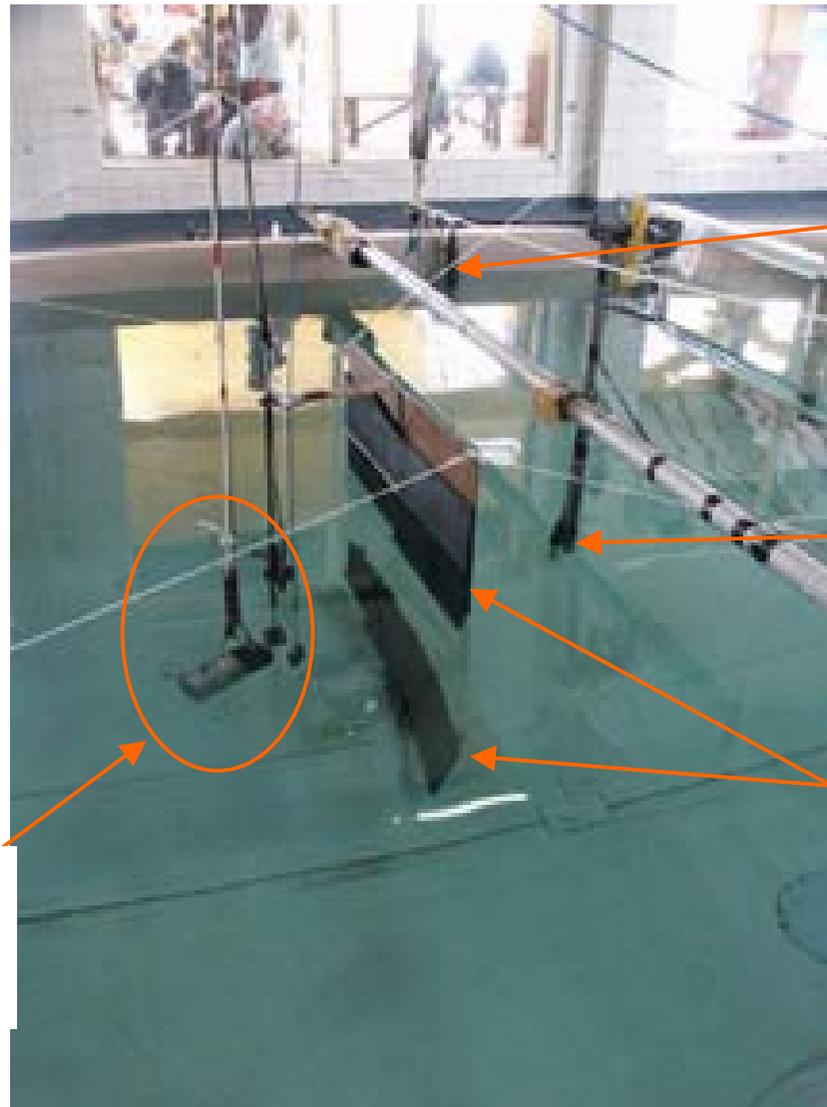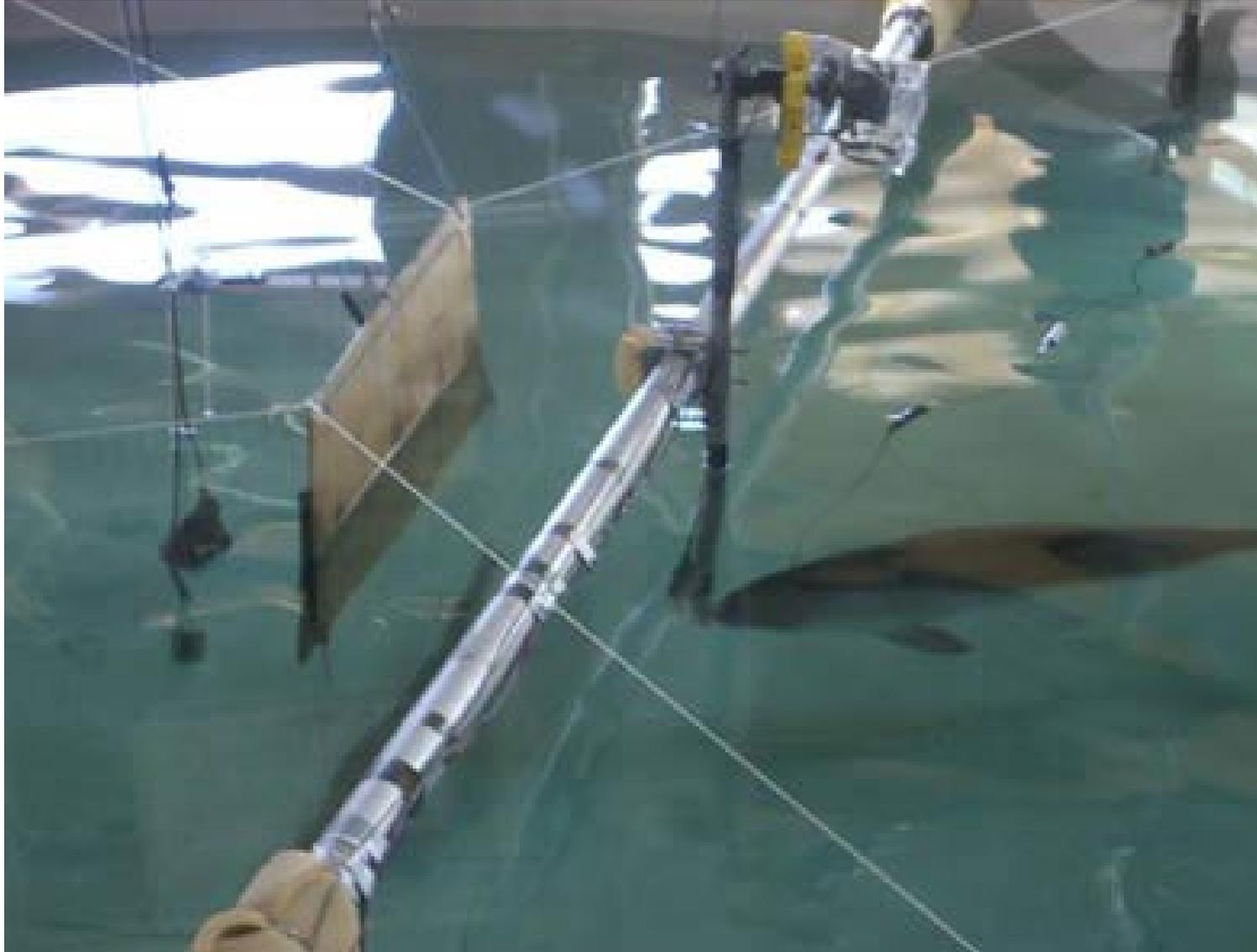# Future work; Needs ??

Studies of animal behaviour to acoustic environments

- **Marine mammal observers (Theodolite tracking, photo ID, etc.)**
- **Passive acoustic noise assessment**
- **Passive / active acoustic tracking**
- **Optical / RF / satellite / IR systems**
- **Physiological and behavioural responses (audiogram / playback etc.)**

Risk Mitigation for off shore operations

- **Passive detection and tracking**
  - **Improved arrays (bandwidth / noise/ localization)**
  - **Detection / classification algorithms**
  - **Other techniques (IR / Optical)**
  - **Marine mammal observers**
- **Long term noise measurement (automated systems)**
- **Noise source measurement and classification**
  - **Shipping**
  - **Off shore operations**
  - **Sonars**
  - **Acoustic systems**