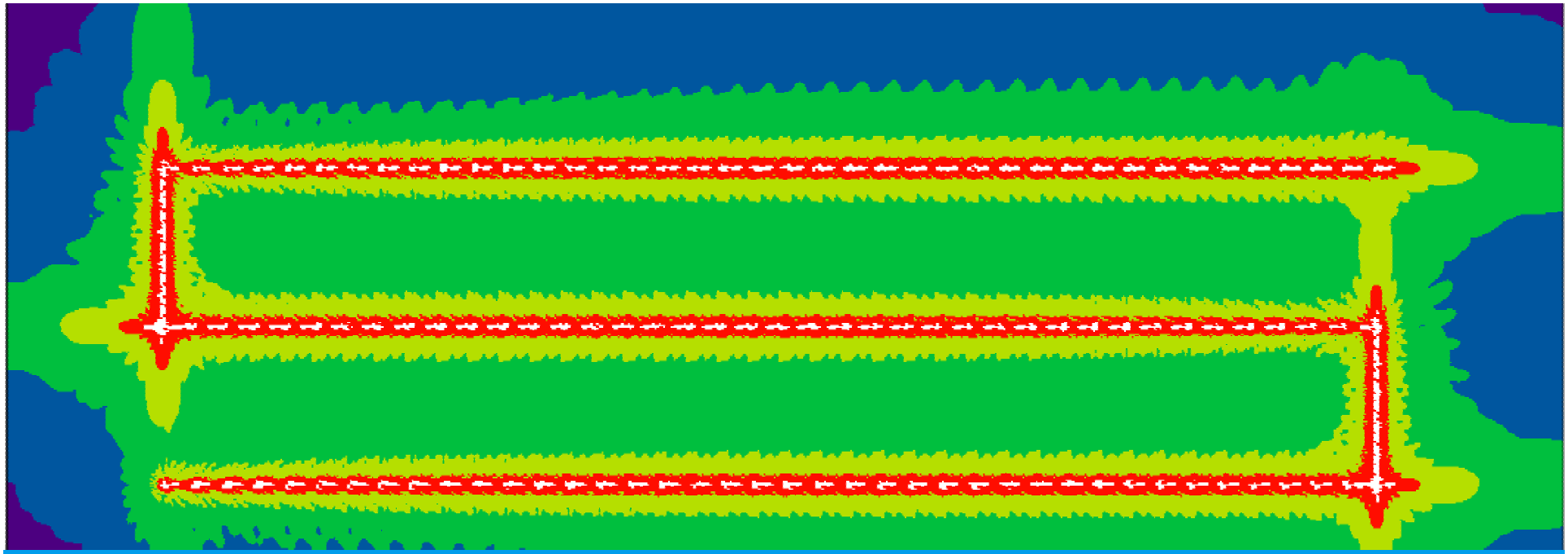

Noise – to measure or model?

Stephen Jones, QinetiQ Ltd

Underwater Noise Measurement Seminar

National Physical Laboratory, Teddington, 13 October 2005

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Contents

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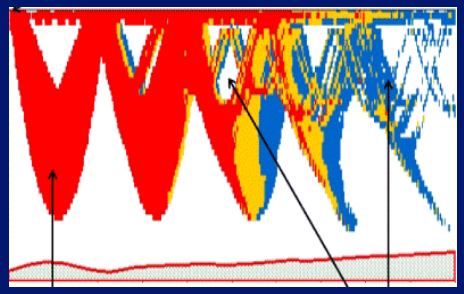
Source-Pathway-Receptor Modelling

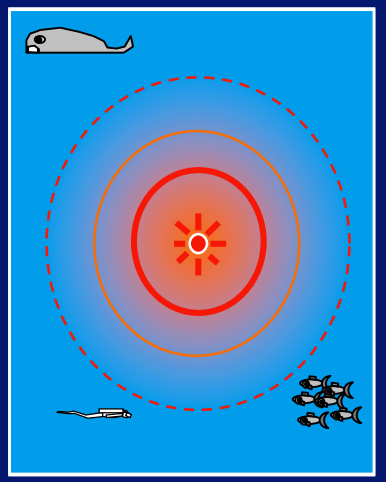
Source → **Pathway** → **Receptor** → **Footprint**

Noise level, duration, spectral content, variability, directionality

Properties of ocean, surface and seabed (models and databases)



Sensitivity of humans, whales, fish, turtles etc & response to sound



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Human noise exposure

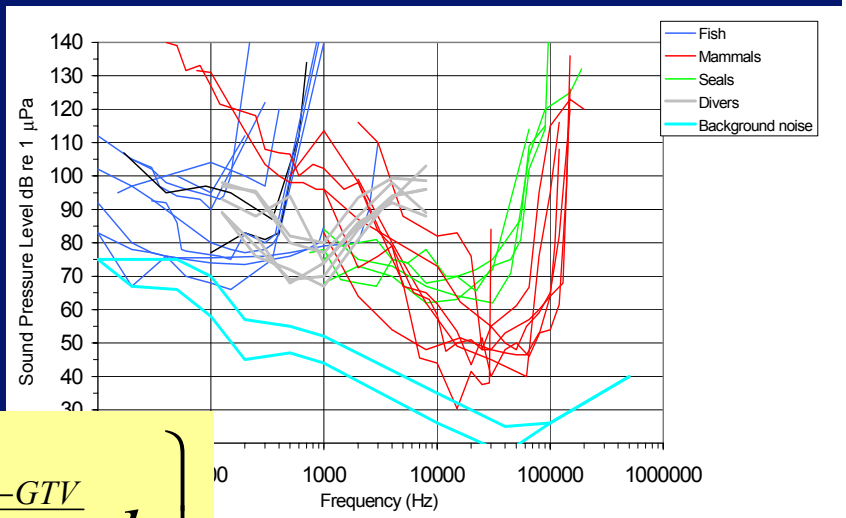
- Human in-air noise exposure
- Concept of sound dosage (duration of exposure)
- Daily noise exposure

$$L_{EP,d} = 10\log_{10}\left\{\frac{1}{T_0}\int_0^{T_e}\left[\frac{p_A(t)}{p_0}\right]^2 dt\right\}$$

- Action limits to reduce risk of hearing damage

Marine receptor noise exposure

- Application of human dosage model to marine fauna
- In-water noise exposure depends on:
  - Radiated noise signature
  - Sound propagation
  - Hearing threshold
  - Duration of exposure



$$L_{EP,d} = 10\log_{10}\left\{\frac{1}{T_0}\int_0^{24h} 10^{\frac{SL-PL-GTV}{10}}\,dt\right\}$$

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Receptor damage risk criteria

- Acoustic Damage Risk Criteria for marine fauna
- Physiological impacts and behavioural effects
- Minimise cumulative noise exposure to reduce risk of
  - Permanent Threshold Shift (PTS) in hearing
  - Temporary Threshold Shift (TTS) in hearing
  - Adverse behavioural reaction
  - Masking
- Stealth increases risk of collision

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Requirement

- Determine in-water noise exposure
  - Radiated noise signature
  - Source-receptor geometry, propagation
- Ambient noise baseline
- Predictions for Environmental Impact Assessment usually required in advance

Noise exposure scenarios

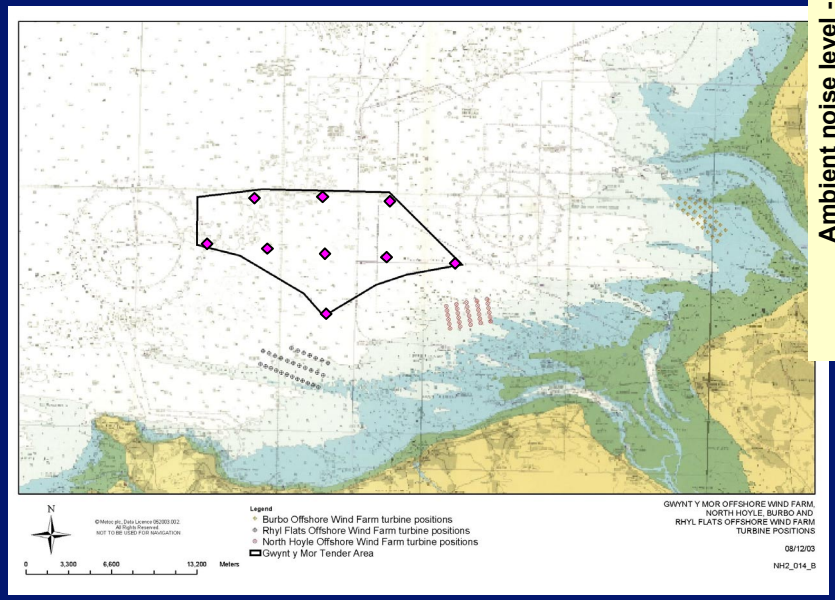
- Noise source – fixed or mobile
- Receptors – habitats or species, stationary or moving
- Determine cumulative noise exposure
  - Measure radiated noise signature of source
  - Model propagated sound field
  - Measurements at critical points
- Measure and/or model ambient noise

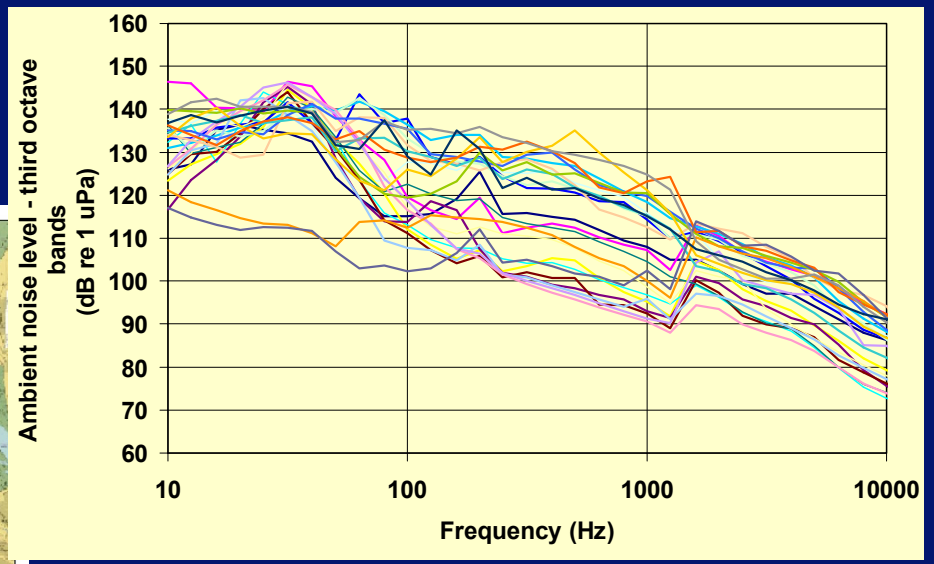
Define existing noise environment

- Required as baseline for EIA
  - Existing environment
  - Ideally prior to installation/operation
  - Used to assess impact of proposed action
- Baseline noise measurement
  - In vicinity of proposed action
- Determine wide area ambient noise spectrum
  - Identify dominant noise contributions
  - Model ambient noise

Baseline noise measurement

- Ambient noise recording at site of proposed wind-farm development http://www.npower-renewables.com/gwyntymor/index.asp
- Shipping, industrial noise
- Wind-sea, surf noise





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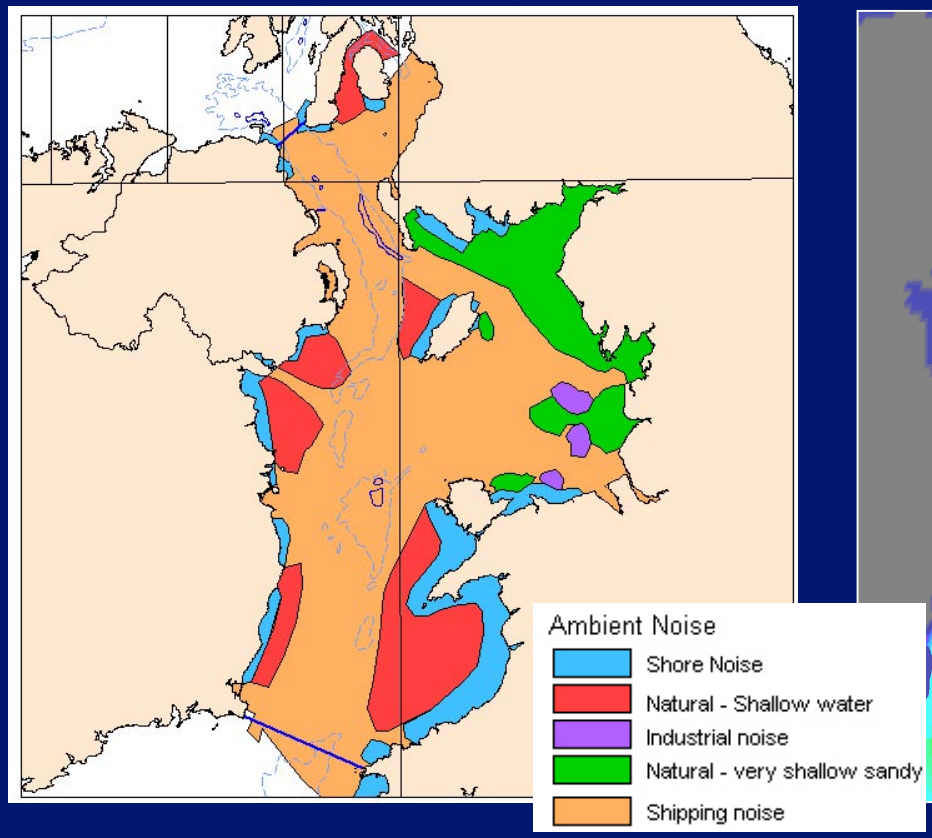
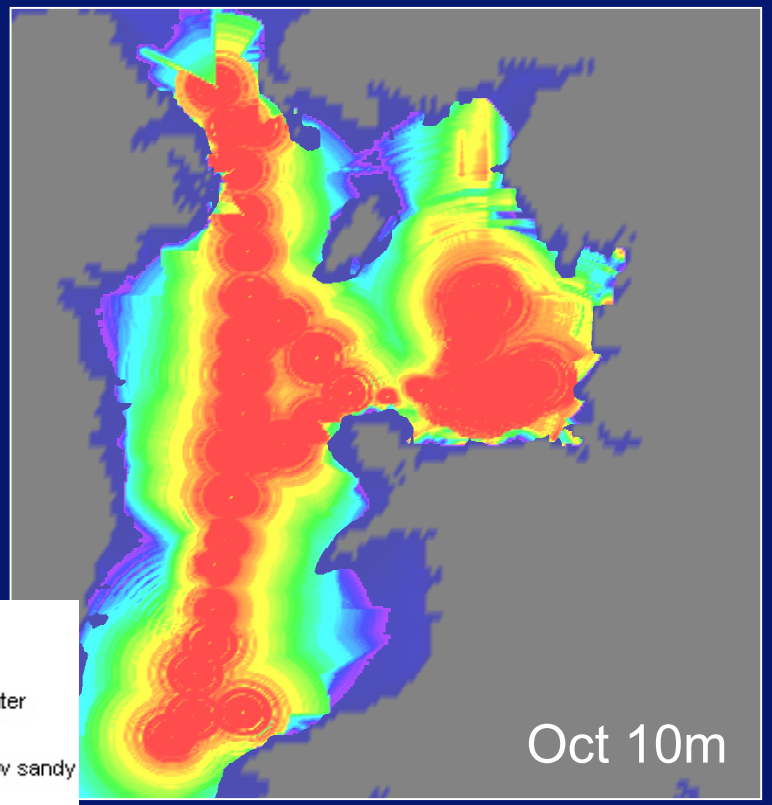
Determine wide area noise spectrum

- Dominant noise signatures



- Modelled noise propagation



DTI SEA 6 Technical Report – Underwater Ambient Noise
http://www.offshore-sea.org.uk/consultations/SEA_6/index.php

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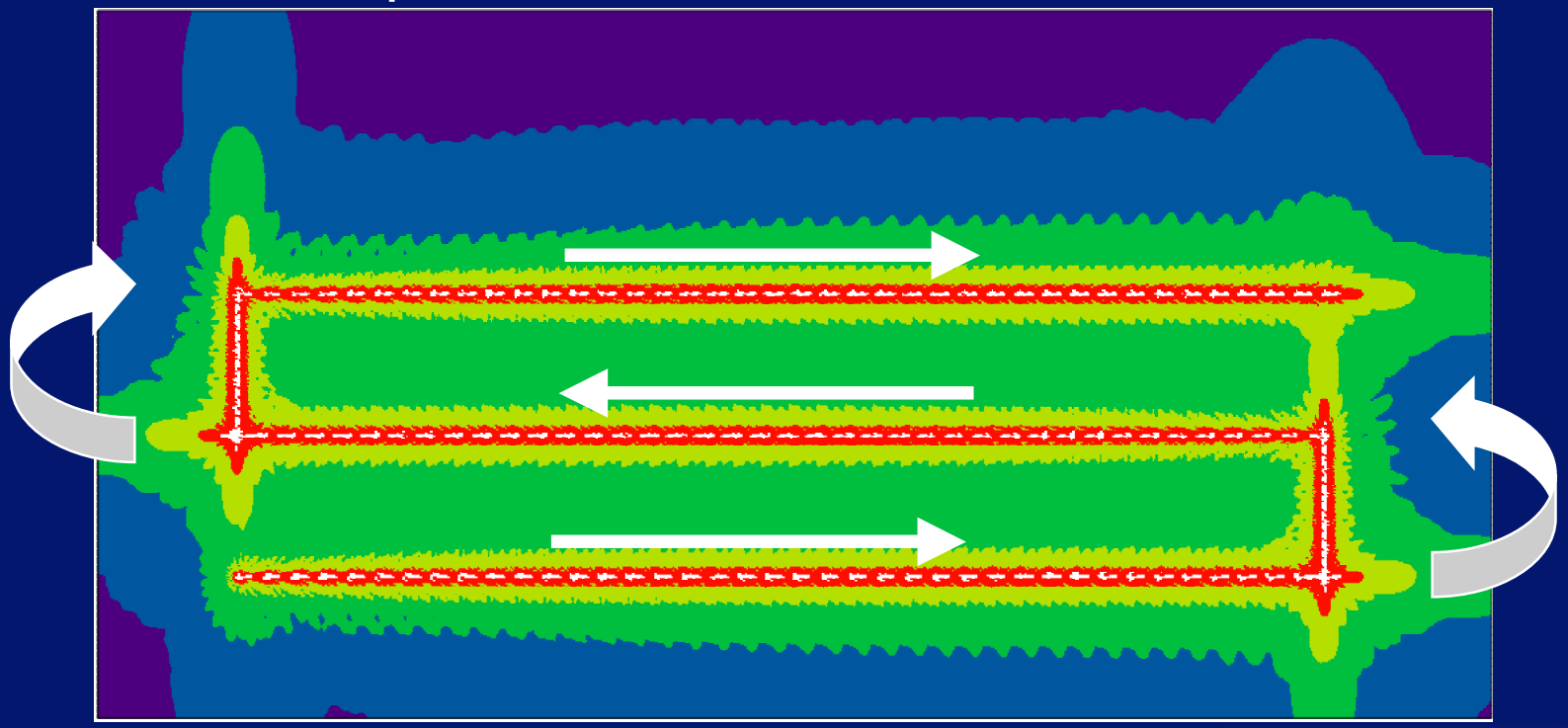
Quantify cumulative noise exposure

- Required to assess potential impact of AUV operation
  - Prior to operation, but …
  - Vehicle track may be unpredictable
- Measure radiated noise signature
- Model cumulative noise exposure
  - *Modus Operandi* of vehicle
  - Multiple vehicles
  - Statistics of receptor movement

Quantify cumulative noise exposure

- Effect of navigation/avoidance sonar
- Static receptor



Summarising …

- For EIA we need to quantify noise exposure
  - Impact predictions required in advance for process noise
  - Wide area ambient soundscape
- Measurements are required
  - Existing environment – baseline measurements
  - Radiated noise signatures
- Balance of modelling v measurement?
  - Depends on scenario

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