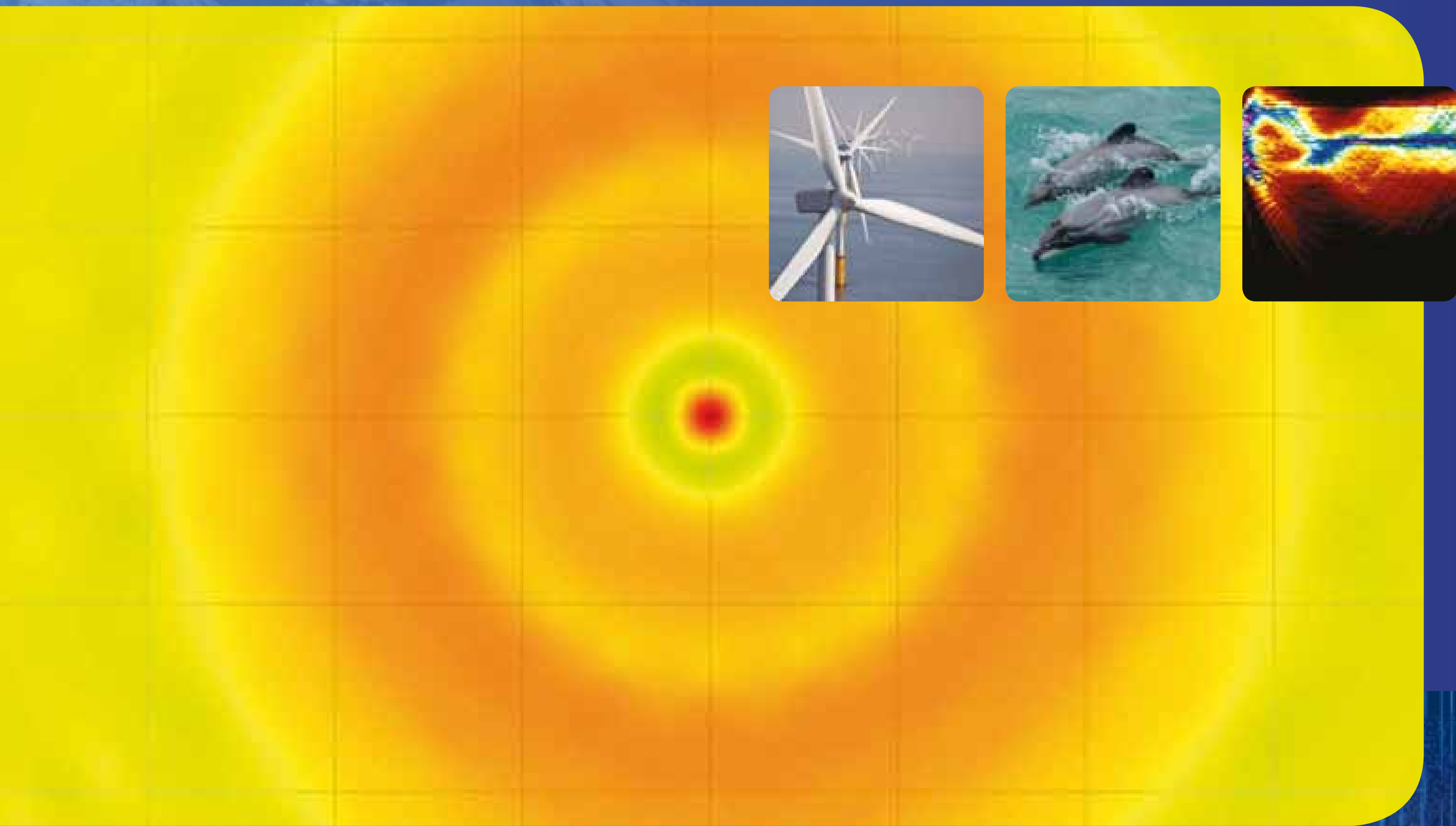
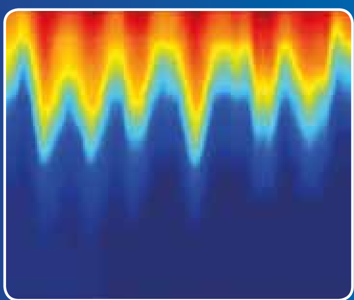
Seiche
Marine Acoustic Solutions

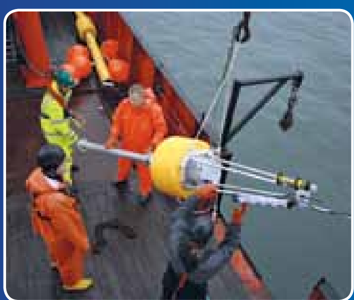


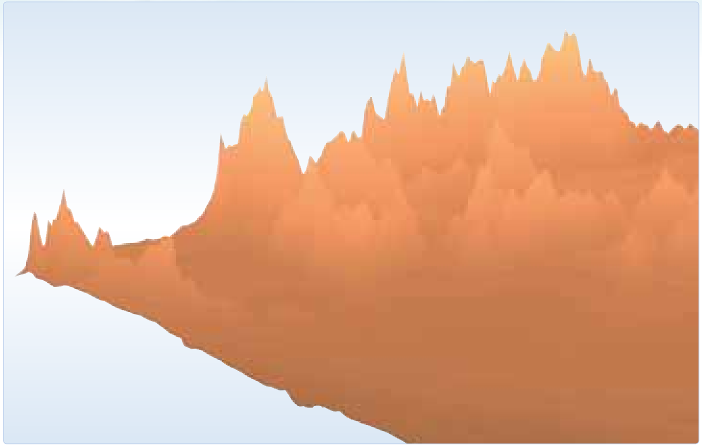
UNDERWATER SOUND MODELLING

MODELLING SERVICES OVERVIEW

Acoustic propagation modelling shows the soundscape of the underwater environment. Models can predict the sound field generated by a source, or a series of moving sources, using computational algorithms to incorporate the interaction between complex environmental variables. Increasing regulatory requirements have prompted the need for high quality underwater sound modelling for industrial projects.







OUR APPROACH

Seiche has collaborated with Plymouth University, Bath University and ZCAT Science to combine in-depth knowledge of underwater sound propagation, computational algorithms and practical knowledge of the marine environment. The Seiche team specialises in modelling propagation of a seismic source over short-term cycles and has particular experience working in Arctic waters, including dynamic river environments.

SCIENCE & ENGINEERING WITH PLYMOUTH UNIVERSITY

From Plymouth University: Dr Shapiro has extensive experience in modelling seasonal and climatic effects, primarily in warmer waters. Dr Feng Chen specialises in modelling the effects on marine mammals of industrial noise, such as ship noise.

ZCATScience

Dr Paul Lepper of ZCAT Science has a deep understanding of a wide range of models and a particular interest in pile driving noise.

UNIVERSITY OF BATH

Bath University acoustician Dr Philippe Blondel is an expert in acoustic propagation and mapping in complex marine environments, with field experience all over the world including deep oceans and very shallow lagoons.

MODELLING OPTIONS

The team provides a comprehensive range of services in underwater acoustic modelling:

PREDICTIVE SOUND SOURCE MODELLING

Predictive modelling of the intensity of a sound source and how it will propagate through a specific environment aids assessment of the potential impact on marine life (for instance, to inform an EIA).

UNDERWATER PROPAGATION MODELLING

An extensive range of dynamic variables influence how sound is absorbed, reflected and refracted within the water column and seabed layers. These include: bathymetry, sediment stratigraphy, seasonality, conductivity, temperature, salinity, sea depth, water flow. Furthermore, to accurately image the soundscape, understanding of temporal and spatial variation of these factors is key. For the requirements of the project, we carefully consider:

- Short-term variation in local environments
- Long-term variation on regional scale

SOUND SOURCE VERIFICATION (SSV)

SSV is used to verify predictive modelling. Seiche's range of field measurement techniques (including drift buoy, sub-sea recorder and digital hydrophone) work in tandem with further acoustic modelling to verify and refine expectations. Acoustic metrics include: sound pressure levels (SPL peak, peak-to-peak, rms) and sound exposure levels (SEL and cumulative SEL).

MITIGATION ZONE DETERMINATION (MZD)

SSV analysis may then factor in expected sensitivity levels of local marine life (typically based on parameters set out in Southall et al, 2007). Mitigation zones of appropriate size and shape are then determined based on the local conditions and environmental regulations in place.

Rather than rely on one single model, we focus on the specifics of a given project and take a bespoke approach that utilises a range of methods. Seiche uses open access, benchmarked sound propagation software based on well-established theories and algorithms developed for predicting underwater sound propagation.

Ray-tracing, normal modes, parabolic equation and fast-field (wavenumber integration) are among the most recurrent underwater sound propagation theories. Each theory has its particularities which make it more suitable for a specific scenario (which means higher efficiency and accuracy).

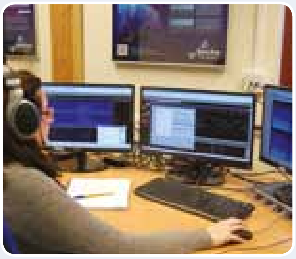
The theory should be selected according to the frequency range to cover, the depth of the water column (shallow vs deep) and requirement of a model whose properties vary with distance (range dependent vs range independent).

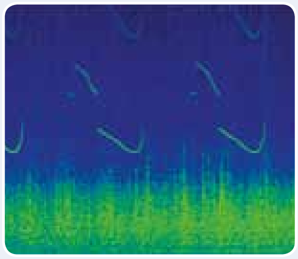
Examples of models:

AcTUP (Acoustic Toolbox User interface and Post-processor) is based on consistent and thoroughly developed theories for prediction of sound behaviour in water.

- Ray-tracing: BOUNCE, BELLHOP
- Normal Modes: KRAKEN, KRAKENC
- Parabolic Equation: RAM, RAMS
- Fast-Field or Wavenumber Integration: SCOOTER

Seiche
Marine Acoustic Solutions





TRAINING

Seiche provides highly regarded training for individuals and companies in the UK and around the globe. The courses cover all aspects of Underwater Acoustics and include:

- Underwater Acoustic Modelling
- Introduction to Underwater Acoustics
- Underwater Acoustics in the Marine Environment
- Underwater Acoustics and Sonar Systems

Institute of Marine Engineering, Science & Technology
IMarEST

University of BATH

ZCATScience

MITIGATION

Regulatory requirements for effective noise mitigation have increased – particularly for the protection of whales and dolphins. It has become standard practice across several industry sectors for Passive Acoustic Monitoring (PAM) to detect vocalising marine mammals – in real-time – to ensure none are within close vicinity of an active sound source.

MEASUREMENT

In partnership with Bath University and ZCAT Science, Seiche hold expertise in the equipment, operation and analysis involved in underwater sound measurement. Regulatory requirements have increased and the assessment of ambient and anthropogenic sound levels must now meet exacting standards. Our collaborative team can complete measurement tasks through the entire process to the highest quality.

www.seiche.com

in

UK OFFICE
Bradworthy Ind Estate
Langdon Road, Bradworthy
Holsworthy, Devon EX22 7SF
T: +44 (0)1409 404050
E: info@seiche.com

US OFFICE
10355 Centrepark Drive
Suite #240, Houston
Texas TX77043
T: +1 832 690 3700
E: b.padovani@seiche.com

SOUTH AFRICA OFFICE
Cape Town
South Africa
T: +27 834 604 4260
E: j.burgers@seiche.com