

# Underwater Acoustics: Webinar Series for the International Regulatory Community

**Webinar Outline: Science of Sound Webinar**  
**Friday, November 13, 2015 at 12:00pm ET**

***Sound Movement and Sound Measurement (Dr. Kathleen Vigness-Raposa, Marine Acoustics, Inc.)***

## **Presentation Outline:**

- *Sound propagation.* At the most basic level, sound is energy transmitted from a source that propagates or moves through a medium, in this case, the ocean's water column. As it propagates, the energy spreads over a greater circumference, getting weaker. It first propagates as a sphere, but when it reaches the sea surface or the sea floor, it changes to cylindrical spreading.
- *Sound absorption.* Absorption of acoustic energy by seawater molecules converts the acoustic energy to heat, decreasing the sound's amplitude more than with sound spreading alone.
- *Sound reflection, refraction, and scattering.* Rather than traveling in a straight line, sound can reflect, refract, and scatter as it moves away from a sound source. These processes have implications for whether sound might affect a marine animal.
- *Propagation of sound with large pressures.* When sound pressures are large (e.g., from an airgun or an explosion), sound behaves differently, with harmonic distortion, shock waves, and cavitation potentially occurring.
- *Characteristics of sound.* A sound can be a tone at a single frequency or a combination of energy at many frequencies. It is important to understand the frequencies of which a sound is composed to determine its potential to affect various marine animals. Just as importantly, the phase of a signal, or really the difference in phase between two signals, determines how they will interact with each other, either adding or canceling each other out.
- *Sound measurement.* Sound is measured in units called decibels, which are relative units, just like degrees of temperature. Just as temperature is described in degrees Celsius or degrees Fahrenheit, the scale on which decibels are being measured (re 1 uPa in water or re 20 uPa in air) must be stated.
  - There are several ways in which the amplitude of a sound wave (its signal level) can be measured: root-mean-square (RMS), 0-peak or peak-peak.
  - To describe the energy at each frequency, the unit dB re 1 uPa<sup>2</sup>/Hz is used. Because the unit is per Hertz, it is the amount of energy in 1-Hertz bins across the range of frequencies of the sound. This unit is commonly used for ambient noise and noise budget calculations (which will be described in the subsequent presentation).

## **Additional information on the DOSITS website:**

Science of Sound > How do you characterize sounds?

(<http://www.dosits.org/science/sound/characterizesound/>)

Science of Sound > What happens when sound pressures are large?

(<http://www.dosits.org/science/sound/largesoundpressures/>)

Science of Sound > Why does sound get weaker as it travels?

(<http://www.dosits.org/science/soundmovement/soundweaker/>)

Sound Spreading (<http://www.dosits.org/science/soundmovement/soundweaker/spreading/>)

Advanced Topic > Cylindrical vs Spherical Spreading

(<http://www.dosits.org/science/advancedtopics/spreading/>)

Sound Absorption

(<http://www.dosits.org/science/soundmovement/soundweaker/absorption/>)

Science of Sound > How does sound move?

(<http://www.dosits.org/science/soundmovement/soundmove/>)

Reflection (<http://www.dosits.org/science/soundmovement/soundmove/reflection/>)

Refraction (<http://www.dosits.org/science/soundmovement/soundmove/refraction/>)

Scattering (<http://www.dosits.org/science/soundmovement/soundmove/scattering/>)

Advanced Topic > How does sound move? Wave Propagation and Huygens' Principle

(<http://www.dosits.org/science/advancedtopics/propagation/>)

Science of Sound > How does sound travel long distances? The SOFAR Channel

(<http://www.dosits.org/science/soundmovement/sofar/>)

History of the SOFAR Channel

(<http://www.dosits.org/science/soundmovement/sofar/sofarhistory/>)

Sound Speed Minimum

(<http://www.dosits.org/science/soundmovement/sofar/speedminimum/>)

Sound Travel in the SOFAR Channel

(<http://www.dosits.org/science/soundmovement/sofar/sofartravel/>)

Sound Channel Variability (<http://www.dosits.org/science/soundmovement/sofar/variability/>)

Science of Sound > How is sound measured?

(<http://www.dosits.org/science/soundmeasurement/measure/>)

Advanced Topic > Introduction to Decibels

(<http://www.dosits.org/science/advancedtopics/decibel/>)

Advanced Topic > Introduction to Signal Levels

(<http://www.dosits.org/science/advancedtopics/signallevels/>)

## ***Ocean Noise Variability and Noise Budgets (Dr. James Miller, University of Rhode Island)***

### **Presentation Outline:**

- Proper accounting of the ocean noise budget must include the background ambient noise component and the contributions from identifiable sources (National Research Council, 2003).
- Individual sources have acoustic signatures that can be used to identify their presence in recorded data.
- The most fundamental understanding of the contributions of sources to background ambient noise is captured in what is called the Wenz curves (Wenz, 1961). Wenz bounded the range of prevailing noise levels, and identified the frequency and energy level in 1-Hz bins for prevailing and intermittent or local sources.
- Archival acoustic recorders are being used around the world to measure the acoustic environment and then compute the noise budget for the region.
- Results from a study that measured and computed the baseline noise budget and projected the impact from operation of the first offshore wind farm in the United States will be summarized.

### **Additional information on the DOSITS website:**

Science of Sound > What are common underwater sounds?

(<http://www.dosits.org/science/soundsinthesea/commonsounds/>)

Science of Sound > How does marine life affect ocean sound levels?

(<http://www.dosits.org/science/soundsinthesea/marinelifeaffectoceansound/>)

Science of Sound > How does shipping affect ocean sound levels?

(<http://www.dosits.org/science/soundsinthesea/shippingaffectoceansound/>)

Science of Sound > How will ocean acidification affect ocean sound levels?

(<http://www.dosits.org/science/soundsinthesea/oceanacidification/>)

Advanced Topic > Ocean Noise Variability and Noise Budgets

(<http://www.dosits.org/science/advancedtopics/noisebudget/>)

People and Sound > How is sound used to measure rainfall over the ocean?

(<http://www.dosits.org/people/studyweather/measurerrainfall/>)

People and Sound > How is sound used to measure wind over the ocean?

<http://www.dosits.org/people/studyweather/measurewind/>

People and Sound > How is sound used to research wind energy?

(<http://www.dosits.org/people/examineearth/windenergy/>)

Hot Topic: Ocean-Based Renewable Energy

(<http://www.dosits.org/hottopic/renewableenergy/>)

Technology Gallery > Archival Marine Acoustic Recording Units

(<http://www.dosits.org/technology/observermarineanimals/archivalmarineacousticrecordingunits/>)