

AN OCEAN OF SOUND



Saturn
Developing Solutions for
Underwater Radiated Noise



SATURN has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101006443.

WHAT IS SOUND?

Sound is a disturbance in pressure created by a vibrating object. Sound travels as a wave through a medium like a gas (such as air), solid (such as the ground), or a liquid (such as water). * Measuring a sound's pressure can tell us how much energy it has and how loudly it is perceived. The higher the sound pressure, the higher the energy the wave carries.

*There is no sound in space because there is no gas, liquid, or solid for it to travel through!



The decibel was named for Alexander Graham Bell.

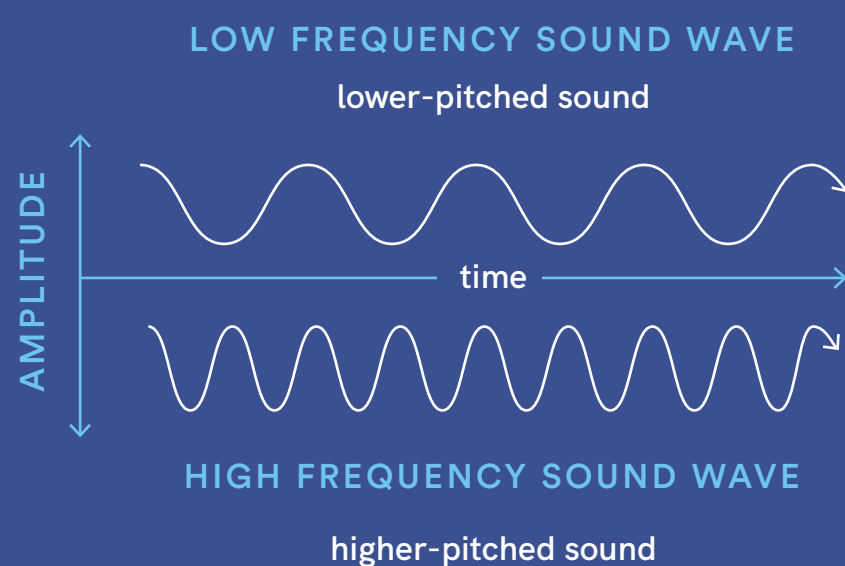
WHAT IS A DECIBEL?

The decibel (dB) is a relative unit of measurement for sound power (or sound energy). Essentially, 1 dB denotes a factor of ten (1 order of magnitude) change in sound energy. Using dB is a way of expressing order of magnitude in simple numbers (without having lots of zeroes)!

scaling factor	decibels
1	0
10	10
100	20
100,000	50
10,000,000,000	100

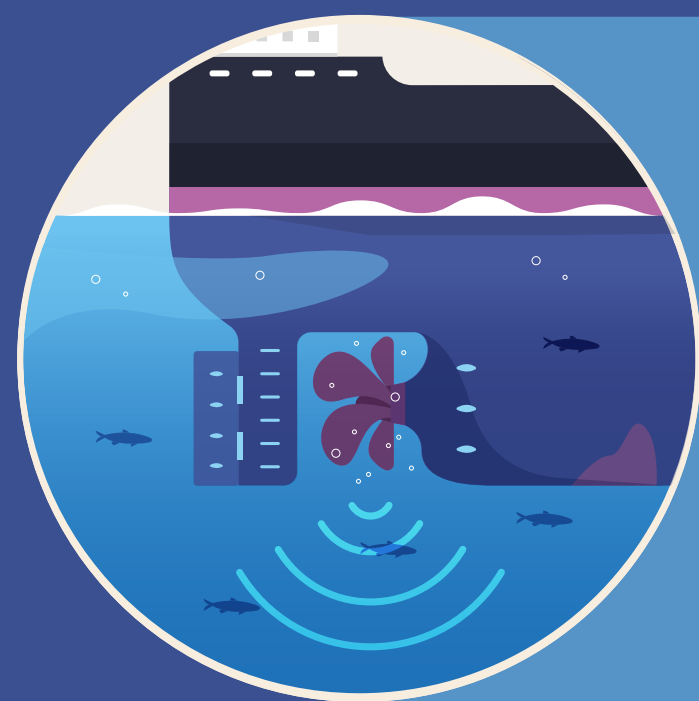
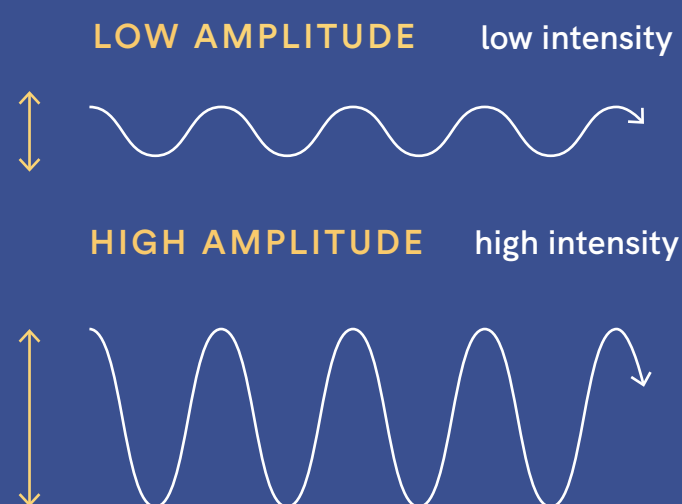
FREQUENCY

The frequency is the number of cycles of a wave per second, measured in hertz (Hz). Frequency controls the pitch of a sound.



AMPLITUDE

Amplitude is the loudness of a sound wave. As the amplitude of a sound wave increases, the intensity of the sound increases.



SOUND IN THE OCEAN

The ocean is a surprisingly noisy place. There are many different sources of sound in the ocean, including waves, rain, whales, fish, and even invertebrates, like shrimp! Just as humans rely heavily on our sense of sight, many animals in the ocean rely on sound to communicate, detect predators, and navigate. Human activities also make sound underwater, which can interfere with these important abilities and even harm

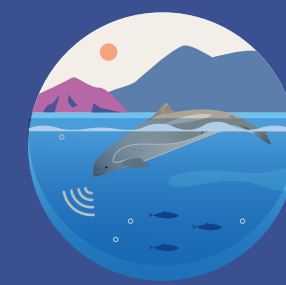
marine life. Ships, for example, are a common source of 'underwater noise' in the ocean. Because sound travels farther and faster underwater than it does in air, the noise made by ships can be heard from far away with little loss in loudness. We can reduce this noise by slowing down ships, avoiding sensitive areas, and designing new propellers that make less noise!

SPECTROGRAMS

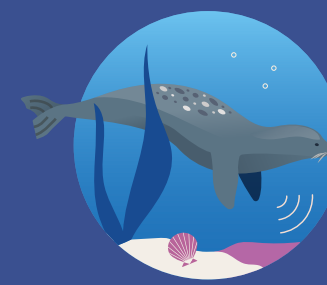
Scientists capture sounds underwater using hydrophones and can use these recordings to make spectrograms. Spectrograms represent sound visually, where the colour shows the sound's intensity. Notice the difference between animals and ships: ships emit constant loud sound, while animals tend to produce sound in bursts (like for echolocation).



Pilot Whale



Harbour Porpoise

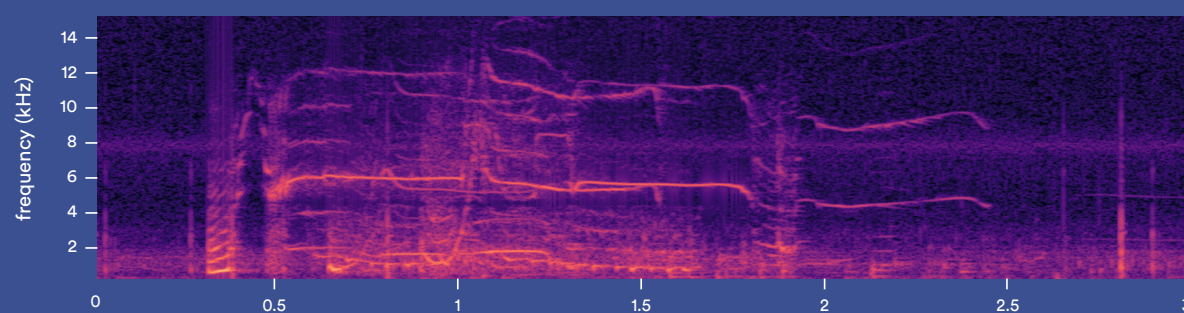


Harbour Seal

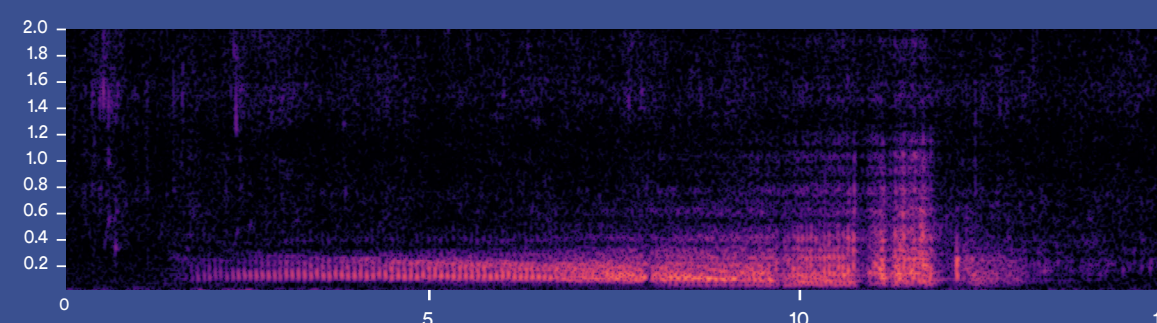


Container Ship

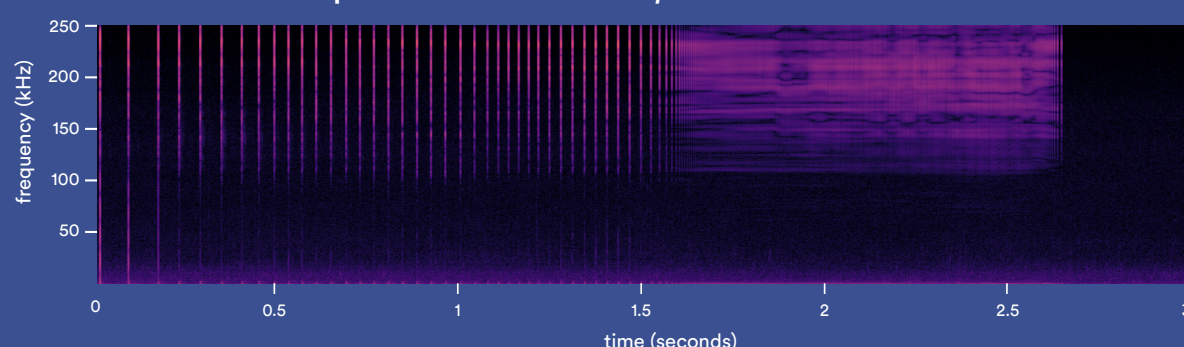
Short-Finned Pilot Whale (*Globicephala macrorhynchus*)



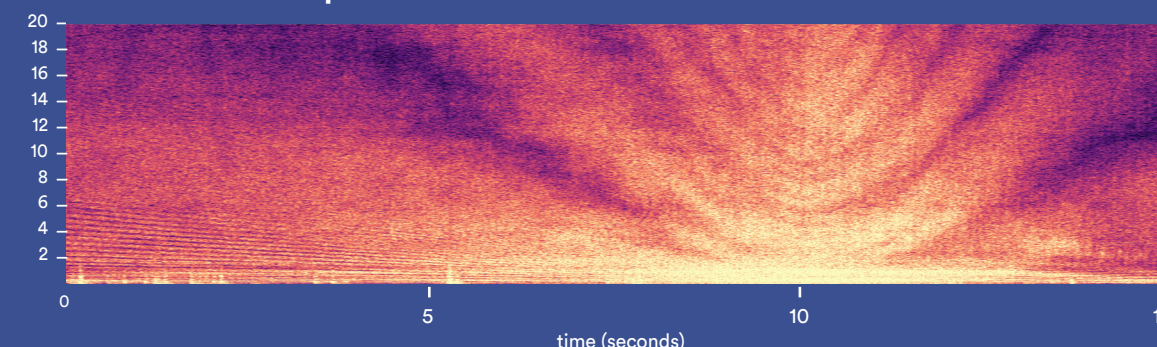
Harbour seal (*Phoca vitulina*)



Harbour Porpoise (*Phocoena phocoena*)



Container ship



Scan the QR code to listen to the sounds behind the spectrograms!

Or visit www.SaturnH2020.eu to learn more.