



## **Natural and anthropogenic ocean noise recorded at long-term and temporary observatories**

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Most people worldwide would assume that the oceans are silent. However, a number of natural phenomenon's like ocean waves, wind, lightening, ice noise, earthquakes, and submarine volcanic activity contributes to the ambient ocean noise. During their evolution, marine animals like fish and mammals have adopted in many ways to the acoustic properties of the sea. Yet in recent decades, anthropogenic and hence manmade ocean noise level has risen profoundly. Due to extreme reliance of fish and mammals on underwater sounds for basic life functions, including searching for food or mate and the absence of any mechanism to safeguard them against it, underwater noise pollution may disrupt marine life. The primary sources of low-frequency anthropogenic noise include sounds associated with shipping, military operations, oil and gas exploration and production, and even research activities. Some scientists suggest that today virtually no marine environment is without any noise pollution. Thus, all marine life forms that rely heavily on the integrity of their acoustic habitat may have to adapt to new conditions. Of greatest concern for whales are low-frequency sounds that travel long distances in the ocean. Ship propellers and motors, for instance, produce sound at low frequencies, as do natural and manmade seismic activity. These profound, loud noises reverberate in the deep ocean and can effectively mask or block vital whale communication. However, in general very little is known about the world-wide distribution of ambient ocean noise. Thus, on a global scale and considering the vast areas of the world's oceans, we know virtually nothing about noise levels in different parts of the oceans and how anthropogenic noise contributes to ambient noise. Here, we use hydrophone recordings from the UN's Comprehensive Nuclear-Test-Ban Treaty organization (CTBTO) and ocean-bottom seismometers to provide an assessment of noise in all major basins, including the Pacific, Atlantic and Indian Ocean at low frequencies of <50 Hz. Hydrophones recorded explosive volcanic eruptions, calls of Fin whales, distant seismic surveys and ship's traffic. Silent setting are characterized at 10 to 50 Hz by a noise level of 50 to 70 dB while areas affected by heavy shipping show noise levels of >100 dB. At frequencies below 1 Hz the ambient noise field is dominated by microseisms, forces by ocean gravity waves and surf.