Warming oceans will significantly alter how sound travels underwater

March 24 2022

Warmer oceans mean sound will travel faster, impacting marine animals who depend on sounds to find each other and eat. The largest effect on the underwater speed of sound can be expected east of Greenland and off Newfoundland in the Atlantic, according to a new study in the AGU journal Earth's Future. Credit: NOAA
Climate change will significantly alter how sound travels underwater, potentially affecting natural soundscapes as well as accentuating human-generated noise, according to a new global study that identified future ocean "acoustic hotspots." These changes to ocean soundscapes could impact essential activities of marine life.

In warmer water, sound waves propagate faster and last longer before dying away.

"We calculated the effects of temperature, depth and salinity based on public data to model the soundscape of the future," said Alice Affatati, an bioacoustics researcher at the Memorial University of Newfoundland and Labrador in St. John's, Canada, and lead author of the new study, published today in Earth's Future, AGU's journal for interdisciplinary research on the past, present and future of our planet and its inhabitants. It is the first global-scale estimate of ocean sound speed linked to future climate.

Two hotspots, in the Greenland Sea and a patch of the northwestern Atlantic Ocean east of Newfoundland, can expect the most change at 50 and 500 meter depths, the new study projected. The average speed of sound is likely to increase by more than 1.5%, or approximately 25 meters per second (55 miles per hour) in these waters from the surface to depths of 500 meters (1,640 feet), by the end of the century, given continued high greenhouse gas emissions (RCP8.5).

"The major impact is expected in the Arctic, where we know already there is amplification of the effects of climate change now. Not all the Arctic, but one specific part where all factors play together to give a signal that, according to the model predictions, overcomes the uncertainty of the model itself," said author Stefano Salon, a researcher at the National Institute of Oceanography and Applied Geophysics in Trieste, Italy.
The ocean soundscape is a cacophony of vibrations produced by living organisms, natural phenomena like waves and cracking ice, and ship traffic and resource extraction. Sound speed at 50 meters depth ranges from 1,450 meters per second in the polar regions to 1,520 meters per second in equatorial waters (3,243 to 3,400 miles per hour, respectively).

Many marine animals use sound to communicate with each other and navigate their underwater world. Changing the sound speed can impact their ability to feed, fight, find mates, avoid predators and migrate, the authors said.

**Changing soundscapes**

In addition to the notable hotspots around Greenland and in the northwestern Atlantic Ocean, the new study found a 1% sound speed increase, more than 15 meters per second, at 50 m in the Barents Sea, northwestern Pacific, and in the Southern Ocean (between 0 and 70E), and at 500 m in the Arctic Ocean, Gulf of Mexico, and southern Caribbean Sea.

Temperature, pressure with increasing depth and salinity all affect how fast and how far sound travels in water. In the new study, the researchers focused on hotspots where the climate signal stood out clearly from the model uncertainty and was larger than seasonal variability.

The new study also modeled common vocalizations, under the projected future conditions, of the North Atlantic right whale, a critically endangered species inhabiting both north Atlantic acoustic hotspots. The whales' typical "upcall" at 50 Hertz is likely to propagate farther in a warmer future ocean, the researchers found.

"We chose to talk about one megafauna species, but many trophic levels
in the ocean are affected by the soundscape or use sound," Affatati said. "All these hotspots are locations of great biodiversity."

Future work will combine the global soundscape with other maps of anthropogenic impacts in the oceans to pinpoint areas of combined stressors, or direct needed observational research.

"With complicated problems like climate change, to combine different approaches is the way to go," said author Chiara Scaini, an environmental engineer at the National Institute of Oceanography and Applied Geophysics.


Provided by American Geophysical Union

Citation: Warming oceans will significantly alter how sound travels underwater (2022, March 24) retrieved 20 October 2023 from https://phys.org/news/2022-03-oceans-significantly-underwater.html

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