TWO ACOUSTIC SCIENTISTS EXPLAIN INFRASOUND

From cars and compressors to waves and wind, it's everywhere

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Larger waves, including those on the Great Lakes, generate infrasound, which travel well beyond the beach.

Scientists believe that some animals, including elephants, communicate by sounds that are below the range of human hearing—low frequency sound vibrations known as infrasound.

But humans can hear them only rarely.

Some people have become deeply concerned about the alleged health effects of wind turbine infrasound, and are calling for mile-plus setbacks for wind farm developments. As that discussion heats up in Michigan, it is important to understand more about these ubiquitous, ultra-low-frequency sounds.

But talking about infrasound is tricky. Not only is it invisible—like regular, audible sound—it also cannot be heard by humans, except at extremely high sound levels.

The Great Lakes Bulletin News Service*contacted two scientists who know a great deal about infrasound, in order to learn more about its nature.*

***Dr. Geoffrey Leventhall**, who lives in the United Kingdom, has studied infrasound for 40 years and recently participated in a research panel assembled by the American and Canadian Wind Energy Associations. He founded the* Journal of Low Frequency Noise and Vibration, *helped organize international conferences on low frequency noise and wind turbine noise, has supervised 30 Ph.D. research projects on the effects and control of noise, and now consults with wind companies on noise abatement strategies.*

***Dr. Kai Ming Li**, of Purdue University's Herrick Laboratories, received his doctorate in mechanical engineering from the University of Cambridge and conducts government- and industry-sponsored research on the environmental impacts of noise. His background is in physical, computational, environmental, and classroom acoustics, as well as outdoor sound propagation, and is on the editorial board of* Applied Acoustics. *Currently, he concentrates on research involving environmental acoustics, including transportation.*

We emailed both scientists a list of questions about infrasound. The questions and answers were combined and edited for this article.

Keep in mind that sounds much above 80 decibels are considered quite loud, and that every 10-decibel increase in a sound measurement represents a doubling of loudness.

What is infrasound?

Dr. Li: A popular interpretation of infrasound is that it is low frequency sound well below the lower limit of hearing—which is around 20 Hz. A more precise definition is that infrasound is described as "acoustic oscillations" below the lower limit of audible sound, which is about 16 Hz [i.e., vibrations per second]. However, infrasound below 16 Hz is audible if the level is sufficiently high. Precise measurements showed that 4 Hz sound can be heard in an acoustic chamber and down to 1.5 Hz if the listener uses earphones.

All other things being equal, especially their decibel levels, does an infrasound wave travel further than a higher-frequency, audible sound wave?

Dr. Leventhall: Higher frequencies are absorbed more rapidly in the air. This effect reduces as the frequency reduces. Hence, infrasound travels further, but does weaken as it spreads out, just like any other wave.

Dr. Li: Because of their long wavelengths, infrasound can pass through walls and windows with little attenuation.

How common is infrasound from either industrial or residential sources? Is there a way for a home or building to insulate itself from external infrasound? Would infrasound generated within a home by an appliance be louder than infrasound from a wind turbine?

Dr. Leventhall: Low frequencies are common in all urban and industrial settings. Infrasound is produced by fans, compressors, combustion, and any rotating machinery. Diesel-powered machinery is an example. Domestic appliances produce low-frequency sounds and possibly some infrasound, the latter mainly from vibration of panels. As far as infrasound from a home appliance being louder than that entering the home from a turbine, that is a difficult question that I have not considered before. But this sounds very possible.

There is infrasound everywhere. Our evolution has been in the presence of infrasound. It is no problem to us at the levels that we experience from natural and other sources.

You need a heavy envelope to contain infrasound. But why bother? Infrasound is not a problem.

Dr. Li: Infrasound exposure can be found in the vicinity of operating heavy machinery. In a Finnish survey of industrial work sites, infrasound pressure levels usually ranged from 80 to 100 dB, significantly higher than in the vicinity of a [non-industrial] workplace. Highest infrasound levels were produced by blowers, pumps, oil burners, air compressors, drying towers, and heavy rotating machinery. The highest level (127 dB) was measured 328 feet from a crusher at a mine. Other sources include explosions, bridge vibration, and air heating and cooling equipment.

A washing machine in the spin cycle emitted infrasound at 81 dB.

Apart from the difficulties of tracking down the source of low frequency noise and infrasound, and assessing its magnitude, practical methods of control are technically difficult and often prohibitive in cost. Indeed, the method for reducing infrasound effectively lies in the fundamental design of the sources themselves. There is also a need to develop agreed standards for measuring and controlling infrasound.

On a mildly windy day along a Great Lakes coastline, does wave action generate infrasound? Would that sound be blocked by, say, a nearby sand berm?

Dr. Leventhall: Waves are one source of natural infrasound—probably the biggest source on earth. Other sources are natural airflows, weather, etc. A sand berm would have to be enormous to interfere with infrasound from waves.

Dr. Li: Infrasound can be generated by thunder, earthquakes, large waterfalls, ocean waves, wind (up to 110 dB at 15 mph), fluctuations in atmospheric pressure, and volcanoes.

Running generates infrasound at levels up to 90 dB; swimming also generates infrasound, but the pressure is more intense (up to 140 dB). Some seismic events send infrasonic waves into the atmosphere, including earthquakes, landslides, and avalanches.

Some studies suggest that a range of natural environmental sources contribute to the complex infrasound background. Thunderstorms, aurora [Northern Lights] and meteor showers may also cause infrasound.

Does road traffic generate infrasound?

Dr. Li: Riding in automobiles exposes drivers and passengers to infrasound at up to 120 dB. Exposures while riding in helicopters, other aircraft, submarines, and rockets range at 120 to 145 dB. In a free field, diesel engines generate infrasound levels up to 110 dB. Jet engines, helicopters, and large rockets generate infrasound at 115 to 150 dB.

In a Finnish survey, infrasound levels exceeding 120 dB were found in cars and railway engines. The usual range in vehicles with closed windows was 90 to 110 dB. Infrasound sound pressure levels in aircraft cockpits and cabins ranged from 80 to 100 dB. In Japan, infrasound was measured at 83 dB at 65 feet from a running truck and 100 dB at 65 feet from a running railroad carriage. So drivers, pilots, and other transportation workers are among those occupations with considerable infrasound exposure.

I've heard that older, "downwind" turbines (blades downwind from tower) generate more infrasound than modern "upwind" turbines.

Dr. Leventhall: Yes, the downwind turbines produced more infrasound than the modern upwind ones. What people are looking for is something to scare others about and have hooked into infrasound.

Jim Dulzo is the Michigan Land Use Institute's managing editor. Reach him at jim@mlui.org. Read our news article about infrasound and wind turbine setbacks.