Stratospheric balloons listen in on ground activity

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Solar-powered hot-air balloons can measure infrasound to investigate natural and human activity on Earth. The technology could also aid in future missions to Venus. Credit: Daniel Bowman, Sandia National Laboratories

Earthquakes, volcanic eruptions, and even severe weather events produce a medley of low-frequency infrasound waves below the range of human hearing. Researchers can investigate these sounds to gain a deeper understanding of our planet. In addition to natural events, infrasound

sensors can pick up events caused by human activity, from city noise to nuclear explosions.

As part of a larger research team, Bowman and Krishnamoorthy detonated a canister located about 50 meters below the ground that was filled with an explosive equivalent to 10 tons of 2,4,6-trinitrotoluene (TNT). A network of instruments on the ground—including accelerometers, seismometers, and microbarometers—recorded ground shaking and pressure waves from the explosion. Ground sensors picked up the pressure waves 12 kilometers from the blast, but another array about 46 kilometers away heard nothing.

By contrast, the researchers report, microbarometers carried by solar-powered hot-air balloons in the lower stratosphere, over 20 kilometers above Earth's surface, detected infrasound signals from the buried chemical explosion. The researchers propose that the balloon-borne microbarometers detected a strong signal because the troposphere directs sound upward. In addition, the sensors would have bypassed background noise and sound-scattering features on the ground.

The new study supports further use of balloon-borne microbarometers for investigating geophysical activity and monitoring explosions on Earth. The results also support mission concepts proposing to use balloons to explore Venus and investigate volcanic activity and venusquakes via infrasound.

More information: Daniel C. Bowman et al, Infrasound From a Buried Chemical Explosion Recorded on a Balloon in the Lower Stratosphere, *Geophysical Research Letters* (2021). DOI: 10.1029/2021GL094861

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