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APPLICATIONS OF HIGH-ALTITUDE INFRASONIC BALLOONING FOR VENUS

Abstract

In situ observations of extraterrestrial atmospheres in our solar system is limited to how long we can keep a lander alive on the surface. Venus has long been a planet of interest but has recently regained significant due to its hostile environment and runaway greenhouse effect. It is known that the surface of Venus is inhospitable to lander probes and other surface exploration (surface temperature > 460C), but the upper atmosphere of Venus is much more hospitable (0-100C) making atmospheric remote sensing an easier challenge than a lander. Zero-pressure solar balloons are a potential platform for long duration observations with no external lifting gas. Infrasonic observations can be a useful tool for identifying and characterizing both a planet's interior structure and atmospheric characteristics since infrasound is generated from a multitude of sources. On Earth these sources range from earthquakes and volcanoes to thunderstorms and waves on the ocean. Infrasound travels long distances in the atmosphere and can be used on a solar balloon for remote sensing of subsurface geology on Venus. Since the upper atmosphere of Venus is comparable to Earth's stratosphere; therefore, the ideology can be tested first on Earth. Then infrasonic observations with remote sensing can take place while the zero-pressure solar balloon stays afloat. When examining seismic activity, the vertical ground motion of seismic waves launches infrasonic acoustic waves into the atmosphere and the resulting excited waves propagate upward. Wave amplitude increases with height owing to conservation of momentum, since the atmosphere is rarefied exponentially with height. Solar balloons carrying multiple sensors allow cross correlation to triangulate location of the source. Infrasonic sensing with zero-pressured solar balloons is currently being investigated by the team. A group of graduate and undergraduate researchers, partnered with NASA Jet Propulsion Laboratory and Sandia National Laboratories, targeted the seismogenic zone over Oklahoma in a campaign over the summer of 2021 and plan to target seismic activity over the summer of 2022. This talk will present design concepts for Venus exploration and results of analog tests on Earth.