24-2024 R3-0015

RFA-078: Detecting Infrasonic Signatures of Venus Seismic Activity by Balloon-Borne Sensors at 55 km Altitude (SMD-GRC)

Louisiana Board Of Regents
Dr. T Gregory Guzik

The proposed research will initiate the first systematic study for Venus exploration in Louisiana. The Science-I is actively involved in international collaborations on planetary science missions for Venus, Mars, Titan, and Saturn.

The project will contribute to aerial seismology on Venus by addressing surface-to-atmosphere acoustic coupling, propagation, and detection of venusquake-generated infrasound. Thus, the proposed work answers to the atmospheric, dynamical, and geophysical components of NASA's Solar System Workings program and as such is highly relevant. It also addresses the need for studies of planetary interior structure, lithospheres, volcanism, and evolution and modification of surfaces. These elements are addressed in the proposed work whose premise is to detect acoustic signatures of seismic activity on Venus.

Central to the problem is understanding the mechanisms by which surface dynamics couples to the atmosphere through acoustic waves. On Earth, earthquakes can produce infrasonic waves that can travel over long distances, with relatively small attenuation. The hot and dense atmosphere of Venus makes it considerably more ``acoustically friendly'' than Earth owing to i) the roughly 70 times more efficient transfer of acoustic energy from surface motion into the atmosphere and ii) small sound attenuation, especially at infrasonic frequencies. These factors, pointing to an efficient surface-to-atmosphere coupling, are especially encouraging for mid-atmospheric sensing of surface-generated infrasound.

In order to be able to detect Venus geodynamic events, landers have to be built to extreme specifications to withstand the planet's harsh environment for long time periods. The work proposed here will ultimately lead to developing an atmospheric remote-sensing approach by which infrasonic arrivals, detected by high-altitude balloons, can be used as a direct probe of Venusian seismic events. The goal of the proposed work is to develop a predictive framework for detecting and quantifying mantle/crustal dynamics on Venus through their acoustic coupling with the atmosphere. The science objectives are: 1) understanding surface-atmosphere dynamical coupling via seismoacoustic infrasound generation, and 2) developing a catalog of synthetic venusquake- generated infrasonic waveforms detected on a freely floating balloon at 55 km.

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