Orbital Remote sensing seismology on Venus: the VAMOS concept.

*Philippe Henri Lognonné[1], Attila Komjathy[2], Siddharth Krishnamoorthy[2], Raphael F. Garcia[3], Balthasar Kenda[1], Brian M. Sutin[2]

1. Université de Paris, Institut de physique du globe de Paris, CNRS, 2. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA, 3. Institut Supérieur de l'Aéronautique et de l'Espace SUPAERO, 10 Avenue Edouard Belin, 31400 Toulouse, France

Due to the adverse surface conditions on Venus with its extremely high temperature and pressure, it is infeasible, even using flagship mission resources, to place seismometers on the surface for an extended period of time. Performing remote atmospheric seismic monitoring from an orbiting platform could provide a breakthrough in the detection of seismicity on Venus and the monitoring of seismic wave propagation in the Venus ionosphere.

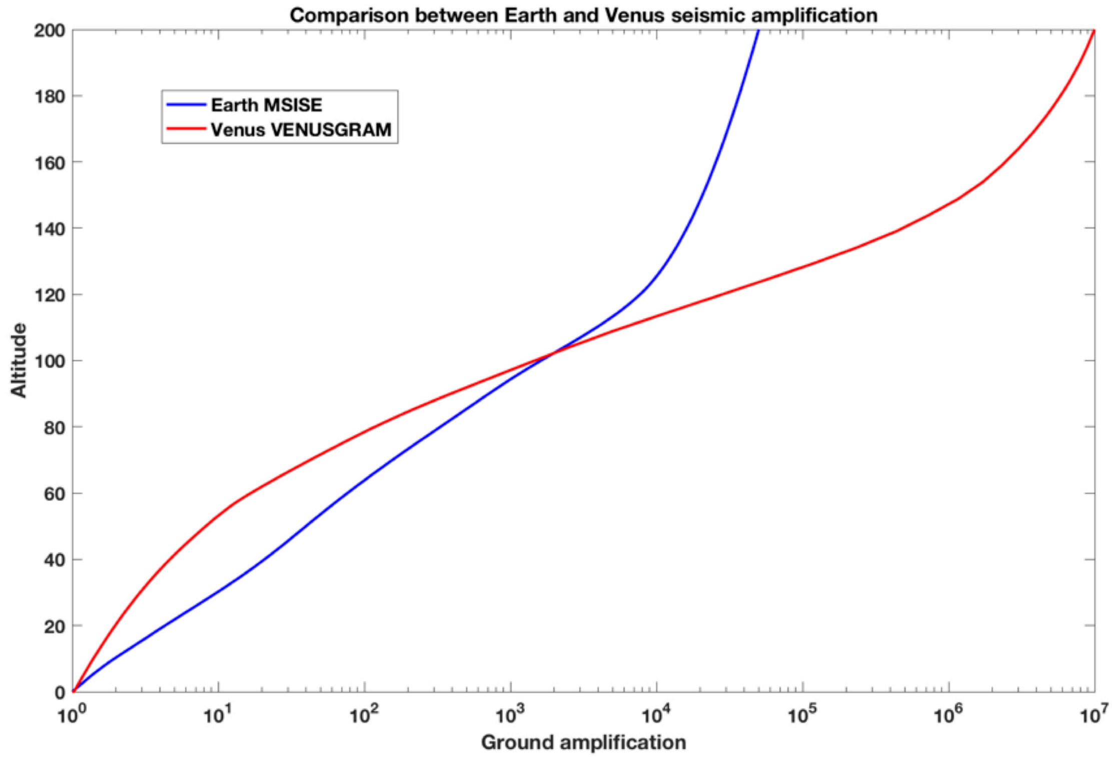
Venus is surrounded by the brightest naturally occurring airglow layer known in the Solar System. Airglow is a result of various atoms, molecules, and ions that get photoionized by ultraviolet radiation from the Sun and then release energy as visible and infrared light when they recombine and return to their normal state. Perturbations in the neutral atmosphere caused by seismicity on Venus leave an imprint in this airglow layer, spanning altitudes from 90-110 km.

We propose to use remote optical observations of this layer to study these perturbations, allowing us to infer the currently unknown seismicity of the solid planet below. Two specific airglow emissions are investigated, one occurring at 1.27 μm (visible on the night-side) and the other at 4.3 μm (visible on the day-side).

The seismic signal in the Venus atmosphere will be related to the amplification generated by the decay of the density with altitude. This is provided on Figure 1 and compared to Earth. An amplification comparable to Earth is obtained at 100 km, the height of the 1.27 microns on Venus. We get a factor 30 of additional amplification at the height of the 4.3 micron emission (135 km) and even more at higher altitude/
We will summarize here the principal findings of the VAMOS concept study, for which we performed an in-depth analysis and modeling both for the 1.27 μm nightglow and the dayside 4.28 μm non-local thermodynamics equilibrium (non-LTE) signals associated with the waves. The results show that the detection threshold for the proposed imager is expected to be Ms=6 for 1.27 μm and Ms=5 for 4.28 μm.

Figure1: Comparison of the amplification of surface waves for Earth and Venus. Earth model is MSISE while Venus model is VENUSGRAM. See Lognonné et al (*J. Acoust. Soc. Am.*, doi: 10.1121/1.4960788, 2016) for models properties and references.

Keywords: Venus, seismology, airglow


Comparison between Earth and Venus seismic amplification
Earth MSISE
Venus VENUSGRAM
Altitude
0
20
40
60
80
100
120
140
160
180
200
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
Ground amplification

