

# The best way to learn about Venus could be with a fleet of balloons

March 17 2023, by Andy Tomaswick

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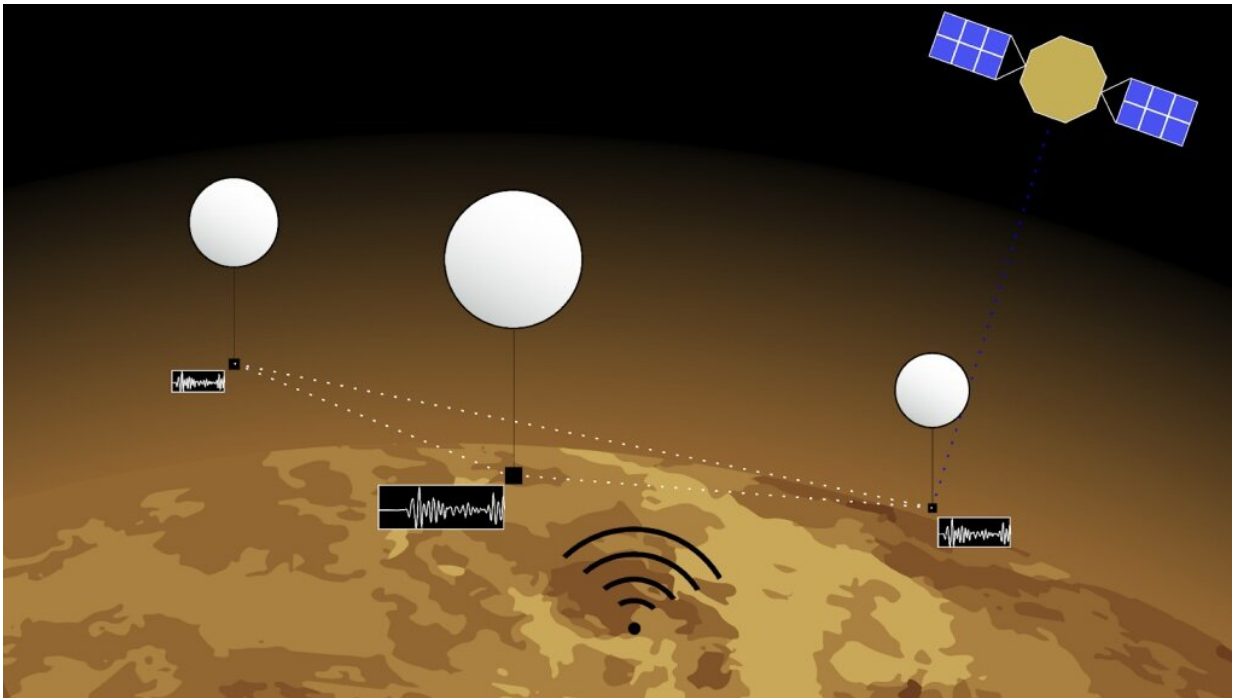


Image of the operational concept detailed in the paper. Credit: Rossi et al.

Interest in the exploration of Venus has kicked up a notch lately, especially after a contested recent discovery of phosphine, a potential biosignature, in the planet's atmosphere. Plenty of missions to Venus have been proposed, and NASA and ESA have recently funded several. However, they are mainly orbiters, trying to peer into the planet's interior from above. But they are challenged by having to see through

dozens of kilometers of an atmosphere made up of sulfuric acid.

That same atmosphere is challenging for ground missions. While some of the recently funded missions include a component on the ground, they are missing an opportunity that isn't afforded on many other planets in the solar system—riding along in the atmosphere. Technologists have proposed everything from simple [balloons](#) to entire floating cities—we even heard of a plan to enclose the entirety of Venus in a shell and live on the surface of that shell.

But for now, balloons seem to be a more straightforward answer. That is the [mission](#) modality proposed by a team of researchers at NASA's Jet Propulsion Laboratory to discover more about something that was only confirmed to exist on Venus in the last week—volcanism.

Scientists have long thought that there are active volcanos on Venus. Some older probes collected data hinting at it, but it wasn't till a recent study analyzing data from Magellan that we knew volcanos on Venus were still active. At this point, anybody's guess is what that means for the study of seismology, evolution, and even the planet's geophysiology. But the proposed JPL [balloon](#) mission would help shed some light on it.

Their mission design, detailed in a paper freely released on one of the author's personal websites, involves utilizing a meshed network of balloons and an orbiting satellite to detect and travel toward active volcanic events and collect as much data as possible from them. That might sound difficult, especially without humans "in the loop" and controlling where the balloons go, but it's certainly better than having them go wherever the [wind](#) takes them.

It's much better—63% better at achieving close-up observations of active or recently [active volcanoes](#), according to the team's simulations. But how they got to that number could use some further explanation.

First, how can you tell when a volcano erupts on a planet completely shrouded from outside view?

They proposed using a technology called infrasound microbarometers—basically, these tiny tools detect pressure differentials in the atmosphere caused by volcanic blasts. If you're looking for a [volcanic eruption](#), analyzing data from one of these instruments can at least point you in the direction of the pressure wave they create. Even if you're pointing in the right direction, how can a balloon with no active propulsion system of its own get close enough to start collecting data?

According to the paper, they can simply ride the winds. Venus's atmosphere is complex, and different layers may have different directional winds at differing speeds. A balloon could raise or lower itself into the right wind current and ride that toward the direction of the eruption. Sound pretty nifty, but one balloon alone wouldn't necessarily be able to detect wind currents outside its immediate area, making it difficult, if not impossible, to plan a path toward the volcano. That's where the meshing comes in.

Orbiting above the planet and looking down through the [atmosphere](#) has one advantage—it allows the orbiter to see different wind currents that could be used to direct balloons in the right direction. Even better, if one balloon detects an interesting pressure change but can't find a way there from its local wind condition, the orbiter could relay that information directly to one of the other balloons in the group, which might have a better chance of getting there due to its own local wind patterns.

So, in addition to acting as a navigator for an individual balloon, it can also act as a relay and coordinator for a whole fleet of them.

Humans can still be helpful, resulting in an increased amount of time near potential spots of interest if they were involved in the pathing of the

balloon system. But humans also need to eat, sleep, and do things other than monitor far-away robotic probes, so their [response times](#) can sometimes lead to a lag that would make them unable to take advantage of current wind conditions. Therefore, an automated system around the planet could serve as the best and quickest way to find the sensor's way toward these spectacular events.

Once a balloon has arrived at one, they might even be able to drop a payload directly into the volcano's caldera, gathering invaluable information, however short-lived the mission might be. Get enough chances at that, and the breakthrough of finding a single volcano on Venus will pass into scientific history as we begin to understand what made and makes our twin planet tick.

**More information:** Proximal Exploration of Venus Volcanism with Teams of Autonomous Buoyancy-Controlled Balloons:  
[www.federico.io/pdf/Rossi.Sabo ... y.Hook.ea.Acta23.pdf](http://www.federico.io/pdf/Rossi.Sabo...y.Hook.ea.Acta23.pdf)

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