Mars landing: Cause for celebration

February 25, 2021

Last week's dramatic landing on Mars by the rover Perseverance marked an important advance in our journey to uncovering the history and resources of the red planet and, indirectly, to better understanding our own planet's evolution. That knowledge also contributes to research about Earth's potential vulnerabilities to climate change and other threats. Scientists are most excited about investigating whether there was ever life on Mars – and they are doing so by studying the geology, minerals, and landforms on the planet just as we do on Earth.

Watch party

Last week, I attended a very well-managed and exciting "watch party" for the landing of Perseverance on Mars. Dubbed "Percy" by the engineers managing the $2.7 billion mission at NASA's Jet Propulsion Laboratory (JPL), the rover took six and a half months to travel 300 million miles to its destination. To celebrate, assistant professors of geological sciences **Mathieu Lapôtre**, **Laura Schaefer**, and **Sonia Tikoo** of geophysics hosted the online event, which nearly 170 people attended from our community and beyond.

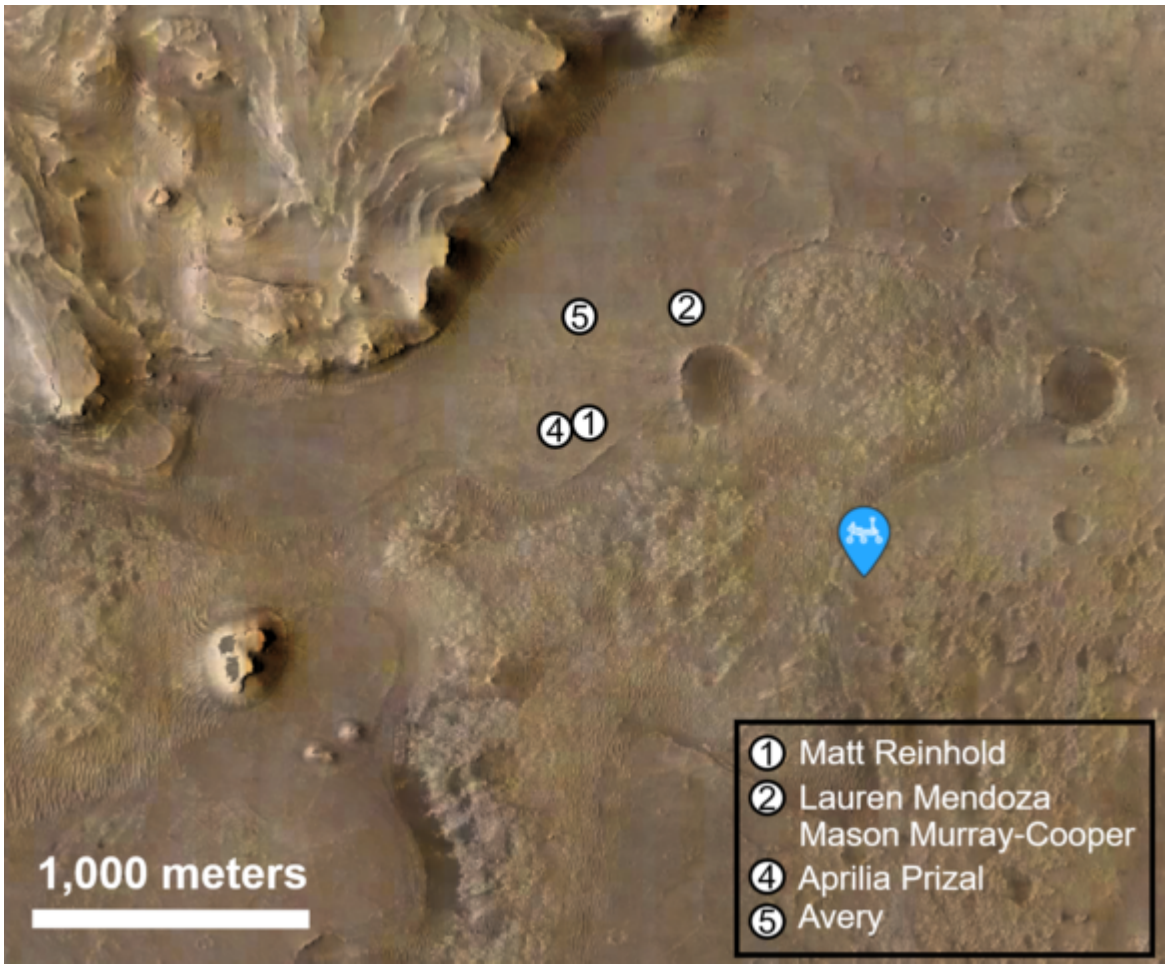
The watch party speakers included NASA Ames scientist Paul Wercinski and Lapôtre, who leads our Earth & Planetary Surface Processes research group. I was mesmerized as we saw in clear and stunning detail the landing of a vehicle on Mars. Until now, the actual landings had not been filmed. I urge you take a look at the NASA video below, which, by the way, has had more than 10 million views!

Perseverance was programmed to land on the floor of the Jezero Crater, which it did with impressive accuracy. Prior to the landing, watch party participants made predictions about where the vehicle would land within its planned landing ellipse. Our own GS PhD student **Matt Reinhold** won first prize. His prediction was closest – 1,219 meters away from the rover's actual touchdown point. In second place, GS student services staff member **Lauren Mendoza** and Aero/Astro MS student **Mason Murray-Cooper** both guessed the rover's landing

location within 1,222 meters. **Aprilia Prizal**, a guest watching from New York City, was only off by 1,296 meters. And Avery, the 8-year-old grandson of my former executive assistant **Susan French** (now supporting **Pam Matson** in ESS) took 4th place with a bet within 1,441 meters of the touchdown.

Why Jezero Crater?

Satellite photos previously captured landforms showing Jezero Crater to be the site of an ancient river delta that fed into a great lake 3.8 billion years ago – perhaps not unlike the lower Mississippi emptying into the Gulf of Mexico.



Participants tried to predict where the vehicle would land within its target zone. GS PhD student Matt Reinhold was closest – guessing 1,219 meters away from the rover's touchdown point. Tied for second place, GS student services staff member Lauren Mendoza and Aero/Astro MS student Mason Murray-Cooperpredicted the location within 1,222 meters. Aprilia Prizal, a guest watching from New York City, was off by 1,296 meters. And Avery, the 8-year-old grandson of ESS administrator Susan French took 4th place with a bet within 1,441 meters of the touchdown. *Graphic by NASA and Mathieu Lapôtre.*

Over four years between 2014 and 2018 Lapôtre participated in NASA workshops to discuss and vote on potential landing sites, first as a student and later as a postdoc. His favorite site candidate, Jezero Crater, was ultimately selected. He also participated in orbital imagery analysis that helped determine whether the delta formed over time scales that would promote the preservation of organic materials.

The former delta is a great site for exploration because preserved geologic and molecular evidence may provide clues to the presence of ancient life there. The rocks on the surface of Mars are much older than those on Earth – and so what we find there could add to our understanding of the solar system's earliest life forms.

Perseverance will probe land forms that are believed to have been created both before and after the existence of water and collect rock and sediment samples. For the first time, samples will be brought back to Earth by a future mission, probably within 10 years. Once here on Earth, the rocks will be dated and analyzed for biosignatures by looking at their isotopic composition – the sort of testing we already do here in our Stanford Earth labs.

Another first is that Perseverance has an assistant – a mini-helicopter called Ingenuity that will be the first flying device in the Martian atmosphere. It will test the ability of aircraft to operate there and will survey areas the rover cannot reach. The rover is also expected to explore the possibility of geothermal springs in hills around the crater.

Why study Mars?

As we are knee deep in planning for a forward-looking, new school of sustainability, why should we care about the ancient history of Mars and the prospect of life forms there billions of years ago? The sedimentary and geomorphic processes that shape planetary surfaces, including Earth's and those of much older planets like Mars, can explain past hydrology, climate, and why planets which may once have been habitable are no longer so. As we observe and grapple with climate change and other threats to planet Earth's complex systems involving its core, its oceans, and its atmosphere, the insights we gain from past processes both on Earth and on other planets can inform our science and solutions going forward. Bravo to those who arranged this celebration and to the faculty and students who pursue the science behind it.

Steve Graham

Check out Science magazine's excerpt of NASA's landing video