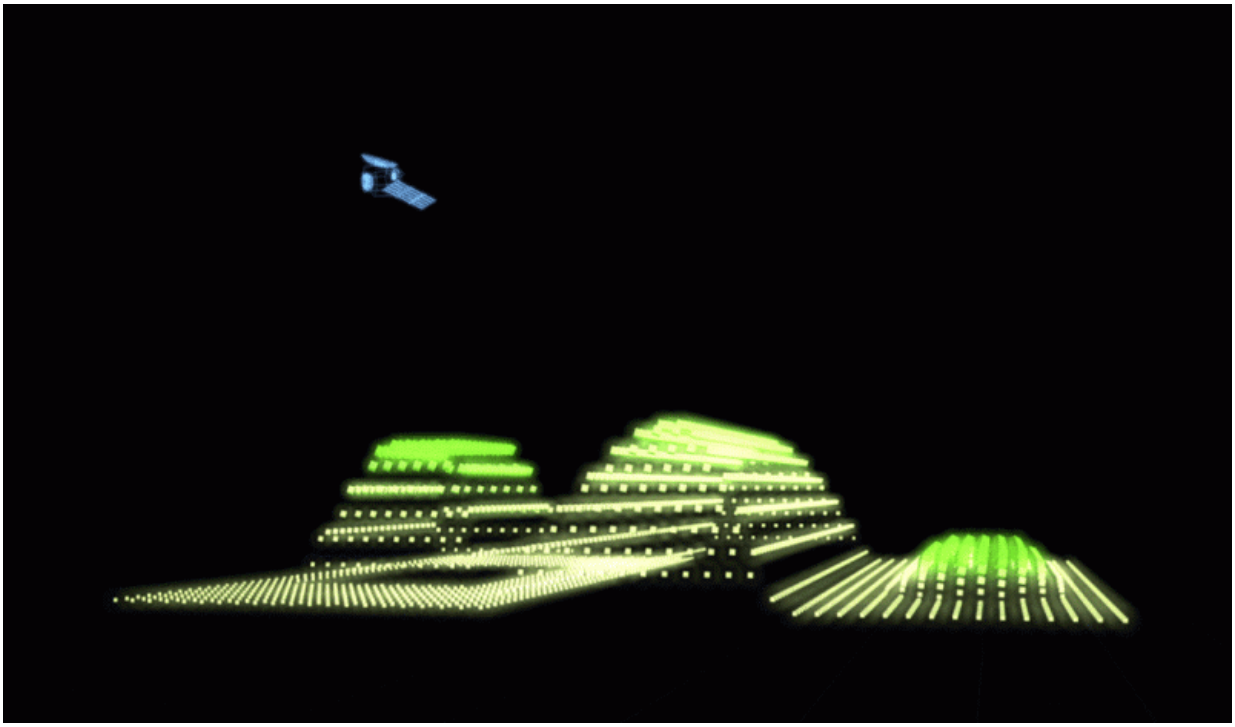
Altimeter assists in MESSENGER's low-altitude navigation

April 14 2015



MESSENGER scientists are using altimeter data to help determine whether orbit corrections need to be made during low-altitude navigation. The altimeter, which measures the range to the spacecraft as it passes over a landscape, was used to map the surface of Mercury, as shown in this animation. Credit: NASA/GSFC

As NASA's MESSENGER mission draws to a close, an on-board science instrument that mapped the surface of Mercury is helping the navigation

team with the spacecraft's low-altitude passes.

MESSENGER remains in an eccentric orbit but is passing much closer to the planet than before. Its periapsis altitude - the closest approach to the planet - now ranges from 6 to 39 kilometers (about 3.7 to 24.2 miles) above the planet's surface.

The navigation team has laid out a schedule of orbit-correction maneuvers to keep the spacecraft operating as long as possible. To confirm that they have correctly predicted the spacecraft's orbit during the close passes, they receive daily updates from the team responsible for the Mercury Laser Altimeter, an instrument normally dedicated to scientific measurements.

"It's a special case to use this science instrument to help with navigation," said Dan O'Shaughnessy, MESSENGER's Mission Systems Engineer, at the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. "But now that we are getting very close to the planet, it's new territory."

MESSENGER passed over this region of the planet earlier in the mission but with a periapsis altitude of 200 to 500 kilometers (about 124 to 311 miles). The orbit predictions there are well tested. Less information is available about the conditions at the lower altitudes.

"The navigation team wanted an independent way to assess how good their orbit predictions are, and the altimeter gives them that," said Erwan Mazarico, a member of the altimeter team, at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

The altimeter makes precise measurements of the distance from the spacecraft to the surface - information that is used to determine where craters, mountains and other features are located and how deep or tall

they are. The team has already produced a map of the planet's surface, called a digital elevation model.

The instrument's new task is to make measurements while the spacecraft is close to the planet. This information is sent to Earth daily, and the altimeter team feeds it into a computer model to track the spacecraft's position in three dimensions.

By comparing the predicted orbit to the actual path the spacecraft took, the navigation team can determine whether they need to make any corrections. For example, the spacecraft might drift downward more quickly than expected, or it might come across an anomaly in the gravity field that was not detected from the higher orbit. Passing through one of these anomalies would be like an airplane encountering a downdraft or updraft.

"The bottom line is that the altimeter data give the navigation team added confidence that their orbit prediction is solid," said Greg Neumann, a member of the altimeter team at Goddard. "We're helping them make sure that the plan they put in place is still the right one to follow."

The Johns Hopkins University Applied Physics Laboratory built and operates the MESSENGER spacecraft and manages this Discovery-class mission for NASA. Goddard designed and built the Mercury Laser Altimeter. Sean Solomon, director of Columbia University's Lamont-Doherty Earth Observatory, is the mission's Principal Investigator.

Provided by NASA's Goddard Space Flight Center