How Geospatial Technology is Vital for Exploring Mars

When NASA's Perseverance rover landed on Mars in February ٢٠٢١, it was equipped with some of the most precise maps of Mars ever created, courtesy of the USGS Astrogeology Science Center. Not only were these new maps essential for a safe landing on Mars, but they also serve as the foundation upon which the science activities planned for the Mars mission will be built.

In order to safely land on the rugged Martian landscape, the spacecraft used a new technology called Terrain Relative Navigation.

As it descended through the planet's atmosphere, the spacecraft used its onboard maps to know precisely where it is and to avoid hazards. For the navigation to work, the spacecraft needed the best possible maps of the landing site and surrounding terrain.

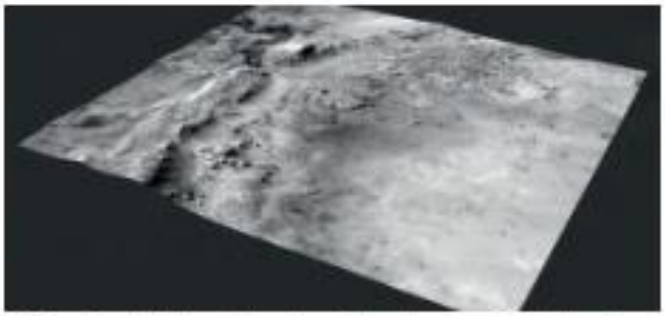
Two USGS-developed Mars maps

The USGS developed two new maps for the Mars mission. The first is a high-resolution (٢٥cm per pixel) map that researchers have used to accurately map surface hazards at the landing site. This map serves as the base map for mission operations and to plot where the rover will explore after landing. The second map is a lower resolution (٦m per pixel) map that spans the landing site and much of the surrounding terrain. This was used onboard the spacecraft, along with the locations of thehazards from the high-resolution map, to help it land safely. The maps have been aligned with unprecedented precision to each other and to global maps of Mars to ensure that the maps show the hazards exactly where they really are.

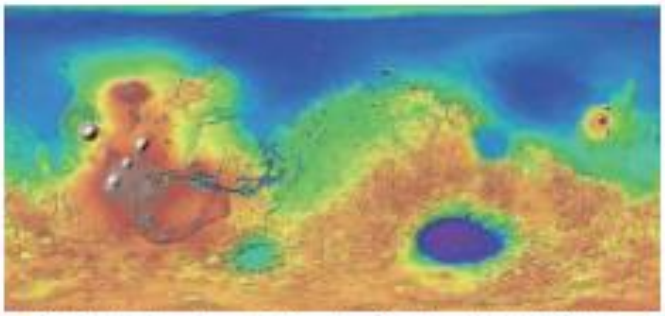
The role of remote sensing data

The landing site for Perseverance had to fit four main criteria: the site had to be geologically diverse, showing signs of the processes that formed it; the location had to be astrobiologically interesting, with signs of possible ancient life; there should be enough suitable material at the site for collection and caching for

possible future pick-up; and the site should contribute new knowledge that will help humans go to Mars.



▲ Oblique view looking toward the northwest shows the western rim and floor of Jezero crater, Mars. (Source: USGS)



▲ DEM of the Martian surface derived from Mars Orbiter Laser Altimeter (MOLA) data that was captured at 463m by 463m resolution during the Mars Global Surveyor mission.

Explore Mars with GIS

Esri recently developed the ability to use other planetary coordinate systems with a ٣D globe, and the timing could actually not be better as we recently witnessed the successful landing of the Perseverance rover. Digital elevation models (DEMs), precise imagery and spatial

data representing previous rover landing sites all display accurately under the Martian coordinate system, and it can all be explored with the Explore Mars app.

In anticipation of future missions to Mars, GIS techniques have already been applied to previously collected elevation data from Mars to model the terrain to aid rovers and, eventually, humans. The National Aeronautics and Space Administration (NASA) created digital elevation models from data provided by the Mars Orbiter Laser Altimeter (MOLA), an instrument on its Mars Global Surveyor spacecraft (١٩٩٧ to ٢٠٠١). Digital terrain models (DTMs) have been produced from the above-mentioned HiRISE camera on board the Mars Reconnaissance Orbiter that has been collecting data since ٢٠٠٦.

“Our understanding of the planets in our solar”system, as well as exoplanets, will begin to increase exponentially. At the same time, we will continue to apply the remote-sensing/GIS processes that we develop for Earth to planetary environments where applicable. Especially for a planet like Mars, where it is likely

humans will be taking fi eld measurements within the next ١٥-٢٠ years, a unique opportunity for planetary image data verifi cation will develop. It will allow us to better interpret the imagery we collect and improve the geospatial models we create for interplanetary study, and I think that's very exciting," François Smith, geospatial data scientist at MDA Information Systems LLC in Gaithersburg, Maryland, USA, stated back in ٢٠١٧.