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Atmospheric model to aid future Mars missions

Chinese scientists have developed a numerical model to simulate the atmospheric environment of Mars, offering research support for China's sample-return mission to the Red Planet.

The study, recently published in the journal Chinese Science Bulletin, said that the China National Space Administration plans to bring Martian samples back to Earth on the Tianwen 3 mission in around 2028.

To provide information on the meteorological conditions for spacecraft landing, scientists at the Institute of Atmospheric Physics of the Chinese Academy of Sci-

ences have designed and built "GoMars", a global open planetary atmospheric model for Mars.

They've used the model to replicate the three critical cycles of the Martian atmosphere — dust, water and carbon dioxide — and validated it based on the observations of Zhurong, China's Mars rover, and NASA's Viking 1 and 2 landers, as well as the OpenMARS reanalysis dataset, a global record of Martian weather.

The results of the study showed that the GoMars model successfully reproduced the unique characteristics of surface pressure on Mars as recorded by the Zhurong

rover and the two Viking landers. Furthermore, the model has good simulation performance for the surface temperature, zonal wind, polar ice and dust.

With the rising complexity of Mars explorations, the demand for Martian weather forecasts is growing. The research team said it would further study weather processes such as dust storms on the planet to offer possible support for future Mars missions, manned Mars landings and resource development on the planet.

Launched on July 23, 2020, China's Tianwen 1, comprised of an orbiter, lander and rover, arrived

on Mars in February 2021. The Zhurong rover drove down from its landing platform to the Martian surface on May 22, 2021, and has been exploring the Red Planet ever since.

Lead researcher Wang Bin said the Tianwen 3 mission will include the tasks of landing, sampling and returning, requiring detailed information about Martian atmospheric conditions.

Last year, the Insight rover from the United States and China's Zhurong rover were shut down due to strong dust, and pebbles caught in a sandstorm damaged a wind sensor on the US Perseverance rover.

Since the 1960s, many countries have committed to the development of Martian atmospheric models.

"The dust cycle on Mars is as important as the water cycle on Earth," said Wang, stressing that dusty weather has had a significant impact on the landing, departure, communication, energy supply and equipment of Mars probes.

On May 18 last year, Zhurong switched to dormant mode after having traveled about 1,921.5 meters on the Martian surface. According to experts, the cause behind Zhurong's dormancy was unclear, but satellite photos showed that its solar panels were covered in dust.

"GoMars can be used to simulate

the dust activity before and after the rover's dormancy, which can provide atmospheric environment data to analyze the possible causes of the dormancy," Wang said.

Far more than just analyzing dusty weather, the model can function as a "virtual Mars". Since observation data on Mars is rare, scientists need simulation data to learn about the planet and then help them select appropriate landing areas and design rovers.

"For example, GoMars can simulate the temperatures of the landing zone, and scientists can use this data to design materials that are suitable for building Mars rovers to cope with extreme cold," Wang explained.

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