



**AGU100** ADVANCING EARTH AND SPACE SCIENCE

# MARS ON THE MALL: WALKING ON MARS IN THE NATION'S CAPITAL

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## INTRODUCTION

The Thermal Emission Imaging System (THEMIS)<sup>[1]</sup> onboard the 2001 Mars Odyssey spacecraft has acquired over 265,000 infrared images of the Martian surface at a resolution of 100 m/pixel since the start of science operations in February 2002. A global map was previously developed by mosaicking together over 24,000 high-quality full-resolution THEMIS daytime infrared images<sup>[2]</sup> and colorizing the mosaic using MOLA<sup>[3]</sup> elevation data. Although the resulting map has been extremely valuable for scientific and mission operations applications, it has been difficult to communicate this value to students, citizen scientists and the general public, since their interactions with the map had previously been limited to computer-based geographic information system (GIS) interfaces.

We determined that in order to better communicate the value and importance of mapping the entire Martian surface at 100 m/pixel resolution, people need to be able to physically interact with the map and experience its scale. Therefore, the THEMIS Day IR with Colorized MOLA Elevation Global Map was printed on a 95ft x 47.5ft vinyl mat, which allows observers to walk across the map and virtually explore Mars for themselves.

## MAP DETAILS

The size of the map (95ft x 47.5ft) was chosen to fit on a standard basketball court, so that a large number of schools will have a sufficiently large indoor surface on which to display the map for education and public outreach events. Due to the vinyl material used, the map must be displayed on smooth or carpeted hard surfaces in order to avoid damage. Displaying the map on uneven or rough surfaces (ex: concrete, asphalt, etc) could cause damage to the vinyl mat and/or the printed surface.

A simple cylindrical projection centered on the prime meridian was chosen for the map because it maximizes use of the printed surface, which is inherently rectangular, while avoiding the division of any major surface regions between the two ends of the map.

In addition to the simple cylindrical map, there are two smaller (15ft x 15ft) polar stereographic maps centered at each pole, which can be displayed along with the simple cylindrical map when sufficient space is available. These smaller maps are designed to give participants a better view of the Martian poles, which are significantly distorted in the simple cylindrical map. Both polar maps use custom MOLA elevation color scales in order to better emphasize the topography of the polar deposits.

The vinyl base material and large-format printing process selected for the map have been proven to be wear-resistant in similar applications by the National Geographic Society's Giant Maps program<sup>[4]</sup> and the Arizona Geographic Alliance's Giant Arizona Floor Map program<sup>[5]</sup>. For events where viewers are able to walk across the map, they are required to wear socks or similarly soft foot coverings, to prevent scratches on the map's printed surface.

## LESSONS LEARNED IN 2018

**Partnerships:** We initially found it challenging to identify schools and events interested in displaying the map. By partnering with the JPL Solar System Ambassadors program<sup>[6]</sup>, we were able to coordinate with educators in Arizona who were already interested in organizing NASA and STEM-related outreach events. The majority of our events in 2018 were co-organized with Solar System Ambassadors.

**Pre-Event Preparation:** Since our very first school event, teachers have expressed interest in additional resources they could use to better prepare their students for the experience of walking on the map. Therefore, we developed an "Introduction to Mars" PowerPoint presentation with extensive notes that teachers can review with their students prior to the map event. Multiple teachers have confirmed that they were able to give the presentation from the notes without any previous knowledge about Mars and students clearly engage with their tour guides more when they have already seen the introduction presentation.

**Student Accountability:** Another request from teachers was for worksheets that students could fill out during the "Introduction to Mars" presentation and while walking on the map, either with a tour guide or as part of the scavenger hunt activities. In response, we created "Introduction to Mars" and "Walking on Mars" worksheets, which are simple enough that they can be used by a wide range of ages. We also produced answer keys so teachers can quickly and easily grade them. The teachers who have used the worksheets so far have verified that they help keep students engaged, since the students know they are being held accountable through a graded assignment.

**Accessibility:** From the beginning, we have wanted to ensure that everyone is able to explore the map, regardless of whether or not they require assistance while walking across it. We have verified that walking casts do not damage the map, as long as a large cleanroom-style shoe cover is worn on the cast. Similarly, we have had participants use crutches and walkers to help them walk on the map, which does not cause any damage as long as the crutch tips, walker tips and/or wheels are free of any dirt or debris. We have also had a participant use a wheelchair to navigate around the map, so we were able to confirm that this does not cause any damage, as long as the wheels are clean and the map is displayed on a hard surface. We have not yet tested a wheelchair on the map when it is displayed outdoors on the softer foam mat, but we plan to do this test at our next outdoor event.

**Web Presence:** In order to more effectively publicize the map to educators and outreach event coordinators, we established a website at: <http://www.walkonmars.space>. The website includes a description of the map, pictures from all of our previous events, download links for our educator resources ("Introduction to Mars" presentation and worksheets), and online versions of our Mars Geography and Mars Landing Site scavenger hunts.

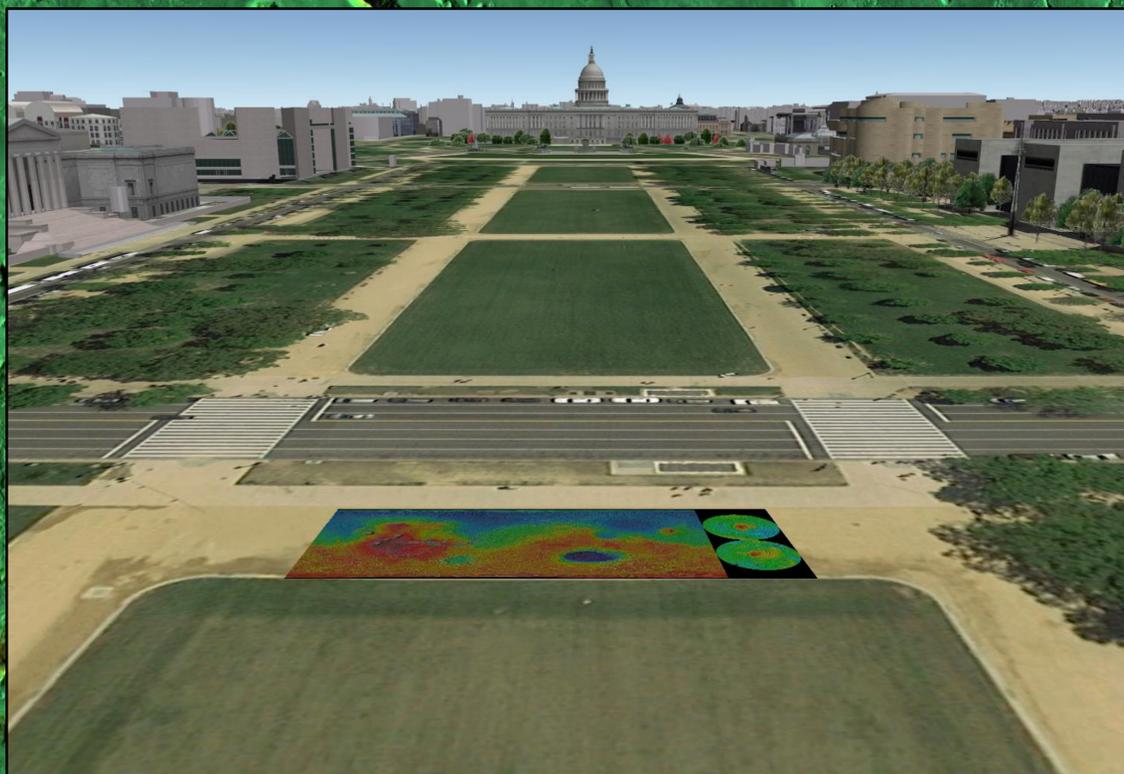


Figure 1: Artist's Rendition of the "Walk on Mars" Map Displayed on the National Mall<sup>[10]</sup>



Figure 2: Time-Lapse Assembly of the Foam Mat Used for Outdoor Map Displays; Same Process Will Be Used on the National Mall

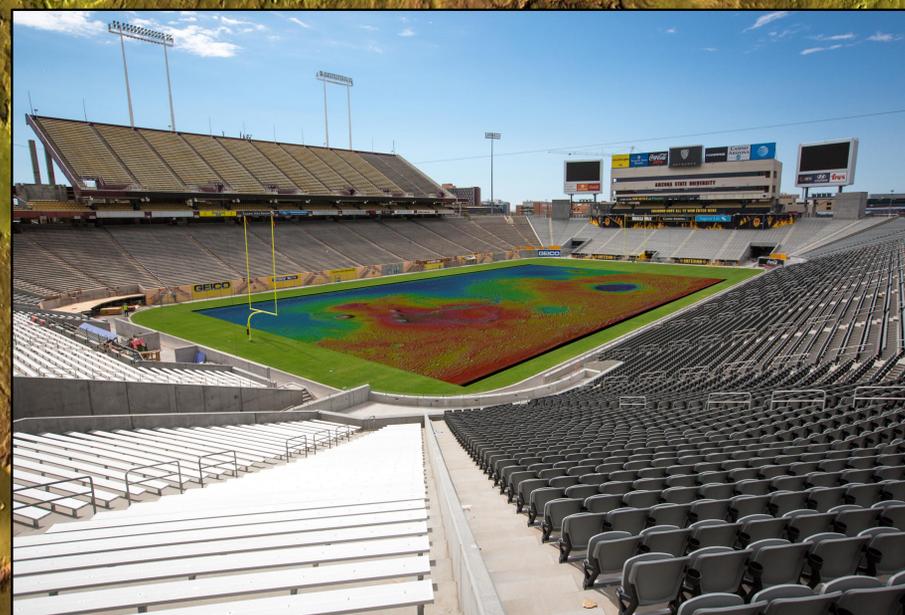


Figure 4: Artist's Rendition of the Football Field-Sized "Walk on Mars" Map Displayed in ASU's Sun Devil Stadium<sup>[11]</sup>

## AGU CELEBRATE 100 GRANT

The THEMIS team has partnered with the American Geophysical Union, through the AGU Celebrate 100 Grants Program<sup>[7]</sup>, as well as the Smithsonian National Air & Space Museum<sup>[8]</sup> and Explore Mars<sup>[9]</sup> to bring the Walk on Mars map to Washington, D.C. in Spring 2019.

The Walk on Mars map will be displayed on the National Mall near the Smithsonian National Air & Space Museum (west of 7<sup>th</sup> Street; Figure 1) on the hardscape surface using our outdoor foam mat (Figure 2) for an entire weekend, so that museum visitors will have the opportunity to explore Mars for themselves and learn about the history and future of Mars exploration. This will address the AGU Celebrate 100 goal of increasing awareness of space science beyond the membership of AGU.

AGU, Explore Mars and Arizona State University will also invite members of Congress and their staffs to join us on the map to talk about the United States' Mars exploration program. This will address the AGU Celebrate 100 goal of increasing awareness of space science amongst decision-makers.

Visitors to the map will be given a brief introduction to Mars and the meaning of the topographic colors on the map, and will then be invited to explore Mars with either the Mars Geography or Mars Landing Site Scavenger Hunts. Our staff will circulate around the map to answer their questions, help them find scavenger hunt locations they are struggling with, or just talk with them about Mars.

The map display will be open during approximately the same hours as the Smithsonian National Air & Space Museum (9am – 6pm). We are planning to hold the event on May 18-19, 2019, but we are still awaiting final approval of our permit request by the National Park Service. When the date has been finalized, it will be posted on our website: <https://www.walkonmars.space>



Figure 3: Families Participating in the Mars Geography Scavenger Hunt at an Outdoor Event

## NEXT STEPS: Walk on Mars at the Stadium

The Mars Odyssey spacecraft, with the THEMIS camera onboard, launched to Mars on April 7th, 2001 and entered orbit around Mars on October 24<sup>th</sup>, 2001. The THEMIS team is aiming to celebrate the 18<sup>th</sup> anniversaries of both events by printing a new "Walk on Mars" map at full resolution, which will make it the size of a football field (Figure 4).

Arizona State University has begun a crowdfunding effort to help raise the \$35,000 needed to print this stadium-sized map. A link to the crowdfunding page is available at: <https://www.walkonmars.space>

All donors can choose their contribution amount (min: \$5) and will be added to our mailing list, so they can receive special updates about the crowdfunding effort and preparations for our first public display of the map. Donors who contribute at, or above, the special giving levels listed on the site will receive small tokens of our appreciation, such as invitations to an early viewing event and being listed as official sponsors.

To supplement the crowdfunding effort, we are also reaching out to potential corporate sponsors. Major contributors will be given the opportunity to have their names and/or logos displayed along the edges of the final map, in recognition of their contributions.

## ACKNOWLEDGEMENTS

The "Walk on Mars" project was partially inspired by the National Geographic Society's Giant Maps program, was completed with the assistance of the Arizona Geographic Alliance, and was largely funded through the Arizona State University School of Earth and Space Exploration (SESE) Summer Exploration Graduate Fellowship program. The "Mars on the Mall" event will be funded by the American Geophysical Union (AGU).

## References

- [1] Christensen et al. (2004) Space Sci Rev 110: 85-130. [2] Hill and Christensen (2017) J. Geophys. Res. Planets, 122, 1276-1299. [3] Smith et al. (2001) J. Geophys. Res. Planets, 106, 23689-23722. [4] <https://www.nationalgeographic.org/education/giant-maps/> [5] <https://geoalliance.asu.edu/GiantTraveling-Map> [6] <https://solarsystem3.jpl.nasa.gov/ssa> [7] <https://centennial.agu.org/centennial-project-support> [8] <https://airandspace.si.edu> [9] <https://www.exploremars.org> [10] Source: Google Earth, March 4, 2019 [11] <https://asunow.asu.edu/20160907-asu-completed-35m-facilities-upgrades-over-summer>

Figure 5: (Background) Subsection of the THEMIS Day IR with Colorized MOLA Elevation Global Map at the Approximate Printed Resolution of the Floor Map