A QUALITY CONSTRAINED THEMIS DAYTIME INFRARED GLOBAL MOSAIC. J. R. Hill[1] and P. R. Christensen[1]; [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287-6305 (jonathon.hill@asu.edu).

Introduction: The 2001 Mars Odyssey spacecraft entered orbit around Mars on October 24th, 2001 and is the longest-operating spacecraft in the history of Mars exploration. The Thermal Emission Imaging System (THEMIS) has been acquiring observations in both infrared and visible wavelengths since the beginning of science operations in February 2002. While previously assembled THEMIS global mosaics have focused only on spatial coverage, this new daytime global infrared mosaic has been optimized to include only the best quality images acquired over the first fourteen years of the mission while still maintaining global coverage.

Background: The THEMIS instrument consists of two multispectral imaging subsystems; a ten-band thermal infrared imager and a five-band visible/near-infrared imager. The thermal infrared camera has a nominal spatial resolution of 100m/pix and covers a wavelength range of 6.7 μm to 14.8 μm [1]. During the first fourteen years of science operations, THEMIS has acquired over 200,000 infrared images of the surface, which includes 100% daytime coverage between 87.3°N - 87.3°S and approximately 95% nighttime coverage between 60N - 60S. In 2011, Edwards *et al.* [2,3] used data acquired during the first 7.5 years of the mission to create daytime and nighttime global mosaics of THEMIS infrared images, but were unable to achieve complete coverage in both mosaics due to the lack of quality data over some regions. In 2014, Hill *et al.*[4], used data from the first twelve years of the mission to complete the daytime global mosaic between 87.3°N - 87.3°S and significantly improve the coverage of the nighttime global mosaic.

Methods: Each quadrangle of the Hill *et al*. [4] THEMIS daytime infrared global mosaic, which was composed of THEMIS band 9 (12.57 μm) images, was visually reevaluated image-by-image. Images that reduced the quality of the overall mosaic (ex: images with significantly errors in their reconstructed geometry, images with noise due to low surface temperatures or atmospheric effects, etc) were removed and replaced by higher quality images. The following are descriptions of some common improvements made throughout the quality constrained version of the global mosaic:

Images with Poor Geometry Replaced. The previous THEMIS global mosaics, as well as this one, do not attempt to tie images to ground points. Instead, the individual images are placed according to geographic positions derived from reconstructed spacecraft position and pointing data. Although the image-to-image registration is rarely perfect, offsets are usually small relative to the 100 m/pixel resolution of the mosaic. However, in cases where the Hill *et al*. [4] daytime global mosaic contained images with large offsets (due to extrapolations over gaps in spacecraft position and pointing telemetry, etc), the images were removed and replaced by images with better geometry data. An example of this correction is shown in Figure 1.

Noisy Images Replaced. The Hill *et al*. [4] daytime global mosaic also contained numerous images with significant noise resulting from low surface temperatures, atmospheric effects, etc. These poor-quality images were identified and replaced by higher-quality images, where possible, as demonstrated in Figure 2.

Remaining Small Gaps Filled. Although the Hill *et al*. [4] daytime mosaic was described as 100% complete between 87.3°N - 87.3°S, a number of small gaps were subsequently identified. These gaps were the result of line dropouts in various images that were not completely filled in by overlap with adjoining images. The gaps were identified by reviewing the entire mosaic at full resolution and then filled with the highest-quality images available.

Polar Gaps Filled with ROTO Images. Due to a combination of the Odyssey spacecraft's orbital inclination and the THEMIS infrared field-of-view, the instrument is not able to observe poleward of 87.3° while in its nominal nadir-pointed attitude. In 2015 the Odyssey team resumed Routine Off-nadir Targeted Observations (ROTOs), which allow THEMIS to request up to ten roll-only ROTOs per month, which can be up to +/-11° from nadir. These ROTOs observations allow THEMIS to observe between 87.3°-88.75° at both poles, which has allowed a significant portion of the existing gaps at both poles to be filled.

Results: This work has resulted in the development of an updated and quality constrained version of the THEMIS Day IR Global Mosaic, which has been designated version 13.0. This is highest resolution and highest quality global map of Mars currently available.

The improved THEMIS Day IR Global Mosaic has also allowed updated versions of two combination global mosaic products to be produced. An updated version of the "THEMIS Day IR with MOLA Color" global map, designated version 2.0, was produced by overlaying colorized surface elevation data from the Mars Orbiter Laser Altimeter [5] on the updated THEMIS Day IR Global Mosaic. Similarly, an updated version of the "THEMIS Day IR with Night IR Color"

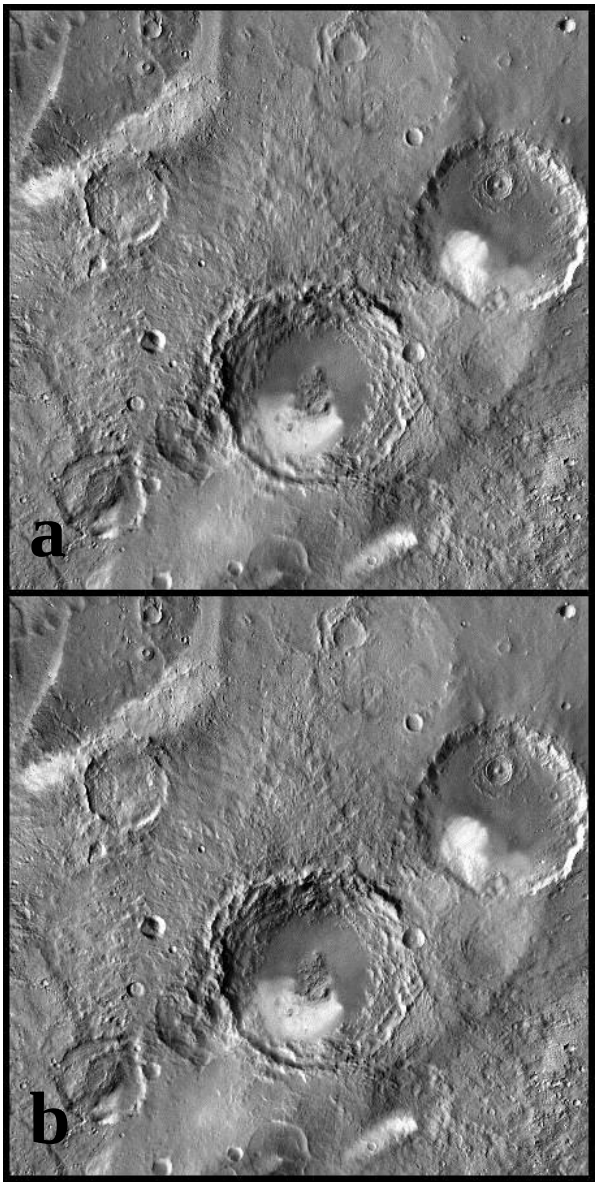

Figure 1: Example of poor geometry image replacement centered at 10.40N, 8.15E; a) Day IR Global Mosaic v12, b) Day IR Global Mosaic v13. Note the removal of smear from above the center crater in (b).

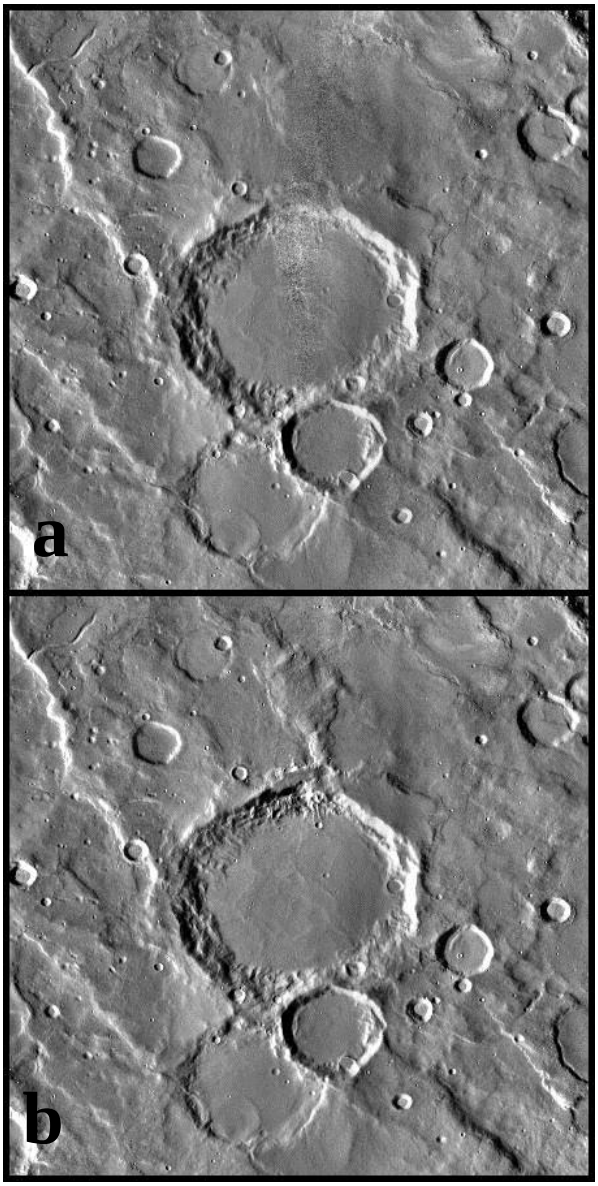

Figure 2: Example of noisy image replacement centered at 25.88N, 41.50E; a) Day IR Global Mosaic v12, b) Day IR Global Mosaic v13. Note the clearer view of the center crater floor in (b).

global map, designated version 2.0, was produced by overlaying a colorized version of the current THEMIS Night IR Global Mosaic (v14) on the THEMIS Day IR Global Mosaic.

All three of these improved global mosaics can be accessed through the JMARS geospatial information system (http://jmars.asu.edu) developed by Arizona State University's Mars Space Flight Facility.

Future Work: Work on a quality constrained version of the THEMIS nighttime global infrared mosaic has already begun. When completed, it will be released along with an undated version of the THEMIS Daytime IR with Nighttime Temperature global map. These products will then be published to the NASA Planetary Data System (PDS) as THEMIS special products.

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References: [1] Christensen et al. (2004) Space Sci Rev 110: 85-130. [2] Edwards et al. (2011) JGR, 116,E10008. [3] Edwards et al. (2011) JGR, 116, E10005. [4] Hill et al. (2014) 8th International Conf. on Mars, Abstract #1141. [5] Smith *et al.* (2003) PDS.