MAPPING THE MARTIAN SURFACE WITH THEMIS GLOBAL INFRARED MOSAICS. J. Hill[1], C. S. Edwards [2] and P. R. Christensen[1]; [1]School of Earth and Space Exploration, Arizona State University, [2]Division of Geological and Planetary Sciences, California Institute of Technology. (contact: 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. Global mosaics of daytime and nighttime THEMIS infrared images have been compiled using data collected over the first twelve years of the mission and combination mosaics have been created by colorizing the daytime infrared mosaic with nighttime temperature and elevation data.

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 its twelve years of science operations THEMIS has acquired over 175,000 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] 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.

Methods: Daytime and nighttime infrared images acquired over the most recent 4.5 years of the mission were used to significantly improve the planet-wide coverage of the global mosaics by filling in gaps and replacing lower quality images. The daytime infrared mosaic was then colorized using nighttime temperature data and elevation data to produce global maps that emphasize surface material properties while retaining morphologic context.

Completion of Day IR Mosaic. Newly acquired THEMIS daytime infrared images were used to complete the Day IR global mosaic between 87.3°N – 87.3°S using the mosaicking methods of Edwards *et al.* [2]. Very few high-quality images are available poleward of 87.3° because the Odyssey spacecraft must perform roll maneuvers in order to bring those regions within the THEMIS infrared camera's field-of-view and such maneuvers are currently only supported under special circumstances. This updated version of the THEMIS Day IR global mosaic has been designated version 12.0 and is the highest resolution global map of Mars available to date.

Improvement of Night IR Mosaic. Nighttime THEMIS infrared images acquired over the same period were used to improve the coverage and quality of the Night IR global mosaic between 60°N – 60°S. Very few quality Night IR images are available poleward of 60° due to seasonal frost coverage and the decreasing day-night surface temperature differential with increasing latitude. This updated version of the THEMIS Night IR global mosaic has been designated as version 14.0.

Day IR Mosaic with Nighttime Temperatures. The Night IR global mosaic was colorized and then superimposed on the Day IR global mosaic to emphasize the relationship between the surface morphology and the thermophysical properties of the surface materials, which are expressed as differences in nighttime temperatures [3]. The resulting global mosaic is only colorized between 60°N – 60°S where there is coverage in the Night IR global mosaic.

Day IR Mosaic with Elevation Data. Mars Orbiter Laser Altimeter (MOLA) colorized surface elevation data [4] was superimposed on the Day IR global mosaic in order to produce a global base map that combines 100 m/pix resolution of surface features with the geographical context provided by the MOLA topography map.

Results: A section of the Day IR global mosaic colorized with nighttime temperature data centered in southern Syrtis Major Planum (~1N, ~69E) is shown in Figure 1. The complex pattern of windstreaks, crater ejecta and underlying bedrock is emphasized by differences in their relative temperatures, which are a direct result of their thermophysical properties, such as grain size, albedo and degree of cementation.

A section of the Day IR global mosaic colorized with MOLA elevation data centered in northern Nili Fossae (~25N,~76E) is shown in Figure 2. The topographic variation between the fossae, cratered highlands and the southern Nilosyrtis Mensae is clearly visible while retaining the Day IR mosaic's 100m/pix resolution of the surface morphology.

Discussion: The new Day IR global mosaic is currently being used as the primary Mars base map by the THEMIS team for science target planning. It is also being used, in conjunction with MOLA colorized elevation data, as the base map for the International Astronomical Union's Martian nomenclature maps [5]. All four maps detailed here are currently undergoing final validation, after which they will be made publicly available through the JMARS tool (http://jmars.asu.edu)

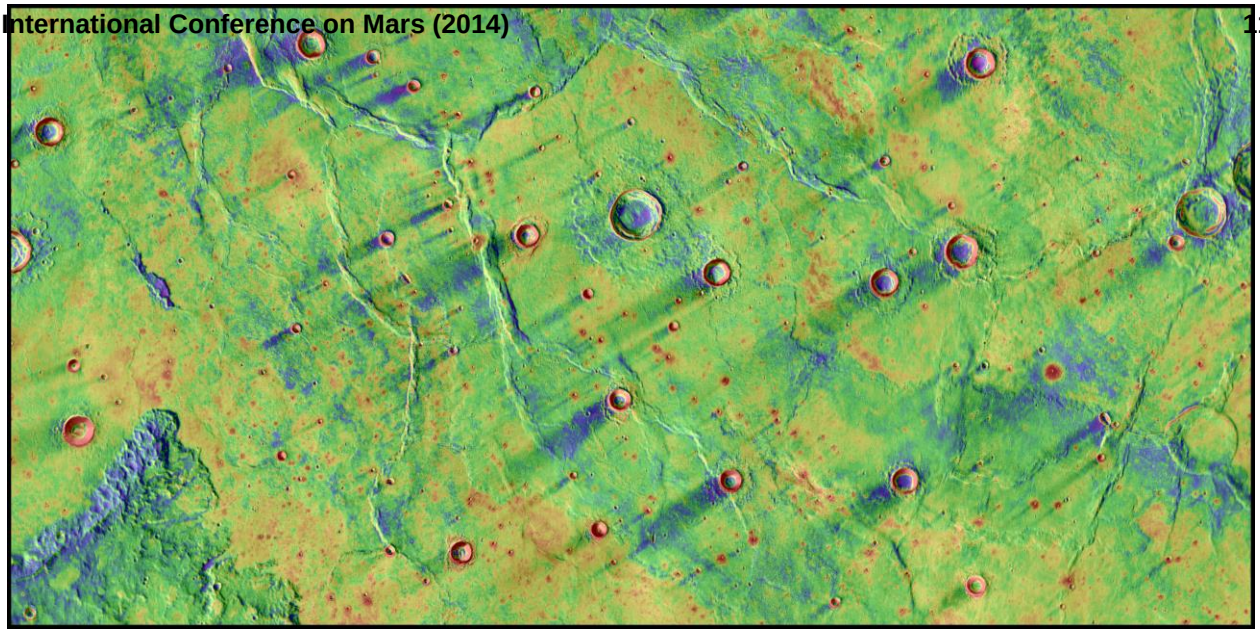

Figure 1: Southern Syrtis Major Planum (1N,69E) shown in a subsection of the THEMIS Day IR global mosaic colorized with THEMIS nighttime temperature data.

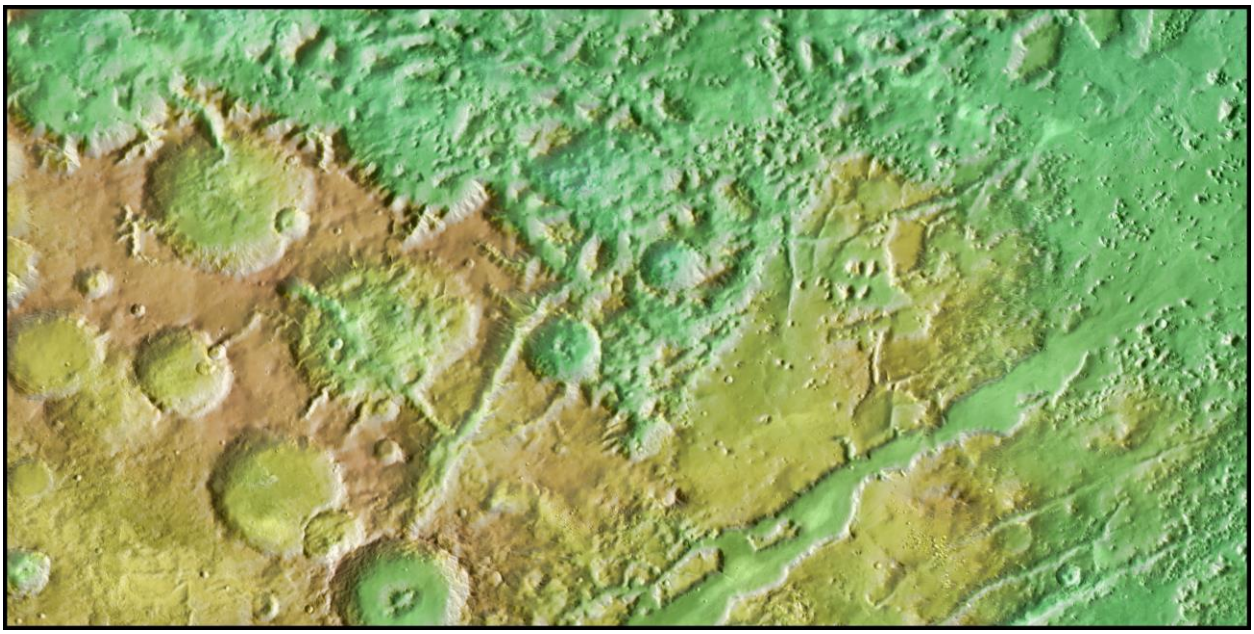

Figure 2: Northern Nili Fossae (25N,76E) shown in a subsection of the THEMIS Day IR global mosaic colorized with MOLA Elevation Data.

developed by Arizona State University's Mars Space Flight Facility [6] and through special PDS products.

Future Work: Using the quality constrained image lists compiled for the Day and Night IR global mosaics, we plan to generate global mosaics further constrained by Mars Year in order to more easily identify large-scale surface changes over the duration of the mission. These mosaics will have incomplete global coverage due to the added temporal constraints, but major surface features are expected to have significant coverage in each yearly mosaic due to the THEMIS instrument's surface monitoring campaigns.

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] Smith *et al.* (2003) PDS. [5] IAU-WGPSN Gazetteer of Planetary Nomenclature Website, Apr 20, 2014. [6] Christensen et al. (2009) AGU Fall Meeting, abstract #IN22A-06.