

AN UPDATE ON THE TES AND THEMIS RETRIEVAL DATASETS

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Introduction: Retrievals of atmospheric parameters (atmospheric temperature, dust and water ice aerosol optical depth, and water vapor column abundance) and surface temperature using thermal-infrared observations made by the Thermal Emission Spectrometer (TES) [1] and Thermal Emission Imaging System (THEMIS) [2] continue to be an important data source for data assimilation models for Mars. Here we provide an update on the status of the available retrieval data products from these two instruments.

Thermal Emission Spectrometer (TES): The TES instrument [3] on-board the Mars Global Surveyor orbiter provided nearly-continuous daily global mapping of the Mars atmosphere (and surface) from 1999 to 2004 (MY 24, Ls=104° to MY 27, Ls=81°) [1]. Some additional observations were also taken during the periods of aerobraking and science phasing in 1997 and 1998 (MY 23, Ls=182° to MY 24, Ls=40°) [4,5].

Recent work on the TES atmospheric retrievals has been performed to improve several aspects of the aerosol retrievals relative to those retrieved results delivered to the PDS and reported in [1].

Specifically, the criterion for accepting a retrieval as valid has been changed from a strict minimum surface temperature to a numerical determination of the sensitivity of each observation to a change in the aerosol optical depth. This new approach is more physically based, allows a greater latitude range of observations to be retrieved, and enables a meaningful uncertainty to be estimated for each individual retrieval. In addition, an error in the original TES retrieval algorithm has been isolated and fixed that had caused biases in retrieved optical depth when surface temperatures were cool. Other minor inconsistencies in the code in handling different spectral resolutions and spectral sampling modes were also identified and corrected.

These changes have minimal impact on most of the TES retrievals for observations with warm surfaces. The largest effects are on the retrievals with cool surfaces, which are generally found in the winter hemisphere at higher latitudes. These new TES retrievals of aerosol optical depth are now in better overall agreement with the retrievals from other instruments.

New versions of the TES Seasonal Climatology and TES Mapped Climatology gridded data products have been produced using the new aerosol retrievals and are available from the author.

Thermal Emission Imaging System (THEMIS): The THEMIS instrument [6] on-board the Mars Odyssey orbiter has taken nearly-continuous observations of Mars since 2002 (MY 25, Ls=330°) [2], which continue to the time of this writing. Although Odyssey is in a Sun-synchronous orbit, the mean local time of the orbit has been systematically varied between approximately 3:30/15:30 and 6:45/18:45 hours over the 8+ Mars Years of the mission. Odyssey's orbit currently has a mean local time of 6:45/18:45.

Recent work on the THEMIS atmospheric retrievals has two main goals. First, to continue the long-term monitoring of atmospheric conditions (atmospheric temperature, dust and water ice aerosol optical depth) and surface temperature. And second, to examine the changes in water ice cloud optical depth and its spatial/seasonal distribution as a function of local time by comparing retrieval results taken during different Mars Years when the spacecraft orbit was at different local times.

The current orbit of Odyssey provides an interesting view of conditions just after sunrise and sunset. However, this later local time is characterized by a relatively low thermal contrast between the surface and atmosphere as compared to earlier local times. This complicates the retrievals. Because of the low thermal contrast, validation of the retrieved aerosol optical depth and accurate estimation of the retrieval uncertainties is very important for properly evaluating trends. Therefore, to aid the THEMIS retrievals many of the new techniques mentioned earlier that have been used to improve the TES retrievals have also been used for THEMIS.

An updated version of the THEMIS Climatology gridded data product has been produced and is available from the author.

References: [1] Smith M. D. (2004) *Icarus*, 167, 148–165. [2] Smith M. D. (2009) *Icarus*, 202, 444–452. [3] Christensen P. R. et al. (2001) *JGR*, 106, 23823–23871. [4] Smith M. D. et al. (2000) *JGR*, 105, 9539–9552. [5] Conrath B. J. et al. (2000), *JGR*, 105, 9509–9519. [6] Christensen P. R. et al. (2003) *Space Sci. Rev.*, 110, 85–130.