When and Where? Prioritizing Temperature Measurements for Thermophysical Analysis

#1902

Jonathan Bapst[1,*], Sylvain Piqueux[1], Chris Edwards[2], and Robin Fergason[3]

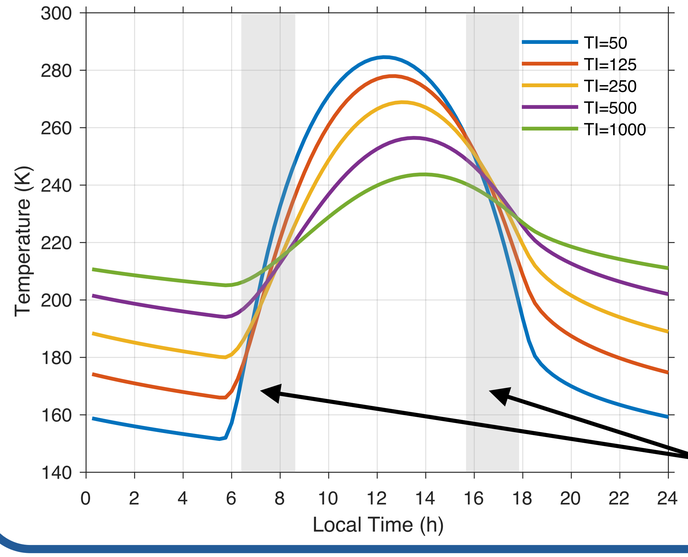
[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, [2]Northern Arizona University, Dept. of Physics and Astronomy, Flagstaff, AZ, [3]US Geological Survey, Astrogeology Science Center, Flagstaff, AZ

Jet Propulsion Laboratory
California Institute of Technology

*Email: jonathan.bapst@jpl.nasa.gov

Background

- Measured temperatures can be used to constrain near-surface physical properties
- Accuracy of derived properties depends on the uncertainty in the data, model, and assumptions



Modeled diurnal temperatures for Mars over a range of thermal inertias (TI; in units of J m^{-2} K^{-1} s$^{-1/2}$).

Setting is 12.5°N and L_S=120° with albedo=0.24

Crossover times

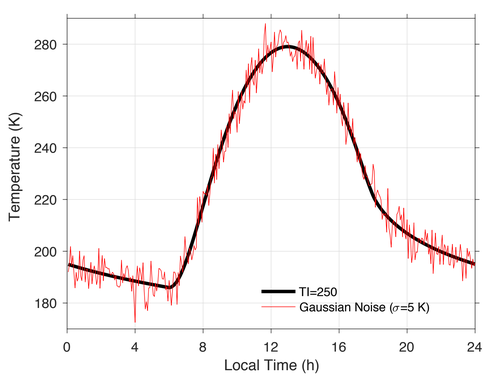
→ **Goal:** Quantify error in derived properties as a function of setting (space & time), model assumptions, and data accuracy

Methods

We employ KRC [1,2], a well-established and validated 1D thermal model. Results are relevant to generic Mars thermophysical analyses using individual temperature measurements.

We explore three sources of error in deriving TI:

1. Numerical & interpolation error
2. Assumed surface albedo
3. Instrument noise (see right figure)



We report the absolute difference in best-fit thermal inertia from prescribed values (TI=250; albedo=0.2) with introduced errors

Results

1. Numerical & Interpolation Error

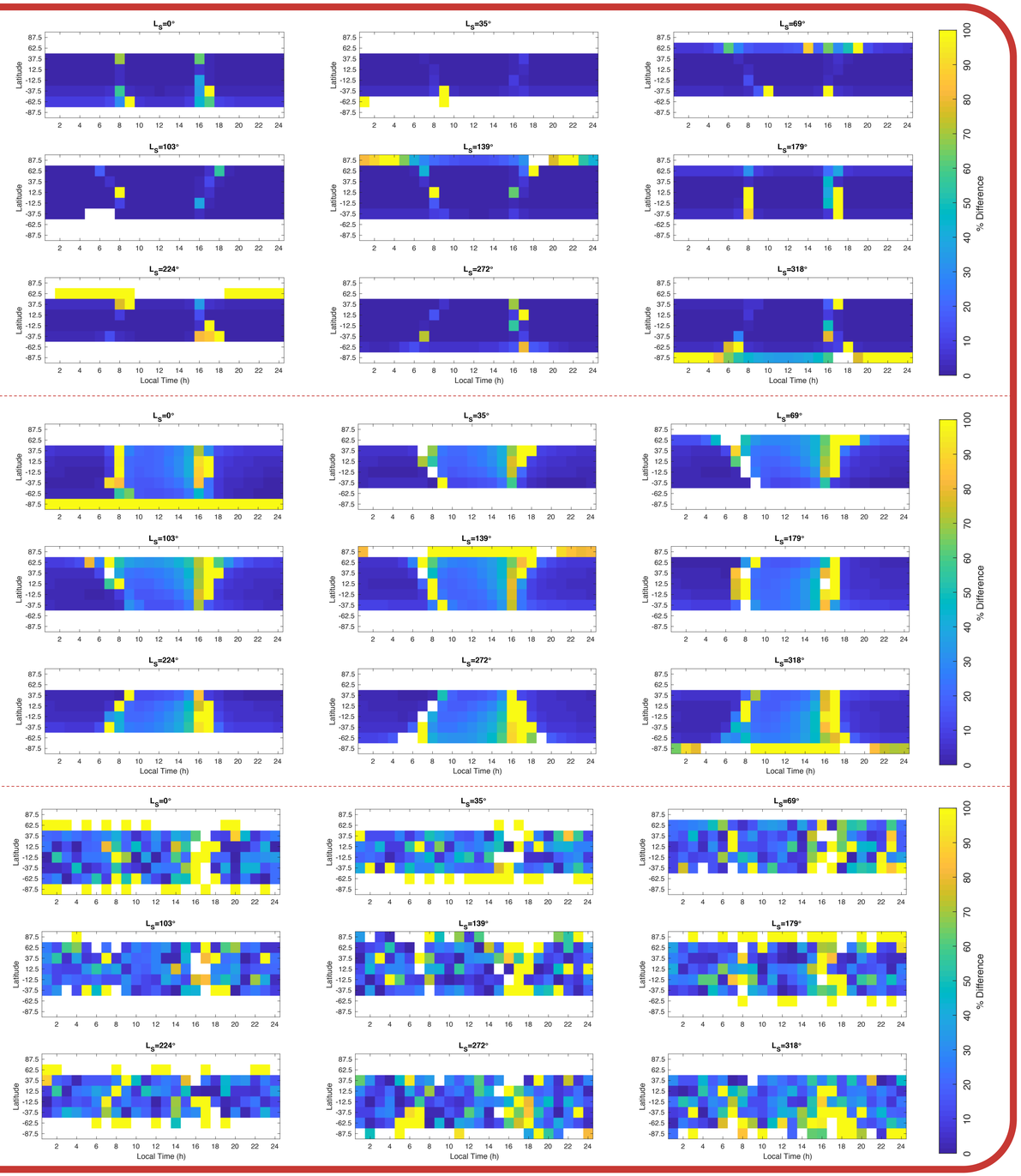
- Best case
- Small uncertainty outside of crossover time (<5%)

2. Assumed Surface Albedo

- Prescribed 25% underestimate
- Daytime derived TI is >20%
- Uncertainty increases throughout daytime

3. Instrument Noise

- Gaussian noise (σ=5 K) added
- Derived TI uncertainty >~20% for all cases



Conclusions

- Crossover times should always be avoided
  - Note dependence with season outside of tropics
- Use nighttime temperatures if albedo is poorly constrained
- Noisy data can yield erroneous properties
  - May be countered by using multiple temperature measurements (future work!)

References & Acknowledgements

[1] Kieffer H. H (2013) *JGR, 118,* 451–470.
[2] Piqueux S. et al. (2018) *LPSC XLIX,* Abstract #1027.

We acknowledge support from NASA grants 15-PDART15_2-0023 and 14-MDAP14_2-0017