

# Thermal Infrared Observations and Thermophysical Modeling of Phobos

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in collaboration with:

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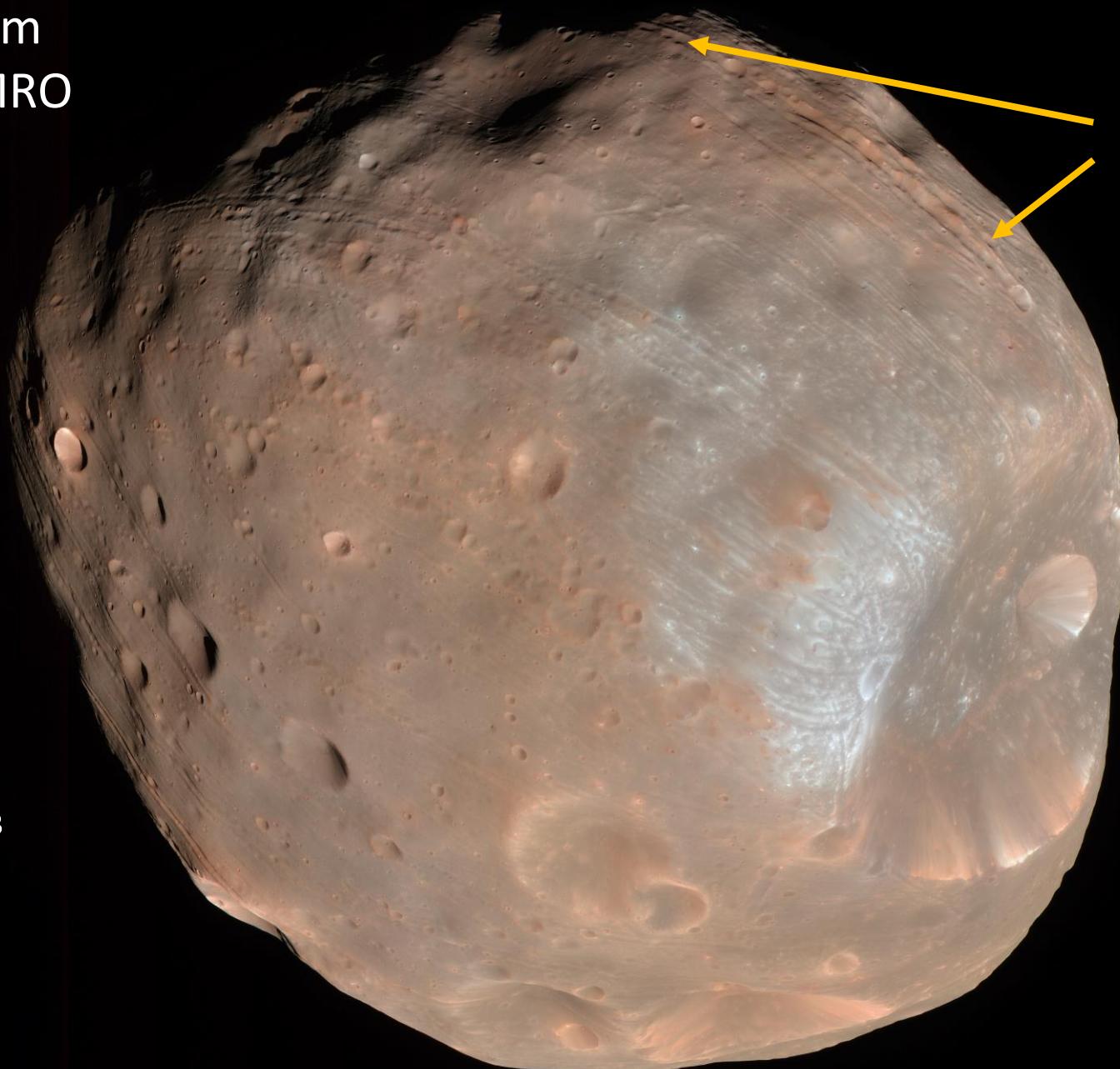
Phobos from 6,800 km  
Camera: HiRISE on MRO

ORBIT:

Semi-major axis:  
9,376 km ( $2.8 r_{\text{Mars}}$ )  
Eccentricity: 0.0151  
Inclination:  $1.1^\circ$   
Period: 7.6 hours

Density:  $1.876 \text{ g/cm}^3$

27 km



Crater chains from  
secondary debris  
impacts

Stickney Crater:  
 $\sim 9 \text{ km}$

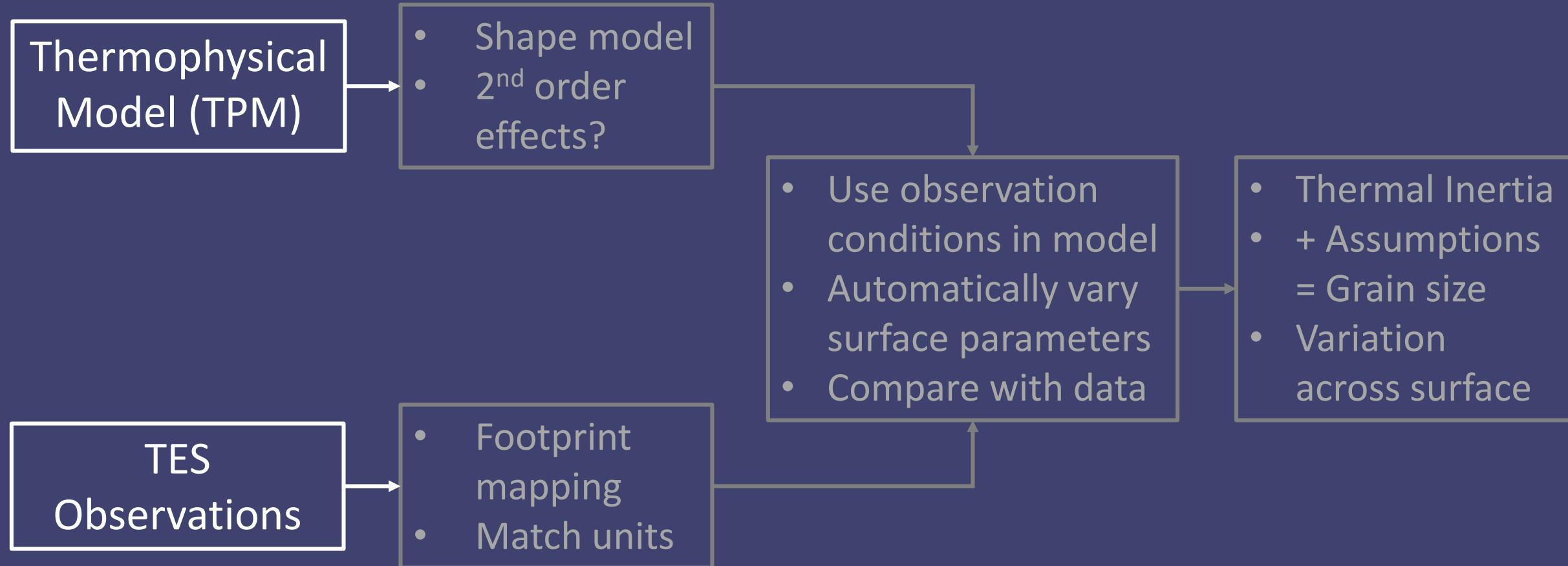
Blanketed in  
dusty regolith

## Existing Assets

## Modifications

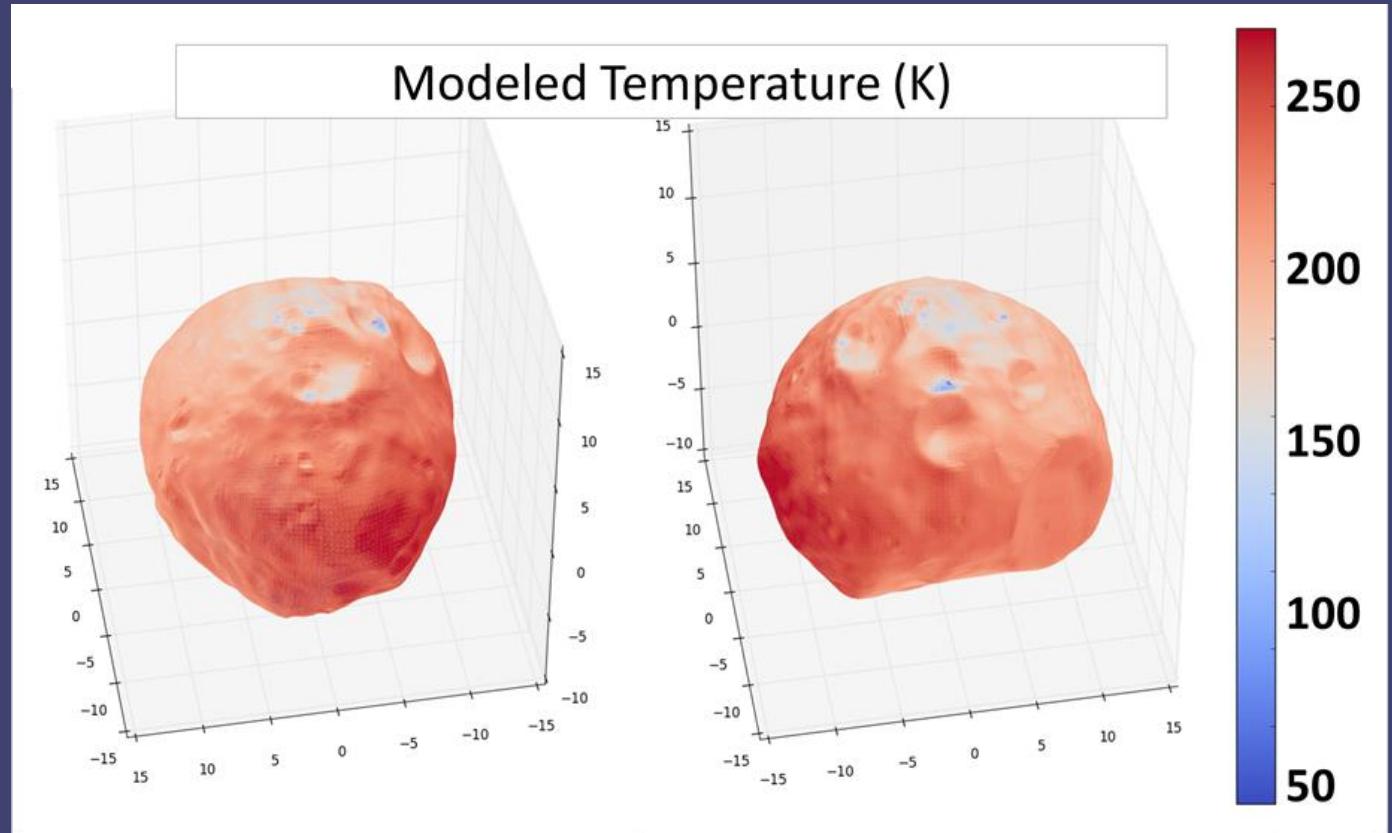
## Integration

## Science Results



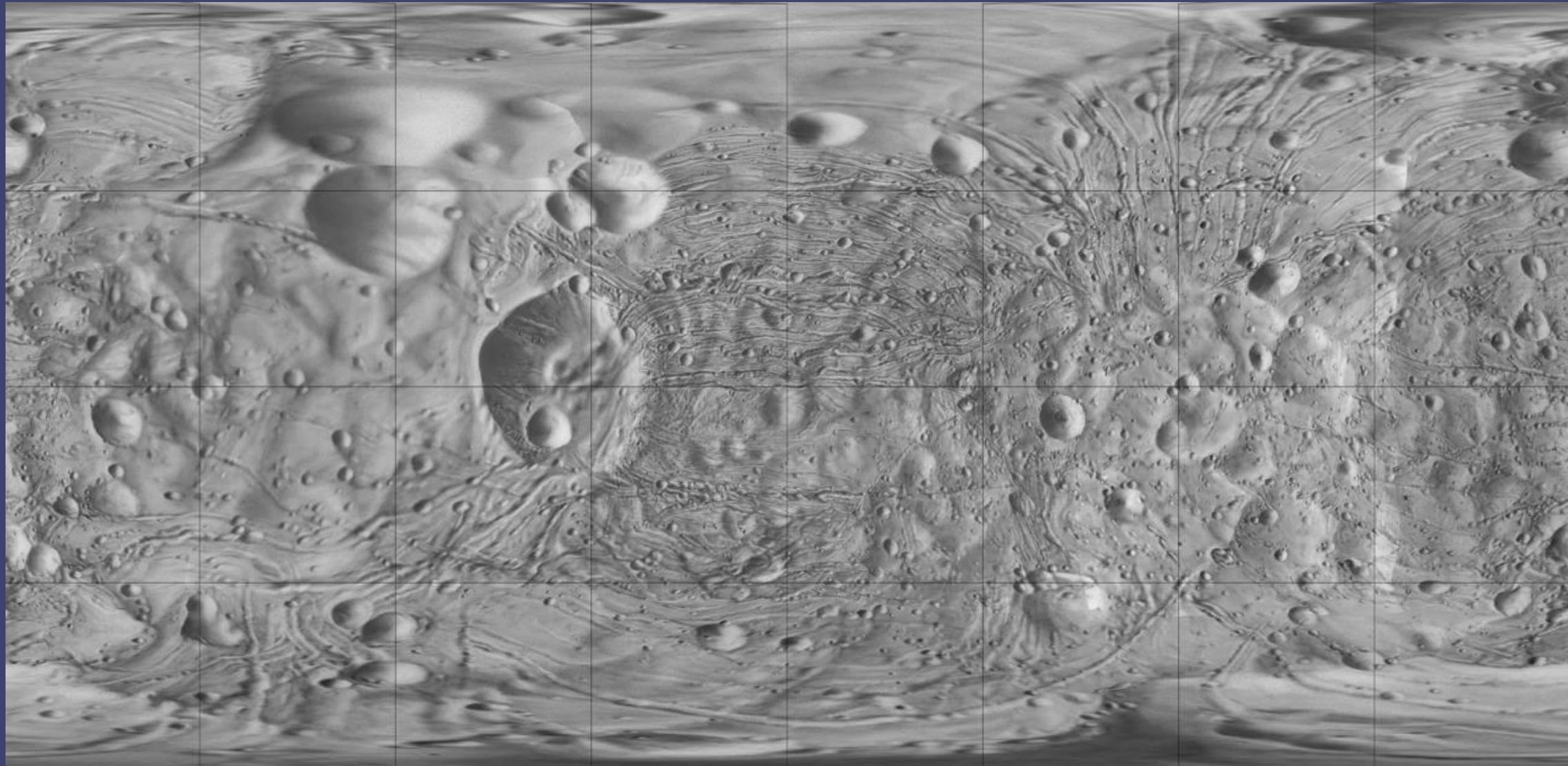
# Thermophysical Model (TPM)

- convex.C : developed for unresolved asteroid observations
- Inputs:
  - Object dimensions, orbit, rotation
  - Illumination geometry
  - Surface properties
  - Viewing geometry
- Outputs:
  - Temperature --->
  - IR Radiance

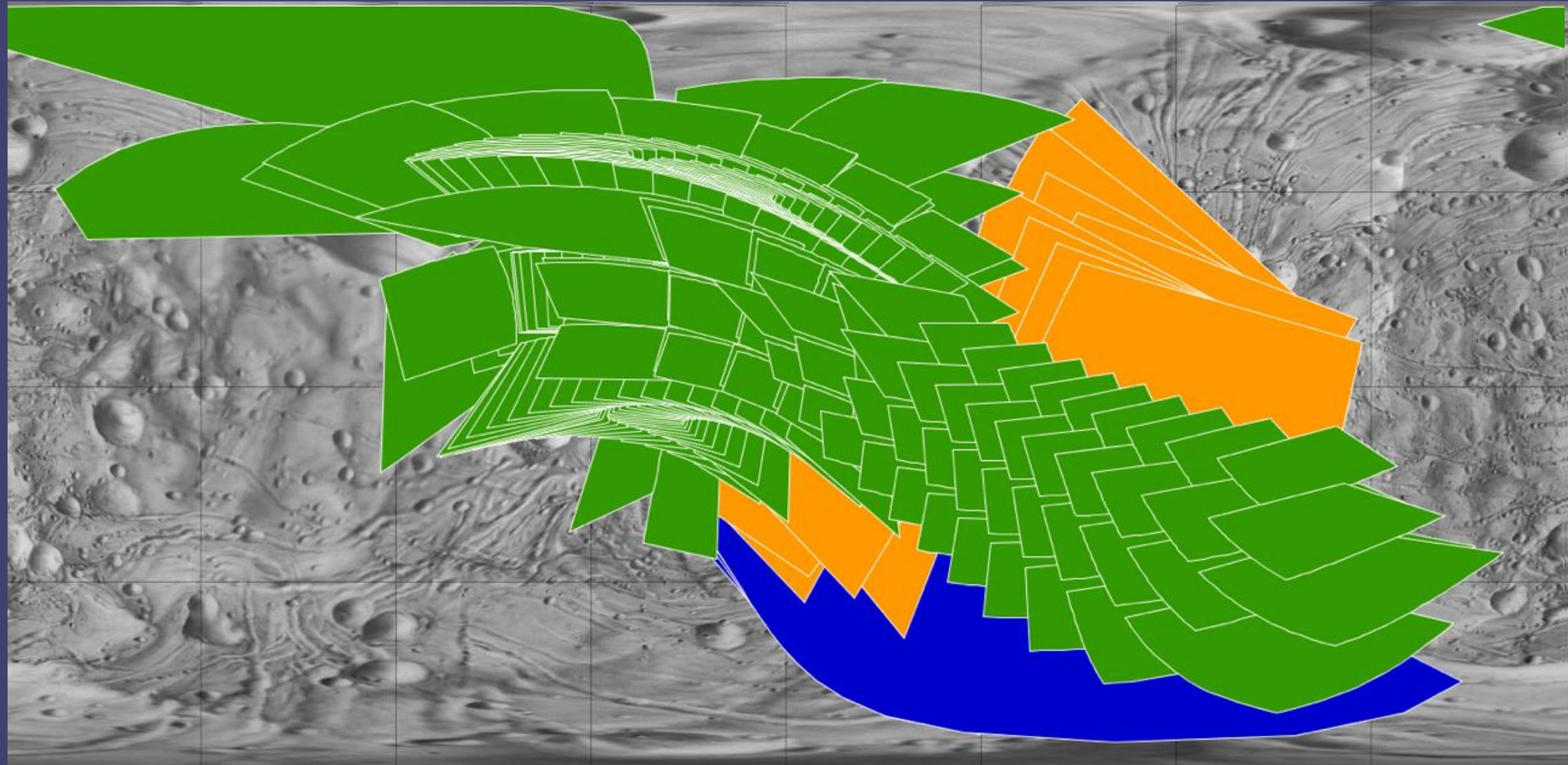


After implementing Phobos shape model

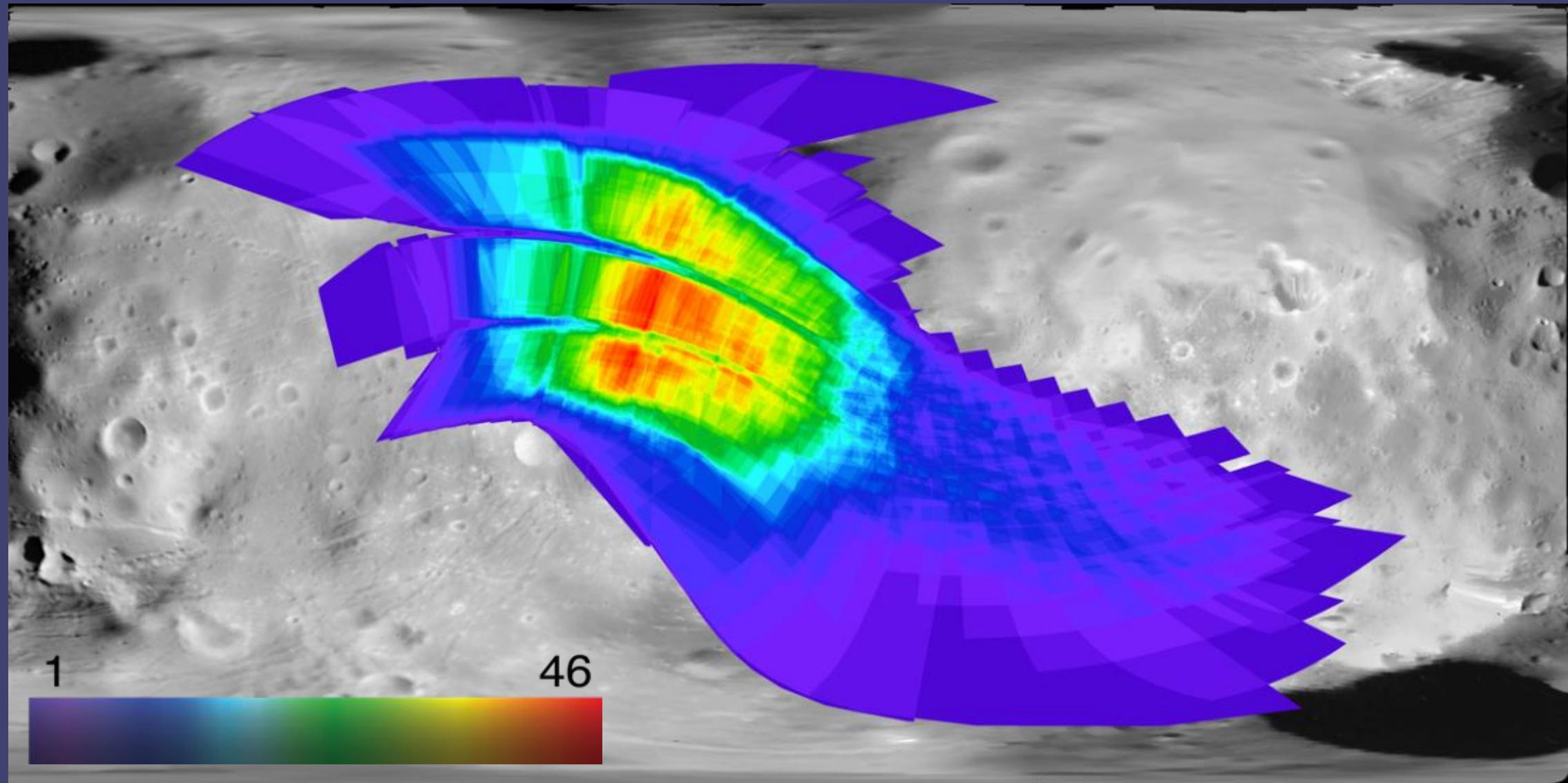
# Thermal Emission Spectrometer (TES) Observations



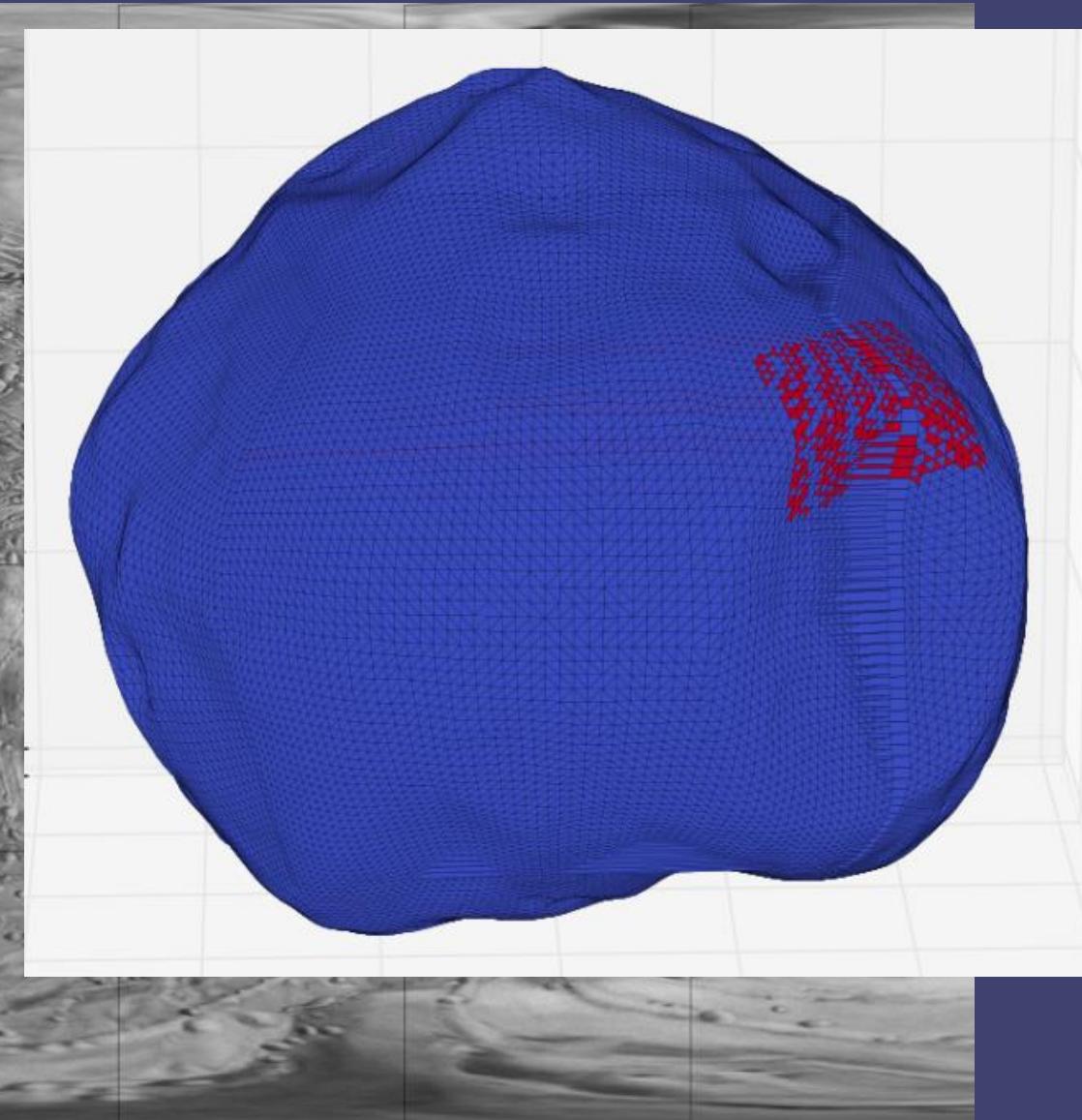
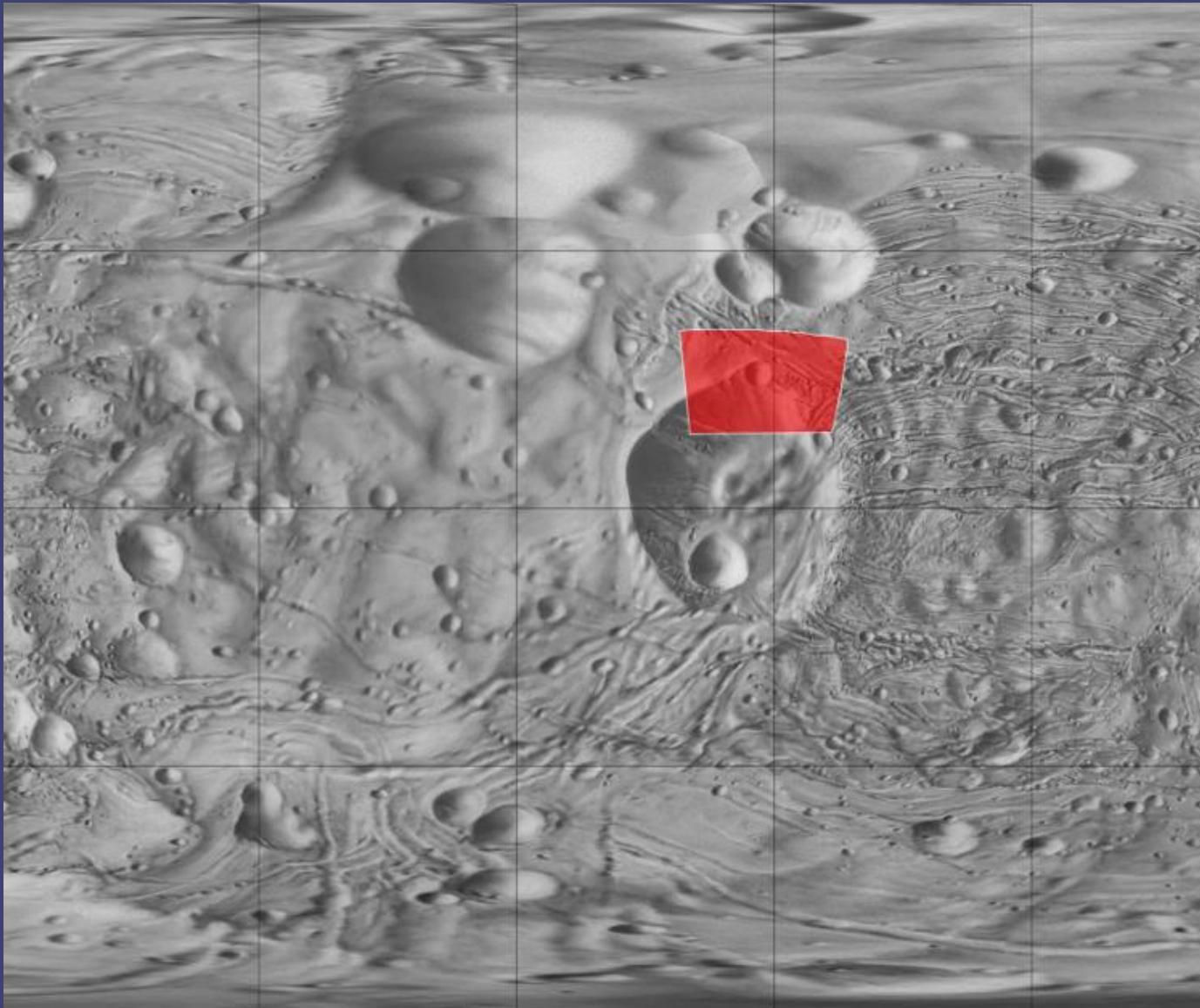
# Thermal Emission Spectrometer (TES) Observations



# Thermal Emission Spectrometer (TES) Observations



TES OBS 551 2429\_2



## Existing Assets

## Modifications

## Integration

## Science Results

Thermophysical Model (TPM)

- Shape model
- 2<sup>nd</sup> order effects?

TES Observations

- Footprint mapping
- Match units

- Use observation conditions in model
- Automatically vary surface parameters
- Compare with data

- Thermal Inertia
- + Assumptions
- = Grain size
- Variation across surface

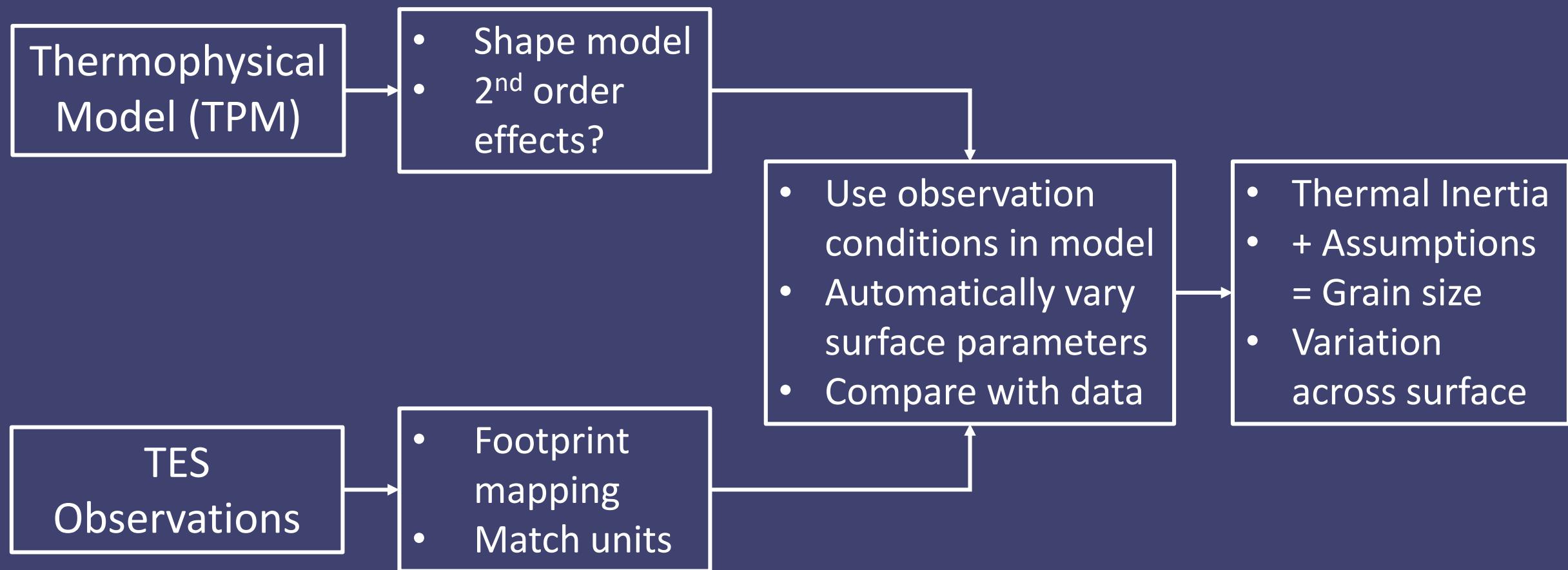
Progress so far...

## Existing Assets

## Modifications

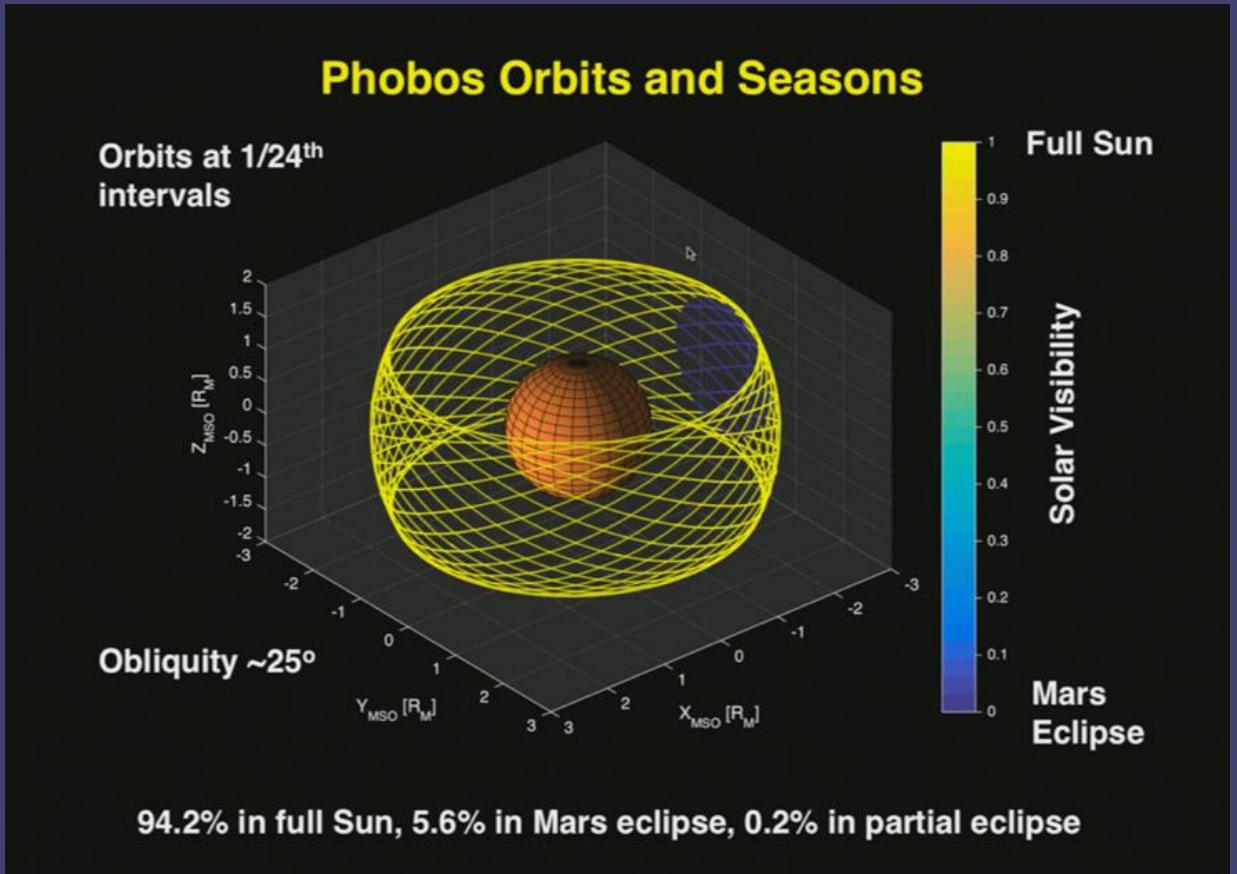
## Integration

## Science Results



# Backups: TPM Modifications

- Shape model
- 2<sup>nd</sup> order effects?
  - Temperature-dependent conductivity
  - Depth-dependent parameters
  - Seasons
  - Eclipses
  - Mars heating
  - Variations across surface
  - Self re-radiation
- Do these effects even matter?



Tim Stubbs – Illumination conditions at Phobos –  
Phobos-Deimos Conference, 7.19.2016

# Backups: TES OBS 551 2429\_2

