

Mars Polar Orbiter Science

Timothy N. Titus, USGS

Thomas H. Prettyman, Planetary Science Institute

Timothy I. Michaels, Southwest Research Institute

Jeffrey Barnes, Oregon State University

Hugh H. Kieffer, Celestial Reasonings

Adrian Brown, NASA Ames Research Center

Shane Byrne, University of Arizona

Kathryn E. Fishbaugh, Smithsonian National Air
and Space Museum

Michael H. Hecht, Jet Propulsion Laboratory

Motivation for Continued Polar Observations

- The polar caps are the most active regions on Mars
- 25-30% of the atmosphere is cycled through the seasonal caps annually
- To understand Mars past climates, we must understand Mars present climate.
- To understand Mars present climate, we must understand the polar regions

Questions – Long term monitoring

- Interannual variations
 - Dust Storms
 - Cold Spots (e.g. CO₂ Snow Storms)
 - Rate of polar cap advance and retreat.
 - Cold trapping of water vapor
 - CO₂ Stability of the south polar residual cap
 - Albedo variations in the north polar residual cap

Questions – Nature of CO₂ Ice

- What are the densities, column mass and areal coverage of the CO₂ ice that composes the seasonal and residual polar caps?
- What is the nature of CO₂ deposition
 - snow or direct frosting
 - continuous or sporadic
- What is the nature of CO₂ sublimation
 - at depth or at the ice surface
 - contribution of contaminant load
- How do these properties vary in space and time?

Mars Polar Science Orbiter

- Determine surface temperature
- Measure surface albedo and emissivity.
- Atmospheric temperatures
- Weather phenomena (e.g., cap-edge dust storms)
- Differentiate between ices of different composition, to observe larger-scale
- High precision changes in elevation
- high-resolution CO₂ ice column densities
- Amount of inert gases in the atmosphere
- Total mass of the atmosphere
- Observe condensation in the polar night.

Mars Polar Science Orbiter

- Thermal/Solar Bolometers
 - TES
 - MCS
- Thermal spectrometer or imager
 - TES
 - THEMIS
- Vis Narrow Angle Camera
 - MOC
 - CTX
- Wide Angle Camera
- Laser altimeter or Interferometric Synthetic Aperture Radar (InSAR),
- High-resolution thermal neutron imager
- Microwave atmospheric sounder
- High-precision radio science (ultra-stable oscillator required)
- Imaging LIDAR (CO₂, H₂O)

Polar Energy Balance

- Thermal/Solar Bolometers
 - TES
 - MCS
 - Continuous Monitoring
- Thermal spectrometer or imager
 - TES
 - THEMIS
 - Surface Temperatures
 - Atmospheric Temperatures

Clouds, Dust & Surface

- Vis Narrow Angle Camera
 - MOC
 - CTX
 - ~1 Meter resolution
 - Polar Vents, Spiders, Halos, etc.
- Wide Angle Camera
 - Dust storms

CO₂ Density Instrument Package

- Thickness of the seasonal CO₂ ice
 - Laser altimeter
 - or Interferometric Synthetic Aperture Radar (InSAR)
- CO₂ ice Column Density
 - high-resolution thermal neutron imager
 - microwave atmospheric sounder
 - high-precision radio science (ultra-stable oscillator required)

CO₂ Phase Change and Polar Night Instrument Package

- Microwave atmospheric sounder
 - Non-condensable Gas Mixing Ratio
 - CO as the tracer
- Imaging LIDAR
 - CO₂ Ice
 - H₂O Ice
 - Clouds
 - See in the dark

Discovery sized Orbiters

- CO2 Density Instrument Package
 - laser altimeter or interferometric synthetic aperture radar (InSAR),
 - high-resolution thermal neutron imager
 - microwave atmospheric sounder
 - high-precision radio science
 - (ultra-stable oscillator required)
- CO2 Phase Change and Polar Night Instrument Package
 - Microwave atmospheric sounder
 - Imaging LIDAR
 - high-precision radio science (ultra-stable oscillator required)

Other science

- Continued quasi-comprehensive observations of the entire planet
 - information that is important to understanding how the Mars climate system operates and varies over time
 - build up more complete observations of geological features and compositions.
- Provide important information about atmospheric composition, structure, and phenomena outside the polar regions.