Mars Polar Orbiter Science

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USGS
science for a changing world

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
  - CO_2 Stability of the south polar residual cap
  - Albedo variations in the north polar residual cap

Questions – Nature of CO_2 Ice

- What are the densities, column mass and areal coverage of the CO_2 ice that composes the seasonal and residual polar caps?
- What is the nature of CO_2 deposition
  - snow or direct frosting
  - continuous or sporadic
- What is the nature of CO_2 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 (CO_2, H_2O)

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

CO_2 Density Instrument Package

- Thickness of the seasonal CO_2 ice
  - Laser altimeter
  - or Interferometric Synthetic Aperture Radar (InSAR)
- CO_2 ice Column Density
  - high-resolution thermal neutron imager
  - microwave atmospheric sounder
  - high-precision radio science (ultra-stable oscillator required)

CO_2 Phase Change and Polar Night Instrument Package

- Microwave atmospheric sounder
  - Non-condensable Gas Mixing Ratio
  - CO as the tracer
- Imaging LIDAR
  - CO_2 Ice
  - H_2O 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.