White Paper

Third International Workshop on Mars Polar Energy Balance and the CO₂ Cycle

July 21–24, 2009 — Seattle, Washington

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The Polar Regions: Where the atmosphere becomes the surface.

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Mars Polar Energy Balance
and the CO₂ Cycle

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& the surface becomes the atmosphere.
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Mars Polar Energy Balance Workshop

- 36 Registered Attendees
  - United States
  - France
  - Russia
  - Germany
  - Switzerland

- Spacecraft Instrument Teams
- Atmospheric Modelers
  - GCM
  - Mesoscale
- Thermal Inertia
- Laboratory Experimentalists
- Spectroscopists
Mars Polar Energy Balance Workshop

- HiRISE
- CRISM
-CTX
- Marci

- THEMIS
- Neutron Spectrometer
- TES
- MOLA
- MOC

OMEGA
Why should you care?

- 25-30% of the Mars Atmosphere is cycled through the polar caps annually.
- Understanding the current climate is a precursor to understanding Mars past climates.
- Most dynamically Active Place today
  - \( \text{CO}_2 \) Jets & the carving of “spiders.”
  - \( \text{CO}_2 \) Ice Snow Storms
Priorities for the Next Decade
(The Teenage Years of the 21st Century)

- Mars Polar Fundamental Research & Data Analysis Program
  - Mars Polar Research is inter-disciplinary.
  - Mars Fundamental Research
  - Mars Data Analysis

- CO₂ Ice Laboratory Experiments
  - What are the densities of the seasonal and residual CO₂ ices as a function of space & time?
  - Long-term monitoring of the mass of the atmosphere.
  - Measurements of the mixture ratios of the Non-condensable Gas Enhancement in the polar region.
Mars Polar Fundamental Research & Data Analysis Program(s)

- Mars Polar Fundamental Research
  - CO$_2$ Ice Laboratory Experiments
    - Spectral Properties of mixtures under Mars conditions
    - Physical Properties of mixtures under Mars conditions
- Mars Data Analysis
  - More allocated funds to analyze the data we have.
  - More interdisciplinary cross-platform research
What are the densities of the seasonal and residual CO$_2$ ices as a function of space & time?

- Height evolution of the seasonal caps
  - MOLA on Steroids
  - Interferometric Synthetic Aperture Radar
- Higher spatial resolution of the Column Density of Seasonal CO$_2$.  
  - Collimated Thermal Neutron Detector
Long-term monitoring of the mass of the atmosphere.

Pressure is the heartbeat of the Climate
Long-term monitoring of the mass of the atmosphere.

- Long-term Stability of the SPRC
Long-term monitoring of the mass of the atmosphere.

- Long-term Stability of the SPRC
- Pressure measurements accurate to a few Pascal per Mars decade.
- Surface Pressure
  - E.g. RTG Polar Lander.
  - Network landers.
- Orbital Measurements
- Telescopical Measurements
Measurements of the mixture ratios of the Non-condensable Gas
Enhancement in the polar region.

- Can increases in the mixing ratio of non-condensable gasses account for observed super-saturation of the atmosphere in the polar night?
- What are the implications for CO\textsubscript{2} cloud and snow formation?
Mars Polar Energy

Balance & CO₂ Cycle Priorities

- Establish a Mars Polar Fundamental Research & Data Analysis Program
  - Mars Fundamental Research
  - Mars Data Analysis

- CO₂ Ice experiments under Mars conditions
- Determine the densities of the seasonal and residual CO₂ ices as a function of space & time.
- Establish long-term monitoring of the mass of the atmosphere.
- Measure the mixture ratios of the Non-condensable Gas Enhancement in the polar region as a function of space & time.
Backup Slides
Mars Polar Discovery Highlights

- TES discovered that jets of dusty gas produce dark markings on the south polar cap.
- TES discovered why the "Mountains of Mitchel" remain bright well into local spring.
- THEMIS solves Martian polar riddle of Jets.
- THEMIS confirms water ice at Mars polar cap.