Atmospheric Characterization for Exploration and Science

ACES

Abstract 8079

The NEXT Generation Meteorological Instrument Suite Designed to Achieve High-Priority SMD, HEOMD, and MEPAG Mars Science Goals

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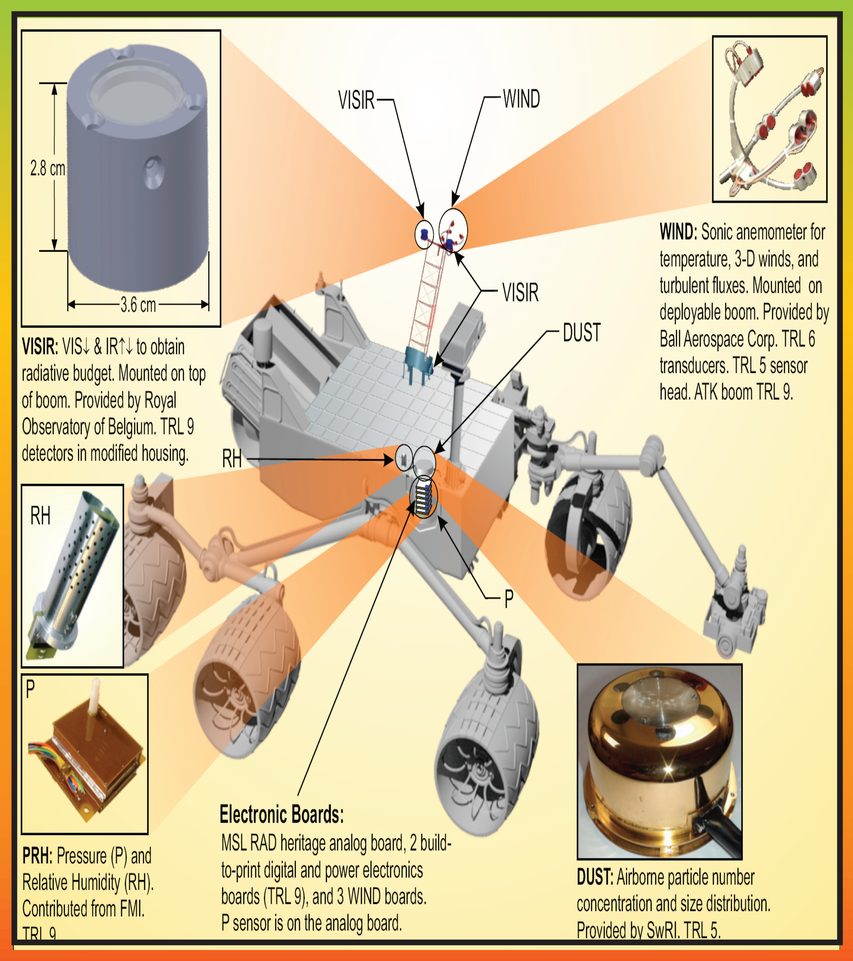
ACES Goals and Objectives

Goals	Objectives
1. Technology: Address Highest Priority HEOMD Strategic Knowledge Gaps and Reduce Risk for Cache Return	A. Obtain dust characteristics and atmospheric properties important to current and future ISRU activities and human health. B. Validate atmospheric models to improve all elements of atmospheric flight and to reduce risk for humans and cache return.
2. Science: Characterize Processes that Formed and Modified Landing Site Geology	A. Quantify aeolian erosion/deposition potential to provide geological context. B. Determine particle entrainment surface stress thresholds and dust deposition rates.
3. Conduct Outstanding High-Priority MEPAG Climate Investigations	A. Determine the processes controlling the present distributions of H_2O, CO_2, and dust in the atmosphere. B. Quantify heat, momentum and mass exchange in the planetary boundary layer.

ACES provides unique science enabled by novel yet mature technology. Far surpassing the capabilities of previously flown meteorological investigations, ACES will directly address the highest priority MEPAG investigations (MEPAG 2010) of the boundary layer. This includes directly measuring turbulent fluxes of energy and momentum. With these turbulent measurements and quantitative characterization of atmospheric dust and sand, parameters controlling dust lifting and sand saltation can be determined for the first time. All of these measurements are also highly relevant to human exploration and technology objectives identified as strategic knowledge gaps (P-SAG 2012).



Heritage

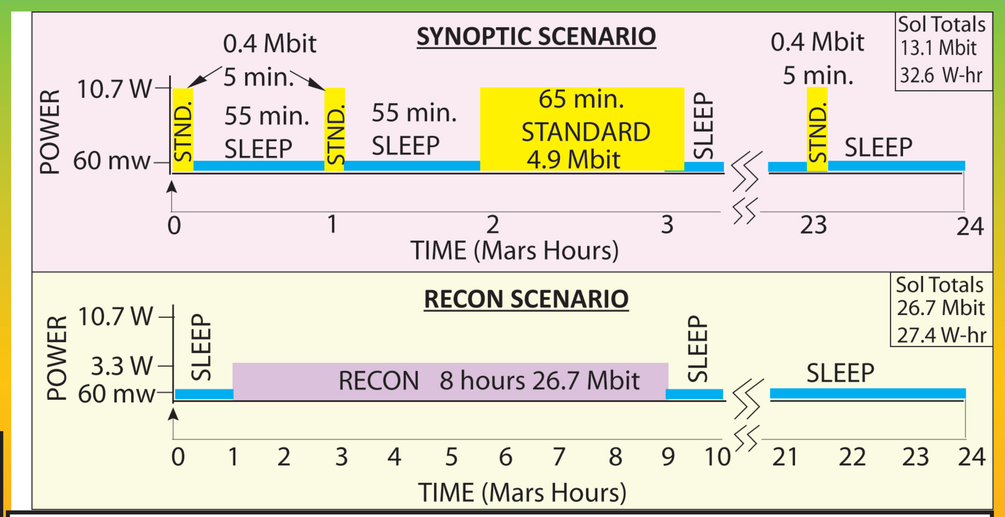
Hardware: PRH from MSL REMS, DUST from ExoMars, boom from MPF. VISIR sensors from PICARD mission

Electronics: Build-to-print MSL RAD digital (ADE) and power electronics (APE); RAD-based sensor electronics (ASE).

Team: High MSL heritage: PI-RAD Project Scientist; PM--MSL RAD; Nearly identical engineering and technical support team to MSL RAD. MSL ground and flight operations MSL RAD FSW team.

ACES Resources and Performance

Attribute	Baseline
Mass	4.4 kg (CBE + 18% cont.)
Power Peak & Avg	12.7 W (CBE + 20% cont.)
Data	15.72 Mbit/sol (CBE + 20% cont.)
Pressure	1-100 hPA ± 2 Pa @ 1 Hz
RH	0-100% to better than 8% accuracy
DUST	Number concentration 1-1000 cm^{-3} Effective radius 0.2 – 250 µm Dust velocity 0.1-20 m/s
VISIR	VIS↓ : 0.3-4.0µm, 0-1000 W/m^2 ± 1.0 W/m^2, 180° FOV; IR↓ : 4.0-60µm, 0-1000 W/m^2 ± 1.0 W/m^2, 180° FOV; IR↑ : 4.0-60µm, 0-1000 W/m^2 ± 1.0 W/m^2, 45° FOV
WIND	0-80 m/s ± 0.05 m/s @ 20 Hz 3 wind components (u,v,w) T through speed of sound 150-343 K ± 0.1 K



When ON, ACES is either in one of two data collection observational modes (STANDARD or RECON), in SLEEP, or in DIAGNOSTIC. All sensors are on during STANDARD mode. The RECON mode is identical to STANDARD, except that WIND is turned off. A typical scenarios is shown above. In the "Synoptic" scenario, there are five minute duration observations each hour, and one hour out of the sol in which data is collected continuously. In between active observation periods, ACES remains in an ultra-low power state and sleeps until the next observation or until the sleep is interrupted by the RCE. The actual sequence and duration of the modes are completely configurable to fit within the resource allocations for a given sol.

References

MEPAG, 2010: Mars Scientific Goals, Objectives, Investigations, and Priorities: J. R. Johnson, ed. 49 p white paper posted September, 2010 by the Mars Exploration Program Analysis Group (MEPAG) at http://mepag.jpl.nasa.gov/reports/index.html.

P-SAG, 2012: Analysis of Strategic Knowledge Gaps Associated with Potential Human Missions to the Martian System: Final report of the Precursor Strategy Analysis Group (PSAG), D.W. Beaty and M.H Carr (co-chairs) +25 authors, sponsored by MEPAG/SBAG, 72 pp., posted July 2012, by the Mars Exploration Program Analysis Group (MEPAG) at http://mepag.jpl.nasa.gov/reports/.