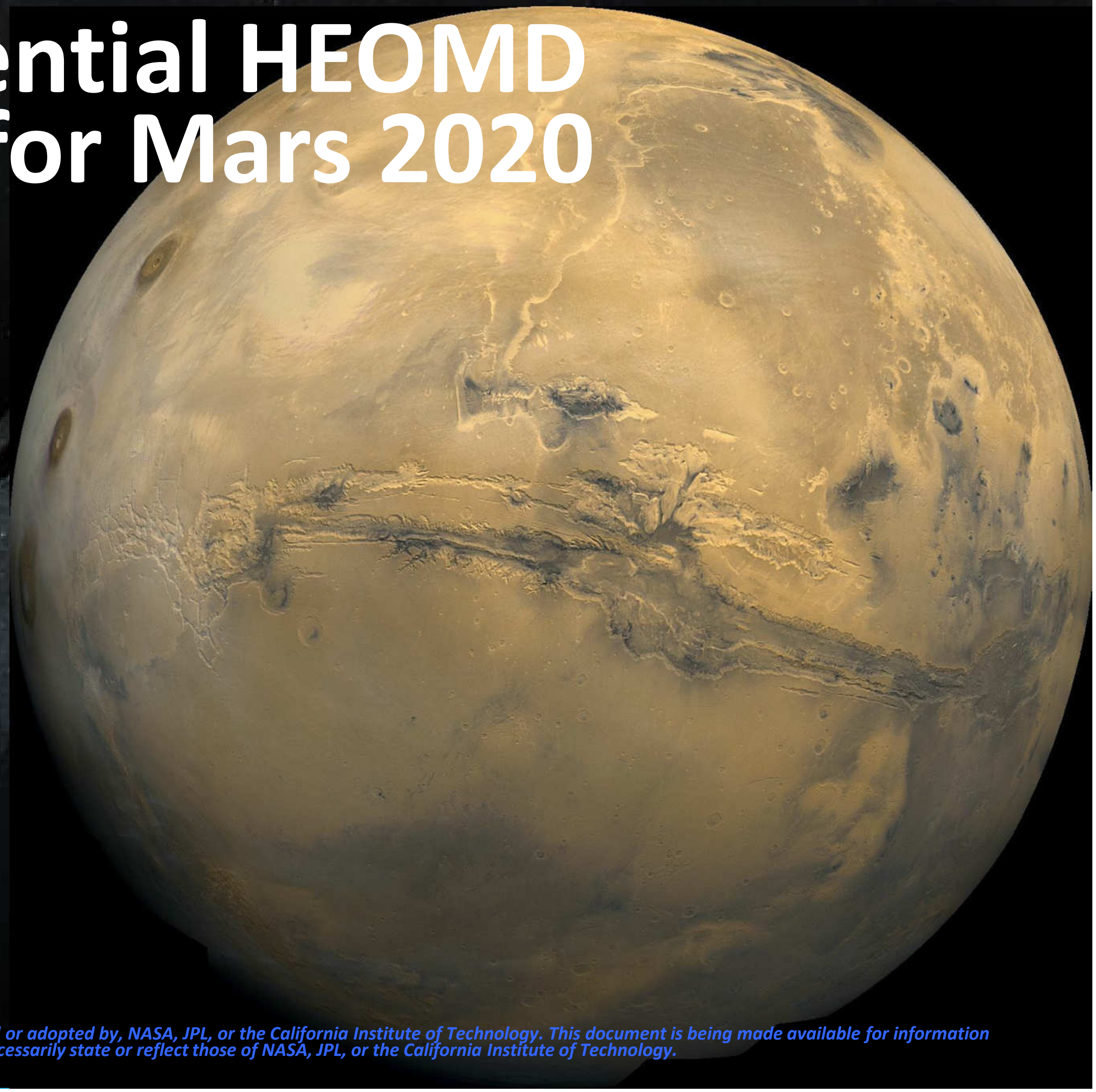
National Aeronautics and Space Administration

Defining Potential HEOMD Instruments for Mars 2020

A Work in Progress...



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HEOMD: Some Context

- **HEOMD needs to address gaps in knowledge that will inform human mission and system design.**
- **These Strategic Knowledge Gaps (SKGs) are the basis for HEOMD's investment strategy.**
- **The Advanced Exploration Systems (AES) Division identifies, prioritizes, and addresses SKGs.**
  - Science-focused missions provide measurement opportunities to fill SKGs
- **The AES Program will develop the HEOMD-contributed instruments or technology demonstrations for Mars 2020.**
- **HEOMD's contribution may leverage investments by the Space Technology Program.**

Objectives

- Collaborate across Mission Directorates on Mars 2020 mission to achieve science, human exploration, and technology objectives (Agency goal).
- Identify dual purpose science and exploration measurements.
- Define potential instruments or technology demonstrations that HEOMD could contribute to the Mars 2020 mission to fill high priority Strategic Knowledge Gaps.

Process for Defining Potential HEOMD Instruments

- Use team of subject matter experts to review results of MEPAG (P-SAG) and MPPG studies on Mars Strategic Knowledge Gaps (SKGs)
- Identify high priority SKGs that will not be addressed by current or planned Mars missions.
- Identify dual purpose science and exploration measurements.
- Define notional instrument concepts or technology demonstrations to address the highest priority remaining SKGs. (Feb. 15)
- Assess capability of Mars 2020 mission to accommodate HEOMD instrument concepts (mass, volume, power, data, etc.) (Mar. 15)
- Develop cost and schedule estimates for each instrument concept through the FY14 Advanced Exploration Systems (AES) Program budget process. (Apr. 19)
- Down select concepts, and obtain approval from senior management to proceed with development. (May 10)
- Formulate an acquisition strategy for instrument development (in-house competed (or directed) vs. fully competed)
- Initiate development in AES Program in FY14. (Oct. 1)

HEOMD Instrument Team

Name	Org	Expertise
John Baker	JPL	MPPG, P-SAG, Radiation
Charles Budney	JPL	P-SAG
Neil Cheatwood	LaRC	Atmospheric measurements, EDL
Cassie Conley	SMD	Biohazards, Planetary Protection
Bret Drake	JSC	MPPG, P-SAG, Mars 2020 SDT
Victoria Friedensen	HEOMD	Joint Robotic Precursor Activities
Jen Heldmann	ARC	Surface Hazards, P-SAG
John James	JSC	Dust Toxicity
Young Lee	JPL	MDT
Chris Moore	HEOMD	Team Lead
Jerry Sanders	JSC	In-Situ Resource Utilization
Mike Wargo	HEOMD	MPPG, P-SAG, Mars 2020 SDT, SKGs

Background

- Teams have been evaluating precursor measurement requirements within NASA and with support from the community since the early 90's.
- Some human specific payloads have already flown on Mars science missions to understand more about the planet surface and a lot has been learned (e.g., MEDLI and RAD on MSL)
- MEPAG revisited the human precursor requirements in 2010, referred to as (MEPAG) Goal IV.
- DRA 5 made some reasonable assumptions which we should use to guide prioritization of measurements.
- The Precursor Strategy Analysis Group (P-SAG) revisited the human precursor measurements in 2012 and identified and prioritized SKGs.
- The HAT Mars Destination Team further assessed the P-SAG SKG analysis from crew safety and mission risk perspectives.
- The HEOMD Instrument Team will make specific measurement recommendations and define instrument concepts for Mars 2020.

Why do we need measurements? (1)

There are three classes of environmental measurements needed:

1. Architecture drivers – measurements that allow us to design vehicles and the mission more efficiently
   - **Atmospheric density and winds**: current uncertainty is large due to limited flight data and diurnal/seasonal variability, and when dust storms are active.

     IMPACT: Landed mass, available landing sites (lower altitude) (MSL)
   - **Resources**: allows for ISRU, dependent on the strategy.

     IMPACT: Landed mass (consumables and prop required to transport)

2. Crew Safety/hazards – measurements that allow us to keep the crew safe.
   - **Radiation:** Determine surface and/or orbital GCR levels (MSL RAD)
   - **Biohazards:** Determine if extant life is present on the surface and poses a hazard to the crew and public.
   - **Toxicity:** Determine if there are materials such as dust with known toxic effects on humans.

Why do we need measurements? (2)

3. <u>Operational </u>– measurements that allow us to operate <u>safely</u>
   - **Trafficability**: Determine surface hazards at the landing site (drives site selection)
   - **Dust effects on systems**: Determine mechanical properties of dust (drives lander/rover/EVA suit/equipment dust tolerance and operations)
   - **Forward Planetary Protection**: Determine how organisms from Earth may survive and possibly contaminate special regions on Mars (landing site selection and operations)
   - **Atmospheric electricity**: Characterize the electric field magnitude and frequencies, atmospheric and surface conductivity (drives lander/rover/suit/equipment grounding design and operations)