Scientific Payload of the Mars MetNet Precursor Mission

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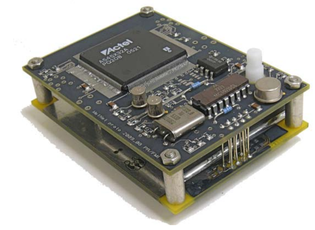
Mission Scientific Objectives

- Atmospheric dynamics and circulation
- Surface to Atmosphere interactions and Planetary Boundary Layer
- Dust raising mechnanisms
- Cycles of CO_2, H_2O and dust
- Evolution of the Martian climate

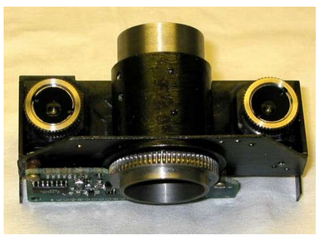
The Mars MetNet Precursor Mission (MMPM) is the technology demonstration project for the deployment of a larger network of small meteorological stations onto the surface of Mars. The development is done in collaboration between the Finnish Meteorological Institute (FMI), the Russian Lavoshkin Association (LA), the Russian Space Research Institute (IKI) and the Spanish National Institute for Aerospace Technology (INTA).

The purpose of MMPM is to confirm the concept of deployment for the mini-meteorological stations onto the Martian surface, to get atmospheric data during the descent phase, and to get information about the meteorology and surface structure at the landing site from the meteorological station during one Martian year or longer.

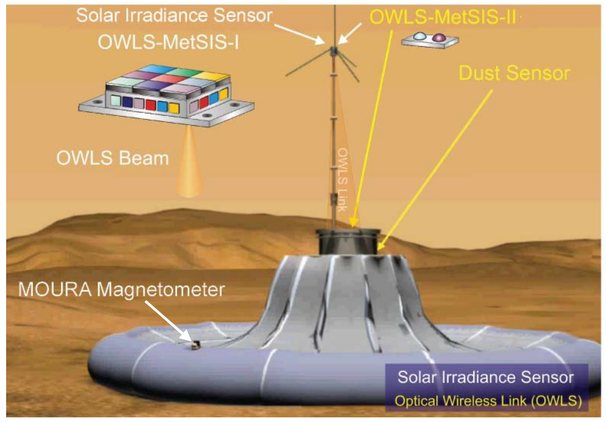


MetBaro Pressure Device: Weight about 100g with the FPGA card (FPGA is shared with the MetHumi humidity device)
- Resolution: 0.5 Pa; Range: 0 – 1015 hPa
- Accuracy: BOL 8 Pa, EOL 15 Pa
- The MetBaro pressure device instrument is based on Vaisala Inc. Barocap® micromachined capacitic silicon sensor and Vaisala transducer technology.

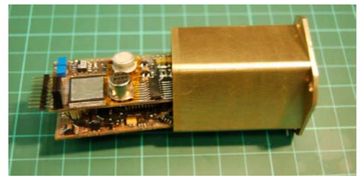
MetHumi Humidity Device: Weight about 15g without the wires
- Resolution: 0.5 %RH; Range: 0 – 100 %RH
- Accuracy: ±2 %RH at +20 °C, ±4 %RH at -40 °C, ±8 %RH at -70 °C
- Miniature MetNet Humidity Instrument is based on MSL/REMS design and Vaisala Inc. Humicap® sensor and transducer electronics that have been used in Vaisala radiosondes.

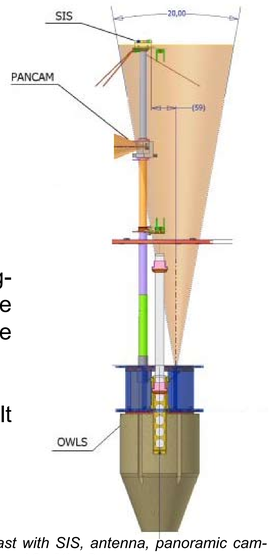


Panoramic Camera: CCD technology based camera (photo on the left) takes panoramic photos of the surrounding environment of the MetNet Lander. The rotating Panoramic Camera is installed below the SIS and antenna. Weight about 100g.



MOURA Magnetometer: Determination of mineral composition by magnetic field variation as a function of temperature. Images below and to the left shows the EQM of the device and location of the magnetometer on the AIBU.
- Relative sensitivity of the used unbalanced Wheatstone Bridge: ±0.3nT
- Self calibration, magnetic noise reduction, data pre-processing by inbuilt ASIC, 3D magnetometer array
- Permalloy stripe detectors

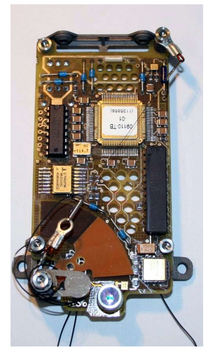




Telescopic mast with SIS, antenna, panoramic camera, MetHumi and 2 of the 3 temperature sensors.

MetSIS Solar Irradiance Sensor: ~65g, FOV ± 90° (schematic above and EQM on the left), 14 spectral, 1 solar eclipse detector, 1 background reference, 3-4 spectral detectors per side. 200-1100nm coverage, dedicated detectors for H_2O, O_2 and O_3 bands, dust optical depth measurements.
1. Measurement of the solar spectrum in the Martian surface and its variation along the day and seasons.
2. Estimation of the atmospheric optical depth (comparison with previous missions).
3. Characterization of the Martian atmosphere: composition, aerosols…
4. Observation of Phobos transits: calculation of the exact landing site.
5. Characterization of the moment of inertia of the nucleus by means of a rotation model.

Dust Sensor (DS): The DS instrument (EQM picture on the right) will perform dust measurements in the Mars boundary layer. It is composed of a set of IR detectors, an IR emitter, both working in the MWIR band, and an SMA actuator. During the mission, the instrument acts as an active sensor, and will perform measurements of the dust in suspension, discriminating on scattering/absorption. The function of the actuator is to provide a black body reference to the detector for calibration.



Scientific Accelerometer: The 3D accelerometer (picture on the left) provides system information during the entry, descent and landing phase. It will also be used in reconstructing the atmospheric profile. The weight is about 50g.

Temperature Sensors: Temperature observations, performed at three positions along the mast, are used to investigate the heat gradients and fluxes and other surface-to-atmosphere interactions. Together with the pressure and humidity observations they provide data to study large scale atmospheric dynamics. The sensors are lightweight redundant thermocouples.

Payload Instruments

Atmospheric Instruments
- Pressure Device MetBaro (FMI)
- Temperature Sensors (IKI)
- Scientific Accelerometer (IKI)
- Humidity Device MetHumi (FMI)

Optical Devices
- Panoramic Camera (IKI)
- Solar Irradiance Sensor MetSIS (INTA) with Optical Wireless Link System OWLS
- Dust Sensor, DS (INTA)

Composition and Structure Devices
- Tri-axial magnetometer MOURA (INTA)
- Scientific Accelerometer (IKI)

More information from the Mars MetNet Mission website http://metnet.fmi.fi

Poster design: Harri Haukka, FMI