Objectives of the Mars Climate Sounder/Mars Reconnaissance Orbiter

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INTRODUCTION

The Mars Climate Sounder (MCS) employs filter radiometry to perform continuous radiometric mapping of the atmosphere and surface of Mars in nine spectral channels covering the wavelength range 0.3 to 50.0 μm. Simultaneous, co-located observations of the surface and atmosphere will be obtained by limb and nadir viewing. Each channel will have a 5 km vertical resolution, allowing profiles of the variation of atmospheric temperature, dust extinction, water vapor mixing ratio and condensate opacity with pressure to be retrieved, together with surface albedo and brightness temperature.

MEASUREMENT OBJECTIVES

The MCS measurement objectives are summarized in Table 1. MCS addresses the same objectives as the Mars Climate Orbiter that was lost in 1998, but it places a greater emphasis on the "follow the water" theme of NASA's Mars Exploration Program through improved measurements of water vapor profiles in the lower and middle atmosphere.

Table 1

Measurement Objectives of the Mars Climate Sounder

- Map the three-dimensional and time varying thermal structure of the atmosphere from the surface to 80 km.
- Map the atmospheric dust loading and its global vertical and temporal variation.
- Map the seasonal and spatial variation of the vertical distribution of atmospheric water vapor to an altitude of at least 35 km.
- Distinguish between atmospheric condensates and map their spatial and temporal variation.
- Map the seasonal and spatial variability of atmospheric pressure.
- Monitor the polar radiative balance.

INVESTIGATION APPROACH

Mounted on the nadir-facing panel of the MRO spacecraft orbiting at an altitude of

approximately 350 km, MCS will obtain simultaneous vertical profiles of atmospheric radiance from the surface to 100 km. Unlike earlier Mars sounders, MCS stares at the fore, aft or side limbs to acquire vertical profiles. MCS is capable of moving its field-of-view 270 deg. about the local horizontal and down to the nadir. Nine spectral channels are distributed between two telescopes (A and B) and each channel uses a 21-element linear thermopile infrared detector array. The channel spectral intervals and the measurement functions selected to meet the measurement objectives of Table 1 are summarized in Table 2.

Telescope/ Channel #	Bandpass cm^{-1}	Band Center - μm	Measurement Function
A1	595 - 615	16.5	Temperature, 20 - 40 km
A2	615 - 645	15.9	Temperature, 40 - 80 km, Pressure
A3	635 - 665	15.4	
A4	820 - 870	11.8	Dust and Condensate extinction, 0 - 80 km
A5	400 - 500	22.2	Temperature, 0 - 20km
A6	3300 - 33000	1.65	Polar Radiative Balance
B1	290 - 340	31.7	Temperature 0 – 20 km
B2	220 - 260	41.7	Water Vapor mixing ratio, 0 - 40 km
B3	230 - 245	42.1	Water Vapor mixing ratio, 0 - 40 km

Table 2. MCS channel spectral characteristics and measurement functions.

CLIMATE, VOLATILE EXCHANGE, AND METEOROLOGY INVESTIGATIONS

Investigations performed by the international science team of MCS and by unaffiliated researchers, will address key questions associated with the modern climate of Mars, the exchange of water among the sources and sinks distributed globally, and the short-term variable phenomena. The MCS team is particularly interested in the recent results from the Mars Odyssey neutron spectrometers suggesting larger than anticipated mixing ratios for water ice in the high latitude regolith. MCS is particularly well suited for observing

the exchange of water between the surface and atmosphere, as well as determining the role of transport in this part of the Martian hydrologic cycle. The science team will also make extensive use of data assimilation schemes to extend the MCS investigation beyond those processes and phenomena, and temporal and spatial domains that are observable by the instrument. In this latter case, continuous, uninterrupted data taking is deemed to be of the highest importance in operating the instrument. Thus the MCS data rate has been keep low (2 kps) to avoid conflicts with others MRO instruments, and the operation of MCS is autonomous.

It is the hope of the MCS science team that additional investigators in the fields of data analysis, data interpretation and numerical modeling of the Martian atmosphere can be added to the team in future.