

The background of the slide is a high-resolution image of the airbags from the Mars rover Opportunity. The airbags are inflated and appear as a series of curved, overlapping surfaces. They are color-coded with a false-color map, showing various shades of blue, cyan, green, and yellow, which likely represent different atmospheric or surface conditions. The airbags are arranged in a fan-like pattern, suggesting they are deployed from the rover's descent stage.

PI Team Masters Forum-3
(Discovery Mission and Mars 2016 TGO US Instruments)

Exomars Climate Sounder (EMCS)

Investigation Overview

Tim Schofield and the EMCS Team

July 29th, 2011

Jet Propulsion Laboratory

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The EMCS instrument is a near replica of the MCS and DIVINER instruments.

- *MCS has been observing the atmosphere of Mars from MRO since 9/2006*
- *DIVINER has been observing the Lunar surface from LRO since 6/2009*

Primary Science Objectives for the EMCS investigation on the EMTGO mission are to:

- *Enhance the understanding of Mars photochemistry by providing daily, global, high vertical resolution fields of atmospheric state, aerosol distribution, water vapor concentration*
- *Extend the MRO/MCS climatology of high vertical resolution measurements of the lower and middle atmosphere of Mars, with the improved coverage of local time provided by EMTGO*
- *Support future Mars missions with measured climatology and near real-time density profile retrievals for landing and aerocapture, in the same way that MRO/MCS supported the Phoenix landing and is supporting the Mars Science Laboratory (MSL) landing*

The EMCS instrument will measure:

- *4-D global fields of atmospheric temperature, pressure, dust, ices and water vapor*
 - *Vertical resolution of < 6-km (half scale-height) and vertical sampling of 0-90 km*
 - *Daily global sampling of 4° latitude and 30° longitude*

Assimilation of EMCS atmospheric fields into Mars GCMs is central to the investigation

- *Provides the interpolated and derived fields, needed to understand atmospheric circulation and the transport, sources and sinks of photochemically active trace gases*





The MRO/MCS Flight Instrument



The LRO/Diviner Flight Instrument

<u>Parameter</u>	<u>Property / Performance</u>
Instrument Type	Filter Radiometer
Spectral Range & Channels	12 to 45 μm in nine spectral channels
Telescopes	Two identical, 4cm aperture, f/1.7 telescopes
Detectors	Nine, 21-element, linear thermopile arrays at 290 K
Fields-of-View (Limb)	Detector IFOV: 3.3 x 6.2 mrad 5.0x9.4 km Instrument IFOV: 70 x 70 mrad 110 x110 km
Instrument Articulation	Two-axis Az/El - Range/Resolution: 270° /0.1°
Operation Modes	Single Operating Mode, 2.048 s signal integration period
Observation Strategy	Limb, nadir and off-nadir staring In-track, Cross-track, and Off-track viewing
Mass	13.0 kg (Radiometer 8.7 kg, Mounting Bracket+IEM 4.3 kg)
Power	19.7 W Mean
Data Rate	2150 bps, 186 MBits/Day, 134 GBits/Mars Year



EMCS Spectral Channel Response & Function



EMCS Investigation Overview

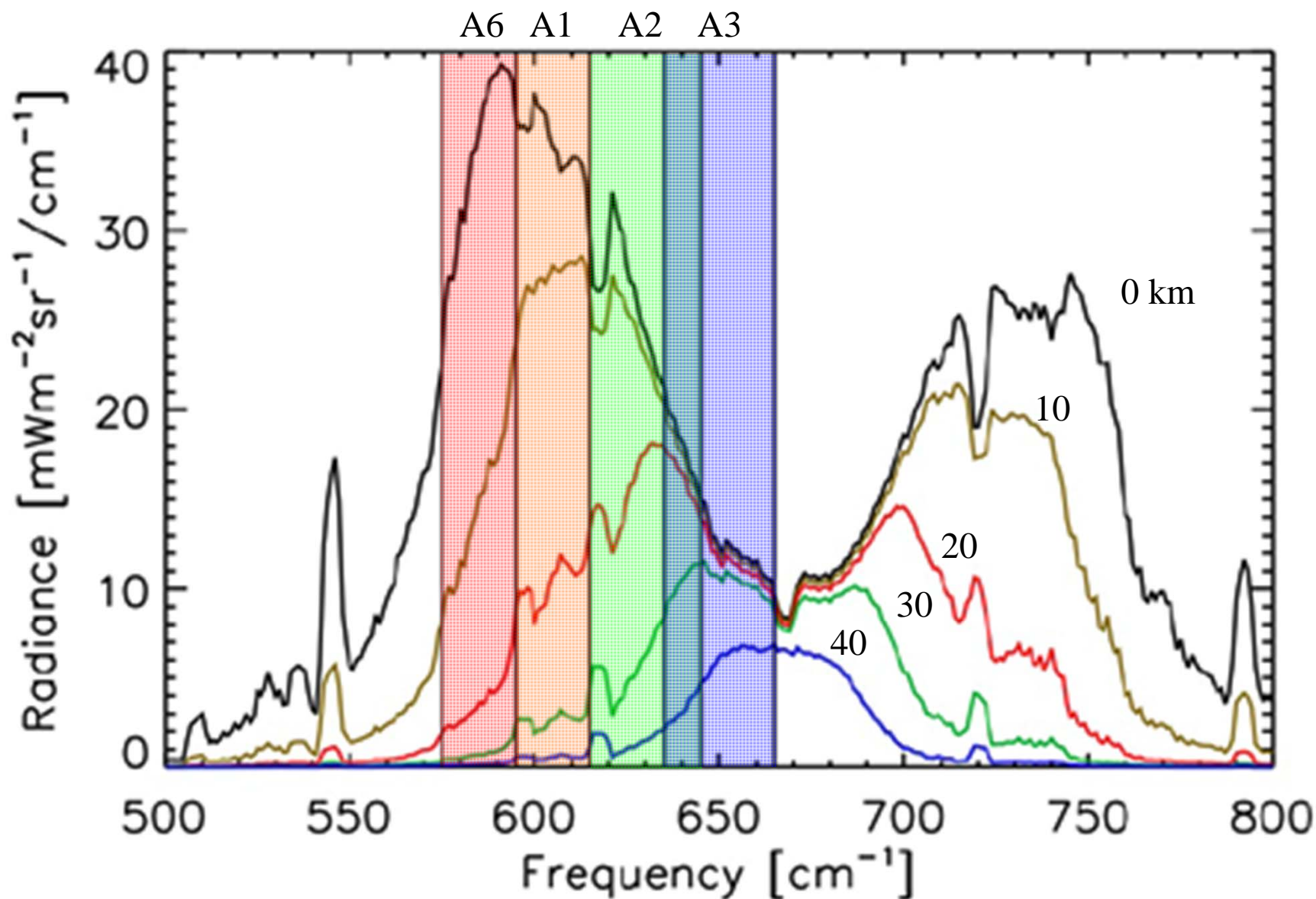
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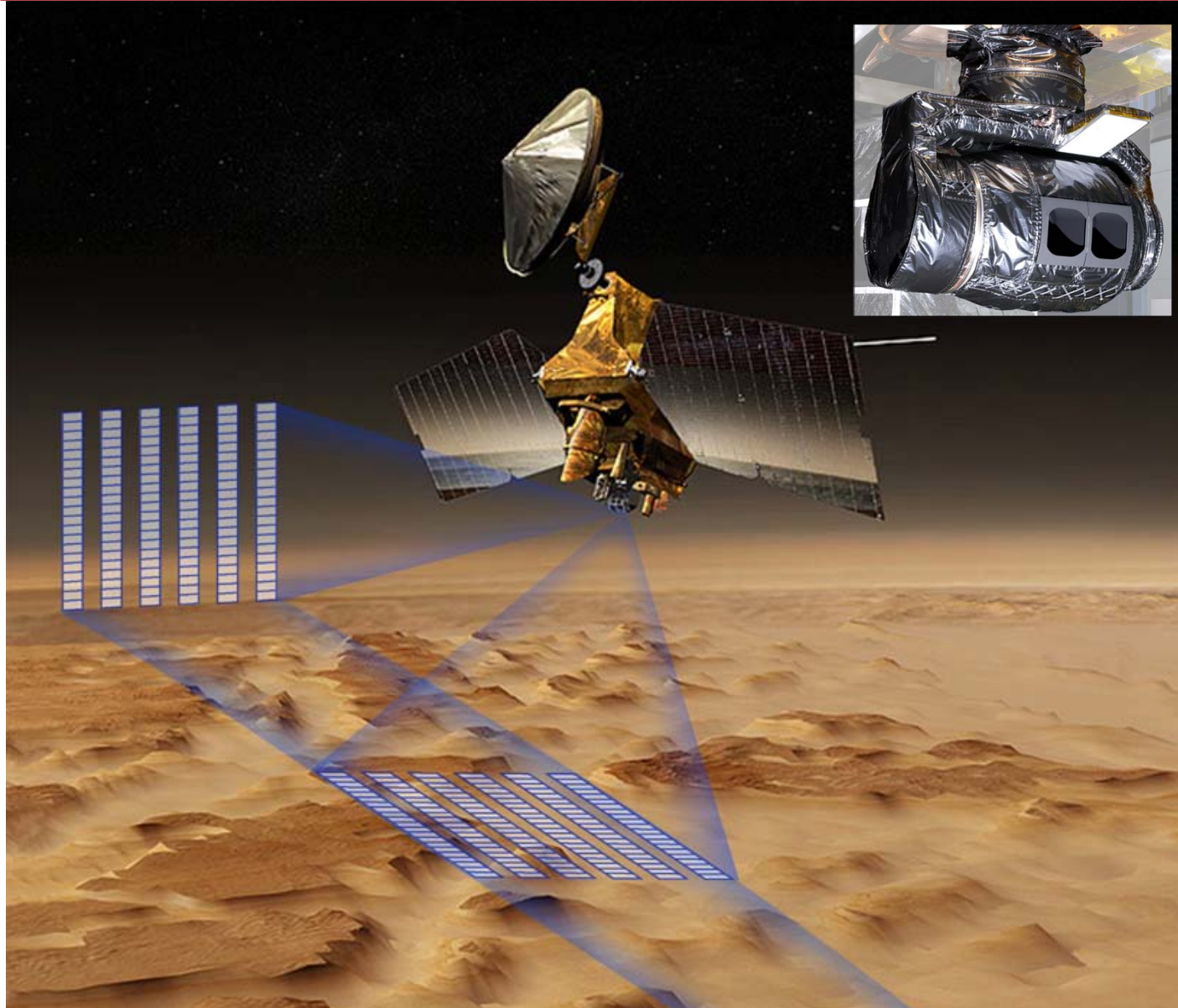
Telescope/ Channel #	Bandpass cm ⁻¹	Band Center - μm	Measurement Function
A1	595 - 615	16.5	Temperature 0-30 km
A2	615 - 645	15.9	Temperature 30-50 km, Pressure
A3	635 - 665	15.4	Temperature 50-90 km, Pressure
A4	820 - 870	11.8	Water ice extinction 0-90 km
A5	400 - 500	22.2	Dust extinction 0-90 km
A6	575 - 595	17.1	Temperature 0-15 km, CO ₂ ice extinction 0-90 km
B1	290 - 340	31.7	Dust and ice extinction 0-90 km
B2	220 - 260	41.7	Water Vapor 0-40 km, Dust ice extinction 0-90 km
B3	231 - 243	42.2	Water ice extinction 0-30 km

Original MCS Channels

Channels changed or modified in EMCS

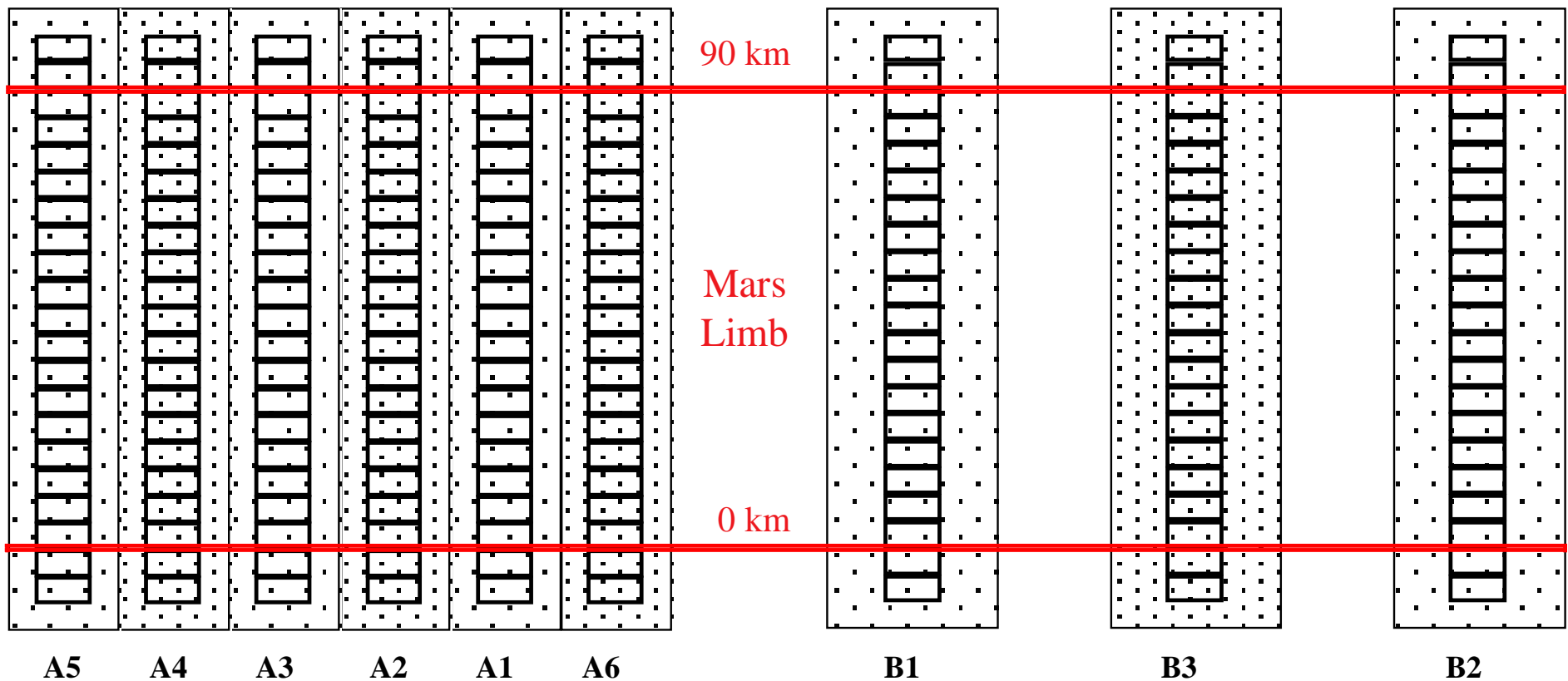
Final Decisional for planning and discussion purposes only



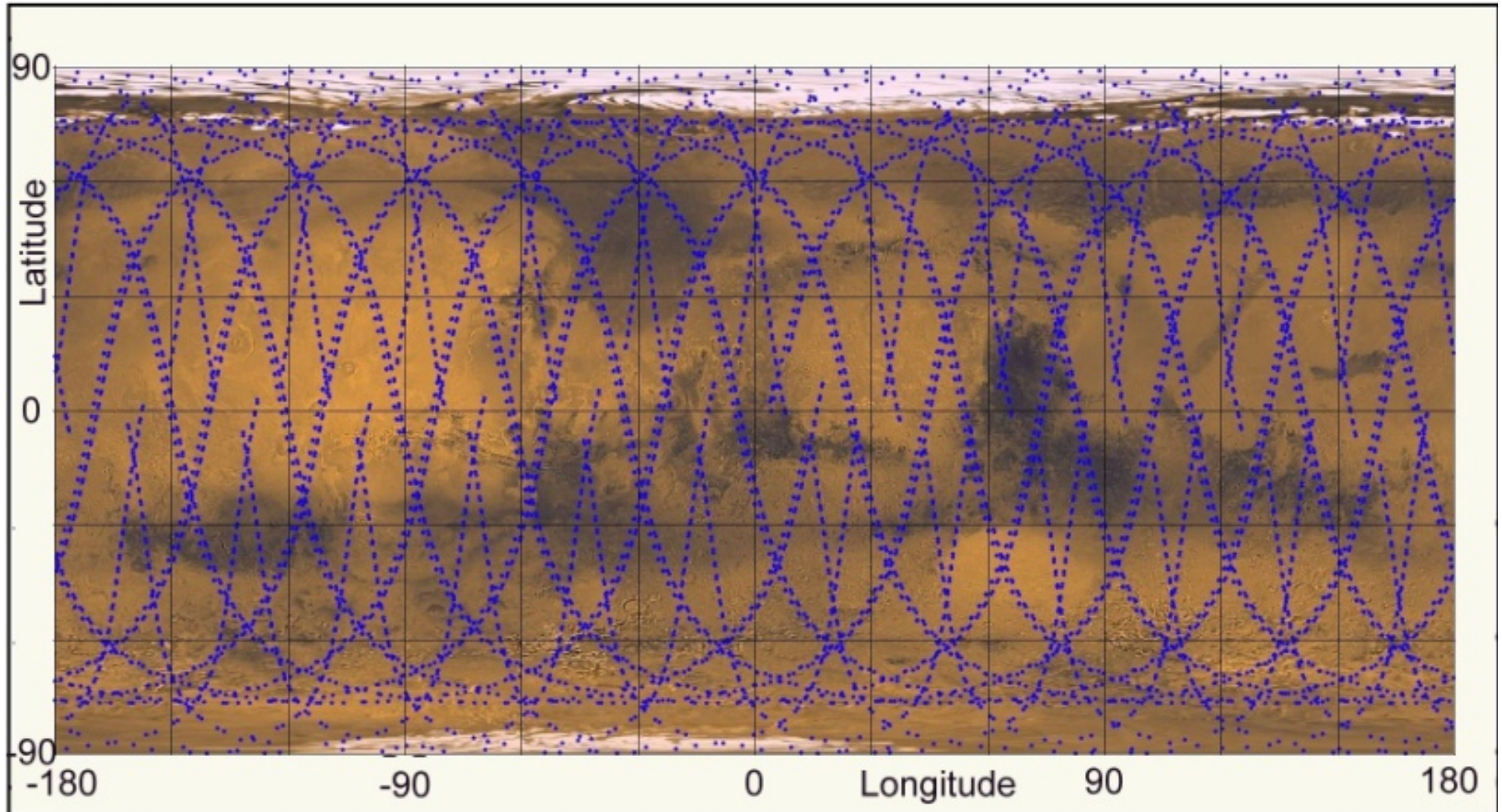


Telescope A

Telescope B

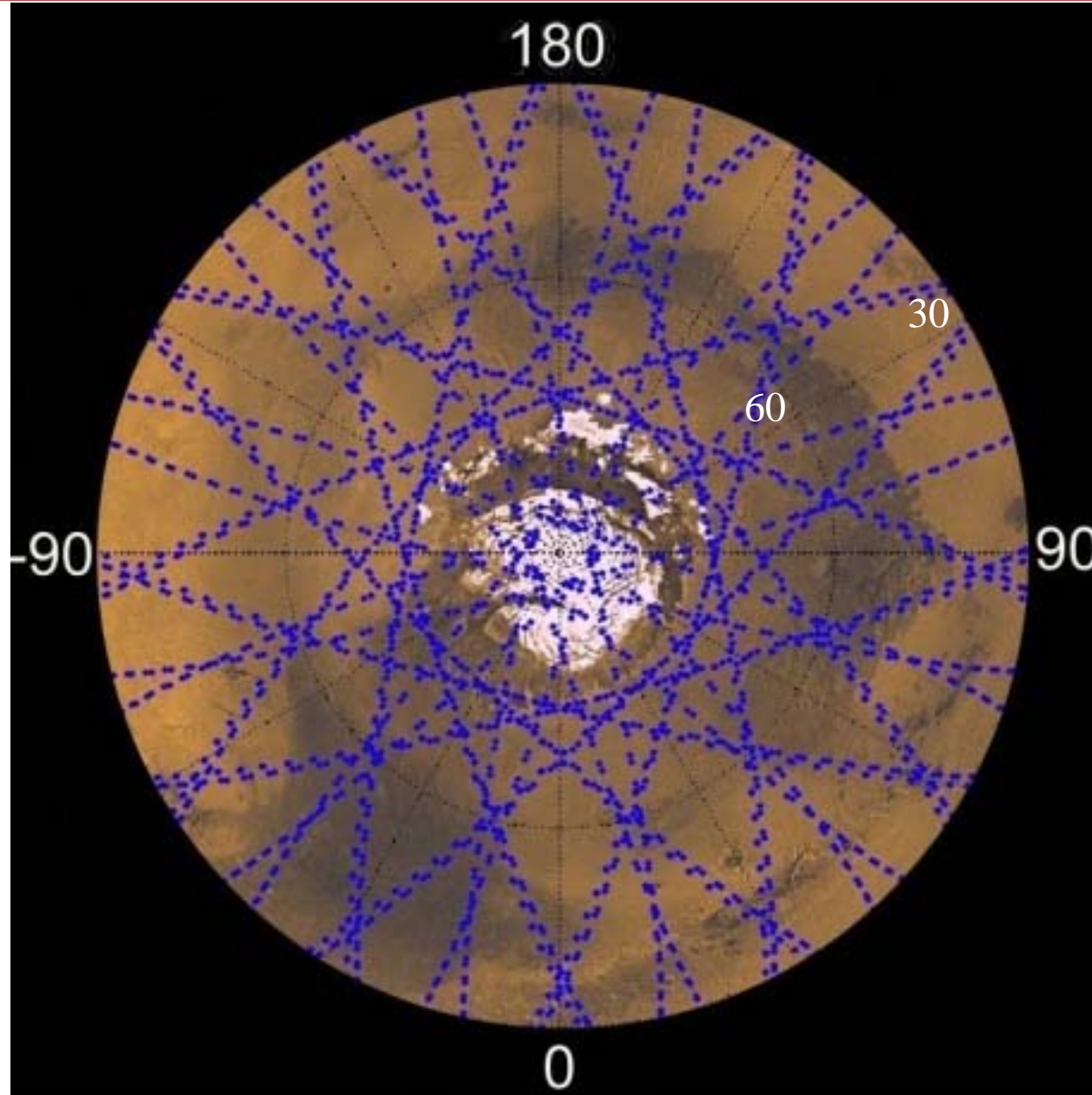


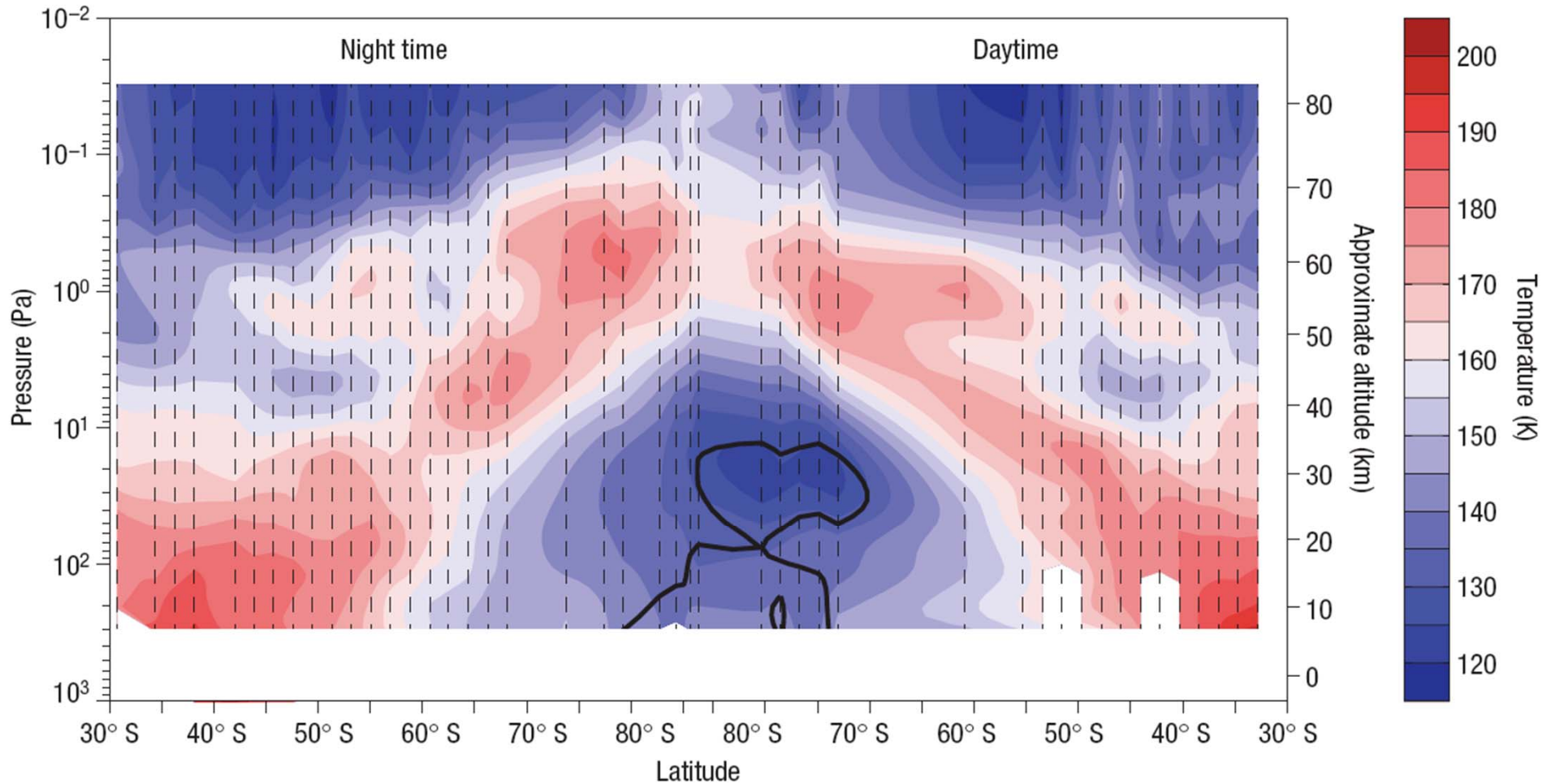
Nominal EMCS detector fields-of-view projected on to the martian limb



Daily EMCS coverage from 400 km, 74 degree inclination, circular orbit
 Alternate in-track and 40° off-track limb scanning (Off-track changes sides at equator)

EMCS Daily Polar Coverage

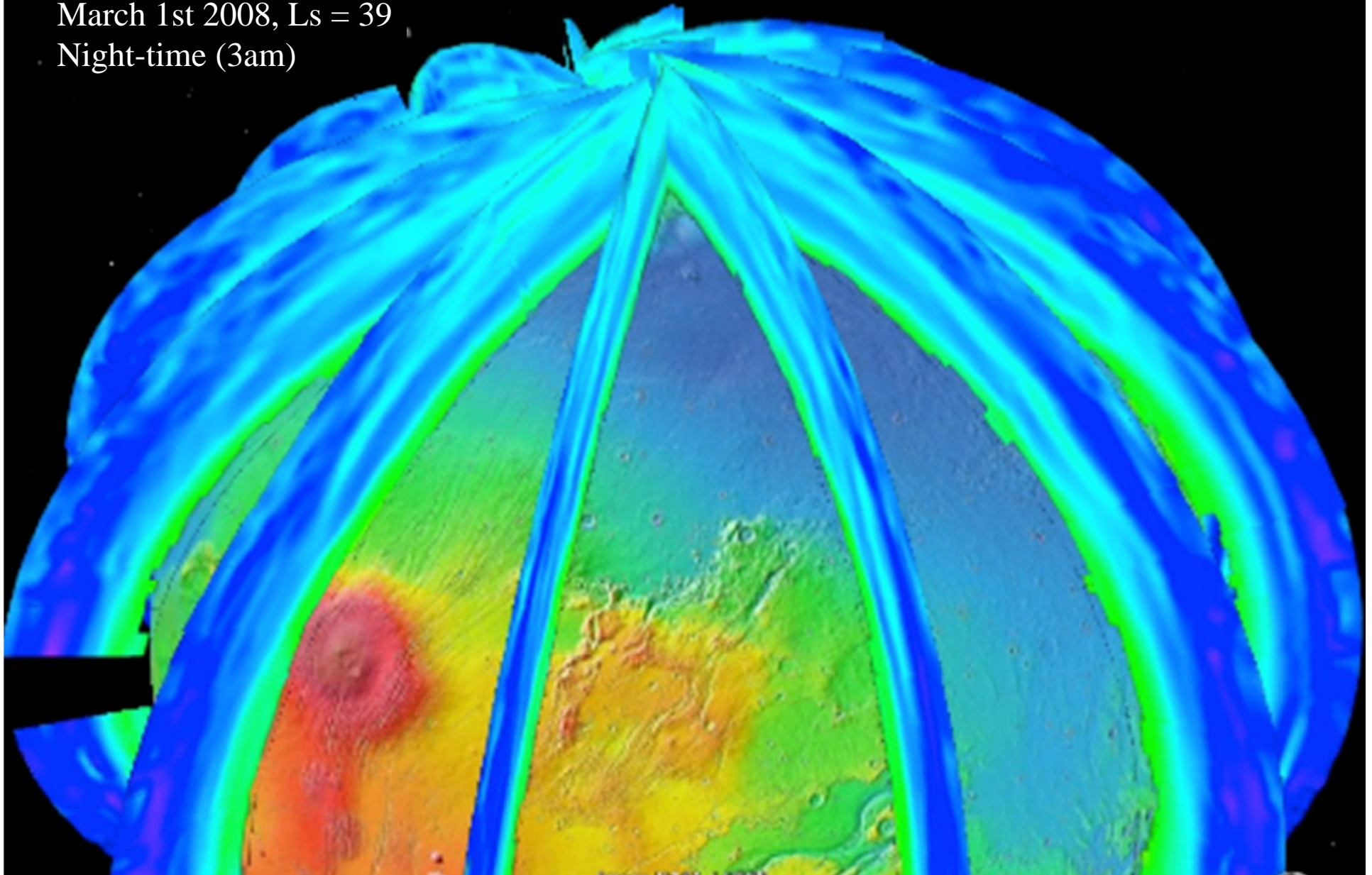




Temperatures retrieved from one orbital pass over the S. Pole of Mars. 16 Nov 2006, $L_s = 136^\circ$

- Successive profile retrievals indicated by dashed lines
- No solar heating $> 70^\circ$ S, Surface covered with seasonal CO_2 frost $> 55^\circ$ S

March 1st 2008, Ls = 39
Night-time (3am)





EMCS Data Products delivered to PDS



EMCS Investigation Overview

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The following data products will be delivered to the PDS at 6 month intervals

Data volumes correspond to a nominal one Mars year (687 day) mission

Level 0 - 66 Gbytes

Unpacked, time-ordered, raw science and housekeeping data

Level 1 - 99 Gbytes

Time-ordered calibrated housekeeping and radiance data with supporting geometry

Level 2 - 49 Gbytes

Time-ordered retrieved atmospheric profiles with supporting geometry

Level 3 - 200 Gbytes

Global measured and derived atmospheric fields from assimilation GCMs