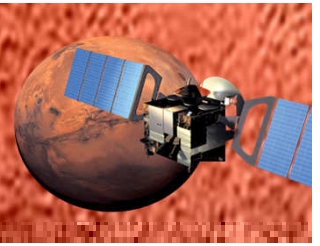
Mars Express Status

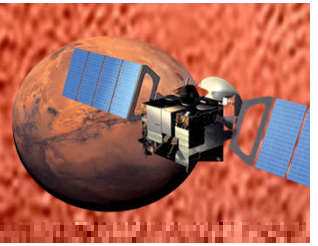


Fred A. Jansen

MEX / VEX Senior Mission Manager

BepiColombo Science Ground Segment Development Manager

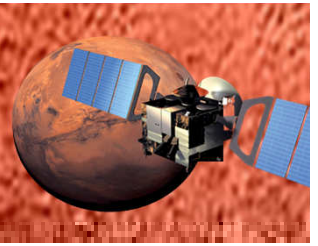
MEX Programme Status



- MEX funding firmly approved until end-2012
- MEX provisionally approved (subject to mid-term technical review) until end-2014
- Mid-2012 process will start to achieve a similar 4 year window

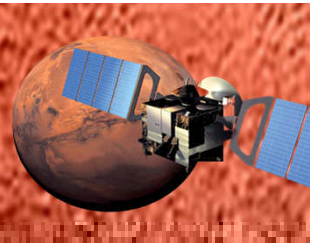
- In general the budget involved in all science mission extensions is a sizeable fraction of the annual budget

MEX Platform + Payload Status



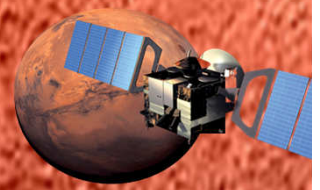
- MEX resources
  - Fuel : usage 0.5 gr/day – 250 gr/yr (incl. safe modes) => some 10-14 yrs of fuel left (significant errors on remaining fuel estimates exist !)
  - IMU : laser diode current degradation – remaining life time unclear, but at least a few yrs
  - Batteries : Eclipse duration up to at least 2017 not a problem
- Only redundancy used on platform is the Solid State Mass Memory B-side controller
- Payload
  - MELACOM software reworked for MSL EDL etc. support
  - OMEGA C-channel Cryocooler failed – L and VIS channel still work
  - Some degradation on SPICAM – under investigation
  - SRC operation on SSMM B-side - under investigation

SSMM - What happened ?



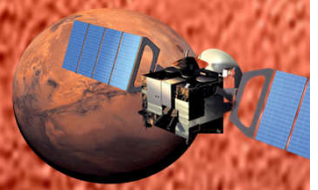
- MEX Spacecraft level safety mechanism:
  - A 'surveillance' mechanism (OEIR) exists, which gets called if critical spacecraft interactions/mechanisms fail.
  - One of the interfaces under surveillance is a call from the DMS to the SSMM (major subsytems related to data storage and management) to fill the command cache with new commands. This command cache then supplies spacecraft/payloads with commands. The mechanism is know as the "long-MTL".
  - During the safe-modes Aug/Sep/Oct 2011 such DMS requests triggered (a.o.) an internal SSMM telecommand between two subunits, and the receiving subunit detected a failed checksum on the command. This failure propagated back into the DMS and thus triggered a safe mode through the OEIR.

SSMM – The Solution ?



- The solution identified used several elements:
  - For commanding, use the short-MTL which resides outside the SSMM
  - Store the command files in the SSMM and load them into the short-MTL; this requires:
    - Make sure the file does not execute if partially loaded (this could happen as the anomaly is still there, but this I/F just is not under OEIR surveillance)
    - Make sure that if a file is not executed, the s/c is always safe, so make sure the files contain safe-to-safe config end-to-end
    - Make sure they fit on the short MTL (117 commands max.)
    - Meet the 117 commands requirement by programming as much as possible into On-Board-Control-Procedures (OBCP = on-board macro's)

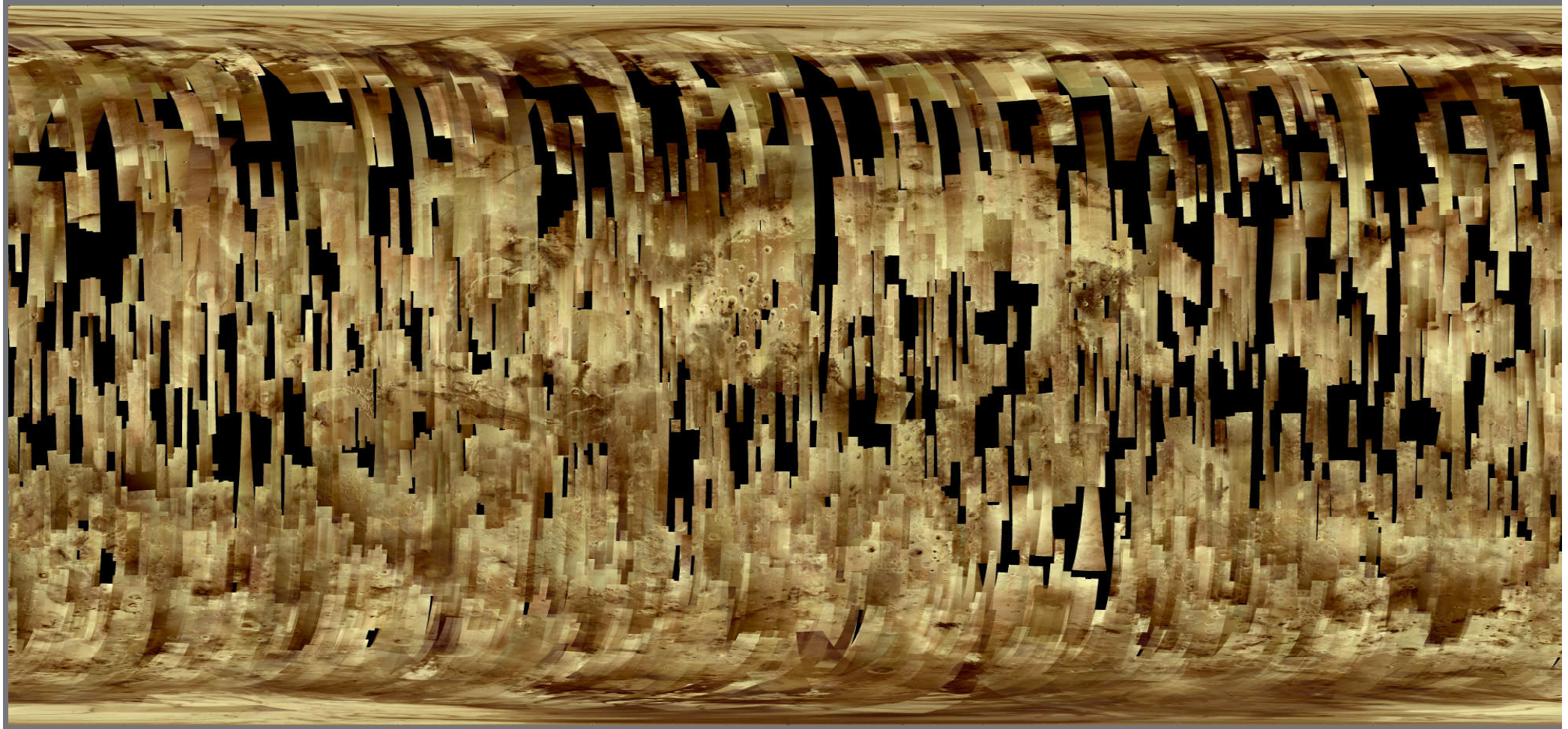
Summary

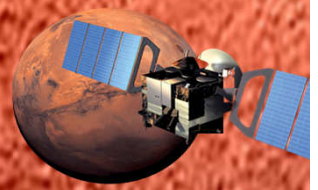


- In summary:
  - Science Operations back to 100%
  - The Mars Express solid state memory shows an intermittent failure
  - A workaround for commanding platform and payload exists
  - Requires strong reduction (~factor 30) in the number of commands to be loaded
  - Use On-Board Control Procedures to mitigate
  - Change in philosophy to always keep mission safe (read errors from SSMM – when commanding – can still occur)
  - Massive changes made at ESOC. ESAC (and PI's) also affected, but to a much lesser extent
  - Concept confirmed to work by no impact on operations when SSMM anomaly re-occurred (occurred three times so far)

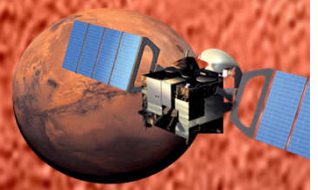

mars express
F. Jansen and O. Witasse
Credits: ESA/DLR/FU Berlin (G. Neukum)

Surface global coverage





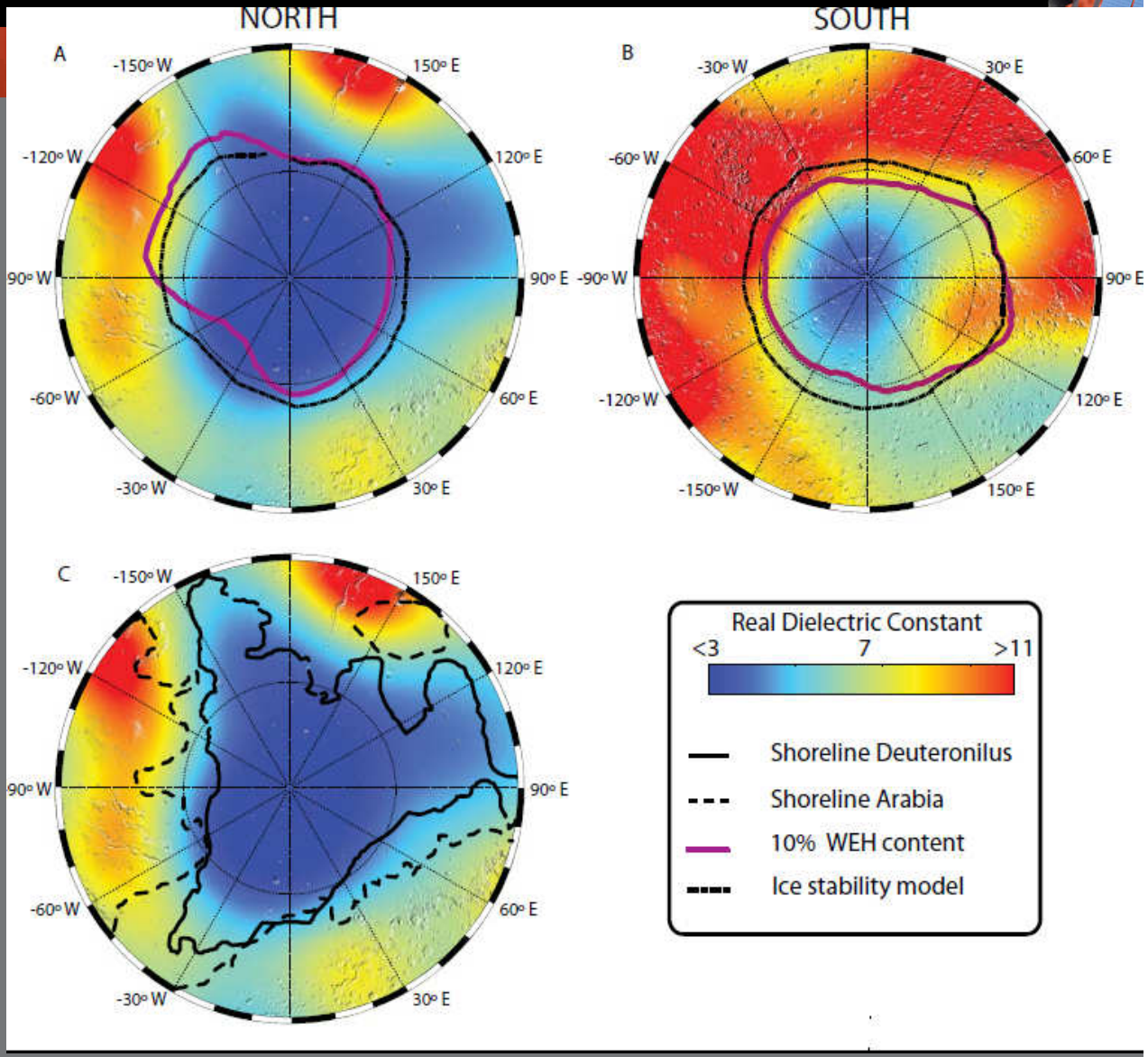
A selection of scientific highlights



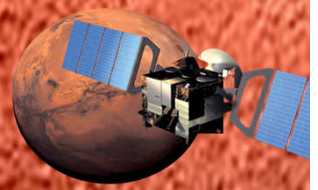
Debate about ocean on Mars

Ocean on Mars? The view from the radar

- Maps of the Martian northern and southern hemisphere
- Blue-red colors: dielectric constant measured by MARSIS
- Low values (blue) are best explained by low density materials like sediments and/or presence of ice
- High values (red) indicate the presence of higher density volcanic materials
- These low values of the dielectric constant supports the hypothesis of an ocean in the Northern hemisphere.
  HOT DEBATE

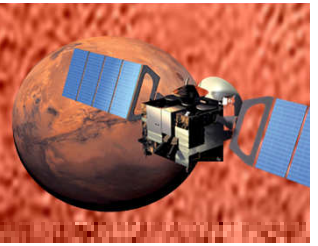


Mouginot et al., *GRL*, 2012



Sounding of the North Pole with the radar

Summary

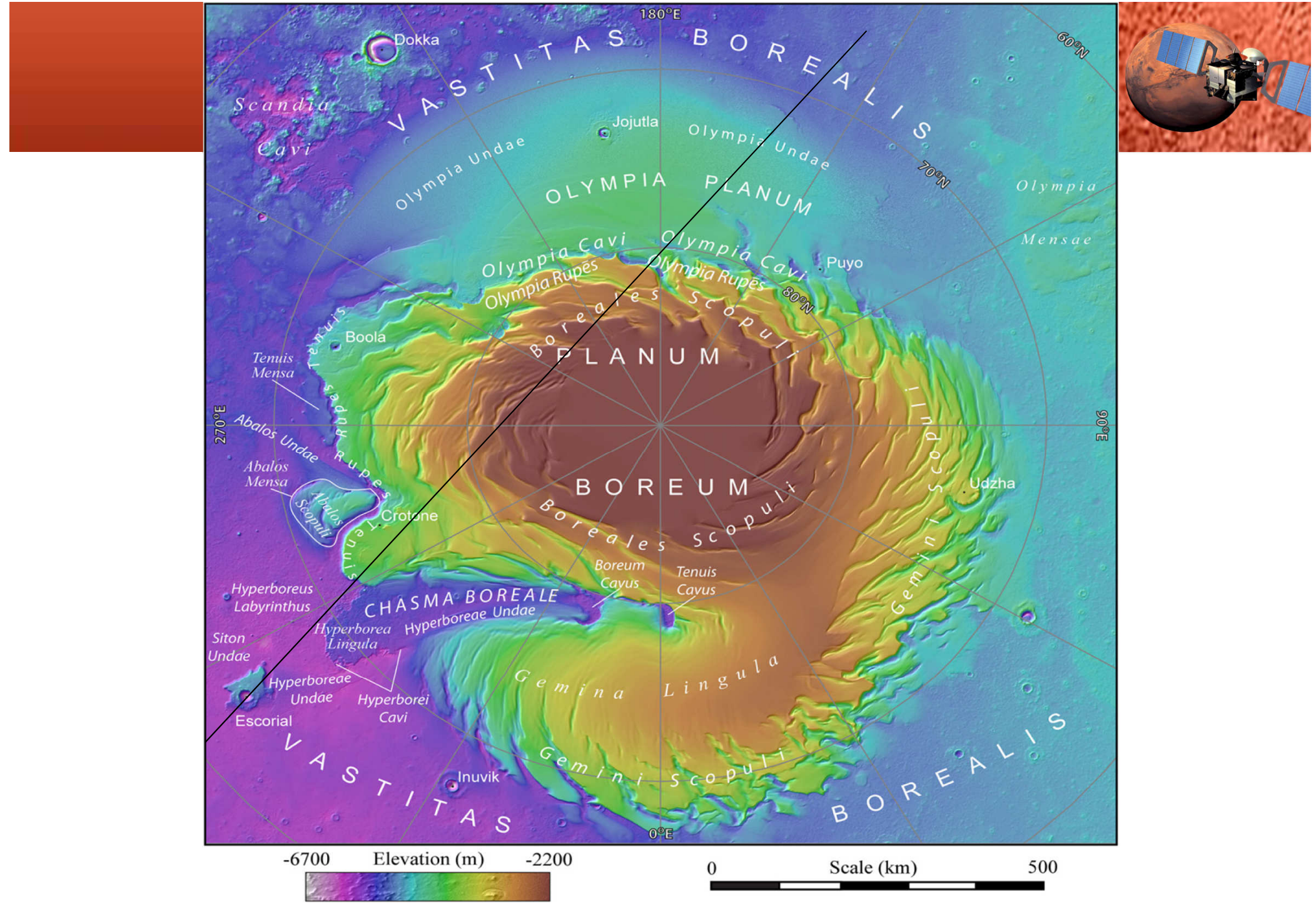


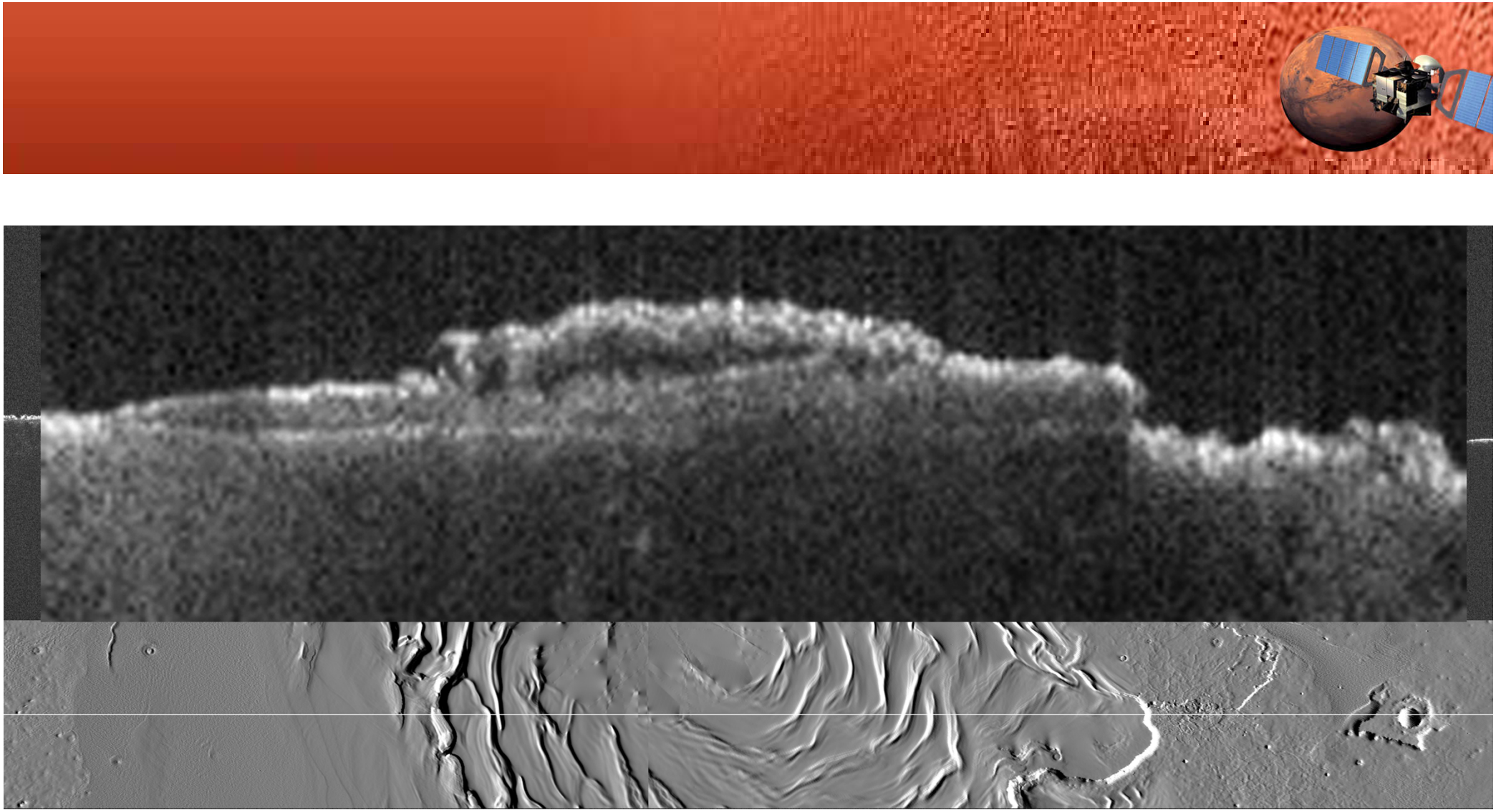
• MARSIS has conducted a successful north polar nightside campaign, but many orbits were missed.

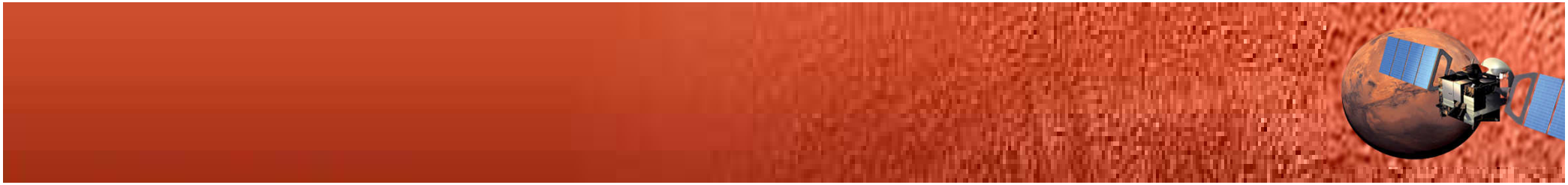
• Many examples of deep detections that were not possible before with MARSIS, and many others that are inaccessible to SHARAD.

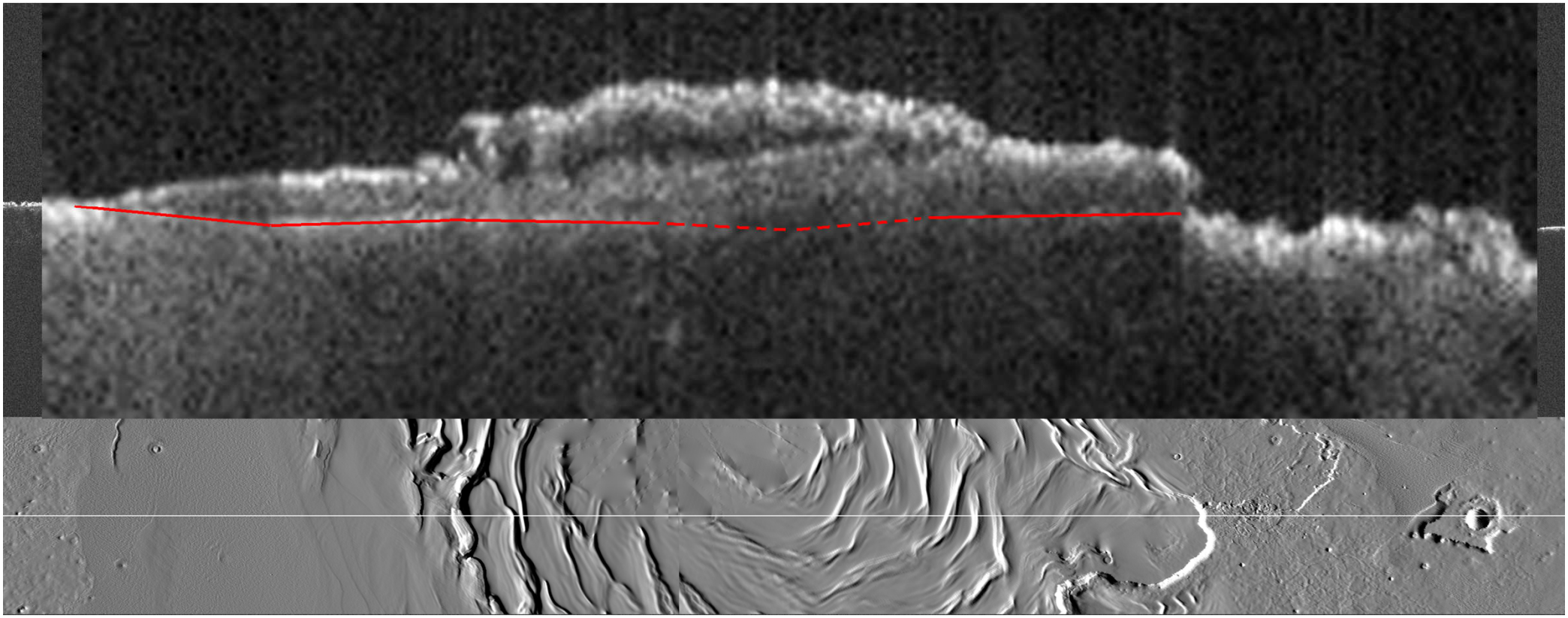
• Base of basal unit is visible across entire polar plateau. Allows better constraints on thickness and volume.

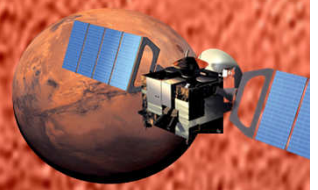
• Preliminary estimate of real dielectric of basal unit at Rupes Tenuis is ~4. Implies lithic component up to ~50%.


180°E
60°N
70°N
80°N
270°E
90°E
0°E
Dokka
Scandia Cavi
VASTITAS BOREALIS
Jojutla
Olympia Undae
OLYMPIA PLANUM
Olympia Cavi
Olympia Rupes
Olympia Mensae
Puyo
Boreales Scopuli
Tenuis Sandy Rupes
Boola
Tenuis Mensa
PLANUM BOREUM
Abalos Undae
Abalos Mensa
Abalos Scopuli
Crotone
Udzha
Gemini Scopuli
Tenuis Cavus
Boreum Cavus
Hyperboreus Labyrinthus
CHASMA BOREALE
Hyperboreae Undae
Hyperborea Lingula
Siton Undae
Hyperboreae Undae
Hyperborei Cavi
Escorial
Gemina Lingula
Inuvik
-6700
Elevation (m)
-2200
0
Scale (km)
500



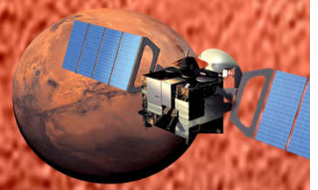




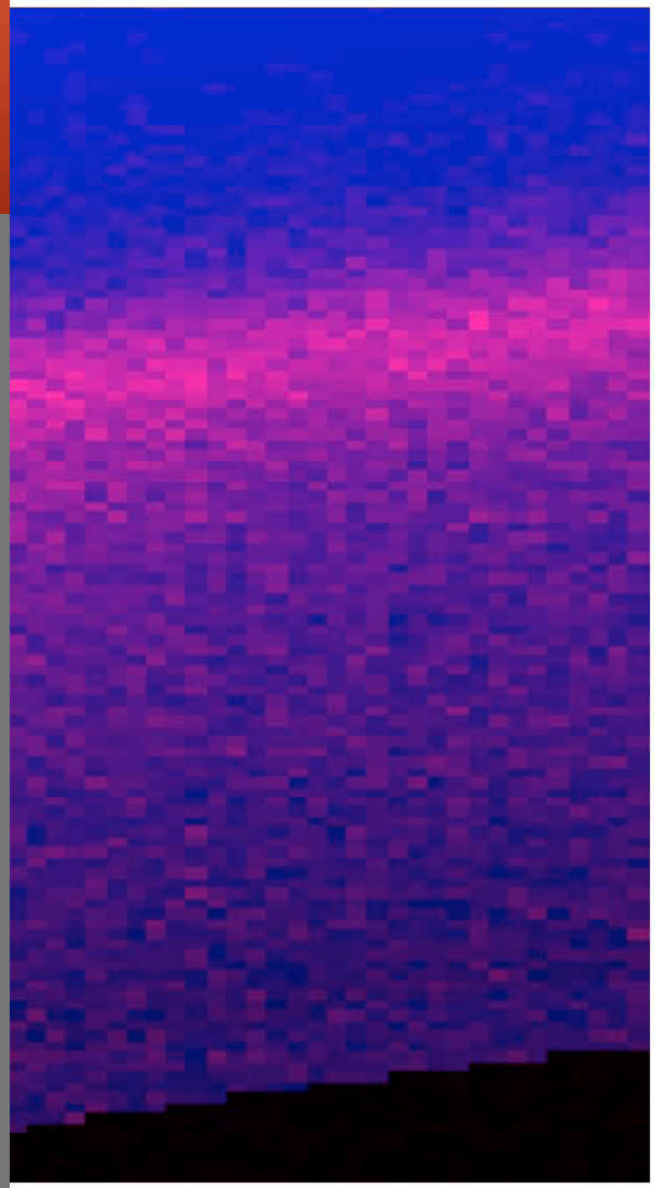


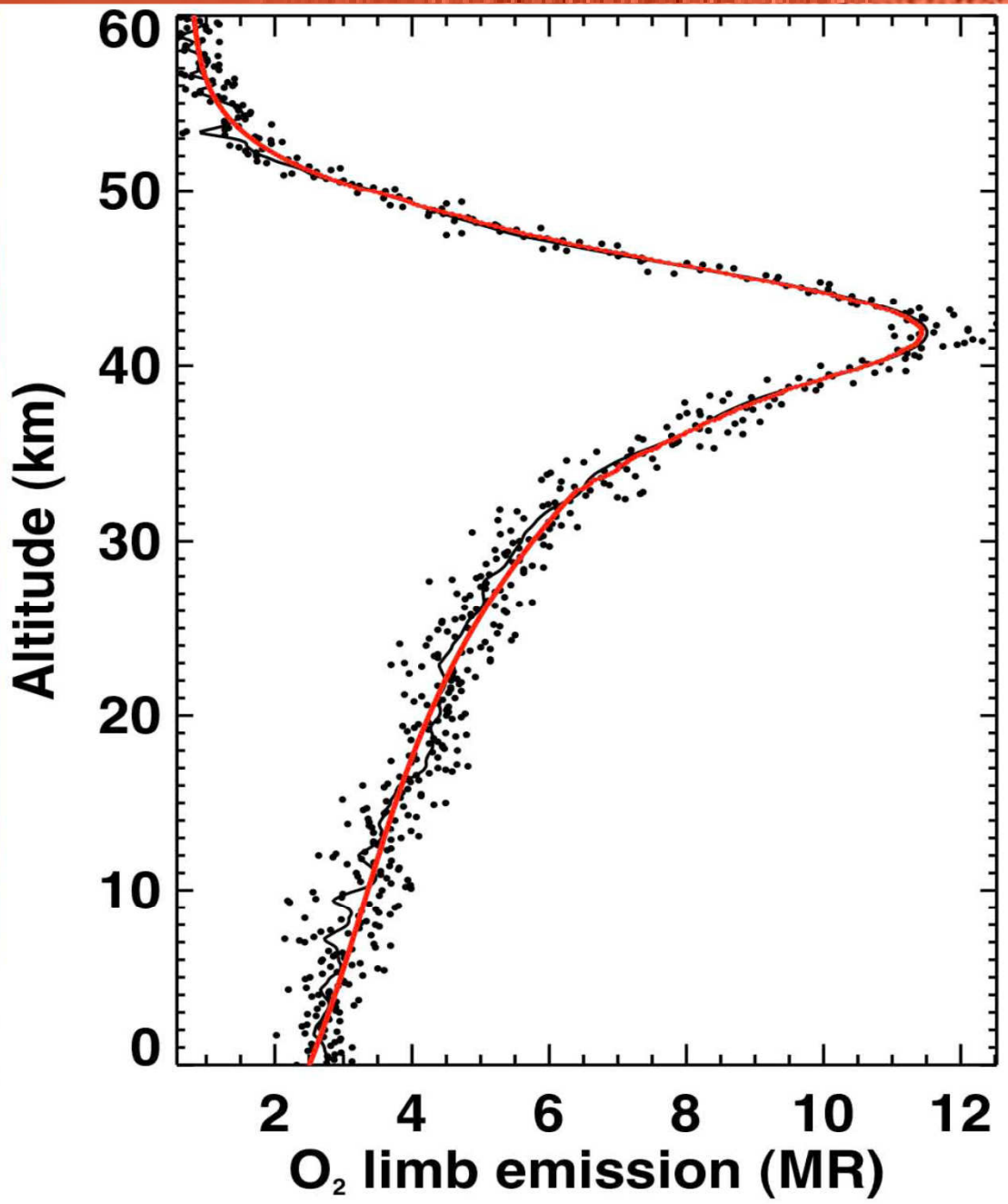
Supersaturation in water vapor

Maltagliati et al., *Science*, 30 September 2011



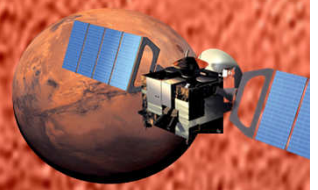
First detection of molecular oxygen nightglow emission at 1.27 µm with OMEGA





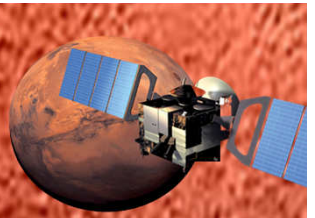
Bertaux et al., *JGR*, 2012

Science operations in 2012: highlights

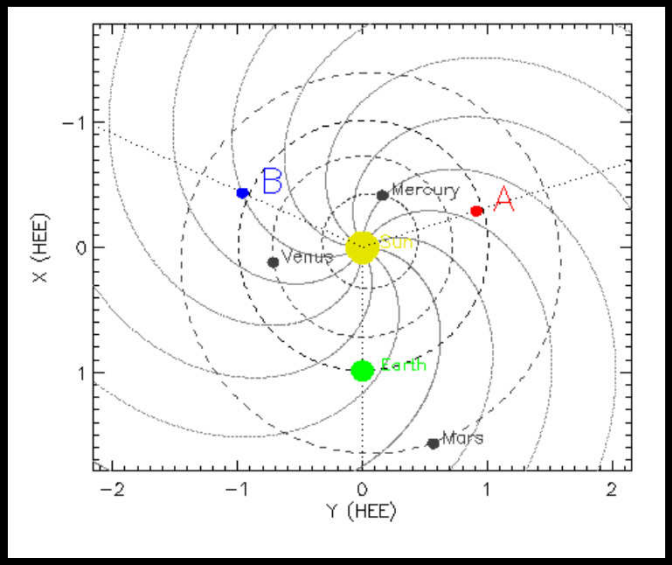


- Monitoring of the CO_2 ice clouds
- April-May: Joint observations of methane by PFS and ground-based observatories (VLT, Subaru, Keck)
- January-May: Solar wind / upper atmosphere campaign (see next slide)
- August onwards: MSL EDL, followed by joint surface operations

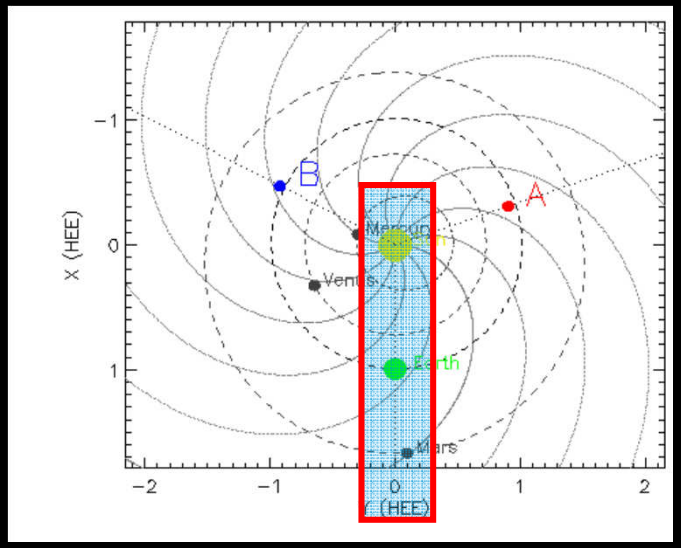
Special Solar Wind / upper atmosphere campaign



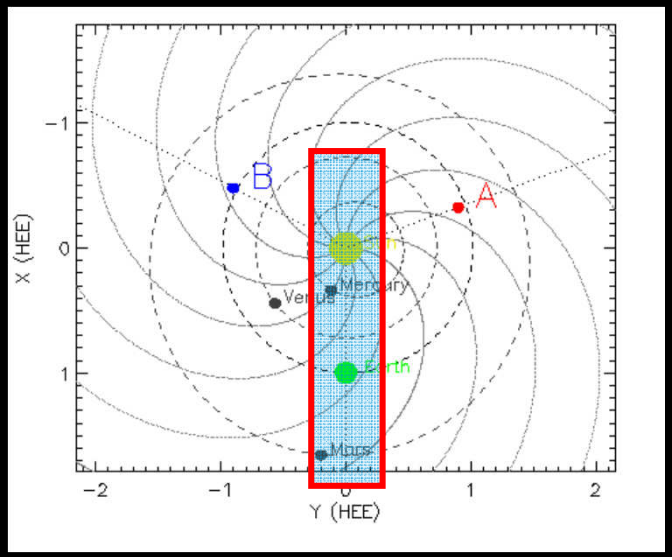
Jan 29, 2012



Feb 27, 2012



Mar 16, 2012



Apr 16, 2012