A photograph of the Mars Express satellite in orbit around the planet Mars. The satellite is shown from a side-on perspective, with its large white high-gain antenna dish and two long blue solar panels extended. It is positioned against the reddish-orange surface of Mars, which is visible in the background. The background beyond Mars is the dark void of space with distant stars.

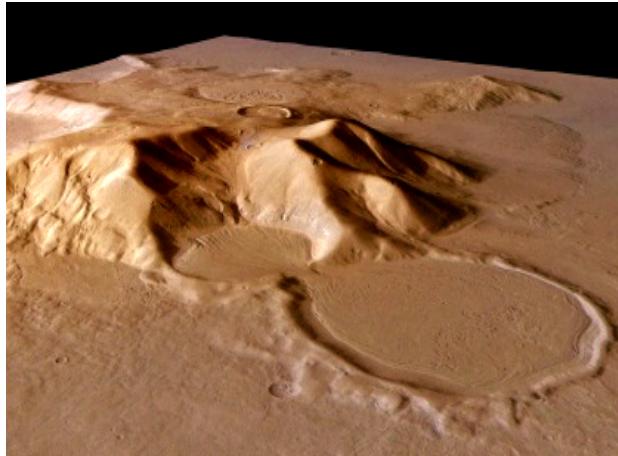
Mars Express highlights on Mars habitability

Dmitrij Titov
Mars Express Project Scientist
ESA/ESTEC

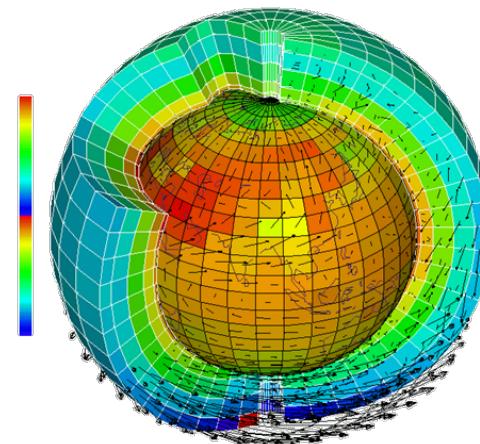
Science themes

Comprehensive study of the surface, atmosphere and plasma environment of Mars in space and time, and Phobos

Geology, interior & history



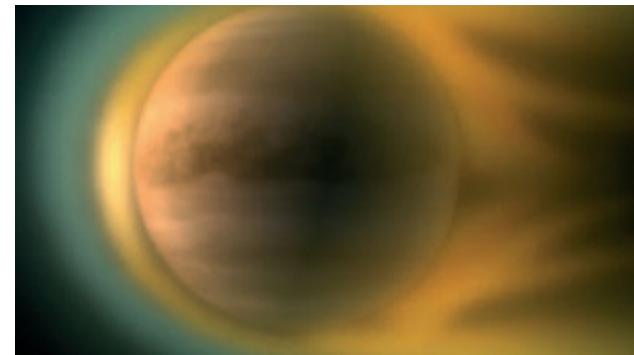
Meteorology & climate



Phobos



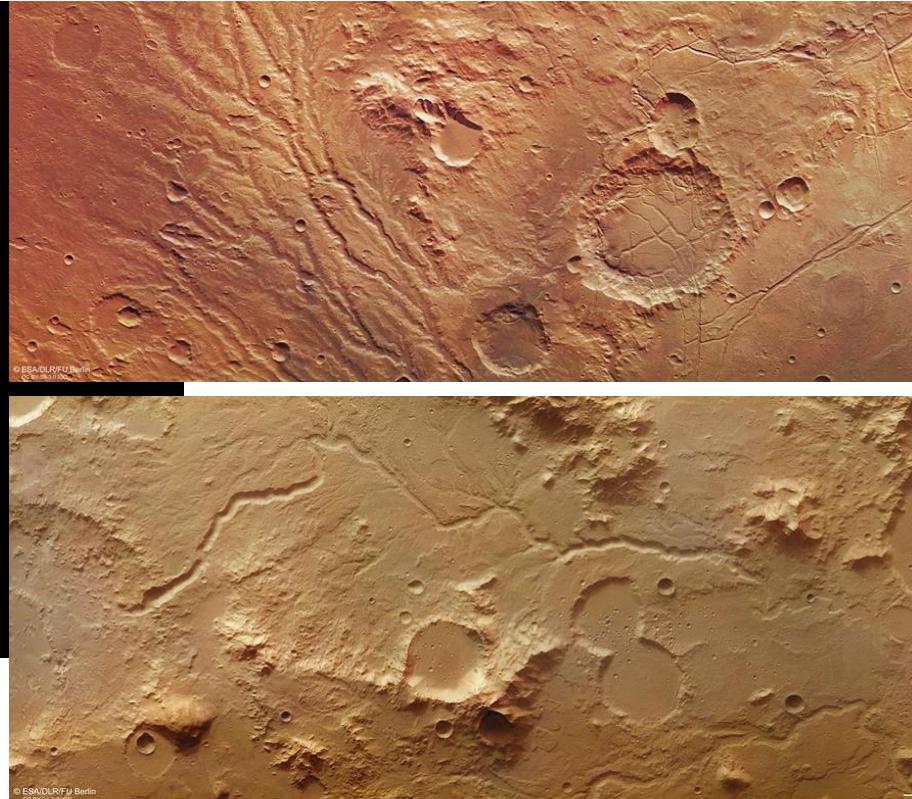
Aeronomy & evolution



Footprints of early warm and wet climate on Mars



Flight over Mawrth Vallis

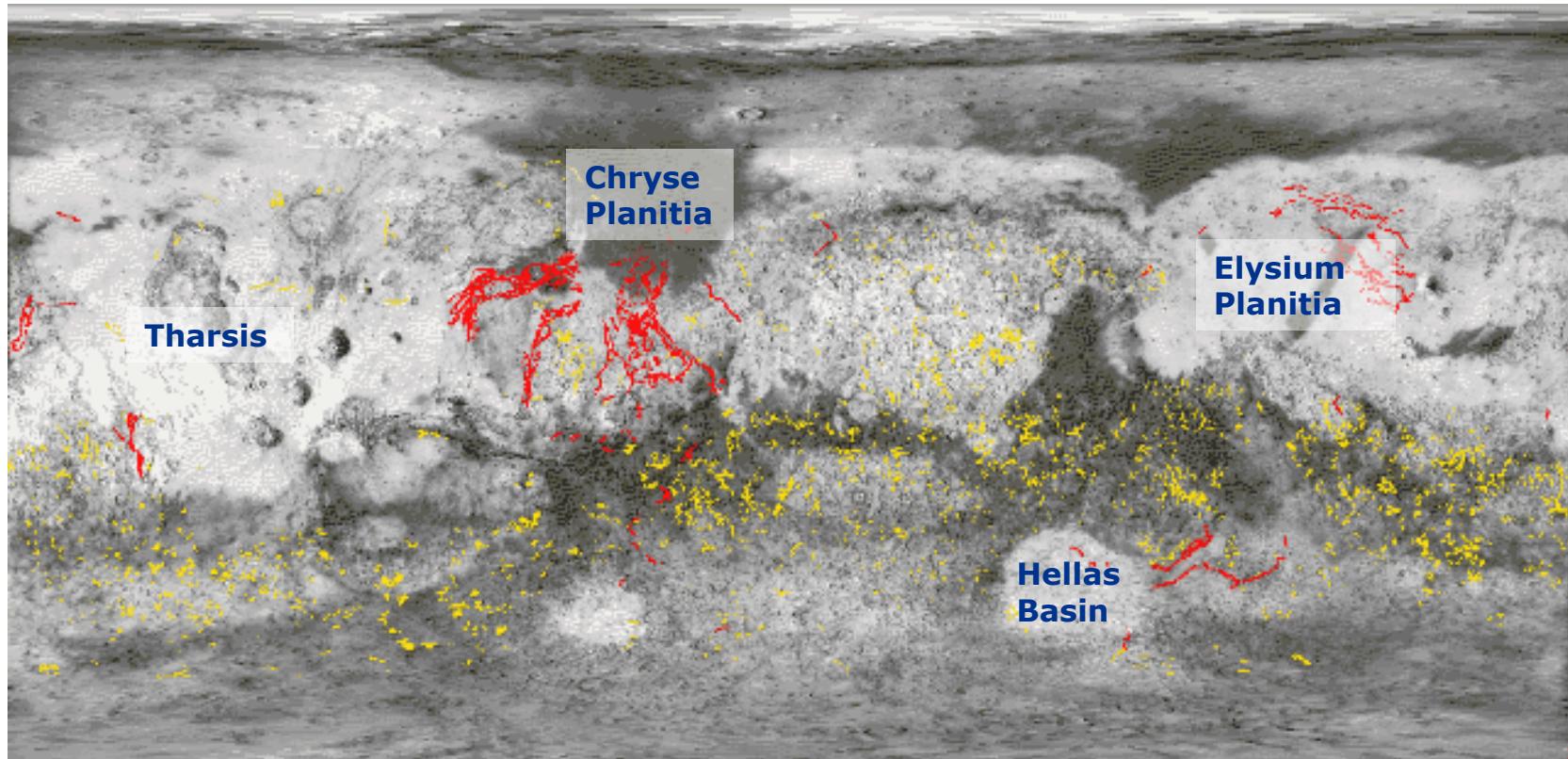


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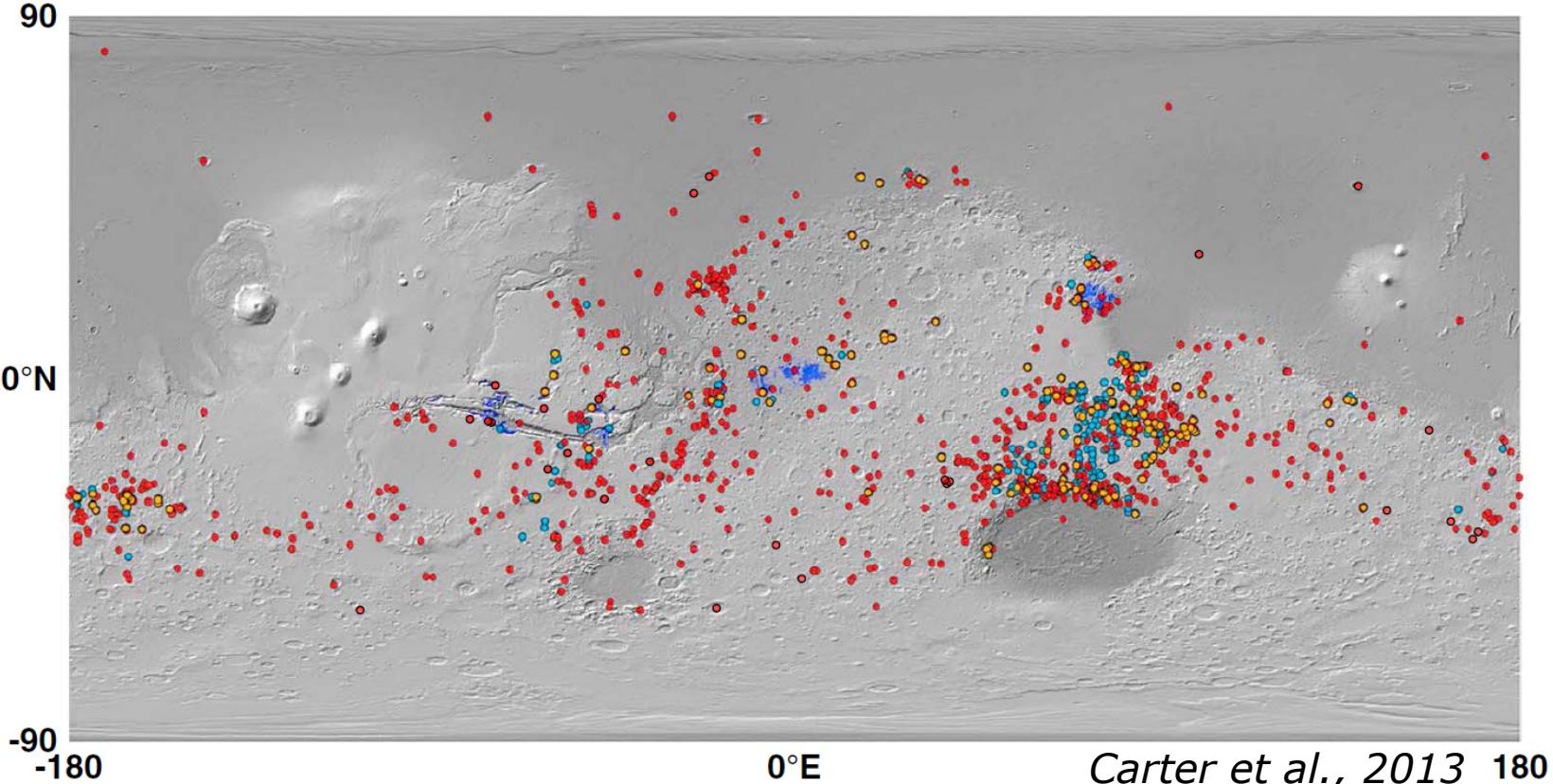


European Space Agency

Distribution and chronology of the outflow channels and valley networks

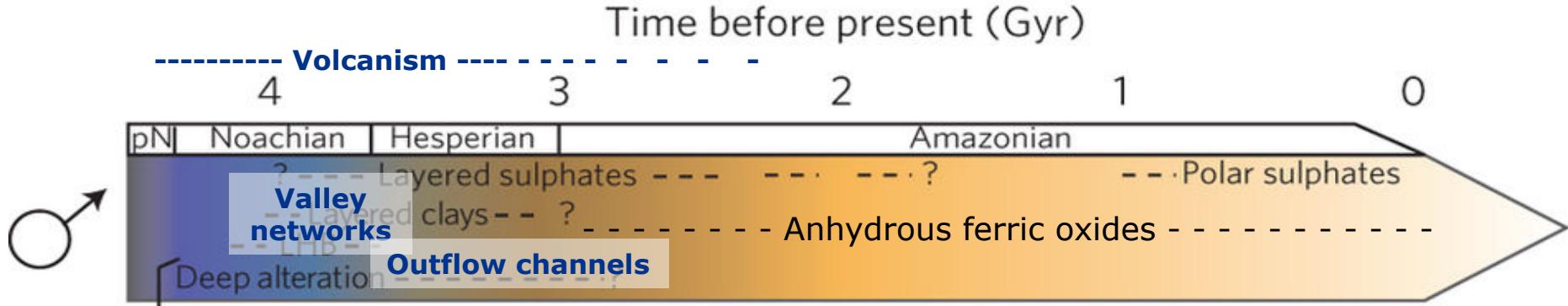


Distribution and chronology of hydrated minerals

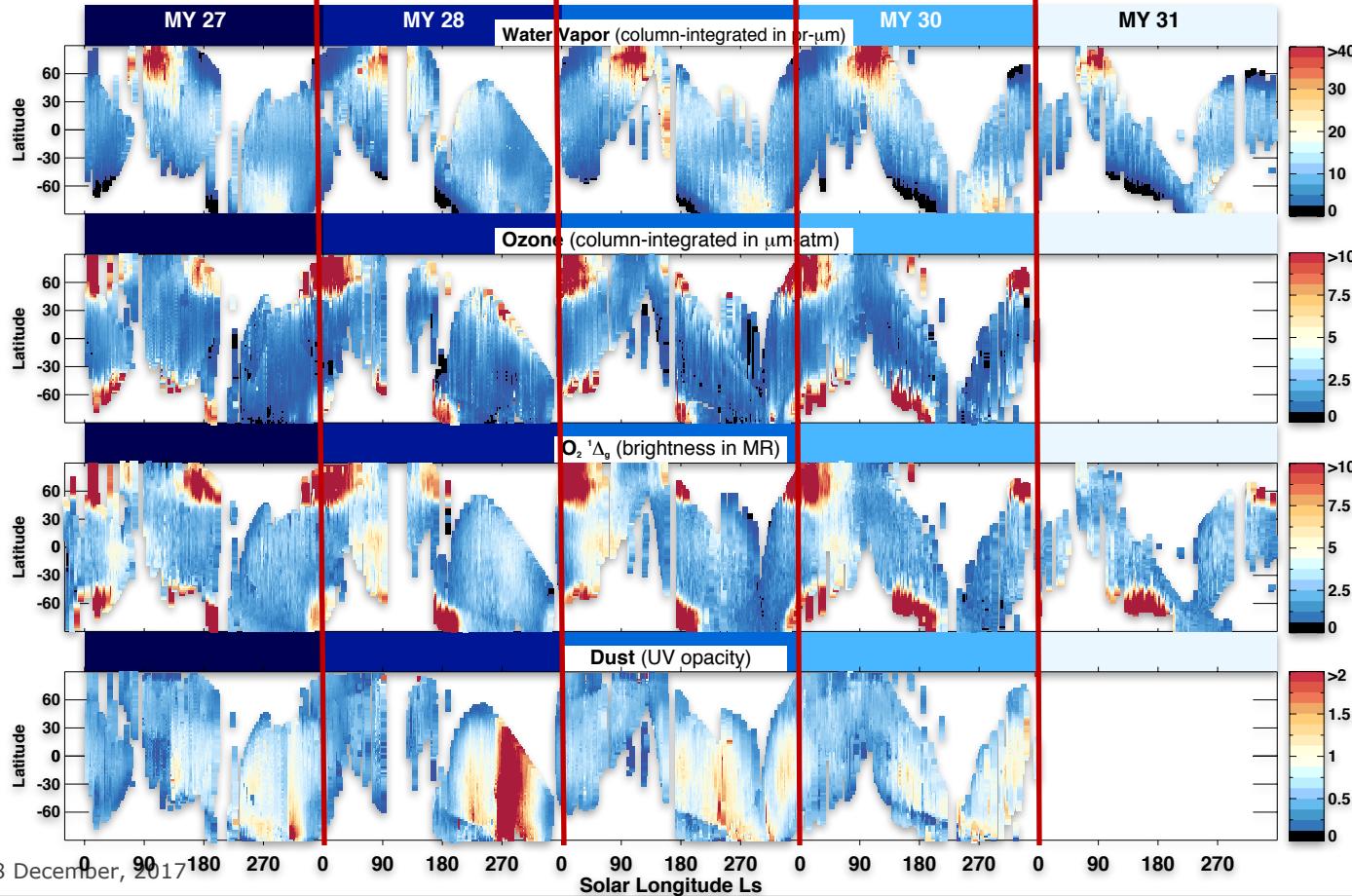


Carter et al., 2013

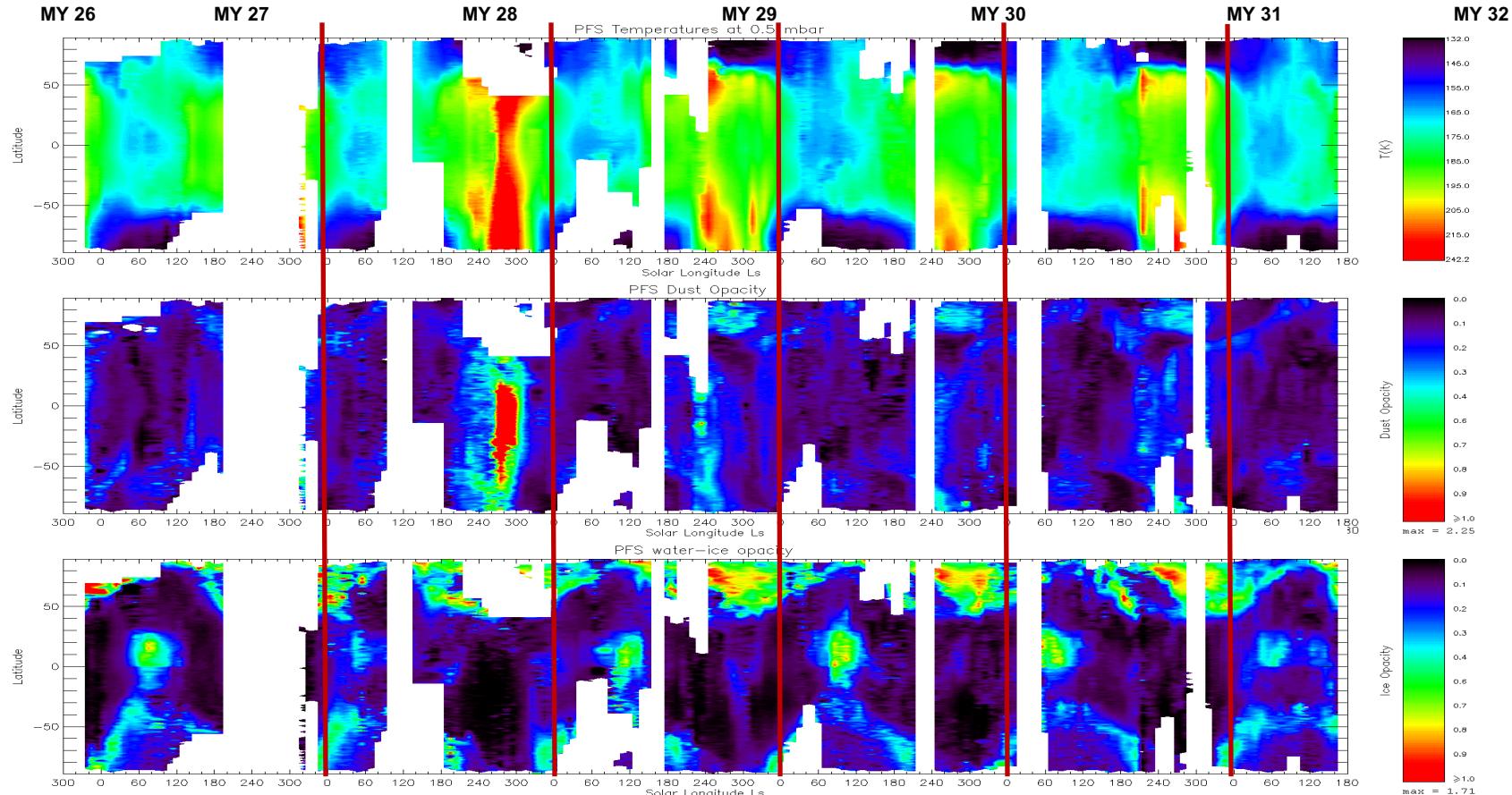
Mars evolution paradigm



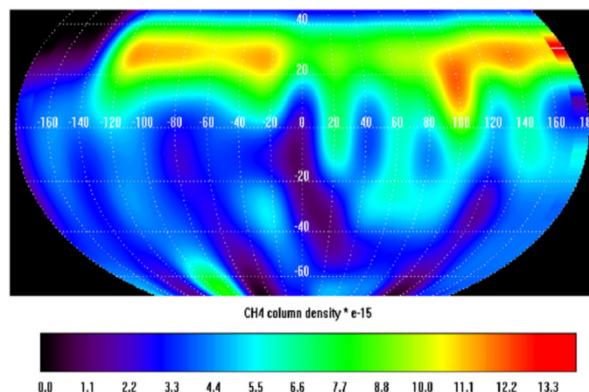
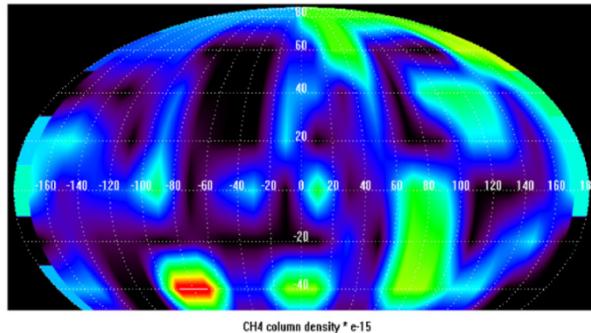
Mars climate today (1)



Mars climate today (2)



Methane on Mars



- Methane mixing ratio 0-45 ppb
- Non-homogeneous distribution suggesting sources and sinks
- Increase of methane column density occurs in the winter hemisphere
- Observations of methane in Gale crater (Curiosity)

Mars climate modelling

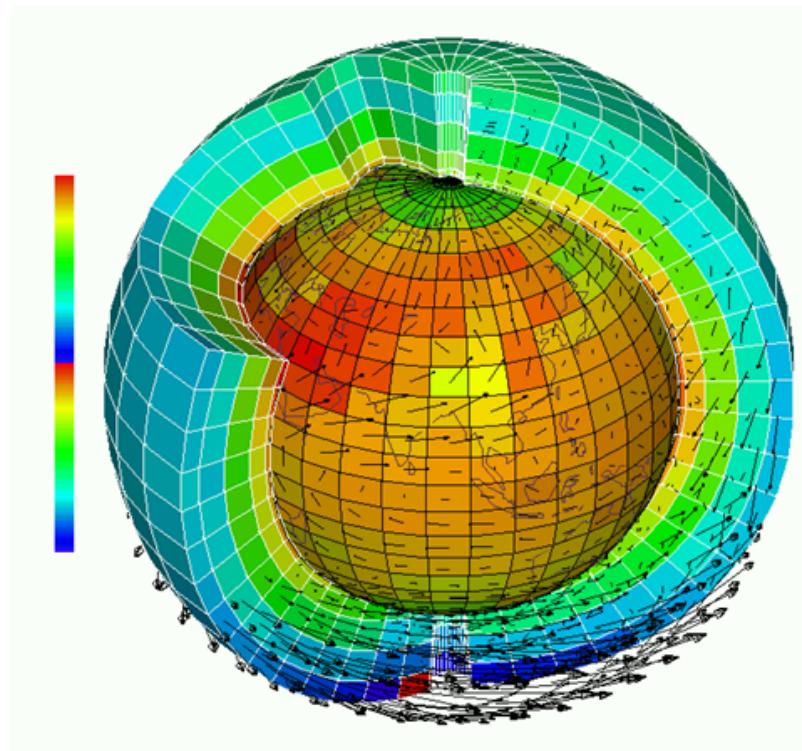


Dataset	
Temperature & Pressure	5
Aerosols & Clouds	15
Water vapour	7
Chemical species & ions	16
Surface frost	3



MEX Legacy Archive

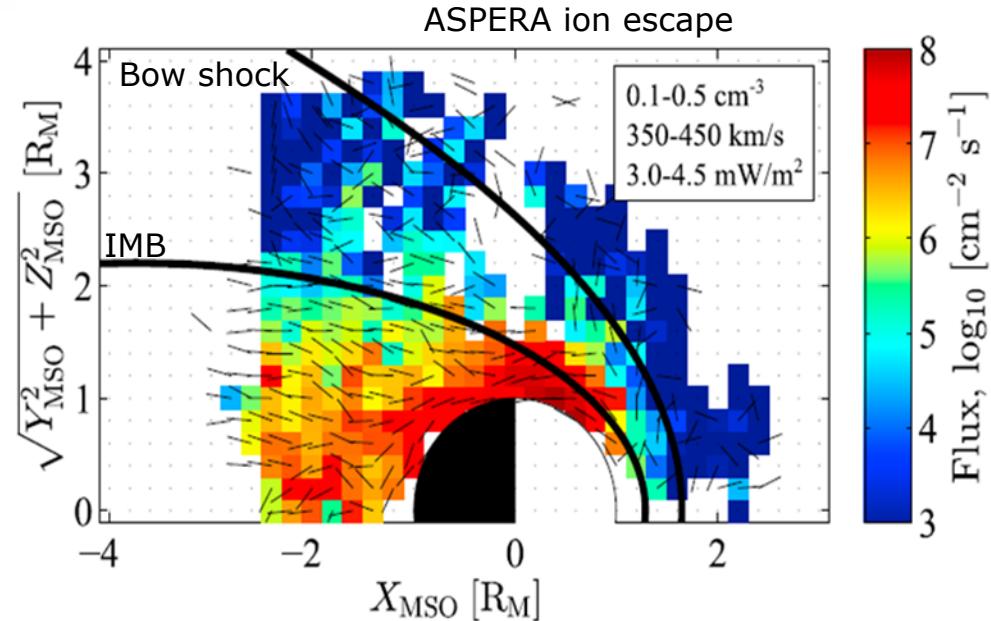
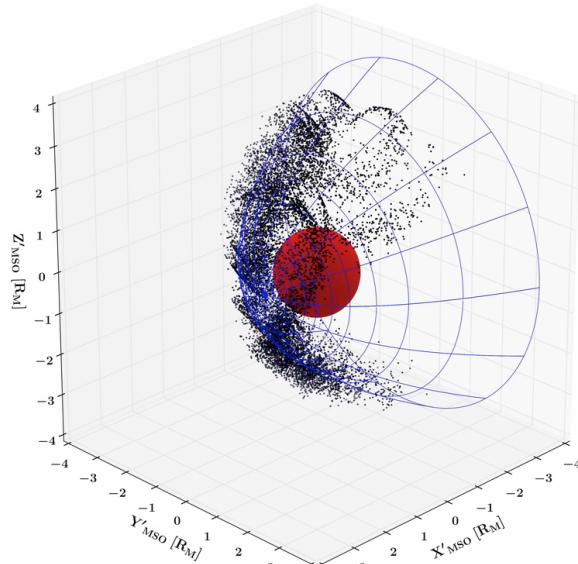
LMD Global Climate Model



Interaction with the solar wind and atmospheric escape

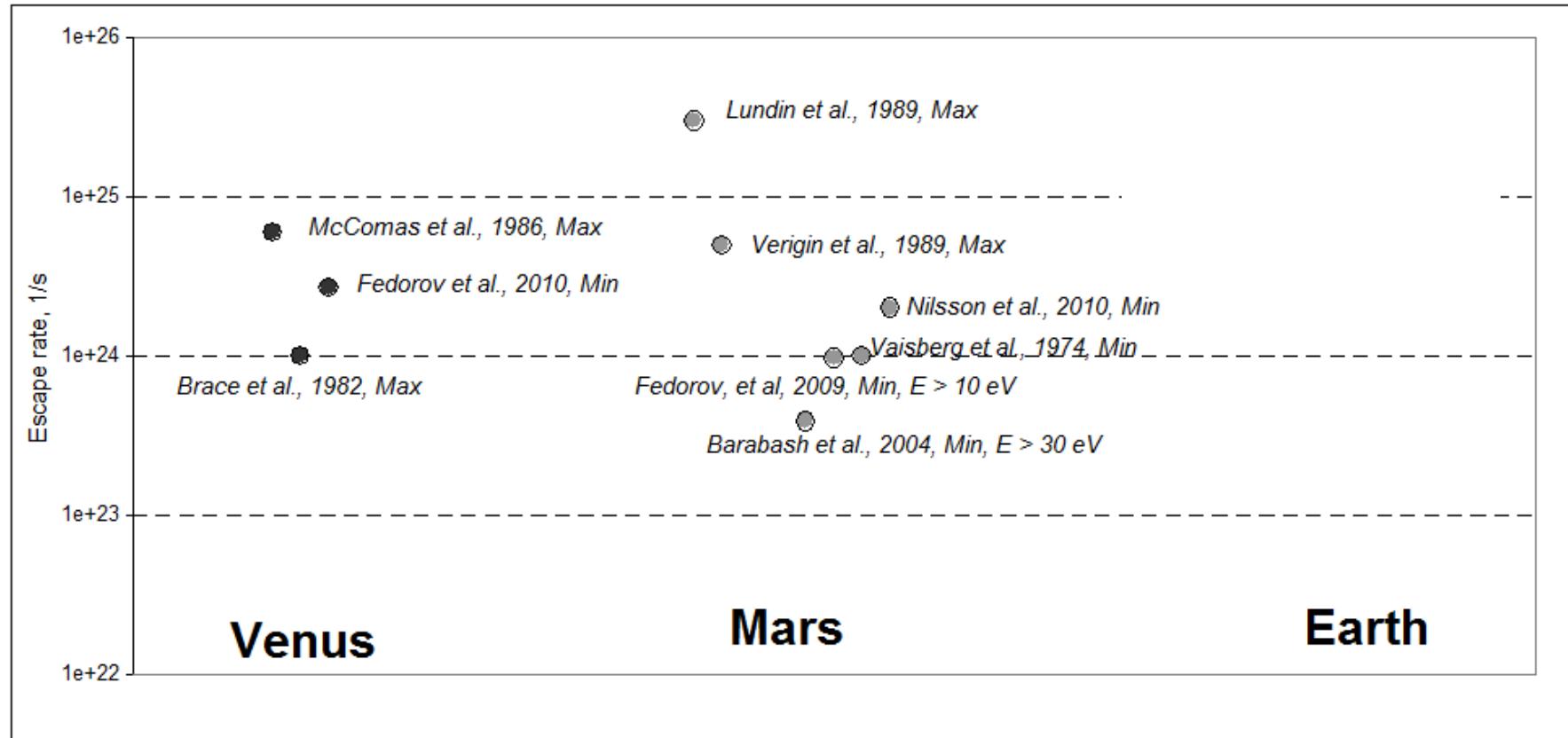


Mars Bow Shock Crossings by MEX
Jan 2004 - May 2015

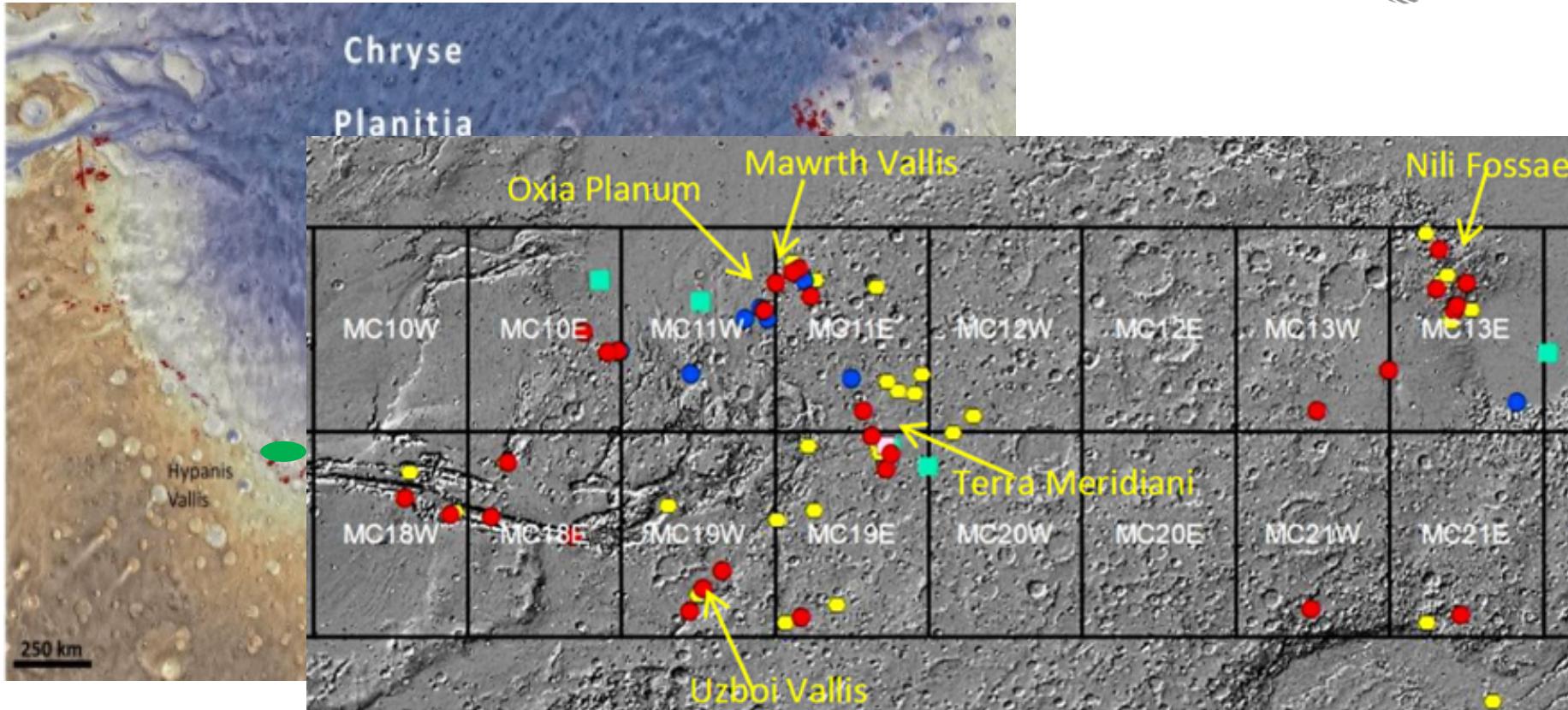


- Ion escape at Mars is production limited
- Losses ~100 g/s → ~1By to remove the atmosphere
- Heavy Venus vs light Mars ?

Does magnetosphere shield a planet ?



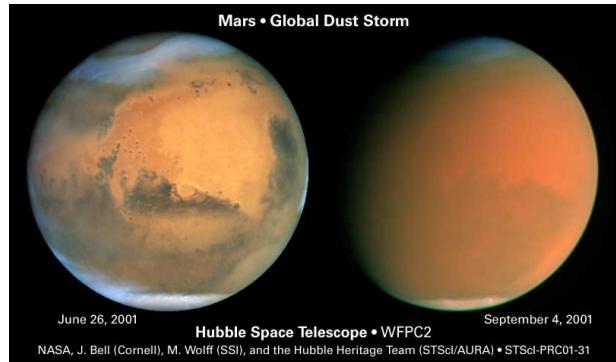
Characterisation of landing sites



Extension science case 2019-2020

2. Meteorology and climate

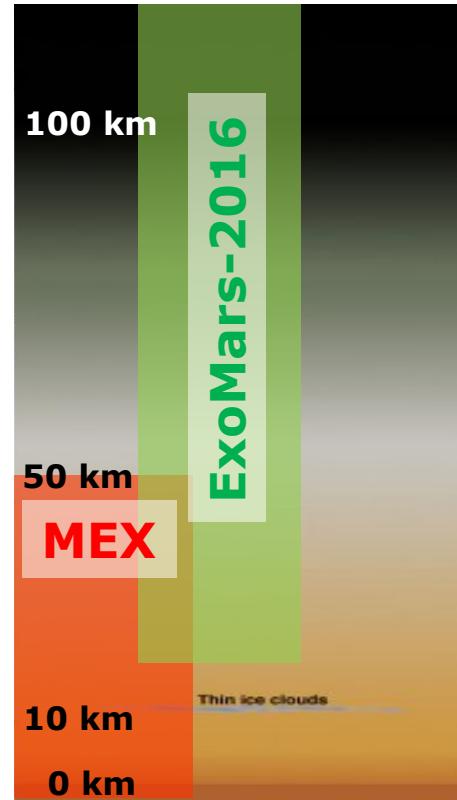
- Filling gaps in the meteorological parameters coverage (late night – early morning)
- Impact of dust on the atmospheric state
- Transient phenomena on the surface and in the atmosphere (cyclones, waves, “plumes”)
- Couplings between the lower and middle atmosphere (in collaboration with ExoMars-2016)



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Upper



Middle

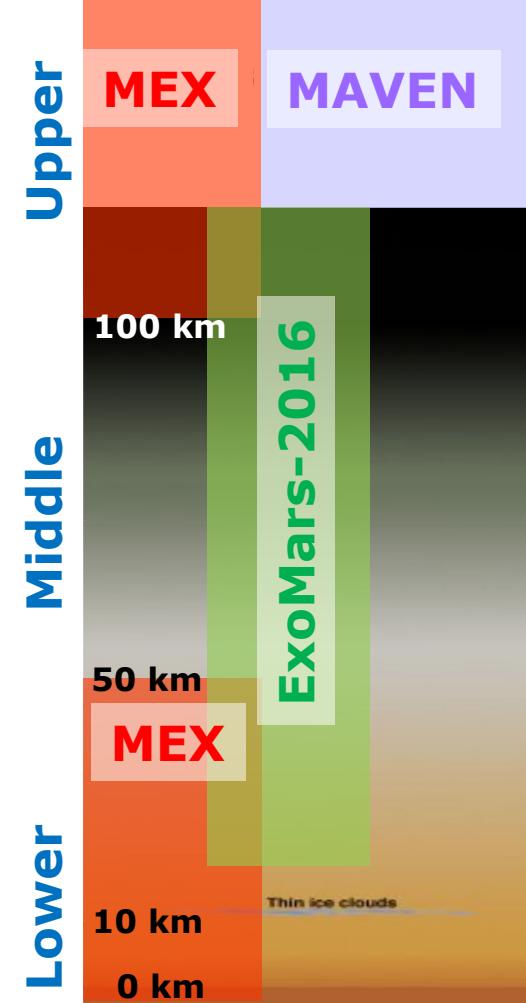
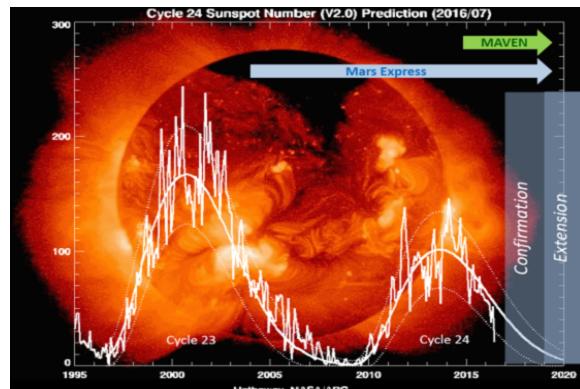
Lower

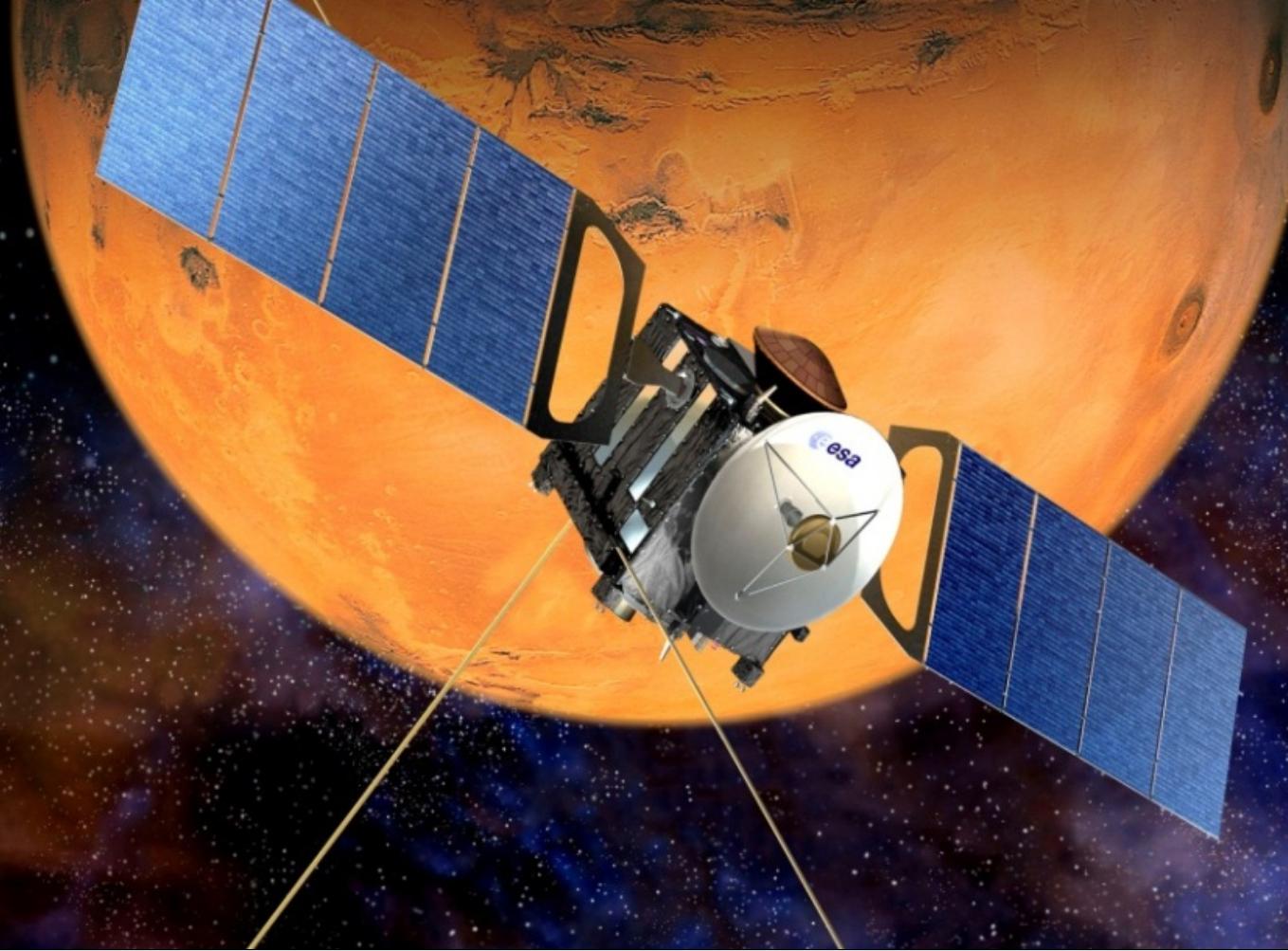
European Space Agency

Extension science case 2019-2020

3. Aeronomy, plasma environment and escape

- Augmenting the ionospheric coverage in latitude, longitude, season and local time
- Continue monitoring the plasma environment
- Aeronomy, ionosphere and escape in the solar minimum #24 compared to the cycle #23
- Coupling between the lower/middle and upper atmosphere (in collaboration with MAVEN)





Thank you !



ESLAB #52

Comparative aeronomy of terrestrial planets

ESTEC, May 14-18, 2018

ESA | 5/12/2017 | Slide 17

Key strengths of Mars Express



- **Multidisciplinary mission covering all layers:**
subsurface → surface → atmosphere → ionosphere → plasma environment
- **Non-sun-synchronous elliptical orbit**
 - *All local times*
 - *Phobos encounters*
- **Payload capabilities**
 - *Global Digital Elevation Model with 50 m/px resolution*
 - *Sounding the structure of the entire ionosphere with two frequencies*
 - *Simultaneous monitoring of H₂O and CO abundance in the lower atmosphere*
- **Longest continuous record of climate and plasma parameters**
- **Together with Venus Express - significant contribution to comparative climatology of terrestrial planets**