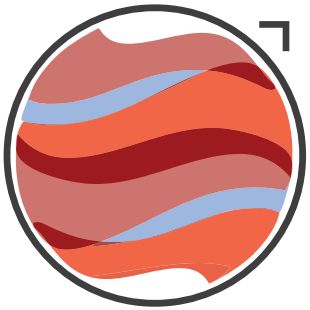
UPWARDS ↘

Press Kit



UPWARDS

UNDERSTANDING PLANET MARS

UPWARDS: Understanding Mars

Mars is key to solving some of humanity's greatest mysteries, including our origins and our place in the Universe. Alongside the intriguing search for extra-solar planets and the fast-growing field of archaeo-biology, understanding Mars is a critical step towards providing tangible answers to the questions of how life emerged on Earth and whether we are alone in the Universe.

UPWARDS is a cutting-edge scientific project which, with the collaboration of groups of leading European experts on Mars, will construct a comprehensive global image of Mars, examining this planet from the subsurface through to the outer atmosphere.

Through the development of new tools and their application to the study of existing unexplored data, UPWARDS aims to address several as yet unresolved questions about the red planet, including: the global water cycle, the exchange of methane and other gases between the atmosphere and the interior of Mars, the behavior of dust storms and the characteristics of the Martian subsurface and surface.

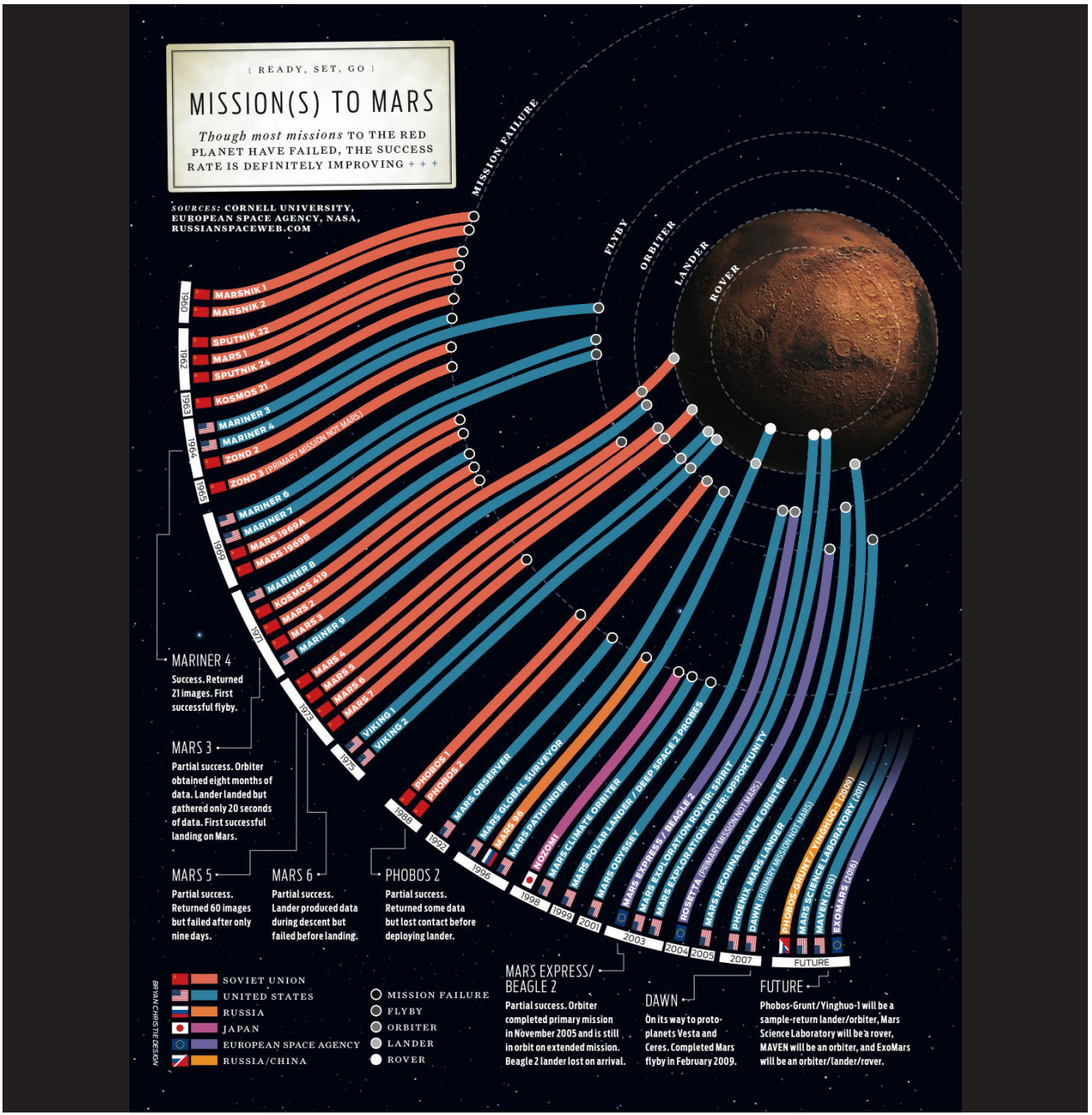
Furthermore, members of UPWARDS are active participants in the European ExoMars mission, 2016-2018 (ESA), and this European project will boost their involvement by creating a scientific framework for this mission and future Mars missions.

UPWARDS form part of Horizon 2020, the European Union's most ambitious research and innovation programme, aiming at excellence in scientific production, industrial leadership and with the quest of providing answers to social challenges.

The UPWARDS consortium is composed of the Spanish National Scientific Research Council (CSIC, Spain); the Open University (OU, United Kingdom); Institut d'Aéronomie Spatiale de Belgique (IASB, Belgium); Centre National de la Recherche Scientifique (CNRS, France); Istituto Nazionale di Astrofisica (INAF, Italy); Koninklijke Sterrenwacht van Belgie (ORB, Belgium) and the Complutense University of Madrid (UCM, Spain).

The UPWARDS project is coordinated from the Instituto de Astrofísica de Andalucía (IAA-CSIC, Spain) by Dr. Miguel Ángel López-Valverde.

"Cooperation between these institutions in a single project places UPWARDS at the forefront of Martian research in Europe" – Miguel Ángel López Valverde (IAA-CSIC, UPWARDS General Coordinator).


[READY, SET, GO]
MISSION(S) TO MARS
Though most missions TO THE RED PLANET HAVE FAILED, THE SUCCESS RATE IS DEFINITELY IMPROVING + + +
SOURCES: CORNELL UNIVERSITY, EUROPEAN SPACE AGENCY, NASA, RUSSIANSPACEWEB.COM
MISSION FAILURE
FLYBY
ORBITER
LANDER
ROVER
1960
MARSNIK 1
MARSNIK 2
1962
SPUTNIK 22
MARS 1
SPUTNIK 24
1963
KOSMOS 21
1964
MARINER 3
MARINER 4
1965
ZOND 2
ZOND 3 (PRIMARY MISSION NOT MARS)
1969
MARINER 6
MARINER 7
MARS 1969A
MARS 1969B
1971
MARINER 8
KOSMOS 419
MARS 2
MARS 3
MARINER 9
1973
MARS 4
MARS 5
MARS 6
MARS 7
1975
VIKING 1
VIKING 2
1988
PHOBOS 1
PHOBOS 2
1992
MARS OBSERVER
1996
MARS GLOBAL SURVEYOR
MARS 96
MARS PATHFINDER
1998
NOZOMI
MARS CLIMATE ORBITER
1999
MARS POLAR LANDER / DEEP SPACE 2 PROBES
2001
MARS ODYSSEY
2003
MARS EXPRESS / BEAGLE 2
MARS EXPLORATION ROVER: SPIRIT
2004
MARS EXPLORATION ROVER: OPPORTUNITY
ROSETTA (PRIMARY MISSION NOT MARS)
2005
MARS RECONNAISSANCE ORBITER
2007
PHOENIX MARS LANDER
DAWN (PRIMARY MISSION NOT MARS)
FUTURE
PHOBOS-GRUNT / YINGHUO-1 (2009)
MARS SCIENCE LABORATORY (2011)
MAVEN (2013)
EXOMARS (2016)
MARINER 4
Success. Returned 21 images. First successful flyby.
MARS 3
Partial success. Orbiter obtained eight months of data. Lander landed but gathered only 20 seconds of data. First successful landing on Mars.
MARS 5
Partial success. Returned 60 images but failed after only nine days.
MARS 6
Partial success. Lander produced data during descent but failed before landing.
PHOBOS 2
Partial success. Returned some data but lost contact before deploying lander.
MARS EXPRESS/ BEAGLE 2
Partial success. Orbiter completed primary mission in November 2005 and is still in orbit on extended mission. Beagle 2 lander lost on arrival.
DAWN
On its way to proto-planets Vesta and Ceres. Completed Mars flyby in February 2009.
FUTURE
Phobos-Grunt/Yinghuo-1 will be a sample-return lander/orbiter, Mars Science Laboratory will be a rover, MAVEN will be an orbiter, and ExoMars will be an orbiter/lander/rover.
SOVIET UNION
UNITED STATES
RUSSIA
JAPAN
EUROPEAN SPACE AGENCY
RUSSIA/CHINA
MISSION FAILURE
FLYBY
ORBITER
LANDER
ROVER
BRYAN CHRISTIE DESIGN

Mars exploration: Rethinking Mars

The last two decades have witnessed the advance of an exciting era of exploration of Mars, with almost a dozen Mars missions. The time for further exploration of Mars is here and now, with an unprecedented amount of recent data to analyze and a plethora of focused questions and revolutionary new observations to conduct.

Europe has invested heavily in Mars research, with two clear milestones: the successful Mars Express mission, launched in 2003, and the upcoming ExoMars 2016 (launch period: 15-25 March 2016) and Exomars 2018 missions, in preparation for a future Sample Return Mission.

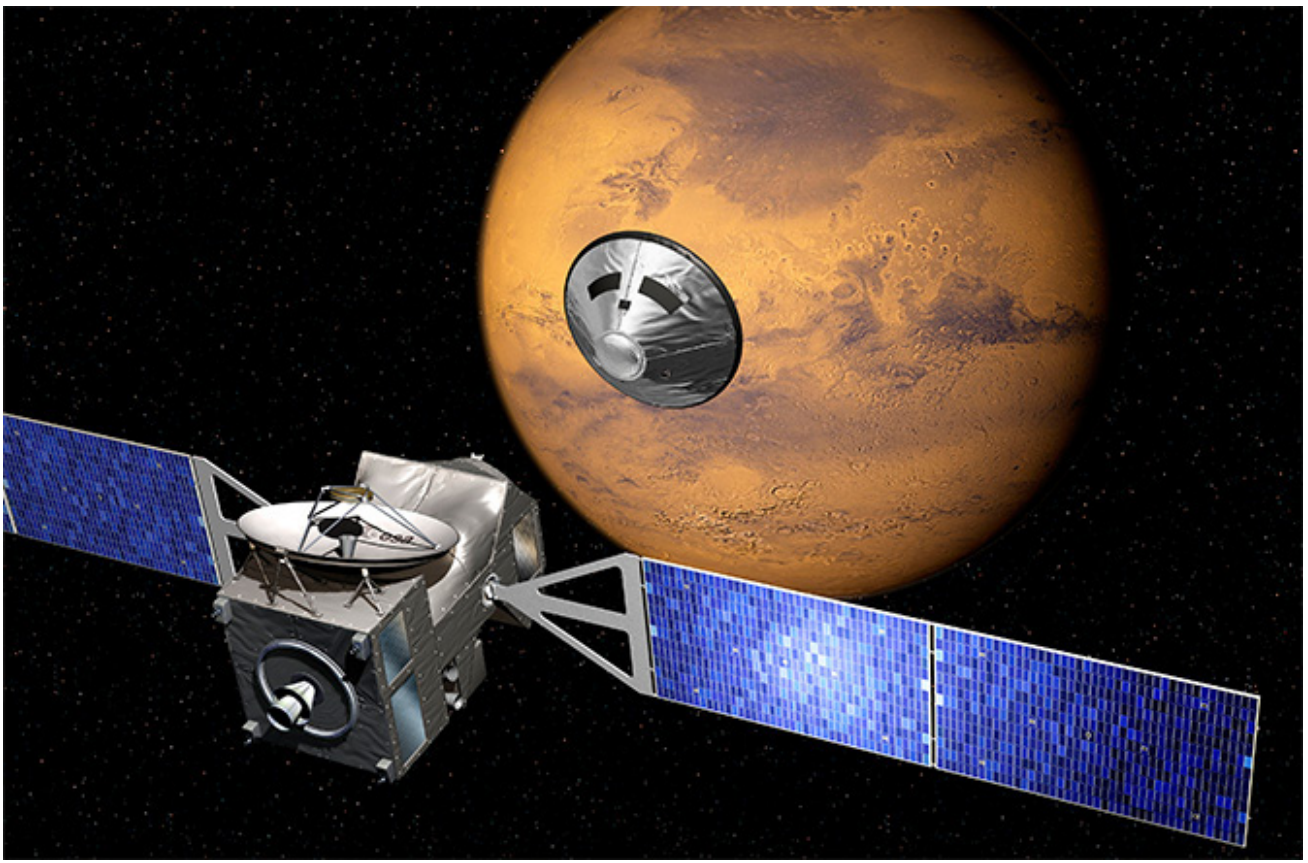
This is the critical moment to complete the exploitation of the first of these milestones, to consolidate the knowledge gained from Mars Express and to direct the next European step towards unlocking Mars, in a phase where new inter-team data analysis is needed.

UPWARDS gathers experts from Mars Express, including PIs and co-Is of many of its instruments, in a multi-disciplinary scientific program. Over the next three years it will create new analytical tools, largely based on the techniques employed in terrestrial climatology and meteorology to analyse data generated by ExoMars 2016.

These tools, together with new geophysical and atmospheric models, will also be used on the huge data set collected from previous missions, with the aim of solving the main existing queries in Martian investigation.

UPWARDS will constitute an updated scientific review of much of our current Martian knowledge, forming the basis of objectives for ExoMars 2018 as well as for future Martian missions.

"UPWARDS is a pioneer in the creation of multidisciplinary groups for the coordinated analysis of the information gathered on a space mission prior to its launch, like ExoMars." – Miguel Ángel López Valverde (IAA-CSIC, UPWARDS General Coordinator).



Artist's impression of the ExoMars 2016 mission, including the Trace Gas Orbiter (TGO) and Schiaparelli, a small landing demonstrator module.

ESA/ATG MEDIALAB

The Martian puzzle

Understanding the evolution of Mars and other solid planets requires exploring them as global systems in which geological and atmospheric aspects are related by means of a combination of complex physical and chemical processes.

The name UPWARDS refers to this unique integration of expertise oriented to understanding the essential couplings within the Martian system, requiring a cross-disciplinary approach including geologists, atmospheric physicists, climate experts, and experienced researchers in theoretical modelling and tools.

The project is specifically focused on a number of challenging issues pending in current Martian research, ranging from the interior and subsurface, surface, the water cycle, methane, dust storms and to the upper atmosphere and escape to space.

UPWARDS is an ambitious project which aims to piece together some of the missing parts of the Martian jigsaw to reveal a Mars hitherto unknown.

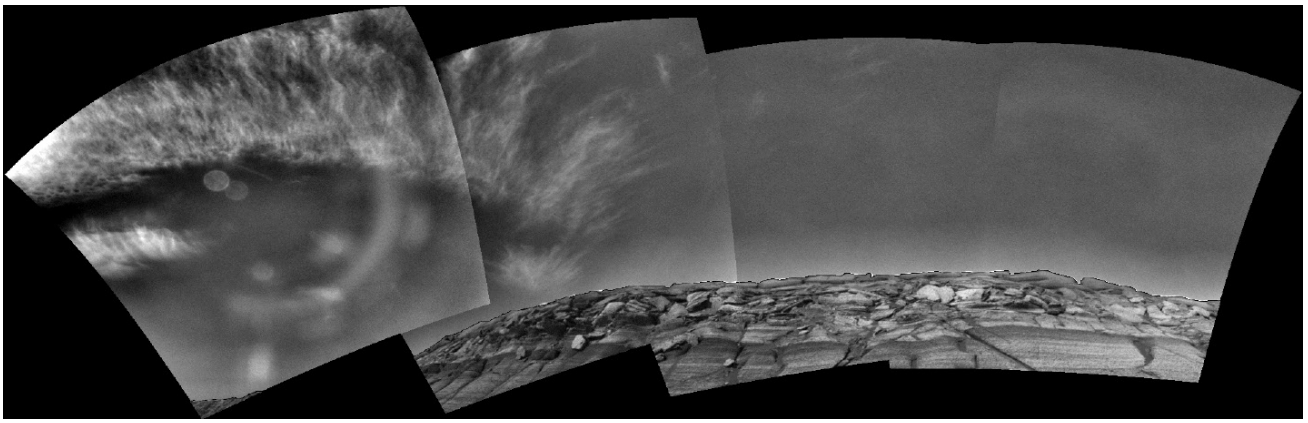
"UPWARDS is an example of a coordinated opportunity for understanding the most challenging open issues in the Mars system that allows us to form a consistent, global image of Mars". – Miguel Ángel López Valverde (IAA-CSIC, UPWARDS General Coordinator).

These are the pieces of the Martian puzzle:

The global water cycle (vapour and ice) on Mars:

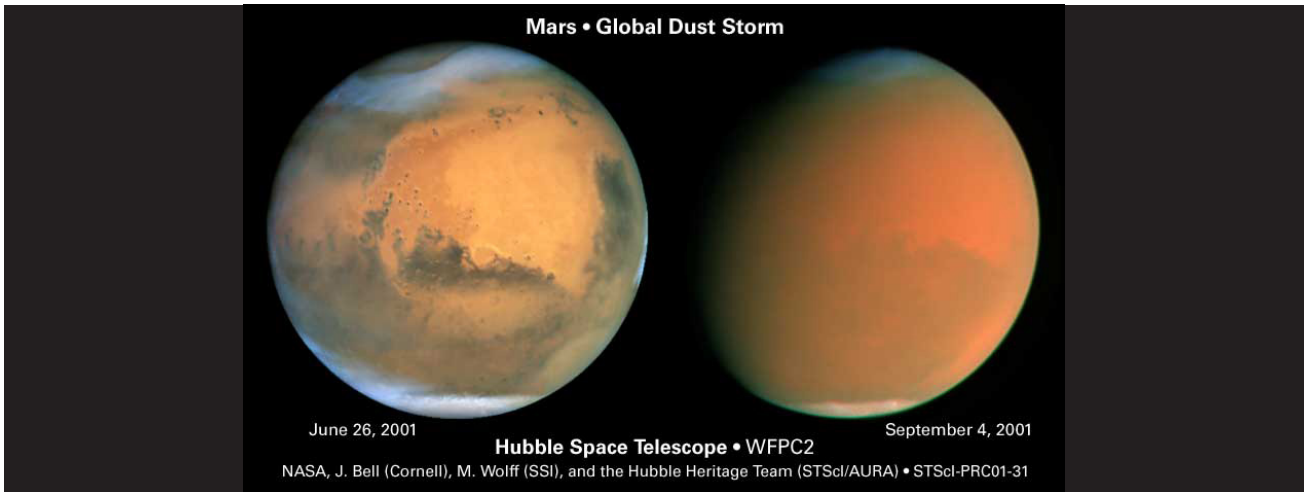
Mars possesses an active water cycle characterized by large spatial and seasonal variations of water vapor, ice clouds, and surface frost. Understanding this cycle is very important; it is thought to play a major role in the present-day Mars climate, and its variations over the last million years have strongly influenced Mars' recent geology, environment and habitability.

UPWARDS will gather all available observations on water vapor, frost and especially clouds in a unique and consistent dataset and will improve the representation of the water cycle in global climate models.



Clouds at the onset of Martian winter. Similar in appearance to cirrus clouds on Earth, these clouds are believed to be composed of water-ice particles on the order of several micrometers (a few the-thousandths of an inch) in lenght.

NASA/JPL - Caltech



Fabulous dust storms.

Another striking feature of our neighbouring planet is the extraordinary recurrent dust storms that can at times envelop its entire surface. What causes these phenomena? We haven't yet got an answer for that, but we do know that they are involved in other processes, such as the formation of surface ice and in the Martian water cycle.

UPWARDS aims to describe dust storms at every level and from a global perspective, revealing their interrelation with other Martian phenomena. Their origin, evolution and properties will be explored through observational analysis as well as very detailed models.

Artist's concept of NASA's Mars Science Laboratory spacecraft approaching Mars.
NASA/JPL - Caltech

The upper atmosphere:

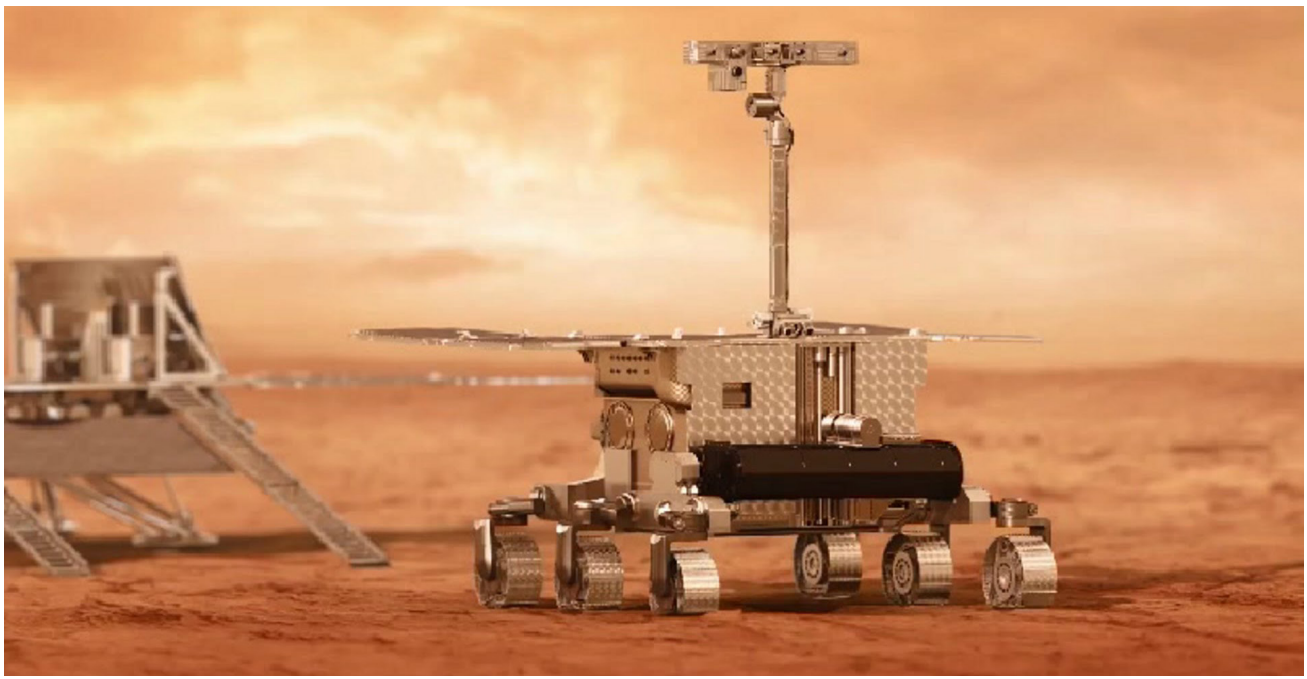
Above 60km, there is a transition zone between the lower Martian atmospheric layers and the outer layers in contact with outer space. This complex zone is crucial to understanding the evolution of the Martian atmosphere from the planet's infancy until its present-day state. We now know that it's dynamic, for example it's very sensitive to surface phenomena like dust storms. It is also a critical region to quantify the aerobraking to be endured by future orbital missions around Mars.

UPWARDS will enable a deeper and more comprehensive vision of this region, like its yearly variability; the possible influence of the water cycle, dust storms and atmospherically suspended dust particles; the loss of chemical species to outer space.

Subsurface reservoirs and transport of trace gas species

Processes active in the subsurface of Mars are currently inaccessible to conventional instruments, but may emit trace gases into the atmosphere, observable with current or future instruments. Observing and understanding the production of these gases requires a holistic understanding of their transport from the subsurface to the atmosphere.

UPWARDS will identify the possible zones of ice deposits in the Martian surface and will quantify the diffusion of trace gases from these sources in the Martian subsurface to the surface.



Artist's impression of the ExoMars 2018 mission . The European rover will drill into the Martian surface, up to two metres down. The rover will be trying to detect traces of organic molecules that indicate the presence of past or present life on Mars.

ESA/ATG MEDIALAB

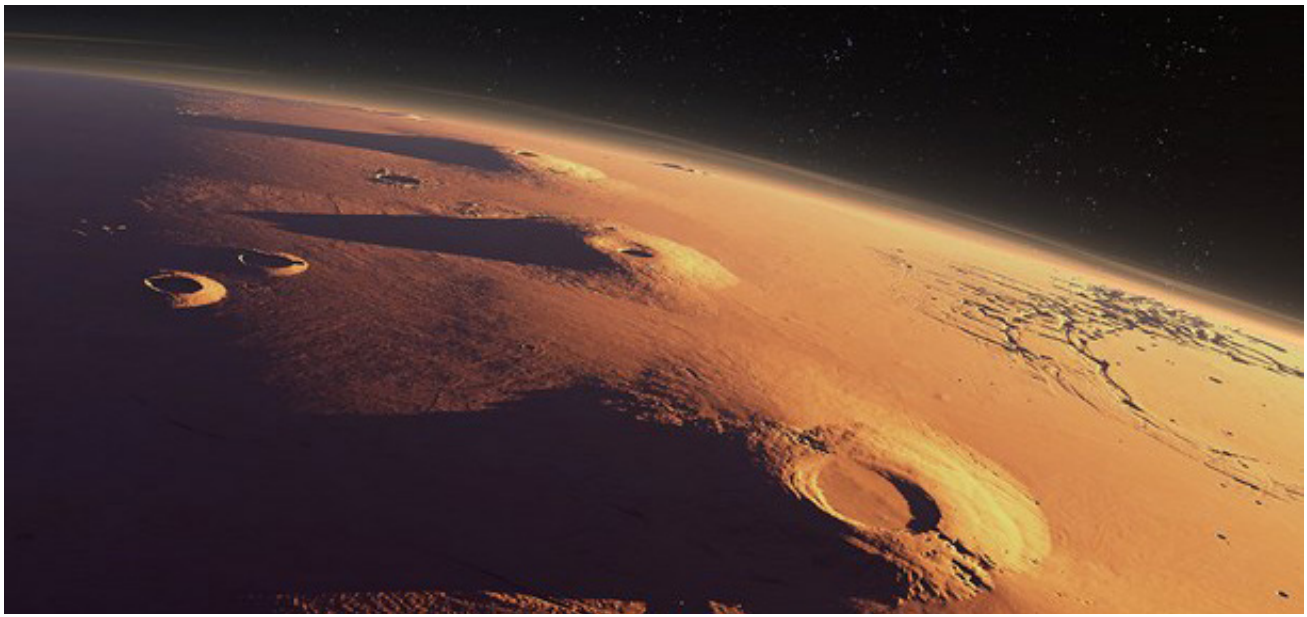
New retrieval tools, validation and optimization for ExoMars:

For the last ten years, a suite of American and European orbiters has provided an incomparable dataset regarding Mars' atmosphere and climate. However, there are many identified areas where this dataset is expected to reveal additional information that traditional retrieval techniques employed up to now have been unable to address. Unlocking this information requires the use of novel retrieval techniques, most of which have already been applied to Earth studies, that the UPWARDS consortium have begun to adapt to the Martian case.

UPWARDS will develop, test and innovate retrieval techniques, optimize the exploitation of measurements taken by various instruments to better constrain the Martian physical parameters and prepare the data processing and anticipate the observational needs (wavelength, spectral resolution) of future missions.

ExoMars 2016 mission. Artist's impression of the Trace Gas Orbiter (TGO) and Schiaparelli, a small landing demonstrator module.

ESA - Jorge Vago



Day-night transition:

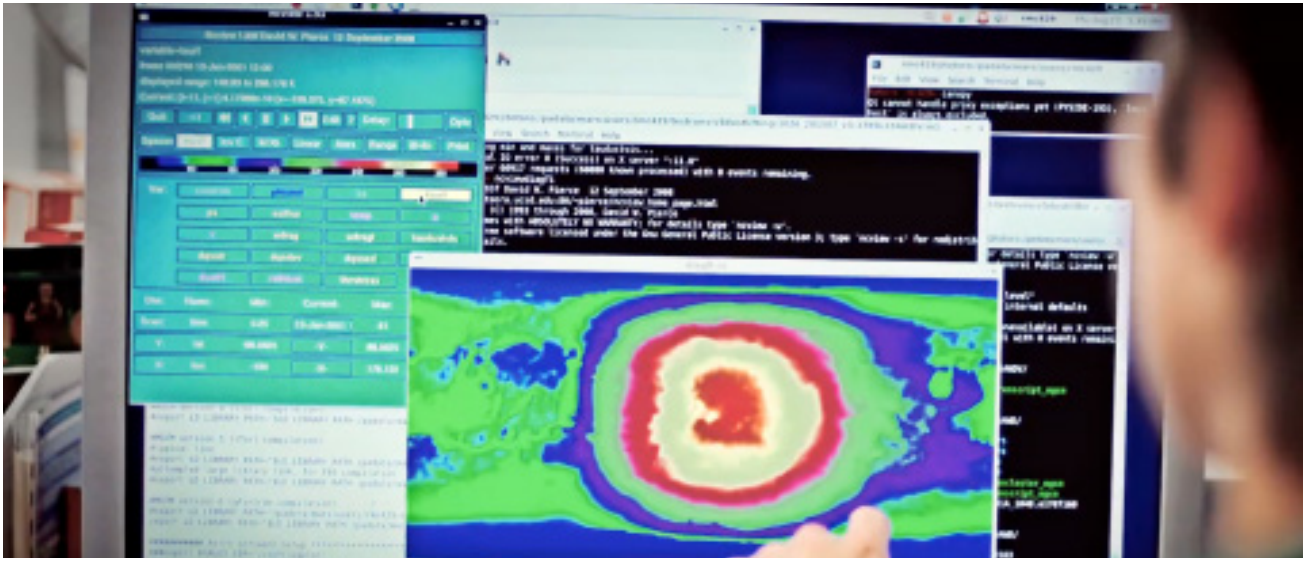
A day-night terminator is the line separating the illuminated (day) and dark (night) sides of a planet. In the Martian case, it is an atmospheric region that will be key during solar occultation observations in the Exomars 2016 mission. The majority of algorithms applied to these types of observation are based on the hypothesis that the atmosphere is spherically symmetrical along the line of sight. This is not valid, as it is known that both the atmospheric densities and the temperature vary, at times drastically, on either side of the terminator.

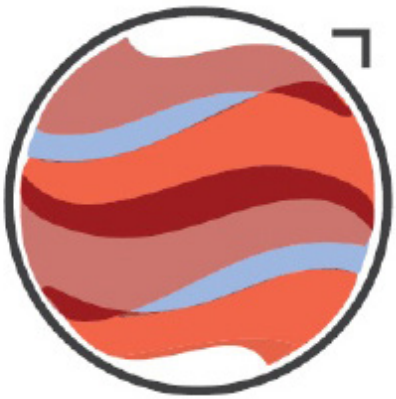
UPWARDS will develop models that give a more realistic portrayal of the physical and chemical aspects of the atmosphere along the terminator, which, in conjunction with the Exomars data, will enable a more thorough understanding of the diurnal Martian cycle.

Martian climate:

Data assimilation is a widely-used technique in meteorology and in weather prediction on Earth. Combining observations from space with numerical models, it is possible to obtain a faithful reconstruction of the atmosphere and its evolution over time. These techniques are currently being adapted to climatology and to the study of the Martian atmosphere.

Specifically, UPWARDS will perfect these techniques to include Martian atmospheric components like trace gases, water and ozone, as well as thermal profiles and atmospheric dust opacity data obtained in previous missions such as Mars Express.





UPWARDS

UNDERSTANDING PLANET MARS
WITH ADVANCED REMOTE-SENSING
DATASETS & SYNERGISTIC STUDIES

The UPWARDS project has created a synergistic collaboration, of expert European Mars research teams, in preparation for a joint exploitation of ExoMars 2016 and 2018. UPWARDS is devoted to a multi-disciplinary analysis of available Mars data, from the interior and subsurface, to the upper atmosphere and beyond (scape to space).

The name of UPWARDS, ***Understanging Planet Mars With Advanced Remote-sensing Datasets & Synergistic Studies***, refers to this unique combination of teams oriented to understanding the essential couplings within the Martian system.

Quick facts

Acronym
UPWARDS: Understanding Planet Mars With Advanced Remote-sensing Datasets & Synergistic Studies.

Program
UPWARDS falls within Horizon 2020, the European Union's most ambitious research and innovation programme, which aims at excellence in scientific production, industrial leadership and the quest for answers to social challenges. UPWARDS is a cutting-edge project which, through the cooperation of groups of excellence, will build a comprehensive image of Mars, from the subsuface to the escape of gases into space.

Funds
The European Commission has classified the science to be deployed in this project as 'excellent' and has granted funding of over €2 million under the Horizon 2020 programme.

Science
The UPWARDS project has built a synergistic collaboration, from expert European Mars research teams, in preparation for a joint exploitation of ExoMars 2016 and 2018. UPWARDS is devoted to a multi-disciplinary research of available Mars data, from the interior and subsurface, to the upper atmosphere, the cycle of water, dust storms and scape to space. The name of UPWARDS refers to this unique combination of teams oriented to understanding the essential couplings within the Martian system.

Goals
The goal of the UPWARDS project is to review and analyse data available from the European Mars Express mission and from other Martian missions, using a novel combination of state-of-the-art retrieval tools and geophysical and atmospheric models, to disseminate the results to open databases and to promote public closeness to Mars exploration.

Members of the consortium
The UPWARDS consortium is composed of the Higher Scientific Research Council (CSIC, Spain); the Open University (OU, United Kingdom); Institut d'Aéronomie Spatiale de Belgique (IASB, Belgium); Centre National de la Recherche Scientifique (CNRS, France); Istituto Nazionale di Astrofisica (INAF, Italy); Koninklijke Sterrenwacht van Belgie (ORB, Belgium) and the Complutense University of Madrid (UCM, Spain).

General coordinator
The UPWARDS project is coordinated from the Instituto de Astrofísica de Andalucía (IAA-CSIC, Spain) by Dr. Miguel Ángel López-Valverde.

Lifetime
The UPWARDS project will last three years, from March 2015 to March 2018.

ExoMars Launch
ExoMars Trace Gas Orbiter (TGO) is expected to be launch in March 2016 and a start of TGO operational scientific mission by November 2017. The second part of the mission is expected to be launch in 2018; it will carry a rover to explore the surface of Mars and will be the preparation for future Sample Return Mission.

Website & press contact
www.upwards-mars.eu | Ana Tamayo - atamayo@iaa.es

“Congratulations for an interesting piece with a very unique personality“,

JORGE VAGO, ESA’s ExoMars project scientist

Understanding Planet Mars: the documentary

The UPWARDS outreach & communication team has created an interesting and visually attractive documentary about Mars. Most key UPWARDS topics are covered in the video, such as the water cycle, subsurface and surface reservoirs, atmospheric dynamics and chemistry, escape to space, dust storms, and the ExoMars and Mars Express missions.

The video's story line is conducted by a journalist, Ana Tamayo, who travels around Europe looking for answers to all time questions and to hot topics about the Red Planet. Within her trip, she interviews more than twenty experts on Mars from nine different institutions, including the seven ones involved in UPWARDS plus a couple of ESA centers. The documentary shows, on the one hand that Mars science represents a link and a common enterprise among European countries and on the other, that the European Martian community, UPWARDS participants in particular, is playing a major role in the exploration of our neighbor planet.

The video was filmed between August and September 2015 in different locations in Brussels (Belgium), London and Milton-Keynes (UK), Madrid and Granada (Spain), Rome (Italy), Paris (France) and ESTEC (The Netherlands) and ESAC (Spain).

The documentary can be watched on *http://www.upwards-mars.eu/content/multimedia* and distributed under the Creative Commons license.


Water & exotic clouds


Miguel Ángel López-Valverde
UPWARDS Project Coordinator
Research scientist at Instituto de Astrofísica de Andalucía (IAA-CSIC, Spain)

Direction

Ana Tamayo

Screenplay

Ana Tamayo & Emilio J. García Gómez-Caro

Director of Photography, editing and post-production

Nacho Chueca

Music performance and recording

Amalia Chueca & José Ignacio Hernández

Dancers and Choreographies

Eva Castillo Carmona & Ignacio Lasala de la Rosa

Production Designer

Nacho Chueca

Road production manager, Sound and 2nd Camera

Kacho Cano

Subtitles

Ana Tamayo & Candice Mckinnon

Produced by

LIPSSYNC MEDIALAB SRL & Instituto de Astrofísica de Astrofísica de Andalucía (IAA-CSIC)

UPWARDS PRESS KIT

Ana Tamayo

UPWARDS Press Officer

www.upwards-mars.eu

e. **atamayo@iaa.es**

t. **+34 958230629**

a. **Instituto de Astrofísica de Andalucía-CSIC**
Glorieta de la Astronomía s/n
18008 Granada
SPAIN