



AMADEE-18 Mars Landing Simulation in the Omani Desert: First Results

Rudolf Albrecht



The Austrian Space Forum

Citizen science organisation led by professionals

Research & Development

Public information and outreach

Extensive K-12 activities

Propagate STEM

- **Hardware:**
 - AOUDA spacesuit simulators
 - Mars analog rovers
- **Research**
 - Planetary surface operations
 - Optimizing remote science support
 - Analog research
- **International Mars simulations**
 - 13 Mars simulations so far



AOUDA.X Spacesuit Simulator

- Based on NASA DRM 5.0 & Aurora design concepts
- 45 kg, unpressurized, Hard-Upper Torso, custom-built OBDH and advanced human-machine-interface
- Outer layer optimized for planetary protection, 4-8 hours of field operations
- Broadband telemetry
- Next generation space suit being developed





A O U D A

CESUIT LAB

WWW.OEWF.ORG



Analog astronaut class of 2015 (from 100 candidates, 5 months basic training)

DACHSTEIN ICE CAVES



MARS2013, MOROCCO



AMADEE-15, KAUNERTAL



AMADEE-18

- ✓ a science and engineering-driven one-month simulation of a Mars landing.
- ✓ strong international collaboration
- ✓ high potential for STEM outreach



Collaboration with the Sultanate of Oman

Negotiations during COPUOS 2016

Scouting Mission Feb 1017

MoU signed Oct 2017

Oman provided the infrastructure and local logistics

Omani researchers participated

Propagate STEM

Propagate international collaboration

In the spirit of capacity building as envisioned in the UNISPACE+50 resolution

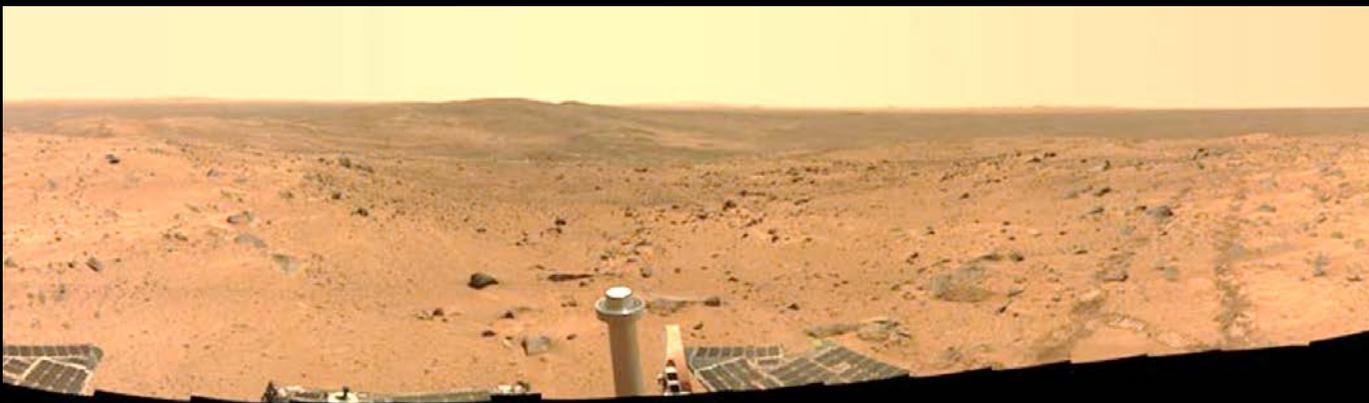






Oman

(CREDITS: OEWf)



Mars

(CREDITS: NASA)

AMADEE-18 Mission Architecture



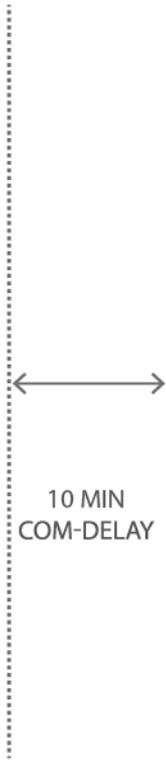
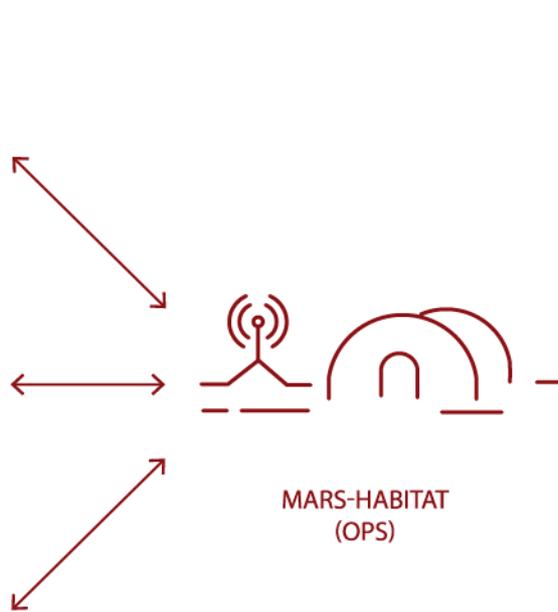
EXPERIMENT 1



EXPERIMENT 2



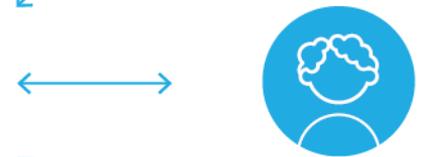
EXPERIMENT 3



MISSION SUPPORT CENTER
(MSC)



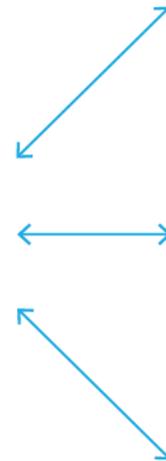
EXPERIMENT
TEAM 1



EXPERIMENT
TEAM 2



EXPERIMENT
TEAM 3



Mission Support Center

Innsbruck, Austria

MOC Tasks

- Planning, scheduling and monitoring of the mission experiments
- Contingency assistance
- Interface with the experiment teams
- Data recording, quality control, storage and distribution



<i>EXPERIMENT</i>	<i>PI</i>	<i>AFFILIATION</i>	<i>DESCRIPTION</i>
HortExtreme	Dr. Sara Piccirillo	Italian Space Agency (ASI/VUS)	Mobile and inflatable green house with hydroponics, to be used for the cultivation of microgreens.
FATIGUE	Dr. Stefan Dobrovolny	Medical Univ. of Vienna, Dep. of Anesthesia, Austria	Analysing physical and mental fatigue in Analog Astronauts during AMADEE-18.
TEAM	Dr. Natalie Allen	Western Univ., Dep. of Psychology & Mission Control Space Services	Study on the level and fluctuation, over time, of team cohesion, conflict and performance and determination of "person" factors (e.g. personality)
MSTAT	Hilel Rubinstein, PhD	Ben Gurion Univ., Earth and Planetary Imaging Facility (EPIF), Israel	The situational awareness training aims to simulate two separated groups of astronauts on Mars.
SIT-AS	Alexandra Hofmann	University of Witten Herdecke, Germany	Examination of the situational awareness in and between co-working teams on Earth and simulated Mars
MIMIC	Dr. Martin Hagmüller	TU Graz, Signal Processing and Speech Communication Laboratory, Austria	A computerized analysis of verbal communication to study the mechanisms of psychological and physiological adaptation or maladaptation in extreme or stressful environments
V(R)ITAGO	Antonio del Mastro	Mars Planet, Italy	Virtual Reality tool for astronaut training and to aid the RSS team in analyzing geological features.

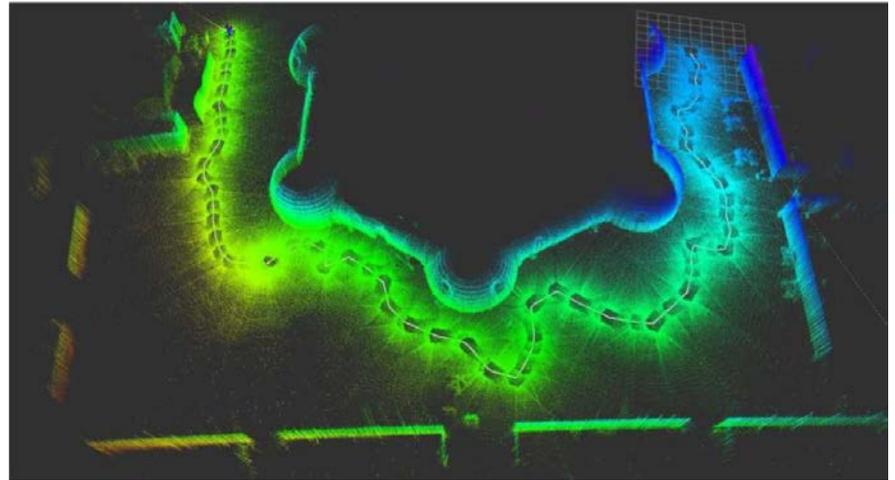
<i>EXPERIMENT</i>	<i>PI</i>	<i>AFFILIATION</i>	<i>DESCRIPTION</i>
HUSKY	Dr. Gerald Steinbauer	Graz Univ. of Technology, Inst. of Software Techn.	An autonomous rover that supports astronauts and aids in area mapping
AVI-NAV	Univ.-Prof. Dr. Stephan Weiss	Institute of Smart System Techn., Alpen-Adria Univ. Klagenfurt, Austria	Drone with vertical take-off and landing capabilities for efficient area exploration and low latency visual feedback to the crew or/and ground personnel
SCANMARS	Maurizio Ercoli, PhD Alessandro Frigeri	Univ. of Perugia, Department of Physics and Geology, Italy Istituto di Astrofisica e Planetologia Spaziali (IAPS), Italy	Subsurface Characterization of a Martian Analogue through 2D/3D Ground Penetrating Radar datasets
FIELD SPECTROMETRY	Eleonora Ammannito	Italian Space Agency (ASI/URS)	Acquisition of reflectance and radiance spectra in an environment analogous to Mars

JUNIOR RESEARCHERS PROGRAMME

<i>EXPERIMENT</i>	<i>PI</i>	<i>AFFILIATION</i>	<i>DESCRIPTION</i>
WATER EXPLORER	Mohammed Al Hosni Maram Dawoodi	Petroleum Development Oman Umm Al Khair Primary School, Oman	Water detection via a set of geophones, which measures the reflection of sound waves in the subsurface
TUMBLEWEED	Stefan Rietzinger	Sir Karl Popper School, Vienna	A wind propelled compact rover to be used for efficient Mars exploration.
A3DPT-2-MARS	Michael Müller	TU Graz, Austria	3D printing operational workflow experiments for crewed Mars expeditions
EOS	Martin Zwifl	HTL Eisenstadt, Austria	Radio Navigation System for EVA's on GPS-less planets

Results – Husky rover

- Autonomous navigation/exploration
- 3D lidar terrain mapping and path planning
- Assisting the analog astronauts
- Operational limits identified



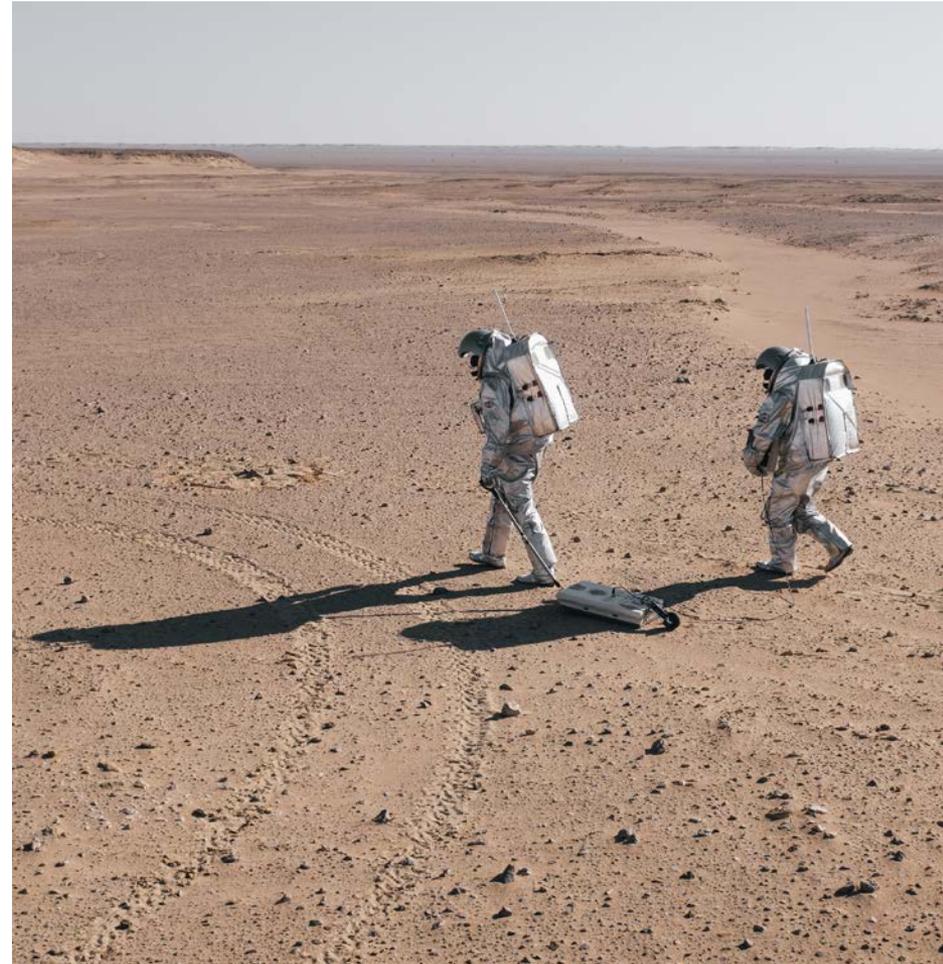
Results – Hortextreme



- Cultivation of 4 species of microgreens
- Rambo raddish
 - 5 kg/ m² in 15 days
 - A record amount
- High energy efficiency

Results - ScanMars

- Subsurface characterization: geology, mineral resources, water, life
- 3D Ground penetrating radar
- 1.7 km covered
 - 93,000 scans performed
 - Dried up riverbed confirmed



Status and plans

- Mars Science Workshop, TU Graz
- Special edition of “Astrobiology” dedicated to AMADEE-18
- Optimizing and expanding remote science support
- Next generation analog spacesuit
- AMADEE-20 being planned



AMADEE-18 brought us closer to Mars