MARS2013

Morocco Mars Analog Field Simulation

Mission Report

Österreichisches Weltraum Forum
Austrian Space Forum

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MARS2013 synopsis

Between 01 - 28. February 2013, the Austrian Space Forum – in cooperation with international partners from 23 countries - led an integrated Mars analog field simulation in the northern Sahara near Erfoud, Morocco in the framework of the PolAres research program.

Directed by a Mission Support Center in Austria, a small field crew conducted experiments preparing for future human Mars missions in the fields of engineering, planetary surface operations, astrobiology, geophysics/geology, life sciences and other.

This technical report summarizes the sequence of events as well as the preparatory activities and the underlying infrastructure. For a detailed account of the scientific activities we refer to the peer-reviewed papers. For details on science data you are encouraged to utilize the Science Data Archive managed by the Austrian Space Forum.

The Austrian Space Forum

The Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) is a national network for aerospace specialists and space enthusiasts, with a focus on space exploration research. It serves as a communication platform between the space sector and the public; it is embedded in a global network of specialists from the space industry, research and politics.

The Forum has a small, but highly active pool of professional members contributing to space endeavors, mostly in (international) cooperation with other space organizations. The spectrum of the Forums' activities ranges from classroom presentations to 15.000-visitor space exhibitions, from space consulting for the government and industry, to independent multidisciplinary and international research endeavors.

Österreichisches Weltraum Forum

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- Stefan Hauth: Coverpage
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Message from the Austrian Vize Chancellor

and Federal Minister of European and International Affairs, Dr. Michael Spindelegger

Message to the scientific team of the “MARS2013” project in Erfoud and Innsbruck on the first of the simulation.

Today we witness the start a fascinating field research project which connects the international scientific community and draws their attention to the Moroccan desert and Innsbruck. While we are here on earth the team of researchers in Morocco simulates a landing on Mars. A manned mission from Earth to Mars seemed unachievable only years ago; today we are confident that it will be feasible in a not so distant future thanks to basic research and applied testing carried out by visionary scientists in cooperation with partners from high tech industries. I am proud that the Austrian Space Forum in Innsbruck forms the hub of this leading edge project which unites researchers from 20 nations on five continents.

This very month, exactly 230 years ago, Morocco and Austria established diplomatic relations. Thus, the anniversary coincides with a bilateral cooperation in the realm of the sciences pointing far into the future. I seize this opportunity to thank all private and government institutions in Morocco, in particular Mr. Lahcen Daoudi, the Minister for Higher Education and Research, and the Gendarmerie Royale for their valuable support on the ground.

We all look forward to welcome the team, staying now in Erfoud, when they will return “from Mars” in three weeks’ time. All the best for a successful “mission to Mars”!

Dr. Michael Spindelegger

Vice-Chancellor and Federal Minister for European

and International Affairs of the Republic of Austria

Message from the Governor of Tirol, Günther Platter

As governor of Tyrol, I am proud that the science location Innsbruck was chosen as the site for the Mission Support Center of the analog field simulation MARS 2013. I wish the people in charge and all participants of the project a successful completion of the mission and I am convinced that MARS 2013 will result in helpful insights, which will benefit international space research.

Governor Günther Platter

1. Executive Summary

Preparatory activities of the desert Mars analog campaign

In the framework of the PolAres research program, the Austrian Space Forum (OEWF) has developed two simulation spacesuits, communication infrastructure and complementory hardware for field deployment. Since 2009, nine field or complex laboratory campaigns have been conducted, ranging from -110°C cryochamber tests in Austria or the Rio Tinto field mission in southern Spain in 2010 to subsurface cave exploration simulations in Germany and Austria.

The long-term goal of the PolAres program is a long-duration Arctic mission – in order to gain operational experience for such a complex expedition, to conduct long-duration performance tests, build the human resource pool and develop the scientific workflows for advanced analog missions, the OEWF decided to conduct a desert expedition.

In early 2011, while still preparing for the Rio Tinto Mission, a scouting project was initiated searching for candidate sites. Potential locations included the Negev desert in Israel, the Chinese Gobi desert, Russian sites, European locations such as Tenerife, or the Atacama desert of Chile. The selection criteria were

- Topographic and geological resemblance to Martian surface features
- Site accessibility, available infrastructure, expected security level of the country,
- Expected reliability of the regional political and scientific partners.

The Ibn Battuta Center at the Cadi Ayyad University of Marrakesh had studied sites in Morocco and published an atlas of sites online. An additional analysis using remote sensing data, weather statistics, map studies and other sources identified these regions as excellent candidates.

Reconnaissance mission and preparing the network in Morocco

Upon invitation of the Ibn Battuta Center, two OEWF team members visited 17 sites in the regions around Erfoud, Merzouga and other locations during a reconnaissance mission between 29Jan-01Feb2012. The analysis included georeferenced photography, taking environmental recordings, obtaining soil and rock samples as well as a regional geographical analysis.

In addition to the site analysis, the authorities relevant to field activities in Morocco were identified. In cooperation with the Austrian Embassy, major space entities received a visit by the PolAres Program Officer, in particular the Ministry for Higher Education and Executive Education, Lahcen Daoudi. During this visit, substantial logistics and legal support from the government was agreed upon. In collaboration with the embassy and the Austrian police attaché, subsequent meetings with the Chief of Staff of the Gendarmerie Royal were held, resulting in the provision of site security (including a 5 km radius security perimeter), power, hygiene and tent infrastructure, radio frequency licenses and other support. The research permit was obtained through the Ibn Battuta Center as a Moroccan entity, the ethical commission permits were obtained through the Medical University of Innsbruck.

The Moroccan Minister for Higher Education, Lahcen Daoudi, Gernot Groemer (OEWF) and the Austrian Ambassador, Wolfgang Angerholzer during the meeting in Oct. 2012.

Selecting the scientific partners and building the human resources

In order to create a healthy scientific program for MARS2013, an Announcement of Opportunity was released in early April 2012, resulting in 25 submitted research proposals (including 3 student-led projects) which underwent a peer-review process. The

One of the preparatory activities included a geological field training at the Blaetterbach-Canyon, Italy. Analog astronaut Christoph Gautsch (with a training version of the spacesuit gloves), trains the geological sampling workflow with Isabella Achorner and Harald Fuchs.

reviewers were senior researchers from space agencies and academic research institutions, selecting 18 of these proposals for further inclusion in the program in July 2012. However, two entities were not able to sustain their commitment and were excluded from the MARS2013 science activities afterwards.

In order to expand the human resources for the project, a world-wide call for volunteers was issued in late May of 2012. Applicants from 25 nations applied, an OEWF-led committee selected 95 candidates. The team training, experiment definitions and construction, logistics preparations, sponsor and industrial partner acquisitions and the media activities were coordinated according to a master roadmap. All milestones from the inception of the MARS2013 project were kept, no delay occurred.

Between September and December 2012, a new class of Analog Astronauts was trained for the Aouda spacesuit simulator system bringing the number of certified suit testers to a total of seven. Three (plus one back-up) of these were chosen for the field mission, completing the 10-person field crew for MARS2013.

Training sessions also included a series of teleconferences, during which the workflows were discussed and trained. In addition, repetitive tasks (such as beginning a simulation etc) were organized be means of Standard Operating Procedures. To harmonize the science and engineering experiment requirements with the flight planning, regular experiment telecons were held between the respective investigators, the mission management and the flight planning groups.

Flight Control room at the Mission Support Center, managed by Flight Director Alexander Soucek and Flight Director assistant Michael Taraba (white shirts). Three additional backrooms for Flight Planning, Remote Science Support and Media complemented the operational segment of the MSC.

MARS2013 was announced to the public during a press conference on 20Sep2013 in Vienna, after the experiments were selected and in the construction phase, the network of research partners was built and industrial sponsorships secured as well as a well-defined plan ready for implementation was defined.

Between 07-11Dec2012, a Dress Rehearsal was held in Innsbruck where both the MSC and Field crews conducted training with the actual expedition hardware, exercised workflows and discussed adjustments in the Standard Operating Procedures.

Logistics and mission infrastructure

The expedition hardware was collected at the OEWF premises in Innsbruck/Austria and shipped via freight container to Casablanca. A bridgehead team of the Austrian Space Forum utilized a convoy of trucks, escorted by the Moroccan Gendarmerie Royal to deploy the hardware at the base camp. This station was named “Camp Weyprecht” in honor of the Austro-Hugarian arctic expedition of Carl Weyprecht and Julius von Payer in 1872. The field crew was connected to a Mission Support Center (MSC) in Innsbruck via satellite and a broadband 3G connection. (The broadband 1.4m satellite dish arrived in mid-February due to a customs delay since November 2012).

The Mission Support Center (500m² size) was led by a Flight Director, supported by a Flight Control Team who in turn were backed by three teams for Science, Flight Planning and Media activities. The work was also facilitated by a ground support team working on logistics, as well as a dedicated team for information technologies. The science data officer acted as a single gateway for research data from the field. In addition, external control centers were coordinated through Innsbruck:

- Tasmars Mission Control, Wellington, New Zealand
- Puli Rover Mission Control, Budapest, Hungary
- Magma Rover Mission Control, Warsaw, Poland

In total, about 5000 working hours were spent in the Mission Support Center.

The connectivity of the MSC was ensured via an LTE (4G) broadband access provided by T-Mobile, the satellite connection in the field was managed by Businesscom Networks utilizing a 2.4 m C-Band antenna to the NSS-10 satellite.

At the base camp near Erfoud, Morocco, the Moroccan government had set up 5 large operations tents which were used as the operations and command tent (“OPS”), a workshop tent, a storage tent, a social/cleanroom tent and a kitchen tent. The field crew was accommodated in camping tents. The Gendarmerie Royal also provided hygiene facilities, base camp illumination and power. Within a perimeter of 5km, the area was closed to the public through checkpoints, guard patrols and a helicopter.

Activities of the field crew were directed by the MSC by means of the Daily Activity Plan (DAP) and discussed two and one days before execution during a daily telecon. As soon as the team went into simulation mode, no real time communication was allowed except in case of emergencies ("Code Red"). All telemetry data from the spacesuits were also delayed.

The field crew was commanded by Gernot Groemer as expedition lead ("EXLEAD"), with Stefan Hauth as deputy. During the simulations, the routine activities were managed by an operator ("BASE"), supported by a science operations officer ("SCIOPS") who recorded all experiment activities and made input to a chat-based recording system.

Real-time monitoring was obtained at the Base-station, where a medical doctor was monitoring the health of the analog astronauts. Whenever an analog-astronaut was performing suited operations, a dedicated safety person was present in the vicinity of the activity.

Several experiments were conducted in parallel; the data stream was received at the MSC at the following points-of-entry:

- Medical data: Biomedical Engineering Console, these data were strictly separated from the scientific data for privacy protection
- Scientific Data: SCIENCE console, supported by the Remote Science Support team who made a fast near-real time quality check on the experiments.
- Sequence of events/Chat protocols: RECORDS – this station recorded all activities on-site as well as in the MSC.

The single line of communication between the MSC and the field was via the CAPCOM station at the MSC. The interface to external experiments was channeled via the CONTACTS console.

The expedition phase

For establishing the base infrastructure, a team of up to 37 participants was present during the preparatory week, including media teams. This period allowed for an acclimatization, to deploy the hardware, training sessions for the isolation crew and generally, allow for a "soft" start of the expedition phase.

On the 09Feb2013 the Moroccan Minister for Higher Education toured Camp Weyprecht, accompagnied with media teams and a delegation of students of the University of Ifrane and industry representatives. After this high-level visit, most of the preparatory crew team members left the base. The isolation phase began on the 11Feb2013, 10:30 CET when the time delay way activated to account for the signal travelling time between "Earth" and "Mars".

A part of the preparatory week crew, including the mobile experiment hardware.

The following scientific experiments were conducted:

- **CLIFFBOT CRV** Cliffbot rover vehicle - terrain trafficability, Association Planete Mars, FR
- **ERAS C3**: Command & Control software project for data processing in the field, led by the Italian Mars Society
- **SREC**: Assessment of small rover exploration capabilities (ATV-like vehicles), Ecole Nationale Supérieure de Cognitique, Institut Polytechnique de Bordeaux, FR
- **DELTA:** Human factors – An assessement of the work economics, time delay of an suited astronaut versus an unsuited, Austrian Space Forum, AT
- **Puli-Rover:** Mobility tests for the Hungarian GLXP rover, Puli Space Tech, HU
- **Hunveyor-4:** Surveyor-class robotic lander with remote access, Óbuda University, Alba Regia University Centre, HU
- **LTMS-MOROCCO:** Long term medical monitoring system, biomedical chest vest, CSEM, CH
- **Magma-White Rover:** Pathfinder-class rover system, mobility & human-robotic interaction, ABM Space, PL
- **MEDIAN**: Methane Detection by In-Situ Analysis with Nano-Landers, Univ. College London, UK
- **microEVA**: Luminescence detection of viable bacterial spores and terbium microspheres, NASA JPL, USA

- **Deployable Shelter**: Deployable Emergency Shelter suitcase for astronauts, Technical University of Vienna, AT
- **Aouda.X/.S**: Series of engineering tests w.r.t. communication, trafficability and materials. Potentially including the Phileas rover.
- **MAT/EP**: medical survey during OEWF field campaigns; includes a field incident reporting system, Medical University of Innsbruck, AT
- **Geosciences**: This experiment studied at the workflows and science processing pathways for geological exploration, supported by a side project focusing on the usage of maps in planetary exploration, and an additional side-project using a Thermal Infrared camera for studying the thermal properties of cavities. OEWF, Univ. of Vienna, Univ. of Budapest, Univ. of Warsaw, AT/HU/PL
- **ANTIPODES:** Communication experiment with Kiwispace, NZ – testing the experiment guidance over to an external Mission Support Center during an ongoing experiment, AT/US/NZ
- **YELLO:** an experimental distance measurement device using signal-travel time for orientation in order to substitute a regional positioning system on Mars, Univ. of Applied Sciences, Mittweida, DE.
- **PENICULUS:** a student-led experiment on the efficiency of a cleaning mechanism for solar power cells
- **OPS-SEAT WHITE**: an ergonomics and thermodynamics test for a foldable computer workplace
- **LIFE Laser**: an laser fluorescence experiment detecting the emission of biomarker molecules in rock samples, University of Innsbruck

Farewell of the Station Peyer crew (right) before taking off from Camp Weyprecht for 4 days.

For all experiment, the minimum amount of experiment runs defined in the pre-mission planning was achieved; most of the experiments were able to acquire more data.

Between 17-21Feb2013, a 4-person detachment of the Camp Weyprecht team was dispatched for a sorties simulation about 80km south near Merzouga, also with the support of the Gendarmerie Royal. During this phase, two full days of extravehicular and geosciences activities were conducted.

The communication infrastructure in the test region was provided via a high bandwidth WIFI network, with industrial hardware donated by LANCOM Systems, powered by custom-built rechargeable power supplies. A network of directional antennas was set-up depending on the planned activities, so nearly every evening the system had to be recharged and every few days the arrangement had to be relocated. In addition to the WIFI system, a radio system utilizing Motorola handsets and a base station served as back-up with a MOTOTRBO-repeater on dedicated frequencies.

The public perception and scientific follow-up activities

MARS2013 had a strong emphasis on public outreach and education: a group of students from the University of Ifrane visited Camp Weyprecht in Morocco during the ministerial visit, two students participated in the preparatory and isolation phase. In the Mission Support Center, the core team was strongly supported by student volunteers.

A dedicated Media team focused on the classical press activities, including three press conferences, numerous press releases and handling of external media requests. In addition, the Social Media team ensured a proper representation in Facebook (111 posts), Twitter (361 tweets) and various other channels, encompassed by blog entries, video clips, picture of the day and complementary means. The efficiency and reach of the MARS2013 activities on these channels were measured and resulted in a significant increase in the rankings.

Highlights of these activities included a one-article-per-day from well-known German authors commenting on the MARS2013 project, a collaboration with “The Globe at Night” and a Google Hangout with a Scandinavian Aurora Tweetup-Expedition. Also locally, the team of the Mission Support Center engaged in various outreach activities, e.g. interacting with pupils and high-school students during an outreach event near Innsbruck.

In addition to the general audience outreach, three science bulletins were released, and there was a significant number of research contacts with external scientists and engineers. In

particular, nearly all research partners from 21 nations achieved a local coverage in their respective media and scientific communities, including the Google Lunar XPrize community.

In parallel to the outreach activities preliminary research data analysis started already during the Mission phase at the Mission Support Center and the international teams. By coincidence the fiftieth session of the Scientific and Technical Subcommittee of the United Nations Committee for the Peaceful Uses of Outer Space (UN-COPUOS) took place in Vienna, Austria, while the Morocco Field Test was in progress. The ÖWF used the opportunity to present a status presentation to the STSC: Preparing the Human Presence on Mars, (19Feb2013).

First results are expected to be reported during a science workshop held in May 2013 at the Technical University of Vienna. The results are to be published in a special edition of the journal *Astrobiology* by end of 2013. Specific findings are also being presented at numerous aerospace and Earth sciences conferences, including the International Astronautical Congress in Bejing, The Humans in Space conference in Cologne, the Mars Society Convention in Boulder, Colorado, the Humans to Mars symposium in Washington to name a few.

Official MARS2013 Partners & Countries involved

Scientific Partners

ABM Space Education, PO

Association Planète Mars, FR

CSEM, CH

Ecole Nat. Sup. de Cognitique, FR

Eötvös Loránd University, HU

GLXP Space Technologies, HU

Ibn Battuta Center, MO

Italian Mars Society, IT

Kiwispace Foudation, NZ

Medical Univ. of Innsbruck, AT

Medical Univ. of Graz, AT

NASA Jet Propulsion Lab., USA

Óbuda Univ., Alba Regia Univ. Centre, HU

University College London, UK

Technical Univ. of Vienna, AT

University of Innsbruck, AT

University of Vienna, AT

Industrial Partners & Sponsors

BusinessCom, UK

Catalysts, Austria

Dräger Safety Austria

Fair Rescue International, Austria

LANCOM, Germany

Motorola Solutions, Austria

Space Applications Services, Belgium

T-Mobile Austria

TECHCOS, Germany

HootSuite Pro, CA

MARS2013 Key personel

PolAres program officer & Expedition lead:

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Mission Support Center

- **Flight director / Deputy Program Officer:** Alexander Soucek
- **Flightplan:** Alexander Karl
- **Rem. Science Support:** Michael
- **IT:** Harald Fuchs
- **Media officer:** Monika Fischer

Ibn Battuta Center, Morocco, www.ibnbattutacentre.org

- **Gian Gabriele Ori,** IRSPS, Universita d'Annunzio, Italy
- **Taj-Eddine Kamal**, Université Cadi Ayyad, Marrakesh, Morocco

Austrian Embassy, Rabat

- Ambassador: **Dr. Wolfgang Angerholzer**

2. Aims of the MARS2013 field campaign

In the framework of the PolAres[1] research program of the Austrian Space Forum and the activities of the Ibn Battuta Center in Marrakesh, the MARS2013 Mars analog field campaign will advance the preparation of future human Mars missions by testing scientific instruments, concepts for human-robotic partnerships as well as engineering and operations trials.

Conducting field research in a representative environment is an excellent tool to gain operational experience and understand the advantages and limitations of remote science operations on other planetary bodies. The area near Erfoud is considered as a relevant proxy for various types of geological features of Mars, as well as a diversity of paleo(micro)biological signatures, terrain topographies similar to the Martian deserts and a test site area size which requires a diligent exploration mission design. This field mission is designed to be

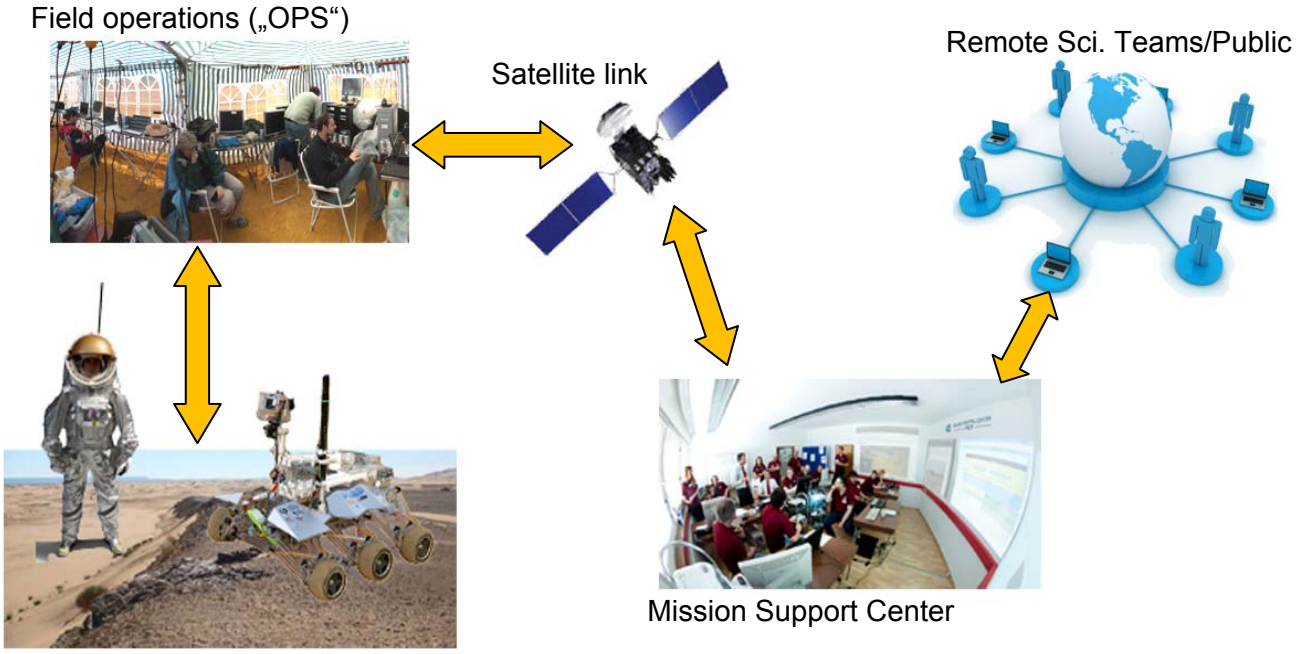
- an opportunity to **study equipment behavior** involving the simultaneous usage of instruments with the option of a human-in-the-loop (via the Aouda.X/.S spacesuit),
- a platform for **testing life-detection or geophysical techniques**, performing terrain tests for rovers and test concepts for high situational awareness of remote support teams,
- **studying the northern Sahara** as a model region for Martian deserts and extreme life,
- **serving as an outreach platform** to enhance the visibility of planetary sciences and human spaceflight

[1] PolAres is an interdisciplinary research program of the Austrian Space Forum preparing exploration strategies for a human-robotic Mars expedition with a focus on planetary protection. After a scouting phase looking for appropriate Mars-analog test sites, a rover and a spacesuit simulator including the support infrastructure have been developed and are optimized for joint operations whilst maintaining planetary protection measures.

PolAres is designed to **develop** hardware and operational requirements for future human-robotic missions to Mars including near-real time decision making procedures for field exploration, **study** contamination issues in planetary exploration (its hardware elements like the rover and the spacesuit simulator serve as a test bed for instruments in a realistic setting), and **engage** the general public in space exploration.

2.1. Baseline design of the MARS2013 field simulation

The actual field mission will take place during in the month of February 2013. Based upon previous high-fidelity Mars analog mission simulations, the Austrian Space Forum has established a field campaign infrastructure and roadmaps which will be implemented during MARS2013. Field activities will be scheduled through a “flight plan” managed by the Mission



The MARS2013 field campaign will take place in February 2013: The first “preparatory week” (01-09Feb2013) will be allocated for tests, trial runs of the experiments and for the media activities in the field. The two Aouda Space Suit Simulators will be fully operational and in simulation.

With the second week (starting on the 11Feb2013), the science-focused weeks start, indicated by the isolation phase where only the internal OEWF field crew will be on the field. Starting on said day all experiments will be set-up and conducted by the OEWF field crew and will remain under the control of the OEWF until the end of February. In the middle of February a relocation of the Base camp to a landing site further south is foreseen. During simulations, a time delay of 10 minutes one way for all communications is introduced to simulate the distance from Mars to Earth, with exceptions available in case of medical emergency or other emergency situations as indicated by the Flight Director (FLIGHT).

2.2. Timeline field operations

Bridgehead team (8 people + IBC representative)

- 26Jan2013, 07:35: Departure from Munich to Casablanca, driving to Marrakesh.
- 27Jan2013, late afternoon or 28Jan: Bridgehead team on-site
- 30Jan2013: Establishment of the core infrastructure.

Arrival Core-crew (10 people + local IBC liaison)

- Departing 01Feb2013,07:35 to Casablanca, driving to Midelt (tbd)
- On-Site: Starting 02Feb2013, around noon.

Departure Core-crew

- Packing in the field: 28Feb + 01Mar
- Leaving Morocco on the 02Mar2013, 16:00 from Marrakesh
- Arrival in Munich: 03Mar2013, 07:10

Summary timeline

- Base operational: 30Jan
- First EVA possible: 02Feb evening (if possible 03Feb)
- Isolation phase starting: 10Feb
- Relocation duration (50km shift of BASE): 3 days
- Isolation phase ending: 27Feb

This scheme allowed for 17 days science-only mode, plus 5 days (03-09Feb) with "mixed-mode", where we have both scientific and media activities taking place.

3. Location & Setting

The Kingdom of Morocco spreads over 446550 km² and has a population of 32 million, mostly located west of the Atlas Mountains. Erfoud, also known as the "Gate to the Sahara", is a oasis town in the Meknès-Tafilalet of the Maghreb region in eastern Morocco. It is located at 31°26′10″N 4°13′58″E. Due to its proximity to the Merzouga desert village in the Erg Chebbi Dunes, Erfoud has developed some tourist related infrastructures such as hotels and restaurants.

3.1. Environmental conditions to expect

During a scouting mission in late January 2012, temperature, pressure and humidity profiles were taken. No major precipitation is expected for the month of February.

Daytime temperature profile (device exposed to direct sunlight with no wind cooling)

- Max. Temp: 46,8°C, min.: 5°C; min humidity in sunlight: 1%
- Max. Temp. In the shade: 24°C

Nighttime temperatures:

- Minimum temperature: 3,6°C @ 07:00 local time
- Min. Humidity: 35% (19:30), Max Humidity: 92% (07:00)

Sunrise / Sunset (given in local time for Erfoud)

	Morning twilight		Evening twilight	
Date	Astronomical	Nautical	Nautical	Astronomical
2013-02-01	5h52m	6h21m	18h44m	19h14m
2013-02-06	5h48m	6h18m	18h49m	19h18m
2013-02-11	5h44m	6h14m	18h53m	19h22m
2013-02-16	5h40m	6h09m	18h57m	19h26m
2013-02-21	5h35m	6h04m	19h02m	19h31m
2013-02-26	5h29m	5h58m	19h06m	19h35m

3.2. Test sites

The test areas were located near the city of Erfoud close to the Algerian border. In order to access several “clusters” of potentially interesting sites, there will be a relocation of the base camp at mid-mission. Both clusters are at an altitude of approximately 750m a.s.l.

Northern “landing site”: **N** 31°21'55.31", **W** -004°04'15.52"

Southern “landing site”: **N** 30°53'59", **W** -003°52'29"

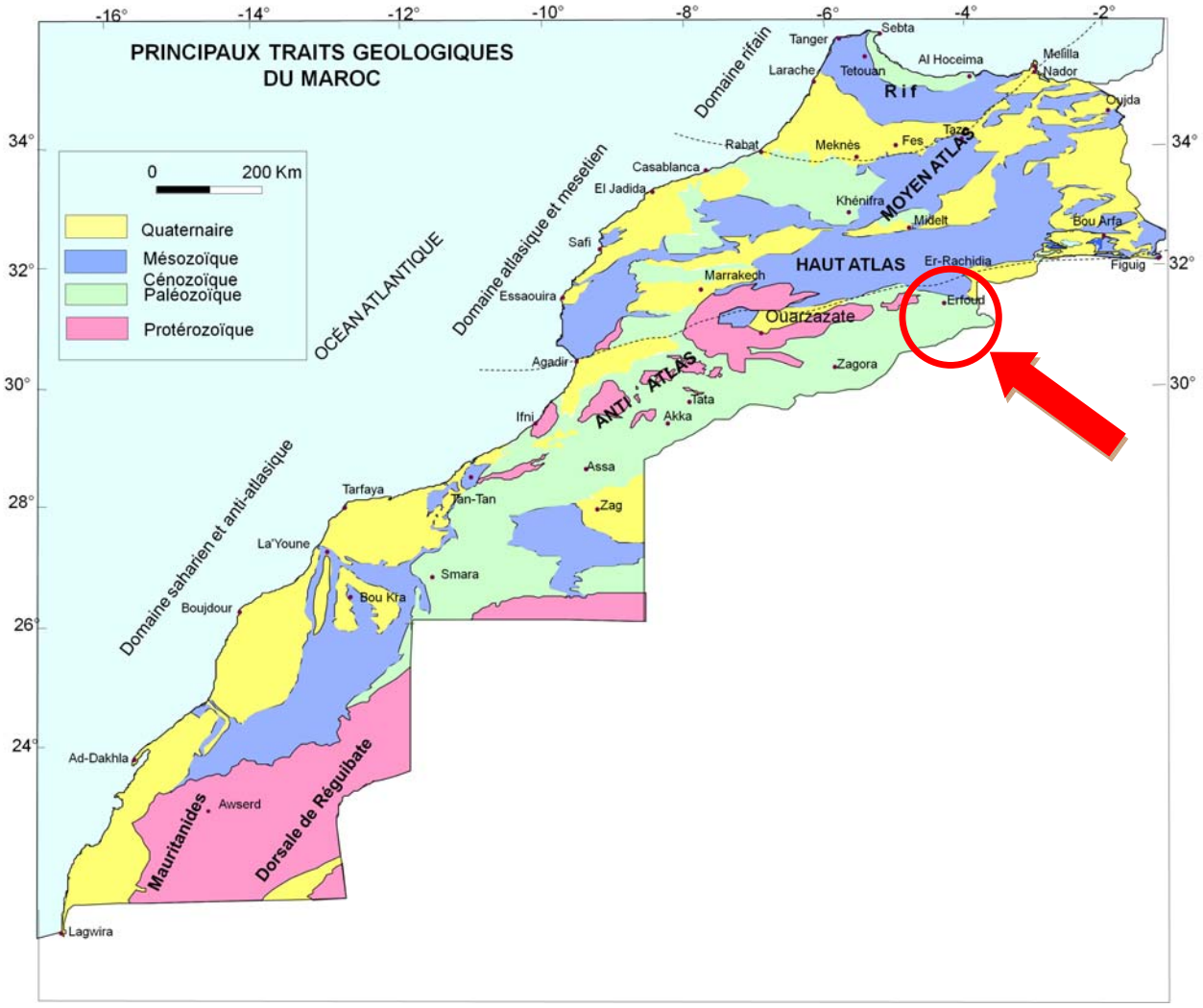
Above: Northern cluster, below: southern cluster.

3.3. Site Geology

This introduction gives a very general overview of the geological setting. Although selective and general, the following description provides some context for the field mission. For details, please contact the geosciences RSS team.

Morocco is one of the African countries the geology of which is best known. The geological structure of Morocco consists of a succession of east-west fold belts bordering the Saharan platform, and being superimposed through time, the youngest being located progressively further to the north.

The regional geology offers a wide range of features such as dry river beds and deltas including evaporites, dunes, sandstones, (altered) basaltic rocks, shales (mostly from the Devonian and Silurian ages including fossil records) and other geomorphological features.



Examples of typical morphologies to expect:

The eastern Anti-Atlas of Morocco consists of Precambrian crystalline basement, which is covered by Palaeozoic and undeformed Cretaceous and Tertiary sedimentary rocks (Fig.1.). The Palaeozoic rocks have been deposited at the NE margin of the Gondwana continent in a shallow, epicontinental shelf region. In the Lower to Middle Cambrian (542-499 Ma) and in the Ordovician (488-443 Ma) several hundred of meters thick sandstones were deposited with absence of Upper Cambrian sediments. - In the Silurian (443-416 Ma) two marker limestone horizons were formed, which are the beginning of the carbonate sedimentation in the eastern Anti-Atlas. In the Early Devonian (416-397 Ma) shale, marl and limestone alternate with rich fossil record (nautiloids, tentaculitids). In the Middle and Upper Devonian (397-359 Ma) carbonate deposition was dominant in the eastern part of Morocco. During the Variscan orogenesis platform-basin topographic relief have formed and four domains established in the area: Mader Platform, Mader Basin, Tafilalt Platform, Tafilalt Basin. Turbidite and debris flow deposites indicate this topographic change.

One of the geologically and biologically most interesting area is the Kess Kess mud mounds (Kess Kess Formation), which are exposed at the Hamar Laghdad Ridge in the Tafilalt region. They have circular, sub-elliptical morphological shape with generally steep (20°-60°) asymmetrical flanks (Fig.3.).

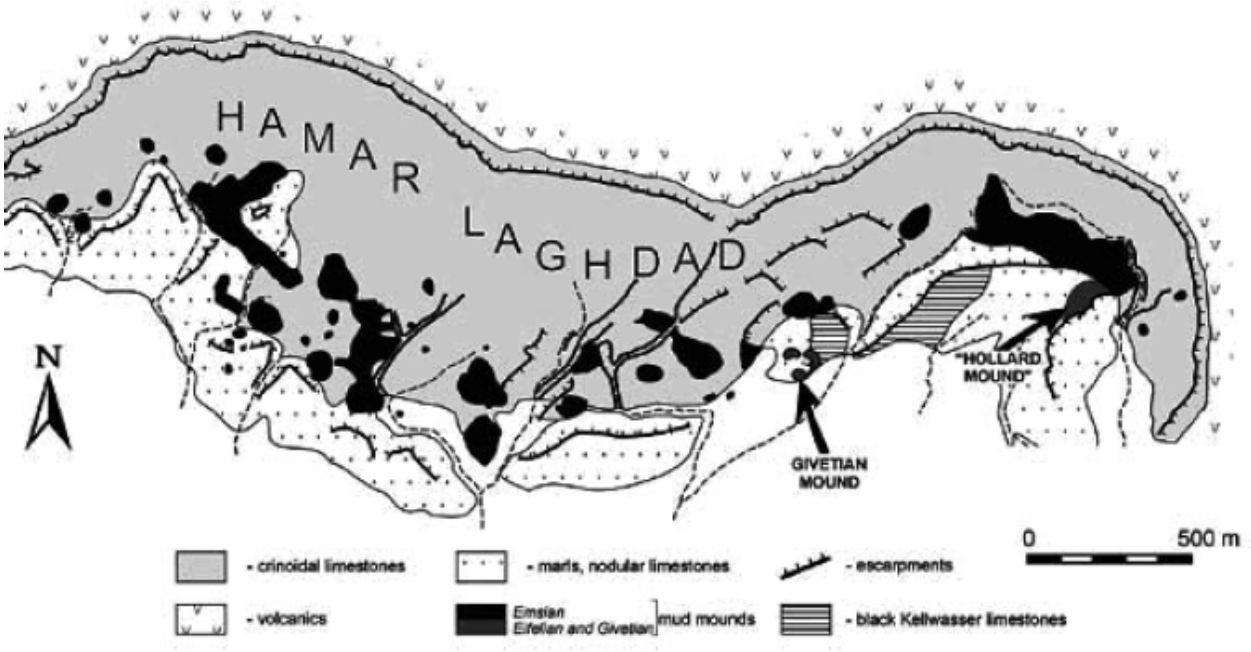


FIGURE 2. GEOLOGICAL MAP OF THE HAMAR LAGHDAD REGION. AFTER BELKA (1998).

Their elevation does not exceed 55 meters, and the average diameter is around 20-30 meters. - The mud mounds have Lower Devonian age, but their origin is debated. As a result of the analysis of the limestone, the carbonate mounds represent relatively shallow water conditions in aphotic environment. The current topography almost reflects the past topographic situation. A detailed geological map shows the diversity of different rock types and the situation of Kess Kess

mud mounds (Fig.2.). Their origin is debated, but various interpretations have been proposed. They possibly developed as a result of submarine volcanic activity, and were associated with fault

FIGURE 3. IMAGE OF THE KESS KESS MUD MOUND.

system. These faults were served as conduits for the hydrothermal fluids originated from laccolithic body and silty material. The mud mounds were precipitated from these fluids on the top of crinoidal limestone (Fig.4., below).

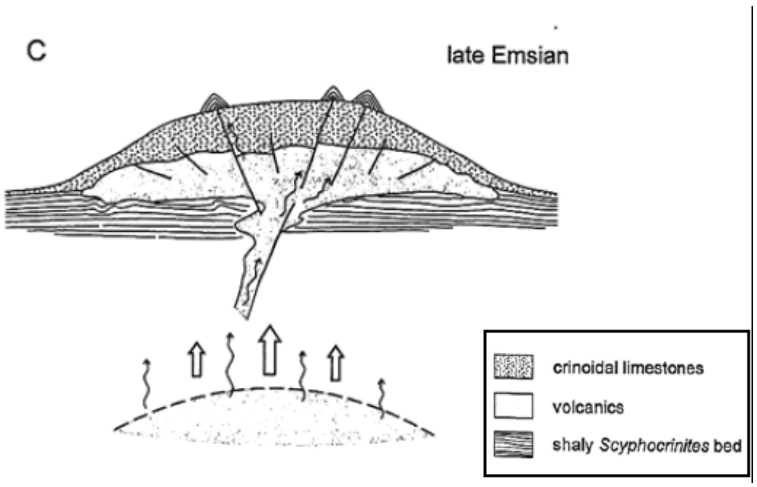


FIGURE 4. MUD MOUNDS

4. Field infrastructure

4.3. Field Accommodation

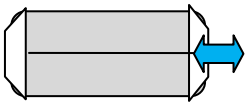
The actual locations of the Base-camps have been chosen by the “landing site”-selection team, based upon remote sensing data.

At the test site, basic infrastructure for the field crew will be provided as follows:

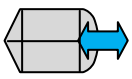
- BASE-camp, hosting the communication and computational infrastructure; most of the science activities will be done there including the sample procurement.
- Basic engineering workshop tent (including soldering, electronics and mechanical workshop, 3d printer)
- Hygiene facilities (sponge baths in the field)
- Common tents (storage, food prep and meals for the crews)
- Technical equipment: Satellite communication, diesel generators (2 x 5 kW)

Accommodation is based upon private tents.

Physical Layout of the BASE

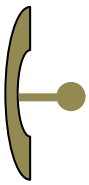
Tent 

Personal tents

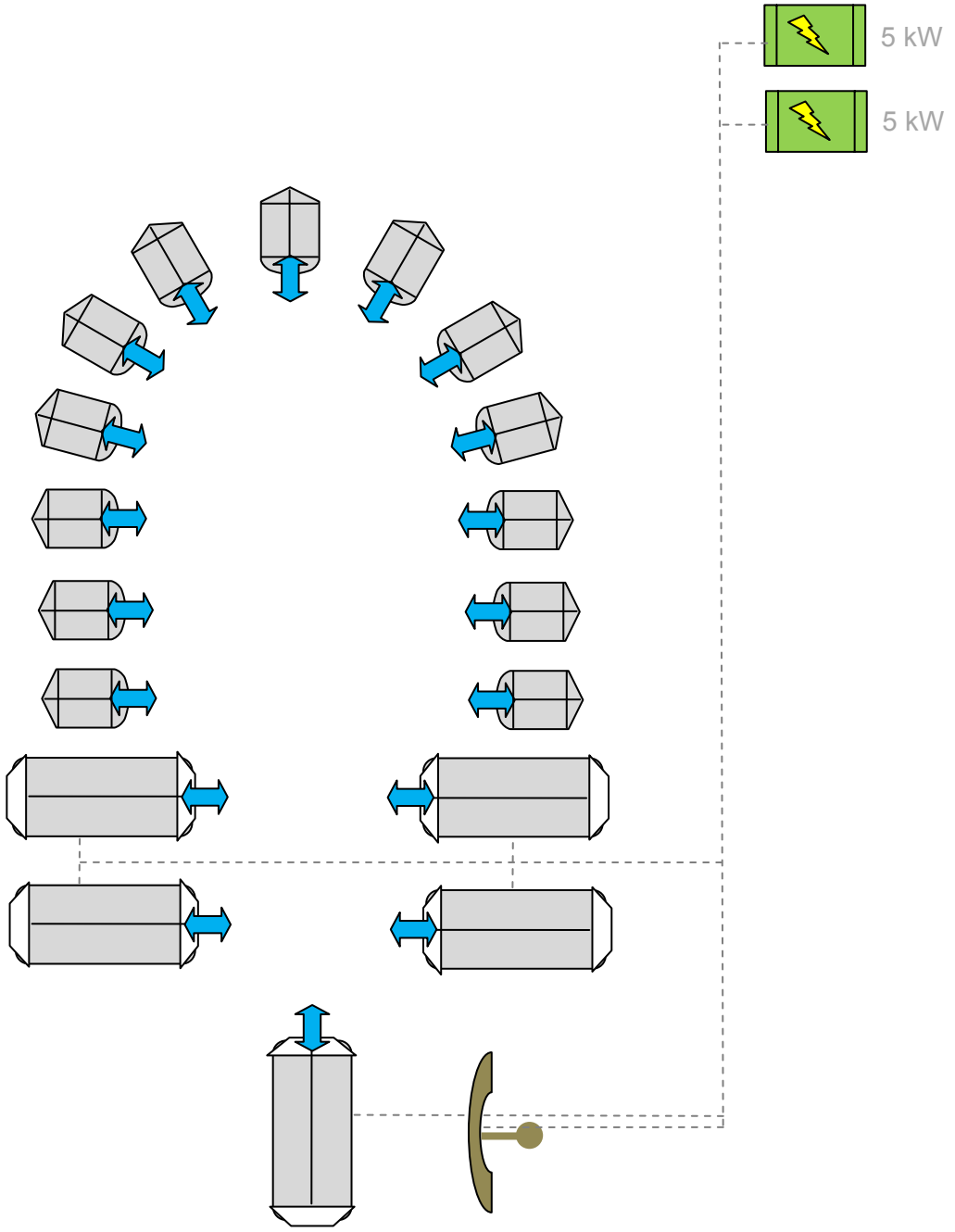
(provided by OEWF) 

Generator  5 kW

Satellite Dish

(provided by OEWF/IBC) 

MARS2013 BASE layout



4.4. Communication infrastructure / Internet

The base camp will be communicating with the MSC via a dedicated broadband satellite connection, based upon a VPN connection.

The satellite link will be provided by BusinessCom:

- 2.4m Prodelin 1251 C-Band Rx/Tx VSAT Antenna
- C-Band 5W SSPA NJRC BUC
- C-Band PLL-stabilized LNB
- iDirect Evolution X5 Series Satellite Router (PEPiDirect VSAT)
- Satellite: SES NSS-10 C-Band

Maximum burstable rate, receive: 2048 kbps / Maximum burstable rate, transmit: 1024 kbps

Dedicated rate, receive: 256 kbps / Dedicated rate, transmit: 128 kbps

The private VPN subnets are routed locally, hence if there is a need for accessing hardware on-site, the protocols (access and configs) have to be established via the MSC IT-team.

Field configuration:

The network used is 192.168.1.0/24 (Gateway 192.168.1.200), all machines not using a fixed IP can be connected via DHCP protocol.

The wireless network in the field is based upon the 802.11a standard at 5 Ghz, around the base camp, a 2,4 GHz network is available.

MSC configuration

Ethernet and WLAN available, dynamic configuration via DHCP. Internet is provided via LTE.

Communication via Mumble

The standard for audio communication within the field and within the MSC is Mumble. During the simulation voice communication is one-way from the field to the MSC (MSC can only listen, a separate text-chat tool is used for two-way communication), out-of-sim (and during contingency situations) normal two-way voice communication is possible. (www.mumble.com, the smartphone version for android is called “plumble”.)

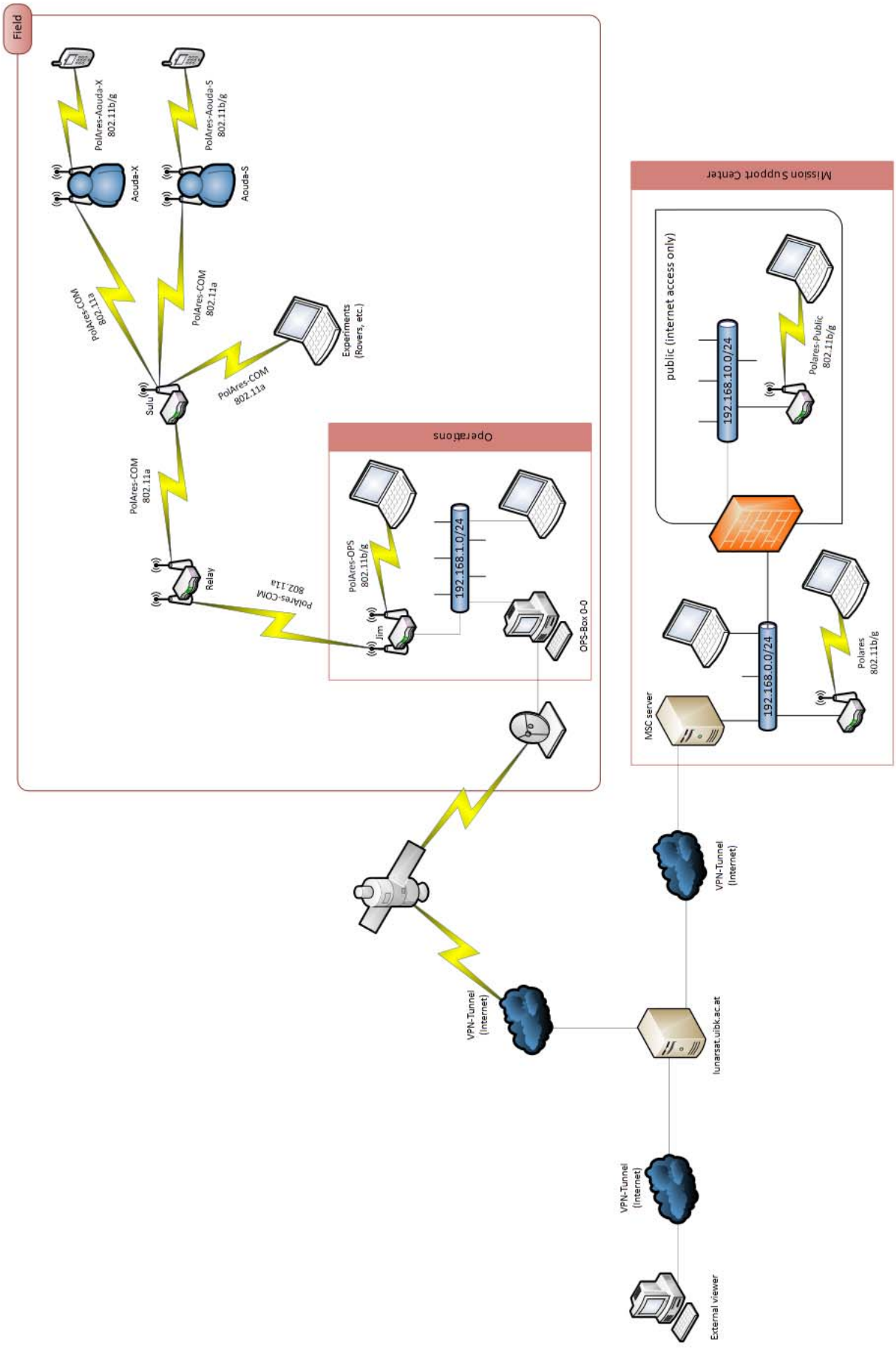
4.5. Radio communication

W-LAN radios were used like in telephone conversations or Skype telecons, with some selected phrases usually heard in airline traffic controls or emergency services. The Aouda.X/.S W-LAN vox system was on continuous broadcast, for the back-up radios (DP3601), we used push-to-talk buttons to minimize background noise and bandwidth; the signal pick-up in the suits is done via throat-microphones for the back-up.

One criterion for the conduct of an EVA was that at least two independent methods of communication were available for the suit tester at all times, AND that at least, two humans were listening to these channels. By default, this was the SAFETY as well as the BASE.

The radios used in the field were based upon 8 units Motorolla DP3601, with a Mototrbo base station. The exact frequencies were allocated by the Moroccan ANRT (Agence Nationale de Réglementation des Télécommunications).

In addition, a repeater frequency was used based upon a frequency allocated to the Royal Moroccan Ham Radio Organisation (Association Royale des Radio Amateurs du Maroc (ARRAM)).


Field
PolAres-Aouda-X 802.11b/g
PolAres-Aouda-S 802.11b/g
Aouda-X
Aouda-S
PolAres-COM 802.11a
PolAres-COM 802.11a
Experiments (Rovers, etc.)
Sulu
PolAres-COM 802.11a
Relay
PolAres-COM 802.11a
Operations
PolAres-OPS 802.11b/g
192.168.1.0/24
Jim
OPS-Box 0-0
Mission Support Center
public (internet access only)
192.168.10.0/24
Polares-Public 802.11b/g
192.168.0.0/24
Polares 802.11b/g
MSC server
VPN-Tunnel (Internet)
VPN-Tunnel (Internet)
lunarsat.uibk.ac.at
VPN-Tunnel (Internet)
External viewer

5. Mission Support Center

5.1. Location and Infrastructure

The Mission Support Center was located at Sillufer 3a, 6020 Innsbruck, Austria in a building of the Innsbruck Red Cross services. On 400 sqm, the MSC included flight control rooms, offices, dormitories and basic cooking/hygiene facilities. The building was donated by the Austrian Red Cross.

In case, the MSC could not have been used (e.g. fire deseaster, etc.) a back-up MSC would have been activated at the premises of the University of Innsbuck (OeWF Spacesuit Laboratory facilities).

IT Infrastructure

The MSC had a broadband connectivity based upon LTE-technology, providing effectively between 10-30 MB/s download capacity. The Science Data Archive was hosted on a set of OEWF servers at the MSC.

5.2. MSC set-up

- **Flight Control Team Room:** The heart of the Mission Support Center was the Flight Control Team Room ("FCR"), where the Flight Director managed the flight controllers (also see MSC team chart). A series of status displays visualized major telemetry data and the flight plan as well as the video feeds.
- **MEDIACOM:** This room, adjacent to the FCT housed the traditional and web-based media teams. This room was the gateway to the public, including image or text releases, blogs, video editing and managing media inquiries.
- **FLIGHTPLAN/RSS/SDO:** This double room was the center of the scientific operations, where the data are being r**eceived,** analyzed and interpreted. This input fed back into the flight planning team which was considering available resources and management

priorities together with the scientific input to be merged into a comprehensive flight planning to be decided on the daily planning conferences and communicated to the field crew. In this room, the SDO team handled the incoming data streams, ensured the safety and security of the data and redistributed the data streams within and outside to the MSC.

- **Ground Support Logistics + IT:** The “gateway to the MSC”: This room hosted the team managing the facility, ensuring the access control and handling logistics ranging from transportation to hygiene. This team also maintained a small car pool to ensure local transportation.
- **Entry point / registration desk**
- Experiment teams were be seated depending on the nature of their work either in the Remote Science Support Room or the Flight Planning.


Mission Support
Center
BME
SCI OPS


RSS
Media
Flight Control
Flightplan
Server
WC
WC
Dining room
N
Dormitory
Ground support &
SDO & IT
Lounge

MSC IT set-up and communication

The MARS2013 IT-Infrastructure consisted of 4 elements:

- Field with OPS-BOX as core unit
- MSC with it's MSC-server as a core unit
- External Users
- Lunarsat Server located at the spacesuit suitlab

Each of these 4 parts is self-sufficient, which means that if connection between any of these parts is lost, the field or the MSC is still able to work within it's own network.

Field / Description of units involved

Main unit in the field was the so called OPS-BOX where all the data of the field crew was processed and stored for transmission. The OPS-BOX also provided the gateway to the internet. For Mars2013 this was planned to be done via the BusinessCom satellite dish but due to problems with the dish the connection was established via UMTS for the first two weeks. It was shown that the equipment as well as the crew was able to switch the way of getting connected to the lunarsat server via the internet.

OPS-BOX: The data hub for the field operations includes two work stations, plus a third in the OPS-SEAT White. The UPS allows for 30min of operation without the main power supply.

MSC / Description of units involved

Main data storage unit in the MSC was the MSC-server where all processed data (done by SDO/IT) was stored according to naming conventions. IT was also granted that access to confidential data (eg. Medical data) was only granted to authorized personel (BMEs). The station based computers were connected via LAN to the server, notebooks could have been connected via WiFi. For guests there was a special WiFi public net, which just granted access to the internet but not to the MSC server. Traffic to the internet was routed via t-mobile LTE equipment, which gave enough speed for all of MSCs needs.

External users

External users had the possibility to VPN to the MSC server and also were able to connect via mumble to the field. We had this done with two Rover groups who steered and chatted directly to the field without any relaying of the MSC. This worked well for the simulation, but had to be done without time delay.

Lunarsat server at Suitlab

The main storage and access point for all the non time critical data between field and MSC

Communication flow

For the MARS2013 mission there were two modes of communicating between the field and the MSC:

Realtime (RT) and time delayed (TD)

Realtime communication was used for morning and evening briefings and in emergency situations. This was done by connecting both the field and the MSC to the same mumble server. We had one server running at the ops-Box and one on lunarsat server in Innsbruck. When polling for going into SIM indicated a GO for EVA the MSC left the ops-Box mumble server and connected to the lunarsat server. The data flow between these mumble servers was a FIFO type buffer that had a lenght so that a 10 minute delay was achieved. In fact when operating in TD mode the MSC role was more of listening as directing via voice was impossible to do.

But there was another possibility to communicate in TD mode to the field that made more sense than talking. A Time delayed text chat gives the possibility to keep up an information flow even thoug it's not in RTBesides the mumble and text chat communiaction channels we had an „emergency line" directly from FD to EXLEAD via an IRIDIUM Satellite phone.

Data flow

Data generated by experiments in the desert was collected by the SCIENCE in the field, processed for transmission (or for bigger data for transport on physical media) and prepared for transmission. These prepared data were transmitted during night hours to the lunarsat server in Innsbruck. In the morning the MSC SDO collected this data stream, processed it to the relevant folders on the MSC server and informed CONTACTS that data for PIs is available on the server. There was also a dedicated folder on lunarsat server for transmitting data from MSC to the field.

Data handling by SDOs was a very good thing as PIs or whoever in need of getting/bringing data to/from the field just had to pass the data to SDO and they took care of the transmission.

Team set-up

Learning from previous missions and considering the sheer size of Mars2013 project now we got at least two IT techs and two SDOs on duty all the time.

IT:

- Thomas Bartenstein
- Wolfgang Jais
- Josef Radinger

SDO:

- Stephan Gerard
- Roberta Paternesi

IT/SDO:

- David Fasching
- Harald Fuchs

Both the IT support team as well as the SDOs performed excellent and showed skills like stress resistance and improvisation but also short reaction times to problems.

IT Accomplishments

Preparation is one of the most important factors to guarantee a smooth flow of the daily routine in IT. To achieve a high quality level the IT and SDO teams started on preparing for this project in summer 2012. Indeed first brainstorming sessions between IT and SDO team leaders took place during the Dachstein 2012 mission. Online meetings (monthly at first later on a weekly base) proved to be of high value to train IT/SDO members and to get feedback from other teams. Last but no least the dress rehearsal was of significant importance to lay open bugs and process faults and to refine (also redefine) procedures and IT systems. Also putting the dress rehearsal two months before the mission start gave the IT team enough time to eliminate those flaws.

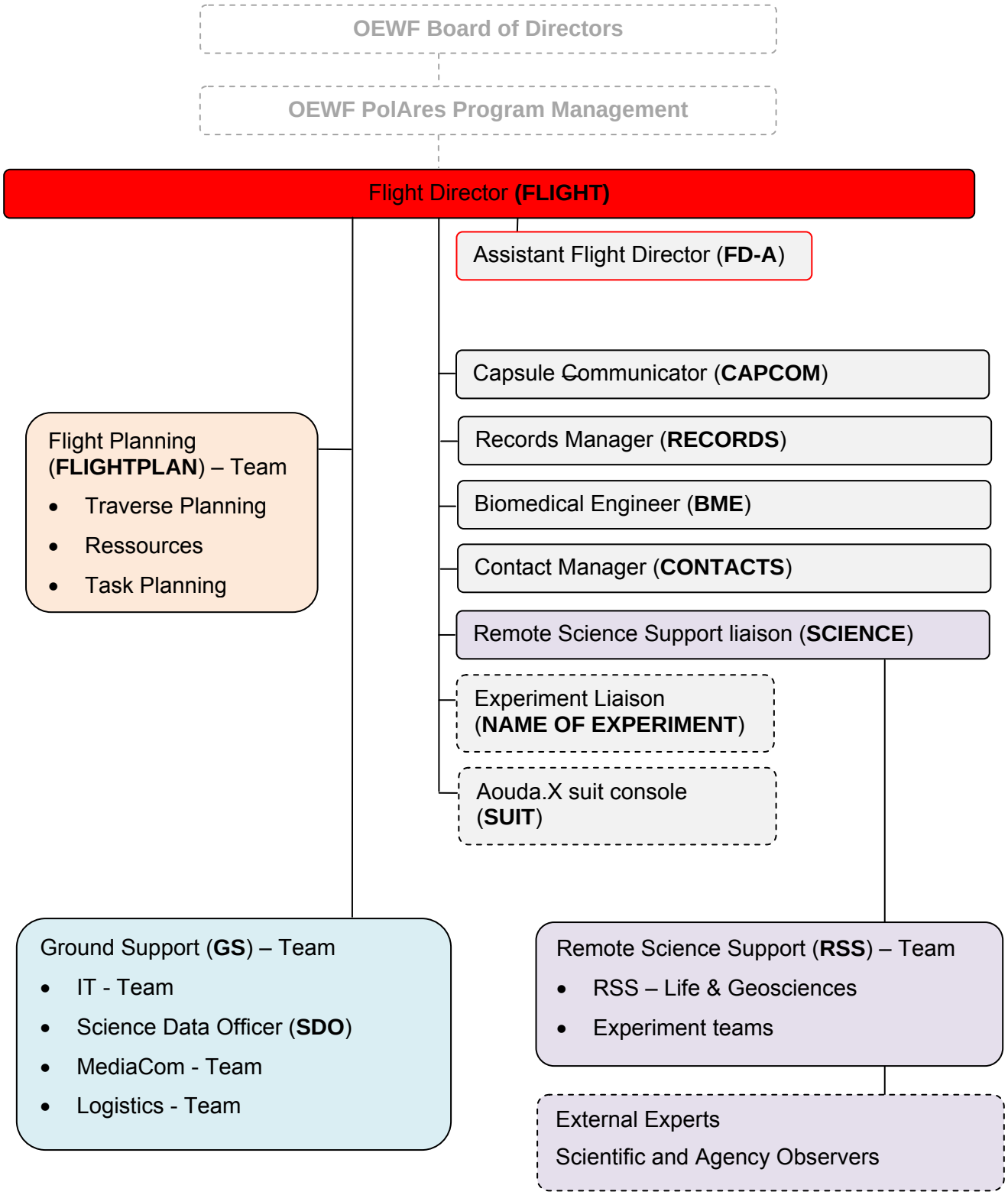
Thank's to hardware donations from various institutions and persons the IT team was able to establish a small but quite strong chain of servers which formed the backbone of the IT infrastructure. In contrast to previous missions stable network access for all teams but also for guests (media teams etc.) could be established by:

- a fast and stable broadband connection by the internet provider
- full WiFi and LAN network coverage in the MSC.
- all IT support team members were trained in the full set up of the IT infrastructure.

Thank's to a well defined storage and backup procedure the data gained by the experiments and media teams was quickly available in spite of the restricted bandwidth and connection times to the field.

MSC team overview

This figure represents the MSC configuration; designations are given in full and their respective abbreviation (e.g. "**FLIGHT**"). Dashed lines indicate optional positions as directed by FLIGHT.



5.4. Flight Director ("FLIGHT")

The Flight Director (FLIGHT) was responsible for the overall MARS2013 mission operation. (The responsibilities for the field safety & security, payload operations and scientific activities were shared with EXLEAD). During mission/simulation preparation, the FLIGHT was responsible for ensuring (at a management-level) that the resources of the MSC and the supporting operational ground segment are adequate to conduct mission operations. This included ensuring adherence to mission rules, and proper coordination of any necessary actions caused by deviations from the Flight Plan. The FLIGHT assumed also the end responsibility for the overall mission conduct; in doing so, he coordinated all actions with the flight planning, science and field crew teams.

The FLIGHT position was staffed on a single shift 8-12 hour per day basis. The FLIGHT and one back-up were physically located in the MSC. During the mission, the Lead FLIGHT always had to be reachable via cell phone 24/7.

In addition, the Flight Director was responsible for modifying and revising the existing overall mission schedule so that it included any necessary changes based on the state of the expedition site and the health of the crew.

Daily tasks

- Morning briefing / daily debriefing with the MSC lead functions and the Morocco EXLEAD
- Organization of planning or situation conferences with necessary staff
- Daily team assignments, making sure everyone knows what job he/she has to do
- Making sure that everyone of the Flight Control Team is on his/her post (e.g. daily roll-call)
- Definition & conduct of Code orange-situations
- Approval of the flight plan generated by the flight plan/procedure specialists and sending it to the team-on-site
- Taking final responsibility of all Non-Standard Operations and procedures including its documentation (copy handed to Records).

5.5. Flight Director Assistant (FD-A)

The FD-A acted as the "first officer" to FLIGHT. In principle, FLIGHT could delegate any task to the FD-A. However, the final responsibility and decision making authority stayed with FLIGHT. Interactions were the same as the FLIGHT.

The Flight Director Assistant was – together with MediaCom - responsible for updating the MediaCom news feed of the OEWF/PolAres website as part of the outreach activities of the MSC.

Daily Tasks:

- Daily "full tour MSC monitoring": what hardware is (dis-)functional, has to be serviced, cleaned, etc...? Any malfunctions to be expected?
- Writing a daily Mission summary for all institutional partners
    - <2 pages objective overview ("Internal Blog")
    - incl. one picture from MediaCom if possible
    - incl. the "Lessons learned" at the end of every day (provided by RECORDS)
- Managing information (requests, complaints, suggestions) coming from the team and mediating disputes between team members
- Explaining to visitors how the MSC and the team-on-site work

5.6. Contact Manager

The contact manager was the "gateway" to external teams. This role acted as the single-point-of-contact for remote science support teams not present at the Mission Support Center as well as for the ANTIPODES-experiment. In addition, the Contact Manager coordinated the telemetry feed to external entities such as school classes, agency representatives, sponsors or VIP's.

Usually, during ongoing external experiments, the contacts manager supervised the connectivity and ensured a high level of situational awareness of the external parties.

The decision on allowing external parties who are not experiment teams to access the telemetry stream beyond the public stream was taken by the Flight Director and the MediaCom.

The contacts managers duties included:

- Ensuring, that external organizations get advance calls and daily updates before their experiments, including the activity plan for the date concerned. This involves notices on potential or actual delays (including explanations to the external parties), technical problems to expect or any other deviation from the original plan.
- Ensuring external parties get their data a.s.a.p. together with the actual activity plan surrounding their experiment.

- Making a quick debriefing-call after the external parties have taken a first look at their data.
- Asking for their immediate feedback, collecting this information and handing it to RECORDS.
- Managing telemetry requests in coordination with IT/SDO.

5.7. Records

RECORDS ensured a continuous logfile of what is happening in the field as well as in the Mission Support Center. This position was vital for the recording of the "as-was flight plan", which in turn was an element of the science data archive (maintained by SDO). The position also provided the input for the update for the external experiments to update them on recent events relevant to their activities.

Biomedical recordings were NOT part of the RECORDS logfiles, these are maintained by the BME due to their sensitive nature.

- Continuous logging of all MSC and field activities (including changes, delays, incidents etc..) on an approx. 15min basis.
- Keeping track of planned and actually executed activities.
- Documenting all experiment activities and any problems that arise
- Logging of lessons learned (daily summary) – hand it to FD-A
- Send daily records & lessons learned to FLIGHT, FLIGHTPLAN, SDO, BME
- Generating a weekly report (or an intermediate report in case of a crew change in the RECORDS position).
- Ensuring a smooth transition to the next console-operator after each week by a detailed briefing on what had happened so far to ensure a maximum awareness of the mission history so far.
- Roughly logging, on an objective basis, "out-of-sim" activities like social activities or preparations in conjunction with Media team.
- At the end of the mission (4th week): Compiling a complete account of the sequence of events in a chronological table.

The format of the continuous RECORDS logfile included at least the following data on a <15 min roster:

- Field activities: what is happening in relation to the actual flight plan, EVA status, experiments conducted, technical parameters (Actual bandwidth (*measured! – for legal/contractual reasons*)) *Source: IT*
- MSC activities, including daily team roster and responsibilities, including major media activities and main outcomes of the daily FLIGHT briefing. *Source: FLIGHT/FD-A*
- Anomalies, break-down, equipment malfunctions, camp & supply status (reported by QUARTERMASTER)
- Weather data at the MARS2013 field site (precipitation, humidity, temperature and pressure – as reported by SCIOPS)

5.8. Science Data Officer / Information technologies (SDO/IT)

The Science Data Officer (SDO) managed the acquisition and archiving of experiment-specific and environmental data during field missions of the Austrian Space Forum. SDO/IT ensured that on a long term perspective, field experiment data were accessible after the missions, building a body of knowledge and field activities.

Hence, during field operations, the responsibilities included:

- Ensuring, that all experiment teams are aware of the SDO position: whenever returning from the field, they first report back to the SDO and hand-in data acquired, or ensure, that data telemetry is properly stored in (near) real-time.
- In cooperation with RECORDS to ensure a proper recording of the Flightplan “as-was”
- Referencing all scientific, engineering and operational activities to the timeline of the Flightplan and how to access these data (either via the OEWF mission archiving, or via the respective PI).
- Recording of general environmental data (weather, etc..)
- Acting as a point of contact for PI’s for retrieving data and clarifying intellectual property issues (in cooperation with EXLEAD, FLIGHTor the OEWF legal team if necessary.)

In addition, if no dedicated IT-support is available on-site

- Ensuring, that all electronic devices have a synchronized clock (including digital cameras, smartphones, Laptops, etc…)
- Ensuring that all hardware connected to the OPS communication infrastructure is Virus-free and is not vulnerable to attacks.
- Providing basic IT support on-site and relaying complex problems to MSC/IT ("*Resolve simple issues, relay complex problems*").

5.9. Biomedical Engineer (BME/DOC)

The BME had the overall responsibility at MSC for crew health related issues, whereas the DOC was doing the same for the field CRW. One of the BME's was designated as the head of the BME/DOC Team and had the overall organizational decisional responsibility w.r.t. to medical issues. The BME/DOC provided support for all issues relating to crew health and medical data management, including pre-flight preparation, real-time monitoring, real-time conferences, and post-flight rehabilitation. The BME also provided support regarding medical or life science payloads, hazardous operations and medical policy making within the complete PolAres program. The BME was also furthermore available to help with health related issues amongst the MSC staff.

The BME position was staffed on an „as needed"-basis as directed by FLIGHT and in coordination with the head of the BME/DOC Team.

The BME/DOC was also responsible for assessing crew members' psychological health and directed psychological experiments in cooperation with the psychologist if needed. The BME/DOC was able to monitor communication with the crew and use it for determining the psychological situation of the crew during the simulation phase.

In case of medical emergencies in the field the DOC (and within the MSC the BME) was the primary liaison between the patients, the hospital and the patient's family in cooperation with the psychologist/KIT-Team if needed. Additionally the DOC in the field had to inform the BME in charge immediately in case of medical interventions in the field, especially in case of any patient transportation intervention.

Daily tasks

- Monitoring of On-site Crew and MSC staff health at any time during the simulation

- Logging of biomedical data during simulations; this includes food and fluid intake of the crew.
- Having a daily safety debriefing between SAFETY, BME & DOC, and report the outcome to the FD-A.
- Medication and treatment decisions in non-critical cases
- Arranging for medical evacuation from the site if necessary (including to higher-level hospitals within the country of the test-site)
- Identifying potential risks for the Crew during simulations and relaying them to FLIGHT
- Having a final “No-go” say on Crew activities if safety is obviously endangered
- After EVA’s: requesting exit-photos of the suit testers shoulders and checking them for bruises.
- Medical documentation by BME and DOC (ensuring redundancy). This documentation must not be given to RECORDS for privacy reasons!

5.10. Psychological Support/Counselling (PS)

Counseling and possibility of reflection for FLIGHT, respectively EXLEAD regarding executive function, group dynamics. Possibility for each member for group a/o single talks if requested – psychological pledge of secrecy is guaranteed. PS was not permanently staffed, but will join for selected mission elements and is on stand-by for the duration of the mission.

Tasks:

- Participates in briefings if team dynamics might be a factor
- Briefing with FLIGHT once a week - more often on request
- Briefing with EXLEAD once a week – more often on request
- Monitoring group dynamics of the Field Crew and the MSC team
- Support if a critical incident occurs
- Will be involved in traumatic situations, and especially be informed of a Code Red.

5.11. Remote Science Support (RSS)-Team / SCIENCE

The Remote Science Support team had the overall responsibility at MSC for the operation and readiness of all experiments conducted. That included the scientific experiment activity planning and balancing time, power and data rate requests from multiple experiments in cooperation with FLIGHTPLAN.

SCIENCE was a console operator in the Flight Control Team and is the liaison between the RSS room and the FCT. The general activity recording was done by RECORDS, the science data archiving was maintained by SDO.

SCIENCE was the “hawks’ eye” on the field research. It closely follows the experiments by

- continuous checking compliance with procedures
- taking notes for the RSS backroom
- alerting PI’s about equipment failures, procedural problems, etc.. (together with CONTACTS)

RSS scope of practice

The RSS team was responsible for processing science data obtained in the field for the purpose of creating an evidence-based picture of the geophysical, etc. geophysical, geological, (paleo)biological and life-science related setting in the field solely by the data which would be available before an actual human landing on Mars (e.g. via Remote Sensing or a single sample return mission) as well as the field data obtained in Morocco “Blinding” of the RSS. In order to avoid an unrealistically high situational awareness, all RSS team members were explicitly asked NOT to learn specifics about the target area unless otherwise authorized by the mission management.

The RSS was supported by a small team of researchers who actually knew the geological setting very well (Csilla Orgel/Univ. Of Budapest and a representative of the Ibn-Battuta Center), and who would observe the blinded RSS team and intervene whenever major problems arise (e.g. overlooking an important geological feature).

Tasks

- Analyzing science data received from the field, generating scientific documents out of the first look data together with the PIs (so they can later be submitted for peer-review)
- Maintaining the technical documentation of the experiments together with the PIs including updates (ensuring via CAPCOM that BASE has always the most recent update)
- acting as a point of contact for science issues and brief FLIGHT daily on important issues related to science. Providing science-directed feed-back to FLIGTHPLAN for the purpose of adjusting the field activity schedule to achieve greater science return, as required.

- Providing the field team with geologic mapping support and FLIGTHPLAN with target-planning mapping support Mediating disputes between PIs (and making final authority decisions with respect to the science payload, safety and experiment priorities), also acting as an appeal route for PIs to FLIGHTand/or FLIGHTPLAN
- Maintaining overview on the requested data volumes to be transferred from/to the field in cooperation with FLIGTHPLAN.
- Support FLIGHTPLAN and MEDIACOM in prediction of environmental conditions (weather, illumination conditions, etc…).

5.12. Capsule Communicator (CAPCOM)

The Capsule Communicator or CAPCOM was responsible for coordinating the use and distribution (enabling/disabling) of Space-to-Ground communications and voice link with the Crew for operations. The CAPCOM was manned on an single shift 8-12 hour per day basis. It gave the space-to-ground communications a necessary comradely touch amongst all the pressures of mission schedule and payload operations duty. CAPCOMs also excelled at explaining to crew or MSC staff the respective point of view of the other group. CAPCOMs also acted as confidential channel between the crew and their families. CAPCOMs had to be able to do extensive multi-tasking and often have to handle multiple requests from the MSC staff at the same time.

Daily tasks

- Daily communication with the on-site crew (BASE)
- Handling multiple communication requests from various sources
- Handling multiple lines of communication (Skype, mumble, phone)
- Helping to federate a positive climate between MSC and field crew
- Managing and supporting visiting family members of on-site crew, when not on active duty
- Mediating disputes between MSC and on site crew
- Archiving of all Data sent to Morocco (eg. Flight plan updates) in conjunction with RECORDS

Responsibilities

- Switching Mumble-groups, including/excluding participants; monitoring every communication channel available at the MSC at all times.
- Removing unauthorized users from Mumble-channels

5.13. Flightplan

The responsibilities of Flightplan was to create a (strategic) „Mission plan“ and an (tactical) „Activity plan“ during pre-mission and mission operations respectively and develop preliminary traverses based on data from science team. The Mission plan was a rough overview of experimental and daily activity that should occur during the execution of the mission. The activity plan was the detailed plan describing all necessary resources and time requirements for all activities. The activity plan was made 3 days before execution with input from previously executed days.

Pre-Mission:

- Obtain and review mission architecture from mission management
- Obtain and review procedures, experiments and experimental locations from the PIs via the science team
- Obtain and review requirements from the media team
- Develop a mission plan including the development of the activity plan for the first 3 days of the mission (Pre-Mission start!)

During-Mission:

- Obtain and review daily records and logfiles from RECORDS and SDO
- Obtain and review activity requests and locations from PIs via the science team, media team and FLIGHT
- Check activity requests with availability of infrastructure (feedback with field crew)
- Obtain a resource report from the quartermaster
- Develop traverse planning, to be approved by the FLIGHT
- Develop the activity plan for T-3 days
- Create daily Powerpoint summaries for briefing (Visualisation of daily activity plan)
- Brief FLIGHT on the activity plan and obtain his authorisation

- Give authorized activity plan, traverses and summary slides to CAPCOM for sending to field, to RECORDS in MSC for storage, to BME for information and to CONTACTS to be forwarded to the PI's and external partners.

5.14. Ground Support (GS) - Logistics

The Ground Support (GS) was responsible for the management of all the MSC and on site ground facilities necessary to support PolAres mission operations. The GS provided support to both the real time and preparation activities for the MSC and on site Operations, infrastructure services and partner communications support. The GS provided MSC facility management. The GS supported the MediaCom in public outreach activities. The GS was responsible for purchasing the necessary equipment, supplies and food to sustain the MSC and on-site team for the duration of the field trip operation. GS was responsible for providing transportation, power, fuel, water and shelter (including restrooms and showers). GS was responsible for maintaining a daily car pool. GS was responsible for meeting any newly arriving team members and giving them a briefing about the way the MSC works.

Daily tasks

- Being present 1 hour before MSC opening and 1 hour after MSC closing each day, at other times being reachable via telephone.
- Staffing the reception desk at the entrance: monitoring of visitors, press representatives (e.g. leading them to interview partners,...). Handling visitor groups during public day.
- Handing out of badges for each shift, inserting name tags in org-chart of the MSC
- Keeping record, who is present at the MSC, who can be reached in what way if off-duty.
- Daily "beautification" at MSC - making sure that it looks tidy and nice (floor, toilets, windows, beach flags, staff members etc...), introduction and enforcement of the house rules ("*Hausordnung*").
- Housekeeping: ensuring that there are plenty of supplies w.r.t. beverages, coffee/milk etc..., towels, office supplies, etc...
- ensuring the security of people, equipment and facility
- Car pool / Transportation/ Drivers stand-by
- Arranging the sleeping and living quarters for all MSC personnel
- support education and outreach activities (e.g. as MSC tour guides)
- brief any newly arriving team members about the way the MSC works

5.15. Media Communication Team (MediaCom)

The Media Communicator (MediaCom) was responsible for coordination of media activities and managing of the media equipment.

This position was also responsible for the implementation of user video product requirements and supporting the distribution of video products for the purposes of public relations. MediaCom was responsible for event planning, especially involving interaction with VIPs. Promotional activities are planned by MediaCom and executed with the help of GS. MediaCom was also responsible for website and Social Media content product generation.

The MediaCom position was planned to be manned on a daily basis, but provided extended support during periods of high activity.

Daily tasks

- Handle all media requests
- Picture of the Day, populate social media channels , video editing/cutting (no daily video)
- VIP / Public / Family / Media guided tours through the MSC
- Cooperating with partners (e.g. Mars Societies, outreach teams)
- Content generation for website and social media channels
- Inviting special guests and dignitaries on a need basis, and planning as well as executing their visits
- Report most important activities to Media Officer

6. FIELD CREW

The Crew (including the Suit Tester) was responsible for conducting all analog science mission activities in „simulation“ („in-sim“) mode, simulating a real flight mission. That included all extravehicular activities (EVA) in the PolAres spacesuit simulator. The Crew was responsible for the „in-sim“ operation of all on-site systems and payloads. Science experiments were conducted „in-sim“ under the supervision of the responsible experiment PI's. (Bio-)Medical experiments were coordinated also with the BME and on-site Safety/Paramedic. Technical equipment as operated and maintained together with the Flight Control/Engineering team.

Daily tasks, both in-sim and out-of-sim activities:

- daily equipment maintenance including battery recharging
- buying supplies including food, water, fuel, oil, spare parts
- helping SAFETY transporting the safety equipment
- constructing housing on site (tent building, deploying tables)
- deploying the IT and communication infrastructure (Sat Uplink, HAM radio)
- Giving input to the MSC about all activities for flight plan generation
- Conducting all repair activities
- Conducting all in-sim activities
- Deploying and maintaining the rover(s), as well as the PI experiments
- writing reports and submitting them to the MSC
- support EXLEAD in media and outreach activities

The field crew roster was as follows:

- EXLEAD: Gernot Groemer
- DEPUTY EXLEAD: Stefan Hauth
- DOC: Pavaan Gorur
- QUARTERMASTER: Julia Neuner
- TECH/COM: Sebastian Sams, Thomas Turetschek
- ANALOG ASTRONAUTS: Daniel Schildhammer, Christoph Gautsch, Luca Foresta

- PHOTOGRAPHER: Katja Zanella-Kux

In addition, during the isolation phase, Maria Aboulahris (University of Hassan II Casablanca) was the representative of the Ibn Battuta Center.

6.1 Expedition Lead (EXLEAD)

The Expedition Leader (EXLEAD) had the overall responsibility at the field test site for the operation and readiness of all personnel working on-site and all equipment used on-site. That included overall activity planning and scheduling tasks. He was in constant communication with the MSC Flight Director. He had the final authority on all decisions to be taken (in sim and out of sim) at the field test site, especially in the case of an emergency. The EXLEAD was reponsible for maintaining contact with local authorities and media.

Daily tasks

- Ensuring on-site daily maintenance, supply, safety and housing
- Coordinating with MSC with respect to the daily activity plan
- Supervising repair activities
- Representing the team to local authorities or media representatives
- Coordinating the team in real and in-sim emergency situations
- coordinating and authorizing all on-site expenses (and paying out money)
- keeping the discipline as needed

6.2. SCIOPS (“Field Science Officer”)

As an “extended arm”, the RSS had a RSS-liaison available in the field crew. This position, called “SCIOPS” was managing the scientific hardware in the field and procures the samples obtained. He/She HAD TO be aware about all scientific activities carried out at any given moment, including what has actually been accomplished, where the samples are, what instruments are in which status etc.

The SCIOPS also supported the console operator at the OPS-station at the BASE.

Daily tasks

- Ensuring correct Charging/Decharging cycles of experiment powerpacks (knowing how long the instruments can operate at any given time)
- Collecting experiment data from the field and transferring it to the SDO (ensuring, that BASE obtains MSC confirmation of data reception)
- Giving input about experiment activities for flight plan generation
- Ensuring that the scientific equipment is available for the EVA's (deployment is usually done by the crew)
- Procurement of physical samples in cooperation with SDO
- Repair and maintenance for the science equipment as directed by the PI's or MSC
- Conduct of experiments on a case-to-case basis.

6.3. Base Camp Communicator (BASE)

BASE was the counterpart of the MSC Capcom, usually communicating in time-delay mode via text messages. Off-Sim and during emergencies, BASE can switch to real-time (audio) communication. He/she were the eyes and ears of the MSC, providing them with a continuous update about the field activities.

BASE communicated with the crew in the test site and ensures a continuous flow of information from the EVA and experiments (supported by the SCIOPS).

- Reporting of field activities (including the non-scientific ones) for RECORDS on a <15 min bases.
- Handling all communication with MSC and suits/crews
- Ensuring that the telemetry streams (incl. robotic videos) arrive at the Base Camp.
- Informs crewmembers about incidents (e.g. high CO2-level in the Aouda.X telemetry – inform DOC and SAFETY X-RAY for confirmation and action.)

6.4. On-site Safety expert / Paramedic (SAFETY) & DOC

The On-Site safety was an Emergency Medical Technician (with an active first aid license, preferably > EMT-B level) at the field trip site for team and crew health related issues. From the

medical perspective, he/she supported the DOC, including support for all issues relating to crew health and medical data management, including real-time monitoring and real-time conferences. The SAFETY also provided support regarding medical or life science payloads, hazardous operations and medical policy making during the field campaign. SAFETY maintained the on-site safety equipment (fire extinguisher, first aid kit, medication etc.), and was also responsible for fire and chemical/Hazmat-safety.

DOC was the expedition medical doctor. He usually was not tasked with the role as SAFETY (to be available to all expedition team members anytime) if both suits are operating at different locations. DOC was also the “extended-arm” of the biomedical research teams, conducted their experiments and was also responsible for issues w.r.t. hygiene.

SAFETY - together with the DOC - was also responsible for assessing crew member’s psychological health and directed psychological experiments.

If there are two suits being operated at different locations >500m apart, there were two SAFETY, designated as “SAFETY X-RAY” (for Aouda.X) and “SAFETY SIERRA” (for Aouda.S).

SAFETY/DOC were both roles with a high responsibility: although usually EVA’s are safe and non-critical, the situation could have changed any moment.

Daily tasks SAFETY/DOC

- Medical checks of on-site crew, especially the suit testers ; coordinating with BME with respect to crew health and providing input for flight plan generation
- logging and transmitting medical data to BME
- taking pictures of suit tester shoulders (check for bruises)
- dispensing medication or providing first aid as needed
- assessing the safety of EVA activities at any given moment. Therefore, both DOC and SAFETY have the right to abort any activity deemed unsafe.
- transport all safety equipment (fire extinguisher, first aid kit) to any place where the suit tester is active
- organize transport of any injured personnel to local doctors/hospital

6.5. Quartermaster

The expedition’s quartermaster was the person responsible for managing supplies and field camp housekeeping. In cooperation with DOC he/she was also maintaining hygiene. Tasks included:

- Maintaining an overview on all consumables, such as water, food, gasoline, etc.
- Managing the car and Quadbike-pool (fuel, tires, keys)
- Managing the general housekeeping, such as cooking, generator refueling, toilet cleaning, shopping, etc, e.g. by requesting crew members to perform these tasks.
- Assisting in scientific, technical maintenance (e.g. Aouda or rover repairs) and media activities.

7. Flightplan

The flight plan was based upon an hourly roster for each field crew member and commentary fields for events. It was coordinated by FLIGHTPLAN and was finally approved by FLIGHT. The preliminary flight plan reflected the on-site activities, 2 crewmembers are permanently staffing the BASE.

Planning and Traverses were provided. The first 2 weeks were the most interesting ones in terms of challenges to be overcome. In the end planning and execution went rather smoothly. Most critical situation was free day when discussion Station Payer scenario. Highlights were the discovery of caves, the call from ISS and Station Payer scenario.

7.1. Decision making processes

The final authority was the Flight Director, if he cannot be reached, the Flight Director Assistant has full authority. For health related matters, the BME had the final responsibility, whereas the FLIGHT decided if it was a medical issue.

The Flight Directors are:

Norbert Frischauf

Alexander Soucek
(Deputy Program Officer)

Christoph Ragonig

The Flight Director Assistants were Michael Taraba and Willibald Stumptner.

Schedule changes were to be authorized by the Flight Control Team, comprised of

- FLIGHT, BME, Flight Plan Team, SCIENCE, Rover & Aouda operators

The Flight Plan for MARS2013 consisted of three parts; the Mission Plan, the Activity Plan and the Traverse Plan.

- **Mission Plan**

  The Mission Plan was a rough pre-mission schedule including all field activities, in-sim as well as off-sim. It allocated certain activities to certain days of the mission without going into too much detail or allocating exact times. The Mission Plan served as a basic structure for the later Activity Planning and evolved during the whole planning process

- **Activity Plan**

  The Activity Plan was a detailed schedule for all field activities including all necessary resources. The Activity Plan was created shortly before and during the mission for each day of the mission, allowing for changes and replanning events.

- **Traverse Plan**

  The Traverse Plan identified the optimized traverses between two experiment locations regarding safety, efficiency, scientific interest and velocity.

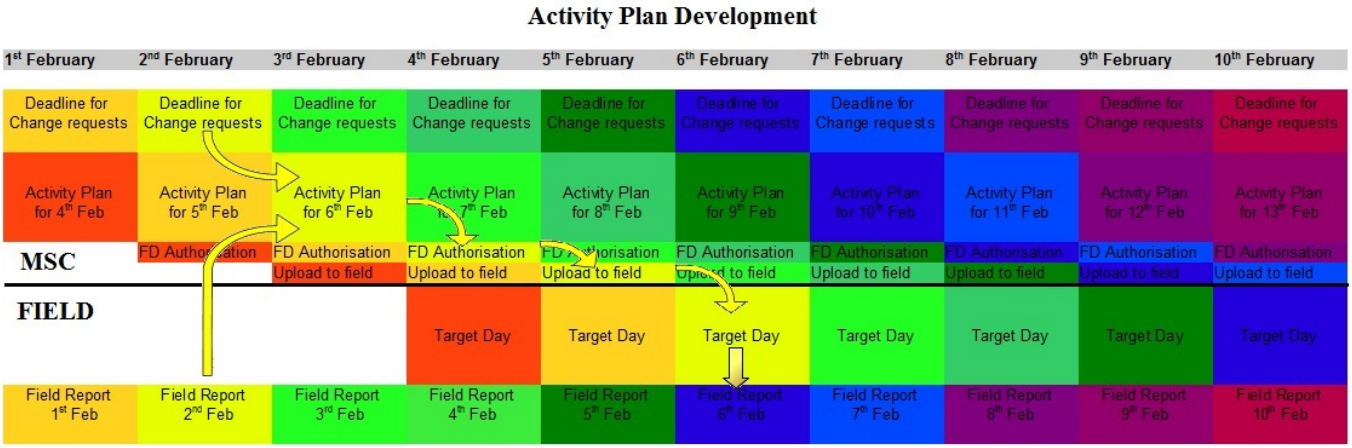
The Planning Strategy for MARS2013

Due to the simulated time delay of 10 minutes one-way for communication between the BASE in Morocco and the Mission Support Center in Innsbruck, a real-time planning response (i.e. directing the suit tester from MSC, adjusting the Activity Plan in real-time to changes, etc) as it was done in earlier OEWF missions was not applicable.

The Activity Plan was authorized and finalized by the Flight Director at least two days in advance, leaving enough time to change the Activity Plan in case of serious concerns or safety issues as presented at the Pool Party.

The Activity Plan for each day of the mission was then sent together with the corresponding Traverse Plan as an Activity Package to the field crew the day before its execution.

The field crew was given the full autonomy to conduct the planned tasks without directions from the MSC. In the evening of each day a detailed report from the field was sent back to MSC including the day's events, which served as inputs to the next Activity Plan.



Polling

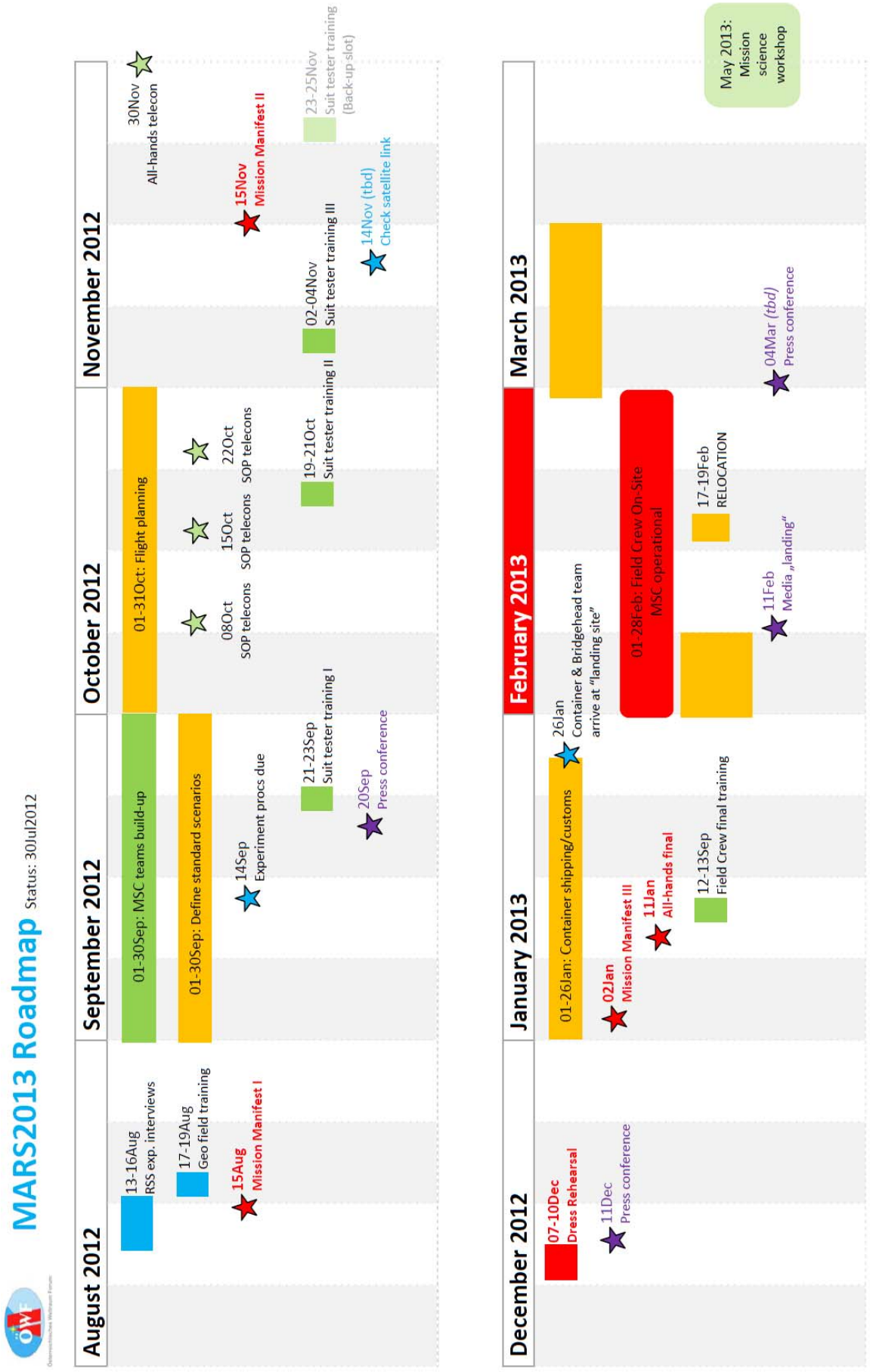
Before the start of any major activity, FLIGHT had to give his final "Go/No Go" for the activity. This decision was preceded by a "polling", where the console operators were asked for their attention, readiness and go/no go decision. E.g. for EVA's, the polling includes: BASE, SAFETY, SUIT, FLIGHTPLAN, BME**.**

EXLEAD was than authorized to actually commence the activity.

Pool Party Approval

At the end of each Pool Party, the team leaders gave their final Go/No Go for activities to be carried out the next day.

7.2. Project Roadmap



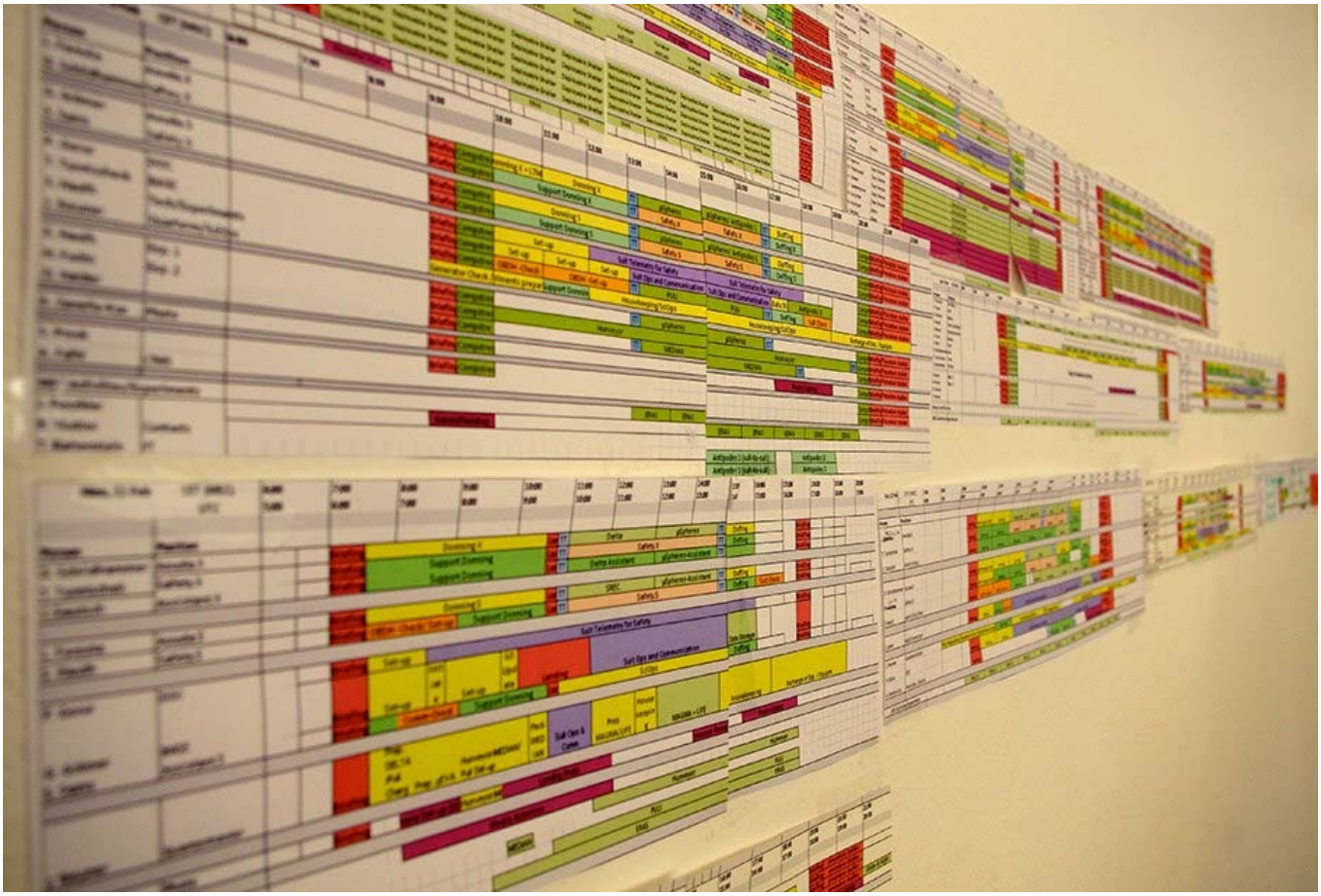
7.3. Flightplan

This Mission Plan served as a rough preliminary schedule for the later planning stages of the Mars 2013 Flight Plan. Please note that there are not yet specific times or resources allocated to the experiments, since this will be done during the future planning process in more detail. Please note also that the allocated timeslot (morning/afternoon) are not yet fully fixed and are likely to vary in later versions. The OEWF will not be responsible for experimenters who have planned their travels to Innsbruck according to this plan as this is a working version and is likely to change.

How to read the Mission Plan:

The Mission Plan extends right now over the four weeks of Simulation activities (Preparation and Break-down days will be included in later versions).

1. The first week is dedicated mainly to Media activities. Experiments planned during this week are likely to not be able to conduct all necessary samples/runs due to the presence of camera teams. That is why these experiments will have enough time allocated in the later weeks to conduct all their samples successful. Since the actual suit testers will enter the Base Camp by the 2nd and be operational by the 3rd, the first two days will be mostly equipment checks with both of the Aouda suits and a backup suit tester.
2. The second week is completely dedicated to scientific experiments, except for the 9th and the 14th which are kept free for crew recreation. Exceptions would be urgent issues or delays in the schedule or severe repair activities.
3. The third week is a short scientific week due to the three days allocated for the relocation of the camp from the Northern to the Southern landing-site.
4. The fourth week starts with a free day, again only to be used for urgent issues. The rest of the week, scientific experiments will be conducted at the Southern landing site. Several days are planned as “left over's” i.e. kept free to repeat experiments that have not yet collect enough data. The last two days will again be governed by the starting of the packing process and therefore encounter lower manpower available for experiment activities.



The colour coding:

- **Yellow**: The yellow marked days are the days dedicated for preparation or already beginning break-down activities and therefore less manpower for experiments will be available.
- **Red**: Red coloured days are due to the relocation from the Northern to the Southern landing site. These days will not be planned for scientific operations.
- **Black**: days to be kept free as “days-off” for the crew, if possible. These days will only be allocated to activities, that have not been able to conduct the days before, or for severe repair activities.
- **Green**: Activities with the Aouda.X. (Light Green: Aouda.X suit testers during non-EVA-time)
- **Turquoise**: These are activities to be conducted with the Aouda.S.
- **Pink**: Activities conducted by field personal without the use of the suit or the training gloves
- **Blue**: These activities are to be conducted by field personal with of the training gloves.
- **Orange**: These activities have to be done by everyone in the field.
- **Greyish Purple**: These experiments are to be conducted at the MSC.

Experiments and Abbreviation:

Antipodes	Antipodes Comm experiment (KiwiSpace Foundation & Eurogeomars)
AMFS SEG	Part of the MATEP ensemble (Medical University of Innsbruck)
CLIFFBOT	Cliff Reconnaissance Vehicle (Association Planète Mars)
COMPSTRESS	The COMPSTRESS experiment ensemble (Medical University of Graz)
DELTA	The DELTA experiment ensemble (Austrian Space Forum)
Deployable Shelter	Deployable Shelter (Technical University of Vienna)
ERAS	The ERAS C3 module (Italian Mars Society)
GEOSCI	A set of geological sample collection (Austrian Space Forum)
Hunveyor	Hunveyor (Óbuda University, Hungary)
LIFE	LIFE (Institute of Ecology University of Innsbruck)
MAGMA	The MAGMA 1 to 3 experiment ensemble (Polish Mars Society)
MEDIAN	MEDIAN (University College London)
µEVA	NASA JPL contamination experiment
Puli	The Puli Rover Experiment (GLXP Space Technologies)
SREC	SREC (Association Planète Mars) – the trafficability exp. with rovers

The detailed Flight Plan is given n the OeWF Multi-Mission Data Archive.

8. OEWF Team Roster

Name	Week 0: 26Jan-01Feb	Week 1: 02-09Feb	Week 2: 10-16Feb	Week 3: 17-23Feb	Week 4: 24-28Feb
Flight Directors					
Alexander Soucek		FD	FD	FD-A	
Norbert Frischauf					FD
Christoph Ragonig				FD	
Michael Taraba			FD-A		
Willibald Stumptner					FD-A (21-28Feb)
Flight Control Team					
Alexander Karl				**Flightplan**	**Flightplan**
Sebastian Hettrich			**Flightplan**	Flightplan	Flightplan
Alejandra Sans		**Flightplan**	Flightplan		
Reinhard Tlustos			Contacts	Records	Contacts
Eva Hauth	Bridgehead	Bridgehead			
Daniel Föger		Capcom			
Tilo Kauerhoff			MSC-Flight Ops	MSC-Flight Ops	MSC-Flight Ops
Jan Klauck					
Petra Sansone	*Psychological Support / Std-by*				
Barbara Ramirez			Records	Flightplan	Flightplan
Quentin Scornet			Flightplan	Flightplan	Records
Nina Sejkora		Flightplan	Flightplan		
Leila Ghasemzadeh					Capcom
Aline Dinkelaker		Fpln (06-13Feb)			
Isabella Pfeil		Flightplan	Flightplan	Capcom	Flightplan

BME					
Thomas Luger, MD	Bridgehead	**Brdghd / BME-Lead**	**BME-Lead**	**BME-Lead**	**BME-Lead**
Egon Winter, MD				BME	BME
Robert Terlevic			BME	BME	BME
Ernst Toferer, MD		BME		BME / Bckground	
Markus Luger, MD			BME / Bckground		BME / Bckground
Andrea Stadler	BME Docu	BME Docu	BME Docu	BME Docu	BME Docu

Remote Science Support					
Linda Moser				RSS / Geo	RSS / Geo
Csilla Orgel		SCIENCE	SCIENCE	RSS / Geo	RSS / Geo
Anna Losiak		RSS / Geo			
Thomas Bartenstein			RSS	RSS	SCIENCE
Isabella Achorner			RSS / Geo	RSS / Geo	
Jane McArthur			RSS / Geo + Exp	RSS / Geo + Exp	
Andrea Boyd		Field	RSS	SCIENCE	
Steffen Wittek		*Remote*	*Remote*		
Natalie Jones			MSC-Flight Ops	MSC-Flight Ops	
Mike Rampey			**RSS-Lead**		

IT / SDO					
Harald Fuchs	Bridgehead	Morocco Set-up	**IT/SDO**	**IT/SDO**	
Roberta Paternesi		Morocco Set-up	IT/SDO		
Stephan Gerard		IT / SDO	IT / SDO		
Wolfgang Jais		IT / SDO			IT / SDO
David Fasching				IT	IT
Thomas Bartenstein			IT	IT	IT
Josef Radinger				IT	IT

Ground Support & Media					
Olivia Haider	Bridgehead	Morocco Set-up			Media
Monika Fischer			Mediaday only		
Petra Groll			Mediaday only		
Matthias Schmitt			Media	Media	Media
Jarno Peschier		Media/Social			
Andreas Kjeldsen				Media/Social	Media/Social
Oana Sandu		Media/Social	Media/Social	Media/bckgrnd	
Daniela Scheer		*Backgrnd Support*	*MediaCom*		
Jan-André Soraru		*Backgrnd Support*	*Backgrnd Support*		
Gerhard Groemer		Photo/Media	Media	**GS** / Photos	
Arnold Sams		**GS**	**GS**		
Bianca Gubo		GS / Mediateam	GS / Mediateam		
Silvia Prock		Mediateam FIELD	Media Suppprt		
Claudia Bothe		*Backgrnd Support*	*Backgrnd Support*		
Muhammad Shadab Khan			Support India	Support India	

The following people were present in the field:

		Arriving in Marrakesh	Arriving at BASE
Car 1 (4WD)	**Gernot Groemer**	26Jan2013, 14:10 RAK, get car & stay 1 night	27Jan2013, late afternoon
	Olivia Haider		
	Katja Zanella-Kux		
Car 2 (4WD)	**Stefan Hauth**	26Jan2013, 14:10 RAK, get car & stay 1 night	27Jan, evening or: 28Jan2013, morning
	Eva Hauth		
	Thomas Luger		
Car 3 (4WD)	**Harald Fuchs**	26Jan2013, 14:10 RAK, get car & stay 1 night	27Jan, evening or: 28Jan2013, morning
	Sebastian Sams		
	Julia Neuner		
Shuttle (no 4WD, >8 seats, + driver)	Andrea Boyd	01Feb2013, 17:50 RAK, stay 1 night	02Feb2013, late afternoon, pick-up in Erfoud by Brideghead
	Luca Foresta		
	Alain Souchier		
	Silvia Prock		
	Daniel Schildhammer		
Public Bus	Christoph Gautsch	09Feb, stay 1 night	10Feb, late evening
Car 4 + Car 5 Depl.Shelter PULI	Thomas Turetschek	03.Feb.13	04Feb2013, late afternoon
	Polina Petrova		
	Kristoffer Stefan		
	Robert Pitschadell		
	Nikolaus Gutscher		
	Zuzana Kerekretyova		
	Zoltán Molnár/PULI	03.Feb.13	04Feb2013, late afternoon
	Péter Benedek /PULI		
	Paavan Gurur		
Car 6 ServusTV	ServusTV/Joachim Walther		02.02.2013 evening
	TV-Team Servus TV 2		
	TV-Team Servus TV 3		
Car 7 PSNC POLAND	Alexandra Krawiec		02.02.2013, evening
	Cezary Mazurek		
	TV-Team PSNC Poland 3		
Car 8 BayernAlpha	Norbert Frischauf		06.Feb
	Gert Baldauf		06.Feb
			06.Feb

Car 9 MAGMA	Mateusz Jozefowicz Sebastian Meszynski robwoj89@mat.umk.pl	03.02.2013 arrival in Casablanca	04.Feb
Car 10 CSEM	Abdessamad FALHI	05Feb	

The departures from Camp Weyprecht were as follows

		Leaving ERFOUD	**Arriving in Marrak.**
Car 1 (4WD)	**Gernot Groemer** Sebastian Sams Luca Foresta Katja Zanella-Kux Christoph Gautsch	01Mar2013 morning	01Mar2013 evening, return car
Car 2 (4WD)	**Stefan Hauth** Julia Neuner Paavan Gurur Thomas Turetschek Daniel Schildhammer	01Mar2013 morning	01Mar2013 evening, return car
Car 3 (4WD)	**Harald Fuchs** Eva Hauth Thomas Luger Olivia Haider	08Feb2013 morning	08Feb2013 evening, return car
Shuttle (no 4WD, >8 seats, + driver)	Alain Souchier Silvia Prock	08Feb2013 morning	08Feb2013 evening, return car
Car 4 Depl.Shelter	Nikolaus Gutscher Polina Petrova Kristoffer Stefan Robert Pitschadell Zuzana Kerekretyova	08Feb2013 morning	08Feb2013 evening, return car
Car 5	Zoltán Molnár/PULI	08Feb2013 morning	08Feb2013 evening,

Puli	Péter Benedek /PULI		return car
Car 6 ServusTV	Servus/Joachim Walther	08.Feb	
	TV-Team Servus TV 2	08.Feb	
	TV-Team Servus TV 3	08.Feb	
Car 7 PSNC POLAND	Alexandra Krawiec	08.Feb.2013, morning	
	Cezary Mazurek	08.Feb.2013, morning	
	TV-Team PSNC 3	08.Feb.2013, morning	
Car 8 BayernAlpha	Norbert Frischauf	08.Feb	
	Gert Baldauf	08.Feb	
		08.Feb	
Car 9 MAGMA	Mateusz Jozefowicz	07.Feb	08.Feb
	Sebastian Meszynski		
	robwoj89@mat.umk.pl		
Car 10 CSEM	Abdessamad FALHI	07Feb	

9. Daily Mission Summaries

02Feb2013

Main items from today:

- MSC first day in operational mode with stations occupied except RSS, SCIENCE, BME.
- Situational awareness from field is excellent and we thank BASE and SciOps for a great job today.
- Science data transmission successful at 1806UTC. Antipodes A123-1 successful via lunarsat server. VPN work in progress.

03Feb2013

MSC second day in operational mode with all stations occupied. Records file log fully established. Situational awareness from field was again excellent. Voice comm was fine throughout the day. Main unforeseen event was the abortion of A.X EVA at due to battery problems. Later also A.S reported battery problems, besides problems with ATV usage discomfort. The cable issue for A.X seems to have been fixed in the afternoon. Pls see below Pool Party action. MSC IT worked on establishing VPN connection for Antipodes but without success so far. No solution has been found so far to allow MDRS and Aouda suits to connect directly. We are in contact with Wellington to assess what that means for Antipodes-3 on 08Feb. Progress from the Sat Dish issue: both M. Usatov and GG Ori got going and we have exchanged 6 emails today; Ori will contact airport customs tomorrow again. sat dish should be physically there.
Science data transmission ongoing at the moment (27MB received). Next MSC morning briefing 0800UTC04Feb2013. RSS now with 3 people and SCIENCE as of tomorrow (wo)manned with Csilla. Hunveyor PI present at MSC.

Fresh from the Pool Party:

RSS team has requested that Suit testers after EVAs in the evening give a short log on items of special interest for mapping purposes (danger zones, etc.). RSS is working on a micro_procedure and Flightplan will build-in 15-30min slots for the coming activity plans post 04Feb.

Pool Party has discussed Activity Package for 06Feb.

ACTION: We would like to ask you to send a short summary log on status of battery problem(s) to MSC before MSC morning briefing tomorrow. Please send it to this email.

04Feb2013

MSC third day in operational mode.

The main event today was the abortion of the Aouda.X EVA (Luca Foresta) after only one hour due to exhaustion, after a code yellow had already been triggered by MSC. Several open questions and concerns surrounded this situation, which is why it was decided to write the "Field Problem Investigation Report #1" (please refer to this document for further information). Luca then slept the entire afternoon which is a hint that it was indeed a wrong decision to charge him with A.X today, overriding today's flight plan which foresaw Gernot Grömer for that task, and that it was not the execution of the DELTA experiment that led to this situation. The situation triggered for the first time higher stress levels for FCR staff.

Aouda.S performed a successful day with geoscience, SREC, MEDIAN and media activities. No high fatigue levels were reported and MSC could witness Daniel in good mood throughout this rather long EVA. Good CONTACT / SREC PI interaction to get an updated questionnaire near real time to field (implemented by SciOps/A.S right away). Also, HUNVEYOR was activated for the first time.

The day brought several lessons learned and gave a first practical hint on the complexity of this mission.

Fresh from the Pool Party:

The Pool Party was held from 1900 to 2005CET, the first time with EXLEAD participating via mumble, which proved very helpful for situational awareness. The EVA abortion situation was discussed and both sides took the opportunity to complement their point of view with the tale "from the other planet".

After a short debate it was decided, based on FD & BME advice, to rest both Luca (unclear situation of today) and Gernot (back ache) for tomorrow, meaning to refrain from SIERRA activation on 05Feb. Daniel will be the suit tester for XRAY but to mitigate him being over-exposed, too, it was decided to shorten his EVA. See below for details on the changes introduced in the flightplan.

In addition it is suggested (via tomorrow's flightplan) to introduce evening slots were experiment procedures shall be trained are re-visited, since both DELTA and SREC today had minor flows (like using the wrong questionnaire for SREC).

Tomorrow will be the first school visit at MSC and the first MAGMA run.

RECORDS was staffed twice now with Jarno Peschier who asked for a replacement for 05Feb since this position is very demanding. This is to be considered in the future and may result in the introduction of half-day shifts for RECORDS.

05Feb2013

This day was very positive, with a long A.X EVA (Daniel) that successfully collected the first sampling data for DELTA and undertook the first MAGMA experiment. Daniel was in good mood over the whole duration of the EVA and showed high compliance.
A problematic issue was discovered with clear signs of an imminent permanent failure of the Solid State Drive of the Aouda.X OBDH. BASE and IT worked excellently together in trying to find a solution but it looks as only a larger SSD size can be organized in time for transport in the filed with Ch. Gautsch on 09Feb. Technical discussions are ongoing and it is suggested to write an Invstigation Failure Report on that item tomorrow for reference.

MSC again had excellent situational awareness. Within MSC, tiredness was setting in today, after yesterday's stress level and an overall exhaustion. Working shifts need to be better recognized also for MSC in general, not only for the field, and the lesson learned to perhaps have FCR shifts like suit tester shifts (e.g. 2 days duty one day off) was logged. Field is working under a very high workload and also here the first "black day" will be very welcome.

Fresh from the Pool Party:

The Pool Party was held from 1830 to 1900CET, with EXLEAD Deputy participating via mumble. The main items discussed included:

- Code Yellow: The threshold of HR150 led to repeated code yellow declarations. It was decided (DOC-BME) to lift the limit to 160, but even here with physical activity many code yellow declarations are expected whenever stronger physical activity occurs. E. Toferer has written some thoughts around Code Yellow (e.g. to base evaluation on combined HR-CO2), and also T. Luger was reflecting on that. The Code Yellow paper of BME is sent to field tonight for complementation by DOCs.
- Suit testers: The Suit Tester situation becomes critical: Out of only three testers, one can't work (Luca, as ordered by DOC), one needs a pause (Daniel, after several days field work in a row) and one has persisting back ache (Gernot). This shows that such an ambitious

planning with two suits practically all days - even with a good logic - can be too much. See also below.

- RSS: Field is asked to fill out the "map questionnaire" which has been put on the server next to the upload folder.
- MSC has collected a first "psycho logfile", a short personal account of each MSC member of the first days. This will be repeated every 3-4 days.
- The antenna / sat dish issue moved ahead with the custom reference number finally discovered, but is still far from resolution.

06Feb2013

The day started, after the coldest night so far (-1deg) with last minute flightplan change requests from the field, which led to some confusion both in MSC and in the field during the following hours. [It was requested to include the Deployable Shelter for Suit interaction and an extended media slot involving both suits, although only SIERRA was planned for today, triggering a cascade of misunderstandings via textchat that could only be resolved via a mumble call at mid morning (half way into SIERRA donning)]. Such problems would multiply under a 10min time delay in full sim, which is why the issue was given to the Pool Party for discussion.

From a science and media point of view, the day went well, with the first Cliffbot scheduled and executed to perfection by SIERRA (Gernot), The last hour of Cliffbot saw a parallel Antipodes-4, with the planning of MDRS commanding SIERRA through a Cliffbot procedure; because MDRS was not reachable at the scheduled 1400UTC slot, MCC Wellington jumped in, leading to a funny situation when SIERRA thought he would talk to MDRS and did not notice he was connected to the other side of the world. From a technical p.o.v., this A-4 was considered a success (live comm Wellington-Erfoud/Suit), but from a procedural-operational p.o.v. it was considered a failure since MDRS was not ready on time, Wellington was not firm in the procedures and MSC Innsbruck had a "cheat channel" open via Skype to MCC Wellington at all times. FD decided that A-4 shall be repeated, next time with the real MDRS (see also below). The rest of the afternoon saw a power outage in Innsbruck (MSC completely offline for 20min + another 40min w/o internet), a media session in the field with the Deployable shelter, including XRAY (w/o exoskeleton) and a "fade out" of the field deviating a bit from the foreseen flightplan but into a nice sunset...

Fresh from the Pool Party:

The Pool Party was held from to 1900 to 2000CET, with EXLEAD and EXLEAD Deputy participating via mumble. The main items discussed included:

FP changes, especially last minute: MSC has not yet put the three-day ahead planning on the lunarsat server, only on the MSC server, which is now changed and field shall try to give change requests earlier. All agreed that the situation will relax after departure of media teams, however also get more complicated with the introduction of the 10min time delay, which will need a lot of discipline on both sides.

Antipodes: To avoid similar issues than today, MSC will from now on have morning meetings between FD-FP-CONTACT-RSS-IT on days where Antipodes-like experiments are planned, to clarify upfront last remaining issues with external PIs and technical details.

Procedures: there is continued concern by MSC that the field crew is not firm in procedures (e.g., SREC data are useless w/o a picture which by procedure must always be taken with the general recording; while data were received, no image have been received so far from any SREC). To the extent, Flightplan includes now a specific time slot "study of procedures" on evenings. Maybe this time slot offer can be considered by the crew.

The power outage reminded of the importance of having phones charged and ready at OPS-BASE and FD/FDA at ALL times.

07Feb2013

This was the first day with major deviations from the flightplan, autonomously decided and implemented by the field crew after an earlier pre-warning to MSC. The fact that MSC had no clear flightplan to follow made things a bit more difficult on the side of FCR, however also more relaxed, from active control to passive recording (see also below, PoolParty). The Magma experiment, scheduled for interaction with Aouda XRAY, was skipped by the crew since no such need was identified; the fact that neither the Magma team nor the crew knew why a human-machine-interaction was scheduled, whereas the MSC followed Magma procedures in doing so, once again underlined the crucial importance of having up-to-date, clear procedures for each experiment available and known on both suits of the communication chain. This has so far turned out to be a major flow. The day concentrated on Deployable Shelter, especially (again) for media purposes, with both suits in action (XRAY-Gernot from early in the day, joined by SIERRA-Daniel in the afternoon). MSC was alerted by several high increases in CO2 of XRAY, with pick numbers of just below 10.000ppm, and related codes yellow. Later it turned out that the ventilation of XRAY was throttled for test purposes and accidentally left at that level (about 60%). An earlier notification of this throttling test might have avoided unnecessary worries for BMEs – but at least

the control chain was well demonstrated. MSC started to prepare for 11Feb (Media Day), implemented summary reports “in(to) the field” (this time from RSS and FlightPlan) and had a Leberkäseparty. Field prepares for media teams and friends leaving tomorrow.

Fresh from the PoolParty:

The main discussion item was how to handle flight plan change requests:

It was decided to implement as from tomorrow a short daily mumble-based Flightplan Briefing between Field and MSC, to go together through the flightplan of T-2 and T-3 days. This shall be kept short (15min) and include Field (BASE/OPS, SciOps, EXLEAD, suit testers) and MSC (RSS, SCIENCE, FD, IT) functions. This conference call will be called the tminus23. The baseline for flight plan changes has been confirmed as follows: changes discussed at tminus23 will be reflected in the flightplan (new graphical activity plan and DAP version); changes between tminus23 and the target day will only be reflected in a new version if due to major unforeseen medical or technical reasons; any other change like “changes of convenience” shall be implemented by the field autonomously, with warning to the MSC in the morning of the target day and a deviation summary for control purposes at the subsequent tminus23 in the evening.

The second item of importance was the status of science / RSS results so far. It turned out that RSS was not using yet the spot device automatic logging of locations, causing major planning uncertainties – this will be corrected as of tomorrow. Nevertheless, a special RSS-SCIENCE-FIELD teleconference (2030CET) was held in addition to the PP, starting at 2045CET, to clarify various other science-related issues.

IT/SDO discussed with the field the best way of adhering to the data transfer protocol. It was decided that the excel sheet containing the actual information of daily transferred data shall be filled out such that empty fields are avoided. Files not transferred on purpose (e.g. because of the file size) shall be identified.

The Moroccan Minister visit on 09Feb was discussed, and it was decided to have a small team in MSC to be able to set up a possible MDRS/Erfoud/Wellington/Innsbruck comm. The visit will be a highly important event which most likely will not leave space for science or other activities.

08Feb2013

Friday 08 February, towards the end of the preparation week, was the first day to implement the 10 minutes communication time delay. As expected, the delay led to a very different working environment in MSC and required more concentration on the communication stream logic while

having less active control. FCR stations digested this well. The communication discipline was very high; only CapCom and BASE communicated via the delayed text chat. The fact that donning was transmitted in real time audio and delayed text chat simultaneously led to a certain confusion later rectified during the pool party (see below). Today, SIERRA was not available due to technical problems (PLSS, OBDH) which could be successfully repaired during the day. XRAY (Luca) undertook the first microSpheres experiment successfully. The initialisation of Antipodes-3 (with BASE directing MDRS suits using a predefined procedure for collecting soil samples using an aseptic technique) was cumbersome (with the lesson learned that experiments with external entities need *meticulous preparation* incl. time zone clarity, 30min pre-warning pings, etc.); however it worked out at the end and brought a highlight when Erfoud (Mars station 1) commanded Utah (Mars station 2) with passive observation from Innsbruck (Earth).

Positively noted from today:

- *The first time-delayed simulation in the field – immediately full day – was a veritable success.*
- *Communication discipline was very high on both sides, thanks to the concentrated work of BASE and CapCom. Small issues of confusion were sorted out in a professional manner.*
- *Field decided autonomously small deviations from the plan, with doing SREC and DELTA to fill a free time window; this was a useful addition and well communicated.*
- *The first Tminus23 telecon in the evening proved to be highly useful: BASE and MSC looked together through the DAPs of 2 and 3 days ahead (10 and 11 Feb).*

Fresh from the PoolParty:

The time delay switch and in-sim sequence was discussed and the following agreed: Text chat will stay in time-delayed mode for the rest of the simulation month. The donning sequence every day will be transmitted in real-time audio, MSC will listen into the channel; BASE / Suit will report milestones in real time, especially the switch-on of the suit ventilation (fans); this milestones triggers the MSC polling; the information “ready for SIM” will be given by CapCom to BASE in the real-time audio channel and confirmed by BASE right away on audio: thereafter the audio switch to time delay will occur and BASE writes the information “In SIM as of now” in the text chat.

An issue of concern is the amount of forward backward reporting between MSC and Field respectively the little time to properly digest information. MSC-Flight took the action to come up with a more streamlined way of reporting.

Another issue reported by RSS is the confusion in map reading, location coordinates, exact internet coverage (zone illumination) and related geographical information between teams in

MSC and in the field. A 90min science telecon has been held yesterday to clarify things: RSS underlines the need for future missions to have a professional geologist in the field as science relay officer. RSS has also introduced today, with the ok from Flight and EXLEAD, the position of a procedures officer (Lutz Ostkamp) who will be the CONTACT within RSS for content-related issues concerning experiments and their teams.

09Feb2013 / 10Feb2013

Minsterial Visit in the field & MSC Day off / No report

11Feb2013

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12Feb2013

Today started with a clear and sunny sky in the field, after a light sandstorm during the night which did not cause problems for equipment or crew. Field crew shifted WIFI router #3 towards the GESU pathway to have better WIFI coverage during the experiment. According to the flightplan, donning of both suits was commenced on time and thereafter the analogue astronauts (X-RAY Daniel, SIERRA Christoph) proceeded to their respective EVAs (microEVA for X-RAY and SREC, followed by deployable shelter, by SIERRA). The GESU experiment, foreseen for X-RAY afternoon, was cancelled due to low batteries, which means that the time left for finishing GESU in the configuration required by the scientific procedures (each astronaut one complete run in X-RAY) is tight, considering that Flight planners would like to close GESU before the Station Payer relocation. The day also brought a flat tire for one of the ATVs; and the field estimates that from now on only one more microEVA run will be possible due to the consumables running out. An important logistic highlight in the field was the setting up of an alternative satellite dish by the Gendarmerie Royale (GR) today (using the INMARSAT network), later on successfully tested. The day at the MSC was quiet and smooth, with a good working routine. Flightplan worked out five different Station Payer scenarios based on the technical requirements received this morning from the field, and RSS started preparations for the scientific reasoning and experiment selection for the expedition. End of sim was at 1622UTC. The Magma rover team left MSC today.

Positively noted from today:

- *A solid, well-executed baseline day both on Earth and on Mars*
- *The Gendarmerie Royal was also very enthusiastic about the ISS call from astronaut Chris Hadfield. Our liaison officer, colonel Youssef, obviously did a web research about*

the ISS for the first time in his life and is turning into a space enthusiast these days :-) ("Boaaa...Il est plus grand qu'un terrain de football!!")

Fresh from the PoolParty:

The Pool Party discussed the details of "Station Payer". It was decided to go for a 2-day EVA scenario, with one preparation and one "coming home day", i.e. 4 days. Crew and flightplan chose the timeframe Sunday 17Feb to Wednesday 20Feb for the Payer expedition. The Pool Party debated whether DOC shall be part of the 4-persons-team dispatched to the southern location or not; this remains to be finally settled.

13Feb2013

Tuesday 12 February was the first full "nominal" day in the mission, which started however with an anomaly: an EVA abort before even starting the EVA. Since Luca in X-RAY felt slightly unwell at the end of the donning process, right after helmet closure and switch into SIM, but before leaving the tent, DOC decided to proceed to doffing and MSC received the abortion information for X-RAY activities. This affected the planned experiments DELTA and GESU (geosciences new). Since the abort happened relatively early into the day (around lunchtime), MSC recommended to assess the option of making a second X-RAY donning attempt with Gernot in order to send him on a shortened afternoon EVA for recovery of GESU. This was accepted by the field, acting accordingly. After a successful GESU execution, X-RAY upon return to Base announced to still be fit for one DELTA run. Such, the flightplan was recovered, science data returned, and later on field reported that the idea of having afternoon / early evening EVAs instead of the baseline time seems appealing to them. SIERRA (Christoph) was on duty full day, successfully performing SREC. For MSC, the day started with a highly fruitful full team morning briefing (1hr), with Flight outlining his philosophy and concrete actions to implement what he calls "MSC 2.0", the MSC acting as one organism for perfect, responsive and responsible support to the field. The preceding analysis made two lines of actions clear: a) improving the information flow on all levels and b) introducing active flightplan management during the entire day. The actions to reach this goal are: a living Action Item list maintained by Flight & Capcom with read-only access by the entire MSC, an all-team briefing of the information and data (transfer) architecture by IT/SDO, the use of the "pidgeon" chat channel, an improved communication discipline, a daily flighplan management meeting just after the morning briefing, the introduction of the Communications Officer, the matching of FCR stations with the best suited profiles of MSC members. All suggested actions were implemented and this was the best day so far in MSC, with moral and efficiency at highest level. A spider identification was the running gag of the afternoon.

MSC developed the “Station Payer Scenario” (see below). The predicted sandstorm decided not to appear.

Positively noted from today:

- *A new MSC info flow and cooperation discipline with excellent results; compliment to all teams*
- *A very good text chat communication discipline between Capcom and BASE/SciOps with great situational awareness on both sides*
- *A successful response to a medical EVA abortion without compromising science thanks to flexibility of the field*
- *A responsible decision by X-RAY (Luca) and DOC, adhering to the principle “safety-science-simulation”*

Fresh from the PoolParty:

The Pool Party discussed one main item, while purposely deferring the decision to tomorrow: the relocation issue. Relocation is planned for 3 days, starting Saturday 16Feb, while several technical and operational risks remain. In order to suggest a compromise solution, MSC developed the “Station Payer Scenario” (see the related document to field). In short: Instead of a full camp relocation to the southern coordinates, a small station “Station Payer” is implemented there; this could be a single Ops tent for occasional visits and EVAs / outdoor donning-doffing; a transport of a suited astronaut to the southern

location for a day-long scouting EVA; activities without the suit, etc. This Camp-Station scenario would introduce a very interesting alternative, be a “first” in Mars simulations, use the advantages of the southern location without putting the field crew under the stress of a full relocation, relax the flight plan and adhere, by the way, to the NASA Design Reference Scenario 5.0. The Field Crew has signalled positive interest, and it was decided to make a decision tomorrow, after consultation with the Gendarmerie Royale and a night sleep over it. Other Pool Party topics included: the MSC 2.0 approach, the first “Report to field on experiment status” compiled today by CONTACTS/Procedures, the media results of yesterday’s media day and the observation that in future missions the topic “weather” (monitoring, prediction, warning) should get higher attention. MSC/RSS is working on a possible cooperation with meteorological experts teams (e.g. ZAMG) even during the following 3 weeks still.

14Feb2013

The field crew enjoyed their first day off duty in various ways, with a common “gala diner” in Erfoud, escaping the camp for once. At the same time, MSC witnessed a hectic yet rewarding day in the spotlight, with the Wickmedia camera team filming between 1030CET and 1700CET, focussing on actions in the FCR and daily routine shown by selected examples of RSS and Flightplan. Thereafter, MSC members worked on the scientific case for Expedition Payer and on background filing, science data scanning, logfile writing and other issues. As irony of history, the original antenna – lost in the customs area of Casablanca for more than two weeks, has finally been freed and is on its way to Camp Weyprecht – just 24hrs after the Gendarmerie Royale has implemented the emergency solution.

Positively noted from today:

- *The silence needed for all which allowed to relax (field) or catch up with work (field / MSC)*
- *A rare moment of “glory” for many MSC members who work constantly in the background*

Fresh from the PoolParty:

There was no Pool Party today.

Since the Pool Party meetings gradually have grown into cumbersome and too long all crew + half of MSC team meetings of often +1hour duration, FD and FD-A agreed today on a radical change in approach of future pool party meetings. Depending on the opinion of EXLEAD and his team, as of tomorrow the Pool Party will be either a) a meeting between FD, FD-A, EXLEAD and EXLEAD deputy only, or b) have a maximum length of 20min in the configuration suggested by the SOP 3.3 with a highly focussed approach. This shall answer critics about discussion proliferation and it should also help to allow staff on both sides to return earlier to their duties. On top, since the Pool Party certainly is outside the simulation scenario, a more personal approach could be an option to create better mutual understanding.

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16Feb2013

It was a busy day: Two separate X-RAY EVAs, one following the other, to get two analogue astronauts (Daniel and Luca) to perform their GESU experiment runs at the predefined location. In conjunction with tomorrow's GESU by Christoph, this experiment can be soon closed at the northern location. (SIERRA was not in operation.) Both astronauts, the BASE and CapCom did an outstanding job today, following the flightplan meticulously, executing the experiments to perfection and communicating fast and efficiently. MSC stations cooperated well. RSS gave an extensive mid-term briefing of work performed so far, despite manpower problems; the central piece of (on-going) work is the Master Map, a GIS-based living document that is fed every day with executed traverses and data collected. This shall later be integrated in the SDA. Flightplan elaborated four possible scenarios for Expedition Payer which were sent to the field for comments. It can be summarised that today the complex Earth-Mars-machinery was working to its best. The free field day yesterday was more than necessary for an overworked field crew. And as far as MSC staff is concerned, today ended with a pizza evening and inspirational late night hours watching "Apollo 13" all together – realising how close our mission has come to "the real stuff".

Positively noted from today:

- *Field-MSC interaction going like a clockwork from morning till evening*
- *Precise experiment execution and good scientific return*
- *Communication patterns (e.g. suit-BASE and BASE/SciOps-MSC) getting better and better*

Fresh from the PoolParty:

Today both sides implemented the first “Pool Party short”: only EXLEAD and EXLEAD deputy at base and FD, FD-A and BME at MSC. Time limit was set with 20min and almost reached (25min). This way is a much more efficient way of communicating and resolving open issues. The four PAYER scenarios developed by FP this afternoon were not discussed since the field crew did not have the time to properly assess the document; however, the MSC explained the requirements under which DOC could remain at Camp Weyprecht: minimum one expert paramedic available for station PAYER at all times (unsuited), a secure telemetry / communication feed, the consent of DOC and an information of the helicopter basis of the expedition PAYER and its location. The solution of the LTMS signal problems (wrong application) was communicated to the field. EXLEAD communicated a serious of issues to MSC, such as the fact that future Flightplans should consider the fixed locations of Hunveyor and MEDIAN, the procedure applied for LIFE (sampling outside and laser examination at camp in the evening), etc. Both sides were very happy with this efficient day.

17Feb2013

Today at 12.00 the expedition crew to Station PAYER left Camp WEYPRECHT led by Sebastian Sams as commander, accompanied by Christoph Gautsch, Katja Zanella-Kux and Luca Foresta. They moved in the camp prepared by the Gendarmerie Royale and reported via INMARSAT that the infrastructure and the guarding by the Gendarmerie is as perfect as in Camp WEYPRECHT.

Today the MSC had it's day off, which means, many people still in MSC working, but in a very relaxed mood. Also FD Alexander Soucek was preparing to leave Innsbruck, FD-A Michael Tarabaalready left in the morning. The new FD Crew FD Christoph Ragonig and FD-A Willi Stumptner arrived this morning and were briefed during the day for the upcoming week. The day off for the MSC was very well received by the people working here. We were curious on when and how we would hear from the expedition of Station Payer and were happy to hear from them at 17:19 local time.

Positively noted from today:

- *Day off for MSC was a good thing for the people here!*
- *Hand-over from former FD Crew.*
- *Flawless transfer to Station PAYER*

Fresh from the PoolParty:

A problem with the power supply of the MEDIAN is arising, as the batteries are getting empty one after the other and the are not “standard” ones with 1.5V which means they can not be easily replaced. We will check with the PI whether to substitute the current batteries or on how to proceed with that problem. Bags for MASC in Station PAYER are quite limited(26pcs), the fieldcrew will check to get more bags locally.

18Feb2013

Highlight of the day was a whole day EVA at Station PAYER executed by analog astronaut Luca, supported by Christoph, Katja and Sebastian. He collected dozens of samples at 15 different locations near and in a small valley. Station Payer is in a very hilly area with quite rough terrain, which was a challenge for the communication infrastructure (solved by placing enough WiFi stations to ensure sufficient coverage). Wind speed picked up significantly and could be felt for most of the duration of the mission, but did not impede the execution of the mission.

Camp Weyprecht in the north experienced a sand storm of moderate proportion, with very strong winds that occasionally made breathing difficult without mask to help against the sand. They continued their tests with the CLIFFBOT at three different locations, finding several caves in the cliffs (some quite large and others inhabited by animals or their skeletons!). The MEDIAN experiment was serviced and they did running engineering tests. The high winds made the planned gas release and detection experiments impossible today. The HUNVEYOR experiment still has an inoperable upper equipment platform. Four runs with the DELTA equipment have been done. More data has been collected using the YELLOW box. The second satellite dish is being prepared and should be operational tomorrow. A new team member (PhD student from IBC) arrived today – she will especially look into the number of meteorites in the desert around Camp Weyprecht.

Operations at the MSC were running smoothly, with new team members being guided by the “veterans” and learning the established routines and protocols. A known problem with “loss of communication” followed by a 10 min waiting period for reacquiring audio and video has occurred repeatedly.

Positively noted from today:

- *Great science return from Station Payer*
- *RSS Master Map being improved with data from the new southern location*
- *Station Payer "Pressurized Rover" exploration scenario works very well so far*

Fresh from the PoolParty:

Pool party was a bit longer (1 hour) compared to the last days, due to the number of points that needed to be discussed. An ORF camera team will visit the MSC tomorrow and will interview the astronaut at Station Payer (with time delay). The procedure to conduct this interview was discussed. A lot of equipment maintenance and data preparation tasks will be scheduled in the next days. To enable PULI operations on the 20th, the DAP 20 will be significantly scheduled. A fast car will drive south to Station Payer and grab the WiFi infrastructure needed for rover operations on the 20th.

19Feb2013

Austrian National TV (ORF Tirol) visited the MSC today, doing an interview with Christoph Gautsch in Aouda-X spacesuit at Station Payer under full time delay conditions. Afterwards more interviews (with Flight Director Christoph Ragonig and RSS mission specialist Robert Terlevic) were conducted and a tour of the facilities was filmed. Meanwhile Reinhard Tlustos was giving a tour of the MSC to a group of visitors. The interview should be available on the ORF website as a streaming video soon.

Station Peyer and Camp Weyprecht experienced their first raindrops during the mission. Which makes it official: ÖWF teams bring the water of life to even the most parched deserts. Station Peyer spent most of the day collecting rock and soil samples on foot and by ATV (unsuited), driving larger distances away from base station compared to yesterday. A photo shooting session wrapped up their daily tasks. The day ended with light rain.

At Camp Weyprecht a lot of (unsuited) work with Cliffbot has been achieved. It has been communicated to the flightplanning crew that future Cliffbot experiments only need to be staffed with two people. More error analysis has been done on the MEDIAN and HUNVEYOR experiments. MEDIAN is running on the second and last battery package. Once again high winds occurred in the north.

Positively noted from today:

- *Quiet day at MSC allowed to catch up with data archiving tasks, writing reports, article drafts and abstracts for science presentations*
- *Rudi Albrecht reports great interest about MARS 2013 from the UNOOSA/COPOUS meeting in Vienna (follow up actions are already planned, based on the interest for more information expressed there)*
- *Amount of science data coming from the field rising every day*

Fresh from the PoolParty:

The location of the WiFi stations has been discussed. It has been decided that MSC only communicates area of coverage needed and the placement of the transponders is decided by the field crew based on assessment of the local terrain. The logistics of moving the Ops Box and the necessary experts to the north on Day 20 was discussed and slightly changed (Sebastian drives north, Daniel stays south and helps packing up the rest). Day 20 will be done mostly out of sim to help discussion during equipment maintenance (only afternoon science session IN SIM)

20Feb2013

The team at Camp Weyprecht experienced a stormy and almost sleepless night due to very high winds. Fortunately no significant damage occurred to the base infrastructure. Station Payer was packed up and transported back “home” during the day. A two person team from Camp Weyprecht came down south to pick up the OPS-Box first and quickly drive it back north before the rest of the equipment. The WiFi capability of the OPS-Box made it possible for the PULI rover team to run the machine through manoeuvres and tests throughout the afternoon. Many repair and maintenance tasks were successfully accomplished today on such experiments as LIFE, MEDIAN or HUNVEYOR. With limited transport capability for most of the day and the Station Payer team arriving late in the day, the planned Cliffbot and DELTA activities were cancelled, which also allowed the team to get some much needed rest after the howling wind in the night. That also means that today was out of sim for the whole day, which greatly improved communication between MSC and Field during maintenance tasks.

Positively noted from today:

- *Delicate repair and maintenance work can be done in the field even under challenging conditions. On-the-feet-problem-solving with improvised materials scavenged from the camp (e.g. dust free “clean room”) can ensure extended lifetime and improved data quality for various experiments.*
- *Watching an ORF Tirol report about MARS2013 via life stream in the MSC*

Fresh from the PoolParty:

Engineering sheet usage will start tomorrow (GPS units to be added to the list). ERAS PI will get biomedical data only after obtaining an Ethics Committee permission. An estimate of the workload needed for breaking down the camp at the end of the mission was discussed. The cave exploration will take place without the Cliffbot, only using the IR camera.

21Feb2013

Today started with a simulation day for both suits, Aouda.X and Aouda.S doing Delta, SREC and LIFE experiments. In parallel a doffed YELLO was conducted by Stefan Hauth. Experiments went well till the afternoon when Aouda.X lost telemetry and - as there was no time left for resetting Marvin - the Fieldcrew decided to abort the actual Delta run. Right after the decision Aouda.X also lost power to the fans, so the suit returned to base with helmet open.

Almost at the same time BASE contacted MSC via Realtime communication that Daniel Schildhammer had an accident with the Quad bike during an SREC session a few hundred meters away from Base. Simulation mode was immediately aborted and - as it was reported that Daniel wasn't injured - FD decided not to call it a code Red at this time. In parallel Doc immediately moved out to check on Daniel. Doc also reported that Daniel is not injured. They safely drove back to Base and a more comprehensive check was done. A time-line of the event was written down in MSC and filed. In addition the audio-stream in the aftermath of the accident was recorded and filed, so we can quite clearly reconstruct what was happening. Luckily the accident happened at a very low speed. After the medical check Daniel was released back to work again. Doffed Delta and doffed Deployable Shelter experiments were conducted afterwards.

This accident reminds us to stay alert and concentrated all the time!

Positively noted from today:

- *The emergency procedures in case of accident worked well today*
- *Complex multi-suit, multi-location work was executed well*

Fresh from the PoolParty:

During the accident the Field was under impression that a Code Red was called by the Flight Director. This was not the case, as FD already knew that no one was injured and declared a “going-out-of-sim” instead of a Code Red. EXLEAD suggests achange to calling a Code Red (stating it twice via Mumble and Chat so that everyone is crystal clear if an emergency situation

was declared). A detailed “Lessons learned” report about the incident will be compiled with input from the field and MSC.

The new revised DAP showing designated WiFi coverage areas was well received by the field team. The field then choses the actual locations of the WiFi stations and reports them back to the flightplanners.

22Feb2013

Today is a day off both for the field and the Mission Support Center.

Positively noted from today:

- *For such a long duration simulation its important to plan some recreation days, so people can get some much needed rest and recharge their inner batteries. Gives them also time to check on all the small aches and private housekeeping duties that came up.*

Fresh from the PoolParty:

No pool party today. FLIGHT and EXLEAD did a short phone conference instead.

23Feb2013

Reinhard Tlustos & Lukas Fritsch visited an exhibition in Hall Salzlager called 'Hall Aktiv'. Dignity Rover, Space for all senses were presented to 400 visitors, mostly children. It was well received and several people knew about MARS2013 and asked about it.

PULI and MAGMA were conducting joint operations for 2.5 hours under duststorm conditions, gaining a lot of experience in maneuvering in tandem and filming another rover in action. Manned operations were greatly hindered by high winds and an even higher dust loading. Dust was blown into the suits via the ventilation systems and an early doffing was approved by FD. The planned SREC und Delta experiments in the suit had to be cancelled. Even the DELTA experiments without suits and the relocation of the WiFi stations were not possible in these weather conditions.

However the planned exploration of the cave to the north was successfully achieved.

Positively noted from today:

- *Great interest from the young audience in Tyrol.*

- *Joint rover operations – even in challenging conditions – were a success*

Fresh from the PoolParty:

Flight Plans asks to get from the field each day on one page a list which experiments were conducted, so that RSS and FP would not have to read the whole log file to get an overview of the experiments performed.

Slight adjustments regarding procedures for LIFE and Cliffbot.

Discussed the much changed new version of the DAP for tomorrow and told the field to let us know in the morning if they could not sleep in the night because of the noisy storm. FIELD reports that everything is covered in dust and this causes more and more equipment malfunctions (especially the keyboards).

24Feb2013

With the sandstorm ceased most of the activities planned for today could be conducted in the planned manner. This involved an exploration of the Skyhole cave, originally discovered by Cliffbot during sunrise and sunset, due to the planned sensor activities with the IR camera.

Late morning saw the WiFi relocation as well as a doffed DELTA by C. Gautsch and L. Foresta; in parallel activities with PULI, Hunveyor, MAGMA and MEDIAN were also performed. After suit donning – both Aouda X and -S – an SRC experiment was conducted, bringing the astronauts to positions in the west of the camp. As discussed in a splinter discussion between Ex-Lead and FD during lunch time, the Deployable Shelter experiment was performed in a Code Orange Mode. Some miscommunication between Field and MSC as well as a vague interpretation of the SOP led to a certain amount of confusion, which got sorted out during the actual experiment.

Lesson learned from the Code Orange exercise:

- Define the objective of he Code Orange exercise: is it to simulate a Code red (hence no time delay), is it to train both FIELD and MSC, is it to involve only FIELD, putting MSC in a pure observer position
- Any Code Orange shall feature at least 1 direct communication channel between Ex-Lead and FD, if it is only to steer the exercise

In total both FIELD and the MSC assessed the Code Orange exercise as a good thing to be done; probably it should be repeated once more taking account these lessons learned.

Positively noted from today:

- *Planned flight plan slots were mostly adhered*
- *Daniel played a very convincing accident victim; probably one should consider nominating him for the OSCAR in the category "best male analogue astronaut" ;-)*

Fresh from the PoolParty:

RSS conducted a survey of the MARS2013 experiments vis-a-vis their completion status; in summary 5 experiments require still a bit more attention, which are:

· MEDIAN

· DELTA

· MATEP

· LIFE

· YELLOW

In addition we should also consider doing another Antipodes experiment with MDRS, paying tribute to Csilla's role over there. Two media activities will involve Paavan and Gernot:

- Workshop with Indian students in the morning with Paavan via Skype
- Tweetup with Gernot and Astronomie.de in the afternoon

25Feb2013

Acting FD and FD-A positions changed as the FD had to attend a satellite launch. Reinhard Tlustos assumed acting FD position but had to leave before the poolparty which was then led by acting FD-A Tilo Kauerhoff. CapCom today was Thomas Bartenstein. Live Skype Video Call to India with a group of undergraduate students asking Paavan Gorur (DOC) questions about MARS2013 and space science in general.

Flightplan/RSS compiled an overview of the experiments done so far and sent this to the field. Still required experiment runs were discussed. Aouda.X (Luca) accomplished two complete donned Delta runs while MAGMA rover was monitoring the situation. Aouda.S (Christoph) SREC runs had to be aborted due to the Saftey.S car being stuck in the sand, recovery operations were eventually successful. Both suits later participated in a photo-shooting.

Unsuited experiments:

Rover teams of PULI and MAGMA both conducted operations. The Field successfully executed three runs of each, YELLO and MEDIAN. Hunveyor did not work due to a loss of power (most likely batteries were empty as reported from Field). In the late afternoon, PULI Rover first experienced some trouble with the WIFI connection and later Field reported a broken left front wheel. Meanwhile, Daniel Schildhammer engaged in a doffed Delta with Katja serving as assistant. They were later joined by EXLEAD Gernot Groemer, as an interview with Spanish Radio did not take place.

The Fieldcrew later successfully completed another WIFI relocation, preparing for tomorrow's SREC run.

Meanwhile the MSC in Innsbruck witnessed a historic event via live stream – Austria's first satellites were launched from India at 13:31 CET, Flight Director Norbert Frischauf was present in Graz to moderate.

Positively noted from today:

- *Successful outreach event in India with a group of undergraduate students via skype hosted by MSC Mediacom*
- *Slight re-scheduling of today's flightplan regarding the Delta experimenter in the morning was accepted and successfully implemented by fieldcrew*
- *Input and ideas regarding experiment opportunities for a possible ANTIPODES run tomorrow were implemented in a quick manner by Flightplan.*

Fresh from the PoolParty:

Information from field: PULI experienced a broken wheel and has WIFI connectivity problems on a regular base which could not been solved by the PI. Acting FD agreed to pack it earlier.

Deployable shelter can not been used anymore due to the deflating mattress. Decision has been taken to pack it earlier as well, also since a sufficient amount of different scenarios have been carried out and the PI does not request any particular experiment runs anymore. Acting FD took note about the wrongful allocation in the flightplan of people in the Fieldcrew to positions they are not familiar with at all. FP's idea is to give people more experience on yet unknown positions. However, given the remaining time it does not seem very useful to carry that out now.

Transportation/Logisitcs – acting FD confirms that there will be no suit activities on the 28th and have FP change the plan accordingly. Acting FD will also relay to FD tomorrow, the request from Field to get in contact with the Gendarmerie Royal through Gian Gabriele Ori to confirm the times and means of transportation (truck arriving at Weyprecht on Feb 28 no later than 1700 UTC) and

to confirm military return convoy on March 1. Confirmation about hotel reservations will be taken care of by Olivia Haider.

Some confusion between Field and MSC (RSS) regarding the number of (already conducted) donned Delta runs of Luca. MSC will look once more through science archive to collect all the data and make sure number of runs of the different suit testers will be nearly the same (according to the requirements by the PI). Acting FD (and RSS team) sincerely appreciate the additional Data input received from SciOps later that evening – thank you!

Issues raised by MSC: request for the status of Hunveyor. Field confirmed, it was switched off this morning but is running again now. Yesterday (Feb. 24) it was running in the morning when checked by Field.

Field was informed about MSC decision (by acting FD and acting FD-A) not to conduct any more Code Orange operations during this mission which was concluded by Field.

26Feb2013

After his excursion to the launch event of TUGSAT-1/BRITE-Austria, Flight Director Norbert Frischauf was back in action again. As Reinhard Tlustos had already left on Monday evening, the FD-A position was taken over by both Tilo Kauerhoff (afternoon) and Sebastian Hettrich (morning). In addition, both did also act as Capcom, swapping then positions . The move to have our master Flightplanner taking over these roles was intended to let him experience other key positions within the MSC. Sebastian Hettrich did a great job, also because he referred quite often to his in-depth flight planning knowledge. Although operations went very smooth this time, we can assume that this experience helped to broaden his horizon vis-a-vis the difficulty to act as direct interface between Earth and Mars and the importance of proper planning, execution and communication.

Aouda.X (Gernot) accomplished two complete donned Delta runs. Aouda.S (Luca) performed an SREC experiment in conjunction with ANTIPODES with the MDRS (Csilla). In the afternoon, Aouda.X (Christoph) performed 3 DELTA runs, therefore Christoph has now also 4 runs and has therefore finished this assignment.

Unsuited experiments:

The PULI rover was already packed in the morning, while MAGMA conducted some operations. Luca performed a doffed DELTA in the morning and took 10 LIFE samples. The envisaged doffed Deployable Shelter activities foreseen for the afternoon by Luca were cancelled because of the shelter's rupture; instead Luca started to pack already.

Positively noted from today:

- Christoph Gautsch has successful conducted all DELTA runs
- ANTIPODES worked out fine
- In general compliance with the Flightplan is very satisfying.

Fresh from the PoolParty:

Information from field:

- ANITPODES has been conducted successfully.
- Christoph has completed all donned DELTAs, therefore tomorrow's Daily Activity Package foresees Gernot in Aouda.X in the afternoon for conducting one DELTA run, so that he will finally also acquire 4 runs.

There will also be another Group photo in the morning with both suits – Christoph will therefore don Aouda.S, while Luca will be in Aouda.X. Regarding MEDIAN configuration tomorrow, the configuration that has been executed the least times so far should be chosen for the scheduled runs.

27Feb2013

The official last scientific day of MARS2013 saw the appearance of the three major FDs in the MSC, C. Ragonig passed by during lunch break and Alex Soucek took an arduous trip from Italy to Innsbruck to experience the last day of MARS 2013 at the MSC. Therefore this last report is written by both Alex and Norbert in a – as we acknowledge – slightly emotional way.

From a scientific point of view today's highlight was that the LIFE analysis activities were conducted successfully. Also Luca performed some DELTA runs in Aouda.X in the morning. Aouda.S was partly donned to support a group photo activity in the morning. As the scientific activities came to an end thereafter, the afternoon was devoted to packing.

Positively noted from today:

- *Scientific part of the mission is finished*
- *Packing has started*
- *Return logistics seem to be running smoothly with the trucks arriving tomorrow afternoon*

Fresh from the PoolParty:

Thanks to all of you – to the Analogue Astronauts and the team in the Morocco desert and to the team in the MSC. You have all shown dedication, focus and the will to go the extra mile when necessary to make MARS2013 a true success. The energy you all invested into MARS2013 puts the project in line with every real space project. For a mission planer, distance is nothing but a secondary parameter in space, what counts is the Delta-V – the velocity change that is utilised to kick-start and accelerate the rocket into the right direction. MARS2013 has shown how much energy can be generated by a group of persons, who have dedication, focus and will. The rocket to Mars is on its way – time will tell when it will arrive...

10. Anomaly Reports

10.1. Report #1 / Abortion of Aouda.X EVA

Date: **04Feb2013**

Problem: **Abortion of Aouda.X EVA after 1h in the field and related communication problems**

Summary:

Aouda.X suit tester for today, 04Feb, was Luca Foresta. Suit donning was completed nominal and first field action (DELTA) commenced with a go for EVA at 1124UTC. It soon turned out that Luca's heart rate was very high, going into code yellow area. BME noticed also yawning and interpreted it as alarming sign in this situation. Independent of the signs in the MSC and parallel to their interpretations, DOC went out to the analog astronaut and ordered immediately a break opening the helmet that solved the problem for now (HR 105). No code yellow was declared by DOC, BME via FD declared it. After a pause of 10min, in which Luca shivered (that was related to the ventilators as Luca himself declared), EVA activities resumed but Luca's heart rate again went over 180 within a short interval. DOC went out again to see after Luca (20 meter away) and parallel MSC suggested abortion of EVA at 1228UTC, and – after this was left unanswered – finally a Mumble telecom was set up between EXLEAD, DOC, CapCom-FDA (acting as FD), where it was decided to abort the EVA. Luca was doffed and then rested for recovery.

Questions arising from the circumstances as recorded:

Note that these questions are not meant to rethink together the exact sequence of events leading to this medical abortion, and to allow us to learn for future cases.

a) Readiness of Luca for EVA

1) Who decided to make the switch of the Aouda.X suit tester this morning, from Gernot to Luca?

→ This was discussed right after having received the flight planning the night before. In fact, receiving the flight plan at 19:15 earliest leaves us in effect about one hour to implement it (of which about 50% are lost of this hour by short term activities, like fixing a loose tent wall, etc.. The rationale was that Luca felt fit & eager for the EVA (and Gernot had 4 days of EVA in a row). Our understanding was that for Delta, this would not make a significant difference as the Delta would be done over again and for the other activities the tester would not matter. We

understand in retrospective that this has flight plan consequences.

2) Why was this switch not discussed with MSC / Flightplan or at least notified earlier than during donning?

→ That was our fault – we were so happy that we had informed all base team members by midnight that we simply didn't realize, that we hadn't informed you.

3) Why did nobody discover the exact state of Luca's bad sleep and his overall tiredness?

→ This is subject to introduce the orthostatic tolerance test AND a short medical history in the standard procedures - We did the medical baseline, but only with a modified orthostatic tolerance test (which is not in the standard procedure but we have done it since we are in Marocco) – that might have been the only evidence, as Luca did not complain at all. From the clinical perspective during baseline Luca did not look tired or suspcious in his behaviour.

4) Why did Luca not say himself that he had a short night with only 5hrs of sleep, and why did he instead declare himself fit for a long EVA?

→ → This is subject to investigation. introduce the orthostatic tolerance test AND a short medical history in the standard procedures . Also, see his comments below.

LF: see answer in 3.

b) Command structure in case of abortion:

1) Why was the command from MSC to abort the EVA left unanswered for more than 15min?

2) Why did DOC gave a command to not go into EVA again when MSC had already aborted since almost 2 hours for the whole day?

→ That was considered as a medical confirmation from on-site. The message was communicated as a "abort EVA" to the experiment team by BASE, the decision "abort at least for the rest of the day" was recognized when going through the chat protocol.

The information communicated thru base which caused this hiccup, was merely thought as relay of information of what was going on in Ops.

3) Why was such an important message not immediately conveyed to the whole team, considering DELTA was running just outside of the tent?

→ The EVA abort history was not an acute one, but rather developed over half an hour (especially, as Luca had a subjective better feeling after the first break). So EXLEAD decided

that the people who have to be aware of the abort are BASE, DOC, AOUDA.X, SAFETY.X, DELTA-ASS (=EXLEAD during that day) + SCIOPS and later the media team.

ACTION ITEMS

P1.1	**EVA abortion decision** Refresh together the chain of command in cases of EVA abortion and medical borderline situations.
P1.2	**Reaction time between CapCom and BASE / SciOps** All stations (MSC & Field) to pay high attention to proper situational awareness and fast rely of messages especially in cases of higher tension around the possible abort of an EVA due to medical reasons.
P1.3	**Fit-for-EVA assessment prior to Donning** Introduce a (better) procedure to check that a suit tester is fit for EVA. Do this before donning is started and do not be satisfied with a simple “feel good” answer, but take circumstances (previous days’ activities; weather; night sleep; proper breakfast; etc.) into account

MARS2013 Field Problem Investigation Report #1

ANNEX: Assessments of FCR Staff

BME

General problems: change of the suit tester, without our agreement; before donning we have no information about the medical status of the suit carriers (for the future - we need an information about the medical status); going out into sim, without telemetry - it's not acceptable - than we are not ready for the sim (that's my opinion)

Problems MSC: I´m here in the competence of a medical doctor - a discussion whether this is an ECG artefact is not good - i think that's my competence; Prof Luger made limits - if we reach this limits we have to give code yellow - so this is not a problem (i think so) - they should just be alert; when we are out of range - there is no discussion about code yellow or not - then we have to give code yellow; afterwards we can discuss.

Problems Field - because we want to know how he feels like - for example if he is driving and we see something on telemetry - and we want to make a questionnaire - the tester has to stop the vehicle immediately (no delay possible) - otherwise an accident is possible!

Today we had the luck, that Luca was in Aouda X - if that happend in Aouda S - we would not know that yet (many problems - because media is here and so on)!

FD-A

A.X / Luca / during morning activities: his heart rate seemed to get high pretty fast and on a continuous high level. We declared Code Yellow. I have no data to compare this to Luca's normal levels but in my experience that was too high to continue safely -> since that would lead to high exhaustion pretty fast, maybe not enough food, sleep; upcoming sickness...or it was just not his day. Additionally he yawned several times, BME says that considering the possible circumstances (lock of sleep) this is a bad sign.

Different thing: During a month long mission we have to plan long in advance - what we all did together, changing major things without going by the proper procedures (like change the analogue astronaut in action for the day) is VERY BAD (changing smaller things like experiments schedules...well, we can talk about that). BUT the Aoudas and therefore the analogue astronauts are the CORE of what we are doing now. We have to think of the long term implications, a few days you can push through little sleep, a month -not so. If suit testers are more exhausted every day there comes a day, when we will have a real code red, that could have been avoided by sacrificing some of the simulation and science. Field should remember the long term implications of what they are doing, just as we are trying to do that for them. This is true especially for when we have time delay.

CapCom

Changes of Positions in the Flightplan must be discussed with MSC; FD should not abort an EVA and afterwards leave the FCR; BASE and Capcom have to react faster when there are medical issues; do a check in the morning if the suit tester is fit for the day.

SCIENCE

From a science point of view, I agreed to abort the EVA because a tired suit tester does not produce good data.

RECORDS

Donning towards EVA was already troubled by telemetry problems from the beginning, and situational awareness was suboptimal (MSC had quite often to ask and even re-ask after some minutes for status updates on running field operations). At 11:21 UTC BME reported strong increase in CO2/O2 and temperature, which was dismissed by the field as probably due to closing of the helmet. At only 11:31 UTC a high heartrate was see (around code yellow threshold), which was close after helmet closure. My personal feeling was that maybe something was wrong, but due to my lack of experience and other in the FCR voiced same opinion I kept this to myself. When information came from BASE, it gave to me a feeling of "we're on top of this, please leave us to do our work" (assumption on my part!) even though the feeling with me that the situation was spiraling out of control. Example: during the medical emergency, BASE announced leaving the station to the DOC to do an interview. I think it was good to declare code yellow - as the field also acknowledged at 7 minutes later - but I do think it might have been declared maybe even a few minutes sooner. When 16 minutes after returning to code green BME saw a peak HR of 175 again and the suggestion of EVA abort was voiced by the FD, my feeling was that Aouda.X with the current astronaut should be finished for today. I had a very negative feeling about the situation. Still, at that point I felt that the field crew was under the impression that the problem was not as severe and wanted to continue the EVA as if nothing really was the matter. It took an emergency telecon to finally get an abort. The situation in the field in my eyes was stressed (maybe because of friction with the TV crew, who knows?). Speculation about weather and Luca not having enough sleep might have been a factor were supported in the MSC by the BME hearing the astronaut yawning more than once. I think in this specific case the unilateral personnel switch for the Aouda.X astronaut from the schedule outlined in the flight plan for today was the major problem that, together with possible general increased field team stress, led to an emergency spiral that was correctly halted in time. I hope this long paragraph captures my feelings about the problems of today in enough coherency to be useful.

Field/EXLEAD

I concur on the fact that the BME's at FCT need a good telemetry. At this point we are spending time on doing 2-3 medical checks during the donning. However, adding an orthostatic tolerance test might be a valuable addition for the donning beginning. But, I do not want the donning to become a medical test orgy – we have to find a healthy balance.

The chain of command has been clarified and I believe the confusion on who actually took the abort decision first (FD), was due to a bad wording without bad intent by the BME.

The worst case scenario could have been a syncopy of the analog astronaut today, something we absolutely want to avoid, so I am confirming our comittement to the 3S principle.

One basic challenge is the level of understanding of the now really complex suit system. E.g. a rise of the CO2 after closing the helmet is an effect due to the change in the airstream pattern within the helmet and was always considered as nominal. It would be great to have a suit expert at the MSC to help interpreting these data patterns. We will be working on these patterns anyway in the future (to study the data patterns when there is an increase in the physiological stress)

Field/DOC

[…]

Aouda.X sui tester (Luca Foresta)

Yesterday night I felt normally tired after a successful day in Aouda.S. I volunteered myself for the Aouda.X, that is switching with Gernot, because I felt fit for it and thought he would be more needed out of the suit (media requests,etc..). This morning (4th Feb), I felt fine even if I knew I lacked proper sleeping since I arrived on the field (2 nights). "Lacked proper sleeping" means 4-6 hours of sleep severely interrupted; I'm positive (and hopeful) this could change by tonight. I think this is the only reason for me not feeling alright today.

Concerning the high value heart rate. I understand now (but why is that?) that BME had no reference. Anyway I did the ISAG test some months ago;the test was not only fine but apparently very good (from what the guys there told during the test itself).During that test I think I reached 198 beats/min (please check), much higher than today. Even if cycling looks much more demanding that DELTA, the moment my heart rate increased (I think) was when I was performing a task in an absolutely uncomfortable position. In fact, as soon as I finished it and rested for a few minutes, I felt my heart rate was back normal and generally felt good. However, after a few more minutes I felt momentarily dizzy and then basically "dead tired". My feeling is that that specific task, together with the short/cold previous 2 nights, drained my energy all of a sudden.

I personally think a good sleep (hopefully tonight) will let me be back fit and fine.

Base (Stefan Hauth)

I was at Base during the morning while donning was in progress. Around 11:30 or so I had an appointment for an interview. It was agreed with EXLEAD that it would be ok to do this as it only was scheduled for 10-15 min and as DELTA was completely monitored from the DELTA Ass. In the field there would not be much to do for BASE. In that time DOC took over the station at Base.

Suit Tech (Stefan Hauth)

In the morning we had constant troubles with all I2C related sensors (O2, CO2, Battery monitoring, Fan Control). It would not have been possible to quickly fix it without risking of loosing it completely. So finally it was decided to go into EVA without those parameters especially as the ECG worked fine. Unfortunatley the troubles appeared very late during donning so we couldn't try to fix it in parallel to other donning activities.

11. Media Activities

The Austrian Space Forum was coordinating and leading the communication campaign to inform the public and the general media about MARS2013.

Media milestones included:

- **20Sep2012 "MARS2013 Go Public":** press conference and event, Vienna/Austria Museum of Natural History. This event also presented the team members and successful proposals.
- **11Dec2012**: presentation of experiments and hardware to the public.
- **11Feb2013 "MARS2013 landing":** after the declaration of "ground operational", the isolation phase will started on the 10Feb2013 with the first EVA happening on the morning of the 11Feb with a large media event at the MSC.
- **05Mar2013 "Arrival-on-Earth":** Press release upon return of the field crew
- **27May2013 "Science Workshop":** Press release following the science workshop in Vienna, Austria.

Questions about media activities should be directed to Mrs. Monika Fischer, head of the MEDIACOM team (monika.fischer@OeWF.org).

Twitter: www.twitter.com/OeWF, the official hashtag for the campaign is #MARS2013

Facebook: www.facebook.com/spaceforum

Youtube: www.youtube.com/OeWF

Website:

- Mission website: mars2013.OeWF.org
- Mission countdown: mission.OeWF.org

Social Media Mission and goals

The MARS2013 social media strategy aimed to *reach* more people, *raise awareness* about OEWF and its current MARS2013 analog mission *and increase brand reputation*. It should *generate enthusiasm* towards the idea of sending humans to Mars, while *informing* and making people *understand* the challenges of such a mission and why we need to prepare humans in this respect. At the same time, it was conveying the *professionalism* of the team and presented its scientific and technological *achievements*.

ÖsterreichischesWeltraum Forum

Dossier de Presse MARS2013

Simulation sur terrain analogue au sol martien au Maroc

Sommaire

Téléchargement du dossier de presse et des photos:
http://www.oewf.org/cms/presse-medien.phtml

Vision. Forschung. Technologie. Politik. Bildung. – Vision. Research. Technology. Policy. Education.

What did we convey?

- An experience: the adventure of exploring planet Mars.
- A technological and human challenge.
- Professionalism.
- Scientific and technological results.
- International cooperation, led by the Austrian Space Forum

Target Groups

- General public/lay people,18-55, connected online
- Scientific community: scientists using online media to stay informed

The hashtag for all social media activities was changed on 11th January 2013 from #MARS2013 to **#simulateMars**. The reason for this was, that Mars2013 was used for French music which will be released in March 2013 (“mars” is the French word for March). As well it was a widely spread hasthag for a specific French rapper. Therefore the decision was taking to create a new hashtag, which isn’t used in a different sense than Mars exploration.

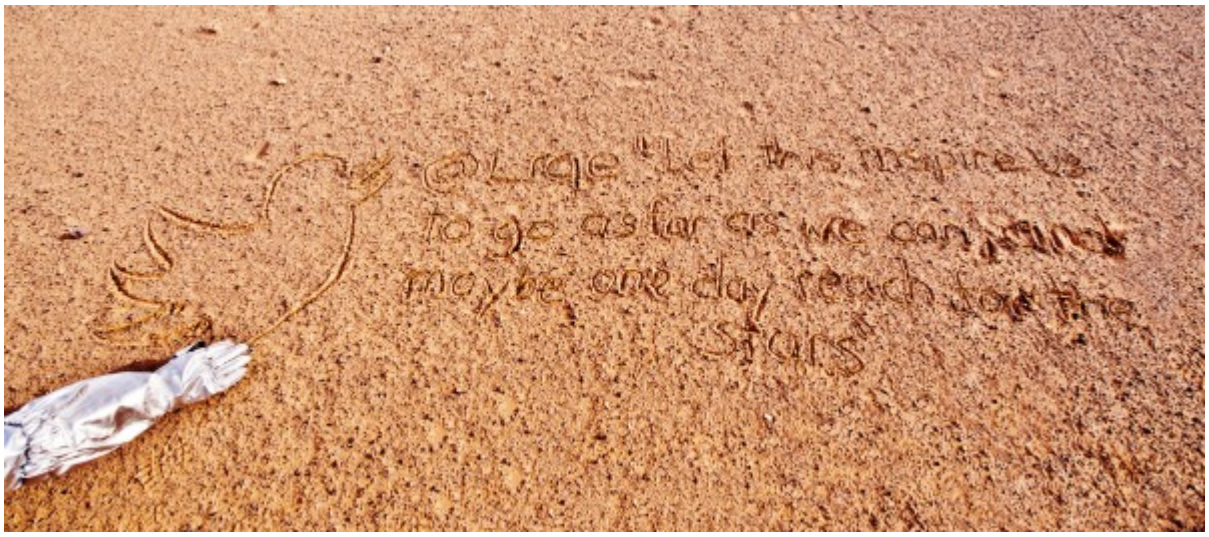
Activities / Statistics

Social media activities are still ongoing. For MARS2013 the highest activities were between 13th January and 10th March 2013. Successive descriptions refer to this time period of time:

- **Blog.OeWF.org (64 articles in total)**
  - People behind the simulation, 12 interviews (german & english)
  - MARS2013 picture of the day, 28 photos & description, 2 articles (german & english)
  - ÖWF on Mars, guest blog articles written by science fiction authors, 18 articles (german)
  - MARS2013 News updates, summary of what was happening the day before 8 articles (English)
  - MARS2013 Science bulletins, 3 articles (English), were also distributed via email to partners
  - Twitter activities, 2 articles (English) Twitter competition "Send your tweet to Mars", MARS2013 Twitter Q&A Roundup
  - Globe at Night meets Mars2013, 1 article (English)
  - Google+ activity, 1 article (English): MARS2013 meets AuroraTweetup Google hangout, 1 article (English)
  - Facebook activities (Polls), 3 articles (English): MARS2013 End-of-mission Polls articles
- **Twitter** (361 tweets with #simulateMars were sent)

  OeWF twitter channel was primarily used to give live updates on the mission. Every day, starting on 11Feb2013 (Landing day) begun with #wakupsongs. Scheduled and ongoing experiments were described, weather forecast etc. to transport the experience of the adventure of exploring planet Mars in an analog simulation.
  On 26Feb2013 a one hour Q& session was hosted, were 27 questions were answered by ExLead Gernot Groemer in the field.

  During the simulation the Twitter competition "Send your tweet to Mars" was ongoing. In total we got 43 valid entries. Winning tweet***: "Let this inspire us to go as far as we can, and maybe one day reach for the stars"*** by @Lrqe



- **Facebook**: (111 post in total)

  Facebook was the main channel for the general public, therefore all pictures of the day were posted to fascinate with the pictures. The news update should give the fans some more background information on what was going on. In addition in the last days three polls on the “big question” about Mars were scheduled to engage with the user.

- **Google+** (ca. 100 posts)

  With the google+ page the goal was to engage with the scientific community on google+. Therefore all English blog articles were shared, the science bulleting got special notice on google+ and a public google hangout between Morocco and Finnland to the #auroratweetup took place on 8Feb2013.

- **YouTube (3 videos in total)**

  This channel was used to publish videos and to attract users on YouTube. During MARS2013 three videos “This week on #simulateMars” were uploaded and also integrated in the science bulletins.

Social media campaign Achievements:

- **Reputation**:
  - Improve search engine results for “Mars simulation”, “Mars analog”, “Mars analog”. Before MARS2013 we didn’t have hits in top 10 Google results. Now (24Mar2013) with Mars simulation we’re No. 6 in google.at and No. 10 in google.com. With “Mars analog” we’re No.3 in google.at and No. 4 in google.com. With “Mars

analog" we're not in the Top10. The reason is that we always use the American English "analog".

- Klout score (Klout is an online tool which measures your social influences). Before MARS2013 are Klout score was 48, now (24Mar2013) it is 62

- **Reach**:
  - Twitter was the most successful channel with 1,913 new followers (24Mar2013)
  - Facebook we attracted 366 new fans (24Mar2013)
  - Gained handful of new Blog RSS Feed subscribers (6 in total, compared to 2 per months)
  - On YouTube we gained 12 subscribers (24Mar2013) and increased the views from total 20,060 before MARS2013 to a total of 30,184 views (24Mar2013). In February we had alone 6,777 views, with a peak on 10Feb2013 with alone 3,767 views. 90% of the views were generated on the OeWF Teaser Trailer video.
  - On the website we got in average 200-300 visits a day during the simulation, compared to 80-100 visits per day before MARS2013. Peak was on 11Feb2013 with 990 visits. This can be explained with the landing day & press conference we had on that day. Therefore a lot of newspaper articles went online and referred to the website.

- **Engagement**:
  - **Twitter** (13Jan-10Mar2013): 329 Retweets (Peaks on 11Feb2013 41 Retweets & 26Feb2013 36 Retweets); 313 mentions (Peaks on 18Feb2013 40 mentions & 26Feb2013 47 mentions [on 26Feb13 the Twitter F&Q took place]); 1141 total clicks on links. Compared to average 10 Retweets & 20 Mentions per month) Most popular link with 122 clicks was about the Twitter competition "send your tweet to Mars", followed by 102 clicks on the picture of the day were we got the call by @Cmdr_Hadfield from ISS.
  - Most retweets with 12 got the tweet on valentines day followed by 9 retweets on the first sentence from #simulateMars. The top mentions by Klout score was by @hoosuite and their blog post on #simulateMars (Klout Score of 84.4), followed by @esa retweeting the post about what doing in an emergency on Mars (Klout Score 72.4).
  - **Facebook** (01Feb-15Mar2013): average 300 people per week talking about OeWF (peaks on 22-27Feb2012: 636 people, lowest 03-09Mar2013: 156 people); average reach 8,000 – 9,000 people per week (peaks on 21-27.Feb13: 20,149

people, lowest: 03-09Mar2012: 5,424 people). Compared to before MARS2013 average 71 people per week talking about OeWF and 1,172 weekly reach. For the three questions we did a pool on Facebook we engaged 125 users. The most likes & shares with 276 likes and 46 share got the post for the picture of day no.10 “The Red planet” (20Feb2012). The most commented post with 11 comments was on 11Feb2013 with the first sentence of the analog astronaut.

- **YouTube** (13Jan-10Mar2013): 26 likes, 0 dislikes, 26 shares; 7 likes & 18 shares for video “this week on simulateMars Week01”. Compared to average 5 likes and 1 share per month.
- **Blog** (13Jan-10Mar2013): 17 comments on MARS2013 articles compared to average 1 comment per month.

12. Standard Operating Procedures

Not detailed in the public version.

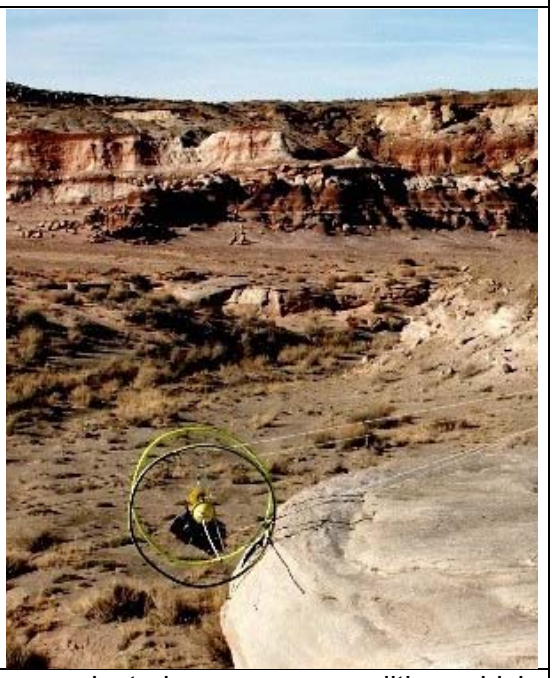
13. Experiment descriptions

	Experiment	Content
01	CLIFFBOT CRV	Cliffbot rover vehicle - terrain trafficability (Association Planete Mars, FR)
02	COMPSTRESS	Crew Fatigue, Sensorimotor Adaptation & Stress Physiology in Analogs (Med.Univ. Graz, AT, Kings College, UK)
03	ERAS C3	Command & Control software project for data processing in the field (MS Italy, IT)
04	SREC	Assessement of small rover exploration capabilities (ATV-like vehicles) (Ecole Nationale Supérieure de Cognitique, Institut Polytechnique de Bordeaux, FR)
05	DELTA	Human factors - work economics, time delay A.X vs unsuited, (Austrian Space Forum, AT)
06	Puli-Rover	Mobility tests for the Hungarian GLXP rover (Puli Space Tech, HU)
07	Hunveyor-4	Surveyor-class robotic lander with remote access (Óbuda University, Alba Regia University Centre, HU)
08	LTMS-MOROCCO	Long term medical monitoring system, biomedical chest vest (CSEM, CH)
09	Magma-White Rover	Pathfinder-class rover system, mobility & human-robotic interaction (ABM Space, PL)
10	MEDIAN	Methane Detection by In-Situ Analysis with Nano-Landers (Univ. College London, UK)
11	microEVA	Luminescence detection of viable bacterial spores and terbium microspheres (NASA JPL, USA)
12	Deployable Shelter	Deployable Emergency Shelter suitcase for astronauts (TU Vienna, AT)
	PolAres program-specific activities	
13	Aouda.X/.S	Series of engineering tests w.r.t. communication, trafficability and materials. Potentially including the Phileas rover.
14	MAT/EP	routine medical survey during OEWF field campaigns; includes a field incident reporting system
15	Geosciences	Geoscience remote science support experiments; includes the management of all geophysical and astrobiological research activities This also includes a set of standard geosciences techniques to be compiled during summer 2012.
16	ANTIPODES	Communication experiment with Kiwispace, NZ – testing the experiment guidance over to an external Mission Support Center during an ongoing experiment.

Plus, there are three opportunistic experiments:

- Peniculus.X: a student experiment looking into solar panel efficiency
- Yellow Box: A navigation experiment
- OPS Box “White”: an operations console concept for the BASE

13.1. Cliff Reconnaissance Vehicle

Description	Vertical exploration robot; lowered down by a human to explore steep terrain
PI	Dr. Alain Souchier
Organization	Association Planète Mars, FR
Summary	The Cliff Reconnaissance Vehicle (CRV) is a demonstrator to test the ability to send and retrieve instruments on various slopes ranging from vertical and overhangings to 45 ° or less which would be too dangerous for access by an astronaut exploring a planet. Cliffs are a location where layers tell a long geological story and thus are interesting to explore by cameras or other instruments. The Morroco campaign will allow testing in new conditions and probably higher cliffs than those on which runs were conducted till now. 
Objectives	According to available views of the area selected, one new condition which could be experimented in Morocco is higher cliffs. Till now the maximum tested was at around 18 m. 50 m could be a goal. • to use the on board video hazcam to monitor the vehicle situation during the run. Improvements are planned compared to the present single view transmitted to the operator. • to test again the vehicle operations with a simulated spacesuit. • to test the usefulness of camera pictures to get information on the cliff layers. This is a limited objective however because it is recognized that other instruments than a camera should be carried by an operational vehicle to acquire more information on the layers
Resources requested	Per experiment: 1 hr / preparation, 1 hr suit tester time 1-2 tests with Aouda.X 10 tests without Aouda.X (out of sim?)
Logistics footprint	Shipment mass: 20 kg Box: 70 x 50 x 30 cm suit case Audio between suit tester and OPS / MSC necessary Power: 100 W for 12 hrs charging (+ 200W for Laptop)

1 Objectives

The Cliff Reconnaissance Vehicle (CRV or "cliffbot") is intended to send cameras and/or scientific instruments downhill on slopes which are not safely accessible by men mostly when they are operating in space suits. The CRV 34 used for the 2013 Morocco simulation and as provided by Planète Mars association is only equipped with a camera.

The CRV and an operator in the Aouda spacesuit

Till now, and it was also the case in the 2012 Dachstein experimentation, main objective has been to demonstrate the vehicle mobility capabilities on slopes with more or less obstacles, different slope angles (even including more than 90° i.e. overhanging) which can be summarized as "terrain trafficability demonstration". One understandable objective is to be able to retrieve and bring back uphill the vehicle. One particular objective for the Morocco simulation may be, according to available photos of the area, to test the vehicle on very high cliffs. Most tests till now have been conducted on less than 18 m high cliffs. Higher cliffs will increase the elastic behavior of the rope.

The second objective is to assess what are the operating difficulties when the vehicle is operated by an operator in space suit. A derived objective is to test the operations only with the gloves.

The third objective, for an operator either in a spacesuit or without a spacesuit is to assess and see how to improve the vehicle situation awareness. The situation awareness is obtained through the forces feeling by the operator on the suspension rope, through visual observation of the vehicle and through the information transmitted uphill by the on board video camera. The visual observation may come from the operator himself but the direct visual link is often quickly lost when the vehicle is in the slope. Then the operator may stop the operations, tie the suspension rope to the anchoring point and have a look from another point to see the vehicle. Or someone else may observe the vehicle from a different point and send information to the operator.

The fourth objective, linked to the present type of instrument on board (i.e. a camera) is to assess geological interpretation capabilities. This activity is conducted in house outside the experiment field. Other instruments may be fitted on the vehicle if wished by other participants. The main limitation is the weight. The payload plate is a multiperforated plate which allows for different types of fixations (bolts, T raps,…)

2 Tests general information

Test n°	Date	Localisation (+ indication on a map separately)	Vertical Heigth m	Rope length m	Comments (spacesuit ops or not, difficulties, duration)	Data acquired (sciencecam, hazcam visual/photos/recording, outside photos or videos)
90	9/12/12	Outside wall Innsbruck Red Cross building	1,5	1,5	Operations in Aouda spacesuit	Sciencecam recorded (6 mn), hazcam on
91	9/12/12	Outside wall Innsbruck Red Cross building	1,5	1,5	Operations in Aouda spacesuit, vehicle in inverted position, 2 runs	Sciencecam recorded (5mn and 2 mn), hazcam on
92	3/2/13	North Camp Erfoud; close to WP1; west from WP1	5	6	Ops by D. Schildhammer in Aouda S; vehicle prepared by A. Souchier (anti roll rods and equipments on); 3 runs; 4m vertical then 35° slope	Hazcam and sciencecam operational; hazcam picture on the monitor; monitor photos; tests 92 to 95 filmed by Austrian TV Servus
93	"	"	8	16	Ops by A. Souchier; blockage at the lowest point: a rock protrudes between the right wheel spokes (see photos); manual deblockage; return up by a different way (length 21 m)	Hazcam and sciencecam operational; hazcam picture on the monitor
94	"	"	6	7	Ops by D. Schildhammer in Aouda S; vehicle prepared by A. Souchier (anti roll rods and equipments on); 4 runs on more than 4 m; 2 runs on 2 m; 1 run on 6 m; 1 run on 4 m; 1 run on 6 m; tests conducted between 15h35 and 16h00	Hazcam and sciencecam operational; hazcam picture on the monitor
95	"	"	7	10	Ops by A. Souchier	Sciencecam off; hazcam operational; objective was video by the TV crew of the hazcam monitor
96	5/2/13	¼ th of the big cliff North of Black Hill	19	19	Blockage on the way up 2 m under the starting point: the anti yaw main rod is stuck and slightly bent between two rocks (photos available); deblockage from under by a 3 m pole from a rocky (photos available); strong help from the polish TV team which was following the test	Sciencecam off; hazcam on and picture on the monitor (excepted when the vehicle is at maximum distance)

97	6/2/13	Above WP 1 at the crest top; 31N22.532 and 4W3.348	8	10	Operations by G. Groemer in Aouda S including all preparatory operations (anti roll rods and equipments on); 8 m vertical; overhang; the vehicle comes back rotated 180°; momentary blockage of the rope in a cliff crack; freed by pulling harder; pole to hold the receiver away from the cliff would be interesting	Hazcam and sciencecam operational; hazcam picture on the monitor
98	"	East of preceding point; 31N22.535 and 4W3.330	20	36 (max rope)	Operations by G. Groemer in Aouda S; 5m vertical then 35° debris slope	"
99	"	East of preceding point; 31N22.532 and 4W3.337	20	36	Operations by G. Groemer in Aouda S; same profile	"
100	"	Very close to first point; 31N22.532 and 4W3.348	20	36	Operations by G. Groemer in Aouda S; same profile; the vehicle rotates 180° in the overhang and roll on the debris slope with hazcam looking in front; comes back still rotated 180°	" Sciencecam videos from tests 92 to 100 provided to the TV teams; also loaded in the base camp computers.
101	18/2/13	31N22,551 et 4W03,280		46	Operations without spacesuit from the top of one of the fossil mud volcanoes. Red laser weak	TBC
102	"	Same location	Around 5	5	From the same location, exploration of a cave with a sky opening. The vehicle is used without the anti roll rods.	TBC
103	"	31N22,902, 4W2,986 Northern end of Kess Kess chain	32	32	Operations without spacesuit; quasi vertical cliff	TBC
104	"	Sphynx point	8	8	Operations without spacesuit; quasi vertical cliff; vehicle stopped before reaching the bottom of the cliff on an horizontal area	TBC
105	19/2/13	31N22,880, 4W 04,442	23	23	Operations without spacesuit; quasi vertical cliff	TBC
106	"	250 m west of previous test	15	15	Operations without spacesuit; quasi vertical cliff	TBC
107	"	31N22,880, 4W04,442; Western tip of the Kess Kess	35	35	Operations without spacesuit; quasi vertical cliff	TBC

97	6/2/13	Above WP 1 at the crest top; 31N22.532 and 4W3.348	8	10	Operations by G. Groemer in Aouda S including all preparatory operations (anti roll rods and equipments on); 8 m vertical; overhang; the vehicle comes back rotated 180°; momentary blockage of the rope in a cliff crack; freed by pulling harder; pole to hold the receiver away from the cliff would be interesting	Hazcam and sciencecam operational; hazcam picture on the monitor
98	"	East of preceding point; 31N22.535 and	20	36 (max rope)	Operations by G. Groemer in Aouda S; 5m vertical then 35° debris slope	"

3 Results

Objective 1

During the 18 tests conducted in Morocco two "trafficability" problems occurred. In test 93 where the vehicle, after a 4 m vertical cliff, was operating in a debris slope, the operator was unable to pull it back because a 40 cm boulder was protruding between the right wheel spokes. Releasing the rope and pulling back, changing the operator position on the cliff was inefficient to solve the problem. The vehicle was moved by an observer on the slope and then brought back by the operator. As an excuse the debris slope is not exactly the type of slope for which the vehicle is designed. A solution however would be to have plain wheels. The present vehicle, which is only a demonstrator, was designed with the requirement of being able to fit in a suitcase for transportation which precludes the use of plain wheels.

During test 96 the vehicle was blocked on its way up a cliff. The rod linking the rope to the vehicle (also called anti yaw rod) engaged in a crack between two rocks which gave it a slight S shape. Releasing the rope was unable to let the vehicle go down under its own weight. The problem occurred 2 m from the top of a 18 m cliff. Fortunately a small plateau under the vehicle provided an access path from which the vehicle was pushed up by a 3 m rod. It is not known if pulling strongly the rope would have solved the problem.

These two tests were conducted by an operator without spacesuit.

During test 97 conducted by an operator in a spacesuit a momentary blockage occurred. The rope was inserted in a roughly vertical crack in the cliff. The vehicle was freed by pulling harder on the rope. The operator suggested that a "tool" pole which could be used to push more or less horizontally the rope away from the cliff would be interesting to solve this type of problem. It could have also been a solution for the blocking during test 96.

No other trafficability difficulties were reported during tests 101 to 109 when the PI was no more on the field in Erfoud.

Vehicle blockage at the end of test 96: the anti yaw rod is engaged (and slightly bent) between two blocks. Under the vehicle (left photo) the black pole which will be used to push it upwards is visible.

Considering the objective of extending the length on which the vehicle was tested, the objective was fulfilled. One test was conducted with a total rope length of 46 m. The rope container holds 36 m of rope and reaching 46 m implied to connect the end of the rope to another one in a second container. Three tests were conducted also till the 36 m of the first container rope length.

Objective 2

No special difficulties seemed to have been encountered linked to the vehicle operations in the Aouda spacesuits.

Objective 3

To improve the vehicle situation awareness by the operator the Hazcam which send real time pictures to the operator, was equipped with a rear facing mirror. For the Morocco campaign the Hazcam was oriented downwards. The orientation can be modified before a test. The rear facing mirror was thus looking upwards, trying to provide a view towards the upper part of the cliff. The

mirror takes one fourth of the camera field of view. Probably it is not enough to have a clear view of the vehicle surroundings. Initially the idea was to equip the vehicle with two Hazcam looking up and down, but a two channels TV emitter was not found in time for the vehicle delivery to Innsbruck in December 2012. A solution where the two camera signals could be alternatively received uphill with only one video channel could be also interesting. The mirror was lost during tests 97 to 100. It was reported by the operator, during tests 97 to 100, that the picture seen uphill from the downward looking Hazcam was giving indications on the vehicle rotation under an overhanging while the vehicle was not visible from above, thus also, by the way, indicating that it was proceding under such an overhanging.

Picture from the Hazcam showing the debris slope with an observer in the upper left corner and the rear (upwards) facing mirror in the upper right corner

The CRV is now equipped with a new HD camera (in the Siencecam position) and the pictures may be received in real time on a smartphone which could improve the situation awareness. This capability was not used in Morocco.

It is interesting to note that the blockage during test 96 was not understandable from the Hazcam picture and also (later on during the analysis) from the Sciencecam picture. Understanding the blockage would have needed a lateral viewing camera looking at the right wheel. During the test 97, the blockage was understood by direct viewing and not by the Hazcam picture. Finally two 170° field of view cameras would be at minimum necessary. One solution tested in 2006 during the MDRS 43 simulation in Utah, was to install the Hazcam in a small pod roughly one meter above the vehicle on the rope and looking towards the vehicle. But the pod itself may be a blocking cause. In Utah it was only experimented on a smooth slope.

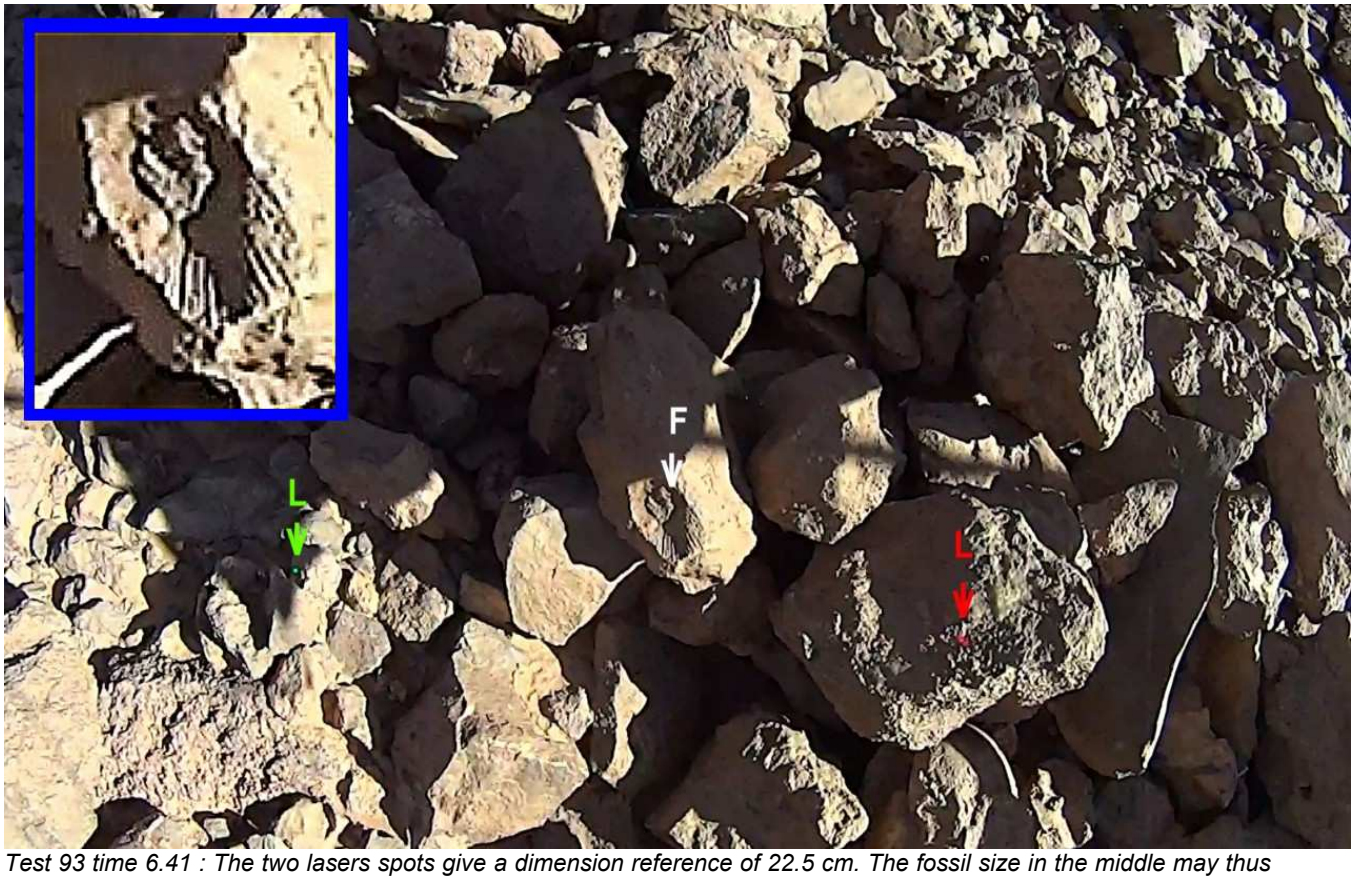
Objective 4

Interesting results were obtained in geological and terrain analysis in Morocco. Ten years ago, with the previous version of the vehicle, some tests were conducted on clay slopes on the Normandy sea side, in an area called the “Black Cows cliffs” where a lot of fossils from the tertiary era are embedded in the ground. Numerous fossils are visible on the ground by an observer. But in the camera field of view which covered only a width of around 20 cm, not so many fossils were visible.

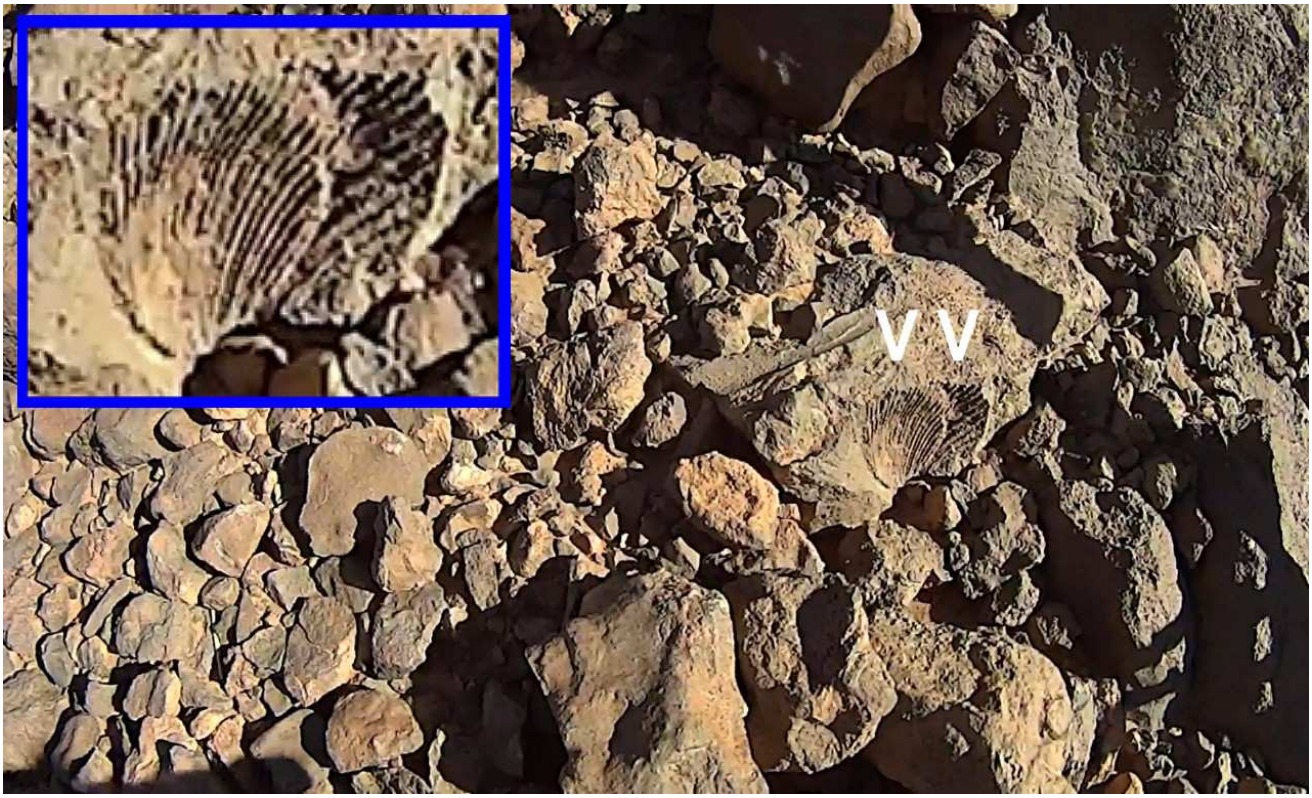
In Utah there were not many fossils visible in the cliffs so the geological analysis was limited to cliff vertical cartography by stitching photos extracted from the videos.

During the Morocco campaign, the new HD camera had a 120° field of view (a 170° field of view can also be selected). Numerous fossils were detected on the videos taken during tests 92 to 100. For the following tests the Sciencecam videos are not yet available.

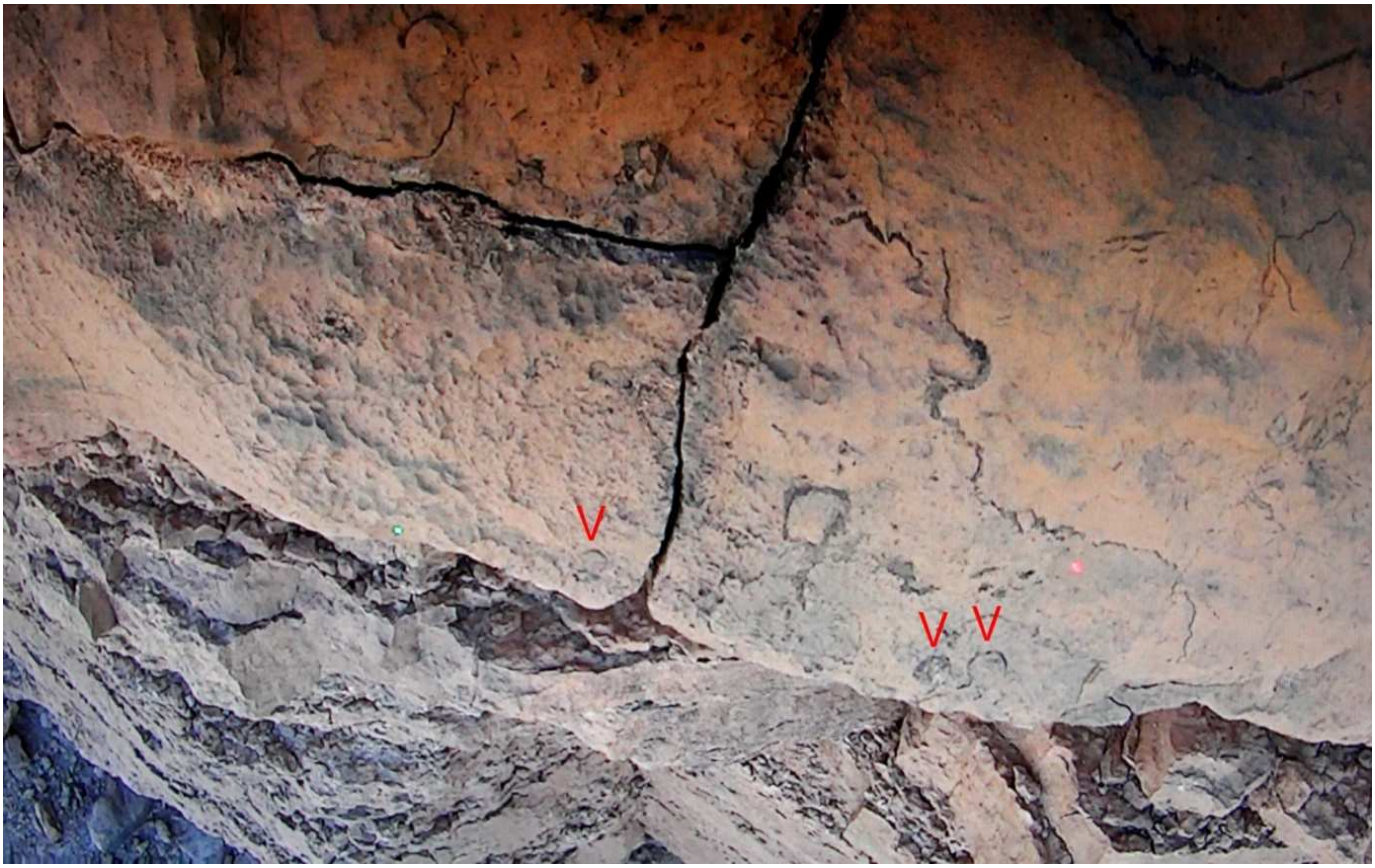
The following photos give examples of the fossils detected in Morocco operations. Also the vehicle was useful to find intriguing blue stones at the bottom of a cliff, which were not visible from above.



Test 93 time 6.41 : The two lasers spots give a dimension reference of 22.5 cm. The fossil size in the middle may thus be deducted at 18 mm.



Test 94 time 24.42: two imbricated shell fossils.



Test 97 time 3.16: possible indication of fossils (circular shapes); the two laser spots, green on the left and red on the right are visible. Their distance is 22,5 cm, thus the circular shapes are 1.2 cm in diameter.

Test 97 time 9.33: possible fossils on the rocks in the debris slope.

Test 98 time 2.48: blue rocks and a fossil in the upper right.

Test 98 time 5.01: cylindrical rock which may be a fossil. Many were found on the field.

Test 98 time 5.11: striated rock.

Test 98 time 7.58: fossil of a shell.

Test 100 time 0.36: grey blue area in the cliff.

Other results

The 18 th of February, the operating team discovered a cave with a sky opening in one of the Kess Kess mud volcanoes and sent the CRV exploring this cave. The anti roll rods were not fitted to the vehicle to decrease the vehicle width. The video taken on board is not yet available to determine if any interesting features were found.

One of the Kess Kess mud volcanoes with a cave featuring a sky opening (doc. OeWF/Katja zanella-Kux).

During test 102 the vehicle is sent in a cave (most probably the one visible in the previous photo; tbc). This is a nice demonstration of accessibility by the vehicle of an area which cannot be reached in a spacesuit.(Doc. OeWF).

Concerning operations, a problem occurred the 6th of February during the batteries loading operations. The vehicle had to be ready at 11 am. The two 6V batteries charging is done in two steps: a long one under 6 V and a short one under 7.5 V. The battery n°1 was left under 7.5 V charging during breakfast and left too long (30 mn) leading to overheating. Fortunately a spare battery was available for this type of problems or others, and, at 9.41 am, the vehicle was ready with the new battery in place fully charged.

Overheated 6V battery one.

4 Conclusions

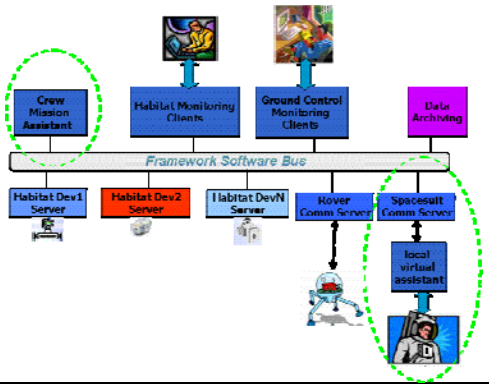
During the Morocco ÖWF Mars 2013 Mars exploration simulation campaign, the Cliff Reconnaissance Vehicle (or “Cliffbot”) test objectives were fulfilled.

13.2. COMPSTRESS

Description	Crew Fatigue, Sensorimotor Adaptation & Stress Physiology in analog environments (part of a larger multi-mission study)
PI	Prof. Dr. Helmut Hinghofer-Szalkay
Organization	Medical University of Graz, AT
Contact	Dr. Nandu Goswami, Medical Univ. Graz +43 664 792 4948, Skype ID: timbuktu9, nandu.goswami@medunigraz.at
Summary	The main objective of this comparative study is to compare the above aspects of stress physiology across the analog environments. In this multi-mission study, the team is assessing 1. sensorimotor adaptation and fatigue, using Psychomotor vigilance test (PVT) and posturography; 2. endothelium-mediated changes in vascular tone, using a non-invasive device (EndoPAT®); 3) retinal vascular diameters, measured by retinography; 4) intracranial pressure changes, measured by the hand-held, battery-driven device (Echodia Elios®); 5) heart rate variability: measured by Chronocord; 6) neuro-hormonal Function, using non-invasive salivary cortisol and salivary alpha-amylase measurements; 7) acute stress reactivity; 8) chronic stress reactivity; 9) circadian measures, using assessment of urinary melatonin; and 10) stress physiology: Using hemodynamic and autonomic monitoring and salivary hormones.    
Objectives	The study is also conducted at the Concordia Station in Antarctica, Indian Antarctic station, Slovenia (hypoxia study), Graz control group. Comparing each study will allow us to test the hypothesis if hypoxia, isolation or altered light cycle is/are solely, in part, or not at all responsible for expected changes in sensorimotor adaptation, intracranial pressure, vascular changes, endothelial responses and stress physiology across these environments.
Resources requested	Per experiment: 1 hr / preparation, 1 hr suit tester time 1-2 tests with Aouda.X 10 tests without Aouda.X (out of sim?)
Logistics footprint	Totals: Weight = 54kg Volume = 0.09 m³ Power = 1.3kW (peak) & 0.45kW (average) Footprint = 0.06 m²

Compstress was not executed due to the inability to deliver the hardware in time.

13.3. ERAS C-3

Description	Command & Control software project for data processing in the field
PI	Franco Carbonari
Organization	Italian Mars Society, IT
Summary	Within the European MaRs Analog Station for Advanced Technologies Integration Project (ERAS), a Command, Control and Communication (C3) subsystem will provide the data processing and communications equipment required to: • monitor and control the habitat's environment and subsystems • monitor and maintain crew health and safety • communicate with mission support, rovers and EVA crewmembers • support data processing related to the mission objectives • host the core part of the crew operations planning and scheduling support system (Crew Mission Assistant, CMA) For the MARS2013 tests a C3 simulation will be running on top of the TANGO Distributed Control Software Framework. During the proposed experiment the remote communication with the Aouda.X on-board computer (in particular all main biomedical and engineering telemetry) and the interfacing to the CMA will be tested. 
Objectives	Location transparency: a location (naming) service should allow to locate a service over the network by name and/or required functionality. Message delivery and format integrity: the system must warranty that messages are not lost or duplicated and that they are delivered uncorrupted. Dynamic invocation of server processes: the client shall not be responsible for starting up the services it needs, but the system shall be able to do it transparently Load balancing: if needed, the system shall be able to redistribute the services to allow load balancing over the distributed servers Security: if needed, the system must be able to handle security of communication using appropriate secure protocols.
Resources requested	Access to MSC telemetry streams from the field Several hours of interaction with field crew
Logistics requested	n/a

Overview

The European MaRs Analog Station for Advanced Technologies Integration (ERAS) project is an extension of the Mars Analog Research Station (M.A.R.S.) program spearheaded by the Mars Society. It aims to address the major issues that could jeopardize a crewed mission to Mars and are not adequately being addressed at existing terrestrial Mars analogs

The ERAS Command, Control and Communication (C3) subsystem will provide the data processing and communications equipment required to:

- monitor and control the habitat's environment and subsystems
- monitor and maintain crew health and safety
- communicate with mission support, rovers and EVA crewmembers
- support data processing related to the mission objectives
- host the core part of the crew operations planning and scheduling support system

This document shortly outline the C3 Prototype tests performed during Morocco MARS2013 Field Tests

The functional diagram for the ERAS C3 Prototype is depicted in Fig. 1. The corresponding hardware architecture is shown in Fig. 2.

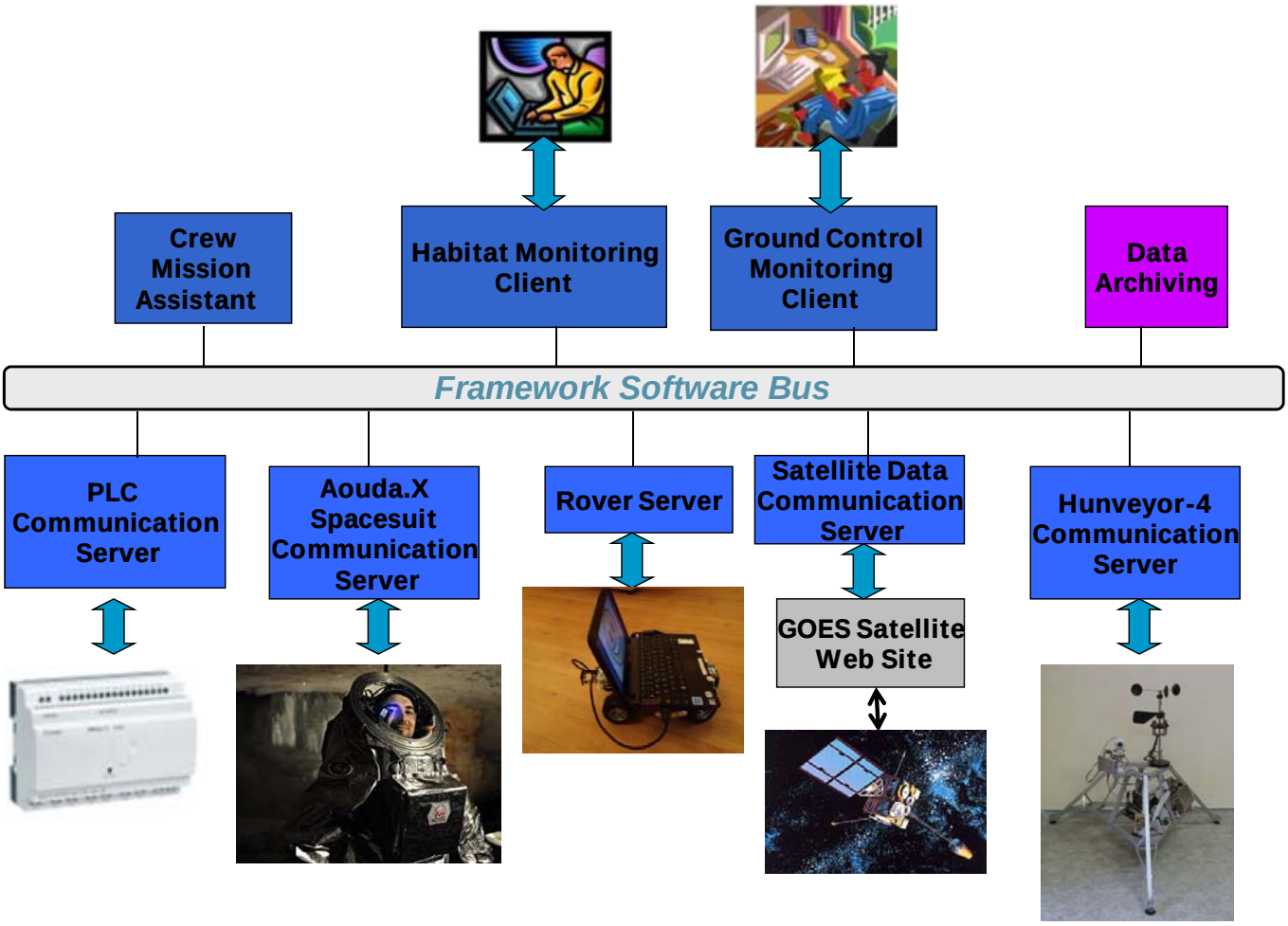


Figure 1

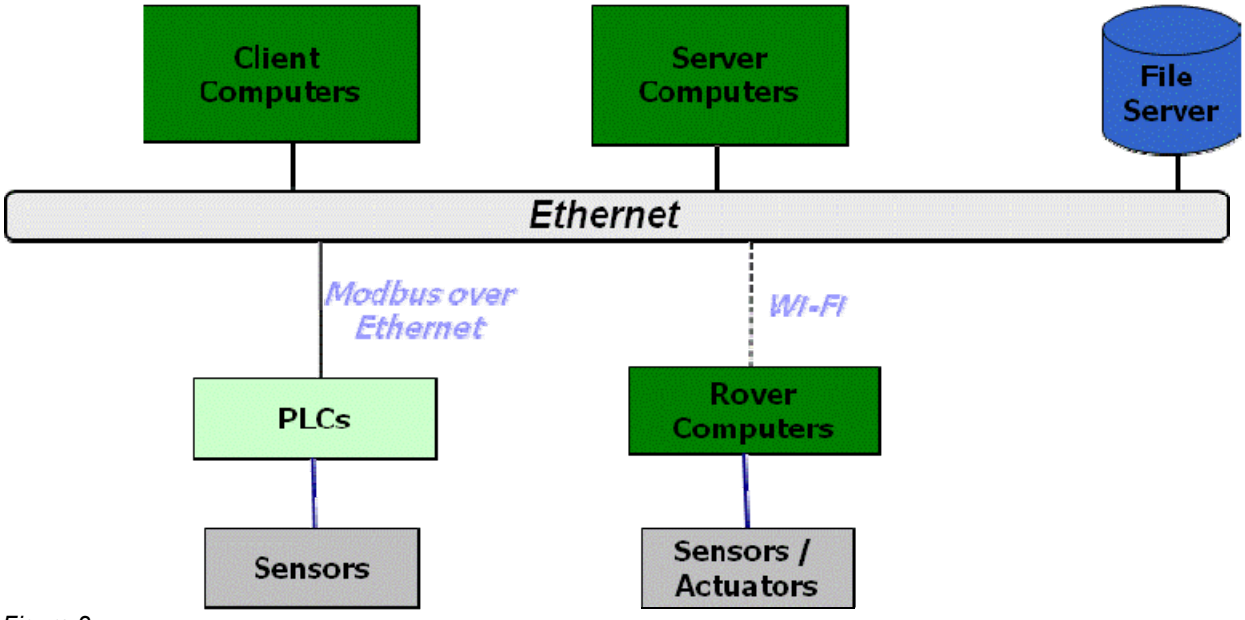


Figure 2

Control Framework Selection

One of the main technical choice needed for the C3 prototyping is the one of the Framework.

The various options which have been considered till now are: the MANGO SCADA (http://mango.serotoninsoftware.com). This Framework was used for the Habitat Monitoring and Alarm System which has been implemented during the MDRS Crew 102 mission.

The TANGO DCS Framework (http://www.tango-controls.org) Since TANGO seems providing all the needed basic functionalities and a great level of expandability for the moment is being used for the C3 prototype implementation. Other Frameworks could be adopted in the future keeping the C3 prototype hardware unchanged.

Functionalities

Of the planned C3 Prototype functionalities those are the ones we have implemented and tested for MARS2013:

- Communication with space suits
- Communication with space probes
- Neural Network dedicated to the detection of anomalous situations from space suit biomedical data.

Communication with space suits

The communication with Aouda.X (the advanced spacesuit designed by the Austrian Space Forum, OeWF) on-board computers has implied the development of a TANGO Communication Device Server (named AoudaOBDH). The development of the corresponding AoudaOBDHJava class implied modifications to the provided telemetry java library which have been integrated onto its officially released version. The communication link implement the capability to retrieve the Aouda.X Spacesuit telemetry data stream from a proxy server (Marvin proxy) in polling mode at low frequency (approx: 1 Hz). The communication has been successfully field tested during Morocco MARS2013 Mars analogue field campaign with very stable Marvin proxy behavior.

Communication with space probes

HUNVEYOR-4 is an advanced space probe model that was engineered by the students at the Alba Regia University Centre, a campus of Óbuda University. As in the other cases, the communication with Unveyor-4 will imply the development of a dedicated TANGO Communication Device Server (in python). The communication link implement the capability to retrieve the data stream in polling mode at low frequency (approx: 1 Hz).

Data has been retrieved via the Redis (http://www.redis.io/) data structure server. Hunveyor-4 uses Redis to simulate the delay between Earth and Mars. The typical data available from Hunveyor-4 are the following: spectral composition of the light and diurnal variations, noise, humidity, temperatures, wind speed and direction, high energy particle radiation.

During the Morocco MARS2013 tests it has been possible to collect data from HUNVEYOR-4 but only from the provided test data queue with simulated data. During our staying at MSC in Innsbruck data collection from the field was never active.

Crew Mission Assistant

The Crew Mission Assistant Neural Network has been implemented as a python TANGO server able to grab needed data from the TANGO software bus and provided by the AoudaOBDH Device Server. For the purpose the Feed-forward neural network for python (ffnet, http://ffnet.sourceforge.net) has been used. The prediction of heart rate (HR) from physical activity (PA, represented by the AccelerationBody signal) has been implemented as foreseen in [1].

During the Morocco MARS2013 we had available very short data set were Heart Rate and Acceleration Body were both available from Aouda.X. Fig.3 shows the difference between the real heart rate and the prediction for the data sets we had available. The prediction was not very much accurate and this was quite obviously linked to the fact the heart rate from Aouda.X seemed not to be correct since fluctuating too much and too rapidly.

As soon as the whole data set collected from Aouda.X during MARS2013 will be provided to us we hope to be able to find more suitable data periods and make further tests.

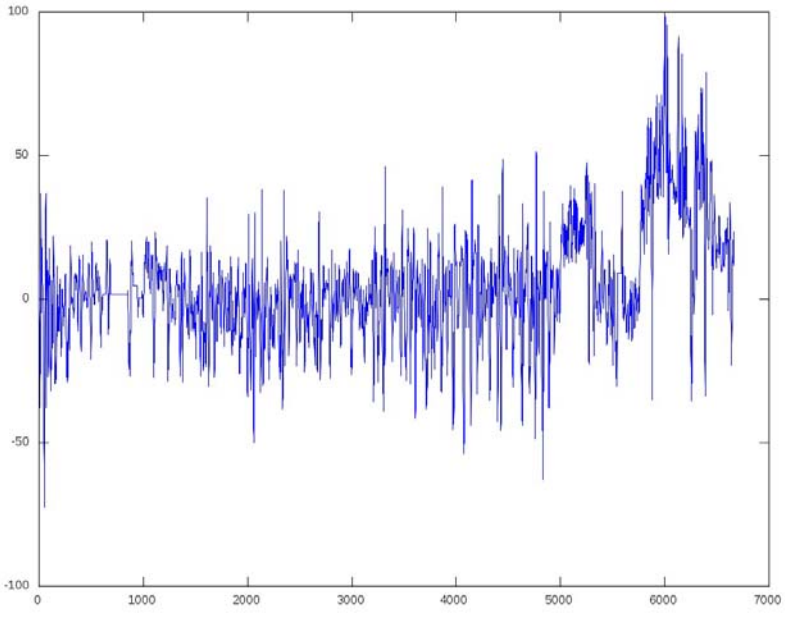


Figure 3

References

[1] Ming Yuchi, Jun Jo, “Heart Rate Prediction Based on Physical Activity using Feedforward Neural Network”

13.4. Small Rovers Exploration Capabilities (SREC)

Description	Assessement of small rover exploration capabilities (ATV-like vehicles)
PI	Dr. Jean-Marc Salotti
Organization	Ecole Nationale Supérieure de Cognitique, Institut Polytechnique de Bordeaux, FR
Summary	This project aims at evaluating the benefits and drawbacks of using an unpressurized rover in the field. We propose several experiments. There will be only two astronauts driving two small rovers. The first part of the work is to determine some interesting locations with very difficult access. It is important to select different categories of difficulties, sandy terrains, rocky terrains, high slopes, small cliffs and holes. In some situations, it should be possible to transport the rovers by hands. The objective is to assess the benefits of using such small rovers for the clearing of the obstacles. A questionnaire will be provided to the team in the field to perform a qualitative assessment. 
Objectives	We propose several types of terrain and obstacles to test for mobility 1) Sandy terrain: How easy or hard is it to cross a small dune or a small area where the crossing is a true challenge? 2) Rocky terrain: What kind of rocks (size, shape, and number) yields to difficulties and require bypasses? 3) Slope: How easy or hard is it to climb a hill or a mountain with the rover? What prevents from going further up? 4) Cliffs and holes: Is it possible to transport the rover in order to cross a trench or a small cliff? What are the conditions?
Resources requested	4 experiments in different terrains: 8 hrs (shared with other experiments)
Logistics requested	Needs pre-campaign ATV driving training in Austria with the suit Need a hiring of vehicles in Morocco (2 ATV's are planned anyway)

As of the release date of the Mission Report, the Data analysis is in progress. Results will be communicated at a later point.

13.5. DELTA

Description	Delay in Experiment performance and Live operations by a Test Astronaut (DELTA), an experiment in the field of Human factors - operation economics, time delay Aouda.X vs unsuited operations
PI	Alexander Soucek, MLaw, MSS
Organization	Austrian Space Forum, AT
Summary	DELTA is based on the conduct of six representative, repeatable and combinable dummy experiments of increasing complexity, addressing different aspects of operating with the Aouda.X spacesuit simulator. Three dummies focus on fine motor skills and spatial orientation, two on physical strain and balance, and one challenges combined operation complexity on a >200sqm obstacle course. Chronopoints (waypoints in time) precisely quantify the duration of assigned tasks. Each single operation is thereby measured in a donned (with suit) and doffed (without suit) situation. All times measured are finally plotted and interpreted, using statistical means, to derive a DELTA value characterising the average delay to be expected when operating with the Aouda.X spacesuit simulator. 
Objectives	• DELTA will quantify the delay introduced in live field operations when operating with the PolAres Aouda.X spacesuit simulator, as compared to a reference non-suit scenario. • The output of DELTA will be, for the first time and derived on statistical ground, an algorithmic value *(the DELTA value)* of time delay experienced when conducting experiments with the Aouda.X spacesuit simulator. • This value and its subsets will allow to better quantify or qualify Estimated Need Times (ENTs) for future experiments conducted during analog field missions, leading to an improved mission flight planning through time allocation optimization. • In addition, DELTA allows for deriving secondary information such as a benchmarking of future versions of Aouda, identification of design or operation criticalities, establishment of long-term time series and cross-calibration of the DELTA value with other experiments through the introduction of chronopoint measurements.
Resources	Suit tester time in-sim: > 3 x 2 hrs (if possible 6 x 2 hrs) Out-of-sim time for reference measurements: > 2hrs
Logistics	2 Aluminium Standard Boxes (80 x 60 x 60 cm) 30 kg each

The DELTA Experiment was set up and performed as outlined in the Mission Manifest v.3 and the DELTA Handbook. The DELTA Procedures version 2.0 remained the baseline, and this baseline was not altered. It proofed the right decision to significantly simplify the procedures prior to the mission, since DELTA per se already required a rather complex set-up with sub-experiments and a variety of different hardware.

The theoretical design of DELTA – both in terms of hardware and procedures – stood the test of reality.

What was actually accomplished? Technical highlights, insights, disasters,...

With an experiment of the complexity of DELTA, the preparation week was absolutely necessary in order to set-up and test all hardware – especially the obstacle path in the desert next to the base camp. Since the flightplan was so overloaded with requests, the preparation week was intensively used to do science already; this led, at least in the case of DELTA, to frustration, since several slots were lost for science due to set-up questions, last-minute swops or other needs (e.g. media). Even though well meant by the planning team, one should in the future better distinguish between set-up / preparation and actual science execution; whereas the first is by

definition work in progress, the second should be used with utmost care for getting the relevant payload / experiment data.

A negative aspect was the fact that the DELTA experiment procedures were not well known even after arrival in Erfoud. The handbook was not used (which however is the fault of the DELTA team, too, since it did not proliferate the final version of the handbook to the whole team, as would have been necessary); the first two crew members, tasked with the experiment set-up during the preparation week, had no idea or any knowledge of the actual hardware and the names and abbreviations used in DELTA, and therefore the DELTA PI from Austria had to guide them via internet communication through the basics of the experiment; the team members did a great job to quickly grasp the most important things, and later accurately set-up DELTA. But such "on-site" training could be avoided with a better preparation, to speed up things once in the field. The same goes for the MSC crew: two days of dress rehearsal seem not enough for a mission of this size.

The field crew did an excellent job in quickly adapting to the needs of DELTA, making up for missing in-depth training beforehand. However it turned out that the DELTA procedures (version 2.0), despite their very thorough development and formulation, contained some commands that were open for misinterpretation (and have been misinterpreted, consequently). Example:

Experiment 4 ALSEP; Suit Tester command #8

"Unreel blue cable in direction West"

From this command it was not clear what "unreel" means; whereas the DELTA team thought of having the astronaut walk westwards (also this was not an accurate enough description) while unreeling the cable, it turned out that during the first execution of ALSEP the astronaut looked in westerly direction while standing still and unreeling the cable next to his feet. This was not the astronaut's fault since the command was not crystal clear. A sketch in addition to the description might have helped.

The above problem would by the way not have been detected from "Earth" if it were not for the helm camera of the astronaut: just by coincidence the blurry image delivered to Earth showed a "cable chaos" next to the feet of the astronaut, indicating that he understood "unreeling" wrongly; only thereafter action could be taken. This leads to the following lesson learned:

As expected before the mission start, the meteorological conditions – partially strong wind – were challenging with regard to the DELTA Obstacle Path, but this problem was solved (in part by

purchasing camping hooks and bringing them to the field, in part by the fact that enough days with calm weather allowed the experiment to be executed).

Although the upfront flight planning gave plenty of opportunities for DELTA, the actual performance was much less than expected based on this planning. In the end, due to an exceptional effort both on the planning side and the field crew side, sufficient DELTA runs were performed to make the experiment a success, but this "last minute effort" was somewhat surprising considering the plenty of time originally considered. In a first analysis, the following factors were found to have impacted and reduced actual performance time:

Procedural and training factors: several slots were "lost" (for science) because they needed to be used for setting DELTA up and performing it correctly.

Human factors: several slots were lost because the analogue astronaut was not in the physical condition to perform the experiment (e.g. due to exhaustion, high CO2 level, etc.); sometimes experiment runs had to be interrupted or aborted; other slots were lost because of misunderstandings (e.g. the astronaut thought only one run had to be done, and so he proceeded to the next experiment although there was still time left to perform another DELTA run).

Time and planning factors: several slots were reduced because donning procedures took longer than expected or other "on the spot requirements" influenced or altered foreseen planning.

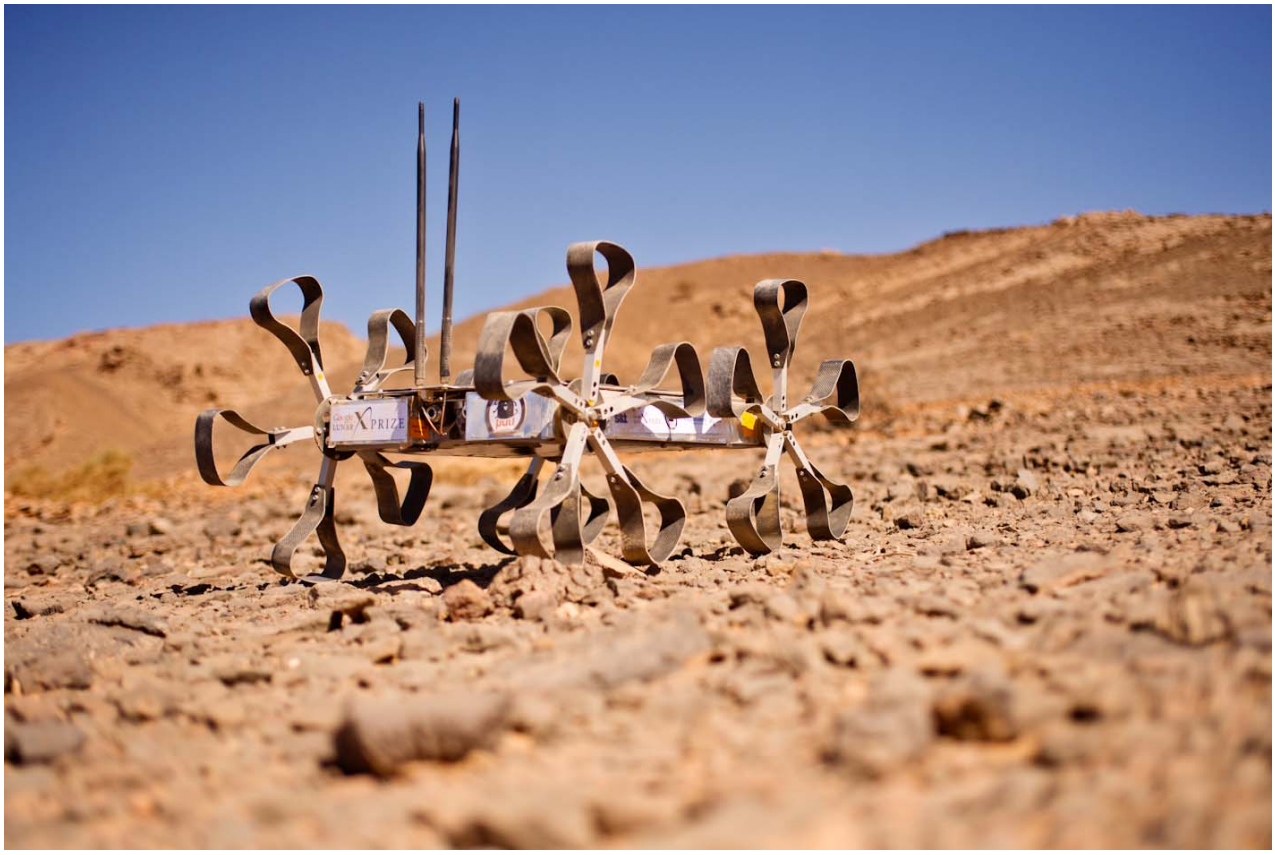
Weather factors: several slots were lost because of adverse weather conditions (too much wind; sandstorm). Technical factors did not play a role. This means that the DELTA hardware was operational and usable during the entire time of the field mission.

Summary:

The DELTA experiment of MARS2013 is a success. The experiment's planning was adequate to meet the actual field requirements. The procedures were sufficiently simple and clear and allowed to meet the most challenging requirement, i.e. the exact repetition of tasks by several astronauts over the time of a month. The hardware was robust enough to withstand the shipment to the field and the daily utilisation. The tasks requested were doable under field conditions. The data collection with the use of a "data sheet" was a good way to freeze the science output in real-time and on the spot. The presence of the DELTA assistant – required by the procedures – was important. It led to the idea of having "experiment assistants" for complex experiments in future field missions. The field crew showed a high level of compliance and was in the end responsible for carrying home the success of this interesting experiment.

13.6. Puli Rover

Description	Mobility tests for the Hungarian GLXP rover
PI	Dr. Tibor Pacher
Organization	GLXP Space Technologies, HU
Summary	Puli Space is the Hungarian team striving to create the smartest rover of its kind within the GLXP competition. The Puli rover is a small, 4-wheeled 10kg construction, capable to move on rough terrain up to 45 degrees slopes, escaping ability from craters moving ability in deep regolith (much finer grains than sand), and on rocky surface remotely supervised navigation based on stereo camera pair and forwarding high quality pictures to mission control thermal, current and voltage sensors 
Objectives	proving mechanical and thermal durability, stability of all rover subsystems stability of standard RS485 ModBus communication between sensor/actuator driver microcontrollers and the onboard FitPC handling of thermal, power consumption of the 4 space-grade Maxxon-motors, battery state-charging characteristics during different tasks and environmental situations navigation based on using stereo cameras, images are sent back to Mission Control for analysis and building up 3D environmental of the rover; demonstration using the Satellite Tool Kit software and its online Earth database (product of Analytical Graphics Interface, US) implementing some autonomous rover behaviour scenarios in case of emergency situations (eg. return to last good place when communication is lost)
Resources requested	Min. 3 x 8 hours, on various environments (may be extended depending on possible other rover test plans). Remotely operated from the Mission Support Center in Innsbruck Bandwidth: 350-400 kB/s
Logistics requested	100 W for charging batteries 100x60x60 cm, total weight 13kg



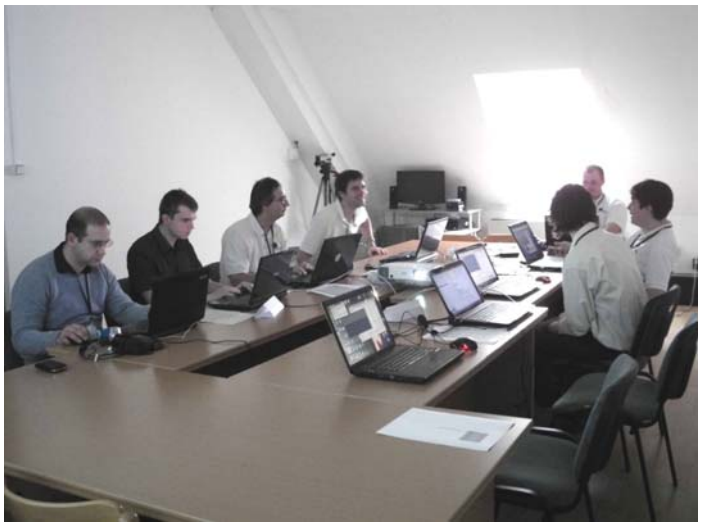
During our experiment the set up was similar to the ÖWF's mission support center. We had a **flight director**, a **rover driver**, a **telemetry person** assisting the driver, a **communicator** with our field members and basically everyone else who were not in the Mission Control room, including the ÖWF capcom. We also had a **hot spare person** and a **mediacom** to collect good photos and keep contact with our blogger.

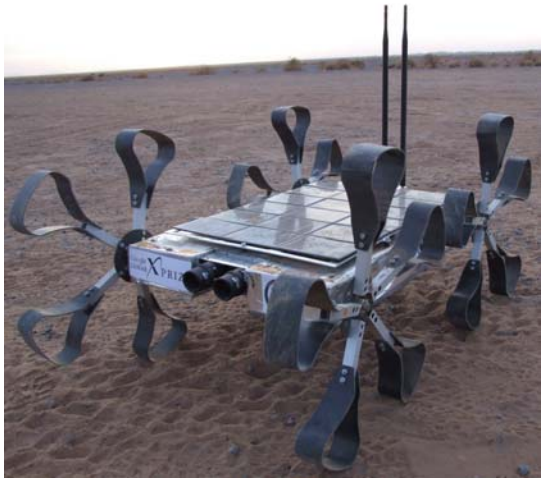
The experiment itself had a very good result detailed as follows:

Key elements of experiment plan in Mission Manifest	**Implementation during 5 running days**
Mechanical rover design ready for use on hard terrain	Succesfully performed, 100% total performance
Remote controlled battery/power management	Succesfully performed, managed >8 hours runs
Telemetry data including thermal conditions of rover	Succesfully received and stored in database
Stereo camera pictures documenting rover movement and supporting remote controlled	Excellent series of pictures obtained, remote navigation was successful

run on difficult terrain	
Mobility test on sandy, rocky and steep (>30deg) terrain	Partially performed, runs were limited by WiFi coverage
Use of solar panels for charging on last running day	Omitted due to weather conditions and time shortage
Test of own Flight Software - Mission Control setup	Succesfully operation during all running days

In summary, we planned originally to test as much capabilities relating to GLXP mission as possible, and it was done successfully. Due to WiFi coverage problems and bandwidth limits we weren't able to provide a Mooncast, but both hadware and software setup performed well so this task can be done well in future experiments.





Analysis of subsystem and team performances:

Rover mechanics, wheel-legs:

On the hardware side, the rover performed very good, we were able to operate on every official run day, the onboard system operated fine. The only unusual thing during the runs were a strange situation where we gave our rover a long forward command but during the execution the rover just took a 180° turn, we suspect due to a high rock which have slightly lifted one side up, so the wheels that touched the land just turned the rover around.

Rover electronics, power management:

We have found out that during the normal conditions – with carefully planned slow movements - one battery could go for abour 8 hours before the system switched on to the seconds battery, of course this highly depended from the previous charging day's length. A technical thing is the temperature profile we have acquired during our runs, usually when we got turned on during the mornings, the temperature of the batteries were around 1°C or 2°C and this could go up to 37°C during the runs.

Software, communication:

The only technical problem we have encountered was the network problem, during our runs we have occassionally entered into areas which had poor WiFi reception, so sometimes we have lost the connection to the rover for half an hours or so, just to have the connection back again for another 2 minutes and then lose it for another half an hour.

On the last day however we were able to locate a good area, and we measured that **the WiFi signal was the best in the area where the suit experiments were carried out**. In those areas the wifi signal was almost as strong as in the workshop tent.

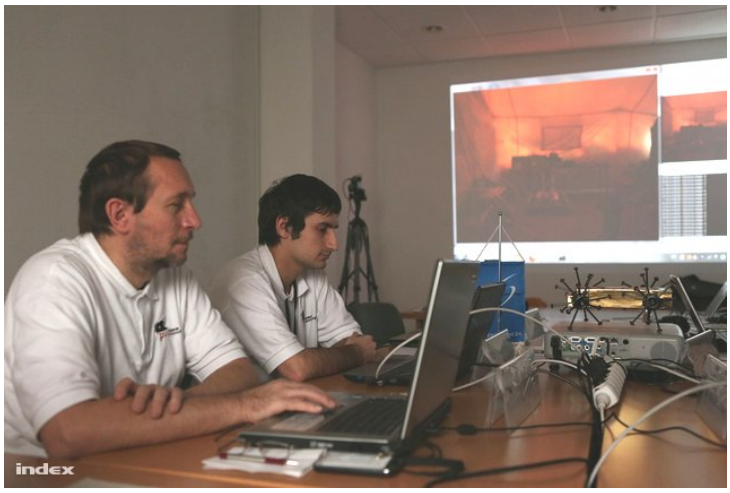
Mission control team, MC center setup:

The runs could forge the Mission Control team into a highly efficient group, we have learnt how to cooperate with each other. The mission planning and mission executing procedures earned us a

lot of experience. The areas provided in our map (which was provided by the RSS team) were suitable for the planning, we have tested multiple fields and during the normal operation, we haven't encountered any problems as we were able to move controlled and safely on any kind of surface.

Media activities:

Arranging the Mission Control room in the Budapest Town Hall – possibility granted by Mayor of Budapest – gave us a splendid base for public outreach.

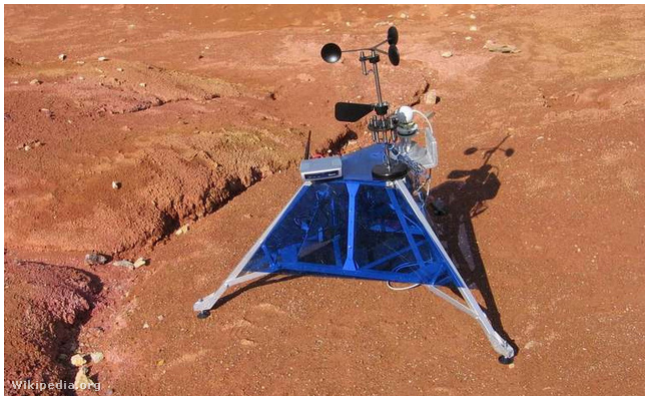
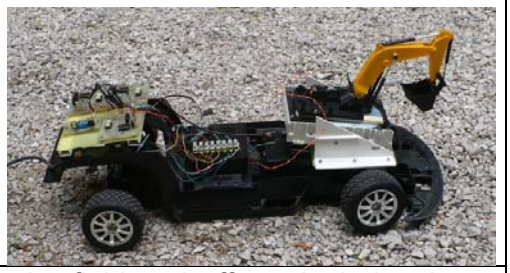


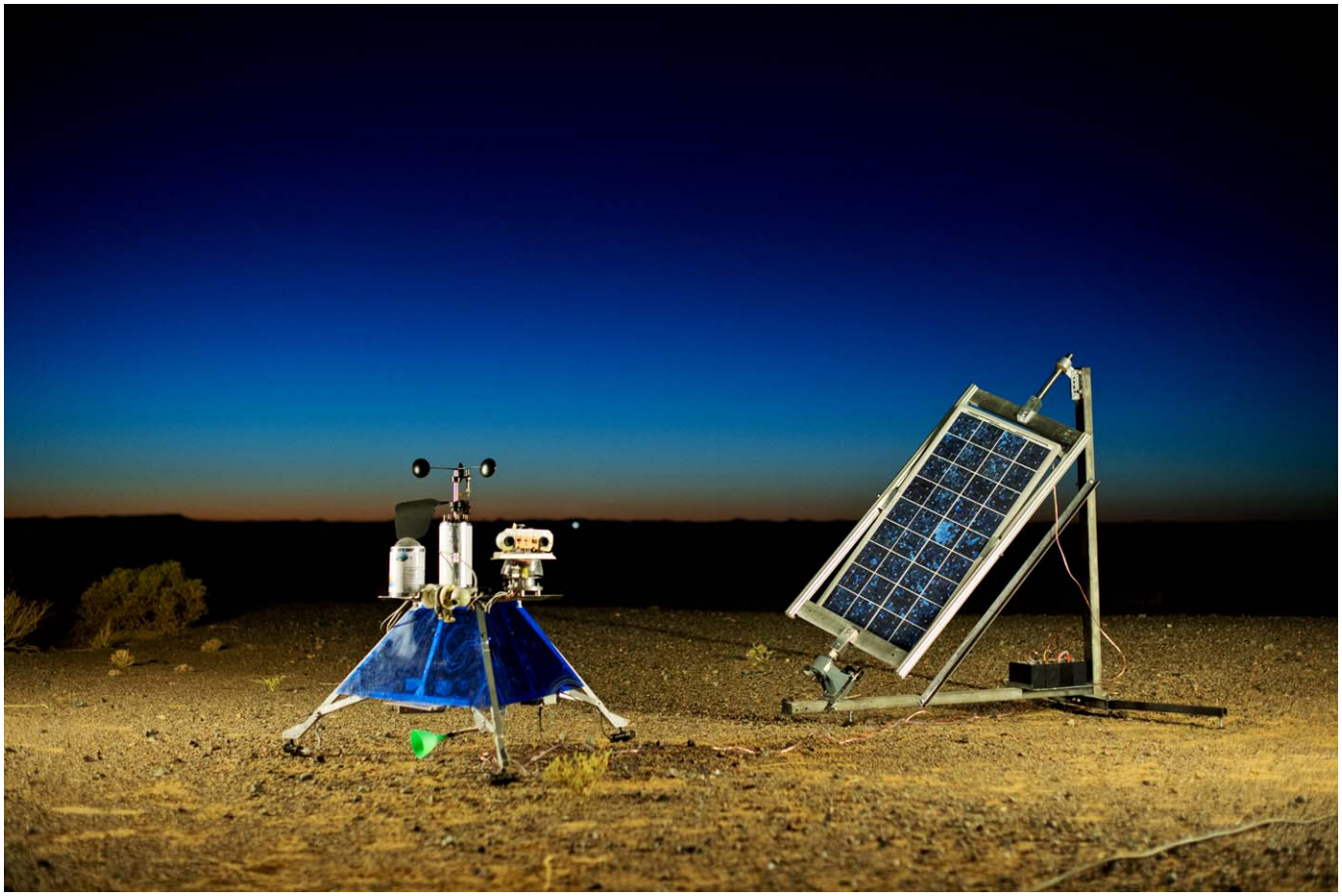
How could we improve? (Logistics, interaction with teams, insights, lessons learned, observations, opportunities missed etc...)

From your side, the communication have improved a lot after the first few days, but we think the communication to both the field and the MSC should be improved as it was very hard to reach the MSC and the Field especially in the first days. We propose that **capcom, or a second capcom who is only responsible for communication with the other experiments (that weren't operated by the ÖWF crew) should be available on Mumble or Skpye during all the time when the experiments are performed**. The flightplan should also be a little more strict, but of course we understand that it's very hard to schedule all the on-going tasks properly, eg. there were a few occasions when we weren't plugged in for charging.

However when we could reach any of the ÖWF personnel, everyone was absolutely helpful and friendly, we have received every support we could get, so only accessing these people should be easier for future experiments.

13.7. Hungarian UNiversity SurVEYOR (Hunveyor-4)

Description	Surveyor-class robotic lander with remote access
PI	Dr. Gyorgy Hudoba, hudoba.gyorgy@arek.uni-obuda.hu
Organization	Óbuda University, Alba Regia University Centre, HU
Summary	The aim of the participation is testing the Hunveyor-4 in various real working situations, and study equipment behavior involving the simultaneous usage of various instruments. This includes withstanding for vibrations (e.g. transportability), withstand for meteorological situations, like daily temperature changes, dew and dust, continuous working and collecting data of its environment and climate. Our goal is testing our concepts and the mainly students built equipments. 
Objectives	testing Hunveyor-4 portability, and ability for continuous work camera observations of the quality of surface events and forms stereo-camera observations for guiding the sample collecting rover Instrumental measurements: monitoring insulation, spectral composition of the light and diurnal variations, noise, humidity, temperatures, wind speed and direction, high energy particle radiation testing the soil collecting rower: mobility, range, radio communication rough spectral analysis of the soil 
Resources requested	Suit tester for deployment and retrieval in the field and off-nominal situations. Otherwise autonomous operation during entire mission. PWR: 20-30 Watts, via batteries and solar panels 2 MB/snapshot every 15 min = 8 MB/hr Receiving end of a 2.4 GHz data transmission (parabolic dish provided by team)
Logistics requested	Shipping mass: 30 kg (lander + rover) + 20 kg (solar panels) Container: 1 x 1 x 1 m



Our aim was testing the Hunveyor-4 in various real working situations, and studying the equipment's behavior involving the simultaneous usage of various instruments. This includes withstanding for vibrations (e.g. transportability study), withstand for meteorological situations, like daily temperature changes, dew and dust, continuous working and collecting data of its environment and climate. We did not intended to make scientific grade instruments and measurements, but testing our concepts and the mainly students built equipments.

The actual set up changes at the time of the dress rehearsal:

1. Our 2.4 GHz wifi connection did not worked correctly, so we removed from the set up. The investigation (at home) revealed that a PCMCIA card was loose in the Access Point.
2. Due to an accidental shortcut the Sun tracking electronics was damaged, so we removed from the solar panel stand. As turned out, we could collect enough power without tracking.
3. We did not install the LED spectrometer for the rough spectral analysis of the soil.

Result of the field operation:

1. The HUNVEYOR survived the transportation
2. We could successfully connect to the device and could retrieve some data.

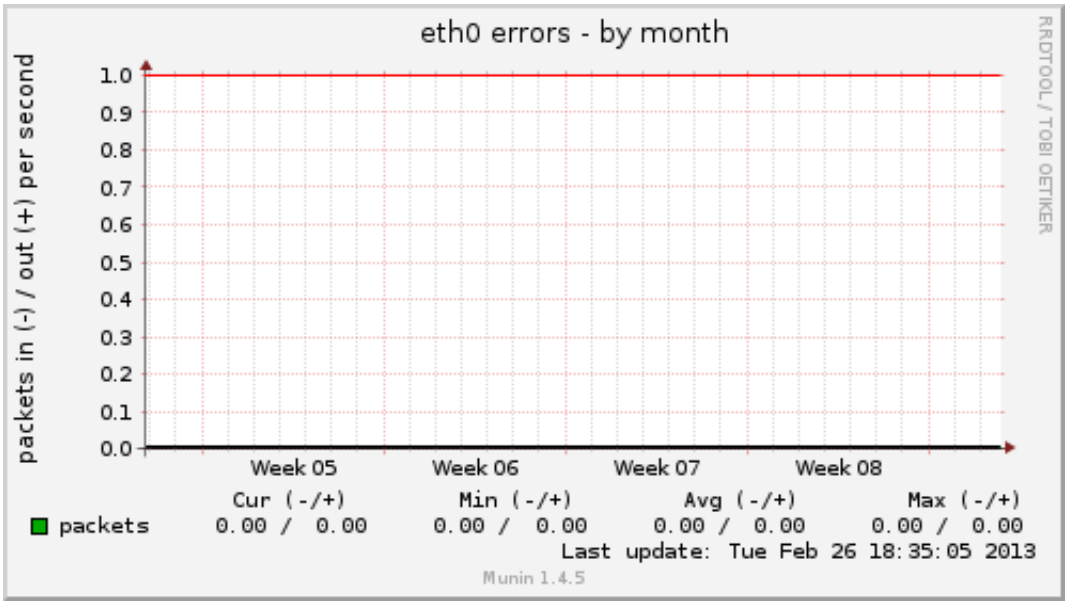


fig. 1. The network controller had no errors

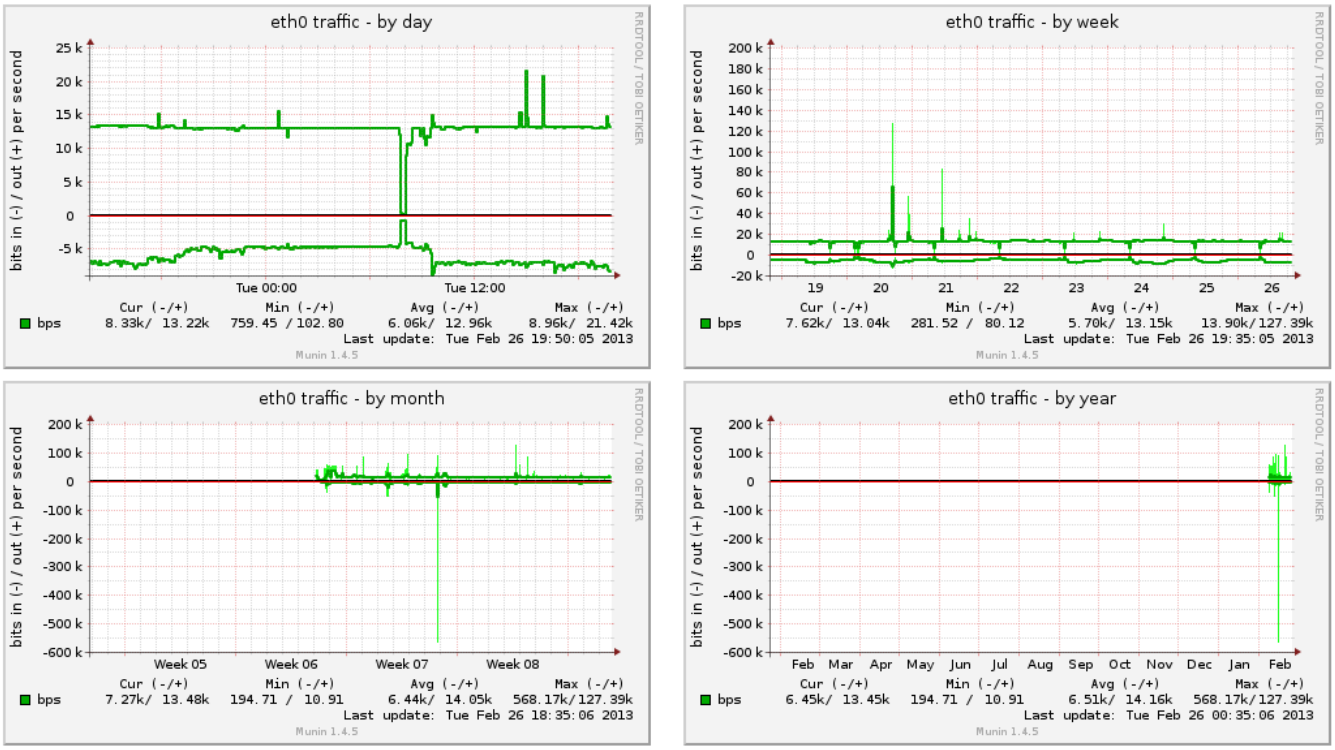


fig. 2. The network traffic summary taken on 26. February 2013. The graphs show the traffic of the eth0 network interface. (Please note that the traffic is shown in bits per second, not bytes.)

3. Unfortunately the connection was interrupted many times. The interrupts was due to power outages (e.g. oil change in the generators, everything shut down at night see fig. 4.), harsh weather conditions (e.g. sand storm), relocation or other network related problems.

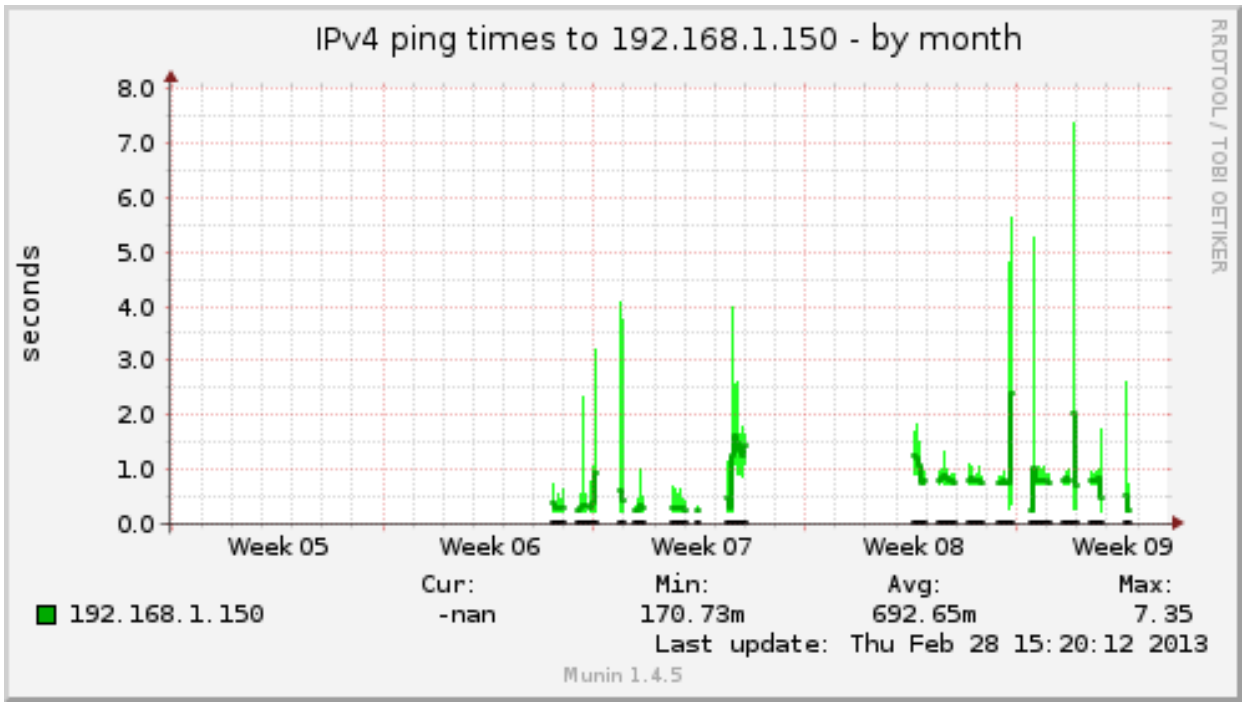


fig. 3. A long interruption, and sometimes extremely long ping time.

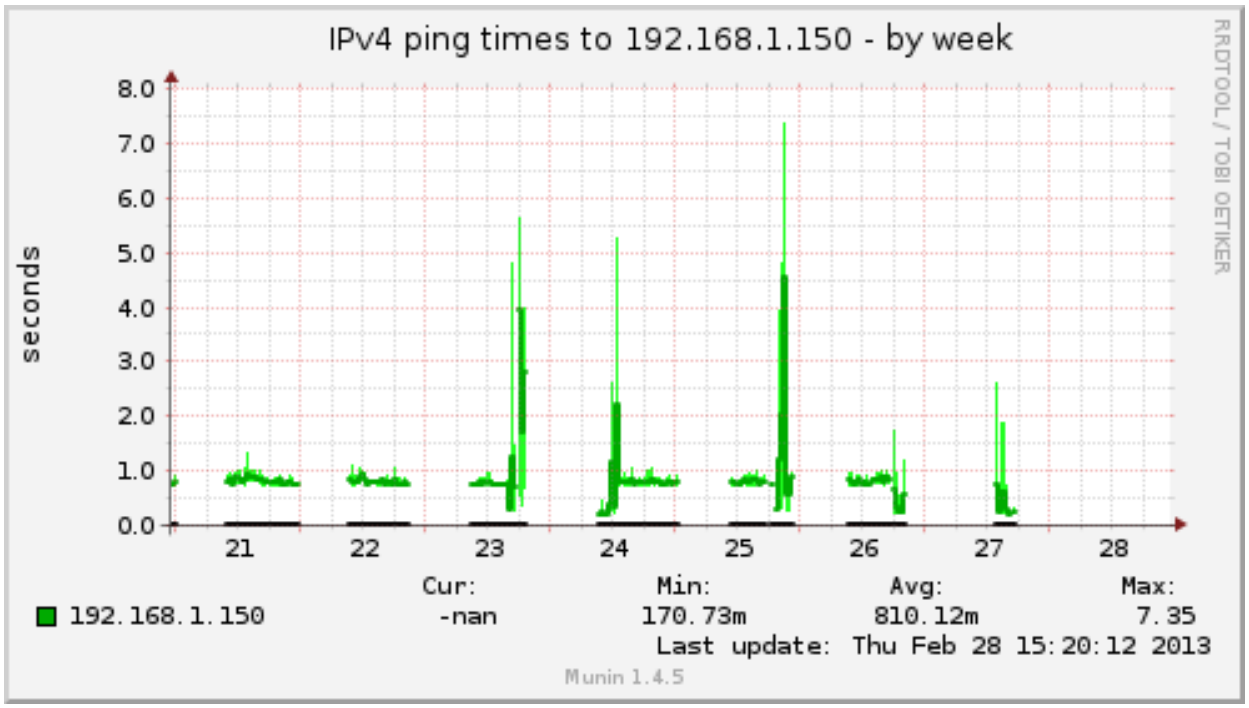


fig. 4. Connection record was taken on 28. February, the last week of the campaign.

4. The solar panel and the battery pack worked excellent, so the HUNVEYOR could have been continuously up more than 24 hours (fig. 5. and 6.). Despite of the original plan the devices, including the HUNVEYOR was usually shut down for the nights. Only one of the

nights the HUNVEYOR was not shut down, so we could test the performance of the energy module – the solar panel, the intelligent charger and the battery pack.

```
login as: root
root@192.168.1.150's password:
Linux hunveyor 2.6.32-5-486 #1 Sun Sep 23 09:17:35 UTC 2012 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Wed Feb 20 16:36:58 2013 from 192.168.0.2
root@hunveyor:~# uptime
 17:26:58 up 1 day, 51 min,  1 user,  load average: 0.08, 0.02, 0.01
root@hunveyor:~#
```

fig. 5. The HUNVEYOR worked overnight (uptime: 1 day 51 min)

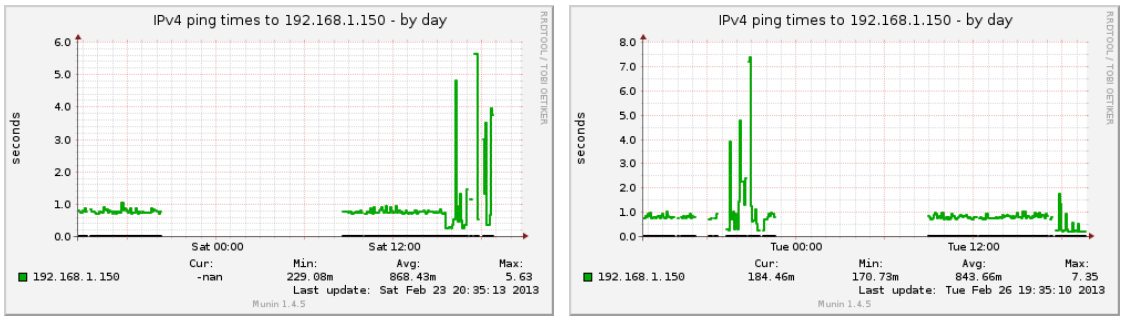
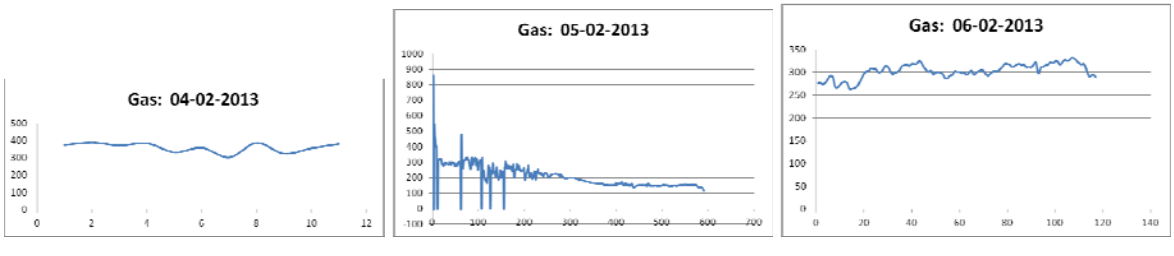
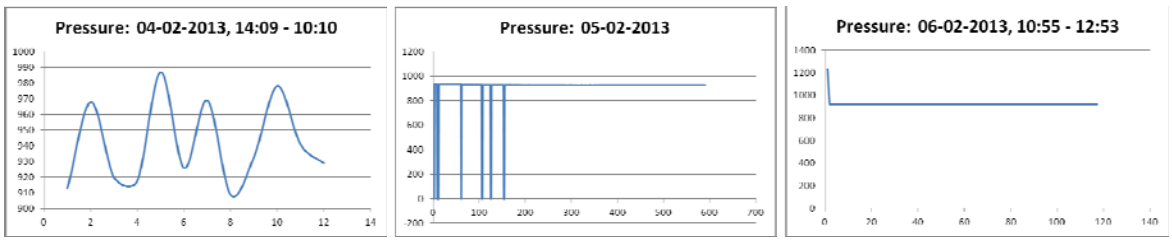


fig. 6. The HUNVEYOR was up at night 22/23 February, running from the battery pack. The interruption is due to network and power outage of the Base Camp. HUNVEYOR was running from the battery pack.

5. We have 619 data sets from the meteorological station for the following days:

04-02-2013 14:09 - 14:10 every 2 seconds, 11 measurements
05-02-2013 11:42 - 23:46 every minutes, 591 measurements, 10 drop outs
06-02-2013 10:55 - 12:53 every minutes, 117 measurements (the first data may invalid)





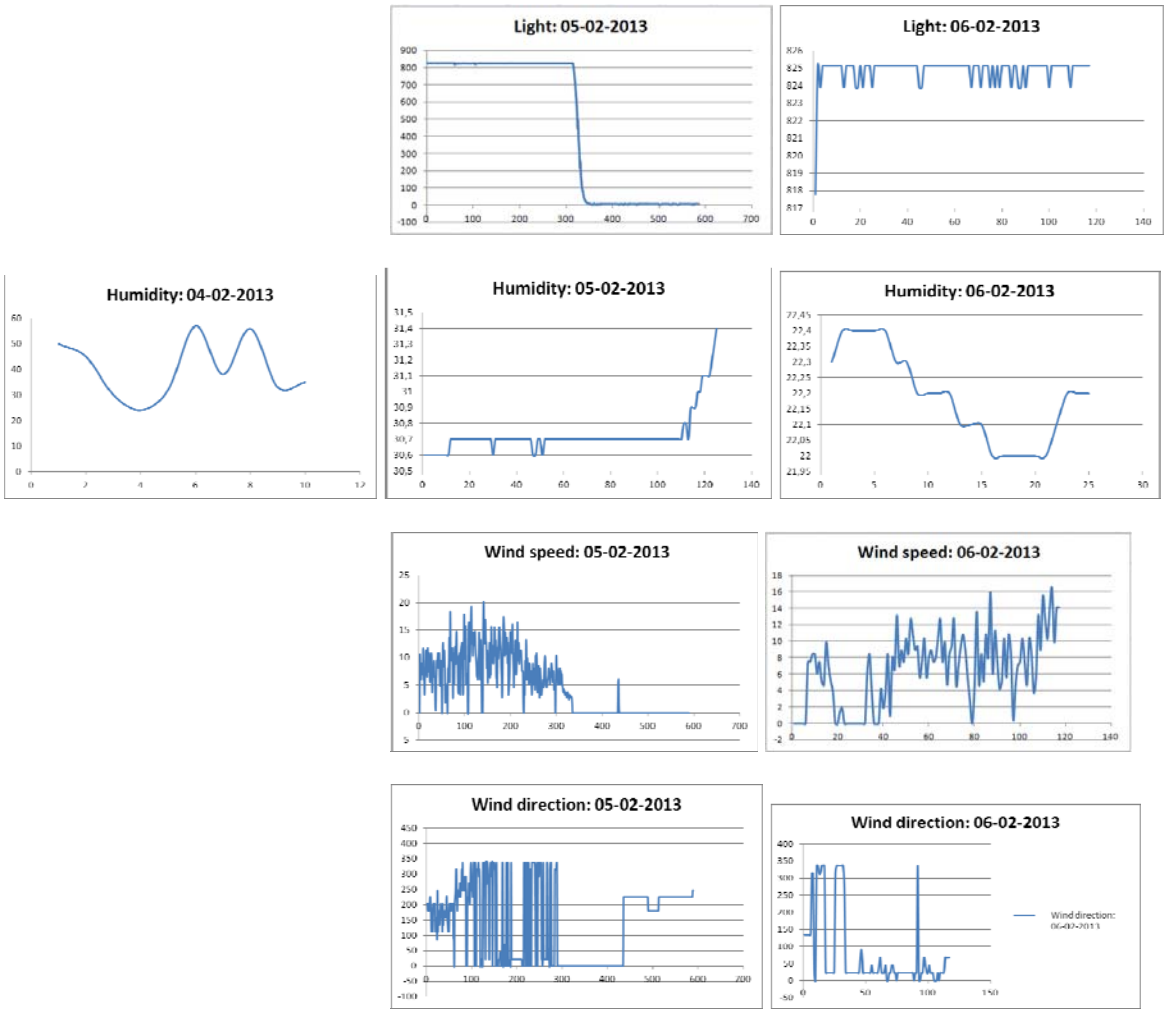


fig. 7. Our data obtained from the meteorological station. Check the sunset on 05-02!

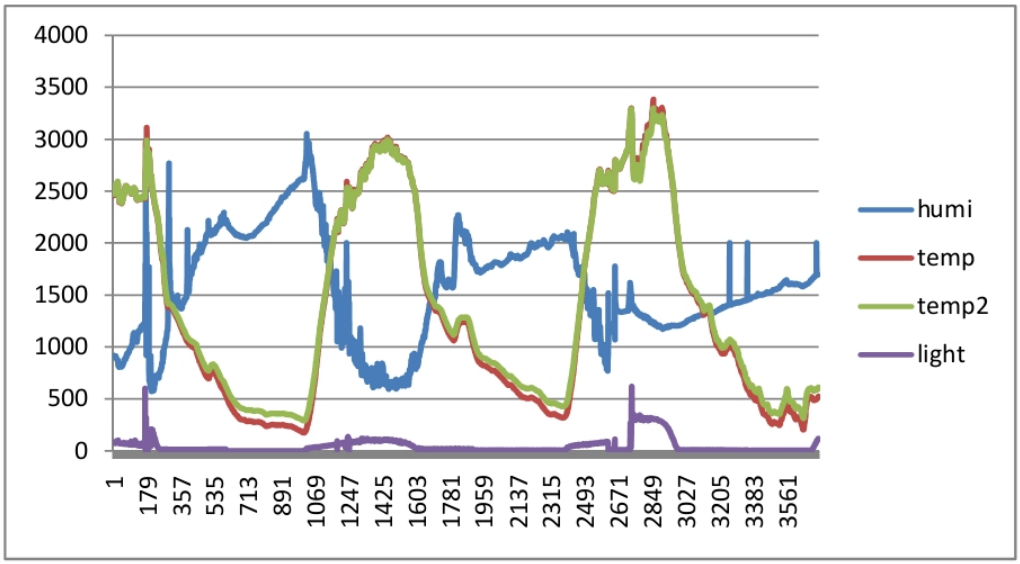


fig. 8. Data sets retrieved from one of the MOTs (the little blue boxes/mobile sensors). The data spans from 04-02-2013 14:37 until 07-02-2013 07:01. The measurements were taken in every minutes.

6. Unfortunately, after a few days only from the start of the campaign, we lost the control to our devices. The loss could be due to the USB controller failure for one group of devices (we lost the complete meteorological station) and battery drain to the others (MOTs), or could be even a software failure too. We can clear up the problems only after the devices will be back to our laboratory. Still there is a hope to retrieve more data from the on-board flash memory of the MOTs.

7. Because the USB failure, we could not use the cameras, so the camera observations of the quality of surface events and forms were cancelled.

8. Because we had no pictures from the stereo camera, we could not test the sample collecting rower.

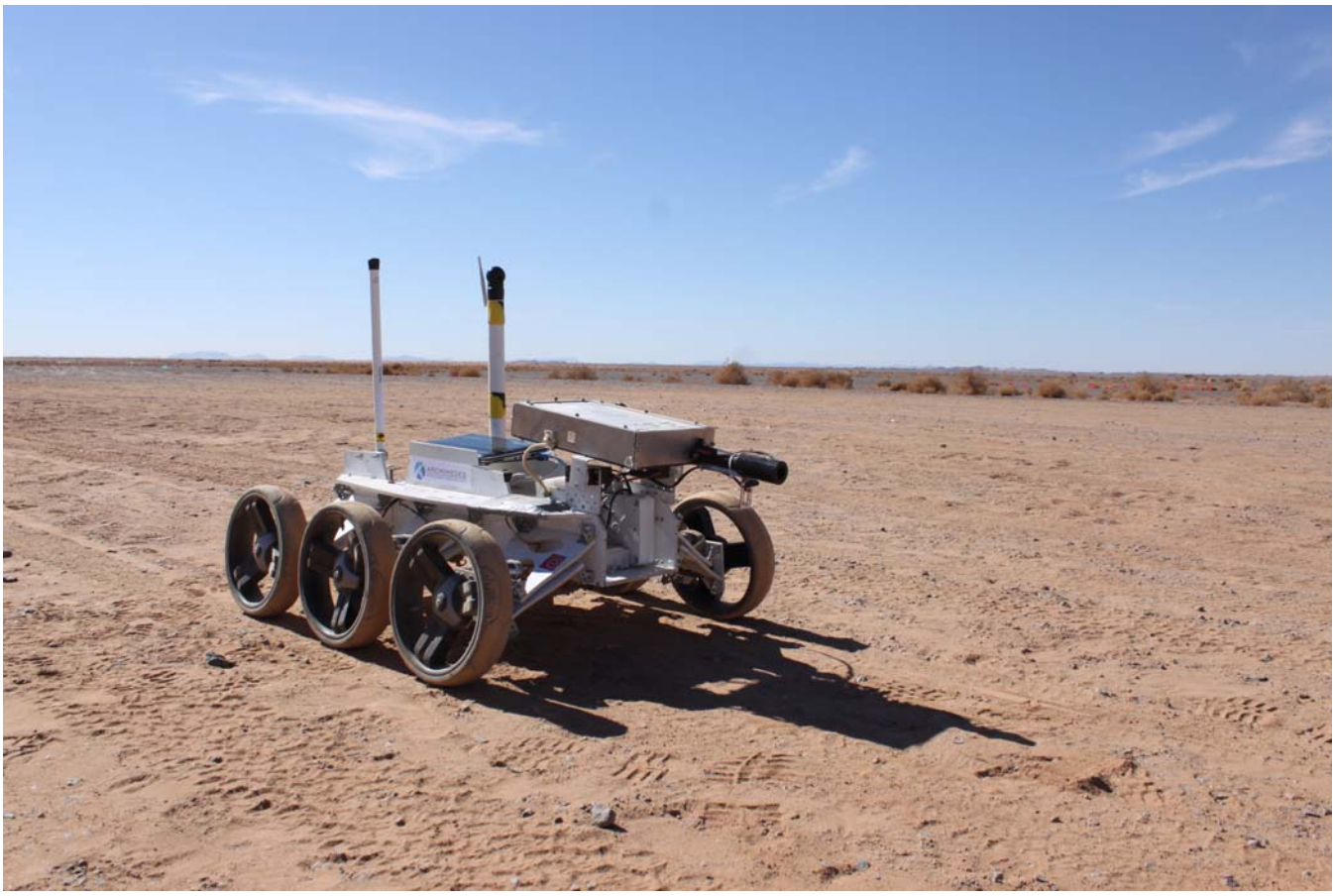
13.8. Long-term medical monitoring system (LTMS)

Description	Long term medical monitoring system, biomedical chest vest
PI	Dr. Marc Correvon
Organization	Centre Suisse d'Electronique et de Microtechnique SA, CH
Summary	CSEM developed a system for ESA for the continuous recording of a large set of physiological data. This "SENSE"-hardware and is able to monitor: • high-quality ECG with dry electrodes, online heart rate • respiration by impedance plethysmographic (breath rate), • 3D acceleration and activity (lying, standing, walking, running), • skin and ambient temperatures. The SENSE system is highly integrated and includes two stand-alone electrode sensors clipped in a fitting single-layer vest. The system is cableless and able to stream data in real-time to a platform embedding Bluetooth (Smartphone or tablet PC). This platform, based on Android OS, can display data. 
Objectives	Functional demonstration under field conditions: The multi-signal vital-sign monitoring vest (SENSE) will be used on the subject wearing the spacesuit simulator, the signals will be streamed in real-time by means of a Tablet PC/Smartphone based on Android OS which will at the same time relay the signals via wifi to a gateway connected to the internet. Then, the signals will transit via a server to which several clients (PC terminal) can be simultaneously connected, e.g., one at the MSC, one at OPS, and one at CSEM/Neuchâtel. Each terminal will run dedicated software that will display in realtime the physiological signals.
Resources requested	Suit tester time requested: X (< 5h per session) Duration of experiment in the field: X+5min Power requirements: rechargeable batteries, recharge after 5h
Logistics requested	Communication: < 400 bytes/s Storage/shipment size & weight: ~1 kg WiFi between Android-based smartphone and OEWF COMM infrastructure

No Experiment feedback received

13.9. Magma-White Rover

Description	Pathfinder-class rover system, mobility & human-robotic interaction
PI	Mateusz Józefowicz
Organization	ABM Space Education & Mars Society Poland
Summary	**#1 Magma White rover** as a measuring mobile platform for the L.I.F.E. laser. This is the main instrument of the MAGMA rover for MARS2013 allowing for the identification of biomarker molecules (chlorophyllium and phycoerythrin) with a laser resonance signal. **#2 Hand gesture remote** steering of Magma White rover. This experiment will use our new rover steering software, dedicated to astronauts. It will allow the astronauts to steer the rover using hand gestures. 
Objectives	The goal of this experiment is to further check how Magma White rover can be used as a mobile science and measuring platform. During the Morocco 2013 simulation we'll continue this experiment, using the L.I.F.E.-Laser (Univ of Innsbruck & Kinohi Institute, California).
Resources requested	TEST #1: 4 days x 4 hours with ABM Space Education team (no suit time requested) , WiFi, 4 days x 4 hours TEST #2: 1 days x 4 hours, Suit tester time requested : 2 hrs
Logistics requested	Magma White rover (200cm x 150cm x 100cm, 35 kg),



For the purposes of *Magma White* runs the team has distinguished three terrain categories: easy (flat, hardened and loose sand surface with fine gravels), moderate (loose sand and diversified gravel size, dry bushes present, periodical shallow stream beds, relatively poor Mars analog), hard (rocky hill slopes with inclination up to 50%, diversified rock sizes). Operations were performed during the day, with temperatures reaching 20°C. The rover was stored for the night in a non-heated tent, while the temperatures dropped to 1°C. Additional difficulties included presence of fine dust and strong winds, every 5-6 days. ABM SE did send a team of 3 to Morocco to install *Magma White* rover in the base camp and perform the communication test with the Innsbruck MSC and the ABM SE headquarters in Toruń. The team left after 5 days of non-simulation mode activities. ABM SE's first simulated sessions were performed from Innsbruck MSC, and the remaining sessions from Toruń, through the MSC. All telemetry, video and control data were available in all the locations. *Magma White* did connect to the base camp network via 5 GHz connection. Two basic mission operation modes were employed: simulation (sim) and non-sim. For non-sim natural signal, video and command delay resulting from the network and satellite band and link quality was present. On the field crew side ABM SE's experiments required basically switching on and off of the rover and charging of the batteries.

L.I.F.E detector was the main payload for *Magma White* in Morocco 2013. Laser light from the tip has to be projected on a probed surface (preferably rock), where microbial life is suspected. The tip has to approach samples quite closely (about 1 cm distance was assumed), and proper flexibility of its movement had to be maintained. The instrument was installed in the front part of the rover (after removing of the standard robotic arm), on two servos allowing its tilting from vertical position (- 90 degrees in relation to rover plane) to servo-off traveling position (+20 degrees in relation to rover plane). This arrangement allows flexible approaching of probed samples. It does not allow movement to the sides, so the whole rover has to be turned. Additionally control laptop, connected directly to the rover's system through an Ethernet cable, was installed on the installation guides on the rover's deck. Eventually this connection was changed to direct connection to 2.4 GHz Polares Ops network. Working with L.I.F.E. has revealed several elements that have to be corrected, including implementation of the solution allowing shading of the sample from ambient light, and possible mass reduction, at least for the analog tests, since moving of a solid one-piece instrument consumes a lot of rover's power resources. For future payloads a modular approach is suggested, where only the manipulated head is placed on moving parts, and as much of other instrument systems as possible are placed in another fixed module. This approach is, however, difficult to achieve with and optical device, such as L.I.F.E., so limiting of the housing mass could be a good solution here. No Earth vs. Mars gravity mass-to-power calculations were performed for optimization of power consumption by the experiment this time. During the mission following main tests were performed.

• *Regolith slope runs,* run 1, non-sim, terrain: hard. Suspension tests on rocky slopes. Local control. Status: success.

• *Rover follow*, run 1, non-sim, terrain: hard. Exercise with EVA suit tester closely following the rover's path, rover as safety scout. Local control. Status: success.

• *L.I.F.E. local test*, run 1½ , additional workshop run, non-sim. First approaches of sample rock set in the workshop conditions. Implementation of autonomous instrument tip control. Status: success.

• *L.I.F.E. payload runs,* runs 1, 2 non-sim, run 5 sim, terrain: easy. Approaches of rock samples in the field, on a selected rock, sampling trials, test of handling the payload by the rover, power consumption tests. Status: moderate success, sampling method requires additional development.

• *Remote control test from Toruń with local supervision*, runs 2, 3, non-sim, terrain: easy to moderate. Establishing of overseas control link, the rover controlled from ABM SE headquarters, supervised locally by ABM SE team in Sahara. Trial runs. Status: success.

• *Presentation to the Moroccan Minister of Science and Higher Education*, run 4, non-sim, terrain: easy. Operated by ABM SE team from Innsbruck. With local non-ABM supervision. The Minister present at the field camp in Sahara.

• *Remote control test from Innsbruck, with local non-ABM SE supervision,* run 5, sim, terrain: easy to moderate. ABM SE team has moved to Innsbruck and all activities of the rover were supervised by the OEWF field team. Control commands and crew messages were sent by ABM SE team from MSC. Status: success.

• *Remote diagnostics with local non-ABM team*, run 6, sim and non-sim, workshop run. Performed by ABM SE team from Innsbruck. After losing of communication with the rover it was moved to the workshop by the field crew and diagnostic procedure was performed, step by step, with and without the field crew, with reestablishing of some vital rover functions. Status: success, no definite cause was defined, but the procedure was efficient and reestablished rover functions. The problem has not appeared again till the end of the mission..

• *Presentation to ESA delegation to Poland*, run 7, non-sim, terrain: easy. Rover operated from Toruń, monitored from Warsaw by ABM SE and ESA delegates.

• *Remote control test from Toruń, without supervision*, run 8, sim/non-sim, terrain: easy to moderate: ABM SE team has left MSC. Control commands were sent from Toruń, with MSC monitoring. Field crew participation limited to switching the rover on and off. Status: success.

• *Navigation and range test without GPS reference,* run 8, sim/non-sim, terrain: easy to moderate. Navigation basing on visual terrain features, analysis for future autonomous software processing. Testing of WiFi coverage in the base camp vicinity. Control from Toruń. Status: success.

• *Power source longevity test,* run 8, sim/non sim, terrain: easy to moderate. Free exploration run with L.I.F.E. payload removed. Control from Toruń. Status: 6 hours of operation confirmed, more available but not tested.

• *Joint run with Hungarian PULI rover*, run 9, sim/non sim, terrain: easy. MSC, PULI Mission Control Budapest and ABM SE headquarters were involved in running of this activity, together with the supervisory field team. Coordination of several control centers was practiced, operation of two rovers, navigating on visual system and taking photos of each other was practiced. WiFi coverage in the vicinity of the base camp was tested, by comparison of WiFi signal strength on each of the two rovers in the same and different locations. Additionally operation in strong wind conditions, with fine dust being blown onto the rovers, and their systems, including optical, was successfully tested. Status: success.

• *EVA suit monitoring,* run 10, sim, terrain: moderate. Test operated from Toruń, in coordination with MSC. Rover monitored EVA suit tester activities during Delta experiment. Practicing of coordination of rover actions with suit actions, to provide a mobile supporting, safety and

monitoring platform for EVA. Status: success, with remarks related to a requirement of dedicated procedure for joint activity.

• *Navigation test*, run 11, sim/non sim, terrain: easy to moderate. *Spot* tracking device installed on the rover, as additional GPS system. The aim of the test was to teach the driver and the route planning team to quickly correlate data from camera images with a satellite image and to decide on the optimum, safest moves, observe the results, observe the power level. Control from Toruń. Status: fair, with slight deviation from the planned route and with loss of *Spot* signal after 23 track points. Rover was driven to base without further position updates.

• *Component trials and analyses for Archimedes, TME and EPAR,* runs 1, 2, 3, 5, 8, 9, 10, 11 sim and non sim, all terrain types - Status: success, valuable data for the partners gathered.

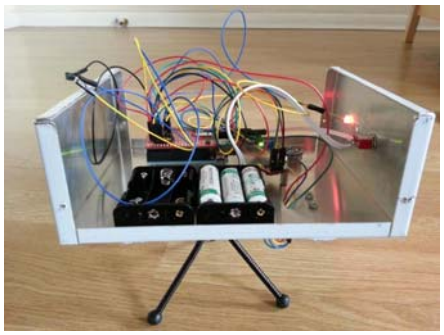
• *New software field trials,* all runs. Status: success.

• *New electronics field trials,* all runs. Status: success.

• *Dust influence trials,* all runs. Status: no adverse effects noted. Fine dust deposition to be confirmed after retrieval of the hardware from Sahara.

• *Prolonged usage trials,* all runs. Status: success. Only one failure noted during 11 main runs, and additional workshop activities, performed between 1st – 28th Feb, without direct, hands-on access of ABM SE team to the hardware from 7th Feb, after transportation in sea shipping container and car transportation to the field, storage in improvised conditions, in dusty environment, with large temperature variations. The failure was not caused by internal rover's problem, but by a problem on the interface between the rover and local network (probable low bandwidth cause).

13.10. MEDIAN

Description	Methane Detection by In-Situ Analysis with Nano-Landers
PI	Jane MacArthur, BSc
Organization	University College London, UK
Summary	We demonstrate the use of three low cost cubesat-sized devices for maping a region of Mars in association with a large scale lander mission, the methane outgassing from detected 'hotspots' on the planet surface. Detections made by ground based observations and from The ESA Mars Express orbiter have demonstrated at low resolution that methane emissions are occurring from the planet. It is our aim to dramatically improve the ground based resolution of these regions, using a matrix of triangulated smaller scale landers with integrated location and transmission systems. 
Objectives	• To determine what level of methane emissions can be accurately located by 3 nano-sat 'landers' placed according to a simulated drop. • To use lander triangulation to determine accurate positional data on the methane emission source region. • To demonstrate the feasibility of using low cost landers deployed from the primary lander during descent phase to do surface science.
Resources requested	The experiment will record 12 hours of daily data over 5 test days and 20 experiment days. Testing time requested: Set up experiment on five test days (half hour/day set up time), take environmental measurements, positional measurements. Upload data to laptop via USB at end of each experimental period (half hour/day). Power requirements – as per devices (battery operated)
Logistics requested	Storage/shipment sizes & weights – 3 nano-landers, 10cm x 10cm x 5 cm. 5 adjustable methane emitters, size 10 x 20 x 25 cm, Spare batteries.

Set up of my experiment was largely as expected. As methane hadn't been obtained, the field team managed to obtain butane in its place as fortunately the detectors were also sensitive to butane.

After seeing a photo of the setup on 10th February, I asked if the gas release could be nearer the ground as I had hoped for ground level release. The field team came up with a very good solution. It would have been helpful if this photo had been available on day 1 – for the future it would be useful to send every PI a photo of their experiment in action the first time to check it is what they were hoping for.

What was actually accomplished?

Useful test data was obtained over 6 days in order to ascertain appropriate distances to be used and to check the detectors were all working and all sensitive to the gas. This also made us aware of battery issues, which again the field found great alternative solutions for.

16 runs were then achieved according to diagrams of placements sent to the field halfway through the mission. (I appreciate these would have been helpful earlier, but also I needed to know how the detectors behaved and what distances were appropriate before I could make them – I regret there was not more time ahead of the mission to do some initial testing which would have been helpful.

The huge problem for MEDIAN is that HUNVEYOR failed to obtain any wind data, which was obviously extremely critical for MEDIAN. With hindsight I realise I should have found budget for a weather station given this was so key to my experiment.

How could we improve?

Much longer lead times ahead of the mission. After hearing my proposal was accepted in July, I didn't manage to achieve confirmed funding until early October, which left me just two months to design, build and ship the experiment, alongside my MSc course and business. Having a proposal accepted is very helpful to encourage funders to support such an experiment, but most funding applications have long lead times/one call a year and there were only a couple of channels available to me.

The experiment was run for long hours in the first few days, before I was given any data to find out there were problems. I would change my procedures to be more clear in the future about this, as it would be useful to analyse one data set before potentially wasting gas/batteries if something is wrong.

From an RSS point of view, PI's should have all attended the training weekend having:

1) Circulated final detailed procedures a month beforehand that should not change – these were not known to RSS until some days into the mission, and then I discovered they were working off an old set and not the latest versions.

2) Circulated a 'dummy' data set of what they expected to be sent back from Morocco during the mission (and data that would be too big and need to come back after the mission), so RSS knew what was expected

3) Brought their final working experiments to explain to everyone in detail

4) Established exactly how, when and with who they would remain in contact with Innsbruck during the mission – eg do they have to ask 3 times for the data or is someone responsible for sending it out to them daily without being asked

5) Had documentation available to show background, literature review, why the experiment was important, what the testable hypothesis was, for full understanding. RSS team should understand (and top level RSS team should be involved in) the rationale for the selection of experiments and PIs should be kept to timescales. (NB Realise with MEDIAN I had as many problems as everyone else with the deadlines, but in a better perfect world……

13.11. Microsphere and Endospore viability assay (microEVA)

Description	Luminescence detection of viable bacterial spores and terbium microspheres to identify desert microbiological hotspots and mitigate forward contamination.
PI	Dr. Adrian Ponce
Organization	NASA Jet Propulsion Laboratory, California Institute of Technology
Summary	The science return from field work could be increased by a portable field instrument that rapidly screens samples to determine those likely to contain greater amounts of microbial life, insuring that there will be sufficient biological material for further lab analysis of the samples. Using a portable instrument, we use viable bacterial spores as an indicator of biomass levels. With the same instrument used for spore detection, we propose to investigate forward contamination by measuring the transfer probability of luminescent microspheres from the suit tester to the sample during a variety of sample acquisition methodologies. Both the spore and microsphere detection is based on time gated imaging of the long lifetime luminescence from terbium ions. When viable bacterial spores enter the first stage of returning to a vegetative state (germination) they release a large amount of dipicolinic acid, a bacterial spore specific marker that favorably binds with terbium ions creating a luminescent complex when excited in the UV. By using a chemical germinant to induce germination in the presence of terbium we can measure individual viable spores.
Objectives	Test the forward contamination probabilities for a variety of sample acquisition protocols by monitoring the transfer of terbium microspheres from the suit tester to the sample.
Resources requested	Field CRW time requested: Spore experiment a minimum of two half days or 4 hrs x 2 = 8 hrs. Microsphere experiment: 8 hrs x 2 = 16 hrs. **Power requirements:** ~ 420 W (some of the instruments need 115 V (!)
Logistics requested	microEVA instrument: 39 x 33 x 59 cm (w x h x l), ~ 20 kg vortexer: 11 x 14 x 16 cm (w x h x l), ~ 4.5 kg vacuum pump: 10 x 12 x 28 cm (w x h x l), ~ 3.5 kg Tent with electrical power

No experiment report received – Data analysis in progress as of the release date of the mission report.

13.12. Deployable Shelter

Description	Deployable and portable emergency shelter suitcase for astronauts
PI	Dr.-Ing. Sandra Häuplik-Meusburger
Organization	Technical University of Vienna, AT
Summary	Test of a deployable and portable multipurpose (emergency) shelter prototype in case of emergency that requires immediate action and where return to the base / rover is not possible in time. The deployable shelter is compactly packed, lightweight and be carried by one astronaut. It shall be easy to deploy and accommodate up to two astronauts (with space suits). The Shelter shall be provided for a minimum duration but up to 48h until rescue arrives or immediate emergency ceases. 
Objectives	The prototype is a simplified mock-up of a deployable pneumatic structure. An outer layer provides protection and can be adjusted to the topological conditions of the deployment site (rocks, uneven terrain, etc.) The volume and shape is controlled by a mechanical device of rigid foldable frame elements.The main goal of the prototype is the simulation of its operability, durability (multiple deployments), function (human / equipment shelter) and adaptability.
Resources requested	On-Site in Marocco a team of three students is anticipated to test the deployment and retraction of the structure, its usability by the students themselves, leading to an evaluation of the design goals. Most of the testing will be conducted by the students and the university team. Following initial deployment and usability testing (3-4 days), we anticipate testing the structure one time with the spacesuit by OEWF (2-3 hours).
Logistics requested	“Rucksack”-size shelter compartment

Project Lead: Dr.-Ing. Sandra Häuplik-Meusburger, DI San-Hwan Lu, DI Polina Petrova
Students: Florian Aigner, Ottokar Benesch, Tzvetan Dineff, Nico Flieger, Daniel Galonja, Nikolaus Gutscher, Katarina Josipovic, Nikolas Karhan, Zuzana Kerekretyova, Thomas Kropatschek, Rene Mathe, Thomas Milchram, Markus Mitrovits, Benjamin Mrowetz, Aida Mulic, Alexander Nanu, Josef Öhreneder, Tanja Pavlovic, Marcin Puchalski, Kathrin Rainer, Markus Scherz, Nina Tica, Stephanie Toussaint, Kristoffer Stefan, Kristina Zodl
Medical Consultants : Simon N. Evetts, Medical Projects and Technology Lead, Wyle GmbH; Dr. Chan Sivanesan, Intern Crew Medical Support office, EAC
Consultant for Mocku-up Fabrication: DI Michael Schultes
Consultants on the AOUDA space-suit: Dr. Gernot Grömer, OEWF; Daniel Föger, Analog Astronaut OEWF, Physics student
Supported by: RUAG Space, Maritime Wien

THE EXPERIMENT:

A series of emergency shelter concepts has been investigated according to aspects of functionality and usability. After an evaluation by the experimenters and the student team the

prior design goals were implemented into a 1:1 mockup. This prototype was tested during the Morocco field study.

The preliminary measurable objectives were as follows:

1. DEPLOYMENT PROCEDURE

On-site the TU-student team and the OEWF analog astronauts tested the deployment procedure for the 'Deployable Emergency Shelter'. In particular the following activities were tested:

- Handling of the mock-up in packed state and transportation
- Deployment of the structure, including opening the package and inflating the floor membrane
- Deployment of the structure under topological conditions
- Retraction of the Shelter and
- Function of the selected pneumatic system

2. FUNCTIONAL USABILITY OF THE PROTOTYPE

The prototype was made to fit a number of human activities based on the most likely emergency scenarios during an EVA on Mars. The following emergency scenarios have been tested during the simulation:

- Scenario A: One astronaut loses consciousness but is still breathing
- Scenario B: Injury of an astronaut during an EVA
- Scenario C: Astronauts get exhausted and need to rest for a while

3. ERGONOMIC USABILITY AND ITS ADABTABILITY

All scenarios have been tested and evaluated according the following issues:

- Interaction between the proposed structure and its users (handling and activities in the shelter)
- Off-nominal situations to test the flexibility of the prototype
- Ergonomic and spatial suitability to actions and
- Individual perception of comfort in relation to these activities

POST-MISSION EVALUATION:

Not all emergency scenarios were tested by the student team and the analog astronauts. However the tests carried out provide sufficient information for the evaluation of the scenario procedure and for further development of the prototype.

- The tests indicate a good functional usability of the mock up. The shelter is easy to roll by one astronaut. The deployment (pop up) works as expected and takes less than a 1 min. Opening (unzipping) the shelter was tested a couple of times. Some difficulties were detected regarding the small size of the zips pull tabs. Additional ribbons were then connected to the pull tabs allowing easier use with the space suit gloves.
- The floor surface (pneumatic cushions) cannot be automatically inflated in the current mock up, thus the deployment procedure of the pneumatic floor cushions was not tested in regard to timing. In all tests carried out by the analog astronauts the pneumatic mattress was inflated before they entered the shelter.
- By design intention a specific amount of air pressure in the pneumatic cushions changes the curvature of the floor mattress, causing the upper part of the shelter to tilt over the heads of the astronauts and thus automatically closing the shelter. The shelter is then locked (zipped) by one of the astronauts using supporting ribbons. The closing mechanism implemented in the mock up is very simple and worked better than expected. It was noticed, that the simulation crew (without spacesuit) had sometimes difficulties to close the zipper, whereas the sim-crew (with astronaut shoes) did not. In addition all parts have to be constructed with high precision in order to work well. The stick used as an aid to enter the shelter was sometimes a barrier in closing the shelter. While getting out of the shelter the astronauts sometimes had to kneel, but they do not see it as a problem.
- The prototype was designed to allow functional adaptability including sitting position as well as lying position for the astronauts, necessary for procedures in respective emergency scenarios. The change between the two positions is achieved trough air shift between two supporting pneumatic cushions, one in front and one in the back of the shelter. This adaptability was tested with two astronauts inside the shelter. The mechanism worked well and fast but the ergonomic usability in the lying position was not sufficient. The problem was that the life support system on the back and the antenna did not allow the astronauts to lean back and they did not feel comfortable.
- It was possible for the not injured astronaut to take off the helmet of his injured teammate. More free space to move and for facilities to deposit the helmets could be implemented in a next prototype.
- Astronauts claim that sitting in the shelter is very comfortable and really allows them to relax. The measurements of the astronauts CO_2 values (carried out by the ÖWF) also support this claim. The sitting height is sufficient. The position of the arm-supports is alright (but could be 5-10 cm higher).

- Rolling of the ‘suitcase’ is a good option (Carrying it like a rucksack is not possible with the Aouda space suit, because of the position of the life support system on the astronaut´s back).
- If tested in the dark, small lamps and/or phosphorescent elements (zipper sliders and ropes, stick, maybe the contour of the shelter) should be integrated.
- The deployment on a slope and rocky surface worked well. The mechanism that allows adjustment to terrain conditions is working well.
- Although retraction of the shelter was not the main design focus, it was tested by the analog astronauts. The folding procedure was not possible by one astronaut. For two astronauts it was possible but took too long.
- For initial testing the concept for the pneumatic system forming the sitting position and separating the interior from the Martian surface worked well. For further development some adjustments have to be made. For maximizing user comfort and to prevent undesirable weight redistribution leading to destabilization a more differentiated chamber configuration is needed (additionally, the inner pressure might be increased). External parts like the control panel and the inflation system have to be integrated in the shelter structure to avoid the need of post-deployment operations from the exterior. Finally, manually operated actions should be minimized or avoided. If possible all system-related procedures should be automated and controlled using an interface.

13.13. Aouda.X spacesuit

Description	Test series with the most recent configuration oft he Aouda.X spacesuit simulator, focussing on Thermal Control System, the upgraded On-Board Data Handling and telemetry relay ("OPS-Box")
PI	Dr. Gernot Groemer
Organization	Austrian Space Forum, AT Technikerstr. 25/8, 6020 Innsbruck Austria, gernot.groemer@OeWF.org +43 (0)676 6168 336
Summary	"Aouda" is able to the mimic border conditions a real Mars spacesuit would provide during a surface EVA, like weight, pressure, limited sensory input etc… • Aouda.X is the prototype with full sim-capability • Aouda.S is the simplified and lighter version, mostly for support activities to Aouda.X wherever a second astronaut is required. Performance envelope • 4-6 hours (incl. donning/doffing) field operations • Temperature limits: -110°C and +35°C (tested) • >1 km W-Lan range (can be extended with directional W-Lan) 
Objectives	Set of technical demonstrations, tear-and-wear patterns
Resources requested	230V Workshop capabilities for maintenance
Logistics requested	Transportation boxes: 5 crates @ 1,5 x 1 x 1 m, 100 kg in total OPS-Box 1x1x1m, 50 kg Dignity Rover Box: 1x1x1 m, 50 kg // 1 x 1,5 x 1 m, 50 kg OPS-Box-Operator Seat: 1,5 x 1 x 1 m, 80 kg

Both the Aouda.S and Aouda.X suits performed nominal. No major electronics defects were detected, the expected tear-and-wear pattern was observed and due to a diligent handling of the hardware, the mechanical structures did not exhibit any major problems.

Communication

Using the Motorola handsets turned out to be a great help for the support personal, especially after assigning different channels for groups. (e.g. Safety and suits and an alternative working channel for crew members outside the suited activities).

However, the throat-microphones needed a precise positioning to enable a clear voice communication. In addition (probably due to the fact that it was not an original throatmike hardware from Motorola), the cable between the radios in the PLSS and the Push-to-talk button at the HUT caused a low-pitched interference signal. By aligning the cable with the hand-set antenna, this problem could be fixed. However, slight changes in the geometry led to the reappereance of the interference.

Structure

The Suit outer layers and underwear did not face major wear problems, except for a few textile seams which did were fixed in the field. The helmets suffered minor scratches in the Visor due to the dust deposit. An PMMA-polish would probably have been a good idea.

The WIFI antennas mounting in both suits suffered from the activities in the Deplyable shelter: There is no way the analog astronaut can feel if his antenna is touching the shelters' hull. Hence, if the partner would not have checked the position of the others antenna, a break of the antenna could have resulted. In fact, in Aouda.S, the antenna mount within the PLSS broke loose at one point and had to be refurbished during the Station Payer phase.

The BME telemetry should be improved. BME 'telemetry' means both on the one hand biomedical data (ECG) and suit environmental data (CO2, O2, humidity and temperature) and on the other hand helmet video data. This is sometimes confusing, so to clarify its is proposed to use the terms "medical telemetry" for physiological data (e.g. ECG), "environmental telemetry" for suit environmental data (e.g. CO2, O2 etc.) and "video telemetry" for the video stream. Every suit (including Aouda-S) used should be equipped with a complete set of telemetry and every signal should be transferred to the console in the field and to the MSC (with time delay).

The helmet absolute temperature and helmet relative humidity measurements were very inconsistent, usually being sent only in the beginning of the simulation, and completely missing later on. It should be checked if this is an OBDH technical issue and if it is possible to get a larger range (up to 20.000 ppm).Additionally telemetry should be completed by pulsoxymetry , endtidal-CO2, body temperature and blood pressure. Currently the suit-environmental CO2 measurement is one the main sources of information for the BME about the suit tester's health status. This is not an ideal situation because this measurement is not very specific and does not correlate well with the suit tester's subjective assessment of their health status. A much more useful approach to monitoring CO2 levels would be to include also an end tidal CO2 measurement, which could be incorporated into the suit, alongside the drinking hose. Also having live realtime pulseoxymetry would go a long way to ensuring that the suit testers' condition is nominal.

Make sure in the future that mission critical pieces of hardware that can break and would be difficult or impossible to acquire in the field (like very specific SSD) have at least one spare copy of the part in mission hardware so there is a redundancy without needing to ship extra hardware to the mission area. Before the next mission such a list of critical parts should be generated and the necessary items acquired. This might be a task for a

"Technical Officer" residing in the MSC, that has an intimate knowledge about the suit systems and is preferably also an analogue astronaut. Equipped with detailed documentation on the suit technology, he could improve the technical expertise in the MSC.

One aspect of operating more than one analogue suit was that the battery packs became a limiting factor for EVA duration. 4 hours was the maximum, with 7 hours or more for operating only one (Aouda-X) suit. More spare battery packs would extend EVA duration and allow more than one analogue astronaut to operate on complex long tasks. This helping each other also distributes the workload more evenly among the suit testers.

It has been suggested that the helmet camera should always record (offline) in high quality throughout the whole EVA. This should not be streamed to base or MSC but stored for later use (e.g. by RSS). Speaking of cameras: the Robocam on the OPS station between donning and doffing should point outside to see the work going on at the BASE or should point at the OPS console (seeing empty tent roofs is not interesting, seeing OPS staffed by BASE (or not) is interesting and increases mission awareness). Also BASE should keep responsive, even – or especially – during medical or other emergencies, otherwise the MSC cannot support anything.

The operation of Aouda-X and -S should be done more independently from each other, using redundant OPS computers. This will make it especially easier to operate suits in two different locations. To increase the usefulness of Aouda-S, it should be brought to the same technological level as Aouda-X. As the letters X and S are close to each other on the keyboard, typing errors occurred sometimes and this caused confusion. A different way of naming the suits should be discussed.

Various other changes to the suits have been proposed:

- water capacity inside suits needs an upgrade for desert conditions
- Mounting a suit knee pad makes sitting on quad much more comfortable
- a camera should *always* be taken on an EVA

- while driving an ATV a battery was audibly knocking against the HUT, which might also have caused a loose cable – suit configuration in a sitting position should be reevaluated
- putting on an ECG during donning without an BME or DOC present should be avoided to improve data quality.
- A way to store geoscience equipment on an ATV instead of the suits should be found
- Skiing googles (especially for the Safety Officer) are a must if you want to work properly in a duststorm
- with respect to bigger changes the suit transmission technique could be redesigned – using lower frequencies to solve the problem of short transmission ranges and reducing the effort in adjusting antennas and WiFi transceivers.

13.14. MAT/SEG/MEDINC

Description	• Stress, emotion and groupdynamics of the crew in the field and the members of the MSC during Analog Mars Field simulations) • Medical emergency database with recording of incidents and near-incidents in all participants during Analog Mars Field simulations • Medical data acquisition under various physical workload conditions & biomedical data telemetry
PI	Univ. Prof. Dr. Thomas J. Luger
Organization	Medical University Innsbruck thomas.luger@i-med.ac.at; +43 (0)676 83144 501
Summary	This experiment is an ongoing OEWF multi-mission study. During the campaign, the crew and the members in the MSC are working close together. These experiments during a simulation are stressful for the suit tester as seen in the "well-being" questionnaire and demand strong efforts from those working in the field and in the MSC. During baseline and the entire Analog Mars Field Simulation we evaluate emotion, actual exposure and stress experience **Data archive inputs:** Medical preparedness, emergency medicine and incidents recording & Long-term medical emergency database **Continuous telemetry of normal to life threatening ECG data in a dummy (technical approach):** Comparison of well defined ECG signals of a data generator, e.g. sinusrhythm, atrial defibrillation, extrasystolia, from the suit (without suit tester inside) to the server in comparison. **Emergency biomedical data telemetry:** The test subjects underwent a sequence of well-defined physiological workload patterns, whilst the routine monitoring data stream was relayed to the biomedical engineering team (BME). The suittester is performing the workload (a) near the Aouda-X and (b) in the fully – equipped Aouda-X, respectively. **Environmental parameter telemetry:** Biomedical environmental data will be recorded (a) in the closed suit without the suit tester inside using a data generator and (b) in the fully – equipped Aouda-X with suittester. The data will be transferred via telemetry between suit and the servers in the Base and MSC.
Objectives	The purpose of this study is to document the (near)injuries and illnesses sustained by all persons in the field and the MSC during the mission and to provide an insight into the frequency and severity of such incidents and into medical preparedness. Comparison of ECG signals of a data generator to check the telemetry quality.
Resources requested	On-site and MSC documentation, telemetry to the base and the MSC on-site recording in the field as control.
Logistics requested	Paperwork (questionnaires), process of closing and sealing, collection of the sealed envelopes by the science officer, transportation to Innsbruck by plane for reasons of namelessness (approx. 5 kg; no electronic transfer)

Results are confidential (biomedical data)

13.15. Geosciences

Description	Application of basic geo- and life-sciences tools for the general assessment of astrobiological potential of the test sites. This experiment supports also all other geo and life-science tests.
PI	Dr. Michael Rampey
Organization	University of Budapest & University Innsbruck Csilla.orgl@OEWF.org, Isabella.achorner@OEWF.org
Summary	The geosciences activities during MARS2013 investigate the operational concepts for planetary surface exploration activities. More specifically, the project seeks to discover imposed limitations in the amount of work area that can be covered as well as the daily duration and long-term number of work sessions that can be maintained.
Objectives	Additionally the project seeks to determine the limitations imposed by the pressure suit on individual geology fieldwork tasks, such as use of rock hammers and other standard, necessary tools. The ultimate goal of the experiment is to produce operations concepts that maximize effective use of the pressure suit despite its necessary limitations.
Resources requested	Series of geosciences-oriented EVA's, monitoring telemetry, positioning information of analog astronauts, workflow for monitoring the sample acquisition process. (>10 EVA's, 5hrs each)
Logistics requested	Sampling tools: scoops, sand samplers, basic geological tools (rock hammer, compass, magnifying glasses etc.) Return shipment of geosamples back to the laboratories in Europe.

This set of experiments is still in the analysis phase as of the release date of this report.

Details will be published in the MARS2013 edition of the Astrobiology journal.

Thermal inertia measurements (As an example of the geosciences performed):

Cave Exploration / Thermal Inertia Measurement

Date: 24Feb2013, 06:00-08:00

Gernot Groemer (PI), Luca Foresta

Location: Skyhole / Cavity

at N 31°22,551 W 004°03,280

Site description: cavity on top of a mud mound, with two openings towards the sky (1,5 & 3 m in diameter) and a third opening in eastern direction (about 2 x 5 m size).

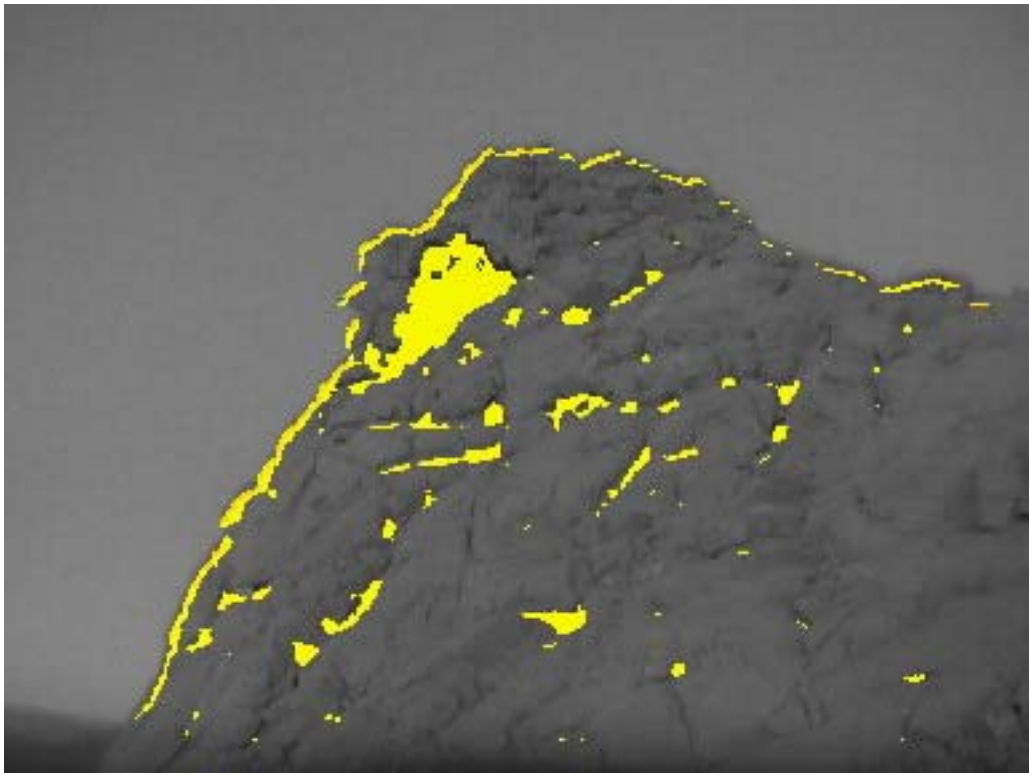
Context image: right

Cliffbot Data: available from 18Feb2013, 5 m rope lenght

Measurements were made with a Draeger UCF9000 FLIR camera, a-Si Microbolometer Array with 384 x 288 Pixel and a sensitivity between 7 to 14 µm. Temperature sensitivity is 0,035°C. Time sare given in UTC.

Local sunrise was at: 06:54 UTC

Local sunset was at: 18:15 UTC

Time stamp / Treshold	Overlay visible + above threshold (yellow)
Optical Context image: (UCF 9000 visual channel)	
06:25 / 12°C Comment: Air temp. : 10°C Rock temp.: 09°C Cave temp.: 14°C	

Suspected meteorite find

As trained, the field crew also looked out for potential meteorite specimens in the desert. There were two candidate found by Maria Aboulahris (University of Hassa II, Casablanca), who accompagnied the field crew as a representative from the Ibn Battuta Center. (See picture of one of the candidiate specimens below). The sample is currently being analyzed, but is considered as a likely candidate.

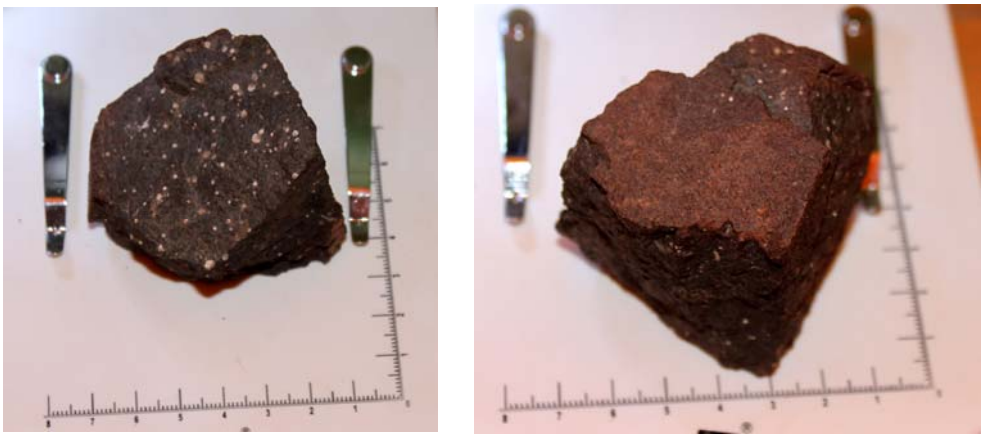


Photo: Suspected meteorite with fusion crust (right) and globules (white specks, left image).

13.16. Antipodes

Description	Antipodes is an operations experiment where a loss of communication (e.g. satellite is out-of-range) to Earth is simulated. A parallel landing party on the other side of Mars is requested to take over the coordination of an ongoing Extra-Vehicular Activity via their habitat's comms system and relay it to the experiment site via a satellite in Martian orbit until Earth is able to reestablish contact again.
PI	Haritina Mogosanu / Gernot Groemer / Diego Urbina
Organization	Kiwispace, New Zealand, www.kiwispace.org.nz haritina.mogosanu@kiwispace.org.nz,Tel. +64 21 269 2908 Skype: haritina.mogosanu
Summary	This is a communications experiment, linking the MSC, the Morocco field crew with an EVA team at the Mars Desert Research Station (MDRS) of the Mars Society, as well as the MDRS Mission Support during the Kiwispace and the Eurogeomars expeditions.
Objectives	Lessons learned during the Antipodes pilot experiment during the Dachstein field campaign in April 2012 covered clear communication and technology reliability. Whilst the technological part would not have necessary expected to have been remedied – as the mere objective of the experiments was a (simulated) technological failure, we identified improvements for the inter-personal communication to be tested during the MARS2013 campaign.
Resources requested	Mumble connection between the MSC, Morocco BASE, Aouda.X/.S, MDRS and the spacesuit simulators used at the MDRS. Suittester time during ongoing experiments to test the connectivity between the BAS, Suit(s), MDRS, Utah EVA team and the Mission Control Center in Wellington.

Data are in the analysis phase and will be communicated during the MARS2013 Science Workshop,

13.17. Complimentary experiments

In addition to these peer-selected experiments, there is a list of additional experiments complimenting the scientific activities

a) Peniculus (N. Sejkora, Univ. of Innsbruck)

A student experiment, devised at the University of Innsbruck during the summer 2012 “Unicamp”. This compares the voltage output of two solar cells with 0,5 m² each. One solar panel was swept by a brush once a day, whereas the other accumulated a fine layer of dust.

No major difference between the voltages was observed.

b) Distance measurement (C. Ragonig, FH Mittweida) “Yellow Box”

Using a high frequency signal emited by a base station, the signal travel time is measured to calculate the distance to the receiver. As on Mars there would be no GPS signal available, this could be used for a triangulation method to determine the location of a field unit.

The data analysis is still in progress, but the method certainly demonstrated its field usability.

c) OPS Box “White” (M. Schneeberger, Intarsico Design)

The classical base station for receiving the telemetry of the Aouda spacesuits has been expanded by an ergonomic design variant. This projects looked into the heat development in the electronics compartment of the OPS-Box “White”.

No major heat development was observed and a commercial prototype will be developed as a result.

14. Lessons Learned

Not to be detailed in the public version.

Appendix / Media Activities

Press: National (Österreich)

Reise zum Mars

Gemeindegut – Ausgabe 01 / März 2013. Weblink

Das Österreichische Weltraum Forum forschte in der marokkanischen Wüste für die erste bemannte Mission zum Mars. Innsbruck war Dreh- und Angelpunkt.

Die "Sneak Preview" auf eine reale Marsmission

DerStandard – 16. März 2013. Weblink

Heimische Raumanzüge bei Mars-Mission in Marokko unter Dauerbelastung getestet. Innsbruck - Ende Februar ging die bisher größte Simulation einer Weltraum-Mission zum Mars unter europäischer Leitung zu Ende.

Notfall auf dem falschen Mars: Flucht in „High-Tech-Biwak“

Krone Seite 10 & 11 – 12. März 2013.

So ein verstauchter Knöchel macht schon im eigenen Wohnzimmer keinen Spaß, geschweige denn auf dem ungemütlichen Mars! Während der Marokko-Mission des Österreichischen Weltraum Forums wurde genau das in der Wüste getestet.

"Marsexpedition" in der Wüste war erfolgreich

sience.orf.at – 11. März 2013. Weblink

Ende Februar ist die bisher größte Simulation einer Weltraummission zum Mars unter europäischer Leitung zu Ende gegangen. Über vier Wochen führten Forscher aus 23 Nationen den Test in der marokkanischen Sahara durch. Federführend beteiligt an der "Marokko Mars Simulation 2013" (Mars2013) war auch das Österreichische Weltraumforum.

"Sneak Preview" auf bemannte Marsraumfahrt

science.apa.at – 11. März 2013. Weblink

Innsbruck (APA) - Am 28. Februar ging die bisher größte Simulation einer Weltraum-Mission zum Mars unter europäischer Leitung zu Ende. Über vier Wochen führten Forscher aus 23 Nationen den Test in der marokkanischen Sahara durch. Federführend an der "Marokko Mars Simulation 2013" (Mars2013) beteiligt war auch das Österreichische Weltraumforum (ÖWF).

Aha-Effekte bei Test-Marsmission

tirol.orf.at – 20. Februar 2013. Weblink

Unter maßgeblicher Tiroler Beteiligung wird derzeit in der marokkanischen Wüste eine Mars-Mission durchgeprobt: von Tests mit Raumanzügen über das Sammeln von Gesteinsproben bis hin zu medizinischen Experimenten. Bislang sei das Projekt nach Plan gelaufen, heißt es.

Die Erde funkt von Innsbruck aus

Der Standard Page 15 – 13. Februar 2013. Weblink

Tiroler Forscher steuern Simulation einer bemannten Marsmission in der Sahara.

Für den Mars mobil gemacht

Tiroler Tageszeitung Seite 6 – 12. Februar 2013.

Gestern startete die dreiwöchige Marssimulation des Österreichischen Weltraumforums in Marokko. Vom Innsbrucker Kontrollzentrum aus wird alles genau kontrolliert.

Mars-Männchen in Marokko

Kurier Seite 26 – 12. Februar 2013.

Reise zum Nachbarplaneten. Astronom Baumjohann über Sinn und Unsinn von Mars-Forschungsprojekten.

Mars-Mission in der Sahara

Krone Seite 19 – 12. Februar 2013.

Unter Federführung österreichischer Forscher startete der Testlauf in Marokko.

Die Erde funkt von Innsbruck aus

derstandard.at – 12. Februar 2013. Weblink

Mit dem sogenannten "Landing day" hat das Österreichische Weltraumforum (ÖWF) am Montag seine "Marokko Mars Simulation 2013" (Mars2013) in der nördlichen Sahara gestartet.

Mann am Mars

Tiroler Tageszeitung Online – 11. Februar 2013.

Mit dem sogenannten "Landing day" hat das Österreichische Weltraumforum (ÖWF) am Montag seine "Marokko Mars Simulation 2013" (Mars2013) in der nördlichen Sahara gestartet.

Weltraumanzüge im Härtetest

Tirol.orf.at – 11. Februar 2013. Weblink

In Marokko startet die heiße Phase der österreichischen Mars-Simulation, die von Innsbruck aus gesteuert wird. Am Montag beginnt man mit den Tests für die Weltraumanzüge. Auch die amerikanische Weltraumbehörde NASA ist an dem Projekt beteiligt.

Die Austro-Mars-Simulation in der Sahara hat begonnen

derstandard.at. – 11. Februar 2013. Weblink

Mit dem sogenannten "Landing day" hat das Österreichische Weltraumforum (ÖWF) am Montag seine "Marokko Mars Simulation 2013" (Mars2013) in der nördlichen Sahara gestartet.

Weltraumforum startete Mars-Simulation in Marokko mit „Landing Day“

wienerzeitung.at. – 11. Februar 2013. Weblink

Mit dem sogenannten "Landing day" hat das Österreichische Weltraumforum (ÖWF) am Montag seine "Marokko Mars Simulation 2013" (Mars2013) in der nördlichen Sahara gestartet.

Die Austro-Mission zum Mars hat begonnen

Nachrichten.at. – 11. Februar 2013. Weblink

Jetzt wird es ernst mit der österreichischen Mars-Mission in der marokkanischen Wüste. Nach monatelanger Vorbereitung ist das Österreichische Weltraumforum (ÖWF) unter Leitung des aus St. Florian bei Linz stammenden Astrophysikers Gernot Grömer (37) im Feld-Camp in der Nordsahara angekommen.

Wie Astronauten Baumarkt-Technik weiterentwickeln

Futurezone.at. – 5. Februar 2013. Weblink

Einige mobile Elektrowerkzeuge, darunter auch der Akku-Bohrer, finden ihren Bedarf zuerst im Weltraum und erst später auf der Erde.

Austro-Mars-Mission in der marokkanischen Sahara

derstandard.at – 31. Januar 2013. Weblink

Internationales Team unter Leitung des Österreichischen Weltraumforums soll Erfahrung für künftige Marsbesuche sammeln.

Keime im Weltall

diepresse.com – 26. Januar 2013. Weblink

Die Raumfahrt hat eine technisch-künstliche, fast sterile Aura. Dabei ist sie eine"schmutzige" Sache, Langstreckenflüge könnten deswegen sogar lebensgefährlich sein.

Countdown für Tiroler Marslandung hat begonnen

tt.com – 24. Januar 2013. Weblink

Am Samstag machen sich die Forscher zu einer besonderen Mission unter Tiroler Führung auf einer Mars-Simulation in der Wüste Marokkos.

Weltraumhygiene: “Für den Marsflug zahlt sich eine Waschmaschine aus”

www.wienerzeitung.at – 22. Januar 2013 Weblink

Im Februar will das ÖWF eine einmonatige Mars-Simulation in der Wüste Marokkos durchführen. Drei "Analog-Astronauten" sollen in den Raumanzugsimulatoren "Aouda X" Tätigkeiten ausführen, wie sie auch später auf dem Mars erledigt werden könnten.

Für Flug zum Mars würde sich eine Waschmaschine schon auszahlen

www.derstandard.at – 22. Januar 2013 Weblink

Astrophysiker Gernot Grömer über die Herausforderungen in Fragen der Weltraumhygiene – Problematische Mikroorganismen im Raumanzug.

Hygiene unter Extrembedingungen

www.chemiereport.at – 22. Januar 2013 Weblink

Im Rahmen eines Dräger Safety Talks am 21. Jänner stellte Gernot Grömer vom Österreichischen Weltraum-Forum (ÖWF) die heimischen Beiträge zu den Bemühungen um einen bemannten Mars-Flug vor.

Bei Marsflug zahlt sich Waschmaschine aus

Science.orf.at– 22. Dezember 2012. Weblink

Ein Flug zum Mars stellt nicht nur enorme Herausforderungen an die Technik, sondern auch an Astronauten - "auch bei Fragen der alltäglichen Hygiene", wie der Astrophysiker Gernot Grömer bei einer Veranstaltung erklärte.

ÖWF plant eine 30-tägige Simulation in Marokkos Wüste

Krone.at – 11. Dezember 2012. Weblink

Unter der Leitung des Österreichischen Weltraum Forum (ÖWF) soll im Februar 2013 in der Wüste Marokkos eine einmonatige Mars-Simulation durchgeführt werden. Das hat ÖWF-Vorstand Gernot Grömer am Dienstag im Rahmen einer Pressekonferenz in Innsbruck angekündigt.

Österreichisches Weltraum Forum plant Mars-Simulation in Marokko

Tiroler Tageszeitung Online – 11. Dezember 2012. Weblink

Zwei Raumanzüge und vier Rover sollen bei dem einmonatigen Feldtest im Februar 2013 zum Einsatz kommen.

Einmonatige Mars-Mission in der Wüste Marokkos

derStandard.at – 11. Dezember 2012. Weblink

Simulation unter Leitung des Österreichischen Weltraum Forums (ÖWF) und in Kooperation mit NASA, ESA und weiteren Partnern.

Ö-Weltraum-Forum plant Mars-Simulation in Marokko

Kleine Zeitung – 11. Dezember 2012. Weblink

Eine einmonatige Mars-Simulation soll im Februar 2013 unter der Leitung des Österreichischen Weltraum Forum (ÖWF) in der Wüste Marokkos durchgeführt werden.

ÖWF plant Mars-Simulation in Marokko

www.zukunftwissen.apa.at – 11. Dezember 2012. Weblink

Eine einmonatige Mars-Simulation soll im Februar 2013 unter der Leitung des Österreichischen Weltraum Forum (ÖWF) in der Wüste Marokkos durchgeführt werden.

FH Wiener Neustadt forciert Raumfahrt

Science.apa.at – 29. Oktober 2012. Weblink

Das Österreichische Weltraum Forum (ÖWF) und das Space Generation Advisory Council (SGAC) werden am 2. November (14 Uhr) in der Fachhochschule Wiener Neustadt eine Kooperationsvereinbarung unterzeichnen und so ihre Zusammenarbeit festigen.

Austrians take part in Mars mission in Sahara

Investinaustria.at – 3. Oktober 2012. Weblink

"We will probably land on Mars on February 11th at 10 a.m.", declared Gernot Grömer, Head of the "Morocco Mars Simulation 2013" (Mars2013).

Österreicher auf Mars-Mission in der Sahara

Science.apa.at – 27. September 2012. Weblink

„Wir werden vermutlich am 11. Februar um 10.00 Uhr am Mars landen", erklärte Gernot Grömer, Leiter der „Marokko Mars Simulation 2013" (Mars2013).

Weltraum Forum schickt Österreicher in die Wüste

derstandard.at – 24. September 2012 Weblink

Neuer Feldtest: Diesmal soll Marokko den Mars simulieren.

Mission-Control in Innsbruck startet Marsmission

Tiroler Tageszeitung Online – 21. September 2012 Weblink

Das Österreichische Weltraumforum wird im Februar 2013 in der marokkanischen Wüste eine große Mars-Feldsimulation durchführen.

Vier Wochen lange Feldmission in Wüste

Kronenzeitung – 21. September 2012.

„Wir werden vermutlich am 11. Februar um 10.00 Uhr am Mars landen“, erklärte Gernot Grömer, Leiter der „Marokko Mars Simulation 2013“ (Mars2013).

Anzug nach Maß – für den Mars. Know-how aus Österreich erobert den Weltraum

Kronenzeitung Beilage – September 2012

Österreich ist bekannt für seine Berge, guten Kaffee, Musik, für seine Küche und seine Gastlichkeit – dabei müsste noch etwas anderes dringend auf die Liste: für seine innovativen Weltraum-Erfindungen.

Österreicher machen Marokko zum Mars

Futurezone – 21. September 2012 Weblink

Das Österreichische Weltraumforum wird im Februar 2013 in der marokkanischen Wüste eine große Mars-Feldsimulation durchführen.

Mission zum Mars: T-Mobile ist Technologiepartner des Österreichischen Weltraum Forum (ÖWF) - BILD

Ots.at – 21. September 2012 Weblink

Bereits zum zweiten Mal in Folge unterstützt T-Mobile Austria das Österreichische Weltraum Forum (ÖWF) als Technologiepartner.

“Mars macht mobil”

science.apa.at – 18. September 2012 Weblink

Kürzlich erst war der Mars in aller Munde. Nicht der Schokoriegel, sondern der nach dem römischen Kriegsgott benannte Planet.

Press: International

Moroccan desert stands in for Mars in manned mission simulation

Wired.co.uk - 04.April 2013 Weblink

The Austrian Space Forum has sent a team of astronauts to Morocco for a simulation of a manned mission to Mars.

BusinessCom Networks Connects Mars 2013

MarsDaily - 03.April 2013 Weblink

Last month in the northern Sahara desert in Morocco, an international group of scientists conducted a series of experiments in preparation for future human missions to Mars.

Austria sends manned mission to Mars ... in Morocco

gizmag - 03.April 2013 Weblink

Of all the nations who might get to Mars first, Austria doesn't loom large. Yet the Austrian Space Forum (OEWF) has sent a manned mission to the Red Planet – or at least, to an Earth-bound version of "Mars" located in the northern Sahara near Erfoud, Morocco..

Africa in pictures: 22 March-28 March

BBC.co.uk - 29.März 2013 Weblink

In this photo released on Friday, a scientist working for the Austrian Space Forum conducts experiments in Morocco's Sahara desert to prepare for a future mission to Mars.

Simulating Mars on Earth

Boston.Com Big Picture - 27.März 2013 Weblink

Scientists in both the United States and Morocco are studying what it would be like for human beings to live on Mars. Researchers with the Austrian Space Forum in partnership with the Ibn Battuta Center spent time in the northern Sahara conducting experiments in engineering, planetary surface operations, astrobiology, and geophysics.

Wageningse klaver voor Mars

NL Volkskrant - 27.März 2013

Amsterdam. Een kleine duizend bloempottern mer kiemplantjes in een Wagenings kas kunnen de komende maanden gaan uitmaken welke gewassen er ooit in kolonies op de maan of Mars zullen groelen.

E.T. phoney home – Mars mission … to Sahara

TheSun - 23.März 2013 Weblink

SPACE scientists from Austria simulate a mission to Mars — in the Sahara Desert. The team of, er, Aus-tronauts, donned spacesuits and “oxygen tanks” for a month in the sands of eastern Morocco to recreate the Red Planet experience.

Marocco, simulazioni di Marte

Corriere della sera - 23.März 2013 Weblink

Presso Erfoud, nel Sahara marocchino, si è svolta una simulazione con la tuta spaziale Aouda, progettata per una missione su Marte (Reuters/OeWF/Katja Zanella-Kux).

Mars Camp 2013: Scientists recreate Red Planet on Earth

NYDaily News - 22.März 2013 Weblink

A handout picture shows a scientist wearing an Aouda Mars space suit simulator as he stands next to the Hungarian Google Lunar X-Prize Rover Puli in the desert of Morocco in February 2013.

H‘ey look, we're on Mars already!' Astronauts rehearse Martian life in the Sahara desert

HurriyetDailyNews - 22.März 2013 Weblink

Between February 1 and 28,2013, the Austrian Space Forum – in partnership with the Ibn Battuta Center in Marrakesh - conducted an integrated Mars analog field simulation in the northern Sahara near Erfoud in Morocco in the framework of the PolAres research programme.

A handout picture shows…

Yahoo News - 22.März 2013 Weblink

…a scientist wearing an Aouda Mars space suit simulator as he stands next to the Hungarian Google Lunar X-Prize Rover Puli in the desert of Morocco in February 2013..

Cientistas usam roupa espacial para simular condições no planeta Marte

globo.com - 22.März 2013 Weblink

Simulação ocorreu na região norte do Deserto do Saara, na África. Pesquisadores também testaram equipamentos e veículos..

La misión que recreó una exploración humana en Marte

El Tiempo.com - 22.März 2013 Weblink

La simulación fue realizada al pie de las dunas del desierto de Merzouga, en el sureste de Marruecos.

Astronautas simulan misión en Marte en el desierto marroquí

24horas.cl - 22.März 2013 Weblink

Durante todo febrero, el Foro Espacial de Austria (OEWF, por sus siglas en inglés) llevó a cabo una simulación de un viaje a Marte al aislarse en una superficie de ocho kilómetros en el desierto marroquí de Marzoga.

Misión recrea exploración humana en Marte

El Nacional (Venezuela) - 22.März 2013 Weblink

Durante febrero 2013, el Foro Espacial Austriaco (OeWF) en conjunto con el centro Ibn Battuta de Marrakech, llevaron a cabo una simulación integral de una exploración de terreno en Marte.

March 22 Photo Brief: Obama in Israel, World Water Day, mystical Islam and tiger tongue kisses

darkroom.baltimoresun.com - 22.März 2013 Weblink

A handout picture shows a scientist wearing an Aouda X Mars space suit simulator in the desert of Morocco in February 2013. Between February 1 and 28, 2013, the Austrian Space Forum – in partnership with the Ibn Battuta Center in Marrakesh – conducted an integrated Mars analog field

simulation in the northern Sahara near Erfoud in Morocco in the framework of the PolAres research programme. (OeWF/Katja Zanella-Kux/Handout/Reuters).

Tak naukowcy przygotowują się do misji na Marsa

wiadomosci.onet.pl - 22.März 2013 Weblink

Na pustyni Sahara, niedaleko miasta Arfud w Królestwie Marokańskim, naukowcy przeprowadzają badania mające przygotować ludzi do lądowania na powierzchni Marsa.

Przygotowania do lotu na Marsa. Testowali sprzęt i ludzi na Saharze

Gazeta.pl - 21.März 2013 Weblink

Łaziki, skafandry, elektronika. W lutym na Saharze odbyły się testy urządzeń, które mają zapewnić powodzenie pierwszej załogowej misji marsjańskiej. Badaniom na miejscu przyglądała się poznańska ekipa telewizji Platon. Co się tam wydarzyło?

Mars 2013 – kosmiczne manewry

tygodnik.onet.pl – 05. März 2013 Weblink

1 lutego czterech astronautów z Austrii i Włoch założyło bazę na niegościnnej, czerwonej pustyni. Wspomagały ich dwa łaziki, stacje pomiarowe i Centrum Wsparcia Misji w Innsbrucku. To jeszcze podbój Czerwonej Planety. Ale prawie.

Astronautas al desierto para simular viaje a Marte

El Tiempo – 03. März 2013 Weblink

Un grupo de 10 astronautas y técnicos, en su mayoría austríacos, ha simulado durante un mes un viaje y exploración en tiempo real a Marte, un experimento que han realizado al pie de las dunas del desierto marroquí de Merzuga, en el sureste del país.

Astronautas simulam viagem a Marte em deserto marroquino

Veja.abril.com.br – 01. März 2013 Weblink

Terminou nesta quinta-feira, 28, uma missão que isolou astronautas e técnicos, na maioria austríacos, no deserto de Merzuga, no sudeste de Marrocos. A experiência, que teve o apoio do governo marroquino e colaboração da Nasa, durou pouco menos de um mês e teve como objetivo imitar ao máximo as condições para exploração humana em Marte.

Astronautas se aislan en el desierto marroquí para simular viaje a Marte

Mexico.cnn.com – 28. Februar 2013 Weblink

El experimento mostró que el uso de trajes especiales para explorar la superficie marciana representa enorme presión física y psicológicas.

Un grupo de astronautas se aisla en el desierto marroquí para simular un viaje a Marte

EFE – 28. Februar 2013 Weblink

Rabat, 28 feb (EFE).- Un grupo de diez astronautas y técnicos, en su mayoría austríacos, ha simulado durante un mes un viaje y exploración en tiempo real a Marte, un experimento que han realizado al pie de las dunas del desierto marroquí de Merzuga, en el sureste del país.

Students get information about journey to Mars

Hindustan – 28. Februar 2013

A workshop on “MARS2013” was organized at Central Academy Senior Secondary School, BASTI on Tuesday. The workshop was conveyed by Muhammad Shadab Khan who explained the students the various aspects of space and planet Mars

Mars-mission til Marokkos sand

Jv.dk – 23. Februar 2013 Weblink

I hele februar måned foregår et avanceret teknologisk rollespil i det røde ørkensand. Simulationen er en forberedelse til en rigtig bemandet rumrejse til Mars, som næsten er inden for rækkevidde.

Mars-expedíció a marokkói sivatagban

index.hu – 18. Februar 2013 Weblink

A Földön is el lehet utazni a Marsra, nem kell mást tenni, mint keresni egy hasonlóan száraz, kietlen kősivatagot bolygónkon.

Mit dem Puli hoch hinaus

budapester.hu – 16. Februar 2013 Weblink

Bereits 1969 begann die Entwicklung der sogenannten Lunar Roving Vehicle (LRV) in einem amerikanischen Forschungsinstitut unter der Leitung des ungarischen Physikers Ferenc Pavlics.

NASA eszközzel közösen tesztelik a magyar Puli holdjárót

itextreme.hu – 13. Februar 2013 Weblink

A Google és az X PRIZE Alapítvány által meghirdetett nemzetközi Holdversenyen résztvevő magyar Puli Space csapat rover prototípusa sivatagi szimulációs teszten vesz részt a marokkói Szaharában.

Astronauten simuleren missie naar Mars in de Sahara

Scientias.nl – 12. Februar 2013 Weblink

Astronauten zijn deze week een heuse Marsmissie gestart. Niet op Mars, maar in de Sahara. Het is een simulatie die de mensheid voor moet bereiden op een toekomstige missie naar Mars.

MARS2013 Radio Interview

Radio Atlantique – 11. February 2013 File in DataArchive

MARS2013 Radio Interview

Radio Atlantique – 10. February 2013 File in DataArchive

Sternzeit: Österreich fliegt zum Mars

Deutschlandfunk – 3. Februar 2013 Weblink

In diesem Monat führt das Österreichische Weltraumforum eine bemannte Mission zum Planeten Mars durch - natürlich nur in einer Simulation. Als Trainingsumgebung dient eine Wüstengegend in Marokko, wo viele geologische Strukturen der Landschaft auf dem Roten Planeten ähneln.

1er Février: Le Maroc Accueille des Martiens

Les Clés de L'Actu – February 2013

Une simulation de mission humaine sur Mars aura lieu de 1er au 28 février dans le nord du Sahara, près d'Erfoud, au Maroc.

MARS2013 Radio Interview

Radio Atlantique – 22. December 2012 File in Dropbox

Austrian Space Forum plans mission simulation in Morocco

ShanghaiDaily.com – 12. December 2012 Weblink

A one-month Mars simulation is planned to be carried out in the Moroccan desert in February 2013, the Austrian Space Forum (OeWF) said in Innsbruck Tuesday.

Scientists working on suit for walking on Mars

NBC Today Show – December 7, 2012 Weblink

Mars has long held a fascination for those of us on Earth, but recent NASA pictures of Martian landscapes are giving us a much better understanding of the red planet...

Mission martienne à Erfoud

Societe – 29. Oktober 2012

Un institut de recherche autrichien va effectuer une simulation de mission martienne dans la région d'Erfoud en février 2013. La ressemblance visuelle et topographique du terrain a motivé le choix de cette région....

MARS2013-Austria prepares for Mars: Morocco Mars Simulation

MarsToday.com – 27. September 2012 Weblink

Between the 1st and the 28th of February 2013, the Austrian Space Forum, in partnership with the Ibn Battuta Center in Marrakesh, will conduct an integrated Mars analog field simulation...

MARS2013-Austria prepares for Mars: Morocco Mars Simulation

Spaceref.com – 27. September 2012 Weblink

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20-Nation Mission to Mars due to touch down February 2013 – in Morocco

moroccoonthemove.com – 27. September 2012 Weblink

via spaceref.com

Österreichisches Weltraumforum startet 2013 eine Mars Analog Feldsimulation in Marokko

Marssociety.de – 26. September 2012 Weblink

In Zusammenarbeit mit dem Ibn Battuta Center in Marrakesh werden unsere Freunde vom Österreichischen Weltraumforum im Februar 2013 eine Mars Analog Feldsimulation in der nördlichen Sahara durchführen.

Raumanzug-Test in Marokkos Wüste

Touring-afrika.de – 24. September 2012 Weblink

Bereits zum zweiten Mal in Folge unterstützt T-Mobile Austria das Österreichische Weltraum Forum (ÖWF) als Technologiepartner.

Web

Moroccan desert stands in for Mars in manned mission simulation

Wired.co.uk - 04.April 2013 Weblink

The Austrian Space Forum has sent a team of astronauts to Morocco for a simulation of a manned mission to Mars.

BusinessCom Networks Connects Mars 2013

MarsDaily - 03.April 2013 Weblink

Last month in the northern Sahara desert in Morocco, an international group of scientists conducted a series of experiments in preparation for future human missions to Mars.

Austria sends manned mission to Mars ... in Morocco

gizmag - 03.April 2013 Weblink

Of all the nations who might get to Mars first, Austria doesn't loom large. Yet the Austrian Space Forum (OEWF) has sent a manned mission to the Red Planet – or at least, to an Earth-bound version of "Mars" located in the northern Sahara near Erfoud, Morocco..

Africa in pictures: 22 March-28 March

BBC.co.uk - 29.März 2013 Weblink

In this photo released on Friday, a scientist working for the Austrian Space Forum conducts experiments in Morocco's Sahara desert to prepare for a future mission to Mars.

Simulating Mars on Earth

Boston.Com Big Picture - 27.März 2013 Weblink

Scientists in both the United States and Morocco are studying what it would be like for human beings to live on Mars. Researchers with the Austrian Space Forum in partnership with the Ibn Battuta Center spent time in the northern Sahara conducting experiments in engineering, planetary surface operations, astrobiology, and geophysics.

Photos Of The Week #12

Radio Free Europe - 24.März 2013 Weblink

Some of the most compelling photographs from RFE/RL's broadcast region and beyond for the 12th week of 2013.

E.T. phoney home – Mars mission … to Sahara

TheSun - 23.März 2013 Weblink

SPACE scientists from Austria simulate a mission to Mars — in the Sahara Desert. The team of, er, Aus-tronauts, donned spacesuits and “oxygen tanks” for a month in the sands of eastern Morocco to recreate the Red Planet experience.

Sandy spacesuits, emergency shelters and waltzing rovers

Machines like us - 23.März 2013 Weblink

A month-long simulation of a Mars expedition, which included field tests of two experimental spacesuits, an astronaut injury scenario, tests of autonomous rovers and a cliff-climbing robot, has concluded successfully.

Month-long Moroccan Mars simulation is hailed 'a success'

design, products & applications - 23.März 2013 Weblink

Spacesuits, emergency shelters and waltzing rovers - the Austrian Space Forum's month-long MARS2013 simulation concludes successfully.

Marocco, simulazioni di Marte

Corriere della sera - 23.März 2013 Weblink

Presso Erfoud, nel Sahara marocchino, si è svolta una simulazione con la tuta spaziale Aouda, progettata per una missione su Marte (Reuters/OeWF/Katja Zanella-Kux).

Mars Camp 2013: Scientists recreate Red Planet on Earth

NYDaily News - 22.März 2013 Weblink

A handout picture shows a scientist wearing an Aouda Mars space suit simulator as he stands next to the Hungarian Google Lunar X-Prize Rover Puli in the desert of Morocco in February 2013.

H‘ey look, we're on Mars already!' Astronauts rehearse Martian life in the Sahara desert

HurriyetDailyNews - 22.März 2013 Weblink

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A handout picture shows…

Yahoo News - 22.März 2013 Weblink

…a scientist wearing an Aouda Mars space suit simulator as he stands next to the Hungarian Google Lunar X-Prize Rover Puli in the desert of Morocco in February 2013..

Cientistas usam roupa espacial para simular condições no planeta Marte

globo.com - 22.März 2013 Weblink

Simulação ocorreu na região norte do Deserto do Saara, na África. Pesquisadores também testaram equipamentos e veículos..

La misión que recreó una exploración humana en Marte

El Tiempo.com - 22.März 2013 Weblink

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24horas.cl - 22.März 2013 Weblink

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wiadomosci.onet.pl - 22.März 2013 Weblink

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Die "Sneak Preview" auf eine reale Marsmission

DerStandard – 16. März 2013. Weblink

Heimische Raumanzüge bei Mars-Mission in Marokko unter Dauerbelastung getestet. Innsbruck - Ende Februar ging die bisher größte Simulation einer Weltraum-Mission zum Mars unter europäischer Leitung zu Ende.

"Marsexpedition" in der Wüste war erfolgreich

sience.orf.at – 11. März 2013. Weblink

Ende Februar ist die bisher größte Simulation einer Weltraummission zum Mars unter europäischer Leitung zu Ende gegangen. Über vier Wochen führten Forscher aus 23 Nationen den Test in der marokkanischen Sahara durch. Federführend beteiligt an der "Marokko Mars Simulation 2013" (Mars2013) war auch das Österreichische Weltraumforum.

"Sneak Preview" auf bemannte Marsraumfahrt

science.apa.at – 11. März 2013. Weblink

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Mars 2013 – kosmiczne manewry

tygodnik.onet.pl – 05. März 2013 Weblink

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Astronautas a desierto para simular viaje a Marte

El Tiempo – 03. März 2013 Weblink

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Para simular viagem a Marte, astronautas vivem um mês no deserto

Officina Da Net– 01. März 2013 Weblink

Uma missão inédita teve fim na última quinta-feira (28). Um grupo de dez astronautas e técnicos passaram um mês no deserto de Merzuga, no sudeste do Marracos para simular uma viagem e uma exploração em tempo real a Marte.

Astronautas passam um mês no deserto simulando viagem a Marte

g1.globo.com.br – 01. März 2013 Weblink

Um grupo de dez astronautas e técnicos, em sua maioria austríacos, simulou durante um mês uma viagem e uma exploração em tempo real a Marte, uma experiência que realizaram perto das dunas do deserto de Merzuga, no sudeste do Marrocos.

Astronautas simulam viagem a Marte em deserto marroquino

Veja.abril.com.br – 01. März 2013 Weblink

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Astronautas se aislan en el desierto marroquí para simular viaje a Marte

Mexico.cnn.com – 28. Februar 2013 Weblink

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Astronautas se aislan en el desierto marroquí para simular un viaje a Marte

Terra.com – 28. Februar 2013 Weblink

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Astronautas se aislan en desierto para simular periplo a Marte

Pysnnoticias.com – 28. Februar 2013 Weblink

Un grupo de diez astronautas y técnicos, en su mayoría austríacos, ha simulado durante un mes un periplo y exploración en tiempo real a Marte, un experimento que han ejecutado al pie de las dunas del desierto marroquí de Merzuga, en el sureste del país.

Científicos se preparan para viajar al planeta rojo

cartaabierta.cl – 28. Februar 2013 Weblink

Astronautas y técnicos simularon un viaje de un mes a Marte aislándose en el desierto de Marzoga en Marruecos. Esta misión termina hoy jueves, y en ella participaron cinco astronautas, un técnico en telecomunicaciones, un médico y varios mecánicos especializados, quienes se alojaron en aquellas tierras inhóspitas.

Se busca matrimonio para viajar a Marte en 2018

lanacion.com.ar – 28. Februar 2013 Weblink

Consiste en un viaje de ida y vuelta al planeta vecino de 501 días de duración, que supondría un hito en la historia espacial.

BGFL006 – ÖWF, Mars2013

bytegefluester.org– 28. Februar 2013 Weblink

Podcast: Ich war im Mission Support Center des Weltraum Forum Österreich in Innsbruck. Im Gespräch mit DI Norbert Frischauf gehen wir auf die Tätigkeiten des ÖWF und die laufende Mission Mars2013 in der Wüste von Marokko ein.

In Marocco si simula l'atterraggio su Marte

wired.it– 27. Februar 2013 Weblink

Fino al 28 febbraio, il deserto marocchino ospita la missione Mars 2013, coordinata dall' Austrian Space.

Mars-mission til Marokkos sand

Jv.dk – 23. Februar 2013 Weblink

I hele februar måned foregår et avanceret teknologisk rollespil i det røde ørkensand. Simulationen er en forberedelse til en rigtig bemandet rumrejse til Mars, som næsten er inden for rækkevidde.

Túl van az első sivatagi teszteken a Puli Space rovere

onkormanyzat.mti.hu – 19. Februar 2013 Weblink

A Városházán berendezett Puli Space Küldetésirányítás termében zajlik az élet: a Puli Space rovere megkezdte a marokkói sivatag felderítését. Tekintve, hogy a MARS2013 szimuláció az első lehetőség, hogy az Iteráció 2 kódnevű rovert távolról irányítva teszteljék terepen, elsőnek alapszintű feladatokat hajtottak végre, tesztelve a kommunikációt, a navigációt és a rover mozgásképességét..

Mars-expedíció a marokkói sivatagban

index.hu – 18. Februar 2013 Weblink

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Mars in Morocco - Austrian Space Forum’s MARS2013 Simulation Underway

www.alphagalileo.org– 15. Februar 2013 Weblink

Mars has come to Morocco – at least until the 28th February. The Austrian Space Forum (OeWF) has begun a series of experiments under simulated conditions in a Mars analog site in the Northern Sahara. As the centerpiece of the field tests the OeWF's two analogue Mars spacesuits, Aouda.X and Aouda.S, will be deployed. A total of 23 nations are participating in the simulation.

NASA eszközzel közösen tesztelik a magyar Puli holdjárót

itextreme.hu – 13. Februar 2013 Weblink

A Google és az X PRIZE Alapítvány által meghirdetett nemzetközi Holdversenyen résztvevő magyar Puli Space csapat rover prototípusa sivatagi szimulációs teszten vesz részt a marokkói Szaharában.

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Scientias.nl – 12. Februar 2013 Weblink

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Mann am Mars

Tiroler Tageszeitung Online – 11. Februar 2013. Weblink

Mit dem sogenannten "Landing day" hat das Österreichische Weltraumforum (ÖWF) am Montag seine "Marokko Mars Simulation 2013" (Mars2013) in der nördlichen Sahara gestartet.

Weltraumanzüge im Härtetest

Tirol.orf.at – 11. Februar 2013. Weblink

In Marokko startet die heiße Phase der österreichischen Mars-Simulation, die von Innsbruck aus gesteuert wird. Am Montag beginnt man mit den Tests für die Weltraumanzüge. Auch die amerikanische Weltraumbehörde NASA ist an dem Projekt beteiligt.

Die Austro-Mars-Simulation in der Sahara hat begonnen

derstandard.at. – 11. Februar 2013. Weblink

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Weltraumforum startete Mars-Simulation in Marokko mit „Landing Day“

wienerzeitung.at. – 11. Februar 2013. Weblink

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Die Austro-Mission zum Mars hat begonnen

Nachrichten.at. – 11. Februar 2013. Weblink

Jetzt wird es ernst mit der österreichischen Mars-Mission in der marokkanischen Wüste. Nach monatelanger Vorbereitung ist das Österreichische Weltraumforum (ÖWF) unter Leitung des aus St. Florian bei Linz stammenden Astrophysikers Gernot Grömer (37) im Feld-Camp in der Nordsahara angekommen.

Wie Astronauten Baumarkt-Technik weiterentwickeln

Futurezone.at. – 5. Februar 2013. Weblink

Einige mobile Elektrowerkzeuge, darunter auch der Akku-Bohrer, finden ihren Bedarf zuerst im Weltraum und erst später auf der Erde.

Sternzeit: Österreich fliegt zum Mars

Deutschlandfunk – 3. Februar 2013 Weblink

In diesem Monat führt das Österreichische Weltraumforum eine bemannte Mission zum Planeten Mars durch - natürlich nur in einer Simulation. Als Trainingsumgebung dient eine Wüstengegend in Marokko, wo viele geologische Strukturen der Landschaft auf dem Roten Planeten ähneln.

einer Mars-Simulation in der Wüste Marokkos.

Austro-Mars-Mission in der marokkanischen Sahara

derstandard.at – 31. Januar 2013. Weblink

Internationales Team unter Leitung des Österreichischen Weltraumforums soll Erfahrung für künftige Marsbesuche sammeln.

Österreicher erproben in Sahara bemannte Marsmission

Oe24.at – 31. Januar 2013. Weblink

Internationales Team unter Leitung des Österreichischen Weltraumforums soll Erfahrung für künftige Marsbesuche sammeln.

Keime im Weltall

diepresse.com – 26. Januar 2013. Weblink

Die Raumfahrt hat eine technisch-künstliche, fast sterile Aura. Dabei ist sie eine"schmutzige" Sache, Langstreckenflüge könnten deswegen sogar lebensgefährlich sein.

Countdown für Tiroler Marslandung hat begonnen

tt.com – 24. Januar 2013. Weblink

Am Samstag machen sich die Forscher zu einer besonderen Mission unter Tiroler Führung auf: einer Mars-Simulation in der Wüste Marokkos.

Weltraumhygiene: “Für den Marsflug zahlt sich eine Waschmaschine aus”

www.wienerzeitung.at – 22. Januar 2013 Weblink

Im Februar will das ÖWF eine einmonatige Mars-Simulation in der Wüste Marokkos durchführen. Drei "Analog-Astronauten" sollen in den Raumanzugsimulatoren "Aouda X" Tätigkeiten ausführen, wie sie auch später auf dem Mars erledigt werden könnten.

Für Flug zum Mars würde sich eine Waschmaschine schon auszahlen

www.derstandard.at – 22. Januar 2013 Weblink

Astrophysiker Gernot Grömer über die Herausforderungen in Fragen der Weltraumhygiene – Problematische Mikroorganismen im Raumanzug.

Hygiene unter Extrembedingungen

www.chemiereport.at – 22. Januar 2013 Weblink

Im Rahmen eines Dräger Safety Talks am 21. Jänner stellte Gernot Grömer vom Österreichischen Weltraum-Forum (ÖWF) die heimischen Beiträge zu den Bemühungen um einen bemannten Mars-Flug vor.

Bei Marsflug zahlt sich Waschmaschine aus

Science.orf.at– 22.1. Dezember 2012. Weblink

Ein Flug zum Mars stellt nicht nur enorme Herausforderungen an die Technik, sondern auch an Astronauten - "auch bei Fragen der alltäglichen Hygiene", wie der Astrophysiker Gernot Grömer bei einer Veranstaltung erklärte.

Austrian Space Forum plans mission simulation in Morocco

ShanghaiDaily.com – 12. December 2012 Weblink

A one-month Mars simulation is planned to be carried out in the Moroccan desert in February 2013, the Austrian Space Forum (OeWF) said in Innsbruck Tuesday.

ÖWF plant eine 30-tägige Simulation in Marokkos Wüste

Krone.at – 11. Dezember 2012. Weblink

Unter der Leitung des Österreichischen Weltraum Forum (ÖWF) soll im Februar 2013 in der Wüste Marokkos eine einmonatige Mars-Simulation durchgeführt werden. Das hat ÖWF-Vorstand Gernot Grömer am Dienstag im Rahmen einer Pressekonferenz in Innsbruck angekündigt.

Österreichisches Weltraum Forum plant Mars-Simulation in Marokko

Tiroler Tageszeitung Online – 11. Dezember 2012. Weblink

Zwei Raumanzüge und vier Rover sollen bei dem einmonatigen Feldtest im Februar 2013 zum Einsatz kommen.

Einmonatige Mars-Mission in der Wüste Marokkos

derStandard.at – 11. Dezember 2012. Weblink

Simulation unter Leitung des Österreichischen Weltraum Forums (ÖWF) und in Kooperation mit NASA, ESA und weiteren Partnern.

Ö-Weltraum-Forum plant Mars-Simulation in Marokko

Kleine Zeitung – 11. Dezember 2012. Weblink

Eine einmonatige Mars-Simulation soll im Februar 2013 unter der Leitung des Österreichischen Weltraum Forum (ÖWF) in der Wüste Marokkos durchgeführt werden.

ÖWF plant Mars-Simulation in Marokko

www.zukunftwissen.apa.at – 11. Dezember 2012. Weblink

Eine einmonatige Mars-Simulation soll im Februar 2013 unter der Leitung des Österreichischen Weltraum Forum (ÖWF) in der Wüste Marokkos durchgeführt werden.

FH Wiener Neustadt forciert Raumfahrt

Science.apa.at – 29. Oktober 2012. Weblink

Das Österreichische Weltraum Forum (ÖWF) und das Space Generation Advisory Council (SGAC) werden am 2. November (14 Uhr) in der Fachhochschule Wiener Neustadt eine Kooperationsvereinbarung unterzeichnen und so ihre Zusammenarbeit festigen.

Austrians take part in Mars mission in Sahara

Investinaustria.at – 3. Oktober 2012. Weblink

"We will probably land on Mars on February 11th at 10 a.m.", declared Gernot Grömer, Head of the "Morocco Mars Simulation 2013" (Mars2013).

MARS2013-Austria prepares for Mars: Morocco Mars Simulation

MarsToday.com – 27. September 2012 Weblink

Between the 1st and the 28th of February 2013, the Austrian Space Forum, in partnership with the Ibn Battuta Center in Marrakesh, will conduct an integrated Mars analog field simulation.

MARS2013-Austria prepares for Mars: Morocco Mars Simulation

Spaceref.com – 27. September 2012 Weblink

Between the 1st and the 28th of February 2013, the Austrian Space Forum, in partnership with the Ibn Battuta Center in Marrakesh, will conduct an integrated Mars analog field simulation...

20-Nation Mission to Mars due to touch down February 2013 – in Morocco

moroccoonthemove.com – 27. September 2012 Weblink

via spaceref.com

Österreicher auf Mars-Mission in der Sahara

Science.apa.at – 27. September 2012. Weblink

„Wir werden vermutlich am 11. Februar um 10.00 Uhr am Mars landen“, erklärte Gernot Grömer, Leiter der „Marokko Mars Simulation 2013“ (Mars2013).

Österreichisches Weltraumforum startet 2013 eine Mars Analog Feldsimulation in Marokko

Marssociety.de – 26. September 2012 Weblink

In Zusammenarbeit mit dem Ibn Battuta Center in Marrakesh werden unsere Freunde vom Österreichischen Weltraumforum im Februar 2013 eine Mars Analog Feldsimulation in der nördlichen Sahara durchführen.

Weltraum Forum schickt Österreicher in die Wüste

derstandard.at – 24. September 2012 Weblink

Neuer Feldtest: Diesmal soll Marokko den Mars simulieren.

Raumanzug-Test in Marokkos Wüste

Touring-afrika.de – 24. September 2012 Weblink

Bereits zum zweiten Mal in Folge unterstützt T-Mobile Austria das Österreichische Weltraum Forum (ÖWF) als Technologiepartner.

Mission-Control in Innsbruck startet Marsmission

Tiroler Tageszeitung Online – 21. September 2012 Weblink

Das Österreichische Weltraumforum wird im Februar 2013 in der marokkanischen Wüste eine große Mars-Feldsimulation durchführen.

Österreicher machen Marokko zum Mars

Futurezone – 21. September 2012 Weblink

Das Österreichische Weltraumforum wird im Februar 2013 in der marokkanischen Wüste eine große Mars-Feldsimulation durchführen.

Mission zum Mars: T-Mobile ist Technologiepartner des Österreichischen Weltraum Forum (ÖWF) - BILD

Ots.at – 21. September 2012 Weblink

Bereits zum zweiten Mal in Folge unterstützt T-Mobile Austria das Österreichische Weltraum Forum (ÖWF) als Technologiepartner.

“Mars macht mobil”

science.apa.at – 18. September 2012 Weblink

Kürzlich erst war der Mars in aller Munde. Nicht der Schokoriegel, sondern der nach dem römischen Kriegsgott benannte Planet.

Students get information about journey to Mars

Hindustan – 28. Februar 2013

A workshop on “MARS2013” was organized at Central Academy Senior Secondary School, BASTI on Tuesday. The workshop was conveyed by Muhammad Shadab Khan who explained the students the various aspects of space and planet Mars

Die Erde funkt von Innsbruck aus

Der Standard Page 15 – 13. Februar 2013.

Tiroler Forscher steuern Simulation einer bemannten Marsmission in der Sahara.

Für den Mars mobil gemacht

Tiroler Tageszeitung Seite 6 – 12. Februar 2013.

Gestern startete die dreiwöchige Marssimulation des Österreichischen Weltraumforums in Marokko. Vom Innsbrucker Kontrollzentrum aus wird alles genau kontrolliert.

Mars-Männchen in Marokko

Kurier Seite 26 – 12. Februar 2013.

Reise zum Nachbarplaneten. Astronom Baumjohann über Sinn und Unsinn von Mars-Forschungsprojekten.

Mars-Mission in der Sahara

Krone Seite 19 – 12. Februar 2013.

Unter Federführung österreichischer Forscher startete der Testlauf in Marokko.

1er Février: Le Maroc Accueille des Martiens

Les Clés de L'Actu – February 2013

Une simulation de mission humaine sur Mars aura lieu de 1er au 28 février dans le nord du Sahara, près d'Erfoud, au Maroc.

Mission martienne à Erfoud

Societe – 29. Oktober 2012

Un institut de recherche autrichien va effectuer une simulation de mission martienne dans la région d'Erfoud en février 2013. La ressemblance visuelle et topographique du terrain a motivé le choix de cette région....

Vier Wochen lange Feldmission in Wüste

Kronenzeitung – 21. September 2012.

„Wir werden vermutlich am 11. Februar um 10.00 Uhr am Mars landen", erklärte Gernot Grömer, Leiter der „Marokko Mars Simulation 2013" (Mars2013).

Anzug nach Maß – für den Mars. Know-how aus Österreich erobert den Weltraum

Kronenzeitung Beilage – September 2012

Österreich ist bekannt für seine Berge, guten Kaffee, Musik, für seine Küche und seine Gastlichkeit – dabei müsste noch etwas anderes dringend auf die Liste: für seine innovativen Weltraum-Erfindungen.

TV

„Energie und Physik ‚spezial' – mit Norbert Frischauf

Mars – 3x hin und zurück! – Die Mission“

Bayern Alpha Österreich - 25.März 2013, 19:30 (45 min) Weblink

Steine, Sand, Staub. Erloschene Vulkane und Fossilien, Temperaturgegensätze von -5 bis über +30°C - die Sahara ist alles andere als lebensfreundlich. Trotzdem war sie im Februar 2013 der Brennpunkt der internationalen Wissenschaft, genauer gesagt der Raumfahrt, als das Österreichische Weltraum Forum(ÖWF) mit 23 Partnerländern in der Nähe der Stadt Erfoud in Marokko seine Marsanalogmission MARS2013 unternommen hat.

Hubble – Mission Universum, Experiment Mars

ServusTV - 17.März 2013, 22:10 (50 min) Weblink

Wissenschaftler testen einen in Innsbruck entwickelten Marsanzug in der Wüste. Wie kann der Mensch auf dem roten Planeten überleben? Einen Monat lang simulieren rund 100 Forscher aus der ganzen Welt, unter Leitung des österreichischen Weltraumforums, eine Marsexpedition in Marokko. Die Wissenschaftler wollen herausfinden, ob man mit heutigen Labormethoden tatsächlich Leben auf dem roten Planeten finden kann. Welche Eigenschaften braucht ein Marsanzug, um die Forscher in der lebensfeindlichen Umgebung zu schützen?

Hallo Mars

Tirol Heute - 20. Februar 2013, 19:00 (ca. 3 min) File in DataArchive

Bericht über Marokko Mission inklusive Interview Flight Director Christoph Ragonig

Scientists working on suit for walking on Mars

NBC Today Show – December 7, 2012 Weblink

Mars has long held a fascination for those of us on Earth, but recent NASA pictures of Martian landscapes are giving us a much better understanding of the red planet.

Radio

MARS2013 Radio Interview

Radio Tirol – 20.Februar 2013 File in DataArchive

Interview mit Flight Director Christoph Ragonig

MARS2013 Radio Interview

Welle 1 Tirol – 13. Februar 2013
Interview mit Flight Director Alexander Soucek

MARS2013 Radio Interview

Radio Atlantique – 11. February 2013 File in DataArchive
Interview mit Flight Director Alexander Soucek

MARS2013 Radio Interview

Antenne Tirol – 11. Februar 2013
Bericht vom MARS2013 Landing Day

MARS2013 Radio Interview

Radio Atlantique – 10. February 2013 File in DataArchive
Interview mit Flight Director Alexander Soucek

MARS2013 Radio Interview

Radio Atlantique – 22. December 2012 File in DataArchive
Interview mit Flight Director Alexander Soucek