

## LIFE & RESEARCH AT SOUTH POLE MOONBASE: EUROMOONMARS CAMPAIGNS RESULTS

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**Summary:** We present life and research at Moonbase from EuroMoonMars campaigns EMMIHS HISEAs, EMMPOL Poland that simulated science and operations at the future lunar south pole Moonbase. We give an update on ILEWG EuroMoonMars Results, with emphasis on activities and field campaigns that took place in 2019-2020 including lunar astronautics events during 2020 pandemics.

EuroMoonMars is an ILEWG programme following up ICEUM declarations as a collaboration between ILEWG, space agencies, academia, universities and research institutions and industries [1-16].

**ILEWG :** ILEWG has been organising ICEUM International Conferences on Exploration & Utilisation of the Moon (ICEUM) where community declarations have been prepared and endorsed by community participants, and co-organised lunar sessions at EGU, COSPAR, EPSC. ILEWG task groups include science, technology, human aspects, socio-economics, young explorers and outreach, programmatics, roadmaps and synergies with Mars exploration, MoonBase, MoonVillage, EuroMoonMars, ArtMoonMars, Young Lunar Explorers, ILEWG Young Professional Grantees. ILEWG has been organising International Conferences on Exploration and Utilisation of the Moon (ICEUM) since 1994, whose proceedings are published. It has also sponsored a number of activities, workshops, tasks groups and publications in collaborations with other organisations: COSPAR, space agencies, IAA, IAF, EGU. Besides the discussion forums, users can also obtain information on how to participate, as well as details on the latest news and events regarding lunar exploration, forthcoming meetings, relevant reports and documents of importance for the work of the ILEWG, summary descriptions of current lunar exploration projects (such as SMART-1, Chang'E1-5, Selene Kaguya, Chandrayaan-1-2, LRO, LCROSS, GRAIL, ARTEMIS) funded by various space agencies, and basic data on the Moon itself. Activities of the related space agencies and organizations can also be found. The ILEWG Forum also hosts the Lunar Explorer's Society. ILEWG proposed the open concept of MoonVillage with the goal of a sustainable human and robotic presence on the lunar surface as an ensemble where multiple users can carry out multiple activities.

**EuroMoonMars programme & field campaigns:** EuroMoonMars is an ILEWG programme following up ICEUM declarations as a collaboration between ILEWG, space agencies, academia, universities and research institutions, and industries. The ILEWG EuroMoonMars programme includes research activities for data analysis, instruments tests and development, Moon/Mars analogue field tests, pilot projects, training and hands-on workshops, and outreach activities.

EuroMoonMars also includes a programme of grants for Young Professional Researchers. EuroMoonMars field campaigns have been organised in specific locations of technical, scientific and exploration interest.

These field campaigns started with EuroGeoMars2009 (Utah MDRS, 24 Jan-1 Mar 2009) with ILEWG, ESA ESTEC, NASA Ames, VU Amsterdam and GWU, and continued with yearly EuroMoonMars Field campaigns in Utah (2010-2014). Other EuroMoonMars analogue field campaigns, using selected instruments from ExoGeoLab suite, were conducted in other MoonMars extreme analogues, such as the Eifel volcanic area, Rio Tinto, Iceland, and La Reunion, and Hawaii, and at ESTEC, the LunAres base in Poland and the HI-SEAS. Latest campaigns have been conducted jointly between EuroMoonMars, International MoonBase Alliance and HI-SEAS: EMMIHS.

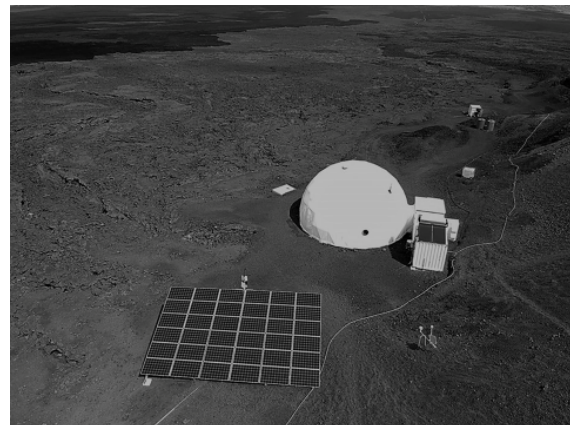


Fig 1: MoonVillage milestone: the IMA MoonBase



Fig 2 EMMIHS crew collecting and documenting samples



Fig 3 EMMIHS crew exploring lavatubes

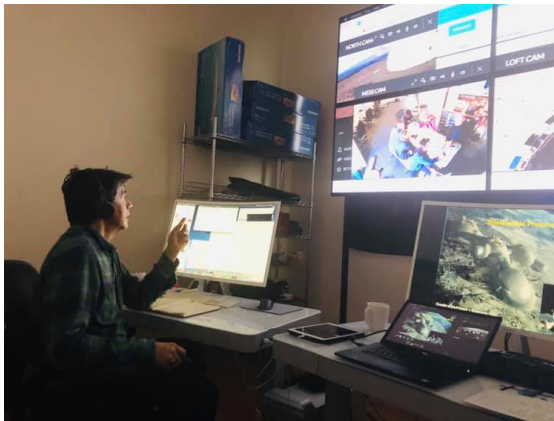


Fig 4 EMMIHS control station at Blue Planet Energy Lab

**EMMIHS campaigns (EuroMoonMars-IMA International Moonbase Alliance- HiSEAS):** EuroMoonMars 2018-20 supported field campaigns at IMA HI-SEAS base on Mauna Loa volcano in Hawaii. The International Moonbase Alliance (IMA), an organization dedicated to building sustainable settlements on the Moon, has been organising regular simulated missions to the Moon or Mars at HI-SEAS. In 2019, the EuroMoonMars campaigns were launched at HI-SEAS, bringing together researchers from the European Space Agency, VU Amsterdam, ILEWG and IMA. Six scientists, engineers, explorers, journalists spent two weeks at the HI-SEAS station performing research relevant to both the Moon and Mars there. Research and technological experiments conducted at HI-SEAS will be used to help build a Moonbase in Hawai'i, and ultimately to create an actual Moonbase on the Moon, as part of IMA & ILEWG major goals.

**EuroMoonMars during 2020 Pandemics** We had to replan and adapt EuroMoonMars workshops and fields events. A number of hybrid and virtual events could be organized following safety distancing instructions. We conducted 35 weekly plenary EMM teleconferences (Fridays 17h CET) and many EMM splinter groups meetings.

**2020/06 EMM Iceland CHILL-ICE Scouting.** A small team explored locations and collaborations for installing a deployable research habitat in lavatube for May 2021.

**2020/10 EMMPOL EuroMoonMars Poland.** We were able to organise in controlled safety conditions 2 one-week Moonbase isolation simulations, in order to conduct a number of research investigations, human factors studies, with 5 crew supported by a remote support team.

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2018 EMMIHS-0 (scouting campaign) Crew: Rogers H&A, Foing, Wilhite, Machida ; BluePlanet: Ponthieux, Cox et al.

2019/1 EMMIHS-I Crew: Musilova, Sirikan, Mulder, Weert, Burstein, Pothier; BluePlanet: Foing, Ponthieux, Cox, Rogers. 2019/6 EMM-IgLuna campaign ; IgLuna SSC support: Benavides, EuroMoonMars VUA/ILEWG ; Crew: de Winter, Heemskerk, Albers, Clement, Bois, Daeter, Vaessen, Glukhova, Sitnikova, Dimova, Wanske, van der Sanden, Foing ; Support: Kruijver, Dingemans, Beentjes, Korthouwer, Moritz, Grosjean et al.

2019/12 EMMIHS-II Crew: Musilova, Kerber, Castro, Wanske, Pouwels, d'Angelo ; Support: BluePlanet: Cox et al., support@ESTEC/VUA: Ageli, Foing, Heemskerk, Beni-est, Sitnikova, Preusterink

2020/1 EMMIHS-III Crew: Musilova M., Brasileiro L., Edison K., Heemskerk M&R, Rajkakati P. ; Support: BluePlanet & ESTEC/VUA Ageli, Beni-est et al

2020/2 EMMIHS-IV Crew: Boross, Dehler, Musilova, Pantazidis, Sheini, Neidlinger ; Support: BluePlanet & ILEWG/ESTEC/VUA Elwertowska, Tricaud, De Abreu, Downes, Ageli, Beni-est, Heemskerk

2020/6 EMM Iceland CHILL-ICE scouting: Heemskerk M, Pouwels, Downes, Kerber

2020/10 EMM Poland EMMPOL, AATC Kolodjczyk, Commanders IR Perrier, R. Landolina, A. Spilkin & IPSA Crew EMMPOL1 & EMMPOL2, Support: Foing, Schlacht, Waltemathe

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