Visegrad Space Analog Mission

🚀 Are you a young adult (18-26) with a passion for space exploration? Here's your chance to experience a mission like no other! Join students from Czechia, Hungary, Poland, and Slovakia in a thrilling simulation that mirrors real-life space missions. The Visegrad Spaceflight Analog Challenge invites you to step into the shoes of astronauts, researchers and engineers, and potentially also mission control specialists, working together on cutting-edge scientific and technological projects.

🌍 This is more than just a competition—it's a gateway to the future of space exploration. Develop essential STEM skills, foster international teamwork, and get hands-on experience that will set you on the path to a career in the space industry. Whether you see yourself as an analogue astronaut, experiment project leader, part of the mission control team or mission promoter working with social media, this is your chance to shine.

🌟 Don't miss this unique opportunity to collaborate with peers across borders, push the boundaries of science and technology, and contribute to the next generation of space missions. Apply now and take your first step towards the stars!

Selection process timeline

Option 1: Apply as **Researchers and Engineers Leading Mission Experiments**	
Application phase	01. 02. – 31. 03. 2025
Selection announcement	01. 04. 2025
Experiment preparation phase	01. 04. – 20. 04. 2025
Experiment conduction in mission	25. 04. – 27. 04. 2025
Final reports from experiments	15. 05. 2025
Option 2: Apply as **Analogue Astronauts** (potentially with **Mission Control Teams**)	
Application phase	01. 02. – 31. 03. 2025
On-line individual selection (AA only)	31. 03. 2025 / 06. 04. 2025
Announcement of invitations to group round	07. 04. 2025
Group on-line selection (AA and MCC)	12. 04. 2025
Announcement of selected AAs and MCCs	17. 04. 2025
On-line workshop with the Hydronaut Team	19. 04. – 20. 04. 2025
Mission (AA in person, MCC remotely)	25. 04. – 27. 04. 2025

All you need to know is in this document!

Read through this document to understand what the mission is about, where it is conducted, who is making it happen, why are we doing this and how can you apply.

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1. Introduction

Overview of the Visegrad Space Analog Mission (VSAM)

The Visegrad Space Analog Mission (VSAM) is an ambitious project that brings together high school students from the Visegrad Group countries: Hungary, Poland, Slovakia, and the Czech Republic. This mission aims to simulate the conditions of planetary space exploration missions on Earth, providing valuable experience of human and technological performance in extreme environments.

Engaging and Inspiring Students

The primary purpose of VSAM is to engage and inspire students, advancing their understanding of space missions. Through hands-on experience and exposure to real-world challenges, students gain a unique perspective on the complexities and excitement of space exploration. This experience can spark their interest in pursuing careers in the space sector, including fields like aerospace engineering, astrophysics, and space medicine.

Educational Benefits

- **Practical Learning:** VSAM provides students with the opportunity to apply classroom knowledge to real-life scenarios. Their knowledge about physics, engineering, biology, environmental science and soft skills related to science popularization and team work will be applied in a practical, immersive setting, providing invaluable experience for their future opportunities.
- **Skill Development:** Participants exercise and develop essential skills such as problem-solving, teamwork, and critical thinking. They learn to navigate complex tasks, work under pressure, and communicate effectively with team members in an international environment.
- **Innovation and Creativity:** By working on scientific and technology experiments, students enhance their creativity and ability to think outside the box. This prepares them for future challenges in the space industry and other high-tech fields.

Possibilities for Future Human Spaceflight in V4 Countries

VSAM not only benefits students but also opens up numerous possibilities for the future of human spaceflight in the Visegrad Group countries:

- **Building a Skilled Workforce:** By inspiring and training the next generation of space enthusiasts and professionals, VSAM helps build a skilled workforce capable of contributing to international space missions and technological advancements.
- **Fostering Collaboration:** The mission fosters collaboration among V4 countries, encouraging the exchange of knowledge and resources. This collaborative spirit can lead to joint space missions, research projects, and technological innovations.
- **Boosting National Space Programs:** The experience and inspiration from VSAM will support and enhance national space programs in the V4 countries. Supporting young talents and showcasing serious interest in space exploration can lead to increased investments in space research and development, furthering the region's capabilities in space exploration.

- **Global Contributions:** By participating in VSAM, students from V4 countries can contribute to global space exploration efforts. It provides a valuable learning experience and base for future individual development which can support international missions to the Moon, Mars, and beyond, showcasing the Visegrad Group's contributions to humanity's quest to explore the cosmos.

Inspiring Future Generations

VSAM has the potential to create a ripple effect, inspiring not only the participants but also their peers, families, and communities. As students share their experiences and achievements, they motivate others to pursue STEAM (Science, Technology, Engineering, Arts, and Mathematics) fields. This widespread inspiration can lead to a more scientifically literate and technologically adept society, ready to tackle future challenges and explore new frontiers.

By providing high school students with a unique and immersive experience, the Visegrad Space Analog Mission paves the way for a brighter future in space exploration for the Visegrad Group countries. It nurtures young talent, fosters international collaboration, and contributes to the advancement of human spaceflight, positioning the V4 countries as key players in the global space community.

Organization team *(alphabetically ordered)*

V4 Kosmos project

- Kinge Gruzecka (PSPA)
- Dorotthia Milankovich (MANT)
- Lucie Ráčková (Planetum)
- Jan Spratek (Planetum)
- Matúš Toderiska (SOSA)

Space Analogue Mission Definition Team

- Ota Michálek, Junior System Engineer (Spacemanic)
- Matej Poliaček, ISS Flight Operations (DLR/ESA)
- Lucie Ráčková, researcher (MUNI)

Advisors:

- Sahba El-Shawa
- Martina Dimoska
- Tomas Ducai
- Eleonore Poli
- Charlotte Powels

Hydronaut team

- Miroslav Rozložník
- Jiří Schneider

2. What is an analog mission and Visegrad?

The Visegrad Group

Also known as the V4, consists of four Central European countries: Hungary, Poland, Slovakia, and the Czech Republic. These countries collaborate on various political, economic, and cultural projects. In the realm of space research, the Visegrad Group aims to combine their expertise and resources to make significant contributions to global space exploration efforts. Project is supported by the International Visegrad Fund which aims to support regional cooperation to advance their relations, exchange and share ideas and promote mutual understanding.

About Space Analog Missions

Following descriptions are taken from the International Guidelines and Standards for Space Analogs, and from NASA.

Why are Analog Missions utilized?

Analog missions are crucial for addressing challenges in spaceflight research.

- Conducting all experiments in space is impractical due to limited time, budget, resources, and personnel.
- Analog missions allow for the testing of countermeasures before deploying them in space, eliminating those that fail in analog settings.
- Studies conducted on the ground through analog missions are faster and more cost-effective.

Engineers and scientists all around the world collaborate with government agencies, academic institutions, and industry partners to establish requirements for testing in challenging environments before applying them in space. They also help identify strengths, limitations, and validity of planned human-robotic operations, and identify ways to combine human and robotic efforts for enhanced scientific exploration. These tests cover new technologies, robotic equipment, vehicles, habitats, communications, power generation, mobility, infrastructure, and storage. They also examine behavioral effects, such as isolation, confinement, team dynamics, and menu fatigue.

In the past, analog missions were used to prepare for leaving Earth's atmosphere, landing on the moon, and orbiting the planet. Continuing this approach, ESA, NASA and other space agencies now use analog missions to prepare for sustained habitation of the Moon and future deep space destinations like asteroids and Mars.

What are Analog Missions?

Space Analog/Analogue[1] Mission: These are missions that mimic conditions of actual space missions and their environments.

Space Analog/Analogue: A facility located on Earth to simulate aspects of a spacecraft/habitat or have physical similarities to the extreme extra-terrestrial environments for the purposes of benefiting human spaceflight.

Space Analog/Analogue Astronaut: Analog astronauts perform activities in a space mission analog during a minimum consecutive 24 hours with the goal of advancing human spaceflight.

Rationale for the 24 hour length: this matches the aquanaut definition for the length of a space analog, one full day and one full night. As space analog missions are meant to "benefit human spaceflight" they exclude tourist or commercial-oriented habitat activities, as they have a different purpose and goal.

[1] Analog and analogue are both English terms. Analog is predominantly used in American (US) English, while analogue is predominantly used in British English (used in UK/AU/NZ).

3. What are the objectives of this mission?

Educational and Outreach Goals

VSAM aims to engage the public, especially high-school students, in STEM (Science, Technology, Engineering, and Mathematics) fields. By showcasing the mission through various outreach activities, VSAM hopes to inspire the next generation of scientists, engineers, and space enthusiasts. Within the mission we focus on progressive aspects of space exploration, e.g. sustainability and diversity aspects. Students are expected to familiarize not only with general knowledge on space exploration, but also with Sustainable Development Goals defined by the United Nations. Educational programs and interactive events will raise awareness about space research and its importance.

Scientific Goals

Specific goals of research activities and technology experiments will be determined by projects selected within Scientific and Technological Experiments Selection. The competition invites students to apply with projects that aspire to advance our knowledge and benefit human spaceflight.

The primary objectives of the VSAM include:

- **Diversity and Inclusion** - ambitious goals of the space sector still face numerous barriers and challenges. All around the world, women and minorities in the space sector often have to deal with discrimination, accepting it as part of a field historically dominated by white men and only specific industries. But as we look ahead to the future of space exploration, it is clear that this needs to change. Diversity is complex and influenced by factors such as nationality, culture, religion, sexual orientation, disabilities, language, and educational background. Inclusivity provides equal opportunities for everyone and positively impacts the community leading to more innovative solutions. You can look for more information in SDG goals #4, #5, #8, #10 [2].

  Our mission provides the first bridge between nationalities, culture and language. The ball is in your court now. All proposals will require addressing aspects of diversity and inclusion.

- **Sustainability** - in the context of space, sustainability has been understood as “ensuring that all humanity can continue to use outer space for peaceful purposes and socioeconomic benefit now and in the long term”[3]. Key aspect is “loop-closure” which indicates recycling and reusing resources toward the establishment of a circular economy. This is critical for minimizing costs, but also for ethical aspects associated with waste generation and preservation of extra-terrestrial environments[4]. Following these principles, aligning with the UN 2030 agenda for Sustainable Development, will also benefit our life on planet Earth, either directly or through

[2] sdgs_targets_overview_resource.pdf (un.org)
[3] swf_space_sustainability-a_practical_guide_2018__1.pdf (swfound.org)
[4] Toward sustainable space exploration: a roadmap for harnessing the power of microorganisms | Nature Communications

spin-offs[5].

All proposals will require addressing aspects of sustainability, and participants are invited to search through materials in footnotes for inspiration.

Furthermore, projects are invited (but not limited!) to address following topics traditionally in the space sector.

- **Manufacturing** - once aboard a space station, you may not have all the tools that you need, but with 3D printing, you can create them. Think about utilizing a 3D printer with non-toxic materials to create tools that you can use in your experiments (however, Hydronaut does not have their own 3D printer). Remember that in-space manufacturing can also be used to create materials not so easily manufacturable down on Earth, you can create material testing shapes or supporting structures and replacement parts for your station!
- **Robotics/Electronics** - tools such as robotic arms or rovers always come in handy. Bring a rover which you can use for surface exploration or develop a robotic arm model which your station could make a use of for your experiments! Simple circuits such as environment monitoring are extremely important, don't forget about them too!
- **Surface exploration** - you can use VR technology at Hydronaut facility, which will bring you closer to the Moon[6]!
- **Earth Observation** - we need to understand our planet from a global scale. Through global observation technologies we can map various connections between our planet's vital processes and climate effects of ongoing natural and human-caused changes[7]. During the mission, you will have opportunity to access Slovak nano-satellite VERONIKA[8] - you can use it to take pictures, download signals, or …?
- **Life Sciences** - although we can not simulate microgravity and radiation, there are still several important topics for investigation, such as the microbiome, plant growth, nutritional needs, and more. Seek further sources for inspiration[9]!
- **Human Behavior and Performance** - we need to understand and mitigate effects of long duration spaceflight on psychology and behavior of astronauts and how to structure and support teams. The challenges we can address in space analogue missions arise from isolation, confinement, sleep loss, and work overload. These results can benefit multiple groups on Earth, such as people working under high pressure (doctors, police, military), in remote areas (Antarctic expeditioners, wildlife

[5] Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space (unoosa.org)

[6] https://www.linkedin.com/posts/hydronautproject_hydronautproject-analogmissions-spaceresearch-activity-7189617728947695616-QjR2?utm_source=share&utm_medium=member_desktop

[7] Earth Science Researchers - NASA Science

[8] New Mission: Veronika - SPACEMANIC; Tretia slovenská družica mieri do vesmíru. Všetky informácie na jednom mieste. - kozmonautika.sk

[9] PowerPoint Presentation (nasa.gov); Plant and microbial science and technology as cornerstones to Bioregenerative Life Support Systems in space | npj Microgravity (nature.com); Toward sustainable space exploration: a roadmap for harnessing the power of microorganisms - PMC (nih.gov); microbial-observatory-mini-book-04-28-14-508.pdf (nasa.gov); Crew time in a space greenhouse using data from analog missions and Veggie - ScienceDirect; https://event.dlr.de/en/ila2022/touching-surfaces/

rangers), or global public for people living long term in isolation (elderly), or during sanitary crises, such as we have experienced during COVID-19 pandemic. Are you interested in exploring these aspects? For more information you can seek materials in footnotes[10].

- **Exploration Medical Capability** - we need to develop special medical equipment that would help us diagnose and treat health related issues triggered by the hazards of spaceflight. These technologies can prove invaluable on Earth too, especially in areas far away from hospitals - such as during expeditions or trips to mountains and far from cities or villages. Do you have innovative ideas for field medical capability? Look for inspiration[11]!

We also encourage participants to reach out to local industrial or universities for partnership and mentorship. You can find relevant business organizations for example by looking at projects supported by ESA BIC (CZ, HG, PL) and SSO (SK). Additional info can be found also at: Czech Space Directory, Space Industry in Slovakia, Space Industry in Hungary, Space Industry in Poland.

[10] HFBP Risks - NASA; Human behavior and performance in deep space exploration: next challenges and research gaps | npj Microgravity (nature.com); Analog Missions - NASA;
[11] About Exploration Medical Capability - NASA; The value of a spaceflight clinical decision support system for earth-independent medical operations - PMC (nih.gov); Earth-Based Research Analogs to Investigate Space-Based Health Risks - PMC (nih.gov); updated-guidance-on-medical-provision-for-wilderness-medicine.pdf (rcsed.ac.uk); Emergency and Wilderness Medicine Training for Physician Astronauts on Exploration Class Missions - Maybritt I. Kuypers, 2013 (sagepub.com); Articles Archive - World Extreme Medicine

4. How will the mission go?

4.1. Location and Environment

The VSAM will take place at the Hydronaut H03 DeepLab in Prague (Czech Republic). The station is designed for short and long-term small groups training and research of isolation and extreme environment on human psychology to test technology functioning under extreme conditions. It is supported by 24/7 monitoring from a local experienced mission control center. The station is very confined, providing only 10 m^3 of habitable area and a tent for possible Extravehicular Activities (EVAs)[12].

4.2. Duration and Timeline

- **Experiment Preparation Phase:** This phase targets experiment teams only. After selection of experiments (April 1st), PIs begin experiment preparation including filling standardized forms which will be communicated regularly to the mission management and Hydronaut team.
- **AA and MCC Preparation Phase:** This initial phase includes participant training and familiarization with the Hydronaut environment. It covers equipment setup, safety procedures, and simulation protocols. This will be conducted through on-line lectures April 19-20, and on-site pre-deployment training on April 25.
- **Habitation Phase:** During this phase, participants will live and work for 24 h in the Hydronaut's habitat. They will conduct experiments, perform daily routines, and deal with the challenges of living in a confined space. This phase will take place on April 26-27.
- **Post-Mission Debriefing:** After the habitation phase, the mission will transition into a detailed analysis period. This involves debriefing and evaluation of both the human and technical aspects of the mission. Findings will be analyzed to assess performance, gather insights, and refine future space mission protocols.

[12] Hydronaut | Project

5. What are the roles and responsibilities?

Participants will take on various roles such as crew members, researchers, and support staff. Each role comes with specific duties, including conducting experiments, maintaining the habitat, and ensuring the overall success of the mission. The relevant subsection depends on which option you choose to participate in.

Option 1: Apply as **Researchers and Engineers Leading Mission Experiments**
Option 2: Apply as **Analogue Astronauts** (potentially with **Mission Control Teams**)

5.1. Researchers and Engineers Leading Mission Experiments

Principle Investigator (PI): The PI is responsible for leading the research or experimental project, ensuring its success from inception to completion. This contains experiment design, planning, preparing protocols, overseeing the timeline and experiment quality. They must possess strong leadership and decision-making skills.

(Optional) Co-Investigator (co-I): The Co-PI supports the PI by contributing specialized expertise to the project, assisting with the design, methodology, and analysis. They work closely with the PI and team, ensuring tasks are completed efficiently. Co-Is should have relevant expertise and experience in the project's focus area and be capable of working collaboratively to achieve the project's objectives.

Every project can have as many co-I as possible, but only one PI who has the primary responsibility for communication of the project.

5.2. Analogue Astronauts and Mission Control Teams

Analogue Astronaut Candidate: An individual selected to serve the role of an astronaut during a simulated crewed mission. Four candidates (one from each Visegrad country) will spend 24 hours in the Hydronaut facility, collaborating and working on scientific and technological projects. This role has an age limit of 18-26 (incl.) at the time of the mission.

(Optional) Analogue Astronauts may apply with their own Mission Control Teams:

Below are listed (non-exhaustively) some common Mission control disciplines you can consider for your team:

- **Flight Director:** The leader of the mission control team supporting their analogue astronaut and managing the respective team. Responsible for leading and managing the mission control team and coordinating with teams from other countries to ensure mission success.

- **Payload Communicator:** Acts as the primary liaison between the mission control team and the analogue astronaut regarding payload operations. Communicates detailed instructions, updates, and troubleshooting information about scientific experiments and equipment. Relays data and status updates from the crew back to the mission control team.

- **IT Ground Control:** Manages and maintains the technological infrastructure that supports mission operations. Ensures the functionality and security of computer systems, networks, and communication links between mission control and the Hydronaut facility central control. Collects mission progress information, addresses issues, and summarizes them in a post-mission report.

- **Payload Specialist for Scientific Experiment:** Coordinates and oversees selected scientific experiments during the space analogue mission. Works closely with experiment principal investigators and the mission control team to ensure proper experiment planning and adherence to protocols. Monitors real-time data acquisition, analyzes results, and provides updates to the mission control team and principal investigators.

- **Payload Specialist for Technological Experiment:** Oversees and manages the implementation of selected technology experiments during the space analogue mission. The role is similar to that of the scientific experiment payload specialist.

- **Communication and Public Affairs Officer:** The primary spokesperson for the team. Manages social media and creates content to share real-time updates, photos, videos, and stories from the mission. Engages with the public through Q&A sessions, live streams, and interactive posts to foster interest and enthusiasm about the mission and facilitate its impact.

- **MCC Back-up:** A person serving as a potential back-up for Flight Director, Payload Communicator, Payload Specialist, Communication and Public Affairs Officer, or IT Ground Control, in case someone from the team will be indisposed (sickness, etc.).

6. How will the preparation for a mission go?

Pre-Mission Training Participants will undergo extensive training to prepare for the mission. This includes technical skills training, and psychological resilience training. The training program is designed to equip participants with the skills and knowledge necessary to handle the challenges of the mission.

Equipment and Technology The mission will utilize life support systems, habitat modules, and scientific instruments. These tools are essential for conducting experiments and ensuring the safety and well-being of the participants.

7. What is it like to be on a mission?

Living Conditions Participants will live in a habitat that simulates the living conditions of a space station or planetary base. The habitat will include sleeping quarters, a common area, a laboratory, and a communication center. Daily routines will involve conducting experiments, maintaining the habitat, and physical exercise.

Challenges and Solutions Living in an isolated and confined environment presents several challenges, including limited resources, psychological stress, and the need for effective teamwork. The mission will implement strategies to address these challenges, such as regular communication with mission control, mental health support, and conflict resolution training.

8. I am ready! How do I apply?

If you think you have what it takes, you are welcomed to join us! See below information detailing necessary steps for application.

Option 1: Apply as **Researchers and Engineers Leading Mission Experiments**
Option 2: Apply as **Analogue Astronauts** (potentially with **Mission Control Teams**)

Deliverables specifications:

- CV must be a maximum of 2 pages. You can use Europass or any other format.
- Motivation Letters must be a maximum of 1 page with no images.
- Experiment Proposal must be submitted using the provided template.

Option 1: Apply as Researchers and Engineers Leading Mission Experiments

1. **Submit Required Documents:**
    - **CVs and Motivation Letters (ML):** Each individual or experiment team member must submit a CV and a motivation letter highlighting their interest and qualifications.
2. **Submit an Experiment Proposal:**
    - A template for the experiment proposal will be released in early September. Applicants are expected to submit their proposals following the template guidelines.
    - All proposals that include human subjects must be complemented with filled out ethics approval document in provided template.

All submissions (CV, ML, and proposal) must be submitted through:
https://is.muni.cz/ekurzy/V4Analogue

Option 2: Apply as Analogue Astronauts and Mission Control Teams

Step 1: Submit Required Documents

- **CVs and Motivation Letters (ML):** Each team member must submit a CV and a motivation letter detailing their interest in space exploration and the mission.
- **Medical Evaluation (ME; for Analogue Astronauts):** Analogue astronaut candidates must submit a medical evaluation equivalent to the PADI license requirement
- **Important:** Analogue astronaut candidates are strongly encouraged to visit the Hydronaut Project facility. If visiting is not possible, candidates must honestly assess

their ability to handle isolation and describe this in their motivation letters and recommendation letters.

(Optional) Step 2: Compose a team

- Form a team of up to eight members. Each team must include analogue astronaut candidates and mission control team members.

All submissions (CV, ML, and AAs' ME) must be submitted through:
https://is.muni.cz/ekurzy/V4Analogue

Step 3: Online Individual Test

- Analogue astronaut candidates will take a 4 hour long on-line test, divided in 4 parts. The test evaluates cognitive skills, technical and scientific knowledge, language proficiency, and mental arithmetic. The top 20 candidates (five from each country) will advance to the next round.

Step 3: Online Group Test

- Groups of four analogue astronaut candidates (one from each country) will collaborate remotely on a 20-minute problem-solving task. Performance will be evaluated by an expert panel.

Step 4: Final Selection

- Four candidates (one from each country) and their respective teams (where applicable) will be selected to participate in a 24-hour mission at the Hydronaut facility in Prague.