# HI-SEAS

## HAWAII SPACE EXPLORATION ANALOG AND SIMULATION

UNIVERSITY of HAWAI'I MĀNOA

# Media Kit

MISSION OVERVIEW

## Who will explore Mars and how will they get along isolated for years far from Earth?

### Is the Right Stuff the best characteristic for the long stuff?

It could be a long trip to Mars despite recent bold assurances of faster rocket ships, or a long stay on the Martian surface. In either case, astronaut crews far from Earth will rely on a social resilience and team cohesion previously untested in deep space.

HI-SEAS (Hawai'i Space Exploration Analog and Simulation) is a University of Hawai'i at Manoa research program funded by NASA. It has operated long-duration planetary surface missions to investigate crew composition and cohesion, since 2012. A crew of up to six, selected from a pool of 'astronaut-like' candidates, monitored by an experienced Mission Support, perform exploration tasks such as geological field work, and life systems management while isolated on the Mars-like northern flank of Mauna Loa on the island of Hawaii, 8200ft above sea-level. The conditions (habitat, mission profile, delayed communication, partial self-sufficiency) are explicitly designed to be similar to those of a planetary surface exploration mission. Daily routines include food preparation from only shelf stable ingredients, exercise, scientific research, geological field work aligned with NASA's planetary exploration expectations, equipment testing, and tracking resource utilization such as food, power, and water. These rigorous routines support a suite of innovative behavioral and psychological tests and tasks performed by the crew that form the primary NASA behavioral research at HI-SEAS.

The primary behavioral research program is the core research performed at HI-SEAS. These studies focus on the need to identify psychological and psychosocial factors, measures, and combinations that can be used to compose highly effective teams for self-directing long-duration exploration missions. The primary research funded by the NASA Human Factors and Behavioral Performance element is conducted by researchers from across the US and Europe who are at the forefront of their fields. During two 8-month missions (Mission V in 2017 and Mission VI in 2018) the studies will include: COHESION a shared social behavioral task as a team-building exercise, continuous monitoring of face-to-face interactions with sociometric badges, a Virtual Reality team based collaborative exercise to predict individual and team behavioral health and performance, and multiple stress and cognitive countermeasures and monitoring studies.

HI-SEAS successfully completed its first one-year isolation mission in August 2016. That mission placed HI-SEAS in the company of a small group of analogs that are capable of operating very long-duration missions (8-months and longer) in isolated and confined environments, such as Mars500, Concordia, and the International Space Station.

http://www.hi-seas.org

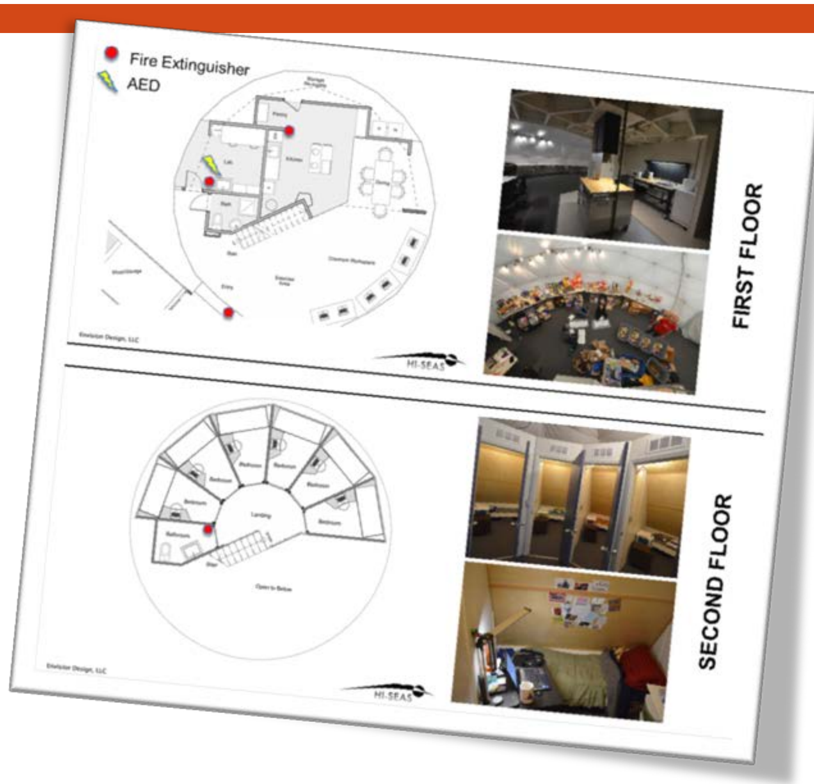
POINTS OF CONTACT

### Dr. Kim Binsted

Dr. Binsted is the project Principal Investigator and Professor at the University of Hawaii at Manoa campus. binsted@hawaii.edu

### Dr. Bryan Caldwell

Dr. Caldwell is the Project Manage of HI-SEAS and a Co-Investigator on the study. He is the contact point for media. bryan@xclassmanagement.com




# Surviving Mars – A Guide to the HI-SEAS Facility

The HI-SEAS Habitat is semi-portable, low-impact, structure. It has a habitable volume of approximately 13,000 cubic feet, a usable floor space of approximately 1,200 square feet, and small sleeping quarters for a crew of six, as well as a kitchen, laboratory, bathroom, simulated airlock and 'dirty' work area.

The habitat dome is supplied by Pacific Domes International. It is an open concept design (Blue Planet Research) that includes common areas such as kitchen, dining, bathroom with shower, lab, exercise, and work spaces. A second floor loft spans an area of 424 square feet and includes six separate bedrooms and a half bath. In addition, a 160 square foot workshop converted from a 20 foot long steel shipping container is attached to the habitat.

## SOLAR ARRAY

A 10kW solar array is located south of the habitat facility and visible from the laboratory window. The panels charge battery banks between sunrise and sunset. On cloudy days, the batteries may not charge fully and the crew employs power saving strategies such as minimizing cooking and heating times.

## BACK UP POWER

The back-up hydrogen fuel cell generator (two 5kW fuel cell arrays and six high-pressure $H_2$ gas tanks) is programmed to kick in when the battery residual state of charge reaches 10%. In the event that there is a hydrogen fuel cell failure, the propane generator can be used to charge the battery bank to re-supply power to the habitat. The generator can supply power for several days if necessary as it draws propane from a 1000 gallon tank located far from the habitat behind the northern ridge.

## WATER SYSTEMS

Water for drinking, cooking, washing and showering is stored in two 500 gallon potable water tanks, re-filled every 4-5 weeks. Toilets in the habitat do not use water to flush. Waste water is fed to two 250 gallon grey water tanks.

## IT SYSTEMS AND COMMUNICATION DELAY

HI-SEAS manages a 20-minute one-way communication delay as would be experienced when Mars is furthest from Earth. Crew members are supplied with NASA email addresses. Their personal email accounts forward to the delayed address during the mission. The crew has restricted access to the internet because of the communication latency. The habitat antenna links to another at the Mauna Loa Observatory (MLO), and a third at the Hawaii Preparatory Academy (HPA).

## HABITAT SENSOR SYSTEMS

A web interface is used by the crew to control remote relays (connected to the heater and fuel cells, for example) and collect sensor information. Data is distributed to investigators outside the habitat for analysis, and to Mission Support for real-time situational monitoring.

## MISSION SUPPORT

HI-SEAS is unique from many Analogs as it operates under high crew autonomy, where crew have more control of their daily schedule and planning of crew involvement in mission tasks. High crew autonomy is the expected operational environment for long duration space missions under delayed communication with Mission Support.

A team of approximately 40 personnel from around the world serves as HI-SEAS Mission Support, interacting with the crew through the one-way 20-minute communication latency.

First Tier Support (FTS) is comprised of 20 personnel located in the US, Canada, Australia, New Zealand, and Europe. Most are experienced mission support team members from other space analogs or actual space missions, rostered for four hour shifts. As the primary interface with the crew for routine communications, FTS acknowledges emails, reviews EVA plans, reads and files the crew's daily reports, and asks follow-up questions as needed. FTS will notify Second Tier Support (STS) of any logistical requirements or other matters requiring decision-making authority such as resupplies or repairs.

Second Tier Support (STS) is comprised of 7 principal investigators, co-investigators, and collaborators on the HI-SEAS research program who are located in the US and Europe. They are very familiar with all aspects of the study, including research procedures, permitting restrictions, safety procedures, budgets, contracts, and other constraints. As such, STS has considerable decision-making authority regarding the mission and are consulted for any non-routine issues. STS members are on call for a 24 hour shift.

Medical and Psychological Support is provided by a mission physician and a mission psychologist, with emergency physicians and EMT responders located in Hilo, Hawaii.

The Systems Group is a group of 9 technical experts who helped design and construct the habitat. They are available to troubleshoot any problems that arise with the sensor, network, power, water, and other systems at the habitat.

A web-based project management tool called Basecamp facilitates communication between Mission Support and the crew. Its features include searchable discussion threads, file sharing, tasking, to-do lists, and calendars. The crew interacts with Basecamp via their time-delayed email accounts supplied by NASA. Currently, all routine interactions are text-based. Crew members are allowed to bring media such as music, TV shows, and movies with them on their missions. Additional content is uploaded to a Dropbox folder. The crew also shares videos they produce for outreach or social media via Dropbox.

# Primary Behavioral and Performance Research at HI-SEAS

Multiple research groups are funded by the NASA Behavioral Health and Performance Element to collect data on team cohesion and performance.

## Team Processes and Team Effectiveness

The research put forward by Michigan State University has 3 specific aims and associated deliverables that represent an integrated approach for measuring, monitoring, and regulating teamwork processes and long-term team functioning in isolated, confined, and extreme (ICE) environments:

(1) **Benchmark long duration team functioning in ICE analog environments.** This research will use experience sampling methods (ESM; daily assessments) to assess team functioning in ICE environments. The product of this research aim is to quantify the expected range of variation in key teamwork processes (e.g., cohesion, collaboration, conflict), identify internal and external shocks that influence variation, and assess dynamic effects on team performance. Benchmark data in ICE analog environments are essential for developing standards to distinguish expected variation in teamwork from anomalies indicative of a threat to team functioning. Such standards are essential for triggering countermeasures /interventions.

(2) **Extend engineering development of an unobtrusive monitoring technology (i.e., a wearable wireless sensor package).** The product of this research aim is to advance development of a prototype monitoring technology to capture dynamic multimodal (i.e., physical, physiological, and behavioral) data capturing team member and teamwork interactions. Initial validation has demonstrated the reliability and accuracy of the monitoring technology sufficient to establish proof of concept.

(3) **Develop teamwork interaction metrics and regulation support systems.** The monitoring technology has the capability to provide high frequency data streams on a range of team interaction and individual-level indicators. The product of this research aim is to develop 3 additional supporting components required for these dynamic data streams to be utilized as a countermeasure for teams to regulate teamwork interactions and psycho-social health. These components include the development of (a) specific metrics to assess interactions and reactions; (b) protocols to fuse the data streams and classify the effectiveness of team functioning; and (c) a system architecture designed to integrate the metrics and classification, and to direct feedback or other countermeasures when the system detects an anomaly in team functioning. Flexible options for distributing and displaying team status assessments and countermeasures need to be provided (e.g., individual team member, dyads, team leader, ground control).

**Contact:** Dr. Steve Kozlowski, Michigan State University, Michigan, USA. stevekoz@msu.edu

## Effectiveness of a Shared Social Behavioral Task as a Team-Building Exercise in Isolated, Confined, and Extreme Environments

Long-duration missions in isolated, confined, and extreme (ICE) environments can lead to social withdrawal and reduced team cohesion, potentially increasing risks to individual and team behavioral health and mission performance. As with physical exercise and individual muscle, bone, and cardiovascular health, regular "social" exercise in ICE environments may help build and maintain some of the behavioral processes that underlie team and mission success. To this end, we recently developed a behavioral software tool called COHESION (Capturing Objective Human Econometric Social Interactions in Organizations and Networks).

COHESION is built on a conceptual, methodological, and analytical foundation of Behavioral Economics, and objectively measures cooperation, productivity, fairness, and other dynamic social processes in small groups. Unlike simultaneous activities that are only passively social (e.g., exercise, meals, TV), or inherently social activities that require competition (e.g., video/board/card games), COHESION allows the expression of a wide range of social behaviors while task success is interdependent and can be facilitated by cooperation and fairness in response to uncontrollable environmental stresses. In addition to its value as a research and assessment tool, systematic qualitative data from HI-SEAS and other isolated environments suggest that a simple shared task environment such as COHESION can actually be enjoyable, defuse tension, and increase positive feelings in data-driven, achievement-oriented teams. As an experimental test of COHESION's effectiveness as a team-building exercise in operational environments, the HI-SEAS Mission V and Mission VI Crews engage in regularly scheduled COHESION sessions alternating with periods of no COHESION. We collect standardized measures of team cohesion, performance, and biopsychosocial adaptation throughout the mission, ultimately comparing the various outcomes during the periods with vs. without COHESION.

These data and behavioral science technologies such as COHESION can help NASA mission planners, military commands, safety-critical work teams, and other professional organizations select, compose, and support the most effective teams for long-term success..

**Contact:** Peter G. Roma, PhD. Institutes for Behavior Resources and Johns Hopkins University School of Medicine, Baltimore, MD, USA. PeteRoma@gmail.com

## Crew Communication in Debriefs

The purpose of this effort is to investigate how communication among crews during required debriefs changes over time and the degree to which it is indicative of team processes.

Dr. Bedwell and her team at the University of South Florida will secure video recordings of crew EVA debriefs as well as any general debriefs that occur throughout the duration of the mission for analysis to determine the degree to which the communication reflects core team processes known to contribute to team effectiveness. Dr Bedwell's team will also have access to crew EVA reports, which crews are required to do upon completion of an EVA. Crews are also required to record EVA debriefs so there are no specific requirements of crews beyond conducting a pre-brief and debrief prior to and after each EVA.

Dr. Bedwell will also conduct all end-of-mission debriefs to gather additional information regarding crew interpersonal interactions and mission-relevant tasking, among other topics necessary to help ensure successful future long-duration space exploration missions in isolated, confined and extreme environments.

**Contact:** Dr. Wendy L. Bedwell, University of South Florida, Tampa, USA. wbedwell@usf.edu

## MENTALBLOCK

This project investigates the feasibility of predicting individual and team behavioral health and performance through performance in a Virtual Reality team based collaborative game. We will utilize advances in data mining to derive psycho-social state assessments and correlate the results with self-reports and team performance to derive factors that predict high performing team compositions. This study directly addresses NASA's need to study interpersonal and intrapersonal issues using empirical data from a high fidelity analog environment.

**Contact:** Sonja Schmer-Galunder, Smart Information Flow Technologies, Minneapolis, MN. sgalunder@sift.net

## Autonomous Behavioral Countermeasures for Spaceflight

The goal of this project is provide individuals in isolated and confined environments (like spaceflight) with tools to reduce conflict, relieve stress, and treat depression. The project has two components: (1) the "Virtual Space Station" suite of interactive-media-based computer programs that address interpersonal conflict and depression and (2) virtual reality natural scenes to aid relaxation by immersion in nature. Crew members will use the programs during different phases of their stay. The research team is interested in the crew's reactions to the content, both positive and negative, so the content can be customized for people living in space. Evaluations will consist of data from the programs, survey questionnaires, and structured interviews at the end of the isolation period. This evaluation in the isolated and confined HI-SEAS environment provides a unique opportunity to assess the program with people who are experiencing an environment similar to long-duration spaceflight. Behavioral health problems are common on Earth, and these programs and technologies could be useful in many Earth settings as well.

**Contact:** Jay C. Buckey, M.D., Professor of Medicine, Geisel School of Medicine at Dartmouth. jay.buckey@dartmouth.edu

## Mission Operational Autonomy: Crew and Mission Support Interaction in Autonomous Exploration of Distant Space and Planetary Surfaces.

Crew operational autonomy will increase necessarily as communication delay increases between Mission Support (MS) on Earth and the astronauts exploring deep space and planetary surfaces. Currently, NASA astronauts assigned to the International Space Station in Earth orbit work under low crew autonomy and real-time communication. In contrast, studies of crew composition and cohesion conducted at the HI-SEAS planetary surface analog are performed under near full crew operational autonomy and 20-minute communication latency. It is likely that crew autonomy during distant space exploration will vary between these extremes depending on the mission timeline and environment. The role of MS in supporting transitions in crew autonomy at relevant stages of distant and long duration space exploration will be a crucial factor in the mission success. This study evaluates the operational interactions between crew and MS transitioning from low and high crew autonomy that are relevant to distant space exploration and remote isolated environments over the duration of an 8-month HI-SEAS mission.

**Contact:** Bryan Caldwell, PhD, Exploration Class Management, Galveston, TX, and Sheryl Bishop, PhD, UTMB, Galveston, TX.
bryan@xclassmanagment.com

## Self-Guided Stress Management and Resilience Training

Stress-related health and mental problems are among the most common and costly in the country, and for those working in operational environments (i.e., astronauts) stress-related problems can seriously impact their performance, safety, and well-being. This project aims to evaluate the effectiveness, usefulness, acceptability, and usability of a self-guided multimedia stress management and resilience-training program called SMART-OP (stress management and resilience training for optimal performance). SMART-OP is designed for individuals working operational settings (e.g., Hi-Seas). Participants will use SMART-OP during the first 6 weeks of their mission. SMART-OP comprises 6 weekly 30-45 training sessions interactively teaching evidence-based stress management and resilience training skills that help the user to think more flexibly, regulate emotions, and behave optimally. Participants will complete pre- and post-mission assessments examining perceived stress, control over stress, resilience, mood, anxiety, sleep, and stress biomarker data (salivary cortisol and α-amylase). An important aspect of the research that NASA supports is the potential applications on Earth and benefits to society in general. SMART-OP could have significant impact on Earth in helping people manage the deleterious effects of stress thereby addressing a major aspect of the important work that NASA pursues and supports.

**Contact:** Raphael D. Rose, PhD, Department of Psychology, UCLA, Los Angeles, CA. rose@psych.ucla.edu

## Asynchronous Geological Exploration Operations at the HI-SEAS Planetary Surface Analog Mission Simulation in Hawaiʻi

HI-SEAS studies team function and autonomy on long duration exploration missions conducted in a remote habitat located on Mauna Loa, Hawaiʻi. The basaltic terrain and sparse vegetation of the site make it a good geologic analog to the Moon or Mars.

We have designed a series of geology-related EVA tasks that we assign the crew on a bi-monthly basis. Each task serves as a mini research project for the crew, who must devise how to gather data and solve the given problem with minimal interaction or direction from mission support. The team-oriented tasks are designed to be gradable with quantifiable metrics so that meaningful conclusions about crew performance on missions of varying length can be drawn.

The geology tasks, which are given in the context of resource exploration and environment characterization, are presented in a progressive fashion so that each activity builds upon the previous one. First, features or areas of interest are identified in aerial imagery. The crew is then asked to scout these features on the ground and characterize their properties. This could take the form of measuring dimensions of a skylight, mapping flow units, collecting rock samples, or analyzing the samples using equipment in the habitat's laboratory. The HI-SEAS geology team evaluates how accurately the crew is able to accomplish these tasks compared with known values. The long duration of these tests enable an evaluation of how the crew is able to build an increasingly detailed understanding of the environment surrounding their habitat site in a manner similar to how future astronauts may explore another planetary body on a long surface stay mission. This unique science operations perspective is highly complementary to other analogs that focus on individual EVAs or shorter duration studies of science operations capabilities.

**Contact:** Brian Shiro and Scott Rowland, PhD., Geology & Geophysics Dept., University of Hawaiʻi at Mānoa, Honolulu, HI.
scott@hawaii.edu and bshiro@hawaii.edu

# HI-SEAS Management and Support Personnel

### Dr. Kim Binsted

Project Principal Investigator and Professor at the University of Hawaii at Manoa campus. binsted@hawaii.edu

### Dr. Bryan Caldwell

Project Manager, Exploration Class Management, Galveston, TX. bryan@xclassmanagement.com

### Paul Ponthieux

Habitat Systems and Design, Blue Planet Research, HI. paul@blueplanetresearch.us

### Dr. Bill Wiecking

IT and Communications, Hawaii Preparatory Academy, HI. bill@hpa.edu

### Joseph Gruber

Mission Support Coordinator. joseph.gruber@gmail.com

# Opportunistic Research at HI-SEAS

Opportunistic projects are separate from but complementary to the primary research objectives. They can be proposed by researchers in academia or industry, or at one of the space agencies.

## Sleep, Fatigue, and Mood during Mission V of the Hawaii Space Exploration Analog and Simulation (HI-SEAS)

Sleep is vital for maintaining human performance, especially for tasks that involve vigilance. The study will assess sleep and activity patterns and overall mood of crewmembers during Mission V of the HI-SEAS project. The specific objectives of this study are to: a) assess sleep/activity, fatigue, and changes in mood while living in the habitat, and b) assess the effect of ambient light and resupply activities on sleep, fatigue, and mood.

Crew members will receive medical-grade actigraphy devices to wear throughout the study. Activity logs and questionnaires will evaluate sleep quality, daytime sleepiness, insomnia symptoms, and mood states. Ambient light and temperature in the common area and sleeping spaces will be monitored using data loggers.

**Contact:** Panagiotis Matsangas, PhD, and Nita Shattuck, PhD, Naval Postgraduate School, Monterey, CA. pmatsang@nps.edu and nlshattu@nps.edu

## Stress Research

For astronauts on long-duration exploration missions, the risks of having a 'bad day' are too high. NASA termed 'adverse behavioral conditions' are critical hazards to mission performance. Researchers at Purdue University are quantifying the 'stress' levels of crew members throughout HI-SEAS long-duration exploration missions by analyzing: 1) behavioral indicators of stress measured with wearable devices tracking activity levels, resting heart rate, and sleep patterns, 2) biological markers of stress that are quantifiable in hair and urine samples, and 3) weekly questionnaires asking crew members for subjective impressions of the frequency and intensity of stress that they have experienced. Together, these data coupled with analytics can help improve our scientific understanding of how stress impacts health and performance on Earth and Mars alike. Stress monitoring is a necessary step in researching how stress develops in small teams over time and how adverse behavioral conditions can be mitigated to reduce mission risks.

**Contact:** Jocelyn Dunn, Purdue University, West Lafayette, IN. joceydunn2@gmail.com

## Remote Support of Additive Manufacturing on Martian Analogs

This study investigates how 3D printing might be useful on a Mars mission to help reduce the number of spare parts needed and to solve unanticipated issues that might occur (à la Apollo 13). This is a continuation of work done on 3D printing during HI-SEAS Mission III during which over 730 individual pieces were printed. Results were presented in a paper titled "Utility of Additive Manufacturing on Martian Analogs and Manned Mars Missions" at the International Astronautical Congress. During Mission III, all design and printing work was done by the HI-SEAS crew. In actual spaceflight, design and prototype work would be given to experts on the ground with astronauts having a more limited role due to requirements to maximize astronaut time on mission objectives. This study will investigate this second operational mode. The HI-SEAS crew will determine the need for 3D printed parts and will send requests to mission support who will do part design and testing. Files for completed parts will then be sent to the crew ready to be printed.

**Contact:** Zak Wilson. zakwmars@gmail.com

## In-Mission Training: Introduction of New Mission Objectives during a Mission Cycle

Long duration human stays on Mars will likely lead to discoveries that motivate new approaches and techniques within a single mission. This would lead to new concepts of operation, new instrument use or new approaches to operating existing hardware that a crew was not trained for prior to the crew's deployment. The HI-SEAS long duration study enables the introduction of new scientific hardware within a single mission deployment for which the crew has not previously been trained. This study involves the introduction of new instrument hardware, a miniaturized Laser Heterodyne Radiometer (mini-LHR) to measure methane and $CO_2$ in the atmospheric column near the habitat site, for which a training curriculum has been developed by the NASA Goddard Space Flight Center Instrument Team. Because this instrument is portable, fits in a backpack, and operates on a single 35W solar panel, it is deployable to remote locations that are often missed by satellite passes due to cloud cover such as southern Asia, the Arctic, and wetlands. In an actual planetary exploration mission, a mini-LHR could be deployed near the astronauts' habitat to monitor the influence of a human presence on the local Mars environment, such as gas leaks from the habitat or suits. At HI-SEAS, the crew will perform EVAs to operate the already deployed instrument and they will conduct trouble shooting with the Instrument Team within the mission constraints, including the time-delayed communication. Over time, crew members in the field (EV) are likely to depend upon crew members inside the habitat (IV) to support real-time trouble shooting of the hardware. This will provide insights into the development of in-mission training curricula and concepts of operation to best enhance crew productivity as approaches and techniques evolve throughout a mission. Additionally, this task encourages crew autonomy to decide when ideal environmental conditions are present for instrument operation as opposed to other EVA goals.

**Contact:** Jacob Bleacher and Emily Wilson, Research Scientists, NASA Goddard Space Flight Center. jacob.e.bleacher@nasa.gov and emily.l.wilson@nasa.gov

## Evaluation of Crew Centric Onboard Planning Tool (aka Playbook)

The objective of this study is to evaluate the feasibility and effectiveness of crew self-scheduling through the custom-designed Playbook scheduling app. This concept of crew autonomy currently does not exist yet in space operations tools, ie. it's not possible for the crew to schedule or plan their own activities.

Through Playbook, we've been introducing walk up and use features to enable more crew autonomy in an astronaut's mission plan than before. These features are first debuted in mission analogs (such as HI-SEAS) and iterated on before going up to the International Space Station or other missions.

**Contact:** Steven R. Hillenius, Principal Investigator, and Jessica J. Marquez, Co-Investigator, NASA Ames Research Center. steven.r.hillenius@nasa.gov and jessica.marquez@nasa.gov

## Meet the Crew of Mission VI: 2018 HI-SEAS 8-month mission

## Commander

https://sites.google.com/site/sukjinhanwebpage/

**Sukjin Han** is an assistant professor in economics at University of Texas at Austin, specializing in econometrics. His research mainly focuses on developing statistical methods to evaluate causal effects of treatments or interventions, such as medical interventions, social programs, or economic policies. He is particularly interested in settings where treatments are endogenously determined by agents in the system, due to the optimization and interaction of the agents.

Sukjin earned a Ph.D. in economics at Yale, and B.A. at Seoul National University. As a Korean, he served in the Korean military for two years in college. As a devotee of art and architecture, he seeks for creative interdisciplinary between art/design and statistics/mathematics, which ranges from conducting economic analyses of artistic products to exploring design solutions of mathematical concepts.

In one of his recent projects, Sukjin designed architectural models that invoke the experience of awe via dimensional shifts, similar to the experience astronauts may have in space. "Space travel is my childhood dream and contributing to human space exploration is my passion."

Sukjin enjoys drawing, taking photographs, playing tennis and dancing salsa.

## Science Officer

http://kozmonautika.sk/category/an-astrobiologists-diary-on-mars/

**Michaela Musilova** is an astrobiologist with a research focus on life in extreme environments (extremophiles). Michaela has a PhD degree from the University of Bristol (UK) and she studied and conducted research at University College London (UK), the California Institute of Technology (USA), Chiba University (Japan) and others.

She is also a graduate from the International Space University (ISU)'s Space Studies Program, 2015. Michaela's astrobiology and space research experience includes: working on astrobiology and planetary protection research projects at the NASA Jet Propulsion Laboratory; simulating lunar and planetary surfaces through NASA's and the UK Space Agency's MoonLite project; searching for exoplanets at the University of London Observatory; and being an analogue astronaut at the Mars Desert Research Station, USA (2014 &2017).

Michaela has received numerous prizes and grants, including the Emerging Space Leaders Grant from the International Astronautical Federation (2016); Women in Aerospace – Europe Student & Young Professional Award (2016) and she was selected as one of the most promising 30 under 30 by Forbes Slovakia (2015). Michaela is actively involved in the Duke of Edinburgh's Award, as a patron of the programme in Slovakia and an Emerging Leader Representative for Europe, Mediterranean and Arab states.

She is currently the Chair of the Slovak Organisation for Space Activities (SOSA), a visiting professor at the Slovak Technical University, a lecturer for ISU and the Masaryk University (Czech Republic), and a senior research adviser for Mission Control Space Services Inc.

Michaela also enjoys participating in STEAM outreach activities from teaching at schools, giving public presentations, to working with the media and more, as well as encouraging people to pursue their dreams.

## Engineering Officer

**Calum Hervieu** is an astrophysicist and systems engineer, who grew up in rural Scotland. He graduated with a Master's degree in Astrophysics from the University of Edinburgh, with a thesis focusing on an alternate formation theory of 'Hot' Jupiter planets in multi-planetary systems.

He went on to complete a 2nd level Masters specializing in Space Exploration and Development Systems (SEEDS) at the Politecnico di Torino, Italy. Here, he served as the project manager of a 20-strong multi-national team for a feasibility study focusing on utilising the Moon's natural resources to aid future human exploration of space.

During this time, he lived in Italy, France, the Netherlands and the UK. He received the Politecnico di Torino's 'Award for Excellence' allowing him to travel to Australia to present a part of the team's work focusing on lunar in-situ resource utilisation at the International Astronautical Congress, 2017.

Prior to joining HI-SEAS Mission VI Calum was part of the Spaceship EAC initiative at ESA's European Astronaut Centre, Germany, where he was working to develop goals and best practices for future human and robotic missions to the lunar surface. He's most excited to explore the volcanic regions around his new Martian home!

Outside of academia Calum's biggest passions are exploring the outdoors and endurance sports such as running, cycling and swimming. He is a keen pianist and enjoys giving outreach talks on space exploration.

## Mission Specialist, Communications

http://lisastojanovski.com/

**Lisa Stojanovski** is a professional science communicator passionate about making humanity a spacefaring civilisation. In 2017, Lisa toured remote and regional Australia with the Shell Questacon Science Circus to earn a Master of Science Communication Outreach. Lisa creates content for the live web show TMRO, while managing the Australian chapter of the Space Generation Advisory Council.

Lisa is a nominee of The Mars Generation 24 Under 24 Leaders and Innovators In STEAM and Space Awards, and a recipient of the International Astronautical Federation Emerging Space Leader grant for 2016.

She is a graduate of International Space University, and designed Martian greenhouse atmospheres with NASA researcher Dr Christopher McKay. In 2015, she completed a Bachelor of Science (Honours) focusing on torpor hibernation in mice, and majored in molecular biology/biochemistry.

In her spare time, Lisa is practicing ukulele, visiting Disneyland or experimenting with recipes to cook on Mars

## MEDIA REQUESTS

We welcome interest from the media and educators. Media can click here to fill out an online request form or visit Media Request Form. Crew members are available for interviews and photographs and video are also available. Simply state your requirements in the "message" box. Please be aware photographs and film taken during the video are copyrighted material and you will need to seek permission to use these materials. The online interview request form can also be used to request images or video. Educators can visit HI-SEAS Outreach for class projects and other information.

As the longest Earth-based Mars simulation, HI-SEAS has generated a considerable amount of interest and outreach requests from media and educators from all over the world. We are committed to public education and aspire to respond to every request. Crew and support staff balance requests with their primary commitment to the ongoing mission and research so we may be unable to respond right away or to accommodate every request.

# GUIDELINES FOR MEDIA

To protect the integrity of all HI-SEAS research there are restrictions for media interviews:

- Access to the Habitat and surrounding area is restricted. It is possible to film around and inside the Habitat before and after a mission while supervised by a HI-SEAS representative. Please contact Project Manager Bryan Caldwell to discuss access. bryan@xclassmanagement.com

- Permission to film will be granted on a case-by-case basis, depending on weather, ground-support availability and the purpose of the visit.

- The mission is designed to simulate the isolation, confinement and some of the austerities of living on Mars. Once the mission starts, crew do not have face-to-face or voice contact with anyone outside the crew for the duration of the mission. **No media access to the Habitat or surrounding area will be permitted during crew isolation.**

- The crew can communicate only through email and file drop. There is a 20-minute delay to simulate space travel. They cannot give real-time interviews.

- There are no phones or Skype.

- The crew can film the following activities:
  - Personal interviews
  - Tours
  - Science activities
  - Tasks outside of the habitat in the simulation spacesuits (but not all crew outside together)

- There are some restrictions to filming. The crew cannot film proprietary research, sensitive crew research, and anything that could compromise security or violate crew privacy.

- Primary research can be discussed in general terms until it is published. Research will be published after completion of Mission VI (October 2018). Please feel free to contact the study researchers directly.

- Photographs and film taken during the HI-SEAS mission are copyrighted material and are available on request. Public domain materials are also available. Please use the Media Request Form for any requests.

## MEDIA REQUESTS

Please use the online form.

## EDUCATOR REQUESTS

Please visit the outreach section of our website.

# HI-SEAS MISSIONS

## COMPLETED and CURRENT MISSIONS

HI-SEAS is part of a NASA HFBP funded campaign to investigate crew composition and cohesion. These missions place HI-SEAS in the company of a small group of analogs that are capable of operating very long-duration missions (8-months and longer) in isolated and confined environments, such as Mars500, Concordia, and the International Space Station. Starting in 2012, the University of Hawai'i at Manoa has received funding from NASA for three campaigns with mission lengths ranging from 4 to 12 months. Each campaign responds to specific Risks and Gaps presented in the NASA Human Research Program Roadmap. Primary research is conducted by researchers from across the US and Europe who are at the forefront of their fields.

## Campaign 1 (Funded by NASA HRP, NNX11AE53G)

The purpose of this campaign was to address the IRP Gap: 'Risks associated with an inadequate food system'. The overall objective of campaign was to compare the resource costs and the nutritional and psychosocial benefits of two food systems proposed for long-term space missions: prepackaged "instant" food, and foods prepared by the crew from shelf-stable, bulk packaged ingredients. The dietary study tracked crew satisfaction with their diet, which was composed exclusively from instant meals or meals prepared from shelf-stable ingredients. The resource-utilization study tracked crew use of power, water, food and supplies over the mission. This was a 4 month mission conducted in early 2013.

### HI-SEAS CAMPAIGN 1

### Mission I (4 Months)

Crew members (from left to right) Angelo Vermeulen, Sian Proctor, Kate Greene, Yajaira Sierra-Sastra, Oleg Abramov, and Simon Engler.

## Campaign 2 (Funded by NASA BHP, NNX13AM78G)

Multiple research groups are collecting data on team cohesion and performance. Studies included: the Team Performance Task/ Price of Cooperation Test, continuous monitoring of face-to-face interactions with sociometric badges, mitigation of the effects of isolation using immersive 3D Virtual Reality interactions with the crew's family and friends, measurement of emotional and effective states using automated analysis of multiple forms of textual communications provided by the crew members to identify relevant and effective teamwork behaviors, and multiple stress and cognitive monitoring studies. Campaign 2 included one 4-month mission in early 2014, one 8-month mission in 2014 – 2015 and a 12-month mission which was completed in August 2016.

## Campaign 3 (Funded by NASA HFBP, NNX15AN05G)

Two 8-month missions are scheduled starting in **January 2017 and 2018**. The purpose of Campaign 3 is to directly address the IRP Team Risk: "Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team". In particular, it will focus on Team 8 Gap: "We need to identify psychological and psychosocial factors, measures and combinations thereof that can be used to compose highly effective crews for autonomous, long duration and/or distance exploration missions". This campaign will be similar to Campaign 2 with two significant changes. Firstly, crew selection itself is studied as part of the development of a model for crew composition. Secondly, autonomy will be varied throughout each mission, with low crew operational autonomy in the first and last two months of the mission and high crew autonomy during the middle months of the mission.

## Crew Recruitment

HI-SEAS crews are selected from a pool of highly 'astronaut-like' candidates. That is, they meet the basic requirements of the NASA Astronaut Program (i.e. an undergraduate degree in a science or engineering discipline, 3 years of experience or graduate study, etc.). In addition, they are evaluated for experience considered valuable in the program, such as experience in complex operational environments. This selection is carried out by a panel of experts who are familiar with the astronaut selection process and the research objectives of the Campaigns.

### HI-SEAS CAMPAIGN 2

### Mission II (4 Months)

Crew members (from left to right) Lucie Poulet, Ross Lockwood, Tiffany Swarmer, Casey Stedman, Ron Williams, and Anne Caraccio.

### Mission III (8 Months)

Crew members (from left to right) Sophie Milam, Zak Wilson, Neil Scheibelhut, Jocelyn Dunn, Allen Mikadyrov, and Martha Lenio.

### Mission IV (12 Months)

Crew members (from left to right): Cyprien Verseux, Christiane Heinicke, Carmel Johnston Tristan Bassingthwaighte, Sheyna Gifford, and Andrzej Stewart.