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

What would Mark Watney do?
We have been asking that question of planetary explorers at HI-SEAS long before The Martian hit the cinema. HI-SEAS (Hawai‘i Space Exploration Analog and Simulation) is a NASA-funded research program operating long-duration planetary surface missions to investigate crew composition and cohesion, since 2012. A crew of six selected from a pool of ‘astronaut-like’ candidates, monitored by an experienced Mission Support, performs 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, 8200 ft 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 carried out by humans or robots, 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 Behavioral Health and Performance element is conducted by researchers from across the US and Europe who are at the forefront of their fields. The studies include: 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 crew members to identify relevant and effective teamwork behaviors, and multiple stress and cognitive monitoring studies.

HI-SEAS is currently running its first one-year isolation mission. This mission places 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 most recently the International Space Station.

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http://www.hi-seas.org
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 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 H2 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

Crew members are supplied with NASA email addresses with inherent 20-minute delay. Their personal email accounts forward to the delayed address during the mission. The crew has restricted access to the internet with a 40 minute delay for receiving information from the restricted internet. The habitat has two different data links, one for telemetry data and one for the internet. An antenna was placed at the habitat, another at the Mauna Loa Observatory (MLO), and a third at the Hawaii Preparatory Academy (HPA). The first link goes from the habitat to MLO to HPA. It is meant to relay telemetry data from the habitat and provide backup communications. The second data link goes from the habitat to Hale Pohaku (HP) on the slope of Mauna Kea. It serves at the primary internet connection.

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

A team of approximately 40 volunteers from around the world serves as HI-SEAS Mission Support, interacting with the crew through imposed one-way 20-minute communications latency to provide Mars-like mission constraints. Mission Support volunteers keep the mission running smoothly.

First Tier Support (FTS) is comprised of 20 volunteers located in the US, Canada, Australia, New Zealand, and Europe. Most are experienced mission support team members from other Mars analog 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 New Zealand. 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 24/7.

Medical Support in the habitat is additionally assisted by an emergency medicine physician and a psychologist, with backup 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. They do not have access to the graphical user interface of the web or mobile applications like the Mission Support team. 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.
HI-SEAS MISSIONS

PREVIOUS, CURRENT, AND FUTURE MISSIONS

HI-SEAS is part of a NASA BHP 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 most recently the International Space Station. Starting in 2012, HI-SEAS 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. HI-SEAS is building the operational experience for very long duration missions.

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: pre-packaged “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.

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 has completed one 4-month mission in early 2014, one 8-month mission in 2014 – 2015 and is currently operating a 12-month mission which will be completed in August 2016.

Campaign 3 (Funded by NASA BHP, NNX15AN05G)

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 will be similar to Campaign 2 with two significant changes. Firstly, crews will have previously participated in 2-week missions at the Mars Desert Research Station (MDRS), in Utah, 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 months of the mission and high crew autonomy during the middle months of the mission.

Crew Recruitment

HI-SEAS crews are composed from volunteers 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 pre-screening is carried out by a panel of experts who are familiar with the astronaut selection process.
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).

**Development of an Objective Behavioral Assay of Cohesion to Enhance Composition, Task Performance, and Psychosocial Adaptation in Long-Term Work Groups**

We developed a simple, rapid, and objective computer-based behavioral task that measures cooperation, productivity, and fairness motivation in small groups. This prototype Team Performance Task (TPT) software is built on a scientific foundation of Behavioral Economics. As a "social personality" test, the TPT allows scientists to precisely quantify how individuals and teams divide their time between selfish and altruistic motivations at different levels of effort in and different types of groups. The HI-SEAS crews regularly complete TPT sessions and provide hormone samples to help us understand the behavioral and biological mechanisms regulating social dynamics and team cohesion over long periods of time in isolated, confined, and extreme environments. These data and behavioral science technologies such as the TPT can help NASA mission planners, military commanders, and various professional organizations select, compose, and support the most effective teams for long-term success.

**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.

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**Cognition**

Human exploration of space requires astronauts to maintain high levels of cognitive performance in the presence of a range of environmental and psychological stressors. Remarkably, it is still unclear to what extent cognitive performance is affected by spaceflight, and if so, whether cognitive domains are affected differentially. To address these knowledge gaps, we developed a brief, comprehensive, and sensitive computerized neuropsychognitive test battery for spaceflight called Cognition, which is currently deployed on the International Space Station, and in several spaceflight analog environments, and was specifically designed for the high-performing astronaut population. The Cognition test battery is administered electronically, allows remote quality control via a web interface, supports repeated administration (15 unique versions), and consists of 10 brief neuropsychognitive tests that cover a range of cognitive domains. In HI-SEAS Mission IV, Cognition is administered to crew members once every two weeks before bedtime to investigate changes in cognitive performance over mission time in an analog that mimics the long-term effects of isolation, confinement, and workload associated with human space exploration missions.

**AD ASTRA: Automated Detection of Attitudes and States through Transaction Recordings Analysis**

NASA’s Human Research Program needs methods to identify the most likely and serious threats to task performance, teamwork, and psycho-social performance during long duration flight. Factors such as lack of team coherence, workload, social monotony, access to family and psychosocial support, and interpersonal and cultural differences are known to affect both crew welfare and task performance. While the techniques exist in the social sciences to perform this research and eliminate this knowledge gap, the real problem is to develop automated techniques and validate those using data from high fidelity simulations or actual spaceflight.
Since psychosocial states of interest to space operations are affected, even largely the product of interpersonal communication, it is not surprising that interpersonal communications are our primary key to them. Recent research suggests that verbal and non-verbal communications can be automatically processed in a variety of ways to provide insight into team cohesion, affective and cognitive states and team performance. We leverage prior work of our own and of others in cultural and socio-linguistic theory to develop standardized, non-intrusive and automated methods for data collection and knowledge extraction about factors salient to crew psychosocial well-being, including mood, topic specific sentiment, team dynamics, temporal orientation, self-vs.-others focus, and meaningful work. We have developed assessment techniques for relevant team coherence and performance factors, and validated them using historical spaceflight data as well as a series of experiments in three separate ground based analogs, including NASA Flight Analog Project’s head down tilted bedrest, NASA Human Exploration Research Analog (HERA), and HI-SEAS.

Contact: Christopher Miller, cmiller@sift.net, or Peggy Wu, pwu@sift.net

ANSIBLE: A Network of Social Interactions for Bilateral Life Enhancement

NASA has identified the need to develop countermeasures to social isolation among flight crew and their family and friends under the likely conditions of a time delay in deep space missions. Stressors from the environment such as sensory monotony can impact psychological health and cause performance detriments. Presently, asynchronous solutions such as email, social network websites, and micro-voice messaging serve to link geographically distributed communities.

ANSIBLE uses immersive and content rich Virtual Worlds (VWs) to counteract physical limitations of vehicle and habitat and combat sensory monotony. It leverages the persistence of VW to augment asynchronous communications between crew and their social support systems (i.e., family, friends, colleagues) to minimize the impact of communication delays on interaction flow and enhance social connections.

Benefits

- **ANSIBLE** supports asynchronous communication beyond email, and can be used in real time, during pre- and post-flight when crew and families may be geographically separated, thus providing a longitudinal continuum for connecting with their social support systems.
- VWs are natural environments to provide training, skills maintenance, as well as cooperative experiential learning.
- Virtual Agents are guides and instructors in other domains, and they will be of greater importance to serve in those roles in the context of limited real-time communications and increased task complexity.
- Beyond NASA applications, we are investigating the use of the ANSIBLE ecosystem for commercial applications, from providing virtual reality based training to providing a new medium for people to connect socially.

Contact: Peggy Wu, pwu@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.

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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-Sea). 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.

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Self-Determination Theory Study (SDT study) or Crew-Ground Study

The purpose of this study is to assess:
1. how crew members perceive instructions from coworkers outside the station (e.g. mission support personnel, maintenance personnel or investigators),
2. how this affects well-being, motivation and performance,
3. if this is dependent upon certain personality traits of the crew members.

In order to address these questions, the crew members are filling out weekly questionnaires.

**Earth Benefits:** This study will lead to a better understanding of how astronauts perceive instructions from coworkers, and how this impacts their performance and well-being. This enables the subsequent development of measures to ameliorate crew-ground interactions, which can be applied not only in human spaceflight operations, but in all situations of interaction and communication, especially with individuals operating in isolated and restricted environments.

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Asynchronous geological exploration operations at the HI-SEAS planetary surface analog mission simulation in Hawai‘i

HI-SEAS studies team function and autonomy on long duration exploration missions conducted in a remote habitat located on Mauna Loa, Hawai‘i. The basaltic terrain and sparse vegetation of the site make it a good geologic analog to the Moon or Mars, and since the site is accessible year-round, it allows for longer-term isolation studies than other analog locations. NASA has funded HI-SEAS for four missions of increasing length starting with a 4-month mission in 2012 to a 12-month mission that will begin in fall 2015. Here we report on geology exploration operations carried out in the HI-SEAS program.

HI-SEAS missions are comprised of six crew members who live in the habitat and interact with a
mission support team remotely via an imposed 20-minute communication delay to provide Mars-like operational latencies. Some of the crew’s activities require them to leave the habitat and conduct extra-vehicular activities (EVAs) while wearing simulated space suits to approximate the encumbrances astronauts would face while conducting such excursions. 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.

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**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.

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**Humor and HI-SEAS**

Research suggests that humor is an effective social support tactic, coping mechanism, stress-reducer, and means of influencing more collaborative interactions. However, the style of humor matters, particularly for adults deployed to live and work on teams in foreign countries or extreme environments. More affiliative and self-enhancing humor styles (e.g. witty banter, riddles, puns, etc.) improve interpersonal relationships and individual resilience through more positive social interactions, while more aggressive and self-defeating styles (e.g. sarcasm, ridicule, self-deprecating, etc.) increase interpersonal conflict and are associated with more stress, anxiety, and depression. Thus, the purpose of this research is to understand the role that humor plays within the dynamics of a team and to observe how this might change over time (when dealing with others for long periods of time, when exposed to certain stressors, etc.).

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Meet the Crew of Mission IV – HI-SEAS first 1-year mission

Crew Commander
snowballschanceonmars.wordpress.com

Hi, I’m Carmel Johnston from Whitefish, MT. I’ve had a passion for natural resources my whole life and am exploring new ways to use them here on SimMars. In high school, I participated in the Flathead River Educational Effort for Focused Learning in our Watershed (FREEFLOW) where we learned about water quality, stream health, and the influence of humans on water quality in the Flathead Valley.

I wanted to continue studying hydrology so I went to school at Montana State University for a BS in Soil and Water Science. I continued on for a MS in Land Resources and Environmental Sciences. This allowed me the opportunity to conduct two summers of field work in Alaska, studying carbon dynamics in permafrost soils. After completing my thesis, I traveled to New Zealand and Australia to learn about livestock management from people who are dealing with climate change right now. And let’s be honest, I also did a bunch of hiking while I was there.

When I came home, I spent the summer hiking around Glacier Park and enjoying a beautiful Western Montana summer before working for the NRCS as a soil scientist. This past summer, I worked on the initial soil mapping project in Glacier which married my favorite things: science and the wilderness.

I decided to join the 4th HI-SEAS Mission so I can continue studying food production, this time within the construct of living on Mars. The research we are conducting will hopefully have implications for food production on Mars as well as Earth. How do we feed a population using the resources you have while not destroying the planet you’re on? Come on world, we need to start thinking about this now!

Chief Scientific Officer & Crew Physicist
www.scilogs.de/leben-auf-dem-mars

Christiane Heinicke is a German physicist and engineer. She is interested in anything that moves, be it air flowing over wheat fields or glaciers sliding down mountain valleys. Most recently she has worked on sea ice, but she has also gained experience working with polar lights, metal melts, and simulations of the Earth’s mantle.

She has received her B.Sc. in Applied Physics from the Ilmenau University of Technology in Germany, and her M.Sc. in Geophysics from Uppsala University in Sweden. After two years abroad, she returned to Ilmenau for her PhD in Engineering during which she also learned how to play the cello.

In a hope to increase her time with snow per year, she then moved to Finland to work with the Aalto University. There, she went camping almost every week before deciding to trade the green forests and plentiful lakes for the vast landscapes of dry rocks at HI-SEAS. Her family did question her sanity, but after spending 2 weeks at the Mars Desert Research Station (MDRS) as a finalist for the Mars Society’s MA365 mission she was unchangeably intrigued by the possibility of living like a Mars explorer, and so ended up heading for a life in the dome.

During her free time there she is planning to coax her fellow crew members into dancing, to learn at least one language and one instrument, and – to distract from her lousy cooking skills – bake a cake from time to time.

Chief Medical and Safety Officer, Crew Journalist
livefrommars.life

Sheyna E. Gifford, MA, MSc, MD, started working for NASA in 1997. Her first project was a Mars Spacesuit design proposal for the Lunar and Planetary Institute. Since then, she has worked on a
Chief Engineering Officer

**Surfing with the Aliens**

Born in Banbury, England, to a military family, **Andrzej Stewart** earned a BS in Aerospace Engineering from the University of Texas at Austin in 2005, and an SM in Aeronautics and Astronautics from MIT in 2007. As part of his life-long dream to become an astronaut, Andrzej became an ardent light aircraft pilot. He’s logged over 500 flight hours, earning his instrument and commercial pilot certificates, and he volunteers with Challenge Air and EAA Young Eagles, introducing kids to aviation. Prior to joining the HI-SEAS Mission 4 crew, Andrzej worked at Lockheed Martin as an interplanetary flight controller. He’s worked on console for the Spitzer Space Telescope, Mars Odyssey, MRO, MAVEN, Juno, and GRAIL. Recently, he served as the Flight Engineer for the sixth mission of NASA’s Human Exploration Research Analog (HERA), simulating a two-week journey to asteroid 1620 Geographos. In his free time, Andrzej is a goalie in a recreational ice hockey league as well as an avid board-gamer. He hasn’t played the guitar in a while, but will be brushing off his skills and (hopefully) entertaining the crew during the mission. When not exploring sMars, Andrzej lives in Denver, Colorado, with his wife Christy, who also aspires to fly in space someday.

Crew Architect

[architecturefrommars.wordpress.com](http://architecturefrommars.wordpress.com)

**Tristan Bassingthwaighte** is currently a doctor of architecture candidate at UH Mānoa. He is completing his master’s degree in architecture from Tongji University in Shanghai, where he studied abroad for a year looking at human habitation in extreme environments. His doctoral work will involve designing a next generation conceptual Mars habitat, with research focusing on social, psychological, and health impacts of long duration isolation on another world.

Crew Biologist

[Walking on red dust.com](http://Walking on red dust.com)

**Cyprien Verseux** is an astrobiologist working on the search for life beyond Earth and an expert in biological life support systems for Mars exploration. Part of his research aims at making human outposts on Mars as independent as possible of Earth, by using living organisms to process Mars’s resources into products needed for human consumption. In other words, he is figuring out how to live on Mars off the land using biology and what is already there. He currently is a PhD student co-directed by Daniela Billi, at the University of Rome II (Italy) and Lynn Rothschild, at NASA Ames Research Center (Moffett Field, California). Prior to focusing on astrobiology he obtained Master’s degrees in Systems and Synthetic Biology from the Institute of Systems and Synthetic Biology (Evry, France) and in Biotechnology Engineering from Sup’Biotech Paris (Villejuif, France). On Earth (or close to Earth) and outside the lab he enjoys skydiving, road trips with a tent and a few friends, swimming in lakes and seas, mountaineering, writing, reading a wide range of books and living stimulating new experiences.

Chief Engineering Officer

**Surfing with the Aliens**

Born in Banbury, England, to a military family, **Andrzej Stewart** earned a BS in Aerospace Engineering from the University of Texas at Austin in 2005, and an SM in Aeronautics and Astronautics from MIT in 2007. As part of his life-long dream to become an astronaut, Andrzej became an ardent light aircraft pilot. He’s logged over 500 flight hours, earning his instrument and commercial pilot certificates, and he volunteers with Challenge Air and EAA Young Eagles, introducing kids to aviation. Prior to joining the HI-SEAS Mission 4 crew, Andrzej worked at Lockheed Martin as an interplanetary flight controller. He’s worked on console for the Spitzer Space Telescope, Mars Odyssey, MRO, MAVEN, Juno, and GRAIL. Recently, he served as the Flight Engineer for the sixth mission of NASA’s Human Exploration Research Analog (HERA), simulating a two-week journey to asteroid 1620 Geographos. In his free time, Andrzej is a goalie in a recreational ice hockey league as well as an avid board-gamer. He hasn’t played the guitar in a while, but will be brushing off his skills and (hopefully) entertaining the crew during the mission. When not exploring sMars, Andrzej lives in Denver, Colorado, with his wife Christy, who also aspires to fly in space someday.

Crew Architect

[architecturefrommars.wordpress.com](http://architecturefrommars.wordpress.com)

**Tristan Bassingthwaighte** is currently a doctor of architecture candidate at UH Mānoa. He is completing his master’s degree in architecture from Tongji University in Shanghai, where he studied abroad for a year looking at human habitation in extreme environments. His doctoral work will involve designing a next generation conceptual Mars habitat, with research focusing on social, psychological, and health impacts of long duration isolation on another world.
MEDIA REQUESTS

We welcome interest from the media and educators. Media can click [here](http://hi-seas.org/?p=3806) to fill out an online request form or visit [http://hi-seas.org/?cat=79](http://hi-seas.org/?cat=79) for class projects and other information.

As NASA’s 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:

- 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 only time the crew can leave the habitat is for short periods of time in simulation spacesuits. During that time they cannot be recorded or observed by people outside the mission.
- 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, staged events, and anything that could compromise security or violate crew privacy.
- Research can only be discussed in general terms until it is published. Research cannot be published until after completion of this mission (August 2016).
- Permission must be received to film around the habitat because it is a restricted area.
- Permission to film will be granted on a case-by-case basis, depending on weather, ground-support availability and the purpose of the visit.
- 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 contact request form](http://hi-seas.org/?cat=79) for any requests.
- The mission is designed so there are only six people in the habitat (on simulated Mars). It is important that the crew do not have face-to-face or voice contact with anyone outside the crew for the duration of the mission. The above restrictions are in place to protect the physical isolation of the crew as they would be if they were on Mars.

MEDIA REQUESTS

Please use the [online form](http://hi-seas.org/?p=3806).

EDUCATOR REQUESTS

Please visit the [outreach section](http://hi-seas.org/?cat=79) of our website.