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Space Hub

Experiment ZEPPELIN NT

Detection of floating macro plastic with imaging spectroscopy
Remote Sensing Laboratories, Dept. of Geography, University of Zurich

Global concern and public awareness of the ecological impacts of plastic pollution in the oceans is increasing, but the precise spatial extent, position and density of the garbage patches remains largely unknown. This experiment tests the feasibility of mapping floating macro plastics using imaging spectroscopy. A specialised camera is deployed on the Zeppelin NT to map three reference areas with plastic abundances varying between 1 % and 5 %. These areas consist of several hundred empty, floating PET bottles arranged in grids and the Zeppelin mounted spectrometer allows to acquire data in a high spatial resolution from different altitudes to test the limits of detectability of floating macro plastics.

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Experiments 3rd SWISS PARABOLIC FLIGHT CAMPAIGN

1.) Microgravity turns soils anoxic
Subsurface Environmental Processes Group, EAWAG-ETH Zurich

For similar hydration conditions, microgravity controls the water configuration in soils, restricting the gas diffusion. This process potentially increases the size and extent of anoxic spots in soils. It implies the promotion of anaerobic processes enhancing the production of greenhouse gases (CO_2, CH_4, and N_2O). We hypothesize that the more efficient production of greenhouse gases under microgravity conditions will affect the plants growth, controlling also the gas composition of local atmospheres (e.g., within the ISS). These should be aspects to be considered in long-term space missions or planets colonization.

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2.) The effect of changing gravity on spinal stiffness
Department of Chiropractic Medicine, Balgrist University Hospital, Zurich Switzerland

The ability to control our posture and the movement of the spine is critical in everyday life. Spinal stiffness is an important factor in spinal control and the result of different stabilization mechanisms. In order to gain a better understanding of spine stabilization mechanisms, this study investigates the effects of earth, hyper-, and microgravity conditions on spinal stiffness, its associated muscle activity and change of lumbar curvature to obtain novel insights into lumbar stabilization mechanisms. It is anticipated that this research will ultimately help with the diagnosis and treatment of patients with low back pain.

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3.) Effects of microgravity on membrane potential in cartilage cells
Institute of Medical Engineering, Lucerne School of Engineering and Architecture, Lucerne University of Applied Sciences and Arts

All biological cells have a membrane potential which is produced by differences in ion concentrations inside and outside the cell. In electrically excitable cells, like neurons, a change in membrane potential is used to transmit signals. Interestingly, it has been shown that neurons also change their membrane potential in weightlessness condition. In this experiment, we examine if microgravity also changes the potential in non-excitable cartilage cells. This could give insight in the development of osteoarthritis and could help to find a cure for it.

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4.) Oxygen-shortage and manned space flights
Institute of Veterinary Physiology, Vetsuisse Faculty, University of Zurich

Extravehicular activities, the backbone of manned space exploration programs, set the astronaut into mild hypoxia. Importantly, microgravity aggravates threatening symptoms of hypoxia such as vision impairment and brain edema. Since higher animals and man crucially dependent on oxygen, evolution developed an extremely rapid cellular sensor that however requires fast cytoskeleton-dependent nuclear transfer of the sensor proteins. Because this fundamental process might be altered by strong changes of gravitational forces (e.g. hyper- and microgravity), we developed a pocketsize cell culture device that can set cells within 20min into strong hypoxia and allows investigation of the cellular hypoxia-response in hyper- and microgravity.

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5.) Structural and molecular dynamics of cellular adaptation to microgravity
University of Zurich

Gravity has been a constant factor throughout the evolution of life on Earth, and played an important role for the architecture and morphology of all biological systems. We are investigating, if and how cellular and molecular functions respond and adapt to gravitational changes or if they strictly depend on Earth's gravity. We are aiming to understand how a gravitational force is being transduced into a cellular reaction, how gravity is connected to molecular and cellular homeostasis and function and finally to obtain fundamental data for an appropriate risk assessment of long-term space missions. The parabolic flight experimentis coordinated with a research rocket experiment conduced in April and an International Space Station (ISS) experiment to be conducted in July, where structural and molecular dynamics of cellular adaptation to microgravity will be investigated.

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6.) Crystallization in microgravity
Spacepharma SA, Courgenay, Switzerland

Spacepharma is a provider of end-to-end solutions for performing research in true space microgravity. Part of it are miniaturized laboratory which can be integrated in different other microgravity platforms. During the Swiss parabolic campaign Spacepharma will crystallize an amino-acid using a flow-crystallization device. The changes in size and structure of the crystals formed in micro-gravity will be studied. The result will assist in better understanding the factors affecting crystallization on Earth, and pave the way for crystallization of more complex proteins. This will open new innovative pathways for the development of new drugs.

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7.) Space Manufacturing Experiment
Technology and Engineering Center for Space Utilization (CSU),
Chinese Academy of Sciences (CAS)

The space manufacturing tested on board Zero-G parabolic flight is conducted by Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences (CSU, CAS), aims at verifying the metal casting technology and studying manufacturing with new material by Digital Light Procession in zero gravity. The feature of the parabolic flight that short preparation cycle, large experiment volume, the possibility of man tending on-board are advantages that cannot be found in any other mean, are keys for testing and maturing the space manufacturing technology in zero gravity. Using of parabolic flights and ground test complementarily, different features of the technology can be validated accordingly before it is really applied in space missions. CSU, as the headquarters of the utilization system, has been leading the space science and utilization of China Manned Space Program and takes the responsibility of mission planning, implementation and achievement outreach. CSU always values the great importance of international academic exchange and cooperation and carries out various kinds of collaboration with international partners. CSU has carried out series of experiments in zero gravity in the frame of collaboration with NOVESPACE, and Zero Gravity Experiment Center (OGEC) is assigned as the implementer on behalf of CSU.

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8.) An exploratory study for measure and genesis of We-Consciousness: Induction through weightlessness in parabolic flights
Research Institute for International Management, Competence Center for High Performance Teams, University of St. Gallen

Many astronauts returned from space reporting a permanent change in their consciousness. On an individual level, states of awe, flow, and self-transcendence constitute the basis of the so-called overview-effect that many astronauts report. On the team level much less consciousness research has been conducted even though team-spirit in space is often even more mission-critical

than individual performance. We hypothesize that teams during weightlessness experience an elevation of their We-Consciousness (WEC), in which team members experience simultaneously states of cohesion, satisfaction, commitment and trust towards the team and elevate in their team-efficacy believes and their wish to continue as a team in the future. During the 3rd Swiss parabolic flight we will measure if and to what extent these individual and team consciousness states emerge during short-term weightlessness, using new questionnaire instruments (for WEC and flow) and voice recognition driven methods (for awe and self-transcendence). We will map these effects against a set of personality constructs in order to explore if certain personality types are more likely to enter more into such elevating consciousness states.

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