

**Announcement of Opportunity
for Human Research Using
Concordia station as Human Exploration Analogue**

AO-2017-Concordia



**Letter of Intent due:
February 1st, 2018**

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**Proposal due:
March 30, 2018**

Summary of this Opportunity

- The Directorate of Human Spaceflight and Robotic Exploration Programmes of the European Space Agency, in cooperation with the Concordia Steering Committee, announces an opportunity to propose investigations in human research using the unique environment of Concordia station as a Human Exploration analogue. Concordia Station is a station located at a location called Dome C on the Antarctic Plateau, owned and funded by the Italian and French National Antarctic Programmes (PNRA and IPEV).
- Eligibility: The scientific institution for which the coordinator of a proposal is working must be located in one of the ESA member or associated member states that contribute to the SciSpace programme: Austria, Belgium, Czech Republic, Denmark, France, Germany, Ireland, Italy, Norway, Poland, Romania, Spain, Sweden, Switzerland, United Kingdom. Scientists from other ESA Member States that do not contribute to the SciSpace Programme and scientists from other European countries having a cooperation agreement with ESA are encouraged to enquire with their national space organisation about the conditions for their participation in proposals to ESA.
- Submission of Letters of Intent and proposals will be done electronically using the template from the Announcement of Opportunity website to
Concordia@esa.int

- Important dates:

| | |
|--------------------------------------|----------------------------------|
| Letter of Intent due: | February 1 st , 2018 |
| AO-2017-Concordia proposal workshop: | February 20 th , 2018 |
| Proposals due: | March 30 th , 2018 |

The AO-2017-Concordia Proposal Workshop will be held in conjunction with a Concordia Science Workshop on past and on-going experiments on February 19th, 2018, to which all interested proposers are invited to attend.

- Implementation schedule: implementation of selected experiments will start as of the winter-over season 2020 with preparation activities (science and operational requirements definition, crew training, hardware shipment, etc.) starting soon after formal selection of proposals.
- For questions related to this Announcement of Opportunity please contact:
Human Research Office
Concordia@esa.int

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1 Introduction

Exploratory missions to Moon and Mars, including the establishment of a permanently crewed base on the lunar surface, will add a new dimension to human spaceflight, taking into account the distance of travel and subsequent remoteness of the crew, the radiation environment, the gravity levels, the duration and mission scenario, and the level of confinement and isolation the crews will be exposed to.

For a long-duration mission, the psychological as well as physiological challenges given by the long distances of travel, the duration of permanent living under dependence of automated life-support systems, the degree of isolation and confinement, and the lack of short-term rescue possibilities in case of emergencies will exceed those that humans have ever been exposed to. This raises the importance of investigating several health issues, including those related to individual and crew performance, individual and crew well-being as well as psychological and physiological issues, which are assumed to become potential limiting factors to human adaptability during these missions and, therefore, need to be efficiently prevented, mitigated and counteracted.

Isolation and confinement studies play an important role in the preparation of human long-duration space missions. They provide unique possibilities to characterize psychological, physical and physiological reactions to isolation and confinement, to develop methods to cope with mission-endangering issues (such as interpersonal conflicts, sensory and social deprivation, and decrease in crew performance) as well as to extend the research to other scientific fields like medicine and life support.

Living in extreme isolation is a great opportunity for ESA to study human adaptation from a psychological and physiological point of view. Space research has been conducted in the polar regions for years – offering conditions on Earth similar to long-term space travel.

Concordia Station is a jointly operated French-Italian station owned and funded by the French and Italian National Antarctic Programmes, IPEV and PNRA respectively. IPEV and PNRA offer support to ESA for access and use of one of the most isolated Antarctic research infrastructure, Concordia station, for the implementation of research experiments in the human research area. Concordia station is considered as the one of the highest fidelity real-life Earth-based analogues for long duration deep space missions and each year since 2005, ESA, in cooperation with IPEV and PNRA, has been carrying out an ambitious science programme, investigating topics such as coping with stress, changes in the immune system, and alterations in circadian rhythms, in preparation of future human exploration missions. Information on the Concordia station can be found on <http://www.esa.int/concordia> and in Annex A of this document, as well as on the Italian and French Antarctic national programmes websites (www.italiantartide.it, www.ipev.fr and on www.concordiastation.aq, which is currently under construction but will be released soon).

2 Objectives of this Announcement of Opportunity

In order to continue to make use of the unique characteristics of Concordia station, the Steering Committee of Concordia (representing the Italian and French National Antarctic programmes) and ESA release this Announcement of Opportunity to address human research questions that are relevant to prepare for ESA's overarching goal to enable a human mission to Moon, Mars or beyond, more specifically:

The Science and Utilization Department of ESA’s Human Spaceflight and Robotic Exploration Directorate recently undertook an extensive exercise to create a new strategy focussing on a set of newly defined goals to help positively shape the future Human Space Exploration and maximise its research potential. In the areas of psychological and neurosensory adaptations to isolation and confinement, the following research questions were identified as deserving high priority:

- Understanding spaceflight-induced stresses and related mechanisms and processes as well as countermeasures for psychological, neurosensory, neuroendocrine and stress-sensitive systems of the human body
- Optimizing crew selection criteria, crew cohesion and performance including, but not limited to, behaviour and performance
- Enhancing and optimizing the human factor contribution to space exploration missions’ operations
- Ultimately enabling future human long-duration spaceflight missions beyond LEO

Figure 1, namely section B, depicts the above listed objectives in more detail:

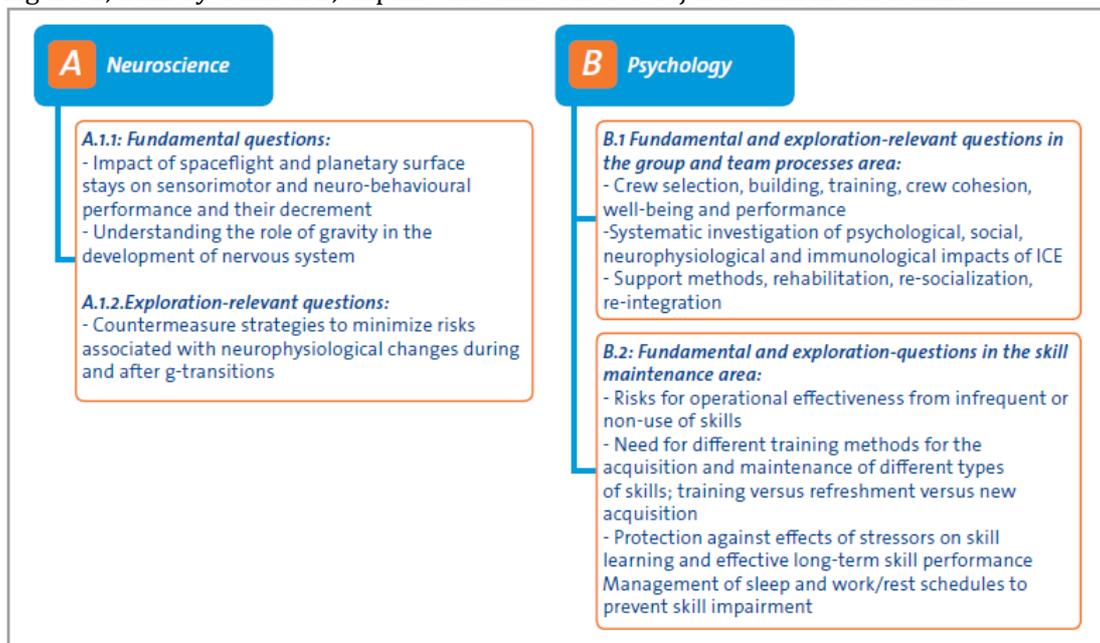


Figure 1: ESA Specific objectives in Psychological And Neurosensory Adaptations.

Scientists are strongly invited to address one (or more) of these topics with their proposed experiments.

3 Proposal Preparation

3.1 Schedule

The schedule for this Announcement of Opportunity is as follows:

| | |
|--------------------------------------|----------------------------------|
| Letter of Intent due: | February 1 st , 2018 |
| AO-2017-Concordia Proposal Workshop: | February 20 th , 2018 |
| Proposals due: | March 30 th , 2018 |

3.2 Announcement of Opportunity Workshop and Concordia Science Workshop

A workshop for this Announcement of Opportunity will be held on February 20th, 2018 at ESA/ESTEC, Keplerlaan 1, Noordwijk, The Netherlands. During the workshop, ESA will provide general information about the Opportunity as well as information on the characteristics and constraints of implementing experiments on Antarctic Research Stations. The workshop will also provide an opportunity for scientists to network and potentially start collaborations, the Letters of Intent will serve as preparatory input to the workshop.

In addition to this one-day AO-2017-Concordia Proposal Workshop, ESA will organize a Concordia Science Workshop on the day before, i.e. on February 19th, 2018 during which scientists whose experiments were implemented in past winter-over seasons will be able to present their results obtained thus far.

3.3 Proposal Submission

All proposals shall follow the template provided on the website. Completed proposals (one single and non-protected pdf) shall be sent (email only) by March 30th, 2018 to the following address: concordia@esa.int

3.4 Proposal Review

Programme-compliant proposals submitted in response to this AO will undergo a scientific merit (peer) review. Only those proposals most highly rated in the scientific merit review process will undergo the additional review for feasibility.

The following criteria will be used in determining the scientific merit score:

Significance: Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods, or products that drive this field?

Approach: Are the theoretical framework, experimental design, data analysis and interpretation methods adequately developed, well integrated, and appropriate to the aims of the project? Is the proposal hypothesis-driven? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas?

Innovation: Does the project employ novel concepts, approaches, or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?

Personnel: Are the scientific personnel appropriately trained and well suited to carry out this work? Is the evidence of the personnel's productivity satisfactory? Are the functions and responsibilities of the team members adequately described and appropriate? Does the project employ useful collaborative arrangements?

Environment: Does the institutional environment, in which the work will be performed, contribute to the probability of success?

In the review, each proposal will receive a scientific merit score between 0 and 100 points. As a result of the scoring the proposals will receive one of the following marks:

- Outstanding 100 - 91 points
- Excellent 90 - 81 points
- Very Good 80 - 71 points
- Good to Fair 70 - 46 points
- Unacceptable 45 - 0 points

The scoring will be weighted according to the 5 sub-criteria:

- Significance 30%
- Approach 25%
- Innovation 20%
- Personnel 15%
- Environment 10%

The peer board will also evaluate the proposal's relevance to the Concordia environment. Again, scores between 0 – 100 will be given, resulting in a second mark. Only proposals receiving a mark of “Very Good” on both the scientific merit and the relevance score will proceed in the evaluation process.

3.5 Technical feasibility

The most highly rated proposals following the peer review will undergo a feasibility evaluation by experts from ESA, IPEV and PNRA. Selected experiments will enter a pool of experiments and will be accommodated as soon as possible in the following seasons, once definitively approved by the Concordia Steering Committee for implementation.

4 Implementation of selected experiments

After proposal selection, implementation is foreseen to start as of the winter-over season 2020 with preparation activities (science and operational requirements definition, crew training, hardware shipment, etc.) starting soon after formal selection of proposals. After completion of the experiment, a report to the Concordia Steering Committee, highlighting findings, namely those that could be of operational interest for the French and Italian National Antarctic Programmes increasing the quality of life at the Station, shall be submitted. This report will remain confidential.

It shall be noted that ESA and its partners do **not** financially support the work of selected experimenters. Any additional expenses related to the proposed work of an experimenter, including costs for travel (e.g., to meetings) and subsistence, are considered investigator-related costs, which are not sponsored by ESA. Funding from national agencies / organisations, universities, or other institutions is required to cover investigator-related costs and implementation.

For those investigators who will visit Concordia Station after the agreement by the Concordia Steering Committee, travel and accommodation from the port of Departure - Hobart (Australia) or Christchurch (New Zealand) - will be covered by IPEV and PNRA, but the travel from their own country to the port of departure and return will be not financially supported.

Due to the experience in recent years, ESA strongly advises all science teams to contact their national representatives to investigate possible national funding procedures and timelines as well as probability of funding in order to identify alternative funding sources if necessary. As a minimum it is recommended to submit the proposal to their national bodies in parallel with their application in response to this Announcement of Opportunity, in order to start applying for national funding as early as possible.

If the proposed experiment is selected, a proof of appropriate funding is mandatory before implementation of the proposals.

ANNEX A: Concordia Station Overview

The Concordia Research Station, operating all year round since 2005, was built and is operated jointly by the French Polar Institute (Institut Polaire Français Paul-Emile Victor, IPEV) and the Italian National Antarctic Research Programme (PNRA). It offers a unique place for conducting advanced research mainly in the areas of Astronomy, Glaciology, Atmosphere sciences, Geosciences and Climate sciences.

Concordia station is located on a high plateau on the Antarctic mainland (Figure 2) at around 3200 meters altitude, exposing the crew to chronic hypobaric hypoxia stress conditions similar to the one expected during long-duration exploration missions. Concordia station can host up to 16 crewmembers but needs a technical manager, chef, doctor, communications technician, plumber, mechanic and an electrician to ensure safe operations. The remaining crewmembers are devoted to scientific projects mainly in the area of glaciology and meteorology. During the Antarctic winter (from February until November) access to the station is virtually impossible due to the extreme weather conditions, during the winterover period, the crew is exposed to four months of complete darkness, (from May until August) and temperatures can go as low as $-60\text{ }^{\circ}\text{C}$ (lowest record in 2002 was $-85\text{ }^{\circ}\text{C}$).

Access to Concordia station is limited to the Antarctic summer (November to February) and transportation is carried out either via plane (personnel and light cargo) or by ship and then ground traverses (heavy cargo).

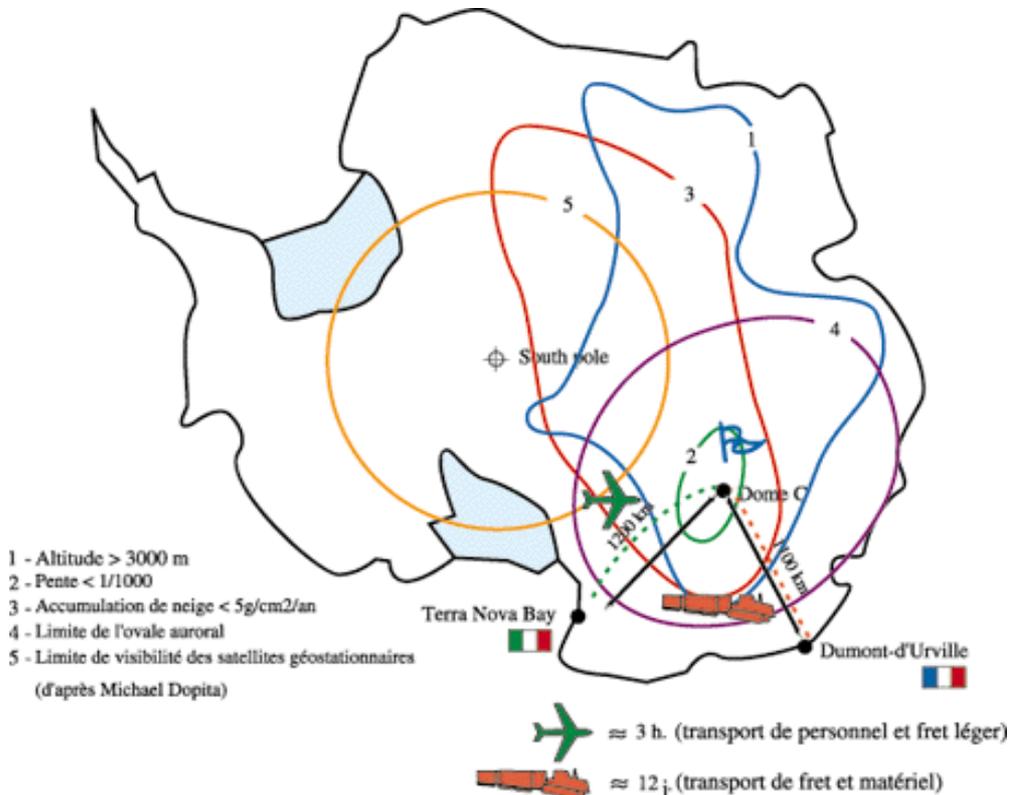


Figure 2: Location of Concordia Station on the Antarctic continent

The base is so unlike anything found elsewhere in the world that ESA uses it as a model for a habitat on extraterrestrial planets. It is not a coincidence that Concordia has been identified both by ESA and NASA as one of the most important Earth-based analogues for long-duration exploration missions and inter-planetary travel. The extreme confinement, self-reliance and autonomy and limited resources make this international research facility an extremely useful testbed for human interplanetary missions.

Every year since 2005, ESA has been sponsoring a dedicated medical research doctor on Concordia station to help studying the long-term effects of isolation. To date European scientists have thus been able to investigate how such an environment can affect the crew's thinking, mood and sleep quality, and have been testing different countermeasures (e.g. exercise and special lighting conditions) to reduce unwanted effects.

The extreme and special conditions of Concordia station lead to specific restrictions for proposed experiments:

- Since Concordia station was originally built to study Earth's climate history through the European Project for Ice Coring in Antarctica (EPICA) the main task of crewmembers is not to serve as test subjects to ESA-selected Human Research experiments. Participation in ESA-selected Human Research experiments is entirely voluntary, it is therefore strongly recommended to devise experiments that are low invasive and little time consuming (roughly two hours per week and per subject are available for human research).
- Knowledge of the English language varies among the crewmembers. It is therefore recommended that, e.g., training and questionnaires are provided also in French and Italian.
- ESA-selected Human Research experiments are implemented through the support of an ESA-sponsored medical doctor, who receives training on the selected protocols by the respective science teams before departure to Concordia station.
- Real-time data transfer capabilities are limited.
- Equipment for medical/physiological/psychological research on site is limited. Special required equipment and consumables have to be provided by the researcher.
- Transportation of necessary equipment has to be organised well in advance. Weight and size of equipment (incl. consumables) shall be minimized.
- General information about Concordia station can also be found here: <http://www.esa.int/concordia> and on the websites of the French and Italian National Antarctic programmes (www.italiantartide.it, www.ipev.fr and www.concordiastation.aq which is currently under construction but shall be released soon).

ANNEX B: Long Term Medical Survey (LTMS)

ESA has established with the help of external advisors a set of biomedical and psychological parameters (the so-called "Long Term Medical Survey" (LTMS)), which are collected in a standardized manner during each Antarctic winterover season. LTMS aims at developing a knowledge base focussing on the adaptation of crewmembers under extreme conditions.

The following measurements are currently part of LTMS and can be requested by science teams in their proposals:

| Measurement | Conducted by | Frequency | Duration |
|--|--|---|---------------------|
| Med Officer record of maladjustment manifestations | ESA Medical Doctor (MD) | Twice a month | 80 min (16x5) |
| Self-record of maladjustment manifestations | Expeditioners | Once per month (during MD consultation) | 5 min |
| Periodical self-assessment (a few simple parameters (mood, physical wellbeing, nutrition satisfaction, sleep, performance, interpersonal relationships)) | Expeditioners | Twice a week | 5 min |
| Leader and MD evaluations | Expeditioners | Once a month | 20 min (for all 16) |
| Log of critical incidents | Leader+MD | When applicable | |
| Self-assessment (mood) | Administered by MD, performed by expeditioners | PANAS every 2 weeks POMS 3 times during stay | 2-3 min 8 min |
| Clinical symptom list (Lake Louise AMS-score) | Expeditioners | Daily during the first week, weekly after that for the rest of the first month, then once per month | 30 sec each |

ANNEX C: Data Rights

General

The general data policies of ESA's Directorate for Human Spaceflight and Robotic Exploration will apply to all data resulting from the experiments in the context of this Announcement of Opportunity, as well as the IPEV-PNRA Concordia guidelines for Scientific Data and Metadata. Final results of the studies shall be made available by the scientific teams to the scientific community through publication in appropriate journals or other established channels as soon as practicable and consistent with good scientific practice. In the event such reports or publications are copyrighted, ESA shall have a royalty-free right under the copyright to reproduce, distribute, and use such copyrighted work for their purposes.

Practical implementation of data policies

Typically, data will be obtained and processed under the responsibility of a Science Team Coordinator (STC) for the experiment protocol. Data not requested by any other STC may be used exclusively by the STC for scientific purposes. For data requested by more than one STC, each STC must agree before the experiments start as to the conditions for the data usage for scientific purposes. This category of data shall be referred to as "STC proprietary data". The STC proprietary data may be used by the sponsoring agencies for internal purposes. The sponsoring agencies agree that this data will not be made public for 1 year after the completion of the experiment.

In case follow-up points are required for publication long after the main experiment, a STC can apply for extension of the one-year exclusive publication period by submitting a



scientific report in the format of a manuscript 1 year after the completion of the main experiment.

Data Access:

A STC may access proprietary data from other STCs participating in the investigations through a written data sharing agreement (signed by involved STCs). In that case, ESA will ensure that a data-sharing plan among the participating STCs is established prior to the beginning of the respective experiments.

Acknowledgement

Any publication on the results generated during the studies solicited in this Announcement of Opportunity must acknowledge the sponsorship of the study by ESA, IPEV and PNRA.

Support of Education and Outreach

The activities covered in this AO provide an opportunity for ESA, IPEV and PNRA to enhance and broaden the public's understanding and appreciation of Human Exploration related research facilitated by ESA's Directorate of Human Spaceflight and Robotic Exploration Programmes. Therefore, the investigators of selected experiments are expected to promote and communicate their experiments to a wide audience (e.g., general public, colleagues and involvement of students) and to support ESA, IPEV and PNRA in the event of organised press conferences, educational events, publications, etc.