

# COSPAR

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## COMMITTEE ON SPACE RESEARCH

President: Prof. L.A. Fisk

Executive Director: Dr J.-C. Worms



### COSPAR PANEL ON PLANETARY PROTECTION

Chair: Dr Athena Coustenis

Vice Chairs: Mr Niklas Hedman and Dr Peter Doran

<https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/>

## COSPAR Panel on Planetary Protection Meeting

*(in Vienna and remotely)*

**19-20 December 2022**

### Minutes

### AGENDA *(all times in CET and indicative)*

#### Day 1: 19 December 2022 (OPEN SESSION)

1. **13:00-13:15 Welcome introduction and purpose of the meeting** (A. Coustenis, N. Hedman)
2. **13:15-13:25 Briefing from COSPAR President** (P. Ehrenfreund)
3. **13:25-14:10 Briefing from COSPAR Executive Director** (J-C. Worms)
4. **14:10-14:30 Introduction of new members and briefing from COSPAR CIR and PSSH committees** (M. Gold and N. Hedman)
5. **14:30-15:10 Information points/activity report since the last meeting/Athens GA campfire discussion** (PPP Leads and Athens GA PPP sessions conveners)
6. **15:10-16:15 Briefings from TBA agency representatives & NASEM on recent activities**  
  
16:15-16:30 BREAK
7. **16:30-16:50 Briefing from the SSB/CoPP and discussion on small bodies policy** (J. Alexander & A. Hendrix)

8. **16:50-17:10 Presentation on Planetary defense matters** (*R. Kofler*)
9. **17:10-17:50 Reports from private and commercial sector representatives on lunar and other space-related activities** (TBD)
10. **17:50-18:00 Report on the NASA PP Office metagenomic workshop** (*S. Green & S. Tighe*)
11. **18:00-18:45 PP considerations for icy moons exploration**
  - 11a) Titan/Dragonfly (*J. Green, E. Turtle*)
  - 11b) New PP considerations for Icy Worlds (*A. Hayes*)
  - 11c) Way forward and future activities

**18:45 END OF DAY 1**

<b>Day 2: 20 December 2022 (OPEN SESSION CONT'D)</b>
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12. **10:00-11:00 Report from PPP subcommittees on Venus and Mars exploration PP requirements papers – other publications** (*K. Olsson-Francis, M-P Zorzano*)
13. **11:00-11:30 Report of the 6th COSPAR Meeting on Planetary Protection Knowledge Gaps for Crewed Mars Missions** (*A. Spry*)
14. **11:30-12:00 AOB Open session – items from previous day**
  - Sessions for next COSPAR GA in Busan in 2024
  - Activities and co-sponsorship of future Workshops
  - Publications/presentations
  - Q/A with attendees

**12:00 END OF OPEN SESSION**

## **PARTICIPANTS**

### **PANEL MEMBERS**

**Niklas HEDMAN**, Panel Vice-Chair and Chair of the Meeting  
**Athena COUSTENIS**, Panel Chair (attending remotely)  
**Eleonora AMMANNITO**  
**Sarah GALLAGHER**  
**Olivier GRASSET** (attending remotely)  
**Alex HAYES** (attending remotely)  
**Vyacheslav ILYIN** (attending remotely)  
**Praveen KUMAR KUTUANPILLAI** (attending remotely)  
**Christian MUSTIN**  
**Karen OLSSON-FRANCIS** (attending remotely)  
**Jing PENG** (attending remotely)  
**Olga PRIETO BALLESTEROS** (attending remotely)  
**Francois RAULIN** (attending remotely)  
**Petra RETTBERG**  
**Yohey SUZUKI** (attending remotely)  
**Kanyan XU** (attending remotely)  
**Maxim ZAITSEV**  
**María Paz ZORZANO MIER** (attending remotely)  
**Colleen HARTMAN**, Ex-Officio Member  
**Michael NEWMAN**, Ex-officio Member  
**Michael GOLD**, Ex-officio Member

### **INVITED GUESTS/SPEAKERS**

**Jean-Claude WORMS**, COSPAR Executive Director  
**Nick BENARDINI**, NASA PPO  
**Joseph ALEXANDER**, CoPP Co-Chair  
**Amanda HENDRIX**, CoPP Co-Chair  
**Ehrenfreund P.**  
**Alexander J.**  
**Green S.**  
**Spry A.**  
**Worms J-C.**  
**Kofler R.**  
**Green J.**  
**Turtle E.**  
**Hendrix A.**  
**Tighe S**  
**Seasly E.**  
**Squyres S.**  
**Boithias H.**  
**Kempf J.**  
**Perino M-A**  
**Margheritis D.B.**  
**Bezdan D.**

## **ATTENDEES**

**Siegel B.**  
**Rummel J.**  
**Willcut S.**  
**Rick U.**  
**Steininger H.**  
**Venkateswaran K.**  
**Cavalazzi B.**  
**Brucato J.**  
**Clement B.**  
**Aaron JANOFSKY, COSPAR**  
**Tanya KEUSEN, UNOOSA/CPLA**

### **Excused:**

**Peter DORAN, Panel Vice-Chair**

## **1. Introduction and purpose of the meeting**

N. Hedman opened the meeting, welcoming all participants. He reviewed the meeting's agenda, and mentioned that the Panel Chair was attending remotely due to a health problem.

## **2.-3. COSPAR items & introduction of new members**

COSPAR new President, Pascale Ehrenfreund and COSPAR Executive Director, J-C. Worms, gave presentations on general COSPAR items and welcomed new members.

The COSPAR Executive Director mentioned the Committee's structure, the strategy for the future and highlighted some perspectives from the COSPAR General Assembly, held in Athens from 16 to 24 July 2022. He recalled that the Panel submits its recommendations to the COSPAR Bureau, which holds its meetings generally in March in Paris. He noted that, in addition to the planned meetings, the Bureau was, however, able to show flexibility and accelerate decisions on urgent matters, as it had done previously when urgent matters like Policy updates were required.

J-C. Worms also reported that COSPAR was still working on building a repository of reports from space agencies, and that more was to come on this point.

## **4. CIR and PSSH**

J-C. Worms mentioned in particular the new Committee on Industrial relations (whose representative, and Vice-Chair, Mike Gold was attending the PPP meeting and the COSPAR Panel on Social Sciences and Humanities (PSSH), whose Vice-Chair is Niklas Hedman.

The Chair mentioned that PPP was looking forward to work with CIR, PSSH and PEX, as well as with the COSPAR Commissions but within well-defined boundaries and tasks so that the Panel members' efforts can be efficient. It was reminded that the important thing to know was what each body didn't do, as much as what they did do... The two Panel representatives gave brief insights on their Panel's responsibilities.

## **5. Information points/activity report since the last meeting (PPP Leads)**

A. Coustenis provided a high-level review of the Panel's purpose, status, current membership, of the COSPAR Planetary Protection Policy, and the PPP's recent activities, publications and meetings to which Panel members have contributed. She recalled, inter alia, the planetary protection category that was specifically assigned for the Martian Moons eXploration (MMX) mission, to highlight that the Panel could work also on a case-by-case basis, and mentioned the future considerations on the Policy for Mars, the icy moons in the outer solar system (following the PPOSS exercise, which were published in 2020), and the lunar Policy update in 2021 published in Space Res. Today 211, 14-20 (Aug. 2021); <https://doi.org/10.1016/j.srt.2021.07.009>.

A. Coustenis encouraged everyone who had relevant planetary protection information to share, to do so, so it could be posted on the COSPAR website. She also addressed new items that could be laid before the Panel for its consideration that were further discussed afterwards.

She mentioned the PPP sessions and other meetings in Athens during the COSPAR GA, which were considered very successful by all participants (see Minutes of July 2022).

*[see PowerPoint presentation]*

## **6. Briefings from agency representatives**

Different agencies representatives presented PP-related aspects of their programs.

*[see available PowerPoint presentations]*

## **7. Briefing from the SSB/CoPP and discussion on small bodies**

A presentation on small bodies was given by the SSB/CoPP followed by a discussion on small bodies policy (*J. Alexander & A. Hendrix*)

*[see PowerPoint presentation]*

The presenters concluded that given the importance of some classes of relatively primitive, volatile-rich, and organic-bearing small bodies to studies of prebiotic chemistry, and the sparsity of current knowledge about them, the Committee sees no reason to reduce the current categorizations (from Category II to Category I) for missions to such objects until such time as scientific knowledge changes. Similarly, Category I remains appropriate for missions to rocky, metamorphosed, near-Earth objects and main-belt asteroids.

CoPP also signaled the need for an archive : It is important that the scientific community is aware of which bodies have been visited by any mission, especially if they have been landed on or crashed into (in case the target is revisited).

Whether a target will ever be revisited is not known prior to visiting it initially.

*Finding : Access to information prepared in response to planetary protection requirements is important for planning future missions to certain small bodies to study chemical evolution and the origin of life. The committee was unable to confirm that an archive of planetary protection information currently exists.*

The Chair mentioned that COSPAR was working towards that effect. But that there were issues regarding confidentiality and sensitive material and permissions from different countries. Also disposition at a certain place and accesses.

## **8. Presentation on Planetary defense matters (*R. Kofler*)**

R. Kofler gave a presentation on the Planetary Defense aspects highlighting the work of the UN on such matters.

*[see PowerPoint presentation]*

## **9. Reports from private and commercial sector representatives on lunar and other space-related activities**

Steve Squyres gave a presentation for Blue Origin describing their program. He mentioned that for self-funded mission they will follow the same procedures as established by COSPAR.

Also representatives from OHB, Thales Alenia Space and Airbus, were given the floor for short mentions of their activities with respect to PP.

[see PowerPoint presentations]

## 10. Report on the NASA PP Office metagenomic workshop

S. Green (RUSH, Workshop Chair) & S. Tighe (Technical Director, Advanced Genomics Lab, Vermont Integrative Genomics Lab, University of Vermont Cancer Center and Co-Chair ABRF Metagenomics and Microbiome Research Group (MMRG)) gave a presentation on a metagenomic workshop hosted by the NASA Office of PP in Jan 2022. The associated report was published in *Astrobiology*: "Metagenomic Methods for Addressing NASA's Planetary Protection Policy Requirements on Future Missions: A Workshop Report" (2023 Aug;23(8):897-907.

doi: 10.1089/ast.2022.0044. Epub 2023 Apr 26).

<https://pubmed.ncbi.nlm.nih.gov/37102710/>

## 11. PP considerations for icy moons exploration

### 11a) Titan/Dragonfly (J. Green, E. Turtle)

Dr Elizabeth Turtle presented NASA's Dragonfly mission to Titan, its exploration strategy, timeline and status.

Jim Green gave a short presentation on planetary protection considerations for Dragonfly. The summary of Planetary Protection Considerations included:

- Although transport of terrestrial material from the Dragonfly Lander to locations on Titan's surface is technically not impossible, comprehensive evaluation of transport and interaction scenarios shows none that credibly permit transfer of material from the lander to the subsurface ocean.
- Heat output of a single MMRTG is too small to permit thermal drilling through the ~100-km-thick ice crust.
- Off-nominal deposition in methane sea would result in efficient chilling of exposed MMRT surfaces (heat transfer coefficient  $h > 20 \text{ W/m}^2\text{K}$ ,  $T \sim 140 \text{ K}$ ).
- Combination of individually improbable circumstances could potentially allow transiently habitable microenvironments on the surface of the MIMRTG if buried in porous/insulating ice-bearing material. However, these could persist only for 1-2 Pu half-lives before freezing to unviable temperatures.
- The Dragonfly project has worked with NASA's Office of Planetary Protection, who coordinated science review of our categorization proposal, and Dragonfly has been assigned Mission PP Category II. The Project will work with NASA to implement the PP plan.

The Panel expressed the desire to hear about the outcome of the report of the ad hoc committee which reviewed the Dragonfly PP plan.

### 11b) New PP considerations for Icy Worlds (A. Hayes)

Alex Hayes presented topics for discussion concerning the Icy Worlds PP Policy.

Topics for discussion suggested were:

- Make use of -28C as baseline for habitability to remove ambiguity of ocean terminology.
- Expand Category III/IV/V requirements for Europa and Enceladus to include all icy bodies
- Define icy bodies (e.g., “bodies with significant surface ice layer (>50% of surface) that orbits the sun entirely beyond Mars”)
- Add probability for microbe survival of landing/impact of Contamination to minimum probability calculation
- Include a definition for Period of Biological Exploration (PBE) in PP Policy  
Extend 1000 year PBE to all icy worlds?

The discussion that followed was around the method to proceed, while ensuring

"..... that in assessing changes to COSPAR planetary protection policies and requirements there is a process to engage the full breadth of stakeholders, including the spaceflight mission and science communities." (*excerpt from "Review and Assessment of Planetary Protection Policy Development Processes" (NASEM, 2018)*)

- Hold Ocean World / Icy Body Planetary Protection Policy workshop
- Schedule adjacent to international conference (EGU)?
- PPP Subcommittee draft a white paper for community review

Ideally both should happen, but what is the right order?

The Panel decided to proceed in parallel with producing an article to review the scientific knowledge available today, while at the same time informing the community and getting expert advice on the matter. The review paper would expose findings perhaps leading to updates of the PP Policy and would encompass authorship from experts outside the Panel as required and as done before for the Mars and the Venus papers. The Panel decided to present the process and the findings to the next PPP meeting in Vienna in April 2023 in an open Sessions and to a number of specialized community meetings (OPAG, etc) and to the SSB/CoPP in 2023.

### **11c) way forward and future activities**

A discussion followed also on the way forward for the Policy. The Panel appointed a subcommittee to work on the Icy Worlds Policy and requested a thorough review of the current scientific knowledge regarding the gas giant moons. The subcommittee included Alex Hayes, Olivier Grasset, Olga Prieto-Ballesteros and Athena Coustenis and was headed by Peter Doran.

Further, the Panel discussed the possibility to make improvements to the Policy through Editorial changes. The Policy has indeed evolved through a somewhat non-coherent way over time.

- Incremental changes were introduced to address mission needs and scientific findings
- Current structure can be difficult to interpret and implement, e.g.,
  - Mixture of roles and responsibilities, definitions, and guidelines.
  - Repetition (e.g., restricted earth return) and outdated references (e.g., to Viking missions)
- Can be improved as an instrument to explain PP's value, build a common understanding of PP objectives and guidelines, and enhance transparency across operators
  - Prepare for increasing exploration missions, including human spaceflight.

## **12. Report from PPP subcommittees on Venus and Mars exploration PP**



### **requirements papers – other publications** (*K. Olsson-Francis, M-P Zorzano*)

The Panel heard about the upcoming publications on the findings and the scientific papers prepared by both the Venus habitability and the Mars knowledge gaps for robotic missions subcommittees. The papers were submitted and in review and should be published soon.

The Chair thanked the two subcommittees for their work and mentioned that the work produced was very useful for the future work of the PP community.

### **13. Report of the 6th COSPAR Meeting on Planetary Protection Knowledge Gaps for Crewed Mars Missions** (*A. Spry*)

Andy Spry gave a presentation on the current understanding of knowledge gaps for Mars' human exploration. An article on this topic with the findings from the group including several PPP members was submitted to *Astrobiology* under the title "Planetary Protection Knowledge Gap Closure Enabling Crewed Missions to Mars" by Spry et al.

The paper was based on NASA and ESA studies that began in 2001, COSPAR adopted principles and guidelines for human missions to Mars in 2008. At that point, it was clear that to move from those qualitative provisions, a great deal of work and interaction with spacecraft designers would be necessary to generate meaningful quantitative recommendations that could embody the intent of the Outer Space Treaty (Article IX) in the design of such missions. Beginning in 2016, COSPAR then sponsored a multi-year interdisciplinary meeting series to address planetary protection "knowledge gaps" (KGs) with the intent of adapting and extending the current robotic mission-focused Planetary Protection Policy to support the design and implementation of crewed and hybrid exploration missions.

The Panel recognized the huge amount of work performed in this great process that is setting a paradigm for future such studies.

The Spry et al. paper describes the outcome of the interdisciplinary COSPAR meeting series, to describe and address these KGs, as well as identify potential paths to gap closure. It includes the background scientific basis for each topic and knowledge updates since the meeting series. The paper includes a KG data table intended to be a point of departure for making future progress in developing an end-to-end planetary protection requirements implementation solution for a crewed mission to Mars.

A. Spry stressed the different aspects considered in this study and said that the paper would need to include more definitions and references.

The Panel voted to endorse the report presented and several PPP members accepted the offer to co-author the paper.

*[see PowerPoint presentation]*

### **14. AOB Open session – items from previous day**

N. Hedman led a discussion on future activities of the Panel and future meetings and thanked everyone for their engaged participation and closed the meeting.

Most of the presentations at the meeting can be found at the Panel's web site:  
<https://cosparhq.cnes.fr/scientific-structure/panels/panel-on-planetary-protection-ppp/>