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COSPAR RECOMMENDATIONS IN A NEW CONTEXT?  
ENVIRONMENTAL ASPECTS OF SPACE MINING

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Abstract

The projects on space mining open numerous questions, including the one on the guarantees of environmental standards of space activities. These are in a general way regulated by Article IX of the Outer Space Treaty (due regard to the corresponding interests of other Parties, avoidance of adverse changes in the environment of the Earth resulting from introduction of extraterrestrial matter, obligation to undertake international consultations). The specific regulations for avoiding interplanetary contamination are developed and regularly amended by the international Committee on Space Research (COSPAR). The contribution analyses the scope of the competences of COSPAR, the legal character of its recommendations, and their applicability to space mining. Special attention is given to the question of the scale of space activities covered by the COSPAR recommendations (e.g. samples return), and the envisaged scale of space mining. In the conclusion, the contribution attempts to answer the question whether the COSPAR recommendations could have influence on space mining, and to which extent.

I. Introduction

The projects on space mining evoke in some parts of the public horrific pictures of destroyed environment on celestial bodies, and biologically contaminated extra-terrestrial materials, deliberately returned to the Earth without going through the “sterilizing” process. These scenarios can be answered on several levels: First, it is generally acknowledged that lunar and asteroidal samples are now known to be sterile; this might not be the case for all Martian rocks<sup>2</sup> but those are not in the focus of the space mining projects. The second level consists of the legal framework of space activities, especially the regulations dealing with the environmental protection in and out of outer space which serve as measures of prevention and cure, in case of necessity. Other means include the

economic self-interest of space mining projects in the protection of the areas where they perform their activities, as well as in the use of ecologically doubtless materials in outer space and on the Earth.

The key to the environmentally cautious behaviour of space resources programs is Article VI of the Outer Space Treaty which connects the space activities of non-State entities with the State of authorization and supervision, the internationally responsible State. It is a matter of national legal order, how this “appropriate State Party” guarantees that the environmental criteria (see below) are respected. It can be general or specific national legislation, under-statutory regulations, or jurisprudence which can set the environmental limits.

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<sup>1</sup> The author thanks to Dr. Petra Rettberg (DLR) and Prof. John Rummel, PhD.(University of East Carolina University) for valuable information and advice.

<sup>2</sup> EURO-CARES Project, Summary, 9/29/15, euro-cares.eu.

On the international level, it is the State of authorization and supervision which is internationally responsible for the eventual violation of the substantial environmental rules by “its” non-governmental entities (Article VI OST). In case of ecological damage to the victims of another State (e.g. damage to health to persons) by a space object, it is in principle one of the launching States which is liable to pay compensation for the damage according to the 1972 Liability Convention.

The substantial rules protecting environment of outer space and the Earth in relation with space activities are contained in Article IX OST.<sup>3</sup> The specific regulations for avoiding interplanetary contamination are developed and regularly amended by the international Committee on Space Research (COSPAR). The contribution analyses the scope of the competences of COSPAR, the legal character of its recommendations, and their applicability to space mining. Special attention is given to the question of the scale of space activities covered by the COSPAR recommendations (e.g. samples return), and the envisaged scale of space mining. In the conclusion, the contribution attempts to answer the question whether the COSPAR recommendations could have influence on space mining, and to which extent.

## II. Substantial Rules

International standard setting in the area of planetary protection goes back to 1958 when, after the successful start of the Sputnik, quarantine standards were introduced by the International Council of Scientific Union (ICSU).<sup>4</sup> By 1967 – prior to the successful landing in a solar system other than Moon – there was a general agreement among space faring nations that

interplanetary contamination should be regulated.

As a consequence, Article IX OST requires from State Parties to pursue studies of outer space, including celestial bodies, and conduct their exploration so as to avoid their harmful contamination. Furthermore, it expects that they avoid adverse changes in the environment of the Earth resulting from the introduction of extra-terrestrial matter. “When necessary”, States are obliged to adopt “appropriate measures” for this purpose.

The general message of this provision is clear: When pursuing space activities, the States have to deliberate whether one of the situation - harmful contamination of outer space or adverse changes to the environment of the Earth - can occur. In case of such probability, they have to take resp. impose on the non-state entities preventive measures. When it comes to the definition of the situation when it should be applied, Art IX it leaves indefinite the circumstances when active measures are to be taken: The presence of the adjective “harmful” modifying contamination indicates that the contamination is not per se prohibited, and also the meaning of “harmful” is far from exact. Furthermore, Article IX leaves open whether the obligation to take measures covers only biological, or non-biological contamination of outer space. Therefore, whether environmental pollution or degradation is covered is not clear. The same can be said about “adverse changes” in the environment of the Earth. Additionally, the modifier “where necessary” blurs the parameters of the requirement. Therefore, the duty to avoid harmful contamination is general and aspirational.

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<sup>3</sup> S. Marchisio, Article IX, in ; CoCoSL, vol I, 169 ff.

<sup>4</sup> C.-A. Conley, COSPAR Planetary Protection Policy – Present Status, in : Mahulena Hofmann/

Petra Rettberg/ Mark Williamson (eds), Protecting the Environment of Celestial Bodies : The Need for Policy and Guidelines, IAA 2010.

However, adverse changes in the environment of celestial bodies and the Earth clearly need not only involve biological contamination – both to protect potential lifeforms on the planetary bodies against contamination from spacecraft and to ensure that future astrobiological research is not compromised. The topic is more complex and means that other aspects of protection have to be taken into account: space environment includes specific geomorphological features of celestial bodies, Earth's orbital resources, lunar orbit and planetary orbits, as well as cultural and historic sites on celestial bodies.<sup>5</sup>

Therefore, the analogical provision of the later 1979 Moon Agreement (MA) (Article 7.1) to Art. IX OST sharpens the OST provisions: The States are obliged to avoid to prevent the disruption of the existing balance of the environment of celestial bodies by introducing “adverse changes” in their environment (see Art. IX OST in relation to the Earth), and by their “harmful contamination through the introduction of extra-environmental matter or otherwise”. In relation to the Earth, the State Parties shall avoid “harmfully affecting the environment of the Earth through the introduction of extraterrestrial matter or otherwise”. As in Art. IX OST, what exactly constitutes “harmful” contamination is unclear, but “adverse changes” and the “introduction of extra-environmental matter” are welcome if limited partial clarifications, signalling that latter phrase can include non-biological matter. “Or otherwise” leaves the door open for other contaminative possibilities which may emerge in the future.<sup>6</sup> In case of probability that such situation might occur, the States Parties are obliged to “take measures to

prevent” these adverse changes. It must be added, however, that the Moon Agreement was adhered to by 16 States only and does not represent customary international law; the main reference remains, therefore, the Outer Space Treaty.

### III. COSPAR

The environmental provisions of both OST and MA have been elaborated on the basis of the expertise and initiatives of the COSPAR (Committee on Space Research) of the ICSU which adopted its first report on the possible contamination from outer space in 1958.<sup>7</sup> Since then, the activities of the COSPAR expanded, the last Planetary Protection Policy being adopted in 2002 and amended in 2005 and 2011. In the course of years, the COSPAR standards developed to “reference for space faring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration, and to provide accepted guidelines in this area to guide compliance with the wording of the Outer Space Treaty and other international agreements”,<sup>8</sup> and an “international consensus standard for biological contamination under the Outer Space Treaty”.<sup>9</sup>

According to its Charter approved by the COSPAR Council by correspondence vote in June 1998 and approved by ICSU during the 76th Executive Board meeting held in 1998 in Paris, COSPAR is a Scientific Committee of ICSU.<sup>10</sup> Its objectives is to promote on an international level scientific research in space, with emphasis on the exchange of results, information and opinions, and to provide a forum, open to all scientists, for the discussion of problems

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<sup>5</sup> Mark Williamson, Scope and Methodology, supra note, 4 ff.

<sup>6</sup> Mahulena Hofmann, Planetary Protection from a Legal Perspective – General Issues ; in : supra note, 38 ff.

<sup>7</sup> News in Science : Development of International Efforts to Avoid Contamination of Extraterrestrial Bodies, 1958, 28 Science 887.

<sup>8</sup> Preamble to the COSPAR Planetary Protection Policy, 2011, available on the COSPAR official website.

<sup>9</sup> C. Conley and P. Rettberg, COSPAR Planetary Protection Policy – Present Status, *ibid* fn. 4, p. 19.

<sup>10</sup> <https://cosparhq.cnes.fr/>.

that may affect scientific space research. This is achieved through the organization of scientific assemblies, publications or any other means (Article I). COSPAR reports to ICSU on its activities and provide scientific advice on matters concerning scientific space research to the UN and other organizations.

It consists of two kinds of Members: National Scientific Institutions, as defined by ICSU, which are engaged in space research and seek membership in COSPAR, and International Scientific Unions federated in ICSU which seek membership in COSPAR. It is governed by a Council responsible for the formulation, approval and execution of all plans and policies of COSPAR. Between meetings of the Council, a Bureau is responsible for administering and conducting the affairs of COSPAR in accordance with policies defined and directives given by the Council. Scientific Commissions shall be responsible for all scientific activities of COSPAR. They shall consist of the individual associates of COSPAR who shall elect from among themselves chairmen and other officers as required. COSPAR conducts its business according to ICSU rules for Scientific and Special Committees. Its By-Laws and Procedures are established within the framework of this Charter and the ICSU rules for Scientific and Special Committees.

The range of activities of COSPAR is manifold: Special interest is focused on advising the UN and other intergovernmental organisations on space research matters or on the assessment of scientific issues in which space can play a role, for example the preparation of scientific and technical standards related to space research.

The scientific activities are performed by Scientific Commissions (Article IV of the

Charter) which consist of the individual associates of COSPAR. According to COSPAR By-Laws, approved by the COSPAR Council at its meeting in 2012 (Article XIII.1.), Panels can be established by the Bureau as subsidiary bodies of COSPAR on topics of interdisciplinary interest, or involving participation from experts from disciplines not represented within Scientific Commissions, *ad hoc* Committees.

The Panel on Potentially Environmentally Detrimental Activities in Space (PEDAS)<sup>11</sup> is concerned with perturbations of the terrestrial and planetary environments resulting from space activities. Typical examples are: space debris in Earth orbit, release of chemicals in the Earth's atmosphere by rocket launches, perturbation of the lunar environment by manned activities as well as possible perturbation of the Martian environment by space activities. The Panel acts on an ad hoc basis to evaluate questions of environmental impacts by space activities alone or together with other relevant organizations primarily to advise the international community, e.g., the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations.

The objective of the COSPAR Panel on Exploration (PEX)<sup>12</sup> is to provide independent scientific advice to support the development of exploration programs and to safeguard the potential scientific assets of solar system objects. This advice will be drawn from expertise provided via the contacts maintained by COSPAR's various bodies with the international community and scientific entities. The advice will represent the consensual view of the international scientific community and should ultimately serve as a guideline for future exploration activity and cooperative efforts.

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<sup>11</sup> <https://cosparhq.cnes.fr/scientific-structure/pedas>.

<sup>12</sup> <https://cosparhq.cnes.fr/scientific-structure/pex>.

In order to establish a specific body dealing with Planetary Protection, following the proposal by COSPAR Scientific Commission F (Life Sciences Related to Space), during the COSPAR Scientific Assembly in Nagoya in 1998, COSPAR Established a Panel on Planetary Protection in 1999. The task statement of the Panel covers the consolidation, maintenance and updates of the COSPAR Planetary Protection Policy. The Panel carries out its task by regularly reviewing the scientific assumptions underlying the policy. The first consolidated COSPAR Planetary Protection Policy (since 1964) was introduced in 2002.<sup>13</sup>

It is concerned with biological interchange in the conduct of solar system exploration, including possible effects of contamination of planets other than the Earth, and of planetary satellites within the solar system by terrestrial organisms; and contamination of the Earth by materials returned from outer space carrying potential extraterrestrial organisms. The primary objectives of the Panel within COSPAR are to develop, maintain, and promulgate planetary protection knowledge, policy, and plans to prevent the harmful effects of such contamination, and through symposia, workshops, and topical meetings at COSPAR Assemblies to provide an international forum for exchange of information in this area. Through COSPAR the Panel will inform the international community, e.g., the Committee on the Peaceful Uses of Outer Space (COPUOS) of the United Nations, as well as various other bilateral and multilateral organizations, of policy consensus in this area.<sup>14</sup>

#### IV. Planetary Protection Policy

The main environmental requirements for space missions are formulated in “Planetary

Policies”: COSPAR has formulated a policy with associated implementation requirements as an international standard to protect against interplanetary biological and organic contamination, and after 1967 as a guide to compliance with Article IX OST.<sup>15</sup> After the first Policy was disseminated in 1964, various elaborations and changes were introduced in the form of COSPAR Decisions, generally through the COSPAR Information Bulletin.<sup>16</sup>

Updating of the Policy is a process that involves representatives of several Scientific Commissions, national and international scientific organisations and individual scientists. After reaching consensus among the involved parties, the proposed update is formulated by the Panel and submitted to the COSPAR Bureau and Council for review and approval. It is not a rigid document but is open for future updates reflecting the scientific developments.

#### V. Legal Character of COSPAR Policies

The Preamble of the Present Planetary Protection Policy refers to the OST (Article IX); the Policy defines its task as “to provide accepted guidelines to guide compliance with the wording of the OST and other relevant international agreements”. The wording of the substantial rules is cautious and usually does not exceed the form of a recommendation: It recommends e.g. that its members inform COSPAR when establishing planetary protection requirements for planetary missions; it recommends that COSPAR members provide information within six months of launch about the procedure and computations used for each flight which is delivered in the form of a record to the UN Secretary General. In sum, it can be stated

<sup>13</sup> Gerhard Kminek, COSPAR’s Planetary Protection Policy, p. 1.

<sup>14</sup> <https://cosparhq.cnes.fr/scientific-structure/ppp>.

<sup>15</sup> Gerhard Kminek, *ibid.* fn. 13.

<sup>16</sup> Now Space Research Today, *supra* note.

that the rules of the Policy have recommendatory character.

In the 2011 IAA international study “Protecting the Environment of Celestial Bodies: The Need for Policy and Guidelines”,<sup>17</sup> the question was raised whether the COSPAR rules could represent a form of gradually evolving international customary rule: It was argued that the broad and internationally accepted practice on their basis can be qualified as *usus longaevus*, with practical examples added. Concerning *opinio iuris*, national legislation on space activities was reported as a sign of understanding the rules as binding – with the US space legislation, specifically the National Environmental Policy Act,<sup>18</sup> or the Space Law of Russian Federation<sup>19</sup> as examples. However, the Study came to the conclusion that to qualify the COSPAR rules on Planetary Protection Policy on the basis of the national environmental legislation as *opinio iuris* would be premature: First, these legal acts do not implement the specific COSPAR rules themselves, but mainly the general rules of the Art IX OST. Second, the practice of involving environmental criteria in the national legislation cannot be qualified as a general practice: Some laws regulating space activities like the 1993 South African Space Affairs Act<sup>20</sup> have not included environmental criteria in their framework; furthermore, many space faring nations have not adopted any space legislation yet. Third, there are not public statements of States expressing their *opinio iuris* in this area, such as in the UN General Assembly.

Finally, there seems that there is not enough argument for stating that the COSPAR standards can be considered an element of evolving customary international rules at

present – which does not exclude that they could become such in the future. However, this does not diminish their importance as a significant tool for interpreting Article IX OST and an important basis for a State practice.

## VI. Applicability of COSPAR Recommendations to Space Mining

The projects aiming on the extraction and use of space resources envisage the transport of a space object from the Earth to outer space, its impact with a celestial body, and the use of space resources either in outer space or their return to the Earth, whereas in the more distant future, the launching of space objects from the Earth can be substituted by completing the space structures in outer space. This opens the question on the applicability of Art. IX OST in the sense of its interpretation through the rules of COSPAR.

COSPAR developed five categories for target body/ mission type combinations with specific ranges of requirements<sup>21</sup> which can be used for interpreting Art IX: In their terminology, space resources missions landing on celestial bodies belong to Category II which comprises all types of missions to those target bodies where there is only remote chance that contamination carried by a spacecraft could compromise future investigations; under “remote” is in principle understood the absence of environment where terrestrial organisms could survive and replicate. The consequence of this categorization is that only simple documentation is needed, including a short planetary protection plan.

In case of bringing space materials to the Earth, Category V of the Policy which

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<sup>17</sup> Mahulena Hofmann, The Role of COSPAR Guidelines in Interpreting Article IX OST, Proceedings of the IISL, Eleven 2011, 311 ff.

<sup>18</sup> 42 U.S.C. 4321. et. seq.

<sup>19</sup> Law of the Russian Federation on Space Activities, August 20, 1993 Resolution No. 5663-1, as amended.

<sup>20</sup> No 24 of 2 July 1993, as amended.

<sup>21</sup> Planetary Protection Policy.

comprises all Earth-return missions could be relevant. This require containment throughout the return phase of all returned hardware; post-mission, there is a need to conduct timely analyses of any unsterilized sample collected and returned to the Earth, under strict containment, and using the most sensitive techniques. However, the question is whether this policy will not be modified in the future, with regard to new scientific information.

As can be seen, the main rationale for COSPAR policy has been to avoid contamination of planetary environments by biological contaminants or terrestrial microbes that could compromise current or future scientific investigations, particularly those searching for indigenous life.<sup>22</sup> Also the Preamble of the present COSPAR Planetary Protection Policy states that COSPAR maintains its planetary policy for the reference of space faring nations, both as an international standard on procedures to avoid organic-constituent and biological contamination in space exploration.<sup>23</sup>

Under “harmful contamination”, the biological and organic constituent contamination is currently addressed,<sup>24</sup> not going beyond “science protection”. The question remains whether this relatively narrow scope will be extended in the future: There are several indications that it could be possible:

In this sense, the 2010 COSPAR Workshop on Ethical Consideration for Planetary Protection in Space Exploration deliberated whether an expanded framework for COSPAR Planetary Policy/policies is needed to address other forms of “harmful

contamination” with adding a separate and parallel policy to provide guidance on requirements/ best practices for protection of non-living/non-life-related aspects of outer space and celestial bodies.

Also the 2013 COSPAR Workshop on Developing a Responsible Environmental Regime for Celestial Bodies<sup>25</sup> stated that there may be a lack of clear and uniform definitions of issues, such as what constitutes “harmful contamination”,<sup>26</sup> in other words of exactly what is being protected. It was pointed out that the broad nature of planetary protection as a whole makes it difficult to carry out; there are many uncertainties involved, including the definition of harmful contamination, the identification of what exactly is to be protected, and for what purpose protection must be ensured.<sup>27</sup> Planetary protection is currently used mainly to narrowly focus on biological contamination.<sup>28</sup> Consequently, the final topic of the panel 2 of the 2013 COSPAR workshop was the problem of bringing the exploitation of planetary resources into the discussion of a broader environmental stewardship.<sup>29</sup> I.a. it was required that the right to use resources on another planetary body must be defined, and protected areas have to be established.<sup>30</sup>

Also other initiatives concentrate mostly to scientific missions, some of them extending this scope to the use of outer space: The EU funded project “Planetary Protection of Outer Solar System” (PPOSS) focuses to preventing contamination between Earth and other bodies in the context of space exploration missions.<sup>31</sup> Its basic mandate is to preserve planetary environment; and to protect Earth and its biosphere from

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<sup>22</sup> Rummel, p. 3.

<sup>23</sup> G. Kminek, J. Rummel, COSPAR Planetary Protection Policy.

<sup>24</sup> John Rummel et. al., Report: COSPAR Workshop on Ethical Consideration for Planetary Protection in Space Exploration, Princeton University 2010, 2012, p. 1.

<sup>25</sup> P. Ehrenfreund, Henry Hertzfeld, Kate Howels, Workshop Report : The 2013 COSPAR Workshop

on Developing a Responsible Environmental Regime for Celestial Bodies, Georg Washington University, March 2013.

<sup>26</sup> Supra note, p. 9.

<sup>27</sup> Ibidem, p. 12.

<sup>28</sup> P. 13.

<sup>29</sup> John Rummel, supra note 24, p. 10.

<sup>30</sup> Ibidem.

<sup>31</sup> PPOSS.org.

extraterritorial sources of contamination. It seems that the main focus are scientific missions, and the outer solar system bodies, including small solar system bodies; however, the program has also an ambition to “develop a European engineering roadmap for the industry sector” – a Planetary Protection Handbook.

Euro-Cares (European Curation of Astromaterials Returned from Exploration of Space) is another EU program.<sup>32</sup> The team of experts from academia and industry is developing a “roadmap” for a European Sample Curation Facility (ESCF), designated to “curate precious samples returned from Solar System exploration mission to asteroids, Mars, moons, and comets”. Interestingly, the main focus of the program seems to be how to deal with the samples returning back to the Earth “from all possible return missions” which implies to keep them as clean as possible from any possible contaminants, while ensuring they remain contained in case of biohazards. The samples should be recovered and transported from the landing site to the permanent curatorial facility using a portable receiving facility. In addition, methods for the transport of samples from the facility to the outside institutions will have to be studied, “to insure security and non-contamination of the samples”. One of the work packages plans to define the state of the art facilities require to receive, contain and curate extra-terrestrial samples and guarantee terrestrial planetary protection. However, the program seems to be focused on the dealing with the samples (only).

ESA adopted the COSPAR planetary protection policy and acts on behalf of the

Member States to ensure that the requirements are met for all missions the Agency is flying or contribution to. The recent steps deals mostly with the scientific mission ExoMars 2016 which is scheduled to arrive at Mars in October 2016.<sup>33</sup>

NASA established Planetary Quarantine (now Planetary Protection) Officer who carries responsibility for the overall NASA program in this area in 1967. NASA’s implementation of planetary protection provisions depends on current scientific knowledge, based on internal and external recommendations including those from the Planetary Protection Subcommittee of the NASA Advisory Council and most notably from the Space Studies Board of the National Academy of Sciences.<sup>34</sup> Other Space Agencies have their specific policies embedded in their legislation.<sup>35</sup>

## VII. Conclusion

In the Introduction of the present contribution, the question whether the COSPAR recommendations have influence on space mining, and to which extent, has been raised. The suggested answer is yes for the first question: The present Planetary Protection Policy does not make any difference among the purposes of the space missions. It defines the necessary measures according to the character of the target/body mission, with measures determined for target celestial bodies with a remote chance that a space activity could compromise any future scientific investigations, meaning that these bodies do not demonstrate any terrestrial organisms which could survive and replicate. This is most probably the majority if not all

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<sup>32</sup> [www.euro-cares.eu](http://www.euro-cares.eu).

<sup>33</sup> Planetary Protection for Exomars : An interview with Gerhard Kminek, [exploration.esa.int/mars/57504-planetary-protection-for-exomars-an-interview-with-gerhard-kminek](http://exploration.esa.int/mars/57504-planetary-protection-for-exomars-an-interview-with-gerhard-kminek).

<sup>34</sup> Petra Rettberg/ John Rummel, COSPAR Planetary Protection Policy – Present Status, in : IAA, p. 11 ff.

<sup>35</sup> For overview, see Ehrenfreund, P., et all, Toward a global space exploration program : A stepping stone approach. J. Adv. Space Res. (2011), doi :10.1016/j.asr.2011.09.014.

asteroids as the main target of space mining missions.

In case that the extra-terrestrial matter will be brought to the Earth, again the Policy does not make any difference between the purpose of the mission at the moment. The fact that it speaks about the containment of “samples” does not make, obviously, any difference: *A fortiori*, the measures required (containment, post-mission requirements) should be applied, if these recommendatory rules are understood as interpretation instruments of Article IX OST. Again, the COSPAR recommendations are flexible rules and can be modified in the future.

The answer to the extent of the obligation to comply with the COSPAR rules is a trickier one: It could be argued, that these are in a steady process of development, that they do not necessarily represent full consensus of all States Parties of the OST, and, naturally, that they have recommendatory, not binding character, meaning that their violation does not evoke any international responsibility of the “appropriate” State.

This short overview cannot be concluded otherwise than by a recommendation: In the era when a creation of any new binding general provisions is extremely difficult, it can be only repeated what has been already recommended in the 2011 IAA Planetary Protection Study:<sup>36</sup> to find a common understanding that States - when applying the requirements Article IX OST - they take into account the recommendations developed by COSPAR; furthermore, when authorizing national space activities, they include measures for environmental protection among the licensing conditions.<sup>37</sup>

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<sup>36</sup> IAA Study, 9.2 Draft Legal Instrument, p. 78.

<sup>37</sup> See also UN Res. 68/74 of 11 December 2013, para 4 (« The conditions for authorization should help ...to minimize risks to ..the environment »).