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**Committee on the Peaceful
Uses of Outer Space**
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Vienna, 7-16 June 2017

Space Science for global development

Report on the United Nations Office for Outer Space Affairs and Committee on Space Research coordination meeting in support of the preparations for UNISPACE+50

Vienna, Austria, 22-23 May 2017

I. Introduction

1. The Committee on the Peaceful Uses of Outer Space at its fifty-eight session in June 2015 endorsed a plan of work (A/AC.105/L.297) for the fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Use of Outer Space, in 2018 (UNISPACE+50) to be undertaken by Committee on the Peaceful Uses of Outer Space and the subsidiary bodies, and the Office for Outer Space Affairs of the Secretariat. UNISPACE+50 will be an opportunity for the international community to gather and consider the future course of global space cooperation for the benefit of humankind to be reflected in a Space2030 agenda.
2. The Committee on the Peaceful Uses of Outer Space in 2016 endorsed a set of seven thematic priorities, which together constitute the common road towards UNISPACE+50 and beyond. The seven thematic priorities are selected based on the cross-cutting areas of governance, resiliency, interoperability, capacity-building and sustainable development. In 2015, these five cross-cutting areas were reaffirmed by COPUOS at the core of its legacy since its inception in 1958.
3. UNISPACE+50 is shaped to take into account the interdependencies in the space sector and foster international cooperation, paying special attention to the needs of developing countries and emerging space nations, in carefully considering the long-term sustainability of outer space activities – leading towards 2030 and the dedicated “Space2030” agenda.
4. This long-term vision for space and the benefits derived from space exploration and the application of space science and technology, will be set around the four pillars of space economy, space society, space accessibility and space diplomacy. The essential message being that investments in the space sector and in space-related infrastructure at the national level, as well as in international cooperation in space activities, benefit society and sustainable development, in a growing manner.



5. The first UNISPACE+50 thematic priority is to seek extended partnership in space exploration and innovation, involving developing countries and fostering cooperation with industry and the private sector. UNISPACE+50 further focusses on the enhancement of international coordination of space weather services and information exchange on space weather events; and to develop enhanced information exchange and notification procedures on space objects and events, including on risk reduction for space operations. An analysis of the state of affairs of the legal regime of outer space is a core area in this regard, including on promoting the safety, security and sustainability of outer space activities. Strengthened cooperation for global health is also a UNISPACE+50 priority, and there is specific attention given to the developing of a roadmap towards enhanced resilient societies, including the protection of space systems and critical infrastructures, and strengthening capacity-building, training and assistance to meet those objectives.

6. The Office for Outer Space Affairs and the Committee on Space Research (COSPAR) agreed to convene a coordination meeting to exchange views and ideas on the scientific and research needs for the implementation of the thematic priorities of UNISPACE+50.

7. COSPAR was established by the International Council for Science in 1958 “to promote at 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 that may affect scientific space research”. COSPAR became the first non-governmental organization to join the Committee on the Peaceful Uses of Outer Space as a permanent observer organization in 1962.

8. The meeting was held at the United Nations Office at Vienna, from 22 to 23 May 2017.

II. Programme and participation

9. In preparation of the meeting, the Office for Outer Space Affairs and COSPAR jointly agreed to focus the discussions on three topics, feeding into UNISPACE+50 thematic priorities¹.

- (a) "Global partnership in space exploration and innovation", linked to thematic priority 1 “Global partnership in space exploration and innovation”;
- (b) "Coordination on Space Weather", linked to thematic priority 4 “International framework for space weather services”, and
- (c) "Access to space and resilient societies", linked to thematic priority 5 “Strengthened space cooperation for global health”, thematic priority 6 “International cooperation towards low-emission and resilient societies”, and thematic priority 7 “Capacity-building for the twenty-first century”.

10. To guide and structure the discussions, the Office prepared a set of questions for each of the three topics, which had been provided to, and agreed with, the COSPAR representatives prior to the meeting.

11. The meeting was attended by staff of the Office for Outer Space Affairs and by 13 COSPAR representatives with expertise in the three topics that had been selected for discussion.

12. The President of COSPAR and the Director of the Office for Outer Space Affairs welcomed the meeting participants with introductory statements. They noted that the recommendations emanating from the meeting would be important for guiding the strategic planning and considerations to appropriately address the role of space science and space research in the framework of UNISPACE+50 and the Space2030 agenda.

¹ See <http://www.unoosa.org/oosa/en/ourwork/unispaceplus50/activities.html>.

13. Following introductory presentations on the status of preparation of UNISPACE+50, and on the work of COSPAR and its relevant scientific roadmaps, three working groups were established. Each working group addressed one of the topics that had been selected for discussion.

14. The working groups, led by a chair and supported by co-rapporteurs nominated by COSPAR and by the Office for Outer Space Affairs, held splinter meetings to consider possible draft recommendations under their assigned topic.

15. On the second and last day the meeting adopted the recommendations contained in this report.

III. General joint recommendations

16. The meeting considered the long-standing role of COSPAR in fostering scientific and technical development for the peaceful exploration and use of outer space, and recognized the potential for enhanced cooperation and coordination with the Committee on the Peaceful Uses of Outer Space and the Office for Outer Space Affairs. It was recommended to highlight and explore the links between thematic priorities with regards to overarching topics such as resiliency and sustainability.

17. As an overarching result of the meeting, the Office for Outer Space Affairs and COSPAR agreed to enter into a bilateral partnership, through the establishment of a memorandum of understanding between the two organizations, to foster closer cooperation and coordination in the contribution of space scientific research to the goals of UNISPACE+50 and the road towards 2030, in order to strengthen scientific research, scientific data exploitation, and knowledge transfer to improve and preserve scientific knowledge. Areas to be covered in closer partnership, include *inter alia*, Earth observation, global navigation satellite systems, telecommunications, space exploration, human space flight and related topics, as well as studying the prospects for cross-cutting activities involving space policy, space law and infrastructure and institution building. The creation of a dedicated COSPAR/Office for Outer Space Affairs fellowship programme for young scientists should be explored in this context.

18. It was further noted that the increasing utilisation of space for peaceful purposes relies on adequate support for research and the development of human capacity in both the developed and the developing world. This requires an adequate knowledge-driven agenda as well as the development of services.

19. It was recommended that the respective national delegations to the sessions of the Committee of the Peaceful Uses of Outer Space and its subsidiary bodies could, as appropriate, be encouraged to increase the involvement of the national scientific communities and their representatives to COSPAR.

20. It was also recommended to highlight and explore further the links between UNISPACE+50 thematic priorities with regard to overarching topics such as resiliency and sustainability.

21. Considering that COSPAR does not have a Scientific Commission or Panel dealing directly with disaster management issues, the meeting recommended that the Office for Outer Space Affairs and COSPAR jointly prepare a call for proposals for the 2019 COSPAR Symposia on the subject of space research about risks, natural disasters and related issues in support of the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030. The Symposia would contribute to building partnerships to support the national and regional implementation of the Framework, building on related knowledge of existing Commissions and Panels of COSPAR such as Commission A on "Space Studies of the Earth's Surface, Meteorology and Climate".

22. The meeting encouraged the Office for Outer Space Affairs to submit a proposal for a side meeting at the forty-second COSPAR Assembly in 2018, to present the outcomes of UNISPACE+50.

IV. Recommendations on global partnership in space exploration and innovation

23. The UNISPACE+50 thematic priority on *Global partnership in space exploration and innovations* has the following objective: Raise awareness of space exploration and innovation as essential drivers for opening up new domains in space science and technology, triggering new partnerships and developing capabilities that create new opportunities for addressing global challenges. Foster dialogue with the space industry and the private sector. Promote cooperation between spacefaring nations and emerging space nations. Allow space exploration activities to become open and inclusive on a global scale. Identify governance and cooperation mechanisms to support this objective (A/71/20, para. 296).

24. In this regard, the meeting agreed that science and scientific knowledge are essential for enabling both exploration and use of outer space. It was thus recommended to strengthen scientific data exploitation and knowledge sharing to improve and preserve scientific knowledge. The increase in actors in outer space activities poses tremendous opportunities, as well as challenges, that need to be recognized in order to secure the long-term sustainability of outer space activities, for which exploration and science will always constitute the foundation. Cooperation efforts and increased partnership between the space science community and all other actors involved in space exploration and utilization are fundamental for the peaceful and sustainable use of outer space. COSPAR, as the reference body and a prime representative of the space science community, is well positioned to contribute to a global vision for space exploration, innovation, and use of outer space for the benefit of all humanity, in particular for the benefit of developing countries.

25. The role that COSPAR has played since its very foundation in providing an international and open forum to discuss planetary protection matters was particularly recognized. The internationally established long-standing COSPAR planetary protection policy was specifically referred to. In this sense the meeting recommended that the Committee on the Peaceful Uses of Outer Space should recognize and reaffirm the expertise and role of COSPAR in maintaining the planetary protection policy as reference standards for space faring nations, in guiding compliance with article IX of the Outer Space Treaty. The meeting recognized this as being particularly important in view of the expansion of outer space activities by a broader community of actors. The meeting highly recommended this important matter to be specifically observed in view of the present fiftieth anniversary of the Outer Space Treaty in 2017. Against this background the meeting agreed that the issue of planetary protection be included in a half-day symposium on space accessibility, to be jointly organized by the Office for Outer Space Affairs and COSPAR, during the dates of 18-19 June 2018, preceding the UNISPACE+50 high-level segment.

26. The meeting recommended that the expertise and role of COSPAR be used more frequently in providing the scientific foundation required to manage several issues of concern to space operations, such as the increasing space debris population. In this regard, it was recommended to promote and encourage the status update on space objects launched into Earth orbit or beyond to cover the final disposition and status of their registered orbit after end of life, in particular for space objects beyond Earth orbit.

27. In considering the role of science in support of UNISPACE+50 and Space2030, the meeting recommended the establishment of a global programme for space science promotion and education, which could take various shapes, from a joint UN/COSPAR fellowship or internship programme to an Erasmus-like "Space-mundi mobility network". Those efforts would contribute to the existing capacity-building and training activities under the Basic Space Science Initiative (BSSI) of the Office for Outer Space Affairs.

28. In expanding the idea of capacity-building activities, the meeting proposed to organize dedicated trainings on space science data archives accessibility and exploitation, for the benefit of all countries. Such events could be associated to or be organized on the margins of existing conferences and meetings, such as the COSPAR General Assemblies. Such efforts could begin with a first hands-on workshop on Cassini or Rosetta data associated with the forty-second COSPAR General Assembly to be held in Pasadena, United States of America, on 14 to 22 July 2018.

29. Considering the growing role of industry and the private sector in outer space activities, the meeting proposed to establish a cooperation programme between academic institutions and the private sector offering PhD or post-doc opportunities in topics related to the work of the Committee on the Peaceful Uses of Outer Space, to be coordinated by the Office for Outer Space Affairs, with the scientific advice of COSPAR.

30. The meeting assessed that COSPAR had a profound role in the efforts to foster global partnership in space exploration, including through its global network of scientific institutions and expertise in promoting cooperation between space faring nations and emerging space nations in allowing the exploration and use of outer space to become open and inclusive on a global scale.

V. Recommendations on international framework for space weather services

31. The UNISPACE+50 thematic priority on *International framework for space weather services* has the following objective: Strengthening the reliability of space systems and their ability to respond to the impact of adverse space weather. Develop a space weather road map for international coordination and information exchange on space weather events and their mitigation, through risk analysis and assessment of user needs. Recognize space weather as a global challenge and the need to address the vulnerability of society as a whole. Increase awareness through developed communication, capacity-building and outreach. Identify governance and cooperation mechanisms to support this objective (A/71/20, para. 296)

32. Against this objective, the meeting assessed the complexity of a variety of scientific, technical, institutional and infrastructural issues in this field, the need for scientific data and information in support of decisions to be taken at all levels, and the urgency of international cooperation and coordination efforts, in line with the objective, referred to above, to enhance resilience to space weather events.

33. As to a research oriented viewpoint, the meeting identified several factors that should be taken into account for an enhanced global resiliency against space weather effects, such as, better requirement definitions to give guidance to the governing science questions, increased abilities to identify, advise and coordinate research activities that ultimately lead to improved knowledge. Improved forecasts for the user community were recognized as prime requirements.

34. The COSPAR/ILWS roadmap on space weather published in 2015 was particularly recognized and was used as reference throughout the meeting. The need was stressed for updating the roadmap through a stronger COSPAR Panel on Space Weather. In this regard the meeting recommended that actions be taken to carry out a gap analysis in particular on what missions and instruments were needed, while taking into account the “low hanging” fruits (e.g. in both data mining and coordinated analysis of data from current multi-satellite missions), in order to ensure the integrity of the current roadmap. In this context, a faster progress was considered needed because the user community of space weather services is continuously increasing. More ambitious goals for long-term plans to develop a global network were indicated to be of significant importance.

35. As to coordination, specifically, the meeting assessed that in satellite mission planning, there should be defined goals to make both the science and operational communities work together (including coordination also at the instrumentation level). Such coordination should also include the requirements for space-based and ground-based assets. Space agencies and multi-national consortia operating ground-based networks should particularly be targeted.

36. The meeting explicitly considered the need for data sharing (Near Real Time/science data, data policy issues, quality control) and data ingestion into models. The definition of metrics for model validation is looked upon, as a crucial element for enhanced coordination in that matter.

37. In this sense, the meeting considered the contribution of the scientific community to the work under the present thematic priority of UNISPACE+50, and assessed that COSPAR should be given an *ex officio* role in a potential future international coordination group on space weather, where the scientific foundation would be secured through capacity-building and awareness raising on a global scale. In this regard, cooperation and coordination of the COSPAR Panels on Space Weather and on Capacity Building, teaming up with SCOSTEP, WMO, ISES, IUGG, IAU, and the Office for Outer Space Affairs, would be important to promote adequate scientific knowledge worldwide, and in particular in promoting cross-sectorial and cross-cutting efforts.

38. The meeting concluded that COSPAR community involvement would be essential in the necessary research-to-operations and forecast validation activities, in view of the presently unclear division of scientific and operational tasks among other coordinating parties. As an example, communication with funding agencies is often sporadic, which affects the operational requirements for the necessary guidance of the end-user community. It was concluded that better communication both ways is necessary, whereby the end-user community needs to understand the limitation of science, and conversely the science community to understand the operational needs.

39. It was agreed by the meeting that the COSPAR community should help address science questions in response to forecast requirements for earlier warning (more than 3 days in advance), including the time, duration, location, amplitude, etc. of space weather events.

40. In order to secure adequate scientific information in support of a possible international coordination group on space weather, and in establishing an international cooperation mechanism for space weather awareness and mitigation, the meeting recommended that towards the implementation of the thematic priority under consideration, there be taken into account the dedicated function of the present Expert Group of the Scientific and Technical Subcommittee, in its role of bringing the science and service provider communities together, of COSPAR, as coordinator and facilitator on the science side, and of the Office for Outer Space Affairs, as the entity connecting the various relevant communities to the Committee on the Peaceful Uses of outer space, the General Assembly, and relevant United Nations system entities.

41. It was in general recognized by the meeting that space weather is a global challenge and there is a need to address the vulnerability of society as a whole in this context. In this regard it was noted that the number of space-faring countries was continuously increasing, and that the everyday life of all people around the world was considerably and rapidly becoming dependent on space-based technology and services increasingly exposed to space weather events, which require for enhanced international cooperation and coordination. There is an urgent need for increased awareness through developed communication, capacity-building and outreach.

42. The meeting recommended that the COSPAR roadmap on space weather should be updated on a regular basis, to support a strengthened scientific knowledge

base on space weather. It was also stressed the need for a supporting educational material and an awareness increasing effort at the international level.

VI. Recommendations on strengthened space cooperation for global health, international cooperation towards low-emission and resilient societies, and capacity-building for the twenty-first century

43. This segment of the meeting combined the three thematic priorities of UNISPACE+50 devoted to Strengthened space cooperation for global health, international cooperation towards low-emission and resilient societies, and capacity-building for the twenty-first century (A/71/20, para. 296). The respective thematic priorities have the following objectives:

- (a) *Strengthened space cooperation for global health:* Improve the use of space technologies and space-based information and systems in the global health domain. Promote enhanced cooperation and sharing of information in emergencies, epidemics and early warning events, as well as on environmental parameters. Enhance capability in integrating health data in disaster management plans. Strengthen capacity-building in advancing space technologies in global health efforts. Identify governance and cooperation mechanisms to support this objective;
- (b) *International cooperation towards low-emission and resilient societies:* Define synergies between climate change mitigation efforts, disaster risk reduction and global development and reducing emissions by replacing carbon energy with renewable energy. Develop a road map for enhanced resiliency of space-based systems and the affiliation of existing and future Earth observation, global navigation satellite system and telecommunication constellations for disaster risk reduction and climate change monitoring and mitigation. Improve integrated space applications approaches and the interoperability of space-based systems and ground/in situ systems. Provide requirements to new developers for coverage in geographical areas not sufficiently monitored or applications that need further development. Identify governance and cooperation mechanisms to support this objective; and
- (c) *Capacity-building for the twenty-first century:* Define new innovative and effective approaches to overall capacity-building and development needs as a fundamental pillar of global space governance. Strengthen comprehensive capacity-building and outreach activities of the Office for Outer Space Affairs. Develop infrastructure for cross-sectoral and integrated applications, with combined scientific, technical, legal and policy outputs. Enhance existing partnerships and forge new ones to strengthen and deliver targeted capacity-building and technical advisory activities based on needs assessments. Promote efforts to encourage science, technology, engineering and mathematics education, especially for women in developing countries.

44. The meeting assessed the objectives under those thematic priorities and determined the need to explore the development of the space segment and the use of space observations to help build societies resilient to disasters, energy shortages, climate change, and epidemics and other health problems. There were complex issues involved and a gap analysis of the monitoring of environment factors causing public health concerns (e.g. fires, dust storms, pollutants dispersion, heat waves, hazards, etc.) – such as the gap analyses performed by such entities as the CEOS, CGMS and GCOS) – was considered important. In the field of public health and ecosystem health, the measurements of atmospheric constituents are needed.

45. The COSPAR roadmap “Observation and Integrated Earth-system Science: a Roadmap for 2016-2025” published in 2016 also provided a strong reference for the meeting. The roadmap was focused on the combined use of observations and modelling to address the functioning, predictability and projected evolution of interacting components of the Earth system on time-scales out to a century or so. It discussed how observations support integrated Earth-system science and its applications, and identified planned enhancements to the contributing observing systems and other requirements for observations and their processing. All types of observation were considered, but emphasis was placed on those made from space. The COSPAR roadmap concluded with a set of discussions covering general developmental needs, requirements for continuity of space-based observing systems, further long-term requirements for observations and other data, technological advances and data challenges, and the importance of enhanced international co-operation.

46. The development of synergies was deemed necessary, and in this regard COSPAR and the Office for Outer Space Affairs, could together reach a broader community, from scientific expertise to decision-makers and end users. COSPAR panels and scientific commissions could be further stimulated to address the critical areas under consideration within the framework of the UNISPACE+50 thematic priorities. Such areas where synergies and cross-cutting attention were needed include:

- (a) Tele-medicine, satellite communications and tele-epidemiology with a focus on the study and correlation of environmental, climatic and meteorological factors and disease vectors;
- (b) Food security and the link with water energy supply. This requires the improvement of the forecasting of yields and the impact of anthropogenic activity on food production, its advantages (e.g. increase in yields) and disadvantages (release of long-lived and short-lived pollutants and their impacts on the environment, human health, ecosystem services, change in land use etc.);
- (c) Quality of life – and the impacts of anthropogenic activity on air and water quality; and
- (d) Migration of people resulting from environmental/climate change and conflict situations. The health management of displaced populations was particularly important.

47. It was recommended that issues of societal relevance be addressed with respect to impacts by either anthropogenic activity and natural phenomena, vis.,
(i) short term issues: disaster risk reduction and emergency response and
(ii) medium/longer term issues: air quality, climate change, ecosystem system services, food security, changes in stratospheric ozone and ultraviolet radiation at the earth’s surface.

48. COSPAR and the Office for Outer Space Affairs could focus, specifically, on the identification of areas of cooperation in the fields of global health and disasters, in the short term on disaster risk reduction and emergency response resulting from either anthropogenic activity (e.g. intense urban pollution, man-made fires/biomass burning, reactor explosion) or natural phenomena (earthquakes, volcanic eruptions, tsunami, flooding, drought, etc.) or synergistic phenomena (e.g. Fukushima reactor in 2011), and in the medium/longer term perspectives on air quality, climate change, ecosystem system services, food security, changing stratospheric ozone and ultraviolet radiation at the Earth’s surface.

49. The meeting assessed that for many key issues such as climate change and related areas, the spatiotemporal sampling of the current Earth observing system was inadequate. Consequently, a strategy for the evolution of the space segment which (i) maintains continuity of measurements, (ii) addresses the gaps in the measurement system, where two prominent examples are the need for higher

spatiotemporal sampling measurements needed to determine the global natural and anthropogenic surface fluxes of greenhouse gases (carbon dioxide, CO₂, methane CH₄, nitrous oxide, N₂O, tropospheric ozone, O₃) and limb measurements of key atmospheric constituents (trace gases, aerosol and cloud parameters) from the upper troposphere to the thermosphere.

50. In order for the international community to ensure the availability, consistency and compatibility of satellite measurements to provide the long time series needed for climate change assessment, there is a pressing need for sustainable data and information management. The examples of the evolution of the Earth observing system for the measurements of long-lived greenhouse gases, short-lived climate pollutants (ozone, aerosol and their precursors), clouds, surface spectral reflectance, were given in this regard.

51. As an example, COSPAR and the Office for Outer Space Affairs could jointly promote the use of synergistic information from space-based, sub-orbital and ground-based instrumentation to improve the accuracy of prediction for both short term risk reduction and medium- longer-term anthropogenic modifications of the Anthropocene.

52. The establishment and maintenance of archives of Earth observation data with optimal accessibility, improved coordination between relevant organization, e.g. through CEOS and CGMS, was recognized. More virtual constellations of measurements, following the CEOS concept, could be developed, comprising the creation of consistent and consolidated data sets of the essential climate variables (ECV), which address the validation issues associated with measurements made from different platforms. Such constellations could be part of a strategy for the next steps including minimum quality observational standards and ensuring no gaps in key data records.

53. Data should be archived and software to read the data should be available to exploit the data. COSPAR and the Office for Outer Space Affairs could agree on common data policy objectives, in accordance with the GEO Data Sharing Principles. This would include the following overarching data and data distribution issues: (a) the data observed by space instrumentation should be open and free; (b) an adequate archiving system for the data from space-based instrumentation and all relevant data from suborbital and ground-based instrumentation should be made available; and (c) data must be archived together with software to read the data.

54. This strategy should consider the possibility of involving the private sector, due to the scientific value of the measurements captured by privately held instruments, in particular when supporting global scientific campaigns, such as the International Polar Year.

55. In this context, COSPAR and the Office for Outer Space Affairs were encouraged to jointly develop a policy for data archiving, and promote the archiving system to a broader range of stakeholders, in particular for the benefit of developing countries.

56. In this regard, the meeting recognized the on-going preparations by the Office for Outer Space Affairs of the “Open Universe Initiative”, which is aimed at providing more comprehensive visibility of available science data services, improve transparency and facilitate the access to scientific data.

57. It was further noted that COSPAR training activities are focused on young professionals. COSPAR capacity-building activities comprised since 2001 a successful series of community-developed regional workshops at a rate of three per year, mostly in developing or emerging countries. Furthermore, COSPAR symposia held in such countries regularly have an associated capacity-building workshop. The COSPAR Panel on Education organizes designed scientific training for high school teachers. Thinking of new ideas, the possible development of webinars and the participation in field campaigns were noted. There was also a special focus on involving decision-makers in capacity building events.

58. The meeting concluded that the COSPAR approach to capacity-building and training could be further studied for closer cross-cutting synergies with the overarching capacity-building programme of the Office for Outer Space Affairs, in particular for the benefit of developing countries.
