United Nations A/AC.105/C.1/122

General Assembly

Distr.: General
21 November 2022

Original: English

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee

Final report of the Expert Group on Space Weather: towards improved international coordination for space weather services

I. Introduction

1. At the fifty-eighth session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space, the Expert Group on Space Weather sought feedback on a draft report and draft set of recommendations entitled "Draft report of the Expert Group on Space Weather: survey of the state of member State preparedness, and current and future activities and needs for space weather impact mitigation", which was provided to delegations at the fifty-eighth session of the Subcommittee in the form of a conference room paper (A/AC.105/C.1/2021/CRP.14).

2. Consistent with the mandate of the Expert Group as extended by the Subcommittee (A/AC.105/1240, paras. 160–165), and following further input from States members of the Committee on the Peaceful Uses of Outer Space and their experts over the past year, the Expert Group has prepared an updated version of the above-mentioned draft report, which will be made available to all delegations at the fifty-ninth session of the Subcommittee in the form of conference room paper A/AC.105/C.1/2022/CRP.10. The updated version contains an updated set of six high-level recommendations and incorporates additional domain-specific recommendations, namely, A.1–A.3, B.1–B.3, C.1–C.3, D.1–D.4 and E.1, which are provided for the potential future consideration and future benefit of States members of the Committee.

3. The draft final report of the Expert Group on Space Weather (A/AC.105/C.1/L.401) included the updated high-level recommendations from the conference room paper (A/AC.105/C.1/2022/CRP.10) and made them available in all official languages of the United Nations for consideration and potential adoption by States members of the Committee.

4. At its fifty-ninth session, the Scientific and Technical Subcommittee expressed its appreciation for the eight years of work of the Expert Group and endorsed the draft final report and the recommendations contained therein, and agreed to consider the draft final report to be the final report of the Expert Group, as contained in the present document (A.AC/105/1258, para. 172).

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II. Background

5. The Committee has highlighted that space weather has the potential to significantly impact both space and ground-based critical infrastructure. In particular, the Subcommittee has had space weather as a permanent item on its agenda since 2013. The Committee further identified space weather as an international concern and adopted the Guidelines for the Long-term Sustainability of Outer Space Activities (A/74/20, annex II), in particular guidelines B.6 and B.7. A major objective now is to promote the implementation of those two guidelines. Support through improved communication, cooperation and coordination within and among international organizations has been identified as a key component of future success.

6. In 2014, the Committee endorsed the formation of the Expert Group on Space Weather with a mandate to promote awareness, provide guidance and enable communication and cooperation in space weather-related activities among States members of the Committee and related national and international organizations. Its workplan included efforts to promote increased and expanded involvement of member States in providing space weather monitoring, from the ground and in space, and in developing, advancing, sharing and delivering space weather services. The Expert Group reports annually to the Subcommittee on its progress, important issues that have been identified and areas where specific action is recommended. Those reports remain available as a resource for reference for the Committee and its member States.

7. In its earlier work, the Expert Group prepared an extensive report on potential mechanisms to further international preparedness against the threat of space weather, entitled “Thematic priority 4: international framework for space weather services” (A/AC.105/1171), in preparation for the fiftieth anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50), and presented it to the Subcommittee.[1] The report on thematic priority 4 also provided a road map that could aid the further implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities with full traceability to guidelines B.6 and B.7. That report remains relevant in the context of the overall implementation of recommendations from the present final report of the Expert Group.

8. Consistent with its mandate from the fifty-eighth session of the Subcommittee, the Expert Group submits the present final report with a series of six high-level recommendations for the consideration of the Subcommittee. The high-level recommendations can facilitate improved global coordination and advance global preparedness in response to the threats and impacts arising from adverse space weather.

9. The Expert Group formulated the high-level recommendations following the analysis of data collected from two surveys conducted among States members of the Committee and from an additional survey of international organizations active in, or impacted by, space weather. Those surveys were carried out by the Expert Group for the purpose of assessing the state of preparedness of member States, their related current and future activities and their needs for improved space weather impact mitigation.

10. Further details on the Expert Group’s findings, derived from an analysis of the above-mentioned surveys and incorporating additional domain-specific recommendations, are provided in conference room paper A/AC.105/C.1/2022/CRP.10. For the sake of completeness, that conference room paper also includes the text of the six high-level recommendations included in the present report.

[1] See also Ian R. Mann and others, “International collaboration within the United Nations Committee on the Peaceful Uses of Outer Space: framework for international space weather services (2018–2030)”, *Space Weather,* vol. 16, No. 5 (May 2018), pp. 428–433.

III. Towards improved international coordination for space weather services

11. Recognizing the significant expertise and activities of international bodies involved in space weather, the Scientific and Technical Subcommittee, with the active support of States members of the Committee on the Peaceful Uses of Outer Space, needs to take specific steps to facilitate improved communication between and coordination among the international organizations involved in facilitating the development, coordination and/or implementation of space weather services.

12. The Expert Group on Space Weather notes that the space weather ecosystem is extremely diverse, with a large number of organizations from various administrations and jurisdictions operating within the domain. While this breadth of activity is a major advantage for the international community, the diversity of actors and the variety of organizations to which they report introduce some major challenges.

13. In particular, the effective coordination of activities among the relevant national and international organizations, with due regard for efficiency and minimizing the duplication of efforts, requires action to improve communication between them. Based on a common agreement, one outcome could be that clearer lines of responsibility are established and distributed among the stakeholder international organizations in the space weather ecosystem, enabling a more efficient implementation of advances in space weather services. To achieve that goal, the Subcommittee should seek and request the collective support of key international organizations involved in the domains of research, observation, services and the development of standards, and promote improved coordination among them.

14. The Expert Group further highlights the importance of best practices and making relevant information available to all Member States. The sharing of information from and among Member States promotes the global preparedness of all nations in response to the threat arising from severe space weather, provides for improved communication and closer collaboration and promotes and facilitates capacity-building among the States members of the Committee.

15. The responses to the space weather surveys and the input obtained by the Expert Group in dialogue with a variety of space weather actors have clearly demonstrated the importance of continued space-based observations in support of space weather services and research. In relation to the development of a fleet of international satellites, the Expert Group noted, in the space agency context, the earlier success of the International Solar Terrestrial Physics programme, as well as, more recently, the example of the International Living with a Star programme. Noting the important role that the Coordination Group for Meteorological Satellites has to play in relation to coordinated space weather monitoring, the Expert Group nonetheless noted an apparent gap in the global coordination of satellite and space missions, in particular in relation to space weather missions being operated, implemented and planned by national and international space agencies. While such space missions are only one component of the required international collaboration in the space weather ecosystem, space missions implemented by space agencies remain a key element of global efforts in the space weather domain.

16. Information-sharing and cooperation among entities active in the space weather domain are needed in order to advance space weather science, provide continuous and new space weather monitoring and alerts and improve global preparedness in response to the threat arising from adverse space weather. The scope of such activities could encompass research needs and related observational gaps, and, as appropriate and with relevant actors in the space weather domain, could include partnerships with other related programmes that deliver new space weather services in response to global user needs. Overall, cooperation involving States and international intergovernmental organizations in the field of space weather should be encouraged in relation to all of the interconnected domains of research, services and standards,

involving States with established as well as emerging capabilities in space weather and, with due regard for user needs, including capabilities provided by industry.

IV. Recommendations

17. Based on the work completed by the Expert Group on Space Weather and an analysis of the results from the surveys of space weather-related activities within States members of the Committee on the Peaceful Uses of Outer Space and within international organizations active in, or impacted by, space weather, the Expert Group submits the following high-level recommendations to the Scientific and Technical Subcommittee for its consideration:

(a) *Recommendation 1*. The Expert Group recommends that the Subcommittee request the Secretariat to send a letter, on behalf of the Committee on the Peaceful Uses of Outer Space, to the leadership of the Committee on Space Research (COSPAR), the International Space Environment Service (ISES) and the World Meteorological Organization (WMO), proposing that they lead efforts to improve the global coordination of space weather activities in consultation and collaboration with other relevant actors and international organizations, including the Committee on the Peaceful Uses of Outer Space. The Expert Group further recommends that member States that are also members of, or are represented at, COSPAR, ISES or WMO engage with those organizations to encourage a response to the Committee on the Peaceful Uses of Outer Space outlining the efforts they will undertake towards the goal of establishing a potential path forward to improve global coordination and collaboration;

(b) *Recommendation 2*. The Expert Group recommends that the Subcommittee identify a central repository for access by all States members of the Committee to best practices, techniques, training materials and standards for space weather services, observations, research, mitigation approaches, capacity-building activities, and socioeconomic impact and risk assessment studies. The repository could also serve as a compendium for space weather information to support States members as they implement the Guidelines for the Long-term Sustainability of Outer Space Activities relating to space weather;

(c) *Recommendation 3*. Consistent with the Guidelines for the Long-term Sustainability of Outer Space Activities pertaining to space weather, the Expert Group recommends that the Subcommittee consider enhanced consultation with space agencies and international organizations to coordinate space weather satellite missions in support of sustained space-based observations for space weather services and research that address international space weather needs;

(d) *Recommendation 4*. Recognizing the ongoing activity relating to the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities and to support the implementation of guidelines B.6 and B.7, the Expert Group recommends that the Subcommittee encourage the Working Group on the Long-term Sustainability of Outer Space Activities of the Subcommittee to consider further analysis of the survey results and the additional domain-specific recommendations in conference room paper A/AC.105/C.1/2022/CRP.10 for possible inclusion in future guidelines. In parallel, the Expert Group recommends that those States members of the Committee that have not yet participated in this process should engage in this activity and consult with the relevant international organizations as needed to facilitate the implementation of the Guidelines;

(e) *Recommendation 5*. The Subcommittee should continue to include on its agenda an item on space weather;

(f) *Recommendation 6*. Bilateral and multilateral cooperation involving States and international intergovernmental organizations in the space weather domain should be encouraged. New mechanisms and/or forums for cooperating in space weather

activities should be identified, including by considering the participation of industry and States with emerging capabilities in space weather.

18. States members of the Committee and other space weather actors are invited to provide voluntary contributions to advance the recommendations of the Expert Group within existing resources.

19. Recommendations 1–6 are proposed in order to help facilitate the implementation of the space weather-related Guidelines for the Long-term Sustainability of Outer Space Activities.

V. Conclusion

20. Overall, a major overarching conclusion derived from the work completed by the Expert Group on Space Weather, and additionally derived from the responses to the surveys, was an appreciation of the enduring importance of space weather to States members of the Committee on the Peaceful Uses of Outer Space. The responses to the two surveys conducted among the States members of the Committee and the information collected from the survey of international organizations involved in space weather all highlight the high level of interest in developing expanded and more capable space weather services, with the support of international collaboration.

21. Improved international cooperation and coordination can lead to improved global resilience and preparedness in response to the adverse impacts of space weather. Such activities are also consistent with the goal of building resilient societies through better coordination and the forging of global partnerships. These are key challenges in the twenty-first century, and they are an integral part of meeting the commitments set out in the three key United Nations global frameworks, namely, the Sendai Framework for Disaster Risk Reduction 2015–2030, the 2030 Agenda for Sustainable Development and the Paris Agreement under the United Nations Framework Convention on Climate Change.