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Item 14 of the provisional agenda*
Long-term sustainability of outer space activities

Information on experiences and practices related to the long-term sustainability of outer space activities

Note by the Secretariat

I. Introduction

The present addendum has been prepared by the Secretariat on the basis of information received from the following United Nations entities and intergovernmental bodies: Economic and Social Commission for Asia and the Pacific, International Telecommunication Union, United Nations Educational, Scientific and Cultural Organization and Office for Disarmament Affairs of the Secretariat; and from the following other international organizations and bodies: Consultative Committee for Space Data Systems, European Organisation for the Exploitation of Meteorological Satellites and Group on Earth Observations secretariat.

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II. Replies received from United Nations entities and intergovernmental bodies

Economic and Social Commission for Asia and the Pacific

[Original: English]
[2 December 2011]

The Economic and Social Commission for Asia and the Pacific (ESCAP) is the regional development arm of the United Nations for the Asia-Pacific region. ESCAP is the most comprehensive of the five United Nations regional commissions; with the membership of 62 Governments, it focuses on issues that are most effectively addressed through regional cooperation.

The regional strategy of ESCAP on space applications for disaster risk reduction focuses on regional and subregional cooperative mechanisms, to better support disaster risk reduction as part of an overall sustainable development strategy, in keeping with the Millennium Development Goals, the World Summit on Sustainable Development and the Hyogo Framework for Action. At its 67th session, in May 2011, the Commission supported the ESCAP secretariat's continued promotion and development of innovative projects for sustainable development that made effective use of information and communications technology (ICT) and space technology in areas such as transport, including satellite-based navigation and positioning systems, and of ICT in the area of trade.

The subject of space applications for disaster risk reduction and management is addressed by ESCAP through both sectoral and multisectoral approaches. The Regional Space Applications Programme for Sustainable Development (RESAP) is aimed at promoting the use of space applications for inclusive, resilient and sustainable development in Asia and the Pacific. It does this through policy research and advocacy, capacity-building and the promotion of regional cooperative mechanisms.

Under RESAP, the Regional Cooperative Mechanism for Disaster Monitoring and Early Warning, Particularly Drought, was established and launched in Nanjing, China, in September 2010 with the support of China, India, Thailand and other stakeholders. The Mechanism is aimed at providing space-based technical tools with a focus on drought, and eventually other types of disasters, beginning with floods, will be incorporated.

The Mechanism will consist of a platform designed to provide satellite information products and services for disaster monitoring and early warning; an information portal for accessing drought disaster management-related information, technical resources and services of the Mechanism; and capacity-building through various technical and non-technical advisory services, training sessions and workshops to assist less capable drought-prone countries in developing institutional capacities for disaster monitoring and early warning at the national level. It will also facilitate the assessment of risks and contribute to the formulation of policies, programmes and projects for the holistic management of drought, including mitigation, preparedness, response, relief and recovery.

In connection with the capacity-building framework of the Mechanism, national training workshops focused on enabling access to and the use of satellite imagery for enhancing countries' capacity for disaster emergency response, risk reduction and development were held in Palau, Papua New Guinea, Tuvalu and Fiji in August and September 2011. Other subjects included access to and the availability and usefulness of satellite imagery data and products from experimental, research and thematic satellites. Specific requests were also made to address data gaps and to facilitate more effective access to satellite imagery and products, as well as the development of a geo-referenced database repository with a view to implementing the National Disaster Risk Management Framework of related Pacific countries. Feedback and requests will be used in the strengthening of the current RESAP framework and the work to operationalize the Mechanism.

For the next steps, the Mechanism is working to enhance the joint research among the members of the Mechanism on data standardization, starting with drought data. The research and conceptualization would be based on the concept notes provided by the members and would be combined with space-based data, ground observation data and historical data so as to achieve more effective monitoring and early warning for drought events and to identify high-risk drought-prone areas.

The ESCAP secretariat continues to support training courses hosted by RESAP training network partners, such as the course on geo-information, held in Indonesia, from 25 July to 7 August 2010. In addition to enabling networking among like-minded colleagues from around the region, the courses provide participants with up-to-date skills that they can share with their local counterparts. These arrangements have been ongoing for more than 10 years, and more than 200 participants have gained substantive knowledge from training on various relevant themes related to space applications.

ESCAP also organized a workshop on developing capacity for resilience to water-related disasters in Pakistan through space applications and flood risk management, in Islamabad from 1 to 4 March 2011, in response to the flood catastrophe in Pakistan. The workshop was aimed at developing national capacity to deal with these priority areas of disaster risk management and enabling the country to deal effectively with other potential impacts of climate change, including the melting of glaciers, drought and desertification, spread of pests and diseases and sea-level rise.

ESCAP co-organized a regional workshop on using space applications for managing water-related disaster risks in Asia, in Bangkok from 7 to 9 December 2010. Supported by the Japan Aerospace Exploration Agency and the Asian Development Bank, the workshop provided an opportunity for flood forecasters and river managers from 11 ESCAP member States to exchange information on the application of space-based technology to measures such as flood risk assessment, flood monitoring, forecast and early warning, and evacuation.

The workshop also had a training session on the Integrated Flood Analysis System (IFAS) which is a flood-runoff analysis system for more effective and efficient flood forecasting, targeting developing countries. IFAS implements interfaces to input both ground-based and satellite-based rainfall data, Geographic Information System (GIS) functions and interfaces to display output results.

The ESCAP secretariat is planning and working to establish a regional cooperative mechanism for disaster communication capacities, the core component of which will be emergency communication, in collaboration with members of the Regional Inter-Agency Working Group on ICT, in particular the International Telecommunication Union and the Asia-Pacific Telecommunity. The mechanism, based on a multi-stakeholder approach and public-private partnership, is aimed at establishing an affordable and sustainable implementation of deployable satellite communications-enriched disaster response capabilities in the Asia-Pacific region.

The ESCAP secretariat is implementing a project entitled "Improving disaster preparedness in the ESCAP region", aimed at strengthening the capacity of countries with special needs to implement the Hyogo Framework for Action through the use of standardized statistical and geographical information tools. The project is expected to have two major accomplishments: (a) Governments will be able to establish and use geo-referenced statistical systems for disaster risk identification, preparedness, post-disaster assessment and recovery planning; and (b) a regional network will be established to link communities of practice for GIS, statistical and information, communications and space technology applications.

This will be achieved by conducting needs assessments and other activities through a survey and two expert group meetings, the development of a standardized geo-referenced statistical information system, the organization of two training workshops for government officials, the conduct of technical advisory missions, the establishment of an online community of practice and a regional knowledge-sharing workshop.

The ESCAP secretariat is planning to update a compendium of information on the space application capabilities of the countries in the region through inputs from all stakeholders, including countries, satellite operators and service providers. Relevant capabilities, initiatives and some best practices on the use of space technology for disaster management will be collected and collated.

International Telecommunication Union

[Original: English]
[17 November 2011]

International Telecommunication Union radio regulatory framework for space services[1]

1. Introduction

The rights and obligations of the member States of the International Telecommunication Union (ITU) in the domain of international frequency management of the spectrum/orbit resource are incorporated in the Constitution and

[1] The full version of the ITU report on the radio regulatory framework for space services will be distributed to the Scientific and Technical Subcommittee as a conference room paper and will be made available on the website of the Office for Outer Space Affairs.

Convention of the International Telecommunication Union[2] and in the Radio Regulations that complement them. Those instruments contain the main principles and lay down the specific regulations governing the following major elements:

(a) Frequency spectrum allocations to different categories of radiocommunication services;

(b) Rights and obligations of member administrations in obtaining access to the spectrum/orbit resource;

(c) International recognition of those rights by recording frequency assignments and, as appropriate, any associated orbits, including the geostationary-satellite orbits, used or intended to be used in the Master International Frequency Register.

Those regulations are based on the main principles of efficient use of and equitable access to the spectrum/orbit resource, as laid down in provision No. 196 of the ITU Constitution (art. 44), which stipulates,

> In using frequency bands for radio services, member States shall bear in mind that radio frequencies and any associated orbits, including the geostationary-satellite orbit, are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of the Radio Regulations, so that countries or groups of countries may have equitable access to those orbits and frequencies, taking into account the special needs of the developing countries and the geographical situation of particular countries.

As indicated in that provision, further detailed regulations and procedures governing spectrum/orbit use are contained in the Radio Regulations, which are a binding international treaty.[3]

Specific procedures have been established to ensure international recognition of the frequencies used and to safeguard the rights of administrations when they comply with those procedures.

The fact that the ITU Constitution and Convention and the Radio Regulations that complement them are intergovernmental treaties ratified by governments means that those governments undertake:

(a) To apply the provisions in their countries;

(b) To adopt adequate national legislation that includes, as the basic minimum, the essential provisions of that international treaty.

The international Radio Regulations are nevertheless oriented mainly towards matters of a global or regional character, and in many areas there is scope for making special arrangements on a bilateral or multilateral basis.

Over the last 40 years, the space regulatory framework has been constantly adapted to changing circumstances and has achieved the necessary flexibility in satisfying the two major, but not always compatible, requirements of efficiency and

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[2] United Nations, *Treaty Series*, vol. 1825, No. 31251.

[3] International Telecommunication Union, *Radio Regulations* (Geneva, 2008).

equity. The dramatic development of telecommunication services has seen an increasing demand for spectrum/orbit usage for practically all space communication services. This increase is attributable to many factors, including not only technological progress, but also political, social and structural changes around the world and their impact on the liberalization of telecommunication services, the introduction of non-geostationary-satellite orbit satellite systems for commercial communications and scientific and radionavigation applications, growing market orientation, the change in the way this widening market is shared between private and State-owned service providers and the general globalization and commercialization of communication systems.

2. International Telecommunication Union Radio Regulations

(a) Leading international radio regulatory instrument

The ITU Radio Regulations, as a leading instrument in the international radio regulatory set-up, are based on the use of two main concepts:

(a) The concept of block allocations of frequencies that are intended for use by defined radio services — table of frequency allocations as contained in article 5 of the Radio Regulations. This concept generally provides common frequency allocations to mutually compatible services operating with similar technical characteristics in specific parts of the spectrum. It also provides a stable planning environment for administrations, equipment manufacturers and users;

(b) The concept of voluntary or mandatory regulatory procedures (for coordination, notification and recording) adapted to the allocation structure.

(b) Objectives

The Radio Regulations have the following objectives:

(a) To facilitate equitable access to and rational use of the natural resources of the radio-frequency spectrum and any associated orbits, including GSO;

(b) To ensure the availability, and protection from harmful interference, of the frequencies provided for distress and safety purposes;

(c) To assist in the prevention and resolution of cases of harmful interference between the radio services of different administrations;

(d) To facilitate the efficient and effective operation of all radiocommunication services;

(e) To provide for and, where necessary, regulate new applications of radiocommunication technology.

3. References

The *BR International Frequency Information Circular* (Space Services) is a service document, published once every two weeks by the Radiocommunication Bureau in accordance with provisions No. 20.2 to 20.6 and No. 20.15 of the ITU Radio Regulations, available from www.itu.int/ITU-R/go/space-brific/en.

The Space Network List is a reference list of regulatory publications concerning planned or existing space stations, Earth stations and radio astronomy stations, available from www.itu.int/ITU-R/space/snl/index.html.

United Nations Educational, Scientific and Cultural Organization

[Original: English]
[27 October 2011]

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has participated in the sessions of the Committee on the Peaceful Uses of Outer Space and has been following with great interest the enormous range of activities that the Committee undertakes. At certain sessions, the Committee has decided to include the topic of "Space for heritage", which has given UNESCO an important role in such sessions. UNESCO is thankful to the Office for Outer Space Affairs of the Secretariat and the Committee for all joint cooperation.

The Committee undertakes a wide range of activities, all of which are in some way related to the long-term sustainability of outer space activities.

Outer space activities can become sustainable only if there is greater access to space data, if space agencies can ensure that they have proper national support to continue their activities and if the young generation is trained to acquire the skills necessary for them to join the space forces of the future.

The Committee is involved in all of these aspects, with the assistance of the Office for Outer Space Affairs and UNESCO. Therefore, UNESCO suggests that the definition of a larger view of what the Committee means for the long-term sustainability of outer space activities be explored. At this moment, in the Committee, that notion is uniquely linked with space debris, which certainly has an impact on our global observing systems and is one of the topics the Committee is mandated to address. However, long-term sustainability of outer space activities involves much more than just space debris.

It is important to clarify this issue because, while the topic of long-term sustainability of outer space activities is perfectly understood in the Committee to be related with space debris, the same topic will have a completely different meaning for people who are not familiar with the Committee. Therefore, we recommend that the Committee describe all the activities that it has endorsed to ensure the long-term sustainability of outer space activities. Afterwards the Committee can focus on the issue of space debris as one component, but not the only one.

UNESCO is not involved in the area of space debris and therefore cannot provide any input on this specific topic. However, if the topic is the long-term sustainability of outer space activities in a broader sense, as is indicated in paragraph 14 (a) of the terms of reference of the Working Group on the Long-term Sustainability of Outer Space Activities (A/66/20, annex II), then UNESCO can make significant contributions.

To provide a better idea of what we are referring to, consider, for example, the Land Remote Sensing Satellite (Landsat) programme of the United States National Aeronautics and Space Administration (NASA). Landsat is a unique satellite that has been acquiring data for over 40 years. It is therefore extremely important for such a sensor to have long-term sustainability. It is a unique tool that, acquiring images of the Earth always using a similar sensor, band and resolution, enables comparisons revealing changes to the Earth's surface over the past 40 years. The whole international community was worried when the possibility arose that the Landsat programme might not continue.

UNESCO has received a proposal to consider a portion of the United States Geological Survey Landsat archive of Earth imagery to be included in activities preserving humanity's documentary history (Memory of the World Register). There are many other applications for which the long-term sustainability of outer space activities needs to be ensured. If the Committee would like to take on these other areas, it will be important to map the overlap with other space-related organizations in this field.

Another extremely important area for the long-term sustainability of outer space activities is capacity-building. The more countries have access and use space data for their national sustainable development, the more space agencies will ensure the sustainability of the associated space data services. Some relevant topics are addressed under the umbrella of the Group on Earth Observations, the Global Earth Observation System of Systems and Global Monitoring for Environment and Security. Therefore, coordination with such initiatives is needed.

UNESCO would be interested in working with other United Nations organizations, in particular the Office for Outer Space Affairs, and space agencies if the mandate of the Working Group on the Long-term Sustainability of Outer Space Activities is extended beyond the topic of space debris. However, such an extension should be effected giving careful consideration to complementarity with the mandates of other space-related organizations.

Office for Disarmament Affairs of the Secretariat

[Original: English]
[3 November 2011]

Since 1982 the prevention of an arms race in outer space has been one of the four core issues on the agenda of the Geneva-based Conference on Disarmament.

From a historical perspective, it should be recalled that it was the Union of Soviet Socialist Republics that, in 1981, wished to have the issue placed on the agenda of the General Assembly as a separate item and submitted a draft treaty on the prohibition of the stationing of weapons of any kind in outer space. In the same year, the Assembly, on the initiative of the Eastern European States, as well as others, adopted resolution 36/99, in which it requested the Committee on Disarmament (as the Conference on Disarmament was called at the time) to start negotiations on a treaty prohibiting the stationing of weapons of any kind in outer space. Also in 1981, on the basis of the initiative of a group of Western countries, the Assembly adopted resolution 36/97 C, in which it requested the Committee on

Disarmament to “consider as a matter of priority the question of negotiating an effective and verifiable agreement to prohibit anti-satellite systems” as an important step towards the prevention of an arms race in outer space. Clearly, a divergence of views among the Member States of the United Nations, as well as among the members of the Committee on Disarmament, on the next steps to be taken to prevent an arms race in outer space has existed since the early years of the consideration of this issue.

From 1985 to 1994, an Ad Hoc Committee was established in the Conference on Disarmament to “examine, as a first step at this stage, through substantive and general consideration, issues relevant to the prevention of an arms race in outer space” and taking into account “all existing agreements, existing proposals and future initiatives” (CD/584).

Among the latest developments on this issue is the new draft treaty on prevention of the placement of weapons in outer space and of the threat or use of force against outer space objects (CD/1839), submitted in 2008 by the Russian Federation and China to the Conference on Disarmament for its consideration. While at that time a number of delegations welcomed the draft treaty, no consensus within the Conference on Disarmament was reached then, nor has one been reached today, on the negotiation of such a treaty.

It should also be recalled that the decision for the establishment of a programme of work for the 2009 session of the Conference on Disarmament (CD/1864), which represents the only programme of work that the members of the Conference on Disarmament have agreed to in more than a decade, provided for the establishment of a working group to discuss substantively, without limitation, all issues related to the prevention of an arms race in outer space. That decision did not, however, provide for a negotiating mandate for the Group. Unfortunately, for reasons unrelated to the prevention of an arms race in outer space, there was no agreement on the implementation of CD/1864.

Despite the formal absence of a working group on the prevention of an arms race in outer space, scheduled debates on this issue take place every year in plenary or informal meetings of the Conference on Disarmament. Such discussions provide an invaluable platform for the exchange of views, although they do not seem to have bridged completely the divergent views among delegations on the issue.

Most recently, the General Assembly, in its resolution 65/68, entitled “Transparency and confidence-building measures in outer space activities”, requested the Secretary-General to establish, on the basis of equitable geographical distribution, a group of governmental experts to conduct a study, commencing in 2012, on outer space transparency and confidence-building measures, making use of the relevant reports of the Secretary-General, without prejudice to the substantive discussions on the prevention of an arms race in outer space within the framework of the Conference on Disarmament, and to submit to the Assembly at its sixty-eighth session a report with an annex containing the study of governmental experts.

The possibility is not to be excluded, although it is by no means certain, that the report of the group of governmental experts could push forward the discussions and perhaps the negotiations on the prevention of an arms race in outer space in the Conference on Disarmament. In fact, increased transparency and confidence-building measures could create a climate of greater trust and possibly also facilitate the negotiation of a treaty, although the final word on this rests, as always, with the States members of the Conference on Disarmament.

III. Replies received from other international organizations and bodies

Consultative Committee for Space Data Systems

[Original: English]
[4 November 2011]

A. Introduction

The present abbreviated version of the report of the Consultative Committee for Space Data Systems is provided to comply with limitations on documents submitted for translation into the languages of the United Nations. Readers are encouraged to read the full report, which contains more context and background on the work of the Consultative Committee.

The present short, informal report is intended to respond to the request from the Office for Outer Space Affairs of the Secretariat. The response was solicited to support the work of the Committee on the Peaceful Uses of Outer Space and the Working Group on the Long-term Sustainability of Outer Space Activities of the Scientific and Technical Subcommittee.

The Consultative Committee for Space Data Systems was formed in 1982 by the major space agencies of the world to provide a forum for the discussion of common problems in the development and operation of space data systems. It is currently composed of 11 member agencies, 28 observer agencies and over 140 industrial associates. The charter of the Consultative Committee is available from http://public.ccsds.org/about/charter.aspx, and much more information is to be found at www.ccsds.org. Unlike many standards organizations, the Consultative Committee distributes its standards free of charge.

B. Preface

The ability of nations, agencies and companies to have spacecraft and ground facilities with compatible communications and data systems is the first and foremost linchpin of sustainability. Enabling joint missions, lower costs and more efficient missions with greater return is clearly a major step towards long-term sustainability.

The Consultative Committee contributes to the long-term sustainability of outer space activities by virtue of the technical standards documents that it produces. The standards, when adopted by space-flight programmes and projects around the world, enable, in summary:

(a) International cooperation in space-flight activities;

(b) Efficient development and operations between the elements of a large organization (such as the centres or contractors supporting an agency);

(c) Lower cost through greater commercialization of components;

(d) Efficient operations, such as rapid contingency operations when one agency must unexpectedly provide communications for another agency's spacecraft.

All of these benefits contribute directly to improvements in the sustainability of outer space activities. The primary objective, however, of Consultative Committee member agencies is the first item, the ability of the agencies to join together in internationally cooperative space-flight missions. This means that Consultative Committee standards will first and foremost provide capabilities that promote regional and interregional cooperation, one of the central objectives of the Committee on the Peaceful Uses of Outer Space.

The report of the Committee on the Peaceful Uses of Outer Space on its fifty-fourth session (A/66/20) stressed the need to support regional and interregional cooperation in the field of space activities. Active promotion by the Committee on the Peaceful Uses of Outer Space of the adoption of interoperability-enabling standards, including Consultative Committee standards, would certainly lead to progress towards that objective. The Consultative Committee would welcome support from the Committee on the Peaceful Uses of Outer Space to recruit strong technical participation by additional agencies.

One technical area warrants special attention, namely, in the space internetworking services area, the work on delay/disruption-tolerant networking (DTN). A consortium of space agencies known as the Interagency Operations Advisory Group (IOAG) has defined a vision of future space internetworking and framed it as the solar system Internet (SSI). SSI brings to space-flight programmes an adaptation of the terrestrial approach to the Internet that can deal with the unique environment of space flight (as terrestrial Internet protocols cannot). Because SSI uses DTN, IOAG has asked the Consultative Committee to take the next step to realize SSI: development of the SSI architecture and the supporting DTN protocols that will enable collaborating nations to support each other with this networked infrastructure. This follows the same paradigm of automated routing that the terrestrial Internet uses, wherein many organizations support other organizations by providing packet and message routing through their systems. However, this Internet is adapted to the disrupted communications and long lightspeed delays that are inherent in the outer space environment. Clearly, such a capability will support the goals of the Committee on the Peaceful Uses of Outer Space by enabling regional and interregional cooperation in space activities, a correlation to similar benefits that are realized on Earth because of the terrestrial Internet.

C. Addressing the major points concerning the scope of the terms of reference of the Working Group on the Long-term Sustainability of Outer Space Activities

The major points concerning the scope of the terms of reference of the Working Group (A/66/20, annex II, sect. IV, para. 14) are set out below, followed by the responses of the Consultative Committee.

1. Sustainable space utilization supporting sustainable development on Earth

Compliance with Consultative Committee standards allows lower-cost exploitation of space by developed countries because of joint collaboration and mission cost-sharing. Lower cost translates into more sustainability.

Compliance with Consultative Committee standards allows developing countries to enter into the exploitation of space with systems compatible with those of developed countries, and sustainability benefits such as lower costs, joint mission capability and overall equitable access to communications functions, similar to that enjoyed by the developed countries.

2. Space debris

The Consultative Committee Navigation Working Group provides a discipline-oriented forum for detailed discussions and development of technical flight dynamics standards (e.g., representation of the trajectories of orbiting objects, representation of spacecraft attitudes, exchange of tracking data, design of manoeuvres, predicted orbital events, etc.). In the area of space debris, the discussions and development are heavily focused on the development of a standard that will be used to communicate information about a conjunction of objects in space once it has been predicted. Space conjunctions represent potential collisions that can exacerbate conditions in the space-debris environment. The Navigation Working Group is developing a standard called the "conjunction data message" (CDM) to communicate information about a predicted conjunction to satellite owners and operators. Conjunction information includes data that may be used by satellite owners and operators to evaluate the risk of a collision and plan manoeuvres if they are deemed necessary. Use of the CDM standard will promote long-term sustainability of the space environment by contributing to efforts to prevent collisions before they happen. Several organizations have already indicated an interest in using their space surveillance network facilities to produce conjunction data messages.

3. Space weather

Traditional Consultative Committee protocols provide capabilities and benefits as described earlier to solar research space-flight missions that improve space weather prediction capabilities.

New advanced space Internet working protocols, which are in development in Consultative Committee's working groups, have the potential of providing "sensor web" capabilities to automate the reaction of multiple orbital research spacecraft for faster responses to space weather events.

4. Space operations

Compliance with Consultative Committee standards can enable short-notice contingency support. Missions in trouble can rapidly configure unplanned communications sessions with other agencies' communications assets. There have been two incidents where compliance with standards allowed one agency to "rescue" another agency's mission, involving the United Kingdom's Space Technology Research Vehicle mission and the European Space Agency (ESA) X-ray Multi-Mirror Mission-Newton.

Operations efficiencies are achieved when standards are used because operations and maintenance teams become familiar with the characteristics of the protocols, and those protocols and the associated experience and training carry over to new missions. This enhances operations capabilities and ground-crew performance with lower costs, thus contributing further to sustainable space missions.

5. Tools to support collaborative space situational awareness

As described in the response under (b) above, the Consultative Committee Navigation Working Group has standardized several navigation message formats, intended to be exchanged between mission control centres. When the messages are exchanged between control centres, they increase the situational awareness of spacecraft flight control teams (for all missions) and of onboard crews (for human space-flight missions).

While several message formats have been completed and are in operational use, the Working Group is now focusing on the conjunction data message, a communications capability that focuses totally on collision avoidance (as mentioned above).

Enhanced communications between mission control teams using other Consultative Committee ground-to-ground standards (such as service interfaces in the mission operations standards from the Spacecraft Monitor and Control Working Group) will naturally increase the level of space situational awareness for parties on both sides of the service interface. The standards will allow the exchange of real-time command and telemetry, planning data and eventually other functions such as simulations and training. Experience from the International Space Station (ISS) programme has shown that large collaborative programmes have a need to exchange an extensive variety of specialized data (command history, antenna management, payload health and status, etc.). For the ISS programme, such data formats were the "proprietary" internal formats of the agencies that "owned" the data, and the result was that either expensive format conversions (multiple conversions per data type per agency) were required, or else the operations concept had to change to deal with the inability to exchange the data. The efforts of the Consultative Committee, if successful, will prevent this obstacle from arising for future programmes. The ability to more freely and efficiently exchange these complex data types will result in increased situational awareness among collaborating control centres.

6. Regulatory regimes

Consultative Committee teams perform technology development and standardization. This is conducive to the transfer of approved technologies from one agency to another as part of the standard development process. It also effectively provides technology transfer to agencies that use the standards, because they benefit from the technology development that was part and parcel of the development of the technical standard.

For the coming age of the solar system Internet, a loosely coupled volunteer-oriented governance framework will be needed by the collaborating space agencies, to enable cooperative Internet-style automated routing across multi-agency assets, as is done on the terrestrial Internet. The same coordination functions will be needed (address assignments, etc.) as are provided by the Internet Engineering Task Force for the terrestrial Internet. Of course, with the initially small population of solar system Internet-enabled spacecraft, a full governance model will not be needed for some time.

7. Guidance for actors in the space arena

Technical standards development and compliance are an asset that all agencies need and many project and programme managers shun. The Committee on the Peaceful Uses of Outer Space should actively promote standards for specific technology touch-points where they most enable cooperative missions. As noted in section II above, of all the potential technology areas involved in space flight, interoperability in the area of communications and data exchange provide the greatest benefit to collaborating entities. The Committee should promote that guidance in that area to actors in the space arena, as humankind begins in earnest to explore the solar system.

D. Recommendations

The Consultative Committee for Space Data Systems recommends that the Committee and its working groups broadly advocate the adoption of interoperability-enabling standards by the space-flight missions of the developed and developing nations of the world.

While the Consultative Committee agencies are engaged in communications and data-system standards because the Consultative Committee believes it is the most critical area for enabling interoperability, the Consultative Committee recognizes that there are other technology areas that also affect interoperability. The Consultative Committee and its working groups should promote the adoption of such standards, including, but not limited to, its standards.

The Consultative Committee recommends that the Committee on the Peaceful Uses of Outer Space and its working groups encourage broader participation in the development of new standards that enable interoperability, but only by organizations that have technical skills in the technology area.

The Consultative Committee welcomes participation in standards development by any nation or organization in the world that endeavours to promote cooperative space-flight missions. However, track records indicate that participants must have genuine technical skills in the technology area; otherwise, they hamper the already difficult process of developing internationally interoperable standards.

Any organization that can contribute resources and technical skills to these difficult but rewarding tasks is invited to first browse the Consultative Committee for Space Data Systems website and Collaborative Work Environment area at www.ccsds.org to familiarize themselves with the current technology efforts, and then contact either the Chairs of the working group on the area that they are interested in (see contact information on the website) or the Consultative Committee secretariat at Secretariat@mailman.ccsds.org.

E. Summary

The Consultative Committee for Space Data Systems welcomes the interest of the Committee on the Peaceful Uses of Outer Space and the Working Group on the Long-term Sustainability of Outer Space Activities in the promotion of standards that enable interoperability between space-flight missions (the primary objective of the Consultative Committee), cost efficiencies, operational flexibility and the improved ability of developing regions to cooperate in space-flight activities (a Committee objective).

The recommendations above are offered in the spirit of promoting the common interests of the Consultative Committee and the community of the Committee on the Peaceful Uses of Outer Space. The Consultative Committee sincerely hopes that they are helpful in raising awareness of this work in the Committee on the Peaceful Uses of Outer Space and that it has provided the appropriate background information to support the recommendations.

In the area of communications and data standards, if the Committee on the Peaceful Uses of Outer Space or its Working Group have a need for any further information or support from the Consultative Committee, the secretariat should be notified and, if agency resources permit, it will be pleased to provide support.

European Organisation for the Exploitation of Meteorological Satellites

[Original: English]
[4 November 2011]

Introduction

In recent years the need to preserve outer space for future usage has been recognized worldwide. According to the Inter-Agency Space Debris Coordination Committee (IADC), it has been a common understanding since the Committee on the Peaceful Uses of Outer Space published its technical report on space debris, in 1999, that man-made space debris today poses little risk to ordinary unmanned spacecraft in Earth orbit, but the population of debris is growing, and the probability of collisions that could lead to damage will consequently increase. It has, however, now become common practice to consider the risk of collision with orbital debris in planning manned missions, so the implementation of some debris mitigation measures today is a prudent and necessary step towards preserving the space environment for future generations.

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) has followed the IADC Space Debris Mitigation Guidelines and reached full compliance with them for the end-of-life operations of Meteosat-5 and Meteosat-6.

However, owing both to the operations of low Earth orbit missions (e.g. Metop) and to the rapid evolution of space debris documentation, EUMETSAT decided to establish the Space Debris Working Group to coordinate the EUMETSAT internal activities on this topic. The Working Group was established in April 2011 with the following tasks:

(a) Establishment of the EUMETSAT guidelines on space debris mitigation;

(b) Establishment, coordination and documentation of the operational aspects of end-of-life and conjunction warning and collision avoidance operations;

(c) Support for EUMETSAT programmes for coordination with external agencies on space debris matters;

(d) Review of applicable standards and guidelines (e.g. IADC Space Debris Mitigation Guidelines, European Code of Conduct on Space Debris Mitigation, International Organization for Standardization standard 24113 (ISO 24113), European Commission code of conduct for outer space activities).

The Space Debris Working Group includes EUMETSAT staff with expertise in fields ranging from flight dynamics to satellite operations and legal matters. The Working Group meets up to twice per year to review the mitigation guidelines and to review the status of in-flight satellites with respect to the space debris guidelines.

The following paragraphs describe the current status of the Working Group's tasks.

Activities on space debris mitigation

1. Guidelines

The EUMETSAT guidelines are intended to establish the EUMETSAT policy for space debris mitigation. They are largely inspired by the recently published space debris mitigation requirements (ISO 24113), and they require an assessment of EUMETSAT satellites against those requirements. A distinction is made between existing projects, for which ISO 24113 is taken as a reference, and future projects, for which ISO 24113 is proposed to be applicable. The guidelines also define a "waiver process" and an "approval agent" for space debris matters.

A first version of the EUMETSAT guidelines was drafted in July 2011 and is currently under review by the Space Debris Working Group. Once that review is completed, the guidelines will be submitted to EUMETSAT senior management and, if approved, will be released before the end of 2011.

2. End-of-life and conjunction warning and collision avoidance operations

(a) End-of-life operations

Both Meteosat-5 and Meteosat-6 have been re-orbited by EUMETSAT, in April 2007 and April 2011, respectively.

For Meteosat-5 the IADC Space Debris Mitigation Guidelines were followed and full compliance with them achieved as far as end-of-life operations were concerned.

For Meteosat-6, ISO 24113 was followed and full compliance with it achieved as far as end-of-life operations were concerned (see below).

Meteosat-6 end-of-life operations

The re-orbiting of Meteosat-6 was performed in accordance with the space debris regulations and in particular with ISO 24113. The activities took place between 28 March and 2 May 2011. The following activities were performed:

(a) Pre-re-orbiting tests:

(i) Full Earth imaging with redundant electronics;

(ii) Full Earth imaging with nominal electronics;

(iii) Rapid scans imaging with nominal electronics;

(iv) Redundant detectors test;

(v) Mission picture transmission coaxial switch test;

(vi) Fuel onboard measurement test;

(b) Re-orbiting manoeuvres;

(c) Spacecraft payload and platform passivation operations;

(d) Final orbit determination.

After the end-of-life tests, which were designed primarily to check the status of the redundant units after so many years in orbit, the proper re-orbiting operations started on 11 April 2011, as planned. The Meteosat-6 re-orbiting operations were prepared by EUMETSAT using the sequences used for the Meteosat-5 re-orbiting as a basis. The re-orbiting operations were reviewed by Thales Alenia Space and were provided to the European Space Operations Center and the Centre national d'études spatiales for comment. Regular teleconferences with Thales Alenia Space were held throughout the most critical phases of the re-orbiting operations to get the necessary support and advice in case of unexpected behaviours.

In compliance with the space debris mitigation guidelines of ISO 24113, the objective was to raise the orbit of Meteosat-6 to at least 250 km above the geostationary ring and, at the same time, to reduce the satellite spin rate. The reduction of spin rate minimizes the risk that satellite debris will re-enter the geostationary ring, should the satellite decompose into fragments in the long term.

For the re-orbiting operations a fuel budget of 3.9 kg was estimated, based on a "bookkeeping" method. Several manoeuvres were performed between 11 and 15 April 2011, followed by a venting of the fuel pipes and tanks to achieve a final orbit of approximately 350 km (perigee) x 384 km (apogee) above the geostationary ring with a final spin rate of approximately 72 rpm (with the initial spin rate having been about 99.9 rpm). The actual fuel mass was found to be about 3.7 kg (i.e. about 200 g less than estimated).

The satellite switch-off was completed on 2 May 2011. The last command to Meteosat-6 was sent at 0908 hours UTC, marking the end of the satellite's operational life after more than 17 years in orbit operations.

All the Meteosat-6 re-orbiting operations were successful, the fuel budget was quite accurate and the ISO 24113 recommendations were fulfilled with good margins.

(b) Conjunction warning and collision avoidance operations

A conjunction warning service was requested by EUMETSAT via the National Oceanic and Atmospheric Administration to the Joint Space Operations Command of the United States Air Force and is currently in place for all EUMETSAT in-flight satellites. That service provides both warning messages and regular screening messages to the operations teams whenever a piece of debris is close to one of the EUMETSAT operational satellites. On the basis of that information, the EUMETSAT operations teams can decide whether to perform a collision avoidance manoeuvre or not. In addition, the service allows checking, before each manoeuvre, to see if the planned manoeuvre brings the satellite any closer to a piece of debris.

Meteorological operational satellite collision avoidance manoeuvre on 1 May 2011

In late April 2011, the satellite collision warning process that EUMETSAT established with the United States Air Force Joint Space Operations Command identified a high-risk debris conjunction event concerning Metop-A. After the analysis performed by the EUMETSAT flight dynamics team, it was decided that the manoeuvre would be performed, as the risk of collision was significantly higher than the acceptable threshold. The burn took place on 1 May 2011 at 0328 hours UTC, in accordance with the manual procedure for unplanned manoeuvres. As usual for an in-plane manoeuvre, this required an outage of both the Space Environment Monitor and the Global Ozone Monitoring Experiment (as they both had to be in safe modes before the firing), and a general degradation of all the other products during the manoeuvre mode. This is the first time that EUMETSAT has had to manoeuvre Metop-A because of a collision risk.

Group on Earth Observations secretariat

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A. Introduction

Recognizing the need for better environmental information, political leaders at the World Summit on Sustainable Development, held in Johannesburg, South Africa in 2002, called for urgent action on Earth observation. Earth Observation Summits in Washington, D.C., Tokyo and Brussels and declarations by three of the annual Group of Eight Summits built on that momentum. Acting on a clear international consensus, ministers established the Group on Earth Observations (GEO) in 2005 with a mandate to build a Global Earth Observation System of Systems (GEOSS).

To establish the System of Systems, governments and organizations have been interconnecting their space-based and in situ observation systems. They have formed partnerships to fill gaps in observing systems, promoted full and open access to data and information, developed interoperability and other technical standards, built the capacity of users to access GEOSS and nurtured new cross-cutting and multidisciplinary data sets. Those actions are making it possible to share resources, data and information for the benefit of all humankind.

The cross-cutting data, decision-support products and end-to-end information services that are increasingly available through GEOSS are improving the ability of governments to promote "green" economic growth, manage natural ecosystems and resources, ensure food security for a global population that may reach 9 billion by mid-century, respond more effectively to disasters, and address climate change, biodiversity loss and other global challenges. Sustained space-based observations are an essential component of the ability of GEOSS to deliver those services.

B. Societal benefits

GEO is serving nine key societal benefit areas. It is supplying concrete examples of how decision makers can use Earth-observation data and services to address major global opportunities and challenges. None of those societal benefit areas exists in isolation: the full value of GEOSS lies in its ability to integrate information across disciplines. The nine societal benefits are as follows:

1. *Reducing loss of life and property from natural and human-induced disasters*. Rapid access to weather forecasts, data on land and ocean conditions, maps of transport links and hospitals, seismographic data and information on socio-economic variables can strengthen disaster preparedness, prediction and response. Key disaster-management services available through GEOSS include the Global Early Warning System for Wildland Fire, Sentinel Asia and (for Africa and Central and South America) the Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (also called the International Charter on Space and Major Disasters), the Global Monitoring for Environment and Security (GMES) Emergency Management Service and the Mesoamerican Visualization and Monitoring System (SERVIR).

2. *Understanding how the environment affects human health*. Key environmental variables include airborne, marine and water pollutants; stratospheric ozone depletion; land-use change; food security and nutrition; noise levels; population trends; and weather-related stresses and disease vectors. For example, analyses of desertification trends and forecasts of windstorms are being used to provide early warning of epidemics in Africa's "meningitis belt"; this allows the World Health Organization and local health experts to target their vaccination programmes more effectively.

3. *Promoting sustainable energy*. Earth observations are vital for monitoring and forecasting fluctuations in hydropower, solar, ocean and wind energy sources; assessing and predicting the environmental impacts of energy exploration, extraction, transportation and consumption; reducing weather-related and other risks to energy infrastructure; and matching energy supply with demand. To support solar energy planners, for example, GEO is coordinating a solar data programme that offers one-stop access to databases, applications and information relating to solar radiation trends and patterns.

4. *Addressing climate variability and change*. GEO is a leading advocate for maintaining and strengthening the climate observation capacities of atmospheric, terrestrial and oceanic monitoring systems. For example, 20-plus GEO members are contributing to the global array of some 3,000 robotic Argo buoys that are monitoring ocean temperatures and salinity. GEO members are also establishing essential decision-support services, such as an innovative system for monitoring and verifying forest carbon content and a Climate for Development in Africa programme.

5. *Improved water-cycle forecasting*. National meteorological and hydrological services, along with several United Nations agencies, are collaborating through the GEO "Integration of in situ and satellite data for water-cycle monitoring" project. That project is aimed at filling gaps in global measurements, standardizing metadata and improving the accuracy of data and predictions. Other ongoing initiatives relate to information products on precipitation, soil moisture and groundwater.

6. *Interlinking weather forecasting systems with other Earth observation systems*. By integrating weather data with the growing number of data sets available in fields such as biodiversity, health, energy and water management, GEOSS will greatly expand the uses to which weather information and forecasts can be put. Other efforts to improve the value of weather forecasting include the World Meteorological Organization (WMO)-led THORPEX Interactive Grand Global Ensemble project (TIGGE), which is aimed at accelerating improvements in the accuracy of one-day to two-week weather forecasts.

7. *Monitoring ecosystems and generating maps and other decision-support tools*. One team is working to improve the classification and mapping of diverse ecosystems. Another is extending a South American network for monitoring ocean temperatures and chlorophyll to the global scale. Still others are collaborating on monitoring and delineating protected areas, including UNESCO World Heritage sites; measuring the impact of tourism and other socio-economic activities on ecosystems; assessing the vulnerability of sea basins around the world; and assessing the vulnerability of mountain regions.

8. *Developing an agricultural monitoring system of systems*. Farmers and policymakers require accurate forecasts and cross-cutting data on food production and supplies, storms and droughts, climate change and variability, water levels, market demand and changes in productive land and ocean areas. They need this information to respond to immediate challenges and opportunities, to craft longer-term strategies for adapting their farming practices to changing conditions and to ensure the sustainable management of fisheries and grazing lands. Enhanced Earth observations will also assist international relief organizations in planning more effectively for famines.

9. *Supporting the conservation and sustainable use of the world's biological diversity*. The GEO Biodiversity Observation Network, known as "the biodiversity arm of GEOSS", is interlinking the field's numerous stand-alone databases and observation systems to improve assessments of plant and animal populations, track the spread of invasive alien species and promote information-sharing and cost savings. It will also connect those systems to other Earth-observation networks that generate relevant data, such as climate and pollution indicators.

C. Space component of the Global Earth Observation System of Systems

The Committee on Earth Observation Satellites (CEOS) is a long-standing GEO participating organization that contributes the space component of GEOSS. CEOS supports GEO stakeholders with Earth-observation data, information products and related expertise. CEOS agencies supported the establishment of GEO, and CEOS has since made continuous and growing contributions to GEO through a wide range of Earth-observation initiatives. Today, CEOS and its member agencies support nearly half of the projects in the GEO workplan.

CEOS is coordinating a series of "virtual constellations" for GEO. Those constellations help to harmonize and maximize efforts by CEOS agencies to deploy Earth-observation missions that contribute to GEOSS, address emerging data gaps, avoid overlaps among systems and make maximum use of existing satellite assets. A virtual constellation consists of multiple satellites, ground systems and related data-delivery systems mobilized in a coordinated manner for greater efficiency. The six currently existing constellations address atmospheric composition, land surface imaging, ocean colour radiometry, ocean surface topography, ocean surface vector wind, and precipitation. The establishment of a sea surface temperature constellation is also under consideration.

CEOS working groups are enhancing coordination and cooperation among CEOS agencies in specific topical areas that provide broad international benefits. The Working Group on Information Systems and Services, for example, provides a range of data and information services to enhance access to Earth observation data based on common guidelines for effective interoperability. The Working Group on Calibration and Validation addresses issues related to calibrating and validating sensor systems and their derived products; this enables reliable comparisons and the synergistic use of information across global Earth-observing systems. The Working Group on Education, Training, and Capacity-Building is now focusing its efforts on capacity-building and "data democracy". The newly formed Working Group on Climate will coordinate and encourage inter-agency activities in the area of space-based climate monitoring.

CEOS is responding to user needs for systematic satellite observations as identified by the Global Climate Observing System. That work is being carried out in close consultation and coordination with GEO and in support of the United Nations Framework Convention on Climate Change.[4]

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[4] United Nations, *Treaty Series*, vol. 1771, No. 30822.

The GEO Forest Carbon Tracking initiative provides coordinated satellite data and processing in support of the GEO Global Forest Observation Initiative. It fosters the sustained availability of satellite and ground observations for national forest inventories and information systems. That Initiative will support the long-term observation needs of the Framework Convention on Climate Change and the implementation of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD-plus).

The data democracy initiative is aimed at building the capacity, particularly in developing countries, to access key data sets free of charge. Additional data democracy initiatives include enhanced data dissemination capabilities, the sharing of software tools, increased training and the transfer of technology to end-users. In this context, CEOS agencies recognize that the GEOSS Data-Sharing Principles should serve as the basis for access to data for the public good. In particular, CEOS agencies will contribute to the GEOSS Data Collection of Open Resources for Everyone by making several data sets available on a full and open basis.

Space agencies have begun to provide data in support of the GEO Joint Experiment for Crop Assessment and Monitoring (JECAM). That initiative is intended to demonstrate the value of the coordinated use of a wide range of satellite and in situ data for improving the productivity of various crop types and for enhancing food security. Created by the GEO Agricultural Monitoring Community of Practice, JECAM also serves as a scientific precursor to the GEO Global Agricultural Monitoring initiative, which is being launched in response to a request by the Group of Twenty Ministers of Agriculture. CEOS is consulting with the GEO Agricultural Monitoring Community of Practice to assess its needs for future satellite data.

D. Satellites and disasters

Space agencies and other GEO partners are working together to expand the use of satellite images and maps for managing the risks posed by fires, floods, earthquakes and other hazards. They are evaluating user needs and matching them with existing or planned technologies and data sets, and they are expanding international access to satellite images via the International Charter on Space and Major Disasters. Satellites have a uniquely valuable vantage point for monitoring many kinds of large-scale disasters, from forest fires to overflowing rivers to earthquake-prone zones. Remotely sensed data can be provided in near-real time or with very little delay and can include maps, optical images or radar images that accurately measure the burnt area, heat, flood extent, land displacement and other key variables.

The Geohazard Supersites initiative coordinates the existing space- and ground-based observation resources of GEO members. This global scientific collaboration is aimed at improving the scientific understanding of the risks of earthquakes and volcanic events in selected regions. The “supersites” currently being addressed are L’Aquila (Italy), Chile, Mount Etna, Haiti, Istanbul, Los Angeles (United States), Mount Vesuvius, Seattle (United States)/Vancouver (Canada) and Tokyo. The supersites partnership consists of space agencies, which provide satellite radar, synthetic aperture radar (SAR) and other Earth-observation data; the providers of ground-based geophysical data, such as seismic and Global Positioning System data; and scientists and decision makers who use and analyse those data. The Geohazard Supersites initiative provides a cyber-infrastructure platform with a single web entry point that allows fast, easy and free-of-charge access to a complete satellite and ground-based geophysical data set derived from diverse sources and geophysical disciplines. This interdisciplinary approach of using data from satellite radar (SAR interferometry), seismology and other Earth-science domains provides the unique potential of narrowing down the scientific uncertainty about future disastrous events. The data can also be used by civil protection agencies responsible for the production of reliable and detailed risk scenarios and consequent emergency plans and by urban planners responsible for land-use planning in risk-prone areas.

CEOS has conducted a comprehensive study of the requirements of disaster managers for satellite data. It looked at requirements for seven different types of disaster, on a global basis, and across the full cycle of disaster management. Using an analysis by the World Bank, the authors of the study were able to determine which areas of the world were more likely to be severely affected by disasters and to establish user requirements associated with those areas on a priority basis. The report was eventually validated by representative users from disaster management organizations and space agencies from around the world. It was presented at a meeting in Bonn organized by the Office for Outer Space Affairs, where 100 participants from various meteorological, disaster relief and emergency management agencies provided feedback on both the methodology and specific user requirements. Completed in 2009, that user-requirements report is now the starting point for a comprehensive gap analysis focused on specific satellite data sets.

The CEOS Disaster Satellite-Based Augmentation Team is working in conjunction with the CEOS Systems Engineering Office to review the specific disaster-related user requirements highlighted in the report and is identifying observation and measurement parameters, which in turn will be tracked against the CEOS database of existing and planned missions for the 2010-2030 time frame. The current Systems Engineering Office database shows 339 (of 415) missions, 391 (of 984) instruments and 88 (of 146) measurements to be relevant to disasters in general. Those measurements are a mixture of atmosphere, land and ocean parameters. Measurement requirements are based on the GEOSS 10-year implementation plan. More detailed gap analyses require a better definition of measurements and their detailed requirements to match relevant missions.

Work is currently under way on flooding and is expected to be completed by late 2011. In parallel to the gap analysis, work is under way in the CEOS Working Group on Information Systems and Services to develop a data-dissemination model to integrate and make use of existing technologies within the Working Group, i.e. sensor web, web service, grid and clearing house for disaster response. The Working Group will then implement a prototype to demonstrate the use of those integrated technologies for disaster response.

E. Satellites and communications

GEO is protecting radio frequencies for Earth observations. Acknowledging the increasing pressure from telecommunications and other sectors on the frequency bands used by the Earth observation community, GEO actively participates in frequency management processes in order to ensure the long-term availability of radio frequencies for terrestrial, oceanic, airborne and space-based observations and data dissemination and avoid any harmful interference that could jeopardize related observations. That effort is currently being handled through the participation of a number of GEO participants, in particular WMO in meetings of the International Telecommunication Union, either during regular working parties or World Radiocommunication Conferences.

GEO has established the GEONETCast global data dissemination system. GEONETCast ensures access to Earth observation data by broadcasting data from dozens of leading data providers to decision makers around the world. The data are transmitted via advanced communications satellites to thousands of low-cost, off-the-shelf receivers. GEONETCast also provides dedicated training and alert channels for capacity-building and risk reduction, particularly in developing countries. GEONETCast is a low-cost information-delivery system that transmits satellite and in situ data, products and services from GEOSS to users through communications satellites. It is a key means of dissemination for GEOSS. The system’s current coverage is provided by the China Meteorological Administration, which operates FENGYUNCast over Asia and parts of the Pacific; the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), which operates EUMETCast over Europe, Africa and parts of the Americas; and the National Oceanographic and Atmospheric Administration of the United States, which operates GEONETCast Americas over North, Central and South America as well as the Caribbean. The Russian Federation has also indicated its interest in providing additional regional coverage. WMO is also a GEONETCast partner and contributes its experience in global systems for disseminating weather-related data.