Towards Peaceful Uses for Space Technologies How to follow up the Vienna Declaration of UNISPACE III?

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Abstract The paper reviews the Vienna Declaration and the Report that have been adopted by the Plenary Session of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (so called UNISPACE III), 19-30 July 1999 in Vienna, Austria. Particularly as the Chairman of the Committee II who represented Asia and Pacific Region and was responsible for remote sensing, satellite communication, navigation/positioning and commercial benefits from space activities, the author focuses on status, issues and concerns and specific action programmes of remote sensing and navigation/positioning.

Keyword Space Technologies, UNISPACE III, Spin Offs

1. Introduction

The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE) was held in 1968 and in 1982 in Vienna, Austria. UNISPACE III was convened in Vienna, 19-30 July 1999 under the theme “Space Benefits for Humanity in the Twenty-First Century”. The Conference is an invitation to the international community to take stock of the significant developments that have taken place since 1982, including geopolitical changes, the contributions of new “space faring” nations and the important role of the private sector. Accordingly, the primary objectives of UNISPACE III are:

To promote the effective means of using space solution to address problems of regional or global significance;

To strengthen the capabilities of Member States, especially developing nations, to use the results of space research

or economic and cultural development;

- To enhance international cooperation in space science and technology and its applications.

Unispace III presented a unique opportunity for the world’s experts and decision-makers to meet and exchange information and ideas to advance human condition into the next millennium.

2. Remote Sensing for Environment and Natural Resources

a. Summary

Reliable weather forecasting and longer-tem climate predictions have become an essential part of our daily life. Weather and climate forecasting, disaster management and the management of Earth’s resources are areas where remote sensing is contributing successfully to the improvement of the human condition. Satellites increasingly provide important information for early warning and management of the effects of disasters and information that is useful in the management of agriculture, forestry, minerals, water resources and fisheries. All these applications need continuos data acquisition and will benefit from improvements in an adaptation of remote sensing technologies and associated data analysis.

Measures should be taken to maximize the benefit of remote sensing systems through increased availability and affordability of data and information products; improved provision of technical information, training and financial support for developing countries in order to assist in decision-making and the use of remote sensing data and derived information in the development process; and improved coordination among ongoing and planned programmes and initiatives to eliminate duplicated efforts and to identify gaps.

b. Status

Present-day applications of satellite data are widespread and cover research and operational and commercial activities. Those activities are of interest both in the global contexts, where Earth observation data are successfully applied in support of a range of different application areas such as applications in weather and climate forecasting, disaster management, management of resources and disease control and health services.

In the applications in weather and climate forecasting, over the past ten or more years, substantial improvements have been made in Earth observation technology and in constructing sophisticated computer models of the Earth's system. Currently, predictions are routinely made of detailed weather anomalies as well as inter-annual climate variability and global climate change.

Ongoing satellite missions make or help derive key global observation of atmospheric structure and dynamics, sea-surface temperature, surface parameters, precipitation, land surface characteristics including biodiversity, and selected at mospheric chemical species via geostationary (GMS, GOES, GOMS, INSAT and METEOSAT) and polar-orbiting platforms (NOAA-AVHRR, Fengyun (China), IRS (India), LANDSAT (US), SPOT (France), Resurs-01 (Russia), Sich (Ukraine), Okean (Russia/Ukraine), International Priroda, TOPEX/Poseidon (France/US), TRMM (Japan/US), ERS (ESA), SIR-C/X-SAR (Germany, Italy/US), JERS (Japan) and Radarsat (Canada).

During the first decade of the next millennium well over 30 new Earth observing satellites are expected to be launched. These will provide an unprecedented capability to monitor, on a global basis, nearly all aspects of the Earth's Climate system.

Future satellite missions will make improved and better calibrated observations of the above mentioned and other parameters such as the concentration and distributions of greenhouse gases, aerosols, ozone, atmosphere chemistry and solar radiation, which are needed to improve global climate change models. Examples of satellite missions are INSAT-2E (India), ADEOS II (Japan), Resurs F-1 and Nika-Kubany (Russia), EOS-AM/EOS-PM and CHEM (USA), ENVISAT (ESA) and Symed Cosmo (Italy).

In the applications in disaster management, which includes (a) disaster mitigation, (b) disaster preparedness, (c) disaster relief and (d) disaster rehabilitation, space technologies can play important roles in early warning and management of the effects of disasters. However, an operational disaster management support service that uses the capabilities of space systems can only be achieved through the joint use of satellite communications and remote sensing images, with other non-space sources providing ground information.

Data from meteorological and Earth observation satellites provide essential information for hazard mapping, risk assessment, early warning and disaster relief and rehabilitation. Such data are particularly useful when combined with geographic information systems (GIS) for analysis and modeling of complex scenarios.

Navigation and positioning satellite systems are another promising tool for disaster prediction, warning and relief activities. With ground positioning receivers and through repeated observations, it is possible to determine relative motions of parts of Earth to within a few millimeters. That could make it possible to assess and map earthquake risk and predict volcanic eruptions and landslide.

he International Search and Rescue Satellite System (COSPS-SARSAT) is an international search and rescue system based on receivers on board meteorological satellites that relay signals from transmitters activated in distress situations to a network of ground stations. The signals are processed to determine the geographical location of the transmitter. Since 1982, COSPAS-SARSAT has saved the lives of over 10,000 people worldwide. Canada, France, India, Russia and USA provide the space segment for the system.

In the applications in management of resources, satellite remote sensing offers several advantages over airborne and ground surveys, such as the lower cost of data acquisition, the speed and relative ease of obtaining satellite images and high frequency of coverage, strengthened by the recent advent of high-resolution remote sensing satellites. Satellite remote sensing combined with GIS are widely applied to the updating of topographic and thematic maps, geological survey, agriculture, drought monitoring and prediction, marine pollution, the rate of forest resources due to commercial logging, shifting cultivation, forest fires etc., coastal/oceanographic resources, water resources, ground water, land use and so on.

In the applications in disease control and health services, data from remote sensing satellites, in combination with other information, have been used successfully to monitor the environmental preconditions for the emergence and outbreak of infectious diseases. The World Health Organization (WHO) and the World Bank are conducting activities to establish relationships between environmental parameters that can be sensed by satellites, such as water, temperature and vegetation cover, the occurrence of disease vectors (e.g. mosquitoes ticks and flies), disease reservoirs (e.g. deer and rodents) and patterns of human settlements, migration and land use. Based on these relationships, predictive models can be developed to aid public efforts to control specific diseases.

Telemedicine applications are increasingly used in emergence and disaster situations involving health hazards. WHO uses mobile satellite communications for epidemic control, most notably in Africa, as part of its rapid epidemic response kit to combat diseases such as river blindness or fast-spreading health hazards such as Ebola. Slow-scan video communications for medical consultations are also possible via moderate-speed satellite data link.

c. Issues

Key issues are as follows

(1)Standardization of reception hardware and data processing software,

(2)Satellite data availability to all countries at lower cost and in a timely manner,

(3)Technology transfer of proper interpretation and analysis of satellite data,

(4)Final use by policy and decision makers of the information derived from satellite data,

(5)The continuing availability of satellite data on an operational basis,

(6)The coordination of ongoing international efforts on global change studies, and

(7)Timely release of data and services offered by space assets for disaster management.

d. Specific action programs

(1)Support for the effort of the Integrated Global Observing Strategy (IGOS) Partnership to achieve a coherent articulation of the requirements for data from Earth observation systems and to stimulate the coordinated development and integration of remote sensing and in situ data collection systems, should be encouraged, Special attention should be given to strengthening the potential of developing countries in research, operationalization, data collection and analysis and application to dill critical gaps in global datasets and their utilization to increase local knowledge of changes in and pressures on environmental resources. As observing systems for environmental data collection prove their usefulness, Governments are encouraged to support the transition from research and development programs to operational environmental observing programs with appropriate institutional arrangements and budgetary support.

(2)As one of the steps towards an integrated global strategy, the UN should support initiatives such as those of CEOS (Committee on Earth Observation Satellite) and DLR (German Aerospace Centre) to develop a CEOS information locator system on the Internet, which uses in developing countries could use to find information about Earth observation data.

(3)The Office of Outer Space Affairs (OOSA), in cooperation with relevant departments of the UN system, the specialized agencies, space agencies, authorities responsible for national receiving stations and value-added companies, should initiate a programme to promote the use of Earth observation data for planning and managing programmes and projects by user institutions in developing countries A needs assessment should be conducted by the OOSA and its partners to identify the type and coverage of satellite images required by each participating project.

(4)Through international cooperation, developed countries should employ their best efforts to transfer to the developing countries the necessary knowledge and skills of their citizens in different aspects of space science and technology, in particular through their participation in the design, development and fabrication of small satellites, with a view to gaining an understanding of the technology and subsequent use of such small satellites for various socio-economic activities.

(5)The international community should initiate a comprehensive programme to promote the use of satellite communications and Earth observation data for disaster management by civil protection authorities, is particular in developing countries.

(6)The International Decade for Natural Disaster Reduction (IDNDR) should be renewed for a new decade (2000-2010) so as to reduce and mitigate the effects of natural disasters throughout the world, in particular in developing countries. The advantages and disadvantages of different pricing models should be explored and assessed against the opportunities to use Earth observation data for specific applications, including disaster management and global observations.

(7)Assessments are required continuously to guide rational and effective decision-making for environmental, health, social and economic policy formulation, implementation and evaluation at the local, national, regional and global levels. To improve the global capability for keeping the environment under continuous review, national and international action is required in the following fields:

- Investment in new and better data collections;
- Enhanced capabilities for integrated assessment and forecasting and analysis of the environmental impact of alternative policy
- options;
- Better translation of scientific results into a format readily useable by policy makers and the general public;
- Development of training courses and workshops for scientists from developing countries on the use of satellite data for monitoring
- the environment and modeling change.

(8)To reach its full potential for operational applications is terrestrial, environmental and disaster monitoring, satellite remote sensing must ensure the high revisiting rate needed for applications in support of sustainable development. The coordination in order to ensure a high revisit capability is encouraged and facilitated through CEOS in collaborations with the OOSA, relevant non-governmental organization and the industry.

(9)Through the UN Programme on Space Applications, the OOSA should increase the awareness of policy and decision makers, scientists and the general public concerned with the protection of the environment and establish a comprehensive list of distributors of data from Earth observation satellites, as well as of analyzed information, including models used, and make same available to Member States.

(10)An appropriate mechanism should be evolved for synergistic cooperation and coordination between COPUOS, UNEP, the Global Environmental Facility, FAO, UNESCO, WMO and WHO, in particular on critical issues such as global warming, climate change, human health problems and sustainable development and with CEOS on the coordination of satellite missions.

3. Navigation and Positioning/Location Using Satellite

a. Summary

There are currently two global navigation satellite systems (GNSS), the Global Positioning System (GPS) of USA and the Global Navigation Satellite System (GLONASS) of Russia. The use of transmitted signals to determine position, velocity and time from these military systems has been offered free of charge to civilian users. The services are used largely in the field of transportation and surveying, but new applications, such as in meteorology and global satellite navigation, telecommunications timing and GIS, have emerged. With a view to further developing the capabilities of such systems,

USA is embarking on a major enhancement of GPS as well as implementing the Wide Area Augmentation System (WAAS), Europe is implementing the European Geostationary Navigation Overlay System (EGNOS), and Japan is implementing the Multi-functional Transport-Satellite-based Satellite Augmentation System (MSAS). For Europe, the next stage will be a second-generation global navigation system, Galileo, which is its initial definition phase. International acceptance of such systems for navigation and other civil applications purposes open access and continuity for civilian use and the enhancement of the system through overlay or argumentation.

b. Status

GPS receivers have been miniaturized and their costs drastically reduced, making the technology more accessible. GPS technology has matured into a resource that goes far beyond its original design goals of enabling more accurate long distance navigation. GPS receivers are now used by scientists, sportsmen, farmers, soldiers, pilots, surveyors, hikers, delivery drivers, sailors, dispatchers, lumberjacks, firefighters and the people in other professions. GPS equipment is being built into cars, boats, planes, construction equipment, film-making gears, farm machinery and even laptop computers.

Currently, civilian users of GPS who need accuracy greater than that provided by the single-frequency Standard Positioning Service (SPS) use dual-frequency semi-codeless receivers as well as differential technique involving GPS and radio transmissions from a known reference base station. However, as the GPS enhancement programme progresses, users will have free use of three signals with similar code structure. With a total of three signals available for civilian use in the future, GPS services will provide more accuracy by allowing easier corrections for atmospheric distortion, greater robustness by protecting against the effects of narrow-band interference, and easier use by allowing more rapid receiver acquisition of signals from the available satellites.

In addition, USA, Japan and Europe will install navigation payloads on geostationary satellites to provide integrity information as well as correction factors that will aid single-frequency users.

Galileo, a civilian system developed through the initiative of the EU and ESA is intended for use in many declines, from agriculture to transportation, and will meet civil aviation requirements for all phases of flight, from en route to precision approach and landing-the strictest of all satellite navigation user requirements. Benefits of more accurate positioning information for civilian include a reduction in the number of accidents, better navigation in all weather conditions and better traffic management.

c. Issues and Concerns

Key issued and concerns are as follows

(1)With the availability of high resolution images from satellites, precision of locations is required to sub-meter levels. Establishing user-friendly, precise transformation and linkage between the images, GNSS observation and their input to GIS databases will be a critical need in the coming years.

(2)A major technical issue associated with the use of GNSS is the fact that cross-correlation between the data that GNSS employs to national data would require the establishment of a geodetic network based on GNSS observations. A key to lowering the cost of implementing these data bases is adaptation of common world standards for GIS that enable quick and easily translation of GNSS observation into national map databases.

(3)The performance of GPS and GLONASS does not meet all requirements of civilian aviation in all countries and needs to be enhanced through the implementation, such as EGNOS.

(4)A number of questions also need to be addressed before a new type of navigation satellite system can be deployed on a global or regional basis.

d. Specific Action Programmes

(1)The radio bands in which all GNSS operate should be kept free of interference from other radio transmission that could degrade performance of GNSS user requirement.

(2)A large degree of regional and global cooperation is essential to achieving a seamless multi-model satellite-based radio navigation and positioning system throughout the world, for an example in the initiative of European entities for EGNOS and Galileo.

(3)Countries interested in using signals from GNSS should indicate their support for keeping the spectrum free from interference or reallocation by commercial interests.

(4)To ensure global civilian safety, countries operating GNSS should commit themselves to not intentionally switching off the navigation signals in use or reducing the quality of those signals.

In defining the terms of access of global navigation satellite signals, due consideration should be given to the provision of a continuous basic service to global civilian users on a free of charge basis.

4. Spin-Offs and Commercial Benefits from Remote Sensinf and Navigation/Positioning

a. Summary

Products and services derived from space technology have improved the quality of life all over the world in countless ways. Space research and development promotes and incorporates innovations in many high-technology areas, such as computer software and hardware, advanced electronics and materials, telecommunications, health sciences, remote sensing, launch services and satellite manufacturing. Other major benefits from space technology investments and spin-offs include transportation, environmental monitoring, and public safety and computer information sectors, including various aspects of sustainable development.

Space agencies are increasingly entering into partnerships with the private sector for the attainment of their programme objectives. Furthermore, commercial firms have become the primary investors in certain parts of space market, such as satellite communications. Next to telecommunications, remote sensing, launch services and GIS may be among the most significant areas for commercial space activities. Directly and indirectly, space technology is now used by thousands of companies worldwide to bring new products, processes and services to the world market and at ever lower, more affordable prices.

For developing countries, relevant space-related technologies can be used to address social and economic problems effectively. However, a number of significant barriers to the transfer of such technologies and would need to be surmounted in order for those countries to take full advantage of the benefits that could result from them.

b. Status

Products and services derived directly from space technology as well as in directly from the large number of its spin-offs contribute in many ways to improving the quality of society. Some benefits are provided directly by the technology, as in the case of telemedecine, tele-education and emergency communications. Other benefits are found in thousands of spin-off products that have resulted from the application of space-derived technology and are used in such fields as human resource development, environmental monitoring and natural resources management, public health, medicine and public safety, telecommunications, computer and information technology and transportation.

The commercialization of some space activities has been a highly positive development. Next to telecommunications, remote sensing and GIS as well as satellite multi-media maybe among the most significant commercial applications. With the launch of 20 new remote sensing satellites expected by the year 2002, data collection capabilities will increase considerably. The new systems will provide users with higher spectral and spatial resolutions.

GIS will become an essential tool for analysing data as well as presenting information for market and geopolitical analysis and for diverse applications such as environmental studies and disaster management planning. It is projected that the GIS market could reach approximately 5 billion US dollars in sales by the year 2000.

In 1997, the various segment of the yearly worldwide civil Earth observation market have been estimated as follows:

$580~620 million for meteorological and remote sensing spacecraft
$230~250 million for satellite launches
$ 60 million for sales of raw data
$280~300 million for terrestrial equipment for receiving, storing and processing satellite data
$830~850 million for data distribution, processing and interpretation services and value-added products and services

Within the net 10 years, depending on the development of some promising market segments (such as real estate, utilities, legal services, insurance, precision farming and telecommunications), the market is expected to grow by a factor of three to five.

Since 1993, the market of GPS equipment alone has gone from about 0.5 billion to 2.0 billion US dollars in 2000. Civil ground applications, already at almost 90 percent of the total market will keep increasing (automotive navigation systems, geodesy, GIS, precision engineering and emerging fields such as precision agriculture). The success is due to the dramatic increase in accuracy of GPS and to the steep drop in price of equipment.

The development of small and mini-satellite technology has the potential to offer many countries great possibilities for affordable access through the rapid development of fully integrated national space programme. Until recently, space missions required very complex satellites, developed at high cost, that could only be undertaken by large space agencies. However, the initialization of components and the use of nano-technologies in space missions, such as those used in small satellites, offer quick and affordable access to space to countries with small space budgets. Such national mini-satellite space programmes can lead to the creation of new industries and actually improve opportunities for transfer of knowledge both locally and internationally.

c. Issues and Concerns

Key issues and concerns are as follows

(1)The cost of developing the basis space infrastructure must be reduced for the commercialization of the potential market for manufacturing in space.

(2)The availability of appropriate methods and infrastructures as well as clearly defined government policy and support are required for the successful transfer of space-related technologies and spin-offs from research and development institutions to industry.

(3)In sufficient global access to the technology related to acquiring environmental data and information is a major concern for the improvement of policy planning and environmental management.

(4)Technology transfer from “space-faring” countries to developing countries would contribute to the direction of civil space technology development.

(5)Favorable international and national environments including human resources development, infrastructure and institutional arrangements and policy framework need to be created to enable space technology applications in developing countries, particularly through the transfer of small satellite technology.

(6)Current mechanisms for fostering South-South cooperation in technology development and transfer are insufficient.

(7)Problems experience by developing countries in the area of space technology exchange and spin-offs are summarized as follows;

- imited access to information
- low number of specialized training centres
- less efficient national technology transfer infra-structure
- lack of qualified suppliers
- insufficient funding and investment opportunities
- incompatibility of national legislation on transfer of technology between recipients and donors
- insufficient effective international cooperation and collaboration

d. Specific Action Programs

(1)International cooperation mechanism should be developed for the space technology transfer, through the training programs based on small satellites.

(2)The benefits derived from space through the commercial use of space technology application should be expanded from developed and technologically advanced developing countries to less developed countries.

(3)The proper legal frameworks and international agreements being developed by the UN, covering such issues as intellectual property rights, trademarks, copyright and foreign licensing are essential for fostering international cooperation in the area of space technology transfer and spin-offs.

(4)The regional centres for space science and technology education and relevant existing national institutions should organize specific training programs to contribute to the building of regional and local expertise and ultimately to the success of know-how and technology transfer.

(5)Each country should create conditions conducive for the investments for the success of the development of space-related activities and technology transfer projects.

(6)The OOSA should expand the technology outreach programme on space for university educators (TOPS) in developing countries corporate relevant aspects of space technology into the curricula of their institutions. “Seed” financial support (not exceeding $10,000 per grant) should be provided for the local implementation of practical activities. The estimated annual cost of TOPS to Member States, through the UN would be approximately $200,000 (corresponding to 20 awards of $10,000).

(7)The OOSA should assist developing countries in obtaining funding for project proposals arising from its training courses and workshops for sustainable use and development of space technology at the local level.

5. The Space Millenium : Vienna Declaration on Space and Human Development

The Vienna Declaration adopted by Unispace Iii includes the following relevant actions with respect to remote sensing and navigation/positioning.

I. Protecting the Earth’s environment and managing its resources

(a)To develop a comprehensive, worldwide, environmental monitoring strategy for long-term global observations by building on existing space and ground capabilities, through the coordination of the activities of various entities and organizations involved in such efforts;

(b)To improve the management of the Earth’s natural resources by increasing and facilitating the research and operational use of remote sensing data, enhancing the coordination of remote sensing systems, and increasing access to, and affordability of, imagery;

(c)To develop and implement the Integrated Global Observation Strategy (IGOS) so as to enable access to and the use of space-based and other Earth observation data;

(d)expanding international cooperation in the field of meteorological satellite applications;

(e)To ensure, to the extent possible, that all space activities, in particular those which may have harmful effects on the local and global environment. Are carried out in a manner that limits such effects, and to take appropriate measures to achieve that objectives;

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II. Using space applications for human security, development and welfare

(a)To improve public health services by expanding and coordinating space-based services for tele-medicine and for controlling infections diseases;

(b)To implement an integrated, global system, especially through international cooperation, to manage natural disaster mitigation, relied and prevention efforts, especially of an international nature, through Earth observation, communications and other space-based services, making maximum use of existing capabilities and filling gaps in worldwide satellite coverage;

(c)To promote literacy and enhance rural education by improving and coordinating educational programmes and satellite-related infrastructure;

(d)To improve knowledge-sharing by giving more importance to the promotion of universal access to space-based communications services and by devising efficient policies, infrastructures, standards and applications development projects;

(e)To improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of universal access to and compatibility of space-based navigation and positioning systems;

(f)To assist States, especially developing countries, in applying the results of space research with a view to promoting the sustainable development of all peoples.

6. Conclusions

Unispace Iii was an epoch making conference after the cold war was ceased. The highlight was that international recognition and agreement on space-based technology are fostered with a focus on global access, technology transfer to developing countries, spin-offs and commercial benefits.

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