Informal Report(Working Paper) on the United Nations/Turkey/European Space Agency Workshop on Space Technology Applications for Socio-Economic Benefits

(Istanbul, Turkey, from 14 to 17 September 2010)

Contents

I. Introduction

1. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), in particular through its resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development"[1] recommended that activities of the United Nations Programme on Space Applications should promote collaborative participation among Member States at the regional and international levels, emphasizing the development of knowledge and skills in developing countries.[2]

2. At its fifty-second session, in 2009, the Committee on the Peaceful Uses of Outer Space endorsed the programme of workshops, training courses, symposiums and conferences of the Programme on Space Applications for 2010[3]. Subsequently, the General Assembly, in its resolution 64/86 endorsed the activities to be carried out under the auspices of the United Nations Programme on Space Applications in 2010.

3. Pursuant to General Assembly resolution 64/86 and in accordance with the recommendations of UNISPACE III, the United Nations/Turkey/European Space Agency Workshop on "Space Technology Applications for Socio-Economic Benefits" was held in Istanbul, Turkey, from 14 to 17 September 2010.

4. The Workshop was organized by the Office for Outer Space Affairs of the Secretariat, as part of the activities of the United Nations Programme on Space Applications in 2010, and hosted by the Scientific and Technological Research Council of Turkey (TUBITAK) on behalf of the Government of Turkey in cooperation with the International Society for Photogrammetry and Remote Sensing (ISPRS) and the National Aeronautics and Space Administration (NASA) of the United States of America. The Workshop was co-sponsored by the European Space Agency (ESA).

5. The present report describes the background to and objectives of the Workshop and provides a summary of the presentations and observations made by the Workshop participants. The report is prepared pursuant to General Assembly resolution 64/86.[4] It has been prepared for submission to the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space at its forty-eighth session, in February 2011.

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[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

[2] Ibid., chap. II, para. 409 (d) (i).

[3] Official Records of the General Assembly, Sixty-fourth Session, Supplement No. 20 (A/64/20), para. 82.

[4] Resolution 64/86 of 10 December 2009, para. 17, and *Official Records of the General Assembly, Sixty-second Session, Supplement No. 20* (A/62/20), para. 82.

A. Background and objectives

6. In its resolution 54/68 of 6 December 1999, the General Assembly endorsed the resolution entitled "The Space Millennium: Vienna Declaration on Space and Human Development",[5] which had been adopted by the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna from 19 to 30 July 1999. UNISPACE III had formulated the Vienna Declaration as a nucleus of a strategy to address future global challenges using space applications. In particular, the Vienna Declaration noted the benefits and applications of space technologies in addressing the challenges to sustainable development, as well as the effectiveness of space instruments for dealing with the challenges posed by matters such as climate change and impact to agricultural development and food security.

7. The implementation of the recommendations contained in the Vienna Declaration could support many of the actions called for in the WSSD Plan of Implementation. In particular, the existing space-based tools could contribute and strengthen the capacities of developing countries, particularly to improve the management of natural resources and environmental monitoring, by increasing and facilitating the use of data acquired from space technologies.

8. The last three decades of the 20th century has witnessed space technology finding increasing application and relevance in daily life, to the point where space applications are an indispensible part of the modern information society. Space-based systems deliver information and services that protect lives and the environment, enhance prosperity and security, and stimulate industrial and economic development.

9. Education, capacity building and space and society initiatives will be pursued to ensure that Member States (or nations) develop the requisite human capital to support national space activities, including the development of space application products and services. The policy also promotes enhanced space awareness at all levels of society as a means to build public understanding of the societal benefits of space technology.

10. It is also necessary to create favourable public perceptions guided towards supporting and raising funds for the sustainable space programmes, to create awareness of space activities and its benefits to society, to ensure the incorporation of space related developments into people's daily lives.

11. The objective of the workshop was to increase the awareness of socio-economic benefits of space technology applications at national, regional and international levels. The participants were provided with examples of socio-economic benefits of space science and technology applications, mainly focusing on satellite remote sensing, satellite communications, GNSS, capacity building, and regional and international cooperation.

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5 Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999 (United Nations publication, Sales No. E.00.I.3), chap. I, resolution 1.

12. The Workshop aimed to contribute to international cooperation by providing opportunity to exchange updated information on space technology applications for socio-economic benefits.

13. The Workshop had the following specific objectives:

a) To promote ongoing relevant national, regional and global initiatives related to demonstrated capabilities and applications of space technology as a means of providing specific solutions to address socio-economic benefits and sustainable development;

b) To promote international cooperation in space technology development and its applications between and among countries at all levels of development, with a particular focus on supporting developing countries through capacity-building activities;

c) To explore socio-economic benefits of using satellite remote sensing (including InSAR), satellite communications, and GNSS;

d) To strengthen regional awareness, information and data exchange networks on the use of space technology;

e) To discuss the means, mediums and tools to create awareness among the public, to outreach to the public, and to promote and attract public support about space programmes, space activities, and space technologies;

f) To initiate pilot projects for joint work at the regional and international level;

g) To develop ideas on space technology and infrastructure for research applications, education, industry, space-based and ground-based space facilities and the establishment of space culture within the society.

B. Programme

14. The opening ceremony of the workshop included introductory and welcoming statements by the Vice President of the Scientific and Technological Research Council of Turkey, the President of the International Society for Photogrammetry and Remote Sensing, the representative of NASA, and representatives of the Office for Outer Space Affairs.

15. The Workshop consisted of a keynote session, six thematic plenary sessions, including a panel discussion, and working group sessions. The keynote addresses were made by the Director of the Earth Data Analysis Center of the University of New Mexico on "*Reflections on a career of science & technology applications from space: 1972-2011*", the President of ISPRS on "*Value of monitoring our Home Planet (from air and space)*", and the Director of the Innovative Partnership Programme of NASA on "T*he socio-economic benefits of space technology applications and spinoffs*".

16. The programme of the Workshop included a series of technical presentations of successful applications of space technology-based tools that provide cost-

effective solutions or essential information for planning and implementing programmes or projects for socio-economic benefits.

17. There were six plenary sessions, at which presentations were given on the following: (i) capacity building in space technology; (ii) remote sensing applications to urban climate, air quality and transportation; on regional climate, water resources and agriculture productivity; and sustainable global development: data, models and the role of public-private sector partnerships; (iii) remote sensing applications for disaster management; (iv) GNSS applications and satellite communications; (v) recent developments in space science and technology; and (vi) regional and international cooperation.

18. Sufficient time was set aside for presentations by participants on their relevant activities and for discussions among participants to identify the priority areas of possible follow-up actions as well as for examining possible partnerships that could be established or strengthened. Two working group sessions were conducted during the Workshop.

19. Workshop participants and the co-sponsors were asked to prepare short presentations on their professional work related to the workshop. These presentations were delivered as an integral part of the workshop programme.

20. The Workshop was conducted in English. A total of 58 presentations were delivered by invited speakers from both developing and industrialized countries and comprehensive discussion sessions were held at the conclusion of each presentation session.

C. Attendance

21. A total of 120 participants from the following 25 countries attended the Workshop: Argentina, Azerbaijan, Bulgaria, China, Egypt, Germany, Greece, India, Indonesia, Iran, Kazakhstan, Kenya, Morocco, Myanmar, Nigeria, Russian Federation, Serbia, Sudan, Syria, Thailand, Tunisia, Turkey, Ukraine, United States of America, and Viet Nam. The Office for Outer Space Affairs was also represented.

22. Funds allocated by the United Nations and the co-sponsors were used to defray the cost of air travel, daily subsistence allowance and accommodation of 19 participants. The co-sponsors also provided funds for local organization, facilities, and transportation of participants.

II. Summary of presentations

23. The presentation sessions provided participants with the opportunity to learn how the use of space technology could benefit various areas, such as aviation, maritime and land transportation, urbanization, mapping and surveying, human health, disaster management, environmental monitoring and natural resources management. Throughout the workshop, national and regional success stories were demonstrated and potential applications were explained. The presentation sessions simulated discussion on how countries could benefit from cost-effective means of

achieving sustainable development goals through strengthening many sectors of space technology and its applications.

24. Further information on the Workshop programme, background materials and presentations are available at the website specifically developed for the Workshop[6].

25. In the keynote session, Prof. Stanley Morain, University of New Mexico, USA, stressed the need to 'socialise Earth observation' and said "remote sensing always had social implications, but it took several decades to grow useful change detection datasets and translate the remote sensing lexicon into social science terms". His message to the participants for optimising the usage of space technology for socio-economic benefits was "we need to be altruistic". Prof. Orhan Altan, President, ISPRS, explained the role of ISPRS in aiding the development of space-based technologies around the world, He said "I hope a culture can provide social checks and balances to correct for systemic distortions" in the keynote address that followed. Mr. Douglas Comstock, Director for Innovative Partnerships, NASA, highlighted the ubiquity of space technology with examples from everyday life and urged participants to submit projects and innovative ideas for collaborative work with NASA.

Session 1- Capacity Building in Space Technology

26. In the first session, the participants were introduced to several institutions conducting space-related activities. They had the opportunity to learn the details of space-related projects of many countries. The importance of international cooperation and education was especially pointed out. Moreover, many examples were used to inform participants about education opportunities in the area of space. Participants were informed about capacity-building initiatives. Public awareness was another important subject in the first session. Some recommendations for making the public aware of the space activities were mentioned. It was noted that government bodies as well as private sector contributes to capacity building in space technology by promoting education activities and building technical infrastructure for the space technology.

Session 2- Remote Sensing Applications

27. Participants were informed about the impact of growing urbanization on air quality and climate. Speakers noted that remotely-sensed data can improve the scientific understanding of the environment as well as improving the quality of life. Participants learned about the method of using satellite data to increase agricultural yields. Various presentations were about the applications of satellite technology to climate, the water cycle and the environment. It was addressed that space technology applications may contribute to an overall monitoring strategy that should be a key component of regional water management and international water policy.

28. Participants learned that changes in climate will place an additional strain on lifestyle of the developing countries. It was also pointed that the challenge for the policy-makers, scientists, academicians and business is how to expand economically vibrant and healthier societies around the world with limited resources. Housing, transportation, energy, water resources management, and agriculture policies are

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[6] See www.tubitak.gov.tr/spaceworkshop

inextricably linked with Earth's natural system at various spatial and temporal scales, requiring a "systems" approach to development planning. In addition to exacerbating the damage that natural disasters cause, unplanned socio-economic development poses an avoidable risk to public health and sensitive ecosystems. Successful sustainable development policy requires a strong scientific approach and use of proven technologies. Information was provided about Turkey's capabilities in remote sensing systems with demonstrations at many levels and satellites.

29. The panel discussion addressed that in transferring scientific knowledge to decision makers, scientist should make serious attempts to gain a clear understanding of societal needs. Participants made suggestions for establishing multidisciplinary working groups that could focus on the effort of increasing the use of satellite observations for development planning. It was pointed out that effective coordination between working groups is essential. It was also suggested that working groups should focus on how to transfer scientific knowledge into applications.

Session 3- Remote Sensing Applications

30. Participants were informed about the importance of remote sensing (Earth observation) data in disaster management before, during and after disasters. It was emphasized that convincing decision makers is critical for making positive changes in disaster management.

31. Various presentations were about modelling systems for predictions before disasters, like dust storm predictions, earthquake and tsunami early warning systems. Some presentations were about the monitoring systems during disasters such as flood, earthquake, desertification, drought and forest fire. Participants were also provided an overview about the activities of the International Charter for Space and Major Disasters and UN-SPIDER that are global disaster management and emergency response initiatives.

32. Participants were informed about the increasing of agricultural yield production by using satellite technology.

33. Information was provided about complex models that are used to predict the effect of urbanization, climate and environmental issues on quality of life and participants learned how to benefit from the use of such models. Also it was noted that many nations have advanced in earthquake research using remote sensing technologies.

Session 4 GNSS Applications and Satellite Communications

34. In the sessions that focused on GNSS applications and satellite communications, information was provided on the various areas in which GNSS technology had become a mainstay. The presentations on national programmes and case studies provided an additional opportunity to share experiences on the use of GNSS for agriculture and disaster relief and emergency services. It was noted that the information production of the space system will provide possibility of its use for following main industrial, socio-economic and scientific tasks. Participants were informed that countries which use of their own GNSS technology may wish to actively support the deliberations of the Working Group A of the International

Committee on Global Navigation Satellite Systems (ICG) on compatibility and interoperability.

Session 5- Recent Developments in Space Science and Technology

35. Participants were informed about recent developments and future drifts in space science and technology around the world. The importance of the increase of public awareness by education of the youth and the teachers for future development was emphasized.

Session 6- Regional and International Cooperation

36. In the last session, the participants were informed about several initiatives in regional and international cooperation in the area of space. Several presentations provided detailed information on space activities of different countries with a special emphasis on the international cooperation. The importance of regional cooperation was heavily underlined during the presentations. The capabilities of not only the governmental agencies but also of the industrial sector and the cooperation between these two also emerged as a key element during the session. The presentations aimed to attract attention to the variety of the ongoing international collaboration and to the further need to enhance these relations, especially focusing on the joint problems shared by different countries.

III. Observations and recommendations

37. The workshop provided an opportunity for scientists and engineers from different countries engaged in the use of space technology for the benefit of their communities to share their experiences, and explore opportunities for collaborative research and application studies. While modelling systems play a central role in regulatory planning decisions throughout the industrialized world, their use in developing countries is limited, partly due to non-availability of scientifically credible data and observations. Remotely sensed data from satellite and airborne platforms can provide information that modelling systems require. Use of these remotely sensed observations and computer models can substantially enhance the ability of communities and countries to embark on a more sustainable path to economic development, substantially reducing the cost associated with inadequate planning.

38. The participants proposed the establishment of a number of working groups to facilitate identification of specific application approaches and studies across regions that demonstrate the integration of space science and technology to support decision making for societal benefit. The following seven thematic areas were identified for working group themes:

- Urbanization and transportation,
- Water resources and agriculture,
- Air pollution and energy,
- Disaster management,
- Natural resource management,
- Extraterrestial exploration,

- Positioning, navigation, timing.

Additionally, seven cross-cutting sub-themes were identified:

- Weather and climate,
- Health,
- Uncertainity and risk assessment,
- Economic valuation,
- Education, outreach and communication,
- International space law,
- Satellite development.

A number of individuals and organizations volunteered to chair and co-chair these working groups.

39. During the next several months, working group chairs would solicit information from the space community and decision-makers regarding development challenges facing communities around the world, and specific application approaches that demonstrate integration of space science and technology to support decision making for societal benefit. UNOOSA will disseminate this information to Member states, seeking participation in further workshops, either as a developer of the scientific approach, a practioner, or as a potential beneficiary of this proposed activity. Case-studies that highlight multiple scientific and engineering approaches, employed in different parts of the world, will be discussed in greater detail during future working group sessions.

40. Participants recognized that the website of the Workshop was vital for disseminating information and recommended that TUBITAK and the UNOOSA to further develop it.

41. Participants also recognized the need for additional workshops and training courses that would build upon the results of the current Workshop.

42. The following member states indicated interest to host future Workshops on socio-economic benefits of space technology: China, Egypt, Indonesia, and Viet Nam.

43. Participants expressed their appreciation to the Scientific and Technological Research Council of Turkey for hospitality and organization of the workshop.

44. Participants also expressed their appreciation for the significant support provided by the co-sponsors: Government of Turkey; the United Nations Office for Outer Space Affairs; and the European Space Agency and the co-organizers: ISPRS and NASA.

Working Group on Health

45. **Mission**

The working group will focus on applications of remote sensing and other Earth observing technologies to understand how natural environments contribute to, or trigger, human diseases. One of the areas of interest is identifying Earth observing data that can be used to improve models and to enhance surveillance systems, decision support tools, and early warning systems. The working group will reach out to colleagues in the scientific and engineering communities as well as to health and well-being communities of practice. This mission is supported by companion working groups in ISPRS, International Council for Science (ICSU), International Union of Geological Sciences (IUGS), Group on Earth Observation (GEO), and others as identified.

46. **Terms of Reference**

a) Integrate Earth observations products with enhanced predictive modelling capabilities for early warning and surveillance of environmental factors that impact human health outcomes in cooperation with other international, national, and regional organizations and activities;

b) Build leadership or collaborative roles in appropriate global health initiatives relevant to UNOOSA programmes and objectives;

c) Develop a registry for human health projects and products that use Earth observations technologies;

d) Bridge Earth observing technologies with human health communities including health professionals by organizing technical sessions, workshops, and symposia at appropriate venues.

Working Group on Water Resources and Agriculture: Recommendations

47. The Working Group on Water Resources and Agriculture made several recommendations that are summarised in the following paragraphs. The group will focus on the implementation of these recommendation as well as aiming to increase the cooperation and information exchange on use of space technology applications for water resource management and agriculture.

48. Building of expertise: The number of satellite-based data sets that could be used in water resources management is rapidly increasing. The most important factor in knowledge-based utilization of these data sources is building of expertise in developing countries. This can only be done through education, active involvement and collaborations. Regional centres, such as the UN-affiliated Regional Centres for Space Science and Technology Education, are excellent resources in this regard. Additionally, availability of graduate-degree fellowships for students in developing countries and encouragement and funding of international collaborations/workshops are highly beneficiary. In this way the hydrologist utilizing satellite-based products will be aware of both advantages and limitations of these products.

49. Testing the utility of satellite-based products: Studies are needed that test the utility of satellite-based products in water resources applications. This can be done through regional applications of these products in hydrologic studies. Methods are needed that optimally merge (and correct) satellite-based estimates using other data sources, that assimilate these data sets into models to improve simulation/prediction performance, that focus on scale issues (downscaling/upscaling) to match the scale of these data sets with scales needed for hydrologic studies.

50. Near-realtime availability: Near-real time availability of satellite-based products is critical for timely warning and mitigation of natural and anthropogenic hazards (such as floods, landslides). Therefore algorithms and web-interfaces need to be developed to minimize the latency of these products.

51. Uncertainty: Also relates to paragraphs 48 and 49 above. Quantification of the uncertainty in satellite-based products will be beneficiary for the end-users.

Working Group on Education, Outreach and Communications

52. The importance of education was emphasized during the Workshop and it was recommended that educational programmes should be organized which aims to enhance the curiosity toward space, to develop the knowledge about space, to encourage the participants to do research, and to make them conceive the importance and the contribution of space technologies to daily life. These programmes should adapt to different age groups, especially to primary school age groups. This young generation will definitely have a very positive attitude towards space provided that they are introduced to space in their very early ages.

Working Group on Extraterrestial Exploration

53. Research on settlements on Moon, Mars and other celestial bodies are very active. Research on design, construction, management and maintenance of these settlements is an open ended area with infinite possibilities and with very significant products to be helpful to humankind. To just give an example, one can guess that, automated construction technique which is to be developed for lunar applications, will be very useful on Earth and will probably change completely the conventional construction industry. It is to be stressed again that research done in all these areas will have an important feedback to improve the quality of life on Earth and will have a positive impact on inventions of many new products and processes. Thus, one can say that this kind of research is to be backed by international organizations aiming at peaceful use of outer space and a more developed world with smaller discrepancies among countries and peoples.

Working Group on Urbanization and Transportation

54. Main topics and objectives of integration of space technology into urbanization processes can be elaborated parallel to various issues in urbanization. These issues can be grouped such as demographic, social, economic, environmental, political, administrative, physical, technical-technological issues. For a more practical approach, the above cited issues of urbanization can also be categorized at three scales, namely macro, meso, and micro. The urbanization issues at the macro level denote overall urban policies, strategies for urban development, main decisions on urban management, administration and economic aspects as well as legislation and regulatory decisions that support the aforementioned issues. The meso level denotes main urban functions -such as housing, transportation, commerce, health, education, tourism, industry, history and archeology, social and technical infrastructure, green and recreational facilities-; urban problems on risks, safety, side effects (unexpected/negative) of development strategies; spatial plans, urban management and development plans and programmes as well as administrative organizations and working programmes. The micro level denotes citizen level dynamics and decisions; urban assets such as buildings, urban furniture, services and utilities; neighbourhood living standards and styles; citizen

interests on urban solidarity, safety, community culture, aesthetic development of physical environment, property rights.

55. Remote sensing tools and methods can be used in monitoring, data collecting, analyses of existing conditions, modelling, and future appraisals for urbanization and transportation. In accordance with the urbanization issues categorized at three levels, the following actors can be subject to use of relevant space technologies:

a) At macro level: Urban policy-makers and administrative officers of the central government or decision makers in the upper level of the local government.

b) At meso level: Mayors, district mayors, decision-makers of local authorities, chambers of related business groups, trade associations, academics and scientific researchers, NGOs which work at the urban settlement scale.

c) At micro level: Citizens, relevant technical professionals such as architects, landscape architects, and engineers, construction institutions (public and private), insurance companies, quality control bodies, and community level NGOs.

Working Group on International Space Law

56. The working group mainly aims at increasing the awareness of space law within the space community and addressing legal issues which might hinder the integration of advanced space technologies to the current international legal framework. The working group believes that efficient legal solutions should be sought through a multidisciplinary approach and therefore gives particular importance to communication and cooperation with other working groups. Legal issues concerning space community may relate to a wide range of space technologies from satellite-based applications to extraterrestrial exploration and human space flight. In this regard, the working group will gather information from the space community to identify and focus on the legal issues that require the most immediate attention. In order to find solutions, the working group will analyse related legal instruments and consult legal experts in the field of space law. In this way, the working group aspires to contribute ultimately to the development of an adequate international legal framework for space applications.

IV. International, regional, and national cooperation in making aware the socio-economic benefits of space technology applications

57. In the following, three examples, as elaborated during the Workshop, are provided for three levels of cooperation in making aware the socio-economic benefits of space technology applications: The International Society for Photogrammetry and Remote Sensing for the international level; A Cooperative Model for Earth Observation Capacity Development in the Black Sea Region – SharEARTH for the regional level; and NASA for the national level.

A. An ISPRS Perspective of the Workshop

58. The International Society for Photogrammetry and Remote Sensing is a non-governmental organization devoted to the development of international cooperation for the advancement of photogrammetry and remote sensing and their applications. Founded in 1910 in Vienna, ISPRS is the oldest umbrella organisation in its fields, which can be summarised as “Information from Imagery”. At its last quadrennial Congress in Beijing some of the outcomes of the Congress and previous technical developments are summarised in a “Beijing Declaration” where the society recognizes the importance of imagery to measure and monitor the natural and man-made features on planet Earth and to explore other planets of the solar system, especially after witnessing the important role of photogrammetry, remote sensing and spatial information systems in the rescue operation and damage assessment of the recent devastating natural disasters. This declaration noted especially:

a) Wide applications of Earth observation technologies and tools to the fields of socio-economic sustainable development, such as natural disaster reduction and mitigation, environmental monitoring, maintenance of biodiversity, cultural heritage conservation, global and climate change monitoring, energy exploration and management, land use and land cover inventory, food security, sustainable use of water resources, and human living environment and health.

b) Significant technological achievement in the acquisition, processing, interpretation and analysis of aerial and satellite imagery, such as the advances of airborne and terrestrial light detection and ranging (LIDAR), development of synthetic aperture radar (SAR) technology, increased maturity of small satellites and geo-sensor networks, validation, calibration and certification of digital cameras and other types of sensors, automated information extraction from all forms of imagery, distributed data processing for information services, and multidimensional data modeling.

c) Great progress in developing new forms of cooperation and knowledge sharing, such as the Group on Earth Observation (GEO) and its programme to establish a Global Earth Observation System of Systems (GEOSS), and the International Council for Science (ICSU) Geo-unions and its activities in Africa, and Joint Board of Geospatial Information Societies (JBGIS).

59. At the workshop ISPRS was very pleased to witness that the outcome of the “Beijing Declaration” is spreading through meetings at different places in the world and expresses its willingness to be an active partner in further meetings like this. In this context ISPRS announced that during its centenary celebrations in July this year the launch of a booklet produced by the Joint Board of Geospatial Societies (JBGIS), entitled ***'JBGIS Best Practices Booklet on Geo-information for Risk and Disaster Management'*** at the United Nations Office for Outer Space Affairs. ISPRS also led a team of GeoUnion experts in executing an International Council for Science (ICSU) project titled “Mapping GeoUnions to the ICSU Framework for Sustainable Health and Wellbeing: Focus on Sub-Saharan African Cities”. Another ICSU Project involving ISPRS technologies is the Extreme Natural Hazards and Societal Implications (ENHAS). With these efforts ISPRS wishes to contribute to answering the question: “*What technologies and methodologies are required to*

assess the vulnerability of people and places to hazards - and how might these be used at a variety of spatial scales?"

B. A Cooperative Model for Earth Observation Capacity Development in the Black Sea Region – SharEARTH

60. The Earth's global environmental system on land and in the oceans and atmosphere are constantly changing. The changes create unpredictable impacts and implications at local, regional and global scales. An effective management of these changes in both its natural and human aspects requires better understanding of the Earth system, on which we all live. The Black Sea environment, home to hundreds of millions of inhabitants, and subject to rapid change in all of its socio-economic, demographic, geophysical parameters, is becoming increasingly difficult to manage, without the effective use of Earth observation (EO) at the international level.

61. Multi-sector, multi-disciplinary regional collaboration is the key element for better management of the data, harmonizing policies and measures and operational achievements arising from the synergy of the joint actions in the region, which also would ensure better analysis of the regional Earth system functioning. This initiative is basically focused on establishing a Black Sea Basin framework for setting up observing systems, data harmonization, transmission, sharing, integration and information management so as to provide users with up to date data, information and knowledge of good quality. In order to optimize the Black sea countries' contribution to the GEOSS, the project will take advantage of the gathering of the existing networks of observations.

62. The project will be implemented as an innovative cooperative model with direct involvement of the participating Black Sea Country stake holders. Buildings on the above mentioned capabilities not only will help to close the gaps in the knowledge about the Black Sea Basin but also will utilize the capabilities and technologies of the next generation of flight missions, Earth observation researches and applications.

63. The project approach is expected to increase i) the synergy between partner countries; ii) the *shared information value* for Earth observation; iii) *the level of science and technology* used in government, research and academic institutions. The complete picture of inputs, outputs, and transformations that take place between system components will emerge as the societal gain from GEO and be better visible to the research community and the general public, leading to better characterization of the system components of the Black Sea Basin.

64. Sharing Earth information is the main idea of this project to overcome these problems that have been outlined up to here. That's why this project is called SharEARTH. The overarching objective of the SharEARTH is to establish a well designed cooperative platform for collaborative EO resources operating in the Black Sea Basin for interested parties. This objective is strategic and will be carried out to avoid duplication of EO capacity building efforts, to create effective collaboration between all stakeholders, to bring the countries on a common line for understanding each other and finally to improve the effectiveness of decision making processes. SharEARTH is an attempt to turn the disadvantage of "too much information and

complexity” into “pertinent and actionable information and simplicity” in an equally shared collaborative platform.

65. The main strategy of this project proposal is to develop a problem solving and result acting methodology for a successful implementation of EO Information Systems for GEO Societal Benefit areas and further for improving the capacities and capabilities in the Black Sea Region. The research project will be performed by succession of four phases in general. The needs and good practices will be identified during phase 1. Phase 2 focusing on real world practices on the Black Sea Basin to improve both national and regional research capacities of the existing initiatives. Phase 3 is designed to develop appropriate technical and innovative tools to contribute GEO capacity building strategy. Black Sea GEO information system based on GEO Portal will be developed to disseminate relevant information to communities. Phase 4 is addressing institutional matters and proposing to establish a cooperative platform under a suitable partnership for effective collaboration and long term based mechanism among the countries located in the Black Sea Basin.

66. Main goal is to facilitate EO activities and to exchange experiences and information. This activity is critical to sustain developments regarding EO systems in the Black Sea Basin. This effort will be composed of multi-cultural, multi-disciplinary and multi-sectoral levels aiming to connect all related organizations, and will be fully integrated in a coordinated manner. The anticipated result that remains after all of these efforts should be the availability of EO to everyone at the click of mouse, with a shared experience of interpreting and using rich information resources for the good of society. The project will provide numerous advantages to a wide range of end-users such as: government policy makers and institutions using decision support systems, local governments (such as municipalities), citizens, non-governmental agencies, security units (such as police, fire departments), and academic society that requires updated information.

C. National Cooperation in Space Technology Applications

Spin-offs of Space Technology: NASA’s Perspective

67. NASA has a long history of producing public benefits from the knowledge gained by its pursuit of advances in aeronautics and space and its scientific research of Earth and its environment. These benefits, some created as a direct result of NASA’s programme and some known as spin-offs, contribute to many industrial sectors including: health and medicine; transportation; public safety; consumer, home recreation; environmental and agricultural resources; computer technology; and industrial productivity. While benefits from NASA’s programmes are often focused on the United States, many have spanned the globe, including numerous applications that are providing vital benefits to developing countries. Such benefits include the following areas:

- Clean drinking water;
- Improved agriculture and food distribution;
- Telemedicine and wireless networks;
- Environmental monitoring and management;
- Disaster warning and relief;
- Educational resources;

- Energy storage;
- Hazard reduction.

A few brief examples of these applications and benefits are summarized below.

68. As NASA explores space, numerous technologies are needed to ensure astronauts are safe and productive. Many of these same technologies have been applied to address challenges in developing countries.

69. Ensuring a supply of clean water on-orbit is critical for safe operations of the Space Shuttle and the International Space Station. To address this technology challenge for NASA, the Microbial Check Valve (MCV) was developed and has been used on every Space Shuttle mission, to prevent growth of pathogens in the crew's drinking water supply. This technology is now also the basis for water purification systems currently deployed in rural areas and developing countries around the world.

70. NASA conducts research on plant growth and food safety for space missions. Increased crop yield, disease resistance, and food preservation are key challenges facing farmers in developing countries. NASA research has yielded growth chambers that help crops resist disease and increase yield, and ethylene reduction systems that helps farmers avoid rotted crops by extending the time to market.

71. For space exploration, NASA needs technologies for remote delivery of medical care – or telemedicine – for long-duration spaceflight missions. Remote and developing regions have limited infrastructure and benefit from space telemedicine technology. One example is in Ethiopia, with a network for communicating public health information from 126 remote medical clinics to 5 corresponding hospitals. Telemedicine networks are also being used in Vietnam, Thailand and Iraq to improve public health monitoring.

72. NASA needs advanced energy storage method for long-term space flights. NASA technology led to development of an iron-chromium hybrid flow battery and new "power-station-in-a-box" products for village electrification, combining solar and wind generation sources.

73. NASA also looks back at Earth from space to advance the scientific understanding of Earth's system and to improve prediction of climate, weather, and natural hazards. Knowledge and data from Earth science research are yielding numerous benefits around the world.

74. NASA has a network of Earth observing spacecraft with many applications, such as: Famine Early Warning Systems Network (FEWS NET) in Africa, providing early warning on emerging food security issues; and the South Asia Drought Monitor (SADM) supplying timely information on drought onset, progression and areal extent.

75. NASA is helping countries of Central America and Africa with SERVIR, a satellite visualization system that monitors weather and climate. SERVIR helps these countries track and combat wildfires, improve land use and agricultural practices, address disease outbreaks, biodiversity and climate change, and respond faster to natural disasters.

76. NASA technologies are also being applied to disaster warning and relief. Conventional tsunami warning systems can result in false tsunami alarms with

negative societal and economic effects. Researchers at NASA's Jet Propulsion Laboratory have developed GPS-based methods of prediction leading to more reliable global tsunami warning systems, saving lives and reducing false alarms. Data from NASA spacecraft and NASA research improve the accuracy of forecasts for landfall, track and intensity of hurricanes, and increases the lead-time for warnings for both hurricanes and floods.

Four-year NASA-funded project about the hydrology of Nile River

77. A letter of agreement (LOA) was signed between Johns Hopkins University and Future University (FU), formerly Computer Man College, to implement a four-year NASA-funded project about the hydrology of Nile River on 18 September 2010[7]. The LOA is about the project Nile: Distributed hydrological information for water management in the Nile basin is designed to build capacity for scientifically-informed water management in nations that share the Nile basin. Over the course of the project, scientists at Johns Hopkins University, NASA, United States Department of Agriculture (USDA), and the University of Wisconsin will work with partners in participating countries, in collaboration with Regional Center for Mapping of Resources for Development (RCMRD), Kenya, to develop satellite-based land cover maps, satellite-derived evapotranspiration estimates, and a Land Data Assimilation System (LDAS) customized to match identified information needs.

78. The FU will collaborate for the areas of Sudan which will include among others the access to all observational and simulation data produced during the project, including satellite-derived hydrological estimates, model output, climate analysis, and integrated data assimilation products. In addition, training in working with these datasets and in operation of project Nile models will be provided under this project.

79. Such partnership was an offshoot of the participation of Prof. Pascual, Director of the Space Technology Center, at the Workshop. His counterpart is Dr. Ben Zaitchik, the Principal Investigator of the project and affiliated from the Department of Earth and Planetary Sciences, Johns Hopkins University, Maryland, Baltimore, USA.

[7] http://fusudan.net/fuunew/news.php?id=9&pg=detail