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Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Forty-fourth session
Vienna, 12-23 February 2007
Agenda item 5
Implementation of the recommendations of UNISPACE III

Contribution of the Committee to the work of the United Nations Commission on Sustainable Development for thematic cluster 2008-2009: inputs from member States

In paragraph 7 of its resolution A/RES/59/2, the General Assembly requested the Committee on the Peaceful Uses of Outer Space to examine the contribution that could be made by space science and technology and their applications to one or more of the issues selected by the Commission on Sustainable Development as a thematic cluster and to provide substantive inputs for consideration by the Commission.

At its forty-ninth session the Committee agreed that to contribute to the policy year of the thematic areas of the Commission for the period 2008-2009 member States of the Committee should be invited to provide inputs for the development of a concise document to be transmitted to the Commission.

The annex to this document contains the inputs that were received from member States.

Contents

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Annex

Contribution of the Committee to the work of the United Nations Commission on Sustainable Development for thematic cluster 2008-2009: inputs from member States

I. Ecuador

[Original text: Spanish]

- Agriculture:

Capturing satellite and other sensor images on a periodic and permanent basis has great relevance and use in studies related to agriculture. Below are some of the studies carried out in Ecuador in this field: Monitoring rice crops in the lower basin of the river Guayas using SPOT satellite images; monitoring banana cultivation using Land Remote Sensing (LANDSAT) images; identifying banana-growing areas using airborne multispectral images; high-precision agricultural applications based on the interpretation of high-resolution airborne multispectral images.

- Rural development:

The wide coverage of space by remote sensor products is a positive characteristic which helps investigators and users of the information to produce land use and cover maps as a first step in different applications. For example, at the national level it has now been possible to update these maps to cover the entire country to a scale of 1:250,000 and parts of the country to a scale of 1:50,000. Among other things, these data are used to establish rural land registers which also help to identify the capabilities and limitations of these land zones.

- Earth resources:

Satellites observing natural resources for studies of the Earth segment carry on their platforms a series of optical sensors which are able to record the energy emitted from bodies. The resulting images are used intensively to identify, evaluate and monitor principal natural resources such as land, water and vegetation. Ecuador has used this technology in the following fields: Forest inventories; land cover and use; hydrological studies; hydrothermal sources; and drainage basins.

- Drought:

The occurrence of drought as a consequence of climate change can be detected directly by satellite images and other remote sensor products, or indirectly by monitoring deforestation, soil erosion, reduced precipitation and other natural and man-made processes. Early detection through the use of remote sensing technology allows decisions to be taken to prevent, correct and mitigate the effects of this phenomenon. These activities should be complemented by the use of other technologies, such as geographic information systems, which are compatible with remote sensing data.

- Ministry of Agriculture and Cattle Geographical and Agricultural Information System (SIGAGRO)

The Intergovernmental Committee met under the chairmanship of Ambassador Raimundo González to examine the Quito draft declaration issued by the Fifth Space Conference of the Americas, which had been initially elaborated and analysed at a preparatory meeting in Santiago and on which consultations had also been held in Vienna.

The countries of the region met within the framework of the Fifth Space Conference of the Americas, held from 25 to 28 July 2006 in Quito, Republic of Ecuador, pursuant to the mandate contained in United Nations resolutions 59/116 and 60/99 and in accordance with the commitments undertaken within the framework of the Fourth Space Conference of the Americas.

The countries recognize the contribution made by the space conferences held in Costa Rica in 1990, in Chile in 1993, in Uruguay in 1996 and in Colombia in 2002. Taking account of the different situations obtaining in the different countries, the conferences have helped to improve knowledge and understanding of space sciences, given impetus to cooperation among the countries of the American continent and beyond the region, and benefited member States through an exchange of knowledge and experience in the field of space science and technology. With a view to further progress in those areas, Ecuador was designated as the location of the new headquarters of the Pro Tempore Secretariat of the Fifth Space Conference of the Americas.

Against that background and taking into account the following five main areas of activity – tele-education, telemedicine, the environment, natural disasters and cultural heritage – the Ministry has been actively participating in work relating to natural disasters and the environment and has also incorporated a macro-project on land management in Ecuador (scale 1:250,000), which was submitted jointly with other State institutions. This project was approved within the framework of the Fifth Space Conference of the Americas recently held in Quito from 25 to 28 July 2006.

Furthermore, through the Geographical and Agricultural Information System (SIGAGRO) within the Ministry's mandate, the Ecuadorian Air Force received information at the national level on: Political and administrative divisions, with the following coverage: Provinces; districts; municipalities; road infrastructure; provincial capitals; district capitals; municipal capitals, and on Health, with the following coverage: name (centre, sub-centre, etc.); code; location; and type.

This information was entered in shapefile (SHP) format (digital), and the form relating to the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) is attached in an annex.

II. Italy

[Original text: English]

In accordance with the Italian Aerospace Plan for the period 2006-2008, a considerable part of the budget - around 30% - is dedicated to Earth Observation and the Italian Space Agency will be carrying out a series of relevant pilot projects in the risk management and, eventually, in particular areas of the sustainable

development, based on Earth-Observation "application oriented" satellite data. These projects are dedicated to the management of the emergencies and also committed to monitoring and controlling the environment and territory.

COSMO-SkyMed will provide a relevant contribution to the development of a global integrated Earth observation system and will be able to play an important role in a sustainable development on Earth. The COSMO-SkyMed constellation, being based on a Synthetic Aperture Radar (SAR) sensor, has an all weather day/night imaging capability. SAR penetrates clouds and darkness and is hence capable to acquire images of the Earth's surface in a high operational fashion. Unlike the majority of SAR sensor actually in orbit, COSMO-SkyMed system offers some innovative features, ranging from a multimode sensor (allowing many trade-offs between sensed surface and pixel size, including hundred of kilometres swaths and metric resolutions), to polarimetric and quasisimultaneous acquisition capabilities, to a revisit time as short as 12 hours (thanks to a 4 satellites in a polar orbit constellation), to a very fast acquisition and product delivery service. All these characteristics play a very important role in a sustainable development of Earth, particularly in the following domains.

- **Agriculture**: SAR data have been used to measure increased growing season length in boreal regions as an indicator of global warming; to monitor the extent and frequency of wildfires in boreal regions to better understand the role of biomass burning in the global carbon cycle; to monitor wetlands, which play a key role in greenhouse gas emissions; and to estimate the biomass of several crops. In the latter application it is particularly important the specific sensitivity of Synthetic Aperture Radar to some soil properties, such as roughness and moisture content, as well as their evolution over time. Multi-temporal SAR data offer valuable information to determine at the earliest stage of the crop season, when and where fields are prepared, and later, the phenological crop's status such as flowering, ripening, plant drying and harvesting. As far as the Precise Agriculture discipline concerns, the high operational degree of COSMO-SkyMed image acquisition & production services as well as the allowed size of the ScanSAR images (up to 40000 km2 in just one image) allow to sense in a short time very large Earth regions, allowing the building (and successive use) of accurate maps of agricultural fields.

- **Rural development**: It is widely recognized that important factors affecting the development in rural areas are land use and infrastructures. Accurate land use data at the right spatial resolution is a primary source of information for decision makers. Land use products are generated by earth surface classification methods, which today is an automated process that can gain many benefits by the COSMO-SkyMed images, thanks to the capability of the system to acquire many images of the same earth portion at various times (days, months, years), at different incidence angles, even with a polarimetric and interferometric content. Such features can optimally complement the spectral richness of the multispectral optical sensors. A further advantage of the SAR technology is associated with the automatic urban areas detection algorithms, allowing e.g. the study of the change in the urban vs. rural extension or the analysis of urban-rural linkages (cities serve as input and output markets for the rural sector and are important conduits for the transfer of agricultural technology). Road growth in rural areas is still a key factor for development of such regions. Lack of access to urban markets limits the possibilities for the rural population to sell their surplus to urban consumers and to

benefit from urban amenities. Areas that have limited linkages to the urban sector can become "spatial poverty traps". The SAR sensors can greatly contribute to this topic, since roads typically appear as linear features in radar imagery. While automatic detection of roads from radar imagery has not been completely successful (extracted road networks appears with gaps), semi-automatic methods (e.g using contextual information) have been proposed, some of them even tuned on rural areas.

- Drought: Space technology has made substantial contribution in all the three phases (preparedness, prevention and relief) of drought and flood disaster management. With respect to the large spatial scale data gathered from meteorological satellites, polar orbiting satellites have the advantage of providing much higher resolution imageries, even if at expense of temporal frequency. COSMO-SkyMed high resolution images can hence be used for detailed monitoring, damage assessment and long-term relief management of drought events.

- Desertification: For what concerns the desertification, COSMO-SkyMed has a great potential (due to limited image cost per km2 and high spatial resolution) in the discovery and mapping of water resources, a primary instrument for sustainable water management and weapon for desert fight. Other great advantages of the SAR are due to the possibility to evaluate the soil moisture contents (even in arid regions), to apply to the study of desertification some indirect techniques like the analysis of deforestation and the soil erosion, while the cloud penetrating capability allows the mapping of desertification in semi-arid and sub-humid region.

- Africa: Italy pays special attention in implementing applications of remote sensing data for sustainable development in Africa. Since 1997, the Italian Space Centre 'Luigi Broglio' (BSC) has started remote sensing activity with the acquisition of ERS1 Synthetic Aperture Radar (SAR) images. Situated at a latitude of 3 degrees South and longitude 40 degrees East, by the sea near Malindi-Kenya, it is the only one of its kind in Africa.

The area covered by the receiving antennas dedicated to remote sensing has a radius of about 2000 km for a typical EO satellite altitude (700 Km). This allows the acquisition of satellite images covering all the East and Central African countries including the islands in the Western Indian Ocean region. Satellite imagery regularly acquired at BSC includes the Advanced Very High Resolution Radiometer (AVHRR) sensor onboard of 5 satellites of the NOM family, the Sea viewing Wide Field Sensor (SeaWiFS) on board of SeaStar through an L-band system, and MODIS/Terra and Aqua satellites and SAR/ERS2 satellites through an X-band system. Over 10,000 satellite images have so far been acquired, pre-processed, processed to level 1 and archived. All data available at the BSC, including the satellite imagery, is for free to the Kenyan research community and other governmental agencies. Interested researchers from institutions in the region may access this data through partnership with the local research communities, or seek authorization from the Kenyan Government.

Since a large amount of satellite data very valuable to ocean applications is available at the BSC, cooperation with the Kenya Marine and Fisheries Research Institute (KMFRI) was initiated some years ago. Through this arrangement, KMFRI utilised and may continue accessing data from this centre in testing and validating sea thermo-fronts with chlorophyll biomass information to predict and map potential

fishing zones in the WIO region. Data from the BSC has also been used by other researchers in assessing and determining desertification hot spots in the Northern frontier districts in Kenya through change detection analysis, or in studying and tackling the Lake Victoria water hyacinth issue.

One of the most important applications of NOAA data is probably the estimate of surface temperature of the sea and the land. These parameters have proved useful to the local research community. Monitoring of sea colour (Laneve et al., 2003) and surface temperature change using a combination of AVHRR and SeaWiFS images is suitable to make an assessment of biomass (phytoplankton) and temperature gradients, a combination which is favourable for Tuna and tuna like fish gathering. Such work has been conducted, in the recent past, in conjunction with KMFRI and will be further developed to implement a regular service to the fishing local community. Among the near-future remote sensing applications that Italian Space Agency (ASI) intends to implement at BSC, the Hot-Spot Detection System (HSDS) based on MSG images and devoted to the early detection of wild fires in the region, deserves special mention.

Another promising application regards the detection of oil spill. This will be of great interest to the Kenya Maritime Authority, Kenya Ports Authority and KMFRI. Analysis and characterization of the seasonal behaviour of the atmospheric aerosol thickness over the region is also possible from SeaWiFS images. This would be an application most welcome by the IGAD Climate Prediction and Applications Centre (ICPAC) and the Department of Meteorology School of Physical Sciences of the University of Nairobi (UoN). The Kenyan Government, through the Desert Monitoring Centre (DMC), now ICPAC, addresses the desertification, drought and land degradation problem especially in the northern parts of Kenya and sees the need to integrate all the available data with satellite imagery to identify and monitor its indicators. The selection of the most adequate high resolution satellite data (Landsat TM. SPOT, etc.) to extract land-surface information is essential, hence it is the wish of ASI to expand the satellite reception capabilities to include these and other satellites with high resolution sensors. ASI also intends to expand the image archiving and distributing capabilities and set up GIS facilities.

Low resolution satellite data, e.g. MODIS, AVHRR and other ancillary data (precipitation and temperature data, climatic map, land use map, topographic and soil map, life zone map, vegetation map historical record of drought, etc.), will be useful to develop new prospective and make recommendations for appropriate and effective interventions for sustainable land management in Kenya and for the entire region may need arise. Landslides in Kenya have been increasing in the recent past. Satellite imagery can be used to make an inventory of previous landslides and to collect data on relevant parameters involved such as those involving soil, geology, slope, geomorphology, land use, hydrology, faults, etc. Various local and regional institutions have shown interest to cooperate with the BSC satellite receiving station to utilize and add value to the data available. Currently negotiations are going on with different Kenyan institutions.

In order for the data available at the BSC to be truly valuable, understood and well applied by the community, three courses have so far been organized at the BSC by the University of Rome “La Sapienza” with participants drawn from the local universities, research institutions and government departments. BSC has also made significant contribution towards the cooperation with KMFRI in terms of human

resources capacity building. A number of KMFRI personnel have undergone training courses at the BSC, and also KMFRI has organised a tailor made course on satellite applications specifically for the Western Indian Ocean region. This course was conducted at the BSC premises bringing together oceanographers from the western Indian Ocean region, namely Madagascar, Tanzania, Mauritius, Mozambique and Kenya. The aim of this course was to equip the participants with the necessary theories and practices to enable them to interpret, appreciate and apply satellite remotely sensed data. Students also have the opportunity to have hands-on experience on real time satellite data acquisition. processing and archiving at the BSC. The continuous involvement of Italian Universities at the BSC will guarantee, for the future, adequate training and study cycles, so that students from the region have a platform and environment to develop their thesis, post graduate studies and access to advanced technology and knowledge.

III. Japan

[Original text: English]

- Advanced Land Observing Satellite (ALOS, "Daichi") will be used for precise land coverage observation

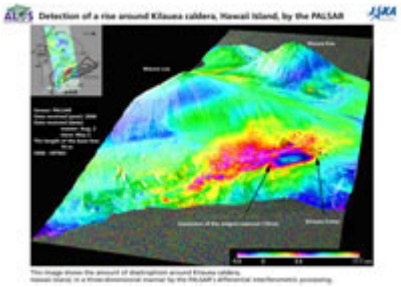
The Advanced Land Observing Satellite (ALOS, "Daichi") has been developed to contribute to the fields of mapping, precise regional land coverage observation, disaster monitoring, and resource surveying. It enhances land observation technologies acquired through the development and operation of its predecessors, the Japanese Earth Resource Satellite-1 (JERS-1) and the Advanced Earth Observing Satellite (ADEOS). Daichi has three sensors: the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM), which is comprised of three sets of optical systems to measure precise land elevation; the Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2), which observes what covers land surfaces; and the Phased Array type L-band Synthetic Aperture Radar (PALSAR), which enables day-and-night and all-weather land observation.

- Daichi will be used not only for cartography, but also for regional and disaster monitoring

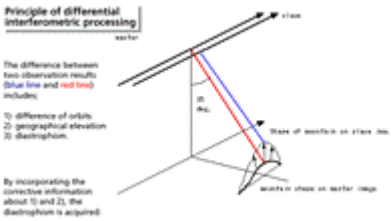
Daichi's remote-sensing equipment enables precise land coverage observation and can collect enough data by itself for mapping on a scale of 25,000 to 1 without relying on points of reference on the ground. It is expected to play an important role in cartography by providing maps of Japan and other countries, including those in the Asia-Pacific region, which is one of Daichi's main objectives. Other objectives include regional observation for harmonization between the environment and development on Earth, domestic and overseas disaster monitoring and resource surveys. Its contributions to the mitigation of environmental destruction and natural disasters will make it an essential satellite for our future. It was launched by the H-IIA launch vehicle No.8 from the Tanegashima Space Center (TNSC) in January 24, 2006. Along with the start of the regular operations, JAXA also started providing observation data to the public on October 24, 2006.

- "Daichi" satellite confirms rise in earth's surface due to magma activities by analyzing PALSAR observation images on Kilauea, Hawaii

According to the "differential interferometric processing" (*) of observation images acquired by the PALSAR onboard the "Daichi" on the south part of Hawaii Island, Hawaii, USA, the five-meter diameter area around the south-west part of the Kilauea volcanic crater rose about 10 cm in three months between May 2 and August 2, 2006, because of the expansion of a magma reservoir.



In the image on the right, the amount of diastrophism is shown in colours. Warm colours show a decrease in the distance between the satellite and the land (rise of land), and cold colours indicate the increase of the distance (subsided land). The caldera area rose by about 10 cm.



GPS receivers are installed around Mount Kilauea, which is an active volcano, and information that supports the rising magma has been acquired over last few months. The observation data by the satellite explained the situation in a two-dimension manner.

http://www.jaxa.jp/missions/projects/sat/eos/alos/img/topics_20061026-bl_e.gif (*) Differential interferometric processing is a technology to extract (interformetrically process) diastrophism (the movement of the earth's crust) by calculating the difference of SRA images observed and acquired from two almost similar orbits and incorporating corrective information such as elevation of the land and distance between the two orbits. (See the left figure) Differential interferometric processing is sensitive to the length of radio frequencies; therefore, it is reported that L-band, whose RF length is longer than that of conventionally used frequencies for SAR, is more suitable for interferometric processing. The observation again proved the excellent performance of the PALSAR, which uses an L-band 23.6 cm in length. This method will be used for detailed disaster analysis in the future.