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United Nations Programme on Space Applications

**Report on the Meeting of the Directors of the Regional
Centres for Space Science and Technology Education,
affiliated to the United Nations**

I. Introduction

A. Background and Objectives

1. In its resolution 69/85, the General Assembly noted with appreciation that the regional centres for space science and technology education, affiliated to the United Nations, continued their education programmes in 2014 and agreed that the regional centres should continue to report on their activities to the Committee on the Peaceful Uses of Outer Space.

2. The Office for Outer Space Affairs organized a meeting of the Directors of the Regional Centres for Space Science and Technology Education, affiliated to the United Nations which was held on the margins of the fifty-seventh session of the Committee on the Peaceful Uses of Outer Space (COPUOS) on 13 June 2014. The directors and representatives of the African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E), the African Regional Centre for Space Science and Technology Education in French (CRASTE-LF), the Regional Centre for Space Science and Technology Education for Latin America and the Caribbean (CRECTEALC), and the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) were present. Representatives of Beihang University also participated in the Meeting as observers. This report contains a summary of the presentations made by the directors of the Regional

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Centres and the representatives of Beihang University as well as the results of the discussions which took place during the Meeting.

B. Programme

3. The programme of the Meeting of the Directors of the Regional Centres consisted of two sessions. The first session was dedicated to the welcoming of the participants and the presentations of the current activities and status of the United Nations Programme on Space Applications along with the presentations concerning the Regional Centres for Space Science and Technology Education, affiliated to the United Nations. During the opening of the Meeting, the importance of the Regional Centres and their role in offering the best possible education, research and application programmes, opportunities and experience for the participants in all its programmes was highlighted.

4. The second session of the Meeting addressed common issues and opportunities for cooperation that the Regional Centres had. In addition, the Office for Outer Space Affairs presented the current status of the education curricula, updates that are envisioned, and the future of space science and technology education as a whole. The Meeting concluded with fruitful discussions on these issues, challenges, experiences and possible solutions to strengthen relationships between the Regional Centres and the Office for Outer Space Affairs. Finally, remarks were made by the Expert on Space Applications to conclude the Meeting.

II. Regional Centres for Space Science and Technology Education, affiliated to the United Nations

A. African Regional Centre for Space Science and Technology Education in the English Language — ARCSSTE-E

5. ARCSSTE-E was inaugurated in November 1998; it is strategically situated on the campus of Obafemi Awolowo University (OAU) in Nigeria and fulfils the requirements of the placement of the United Nations-affiliated Regional Centres in existing national and regional educational institutions in developing countries. Since 1999, the Centre has operated under the administration of the National Space Research and Development Agency (NASRDA) of the Federal Ministry of Science and Technology of Nigeria and it serves as NASRDA's Centre for Space Science and Technology Education (CSSTE).

6. The Centre has 24 Anglophone African State Members that have benefited from the Postgraduate courses offered by ARCSSTE-E. These Member States are: Botswana, Cameroon, Egypt, Ethiopia, Eritrea, Ghana, Kenya, Lesotho, Liberia, Mauritius, Malawi, Mozambique, Nigeria, Namibia, Somalia, Swaziland, Sudan, South Africa, Sierra Leone, Tanzania, Gambia, Uganda, Zambia and Zimbabwe.

7. From 2001 to 2014, ARCSSTE-E offered the following Postgraduate Diploma (PGD) Programmes: Basic Space and Atmospheric Science (BSAS), Remote Sensing and Geographic Information Systems (RS & GIS), Satellite Communications (SATCOM), Satellite Meteorology (SATMET) and Global

Navigation Satellite Systems (GNSS) which commenced in 2014. The selection of participants is based on reviewing the quality of each candidate's academic qualifications, work and practical experience, and geographical representation. To encourage international participation, ARCSSTE-E offers a full scholarship to selected participants, and this includes the payment of tuition fees, hostel accommodation, medical services, course and project materials, and a monthly stipend per participant. The Office for Outer Space Affairs contributes toward the payment of travel air tickets for international participants.

8. PGD Programmes are scheduled for a duration of nine months. They are comprised of an orientation programme, a six-month course module that includes lectures, practical sessions and education tours, and a three-month research module in which participants execute individual projects, field work/experience, and seminars. The PGD Programme ends with a graduation ceremony.

9. Some of the major milestones achieved by ARCSSTE-E in the last year include: the commencement of the long-awaited PGD course on GNSS and the commencement of Master's Degree programmes in conjunction with the Federal University of Technology, Akure, Nigeria. Additionally, the Centre reported that it had received the prestigious American Society for Photogrammetry and Remote Sensing (ASPRS) International Literature Award in 2014 in Louisville, Kentucky, United States of America. Moreover, ARCSSTE-E was awarded with one of the 19 clinostats distributed by the Office for Outer Space Affairs in 2013 as part of the Human Space Technology Initiative (HSTI).

10. ARCSSTE-E also has carried out various activities under the Education Outreach Programme nationwide and regionally. For instance, school workshops are delivered at primary, secondary and tertiary institutions. The Centre raises public awareness by celebrating world space week, holding carnivals, and media educational activities through mass media and lectures open to the public. The Centre has launched a Robotics Education Programme (REP) in collaboration with iLab-OAU and ArcLights, a virtual laboratory that enables students to expand the benefits of science by inspiring them to develop their interests in sciences, technology, engineering and mathematics.

11. ARCSSTE-E dedicates its efforts to space research and development. In this respect, the Centre has developed a CanSat programme in which cansats, or satellite simulations, have been launched with water and experimental rockets for outreach and scientific purposes, respectively. The model rocket project involved the development of a small model rocket whose parts were made out of polyvinylchloride (PVC) pipes. The High Altitude Experiment (HALEX) was designed with the purpose of building on the CanSat programme by increasing the life span of the mission through the use of a helium balloon, solar panels and batteries. This aimed to ensure unlimited power and indefinitely transmission.

12. Despite the challenges encountered by the Centre, ARCSSTE-E has carried on its activities in line with the Centre's mandate and has achieved its goals of research and development, PGD programmes and space education outreach. Nevertheless, while these activities have enlightened and empowered the target audience in the region, there is an urgent need to address the constant financial challenges the Centre has experienced throughout the years. The paucity of funds, has drastically

affected the progress of infrastructural development whilst it has also hindered the maximum efficiency in terms of output and delivery.

13. As part of their projections, ARCSSTE-E is looking forward to continuing to offer the GNSS programme because it has proven to be of great importance. The Centre expects to establish a Geonetcast facility which will enable it to acquire satellite imagery for teaching and research purposes in collaboration with the Faculty of Geo-Information Science and Earth Observation (ITC), the University of Twente in the Netherlands. Furthermore, ARCSSTE-E seeks to cooperate with relevant national and international institutions, such as NASRDA, ITC and the Russian Space Agency through the International Committee on Global Navigation Satellite Systems (ICG) for cross-border education, including distance learning within the Anglophone African region.

B. African Regional Centre for Space Science and Technology Education in the French Language — CRASTE-LF

14. CRASTE-LF was established in 1998 and is comprised of 13 Francophone African States: Algeria, Cameroon, Cape Verde, Central African Republic, Côte d'Ivoire, Democratic Republic of Congo, Gabon, Morocco, Mauritania, Niger, Senegal, Togo and Tunisia.

15. CRASTE-LF has the objectives of increasing knowledge in Space Sciences and Technologies by organizing courses, seminars, workshops, and conferences at the regional level while also improving the technical competences of experts, teachers and decision makers. The Centre aims to promote international cooperation between developed countries and State Members as well as among themselves.

16. The Centre has been operating since the year 2000. The main courses and programmes taught at CRASTE-LF include the education curricula for the Regional Centres for Space Science and Technology Education, developed by the Office for Outer Space Affairs, namely: BSAS, RS & GIS, SATCOM, SATMET and Global Climate, and GNSS. Training sessions take place in two phases. Phase I lasts from nine to ten months or three semesters in which theoretical and practical courses, land studies and pilot projects are given on the Centre's premises. During Phase II, students complete their Research Projects at their own educational centres. This phase lasts from nine to 12 months. At the end of Phase II, students are expected to present and defend their theses before Jury Members.

17. Students at the Centre have engaged in different research projects necessary for the preparation of their work to obtain Master's Degree diplomas in Space Sciences and Technologies which have covered topics on mapping, agriculture, geology, water and natural resource management, ecology, forest, desert progress, coast management and migration of populations. Other topics of research projects include communications, image and ground station reception, telemedicine, climate change, desert progress and epidemiology vectors.

18. CRASTE-LF has held a variety of international conferences, workshops and courses in the Francophone African region. These events have tackled relevant topics in the areas of climate change, Earth observation, space weather, space law, GNSS, and disaster management.

19. To date, CRASTE-LF has been responsible for training 287 students from 19 countries, who have pursued postgraduate courses at the Centre. Besides that, the Centre has delivered 82 Master's Degree Diplomas in Space Science and Technology in various fields of expertise. Furthermore, 1,800 experts from over 50 nations worldwide have attended one or more of the different Conferences and Workshops organized by the Centre in any of the Space Technology fields.

20. The Centre has reported that up to 90 per cent of their students return to their home countries where they are able to develop research projects addressing issues at the local level. In many cases, students have generated new activities related to space technology in their countries by providing these courses in local universities. This has helped to create and strengthen a regional Expert Network that aims to substantially contribute to raising awareness of the utility of space technologies for development, particularly in the use of Earth Observation and GIS.

21. CRASTE-LF is projected to continue with the launch of postgraduate Programmes on Space Science and Technology with the options of Remote Sensing and GIS and Satellite Meteorology and Global Climate as well as the option of GNSS. Additionally, the Centre will be organizing workshops on the use of Earth Observation that will be taking place in Senegal, Gabon and Morocco.

C. Regional Centre for Space Science and Technology Education for Latin America and the Caribbean — CRECTEALC

22. CRECTEALC was established in 1997 with operations in Mexico and Brazil. The campus in Mexico commenced its activities in 2002, hosted by the National Institute of Astrophysics, Optics and Electronics (INAOE) in the State of Puebla. The campus in Brazil is hosted by the National Institute for Space Research (INPE). Its goal is to train highly qualified individuals in the field of communications, remote sensing, meteorology, basics sciences and GNSS.

23. Along with other Centres, CRECTEALC shares the objective of expanding knowledge in the various disciplines of space science and technology of Member States and thus increasing their scientific, economic and social development. In addition, the Centre organizes programmes of teaching, research and development of practical applications.

24. CRECTEALC offers postgraduate programmes of nine and 12 months that are supplemented by projects such as the construction and/or integration of nano-satellites, telemedicine and cyber health, inventory system of talent and resources, data mining applied to human environmental history, EO-POWER and NEOs observing network that take place in partnership with Mexican universities.

25. The two campuses provide 12 month courses in two modules and an application project. The first module is on RS and the second one includes GIS and photogrammetry. For the postgraduate programmes of nine months, the Centre offers studies on SATCOM in two modules and an application project.

26. The campus in Mexico has implemented diverse projects for the benefit of its students. With the themes of RS and GIS, the projects include the creation of a tool for generating maps from spatial queries, the implementation of an energy balance model (SEBAL) for determining the daily and monthly evapotranspiration in flat

areas, detection of high-risk areas for floods in southern Mexico, data mining, evaluation of flood hazard in the region and the use of GIS for management and conservation of coastal ecosystems.

27. Furthermore, CRECTEALC has performed many projects related to SATCOM such as the calculation of losses in coaxial lines and rectangular waveguides, antenna design software, development of software for calculating links via satellites, design and performance of a communication system in the 2.4 Ghz band, calculation of satellite links and sensors and telemetry.

28. The Centre has organized a diversity of workshops and courses that have taken place in different Mexican cities and in other countries in the region. These events have been arranged with other international organizations such as the Mesoamerican Centre for Theoretical Physics (MCTP) and the Safe World Foundation (SWF).

29. As for its accomplishments, it was reported that CRECTEALC was accepted as a member of the Committee on the Earth Observation Satellites Working Group on Capacity-Building and Data Democracy (WGCapD) and established contact with other key national and international space entities to support the work of the Group on Earth Observations (GEOSS). Moreover, among its projects, the Centre is working on the development of GNSS by controlling trajectories, rotations and direction of spacecrafts, quad-rotor testing and a space flight simulator.

30. In the near future, CRECTEALC expects to have more countries become Member States of the Centre, to optimize the use of national and regional resources, to participate in the training of human resources at INAOE and other regional institutions as well as to promote the exchange of students, professors and experts between the campuses.

D. Centre for Space Science and Technology Education in Asia and the Pacific — CSSTEAP

31. CSSTEAP was the first regional centre established in New Delhi in November 1995 with the agreement of ten nations. To date, CSSTEAP has 16 Governing Board members and two observers which lead the activities of the Centre. The Governing Board is composed of representatives from the following governments: India, Democratic People's Republic of Korea, Indonesia, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Malaysia, Mongolia, Myanmar, Nauru, Nepal, Philippines, Republic of Korea, Sri Lanka, Thailand and Uzbekistan. The Government of the Netherlands and the United Nations participate as observers in the Governing Board meetings. The headquarters of the Centre is located in Dehradun, India, hosted by the Indian Institute of Remote Sensing (IIRS). CSSTEAP has other operational campuses located in Ahmedabad within the premises of the Space Applications Centre (SAC), the Physical Research Laboratory (PRL). Besides that, the Indian Space Research Organization (ISRO) Satellite Centre (ISAC), Department of Space in Bengaluru also serves as one of the Centre's campuses in India.

32. CSSTEAP actively participated with the Office for Outer Space Affairs in the development of educational curricula that are currently used by all regional centres. The educational programme structure of the Centre is based on the courses they

provide: Remote Sensing and GIS, Satellite Communication, Satellite Meteorology and Global Climate, and Space and Atmospheric Sciences. After completing any of these courses, the Centre awards students with a postgraduate Diploma which could be completed with either a one-year project in each participant's home country or one more year of fellowship studies at the Centre in India. Andhra University recognizes the two years of studies by awarding a Master's Degree diploma to participants.

33. The Centre has developed a number of educational materials which include relevant publications and CDs aiming to support the postgraduate and short courses offered at the Centre. In addition, the Centre has issued several newsletters, memoirs, course reports and general information brochures throughout its existence that have promoted space science and technology education in the region.

34. Among the Centre's overall achievements, CSSTEAP has served 1,360 students from over 50 countries. Of those, 719 have participated in one or more of the postgraduate courses in the Centre. Moreover, a total of 121 students from 15 nations have been awarded with a Master's of Technology degree by Andhra University in India. Selected participants who study at CSSTEAP receive several benefits that include international travel support, accommodations, a digital library, medical facilities, a waiver of tuition fees and other administrative expenses, allowances, English classes, and access to technical and research facilities as well as to field observation stations.

35. Some of the research activities handled by CSSTEAP include those related to RS and GIS, such as advanced RS and data analysis, natural disaster monitoring and management, modelling Earth processes and advanced GIS. Regarding the research activities related to BSAS, the Centre has put efforts in solar physics, astronomy and space weather in which it has studied the solar X-ray impact on the ionosphere, the satellites of various planets, the mesosphere and thermospheric airglow emissions and plasma temperature density as well as research dedicated to studying atmospheric science. In the field of SATCOM, students have developed a variety of communication techniques, Earth station technologies, signal processing and antenna systems. CSSTEAP has carried out SATMET research activities on meteorology, image processing and interpretation, advanced concepts in satellite meteorology and the global climate environment.

36. CSSTEAP relies on the feedback received by its alumni, which has been crucial in continuing with the activities of the Centre. Former students have reported that after the completion of their studies at the Centre, they have increased their efficiency at their workplace by assuming higher responsibilities and managerial roles, developing research projects, and continuing with PhD. programmes in their own countries. Alumni have introduced courses and new teaching methods in their respective countries, collaborating with other organizations at the local and international levels, which have contributed to the overall development in Science and Technology in their countries and in the region. The Centre will continue with its activities and will keep providing postgraduate courses in accordance with the Office for Outer Space Affairs' educational curricula.

III. Observations

37. The Meeting provided the opportunity, for all the directors and representatives of the Regional Centres, to have an open discussion on different issues. It was noted that some Centres experienced challenges regarding their financial situation. New ways of funding need to be implemented in order to improve this situation while also establishing and strengthening relationships among Member States. Nonetheless, it was recognized that the overall support and financial contribution provided by the Office for Outer Space Affairs was crucial for the functioning of the Regional Centres as well as for their scientific training activities.

38. Moreover, the Regional Centres expressed their desire to have expert educators in newly thematic areas such as Space Law so that they could start teaching the respective curriculum in this field. In some Centres, the teaching curricula is part of Master's Degree Programmes. Other Centres expressed their interest in replicating the practice in which students could benefit from the international recognition while obtaining their Masters' and PhD. degrees. The Office for Outer Space Affairs was asked to develop additional topics as part of the programmes offered by the Centres in the thematic area of space engineering, aerodynamics, space craft design, communications, small satellites, volcanic activity, disaster management and flooding. Furthermore, the Regional Centres expressed their interest in the development of new curricula which should be relevant and consistent with the mandate of the Centres.

39. The Regional Centres acknowledged the unique quality of the diplomas issued to students upon the completion of their programmes which echo the authenticity of the Centres, their Member States and their affiliation to the United Nations. The concept of the Regional Centres is still important at the local, regional, and international levels. Overall, the Regional Centres have raised awareness of the usefulness of space science and technology in their respective regions and of their importance for offering the high-level educational programmes, research and application activities, opportunities and experience to students.

IV. Conclusions

40. During the Meeting of the Directors of the Regional Centres, the representative of Beihang International Space Education Centre presented future programmes and activities to be carried out by the upcoming United Nations Regional Centre for Space Science and Technology Education in Asia and the Pacific (China). The Centre is expected to start offering postgraduate courses in 2015.

41. Directors and representatives of the Regional Centres, after presenting and discussing the current status of their Centres, considered common issues and opportunities for mutual collaboration and benefit. At the Meeting, it was decided to strengthen communication among the Regional Centres and between the Regional Centres and the Office for Outer Space Affairs. Moreover, the Regional Centres welcomed the newly developed education curricula on GNSS and space law. Directors and representatives discussed with great interest the development of a new curriculum in relation to basic space technology.