

CAPACITY BUILDING IN SPACE SCIENCE AND TECHNOLOGY: ACHIEVEMENTS OF ARCSSTE-E

By

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Presentation Outline

- **Introduction**
- **Postgraduate Diploma (PGD) Programme**
- **Research and Development (R & D) Activities**
- **Space Education Outreach Programme**
- **Benefits/Spin Offs From The Capacity Building Programme**
- **Conclusions**

1. Introduction

- Benefits of space science and technology (SST) are quite tangible and cannot be over-emphasized.
- Space science and technology development and applications have grown rapidly and become the key to the prosperity and security of nations.
- Rapid achievement of sustainable economic and social development now depends on sound education and research in the development and/or applications of SST
- To assist the developing countries to benefit from the emerging and fast growing technology, the second United Nations Conference on Exploration and Peaceful Uses of Outer Space (UNISPACE II), held in 1982 in Vienna, Austria, recommended that the United Nations Office for Outer Space Affairs (UNOOSA), through its Programme on Space Applications, should focus its attention, inter alia, on the building of indigenous capacities for the development and utilization of SST.
- Consequently, this recommendation was endorsed by the United Nations General Assembly (GA) in its resolution 37/90 of 10th December 1982.



Introduction continued

The United Nations General Assembly, in its resolution 45/72 of 11 December 1990 endorsed the recommendation of the Committee on the Peaceful Uses of Outer Space that

"... the United Nations should lead, with the active support of its specialized agencies and other international organizations, an international effort to establish regional centres for space science and technology education in existing national/regional educational institutions in the developing countries. "





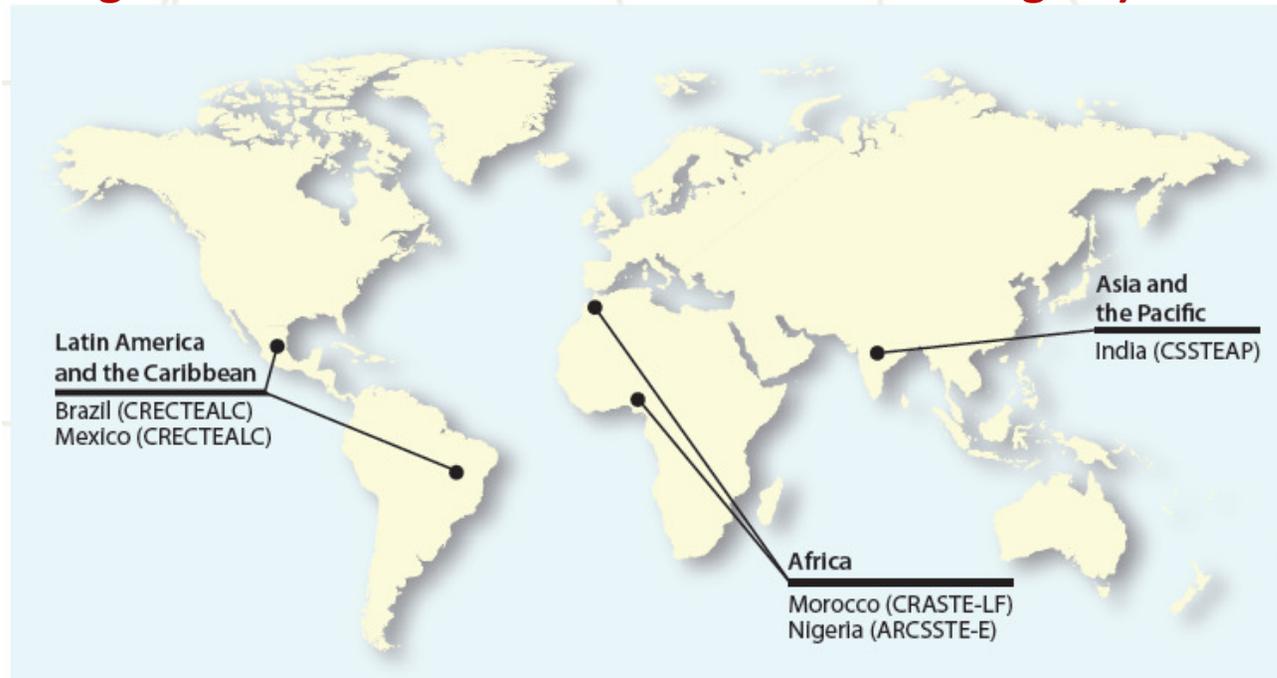
In 1995, the United Nations General Assembly further endorsed the regional centres initiative and in its resolution 50/27 of 6 December, 1995 and recommended that

"... these centres be established on the basis of affiliation to the United Nations as early as possible and that such affiliation would provide the centres with the necessary recognition and would strengthen the possibilities of attracting donors and of establishing academic relationships with national and international space-related institutions."





Locations of the Regional Centres, affiliated to the United Nations are shown. (Two new Centres are being established at Jordan for the Middle East region and China for the North East Asian region)





The goal of the Centres is to develop, through in-depth education, an indigenous capability for research and applications in SST in the core disciplines:

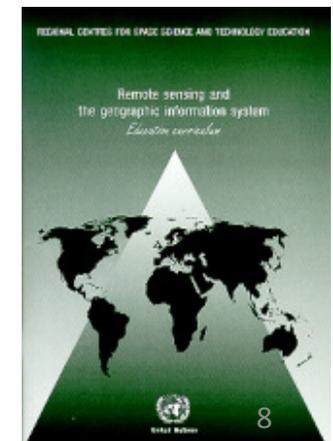
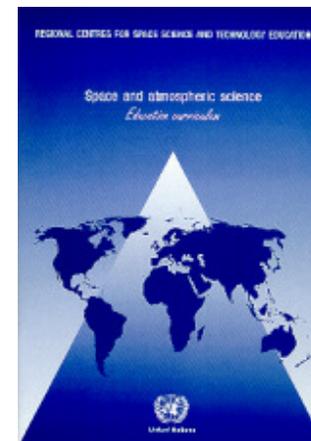
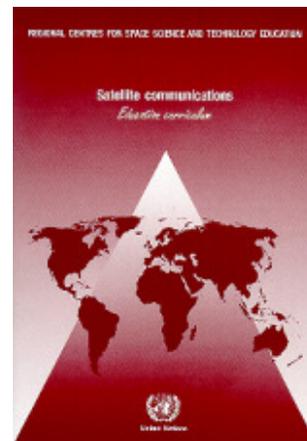
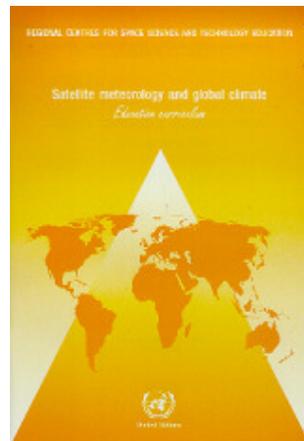
- **Remote Sensing and Geographical Information Systems,**
- **Satellite Communications,**
- **Satellite Meteorology and Global Climate, and**
- **Basic Space and Atmospheric Sciences**
- **(Global navigation satellite systems (GNSS))**
- **(Space Law)**





Postgraduate courses provided by the Centres are based on education curricula developed through UN expert meetings, with the support of prominent educators, in 1989, 1995, and 2001 for each topic of the core disciplines.

UN-OOSA has just held the fourth United Nations expert meeting on the regional centres for space science and technology education in December, 2011. At that meeting, efforts were made to revise, update and expand existing education curricula, which include GNSS and Space law.





Office for Outer Space Affairs
United Nations Office at Vienna



The African Regional Centre for Space Science and Technology Education - in English (ARCSSTE-E), affiliated with the United Nations, was inaugurated in Lagos, Nigeria on 24 November, 1998.

ARCSSTE-E is located on the Obafemi Awolowo University Campus at Ile-Ife, Nigeria



ARCSSTE-E, OAU CAMPUS, ILE-IFE

ARCESSTE-E building at the Obafemi Awolowo University in Ile-Ife, Nigeria



Overall Objectives of Centre's Mandate:

- (a) Develop, through in-depth education, an indigenous capacity in the applications and development of space science and technology (SST), especially in all principal areas (RS & GIS, Sat Com., Sat Met, BaS & AtSc, GNSS & Space Law).**
- (b) Develop basic and atmospheric sciences curricula from elementary to tertiary institutions (in collaboration with relevant institutions).**
- (c) Develop skills for satellite communications applications including those associated with rural development and health services, long distance education, disaster mitigation, navigation and regional networking/linkages with industries.**
- (d) Promote/Develop capacity for regional and international cooperation in SST**
- (e) Organise Space education outreach programmes for students and teachers of primary and secondary schools, tertiary institutions and the general public.**

The technical aspects of ARCSSTE-E's mandates are executed under three major activities:

- Post Graduate Diploma Programme**
- Research and Development**
- Space Education Outreach Programme**

AFRICAN REGIONAL CENTRE FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION – ENGLISH

Present Organogramme

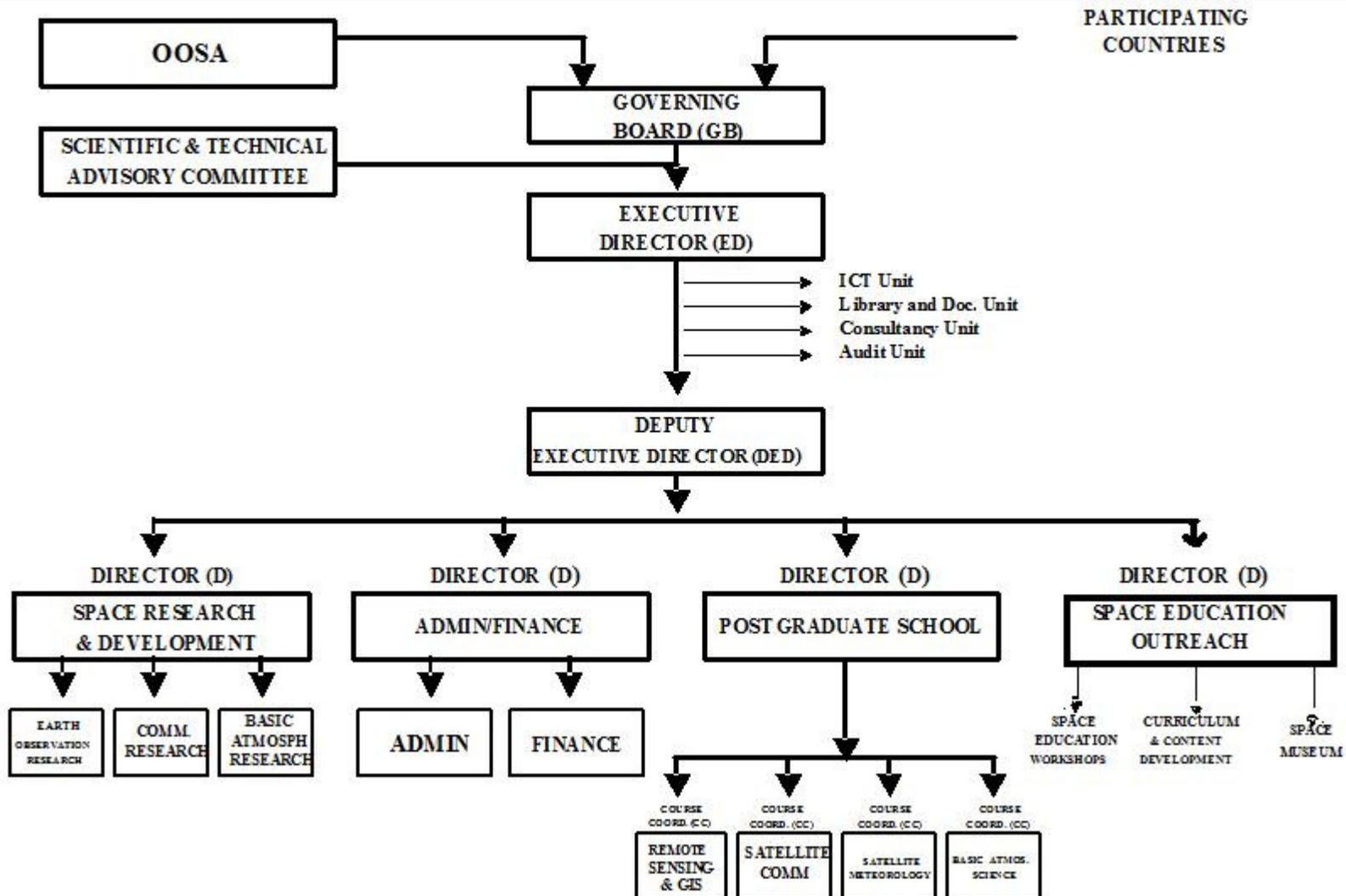
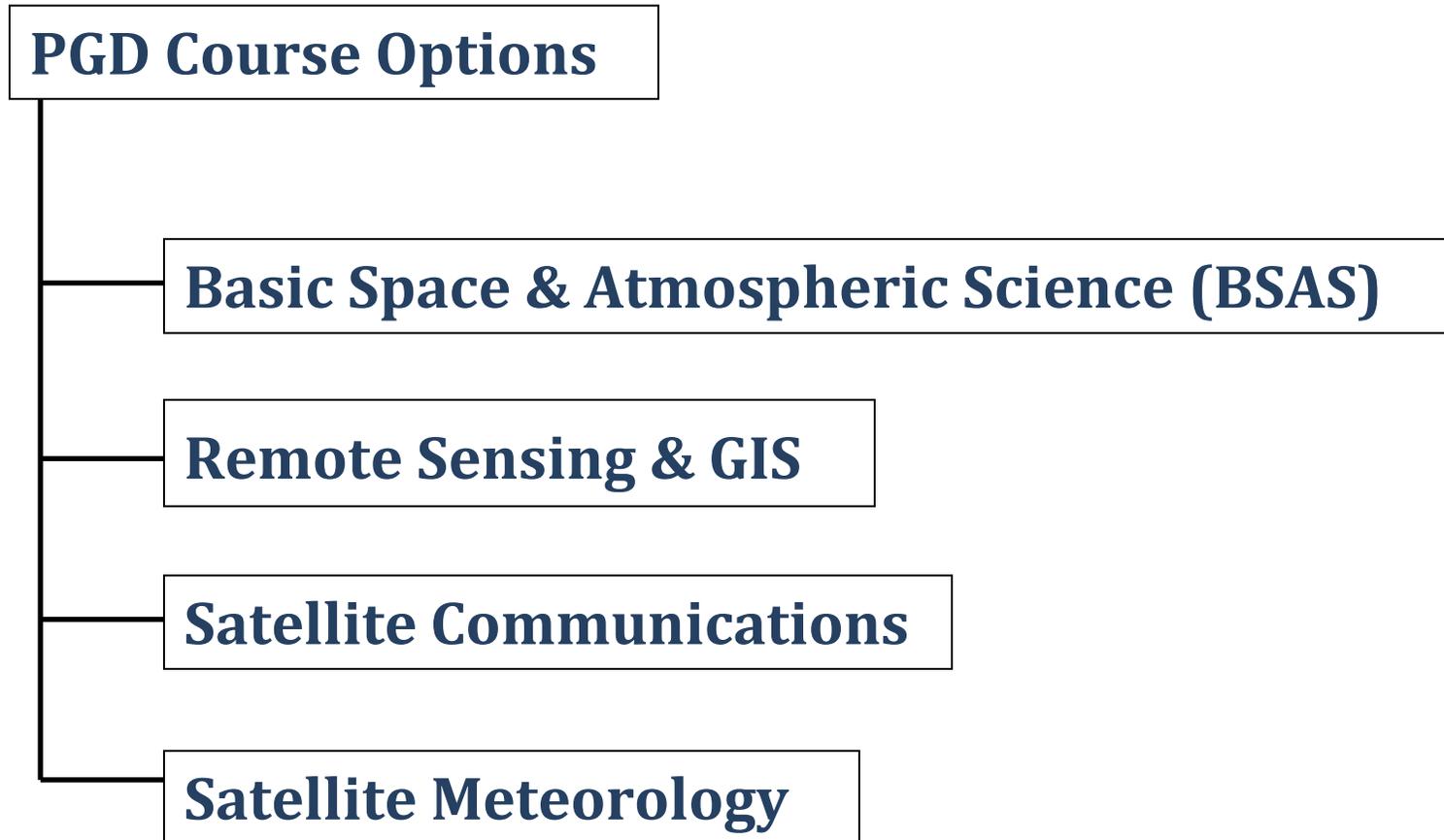


Fig.: Organogramme of ARCSSTE-E illustrating general structure of the Regional Centres.

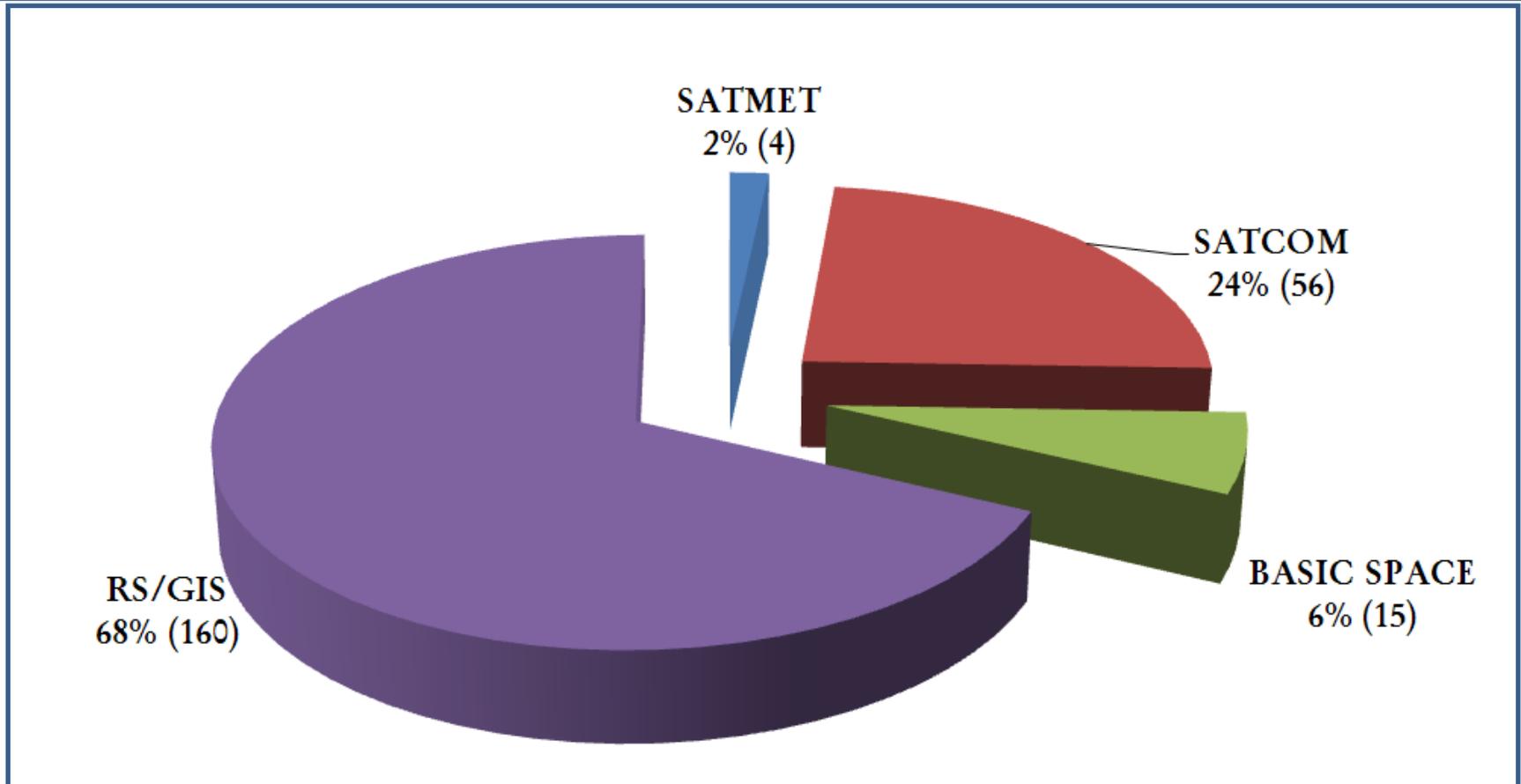
2. Post Graduate Diploma (PGD) Program From 2001 - 2011



Number of Post Graduate Programs since Inception

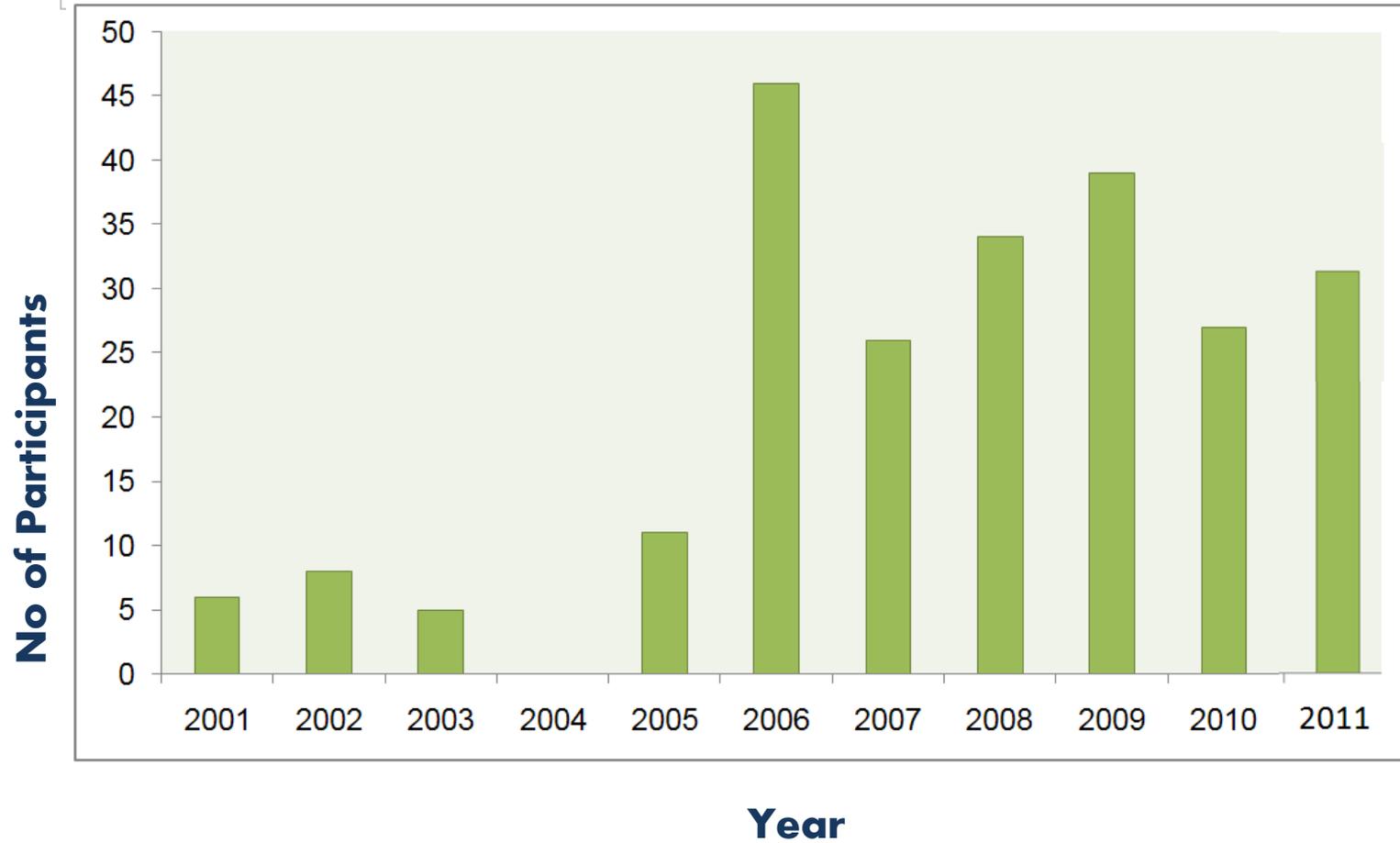
<i>To Date</i>	<i>Venue</i>	<i>Activity</i>
Dec, 2011	Obafemi Awolowo University, Ile-Ife, Nigeria	Tenth Postgraduate Course on Remote Sensing and GIS
Dec, 2011	Obafemi Awolowo University, Ile-Ife, Nigeria	Fourth Postgraduate Course on Basic Space and Atmospheric Sciences
Dec, 2011	Obafemi Awolowo University, Ile-Ife, Nigeria	Fourth Postgraduate Course on Satellite Meteorology and Global Climate
Dec, 2011	Obafemi Awolowo University, Ile-Ife, Nigeria	Eighth Postgraduate Course on Satellite Communications

Distribution of PGD Participants by Course Options

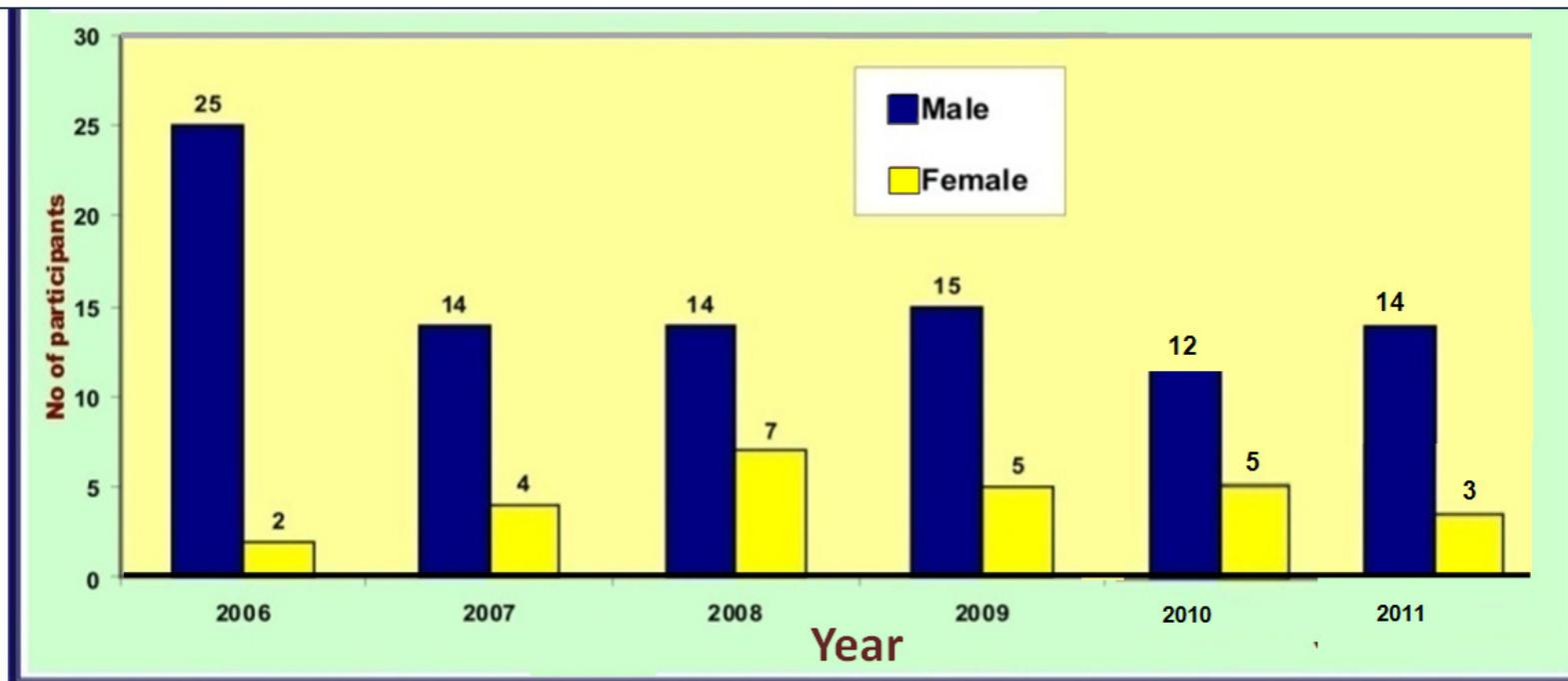


**From 2001 to 2011
Total number of PGD Participants = 235**

Annual Distribution of PGD Participants



Total Number of PGD Participants by Sex RS/GIS Option (2006-2011)



Total number of participants by sex 2006 – 2011.

Distribution of PGD Participants by Country

Country	Session											Total
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Botswana	-	-	-	-	-	-	-	-	-	2	-	2
Cameroon	-	-	-	-	-	4	7	3	3	2	2	21
Congo DRC	-	-	-	-	-	-	1	-	-	-	-	1
Ethiopia	-	-	-	-	-	3	-	-	--	-	1	4
Gambia	-	-	-	-	-	1	-	-	-	-	-	1
Ghana	-	-	-	-	-	-	-	-	1	-	-	1
Kenya	-	-	-	-	-	3	-	-	2	3	2	10
Liberia	2	-	-	-	-	1	-	-	-	-	2	5
Malawi	-	-	-	-	-	1	2	2	2	-	-	7
Nigeria	3	8	5	-	11	28	13	22	26	13	24	153
Sierra Leone	1	-	-	-	-	-	-	-	-	-	-	1
Sudan	-	-	-	-	-	2	3	1	-	1	1	8
South Africa	-	-	-	-	-	1	-	-	-	-	-	1
Tanzania	-	-	-	-	-	-	-	2	2	1	--	5
Uganda	-	-	-	-	-	1	-	3	1	4	1	10
Zambia	-	-	-	-	-	1	-	-	1	1	-	3
Zimbabwe	-	-	-	-	-	-	-	1	1	-	-	2
Total	6	8	5	-	11	46	26	34	39	27	33	235



International Committee on GNSS

- **Global Navigation Satellite Systems (GNSS) and their applications are overarching, enabling space technologies**
- **ICG Membership is open to GNSS providers or users of GNSS services**
 - **9 nations and the European Community**
 - **15 organizations (UN system entities, IGOs, NGOs)**
- **To date 6 Meetings of the ICG have been held**
 - **Adopted the ICG Work Plan and Terms of Reference**
 - **Established a Providers Forum**
- **UNOOSA acts as the ICG Secretariat and the Regional Centres as information dissemination and capacity building Centre**



ARCSSTEE has been participating in the ICG meetings and has organised one Traing Workshop for participants from Anglophone African countries.



International Committee on
Global Navigation Satellite Systems

Training Workshops, Short Tailor-made and Refresher Courses, Conferences and Seminars :

ARCSSTEE has organised many training workshops, conferences and seminars including a GNSS Training Workshop, a Regional Conference/Alumni Inauguration and an Annual lecture

- **GNSS Training Workshop (4 – 29 October, 2010)** with Thirty (30) participants from nine African countries, Uganda, Cameroun, Nigeria, Kenya, Sudan, Mozambique, Botswana, Zimbabwe and Zambia, in attendance.



(i) Group photograph of participants at the GNSS workshop

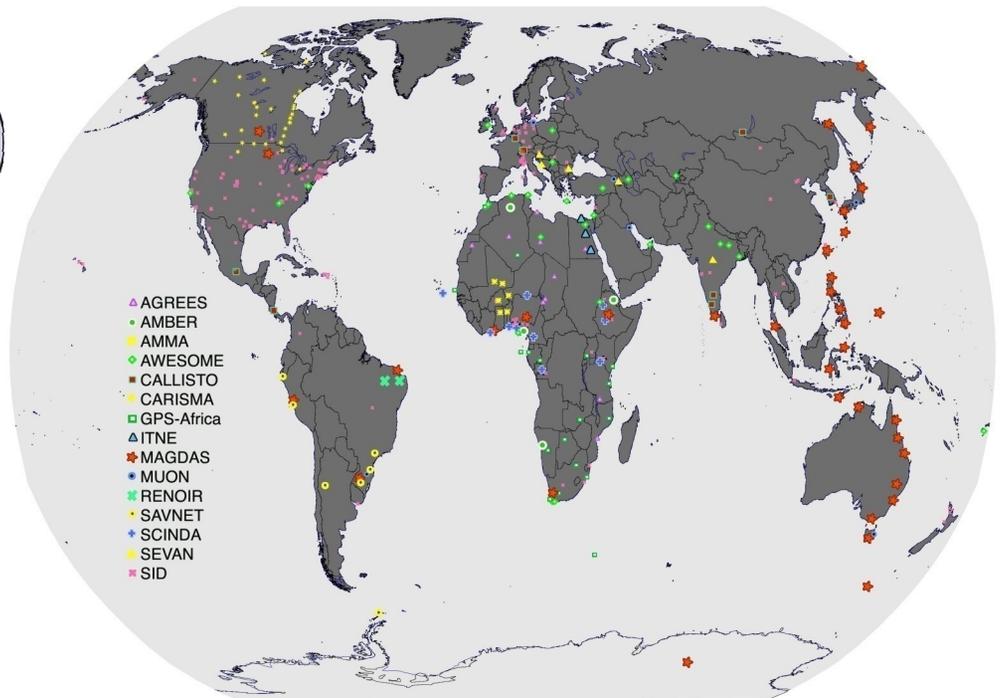
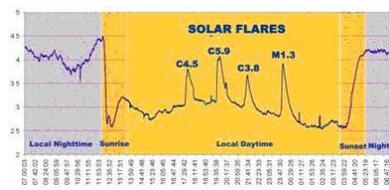
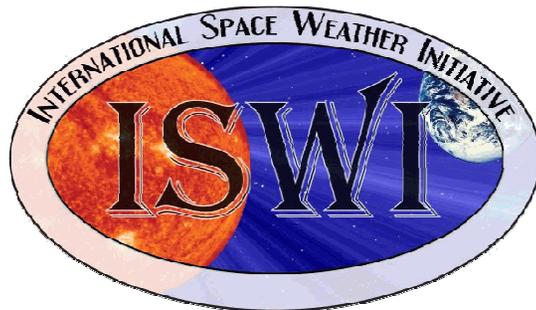
(ii) Participants at lecture room and field sites taking GPS readings



United Nations Programme on Space Applications

Through Basic Space Science Initiative (BSSI) and ISWI (2010 - 2012) almost one thousand instruments were deployed in 14 ground-based networks all over the world to observe solar phenomena.

ARCSSTEE co-sponsored and participated actively in the ISWI/MAGDAS school on 'Litho-space Weather' organised in Nigeria in August, 2011 and ISWI conference organised by CBSS, Nssuka in collaboration with OOSA in Oct, 2011



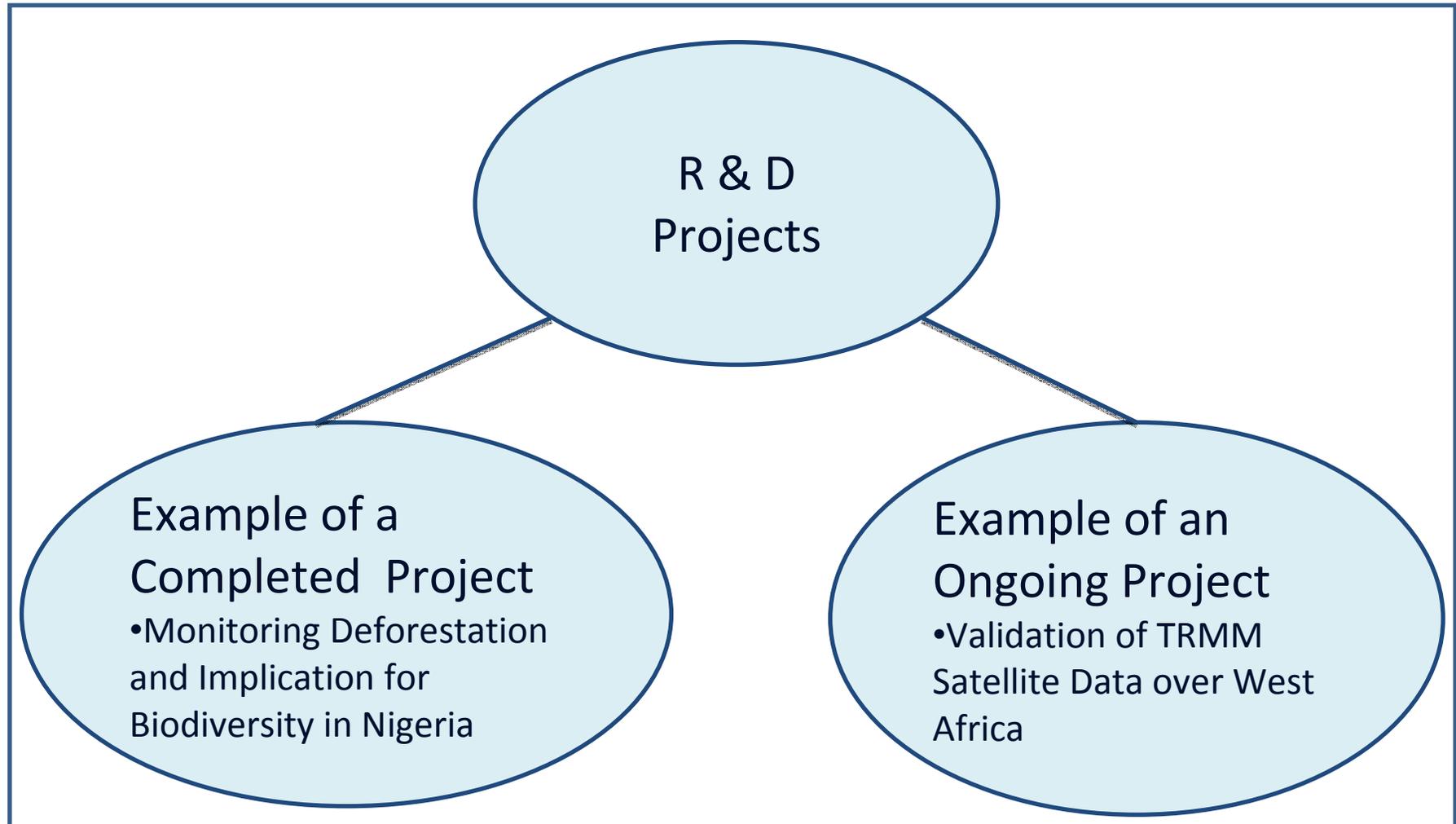
3. Research & Development (R & D) Activities

ARCSSTE-E has successfully executed, and is presently carrying out many local, national and international Research and Development activities in collaboration with institutions in Nigeria and abroad.

Some of these activities include:

- Monitoring Deforestation and Implication for Biodiversity in Nigeria**
- Nigerian Mesoscale Experiment (NIMEX)**
- Desertification Impact Modeling using field measurements from a Distributed Sensors Network**
- Climate Impact Modeling: Impacts of global climate change in the African region**
- Validation of TRMM Satellite Data Over West Africa**

Focus on Research & Development Projects



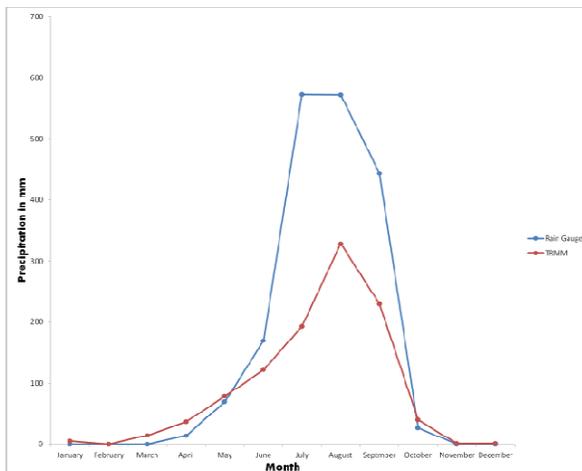
Validation of TRMM Satellite Precipitation Data Over West Africa

This project is conducted by ARCSSTE-E, through the Satellite Meteorology Department of the Post Graduate Diploma Program



- **Importance of the Project:** Adequate and reliable information on the amount and spatial distribution of rainfall is important for agricultural, water resource and climate related studies, as well as for the evaluation of regional model stimulations.

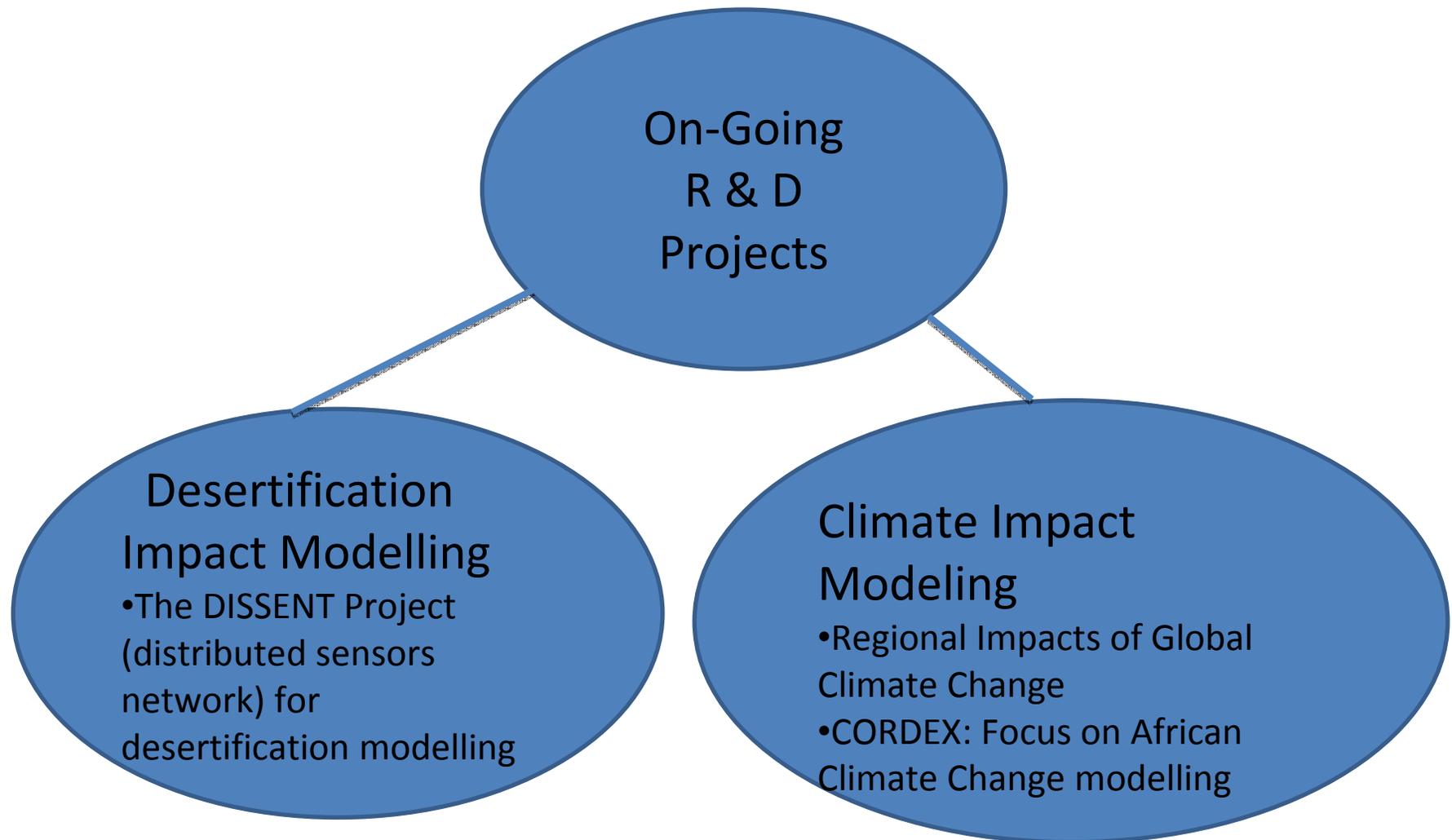
- **Progress made so far:**



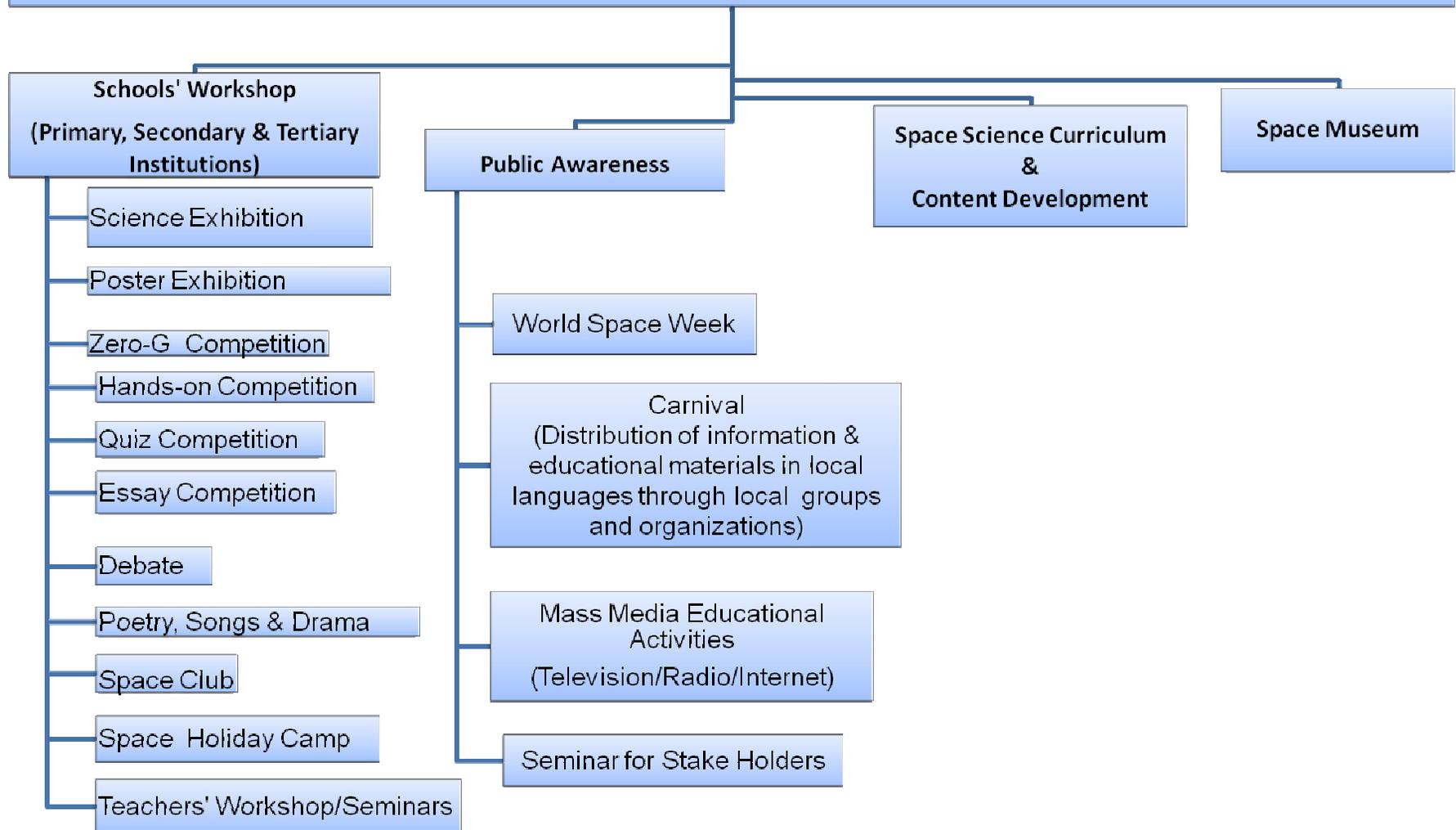
Comparison of Monthly Precipitation (1998) between rain-gauge and TRMM at Kano, Nigeria (18.5°E, 12.1°N)

- Validation activity over **Nigeria** indicated a strong correlation between satellite derived precipitation and rain-gauge measurements in the Southern part of Nigeria, but not in the Northern part, during the peak of the rainy season.
- Validation activity over **Liberia** indicated a strong correlation between satellite derived precipitation and rain-gauge measurements.

Research and Development Projects



4. Space Education Outreach Program



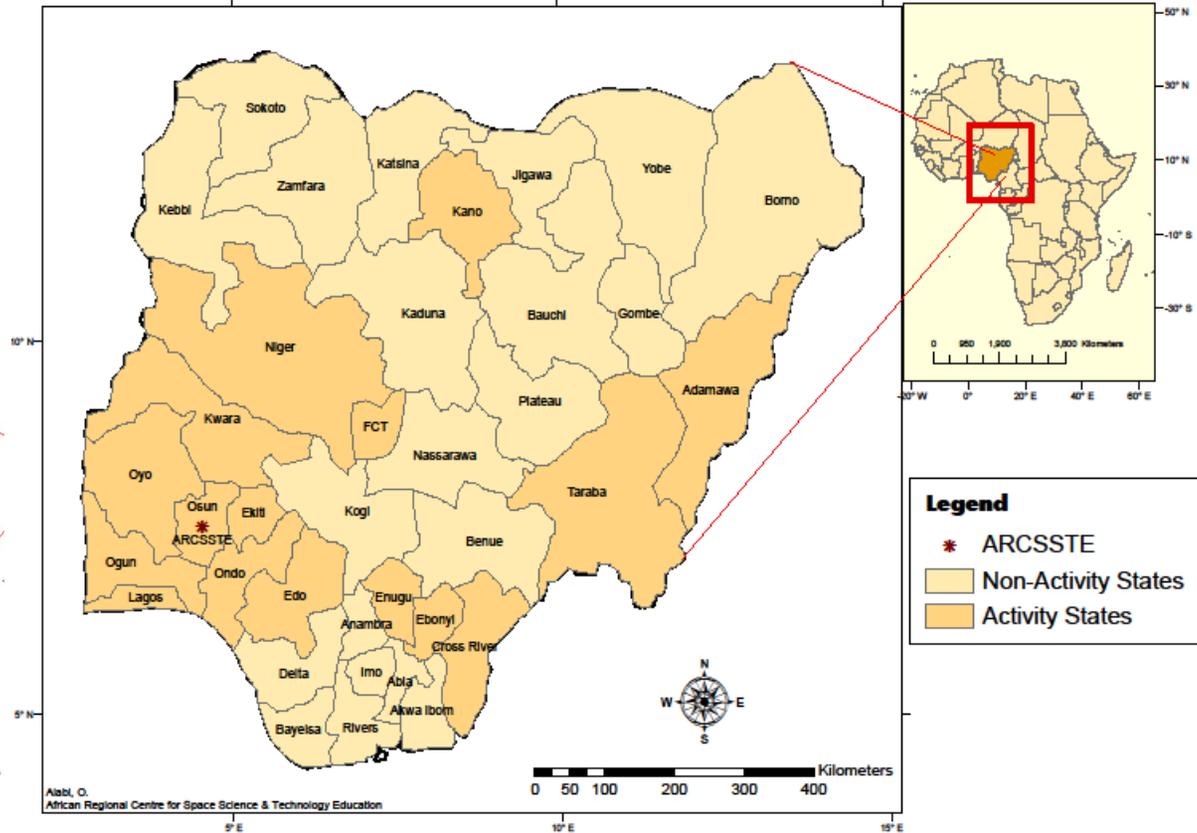
Coverage of ARCSSTE-E's Space Education Outreach Programme

Distribution of states by political zones in Nigeria



Political Zones

- North West Zone
- North East Zone
- North Central Zone
- South West Zone
- South East Zone
- South South Zone



Abdul, O.
African Regional Centre for Space Science & Technology Education

Photographs of participating students and staff assessing students' exhibitions during the 2009 Annual Schools' Workshop organised by ARCSSTEE at OAU, Ile-Ife



2009 WORLD SPACE WEEK ACTIVITIES AT EAGLE SQUARE, ABUJA, Nigeria



Pupils/Students at Training Workshop, Eagle Square, Abuja



Pupils dressed as Astronauts in space presenting a song/drama



Students explaining the techniques of making a model of a space rocket



Demonstration of the launch of a water rocket by ARCSSTE-E staff

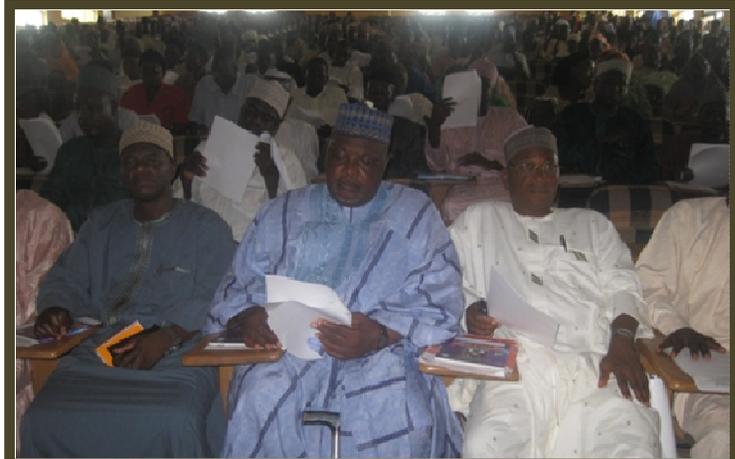


Model of the space station exhibited by students



Participants at Seminar on space Education curriculum development

2010 World Space Week Celebration, titled **“Mystries of the Cosmos”** took place in Niger State, Nigeria with about 1,400 participants comprising the students, teachers and public audience



Students and their teachers paid rapt attention and took notes on what they learned, as well as the public audience, during the lecture organised by ARCSSTEE.



Locally fabricated Robot designed to perform environmental sanitation:

This project was presented by Government Secondary School, 1st runner up of the Science Fair during the 2010 World Space Week Celebration in Nigeria.

Space Science Curriculum Development



inauguration of the technical committee on curriculum development.



Members of the curriculum development committee in a session

ARCSSTE-E'S ZERONAUT PROGRAMME AS PART OF THE WORLD SPACE WEEK ACTIVITIES



Stella Felix
ARCSSTE-E's 1st Zeronaut
2006



Adeolu Akano
ARCSSTE-E's 2nd Zeronaut 2007

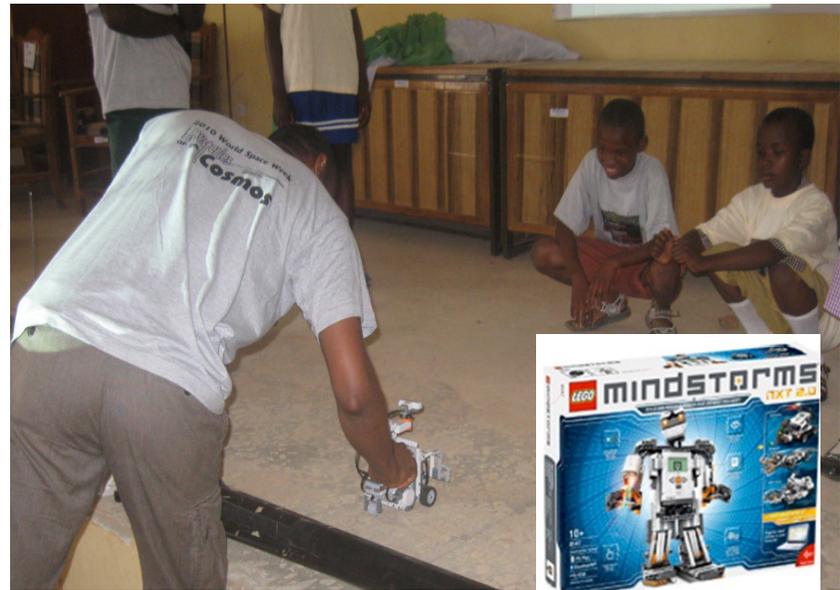


Omolola Ibrahim
ARCSSTE-E's 3rd Zeronaut 2008

The Zeronaut Programme was established to inspire the young ones. It takes place annually at the Kennedy Space Center, Florida, USA in collaboration with Space Week International Association (SIA). Three Nigerian secondary school students selected by ARCSSTE-E have been privileged to participate in the Zero-G flight, and experience the floating conditions associated with space flights.

Introduction to Robotic Education

- In March, 2011, demonstrations on the 'Exploration Robots' using the LEGO MINDSTORMS kit captured the attention of the young pupils/students.
- Students were informed that with LEGO MINDSTORMS kit, they can build and program robots to do what they want as demonstrated by instructors
- A space camp was later organized where students had the opportunity to build and programme robots, and learn more about robotics education.
- Students were later given the opportunities to participate in national and international robotic competitions



Captivated youngsters watched an instructor's Robots demonstration

World Robot Olympiad (WRO) at Abu Dhabi (UAE)

The Center's representatives participated in the 2011 World Robotic Olympiad (WRO) that was held in Abu Dhabi, United Arab Emirates from 18 to 20 November, 2011.

The World Robot Olympiad (WRO) is a global robotics competition for students between the ages of seven (7) and nineteen (19).



One of the projects presented at the WRO was the Automatic Road Mapping Utility (ARMU). With the aim of mapping and recording pot-holes on any given road. The event provided the team with motivation to further develop the project and improve on it.

ARCSSTE-E CO-HOSTS SCIENCE OUTREACH PROGRAMME WITH ORGANISATION OF WOMEN IN SCIENCE FOR THE DEVELOPING WORLD (OWSDW)

- The Organization of Women in Science for the Developing World (OWSDW) Federal University of Technology, Akure held the first year anniversary on Thursday, 7th July, 2011, with ARCSSTE-E as co-host.
- **The outreach programme was aimed at promoting the female child education in science, technology, engineering and mathematical (STEM) subjects.**
- The programme was attended by students from over 100 primary and secondary schools.
- There were presentations on Robotics by Master Kola Hayward-Rotimi, a 12 year old student of Teak Academy, Ile-Ife and students of Adesina College, Ibadan, the winner of the Science Fair organized during the 2010 World Space Week.





5. Benefits And Spin Offs Of Space Technology

Through The United Nations Programme on Space Applications

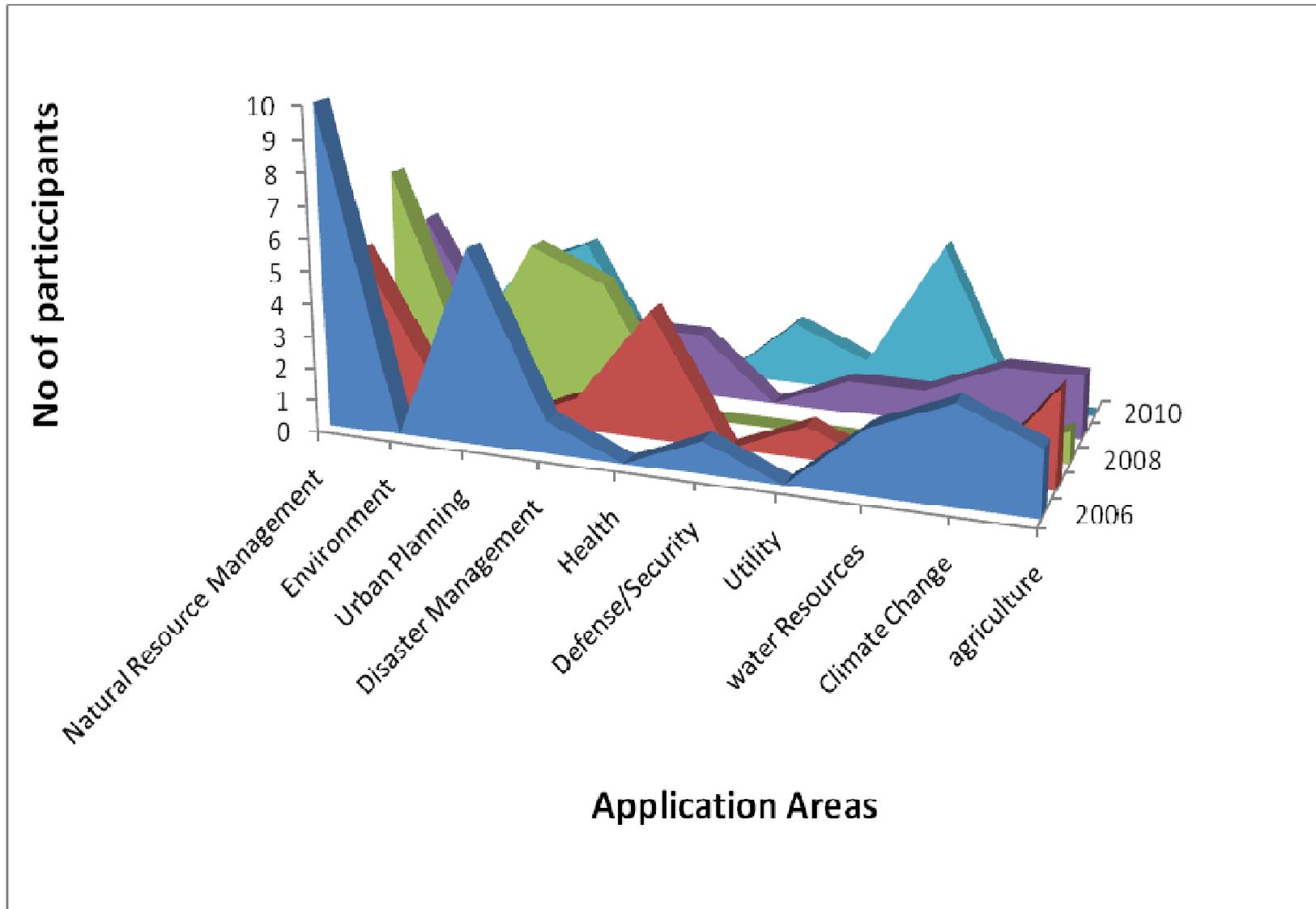
Priority thematic areas:

- Education and capacity-building, including research areas in basic space sciences
- Natural resources management and environmental monitoring
- Satellite communications for tele-education and telemedicine applications
- Global navigation satellite systems
- Disaster management
- Climate change



Application of Capacity Building in ARCSSTE-E on Socio-Economic Development:
Categories of RS and GIS projects carried out by course participants

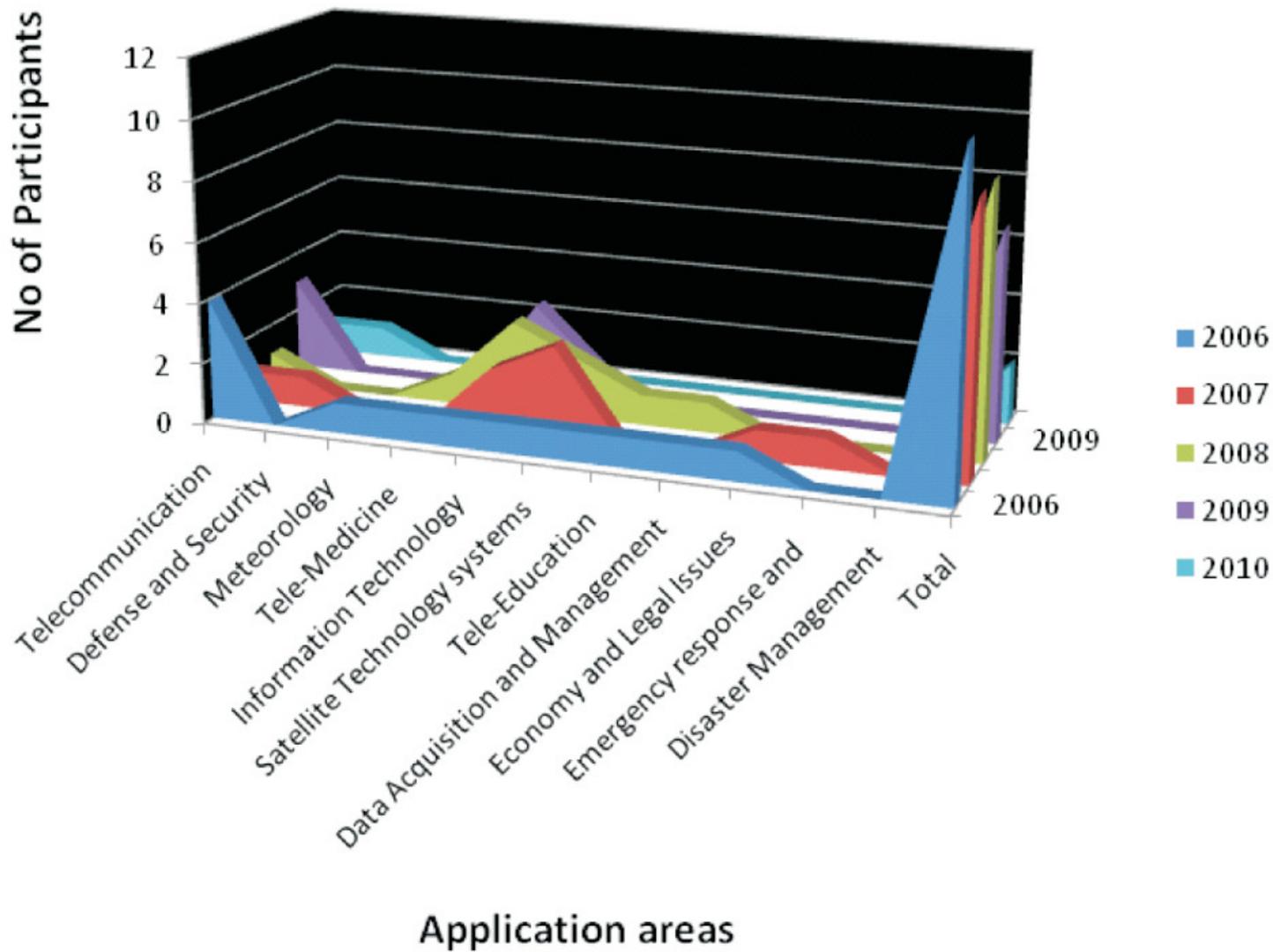
GIS Applications	2006	2007	2008	2009	2010	Total
Natural Resource Management	10	5	7	5		27
Environment		1	1	1	3	6
Urban Planning	6		5	4	4	19
Disaster Management	1	1	4	2		8
Health		4		2		6
Defence/Security	1				2	3
Utility		1		1	1	3
Water Resources	2			1	5	8
Climate Change	3			2		5
Agriculture	2	3	1	2		8
Total	25	15	18	20	15	93



Number of student RS/GIS projects in various application areas 2006 – 2010.

**Application of capacity building in ARCSSTE-E on socio-economic development :
Categories SATCOM projects carried out by course participants**

SatCom Applications	2006	2007	2008	2009	2010	Total
Telecommunication	4	1	1	3	1	10
Defense and Security		1			1	2
Meteorology	1					1
Tele-Medicine	1		1			2
Information Technology	1	2	3	3		9
Satellite Technology systems	1	3	2	1		7
Tele-Education	1		1			2
Data Acquisition and Management	1		1			2
Economy and Legal Issues	1	1				2
Emergency response and Disaster Management		1				1
Total	11	9	9	7	2	38



Number of student SATCOM projects in various application areas 2006 – 2010.

6. Conclusion

- **The advent of operational remote sensing from Earth observation satellites in the 70's and 80's coupled with the ICT innovations revolutionized the development and use of Space Technology in virtually all areas of socio-economic development in many developed countries.**
- **Applications/use of SST is critical to the economic reforms in the areas of oil and gas exploration and exploitation, defense and security, food security, tourism, population census, monitoring and control of education, healthcare delivery, communications, water resources development/management, environmental and disaster monitoring/management, commerce and industry and wealth creation.**
- **As with many new technologies, early acceptability and use was slow in many developing countries for various obvious reasons which include high cost of infrastructural development and inadequate man-power to use and transfer the knowledge.**
- **The intervention of the UN became very important, in assisting the developing countries build their indigenous capacity in SST applications, through the establishment of the Regional Centres for SST Education, affiliated to UNOOSA, in order to maximize the vast and unlimited benefits of SST.**

Conclusion contd.

- **It also became necessary to integrate space education outreach and awareness programmes/activities , especially “the catch them young programme” into the overall strategy for capacity building and the development of indigenous capability in all aspects of SST, including the use of robots in space exploration.**
- **These include the development of curricula for space education in primary and secondary schools and promotion of gender equality and women empowerment, noting that the first Zeronaut participant in Nigeria and Africa, selected through some criteria including keenly contested essay competitions, was a female student of Moremi High School, Ile-Ife, Nigeria.**
- **The role of the Organisation of Women in Science for the Developing World in collaboration with ARCSSTE-E cannot be overemphasized which include the promotion of the female child education in science,technology, engineering and mathematics(STEM).**
- **With the on-going efforts to sustain African regional space programmes, following the launch of some EO satellites: Alsat-1, NigeriaSat-1, NigeriaSat-2 and NigeriaSat-X, Sumbandilasat, as well as communication satellites such as NigcomSat-1R, ARCSSTEE is collaborating with some of the regional space agencies, such as NASRDA, to maximize the utilization of these satellites in its capacity building programmes.**



Stella Felix

ARCSSTE-E's Zeronaut 2006



Adeolu Akano

ARCSSTE-E's Zeronaut 2007

Thank You



Omolola Ibrahim

ARCSSTE-E's Zeronaut 2008
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