❖ CSSTE-AP Newsletter ❖

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Space Science : Scope for CSSTE-AP

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Space Science covers a large range of topics like structure and evolution of the universe on one side, to the Earth's environment nearer to us. Space science essentially seeks to discover the mysteries of the universe, explore solar system, find planets around other stars, search for life beyond Earth and many more. In fact the diversity of the topics is as limitless as space itself. Humans are basically inquisitive, with a spirit of exploration. Early man would have been sleeping in open and lying on his back must have marveled at the stars, planets, their beauty and their systematic movement. No wonder, astronomy is supposed to be one of the early areas of scientific study. It surprises me how the visual observations of planetary motion by Kepler could establish quantitative relationship between period and orbit radius, which holds good even with present day sophisticated instruments. In the early days of scientific discovery or technical innovation, both pure science and technology progressed independent of each other. But as the time progressed good science depends to a great extent how the technology is matured to meet the experimental needs and vice versa, that is basic science paved way for new technology. The launch of Sputnik, the first artificial satellite of earth, in 1957 opened new vistas to understand the outer space. 'Space Science' includes 'Science of Space' and 'Science using Space'. The former includes structure and evolution of the universe, exploration of the solar system, sun-earth connection, search for life outside earth, to name a few exciting areas. Science using space covers innovative uses of zero gravity of space platforms to understand aspects varying from crystal formation to germination of seeds.

Scientists believe our universe began with a 'big bang' some 15 billion years ago. If all the events of the history of universe until now were squeezed into 24 hours, earth would not form until late afternoon and humans would have existed for only 2 seconds. Our quest is to know our cosmic origins and destiny. Looking out in space to the most distant observable luminous objects is looking back in time. The way to look out in space is through electromagnetic radiation. The whole spectrum from x-rays to radio waves has some thing to reveal. For example x-ray telescopes are the only way we can observe extremely hot matter with temperatures millions of degrees Celsius. It takes gigantic explosions, or intense magnetic or gravitational fields to energize particles to these high temperatures. Thus x-ray observation can give us better understanding of such phenomenon. Measurement in long infrared wavelengths are needed to observe star light emitted from galaxies at earlier epochs. Observation of outer space from earth is limited due to the intervening atmosphere. Atmosphere limits the resolutions of optical / IR telescopes and does not permit observation in x-rays and ultraviolet due to the absorption.

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Thus the observations from satellites have shed more lights on the mysteries of the universe and about our own planet, which was not possible earlier. I would consider the last decade (1990-2000) is the golden era for space based observation to unravel the secrets of the origin and evolution of the universe with three space observatories covering a large portion of the electromagnetic spectrum.

Worlds first space based optical telescope was deployed in April 25, 1990. The telescope is named after American astronomer Edwin P. Hubble. The Hubble space telescope is 13.2 meter long (4 storied building), with maximum diameter of 4.2 m and weighs about 11.1 ton. The Hubble Space Telescope's 'eye' has a 2.4 meter primary mirror. This is only about 1/4th of the biggest ground based telescope. But Hubble has a resolution of 0.1 arc seconds, which is ten times better than any ground based telescopes. Hubble has captured many exciting cosmic events. Hubble observations have given strong evidence that super massive black holes exist at the center of active galaxies and observed proto-planetary discs around young stars, in the Orion Nebula, suggesting that planetary formation may be more common than previously thought.

The next is NASA's Compton Gamma ray observatory launched in 1991. The primary objective of the observatory was to study the phenomenon of gamma-ray bursts, although the detectors also recorded data from pulsars, black holes and other exotic astrophysical objects. The Compton Gamma ray observatory has made a number of observations giving insight into the gamma ray bursts. On June 4, 2000 the successful nine year mission of the Compton Gamma ray observatory ended.

NASA's Chandra X-ray Observatory (named after the scientist of Indian origin, Subramanyam Chandrasekhar), which was deployed in July 1999, is the most sophisticated x-ray observatory built to date. Chandra is designed to observe x-rays from high energy regions of the universe, such as hot gas in the remnants of exploded stars. A group of astronomers using the Hubble space telescope and Chandra x-ray observatory, in concert with other telescopes, have directly detected for the first time, a new type of stellar flare occurring in a narrow temperature range of gas on a star other than sun. There are many exciting discoveries made by Chandra within just one year.

The exploration of the universe using radio waves Radio Astronomy can be well done from ground. Exploration of the universe through naturally produced radio waves has given rise to many great discoveries, such as radio galaxies, quasars, pulsars and a large number of molecules in the inter stellar space. Ooty Radio Telescope, built by the Tata Institute of Fundamental Research, Mumbai, has been a unique tool for radio astronomical observations as the telescope antenna is mounted on a hill whose natural slope is parallel to the local longitude. Because of the very long wavelength of radio waves (1 cm - 10 m) the resolution possible with a single antenna is very coarse. However, if one has an array of antennas separated, by a technique called Very Long Base Interferometry (VLBI), one can obtain resolutions as high as a thousandth of an arc second much higher than possible with the optical telescope. The worlds' largest Radio telescope which can operate in VLBI mode has been developed by the National Centre for Radio Astronomy (NCRA), Pune and is located at Narayangaon near Pune, India. Giant Meterwave Radio Telescope (GMRT) consisting of 30 fully steerable parabolic dishes, each of 45 m diameter. Though, GMRT will be a very versatile instrument for investigating a variety of radio astrophysical problems, two of its most important objectives are (i) to detect highly red shifted spectral lines of neutral hydrogen (ii) to search for and study rapidly rotating pulsars in our milky way galaxy.

Planetary exploration is another exciting area. July 20, 1969 is a landmark in history, when man stepped on moon for the first time, a feat which 50 years back would have been a fairy tale. Moon is likely to be of strategic and economical importance for our existence. Fifty years from now human colonization on moon cannot be ruled out.

Outside of the Earth-Moon system, Mars is the most hospitable body in the solar system for humans and is currently the prime candidate for future human exploration and colonization. This is because other planets are not promising candidates for habitation as much as Mars. For example, Mercury is far too close to the Sun - radiation and temperature extremes and has almost no atmosphere; Venus is far too hot and the surface pressures are extreme, the gas giants - Jupiter, Saturn, Uranus and Neptune do not provide a surface on which to land, at least until the pressure is far too great and Pluto is far too cold and distant. Some of the moons of Jupiter - Europa and Saturn Titan are interesting targets in the search for life elsewhere in the solar system, but they are much farther away and far more inhospitable than Mars.

Mission to MARS is currently pursued seriously by Space agencies. Mars global surveyor has given valuable data to understand Mars better. Gullies seen on Martian cliffs and crater walls in a small number of high resolution images from the Mars Global Surveyor (MGS) Camera suggest that liquid water has seeped onto the surface in the geologically recent past.

In India also, a number of research institutes such as TIFR Mumbai, PRL Ahmedabad, IIA Bangalore, etc., have developed many ground based telescopes, radars, lidars, optical imagers, spectrometers, etc., as well as rocket, satellite and balloon borne experiments for studying astronomical and aeronomical aspects of space surrounding us. A world class optical and infrared observatory has been commissioned very recently at Hanle, in India. This observatory is located at an altitude of 4,467 m, which is the highest altitude for any observatory in the world and operates with a 2 meter aperture remotely operated optical infrared telescope and 0.5 m aperture robotic telescope. National MST Radar Facility (NMRF), located at Gadanki near Tirupati in India, is an example of world class instrument which is being used by Indian as well as foreign scientists for studying very minute structures in the ionosphere as well as the neutral atmosphere.

From the efforts of scientists all over the world, we have learned much about the universe but many questions remain to be answered. No doubt space science and exploration has inspired and enriched our knowledge. Are the glorious days of space science and space exploration in front of us or behind us. I feel the best days of space activity are yet to come. The International

International Workshop on Earth Observation Education and Training - A Report

Committee on Earth Observation Satellites (CEOS) is a concept and consensus opinion of about 41 members mainly from space agencies of various countries and other institutes all over the world. The 14th CEOS Plenary meeting was held in Stockholm from 10-12 November 1999. During this plenary an ad-hoc Working Group on Education (WG-Edu) was set up. Keeping in view, as the education holds the key to future space technology development and its applications. The first meeting of this working group on Earth Observation (EO) Education and Training was held at Indian Institute of Remote Sensing, (NRSA), Dehradun, India on 11th August 2000 proceeding the CEOS WG-Edu meeting an "International Workshop on EO Education and Training was hosted by Indian Institute of Remote Sensing (NRSA), Dehradun.

This workshop was organised by CEOS working group on Education and Training (WG-Edu) and Indian Space Research Organisation (ISRO), India and was sponsored by Asian Institute of Technology (AIT), Thailand, International Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands, United Nations Office for Outer Space Affairs (UN-OOSA), Austria, Centre for Space Science and Technology Education in Asia and the Pacific (CSSTE-AP), India and Indian Institute of Remote Sensing (IIRS), India.

About 29 delegates from 7 countries have participated in the workshop. The international participants were mainly from National Oceanic Atmospheric Administration (NOAA), USA, Centre for Remote Sensing, Canada, German Space Agency (DLR), ITC, The Netherlands, French Space Agency (CNES), France and GDTA, France, Asian Institute of Technology (AIT), Thailand and NASDA, Japan.

The Indian participants were from Indian Space Research Organisation (ISRO), National Remote Sensing Agency (NRSA), Centre for Space Science and Technology Education in Asia and the Pacific (CSSTE-AP), and Indian Institute of Remote Sensing (IIRS). In addition to the above, India was represented by 4 universities which are involved in the Earth Observation (EO) education and training in India. During this workshop, about 20 technical presentations were made on the following topics. They are:

- EO Education and Training - the need for international coordination.
- Space Agency Efforts in EO Education and Training.
- Institutional programme in EO Education and Training.
- Debate on EO Education and Training.

Towards the end of the workshop a Panel Discussion on "Road Map for EO Education and Training Activities". The result of the deliberations during the workshop resulted into the following recommendations.

Need for effective coordination mechanism of the EO Education and Training. Efforts- such as space agencies could develop/promote material, teaching aids and also EO data to strengthen the educational institutes which are offering programmes on EO Education.

- To keep pace with the technology trends and application needs educational institutions need to update the curricula on regular basis and also exchange of curricular information. The curriculum design should take into consideration the region dependent socio-economic constraints to the adoption of space based technologies at the local level and emphasize on more large and community awareness of the potential benefits of "EO".
- Institutions and Universities to consider tailor made customized training programmes for professionals to support application needs. University systems may formalize the educational programmes leading to the award of degree/diplomas.
- Specific educational/training programme are essential to cover the area of global change, disaster management, sustainable development and earth processes/system science. This requires combined support of space agencies, national governments and inter-governmental institutions like IGBP, WCRP, IGOS etc.

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Post Graduate Course on Satellite Meteorology and Global Climate

The second 9-months Post Graduate Course on Satellite Meteorology & Global Climate (SATMET-2K) commenced on July 1, 2000 at Space Applications Centre (SAC), Ahmedabad, India. 21 participants from 13 countries in Asia-Pacific have been selected for this course. Arrangements were made to receive the participants at the International airports in Mumbai and New Delhi and to help them board the domestic flight to Ahmedabad. All the participants have been provided with comfortable accommodation in the International hostel very near to SAC campus.

The course was formally inaugurated on July 10, 2000. Prof. B.L. Deekshatulu, Director, CSSTE-AP, Mr. A. K. S. Gopalan, Director, SAC, faculty members of the course and other distinguished guests were present on this occasion. All the lecture notes of the first SATMET-98 course were edited and have been brought out in three lecture volumes. These were released during the inaugural function and all the participants have been given copies of the same. These form the basic course material and is being followed by the faculty. The supplementary lecture notes, if any, for additional reading are being distributed separately by the faculty.

The first three months of the course, called Unit I, covers the basic aspects of Satellite Meteorology, Climatology, Mathemetics and Computer Programming. The afternoon sessions are devoted to processing of Operational data and its analysis. INSAT-VHRR and NOAA-AVHRR are the main data sets being used by the participants for this purpose. The participants are divided in a group of two each and each group is provided with a workstation to carry out these practicals. Various Visualization Packages like GRADS, NCAR Graphics etc are being used by the participants. A number of Multimedia CD-ROMs on various topics of interest have been given to them for their use during computer aided self learning sessions. Period objective tests to evaluate their progress have been conducted. Participants have already completed one round of seminars during which they talked about the weather and climate of their country, the nature of their work and meteorological problems (disasters, non availability of data etc) needing attention.

A number of tutorials involving computations, problem solving etc., by the participants have been conducted. A major highlight of the afternoon sessions is the weekly Map Discussion of the current weather over India and the Asia -Pacific using satellite Images and the weather charts available from various sources including Internet. Two participants per week collect all the required information and materials and make power point presentations about the status of weather conditions. Once a month, the participants visit Meteorological Centre at Ahmedabad Airport for the detailed weather chart analysis and discussions with operational forecasters. The first visit took place in August.

In order to overcome the lack of proficiency of English language, in some of the participants, special English classes have been arranged after the office hours. A total number of 10 participants are availing this facility.

A Board of Studies, for periodical review of the syllabus and the evaluation procedure has been constituted by Director, CSSTE-AP.

On July 12th, the National Day of Mongolia was celebrated by the course participants. Lectures and a video show highlighting the culture and other aspects of Mongolia were arranged. The Indian participants along with course faculty and their family members celebrated the Independence day on 15th August. In the morning, all the participants witnessed the unfurling of the National flag by Director, SAC. In the evening, a special cultural programme with patriotic songs and depicting various facets of Independence struggle was arranged by the children of the course faculty members. The 18 foreign participants participated in the "India Quiz" arranged and conducted by the 3 Indian course participants and the prizes were distributed to the winners. This evening function was enjoyed by all the course participants who had turned up in the traditional Indian dress.

Countrywise Distribution of SATMET-2K Participants

Country	No. of Participants
BANGLADESH	1
DPR KOREA	2
INDIA	3
INDONESIA	2
IRAN	1
KAZAKHSTAN	2
KYRGYZ REPUBLIC	1
MONGOLIA	2
NEPAL	2
PHILIPPINES	2
SRI LANKA	1
UZBEKISTAN	1
VIETNAM	1
TOTAL	***21***

Fourth RS & GIS Course

The valedictory function of fourth RS & GIS Course of CSSTE-AP was held on July 6, 2000 at Indian Institute of Remote Sensing (IIRS), Dehradun. This function was attended by Dr. K. Kasturirangan, Chairman, Governing Board of CSSTE-AP and Secretary to the Government of India, Department of Space as Chief Guest of the function, Dr. D. P. Rao, Director, NRSA, Hyderabad as Guest of Honour, Director, CSSTE-AP; Dean, IIRS, dignitaries of Board of Governors, CSSTE-AP, Director SAC Ahmedabad; Director & Deputy Director (T & S) of EOS, ISRO, Hq. and Heads of various organizations of Dehradun and staff members of IIRS and RRSSC-D. The distribution of certificate and valedictory address was delivered by Dr. K. Kasturirangan. A memoir and CD-ROM of lecture notes of RS & GIS course were also released by Chief Guest to mark the occasion. Director, NRSA, the Guest of Honour and Director, CSSTE-AP in their addresses, described the role of CSSTE-AP in the promotion of RS & GIS technology in Asia-Pacific region. Course report was presented by Dean IIRS who is also the Course Director. The feed back about the course were given by two participants, one each from the Sri Lanka and Vietnam.

Short term course on RS & GIS

A short term (4 weeks) International training course of CSSTE-AP on Remote Sensing & GIS- Technology and Applications in Natural Resources and Environmental Management" started at Indian Institute of Remote Sensing (IIRS), Dehradun from August 28, 2000. 14 participants from 9 countries are attending this course. The participants are from - Uzbekistan (2), Ghana (1), Mauritius (1), Kazakhstan (2), Vietnam (1), Romania (2), Lao PDR (1), Kenya (1) and India (3).

Message

Role of CSSTE-AP in new millennium is significant and it should speed up developments in the field of environment and earth sciences. Research results, received with the help of space technologies on mineral deposits, condition of underground waters, agriculture, forestry, earthquakes and landslide processes etc., allows to talk about scientific and practical value of this centre.

In this connection the Department for Science and New Technologies under the Ministry of Education, Science and Culture of the Kyrgyz Republic expresses its gratitude to the CSSTE-AP for training the high skilled experts. The number of students graduated go up year by year and no doubt those from Kyrgyzstan will make their scientific and practical contribution into our Republic.

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CEOS Workshop... (Contd. from Page-4)

- Training of trainers is important and institutions need to enable their faculty to acquire additional knowledge, newer skills and this could be integrated with specific training programmes or embedded into research programmes.
- Efforts are required for increasing the awareness of EO Technology and applications in different countries especially in developing countries and a coordinated programme is essential to address this at national and international level.
- Enable the emergence of regional hubs of EO Education/training by committing support to national/international and UN regional centres. These centres can effectively enable the outreach of EO data/services/tools to the developing countries in the world.
- Involve private sector for enhancing out reach of EO education and Training activities and products.

SATCOM ACTIVITIES

Short Term Course

A Short Term Course on **Applications of Satellite Communications for Development** was successfully conducted at Space Applications Centre, Ahmedabad, during July 17-July 21, 2000. The course was jointly sponsored by ISRO, CSSTE-AP and the Centre for Science & Technology of Non-Aligned and other countries. Ten participants from Bangladesh, Botswana, Egypt, Indonesia, Iraq, Malaysia, Mauritius, Nepal, Syria and Zambia along with eight participants from India attended the course.

The objective of the short-term course was to make the participants familiar with the applications of different satellite communications technologies suitable for the development of countries. Dr. Dipti Rustogi, Deputy Director, SATCOM Applications Area, SAC, Ahmedabad, was the Course Director.

On 17 July, 2000, the inaugural function of the short-term course was attended by Prof. B. L. Deekshatulu, Director, CSSTE-AP, Mr. K. N. Johry, Director, NAM S & T Centre, Mr. A. K. S. Gopalan, Director SAC, Ahmedabad and other invitees. Mr. B. S. Bhatia, Director, Development and Educational Communication Unit of ISRO delivered the key-note address. As part of the course, different experts in the field delivered lectures on topics of satellite communications and various issues related to development. The participants also presented country reports of the respective countries.

The participants took keen interest in the course and appreciated the efforts made by ISRO, CSSTE-AP and NAM S & T Centre. On July 21, 2000, Mr. A. K. S. Gopalan, Director, SAC, delivered the valedictory address and distributed the certificates to the participants of the course.

First Post Graduate Course on Satellite Communications

Seven out of thirteen participants of the first post graduate course on Satellite Communications (1997-1998) have successfully completed the one year projects undertaken as part of the course. Till July 2000, M. Tech Degree of Andhra University has been awarded to the following participants :

- Mr. Rajesh Kumar Uppal, India
- Mr. Mostafa Torabian, Islamic Republic of Iran
- Mr. Min Kyung Hyun, Republic of Korea
- Mr. Lassana Weeratunge, Sri Lanka
- Mr. M. S. H. Cooray, Sri Lanka
- Mr. Botir Sh Usmonov, Uzbekistan

The Meeting of Governing Board and Advisory Committee

The 2nd Advisory Committee Meeting was held on July 4th 2000. The meeting was chaired by Dr. Mazlan Othman, the Director of UN-OOSA, VIENNA. The Committee appreciated the academic excellence of the centre's educational programmes. Subsequently, the meeting of the Governing Board was also held on July 6th, 2000. The Governing Board meeting was chaired by Dr. K. Kasturirangan, Chairman of Indian Space Commission and the Chairman of the Governing Board. The Governing Board extended its whole hearted support to the progressing activities of the centre.

Members of the Governing Board and invitees at the venue of the meeting on 6th July, 2000.

Dr. Mazalan Othman, Director UN-OOSA presiding over the Advisory Committee meeting on 4th July, 2000.