

A special session on
Indian Initiatives on International
Year was organized during
Indian Science Congress
January, 3rd to 7th 2007.



ABSTRACTS

of discussions on Important
Topics related to International Years

TS20 09:00 – 10:45	International Year of Planet Earth: Indian Initiatives [Discussion Session]	Discussions on Topics related to IYPE
Convener	Dr. N.C. Mehrotra Director, Birbal Sahni Institute of Palaeobotany Lucknow	
Local Coordinator	Dr. G. Vasanthakumar Professor and Head, Dept. of Agriculture Extension. Annamalai University, Annamalainagar	
Speakers	Dr. N.C. Mehrotra Director, Birbal Sahni Institute of Palaeobotany, Lucknow	Introduction
	Prof. Ed F.J. de Mulder Chair, Commission on Planet Earth The Netherlands	The International Year of Planet Earth
	Prof. B.R. Arora Director, Wadia Institute of Himalayan Geology, Dehradun	Challenging issues of Himalayan Geology: Focal program for IYPE
	Dr. V.P. Dimri Director, National Geophysical Research Institute, Hyderabad	Solid Earth Research at NGRI: Contributions to International Year of Planet Earth
	Prof. Archana Bhattacharya Director, Indian Institute of Geomagnetism Navi Mumbai	International Year of the Planet Earth: Indian Initiatives in Geomagnetism and Aeronomy
	Dr. Shailesh Nayak Director, Indian National Centre for Ocean Information Services, Hyderabad	Impact of episodic events and climate change on coastal and marine ecosystems
	Dr. Rasik Ravindra Director, National Centre for Antarctic & Ocean Research, Goa	International Polar year – Indian initiative
	Dr. Satish R. Shetye Director, National Institute of Oceanography Goa	
	Dr. S. Kathioli Director, National Institute of Ocean Technology Chennai	Ocean Energy Systems- Indian Initiatives
	Dr. K. Radhakrishnan Director, National Remote Sensing Agency Hyderabad	Space Applications
	Dr. B.N. Goswami Director, Indian Institute of Tropical Meteorology Pune	
	Dr. N.C. Mehrotra Director, Birbal Sahni Institute of Palaeobotany Lucknow	International Year of Planet Earth: Indian Initiatives at Research Institutions
	Dr. V.M. Tiwari Scientist, National Geophysical Research Institute Hyderabad	Significance of Recent Gravity and Isostatic Studies over Indian Lithosphere

The International Year of Planet Earth

Ed de Mulder

Chair, Commission on Planet Earth
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Natural disasters like the 2004 tsunami provide graphic testimony of the Earth's incredible power. More effective use of geoscientific knowledge can save lives and protect property. Such knowledge also enables us to satisfy the growing needs for Earth's resources for an expanding human population in a sustainable manner. Such knowledge is readily available in the practical experience and publications of some 500,000 Earth scientists all over the world, a professional community that is ready and willing to contribute to a safer, healthier and wealthier society if called upon by politicians and decision makers.

The International Year of Planet Earth (2007 - 2009) aims to contribute to the improvement of everyday life by promoting the societal potential of the world's Earth scientists, as expressed in the Year's subtitle *Earth sciences for Society*. Ambitious outreach and science programmes constitute the backbone of the International Year, politically endorsed by all 191 member states of the United Nations Organisation when it proclaimed 2008, the central year of the triennium, as the UN Year of Planet Earth. This has been an initiative of the International Union of Geological Sciences (IUGS) and UNESCO. It is supported by 12 Founding and 26 Associate Partners covering almost the entire international geoscientific community.

The International Year of Planet Earth has a science and an outreach programme. In the science programme, ten science themes are identified, all with a strong focus on addressing societal needs. These include: Groundwater: reservoir for a thirsty planet? Hazards: minimizing risks, maximizing awareness, Earth and Health: building a safer environment, Climate Change: the 'stone' tape, Resources: towards sustainable use, Megacities: our global urban future, Deep Earth: from crust to core, Ocean: abyss of time, Soil: Earth's living skin, Earth and Life: origins of diversity. For all science themes easily accessible brochures have been printed, also available via the website (www.yearofplanetearth.org).

The website gives also access to our two outreach brochures describing how proposals for science and outreach projects can be submitted. As of today, 26 nations, including India, developed National Committees to implement the Year of Planet Earth in their own countries. The Indian National Committee is invited to develop coherent national science and outreach plans, to organise a major launching event, to identify potential sponsors, partners and a Patron, and to explore options to organise a Regional Top Conference on 'Earth Sciences for Society'.

Challenging Issues of Himalayan Geology: Focal program for IYPE

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One of the challenging problems of the Himalayan Geology is the development of geodynamic model of the orogenic belt that can not only explain the archetype of the collision tectonics but can also trace the metamorphic history, constrain high rate of erosion and exhumation, extent and nature of crustal shortening, kinematics of the crustal deformation as well as can provide clues to the space-time distribution of seismicity. High-resolution geophysical imaging of the MBT, MCT and local thrusts vis-à-vis the basal detachment will be critical in evaluating seismic hazard of lesser Himalaya. Regional mapping and sampling for geochronology, thermochronology, and isotope geochemistry will identify metamorphic/kinematic history related to the evolution of the Himalaya as well provide constraint on the thermal and temporal constraint on regional uplift and exhumation. Further, impact of tectonic uplifts individually or coupled with climate-induced erosions are faithfully preserved in foreland and fore arc basins. Petrography, stable isotopes, paleontology, clay mineralogy, geomorphology, geochemistry are the basic tools to gain insight in the tectonics and climate interactions on different time-scale. To unveil these mysteries, Wadia Institute of Himalayan Geology, as a part of the program during the International Year of Planet Earth (IYPE), proposes to initiate major multi-disciplinary studies along the extended Geotransect in NW and Eastern Himalayan Syntaxis, zones dominated by head-on and oblique subduction respectively. Adequate focus will be on improving our knowledge base on the seismic hazards. VSAT linked dense network of digital broadband seismometers will form the central observational activity to investigate the space depth distribution of epicenters, focal mechanism, stress pattern. This coupled with Strain budgeting from extended network of Global Positioning System will identify locked segments of the Himalayan arc and allow testing whether regions of long seismic gaps are potential regions overdue for great earthquakes. Establishment of Multi-Parameter Geophysical Observatory, first of its kind in India, in Uttranchal Himalaya is yet another important step towards identifying precursors to earthquakes.

Solid Earth Research at NGRI: Contributions to International Year of Planet Earth

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National Geophysical Research Institute (NGRI), endeavours in the research areas related to exploration of natural resources, Earth's structure & tectonics and societal oriented research in the field of ground water and natural hazards. Many of the recent activities at NGRI can be included in the outreach as well as science programme of the International Year of Planet Earth (IYPE), such as: mapping of sub-trapean Mesozoic sediment, exploration of gas hydrates, exploration of radioactive minerals, studies related to recent Sumatra earthquake & tsunami, lithosphere structure, solving fluoride problem in the ground water, geochemical and geophysical mapping of India, monitoring seismicity and medium range forecasting of earthquake. In recent year several new programmes like marine magnetotelluric, 4 D Seismics, development of the facilities for precise measurements of geophysical and geochemical data etc have been initiated at NGRI. NGRI has also conducted several national and international seminar and symposium during past years. Some of the NGRI's contributions will be discussed for considerations as Indian inputs to IYPE.

International Year of the Planet Earth: Indian Initiatives in Geomagnetism and Aeronomy

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The International Geophysical Year (IGY) gave us scientific satellites. As we celebrate the 50th anniversary of IGY in 2007, which marks the beginning of the International Year of Planet Earth as well as being designated as the International Heliophysical Year (IHY), it is clear that such satellites have not only contributed immensely to our present knowledge of geomagnetism and aeronomy but are going to play a major role in future research endeavours in these areas. Today it is possible to access data from a number of satellites that have been launched to study the Earth's magnetic field and the upper atmosphere including the ionosphere and magnetosphere. Development of ground-based observations in India provides excellent supplementary data for the new Indian initiatives in the areas of geomagnetism and aeronomy planned for the International Year of Planet Earth. The network of magnetic observatories in different parts of India occupies a prime place amongst the ground-based observational facilities in the country, and provides data that have a variety of uses from the preparation of regional anomaly maps to the computation of geomagnetic activity indices, which are important for specification of 'space weather'. Radio wave techniques such as GPS, ionospheric scintillations, ionosonde, and radar; and the optical airglow observations provide information about the dynamics of the ionospheric plasma and the neutral atmosphere. Investigation of all these aspects should further our knowledge of the Sun-Earth connection, even as we use geomagnetism to probe the interior of the Earth. Globally these are exciting times for geomagnetism, as the main geomagnetic field is undergoing rapid decrease in certain regions such as in the vicinity of Maitri, the Indian station in Antarctica. This talk summarizes some of the challenges that shall be taken up during International Year of Planet Earth.

Impact of Episodic Events and Climate Change on Coastal and Marine Ecosystems

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Coastal zone has been receiving an increasing importance in view of its high biological productivity, wealth of species and genetic diversity, fluvial discharge, high rates of population growth and development of trade, industries and commerce. The episodic events such as cyclones, floods and tsunamis also modify the shoreline and affect coastal ecosystem. It has been reported that the magnitude of cyclones have increased during last few decades, probably due to global warming.

The coral reef and mangroves are two vital ecosystems. These ecosystems are affected by natural hazards such as cyclones and tsunamis as well as anthropogenic changes. The impact of cyclones on mangroves was observed. In most cases, trees do not get uprooted. The mangroves such as *Avicennia* having pneumatophores are generally affected. Hence we need to have knowledge about extent and condition of major communities of mangroves. Increased frequency of cyclones may damage such mangroves permanently.

The tsunami of 2004 greatly damaged both coral reef and mangroves, especially on the Andaman and Nicobar islands. Large scale damage occurred because of incoming wave, which destroyed the coral reef and mangroves. The backwash was equally harmful as they deposited huge amount of detritus on coral reef and mangrove areas and especially corals got killed. The damage to ecosystem affects the village communities who are directly dependant on the health of ecosystems for their livelihood.

The ocean colour data is useful in quantifying ocean carbon flux and understanding how it is controlled and why it varies from year to year. It also provides a synoptic, observational link between the development of the ocean ecosystem and the physics of the mixed layer and helps in assisting with the scientific analysis and management of the coastal zone, including fisheries management. It was observed that the productivity is increasing the Arabian Sea in the month of September continuously from 1998 onwards. It was observed that the productivity of near shore water increases considerably after cyclones, possibly due large influx of nutrients to sea. These are being investigated to study effect of this increase in productivity on the fish catch.

Climate change may affect coastal ecosystems through warmer SST, altered circulation patterns, changing storm frequency and rising sea levels. It is necessary to determine present status of ecosystems and predict future conditions.

International Polar Year – Indian Initiative

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The ocean – atmosphere linkage governs the climate system of our Planet Earth. Polar regions- Arctic and Antarctic being the prominent areas of ‘ Heat Sink ‘ play a significant role in shaping the changing scenario of our planet. It is therefore of great that the International Year of Planet Earth is also being designated significance International Polar Year.

The International committee on Polar Year has scrutinized about 500 proposals received from scientific bodies, universities, government and non-government bodies and has finally drawn six major themes covering.

- a) Environmental Status of Polar regions.
- b) Quantification of changes – past present and future (expected)
- c) Global linkages between Polar Regions and interior of the globe.
- d) Exploring new frontier of science in Polar Regions.
- e) Increasing the capabilities to explore the outer space from interior of earth and
- f) Develop an outreach, educational program.

Indian initiative for the International Polar Year focuses mainly on the atmospheric science, palaeoclimate and marine biology of the southern oceans. Three Indian proposals have already found international linkages and have been accorded ID numbers. These projects are: -

- a) Monitoring of the upper ocean circulation transport and water masses between Africa and Antarctica (ID No. 924)
- b) Short term Holocene climate variability in Antarctica and the south latitudes utilizing sediment cores from the Indian ocean and the shallow ice cores from Antarctica (ID No.850)
- c) Land based anthropogenic impact of coarse particles on Antarctic shelf (Activity ID No. 129)

Apart from these projects India has been included in the steering group of IPICS, (international Partnership in ice core sciences), and ITASE (International Trans Antarctic Scientific Expedition). NCAOR in collaboration with GSI, has planned to drill several short holes to retrieve ice core from ice shelf between Dakshin Gangotri (on coast) and Maitri inland station at a distance of ~ 100 km to contribute towards understanding of Holocene palaeoclimate.

India also intends to initiate a programme on functional and taxonomic diversity of bacteria from the Indian Ocean sector of Southern Ocean as also from the part of Antarctic Ocean, adjacent to eastern Antarctic margin.

Ocean Energy Systems- Indian Initiatives

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Ocean energy systems are technologies that harness energy from the oceans. Gravitation of planets like sun and moon can pile-up and drain waters in gulfs and creeks to significant tidal ranges, when the topographic conditions are conducive. Favourable sites in India include the Gulf of Kutchch and Gulf of Khambhat in Gujarat and some creeks like Durgaduani creek in Sunderbans, West Bengal. While the energy potential in the gulfs exceeds over 10000 MW, those in small creeks in Sunderbans are of the order of 1-5 MW. Nevertheless, they are useful in such remote sites where there is no electricity transmission line or other forms of energy. Top layers of ocean near equator receive tremendous solar energy due to radiation and thus have accumulated immeasurable amount of energy which is renewable. Thermal difference between the top and sufficiently (800-1000 m) deep water could be exploited to generate the so-called ocean thermal energy (OTEC). The estimated potential within the Indian Exclusive Economic Zone is well over 300000 MW. The only hitch on OTEC is that the plants could be set up only in very deep waters which in Indian context is 20-50 km offshore. Unequal heating of earth and atmosphere by sun due to varying angle of incidence leads to atmospheric pressure difference and hence, winds. These winds when pass over seas, transfer a portion of energy to the top layer of oceans generating waves. In general, oceans near the equator have much lesser wave energy in comparison to oceans at higher latitudes and India is no exception. In general, ocean energy projects are high capital cost intensive and this had been a major hurdle for serious development. However, growing awareness of green house gas emissions on climate and the increasing prices of fossil fuel are slowly changing the balance and renewable energy from oceans have started gaining currency. Cost of ocean energy becomes competitive when the power plants are made multi-purpose oriented. For instance, OTEC plants can be designed to provide power and water. Tidal barrages are planned to act as efficient roadways apart from capturing power. Wave energy plants are combined to serve also as breakwaters for harbours. Modest attempts have been made in all these fronts in the country. This paper assesses the potentials of various forms of ocean energy in India and reports the status of various ocean energy projects. Experience from pilot plants of wave energy and OTEC are shared.

International Year of Planet Earth : Indian Initiatives at Research Institutions

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Recent endeavours and proposed new initiatives at various research institutions in India are well within the domain of science as well as outreach programmes of the International Year of the Planet Earth. Earth scientists need to find a link between academic pursuit and answering societal obligations in order to demonstrate utility of earth science for the benefit of mankind. At the Wadia Institute of Himalayan Geology (WIHG), Dehradun, major multi-disciplinary studies in the areas of seismicity and tectonics are proposed so as to improve our knowledge base on the seismic hazards in the Himalayan region. The National Geophysical Research Institute (NGRI), Hyderabad endeavours in areas related to earth's structure and tectonics, ground water, natural hazards and exploration of mineral and gas hydrate. The Indian Institute of Geomagnetism (IIG), Mumbai has outlined new Indian initiatives in the areas of geomagnetism and aeronomy. Such investigations should further our knowledge of the sun-earth connections well as probing the interior of the Earth.

At the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, a comprehensive study of present status of coastal ecosystems is emphasized to predict future conditions. The National Centre for Antarctic and Ocean Research (NCAOR), Goa has set a goal for itself during the International Polar Year as Polar Regions play a significant role in shaping the changing climate scenario of our planet. Indian initiative focuses mainly on the atmospheric science, palaeoclimate and marine biology of the southern oceans. The National Institute of Oceanography (NIO), Goa endeavours researches on several themes under the science and outreach programmes in the domain of Oceanography such as Oceans and climate including ecosystems and resources etc. The National Institute of Ocean Technology (NIOT), Chennai emphasises development of technologies for harnessing ocean energy.

The Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow is a nodal centre of research in Palaeobotany and allied Earth System Sciences. Palaeobotany began as a purely academic pursuit for the study of the past mega- and micro-plant remains to allow glimpses into the early evolution of life on earth, plant evolution through the geological past and its application to geologic problems. Such studies helped to build up a vast data bank and allowed diversification of research in Palaeobotany (including Palynology) to closely interact with allied Earth Science disciplines, such as sedimentology, micropalaeontology, geochemistry, geophysics, oceanography, etc. Integrative multidisciplinary studies emerging out of this interaction have enhanced knowledge of past life and its application in fossil fuel (oil and coal) exploration and palaeoclimate research. These are the major areas of global and national importance where palaeobotany (palynology and organic petrology) plays a significant role.

Palynological studies including biostratigraphy, biostratigraphy, biostratigraphy, palaeoenvironmental modeling, sequence biostratigraphy and source rock evaluation have proven their application in all the hydrocarbon (oil and natural gas) producing sedimentary basins of India. In Palaeoclimate research, reconstruction of past global climate/environment changes require retrieval of proxy biotic records from various continental and marine domains. Palaeobotanical entities (tree-ring, leaves, stomatal structures, pollen, organic matter, marine phytoplankton) are significant parameters to study global warming and climate change, vegetation dynamics, coastal vegetation, shoreline fluctuations, anthropogenic impacts and possibly effects of Tsunami in the recent past. Research activities being pursued at BSIP can be included in Science (Climate, Resources, Earth & Life) as well as Outreach programmes of the IYPE .

Significance of Recent Gravity and Isostatic Studies over Indian Lithosphere

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The knowledge of the density distribution in the earth's interior, is essential to map resources and to understand the structure & tectonics, involved in the geo-dynamic processes such as geological evolutions and earthquakes. Geophysical methods, particularly modelling of gravity data, have been extensively used for deciphering the same. It is well known that isostatic compensation of geological and topographical load produces a large wavelength gravity anomalies, thus Isostatic studies are used to resolve shallow density heterogeneities from gravity data in addition to study the long term (geological time scale) mechanical behaviour of lithosphere. In recent years we have recoded, processed and modelled thousands of terrestrial data to map the structure, behaviour and resources of the different parts of Indian lithosphere. Understanding of many frontier regions like collision and subduction zones e.g. Himalaya Sumatra etc. are complimented to the some extent by utilizing the new-generation of satellite gravity data. These studies, related to gravity and isostasy over Indian lithosphere can be categorised under two themes "*Earth's resources and its deep interior*" amongst ten identified themes of Science and Outreach programmes of *International Year of Planet Earth (IYPE)* and have potential to be considered as an important Indian contributions to IYPE.