Abstract Book

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INTRODUCTION

The International Year of Planet Earth-2008 has brought awareness not only in the society about the role of earth science but also among scientists of different domains to come closer and interact in the interest of common people as well as for integration of scientific research. India took a step forward by constituting "The Society of Earth Scientists" to bring scientists of different disciplines on a single platform and also to encourage them for outreach activities. SES also launched India's first e-Journal in earth sciences "Earth Science India- www.earthscienceindia.info" on 26th January, 2008, a quarterly open access journal. It received an overwhelming support from the scientific community across the globe and its new International addition was launched in January'11. Apart from peer-reviewed technical papers, it also publishes popular articles, News, Gallery etc. SES diversified its activities by organizing brain storming session, National conferences and other outreach activities. A National conference on 'Earth system processes and disaster management' was organized in Goa on September'2009 jointly with National Center for Antarctic and Ocean Research and Indian Institute of Technology, Kanpur.

Evidence from the geological record is consistent with the physics which shows that adding large amounts of carbon dioxide to the atmosphere warms the world and may lead to: higher sea levels and flooding of low-lying coasts; greatly changed patterns of rainfall; increased acidity of the oceans; and decreased oxygen levels in seawater. Life on Earth has survived large climate changes in the past, but extinctions and major redistribution of species have been associated with most of them. With the current and growing global population, much of which is concentrated in coastal cities, such a rise in sea level, will have a drastic effect on our complex society. It seems that as warming continues, some areas may experience less precipitation leading to drought. Climate prediction is difficult because it involves complex, nonlinear interactions among all components of the earth's environmental system. Furthermore, climate predictions have not demonstrated skills in projecting future variability and changes in such important climate conditions as growing season, drought, flood-producing rainfall, heat waves, tropical cyclones and winter storms. It is, therefore, imperative that scientists of different domains of earth science interact more vigorously and more frequently to come to a consensus about issues related to social importance.

The Executive Council of SES decided to organize another multidisciplinary conference on "Science of climate change and Earth's sustainability: Issues and

challenges" at Lucknow on scientists-people partnership. The delegates of the conference will also be involved in outreach activities apart from scientific deliberations. The main themes of the conference were selected in such a way to address all the domains of earth sciences:

1. Climatic changes in the geological history, impact on Earth, and imprints of Quaternary and recent climatic change as studied in glacial, fluvial and marine systems.
2. Indian monsoon and climate change
3. Atmospheric processes and climate change
4. Natural resource management- surface and ground water, mineral and fuel wealth.
5. Environmental pollution, solid-waste management
6. Green chemistry and related studies and impact on ecology and agriculture, forestry
7. Sustainable Development and renewable energy resources

Apart from various technical sessions a panel of eminent scientists will also discuss **"National strategies and plan for human and institutional capacity building in climate change".** An exhibition on 'Solar Energy' is also organized. As a part of outreach activities of SES a school children poster painting competition on **'Save your Planet'** is also being organized jointly with Regional Science City, Lucknow to aware young students about the treat of climate change and their responsibility. Delegates have also offered to deliver popular lectures in surrounding schools and to interact with students. School students will also be invited in the inauguration of the conference to witness scientists interacting on core topics of science so as they are encourage to have career in earth sciences.

The financial support received from the Ministry of Earth Science, Department of Science and Technology and Hindustan Aeronautics Limited greatly helped SES in organizing the Conference. Volunteer scientists of SES and other organizations and quality of technical papers received from delegates, show their commitment towards the society. We express our sincere gratitude to all of them.

Satish C. Tripathi
Usha Bajpai

UNDERSTANDING THE INDIAN MONSOON THROUGH FAUNAL AND GEOCHEMICAL SIGNALS SINCE THE EARLY MIOCENE

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The Indian monsoon is one of the most spectacular features on Earth marked by seasonally reversing winds. During summer (June-August), the monsoon winds are stronger and wet, whereas during winter (December-February) the winds are dry and variable. The summer and winter monsoon winds impact several parts of the Indian Ocean and its surrounding regions, driving important changes in ocean productivity and land vegetation. The summer monsoon rains are critical for food production, water supply and economic growth of the Asian societies. Thus the Indian monsoon constitutes a critical resource for the region's largely agrarian economies, as almost two-third of India's food production depends on summer rains, so are the rivers that cater to the domestic needs of the region.

Northern Indian Ocean marine records of upwelling and sediment deposition indicate that the Indian monsoon experienced abrupt changes with major intensification during the middle (12-11 Ma) and late Miocene (10-8 Ma). These changes coincide with a shift in the continental vegetation from dominant C_3 type to dominant C_4 type plants. Evolution of the Indian monsoon has been closely related to the uplift of the Himalaya-Tibetan plateau with a major intensification during 10-8 Ma. However, there are debates about the relation of the 10-8 Ma event with the elevation changes in the Himalaya-Tibetan plateau. The study presents a new faunal and geochemical dataset from the Arabian Sea that indicates major changes in the Indian monsoon during the early and middle Miocene. The elevated heat source of the Himalaya and the Tibetan plateau is of vital importance to the establishment and maintenance of the Indian summer monsoon circulation.

The Indian monsoon has varied on orbital and suborbital time scales. While long term changes in the Indian monsoon have been linked to the phased uplift of the Himalaya-Tibetan plateau superimposed by orbital changes, small scale, rapid changes as documented in late Quaternary and Holocene proxy records from marine sequences, speleothems, peat deposits, runoff in the Bay of Bengal, and fluvial sediments have been related to boundary conditions including Himalayan-Tibetan snow, North Atlantic variability, Eurasian temperatures, tropical sea surface temperatures, solar activity, vegetation changes, and linkages with the El-Nino Southern Oscillation, Indian Ocean Dipole or North Atlantic Oscillations. The late Quaternary and Holocene records of the monsoon from the Arabian Sea

indicate presence of North Atlantic events including Bond, Dansgaard-Oeschger (D-O) and Heinrich events, indicating that North Atlantic variability brings pronounced changes in the Indian monsoon on millennial time scales.

ROLE OF ECO-GEOMORPHOLOGY IN MANAGEMENT OF LARGE RIVERS: FOCUS ON THE GANGA RIVER

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River management strategies all around the world have moved from the engineering dominated *'command and control'* approach to an integrated *'ecosystem based approach'* that relies on synthesis of hydrological – geomorphological and ecological data. Attempts are now on to design engineering solutions using scientific framework of the river system as the basic template for human intervention. Over the years. the *'command and control'* approach has been followed in river management which is based on single purpose, deterministic approach, which remained focused on site or reach specific scales without serious consideration of upstream and downstream consequences and related connectivity issues. On the contrary, the *'ecosystem based'* approach is a cross-disciplinary, holistic approach applied at catchment scale - a probabilistic approach which recognizes uncertainty and complexity in the system. The physical template of a river system provides the basic structure to analyse the different aspects in an integrated approach. The ecological condition and biotic associations in a river are significantly influenced by geomorphic condition of the river, and therefore, any efforts towards river rehabilitation must address these issues to derive a long-term benefit. Such geomorphic diversity may be generated in various ways – discharge regimes and vegetation cover (driven by climatic setting), channel slope and bankline (driven by catchment morphology), sediment flux and accommodation (driven by geological settings). Recent research on river systems has also highlighted the importance of understanding controls on channel morphology as a basis for river management and rehabilitation work. River morphology not only varies from upstream to downstream in a particular system but also from catchment to catchment in a particular region. Characterisation of the geomorphic conditions of river systems provides the basic and first order data set for stream management programme.

This paper is based on our new results from a large programme on Ganga River Basin Management Plan (GRBMP) initiated by the Ministry of Environment and Forests has which aims to provide a basic framework for developing a river

management plan based on four fundamental premises: (i) river must continuously flow , (ii) river must have longitudinal and lateral connectivity, (iii) river must have adequate space for its various functions, (iv) river must function as an ecological entity, and (v) river must be kept free from any kind of wastes. This programme is being coordinated by IIT Kanpur with participation from all other IITs and several universities and institutions across the country. The geomorphic component of this programme involves (a) preparation and compilation of geomorphic map of the Ganga River and classification of the reaches in terms of their geomorphic condition, (b) mapping the patterns of river dynamics at different reaches and to understand the causative factors, (c) Generation of stream power distribution pattern of various reaches of the Ganga river and analysis of its variation in the Ganga River, (d) determination of the effects of river energy and sediment supply as controls on channel morphology, (e) assessment of the hydrological-geomorphological-ecological relationships to develop tool for monitoring river health and sustainable river management based on River Styles Framework, and (f) defining environment flow for different reaches on the basis of geomorphic conditions. The paper will discuss the most recent results on the development of river style framework for the Ganga River and geomorphic assessment of river health.

CONTROL OF CLIMATE AND TECTONICS AS EVIDENCED FROM GEOMORPHIC FEATURES OF NY-ALESUND REGION, ARCTIC

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Snow, ice, and glaciers play a significant role in providing some clue regarding the climate change as they shrink and expand in direct response to the climatic fluctuations. The glaciers in the Arctic have undergone many major and minor changes in its spatial extent, which is evidenced by the presence of lateral and recessional moraines occupying different elevations and positions. The surface processes and the related landforms can be identified on the basis of facies association, sedimentary structures, granulometric parameters and geomorphic location.

Ny-Alesund located in Spitsbergen, Arctic exhibits complex topography and geomorphic features evolved under direct control of climate and tectonics. The geomorphic features such as moraines, alluvial fans, channel bars, lacustrine features,

delta, and marine terraces are evolved by glaciers during glaciations and by mass movement, fluvial, lake, delta, and sea respectively during deglaciations.

The landforms were analysed on the basis of field documentation of this area. The terrestrial valley glaciers of this region are characterized by convex wrinkled surface, crevasses, bergchrunds, supraglacial streams, longitudinal debris strips, lateral moraines, recessional moraines, hummocky moraines, thrust moraines, convex longitudinal profile with break in slopes, fractures and joints. The surging of glaciers modifies the evidences of the preexisting glacier events. Therefore the surging glaciers provide very little information about the advance and retreat of the glacier and so the climate change. The moraines and outwash plain deposits are made up of clast to matrix supported boulders with varying clast, matrix, and gravel size. The matrix supported facies capped by clast supported facies indicate the increasing energy of the glacial and so the cold climate. The bimodal palaeocurrent pattern suggests two prominent directions for the movement of glaciers in the past under direct control of tectonic activity. The granulometric analysis of the streams indicates that the mean grain size decreases from origin to the middle reaches of the river whereas it again increases near its mouth. The percentage of the finer sediments decreases and coarser fragments increases in the downstream direction. The granulometric parameters which are contrary to the normal fluvial system are due to the tectonic events.

The present study provides the basic characteristics of the surface processes of this area and explains that theses environments indicate the control of tectonic activity in this region and very little about the climate change.

CLIMATIC CHANGES AND ITS IMPACT ON THE HIMALAYAN GLACIERS

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It is now a well-established fact that the glaciers are receding by and large worldwide. Warmer climate in the future may cause increased melting of glaciers which will lead to a rise in sea level. Changes in climatic trends is clearly reflected in mass and temperature changes of glaciers and permafrost. The work deals mainly with the climatic changes and its impact on the Himalayan glaciers based on the study of landforms formed by various stages of advance and retreat of the Chorabari (in the Kedarnath Temple area), Dokriani, and Gangotri glaciers, Garhwal Himalaya and Chota Shigri glacier, H. P., and dating of various cycles of their advance and retreat by lichenometry. It has been found that Glaciers have advanced and retreated many times in the past as a part of Natural Cycles of Warming and cooling, with absolutely no

connection to humans and/or the atmospheric concentration of greenhouse gases. To pronounce that glaciers are responding to anthropogenic CO2 seems to disregard their behavior during periods when human activities certainly had no impact.

ASSESSING THE IMPACT OF CLIMATE CHANGE ON SURGING GLACIERS: A CASE STUDY IN SHYOK VALLEY OF KARAKORAM HIMALAYAS, J&K STATE, INDIA

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Ever since the last glacial maxima, the snow and ice fields are on a decline. The glaciers all over the Himalayas are on a continuous retreat, diminishing both in their shape & size and the stored water content. The large glaciers have reduced in size while the smaller ones are either on the "verge of extinction" or have already melted off. In this glooming scenario of global warming, an altogether new phenomenon of 'surging glacier' have been monitored in Shyok valley of Karakoram Himalayas in the N-E extremity of J&K state in India.

Four groups of glaciers namely the Rimo group, Chong Kumdan, Kichik Kumdan and Aqtash glaciers on the right bank of Shyok River have been studied. These were last studied and reported in 1958 by V.K.Raina and no data has been generated since then. In the present exercise, in additions to SOI topographical sheets surveyed in 1975, multi-date satellite data pertaining to each year from 1990 to 2009 have been visually and digitally analyzed. The actual configurations of each of these compound glaciers have been delineated and then superimposed using GIS technology to monitor the temporal variations in frontal parts of these glaciers.

Rimo Glacier

This is a complex basin glacier having two distinct limbs – the northern limb and southern limb. Each of these limbs behaves in a different manner but both demonstrate the phenomena of surge in recent times. Survey of India topographical sheets of 1962 have been taken as the base data for reference and successive variations have accordingly been monitored. With respect to 1962, the 1990 satellite data demonstrate that during this period there has been a retreat of 1.0 km. in the northern limb. This limb continuously shows an advance from 1990 to 1997 to the tune of 1.8Km and then after it again shows retreat. The southern limb of Rimo glacier shows an advance (surge) of

approx. 0.285 km between 1962 and 1990. Then after glacier retreated to the tune of 0.230 km upto 1997. Subsequently, the southern limb experiences surge during 1997 to 2001 by 0.670 km and during 2001 to 2008 it again shows retreat.

Chong Kumdan Glacier

This glacier has three prominent limbs, the northern, central and southern. The 1975 topographical sheets demonstrate that all the three limbs are merging together to form a single snout. The 1990 satellite data shows that the northern and the central limbs still remain merged together while the southern limb shows a slight retreat. The relative retreat of the northern, central and southern limbs between different years have been monitored in the present investigation.

The Northern limb has demonstrated alternating advance and retreat in subsequent years upto the year 2004. Between 1990 and 1992 this shows a retreat of approx. 50 m. while between 1992 and 1996 this limb advances by approx. 300 m. Subsequently, this again shows a retreat of 300 m. between 1996 and 1997. This surge and the retreat phenomena is continuous until 2004, where after between 2004 and 2005 this northern limb shows an abrupt advance of almost 1100 m. In subsequent years this frontal part of the northern limb gradually retreats back until 2009. On the whole, the northern limb shows an overall surge of approximately 2278 m. between 1997 and 2009.

The Central limb show pre-dominantly retreat phenomena upto 2001 and then after there is a continuous surge in the frontal part of this limb. Between 2005 and 2006 this frontal part has advanced by almost 500 m. and then again between 2006 and 2007, this has further surged by another 450 m. This limb starts to recede back between 2008 and 2009.

The Southern limb also has a history of relative oscillations during the period of observation. This advances upto 1996 and then retreats back upto 1999. Between 1999 and 2000 this again advances by almost 370 m. where after the frontal part against recedes back. Between 2003 and 2004 this again shows surge while between 2004-05 and 2005-06 this again retreats back. From 2007 onwards this limb shows a continuous surge of approx. 400 m.

The coalescence of northern and central limb of Chong Kumdan glacier has given rise to a very distinct medial moraine. The central limb pushes the northern limb upto 1997 where after the trend changes and the northern limb starts surging ahead and pushing the central limb. This is clearly demonstrated by the shifting of the medial moraine by approx. 2200 m. over a period between 1997 and 2009.

Kichik Kumdan Glacier

This glacier has a northern limb and southern limb. The 1975 topographical data shows that both limbs merge together to form a single snout. The northern limb shows a marked retreat of 0.53 m during 1990 to 1997. The frontal lobe of the glacier shows interesting phenomena. The 1975 topographical sheet demonstrates that the frontal lobe is pushing the Shyok River to the left bank. Between 1975 and 1990 this frontal part has

receded by almost 750 m. Except for a small period of advance this lobate front shows a continuous retreat upto 1997. Between 1997 and 1999 this shows an abrupt surge of approx. 800 m. This further advances by another 400 m. upto the year 2000. Then after the frontal part starts receding back and except for a slight surge between 2003 and 2004 this frontal part continuously recedes back until 2009. On the whole the frontal part of Kichik Kumdan glacier shows an advanced stage in 1975, a retreat of almost 800 mtrs. between 1975 and 1990, an advance of approx. 1200 m. between 1997 and 2000, and then again a retreat of approx. 550 m. between 2000 and 2009.

Aqtash Glacier

This is a single limb glacier and the multidate satellite data indicates a sort of oscillatory behaviour in it's frontal part. On the whole the glacier shows a retreat of approx. 300 m. between 1975 and 1992. Notwithstanding the minor retreats noticed in between, the frontal part shows a surge of more than 800 m. between 1993 and 2003. Then after this recedes back upto 2006 but then after this glacier again shows a continuous surge up-to 2009.

On the whole, these four glaciers show a sort of cyclicity in their behavior. Each of these glaciers advance for a couple of years, remain standstill for some time and then retreat for another couple of years before again reverting back to the advancing position. This advance and retreat cyclicity has been continuously going on and perhaps the periodicity of the cyclicity is also well defined for each of these glaciers. However concrete evidences of a regular periodicity would be established only after a longer data set is analyzed.

All these four glaciers of Shyok valley demonstrate independent characteristics and show no uniform trend or tendency. Since Shyok valley is a confined valley in the part of Karakoram Himalayas, it could be presumed that the overall climatic variations in the valley would be more or less of the same order. Moreover, the frontal part of these glaciers are also in the same elevation ranges and hence altitudinal variations is also not much. The causative factors for the surging phenomena in these four glaciers is hence still not well understood, but one aspect is quite clear that **climate change is perhaps not the causative factor for the surging phenomena**. A great more effort and investigations are required to be able to comprehend the reasons for this exceptional glacial phenomena.

GLACIAL-INTERGLACIAL PRODUCTIVITY FLUCTUATIONS FROM INDIAN ANTARCTIC POLAR FRONT OF SOUTHERN OCEAN

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Southern Ocean (SO) plays a pivotal role in regulating glacial-interglacial variability of atmospheric CO_2 due to deep-water masses protrusion and exchanges of gases with the atmosphere. The circumpolar connection in the SO permits a global-scale overturning (thermohaline) circulation to exist. Diatoms are dominant primary producers in SO and play decisive role in global cycling of silicic acid and carbon. Their cell sizes determine carbon sequestration efficiency as large cells export disproportionately large amount of carbon to the ocean floor due to their faster sinking and slower dissolution. Diatom *Fragilariopsis kerguelensis* is endemic to SO and its abundance reaches up to 90% of the total assemblages in surface sediments. Due to its abundance and good preservation in the sediments, it can be used as a potential proxy to decipher the cycling of nutrients and productivity fluctuations through glacial-interglacial cycles in SO. Therefore, we present biometric investigations of *F. kerguelensis* from a well dated core SO136-111 from Indian Antarctic Polar Front (APF) of SO over the last 40,000 years. Apical length, trans-apical length and valve area of *F. kerguelensis* are compared to its absolute and relative abundances as a proxy for the species productivity, along with sea surface temperature and sea ice duration reconstructed through diatom-based transfer function by applying modern analogue technique.

Downcore records demonstrate that *F. kerguelensis* valves were longer and more abundant during the Holocene than during the glacial-deglacial period which is opposite to the records of Atlantic sector of SO. The opposite records in the Indian and Atlantic sectors of the Southern Ocean may indicate that different factors regulated diatom biology in these basins. In the Atlantic sector, longer *F. kerguelensis* during the last glacial period may have resulted from greater iron availability from melting ice [Cortese and Gersonde, 2007]. In the Indian sector where little ice melt was registered during the glacial period, longer *F. kerguelensis* during the Holocene may have resulted from the prevalence of warmer oceanic conditions and greater upwelling, which is more favourable for sexually-induced production of long initial cells. Instead of being opposite records, both these studies argue against the high opal fluxes recorded during

the 10,000-17,000 years BP period in the Southern Ocean and attributed to enhanced wind-driven upwelling [Anderson et al., 2009].

WAS MID-BRUNHES CLIMATE SHIFT (MBCS) A RESPONSE TO ECCENTRICITY MINIMUM REPEATED AT EVERY 400-KA IN THE LAST ~3 MILLION YEARS?

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Mid-Brunhes Climate Shift (MBCS) at ~300 ka (kilo-years) was first recorded as a conspicuous change in the variation of eolian grain size data from northwest Pacific in the early eighties. Since then, it is recorded in several climate proxies, i.e., planktonic foraminifers, radiolarians, magnetic susceptibility and the calcium carbonate content in the world oceans. Recently, the MBCS are reported from the radiolarians/g data, and subsequently in planktonic foraminiferal variation from equatorial Indian Ocean. Here, we analyze radiolarians/g dry sediment, organic carbon, particle mean size data from a sediment record in the central Indian Ocean, and the differential summer solar insolation at 30^{o}N-30^{o}S, precession, and Earth's orbital eccentricity by continuous wavelet (Morlet) transform (CWT) spectrum to study the variation in the strength of power through the time, which are associated with orbital forcing responsible for MBCS event. Results suggest that strength of the spectral power associated with insolation cycles due to its precession (23-ka) and eccentricity (126-ka) components weakened during the MBCE. Thus, the weakening of insolation might have resulted in climatic events similar to MBCS in the geological past. Analyses of our data, published data, orbital eccentricity and the solar insolation suggest that possibly, there were possibly seven climate shifts (S1-S7) similar to MBCS, at almost regular interval of ~400-ka cycles in the last 3 million years (Ma).

EVOLUTION OF SUBGLACIAL DRAINAGE SYSTEM IN HIMALAYAN GLACIERS DURING ABLATION SEASON- A CASE STUDY FROM BHAGIRATHI BASIN OF GLACIERS, GARHWAL HIMALAYA

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Himalayan rivers are the continuous source of water because of having huge amount of snow and glacier covered areas. Runoff contribution from the glaciers to Himalayan rivers starts in the month of May after depletion of accumulated seasonal snow, depending upon the climatic conditions. Presently, Himalaya is under increasing pressure due to growing demand for fresh water in the country due to increasing population and industrial development. Hydrological investigations of Himalayan glaciers become inevitable because of their importance mainly as water resources, as well as in hydroelectric power generation. Number of projects like Bhakra at Satluj and Tehri at Bhagirathi and other Runoff river projects heavily depend on melt runoff generated from melting of snow and glaciers. Melt contribution from these glaciers continues till October. To understand melt generation processes from glaciated basins, two glaciers from Bhagirathi basin have been selected for the present study. Gangotri and Dokriani are well known glaciers from Garhwal Himalaya, dimensions of these two glaciers are different, so comparative results also suggest the general picture of melting processes. Analysis of discharge and air temperature suggested that melt-water generated from these glaciers come into sight as runoff with different time–lags during ablation season (May-Oct). In order to understand this, hourly temperature and discharge data were collected near the snout of the glaciers (3800 m.a.s.l) for the entire ablation period (May-Oct). In the early stages of advancement of ablation season, merge drainage network due to the seasonal snow cover resulted runoff with higher time lag at snout. The time-lag is reduced with the advancement in melt season because of the efficient and well developed drainage network. The channelized drainage system results due to the exposed ice surface, reduction of snow covered area and snow depth.

CLIMATE-TECTONIC CONTROL ON ALLUVIAL FAN SEDIMENTATION IN THE PIEDMONT ZONE OF THE WEST GANGA PLAIN

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In the Piedmont Zone (PZ) of the western Ganga Plain, two different morphostratigraphic surfaces, separated by an erosional contact, have been identified on the alluvial fan of the Malin River. The lower surface extends up to the distal part, whereas the upper surface is restricted only to proximal and medial parts of the fan. The lower surface comprises facies of dominantly the sediment-gravity flow and fluid-gravity flow processes in the proximal and mid fan areas. In the distal part, however, the lower part of the lower surface comprises facies only of sediment-gravity and fluid-gravity flow process, whereas the upper part comprises only the fuvial facies. The upper surface, on the other hand, is dominated by sediment-gravity flow facies in the proximal area, and sediment-gravity and fluid-gravity flows facies in the mid fan area (i.e. the distal part of this upper surface).

These two stratigraphic surfaces represent two different evolutionary cycles of the fan. The older cycle represented by the lower surface was formed under the conditions of ample water availability, corresponding to wet climatic conditions, during which sediments were transported and deposited up to the distal fan area. In contrast, the younger cycle represented by the upper surface was formed under the conditions of less water availability, corresponding to the dry climatic conditions, when the sediments were deposited mainly by sediment gravity flows under intermittent short lived events of high rain fall. These flows were not powerful enough to carry the sediments for longer distances down the fan.While the flushing out of sediments from the drainage basin is climatically controlled, the sediment production seems to be controlled by tectonic and climate driven processes.

Presently, the water flow of the Malin river is confined to a single channel entrenched by a few meters up to the medial part of the fan due to activity along the Himalayan Frontal Thrust (HFT) passing through the proximal part of the fan. Thus, the fluvial and fluid-gravity flow processes are not depositing sediments on the fan surface.

HOLOCENE ENVIRONMENTAL MODIFICATIONS ALONG THE SOUTHWEST COAST OF INDIA: AS INFERRED FROM THE MULTI-PROXY ANALYSIS OF PALAEO-DEPOSITS OF MEENCHIL RIVER, KERALA, INDIA

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The morphology and behaviour of a large number of rivers completely changed during the climate changes of Quaternary times. The Quaternary sea-level changes caused for the channel shifting of many rivers. Neo-tectonism has also had its influence in the fluvial systems and this metamorphosis reflected great changes of discharge and sediment load. Earlier studies suggested that the sea level along the southwestern part of the coast stood around 60–100 m below the present msl during the last glacial maxima (around 20,000YBP) and the rivers flowing at that time incised their valleys to this base level. Later, during the Holocene, a prominent event of marine transgression (8000-6000YBP) and another event of regression (5000-3000YBP) were occurred along Kerala coast. Geomorphological modifications were also recorded according to these sea level changes and contemporaneous tectonism. It was evident that the river systems of Kerala might have affected by these geological processes. The remarkable presence of palaeodeposits in the lower reaches of Meenachil River led to an investigation into the palaeoenvironmental conditions and nature of deposition of these deposits. The textural analysis showed that palaeo-deposits of sand characteristically exhibit different sets of depositional environment suggestive of marine transgression and regression episodes. It is also suggested that the region might have experienced structural disturbances leading to the phenomena like river avulsion and channel abandonment. The radiocarbon dating of the samples revealed that the age of the palaeo-deposits is fairly older than the age of formation of the Vembanad Lake. The evaluation of the organic carbon, nitrogen and the C/N ratio of the embedded carbonaceous clay suggested that the deposits were formed by terrestrial plants and the region had experienced high intensity rainfall during the earlier part of the Holocene. The evaluation also suggested a fairly relevant shift of the Meenachil main channel from south to north. The occurrence of *Bombax ceiba, Terminalia* sp, *Bauhinia* sp. pollens from the sedimentary layers showed the presence of nearby deciduous forest formed due to possible conversion from evergreen forests due to the changes in atmospheric and environmental conditions.The palaeo-palynological studies suggested a dry climate during the later part of the Holocene. On the other hand, the analysis of the embedded

carbonized woods in palaeodeposits of sand suggested a highly productive environment during the early - middle Holocene. The assemblage of *Artocarpus*, *Holigarna* and *Canarium* indicated that the area was covered by dense forest and the area witnessed the high intensity rainfall. Later, the region experienced dry climate, as revealed from the later deposition of *Spondias*. However, occurrence of *Sonneratia*, specially indicated the proximity of sea in the area at the time of deposition. Obviously, the sea level was much higher at that time than at present and the sea had receded then.

CLIMATE AND SEISMICITY IN THE LAHAUL AND SPITI, NW HIMALAYA DURING THE LAST 25 KA: EVIDENCES FROM YUNAM BASIN, INDIA

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Two aspects make the area around the Baralacha La, H.P. (altitude 4,573m) significant from the viewpoint of tectonics and climate. Firstly, it is situated in the north of the Pir Panjal a domain which is considered to have undergone the active tectonic uplift from Miocene to the Late Cenozoic times. Further, it is positioned on the northern margin of the Intertropical Convergence Zone (ITCZ).

Since the higher north-western Himalaya receives most of its moisture from the westerlies, it becomes climatically a sensitive area where changes in the strength of monsoonal circulation system and its influence on hillslope processes can be evaluated. Presently, the westerlies are responsible for dominant source of precipitation (about 75% of annual) at Baralacha Pass, the surroundings of which are characterized by sharp temperature contrasts between sunny and shady slopes, high diurnal temperature variability, temperature inversions and variability in rainfall. The Baralacha fault was responsible for damming the Yunam Tso due to the tectonic upliftment around >ca. 25.3 ka BP. Quaternary climate change of the region is summarized from proxy records. In order to reconstruct the possible monsoonal impact on the hydrological system of the Yunam lake basin during the last 25.3 ka BP, we studied the geomorphology of the basin and combined the results with multi-proxy records from Yunam varve sediments. Major analyses on the 7.56 m long varve palaeolake profile comprise geochemical data (multi-elements, high-resolution X-ray fluorescence, XRF), mineral composition (XRD), mineral magnetism (χ, S-ratio), soft sediments and carbon isotope (C_3 and C_4 vegetation). The results indicate the maximum glacier advance falls within the period between ca. 20.1-17.5 ka BP. The last glacial maximum was cool and dry. The climate

was controlled by westerly air flow under cold and dry conditions. Climatic amelioration, the post LGM warming seem to have taken place ca. 17.5 and 12.5 ka BP, can be suggested to document strong chemical weathering, strong hydrodynamics and organic enrichment in the lake under the raised precipitation conditions. A weak monsoon between ca. 12.5 and 11.3 ka BP is inferred by the presence of low Kaolinite, Illite, LOI, SiO_2 and high Muscovite, K, Ti, Fe, MgO, TiO_2, Na_2O and positive $\delta^{13}C$. The lake level started to rise from about ca. 11.3 ka BP onward due to intensified glacier melt and the onset of summer monsoon moisture supply. Summer monsoon influence weakened after ca. 10.8 to 7.2 ka BP and fostered a return to dry conditions with the increasing influence of westerly disturbances. The period between ca. 7.2 and 5.8 Ka BP is interpreted as strengthening of monsoon, chemical weathering, accumulation of fine grained material and eutrophic conditions and may suggest high precipitation regime. The lake shrank gradually after ca. 5.8 ka BP towards its lowest stand at about ca. 4.2 ka BP, as an abrupt decrease in monsoon precipitation. Our results indicate that the orbitally driven regional climate variability is well reflected in the Yunam basin by hydrological cycles. Extensive summer monsoon moisture seems to have influenced the area only during the early Holocene.

The soft sediment deformation structures from four prominent horizons within the profile, approximately ca. 25.3-24.8 ka BP, ca. 20.8-19.5 ka BP, ca. 18.0-17.5 Ka BP, and ca. 12.5-12.0 ka BP in age are incorporated. These dates constrain the palaeoseismic activity during Quaternary as manifestations of the ongoing tectonic processes.

SIMULATION RESULTS FROM A MATHEMATICAL OCEAN MODEL

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A z-coordinate numerical ocean model with free surface rigid lid approximation has been implemented for global domain and driven at surface by NCEP/NCAR wind stress climatologies and executed for 25 years. Several results of interest were studied mainly for the Southern Indian Ocean region spanning from 60°S-10°N, 30°E-120°E including Antarctic Circumpolar Current (ACC) region (40°S to 60°S). The fidelity of the model is examined for sub-surface horizontal circulation, sub-surface vertical velocity (overturning circulation), transport phenomenon, heat fluxes including statistical estimation for Sea Surface Temperature (SST). Statistical estimation of SST

include studying Model Error (ME)(bias), Root Mean Square Error (RMSE), Correlation coefficient (R) and Skill Score (SS). The results show high correlation over the region of study between model/observed SST with annual mean error between 0 to 1° C. It is noticed that in the upper ocean, the zonal transports are eastward that may directly follow the surface currents.

MONSOON AND CYCLONES: ROLE OF CLIMATE CHANGE

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Monsoon and cyclones are the two prominent meteorological attributes of the Indian subcontinent. The southwest monsoon contributes about 60-80% of the mean annual rainfall of various meteorological sub divisions, where as the northeast monsoon contributes to the rainfall of the southeast peninsular India region. There are important aspects which make each monsoon unique, they are the a) monsoon onset over Kerala b) activity within the monsoon life cycle (i.e active and break in monsoon conditions) and c) the quantum of monsoon rainfall. Out these it is the activity within the monsoon life cycle which decides the fate of each monsoon. A prolonged break can cause severe droughts as is the case in recent years of 2002 and 2009. Causes of disruption in monsoon rainfall during the peak monsoon months of July and August for the period 1951-2007 are investigated using a suite of in situ, satellite and reanalysis data sets. Most of the prolonged breaks in recent decades were associated with convective activity over southern hemispheric equatorial trough region (SHET). The association between prolonged break events and convective activity over Bay of Bengal, SHET and North West Pacific (NWP) regions were further explored. The convective activity was found to be more intense over SHET and NWP during the prolonged break in monsoon conditions. Further, it was found that the number of convective systems over NWP were twice the number of systems in Bay of Bengal during deficit and break in monsoon conditions. Thus it is found that the ocean atmospheric processes over the tropical Indian Ocean was found to play a major role in the prolonged break events in recent decades over the Indian subcontinent.

The cyclones over the north Indian Ocean form during two seasons, namely a) pre monsoon season and b) post monsoon season. In the present study we look at the role of the various ocean atmospheric parameters on the cyclogenesis of the convective systems over the north Indian Ocean. Further, we have looked at mostly only on the Bay of Bengal region as the bay has about 2 to 3 times more convective storms than the Arabian Sea. An analysis of the various cyclogenesis parameters over the Bay of Bengal

during the recent decades has shown that there is a decreasing trend in the number of convective systems, even though the sea surface temperature (SST) is showing an increasing trend in recent decades (1951-2007). We feel that the environmental parameters such as vertical shear of the horizontal wind between lower and upper troposphere, mid tropospheric humidity and low level relative vorticity all play an equally important role as the oceanic parameters such as SST and oceanic heat content.

OCCURRENCE OF EXTREME RAINFALL EVENTS IN GLOBAL WARMING SCENARIO AND SATELLITE INPUTS FOR PRECAUTIONARY MEASURES

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In the present scenario of global warming and climate change, extreme rainfall events are observed frequently at various places over the Indian region. Due to occurrence of such unusual phenomenon there is demand from public for precise short-range forecast to overcome the grievances likely to occur. As we recognize, the major part of Indian land mass is prone to several natural disastrous events with east and west coasts being affected by super cyclonic storms, deep depressions and severe off shore vortices. At present, the focus of disaster management community is increasingly moving towards effective utilization of emerging technologies such as satellite remote sensing for monitoring potential impacts.

Here, in the present study, we have highlighted potential utility of satellite data at pixel resolution to get maximum details of convection of any weather system which is not received from operational data of IMD i.e. OLR observations at very high resolution. In our study we have shown how very high resolution OLR data can give indication of major convection for occurrence of extreme rainfall event. Here, especially recent severe weather development cases at Koyana Dam area, Mumbai region and Leh hilly-surroundings are studied to get feedback for early warning.

At present, Doppler radar is installed at Navy complex, Mumbai for getting instantaneous information of convection and precipitation rates of any atmospheric system. This will give the range of 400 km from the coast. However, if genesis and development of such system is beyond 400 km then we have to depend upon digitized data obtained from INSAT satellite. In this study, particularly, INSAT pixel data at a high temporal and spatial resolution is used for the unique case of exceptionally heavy rainfall of 26 July 2005 at Santacruz. In case of excessive rainfall event over Santacruz it is seen from the satellite synergy that integrated water vapor (60 mm), cloud liquid

water content (0.3 mm), deep convection (85 W/m²) and precipitation rates (50 mm/hr) were of maximum value in the region of vortex when TRMM satellite was passing over Mumbai region. Thus we understood that effective utilization of high resolution satellite data could promise to disseminate disastrous information in real time to public to mitigate the damage likely to occur in disaster prone area.

WEAKENING OF SUMMER MONSOON RAINFALL OVER CENTRAL NORTHEAST INDIA

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Indian summer monsoon rainfall (ISMR), contributing around 3/4th of the annual precipitation is the manifestation of land-sea thermal contrast between the Asian land mass and tropical Indian Ocean. The summer monsoon rains are critical for agriculture, water supply and the general economic well-being of the society. Despite being a most studied phenomena in the tropics there is no consensus on the trend of monsoon in context of the global change. Inconsistency in GCM simulations of ISMR reflects incomplete understanding of the monsoon system. High spatial and temporal variability indicated in instrumental and proxy records underscore the need of high-resolution monsoon records and other variables that drive the monsoon. Distinct inverse relationship between tree ring derived precipitation with dominant winter-spring precipitation signal in the Trans-Himalayan region and summer monsoon rainfall over the central northeast India has been found. The increasing trend in winter-spring precipitation over the 20th century implies to the ISMR weakening in context of the past seven centuries and is consistent with other proxies from the Himalayan region. If this trend continues, it will have serious implications on water availability and food security of the country.

TREND IN MID- LATITUDE WESTERLY TROUGH AT 500 H PA AND IN EXTREME SUMMER MONSOON OVER INDIAN REGION

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In this paper, quantification of Mid- Latitude Westerly Trough Index called as (MWTI) is derived by using the Principal Component Analysis (PCA) technique on daily basis, over the Indo-Pak region and over North West Indian for the period 1957-2002. The gradient between (PC1+PC2) time series of daily geo potential field of the first region and second region is calculated during the Indian summer monsoon period (June- September) and these index referred to as Mid- Latitude Westerly Trough Index (MWTI). The trend analysis of MWTI in extreme monsoon years i.e. in drought and flood monsoon years have been studied and it is observed that the intrusion of westerly trough is showing the significant negative trend in drought monsoon year, while in flood monsoon it shows a significant positive trends. The trend analysis of upper troposphere temperature is also studied simultaneously. It is seen that cold temperature anomalies is present over NW Indian region in drought monsoon year while it is reverse in flood monsoon years. The study was further carried out the relationship between daily North Atlantic Oscillation Index (NAOI) and MWTI in same period. The analysis suggested that during the weak phase and active phase of monsoon the relationship between NAOI and MWTI is an reverse and statistically significant. This relationship is concurrent and may be useful for explaining the role of NAO activity and intrusion of mid-latitude troughs over the Indian region, which affects the rainfall variability during the monsoon period.

LONG TERM TREND OF HEAVY PRECIPITATION OVER NORTHWEST HIMALAYAS

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In the Indian subcontinent context, Himalaya governs the climate and weather of the region and drive the major weather system like Western Disturbances (WDs) during

winter time and monsoon phenomenon during summer time. The WDs influence the life of northwest Himalaya by causing heavy precipitation and subsequent avalanches over the region. Also, the impact of the weather events are enhanced by topography of the region, which makes the area more prone to cloud bursts, flash floods and landslides. Therefore, study of heavy precipitation is very important for this region.

In the present study, frequency of rather heavy (>24.4 mm) and heavy (>64.4 mm) precipitation events over northwest Himalaya has been studied using the available long term meteorological surface data (1901-2010) from India Meteorological Department (IMD). Three stations namely Srinagar, Qazi Gund and Banihal stations over northwest Himalaya have been considered due to their consistent long term daily data.

The study shows that the frequencies of rather heavy precipitation events are maximum in the month of March over all the three stations. But in case of frequencies of heavy precipitation events, Qazi Gund and Banihal receive in the month of March and the Srinagar receives in the month of December. The least number of rather heavy and heavy precipitation events occur in month of October over Qazi Gund and Banihal and in month of November over Srinagar. November month was found free from heavy precipitation events over Srinagar and in October over Banihal. Analysis of data shows that there is an increasing trend in rather heavy and heavy annual precipitation events over Srinagar and decreasing trend over Banihal and Qazi Gund.

Seasonwise, there is an increasing trend in rather heavy precipitation events over Srinagar in all the seasons except winter. However, trend is statistically significant (95% confidence level) for post-monsoon season only. But in case of Banihal, there is opposite trend in rather heavy precipitation events, which shows a decreasing trend in all the seasons except winter. Over Qazi Gund, trend is increasing for winter and monsoon seasons and decreasing trend for pre-monsoon and post-monsoon seasons. Trend of heavy precipitation events also studied in the paper. Results are presented in detail in the paper.

IMPACT ANALYSIS OF CLIMATIC CHANGE ON RAINFALL PATTERN USING CLOUD IMAGES

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Water is elixir of life. So rainfall becomes the inevitable part of every nation which decides the prosperity and economic scenario of a country. In this fast moving world, estimation of rainfall has become a necessity especially when the global heat

levels are soaring. The approach here is to use the digital cloud images to predict rainfall. Considering the cost factors and security issues, it is better to predict rainfall from digital cloud images rather than satellite images. The status of sky is found using wavelet. The status of cloud is found using the Cloud Mask Algorithm. The type of cloud can be evolved using the K-Means Clustering technique. As per previous research works done by the researchers, it is stated the Nimbostratus and Cumulonimbus are the rainfall clouds and other clouds like cumulus will produce rain at some rare chances. The type of rainfall cloud is predicted by analyzing the color and density of the cloud images. The cloud images are stored as JPEG file in the file system. Analysis was done over several images. The result predicts the type of cloud with its information like classification, appearance and altitude and will provide the status of the rainfall. The approach can be utilized by common people to just take the photograph of cloud and can come to conclusion about the status of rainfall and to get the desired detail. Temperature changes vary over the globe. Evidence for warming of the climate system includes observed increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. Our proposed approach mainly focuses on the cloud images. Here we analyze the status of the cloud in previous years, current year and forthcoming years due to the increase in temperature.

STRONG REDUCTION IN THE INDIAN SUMMER MONSOON AROUND 2 KYR BP: EVIDENCE FROM $\delta^{18}O$ IN STALAGMITES FROM ANDAMAN ISLANDS

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Indian sub-continent has a typical systematic precipitation pattern, during summer monsoon which lasts for about a quarter of a year, intense clouds formed over surrounding oceanic region travel inland and rain over dry and parched continent leading to good agriculture necessary for the survival of large and densely populated area. Over the years sometimes this has failed that led to severe drought, influencing economy and food scarcity in the area. Knowledge of occurrences of large scale monsoon failures in the past is essential to understand the causative processes, eventually for better prediction and management in figure. Stable oxygen isotopic composition ($\delta^{18}O$) of precipitation in the tropics depends on the amount of rainfall called "amount effect". Therefore, $\delta^{18}O$ preserved in natural archives such cave carbonate deposits (speleothems) can be used for past rainfall reconstruction.

Two stalagmites from Baratang cave in Andaman Islands have been investigated for the temporal variations in $\delta^{18}O$ to reconstruct Indian summer monsoon during last ~3 kyr. During 1850-2100 cal BP, strong reduction in the monsoon (by more than 33%, compared to the present) is recorded in the islands; this seems to have occurred wide spread as similar events are registered in the other paleoclimate records located in the monsoon affected areas. Also low monsoon like situation is observed during 1500-1650 and 450-650 cal yr BP. During the last ~3kyr, the strongest rainfall (~6 % more than the present), was observed during 900-1300 cal yr BP and the monsoon has remained unchanged during the recent ~400 yrs. This is the first continuous high resolution paleomonsoon records of the late Holocene (last ~3 kyr) from the Andaman Islands using stalagmite $\delta^{18}O$.

ANNUAL AND SEASONAL TRENDS IN METEOROLOGICAL PARAMETERS OVER INDO-GANGETIC PLAINS DURING 1961-2008

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Due to its possible effects on human being, climate change has been a significant topic of research in recent years. Trend analysis of meteorological parameters is a basic tool to understand the climatic variations in time. The Indo-Gangetic Plains (IGP) is a very important region of India from the food security point of view. In this study, trends of some meteorological parameters over the IGP during the period 1961-2008 are studied. The stations selected are Amritsar, Ambala, New Delhi, Gwalior, Lucknow, Allahabad, Varanasi, Patna, Kolkata and Guwahati. The calculated annual and seasonal trends in temperature, rainfall, relative humidity, total cloud cover, sunshine duration and wind speed are tested at 95% level of confidence using Student's t-test. The results show that annual mean maximum temperature is significantly increasing at Gwalior (+0.1^{o}C/decade) and Guwahati (+0.2^{o}C/decade) and significantly decreasing at Amritsar (-0.2^{o}C/decade), Ambala (-0.2^{o}C/decade) and Kolkata (-0.1^{o}C/decade). The rate of increase in minimum temperature is significantly higher in the IG plains where except Amritsar and Ambala (both decreasing significantly at -0.1^{o}C/decade) all other stations are showing increase in minimum temperature. Annual mean minimum temperature is significant increasing at the rate +0.1^{o}C/decade at New Delhi and Gwalior; at the rate +0.2^{o}C/decade at Allahabad, Patna, Kolkata and Guwahati; at the rate (+0.3^{o}C/decade) at Lucknow. The annual diurnal temperature range (DTR) is significantly decreasing at

Lucknow, Allahabad, Patna and Kolkata. Both morning (0300 UTC) and evening (1200 UTC) annual mean relative humidity trends are significantly increasing over the region. Annual mean total cloud cover is significantly increasing at Amritsar, Ambala and Lucknow and significantly decreasing at Gwalior for morning as well as evening hours. Annual total rainfall and rainy days trends are significantly increasing at Kolkata. Annual mean sunshine duration and annual mean wind speed trends are significantly decreasing over the IGP. Seasonally, winter mean maximum temperature is significantly decreasing at stations in the western part of the IGP and significantly increasing at stations in the eastern part of the IGP during post monsoon season. While winter mean minimum temperature is significantly decreasing at Amritsar and Ambala, it is significantly increasing at all other stations except at Varanasi (increasing but not significant). Winter mean DTR trends are decreasing significantly at most of the stations. Majority of stations are having significant decreasing trends in sunshine duration and wind speed in all seasons. Relative humidity and total cloud cover trends are similar to annual trends. Seasonal rainfall trends are significantly increasing at New Delhi (winter), Gwalior and Varanasi (summer), Kolkata (post monsoon) and significantly decreasing at Patna (post monsoon).

RAINFALL PARTITIONING OF PATAN TALUKA (GUJARAT) FOR THE YEAR 2006 TO 2010 USING GEO-INFORMATICS BASED DATA FOR THORNTHWAITE MODEL AND SCS-CN MODEL

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Present work describes a simple method for rainfall partitioning into runoff, evapo-transpiration and infiltration. For this purpose, Thornthwaite water balance and SCS-CN models have been used. Graphical User Interface (GUI) for Thornthwaite model is developed by U. S. Geological Survey. SCS –CN model developed by United States Department of Agriculture is widely used for quick runoff estimation. In Patan Taluka of Patan district, Gujarat there is a perennial problem of water scarcity. Hence, it is difficult to sustain agrarian and dairy economy. In order to understand basic

hydrological processes in the study area, rainfall–runoff properties were analyzed using above mentioned two models. Several hydrological and climatological components such as precipitation, temperature, soil-moisture storage capacity etc. have been considered. Potential evapo-transpiration and actual evapo-transpiration were estimated using Thornthwaite model while infiltration was estimated using SCS-CN model. GIS and Remote Sensing had a significant role in some parameter value estimation. Temporal changes in hydrological variables of study area have also been studied.

ASSESSMENT OF CLIMATIC TRENDS OVER SOUTHERN INDIA DURING THE LAST CENTURY

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Southern India, which covers whole of the Indian peninsula, is characterized by diverse climatic regimes. These vary from perhumid over southern part of west coast to hyper-arid over a region falling in rain shadow zone of south central peninsula. The region is agriculturally and industrially very productive. This is also the reason for rapid urbanization in region which has given strong impetus to the economy of the adjoining areas. No doubt that urbanization and industrialization have had positive effect on development, but they have also been responsible for numerous environmental problems. One such issue which has attracted more attention from scientific community is that of changing climate. Systematic analyses of maximum temperature (TMAX) and minimum temperature (TMIN) trends by several researchers over land areas indicate that the minimum temperatures have increased more rapidly than maximum temperatures. Since whole of the southern India falls in tropical zone it would be important to know whether the region is cooling or warming. This would have significant bearing on future planning. Thus, the present paper describes observed tendencies in TMAX and TMIN at annual and seasonal scales. Climatic data during the period 1901 to 2000 for selected stations was collected and analysed using regression techniques. It was revealed that majority of the trends showed positive change with some exceptions. Some of the stations witnessed very steep rise in temperatures. Thiruvananthapuram, for example, recorded a statistically significant rise of about 4 deg. Cel. in winter TMAX. Interestingly the same station witnessed fall in winter TMIN. Trends at maximum locations over southern tip of Indian peninsula indicate day-time warming, i.e. increase in TMAX during winter. This holds true for other seasons also. The northern parts of peninsula too recorded positive tendencies. Overall, in the near future southern India may experience a climate regime characterized by higher temperatures.

CLIMATE CHANGE AND TROPICAL CYCLONES IN THE INDIAN SEAS

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On an average, about 5-6 tropical cyclones form in the Indian seas every year, of which about 2 may reach the severe stage. About 80% of the total number of tropical cyclones of the Indian seas form in the Bay of Bengal. Most of the severe cyclones of the Indian seas form during the post-monsoon season in the months of October and November. A few severe cyclones also form during May. The east coast of India and the coasts of Bangladesh, Myanmar and Sri Lanka are vulnerable to the incidences of tropical cyclones of the Bay of Bengal. Every year these cyclones inflict heavy loss of life and property in this region. The average frequency of cyclones in the Arabian Sea is relatively less, ie approximately 1 cyclone per year. The Arabian Sea cyclones generally affect Maharashtra and Gujarat coasts. Sometimes, these cyclones travel northwest and strike Pakistan and Oman coasts.

Global climate change resulting from anthropogenic activity is likely to manifest itself in the weather and climate of the Indian Ocean region also. The long-term trends in the frequency and intensity of tropical cyclones of the Indian seas during intense cyclonic months May, October and November is one such problem which has been addressed in the present paper.

Utilizing the existing data of 129 years (1877-2005) pertaining to the tropical cyclone frequency and intensity in the Indian seas during May, October and November, a study was undertaken to investigate the trends in the frequency of severe cyclonic storms (SCS) during past decades. The results of the trend analysis reveal that the SCS frequency over the Bay of Bengal has registered significant increasing trends in the past 129 years during the intense cyclonic months. It may be emphasized that these are long-term trends for more than hundred years based on statistical analyses which do not necessarily imply that SCS frequency has increased continuously decade after decade. The intensification rate during November, which accounts for highest number of intense cyclones in the Indian seas, have registered a steep rise of 26% per hundred years, implying that a tropical depression forming in the Bay of Bengal during November has a high probability to reach the severe cyclone stage. A regional climate model simulation revealed the enhanced cyclogenesis in the Bay of Bengal during May, October and November as a result of increased anthropogenic emissions in the atmosphere.

SOLAR IRRADIANCE FORCING OF TERRESTRIAL CLIMATE: AN UNDENIABLE FACT EVEN IN THE ANTHROPOCENE ERA

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Despite continued skepticism, solar intrinsic forcing has emerged as key factor governing natural climate variability on decadal to centennial timescales (Gray et al., 2009). Several important advancements in the field of sun–earth climatic connection have been made in last few years that have eventually led scientific community to incorporate solar forcing component in modeling of terrestrial climate (Meehl et al., 2009). Sustained efforts are required for quantitative estimation and sensitivity analysis of internal climate drivers against this external forcing for making realistic climatic projections in the present era when greenhouse gas forcing is suspected to have taken a dominant role governing terrestrial climate. Here we present (i) how temporal variations of solar irradiance govern inter-decadal variability of Indian monsoon (Agnihotri et al., 2011) and (ii) brief review of recent major investigations carried out across the globe that collectively reinforcing a definite role of solar intrinsic variability governing natural climate variability in the recent past (Mauas et al., 2008, 2010; Stager et al., 2007). It is attempted to address a few important knowledge gaps in the sun-climate relationship desired for successful delineation of natural versus anthropogenic forcing of recent climate change in the present Anthropocene era.

LONG TERM CHANGES OF TOTAL OZONE COLUMN CONTENTS OVER TROPICAL STATION I.E., UDAIPUR

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After the great scientific discovery of the "Ozone Hole", assessment of long term trends of total ozone contents over different parts of the world has now become frontier research topics, which is seriously concerned to global environment. In the past one decade, extensive studies based on various ground and satellites measurements of Total

Ozone Column Contents have shown an overall declining trend of total ozone contends (TOC) over northern high, mid and low latitude stations. They interpreted their results based on popular hypothesis of atmospheric dynamics and chemistry coupled processes.

In the present investigation, an attempt has been made to study the long term changes in TOC over tropical station like Udaipur (Geo. Lat. 24.6° N, Geo. Long. 74° E, Altitude 580 meter) to find out the basic causes of observed declining trend of TOC in the present study of the order of .5 t0 .9 Dobson Unit per year over tropical latitude. More details of the results would be discussed during the presentation.

In the present study, the daily value of TOC at these station collected by TOMS during the period 2002 to 2010 are used and the monthly median values and its standard error bars are computed for plotting the variations between their TOC values of particular months with different years for the two stations. In addition to this, variations of monthly mean values of contents of other atmospheric parameters like Aerosols Index at 330 nm, Stratospheric height Zonal Wind, Meridional Wind and Air Temperature at 10 mbar for the same low latitude as well as same period of study are also plotted along with monthly TOC variation and are also shown in the same figure to correlate the long term declining trend of the TOC with these parameters. It is found that among all the parameters, air temperature at 10 mbar showed the highest positive correlation coefficient of the order of .76 and lowest for Zonal Wind velocity and least for AI index at 330 nm and Meridional Wind at 10 mbar.

ANTHROPOGENIC CONTRIBUTION TO THE COMPOSITE AEROSOL OPTICAL AND RADIATIVE PROPERTIES OVER DELHI IN THE GANGA BASIN

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An optically equivalent model has been formulated on the basis of surface measured aerosol chemical compositions and the retrieved optical aerosol properties (during the year 2007) over Delhi- a typical urban station in the western part of the Ganga basin. The measured water-soluble and black carbon (BC) concentrations are considered to be the main anthropogenic components over the station on the basis of aerosol chemical compositions; however, the concentrations of insoluble and mineral dust were decided by varying their concentrations iteratively in the model while maintaining the mass fraction of BC, so that the model-derived optical properties for composite aerosols match with the measured one. Further, a different approach in the

optical model was used to quantify the contribution of anduopogenic aerosols in the composite aerosol properties by assuming water-soluble and BC as the major contributors in anduopogenic aerosols over the station. Model estimated various aerosol parameters such as aerosol optical depth (AOD), single scattering albedo (SSA) and asymmetry parameter (AP) for composite and anthropogenic aerosols were estimated independently, which shows significantly different features on monthly and seasonal basis.

The anduopogenic components measured at Delhi were found to be contributing -72% to the annual composite A0130.5 (-0.84±0.19), which was found to be more during the winter (84%) and post monsoon (-78%) periods and less during the summer (-58%). Results are highly associated with the surface meteorological conditions including the nature of boundary layer. The derived optical properties for composite and anduopogenic aerosols were used in a radiative transfer model for estimating the direct radiative forcing and the atmospheric heating rate due to these aerosols over the station. Also, the contribution of anthropogenic fraction to the total atmospheric forcing (due to composite aerosols) was estimated and discussed.

STUDY OF CHARACTERISTICS OF ATMOSPHERIC AEROSOLS DURING DUST STORMS IN INDO-GANGETIC BASIN

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Dust storms are normally occurring event that take place in arid and semi-arid region of earth, temperate, tropical and sub-tropical latitude characterized by dry soil/sand. Arid regions around the Arabian Sea like Iran, Afghanistan, India and Pakistan usually experience a high frequency of dust storms per years. The Kanpur AERONET (Aerosol Robotic Network) station and Moderate Resolution Imaging Spectro-radiometer (MODIS) data show pronounced effect on the aerosol optical properties and aerosol size distribution during major dust storm events over the IG plains that have significant effect on the aerosol radiative forcing (ARF). The Moderate Resolution Imaging Spectroradiometer (MODIS) and the Multiangle Imaging Spectro Radiometer (MISR) on board terra/aqua platform can be used for aerosol measurements. In the present study the AOD derived from ground measurements (AERONET) as well as satellites measurements (MODIS, MISR) are utilized to study the effects of dust storms over the IG-basin. The back-trajectory analyses of storm

shows the incoming flux of dust from the western desert region. The study found enhancement of Aerosol over the IG-basins during the period of dust storms.

VARIATION OF AEROSOL OPTICAL DEPTH OVER VARANASI LOCATED IN INDO-GANGETIC BASIN

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Aerosols are tiny particles suspended in air either in solid or liquid form and play a very important role in global climate change and their radiative forcing on climate. The diurnal and seasonal variability of aerosol optical depth (AOD) is very important for the study of aerosol interaction with pressure, temperature and cloud. At Varanasi, located in the heart of Indo-Gangetic Basin (IGB), we are using the pair of MICROTOPS, manufactured by the solar light company Philadelphia, USA for measuring the aerosol optical depth (AOD) and metrological parameters like temperature, pressure and water vapor. The paper analyzes six month data from January to June 2011 to study the variation of AOD over Varanasi and its relation with meteorological parameters. We compared these ground observed AOD with that of satellite derived data using MODIS onboard Terra satellite. We also used LAMP (Lidar for Atmospheric Measurement and Probing) for the study of boundary layer dynamics of aerosol distribution over Varanasi and detected haze layers over Varanasi during winter session. The results are discussed as the variability of AOD over the IGB.

BIAEROSOL: A NEW RESEARCH PERSPECTIVE IN CLIMATE CHANGE

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Atmospheric particulates have significant implications for climate change and human health. The particulate emitted from different sources and suspended in the air

constitutes biotic (biological) and abiotic (non biological) components both. Presence of biological constituents in the particulate matter increases number of cloud drops and decreases the rain intensity and also causes incidences of infectious diseases resulted into the attraction of scientific community worldwide towards the biological study of aerosol. But in India little attention has been given so far in-spite of this fact that 40% Indian population living on the bank of Indo-Gangetic plain are experiencing a large number of diseases like asthama, bronchitis, malaria, chickengunia, monkeygunia and other respiratory and cardiovascular diseases. The present study deals with biochemical characterization of aerosol at Dayalbagh, Agra, a suburban site of India. Biological concentration increases with increase in the level of particulate matter and there have been differences in the types of species. Chemical characterizations of aerosols were also carried out with aim to study the level of tracer species as they are known to exacerbate the biological activities.

STUDY OF PLASMA BUBBLES USING GPS DATA AT LOW LATITUDE GROUND STATION VARANASI

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Equatorial Plasma Bubbles (EPBs) are plasma density depletions and accompanying plumes of irregularities that give rise to severe radio signal disruptions. These ionospheric irregularities not only can reduce the accuracy of GPS/Satellite Based Augmentation System (SBAS) receiver pseudo-range and carrier phase measurement but also can result in a complete loss of lock on a satellite. To study the characteristics of ionospheric plasma bubbles during the solar minimum period, we have analyzed the GPS based measurements of Slant Total Electron Content (STEC) data using method of Portillo et al. (2008) from May 2007 to May 2011. It is observed the equatorial plasma bubbles of duration 61 to 176 minutes and maximum depletion in the density of plasma bubble of 8.04 TEC units. The maximum occurrence of plasma bubbles has been observed in equinox months for each year. These observations of plasma bubbles are discussed with other reported results.

LONG-TERM TREND IN TROPOSPHERIC OZONE AND AEROSOL OVER THE NORTHEASTERN GANGETIC PLAIN, INDIA

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Using monthly mean Tropospheric Ozone Residual (TOR) and Aerosol Index (AI) datasets from satellite measurements of Total Ozone Mapping Spectrometer (TOMS) during the period 1979-1992, the association between TOR and anthropogenic activity in northeastern part of Indian region (Indo-Gangetic Plain, IGP) has been examined. Increasing trends in tropospheric ozone are observed over most of the regions of India. The regressed TOR pattern during monsoon season shows large trend in TOR over the entire IGP region and is highest, 6 - 7.2%/decade, over the northeastern part of India. The increasing trend in tropospheric ozone over India is quite consistent with the observed trends in coal (9.2%/y) and petroleum (8.3%/y) consumption in India during the study period. Annually, trend of about 0.4 ±0.25 (1σ) % per year has been seen in TOR over then northeastern region of India. Similar trend in AI over this region (1.7 ±1.2 (1σ) % per year) is also detected during the same period. The quality of correlation between TOR and AI suggested that tropospheric ozone appeared to be influenced by the increased anthropogenic activities in this region.

CHARACTERIZATION OF IONIC SPECIES IN FINE AND COARSE PARTICLES, IN AN URBAN CITY, DELHI

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Mass size distribution of PM_{10} aerosol was studied for two years during Jan 2006 to Dec 2007 inside the campus of National Physical Laboratory by using 8-stage Andersen Cascade Impactor (ACI) sampler. The mass of fine ($PM_{2.5}$) and coarse ($PM_{10-2.5}$) particles was integrated from particle mass determined in different stages. Average concentrations of PM_{10-25} and $PM_{2.5}$ during study period are observed to be

$170\pm104\mu gm^{-3}$ and $136\pm8\mu gm^{-3}$, respectively which is far in excess of the $60\mu gm^{-3}$ and $40\mu gm^{-3}$ annual averages permitted by the Indian National Ambient Air Quality Standards. Effective Cut Diameter (ECD) for $PM_{1.0}$ was also calculated and it was found $77\mu gm^{-3}$. The percentage contribution of $PM_{10\text{-}2.5}$, $PM_{2.5}$, and $PM_{1.0}$ to PM_{10} were about 56%, 44% and 25% respectively. Statistical analyses such as paired sample T - test were performed through SPSS for window software and found that there was no large variation in ECD for $PM_{2.5}$ and $PM_{10\text{-}2.5}$. Major cations (NH_4^+, Na^+, K^+, Ca^{2+} and Mg^{2+}) and anions (F^-, Cl^-, SO_4^{2-} and NO_3^-) were analyzed along with pH. The average concentrations of major anions such as SO_4^{2-} and NO_3^- were observed to be 12.93 ± 0.98 and $10.33\pm1.10\mu gm^{-3}$, respectively. Very high concentrations of SO_4^{2-} and NO_3^- were found in fine mode aerosols. The major sources of SO_4^{2-} are due to thermal power plants which are located in southeast direction and incomplete combustion by vehicle exhaust. A good correlation among secondary species (NH^+, NO_3^- and SO_4^{2-}) suggests that, most of NH_4^+ is in the atmosphere in the form of ammonium sulphate and ammonium nitrate. During winter, the high concentration of Ca^{2+} is observed due to re-suspension of road side dust particles and traffic activities.

DUST PARTICLE MORPHOLOGY: IMPLICATIONS TO AEROSOL OPTICAL PROPERTIES

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Role of atmospheric aerosols (mineral and carbonaceous) in terms of their radiative effects is still highly uncertain (IPCC, 2007). One of the major sources of this uncertainty is owing to relatively unknown morphology of dust in the atmosphere. Here we present morphological parameters (shape, size, Aspect Ratio (ratio of maximum projection of particle to its width, AR) and Circulatory Parameter (CIR)) of selected ambient particles collected from NPL, New Delhi during pre-monsoon season, 2010. The morphological parameters are determinants of the extent of particle nonsphericity. The Cu-TEM grid and tin sheet were used as collection substrates for atmospheric particles. The morphological studies were carried out using SEM (Scanning Electron Microscope) and HRTEM (High Resolution Transmission Electron Microscope) facilities at NPL. For some of the particles, aggregates of black carbon spherules were found to be adhered on their surfaces. A range of AR was found to be from 1.2 to 2.6 whereas the conventional value of AR of atmospheric particle taken as 1.5 (Okada et al., 2001). The shape distribution has been generated using CIR parameter with limited

number of samples. More data of such kind are very important for numerical estimation of particle optics which is major input for aerosol radiative forcing models.

SIMULATION CLIMATE USING A1B SCENARIO

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Detailed study of simulated temperature and precipitation have been done using a very high resolution Icosahedral-Hexagonal grid point global model (hereafter referred to as GME) run at 40km horizontal resolution under forcing prescribed from the A1B emission scenario of the Intro-governmental Panel on Climate Change (IPCC, 2000). We have focused only winter (December, January and February; DJF) and rainy (June, July and August; JJA) seasons in three time slice experiments which can be considered as (a) the present climate (1979–1983), (b) mid century climate (2041-2045) and (c) end of century climate (2081-2085). Results indicated that the inland area of South America and Australia will be warmest regions in winter while the Middle East Asia will be in rainy seasons. High temperature zones (above 20°C) can be seen between 30S and 30N during winter and 30S and 40N in rainy seasons. We have also focused the accompanied difference in the precipitation in time slice experiments for the same periods. Results indicate increasing trend in precipitation over large area of the globe, it can be indicative of activated convection systems. This may help to understand "seeding" of the tropical cyclone generations. These features may be responsible for increasing the frequency of the cyclones over the North Atlantic Ocean, the North Indian Ocean in the Middle of present century and over the North Atlantic Ocean and the Indian Ocean in the end of present century. Based on modeling study, increasing trend in temperature is very clear and high precipitation is found in smaller periods.

SOLAR VARIABILITY, COSMIC RAYS AND CLIMATE

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The Sun is the ultimate source of the energy on the Earth and play a key role in its climate change. Variations in solar activity, at least as observed in numbers of sunspots, have been apparent since ancient times but to what extent solar variability may affect global climate has been far more controversial. The small variation in the solar irradiance and changes in its spectral distribution leads to a large variation in climate. An attempt has been made to report the present understanding of the solar variability and its consequences on the variability of solar irradiance which exhibits 11-year cyclic variation and modulation on higher time scale. Galactic Cosmic Rays (GCR) reaching the earth's atmosphere is modulated by the solar wind and geomagnetic field, which also exhibit 11-year cyclic variation. The relation between GCR and cloud cover has been discussed. In the present paper I have briefly summarized our current knowledge on physics of solar variability, its effects on cosmic rays and climate.

DISTRIBUTED BASIN-SCALE MODEL FOR WATER RESOURCES ASSESSMENT UNDER DIFFERENT CLIMATE CHANGE SCENERIO

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A number of climate change scenerio predict rise in temperature and change in precipitation characteristics in the near future which may affect various components of the water cycle, thereby changing the availability of water in space and time. To cope up with the emerging challenges due to climate change impact on the water resources and develop adaptation strategies, it is important to carry out detailed modeling analysis at basin scale so that the current components of water cycle at/below the land surface could be evaluated and future components could be predicted in the light of various climate change scenerio.

In the present modeling approaches, it is difficult to account for the effect of various developmental activities and climate sensitive parameters on the water resources scenario in a river basin. Groundwater is not given enough attention in the

assessment of total water resources in the basin and the water requirement for different purposes is not precisely estimated. Discharge is considered as the basic unit for water availability estimations which may be affected by a number of basin parameters and developmental activities such as population, industrialization, change in the irrigated areas, improvement in irrigation efficiencies, availability and development of groundwater, change in land use (increase/decrease in forest area, urban land, barren land etc.), change in the climate of the region (increase/decrease in temperature, precipitation etc.), construction of hydraulic structures etc. Therefore, a need was felt to develop a detailed model to assess various components of the hydrological cycle in a river basin and to estimate the demands for various purposes.

To evaluate various components of the hydrological cycle at the basin scale, a conceptual spatially distributed water balance model has been developed. In this model, focus is given to incorporate spatial variation of land-use, soil type, rainfall, evapo-transpiration, physiographic characteristics, cropping pattern, irrigation development, groundwater conditions, river network and hydraulic structures in a river basin. GIS is employed to link the spatial data with the simulation model and to project the model results in map form for easy visualization. The basin is divided into grids of uniform size (~ 1 km) and model computes various components of hydrologic cycle such as actual evapo-transpiration, overland flow, groundwater recharge, and residual soil water content at monthly time step for each grid. The model brings out total water availability in the basin; water consumed by different uses; and water storage in different hydraulic structures, in soil water zone, and in groundwater aquifer in a river basin.

The present paper gives a brief description of the developed model. Using this model, it is possible to simulate various past, present or future hydrological scenarios in a river basin.

UTTAR PRADESH STATE ACTION PLAN ON CLIMATE CHANGE: WATER MISSION

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While more and more of the natural flow is stored, used or diverted out of the river, we looked for a set of ameliorative measures that would be implemented to mitigate impacts of climate change on water resources of the state. These measures would be scheduled to begin with ensuring 50% water in rivers for maintenance of minimum flow for ecological and livelihood water requirement, no encroachment in river flood plain within 500 m (as per HC, Allahabad Orders) towards the quality and

quantity of water and its seasonal changes, biological species, processes, and resource linkages-the unprecedented growth of water hyacinth, encountering with the problem of pollution due to untreated sewerage discharge into the river and high sedimentation load causing meandering and flooding of the river. Sanitation is also water centered. To find the aquatic ecosystem for sustenance of the water resource base, tree plantation to arrest soil erosion and enhance groundwater recharge at places of economic importance and demographic stress, a river basin management water plan is required to live with climate change scenario.

Water sector climate change strategy and action plan includes: enhancement of observational infrastructure ' early warning system' and status of ground water decline, means for saving of water and enhancing water use efficiency adopting water efficient crops; pressure irrigation and saving water losses in transmission and distribution, policy changes regarding simultaneous water extraction and ground water recharge, organizational changes like lake conservation authority, aquifer management authority and more teeth given to Water Management and Regulatory Commission for water allocation across the sectors to avoid water conflicts: rural vs urban, agriculture vs industry, ecology vs development and finally equity in water uses- rich vs poor, etc.

This paper describes Uttar Pradesh state action plan formulated for water mission on climate change.

ASSESSMENT OF CLIMATE CHANGE IMPACT ON HYDROLOGY IN THE BHIMA RIVER BASIN, INDIA

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The general impact of climate change on water resources have been brought out by the Third Assessment Report of the Intergovernmental Panel of Climate Change (IPCC), 2001). Observed warming over several decades has been linked to changes in the large-scale hydrological cycle such as, increasing atmospheric water vapour content; changing precipitation patterns, intensity and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff. Precipitation changes show substantial spatial and inter-decadal variability. Over the 20th century, precipitation has mostly increased over land in high northern latitudes, while decreases have dominated from 10°S to 30°N since the 1970s.

Keeping the importance of the subject, an attempt has been made in this study to quantify the impact of climate change on the water resources of the Bhima river basin using hydrological model. The study uses the PRECIS (**P**roviding **R**egional **C**limates for **I**mpacts **S**tudies) daily weather data to determine the control or present and GHG

(Green House Gas) or future Water availability in space and time. PRECIS (pronounced as in the French précis - "PRAY-sea") is based on the Hadley Centre's regional climate modelling system.

A distributed hydrological model namely **S**oil and **W**ater **A**ssessment **T**ool **(**SWAT**)** has been used for study of the Bhima river basin. The framework predicts the impact of climate change on the hydrological regime with the assumption that the land use shall not change over time and any manmade changes are not incorporated. Simulation at 29 sub-basins of the Bhima basin has been conducted with 30 years of data belonging to control (present) and the reaming 30 years data (2011-2040) corresponding to CHG (future) climate scenario. Quantification of climate change impact has been done through the use of SWAT hydrological model . The initial analysis has revealed that increase in precipitation has been predicted in almost half of the month of the year, while in the remaining months decrease in precipitation has been predicted. The magnitude of this increase/decrease in precipitation over the Bhima basin has been variable over various months.

GROUNDWATER LEVEL PREDICTION - AN ARTIFICIAL INTELLIGENCE APPROACH

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Due to rapid growth in the population, urbanization, industrialisation and change in life style in general etc. has increased the demand of water manifold which in turn forced water level to decline. Keeping in mind the scarcity of available water resources in the near future and its impending threats, it has become imperative on the part of water scientists as well as planners to quantify the available water resources for its judicial use. Thus, a ready reckoner to monitor the fluctuations in groundwater levels well in advance is the need of the hour to devise sustainable water management protocols. In this direction several studies were carried out for forecasting the groundwater levels using conceptual/ physical models that are not only laborious, but also have practical limitations, as many inter-related variables are involved. In the recent past, artificial intelligence techniques like Artificial Neural Networks (ANNs) and Adaptive Neuro Fuzzy Inference System (ANFIS) have been used increasingly in various fields of science and technology for prediction purposes. In particular, these have been found useful in the area of hydrologic time series modelling. The ANN is a general-purpose model with a limited set of variables, and is used as a universal

functional approximator. On the other hand ANFIS uses the combination of ANN and Fuzzy logic approach.

The present case study relates to the development of a reliable forecasting simulation models for predicting the groundwater level in an alluvial country using groundwater level data and other meteorological parameters through ANN and ANFIS techniques. The input data sets are divided into training and testing subsets. The simulation models having various input structures are trained and tested to investigate the applicability of ANN and ANFIS techniques. The results of all the models both for training and testing data sets are evaluated and the best fit input structures and methods are determined according to criteria of performance evaluation viz. Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), correlation coefficient (r^2) and Coefficient of Efficiency (CE). This paper identifies the proficiency of ANN and ANFIS modelling techniques to capture the complex dynamics involved in groundwater level prediction. The results also show the importance of input data selection and its effect on prediction accuracy. Also, the study confirms that ANN and ANFIS models are capable in predicting the groundwater levels even in complicated hydrologic cycles by using common hydrological data. The results are highly promising and a comparative analysis suggests that the proposed ANFIS modelling approach outperforms ANNs models in terms of computational speed, forecast errors, efficiency etc. It was further observed that the ANFIS model also preserves the potential of the ANN approach fully, and eases the model building process.

GIS BASED MODELING AND IMPACT ASSESSMENT OF URBANIZATION ON NATURAL CHARACTERISTICS OF GOMTI BASIN: A CASE STUDY OF LONI WATERSHED

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The negative effects of urbanization on natural characteristics of watershed have been recognized for many years. In the urban scenario the ever-increasing population and resultant concretization significantly influences the natural recharge of groundwater resource. Urbanized areas are associated with changes in natural land use, increased

groundwater pumping and surface runoff. The result is a drop in the local water table and a reduction of ground water discharge, or base flow, in local streams. Since the rate of recharge of several tiers of water table is far from its optimal value, the crucial geo-environmental problem sets in, this ultimately affects the large population of major cities. In the Gomti basin, Loni river contributes a lot in Lucknow region and will be influenced by growing urbanization due to its agriculture domain in due course of time. Therefore, it becomes significant to access the changes taking place in this area.

The present study is an attempt to assess the impact of urbanization on natural characteristics of Gomti basin taking a case of Loni watershed and selecting suitable sites for further development programmes through cost benefit approach using Geographical Information System (GIS) technique to minimize further environmental degradation. Gomti basin is located in the interfluves region of the Ganga and the Ghaghara rivers, in central part of the Ganga Plain. It is essentially ground water fed channel that flows within the vast alluvium of Ganga Plain. The major fluvial processes of rivers are principally controlled by monsoonal precipitation. During its course the river flows through the various districts of Uttar Pradesh including state capital Lucknow where the Loni watershed contributes to the Gomti basin. Here, urbanization and industrialization is unscientific, uncontrolled and unplanned in many areas. There is a mad rush towards it in search of livelihood, resulting in an accelerated urban growth. In 1901 the total urban area of Lucknow city was 44.03 sq km which has increased to 303.63 sq km in 2011 and if this increase remains continuous it will be 414.34 sq km by 2021. The analysis of the spatial arrangement of the urban sprawl in Lucknow city shows that it covers a wide strip from one end to the other in north and south direction of Lucknow district. The buffer zone created using GIS along urban realm of Lucknow city shows that the district boundary along the north and south is entirely engulfed. Now the spread is towards north-west and south-east. In the south-east major part of the Loni watershed will be covered by 2021 estimation ascertained by GIS analysis. Thus it seems that within approximately 8-10 years more than 50 percent of its area will be converted into concrete jungle. This will result in loss of fertile agricultural land, lowering of the water table due to excess use of groundwater, loss of natural water bodies that will directly affect the natural recharge system of the region thus loss of present ecosystem and habitat. The Loni watershed that plays a pivotol role in Gomti basin seems to be engulfed in due course of time. Therefore, land use and land cover of the region must be sustainably handled and use of wasteland and saline soils should be taken for development programs so as to make minimal loss of environment. This will provide an option for securing the natural environment with proper assessment for development programs. Therefore, there is utmost need to attract everybody's attention towards this problem to save this natural resource as well as our environment.

ESTIMATING COEFFICIENT OF ANISOTROPY USING VES DATA – AN INDICATOR FOR SUB-SURFACE GEOLOGICAL FEATURES AND STRUCTURES IN HARD ROCK AQUIFERS

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The electrical resistivity method, particularly Vertical Electrical Sounding (VES) is a well known technique for groundwater prospecting in various geological terrains. But in case of hard rock terrain along with the standard interpreted results of VES data, another important parameter, namely coefficient of anisotropy (λ) is the key geoelectric parameter which gives additional informations like inhomogeneity, nature of anisotropy, dip of the beds and identification of geological formations more accurately. Anisotropy is caused by the formation layering, fracture, joints, fault, grains boundary cracks and aligned mineral grain orientations which are common features of the hard rock aquifers. It helps in identifying the groundwater potential zone.

Vertical Electrical Sounding have been carried out in Deccan basalt region in parts of Kalmeshwar Taluk, Nagpur district, Maharashtra and data were interpreted using standard interpretation technique. In the present work coefficient of anisotropy (λ) is being estimated from VES data covering the investigated region. The estimated values of coefficient of anisotropy (λ) indicate heterogeneous and anisotropic character of sub-surface formations. It varies between 1 and 1.64 which characterizes the water saturation condition in the sub-surface formations/structures. The present work can help in quantifying the distribution of water saturation formation and geological structures.

NEED OF IMPLEMENTING RAIN WATER HARVESTING THROUGH PEOPLE-SCIENTIST PARTICPATION TO CONQUER PROBLEM OF WATER CRISIS RESULTING DUE TO CLIMATIC CHANGES

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Rainwater harvesting is a traditional practice all over the world especially in the areas where no perennial drainage system exists and people are dependent either on groundwater resources or on available rainwater harvested in the surface reservoirs. All great civilizations flourished on the banks of river and the areas that are devoid of rivers or surface water bodies relied on practices of rainwater harvesting for domestic, agriculture and livestock needs. Many peoples in the world have continued to rely on water harvesting practices. Others have returned to it in order to relieve pressure on overburdened groundwater tables or municipal water systems. Due to day by increasing water demand as a consequence of increasing population, agriculture activities, industrial activities, and changing climatic conditions, the surface water and groundwater resources are declining at rapid rate.

Changing climatic conditions in the form of global warming due to increasing anthropogenic greenhouse gases are serious issues all over the globe, which in turn puts additional stress on water resources due to increasing evaporation losses especially in arid and semi-arid regions of the world.

It has been observed that increase of temperature of 1°C will throw additional stress upto 20% on groundwater reserves in semi-arid and arid regions. It has been projected that there will be increase of 1.4 to 5.8°C temperature over a period of 1990 to 2100 thus throwing relatively large stress on groundwater system.

The global temperature is projected to rise upto 5 degree celsius this century that will be twice the entire warming after last ice age 12000 years ago and it will take place in 100 years rather than thousands giving the natural world and human civilization little time to adapt. The only solution for this decline of water resources in major part of the world is revival of ancient rainwater harvesting techniques and its application in modern era with scope of groundwater recharge.

This paper deals with history of rainwater harvesting and illustrations of revival of traditional rainwater harvesting techniques and modern application of rainwater harvesting and future of these techniques by Scientists-People participation to conquer the forseen water crisis resulting from changing climatic conditions.

REVIVAL OF DYING RIVER SYSTEMS OF GANGA BASIN IN UTTAR PRADESH

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Ganga basin had been the citadel of civilization. The intrinsic network of drainages with rich and fertile soil has witnessed enormous developmental activities.

The perennial rivers had all-through been the main lifeline. However, with the climate change resulting in diminishing snow and glaciers in the source areas, the melt water discharge in the Himalayan rivers has been decreasing year after year. Coupled with this, is the environmental degradation in the upper catchment resulting in ever increasing sediment load being eroded off and 'dumped' in the river channels as they enter into the plains. The two factors have adversely affected the 'health' of majority of the rivers. The sand bar/channel ratio has increased by almost 30% in the last 50 years in a part of Ganga river. Ghaghra river between the foot hills and Faizabad city is today almost 78% filled with sand bars. This has resulted in the rivers gradually diminishing in their prominence.

Not only the major Himalayan rivers, but also the depleting ground water scenario has resulted in smaller ground water fed rivers gradually 'dying out'. Gomti river which has it's origin in the vicinity of Madho Tanda in Pilibhit district provides water to 15 major townships in Uttar Pradesh in addition to providing irrigational facilities to large agricultural stretches, before merging into Ganga river at Saidpur in Jaunpur district. Today Gomti river is literally a 'sluggish' river with literally 'no' continuous flowing water in the lean period in its upper almost 25 kms stretch. Even in the low reaches for eg. at Lucknow, the flow is abysmal during summer months. Even worse is the case of Sai river which originating in the vicinity of Pihani village, Hardoi district of U.P. is almost dry with no continuous flow during lean period in a majority of it's upper reaches. If not taken care of, these 'dying' rivers of Ganga basin may soon be the 'dead river systems' in not too far a future.

An attempt has here been made to revive the 'dying' Gomti and Sai rivers of U.P. High resolution satellite data coupled with extensive field surveys have enabled proposing preliminary remedial measures.

Mighty Sarda river flowing north of Madho Tanda has enormous perennial discharge and the excessive discharge during monsoon time over- spills the banks and causes flood havoc. The water from Sarda river is today diverted through canals into the Sarda Sagar reservoir, which is then used for canal irrigation in major parts of U P. This Sarda Sagar today is being used to half its original proposed capacity and the remaining half of reservoir bed is encroached upon by local dwellers. Villages and semi permanent structures have come up on this encroached reservoir bed.

It is proposed that the 'excess' water in Sarda river during monsoon times may be diverted into the Sarda Sagar to fill it to the original proposed capacity or even up-to it's augmented capacity through raising of it's embankments. However the displaced inhabitants of the area would have been re-located at some other suitable place. This additional stored water in Sarda Sagar could meaningfully be utilized for augmenting the discharge in Gomti river during lean period. The existing Sarda canal (Hardoi Banch) or an additional canal could be used to conduit this water from Sarda Sagar into Gomti river in the vicinity of Haripur Fulhar /Rampur Fakire villages, where the lateral distance between the canal and river channel is hardly 23 m., and the river cuts even

closer to the canal during rainy season. Present investigations have enabled identifying four possible sites from where Gomti river could be fed with the Sarda river water.

This storage of additional water of Sarda river in Sarda Sagar and subsequently its diversion into the Gomti river would have a two fold benefit. The large scale inundation caused by over spilling of Sarda river banks could be mitigated to a certain extent, and more importantly this excess 'waste' water of Sarda river could be meaningfully utilized to save the life of the 'little sister' Gomti river.

Similar exercise of possibility of diverting, the excess water of Garra/Deoha river into the upper reaches of Sai river have also been studied. The continuous chain of abandoned river channels in the area between Garra/Deoha river and Sai river, could again be activated through dredging and used as a conduit to carry the Garra river water into Sai river.

The re-activation of these 'dying' smaller rivers would be a first step towards attempting to salvage the entire network of river systems in the Ganga basin.

PROLIFICATION OF ARSENIC IN GROUND-WATER OF DISTRICT BAREILLY, U.P. - CASE STUDY

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It is a well known fact that the consumption of arsenic contaminated water leads to chronic health effects. Signs of chronic arsenic-ailments include dermal lesions, peripheral neuropathy, skin cancer etc.

The presence of Arsenic in ground-water has been reported from many parts of the world particularly in the Bengal Delta and Bangladesh, China, Vietnam and Nepal. In 1976 Arsenic contamination was reported from some states of Northern India including U P. In 1984 groundwater Arsenic contamination was discovered in lower Ganga Plain of West Bengal, in 2001 groundwater Arsenic contamination in the terai area of Nepal came to notice. In June 2002 Chakraborti et al. discovered Arsenic contamination in Bihar in middle Ganga plain and at the same time apprehended contamination in U.P. lying in middle and upper Ganga plain.

Arsenic contamination was detected in U.P. in 2003 by the team from Jadavpur University in three Blocks of Ballia district. In 22 villages, Arsenic was found at concentrations of 50 ppb or higher. The highest concentration reported was 1000 ppb. In 5 villages case of Arsenicosis was detected and skin lesions typical of Arsenicosis were found in 53 of the 307 people screened.

Bareilly district borders Pilibhit and Shahjahanpur on east and Rampur on west, Udham Singh Nagar in north, Budaon in south. It is a level terrain watered by many

streams. The river Sarda or Gogra forms the eastern boundary of the district, next is Ramganga and Deoha, the Gomti also passes through the district.

Bareilly district was selected for this survey on the basis of its central location and as a part of terai region of U.P. On random basis this survey was conducted in 176 villages of 9 Blocks of the district and water samples from 2532 nos. of India Mark II hand-pumps were analysed using the standard method of Arsenic analysis. The outcome of the survey in detail is given in this deliberation block-wise. Though, the situation of Arsenic proliferation in groundwater of Bareilly is not alarming but the study gives a ground for an early pondering over it before it goes beyond our control.

AIR POLLUTION DUE TO PARTICULATE MATTER (PM) AND HUMAN HEALTH

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Epidemiological studies suggest that air pollution due to Particulate Matter (PM) is one of the major concerns because human health is at risk and a large number of people are exposed to it in urban and industrial areas. PM, an ambient air criteria pollutant, has size ranging from nanometer to 10 μm and can be aspirated into the lung airways. Smaller PM cause severe adverse effects on health. PM is a complex mixture of chemical agents of different shapes and sizes. Recent studies reveal that the effect of PM on human health will depend on the chemical composition of PM, besides its number and mass concentration. At present PM standard in ambient air is limited to the mass concentration within two specified size ranges $PM_{2.5}$ (< 2.5 μm) and PM_{10} (< 10 μm,). At elevated levels at both size ranges, mortality and morbidity of humans have been reported. The routine air monitoring data on components of the PM mass is essential for epidemiological studies which may identify the chemical constituents of PM which cause health effects and also the source. This paper reviews the recent studies on air pollution due to PM and implementation of regulatory standard.

PLASTICS SOLID WASTE MANAGEMENT: CHALLENGES, STRATEGIES AND INNOVATIVE DEVELOPMENTS

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Plastics and polymeric products are ubiquitous material of choice and find multiple applications in our regular activities. Climate change is likely to effect population in future and transform the lifestyle and wellbeing of billions of people at increased risk. It is widely accepted that even after introducing significant measures to reduce greenhouse gas emissions, additional global warming is inevitable. It has significant global economic, social and environmental implications. There is a growing recognition that planning for changes in the intensity and frequency of extreme events may pose the challenging problems for natural resource managers. The waste generation is quite obvious and needs attention towards its management. Plastic wastes that are dumped in landfills release leachable constituents and incineration may release toxic gases and contribute to temperature rise. The usage of plastics and its average growth rate is 12-25%. Incineration is the second most used method in disposing waste worldwide. The dioxins and furans are a matter of concern for the environmentalists and regulatory authorities. The modern incinerating facilities and remedial methods are cost effective, improvised, sophisticated and with ease of operation as they lessen the consumption of fossil fuel to run incinerating machines and reduce the amounts of generated pollutants. The uncontrolled consumption of petroleum based products, extraction, processing and disposal may lead to global warming and thus needs immediate attention for prevention and better living conditions.

Globally, climate change may be handled efficiently by mitigation or adaptation. Bio toxins and degradation products of New Chemical Entities (NCE's) may enter the food chain and pose a threat to the environment. We have to tailor interventions to meet the needs of the environmental conditions as well as ensuring the recovery, growth and stabilization of the livelihoods of the individuals or develop appropriate marketing strategies. Climate Change is a global phenomenon and requires collaborative planning and implementation in true sense from local areas to the multicentric and multidisciplinary approach. The polluters pay principle be implemented for strict enforcement and as a lesson for others. The prevention policy incorporates laws regulating the discharge and treatment of sewage. The mass dissemination of knowledge can play an important role and inspire others to work towards the necessary behavioural changes and minimization of nonpoint pollution and primary sources. The

holistic approach to understand and take preventive measures is vital for sustainable development. To sustain the growth in an environmentally and economically responsible manner, plastics end of life reuse or reprocessing solutions are vital and needed in an efficient scientific manner. The solutions need to be self sustaining, reflecting carbon footprint reductions and with environmental responsibility that is waste to fuel oil and value added products.

CHEMICAL CHARACTERISTICS OF RAINWATER AT AN URBAN SITE OF NORTHERN INDIA

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The chemical characteristics and the pH variation of rainwater have been studied during monsoon session 2009 at New Delhi. The pH varied from 5.68 to 6.85 with an average of 6.61 which suggests the alkaline nature of rain water over the station. The equivalent concentration of components followed the order: $Ca>SO_4>Cl>NO_3>Na>NH_4>Mg>F>K$. The relative percentage contribution was studied and found ~42% of the total measured ionic composition was contributed by cations whereas anions contributed ~58% to the total ionic concentration. The ratios of different components with respect to seawater ratios were observed to be higher, indicating the significant influence of non-marine sources at this site. The relative importance of natural and anduopogenic sources was estimated by chemical balancing. Acidity was found due to the presence of sulphuric and nitric acid in some cases. High concentrations of soil oriented elements especially Ca has been found to play an important role in neutralizing the acidity of rainwater and maintaining high alkaline pH. Most of the SO_4 in rainwater was in the form of $CaSO_4$. Results suggest that $CaCO_3$ is the main neutralizing agent. The role of NH_3 in the neutralization process is very small.

MEASUREMENTS OF FIREWORKS GASEOUS EMISSIONS DURING DIWALI FESTIVAL AT DELHI

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On the occasion of Diwali, burning of fireworks emit huge amount of gaseous as well as particulate pollutants in the atmosphere. Often the levels of SO_x and NO_x are reached beyond permissible limits which can cause serious health problems such as asthma, cardiovascular diseases, reproductive problems etc. The present study reports the results of a case study carried out during Diwali, 2010. On the day of Diwali (November 5, 2010), concentrations of all the gaseous species were noticed extremely high. The air ambient levels of chlorine, oxides of sulphur and nitrogen increased from 118, 13, 7 to 860, 1227, 34 respectively on Diwali night respectively. This huge increase in concentrations of these gaseous species can be attributed to the burning of raw material of fireworks. Estimate showed that approximately 60 tonnes of S and 1.8 tonnes of N were deposited on this occasion at Delhi.

STUDY OF OZONE CONCENTRATIONS DURING THE FESTIVAL OF DIWALI: A CASE STUDY OF NEW DELHI

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The changes in atmospheric Ozone concentration at New Delhi in India, during the festival of Diwali has been studied using Ozone data obtained from earth probe Total Ozone Mapping Spectrometer (EP – TOMS), Ozone Monitoring Instrument (OMI), surface ozone values were measured using electrochemical method and data obtained from Central Pollution Control Board, New Delhi, for the period 2003 – 2010. Compared to the normally observed ozone levels, the ozone concentration was found to peak either on, or a few days after Diwali and decrease thereafter. The ozone levels were found to exhibit an increasing trend during Diwali for the years 2003 – 2010. The surface Ozone values were found to be exceeding the national standards for ambient air quality (120 ppbv) indicating high levels of ozone pollution.

SPATIAL ASYMMETRY OF TEMPERATURE TRENDS OVER INDO-GANGETIC PLAIN AND POSSIBLE ROLE OF AEROSOLS

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Increase in greenhouse gases viz., CO_2, CH_4, CFCs, N_2O etc. and water vapour in the atmosphere are mainly responsible for the temperature warming, while aerosols in the atmosphere through their negative radiative forcing are responsible for lowering the land surface temperatures. Keeping this view, we examined dissimilarities of temperature trends both in space and time over the Indo Gangetic Plain (IGP) to look for signatures of aerosols influence. IGP temperature time series have been prepared for dry (November-May) and wet (June-October) seasons for the period 1901-2007 and trends for the entire period and different sub periods of 1901-50, 1951-1990 and 1991-2007 have been examined to isolate the aerosol and other greenhouse gas influences on temperatures. Similarly, for IGP, Aerosol Index (AI) monthly time series are prepared for the period 1979- 2005 (1993-1996 data is missing).

Maximum (day-time) temperatures during dry season corresponding to IGP region showed significant warming trend of 0.8°C per hundred years during the period 1901-2007. While, minimum temperature showed nebulous trend of 0.2°C per hundred years over IGP region. During the wet season, maximum temperature shows nearly half of dry season maximum temperature warming trend.

However, asymmetry is observed in dry season maximum temperature trend during post industrial period 1951-1990 wherein IGP shows decreasing trend, while during the recent period 1991-2007 trend is positive. Spatial and temporal asymmetry in observed trends clearly point to the role of aerosols in lowering temperature trends over IGP. AI showed pronounced increasing trend for the months March, April, May, June and July. Increasing trend in the month of July might be due to occurrence deficient monsoon years during the study period. There is very little or no trend in AI for monsoon months August, September and October.

In the post-industrial era, after 1951, IGP region during dry season, maximum temperatures show decreasing trend until 1990, while notable positive trend is observed there after up to 2007. The negative radiative forcing of aerosols dominates the temperature trends over IGP region during 1951-90 period and after 1991 it appears that the atmospheric concentrations of greenhouse gases and black carbon are more than compensating the aerosol related cooling and hence warming trends ensued.

SUSTAINABLE CLOSURE PLAN OF JHARIA COALFIELDS

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There are about 70 coalfields in India ranging in areal extent from a few square kilometers to several hundred square kilometers, producing more than 500MT of coal per annum. Mine Closure Plan is scheduling to stop the mining operations after it becomes uneconomical, exhausted of its mineral resources or it is technically not feasible for mining. The planning should cover the post mining land use, safety and favorable environmental condition for the inhabitants nearby. This paper discusses author's conceptual 'closure plan' of Jharia coalfield where mining started more than two century ago and will continue for two more centuries more with the current production rate of 30MT per year. There are 49 overlapping coal seams of various thickness, unapproachable old mine working, ravaging mine fire, numerous environmental problems and highly populated surface along with important infrastructures like townships, national highways, railways, aerial ropeways, etc. Geological study, seam orientation, geographical boundaries, method of working and closure legislations were studied to establish closure plan for different areas/geological measures of the coalfields. The outcome of the study will enable the mine executives to take appropriate steps during the present mining operations to achieve sustainable mine closer and post mining environmental management in Jharia and other coalfields also.

LEACHING STUDY OF SELECTED TRACE ELEMENTS FROM COAL FLY ASH

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Thermal power plants produce large amount of fly ash during the combustion of coal. Fly ash is the noncombustible mineral matter in coal which is thermally altered as it cycles through the combustion process.

In recent years a significant amount of fly ash is being utilized in construction, building engineering, road, back filling and in agriculture. The leaching of coal fly ash

during the disposal from the plant is of great concern for potential contamination of soil, surface water and ground water. The unmanaged fly ash disposal may result in significant problems for ecology and environment. The leaching of fly ash during disposal is of concern for possible contamination, especially for aquatic environment when ash is in direct contact with water. In the present study, laboratory leaching tests have been conducted to determine the potential mobility of elements like Fe, Cu, Cr, Pb, Ni and Cd from fly ash samples. Batch leaching experiments have been carried out to determine the leaching characteristics of trace elements from coal fly ash obtained from Rajghat Power House located in Delhi. The shake test was performed as per the American Society of Testing Materials (ASTM) method using an agitation device designed to rotate about a central axis at the rate of 100 rpm with an L/S ratio of 20:1, using 12.5 gm dried fly ash in 250ml of extraction solutions over varying periods of leaching. The leachates obtained analyzed for selected trace elements. The results for leachates indicate that there is no regular pattern of leaching of trace elements.

Among the trace metal originally present in fly ash, Pb and Cd occur, at very minor concentrations in the leachates obtained over the different intervals. The other elements such as Fe, Ni, Cu and Cr which were detectable in the leachates show their presence. The agitation time influenced the pH and the concentration of different elements leached into the solution, since different phases are dissolved at different rate.

GOMTI RIVER: FIGHTING FOR ITS EXISTENCE

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There is no dearth of statistics and data claiming the alarming rate at which earth's water resources are being depleted, polluted and rendered unpotable. As rivers shrink, man has not become any wiser which is proven by the fact that pollution rates have sky rocketed in the past decades. By the year 2025, 2/3 of the world's population will be facing water shortage. According to UN surveyed reports, India is expected to face critical levels of water stress by 2025 and there will be serious water shortages. The dynamics of fresh water depletion not only holds true for the world and our own country but also for our state of Uttar Pradesh where Lucknow city itself is an example of how a township is subjected to such hydrological stress. Disappearing and drying up of water bodies has resulted in the lack of availability of surface water. This scenario has made us dependent on the ground water which is not being replenished as infiltration of rain water into the ground has decreased due to concrete landscape.

We conducted two studies first shifting channels of the Gomti river with the help of satellite data IRS 1-D PAN LISS III and second regarding presences of heavy metal contamination in the water of Gomti river. Thus water management has emerged as the need of the hour. Revival of water bodies and judicious use of water resources is the only way to ensure its availability in the due course of time. Therefore, under water management , we will unfold past, present situation of the dying '*Life-Line*' of the city and solutions that will encourage groundwater recharging in the potential zones in-order to restore and rejuvenate one of the most precious gift bestowed by God on the city of Nawabs 'Gomti river'.

EVALUATION OF RISK OF LAND VULNERABILITY ASSESSMENT THROUGH EDAPHIC CHARACTERISTICS: USING GEO-SPATIAL APPROACH

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Land vulnerability involves long term changes in the floral and faunal characteristics, its soil productivity and its biological production potentials. The soil of an arid environment varies in their nature and composition. Generally, soils of these areas developed under the condition of high thermal regime and stress of moisture supply. These are prone to severe wind erosion unless properly protected by vegetation cover. The physical properties of soil depend on amount, nature, size, shape, arrangement and mineral composition of its particles, organic matter and content. The physical properties of a soil greatly influence its use and behaviour towards sustenance of plant life. Now remote sensing application and G.I.S technique has become subject of prime interest for soil scientist to detect inherent spectral behaviour of heterogeneous characteristics of soils. The main aim of this research paper to examine how edaphic characteristics derived from remote sensing are useful in characterization of vulnerability to land degradation in Churu district of Western Rajasthan.

COMPARATIVE ASSESSMENT OF AMBIENT AIR QUALITY IN SELECTED SITES OF VARANASI

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Air quality data (SPM, NOx and SO_2) of five sites (Godaulia, Sigra, B.H.U., Pandeypur and Cant Railway Station) of Varanasi was analyzed and compared to evaluate: (1) the exceedances of air quality against CPCB air quality limits, (2) primary air pollution sources and their contribution to the ambient load and (3) monthly patterns of air pollutants. High SPM levels, close to the thresholds for human health and clearly above the threshold for the protection of plants and ecosystems, were observed in Godaulia and Pandeypur. SPM and NOx level in Sigra was significantly higher than the limits for human health and plant's protection. The values of all SPM, NOx and SO_2 were higher in Cant railway station than other three sites, whereas all the values of SPM, NOx and SO_2 were lower than the CPCB limit at B.H.U.. The high traffic in these areas may drive the diurnal pattern of SO_2, NO_x and SPM in the city. Our results support the hypothesis that the high concentration of SPM is due to the construction activity and the excessive movement of pedestrians in the studied areas and this has reduced in such areas. However the higher value of SO_2 and NOx emission is due to vehicular traffic congestion. Based on the comparison of all the five sites of Varanasi, we suggest the occurrence of a feedback mechanism between green belt ecosystem (B.H.U.) and the polluting anthropogenic ones (selected study sites).

PARTICULATE MATTER AND ASSOCIATED METALS LEVELS IN AMBIENT AIR AROUND A COAL BASED THERMAL POWER PLANT

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Particulate Matter (PM), an ambient air criteria pollutant, is a complex mixture of chemical components. Nowadays, the level of PM in ambient air is a major concern

because a large number of people is exposed to it and in excess PM is associated with high mortality and morbidity. The present study deals with the assessment of ambient air quality with respect to Non Respirable Suspended Particulate Matter (NRSPM >10 μm), Respirable Suspended Particulate Matter (RSPM or PM_{10} ≤10 μm) and trace metals (Fe, Pb, Zn, Cu, and Cr) in particulates at five locations around a coal based thermal power plant, situated in eastern Uttar Pradesh during winter and summer seasons. The 24 hrs mean concentration of NRSPM was found to be in the range of 160.8 to 249.0 μg m^{-3} and RSPM ranged between 85.5 and 232.3 μg m^{-3}. The RSPM level was found to be above the permissible limit (100 μg m^{-3}) of National Ambient Air Quality Standards (NAAQS) except at one location (control site). The 24 hrs mean concentration of metals in NRSPM at all the locations was found in the order of Fe (15.390) < Zn (1.971) < Cu (0.364) < Cr (0.243) < Pb (0.221), whereas in RSPM it was Fe (1.402) < Zn (0.330) < Pb (0.243) < Cu (0.126) < Cr (0.015) . The ambient air was dominated mostly by Fe and the least by Cr among the metals analysed. The result reveals that continuous exposure at a high level of PM may affect the respiratory and cardiovascular system and cause other health related problems in local people and needs detailed epidemiological study as well as characterisation of PM.

RAINWATER CHEMICAL CHARACTERISTICS AT VARANASI, INDIA: A REPRESENTATIVE EASTERN INDO GANGETIC-PLAIN SITE

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A comprehensive study on the chemical composition has been collected for monsoon season rainwater (June-September) for Varanasi, India, in the campus of Banaras Hindu University for the year 2009. Samples have been analyzed for pH, conductivity, anions (F-, Cl-, NO3- and SO42-) and cations (NH4+, K+, Na+, Ca2+ and Mg2+). pH is found to range between 5.61 and 6.85 with an average of 6.03 (±0.39) indicating alkaline nature of rainwater. The analysis of the studied variables shows that the neutralization of the rainwater occurred in precipitation samples, with major contribution of Ca^{++}. Source identification of chemical species of rainwater, done by principle component analyses, informed that the three components, which accounted for 87% variance, were sea salts spray (Na+ and Cl−) accounted for 13.7%, soil particles of natural origin, (Mg2+, Ca2+ and HCO3−, NH4+) accounted for 63.4%, where

ammonium is due to bacterial action on nitrogen compounds in the soil and biomass burning, together. The non sea salt (nss) fraction analyses suggest that the contribution of nss- SO_4^{--} is 94%. The acidic pollutants, such as sulphate and nitrate are derived by long distance transport, local industrial as well as traffic sources. The major sources of nitrate in this area are emissions of oxides of nitrogen from automobiles, biomass burning and soil. The results of this study suggest that the rainwater chemistry is strongly influenced by local pollution as well as anthropogenic sources.

A CASE STUDY ON ENVIRONMENTAL DIOXIN INCREASE IN HARYANA: THREAT FOR HIGH CANCER RISK IN THE STATE

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Strong evidences have emerged that food and environment are major causes of cancer in human population. Dioxins emitted from various industrial processes and diesel combustion are proven human carcinogen, as per USEPA and ICRA. A case study of dioxin release from auto-rickshaws, crude diesel generators, municipal waste burning and industrial combustion was done in Yamuna Nagar district, Haryana. There is a regular incomplete combustion of 69,131,00 liters or 5599 Metric Tons (MT) of Diesel, annually, by Auto-Rickshaws & unapproved crude diesel generators used by the public and 15,330 MT of solid wastes burning every year, releasing total dioxin emission more than 370 MT in the environment. Dioxin is such a dangerous carcinogen that 0.1 microgram per liter of air causes 10 cancer cases. What is more important that while smoke released by Industries is released above 30 feet but the smoke containing dioxin released by auto-rickshaws, unapproved diesel generators, and municipal waste burning in open remains at lowest strata upto 10 feet where human population breathes more, thus inhaling even higher doses of dioxin per day. Out of approximate 400 cancer cases in the district, 209 cases are estimated to be due to dioxins alone! This district model of dioxin related carcinogenesis could be well extended to other cities as well. The policy makers and pollution law enforcing agencies need to swing into action for absolute curb on emission of dreaded dioxin in the environment. They need to realize that they also breath the same dioxin contaminated air that their fellow countrymen breath.

MEETING THE CHALLENGE OF CLIMATE CHANGE THROUGH GREEN MANUFACTURING TECHNOLOGIES OF ENERGY

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Energy security means ensuring that a country can supply lifeline energy to all its citizens at an affordable cost. The paper focuses on the consumption of different primary energy sources and it identifies that coal will continue to remain as the prime energy source in foreseeable future. However, direct use of coal leads to environmental pollution. This paper emphasizes the need to develop green manufacturing technologies where coal can be refined in coal refineries to obtain different fractionated products having different quality – grade – class (QGC) of fuels. Liquefaction of coal affords liquid fuels from coal for further refining for reducing the import of petroleum. The use of ultra clean coal in gas turbines directly will enhance the efficiency of power generation to 52-55% from the existing efficiency of pulverized coal power generation of 33 - 38%.It discusses the mechanisms that are driving global climate change. It highlights the impact of climate change on energy sector and its engineering solutions like clean development mechanism through efficient technologies in terms mining technologies, extraction of coal bed methane and underground coal gasification are discussed in this paper. Challenge lies in de-linking economic growth and environmental degradation. Power plant performance improvement is required to support public and private power plant operators. To reduce green house gas emission it has become important to justify the use of nuclear energy. The danger of radiation due to the damage cased by earthquakes and tsunamis are discussed. The Renewable Energy Potential like solar energy, energy from agricultural wastes, wind energy, carbon sequestration, integrated gasification combined cycle, fuel cells are also discussed in this paper. The paper concludes that green manufacturing technology as proposed here can meet the energy security of a country in a sustainable manner.

CO_2 SEQUESTRATION TECHNOLOGY FOR MANAGING CARBON IN THE ATMOSPHERE

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The Carbon Capture and Storage (CCS) is providing new paradigms in research in inter-disciplinary areas for tackling environment pollution. It aims at reducing atmospheric CO_2 concentrations, either through reduction of emissions by the use of clean technologies or capture of excess CO_2 from the atmosphere. The technology for CO_2 sequestration is fast developing and a lot of activity to launch pilot and demonstration projects in CCS is taking place globally. The Carbon Capture and Storage (CCS) is based on capturing CO_2 from its large point sources and safely storing in underground reservoirs so that it does not enter the atmosphere again. The CO_2 storage is not yet acceptable and favored approach unlike most of the other CO_2 neutral energy technologies. Increased understanding of earth processes is required through simulations and observations to address some of the issues and concerns arising out of CO_2 storage. In this paper we enumerate current status of CCS projects worldwide, provide glimpses of CCS research in India and examine the opportunities. A brief summary of capacity building programmes on carbon capture and storage held with a focused goal of dissemination of knowledge among its stakeholders from industry and academia is also presented.

SUSTAINABLE FARMING FOR SUSTAINABLE WORLD

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We wish to live in a green world. While we live, we pollute. We are 6.5 billion along with 56 billion animals.

We must ensure the availability of food for everyone. This is possible through organic process which is here to rescue the mankind. In organic farming earnings are retained in the rural area. It is not transferred to the town/cities. The village becomes the centre of rural development.

Increase in agricultural production through organic process would satisfy parameters of sustainability, social acceptance and economic viability. All this is possible with direct assistance of animal population.

It is beyond doubt that agriculture is not an industry. Industry is for the rich while agriculture is for the poor. Vice-versa is not true. Agriculture provides food for all.

Animal's solid waste is an asset for the mankind. They serve the mankind sincerely throughout their life. They do not affect the balance of nature – air, water and food. They have everything man needs – fertilizer, pesticide and energy.

Human beings 'only talk' of 'green economics' while animals live and maintain 'green economy' by themselves. Humans need to learn from these animals. The active support of these animals should be utilized (not exploited).

The treatment of animal waste will take place in cottage industry model at family level in the villages. The village economy and hence the national economy will undergo drastic change.

The potential of this sector in India is worth about $ one trillion per year.

CLIMATE INDUCED LATE-HOLOCENE ECOLOGICAL CHANGES IN PICHAVARAM ESTUARY

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Variation in the preservation of biotic forms in chronological order has been studied in ecological perspective in two 2.5 and 5m deep sediment cores deposited since ~3440 yrs BP and ~3630 yrs BP, respectively in the central part of Pichavaram mangrove wetland, Cauvery river delta. The preservation of organic matter is mainly in clay to silty clay sediments which constitutes remains of fresh water algal matter, fungal remains, dinoflagellate cysts, thecamoebians, foraminifera and loricated tintinid remains. The percentages of these vary in the sediment cores indicating 4 different ecological zones. The Phase I (~3630-3190 yrs BP) shows a stabilized estuarine ecosystem with a warm and humid climate coupled with moderate monsoon condition. Phase II (~3190-2750 yrs BP) reveals a high fluvial energy condition suggesting climatic amelioration from warm and humid to dry and arid. Phase III (~2750-760 yrs BP) shows a dry and arid climate coupled with weakened monsoon and Phase IV (since ~760 yrs BP) shows a stratified estuarine condition with low fluvial energy favoring the growth of both fresh water and marine forms. Overall palynological and

sedimentological results reveal a climate shift from warm and humid (~3630-3190 yrs BP) to dry and arid (~2750-760 yrs BP). However, similar cyclicity of warm and humid climate is evident since 760 yrs BP. The fluctuation in sea level during these phases may be attributed to climatic and hydrostatic changes in the Pichavaram wetland.

ANTIFUNGAL POTENTIAL OF METABOLITES PRODUCED BY *ASPERGILLUS* SPP. AGAINST *FUSARIUM OXYSPORUM* F.SP.*LINI*

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For eco-friendly and sustainable management of the linseed wilt, antagonistic activity of four species of *Aspergillus* viz., *A. flavus*, *A. niger*, *A. luchuensis* and *A. sulphureus* were evaluated *in vitro* against *Fusarium oxysporum* f. sp. *lini* at different concentrations causing wilt disease in linseed. It was found that maximum inhibition of *Fusarium oxysporum* f. sp. *lini* was recorded by *A. flavus* and *A. luchuensis* at 75% concentration followed by *A. niger and A. sulphureus*. The result obtained indicates that these may be exploited in field condition to control the growth of the pathogen.

USES OF WILD PLANT RESOURCES BY FOREST DEPENDENT COMMUNITIES IN SOUTHERN INDIA

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The Malai Maadeshwara Reserve Forest (MM Hills) is located in the Chamarajanagara district of Karnataka. It comprises different types of vegetation such as dry deciduous forest (64.34%), scrub woodland (20.50%), scattered patches of moist deciduous and riparian forest (2.47%) and serves as an important elephant corridor between sanctuaries. It receives an average annual rainfall of 900 mm.

There are about 16 settlements (villages) mainly belonging to Soliga and Lingayath communities scattered within the reserve forests who also exert tremendous pressure on the forests for agriculture, NTFP harvesting, fuel wood collection, road

construction. The *Soligas* are the indigenous people of this area who have traditionally resided in the forested regions of MM Hills. *Lingayaths* migrated to MM Hills around 600 years ago as local priests. Both communities have long term dependence and links with the forest, their traditional ecological knowledge is still rich and extensive. They are marginal farmers having average 1.5 acre of agriculture land which is not fully fit for farming. Their average per capita agriculture income is Rs.485 for Soligas and Rs.1165 for Lingayath which is not even sufficient for six months. Therefore, they have been depending on public distribution system for their food and wild vegetables for their nutrients and calories to supplement their diet. They eat a variety of wild plant parts species in different seasons. This study is dedicated to develop a comprehensive inventory of ethno botanical knowledge from forest dependent communities in Malai Maadeshawara (MM) Hills Reserve Forest before it erodes.

Documenting the traditional knowledge of tribal communities on wild vegetables and to assess the conservation status of more frequently used wild vegetable species in the forest, data was gathered by using a questionnaire and random transact sampling.

The database from the ethno botanical inventory was used to calculate a Use Index (UI) for each species. Ninty-two plant species are used by the forest dependent community as wild vegetables, of which 58 (62%) species are collected from the forest; the remaining are found as wild in agriculture lands. Four wild plants are popular and were found to be used in all houses as food.

The uses of diversity of wild plants have evolved over generations as a survival strategy. Unique recipes incorporating these wild plants are a tradition among these families. We found that the local communities perceive a decline in the availability of the wild edible plants species, possibly due to unsustainable harvesting practices. The communities relate usage of wild plants to seasonal plant availability and the plant's phonological status. They can predict the availability of wild vegetables with respect to micro-climatic changes, indicating long-term intimate knowledge of their surrounding. The overall potential dietary pattern is that of a pronounced seasonal change in the quality of plant foods. Variety of types of food items provided by several different type of plants during the rainy season to mainly fruit/seed/pods and/or underground parts in the dry season. These findings will be useful for further studies on the nutritional values and conservation of these plants.

GREEN CHEMICAL APPROACH TO SYNTHESIZE 4-(SUBSTITUTED-BENZYLIDENE-2-PHENYL-1-(5-PHENYLTHIAZOL-2-YL)-1H-IMIDAZOL-5(4H)-ONE AND ITS ANTIMICROBIAL STUDIES

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One of the most attractive concepts in chemistry for sustainability is Green Chemistry, which is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture, and applications of chemical products. One of the key areas of Green Chemistry is the elimination of solvents in chemical processes or the replacement of hazardous solvents with environmentally benign solvents. Microwave heating has attracted the attention of investigators in that it makes it possible to shorten the length of reactions significantly, to increase their selectivity, and to increase the product yields, which is particularly important in the case of high-temperature processes that take a long time.

Reactions in microwave ovens are currently in use for the synthesis of medicinally important compounds. Within the framework of 'Green Chemistry' we have now developed an environmentally benign and novel approach for the synthesis of (E)-4-(substituted benzylidene)-2-phenyl-1-(5-phenylthiazol-2-yl)-1H-imidazol-5(4H)-one. These compounds have been prepared by the reaction of 5-(pyridin-4-yl)-1,3,4-thiadiazol-2-amine with various (Z)-4-(substituted benzylidene)-2-phenyloxazol-5(4H)-one by using modified domestic microwave oven. The structure of these compounds was assigned on the basis of elemental analysis, IR, ^{1}H NMR spectral data. The compounds showed significant antibacterial and antifungal activity against *E. coli, P. aeruginosa, S. aureus , C. albicans* and *A. niger* using cup plate and agar well diffusion technique.

A GREEN CHEMICAL APPROACH PHARMACOLOGICAL EVALUATION OF SOME 1, 3, 4-OXADIAZOLE DERIVATIVES

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The solvent-free organic reactions assisted by microwaves in particular, have gained special attention in recent years. The use of microwave irradiation in organic synthesis can increase the purity of the resulting products, enhance the chemical yield and shorten the reaction time. Solvent-free reaction leads to a clean, eco-friendly and economic technology. Reactions on solid support without using solvent usually with open vessel in domestic microwave ovens are currently in use for synthetic chemist to create eco-friendly atmosphere. In view of these facts, we present herein a rapid and efficient method for the synthesis 1, 3, 4-oxadiazoles derivatives in solvent-free conditions under microwave irradiation using silica gel as solid support. Reaction of isonicotinohydrazide with different aromatic aldehydes under the microwave irradiation gives Schiff's bases. These Schiff's bases were converted into 1, 3, 4-oxadiazole derivatives by treating with acetic anhydride under the microwave irradiation. The structures of the compounds were confirmed by elemental analysis, IR, ^{1}HNMR and Mass spectral data. The synthesized compounds were screened for antimicrobial, analgesic and anti-inflammatory activities.

ON SOME QUALITATIVE ASPECTS OF STOCHASTIC MODEL ON A DIFFERENTIABLE MANIFOLD: AN ATMOSPHERIC SCENARIO

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Droughts and floods are two opposite scenario in atmospheric science. Ornstein-Uhlenbeck process is the stochastic model representing droughts and floods. The main emphasize in this paper is to study the Stochastic Differential Equation of droughts and

floods on a differentiable n-manifold (M). The Stochastic Differential Equation (SDE) in a differentiable manifold has been studied by many scientists viz., P. Levy, F. Perrin. The existence and uniqueness theorem of SDE in an n-dimensional Euclidean space has been established by K.Ito. In his paper, Ito has defined an n-dimensional manifold M, a Hausdorff space with second countability axiom and with coordinate neighborhoods, each homeomorphic to the interior of a sphere of n-dimensional Euclidean space and also defined a continuous random motion in M as a M-valued function π (t, w) of t and w to which is measurable in w to for each t and continuous in t for each w. The obvious question arises whether a random motion is defined in such a space Al. It is possible to define a random motion on a differentiable manifold (a locally compact space) and it may be noted that if the manifold is connected (it is always locally connected) then it is a metric space also. Now there arises an obvious problem if we switch on from a locally compact metric space to an n-manifold which is compact, connected and Hausdorff.

Generally, a differentiable n-manifold cannot be defined by a single chart; rather on an n-manifold more than one chart exists. Naturally, under a change of basis more than one vector fields would occur corresponding to each chart and the latter one depends on the former. Thus the present paper establishes the qualitative study viz., existence and uniqueness theorem.

VEGETATION AND CLIMATE HISTORY FROM KUSUMELLI SWAMP, SEHORE DISTRICT, MADHYA PRADESH SINCE EARLY HOLOCENE

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The present study deals with the reconstruction of vegetation and climate since Early Holocene through pollen analysis from two profiles of Kusumelli Swamp Sehore district, Madhya Pradesh. Based on changing relative frequencies of major arboreal and non arboreal taxa, three pollen zones (KDC-1 to KDC-3 and KDT-1 to KDT-3) of vegetation and corresponding climate fluctuations have been recognized from KDC core of 1.5m and KDT trench of 1m respectively.

KDC zone-1 exhibits diverse floristic and dense augmentation of flora. *Madhuca indica, Buchanania lanza, Butea monosperma, Shorea robusta, Terminalia* sp., *Tectona grandis*, etc are major deciduous trees. In addition, few dry deciduous taxa i.e. *Holoptelea* sp., *Lannea* sp., *Diospyros* sp., *Flacourtia* sp., *Acacia* sp. and Meliaceae also encountered. The floristic suggests a mixed tropical deciduous forest developed in

the region in between 11,000- 8500 yr BP. The grasses, other herbs (aquatic or terrestrial) and ferns profoundly thriving suggesting high humidity and temperature increase due to high SW monsoon activity. Subsequently, the area witnessed sudden decline in vegetation concentration during 8500 to 7000 yr BP. The floristic composition indicates the alteration of deciduous forest into tree savannah type of vegetation almost certainly due to small spell of cooler and dryer climate which corresponds to 8.2 ka short global cooling event. During 7000 to 5100 yr BP, the alteration in palaeofloristic pattern from tree savannah type of vegetation to dry deciduous forest has occurred due to warm and humid but probably not as humid as Early Holocene. The moist tree taxa have certainly decreased although dry deciduous taxa flourished suggesting less precipitation in the region as compared to early Holocene.

Kusumelli Swamp trench profile (KDT) endowed the floristic composition which reveals the grasses and other herbs with intermittent trees and shrubs constituted tree savannah during 4000 to 3100 yr BP (KDT-1). The profound growth of grasses, Chenopodiaceae /Amaranthaceae, *Artemisia* sp. while strewn record of other herbs and hostile conditions for trees growth portrays cooler and dryer climatic conditions. However, ameliorating trend of climate could be inferred towards the end of zone. Subsequently, KDT-2 pollen zone show recurrence of both moist and dry deciduous trees such as *Tectona grandis*, *Shorea robusta*, *Lagerstoemia* sp., *Diospyros* sp., *Lannea coromendalica*, *Buchnania lanza*, *Flacourtia* sp., *Mangifera indica*, *Azardirachta* sp., *Emblica officinalis*, Meliacaea, *Syzygium* sp., *Butea monosperma* and *Acacia*. In addition, increase of *Terminalia* sp, *Madhuca indica* and *Holoptelea* sp. have prompted towards increase in total diversity of flora. The floristic composition envisages that tree savannahs transformed into open mixed deciduous forest. The depletion in Chenopodiaceae/Amaranthaceae growth accompanied by profound occurrence of grasses exhibit amelioration of climate towards warmer and wetter conditions with improved monsoon during 3100 to 1350 yr BP. Later on during 1350 to 377 yr BP (KDT-3), the association of tree taxa suggests the recuperated growth of dry deciduous trees with inter dispersed moist taxa and shrubs. The floristic composition shows improving trends of vegetation enhancement towards edifice of dry deciduous forest. The whole vegetational assemblage suggests a warm and humid climate coupled with active inception of south west monsoon i.e. more or less similar to climatic condition prevailing today.

POLLEN DEPOSITION PATTERN IN TROPICAL DECIDUOUS SAL (*SHOREA ROBUSTA* GAERTN.) FORESTS IN SHAHDOL DISTRICT, MADHYA PRADESH, INDIA

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This paper describes the results of a modern pollen survey of plant communities in tropical deciduous sal (*Shorea robusta* Gaertn) forests in Shahdol district through the pollen analysis of 6 surface samples (moss pollsters). The pollen assemblage reveals the relatively lower frequencies of arboreals in contrast to the non-arboreal taxa. Among the arboreals, *Shorea robusta*, a dominant forest constituent, is not represented honestly in the pollen-rain and encountered with av. 1.5% pollen only in the sediments. This under-representation of *Shorea robusta* pollen, despite being an enormous pollen producer, could be attributed to its poor preservation in the sediments as well as low dispersal efficiency. On the other hand, the consistent presence of *Madhuca indica*, a common associate of sal and Sapotaceae with highest frequencies of 30% and 13%, respectively corresponds more or less to their frequent presence in the forest coupled with good preservation of their pollen in the sediments. However, the other associates of sal viz., *Terminalia*, *Lagerstroemia*, *Emblica officinalis*, *Syzygium*, *Holoptelea*, *Sterculia*, etc., occurring in good proportion in the forest, are marked by their sporadic presence owing to their low pollen productivity, since majority of them show a strong tendency of entomogamy.

The representation of grasses, sedges, Tubuliflorae, Cheno/Am, etc. in good numbers exhibits more or less the actual composition of ground flora in the forest floor. The consistently high frequencies of Cerealia pollen and concomitant crop weeds such as *Artemisia*, *Cannabis sativa*, members of Cheno/Am, Caryophyllaceae and Urticaceae are the indicative for the proximity of cultivated land and human habitation to the study area.

INTERPLAY BETWEEN POLLEN AND EXTANT VEGETATION IN WETLAND ENVIRON OF LOWER BRAHMAPUTRA FLOODPLAIN OF ASSAM, INDIA

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A total of twenty eight surface samples (9 dry soil samples and 19 mud samples) were procured from two major wetlands namely Hasila and Deepor beel of Goalpara and Kamrup Districts of Lower Brahmaputra valley, Assam. The samples were palynologically analyzed to determine the composition of pollen deposited on the surface sediments. The study predicts that inspite of partial coherence between modern pollen rain and extant vegetation due to differential pollen productivity, dispersal and deposition, pollen frequencies of surface samples somehow portrays the extant floral distribution in and around the wetland which is well evidenced from our studies where relative frequency of the assemblage includes local arboreals at the average value of 42.94% and 28.53% at near proximity of forest, 24.27% and 18.97% at upland area and within 11% at submerged area of Deepor and Hasila wetland respectively. Thus, the surface samples from near proximity of the woods dominate in the arboreal pollen percentages which are quite relevant to extant floral composition. However, under representation of *Shorea robusta* as a dominant ingredient of nearby forest could be attributed due to poor preservation of its pollen in sediment despite its high productivity. Low profile of phytoplankton viz., diatoms/desmids indicates poor water condition and preservation status in the wetland sediments. The representation of fungal elements belongs to Deuteromycetes and Ascomycetes (grass pathogen) as evidenced by degraded pollen and spores are suggestive of biological degradation in wetland sediments. Therefore, there is a need to precisely observe the behavioural pattern of modern pollen deposition which could be helpful in inferring past climate and vegetation in and around the pristine wetland ecosystem.

HYDROGEN ENERGY TECHNOLOGY AND CHALLENGES

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India has drawn a national hydrogen energy road map which has been approved by national hydrogen board in 2006. Road map visualizes commercial production of one million hydrogen fuel vehicles (mostly 2 and 3 wheelers) and establishment of 1000 MW aggregate hydrogen based power generation capacity. Required investment has been suggested for infrastructure development by hydrogen economy programmed. We have experienced that when technologically complex programmers with huge investment has to be realized in a time bound manner, it is necessary to identified number of milestones and real time corrective mechanisms to keep the programmed.

Similarly, a large number of private, public sector and academic institutions are working on the development of fuel cells in which hydrogen and oxygen combine to produce electricity and water. IOC R&D has introduced hydrogen-CNG blend as fuel in vehicles, created a hydrogen dispensing station and hydrogen fueling station. From the analysis of this experience, we can see that we are yet to reach to common man.

Meanwhile, there has been some progress in developing large scale production of hydrogen through gasification of coal and biomass, thermo-chemical splitting of water and solar assisted hydrogen production.

In India, R& D efforts are in progress with support from the MNRE Govt. of India, and many institutions like BHU has developed hydrogen motorcycles by converting existing petrol driven motorcycles to operate with hydrogen, IIT Delhi has worked on developing 2.5 KVA output alternator by coupling a 5hp engine using hydrogen as the fuel. Similarly, a large number of private, public sector and academic institutions are working on the development of fuel cells in which hydrogen and oxygen combine to produce electricity and water. IOC R&D has introduced hydrogen-CNG blend as fuel in vehicles, created.

In the University of Rajasthan, considerable efforts have been made to teach different aspects of Hydrogen production, storage, purification and ecological aspects at research level and PG teaching level. The talk will cover the innovative methods of hydrogen production through multi electrodes cell as conceptual on-board fuel production for vehicles, purification by polymer membranes and hydrogen storage in thin films and bulk metal hydrides as safe storage.

SUSTAINABLE HABITAT AND CLIMATE CHANGE

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We are faced with the challenge of sustaining our economic growth while dealing with the global threat of climate change. This threat emanates from accumulated greenhouse gas emissions in the atmosphere, anthropogenically generated through long-term and intensive industrial growth and high consumption lifestyles in developed countries. In charting out a developmental pathway which is ecologically sustainable, India has a wider spectrum of choices precisely because it is at an early stage of development.

In dealing with the challenge of climate change we must act on several fronts in a focused manner simultaneously. The focus will be on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation. The strong positive correlation between energy use and human development is well recognized. The integrated energy policy which was adopted in 2006 has some key provisions of promotion of energy efficiency in all sectors, emphasis on mass transport, emphasis on renewable including biofuels plantations, accelerated development of nuclear and hydropower for clean energy and focused R&D on several clean energy related technologies. The development of sustainable habitat may have three components, i.e. promoting energy efficiency in the residential and commercial sector, management of municipal solid waste and promotion of urban public transport.

The residential sector accounts for around 13.3% of total commercial energy use in India. Electricity use in recent past has increased at 8.25% annually in the residential sector. Electricity consumption in the residential sector is primarily for lighting, space conditioning, refrigeration and other appliances. The commercial sector comprises various institutional establishments. Electricity consumption has increased at the rate of 7.4% annually in the last decade in the commercial sector. Energy use in residential and commercial buildings also varies significantly across the income groups, building construction typology, climate and several other factors. While the use of more efficient appliances can play a key role in reducing final energy demands, energy-efficient appliances typically have higher upfront costs than their non-labeled counterparts. Adopting of energy-efficient lighting and space-conditioning technologies should be integrated into housing finance schemes of financial institutions, appliance financing schemes need to incentivize purchase of energy-efficient equipment and utility-based programmes should be put in place to pay for the higher upfront capital costs of lighting systems in the utility bills. The Energy Conservation Building Code (ECBC) aims to

reduce the baseline energy consumption by supporting adoption and implementation of efficiency savings and savings in GHG emissions, besides other benefits.

Municipal solid waste (MSW) generation reflects not just income levels, but also lifestyle choices. Recycling of materials is an important option for reducing environmental pressures. Efforts at composting and generating energy from waste have normally not been successful for a variety of systemic, technology and pricing issues, including variable quality of waste, insufficient segregation of MSW, and opposition to sitting the facilities from local residents and accordingly, the practice of open dumping continues. Broad guidelines for policy reform in the MSW sector may be common regional facilities and integrated systems for collection, transport, transfer, treatment and disposal facilities.

An increase in the demand for transportation services for both passengers and freight is inevitable, given economic growth and increase of population. Mass transport options including buses, railways and mass rapid transit systems, etc. are the principal option for reducing energy use in the urban transport sector and mitigating associated GHG emissions and air pollution. The use of CNG has helped reduce air pollution due to diesel use in some cities because of its lower particulates emissions. Regarding biofuels, ethanol blending of gasoline upto 5% may be desirable.

The effort being undertaken by various state governments and the central government under the National Action Plan on Climate Change may go a longway in providing sustainable habitat to fight the menace of climate change.

RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT IN INDIA

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In India, during the last three decades, there have been continuous efforts relating to research, development, demonstration and application of a variety of renewable energy technologies. While in the first one and a half decade we were engaged in developing institutions, initiating interdisciplinary research, developing and adopting appropriate technologies, setting up renewable energy agencies at state level and installing a number of pilot and demonstration installations, commercialization efforts essentially started from 1993 onwards.

Since quality of projects and equipment utilized thereof are important for reliability and long term operation of technologies, emphasis was put on developing standards and test protocols and a number of testing and evaluation facilities were set

up. Suitable sites for renewable energy installations were identified through resource assessment, fiscal and financial incentives were announced, policies conducive to private participation were put in place. As a result, renewable energy in India has made a noteworthy progress with its definite contribution in the energy technology portfolio of the country. To day, the total installed grid interactive renewable power generating capacity stands at around 20 GW. This constitutes 11% of the total power generating capacity in the country. The Jawaharlal Nehru Solar Mission being implemented by the Government is an important initiative. Within one year, the achievements made under the Mission have attracted attention world over.

Apart from grid interactive power, the contribution of decentralized renewable energy systems like photovoltaic (PV) lighting systems, small PV power plants, solar pumps, water heating systems, biogas plants, biomass gasifiers is not only significant in terms of energy generation and savings but also because of the impact these could create in the society. Potential of various renewable energy technologies in the country has been estimated based on the state of technology currently available. However, for harnessing this potential, still there are constraints in terms of low capacity utilization factor, high initial investment, problems in energy storage and balance of systems, load management, maintenance etc. Eventually renewable energy technologies will have to compete with their conventional counterparts in terms of quality, reliability and cost. It is therefore required to realign our strategies on R&D, technology development, management, industrial production, financial & fiscal incentives, policies in such a way that larger share of renewable energy can be achieved in shorter period with concomitant environmental benefits.

PHOTOSYNTHETIC EFFICIENCY TO CONVERT SOLAR ENERGY: LESSONS TO LEARN FROM NATURE

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Photosynthesis is the fundamental biological process that converts the electromagnetic energy of solar radiation into stored biomass energy. Over millions of years, nature evolved this phenomenon to harness the energy from sun. It is a very complex process that involves a series of reactions starting with the splitting of water molecules into molecular oxygen, protons and electrons, followed by a chain of electron transfer reactions resulting in the production of chemical energy used in cell metabolism.

Chlorophyll is a prime component of this process. It captures the energy of sunlight and allows this energy to power the complex chemical reactions inside the plant. The transfer of energy from light-harvesting Chlorophylls to the reaction centres that have been intelligently crafted by nature is a highly efficient process. However, the actual percentage of solar energy ultimately stored by plants in the form of biomass is very less, and therefore, the overall photosynthetic efficiency is low. There are a number of intermediary steps that work in tandem to produce the resultant biomass. It is necessary to revisit this path that nature has built and perfected over a long time and to understand the process to learn a few lessons.

In this paper the efficiency of photosynthesis has been discussed in analogy to other solar energy conversion processes that are being developed today in search of sustainable sources of energy.

CLIMATE CHANGE AND INDIAN TELECOMMUNICATION SECTOR

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With increasing pervasiveness of mobile phones and the widespread adoption of Information and Communications Technology (ICT) worldwide, the ICT sector is expected to contribute around 3% of the global emissions of greenhouse gases (GHG) by the year 2020. While globally the telecommunication sector contributes around 0.7% of the global GHG emissions, the corresponding figure in India is 1%.The main contributing sectors within the ICT industry include the energy requirements of PCs and monitors (40%), data centres about 23% and fixed and mobile telecommunications contribute about 24% of the total emissions. The telecommunication sector can help in climate change mitigation by reducing the sector's energy requirements, using renewable energy sources and providing technology to implement and monitor reductions in other sectors of the economy.

This paper discusses the approach of Indian telecommunication service providers to the climate change by efficient power management, infrastructure sharing, use of eco-friendly renewable energy sources and cutting down carbon emission.

METAL OXIDES AS HUMIDITY SENSORS

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Environment degrades materials and material degrades environment. Water, which is supposed to be the nectar on earth not only supports life on earth but at the same time, degrades the quality of life by its unique molecular arrangement. In our daily life we observe materials, which support our life style degrade due to rust, mold, mildew, rot, decay, wrapping, stretching, lumping, caking, agglomeration and decomposition. These are all common enough problems encountered in our daily life leading to reduced efficiencies and product wastage. It is interesting to note the root cause of all these problems and many more is the presence of moisture and humidity in the air. The storage manufacture and transportation of materials often take place in a humid environment which is not suited to moisture sensitivity of the material leading to deterioration of stored material, machinery equipment and reduced product appeal. Sensing humidity and controlling it for providing proper environment had been highly challenging since time immemorial. Authors have worked on many metal oxide systems e.g. Nb_2O_5, Nd_2O_3, La_2O_3, ZnO, ZnO-TiO_2, ZnO-Nb_2O_5 etc and found that metal co-oxides work as better humidity sensors. Out of all investigated material, ZnO-Nb_2O_5 co-oxide gave highest sensitivity 19 MΩ/%RH and better reproducibility than others, with 5% hysteresis over entire range of RH and can be fabricated easily under limited cost.

PASSIVE CONCEPT USED IN TOMB OF ALIYA BEGAM: A CASE STUDY

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Energy is the basic indicator of the development of a country and considerable energy is used in buildings for heating, cooling and lighting among others. Due to inappropriate design of the buildings, more energy is consumed. The last decade has

witnessed a grave energy crisis in developing countries during summer season primarily due to cooling load requirements of the buildings. We can save a lot of energy by proper designing of the buildings.

Our old architects have set an example of using solar passive concepts in buildings to fulfill the need of comfort like visual, thermal and acoustic without using any significant amount of energy. They had used different methods to reduce the cooling and heating load of houses and buildings in the most sustainable method.

This paper describes solar passive heating and cooling concepts applied by our ancient architect to Tomb of Aliya Begam, Lucknow which is an Awadh architectural building. They used passive concept like dome roof, high roof and thick wall, octagonal shape of building to meet the needs of heating, cooling and natural lighting. The paper describes the results obtained on several parameters like U- value, R- value, time lag, decremental factor and day light factor concerning heating, cooling and natural lighting. The buildings which are designed with sustainable features like Tomb of Aliya Begam are advocated to reduce the comsumption of energy in buildings.

CHARACTERIZATION OF SOLAR PHOTOVOLTAIC MODULES ON THE BASIS OF AMBIENT TEMPERATURE

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Solar photovoltaic modules are generally characterized in simulated conditions. On actual sites the performance of the modules may vary. An effort has been made to measure the performance of solar photovoltaic modules in different months at particular location i.e. Lucknow with respect to temperatures for the different seasons for a year. In this paper, data is presented for months of May, June, July and August.

With the given data, an equation has been developed mathematically which is in good correlation with the measured data. It is helpful in developing a relation of the efficiency of modules with corresponding ambient temperatures.

In this paper, only one climatic parameter has been considered i.e. ambient temperature, while considering all major parameters like temperature, humidity, wind velocity, cloud cover, dust etc, a standard equation can be developed which would be helpful in having a relation of all major climatic parameters with the performance of solar photovoltaic modules and the level of accuracy of proposing the efficiency of modules would increase while increasing the number of climatic parameters.

COMPARATIVE STUDY OF BIO-METHANATION FROM FLOWER WASTE AND KITCHEN WASTE

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Several studies have been carried out in India and abroad on production of biogas using cattle and other waste materials. In this work, a comparative study of biogas production from kitchen waste and flower waste was done under the same operating conditions. Two kg of each waste was mixed with 30 liter of water and loaded into the proto-type biogas digester. Biogas production was measured for every day and at an average temperature of mesophilic range. Results indicated that kitchen waste produced biogas in range of 0.504- 1.038 m^3/day and flower waste produced 0.504- 0.792 m^3/day. It is concluded that kitchen waste as compared to the flower waste is more efficient for biogas production.

This paper also discusses that several environmental factors such as temperature, pH, total solid, volatile solid, moisture content and carbon-nitrogen ratio affect the production of biogas.

RELEVANCE OF ENVIRONMENTAL ETHICS (EE) TO SUSTAIN PLANET EARTH

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Human existence on earth is dependent on multiple factors. A synergy of the micro- and mega – components foretell future of planet earth. Sustenance of earth is dictated by level of awareness and conscious involvement of human beings in ecological processes. Unscrupulous consumption of natural resources and subsequent damage gave rise to environmental concerns like biodiversity, climate change etc. Human activity should not direct perceived self-destruction. Massive human economic activity has already disturbed balance of our living planet. World does not exist as a resource to be freely exploited by humans. Present human interference with the natural system may lead to nemesis of natural world. Humans have no right to reduce richness

and diversity of green earth except to satisfy vital human needs. There is a need for paradigm shift from anthropo-to eco-centric development. Environmental Ethics (EE) for all developmental strategies should be focused on holism of nature with anthropogenic partnership. EE provides moral responsibility and affirms right of all resources, effectively change our role as a conqueror to custodian of environment and also provides regulatory mechanism for sustainable development. There is a growing realization that like humanity, the living environment as a whole has the same right to live and flourish. An inter-connected system prolongs sustenance. Deep experience, questioning and commitment give rise to a more holistic view of the world. Ecological wisdom and harmony should be fostered. Being important component of the biotic community humans have an additional moral responsibility through preserving integrity, stability and beauty of the biosphere. Since everything is connected to everything else a new environmental ethics, considering global health should be adapted. Eco-centric perspective can be perceived through a process of re-earthing. EE holds that a whole system is superior to any of its parts. Intrinsic and inherent value of earth and related components should be realized. Values are independent of the usefulness of the nonhuman world for human purposes. Policies must therefore be changed to suit strategic economic, technological, and ideological structures. Ideological change is required to appreciate life quality, rather than adhering to an increasingly higher standard of living. Difference between big and great should be understood. Besides, issues like social equity, human well being and sustainability should be widely propounded. Practices like 'Green Economy' through perspective planning at social, economic and political levels can achieve remarkable results in the form of generating sustainable wealth, optimal use of natural resources, creating jobs, enhancing productivity, bringing positive changes in consumption levels, altering life style patterns and increasing awareness about environment. Encouraging implementation of renewable energy, green buildings, clean transportation, prudent water, waste and land management augur well to enhance economic well being. No compromise should be made in defense of mother earth. A cosmo-centric approach is recommended for greater sustainability of planet earth.

ENERGY INFORMATICS – COMPUTER SCIENCE FOR ENERGY SYSTEMS

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The core concept of energy informatics is energy plus computer science aided information with a view to reduce the energy consumption in a particular system. This means analyzing, designing and implementing information systems to increase energy efficiency. The energy informatics consists of collection and analysis of energy data sets, optimization of energy distribution networks and optimization of energy consumption systems with computer algorithms and simulations.

It incorporates the framework for supply and demand sides, flow networks, sensor network, sensitized object and information system with strong coupling between computing components and non-computing processes in physical environment. The work of computer supported information system is that it ties together the elements to provide a complete solution, integrates supply and demand for a comprehensive solution, provides interfaces for suppliers and consumers, automates aspects of the flow network and incorporates sense and act mechanisms.

Computing systems having strong coupling with the physical environment are referred to as the Cyber-Physical Systems (CPSs). These systems usually monitor, coordinate, and control non-computing processes. Recent advances in the sensor technologies and embedded computing systems have seen a surge of CPSs being investigated.

Many developed and developing countries are trying to use energy informatics in their traffic management, building automation, energy management programmes and fleet management among others.

With the increasing cost of electricity and other conventional energy supplies (oil, coal and natural gas), the emphasis is being laid on the eco-friendly sources of energy like solar, wind, biomass and others and also on enhancing the energy efficiency in various sectors of energy use to combat global warming and climate change. Energy informatics has a great role to play for the energy systems in the near future.

EFFECT OF GLOBAL WARMING ON CLIMATE CHANGE OF THE EARTH

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Global warming is a very crucial problem for whole environment because of increase in average temperature of troposphere and stratosphere. The depletion of ozone layer, release of carbon dioxide (CO_2), carbon monoxide (CO), methane (CH_4) and other heat - trapping gases from smokestacks, construction, industries, transport, consumption and burning forests has been raising temperature of atmosphere day by

day. Nowadays, there is a serious problem of global warming and continuously affecting to the earth's climate. Therefore, earth's climate is suddenly changing through a natural cycle. Climate change is a long term change in the statistical distribution of environment and weather. These changes may be attributed to directly or indirectly to human activity that alters the composition of the global atmosphere. In addition to natural climate variability observed over long periods. Climate change reflects variation in the energy balance of the climate system. The relative balance between incoming solar radiation and outgoing infrared radiation from the earth attribute to radiative forcing. Efforts have been made for curing such a big problem by using unlimited renewable energy sources.

EFFECT OF GEOMAGNETIC ACTIVITY ON IONOSPHERIC RANGE-ERROR IN GPS SIGNAL DURING LOW SOLAR-ACTIVITY PERIOD AT LOW LATITUDE STATION

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Present paper describes analysis of GPS-data recorded at Varanasi, a station near the Equatorial Ionization Anomaly (EIA) to study the effect of magnetic activity on ionospheric range error. The variability in GPS range error due to presence of Total Electron Content (TEC) of the ionosphere during five most quiet and most disturbed days of each month of year 2008 is carried out. The result shows GPS ranging error is found to be more during disturbed days compared to quiet days, showing maximum in equinox, minimum in summer and winter season. The variability of positioning error during the period of two geomagnetic storms, March 2008 and October 2008 is also studied.

TRENDS IN THE DISTRICTWISE DROUGHT INCIDENCES OVER INDIA

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Drought is a normal, recurrent feature of climate and is observed in all the climatic zones. However, it has significantly different characteristics from one region to another. Drought differs from aridity. Aridity is a permanent feature of climate over regions where rainfall received is generally low. On the other hand, drought over a geographic area is a temporary condition caused by significantly less (deficient) rainfall for an extended period of time, usually during a season when substantial rainfall is normally expected over the area.

The deficiency in the rainfall is measured relative to the Long-Period Average (LPA) of rainfall over the area. While considering the drought, it is also important to take into account the timing (i.e. principal season of occurrence, delays in the start of the rainy season) and the effectiveness (i.e. rainfall intensity, number of rainfall events) of the rains. The severity of the drought can also be aggravated by other climatic factors such as high temperature, high wind and low humidity.

A drought index is typically a single number value used for indicating severity of a drought and it is far more useful than raw data to understand the drought conditions over an area. Due to multidisciplinary importance of drought, several drought indices can be found in the literature. In this study, Standardized Precipitation Index (SPI) has been used as a drought index to examine the District-wise drought Climatology and trends in the drought incidences over India for the southwest monsoon season (June to September). SPI was computed using long time-series (1901 to 2003) of southwest monsoon season rainfall data of 458 districts over the country.

It was observed that SPI is a suitable drought index for the district-wise drought monitoring over the country, as SPI was not biased by aridity. The trends in the district-wise SPI time series was computed using data of districts having data for at least 70 years. The trend analysis of district-wise SPI series showed significant decreasing trends over many districts in Uttaranchal, Kerala and in the sub-divisions from east central India such as east Madhya Pradesh, Vidarbha, Chhattisgarh, Jharkhand, Bihar etc., and significant increasing trend was observed over several districts from Konkan region, Karnataka, west Madhya Pradesh, Andhra Pradesh, Punjab and West Uttar Pradesh. Some districts of Kerala and Chattisgarh showed decreasing trends in SPI series and relatively high probability of droughts of moderate and above intensity.

DIURNAL TIDE IN THE TROPOSPHERE AND LOWER STRATOSPHERE OVER HYDERABAD, A TROPICAL STATION

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This paper reports measurements of diurnal tidal oscillations in the lower atmosphere over Hyderabad, a low latitude station in the northern hemisphere. Wind and temperature data obtained through high resolution (in height) GPS radiosonde flights carried out by India Meteorological Department (IMD), Hyderabad have been used for the study. Diurnal amplitudes in both wind and temperature are observed to be quite appreciable (2 - 4.5 m/s for winds and ~2k for temperature). No clear structure can be found in the phase profiles. Amplitudes in the summer months are larger indicating contribution of non - migrating modes.

TRENDS ANALYSIS OF RAINFALL SERIES IN HARYANA

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In this study, trends analyses of rainfall series have been carried out for annual and seasonal basis for 19 districts of Haryana. The trends of rainfall series have been examined using the Mann–Kendall test and magnitude of trends using Sen's slope estimator for the period during 1901–2010. Almost all the districts show the significant increasing trends in annual rainfall series at a significance level of 1%, 5% and 10%. The magnitude of increase in annual rainfall varied from 0.64 mm per year (Kaithal district) to 1.63 mm per year (Sirsa district). Further, significant increase was also found in annual, pre monsoon and monsoon series over entire Haryana during the period of

analysis. Annually, the increase in magnitude was 1.04 mm per year over entire Haryana. On the seasonally scale, increase in magnitude was 0.05 mm per year for pre-monsoon season and 0.19 mm per year for monsoon season.

CLIMATE CHANGE AFFECT ON SW AND NE-MONSOON SEASONS OF INDIA

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Scientists are investigating the anticipated effects of climate change on India's Monsoon Season and the impact that alterations in India's water cycle will have on the country's people, agriculture and wildlife. Changes to India's annual monsoon are expected to result in parts of India in severe droughts and intense flooding. Scientists predict that by the end of the century the country will experience a 3 to 5°C temperature increase and a 20% rise in all summer monsoon rainfall. The livelihood of a vast population in India depends on agriculture, forestry, wetlands and fisheries and land use in these areas is strongly influenced by water-based ecosystems that depend on monsoon rains. Changes to the water cycle may also cause an increase in water borne diseases such as cholera and hepatitis, as well as diseases carried by insects such as malaria. The increasing failure of the monsoon has been attributed to a number of factors including temperatures rising by an average on 0.5 degrees Celsius over the last hundred years, receding Himalayan glaciers and rising sea levels. Keeping the above in view a study has been undertaken to investigate the effects of climate change on cyclonic storms and depressions forming over Bay of Bengal and Arabian Sea.

HEAT WAVE CONDITIONS OVER INDIA DURING 1961-2010

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Using heat wave information of 104 stations from Indian main land during the hot weather season (March to July) various aspects of heat waves such as its long term climatology, decadal variation and trends over India were examined. For deriving information regarding heat wave, daily maximum temperature data over these stations

for the last 50 years (1961-2010) were used. The daily maximum temperature data for the period 1969-2010 were obtained from National Data Center, India Meteorological Department, Pune and data for the period 1961-1968 were derived from daily Indian Daily Weather Report logs published by India Meteorological Department.

It was observed that the stations from the northwest Rajasthan and neighboring Punjab, north M. P and coastal Andhra Pradesh experienced more than 700 days of heat wave days during the data period 1961-2010. Also stations from Uttaranchal, east Uttar Pradesh, Bihar, and Orissa experienced more than 60 severe heat wave days during the data period of 1961 – 2010. Among the 104 stations used here, Nellore has experienced maximum number of heat wave days (1646) during the entire period followed by Ganganagar (830), Chennai (781) and Jhansi (769). Ganganagar, Hissar, Bhubaneswar showed consistently increasing trend of heat wave across all the decades. In the case of severe heat wave days, Dehradun experienced the maximum number of severe heat wave days (82), followed by Bahraich (64), Purnea (63) and Balasore (62). The maximum number of heat wave days was observed in the month of May and maximum number of severe heat wave days was observed in the month of June. The decade 2001-2010 experienced the maximum heat wave spells. The year 2010 had the maximum number of both heat wave and severe heat wave days. There is a significant increase in the spatial coverage of heat wave and severe heat wave during the decade 2001 – 2010 compared to the previous decade.

The results of trend analysis show evidence of an increasing trend in heat wave days over India during 1961-2010 with more than 50% stations showing statistically significant increasing trend.

It can be concluded that the observed increasing trend in the heat waves in India is in tune with the observed global warming.

GREEN SYNTHESIS AND ANTIMICROBIAL STUDY OF SOME (E)-4-(4- SUBSTITUTED BENZYLIDENE-1-(MONO/ DI -CHLOROPHENYL)-1, 3, 4-THIADIAZOL-2-YL)-2-PHENYL-1H-IMIDAZOL-5(4H)-ONE

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Green chemistry is placed in the frontier areas of research and has been focused for considerable recent research. Green chemistry, the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances is an overarching approach that is applicable to all aspects of chemistry. From feedstock's to solvents, synthesis and processing green chemistry actively seeks ways to produce materials in a way that is more benign to human health and the environment. The current emphasis on green chemistry reflects a shift away from the historic command and control approach to environmental problems that mandated waste treatment, control and clean up through regulation and towards preventing pollution at its source rather than accepting pollution at its source. Green chemistry seeks new technologies that are cleaner and economically competitive.

All synthetic processes involve the use of different solvents which inevitably lead to environmental damage, through pollution, risks to human health and to resource depletion, we need to develop and apply more environmentally friendly approaches.

Green chemistry involves design and redesign of chemical synthesis and chemical products to prevent pollution and thereby solve environmental problems. Clearly there will be a continuing need for the definition of novel reaction routes to both multifunctional scaffolds for lead generation and to unique drug like heterocyclic structures microwave irradiation has proved to be a powerful tool for both speeding up chemical optimizations and for efficient preparation of new target compounds.

So, all traditional and old synthetic routes are more or less "Grey" in their working and obviously give adverse effects to the mankind and all living beings. Green chemistry provides "Green" paths for different synthetic routes using non-hazardous solvents and environmental friendly chemicals.

The fundamentally attractive concept of green chemistry is solvent free reactions. Solvent free reactions can be accelerated by microwave activation and this combined clean technology approach to "greening" chemical reactions.

The major aim of this article is to provide / discuses the emerging trends in environment management and evolve sustainable management strategies to solve the burning environmental problems.

Microwave enhanced synthesis has attracted substantial attention in recent years, enabling many organic reactions to proceed much faster and with higher yields than, when conventional heating is employed. Microwave irradiation has become a powerful synthetic tool for rapid synthesis of a variety of organic compounds. Microwave assisted reactions have attracted much interest because of the simplicity in operation, milder reaction conditions, increasing reaction rates and formation of cleaner products.

Microwave synthesis is one of them, which involves modified engineering, practices, bioremediation, eco-friendly reaction media and concept of atom economy leading to almost zero waste. It clearly differentiates the grey synthetic processes with that of green natural processes having strategic objectives with social and environmental benefits.

In view of these, it was planned to synthesize a new series of oxazolones by microwave irradiation and to evaluate the new compounds for their antimicrobial activity. The synthesis of newer class of antibacterial and antifungal agents is in need of time, especially against drug resistant bacteria and fungi which are responsible for a number of serious infections in acute and chronic care units in hospitals.

Imidazolinone ring system is of biological and chemical interest since long. The Imidazolinone units are found in many biologically active compounds including anticancer, anti-HIV agents, anticonvulsants, monoamine oxidase inhibitors, anti-parkinsonian drugs, CNS depressants, antimicrobials and anthelmintic etc.

The development of simple, efficient and environmentally benign chemical processes or methodologies for widely used organic compounds from readily available reagents is one of the major challenges for chemists in organic synthesis.

HUMAN IMPACT AND NATURAL RESOURCE MANAGEMENT: FAST DEPLETING OF NATURAL RESOURCE IN CHENNAI AND IT'S SUB-URBAN

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Over the last decades, Chennai has experienced a rapid growth of it's population. While the city was founded in 1639, based on only a few settlements, the city expanded it's size and population steadily and totalled 4.34 million inhabitants in 2001. The size of the city is 176 Km^2 and accepted plans by the Corporation of Chennai suggests an expansion of the city area by upto 426 Km^2. Besides dealing with the effects of urbanization, Chennai is vulnerable to climate-related hazards. Although the number of registered cyclones one of the main natural hazards, has not yet significantly increased , impacts of occasionally succeeding intense rainfall events from cyclones are likely to become more severe in the future.

Resource Identification

Water resources, and bio-diversity, both of them mingle with each other's and play a vital role in Chennai' s fast depleting resources. Water resource identification as, rivers, lakes and ponds. Bio-diversity as natural forests in city limits.

ASSESSING THE MINING AND URBANIZATION IMPACTS ON LAND USE LAND COVER IN ANGUL-TALCHER REGION, ORISSA

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The rate and intensity of Land Use Land Cover (LULC) change has increased considerably during the past couple of decades. Mining and urbanization bring significant alterations in LULC specifically due to its impacts on forest cover and agricultural lands. Land use land cover in Angul Talcher region is changing rapidly due to increase in mining activities urbanization pattern. The areas under forest cover and agricultural land have decreased from 38.67% to 27.96% and 42.14% to 28.92% over the study period (1973 – 2007) respectively. The water bodies have slightly decreased (0.07%) from 1973 to 2007. Mining areas and barren lands have increased from 0.04% to 1.70% and 5.50% to 20.78% since 1973 to 2007. The maximum rate of change of land use land cover has decreased in agricultural land (-0.92%) and forest cover (-0.81%). The study revealed that mining activities and urbanization were detrimental to LULC. Thus, it is advisable that such activities have to be strictly regulated to avoid further damage and scientific mining has to be taken up in a proper manner to minimize the land use land cover.

WEAKENING OF ZONAL TEMPERATURE GRADIENT BETWEEN INDIAN LANDMASS AND NEIGHBOURING OCEANS AND ITS IMPACT ON INDIAN MONSOON

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The study shows that in the scenario of global warming temperature gradient (TG) between Indian land mass and Arabian Sea/Bay of Bengal is significantly decreasing in the lower troposphere with maxima around 850 hPa. TG during pre monsoon (March to May) is reducing at a significant rate of 0.036°/ year (Arabian Sea) and 0.030°/year (Bay of Bengal). The above alarming results are based on sixty years (1948-2007) of daily temperature and wind data extracted from CDAS-NCEP/NCAR reanalysis data sets. TG based on ERA-40 data also indicate a decreasing trend of 0.023°/year and

0.040^{o} /year for Arabian Sea and Bay of Bengal respectively. As TG is not governed by any type of significant oscillation, there is a possibility of TG tending to zero in another 150 years. In such a scenario, the low level westerly jet (i.e. monsoon current over Arabian Sea) would become weak. This will lead to reduced rainfall activity over Indian Peninsula. The break like circulation will prevail for a longer period of time.

It is further observed that the rate of warming over the oceans is more than that over the land which has resulted into the weakening of TG. Pre monsoon TG has significant correlations with i) All India Seasonal Monsoon Rainfall (AISMR), ii) Kinetic energy of waves 1 and 2 at 850 hPa, iii) Kinetic energy and iv) Stream Function at 850 hPa over Indian land mass during monsoon season. Except AISMR, the decreasing trends observed in all the above parameters are significant. All India rainfall for July and August together shows a significant decreasing trend of 0.995 mm/year. Reducing number of depressions and cyclonic storms and increasing number of break days during monsoon over India are the reflections of weakening of TG.

IMPACT OF CLIMATE CHANGE ON WATER RESOURCES

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The impact of climate change on water resources are seen in different scenarios. As an example, due to melting of glaciers, water level will rise in rivers and after some time they will become dry. Climate change is expected to increase the frequency and intensity of current extreme weather events, greater monsoon variability and also the emergence of new disaster. Coastal cities will get inundated under water while increase in heat will lead to dryness of ponds and wells. Hence we have to control the increasing temperature of the earth. For this we have to limit uses of energy in order to avoid emission of Green House Gases. The impact of climate change on water resources, energy and human health will be felt more intensely by the urban population due to high population density and vulnerable growth. This paper presents some of the ideas which may likely to send out a message to the administrators and policy makers.

SOLID WASTE MANAGEMENT

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Waste generation, both domestic and industrial, continues to increase worldwide in tandem with growth in consumption. In developed countries, per capita waste generation increased nearly three-fold over the last two decades reaching a level five to six times higher than that in developing countries with increase in population and living standards, waste generation in developing countries is also increasing rapidly, and may double in volume in the current decade. If current trend continues, the world may see a five-fold increase in waste generation by the year 2025. A high proportion of the waste could be recycled by the urban poor generating income for them-selves protecting the environment. There is need to develop an integrated approach where public, private and community sectors work together to develop local solutions promoting sustainable solid waste management.

TEMPORAL VARIABILITY IN ANNUAL PRECIPITATION AND TEMPERATURE SERIES AT NAGALAND, INDIA

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In the present study an attempt has been made to study the temporal variability of annual precipitation and temperature (minimum and maximum) series at Nagaland, India. Mann Kendall test was used to detect the significance of trends using the period of 1901-2002. Out of seven stations, only two stations showed the significant decreasing trend in precipitation series. Further, no significant trend was detected in precipitation over the entire Nagaland. In temperature series (minimum and maximum) the significant increasing trends was found at all the stations. The maximum temperature shows the greater increase in trend than minimum temperature. Over the entire Nagaland, significant increasing trend was detected in maximum and minimum temperature. Percentage changes over mean values were also calculated. Increases in magnitude greater than 10% were found in temperature and precipitation series at all the stations.

ECOFRIENDLY SYNTHESIS AND MICROBIOLOGICAL PROPERTIES OF (E)-4-(SUBSTITUTED BENZYLIDENE)-2-PHENYL-1-(5-(PYRIDIN-4-YL)-1, 3, 4-THIADIAZOL-2-YL)-1H-IMIDAZOL-5(4H)-ONE

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Green chemistry is placed in the frontier areas of research and has been focused for considerable recent research. Green chemistry, the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances is an overarching approach that is applicable to all aspects of chemistry. From feedstock's to solvents, synthesis and processing green chemistry actively seeks ways to produce materials in a way that is more begin to human health and the environment. The current emphasis on green chemistry reflects a shift away from the historic command and control approach to environmental problems that mandated waste treatment, control and clean up through regulation and towards preventing pollution at its source rather than accepting pollution at its source. Green chemistry seeks new technologies that are cleaner and economically competitive.

All synthetic processes involve the use of different solvents which inevitably lead to environmental damage, through pollution, risks to human health and to resource depletion, we need to develop and apply more environmentally friendly approaches.

Green chemistry involves design and redesign of chemical synthesis and chemical products to prevent pollution and thereby solve environmental problems. Clearly there will be a continuing need for the definition of novel reaction routes to both multifunctional scaffolds for lead generation and to unique drug like heterocyclic structures microwave irradiation has proved to be a powerful tool for both speeding up chemical optimizations and for efficient preparation of new target compounds.

So, all traditional and old synthetic routes are more or less "Grey" in their working and obviously give adverse effects to the mankind and all living beings. Green chemistry provides "Green" paths for different synthetic routes using non-hazardous solvents and environmental friendly chemicals.

The fundamentally attractive concept of green chemistry is solvent free reactions. Solvent free reactions can be accelerated by microwave activation and this combined clean technology approach to "greening" chemical reactions.

The major aim of this article is to provide / discuss the emerging trends in environment management and evolve sustainable management strategies to solve the burning environmental problems.

Microwave enhanced synthesis has attracted substantial attention in recent years, enabling many organic reactions to proceed much faster, higher yields and formation of cleaner products than conventional heating is employed. Microwave irradiation has become a powerful synthetic tool for rapid synthesis of a variety of organic compounds. Microwave assisted reactions have attracted much interest because of the simplicity in operation, milder reaction conditions, increasing reaction rates

Microwave synthesis is one of them, which involves modified engineering, practices, bioremediation, eco-friendly reaction media and concept of atom economy leading to almost zero waste. It clearly differentiates the grey synthetic processes with that of green natural processes having strategic objectives with social and environmental benefits.

Within the framework of 'Green Chemistry' we have now developed an environmentally friendly and novel approach for the synthesis of (E)-4-(substituted benzylidene)-2-phenyl-1-(5-(pyridin-4-yl) 1, 3, 4-thiadiazol-2-yl)-1H-imidazol-5(4H)-one. The title compounds were prepared by the reaction of 5-(pyridin-4-yl)-1,3,4-thiadiazol-2-amine with various (Z)-4-(substituted benzylidene)-2-phenyloxazol-5(4H)-one by using modified domestic microwave oven. The structure of these compounds was assigned on the basis of elemental analysis, IR, ^{1}H NMR spectral data. The compounds showed significant antibacterial activity against *B. subtilis, S. aureus* (gram-positive) and *E. coli* (gram-negative) bacteria and antifungal activity against *C. albicans* and *A. niger* fungi.

ROLL OFF RATE OF AEROSOL BACKSCATTER PROFILES OF MICROPULSE LIDAR OF GUWAHATI UNIVERSITY ON IDENTIFICATION OF CLOUD TYPE AT DIFFERENT ENVIRONMENTAL SITUATIONS

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The aim of this paper is to describe an approach for identifying 'cloud type' from echogram of backscatter and extinction coefficient 'profile-shape', obtained from Micro Pulse Lidar (MPL) operated at Guwahati. The Lidar that transmits 532 nm signal at 5 KHz PRF (Pulse Repetitive Frequency) can receive cloud and aerosol features up to

heights of 5 to 15 km respectively with a resolution of 15-30 m. With bin time of 100 ns and average integrating time of 20s for one profile, the backscatter counts could offer profiles of high temporal resolution. Utilizing the system–character, the backscatter count and extinction coefficient of aerosols are examined in temporal resolution of a minute or less for extraction of cloud–aerosol association at different environmental situations. The basic approach adopted here is through determination of Roll Off rate of decay of the intensity profile (both for backscatter count and extinction coefficient) of each echogram as tail carries the information of mixed population of the scatterers in the atmosphere. Utilizing character of Roll Off rate from a number of echograms covering different periods of a year, the paper offers how identification of precipitating and non precipitating cloud is possible from an MPL system. The contribution of dust particles in modifying the aerosol-cloud interaction is also investigated.

ASSESSING IMPACT OF EXTREME WEATHER EVENTS IN INDIA

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Extreme weather events have enormous impacts on socio-economic and ecosystems. There is increasing consensus about shift in frequency as well as in magnitude of extreme weather events in changing climate due to augmentation in atmospheric concentration of greenhouse gases and aerosols. India is additionally vulnerable to climatic extremes due to high population density, poor infrastructure, low human development index and minimal coping capacity. In this scenario it is important to look at damage caused by climate extremes over India, spatially and temporally. Impacts data constitute information about mortality, persons affected, villages affected, crops affected and total economic loss. All extreme weather events combined together show significant increasing trend in impact. Significant increasing impacts are observed in case of duststorm, flood, hailstorm and lightening. Floods share maximum impacts caused by climate extremes. Spatially, total mortality due to the extreme climate events is maximum in Orissa. It also stands first in normalized mortality. Cold wave has significant increasing trend in impact on Haryana, Rajasthan and West Bengal, whereas significant decreasing trend in Madhya Pradesh. The states showing greater number of events do not necessarily depict higher impact. Thus adaptive capacity and resilience of the society to the climate extremes play important roles on overall impact on the system. Finally policy implications of impacts of these events and future work have been discussed.

PRECIPITATION BURST AND GROWTH OF CAPE AT NORTH EAST REGION: AN ANALYSIS THROUGH MODEL AND OBSERVATION

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In this paper growth and development of burst type precipitation and CAPE, in the entire NE region are analyzed from satellite and ground based data, for understanding physics and dynamical situations involved in the process. The data inputs are wind direction and magnitude, cloud features, precipitation type and thunderstorm magnitude. The paper presents the changes in thunderstorm pattern over this region from 1995 onwards,when instead of its increase in intensity during vernal equinoxial months , the period shifts to August - September in recent years and variations are discussed in terms of SST , wind flow pattern and lapse rate. Track of a few cyclones developed at Bay of Bengal is determined and role of such situation on inducing burst type of precipitation over North Eastern part (NE) is brought in to discussion. For this purpose VARSHA model run at 8-processor Flosolver machine at Gauhati University, is used for track prediction for a few cyclonic cases along with NOAA data. For calculation of precipitation magnitude, the VARSHA model output is compared with IMD and TRMM observation. The analysis presents that zonal wind acts as a good precursor for burst type rain at least five days in advance. The paper also shows that cyclonic situation causes significant burst type rain in southern part of the river Brahmaputra, with magnitude more than 20mm, in cases.

CLIMATE CHANGE: ADAPTATION STRATEGIES FOR PROTECTING PEOPLE AND THE ENVIRONMENT

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Climate change is likely to affect most populations in the next decades and put the lives and wellbeing of billions of people at increased risk. There is strong scientific consensus about climate change. We need to monitor, plan and develop adaptation strategies to deal with its impacts. Global trends are becoming apparent, but the exact

impacts of climate change at the regional and local levels are not well understood. It is widely accepted that even after introducing significant measures to reduce greenhouse gas emissions, additional global warming is inevitable. This will have a significant global economic, social and environmental impact. Climate change may manifest itself as a shift in mean conditions or as changes in the intensity and frequency of extreme events such as flooding and drought. There is a growing recognition that planning for changes in the intensity and frequency of extreme events may pose the most challenging problems for natural resource managers. While uncertainties remain and must be acknowledged, there is growing confidence in the ability of climate simulation models to provide natural resource managers with useful projections of future climate scenarios to support planning and management activities across a range of space and time scales.

Globally, there are two broad policy responses to address climate change is mitigation, which is aimed at slowing down climate change by moderating greenhouse gas emission and adaptation, which is aimed at adjusting resource uses and economic activities in order to moderate potential impacts or to benefit from opportunities associated with climate change. From urban and agricultural water supplies to flood management and aquatic ecosystem protection, global warming is affecting all aspects of water resource management of the world. Rising temperatures, loss of snowpack, escalating size and frequency of flood events, and rising sea levels are just some of the impacts of climate change that have broad implications for the management of natural resources. Bio toxins and degradation products of new chemical entities (NCE's) may enter the food chain and pose a threat to the environment.

As the responsibility of every citizen, we have to tailor interventions to meet the needs of the environmental conditions as well as ensuring the recovery, growth & stabilization of the livelihoods of the individuals or businesses we serve. Climate Change is a global phenomenon that will require collaborative action by individuals, communities, governments, organizations and corporations to bring about meaningful change. The prevention policy incorporates laws regulating the discharge and treatment of sewage. Climate change has an important role to play in direct implementation of adaptation and mitigation programming. The mass dissemination of knowledge can play an important role is to inspire others to work towards the necessary behavioural changes and minimization of nonpoint pollution and primary sources. The holistic approach to understand and take preventive measures is vital for sustainable development.

IMPACT OF GLOBAL CLIMATE CHANGE ON ECOSYSTEMS AND THEIR RESTORATION

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The climate change is a long term change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. The fauna and flora of the world has been subjected to destruction due to global climate change. All the communities of plants and animals exist in a dynamic equilibrium with their environment, the disturbance in environment, directly and adversely affect these communities. The global climate changes may result into water stress, changes in weather patterns, increase in mean temperatures, changes in pattern of precipitation, increasing incidence of extreme climatic events, sea level rise, enhancing the incidence of vector borne and infectious diseases, reduction of forest and wildlife diversity, etc. the potential effects on health due to sea level rise will include death and injury due to flooding, agriculture produce, reduced availability of fresh water due to salt water intrusion, distribution of disease spreading insects, population displacement. The population explosion, increasing trend of industrialization and adoption of latest technology has resulted into the excess use of materials like metals, petroleum, plastics, etc. and contributed enormously in global climate change. The burning of plastic substances produces toxic and fugitive emissions which has raised the concentration of Green House Gases (GHG) in the environment and degraded its quality. The climate change may increase air pollution levels by accelerating the atmospheric chemical reactions that produce photochemical oxidants due to a rise in the temperature.

The ecological restoration methodologies should not be same for all types of ecosystem as the degree of degradation differs ranging from arid and semi-arid lands, tropical and sub- tropical forests, aquatic and marine ecosystem. The Ecosystems, in various regions across the world have already been affected by changes in climate. The Intergovernmental panel on Climate Change reviewed relevant published studies of biological systems and concluded that 20% to 30% of species assessed may be at risk of extinction from climate change impacts exceed 2-3°C (3.6- 4.5°F) relative to pre-industrial levels. The climate change has both adverse and beneficial effects on species.

The future strategies for adopting new changes and restoration should be scientifically planned with multidisciplinary inputs with understanding of implication on transboundary areas and transformation of genetic diversity, ecological hierarchy, competitive interactions. We should take cognizance of Meteorological Department Information. Future- aimed restoration methodologies are required to consider the dynamic nature of ecological communities with multiple trajectories, and connect landscape elements for improving ecosystem functions structures. The use of renewable

sources will decrease the emission of Green House Gases substantially and switching to cleaner fuels and energy efficient technologies will reduce local pollutants with beneficial impact on health.

GEOSEQUESTRATION: A NOVEL APPROACH FOR MITIGATING GLOBAL WARMING

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Geosequestration is the term broadly applied to the processes of Carbon Capture and Storage (CCS), Carbon Capture and Geological Storage (CCGS), carbon dioxide capture and storage, or clean-coal technology. Geological storage (aquifer storage) of any kind necessarily takes place in sedimentary rocks, because sedimentary rocks are porous and have required storage capacity. Storage of CO_2 in underground beneath a layer of impermeable rock (cap rock) which acts as a seal to prevent the CO_2 from leaking out is the most popular option. Presently, there are mainly following types of proposed underground storage sites, i.e. deep saline water-bearing formations (saline aquifers), depleted oil and gas reservoirs, oil reservoirs that may be used for Enhanced Oil Recovery (EOR) , deep coal seems containing methane (Enhanced Coal Bed Methane Recovery (ECBM) , and deep ocean storage.

The present global warming situation of our planet earth has left a pertinent task before geoscientists and environmental technologists to control the effects of greenhouse gases, which are responsible for rapid climate changes. The increasing use of fossil fuels is a major source of excess CO_2 that contributes to the increased concentration of greenhouse gases in the atmosphere. The high concentration of greenhouse gases is the major cause of producing rapid climate changes. Thus, there is a compelling need to reduce the concentration of CO_2 in the atmosphere.

Capturing and storing of CO_2 by injecting it in geologic formations is one of the possible mitigation option. Proven and emerging geophysical technologies could be used for assessing the reliability and long term stability of CO_2 storage to meet the challenge of monitoring CO_2 sequestration. The optimum site selection for geologic storage requires thorough analyses of data, integration of results and fully characterizing the subsurface formations. This process requires years of preparation, feasibility studies, field data collection, data integration and interpretation of results. Carbonate reservoir rocks are notorious for their matrix heterogeneity. The porosity, permeability distribution and facies changes due to depositional stratigraphy, diagenesis, and fracture characteristics greatly affect the volume of CO_2 injection and its long term storage. The

storage is also dependant on the integrity of the seal in the cap rock or the impermeable rock layer that overlies a reservoir. The strength and composition of the seal rock under different injection pressures determine if the CO_2 will be contained or ultimately leak out of the reservoir. The CCS as a bridge to renewable energy and sustainability, is a 'bridging' technology that will ensure that emission targets are achieved. However, Carbon Capturing and Storage is not a 'silver bullet' (straightforward solution perceived to have extreme effectiveness) to combat global warming.

The global recovery of hydrocarbons from the subsurface using integrated geoscience and engineering technology, termed as 'petroleum geoengineering' is an activity with global impact.
The modern concept of geoengineering is usually taken to mean proposals to deliberately manipulate the Earth's climate to counteract the effects of global warming from greenhouse gas emissions. Some geoengineering techniques are based on carbon sequestration. These seek to reduce greenhouse gases in the atmosphere directly. These include direct methods (e.g. carbon dioxide air capture) and indirect methods (e.g. ocean iron fertilization). These techniques can be regarded as mitigation of global warming. However, there is need of further researches and development efforts for adapting currently proven and emerging geophysical tools applied for other applications for CO_2 and also in developing new innovative tools for CO_2 sequestration application.

INCREASING IMPERVIOUS SURFACES AND ITS IMPACT ON LAND SURFACE TEMPERATURE OF PUNE CITY, INDIA

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Surface energy balance is influenced by changing land surface characteristics which is expressed in the form of Land Surface Temperature (LST) and its spatio-temporal variations. LST is regarded as a function of four surface and sub surface properties: albedo, emissivity, the thermal properties of urban construction materials (including moisture), and the composition and structure of urban canopy (Goward, 1981). LST, which is heavily influenced by urban surface structures, is a significant parameter in urban environmental analysis. This study attempts to examine the effect of impervious surfaces (IS) spatial patterns on LST over Pune, India. An NDVI and TC band II approach was adopted to estimate the IS by employing Landsat TM and ETM+ data of 1990 and 2009. One of the indicators of increasing IS is the built-up area, and therefore, IS is represented by built-up area in this study. LST was retrieved for both the

images (1990 and 2009) to examine the relationship between IS and LST. The results obtained indicated rapid growth in the IS over the last two decades and a drastic decrease in vegetation cover. This has led to an increase in LST over different localities in the city. By and large it was observed that the net IS areas increased by almost 21% in the past two decades and led to increase in LST by 2 to 12 deg. Cel. This is an indication of intensification of day time urban heat island over Pune city. The outcome provides a theoretical basis for improving urban planning efforts to lessen urban temperatures and thus diminish urban heat island effects.

INSTANT TOTAL SOLAR RADIATION IN TWO DIFFERENT CLIMATIC CONDITIONS AND FACTORS INFLUENCING THE RADIATION: CORRELATION WITH METEOROLOGICAL PARAMETERS

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In this paper an attempt has been made to see the correlation of instant total solar radiation with twelve meteorological parameters. For this, two different sites of different climatic zones of India – cold and cloudy (Shilong) and hot and dry (Jaiselmer) have been taken. In this study some meteorological parameters (dry bulb temperature, wind speed, wind direction and visibility) are directly associated while some parameters (dew point temperature, relative hunidity, vapour pressure, rainfall, cloud cover and moisture) are inversely associated with the instant total solar radiation. This study determines the potential of influencing meteorological parameters of instant total solar radiation in two different climatic zones. The strength of the correlations has been confirmed from the values of coefficients of correlation.

SPACE BASED SOLAR POWER – A REVIEW STUDY

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In this review study, an attempt has been made to draw the attention towards space-based solar power or solar power satellite. It is a technology to collect solar power on space for use on earth. As on the earth surface, solar insolation is not available all the time of the day and in all season. It differs from place to place. It is affected by cloud cover and visibility. So if it is possible to collect solar power in space for the use on earth, various problems related to solar systems being used today, are solved. This review study draws attention towards benefits of space-based solar power and also towards its hurdles.

Space-based solar power was proposed by Aerospace Engineer and Consultant, Dr. Peter Glaser in 1968 and basic outline of the plan have remained largely unchanged since then. In 1995, NASA conducted a 'Fresh Look' on space solar power concepts and technologies under leadership of John Mankins. Low-cost with small infrastructure SBSP system is being expected in near future in the light of advanced technology. Indian Space Research Organization and US National Space Society launched a joint forum to enhance partnership in harnessing solar energy through space-based solar collectors. Called the Kalam-NSS initiative after the former Indian President Dr APJ Abdul Kalam, the forum will lay the groundwork for the space-based solar power program which could see other countries joining in as well.

The idea of a multilateral space-based solar energy program was initiated by the Indian Ministry of Defence think tank, Institute of Defence Studies and Analyses. A report prepared by Peter Garretson, a US Air Force Lieutenant Colonel called up on the governments of India and the United States to initiate this path-breaking project and make the space-based solar energy a commercially viable business venture by 2025. This partnership between the two countries is likely to gain pace and strength as the United States has now removed some technology-transfer restrictions which were imposed on some scientific research organizations in India after the 1998 nuclear tests. Organizations like the ISRO and Bharat Dynamics will now have access to some sensitive and unique technology.

One of the biggest advantages of space-based solar energy is that it is not intermittent in nature as ground-based solar energy resource. An array of solar panels stationed in a geostationary orbit around the world will receive sunlight for 99 percent time of the year. Plus there are no losses due to atmospheric interferences.

This review study encourages us to give our best to get an eco-friendly and never lasting source of energy. No doubt solar power helps in sustainable development. Space-based solar power may be a solution of the problems related to solar power systems and hence it will be helpful for sustainable development. It is also being reviewed in this study that space-based solar power is helpful to solve the problem of climate change as other sources of renewable energy do.

GLOBAL WARMING: WHO IS RESPONSIBLE?

Pradeep Kumar, Ajay Kumar

पृथ्वी का बढ़ता तापमान : जिम्मेदार कौन?

प्रदीप कुमार[1] एवं अजय कुमार[2]

[1] मानवाधिकार विभाग, बाबा साहेब भीमराव अम्बेडकर विश्वविद्यालय, लखनऊ
[2] समाजशास्त्र विभाग, बाबा साहेब भीमराव अम्बेडकर विश्वविद्यालय, लखनऊ

पृथ्वी किसकी है? और *पृथ्वी के बढ़ते तापमान से कौन प्रभावित होगा?* शायद यह अपने को सभ्य कहलाने वाले विकसित देश भूल गये हैं कि पृथ्वी पे वे भी निवास करते हैं। पर्यावरण संकट को किसी राष्ट्र की धूरी पर नहीं बांधा जा सकता इससे प्रत्येक व्यक्ति प्रभावित होगा न कोई देश, न कोई प्रान्त, न कोई जीव इससे बच सकता है। तो विकसित देश विकास के नाम पे अन्धाधुन्ध इसका दोहन क्यों कर रहे हैं। जब जिम्मेदारी की बात आती है तो, वे जो पिछले १०० वर्षों से प्राकृतिक संसाधनां का बेतहाशा दोहन और पर्यावरण की अनदेखी कर रहे हैं, आज कार्बन उत्सर्जन के सबसे बड़े जिम्मेदार हैं, वे अपनी इस जिम्मेदारी से बचना चाहते हैं।

संयुक्त राष्ट्र पर्यावरण कार्यक्रम के अनुसार पूरी दुनिया में कार्बन का सलाना उत्सर्जन ४४ अरब टन से ज्यादा नहीं होना चाहिए, जो इस समय ४७ अरब टन है। और अभी तक सिर्फ २ अरब टन की स्वैच्छिक कटौती की घोषणा पर सहमति बनी फिर भी जो आवश्यक स्तर है उससे एक अरब टन कम है। समस्या सिर्फ यही नहीं है, जब भी पर्यावरण के संरक्षण के जिम्मेदारी की बात आती है तो विकसित देशों के अड़ियल रवैये के कारण तमाम कोशिशें नाकाम हो जाती हैं।

जब हमने अपने पर्यावरण का ***'मैगनाकार्टा' स्टॉकहोम सम्मेलन १९७२*** में पहली बार ***'एक ही पृथ्वी'*** के सिद्धान्त को स्वीकार कर चुके हैं तो क्या इसकी रक्षा करना प्रत्येक राष्ट्र का कर्त्तव्य नहीं है कि वे आगे आने वाली भावी पीढ़ियों के लिए साथ ही साथ अपने लिए पृथ्वी को बचाए रखें।

प्रथम पृथ्वी सम्मेलन ***रिओ घोषणा, १९९२*** एवम् द्वितीय पृथ्वी सम्मेलन ***जोहान्सवर्ग घोषणा, २००२*** के सिद्धान्तों में भी विकसित देशों को जिम्मेदारी से प्रतिबद्ध करने का प्रावधान किया गया है परन्तु वे विकास के मदों में चूर जैविक व आणविक हथियारों को बनाने के होड़ में शामिल रहें।

ऑकड़े बड़े चौकाने वाले हैं कि विकसित देश की जनसंख्या विश्व की जनसंख्या की २२ फीसदी है जबकि वे ८८ फीसदी प्राकृतिक संसाधनों एवं ७३ फीसदी ऊर्जा का इस्तेमाल करते हैं। साथ ही विश्व की ८५ फीसदी आय पर उनका नियंत्रण है।

जबकि अन्य देश की जनसंख्या ७८ फीसदी महज १२ फीसदी प्राकृतिक संसाधन एवं २७ फीसदी ऊर्जा का इस्तेमाल करते हैं इनकी आय १५ फीसदी ही है। इससे यह साफ प्रतीत होता है कि पर्यावरण के प्रदूशण के जिम्मेदार विकसित देश कहीं अधिक है अपेक्षा की अन्य देशों से। २००५ में अमेरिका द्वारा प्रतिवर्श प्रति व्यक्ति २३.५ टन कार्बन उत्सर्जन किया जा रहा था जबकि भारत में प्रति व्यक्ति १.७ टन। ऐसे में अमेरिका कि जिम्मेदारी ज्यादा बनती है। समस्या तो यह है कि वे स्वेच्छिक कटौती से भी बचना चाहते है।

यह विकसित देशों का अड़ियल रवैया था कि कापेन हेगन २००६ जलवायु सम्मेलन १२ दिन तक चलने के बाद कुछ हासिल न होने पर एक दिन बाद भी जारी रहा पर कोई बात नहीं बनी विकसित और विकासशील देशों के बीच दूरी बढ़ती गई और अभी तक कोई स्पष्ट समय सीमा और कानूनी बंदिश पृथ्वी के बढ़ते तापमान को राकने के लिए नहीं बन पाई। जो भी हो २०१२ में क्योटो प्रोटोकाल समाप्त हो रहा है अगर हम आपसी सहमति से किसी बाध्यकारी लक्ष्य को नहीं पहुँच है तो इसका परिणाम हम सभी पृथ्वीवासी को ही भुगताना होगा।

पृथ्वी सबकी है, अतः हमें इसकी रक्षा करने के लिए व्यापक आवश्यक एवम् बाध्यकारी कदम उठाना होगा और प्रत्येक राष्ट्र को अपनी आर्थिक एवं सामाजिक क्षमता के तहत कुछ कड़े लक्ष्य निर्धारित करना होगा। पृथ्वी के बढ़ते तापमान को रोकने के लिए संरक्षण के लिए एक विश्वव्यापी पहल लाना होगा जिसमें विकसित एवम् विकाशील दोनों की कि सहभागिता समान रुप से निर्धारित करना होगा। क्योंकि हम सब साथ मिलकर ही जलवायु परिवर्तन के चुनौतियों से निपट सकते हैं और मानव जाति के भविष्य को बचाए रख सकते हैं।

CONSEQUENCES OF CLIMATE CHANGE FOR INDIA

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With numerous contradicting reports pouring in on the depletion of Himalyan glaciers, the focus is now on India. In this scenario, it seems imperative to explore the consequences of climate change for our countries economy and agriculture in the coming years even at the minimal increase in global temperatures. The poorest communities will be the most vulnerable to the impacts of climate change as they have fewer resources to invest in preventing and mitigating the effects of climate change. Some of the most at-risks of people include subsistence farmers, indigenous people and coastal populations. Climate change can impact agricultural sustainability in two interrelated ways: first, by diminishing the long-term ability of agroecosystems to provide food and fiber for the world's population; and second, by inducing shifts in agricultural regions that may encroach upon natural habitats, at the expense of floral and faunal diversity. While the overall global impact of climate change on agricultural production may be small, regional vulnerabilities to food deficits may increase, due to problems of distributing and marketing food to specific regions and groups of people. For subsistence farmers, and more so for people who now face a shortage of food, lower

yields may result not only in measurable economic losses, but also in malnutrition and even famine. According to scientists, some positive effects of climate change may also be expected because of increase in CO_2 in the atmosphere, which may have fertilizing effect on crop growth and yields. Ecosystems that cannot move northwards at a rate dictated by global warming will be most at risk. These include, glacial ecosystems, coral reefs, atolls, forests and Himalayan systems. Indian winters may experience a decline of 5-25% in rainfall. More intense rainfall spells are expected in a warmer atmosphere. If rainfall decreases, water flow of rain fed rivers will decrease affecting ground water recharge. Increase in rainfall might aggravate flood situations, bringing destruction and disease. India is expected to lose 125 million tons (about 18%) of its rain fed cereal production potential. If agriculture production goes down, the price of staple food commodities will increase. According to a World Bank study, a 2°C rise in temperature along with a 7% increase in rainfall will reduce net agriculture revenues by 12.3% for the whole country. With the right policies, the rise in the level of greenhouse gases in the atmosphere can be slowed and ultimately stabilized. Cleaner technologies and energy efficiency can provide solutions, allowing economic growth and the fight against climate change to proceed hand in hand.

GREENING THE BUILT-ENVIRONMENT: THINGS TO DO NOW LEARNING THROUGH A CASE EXAMPLE

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The construction industry is one of the highest energy consuming sector. In most developing nations, CO_2 emissions have been relatively constant over the past 25 years. The increase in global emissions has been largely driven by increased emissions from India, China and other growing economies of the Asia-Pacific region. These areas have seen a spectacular spurt in economic growth which has resulted in large scale urbanisation subsequently followed by construction activity spanning all spectrums.

Alternative building technologies and sustainable design has been limited to the academic and experimental domains, with extremely few examples, especially in India. Public awareness of these practices, therefore, is low.

It is generally assumed that minimizing the use of energy impact of architecture would require a real breakthrough in the building industry. For example, cement is recognized as an energy intensive material; but so thoroughly has it been assimilated

into the construction industry (all scales and types) that it is impossible to visualize a structure (however small or even temporary) without the use of cement. The tendency then is twofold; one both regresses in time and researches the use of traditional building techniques and materials largely phased out (like mud and straw), or one looks to modern research and technology to provide an alternative (cement).

Both approaches have their place in the ongoing search for green practices in architecture. It is also true that neither have as yet produced viable alternatives that have large scale acceptance. One hopes that this research will bear fruit and open up exciting avenues in building design and construction.

However, the need for green buildings is much more pressing does not allow a waiting for solutions. What one needs to do now is to explore a middle path; one which is most easily comprehended and therefore most likely to be executed by the majority of society in developing countries.

The case example deals with a design competition entry of a Sustainable Building Technology Center proposed at Kasarwadi near Pune in India. The SBTC aims at propagating energy-efficient building practices amongst those directly and indirectly related to the building industry and otherwise as a vehicle for increasing awareness in this respect. It goes without saying that a center of this nature had to be an "energy and resource efficient" building/campus in the truest sense. Therefore, the kind of technologies adopted and propagated by the Center addressed the issue of mass scale acceptance calling for careful and place-sensitive selection of sustainable building practices. The emphasis was on the use of solutions that were most easily understood and implemented. The proposal based itself on two broad aspects – Environmental/Energy and Architecture; both inherently interlinked and reflections of each other.

One maintains that such design interventions, applied over a large number of building projects, will definitely have a profound effect on our energy consumptions. This paper sets out to illustrate, through a case example, a viable list of "things to do" while academia comes up with a solution to our present state of crisis.

And indeed, there is much that can be done.

CLIMATE CHANGE, ITS IMPACT AND MITIGATION -AN OVERVIEW

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Climate change is any long-term significant change in the expected patterns of average weather of a specific region (more relevantly to contemporary socio-political concerns, of the earth as a whole) over an appropriately significant period of time. Climate change reflects abnormal variations to the expected climate within the earth's atmosphere and subsequent effects on other parts of the earth, such as in the ice caps over durations ranging from decades to millions of years. The climate of the earth is always changing. In the past it has altered as a result of natural causes. There is no doubt anymore in the mainstream of scientific community that the earth is warming and increasing evidence shows that human activities are responsible and have a significant part in it (IPCC, 2007). Since the Industrial Revolution in the 1700s, the burning of fossil fuels, destruction of forests and other human activities have added a significant amount of GHG to the atmosphere. These gases trap heat in the atmosphere, much like a greenhouse, and cause air and sea temperatures to increase. The changes over recent years and those which are predicted over the next 80 years are thought to be mainly as a result of human behaviour rather than due to natural changes in the atmosphere. Climate impacts are not only related to exposure, but also to adaptive capacity. Urban settlements with a long history of investment in housing, urban infrastructure and services (such as in many high-income countries), and public emergency response (such as in Cuba), as well as those with economic/financial losses much reduced by insurance, will be relatively more resilient to cope with the impacts of climate change. In the present paper an attempt has been made to discuss various important issues of climate change such as-its impact on environment and mitigation measures to meet the challenges through national and international coordination, cooperation and awareness.

SUSTAINABILITY OF ENVIRONMENT & AGRICULTURE BY USE OF ECO FRIENDLY TECHNOLOGY & ECONOMICALLY BENEFICIAL MEDICINAL PLANTS

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Climatic instability & improper planning is the major reason for loss of crop productivity and there by sustainability in agriculture and environment. The concept of sustainable environment by eco-friendly measures is paying heed from all walk of science .One of them is use of biofertilizer for enhancement in product quality and quantity besides controlling the excessive load of nutrient in soil or in air and water which is not available to plant for growth. If bound form inoculants (microorganism ;bacteria ,fungi, algae) is applied then it might be beneficial for plant growth for long term; because these(lower plant) play crucial role to the fate of applied available nutrient .For instance; my work revolve around potted Aloe vera ; a medicinal plant and application of Azospirillum +Bacillus .Former has a vast potential to fix nitrogen and later one I preferred for its phosphate solublizing capability from ambient environment particularly from soil. Because basic building block element of cellular structure (among total 118 element) is framed by these two element in the form of amino acid for protein formation and DNA as a chromatin material by nitrogen and phosphorus respectively The losses caused by leaching, emission, run-off by indiscriminate use of chemical fertilizers, particularly the nitrogenous, has led to substantial pollution of soil, air and water. High permissible limit of nitrate and nitrite in water bodies, soil; caused by run off and leaching of excessive nitrogen salt, applied as fertilizer are also responsible for ozone depletion.

Aloe vera a medicinal plant of liliacae family is used to monitor the consequences and its result has shown that we could overcome adversity if proper management and planning have done. So medicinal plant of high economical value like *Aloe* farming and use of eco friendly technique would be a better way to achieve sustainability for both agriculture and environment and thereby human welfare.

EFFECT OF DIFFERENT *RHIZOBIUM* STRAINS AND PHOSPHORUS ON SOYABEAN CROP (*GLYCINE MAX* L.)

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Pot experiments were conducted to evaluate the effect of different *Rhizobium* strains alone or in combination with phosphorus on soyabean. The parameters studied were nodule per plant, root and shoot length at 30, 60 and 90 days, beside these root / shoot fresh and dry weight, grain yield were also studied after harvesting. Surface sterilized seeds of soyabean were sown in earthen pots filled with sterilized soil. Level of phosphorus applied was 0, 40, 60 and 80 kg P_2O_5 ha^{-1} as single super phosphate at the time of sowing in the soil. Among the three strains K-10 performed well compared to other two *Rhizobium* strains i.e S-10 and L-10. Application of *Rhizobium* strain and phosphorus also increased the growth and yield of soyabean and also improves soil fertility and NPK uptake by plant.

CLIMATE CHANGE- A CASE STUDY OF DEBRIS FLOW IN LEH, LADAKH, J & K

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The intensive rainfall on 5th and 6th August, 2010 caused extensive damages in Leh, *Ladakh, Jammu & Kashmir*. The biggest ever natural catastrophe in the recent history, due to debris flow caused more than hundred deaths, damaged mostly all houses and breached all major communication networks in Leh, at a height of 11,500 feet amsl, and located 424 km northeasterly from Srinagar along NH-1D.

The region lies in the rain shadow zone of Himalaya which is absolutely devoid of the monsoon winds. The rainfall record of the region for the past five years shows that the average annual precipitation reported from the area is 75.7mm which includes

winter precipitation in the form of snow as well. Therefore, the Leh area is described as a cold desert, which has not witnessed such a rainfall in the recent past.

On the fateful night of August 5th 2010, the rainfall recorded at the Air Force Station at Leh, situated about 6 km from the catchment of Shaksaling nala was 12.8 mm. The rainfall lasted only for 15 minutes implying the cloud burst was highly localized.

The sudden downpour resulted in runoff on the slopes, which had enough velocity to initiate movement of overburden comprising gravel, boulder and sand-silt matrix on the stream slopes. The water mixed with debris converted into a fast moving mass of the muddy water with high velocities of flow, having great destruction potential as it flowed down the streams. As a result , the debris flow over spilled the stream banks, laterally spreading in a wide area and carving out new undefined channels in the low lying areas causing widespread damages to the settlements falling along these newly carved out channels.

In Leh area, the damage was confined to the catchment of Shaksaling nala, flowing from an elevation of 3800 m to 3410 m. The debris flow mobilized and damaged the settlements, bus stand building, BSNL building, hospital complex, radio station, etc. in its 3 km run-out distance.

Further downstream, the debris flow washed away the bridge located near village Sabu and spread out in the downstream commands having a run-out length of about 26 km before reaching the Choklamsar village. This caused huge damage in the downstream Choklamsar village, ITBP Camp, Leh-Manali road, new Choklamsar market, etc.

The bridges on Phyang, Taru, Umlah, Nimu, and Bazgo streams have been completely washed away. The concrete abutments of some of the bridges have also been severely damaged.

This type of cloud burst is a rare occurrence in the area. As the stream courses are dry and only carry small quantity of discharge in the event of rainfall or snow melt, the stream courses have been occupied by human settlements. The scarcity of potable water prevailing in the area further compels the local population to construct houses in low lying areas near the stream banks.

Therefore, it is concluded that due to change in the climatic regime of the Leh area, the natural catastrophe has taken place. However, the lesson learned from this has to be utilized to devise proper urban planning for the Leh area and no anthropogenic activity may be allowed along the stream courses.

RAIN WATER HARVESTING: RESPONSE TO CLIMATE CHANGE AN OVERVIEW

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Climate change is presently one of the most critical global challenges. Climate change makes an additional threat that puts increased pressure on the already stressed hydrological systems and water resources. The impact of climate change is already visible given that rainfall variability has intensified over the last two decades and it is recommended that appropriate adaptation measures must be taken. Rain Water Harvesting (RWH) is listed among the specific adaptation and responsive measures that the water sector needs to undertake to cope with future climate change. RWH is an environmentally friendly and low cost technology. With an insightful policy, rainwater harvesting can be promoted as a core adaptation and responsive strategy for achieving the global security and sustainability and water resources in an era of anthropogenic climate change. RWH is not only an alternative to centralized systems to water supply but can also reduce storm water runoff in urban areas and has the potential to increase the productivity of arable lands where water shortage is common because of scanty rainfall. The present paper to discusses the worth of rainwater harvesting as a response to climate change, especially in urban areas where water resources are fast depleting due to rapid increase in population and unrestricted use of water. Climate policy and water policy would require to be streamlined to promote rain water harvesting in the water stressed regions of the world.

GEOMORPHIC EVOLUTION IN RESPONSE TO CLIMATE CHANGE AND NEOTECTONICS IN PART OF MID-GANGA PLAIN, AROUND ALLAHABAD, U.P.

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The Indo-Gangetic Plain (IGP) is situated in a peripheral foreland basin to the south of the rising Himalaya. The Ganga Plain foreland basin is a part of IGP and the

study area forms a segment of Mid-Ganga Plain around confluence of Ganga, Yamuna and vedic Saraswati rivers at Allahabad. Present study revolves around two interrelated aspects of fluvial geomorphology in response to climate change: (I) geomorphic surfaces, and (II) neotectonics and pattern of channel shifting.

Geomorphic surfaces

The wide range of geomorphic features present in the Ganga Plain, their different relief and spatial distribution strongly indicate their genesis in climatic conditions different from what prevails today. Hence, the water budget and base level conditions were also in all probability in variance with what exist at present. In the study area, three distinct geomorphic surfaces i.e. T_0, T_1 and T_2 have been recognised with the help of satellite imagery. The regional plateau or upland is a terrace (T_2) form of higher planer surfaces, and might have formed during a major period of humid climate leading to widespread alluviation and planation. T_2 – Surface is characterised by tightly meander of high amplitude channel remnants indicating a higher water budget during active phase in the past. It is now well established that there have been several sea level fluctuations ever since Late Quaternary. The last sea level low stand was around 18 Ka BP and a rapid sea level rise reached a maximum around 6 Ka BP and since then the rise in sea level is minimal. The "Terrace" surfaces observed in the Gangetic Plain are considered to have formed due to the sea level changes. During the last sea level low stand of 18 Ka BP, extensive fluvial drainage developed within the alluvium, which drained the high plateau-surface. The rise of the sea level after that resulted in the lowering of the hydraulic gradient, and consequent reduction of drainage area. Most of the drainages were abandoned or filled up and the imprints of such are now observed on the plateau surface throughout the Ganga Plain**.** The Ganga river was entrenched deeper into its T_1- Surface during the last sea-level low stand and adjusted to palaeo base level of erosion till the beginning of last major sea-level rise. T_0- Surface of the Ganga River has only developed during the last phase of sea-level rise and has been continued till date with minor fluctuations at places.

Neotectonics and pattern of channel shifting

Neotectonic activities of the recent past and even the present time are mostly responsible for present day landscape geometry. The parameters used in identification of neotectonic activity in the Ganga Plain are: (i) preferred alignments of rivers; (ii) sudden change in the direction of the river course; (iii) nick points; (iv) straightening of the river course; and (v) presence of escarpments and asymmetrical terraces. A few indirect evidences of neotectonic movements are observed in the area possibly in relation to the isostatic adjustment. The deformation structures in clay beds, tilting of beds in the Banda Older Alluvium (BOA) in Yamuna river section near Deoria and sagging of horizontally bedded channel bar sections in the Ganga river near Mawaiya, straightening and abrupt change in the course (as in Ganga river before confluence), widening of low level terrace zone (T_1) of the Ganga between Dubwal and Diha (after

confluence,) and sudden entrenchment of rivers, are all indicative of neotectonic activities. Sharp bends of the Ganga river near Kara and Dharampur also indicates some neotectonic control on the river course. Similarly Yamuna river also shows sudden change in its course near Deoria. A fault with ENE-WSW trend has been recorded between Dubawal and Chak Gauri Shankar. As a result of this fault, the depositional terrace of the Ganga and the dark grey clay horizon of the BOA occurring at the river level at Kanjasa have been displaced about 6m near Chat Kahara.

The most fascinating outcome of interpretation of the satellite data is the delineation of the palaeochannels and recognition of channel shifting pattern in three sectors of the study area. In case of Ganga river (before confluence), the channel has shifted northwards leaving old course far behind, which can be correlated with some neotectonic reactivation/adjustment of the two basement faults. In Yamuna river, besides present day channel (T_0/III), two other palaeochannels have been identified, which represent different stages (I & II) of the channel shifting. In the case of the Ganga river downstream of confluence, oscillatory shifting is distinctly shown by the palaeochannels of Stage-II. One more abandoned old course has been identified in the east of Yamuna river, which is probably related to the palaeochannels of the Stage-I. These abandoned channels are potential source of ground water and several of the tube wells at Humoyan village are located therein. There are also occurrences of growth lines along the upstream nose of a Present Day Channel Island in Ganga River downstream of confluence, indicating addition of materials and upstream advancement of the present day channel islands.

PACIFIC NORTH AMERICA OSCILLATION AND THE INDIAN SUMMER MONSOON RAINFALL IN RELATION TO QBO

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Various studies show the evidence for the variability of the pressure anomaly over North Pacific Ocean and North American region. The importance of this phenomenon in causing persistent anomalies over different regions of the globe has drawn considerable attention in view of its relevance in climate assessment. The association of the pacific north American pattern (PNA) with Indian summer monsoon have been examined by considering the 53 years data from 1954-2006 by using the correlation technique for full time series as well as by grouping the data according to the easterly

and westerly phase of Quasi Biennial Oscillation (QBO) at 50- hpa level. The 30-year sliding correlation coefficient also has been made to know the PNA parameter is efficient predictor of Indian summer monsoon rainfall in present condition. In both cases DJFMAM, FMA, MAM and April shows the significant association with Indian summer monsoon rainfall and association of these parameter is also changed according with QBO phase.

RAINWATER HARVESTING MODELING FOR SUSTAINABLE DEVELOPMENT OF GROUND WATER RESOURCE IN LUCKNOW DISTRICT, UTTAR PRADESH

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Water, the most essential component in the living environment, though widely distributed but only limited volume can be used for drinking and domestic purposes. Global factor on water corresponds to the fact that very limited water can be utilized for household activities and within that also much of the stored water is in the form of groundwater. In a densely populated and agriculture based country like India, ground water resource has significant role. The agricultural sector totally depends upon the monsoon and if the rainfall is not adequate then ground water is used exhaustibly to meet the demands. In many places of the world including India, this indispensable resource is under stress due to continuous failure of monsoon, increasing urbanization, acquisition of natural water bodies, excessive extraction and the excess use of ground water and ultimately leading the country to a stage of 'hydrological poverty' resulting in environmental degradation. In the present study an attempt has been made to use rainwater harvesting (RWH) model in the Lucknow region so that the excess rain water that is wasted in the form of runoff can be stored and managed sustainably for local use as well as ground water recharge. This RWH model is based on remote sensing (RS) and geographical information system (GIS) techniques by utilization of land use sector.

Lucknow, the capital of the most populated state (Uttar Pradesh) of the country, has shown a quantum jump in population growth and expansion in its urban sector. The continuous increase of the population in the last 3 decades has put tremendous pressure on the existing civic services including supply of water. The present demand for water in Lucknow is around 791.51 MLD whereas the supply from all the available sources is

about 515.87 MLD. The financial, administrative and technical deficiencies of the supply system have led to the deterioration of the water supply in the city. The demand of water has considerably increased due to the improvement in standard of living vis-à-vis growth. The increasing pressure on the ground water resources, has led to an alarming situation. Though, the rate of declining of ground water is different in different localities, however, the average is 0.82 m per year for the entire city.

In the present RWH model, the RS and GIS methodology has been successfully incorporated to visualize the suitability of different classes for best use of rain water. In total, nine zones have been indentified for land utilization purpose. These are based on the suitability index according to their use in agriculture, water body and settlement mask with least proportion designated as poor or very poor class. The zones 1 to 7 represent excellent to satisfactory in RWH model this indicate that these sectors have to be primarily used for the rain water harvesting practices. This includes the agricultural land with settlement masks and natural water bodies. The 8 and 9^{th} class designated as poor and very poor zones are salt affected or wasteland. The present RWH model can be used for utilization of rainwater for recharging ground water. In addition it is sustainability that counts in the end and the present model has been stipulated for the betterment of land use of the given area in future.

ALTERNATIVE TO MINING AND METALLURGY

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The day is not for of when we will have to look for an alternative to our mother earth for our survival. The pace with which we are draining our resources the day is not for of when certain of our most valuable natural resources such as ores, minerals will disappear. So sooner the better we realize and start conserving, preserving and ensure optimal utilization so as to avoid the wastage. At the same time we should start looking for possible synthetic route for our valuable ores in the laboratory which will be helpful in controlling environmental degradation due to mining and excavation. We have ventured to synthesize in the laboratory minerals of the alunite series in the laboratory. Alunite has potential value as a source of both aluminium and potassium compounds. Alunite and related jarosites are of the mineralogical interest on account of many types of isomorphous replacements shown by them. A clearer understanding of the structure of these minerals may pave the way in aiding mineralogist and geologist in study of the genetic significance of the aluminium hydroxide minerals and possible of related clay minerals. Lattice parameters and densities of the synthesized minerals as well as

naturally occurring have been reported. As could be seen there is astonishing agreement between the calculated and observed densities obtained.

GENERATION OF BIOGAS – A CLIMATE NEUTRAL PROJECT

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The accumulation and unhygienic handling of organic wastes create several environmental problems including the emission of dangerous gases to the atmosphere. Organic waste water discharged from houses and other institutions also emit poisonous gases through anaerobic fermentation. Methane is the main gas generated by the anaerobic fermentation. Methane is 22 times more dangerous than carbon dioxide. Through the installation of domestic and institutional type bio-waste treatment biogas plants, the emission of methane can be controlled to a considerable extent. To achieve this goal, every house including public and private institution should come forward to install decentralized bio-waste treatment biogas plant. With the experience of several years in the field of implementing decentralized waste treatment projects, BIOTECH had installed more than 22000 family size bio-energy plants in houses as well as bigger capacity plants in several public and private institutions including 52 wastes to electricity projects. These plants help to reduce the emission of poisonous gases to a great extent. A one cum Biogas plant is sufficient to control the emission of 3.5 metric tones of carbon dioxide every year. Every one can be a part of climate protection programme through the installation of methane capturing plants in all places where ever waste is generated.

SOIL: A NATURAL RESOURCE AS WELL AS AN IMPORTANT TOOL OF CARBON SEQUESTRATION

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Soil is a natural resource and cannot be assumed as a high quality permanent source of sustainable nutrition for plants. Proper management and utilization of this natural resources are very important and should be given due priority. Our natural resources are under tremendous pressure. Our forests are suffering from great pressure to cater the need of fuel, fodder, timber etc to the large population of the country. Large-scale deforestation is one of the major causes for increasing CO_2 in the atmosphere on one hand and depleting nutrients in soil on the other hand. Trees have the potential to store the carbon for the long time in the wood and thus halting the depletion of ozone layer. Concentration of atmospheric CO_2 can be lowered either by reducing emissions or by taking CO_2 out from the atmosphere and stored in the terrestrial, oceanic or aquatic ecosystems. Soil organic matter contains the largest terrestrial reservoir of carbon in the biological global carbon cycle. As such, it plays a major role in the control of carbon dioxide levels in the atmosphere. Soils store 2.5 to 3.0 times as much carbon that stored in plants and two to three times more than the atmospheric as CO_2.. Soil carbon has much longer residence mean times than the carbon in the vegetation that the soils support. Changes in forest type, productivity, decay rates and disturbances can effectively modify the carbon contents of forest soils. Some reports indicate, up to 87 % decrease in soil organic carbon due to deforestation. Plantations are consequential to diverting pressure from natural forests by providing fuel, fodder and timber to the growing population. Soils and vegetation, therefore, represent potential sinks for this additional carbon and several authors have suggested afforestation as a possible means of mitigating global climate change**.** The carbon store in forest land is the highest followed by agroforestry, agricultural lands and barren lands**.** The effect of land use change on soil carbon stock is of concern in the context of international policy agenda on GHG emission mitigation. Trees enrich the soil through adding organic matter, nutrient cycling, provide shade to conserve moisture, promote microbial activities and improve soil physicochemical behaviour. Deforestation results in increased air movement and facilitates oxidation of organic matter thus emitting CO_2. Increase in atmospheric temperature due to climate change is also enhancing the decomposition of organic matter and release of CO_2 in the atmosphere. Soil organic carbon is sensitive to impact of anthropogenic activities. There is a major potential for

increasing soil organic carbon through restoration of degraded soils and widespread adoption of soil conservation practices.

The Intergovernmental Panel on Climate Change identified creation and strengthening of carbon sinks in the soil as a clear option for increasing removal of CO_2 from the atmosphere and has recognized soil organic carbon pool as one of the five major carbon pools for the Land Use, Land Use Change in Forestry sector. Land is being used for different purposes *viz.* for forestry, agriculture, agroforestry, pastures, horticulture, plantations, habitat etc. Land use and soil management practices can significantly influence soil organic carbon. Accurate quantification of soil carbon is necessary for detection and prediction of changes in response to changing global climate**.** Enhanced sequestration of atmospheric CO_2 in the soil, ultimately as stable soil organic matter, provides a more lasting solution than sequestering CO_2 in standing biomass.

SUSTAINABLE DEVELOPMENT BY PERENNIAL WATER SUPPLY IN UTTARAKHAND

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Uttarakhand is bestowed with a high potential of water resources. It receives water from monsoon rain as well as from westerly disturbances. These westerly Disturbances are also the main source of snow fall in upper regions and rainfall at lower elevations. Geomorphology and geology of Uttarakhand favours storage of enormous amount of rain water which can be utilized for generation of electricity and for continuous and regulated flow of water through integrated natural drainage system.

The present study is based on interpretation of different satellite data sets. The imagery from Indian Remote Sensing Satellite (IRS) is utilized for gathering geological and geomorphological information. Satellite RADAR data is found to be exceptionally useful for studies related to snow, ice, glaciers and permanent as well as temporary water bodies. Radar data has helped in mapping of certain geomorphological features related to surface roughness and moisture content in different units.

The study also formulates technique which can be applied for, not only assessment of water resources but also proper utilization for development and revenue generation for the state. This will flooding in Ganga and Yamuna basins in adjacent states.

RECYCLING OF AGRICULTURAL SOLID WASTES FOR THE REMOVAL OF ORGANIC AND INORGANIC POLLUTANTS FROM WASTE WATERS BY ADSORPTION PROCESS

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Industrial growth and associated technical sophistication in the last three decades or so has posed major problems of solid waste disposal. It has become essential either to find suitable ways for the safe disposal of the wastes or to suggest novel uses, considering them as by-products. Otherwise these will remain an accumulated waste, contributing highly to environmental pollution. The choice between recovery of valuable materials from waste and disposal of waste depends mainly on three factors: technology, economics and attitude.

In developing countries like India, industries cannot afford to use conventional wastewater treatment chemicals like alum, ferric chloride, polymer flocculants and coal based activated carbon because they are not cost-effective. Among the treatment methods adsorption seems to be an effective method. An inexpensive and more easily available adsorbent would make the removal of pollutants an economically viable alternative. Agricultural wastes like orange peel, banana pith, coir pith, peanut hull etc. are discarded in the agricultural sector. These wastes contain cellulose and lignin, which act as very good adsorbents. Namasivayam and coworkers have investigated to recycle these agricultural solid wastes as adsorbents with and without chemical modification for the treatment of industrial effluents. Physically and chemically activated carbons derived from coir pith, peanut hull and Jatropha husk; and wastes such as biogas residual slurry, banana pith and orange peel were found to be efficient for the removal of dyes, toxic metal ions and anions from industrial wastewaters. Results of batch mode adsorption studies using the above adsorbents and applications to the treatment of real industry effluents will be presented in this lecture. Kinetics and temperature effects of adsorption will be discussed.

DEVELOPMENT OF A COMPREHENSIVE CONSTRUCTION CARBON CALCULATOR - IN AN INDIAN PERSPECTIVE

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Global increase in carbon emissions causing climate change has captured special attention among environmentalist during Kyoto Protocol and Copenhagen Summit. The later summit imposed legal bindings on the nations, especially for industrialized economies to cut carbon emissions. Meeting urgent need, various emission monitoring methodologies have been evolved including carbon footprint calculator, the most preferred tool, especially for construction sector. However, on critical analysis of globally available construction carbon calculators; wide discrepancies in carbon estimation methods and huge variations in results were arisen, even with similar inputs. Similarly, calculators are inconsistent in identification of actions that significantly contributes in carbon emissions. Several calculators also lack transparency and user friendliness. The criticality is further enhanced in case of developing nations as most calculators require data in unconventional units. The present study was conceived to meet the pressing necessity for development of a more efficient and comprehensive construction carbon calculator. The study considered carbon foot prints of materials and actions as applicable for growing economies, especially in Indian context. The designed calculator deals with all three phases of building lifecycle as accounts for carbon emission during construction, operation and maintenance. It may be effectively applicable in billing the carbon footprint of different kinds of buildings and for estimation of incremental impact on concentration of carbon dioxide in the atmosphere. On evaluation with two sets of real construction data, the formulated calculator is proven to be more efficient and comprehensive as incorporates better sense of environmental protection.

A CRITICAL ANALYSIS OF CONSTRUCTION CARBON CALCULATORS

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Anthropogenic developmental activities have been appeared as prime culprit for increasing greenhouse gases, causing climate change. The construction sector is one of the most severe contributors among developmental activities, and got special attention, especially by developing courtiers. Meeting the urgent need, many monitoring and management tools for carbon emissions are emerged. However, calculation of carbon footprint is most preferred and prevalent on internet, but none calculators been universally accepted by scientific community. Thus, the present study been considered for critical evaluation of six universally available construction carbon calculators developed by federal and non-federal agencies. Even with same input. these calculators generate widely discrepant results, often as much as several hundred metric tons of carbon emission. Overall, the calculators are inconsistent in estimation and adopted methodologies; especially in identification of carbon contributing actions. Similarly, several calculators hide incorporated methods for estimations that impede comparison. Additionally, few calculators also require data in unconventional units and lack user friendliness. An attempt has also been made to identify- the best calculator that incorporated most of culprit activities including off-site and allied actions. Though construction carbon calculators can enhance the competency in designing buildings posing lesser carbon footprints, the paper reveals the urgent necessity for development of better construction carbon calculators with higher comprehensiveness, friendliness and transparency.

STUDY OF SPATIAL VARIABILITY OF GROUND WATER DEPTH AND QUALITY PARAMETERS IN HARIDWAR DISTRICT OF UTTARAKHAND

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Ground water is a key source of drinking water that is essential to life on Earth. Assessing the quality of groundwater is important to ensure sustainable safe use of these resources. Geostatistical methods have been used widely as a convenient tool for assessing groundwater depth and ground water quality parameters. The objective of the study is to determine the groundwater quality and to assess the risk of groundwater pollution in Haridwar district of Uttarakhand, India by using geostatistic techniques. The groundwater quality parameters were analyzed from the existing wells of the Haridwar district and the thematic maps were generated using geostatistical concepts. Ordinary kriging was used to analyze the spatial variability of groundwater depth and quality parameters such as electrical conductivity (EC), bicarbonate, calcium, chloride, magnesium, sodium, potassium and sulphate with concentrations equal or greater than their respective groundwater pollution cutoff value, whereas indicator kriging was used to analyze groundwater quality parameters equal to or greater than the pollution threshold values. It was observed that the semi-variogram parameters fitted well in the gaussian for water depth and in the spherical model for water quality parameters. (EC followed a log-normal distribution and demonstrated a moderate spatial dependence according to the nugget ratio) (Cross-validation errors are within an acceptable level). The indicator kriging method is useful to assess the risk of groundwater pollution by giving the conditional probability of concentrations of different chemical parameters exceeding their cutoff values. Thus, risk assessment of groundwater pollution is useful for proper management of groundwater resources and minimizing the pollution threat.

ECO-FRIENDLY LIVELIHOOD GENERATION AND WASTE MANAGEMENT

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Livelihood is a primary tool for the holistic development of any society. The present research paper signifies the need of generation of sustained livelihood means for women of underprivileged strata dwelling in urban slums. Ecofriendly livelihood helps in developing environmental awareness, capacity building, sensitivity to social issues and healthy life-style.

In the present scenario of "Global Climate Change" mankind is forced to adopt the ecofriendly approach for sustainable development. Present concern of ecofriendly livelihood for poor women is a vital element especially for mothers and would be mother work force. In this study household products such as kitchen mops, wash-basin/ tiles scrubbers, doormats, dry-fruit containers, car accessories etc were made from various raw materials such as post consumer paper waste, coconut shells, vegetative (leaf, stem), corn leaves, wheat straw, bagasse etc. In the process of manufacturing the consulate oriented value addition was carried out in a natural and ecofriendly manner to achieve aesthetic value, optimum waste utilization and to make user friendly products. The flowers, aromatic oils, chandan powder, vegetative colors and natural fragrance were used instead of synthetic and environmentally harsh components.

Hence the complete process to make value added products can be categorized as Green Process which also generate money along with waste reduction and causing least burden on the climate.

IDENTIFICATION OF GROUND WATER POTENTIAL ZONES IN PALAKKAD DISTRICT, KERALA THROUGH MULTICRITERIA ANALYSIS TECHNIQUES USING GEOINFORMATION TECHNOLOGY

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The study is based on a GIS based analysis methodology where for current data acquisition, Remote Sensing and Global Positioning System (GPS) were made use of. The study area selected was Palakkad district of Kerala, located in the realm of tropical climate lying between 10°21'–11°14'N lat. and 76°02' and 76°54'E long. The various thematic layers like panchayath boundary, contour, drainage, roads were extracted from the SOI toposheets. IRS –1D LISS III digital images were used for preparation of the current landcover and geomorphology of the area. Geological information was derived from the GSI map. Field and knowledge based multicriteria analysis techniques were adopted. Fussy based techniques were used to give ranks and weightages to each individual thematic layer, which in turn was taken into consideration in determining the ground water potential zones. Drought maps for three different years were prepared and field verified with depth to ground water level of the area. The three consecutive years viz. 2008, 2009 and 2010 data was used for the modeling of ground water potential zone. The final output shows ground water potential map of Palakkad district in four categories such as Very high / Excellent, High, Moderate and Low. The results can be used for further investigation and environmental management of ground water.

GEOINFORMATICS: A NOVEL TOOL FOR GROUNDWATER POLLUTION MODELING AND MANAGEMENT – A CASE STUDY IN PALAKKAD DISTRICT, KERALA, INDIA

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Groundwater, which plays an important role in meeting the requirements of humans is an integral part of the environment, and hence cannot be looked upon in isolation. There has been a lack of adequate attention to water conservation, efficiency in water use, water re-use, groundwater recharge, and ecosystem sustainability. An uncontrolled use of the bore well technology has led to the extraction of groundwater at such a high rate that often recharge is not sufficient. The study area selected was Palakkad district of Kerala with the main objective of evaluating the groundwater quality in a semi urban setup and suitability for various uses. As GIS is an integrating tool for accurate representation and analysis of groundwater quality data, it was used to bring out effectively the ground water quality index of the study area. The source of attribute data is field data and laboratory analysis data. The physical and chemical parameters were tested in the laboratory to study the concentration of constituents varying in different locations. The land use pattern, roads, streams etc were used for the GIS analysis. Three water quality index maps were brought out by analyzing monthly water quality data of three different years and based on which water quality modeling was done in community level. The result of the study was used for the preparation of water quality management strategies at local level.

POLAR REGIONS AND THE EARTH'S CLIMATE

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Polar regions are vital for earth's climate and its sustainability. The vast continental ice sheet if melts, has the potential to raise global sea level by several meters. Sea ice in both Polar Regions provides a link to the deep thermohaline circulation and the surface circulation thus invigorating the entire ocean ecosystem. The variability of sea ice extent has the influence on the fluxes between ocean and atmosphere and hence modifies the circulation patterns. The ozone at Antarctica hole discovered by Joe Farman of British Antarctic Survey has alarmed the entire world about the effect of chemical pollutants in our earth's environment and the subsequent remedial steps taken globally through Montreal Protocol is an example of the importance of polar regions. Recent International Polar Year (2007-2009) which has just been concluded has given new impetus to Polar programmes globally.

India has an ambitious polar programme with a dedicated centre at Goa focusing on Polar Regions which also includes the studies of the southern ocean. This has provided unique platform to many national and international scientists to pursue polar research in various domains of science. Ice cores and sediment cores in the southern ocean provides climate history. We will review the development related to earth's climate and the polar regions.

TREE-RING VARIATION IN TEAK (*TECTONA GRANDIS*) FROM CENTRAL INDIA IN RELATION TO MOISTURE AND PALMER DROUGHT SEVERITY INDEX

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I have developed the ring-width index chronologies of teak trees (*Tectona grandis*) from a moisture stressed area of central india. The Correlation analysis indicated that moisture index (MI) and Palmer Drought Severity Index (PDSI) showed better performance rather than same year rainfall over the region. Tree-ring variations were most correlated positively with PDSI and moisture index during different seasons as compared to rainfall over the region. This study shows that the moisture availability during the growing season has a significant role in development of annual growth rings.

MANAGEMENT OF SOIL CARBON SEQUESTRATION IN SOIL RECLAIMED MANGANESE MINE LAND BY PHYTOMITIGATION

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The article explores the reasons for the observed increase in very recent atmospheric carbon dioxide concentration. The fall of atmospheric carbon dioxide over the last half billion years and the very recent inverse correlation of atmospheric oxygen response support the well documented growth response of plants to elevated carbon dioxide. This confirms a dynamic equilibrium that adjusts the uptake of carbon sinks in response to carbon dioxide availability, and suggests that the increase of atmospheric carbon dioxide requires more than a minor rise in carbon dioxide input.

Carbon emission is supposed to be the strongest factor for global warming. Removing atmospheric carbon and storing it in the terrestrial biosphere is one of the cost-effective options, to compensate greenhouse gas emission. Millions of acres of abandoned mine land throughout the world, if restored and converted into vegetative land, would solve two major problems of global warming and generation of degraded

wasteland. A manganese spoil dump at Gumgaon, Nagpur India was reclaimed by phytomitigation. Increase in SOC level of reclaimed site was compared with a native forestland and agricultural land after 20 years of reclamation. And results found that forest land showed highest SOC level followed by reclaimed land, and agricultural land. Soil profile studies of all three sites showed that SOC pool decreased from 0–15, 15–30, and 30–45 cm depths. Although the SOC content of reclaimed land was less than forestland, it showed better SOC accumulation rate. Phytomitigation of mine lands is cost-effective option for decreasing CO_2 concentration.

MODELING OF REGIONAL HYDROCLIMATE CHANGE OVER THE INDIAN SUBCONTINENT: IMPACT OF THE EXPANDING THAR DESERT

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The Thar Desert between northwestern India and Pakistan is the most densely populated desert region in the world, and the vast surrounding areas are affected by rapid soil degradation and vegetation loss. The impact of an expanded desert (implemented by changing vegetation type and related greenness fraction, albedo, surface roughness length, emissivity, among others) on the South Asian summer monsoon hydroclimate is investigated by means of 7-month, 4-member ensemble sensitivity experiments with the Weather Research and Forecasting model.

It is found that extended desertification significantly affects the monsoon at local and large scales. Locally, the atmospheric water cycle weakens because precipitation, evaporation, and atmospheric moisture convergence all decrease; soil moisture and runoff reduce too. Air temperature cools because of an increase in albedo (the desert makes the area brighter) and a reduction of surface turbulent fluxes; the cooling is partially offset by adiabatic descent, generated to maintain thermodynamic balance and originating at the northern flank of the low-level anticyclone forced by desert subsidence. Regionally, an anomalous northwesterly flow over the Indo-Gangetic Plain weakens the monsoon circulation over northeastern India, causing precipitation to decrease and the formation of an anomalous anticyclone in the region. As a result, the middle troposphere cools because of a decrease in latent heat release, but the ground heats up because of a reduction in cloudiness. At larger scale, the interaction between the anomalous circulation and the mountains leads to an increase in precipitation over the eastern Himalayas and Indochina.

The findings of this study reveal that the expansion of the Thar Desert can lead to a pronounced and large-scale impact on summer monsoon hydroclimate, with a potential to redistribute precious water over South Asia.

RECENT CHANGES IN THE CIRCULATION PARAMETERS AND THEIR ASSOCIATION WITH INDIAN SUMMER MONSOON RAINFALL

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The phenomena of Earth's climate system and its associated rainfall are mainly driven by the changes in various circulation parameters embedded with the local atmospheric instability. In this context, an attempt has been made in the present study to examine the recent changes in the regional circulation parameters viz., zonal wind at 200 hPa level over Tibetan Anticyclone region (TA_{U200}), zonal wind at 100 hPa over peninsular India i.e. Tropical Easterly Jet (TEJ_{U100}), meridional wind (Somali Jet) at 850 hPa over Somali Coast (SJ_{V850}) and meridional wind at 850 hPa over Arabian Sea (AS_{V850}) using NCEP/NCAR reanalysis dataset during the period 1949-2008. The influences of these circulation parameters in the Indian summer monsoon rainfall (ISMR) have also been brought out. The circulation parameters AS_{V850} and TEJ_{U100} show decreasing tendency which in turn leads to the weakening of the moisture transport mechanism over the Indian sub-continent during the monsoon season whereas the other parameters TA_{U200} and SJ_{V850} show increasing tendency. TEJ_{U100} shows significant decreasing trends throughout the monsoon months and season with a very strong positive relationship with monthly ISMR. The intensity of the TA_{U200} on monthly scale seems to have less impact than those of the other parameters on ISMR during the warming scenario though it plays a vital role in modulating the general atmospheric circulation. The most significant recent changes have also been noticed for TEJ_{U100} and SJ_{V850} throughout monsoon months.

CLIMATE CHANGE: WAR AT YOUR DOORSTEP

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The issues of generation, conversion, reduction and sequestration of green house gases have been the subject of intense research and development for the past few years. The varying potential of different activities in contributing to the problem or the solution is debated hotly at different forums.

The role of particulate matter, factory emissions and aerosols in impacting on the solar radiation received and reflected is being better understood.

Debates in the scientific community continue on anthropogenic and natural factors and the potential contribution possible from each towards the escalating and accelerating the impact of climate change. The experts can continue to argue using more and better models projecting the likely changes and the causative factors. This knowledge will be important in working out a consensus at the global level.

Climate in the next fifty years is likely to be a very significant player in the process of development. Industry has a bigger responsibility and also access to resources for improving energy efficiency, reducing wastes and recycling water. Civic organisations have to adopt measures for municipal waste treatment and recycling water. Incentives including recognition of good performance may encourage better practices.

There is no emphasis needed to understand that investment in energy generation is coupled to environment. Integrated energy solutions using alternative non-carbon sources need promotion at many levels to become commercially successful. Clean fuel concepts are as much desired for a rural household as for the unorganised sector or for the large petrochemical complex. Are adequate numbers of R&D teams deployed on such priority projects? Can civil society raise a demand for investing more resources for more research and faster development?

There is an emerging new discipline that understands and explains the science of climate change. Students gain familiarity with assessment and measuring of changes in the precipitation of rain and snow, time scale changes of surface temperatures, understand consequences of significant factors both natural and man-made. Identification of vulnerabilities and steps to reduce risks will be necessary components of such studies requiring multi-disciplinary skills. Every concerned citizen also needs to understand the core of the arguments and how global warming and climate change impair development.

At one level, an outreach campaign can explain the greenhouse phenomenon, ice core and tree ring studies that establish periods of earlier climate change and early

evidence of climate change and its consequences. 'Trigger' films will be very significant for most audiences. PC based games would attract the youth and help internalise the significant factors and their short- and longterm consequences. Life style changes to impact on emission and consumption patterns may be necessary not only for citizens of the developed countries but the privileged sections of the society in the developing countries also. This will enable informed discussion and prepare the community for adaptation measures.

Action by families and communities can reflect concern for the issues and also become small but meaningful steps in the adaptation and mitigation efforts. Selective planting of herbs and vegetables in the backyard in rural areas or on terraces and balconies in urban areas can help supplement nutrition in one's diet, reduce frequency of visit to the market, and sequester greenhouse gases. Planting selected trees on farm boundaries can limit soil and crop damage due to strong winds, help store carbon dioxide, and yield biomass, etc. Campaigns for outreach then must have a clear agenda addressing urban citizens, rural leaders, or industry captains. Communicators should rise to this challenge and view it as an opportunity.

GROUNDWATER RESOURCE MANAGEMENT IN A SEMI ARID REGION USING GROUND WATER MODELING APPROACH – A CASE STUDY OF NORTHERN PART OF MENDHA SUB-BASIN, NE RAJASTHAN, INDIA.

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The arid and semi arid climate, lack of perennial streams and the increasing demands of water for meeting the growing needs of various use sectors in the state of Rajasthan have all collectively led to increasing dependence on groundwater resources. Therefore planning and management is the much needed tool for a judicious use of the groundwater resource. Groundwater simulation models are powerful techniques for evaluating and assessing the problem and in finding some alternative approach for groundwater development and management.

In this work an attempt has been made to develop the groundwater flow model in the northern part of the Mendha sub-basin, of Shekhawati river basin, NE Rajasthan. The study area is characterized by heavy groundwater draft for agriculture, industrial

and drinking purposes. The model simulates groundwater flow over an area of 1937 km^2 with 33 rows and 28 Column and single layer. The model was calibrated for steady and transient state condition for the period 1998-2005 using available historical water level and other auxiliary data. There was a reasonable match between the observed and computed heads. The calibrated model has then been used to simulate the groundwater regime and found helpful to solve the problem of the area using various water management strategies.

THE STUDY OF EXTREME RAINFALL AND TEMPERATURE EVENTS OVER VARANASI

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Climate is defined not simply as average temperature and precipitation but also by the type, frequency and intensity of weather events. Human-induced climate change has the potential to alter the prevalence and severity of extremes such as heat waves, cold waves, storms, floods and droughts.

The frequency increase of extreme temperature events reduces yields in warmer regions due to heat stress at key level, quality of life for people and increases water demand, water quality problems, risk of heat-related mortality. Whereas increase in extreme precipitation events results in damage to crops, soil erosion, water logging of soils, adverse effects on quality of surface and groundwater, disruption of settlements.

In the present work the extreme temperature and rainfall events has been analysed over Varanasi, U P using 30 years daily surface data of temperature and rainfall from 1980 to 2010. Although present study needs to be extended in terms of space and time, it reveals that frequency of extreme rainfall and temperature events has been increased slightly. It also suggests that these extreme events may increase in future in response to increasing global warming.

TARGET POTENTIAL FOR ZERO GAS EMISSIONS IN INDIA: CO_2 SEQUESTRATION IN COAL BEDS

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Coal is one of the most important and interesting energy sources of today and future. It produces the maximum CO_2 per unit energy of all fossil fuels, yet it is identified enough in abundance to last for centuries. It is also gaining attention for production of an alternative energy source i.e. natural gas called coalbed methane (CBM) vis-à-vis for long term storage of waste green house gas namely CO_2. CBM has traditionally been identified as an evil companion of coal, bringing in major safety problems in underground mining and later got recognized as an important source of low carbon green energy. Similarly, carbon dioxide which was initially injected underground to enhance the yield of hydrocarbons in oilfield is now a critical and promising solution for reducing its atmospheric concentration. The dual benefit approach of using Carbon Capture and Storage (CCS) technology in enhanced oil and gas recovery seems to be a win-win proposition.

India with its large potential coal reserves has ample opportunities for production of CBM. At the same time, India is one of the major contributors of waste gases into the atmosphere. Therefore, sequestration of CO_2, if at all planned, must be opted first in the deep seated coals or methane producing units. This will mitigate the costs of CO_2 capture, compression, transport and storage by enhanced recovery of methane.

Limited studies on the numerical simulation of CO_2 enhanced CBM recovery has been carried out for Indian scenario. Numerical approach, despite its constraints, is a key to understand the details of a process with relative ease as compared to the actual set up which involves large influx of money. This study is conducted for modeling the scenario of CBM producing units in India under a scenario of CO_2 injection and the results indicate that long term storage of gases in coal beds are feasible for a geo-scientific point of view. The production and storage characteristics of the coal block has been investigated and it is recommended to opt for CO_2 enhanced ECBM recovery in the longer run.

GEOCHEMICAL STUDY OF FE-NUTRIENT-PIGMENT VARIABILITY IN CORE SEDIMENTS OF COCHIN ESTUARINE SYSTEM (CES)

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Geochemistry, the vital aspect determining the chemical composition is a reliable tool for predicting the climatic condition residing in an ecosystem. Hydrosphere requires a special orientation since complex reactions occur both in the flora and fauna and well regulated by human interventions. Coastlines, estuaries and inland waters are the prone and peak areas vulnerable for variation beneath the vibrant system of hydrosphere. Rapid Urbanization and subsequent Industrialization had resulted in generating an enormous amount of pollutants into these fragile systems. Geochemical studies of surficial sediment as well as sediment cores are helpful in the evaluation of environmental composition. Sediment cores are the crucial data source for providing information on sea bed character, depositional history and environmental change. Deep sea sediment is inimitable and closely associated with the geochemical history of the earth. Cochin Estuarine System, where multifaceted activities are foregoing is an imperative place to cram. This Estuary stands versatile since various physical, chemical and biological activities reach its climax. Many studies relating to diverse types of actions occurring in the estuary had become a subject of study. The topography of this estuary is typical and primitive. In this context sediment geochemistry plays a critical role in instigating and unraveling the benchmark of sediment characterization.

The present study comprises three characteristic zones which are distinguished on the basis of salinity and core sediments were collected from riverine, coastal and estuary region of CES. The core sediments were sliced into 3cm intervals, tightly packed and stored at 4°C until analysis. Nutrients, chlorophyll, Textural characteristics, quantification of organic matter (Total Organic Matter, Protein, Lipid, Carbohydrate, Tannin and Lignin) and Iron were estimated. Protein to carbohydrate ratio and lipid to carbohydrate ratio were encountered to understand the respective freshness and nutritional quality of the sediments. In addition to core sediments, surface and bottom water were sampled for nutrient and pigment analysis. These results served as a rejuvenating tool for the prediction of status of sediment cores prevailing in the Cochin estuarine System.

BASIC CONCEPT OF SUSTAINABLE DEVELOPMENT

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Sustainable developments are those which fulfill the present needs of the mankind without curtailing (or compromising) the needs of future generation. Sustainable development is defined as a development that continues forever or is long lasting. It is also defined as a regularly maintained development. In context with the environment, it is the utilization of natural resources in such a way that it does not get exhausted completely but continues to renew for the coming generation. In order to achieve a sustainable life, a balanced and equal distribution of natural resources is necessary throughout the world so that basic needs of each and every living being may be fulfilled.

The idea of sustainable development was conceived in early 1970s, when the need was felt to preserve our natural resources as they were depleting at a very faster rate. As per the definition of the World Health Organization (WHO), sustainable development means: "Meeting the needs of the present without compromising the ability of future generations to meet their needs". In 1992, the UN conference on Environment and Development (UNCED), popularly known as the Earth Summit, was held at Rio de Janeiro, Brazil. The Rio declaration on Agenda-21 adopts a global programme of action on sustainable development in social, economic and political contexts for the 21st century.

HYDRO CARBON GASEOUS ANOMALIES FOUND IN AGRICULTURE FIELD AROUND SAGAR-DAMOH, SOUTHERN FRINGES OF BUNDELKHAND REGION, MADHYA PRADESH, INDIA

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In the year 2006-2007 a leakage and seepage of the natural petroleum and helium gas was reported from more than 20 tube wells scattered in the 200 km long belt in Vidisha-Sagar- Damoh-Panna-Satna distts in the southern fringes of Bundelkhand region in M.P. The discovery of the rare gas helium in hydrocarbon rich zone in the tube wells in agricultural field of Pipariya-Bhutoli Garhakota Tahsil and Meerkheri and Rahatgarh town in Rahatgarh tahsil of Sagar district in M.P., is a unique finding in the history of Earth Science in India. It is remarkable to note that values of helium contents varies from 0.34 % to 0.732 % along with the 72% to 99 % of methane and ethane, and minor amount of oxygen, nitrogen and CO_2 gases in the hydrocarbon rich zone are recorded during the geochemical and stable isotope analysis. It has been found in the stable isotope δC^{13} value, the values for the methane is -43.6 per mil w.r.t. to 54.9 per mil w.r.t. PDB and for the Ethane gas is --24.9 to -- 26.4 per mil w.r.t. PDB in the gas samples collected in the saturated sodium chloride solution in the glass bottles at Rahatgarh, Meerkheri, Piparia, Bhutoli villages in Sagar district. The occurrence of rare helium gas in the hydrocarbon rich zone is reported first time in Jan, 2007 from the tubewells of Sagar Distt, which were geochemically and stable isotopically analyzed at KDMIPE Dehradun and NGRI Hyderabad. The gaseous hydrocarbon analysis show the presence of moderate to low concentration of methane (C1) 1 to 104 ppb, Ethane (C2)-1 to 14 ppb, Propane (C3) 1 to 10 ppb, i- Butane (i C4) 1 to 9 ppb and nButane (n C4) 1 to 8 ppb in the soil samples collected from different locations. The result of the stable isotopic analysis of Ethane gas in these samples δC^{13} value are ranging from -24.9 per mill w.r.t. PDB and -26.9 per mill w.r.t. PDB are indicative that this gas is of thermogenic origin, which must have been formed at very high temperature and pressure condition in the deeper horizon of the Great Vindhyan sedimentary basin of early Proterozoic (>500m.y.) period.

NATURAL RESOURCE MANAGEMENT - SURFACE AND GROUND WATER RIVER SYSTEMS OF MIZORAM POTENTIAL WATER WAYS TRANSPORT RESOURCE

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Mizoram is one of the Seven Sister States in North Eastern India. It shares land borders with the states- Tripura, Assam, Manipur and countries Bangladesh and Myanmar. Inland connectivity of the Mizoram state is very poor with the rest of the country. The southern end of the state shares international borders with Myanmar and Bangladesh. The eastern most state Tripura, of the region is also cut off from the main

land India. The only connection with the mainland is, through the very long and tedious journey through chicken neck corridor.

In the wake of full socio-economic development of the region, it is high time to look for some better communication alternatives to break this land lock. The recent development in the international ties with Myanmar and Bangladesh to develop the north east region as an important international trade hub, has actually opened a bright prospect to convert the Mizoram rivers into important water transport resources.

In 2008 India and Myanmar have reached an agreement to open a border trade centers at Zowkhathar in Mizoram and Avakhung in Nagaland in addition to the existing centers at Moreh in Manipur, India is developing the Sittwe port in Myanmar at a cost of Rs.5.4 billion and the port on the Kolodoyne river as a gateway for the northeastern states to the rest of the world, as the distance between Kolkata and Sittwe is just 600 km.

In addition, the new 100-km highway, from Lawngtlai in eastern Mizoram to Myanmar border at an estimated cost of Rs.650 Crore, is coming up on NH-54, to provide linkage to the under-construction Sittwe port in Myanmar. The "Kolodoyne Multi-Modal Transport Project", is expected to be commissioned by end of 2012.

All the rivers in Mizoram are monsoon fed and they attain maximum volume in the monsoon and post monsoon period. The drainage of major northerly flowing river of Mizoram, Tlawng, is connected to the Barak -Bhrahmputra drainage system, and the drainage of major southerly flowing river Kolodoyner is connected to Bay of Bengal at Sittwe port of Myanmar.

In view of the connectivity of Mizoram rivers with Barak –Brahmputra to the north and with the Bay of Bengal to south, it is prime time to work out the navigability of northerly flowing Tlawng and Southerly flowing Kolodoyne rivers, to strengthen the Multi Modal Transport system in the hitherto landlocked region. Barak river has already become a part of National Waterway-6 (from Lakhipur to Bagha).

A detailed study of the two main river systems of Mizoram may reveal valuable information regarding the identification of stretches of deeper and navigable part of these rivers, annual flow discharge. Another challenge is to combat the problem of excess silting in the river course.

PACIFIC NORTH AMERICA OSCILLATION AND THE INDIAN SUMMER MONSOON RAINFALL IN RELATION TO QBO

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Various studies show the evidence for the variability of the pressure anomaly over North Pacific Ocean and North American region. The importance of this phenomenon in causing persistent anomalies over different regions of the globe has drawn considerable attention in view of its relevance in climate assessment. The association of the pacific north American pattern (PNA) with Indian summer monsoon have been examined by considering the 53 years data from 1954-2006 by using the correlation technique for full time series as well as by grouping the data according to the easterly and westerly phase of Quasi Biennial Oscillation (QBO) at 50- hpa level. The 30-year sliding correlation coefficient also has been made to know the PNA parameter is efficient predictor of Indian summer monsoon rainfall in present condition. In both cases DJFMAM, FMA, MAM and April shows the significant association with Indian summer monsoon rainfall and association of these parameter is also changed according with QBO phase.

DETERMINANTS OF PUBLIC AWARENESS AND ATTITUDES ON CLIMATE CHANGE OF HIGHLAND COMMUNITIES IN SIKKIM HIMALAYA – MULTIVARIATE ANALYSIS WITH LOGISTIC REGRESSION

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The global environmental changes are expected to affect most the highland communities around the world which is a contested and complex environment with many conflicts of interest and challenges surrounding the use and management of

natural resources (IPCC, 2007; World Bank, 2008 & Douglas, 2009). These marginalized isolated highland communities are going to face the climatic stress because they largely dependent on climate-sensitive sectors, such as rain-fed agriculture; its fragile mountain ecosystems and dramatic topography make the country prone to natural hazards. These changes will create tremendous stress and shocks to highland communities by declining agricultural productivity with increasing problem of food security in mountainous region. The variability of climate is a complex problem without clear scientific and political solutions. The mounting threats of runaway climate change topics are very much on public, political and scientific agenda with major political, economic, socio-cultural, psychological, and ethical implications, which must be understood by the policy makers and wider society in order to respond effectively. The paper presents an empirical analysis to examine the key determinants and dimensions of public awareness of, response to climate change. This study use mixed methodology approach to explore a variety of potentially salient influences on perception of and behavioural response to climate change. The required data and basic information of rural household and communities of highlands related to impact climate change and indigenous adaptations were collected from direct questionnaire based primary field study and physical survey based on the results of 140 respondents in highland villages of Sikkim. To ensure well-distributed representation, the selection of samples from the study area was done by a simple random sampling and on the basis of their economic categories: namely, rich, middle class and poor via wealth ranking assessment. Stratified random sampling was applied to select the household in the study villages. PRA method was applied to gather information on perception and awareness of climate change, vulnerability induced by climate change and adaptation measures of local mountain communities to minimize such impacts. Focused Group Discussion **(**FGD) was applied to understand the perceptions, attitudes and practices. Data analysis comprises of complementary qualitative and quantitative techniques, comparing statistical patterns in the data using SPSS. The head of households who receive formal education, having media access, personal or family experiences of different form of hazards are more concerned group and are more likely to develop proper environmental attitudes. Though most of the people are having pro environmental attitude, at the same time they are less willing to make much financial sacrifices for the sake of environment. The main barrier of highland rural households response to adverse environmental challenge in the past were lack of awareness/information, financial constraints, lack of institutional supports. The public policies and investment strategies must support education, markets, credit and information about crafting adaptation strategies to climate change, including technological and institutional methods, particularly for poor highland households in highlands of different country in South Asia.

IMPACT OF INTRUSION OF OZONE FROM THE STRATOSPHERE ON THE TROPOSPHERIC OZONE LEVELS IN INDIA

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Decrease in stratospheric ozone will result in an amplification of the solar ultraviolet B radiation reaching the ground, which is a threat to the human society. On the other hand, ozone being toxic to the living system and an important contributor to anthropogenic global warming, high levels of tropospheric ozone will have adverse effects on the air quality and climate. Transport of ozone from the stratosphere to the troposphere will cause stratospheric ozone to decrease and tropospheric ozone to increase, which can in turn have serious consequences for life on earth. Stratosphere-Troposphere Exchange (STE) is regarded as an important factor controlling the budget of ozone in the troposphere and lower stratosphere. Study of STE events in India are so far restricted to coordinated campaigns and measurements over longer periods are relatively scarce. The surface ozone levels in some Indian cities have increased significantly in the recent years. In the light of these observations, the paper is aimed to identify the Indian latitudes, which are most likely to be affected by STE, the frequency of occurrence of shallow and deep STE events and the depth up to which stratospheric ozone descends into the troposphere during these events over the period of 24 years. In addition, the contribution of STE events to the observed high surface ozone levels for a number of cities covering north to south of India will be presented.

CLIMATE CHANGE AND MONSOONAL RAIN-PRODUCING WEATHER SYSTEMS ACROSS INDIA

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Attempts have been made to understand relationship amongst global warming-cooling, Asian-Indian summer monsoon circulation intensity, El Niño-La Niña in the equatorial central and eastern Pacific Ocean and rainfall across India. During warmer

troposphere over Afro-Asian highlands, the monsoon is stronger, La Niña condition in the Pacific and intense rainfall across India, while reverse was the changes during cooler troposphere. In recent years, the Asian-Indian monsoon circulation is weaker and rainfall across India because of cooler upper troposphere over Tibet-Himalaya-China-Mongolia-Manchuria sector and warmer lower troposphere over the surrounding water bodies (Pacific, Indian, Atlantic and Southern Oceans). In general, the troposphere over the southern hemisphere is warming at a faster rate due to large water bodies compared to that over northern hemisphere, so there is lesser exchange of the mass-moisture between the two hemispheres. During boreal summer, decreasing trend is seen in the intensity of the general atmospheric circulation over the period 1949-2009.

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