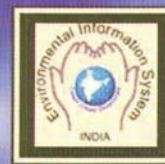




# ENVIS NEWSLETTER



## Acid Rain and Atmospheric Pollution Indian Institute of Tropical Meteorology, Pune

(A Project of the Ministry of Environment and Forests, Govt. of India)

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### Editor's Desk:

Year 2007 has been a tremendous encouraging and happening year for people working in the field of environmental sciences due to the attention that was received from the Nobel committee for the first time. Since then the activities in this field have successfully attracted attention of people worldwide who now seriously feel their responsibilities and are ready for fighting against all the environmental related issues. In our previous issue of ENVIS newsletter we tried to give a view of the ongoing activities and also covered a brief information & understanding on some topics related with pollution. However, development or research never comes to an end and so does our information!!!!

We are now happy to bring in focus this issue of ENVIS Newsletter of IITM in the year 2008 where we have tried to cover information related to a major topic of today viz. "Global Warming". We have tried to put light on some major aspects behind global warming along with the pros and cons which will definitely make us think about the issue seriously. To support this fact examples are provided in the form of the short articles on acid rains and black carbon emission scenarios in India. Some useful tips and suggestions on how one can contribute to fight against the warming situations have also been provided towards the end.

In addition, keeping in mind the interest and for the benefit of young researchers and scientists in India for the first time we have included information regarding various upcoming events and conferences that are to be held in 2009. To make the Bulletin a truly effective forum for all atmospheric pollution related issues of the country, feedback and contributions from scientific communities and research groups are highly appreciated.

G. Beig

EDITORS

B. N. Goswami

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## **GLOBAL WARMING: Other side of the coin - A reality**

Debate on global warming is one of the hottest topic of today. Most mainstream scientists believe that human activity - notably emissions of greenhouse gases - have contributed to a significant increase in the average surface temperature of the planet. However, there are still a sizeable group of researchers who disagree to this. They question much of the science which supports the global warming hypothesis. The two main aspects behind this include: the source of data collection and computer models used for predicting the future scenario.

### **Urban heat islands**

Data from weather stations on land and at sea have been used to reconstruct variations in the Earth's annual-mean surface temperature over the past century. These show a warming in the range 0.3-0.60 C over the period. But there is doubt whether much, or any, of the warming can be linked to increases in CO<sub>2</sub>. Much of the collected data comes from weather stations close to towns and cities. Therefore, the warming may simply reflect the heat associated with the growth of those towns and cities. Any "real" warming that may exist once this influence has been properly extracted falls well within the "noise" of natural climate variability.

### **Satellites and balloons**

The inconsistencies between the surface temperature records and the data produced by satellite and balloon studies are also emphasized. The latter show little, if any, warming in the last two decades of the low to mid-troposphere where the atmospheric layer is extending up to about 8km from the Earth's surface. Climate models generally predict that temperatures should increase in the upper air as well as at the surface if increased concentrations of greenhouse gases are causing the warming recorded at ground level.

### **Computer Models**

Another question arises about the scenarios of future climate change that are produced by computer models which are deeply flawed. It is believed that the task of simulating the complexities of our climate system is beyond the

capabilities of even the fastest supercomputers. Certain phenomena, such as cloud formation, oceanic heat transport and the mixing of the air, are still so poorly understood that certain assumptions have to be made about the way the atmosphere behaves.

### **Sun**

The Sun is one of the major significant factors in climate change than the rising load of man-made heat-trapping gasses in the atmosphere. It has been suggested that the solar wind and the Sun's magnetic field can limit the number of cosmic rays (high-energy particles) that enter the Earth's atmosphere. The cosmic rays are said to collide with air molecules to produce secondary particles that seed the cloud types that act to cool the Earth. In other words, increased solar activity means fewer cosmic rays, fewer clouds, and more warming. Some greenhouse sceptics argue that this correlation between Earth temperature and solar activity is better and smoother than for any correlation with CO<sub>2</sub>.

Natural processes involving changes in the Sun could have at least as powerful an effect on global temperature as increased emissions of carbon dioxide (CO<sub>2</sub>). Climate scientists have already looked at changes related to Sun spot activity - a cycle of approximately 11 years - and long-term changes in the Sun's brightness, which has a cycle that lasts for centuries. They have discounted the effect of both on the temperature increase over the last century because they either happen over too short a timescale, or they are too weak.

However two other factors also need to be taken into account:

1. Changes in the amount of ultraviolet radiation from the Sun affect the ozone layer. This is a very important part of the atmosphere where lots of chemical reactions take place that govern the way the rest of the atmosphere works. The Sun's magnetic field and solar wind - mainly in the form of electrons and protons coming out of the Sun - protects the entire Solar System by acting as a sort of shield from cosmic rays (very energetic particles and radiation from outer space). This shield does not stop all the cosmic rays from getting through, and its effectiveness varies with the long-term changes in the activity of the Sun, which can rise and fall on a timescale of centuries.



2. The effects due to cosmic rays which influence how cloudy the Earth is. If the Sun undergoes long term changes in activity, the amount of cosmic rays reaching the earth will also vary which will affect the planet's overall cloudiness which in turn affects the radiation from the sun reaching the earth's surface thus affecting the global temperature. The satellite data show that the amount of low clouds over the earth closely follows the amount of cosmic rays reaching the earth. Thus the resulting warming due to this effect over the last century could be comparable to the amount of warming people think has been due to the greenhouse effect.

The other side of this coin is that reducing greenhouse emissions will have much less effect in ceasing rising temperatures than some people think, and it might have hardly any effect at all. The energy emitted from the Sun drives the climate system, and natural changes in its behaviour can have a far greater effect than human behaviour. The question therefore arises as to is it really necessary to bother about greenhouse gases and asking industries to cut emissions when it is pointless? If the Sun is indeed the main contributor to the recent climate change, the money may be better spent providing clean air in big cities and clean drinking water to the Third World.



### Acid Rains in India

When it rains in Pune and Nagpur, the raindrops may not taste unusual. But weathermen who recently studied the composition of rainwater from 10 cities are worried that it's raining 'acid rain' caused by vehicular, industrial pollution and uncontrolled urbanisation.

According to a senior meteorologist from India Meteorological Department (IMD), V. K. Soni,

"In Pune and Nagpur, the amount of acid in rainwater has gone up five times since 1995." The study was conducted along with colleague Jayant Sarkar, former director of the IMD's air pollution unit. The researchers also collaborated with the World Meteorological Organisation.

Samples of rainwater from this year's first showers and last year's monsoon from Pune, Nagpur, Vishakhapatnam, Srinagar, Allahabad, Jodhpur, Kodaikanal, Minicoy (Lakshadweep) Mohanbari and Port Blair were tested at the IMD, Pune. The results indicated high amounts of sulphur dioxide and nitrogen oxide - major contents of acid rain - emitted into the atmosphere from vehicles, coal-fired power plants and industries.

The US Environmental Protection Agency (EPA) website says pollutants in acid rain interact in the atmosphere to form fine sulphate and nitrate particles that can be 'transported long distances by winds and inhaled deep into people's lungs. Fine particles can also penetrate indoors.'

**FACT:** "Drinking acidic rainwater directly or consuming vegetables grown on water containing acidic or metallic elements can cause Alzheimer's."

### Black Carbon emission scenarios in India during 1990s

In the developing countries, demand of energy has been increasing day by day due to industrialization, change in technology and urban developments. The production of energy is always associated with the release of atmospheric pollutants like black carbon (BC). In the early and middle 20<sup>th</sup> century, United States of America (USA) and European countries were the largest sources of BC emission from fossil fuel but in the recent decade, China and India have become the greatest sources of BC emissions. In the global emission budget, East and South Asia contributes more than 50 % of BC emissions. There are various reasons due to which the importance of BC has become a point of interest. Recently BC has received global attention because of their immediate warming impact which is much greater than those of CO<sub>2</sub> and CH<sub>4</sub>. In term of radiative forcing, BC (0.8 W/m<sup>2</sup>) is the second most important atmospheric pollutant after CO<sub>2</sub> causing global warming. Primary source of light absorbing BC is combustion of carbon-based fuels. Therefore most of incomplete combustion



processes release BC as by-product. Atmospheric aerosol is a mixture of fine particles of carbonaceous particles, sulfates, nitrates, mineral dust and sea salt. The dark component of carbonaceous aerosols often referred to as soot or BC, is actually a mixture of graphite like particles and light absorbing organic matter. BC has proportionally a greater effect on the radiation budget than the short-lived organic carbon and sulphate. BC heats up the air, which leads to altering of regional atmospheric stability, vertical motion and large-scale circulation with significant regional climate effects. Hence, prediction of radiative forcing requires accurate information of BC. Increasing population and modern life style has enhanced the consumption of conventional energy sources like fossil fuel which has resulted in increase of BC emission. Fossil fuel and bio-fuel are the major sources of BC emission in India. An emission inventory details about the amount and types of air pollutants released into the air and also provide information on the types of sources that are emitting the pollutants, their location and the amount of the pollutants emitted.

An attempt has been made to develop the emission inventory of BC over Indian geographical region for the base years 1991 and 2001 using all micro-details of activity data of various sources and sectors as shown in Figure 1 and Figure 2 respectively. The decadal growth of BC emission for 1990s has also been calculated. Our calculated total BC emissions were 1343.78 Gg and 835.50 Gg for the base years 2001 and 1991 respectively with a decadal growth of around 61 %, which is highly significant. The district level analysis shows a diverse spatial distribution with the top 10 % emitting districts contributing nearly 50% of total BC emission. Coal contributes more than 50 % of total BC emission. All the metropolitan cities show high BC emissions due to high population density giving rise to high vehicular emissions and more demand of energy. Indo-Gangatic Plan (IGP) marked in red color in figure (1) is one of the most polluted regions in India followed by western India and Southern India. In the gridded image, the IGP belt shows more emission due to high population density and it is the most fertile region for agriculture in the country. All the metropolitan cities like Delhi, Mumbai, Kolkata and Chennai show high BC values due to high vehicular BC emissions and more demand of energy supported through thermal power station. Some part of

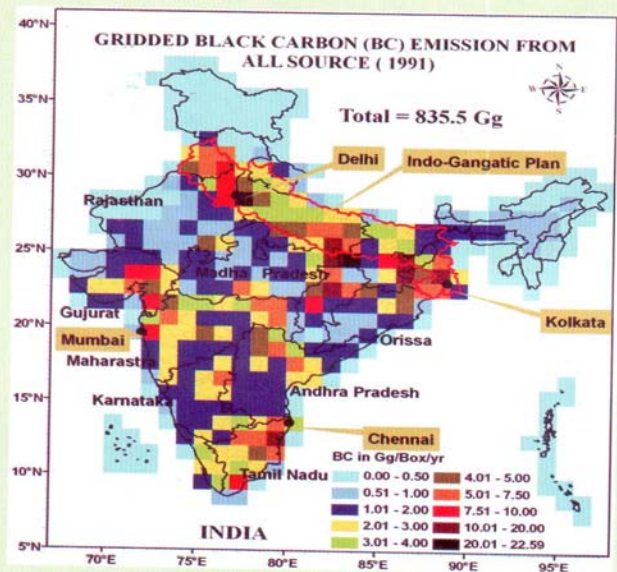


Figure 1

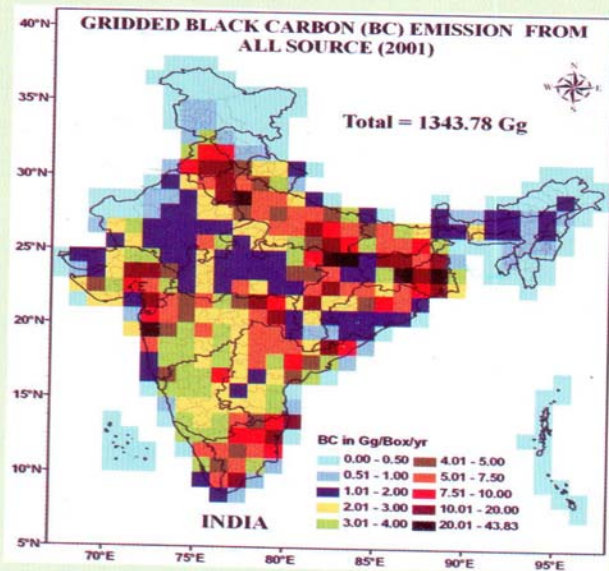


Figure 2

central India, North-western, Eastern, and Northeast region show less BC emissions as compared to other parts of India due to low population densities and few numbers of low capacity thermal power stations. This emission inventory could be able to provide detailed information about "Hot Spots", relative contribution of various sources and sector that can be targeted for mitigation. This inventory will not only improve the understanding on emission scenarios in the country with their possible impact but also can be used in national interest for the future emission strategies.

**(This article is contributed by Mr. Saroj Kumar Sahu, IITM, Pune)**



## Climate Change and its Impact in the Arctic and Antarctic

The changes taking place in the atmosphere have become one of the serious threats the world faces today. Manifestations of adverse climate change due to anthropogenic interference are now discernible and this might result in irreversible adverse impacts in a few decades. Human activities have the potential to disturb the balance of natural systems and cause warming of the planet to an unprecedented extent therefore it is quite clear that climate change is one of the most serious environmental challenges the world is facing. Climate change refers to any long-term significant change in the "average weather" that a given region experiences. The term average weather may include average temperature, precipitation and wind patterns. These changes in the variability or average state of the atmosphere persists over durations ranging from decades to million of years. The classical period for averaging these variables is defined by the World Meteorological Organization (WMO) to be 30 years.

The dynamic processes on Earth or the external forces including variations in sunlight intensity, and more recently the human activities have been the major possible reasons behind the climate change. To fully confront with this issue it is first necessary to understand the science behind it: as to how the circulation of the Earth's carbon atoms drives climate change. Climate change is caused by persistent build-up of green house gases (GHG) such as CO<sub>2</sub> in the earth's atmosphere. Concisely, the greenhouse effect plays an important role in regulating the climate of the earth. The ability of certain trace gases to be relatively transparent to the incoming visible light from the sun yet opaque to the energy radiated from earth is one of the best understood processes in atmospheric sciences. This phenomenon is called the greenhouse effect because the trace gases trap heat similar to the way the greenhouse's transparent covering traps heat; and without our atmospheric greenhouse effect, earth's surface temperature would be far below freezing. On the other hand, an increase on the atmospheric trace gases could result in increased trapped heat and rising global temperatures. Some of the activities that have dramatically increased GHG emissions are burning of fossil fuels, industrial practices and consumerism, deforestation and agriculture. These activities have increased emissions to the extent that far

exceeds the ability of natural systems to assimilate these gases. As a result, climate change has started endangering biodiversity, human health and food and fresh water supplies, coastal and low lying system, impacting people worldwide.

Sea ice can be considered as a "key indicator" of climate change, as it is very sensitive to temperature changes both in the air above and the sea below. Therefore it can be regarded as an early warning system for climate change, like the "canary in a coal mine". According to the observations made by scientists, the Arctic temperatures have been found to rise twice as rapidly as the global temperature over the last 40 years. The snow cover has declined 10% in its extent over the last 30 years. The average annual extent of sea ice has declined by 8 % over the same period, but much more in summer by 15 to 20 %. In regions where it still exists, sea ice has become thinner by 10 to 15%. The Arctic ice cap declined to a record minimum size in summer 2007, and according to climate scientists this fast pace of decline in the Arctic sea ice cover is attributable to human induced global warming. In Antarctica, only on the peninsula, a similar picture is observed by scientists. Even though Antarctica as a whole has been cooling, glaciers on the Antarctic Peninsula have been retreating increasingly faster since 1950. The peninsula is a small extension of the continent that extends northward 800 km toward South America. It is the only area of Antarctica that has experienced warming in historic times, warming about 2°C since the 1950's. The study published in *Science* by Cook et al. (*Science*, vol. 308, p. 541-544, 22 April 2005) states that 87% of 244 glaciers on the Peninsula have retreated since their earliest known position (which was in 1953, on average), while the remaining 32 glaciers have advanced. The rate of retreat of the glaciers has been increasing in these years.

The authors inspected more than 2000 aerial photographs taken since the year 1940 and more than 100 satellite images. They discovered an abrupt transition line between a region of glacier retreat and glacier advance. The transition line has shifted even closer to the pole, from a position at 64°S latitude fifty years ago to about 70°S now, so that glaciers on the whole Peninsula are now retreating.

The Arctic Climate Impact Assessment (ACIA) have chosen five different climate models from various research centres to simulate future



responses of the atmosphere, oceans, ice cover, and other parts of the climate "system". However it is found that every model simulation projects significant global warming over the next 100 years, even using the model that gives the least warming, and using the lowest scenario for future emissions, leads to a prediction that earth will warm twice as much over the next 100 years as it warmed in the past century. The main points concluded from these models are as follows:

- After 100 years, annual **temperatures** in the Arctic are forecast to rise by 3 - 5°C over land but as much as 7°C over the oceans. In winter, temperatures are projected to rise even more, 4 - 7°C over land and 7 - 10°C over the oceans. Arctic changes are approximately twice as great as the expected changes for the whole globe.
- **Precipitation** in the Arctic is expected to increase about 20% by the end of this century. Most of the increase will be in the form of rain, not snow. Precipitation would increase much more in the Arctic than on Earth as a whole, and in all 5 climate models the variability from year-to-year is tremendous.
- **Sea ice** is expected to decline by 10 to 50% in addition to what has already occurred. In the summer, sea ice is expected to decrease by more than 50%, in the average of 5 models.
- The models suggest that **snow cover** will decrease by 10 to 20% in addition to the 10% that has been observed recently. The decreases will be greatest in April and May, which would shorten the snow season and provoke an earlier, stronger pulse of river runoff to the Arctic Ocean.

Thus in conclusion it can be said that the climate change is definitely creating a great impact on the vegetation, animals, and in general on human society worldwide and this issue needs to be examined seriously prior to any severe effect.



### List of National & International Conferences to be held in 2009

#### 1. INTERNATIONAL CONFERENCE ON WATER, ENVIRONMENT, ENERGY AND SOCIETY (WEES)-2009

(12-16 January 2009), New Delhi, India

Website: [www.nih.ernet.in](http://www.nih.ernet.in)

Email: [wees09@yahoo.com](mailto:wees09@yahoo.com)

This is an international conference organized by the Government of India (National Institute of Hydrology) in association with TEXAS A & M UNIVERSITY, USA

Water is vital to all forms of life and fundamental for environmental health and management. The importance of water varies with space and time. The role of water in the environment also depends on other conditions. Forests, pastures, agriculture, and urban areas each create different types of environment. The approach for water resources development varies considerably from one type of environment to another. Many ills of water development programmes have their roots in inadequate appreciation of these differences and the employment of similar solutions for dissimilar environmental conditions. Water management in arid regions is different from the water management in humid areas. Water is also an important source of energy. Living beings are energized when they consume water. Water falling under gravity turns the blades of turbine, which generate electrical energy. A main attraction of hydropower is based on the use of a renewable resource. Every source of energy generation has an associated environmental cost and a comparative evaluation of various sources is necessary to evolve the strategy to meet energy requirements while causing the minimum damage to the environment and society. Although water is a renewable resource, availability of water for the society is limited. Consequently, there is a tremendous pressure on the available water resources due to increasing population and growing water consumption. In many mega-cities, people do not get an adequate amount of water to meet their daily needs and supplies are uncertain. Quality of drinking water is often poor, particularly during rainy season, leading to high incidence of water borne diseases. Also, the metropolitan cities have inadequate drainage networks which get choked frequently, resulting in water logging, disruption of traffic, and health hazards. Owing to indiscriminate abuse, many rivers have died and many others have become sewers because municipal and industrial waste is dumped in them with little or no treatment. In the future, considerably more water will be required for domestic, irrigation, hydropower, and other uses. The need for better management of available water resources to meet the basic necessities for



ever-increasing population and industrial activities and to provide hazard-free water for the society has never been more important. Importantly, many developing countries are facing similar problems to varying degrees. Does it reflect failure of policies? Or planning? Or is it sheer negligence?

To put it succinctly, we are facing increasing demand and uncertain supply of water, and are witnessing growing concern for protection from hydro-hazards. Policies for water management need to be critically re-examined and, if necessary, reformulated in view of the changing conditions. The health and economic effects of the shortage of freshwater are matters too serious to ignore. These issues need to be deliberated and discussed in a technical gathering and the proposed conference is an attempt in this direction. This conference is India's contribution to the UNESCO-IHP VII (2008-2013).

## **2. INTERNATIONAL CONFERENCE ON IMPLEMENTING ENVIRONMENTAL WATER ALLOCATIONS ( 23 to 26 February 2009), Port Elizabeth, South Africa, South Africa**

**Website:** <http://www.wrc.org.za>

This is an international conference organized by Water Research Commission-SA/DWAF-SA/IUCN/IAHS to promote the sustainable use of rivers, wetlands, estuaries and groundwater. The main objective is identifying and critiquing global trends in the implementation of environmental water allocations.

## **3. CLIMATE CHANGE: Global Risks, Challenges & Decisions (10 to 12 March 2009), Copenhagen, Denmark**

**Website:** <http://climatecongress.ku.dk>

An international scientific conference organised by IARU as part of the official preparation for the UN Climate Change Summit (COP 15) to be held in Copenhagen in 2009. A written synthesis of the conference results will be a part of the mat

## **4. AIR POLLUTION 2009: Seventeenth INTERNATIONAL CONFERENCE ON MODELLING, MONITORING AND MANAGEMENT OF AIR POLLUTION (20 - 22 July 2009), Tallinn, Estonia**

This is the 17th Annual Meeting in the successful series of International Conferences dealing with Modelling, Monitoring and

Management of Air Pollution which started in Mexico (1993) and held till date in various countries.

Air Pollution is one of the most challenging problems facing the international community; it is widespread and growing in importance and has clear and known impacts on health and the environment. The human need for transport, manufactured goods and services brings with it impacts on the atmospheric environment at scales from the local to the global. The rate of development of the global economy brings new pressures and the willingness of governments to regulate air pollution is often balanced by concerns over the economic impact of such regulation. Science is the key to identifying the nature and scale of air pollution impacts and is essential in the formulation of policies for regulatory decision-making. Continuous improvements in our knowledge of the fundamental science of air pollution and its application are necessary if we are to predict properly, assess and mitigate the air pollution implications of changes to the interlinked local, regional, national and international economic systems.

The goal of this conference is to bring together researchers who are active in the study of air contaminants and to exchange information through the presentation and discussion of papers dealing with the wide variety of topics.

## **5. International Scientific Conference on the Global Energy and Water Cycle on 24-28 August 2009 in Melbourne, Australia.**

**Website:** <http://www.gewex.org>

**Email:** [gewex@gewex.org](mailto:gewex@gewex.org)

World Climate Research Programme (WCRP) Global Energy and Water Cycle Experiment (GEWEX) will hold its 6th international conference. The Conference will be held in parallel with the 2nd Integrated Land Ecosystem-Atmospheric Processes Study (iLEAPS) Science Conference. The theme for both conferences is "Water in a Changing Climate: Progress in Land-Atmosphere Interactions and Energy/Water Cycle Research." Joint sessions are planned on the following topics:

- 1) Land in the Climate System
- 2) Aerosol, Cloud, Precipitation and Climate Interactions
- 3) Future Integrated Observations and Modelling Systems



## Did you Know ????

1. Making use of alarm clocks used by forefathers will help reduce 48gms of carbon dioxide emission in air.
2. Instead of walking on the usual treadmills for 45 minutes in gymnasium, simply walking in fresh air will help reduce emission of 1 kg of carbon dioxide in air.
3. Many idle electronics TVs, VCRs, DVD and CD players, cordless phones, microwaves - use energy even when switched off to keep display clocks lit and memory chips and remote controls working. Nationally, these energy "vampires" use 5 % of our domestic energy and cost consumers more than 3 billion annually.
4. Water is not "nothing" - **WATER IS A VERY POWERFUL FUEL**. Scientists are making devices for replacing fuel in the car. They are making use of a little separate water into a gas called **HHO** (2 Hydrogen + 1 Oxygen). HHO, also called electricity out of the car's battery, to Brown's Gas or Hydroxy, burns beautifully and provides TONS of energy while the end product is just WATER!!! Isn't this a good replacement for fuel???

## Earth Day Celebrations

Earth day is one of the largest and most widely celebrated international environmental events of today's era. This is the day which can help people remind that we all "**SHARE**" the same planet and therefore are equally responsible for the rising environmental challenges such as global warming that we are facing now and that we are the only ones who have to take future steps for finding

proper solutions to solve these problems. Thus protecting our Mother Earth is every person's and every country's responsibility. In short learning about and protecting the incredible biodiversity of our planet Earth is what Earth Day is all about. Keeping in mind the importance of the Earth Day, **22<sup>nd</sup> April 2008** was celebrated as Earth Day at IITM, Pune. As a part of celebrations, competitions in three events viz. poster painting, cartoons and slogan contests were held for children from class I to class XII which received an overwhelming response from schools and colleges all over Pune. Prizes were awarded by the hands of the Director IITM, to the winners and 1<sup>st</sup> runner up in each category.

## Few Ways to help Mother Earth Everyday.....

- **Walk or ride a bicycle** to school, the park, or the store. Encourage your parents to walk or ride to work, too. This is a great way to help **reduce the pollution** created by cars, trucks, buses, trains, and airplanes.
- **Plant trees**. Trees help keep the air clean.
- **Do not litter**. Pick up litter on the sidewalk, street, beach, or riverbank. This will help keep the environment free of contaminants.
- **Create a compost pile** for food scraps and plant waste from the garden. This is a good way to cut down on the amount of trash that goes into a landfill. As a bonus, compost helps create rich soil for gardening.
- **Recycle!!!** Recycling is an important part of keeping Earth clean. It is very easy to do. By giving old things a new life we put less pressure on important resources all of us will need in the future to survive.

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