of corporate social responsibility through its employees. Each employee of GE is expected to be involved in some kind of community development work giving his/her quality time over the weekend, as part of volunteer activities. We decided to bring this element in our scholarship programme as well. While applying for the GE Foundation scholarship, every student has to write an individual, well-focused project proposal on some kind of community development work in the location where they are studying. They would have to identify the beneficiary group, decide on the nature of activity they would take up and commit at least 50 h of work during the scholarship period. We never monitored their work, nor did we ask for regular reports or log-books of their activities. We just sensitized them to this aspect of 'community development'. We gave guidelines for them to write a project proposal. At a suitable time, we would get all the scholars together and they would present their projects, answer questions raised by other scholars, explain the difficulties they faced and share their experiences. By and large it was clear that we had achieved our objective of sensitizing and energizing the scholars to their social responsibility. The fact that submitting the community development project was made mandatory was the only catalytic role we played. The young scholars were energized to the community around them and its needs. The programme that started with 40 scholarships has now completed 10 years; and 581 GE Foundation Indian scholars from 40 different institutions have now begun their careers with this exposure.

The business of GE cuts across many disciplines, ranging from aircraft engines, to transportation, healthcare, energy generation, plastics and other engineering areas. As a result, JFWTC is home to state-of-the-art laboratories working on research and development in the areas of mechanical engineering, electronics and electrical system technology, ceramics and metallurgy, catalysis and advanced chemistry, chemical engineering and process, polymer science and new synthetic materials, process modelling and simulation, power electronics and analysis technologies. We therefore picked our scholars from wide range of disciplines. Each year, we grouped the students in several teams, with diverse disciplines, and introduced a major new component in the programme, when we challenged the individual teams to come up with an innovative 'product' or a 'service' which company may take up as part of its business. These teams of students operated on-line for a few months, without seeing each other face-to-face, but they knew who their team members were. Even a 'virtual team manager' was appointed. The GE mentors were identified, who would also be occasionally consulted on-line. After four months of 'virtual meetings', the scholars were physically brought together for a four-day workshop at JFWTC.

The ambience of the research environment, fun and frolic, sharing ideas on their community development projects, the secret discussions on their potential 'innovative projects', with a competitive approach, were exciting for the students. They also visited the JFWTC laboratories to meet the ever-helpful engineers. Then they were huddled into a discussion room to brain storm on their ideas amongst their teammates. This is when they are encouraged to think out of the box and then use different disciplines to arrive at a product or a service which they have to 'develop' and also ensure that it is marketable and finally present it to the management for 'acceptance'.

This mock exercise gives them the thrill of working on challenging ideas that they have thought of themselves. This workshop is called the 'energize to innovate', which is an experience they remember for a long time. This is where they learn to work in multidisciplinary teams, take up responsibility and work on a well-defined and tight time schedule. The workshop is the climax of the GE Foundation scholarship programme, and energizes them for their future career.

The programme was not restricted to leading institutions like the IITs, but also smaller engineering colleges. We did not see a major difference between the talents that we picked from these diverse institutions. One hopes that many more corporate houses, and even perhaps our scientific agencies, undertake such innovative programmes. The educational institutions have not been themselves as enthused and participative as we would have liked them to. We did not see the imprint of the teachers on the students, but what we saw was a sense of determination and a spirit of wanting to work together as a team and finding solutions to problems. Only with such enthusiasm and team work can young Indian talent achieve bigger goals. Truly India is a developing country with developed talent. Let us nurture this talent.

P. J. Lavakare, No. 19 Khagol Society, 38/1, Panchavati, Pashan Road, Pune 411 008, India.
e-mail: lavakare@vsnl.com

MEETING REPORT

Aerosols and clouds: climate change perspectives*

The understanding of changes in climate and weather conditions, especially the significant changes which have occurred in the past decade mainly due to anthropogenic activities, necessitates a good knowledge of all the factors contributing to the global radiation budget, aerosols and clouds being the most important ones. Aerosols, small particles suspended in air, may occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation and sea spray. Human activities such as the burning of fossil fuels also generate aerosols. These have a large impact on the radiative balance of the earth and subsequently on climate change through the scattering of incoming sunlight, cloud formation or enhanced absorption of sunlight by soot. Clouds also play a major role in climate through their direct interaction with solar radiation and also

*A report on the 12th Biennial National Conference of the Indian Aerosol Science and Technology Association on 'Aerosols and Clouds: Climate Change Perspectives' held during 24–26 March 2010, and organized by the Bose Institute, Kolkata at its Mayapuri Centre in Darjeeling.

through indirect effects based on cloud lifetime, precipitation and energy redistribution. They absorb the infrared radiation emitted by the earth, thereby influencing its radiative balance and the rate of photochemical reactions. Thus, the role of aerosols and clouds and their interaction is extremely important for the understanding of climate and weather-related studies.

Sibaji Raha (Director, Bose Institute, Kolkata) in his welcome address, discussed the genesis of the Centre for Astroparticle Physics and Space Science, a national facility at the Darjeeling Campus of Bose Institute. He highlighted its relevance for air-space monitoring, as the Himalaya is subject not only to emissions from the Indo-Gangetic Plains (IGP), but also to pollutants transported over long distances from other regions. P. C. S. Devara (President, IASTA) briefed about the objectives, activities and future plans of the association.

D. R. Sikka (Indian Institute of Tropical Meteorology (IITM), Pune) in his keynote address, reviewed the studies done on the impact of anthropogenic and natural aerosols on the Indian monsoon seasonal climatic variability, as well as on the modulation of the monsoon on sub-seasonal scale during its break phase. He suggested modelling and observational methodologies under the ongoing field phases in the Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX) and the Continental Tropical Convergence Zone (CTCZ) experiment.

C. B. S. Dutt (Indian Space Research Organization (ISRO), Bangalore) discussed the objectives of the ISRO–Geosphere Biosphere Programme (GBP) which are mainly focused on the large-scale issues contributing to the understanding of parameters responsible for climate change. The Specific Atmospheric Assessment Projects (SAAP) are directed towards the understanding of different issues such as aerosol radiative forcing over India, atmospheric trace gases composition and transport over India, atmospheric dust composition and transport, atmospheric boundary-layer characterization, and energy and mass exchanges in vegetative systems. He also talked about other projects such as Integrated Land Ecosystem and Atmospheric Projects (ILEAP) and Intense Observational Projects (IOP) for carbon pool assessment.

Chandra Venkatraman (Indian Institute of Technology, Bombay, Mumbai) spoke about a combined chemical transport and receptor modelling approach towards understanding source–receptor relationship over India using examples from observational campaigns. She also discussed source influence on aerosol loading, optical depth and radiative forcing on different receptor domains in the subcontinent.

Usually, both observations and model calculations of aerosol radiative forcing are applicable for cloud-free condition only. Study of aerosol radiative forcing during cloudy condition, which is essential for the understanding of aerosol–cloud interactions, is a difficult task. A. Jayaraman (National Atmospheric Research Laboratory (NARL), Gadanki) discussed different aspects of aerosol–cloud interactions in view of the observations made at NARL and future plans for ground-based remote sensing and satellite-based observations.

P. K. Nag (National Institute of Occupational Health (NIOH), Ahmedabad) underlined the effect of specific climatic conditions, such as extreme heat events on human health. He emphasized the integration of geo-spatial and enviro-climatic information, socio-economic data and health outcomes along with well-being measures in planning responses to a heat wave.

On a global scale, natural aerosols are 4–5 times more than anthropogenic aerosols. But on a regional scale, the contribution of anthropogenic aerosols sometimes exceeds that of natural aerosols, even several-fold. The spatial and temporal variations in aerosol properties induce the largest uncertainty in the prediction of global climate forcing and in assessing environmental/biological impacts. The large heterogeneities in aerosol sources and the influence of meteorological conditions in modifying their physical and chemical properties demand characterization of aerosols on a regional basis and at short timescales. The Indian subcontinent with its varied topography, geographic features and climatic patterns is one of the prime regions where aerosol characterization is essential. Several networks of stations have been set up and a number of field campaigns have been conducted in India for this purpose. Such campaign-mode observations were reviewed by Prabha R. Nair (Space Physics Laboratory, Thiruvananthapuram.

P. C. S. Devara (IITM, Pune) examined the results of optical remote-sensing studies of tropical atmospheric aerosols, gases and clouds over Pune. Multi-year, multi-institutional, poly-platform, vertical profile/columnar distributions of aerosols, gases and clouds have been archived with a variety of lidar and radiometric techniques at IITM.

Away from the earth's surface, cosmic rays are the main source of ionization in the atmosphere. They may also provide fine condensation particles which finally give rise to condensation nuclei for formation of clouds, influencing the earth–atmosphere radiation balance. Recent developments in the understanding of cosmic rays–cloud connection, through observational and theoretical studies, were discussed by S. K. Ghosh (Bose Institute, Kolkata).

Centre for Astroparticle Physics and Space Science: A National Facility, Bose Institute, Darjeeling.

Radioactive fission products are released from the fuel elements and carried into the containment during a nuclear reactor core melt-down accident. In order to assess the potential radioactivity release from the containment to the environment, the behaviour of fission products, which are mostly in the form of aerosols, must be known. B. K. Sapra (Bhabha Atomic Research Centre (BARC), Mumbai) described the Nuclear Aerosol Test Facility which has been developed to study the transport and deposition behaviour of aerosols in the containment, to validate the existing computer codes and develop in-house computer models which estimate aerosol behaviour in the containment.

In the context of safety studies on fast reactors, the physical and chemical characteristics of sodium aerosols are important. R. Baskaran (Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam) discussed the sources and consequences of aerosols in a fast reactor, details of an aerosol test facility developed at IGCAR, the studies carried out with it and the results obtained.

Surface measurements were reported at the conference, including particulate matter (total suspended particles; TSP), particulate matter ($PM_{2.5}$ and PM_{10}) concentration, aerosol optical depth using lidar and Microtops, rain rates and drop-size distribution using rain gauges and radiometers, and aerosol mass size distribution from quartz crystal microbalance impactor. Seasonal and diurnal variation of aerosols along with carbonaceous aerosol and black carbon were reported from various parts of the country, including IGP and the Western and Eastern Himalayas. Understanding of aerosol loading is important as high aerosol loading decreases/increases the water availability of individual aerosols depending on their chemical composition, and hence the growth of cloud water and ice droplets. Increase in aerosol loading over the years was reported by several groups. Influences of planetary boundary layer and local meteorological conditions were also discussed. Importance of long-range transport was pointed out by most of the groups irrespective of the location of the observational station.

Tropospheric ozone – a greenhouse gas and pollutant – is produced photochemically by reaction between oxides of nitrogen and volatile organic compounds. Atmospheric aerosols play a significant role in altering the tropospheric ozone concentration. Several studies were reported to understand the aerosol–ozone relationship (heterogeneous chemical effect).

Cloud droplets form on a subset of aerosol particles, usually known as cloud condensation nuclei (CCN). The CCN concentrations and their size distributions over continents get modified due to increase in anthropogenic aerosols, thus leading to the increase in industrial and urban air pollution. Several papers on aerosol–cloud interactions were presented. The studies were mostly done under the CAIPEEX programme.

An observational campaign known as Integrated Campaign of Aerosols, trace gases and Radiation Budget (ICARB) was conducted over the Bay of Bengal and the Arabian Sea during the pre-monsoon season from 18 March to 8 May 2006. Aerosol optical depth and mass concentrations observed were found to exhibit significant spatio-temporal variations which could influence atmospheric radiation and heating.

Understanding of atmospheric electricity is significant in the study of processes like thunderstorms, lightning and cloud electricity. The global electric circuit shows complex variations with different parameters and processes, including pollution and climate change. The absence of ions would mean zero electric field in the atmosphere and most probably no thunderstorms or lightning. The electrical conductivity of air is entirely due to the small ions. The concentration of these small ions gets altered by the presence of aerosols apart from the usual loss due to mutual recombination between ions of opposite polarity. The importance of number concentration along with size distribution for the study of small ion concentration was reported in the conference. Enhancement of mesosphere–stratosphere–troposphere (MST) radar echo strength because of electron density fluctuation produced by electron attachment and photo-ionization was discussed in a separate work. A model study was also presented to compute the background conductivity and electric field profiles for an equatorial dusty mesosphere. The results are indicative of possible role of small dust particles in the modification of electric conductivity and increase in electric field strength in the region.

Other aspects covered in the conference were radioactive aerosols, aerosol health effects, nanoparticles and indoor aerosols. Study of the aerosol charging mechanism during its generation is important for the understanding of processes like particle deposition, electrical migration, sampling and transport in nuclear safety analysis. Interesting results on various such studies related to the reactor were reported. Most of the radionuclides naturally occurring in air are radon (^{222}Rn) and its daughter products released from the uranium (^{238}U) series. Inhalation of short-lived radio progeny may be the most important component of radiation exposure of the population from natural sources. Studies to understand and determine the population dose necessary to estimate radon-related lung cancer risk were reported. The role of ionizers in reducing the dose was discussed in a separate paper.

In the last few years, nanoparticles in various forms, such as drug particles, polymer particles and solid–liquid nanoparticles, have been developed for oral, pulmonary and transdermal delivery. In this context, aerosol synthesis is important as it offers a single-step continuous process to produce nanoparticles. Several methods for nanoparticle synthesis such as low temperature aerosol reactors and their characterization were put forth.

Many papers were presented to discuss the different modes of generation of indoor aerosols, such as from pesticides, pyrethroids, biomass, agricultural residues and charcoal; their characterization and comparative health effects.

During the concluding session, several scientific research problems particularly the role of aerosols in earth–atmosphere radiation balance, environmental pollution and climate change that need immediate attention, were pointed out. The requirements of both observational (especially long term, through networks) and modelling (especially on a regional scale) efforts to address these issues were discussed thoroughly.

P. C. S. Devara, Physical Meteorology and Aerology Division, Indian Institute of Tropical Meteorology, Dr Homi Bhabha Road, Pashan, Pune 411 008, India; **Sanjay K. Ghosh** and **Sibaji Raha*,** Centre for Astroparticle Physics and Space Science, Bose Institute, Block EN, Sector V, Kolkata 700 091, India and Department of Physics, Bose Institute, 93/1 A. P. C. Road, Kolkata 700 091, India.
*e-mail: sibajiraha@bic.boseinst.ernet.in