# International Workshop On

## Changing Chemistry in Changing Climate : Monsoon - C4:Monsoon

## &

## Metropolitan Air Quality Forecasting & Services (SAFAR)

**Venue: Indian Institute of Tropical Meteorology, Pune,**

**01st to 03rd May 2013**

**C4 Abstract**

**Invited**

## Measuring the Land-Atmosphere Exchange of Ozone

**Mhairi Coyle**
Neil Cape, David Fowler, Ben Langford, Eiko Nemtiz, Ivan Simmons
NERC-CEH Edinburgh, Bush Estate, Penicuik, Midlothian, UK

The land-atmosphere exchange of trace gases and aerosols has been measured by CEH over many landscapes from remote moorlands and forests to city centres, with the aims of quantifying total emissions or deposition to ecosystems and understanding the underlying processes. Ground-level ozone deposition is an area of particular interest due to ozone's important role as a greenhouse gas, in atmospheric chemistry and its effects on the health of people and vegetation. Although the lifetime of ozone in the atmospheric boundary layer can be relatively short (~2 hours to ~20 days) its radiative forcing is 25% to 150% that of carbon dioxide. Its role in atmospheric chemistry is to influence the concentrations of many other species, such as the OH radical, NOx, $CH_4$ and other VOCs. Ozone has also been shown to affect human health, irritating the lungs and triggering an inflammatory response which can lead to hospital admission in sensitive individuals. Its detrimental impact on vegetation is also well quantified, with the stomatal uptake of ozone causing reduced crop yields, visible injury and changes in species composition of natural ecosystems.

Ozone deposition is measured using two methods: aerodynamic gradients with concentrations measured at fixed heights above the surface and the flux estimated using similarity theory; and eddy-correlation which measures the flux directly using fast-response instruments. Nitrogen dioxide and nitrogen oxide are often measured alongside ozone to allow their chemical interaction and influence on the total flux to be quantified. Measurements made over moorland, managed grasslands and a potato crop have been used to examine the deposition process and segregate the total deposition into different pathways such as the leaf cuticle, soil and plant stomata. For forest ecosystems the interaction of ozone with biogenic VOC emissions may also be another potentially significant factor. The importance of different sinks has been shown to vary with several parameters such as stomatal conductance, surface moisture levels, solar radiation and temperature, but quantifying the different parameters for modelling purposes is proving challenging. Data from several field sites will be presented to illustrate these processes and methods of assessing ozone impacts.

## Role of the Asian Monsoon in stratosphere-troposphere exchange

Martin Riese
Institute for Energy und Climate Research (IEK-7), Forschungszentrum Jülich, Germany

The composition of the upper troposphere / lower stratosphere (UTLS) has a significant impact on surface climate and its variability, through radiative and dynamic couplings. The quality of chemistry-climate models (CCMs) therefore relies on the quantitative representation of UTLS composition and underlying processes such as stratosphere-troposphere exchange. The Asian monsoon circulation plays a crucial role in this context. A prominent feature of the Asian monsoon circulation in terms of stratosphere-troposphere exchange is the presence of an anti-cyclone located in the upper troposphere extending from Asia to the Middle East. At the edge of this anti-cyclone, extra-tropical stratospheric air is transported equator-wards, significantly affecting trace gas budgets (e. g., ozone) in the upper part of the tropical tropopause layer (TTL) and subsequently in the lower stratosphere (e.g. Konopka et al.

2009). Global satellite observations of water vapor (MLS) combined with simulations by the chemical-transport model CLaMS furthermore highlight the significant influence of the Asian Monsoon on the water vapor budget in the extra-tropical lowermost stratosphere (Ploeger et al., submitted). The presentation gives an overview on climate-relevant processes in the UTLS with a focus on the role of the Asian monsoon circulation.

**EXTREME CHEMICAL EVENTS IN CHANGING CLIMATE**

**Gufran Beig**
Indian Institute of Tropical Meteorology, Pune, india

South Asia plays both a key role in the Earth System where the tropics has very special role. As many of its mega cities are rapidly growing economies of the world, increasingly contributing to anthropogenic emissions to the atmosphere is bound to happen. There are many challenging problem of the anthropocene require global scientific basis. This talk will focus on ever increasing trend of extreme pollution events in recent time. These are either triggered by erratic synoptic meteorological conditions or increasing emissions of toxic atmospheric chemical species. In an interactive atmospheric system, the impacts of these events are vital and play an important role in weather and climate. In some mega cities like Delhi, both positive and negative radiative forcing in tropospheric region by rapid increase in tiny particulate matters, started to influence the weather in a shorter scale. However in some cases the origin of these extreme chemical events is unique weather patterns which are not so frequently seen in earlier time. A brief overview of such events for Indian sub-continental region will be discussed.

**AEROSOL FEEDBACKS ON CHEMISTRY AND CLIMATE AT URBAN AND REGIONAL SCALES**

Gregory R. Carmichael
College of Engineering and Center for Global and Regional Environmental Research (CGRER), University of Iowa, Iowa City, Iowa, USA.

Black carbonaceous aerosol (BC) is an important component of atmospheric particulate matter because of its dual roles in health and climate impacts. A fully-coupled meteorology-chemistry-aerosol model (WRF-Chem) is used to assess the impacts of BC and other aerosols on radiative forcing, weather and atmospheric chemistry. A series of simulations from different aerosol - cloud environments ranging from heavily polluted cities in East (Beijing) and South (Delhi) Asia to relatively clean coastal areas with permanent cloud cover (VOCALS experiment off the west coast of Chile/Peru) are simulated. The results are further analyzed using adjoint sensitivities of meteorological and cloud parameters calculated using a new adjoint model of WRF-Chem. We also present new results testing a data assimilation technique to constrain modeled aerosol concentrations using satellite retrievals of cloud optical depth (COD) and liquid water path (LWP).

**On Understanding and Addressing Air Pollution in Northern South Asia**

Maheswar Rupakheti
Group Leader
Sustainable Interactions with the Atmosphere (SIWA)
Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany

The presentation will highlight our approach, plan and expected outcomes of an “end-to-end” study, called “Sustainable atmosphere for the Kathmandu valley (SusKat)”. Susakt is a coordinated approach that integrates quality atmospheric observation, improved emission inventories, and focused

atmospheric modeling to get the science right. This will solid scientific foundation will be used in assessment of impacts and evaluation of the mitigation potentials (availability, cost-effectiveness, anticipated reduction of impacts, scaling up potential etc.) of various mitigation measures (e.g., technological, financial, regulatory, legal and political measures, planning strategies, including current policy in use etc.) that are suitable under local context. This is expected to lead to identification, and later pilot demonstration, of science-based solutions that are locally suitable, cost-effective and realizable in a step-wise way for the mitigation of air pollution in the Kathmandu valley, while providing useful learning for local/regional/global air quality and climate solutions. Preliminary findings of SusKat-ABC atmospheric characterization campaign in Nepal, including first time measurement of speciated-VOCs with PTRTOFMS in South Asia, among many other measurements, will be presented.

**Enhanced formation of secondary air pollutants and aggravation of urban smog due to post harvest crop residue burning emissions of benzenoids in North India**

Vinayak Sinha
Indian Institute of Science Education and Research Mohali, Sector 81, SAS Nagar,Mohali, PO Manauli, Punjab 140306, India.

**Abstract:**
My talk will focus on emissions of benzenoids from post harvest crop residue burning activity, which occurs every year in the months of Oct-Nov and April-May in North India. Benzenoids are organic pollutants thought to be mainly emitted from traffic and industrial sources. Using the combination of online in-situ measurements of several benzenoids and methyl cyanide (a biomass burning tracer) for the time within India, satellite remote sensing data of fire counts and back trajectory of air masses at a site in Mohali, we show that massive amounts of benzenoids are released from post harvest paddy residue burning as well. The measurements were performed using the IISER Mohali atmospheric chemistry facility which houses India's first Proton Transfer Reaction Mass Spectrometer (PTR-MS) integrated to a state of the art ambient air quality and meteorological station. Two periods with similar meteorology but which differed only in terms of absence/presence of crop residue fires respectively, were chosen to assess normal and perturbed levels. Peak values of 3830ppb CO, 100ppb NOx , 40ppb toluene, 16ppb benzene, 24ppb for sum of all C-8 benzenoids and 13ppb for sum of all C-9 benzenoids were observed during the fire affected period with average enhancements in benzenoid levels more than 300 %, even accounting for boundary layer dilution effects. The ozone formation potential of benzenoids matched CO with both contributing 5ppb /h each. The impact of such strong increases in ambient benzenoid levels will be discussed in relevance to regional atmospheric chemistry, air quality and health.

**Development of an Earth System Modeling Framework to Study Chemistry and Climate in Asia**

Mary Barth
NCAR

As part of an Earth System Modeling project supported by the U. S. National Science Foundation, we are developing an integrated, inter-disciplinary program to build and foster a research community to study the interactions between climate, air quality, social vulnerability, and human impacts in the Asian region. A second goal of the project is to establish research facilities and a framework for investigating chemistry and climate over Asia. These facilities include conducting pilot high-resolution simulations, compiling emission inventories at high resolution (via downscaling procedures), analyzing satellite data,

and initiating studies of human vulnerability to air quality and climate. In this presentation we will describe in more detail the activities addressing both goals. As an initial component of this program, an international workshop on â€œHealth Impacts of Air Quality and Climate Change in Asiaâ€• was organized and held at Sun Yat-sen University in Guangzhou, China in April 2012. The discussions during this workshop produced the key scientific question, â€œWhat are the drivers of emissions and social vulnerabilities in Asia, and how do these contribute to the barriers and benefits of mitigation scenarios?â€•, a list of challenges for connecting the atmospheric chemistry and health communities, and a plan for an air quality-health study comparing three cities within the greater China region. Highlights will be presented of higher-resolution (0.5Â°x0.5Â°) global simulations and nested regional-scale chemistry-climate (NRCM-chem) simulations that address surface ozone predictions and aerosol-cloud interactions. In addition, we continue to compile and prepare emissions data, conduct satellite data analysis, and human vulnerability studies. A workshop, to be held 9-12 July 2013 in Boulder, Colorado, will address health, agricultural, and water risks associated air quality and climate.

**Role of atmospheric aerosols in climate and human health: Indian perspective**

Sachin Gunthe
IIT Chennai

Aerosol particles are ubiquitous and have multiple effects on climate, and air quality. Aerosols, by absorbing and scattering incoming solar radiations play important role in Earth's radiation budget (direct effect) and by acting as cloud condensation nuclei (CCN), influence the cloud microphysical properties, their life-time, and precipitation (indirect effect) – climatic impact. The inhalation of fine particulate matter particularly that of biological origin is correlated with lungs and heart deceases – health impact. To understand the effects of aerosols on climate, measurements of chemical and physical aerosol properties, mainly size distributions and concentrations, are indispensable. On the other hand the aerosol particles of biological origin, a very diverse group of biological material and structure in recent year has shown significant impact on human health and climate. The lack of proper representation of such data in climate models, due to limited measurements, is a major reason why aerosol direct and indirect effect is largest uncertainty in current understanding of climate change. The paucity of such observations over India is highly contradictory to its global relevance as major source of aerosol particles and their role in radiation budget, precipitation, and human health. It is more so important over Indian region because of high spatial variability complimented by strong season dependence due to cyclic and systematic monsoon circulations. I will present some of the measurement results of aerosol number size distribution of aerosol and bioaerosols from south Indian region.

**PRECIPITATION-AEROSOL INTERACTION (PAI): IMPLICATIONS TO CLIMATE AND CLIMATE CHANGE**

P.C.S. Devara
Indian Institute of Tropical Meteorology, Dr. Homi Bhabha Road, Pune 411008, India

Atmospheric aerosols influence the hydrological cycle in two broad ways – (i) precipitation formation and (ii) scavenging processes. Despite rigorous research by several climate scientists world over, our scientific understanding of the first aspect is very poor. The precipitation-aerosol interaction (PAI) is a highly complex subject, primarily because of aerosol phase and underlying mechanisms that operate through indirect effect of aerosols via clouds. In recent years, some investigations, in this direction, have been carried out at the Indian Institute of Tropical Meteorology (IITM), Pune — a fast-growing tropical urban station in India. These studies have utilized large data sets that have been archived with ground-based active and passive remote sensing techniques and concurrent satellite products. Both column-integrated and vertical profile measurements of aerosols have been used for these studies. The salient results indicate that the PAI is location-specific and its influence on precipitation mainly depends on the refractive index (both real and imaginary components representing scattering and absorption properties, respectively) and hence the size distribution of aerosols prevailing over the region. The role of aerosols in local/regional monsoon activity, extreme weather events in particular, is discussed. The pathways, involving re-generation of fresh cloud-active aerosols following the land-fall precipitation, and in-cloud as well as cloud-boundary turbulence gradients that control the cloud organization and resultant precipitation development are also presented.

**Theme - CHEMISTRY**

**Oral Presentation list for C4**

**OP 1**

**Surface Ozone over Eastern Himalaya, India: Role of its Precursor Gases and Micro-meteorological Parameters**

Abhijit Chatterjee, Ajay K Singh, Sanjay Ghosh, Si
Bose Institute, Kolkata

In order to investigate the interaction of surface ozone and one of its important and major precursor gases NO2, the study has been made on the diurnal variability of Ozone and NO2 during premonsoon season (March-May) in the year of 2011 over a high altitude (2200 masl) hill station Darjeeling (27Â º 02â€™ N, 88Â º 16â€™ E) at eastern Himalaya, India. Continuous monitoring of surface ozone and NOx was made using on-line analyzers (Ecophysics, Switzerland for NOx and Horiba, Japan for Ozone) at the campus of Center for Astroparticle Physics and Space Sciences, Bose Institute, Darjeeling, India. NO2 was measured using chemiluminescence method whereas ozone was measured using UV absorption method. It was observed that surface ozone concentration was quite low during night-time and started increasing at around 09:00-10:00h (IST), and attained its maximum level in the afternoon around 13:00-15:00h mainly due to the photolysis of NO2. During evening hours, around 17:00-18:00h the surface ozone concentration started decreasing and reached to a minimum. Low value of O3 during night could

mostly be due to the absence of sunlight and hence photodissociation could not take place. O3 in night time was found to be destructed through titration with NO. The night-time concentration of Ozone varied between 10-15 ppbv whereas during daytime it varied between 15-25 ppbv. The low concentrations of ozone observed during morning hours could be due to the lower boundary layer height which inhibited the mixing of ozone between lower surface level ozone and upper ozone rich layer. The higher ozone concentration of ozone during early afternoon could also be due to the transport of ozone from the nearest plain land regions driven by up-slope valley wind favoured by high convective activity during premonsoon. Thermodynamic conditions within the boundary layer and micro-meteorological parameters also played a significant role in the ozone variabilities on the diurnal scale. The pattern of the diurnal variation of NO2 was opposite to that of surface ozone. The average concentration of NO2 was higher during late evening hours and sustained till early morning. Premonsoon being the peak tourist season over Darjeeling, vehicular activities played major role in generation of NO2 and got trapped near the Earthâ€™s surface due to the lowering of boundary layer height due to the production of nocturnal boundary layer. After the sunrise, the NO2 gets diluted due to the increased height of the boundary layer and photodissociation takes place to form ozone. The production of surface ozone was found to be directly related to the temperature and inversely related to the relative humidity. The radiation controls the temperature and hence photolytic efficiency to destruct NO2 to form ozone increased. Also, relative humidity increased the efficiency of the photochemical pathway for the removal of ozone and higher relative humidity is associated with the higher cloud cover and rain wh

**OP 2**

**Temporal variation of methane over Indian sub-continent**

Meena Jain

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Methane is the most important anthropogenic greenhouse gas (GHG) after carbon dioxide, causing both direct and an indirect radiative forcing and climate change. The anthropogenic sources include waste decomposition, paddy fields, wet lands, domestic ruminant, biomass burning etc. Because of the biodiversity and economic conditions the emission rates of the pollutant gases like methane are different over different regions in India. Hence it is important to find hotspots for the abundance of methane over Indian region. SCHIAMCHY (Scanning Imaging Absorption Spectrometer for Atmospheric Cartography) data (level 3) for methane for the period 2003-2009 is obtained to pinpoint hotspot for increasing methane over Indian sub-continent. The column average methane data is available at latitude, longitude mesh grid of 0.50 x 0.50. The data is retrieved at all grid point over Indian sub-continent which includes around 2000 data files. The monthly averages of SCHIAMACHY data from 2003 to 2009 is found to be more over Indian region compared to other neighboring countries. The methane abundance is significantly high in Indo-Gangatic Plains (IGP) and some regions of Andra Pradesh. To find the temporal rate of change in methane abundance over India, trend is calculated using following regressive model Z(t) = Âµ0 + Ï‰* t + âˆ‘Î±i sin(2Ï€(t+Ï„i)/pi) + âˆ‘ Î•j* Vj+ Nt (1) where Âµ0 is a base level constant value for Z(t);Ï‰ the slope of the trend in Z with time; pi, Î±i, and Ï„i the period, amplitude and phase difference corresponding to the ith seasonal cycle taken in the analysis; Î•j, and Vj, the coefficient of regression and value of the jth regressive variable such as QBO and Nt the noise term. The unknown constants Âµ0, Ï‰, Î±i, Ï„i and Î•j in the model representative function of time for the observed parameter Z(t) in (1)) are found out by the least square fit technique. The cyclic variations

caused by seasonal cycles of 6 and 12months are included in the model. The variations caused by El NiÃ±o/La NiÃ±a-Southern Oscillation (ENSO) which is a quasi-periodic climate pattern that occurs across the tropical Pacific Ocean at irregular intervals of 3â€“7 years with an average period-length of 5 years and lasts nine months to two years and Qassi-biennial Oscillation (QBO) which is quassi-periodic equatorial zonal wind pattern with period varying from 24 to 30 months are also taken in the model. The 30hPa and 70hPa Singapore winds as proxy for QBO and Southern-Oscillation Index (SOI) as a proxy for ENSO are used in the model. Trend in methane calculated at each grid point over Indian Subcontinent shows increase in trend over western Indo Gangatic Plains (IGP) and few stations in Maharashtra.

**OP 3**

## Variations in the Ozone Distribution over Northern India: Influences of Stratosphere-Troposphere Exchange and Biomass Burning

Narendra Ojha
Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, India

Tropospheric ozone is an effective greenhouse gas particularly in the upper troposphere and contributes significantly to the global warming. The quantitative contributions of Stratosphere-Troposphere Exchange (STE) processes in the budget of tropospheric ozone are not well understood. For identifying STE events and for estimating their contribution, measurements of ozone and meteorological parameters in the Upper Troposphere and Lower Stratosphere (UTLS) are essential. Observations of ozone vertical distribution are very limited over the South Asia, where rapidly increasing emissions are anticipated to intensify the atmospheric chemistry. Moreover, dynamics over this region is complex as indicated by the frequently observed tropopause folds over Tibetan plateau and stratospheric intrusions over the southern Himalayas. The vicinity of this region to the subtropical jets provides favorable conditions for STE; however, such studies are nearly non-existing over the Indian region. We analyze the yearlong ozonesonde measurements from a high altitude site Nainital (79.5oE, 29.4oN, 1958 m amsl) in the central Himalayas. Balloons, carrying an ozonesonde (EN-SCI 2ZV7 ECC) and a radiosonde (iMet-1-RSB 403 MHz GPS), were launched with a frequency of 3-4 flights per month resulting in a collection of total 48 profiles during 2011. Maiden observations revealed large week-to-week and seasonal variabilities in the vertical distribution of ozone and meteorological parameters. Tropopause pressure estimated from radiosonde observations is generally in agreement with the satellite (AIRS and TES) and model (WRF) results (~100 hPa) but shows dramatic variability (150-250 hPa) during winter-early spring. Occasionally observed very strong winds (~40 to 80 m/s) in middle-upper troposphere could be associated with the subtropical jets. Lower tropospheric (2-6 km amsl) ozone shows a prominent maxima during spring (~70-110 ppbv in May) and minima during summer-monsoon (~20-50 ppbv), consistent with surface observations. Signatures of stratospheric intrusion noticed during winter are studied using the meteorological observations, satellite data and chemistry transport models (MOZART and WRF-Chem). Radiosonde and satellite (AIRS) observations show reductions in the relative humidity and WRF Potential Vorticity (PV) shows large enhancement around the site during high ozone event. Seasonal variation in WRF PV at different pressure levels indicates the influences of STE except during summer-monsoon. A classification of springtime ozone profiles into high and low fire activity periods using MODIS fire counts shows significant enhancement of about 20 ppbv (paired t-test) in 2 to 4 km altitude range. Springtime lower troposphere ozone maximum is attributed to the regional

photochemistry supplemented with the biomass burning, while middle-upper tropospheric ozone is more influenced by the dynamical processes including advection and stratospheric intrusions. A comparison of oz

**OP 4**

**Emission estimates of trace gases and aerosol from residential fuels used in Western India**

T.K.Mandal, Avirup Sen, S.K.Sharma, N.C. Gupta, Tr
NATIONAL PHYSICAL LABORATORY

We have determined emission factor of trace gases (SO2, NOx) and aerosol (OC, EC, Ions, PAH) from burning of residential used in the rural sector of Western India. We have collected biomass fuels from villages of different districts of four states namely Gujarat, Maharashtra, Rajasthan and Madhya Pradesh. Using emission factor and consumption data over Western India, we have determined total estimate from different states and Western region of India. We have also compared with the same from Indo Gangentic Plain, India. It has observed that Indo Gangentic Plain emits higher trace gases and aerosol from residential fuels. This study gives for the first time spatial distribution of emission factor of trace gases and aerosol from residential fuels.

**OP 5**

**Impact of transport of ozone between South Asia and East Asia using HTAP-Ensemble model simulation**

Tanusri Chaktaborty,Gufran Beig, Frank Dentener ,
Indian Institute of Tropical Meteorology

Tropospheric ozone is a naturally occurring greenhouse gas and air pollutant occurring naturally but also from the emissions of anthropogenic precursor gases, formed as a product of photochemical reactions with precursors: NOx, CH4, CO and volatile organic compounds (VOCs).These emissions has been increased over Asia over the past few years due to the rapid economic growth. The main objective of this paper is toÂ studyÂ theÂ  effectÂ of emissions fromÂ neighboringÂ countriesÂ of East Asia (EA) onÂ southÂ Asia(SA)Â  andÂ vice versa, relative to their â€˜own emissionsâ€™. In December 2004, the executive body of the UNECE convention on long range trans-boundary air pollution establishes the Task force on hemispheric transport of air pollution (TF HTAP). This scientific organization works in the field of emission inventories, analysis of ambient monitoring and remote sensing global and regional modeling and the impact assessment to understand the intercontinental flow of ozone and its precursors and other fine particles. Four sets of region, North America (NA), Europe (EU), South Asia (SA) and East Asia (EA) were considered to study the intercontinental transport of pollutants. In this paperÂ weÂ areÂ usingÂ theÂ model simulation of 20% anthropogenic emission reduction over SA and EA and the controlled run. Comparing the controlled run and 20% emission reduction we are evaluating the foreign contribution. The ozone data obtained from the Ensemble mean from fourteen HTAP models has been validated against the satellite data of tropospheric ozone and ozone ground observation at Pune, Udaipur, Hyderabad and Jabalpur. Surface ozone concentration calculated by the model simulation is higher than the surface observation but model is able to generate the seasonal cycle of surface ozone. Comparing the controlled run and 20% emission reduction we have seen that in the months of March, April, May and June the contribution of South Asia (SA) to East Asia (EA) is more than the contribution of

EA to SA. But in the post monsoon the contribution of EA to SA drastically increase from 0.1 ppbv to 0.35 ppbv.

**OP 6**

**Assessment of carbonaceous particles at some MAPAN stations in India**

Kaushar Ali and G. Beig
Indian Institute of Tropical Meteorology, Pune

Sampling of PM2.5 was carried out on pre-treated quartz filter papers at some of the MAPAN stations in India viz., Pune, Hyderabad, Jabalpur, Udaipur and Delhi in order to quantify carbonaceous aerosol concentration at these locations in terms of Organic Carbon (OC) and Elemental carbon (EC). These filter papers were analyzed for EC and OC using an advanced DRI Thermal Optical Carbon Analyzer. The results for Pune indicate an enhanced EC and OC concentration during winter season (Average of up to 33.8Â±4.9 Âµgm-3 OC and 10Â±0.5 Âµgm-3 EC) which is due to high combustion of biomass for heating the surroundings and low mixing height. Concentrations of both kinds of carbonaceous particles during monsoon season were low which is attributed to the rain out and wash out of the aerosols. Other stations also showed nearly similar pattern of variation in the concentration of OC and EC aerosols. Further fractions of OC and EC particles were also determined. Details of the analysis and major results for all the stations will be presented later.

**OP 7**

**Chloromethane and dichloromethane in the tropical Atlantic ocean**

Seshagirirao Kolusu
University of Hamburg

The concentrations of chloromethane and dichloromethane were measured in the air of marine environment and in the seawater during a cruise from the Port of Spain to Rio de Janeiro over the tropical Atlantic ocean in April and May of 2009. The variation of chloromethane and dichloromethane concentrations in the air and seawater was analysed as a function of latitude with respect to their reliability. There is no correlation observed between chloromethane and dichloromethane concentrations in the seawater, suggesting that they may not have a common oceanic source. In addition, the diurnal cycle of concentrations, fluxes and Sea surface temperature dependency on concentrations and fluxes were studied. Sea surface temperature does not show any significance on dichloromethane concentrations in the sea water. Chloromethane and dichloromethane are supersaturated in the seawater during the cruise. This implies that the tropical Atlantic ocean emits chloromethane and dichloromethane in to the atmosphere. The tropical Atlantic ocean mean fluxes of chloromethane and dichloromethane were 150 nmol m-2 d-1 and 81 nmol m-2 d-1 during the cruise, respectively. Sources of chloromethane and dichloromethane were determined by calculating backward trajectories.

## Poster Presentation for C4

**A1**

**NOx and VOC Controls on Surface Ozone formation Inferred from SCIAMACHY Observation & WRF-Chem Stimulation.**

Ashish Soni
Doon University

Formaldehyde (HCHO) is an important compound in the troposphere. Source of HCHO are largely dominated by its secondary production from VOC oxidation, methane and isoprene being the main precursor in unpolluted areas. In this study we investigate, spatial and seasonal variation of HCHO using 9 years (2003-2011) of HCHO measurement and compare with the WRF-Chem model simulation. In order to investigate whether the region is NOx limited regime or VOC limited regime, we used troposphere NO2 retrieval for the 9 years period and examined the HCHO/VOC ratio over the Indian domain for different seasons. We found that our major industrialized city such as Bombay, Delhi, cities in Gujarat-Bombay industrialize corridor and site of high capacity thermal power plant, Ratio is <1. We will also compared this ratio with model stimulation HCHO and NOx and found that ozone level are low over the region where ratio is <1.

**A2**

**Evaluation of a regional chemistry model (WRF-CHEM) over Gangetic plain using CAIPEXX measurements**

Chandan Sarangi
IIT Kanpur

Weather Research and Forecasting model coupled with Chemistry (WRF-CHEM), is a regional model able to simulate chemistry-climate interactions. Presently there is very limited knowledge about WRF-CHEM\'s ability to simulate aerosol concentration and cloud micro-physics over Gangetic plain and scope of using WRF-CHEM in investigating aerosol\'s influence on Indian monsoon. During monsoon 2009, Indian Institute of Tropical Meteorology, has conducted few sorties (23rd Aug - 25th Aug, 2009 ) near Bareilly, (UP) under the Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEXX) program and have measured aerosol concentrations and cloud micro-physical variables like cloud droplet concentration and hydro-meteor concentration. In this study, we have performed high resolution nested simulations using WRF-CHEM near Bareilly,during period of CAIPEXX sorties to evaluate the chemistry model at short time scale. We have used nests with resolution of 27 km (outer), 9 km (middle), and 3 km (Inner) and the spin up time was 50 hours. Model tuning was done to select the best performing configuration of physics parameterization. We have used MADE/SORGAM and RADM packages for parameterization of aerosol and gas-chemistry. The model is able to simulated vertical profiles of meteorological variables like Rh, Temperature, horizontal and vertical wind as well as CCN with comparative success but fails to simulate the spatial distribution as well as magnitude of hydro-meteor concentrations.

**A3**

**Surface O3 and fog**

D. K. Chakrabarty, N. N. Purkait, S. K. Peshin
Physical Research Laboratory, Ahmedabad 380009, India, University of Calcutta, India Meteorology Dep

Most of the days during winter months (November to February), the whole of the northern belt of India, starting from west to east, remains under heavy fog. We have studied surface pollution data of two stations in this belt, Kolkata (22.36oN, 88.24oE) and Haldia (22.05oN, 88.03oE), along with wind during this period. These are as follows: Wind O3 CO NOx NMHC Kolkata: low (0-90o) low high high high Haldia: high (270-360o) low no change no change no change Study shows that during this period, the surface ozone value is much less than that in other months. This trend also does not match with the trend at

stations outside this belt. A simplified 1D steady state photochemical scheme shows that since during this period, there is no sunshine on the surface, photo-dissociation of NOx (which is the main source of O3), cannot take place, as a result low value of O3 and high values of CO, NOx and NMHC for Kolkata are understandable. But for Haldia also there is no sunshine, yet O3 value is low and there is no change in CO, NOx and NMHC values during this period. Both Kolkata and Haldia are close to Bay of Bengal. For Kolkata, the wind is low, but, its neighbor, Howrah, is an equally highly polluted city. So even if wind drives away pollutants and fog particles, they will come again from Howrah. For Haldia, wind is high. But here if the wind removes the pollutants, then it should also remove the fog particles which have not happened. In a wet atmosphere, as the temperature decreases, the water vapor is condensed out and the latent heat of condensation is released. The tiny drops of water thus formed combine with dust particles and form aerosol particles of fog. Release of latent heat further decreases the temperature releasing more water droplet and making fog denser. In the absence of sunshine during fog, NO2 should be high and then O3 would be low. How does fog relate with O3?

**A4**

**Role of Long Range Transport in Evaluating the Unusual SO2 Levels Observed at a Semi-Urban Surface Site of Kolkata, India**

Dipanjan Ghosh
Jadavpur University

With increasing population, stationary and mobile emissions from different sources are gradually worsening the air quality of the Kolkata city. The semi-urban experimental site is under the confluence of emissions from both natural and man-made sources, with anthropogenic contribution being at a greater hand. Natural sources include onlylandfill and waste-water emission of DMS and DMDS (dimethyl sulphide and dimethyl disulphide), which on photo-oxidation emits sulfur dioxide (SO2). Anthropogenic emissions are mostly from factories, automobiles and fugitive emissions from the neighbouring residential and office complexes.Stack emissions from thermal power plants (coal based) where lignite coalis the preferred category in use (contains 0.4% sulfur of the total mass) play a major role in ambient SO2 concentration.Other contributors include cement, metallurgy, and mining factories. Fossil fuels and biomass contain a good amount of sulphur, which upon combustion emits sulfur dioxide. The site being near to the edge of city roadways, experiences emission effects from both heavy and light duty vehicles (run on both leaded and unleaded diesel and petrol). The present study focuses on evaluating the role of long range horizontal transport towards the unusual rise in the levels of ambient sulfur dioxide (SO2) concentration (one of the major primary pollutants in the atmosphere) using Hybrid Single Particle Integrated Trajectory (HYSPLIT) model. Recorded data show an hourly average diurnal value of 0.9 ppbv with a minimum attained 0.8 ppbv and a maximum of 1.0 ppbv for the pre-monsoon period (1stMarch-7th June) as compared to an hourly average diurnal value of 6.43 ppbv with a minimum at 4.4 ppbv and a maximum of 9.2 ppbv for the post-monsoon period (11th October- 31st December). However, on 26th October 2012, we recorded the highest SO2 concentration of 80.3 ppbv (till date) with 5mins averaging time and 44.93 ppbv with 1-hr averaging time. Similar scenario is also pointed out on 11th January, 2012 when 62.2 ppbv (5 min time averaged) is recorded as compared to 39.7 ppbv (hourly average). The residence time of sulfur dioxide in the atmosphere varies from 1-8 days with 1-2 days being in the lower atmosphere. Thus, with 48-hr runtime, air-mass back-trajectories are generated for the sampling site using NOAA HYSPLIT model. Using vertical velocity field, trajectories for three different altitudes â€“ 500m, 1000m, 1500m agl (above ground level) are computed using the HYSPLIT model. From the model output, westerly and north-westerly air mass trajectories, overlaid with

thermal power station locations are accounted for the sudden jump in SO2 levels on the specific days at the study site.

**A5**

**Slant Column Density of NO2, O3, BrO, OClO and O4 using Zenith Sky Solar Spectrum in the Spectral Range of 346â€“358 nm**

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Zenith sky scattered light spectra have been observed in the spectral range of 346â€“358 nm using UV / visible spectrometer over tropical station, Pune (18Â°31Â´ N, 73Â°55Â´ E). The spectra are analyzed using differential optical absorption spectroscopy (DOAS) technique to retrieve slant column density of NO2, O3, BrO and OClO. Differential optical density (DOD) fitting technique is applied for the right selection of a suitable spectral region for the analysis to minimize interference and poorly fitting absorption features, and also minimize the residual of the fit. Observed DODs of O3, NO2, BrO, OClO, O4, Rayleigh and Ring are found to be well fitted with the calculated DODs varying between 0.13 and 1.5%. Cl and Br species play an important role in the ozone depletion during twilight; hence O3, NO2, BrO and OClO slant column densities (SCDs) have been derived between 76Â° and 94Â° solar zenith angles (SZAs). The SCDs of O3 is found to be increasing up to 90Â° SZA of 1.1Ã—1020 molecules cmï€2 after that found to be decreased in twilight period (i.e. between 90Â° and 94Â° SZA) in presence of sufficient BrO and OClO amount. The highest SCDs for BrO and OClO are observed of the order of 3.9Ã—1014 molecules cmï€2 and 6.2Ã—1014 molecules cmï€2 at 90Â° and 94Â° SZAs, respectively during April 2008. The OClO have to smooth increasing trends however after 90Â° SZA sudden enhancement is observed. These enhancements in OClO densities are may be cause of BrO and ClO reaction during twilight period, which is most significant at low temperature.

**A6**

**Observed diurnal variations of carbon dioxide fluxes over Pune during monsoon and winter season.**

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An increase of carbon dioxide (CO2) concentrations in the atmosphere due to anthropogenic activities is responsible for the global warming and hence in recent years, CO2 measurement network is expanded globally. We measured the concentrations of CO2 /H2O along with u,v,w components of wind and air temperature over a station Pune (18O32â€™N, 73O51â€™E, 559 m MSL) by Eddy Covariance system with the help of CO2/H2O open path gas analyzer (Model LI- 7500A by Licor Inc.) integrated with 3D sonic anemometer (Model wind master Pro by Gill Instruments). The observed CO2 concentration was in the range of 352.8 Â± 7.3 ppm in monsoon and 351.6 Â± 12.7 ppm in winter season. The diurnal variability of CO2 flux was positive during nighttime and negative during daytime and was in phase with convective instability. The result showed decrease of CO2 fluxes with an increase in sensible and latent heat fluxes. The observed CO2 flux was in the range of -1.47 Â± 5.60 Î¼ mol mâˆ’2 sâˆ’1 in monsoon and -2.55 Â± 5.06 Î¼ mol mâˆ’2 sâˆ’1 in winter season.

**A7**

**Development of high resolution Methane emissions Inventory and sectorial contribution over Maharashtra, India**

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The high global warming potential and the reactivity of Methane make it an important gaseous pollutant which has significant impact on both tropospheric and stratospheric chemistry. District wise methane emission inventory has been developed for the year 2012 using local activity data, country specific emission factors, latest IPCC guidelines and GIS based modeling. Major sectors covered in the present study are agriculture, waste and energy which include activities viz. rice cultivation, life-stock i.e. enteric fermentation, manure management, solid waste disposal, mining and oil production. The estimates show that Agricultural sector contributes maximum 64% to the methane emission in the state followed by waste sector (35%) and energy sector (1%). However, the magnitude and distribution of each source activity plays a crucial role in the specific emission distribution pattern observed over Maharashtra which has been discussed in detail in the present study. On sub-divisional scale Methane emissions are maximum over the coastal belt of Maharashtra and it reduces from west to east over Madhya Maharashtra and Marathwada and again increases over Vidarbha region. Results shows that top five methane emitting districts in the Maharashtra are (i) Greater Mumbai (ii) Thane, (iii) Pune, (iv) Chandrapur and (v) Gondia. Such district level estimates will help to adopt mitigation strategies at local level which may lead to effective management of pollution problems.

**A8**

**Observational studies of ozone and its precursors at Udaipur in India.**

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The real time measurements of surface O3, CO, NOx, NMHCs and meteorological parameters were made during January 2011 â€“ January 2012 at semi urban site Udaipur (24.58o N, 73.68o E) in a western state of India. The diurnal pattern of O3 shows high mixing ratios (in the range of 20-50 ppbv) during day time and low concentrations during late evening and early morning hours, due to photochemical production of ozone in the presence of oxides of nitrogen (NOx). The diurnal variability during winter months was highest and little variations were observed during the summer monsoon season. The monthly averages mixing ratio of O3 and its precursors like CO, NOx, and NMHCs were measured to be highest in the pre monsoon season. The ozone concentrations were found be higher 31-37 ppbv in winter season. In this season, the NE/NW winds transport the pollutants while higher temperature and increased levels of precursors gases favors the higher rate of O3 formation. The monthly average ozone concentrations were found to be 18-25 ppbv and also precursorâ€™s gases were lower in summer monsoon season due to prevalence of cleaner marine air. The precursors were highest during the nighttime as planetary boundary layer (PBL) comes down in winter. The correlations of O3 with temperature and wind speed have been also studied. Although temperature and wind speed showed positive correlation and relative humidity, rainfall showed negative correlation. Details will be presented.

**A9**

**Maiden observations of light (C1-C5) Hydrocarbons over the central Himalayas: Implications for Ozone Chemistry**

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Methane and Non-Methane Hydrocarbons (NMHCs) play vital roles in the air pollution, tropospheric chemistry and climate change. Systematic observations supplemented with the model simulations are essential to understand the atmospheric distributions of NMHCs and their role in the highly complex and non-linear ozone chemistry. Variabilities in various hydrocarbons along with their role in ozone chemistry have been studied over the North America and Europe; however, such studies are very limited over the South Asia. Increasing anthropogenic emissions along with the naturally available intense solar radiation and higher water vapor content makes the tropical Indian region photo-chemically most active. The Indo-Gangetic Plain (IGP) region in the northern India encompasses a variety of natural and anthropogenic emissions including fossil fuel combustion, thermal power plants, industrial sources and biomass-burning, resulting in the emissions of large amount of trace gases. However, the systematic and simultaneous measurements of various hydrocarbons along with ozone are nearly non-existing over this region. In view of these conditions, we present the maiden observations of light (C1-C5) hydrocarbons from a high altitude site Nainital (29.30N, 79.40E, 1958 m amsl) in the central Himalayas. This site is located just north of the IGP and has been shown a better regional representative of this region. Air samples, collected at a frequency of about three samples per week in pre-evacuated glass bottles at a pressure of 0.15 M Pa and are analyzed using Gas Chromatograph (GC) coupled with Flame Ionization Detector (FID). Seasonal variation in CH4 shows maximum levels during late autumn and early winter (~ 1.9 ppmv). Methane levels starts decreasing towards early spring and attains minimum during summer-monsoon (~1.79 ppmv). The seasonal variations in NMHCs are observed to be more-or-less similar to that in Methane. The annual mean mixing ratios of ethane, ethene, propane, propene, i-butane, acetylene, n-butane and i-pentane are about 1.7, 0.7, 0.6, 0.6, 0.6, 0.5, 1.0 and 0.5 ppbv respectively. Observed positive relationships among ethane, acetylene, propane and propene could be associated with the emissions from fossil fuel combustion and power plants in the IGP. Ozone levels at a given propane/ethane ratio discern higher variability during spring and summer-monsoon indicating more photochemical processing. The C2H2/CO ratio, an indicator of the age of air mass, suggests that during winter and summer the site generally receives aged air masses, while, during spring and autumn, moderately fresh emissions influence the site. These observations have also been used to simulate ozone diurnal variations using a chemical box model (NCAR Master Mechanism). The model is being used to investigate the ozone photochemistry and its sensitivity to changes in NMHCs. More discussions will be made during the presentation.

**A10**

**SEASONAL AND INTERANNUAL EVOLUTION OF THE MONOACIDS ORGANICS IN THE ATMOSPHERE OF THE HUMID SAVANNA OF LAMTO (CÃ”TE Dâ€™IVOIRE)**

TOURE PELEMAYO RAOUL
UNIVERSITE FELIX HOUPHOUET BOIGNY

This work was made within the framework of the network IDAF (IGAC/DEBITS/Africa). It concerns the follow-up of the acidity of the atmosphere of an ecosystem of wet savanna from the organic fraction of the free acidity. It is a question of understanding the major factors which cause the variability of this

organic acidity in the interannual and seasonal scales. During ten-year period (1995- 2004) 860 rainy samples were collected in the wet savanna of Lamto. By using Henry\'s law, we determined the contents in the air of major organic monoacids (HCOOH and CH3COOH) from the concentrations of these acids measured in rains. The annual partial pressure of organic monoacids on the decade is extremely variable. It is 0,675 Â± 0,56 ppb and of 0,413 Â± 0,14 ppb respectively for the formic acid and for the acetic acid. This strong variability is bound to their various sources which are also very variable from one year to the next. The organic acidity varies from 40 % to 60 % on average and almost stable rest from a season to the other one. The seasonal analysis shows that generally the partial pressures of organic acids are of a factor twice as raised in dry season that in wet season. This difference is not inevitably connected to the quantity of haste registered from a season to the other one. But would more be connected to the biomass burning which contribute from 21 % to 51 % to the formation of organic acids in the wet savanna of Lamto.

**A11**

**Response of tropical wheat (Triticum aestivum L.) cultivars against elevated ozone under carbon dioxide enrichment with particular reference to growth, yield and grain quality**

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In past few years, anthropogenic activities led to increase in atmospheric concentrations of carbon dioxide (CO2) and ground-level ozone (O3). Both the gases exert their direct effects on the growth and productivity of various crop plants. The present investigation was planned to study the individual and interactive effects of elevated CO2 and O3 on two tropical wheat cultivars (HUW-37 and K-9107) on their growth, yield and grain quality by using open top chambers (OTCs) having near natural field conditions. Plants were continuously exposed to elevated CO2 (700 ppm) and elevated O3 (ambient+10 ppb) for four hours from germination to the maturity. Increment in growth parameters were noticed in elevated CO2 (EC), however, exposure to elevated O3 (EO) showed an opposite trend than EC. In combined treatment (ECO), elevated CO2 alleviated the negative effects of EO in both the cultivars. Yield components showed a significant increase in EC followed by ECO while significant reductions were observed under EO treatment. Soluble protein and total free amino-acids in grains were found decreased in EC, EO and ECO treatments as compared to their respective controls. Significant increment in totle soluble sugars (TSS) and starch content (SC) were recorded in EC and ECO, however, TSS and SC reduced under EO exposure. Yield data from the experiment revealed differential cultivar response as HUW-37 proved to be more sensitive than K-9107 against elevated level of O3. Therefore, the study concludes that elevated CO2 ameliorated the toxic effects of elevated O3 with change in grain quality in both the cultivars of wheat.

**A12**

**Forecasting the Concentration of Atmospheric Pollutants: Skill Assessment of Autoregressive and Radial Basis Function Network Models**

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Forecasting the Concentration of Atmospheric Pollutants: Skill Assessment of Autoregressive and Radial Basis Function Network Models Debanjana Das, Anirban Middey, Sayantika Goswami and Sutapa Chaudhuri Department of Atmospheric Sciences, University of Calcutta 51/2, Hazra Road, Kolkata India

chaudhuri_sutapa@yahoo.com debanjanadas88@gmail.com Abstract The purpose of the present study is to develop a model to forecast the concentrations of some important atmospheric pollutants over Kolkata (22Â° 32â€²N; 88Â° 20â€²E), India during the period from 1st April 2009 to 30th November 2010 with considerable accuracy and adequate lead time. The pollutants considered in this study are respiratory suspended particulate matter (RSPM), nitrogen oxide (NOx), and sulphur oxide (SOx). The auto regressive (AR) models with different orders and radial basis function network (RBFN) model are developed to attain the objective. The skill of both the models is compared. The results of the study reveal that the 3rd order Auto-Regressive Model, AR (3) represents the best statistical model for the prediction of concentrations of all the three different pollutants over Kolkata. The study thus, depicts that the pollutants can be predicted with considerable accuracy and 3 days or 72 hours lead time using AR (3) model. The skill of the AR (3) model is compared with RBFN model. The result further reveals that the percentage error in forecast with 72 hours lead time is much less with RBFN model than AR model. Keywords-Concentration of pollutants, prediction, AR model, RBFN model

**A13**

## Ambient Formaldehyde in a Semi-Urban location: An important Precursor for the net production of Surface Ozone

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Ambient formaldehyde (HCHO) is measured at a surface site in Kolkata (22Âº33\'N, 88Âº30\'E; 6m amsl), located in the eastern part of India. It is one of the densely populated urban areas in the world and experiences heavy traffic. The study site is located in the semi-urban eastern part of the city at Jadavpur University Salt Lake (JUSL) Campus. The natural sources of HCHO include bio-degradation based processes, combustion, photo-dissociation of organic matter and oxidation of naturally occurring hydrocarbons (methane, isoprene and terpenes). Anthropogenic sources of HCHO include factories (furniture, garment, etc.), mills (paper, textiles, plywood) and industrial plants (Formaldehyde and resin manufacturing, wood-product, mineral fibre plants, etc.). In urban areas, a major anthropogenic source of HCHO is incomplete combustion of hydrocarbons in fuel and automobile emissions. Researchers have shown that combustion of pure diesel and diesel blended with alcohol may increase the HCHO emission upto 413% depending on the operating condition of the engine. During the study period, high values of HCHO ranging from 11.08â€“54.71 ppbv are recorded either in the morning (0800-1000 hrs) or in the evening (1700-1800 hrs) hours, characterized by peak traffic loads. The daytime average HCHO concentration is found to be 31.91 ppbv, with a minimum and a maximum value of 1.57 ppbv and 54.71 ppbv respectively for our period of study. Besides this, HCHO is also produced in sufficient quantities through the photo-oxidation of hydrocarbons, primarily methane, through numerous intermediate steps. The major sink of HCHO is either photo-dissociation by which CO is produced or reaction with OH, which further produces other free radicals that subsequently generate hydrogen peroxy radicals, HO2ï‚Ÿ. Along with other peroxy radicals, they are involved in the formation of the primary precursor NO2, for the formation of tropospheric ozone. During morning hours, when the production of ozone has an increasing trend, HCHO shows extremely low negative correlation (R2=0.009) indicating the existence of a highly complex chemistry among these species. Meteorological parameters also have a significant role. Low levels of HCHO are recorded with high relative humidity, indicating adequate wet deposition as HCHO is water soluble (Henryâ€™s law constantHCHO = 3.41x10-2 Pascal.m3/mol at 25Â°C) to a good extent. To understand the basic chemistry of HCHO simple experiments are carried out following a sampling methodology based on USEPA Compendium Method TO-11A using 2,4-dinitrophenylhydrazine (2,4-DNPH). The samples are analysed by isocratic reverse phase High Performance Liquid Chromatography (HPLC) with an Ultra-Violet (UV) detector at a wavelength of 360 nm. Formaldehyde is

identified and quantified by comparison to their retention times and peak heights with those of the standard solutions.

**A14**

**Cloud-water chemistry at a high altitude station in South Asia**

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Cloud-water chemistry at a high altitude station in South Asia K. B. Budhavant1, P.S.P. Rao2, P.D. Safai2, L. Granat3 and H. Rodhe3 1. Maldives Climate Observatory-Hanimaadhoo, Hanimaadhoo, Rep. of Maldives 2. Indian Institute of Tropical Meteorology, Pune, Maharashtra, India 3. Department of Meteorology, University of Stockholm, Stockholm, Sweden Abstract: Data from a groundâ€•based, cloud-water collection system intercepting water from clouds at a mountain field station, Sinhagad near Pune in India are presented. This study was part of an Indo-Swedish Collaboration Project on Atmospheric Brown Cloud-Asia (ABC-A). Cloud-water and rainwater (wet-only) samples were collected during June 2007 to Dec 2010. Concentrations of major anions and cations were determined. Ion concentrations were generally higher in cloud-water samples than in rain collected during the same days. The average pH of cloud-water samples was 6.0 with about 20 % of the values below 5.6. Despite high concentrations of SO42- and NO3- the cloud water samples were on an average not more acidic than rainwater collected during the same days. This is different from most other studies of cloud water acidity which have noted a substantially higher acidity in cloud-water than in rainwater. The relatively low acidity in our cloud water samples is mainly due to the presence of high concentration of soil derived calcium carbonate. A separation of the cloud-water data into trajectory groups showed that samples in air-masses having spent the last few days over land areas were in general more acidic than those collected during days with air-masses of marine origin. An analysis indicates that anthropogenic emissions were responsible for almost all of the SO42-, NO3- and NH4+ found in the cloud-water also during monsoon circulation. Most of the Ca2+ and Mg2+ are derived from crustal sources. Keywords: Cloud-water; Rainwater; Acidic deposition; India

**A15**

**First car MAX-DOAS measurements of different trace gases in Pakistan**

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South Asian region is getting attention of world due to decent growth in GDP of developing nations (India, Bangladesh and Pakistan) during last decade, and of scientific community due to consequent increase in atmospheric pollution. This region with worst air quality is relatively less studied. Therefore, it strongly needed much attention of scientific community to promote atmospheric research activities and scientific collaboration in order to have better understanding of atmospheric composition of this region. A step toward this direction has been taken by installing a first mini MAX-DOAS instrument in Pakistan with collaboration of Max-Planck institute for Chemistry Mainz Germany. MAX-DOAS is sophisticated equipment and DOAS (differential optical absorption spectroscopy) is a novel measurement technique. It is mainly used for the measurement of a variety of chemically active atmospheric trace gases (e.g. SO2, NO2, O3, and formaldehyde etc.). In particular, it is more practical and can be used at various platforms e.g. roof top, aircraft and on top of an automobile as well. An international field campaign was conducted along the N-5 national highway from Islamabad to Lahore

(about 300 km long) in November 2012. It involved both national and international scientists, in particular, from Max-Planck Institute for Chemistry Mainz, Germany, and from Kyoto University Japan and MS and PhD research students from IESE-NUST. Main objectives of this field campaign were to acquire data using Car-MAX- DOAS for ambient air quality analysis and to identify the different sources (traffic and industrial units) along the N-5 Highway Two days long field campaign by using Car-MAX-DOAS was conducted successfully. The preliminary results show, how the air quality is worsened along the field track and also around the larger cities like Rawalpindi, Gujranwala and Lahore. The result will be discussed in this paper in further details.

**A16**

**VARIATIONS OF SURFACE OZONE AND ITS IMPACT ON REGIONAL CLIMATE CHANGE OVER KANNUR**

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The concentrations of trace gases are quite low in the atmosphere, yet they play a vital role in varying the ambient air quality over a region. Moreover, their chemistry could effectively modulate radiative transfer which often results climate changes. Exploring the schemes of interactions among these gases is highly essential to understand their potential role in the radiative forcing that lead to the dynamics of the atmosphere. In addition to this, the secondary species produced from the pollutant trace gases impart environmental impacts that can be expected with modifications to their sources and sinks. Ozone (O3) produced on the ground level is one of the important secondary pollutants in the atmosphere which has a strong influence on human health and agricultural crop yield. O3 is produced in the troposphere when Methane (CH4), non-methane hydrocarbons (NMHCs) and carbon monoxide (CO) are photo-chemically oxidized in the presence of nitrogen oxides (NOx) present in the ambient air. These precursors have a wide variety of sources by which they exhibit a non-linear effect on local O3 production and its variation is strongly influenced by meteorological processes. The tropospheric O3 concentration is determined by downward transport from the stratosphere, dry deposition to the Earthâ€™s surface and photochemistry in the troposphere involving its precursors. Being a strong oxidant in the atmosphere, tropospheric O3 plays a significant role in the radiative balance of the atmosphere. Thus the diurnal and seasonal variations of surface O3 are quite significant to explore the chemistry and its impact on the radiative forcing of atmosphere. This would further leads to the investigation of the major role played by the efficiency of O3 towards global warming and thereby the climate change. This study mainly focuses on to the seasonal variation of surface O3 and its prominent precursors NOx, CH4 and total non-methane hydrocarbons at Kannur (11.90N, 75.40E, 5m asl), a rural location confined between the costal belt of the Arabian sea and Western Ghats in Kerala state. The study further revealed that O3 and NOx have a very strong inverse correlation during the period of observations suggesting the possible VOC sensitive characteristics of the study location. Besides, monthly average maximum and minimum CH4 concentrations have been observed in December and in August in a year. The diurnal variations of CH4 are quite similar to that of NOx and it has been found that CH4 shows a gradual buildup in early morning hours of all days in a year due to the peak traffic emissions and boundary layer processes. CH4 is observed to be fairly low during noon time and thereafter it starts increasing in evening hours of all months. The prominent organic species detected in the ambient air at this location throws light on the influence of complex chemistry involving VOC and its major role in the enhancement of O3 at this site. This attempt could classify the variation of t

**A17**

**Cloud water chemistry at Sinhagad- a high altitude background site near Pune**

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Abstract Four years data from a groundâ€•based, cloud-water collection system intercepting water from clouds at a mountain field station, Sinhagad near Pune in India has been studied. This study was part of an Indo-Swedish Collaboration Project on Atmospheric Brown Cloud-Asia (ABC-A). Cloud-water and rainwater (wet-only) samples were collected during June 2007 to Dec 2010. Concentrations of major anions and cations were determined. Ion concentrations were generally higher in cloud-water samples than in rain collected during the same days. The average pH of cloud-water samples was 6.0 with about 20 % of the values below 5.6. Despite high concentrations of SO4 and NO3 the cloud water samples were on an average not more acidic than rainwater collected during the same days. This is different from most other studies of cloud water acidity which have noted a substantially higher acidity in cloud-water than in rainwater. The relatively low acidity in our cloud water samples is mainly due to the presence of high concentration of soil derived calcium carbonate. A separation of the cloud-water data into trajectory groups showed that samples in air-masses having spent the last few days over land areas were in general more acidic than those collected during days with air-masses of marine origin. An analysis indicates that anthropogenic emissions were responsible for almost all of the SO4, NO3 and NH4 found in the cloud-water. Most of the Ca and Mg are derived from crustal sources.

**A18**

**Surface ozone variation at Bhubaneswar**

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This study represents an year long (December 2009 to January 2011) continuous measurement of daytime (0700â€“1745) near surface Ozone (O3) in the ambient air and related meteorological parameters at Bhubaneswar (21Â°15â€™ N; 85Â°15â€™ E), Odisha. Diurnal variation of ozone mixing ratio along with solar flux shows the normal trend of rise in ozone mixing ratio with solar flux and vise versa suggesting the photochemical build-up of ozone. Seasonal variation of surface ozone shows distinct daytime ozone maxima during winters with a peak in January (~85 ppbv), decreases through the pre-monsoon and reaches the lowest in August (~20 ppbv) and again starts building up in the post-monsoon. On analyzing the backward wind trajectory (120 hrs) reaching Bhubaneswar in different seasons it was found that during winter months there is a major role of long distance transport of air mass carrying pollutant precursors from Indo-Gangetic Plains (IGP) and western part of Indian peninsula which are considered to be heavily polluted regions. However, in other seasons wind reaches the observation site from less polluted landmasses and the Bay of Bengal, thereby considerably reducing the pollution load. Wind rose was also plotted on a monthly basis for the measurement site. In winter months it showed the dominance of calm conditions and low wind speed, in pre-monsoon wind blew at higher wind speed and no calm conditions were seen. An anti-weekend ozone effect (~5 ppbv) was observed in winter. Statistical analysis i.e. paired t-test and F-test was done to determine significance between daily, monthly and seasonal variation of near surface ozone. The t-and F-test showed significant monthly variation in a season and non-significant on a daily basis.

**A19**

**Atmospheric chemistry of surface ozone formation at an urban tropical site in India- Recent observations of temporal trends and special events**

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The urban population is often exposed to high levels of air pollution due to industrialization, increased anthropogenic activities and vehicular traffic, besides, they are also the main source of fine and ultrafine particles which influence the air quality. Increasing concentrations of air pollutants viz., nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and ozone (O3) in urban areas are the consequence of accumulation, dispersion, and transformation of contaminants. O3 is not emitted directly by any natural source, but is indeed formed through a set of photochemical reactions involving primary pollutants such as NOx and non-methane hydrocarbons (NMHCs) from natural and anthropogenic emissions. Photochemical smog formed due to O3 has detrimental effect on vegetation, human health and various materials at elevated concentrations. Diurnal variation of O3, NOx, CO and SO2, NMHCs and black carbon (BC) measurements were carried out during four consecutive years (2009-12). Variations of these pollutants were influenced by meteorological parameters viz., solar radiation, temperature, relative humidity, and wind speed and wind direction. Diurnal profiles were studied during different seasons and months to understand the photochemistry of surface O3. Seasonal O3 episodes indicated maximum O3 mixing ratio during summer followed by winter and rainy season attributing to solar insulation, localization of precursor gases in shallow boundary layer under humid conditions and wet surface deposition of precursor gases, respectively. Atmospheric chemistry of NOx and heterogeneous chemistry of BC during night-time on O3 were studied. In addition, the present study focused on the influence of special episodes such as Diwali fireworks and ozone weekend effect on urban air quality. Oxides of nitrogen, nonmethane hydrocarbons and black carbon emission played significant role on weekend effect of ozone during three seasons in the year 2010. High O3 concentrations were observed on weekends compared to weekdays, however, NOx and BC were observed to be low during weekends. The importance of hydrocarbons (C2-C5) in the formation of the respective peroxy radicals and its reaction to form OH free radicals and NO2 through various intermediate reactions and NMHCs/NOx ratio during weekend weekday were as well substantiated. The influence of Diwali firework emissions on surface O3, NOx, SO2 and BC aerosol concentrations during pre-, post- and Diwali days for three consecutive years (2009-2011) were studied. The high correlation coefficient (~0.74) between NOx and SO2 concentrations and higher SO2/NOx (S/N) index suggested air quality degradation due to fire crackers burning.

**A20**

## The behavior of surface ozone and aerosols during grassland fire over a semi-arid region in southern India.

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The measurement of surface ozone and aerosols were studied during an extensive grassland fire at a semi-arid region in southern India. The impact of an extensive grassland fire onthe physical and optical properties of aerosols and surface ozone ($O_3$) at a semi-arid station was measured from ground based measurements using a MICROTOPS-II sunphotometer, an aethalometer, quartz crystal microbalance impactor (QCM) and ozone analyzer. Observations revealed a substantial increase inaerosol optical depth (AOD) at all wavelengths during burning days compared to normal days.High AOD values observed at shorter wavelengths suggest the dominance of accumulation modeparticle loading over the study area. Daily mean aerosol size spectra shows, most of the time,power-law distribution. To characterize AOD, the Angstrom parameters (i.e., α and β) wereused. Wavelength exponent (1.38) and

turbidity coefficient (0.21) are high during burning dayscompared to normal days, thereby suggesting an increase in accumulation mode particle loading.Aerosol size distribution suggested dominance of accumulation mode particle loading duringburning days compared to normal days. A significant positive correlation was observed betweenAOD at 500 nm and water vapor and negative correlation between AOD at 500 nm and windspeed for burning and non-burning days. Diurnal variations of black carbon (BC) aerosol massconcentrations increased by a factor of ~2 in the morning and afternoon hours during burningperiod compared to normal days. A substantial increase in surface ozone concentration during burning days to compare with normal days. The daily average of normal days and burning days ozone concentration was 41.2 ppbv and 51.8 ppbv. The correlation of surface ozone with black carbon and total mass concentration was discussed. The variations of $O_3$ with black carbon aerosols and total aerosol mass concentration have been studied and its relevant results are reported during burning event and in normal days. The impact of water vapor and boundary layer height was reported during normal and burning days. The daily averages of surface and aerosols optical depth were compared with the satellite measurement and correlation appears to be good.

**A21**

**Performance of a Chemical Transport Model over India**

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Aerosol distribution estimation over globe is still a challenge in-front of scientist even after several after national and international efforts and same is true with respect to Indian perception. In addition to climate impacts, aerosols cause respiratory and cardiovascular diseases, air quality degradation, acidification of aquatic and terrestrial ecosystems. Thus study of aerosols distributions is worth study with respect to climate as well as environmental perspective. Present work is an attempt to model aerosol distribution over Indian region with the help of a chemical transport model and the model used for this study is CHIMERE model. Model simulation has been carried out for three consecutive years, 2006-2008 over Indian domain (4° N- 37.5° N; 67° E-88.5° E). Spatial and temporal distributions of particulate matter, black carbon and OC to BC ratio are studied. Spatial distribution shows that model was able to capture the broad features of the regional distribution of aerosols. Results also demonstrated that model could simulate the meteorological related features, i.e. rain fall impact on washout of particulate matter during monsoon months. Simulation results showed the capabilities of model but it is essential to evaluate the accuracy and efficiency of model qualitatively by comparing against ground-based and space-based observations. To validate the model over Indian domain, we compared its outcome with ground measurements at several locations, both inland and island measurements, data from various sources. Comparison of modeled BC with measured BC at various locations (oceanic, inland and island) showed that model performance was satisfactory. Correlation analysis between particulate mass concentration from model with AERONET AOD shows reasonably good performance of model. We have also made correlation analysis between particulate mass concentration from model with MODIS AOD and this comparison showed a very good correlation throughout the year except for the monsoon months. All these results shows the capability of model over Indian domain but it appears that improvement is required in the model in order to capture the pollutants concentration during the monsoon months.

**A22**

**Contribution of Indian chemical emissions to the tropospheric ozone levels in Southern Asia**

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We investigate the impact of chemical emissions in the Indian subcontinent on the tropospheric abundance of ozone and its precursors in the surrounding south Asian region. The study makes use of the Chemistry-Transport Model (MOZART) version-2 forced with dynamical fields provided by meteorological analyses, and new emission inventories established for 2001. Ozone production in this region is dominated by the anthropogenic emissions of carbon monoxide, oxides of nitrogen and non-methane hydrocarbons. The influence of Indian emissions over most of the surrounding South Asian region leads to a 1-5 ppbv increase in the ozone concentration and a 1-10 ppbv increase in the CO concentration in most part of the free troposphere. During the monsoon period of July, the marine winds transport boundary level ozone and CO towards the northeastern region of South Asia as opposed to what is occurring during the pre-monsoon period. However, due to the short residence time of NOx, convective transport of nitrogen oxides is not strong and hence changes in the concentration of this compound are small in the free troposphere.The background level of ozone over the Indian region, (fraction of ozone present in a given area that is not attributed to anthropogenic sources in this area) is approximately 10-30 ppbv and is even larger in the northern part of India during the monsoon period. The contribution of long-range transport of ozone from distance pollution sources in south Asian region to the Indian region is substantial for ozone and CO, but insignificant for NOx.

**A23**

**Study of air pollution episodes over Delhi and their impacts on vertical ozone distribution**

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Air pollution is a leading cause of many diseases in Delhi. The major anthropogenic sources of air pollution in Delhi are vehicle emission, energy generation, construction, waste generation, domestic cooking etc. It has been observed that many meso-scale meteorological events also have significant impact on air pollution scenario in Delhi. We have studied three air pollution episodes over Delhi which occurred in the year 2012. The first episode is a very unusual dust plume which was generated from dust-storm activity over Arabian Peninsula and Southwest Asia affected the north-west region of India between March 20 and 23, 2012, causing significant reductions in air quality and visibility. Using meteorological information and multiple satellite remote sensing data sets, the distribution of dust e.g. Particulate matter and its potential effects on the Earth-atmosphere system has been studied. The second episode was a severe pollution episode that had again gripped National Capital region Delhi starting around 27$^{th}$ October 2012. Particulate pollutants increased significantly and reached to a dangerous level. $PM_{2.5}$ reached to a critical level of 400 μg/m$^3$ on 5$^{th}$ Nov. The level of $PM_{10}$ had also reached to a peak level of 620 μg/m$^3$ on 5$^{th}$ November. However, due to the significant increase in the level of NOx and triggering of titration reaction, the level of toxic ozone has gone down and entered in "Good" category from "Moderate" range. The reason for above drastic increase in particulate pollution level was purely due to peculiar meteorological conditions supported by long range transport of pollution from neighbouring state. The levels of Air Pollution on Diwali festival and the impacts of all these episodes on vertical distribution of ozone have also been studied. The Increase in surface Ozone concentration during Diwali festival has clearly shown that tropospheric ozone is significantly influenced by the Smoke (NOx, CO etc.) due to burning of fire-crackers.

Key words : Air pollution, Particulate Matter, Surface Ozone, vehicular pollution.

**A24**

**Role of NOx (NO+NO2) on the production of surface O3 and its impact on total oxidant concentration at a tropical urban site in Deccan plateau region**

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Increasing levels of anthropogenic emissions due to industrialization, urbanization and heavy vehicular traffic have resulted in worsening of air quality. Formation of photochemical oxidants is one of the major concerns in urban localities. Surface ozone is a secondary air pollutant which is formed by the photochemical oxidation between precursor air pollutants. Among these the effect of NO2 on O3 is inextricably linked and reduction in the levels of NO2 is directly associated to subsequent raise in the concentration of O3. In addition, changes in the levels of O3 and NO2 by local and regional contributions will lead to an increase in the background mixing ratio, so it is necessary to understand the relationship between O3, NOx (NO+NO2) and OX = (NO2 + O3) under different atmospheric conditions. Temporal (diurnal/seasonal) variations of surface O3, NOx, NO and NO2 were continuously monitored and the influence of meteorological parameters on the variation of these pollutants was studied throughout the study period (2009-11) in the urban site, Hyderabad. Variations of NO, NO2 and O3 versus NOx concentrations were empirically correlated. The cross-over points which are maximum levels of NO2 for the formation of O3 were indentified for all the three seasons during the three consecutive years. The results for O3, NO and NO2 indicate that the level of oxidant concentration [OX] at a given location is the sum of NOx-independent â€œregional contributionâ€• (background level of O3) and NOx-dependent â€œlocal contributionâ€•. This work was carried out to understand the behavior and variability of total oxidant levels at Hyderabad. Positive influence of O3 over OX concentration along the diurnal scale was distinctly observed and correlates with the level of local vehicular emissions (light and heavy duty vehicles). Ratios [NO2]/[OX] and [NO2]/[NOx] vs. [NOx] were analyzed for NO2 fraction of OX and the possible source of the local NOx-dependent contribution was established.

**Poster Presentation for SAFAR**

**A1**

## Seasonal Variation of Polycyclic Aromatic Hydrocarbons (PAH) in the Roadside Ambient air of the metropolis of North India

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Sixteen Atmospheric Polycyclic Aromatic Hydrocarbons (PAHs) concentrations were measured at two monitoring stations in the cities of New Delhi, Agra and Kanpur each with one monitoring station in the centre and the other in the outskirts for a span of one year. The objective of the study was to ascertain PAHs contamination levels of air, their distribution behavior, seasonal variation and ratio of low and high carcinogenic PAHs in the ambient air. Samples were collected using high volume sampler fitted with glass fibre filter paper and polyurethane foam plug (PUF) erected at the monitoring stations of the cities. The PAHs were extracted by soxhlet using toluene as a solvent and analysed on GC-FID. Recovery range was found between 30% and 70 % with the lower value corresponding to the low molecular weight PAHs compound. The mean concentration of total low and high carcinogenic PAHs for the year was found to be 4.79 ng/m3 to 5.49 ng/m3 (ratio 1: 1.22), 3.79 ng/m3 to 4.10 ng/m3 (ratio 1: 1.10) and 4.27 ng/m3 to 5.04 ng/m3 (ratio 1: 1.18) in the central part of New Delhi, Agra and Kanpur respectively and 3.95 ng/m3 and 6.01 ng/m3 (ratio 1: 1.52), 3.05 ng/m3 and 5.11 ng/m3 (ratio 1: 1.67) and 3.68 ng/m3 and 5.79 ng/m3 (ratio 1: 1.57) in the outskirts of the three cities respectively. The mean concentration of total PAHs for the year at the central parts of New Delhi, Agra and Kanpur were 81.6 ng/m3, 75.9 ng/m3and 80.2 ng/m3 whereas at outskirts were 77.0 ng/m3, 65.2 ng/m3 and 73.2 ng/m3 respectively. It was also observed that four ringed PAHs were higher in concentration in the central part of the cities whereas two, five and six-ringed PAHs were higher in concentration at the outskirts of the cities.

Fluoranthene and Fluorene were two individual PAHs found in highest concentration in the central part of the cities and Fluorene and Benzo pyrelene were highest in the outskirts of the metropolis.

**A2**

**Influence of anthropogenic sources on snowfall Chemistry in north- western Himalayan ranges of India**

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A rapid growth of industrialization and urbanization in India is responsible for large emissions of air pollutants which adversely affect not only the urban localities but also remote areas. Sensitive ecosystem of Himalayan ranges is also not the exception in this regard. These pollutants are responsible for altering the composition of atmosphere. This study reports chemical characteristics of snowfall and air mass trajectory analysis at Manali and Nainital. Results indicated that snowmelt of Manali and Nainital had very high concentrations of pollutants. The average pH of snowmelts was recorded as 5.89 (Manali) and 6.9 (Nainital). Relatively higher concentrations of SO4-2 and NO3- were recorded at Nainital than Manali indicating significant influence of fossil fuel and biomass combustion in Himalayan region. It is interesting to note that in spite of high concentrations of SO4-2 and NO3-, the pH was recorded high at Nainital due to high concentration of Ca+2 and Mg+2. The higher pH with reference to natural pH of cloud water (pH-5.6) could be related to very high concentration of Ca+2 and Mg+2.Air mass trajectory analysis revealed significant influence of local sources at Nainital as well as Manali. The detailed results of the study will be discussed in the conference.

**A3**

**Role of NOx (NO+NO2) on the production of surface O3 and its impact on total oxidant concentration at a tropical urban site in Deccan plateau region**

D.N.S.K. Chitanya, R. Venkanna, G.N. Nikhil, P.R. Sinha, Y. V. Swamy*
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Increasing levels of anthropogenic emissions due to industrialization, urbanization and heavy vehicular traffic have resulted in worsening of air quality. Formation of photochemical oxidants is one of the major concerns in urban localities. Surface ozone is a secondary air pollutant which is formed by the photochemical oxidation between precursor air pollutants. Among these the effect of NO2 on O3 is inextricably linked and reduction in the levels of NO2 is directly associated to subsequent raise in the concentration of O3. In addition, changes in the levels of O3 and NO2 by local and regional contributions will lead to an increase in the background mixing ratio, so it is necessary to understand the relationship between O3, NOx (NO+NO2) and OX = (NO2 + O3) under different atmospheric conditions. Temporal (diurnal/seasonal) variations of surface O3, NOx, NO and NO2 were continuously monitored and the influence of meteorological parameters on the variation of these pollutants was studied throughout the study period (2009-11) in the urban site, Hyderabad. Variations of NO, NO2 and O3 versus NOx concentrations were empirically correlated. The cross-over points which are maximum levels of NO2 for the formation of O3 were indentified for all the three seasons during the three consecutive years. The results for O3, NO and NO2 indicate that the level of oxidant concentration [OX] at a given location is the sum of NOx-independent â€œregional contributionâ€• (background level of O3) and NOx-dependent â€œlocal contributionâ€•. This work was carried out to understand the behavior and variability of total oxidant levels at Hyderabad. Positive influence of O3 over OX concentration along the diurnal scale was distinctly observed and correlates with the level of local vehicular emissions (light and

heavy duty vehicles). Ratios [NO2]/[OX] and [NO2]/[NOx] vs. [NOx] were analyzed for NO2 fraction of OX and the possible source of the local NOx-dependent contribution was established.

**A4**

**Development of high resolution emissions inventory for Pune Metropolitan Region, India**

Neha S. Parkhi, Saroj Kumar Sahu and G. Beig

IITM

Under the project System of Air quality Forecasting and Research (SAFAR)-Pune, a high resolution Emission Inventory (EI) has been developed for a domain 120.24 X 125.25 km covering Pune Metropolitan Region and surrounding area with a 1.67 km x 1.67 km resolution for the year 2012. The emissions has been estimated for PM10, PM2.5, CO, NOx, BC, OC and VOCâ€™s using latest IPCC guidelines, Geographical Information System (GIS), local activity data and country specific emission factors. The major sectors covered are, transport, industries, residential and commercial which includes fossil fuel and biofuel burning for verities of activities like cooking, heating, traveling etc. The intensity of each of these activities are found to be specific to the locality and show a wide variation from place to place, hence, to make the inventory more accurate by considering ground realities, a primary data set has been generated across Pune Metropolitan Region and available secondary data set has been collected from different governmental organizations and institutions by initiating several month long campaign with the involvement of more than 100 students from different colleges during the year 2012. The details of the findings of the field survey, estimated emissions and the spatial distribution of above mentioned pollutants over Pune Metropolitan Region have been presented in details in the study.

**A5**

**VARIATIONS OF SURFACE OZONE AND ITS IMPACT ON REGIONAL CLIMATE CHANGE OVER KANNUR**

NISHANTH.T

KANNUR UNIVERSITY

The concentrations of trace gases are quite low in the atmosphere, yet they play a vital role in varying the ambient air quality over a region. Moreover, their chemistry could effectively modulate radiative transfer which often results climate changes. Exploring the schemes of interactions among these gases is highly essential to understand their potential role in the radiative forcing that lead to the dynamics of the atmosphere. In addition to this, the secondary species produced from the pollutant trace gases impart environmental impacts that can be expected with modifications to their sources and sinks. Ozone (O3) produced on the ground level is one of the important secondary pollutants in the atmosphere which has a strong influence on human health and agricultural crop yield. O3 is produced in the troposphere when Methane (CH4), non-methane hydrocarbons (NMHCs) and carbon monoxide (CO) are photo-chemically oxidized in the presence of nitrogen oxides (NOx) present in the ambient air. These precursors have a wide variety of sources by which they exhibit a non-linear effect on local O3 production and its variation is strongly influenced by meteorological processes. The tropospheric O3 concentration is determined by downward transport from the stratosphere, dry deposition to the Earthâ€™s surface and photochemistry in the troposphere involving its precursors. Being a strong oxidant in the atmosphere, tropospheric O3 plays a significant role in the radiative balance of the atmosphere. Thus the diurnal and seasonal variations of surface O3 are quite significant to explore the chemistry and its impact on the radiative forcing of atmosphere. This would further leads to the investigation of the major role played by the efficiency of O3 towards global warming and thereby the climate change. This study mainly focuses on to the seasonal variation of surface O3 and its prominent precursors NOx, CH4 and total non-methane hydrocarbons at Kannur (11.90N, 75.40E, 5m asl), a rural location confined between the costal belt of the Arabian sea and Western Ghats in Kerala state. The

study further revealed that O3 and NOx have a very strong inverse correlation during the period of observations suggesting the possible VOC sensitive characteristics of the study location. Besides, monthly average maximum and minimum CH4 concentrations have been observed in December and in August in a year. The diurnal variations of CH4 are quite similar to that of NOx and it has been found that CH4 shows a gradual buildup in early morning hours of all days in a year due to the peak traffic emissions and boundary layer processes. CH4 is observed to be fairly low during noon time and thereafter it starts increasing in evening hours of all months. The prominent organic species detected in the ambient air at this location throws light on the influence of complex chemistry involving VOC and its major role in the enhancement of O3 at this site. This attempt could classify the variation of tropospheric O3 concentration which acts as a tracer in the atmosphere to monitor the chemistry of trace gases over a rural location in Kerala.

**A6**

**Atmospheric chemistry of surface ozone formation at an urban tropical site in India- Recent observations of temporal trends and special events**

R. Venkanna, D.N.S.K. Chitanya, G.N. Nikhil, P.R. Sinha, Y. V. Swamy*
Indian Institute of Chemical Technology, Hyderabad

The urban population is often exposed to high levels of air pollution due to industrialization, increased anthropogenic activities and vehicular traffic, besides, they are also the main source of fine and ultrafine particles which influence the air quality. Increasing concentrations of air pollutants viz., nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and ozone (O3) in urban areas are the consequence of accumulation, dispersion, and transformation of contaminants. O3 is not emitted directly by any natural source, but is indeed formed through a set of photochemical reactions involving primary pollutants such as NOx and non-methane hydrocarbons (NMHCs) from natural and anthropogenic emissions. Photochemical smog formed due to O3 has detrimental effect on vegetation, human health and various materials at elevated concentrations. Diurnal variation of O3, NOx, CO and SO2, NMHCs and black carbon (BC) measurements were carried out during four consecutive years (2009-12). Variations of these pollutants were influenced by meteorological parameters viz., solar radiation, temperature, relative humidity, and wind speed and wind direction. Diurnal profiles were studied during different seasons and months to understand the photochemistry of surface O3. Seasonal O3 episodes indicated maximum O3 mixing ratio during summer followed by winter and rainy season attributing to solar insulation, localization of precursor gases in shallow boundary layer under humid conditions and wet surface deposition of precursor gases, respectively. Atmospheric chemistry of NOx and heterogeneous chemistry of BC during night-time on O3 were studied. In addition, the present study focused on the influence of special episodes such as Diwali fireworks and ozone weekend effect on urban air quality. Oxides of nitrogen, nonmethane hydrocarbons and black carbon emission played significant role on weekend effect of ozone during three seasons in the year 2010. High O3 concentrations were observed on weekends compared to weekdays, however, NOx and BC were observed to be low during weekends. The importance of hydrocarbons (C2-C5) in the formation of the respective peroxy radicals and its reaction to form OH free radicals and NO2 through various intermediate reactions and NMHCs/NOx ratio during weekend weekday were as well substantiated. The influence of Diwali firework emissions on surface O3, NOx, SO2 and BC aerosol concentrations during pre-, post- and Diwali days for three consecutive years (2009-2011) were studied. The high correlation coefficient (~0.74) between NOx and SO2 concentrations and higher SO2/NOx (S/N) index suggested air quality degradation due to fire crackers burning.

**A7**

**The short term trends in surface ozone and its precursors over a semi-mountain location of western India**

Ravi yadav,S.N.A. Jaaffrey and Gufran Beig
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The city of Udaipur (24.58 oN, 73.68 oE) in the province of Rajasthan in Western part of India has special significant as it is surrounded by Aravalli mountain ranges in one side and desert on another side. The measurement of surface ozone and its precursors are taken during the past 3 years (2010-2012) to understand the trends in the seasonal variability and impact of surrounding environment on the distribution of these parameters. The back trajectory analyses were made to determine the wind pattern along with measurements of other meteorological parameters. There is no discernible trend seen from 2010 to 2012 although the trend is the emissions load of precursors are on steady increase. The lowest ozone value of 17 ppb in the month of August in 2010 is associated with maximum rainfall whereas ozone is minimum in the month July during 2011 and 2012. Convective activities in the month of June drift away the pollution from subcontinent to further away and hence we see relatively very low values even in June. The good correlation is found with an increase in pollution during winter and temperature which bring down the boundary layer. Details will be presented.

**A8**

**Studies on the status of vehicular emission loads of gaseous pollutants at selected locations of Madurai city, South India**

M.RAJESHKUMAR
Madurai Kamaraj University

Studies on the status of vehicular emission loads of gaseous pollutants at selected locations of Madurai city, South India RajeshKumar.M1. Tennyson Daniel2, Jeba Rajasekhar.R.V.3, Kumara guru A.K.4 and Sundaram.A1 1 Department of Solar Energy, School of Energy, Environment and Natural Resources, MKU, Madurai. 2 RegionalTestCentre (Solar Thermal), School of Energy, Environment and Natural Resources, MKU, Madurai. 3 Department of Physics, Govt. Arts College, Melur. 4 Department of Environmental Studies, School of Energy, Environment and Natural Resources, MKU, Madurai Abstract Madurai city (9Â°54â€™ N 78.06Â°E and 101 m MSL) located 450 km south of Chennai, is the second largest and densely populated city in the state of Tamil Nadu having surface area of 130 kmÂ² and estimated population density of 1,016,885. The city is well known for its ancient temples and monuments. The increase in the rate of conventional fuel driven vehicles (automobiles) and their heavy emission loads have imposed great burden to overall environment of Madurai city. In this context, an independent traffic survey was conducted at 30 selected locations of Madurai city by physical counting in both directions of the traffic flow to estimate the emission rates of the traffic related gaseous pollutants, such as carbon monoxide (CO), nitrogen oxides (NOx) and sulphurdioxide (SO2). The results of the study revealed that the emission load of CO was high followed by NOx and SO2. By considering the high estimated emission loads and their adverse effects, we emphasize that implementation of scientific traffic management strategies and execution of vehicular pollution abatement measures are essential to safeguard the health of people residing in the urban environment of Madurai city. Key words: Urban air pollution, Emission inventory, Automobiles, Gaseous pollutants

**A9**

**SEASONAL AND INTERANNUAL EVOLUTION OF THE MONOACIDS ORGANICS IN THE ATMOSPHERE OF THE HUMID SAVANNA OF LAMTO (CÃ”TE Dâ€™IVOIRE)**

TOURE PELEMAYO RAOUL
UNIVERSITE FELIX HOUPOUET BOIGNY

This work was made within the framework of the network IDAF (IGAC/DEBITS/Africa). It concerns the follow-up of the acidity of the atmosphere of an ecosystem of wet savanna from the organic fraction of the free acidity. It is a question of understanding the major factors which cause the variability of this organic acidity in the interannual and seasonal scales. During ten-year period (1995- 2004) 860 rainy samples were collected in the wet savanna of Lamto. By using Henry\'s law, we determined the contents in the air of major organic monoacids (HCOOH and CH3COOH) from the concentrations of these acids measured in rains. The annual partial pressure of organic monoacids on the decade is extremely variable. It is 0,675 Â± 0,56 ppb and of 0,413 Â± 0,14 ppb respectively for the formic acid and for the acetic acid. This strong variability is bound to their various sources which are also very variable from one year to the next. The organic acidity varies from 40 % to 60 % on average and almost stable rest from a season to the other one. The seasonal analysis shows that generally the partial pressures of organic acids are of a factor twice as raised in dry season that in wet season. This difference is not inevitably connected to the quantity of haste registered from a season to the other one. But would more be connected to the biomass burning which contribute from 21 % to 51 % to the formation of organic acids in the wet savanna of Lamto.

**Theme – Aerosols**

**Oral Presentation list for C4**

**OP 8**

**Chemical finger printing of atmospheric outflow from the Indo-Gangetic Plain to the Bay of Bengal: Impact of Biomass burning emissions**

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In the present-day scenario of growing anthropogenic activities, atmospheric particulate matter is considered to be of immense significance in influencing the Earthâ€™s radiation budget and climate on a regional scale. In order to understand the climatic perturbations, aerosol radiative forcing not only requires quantitative assessment but needs to be evaluated in terms of atmospheric chemical constituents and their sources. In this context, large degree of uncertainty associated with absorbing and scattering properties of ambient aerosols assumes particular importance in polluted regions of the Indo-Gangetic Plain (IGP). During the wintertime (Dec-Feb), emissions from post-harvest agriculture-waste burning, wood-fuel burning for domestic heating and fossil fuel combustion result in enormous amount of organic carbon (OC) and elemental carbon (EC) that modify the total particulate carbon content of the atmosphere. The shallow atmospheric boundary layer during this period not only allows the efficient trapping of aerosols but also responsible for their subsequent downwind transport and influencing the chemical composition of aerosols in the marine atmospheric boundary layer (MABL). Therefore, to characterize this atmospheric outflow, fine mode (PM2.5) aerosols were collected from a downwind sampling site, Kharagpur (22.3 N, 87.3 E), in the IGP during Novâ€™09-Marâ€™10. During

sampling days, air mass back trajectories have clearly shown the impact of continental outflow. The chemical composition is dominated by carbonaceous species, organic & elemental carbon (Organic matter & EC), account for ~ 50 % of mass; whereas water-soluble ionic constituents (WSIC) and mineral dust account for ~ 31 and 12 % of PM2.5 mass, respectively. Anthropogenic water-soluble ions (NH4+ NO3- + nss-SO42- + nss-K+) dominates the Î£WSIC in the IGP-outflow. Significant correlation of water-soluble K+ with OC (P-value < 0.05), suggests their contribution from biomass burning emissions. Furthermore, the mass ratios of OC/EC (~ 7.0) nss-K+/EC (~ 0.50) and nss-K+/OC (~ 0.07) from this study are consistent with that reported for other upwind sampling sites in the IGP; thus, characterizes the source signature of biomass burning emissions. A close match of chemical composition of aerosols from the MABL with the IGP, therefore, emphasizes the impact of biomass burning emissions.
Study of aerosols during two alternative pre-monsoon seasons: Influence of meteorological parameters

**OP 9**

## The Dependency of the Atmospheric Removal of Black Carbon on the Nature of Rain over Eastern Himalaya, India

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The major and important pathway for the atmospheric removal of Black Carbon (BC), the most important atmospheric constituents responsible for Global Warming, is its wet deposition. In order to investigate the interaction between BC and rain and the degree of BC scavenging below the cloud, an extensive study was made at Darjeeling, a high altitude hill station (2200 masl, 27Â° 02â€™ N, 88Â° 16â€™ E) at eastern Himalaya. BC was monitored continuously at an interval of 5 minute using Aethalometer (Magie Scientific, USA) and rainfall was measured using an automated weather station (Campbell Scientific, USA) at the Darjeeling campus of Bose Institute during premonsoon, monsoon and postmonsoon in the year of 2010. A total of 51 rain events have been studied during the entire study period. In order to asses the impact of rain of various nature on BC scavenging, the rain events have been classified into three groups based on the duration of rain. The events which lasted for less than 2 hours have been grouped as short, the events which lasted between 2 to 12 hours have been grouped as medium and the events which lasted for more than 12 hours have been grouped as long rain. In general, it was found that BC concentration was higher during daytime (0600 hrs-1800 hrs) compared to nighttime (1800 hrs-0600 hrs). Medium rain was found to scavenge BC more during daytime compared to night-time. This could be attributed to the fact that during night-time, the boundary layer height remains lower compared to daytime and all the BC particles were accumulated near the surface along a thinner layer for which the rain drops travelled a shorter distance through the BC particles and scavenging was less compared to daytime. We observed some interesting features for the scavenging of BC under short and long rain events. It was observed that short rain events scavenged more BC particles when the initial BC loading before the rain started was higher. We found a strong correlation ($r^2 = 0.76$) between the initial BC concentration and BC scavenging for short rain events. It was also observed that for short events, BC scavenging increased with the increase in rain rate, scavenging attained a maximum and above ~ 15 mm/hr rain rate, the scavenging dropped significantly. The same trend was observed for the medium rain events which scavenged BC particles during night-time. In case of long rain events, it was observed that as the rain rate increased, the scavenging of BC particles decreased i.e. the rain like drizzle washed out BC particles more from the atmosphere than the rain like heavy rain. This could be

attributed to the fact that for a long event, the rain drops of smaller size interact strongly with the smaller BC particles (as BC mainly accumulated in submicron aerosols) compared to the rain drops of larger size. This study based on the interaction between BC and raindrops will surely help in assessing rainfall-climate relationship over eastern Himalaya.

**OP 10**

**Quantification and Source Determination of Carbonaceous Aerosols in the Lidder Valley, Kashmir Himalayas**

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Four PM2.5 (particles with aerodynamic diameters less than 2.5 micrometer [Î¼m]) atmospheric particulate samples were collected on preheated quartz fibre filters using Envirotech APM 550MFC Fine Particulate Sampler during spring of 2012 at Aru (Pahalgam), Lidder valley in the Kashmir Himalayas for measuring the concentrations Black Carbon (BC) and organic carbon (OC). These samples were analyzed for OC/EC by thermal/optical reflectance (TOR) following the Interagency Monitoring of Protected Visual Environments (IMPROVE- A: a modified version of IMPROVE) protocol. Using this methodology the eight carbon fractions (OC1, OC2, OC3, OC4, EC1, EC2, EC3 and OP) were determined and the average concentration of these fractions was 0.025, 24.784, 6.773, 0.803, 0.734, 0.522, 0.600 and 1.086 Î¼g/m3 respectively. The total carbon (TC) concentration varied with time and was found in the order evening >late morning>afternoon> early morning which may be attributed enhanced human activities during late morning and evening time. In this study, EC to OC or/and EC to TC were used to differentiate the source of the black carbon and it was found all the samples show EC/OC ratio less than 0.5 and EC/TC ratio less than 0.1 which show that biomass burning is primary source of black and organic carbon in and around the sampling site. In the study there is negative correlation between OC and EC (r= -0.13), however the correlation between OC and TC is very strong (r=0.99) suggesting that secondary organic aerosol (SOA) formation by photochemical reactions is the main process responsible for higher concentration of OC in the atmosphere which also imply the higher concentration of Reactive organic gases (ROGs) in the atmosphere. Overall, these ï¬•ndings suggest that Biomass burning and photochemical activity appreciably affect total environment of the Lidder valley, which has future concerns for climate, water in the Jhelum Basin (Kashmir Valley) as the snow and glacier resources of the Lidder valley are the water house for the former and EC and OC are intermediate preventable threat to these water resources. Keywords: Lidder valley, organic carbon, elemental carbon, IMOROVE protocol.

**OP 11**

**Simulation of Aerosol Concentration Over Indian Region with an Online Chemistry Model**

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Over the Indian region both anthropogenic and natural sources (both proximate and remote) contribute to aerosol loading. The influence of aerosols on the Asian Monsoon system has been a topic of increased interest over a last decade. Simulations of aerosols over Indian region have been a challenge due to their diversified spatial and temporal distribution and have several limitations which result in large

deviations from measurements. We have studied the spatial and temporal distribution of aerosols over Indian region [55E- 97E, 1N- 37N] using a coupled atmospheric chemistry model, WRF-Chem. The model\'s performance has been validated by comparing with measurements made at several surface observatories, satellite data, aircraft observations and also with estimates from another global chemistry transport model . Our study shows that model is able to capture the spatial pattern of aerosol optical depth (AOD) at 550 nm over the region, for both the months considered in this study (May 2011 and October 2011) vis-a-vis MODIS satellite instrument. However, model fails to reproduce the magnitude of AOD as compared to MODIS. On an average, model AOD over the region is approximately half of the MODIS AOD during the study period. Similarly, based on comparison of aerosol black carbon (BC) simulated by the model with that measured at surface observatories, it was found that absolute magnitudes differ substantially with model underestimate measurements. Model fails to replicate the diurnal variations of BC concentration as compared to observations. Additionally, in comparison with aircraft observations, model underestimates the BC mass concentrations in the vertical profiles. Still, model simulation is in good agreement with the monthly mean black carbon concentration estimated by SPRINTARS (a global chemistry transport model) , for May 2011. Our analysis shows that, model\'s performance in simulating anthropogenic aerosols and their radiative effects (AOD) is affected by the use of deficient emissions inventory. Furthermore, it is seen that, model\'s inability in estimating BC surface concentrations looks to be tightly coupled with incorrect simulations of atmospheric state variables like atmospheric boundary layer (ABL) height and wind speed. From the analysis it is concluded that, there is a convincing need to improve the predictions of meteorological parameters, along with the necessary improvements in the state of the emissions inventory used in simulations, in order to have accurate simulations of aerosols.

**OP 12**

**Chemical characterisation and source apportionment of PM2.5 at urban location of Delhi during February to May 2011**

Gazala Habib, Abhijeet Pathak, D. Saha, Anil J. Ku
Assistant Professor

This paper discusses chemical composition of fine aerosol (PM2.5) and probable source contribution to local air quality of central road research institute (CRRI) during February to May 2011. The aerosol concentration was highest in February (212Â±90 ï•¬g/m3) and declining in successive months, lowest concentration was observed in May (81Â±27 ï•¬g/m3). In pre-monsoon period (April and May) the meteorology in terms of high wind speed and temperature supports the dilution and dispersion of aerosol resulting in lower PM2.5 concentration. Chemical constituents including carbonaceous fraction, ions and trace elements constitute 68, 78, 81 and 77% of total PM2.5 in February, March, April and May respectively. The unexplained mass varies from 19% in April to 32% in February. Unexplained mass could be due to unidentified organics (other than organic carbon) and water. Among chemical constituents carbonaceous aerosol concentration followed same trend as PM2.5. Highest concentration was observed in February 64Â±30 ï•¬g/m3 (30%), followed by March 53Â±26 ï•¬g/m3 (38%), April 49Â±24 ï•¬g/m3 (36%) and May 23Â±9 (28%). Average EC to OC ratio ranged from 0.7 to 0.8 in various months indicating the strong influence of anthropogenic sources (especially traffic) at CRRI. Among Ions sulphate, ammonium and chloride are major components following the same trend as PM2.5. Possibly

the ammonium nitrate having high vapour pressure evaporates at high temperature reflected by substantially declining concentration in many of the sampling days of warmer months (March, April and May). Trace element concentration was highest (31Â±12 ï•¬g/m3) in February and April, moderate in March (21Â±6 ï•¬g/m3) and lowest in May (17Â±6 ï•¬g/m3). Among trace elements sulphur dominated the aerosol mass followed by, potassium, calcium, iron, lead and chromium in all the months. The high sulpur content of aerosol mass could be attributed to coal combustion in 3 thermal power plants (Indraprasth, Rajghat, and Badarpur). The coal used in these plants contains 0.35-0.5% sulphur reported by Central Board of Irrigation and Power, (1997). PMF identified major sources as biomass burning, power plants, non-ferrous smelter, dust, vehicular emission, secondary aerosols, chromium and copper plating/battery processing industries. The implication of fine aerosol and chemical constituents on local air quality and regional climate will be discussed.

**OP 13**

**Decadal changes of aerosol-cloud interactions over Indian subcontinent**

Saurabh Das
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Atmospheric aerosols are important parameter which modulates the cloud characteristics through various indirect effects which are not yet fully quantified. It has been reported that the anthropogenic aerosols are the primary reason for change in cloud properties. The smaller cloud droplets are also observed in polluted places compared to unpolluted region. Therefore it is very important to study the effect of decadal changes of aerosols on the decadal changes of cloud properties, which is directly related to the climate change. The increases of aerosol over the years are reported by various researchers from Indian subcontinent. However, the impact of such changes of aerosol property on cloud structure over this region is not fully explored. With the availability of 10 years of MODIS satellite based aerosol and cloud data over land and ocean surfaces, the decadal changes of the interactions between aerosol and cloud effective radius (CER) has been studied over Indian subcontinent. In this paper we have shown the correlation between this two parameter changes appreciably over some parts of the country, which is found to have significant growth in population. The results may have important implication on the modeling of monsoon rain over Indian region.

**OP 14**

**Investigation on the effects of anthropogenic aerosols on East Asian Monsoon Climate**

Tijian Wang
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The Regional Climate Chemistry Modeling System (RegCCMS) was applied to investigate the spatial and temporal distribution of anthropogenic aerosols as well as their radiative forcing and effect on monsoon climate over East Asia. Results show that high level of aerosols distributed in southwest and center to east China with substantially seasonal variations. The maximum column burdens exceed 90.0, 27.0, 8.0, 18.0 mg/m2 for sulfate, nitrate, black carbon and organic carbon, respectively. Annual mean aerosol direct, first indirect and combined radiative forcing(RF) at TOA was -1.02, -1.87 and -2.89 W/m2, respectively. Strong direct RF appeared in spring and fall while indirect effect forcing appeared in summer. Cloud amount, absorbed column solar radiation, surface air temperature, total precipitation and cloud liquid water path changed by -0.02 %, -4.76 W/m2, -0.25 K, -0.17 mm/d and +4.67 g/m2 over

the region due to the affections of aerosols. Owing to more cooling effects of aerosols over continent, air temperature gradient between land and ocean increase in winter while decrease in summer, which may lead to stronger winter monsoon and weaker summer monsoon in East Asian. The weakness of summer monsoon and the second indirect effects of aerosols resulted in less precipitation over south China. Decreases of rainfall and air temperature were in favor of the formation and accumulation of aerosols, which would in turn strength the climate effect induced by aerosols. Thus, a positive feedback processes may occur between aerosol and monsoon climate.

## Poster Presentation list for C4

**B1**

**Study of aerosols during two alternative pre-monsoon seasons: Influence of meteorological parameters**

Dinesh Kumar Sharma
Manav Rachna College of Engineering

The aerosol size distribution has been done by many workers (Aher and Agashe, 1997; Devera and Raj, 1998; Vakeva, 2000; Zhang, 2001 etc.). In this paper the aerosol density distribution for different ranges has been studied in relation with some meteorological parameter like relative humidity, temperature, rainfall and wind speed during two alternative Southâ€“East (SE) pre-monsoon (May-July 1999 and May-July 2001) at Roorkee (77ï‚°53\' E, 29ï‚°52\' N and hmsl 275m). The measurements were done with the help of Optical particle counter by exposing the particles to light and counting their number determining their size. The counter monitors the particle concentration in four different size ranges viz: 0.3-0.5 ï•m, 0.5-1.0 ï•m, 1.0-2.0 ï•m and 2.0-5.0 ï•m. These size ranges are mainly responsible for the optical effect, cloud condensation and radiation budget in the atmosphere. An analysis has been done taking the daily average number density of aerosols and meteorological parameters. An effort has been made to compare the effect of meteorological parameters on aerosols concentration for two alternative pre-monsoon seasons. The present study brings out the fact that the number density of aerosol is very much affected by the meteorological parameters. During this period the rain has played significant role to modulate the aerosol concentration. In the month of July the concentration of aerosol was less than that from the month of June and it was maximum in the month of May during both years. The large size ranges (1.0-2.0 ï•m and 2.0-5.0 ï•m) were much effective compare to the lower size ranges (0.3-0.5 ï•m and 0.5-1.0 ï•m). The decrease of concentration for aerosol in the month of July has been attributed to the scavenging by the prevailing monsoon rain. The size spectrum has been shown a significant shift towards bigger sizes due to high humidity and low temperature. The wind speed was not effective in characterizing the aerosol concentration during both years. References 1. Aher, G. R. and Agashe, V. V., 1997, abstract book of TROPMET\'97, IISc. Bangalore, 31-32. 2. Devara, P. C. S. and Raj, P. E., 1998, Atmosfera, 11, 199-204. 3. Vakeva, M., Hameri, K., Puhakka, T., Nilsson, E. D., Hohti, H. and Makela, J. M., 2000. Journal of Geophysical Research, 105, 9807-9821. 4. Zhang, X. Y., Arimoto, R. Cao, Jun J. An, Zhi S. and Wang D., 2001. Journal of Geophysical Research, 106, 18471-18476.

**B2**

**Winter Time study of PM10 and PM2.5 Aerosols at Pune**

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Indian Institute Of Tropical Meteorology

Abstract: Monthly mean levels of particulate matter (PM2.5 and PM10) in the ambient air measured at a tropical urban city Pune, situated in South West India during Jan to Dec 2008 have been studied. Observations were carried out on the terrace of the IITM building using an aerosol spectrometer GRIMM (Model 1.108) at every 5 minute interval. This portable instrument gives single particle counts or masses and size classifications in 15 size interval (from 0.30 to > 20 Âµm) in real time. Ambient air is sampled by a volume controlled in-built pump at the flow rate of about 1.2 l/min. Mean monthly variations indicated high levels for both PM10 and PM2.5 during the post-monsoon (Oct-Nov) and winter (Dec to Feb) seasons with mass concentrations of 115.7 and 111.4 Âµg/m3, respectively for PM10 and 93.4 and 79.8 Âµg/m3, respectively for PM2.5. These high values are because; the observations were carried during post-monsoon and winter seasons when the local boundary layer is shallow and dispersal of particles is low. Also, particles from anthropogenic sources like biomass burning are more. This study is important because these particles cause degradation of local air quality and also show harmful effects on human health.

**B3**

**RADIATIVE FORCING DUE TO BLACK CARBON OVER DELHI**

Divya Surendran
Indian Institute of Tropical Meteorology,Pune

The radiative effects of black carbon (BC) aerosols over New Delhi, the capital city of India, for the period August 2010-July 2011, has been investigated using Santa Barbara DISTORT Atmospheric Radiative Transfer model (SBDART) in the present paper. The monthly mean BC concentrations in Delhi, an urban location varies in between 15.1Î¼gm-3 (December2010)-1.8Î¼gm-3 (July2011).The highest value for monthly mean BC forcing has been found to be the in May2011(99.90wm-2 ) and the lowest in October 2010 (6.04wm-2 ). Generally, the atmospheric burden of aerosols is expected to be the minimum during the monsoon months (JJAS), however in this special case, we found that the BC forcing is the minimum in the month of October. This striking result could be due to the fact that, during Common Wealth Games 2010, (03-14 October 2010), there had been a strict restriction on the traffic, the construction activities and the functioning of thermal power plants, thereby a significant reduction in the emission of fossil fuel aerosols. Even though the stability of the atmosphere during Games was favorable for the build-up of aerosols in the boundary layer, the BC-induced radiative forcing is found minimum in the month of October. This is also attributed to the imposed restriction of traffic and other anthropogenic activities during the same period.

**B4**

**Seasonal Variation of Black Carbon Aerosol over Sinhagad**

M.P.Raju
IITM Pune

The Black Carbon (BC) is emitted into the atmosphere as a byproduct of all in-complete combustion processes and is a strong absorber of solar radiation and thus contributes to climate warming. BC causes harmful effects on human health too. The Aethalometer (Magee Sci., Inc., USA, Model AE-42) was used for the real-time measurement of BC aerosols in the atmosphere at Sinhagad, a high altitude station situated in Western ghat region of India at around 1450 m amsl altitude. BC observations were carried out at every 5 min interval with a sample flow rate of about 3 LPM. Observations were undertaken for three consecutive years during 2010 to 2012 in the summer and winter seasons. Studies revealed that the BC mass concentration was high during winter season than in summer season, because in winter season boundary layer is shallower than in summer. During 2010, 2011 and 2012 mean BC

concentration in winter season was 2.25, 4.21 and 3.94 Âµg/m3 and in summer it was 1.8, 0.98 and 1.91 Âµg/m3, respectively. Diurnal variation of BC concentration was also studied. MODIS Satellite derived AOD500 and BC showed good correlation during the entire period of the study. BC showed good correlation with temperature and negative correlation with humidity.

**B5**

**Chemical Composition Change of PM10 over a period of five years at an urban location**

Nikhil Rastogi, Tarun Gupta
IIT Kanpur

Ambient aerosol measurement and collection followed by gravimetric and chemical speciation in and around Kanpur (a prominent site in the Indo-Gangetic Plains) has been going on for quite some time. Filter based samples of submicron (PM2.5) particles have been collected in the last year inside IIT Kanpur campus (26Â°50Â´ N, Longitude: 80Â°20Â´ E). They were primarily analyzed for ions (NH4+, Cl-, NO3- and SO42-), trace elements (Ti, V, Cr, Mn, Co, Ni, Cu, Fe, Zn, Pb, Cd, Sr, Ca, Na, K, Mg etc.). The aim of this study was to quantify the chemical properties of dust and the intensity of mixing due to interaction with the various anthropogenic activities during its long range transport. It was observed that most of the crustal elements (Ca, Fe, K, Mg, and Na) have higher concentration than non-crustal elements. When compared to Dusty & Non Dusty days, the non-crustal elements didnâ€™t show much variation whereas the crustal elements increased by 2-3 times on dusty days when compared to days just before the dust events. But their concentration just after dust event didnâ€™t came down much. This means that some dust stayed in the atmosphere even after the dust storm got over. The concentration of non-crustal elements (like Cu, Ni, Se, Cr etc.) increased continuously even after the dust-storm subsided. We observe just before a dust event the crustal elements had EF<1 which means that they were of crustal origin only but during and after dust days these elements were suitably enriched suggesting that some part of those came due to mixing with anthropogenic sources which then formed a part of dust for a few days. Most of the non-crustal elements except Cd, Pb, Se & Zn were moderately enriched while Cd, Pb, Se & Zn were very highly enriched meaning domination of anthropogenic sources. The possible source for Cd is household-waste combustion, fossil-fuel burning and refinery. Pb includes leaded gasoline, fuel combustion, industrial processes and solid waste combustion. Pb in coarse mode was probably emitted from the mining activities. Higher concentration of Cd and Pb during the non-event days suggests that possibly, they are emitted within the basin and get mixed with the dusts during the transport over the polluted areas. 5 day backward trajectories of the air mass were computed at 0-2 km height from final run data archive of GDAS model using the NOAA Air Resource Laboratory (ARL) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) program to study how source & long range transport affected chemical composition. From our study we could conclude following things: â€¢ Major part of dust comprised of mineral dust on both dusty and non-dusty days. â€¢ Pollutant elements were always in lower conc. but highly enriched. â€¢ Back trajectory analyses show that the source of most of the dust were gulf countries.

**B6**

**Relation between rainfall and aerosols in the north western part of India**

Priya Narayanan
TERI University

Understanding the importance of Aerosols on the rainfall pattern of North western part of India using a bottom up approach of comparing station based rainfall data (1949- 2009)with specific climatic indices to show the long term variation in monthly and seasonal rainfall. Computation of aerosol indirect effect using MODIS data for the period between 2003-2012, to understand the relation between changing

rainfall and aerosols. The dominant source of aerosol in this region is dust but with increasing urbanization and changing land use dynamics near the cities studying aerosols and rainfall on smaller scale could become increasingly important. Computation of aerosol indirect effect and correlation with rainfall gives the spatial relation.

**B7**

**Interannual variability of Total Columnar Ozone and Aerosol Optical Thickness over eastern Himalaya, India**

Ajay K Singh, Abhijit Chatterjee, Sanjay Ghosh, Si
Bose Institute, Darjeeling, India

An extensive study has been made to investigate the seasonal and inter-annual variability of total columnar ozone over Darjeeling (27Â º 02â€™ N, 88Â º 16â€™ E), a high altitude hill station (2200 masl) at eastern Himalaya. In order to do this, total columnar ozone (TCO) was measured over Darjeeling campus of Center for Astroparticle Physics and Space Science, Bose Institute using hand held Sunphotometer (Microtops, Solar Light Company, USA). The data were collected only on the clear-sky, cloud free sunny days at an interval of 15 minutes. TCO were measured along with Aerosol Optical Thickness (AOT) at the wavelength of 500 nm for the consecutive four years from January 2009-December 2012. It was observed that TCO varied between 212 DU and 543 DU with an average of 311 DU during the entire study period. TCO showed a strong interannual variability from 2009 to 2012. It was observed that TCO increased gradually from 2009 to 2012. The average TCO were 277 DU in 2009, 308 DU in 2010, 322 DU in 2011 and 336 DU in 2012. However, the gradual increase in TCO from 2009-2012 was found during winter (Jan-Feb) and premonsoon (Mar-Apr) seasons only. The increase in TCO was highest during premonsoon (30-40 %) compared to winter (20-25 %). During postmonsoon (Oct-Nov) season, the minimum TCO was found in 2009 and the maximum was found in 2010 and it gradually decreased from 2010 to 2012. Monsoon did not show any systematic pattern in the interannual variability of TCO. AOT at 500 nm showed a strong seasonal variability during each year of the entire study period. The average AOT was found to be 0.32. It was observed that AOT was maximum during premonsoon followed by winter and postmonsoon. This trend was observed in each year. The average AOT was found to be gradually decreased from 2009 till 2011 and again increased in 2012. The high aerosol loading during premonsoon could be due to the higher vehicular and other anthropogenic activities as premonsoon season is the peak season for the tourists. Also, the transport of fine mode aerosols from the long distant source regions driven by premonsoon westerlies could play role in high loading of aerosol and hence AOT at 500 nm. On the other hand, massive biomass burning could enhance the aerosol loading during winter. This long-term data on AOT could be used in validating the satellite derived data and in climate model on the regional context and also could be used in deriving radiative parameters over eastern Himalaya.

**B8**

**Characterization of atmospheric fine and coarse particles in northern India**

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Characterization of atmospheric fine and coarse particles in northern India Atar Singh Pipal* and Ajay Taneja Department of Chemistry, Dr. B. R. Ambedkar University, Agra, India- 282002 *Email: aspippal@gmail.com Morphological and individual elemental composition of atmospheric particulate matter and their probable sources has been conducted at roadside and semirural site of Agra during summer and monsoon season in north central part of India. Scanning electron microscopy coupled with

energy dispersive spectrometer was used to understand the difference between shapes, morphology and elemental composition of aerosols. The average mass concentration of PM2.5 varied from 33.00 - 90.14 ï•g/m3and PM10 varied between 71.00 - 279.00 ï•g/m3 at roadside whereas at semirural site it was found between 89.12-96.00 ï•g/m3 and 111.00-235.00 ï•g/m3 for PM2.5 and PM10 respectively. The EDX spectrum indicates the individual elemental composition of particles. The major composition of fluorine, carbon, oxygen, Silicon and Na rich particles were observed in fine and coarse at roadside as well as semirural site. SEM micrograph indicates that the particles are spherical, cluster, flaky, chain like shape in PM2.5 and PM10 have irregular, spherical, fine rod like shape, crystalline shape particles during summer period. In monsoon the morphology of PM2.5 particle are dominated by flaky, net, lattice shapes, and scavenged type particles whereas morphology of PM10 particles is spherical, elongated and rod like shape at both sites. On the basis of morphology and elemental composition, the particles are classified as mineral, tarballs, fly ash, aluminosilicates, carbon rich, and Cl-Na rich. It was concluded that SEM-EDS is a convenient method to identify individual elemental composition and morphology of particle and their sources of emission.

**B9**

**Chemical, optical and physical characteristics of aerosol over Indo-Gangetic plain**

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Chemical, optical and physical characteristics of aerosol over Indo-Gangetic plain Ashok Jangid1 and Ranjit Kumar2 1Department of Physics and Computer Sciences, Faculty of Sciences, Dr. B.R. A. University, Agra. E-mail: ashjangid@gmail.com 2Department of Chemistry, Technical College, Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra-5. E-mail: rkschem@rediffmail.com Abstract: Atmospheric aerosols play an important role in radiative forcing and climate change. In addition, they are responsible for visibility impairment and have significant implications for human health. Estimation of aerosol effect on radiation is more uncertain than that due to well mixed green house gases, because of their short life times, highly inhomogeneous spatial distribution and its complex nature of interaction with radiation. Indo-Gangetic plains is facing drastic changes in climate since last few decades and suffering from changes in monsoon patterns and number of diseases. These effects depend upon chemical, physical and optical properties of aerosols. Hence, measurements of mass, number and chemical constituents of aerosol as well as aerosol optical thickness and modeling are reported in Agra over Indo-Gangetic plain in India.

**B10**

**Carbonaceous Aerosols over the Tropical Urban Station Pune, India**

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Carbonaceous Aerosols over the Tropical Urban Station Pune, India P.D. Safai, M.P. Raju, G. Pandithurai, P.S. P. Rao and P.C. S. Devara Indian Institute of Tropical Meteorology, Pune-411008 Abstract Growing anthropogenic activities associated with emissions from fossil-fuel, biomass burning, land use changes and industrial growth have led to rapid increase in the atmospheric concentrations of carbonaceous species over Pune. The present paper deals with the results obtained from an year long (2012-13) observations on Organic and Elemental Carbon as well as Black Carbon; using the OCEC Analyzer and Aethalometer, respectively. The average mass concentrations of OC were 18.5 Â± 5.2, 13.5 Â± 5.1, 5.7

Â± 2.9 and 1.9 Â± 1.4 Âµg m3, respectively during winter, post-monsoon, summer and monsoon seasons. Whereas, those for EC were 6.7 Â± 1.9, 5.5 Â± 1.9, 2.3 Â± 0.9 and 1.3 Â± 0.6 Âµg m3. Mean annual OC/EC ratio was found to be 2.56 Â± 1.98 during the study period, suggesting the presence of secondary organic aerosols (SOC) in the atmosphere over Pune. Estimated SOC was found to form about 90 % of OC mass concentration (varying between 84 % in summer to 94 % in winter). OC and EC were also found to be significantly well correlated ($r = 0.95$, $p < 0.0001$) to each other, indicating towards common sources from biomass/fossil fuel burning. Mean annual EC/TC ratio was 0.32 indicating that about 1/3 of TC is formed from fossil fuel burning (mainly vehicular emissions) which is very crucial as Pune has more than 1.7 million two wheelers out of about 2.2 vehicles on road. Thermally derived EC and optically derived BC (from Aethalometer data) were found to correlate very well ($r = 0.92$, $p < 0.0001$) indicating a good comparison between these two equipments.

**B11**

**THE ACUTE EFFECT OF AMBIENT PM2.5 RESPIRATORY FUNCTIONS AMONG HEALTHY INDIVIDUALS OF IIT DELHI.**

Gaurav Singh
IIT Delhi

Urban air pollution is a matter of concern due to its adverse consequences for human health and the environment. The dynamics of economic growth, industrialization and urbanization coupled with population growth are primarily responsible for air pollution. Worldwide, it is estimated that urban air pollution causes 800,000 deaths annually, 2/3rd of which occur in the developing countries of Asia. Among air pollutants fine aerosol (PM2.5) has been especially linked with disease like cancer, respiratory and cardiac illness. Present study focuses on development of statistical relationship of ambient concentration of fine aerosol (PM2.5) with respiratory symptoms and pulmonary function during winter season. The subjects (Healthy and susceptible) were recruited based on standard questionnaire survey designed by American thoracic society and modified for present study. The questionnaire included information about physical parameters (i.e. height and weight), medical history, persistence of respiratory symptoms, medication details, diet, smoking habits, physical activities, family history and occupational pollution exposure. Questionnaire was filled by 117 individuals (84 male and 31 female) between age 17 to 30 years. Prevalence of cough, phlegm and dyspnea was found in 17, 15 and 25% of participants. Morning and evening pulmonary functions i.e. force vital capacity (FVC); force expiratory volume in 1 second (FEV1); peak expiratory flow rate (PEFR); FEV1/FVC) were measured among 18 selected students of average age 21 years (20-27) of IIT Delhi. 10-h average ambient day and night PM2.5 concentration measured at IIT Delhi during winter season (December, 2012 and January, 2013) were 164 Â±75 ï•¬g/m3 and 171Â±77 ï•¬g/m3 respectively. This paper will discuss the relationship between PM2.5 concentration, regional meteorology, local and trans-boundary pollution sources and respiratory symptoms.

**B12**

**Meteorologically-adjusted trend analysis of surface observed PM2.5 concentrations at ITO site in Delhi, India: 2007-2010**

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Indian Institute of Social Welfare and Business Management

It is well known that meteorological parameters have significant impact on surface particulate matter concentrations. Therefore it is important to remove the effects of meteorology on PM2.5 concentrations

to correctly estimate long-term trends in PM2.5 levels due to the changes in different emissions source categories. This is important for the development of effectual emission control strategies. In this study surface observed met-adjusted PM2.5 trends in New Delhi are analyzed using different statistical analyses tools such as Kolmogorov- Zurbenko filter and the CART regression tree methods The statistical models are applied to the PM2.5 data at the ITO site in New Delhi metropolitan areas, The ITO site is located adjacent to a traffic crossing. This is the only site in New Delhi where long-term PM2.5 data is available. The ITO site is also influenced by local industrial emissions. Preliminary results after applying KZ filter to 24-hr average PM2.5 concentrations at the ITO site reveal that short term component of PM2.5 influenced by weather has the largest variance followed by the baseline component attributable to climate and policy. The seasonal component has the least variance. In subtropical regions the variability in seasons is less and hence do not strongly influence concentrations. Since PM2.5 shows poor correlation with temperature, other meteorological parameters such as wind speeds, mixing heights or a combination of both may have a bigger influence on PM2.5 concentrations in Delhi.

**B13**

**AEROSOL PROPERTIES OVER RANCHI MEASURED FROM AETHALOMETER**

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Birla Institute of Technology,mesra

In Ranchi, the atmospheric aerosols are a combination of anthropogenic, maritime and continental types. Their signatures, which are also attributes of their history, may be identified by the relative concentrations of fine and coarse particles, single scattering albedo, and optical refractive index when chemical analysis of air samples is not available. The Black carbon is major component of the aerosol over the polluted city like Ranchi. The present study is primarly concerned with the measurement of BC over Ranchi, to report on the measured aerosol characteristics over Ranchi in India using a Aethalometer. The correlations between column volume concentrations of different aerosol concentration measured by an Aethalometer from July 2010 are given, one important thing of Diurnal variations Black Carbon (BC) that BC concentrations are high during morning (0600 to 0900 h) and evening hours (1900 to 2300 h) compared to afternoon hours. Compared to weekdays, significant reduction in BC values has been observed during weekends. BC concentrations are high during dry season compared to rainy days. In this paper site taken as non-polluted area as BIT Mesra, Ranchi, where we chosen month of July as rainy season to compare the result of clear days and rainy days with weekend of another months.The peak value of BC during rainy of July month reaches upto((~5850ng/m3) at 06:25 hours while during clear day it reaches only upto(~17865ng/m3) at 00:10 hours in30/9/10 and on weekend it reaches upto(~29154ng/m3) at 00:45hoursin2/10/10. The results are discussed in detail in the paper. Keywords: Black Carbon(BC), Aethalometer.

**B14**

**Cloud condensation nuclei and aerosol measurements over the Bay of Bengal**

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Cloud condensation nuclei and aerosol measurements over the Bay of Bengal R. T. *Waghmare, Chate, D. M., Gopalkrishanan, V., Beig, G., Sachin D. Ghude, Chinmay Jena and P. C. S. Devara Indian Institute of Tropical Meteorology, Pune - 411 008, India (*Author for correspondence: ravi@tropmet.res.in)

Abstract Measurements of Cloud Condensation Nuclei (CCN) distribution with super saturation (ss) between 0.2 and 1 % and aerosol size distribution were made over the Bay of Bengal (BoB) during Continental Tropical Convergence Zone (CTCZ) cruise campaign. In this study we present CCN and aerosol distribution on board during stationary position of Sagar Kanya cruise observations (21 to July 28 2012) over the BoB. A power law relationship between CCN concentrations and atmospheric super saturation (ss) in terms of empirical constants C and k, the CCN spectra are derived for averaged CCN concentrations over stationary period. The fitted spectral parameter of C is 1416 cm-3 and k is about 0.27 over the BoB show that they are classified to the CCN in maritime environment. The empirically derived C and k values are comparable to those reported over the sea surface in the world and thus support the quality of our CCN measurements and may be useful for a case study of CCN closure in marine environment. Keywords: CCN, CTCZ, power law, atmospheric super saturation, CCN-100

**B15**

**Nocturnal observations of aerosol backscatter profiles using LiDAR over central Himalayas and the validation of CALIPSO data**

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Aerosols play vital roles in the earthâ€™s radiation budget, cloud formation and climate change. The measurements of vertical distribution of aerosols are critical to assess the radiative impact of aerosols on the surface and atmosphere. In addition, aerosols influence the lifetime and micro-physical properties of clouds, precipitation rates, and tropospheric chemistry. Considering such an importance, numerous efforts were made from ground based and space borne observations of aerosol distribution and properties along with model simulations around the globe. However, such studies are very limited over the Indian region particularly those having the information on the vertical distribution of aerosols. Over the Indian regions, satellite based observations have shown very high pollution loadings in terms of aerosol optical depth particularly over the Indo-Gangetic Plain (IGP) region. However, due to sparsity of the ground-based observations, satellite data validation is still severely lacking over this region. On account of this scenario, regular observations of aerosol backscatter profiles are being made using LiDAR for Atmospheric Measurements and Probing (LAMP) from a high altitude station Manora Peak (29.360N, 79.450E, 1951 m amsl), Nainital, located in the central Himalayas since October 2011. LAMP measures the atmospheric backscatter at 532 nm, 2.5 KHz PRF and 15m vertical resolution. We analyze a total of 82 night observations in order to understand day-to-day and seasonal variability in the vertical distribution of aerosols over this region. Further, we attempt to validate the satellite (CALIPSO) retrieved vertical profiles over this region. The validation of CALIPSO over such a complex terrain would enable the retrievals to be used with greater confidence over the Himalayas and the adjoining IGP region. The backscatter profiles for aerosols show strong seasonality in the vertical distribution of aerosols 2 km above ground level (AGL). During winter months the backscatter coefficient varies from 0.8 to 2.3(Â±0.4) (Mm sr)-1 within 2 km above ground level, whereas during the spring, higher aerosol backscatter of 1.0 to 2.3(Â±0.5) (Mm sr)-1 up to 5 km AGL, is observed, including some cases of elevated aerosol layer up to 6 km. The pre-monsoon period witnesses few thunderstorm activities, due to which backscatter coefficient is found to have the maximum values of 4.0(Â±0.8) (Mm sr)-1 up to 4 km. These observations suggest that the regional emissions along with the stronger tropical convection which uplifts the aerosols throughout the lower troposphere is responsible for aerosol loading up to 5km (AGL) in the atmosphere. The observed elevated aerosol layers have been analyzed using the back air trajectories simulated by HYSPLIT model. In order to validate the satellite data, Level2 Version 3.02 of CALIPSO

archived data sets have been utilized in this study. Nearly simultaneous retrievals are selected spatially within 250 km between satellite

**B16**

**Pre-monsoon Characteristics of Atmospheric Aerosol over Indo-Gangetic Basin (IGB) using AERONET during 2011**

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Pre-monsoon Characteristics of Atmospheric Aerosol over Indo-Gangetic Basin (IGB) using AERONET during 2011 S. Tiwari1, A. K. Singh*1 and A. K. Srivastava2 1Atmospheric Research Laboratory, Department of Physics, Banaras Hindu University, Varanasi â€“ 221005, India. 2Indian Institute of Tropical Meteorology (Branch), Prof Ramnath Vij Marg, New Delhi, India Abstract: Atmospheric aerosol play a vital role in Earthâ€™s radiation budget and global climate studies. In the present paper, aerosol characteristics are studied at five different location in the Indo-Gangetic Basin (IGB) viz. Karachi (24.870N, 67.03 E), Lahore (31.540 N, 74.320 E), Jaipur (26.900 N, 75.900E), Kanpur (26.40 N, 80.40 E) and Gandhi College, Ballia (25.8â—¦ N, 84.2â—¦E) during pre-monsoon season (April - June ) 2011. The study was carried out using AERONET (AERosol RObetic NETwork) level 1.5 data for measuring the Aerosol Optical Depth (AOD) and other parameters and find that AOD loading and their other associated parameter are high during pre-monsoon. We observed that during pre-monsoon season coarse aerosol particles are dominant which may be due the dust storm carried out from the Middle East and Thar Desert region. Interesting observed results are discussed in terms of optical and radiative properties of aerosol. Keywords: Optical properties; Radiative properties; pre-monsoon; Indo-Gangetic Basin

**B17**

**Black Carbon Variation at Bhubaneswar**

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CSIR - Institute of Minerals and Materials Technology

Black Carbon (BC) mass concentration variations were studied at Bhubaneswar (21Â°15â€™ N; 85Â°15â€™ E), a rapidly developing city of Odisha over a period of one year (Dec 2011-Nov 2012). Daily, monthly and seasonal measurements of BC revealed a winter maxima followed by post monsoon, monsoon and lowest during pre monsoon. The seasonal variation of the BC mass concentration was also interpreted through the meteorological parameters (temperature and wind speed), boundary layer effect and GIS analysis of fire events. This study further discloses that the winter maxima are basically due to several factors such as stable atmospheric conditions, long range transport over the IGP and Western Asia vide back trajectory analyses, fumigation effect and compressed boundary layer. Study of diurnal pattern of BC mass concentration at Bhubaneswar suggested the presence of two characteristic peaks that were observed in all four seasons. However, during winter the morning and evening peaks were more distinct. Local boundary layer dynamics along with anthropogenic activities have been assumed to have a pronounced effect on the diurnal cycle in different seasons. Day-night variation in BC mass concentration was found to be distinctly high during winter followed by post monsoon and monsoon, whereas no such variation occurred during pre-monsoon. To see a coorelation of BC with CO at our site 12-hour day time daily averages of BC and CO were taken for the above mentioned time period. A positive correlation was seen between CO and BC which would suggest that both the species

might have same source of production. Finally statistical analysis of the data showed that the variation of BC was significant during the months in a season and non-significant during the days.

**B18**

**Variability in OC and EC during Pyrotechnic Display in 2011 and 2012**

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The atmospheric abundance of Elemental Carbon (EC), Organic Carbon (OC) and Total Carbon (TC) has been measures during the Diwali time of 2011 and 2012 along with Pre and Post Diwali periods over two tropical cities of India namely Jabalpur and Pune. The abundance in the concentration of OC during 2011 at the Pune shows a peak value (~ 34 ï•¬g/m3) on 18th Octâ€™11 compared to all the other days during pre-Diwali period and it has significantly gets decreased in the constituent days, while the Concentration of OC has remain the same during the post-Diwali period. However in 2012 the concentrations OC is significantly increasing during the pre-Diwali period till 7th Novâ€™12 and then it has reduced. The concentration of EC during 2011 Pre-Diwali period is increasing and peaked (~ 17.5 ï•¬g/m3) on 18th Octâ€™11 and from there it has decreased in the constituent days of the period, while in the Post-Diwali period the concentration of EC has remained almost constant. Here Both the OC and EC are showing the same trend during the sampling days in both the years. The value of concentration of OC/EC here for the Pune site is indicating that it is influenced majorly by firework combustion. The concentrations of the OC/EC ratio were significantly increased after Diwali period compared to the before Diwali period because of the combustion of the firework made during the Diwali.

**B19**

**Physical and optical properties of aerosols over Anantapur during monsoon**

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Surface measurements of aerosol physical properties were made at Anantapur ($14^0\ 62^1$N, $77^0 65^1$E, 331m asl), a semiarid rural site in India, during Jun-Dec 2012. Measurement included the segregated sixes of aerosol as well as total mass concentration and size distributions of aerosols measured using a Quartz Crystal Microbalance (QCM) in the 25-0.05 µm aerodynamic diameter range. The hourly average total surface aerosol mass concentration in a day varied form 9-40 µg/$m^{-3}$ with a mean value of 17.07±6.9 µg/$m^{-3}$ for the entire study period. A clear diurnal pattern appeared in coarse, accumulation and nucleation-mode particle concentrations, with tow local maxima occurring in early morning and late evening hours. The concentration of coarse-mode particles was high during monsoon season, with a maximum concentration of 12.51±1.05 µg/$m^{-3}$ in the month of September, where as accumulation mode concentration was observed to be low in the monsoon period contributed >35% to the total aerosol mass concentration. Accumulation aerosol mass fraction $A_f$ ($=M_a/M_t$) was observed during monsoon (mean value of $A_f$ ~ 0.50) and (lowest of $A_f$ ~ 0.24). The regression analysis shows that both $R_{eff}$ and $R_m$ are dependent on coarse-mode aerosols. The relationship between the simultaneous measurements of daily mean aerosol scattering coefficient at 550nm ($\sigma_{sp}^{550}$) and $PM_{2.5}$ mass concentration shows that surface-level aerosol mass concentration positive correlation with scattering coefficient of aerosols.

**B20**

## BLACK CARBON (BC) AEROSOLS AND THEIR IMPACT ON CLIMATE

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Atmosphere consists of gases and aerosols in concentrations that can affect environment and health. Most of the aerosol sources are located near the Earth's surface. Atmospheric aerosols are of natural and anthropogenic origin. Studies of Central Pollution Control Board (CPCB) have revealed that the Respirable Suspended Particulate Matter at several stations far exceeds the National Ambient Air Quality Standards. A decreasing trend in sulphur dioxide and nitrogen dioxide levels have been observed due to various measures taken for Vehicular pollution control. It has been argued that aerosols cause air quality degradation in Asian region during winter. The concentration of aerosols in Indian region has reached high values and may have adverse impact on our regional climate, agricultural production and health. Aerosols produced from different natural and anthropogenic sources are mixed together in the atmosphere and hence each aerosol particle is a composite of different chemical constituents. The chemical composition of aerosols determines their complex refractive index which depends on the source of particle. Aerosols, in general, consists of sulphates, nitrates, sea salt, mineral dust, black carbon (BC) and organic carbon (OC). On a global basis, approximately 20% of BC is emitted from burning s biofuels, 40% from fossil fuels and 40% from burning bio-mass in open. The range of BC mass concentrations varies from 1 $\mu gm^{-3}$ to as high as 16 $\mu gm^{-3}$. Recent studies ever the Indian region have shown that irrespective of the comparatively small percentage contribution in optical depth, aerosol BC has an important role in the overall absorption and hence warming of the lower atmosphere. Aerosol BC mass concentration over India and china is quite large (10-20 $\mu gm^{-3}$ ). When the amounts of absorbing aerosols is significant, the reflectance of underlying surface Plays an important role due to its short wavelength absorption. An aerosol with significant BC content can have net warming effect and complement the green house warming, but simultaneously it cools the earth surface by reducing the incoming solar radiation. Atmospheric temperature decrease due to the surface dimming is larger than atmosphere warming by BC. Thus, reduction of BC leads to reduction of surface cooling and may lead to an increase in atmosphere warming.

Key Words: Aerosols, pollution, climate, aerosol BC, atmospheric warming.

**B21**

## Carbonaceous and Inorganic Species in PM2.5 over the Source Region of Biomass Burning Emissions in the Indo-Gangetic Plain

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Perennial haze and wintertime fog has been observed every year over the Indo-Gangetic Plain (IGP) with limited understanding on corresponding particulate composition. The chemical characteristics of absorbing (elemental carbon (EC)) and scattering types particles (sulphate, nitrate, and organic carbon (OC)) in ambient PM2.5 have been studied from a site (Patiala, 30.2 oN, 76.3 oE; 250 m amsl) located in the source region of haze over IGP. The study was carried out during October 2011 to March 2012, a time span covering periods dominated by post harvest paddy-residue burning (October-November, period-1), fossil fuel and biomass burning (December-February, period-2) and local semi-urban emissions (March, period-3) with different meteorological conditions. The contribution of total carbonaceous aerosols to PM2.5 ranged from 40 to 70% during the study period with higher values

during period 1. Striking diurnal differences were observed in PM2.5 masses as well as in the concentrations of several important chemical species (e.g., SO42-, NO3-, OC, EC, and WSOC) during period-1. On average, OC/EC ratios for the daytime and nighttime samples were ~8.7, 6.5 and 3.1, and ~13, 7.3, and 3.9 during the periods 1, 2 and 3, respectively; suggesting EC contribution to carbonaceous species is significantly lower in period-1 and increases subsequently. A linear correlation between daytime and nighttime OC and K+ was observed for all the three periods over the study site, suggesting that the K+ can be used as a tracer for biomass burning over the IGP with the OC/K+ characteristic ratio of ~16. Further, nitrate concentrations were comparable to SO42-, and OC was significantly higher than SO42-, suggesting the significant abundance of scattering aerosols (in addition to sulphate) and their role in radiative forcing estimation over IGP region. These results have implications in understanding the impact of biomass burning emissions on regional air quality and climate change, and designing appropriate mitigation strategies.

**B22**

**First time measurement of Cloud Condensation Nuclei at a high altitude station in Central Himalayas during the GVAX Field Campaign at ARIES, Nainital**

U C Dumka Manish Naja N. Singh D V Phani Kumar Ram
ARIES

Simultaneous and continuous measurments of cloud condensation nuclei (NCCN) and condensation particles (NCN) were made along with the measurments of optical and physical properties of aerosols and meteorological parameters during the first Atmospheric Radiation Measurement - Mobile Facility (AMF1) deployment at a high altitude site ARIES, Nainital (29.4Â°N, 79.5Â°E; 1950 m amsl) in central Himalaya under the â€˜Ganges Valley Aerosol Experimentâ€™ (GVAX) programme. As a part of GVAX campaign the cloud condensation nuclei counter (single-column DMT Model 1) and condensation particle counter (TSI Model 3010) was operated round the clock since June 2011. The concentrations of NCCN are measured at seven supersaturations (%SS) between -0.01% to 0.75% in steps. The number concentration of condensation nuclei and cloud condensation nuclei shows significant variations and signature of transport of aerosols to the observational site with the prevailing winds. The observed prominent wind direction is easterly/southeasterly and westerly/northwesterly with a percentage of occurrences is ~15% to ~23% of total respectively. The observed number concentration of NCN and NCCN shows significant diurnal variations with daytime highs around 12:00-19:00 local time. The CCN empirical fit value â€œkâ€• tends to decline during the upslope conditions indicates that the CCN activities at the lower %SS value than during the night and morning hours.

**B23**

**Study of Impact of Black Carbon on Radiative Forcing during Agriculture Waste Burning Period (2008 and 2009) over Patiala, Punjab, India**

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Atmospheric aerosols influence the earthâ€™s radiative balance by scattering and absorbing the sunlight. Scattering aerosols such as sulfate have cooling effect while black carbon (BC) aerosols absorb sunlight resulting in warming of the atmosphere. Agriculture crop residues are burnt during the months of October and November (Post-monsoon season) every year in the North-West region of India injecting enormous amount of black carbon (BC) into the atmosphere leading to high aerosol loading. In the present study, we have examined the variation of BC mass concentration and aerosol properties over Patiala (30.33Â°N, 76.4Â°E, 249 m a.s.l) during post-monsoon (PoM) season of the year 2008 and 2009

using ground based measurements as well as satellite data. Few intense biomass burning images have been identified over the study area using MODIS true color composites during PoM-2008 and 2009. BC mass concentration ranges between 1.60-17.89 Âµg/m3 during PoM-2008 with a mean value of 8.99 Â± 3.77 and 3.19-16.70 Âµg/m3 during PoM-2009 with a mean value of 8.34 Â± 2.97. The maximum value of Aqua-MODIS AOD550 and MICROTOPS-II AOD500 were 1.87 and 2.6 for PoM-2008 and were 1.27 and 1.71 for PoM-2009 respectively. The Angstrom Exponent Î±380-870 and turbidity parameter Î² varies from 0.73 to 1.43 (Î±380-870) and 0.13 to 1.03 (Î²) during PoM-2008 and 0.13 to 0.76 (Î±380-870) and 0.13 to 1.06 (Î²) respectively. The negative values of coefficient Î±2 indicate the presence of abundance of fine mode particles during PoM-2008 and 2009. MICROTOPS-II based AOD found to be in good agreement with Aura-OMI and Aqua-MODIS observations [R2388 =0.80 (PoM-08) and R2388 =0.59 (PoM-09)], [R2442 = 0.77 (PoM-08), R2442 = 0.63 (PoM-09)], [R2550 =0.80 (PoM-08), R2550 =0.70 (PoM-09)] at 388nm, 442nm and 550nm wavelengths suggesting that the satellite based techniques of monitoring aerosol properties over the region has reasonable accuracy. The absorption coefficient shows maxima during morning hours and minima during afternoon hours. The percentage difference of BC mass concentration measured at two different channels [i.e. (BC370 â€“ BC880)/BC880] shows positive values during PoM-2008 and 2009 suggesting significant contribution from biomass burning emissions to BC mass concentration over the measurement site. The single scattering albedo (SSA) varies from 0.67-0.70 and 0.67-0.69 during PoM-2008 and 2009. Increased BC concentration leads to high atmospheric radiative forcing with a mean value of +63.3 W/m2 (PoM-2008) and 56.7 W/m2 (PoM-2009) which may lead to warming of the lower atmosphere and hence affecting the regional climate.

**B24**

**Patterns of spatial and temporal variations of SPM along with correlations of SPM, NO2 and SO2 with the AODs in India.**

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*School of Environmental Sciences, JNU, New Delhi*

To study the relation of air quality parameters such as suspended particulate matter, $NO_2$ and $SO_2$, analysis of available data in various reports and coupling these with satellite data is carried out. In this study an effort has been made to investigate the relationship of SPM, $NO_2$ and $SO_2$ with aerosol optical depth over the Indian region. Maps prepared for depiction of three yearly (from 2004 to 2006) SPM patterns were coherent wisth the earlier findings. Out of the top ten districts with the highest levels of particulate matter in the Indian region, nine districts belonged to the state of Uttar Pradesh, reiterating the earlier findings whereby Indo – Gangetic plains are believed to be the hub of particulate concentration. The places which recorded the lowest levels of the SPM were from the southern stretches of the country, accounting for their relatively calmer, pollution free environment along with sufficient rainfall. An attempt to study the association of suspended particulate matter with aerosol optical depth showed that the two show a significant correlation in the Indian context. $NO_2$ and $SO_2$ when correlated with the AOD values showed an intriguing correlation, having a significant correlation coefficient for $NO_2$. The seasonal pattern of particulate matter matched with the pattern for aerosol optical depth variation. Thus, the analysis of spatial and temporal, published data for air quality parameters, SPM, $NO_2$ and $SO_2$, brings out interesting patterns matching with satellite data.

**B25**

**Role of biochemical constituents of aerosols in climate change and public health**

Dr. Ranjit Kumar
Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra-5

Aerosol play very important role in climate change and public health indirectly by scattering and absorbing the radiation and directly by inhalation. These effects depend upon their biotic and abiotic constituents. Ambient microbial concentrations determinations depends on geography and climate because the transport of bioaerosol is primarily governed by hydrodynamic and kinetic factors, while their fate is dependent on their specific chemical makeup and the meteorological factors to which they are exposed. Hence, the monitoring of outdoor airborne microorganisms is necessary to evaluate the risk on rain and human health as well as plants and to study its evolution. Bioaerosols are living or dead organic compounds in the air, such as dust, bacteria, pollen, leaf dust, viruses and might be significant in understanding climate and climate change. It has power to generate rapid and dramatic chemical reactions change at the very least alter and hence the course of climate science. Bioaerosols are capable of forming clouds similar to inorganic aerosols. They play role in the interfaces between snow and air, snow and water and fog and clouds. They also play a role as ice nuclei for cloud formation, yet their impact on driving chemistry and impact of chemical reactions on physics of atmosphere are not very known. Bioaerosols contribute about 10-20% of aerosols load but their impacts are significant. They get affected by the climate as atmospheric environmental conditions are not favorable for their growth but alter the climate by making CCN and by increasing the atmospheric temperature as they are present everywhere. The aim of the present investigation is to include the bioaerosols in climate research as their effects get exacerbated in the presence of abiotic constituents. Only limited data are available for the biotic components in the atmosphere and most of which are from outside India which is also passive analysis not quantitative analysis. In the present investigation biotic and abiotic characterizations of aerosols are performed and role of environmental conditions are established.

**Poster Presentation list for SAFAR**

**B1**

**The role of meteorology on atmospheric dynamics, air mass transport and aerosol characteristics**

Dimitris Kaskaoutis and Panagiotis Kosmopoulos
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The present study highlights the specific role of meteorology as well as the anomalies from the mean climatological conditions on atmospheric dynamics, air-mass pathways, emission, transport and characteristics of aerosols. It emphasizes on results obtained over climatically sensitive areas influenced by differing air masses and aerosol properties, such as eastern Mediterranean and India. To this respect, local and regional meteorology plays a vital role in the air-mass transport from different pathways and enables to carry aerosol of various physico-chemical and optical properties over a specific location. Such results are analyzed over Greece both for a long-time period (~5 years) and specific cases. Different synoptic weather conditions control the source regions and air-mass pathways as well and, in turn, influence the aerosol type and characteristics over Athens, Greece. Specific weather patterns are associated with intense Sahara dust exposures during the winter season, when dust presence over the region is rare. Furthermore, dynamic meteorology and convection affects the transport height of the dust plumes, either within the boundary layer or in the free troposphere. On the other hand, prolonged dry and drought conditions during the monsoon period have been observed to play a major role on the accumulation of aerosols and pollutants over Indian sub-continent and, more specifically, over the densely populated Indo-Gangetic Plains (IGP). This was the case during the erratic monsoon in July 2002

and the prolonged dry conditions in late-pre-monsoon of 2003 favoring intense dust exposure over the region and longer aerosol lifetime. Furthermore, there is strong evidence that the exceptional high aerosol loading over IGP during the monsoon season of 2002 and the late-pre-monsoon of 2003 controls the whole decadal (2000-2010) aerosol trend over northern India as shown via AERONET, MODIS and MISR observations.

**B2**

**To examine the association between variations in middle tropospheric aerosol loading and different types of clouds**

Pratibha B. Mane

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To examine the association between variations in middle tropospheric aerosol loading and different types of clouds Pratibha B. Mane, D. B. Jadhav, A. Venkateswara Rao a- Department of Physics, Shivaji University, Kolhapur-416 004, Maharashtra state, India. b- Indian Institute of Tropical Meteorology, Dr. Homi Bhabha Road, Pashan,Pune-411 008, India. Corresponding author Email: pratibhabm263@gmail.com Abstract Vertical distribution of atmospheric Aerosol Number Density per cm3 (AND) measurements have been carried out at Kolhapur (16Â°42â€²N, 74Â°14â€²E) by using newly designed Semiautomatic Twilight Photometer . Detail study of AND vertical profiles from 6 to 7 km gives pre-information about occurrences of high level cloudy days. The results acquired reveal that one peak was detected three days prior to the high level cloudy sky days. This peak was at ~6.8 to 6.9 Km, having AND ~125 to 185 particles per cm3. This peak was found to be moving downwards with an average speed of the order of ~0.2 to 0.3 km per day for the two subsequent days after perceiving it. The AND at 6 km was increased up to ~1000 particles per cm3 at former to the high level cloudy sky conditions. On the clear sky days following cloudy sky conditions, the values of AND at ~6 Km was found lower (~260 to 300 particles/cm3) in most of the cases. Middle and low level clouds were frequently observed following with high level clouds. In very rare cases middle level cloudy days were noticed separately after any clear sky day. The bases of mid-level clouds typically appear between 2 to 6 Km. The sudden increase in the values of aerosol loading, Q in between 6 and 7 km at any day followed by sudden decrease at subsequent day could be a precursor of middle level cloudy days. Vertical profiles of AND at 8 to 12 km obtained at clear sky days former the contrail happening days were studied for the observational period and got the results. The results acquired reveal that one or two broad aerosol layers noticed in between 8 to 12 km on the AND vertical profiles at any day could be a forerunner of the contrail occurring at subsequent day. Optically thin cirrus layers were frequently observed just below the tropopause. These clouds were invisible for normal eyes. Using twilight technique existence of thin invisible cirrus clouds in the field of view of the twilight photometer can be discovered. The increased aerosol loading in between 8 to 11 km at any day was responsible to create favorable conditions for the invisible cirrus clouds development on the next day. The small fine-scale features visible in the profiles derived in the present study are the attribution of improvement in height resolution (0.03 km at 6-10 km), one of the main advantages of the semiautomatic twilight photometer. However, at present the definite relation between the variations in middle tropospheric aerosol number density per cm3 (AND) and weather conditions could not be established with so few data events, more sets of observations are required.

**B3**

**Role of biochemical constituents of aerosols in climate change and public health**

Ranjit Kumar

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Aerosol play very important role in climate change and public health indirectly by scattering and absorbing the radiation and directly by inhalation. These effects depend upon their biotic and abiotic constituents. Ambient microbial concentrations determinations depends on geography and climate because the transport of bioaerosol is primarily governed by hydrodynamic and kinetic factors, while their fate is dependent on their specific chemical makeup and the meteorological factors to which they are exposed. Hence, the monitoring of outdoor airborne microorganisms is necessary to evaluate the risk on rain and human health as well as plants and to study its evolution. Bioaerosols are living or dead organic compounds in the air, such as dust, bacteria, pollen, leaf dust, viruses and might be significant in understanding climate and climate change. It has power to generate rapid and dramatic chemical reactions change at the very least alter and hence the course of climate science. Bioaerosols are capable of forming clouds similar to inorganic aerosols. They play role in the interfaces between snow and air, snow and water and fog and clouds. They also play a role as ice nuclei for cloud formation, yet their impact on driving chemistry and impact of chemical reactions on physics of atmosphere are not very known. Bioaerosols contribute about 10-20% of aerosols load but their impacts are significant. They get affected by the climate as atmospheric environmental conditions are not favorable for their growth but alter the climate by making CCN and by increasing the atmospheric temperature as they are present everywhere. The aim of the present investigation is to include the bioaerosols in climate research as their effects get exacerbated in the presence of abiotic constituents. Only limited data are available for the biotic components in the atmosphere and most of which are from outside India which is also passive analysis not quantitative analysis. In the present investigation biotic and abiotic characterizations of aerosols are performed and role of environmental conditions are established.

**B4**

## EMISSION FACTORS FOR PM FINES FROM VEHICULAR EXHAUST: NEED FOR EMISSION INVENTORY AND AIR QUALITY MANAGEMENT

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Keywords: Vehicles, PM fines, Emission Factor, Emission inventory, source signature Background Growing global concerns about adverse health effects of Ultrafine including Nano Particle (NP) are highlighted when we note that NPs have been certified as carcinogenic by World Health Organization. Owing to their large surface area Nano particles provide large sorption sites to hazardous chemicals and due to their small size can penetrate deep inside the human breathing system. Vehicle exhaust emissions have been found to increase ambient air with nano particles number concentrations by two folds or more (104- 106 #cm-3) relative to the background level (103-104 # cm-3). Increase in vehicles on Indian roads has seen a meteoric rise. While number of road vehicles nearly doubled over two decades (92.6% from 1980â€“1981 to 2003â€“2004 (Ramachandra and Shwetmala 2009), car and truck sales in India totaled ~30 lakh (30 x105) in 2010 (ICCT). A review on emissions from Indiaâ€™s transport sector (Ramachandra and Shwetmala 2009) reveals an absence/lack of appropriate scientific data on air quality monitoring, source apportionment and emission factors. Emission Factors Emission factors used to derive estimates of air pollutant emissions based on the amount of fuel combusted, or distance travelled, are related to vehicle age, weight class and fuel type. Large variation of the PM concentration and emission factors with season and with location have also been observed; with PM10 and PM2.5 emission factors being lower in the summer month than the rest of the year (Ketzel etal. 2007). Studies in highly congested cities in Europe have shown that diesel vehicles are more significant contributors of NPs than petrol vehicles (Siegmann 2008). With increasing use of diesel vehicles in India, the issue of health impacts due to emissions from diesel vehicles is of immense concern. Emission inventories are

scarce despite their suitability for researchers and regulating agencies for managing air quality and PM reduction measures. Conclusion It is important to note that only a few studies on vehicle exhaust characterization have been conducted within India and currently emission factors are known only for PM10 and PM2.5. Consequently information about the occurrence and behavior of PM fines in Indian environment is very limited. Research needs to focus on development of emission factors for PM fines and source characterization to assess scale of emissions under Indian traffic conditions. This poster provides an overview of results of source identification studies and the information available about emission factors. The poster will also showcase proposed research focused on development of emission factors for PM fines for Indian vehicles (4W Passenger cars). Results will compliment current air quality monitoring efforts and further aid and enhance emission inventories and model development. Availability of source signature from this study will help in source identification on Indian roads and assist in policy development towards control of emissions from cars and Enhancement of Air Quality Management (AQM) efforts.

**B5**

**Air ion variation in winter at urban station Sangli (17Â° 4â€™ N 74Â° 25â€™ E) and rural station Ramanandnagar (17Â° 4â€™ N 74Â° 25â€™ E) India.**

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Air ion variation in winter at urban station Sangli (17Â° 4â€™ N 74Â° 25â€™ E) and rural station Ramanandnagar (17Â° 4â€™ N 74Â° 25â€™ E) India. ABSTRACT There are several man made sources of ionization such as the exhaust from automobiles or aircrafts, industrial processes etc. Contributions of such local sources to the ion concentration of the atmosphere may be dominant in the neighborhood of such activities. In the atmosphere ions diffuse to aerosol particles and transfer their charge to the particles. In rural areas, the auto-mobile exhaust or other human activity cause introduction of large concentration of aerosol particles in the atmosphere. At urban station there are lmitited sources for the production of air ions, at the same time produced air ions are consumed by aerosol in the atmosphere.Therefore their concentrations in the atmosphere show large spatial and temporal variations. Variations of air ions in atmospheric air have been investigated using Gerdien type air ion counter. This air ion counter indigenously designed and developed at the Indian Institute of Tropical Meteorology Pune and operated at rural site Ramanandnagar and urban station Sangli. At urban station positive air count varies in the range 2-3 x102 ions per cm3, while positive air count at rural station varies in the range 5.5-8 x102 ions per cm3. Negative air ion count varies in the range 0.7-1.5x102 ions per cm3 at urban station, while it varies in the range 5-7.9x102 ions per cm3 at rural station. The pollution index above 1.5 during all the time period for urban station, which is harmful to human health. Such highly polluted atmosphere could trigger allergic respiratory disease and exacerbate existing respiratory allergy have reported evidence of close related decline in lung function. KEYWORDS: Air Pollution, Air Quality, Aerosol, Transperation.

**B6**

**Characterization of carcinogenic compounds from incense burning at Places of Worship**

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Background: Polycyclic Aromatic Hydrocarbons (PAHs) a group of more than 200 different congeners are among pollutants of concern due to their carcinogenicity and mutagenicity. PAHs originate mainly from combustion processes and indoor sources of PAHs are cooking, smoking, burning fuels (Natural gas, LPG,

kerosene, wood, dung, & coal), candles and incense. Depending on ventilation conditions, transport from the outdoor smoke can also contribute significantly to indoor levels (Dubowsky, 1999). Smoke emitted from burning incense sticks has been found to contain carcinogenic PAHs. PAHs have been reported to have caused cancer of skin, lungs, stomach, liver and bladder in laboratory rats. Alarmingly, female rats receiving a single dose of synthetic PAH - DMBA (7, 12-dimethylbenz[a] anthracene) developed breast tumors (BCERF Fact Sheet 41). Problem description: At religious places like temples, burning incense sticks is one of the important customs in many Asian countries. Most of these places are closed structures with poor ventilation and indoor air quality is greatly impacted by burning of incense sticks. This is of concern since inhalation is the main source of exposure to PAHs originating from incense smoke. Some studies found levels of indoor total-PAH concentration, and PPAH (Particle bound PAH) concentration as high as 6258 ng/m3, and 490 Âµg/g of particles respectively (Li & Ro; 2000). Combustion of Indian sandalwood incense stick has been found to emit ultrafine PM (5.6â€“560 nm) at the rate of 5.10*1012 to 1.42*1013 per hour (or 3.66*1012 to 1.23*1013 per gram) of incense burned (See, 2007). These ultrafine particles can reach deep into human lungs and affect health. Various models like LUDEP (Lung Dose Evaluation Program; ICRP (International Commission on Radiological Protection; Publication 66) are available to determine doses of RSPM delivered to different regions of respiratory tract. Further research to examine levels of PAHs exposure to humans in temple, followed by physico-chemical characterization of PM, will help to understand the effects of PAHs on human health and environment. Conclusion: This poster provides an overview of impacts of PAHs on human health and characterization of these compounds from incense smoke in temples. There is a need for characterization of PAHs emitted through incense stick smoke and examination of effect of ash on environment. This will help to better understand the health implications due to inhalation of harmful smoke at places of worship. This poster also discusses proposed research to examine levels of exposure and physico-chemical characteristics of indoor air quality in a temple. Examination of PM emission rate on size segregated basis will enhance understanding of health risks and, by extension, prediction of exposure concentration. Determination of particle deposition in different parts of the lungs through the use of LUDEP will aid in better assessment of public health concerns due to exposure to incense smoke.
Keywords: Incense smoke, Indoor Air Quality, PAHs, Human Health, Air Pollution

**B7**

## UNDERSTANDING AEROSOL MIXING AND AGING USING PARTICULATE MASS AND CHEMICAL DATA COLLECTED OVER THE LAST FIVE YEARS AT AN URBAN LOCATION

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IIT Kanpur

Ambient aerosol measurement and collection followed by gravimetric and chemical speciation in and around Kanpur (a prominent site in the Indo-Gangetic Plains) has been going on for quite some time. Filter based samples of submicron (PM2.5) particles have been collected in the last year inside IIT Kanpur campus (26Â°50Â´ N, Longitude: 80Â°20Â´ E). They were primarily analyzed for ions (NH4+, Cl-, NO3- and SO42-), trace elements (Ti, V, Cr, Mn, Co, Ni, Cu, Fe, Zn, Pb, Cd, Sr, Ca, Na, K, Mg etc.). The aim of this study was to quantify the chemical properties of dust and the intensity of mixing due to interaction with the various anthropogenic activities during its long range transport. It was observed that most of the crustal elements (Ca, Fe, K, Mg, and Na) have higher concentration than non-crustal elements. When compared to Dusty & Non Dusty days, the non-crustal elements didnâ€™t show much variation whereas the crustal elements increased by 2-3 times on dusty days when compared to days

just before the dust events. But their concentration just after dust event didnâ€™t came down much. This means that some dust stayed in the atmosphere even after the dust storm got over. The concentration of non-crustal elements (like Cu, Ni, Se, Cr etc.) increased continuously even after the dust-storm subsided. We observe just before a dust event the crustal elements had EF<1 which means that they were of crustal origin only but during and after dust days these elements were suitably enriched suggesting that some part of those came due to mixing with anthropogenic sources which then formed a part of dust for a few days. Most of the non-crustal elements except Cd, Pb, Se & Zn were moderately enriched while Cd, Pb, Se & Zn were very highly enriched meaning domination of anthropogenic sources. The possible source for Cd is household-waste combustion, fossil-fuel burning and refinery. Pb includes leaded gasoline, fuel combustion, industrial processes and solid waste combustion. Pb in coarse mode was probably emitted from the mining activities. Higher concentration of Cd and Pb during the non-event days suggests that possibly, they are emitted within the basin and get mixed with the dusts during the transport over the polluted areas. 5 day backward trajectories of the air mass were computed at 0-2 km height from final run data archive of GDAS model using the NOAA Air Resource Laboratory (ARL) Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) program to study how source & long range transport affected chemical composition. From our study we could conclude following things: â€¢ Major part of dust comprised of mineral dust on both dusty and non-dusty days. â€¢ Pollutant elements were always in lower conc. but highly enriched. â€¢ Back trajectory analyses show that the source of most of the dust were gulf countries.

**B8**

**Chemical Composition Change of PM10 over a period of five years at an urban location**

Nikhil Rastogi, Tarun Gupta
IIT Kanpur

Ambient aerosol measurement and collection followed by gravimetric and chemical speciation in and around Kanpur (a prominent site in the Indo-Gangetic Plains) has been going on since 2008 till now. Filter based samples of submicron (PM2.5 & PM1) particles have been collected in these years inside IIT Kanpur campus (26Â°50Â´ N, Longitude: 80Â°20Â´ E). They were primarily analyzed for anions (F-, Cl-, NO3- and SO42-), trace elements (Ti, V, Cr, Mn, Co, Ni, Cu, Fe, Zn, Pb, Cd, Sr, Ca, Na, K, Mg etc.). The aim of this study was to quantify the chemical properties of ambient aerosol. Also a comparison will be made between changes in PM concentration over the years and change in pollutant sources. A comparative source apportionment study using PMF is being carried out to identify major pollutant sources. We will also study trend of PM2.5 and influence of meteorology in the observed changes in pollutant conce! ntrations. The sampling has been done almost all throughout the year at regular intervals for all the years. However we have only analysed PM1 data for first year, both PM2.5 & PM1 for second year and PM2.5 for the rest of the period. Every year we had collected around 50 to 100 samples. To provide uniformity to the data we have up scaled PM1 data by a factor of 70% so that all data is in terms of PM2.5. This is based on the study comparison made in the second year of our sampling period when we had measured both PM2.5 & PM1. PM1 was around 70% of PM2.5 for the samples. The population as well as number of vehicles has increased over the years but the land use pattern hasnâ€™t changed much here. Major pollutant sources here have always been industrial emissions as well as vehicles. To identify the trend of climate change we have recorded avg. temperatures on sampling days and classified them into four seasons: Summer, Winter, Autumn and Monsoons to study the pattern. We found that for every season Particulate Matter (PM) Concentration was increasing for the first 3 years and then it started decreasing owing to some measures taken to mitigate pollution. Ban on leaded petrol, introduction of CNG powered vehicles, change in vehicular

pattern were major changes that were introduced during this period. We are going to study how they are affecting local weather phenomenon by comparing with meteorological data.

**B9**

**Long-term Aerosol – Ozone Relationship over Pune, India**

K. Vijayakumar and P.C.S. Devara*

**B10**

**A low cost chromatic modulation, dust sensor based real time respirable particulate and black carbon monitor, a preliminary design**

Nishadh K A

SÃ¡lim Ali Centre for Ornithology and Natural History

A low cost chromatic modulation, dust sensor based real time respirable particulate and black carbon monitor, a preliminary design Nishadh K A (a), Mohanraj R (b) and Azeez P A (a) (a)- Environmental Impact Assessment Division, SÃ¡lim Ali Centre for Ornithology and Natural History, Anaikatty Post, Coimbatore-641108- Tamil Nadu, India (b)- Department of Environmental Management, Bharathidasan University, Trichirappalli-620024, Tamil Nadu, India Apart from their impacts on climatic variables, anthropogenic particulate and black carbon emissions have serious health effects. Real time monitoring of these pollutants have huge potential in providing relevant health advisories and enforcing time bound regulatory restrictions. High upfront and running costs for commercial monitors for these parameters with adequate spatial and temporal resolution largely hinder their wide deployment. Recent technological developments in micro electro-mechanical systems provides huge cost reduction in instrument components for monitors working based on optical differentiation and paves the way to much cheaper chromatic modulation (colour variation) based monitors. Several recent studies showed promising features of those kinds of low cost monitors in particulate and black carbon monitoring (1, 2, 3). The present paper deals with design of a low cost real time monitor for particulate and black carbon by a dust sensor coupled with chromatic modulation technique. The monitor comprises a rotational 10 micrometer particulate filter with web camera to capture the dust accumulation for chromatic modulation analysis, a column with dust sensor and light source, a vacuum air pump and a microprocessor to program the whole monitoring processes. The main contribution of this design is the coupling of optical property differentiation, chromatic modulation technique in single platform and introduction of invasive sampling features for particulate monitoring. The dust sensor SHARP GP2Y1010AU0F is based on optical sensing which measures the quantity of dust particles by reflected infrared rays on phototransistors from a dust column. Black carbon is quantified in chromatic modulation by measuring the colour variation in dust filter though image colour algorithmic method (3). By following the PIXIE streaker sampler design the present monitors introduce the invasive sampling feature, which delivers the further analysis of filtered dust particles for heavy metals or other chemical component for further research. Reference: 1. YR Kolupula, MA Aceves-Fernandez, GR Jones, AG Deakin and JW Spencer (2010). Airborne particle monitoring with urban closed-circuit television camera networks and a chromatic technique. Measurement Science and Technology 21, 115204. 2. N Ramanathan, M Lukac, T Ahmed, A Kar, PS Praveen, T Honles, I Leong , IH Rehman, JJ Schauer and V Ramanathan (2011). A cell phone based system for large-scale monitoring of black carbon. Atmospheric Environment 45, 4481-4487. 3. TS Dye (2013). A Scientist with Sensors and Spare Time: Backyard Comparisons of Particulate Matter Sensors. (Abstract). EPAâ€™s Next Generation Air Monitoring Workshop Series Air Sensors 2013: Data Quality & Applications.

**B11**

**The linkages of Anthropogenic Emissions and Weather in rapid increase of Particulate Matters at footwill city of Arawali range in India.**

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Mohanlal Sukhadia university, Udaipur India

The city of Udaipur (24.58oN, 73.68oE) in the province of Rajasthan in Western part of India has special significant as it is surrounded by Arawali mountain ranges in one side and desert on another side. It is located around foothill of rocky Arawali range. It is on the world map due to its tourist attraction. The changing pattern in particulate matter (PM2.5 and PM10) during the past three years indicates a alarming increasing trends, posing a threat to its environment & tourism sector which regulation its economy, During monsoon, distribution of particulate matter is found to be governed by the meteorology and trend get mixed up. The level of PM10 which was already above the threshold level in 2010 further increased in 2012. The trend is found to be rapid during the month of October & November where an increase by 37 % is observed in 3 years. The level of PM2.5 which is most hazardous for respiratory system diseases now started to cross the ambient air quality standards set by world Health Organization. The impact is highly significant during winter when inversion layer is down due to colder temperature and foreign tourists are at peak giving rise to increased morbidity rate. The linkages of local weather with anthropognically induced trend and long rang transport of pollutants have been outlined.

**B12**

**TRANS-BOUNDARY AND LONG RANGE TRANSPORT OF AEROSOLS**

Daniel Mbithi
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This study used aerosol optical depth (AOD) from satellite based Moderate Resolution Imaging Spectro-radiometer (MODIS) observations at 550nm in 1Âº Î§ 1Âº grid resolution to investigate the trans-boundary and long range transport of aerosols over the East African region. The aim of the study was to perform spatial analysis using monthly means of MODIS Terra AOD data and simulate trans-boundary and long range transport of the AOD during the North Easterly Trade winds and the South Easterly Trade winds to identify the possible sources of the aerosols. The region of study lies within 28.5Â°E-42.5ÂºE, 4.5ÂºN-12.5ÂºS. The HovmÃ¶ller analysis revealed spatial and temporal patterns of the aerosols hence clearly showing areas of higher AOD values in space and time; an indication of high aerosol concentrations. Backward air trajectory analysis was performed to identify the possible sources of aerosols for a period of forty eight (48 hrs) hours of air transport over three selected locations which had indicated higher AOD values by performing spatial and HovmÃ¶ller analysis.

**Theme – Air Quality**

**Oral Presentation list for C4**

**OP 15**

**Ambient Air Quality in Islamabad, Pakistan: A Monitoring Based Analysis**

Anjum Rasheed
Fatima Jinnah Women University

Ambient air quality data of Islamabad for six representative air pollutants (carbon monoxide (CO), oxides of nitrogen (NO and NOyâ€²), sulfur dioxide (SO2), ozone (O3), fine particulate matter (PM2.5), and non-methane hydrocarbons (NMHCs)) was collected for five years (2007-2011). For this purpose, automated fixed and mobile air monitoring stations with prescribed analyzers for each pollutant were used. Data analysis reveals annual average mass concentration of PM2.5 (~45 to ~95 Âµg/m3) and NO concentration (~41 to ~120 Âµg/m3) higher than Pakistanâ€™s National Environmental Quality Standards (NEQS). The annual O3 concentration is within the permissible limits, however, the hourly concentration exceed the NEQS mostly during summer months. Correlation studies show that carbon monoxide has as a significant (p-value â‰¤0.01) positive correlation with NO and NOyâ€², whereas, with ozone, a significant (p-value â‰¤0.01) negative correlation is observed. The regression analysis estimates the background CO concentration to be ~300 to ~600 ppbv in Islamabad. The higher ratio of CO/NO (~10) suggests that mobile sources are the major contributor to NO concentration. On the other hand, the lower SO2/NO ratio (~0.011) indicates the contribution of point sources in Islamabad. NO and SO2 correlation indicates a direct emission sources containing high sulfur content. A fraction of secondary PM2.5 is produced by chemical conversion of NO into nitrates. The regional background O3 concentration for Islamabad has been determined to be ~31ppbv. The study suggests that there is an increase in O3 concentration with increases in degree of photochemical conversion of NO to reservoir NOyâ€² species. It recommends the need to develop effective control strategies to meet the ambient air quality standards through an integrated assessment model.

**OP 16**

**A surmised review of changes in meteorological conditions and air pollutants in Delhi**

Dr. Dipankar Saha
Central Pollution Control Board, Delhi

A surmised review of changes in meteorological conditions and air pollutants in Delhi M. N. Mohanan, M. Satheesh Kumar, D. Saha* & J. S. Kamyotra Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India) Parivesh Bhawan, East Arjun Nagar, Delhi 110 032, India *Corresponding Author dsaha.cpcb@nic.in Abstract: A SODAR system is in continuous operation at Parivesh Bhawan CPCB to measure mixing height of the lower atmosphere for past many years. The data obtained from this system is being regularly analyzed for determination of mixing height in lower atmosphere vis-Ã -vis dispersion of pollutants. It gives the height up to which pollutants can disperse in the atmosphere. The present paper deals with data analyses report for the period of 2007 to 2012 (6 years). On analyses of monthly variation of mixing heights and periods of high/low convective activity, a series of observations are made. In this study, the mostly occurring period of high convective activity (when thermal plumes exist in the SODAR echogram) was minimum in November 2012 and the time period was noted to be 11 AM to 4 PM followed by December 2011 having the time slot between 11 AM to 4 PM or 5 PM The maximum period of high convective activity was noted in June 2007, September 2007, June 2008 and July 2008 during the time period of 7 AM or 8 AM to 6 PM or 7 PM followed by August 2008 and September 2008 during 7 AM or 8 AM to 6 PM The longer duration of high convective activity helps to have better air quality. During this period of investigation monthly mean mixing height in the period of high convective activity was minimum in October 2007 of 701 meters, while the maximum was in February 2012 of 1440 meters. Mean mixing height in the period of low convective activity was maximum in March 2012 ie.337 meters and it was minimum in September 2007 i.e. 107 meters. Monthly mean mixing height maximum was 731 meters in September 2011 and minimum was 289 meters in November 2007. In this period of study mixing height is found as lower in 2007 and higher in 2011 and 2012. The critical examination of climatological conditions with respect to wind pattern and rainfall over the years of 2007 to 2011, reveals that in general, the percentage of calm period was

maximum in the month of November followed by December and October. Percentage of calm period was found to be minimum in June followed by July. In Delhi, monsoon season is spread over July to September period. Scavenging can remove both gases and particulate matter. Attempts have also been made to correlate the above observations with the air pollution data of Delhi during these years. Key Words: SODAR System (Sound Detection And Ranging System), Mixing Height, period of high convective activity, thermal plumes, Meteorology, Delhi

**OP 17**

**Impact on Ambient Air Quality of Measures & Management Strategies in Capital city of India, Delhi: A Synoptic Review**

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Abstract: Due to rapid urbanization, rise in population, industrial activity and automobiles in the Delhi there is significant increase in the environmental pollution. Air pollution is a matter of great concern as it affects not only the human health but shows its harmful impacts on vegetation and aesthetic property like monuments, cultural & heritage building materials. On one hand, pollution is a challenge while on the other it is an opportunity for India. Economic development of any nation may lead to the environmental degradation however, at the same time it is a key resource to improve environmental management and prevent pollution across the globe. The present paper explains the trend of air quality with a particular emphasis on the criteria pollutants viz. $SO_2$, $NO_2$ and SPM in the Capital city of India over a period of 24 years since 1989 till 2012 vis-à-vis preventions and control strategies during these years of rapid industrialization and urbanization. It is needless to mention that with a view to provide the better air quality across the country, various control measures and management options & strategies have been implemented over the years. To explain the impact of these policies on the improving the quality of air, an attempt has been in this paper. The results indicate that inspite of tremendous growth of human population, vehicular growth, urbanization; the combined effect of all the steps taken viz., the improvement in the fuel quality, alternative fuel for automobiles, installation of catalytic converters in automobiles, phasing out of the grossly polluting commercial vehicles, introduction of mass transport system in the form of metro rail, mass awareness programs on MRTS-Mass Rapid Transport System etc. demonstrates pronounced impact and shows the remarkably significant improvement in the air quality of Delhi, the Capital city of India.

***Keywords: SPM (Suspended Particulate Matter), $PM_{10}$, CNG (Compressed Natural Gas), Criteria pollutants.***

**OP 18**

**Atmospheric conditions associated with large scale dust and poor air quality over north India under two contrasting conditions**

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Analysis of the meteorological conditions associated with large scale dust, poor air quality and reduced visibility due to extensive dust over north India. The air quality was considerably reduced in terms of suspended particulate matter. These two events, however, were contrasting in nature in terms of origin of the dust. The first case pertains to 07-08 October, 2009 and the other to 20-21 March, 2011. A thick blanket of smog engulfed the National Capital Region of Delhi on 07 and 08 November, 2009 with

visibility reducing to below 500 metres in the city. This was a case of accumulation of locally generated pollutants in lower troposphere in response to progressive increase in atmospheric stability. Analysis of meteorological conditions which led to stagnation of the pollutants in the atmosphere have been studied and it was found that the wind flow patterns in the lower tropospheric levels (850/925 hPa) was dominated by an intensifying anticyclonic circulation centred over Delhi from 06 to 08 Nov leading to subsidence over the region. Analysis of stability showed an intense inversion of more than 20Â°C/Km during 05 to 08 November. Positive values of lifted index (LI), another indicator of stability in the atmosphere, showed large positive values of LI from 06 November to 10 November. The second case pertains to a large cloud of dust that engulfed most parts of northwest and western India on 20-21 March 2012. This was a case of large distance transport of dust. Track of this duststorm and its life cycle have been presented using various surface and upper air meteorological data, aerosols and satellite observations. The study finds out that the dust was transported over to India by strong winds caused by strong pressure gradient in the rear of a western disturbance over north Pakistan and neighbourhood during 18 to 20 March. Winds with strength of about 40-50 knots in the lower tropospheric levels were observed over west Afghanistan on 19 March. Analysis of satellite imageries shows that these strong winds raised a severe duststorm over Iran-south Pakistan which travelled south-eastwards into Pakistan and western parts of India. Analyses of back trajectories and data from air quality system installed in New Delhi have also been presented. The study shows that large scale dust can be caused by both local accumulation under highly stable atmospheric conditions and by large scale transportation. Identification of these types of atmospheric conditions can be a useful tool for providing outlooks for poor visibility and high dust concentration; and advisories on associated health and aviation risks well before onset of such conditions as realiable forecasts for atmospheric conditions are now available upto 5-7 days in advance through NWP models. The air quality forecast system can then be used to provide specific quantitative warnings 1-2 days in advance.

## Poster Presentation for C4

**C1**

**A Pilot Study to Understand the Variation in Indoor Air Quality in Different Economic Zones of Delhi University**

Abhinav Garg and Chirashree Ghosh
University of Delhi

Today, one of the most grave environmental health problems being faced by the urban population is the poor air quality one breathes in. To testify the above statement, the recent survey report, World health statistics (WHO, 2012) reflects the fact that childhood mortality ratio from acute respiratory infection is one of the top leading causes of death in developing countries like India. Urban areas have a complex social stratification which ultimately results in forming different urban economic zones. This research attempts to understand the Indoor Air Quality (IAQ) by taking into consideration different lifestyle of occupants inhabiting these economic zones. The Study tries to evaluate the outdoor and indoor air quality by understanding the variation of selected pollutants (SPM, SOx, NOx) for the duration of four months â€“ from October, 2012â€“January, 2013. For this, three economic zones (EZ) of Delhi Universityâ€™s North Campus, were selected - Urban Slum (EZ I), Clerical (EZ II) and Faculty residence (EZ III). The statistical study indicates that Urban Slum (EZ I) was the most polluted site reporting

maximum concentration of outdoor pollutants, whereas no significant difference in pollution load was observed in EZ II and EZ III. Further, the indoor air quality was evaluated by quantifying the indoor and outdoor pollution concentration ratios that shows EZ III have most inferior indoor air quality, followed by EZ I and EZ II. Moreover, it was also observed that ratio (phenomenon of infiltration) was dominant at the EZ II but was low for the EZ I and EZ III. With the evidence of high Indoor air pollution, the risk of pulmonary diseases and respiratory infections also increases, calling for an urgent requisite for making reforms to improve IAQ. Key words: Urban Area, Slum, IAQ, SOx, NOx, SPM. Reference: Report: World health statistics (WHO, 2012), ISBN: 9789241564441 (http://www.who.int/gho/publications/world_health_statistics/EN_WHS2012_Full.pdf)

**C2**

**Impact of Nitrogen Oxide Gases for Human Health & Agriculture in India**

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Abstract Nitrogen oxides (NOx) are important components of ambient and indoor air pollution and are emitted from a range of combustion sources, including on-road mobile sources, electric power generators, and non-road mobile sources. While anthropogenic sources dominate, NOx is also formed) is also emitted by lightning strikes and wild land ï¬•res and is also emitted by soil. Reduced nitrogen (e.g., ammonia, NH3 by various sources, including fertilizer application and animal waste decomposition. Nitrogen oxides, ozone (O3) and ï¬•ne particulate matter (PM2.5) pollution related to atmospheric emissions of nitrogen (N) and other pollutants can cause premature death and a variety of serious health effects. Climate change is expected to impact how N-related pollutants affect human health. For example, changes in temperature and precipitation patterns are projected to both lengthen the O3 season and intensify high O3 episodes in some areas. Other climate-related changes may increase the atmospheric release of N compounds through impacts on wildï¬•re regimes, soil emissions, and biogenic emissions from terrestrial ecosystems. This paper examines the potential human health implications of climate change and N cycle interactions related to ambient air pollution. Excess of Nitrogen application may cause Rice stem borer attack to Paddy field, sometimes it leads to lodging of Plants in the Agricultural land and also causes hardening of soil by causing Soil Pollution. Air pollution receives one of the prime concerns in India, primarily due to rapid economic growth, industrialization and urbanization with associated increase in energy demands. Lacks of implementation of environmental regulations are contributing to the bad air quality of most of the Indian cities. Air pollutants produced in any air shed are not completely confined, but at time trespassing all the geographical boundaries, hence do not remain only a problem of urban centres, but spread and affect remote rural areas supporting large productive agricultural land. Air pollutants pose risks on yield of crops depending on the emission pattern, atmospheric transport and leaf uptake and on the plantâ€™s biochemical defense capacity. Recent trends have shown decrease in SO2 emissions, but increase in NO2 emission due to more number of automobiles. In past few decades, tropospheric O3 has been identified as a most important air pollutant of rural areas. Air pollutants produce reactive oxygen species (ROS), which adversely affect biochemical processes of plants and reduce their tolerance capacity to other stresses also. Several vital physiological processes such as photosynthetic CO2 fixation and energy metabolism are also affected negatively by air

pollutants. An adverse effect caused by air pollutants depends not only upon its concentration, but also on the duration and combination of air pollutants. Keywords:-Nitrogen oxides, Ozone, Air pollution, Hum

**C3**

**Impact of fire emissions in south Asia on air quality in the region**

Chinmay Kumar Jena
Indian Institute of Tropical Meteorology

Open biomass burning yields large amount of trace gases and particulates to the atmosphere on a regional and global scale. Emissions of these trace gases strongly influences chemical environment, leads to formation of secondary pollutants, and significantly impacts local air quality. It is believed that open biomass burning (burning of forest, savanna/grasslands and crop residue) in South Asia and south East Asia is significant if not dominant contributor to the air pollution in the region. Biomass burning both from forested areas and croplands in South Asia mainly occurs during February to May. Cropland burning varies with geographical location corresponding to major harvesting seasons in the region, but is predominant in March and April. The purpose of this study is to quantify the impact of fire emissions on regional air quality using chemical transport model, WRF-Chem, set up for the Indian domain. The model simulations were performed on hourly basis for the peak biomass burning period (March-April-May) in India during 2005 together with the INTEX-B emissions and Fire Inventory from NCAR (FINNv1). In the analysis we used daily satellite measurements and modeled simulations of Nitrogen dioxide (NO2), carbon monoxide (CO) and ozone (O3) over the South Asia. We show that correlation between modeled and measured (satellite) NO2, CO and O3 over the regions dominated by the biomass burning improve significantly with FINN inventory. A clear increase in modeled predicated ozone, up to 10-12 ppb, over the biomass burning region is observed. The findings demonstrate that biomass burning in South Asia can significantly deteriorate the air quality in this region during peak burning period.

**C4**

**Monitoring of Air pollution through the Electrical conductivity of the Atmosphere**

Dr Kamsali Nagaraja
Bangalore University

Kamsali Nagaraja1, Charan Kumar K1, SD Pawar2, P Muragavelu2, Gopalakrishnan2 1Department of Physics, Bangalore University, Jnanabharathi Campus, Bangalore â€“ 560 056 2Indian Institute of Tropical Meteorology, Pune - 411 008 The electrical conductivity of the lower atmosphere, a manifestation of the presence of mobile ions, of both polarities, is governed by ionization of the atmospheric constituents producing the electron-positive ion pair, ion-chemical reactions that convert the electrons and positive ions into complex ions of both polarities, loss of these charged species through attachment with the ambient aerosols, resulting in aerosol ions, loss mechanism for the small molecular ions and aerosol ions through mutual recombination of the oppositely charged species and mobility of the small ions. Near to the surface of Earth and up to few hundreds of meters above the ground, natural radioactivity induced ionization is prominent and adds to the ionization from galactic cosmic rays, which however is very small. The aerosols at boundary layer arise from natural and anthropogenic sources are subjected to series of meteorological influences. Modeling the temporal and spatial variations of tropospheric conductivity assumes added significance in view of the pollutants generated aerosols that modulate the background or pollution free atmospheric electrical conductivity.

Atmospheric conductivities for the aerosol free and with background aerosols were computed from the model values of small ion densities. The results show the direct dependence of decrease in conductivity on aerosol concentration. Model computed values of conductivity for varying levels of aerosol concentrations can be used for assessing the air pollution levels in urban locations. It is interesting to note that for an increase of aerosols by 3-fold the percent reduction in conductivity is 7%, and for an increase of aerosols by 6-fold the reduction in conductivity is 10% from the pollution free atmosphere. The results are discussed in detail.

**C5**

**Thermoluminescence Study of Ceramic Tiles Materials Plays Important Role In Detection of Environmental And Accidental Radiation**

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Thermoluminescence Study of Ceramic Tiles Materials Plays Important Role In Detection of Environmental And Accidental Radiation (1)Dr.H.C.Mandavia , (2) Dr. K.V.R.Murthy ( 1 )Shri M. M. Science College,Morbi-363 642(Gujarat ) ( 2) Display Materials Laboratory, Applied Physics Department Faculty of Technology, M. S. University, Baroda-390 001, India . .Corresponding author: himaphysics@yahoo.com Cell : 098242 39366 Abstract: The present study discuss the utility of ceramic tiles as radiation dosimeters in case of nuclear fallout and for detection of environmental radiation .Many flooring materials most of them are in natural form are used to manufacture floor tiles for household flooring purpose. In India ceramic industry is fast growing one, more then 450 units of manufacturing ceramic tiles, vitrified tiles and sanitary ware, situated around Morbi, Rajkot, Gujarat, India having an annual turn over of around Rs.500 Cores. Many natural minerals are used as the raw materials required for the manufacturing ceramic ware. The following minerals are used to manufacturing the ceramic tiles i.e. Quartz, Feldspar, Zircon, Talc, Grog, Alumina oxide, etc. Most of the minerals are from Indian mines of Gujarat and Rajasthan states, some of are imported from Russian sub continent. The present paper reports the thermoluminescence characteristics of Feldspar and Quartz minerals collected from the ceramic tiles manufacturing unit, Morbi. The as received minerals TL was recorded (NTL) and also 20Gy beta dose was given to each 3mg weighed sample and ATL was recorded. Annealed and quenched from 300, 500, 700, 900, 1000 and 1200oC followed by 20Gy beta dose given from Sr-90 beta source. The systematic study of such materials at different radiation dose are useful in thermoluminescence dosimetry applications as for detection of radiation in environment .

**C6**

**Estimation of aerosol particle deposition in the human respiratory tract of West African populations**

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Toxicological and epidemiological studies have shown associations between fine particles and human health effects (e.g. Pope and Dockery, 2006), with exposure to high levels of particulate matter increasing the rate of respiratory diseases at short and long terms. Therefore, it is important to assess particle deposition in human respiratory tract. In this study, the DEPosition Clearance LUNG (DEPLUNG) model derived from the International Commission on Radiological Protection, Publication 66 (ICRP66) was used to estimate compartmental particle deposition for West African people of different ages and

genders. For West African adults (males and females), 31 Â± 9% (36 Â± 12%) of predicted particulate deposition occurs in the extra-thoracic region (ET1 - ET2), 3 Â± 1% in the bronchial region (BB), 6 Â± 5% in the bronchiolar region (bb) and 24 Â± 15% in the alveolar region (Al). Results show that the deposition fractions (DF) for West Africans are rather close to Caucasian references, though with larger differences between children. A real case has been also tested related to exposures measured at Bamako (with or without dust event), and in Dakar at traffic sites in the frame of POLCA, DEPCLUNG was used to evaluate the role and effects of particle sizes and chemical compositions deposited in human respiratory tracts. Differences in size distributions affect particle deposition in lung compartments, highlighting the prominent role of this parameter. Aerosol chemical composition has also been shown to be important. This has strong implications for in vitro studies in which differences in regional deposition are to be considered.

**C7**

**A review: World Scenario of Biomass burning and its impact on earthâ€™s atmosphere**.

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Biomass burning is the burning of living and dead vegetation. It includes the human-initiated burning of vegetation for land clearing and land-use change as well as natural, lightening-induced fires. This research is based on the meta-analysis of journal articles on biomass burning and its impact on earth atmosphere published in peer reviewed journals from 1990 to till date. This paper has identified overall statues of natural burning and human burning of biomass and its impact on earthâ€™s atmosphere. Scientists has estimated that humans are responsible for about 90% of biomass burning with only a small percentage of natural fires contributing to the total amount of vegetation burned. Burning vegetation release large amounts of particulates (solid carbon combustion particles) and gases, including greenhouse gases that help warm the earth. Studies suggested that biomass burning has increased on a global scale over the last 100 years, and computer calculations indicate that a hotter Earth resulting from global warming will lead to more frequent and larger fires. Biomass burning particulates impact climate and can also affect human health when they are inhaled, causing respiratory problems. Vegetation acts as a sink or natural storage for carbon dioxide by storing it over time through the process of photosynthesis. As burning occurs, it can release hundreds of yearsâ€™ worth of stored carbon dioxide into the atmosphere in a matter of hours. Since fires produce carbon dioxide, a major greenhouse gas, biomass burning emissions significantly influences the earthâ€™s atmosphere and climate. Biomass burning has short and long term impact on the environment. Burning also will permanently destroy an important sink for carbon dioxide if the vegetation is not replaced. So, it is very important to identify the statues of biomass burning and its impact on the earthâ€™s atmosphere. Anthropogenic activities on biomass burning needs to be urgently addressed which can have very helpful role in mitigating climate change.

**C8**

**Assessment of differential responses of three mung bean cultivars with respect to growth, reproductive and yield parameters against ambient and elevated levels of ozone**

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Tropospheric ozone (O3) has been recognized as an important constituent of air pollutant and is considered to be a phytotoxic air pollutant significantly affecting plantâ€™s performance poses a

potential threat for agriculture. Background O3 concentrations continuously increased in the troposphere in the recent decades. In tropical areas high concentrations of O3 are mainly attributed due to favourable meteorological conditions such as high temperature, atmospheric humidity and high level of solar radiation. Legumes are comparatively most susceptible with respect to O3 and subjected to huge yield loss. Present study was conducted to assess the impact of O3 on three popular cultivars of mung bean (Vigna radiata L. HUM-1, HUM-6 and HUM-23) against and elevated levels of O3 (ambient+10 ppb O3) under open top chambers (OTCs). Results showed negative impact of O3 on various growth, reproductive and yield parameters with distinct differential response among all the test cultivars. Cultivar HUM-1 showed higher damage in its vegetative parts (shoot and root height, leaf number and leaf area) and reproductive structures (number of flowers and pollen viability) as compared to other cultivars. Yield response to stress also revealed that degree of damage was more severe under elevated concentrations of O3 over ambient in all cultivars. Significant reductions in yield were noticed and cultivar HUM-1 proved to be more sensitive. Therefore, the present study supported the selection of sensitive cultivar as a bioindi

**C9**

**Enumerating the Spatial Distribution of Bioaerosol in Indoor Environment: A Pilot Study**

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Bioaerosols are microorganisms of biological origin (i.e., alive or released from a living organisms) that are suspended in the air, which may consist of bacteria, fungi, viruses, endotoxins, pollen, etc and present everywhere in the environment. The sizes of bioaerosols range from sub-micrometers to over hundred-micrometers. Kitchen is one of the major indoor sources of bioaerosol and people working in kitchen are always under the high risk of exposures. In this study, concentrations of bacteria and fungi were calculated inside (cooking area) and outside (dining area) the kitchen during summer months. Mean concentrations of bacteria and fungi inside the kitchen were (580 cfu/m3) and (810 cfu/m3) and at outside the kitchen were (420 cfu/m3) and (601 cfu/m3), respectively. It was observed that inside kitchen bioaerosols concentration were higher as compared to the outside. In addition to micro flora estimation, major meteorological parameters (air temperature, RH and wind speed) were also measured and recorded. Among all influencing factors (air temperature, relative humidity and wind speed), relative humidity played an important role in affecting bioaerosol concentrations inside and outside the kitchen. The pilot work shows that bacteria and fungi follows similar pattern of spatial distribution in indoor environment at our study sites. Keywords: Bioaerosol, Bacteria, Fungi, Kitchen, Indoor environment.

**C10**

**PHYSIO-CHEMICAL CHARACTERISATION OF PARTICULATE MATTER & ITS IMPACT ON HUMAN HEALTH**

VIJAY KUMAR
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PHYSIO-CHEMICAL CHARACTERISATION OF PARTICULATE MATTER & ITS IMPACT ON HUMAN HEALTH Vijay Kumar* Department of Botany, Environmental Science*, B.H.U. Varanasi. 221005 Email: vijuevs@gmail.com Mob. No. (8960844858) With Indiaâ€™s rapid increase in population and pollution the environmental health problem have become serious. Air pollution has increased several folds with the increasing urban population, number of vehicle, fuel with poor, environmental performance, badly maintained road etc. Excessive increase in vehicular pollution has lead to exposure of fine particulate matter with aerodynamic diameter less than 10 Âµm. Epidemiological studies have shown linear relationship between air borne particulate matter and effect on human health (Guiseppe Pizzo and Meriana Clerico, 2012) It has studied out that finer particles have strongest health effect (Schwartz et al.1998). These particulate matters have adverse health impact on cardiovascular and respiratory systems. Source, characteristics and potential health effect of particulate matter (PM2.5 and PM10) are different. The former can penetrate more readily into lungs and therefore have short and long term effect such as premature death, increased respiratory symptoms and decreased lung function and alteration (Sharma and Maloo, 2005). Particle size is very important both in terms of deeper penetration and as a carrier of pollutants including heavy metals and organic compound. Exposure to heavy metals can cause adverse effect including metal toxicity. Many organic compound are carcinogenic, mutagenic and genotoxic. The WHO 2006 has described the effect to human health from particulate matter, ozone, nitrous oxide and sulphur-dioxide .WHO estimates that each year at least 8000 people die prematurely due to long term effect of particulate matter. By 2020 because of PM2.5 there is a loss of life expectancy of 5.5 month. This paper is a critical representation of particulate matter affecting human health. The challenge in this paper is to describe the comprehensive effect of particulate matter and its minimisation in the environment with the view of developing its effective control strategies for adequate air quality management. Keywords: Particulate Matter, Aerodynamic diameter, Heavy metal, Carcinogen, Genotoxic.

**C11**

**Nanotechnology Enabling Green And Clean Hydrogen Fuel: A Novel Mechanism**

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In the current world scenario energy crises are increasing day by day as the population pressure is also increasing on the available natural resources. Fulfillment of the energy demands with conventional fuels is causing serious problems i.e. global warming, climate change, green house effect, acid rains etc. There is an urgent need to develop a novel, clean & green mechanism(fuel) to establish an equilibrium between energy demands and energy supply, along with the developed mechanism should be highly efficient, eco-friendly and economically suitable. Hydrogen fuel has been proved as the best candidate for above. Photo catalytic hydrogen evolution using solar radiation to split water into hydrogen, is currently a hot intensive research area. Most of the developed photo catalysts are UV- light responsive, which only accounts a small fraction (3%) of the incoming solar radiation. The development of visible light driven photo catalyst for photo catalytic hydrogen evolution from water is most suitable & favorable as the visible light accounts a large fraction (44%) of the incoming solar radiation. The developed photo catalyst should exhibit high efficiency & stability, for it we have to consider the energy band gap of the photo catalyst corresponds well with solar spectrum (Visible Light) and the developed photo catalyst should be photo corrosion resist. Multi Wall Carbon Nanotubes (MWCNTs) show

excellent photo corrosion resistant properties. Multi Wall Carbon Nanotubes (MWCNTs) doped CdZnS nanocomposite has been developed by chemical co-precipitation method. For it MWCNTs have been functionalized by acidic treatment, which develops several functional groups upon MWCNTs surface. These functionalized multi wall carbon nanotubes (F-MWCNTs) are then further treated with acetate salts of Cd+2 and Zn+2 and then finally excess sulphide salt to prevent the oxidation of Cd+2 by photo generated holes. Finally the developed F-MWCNT/CdZnS nano-photo-catalyst(NPC) was investigated by Raman Spectroscopy, FTIR (Fourier Transform Infrared) Spectroscopy, X-Ray Diffraction(XRD), SEM(Scanning Electron Microscope), HRTEM(High Resolution Transmission Electron Microscope) for analyzing various information i.e. structure, shape, size, surface morphology of the developed nano-photo â€"catalyst. The activity of the developed nanocomposite was evaluated by fabricating a photo electrochemical cell. High efficiency and stability was observed. A novel, efficient, economic & eco friendly mechanism (fuel) was developed by utilizing the natural resources(Solar Energy and Water) which is clean and green in operating mode. Keywords: UV-light (Ultra Violet), MWCNTs (Multi Wall Carbon Nano Tubes), CdZnS (Cadmium Zinc Sulphide), F-MWCNT (Functionalized-Multi Wall Carbon Nano Tubes), NPC (Nano- Photo- Catalyst).

**C12**

**Dryness of ephemeral lakes and consequences for dust storm activity in the Sistan region, southeastern Iran**

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The Sistan region in southeast Iran is considered as one of the most windiest and active dust source regions in south west Asia. The northern part of Sistan is covered by ephemeral, marshy lakes, the so-called Hamoun lakes. During prolonged dry or drought periods, the end result is a decrease in the water coverage in the basin, or even complete dryness as occurred in 2001. Then, the strong â€œLevarâ€• winds in summer blow fine sand and silt off the exposed lake bed enhancing the dust activity and aerosol loading over the region, thus affecting climate, ecosystems, local economy and human health. Satellite (Landsat, TOMS, MODIS, MISR) and meteorological observations reveal that the water levels in the Hamoun lakes exhibit a pronounced interannual variability and are strongly related to anomalies in precipitation and concurrent changes in the frequency of the dusty days, aerosol loading and deterioration of visibility. This study discusses also some results corresponding to the influence of changes in land use - land cover over Hamoun on visibility, dust-storms, aerosol loading, grain size distribution, particulate matter concentration and pollution levels over the region. Particulate matter (PM10) measurements were performed in two cities (Zabol and Zahedan) during the recent years. Extreme-high daily PM10 levels are found in Zabol, rising up to 2000 ï•¬gm-3, even reaching to 3094 ï•¬gm-3, during intense dust storms, while the monthly mean PM10 shows extreme values (>500 ï•¬gm-3) for the period June to October. Significantly lower PM10 concentrations are found in Zahedan (highest monthly mean of 172 Î¼g mâˆ'3 in June) located farther to the south. Analysis of the Air Quality Index (AQI) shows that 61% of the days in Zabol are associated with a high health risk, while 30.1% are even identified as hazardous. In Zahedan, the 15.3% of the days are unhealthy for sensitive people, while 2% are considered as hazardous. Analysis of the meteorological records in Zabol shows that the temperature, number of dusty days and days with visibility below 2 km have been increased, especially during 2000s, close related to persistent droughts over Hamoun. The desiccation of the Hamoun lakes in certain years is an example of the effect of climate change on atmospheric dust aerosols, air quality and human health over this arid environment, which is expected to be more severe in the future.

**C13**

**Studies of Air Quality Index (AQI) of Jamshedpur City, East India**

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Air pollution is a major environmental concern in major cities around the world. The major causes of air pollution include rapid industrialization/urbanization and increased non environment friendly energy production. The purpose of this paper to highlight the Ambient Air samples were collected between Jan 2010 to June 2011 in the urban-industrial area of Jamshedpur city, by high volume sampler, quality of air were monitored. The particulate matter (PM10 & PM2.5), Sulphur dioxide (SO2), Nitrogen oxide (NO), Ozone (O3), Suspended particulate matters (SPM) and Mercury (Hg) which give a fair idea of pollution load carried by the air. The monitoring data were collected from ten sites randomly selected in Jamshedpur city. The Air Quality Index (AQI) of PM10 & PM2.5 concentration was found to be moderate, SO2, NO, O3 concentration were discussed.

**C14**

**Impact of traffic related air pollution on lung function capacity**

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Impact of traffic related air pollution on lung function capacity Jadhav V.V., Ingawale R.R., Jadhav A.S. and P.D.Raut Department of Environmental Science, Shivaji University, Kolhapur 416004. drpdraut@yahoo.co.in Abstract: Air pollution has been associated with several health hazards. Traffic related air pollution which includes air pollution due to vehicles is the major contributor. People like traffic police, shopkeepers, hawkers, road side venders are daily exposed to such type of pollution and becomes victims of lung diseases. Occupational diseases are dependant on time and frequency of exposure to air pollutants. Most information is about acute health effects of air pollution. Health effect due to chronic exposure is not well known. Study was carried out to know abnormalities in lung functioning capacity with the help of spirometer at different location in Kolhapur city. In present study, the samples were collected from three locations viz. Dabholkar Corner, Mahadwar Road and Shivaji University campus, which were categorized as highly, moderately and low polluted areas. At each location 50 members were examined who has been daily exposed to traffic by using Spirometry. The questionnaire was also used to produce the basic as well as occupational information of the people. Lung function capacity were examined with Pulmonary Function Testing (PFT) which includes FVC, SVC, MVV. People exposed to vehicular pollution at Dabholkar Corner and Mahadwar road are having severe abnormalities in lung function and lung disorders than that of University campus area. The detailed results are discussed in the paper. Keywords: Traffic, Vehicular pollution, Lung disorder , Pulmonary Function Testing (PFT), FVC

**C15**

**Optimization of a New Portable Dilution System for Aerosol Emission Measurement of Automobiles**

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The aerosol emission from sources varies across the world depending upon the energy use and prevailing technologies in a region. Previous emission inventories have reported biomass fuel for energy in domestic sector as a major source of aerosol emission in developing regions like India and other part of South Asia, with rapidly growing contribution from fossil fuel. Among sectors using fossil fuel as energy source, road transportation is one of the major contributors to aerosol emissions in India. Real-time emissions represent complex mixture of solid particles (like EC), inorganic and organic compounds as they would appear soon after exiting the source, cooling, and equilibrating to ambient conditions. This paper presents a new design, development and optimization of a portable dilution system for on road measurement of PM2.5 from automobiles under similar conditions when exhaust comes into the atmosphere. The system will be calibrated for particle loss and nucleation at laboratory using known particle number recorded with particle counter. The system will be optimized for exhaust measurement under stationary conditions of light duty vehicles. The portable dilution system will be equipped with particle sampling probe, PM2.5 cyclone separator, a bypass, ambient CO2 analyzer, temperature and relative humidity sensors. The system will be attached to tail pipe of the stationary vehicle through stainless steel duct and a fraction of exhaust will entrain the dilution tunnel through particle sampling probe, where it will be diluted through measured quantity of zero air and sampled within residence time of 3 sec. Velocity and CO2 of exhaust in the duct will be recorded each minute. The dilution ratio will be calculated using CO2 measured in duct and in dilution tunnel. The particles will be collected on quartz fiber filter. The average emission factors will be calculated using particle mass collected on filter, flow rate, experiment time and fuel consumption. The paper will discuss the optimization of dilution ratio and its effect on PM2.5 emissions for light duty vehicles. The implication of the results for refinement of emission inventory and regional climate study will be discussed. Keywords: PM2.5; Fossil fuel; Automobile emission; Source characterization; Emission inventory.

**C16**

**PRE-ASSESSMENT ON DIFFERENT LEVELS OF NOISE POLLUTION IN AIZAWL CITY, MIZORAM**

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Assessment of noise pollution was carried out in Aizawl city of Mizoram during August 2009 â€“ July 2011. Different levels of noise were recorded from industrial zones, commercial zones, residential zones and silence zones by using Sound Level Meter 2031/A. Of all the four zones, residential zones and silent zones were found to exceed the standard prescribed by the Noise Pollution (Regulation and Control) Rules, 2000. Among the commercial zones New Market and Zangena Petrol Pump exceed the standard level. And all the study sites under industrial zones were within the standard level. Detailed information is presented in the paper.

**C17**

**IMPACT OF JHUM BURNING ON AIR QUALITY AND HUMAN HEALTH IN MIZORAM**

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Deterioration of air quality, which is an alteration of atmospheric chemistry by pollutants from natural and anthropogenic sources is of major global environmental concerns today. The sources of deterioration of air quality in Mizoram is mainly due to shifting cultivation or slash and burn agriculture or Jhum burning, one of the main form of agriculture and livelihood of the villagers. Large amounts of air pollutants are emitted during prescribed forest fires (Jhum burning). Unlike wildfires, prescribed fires are intentionally ignited in order to maintain ecosystem health and minimize adverse impacts of long-term fire suppression while protecting property. However, jhum burning has resulted in many forms of pollution, directly and indirectly hampering the natural environment .The need to understand the effect of jhum burning and the consequences not only on soil, but on air and human health is important.

**C18**

**An analysis of recent trends in Urban Heat Island in Delhi using data of the SAFAR network (CWG-2010)**

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An analysis of recent trends in Urban Heat Island in Delhi using data of the SAFAR network (CWG-2010) M. Y. Aslam, Beig .G, Ali .k, and *Chate .D.M Indian Institute of Tropical Meteorology, Pune-411008 INDIA *Corresponding Author: Chate@tropmet.res.in Abstract In different areas of Delhi and Delhi-NCR, changes in land use and land cover, expansion of infrastructure, choice of building materials influence the ambient temperature. The heating of the urban surfaces during the daytime sets the initial temperature and this overheating is dissipated during the night-time through mean convection motion. The lowest temperature reached at the end of this cooling period corresponds to the Urban Heat Island (UHI) effects. In this work, we present analysis of UHI, based on average temperature differences over daytime and nighttime periods, compared them with the results of UHI obtained from population and observed winds in study areas and investigate the influence of changes in pollutants concentrations during policy-induced air quality measures (1-14th October, 2010) period (CWG-2010) and post-CWG period (15-30th October, 2010) using air quality and weather datasets of the SAFAR network. Daytime average temperature differences between post-CWG and CWG periods were 0.38, 0.18, 0.19 and 0.20C over IITMD, CWGV, DU, and NDMC areas in Delhi respectively, whereas nighttime temperature differences were 1.21, 1, 1.04 and 1.090C respectively. During daytime, we found increase in UHI by 0.40C over DU and MDNS areas and 0.260C over airport for post-CWG period over to those UHI over CWG period. The air quality improvement during CWG period over to post-CWG period for reduced fine PM2.5 and coarse (PM10-2.5) particles may be responsible for the above temperature differences and UHIs. Detail air quality and weather data analysis will be presented in the extended abstract for a wide range of causes, including the land surface temperature balance (or imbalance) due to increased anthropogenic emissions during post-CWG periods over Delhi and Delhi-NCR study areas. Keywords: Urban Heat Island, CWG-2010, air quality, SAFAR

**C19**

**Air Pollution & Climate Change; Impact on Health: Taurine in Nutrition-Natural Cleaning**

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Climate, Environment and Health can not be separated; in fact they are spiral bonded. Any alteration in climate can be easily notice in environment/ecology; subsequently can be reflected in health status. Now health issues are basically much more nature dependent; physically, chemically as well biologically (Genetics, physiology) and so on. Environmental issues are composite in nature and cover varieties of aspects of which pollution takes major share ranging air to water and many others .Because of seriousness these are now becoming part of discussion from coffee table to round table. Often while dinning or socializing this issue invisibly comes up with hot or chilled cold end, with helplessness. Any serious change in natural condition affects our entire life activities this may be food, feed, or function. . To cope, such situation and to provide remedies; is the sincere demand from the all corner and to get the answers one has to look back the nature again and again. Medicine and food have a common origin. What medicine can do food can also do ,a food can be regarded as â€˜functionalâ€™ If it is satisfactorily able to demonstrate its beneficial effects on one or more target functions in the body thus improving the state of health and strengthening the well being and or participating in reduction of risk of diseases . Such nutriceulicals in broader term must remains as component of food rather than individually as capsule or in other forms. There is increasing evidences that sulfur amino acids (SAA) play an important metabolic and functional role in human health and disease prevention. One of such sulfur amino acid is Taurine .Though taurine presence is recorded in our planet formation but in reality it was rediscovered about 200 years ago. Air pollution and climate change influence each other through complex interactions in the atmosphere. Direct emissions of air pollutants or those formed from emissions, can also influence this energy balance. . Thus, climate change and air pollution management have consequences for each other. The agents responsible for climate change and air pollution are also responsible for adverse impacts on human health, ecosystems and the climate. Air pollution produces pollutants which are sources to generate free radicals in the form of oxidants, toxic metals, all these newly generated molecules act as modulators of â€œpulmonary host resistanceâ€• leading to infection, growth of cancer, adverse effects on nervous system resulting to the development of a correlation between air pollution and health impact. To ease such situation â€œprevention is better than cure â€œstill hold strength, hence dietary supplement of natural molecules which occupy place in our host defense system should be natural selection. Taurine ,chemically 2- Amino Ethane Sulfonic Acid is second highest free amino acid in mammals and an adult human of 70 kg contains about 70 g of taurine .Taurine is a recognized agent of host defense and is promi

**C20**

## Air/vegetation ozone fluxes and their role in ecosystems damage

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The amount of ozone contained in the troposphere has been continuously increasing in the last 150 years and abatement measures seem insufficient to reduce it, mainly due to the complexity of ozone formation mechanisms. Ozone causes adverse effects to human health and to vegetation. Its implications on the climate system are multiple. First, ozone is a greenhouse gas, and its radiative forcing potential is the third in importance after carbon dioxide and methane. Second, its damaging effect on plant growth causes slower carbon sequestration, thus indirectly contributing to global warming. Crop yield losses due to penetration of ozone in leaf tissues cause important agricultural

production losses, especially in developing countries. Assessment of effects on vegetation necessitates a correct metric to quantify the amounts of ozone taken up by plants. Mpst regulatory measures in force in various countries of the world fail to give a reliable quantification of this take-up because they are mostly based on concentration records whereas plants are sensitive to fluxes, i.e. the quantity of molecules penetrating into the plants per unit area and time. Knowledge of fluxes is thus essential, but requires sophisticated measuring techniques. Results of ozone flux measurements and model studies are presented here, such as to compare time-integrated fluxes to exposure indices based on concentration records, showing the differences between these two approaches, which are far from equivalent.

**C21**

**Low cost monitoring network for real time air pollution observations, predictions and health impact studies: A case study on particulate matter pollution in urban Coimbatore, India**

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Low cost monitoring network for real time air pollution observations, predictions and health impact studies: A case study on particulate matter pollution in urban Coimbatore, India Nishadh K A (a), Mohanraj R (b) and Azeez P A (a) (a)- Environmental Impact Assessment Division, SÃ¡lim Ali Centre for Ornithology and Natural History, Anaikatty Post, Coimbatore-641108- Tamil Nadu, India (b)- Department of Environmental Management, Bharathidasan University, Trichirappalli-620024, Tamil Nadu, India There is a growing realization that low cost monitoring network would be an important enabler for high spatial resolution air pollution observations and related applications. EPA\'s recent draft report on â€œroad map for next generation air monitoringâ€• specifically emphasizes such requirements(1). Field trails also, show that low cost sensors with advanced calibration techniques would be an important asset for real time air observation (2). The experiences shows that, it involves the huge challenges in terms of tuning sensing technology, data management, networks sustenance and the collected information\'s better usage (3). The ongoing case study on particulate matter pollution in urban Coimbatore, a fast growing urban conglomerate in the Tamil Nadu, India is intended to address this question of how low cost monitoring network would be useful for real time air pollution observations, predictions and health impact studies. We here propose an open hardware development route with sensor web enablement for standardization, community involvement and engagement tool for community sensing, application derivation, and sustenance of the network. By following the open hardware development route, the study intends to develop a low cost sensor that would act as an important enabler for high spatial resolution sensing (since low cost would mean more sensors) and further development in public domain. Using the sensor web enablement, the project foresees better management of sensors and its network with more intuitive information models and services capabilities of a typical sensor network. By involving common public in possible ways for developing this network, the project is expected to establish a community sensor platform for air pollution problems and thus ensures the sustenance of network helpful for further research. Reference: 1. United States Environmental Protection Agency (2013). DRAFT road map for next generation air monitoring.

https://sites.google.com/site/airsensors2013/background/ASAP%20FINAL%20draft%20Roadmap_2013_03_08.docx?attredirects=0. Accessed on 25th March 2013. 2. D Hasenfratz, O Saukh, and L Thiele. On-the-flycalibration of low-cost gas sensors. In Springer EWSN, 2012. 3. K Aberer, S Sathe, D Chakraborty, A Martinoli, G Barrenetxea, B Faltings and L Thiele (2010). OpenSense: Open Community Driven Sensing of Environment. IWGS â€™10, San Jose, CA, USA.

**C22**

**Adsorption of radionuclide Cs ions through low cost biodadsorbents**

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The present study deals with the radionuclide uptake by dry aquatic plant species under variable exposure time, adsorbent dose and radionuclide concentrations conducted as laboratory experiments. Herein, two plant species namely myriophyllum and hydrilla were used to understand the activity uptake by these plants in dried form. The experiments performed show that better results were seen using hydrilla species with a percentage activity reduction of almost 92% compared to myriophyllum with a percentage activity reduction of around 84% for the same which were analysed using HPGe. This study includes the variation in particle size (5 sets - < 100u, 100u to 150u, 150u to 200u, 200u to 250u and 250u to 300u) of the dried aquatic plant species along with variation in the mass of each particle size taken (0.2gm, 0.4gm, 0.6gm, 0.8gm and 1.0gm). It is seen smaller the particle size and more the mass, more the time of exposure better is the activity removal efficiency but again it can lead to hazardous waste generation. Thus, results show there is hardly major difference in the activity removal efficiency by exposing the radioactive Cs source for same time but with lesser mass for each particle size, with the smallest particle size giving the maximum activity removal efficiency.

**C23**

**Seasonal Air Pollution studies over semi-urban and semi–arid station over western Indian tropical region with special reference on Long- Range Transport Phenomena**

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The air pollution studies have now become more relevant and furthermore aggravated in present age due to rapid rise in several industrial sectors, growing cities, increasing traffics activities and high level of energy consumptions under the high influx population to urban, semi-urban and rural area. Currently, in India, air pollution is becoming widespread problem concerning to such as, reduction of air visibility due to fogs and smokes formations, health hazard to human beings as well as air toxic agent to natural vegetations along with earth climate change assessment. Further more, air pollution is not confined only in Urban area but also to other less polluted source sites like towns, villages, national highway roads etc., . In among of all different sources of air pollutants emissions by man-made activities like as, industries, thermal power plants, vehicular emission the another major contributors of air pollutants, produced by combine action of anthropogenic activities and natural activities, are long range transportation phenomena sources which are also plausible cause of day to day and seasonal variation

in several air pollutant concentration such as Black Carbon (BC), Particulate Matters ( PM2.5), Realizing this, it is essential to assess the seasonally air pollutants concentrations in views of long range transportation phenomena using calculated Air Mass Back Ward Trajectories at 500m above observing site i.e., Udaipur ( 24.6Â°N, 73.8Â°E, 580 m). In this direction, the results based on simultaneous measurements of atmospheric black carbon mass concentration , PM 2.5 , AOT 1020, & TWC over Udaipur during the different seasons of period from 2010-12 would be presented in light of several air mass wind back ward trajectory parameters like percentage occurrence of air mass flows, their corresponding origin altitude, percentage contribution of trajectory path over continent path and sea path duration for the eight air mass flow sectors like North, North East, East, South East, South, South West, West and North West direction from Udaipur. More details about the results and its possible causes would also be discussed.

**C24**

**Rainwater chemistry of a rural site in mid-Brahmaputra valley in Assam**

Pranamika Bhuyan and Raza R Hoque
Tezpur University

A yearlong study of wet precipitation was conducted during November 2011 to October 2012 at a rural receptor site in the mid Brahmaputra Valley of Assam. Rain samples were collected event wise and 122 number of samples were analyzed for pH, Conductivity and ionic constituents. The arithmetic mean pH was found to be 5.8 , however, the volume weighted mean (VWM) pH for the entire period was found to be 4.8, which is acidic. Major anions viz. F- , Clâˆ’, Brâˆ’, NO3âˆ’ , SO42- and PO43- were analyzed by ion chromatograph (Metrohm IC 882 Professional). Among the measured anions, volume weighted mean (VWM) of Chloride was found to be dominating. Among the cations, VWM of Calcium was found to be dominating. Samples were also measured for TOC, TC and IC by a TOC analyzer (Analytik Jena 2100). Rain samples were having more TOC during monsoon period than in pre and post monsoon showers. This is indicative of the fact the monsoon winds would have carried much organic load from elsewhere. (This study is a part of ongoing project funded by Ministry of Earth Sciences, Government of India (No. MoES/16/16/10-RDEAS)).

**C25**

**Long-term changes in extreme air pollution meteorology and implications for air quality**

Shiliang Wu
Michigan Technological University

Air quality and atmospheric chemistry are significantly affected by meteorology, especially for the extreme meteorological events such as heat waves, temperature inversion, atmospheric stagnation and lighting. We analyze the observed long-term changes in air pollution meteorology for the past decades (1950-2010) to identify their possible trends in the context of global climate change. The potential impacts of climate change on air pollution meteorology and the implications for air quality will be investigated.

**Poster Presentation list for SAFAR**

**C1**

**Forecasting the Concentration of Atmospheric Pollutants: Skill Assessment of Autoregressive and Radial Basis Function Network Models**

Debanjana das
calcutta university

Abstract-The purpose of the present study is to develop a model to forecast the concentrations of some important atmospheric pollutants over Kolkata (22Â° 32â€²N; 88Â° 20â€²E), India during the period from 1st April 2009 to 30th November 2010 with considerable accuracy and adequate lead time. The pollutants considered in this study are respiratory suspended particulate matter (RSPM), nitrogen oxide (NOx), and sulphur oxide (SOx). The auto regressive (AR) models with different orders and radial basis function network (RBFN) model are developed to attain the objective. The skill of both the models is compared. The results of the study reveal that the 3rd order Auto-Regressive Model, AR (3) represents the best statistical model for the prediction of concentrations of all the three different pollutants over Kolkata. The study thus, depicts that the pollutants can be predicted with considerable accuracy and 3 days or 72 hours lead time using AR (3) model. The skill of the AR (3) model is compared with RBFN model. The result further reveals that the percentage error in forecast with 72 hours lead time is much less with RBFN model than AR model. Keywords-Concentration of pollutants, prediction, AR model, RBFN model

**C2**

**Air Pollution Dispersion Sensitivity Model and its Environmental Impact in Tiruchirappalli city Corporation of Tamil Nadu, India.**

Dr. M. Govindaraju
Bharathidasan University

Air pollution plays a major role in climate change which increases the earthâ€™s temperature. It can have an adverse effect on human health and ecosystem. The air quality in an urban area is influenced by many factors such as local meteorological, natural and anthropogenic activities. Tiruchirappalli City Corporation is one of the fourth largest city in Tamil Nadu, which is situated on the banks of the river Cauvery at 10.5Â°N, 78.43Â°E in India. It spreads over an area of 146.7 sq. km with the total population of 7, 52,066 (2011 census). The total annual rainfall is 746 mm and the temperature varies from 37.2 Â°C to 20.6Â° C. Ambient air quality such as SPM, SO2 and NOx has been monitored seasonally in ten selected locations using high volume respirable dust sampler. The population density map, Land Use/Land Cover map, Air pollution dispersion sensitivity model has prepared by Remote Sensing and GIS technologies. Spatial dispersion sensitivity air pollutants were discussed with considering LU/LC features such as settlement, road network, urban vegetation , etc., Also climatic variables such as temperature, rainfall, wind speed , direction and social factors population density diversity and so on. Finally the study are have been classified into three categories like high, medium and low based on the dispersion sensitive of air pollutants. Spatial dispersion analysis shows that the level of impact is high locations having high population density. In the present study Chattram bus strand, Main guard gate, Central bus strand and Post office are sensitive areas in respect with air pollution. These areas are having high vehicular emission due to commercial and transportation activities. The medium and low sensitivity is presented in Multi fly over bridge, Mambalasalai, Pudhur, Palakkarai, Gokinur, and Thillai Nagar, which are combined (commercial and residential) and residential areas. The air pollution dispersion is also varied seasonally, in winter low dispersion and summer high dispersion because of wind speed and moisture content of air.

**C3**

**Ambient Air Quality Monitoring and Assessment of air pollution status in Kolhapur City**

Jadhav Vikas Vishwas
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Ambient Air Quality Monitoring and Assessment of air pollution status in Kolhapur City Jadhav V.V., Mangalekar S.B., Patil V.N., Lad R.J. and Raut P.D. Department of Environmental Science, Shivaji University, Kolhapur 416004. drpdraut@yahoo.co.in Abstract: Growing urbanization and up come of vehicles numbers which have emerged major issues about the air pollution. The high disease burden due to air pollution has started to impact the economy of the urban centers. Kolhapur city is a district place in the Maharashtra State (India) with population of 5, 49,283. Increased vehicular traffic is foremost to deterioration of air quality in streets of Kolhapur city in recent years. In Kolhapur city air quality has monitored with view to establish current levels and also sample collect for source appointment related analysis by the Department of Environmental Science of Shivaji University. Three representative sites were selected namely Shivaji University, Dabholkar Corner and Mahadwar road on basis of traffic problems, and population density which representing the Kolhapur City. Air quality pollutants were monitored as per the guidelines provided by CPCB. Air quality monitoring was accomplished by carrying out for 6 days of week and each site monitored for the 2 times in a week, for 24 hours a day. Air Quality Monitoring done continuously in each season for three seasons viz. summer, post monsoon, winter. After every four hours the monitoring of air pollutants was doing like SPM, SO2 and NOx which are associate with the vehicular emission. Ambient Air Quality Monitoring sets out the basic framework for the measurement of air quality in Kolhapur city. Dabholkar Corner has showed maximum pollution due to the huge amount of traffic. Mahadwar road shows the medium level of the pollution and the Shivaji university site showed the low pollution level as compared to other sites. The average concentrations of different pollutants at selected monitoring sites will be representing in the full paper. Keywords: SPM, Dust sampler, Sox, Nox, air quality

**C4**

**PRE-ASSESSMENT ON DIFFERENT LEVELS OF NOISE POLLUTION IN AIZAWL CITY, MIZORAM**

Lalremruati Ralte & Lalnuntluanga
Mizoram University

Assessment of noise pollution was carried out in Aizawl city of Mizoram during August 2009 â€“ July 2011. Different levels of noise were recorded from industrial zones, commercial zones, residential zones and silence zones by using Sound Level Meter 2031/A. Of all the four zones, residential zones and silent zones were found to exceed the standard prescribed by the Noise Pollution (Regulation and Control) Rules, 2000. Among the commercial zones New Market and Zangena Petrol Pump exceed the standard level. And all the study sites under industrial zones were within the standard level. Detailed information is presented in the paper.

**C5**

**IMPACT OF JHUM BURNING ON AIR QUALITY AND HUMAN HEALTH IN MIZORAM**

Lalrinpuii, Hilda& Lalnuntluanga
Mizoram University

Deterioration of air quality, which is an alteration of atmospheric chemistry by pollutants from natural and anthropogenic sources is of major global environmental concerns today. The sources of deterioration of air quality in Mizoram is mainly due to shifting cultivation or slash and burn agriculture or Jhum burning, one of the main form of agriculture and livelihood of the villagers. Large amounts of air

pollutants are emitted during prescribed forest fires (Jhum burning). Unlike wildfires, prescribed fires are intentionally ignited in order to maintain ecosystem health and minimize adverse impacts of long-term fire suppression while protecting property. However, jhum burning has resulted in many forms of pollution, directly and indirectly hampering the natural environment .The need to understand the effect of jhum burning and the consequences not only on soil, but on air and human health is important.

**C6**

**Study of Bioavailable Trace Metals in Particulate Matter and its Risk Assessment**

Suman Yadav, Amruta P. Kodre, Ritwika Roy and P. Gursumeeran Satsangi*
Department of Chemistry, University of Pune

24-hr samples of PM10 and PM2.5 were collected by Mini - Vol TAS sampler at Department of Chemistry, University of Pune, a semi-urban site of Pune. The average concentration of PM10 and PM2.5 were 113.8 Â± 51.6 Î¼g m-3 and 72.3 Â± 31.3 Î¼g m-3. The maximum and minimum concentration were observed to be 236.1 Î¼g m-3 and 13.8 Î¼g m-3 for PM10 and 180.5 Î¼gm-3 and 13.8 Î¼g m-3 for PM2.5, respectively. Toxicological studies have implicated trace metals in airborne particles as possible contributors to respiratory and/or cardiovascular inflammation. This study reports quantification of toxicity of PM bound metals and their possible associated risk to human health. Samples were extracted with ultrapure water and analyzed for (Cd, Zn, Mn, Fe, Ni, Cu, Cr, Co, Zn and Pb ) bioavailable (i.e. soluble) metals. Soluble fraction of the trace metals is readily bioavailable once inhaled to the respiratory system, possessing the maximum risk to human health. The average concentration of metals ranged from 60 ng m-3 to 3400 ng m-3. The results for the total mean concentrations of individual metals specify Ni as the most abundant metallic element (3390 ng m-3) followed by Fe > Cr > Co > Cu > Zn > Cd > Mn > Pb. In the present study, among the toxic metals, Cd showed higher concentration in the soluble fraction and thus represents the higher bioavailability index. From the results, it is clear that it is the most bioavailable metal which is followed by Zn, Cu, Mn, Pb, Ni, Co, Cr. Higher value of BI for Cd indicate that it may be totally available to physiological activities once inhaled to lung system, which might hold higher risk to human health. Further, risk calculations with a simple exposure assessment method showed that the cancer risks of the bioavailable fractions of Cr, Cd and Ni were greater than the standard goal. The study illustrated that special attention has to be taken to the mentioned elements and their related sources for health impact assessments and when planning mitigation measures for urban atmospheric pollution and for providing a sustainable development of cities and megacities. Key words: Soluble trace metals, Toxicology, Bioavailability, Cancer risk

**C7**

**Assessing health risks in urban India: Application of Air Quality Health Index (AQHI) to air quality data**

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IIT Kanpur

Risk based multi-pollutant Air Quality Health Index (AQHI) is considered to be more effective in communicating the air pollution-related health risks than the AQI (Air Quality Index) .This study examines usefulness of AQHI reporting system in assessing health risks to population exposed. AQI (that uses major criteria pollutants such as NO2, SO2, O3, CO, RSPM and SPM) was used in selected locations in Kanpur and Lucknow. Three residential areas in Kanpur (4 in Lucknow) and 1 industrial location in each city were selected. Air quality data (from CPCB monitoring stations) for years 2005 to 2010 was

used to calculate sub-indices using a segmented linear function for each pollutant (as per Indian Ambient Air Quality Standards and USEPA standards). Maximum operator concept was used to calculate overall AQI. Seasonal variability in air quality was clearly reflected in AQI values. Air quality worsened (poor to very poor) in winter (December, January and part of February) and summer months (March, April and part of May).Summer months were characterised by dusty winds resulting in high SPM in both residential and industrial areas. As expected, at all locations high SPM level is responsible (> 95% of the cases) for the overall AQI. Comparison of residential and industrial locations reveals that industrial area has higher AQI value in both cities. It is interesting to note that between industrial sites of both the cities, Lucknow location has more SPM concentration resulting in higher AQI. This can be attributed to the nature of the location: the site is influenced by a lot of high human and commercial activities like industrial processes, agricultural operations, combustion of wood and fossil fuels, construction and demolition activities, entrainment of road dust into the air also occurs. Results highlight the fact that SPM is critical pollutant. The fact that increased pollutant emission causes deteriorated environmental quality and impacts human health further suggests that more abatement strategies should be focused on SPM to improve the air quality. This poster discusses application of AQHI since current AQI does not account for health risks. Exposure to air pollutants may cause increased frequency and / or severity of symptoms, resulting in increased medication requirements. It is important to note that the proposed AQHI focuses on 2 populations: â€œGeneralâ€• Population and â€œAt riskâ€• population. The latter consists of children and elderly people with existing respiratory and cardiovascular diseases. It reports air quality on a scale from 1 to 10+ based on 3 major air pollutants ground level ozone (O3), particulate matter (PM) and nitrogen dioxide (NO2). Implementing new AQHI will provide opportunity to issue health advisory based on local air quality conditions. This in turn will limit exposure to air pollution and permit adjusting activity levels.

**C8**

**Impact of Nitrogen Oxide Gases for Human Health & Agriculture in India**

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Abstract Nitrogen oxides (NOx) are important components of ambient and indoor air pollution and are emitted from a range of combustion sources, including on-road mobile sources, electric power generators, and non-road mobile sources. While anthropogenic sources dominate, NOx is also formed) is also emitted by lightning strikes and wild land ï¬•res and is also emitted by soil. Reduced nitrogen (e.g., ammonia, NH3 by various sources, including fertilizer application and animal waste decomposition. Nitrogen oxides, ozone (O3) and ï¬•ne particulate matter (PM2.5) pollution related to atmospheric emissions of nitrogen (N) and other pollutants can cause premature death and a variety of serious health effects. Climate change is expected to impact how N-related pollutants affect human health. For example, changes in temperature and precipitation patterns are projected to both lengthen the O3 season and intensify high O3 episodes in some areas. Other climate-related changes may increase the atmospheric release of N compounds through impacts on wildï¬•re regimes, soil emissions, and biogenic emissions from terrestrial ecosystems. This paper examines the potential human health implications of climate change and N cycle interactions related to ambient air pollution. Excess of Nitrogen application may cause Rice stem borer attack to Paddy field, sometimes it leads to lodging of Plants in the Agricultural land and also causes hardening of soil by causing Soil Pollution. Air pollution receives one of the prime concerns in India, primarily due to rapid economic growth, industrialization and urbanization with associated increase in energy demands. Lacks of implementation of environmental regulations are

contributing to the bad air quality of most of the Indian cities. Air pollutants produced in any air shed are not completely confined, but at time trespassing all the geographical boundaries, hence do not remain only a problem of urban centres, but spread and affect remote rural areas supporting large productive agricultural land. Air pollutants pose risks on yield of crops depending on the emission pattern, atmospheric transport and leaf uptake and on the plantâ€™s biochemical defense capacity. Recent trends have shown decrease in SO2 emissions, but increase in NO2 emission due to more number of automobiles. In past few decades, tropospheric O3 has been identified as a most important air pollutant of rural areas. Air pollutants produce reactive oxygen species (ROS), which adversely affect biochemical processes of plants and reduce their tolerance capacity to other stresses also. Several vital physiological processes such as photosynthetic CO2 fixation and energy metabolism are also affected negatively by air pollutants. An adverse effect caused by air pollutants depends not only upon its concentration, but also on the duration and combination of air pollutants. Keywords:-Nitrogen oxides, Ozone, Air pollution, Human health, Soil pollution, SO2, NOx, O3, ROS, crops References Lal, S., Naja, M., Subbaraya, B.H., 2000, Seasonal variations in surface ozone and its precursors over an urban site in India. Atmospheric Environment 34, 2713- 2724. Lee, E.H. 1999. Early detection mechanisms for tolerance and amelioration of ozone stress in crop plants. In: Environmental Pollution and plant response. (eds. Agrawal, S.B. and Agrawal, M.). Lewis Publishers, Boca Raton London, New York, Washington DC. pp. 203-222.

**C9**

## PUBLIC HEALTH IMPLICATIONS OF POLYCHLORINATED BIPHENYLS (PCBS) IN THE INDIAN ATMOSPHERE

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Keywords: Risk Assessment, Health Implications, Cancer Risk, PCB, India BACKGROUND INFORMATION PCBs are a group of synthetic organic chemicals that contain 209 individual compounds (known as congeners). They have been used mainly in industry as dielectrics in transformers and large capacitors, heat exchange fluids, and also as paint additives since 1929. They became a target of the environmental movement in the US and other places, beginning in the 1960s. An estimated 1.1 billion pounds (4.98x 10^5 tons) of PCBs were produced in U.S. alone between 1929 and 1977. They are persistent Organic Pollutants (POPs) and are found in almost all environmental compartments. PCBs are known to bio-magnify and bioaccumulate through the food chain and represent a potential threat to public health. Recognition of various health issues has resulted in efforts to reduce their production and use; US officially banned their production in 1979. Co-signatories of the Stockholm Convention (an international environmental treaty, effective from May 2004) agreed to outlaw nine of the dirty dozen chemicals which include PCBs. Despite being prohibited on usage in most South East Asian Countries PCBs still linger in the environment and India is being considered as a major source. Even though initiatives by Indian government to phase out PCBs will help in reducing active sources to the environment, PCBs residuals will be around for a long time to come. RISK ASSESSMENT Today, main sources of PCBs to the environment include poorly maintained hazardous waste sites, and illegal or improper dumping of PCB e-wastes. India generates approximately 150 000 t/year of e- waste which is poorly managed. Total PCB levels in air (Î£28PCB: range: 120 to 1077 pg/m3) at coastal and inland sites in India are higher than reported in other Asian countries (Î£28PCB: 5-340pg/m3) (Zhang et al., 2008). The calculated average daily intake of PCBs through inhalation at costal sites in India is (1.6x 102pg/kg-day) for adults and (4.4x102 pg/kg-day) for children and in other Asian countries is (4.83x102pg/kg-day) for adults and (1.28x102 pg/kg-day) for children. The calculated probability cancer risk estimate for PCB exposure through inhalation at costal sites in India is three times higher than in other Asian countries for adults.

To ensure public health safety, a tolerable daily intake (TDI) has been set by WHO which considered the upper range of 4 pg TEQ/kg/day to be the maximal tolerable intake on a provisional basis. The observed intake for adults and children are much lower than recommended acceptable daily intake but it should be reduced below 1 pg TEQ/kg/day. The acceptable risk distribution is lower than 10â€“6 for carcinogens (it may be upto 10â€“4) suggests minimum risk to the adults and children due to PCBs through exposure to the atmosphere in India as well as in Asia. CONCLUSION Research needs to focus on aerosol characterization to assess occurrence in atmosphere, source distribution and transport of PCBs in the environment under Indian climatic conditions. Although India emits more PCBs than other surrounding countries (Kang et al., 2009) only a few studies have been conducted within India (Bhupander et al., 2012; Zhang et al., 2008). Consequently information about the occurrence and behaviour of PCBs in Indian environment is very limited. This poster provides an overview of the information available about occurrence and source distribution of PCBs in India. The poster will also showcase initiatives by Indian government to phase out PCBs in India and will also present the intake and cancer risk assessment.

**C10**

**Assessment of differential responses of three mung bean cultivars with respect to growth, reproductive and yield parameters against ambient and elevated levels of ozone**

NIVEDITA CHAUDHARY
BANARAS HINDU UNIVERSITY

Tropospheric ozone (O3) has been recognized as an important constituent of air pollutant and is considered to be a phytotoxic air pollutant significantly affecting plantâ€™s performance poses a potential threat for agriculture. Background O3 concentrations continuously increased in the troposphere in the recent decades. In tropical areas high concentrations of O3 are mainly attributed due to favourable meteorological conditions such as high temperature, atmospheric humidity and high level of solar radiation. Legumes are comparatively most susceptible with respect to O3 and subjected to huge yield loss. Present study was conducted to assess the impact of O3 on three popular cultivars of mung bean (Vigna radiata L. HUM-1, HUM-6 and HUM-23) against and elevated levels of O3 (ambient+10 ppb O3) under open top chambers (OTCs). Results showed negative impact of O3 on various growth, reproductive and yield parameters with distinct differential response among all the test cultivars. Cultivar HUM-1 showed higher damage in its vegetative parts (shoot and root height, leaf number and leaf area) and reproductive structures (number of flowers and pollen viability) as compared to other cultivars. Yield response to stress also revealed that degree of damage was more severe under elevated concentrations of O3 over ambient in all cultivars. Significant reductions in yield were noticed and cultivar HUM-1 proved to be more sensitive. Therefore, the present study supported the selection of sensitive cultivar as a bioindicator for O3 and suitable tolerant cultivar for the areas having higher concentrations of O3.

## Theme - Climate

### Oral Presentation list for C4

**OP 19**

**The exceptional hot 2007 summer in Eastern Mediterranean and the Greek wildfires: Pollution levels and Climate Implications**

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Biomass burning and associated emissions of aerosol and pollutants into the atmosphere play a vital role in atmospheric composition, climate change and human health. This work aims at presenting some results based on the synergy of ground-based observations, satellite remote sensing and model simulations focusing over eastern Mediterranean and Greece during the exceptional hot summer of 2007. During that period, the region was struck by three heat waves (in June, July and August) and a number of forest ï¬•re episodes, greatly affecting air pollution levels. Since heat waves are projected to occur more frequently over eastern Mediterranean in a future climate, the present results also make a contribution to climate change impact research. As a direct consequence of the heat waves and the persistent high temperature and drought during summer of 2007, Greece faced the worst natural disaster recorded in recent decades in terms of human losses, number of fire outbreaks and extent of the burned areas (more than 12% of the total forested areas in Greece). The impact of these fire events, mainly located in the western Peloponnese, on atmospheric aerosol and pollutant concentrations can be characterized as severe as shown via combination of satellite data (MODIS, OMI, MOPITT, IASI) and chemical transport models. Satellite observations showed smoke plumes traversing thousands of kilometers southwards influencing the central Mediterranean as well as the north African coastal regions. These thick smoke plumes dramatically affected aerosol optical depth and aerosol-mass concentrations over the region and altered the microphysical aerosol properties, such as the effective radius and absorption coefficient. Furthermore, the concentrations of tropospheric pollutants like O3, NO2, CO reached to maximum levels due to the combined effects of biomass burning and high temperature. On the other hand, SBDART model calculations suggest that the shortwave radiation at the ground was reduced by ~50 Wm-2, while that at the top of the atmosphere was reduced by ~20 Wm-2 resulting in atmospheric heating of ~30 Wm-2 over the areas affected by the smoke plumes.

**OP 20**

## Effects on Stratospheric Moistening by the rates of change of Ozone and Aerosol Optical Depth due to Solar Activity in the tropics

UPAL SAHA

S. K. Mitra Centre for Research in Space Environment, Institute of Radio Physics and Electronics, CU

Stratospheric moistening (SM) is the water vapour intrusion in the stratosphere which affects ozone, surface climate and stratospheric temperatures. Increased stratospheric water vapor may be a major cause of global warming as it warms the underlying troposphere, cooling the stratosphere above. SM is controlled by the transport through the tropopause region. Ozone, one of the minor greenhouse gases; and aerosol optical depth (AOD), a measure of the amount of atmospheric aerosols, can significantly affect the intruded water vapour to stratosphere. The solar-induced changes in ozone and AOD cause some perturbations of tropospheric circulations and climate. The rate of change (roc) of Ozone due to SSN sharply decreases (r = 0.754) indicating a negative gradient whereas the roc AOD sharply increases (r = 0.632) indicating a positive gradient with solar activity. Atmospheric aerosols can scatter and absorb solar radiation and thus have important roles in the changes of solar radiation in the atmosphere. It is found that with the increase of the roc Ozone, there is a sharp decrease of SM (r = 0.863) reflecting a cross-over between the duos for the period under study. But it is observed that with the increase of roc AOD, there is a sharp increase of SM (r = 0.684) for the same period. An increase in AOD may cause a

significant increase in the gradient of vertical temperature profile. This may lead to formation of a strong convective system in the atmosphere which is an important controlling factor for vertical transfer of water vapour affecting SM. Thus, the roc Ozone and AOD due to solar activity has a prominent effect on SM in the tropics.

**Poster Presentation for C4**

**D 1**

## RAPID AEROBIC COMPOSTING OF ORGANIC SOLID WASTES AND ITS RELEVANCE ON GLOBAL WARMING

BALASUBRAMANIAN, S., P. SUBRAMANIAN
TAMIL NADU AGRICULTURAL UNIVERSITY

The very urgent environmental concern today is the exponentially increased concentration of Carbon dioxide (CO2), Nitrogen oxides (NOx), Methane (CH4), and other green house gases (GHG\'s) in the atmosphere. A much bigger proportion of these gases came from anthropogenic activities. Incineration of biomass solid wastes from agriculture, residential/commercial and industrial sources and fertilizer overuse due are among the unnoticed but significant anthropogenic sources of GHG\'s. There have been a lot of both local and international initiatives to control these emissions such as Kyoto and Montreal protocols and various earth summits . However, hard data show that these interventions are not enough to reverse the trends of air pollution as evidenced by the recorded increase in global temperature which is perceived to be caused by rapid industrialization without relevant and sustained environment. Aerobic composting is probably a major key to help solve or compliment the global and local efforts to arrest manâ€™s rendezvous towards environmental disaster. Composting is an aerobic process that transforms a range of organic substrates into a stable, humus like material through microbial decomposition. Composting can be considered to be a Carbon-based system, categorically similar to reforestation, agricultural management practices, or other waste management industries, unlike â€œsmoke-stackâ€• industries, which are relatively simple to document. Composting will likely become an important consideration in terms of the â€œqualityâ€• of Carbon credits and market risks and values associated with Carbon trading for these credits. The reduction of GHG\'s emissions must be the ultimate goal to control global warming coupled with the enhancement of carbon fixers or users. Aerobic composting is probably a pioneering approach to help reduce the emissions of CO2, Nox, CH4 and GHG\'s. Actual experimental studies on aerobic composting of agricultural and municipal solid wastes reveal that anthropogenic CO2 emission can be reduced by 13 percent, Nox emission by 14 percent and CH4 emission by 11 percent. CO2 emission reductions from aerobic composting of biomass residues from agricultural crop production and municipal solid wastes are: Y = 0.61X and Y = 0.165X respectively. On dry basis, the equation is: Y = 0.825X for both sources of wastes where Y is weight of emission and X is weight of biomass composted. This means that for every ton of biomass waste (dry weight) composted instead of being burned, 0.825 ton CO2 is not generated. Addition of compost to the farm lands will minimize Nox equivalent to approximately 5 percent of total anthropogenic CO2 released to the air as well as enhancing the carbon absorption by the soil roughly equivalent to another 5 percent

of the total CO2 these are the relevant mitigating effects of aerobic composting on the global warming phenomenon. The study on rapid aerobic composting, brings new technology of reducing the num

**D 2**

**Spatiotemporal variation of rainfall over the central Himalayan region revealed by TRMM Precipitation Radar**

Dibas Shrestha
Nagoya University, Nagoya

The rainfall-elevation relationship in the central Himalayan region (CHR) for premonsoon and monsoon seasons is analyzed utilizing the 11-year (1998â€“2008) high-spatialresolution TRMM PR 2A25 near-surface rainfall data. The results indicate a strong relationship between rainfall and elevation during both seasons. The investigation reveals a relatively large amount of rainfall over higher elevations during pre-monsoon season. Interestingly, two significant rainfall peaks appear over the southern slope of the Himalayas during summer monsoon season. The first primary peak appears along the Sub-Himalayas (500â€“700 m above MSL), while the second appears along the Lesser Himalayas (2,000â€“2,200 m above MSL). The former rainfall peak is attributed to fewer heavy rainfall events, and the latter to frequent, weak, but persistent rainfall. It is suggested that the atmosphere is insufficiently moist to trigger convections during the pre-monsoon season, and sufficiently moist during summer monsoon season. The convections over the Sub-Himalayas may moisten the middle layer, and the water vapor in the atmosphere condenses because of the forced lifting along the slope, forming the second rainfall band. The total rain amount is primarily determined by the frequency of rain. The rainconditioned rain rate along the slope monotonically decreases with elevation. This shows that the precipitation occurs because of forced lifting. In addition, our results show that seasonal variation of rainfall is rather similar to the variation of rainfall characteristics observed during active and break periods.

**D 3**

**Effect Of Weather & Storage Containers On Seed Mycoflora**

Dr. Dattatraya Vilas Harpale
HPT Arts & RYK Science College, Nashik

Effect Of Weather & Storage Containers On Seed Mycoflora Dr. Smita S. Harane, Dr. Dattatraya Harpale & Prof. Manoj Nimbalkar G. T. P. College, Nandurbar Dist. Nandurbar. HPT Arts & RYK Science College Nashik-5 Shardabai Pawar College, Baramati A preliminary survey of seed mycoflora of the was undertaken at four locations during the years 2011-2012. Seeds are used as medicine. These seeds are found to be frequently contaminated by fungi (Roy et al. 1988, Mamatha et al., 2000). Chaurasia (1990) investigated that almost all medicinal seed samples were associated with a large number of fungi. Some of these had heavy contamination of toxigenic Aspergillus flavus strains. The drug manufacturers without examining the raw drug samples from microbial association manufacture the finished herbal drugs. Therefore, it is essential to pay adequate attention to the effect of weather on medicinal seed mycoflora. Seeds of medicinal plants, like those of agricultural and horticultural crops, carry a wide

variety of micro-organisms like fungi, bacteria and even some viruses. Seeds may be attacked by the microbes while still borne on the trees in the field, during storage and subsequent handling before use. Therefore, the study of effect of weather on mycoflora of medicinal seeds is essential. The number of fungi was reduced when the seeds were stored in cotton bags, tin boxes and plastic bottles in descending order. Storing seeds in plastic bottle was found to eliminate maximum storage fungi from all the seed samples. The storage methodology of seeds is found to be different at various places such as market, godowns, laboratories etc. They may be stored in gunny bags, tin box, glass bottles etc.

**D 4**

**Potential roll of solar activities on climate change and global warming**

Dr. Subhas Chand Dubey
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The world has warmed 0.74Â°C in the past hundred years due to increases in greenhouse gas concentrations. Global average temperature is forecast to rise 4Â°C (7.2Â°F) toward the end of the 21st century. Human activities and Industrial Revolution is not only cause of climate change and global warming. Of the many objects in the universe, only two are well known for our climate change and global warming, one is Earth itself and other is the Sun. In the present work, we have high-lighted the potential role of solar activities on climate change and global warming. The climate change and global warming both are different things and the biggest issues in the world today. The Solar activities, galactic cosmic rays, interstellar dust and Sun-Earth geometry have strong influence on climate and can increase concentration of greenhouse gases. The enhanced ultra-violet radiation released from the Sun during high solar activity period increases the amount of ozone in the stratosphere, whereas less ozone is found during solar minima. One consequence of these solar perturbations is to complicate the detection of human-induced depletion of the protective ozone layer; another may be to perturb the temperature at the Earthâ€™s surface, through connections that link the upper and lower parts of the atmosphere. Internal variations in the Earthâ€™s climatic system may be caused by changes in the concentrations of atmospheric gases, mountain building, volcanic activity, and changes in surface or atmospheric albedo. Atmospheric carbon dioxide (Co2) is an important kind of greenhouse gas which influences global temperature. The increase in Co2 then amplified the global warming by enhancing the greenhouse effect. The long term climate change represents a connection between the concentrations of Co2 in the atmosphere and means global temperature. Certain atmospheric gases, like carbon dioxide, water vapor and methane, are able to alter the energy balance of the Earth by being able to absorb long wave radiation emitted from the Earth\'s surface. Without the greenhouse effect, the average global temperature of the Earth would be a cold -18Â° Celsius rather than the present 15Â° Celsius. Co2 concentrations in the atmosphere have increased from about 280 ppmv in pre-industrial times to 393 ppmv at present. The resulting agricultural depression contributed to the Great Depressionâ€™s bank closures, business losses, and increased unemployment. These hardships sent economic and social ripples throughout the country. Millions of people migrated from the drought areas in search of work, which resulted in conflicts between the newcomers and the longer-established residents and overburdened relief and health agencies.

**D 5**

**IMPACTS OF ATMOSPHERIC BROWN CLOUDS ON CLIMATE CHANGE & HUMAN HEALTH: A THREAT TO PRESENT & FUTURE**

JITENDRA KUMAR PATEL
BANARAS HINDU UNIVERSITY

IMPACTS OF ATMOSPHERIC BROWN CLOUDS ON CLIMATE CHANGE & HUMAN HEALTH: A THREAT TO PRESENT & FUTURE Jitendra Kumar Patel* Department of Botany, Environmental Science*, B.H.U. Varanasi. 221005 Email: jitendra.patel080788@gmail.com (Mob. No. - 9580785128) Climate change is the most significant global environmental challenges which could have various direct and indirect consequences on human health and environment. Besides the Global Warming, Ozone-depletion and Green House Gases (GHGs) a number of researches is going on from the last decade. But recently a new atmospheric issue has been arises i.e. Atmospheric Brown Clouds ( ABCs); which is a trans-boundary & regional climate change. Atmospheric brown clouds (ABCs) are regional scale plumes of air pollution that originates due to the burning of biomass and fossil fuel. ABCs consists of abundant amount of tiny particles of soot, indoor (biomass) and outdoor (fossil fuels) burning consisting of primary aerosols and pollutant gases such as (SO2), (CO), (NOx), (NH3), and organic gases and acids. Scientific evidences regarding the ABCs suggest that if steps have not taken it will cause a serious threat on human health as well as food security, water security, agriculture, vulnerability to monsoon, loss of biodiversity, change in rainfall pattern and others. Reduction in the crop production reduces the economy of the country. The most serious health impacts of particles associated with the ABC include cardiovascular and pulmonary effects leading to chronic respiratory problems, hospital admissions and deaths. The 5 ABCs hotspots are East Asia, Indo-Gangetic Plain in South Asia, Southeast Asia, Southern Africa; and, the Amazon Basin where aerosol optical density (AOD) exceeds 0.3 when measured. Satellites and aircrafts observation have shown that ABC extends up to 3 km from the surface. ABC caused surface dimming and solar heating of the atmosphere; thereby effecting cooling and heating cycle of the atmosphere. The net effect of ABCs on the global mean climate is determined by top of the atmosphere (TOA) forcing, which is described in the fourth assessment report of IPCC (IPCC 2007). The paper addresses these threats in two parts. The first part concerns with the current scenario of ABCs in developing countries and international cooperation associated with and also the new ideas related to climate change. The second part discusses to mitigate cooperation at the international and national level to overcome the problems of ABCs over climate change. The paper reveals new dimensions & innovations for climate change in future. The paper concludes with some suggestions for improvement in the climate change for the sake of this globe. Keywords: Ozone depletion, GHGs, ABCs, AOD, TOP, Surface dimming & Solar heating.

**D 6**

**Weather, climate variability and their impact on human health**

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This paper addresses the effects of climate extremes on human health. Weather is the complex and continuously changing condition of the atmosphere usually considered on a time-scale from minutes to weeks. The atmospheric variables that characterized weather include temperature, precipitation,

humidity, pressure, and wind speed and direction. Climate is the average state of the atmosphere, and the associated characteristics of the underlying land or water, in a particular region over a particular time-scale, usually considered over decades or longer time-scales. Climate variability is the variation around the average climate, including seasonal variations as well as large-scale variations in atmospheric and ocean circulation. Research on the health impacts of climate variability and change aims to increase understanding of the potential risks and to identify effective adaptation options. Extreme climate events are expected to become more frequent as a result of climate change. Climate extremes can have devastating effects on human societies. History records widespread disasters, famines and disease outbreaks triggered by droughts and floods. These complex, large-scale disruptions exert their worst effects in poor countries but even the richest industrial societies are not immune. Climate can also affect infectious diseases that are spread via contaminated water or food. Water-related diseases are a particular problem in poor countries and communities, where water supplies and sanitation often are inadequate. Outbreaks of cholera, typhoid and diarrhoeal diseases can occur after flooding if the floodwaters become contaminated with human or animal waste, while drought reduces the water available for washing and sanitation and also tends to increase the risk of disease. Forecasts of climate extremes can improve awareness and reduce adverse effects. Focusing attention on extreme events also may help countries to develop better means of dealing with the longer-term impacts of global climate change. Conversely, the pressures on the biosphere that drive climate change may cause critical thresholds to be breached, leading to shifts in natural systems that are unforeseen and rapid. Studying historical extremes of climate cannot forewarn on the consequences of such events. Rapid changes in climate during extreme events may be more stressful than slowly developing changes due to the greenhouse effect.

**D 7**

## GLEs and Their Space Weather Aspects during solar cycle 23

Subhash Chandra Kaushik , Varsha Sahu and Soni
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Studies have indicated the association of space weather activities like, geomagnetic storms with various solar and interplanetary features and also with the Cosmic rays. Whilst the intensities of the cosmic rays are observed to be enhanced with sudden, sharp and short-lived increases, they are termed as ground level enhancements (GLEs). They are the occurrences in solar cosmic ray intensity variations on short-term basis, so different solar factors erupted from the Sun can be responsible for causing them. We try to study the space weather effects and extend the analysis to the rainfall data for the selected period. In this context, an attempt has been made to determine quantitative relationships of the GLEs with solar / interplanetary and Geophysical Parameters. We have taken the data for solar cycle 23. Results suggest that GLE peaks might be caused by solar energetic particle fluxes and solar flares. The proton fluxes which seemed to cause GLE peaks were also supported by their corresponding fluences. Coronal mass ejection presumably causes geomagnetic disturbances characterized by geomagnetic indices and polarities of interplanetary magnetic fields. Analysis reveals distinctly different effects of these two signatures on ionospheric/ magnetospheric geo- effective events on short-term basis.

**D 8**

**Monitoring the seasonal and interannual variation of the carbon sequestration in a temperate deciduous forest with MODIS time series data: A novel approach**

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Understanding the seasonal and interannual variation of the ecosystem carbon balance and the mechanisms that control it is crucial for assessing the vulnerability of the terrestrial carbon pools under future changing climate conditions. Expanding on the previous work, an improved predictive model was developed to estimate the carbon sequestration of a temperate deciduous forest exclusively from remotely sensed time series data, including MODIS land surface temperature (LST), Terra nighttime LSTâ€™, enhanced vegetation index (EVI), land surface water index (LWSI), the fraction of absorbed photosynthetically active radiation (FPAR) and leaf area index (LAI). The objectives of this study are to relate remotely sensed proxies of environmental drivers to both seasonal and interannual carbon sequestration observed from seven yearsâ€™ net ecosystem carbon exchange (NEE) data, and to extrapolate long-term trends in forest carbon balance. Our results suggest that the improved model provided good estimates of NEE and well reflectd the seasonal dynamics of the temperate deciduous forest, though with limited skill during the spring and autumn transitions. Correlation analysis showed that these MODIS products have different relationships to NEE at 8-day and interannual time scales. The mature forest ecosystem acted as a strong carbon sink during the entire decade; however, a trend of decreasing carbon sequestration in the forest was observed as time goes on.

**D 9**

**The study of chemical composition of atmospheric precipitation under the climate change conditions (for example on the Tashkent province)**

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The global climate change causes the change of the number and intensity of adverse weather events. Under these conditions, the interest is increased in studying the air quality, including those associated with intense economic activity. Due to changes in atmospheric gas composition and the increase of aerosols in the atmosphere there is a direct impact on the ecological situation in a particular region. The current rates of pollution lead to global climate disturbances. Air pollution has a negative impact on the neighboring environment. Due to increased interest in this problem in recent years emerged a new trend in atmospheric chemistry: the study and use of the chemical composition of precipitation as an indicator of air quality. Precipitation may be integral (complex) index of air pollution. Scientific and practical interest in the territory of the Republic of Uzbekistan is the study of trends in the chemical composition of precipitation under the influence of various factors. However, there is not enough the studies about impact of synoptic processes types on the chemical composition of precipitation in arid zones. In this connection, the object of our research is to air pollution, and the ability to use the precipitation as an integral factor. The Tashkent district is a major industrial and agricultural region. It is

necessary to study the data of systematic monitoring observations for the chemical composition of precipitation and the types of synoptic processes for this area.

**D 10**

**Assessment of residential biomass burning emission in India and potential climate forcing impact**

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The generation of reliable inventories of emissions due to biomass burning is crucial in order to assess their environmental impact. This paper presents an emission inventory (EI) for biomass burning in the residential sector. EI for India has been prepared by collecting and analysing the biomass samples from the IGP region for carbonaceous aerosols, water soluble ionic species and trace gases. The total emission of PM, SO2, NOx, OC, EC and total ionic species from residential biomass burning from India are estimated as 3.58 Tg, 0.13 Tg, 0.35 Tg, 0.80 Tg, 0.18 Tg, and 0.47 Tg, respectively. It is estimated that IGP, India contributes 41%, 22%, 20%, 45.38%, 31.82% and 31.09% of PM, SO2, NOx, OC, EC and total ionic species emissions respectively to total emissions from India. Globally 14% PM, 18% SO2, 12% NOx, 7% OC and 11% EC are emitting from India due to residential biomass burning. Total estimated climate forcing from residential burning in India is 208 (20-year) and 75 (100-year) Tg CO2 equivalents.

**D 11**

**Fate of aragonitic pteropod in a changing atmospheric chemistry: looking from past to present**

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Human influence on climate change is a documented phenomenon affecting all aspects of ecosystem with far reaching impact on the biological systems. Here we report the impact of increased CO2 concentration on marine gastropods such as pteropod shells from the past to present. Pteropods are made up of aragonitic shells, a metastable polymorph of CaCO3 which is highly susceptible to dissolution than calcite. Occurrence and abundance of aragonitic pteropod during the latest Holocene (Anthropocene) is a subject of renewed interest owing to the fact that they are the most vulnerable among the major plankton producers of CaCO3 in the current levels of atmospheric CO2 resulting from ocean acidification [1]. Besides, planktic foraminifera and coccoliths, pteropods represent an important constituent of oceanic plankton, which play dominant role in oceanic CO2 system. The pteropod record from the Andaman Sea and other records from the north-western Indian Ocean show that they are absent during the Holocene (last 10,000 years) which may have implications on shoaling of aragonite compensation depth and ocean acidification driven by enhanced atmospheric CO2 concentration. Looking further back, their good preservation/abundance was seen during glacial times associated with very low atmospheric CO2 concentration [2]. Increased concentration of atmospheric CO2 during Holocene resulted in ocean acidification thus reducing the saturation levels of aragonite compensation depth of the oceans [1, 3]. The recent study from the Indian Ocean has revealed the anthropogenic effects on aragonite preservation [4]. The aragonite saturation depth during the recent times shoaled significantly by 25-155 m in the Indian Ocean due to the absorption of anthropogenic CO2 in the subsurface water masses and also due to increased organic matter decomposition rates [4, 5]. The aragonite saturation level of present day in the Indian Ocean is significantly shallower than the pre-

industrial time. For example, current ASD in the Arabian Sea and the BOB is shallower by 100-200 m than that of pre-industrial times [4, 5]. The climate change caused by increased CO2 concentration plays a prominent role in dissolution of carbonate with larger effect on aragonitic pteropods. If the CO2 increase continues; the pteropods might be at risk and their demise would be catastrophic. Keywords: Pteropods; Ocean acidification; Aragonite Compensation depth; Aragonite saturation depth; Carbon dioxide; Holocene. References [1] Feely, R., Sabine, C., Lee, K., 2004. Science 305, 362-66. [2] Kleypas, J.A., Buddemeier, R.W., D. Archer et al., 1999. Science 284, 118-120. [3] Sijinkumar, A.V., Nath, B.N., Gupta, M.V.S., 2010. Marine Geology 275, 221-229. [4] Sabine, C.L., R. M. Key et al., 2002. Global Biogeochemical Cycles 16, 1067. [5] Sarma, V.V.S.S., Ono, T., Saino, T., 2002. Geophysical Research Letters 29, 124.

**D 12**

**Monsoon Variability, Infrastructure Idiosyncracies, and their Interactions: A Research Agenda**

Jessica Seddon
Okapi Research

The monsoonâ€™s importance for Indian agriculture and its larger economy is well-recognized. Forecasts move markets, surprises can wreak havoc on regional economies, and the prospect of changes in the timing, geographic pattern, and variability of Indiaâ€™s monsoon is one of the climate change dangers that worries farmers and macroeconomists alike. The relationship between the monsoon and economic activity, however, works in two directions: local choices about fuel and energy use, shaped in part by the existing economic structure and infrastructure context, also influence the monsoon. These feedback relationships are potentially important, but less well understood or quantified. Further interdisciplinary research on the interaction between the monsoon and structurally induced human behavior is essential for identifying points of leverage for policy efforts to limit feedback loops as well as improve Indiaâ€™s resilience to monsoon variability. Consider the following plausible but unverified and unquantified chain of events: Changes in the timing and location of the monsoon affect the need to use groundwater for crops on un-irrigated land. The use of groundwater requires additional electricity for pumping, which in turn increases the gap between supply and demand in the short run. To the extent that this gap is â€œmetâ€• by cutting power elsewhere, it would be associated with increased use of diesel generators. States that focused on maintaining power supply to agriculture during times of shortfall â€“ as is the case in Uttar Pradesh according to Golden and Min (2012) â€“ would also see fiscal consequences and further deterioration of State Electricity Board (SEB) finances since electricity prices for agriculture are lower than for other uses. Weak SEB finances, in turn, limit prospects for new investment in potentially cleaner generation capacity since these remain the main customers for new generation capacity due to delay in implementing legislation and regulation to make the distribution market more competitive. The resulting increases in emissions, from diesel as well as existing coal power plants, further disrupts the monsoon. This is one example of a way in which monsoon variability may interact with India\'s infrastructure and infrastructure policy context. Assessing the importance of this potential feedback loop would require inputs from science and social science, but a credible study could add further weight to existing policy efforts to reform the electricity sector and invest in rural infrastructure. This presentation would propose some candidates for an interdisciplinary research

agenda to identify and quantify potential feedback loops as a first step toward designing policies to avoid them. It would also discuss ways to enable further science-social science collaboration to develop a stronger and more widely accessible empirical base for decision-making on urgent policy matters related to environmental change. Backgr

**D 13**

## Rhetoric or reality - Climate change

Kailash Pandey
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Biotic and abiotic constituents of an ecosystem have intricate and inalienable relations to sustain life on earth. Imbalance in this relation of any kind could prove to be catastrophic for continuance of life. Increased human activity and competing individual and national interests all over is unfortunately fast eroding this harmonious relation with consequent changes in climate profile. Impact of climate change is manifested differently and differentially in loss of life, damage to property, poor health or failing economy etc. A growing concern over changing nature of climate has caught imagination of global audience. People and governments strive to find effective measures to fix the problem and build resilience. Phenomenon of climate change, however complicated may be to understand is increasingly felt by people and cities across the world. Gorakhpur too is not spared; and common experience of people with climate will tell a similar tale. So, coming back to answer the moot question, is climate change a rhetoric or reality, it was thought to have a critical review of basic elements of climate over Gorakhpur city. Thermo hydrological cycle and climate â€“ an introduction Although there is much to know and learn about climate and complexities of relationships between ever changing factors, core of climate is generally understood or felt by commoners in terms of changes in temperature and precipitation. Physical phenomenon of heating, vaporization, precipitation and cooling forms the fulcrum to climate and hydrology with intermittent factors viz. wind, pressure, wind break, flora, fauna and natural phenomenon render garnishing effects to complicated science of climatology. Delicate and dynamic balance between constituting factors is naturally influenced, it is precariously dented by anthropogenic phenomenon borne out of human needs and behavior. Food and energy securities of nation are two key dependants and determinants clamoring for growth on a constrained water budget. Rainfall received in region is important in determining quantum of water available to meet various demands, such as agricultural, industrial, domestic water supply. Global and local climate change may influence long-term rainfall patterns impacting availability of water, along with danger of increasing occurrences of droughts and floods. The South West Monsoon which brings about 78% of the total precipitation over the region is critical for the availability of fresh water for drinking and irrigation. Changes in climate over East Uttar Pradesh, particularly the South West Monsoon would have a significant impact of agricultural production, water resource management and livelihoods of millions of poor households. Present article would only make exhaustive analysis of two variables which are critical for regional hydrology i.e. rainfall & temperature.

**D 14**

**Assessing Change in the Carbon Sequestration Potential of Lidder Valley, Kashmir Himalayas.**

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Abstract The present study was conducted for assessing changes in the carbon sequestration potential of Lidder watershed, Kashmir Himalayas using multi-date satellite data from 1980 to 2005. Using on-screen image interpretation at 1:50000 scale, nine vegetation types were identified from satellite data. These include Dense Evergreen Forest, Degraded Forest, Moist Alpine Scrub, Moist Alpine Pasture, Open Scrub, Agriculture, Orchards, Marsh Lands, and Plantation. Total above ground biomass for different vegetation types were estimated from allometric volume equations of different plant species present in the study area.The results revealed that largest area is covered by Dense Evergreen Forest with area of 430 km2, 402 km2, and 380 km2 for the years 1980, 1992 and 2005 respectively. There is no a significant change in Moist Alpine Pastures and Moist Alpine Scrub. There is a decrease of 20 km2 in forest area from 1980 to 2005, hence an obvious decrease in the carbon storage potential of the forests. Forested areas are being converted into Agriculture and horticulture, mainly Apple and Almond Orchards. Moreover, conversion of Agriculture to Horticulture is rampant because Orchards fetch more money than agricultural crops. Forest area shows the highest above ground biomass accumulation and carbon storage in the watershed. The carbon storage in agriculture shows a decreasing trend of 123813 Mega grams to 93964 Mega grams from 1980-2005. It is concluded that remote sensing along with field based-observations can act as an efficient tool in monitoring the biomass change in forested landscapes of Himalayas. The study has a good potential to assess the changes in the carbon stock due to the land use and land cover changes taking place in the Himalayas. Keywords: Above Ground Biomass, Geoinformatics, Kashmir Himalayas, Change detection Analysis

**D 15**

**Understanding the Household Perceptions of and Adaptations to Heat Wave in Odisha, India**

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This paper makes an attempt to understand perception of households on impact of heat waves and identify and analyze the factors influencing their adaptation strategies. The study is based on the household level data collected from a field study carried out in the Ib Valley coal mining region of western Odisha, India, where residents have been experiencing extreme heat waves since last several years. Both logit and multinomial logit model are used to assess impact of heat waves and to examine factors that influence the adaptation strategies to heat waves respectively at household level. The descriptive statistics show that local pollutants are perceived more than the global pollutants as the cause of heat wave in the region. It is found that households that own adaptation assets are likely to reduce heat related illness in their family members. Socio-economic characteristics of the household such as gender, caste, income, education and land holding size are likely to have significant influence on the adaptation strategies. Male members of the households are more likely to adapt to heat wave than

their female counterparts in terms of reducing working hours, not working during heat waves, etc. Social background of the household (Caste) is inversely associated with the adaptation strategy of not-working, which suggest that lower caste people do continue to work during extreme heat wave as compared to their richer counterparts. People with higher income are found to be not-working during the periods of heat wave. Landholding size is also inversely associated with all the three adaptation strategies, suggesting that poor and landless people are not likely to adapt to the heat waves. Government at local level should be more active during oppressive heat periods and measures like heat warning, proper and adequate supply of electricity, water etc should be undertaken in order to reduce mortality and morbidity during heat wave.

**D 16**

**A NEW PERSPECTIVE ON THE INFRARED BRIGHTNESS TEMPERATURE DISTRIBUTION OF DEEP CONVECTIVE CLOUDS.**

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We are proposing a statistical technique to analyze the best fit of the histogram of infrared brightness temperature of convective cloud pixels. For this we have utilized the infrared brightness temperatures (IRTB) of Kalpana-1 (8 km resolution) and globally merged infrared brightness temperatures of Climate Prediction Centre NCEP/NWS (4km resolution, merged from all the available geostationary satellites GOES-8/10, METEOSAT-7/5 & GMS ), for both deep convective and non-deep convective (shallow cloud) cases. It is observed that Johnson SB function is the best continuous distribution function in explaining the histogram of infrared brightness temperatures of the convective clouds. The best fit is confirmed by Kolmogorov Smirnov statistic. Johnson SBâ€™s distribution of histogram of infrared brightness temperatures clearly discriminates the cloud pixels of deep convective and non-deep convective cases. It also captures the asymmetric nature in histogram of infrared brightness temperatures. We also observed that Johnson SB distribution of infrared brightness temperatures for deep convective systems is different in each of the pre-monsoon, monsoon and post-monsoon seasons. And Johnson SB parameters are observed to be best in discriminating the Johnson SB distribution of infrared brightness temperatures of deep convective systems for each season. Due to these properties of Johnson SB function, it can be utilized in the modeling of the histogram of infrared brightness temperature of deep convective and non- deep convective systems. It focuses a new perspective on the infrared brightness temperature that will be helpful in the cloud detection, classification and in modeling. Key words: Johnson SB continuous function, Infrared Brightness Temperature (IRTB), Kolmogorov Smirnov statistic.

**D 17**

**Impact of Climate Change on Soil Health and Agriculture: Gypsum an Alternative**

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Abstract: Human activities impact the global environment resulting in a significant threat of climate change. Climate change implies to the variation in seasonal rainfall patterns, intensity of precipitation, temperature fluctuations which has the potential impacts on the physico-chemical properties of soil, soil

structure & texture, capability in terms of sustainable use, production capacity and biodiversity of the soil ecosystem. These impacts results in the degradation of the soil related to the climate change scenario either in terms of erosion, soil structure decline, intensification of salinity and sodicity, loss of soil carbon, nutrient deficiency, soil acidification, acid sulfate soils, and decrement in the micro/macro biological activity, reduced biodiversity or mass movement. Well structured, nutrient rich soil is required for the agricultural use in which the plants can grow efficiently, provides the conducive environment for the biological activity and beneficial in terms of productivity. However, poorly structured and degraded soil fails in one or most of these functions thus affect the agro economy of the nation. To maintain the synergy between environmental and agricultural concerns is a major challenge of present times. Excessive external inputs like fertilizers, pesticides although helps in enhancing agricultural production but adversely affect the soil health and results in polluting the natural resources. In such a condition an alternative source like natural minerals proves effective in reclamation of soil, for sustainable agriculture and improving the soil fertility to fulfill the human needs . Experimental work with the use of gypsum, a sulphate mineral in agricultural alone or in conjugation with other amendments attains great success. Use of gypsum combined with the water soluble polymers decreases wind and water erosion of soil. Root growth and plant development may get severely restricted in the acidic soils due to the presence of toxic Al3+. Surface application of lime can be used for neutralization of acid soils resulting due to excess rainfall (leaching of base cations), fertilizer use, plant root activity, pollutants such as acid rain and mine spoiling or weathering of primary or secondary soil minerals. Since the lime moves slowly in soils, so the surface application of the lime has little effect on the subsoil acidity or the Al3+ ion toxicity. However gypsum helps to reduce the subsoil aluminium toxicity enhances sub soil root growth and increases the efficiency of uptake of soil nutrients. Thus, it is advisable to use lime in conjugation with gypsum for surface as well as sub soil activity. Application of gypsum not only ameliorates the subsoil acidity but also helps in the reclamation of the Saline and Sodic soils. Research studies indicate that gypsum alone or in combination with other amendments like rock phosphate, Dhaincha improves the physical appearance as well as the crop productivity in terms o

**D 18**

**Effect of chemical composition and rainfall intensity**

V GOPALAKRISHNAN, P D SAFAI, M V RAJU AND S D PAW
INDIAN INSTITUTE OF TROPICAL METEOROLOGY PUNE

Effect of chemical composition and rainfall intensity on wet scavenging of aerosols V GOPALAKRISHNAN, P D SAFAI M V RAJU AND S D PAWAR INDIAN INSTITUTE OF TROPICAL METEOROLOGY, PUNE Precipitation scavenging is one of the important processes for removal of aerosols from the atmosphere. However, the removal of aerosols by rain is a complex process as studies suggests that the scavenging is affected by the properties of aerosols-both physical and chemical, and their age (Andronache et al., 2006; Wang et al, 2011). Further, while the size range of aerosol particles spreads over a wide range, the size of hydrometers which removes these aerosols also vary by about an order of magnitude. (Pranesha and Kamra, 1997). Hence, it is of interest to study how this scavenging process is affected by raindrop size distribution (RSD) and rainfall intensity, which influences the rainfall size distribution. The concentrations of size-segregated aerosols viz PM1.0, PM2.5 and PM10 along with black carbon (BC)

measured at Pune before, during and after rainy period are studied with the rainfall intensity to understand the effect of rainfall intensity and RSD on scavenging. It is observed that there is no one-to-one relationship between these aerosols of any category and rainfall amount; rather the scavenging efficiency can be related to rainfall intensity and size distribution. Further, as BC is hydrophobic, unlike other aerosol particles, its savenging properties are little different. Our observations, averaged for several days, show that during days with rain less than 5mm/hr, there is increase in BC concentration. On days with rain throughout the day and when rain intensity exceeds 20 mm/hr, we observe reduction in the concentration of BC. These results are further explained in terms of chemical nature of aerosols, and rainfall intensity. References: Andronache C, T. GrÂ¨onholm , L. Laakso , V. Phillips, and A. VenÂ¨alÂ¨ainen, Scavenging of ultraï¬•ne particles by rainfall at a boreal site:observations and model estimations, Atmos. Chem. Phys., 6, 4739â€“4754, 2006 Pranesha, T S and A. K. Kamra, Scavenging of aerosol particles by large water drops : Washout coefficients, half-lives, and rainfall depths, J. Geophys. Res. . 102, 23,947-23,953, 1997. Wang X, L. Zhang, and M. D. Mora, On the discrepancies between theoretical and measured below-cloud particle scavenging coefi¬•cients for rain â€“ a numerical investigation using a detailed one-dimensional cloud microphysics model, Atmos. Chem. Phys., 11, 11859â€“11866, 2011

**D 19**

**Impacts of LULC changes on LST in Addis Ababa city Ethiopia using Landsat satellite imagery**

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Urbanization has been a major force of Land Use Land Cover (LULC) throughout human history that has had a great impact on climate change. To evaluate the effects of atmospheric correction, NDVI was calculated from both the original image and atmospherically corrected image by using the NDVI formula. To derive emissivity image the NDVI equation was written in the spatial modeler of ERDAS. This study has examined LULC changes in the capital of Ethiopia, Addis Ababa from 1986 to 2010. Urban/built-up areas expanded dramatically, while agricultural land and forest declined. Barren land increased, mainly in the boundary areas between forest and dry agricultural ï¬•elds, especially in steeply sloping areas. The observed changes in LULC were largely attributed to population pressure on the land, a rapidly growing infrastructure and poor land use planning. Changes in LULC were accompanied by changes in Land Surface Temperature (LST). This could lead to an intensive urban heat island (UHI) effect in the urban areas. The abundance of forest was an important factor that influenced LST. Moreover, temperature differences between the urban/built-up and the surrounding rural areas signiï¬•cantly widened. The study assessed the UHI spatial patterns and temporal variations in the Addis Ababa city. The urban-rural temperature differences between the urban core and its surrounding areas show a maximum difference of more than 20 degrees centigrade. Greening of the urban set up is highly recommended in this study.

**D 20**

**TO EXAMINE THE ASSOCIATION BETWEEN OSCILLATIONS OF THE JUNGE LAYER PEAKS AND DIFFERENT TYPES OF CLOUDS**

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TO EXAMINE THE ASSOCIATION BETWEEN OSCILLATIONS OF THE JUNGE LAYER PEAKS AND DIFFERENT TYPES OF CLOUDS Pratibha B. Mane, D. B. Jadhav, A. Venkateswara Rao a- Department of Physics, Shivaji University, Kolhapur-416 004, Maharashtra state, India. b- Indian Institute of Tropical Meteorology, Dr. Homi Bhabha Road, Pashan, Pune-411 008, India. Corresponding author Email: pratibhabm263@gmail.com Abstract Aerosol measurements have been carried out at Kolhapur (16Â°42â€²N, 74Â°14â€²E) by using newly designed Semiautomatic Twilight Photometer to study the vertical distribution of the stratospheric Aerosol Number Density per cubic centimeter (AND). The stratospheric aerosol layer is often called as the Junge layer. The altitudes of the layer of aerosol maximum on measurement days were derived from the aerosol vertical profiles. From these, oscillations of the Junge layer peaks on consecutive days were calculated. The association between oscillations of the stratospheric aerosol layer peaks and different level clouds was examined. The aerosol number density per cubic centimeter (AND) for peak point of the Junge layer was also calculated for every clear sky day. The sky was almost clear in January and March. In February all the three types of clouds were observed frequently. It was observed that the altitude of Junge layer peak for clear sky day, preceding the high level cloudy sky day lowered down to ~11 Km and increased up to ~19 Km on the clear sky day following the high level cloudy sky day. Middle and low level clouds were frequently observed following with high level clouds. It implies that the CCN particles perturb downwards. In very rare cases middle level cloudy days were noticed separately after any clear sky day. It was detected that the altitude of Junge layer peak decreased one day before the low level cloudy days and value of AND increased near about three times the normal values. In winter fog or dew drops were observed. Fog is also one type of cloud. The AND of Junge layer peak increased nearly three times for clear sky days prior to the days on which fog or dew drops were observed. The annual variation of the altitude of the peak of Junge layer shown that, this layer appeared to be drifting downwards as the monsoon season approached. During the post monsoon season the variations were large in between 12 to 28 Kms. The altitudes of Junge layer peaks for clear sky days were maximum, ~ 23 Km in the month of January. However, a steady decrease in this from ~23 to 15 Km was noticed during January to April 2011. The AND of Junge layer peak for clear sky days increased slowly form ~4-6 particles/cm3 for the month of January to ~7-8 particles/cm3 for the month of April. The annual variations of the altitudes of the peaks of Junge layer and the AND of Junge layer peaks showed opposite phase relation. It will be possible to establish the definite relation between oscillations of the stratospheric aerosol layer p

**D 21**

**Aircraft measurements in the large-scale outflow of the Asian Summer Monsoon in the UTLS during the ESMVal campaign**

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Aircraft measurements in the large-scale outflow of the Asian Summer Monsoon in the UTLS during the ESMVal campaign Anja Reiter, Heinfried Aufmhoff, Isabell Krisch, Helmut Ziereis, Paul Stock, Robert Baumann, Veronika Eyring, Hans Schlager Deutsches Zentrum fÃ¼r Luft- und Raumfahrt (DLR), Institut fÃ¼r Physik der AtmosphÃ¤re, Oberpfaffenhofen, Germany Ascending airstreams associated with cyclones may be very efficient in transporting trace gases into the upper troposphere and lower stratosphere (UTLS). Uplifted trace gases have a larger climatic impact due to longer residence times and larger radiative effects in the UTLS compared to lower altitudes. A major large-scale cyclonic system is the Asian Summer Monsoon. Here, emissions from polluted regions in Asia, e.g. from China and India, may be efficiently transported into the UTLS. During the ESMVal (Earth System Model Validation) measurement campaign in September 2012 with the German research aircraft HALO (High Altitude and Long Range Research Aircraft) measurements very performed in the large-scale outflow of the Asian Summer Monsoon. We present observations of elevated SO2 and NOx in the Asian Monsoon outflow measured by chemical ionization ion trap mass spectrometry and chemiluminescence technique. Backward trajectory calculations were used to study the origin of the sampled air masses in the UTLS with enhanced SO2 and NOx mixing ratios.

**D 22**

**THE SOLAR CYCLE AND RAINFALL VARIATION OVER INDIAN REGION**

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The objective of this study is to examine critically the relationship between solar cycles and Indian monsoon rainfall, for the period 1871â€“2002, and to search for significant periodicities, by utilizing the wavelet analysis. The results of this study using wavelet analysis show clearly a significant 11-year cycle in solar activity and rainfall. Also present is a significant 8-year cycle in rainfall. The solar minimum activity coincides with the maximum rainfall over all India region. The double (Hale) sunspot cycle is not discernible here either in sunspot number or in rainfall. The cross-spectral analysis between the sunspot number and rainfall confirms the existence of a reasonable anti correlation over an 11-year cycle with a relative phase lag of few months.

**Poster Presentation for SAFAR**

**D1**

**Long-term (1951-2007) rainfall trends around six Indian cities: Evidence of anthropogenic influence**

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The present study focuses on analyzing the precipitation trends (rainfall amount, number of rainy days) over six Indian cities during the period 1951-2007, also attempting to link them with the impact of anthropogenic aerosols and pollution, by examining the variation in precipitation in the upwind and downwind directions during the rainy summer monsoon season (June-September). The analysis shows negative trends in the total number of rainy days over Hyderabad (-10.4%), Kanpur (-7.1%), Jaipur (-10.5%) and Nagpur (-4.8%) and positive trends over Delhi (7.4%) and Bangalore (22.9%). On the other hand, decreases of -21.3%, -5.9%, -14.2%, and -14.6% in seasonal rainfall amount are found over Delhi, Hyderabad, Jaipur and Kanpur, respectively, whereas Bangalore and Nagpur exhibit 65.8% and 13.5% increase. However, in the majority of the cases, these variations are not considered as statistically significant at 95% confidence level. The most important finding is a decreasing trend in both seasonal rainfall and total number of rainy days in the downwind direction of the cities Hyderabad, Delhi, Kanpur,

Jaipur and Nagpur, while Bangalore shows an increasing trend; furthermore, precipitation is lower in the downwind directions. The lesser precipitation, along with the mostly declining trend, in the downwind directions of the Indian cities constitutes an evidence of an urban-anthropogenic influence in the rainfall amount, rainy days, monsoon onset and intensity associated with the increased anthropogenic emissions due to expansion of the urban areas and the increase of population.

**D2**

**The Space Weather and Ionospheric Modulation effects during solar cycle 23**

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Studies have indicated the association of space weather activities like, geomagnetic storms with various solar and interplanetary features and also with the Cosmic rays. These transients are moreorless responsible for the modulation of ionospheric regions. We try to study the space weather effects and extend the analysis to the rainfall data also for the selected period. In this context, an attempt has been made to determine quantitative relationships of these solar / interplanetary and Geophysical Parameters. We have taken the data for solar cycle 23. Coronal mass ejection presumably causes geomagnetic disturbances characterized by geomagnetic indices and polarities of interplanetary magnetic fields. Analysis reveals distinctly different effects of these two signatures on ionospheric/ magnetospheric geo- effective events on short-term basis.