



Newsletter of the

DIVECHA CENTRE FOR CLIMATE CHANGE

**Digital solutions to accelerate adaptations to climate change
in agriculture**

Interschool quiz competition

Launch of the report on Future Earth 2020

Open day 2020





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FROM THE CHAIR

Greetings!

For the past couple of months several nations are under full or partial lock-down to combat the cataclysmic effects of the COVID-19 pandemic. It is not clear now, when the lock down would be lifted, and normalcy would be restored. It is also possible that restrictions on gatherings and movements may continue for the next several months even after the lock-down period. This calls for a major shift in the manner we work and consider various options for our research and outreach activities as well as interaction with policy makers. Despite the large adverse impact the pandemic is having on the global economy, there are several positive sides of the lock-down in terms of reduced human activities, leading to large improvement in air quality, especially in urban areas from alarming and poor to satisfactory and good, reductions in GHG emissions, noise pollution, water pollution and solid waste generation. The large reduction in air-traffic results in significant reduction in emission in the upper atmosphere, some of which are already shown to impact the stratospheric ozone layer through self-lofting of pollutants. This would further the recovery of ozone hole already taking place.

In India, about 60 per cent of irrigation water and 80 per cent of drinking water is met through groundwater. COVID-19 virus discharged into sewage water and consequent contamination of ground water is another unresolved issue. As it takes several weeks, well beyond the lifetime of the virus, for surface water to recharge the groundwater table, the threat to groundwater contamination in shallow open wells, close to sewage discharge channels or rivulets are low. The age-old practice of boiling the water before drinking can practically eliminate the risk of COVID-19 spreading through drinking water. Of course, in the urban environment, where RO systems fitted with UV are used in every household, the question of CORONA contamination does not arise.

A recent editorial published by the interdisciplinary journal of India, "Current Science", warned that "*The sudden appearance of the deadly COVID-19 pandemic this year should persuade the world leaders to take the repercussions of environmental degradation seriously*".

We wish success to all in their fight against COVID-19 and let us all hope to get out of this grim situation at the earliest.



S. K. Satheesh

ASIA REGIONAL WORKSHOP ON “DIGITAL SOLUTIONS TO ACCELERATE ADAPTATIONS TO CLIMATE CHANGE IN AGRICULTURE”



Fig 1: Panel discussions in progress during the Agriculture Workshop held on 13-14 January 2020 at Divecha Centre for Climate Change.

Divecha Centre for Climate Change and Consultative Group on International Agricultural Research (CGIAR) program on Climate Change, Agriculture and Food Security (CCAFS) jointly organized an Asia Regional Workshop on “Digital solutions to accelerate adaptation to climate change in agriculture” on 13-14 January, 2020. This joint workshop brought together people from research, industry, civil society, and governments from Asia to accelerate the applications of digital techniques for climate change adaptation. Prof. J. Srinivasan, DCCC and Dr Pramod Aggarwal, CCAFS jointly formulated the objectives of this workshop. This workshop included discussions on novel frontiers in agricultural practices and state of the art digital techniques to include innovative solutions.

The Inaugural session began with a welcome Address by Prof. S.K. Satheesh, Chair, DCCC on the importance of Digital agriculture and food security in a

changing climate. He laid emphasis on the impacts of climate change and monsoon variations on agriculture and the need to sustain food production with increase in population. Prof. J. Srinivasan, DCCC gave an overview of the Monsoon Asia Integrated Research for Sustainability (MAIRS) program. He articulated the vision and the main objectives of the MAIRS program and its involvement with DCCC. Dr. J. R. Bhatt, Ministry of Environment, Forest and Climate Change, emphasized that agriculture is the lifeline for human sustainability. Agriculture farms emit greenhouse gases in the form of methane and nitrous oxide. He also highlighted how India contributes minimally to climate change. Dr. Bhatt raised concern over India being vulnerable to the impact of climate change. Dr. Pramod Aggarwal, Program Leader of the CCAFS program, South Asia, introduced the workshop agenda and indicated the importance of digital agriculture as a powerful strategy to

adapt to climate change. He showed how early warning systems can be used to overcome challenges in crop production and how digital technology can be used to ensure food sustainability. Dr. S. Ayyappan, Chancellor, University of Agriculture, Imphal, gave an overview on smart farming. Dr. Ayyappan stressed that food safety and quality, is more important than quantity and spoke on the efficiency, viability and sustainability of small farms. He spoke about the biodiversity for prosperity of farmers. He gave an overview of some climate smart villages with different agricultural practices such as stress agriculture management, new agriculture methods, innovation in water management, use of Nano fertilizers, precision agriculture, organic farming, and biofortification farms. Some new methods of productive farming are floating agriculture, terrace farming, and vertical farming. An agriculture business system, Agripreneur, needs to be in place where technology such as artificial intelligence and drones can be used for farming. Dr. S. D. Attri, Deputy Director General, Indian Meteorological Department (IMD) talked about the district level Agromet Advisory Service System. He spoke about the various farmer awareness programs conducted by IMD and services offered by IMD such as 200 District Agromet Unit (DAMU) for weather observation and monitoring. Speaking on the Krishi Darshan program for rural farmers, he gave an overview of application of a web enabled Decision Support System (DSS) for real time crop monitoring at district level. The Meghdoot mobile app assists farmers for weather-based farm management and Information and Communication Technology (ICT) dissemination tools include WhatsApp social media groups with all department officials, state government extension

networks, district, block and panchayat level groups. Mr. Abhishek Poduri, Regional Head South Zone, Tata Trusts wondered if the farmers are ready for the new technology as it involves high cost. He underlined three important aspects of agriculture namely 1) Sustainable increase in agriculture 2) Adaptation and Resilience in agriculture and 3) Reducing greenhouse gas emissions. He recommended better technology for irrigation purposes and improving ground water stability.

In the second session on “Linking data to Success stories”, Mr. P. R. Seshagiri Rao farmer and VP, Natural Remedies, spoke on the success of adapting agriculture practices to current and future climate. He spoke about the Extended Range Forecast System for Climate Risk management in Agriculture (ERFC) project and showed how the production profit grew up to a factor of 3. The benefits of this program were 1) increase in productivity with reduced constraints on tropical Agro ecosystems, soil water and nutrients 2) Multi storey Agro-forestry and Generate productivity variability. He recommended more soil water retention by runoff harvest and thereby generating a virtuous water cycle. He highlighted the use of technology such as crop simulation models, and sensors with climate information, especially on the simulation model APSIM used for climate forecast based agricultural/crop management. He cited few big challenges of agriculture to adapt to climate change such as decline in ground water, and disruption of both surface and ground water. He suggested feasible options to overcome this by direct recharge of bore wells by private owners and support through real time monitoring of water levels. Mr. Himanshu Goyal from IBM gave a brief overview

about the new Wather company acquired by IBM. He spoke about the tools used to obtain personal weather stations data worldwide. The tool uses supercomputer architecture and the models are run in such a way that decisions can be made prior to any extreme weather events. Mr. P.C. Ray from Watershed Development Department from Government of Karnataka, spoke on the ongoing Sujala-III project on land inventory and other science-based approaches for climate smart agriculture. He talked about the empowerment of farmers and youth in agriculture. He gave a brief insight of the project on how soil profiling is done by collecting soil samples and land resources managed. Some of the other activities of the Sujala-III project were horticulture, animal husbandry, establishment of digital library, portals, DSS (Decision Development System) and mobile apps. Dr. Ram Shrestha from Nepal discussed about the policy and institutional framework on climate and agriculture, rainfall trends, livestock development, crop and weather monitoring and some of the prevailing climate change adaptation techniques used in Nepal. He also spoke about the mitigation strategies and practices currently used in Nepal. Mr. Anandaraj from WIPRO Ltd. showed how hyper spectral imaging (HSI) technology is used in segregation of infested fruits and vegetables without cutting them. He showed how spectroscopy does a chemical analysis combined with a unique reflectance which gives objects a chemical spectrum. Visual observation, RGB photos and HIS photos are used to detect infested fruits and vegetables. This technology can also be used to detect seed quality, pesticide recommendation, best time to harvest and ripeness grading. Mr. Ram Dhulipala from International

Crops Research Institute for the Semi-Arid Tropics (ICRISAT) spoke about the linkages between natural farmers and organic farmers. He also spoke about risks in agriculture with respect to high costs of technology and also spoke about business models such as Michael Porters ,Value Framework model that helps to analyze specific activities through which firms can create value and competitive advantage to make money.

The third session was on “Crop insurance in India: Digital Data Driven Solutions”. In this session Dr S. S. Ray from Mahalanobis National Crop Forecast Centre (MNCFC) spoke on the early efforts on crop insurance such as the pre-independence rainfall insurance scheme of 1920 in states of Mysore and Madhya Pradesh, two pilot schemes by Dr. Rajendra Prasad in 1950, and 1960s crop insurance bill; and experimental schemes of 1970 which were implemented in Maharashtra and Gujarat. He spoke on how Weather Based Crop Insurance Scheme (WBCIS) provide insurance protection to farmers against adverse weather incidences such as excess or deficit rainfall, high or low temperature, and humidity. However, limited availability and poor-quality AWS (Automatic Weather Station) data and poor correlation parameters with yield are the major limitations. Case studies such as smart sampling in Jharkhand and yield estimation studies were discussed. The pilot studies in CCE (Crop Cutting Experiments) over India during 2018-19 along with few private, government, and international agencies were highlighted. The presentation has focused on Pradhan Mantri Fasal Bima Yojana (PMFBY) 2016. PMFBY is the third largest scheme in the World next to USA and China. Digital data driven

solutions viz. farmers' database for crop insurance portal, satellite data-based assessment of area, yield and loss, weather insurance based on weather data were explained. Mr. Kunal Prasad, CEO, CropIn, spoke on "Leveraging ML & AI to improve efficiency in PMFBY". Interventions using mobile app or web through which the information can be transferred to the stakeholders is the prime motive of CropIn (private sector). Building these technologies stack based on AI (Artificial intelligence) and ML (Machine Learning), CropIn Pvt. is mainly trying to get a transformation in the agriculture sector by helping the sector increase productivity without compromising sustainability. Dr. Paresh Shirsath (CCAFS) spoke on science and tools used in agriculture insurance sector. The impact of fusion of remote sensing and crop models, crop condition monitoring, statistical techniques were shown. Dr. Nagaraj Nareppa from Institute for Social and Economic Change (ISEC), Bangalore introduced the fourth session by stating that, "Digital tools have led to smart and precision farming where we measure the exact input and output requirements. Data and insights can improve both design and evaluation of policy for action." Mr. Y. B. Srinivasa from Tene Agricultural Solutions spoke about the list of practices that can be adopted in the wake of climate change. He discussed the self-medication approach at the farmer level and the technology approach useful in crop health. According to him, the DESEE (Digitally Empowered Self-Employed Extension Force) is a unique initiative of self-employed, digitally empowered crop doctors that includes urban, rural men and women. Mr. Man Kshetri, UN (WORLD FOOD PROGRAM), Nepal spoke on Monitoring Climate Risk for Food

Security and Livelihood. He mentioned that the overall objective of agricultural security was to identify the vulnerable areas, affected population, and to help the Government develop food security policies, build resilience to disaster for these communities and achieve zero hunger. Mr. Sanjeev Sharma, Indian Farmers Fertiliser Cooperative Limited (IFFCO) spoke on how IFFCO Kissan Sanchar uses technology to help transform agriculture into a sustainable climate smart sector. IFFCO launched the mobile app for Airtel subscribers to empower the farmers with updated crop relevant information. The farmers can access Agro advisory services and personalized voice messages in addition to voice clips and text messages. Over 4 lakh beneficiaries from across 17 states receive daily voice-based advisory in 11 languages. These voice messages give information on animal husbandry, weather, market rates and education as well.

In the fifth session on Innovative digital solutions for agronomy, Dr. C. S. Murthy, Head, Sustainable agriculture, National Remote Sensing Centre (NRSC), spoke about "Suitable environments for digital innovation in agriculture." He presented digital innovation techniques in agriculture with focus on opportunities, examples, and challenges of digital innovation. Current challenges in agriculture according to him were: Farmer's income security, Nation's food security, and climate resilient agriculture. Digital innovations can be employed with two end user targets: (1) Farmer centric needs (e.g. real time advisory, minimization of cultivation risks, crop yield improvement, market advisory) and (2) Planning/Development centric needs (e.g. Crop management decision support,

relief and compensation mechanism, implementation of government schemes and monitoring the impact). Multiple datasets (i.e. remote sensing satellite data, weather data, soil data, crop information etc.) and techniques (e.g. Random forest, Deep Convolutional Neural Networks) are utilized in the process. Very high resolution (e.g. 50 cm) remote sensing data (e.g. optical, SAR, RADAR) are utilized for crop monitoring and yield forecast. Mobile apps (e.g. Geo-ICT, CROPSAPP) are used for collection of real-time field data, which help in crop health surveillance and yield estimation. Crop cutting experiments (CCE) are also carried out for yield estimation but the fields for CCE need to be reduced by smart selection and this he suggested can be replaced with crop models. He concluded that major challenges of digital innovation are (1) crop management/ data collection system, (2) data collection mechanism is not much organized, (3) data formats are not standardized, (4) CCE data analysis are not providing sufficient additional value, (5) unavailability of reliable historical data. Mr. Purushottam Ojha, Nepal, said that Government of Nepal has set up an Agricultural Management Information System (NAIMS) to support the farmers by disseminating information on weather, climate change, early warning system, and facilitating the adaptation of agricultural practices. Dr. Sampath Wahala, Sabaragamuwa University, Sri Lanka, spoke on Digital innovations in biodiversity with regard to agriculture and climate change. Sri Lanka E-agriculture vision is "Excellence in adopting e-solutions to transform agriculture for national prosperity." Dr. W. Attavanich, Kasetsart University, Bangkok, spoke on Accelerating climate change adaptation with digital solutions

in Thailand's agriculture. His talk focused on Thailand's agriculture and the World's food security which are likely to be affected by climate change because majority of farmers are older, and poor. Mr. H. Vinayakaram, WIPRO Ltd., spoke on Block Chain technology for climate resilience in value chain. Block chains will replace networks with markets. Block chains allow meritorious participants in an open network to govern without a ruler and without money. Dr. Rohini Mattoo, DCCC, introduced the sixth session on Early warning systems where she spoke on various challenges in early warnings in climate resilient agriculture and tools used in this. Dr Namita Singh, Digital Green, spoke on "Real-time early warning systems for agriculture". She spoke on how technology can help farmers to prepare for various climate threats such as drought, and pest infestation. Dr. Srikanth R. and Mrs. Bianca Kummer from Plantix spoke on the artificial intelligence systems used in Climate resilient agriculture and many digital platforms like the Plantix, a mobile crop advisory application for gardeners, farmers and agricultural workers. The App can be used in diagnosis of crop damage due to pests, plant diseases etc. There is an interactive discussion between farmers, plant experts, and scientists which access local weather reports and aid farmers in warning them against future calamities in agriculture. The workshop included posters by Miss Phub Dem, Royal University of Bhutan on Impact of Climate Change on Agriculture Sector in Bhutan, Mr. Subash Singh Karki, Centre for Green Economy Development – Nepal on Information Technology (ICT) supporting Agriculture Knowledge Centers (AKC) to promote sustainable growth and development, Miss Shiwani Bhattarai, IDS, on Nepal

Adapting technologies to climate change in Nepal's Agricultural sector, Mr. Sushil Dhakal, Community Development and Advocacy Forum - Nepal on Riverbed farming on reclaimed areas adopting climate smart technologies by enhancing ICT Services and Mr. Jigme Sherab, Royal University of Bhutan on Digital technology and Climate Change on Agriculture in Bhutan.

The last session was a panel discussion on "Future directions towards a more digitally equipped climate resilient agricultural system" was moderated by Dr Pramod Aggarwal, The panelists Dr. C. S. Murthy, Mr. Seshagiri Rao, Dr. Namita S., Dr. Ram Shreshta, Dr. Witsanu A. and Dr. Rohini Mattoo provided ideas for future digital innovations and addressed how we could overcome the challenges in Climate resilient agriculture. Prof. J. Srinivasan in his concluding remarks on the workshop spoke about how public outreach and scientific interactions with people from across the globe served as the main goal of the Centre. He then went on the highlight how there is a scale mismatch in information when shared between different groups. The success stories in countries like Bangladesh,

Bhutan and Myanmar, may also be relevant to states in India. For instance, successful solar projects in Bangladesh may also prove to be very efficient in various states of India, owing to similar geographical and climatic conditions and similar land holding sizes. Similarly, if successful in Sri Lanka, Nepal and Bhutan, States in India like Uttarakhand and Himachal may also benefit immensely from it. It thus becomes very crucial for countries to have discussions on common problems in the Himalayan terrain. Moreover, the topic of crop insurance was also discussed wherein Prof Srinivasan went on to express the need to compare the crop insurance system and policies in different South Asian countries. To identify the diverse approaches adopted by all the South Asian countries and study how the insurance system works for different nations. To understand the various merits and limitations of the systems. In summary, the workshop served as a platform for interdisciplinary exchange of exciting results, innovations, and practical solutions by researchers, experts, farmers, industry personnel, policy makers, government representatives in the field of Climate resilient agriculture.



Fig 2: Participants who attended the agriculture workshop.

EUREKA WITH S.K. SATHEESH



Fig 3: Prof. S.K. Satheesh, Chair of Divecha Centre for Climate Change, giving a talk in the Rajya Sabha TV on 25 January 2020.

Rajya Sabha TV (RSTV) is owned and operated by the upper house of Indian Parliament. Apart from telecasting live coverage of Rajya Sabha proceedings, it provides a platform for knowledge-based programmes as well. RSTV periodically telecast a programme known as “Eureka” for propagating Science and Technology awareness in the country. In this programme, leading scientists of India are being interviewed. The weekly interviews are aimed at showcasing scientific contribution of individuals & Institutions. Eureka program is of great value to young scientists, students as well as common public and will go a long way to motivate them for serving the nation. On 25 January 2020, RSTV telecasted an interview with Prof. S.K. Satheesh, Chair of Divecha Centre for Climate Change, IISc, Bengaluru. In this interview, he explained how the microscopic particles suspended in the atmosphere impact climate. He described various types of aerosols and his efforts to unravel the intricacies of the regional/global climate

implications of light-absorbing aerosol particles. Specifically, how his field observations combined with laboratory experiments helped to explain/resolve the highly debated global issue of ‘anomalous’ absorption paradox, based on a new theory based on the mixing state of aerosols. He also mentioned above his persistent endeavor through numerous field experiments over remote and hostile environments over Indian landmass and adjacent oceans, in pursuit of the science of light-absorbing aerosols, employing research ships and aircrafts, besides network of ground-based observatories. These observations have led to the discovery of strong meridional gradients in aerosol-induced atmospheric warming. Some aspects of the societal impacts of his research also was also discussed. The interview can be viewed at RSTV YouTube channel and the web link is provided below.

<https://www.youtube.com/watch?v=fZglZMq1s7g>

IMPACT OF WEATHER ON RENEWABLE ENERGY GENERATION

India has plans to install 175 GW of renewable power plants by 2022. The availability of renewable energy is, however, unreliable, since it is dependent on weather. A national seminar on “Weather Dependent Prediction of Renewable Energy Generation for Grid Management” was held at Rajabazar Science College, Kolkata on 12 March 2020.

Anasuya Gangopadhyay, a doctoral student from Divecha Centre for Climate Change, spoke about the impact of spatial variation of wind pattern in Karnataka. Integration of wind plants located at various geographically diverse parts of Karnataka may result in a smoothing of the aggregate energy output. This is defined as “geographical Smoothing”. She presented data on wind speed and wind generation in Karnataka and

highlighted the potential for geographical smoothing. In Karnataka, installation of new wind plants in Ballari and Pavagada region would bring in geographical smoothing. These areas also experience high average wind speed during monsoon. Hence, she recommended installation of new wind power plants at these locations.

The seminar concluded with a panel discussion where all the participants discussed various aspects of grid integration of largescale renewables. The uncertainties involved with the wind forecasting was discussed. The need for strengthening of the real-time spot market for energy to balance the unpredictable sharp changes in the renewable generation was highlighted.



Fig 4: Anasuya Gangopadhyay, Doctoral student, Divecha Centre for Climate Change, giving a talk at Rajabazar Science College, Kolkata on 12 March 2020.

INTER-SCHOOL QUIZ COMPETITION



Fig 5: Students from national public school Rajajinagar who won the first prize in the Inter-school quiz competition held on 9 January 2020 at J. N. Tata auditorium.

The Divecha Centre for Climate Change, held the Annual Science and Environment quiz at the J. N. Tata auditorium on 9 January 2020. This year over 700 students from 14 different schools from Bengaluru attended this inter school quiz.

The team comprising of Indraneel Arvind Acharya, Samrudh H., Vartika T. Rao from National Public School Rajajinagar bagged the first prize. They were awarded a cash prize of Rs 2000, each besides a certificate and a cup for the team.

The second prize went to Airforce School Hebbal. The team of S. B. Abrish, Aaditya, Adarsh Raj received Rs. 1000 each along with a certificate and a cup

for the team.

The third prize went to Kendriya Vidyalaya, Malleswaram. Abdul Haleem Ahmed, Anil Mahajan and Hari Om from the team were awarded a certificate and Rs 500 each along with a cup for the team.

LAUNCH OF THE REPORT ON “OUR FUTURE ON EARTH, 2020”



Fig 6: The launch of the book Future Earth 2020 at faculty hall on 13 February 2020.

The Divecha Centre for Climate Change organized the launch of the Report on “Our Future on Earth, 2020”, at Faculty Hall, IISc Main Building on 13 February 2020. The guest of honor, Dr. K. Kasturirangan, Padma Vibhushan, Former Chairman, Indian Space Research Organization (ISRO), released the report.

Prof. S. K. Satheesh, Chair, Divecha Centre for Climate Change, delivered the welcome address and talked about the main activities of the Centre. Prof. J. Srinivasan, Distinguished Scientist, Divecha Centre for Climate Change, gave a brief talk on our future on Earth. Dr Vijayakumar Gogi, Principal Secretary to Government of Karnataka, Forest, Ecology and Environment Department, Government of Karnataka, gave a talk on sustainability and challenges faced by the ecological environment with respect to climate change.

This launch is a globally distributed effort by the future earth communities

and global hubs around the world to simultaneously launch the report between 13-21 February 2020. The purpose of this parallel launch event around the world is planned in order to reduce the carbon footprint convening this as a global statement about our future and to halt global warming below 2°C by 2050. The Report states the current state of our planet and the future our global society. A two-hour program was designed by the Future Earth South Asia Office as an Awareness Program to discuss the issues raised in the report. The program focused on the status of our environment with deliberations on Climate Change, Water Crisis, Food and Agriculture Security and the possibility of a transition towards a Renewable Energy society. The program was concluded by a few speakers giving a brief talk on findings from the report on Future Earth such as climate change, water, energy, food and agriculture.

THE TIMES GROUP BANGALORE DEVELOPMENT SUMMIT



Fig 7: Honorable Deputy Chief Minister, Government of Karnataka, Shri. Ashwathnarayana with the DCCC team at Marigowda Hall, Lalbagh Botanical Gardens, Bengaluru held on 29 February 2020.

Media giant, Times Group comprising of The Times of India, Bangalore Mirror and Vijay Karnataka brought together an eclectic group of citizens and scientists from all walks of life for a conclave on climate change. The “Bangalore Development Summit”, Program was held on Saturday, 29 February 2020 at the Marigowda Hall – Lalbagh Botanical Gardens, Bangalore.

A team comprising of Research students and Scientists from the Divecha Centre for Climate Change, exhibited posters highlighting their research contributions to combat climate crisis.

Dr. R. Srinivasan, head of the water quality group was present at the conclave. Mrs. Sowmithri Ranganathan,

Science and Policy Consultant, DCCC, coordinated the entire event. The exhibited posters highlighted work on renewable energy, aerosols and ground water contaminants.

Research scholars Anusuya and Shravanth presented their work on solar and wind energy research while Arun and Prashanth presented their findings of aerosol loading within Bengaluru campus of IISc verses aerosols at the Chellakere campus. Posters highlighting the research work on ground water explaining the Geogenic contaminants and their ill effects on human health was presented by Kavitha and Sushma from the water quality group.

Honorable Deputy Chief Minister,

Government of Karnataka, Shri. Ashwathnarayana, Chief guest at the Conclave, evinced keen interest in the activities of the Centre and spent a considerable amount of time, talking to the DCCC scientists.

Several other dignitaries including the Bengaluru Central MP, Mr. P.C. Mohan, BBMP Commissioner, Mr. B.H. Anil Kumar, BBMP Mayor Gowtham Kumar, Mr. Anil Shetty of Nava Bengaluru Foundation along with Mr. Ranjeet Kate, CEO of Bangalore Mirror and Vijaya Karnataka and citizens of the city of Bangalore, who were a part of the Conclave, visited the DCCC Stall and

interacted with the scientists there.

The Conclave was well attended and there was an opportunity for Scientists from the Divecha Centre for Climate Change to exchange ideas with the public at large and to showcase the work being carried out at the Center.



Fig 8: Honorable Deputy Chief Minister, Government of Karnataka, Shri. Ashwathnarayana viewing the posters at the stall.

OPEN DAY 2020

The Indian Institute of Science, Bengaluru organized the annual Open Day this year on 29 Feb 2020 where some of its best and brightest scientific ventures were showcased. The event, which takes place every year, marks the birth anniversary of J.N. Tata, founder of the institute.

This year about 1000 visitors, including school and college students, and science enthusiasts made their way to Divecha Centre for Climate Change to get an exposure of newer science-based technology. Research students showcased their work through live demonstrations and poster presentations. Some of the experiments shown this year were depicting greenhouse effects caused by Infra-Red absorptions by gases such as carbon-dioxide in the atmosphere, Real time measurement of black carbon particles, Simple experiment to show the influence of surface heating on vertical wind, experiment to show the inefficiency of incandescent lamps, and Plants, soil erosion & Climate change. Research students also had put up posters and explained the general public on Physics of Greenhouse effect, Aerosol instrumentation, 20 kW PV System at the institutes main Library, Impact of seasonal variations on wind generation yield – Karnataka and Tamil Nadu.

There was a special poster session on water which is SDG number and a very important factor for sustainability. Water is the basic necessity to sustain lives of people globally and many posters were put up to educate the young children and general public of its importance.

Some of the posters were Geogenic contamination in ground water, and Water quality: Holistic approach. A poster on Natural Water Purification System was displayed in the Kid's Zone.

Some other posters included Geomorphology of glaciers, Dynamical aspects of monsoon climate change during the twenty-first century, Himalayan glaciers and Interdisciplinarity of climate change research and action. A quiz program on "Whether you know weather" and glaciology quiz were also conducted on global warming and climate change to educate the visitors on the hazards and ill effects and how the Earth can be saved. The school students had the opportunity to participate in the quiz competition and were given the basic knowledge on climate change.

The open day intended to enlighten the general public and create awareness about science, technology and engineering to see how they can contribute towards a better future.



Fig 9: School students participating in the quiz program at the Open Day event.



Fig 10: Research student giving a demo to the school students at the Open Day event.

RESEARCH HIGHLIGHTS



PHOTOCHEMICAL DEGRADATION AFFECTS THE LIGHT ABSORPTION OF WATER-SOLUBLE BROWN CARBON (BrC)

Light-absorbing organic aerosols, known as brown carbon, counteract the overall cooling effect of aerosols on Earth's climate. There have been speculations that the warming by these aerosols may counteract the cooling by sulphate aerosols.

The spatial and temporal dynamics of their light-absorbing properties of brown carbon are not represented well in climate models, because the

number of observations is limited. New observations of a carbon isotope (C^{13}) in these aerosols and light absorption (using a conceptual aging model) has been reported based on a major field experiment.

The authors found that atmospheric photochemical oxidation reduces the light absorption of water-soluble Brown Carbon by around 84% when it is transported over 6000 km from the

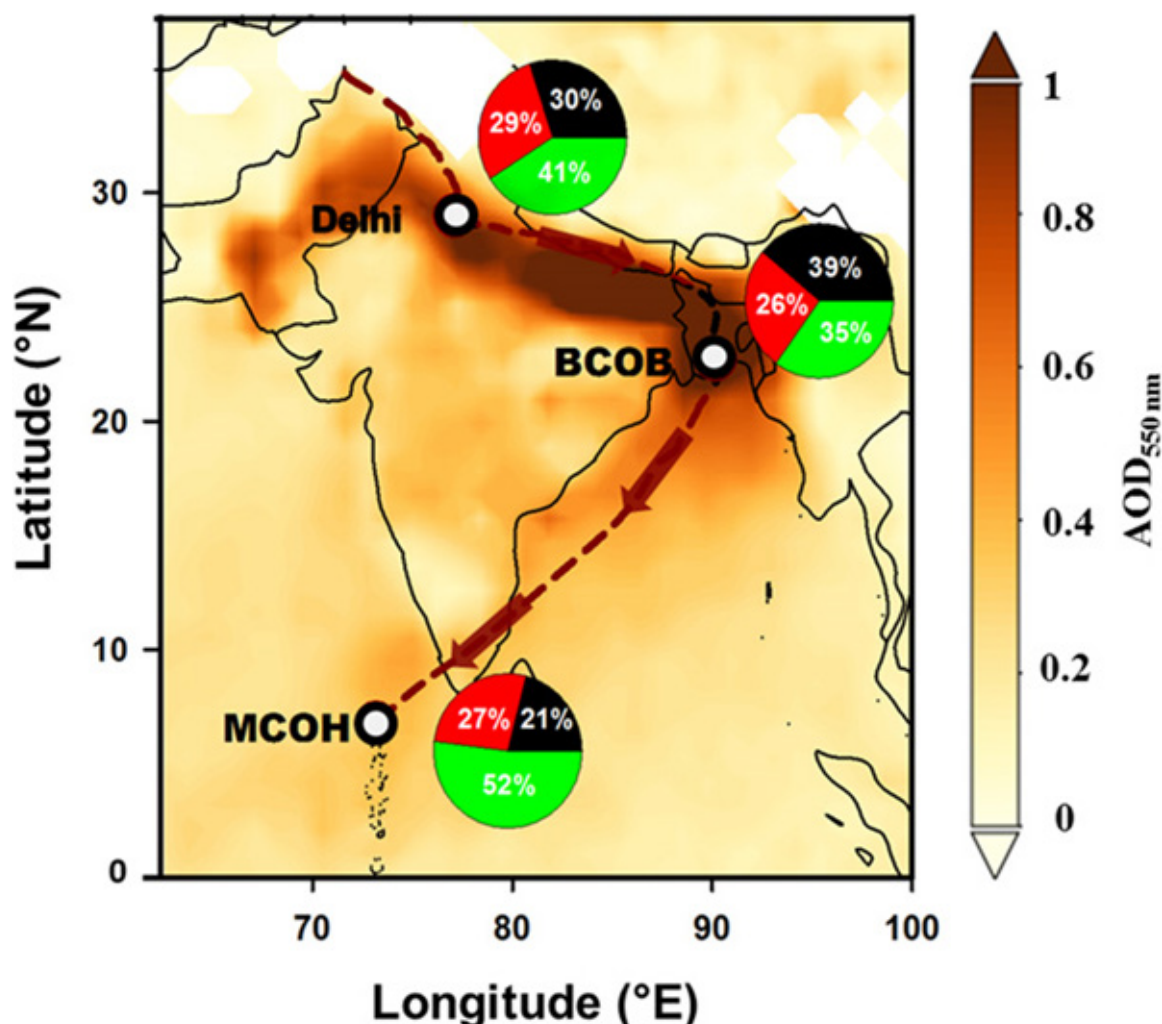


Fig 1: The average aerosol optical depth (AOD) at 550 nm during January to March 2016 over the South Asian region and sampling sites of Delhi, Bangladesh Climate Observatory at Bhola (BCOB), and Maldives Climate Observatory at Hanimadhoo (MCOH).

Indo-Gangetic Plan to a receptor site in Maldives.

This study shows that the ability to absorb light by Brown Carbon transported from Indo Gangetic basin to Indian Ocean is lower than previously thought. This implies that the previous estimates of global warming caused by Brown carbon may be too high. The rapid reduction of these aerosols has been suggested as way to reduce global warming in the next decade. This work indicates that this approach may not be fruitful

Reference: S.Dasari, A.Andersson, S.Bikkina, H.Holmstrand, K.Budhavant, S.K. Satheesh, E.Asmi, J.Kesti, J.Backman, A.Salam, D.S.Bisht, S.Tiwari, Z.Hameed and Örjan Gustafsson, Photochemical degradation affects the light absorption of water-soluble brown carbon in the South Asian outflow, Science Advances, 5:eaau8066, 1-10, 2019.

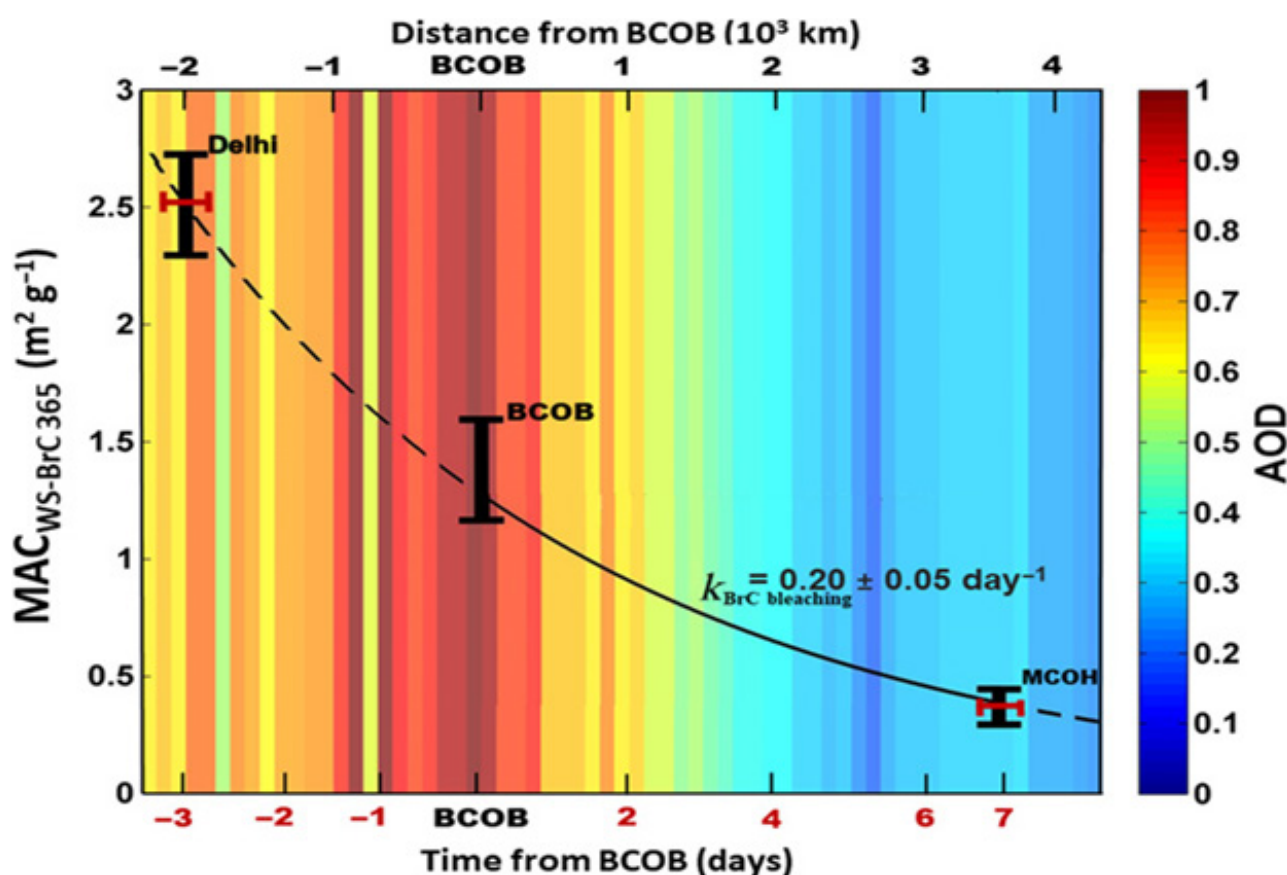


Fig 2: The decay/bleaching of the mass absorption cross section at 365 nm (MACWS-BrC 365) (vertical bars in black) of Water Soluble – Brown C between source-to-receptor sites in the South Asian outflow.

DERIVATION OF SOLAR IRRADIANCE OVER INDIA FROM INSAT-3D

As a part of Paris climate agreement, India has promised to install 100 GW of solar power plants by 2022. These solar power plants need to provide advanced information about electric power generation every day so that the grid stability is maintained. To predict the electric power generation by a solar power plant, an accurate knowledge of the total solar radiation incident on the ground is needed. We do not have sufficient number of ground-based observations of the total solar radiation. Hence, we need to utilize data from satellites to infer the total solar radiation incident at the ground. The data from geostationary satellite has been found

to be useful because they provide frequent observations of clouds in the tropics. When there are no clouds one can predict the solar radiation incident at the ground based on the knowledge of aerosols, ozone and water vapor. In the presence of clouds, the estimation of solar radiation incident on the ground is more difficult. The present weather forecast models are able to predict the amount clouds that may occur the next day.

In this paper the authors have compared the total solar radiation incident on the ground obtained from ground observations in 19 stations in

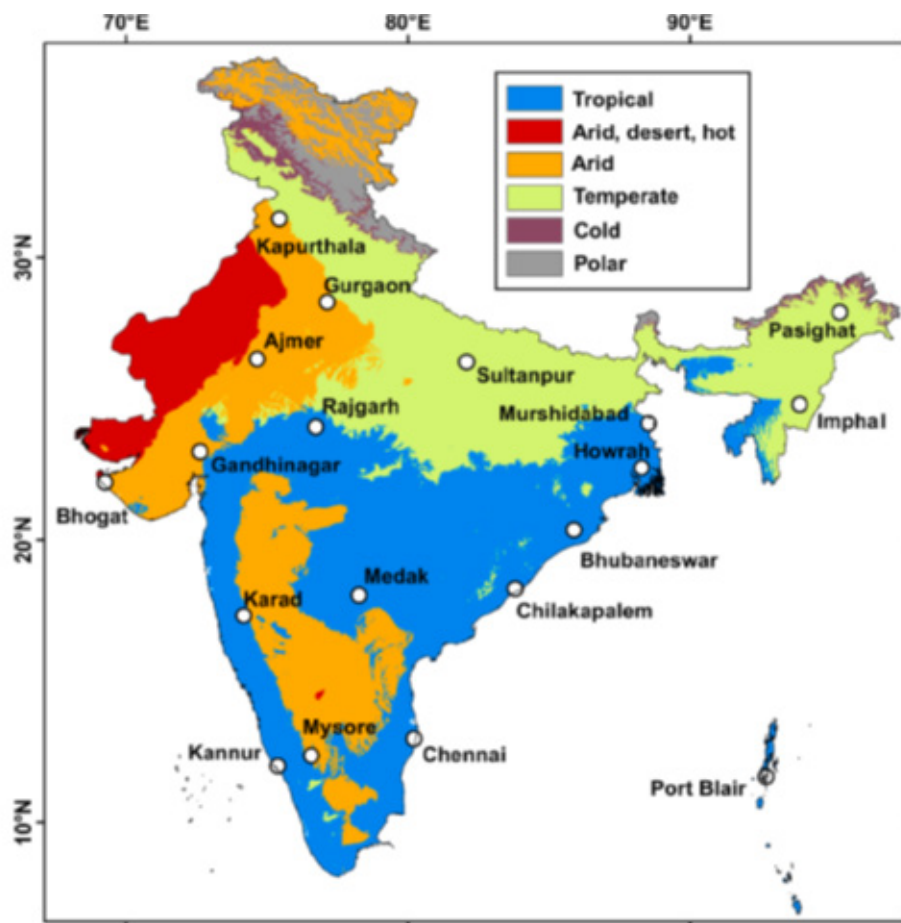


Fig 3: Location of stations where total solar radiation is measured in different climatic zones.

India with that derived from the Indian geostationary satellite INSAT-3D.

In the present paper the authors first calculate the clear sky solar radiation incident at the ground based on data on aerosols and water vapor. When it is cloudy a cloud index is derived based on half-hourly INSAT-3D data. The comparison between the calculated total solar radiation incident at the surface with observations indicates that the root-mean-square error in the present method is about 40% lower than methods used earlier.

Reference: Validation of global irradiance derived from INSAT-3D over India
Harsh G. Kamath and J. Srinivasan,
Solar Energy, 202,45-54,2020



