

Newsletter of the

DIVECHA CENTRE FOR CLIMATE CHANGE

Recent IPCC assessment reports on climate change

Quiz program 2022

Conclave on environment, sustainability, and climate change

World Environment Day - "A healthy environment for a healthy life"





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FROM THE CHAIR

Greetings!



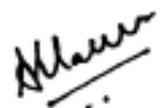
Global surface temperature change is likely to exceed 2 to 3°C relative to pre-industrial times by the end of the century. A recent report of the Intergovernmental Panel on Climate Change or IPCC clearly states that we are already facing the consequences of 1 degree warming such as extreme weather events, sea-level rise, and glacier melting.

Impacts of climate change have significant effect on human health either directly or indirectly. Climate change has direct effects on human health. For example, extreme weather can cause injury, destruction and loss of life. Indirect effects include poor nutrition caused by crop failures or a lack of access to clean water or issues due to poor air quality. Climate change also poses more dispersed effects such as poverty, displacement, and mental health issues. Heat-related mortality or morbidity; air pollution-related illnesses; infectious diseases, particularly those transmitted indirectly by water or by insects or rodent vectors; and refugee health challenges associated with forced population migration are all public health concerns due to a changing climate. Mental health issues include “eco-anxiety”, a condition which is found to be more prominent among the younger generation. Eco-anxiety is defined by the American Psychology Association (APA) as “the chronic fear of environmental cataclysm that comes from observing the seemingly irrevocable impact of climate change and the associated concern for one’s future and that of next generations”. Such negative health effects of climate on global public health are found to be increasing over the years. The recent discovery of microplastics in human blood justifies this statement. The study shows that the participants had been exposed to microplastics through the air, water, and food, as well as personal care products.

More than 230 medical journals issued a statement in 2021 claiming that climate change has already harmed human health by stating that “an increase in heat deaths, dehydration, and kidney function loss, skin cancer, tropical infections, mental health issues, pregnancy complications, allergies, and heart and lung disease, as well as deaths associated with them.” While the majority of these events are unavoidable, many of the health risks can be avoided by constructing climate-resilient health systems that increase risk reduction, preparation, response, and recovery.

Hence medical practitioners and climate scientists should work together to tackle such important global issues.

S. K. Satheesh



Nature's crucial services at risk in a warming world



Pollination



Coastal protection



Tourism / recreation



Food source



Health



Water filtration



Clean air



Climate regulation

RECENT IPCC ASSESSMENT REPORTS ON CLIMATE CHANGE: AN INDIAN PERSPECTIVE



Participants of the IPCC webinar held on 5 May 2022

Future Earth National Committee-India and Future Earth Global-Hub South Asia, Divecha Centre for Climate Change jointly organized the “The Recent IPCC Assessment Reports on Climate Change: An Indian perspective” webinar on 5 May 2022. The Chair and moderator, Dr. M. N. Rajeevan welcomed the guest speakers and introduced them.

There were two sessions, session

1 presentations on the IPCC Sixth Assessment Report from an Indian Perspective and session 2 panel discussions. The Intergovernmental Panel on Climate Change (IPCC) has recently brought out the Sixth Assessment Reports on Climate Change by their Working Group -I (The Physical Science Basis), Working Group- II (Impacts, Adaptation and Vulnerability) and Working Group III (Mitigation of Climate Change).

Working group-I was presented by Dr. R. Krishnan, Director, Centre for Climate, Change Research, Indian Institute of Tropical Meteorology-Pune. He presented the sixth assessment report for policy makers. He spoke about the changing state of climate change, human influence on climate change, future global climate scenario-based projections, global carbon and other biochemical cycles, the Earth's energy budget, water cycle changes, ocean, cryosphere, sea level changes, weather and climate extreme events followed by risk assessment.

Working group-II was presented by Dr. Aditi Mukherji, Principal Scientist, International Water Management Institute, New Delhi. She spoke about how nature's crucial services such as food source, tourism, pollination, coastal protection, health, clean air and water, climate regulation is at risk due to global warming. Working group-III was presented by Dr. Ulka Kelkar,

Director, Climate, World Resources Institute-India. She spoke about how the gap between global emissions and the level associated with limiting warming to 1.5deg C will still be 19-26 Gigatonnes of Carbon equivalent in 2030.

This was followed by panel discussions followed by closing remarks. The Panel Discussion covered the aspects on what India should do for mitigating the impacts of climate change. These reports discuss the updates on observed and future changes in the climate system, the impacts and vulnerability of climate change on different sectors, what are the choices and issues on adaptation and mitigation of climate change. It is very important for us to discuss what these reports mean to India. What we can learn from these updated reports for improving our knowledge on climate change and reviewing and updating our climate change policies.

SIXTH ASSESSMENT REPORT
Working Group II – Impacts, Adaptation and Vulnerability

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WHO UNEP

5th May, 2022

Water, land and ecosystems findings from WGII

Aditi Mukherji, IWMI
a.mukherji@cigar.org



Dr. Aditi Mukherji, International Water Management Insti...

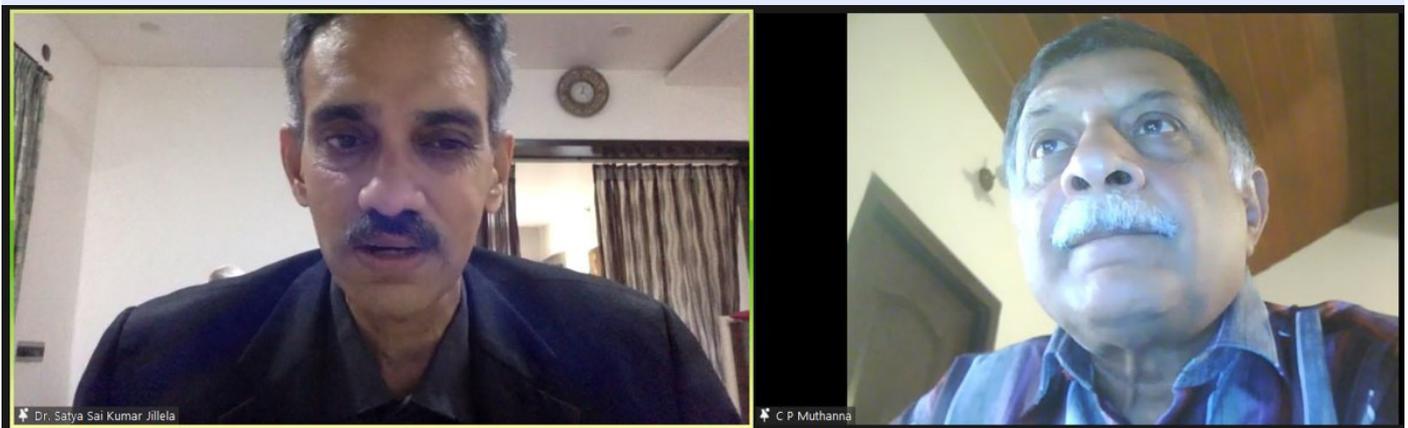


[Axel Fassio/IFOR Flickr, CC BY-NC-ND / Unsplash]

Dr. Aditi Mukherji presenting the talk on 5 May 2022



SUSTAINABLE COMMUNITIES: COPING WITH CLIMATE CHANGE



Speakers of the webinar Dr. Satya Sai Kumar Jillella (*Left*) and Col. C.P. Muthanna (*Right*) held on 16 June 2022

Future Earth Global Hub South Asia and Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru, organized a webinar on "Sustainable Communities: Coping with Climate Change" on 16 June 2022. Maitreyi Murali, Science Officer, Sustainable Communities, Divecha Centre for Climate Change, welcomed and introduced the keynote speakers.

The Future Earth South Asia Global Hub has initiated its flagship Regional Programme, which aims to integrate the Sustainable Development Goals and Paris Agreement climate targets to accelerate change necessary to address issues related to Food

Security, Coastal Resilience, Sustainable Urban Development and Associated Health Risks in South Asia. Many of these concerns transcend national borders and much can be gained from regional collaboration to address them.

Dr. Satya Sai Kumar Jillella, Pro – Vice Chancellor, Srinivas University, Mangalore, Karnataka, Former UN Expert, deliberated on the topic "Implementation of public policies in the field of sustainable road transportation, management and safety". He presented six Sustainable Development Goals (SDG) targets that are directly related to the

transport sector, addressing road safety, reducing air pollution, energy efficiency, sustainable infrastructure, urban access, and fossil fuel reduction. Transport sector is responsible for significant emissions of carbon dioxide, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur dioxide, and suspended particulate matter. These pollutants have adverse health effects and reduced lung function, cardiovascular diseases, respiratory diseases, and infections. Stated sustainable transport can improve economic growth and integration. Dr. Satya outlined a course of action for achieving sustainable transport such as prioritizing and promoting non-motorized means of transport, cycling, using green technologies and e-vehicles. He also outlined sustainable transport policy priorities such as going electric with clean energy, rebuild mass transit plans to integrate land use. He concluded his talk by highlighting the need to implement physical policies and knowledge policies. Physical policies include physical infrastructure element and knowledge policies emphasizes the important role of investment in

research and development for a sustainable model of mobility for the future.

The second guest speaker, Col. C.P. Muthanna (Retd), Vice Chair of Kodagu Model Forest Trust (KMFT), deliberated on the topic “The looming dangers of climate change”. He highlighted some of the consequences of climate change in India such as millions of people getting displaced due to sea level rise, Lakshadweep Islands getting submerged, Andaman and Nicobar Islands being uninhabited, and massive loss of snow and ice cover in the Himalayas. He suggested four pronged strategies for sustainable development; 1. Cutting down on India’s dependence on coal and transiting towards renewable energy, 2. Preparing for sea level rise, 3. Zoning of Indian landscape to prepare for climate change, and 4. Stabilization of climate change in the Himalayas and the Mekong basin through regional co-operation. Col. Muthanna further suggested plans on how to prepare for rising sea levels and also highlighted that catchment area policies needs to be reviewed.

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Research, Innovation, Sustainability

DIVECHA CENTRE
CLIMATE CHANGE

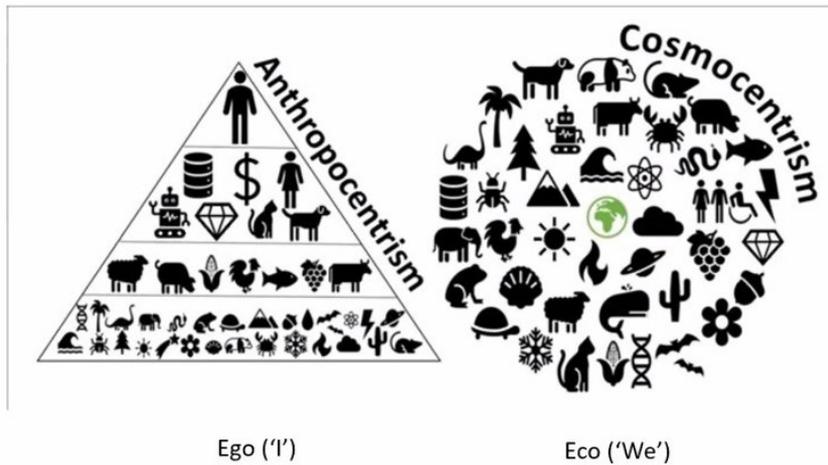
16 JUNE 2022
09:00-10:35 AM IST

SRINIVAS
UNIVERSITY

Implementation of public policies in the field of
Sustainable Road Transportation, Management & Safety

Dr. Satya Sai Kumar Jillella

Dr. Satya Sai Kumar Jillella presenting his talk on 16 June 2022



EMBRACING INDIGENOUS KNOWLEDGE IN A CHANGING CLIMATE: A HEALTH PERSPECTIVE

Embracing Indigenous Knowledge in a Changing Climate: A Health Perspective

Dr. Nicole Redvers, ND, MPH
Assistant Professor, Department of Family & Community Medicine
Assistant Professor, Department of Indigenous Health
University of North Dakota, School of Medicine & Health Sciences
~Co-Founder/Board Chair-Arctic Indigenous Wellness Foundation

Dr. H. Paramesh

Dr. Nicole Redvers

Suraj Das

Dr. Nicole Redvers (Right Centre) presenting her talk on 20 June 2022

Future Earth Global-Hub South Asia, Divecha Centre for Climate Change, Indian Institute of Science, organized a webinar on “Embracing Indigenous Knowledge in a Changing Climate: A Health Perspective” on 20 June 2022. Dr. Joshitha Sankam, Lead- Health Sensitization & Science Officer, Future Earth Global Hub-South Asia, welcomed the guest speakers and introduced them.

The consequences of climate change, particularly their impact on vulnerable people, have highlighted serious harms to disadvantaged populations, which are least able to plan for and recover from climate impacts such as heat waves, poor air quality, flooding, and other effects. Climate change poses a serious threat to the livelihoods, cultures, identities, and ways of life of the Indigenous

population, as the majority have a close cultural link with the environment and are typically reliant on land and natural resources to meet their subsistence needs. However, an understanding of the agency and knowledge that Indigenous communities bring to tackling climate change is frequently missing from dialogues focusing on these injustices, especially in the domain of health. Incorporating Indigenous knowledge into global efforts to combat climate change could help to inspire scientific best practices for climate resilience and boost multi-stakeholder engagement at the local, regional, and national levels.

The first speaker, Dr. Nicole Redvers, Assistant Professor, Department of Indigenous Health, Department of Family & Community Medicine, School of Medicine and Health Sciences, University of North Dakota, deliberated on the topic “Embracing Indigenous Knowledge in a Changing Climate: A Health Perspective”. She presented concentration of carbon dioxide levels during ice ages and warm periods for the past 800,000 years. She showed a graph of the earth system trends and the socio-economic trends for many years from the past to present. She outlined the anthropocentric and Cosmo centric world views or merged existence and their roles in maintaining the world.

Dr. Nicole presented the philosophy of nature’s law and how it governs both nature and global systems. Indigenous traditional knowledge is directly nested within understandings of natural or first law that is law of

living whose meaning is deeply rooted within the respective lands globally. She concluded her talk by indicating the determinants of planetary health from an indigenous perspective such as mother earth determinants, interconnecting determinants and indigenous people level determinants like their rights, language, and health.

The second speaker, Suraj Das, Department of Humanities and Social Sciences, Indian Institute of Technology (IIT)-Roorkee, deliberated on the topic “Locating Indigenous Beliefs in Climate Change Adaptation Policies through Traditional Dietary Habits”. He spoke about the contextual meaning of climate change, concept of indigenous people, dynamics of climate change and indigenous community, and indigenous response to climate change. He emphasized that climate change is responsible for altering social relations and indigenous communities face direct consequences as they depend upon the environment and have a close relationship with the surroundings. Loss of land and resources, discrimination and unemployment are some of the major consequences faced by the indigenous community. He concluded his talk by showing some examples on how climate impacts indigenous communities such as farming since they use traditional methods of farming.



PROTECTING COASTAL COMMUNITIES - RISKS FROM CHANGING CLIMATE



Climate Change & Coastal Communities



Healthy coastal ecosystems immensely support fisheries, tourism, human health, and public safety.

Many of these ecosystems are being transformed, degraded, or lost due in part to climate change, particularly sea level rise and higher numbers of extreme weather events.



Mr. Thushan Kapurusinghe presenting his talk on 6 July 2022

Future Earth Global Hub South Asia and Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru, organized a webinar on “Protecting Coastal Communities - Risks from Changing Climate” on 6 July 2022. Coastal areas across the globe are highly vulnerable regions, especially under a changing climate. Much of the Indian Ocean and South Asia’s coastline is vulnerable to rising

sea levels, cyclones, and marine pollution, particularly in low-lying countries. Alongside the imminent threat of submergence, rising sea levels also cause saltwater intrusion into both surface and groundwater reservoirs in the seaside areas. In addition to the degradation of the coastal ecosystem, saltwater intrusion also results in the displacement of millions of lives and severely affects

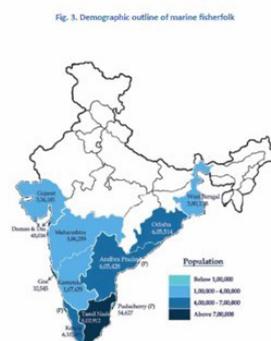
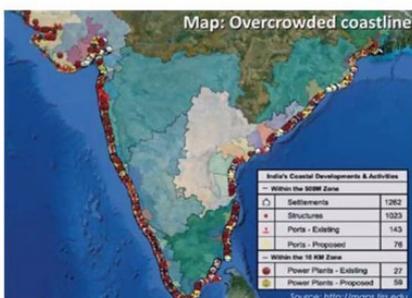
the livelihoods of coastal communities. The human adaptive capacity is also meager in many coastal regions of South Asia, thus creating hotspots of vulnerability. As a developing region, home to about 25% of the world's population, the sub-continent needs greater research and activity in this regard to truly protect its residents. The objective of this Co-note talk was to understand the localized challenges, best practices, and policy imperatives for decreasing the coastal risks to communities in South Asia with a focus on India and Sri Lanka.

Mr. Thushan Kapurusinghe is the Project Leader and co-founder of TCP Sri Lanka, deliberated on the effects of climate change on coastal communities and their habitats. Healthy coastal ecosystems immensely support fisheries, tourism, human health, and public safety. Many of these ecosystems have been degraded, transformed, or lost due to climate change, partly due to rise in sea level and extreme weather events. Mr. Thushan further showed how climate change has affected coastal

communities where fishing harvest has decreased, lack of drinking water and collapse of tourism industries. He also weighed on the ill effects on health of coastal communities caused by climate change. Mr. Thushan suggested some indicators for mitigation, adaptation and building resilience among coastal communities like increasing awareness about climate change in people, actions to reduce global warming and diversification of livelihood.

The second speaker, Dr. Naveen Namboothri, founder trustee of Dakshin Foundation, presented an overview of India's coastal and marine systems. He explained how different types of climate change-related issues affect the coastal region and the Indian islands adjoining the coast. He projected the impacts of climate change on each Indian state and listed out the vulnerabilities that they face. Dr. Naveen pressed the need for more research to be done and increase the data deficiency related to impacts of climate change in coastal regions.

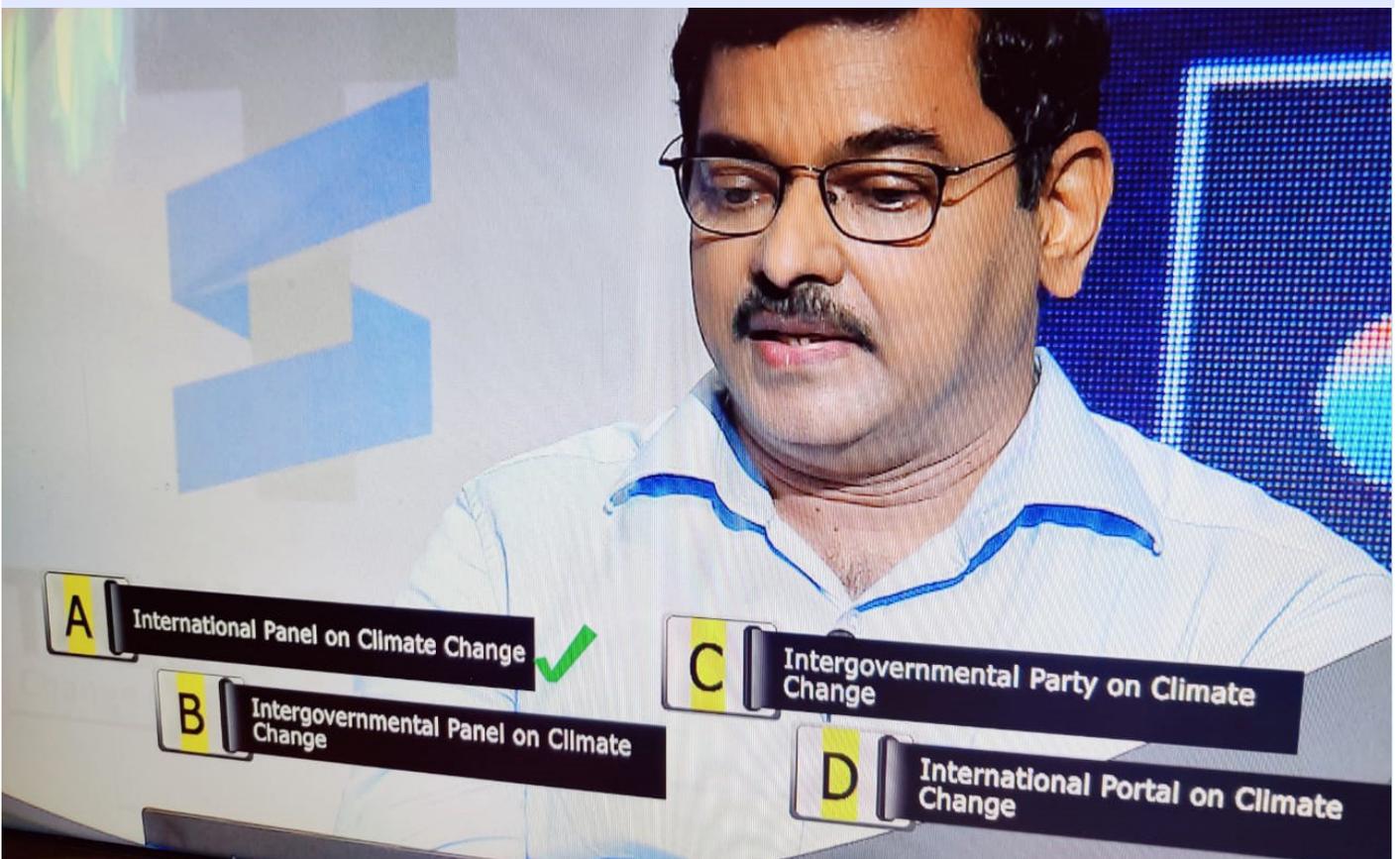
Overview of the India's coastal and marine systems



Dr. Naveen Namboothri presenting his talk on 6 July 2022



QUIZ PROGRAM 2022



Prof. S. K. Satheesh, Chairman, DCCC conducting the quiz on 30 July 2022

During the period 2009 to January 2020, Divecha Centre for Climate Change conducted quiz contests at J. N. Tata Auditorium to create awareness about the climate and environment. After the advent of the pandemic most

of the events were conducted online. In 2022, DCCC along with Talentspire conducted a national climate and awareness program for school children. Talentspire is a collective of academicians, scientists and

entrepreneurs who believe learning should be both fun and meaningful. In the first round Talentspire conducted a written exam on scientific topics. The number of students who registered were 1967 from 1789 schools (including some from the Middle-east). The number of students who attended the screening exam were 9876. From this group 1192 were selected for a written exam on climate science. Based on these exams, 24 students were selected for an oral climate science and awareness quiz on a national television channel. The quiz was conducted on 30 July 2022 at Thiruvananthapuram by Prof. S. K. Satheesh, Chairman, DCCC and Dean (infrastructure), IISc.

The four students who reached the final round were:

1. Shibilin Suresh (Class 11)

Mezhatoor, Kootanad, Palakkad

2. Ujjwal Naveen (Class 9) Delhi public school, Kollam

3. Ashaam Firdouz J. (Class 11) CSIEMHSS, Thiruvananthapuram

4. Safin Mathew Sam (Class 12) CMS higher secondary school, Mallapally Pathanamthitta

In the final round Mr. Ujjwal Naveen won the first prize. He was given a cash prize of Rs100,000. The finalists and their schools were given academic materials and a total of Rs.50,00,000.

This program was broadcast on the national television channel (Doordarshan) on 13, 20 and 27 August 2022. This new approach is expected to reach a much wider audience.



Prof. S. K. Satheesh, Chairman, DCCC at the T.V. studio on 30 July 2022

CONCLAVE

ENVIRONMENT, SUSTAINABILITY & CLIMATE CHANGE
SOCIAL AND TECHNOLOGICAL ASPECTS

SAVE OUR ENVIRONMENT
AND THE WORLD

CONCLAVE ON ENVIRONMENT, SUSTAINABILITY, AND CLIMATE CHANGE



Prof. J. Srinivasan, Distinguished Scientist, DCCC with the chief guest, Shri Ashwini Choubey, Hon'ble Minister of State, Environment, Forest and Climate Change, at the Faculty hall, IISc, Bengaluru on 15 May 2022

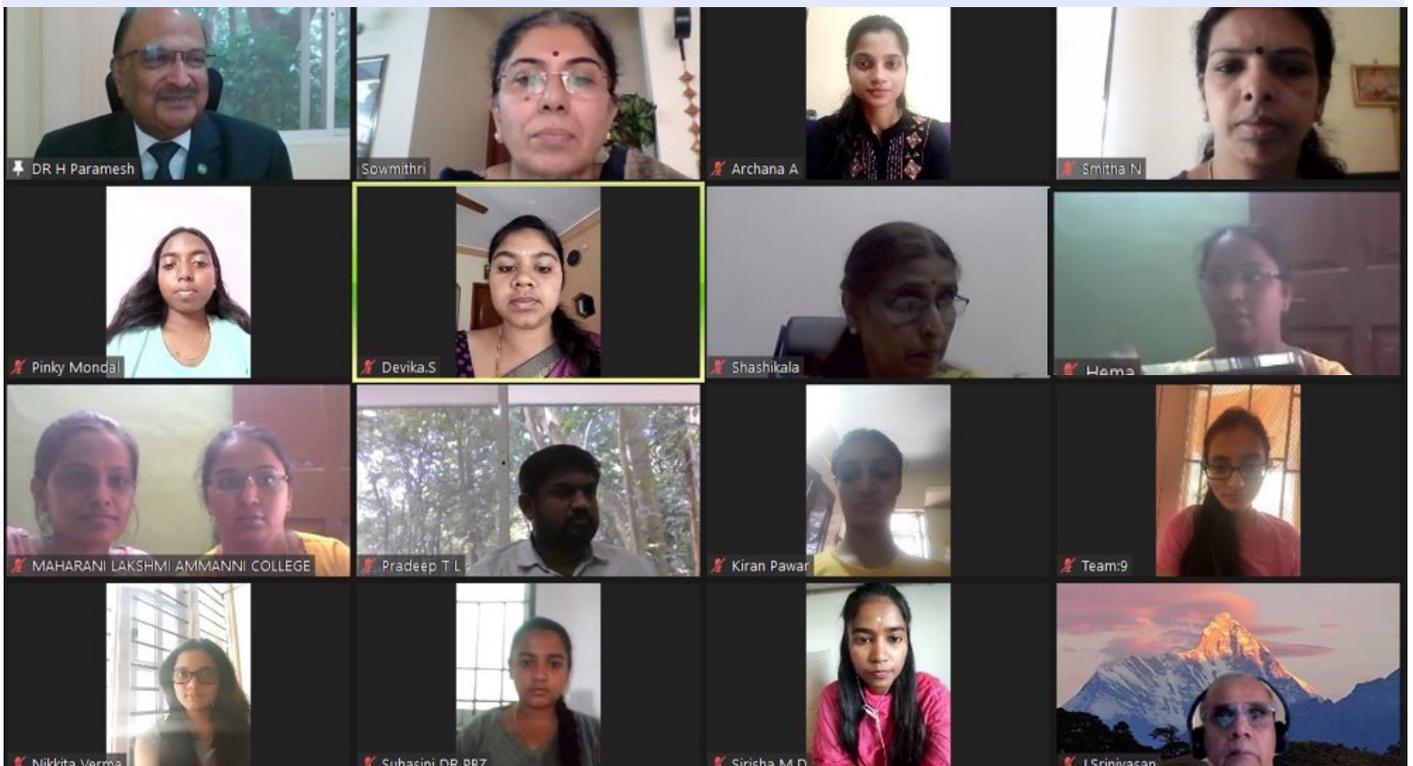
Mr. Ashwini Kumar Choubey, Honorable Minister of State for environment, forest and climate change attended a conclave on environment, sustainability, and climate change on 15 May 2022 at the faculty hall of the Indian Institute of Science, Bengaluru. The minister highlighted the role played by the Indian government to promote renewable energy in India during the past 8 years. He mentioned the programs initiated by the government to improve sanitation in rural areas and reduce the pollution in the river Ganga. Prof.

J. Srinivasan, Distinguished Scientist, DCCC informed that students that India had managed to increase the installed capacity of solar and wind power plants to 100,000 MW in just ten years. He indicated there were more than 100,000 electrical vehicles on the road (mainly two and three-wheel vehicles) and expected electrical vehicles to grow rapidly in the next ten years. This will reduce the air pollution in the India cities and reduce carbon dioxide emission. The program ended with a resolve to encourage people to reduce the degradation of the soil.



WORLD ENVIRONMENT DAY

WORLD ENVIRONMENT DAY - “A HEALTHY ENVIRONMENT FOR A HEALTHY LIFE”



Participants attending the Environment Day webinar held on 5 June 2022

Divecha Centre for Climate Change in association with Department of Zoology, Maharani Lakshmi Ammanni College for Women, Malleshwaram, organized a public lecture on World Environment Day - “A Healthy Environment for A Healthy Life” by Dr. Paramesh, Visiting Professor Divecha Centre for Climate Change, on 5 June 2022 at the college premises. Dr. Paramesh spoke about the role of environment on planet and human

health. The environment is a mix of living and non-living elements having impact on human life. It also sustains life for good health. Climate change has an impact on our environment which in turn impacts human life. Air pollution is the number one cause for health-related issues in human beings. Air pollution can also affect and have an impact on an unborn fetus with health complications.



SCIENTISTS WARNING TO HUMANITY: MICROORGANISMS AND CLIMATE CHANGE



Dr. Virginia Rich (*Top Left*) attending the webinar on 7 July 2022

Divecha Centre for Climate Change organized a webinar on “Scientists’ Warning to Humanity: Microorganisms and Climate Change” by Dr. Virginia Rich, Associate Professor, Microbiology Department, The Ohio State University, on 7 July 2022.

Microorganisms contribute to the trajectory of human-induced climate change, in some cases accelerating it and in others dampening it. Microbes are important producers and consumers of greenhouse gases and are themselves changing rapidly

in response to climate change. Accurate projection of climate trajectories this century thus requires better understanding of these biotic feedbacks. Microbes are also powerful potential allies in mitigating the extent and impact of climate change, with opportunities for innovation and economic growth. Dr. Rich in her talk reviewed her recent “Scientists’ warning” article on microorganism’s role in climate change trajectory and humanity’s potential responses, and presented several examples, from the Arctic to Sub-Saharan Africa.



SOLID-STATE Li-ION BATTERIES: IS THE FUTURE SOLID?



Dr. Naga Phani giving his talk at DCCC auditorium on 21 July 2022

Divecha Centre for Climate Change organized a webinar on “Solid-State Li-Ion Batteries: Is the Future Solid?” by Dr. Naga Phani B Aetukuri, Assistant Professor, Solid State and Structural Chemistry Unit, IISc on 21 July 2022.

The widespread adoption of renewable energy sources is essential for decarbonizing the electricity system. However, renewable energy sources are variable. For better grid

management, energy needs to be stored for on-demand consumption. Hence, there is a need for inexpensive energy storage options. Lithium-ion batteries have the necessary techno-economic attributes for decreasing the levelized cost of storage.

However, the flammable organic liquid electrolyte inside Li-ion batteries raises safety concerns. Often this liquid is responsible for battery fires.

One option to avoid such battery fire is to adopt solid-state Li-ion batteries, which use metallic lithium as an anode and an inorganic solid-state electrolyte. This battery also has a higher energy density and long cycle of life.

These batteries are unusable at high current densities due to the growth of lithium filaments through solid-state electrolytes. The talk explored several possible origins of lithium filament

growth through inorganic solid electrolytes. Dr. Aetukuri presented his team's recent work that provides a framework that enables the high current density application of solid-state lithium metal batteries. He also touched upon the techno-commercial requirements to be met if batteries were to enable total electrification of transportation, including grid storage and electric aviation.



Participants attending the seminar-cum-webinar



Ensure availability and sustainable management of water and sanitation for all

INFOSYS TALK



Ms. R. Girija, giving the talk at the Infosys Science Foundation on 14 July 2022

Ms. R. Girija, a doctoral student at the Divecha Centre for Climate Change was invited to give a talk during the inauguration of the Bengaluru office of the Infosys Science Foundation on 14 July 2022. She spoke in the session “Portrait of a Young Scientist in India: Aspirations and Challenges of Doing Impactful Research in India”.

The main objective of the session was to hear the experience of the young scientists working and conducting research in India and their challenges

and aspirations. Ms. Girija in her talk emphasized on the issue of low women representation in research, under representation of global south in research landscape, the need to work on the real issues on the ground, the need to convert research findings from laboratory to field, dissemination of scientific findings to the larger good and linking science and policy for larger impact on society.

RESEARCH HIGHLIGHTS



THE ROLE OF WIND-SOLAR HYBRID PLANTS IN MITIGATING RENEWABLE ENERGY-DROUGHTS

Renewable (wind and solar) capacity is increasing rapidly worldwide as it is essential to decarbonise the electricity grid. When there is no renewable generation, balancing the electricity demand with the available generation in a renewable-rich grid can be challenging. We define these days as “energy-drought” days. Here, we analyze India’s wind, solar, and hybrid energy droughts for the first time using a stochastic weather generator. While the previous studies use short time series data, we simulated 5000 years long possible wind solar generation dataset to estimate energy drought. Our analysis shows that wind droughts are more intense than solar droughts in India. We examine wind-solar hybridization’s role in offsetting low wind energy episodes. The benefits of hybridization are regionally dependent. In South India, hybrid plants have advantages over either wind or solar plants alone. In comparison, for Rajasthan, the benefits of hybridization are limited. Further investigation shows that when one of the regions has a

renewable drought, the other region has only a 10% probability of having a similar drought. Our findings highlight the need for having robust inter-regional grid connections to mitigate regional-level renewable droughts. The figure below shows the complementary nature of energy drought phenomena for India’s wind, solar, and hybrid plants. The legends indicate the fraction of days different regions face energy drought while the region marked with white boxes (Rajasthan and South India) faces energy drought. Wind, solar, and combined droughts are defined as less than 1%, 50%, and 25% of maximum generations from respective sources.

Reference: A. Gangopadhyay, A.K. Seshadri, N.J. Sparks, R. Toumi, The role of wind-solar hybrid plants in mitigating renewable energy-droughts, Renewable Energy, Volume 194, 2022, Pages 926-937, ISSN 0960-1481, <https://doi.org/10.1016/j.renene.2022.05.122>.

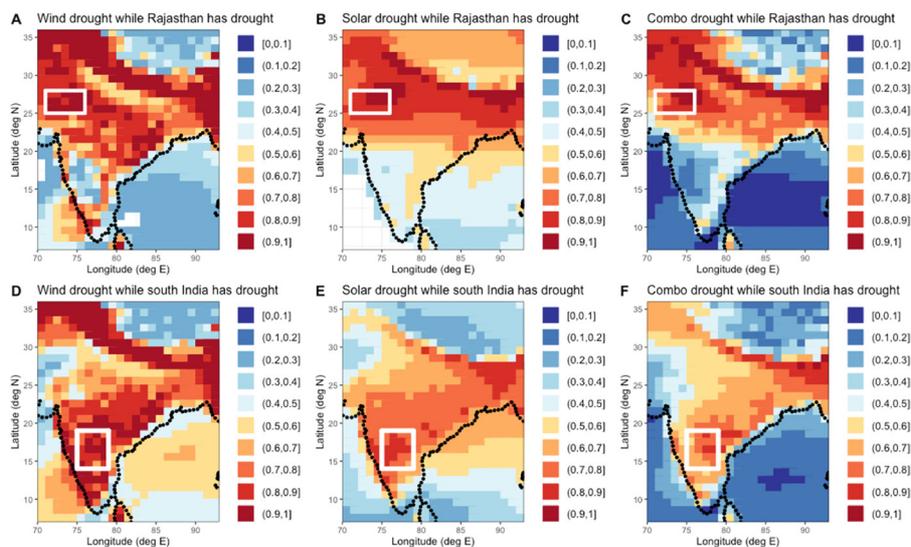


Figure: Figures A, B, and C show wind, solar and combined droughts (as the fraction of days) when Rajasthan has energy-drought. Figure D, E, and F. show wind, solar and combined droughts (as the fraction of days) when South India has an energy drought.

LONGITUDINAL VARIATIONS IN THE VERTICAL DISTRIBUTION OF ATMOSPHERIC AEROSOLS OVER THE INDIAN REGION

Despite its importance in accurately estimating atmospheric radiative forcing due to aerosols (tiny suspended particles in the atmosphere), the vertical structure and its spatial variation of aerosols remains mostly at large over the south Asian region. Consequently, most of the studies rely upon columnar information inputted to radiative transfer estimation resulting in significant uncertainties in the radiative forcing estimates, especially its vertical structure. However, it is very important to know what heating occurs at different altitudes, because for a given amount of radiation absorbed by the aerosols, the atmospheric heating would be higher at higher altitudes owing to the vertically decreasing air density.

Scientists from the Divecha Centre for Climate Change, have for the first time,

made a comprehensive estimate of the vertical structure of aerosol-induced atmospheric heating rate over the South Asian region (Indian mainland and the adjoining oceans) and its seasonality using long-term (2007–2020) satellite observations, assimilated aerosol single scattering albedo, and radiative transfer calculations. The results show strong, seasonally varying zonal gradients in the vertical extent of aerosol extinction over the study region; being rather shallow over the oceans (where the vertical extent of aerosols is confined within 3 km) becoming deeper with the aerosol extinction coefficients extending to considerably higher altitudes over the mainland, reaching as high as 6 km, during pre-monsoon and monsoon seasons over the landmass. This feature is most pronounced over the northern

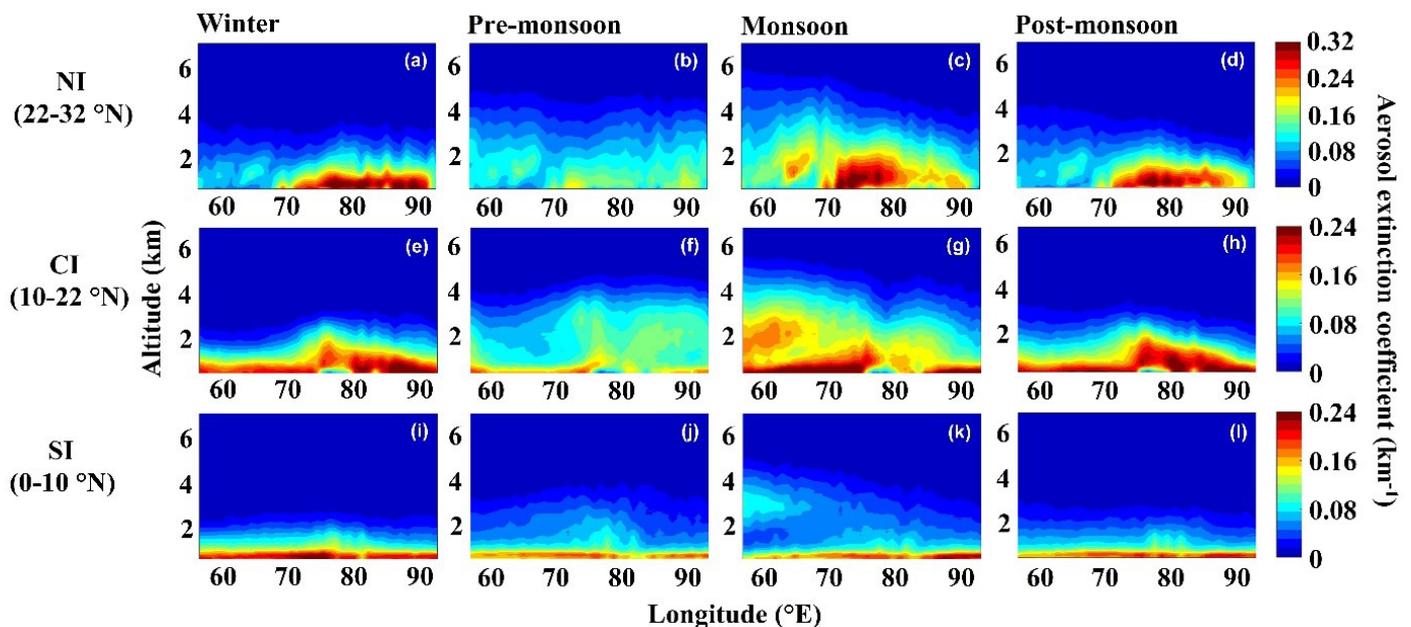


Figure 1: Longitudinal variations in the vertical distribution of aerosols over north (NI; top rows), central (CI; middle rows), and south (SI; bottom rows) India. Each column corresponds to a particular season, as marked above them. The colour scheme marks the magnitude of aerosol extinction coefficient.

Indian mainland compared to the southern parts (Figure 1). Particulate depolarisation ratio profiles identified that the elevated aerosol layers mostly comprise of advected dust.

Using high spatial resolution aerosol extinction profiles and single scattering profiles (generated from measurements and statistical assimilation) as input to radiative transfer calculations, the spatial pattern of vertical structure of aerosol induced heating rate are estimated for different distinct season over the south Asian region and are shown in Figure 2. The results show, for the first time, the influence of incorporation of realistic values of the vertical distribution of

aerosol extinction coefficient and the absorption potential of aerosols with high spatial resolution on atmospheric heating rates. Incorporation of these in regional climate models will further demonstrate the implications for the thermal structure and stability of the atmosphere.

Reference: Kala, N. K., Anand, N., Manoj, M. R., Pathak, H. S., Moorthy, K. K., & Satheesh, S. K. (2022). Zonal variations in the vertical distribution of atmospheric aerosols over the Indian region and the consequent radiative effects. *Atmospheric Chemistry and Physics*, 22(9), 6067-6085, <https://doi.org/10.5194/acp-22-6067-2022>

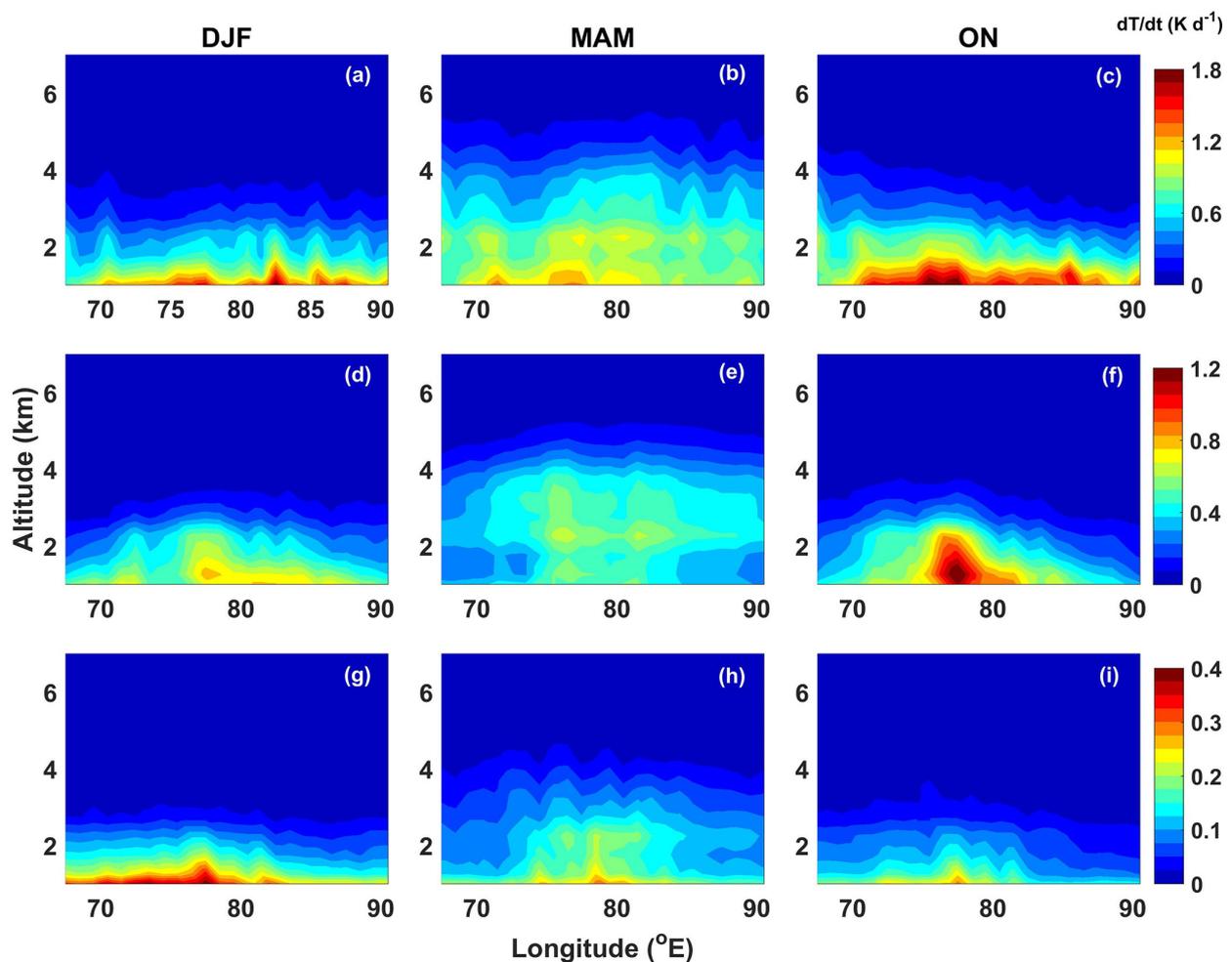


Figure 2: Zonal variation of the vertical structure of aerosol induced atmospheric heating rate over different sub-regions of South Asia clearly depicting the seasonality.

