

University of Sargodha

Brief Report of the One-Day Seminar: ‘Environmental Impact of Climate Change and Extreme Weather Events’ held on October 3, 2023, at the University of Sargodha

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The Office of Research, Innovation & Commercialization (ORIC) at the University of Sargodha (UoS), in collaboration with the Department of Mathematics and with technical support from the Global Climate-Change Impact Studies Centre (GCISC), Ministry of Climate Change & Environmental Coordination (MoCC & EC), Islamabad, successfully organized a seminar titled "**Environmental Impact of Climate Change and Extreme Weather Events**" on October 3, 2023, at the University of Sargodha. The seminar's primary objective was to enhance the understanding of climate change, monsoon-related climate extremes, and air pollution in the context of Pakistan among university students. The coordination of the seminar and group meetings was led by Dr. Muhammad Ashraf, Assistant Professor in GCISC seminar room on July 10, 2023 and then in the Department of Mathematics, while Mr. Shahbaz Mehmood, Head of Climatology & Environment, Mr. Muhammad Adnan, Senior Scientific Officer, and Dr. Kaleem Anwar Mir, Scientific Officer, represented GCISC as speakers during the event.

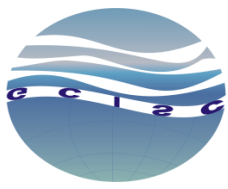
Opening and Technical Sessions:

The seminar's inauguration featured opening remarks from Prof. Dr. Qaisar Abbas, Vice Chancellor (VC) of the University of Sargodha, and Mr. Shahbaz Mehmood, Head of the Climatology & Environment Section, GCISC. Distinguished scientists from GCISC and Dr. Muhammad Ashraf an expert of environmental heat transfer from University of Sargodha subsequently delivered presentations on four pivotal and contextually significant subjects related to climate change in Pakistan, encompassing climate modeling, climatic extremes, monsoon variability, and the interplay between air pollution and climate change. A brief overview of these technical presentations is provided below:

Reviewing Climate Change & Its Impacts on Pakistan

Speaker: Mr. Shahbaz Mehmood (Head Climatology & Environment, GCISC – MoCC & EC, Islamabad)

The technical session started with the talk by Mr. Shahbaz Mehmood. Mr. Shahbaz has more than fifteen years of research experience in the area of climate change and its impacts. He has contributed in various research projects, articles for peer reviewed scientific journals, technical reports, and has also served as expert reviewer for sixth Global Environment Outlook (GEO-6) of UNEP and HIMAP report by ICIMOD. After briefly introducing his Centre, the speaker explained to the students about the basics of climate science and interaction among various



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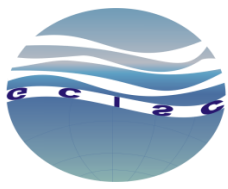
components of climate system i.e. atmosphere, lithosphere, hydrosphere, cryosphere, and biosphere. He then described in detail the greenhouse effect and role of greenhouse gases (GHGs) in altering the global energy budget by trapping more and more sunlight resulting in the global warming. He also shared the past and present trends of global warming and their linkages with increasing concentrations of GHGs. The students were also given an overview of the projected global trends of temperature, rainfall, sea level rise, and extreme events.

The threats posed by climate change to the food security, water security, energy security, and public health systems globally as well as nationally in near and far future under various scenarios were also highlighted. Mr. Shahbaz described climate models and mathematical equations used in these models to simulate the future climate. He also explained how various scenarios are embedded in the climate models to obtain a range of future climate projections. The climate change related concerns of Pakistan were also highlighted by the presenter. In the last part of his presentation, Mr. Shahbaz shared the key findings of the research carried out by the Climatology & Environment Section. The Pakistan specific future projections based on a suite of around fifty GCMs developed by GCISC show that warming rate over Pakistan is higher than that of global trend by about 1°C under all emission scenarios. The projected temperature rise in northern parts of the country is higher as compared to the southern region. Further, the projected warming rate over GB, KP and AJK is even higher than all Pakistan average. The speaker, in the end, emphasized the importance of climate resilient development, adoption of climate resilient policies, and need for immediate climate action.

Climate Extremes, Monsoon Rainfall Variability & Predictability over Pakistan

Speaker: Mr. Muhammad Adnan (Senior Scientific Officer, GCISC – MoCC & EC, Islamabad)

Mr. Muhammad Adnan delivered presentation on climatic extremes and monsoon variability under changing climate. Mr. Adnan is the Lead Author in Intergovernmental Panel on Climate Change's (IPCC) Working Group 1 (WG1) Sixth Assessment Report (AR6), and also served as expert reviewer for IPCC Fifth Assessment Report (AR5). He has published several articles in various national and international journals and contributed in various research projects. He shared detailed information about past climate changes over globe & specifically Pakistan, status of weather & climate extremes and importance of summer monsoon rainfall variability and predictability over Pakistan and their impacts on the different socio-economic sectors. He also gave an overview of the IPCC Assessment Report. He presented the results showing that the mean temperature change over globe is 0.29 °C per decade whereas the mean temperature change over Pakistan is 0.36 °C per decade for last three years. He further shared that the global mean temperature in recent decades has increased but the temperature increase over Pakistan is found to be higher compared to the global temperature rise in recent past. In case of presentation, increase is observed in most parts of the country with greater in summer and that too in monsoon region of Pakistan. There is an increasing trend in warm extremes (warm days & warm nights) and decreasing trend in cold extremes (cool days & cool nights).



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Mr. Adnan also shared some results from one of his published paper entitled: “Variability and Predictability of Summer Monsoon Rainfall over Pakistan”. The paper focuses on the importance of monsoon variability and predictability for climate sensitive sectors like water resources and agriculture. He also described the monsoon phenomena: Monsoon is defined as a tropical and subtropical seasonal reversal in both the surface winds and associated rainfall, caused by differential heating between a continental-scale land mass and adjacent ocean. South Asian Monsoon refers to the large scale seasonal winds blowing from Bay of Bengal and Arabian Sea, respectively from the southeast and southwest bringing in their wake rains to these areas. This can happen only during the summer months. He showed that observed and estimated rainfall shows a close agreement, except for few extreme years as Intra-annual predictability is dependent on monthly rainfall variability, as high variability in rainfall affects the model’s predictability skills. Predictability of rainfall can help in better planning of water resource management for agricultural sector which contributes around one quarter to Pakistan GDP

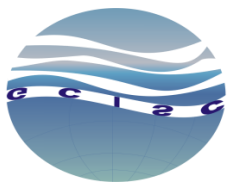
Concurrently Addressing Air Pollution and Climate Change in Pakistan

Speaker: Dr. Kaleem Anwar Mir (Scientific Officer, GCISC – MoCC & EC, Islamabad)

Dr. Kaleem Anwar Mir recently earned a PhD in Environmental Sciences and Biotechnology from Hallym University, South Korea. His doctoral research focused on Integrated Assessment Modelling analysis of air pollution control and climate change mitigation in Pakistan, covering activity-based integrated air pollutant and GHG emissions inventory, future emissions simulations, mitigation scenarios, air quality improvements, public health impacts, and cost-effectiveness analysis. He served as Chapter Scientist for Chapter 4 in the IPCC WGIII AR6 and is a member of the UNFCCC energy sector expert reviewer team, which reviews Annex-I Parties' GHG emissions inventories. He holds a BSc in Chemical Engineering from the University of Punjab, Pakistan, and an MSc in Environmental Management from the National University of Singapore, Singapore.

In his presentation, Dr. Mir emphasized the interconnection between air quality and climate change, highlighting the need for comprehensive strategies to address both challenges simultaneously. Pakistan’s legal framework acknowledges these issues but lacks a comprehensive approach. Dr. Mir’s research, published in Environmental Science & Policy journal (<https://doi.org/10.1016/j.envsci.2022.03.008>), employed established models, such as the GAINS integrated assessment model and EnerNEO Pakistan energy model, to assess the potential benefits of combined climate and pollution control policies. The results indicate the potential of advanced emission control technologies for improving air quality and reducing pollution-related health issues. By integrating these measures with national sustainable development strategies, a significant reduction in greenhouse gas emissions by 2050, leading to substantial cost savings, is feasible. This approach also has the potential to decrease pollution-related deaths by 24%.

The significance of addressing air pollution and climate change simultaneously lies in the promise of cleaner air, enhanced public health, and substantial cost savings. Dr. Mir’s findings underscore the importance of incorporating efficient pollution and emission control measures into Pakistan’s future policy decisions, setting the stage for a cleaner, healthier, and more sustainable future for the nation. The need for action is paramount, and the path forward is clear. Pakistan has the opportunity to enact bold policies that can reshape its environment, safeguard public health, and fortify its economic well-being.



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Impact of thermophoretic transportation convective heat transfer on climate change

Speaker: Dr. Muhammad Ashraf (Assistant Professor, Department of Mathematics, University of Sargodha)

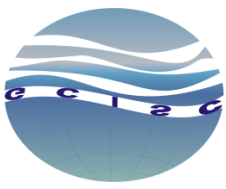
Dr. Muhammad Ashraf earned his Ph. D. degree from COMSATS University Islamabad in 2012, in the field of Computational Fluid Dynamics and Heat Transfer. He has produced six (06) Ph. D and several M. Phil students in the same field. Further, he has published seventy (70) research articles in well reputed international journals in his carrier as Assistant Professor at University of Sargodha. He has also served on a research project “Thermal fluid flow along complex geometries like solid and flexible” in Thermal Fluids Lab, Department of Mechanical Engineering, National Autonomous University of Mexico, for one year. In his talk Dr. Muhammad Ashraf proposed a mathematical model to describe the impact of thermophoretic convective heat transfer on climate change. In the proposed model there are three regions; heated air (atmosphere) adjacent to the water layer (hydrosphere) and then the water layer is connected with the melting phase of ice region via temperature difference in the presence of thermophoresis particles. In this presentation, it is analyzed that how the hydrosphere and atmosphere distribute the solar energy around the globe in the presence of thermophoretic particles and effects the globe climate. In this study, it is also analyzed that the hydrosphere (Oceans) and atmosphere are heat sink reservoir that absorbed and store thermal energy. In the obtained results, it is further predicted that the hydrosphere (Oceans) can absorb more energy as compare to the atmosphere and are the main cause of the climate change.

Side Meetings: Strengthening Collaborative Endeavors

A series of productive meetings transpired between GCISC scientists and faculty members from various departments, including Statistics, Physics, Chemistry, Economics, and ORIC. These interactions extended into the following day, showcasing the enthusiastic engagement of participants in the discourse on climate change. Each meeting, lasting over an hour, revolved around the potential integration of climate science courses into the existing degree programs of respective departments. Furthermore, the GCISC team encouraged faculty members to explore climate change-related research topics for M. Phil and PhD thesis. The proposal to send students for internships and thesis work at GCISC was also met with keen interest.

The GCISC delegation had the privilege of meeting the esteemed Vice Chancellor (VC) of the university. During this encounter, Mr. Shahbaz Mehmood provided a comprehensive overview of the seminar and the collaborative meetings with various departments. He specifically commended the Department of Mathematics, with Dr. Muhammad Ashraf at the helm, for the successful organization of the seminar. In the spirit of elevating the university's national and international visibility and equipping students with knowledge pertinent to the challenges of the 21st century, GCISC scientists proposed the establishment of a department dedicated to environmental studies and climate change. The VC briefly elaborated on the initiatives implemented during his tenure to foster a research culture that aligns with the country's leading universities.

Outcomes and Future Steps:



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1. Both parties have reached a mutual agreement in principle to formalize their collaboration through the signing of a Memorandum of Understanding (MoU).
2. Mr. Shahbaz emphasized the pivotal role of establishing a dedicated department for climate change and environmental studies within the university. The Vice Chancellor (VC) welcomed this proposal, and they have concurred to jointly work towards its realization with the technical assistance provided by the Climatology & Environment Section of GCISC, Ministry of Climate Change & Environmental Coordination.
3. Following the meetings, faculty members have shown their commitment to integrating climate change-related courses into their curriculum and selecting topics associated with climate change for M. Phil and PhD thesis, as recommended by GCISC.