A Certificate Course on

Advanced Statistical Methods and Machine Learning in Hydrological Studies under Climate Change

Department of Civil Engineering, Indian Institute of Technology, Kharagpur, India

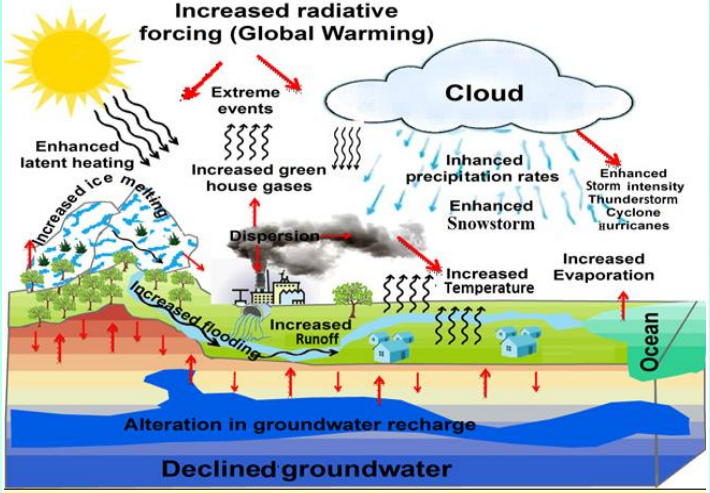
23rd to 25th June, 2025

About the Course

In hydrology and climate science, the application of statistical and machine learning (ML) methods is indispensable for addressing the inherent uncertainties in natural systems. This short course provides a comprehensive introduction to advanced statistical techniques crucial for analyzing hydrological processes, along with basic introduction to ML, particularly in the context of changing climate. Beginning with fundamental statistical concepts, the course advances to multivariate techniques such as Principal Component Analysis (PCA), Supervised PCA, Canonical Correlation Analysis, Empirical Orthogonal Functions (EOF), Analysis of Variance (ANOVA), and Copula-based modelling. It also includes an overview of climate modelling and climate change science—its drivers, trends, and potential impacts. Participants will engage in hands-on sessions for climate data acquisition, preprocessing, and implementation of the discussed techniques using MATLAB. The course also features insights from some recent researches on the impacts of climate change on water resources. Designed for postgraduate students, early-career researchers, and professionals, this course aims to build practical expertise in applying statistical and ML techniques to real-world hydroclimatic datasets.

Objectives of the Course

- To introduce participants to advanced statistical methods and machine learning in hydroclimatic studies.
- To discuss recent advancements in the domain of hydroclimatic modelling under climate change.
- To enable participants to design data-driven models in water resources engineering.
- To provide hands-on experience on advanced statistical tools in analyzing climate data.



Course Highlights

- A combination of expert lectures and hands-on experience towards problem solving.
- In-depth discussion on different key statistical techniques in multivariate data analysis.
- Session on programming using MATLAB for practical data analysis
- Interactive discussions and networking opportunities.

Course Materials

Necessary course materials for this short course will be provided to the participants during the course.

Course Coordinator

Dr. Rajib Maity *is a professor and AK Singh Chair faculty in the Dept. of Civil Engineering, IIT Kharagpur India. He is a Fellow of the Royal Meteorological Society, UK. His diverse research areas include Hydroclimatology, Climate Change Impact on Water Resources, Analysis of Hydroclimatic Extremes, Sea Level Rise, Remote Sensing Applications in Hydrology, Artificial Intelligence and Machine Learning applications in hydroclimatology. Apart from AK Singh Chair Faculty and Fellow of the Royal Meteorological Society, his other professional recognitions include Humboldt Fellowship (Experienced Researchers, Germany), James Rennell MoES Young Fellow (MoES, GoI) Faculty Excellence Award (IIT Kharagpur), Prof. R. J. Garde Research Award (ISH, India), Emerging Leaders Fellowship (Australia), BOYSCAST Fellowship, IEI Young Engineers Award, DAAD Fellowship (Germany), International ICE WaRM Fellowship (Australia), and Prof. N. S. Govinda Rao Memorial Medal from IISc, Bengaluru. Prof. Maity has published two books and more than 200 research articles in different peer reviewed journals and conferences and chapters in books. His recent book on Statistical methods in Hydrology and Hydroclimatology (2nd Edition) is published by Springer. He is also currently serving as an Associate Editor of the Journal of Hydrology (Elsevier), Scientific Reports (Nature), Journal of Hydrologic Engineering, (ASCE) and ISH Journal of Hydraulic Engineering, Taylor and Francis.*

Who should attend?

- Students interested in the domain of advanced statistical methods and machine learning techniques.
- Researchers in climate science, hydrology, and data science
- Professionals and engineers working in water resources management, environmental sciences, and related fields

Important Details

- Course Schedule: 23rd to 25th June, 2025
- Last date for course registration: 30th May, 2025
- Last date for fee submission (Only for selected participants): 4th June, 2025
- Venue: Seminar Room, Department of Civil Engineering, IIT Kharagpur
- Certificates will be provided to the participants

Accommodation

Accommodation will be provided on a first-come-first-served basis and only for the participants from outside IIT Kharagpur. Due to the limited capacity, only 30 participants will be accommodated in the course, and the accommodation will be provided in the Guest House inside campus (see options in the table below).

Registration fee*

Category	Description	Fees (INR)	Registration Fee includes	
			Accommodation	Food#
A	IIT Kharagpur Students	3,000/-	Not applicable	Included (Type 1)
B	Participants from other institutes/industries	15,000/-	Double sharing in Guest House	Included (Type 2)
C	Participants from other institutes/industries	20,000/-	Single Occupancy in Guest House	

*Payment should be made only after receiving the registration confirmation mail

#**Food Type 1:** Snacks and Lunch (Venue)

#**Food Type 2:** Breakfast (Guest House), Snacks and Lunch (Venue), Dinner (Guest House)

How to apply:

https://erp.iitkgp.ac.in/CEP/courses.htm (use the link to apply online)

Sign up → Verify your email-id → Login → Fill up profile details → Choose your program from the dashboard → Click on 'APPLY NOW'

- This is a one-time sign up process for applying through IIT Kharagpur online program registration portal. You can apply for any other program any number of times using the same Login-id and Password.
- An e-mail will be communicated from Principal Coordinator/ Convener/ Organizer, IIT Kharagpur to the shortlisted applicants stating the payment procedure once shortlisting is confirmed.

Course Content

✓ **Theoretical Lectures:**

- Basic concepts of statistics in Hydrology and Hydroclimatology.
- Multivariate Hydroclimatic Data Analysis: PCA, SPCA, CCA, EOF.
- Analysis of Variance in Hydrology and Hydroclimatology.
- Copula in Hydrology and Hydroclimatology.
- Introduction to Climate Change and Climate Modelling.
- Fundamentals of Artificial Intelligence and Machine Learning in Hydroclimatology

✓ **Research Topic based Lectures:**

- Climate Change Impacts: Recent Developments and Challenges.
- Recent Developments in Change Impact assessments Studies: Hotspot Identification, Compound extremes and Population Exposure.
- Recent advancements of ML/DL in hydroclimatic modelling.

✓ **Hand-on Sessions:**

- GCM data download, preprocessing, interpretation and visualization
- Application of PCA, SPCA in dimensionality reduction
- Application of Copula-based modelling,
- Application of some fundamental ML techniques.

Contact us

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