

Email Address	Name of the faculty member	PhD Topic	In the TA category?	If in the project category, PI can enter the project code	A brief description about the topic, and your specific requirements, if any
deepak.singh@iitb.ac.in	Deepak Singh (Co-guide Gulab Singh)	Evolution of Lunar Polar Craters and Volatiles from Dual-Frequency Polarimetric SAR Observations	Yes		The work will investigate how crater degradation in lunar polar regions governs radar backscatter behavior and whether it can serve as a reliable proxy for surface evolution, particularly within permanently shadowed regions. By using DFSAR data from Chandrayaan-2, it will also address the long-standing ambiguity in interpreting high circular polarization ratios—discriminating between contributions from subsurface water ice and blocky ejecta. The study aims to establish a coupled physical framework linking crater degradation state, regolith properties, and volatile accumulation, thereby advancing our understanding of the processes controlling the stability and spatial distribution of lunar polar ice.
deepak.singh@iitb.ac.in	Deepak Singh	Energy-Driven Evolution of Icy Worlds	Yes		This work will utilize a comparative research framework to investigate how internal energy drives the geological and compositional evolution of icy ocean worlds, specifically contrasting Pluto, Europa, and Enceladus. The project aims to quantify the thresholds of internal energy (derived from radiogenic and tidal heating) required for sustained chemical and thermal activity. By establishing Pluto as a transport-limited, low-energy baseline and comparing it to the actively recycling environments of Europa and Enceladus, the research seeks to define the volatile transport mechanisms that link planetary interiors to observable surface signatures.
deepak.singh@iitb.ac.in	Deepak Singh	Investigating surface-atmosphere interaction on Venus through Multi-Mission Data Analysis	Yes		The work aims to understand Venus' surface and atmospheric interactions via radiative modeling, data analysis, energy budget, and atmospheric dynamics. Fundamental knowledge of Machine Learning and modeling is desired. Experience in remote sensing or handling large planetary data is a plus.
pritam.das@iitb.ac.in	Pritam Das	Multi-Satellite Surface Water Probe	No	RD/0525-IRCCSH0-034	Remotely-sensing surface water from space using satellites has proven to be highly effective in for improved water resource management. Satellites, such as, JASON-3, Landsat series, Sentinel series, SARAL-AltiKa, ICESat-2, and Surface Water and Ocean Topography (SWOT), have a proven record of providing vital observations of surface water dynamics. However, satellite-based techniques are also limited in their accuracy, spatial coverage, spatio-temporal resolution, and by atmospheric conditions. In this project, the scholar will develop a multi-sensor method for estimating water surface dynamics using the arsenal of existing remote sensing satellites. The focus would be especially on the water surface elevation, surface area, and volume. The project will involve developing public-facing dashboards in later stages of the project. An ideal candidate would have: Demonstrable background in statistics, machine learning, data science, artificial intelligence, programming.
pritam.das@iitb.ac.in	Pritam Das	Streamflow Estimation in Regulated Rivers within a Data Assimilation Framework	Yes		Rivers in the 21st century require explicit consideration of regulatory structures such as dams. However, data on dam operations is largely not available, barring a few cases of published records. Satellite-based estimates of dam operations are a viable alternative for estimating regulation within a basin. Both the feasibility of estimating reservoir operations from space, and an improvement in accuracy of streamflow estimation have been demonstrated previously. The scholar in this project will develop the existing Reservoir Operations-driven River Regulation (ResORR) model further, to improve the accuracy of regulated streamflow, quantify the uncertainty in estimates, and provide decision-ready estimates. The project will involve developing public-facing dashboards in later stages of the project. An ideal candidate would have: Demonstrable background in statistics, machine learning, data science, artificial intelligence, programming.

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pritam.das@iitb.ac.in	Pritam Das	Incorporating Human Agency into Data-Driven Streamflow Estimation for Regulated Rivers	Yes		Deep Learning methods have shown tremendous potential to improve streamflow prediction in the past. These models still perform poorly in basins with a high degree of river regulation. The scholar will develop new, or improve existing ML-driven approaches to streamflow estimation, focusing primarily on regulated rivers. An ideal candidate would have: Demonstrable background in statistics, machine learning, data science, artificial intelligence, programming.
soumyakar@iitb.ac.in	Soumyashree Kar	Crop Canopy Characterization and 3D Plant Phenomics using Deep Learning	Yes		Crop canopy characterization is critical to understanding the effects of canopy light interaction on the development of plant traits and its responses to the environmental effects. In the current research landscape, 3D phenomics is the gold standard because it allows for the measurement of such complex traits by integrating both physical crop models and deep learning in a high throughput manner. Candidates with AI/ML background (especially computer vision and time series analysis), strong programming skills, and crop modeling will be preferred.
soumyakar@iitb.ac.in	Soumyashree Kar	Knowledge-Guided GeoAI for High Throughput Plant Phenotyping	Yes		In the plant science domain, data is largely multimodal and unstructured lacking standardized methods to perform integrated analysis on the siloed datasets. This work, therefore, aims to abridge the raw, messy plant biology data with structured logic within a GeoAI framework to accelerate the way we understand plant traits. Candidates with Geoinformatics and AI/ML background (especially computer vision and semantic knowledge representation), strong programming skills, and with an interest in vegetation studies will be preferred.
sdurbha@iitb.ac.in	Prof. Surya Durbha	Quantum Machine Learning for Geospatial Data Analysis and Earth Observation	Yes		Research related to quantum kernels, variational quantum classifiers, and quantum neural networks for improving the performance for high-dimensional remote-sensing problems compared with classical ML.
sdurbha@iitb.ac.in	Prof. Surya Durbha	Knowledge-Guided Agentic GeoAI for Spatial Reasoning	Yes		Combine LLMs, geospatial knowledge graphs, ontologies and GeoSPARQL with autonomous agents and use this geographic knowledge to reason about spatial relationships, constraints and domain concepts
sdubrha@iitb.ac.in	Prof. Surya Durbha	Small and Efficient Geospatial Foundation Models	Yes		Research on small, efficient models can retain the generalization capability of large foundation models and can be deployed on edge devices and operational geospatial systems

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karthikl@iitb.ac.in	Karthikeyan Lanka	Downscaling of Satellite Soil Moisture Using Multi Sensor Fusion and AI (with Prof. Avik Bhattacharya and Biplab Banerjee)	Yes		Soil moisture is a critical variable for agriculture, drought monitoring, hydrology, and climate studies. Satellite based soil moisture products currently suffer from a fundamental trade-off between spatial and temporal resolutions. Missions such as Soil Moisture Active Passive (SMAP) provide frequent observations but at coarse spatial scales (tens of kilometers), while higher-resolution radar missions like NASA-ISRO Synthetic Aperture Radar (NISAR) offer finer spatial detail but with large revisit gaps (e.g., ~10 days). As a result, we lack soil moisture datasets that are both high-resolution and temporally continuous, limiting their use in agriculture, hydrology, and climate applications. The core problem is to develop a physics-informed deep learning framework that can fuse multi-sensor satellite and meteorological data to generate soil moisture estimates that are available at high-resolution in space and continuous in time while remaining physically consistent with soil water processes. The aim of this project is to develop a physics-informed deep learning framework that produces soil moisture data that is both high-resolution in space and continuous in time by fusing multi-sensor satellite and meteorological data. Specifically, the project will aim to: 1. Downscale or improve the resolution of coarse soil moisture products (e.g., Soil Moisture Active Passive (SMAP)) using high-resolution SAR and optical/thermal data. 2. Fill temporal gaps in radar-based soil moisture (e.g., NASA-ISRO Synthetic Aperture Radar (NISAR)) using meteorological information. 3. Embed physical soil water balance constraints into deep learning models to ensure physically consistent predictions. Requirements: Technical Capabilities: • Strong programming skills in Python (PyTorch/TensorFlow preferred). • Solid understanding of machine learning and deep learning, especially spatio-temporal modeling. • Experience with handling large geospatial datasets (satellite or gridded data). • Familiarity with remote sensing data formats (e.g., NetCDF, HDF) and GIS tools. • Knowledge of numerical modeling and basic statistics. Desirable (but not mandatory): • Background in microwave remote sensing or SAR data processing. • Understanding of hydrology, land surface processes, or soil moisture dynamics. • Experience with physics-informed neural networks or hybrid modeling frameworks. • Experience working in high-performance computing (HPC) environments.

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karthikl@iitb.ac.in	Karthikeyan Lanka	Deep Learning Post-Processing of AI and Dynamical Forecast Systems for India-Specific Weather and Seasonal Prediction (with Prof. Biplab Banerjee)	Yes		The emergence of AI-based global forecast systems — GraphCast, GenCast, Pangu-Weather — alongside established dynamical models such as GFS and seasonal forecast systems such as CFSv2 and SEAS5, has fundamentally altered the landscape of operational weather and climate prediction. These systems demonstrate impressive global skill, yet they are trained or tuned on global reanalysis products that systematically underrepresent the observational density, orographic complexity, and mesoscale dynamics of the Indian subcontinent. Furthermore, the potential of physically informed causal climate features as auxiliary inputs to improve post-processing skill at extended lead times remains underexplored for a domain as teleconnection-sensitive as India. This project aims to address the following question: Can timescale-appropriate deep learning architectures, trained on Indian observational and reanalysis products and conditioned on physically informed climate state features where relevant, systematically improve the reliability and resolution of forecasts from multiple AI and dynamical systems for India-specific extremes of rainfall, temperature, and soil moisture across weather-to-seasonal lead times? Requirements: Technical Capabilities: • Strong programming skills in Python (PyTorch/TensorFlow preferred). • Solid understanding of machine learning and deep learning, especially spatio-temporal modeling. • Experience with handling large geospatial datasets (satellite or gridded data). • Familiarity with remote sensing data formats (e.g., NetCDF, HDF) and GIS tools. • Knowledge of numerical modeling and basic statistics. Desirable (but not mandatory): • Understanding of hydrology, land surface processes, or soil moisture dynamics. • Experience with physics-informed neural networks or hybrid modeling frameworks. • Experience working in high-performance computing (HPC) environments.