Name of the faculty member	PhD topic	A brief description about the topic, and specific requirements
Alok Porwal	Towards data-driven mineral prospectivity modeling with little training data	Data-driven algorithms tend to overfit because of two reasons. First, most known deposits that are used for training are very similar in attributes and may not adequately represent the overall population of deposits occurring in a geological province. Second, using the conceptual models of mineral systems to guide feature extraction tends to bias the input features towards the existing knowledge about how different deposits form, which, in turns, draws from the existing deposits. Hence, because of the bias in both training data and in the input features, the output prospectivity maps tend to identify the known deposits and their geological analogues. This research aims at using primary grid data such as air-borne, space-borne and ground geophysics, surface and bed rock geochemistry, and space-borne and air-borne hyperspectral and multispectral remote sensing data to (1) learn mineral systems model and (2) generate prospectivity maps. Preference will be given to candidates with (1) computational background and interest in machine learning or (2) geology background who are comfortable in mathematics and computation.
Avik Bhattacharya	SAR-Based Change Detection of Human-Made Targets	Synthetic Aperture Radar (SAR) is a powerful resource for characterizing human-made targets owing to their strong coherent backscatter, distinct texture patterns, and sensitivity to the geometric characteristics of such targets. While change detection using bi-temporal SAR data is feasible, it remains challenging—especially in the context of human-made targets. A key difficulty arises from the inherent sensitivity of radar backscatter to changes in both human-made and natural targets, making detecting changes in human-made targets challenging. For instance, even slight changes in the crop growth stage (or vegetation areas) between two acquired SAR images will lead to variations in the backscatter values, leading to false change detections in human-made targets. This project aims to develop descriptors/methods based on SAR data to improve accuracy in human-made target detection.
Biplab Banerjee	Multi-modal learning in the context of remote sensing image analysis	The goal is to develop advanced deep learning models that can learn meaningful features from multiple remote sensing modalities under varied learning conditions
Karthikeyan Lanka	Sub-seasonal to seasonal agricultural drought prediction	Sub-seasonal to seasonal predictions are now the frontline research to ensure adequate time for planning and adaptation. There is limited effort that is made to carry out predictions at S2S scales (1-3 months ahead) in India. This work deals with developing models using hybrid models that utilize strengths of machine learning models and seasonal forecasts from dynamical models to predict various aspects of droughts at S2S scales. Candidates with a good understanding of atmosphere processes and programming background are desirable for this project.
Karthikeyan Lanka	Land-atmosphere interactions during dry extreme events	Soil moisture has a significant role in influencing the feedback from the land surface. There is a growing literature that depicts its influence on the evolution of dry extreme events. This project deals with a thorough examination of soil moisture feedback using numerical weather model Weather Research and Forecasting (WRF) model simulations. Specifically, we would be interested to study the role of land using water and heat tracking schemes when extreme dry events and compound extremes get triggered. It is desirable for the candidates to have experience running the WRF model. The student will be co-supervised by Prof. Vishal Dixit.
Karthikeyan Lanka	Downscaling satellite soil moisture using multi-sensor integration	Soil moisture can now be measured using multiple satellite sensors, including SMAP SMOS Sentinel-1. Upcoming NISAR would bolster our ability to monitor soil moisture at fine resolution. However, each of these sensors have their own limitations in terms of resolution and accuracy bringing need to develop seamless high resolution soil moisture datasets by utilizing data from above sources and optical/thermal sensors. Through this project, the student will have an opportunity to develop such algorithms to improve resolution of satellite soil moisture. It is desirable for the student to have some understanding of hydrometeorological processes and Remote Sensing. Good experience with programming is also a necessary requirement.
Soumyashree Kar	Role of canopy architectural traits in crop yield prediction	Agricultural productivity faces significant challenges due to marginal land holdings and numerous unprecedented variabilities. To address the consumption needs, it is crucial to enhance the yields of staple crops. Several plant architectural traits have been identified to positively respond to optimal field management practices. This research aims to utilize AI/ML algorithms on 3D imaging and other UAV-based phenotyping datasets (rather than only RGB) to improve identification of such traits that influence yield and study the environmental influences. Candidates with Machine Learning background (especially computer vision and time series analysis) and with an interest in vegetation studies will be preferred.
Soumyashree Kar	Quantifying stress severity levels in field crops using multi-modal learning	Plant phenotyping experiments conducted indoors under controlled conditions often fail to translate effectively to field environments, where changing ambient conditions continually influence plant growth. Furthermore, multiple plant stresses can occur that are not visually observable. To enhance our understanding of plant stress dynamics and crop resilience, this research aims to utilize hyperspectral imaging, along with other proximal remote sensing data to identify pre-visual stress indicators and their growth patterns in both lab and field set-ups. Candidates with Machine Learning background (especially computer vision and time series analysis) and with an interest in hyperspectral remote sensing and vegetation studies will be preferred.