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Knowledge-guided machine learning for global change ecology research

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报告人简介

金哲侬 2024年9月入职北京大学，现为城市与环境学院长聘副教授、研究员。曾先后在美国斯坦福大学、Atlas AI公司、明尼苏达大学从事科研、教学与产品研发工作，并获美国国家基金会职业生涯发展奖（NSF CAREER Award）。主要研究方向为农业生态学、农业遥感、人工智能与生态系统建模等，旨在为监测和管理农业生态系统提供科学依据和技术支撑。相关论文发表在*Science*，多个*Nature*子刊及*Remote Sensing of Environment*等期刊。担任AGU期刊*Earth's Future*副主编，《中国科学：生命科学》编委等。

报告摘要

Recent advances in deep learning have significantly improved our ability to estimate canopy properties from remote sensing data, offering new insights into vegetation monitoring and management. The integration of physical models into AI frameworks—also known as Knowledge-Guided Machine Learning (KGML)—is further transforming how we predict key canopy metrics like LAI. This talk will discuss some recent advances in this domain. The first case shows how a pre-training and fine-tuning framework can improve the Bi-directional Long Short-Term Memory (Bi-LSTM) model in generating high spatiotemporal resolution LAI product. The second case will introduce an innovative method that combines gap-fraction theory with Neural Radiance Field (NeRF) technology to estimate LAI from 2D images by implicitly representing 3D scenes, which helps to bridge the gap between point-level measurements and large-scale monitoring. Overall, we show that these hybrid models incorporate established biological processes, improving accuracy and reducing data demands.

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