ForestSAT 2026

Association for Forest Spatial Analysis Technologies

May 4-8, 2026 | Gainesville, Florida, USA

Title: 3D Radiative Transfer Simulations of Virtual Forest Scenes: from Reflectance, SIF to Photosynthesis

Instructors/Affiliation: Jianbo Qi

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Description: Understanding the interaction between solar radiation and forest canopies is important for advancing our capabilities in remote sensing retrieval of biophysical parameters, plant phenotyping studies, and ecological modeling. LESS (www.lessrt.org) is a ray tracing-based 3D radiative transfer model that can simulate various remote sensing signals and radiative budget related parameters over arbitrary complex landscapes, thus helping us to understand how solar radiation is affected by complex vegetation structures. This tutorial will first provide a short introduction to the basic principle of 3D radiative transfer modeling. Then, a hands-on demonstration on how LESS (and its Python SDK) can be used to simulate images, bidirectional reflectance factor, absorbed photosynthetically active radiation, LiDAR waveform/point cloud, chlorophyll fluorescence, canopy photosynthesis, radiative budget, among others, over generated/reconstructed forest virtual scenes. It also includes basic processing of airborne and terrestrial LiDAR data to create 3D forest scenes for radiative transfer simulations.

Learning Objectives: By the end of the tutorial, participants will:

- Understand the basics of 3D radiative transfer modeling and its importance in forest remote sensing
- Learn how to use the LESS model and its Python SDK to simulate various remote sensing signals
- Gain hands-on experience simulating images, reflectance, LiDAR waveforms, chlorophyll fluorescence, and canopy photosynthesis
- Learn basic processing of airborne and terrestrial LiDAR data to create 3D forest scenes for simulations

Target audience: Researchers, graduate students, and professionals in remote sensing, ecology, forestry, or environmental science interested in radiative transfer modeling and forest canopy analysis.

Format & Activities: The tutorial combines brief theoretical introduction with hands-on demonstrations. Participants will use LESS software and its Python SDK to simulate remote sensing data over 3D forest scenes generated from LiDAR datasets. The session includes both model setup and basic LiDAR data processing.

Expected outcomes: Participants will:

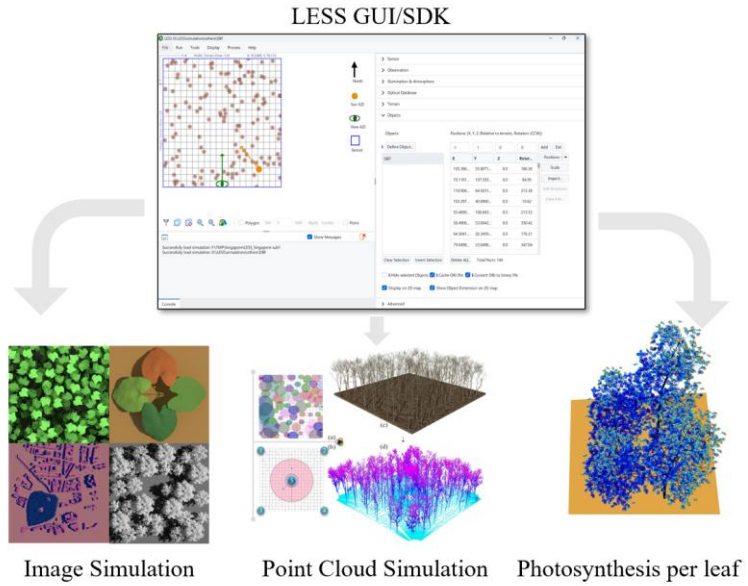
- Gain foundational knowledge of 3D radiative transfer principles
- Be able to run simulations using LESS and interpret outputs related to forest canopy radiation
- Acquire skills in processing LiDAR data to build virtual forest scenes for modeling
- Understand applications of radiative transfer models in ecological and remote sensing studies

Language: English

Requirements: Computer (Windows OS) with LESS (www.lessrt.org) installed.

Schedule: November 10, 9:00 AM – 2:00 PM (EST)

Duration: 4 hours.



Instructor Biography:

Jianbo Qi is an associate professor in Beijing Normal University, China. He obtained his PhD degree from Beijing Normal University and Paul Sabatier University in France. His research mainly focuses on 3D radiative transfer modeling of complex land surfaces, LiDAR point cloud processing. He developed a novel radiative transfer model, LESS (http://lessrt.org/), which can efficiently simulate visible images, thermal infrared images, and LiDAR signals for heterogeneous 3D scenes, and it has been frequently used in quantitative remote sensing modeling and inversion validation applications for vegetation. He also proposed and implemented a point cloud filtering method called CSF (https://github.com/jianboqi/CSF) based on cloth simulation, which has the advantages of simple parameters and high accuracy compared to traditional algorithms. CSF has received widespread acclaim and has been adopted in many open source (e.g., CloudCompare) and commercial point cloud processing software (3DF Zephyr).

Agenda

Eastern Time (ET)	Topic	Instructor
9:00-9:30	Introduction to the basic principle of 3D radiative transfer modelling of forest. This will include: • The motivation to use 3D RT model for forest remote sensing studies • The basic principle of 3D RT modelling, and the comparison with existing popular 1D models • A brief of typical 3D radiative transfer models, particularly the LESS model that will be used in this tutorial.	Jianbo Qi
9:30 – 10:30	Simulating Remote Sensing Signals with LESS GUI and Python SDK. This will include: • The basic workflow of using LESS for simulating remote sensing signals • Basic optical multispectral/hyperspectral image simulations	Jianbo Qi

	• LiDAR waveform and point cloud simulations • 3D light distribution and photosynthesis simulation for each leaf/crown/plot • Other useful tools, e.g., batch processing, embedded python code editor	
10:30 – 11:30	LiDAR Data Processing and 3D Scene Construction. This will include: • Different approaches to prepare 3D scenes for LESS simulations • Reconstruction of forest plot scenes with voxel/ellipsoid/Alpha Shape from airborne LiDAR scanning for LESS simulations • Reconstruction of individual trees from TLS LiDAR scanning for LESS simulations	Jianbo Qi
11:30 – 12:30	**Break**	Jianbo Qi
12:30 – 14:00	Case Studies, and Questions. This will include: • Some typical applications that use LESS for data simulations • Questions from dicussions	Jianbo Qi