Xiaoxuan Li

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SUMMARY OF EXPERTISE

- Analysis of optical, multispectral, hyperspectral, LiDAR (terrestrial, airborne, spaceborne), SAR, etc.
- Calibration and validation of spaceborne LiDAR datasets (GEDI in particular).
- Data fusion of multi-platform remote sensing data, such as optical, airborne and spaceborne LiDAR and SAR.
- Pixel-based and object-based classification, image segmentation, tree crown delineation.
- Time series analysis and anomaly detection in remote sensing data (e.g., Landsat, MODIS, SAR).
- Quantitative analysis, predictive modeling, cluster analysis, and machine learning methods.
- Assessing uncertainty in the vegetation metrics derived from spaceborne LiDAR and SAR.
- Processing and analysis of large-scale, multi-dimensional datasets (e.g., NetCDF and HDF).
- Collecting and processing in-situ field measurements and developing allometric models.

EDUCATION

George Mason University | Fairfax, VA, USA Sep. 2019 – Dec. 2023
Ph.D. (GPA: 4.0/4.0) Earth Systems & Geoinformation Sciences
- Dissertation: Space-based LiDAR for Estimating Vegetation Structure

University of Texas at Dallas | Richardson, TX, USA Sep. 2016 – Jun. 2018
M.S. (GPA: 3.9/4.0) Geospatial Information Sciences
- Thesis: Combining Water Fraction and DEM-Based Methods to Create a Coastal Flood Map: A Case Study of Hurricane Harvey

Liaoning Technical University Fuxin | Liaoning, China Sep. 2012 – Jun. 2016
B.E. (GPA: 3.2/4.0) Surveying & Mapping Engineering (Remote Sensing & Photogrammetry)
- Thesis: Decade of Forest Change Analysis with Landsat Time Series in Tieling City

WORK EXPERIENCE

George Mason University | Fairfax, VA, USA Sep. 2019 – Present
Research Assistant
- Calibrate and validate large-scale spaceborne LiDAR datasets (e.g. GEDI and ICESat-2) using airborne LiDAR, GEDI simulator and field measurements.
- Develop SAR-based biomass models using machine learning and generalized linear models and propagate model uncertainty using Monte Carlo simulation.
- Monitor a decade of vegetation changes using airborne LiDAR and ALOS-2 PALSAR-2 in African Savannas.
- Evaluate the relationship between GEDI structural metrics and bird and mammal species in Amazon rainforest.
- Quantify the spatio-temporal impacts of increased elephant densities on woody vegetation structure and biomass with SAR time series.
- Develop web-based GIS applications (tools including Mapbox, CartoDB, etc.).
- Assess the impacts of natural hazards (floods, wildfires, etc.) using predictive modeling and machine learning methods.
- Manage LiDAR and SAR database and mentor PhD, master's and undergraduate students.

SKILLS

- **Programming Languages:** Python (proficient in Arcpy, NumPy, Pandas, GDAL, geopandas, h5py, leafmap, scikit-learn, whitebox), R (proficient in lidR, raster, rgdal, rGEDI, caret, randomForest, car, plot3D, ggplot), MATLAB, VB, JavaScript, MySQL
- **Software:** ArcGIS products (ArcGIS Pro, ArcGIS Online and Extensions, Esri Leaflet), LAStools, Linux-based SeaDAS, ERDAS, ENVI, eCognition, CloudCompare, ESA SNAP, GraphPad Prism, Global Mapper
- **Sensors:** GEDI, ICESat-2, airborne LiDAR, terrestrial LiDAR, ALOS PALSAR 1&2, ATMS, Landsat series (5, 7, 8), MODIS, AVIRIS, Hyperion, NCEI (NCDC, NEXRAD), MERRA-2
- **Coursework:** Advanced GIS, Advanced Remote Sensing, Advanced Earth Data Analysis, GIS Programming, Science Data Mining, Quantitative Methods, Web-based GIS, 3D Data Capture and Ground LiDAR, Data Management

PROJECTS

NASA's Carbon Monitoring System (PI: John Armston, UMD) Jan. 2020 – Present
Savanna-Bio: Biomass estimation with new spaceborne missions for MRV in Dry Forests and Savannas

- Validate and improve large amounts of spaceborne LiDAR (GEDI and ICESat-2) estimates of structure and biomass for dry forests and savannas.
- Develop prototype structure and biomass maps for international pilot sites using GEDI and SAR (ALOS-2 PALSAR-2) datasets.
- Use independent field and airborne LiDAR data to validate biomass products and evaluate the uncertainty following the CEOS Land Product Validation protocol for biomass.
- Work with stakeholders to quantify the impacts of woody degradation and regrowth on aboveground biomass and carbon stock change with reference to existing MRV activity data.

The Hydrosphere Final Project Jan. 2021 – Apr. 2021

Prediction of Drought Index Based on Machine Learning Algorithms

- Implemented Random Forest (RF) algorithm to predict drought conditions in the US and identify important factors that affect droughts the most. Several data sources were used, such as MODIS time series, gridMET, and TerraClimate.
- Compared RF with other machine learning algorithms (SVM, ANN, GLM, RPART) and mapped droughts across the US
- RF was the best model compared to others in terms of highest $R^2 > 0.9$.

Independent Study Jan. 2021 – Apr. 2021

Spatio-temporal Crime Cluster Analysis and Machine Learning Based Classification in San Francisco City

- Detected anomalous clusters in spatial and temporal crime data.
- Predicted which category of crime events may occur given a specific time, location, and demographic information using multiple machine learning algorithms (e.g. ANN, RPART, KNN, RF, etc.).
- RF was the most suitable prediction model due to its relatively high accuracy and low logloss values.

Independent Study May 2020 – Sep. 2020

Spatial-temporal Sea Surface Salinity Retrieval and Analysis in the Gulf of Mexico

- Extracted and processed daily NASA MODIS/Aqua level-2 data products using Linux-based SeaDAS Graph Processing.
- Implemented multiple methods such as multiple nonlinear regression, cubist model, Random Forest (RF), and Support Vector Machine (SVM) to predict Sea Surface Salinity (SSS) using the processed MODIS data products.

Advanced Remote Sensing Final Project Apr. 2017 – May 2017

Object-based Classification Based on Hyperspectral AVIRIS Data

- Preprocessed AVIRIS data and applied forward and inverse MNF transformations including FLAASH processing, no-calibrated bands removal and conversion of DNs to at-sensor radiance.
- Developed an object-based classification method using eCognition and evaluated the result of object-based classification and compared it with pixel-based classification results (Overall accuracy: 0.9).

PUBLICATIONS

- **Li, X.** (2023). Space-Based LiDAR for Estimating Vegetation Structure (Doctoral dissertation, *George Mason University*).
- **Li, X.,** Wessels, K., Armston, J., Hancock, S., Mathieu, R., Main, R., ... & Scholes, R. (2023). First validation of GEDI canopy heights in African savannas. *Remote Sensing of Environment*, 285, 113402.
- Wessels, K., **Li, X.**, Bouvet, A., Mathieu, R., Main, R., Naidoo, L., ... & Asner, G. P. (2023). Quantifying the sensitivity of L-Band SAR to a decade of vegetation structure changes in savannas. *Remote Sensing of Environment*, 284, 113369.
- Wang, Z., **Li, X.**, & Xu, H. (2022). 3D Digital City Structure Model Based on Image Modeling Technology. In *Computer Graphics International Conference (pp. 381-392). Cham: Springer Nature Switzerland.*
- **Li, X.**, Cummings, A. R., Alruzuq, A. R., Matyas, C. J., & Amanambu, A. C. (2019). Combining Water Fraction and DEM-Based Methods to Create a Coastal Flood Map: A Case Study of Hurricane Harvey. *ISPRS International Journal of Geo-Information*, 8(5), 231.
- Sun, H. and **Li, X.** (2016). A Fast Classification Algorithms for High-dimensional Remote Sensing Images. *Science of Surveying and Mapping*, No. 8.

MANUSCRIPTS IN PREPARATION

- **Li, X.,** Wessels, K., Armston, J., Duncanson, L., Urbazaev, M., Naidoo, L., & Main, R. Evaluation of Gedi Footprint Level Biomass Models in Southern African Savannas Using Airborne Lidar and Field Measurements. Manuscript under review at *Science of Remote Sensing,* preprint available at SSRN 4716466.
- Qu, Y., Zheng, G., Xu, C., Ma, X., **Li, X.** "Characterizing savanna canopy heights using GEDI and spatially continuous spectral and backscattering information in a landscape level." Manuscript under review at *Remote Sensing of Environment.*
- Wang, Z., Zhang, L., **Li, X.,** Xu, H., "Computer dynamic geometry data visualization method based on human-computer interaction." Manuscript submitted to *Image and Vision Computing*.
- Li, H., **Li, X.,** Kato, T., Hayashi, M., Fu, J., Hiroshima, T., "Evaluation of NASA's GEDI for estimating terrain and canopy height in Japanese artificial forest." Manuscript to be completed by March 2024.

- Urbazaev, M., Armston, J., **Li, X.,** Wessels, K., Duncanson, L., Xiong, L., Hancock, S., Levick, S., Bhogapurapu, N., Siqueira, P. "Improving the applicability of canopy structure measurements from GEDI and ICESat-2 to global savannas." Manuscript to be completed by March 2024.

PRESENTATIONS AND CONFERENCE ABSTRACTS

- **Li, X.** (2023). Space-based LiDAR for Estimating Vegetation Structure in Savannas, *University of Washington,* May 18th, Seattle, WA.
- Urbazaev, M., Armston, J. D., **Li, X.,** Wessels, K. J., Duncanson, L., Bhogapurapu, N., & Siqueira, P. (2023). Improving the applicability of canopy structure measurements from GEDI and ICESat-2 to global savannas. *American Geophysical Union Annual Meeting*, December 11th, San Francisco, CA.
- Bhogapurapu, N., Siqueira, P. R., Armston, J. D., Urbazaev, M., **Li, X.,** Wessels, K., & Duncanson, L. (2023). Forest canopy height estimation using C-and L-band InSAR coherence over savannas and dry forests. *American Geophysical Union Annual Meeting*, December 11th, San Francisco, CA.
- Urbazaev, M., Armston, J., **Li, X.,** Wessels, K., Duncanson, L., Bhogapurapu, N., Siqueira, P. (2023). The Efficacy of GEDI and ICESat-2 for Estimation of Vegetation Cover and Height in Savannas, *ESA POLINSAR & BIOMASS Workshops 2023*, June 21st, Toulouse, France.
- Bhogapurapu, N., Siqueira, P., Armston, J., **Li, X.**, Urbazaev, M., Wessels, K., Duncanson, L. (2023). Large-Scale Canopy Height Estimation using C-band InSAR Correlation, *ESA POLINSAR & BIOMASS Workshops 2023*, June 21st, Toulouse, France.
- **Li, X.**, Wessels, K., Armston, J., Duncanson, L., Urbazaev, M., Hancock, S., Mathieu, R., Main, R., Naidoo, L., & Erasmus, B. (2022). Comparison of GEDI and ICESat-2 Terrain and Canopy Height Estimates in African Savanna Vegetation, *American Geophysical Union Annual Meeting*, December 15th, Chicago, IL.
- Bhogapurapu, N., Siqueira, P., Armston, J., **Li, X.**, Urbazaev, M., Wessels, K., Duncanson, L. (2022). Temporal analysis of C-band InSAR decorrelation for canopy height mapping over dry forests and tropical savannas, *American Geophysical Union Annual Meeting*, December 15th, Chicago, IL.
- **Li, X.**, Wessels, K., Armston, J., Hancock, S., Mathieu, R., Main, R., Naidoo, L., Erasmus, B., & Scholes, R. (2021). First Validation of GEDI Canopy Height in African Savannas, *American Geophysical Union Annual Meeting*, December 13th, New Orleans, LA.
- **Li, X.**, Wessels, K., Armston, J., Hancock, S., Mathieu, R., Main, R., Naidoo, L., Erasmus, B., & Scholes, R. (2020). First Validation of GEDI Vegetation Structure Metrics in South African Savannas, *American Geophysical Union Annual Meeting*, December 8th, online.
- **Li, X.** (2019). Integrated Vulnerability Analysis: Case Studies of Tropical Storm Allison and Hurricane Harvey, *Association of American Geographers Annual Meeting,* April 4th, Washington D.C.
- **Li, X.** (2018). Combining Water Fraction and DEM-based Methods to Create a Storm Surge Map: A Case Study of Hurricane Harvey, 73rd *Association of American Geographers Southeast Division Annual Meeting,* December 5th, Johnson City, TN.

AWARDS & HONORS

- George Mason University Summer Presidential Scholar Research Fellowship, 2020 – 2023
- George Mason University Presidential Scholarship, 2019 – 2023
- University of Florida Open Access Publishing Fund, May 2019
- University of Florida Department of Geography Travel Award, Feb. 2019