Song Shu, Ph.D.

Assistant Professor
Department of Geography and Planning, Appalachian State University
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Research Interests

- Remote sensing, UAV, satellite radar and laser altimetry, LiDAR, Hyperspectral
- Water resources, lake and snow hydrology, soil erosion, climate change

Education

2013 – 2019 **Ph.D.** in Geography and Geographic Information Science, University of Cincinnati (UC), U.S.
Dissertation: *Satellite Radar and Laser Altimetry for Monitoring of Lake Water Level and Snow Accumulation in Arctic Regions.* Advisor: Hongxing Liu

2010 – 2013 **M.S.** in Geographic Information Science, East China Normal University (ECNU), China
Thesis: *Spatial Cluster Analysis of Urban Landscape Pattern Using Stable Nighttime Light Satellite Images*. Advisor: Bailang Yu

2006 – 2010 **B. S.** in Physical Geography, East China Normal University (ECNU), China
Thesis: *Methods for Deriving Urban Built-up Area Using Nighttime Light Data: Assessment and Application*. Advisor: Bailang Yu

Appointments

08/2019 – present	Assistant Professor, Department of Geography and Planning, Appalachian State University
08/2018 – 08/2019	Adjunct Instructor, Department of Geography & GIScience, University of Cincinnati
01/2018 – 05/2018	Adjunct Instructor, Department of History & Geography, Northern Kentucky University
05/2017 – 01/2018	Research Assistant, Department of Geography & GIScience, University of Cincinnati
08/2013 – 05/2016	Teaching Assistant, Department of Geography & GIScience, University of Cincinnati
09/2010 – 06/2013	Teaching Assistant, Department of Geography, East China Normal University

Referred Publications

Published

39. Wang, L., Liu, H., Wang, J., Kang, L, Su, H., & **Shu, S**. (2025). Spatiotemporal continuous shallow water bathymetry from a Kriged Kalman filter. *Photogrammetric Engineering & Remote Sensing*. Accepted.

38. Xu, J., Tang, Y., Xu, J., Chen, J., **Shu, S.,** Ni, J., Zhou, X., Yu, B., Wu, J., & Huang, Y. (2025). Impact of snow on vegetation green-up dynamics on the Tibetan Plateau: Integration of survival analysis and remote sensing data. *Agricultural and Forest Meteorology*, 362, 110377.

https://doi.org/10.1016/j.agrformet.2024.110377

37. **Shu, S.** and Wu, B. (2024). LiDAR Point Cloud Analysis. *Geographic Information Science & Technology Body of Knowledge (2024 Edition)*. John P. Wilson (Ed.). DOI: 10.22224/gistbok/2024.1.26

36. Beck, R., Liu, H., **Shu, S**., Xu, M., Su, H., & Wang, L. (2024). Low-Cost, High-Density Field Water Quality Data Enable High-Accuracy Minimalist Remote Sensing for Local Sustainability and Resilience with Sentinel-2 Multispectral Imager. In, IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium (pp. 871-874). https://doi.org/10.1109/IGARSS53475.2024.10642551

35. Liu, H., Miliutina, E., Su, H., Beck, R., **Shu, S.,** Lu, Y., Xu, M., Henry, J., Wang, L., & Cohen, S. (2024). Spatial Transferability and Temporal Repeatability of Water Quality Remote Sensing Inversion Models for Inland Lakes and Rivers. In, IGARSS 2024 - 2024 IEEE International Geoscience and Remote Sensing Symposium (pp. 5060-5062). https://doi.org/10.1109/IGARSS53475.2024.10642570

34. **Shu, S.,** Yu, O.-Y., Schoonover, C., Liu, H., & Yang, B. (2023). Unmanned Aerial Vehicle-Based Structure from Motion Technique for Precise Snow Depth Retrieval – Implication for Optimal Ground Control Point Deployment Strategy. *Remote Sensing*, 15, 2297 (IF: 5.0) https://doi.org/10.3390/rs15092297

33. Xu, M., Liu, H., Mitchell, D., Lu, Y., Beck, R., Cohen, S., **Shu, S.**, & Dimova, N. (2023). Mapping river turbidity at a large basin-scale with a spatially transferable ensemble model using Landsat 8 multispectral imagery. *International Journal of Remote Sensing*, 44, 4486-4505 (IF: 3.53) https://doi.org/10.1080/01431161.2023.2237663

32. Xu, J., Tang, Y., Xu, J., **Shu, S.**, Yu, B., Wu, J., & Huang, Y. (2022). Impact of Snow Cover Phenology on the Vegetation Green-Up Date on the Tibetan Plateau. *Remote Sensing*, 14 (IF: 5.0) https://doi.org/10.3390/rs14163909

31. Xu, J., Tang, Y., Xu, J., Chen, J., Bai, K., **Shu, S.**, Yu, B., Wu, J., & Huang, Y. (2022). Evaluation of Vegetation Indexes and Green-Up Date Extraction Methods on the Tibetan Plateau. *Remote Sensing*, 14 (IF: 5.0) https://doi.org/10.3390/rs14133160

30. Yang, B., Liu, H., Kang, E.L., Hawthorne, T.L., Tong, S., **Shu, S.,** & Xu, M. (2022). Traffic restrictions during the 2008 Olympic Games reduced urban heat intensity and extent in Beijing. *Nature Communications Earth & Environment*, 3, 105 (IF: 7.9) https://doi.org/10.1038/s43247-022-00427-4

29. Huang, Y., Song, Z., Yang, H., Yu, B., Liu, H., Che, T., Chen, J., Wu, J., **Shu, S.**, Peng, X., Zheng, Z., & Xu, J. (2022). Snow cover detection in mid-latitude mountainous and polar regions using nighttime light data. *Remote Sensing of Environment*, 268, 112766 (IF: 13.5) https://doi.org/10.1016/j.rse.2021.112766

28. **Shu, S.**, Liu, H., Beck, R.A., Frappart, F., Korhonen, J., Lan, M., Xu, M., Yang, B., & Huang, Y. (2021). Evaluation of historic and operational satellite radar altimetry missions for constructing consistent long-term lake water level records. *Hydrology and Earth System Science*, 25, 1643-1670 (IF: 6.9) https://doi.org/10.5194/hess-25-1643-2021

27. Wu, B., Yu, B., **Shu, S.**, Liang, H., Zhao, Y., & Wu, J. (2021). Mapping fine-scale visual quality distribution inside urban streets using mobile LiDAR data. *Building and Environment*, 206. (IF: 7.4)

https://doi.org/10.1016/j.buildenv.2021.108323

26. Zhao, Y., Wu, B., **Shu, S.**, Yang, L., Wu, J., & Yu, B. (2021). Evaluation of ICESat-2 ATL03/08 Surface Heights in Urban Environments Using Airborne LiDAR Point Cloud Data. *IEEE Geoscience and Remote Sensing Letters*, 1-1(IF: 4.8) http://dx.doi.org/10.1109/LGRS.2021.3127540

25. Wang, C., Yu, B., Chen, Z., Liu, Y., Song, W., Li, X., Yang, C., Small, C., **Shu, S.,** & Wu, J. (2021). Evolution of Urban Spatial Clusters in China: A Graph-Based Method Using Nighttime Light Data. *Annals of the American Association of Geographers*, 1-22 (IF:3.98) https://doi.org/10.1080/24694452.2021.1914538

24. Frappart, F., Blarel, F., Fayad, I., Bergé-Nguyen, M., Crétaux, J.-F., **Shu, S.,** Schregenberger, J., & Baghdadi, N. (2021). Evaluation of the Performances of Radar and Lidar Altimetry Missions for Water Level Retrievals in Mountainous Environment: The Case of the Swiss Lakes. *Remote Sensing*, 13, 2196 (IF: 5.0) https://doi.org/10.3390/rs13112196

23. Xu, M., Liu, H., Beck, R., Lekki, J., Yang, B., Liu, Y., **Shu, S.,** Wang, S., Tokars, R., Anderson, R., Reif, M., & Emery, E. (2021). Implementation Strategy and Spatiotemporal Extensibility of Multipredictor Ensemble Model for Water Quality Parameter Retrieval with Multispectral Remote Sensing Data. *IEEE Transactions on Geoscience and Remote Sensing*, 1-16 (IF: 8.13) https://doi.org/10.1109/TGRS.2020.3045921

22. Wang, S., Alexander, P., Wu, Q., Tedesco, M., & **Shu, S**. (2021). Characterization of ice shelf fracture features using ICESat-2 – A case study over the Amery Ice Shelf. *Remote Sensing of Environment*, 255, 112266 (IF: 13.5) https://doi.org/10.1016/j.rse.2020.112266

21. Yang, B., Liu, H., Kang, E.L., **Shu, S.**, Xu, M., Wu, B., Beck, R., Hinkel, K., & Yu, B. (2020). "Spatio-temporal Cokriging Method for Assimilating and Downscaling Multi-scale Remote Sensing Data." *Remote Sensing of Environment*, 112190 (IF: 13.5) https://doi.org/10.1016/j.rse.2020.112190,

20. **Shu, S.**, Liu, H., Frappart, F., Kang, E.L., Yang, B., Xu, M., Huang, Y., Wu, B., Yu, B., Wang, S., Beck, R., & Hinkel, K. (2020). "Improving Satellite Waveform Altimetry Measurements with a Probabilistic Relaxation Algorithm." *IEEE Transactions on Geoscience and Remote Sensing*, 1-16 (IF: 8.13) https://doi.org/10.1109/TGRS.2020.3010184

19. **Shu, S.**, Liu, H., Beck, R.A., Frappart, F., Korhonen, J., Xu, M., Yang, B., Hinkel, K.M., Huang, Y., and Yu, B., (2020). "Analysis of Sentinel-3 SAR altimetry waveform retracking algorithms for deriving temporally consistent water levels over ice-covered lakes." *Remote Sensing of Environment*, 239: 111643 (IF: 13.5). https://doi.org/10.1016/j.rse.2020.111643

18. Wu, B., Yu, B., **Shu, S.**, Wu, Q., Zhao, Y., & Wu, J. (2020). A spatiotemporal structural graph for characterizing land cover changes. *International Journal of Geographical Information Science*, 1-29 (IF: 5.7) https://doi.org/10.1080/13658816.2020.1778706

17. Zhao, Y., Wu, B., Wu, J., **Shu, S.**, Liang, H., Liu, M., Badenko, V., Fedotov, A., Yao, S., & Yu, B. (2020). Mapping 3D visibility in an urban street environment from mobile LiDAR point clouds. *GIScience & Remote Sensing*, 57, 797-812 (IF: 6.7) https://doi.org/10.1080/15481603.2020.1804248

16. Chen, H., Huang, Y., Wang, S., **Shu, S.**, Yu, B., & Wu, J. (2020). Vertical Accuracy Analysis of ASTER GDEM V2 in Byrd Glacier, Antarctica. *Journal of Remote Sensing* (Chinese), 24-8 (IF:2.3) http://dx.doi.org/10.11834/jrs.20208361

15. Xu, M., Liu, H., Beck, R., Lekki, J., Yang, B., **Shu, S.**, Liu, Y., Benko, T., Anderson, R., Tokars, R., Johansen, R., Emery, E., & Reif, M. (2019). Regionally and Locally Adaptive Models for Retrieving Chlorophyll-a Concentration in Inland Waters from Remotely Sensed Multispectral and Hyperspectral Imagery. *IEEE Transactions on Geoscience and Remote Sensing*, 1-17 (IF: 8.13) https://doi.org/10.1109/TGRS.2019.2892899

14. Xu, M., Liu, H., Beck, R., Lekki, J., Yang, B., **Shu, S.**, Kang, E.L., Anderson, R., Johansen, R., Emery, E., Reif, M., & Benko, T. (2019). A spectral space partition guided ensemble method for retrieving chlorophyll-a concentration in inland waters from Sentinel-2A satellite imagery. *Journal of Great Lakes Research*, 45, 454-465 (IF:3.03) https://doi.org/10.1016/j.jglr.2018.09.002

13. Beck, R., Xu, M., Zhan, S., Johansen, R., Liu, H., Tong, S., Yang, B., **Shu, S.**, Wu, Q., Wang, S., Berling, K., Murray, A., Emery, E., Reif, M., Harwood, J., Young, J., Nietch, C., Macke, D., Martin, M., Stillings, G., Stumpf, R., Su, H., Ye, Z., & Huang, Y. (2019). Comparison of satellite reflectance algorithms for estimating turbidity and cyanobacterial concentrations in productive freshwaters using hyperspectral aircraft imagery and dense coincident surface observations. *Journal of Great Lakes Research*, 45, 413-433 (IF:3.03) https://doi.org/10.1016/j.jglr.2018.09.001

12. **Shu, S**., Liu, H., Frappart, F., Huang, Y., Wang, S., Hinkel, K.M., Beck, R.A., Yu, B., Jones, B.M., Arp, C.D., Wang, L., & Ye, Z. (2018). Estimation of snow accumulation over frozen Arctic lakes using repeat ICESat laser altimetry observations – A case study in northern Alaska. *Remote Sensing of Environment*, 216, 529-543 (IF: 13.5) https://doi.org/10.1016/j.rse.2018.07.018

11. Liu, H., & **Shu, S**. (2018). Derivation of Reliable Surface Elevation Measurements from ICESAT/GLAS Waveforms by Incorporating Spatial Contextual Information. In, *IGARSS 2018 - 2018 IEEE International Geoscience and Remote Sensing Symposium* (pp. 7438-7440) https://doi.org/10.1109/IGARSS.2018.8517985

10. Johansen, R., Beck, R., Nowosad, J., Nietch, C., Xu, M., **Shu, S.**, Yang, B., Liu, H., Emery, E., Reif, M., Harwood, J., Young, J., Macke, D., Martin, M., Stillings, G., Stumpf, R., & Su, H. (2018). Evaluating the portability of satellite derived chlorophyll-a algorithms for temperate inland lakes using airborne hyperspectral imagery and dense surface observations. *Harmful Algae*, 76, 35-46 (IF: 5.9) https://doi.org/10.1016/j.hal.2018.05.001

9. Beck, R., Xu, M., Zhan, S., Liu, H., Johansen, R.A., Tong, S., Yang, B., **Shu, S**., Wu, Q., Wang, S., Berling, K., Murray, A., Emery, E., Reif, M., Harwood, J., Young, J., Martin, M., Stillings, G., Stumpf, R., Su, H., Ye, Z., & Huang, Y. (2017). Comparison of satellite reflectance algorithms for estimating phycocyanin values and cyanobacterial total biovolume in a temperate reservoir using coincident hyperspectral aircraft imagery and dense coincident surface observations. *Remote Sensing*, 9 (IF: 5.0) https://doi.org/10.3390/rs9060538

8. Ye, Z., Liu, H., Chen, Y., **Shu, S**., Wu, Q., & Wang, S. (2017). Analysis of water level variation of lakes

and reservoirs in Xinjiang, China using ICESat laser altimetry data (2003–2009). *PLoS ONE*, 12(9). doi: 10.1371/journal.pone.0183800 (IF: 3.75) https://doi.org/10.1371/journal.pone.0183800

7. Beck, R., Zhan, S., Liu, H., Tong, S., Yang, B., Xu, M., Ye, Z., Huang, Y., **Shu, S.**, Wu, Q., Wang, S., Berling, K., Murray, A., Emery, E., Reif, M., Harwood, J., Young, J., Nietch, C., Macke, D., Martin, M., Stillings, G., Stump, R., & Su, H. (2016). Comparison of satellite reflectance algorithms for estimating chlorophyll-a in a temperate reservoir using coincident hyperspectral aircraft imagery and dense coincident surface observations. *Remote Sensing of Environment*, 178, 15-30 (IF: 13.5) https://doi.org/10.1016/j.rse.2016.03.002

6. Wang, L., Liu, H., Wang, S., & **Shu, S.** (2015). "Antarctica 2013/2014 Seasonal melt extent and duration [in .*State of the Climate in 2014*.]". Bulletin of the American Meteorological Society (BAMS), 96(7): S155-S157. (IF: 9.12) http://dx.doi.org/10.1175/2015BAMSStateoftheClimate.1

5. Wang, L., Liu, H., Wang, S., & **Shu, S.** (2014). "Antarctica 2012/2013 Seasonal melt extent and duration [in .*State of the Climate in 2013*.]". Bulletin of the American Meteorological Society (BAMS), 95(7): S149-S150. (IF: 9.12) https://doi.org/10.1175/2014BAMSStateoftheClimate.1

4. Yu, B., **Shu**, **S.**, Liu, H., Wu, J., & Chen, Z. (2014). Object-based Spatial Cluster Analysis of Urban Landscape Pattern Using Nighttime Light Satellite Images: A Case Study of China, *International Journal of Geographical Information Science*, 28(11), 2328-2355. (IF: 5.7) https://doi.org/10.1080/13658816.2014.922186

3. Wu, B., Yu, B., Yue, W., **Shu**, **S.**, Tan, W., Hu, C., Huang, Y., Wu, J., & Liu, H. (2013). "A Voxel-Based Method for Automated Identification and Morphological Parameters Estimation of Individual Street Trees from Mobile Laser Scanning Data", *Remote Sensing*, 5(2), 584-611. (IF: 5.0) https://doi.org/10.3390/rs5020584

2. Hu, Z., Wu, J., Wu, B., **Shu, S**., & Yu, B. (2012). Simulating and mapping the variations of solar radiation at the Lujiazui region of Shanghai using Airborne LiDAR data. In, *Key Engineering Materials* (pp. 511-516) (IF: 0.44) https://doi.org/10.4028/www.scientific.net/KEM.500.511

1. **Shu, S.**, Yu, B., Wu, J., & Liu, H. (2011). "Methods for Deriving Urban Built-up Area Using Night-light Data: Assessment and Application", *Remote Sensing Technology and Application* (in Chinese). 26(2), 169-176. (IF: 1.34) http://www.rsta.ac.cn/CN/10.11873/j.issn.1004-0323.2011.2.169

In Review/Revision

4. Wu, B., Huang, H., **Shu, S.,** Wang, Y., Li, J., & Yuan, Y. "Spatially localized hexagonal grid-based model for urban building height estimation", *Remote Sensing of Environment*

3. **Shu, S.,** Liu, H., Beck, R., & Wang, L., "Extending SWOT Capability for Daily Lake Surface Topography Mapping by Integrating Satellite Radar Altimetry Observations". *Water Resource Research*

2. Xu, J.Y., Tang, Y., Xu, J.H., Chen, J., **Shu, S**., Ni, J., Zhou, X., Yu, B., Wu, J., & Huang, Y., "Vegetation green-up response to snow cover variation on the Tibetan Plateau: integration of survival analysis and remote

sensing data". *Agricultural and Forest Meteorology*

1. Wang, L., Liang, X., Liu, H., Kang, E.L., Su, H., **Shu, S.,** & Wang, J. "Spatiotemporal continuous shallow water bathymetry from a Kriged Kalman filter". *Cartography and Geographic Information Science*

In Preparation

1. Keefer, Q., Gibbs, L., Ekstrand, J. O'Neill, A., Platt, J., **Shu, S.,** Yu, O., Martin, D. & Andrade, B., Evaluating the Accuracy of UAV-Based Soil Erosion Monitoring at the Ward Mill Dam Removal Site in Valle Crucis, North Carolina.

Grants

Awarded

- "CIROH: Near-Real-Time Monitoring of Key Reservoir Variables by Integrating Wide-Swath SWOT Altimetry, Multi-sensor Satellite Observations, and Deep Learning Techniques: Toward advancing National Reservoir Operation Models", *NOAA-RT1-FA6. Reservoir Simulation*, **Co-I** (**Institutional PI**) with Dr. Hongxing Liu (PI), Dr. Sagy Cohen (Co-I), Dr. Matthew LaFevor (Co-I), Dapeng Li (Co-I), Shujie Wang (Co-I), and Haibin Su (Co-I). **$ 727,633**. July 2024 – June 2026.

- "Building a New Online Graduate GIS Certificate Program", Teaching Quality Framework Grant, Center for Excellence in Teaching and Learning for Student Success (CETLSS), **Co-I** with Dr. Zhiyuan Yao (PI), Dr. Johnathan Sugg (Co-PI); and Dr. Hui Wang (Co-PI). **$2,000**, 2025 Spring.

- "River Flow Velocity, Discharge, and Channel Morphologic Data Acquisition and SWOT-enabled Sedimentation Investigation in the Mobile River Basin in USA and the Gandaki River Basin in Nepal", *NASA Research Opportunities in Space and Earth Science (ROSE-2022) – A.20 Terrestrial Hydrology,* **Co-I** (**Institutional PI**) with Dr. Hongxing Liu (PI), Dr. Sagy Cohen (Co-I), Dr. Lei Wang (Co-I). **$633,761**. May 2023 – May 2026.

- "Water Quality and Storage Monitoring Services for the Great Lakes Region of Eastern and Southern Africa by Integrating Multi-sensor Satellite Observations, Machine-learning Models and Cloud Computing Platform", *SERVIR Joint Initiative* of *NASA and the U.S. Agency for International Development (USAID)*, **Co-I (Institutional PI)** with Dr. Hongxing Liu (PI) and Dr. Richard Beck (Co-PI). **$670,000**. February 2023 – January 2026.

- "UAV-based Bathymetric Mapping and Soil Erosion Monitoring using LiDAR for the Removal of Ward's Mill Dam", *NCDOT (North Carolina Department of Transportation) Research and Development*, **Co-PI** with Dr. Narcisa Pricope (PI) and Dr. OK-Youn Yu (Co-PI). **$ 448,735**. August 2022 – August 2024

- "Monitoring Long-term Water Level and Storage Dynamics of Arctic Lakes with Multi-Mission Satellite Radar and Laser Altimetry Data", *2022 Summer Stipend for Writing A Grant (SWAG) Program*, the Office of Research at Appalachian State University, **Sole PI**. **$3,500.** 2022 summer.

- "UAV-based Soil Erosion Monitoring for the Removal of Ward's Mill Dam", *Chancellor's Innovation Scholars Program 2020 – 2021*, Appalachian State University, **PI** with Dr. OK-Youn Yu (Co-PI). **$10,000.**

2020 – 2021

- "Monitoring snow accumulation in Appalachian Mountains with unmanned aerial vehicle (UAV) observations", *CAS Research/Proposal Development Summer Grant*, Appalachian State University, **Sole PI**. **$5,000**. 2021 Summer

- "Phase II: Use of UAV-Based Thermal Infrared (TIR) Remote Sensing in Building Energy Performance Analysis", *Appalachian Energy Center Internal Grant Program*, Appalachian Energy Center, **Co-PI** with Dr. OK-Youn Yu (PI). **$4,976**. August 2021

- "Use of UAV-Based Thermal Infrared (TIR) Remote Sensing in Building Energy Performance Analysis", *Appalachian Energy Center Internal Grant Program*, Appalachian Energy Center, **Co-PI** with Dr. OK-Youn Yu (PI) and Chris Schoonover (Co-PI). **$4,999**. December 2020 – June 2021

- "UAV-Based Soil Erosion Monitoring and Assessment", *Conducting Complex Research Together (CONCERT) Grants*, Appalachian State University's Research Institute for Environment, Energy, and Economics (RIEEE), **Co-PI** with Dr. OK-Youn Yu (PI) and Chris Schoonover (Co-PI). **$4,897**. January 2020 – May 2020

Pending

- "Enhancing and expanding ephemeral surface water monitoring and mapping capability in West Africa by integrating SWOT, SAR and Optical Satellite Observations", *SERVIR Joint Initiative* of *NASA and the U.S. Agency for International Development (USAID)*, Step 1 proposal submitted and waiting for if Step-2 full proposal is solicited or not. **Co-I (Institutional PI)** with Dr. Hongxing Liu (PI), Dr. Amobichukwu Amanambu (Co-I), and Dr. Dan Tian (Co-I). July 2025 – June 2028.

Not Awarded

- "University Transportation Center of Excellence for Advanced AAM/UAS Infrastructure", *North Carolina Department of Transportation,* **Co-PI** with Dr. Zeljko Pantic (PI), Dr. Jake Smithwick (Co-PI), Dr. Tara Cavalline (Co-PI), Dr. Ning Lu (Co-PI), Dr. Ali Gurbuz (Co-PI), Dr. Ismail Guvenc (Co-PI), Dr. Mihail Sichitiu (Co-PI), Dr. Brian Raichle (Co-PI), Dr. Ok-Youn Yu (Co-PI), Dr. Lalitha Dabbiru (Co-PI), Dr. Brandon McClenton (Co-PI). $2,000,000. January 1, 2025 – December 31, 2026.

- "Commercial Smallsat Data Scientific Analysis: NASA ESD R&A Focus: Applied Sciences Programs: Water Resources: Expanding Inland Drinking Water Threat Monitoring with Meta-constellations of Earth imaging satellites", *NASA Research Opportunities in Space and Earth Science (ROSE-2022) – A.44 Commercial Smallsat Data Acquisition (CSDA) program,* **Co-I** with Dr. Richard Beck (PI) and Dr. Hongxing Liu (Co-PI). **$199,040**. February 2023 – December 2026.

- "Mapping Snow Water Equivalent using UAV-based Photogrammetry and in-field Gamma Radiation Observations", *ORAU Ralph E. Powe Junior Faculty Enhancement Award*, **Sole PI (Institution Finalist)**. **$10,000**. 2022 – 2023

- *Faculty Reassigned Time for Spring 2022*, the Office of Research at Appalachian State University, one course release, Spring 2022

- "Mapping Bathymetry and Monitoring Water Level and Storage Dynamics of Arctic Thermokarst Lakes

with ICESat-2 Observations and Multispectral Satellite Images", *NASA Research Opportunities in Space and Earth Science (ROSES-2019)*, **Co-PI (Institutional PI)** with Dr. Hongxing Liu (PI) and Dr. Richard Beck (Co-PI). **$441,072**. April 2020 – April 2023.

- "Monitoring Snow Accumulation Surrounding Boone with Unmanned Aerial Vehicle, Airplane, and Satellite Elevation Observations ", *Conducting Complex Research Together (CONCERT) Grants*, Appalachian State University's Research Institute for Environment, Energy, and Economics (RIEEE), **PI** with Dr. OK-Youn Yu (PI). **$5,479**., January 2021 – September 2021
- "Monitoring Snow Accumulation in Appalachian Mountain Regions with Unmanned Aerial Vehicle (UAV), Airplane, and Satellite Surface Elevation Observations", *University Research Council Grants*, Appalachian State University, **PI**, **$5,000**. 2020-2021
- "Comparative Analysis of Unmanned Aerial Vehicle (UAV) Surveying Accuracy", *Chancellor's Innovation Scholars Program 2019 – 2020*, Appalachian State University, **Co-PI** with Dr. OK-Youn Yu. **$10,000.** 2019 – 2020
- "Estimating Mountain Snow Accumulation using NASA ICESat-2 Satellite Laser Altimetry Observations", *ORAU Ralph E. Powe Junior Faculty Enhancement Award*, **Sole PI**. **$10,000**. 2020 – 2021
- *CAS Research/Proposal Development Summer Grant*, Appalachian State University, **Sole PI**. **$5,000**. 2020 Summer

Conference and Invited Presentations

- **Shu, S.,** Liu, H., Beck, R., and Wang, L., "*Extending SWOT Capability for Daily Lake Surface Topography Mapping by Integrating Satellite Radar Altimetry Observations*", AGU Annual Meeting, Washington D.C., December 9 – 13, 2024
- Wang, L., Liu, H., Tian, D., Men, J., Bhandari, K.P., Pandey, V.P., **Shu, S**., Cohen, S. "*SWOT-enabled Sediment Load Estimation from Satellite Data*", AGU Annual Meeting, Washington D.C., December 9 – 13, 2024
- Miliutina, E., Liu, H., Lu, Y., Men, J., Wang, L., **Shu, S.,** and Xu, M., "*Spatially Transferable and Temporally Repeatable Remote Sensing Models for River and Lake Water Quality Monitoring*", AGU Annual Meeting, Washington D.C., December 9 – 13, 2024
- Seo, J., Liu, H., Bhandari, R., Tian, D., Wang, L., Cohen, S., and **Shu, S**., "*Application of Large-Scale Particle Image Velocimetry Technique to UAV-Based NIR Video Images for River Flow Velocity Field Derivation*", AGU Annual Meeting, Washington D.C., December 9 – 13, 2024
- Liu, H., Tian, D., Cohen, S., Wang, L., Shu, S., Seo, J., Palaparthi, A., Bhandari, K., and Pandey, V., "*Extensive Field Measurements on Channel Morphology, Flow Velocity and Discharge in the Mobile River Basin for SWOT River Data Product Validation*", AGU Annual Meeting, Washington D.C., December 9 – 13, 2024
- Liu, H., Miliutina, E., Su, H., Beck, R., **Shu, S.,** Lu, Y., Xu, M., Henry, J., Wang, L., and Cohen, S., "*Spatial Transferability and Temporal Repeatability of Water Quality Remote Sensing Inversion Models for Inland Lakes and Rivers*", IGARSS 2024, Athen, Greece, July 7 – 12, 2024
- Beck, R., Liu, H., **Shu, S.,** Xu, M., Su, H., and Wang, L., "*Low-Cost, High-Density Field Water Quality Data Enable High-Accuracy Minimalist Remote Sensing for Local Sustainability and Resilience with*

Sentinel-2 Multispectral Imager", IGARSS 2024, Athen, Greece, July 7 – 12, 2024

- Henry, J., Liu, H., Wang, L. and **Shu, S**. 2024. "*Long-term Trend and Seasonal Variation of Water Quality in Lake Victoria Observed by MODIS satellite*", AAG Annual Meeting 2024, Honolulu, HI, April 16-20, 2024.
- **Shu, S.**, Liu, H., Beck, R.A., and Wang, L. 2024. "*Automated Integration of Operational Satellite Radar Altimetry Missions for Timely Lake Water Level Monitoring*", AAG Annual Meeting 2024, Honolulu, HI, April 16-20, 2024.
- Hongxing Liu, Rupesh Bhandari, Lei Wang, Sagy Cohen, **Song Shu,** Dan Tian, 2024. "*Derivation of Stream Flow Velocity Fields with Drone-based NIR Image Velocimetry Technique*," AGU CHAPMAN CONFERENCE Remote Sensing of the Water Cycle: Sensors to Science to Society, Honolulu, HI, February 13-16, 2024.
- Hongxing Liu, Haibin Su, **Song Shu,** Richard Beck, Javar Henry, Dixon Odongo, Lei Wang, George Mwazighe, Edna Waithaka, Chrisphine Nyamweya, James Wanjohi Nyaga and Robinson M Mugo, 2023. "*Mapping and monitoring water quality parameters of the African Great Lakes using multi-resolution satellite multispectral images*," AGU Annual Meeting 2023, San Francisco, CA, December 11-15, 2023.
- Hongxing Liu, Javar Henry, Lei Wang, **Song Shu,** Richard Beck, Haibin Su, Chrisphine Nyamweya, James Wanjohi Nyaga, 2023. "*Long-term trend, seasonality and abrupt changes of the water level and storage of the African Great Lakes*," AGU Annual Meeting 2023, San Francisco, CA, December 11-15, 2023.
- Henry, J., H. Liu, L. Wang, **S. Shu,** R. Beck, 2023. "*Spatio-temporal dynamics of water level of the African Great Lakes in the past three decades*," AAG Annual Meeting 2023, Denver, March 23-27, 2023.
- Henry, J., H. Liu, L. Wang, **S. Shu,** R. Beck, 2023. "*Long-term satellite altimetry observations on Spatio-temporal dynamics of the African Great Lakes*," AWI Symposium, April 6-7, Tuscaloosa, AL.
- **Shu, S.,** Yu, O., Platt, J., & Martin, D. "*UAV‐based Monitoring of Soil Erosion Induced by Dam Removal*", American Geophysical Union Annual Meeting, San Francisco, CA, USA, December 2023
- **Shu, S.,** Yu, O., Schoonover, C. *"Ground Control Point Survey Strategy for Snow Depth Retrieval Using Drone-based Structure-from-Motion Photogrammetry"*, American Geophysical Union Annual Meeting, New Orleans, LA, USA, December 2021
- Liu, H., Xu, X, & **Shu, S**. *"Mapping Bathymetry of Arctic Lakes with ICESat-2 Observations and Multispectral Satellite Images"* IEEE International Geoscience and Remote Sensing Symposium 2020.
- **Shu, S.**, "*A General Introduction to ICESat-2 Satellite Mission, Data Products and Processing Tools*", Webinar invited by Dr. Hongxing Liu at Department of Geography, University of Alabama, Tuscaloosa 2020.
- **Shu, S.**, Liu, H., Beck, R.A., and Frappart, F., (2019). "*Analysis of Sentinel-3 SAR altimetry waveform retracking algorithms for deriving temporally consistent water levels over ice-covered lakes*" American Geophysical Union Annual Meeting, San Francisco, CA, USA, December 2019.
- Liu, H., & **Shu, S.**, *"Derivation of Reliable Surface Elevation Measurements from ICESAT/GLAS Waveforms by Incorporating Spatial Contextual Information"* IEEE International Geoscience and Remote Sensing Symposium 2018
- **Shu, S.**, & Liu, H. (2018). *"Waveform Analysis of Sentinel-3 SAR Altimetry in the Retrieval of Water*

Levels over Seasonally-frozen Lakes", AAG Annual Meeting 2018, New Orleans, Louisiana, USA, April, 2018.

- **Shu, S.**, Liu, H., & Frappart, F., (2017). "*Improving Satellite Waveform Altimetry Measurements with a Probabilistic Relaxation Algorithm*", AAG Annual Meeting, Boston, USA, April, 2017.
- **Shu, S.** (2017) The Department of Geography Colloquium, "*Estimation of the Arctic Snow Depth using Satellite Laser Altimetry Observations*", University of Cincinnati, Ohio, USA, February, 2017.
- **Shu, S.**, Liu, H., Frappart, F., Kang, L.E., Wang, L., & Hinkel, K.M. (2016). "*Improving ICESat-1 Altimetric Measurements Using Probabilistic Relaxation Algorithm*", AAG Annual Meeting 2016, San Francisco, California, USA, April, 2016.
- **Shu, S.**, Liu, H., Hinkel, K.M., Beck, R.A., Wang, L., Jones, B.M., Ye, Z., & Yu, B. (2015). "*Snow Depth and Lake Elevation Variability of Alaskan Arctic Coastal Plain Derived from ICESat-1 Laser Altimetry*", AAG Annual Meeting, Chicago, Illinois, USA, April, 2015. (**Winner, first Place**)
- **Shu, S.**, Liu, H., Hinkel, K.M., Beck, R.A., & Wang, L. (2014). "*Spatio-temporal Variability of Ice and Snow Surface Elevation in Alaskan Arctic Lakes from ICESat Altimetry Observations, 2003-2009*", AAG Annual Meeting, Tampa, Florida, USA, April, 2014.
- Liu, H., Yang, B., & **Shu, S.** (2013). "*Spatio-temporal analysis of surface temperature and water level variability of thermokarst lakes on the Arctic Coastal Plain of northern Alaska using multiscale satellite thermal images and ICESat laser altimetry*", AGU Annual Meeting, San Francisco, USA, December, 2013.
- **Shu, S.**, Yu, B., Liu, H., & Wu, J., (2012). "*Object-based Spatial Cluster Analysis of Urban Landscape Pattern Using Nighttime Light Satellite Images: A Case Study of China*", AAG Annual Meeting, New York, USA, February, 2012.

Teaching

Courses Taught at Appalachian State University

GHY 3310	*Environmental Remote Sensing*. 2019 – present, as Instructor
GHY 3812	*Geographic Information Science*. 2019 – present, as Instructor
GHY 4810/5810	*Satellite, Drones, and Spatial Analysis (*formerly named *Digital Image Processing)*. 2019 – present, as Instructor
GHY 4812/5812	GIS Analysis and Modelling (formerly named Advanced GIS). 2023 – present, as Instructor
GHY 5000	*Research Themes in Geography*. 2019 – Present, as Guest Lecturer
GHY 3000	*Communicating Geographic Information*. 2023, as Guest Lecturer

Courses Taught at Northern Kentucky University

GEOG 419	*Introduction to Remote Sensing*. Spring 2018, as Instructor

Courses Taught at University of Cincinnati

GEOG 1044	*Natural Disasters and Hazards*. Summer 2019, 2018, 2017, 2016, as Instructor
GEOG 1040	*Earth from Space*. Summer 2019, as Instructor
GEOG 6091	Advanced GIS. Fall 2018, as Instructor

GEOG 6071	*Introduction to GIS*. Summer 2018, as Instructor
GEOG 6085	*Spatial Statistics II*. Spring 2016, 2015, as Teaching Assistant
GEOG 3033	*Advanced Environmental Geography*. Fall 2014, as Teaching Assistant
GEOG 6051	*Urban Habitat.* Fall 2014, as Teaching Assistant
GEOG 2062	*People and Environment II*. Spring 2014, as Teaching Assistant
GEOG 6074	*Computer Cartography*. Fall 2013, as Teaching Assistant

Mentoring

Graduate Student at Appalachian State University

Alex O'Neill	Graduation: Fall 2020. Thesis: *A Modeling Approach to Hazard Analysis in High Mountain Regions: A Case Study of the Sagarmatha National Park, Nepal.*
Bailey Chavis	Graduation: Spring 2022. Non-thesis track.
Jacob Ekstrand	Graduation: Spring 2022. Non-thesis track.
Quinn Rundgren	Graduation: Spring 2024. Thesis: *A County Case Study Approach to Greenspaces: Background Scoping Review on COVID-19 Death Rate and Health Variables*
Leon Horne	Graduation: Spring 2024. Non-thesis track
Allison Ingram	Graduation: Spring 2025. Assessing the Influence of Large Wood on Channel Bedforms in Coastal Plains Rivers
William Joca	Graduation: Spring 2026. Thesis title not determined

Undergraduate Student at Appalachian State University

Anton Hengst	Graduation: Fall 2020. Thesis: *Sub-Annual to Annual Dynamics of Alaskan Ice-Marginal Lakes from Automated Image Classification Using Google Earth Engine*
Lacey Gibbs	Graduation: Spring 2023. Non-thesis.
Quinn Keefer	Graduation: Spring 2025. Thesis title not determined

Ph.D. Dissertation Committee at the University of Alabama

Javar Henry	Graduation: Fall 2025. Dissertation: *Investigation of water quality and storage dynamics of The African Great Lakes with multispectral satellite imagery and radar altimetry observations*.

University Service

Department of Geography and Planning, Appalachian State University

2020 – 2022	Member, Department Personnel Committee
2020 – 2023	Chair, Graduate Exam Committee
2019 – Present	Chair, Speaker Committee
2019 – 2022	Advisor, Appalachian Geographical Society, GTU Honor Society

Professional Service

Journal Reviewer

Remote Sensing of Environment
GIS & Remote Sensing

Journal of Oceanology
Remote Sensing
IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing
Wetland
Southeastern Geographer
Sustainability
International Journal of Remote Sensing

Journal Themed Issues

2020 – 2021 Guest Editor, *Remote Sensing*, Special Issue – *Radar Based Water Level Estimation* (With Frédéric Frappart, Isabel Vigo, Joana Fernandes, David García-García, José Darrozes, Fabien Blarel, Cassandra Normandin)

2023 – 2024 Guest Editor, *Sustainability*, Special Issue – *Sustainable Development: Role of Geospatial Modeling, AI and Remote Sensing* (with Minxuan Lan and Bo Yang)

Other Service Activities

2024 Panelist, NASA Ocean Physics Program, NASA Research Opportunities in Space and Earth Science (ROSE-2023) – A.11 SWOT Science Team

2019, 2021, 2023 Judge for the Outstanding Student Presentation Awards (OSPA) of American Geophysical Union Annual Meeting

Community Outreach

- March 29, 2024. Mabel Elementary School, Watauga County, North Carolina. Teaching 5th Grade students about how drones are used in remote sensing and water resources monitoring. https://www.facebook.com/share/p/c8iUzc7cY5x3mbfx/

Research Field Survey

- December 16, 2024 – January 3, 2025. Field survey of river hydraulic parameters on Gandaki River System. Bharatpur, Nepal. Participants: Hongxing Liu, Song Shu, Lei Wang
- November 1, 2024. Bathymetric survey of Rhodhiss Lake under Huffman Bridge in North Carolina with UAV-based echo sounder after Hurricane Helene. Hickory, U.S. Participants: Benjamin Sanchez Andrade, Quinn Keefer, Alex O'Neill, Song Shu, Ok-Youn Yu
- September 20, 2024. Bathymetric survey of Price Lake in North Carolina with UAV-based echo sounder (ground truth data collected). Boone, U.S. Participants: Benjamin Sanchez Andrade, Quinn Keefer, Alex O'Neill, Song Shu, Ok-Youn Yu
- August 22, 2024. Bathymetric survey of Rhodhiss Lake under Huffman Bridge in North Carolina with UAV-based echo sounder (ground truth data collected). Hickory, U.S. Participants: Benjamin Sanchez Andrade, Quinn Keefer, Alex O'Neill, Song Shu, Ok-Youn Yu
- June 1 – July 4, 2023. Field survey of water quality parameters on Lake Victoria and four lakes in the Great Rift Valley, https://arcg.is/Teezj0. Kisumu and Nakuru, Kenya. Participants: Richard Beck,

Hongxing Liu, Song Shu

Awards and Honors

- 11/21/2024 **Winner**, the 2023 – 2024 William C. Strickland Outstanding Junior Faculty Award, College of Arts & Sciences, Appalachian State University
- 10/18/2023 Nominee, the 2022-2023 William C. Strickland Outstanding Junior Faculty Award, College of Arts & Sciences, Appalachian State University
- 10/26/2022 Nominee, the 2021-2022 Richard N. Henson Outstanding Advising Award for the College of Arts and Sciences at Appalachian State University
- 04/2018 **The Robert Bruce McNee Award for Outstanding Academic Achievements** in Department of Geography and Geographic Information Science, University of Cincinnati
- 04/2017 **Finalist of Student Paper Competition** in AAG Remote Sensing Specialty Group, "*Improving Satellite Waveform Altimetry Measurements with a Probabilistic Relaxation Algorithm*", AAG Annual Meeting 2017, Boston, U.S.
- 2016 – 2017 **Graduate School Dean's Fellowship**, University of Cincinnati
- 04/2015 **First Place Award** in R.S. Tarr Student Illustrated Paper Competition in AAG Cryosphere Specialty Group, "*Snow Depth and Lake Elevation Variability of Alaskan Arctic Coastal Plain Derived from ICESat-1 Laser Altimetry*", AAG Annual Meeting 2015, Chicago, Illinois, U.S.
- 06/2013 Shanghai Outstanding Graduate Student Award
- 02/2012 **Third Place Award** in AAG GIS Specialty Group, "*Object-based Spatial Cluster Analysis of Urban Landscape Pattern Using Nighttime Light Satellite Images: A Case Study of China*", AAG Annual Meeting 2012, New York, U.S.
- 2012 Excellent Student Award of East China Normal University
- 2012 "Wisdom" Scholarship for excellent graduate students in East China Normal University
- 2011 Excellent Student Award in Department of Geography, East China Normal University
- 2008 Excellent Student Award of East China Normal University
- 2008 Second-level Outstanding Scholarship of East China Normal University
- 2007 Third-level Outstanding Scholarship of East China Normal University

Society Membership

2013 – present	American Association of Geographers (AAG)
2019 – present	American Geophysical Union (AGU)

Professional Skills

Programming language:	Python, R, C#, Matlab, VB.NET, C++, SAS, ArcObjects, ENVI IDL
Cloud Computation:	Google Earth Engine, Planetary Computers

Professional software:	ArcGIS (Pro and Desktop), ENVI, Drone2Map, eCognition, SPSS, SAS, Microsoft Visual Studio and Code, Microsoft Office, CorelDraw, Orange