Song Shu, Ph.D.

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

- Remote sensing, Satellite radar and laser altimetry, Lidar, hyperspectral image analysis
- Lake and river hydrology, snow accumulation, water resources
- Cryosphere, global climate change, urbanization

Education

2013 – 2019	Ph.D. in Department of Geography & GIScience, University of Cincinnati (UC), USA
2010 – 2013	M.S. in Department of Geography, East China Normal University (ECNU), China
2006 – 2010	B. S. in Department of Geography, East China Normal University (ECNU), China

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

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: 5.86) 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:9.09). 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: 3.73) 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* (IF: 5.97) (Accepted, forthcoming)

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:1.58) 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: 5.86) 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:1.93) 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:1.93) 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:9.09) 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: 3.71) 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: 4.51) 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: 2.74) 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:9.09) 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: 9.38) 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: 9.38) 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: 3.73) 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: 4.51) 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: 0.39) 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*. 26(2), 169-176. (CSCD, In Chinese) (IF: 1.19) http://www.rsta.ac.cn/CN/10.11873/j.issn.1004-0323.2011.2.169

In Review/Revision

5. **Shu, S.**, Liu, H., Beck, R.A., Frappart, F., Korhonen, J., and Lan, M., Xu, M., Yang, B., & Huang, Y. (2020). "Evaluation of Eleven Satellite Radar Altimetry Missions for Retrieval of Lake Water Levels", *Remote Sensing of Environment* (IF: 9.09)

4. Wu, B., Yu, B., **Shu, S.**, Liang, H., Zhao, Y., & Wu, J. (2020). "Investigating spatial distribution of visual quality inside urban streets using mobile LiDAR data", *International Journal of Geographical Information Science* (IF: 3.73)

3. Wang, C., Yu, B., Chen, Z., Liu, Y., Song, W., Li, X., Yang, C., Small, C., **Shu, S.**, and Wu, J., (2020). "Evolution of Urban Spatial Clusters in China: A Dynamic Graph-based Method from Nighttime Light Remote Sensing", Annals of the Association of American Geographers (IF: 2.76).

2. Yang, B., Liu, H., Kang, E.L., Hawthorne, T.L., Tong, S., **Shu, S.**, (2020). "Accessing traffic volume impacts on urban heat island: A case study of Beijing 2008 Olympics", *Geophysical Research Letters* (IF: 4.34)

1. Yang, B., Liu, H., Kang, E.L., & **Shu**, S. (2020). "Spatio-temporal Cokriging Method for Assimilating and Downscaling Multi-scale Remote Sensing Data", *IEEE Transactions on Geoscience and Remote Sensing* (IF: 5.86)

In Preparation

4. Wang, S., Alexander, P., Wu, Q., Tedesco, M., & **Shu, S**. "Object-oriented characterization of ice shelf fracture morphology using ICESat-2 – a case study over Amery Ice Shelf"

3. Wang, S., Liu, H., Jezek, K., Yu, B., Wang, L., Huang, Y., **Shu, S.**, Beck, R., & Ward, D. Half-century ice velocity records reveal the instability development process of Larsen Ice Shelf.

2. Wang, S., Liu, H., **Shu, S.**, Wu, Q., Huang, Y., Ward, D., & Beck, R. Integrating multi-source remote sensing data to investigate the decadal changes of Larsen B outlet glaciers following ice shelf collapse.

1. Xu, M., Liu, H., Beck, R.A., Lekkic, J., Yang, B., Liu, Y., **Shu, S.**, etc., (2020). "A multi-predictor ensemble method for improving the accuracy and extensibility of empirical water quality remote sensing models"

Grants

Awarded

"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**. **$4,897**. January 2020 – May 2020

Pending

"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)*, **Institutional PI**. **$441,072**. April 2020 – April 2023.

Declined

"Comparative Analysis of Unmanned Aerial Vehicle (UAV) Surveying Accuracy", *Chancellor's Innovation Scholars Program*, Appalachian State University, **Co-PI**. **$10,000.** 2020 – 2021,

"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

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.

Research Experience

2020 – 2020	Co-PI, "*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) (PI: Dr. OK-Youn Yu, Fangxiao Liu)
2016 – 2018	Research Assistant, NASA project *"Algorithm development and comparison for deriving water quality parameters for inland lakes and rivers from multispectral and hyperspectral images"* (PI: Dr. Hongxing Liu), University of Cincinnati
2016 – 2017	Research Assistant, USDA project *"Application of Airborne LiDAR Remote Sensing of Forest Canopy Structure and Fragmentation with Oil/Gas development in the Appalachian Region"* (PI: Dr. Hongxing Liu), University of Cincinnati
2014 – 2015	Research Assistant, NSF project *"Toward a Circumarctic Lakes Observation Network (CALON): Multiscale observations of lacustrine systems"* (PI: Dr. Hongxing Liu), University of Cincinnati
2012 – 2013	Research Assistant, project "*Spatio-temporal analysis of urban clusters in the Yangtze River Delta using nighttime light data and object-based method.*" (PI: Dr. Bailang Yu), East China Normal University
2011 – 2012	Research Assistant, project "*Geographic Information System of Monitoring and Controlling the Gasoline Evaporation in Typical Cities of China.*" (PI: Dr. Bailang Yu), East China Normal University
2011 – 2012	Research Assistant, the project "*Identification and morphological parameters estimation of individual street trees from Vehicle-borne Laser Scanning data.*" (PI: Dr. Bailang Yu), East China Normal University

Teaching

Course Taught at Appalachian State University

GHY 3310   *Environmental Remote Sensing*. Fall 2019, 2020; Spring 2019

GHY 3812   *Introduction to GIS*. Fall, 2019, 2020; Spring 2019

GHY 4810   *Digital Image Processing*. Spring 2020

Course Taught at Northern Kentucky University

GEOG419   *Introduction to Remote Sensing*. Spring 2018.

Course Taught at University of Cincinnati

GEOG 1044   *Natural Disasters and Hazards*. Summer 2019, 2018, 2017, 2016

GEOG 1040   *Earth from Space*. Summer 2019

GEOG 6091   Advanced GIS. Fall 2018

GEOG 6071   *Introduction to GIS*. Summer 2018

GEOG 6085   *Spatial Statistics II*. Spring 2016, 2015 (Teaching Assistant)

GEOG 3033   *Advanced Environmental Geography*. Fall 2014 (Teaching Assistant)

GEOG 6051   *Urban Habitat*. Fall 2014 (Teaching Assistant)

GEOG 2062   *People and Environment II*. Spring 2014 (Teaching Assistant)

GEOG 6074   *Computer Cartography*. Fall 2013 (Teaching Assistant)

Mentoring

Current M.A. Thesis at Appalachian State University

Alex O'Neill   Expected Graduation: Fall 2020. Thesis: *A Modeling Approach to Hazard Analysis in High Mountain Regions: A Case Study of the Sagarmatha National Park, Nepal.*

University Service

Department of Geography and Planning, Appalachian State University

2020 – Present   Member, Department Personnel Committee

2020 – Present   Member, Graduate Exam Committee

2019 – Present   Member, Speaker Committee

2019 – Present   Advisor, Appalachian Geographical Society

Professional Service

Journal Reviewer

Remote Sensing of Environment

IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing

Southeastern Geographer

International Journal of Remote Sensing

Journal Themed Issues

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

Other Service Activities

2019   Judge for the Outstanding Student Presentation Awards (OSPA) of American Geophysical

Awards and Honors

- 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: C#, Matlab, VB.NET, C++, R, SAS, ArcObjects, Python, ENVI IDL
Professional software: ArcGIS, ENVI, eCognition, SPSS, SAS, Microsoft Visual Studio, Microsoft Office, CorelDraw, Orange