Guta Wakbulcho Abeshu PhD

Postdoctoral Research Associate in Computational Climate Science
Pacific Northwest National Laboratory, Richland, WA, USA
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Google Scholar

Education

University of Houston **Houston, TX, USA**
Ph.D. in Civil Engineering (Hydrosystems) *May 2022*
Dissertation: Understanding catchment ecohydrological processes and their interactions across multiple spatiotemporal scales: A Darwinian Perspective

Swiss Federal Institute of Technology (ETH Zurich) **Zürich, Switzerland**
Master of Advanced Studies in Sustainable Water Resources *Feb 2016*
Thesis: Remote Sensing-Based Evaluation of Hydrogeological Surplus in the Drought Prone Regions of East Africa

Addis Ababa University **Addis Ababa, Ethiopia**
M.Sc. in Water Resources Engineering and Management *Jul 2013*
Thesis: Hydrological and Hydrogeological Characterizations and Classifications using Remote Sensing Datasets and Models

Arba Minch University **Arba Minch, Ethiopia**
B.Sc. in Hydraulic and Water Resources Engineering *Jul 2009*
Thesis: Developing Rainfall-Runoff Model for Upper Omo-Ghibe River Basin and Understanding of the Cause of 2006 Flood at Omorate, Omo-Ghibe Basin, Ethiopia

Research Interest

My research focuses on advancing the understanding and sustainable management of water resources in the face of global environmental challenges. By integrating hydrological modeling, artificial intelligence, and ecohydrological principles, I aim to develop innovative solutions for addressing both immediate and long-term water sustainability issues. My primary areas of interest include medium- to large-scale hydrological and water resource modeling, water resource systems, hydrological extremes, dynamic risk management, resilience of water infrastructure, catchment hydrology, urban ecohydrology, global water sustainability, and transboundary water management.

Research Experience

Pacific Northwest National Laboratory **Richland, WA, USA**
Postdoctoral Research Associate, Computational Climate Science *01/2024 - Present*

- **Project : GCIMS**
  Topic : Developing a novel approach to global lake modeling using hybrid physics-based and deep learning methods(with Thomas Wild, Menqi Zhao, and Hong-Yi Li).
- **Project : ICoM**
  Topic: Utilizing transfer-learning and meta-learning for hydrological signature regionalization. (with Hong-Yi Li, Zeli Tan, and L. Ruby Leung).
- **Project: WACCEM**
  Topic: Developing a numerical water tracer model for E3SM(with Huancui Hu and L. Ruby Leung)
- **Drought Project:** Investigating the connection between East African drought topology and the African Monsoon System. (Personal initiative with Sifan Koriche, University of Alabama)
- **Book Project:** I am currently working on producing the second edition to seminal book on climate and water balance of Ethiopia. The book is titled "Aspects of Climate and Water Budget in Ethiopia" (1977), Addis Ababa University Press, Addis Ababa, 71p by Daniel Gemechu.
- **Mentoring**
  -Supervising 2 PhD students from Dr. Hong-Yi Li's group at University of Houston, Houston, Texas, USA
  -Supervising junior researchers at Addis Ababa University and the Ethiopian Artificial Intelligence Institute on physics-informed deep learning for a national streamflow model for Ethiopia.

University of Houston **Houston, TX, USA**
Postdoctoral Research Fellow *07/2022 - 09/2023*
Department of Civil and Environmental Engineering
- Developing a global lake modeling module for a global hydrologic model.
- Mentoring graduate students.

University of Houston
Department of Civil and Environmental Engineering **Houston, TX, USA**
Graduate Research Assistant *08/2018 - 05/2022*
- Theoretical analysis: Catchment Ecohydrology.
- Modeling and machine learning development for various projects, including Xanthos-W and MOSART-Sediment.

Montana State University
Department of Land Resources and Environmental Sciences **Bozeman, MT, USA**
Graduate Research Assistant *01/2017 - 08/2018*
- Theoretical analysis: Catchment Ecohydrology.
- Modeling for several projects, including Xanthos and MOSART.

Teaching Experience

University of Houston **Houston, TX, USA**
Guest Lecturer *2019 - 2024*
- Hydrology (2 Semesters); Watershed Hydrology & Modeling (2 Semesters); Global Climate: Physical Models (2 Semester).

Montana State University **Bozeman, MT, USA**
Teaching Assistant *2017 - 2018*
- Developed lab teaching material and taught lab for Watershed Analysis course.

Arba Minch University
Department of Hydraulic and Water Resources Engineering **Ethiopia**
Assistant Lecturer / Lecturer *Sep 2009 - Dec 2016*
- Courses taught: Hydraulics, Open Channel Hydraulics, Engineering Hydrology, and more.
- Supervised Bachelor Projects.
- Served as an academic program advisor.

Peer-reviewed Publications

Published

Abeshu, G. W., Li, H.-Y., M., S., Brookshire, J., Tang, J., Xu, C., McDowell, N., & Leung, L. (2024). Generalized relationship linking water balance and vegetation productivity across site-to-regional scales. *Journal of Hydrologic Engineering*. https://doi.org/https://doi.org/10.1061/JHYEFF.HEENG-6163

Abeshu, G. W., Hongyi, Li Shi, M., & Leung, L. R. (2024). Causal relationships between vegetation productivity, water availability, and atmospheric dryness at the catchment scale. *EGUsphere [preprint] Hydrology and Earth System Sciences*. https://doi.org/10.5194/egusphere-2024-1748

Zhang, J., Yang, Y. E., Abeshu, G. W., Li, H., Hung, F., Lin, C.-Y., & Leung, L. R. (2024). Exploring the food-energy-water nexus in coupled natural-human systems under climate change with a fully integrated agent-based modeling framework. *Journal of Hydrology*. https://doi.org/https://doi.org/10.1016/j.jhydrol.2024.131048

Abeshu, G. W., Tian, F., Wild, T., Zhao, M., Turner, S., Chowdhury, A. F. M. K., Vernon, C. R., Hu, H., Zhuang, Y., Hejazi, M., & Li, H.-Y. (2023). Enhancing the representation of water management in global hydrological models. *Geoscientific Model Development*, *16*, 5449–5472. https://doi.org/https://doi.org/10.5194/gmd-16-5449-2023

Kreibich, H., Schröter, K., Di Baldassarre, G., Van Loon, A. F., Mazzoleni, M., Abeshu, G. W., Agafonova, S., AghaKouchak, A., et al. (2023). Panta rhei benchmark dataset: Socio-hydrological data of paired events of floods and droughts. *Earth Syst. Sci. Data*, *15*, 2009–2023. https://doi.org/https://doi.org/10.5194/essd-15-2009-2023

Zhao, M., Wild, T. B., Graham, N. T., Kim, S., Binsted, M., Chowdhury, A. F. M. K., Msangi, S., Patel, P. L., Vernon, C. R., Niazi, H., Li, H.-Y., & Abeshu, G. W. (2023). Gcam-glory v1. 0: Representing global reservoir water storage in a multisector human-earth system model. *Geoscientific Model Development Discussions*. https://doi.org/https://doi.org/10.5194/gmd-2023-204

Abeshu, G. W., Li, H.-Y., Zhu, Z., Tan, Z., & Leung, L. R. (2022). Median bed-material sediment particle size across rivers in the contiguous u.s. *Earth Syst. Sci. Data*. https://doi.org/10.5194/essd-14-929-2022

Kreibich, H., Van Loon, A. F., K., S., Ph., W., M., M., N., S., G.W., A., S., A., A., A., et al. (2022). The challenge of unprecedented floods and droughts in risk management. *Nature*, *608*, 80–86. https://doi.org/10.1038/s41586-022-04917-5

Li, H.-Y., Tan, Z., Ma, H., Zhu, Z., Abeshu, G., Zhu, S., Cohen, S., Zhou, T., Xu, D., & Leung, L.-Y. R. (2022). A new large-scale suspended sediment model and its application over the united states. *Hydrol. Earth Syst. Sci.* https://doi.org/10.5194/hess-26-665-2022

Abeshu, G. W., & Li, H.-Y. (2021). Horton index: Conceptual framework for exploring multi-scale links between catchment water balance and vegetation dynamics. *Water Resources Research*, *57*. https://doi.org/10.1029/2020WR029343

Golaz, J. C., Caldwell, P. M., et al. (2019). The doe e3sm coupled model version 1: Overview and evaluation at standard resolution. *Journal of Advances in Modeling Earth Systems*, *11*(7), 2089–2129. https://doi.org/10.1029/2018MS001603

Awange, J., Gebremichael, M., Forootan, E., Wakbulcho, G., Anyah, R., Ferreiraf, V., & Alemayehu, T. (2014). Characterization of ethiopian mega hydrogeological regimes using grace, trmm, and gldas datasets. *Advances in Water Resources*. https://doi.org/10.1016/j.advwatres.2014.07.012

Presentations

Conference:

Abeshu, G. W., Li, H. Y., TB, W., & Zhao, M. (2023). Advancing global hydrological models with a novel approach to global lake modeling [Poster]. *AGU Fall Meeting 2023*.

Abeshu, G. W., & Li, H. Y. (2022). A simple ecohydrological model for simulating vegetation carbon uptake at global scale [Oral]. *AGU Fall Meeting 2022*.

Abeshu, G. W., Li, H. Y., TB, W., & Zhao, M. (2022). Representing lakes in the global hydrological model xanthos [Poster]. *AGU Fall Meeting 2022*.

Abeshu, G. W., & Li, H. Y. (2021). A unified functional relationship between catchment water balance and vegetation productivity [Oral]. *AGU Fall Meeting 2021*.

Abeshu, G. W., Li, H. Y., Hejazi, M., Wild, T., Vernon, C., & M., Z. (2021). A new global water management module: Distributed vs. lumped representations [Poster]. *AGU Fall Meeting 2021*.

Abeshu, G. W., & Li, H. Y. (2020). Analytical expression of horton index using generalized proportionality hypothesis [Oral]. *AGU Fall Meeting 2020*.

Abeshu, G. W., & Li, H. Y. (2019). Catchments-scale vegetation water use efficiency: Patterns, processes, and implications [Poster]. *AGU Fall Meeting 2019*.

Abeshu, G. W., & Li, H. Y. (2018). Drought propagation through natural-human systems: The nonlinear filtering effects [Poster]. *AGU Fall Meeting 2018*.

Abeshu, G. W., Li, H. Y., Yigzaw, W., Hejazi, M. I., Tang, J., & Demissie, Y. (2017). Reservoir-induced alterations in flood seasonality: Patterns, processes, and implications [Poster]. *AGU Fall Meeting 2017*.

Abeshu, G., & Li, H. Y. (2017). Catchment-scale water carbon coupling across the contiguous united states: A data-based analysis [Oral]. *American Water Resources Association Montana Section Conference*.

Invited:

- Multi-Scale Links Between Catchment Water Balance and Vegetation Dynamics, Department of Civil and Environmental Engineering, University of Houston, Houston, Texas, USA, February 11, 2022
- Drought Propagation through Coupled Water-Human System: A Darwinian Perspective, Department of Land Resources and Environmental Sciences, Montana State University, Bozeman, Montana, USA, December 4, 2017

Professional Activities

Committee Member:

- *Risk, Uncertainty, And Probabilistic Approaches Committee, American Society of Civil Engineers (ASCE)*
- *Guest Editor's Member for ASCE Journal of Hydrologic Engineering Special Collection*

Convened Session at Scientific Conferences:

- Primary Convener, *Understanding and Modeling Lakes Within the Hydro-Human-Ecosystem-Climate Nexus*

Across Local to Global Scales, AGU2023.
- Primary Convener, *Advances in Understanding Climate, Vegetation, Soil, and Topographic Controls on Hydrologic Patterns, Processes, and Functions at the Watershed and Larger Scales*, AGU2023.
- Primary Convener, *Advances in Understanding Climate, Vegetation, Soil, Topographic, Precipitation Processes, and Their Subgrid-Scale Parameterization at the Watershed and Larger Scales*, AGU2021.
- Session chair, *H104, Soil, Plant, and Climate Interactions in the Critical Zone under Varying Land Use, Ecosystem Management, and Climatic Forcing III eLightning*, AGU2020.
- Session chair, *H130, Human Influence on the Regional/Natural Hydroclimate*, AGU2019.
- Session chair, *H221, Water–Soil–Vegetation Dynamic Nexuses and Equilibriums in Changing Climate*, AGU2018.

Referee Roles:
- *Water Resources Research (WRR)*
- *Journal of Hydrology (JoH)*
- *Stochastic Environmental Research and Risk Assessment (SERRA)*
- *Journal of Hydrologic Engineering*
- *Journal of Open Source Software (JOSS)*

Memberships:
- American Geophysical Union (AGU)
- American Society of Civil Engineers (ASCE)
- European Geophysical Union (EGU)
- Ethiopian Geoscience Union International (ETGUI)

Technical Skills

Programming Languages: Python (proficient); MATLAB (proficient); FORTRAN (medium)

Software & Tools: ArcGIS / QGIS (proficient); Linux (working knowledge)

Techniques: Parallel Computing (working knowledge); Machine/Deep learning (proficient)

Grants

Project: Hydropower Reservoir Modeling Powered by Deep Reinforcement Learning
- **Agency:** The U.S. Department of Energy's Water Power Technologies Office (WPTO)
- **Grant Amount:** $250,000
- **Role:** Co-PI, Principal drafter of the pre-proposal and the main proposal
- **Status:** Funded

Honors & Awards

- Department of Civil and Environmental Engineering Best Dissertation Award, University of Houston, 2022
- Graduate Student Teaching Award for Merit (2018), North American Colleges and Teachers of Agriculture (NACTA), Montana State University, Montana, USA
- Honor award, Ethiopian Institute of Water Resources, Addis Ababa University, Jul. 2013
- WaterSmart Innovations and Exposition Travel Scholarship, Las Vegas, NV, 2017
- Oeuvre St Justin Scholarship for MAS study at ETH Zurich, Sep. 2014 - Sep. 2015
- USAID-HED Fellowship award for M.S. study, Jun. 2011 – Jul. 2013