

NEELARUN MUKHERJEE

Department of Earth and Planetary Sciences, Jackson School of Geosciences, University of Texas at Austin

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RESEARCH PROFILE

Computational environmental scientist developing observation-constrained multiphysics models coupling coupled fluid, energy, and reactive transport. Expertise in integrated surface–subsurface hydrology, freeze–thaw processes, reactive transport.

Research Areas: Computational Hydrology, groundwater–surface-water interactions; Hydro-biogeochemical modeling; reactive transport; cold-regions hydrology; terrestrial carbon cycling; uncertainty quantification.

EDUCATION

University of Texas at Austin 2027 (expected)
Ph.D. Candidate in Hydrology

Dissertation Topic: Flow and transport processes in supra-permafrost aquifers in the Arctic

Committee: Dr. M. Bayani Cardenas, Dr. Jingyi Chen, Dr. Daniel O. Breecker, Dr. George W. Kling, Dr. Ethan T. Coon, Dr. Pin Shuai

Indian Institute of Technology (IIT), Kharagpur 2021
Integrated M.S. and B.S. in Exploration Geophysics

Specialization in Fluid Mechanics and Microfluidics

Thesis: Numerical modeling of seawater intrusion considering diurnal head changes of seawater and matrix compression and rebound. <http://dx.doi.org/10.13140/rg.2.2.15345.25443>.

Advisors: Dr. Abhijit Mukherjee & Dr. Aditya Bandopadhyay

RESEARCH EXPERIENCES

University of Texas at Austin, Austin, TX *Graduate Research Assistant*
Advisors: Dr. M. Bayani Cardenas, Dr. Jingyi Chen 2021–2027

Flow and transport processes in supra-permafrost aquifers

- Observation-constrained data-driven numerical modeling of groundwater, thermal, and carbon transport over permafrost.
- Developed the first observation validated integrated surface-subsurface model of permafrost systems with freeze thaw and reactive transport

Oak Ridge National Laboratory, Oak Ridge, TN *Graduate Research Intern*
Mentor: Dr. Scott L. Painter Summer 2026, Fall 2025

Flow and Reactive Transport in Supra-permafrost Aquifers

- Developed a coupled ATS-PFLOTRAN framework for simulating surface–subsurface flow, energy transport, freeze–thaw dynamics, and reactive carbon transport in continuous-permafrost terrain.
- Implemented and tested a 14-reaction biogeochemical network representing microbial carbon degradation, iron redox cycling, oxygen dynamics, and CO₂ and CH₄ production.

University of Alberta, Edmonton, Canada *UARE Fellow*
Advisor: Dr. Peichun Amy Tsai Fall 2020

Low-Capillary-Number Microfluidic Emulsions

- Conducted high-resolution three-dimensional simulations of CO₂ plug flow in microchannels.
- Characterized internal recirculation and interface dynamics controlling transport and flow stabilization.

Sorbonne Université, Paris, France *Intern*
Advisor: Dr. Damien Jougnot Summer 2020

Rayleigh Taylor Instabilities in porous media with geoelectrics

- Developed an OpenFOAM solver coupling variable-density flow, solute transport, and ERT response.
- Investigated geophysical signatures of Rayleigh–Taylor convection in porous media.

Université de Rennes, Rennes, France

Advisor: **Dr. Yves Meheust**

Charpak Fellow

Summer 2019

Numerical simulations and Experimental study of CO₂ sequestration in deep aquifers

- Developed a variable-density OpenFOAM solver for miscible Rayleigh–Taylor convection relevant to solubility trapping of geologic CO₂.
- Connected numerical simulations with pore-scale laboratory experiments for validation.

IIT Kharagpur, WB, India

Advisor: **Dr. Saibal Gupta**

Undergraduate Research Assistant

2018–2019

Thermal Transport in Connected Aquifers

- Modeling mineral mixing rates from transport of a radiogenic heat source using a coupled groundwater flow and heat transport model.

GRANTS

Cold-regions Hydro-biogeochemical Processes

Environmental System Science Program (ESS), Department of Energy (DOE)

Team: M. B. Cardenas (PI, UT Austin), B. T. Neilson (Col, Utah State Univ.), P. Shuai (Col, Utah State Univ.), R. M. Cory (Col, Univ. of Michigan), G. W. Kling (Col, Univ. of Michigan), E. T. Coon (Col, Oak Ridge Nat. Lab.), N. Mukherjee (Grad Student, UT Austin), D. Hill (Grad Student, Utah State Univ.)

Future Investigators in NASA Earth and Space Science and Technology

National Aeronautics and Space Administration (NASA)

Team: J. Chen (PI), M. B. Cardenas (Col), Y. Wu (FI), N. Mukherjee (FI), UT Austin

AWARDS AND SCHOLASTIC ACHIEVEMENTS

2025, 2024	Travel Grant, Earth System Science (ESS) PI Meeting, Dept. of Energy
2024	Outstanding Student Presentation Award (OSPA), AGU Fall Meeting
2024	First Place, Geoscience Hackathon on Computational Reproducibility, UT Austin
2023	Travel Grant, Reactive Transport Workshop using PFLOTTRAN, CUAHSI
2023	Jackson School Summer Off-Campus Research Grant, UT Austin
2021	Dean's List, IIT Kharagpur
2021	Prof. Supriya Mohan Sengupta Memorial Award, Best Masters' Thesis, IIT Kharagpur
2021	Best Undergraduate Project Award, IIT Kharagpur
2020	University of Alberta Research Experience (UARE) Award
2019	Indo-French Summer Research Charpak Scholarship
2016-2021	Innovation in Science Pursuit for Inspired Research (INSPIRE) Fellowship, Govt. of India
2016	All India Rank 6193 (out of 1.2 million aspirants) in Joint Entrance Examination (JEE)

PUBLICATIONS

- [5] Mukherjee, N., Gao, B., Painter, S., Shuai, P., Coon, E. T., Neilson, B. T., Cory, R. M., Kling, G. W., and Cardenas, M. B. *Fate of soil carbon in supra-permafrost aquifers after 40 years of warming*. [Under Prep.]
- [4] Mukherjee, N., Gao, B., Shuai, P., Coon, E. T., Hill, D., Neilson, B. T., Kling, G. W., and Cardenas, M. B. *The effects of extreme weather variability on supra-permafrost hydrology: Flashy hillslopes with more outflow* (Submitted, Under Review). Preprint: <https://doi.org/10.22541/essoar.15005310/v1>
- [3] Mukherjee, N., Gao, B., Shuai, P., Coon, E. T., Hill, D., Chen, J., Neilson, B. T., Kling, G. W., and Cardenas, M. B. *Seasonal to decadal changes in supra-permafrost soil and aquifer thermal hydrology: broader, deeper, and longer activity*. (Submitted, Under Review). Preprint: <https://doi.org/10.22541/essoar.15006029/v1>

- [2] Mukherjee, N., Chen, J., Neilson, B. T., Kling, G. W., and Cardenas, M. B. (2024). *Water and carbon fluxes from a supra-permafrost aquifer to a stream across hydrologic states*. Journal of Hydrology, 645, 132285. <https://doi.org/10.1016/j.jhydrol.2024.132285>
- [1] Virappane, S., Azadi, R., Mukherjee, N., and Tsai, P. A. (2024). *Three-dimensional simulations of two-phase plug flow in a microfluidic channel*. Physics of Fluids, 36(10). Editors' Choice. <https://doi.org/10.1063/5.0220101>

CONFERENCE PRESENTATIONS

- [16] Mukherjee, N.^{*}, Gao, B., Shuai, P., Coon, E., Hill, D., Neilson, B. T., Cory, R. M., Kling, G. W., Chen, J., and Cardenas, M. B. (2025). *The Effects of Weather Variability on Supra-Permafrost Thermal Hydrology*. AGU Fall Meeting C32B-05, New Orleans.
- [15] Mukherjee, N.[†], Gao, B., Shuai, P., Coon, E., Hill, D., Neilson, B. T., Cory, R. M., Kling, G. W., Chen, J., and Cardenas, M. B. (2025). *Arctic Active Layers are Staying Unfrozen: 40 years of Thermal-Hydrologic Change* AGU Fall Meeting B51M-0759, New Orleans.
- [14] Hill, D.[†], Mukherjee, N., Cardenas, M. B., Gao, B., Shuai, P., Coon, E., Cory, R. M., Kling, G. W., and Neilson, B. T. (2025). *Hydrologic Observations Across the Hillslope-to-River Corridor of an Arctic Tundra Watershed*. AGU Fall Meeting, New Orleans.
- [13] Mukherjee, N.^{*}, Gao, B., Shuai, P., Coon, E., Hill, D., Neilson, B. T., Cory, R. M., Kling, G. W., Chen, J., and Cardenas, M. B. (2025). *Using a fully calibrated and validated model to unravel hidden unfrozen layers inside a frozen ground due to warming winters*. [Invited Talk]. ATS Short Course, Knoxville, Tennessee
- [12] Mukherjee, N.[†], Gao, B., Shuai, P., Coon, E., Hill, D., Neilson, B. T., Cory, R. M., Kling, G. W., Chen, J., and Cardenas, M. B. (2025). *Impacts of changing hydrologic conditions on groundwater flow and reactive solute transport in supra-permafrost aquifers* Department of Energy: Earth System Sciences PI Meeting, Reston, Virginia.
- [11] Hill, D.[†], Mukherjee, N., Neilson, B. T., Shuai, P., Cory, R. M., Kling, G. W., Gao, B., Coon, E., and Cardenas, M. B. (2025). *Hydrologic Observations Across the Hillslope-to-River Corridor of an Arctic Tundra Watershed* Department of Energy: Earth System Sciences PI Meeting, Reston, Virginia.
- [10] Cardenas, M. B., Mukherjee, N.[†], Hill, D.[†], Neilson, B. T.[†], Shuai, P., Cory, R. M., Kling, G. W.[†], Gao, B., Coon, E. (2025). *Advancing Understanding of Flow and Reactive Transport Processes Across the Hillslope-to-River Corridor of Arctic Watersheds* Department of Energy: Earth System Sciences PI Meeting, Reston, Virginia.
- [9] Mukherjee, N.^{*}, Shuai, P., Gao, B., Coon, E., Chen, J., Hill, D., Neilson, B., Kling, G.W., and Cardenas, M. B. (2024). *Investigation of groundwater flow and reactive transport in supra-permafrost aquifers*. AGU Fall Meeting C42C-04, Washington DC.
- [8] Villaruel, S.[†], Mukherjee, N., Hill, D., Cardenas, M., Shuai, P., Gao, B., Coon, E., Chen, J., Neilson, B., Kling, G.W., and Cardenas, M. B. (2024). *Hydro-stratigraphy of the active layer in riparian valley bottoms of an arctic watershed*. AGU Fall Meeting, Washington DC.
- [7] Clark, Z.[†], Chiu, C. Y.[†], Mukherjee, N., deFabry, C. M., Nachimuthu, S., Herrera, R. G., Gonzalez, R. M., Bennett, P. C., Shanahan, T. M., and Cardenas, M. B. (2024). *Characteristics of the Coastal Groundwater of Celestún, Mexico on the West Coast of the Yucatan Peninsula for Extreme Conditions During the Dry Season*. AGU Fall Meeting, Washington DC.
- [6] Mukherjee, N.^{*}, Chen, J., Neilson, B., Kling, G. W., and Cardenas, M. B. (2024). *Groundwater dominates fluxes of water and organic carbon in a permafrost watershed across hydrologic states*. Department of Energy: Earth System Sciences PI Meeting, Reston, Virginia.
- [5] Cardenas, M. B.[†], Neilson, B. T., Shuai, P., Cory, R. M., Kling, G. W., Mukherjee, N., Gao, B., and Coon, E. (2024). *Dynamics of interconnected surface-subsurface flow and reactive transport processes across the hillslope-riparian zone river corridor continuum of cold, high-latitude watersheds*. Department of Energy: Earth System Sciences PI Meeting, Reston, Virginia.

- [4] Mukherjee, N.[†], Shuai, P., Gao, B., Coon, E., Chen, J., Hill, D., Neilson, B., Kling, G.W., and Cardenas, M. B. (2023). *Investigating Groundwater Flow and Thermal Transport in Arctic Supra-Permafrost Aquifers Using Field Observation Driven Integrated Hydrologic Models*. AGU Fall Meeting C53C-1052, San Francisco, California.
- [3] Mukherjee, N.^{*}, Cardenas, M. B., Chen, J., Neilson, B., and Kling, G. W. (2022). *Supra-permafrost groundwater's contribution to stream flow and organic matter chemistry in the Arctic: estimation using combined mechanistic and statistical approaches*. AGU Fall Meeting H16G-07, Chicago, Illinois.
- [2] Keith, D. G.[†], Mukherjee, N., deFabry, C. M., Cabraal, S. A., Schmidt, L., Turetaia, A., Nguyen, W. D., Bennett, P. C., Shanahan, T. M. and Cardenas, M. B. (2022). *Hydrologic, Geophysical, and Geochemical Characterization of an Aquifer along the Beach of a Barrier Island*. AGU Fall Meeting, Chicago, Illinois.
- [1] Mukherjee, N.[†], Dhar, J., Jougnot, D., and Méheust, Y. (2021). *Characterizing Rayleigh Taylor Instability and Convection in a Porous Medium with Geoelectric Monitoring*. AGU Fall Meeting, New Orleans, Louisiana.

Talks^{*} & Posters[†]

TECHNICAL EXPERTISE

Programming: Python, C++, C, Julia, MATLAB, Shell, Jupyter Notebook, Git, GitHub, Linux, $\LaTeX$

Multiphysics Codes: Amanzi-ATS, PFLOTRAN, OpenFOAM, Basilisk, COMSOL, SolidWorks, Fluent

Data and Visualization: ArcGIS, ParaView, VisIt, Affinity Designer, Adobe Illustrator

Lab/Field Equipment: Levelloggers, Total Stations, Benchtop KSAT, Hyprop, Chemetrics, ABEM Terrameter

FIELD EXPERIENCES

2022-2026 (Total 15 weeks)	Imnavait Creek, North Slope, Alaska, USA Investigations on groundwater flow and reactive transport in supra-permafrost aquifers
2023, 2024	Austin, Texas, USA Understanding tidal response of a river to groundwater flows in Lower Colorado river
June 2024	Celestun, Mexico Groundwater survey to understand seawater-freshwater mixing along a beach
June 2024	Anillo de Cenotes, Mexico Groundwater survey to understand Karst geochemistry and hydrodynamics of seawater groundwater mixing
Dec 2019	Purulia, West Bengal, India 2-D electrical Resistivity tomography to understand confined groundwater aquifer hydrologic stratification
Dec 2018	Kharagpur, West Bengal, India Geophysical interpretation via 12 channel seismic data acquisition

TEACHING

Fall 2026, 2022	COE 301: Introduction to Computer Programming UT Austin Instructed over 150 hours of lab and in-class sessions (90 freshmen across various disciplines)
Summer 2026, 2024	GEO376L: Hydro Field Camp UT Austin Instructed 2 field classes of more than 20 students where we spent three weeks spanning Texas and Yucatan, Mexico

Fall 2024, 2023	GEO 382S: Physical Hydrology UT Austin Led graduate sessions in groundwater hydrology
Spring 2023	GEO 401: Introduction to Geology UT Austin Instructed over 150 hours of lab sessions (100 freshmen across various disciplines)

MENTORSHIP

2023 – 2024	Sydney R Villaruel	Undergraduate Student @UT Austin. Currently pursuing MS @ University of South Carolina
2022 – 2024	Chengwei Zhang	PhD Student @ UT Austin
2021 – 2023	Santhosh Virappane	Masters Student @Univ. of Alberta. Currently Scientist-Engineer @ RWDI

PROFESSIONAL SERVICE

Reviewer: Water Resources Research (2026 @3), The Cryosphere (2025 @1, 2026 @3), Catena (2025 @1), Journal of Hydrology (2025 @2), AGU Fall Meeting OSPA Judge (2023, 2024)

Conference:

2026	Primary-Convener	Neelarun Mukherjee , Xingyuan Chen, Pin Shuai, Cansu Demir. Coupled surface and subsurface flow and reactive transport across aquatic-terrestrial interfaces: Linking observations, experiments and models <i>American Geophysical Union Fall Meeting</i> , San Fransisco, CA, December 2026
2026	Student-Convener	Pin Shuai, Zhi Li, Lijing Wang, Youngjun Son, Neelarun Mukherjee . Advances in Integrated Hydrologic Modeling: Applications Across Complex Systems <i>American Geophysical Union Fall Meeting</i> , San Fransisco, CA, December 2026
2026	Student-Convener	Barret Kurylyk, Michelle Walvoord, David Rudolph, Cansu Demir, Neelarun Mukherjee , Amelia L. Grose, Jeffrey M. McKenzie. Cold-Regions Hydrology and Hydrogeology <i>GSA Connects 2026</i> , Denver, CO, October 2026
2025	Student-Convener	Barret Kurylyk, Michelle Walvoord, David Rudolph, Cansu Demir, Neelarun Mukherjee . Hydrology and hydrogeology of thawing cold regions. <i>GSA Connects 2025</i> , San Antonio, Texas. October 2025

Outreach:

May 2022	Volunteer	Kiker Elementary School, Austin, TX Created engaging and interactive modules to introduce elementary school students to basic hydrogeology
2016-2017	Community Service	National Service Scheme, Government of India Elementary maths teacher in primary school, repaired roads and organized health awareness camps in rural areas

Curriculum Vitae as of July 2026