

Neelarun Mukherjee

Department of Earth and Planetary Sciences, University of Texas at Austin.

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Curriculum Vitae as of February 2025

RESEARCH INTERESTS

My primary research focus is unraveling the complexities of flow and reactive transport within hydrological and biogeochemical processes. I aim to address the global drinking water crisis caused by groundwater contamination by developing robust models to explain complex transport phenomena in the subsurface, particularly within the vadose and critical zones. My approach integrates field, laboratory, and remote sensing data with numerical models and high-performance computing to quantify the flow and transport of heat, nutrients, and biogeochemical reactions in porous media. In addition, I investigate how hydrobiogeochemical processes respond to environmental variability through data-driven modeling.

EDUCATION

- **The University of Texas at Austin** 2021 – 2026 (expected)
Ph.D. in Hydrology GPA 3.96/4.0
Dissertation Topic: Flow and transport processes in supra-permafrost aquifers in the Arctic
Co-advisors: Dr. M. Bayani Cardenas & Dr. Jingyi Ann Chen
- **Indian Institute of Technology (IIT), Kharagpur** 2016 – 2021
M.S. and B.S. in Geophysics GPA 8.46/10.0
Micro-specialization in Fluid Mechanics and Microfluidics
Masters' 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>.
Co-advisors: Dr. Abhijit Mukherjee & Dr. Aditya Bandopadhyay

AWARDS AND SCHOLARSHIPS

- **First Place in Geoscience Hackathon on computational reproducibility** Oct, 2024
The University of Texas at Austin Austin, TX
- **Earth System Science (ESS) PI Meeting Travel Grant** Apr, 2024
Department of Energy, U.S. Federal Government Reston, VA
- **Travel Grant for Reactive Transport Workshop using PFLOTRAN** Nov, 2023
Consortium of Universities for the Advancement of Hydrologic Science, Inc Richland, WA
- **Summer Off-Campus Research Grant** May, 2023
The University of Texas at Austin Austin, TX
- **Dean's List, International Student Affairs** Jul, 2021
Indian Institute of Technology, Kharagpur Kharagpur, India
- **Prof. Supriya Mohan Sengupta Memorial Award for best Masters' Thesis** Dec, 2021
Indian Institute of Technology, Kharagpur Kharagpur, India
- **Best Undergraduate Project Award** Dec, 2021
Indian Institute of Technology, Kharagpur Kharagpur, India
- **University of Alberta Research Experience (UARE)** Jan, 2020
Department of Mechanical Engineering, University of Alberta Edmonton, Canada
- **Summer Research Scholarship** May, 2019
Centre National de la Recherche Scientifique (CNRS) Rennes, France
- **Inspire Scholarship** Mar, 2019 – May, 2021
Department of Science and Technology (DST), Government of India Kharagpur, India

PEER-REVIEWED PUBLICATIONS

- 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>
- 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). <https://doi.org/10.1063/5.0220101> [Editor's Choice]

CONFERENCE PROCEEDINGS (TALKS* & POSTERS†)

- Mukherjee, N.*, Shuai, P., Gao, B., Coon, E., Chen, J., Hill, D., Neilson, B., Kling, G.W., and Cardenas, M. B. (2024). Impacts of climate conditions on groundwater flow and reactive solute transport in supra-permafrost aquifers. *AGU Fall Meeting*, Washington DC.
- Villaruel, S. †, Mukherjee, N., Hill, D., Cardenas, M., Shuai, P., Gao, B., Coon, E., Chen, J., Hill, D., 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.
- Clark, Z. †, Chiu, C. Y., deFabry, C. M., Mukherjee, N., 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.
- 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.
- 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*, Chicago, Illinois.
- 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.
- 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.
- Mukherjee, N. †, Dhar, J., Nadal, F., Le Borgne, T., Meunier, P., and Meheust, Y. (2019) Gravitational instability and convection in a granular porous medium: pore scale experimental study and implications for solubility trapping of CO₂, *AGU Fall Meeting*, San Francisco, CA.

RESEARCH PROJECTS

- **Department of Earth and Planetary Sciences, UT Austin** Aug, 2021 – present
Graduate Research Assistant Texas, U.S.
 - Developing a process-based understanding of the flow of groundwater and reactive transport of DOC in supra-permafrost aquifers in continuous permafrost regions using a MODEX approach.
 - Developed a stochastic workflow to quantify uncertainty of water and organic carbon fluxes in permafrost watersheds across hydrologic states.
- **Department of Geology and Geophysics, IIT Kharagpur** Jul, 2018 – Aug, 2021
Undergraduate Research Assistant West Bengal, India
 - **Effect of changes in seawater head on seawater-groundwater interaction [Thesis]**
 - Understanding groundwater flow due to diurnal and seasonal head variation for pre and post-monsoon period, considering matrix compression and rebound with a coupled flow and solute transport model.
 - **Thermal Transport in Connected Aquifers**
 - Determination of mixing rate considering reactive transport of some specific elements responsible as radiogenic heat source using a coupled flow and heat transport numerical model.(PI: Dr. Saibal Gupta)
- **Department of Mechanical Engineering, University of Alberta** Nov, 2020 – Apr, 2021
Research Intern, PI: Dr. Peichun Amy Tsai Edmonton, Canada
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- **Three-dimensional Flow Field of Low-Capillary-Number Microfluidic Emulsions**
 - Numerical simulations of mass-transfer and phase change across immiscible interfaces between supercritical CO₂ using VOF in a T-Junction microfluidic channel
 - Investigation of different droplet formation pressure regimes in a T-junction microchannel
- **CNRS, UMR7619 METIS, Sorbonne Université** Apr, 2020 – Jul, 2020
 Research Intern, PI: Dr. Damien Jougnot Paris, France
 - **Numerical study of Rayleigh Taylor Instabilities in porous media with geoelectrics**
 - Developed a flow and transport solver for Rayleigh Taylor Instability in porous media
 - Coupled effective conductivity with flow and transport by current injection during instability evolution
 - Analyzed anisotropy with the change in mixing length using an inverse formulation
- **CNRS, UMR6118 Geosciences Rennes, Université de Rennes1** May, 2019 – Jul, 2019
 Research Intern, PI: Dr. Yves Meheust Rennes, France
 - **Numerical simulations and Experimental study of CO₂ sequestration in deep aquifers**
 - Designed and performed a 3D experiment for laser scanning of Rayleigh Taylor instability of miscible fluids in a porous media
 - Studied the variation of onset time and mixing length in pore scale for density-driven instability
 - Analyzed anisotropy with the change in mixing length using inverse formulation

TECHNICAL SKILLS

- **Languages:** Python, MATLAB, Shell, C++, C, FORTRAN, L^AT_EX
- **Open-source numerical codes:** Amanzi-ATS, PFLOTRAN, OpenFOAM, FEniCS
- **Other softwares:** COMSOL, SolidWorks, Fluent, ArcGIS, ParaView, Visit, Adobe Illustrator
- **Lab/Field equipments:** Levelloggers, Total Stations, Benchtop KSAT and Hyprop, Chemetrics

TEACHING/MENTORING EXPERIENCE

- **University of Texas at Austin**
 Teaching Assistant
 - **Summer 2024** Instructed a field class of 21 students (GEO376L: Hydro Field Camp) where we spent three weeks spanning Texas and Yucatan Peninsula, Mexico.
 - **Fall 2023, 2024** Assistant instructor of graduate sessions in groundwater hydrology during the absence of lead instructor Dr. M Bayani Cardenas.
 - **Spring 2023:** Instructed laboratory sections (60 freshmen across various disciplines) for GEO 401: Introduction to Geology: Over 150 hours of teaching experience
 - **Fall 2022:** Instructed laboratory sections and class (90 freshmen across various disciplines) for COE 301: Introduction to Computer Programming: Over 150 hours of teaching experience.
- **University of Texas at Austin**
 Mentorship
 - Sydney R Villaruel, Undergraduate student mentee
 - Chengwei Zhang, Grad-student mentee
- **University of Alberta**
 Mentorship
 - Santhosh Virappane, Masters student mentee

FIELD EXPERIENCES

- **North Slope, Alaska:** Understanding the flow and reactive transport in supra-permafrost aquifers in continuous permafrost aquifers.
- **Austin, Texas:** Understanding tidal response of a river to groundwater flows in Lower Colorado river.
- **Celestun, Mexico:** Groundwater survey to understand seawater-freshwater mixing along a beach.
- **Anillo de Cenotes, Mexico:** Groundwater survey to understand Karst geochemistry and hydrodynamics of seawater groundwater mixing.
- **Purulia, West Bengal:** 2-D electrical Resistivity Tomography using ABEM Terrameter.
- **Kharagpur, West Bengal:** 12 channel seismic data acquisition using sledgehammer as seismic source and McSEIS-SX 48 seismograph system for recording.
- **Kharagpur, West Bengal:** 3D radiometric nuclear prospecting.
- **Balasore and Chandipore beach, Orissa:** Coastal hydrogeology basics.

PROFESSIONAL AFFILIATIONS

- American Geophysical Union (AGU)
- Geological Society of America (GSA)

LEADERSHIP & OUTREACH

- **Kiker Elementary School** May, 2022
Community Service Austin, TX
 - Created engaging and interactive modules to introduce elementary school students to basic geology concepts, fostering active learning and hands-on exploration
- **TeamKART, Formula SAE Team, IIT Kharagpur** 2017 – 2021
Team Head, Suspension and Vehicle Dynamics West Bengal, India
 - Played a key role in designing vehicle dynamics components (suspension geometry, chassis aerodynamics) for Formula SAE car K4. The car competed in Formula Bharat 2019, showcasing expertise in optimizing performance
 - Led as the Engineer and Mentor for Formula SAE car K5, securing a commendable 10th place in Formula Bharat 2020. Demonstrated effective leadership and mentorship in competitive motorsports engineering
- **National Service Scheme, Government of India** 2016-2017
Community Service West Bengal, India
 - Participated in teaching students in rural areas, repairing roads in villages and organization of health awareness camps in rural areas