

Neelarun Mukherjee

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Curriculum Vitae as of April 2025

RESEARCH INTERESTS

My research focuses on deciphering the complexities of flow and reactive transport in subsurface hydrological and biogeochemical processes. I integrate field observations, laboratory experiments, and remote sensing data with numerical modeling and high-performance computing to quantify the movement of heat, nutrients, and biogeochemical reactions in porous media. Currently, I am investigating the intricate flow and transport dynamics in the supra-permafrost zone of the Arctic - a critical region that influences the stability of 50% of the world's soil carbon.

EDUCATION

- **The University of Texas at Austin** 2021 – 2027
Ph.D. in Hydrology GPA 3.96/4.0
Dissertation Topic: Flow and transport processes in supra-permafrost aquifers in the Arctic
Committee: Dr. M. Bayani Cardenas (Supervisor), Dr. Jingyi Ann Chen (Co-Supervisor), Dr. Dan Breecker, Dr. Pin Shuai, Dr. Ethan Coon, Dr. George W. Kling
- **Indian Institute of Technology (IIT), Kharagpur** 2016 – 2021
Integrated M.S. and B.S. in Exploration Geophysics GPA 8.46/10.0
Micro-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

AWARDS AND SCHOLASTIC ACHIEVEMENTS

- **Outstanding Student Presentation Award (OSPA)** December, 2024
American Geophysical Union (AGU) Washington DC
- **Earth System Science (ESS) PI Meeting Travel Grant** April 2024, 2025
Department of Energy, U.S. Federal Government Reston, VA
- **First Place in JSG Geoscience Hackathon on computational reproducibility** Oct, 2024
Department of Earth and Planetary Sciences, The University of Texas at Austin Austin, TX
- **Reactive Transport Workshop using PFLOTRAN Travel Grant** Nov, 2023
Consortium of Universities for the Advancement of Hydrologic Science, Inc Richland, WA
- **Jackson School of Geosciences - Off-Campus Research Grant** May, 2023
Department of Earth and Planetary Sciences, The University of Texas at Austin Austin, TX
- **Dean's List** 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) Award** Jan, 2020
Department of Mechanical Engineering, University of Alberta Edmonton, Canada
- **CNRS Summer Research Scholarship** May, 2019
Centre National de la Recherche Scientifique (CNRS) Rennes, France
- **Inspire Scholarship** 2016 – 2021
Department of Science and Technology (DST), Government of India Kharagpur, India
- **Achieved a top 0.3 % rank (6,193/1,200,000) in India's Joint Entrance Examination (JEE)** 2016

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). *Editors' Choice*. <https://doi.org/10.1063/5.0220101>

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., 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.
- 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.
- **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*, San Francisco, California.
- **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 groundwater flow and DOC transport in supra-permafrost aquifers using a MODEX approach
 - Designed a stochastic workflow to quantify uncertainty in permafrost water and carbon fluxes
- **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
 - **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 a 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, Julia, C++, C, Shell, FORTRAN, \LaTeX
- **Open-source numerical codes:** Amanzi-ATS, PFLOTTRAN, OpenFOAM, Basilisk (Gerris), FEniCS
- **Other softwares:** COMSOL, SolidWorks, Fluent, ArcGIS, ParaView, Visit, FreeCAD, Affinity Designer, MS-Office
- **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 week spanning Texas and Yucatan Peninsula, Mexico
 - **Fall 2023, 2024** Led graduate sessions in groundwater hydrology, instructing in the absence of 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 for capstone project
 - Chengwei Zhang, Grad-student mentee
- **University of Alberta**
Mentorship
 - Santhosh Virappane, Masters student mentee: Resulted in a peer review paper and one masters thesis

FIELD EXPERIENCES

- **North Slope, Alaska:** Investigated groundwater flow and reactive transport in supra-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 to understand confined groundwater aquifer hydrogeologic stratification
- **Kharagpur, West Bengal:** Understanding geological features via 12 channel seismic data acquisition with point Klauder source and McSEIS-SX 48 seismograph system for recording
- **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