

Mohammad Afzal Shadab

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POSITIONS HELD

Future Faculty in the Physical Sciences Postdoctoral Fellow Departments of Civil and Environmental Engineering and Geosciences, <i>Princeton University</i>	2024- Present Princeton
Graduate Research Assistant Oden Institute for Computational Engineering and Sciences, <i>University of Texas at Austin</i>	2019-24 Austin
NASA-JPL Graduate Fellow Planetary Science Division, <i>NASA Jet Propulsion Laboratory, California Institute of Technology</i>	Summer 2023 Pasadena
NASA-JPL Graduate Fellow Earth Science Division, <i>NASA Jet Propulsion Laboratory, California Institute of Technology</i>	Spring 2022 Pasadena
MIT Visiting Graduate Student Researcher Department of Mechanical Engineering, <i>Massachusetts Institute of Technology</i>	2018-19 Cambridge
Graduate Research Assistant Dept. of Mechanical and Aerospace Engg., <i>Hong Kong University of Science and Technology</i>	2016-18 Hong Kong

EDUCATION

Doctor of Philosophy <i>Computational Science, Engineering & Mathematics</i> The University of Texas at Austin, United States <i>Title:</i> Modeling Subsurface Flow of Water in Earth and Planetary Sciences <i>Advisor:</i> Dr. Marc Hesse, Professor of Earth and Planetary Sciences	2024
Master of Science <i>Computational Science, Engineering & Mathematics</i> The University of Texas at Austin, United States <i>Advisor:</i> Dr. Marc Hesse, Professor of Earth and Planetary Sciences	2021 GPA: 3.90/4.0
Master of Philosophy <i>Mechanical Engineering</i> The Hong Kong University of Science and Technology <i>Thesis:</i> Fifth-Order Finite Volume WENO in General Orthogonally-Curvilinear Coordinates 📄 <i>Advisor:</i> Dr. Kun Xu, Chair Professor of Mathematics and Mechanical & Aerospace Engg.	2018 GPA: 4.0(A)/4.3(A+)
Bachelor of Technology <i>Mechanical Engineering</i> Aligarh Muslim University, India	2016 GPA: 9.62/10.0

GRANTS

How Earth's Ocean World informs other Ocean Worlds? Leveraging scientific discoveries from the International Ocean Discovery Program (Pending) - NASA ROSES'24 Interdisciplinary Consortia for Astrobiology Research Co-I (leading the geophysical modeling team) - \$449,288 to PU, 7/2025-7/2030
Sustaining the Community Firm Model - NASA ROSES'24 Support for Open-Source Tools, Frameworks, and Libraries Collaborator (implementing enthalpy formation in CFM and validating), \$0 to PU, 1/2025-1/2028
Carbon Dioxide Removal through Enhanced Rock Weathering Deployments with Smallholder Rice Paddy Farmers in India (Pending) - Milkywire Climate Transformation Fund 📄 Collaborator (on coupled hydrologic & reactive transport modeling) - \$0 to PU, 4/2025-7/2026
Oxidant Transport into Europa's Internal Ocean by Brine Migration Through the Outer Ice Shell - Research Award in Planetary Habitability by UT Center for Planetary Systems Habitability 📄 PI - \$16,425, 08/2022-12/2022


RESEARCH EXPERIENCE

Modeling and Understanding Large-Scale Integrated Soil and Firn Hydrology Princeton University Future Faculty in the Physical Sciences Postdoctoral Fellow 2024- Present

Advisor: Prof. Reed Maxwell, *Collaborator:* Prof. Howard Stone

- Learning basics of ParFlow hydrologic model, overland flow modeling, and Community Land Model.
- Analyzing effect of capillary forces on large scale hydrology using ParFlow with Community Land Model.
- Developing and implementing multidimensional melt percolation and ice layer formation in firn.
- Extending conventional vertically-integrated models for unconfined aquifers to firn aquifers using scaling analysis and solving PDEs (semi-)analytically.

Reactive Transport Modeling of Enhanced Weathering in Soils for CO₂ Removal Princeton University Research Collaborator Summer 2024- Present

Project Lead: Dr. Jacob Jordan (Mati Carbon - XPRIZE Carbon Removal Winner 2025 )

- Assisting in development of a chromatographic theory to represent transport and exchange of cation assemblages through a soil column beneath an enhanced rock weathering deployment.
- Constructed the analytic solutions for different cases involving wave propagation and coded them in Matlab.
- Validating the solutions using PHREEQC geochemical modeling software.

Modeling Subsurface Flow of Water in Earth and Planetary Sciences UT Austin Graduate Research Assistant, *Doctoral Thesis* 2019-24

Advisor: Prof. Marc Hesse

- Developed and validated a conservative finite-difference based discrete operator toolbox in Python for simulating 1D/2D two-phase flow in non-deforming porous media.
- Implemented the solver to investigate the melt percolation on ice masses and formation of ice layers.
- Formulated kinematic wave theories for infiltration in soil and firn to understand the physics of the process and compare the performance & improve existing models.

Vadose Zone and Groundwater Hydrology on Early Mars UT Austin Collaborative Research 2020- Present

Collaborators: Eric Hiatt, Dr. Rickbir Bahia (ESA), Dr. Eleni Bohacek (ESA), and Prof. Marc Hesse

- Utilized kinematic wave infiltration theory to study infiltration into Martian regolith to investigate its effects on surface geomorphological & water budget evolutions, and estimate water residence times in vadose zone.
- Developed theoretical groundwater (GW) model for deep crustal aquifer on a spherical shell with vertical heterogeneity and estimated GW residence times.
- Assisted ESA collaborators implement infiltration process in Martian aeolian-fluvial interaction (MAFI) model.

Improving the Numerical Toolset for Geodynamics of Icy Oceans World Jet Propulsion Lab NASA Jet Propulsion Lab Graduate Fellow Summer 2023

Advisor: Dr. Steven Vance

- Developed multidimensional model and code for single phase flow in viscously compacting matrix, i.e., convecting ice sheet with pore fluid, in cylindrical coordinates.
- Implemented tracers to track organics during melt migration across ice shells of icy ocean worlds.
- Formulated a theoretical model for calculating time scales of melt migration & validated with simulations.

Modeling Meltwater Percolation in Greenland's Firn Jet Propulsion Lab NASA Jet Propulsion Lab Graduate Fellow Spring 2022

Advisor: Dr. Surendra Adhikari

- Developed a three-phase (snow / water / air) firn hydrology simulator in 1D.
- Derived and validated vertically integrated model for meltwater gravity currents without phase change.
- Estimated field parameters using kinematic wave theory and investigated meltwater infiltration in Greenland.

Investigating Groundwater Flows using Physics Informed Neural Networks UT Austin Collaborative Research 2020-23

Collaborators: DingCheng Luo, Yiran Shen, Eric Hiatt, and Prof. Marc Hesse

- Wrote python codes for data-driven discovery of steady-state PDE from experimental data.
- Investigated the effect of PDE regularization in PINNs and the role of PDE & data misfit.

- Learned the PDE model parameters and boundary conditions for the transient seepage across edge of a porous reservoir simulated using finite-element method based model (FEniCS).

Free Fall of a Viscous Drop in a Viscoelastic Medium

Massachusetts Institute of Technology
2018-19

Visiting Graduate Student Researcher

Advisor: Prof. Irmgard Bischofberger

- Performed a rheological characterization of viscoelastic polymers to estimate their Deborah numbers.
- Designed the drop dynamics experiments and apparatus with high-speed imaging.
- Wrote Matlab scripts for analyzing moving camera videos without fixed reference using template matching.

High-Order Finite-Volume Methods in Curvilinear Coordinates

HKUST, Hong Kong
2016-18

Graduate Research Assistant, *M.Phil. Thesis*

Advisor: Prof. Kun Xu

- Proposed a high order finite volume spatial reconstruction technique in curvilinear coordinates.
- Derived analytical relations, implemented in CFD codes and validated fifth order of spatial accuracy.

Low Order Model Development of a Thermoacoustic System

HKUST, Hong Kong
Fall 2016

Collaborative Research

Collaborators: Prof. Peter Schmid (Imperial), Prof. Simone Hochreß (Cambridge), Prof. Larry Li

- Analyzed and compared the prominent modal decomposition techniques such as POD, DMD and FFT.
- Investigated the interaction between flame & external acoustic forcing with variable amplitudes & frequencies.

TEACHING EXPERIENCE

Wintersession 2025 Analyzing Remote Sensing Data with QGIS (Undergrad/Graduate)

Winter 2025
Princeton

Princeton University

Position: Instructor

Responsibilities: Developed course content and conducted a hands-on Wintersession on fundamentals of QGIS, remote sensing, and data visualization

GEO 325C/398C Continuum Mechanics (Graduate)

Fall 2022, 2023
Austin

University of Texas at Austin

Position: Teaching Assistant, Instructor: Prof. Marc Hesse

Responsibilities: Taught tutorial lectures, clarified concepts on Piazza, evaluated assignments

GEO 325M/398M Numerical Modeling in the Geosciences (Graduate)

Spring 2023
Austin

University of Texas at Austin

Position: Teaching Assistant, Instructor: Prof. Marc Hesse

Responsibilities: Conducted tutorials and coding exercises, resolved coding/conceptual issues

SIAM Applied Mathematics Mentorship Program Lectures (Undergrad/Graduate)

Fall 2022
Austin

University of Texas at Austin

Position: Instructor

Responsibilities: Designed and conducted lectures such as Intro to \LaTeX (, )

MECH 1907 Introduction to Aerospace Engineering (Freshman, Sophomore)

Spring 2018
Hong Kong

The Hong Kong University of Science and Technology

Position: Teaching Assistant, Instructor: Prof. Rhea Liem

Responsibilities: Designed & evaluated exams & HWs, taught tutorial and two class lectures

MECH 3690 Aerospace Engineering Laboratory (Senior, Junior)

Spring 2017
Hong Kong



The Hong Kong University of Science and Technology

Position: Teaching Assistant, Instructor: Prof. Jinglei Yang

Responsibilities: Taught multiple class lectures and lab briefings, contributed to lab manual

For all teaching feedback reports and certificates, click .

PEDAGOGICAL TRAINING

Teaching Transcript Program 	Fall 2024 – Present Princeton University Workshops and discussions on teaching and academic careers, and teaching observations.
Inclusive Course Design Institute 2023 	Summer 2023 The University of Texas at Austin Designed a course from ground up using Universal Design for Learning (UDL) and best practices.
Inclusive Classrooms Leadership Certificate Seminar Series	Spring 2023 The University of Texas at Austin Learned strategies for developing and sustaining an inclusive classroom along with course design.
Advanced Teaching Preparation Series Certificate	Spring, Fall 2022 The University of Texas at Austin Learned and practiced techniques of good classroom teaching.
Graduate Teaching Assistant Training Program	2017-18 The Hong Kong University of Science and Technology Learned the fundamentals of teaching assistantship and effective pedagogy.

SKILLS

Languages: C, C++, Fortran 77/90, Python (SciPy, NumPy, Matplotlib, Pandas, Pytorch, Tkinter, Tensorflow, GUI programming, Webscraping), HTML, Matlab, Mathematica, Shell Scripting, \LaTeX , High Performance Computing (SLURM), FEniCS






General Software: AutoCAD, SolidWorks, ANSYS, Fluent, COMSOL Multiphysics, TecPlot, ParaView, Microsoft Office, Git, Travis CI, Docker

Geoscience Software: Hydrus, VPLANet, QGIS, QGreenland, ENVI, PlanetProfile, PHREEQC, ParFlow, CLM

OS: Linux, Windows, Mac

HONORS AND AWARDS

Princeton University Future Faculty in the Physical Sciences Fellowship 	2024-27 A postdoctoral fellowship to increase research excellence and faculty diversity
NASA Open Science Badge 	2024 Completed five modules on open science including tools offered by NASA TOPS Program  .
AGU Cryosphere Innovation Award / Flash Freeze Competition Winner 	2023 Awarded based on a two-minute pitch of innovative idea to a panel of five judges at AGU 2023.
UT Austin Graduate School Summer Fellowship 	Summer 2024 Awarded summary salary and tuition based on academic standing and research experience.
UT Austin Graduate School Spring Dissertation Writing Fellowship 	Spring 2024 Received spring semester salary and tuition for academic and research excellence.
NASA Jet Propulsion Laboratory Graduate Fellowship 	Summer 2023 To investigate life-supporting conditions on Europa with Dr. Steve Vance at JPL.
Purdue Climate Scholar by Purdue University and Office of Naval Research 	Summer 2022 To attend Summer Institute for Sustainability & Climate Change at Purdue University.
NASA Jet Propulsion Laboratory Graduate Fellowship 	Spring 2022 To study effect of climate change on Greenland ice sheet with Dr. Surendra Adhikari at JPL.
MIT - Houston Energy Innovation Student Fellow 	2022-23 Representing UT Austin as a liaison between MIT's Martin Trust Center and Greentown Labs.
Lunar and Planetary Institute Career Development Award 	2022 For first author abstract and application materials submitted at LPSC 2022.

UT Austin Cactus Standout Award 	2022
For academic excellence and leadership contributions. Inducted into UT Annual Yearbook 2022.	
Outstanding Student Presenters Award by Unsaturated Zone Technical Committee, AGU 	2021
For oral presentation: <i>H52D-10 Rainwater Infiltration</i> at AGU Fall Meeting 2021. 	
Blue Sky Student Fellowship by University of Texas Institute for Geophysics	2021-22
Year-long fellowship covering tuition, insurance & stipend awarded for research proposal.	
Certificate of Recognition by Society for Industrial and Applied Mathematics	2021
For outstanding service and contributions to the UT Austin Student Chapter of SIAM.	
Best Teaching Assistant Award by Dept of Mech & Aero Engg, HKUST	2018
Awarded for <i>MECH-1907 Introduction to Aerospace Engineering</i> course.	
Judge's Award and Audience Award at MIT MEMSI Program	2018
Awarded by MIT and Hong Kong Innovation Node for best startup idea & pitch in the program.	
Recognitions in Reviewing	2018, 2023
Outstanding Contribution in Reviewing Recognition by <i>Journal of Computational Physics</i> . Mentioned in <i>Geophysical Research Letters</i>  , <i>Journal of Geophysical Research - Planets</i> 	
Postgraduate Studentship by HKUST	2016-18
Competitive stipend for research postgraduate students (M.Phil.) at HKUST.	
Global Scholar Award by Sir Syed Education Society of North America	2015
For top 20 students of AMU based on their academic achievements and research, for higher education.	
National Summer Research Fellowship by Indian Academy of Sciences	Summer 2015
Awarded national fellowship to pursue research in Indian research institutes like IITs/IISc.	
University Merit Scholarship by AMU Alumni Association Toronto, Canada	2015
Merit based scholarship for students pursuing education at AMU.	

TRAVEL GRANTS AND FUNDED SHORT SCHOOLS

AGU Cryosphere Section Student Travel Grant for Diversity (CryoStuD) 	2024
Travel grant for uplifting traditionally marginalized scientists to present research at AGU'24.	
Center for Planetary Systems' Habitability Student Travel Award	2022, 2023, 2024
Awarded a travel grant to attend the LPSC.	
UT Austin Professional Development Awards 	2022, 2024
For presenting two research works conducted at UT Austin.	
Early Career Travel Award by European Space Agency	2023
Received a travel award to attend the FAIRPLAY 2023 Workshop in the Netherlands.	
Early Career Tiny Grants - AGU Ecohydrology Committee	2022
For early-career scientists presenting ecohydrology-related work at the AGU Fall Meeting 2022.	
SIAM Student Travel Award	2021
Awarded a student travel grant by SIAM to attend the SIAM Annual Meeting 2021.	
ICOSAHOM Conference Travel Grant	2018
Awarded a student travel grant to attend the International Conference on Spectral And High Order Methods at Imperial College London.	
Numerical Simulations ICNM 2017 Conference Travel Grant	2017
Awarded full funding for attending the 5th International Conference on Numerical Simulations for Multimaterial and Multiphysics Problems in China.	
Advanced Research in Turbomachinery Summer School Grant	Summer 2019
Received a scholarship to attend this summer school organized by the University of Florence, Italy and sponsored by ANSYS and GE.	

MIT StartMIT Course Grant	Winter 2019
Received full sponsorship from MIT Martin Trust Center for this course on entrepreneurship.	
Fluid Dynamics across Scales Summer School Grant	Summer 2018
Received funding to participate in the Centre for Doctoral Training in Fluid Dynamics across Scales at Imperial College London.	
MIT Entrepreneurship and Maker Skills Integrator Bootcamp Funding	Summer 2018
Received full funding from MIT and Hong Kong Innovation Node to attend the program.	

INVITED TALKS AND SEMINARS

- [11] April 2025: NASA Jet Propulsion Laboratory, *Earth Science Division Seminar*
- [10] April 2025: Princeton University, *Solid Earth Geosciences Brown Bag Seminar* 
- [9] April 2024: Mathematics on Ice Forum 
- [8] Jan 2024: California Institute of Technology - *Graduate Aerospace Laboratories (GALCIT) and Fu Research Group*
- [7] Oct 2023: The University of Texas at Austin - *Center for Planetary Systems Habitability*
- [6] Sept 2023: The University of Texas Institute for Geophysics
- [5] August 2023: NASA Jet Propulsion Laboratory, *Planetary Science Division Seminar*
- [4] June 2022: NASA Jet Propulsion Laboratory, *Earth Science Division Seminar*
- [3] June 2022: California Institute of Technology, *Fu Research Group*
- [2] May 2017: 5th International Conference on Numerical Simulation for Multimaterial and Multiphysics Problems
- [1] 2016-2017: The Hong Kong University of Science and Technology - *Aeronautics Interest Group (AIG)*

PEER REVIEWED PUBLICATIONS


- [13] **Shadab, M.A.**, Rutishauser, A., Grima, C. and Hesse, M.A., 2025. A unified kinematic wave theory for melt infiltration into firn. arXiv:2403.15996. (In press in *Journal of Glaciology*).
- [12] **Shadab, M.A.**, Hiatt, E., Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 2025. Infiltration dynamics on early Mars: Geomorphic, climatic, and water storage implications, *Geophysical Research Letters*, 52, e2024GL111939, 11+12pp.
<https://doi.org/10.1029/2024GL111939>
- [11] Barnes, R., ... **Shadab, M.A.**, ..., 2025. History and habitability of the LP 890-9 planetary system, *The Planetary Science Journal*, 6(1), p.25, 13pp.
<https://www.doi.org/10.3847/PSJ/ad94dc>
- [10] Vanek, S., ..., **Shadab, M.A.**, ..., 2024. Exploring the past, present, and future of USAPECS: Lessons from a decade of supporting early career research across national and international polar networks. *Arctic Yearbook*, 14pp.
<https://arcticyearbook.com/>
- [9] **Shadab, M.A.**, Adhikari, S., Rutishauser, A., Grima, C. and Hesse, M.A., 2024. A mechanism for ice layer formation in glacial firn. *Geophysical Research Letters*, 51(15), p.e2024GL109893, 12+37pp.
<https://doi.org/10.1029/2024GL109893>
- [8] **Shadab, M.A.** and Hesse, M.A., 2024. A hyperbolic-elliptic PDE model and conservative numerical method for gravity-dominated variably-saturated groundwater flow. *Advances in Water Resources*, p.104736, 17pp.
<https://doi.org/10.1016/j.advwatres.2024.104736>
- [7] Hiatt, E. **Shadab, M.A.**, Hesse, M., Goudge, T., Gulick, S., 2024. Limited recharge of the southern highlands aquifer on early Mars, *Icarus*, 408, p.115774, 10+16pp.
<https://doi.org/10.1016/j.icarus.2023.115774>

- [6] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. PKgui: A GUI software for Polubarinova-Kochina's solutions of steady unconfined groundwater flow, *SoftwareX*, 24, p.101573, 5+5pp.
<https://doi.org/10.1016/j.softx.2023.101573>
- [5] **Shadab, M.A.**, Luo, D., Hiatt, E., Hiatt, E. and Hesse, M.A., 2023. Investigating steady unconfined groundwater flow using physics informed neural networks, *Advances in Water Resources*, 177, p.104445, 16+18pp.
<https://doi.org/10.1016/j.advwatres.2023.104445>
- [4] **Shadab, M.A.** and Hesse, M.A., 2022. Analysis of gravity-driven infiltration with the development of a saturated region, *Water Resources Research*, 58(11), p.e2022WR032963, 27pp.
<https://doi.org/10.1029/2022WR032963>
- [3] **Shadab, M.A.**, Balsara, D., Shyy, W. and Xu, K., 2019. Fifth-order finite volume WENO in general orthogonally - curvilinear coordinates. *Computers & Fluids*, 190, 26pp.
<https://doi.org/10.1016/j.compfluid.2019.06.031>
- [2] **Shadab, M.A.**, Ji, X. and Xu, K., 2018. Fifth-order finite volume WENO on cylindrical grids. *Spectral and High Order Methods for Partial Differential Equations (Springer)*, 10pp.
https://doi.org/10.1007/978-3-030-39647-3_51
- [1] **Shadab, M.A.** and Baig, M.F., 2017. Investigation and control of unstart phenomenon in scramjets. In *21st AIAA International Space Planes and Hypersonics Technologies Conference* (p. 2298), 16pp.
<https://doi.org/10.2514/6.2017-2298>

UNDER REVIEW

- [1] **Shadab, M.A.**, Vance, S.D., Silber, E A., Crósta, A.P., Carnahan, E., Jordan, J.S., Hesse, M.A., 202X. Rapid migration of impact melt through ocean world ices: Selk crater on Titan and Mannann'an crater on Europa. (Under review in *Earth and Planetary Science Letters*)

IN PREPARATION

- [8] **Shadab, M.A.** and Maxwell, R.M., 202X. Effects of soil capillarity on multidimensional, integrated surface-subsurface hydrology at different spatial scales. (for *Water Resources Research*)
- [7] **Shadab, M.A.**, Stone, H.A., and Maxwell, R.M., 202X. Heat advection dominated gravity currents in cold firn. (for *Journal of Fluid Mechanics*)
- [6] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 202X. Analytical solutions of a low-aspect-ratio unconfined aquifer on a spherical shell: Application to early Mars. (for *Journal of Geophysical Research - Planets*)
- [5] **Shadab, M.A.** and Hesse, M.A., 202X. An open source discrete operator toolbox (DOT) to solve geophysical flow problems. (for *Geoscientific Model Development*)
- [4] Hiatt, E. **Shadab, M.A.**, Hesse, M., Goudge, T., Gulick, S., 202X. Transient groundwater models suggest short lived recharge events on early Mars. (for *Nature Geoscience*)
- [3] Hiatt, E. **Shadab, M.A.**, 202X. Experimental and numerical investigations of seepage face dynamics: A physics solution. (for *Journal of Fluid Mechanics*)
- [2] Jordan, J.S., **Shadab, M.A.**, et al., 202X. On the storage and transport of anthropogenic alkalinity in porous media: Soil as a chromatographic column, (for *American Journal of Science*)
- [1] Hesse, M.A. and **Shadab, M.A.**, 202X. Numerical modeling for geoscientists. (book draft )

EXTENDED CONFERENCE ABSTRACTS

- [11] Hiatt, E., **Shadab, M.A.** et al., 2025. Transient Groundwater Recharge of Early Mars' Groundwater Systems & Subsequent Climate Constraints *56th Lunar and Planetary Science Conference*, #2629, 2pp.
- [10] **Shadab, M.A.** et al., 2024. Evolution of impact generated melt at Selk crater: Effect of phase change, percolation, and viscous foundering. *55th Lunar and Planetary Science Conference*, #1317, 2pp.

- [9] **Shadab, M.A.** et al., 2024. Infiltration on early Mars & its implications toward aeolian-fluvial interactions. *55th Lunar and Planetary Science Conference*, #1383, 2pp.
- [8] Hiatt, E., **Shadab, M.A.**, Gulick, S.P.S., Goudge, T. and Hesse, M.A., 2024. Martian lakes: a critical requirement for transient groundwater models. *55th Lunar and Planetary Science Conference*, #2408, 2pp.
- [7] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. A deep crustal aquifer model for southern highlands of Noachian Mars shows groundwater age and near-surface dynamics. *NASA Exploration Science Forum*, 2pp.
- [6] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. A deep crustal aquifer model for southern highlands of Noachian Mars shows groundwater age and near-surface dynamics. *Brines Across the Solar System: Ancient and Future Brines Conference*, #2025, 2pp.
- [5] **Shadab, M.A.**, Hiatt, E. and Hesse, M.A., 2023. Investigating groundwater dynamics and residence times on early Mars using unconfined aquifer model with vertical heterogeneity. *54th Lunar and Planetary Science Conference*, #1736, 2pp.
- [4] Hesse, M.A., **Shadab, M.A.** and Hiatt, E., 2023. Time scales for terminal groundwater drainage from the southern highlands on Mars. *54th Lunar and Planetary Science Conference*, #1637, 2pp.
- [3] Hiatt, E., **Shadab, M.A.** and Hesse, M.A., 2023. Planetary scale groundwater and surface water interaction on early Mars. *54th Lunar and Planetary Science Conference*, #2415, 2pp.
- [2] **Shadab, M.A.**, Hiatt, E., and Hesse, M.A., 2022. Estimates of Martian mean recharge rates from analytic groundwater models. *53rd Lunar and Planetary Science Conference*, #1775, 2pp.
- [1] Hiatt, E., **Shadab, M.A.**, Gulick, S.P.S., Hesse, M.A., Goudge, T. and Hesse 2022. Estimates of groundwater divides and basins on Noachian Mars. *53rd Lunar and Planetary Science Conference*, #2618, 2pp.

SELECTED CONFERENCE TALKS

- [8] **Shadab, M.A.** et al., 2024. Multi-scale multi dimensional infiltration in glacial firn and mechanism of ice layer and chunk formation, *AGU Fall Meeting*.
- [7] **Shadab, M.A.** et al., 2024. Dynamics of Infiltration on Early Mars, *AGU Fall Meeting*.
- [6] **Shadab, M.A.** et al., 2023. Mechanism & factors controlling ice layer formation in glacial firn, *AGU Fall Meeting*.
- [5] **Shadab, M.A.** et al., 2023. A unified kinematic wave theory for melt infiltration into firn, *AGU Fall Meeting*.
- [4] **Shadab, M.A.** et al., 2023. Infiltration on early Mars and its implications toward aeolian-fluvial interactions, *Fluvial-Aeolian Interactions on Planetary Surfaces (FAIRPLAY)*, *European Space Agency*.
- [3] **Shadab, M.A.**, and Hesse, M.A., 2022. Extending Richards equation to simulate variably saturated flows, *AGU Fall Meeting*.
- [2] **Shadab, M.A.**, and Hesse, M.A., 2021. Fluid infiltration in unsaturated porous medium with the development of a saturated region, *AGU Fall Meeting*.
- [1] **Shadab, M.A.** et al., 2021. Investigating fluid drainage from the edge of a porous reservoir using physics informed neural networks, *SIAM Annual Meeting*.

OPEN SOURCE SOFTWARE

- [6] **Shadab, M.A.** et al., 2024. mashadab/ice-layer-formation: v1.0.0, Zenodo.
<https://doi.org/10.5281/zenodo.12706191>
- [5] **Shadab, M.A.** and Hesse, M. A., 2024. mashadab/VarSatFlow: v1.0 (v1.0), Zenodo.
<https://doi.org/10.5281/zenodo.11398273>
- [4] **Shadab, M.A.** et al., 2023. mashadab/PKgui (v1.0.1), Zenodo.
<https://doi.org/10.5281/zenodo.8034146>
- [3] **Shadab, M.A.** et al., 2021. PINNs for unconfined groundwater flow (v1.0), Zenodo.
<https://doi.org/10.5281/zenodo.5803542>

- [2] **Shadab, M.A.** and Hesse, M.A., 2022. Gravity driven infiltration with the development of a saturated region (v1.0), Zenodo. <https://doi.org/10.5281/zenodo.6558260>
- [1] **Shadab, M.A.**, 2021. Reservoir-Simulator, Zenodo. <https://doi.org/10.5281/zenodo.6581752>

REVIEWER

Geoscience: Computational Geoscience, Water Resources Research, Geophysical Research Lett., J. of Geophysical Research, Biosystems Engineering, J. of Hydrometeorology
Numerical Methods: Journal of Computational Physics, Geoscientific Model Development, Computer and Fluids, Engineering with Computers, SoftwareX

SERVICE

AGU25 Sessions' Early Career Convener, Four Sessions 	2025
Convening C040 - <i>Cryosphere Is for All</i> , P041 - <i>The New Mars Underground VIII</i> , C040 - <i>The End of The Golden Era of Polar Science in the US?</i> , U014 - <i>Navigating Broader Impacts in Current Political Climate</i>	
Mentor, Interagency Arctic Research Policy Committee Mentorship program 	2024-25
Providing career counseling and skills training.	Virtual
AGU24 Sessions' Convener and OSPA Liaison and Judge, Three Sessions 	2024
Designing oral/poster/e-lightening sessions with AGU Cryo team titled C24A/C41C/C43C <i>The Cryosphere Is for All: Overcoming Barriers to Participation in the Cryospheric Sciences</i> at AGU24.	
Executive Secretary and/or Reviewer, Seven NASA ROSES Review Panels 	2023- Present
Managed panel reviews or reviewed proposals in panels, receiving honorariums	
Executive Committee Member, AGU Cryosphere Division 	2024- Present
Serving in the Diversity, Equity, and Inclusion (DEI) and Canvassing Working groups.	Virtual
Judge, AGU Fall Meeting Travel Award 	Fall 2024
Reviewed cryosphere division related applications for AGU 2024 from around the world.	Virtual
Judge, International Mission to Mars Engineering Design Contest 	Summer 2024
Organized by Mars Society for high school students from around the world.	Virtual
Young Professional Mentor, Zed Factor Fellowship Program 	2023-24
Mentor rising undergraduate students in aerospace engineering.	Virtual
Team Member, UT Austin Libraries HELIOS team 	2023-24
To advance Higher Education Leadership Initiative for Open Scholarship (HELIOS). Gave a speech at <i>US White House</i> Listening Sessions on Open Science (News  , Post  , Video ). Panelist at multiple open science events , ,  .	Austin
Co-Chair & DEI Team Lead, US Assoc. of Polar Early Career Scientists 	2022- Present
Fostering climate and DEI-conscious collaborations between academia & polar organizations.	Virtual
Board Member, AGU Hydrology Section Student Subcommittee (AGU-H3S) 	2023- Present
Providing professional development & networking opportunities to early career hydrologists.	Virtual
Volunteer, MIT Energy Conference 	2023
Assisted in organizing in-person sessions at the conference.	Boston
Coordinator, Center for Planetary Systems Habitability Student Travel Award 	Spring 2023
Organized, coordinated and liaised the application process for student travel to LPSC 2023.	Austin
MIT - Houston Energy Innovation Student Fellow 	2022-23
Cultivated & supported energy innovation startup ecosystem considering threat of climate change.	Austin
Volunteer / Braindate Lounge Assistant, AGU Fall Meeting 2022 	2022
Facilitated collaborations between researchers and scientists through Braindate at AGU 2022.	San Francisco
Mentor, American Geophys. Union Earth & Planetary Surface Processes (EPSP) 	2022- Present
Mentoring graduate students across the world to develop technical and research skills in EPSP.	Virtual

Geoscience Ambassador, Jackson School of Geosciences, UT Austin ↗	2021-22
Making geoscience accessible to broader community & promoting interdisciplinary research.	Austin
Session Chair, Society for Industrial & Applied Mathematics Annual Meeting ↗	2021
Chaired the <i>CP15: Machine Learning and Data Mining</i> Session.	Virtual
President & Senior Advisor, SIAM Chapter of UT Austin ↗	2020-23
Spearheaded several programs & won Best Graduate Organization at UT Austin Award.	Austin
Mentor, Mentoring365, American Geophysical Union ↗	2021- Present
Facilitating an exchange of professional knowledge, skills, and experiences in Earth and space sciences.	Virtual
Mentor, SIAM Applied Mathematics Mentorship ↗	2021-23
Conceptualized the program and mentoring UT students for applied math concepts and prospects.	Austin
Volunteer, Lunar and Planetary Science Conference 2022 ↗	2021
Managed a virtual and an in-person session and moreover conference logistical tasks.	Houston
Mentor, Sir Syed Global Scholar Award ↗	2016- Present
Mentoring top AMU students from humble backgrounds for US grad school applications.	Virtual
Zonal Head & College Head Ambassador, Smilyo Educational Charitable Society ↗	2014-15
Managed multi-university teams & provided educational resources to not-so-privileged.	New Delhi, India

MEDIA COVERAGE

\$50 million XPRIZE carbon removal awarded to Mati - Time ↗ , Washington Post ↗ , AP news ↗	2025
On carbon removal work using enhanced rock weathering led by Mati Carbon (XPRIZE website ↗).	
Is Mars Storing its Water Underground? - Universe Today ↗ , SciTech Daily ↗ , Astrobiology ↗	2025
Article on the work on infiltration on Early Mars.	
Grad students find missing link in early Martian water cycle - UT ↗ , AAAS ↗ , Phys.org ↗	2025
For the collaborative research on Infiltration on early Mars done in collaboration with ESA.	
Understanding ice layer formation to estimate sea level rise - UT ↗ , AAAS ↗ , Phys.org ↗	2024
For the thesis work on understanding ice layer formation done in collaboration with NASA-JPL.	
Little groundwater recharge in ancient Mars aquifer - UT ↗ , EurekAlert ↗ , AAAS ↗ , Phys.org ↗	2024
For the collaborative work with Eric Hiatt on water on early Mars.	
Fulfilling my NASA dream - Sir Syed Global Scholar Award Story of the Month ↗	2022
On my post-baccalaureate experience towards landing a graduate fellowship at NASA JPL.	
Mars may have less water than previously estimated - Multiple news outlets	2022
UT Austin Website (front cover) ↗ , ↗ & ↗ , Phys.org ↗ , Times of India ↗ , Bailey Universe ↗	
Outstanding Student Presentation Award at AGU 2021 - UT Austin ↗	2022
For outstanding student presentation on Rainwater Infiltration in AGU Fall Meeting 2021.	
CPSH Travel Grant sends 11 students to LPSC - UT Austin ↗	2022
For travel grant from Center for Planetary Systems Habitability to attend LPSC 2022.	
Lunar & Planetary Institute Career Devel. Award News - UT Austin ↗ , LPI News ↗	2022
For outstanding first-authored work on fate of water on early Mars at LPSC conference.	
How to stay productive while in quarantine - Oden Institute Feature Article ↗	2021
For academic & research achievements and service at Oden Institute during quarantine.	

MEMBERSHIPS

American Geophysical Union
 International Glaciological Society
 Association of Polar Early Career Scientists
 Society for Industrial and Applied Mathematics
 American Physical Society