

# Mohammad Afzal Shadab

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## POSITIONS HELD

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

## EDUCATION

<b>Doctor of Philosophy</b>   <i>Computational Science, Engineering &amp; 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
<b>Master of Science</b>   <i>Computational Science, Engineering &amp; 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
<b>Master of Philosophy</b>   <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+)
<b>Bachelor of Technology</b>   <i>Mechanical Engineering</i> Aligarh Muslim University, India	2016 GPA: 9.62/10.0

## GRANTS

<b>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</b> Co-I (leading the geophysical modeling team) - \$449,288 to PU, 7/2025-7/2030
<b>Sustaining the Community Firm Model - NASA ROSES'24 Support for Open-Source Tools, Frameworks, and Libraries</b> Collaborator (implementing enthalpy formation in CFM and validating), \$0 to PU, 1/2025-1/2028
<b>Carbon Dioxide Removal through Enhanced Rock Weathering Deployments with Smallholder Rice Paddy Farmers in India (Pending) - Milkywire Climate Transformation Fund</b> 📄 Collaborator (on coupled hydrologic & reactive transport modeling) - \$0 to PU, 4/2025-7/2026
<b>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</b> 📄 PI - \$16,425, 08/2022-12/2022

## RESEARCH EXPERIENCE

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**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

- 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 CO<sub>2</sub> Removal** Princeton University  
Collaborative Research Summer 2024- Present  
*Collaborators:* Dr. Jacob Jordan (Mati), Prof. V. Prigiobbe (U. Padua), Prof. N. Planavsky (Yale)

- 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.

### **Modal Decomposition Techniques on 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 for developing low order models.
- 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

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

## SKILLS

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**Languages:** C, C++, Fortran 77/90, Python (SciPy, NumPy, Matplotlib, Pandas, Pytorch, Tkinter, Tensorflow, GUI programming, Webscraping), HTML, Matlab, Mathematica, Shell Scripting,  $\text{\LaTeX}$ , 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

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

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

## TRAVEL GRANTS AND FUNDED SHORT SCHOOLS

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

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

## INVITED TALKS AND SEMINARS

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- [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

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- [12] **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*).
- [11] **Shadab, M.A.**, Hiatt, E., Bahia, R.S., Bohacek, E.V., Steinmann, V. and Hesse, M.A., 2025. Infiltration dynamics on early Mars: Geomorphic, climactic, and water storage implications, *Geophysical Research Letters*, 52, e2024GL111939, 11+12pp. (In press)  
<https://doi.org/10.1029/2024GL111939>
- [10] 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>
- [9] 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/>
- [8] **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>
- [7] **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>
- [6] 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>

- [5] **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>
- [4] **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>
- [3] **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>
- [2] **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>
- [1] **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](https://doi.org/10.1007/978-3-030-39647-3_51)


## UNDER REVIEW

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- [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

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- [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

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- [12] 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.
- [11] **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.
- [10] **Shadab, M.A.** et al., 2024. Infiltration on early Mars & its implications toward aeolian-fluvial interactions. *55th Lunar and Planetary Science Conference*, #1383, 2pp.
- [9] 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.

- [8] **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.
- [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. *Brines Across the Solar System: Ancient and Future Brines Conference*, #2025, 2pp.
- [6] **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.
- [5] 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.
- [4] 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.
- [3] **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.
- [2] 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.
- [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>

## SELECTED CONFERENCE TALKS

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- [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

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- [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

## SERVICE

<b>Mentor, Interagency Arctic Research Policy Committee Mentorship program</b> 	2024-25
Providing career counseling and skills training.	Virtual
<b>AGU24 Sessions' Convener and OSPA Liaison and Judge, Three Sessions</b> 	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.	
<b>Executive Secretary and/or Reviewer, Seven NASA ROSES Review Panels</b> 	2023- Present
Managed panel reviews or reviewed proposals in panels, receiving honorariums	
<b>Executive Committee Member, AGU Cryosphere Division</b> 	2024- Present
Serving in the Diversity, Equity, and Inclusion (DEI) and Canvassing Working groups.	Virtual
<b>Judge, AGU Fall Meeting Travel Award</b> 	Fall 2024
Reviewed cryosphere division related applications for AGU 2024 from around the world.	Virtual
<b>Judge, International Mission to Mars Engineering Design Contest</b> 	Summer 2024
Organized by Mars Society for high school students from around the world.	Virtual
<b>Young Professional Mentor, Zed Factor Fellowship Program</b> 	2023-24
Mentor rising undergraduate students in aerospace engineering.	Virtual
<b>Team Member, UT Austin Libraries HELIOS team</b> 	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
<b>Co-Chair &amp; DEI Team Lead, US Assoc. of Polar Early Career Scientists</b> 	2022- Present
Fostering climate and DEI-conscious collaborations between academia & polar organizations.	Virtual
<b>Board Member, AGU Hydrology Section Student Subcommittee (AGU-H3S)</b> 	2023- Present
Providing professional development & networking opportunities to early career hydrologists.	Virtual
<b>Volunteer, MIT Energy Conference</b> 	2023
Assisted in organizing in-person sessions at the conference.	Boston
<b>Coordinator, Center for Planetary Systems Habitability Student Travel Award</b> 	Spring 2023
Organized, coordinated and liaised the application process for student travel to LPSC 2023.	Austin
<b>MIT - Houston Energy Innovation Student Fellow</b> 	2022-23
Cultivated & supported energy innovation startup ecosystem considering threat of climate change.	Austin
<b>Volunteer / Braindate Lounge Assistant, AGU Fall Meeting 2022</b> 	2022
Facilitated collaborations between researchers and scientists through Braindate at AGU 2022.	San Francisco
<b>Mentor, American Geophys. Union Earth &amp; Planetary Surface Processes (EPSP)</b> 	2022- Present
Mentoring graduate students across the world to develop technical and research skills in EPSP.	Virtual
<b>Geoscience Ambassador, Jackson School of Geosciences, UT Austin</b> 	2021-22
Making geoscience accessible to broader community & promoting interdisciplinary research.	Austin

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

## MEDIA COVERAGE

<b>Understanding ice layer formation to estimate sea level rise - UT</b> , <b>AAAS</b> , <b>Phys.org</b>	2024
For the thesis work on understanding ice layer formation done in collaboration with NASA-JPL.	
<b>Little groundwater recharge in ancient Mars aquifer - UT</b> , <b>EurekAlert</b> , <b>AAAS</b> , <b>Phys.org</b>	2024
For the collaborative work with Eric Hiatt on water on early Mars.	
<b>Fulfilling my NASA dream - Sir Syed Global Scholar Award Story of the Month</b>	2022
On my post-baccalaureate experience towards landing a graduate fellowship at NASA JPL.	
<b>Mars may have less water than previously estimated - Multiple news outlets</b>	2022
UT Austin Website (front cover) ,  & , Phys.org , Times of India , Bailey Universe	
<b>Outstanding Student Presentation Award at AGU 2021 - UT Austin</b>	2022
For outstanding student presentation on Rainwater Infiltration in AGU Fall Meeting 2021.	
<b>CPSH Travel Grant sends 11 students to LPSC - UT Austin</b>	2022
For travel grant from Center for Planetary Systems Habitability to attend LPSC 2022.	
<b>Lunar &amp; Planetary Institute Career Devel. Award News - UT Austin</b> , <b>LPI News</b>	2022
For outstanding first-authored work on fate of water on early Mars at LPSC conference.	
<b>How to stay productive while in quarantine - Oden Institute Feature Article</b>	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