Hamid A. Pahlavan

Rice Academy Fellow

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RESEARCH INTERESTS

My research seeks to I) expand our knowledge of the stratospheric circulations and dynamics, II) uncover a deeper understanding of atmospheric gravity waves and their interaction with the mean flow, as well as to improve their representation in the weather and climate models, and III) develop novel data-driven methods for climate analysis and modeling. The integration of outcomes from these areas is crucial for enhancing the climate change projections of future climate variability and weather extremes.

EDUCATION

University of Washington (Seattle, WA)   *2019-2022*
Ph.D. in Atmospheric Sciences: Data Science
Advisors: Profs. John M. Wallace & Qiang Fu
Thesis: The QBO Dynamics and Gravity Waves Characteristics as Seen in ERA5 Reanalysis

University of Washington (Seattle, WA)   *2016-2019*
M.Sc. in Atmospheric Sciences
Advisors: Profs. John M. Wallace & Qiang Fu
Thesis: The Effect of Hydrometeors on MSU/AMSU Temperature Observations over the Tropical Ocean

University of Tehran (Tehran)   *2012-2015*
M.Sc. in Civil Engineering (Water Resources Engineering)
Advisor: Prof. Zahraie
Thesis: Evaluation of Climate Change Impact on Extreme Precipitation Events Using Statistical Downscaling

Iran University of Science and Technology (Tehran)   *2007-2012*
B.Sc. in Civil Engineering

RESEARCH AND PROFESSIONAL EXPERIENCE

- **Rice University**, Houston, TX & **NWRA**, Boulder, CO   **Postdoctoral Fellow**

  Supervisors: Prof. Pedram Hassanzadeh & Dr. M. Joan Alexander   *2022-Present*
  - Exploring strategies for training neural networks as subgrid-scale parameterizations
  - Examining the role of non-local dynamics in the propagation and dissipation of gravity waves (GWs), as well as approaches for incorporating this non-locality into data-driven GW parameterization
  - Using GW-resolving simulations to develop data-driven GW parameterization
  - Emulating GW parameterizations in WACCM
  - Leading the QBO working group of the SNAPSI project

- **Department of Atmospheric Sciences**, University of Washington, Seattle, WA   **Research Assistant**

                                                                                  2016-2022
  - Investigated the characteristics of tropical convective gravity waves resolved by ERA5 reanalysis
  - Evaluated the momentum budget of the QBO using ERA5 reanalysis dataset
  - Evaluated the contributions of different types of waves to the driving of the QBO using ERA5 reanalysis
  - Examined the BDC changes for 1980-2018 based on MSU/AMSU temperature observations
  - Investigated the hydrometeor effects on MSU/AMSU temperature observations

- **Water Institute**, University of Tehran, Tehran, Iran $\qquad$ **Research Assistant**

  2013-2016

  – Developed a monthly statistical downscaling model for assessing climate change impacts on different meteorological variables such as precipitation, temperature and evaporation.

  – Investigated various climate change model-scenarios for projecting the intensity of dry and wet spells in the future and their impacts on the quality and quantity of water flow of Karun river.

PUBLICATIONS

Published

1. **H. A. Pahlavan**, J. M. Wallace, Q. Fu, "Characteristics of Tropical Convective Gravity Waves Resolved by ERA5 Reanalysis", *Journal of the Atmospheric Sciences*, 2023. [Paper]

2. **H. A. Pahlavan**, J. M. Wallace, Q. Fu, G. N. Kiladis, "Revisiting the Quasi Biennial Oscillation as Seen in ERA5. Part II: Evaluation of Waves and Wave Forcing", *Journal of the Atmospheric Sciences*, 2021. [Paper]

3. **H. A. Pahlavan**, Q. Fu, J. M. Wallace, G. N. Kiladis, "Revisiting the Quasi Biennial Oscillation as Seen in ERA5. Part I: Description and Momentum Budget", *Journal of the Atmospheric Sciences*, 2021. [Paper]

4. **H. A. Pahlavan**, Q. Fu, J. M. Wallace, "The Effect of Hydrometeors on MSU/AMSU Temperature Observations over the Tropical Ocean", *Journal of Atmospheric and Oceanic Technology*, 2018. [Paper]

5. **H. A. Pahlavan**, B. Zahraie, M. Nasseri, and A. Mahdipour, "Improvement of Multiple Linear Regression Method for Statistical Downscaling of Monthly Precipitation", *International Journal of Environmental Science and Technology*, 2018. [Paper]

6. A. J. Sweeney, Q. Fu, **H. A. Pahlavan**, P. Haynes, "Seasonality of the QBO Impact on Equatorial Clouds", *Journal of Geophysical Research - Atmospheres*, 2023. [Paper]

7. Q. Fu, S. Solomon, **H. A. Pahlavan**, P. Lin, "Observed changes in Brewer–Dobson circulation for 1980–2018", *Environmental Research Letters*, 2019. [Paper]

8. Q. Fu, M. Wang, R. H. White, **H. A. Pahlavan**, B. Alexander, J. M. Wallace, "Quasi Biennial Oscillation and Sudden Stratospheric Warmings during the Last Glacial Mcaximum", *Atmosphere MDPI*, 2020. [Paper]

Manuscripts under Review

- **H. A. Pahlavan**, J. M. Wallace, Q. Fu, M. J. Alexander, "Characteristics of Gravity Waves in Opposing Phases of the QBO: A Reanalysis Perspective with ERA5". [Paper]

- **H. A. Pahlavan**, P. Hassanzadeh, M. J. Alexander, "Explainable Offline-Online Training of Neural Networks for Parameterizations: A 1D Gravity Wave-QBO Testbed in the Small-data Regime". [Paper]

- Y. Q. Sun, **H. A. Pahlavan**, A. Chattopadhyay, S. W. Lubis, P. Hassanzadeh, M. J. Alexander, E. Gerber, "Data Imbalance, Uncertainty Quantification, and Generalization via Transfer Learning in Data-driven Parameterizations: Lessons from the Emulation of Gravity Wave Momentum Transport in WACCM". [Paper]

BOOK CHAPTERS

- **H. A. Pahlavan**, "Chapter 10: Wave-Mean Flow Interaction in the Tropical Stratosphere", in J. M. Wallace, D. S. Battisti, D. W. J. Thompson, D. L. Hartmann, *The Atmospheric General Circulation*. Academic Press: MTP, 2022. [Link]

Selected Presentations

Invited Talks

- "Characteristics of Tropical Convective Gravity Waves Resolved by ERA5 Reanalysis", *Meteorological Institute, University of Hamburg.* Virtual, December 2023

- "Evolution and Wave Forcing of the QBO in the Subseasonal Forecast Models", *The Role of Atmospheric Dynamics for Climate and Extremes — A Joint DynVar/SNAP Meeting.* Munich, Germany, October 2023

- "The QBO Dynamics and Gravity Waves Characteristics as Seen in ERA5 Reanalysis", *Department of Applied Mathematics and Theoretical Physics, University of Cambridge.* Virtual, September 2021

Conferences

- 104th American Meteorological Society Annual Meeting: *Explainable Offline-Online Training of Neural Networks for Parameterization: A 1D Gravity Wave-QBO Testbed.* Baltimore, MD, January 2024 [Poster]

- NeurIPS 2023 Workshop: Tackling Climate Change with Machine Learning: *Explainable Offline-online Training of Neural Networks for Multi-scale Climate Modeling.* New Orleans, LA, December 2023 [Poster]

- AGU Fall Meeting: *Explainable Offline-Online Training of Neural Networks for Parameterization: A 1D Gravity Wave-QBO Testbed.* San Francisco, CA, December 2023 [Talk]

- 103nd American Meteorological Society Annual Meeting: *Training Convective Gravity Wave Parameterization with Ensemble Kalman Inversion to Simulate the QBO.* Denver, CO, January 2023 [Talk]

- 102nd American Meteorological Society Annual Meeting: *Characteristics of Gravity Waves in Opposite QBO Phases in ERA5 Reanalysis.* Houston, TX, January 2022 [Talk]

- AGU Fall Meeting: *Characteristics of Gravity Waves Resolved by ERA5 Reanalysis.* New Orleans, LA, December 2021 [Talk]

- 100th American Meteorological Society Annual Meeting: *Revisiting the Quasi-Biennial Oscillation.* Boston, MA, January 2020 [Poster]

- 22nd Conference on Atmospheric and Oceanic Fluid Dynamics: *Thermodynamic and dynamical structures of the Quasi-Biennial Oscillation (QBO) and associated wave-mean flow interactions.* Portland, ME, June 2019 [Poster]

Teaching Experience

Responsibilities included occasional lecturing, leading class discussions, grading assignments, and meeting with students during office hours.

- Teaching Assistant, **ATM S 431: Boundary-Layer Meteorology**, UW, ATM S, 2019 & 2020.
- Teaching Assistant, **ATM S 101: Weather**, UW, ATM S, 2018.

Fellowships and Honors

- Rice Academy Postdoctoral Fellowship, Rice University, Houston, TX, 2022.
- Ranked **1st** among master's students ,Civil Eng. (Water Resources Eng.), College of Engineering, University of Tehran, Iran, 2014.
- Ranked among **Top 1%** of 40,000+ participants in Nationwide Graduate University Entrance Exam, Iran, 2012.

References

Prof. **John M. Wallace**, University of Washington, Seattle, WA
Homepage: https://atmos.uw.edu/wallace/
Email: wallacem@uw.edu

Prof. **Qiang Fu**, University of Washington, Seattle, WA
Homepage: https://atmos.uw.edu/faculty-and-research/core-faculty/qiang-fu/
Email: qfu@uw.edu

Prof. **Pedram Hassanzadeh**, Rice University, Houston, TX
Homepage: https://pedram.rice.edu/director/
Email: ph25@rice.edu

Dr. **M. Joan Alexander**, NorthWest Research Associates (NWRA), Boulder, CO
Homepage: https://www.cora.nwra.com/ alexand/
Email: alexand@nwra.com