

# Arman Pouyaei

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## Climate Scientist

Results-driven professional with extensive experience and expertise in developing Earth System models, in particular processes related prognostic fire modeling and its interaction with other components of the Earth. Highly adept at analyzing and interpreting patterns and trends, developing, and utilizing new and existing atmospheric models to study origins, transport, and influence of atmospheric pollutants on the environment and climate. Effective at collaborating with research teams in the preparation and writing of research papers for submission to peer-reviewed journals and conference proceedings. Efficient at leading original, high-level individual and collaborative research, delivering presentations at national and international conferences.

### Areas of Expertise

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|---|---|--|
| • Scientific Writing & Academic Communications  | • Team Leadership, Mentoring & Training | • Computational Fluid Dynamics Modeling    |
| • Research and Application                      | • Project Management                    | • Data Science and Management              |
| • Atmospheric Model Development and Application | • Data Assimilation & Inverse Modeling  | • Climate Modeling and Weather Forecasting |
| • Atmospheric Chemistry                         | • Reporting & Documentation             | • Statistical Modeling and Analysis        |
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## EDUCATION

**Ph.D., Atmospheric Science** | University of Houston, Houston, Texas, 2018 – 2022

**M.Sc., Renewable Energies Engineering** | University of Tehran, Iran, 2013 – 2016

**B.Sc., Mechanical Engineering** | University of Shiraz, Iran, 2008 – 2012

## AWARDS & DISTINCTIONS

***Awarded Scholarships** for Outstanding Graduate Work in Atmospheric Science, University of Houston, Houston, 2022 & 2021, **Awarded Full Scholarship** for MSc at the University of Tehran, 2013 and BSc at the University of Shiraz, 2008*

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## EXPERIENCE HIGHLIGHTS

**NOAA GFDL / PRINCETON UNIVERSITY**, Princeton, USA, March 2023 to now

**Postdoctoral Research Associate (Cooperative Institute for Modeling the Earth System (CIMES))**

Development of new methods and technologies for project advancement.

### **Key Accomplishments:**

- Development of wildfire plume injection for GFDL's climate/atmospheric models.
- Analysis of the tropospheric ozone radiative forcing connection to biomass burning variability
- Development of dynamic biomass burning emission (aerosols/trace-gases) for coupled Earth System modeling

### **Selected Projects:**

- **Project 1:** Design and develop plume injection scheme for biomass burning emissions in GFDL's AM4 and implement the scheme into aerosol module to study the decadal impact of plume injection height from wildfires on coupled climate modeling system. *Supervisor: Paul Ginoux (NOAA GFDL)*
- **Project 2:** Implement plume injection scheme for biomass burning emissions in GFDL's AM4.1 full-chemistry model to study the decadal relationship between tropospheric ozone radiative forcing and biomass burning variability. *Supervisors: Paul Ginoux (NOAA GFDL) / Vaishali Naik (NOAA GFDL) / Larry Horowitz (NOAA GFDL)*

- **Project 3:** Develop dynamic biomass burning emissions from dynamic fire and vegetation in land model (LM4.1) and couple to atmospheric model (AM4.1) to analyze the change in wildfire intensity and frequency with future projection SSP scenarios. *Supervisors: Paul Ginoux (NOAA GFDL) / Elena Shevliakova (NOAA GFDL) / Sergey Malyshev (NOAA GFDL)*

UNIVERSITY OF HOUSTON, Houston, USA, September 2022 to February 2023

**Postdoctoral Research Fellow (Department of Earth and Atmospheric Sciences)**

Team management, development of new methods and technologies for project advancement, undergraduate/graduate students' mentorship, and preparation of proposals.

**Key Accomplishments:**

- Data assimilation/inverse modeling model development.
- Collaborate with researchers in writing and editing research papers for publication and presentation.
- Develop research plans and proposals for DOE/NOAA/NASA/NSF.

**Selected Projects:**

- **Project 1:** Introduced a novel approach for investigating aerosol-cloud interaction using data assimilation and spectral bin method for microphysics. Designed the forward operator for NEXRAD radar assimilation. Designing a 3DVAR framework for application of data assimilation. *Collaborators: Michael Jensen (BNL), Jiwen Fan (PNNL).*
- **Project 2:** Development of sectional aerosol model (CARMA) for application in CESM model for potential application in aerosol-cloud interaction in climate models and geo-engineering studies. *Collaborator: Simone Tilmes (NCAR).*
- **Project 3:** Application of MUSICAv0 configuration of CESM model to investigate the relation of US background ozone to mesoscale meteorological/climatological variables. *Collaborators: Louisa Emmons (NCAR).*

UNIVERSITY OF HOUSTON, Houston, USA, 2018 to 2022

**Graduate Research Assistant (Air Quality Forecasting and Modeling Lab)**

Drive the planning and development of new methods and technologies for project advancement, collaborating with internal and external personnel in preparing research proposals and papers for scientific conferences and scientific journals.

**Key Accomplishments:**

- Designed a world-class research practice by defining quality and best practices, leading the model development in various projects to maximize knowledge transfer, developing 4 independent research papers.
- Spearheaded the writing of reports to summarize data and the implication of the results of the research project.
- Develop research plans and proposals, protocols, and budgets for DOE/NOAA/NASA.

**Selected Projects:**

- **Project 1:** Introduced a novel Lagrangian model, C-TRAIL v1.0, providing an alternative method for simulating atmospheric diffusion through incorporation in an Eulerian air quality model. Validated model results with in-situ/satellite/aircraft-campaign measurements (GMD 2020). Extended the development of trajectory model in the CMAQ framework to track PM concentrations during long-range transport (AE 2022).
- **Project 2:** Developed a physically accurate sub-grid cloud convection module based on meteorological approach for accurate quantification of vertical and long-range transport in CMAQ air quality modeling (JAMES 2021).
- **Project 3:** Developed Forward Operator for OMI HCHO/NO<sub>2</sub> and implemented them in the WRF-Chem/DART framework, to study wildfire-related ozone formation during 2019 FIREX-AQ campaign (JGR: Atmospheres 2023). *Collaborator: Dr. Arthur Mizzi (NASA).*

**Graduate Teaching Assistant (Department of Earth and Atmospheric Sciences)**

- Assisted the professor in teaching “Dynamic Meteorology” and “Principles of Atmospheric Science” through in-class support, demonstrating to undergraduate and graduate students the simulation and visualization of atmospheric models.

UNIVERSITY OF TEHRAN, Iran, 2014 to 2017

**Graduate Research Assistant (Vehicle, Fuel and Environment Research Institute)**

Spearheaded the conduct of design studies and experiments following work plans and research objectives, leveraging data science workflows to build predictive models and achieve project deliverables.

**Key Accomplishments:**

- Enabled the conduct of a wide variety of experimental tests, extracting and manipulating large and complex datasets to design, simulate, and build a full stand-alone energy system.
- Determined research directions and created roadmaps in collaboration with a broader research team, leading the preparation of research papers and materials and the presentation in conferences.

**Selected Projects:**

- Project 1:** Designed a novel optimization framework incorporating a CFD modeling for a PV/Wind/Battery energy system, creating a research paper for presentation at an IEEE conference and publishing in the Journal of Energy Conversion and Management (ECM).

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**PUBLICATIONS - JOURNAL ARTICLES**
**2025:**

- Pouyaei, A.**, Ginoux, P., Shevliakova, E., Malyshev, S., Horowitz, L. W., Paulot, F. (2025). Coupling interactive fire emission and injection with atmospheric composition and climate in GFDL’s Earth System Model. *Geoscientific Model Development (in preparation)*.
- Pouyaei, A.**, Ginoux, P., Naik, V., Feng, J., Horowitz, L. W., Paulot, F. (2025). ENSO-driven Variability in Ozone Sources and Its Impact on Tropospheric Ozone Radiative Forcing. *Journal of Geophysical Research Letters (under internal review)*.

**2024:**

- Pouyaei, A.**, Ginoux, P., Ward, D. S., Yu, Y., Horowitz, L. W. (2024). Implementation of Dynamic Fire Injection Height in GFDL’s Atmospheric Model (AM4.0): Impacts on Aerosol Profiles and Radiation. *Journal of Advances in Modeling Earth Systems, (under journal review)*, DOI: 10.22541/essoar.171535920.04238206/v1.
- Khorshidian, N., Choi, Y., Mousavinezhad, S., **Pouyaei, A.**, Park, J., & Fan, J. (2024). Comparing the interactions between particulate matter and cloud properties over two populated cities in Texas using WRF-Chem fine-resolution modeling. *Atmospheric Environment*, 338, 120795.
- Moon, J., Choi, Y., Jeon, W., Kim, H. C., **Pouyaei, A.**, Jung, J., ... & Kim, D. (2024). Hybrid IFDMB/4D-Var inverse modeling to constrain the spatiotemporal distribution of CO and NO<sub>2</sub> emissions using the CMAQ adjoint model. *Atmospheric Environment*, 327, 120490.
- Payami, M., Choi, Y., Salman, A. K., Mousavinezhad, S., Park, J., & **Pouyaei, A.** (2024). A 1D CNN-Based Emulator of CMAQ: Predicting NO<sub>2</sub> Concentration over the Most Populated Urban Regions in Texas. *Artificial Intelligence for the Earth Systems*, 3(2), e230055.
- Lin, M., Horowitz, L. W., Zhao, M., Harris, L., Ginoux, P., Dunne, J., Malyshev, S., Shevliakova, E., Ahsan, H., Garner, S., Paulot, F., **Pouyaei, A.**, ... & Zhou, L. (2024). The GFDL Variable-Resolution Global Chemistry-Climate Model for Research at the Nexus of US Climate and Air Quality Extremes. *Journal of Advances in Modeling Earth Systems*, 16(4), e2023MS003984.
- Momeni, M., Choi, Y., Yeganeh, A. K., **Pouyaei, A.**, Jung, J., Park, J., ... & Cady-Pereira, K. E. (2024). Constraining East Asia ammonia emissions through satellite observations and iterative Finite Difference Mass Balance (iFDMB) and investigating its impact on inorganic fine particulate matter. *Environment International*, 184, 108473.

**2023:**

- **Pouyaei, A.**, Mizzi, A. P., Choi, Y., Mousavinezhad, S., Khorshidian, N., (2023). Downwind Ozone Changes of the 2019 Williams Flats Wildfire: Insights from WRF-Chem/DART Assimilation of OMI NO<sub>2</sub>, HCHO, and MODIS AOD Retrievals. *Journal of Geophysical Research: Atmospheres*, e2022JD038019.
- Kia, H. Z., Choi, Y., Nelson, D., Park, J., & **Pouyaei, A.** (2023). Large eddy simulation of sneeze plumes and particles in a poorly ventilated outdoor air condition: A case study of the University of Houston main campus. *Science of The Total Environment*, 891, 164694.
- Singh, D., Choi, Y., Dimri, R., Ghahremanloo, M., & **Pouyaei, A.** (2023). An Intercomparison of deep-learning methods for super-resolution bias-correction (SRBC) of Indian summer monsoon rainfall (ISMR) using CORDEX-SA simulations. *Asia-Pacific Journal of Atmospheric Sciences*, 59(4), 495-508.
- Lops, Y., Ghahremanloo, M., **Pouyaei, A.**, Choi, Y., Jung, J., Mousavinezhad, S., ... & Hammond, D. (2023). Spatiotemporal estimation of TROPOMI NO<sub>2</sub> column with depthwise partial convolutional neural network. *Neural Computing and Applications*, 35(21), 15667-15678.
- Noorollahi, Y., Pakzadmanesh, M., Kashani, A., **Pouyaei, A.**, Yousefi, F., Roumi, S., & Jalilinasrabady, S. (2023). Reliable renewable power production by modeling of geothermal assisted solar chimney power plant. *Geothermics*, 111, 102701.
- Mousavinezhad, S., Ghahremanloo, M., Choi, Y., **Pouyaei, A.**, Khorshidian, N., & Sadeghi, B. (2023). Surface ozone trends and related mortality across the climate regions of the contiguous United States during the most recent climate period, 1991–2020. *Atmospheric Environment*, 300, 119693.

**2022:**

- **Pouyaei, A.**, Choi, Y., Jung, J., Mousavinezhad, S., Momeni, M. & Song, C. H. (2022). Investigating the long-range transport of particulate matter in East Asia: Introducing a new Lagrangian diagnostic tool. *Atmospheric Environment*, 278, 119096.
- Salman, A. K., **Pouyaei, A.**, Choi, Y., Lops, Y., & Sayeed, A. (2022). Deep learning solver for solving advection–diffusion equation in comparison to finite difference methods. *Communications in Nonlinear Science and Numerical Simulation*, 115, 106780.
- Sayeed, A., Choi, Y., **Pouyaei, A.**, Lops, Y., Jung, J., & Salman, A. K. (2022). CNN-based model for the spatial imputation (CMSI version 1.0) of in-situ ozone and PM<sub>2.5</sub> measurements. *Atmospheric Environment*, 289, 119348.
- Sadeghi, B., Ghahremanloo, M., Mousavinezhad, S., Lops, Y., **Pouyaei, A.**, & Choi, Y. (2022). Contributions of meteorology to ozone variations: Application of deep learning and the Kolmogorov-Zurbenko filter. *Environmental Pollution*, 310, 119863.
- Park, J., Jung, J., Choi, Y., Mousavinezhad, S., & **Pouyaei, A.** (2022). The sensitivities of ozone and PM<sub>2.5</sub> concentrations to the satellite-derived leaf area index over East Asia and its neighboring seas in the WRF-CMAQ modeling system. *Environmental Pollution*, 306, 119419.
- Jung, J., Choi, Y., Mousavinezhad, S., Kang, D., Park, J., **Pouyaei, A.**, ... & Kim, H. (2022). Changes in the ozone chemical regime over the contiguous United States inferred by the inversion of NO<sub>x</sub> and VOC emissions using satellite observation. *Atmospheric research*, 270, 106076.
- Sadeghi, B., **Pouyaei, A.**, Choi, Y., & Rappenglueck, B. (2022). Influence of seasonal variability on source characteristics of VOCs at Houston industrial area. *Atmospheric Environment*, 277, 119077.

**2021:**

- **Pouyaei, A.**, Sadeghi, B., Choi, Y., Jung, J., Souri, A. H., Zhao, C., & Song, C. H. (2021). Development and Implementation of a Physics-Based Convective Mixing Scheme in the Community Multiscale Air Quality Modeling Framework. *Journal of Advances in Modeling Earth Systems*, 13(6), e2021MS002475.
- Mousavinezhad, S., Choi, Y., **Pouyaei, A.**, Ghahremanloo, M., & Nelson, D. L. (2021). A comprehensive investigation of surface ozone pollution in China, 2015–2019: Separating the contributions from meteorology and precursor emissions. *Atmospheric Research*, 257, 105599.
- Sadeghi, B., **Pouyaei, A.**, Choi, Y., & Rappenglueck, B. (2021). Measurement report: Summertime and wintertime VOCs in Houston: Source apportionment and spatial distribution of source origins. *Atmospheric Chemistry and Physics Discussions*, 2021, 1-27.

- Lops, Y., **Pouyaei, A.**, Choi, Y., Jung, J., Salman, A. K., & Sayeed, A. (2021). Application of a partial convolutional neural network for estimating geostationary aerosol optical depth data. *Geophysical Research Letters*, 48(15), e2021GL093096.

#### 2020:

- **Pouyaei, A.**, Choi, Y., Jung, J., Sadeghi, B., & Song, C. H. (2020). Concentration Trajectory Route of Air pollution with an Integrated Lagrangian model (C-TRAIL Model v1. 0) derived from the Community Multiscale Air Quality Model (CMAQ Model v5. 2). *Geoscientific Model Development*, 13(8), 3489-3505.
- **Pouyaei, A.**, Golgouneh, A., & Kholghi, B. (2019, November). A New Local Searching Approach for Wind Farm Layout Optimization Problem. In *2019 IEEE 2nd International Conference on Renewable Energy and Power Engineering (REPE)* (pp. 114-119). IEEE.

#### Before 2020:

- Tahani, M., Babayan, N., & **Pouyaei, A.** (2015). Optimization of PV/Wind/Battery stand-alone system, using hybrid FPA/SA algorithm and CFD simulation, case study: Tehran. *Energy conversion and management*, 106, 644-659.
- Tahani, M., Babayan, N., **Pouyaei, A.**, Mirhosseini, M., & Sedaghat, A. (2015, November). Increasing the produced power of building mounted wind turbines by optimization of roof geometry and utilization of solar panels. In *2015 International Conference on Sustainable Mobility Applications, Renewables and Technology (SMART)* (pp. 1-5). IEEE.

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### SELECTED ACADEMIC PRESENTATIONS

- **A. Pouyaei** | The role of ENSO-driven biomass burning variability on tropospheric ozone radiative effects | AGU Annual Meeting 2024, In-person, Washington, D.C., USA. December 2024.
- **A. Pouyaei** | Unraveling the Direct Radiative Effects of Aerosol Injection from Extreme Wildfires Using GFDL's AM4/LM4 | AMS Annual Meeting 2024, In-person, Baltimore, MD, USA. January 2024.
- **A. Pouyaei** | Assessing Direct Radiative Effects of Biomass Burning Injection Height Schemes Using GFDL's AM4/LM4 | AGU Fall Meeting 2023, In-person, San Francisco, CA, USA. December 2023.
- **A. Pouyaei** | Dynamics and Chemistry of 2019 Williams Flats wildfire plume during FIREX-AQ campaign: WRF-Chem/DART data assimilation modeling incorporating OMI/MODIS retrievals | AGU Fall Meeting 2022, In-person, Chicago, IL, USA. December 2022.
- **A. Pouyaei** | Development and implementation of a physics-based convective mixing scheme in the Community Multiscale Air Quality (CMAQ) modeling framework | AGU Fall Meeting 2021, In-person, New Orleans, LA, USA. 13-17 December 2021.
- **A. Pouyaei** | Implementation of Kain-Fritsch convective mixing scheme into CMAQ subgrid cloud modeling | 20th CMAS Conference, Virtual, Chapel Hill, NC, USA. November 2nd, 2021.
- **A. Pouyaei** | C-TRAIL model derived from CMAQ | 19th CMAS Conference, Virtual, Chapel Hill, NC, USA. October 26th, 2020.

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### SERVICE

#### Outreach activities:

- Organizing committee member: The Quest for Environmental and Climate Justice Talk featuring Dr. Robert Bullard, University of Houston, 2022.
- Organizing committee member: Spring Into Science, Science Outreach program at Princeton University for students (4th - 10th graders), Princeton University, 2024.
- Collegiate Mentorship Program (CMP): Mentored two high school students from India and China. 2024.

#### Reviewer:

- *Springer Nature – Scientific Reports, Springer Nature – Environmental Science and Pollution Research, Journal of Geophysical Research – Atmosphere, Atmospheric Pollution Research, Atmospheric Environment, Asia-Pacific journal of Atmospheric Sciences, Frontiers in Earth Science – Atmospheric Science, International Journal of Earth Science and Geophysics*

**Session Convener:**

- AGU Fall Meeting 2024, A51T, A54G, Recent Advances in Aerosol Representation and Its Impacts on Climate, Air Quality, and Health
- AGU Fall Meeting 2024, A34I, Upper Troposphere, Stratosphere, and Mesosphere: Chemistry, Dynamics, Transport, and Radiation

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**REFERENCES****Paul Ginoux**

Research physical scientist (atmospheric aerosols), NOAA GFDL  
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**Elena Shevliakova**

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**Arthur Mizzi**

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**Yunsoo Choi**

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**Larry W. Horowitz**

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