Leo Matak

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Education

University of Houston May 2025
Ph.D. in *Civil and Environmental Engineering*
Advisor: **Mostafa Momen, Ph.D.**

University of Zagreb, Croatia Aug 2021
M.Sc. in *Aeronautical Engineering*
Advisor: **Karolina Krajcek-Nikolic, Ph.D.**
Thesis title: "Aerodynamic characteristics estimation of variable geometry airfoil in supersonic air flow"

University of Zagreb, Croatia Aug 2018
B.Sc. in *Aeronautical Engineering*
Advisor: **Karolina Krajcek-Nikolic, Ph.D.**
Thesis title: "Experimental Determination of Inertia Moments on a Rotary Wing Unmanned Aerial Vehicle"

Research Experience

Research Assistant, University of Houston, Texas Aug 2021 – Present

- With the Environmental Fluid Mechanics research lab, I focus on theoretical and applied atmospheric modeling studies. My work is based on atmospheric boundary layer dynamics, including hurricane and urban-area boundary layers.
- Conducted in-depth studies on urban and regional air quality forecasting, integrating computational fluid dynamics (CFD) with real-world emissions data to improve the precision of weather simulations.
- Leveraged state-of-the-art High-Performance Computing (HPC) infrastructure to execute large-scale simulations of severe weather events, achieving high-resolution outputs necessary for accurate representation of turbulent flows and hurricane rapid intensifications.
- Applied machine learning techniques to improve traditional physics-based modeling approaches and forecast reliability for urban area wind forecasting.

Research Assistant, University of Zagreb, Croatia Aug 2018 – May 2021

- Conducted research focusing on CFD, specifically investigating airflow characteristics over F-16 aircraft wings.

Teaching Experience

Teaching Assistant, University of Houston, Texas Aug 2022 – Aug 2023

- Teaching Assistant for undergraduate and graduate Fluid Mechanics courses.

Industry Experience

Application Scientist, Heath Consultants Inc, Houston, TX Jan 2025 – Present

- Developed data analytics algorithms and techniques leveraging expertise in fluid dynamics, atmospheric sciences, and statistics.
- Conducted field experiments, analyzed data, developed protocols, and contributed to research papers on methane emissions.
- Summarized data and generated reports aligned with measurement protocols and scientific best practices to support regulatory compliance.
- Collaborated with research institutions to coordinate data collection and analysis, enhancing understanding of methane emissions from oil & gas infrastructure and identifying mitigation opportunities.

Software Developer Intern, UCAR Unidata, Boulder, CO May 2024 – Aug 2024

- Developed a back-end dynamic service provider (Java), enabling real-time data transformations for Earth-System datasets.
- Designed a server-side virtual data processing solution for the THREDDS Data Server (TDS), reducing computational overhead and optimizing resources for the large-scale geospatial data in Numerical Weather Prediction (NWP) models.
- Conducted unit and integration testing to ensure code robustness and accuracy.
- Managed collaborative development within a 50,000+ line codebase using Git.

Peer-reviewed Publications

1. **Matak, L.,** and M. Momen, **2025**: "Enhancing Air Pollution Forecasts In Cities By Characterizing The Urban Heat Island Effects On Planetary Boundary Layers", **Atmospheric Research**, https://doi.org/10.1016/j.atmosres.2025.107923
2. Romdhani, O., **Matak**, **L.,** and M. Momen**, 2024:** "Hurricane track trends and environmental flow patterns under surface temperature changes and roughness length variations", **Weather and Climate Extremes** https://doi.org/10.1016/j.wace.2024.100645
3. **Matak, L.,** and M. Momen, **2023**: "The Role of Vertical Diffusion Parameterizations in the Dynamics and Accuracy of Simulated Intensifying Hurricanes," **Boundary Layer Meteorology** https://doi.org/10.1007/s10546-023-00818-w
4. Li, M., J. A. Zhang, **Matak, L**., and M. Momen, **2023**: "The impacts of momentum roughness length on strong and weak hurricanes forecasts: a comprehensive analysis of different surface flux models using weather simulations and observations," **Monthly Weather Review** https://doi.org/10.1175/MWR-D-22-0191.1
5. **Matak, L**., and K. Krajcek-Nikolic, **2022**: "CFD Analysis of F-16 Wing Airfoil Aerodynamics in Supersonic Flow", **The Science and Development of Transport** https://doi.org/10.1007/978-3-030-97528-9_13

Conference Presentations

1. **Matak, L.**, and M. Momen, **2025**: "Improving Urban Parameterizations in Numerical Weather Models and Their Impacts on Meteorological and Air Quality Forecasts" **105th Annual Meeting, American Metrological Society,** New Orleans, LA.
   https://ams.confex.com/ams/105ANNUAL/meetingapp.cgi/Paper/450467

2. **Matak, L.,** Drwenski, T., Johnson, H., Martin, T., **2024**: "Extensible NcML for AI/ML Ready Data on the THREDDS Data Server," **Annual Meeting, American Geophysical Union**, Washington D.C.
   https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1637564

3. **Matak, L.**, and M. Momen, **2024**: "Enhancing Air Quality Forecasts in City Environments: Characterizing the Impacts of Boundary Layer and Urban Schemes in Numerical Weather Prediction Models" **104th Annual Meeting, American Metrological Society,** Baltimore, MD.
   https://ams.confex.com/ams/104ANNUAL/meetingapp.cgi/Paper/432377

4. Momen, M., **L. Matak, 2024**: "Evaluation of Eddy Diffusion Adjustments on Improving Hurricane Simulations in Weather Forecasting Models" **104th Annual Meeting, American Metrological Society**, Baltimore, MD.
   https://ams.confex.com/ams/104ANNUAL/meetingapp.cgi/Paper/431563

5. Momen, M., **L. Matak**, and M. Li 2023: "The Role of Turbulence and Roughness Length Parameterizations in Improving Major Hurricane Simulations in Weather Forecasting Models," **ASCE Engineering Mechanics Institute Conference, Atlanta, GA**.
   https://www.emi-conference.org/program

6. **Matak, L.,** and M. Momen, 2023: "The Impacts of Vertical Diffusion Parameterizations on Intensifying Hurricane Simulations," **103rd Annual Meeting, American Metrological Society**, Denver, CO.
   https://ams.confex.com/ams/103ANNUAL/meetingapp.cgi/Paper/415851

Skills

- Considerable experience in working with Linux/Unix clusters in HPC environment. Research conducted on University of Houston clusters, NSF Derecho, Cheyenne and NSF ACCESS resources.

- Installing libraries and software from source code, running parallel jobs with OpenMP and MPI standards, using version control systems (e.g. git).

- Data analysis tools (e.g., Python, MATLAB, and Microsoft Excel) with specialized expertise in handling Earth system science data formats (e.g., netCDF, GRIB)

- Proficient in different programming languages (Java, FORTRAN) and Linux/Unix shell scripting languages (e.g. Bash, Cshell, PERL) as well as meteorological and air quality models and related pre/post-processors (e.g., WRF, WRF-CHEM).

- Strong understanding of methane regulation frameworks and experience collaborating with teams to define product requirements, develop test protocols, and analyze data for emission reduction solutions.

- Expertise in conducting methane emissions field measurements, developing measurement protocols, and analyzing emissions data using advanced instruments and scientific methods.