EESHAN BASU

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PROFILE SUMMARY

Ph.D. candidate in the Department of Civil and Environmental Engineering at Northeastern University in Boston, working as a research assistant in the CASCADE lab. Expert in atmospheric modeling and air quality, specializing in the assessment, transport, and chemistry of both greenhouse gases and criteria air pollutants using advanced computational models. Focused on improving how we model and understand the interactions between greenhouse gases and air pollutants in the atmosphere, including better representation of emission sources and their vertical distribution. Skilled in processing large-scale emissions datasets, performing multiscale simulations, and utilizing high-performance computing. Adept at translating complex scientific data into clear visualizations and insights for diverse audiences. Passionate about community engagement and fostering meaningful connections through various leadership initiatives. Combines strong technical expertise in environmental modeling with a passion for data-driven analysis, including developing machine learning tools for financial market analysis as a personal hobby.

EDUCATION

Doctor of Philosophy - Interdisciplinary Engineering **Expected December 2025**
Northeastern University, Boston, MA
Research area: High-Performance Computing, Numerical Mesoscale Modeling

Master of Science - Geoinformatics **July 2020**
IIEST Shibpur, Howrah, West Bengal
Research area: Satellite Image Processing, Remote Sensing, Machine Learning, Statistics

Bachelor of Technology - Civil Engineering **August 2017**
MAKAUT, Kolkata, West Bengal
Specialized area: Structural Analysis, Engineering Drawing, Soil Mechanics, Surveying

RESEARCH EXPERIENCE

Doctoral Researcher **September 2020 - Present**
Northeastern University **Boston, MA**

- Engineered and implemented the Briggs plume-rise mechanism in WRF-Chem-GHG to improve the vertical allocation of CO_2 emissions from power plants, enhancing model agreement with observed vertical profiles
- Integrated 17 CO_2-producing chemical reactions into the Carbon Bond mechanism using the kinetic pre-processor, enabling more comprehensive representation of CO_2 chemistry in urban and regional simulations and reducing CO_2 underpredictions by 2%
- Developed and rigorously validated a novel background CO_2 subtraction method that significantly enhanced the model's ability to capture temporal variability, addressing a critical gap in CO_2 evaluation and enabling more accurate attribution of anthropogenic signals, while reducing error terms by 4%
- Utilized updated fire emissions datasets to quantify pollutant contributions from biomass burning, resulting in model performance improvement for $PM_{2.5}$ and SO_2 by ~6% and ~10% based on NMB metrics

- Processed and integrated multiple $FFCO_2$ datasets (e.g., EDGAR, FFDAS, ODIAC, Vulcan) into the WRF-GHG, enabling spatially and sectorally resolved fossil fuel CO_2 simulations across urban and regional scales
- Optimized post-processing workflows by developing custom scripts in Python and C shell, reducing analysis time from several days to several hours and significantly improving the efficiency and reproducibility of model evaluation
- Presented research findings at international conferences, effectively translating complex atmospheric modeling and emissions science to multidisciplinary audiences

Graduate Researcher **August 2018 - June 2020**
IIEST, Shibpur **Howrah, West Bengal**

- Developed and implemented machine learning models using Artificial Neural Networks and Random Forest to predict $PM_{2.5}$ concentrations from AOD and meteorological variables during the fire-prone pre-monsoon season (March–May) and the monsoon period (June–September), achieving over 95% correlation and optimizing model performance for air quality forecasting
- Applied statistical analysis and remote sensing techniques, including MODIS and Landsat imagery, photogrammetry, and cartography, along with GIS-based spatial mapping and interpolation methods, to extract meaningful insights and generate high-resolution pollution exposure maps with spatial accuracy exceeding 85%
- Utilized ArcGIS to conduct spatial overlay analysis, reclassification, and raster calculations in support of environmental assessments, improving geospatial data integration and visualization for multi-variable atmospheric research

COMPUTATIONAL EXPERIENCE

Doctoral Researcher **September 2020 - Present**
Northeastern University **Boston, MA**

- Extensive experience in running large-scale atmospheric simulations on HPC clusters using WRF-Chem-GHG, with a focus on applying and developing model schemes to investigate air quality and climate interactions
- Proficient in parallel computing environments and familiar with MPI and OpenMP frameworks, executing computationally intensive WRF-Chem-GHG simulations and conducting multiple sensitivity tests to assess model efficiency, with optimal configurations achieving approximately 50% reduction in runtime compared to less efficient settings
- Advanced skills in R, Python, and NCL for automating workflows, data analysis, and visualization. Experienced in developing and maintaining complex scripts for processing large environmental datasets and integrating various model outputs

SKILLS

Computational Skills: High-performance computing, Linux, Python, R, Shell Scripting, Fortran, NCL, Data Science, Machine Learning, Modeling, Simulation
Technical Skills: WRF-Chem-GHG, WRF-GHG, ArcGIS, Statistical Analysis, Git, Version Control, AutoCAD, Autodesk Revit
Soft Skills: Communication, Leadership, Problem-Solving, Critical Thinking, Adaptability, Creativity, Enthusiasm, Teamwork, Collaboration