Arka Mitra

Atmospheric Scientist | Remote Sensing & Geospatial Analysis | Argonne National Laboratory
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SUMMARY

Atmospheric scientist with interdisciplinary training in satellite remote sensing, geospatial image processing, and 3D visualization for Earth and planetary sciences. Experienced in wind resource modeling, boundary-layer meteorology, and large-scale data fusion. PI of a DOE-funded global wind benchmark project; contributor to satellite-model fusion for PBL process characterization. Expertise in time-series modeling, AI post-processing, model validation, and large-scale data workflows.

CORE EXPERTISE

Remote Sensing Analysis: Validation/analysis for MISR, MODIS & CERES; multi-sensor fusion.
3D Photogrammetry & Point-Cloud Processing: Stereo retrievals, lidar validation.
Image & Change Detection: Sub-pixel change detection, global time-series trend analysis.
AI/ML for Geoscience: CNNs, SOMs, LSTM, XGBoost for classification, clustering, and forecasting.
Geospatial Data Systems: NetCDF, HDF5, xarray, Zarr, rasterio, geopandas, shapely, cartopy; ArcGIS.
Radiative Transfer & Atmospheric Retrievals: Cloud-top height fusion, radiative flux modeling.
Wind Energy & Climate Analytics: Wake models, capacity factor optimization, cost metrics, Variability.
Scientific Software Development: Python-based geospatial pipelines, Git, cluster/cloud computing.
Research Communication & Collaboration: PI on DOE-funded projects, NASA campaign support, cross-disciplinary team collaborations, peer-reviewed publishing, and student mentoring.

PROFESSIONAL EXPERIENCE

Postdoctoral Scientist – Wind Energy & Climate Science   Mar 2023 – Present
Argonne National Laboratory, Environmental Sciences Division

- Led large-scale geospatial analysis and visualization of U.S. West Coast offshore wind areas, integrating satellite (e.g., GOES) and reanalysis data with machine learning (image classification, SOM, PCA) and 3D wake modeling.
- PI, DOE LDRD project ($25k) to develop a global benchmark satellite dataset of PBL-height winds.
- Developed reproducible pipelines combining remote sensing and NWP post-processing.
- Led atmospheric physics studies (drizzle, radiative flux measurements etc.) for DOE ARM program.
- Published in *Wind Energy Science* and *Journal of Climate*; additional manuscripts near submission.

Graduate Research Assistant – Satellite Remote Sensing   Aug 2017 – Feb 2023
University of Illinois Urbana-Champaign, Department of Atmospheric Sciences

- Designed novel satellite cloud-top height algorithm via MISR- MODIS fusion; validated against lidar.
- Co-wrote successful NASA MEaSUREs proposal ($400k/yr x 3) to develop satellite fusion datasets.
- Designed global trend and error budgets for MISR - MODIS time series (22-year, 100 terabytes).
- Supported NASA CAMP2Ex field campaign by developing radar-based cloud property retrievals.

Graduate Project Scientist – Space Weather & ML-based Modeling   Jan 2017 – Jun 2017
Indian Institute of Geomagnetism, Middle & Upper Space Weather Division

- Trained CNNs for ionospheric electrodynamics using Radio Occultation data; leading to 2 papers.
- Analyzed equatorial electrodynamics and data-driven modeling for geomagnetic indices.

SELECTED RESEARCH PROJECTS (Argonne National Laboratory)

- **InflowEffects** (Offshore Wind Siting & Wake Optimization, 2023–Present) - Built Python package combining ERA5, PyWake, and cost modeling (LCOE, CF loss, Variability) to rank turbine locations. Integrated rotor-layer output estimates with spatial optimization using PyWake software suite.

- **SOM-WEA** (Wind Regime Classification via Self-Organizing Maps, 2024–Present) - Applied PCA + SOMs to classify vertical wind profiles; used regime transitions and anomaly clusters to study wind resource variability. Developed transition risk analysis and persistence maps.

SELECTED INDEPENDENT PROJECTS (Self-Initiated)

- **AQI-Cast** ([GitHub](#)) Real-time AQI forecasting platform (Prophet, LSTM, XGBoost) with gridded visualization, ensemble modeling, and EPA/WHO-based thresholds. Deployed via Streamlit + Fly.io; includes dynamic forecast benchmarking and model interpretability tool.
- **CropGuard** ([GitHub](#)) Lightweight deep-learning web app for crop disease detection from leaf images using CNNs. Built with Gradio, tested on public imagery datasets, and deployed free-tier online. Includes GradCAM explainability and class-wise performance reports

TECHNICAL SKILLS

Programming & Tools: Python, FORTRAN, R, Bash, SQL, Git, Docker, GitHub Actions, JavaScript
ML & Forecasting: XGBoost, LSTM, Prophet, CNNs, SOM, SHAP, Ensemble methods, PyTorch
Atmospheric & Environmental Modeling:
- **NWP post-processing:** HRRR, RAP, PBL dynamics, sub-cloud processes
- **Radiative transfer:** modeling (libRadtran), cloud-layer height retrieval, model–satellite fusion

Geospatial & Climate Data: NetCDF, HDF5, xarray, Zarr, geopandas, rasterio, shapely, cartopy
Satellite & Reanalysis Data: MISR, MODIS, GOES, CERES, CATS, ERA5
Scientific Computing & Workflows: CI/CD pipelines, reproducibility practices, cloud deployment (Fly.io), SLURM-based clusters, AWS (basic)

EDUCATION

Ph.D in Atmospheric Sciences   Aug 2017 - Feb 2023
University of Illinois, Urbana-Champaign | USA | Advisor: Dr. Larry Di Girolamo

M.Sc. in Physics   Aug 2015 - May 2017
Presidency University, Kolkata | India | Thesis Project: Indian Institute of Geomagnetism, Mumbai

B.Sc. in Physics   Aug 2012 - May 2015
Presidency University, Kolkata | India | Minor: Mathematics

PUBLICATIONS

- Mitra, A. et al. (2025). *Locating the Optimal Wind Resource within Two Californian Offshore Wind Energy Areas*. Wind Energy Science. [Preprint DOI:10.5194/wes-2025-55]
- Mitra, A. et al (2025). *Wind and Climate Variability within the Californian* Offshore Wind Energy Areas, *Argonne Technical Report (ANL/NSE-24/26), Pending Release at U.S. DOE-OSTI [Currently accessible online at: https://publications.anl.gov/anlpubs/2025/05/196524.pdf]*.
- Di Girolamo, L., Zhao, G., Zhan, G., Wang, Z., Loveridge, J., **Mitra, A.** *(2025). Decadal changes in atmospheric circulation detected in cloud motion vectors*. Nature. [DOI: 10.1038/s41586-025-09242]
- Mitra, A. et al. (2023). *Fusion of MISR Stereo Cloud Heights and MODIS IR Radiances*. JGR Atmospheres, 128, e2022JD038135. [DOI:10.1029/2022JD038135]
- Mitra, A. et al. (2021). *Assessment of Terra MODIS and MISR Cloud-Top Heights via ISS-CATS*. JGR Atmospheres. [DOI:10.1029/2020JD034281] **+5 more** available upon request

LEADERSHIP & GRANTS

- PI, DOE LDRD Seed Grant ($25k) – Global Benchmark Winds for Energy & Climate (2025)
- Co-I, NASA MEASURES Grant ($400k/year x 3 years) - Satellite Fusion Algorithm Data Creation
- Lead Analyst, DOE ORACLE Project (2023–Present)
- Convener & OSPA Judge, AGU Fall Meeting (2024)
- Community Science Expert, AGU Thriving Earth Exchange (2021)
- Journal Reviewer for JGR Atmospheres, Atmospheric Measurement Techniques, JQSRT, MDPI Remote Sensing (2021-present)