

Rituparna Sarkar

Summary

Ph.D. in Atmospheric and Space Sciences with a thesis focused on the development of an operational lightning forecast system using a global model and artificial intelligence (AI). As a Project Scientist II at the Indian Institute of Tropical Meteorology (IITM) under the National Monsoon Mission (NMM), two years of experience in the development of lightning parameterization in global models (GFS T1534 and BFS). Architect of a novel hybrid lightning forecast system (Two Autoencoder-based Classification or C_{2AE}) with results published in a peer-reviewed journal. To address the data volume of the km-scale global model (Bharat Forecast System or BFS) I/O, have developed and operationalised a parameter extraction tool that reduced data volume by a factor of 4× while increasing extraction speed by 12-fold. Work on organised convection indices and experiments conducted in WRF has been presented at international conferences. Skilled in programming, parallel computing, HPC, operational forecasting, research collaboration and research communication.

Publications

- Sarkar R, Mukhopadhyay P, Pawar S D (2025) Performance of a novel NWP–AI hybrid lightning early warning system over Indian Subcontinent. *Journal of Earth System Science* 134: <https://doi.org/10.1007/s12040-024-02470-5>
 - Sarkar R, Mukhopadhyay P (2025) Lightning Forecasting and Utilization of AI/ML in Early Warnings. *Severe Storms* 481–506. https://doi.org/10.1007/978-981-97-7075-5_18
 - Sarkar R, Mukhopadhyay P, Bechtold P, et al (2022) Evaluation of ECMWF Lightning Flash Forecast over Indian Subcontinent during MAM 2020. *Atmosphere* 13:1520. <https://doi.org/10.3390/atmos13091520>
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Awards

- Recipient of **AGU23 Student Travel Grant** held 11–15 December 2023 in San Francisco, California, USA for the abstract “*A Novel NWP-AI Hybrid Approach for Lightning Early Warning System.*”
- Recipient of **Best Student Award** for ranking first in the two-semester

Ph.D. course, 2018–2019, by Development of Skilled Manpower in Earth System Sciences (DESK), IITM, Pune.

- Recipient of **DST INSPIRE Fellowship, 2018** by the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India.
- Ranked 492 in **GATE 2018**.
- Ranked 17 in **CSIR-UGC Lectureship, 2017**.
- **DST INSPIRE Scholarship, 2012** from the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India.

Skills

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| <ul style="list-style-type: none"> • Working Experience with HPCs: Arka, Pratyush, Aditya • Operating system: UNIX, LINUX, Windows • Scripting Languages: Python, Bash, Shell, C++, Fortran, MATLAB • Experience with handling large datasets in NetCDF, HDF, GRIB, GRID, CSV and Binary format • NWP model: BFS, GFS T1534, ARW-WRF (v4.2, v3.9.1.1, v3.4) • WRF tools and packages: WRFDomainWizard, ARWpost, p_interp, ncl_convert2nc, wrf-python | <ul style="list-style-type: none"> • AIML Packages: Numpy, XArray, Pandas, DASK, Theano, Scikit-learn, SciPy, TensorFlow, PyTorch, Keras • Parallel computation using OpenMP, MPI, NVIDIA CUDA, DASK and data serialisation using Pickle • GIS and meteorological data analysis tools: GrADS, CDO, NCO, CDO{py}, eccodes, metpy, imdlib, cf-python, nctoolkit, geopandas, rioxarray, pangaea, netcdf4-python, ncview, GRIB-API, wgrib, wgrib2, ftn_wgrib2api | <ul style="list-style-type: none"> • Data Visualisation: GrADS, Matplotlib, Seaborn, Basemap, Cartopy, Shapely, PyNCL, PyNIO, PyNGL • Text editor: vim, notepad, notepad++, VS Code • Version Control Software: Git • Document preparation: Markdown, LaTeX, Microsoft Office, Google Workspace, Jupyter Notebook, GitHub, Notion, draw.io, mermaid.js, Canva, Adobe, Jekyll, HTML |
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Academic, Teaching and Organisational Experience

- **Organiser of the webinar Series “Next Steps after Your PhD? Unlocking Your Postdoc Potential”** as part of the platform named **PostDoc Potential in collaboration with “Climate Dialogues: Way Forward”** (Ongoing)
- **Subject expert** for the *Bengali Balbharati Class 2 Textbook* published by **Maharashtra State Textbook Production and Curriculum Research Board** for the 2025 edition
- **Reviewer** for **Pure and Applied Geophysics**, Springer Nature
- **Reviewer** for **Proceedings of the Indian Academy of Sciences: Earth and Planetary Sciences**, Springer Nature (New York, US)
- **Presented at the 5th Refresher Course** on “*Interpretation and Application of NWP Product in Weather Forecasting Services*” organised by the **Numerical Weather Prediction Division, IMD, MoES** in 2024
- **Given talk** on “*Short Range Forecast of Thunderstorm*” and “*Hands-on Training on WRF Model*” at **DESK-IITM Training for Indian Air Force (IAF) officers** 2024
- **Volunteered** at the **International workshop on Stratosphere-Troposphere Interactions and Prediction of Monsoon weather EXtremes (STIPMEX)** in 2024 at IITM, Pune.
- **Instructor** at the **2nd IITM Workshop of Indian Air Force Officers’ Training**, in October 2023
- **Created a short documentary** titled “*Who Came Before Us: Remembering S S Vaidya*” for **Workshop on Role of Women in Weather and Climate Sciences**, 2023, [Link: https://iccp2020.tropmet.res.in/videos/womens_day_2023/Vaidya.mp4].
- **Conducted workshop** on **Meteorological Forecast for Wind and Solar Energy Generation: Current Status and Future Perspective**, 2021.
- **Represented IITM** at the **2020 National Science Day Exhibition** at GMRT, Khodad.
- **Volunteered** at **International Workshop on Prediction skill of Extreme Precipitation Events and Tropical Cyclones: Present status and future Prospect (IP4)** in 2019 at IITM, Pune.

Presentations and Training

- **Delivered a guest talk** titled “*Forecasting Lightning: Physics-Based and Data-Driven Approach*” at the **Department of Atmospheric Sciences, University of Calcutta**, on March 06, 2026

- **Presented recent research outcomes as a poster titled “A Novel NWP-AI Hybrid Approach for Lightning Early Warning System,” at AGU23 session Advancements in Lightning Meteorology, Air Quality, and Climate** held 11–15 December 2023 in San Francisco, California, USA
- Presented at the 2nd Workshop on Cloud Organisation and Precipitation Extremes, 2022.
- Presented a poster at the Workshop on Spatial Organisation of Convection, Clouds and Precipitation in May 2021.
- Online training on AI/ML for atmosphere-ocean applications for beginners, 2021.
- **Completed Coursework:** SMART Training Program on Basics of Satellite Meteorology, 2018 at SAC, ISRO.
- Participated in The National Seminar on Monsoon and Its Variability in 2017.
- Participated in The International Workshop on Climate Extremes: Observation, Analysis and Modelling in 2017
- Participated in the National Science Day Celebration Program in VECC, Kolkata, in 2014.

Research Experience

Indian Institute of Tropical Meteorology, Dr. Homi Bhabha Road, Pashan, Pune 411008

Project Scientist II, January 2024 – January 2026

- **Project:** *Application development for wind energy/ solar power sectors* under National Monsoon Mission (NMM)
- Experience in the development of lightning parameterization in BFS using Fortran and shell scripting in Arka HPC
- Experience in development and operationalisation of parameter extraction tools for the BFS model output (in ≥ 100 TB) using shell scripting in Arka HPC
- Experience in BFS model output analysis and visualisation using Python and GrADS scripting
- Experience in the implementation of mesoscale convective system tracking (organization_indices and PyFLEXTRKR) using BFS, GFS T1534 and ERA5 datasets
- Completed basic course on Code of Conduct for Government Employees by the Institute of Secretariat Training and Management, along with six other certificate courses on the Karmayogi platform
- Work has been presented at the Eighth WMO International Workshop on Monsoons (IWM-8), 2025 and at INTROMET-2025.

IITM Research Fellow, August 2023 – January 2024

DST INSPIRE Research Fellow, August 2018 – August 2023

- Experience in the development of lightning parameterization for IITM GFS T1534 with the help of Fortran and shell scripting in Pratyush HPC.
- Developed a unique NWP AI-hybrid lightning prediction system with IMD WRF operational output as model input.
- Participated in the Short-Range Prediction System daily operational forecast by generating meteorological forecast products using daily forecast output from GFS T1534 and GEFS T1534.
- Experience in successful installation and execution of GFS T1534 and ARW WRF v3.9.1.1.
- Have conducted extensive data preprocessing of operational forecasting datasets for global and regional models, as well as raw observational data, using Python, CDO, NCO and shell scripting on the UNIX operating system.
- Computed complex statistical analyses and interpreted data using Python, CDO and GrADS.
- Collected data and observed trends while analysing global and regional numerical model output.
- Compiled data in reports and other documents using Markdown, LaTeX, Microsoft Office, Google Workspace, Jupyter and Notion.
- Collaborated with other researchers to write and distribute the impactful results of the forecast skill of the lightning prediction system generated by the global numerical model.
- Followed best practices and scientific protocol to reach defensible conclusions based on solid evidence.
- Upheld all university and regulatory requirements for documentation of findings.

Education

Indian Institute of Tropical Meteorology, Dr. Homi Bhabha Road, Pashan, Pune 411008; Savitribai Phule Pune University, Pune 411007
Ph.D., Atmospheric and Space Sciences, August 2025

- **Thesis Paper:** Development of the Lightning Forecasts in Global Forecasting Models and in Data-Driven Weather Forecasting Models.
- **Completed Coursework:** Two-Credit Course 2023–24 on Research and Publication Ethics conducted by the Centre for Publication Ethics, Savitribai Phule Pune University.

University of Calcutta, Ballygunge Science Campus, Kolkata 700 019
Master of Science, Atmospheric Sciences, September 2017

- **Final Grade: 80.1%**

- **Dissertation:** Probing for connectivity between lightning activity and depth of convection during pre-monsoon season over Kolkata.

University of Calcutta, Asutosh College, Kolkata 700 026

Bachelor of Science, Physics (Honours), Mathematics, Chemistry, June 2015

- **Final Grade: 65.75 %**

West Bengal Council of Higher Secondary Education, Bachamari G.K. High School, Maldah 732142

Higher Secondary, Bengali, English, Chemistry, Mathematics, Physics, June 2012

- **Final Grade: 83.2 %**

West Bengal Board of Secondary Education, Barlow Girls' High School, Maldah 732101

Madhyamik Pariksha (Secondary Examination), Bengali, English, Physical Sciences, Mathematics, Life Sciences, History, Geography, May 2010

- **Final Grade: 74.88 %**