

## DR. SHASHANK KUMAR ROY

Postdoctoral Researcher, Lab-STICC

Institut Mines-Télécom (IMT), Atlantique, Bretagne Pays de la Loire École Mines-Télécom  
Technopôle Brest-Iroise, 29238 Brest cedex 03, France

**Email:** shashank.roy@imt-atlantique.fr

**Phone:** +33-780490940

**GitHub:** [shashankkroy.github.io](https://github.com/shashankkroy)

**LinkedIn:** [linkedin/shashankroy](https://www.linkedin.com/in/shashankroy)

**Office:** K01-223A

**Citizenship:** Indian

### Research interests

General state estimation and prediction problems in geosciences, Machine Learning, Deep learning for Data Assimilation, Weather and Climate modelling, Sequential state estimation, Physics-based Modelling and Simulation, Bayesian data assimilation, Gaussian processes, Markov chain Monte-Carlo methods, Generative modelling for probability distributions, Optimal transport applications, Dynamical systems, Data Science.

### Publications

- [1] **4DVarNet-LU: An end-to-end Generative Model for Neural Data Assimiation**, Shashank K. Roy, Ronan Fablet. *In Preparation*
- [2] **Spatiotemporal Coherent Displacements for Ensemble-Based Neural Data Assimilation**, Shashank K. Roy, Ronan Fablet. *Submitted to Climate Informatics 2026*
- [3] **A note on the sensitivity of Lyapunov Vectors to trajectory perturbations**, Shashank Kumar Roy, Amit Apte. *Accepted(In Press), NPG, 2025. doi.org/10.5194/egusphere-2023-2168*
- [4] **Probing robustness of nonlinear filter stability numerically using Sinkhorn divergence** Pinak Mandal, Shashank Kumar Roy, Amit Apte, *Physica D*, 2022, *doi.org/10.1016/j.physd.2023.133765*.
- [5] **Stability of nonlinear filters - numerical explorations of particle and ensemble Kalman filters** Pinak Mandal, Shashank Kumar Roy, Amit Apte, *2021 Seventh Indian Control Conference (ICC), Mumbai, India, 2021, pp. 307-312, doi: 10.1109/ICC54714.2021.9703185*.

### Education

**PhD, Physics, International Center for Theoretical Sciences** Bangalore, India  
Advisors: Prof. Amit Apte and Prof. Samridhi Sankar Ray July 2020 – Jan 2025  
Title: A study of dynamical instability and filter stability using the ensemble Kalman filter. PhD awarded, Jan 2025.

**International Center for Theoretical Sciences** Bangalore, India  
Masters in Physics, *GPA: 7/10* July 2017 – December 2020  
Mentors: Prof. Amit Apte, Prof R. Loganayagam

**University of Delhi** New Delhi, India  
Bachelors in Physics (Honours) *Percentage: 87 %* July 2014 – July 2017

### Seminar/ Conf. Presentations

**Performance Gains and Advantages of 4DVarNet in End-to-End Learning for Data Assimilation** Shashank Kumar Roy, Ronan Fablet, *EGU General Assembly 2025, Vienna, Austria, 27 Apr–2 May 2025, EGU25-4300, doi.org/10.5194/egusphere-egu25-4300*.

**Automatic differentiation for 4DVar data assimilation with single layer quasi-geostrophic dynamics** Space Application Center, India Space Research Organisation (ISRO) Ahmedabad, India

## Projects

**Workshop lecture: AI for Data Assimilation - 4DVar & 4DVarNet for Ocean dataset,** National Atmospheric Research Laboratory, Department of Space, GOI. Tirupati, India.

**4DVarNet: A neural network model for data assimilation** Seminar, Department of Data Science, IISER Pune. India

**Tutorial on 4DVarNet: A neural data assimilation framework,** BIRS-CMI Mathematical and computational foundations of climate modelling, Chennai Mathematical Institute. India

**4DVarNet-LU: An end-to-end trainable ensemble model for data assimilation.** Oceanix, Lab-STICC, IMT Atlantique

Generates an ensemble of reconstructions based on a positional-uncertainty model based on using Gaussian random fields, given a sequence of observations Aug – Jan 2026

**Neural-ODE approach to weak-4DVar with sparse and noisy pseudo-altimetry observations** , Oceanix, Lab-STICC, IMT Atlantique

Solving a 4DVar optimisation problem for quasi-geostrophic model and LBFGS, SGD, etc. as optimisers leveraging automatic-differentiation in PyTorch. August – Dec 2019

**Sequential filtering algorithm for high-dimensional chaotic system with partial and noisy observation** , Mentor: Prof. Amit Apte, Semester Project, ICTS August – Dec 2019  
Implementing ensemble kalman filter for Lorenz-96 ode to compute conditional distribution.

**Cytoplasmic streaming driven by Surface flows using Vector Spherical Harmonics**

Mentor: Prof Vijay Kumar Krishnamurthy, Biophysics Group at ICTS

Analytical solution of Stokes equation for spherical geometry for bulk flow inside a sphere driven by a surface flow May – August 2018

**An Interdisciplinary Study of Light Pollution in Indian Context (Extension)**

Late Dr.N.Rathnasree, Ex-Director, Nehru Planetarium) and Dr Ashok Kumar, Department of Physics, Ramjas College .

University of Delhi under Innovation Project Scheme 2015-2016 (RC302) Oct 2015 – Nov 2016

## Academic Visits

**Prof. David Greenberg's Lab, Hereon Zentrum** Hamburg, Germany. Jan 2024 – Feb 2024

**University de Grenoble, Host: Dr. Julien Lessomer** Grenoble, France

**Department of Data Science, IISER Pune, Host: Prof. Amit Apte** Pune, India

## Teaching experience

**Teaching assistant, Computational Tools for Climate Science, Climatedata Academy, US** A course on climate data analysis and modelling for understanding and answering questions through coding in python and jupyter notebook. My role as a teaching assistant was to initiate discussions, motivate questions and guide students through the coding exercises. July 2023

**Teaching assistant, Department of Data Science, IISER Pune, India, DS4233: Time Series** Course on basic time series analysis and modelling. Curating Jupyter notebooks for demonstrations and taking tutorial sessions. Jan-April 2023

**Advanced Physics Subject Matter Expert (Chegg.com)** July 2020- July 2021

Freelance Tutor for solving university level doubts and problems for students.

Licences and Certifications	NVIDIA, Deep Learning Institute	Summer 2022
	[1] Applications of AI for Anomaly Detection	Issued on July 2022
	[2] Accelerating Data Engineering Pipelines	Issued on Feb 2022
	[3] Fundamentals of Deep Learning	Issued on Feb 2022
	IBM, Qiskit	
	[1] Quantum Computation -Certified Associate Developer	Januray 2022
	[2] IBM Quantum Challenge 2021 Achievement - Advanced	June 2021
	Neuromatch Academy - Deeplearning Course and Project <a href="#">view</a>	August 2021
	Imperial College London-Online course on Data Assimilation <a href="#">view</a>	11-15 July 2022
Achievements	Secured 10th best score in IBM Quantum Challenge	2021
	Department of Atomic Energy Fellowship for pursuing PhD in Physics	2019
	Joint Entrance Screening Test AIR-95, Percentile-98.8 and IIT-JAM 2017, AIR-259	2017
	Awarded ISC-2014 School Topper in Science, 3rd at district level, Senior Secondary Exam 2014	
Conferences and Workshops	<b>Conference on Nonlinear Systems and Dynamics 2022, IISER Pune, India</b> , Presented a poster titled, " <i>Reconstructing Covariant Lyapunov Vectors using Nonlinear Filtering</i> "	Dec 2022
	<b>ECMWF-ESA Machine Learning for Earth Observation and Prediction</b>	14-17 Nov 2022
	Workshop on machine learning and data assimilation on using earth observations data.	
	<b>Qiskit Global Summer School on Quantum Machine Learning, IBM</b>	July-August 2021
	Summer School focusing on quantum machine learning formalisms and algorithms with hands-on experiemnts via IBM-Quantum lab.	
	<b>ICTS Workshop on Climate Studies</b>	July-Aug 2021
	Talks and lectures on climate modeling, topics relevant to climate change and related policies.	
	<b>Indo-US Workshop on Recent Advances in AI ML for Climate Sciences</b>	Nov 13-15 2021
	Technology Innovation Hub, Indian Statistical Institute, Kolkata and IEEE GRSS Kolkata Chapter, on the problems and applications in climate data science	
	<b>Meta- Heuristic Optimization, Machine Learning and AI-Workshop</b>	March 8-12 2021
	Talks and tutorials organized by SAMSI, on the theory and practical applications of metaheuristic optimization methods in statistics such as swarm and evolutionary algorithms.	
	<b>Numerical Analysis in Data Science Workshop</b>	August 26-27 2021
Technical Skills	Workshop on inverse problems and uncertainty quantification, sensitivity analysis, Reinforcement Learning and dimension Reduction in time series.	
	<b>The Fields Institute Second Symposium on Machine Learning and Dynamical Systems</b>	
	On the intersection of machine learning and dynamical systems theory to solve problems in representation leanring, analysis and prediction.	September 2020
	<b>Programming languages and frameworks</b>	
	Pytorch, Python, Xarray, Pandas, Numpy, Scipy, Jax	
	Familiar with C++, Fortran	
	<b>Languages</b>	
	English (advanced), Hindi (fluent)	