



Shalini Balaram Ph.D.

Computational hydrologist – Stochastic modelling, drought dynamics, and GeoAI for water resources.

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SUMMARY

Hydrologist with doctoral training at IIT Madras specialising in stochastic and statistical methods for rainfall and streamflow simulation, with methodological strength in machine learning and applied geospatial analysis for water resources. Research spans stochastic streamflow modelling (Environmental Research Communications, 2025), global reservoir drought recovery (under review, Environmental Research Letters), and Indian-monsoon hydroclimate under CO₂-removal scenarios (under review, Climate Dynamics). Industry experience at AtkinsRéalis and prior ML engineering complement academic training with production-grade modelling practice.

EDUCATION

2016–2025	Ph.D. – Civil Engineering (Water Resources / Stochastic Hydrology) <u>IIT Madras</u> Full-time; HTRA Fellowship (MHRD)
2013–2015	M.E. – Water Resources Engineering <u>UVCE, Bangalore University</u> First Class with Distinction; GATE PG Scholarship
2008–2012	B.E. – Civil Engineering <u>BMS College of Engineering (BMSCE), VTU</u> Elective: Remote Sensing & GIS in Environmental Engineering

Hybrid Stochastic Frameworks for Multi-site Rainfall and Streamflow Simulation with Application to Drought Analysis

IIT Madras, Department of Civil Engineering

Dr. K. Srinivasan (Supervisor); Dr. R. Srivastav (Co-Supervisor) · Defended 30 June 2025 · Awarded 11 July 2025

A hybrid stochastic modelling framework for synthetic rainfall and streamflow generation at multiple sites, with explicit application to drought characterisation and frequency analysis. Introduces a multi-step methodology coupling PcStream clustering with Markov-chain processes for daily streamflow simulation, validated on river basins, supporting Monte-Carlo hydrological risk assessment and severity/intensity-duration-frequency (S/IDF) curves for drought analysis.

- Novel coupling of PcStream clustering with Markov-chain processes for synthetic daily streamflow simulation (published, Environmental Research Communications, 2025).
- Multi-site simulation frameworks preserving spatial cross-correlation across gauging stations.
- Hydroclimatic drought characterisation and demand-aware drought-monitoring frameworks.
- S/IDF curves and their application to hydrological risk assessment.
- Large-scale Monte-Carlo simulation pipelines in MATLAB and Python.

Journal articles

1. **A novel multi-step methodology for stochastic simulation of streamflow time series using PcStream clustering.** PUBLISHED

Balaram, S., Srivastav, R., & Srinivasan, K. (2025). *Environmental Research Communications*, 7(2), 021011. DOI: 10.1088/2515-7620/adb544. IOP Publishing; Scopus & Web of Science indexed.

Manuscripts under review

1. **Reservoir Storage Anomalies Often Recover More Slowly Than They Develop Across Global Records.** UNDER REVIEW

Balaram, S. (2025). *Environmental Research Letters* Sole / corresponding author. Under review.

2. **Hysteresis in Hydroclimatic Drought Under CO₂ Removal: Atmosphere–Land Recovery Decoupling in the Indian Monsoon Region.** UNDER REVIEW

Balaram, S., & Shilpa, L. S. (2025). *Climate Dynamics (Springer)* First author. Under review.

Conference papers

1. **Season-Adaptive GeoAI Framework for Drought Propagation Prediction in Monsoon Climates.**

CONFERENCE

Balaram, S. (2025). *ISG-ISRS National Symposium 2025, Kolkata, India*. Mixture-of-Experts across 242 Indian catchments and 6,690 drought events (CAMELS-IND).

2. **HydroAlert: AI-Powered Water Disaster Detection – Automated Bilingual News Monitoring for Kerala’s Water Safety.** CONFERENCE

Balaram, S., & Shilpa, L. S. (2025). *Kerala Science Congress 2025, Kerala, India*.

3. **A synthetic streamflow generator method: coupling the clustering technique with the Markov chain for daily streamflow generation.** CONFERENCE

Balaram, S., & Srinivasan, K. (2022). *STAHY 2022, Chia, Italy. IAHS*.

EXPERIENCE

Feb 2026 –
Present

Engineer II, Water Resources, AtkinsRéalis

Bangalore

- Water-resources decision-support models using Pywr for resource-allocation modelling (South East Water).
- Surface-water yield and supply–demand simulation using Aquator (Carlisle water-system project).
- Translating client requirements into model configurations, scenario design, and reporting for UK water utilities.
- Bridging research-grade stochastic methods with production-grade modelling workflows.

May 2023 – Jan
2026

Project Strategist, ML & Data Engineering, Makerstudio

Bangalore

- Automated forecasting frameworks (Python, PySpark) for short-term demand and inflow prediction.
- Designed and maintained production data pipelines with end-to-end documentation and operational reliability.
- Translated technical requirements into stakeholder-facing specifications and delivery roadmaps.

Jul 2012 – 2013

Junior Research Fellow, Indian Institute of Science (IISc)

Bangalore

- Comprehensive SWAT model of the Mahanadi basin: watershed delineation, sub-basin setup, HRU configuration.
- Processed DEM, soil, LULC, and climate inputs for distributed hydrological modelling.
- LULC classification with ERDAS IMAGINE; integrated with ArcGIS for SWAT-ready geospatial inputs.

AWARDS & FELLOWSHIPS

- **IOP Trusted Reviewer** – IOP Publishing (May 2025) – for detailed, insightful, timely peer-review reports.
- **WLI Research Award 2022** – Women Leading IITM Research Award; competitive grant of ₹2,10,000; IIT Madras.
- **Half-Time Research Assistantship (HTRA)** – MHRD, Government of India; Ph.D. fellowship, IIT Madras (2016–2025).
- **GATE Postgraduate Scholarship** – AICTE/MHRD; M.E. programme at UVCE (2013–2015).
- **Junior Research Fellowship (JRF)** – Indian Institute of Science (IISc), Bangalore (2012–2013).

TEACHING

Courses prepared (core): Surface Water Hydrology; Water Resources Planning & Management; Stochastic Hydrology; Simulation Modelling in Water Resources; Computational Methods & Hydroinformatics in Water Resources.

Proposed electives: Sustainable River Basin Management; GeoAI for Water Resources Applications.

- IIT Madras (Ph.D.): Water Resources Planning & Modelling (M.Tech./Ph.D.) – set/graded homework, ran problem-solving sessions; Hydrology (B.Tech.) – homework + hands-on EPANET instruction.
- UVCE (M.E.): Hydraulics Laboratory – lab instruction; developed lab-exercise structure and reporting format.

Individual problem-solving support to UG students (Hydrology, EPANET water-network exercises, IIT Madras) and coursework support for M.Tech./Ph.D. students (WRPM). Formal supervision to commence upon faculty appointment.

TECHNICAL SKILLS

Programming & computation: Python (advanced), R, MATLAB, PySpark, SQL.

Hydrological & water-systems modelling: Pywr, Aquator, HEC-RAS, ArcSWAT / SWAT, EPANET.

GIS & remote sensing: ArcGIS, QGIS, ERDAS IMAGINE, GPM-IMERG, CAMELS-IND.

Machine learning & statistics: XGBoost, scikit-learn, Mixture-of-Experts, time-series analysis, SHAP, Monte-Carlo & Markov-chain methods, frequency analysis.

Data infrastructure: pipeline orchestration, workflow automation, production data engineering, NetCDF / xarray.

Tools: Git/GitHub, Linux/Unix shell, LaTeX, Jupyter.

OPEN-SOURCE SOFTWARE

- **HEC-RAS Flood Analysis** (Python) — Guadalupe River flood-analysis utilities using USGS/NOAA data, HEC-RAS controller checks, and peak-flow reporting. [ShaliniBalaram/hec-ras](#)
- **GPM-IMERG Tools** (Python) — Tools for downloading, clipping, and analysing NASA GPM-IMERG satellite precipitation. [ShaliniBalaram/GPM_IMERG_Tools](#)
- **LSTM Streamflow Forecasting** (Python) — Rainfall-runoff LSTM forecasting pipeline with reproducible metrics and plots. [ShaliniBalaram/LSTM-streamflow-forecasting](#)
- **Raven** (Python) — Geomatics toolkit for DEM conditioning, stream extraction, basin delineation, and reach-network validation. [ShaliniBalaram/Raven](#)
- **pywrscope** (TypeScript) — Desktop visual editor and validator for Pywr water-resource network models. [ShaliniBalaram/pywrscope](#)
- **NYC Data Pipeline** (Spark / Airflow) — Data-engineering pipeline for NYC trip records with Spark and Airflow-style orchestration. [ShaliniBalaram/NYC_assessment](#)

PROFESSIONAL SERVICE & MEMBERSHIPS

- Peer Reviewer, IOP Publishing — IOP Trusted Reviewer status (May 2025).
- Workshop Coordinator, SWAT 2018 Conference — organizing committee, IIT Madras.
- Associate Member, Institute of Physics (IOP), UK.
- Member, International Association of Hydrological Sciences (IAHS).

SELECTED PRESENTATIONS

- ISG-ISRS National Symposium 2025, Kolkata — Season-Adaptive GeoAI Framework for Drought Propagation.
- Kerala Science Congress 2025 — HydroAlert: AI-Powered Water Disaster Detection.
- STAHY 2022, Chia, Italy — stochastic streamflow generation using clustering and Markov-chain methods.

REFERENCES

Available on request.