Sandra Rebecca Babyale

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Professional Summary

I'm a highly motivated Ph.D. candidate in Computational Mathematics with a strong background in scientific computing, numerical modeling, data assimilation and inverse methods. My research focuses on modeling complex physical systems, particularly wildfire smoke transport, by combining high-performance computing with techniques from data assimilation and inverse problems. I enjoy building and testing algorithms, running large-scale simulations, and working across disciplines to solve real-world problems. Sharing my work through writing and presentations has also been a key part of my growth as a researcher.

Education

Boise State University — Boise, ID, USA
Ph.D. in Computational Mathematics, Science & Engineering — Jan 2022 - present
CGPA: 3.968/4.0
Relevant coursework: Parallel Scientific Computing, Numerical Methods for PDEs, Numerical Linear Algebra, Inverse problems, Optimization, and Hydroclimate Data Analysis. Computing foundations for Computer science, Data science, Machine Learning.

African Institute for Mathematical Sciences — Kigali, Rwanda
M.Sc. in Mathematical Sciences (Distinction) — Aug 2020 - Jul 2021
Relevant coursework: PDEs, Data Assimilation, Numerical Methods, Fluid Dynamics, Climate Modeling, Python Programming, Statistical Regression (R).
Thesis: *Assimilating Long-Range Regional Transport of Smoke by Estimating PM2.5 Concentration Using Weak Constraint Data Assimilation (Supervised by Prof. Jodi Mead and Prof. Donna Calhoun from Boise State University)*

Busitema University — Tororo, Uganda
B.Sc. in Physics (Major) and Mathematics (Minor) — Aug 2016 - Jul 2019
CGPA: 4.20/5.0
Research title: *Design and Construction of a Variable DC Power Supply (2V-30V), (Supervised by Dr. Mike Seeti)*

Research Experience

NSF Project: Data-enabled Modeling of Wildfire Smoke Transport — Boise, ID, USA
Graduate Research Assistant | Boise State University — Jan 2022 - present

- Developed methods for estimating model error covariance in weak-constraint variational data assimilation using regularization parameter selection techniques.
- Designed and tested numerical experiments using 1D and 2D advection-transport equations for wildfire smoke dispersion modeling.
- Applied high-performance computing to parallelize large-scale simulations on Borah (Boise State University supercomputer).
- Conducted computational experiments to evaluate the impact of isotropic and non-isotropic

model error covariances on forecast accuracy.
• Presented research findings at national SIAM, IMSI, AWM, and other national conferences and workshops.
• Used tools such as Python, NumPy, SciPy, LaTeX, Git, HPS, and Bash for reproducible scientific research

Research Intern | African Institute for Mathematical Sciences — Kigali, Rwanda
Mar 2021 - Dec 2021
• Used Python and R to perform statistical and computational analysis on regional climate datasets.
• Investigated the use of numerical optimization methods for climate modeling.
• Processed and analyzed Climate Model Output (CMO) stored in NetCDF format, including data extraction, cleaning, and visualization.
• Communicated findings through presentations and written reports.

Publications

• **Model Error Variance Estimation for Weak-Constraint Data Assimilation**, accepted for publication in *SIAM/ASA Journal on Uncertainty Quantification* (2025)

Other Experience

IMSI Summer Data Science Bootcamp | University of Chicago — Online
Jun 2rd - 13th 2025
• Participated in a hands-on data science training focused on using Python and R to analyze different data types, including numerical, image, and text. Worked on both individual and team-based projects, exploring tools and techniques widely used in industry and research applications.

US Research Software Sustainability Institute Summer School | George Washington University — Washington DC, USA
Jun 24th - 26th 2024
• Gained hands-on experience in software design, modular programming, version control with Git/GitHub, testing, packaging, and documentation. The program also emphasized reproducibility, open science, and collaborative development, with dedicated time to apply these tools directly to my research code.

LeaderShape Institute | Boise State University — Boise, ID, USA
May 6th - 9th 2024
• Attended this four-day workshop focused on personal leadership development through hands-on activities, group discussions, and self-reflection. The experience helped me strengthen my ability to lead with vision, communicate effectively, and collaborate within diverse teams.

Tutor Intern | African Institute for Mathematical Sciences — Kigali, Rwanda
Aug 2021 - Dec 2021
• Supported teaching and learning by assisting with lectures, leading tutorials, grading assignments, and helping organize academic logistics. Provided one-on-one and group mentoring to students, offered technical support for scientific software, and helped manage library and learning resources to ensure a smooth and enriching academic experience.

Online Internship Assistant | University of Liverpool — Online
Apr 2021 - May 2021
• Supported teaching and learning by assisting with lectures, leading tutorials, grading

assignments, and helping organize academic logistics. Provided one-on-one and group mentoring to students, offered technical support for scientific software, and helped manage library and learning resources to ensure a smooth and enriching academic experience.

Conferences and Workshops

- **IMSI Uncertainty Quantification and Machine Learning for Complex Physical Systems workshop -** Chicago, IL (2025)
  Poster presenter

- **Association for Women in Mathematics Workshop at the SIAM Annual Meeting** - Spokane, WA (2024)
  Poster presenter and award recipient

- **7th International Fire Behavior and Fuels Conference** – Boise, ID (2024)
  Participant

- **SIAM Pacific Northwest Section Meeting** - Bellingham, WA (2023)
  Gave an oral research presentation

- **AI Institute Launch (University of Washington) -** Seattle, WA (2022)
  Participant

Technical Skills

- **Programming languages and tools:** Python, R, MATLAB, C++, Fortran
- **Tools:** Bash, Git/GitHub, VS Code, LaTeX, HPC (Borah, R2 super computers), Anaconda
- **Certifications:** IBM Data Science, Machine Learning, and Deep Learning

Honors and Awards

- **NSF Graduate Research Funding**, Boise State University
- **AWM SIAM Poster Award**, SIAM Annual Meeting 2024
- **Fully Funded Master's Scholarship**, AIMS Rwanda
- **Government Scholarship**, Busitema University

Leadership & Service

- **Marketing and Operations Manager**, AWM and SIAM Student Chapters at Boise State University
  I coordinate outreach, event planning, and chapter communications to promote student engagement in applied mathematics and research communities.
- **Volunteer** at the Campus Food Pantry at Boise State University
  Assisted with food distribution and inventory, supporting students facing food insecurity.
- **Volunteer** at Infinity Care and Services LLC
  Provided community support and care services, contributing to wellness initiatives for individuals and families.
- **Mentor,** Busitema University Department of Physics & African Institute for Mathematical Sciences
  I provide academic and career guidance to undergraduate and graduate students, supporting them in navigating research opportunities, graduate school applications, and career development in STEM fields.