Malarvizhi Arulraj, Ph.D.

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CURRENT AFFILIATION

University of Maryland June 2020 - Present
Postdoctoral Associate at CISESS/ESSIC

- Development, monitoring and validation of precipitation retrieval from Passive Microwave Sensor, AMSR-2 on board of GCOM-W1 satellite.
- Designing an open-source-based, automated validation system to assess the performance of the NOAA satellite-based precipitation products over United States in near real-time.
- Design, development and management of a web-based application, NPreciSE - NOAA Satellite Precipitation Validation System (https://precip-val.umd.edu/) to publish the validation results of Level-2 and Level-3 precipitation products in near real-time.
- Machine-Learning based framework design to classify reflectivity profiles based on its structure to better understand the impact of the precipitation vertical structure in the satellite-based precipitation retrieval errors.
- Synthetic generation of high temporal resolution Passive Microwave Brightness Temperature by leveraging on Advanced Baseline Imager observations from geostationary satellites using Deep Learning Models.

PAST AFFILIATIONS

Duke University February 2020 - May 2020
Research Associate

Duke University June 2015 - December 2019
Graduate Research Assistant

Indian Institute of Science August 2012 - June 2014
Research Assistant

EDUCATION

Ph.D. in Hydrology and Fluid Dynamics August 2014 - December 2019
Department of Civil and Environmental Engineering
Duke University, Durham, U.S.A.
Advisor: Dr. Ana P. Barros
Dissertation: Quantifying and Elucidating the Physical Basis of Uncertainty in GPM Precipitation in Mountain Regions using Multi-Frequency Observations and Models

Master of Technology in Climate Science August 2012 - June 2014
Centre for Atmospheric and Oceanic Sciences
Indian Institute of Science, Bangalore, India.
Advisor: Dr. V. Venugopal

Bachelor of Technology in Electronics & Communication July 2008 - May 2012
Department of Electronics and Communication Engineering
Amrita Vishwa Vidyapeetham, Coimbatore, India.

GRANTS

CISESS Seed Grant January 2023 - December 2023
Title : 3D-VisSys: Three-Dimensional Weather Visualization System for Maryland-DC Region
Grant: USD 25,000 + 1 summer intern
Role : PI

NASA ROSES Pending
Title : Augmenting geostationary observations to understand precipitation across complex orographic regions
Call : A.29 Earth Science Research from Operational Geostationary Satellite Systems
Role : PI

AWARDS AND SCHOLARSHIPS

- Student Oral Presentation Award 3rd prize — July 2022
  NOAA Cooperative Research Programs (CoRP) Science Symposium 2022
- NASA Earth and Space Science Fellowship — September 2016 - August 2019
  Proposal title - Quantifying and Elucidating the Physical Basis of Uncertainty in GPM Precipitation in Mountain Regions using Multi-Frequency Radar Observations and Models.
- Professor Senol Utku Award — 2018
  Annual Award for best pre-Ph.D. journal papers by Civil and Environmental Engineering, Duke University
  High Distinction awarded for Arulraj and Barros, 2017.
- Graduate School Fellowship, Duke University — August 2014 - May 2015
- International Summer School Scholarship — July 2013 - August 2013
  Exeter University, Exeter, U.K.
- Grantham Fellowship — January 2013 - June 2014
  Awarded for top GPA by Divecha Center for Climate Change
- HRD India Scholarship — August 2012 - June 2014
  Ministry of Human Resources and Development, India
- International Precipitation Conference (IPC12) Travel Award — June 2019
  Funded by NASA and NSF.
- Conference Travel Award — December 2018
  Graduate School, Duke University

TEACHING EXPERIENCE

University of Maryland — June 2022 - August 2022
Mentor: CISESS Summer Internship 2022

- Investigating the potential to use CoCoRaHS precipitation measurements to the validation of satellite-based precipitation products.

University of Maryland — June 2021 - August 2021
Mentor: CISESS Summer Internship 2021

- Developing an user-interactive website with Python back-end to display the performance of satellite precipitation retrievals over United States in real-time (https://precip-val.umd.edu/).

Duke University — May 2019 - July 2019
Mentor: Undergraduate Summer Research

- Mentored an Undergraduate student, Ms. Sarah Mosier on project titled: " Characterizing long-term variability and non-stationarity of extreme precipitation events using GPCP, IMERG, CMIP5 and CMIP6 model simulations"

Duke University — January 2017 - June 2017
Teaching Assistant - Uncertainty, Design and Optimization

- Administered lab sessions and office hours for 25 undergraduate students to solve optimization problems using Matlab.

BOOK CHAPTER

Barros, A. P., and **Arulraj, M.**, 2020: Remote Sensing of Orographic Precipitation, In *Satellite Precipitation Measurement*, Ed. Levizzani, V., Springer, pp. 559-582.DOI: 10.1007/978-3-030-35798-6.

PEER-REVIEWED PUBLICATIONS

Miller, D., **Arulraj, M.**, and Co-authors: A study of two impactful heavy rainfall events in the southern Appalachian Mountains during early 2020, part II; regional overview, rainfall evolution, and satellite QPE utility, *Remote Sens.*, **13**(13), 2500.

Arulraj, M., and Barros, A. P., 2021: Automatic detection and classification of low-level orographic precipitation processes from space-borne radars using machine learning, *Remote Sens. Environ.*, **257**, 112355.

Arulraj, M., and Barros, A. P., 2019: Improving Quantitative Precipitation Estimates in Mountainous Regions by Modeling Low-Level Seeder-Feeder Interactions constrained by Global Precipitation Measurement Mission Dual-frequency Precipitation Radar Measurement, *Remote Sens. Environ.*, **231**, 111213.

Barros, A.P., Hodes, J. L., and **Arulraj, M.**, 2017: Decadal climate variability and the spatial organization of deep hydrological drought, *Env. Res. Letters*, **12**(10).

Arulraj, M., and Barros, A. P., 2017: Shallow Precipitation Detection and Classification using Multifrequency Radar Observations and Model Simulations, *J. Atmos. Ocean. Tech.*, **34**, 1963-1983.

SUBMITTED AND IN PREPARATION

Arulraj, M., Petkovic, V, Ferraro, R. R., Meng, H.: Precipitation Vertical Structure Characterization - a Feature-based approach, *submitted to AMS JHM.*

Arulraj, M., Petkovic, V, Ferraro, R. R., Meng, H.: NPreciSe: An Automated NOAA Satellite Precipitation Validation System, *to be submitted to Remote Sensing by March 2023.*

ORAL PRESENTATIONS

Arulraj, M., Petkovic, V, Meng, H., Ferraro, R. R., 2022: Exploring the bias in satellite-based passive-microwave retrievals from vertical structure perspective, *American Geophysical Union Fall Meeting 2022*, Chicago, Illinois, U.S.A. **Arulraj, M.**, Petkovic, V, Ferraro, R. R., Meng, H., 2022: Characterizing Precipitation Vertical Structure Feature-based Approach, Particle Size Distribution Working Group, Precipitation Measurement Mission, NASA, Virtual.

Arulraj, M., Petkovic, V, Ferraro, R. R., Meng, H., 2022: Assessing the Impact of Precipitation Vertical Structure in the Satellite Precipitation Retrievals Feature-based approach, *NOAA Cooperative Research Programs (CoRP) Science Symposium*, Fort Collins, Colorado, U.S.A.

Arulraj, M., Petkovic, V, Ferraro, R. R., Meng, H., 2022: Building an Enterprise NOAA/NESDIS Satellite Precipitation Validation System, *American Meteorological Society Annual Meeting 2022*, Virtual.

Arulraj, M., Petkovic, V, Ferraro, R. R., Meng, H., 2021: Exposing the Physical Basis of Satellite Precipitation Retrieval Errors, *American Geophysical Union Fall Meeting 2021*, New Orleans, Louisiana, U.S.A.

Barros, A. P., Chavez, S., Lihui, J., and **Arulraj, M.**, 2021: Fingerprinting Precipitation Processes in Remote-Sensing Observations, *European Geosciences Union General Assembly 2021*, Virtual.

Arulraj, M., Petkovic, V., and Ferraro, R., 2021: Automated Validation for NOAA Satellite Precipitation Products, *Joint Polar Satellite System (JPSS) STAR Leads Meeting*, Virtual.

Petkovic, V., Orescanin, M., Ferraro, R., and **Arulraj, M.**, 2021: Predicting Satellite Passive Microwave Brightness Temperature from the GOES Advanced Baseline Imager, *American Meteorological Society Annual Meeting 2021*, Virtual.

Barros, A.P., **Arulraj, M.**, and Mosier, S., 2019: Flood Ready and Extremely Prepared-Multiscale Predictability of Hydrometeorological Extremes, Inventorying and Monitoring Systemic Risk, and Adaptation, *American Geophysical Union Fall Meeting 2019*, San Francisco, California, U.S.A.

Arulraj, M., 2019: Remote Sensing of Orographic Precipitation, *Duke Remote Sensing Round-table Discussion*, Durham, North Carolina, U.S.A.

Arulraj, M., and Barros, A. P., 2018: Systematic Characterization of Orographic Precipitation Microphysics to improve GPM-DPR retrievals, *American Geophysical Union Fall Meeting 2018*, Washington D.C., U.S.A.

Arulraj, M., and Barros, A. P., 2018: Orographic Low-level Rainfall Dynamics: Characterization of Drop Size Distribution, *Particle Size Distribution Working Group*, Precipitation Measurement Mission, NASA.

Arulraj, M., and Barros, A. P., 2017: Characterizing the physical-basis of orographic rainfall retrieval errors due to terrain artifacts on GPM-DPR reflectivity profiles, *American Geophysical Union Fall Meeting 2017*, New Orleans, Louisiana, U.S.A.

Barros, A.P., Hodes, J. L., and **Arulraj, M.**, 2016: Decadal Climate Variability and the Spatial Organization of Deep Drought, *American Geophysical Union Fall Meeting 2016*, San Francisco, California, U.S.A.

POSTER PRESENTATIONS

Arulraj, M., Petkovic, V., Meng, H., and Ferraro, R.R., 2022: NPreciSe: Introducing near-real-time NOAA Satellite Precipitation Validation System, *American Geophysical Union Fall Meeting 2022*, Chicago, Illinois, U.S.A. Gorooh, V.A., Petkovic, V., Nguyen, P., Hsu, K., Sorooshian, S., **Arulraj, M.**, and Ferraro, R. R., 2022: Towards Optimal Precipitation Retrieval: Complementing Satellite Products, *American Geophysical Union Fall Meeting 2022*, Chicago, Illinois, U.S.A. **Arulraj, M.**, Petkovic, V, Ferraro, R. R., Meng, H., 2022: Assessing the Impact of Precipitation Vertical Structure in the Satellite Precipitation Retrievals, *10th International Precipitation Working Group and 6th International Workshop on Space-based Snowfall Measurement*, Fort Collins, Colorado, U.S.A

Petkovic, V, **Arulraj, M.**, Ferraro, R. R., Meng, H., 2021: A decade of GCOM-W1 AMSR2 rainfall record at NOAA, *American Geophysical Union Fall Meeting 2021*, New Orleans, Louisiana, U.S.A.

Arulraj, M. and Barros, A. P., 2021: Improving orographic precipitation estimates from space-borne radars using Machine Learning, *UMD/NASA AI Workshop*, College Park, Maryland, U.S.A.

Arulraj, M., Ferraro, R., Petkovic, V., Meyers, P. C., Kirstetter, P.-E. and Kulie, M., 2021: An Overview and Design of the STAR precipitation and water vapor Validation System, *American Meteorological Society Annual Meeting 2021*, Virtual.

Arulraj, M., and Barros, A.P., 2019: Towards a physically-based orographic precipitation retrieval correction algorithm for GPM-DPR using Numerical Weather Prediction Model simulations and ground-based observations, *American Geophysical Union Fall Meeting 2019*, San Francisco, California, U.S.A.

Arulraj, M., and Barros, A.P., 2019: Coupling GPM and GV Observations to model the vertical Microstructure of Precipitation, *Precipitation Measurement Mission Science Team Meeting 2019*, Indianapolis, Indiana, U.S.A.

Arulraj, M., and Barros, A.P., 2019: Toward a Generalized GPM DPR Rainfall Retrieval Error Diagnostics and Correction Framework in Mountain Regions, *12th International Precipitation Conference*, Irvine, California, U.S.A.

Xie, Y., **Arulraj, M.**, and Barros, A. P., 2018: Multifractal Metrics of Inter-annual and Decadal Variability in Global Precipitation, *American Geophysical Union Fall Meeting 2018*, Washington D.C., U.S.A.

Barros, A.P., **Arulraj, M.**, and Chavez, S., 2018: Fingerprinting Orographic Precipitation Microphysics in Remote Sensing Measurements, *Precipitation Measurement Mission Science Team Meeting 2018*, Phoenix, Arizona, U.S.A.

Arulraj, M., Duan, Y., and Barros, A. P., 2017: IPHEx Follow-On Studies, *Precipitation Measurement Mission Science Team Meeting 2017*, San Diego, California, U.S.A.

Barros, A. P., Duan, Y., and **Arulraj, M.**, 2016: Orographic Precipitation Processes - from TRMM to GPM, *Precipitation Measurement Mission Science Team Meeting 2016*, Houston, Texas, U.S.A.

Wilson A., Tao, J., Duan, Y., **Arulraj, M.**, Cadeddu, M., Cutrell, G., Dawson, K., Petters, M., Miller, D., and Barros, A. P., 2015: IPHEx Data Sets and Ongoing Studies. *Precipitation Measurement Mission Science Team Meeting 2015*, Baltimore, Maryland, U.S.A.

Arulraj, M., Venugopal, V., Papa, F., Bala, S. K., 2014: Scaling Analysis of Ganges-Brahmaputra River Discharge. *European Geosciences Union General Assembly 2014*, Vienna, Austria.

DATASETS AND WEBSITES

Barros, A.P., Miller, D., Wilson, A.M., Cutrell, G., **Arulraj, M.**, Super, P., and Petersen, W.A. 2017: GPM Ground Validation Southern Appalachian Rain Gauge IPHEx [indicate subset used]. *Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC*, Huntsville, Alabama, U.S.A. DOI: 10.5067/GPMGV/IPHEX/GAUGES/DATA301

Arulraj, M., Petkovic, V., Ferraro, R. R., Meng, H.: Ground-based precipitation observations matched with NOAA satellite precipitation products over CONUS, Available upon request.

NPreciSe: NOAA Satellite Precipitation Validation System
URL: https://precip-val.umd.edu

FIELD EXPERIENCE

- Precipitation Measurement Mission (PMM) Great Smoky Mountains Network 2015 - 2020
  Pigeon River Basin, Haywood County, NC.

PROFESSIONAL CERTIFICATIONS, AND MEMBERSHIPS

American Geophysical Union Precipitation Technical Committee
International Precipitation Working Group
New York Academy of Sciences
American Geophysical Union
American Meteorological Society

PROFESSIONAL SERVICE AND OUTREACH

- AGU Precipitation Technical Committee — July 2022 - Present
  Subcommittees: Early Career and Awards
  Lead for Precipitation Technical Committee Student Award
- Hydrology Initiative Meetings — 2020 - Present
  JPSS, NOAA.
- Land-Surface Working Group — 2020 - Present
  Global Precipitation Measurement Mission, NASA.
- Particle Size Distribution Working Group — 2016 - 2020, 2022 - Present
  Global Precipitation Measurement Mission, NASA.
- Panelist — 2021
  Future Investigators in NASA Earth and Space Science and Technology (FINESST)
- Peer-reviewer — 2018 - Present
  AI
  Artificial Intelligence for the Earth Systems
  Atmosphere
  Atmospheric Research
  Bulletin of American Meteorological Society
  Climate
  Frontiers in Climate
  GIScience and Remote Sensing (Top 4% reviewer)
  International Journal of Environmental Research and Public Health
  Journal of Applied Meteorology and Climatology
  Journal of Hydrology
  Journal of Hydrometeorology
  Remote Sensing
  Remote Sensing of Environment
  Sensors
  Sustainability
  Transactions on Geoscience and Remote Sensing
  Urban Science
  Water
  Weather and Forecasting
- Barros Group Volunteer and Team Lead — 2015-2018
  FEMMES (Females Excelling More in Math, Engineering, and Science) Capstone Event.
- New York Academy of Sciences - Mentor — 2022
  Junior Academy
  Project: Protecting and Administering Forest Using Artificial Intelligence
  Winning team of the "Forestry for a Sustainable Future" challenge

OUTREACH PRESENTATIONS

Arulraj, M., 2022: Navigating Through Research in Interdisciplinary Fields, Tech Talk Series, Amrita School of Engineering, Bengaluru, India. Virtual.