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Professional Profiles : [Google Scholar](#) | [ResearchGate](#) | [LinkedIn](#)

RESEARCH INTERESTS

- Climate change impact assessments on agricultural systems, rural-urban environments, and communities
- Practices and solutions for ecosystem services (carbon sequestration, soil health, water quality)
- Mitigation and adaptation measures to build resilience to extreme hydro-climatic events.
- Farm- and watershed-scale decision tools such as
 - USDA Agricultural Conservation Planning Framework (ACPF) for locating suitable conservation in-field and edge-of-field conservation practices and
 - NRCS Stewardship Tool for Environmental Performance (STEP) for payment for ecosystem services
 - USDA Soil and Water Assessment (SWAT) for evaluation of Ag conservation practices for water quality benefits and soil health
- Remote Sensing and GIS-based database management
- Water quality, carbon, and soil health modeling at field-to-watershed scales

EDUCATION

- 2015 **Ph.D. in Hydrology,**
Indian Institute of Technology (IIT), Roorkee, India
Dissertation title: Impact of Climate Change on Hydro-meteorological Variables in Bhima basin (India) (Advisor: Dr. D.S. Arya)
- 2009 **Master of Technology in Soil and Water Conservation Engineering*,**
Tamil Nadu Agricultural University (TNAU), Coimbatore, India
Thesis title: Evaluation of soil less culture for beet root under protected cultivation (Advisor: Dr. D. Palanisamy)
**University Gold Medal for academic excellence among all engineering departments*
- 2007 **Bachelor of Technology in Agricultural Engineering,**
Marathwada Agricultural University (MAU), Parbhani, India.
Thesis title: Design of soil and water conservation structure using ‘Watershed A to Z’ computer software (Advisor: Dr. A.S. Kadale)

PROFESSIONAL EXPERIENCE

- Sept 2022-June 2023 **Research Scientist,** Department of Food, Agricultural and Biological Engineering (FABE), The Ohio State University, Columbus Ohio (*Farm- and watershed scale decision tools such as ACPF, ecosystem services assessment using STEP, climate change, hydro-climatological modeling in Western Lake Erie and Scioto River Basins, Assessing impacts of H2Ohio and other conservation practices such as cover crops, no-till, drainage water management, wetlands, riparian buffers*)
- February 2018-Aug 2022 **Postdoctoral Scholar,** Department of Food, Agricultural and Biological Engineering (FABE), The Ohio State University, Columbus Ohio (Supervisors: Drs.

Jay Martin and Margaret Kalcic) (*Evaluating Water Quality Impacts of the Runoff Risk Advisory Forecast – RRAF tool; multi-model approaches for evaluating conservation practice performance in Western Lake Erie Basin, Stakeholder-driven watershed modeling and practice recommendations*)

CIGLR Postdoctoral Fellow (June 2019 to May 2020), Department of Food, Agricultural and Biological Engineering (FABE), The Ohio State University, Columbus Ohio (*Winner of the prestigious 2019 Cooperative Institute for Great Lakes Research (CIGLR) postdoc fellowship for: Comparison of model flow predictions to Edge of field (EOF) data: Determining the ability of a watershed model (SWAT) and forecast tool (NOAA RRAF) to predict runoff from agricultural fields in western Lake Erie watersheds*) (Supervisors: Drs. Jay Martin, Margaret Kalcic; Advisor: Dr. Craig Stow)

March 2016-February 2018 **Postdoctoral Researcher**, Byrd Polar and Climate Research Center (BPCRC), The Ohio State University, Columbus Ohio (*NSF-CNH Project: Fish, floods and societies: Exploring social, ecological, and hydrological regime shifts in the Logone Floodplain, Cameroon*) (Supervisor: Dr. Michael Durand)

March 2015-April 2015 **Senior Research Fellow**, Department of Hydrology, Ministry of Water Resources-Chair, IIT Roorkee, India (*Project: Study for Adaption to Impact of Climate Change on Water Resources Storage and Desilting*) (Supervisor: Dr. N.K. Goel)

July 2011-December 2014 **Senior Research Fellow** (Ministry of Human Resources Development), Department of Hydrology, IIT Roorkee, India (*Project: Impact of Climate Change on Hydro-meteorological Variables in Bhima basin (India)*)

July 2009-June 2011 **Junior Research Fellow** (Ministry of Human Resources Development), Department of Hydrology, IIT Roorkee, India (*Project: Impact of Climate Change on Hydro-meteorological Variables in Bhima basin (India)*)

GRANTS AND EXTERNAL FUNDING

(# Led/co-led the proposal development effort and/or project management)

- **Funded proposals (\$2.06 M approx.)**
 - **Murumkar A.**,[#] Martin J., Vance C., Kujawa H. Kalcic M. and Apostel A. (2022-2024). Evaluating the dynamics of legacy fields nutrients and effectiveness of conservation practices under future climate at field to watershed scales in the Maumee River Watershed. Ohio Department of Higher Education Harmful Algal Bloom Research Initiative 2022. \$325,000
 - Shedekar V.S., Kalcic M., **Murumkar A.**, Williams, M., King K., Osterholz W., and Johnson L. Advancing prediction of legacy phosphorus dynamics in tile-drained landscapes and/or watersheds. NRCS/USDA-ARS. \$100,000
 - Raymond H. (2021-2022). 9-Element NPS-IS Plans for Priority Watershed in the Western Lake Erie Basin. SWAT modeling effort and leaders – Kalcic M. and **Murumkar A.** Ohio Environmental Protection Agency (Ohio EPA). \$117,003
 - Martin J., and **Murumkar A.**[#] (2021-2022). Evaluating Water Quality Impacts of the Runoff Risk Advisory Forecast (RRAF). NOAA-NWS through Ohio Sea Grant. \$50,000

- **Murumkar A.,**[#] Martin J., Czajkowski, K., King K., Mehan S., and Shedekar V. (2021-2023). Evaluating field-and watershed-scale water quality benefits of H2Ohio conservation practices in the Maumee River watershed. Ohio Department of Higher Education Harmful Algal Bloom Research Initiative 2021. \$300,000
- Martin J., Kalcic M., **Murumkar A.,**[#] Czajkowski, K., and Shedekar V. (2021-2023). Evaluating field-and watershed-scale water quality benefits of H2Ohio conservation practices in the Maumee River watershed using watershed modeling. Ohio Lake Erie Commission through Governor Mike's H2Ohio program Initiative. \$250,000
- **Murumkar A.,**[#] and Martin, J. (2020-2022). Farming for cleaner water in the Upper Scioto Watershed. In collaboration with American Farmland Trust (AFT) (Lead Team). EPA-GM-2020-FARMER. \$853,866. (OSU fund-\$153,000)
- **Murumkar A.,**[#] Martin J. and Kalcic M. (2019-2020). Comparison of model flow predictions to Edge of field (EOF) data: Determining the ability of a watershed model (SWAT) and forecast tool (NOAA RRAF) to predict runoff from agricultural fields in western Lake Erie watersheds. 2019 Cooperative Institute for Great Lakes Research (CIGLR) Postdoctoral Fellowship. \$70,000
- Other grant writing experience (Unfunded proposals)
 - Khanal S., Shedekar V. S., Shah A., Witter J., **Murumkar A.** and Czajkowski (2023-2026). Identification and characterization of drainage infrastructure in large regions using scalable remote sensing and machine learning approaches. USDA-NIFA AFRI 2022. \$650,000.
 - Vance C., **Murumkar A.,**[#] Shedekar V. S., Brand B. and King K. (2022-2024). Evaluate Field-Specific Risk, Nutrient Loss Mitigation Efforts, and Watershed-Scale Water Quality Benefit using Decision Support Tools and Watershed Modeling. Ohio Department of Higher Education Harmful Algal Bloom Research Initiative 2023. \$300,000
 - Thompson A., Kalcic M., Pease L., Fermanich K., Baumgart P., Martin J., **Murumkar A.,**[#] and Shedekar V. (2022-2024). Finding common ground across spatial gradients: Sources and conversion solutions for nutrient contributions to three Great Lakes. 2021 Sea Grant Joint Call (Wisconsin, Minnesota and Ohio). \$600,000 (OSU fund -\$200,000) – *High Rank*
 - Lyon S., Kalcic M. and **Murumkar A.** (2021-2023). Improved water quality monitoring to better target water quality best management practices. 2020 OARDS SEEDS RGE-IGP. \$50,000 – *High Rank*
 - Kalcic M., **Murumkar A.,**[#] and Martin J. (2020-2022). Integrating precision conservation and high-resolution watershed modeling for nutrient runoff reduction in the Upper Scioto Runoff reduction in the Upper Scioto River Watershed. In collaboration with American Farmland Trust (AFT). 2020 Ohio Water Development Authority (OWDA) Research and Development Grant Program. \$200,000 – *High Rank*
 - Moritz M., and **Murumkar A.,**[#] et al., (2019-2023). Hydroclimatic variability, Flood Control, and adaptation in an African Floodplain. NSF-CNH-L, \$1.5M – *High Rank*
 - Moritz M., and **Murumkar A.,**[#] et al., (2018-2022). Hydroclimatic variability, Flood Control, and adaptation in an African Floodplain. NSF-CNH-L, \$1.5M – *High Rank*

- Islam K.R., Shedekar V.S. and **Murumkar A.**,[#] et al., (2018-2022). Assessing agroecosystem resiliency to extreme weather conditions: Synthesis of long-term climate and agronomic research from two agro-climatic zones of Ohio. OARDC SEEDS, \$80,000 – *High Rank*
- Brown L.C., Shedekar V.S. and **Murumkar A.** (2018-2019). Water and energy need for irrigated grain crops in Ohio. Ohio Water Resources Center, \$30,700 – *High Rank*
- Durand M., and **Murumkar A.**,[#] et al., (2017-2021). Modeling risks of extreme hydroclimatic events in dynamic coupled systems of the Logone Floodplain, Cameroon. NSF-PREEVENTS, ~\$1.5M – *High Rank*
- Moritz M., and **Murumkar A.**, et al., (2017-2020). Modeling extreme hydroclimatic Events in Dynamic Coupled Systems of the Logone Floodplain, Cameroon. NSF-CNH-L, \$1.8M – *High Rank*
- Islam, K.R. Shedekar V.S. and **Murumkar A.**, et al., (2018 to 2022). Integrated Research and Extension Initiative for Climate-Smart agriculture. USDA-AFRI, \$1.2M – *High Rank*
- **Murumkar A.**[#] and Durand M. (2015-2016). Assessment of climate change impacts on spatio-temporal variability of hydro-meteorological variables in the Logone River basin, Cameroon (Africa). 2015 The Byrd Fellowship Program. \$48,000 – *High Rank*

REFEREED PUBLICATIONS (Google scholar citations: 474, h-index: 10)

1. Kujawa H., Kalcic M., Martin J., Apostel A., Kast J., **Murumkar A.**, Evenson G., Aloysius N., Becker R., Boles C., Confesor R., Dagnew A., Guo T., Muniech R.L. Redder T., Scavia D., Wang., Y.C. (2022). Ensemble of watershed models to assess agricultural conservation effectiveness and uncertainty in a future climate. *Journal of American Water Resources Association*.
2. Martin J. F., Kalcic M.M., Aloysius, N., Apostel A.M., Brooker M.R., Evenson G., Kast J.B., Kujawa H., **Murumkar A.**, Becker R., Boles, C., Confessor R., Dagnew, A., Guo, T., Long C.M., Muenich R.L., Scavia D., Redder T., Robertson D.M., Wang Y-C. (2021). Evaluating management options to reduce Lake Erie Algal blooms with Ensemble Models of watershed models. *Journal of Environmental Management*, 280, p.111710.
3. Evenson G.R., Kalcic M., Wang Y.C., Robertson D., Scavia D., Martin J., Aloysius N., Apostel A., Boles C., Brooker M., Confesor R., Dagnew A.T., Guo T., Kast J., Kujawa H., Muenich R.L., **Murumkar A.**, and Redder T. (2021). Uncertainty in critical source area predictions from watershed-scale hydrologic models. *Journal of Environmental Quality*, 279, p.111506.
4. **Murumkar A.R.**, Durand M., Moritz M., Mark B., Hamilton I., Fernández A., Phang S. Laborde S., Shastry A. and Scholte P. (2020). Trends and spatial patterns of 20th century temperature, rainfall and PET in the disaster-prone Logone River Basin, Sub-Saharan Africa. *Journal of Arid Environment* 178: 104168.
5. Kujawa H., Kalcic M., Martin J., Apostel A., Kast J., **Murumkar A.**, Evenson G., Aloysius N., Boles C., Redder T., Confesor R., Becker R., Muenich R., Dagnew A., Wang Y. (2020). The hydrologic model as a source of nutrient loading uncertainty in a future climate. *Science of the Total Environment* 724:138004.
6. Shastry A., Durand M., Neal J., Fernandez A., Phang S.C., Mohr B., Kari, S., Moritz M., Mark B.G., Laborde S., **Murumkar A.**, Hamilton I. (2020). Small-scale anthropogenic changes impact floodplain hydraulics: simulating the effects of fish canals on the Logone Floodplain. *Journal of Hydrology* 588: 125035.
7. Dhari S., Arya D.S. and **Murumkar A.R.** (2015). Application of remote sensing and GIS in sinuosity and river shifting analysis of the Ganga River in Uttarakhand plains. *Applied Geomatics*, 7(1): 13-21.

8. Taxak A.K., **Murumkar A.R.** and Arya D.S. (2014). Long-term spatial and temporal rainfall trends and homogeneity analysis in Wainganga Basin, central India. *Weather and Climate Extreme*, 4:50-61.
9. **Murumkar A.R.** and Arya D. S. (2014). Trend and periodicity analysis in rainfall pattern of Nira Basin, central India. *American Journal of Climate Change*, 3: 60-70.
10. Kumar, D., Arya, D. S., **Murumkar, A.R.** and Rahman, M. M. (2014). Impact of climate change on rainfall in North-western Bangladesh using multi-GCM ensembles. *International Journal of Climatology*, 34(5):1395-1404.
11. Barikara, U., Bosu, S. S., Rema K.P. and **Murumkar A.R.** (2013). Drip irrigation with fertigation on soil less media for tomato under controlled cultivation. *Journal of Applied Horticulture*, 15(3):195-197.
12. Misir, V., D.S. Arya, and **Murumkar A.R.** (2013). Impact of ENSO on river flows in Guyana. *Water Resources Management*, 27 (13): 4611-4621.
13. **Murumkar, A.R.**, D.S. Arya and Rahman M.M. (2013). Seasonal and annual variations of rainfall pattern in the Jamuneswari Basin, Bangladesh. On a Sustainable Future of the Earth's Natural Resources (ed.), Springer Earth System Sciences, DOI 10.1007/978-3-642-32917-3_19, Springer-Verlag Berlin Heidelberg, pp 349-362.
14. **Murumkar A.R.**, Barikara, U., Palanisamy, D., Bosu S.S. and Durairaj C. (2013). Effect of growing media on its physical and chemical properties on beet root yield under protected cultivation. *Indian Journal of Agricultural Research*, 47 (2):124-129.
15. **Murumkar A.R.**, Barikara, B., Palanisamy, D., Bosu S.S. and Durairaj C. (2012). Evaluation of soil less media for beet root under protected cultivation. *Environment and Ecology*, 30 (2): 332-335.

In Preparation (Under internal review process/first draft ready)

1. **Murumkar A.**, Kalcic M., Stow C., Shedekar V.S., Goering D., King K., Thorstensen A., Martin, J. Performance evaluation of a field-scale SWAT model using multi-site edge-of-field data in the Western Lake Erie Basin, USA. *Journal of Hydrology*. (Internal Review)
 2. **Murumkar A.**, Martin, J., Kalcic M., Goering D., Thorstensen A., Shedekar V.S., Boles C., Redder T., Confesor R. Analysis of impact of timing of fertilizer and manure applications on nutrient runoff during high risk of rainfall events in the Great Lakes Region. *Science of The Total Environment*. (Internal Review)
 3. **Murumkar A.**, Martin, J., Kalcic M., Goering D., Shedekar V., Murumkar A., Martin, J., Kalcic M., Stow C., Goering D., King K., Shedekar V.S., Thorstensen A. Evaluation of Hydrologic models at field to watershed scales for decision support tool. *Water Resources Research*. (First draft is ready)
 4. **Murumkar A.**, Durand M., Fernandez A. Moritz M. and Mark B. Uncertainty of CMIP5 GCMs for assessment of future streamflow of the Logone River using VIC model. *International Journal of Climatology*. (First draft is ready)
 5. **Murumkar A.**, Shedekar V.S., Rahman, M. M., Arya D.S. Evaluation of methods of estimation of missing daily rainfall data in the Jamuneswari River Basin, Bangladesh. *Meteorological Applications*. (First draft is ready)
 6. Phang S.C., Laborde S., Ziebe R., Moritz M., Fernandez A., Mark B.G., Shashtry A., **Murumkar A.**, Durand M., Xiao N., Kari, S. and Hamilton I.M. Trading resilience for fish in a variable fishery. *Fisheries Research*. (First draft is ready)
 7. Phang S.C., Laborde S., Ziebe R., Moritz M., Mohr B., Durand M., Kari S., Mark B., **Murumkar A.**, and Hamilton I.M. Drivers of fishing returns in the Logone Floodplain Fishery, Cameroon. *Canadian Journal of Fisheries and Aquatic Sciences*. (First draft is ready)
- (Note: 5+ manuscripts will come out as a result of graduate students and post-docs mentoring in 2025)

EXTENSION AND OUTREACH EXPERIENCE

- **Summary of Extension and outreach impact:**
 - Total audience reached: ~500
 - Locations/extent of extension/outreach activity: Ohio (USA), Cameroon (Africa), Bandung (Indonesia), India
 - Number of trainings delivered (25 total):
 - Organizer + instructor/speaker: 20
 - Invited instructor/speaker: 5
 - Number of extension/outreach curricula developed: 10
 - Number of extension/news articles: 5
- **Press Releases**
 - Flow prediction at field scale: comparing model estimates with observed conditions. Cooperative Institute for Great Lakes Research (CIGLR) Annual Magazine: Ripple Effect 2020. (https://issuu.com/ciglr/docs/ciglr_2020_ripple_effect?fr=sMjEwNTI1ODg0Mw)
 - Ohio State Report Evaluates Options for reducing Lake Erie’s harmful algal blooms. November 21, 2019. The Knowledge Exchange, Ohio State University’s College of Food, Agriculture, and Environmental Sciences. (<https://cfaes.osu.edu/news/articles/ohio-state-report-evaluates-options-for-reducing-lake-erie%E2%80%99s-harmful-algal-blooms>).
 - Advisory forecast guides fertilizer applications to improve water quality. Cooperative Institute for Great Lakes Research (CIGLR) Annual Magazine: Ripple Effect 2019. (https://issuu.com/ciglr/docs/ciglr_2019_ripple_effect?fr=sNDIzNzI1ODg0Mw)
 - Building a better weapon against harmful algal blooms. December 14, 2018 (<https://news.osu.edu/building-a-better-weapon-against-harmful-algal-blooms/>). (<https://www.sciencedaily.com/releases/2018/12/181217101801.htm>).
 - Complex systems summer school alumna launches complex systems workshop in Cameroon. June 27, 2017. (<https://www.santafe.edu/news-center/news/complex-systems-summer-school-alumna-launches-complex-systems-workshop-cameroon>).
- **Invited Presentations**
 - Watershed Models of the Western Lake Erie Basin: Improvements and Latest Results, Understanding Algal Blooms: State of the Science Conference, Sept 2023
 - Watershed Modeling for Water Quality Outcomes, using OpTIS Satellite Data to Help Unlock Insights on Water Quality – Organized by Regrow Ag, Conservation Technology Information Center (CTIC), The Nature Conservancy, April 2023
 - Water Quality Benefits of H2Ohio Practices using high resolution watershed model, Ohio Domestic Action Plan – Public Workshop, April 2023
 - Guest Lecturer in FABE2720, OSU – April 2023 (2 talks)
 - Geospatial tool and Hydrologic modeling for water quality and soil health benefits
 - Public Data Sources
 - Introduction to Agricultural Conservation Planning Framework (ACPF), SWCD, Delaware Ohio, July 2022
 - Invited presenter (‘Climate Change Impact Assessment - Overview and a Case Study’) and session chair at the 2nd International Conference on Food and Agriculture, Dhanbad, Jharkhand, India (March 29-31, 2018).
 - Socio-hydrological systems and climate change in the Logone floodplain, Africa. Rutgers Educator Workshop, OSU-Byrd Polar and Climate Research Center, Columbus Ohio (June, 2017)

- Socio-hydrological systems and climate change in the Logone floodplain, Africa. Brown bag seminar, OSU-School of Earth Sciences, Columbus Ohio (April, 2017)
- USA: Climate change impacts at river basin scales in India. OSU-FABE seminar series, Columbus Ohio (October, 2014).

- **Outreach activities**

- **Ohio, USA**

- Organizing committee member and expert lecturer in an Annual Maumee Watershed Modeling Stakeholder Advisory Group Meeting 2021, October 2021 (Upcoming). On Virtual Platform, OSU.
- Organizing committee member and expert Lecturer, ‘Tap your potential: A training to grow farmer leadership in watershed management’ 3-day workshop on Virtual Platform, Famer-Led Watershed Management, Mississippi Atchafalaya River Basin, Collaborative efforts among The Ohio State University, Iowa State University, University of Kentucky, University of Wisconsin-Madison and University of Arkansas System, December 2020
- Organizing committee member in an Annual Maumee Watershed Modeling Stakeholder Advisory Group Meeting 2019, 2020, 2021, 2022 In-person/Virtual platform, OSU.
- Hosting member and expert lecturer in the 3rd Annual regional Runoff Risk Meeting 2019, August 2019 at Columbus, Ohio USA.
- Organizing committee member and expert lecturer in an Annual Maumee Watershed Modeling Stakeholder Advisory Group Meeting 2019, May 2019 at Columbus, Ohio USA.

- **Cameroon (Africa)**

- Organizing committee member and expert lecturer in a week-long interdisciplinary workshop around Social-ecological Sciences and Sustainability, May 2017 at N’Gaoundere, Cameroon

- **Bandung (Indonesia)**

- One of the 70 international master’s and PhD students selected to participate in the International Student Conference on Global Citizen (Theme: Water and Environmental Sustainability), organized by Universitas Katolik Parahyangan at Bandung (Indonesia), Jan 17-24, 2013.

- **India**

- International Training Course on Climate Change Issues and Impacts on Water Resources Management in Coastal and Seasonal Wetlands, Bangladesh Water Development Board, Dhaka, Bangladesh, Apr 7-17, 2014.
- Remote Sensing and GIS Applications in Water resources Projects, Irrigation Management Institute, Tamil Nadu under IAMWARM project, Trichy, India, Feb 9-14, 2014.
- International Training Course on Climate Change Issues and Impacts on Water Resources Management in Coastal and Seasonal Wetlands, Bangladesh Water Development Board, Dhaka, Bangladesh, Jun 10-20, 2013.
- International Training Course on Climate Change Issues and Impacts on Water Resources Management in Coastal and Seasonal Wetlands, Bangladesh Water Development Board, Dhaka, Bangladesh, Mar 11- 20, 2013.
- Remote Sensing and GIS Applications in Hydropower Projects, National Hydro Power Corporation Limited, Faridabad, India, Jan 14-18, 2013.

- International Training Course on Hydrological Analysis for Water Resources Planning and Management in Environmental Aspects, Bangladesh Water Development Board, Dhaka, Bangladesh, Jun 11-20, 2012.
- International Training Course on Effect of climate Change on Flood Estimates and Hydrological Variables, Bangladesh Water Development Board, Dhaka, Bangladesh, Mar 5-14, 2012.
- Crop Water Management, OCTMP, Water Resources Department, Govt. of Odisha, Bhubaneshwar, India, Dec 13-17, 2011.
- Estimation of Design Flood and design of Spillways for Minor Irrigation Projects, OCTMP, Water Resources Department, Govt. of Odisha, Bhubaneshwar, India, Dec 1-5, 2011.
- Remote Sensing and GIS Applications in Hydropower Projects, National Hydro Power Corporation Limited, Faridabad, India, Oct 19-21, 2011.
- Hydrological Assessment and Water Resources Planning, OCTMP, Water Resources Department, Govt. of Odisha, Bhubaneshwar, India, Sep 26-30, 2011.
- Remote Sensing and GIS Applications in Hydropower Projects, National Hydro Power Corporation Limited, Faridabad, India, Jun 20-22, 2011.
- International Training Course on Flood Estimation in a Changing Climate, Institute of Water Modelling, Dhaka, Bangladesh, Mar 6-12, 2011.
- Use of ArcGIS and MODFLOW in Analysis and Modelling of Groundwater in Hard-rock Areas, Ground water and Surveys and Development Agency, Pune, Govt. of Maharashtra, India, Nov 22-Dec 11, 2010.
- International Training Course on Urban Flood Modelling and Drainage Design, Lunawa Environment Improvement & Community Development Project (Technical Component), Ministry of Urban Development and Sacred Area Development, Govt. of Sri Lanka, Mar 22-27, 2010.
- Remote Sensing and GIS Applications in Hydropower Projects, National Hydro Power Corporation Limited, Faridabad, India, India, Feb 22-27, 2010.
- **Participation in Extension and Outreach Groups**
 - Lead organizer of the Annual Maumee Watershed Modeling Stakeholder Advisory Group since 2018, Department of Food Agricultural and Biological Engineering, The Ohio State University (total 8 annual meetings)
 - Member of Agricultural Conservation Planning Framework (ACPF) modeler group in Ohio
 - Watershed and water quality modeler representative on Agricultural Conservation Planning Framework (ACPF) work in Western Lake Erie basin on Environmental Working Group (EWG) Joyce foundation project – 2021-2022.

TEACHING/MENTORING EXPERIENCE

Courses Taught (7 total, at IIT Roorkee and TNAU Coimbatore: Instructor/co-instructor)

Hydro-meteorology and Climate Change 2013, 2014

Soil erosion and sediment transport, Design of surface irrigation and drainage systems, Design of pressurized irrigation systems, Research methods, Precision farm 2007 - 2008 engineering

Lab Instruction (7 total at IIT Roorkee)

Remote sensing and GIS applications in hydrology, Computer programming in hydrology, Hydrological data collection, Processing and analysis, Stochastic hydrology, Urban hydrology, Watershed modeling and simulation 2011 to 2014

Research Mentoring

4 PhD and 6 MS students (3 International scholars from Guyana, Iraq and Sudan)
2 post-doctoral scholars

SOFTWARE SKILLS AND KNOWLEDGE

- Programming Languages: MATLAB, FORTRAN, C++, -
- Hydrologic/Hydraulics Models: VIC, SWAT, SWAT+, SWMM, HEC-HMS, MODFLOW, HEC-RAS
- Crop Model: CROPWAT, NRCS STEP (Stewardship Tool for Environmental Performance)
- Global climate data downscaling models: LARSWG, SDSM
- Statistical Software: Minitab
- Remote Sensing and GIS: ESRI Arc GIS, ERDAS Imagine, Idrisi, QGIS, GRASS, ACPF
- Others: Google Earth, MS Office (MS Access, MS Excel, MS Word, MS PowerPoint)

PROFESSIONAL SERVICES & MEETING ACTIVITIES

- **Editor**

Edited book on 'Big Data and Hydro-informatics in Agriculture and Water Science' with Springer-Nature publisher. (Editorial board members: **Dr. Asmita Murumkar**, Dr. Sushil Kumar Himanshu (Asian Institute of Technology, Bangkok), and Dr. Ashish Kumar (University of Guelph, Canada).

- **Manuscript reviewer**

- Water Resources Management (Springer)
- Environment, Development and Sustainability (Springer)
- Asia-Pacific Journal of Atmospheric Sciences (Springer-Nature)
- International Journal of Agricultural and Biological Engineering
- Meteorological Applications

- **Professional Meetings**

- Session moderator: Agricultural Water Management: Monitoring and Modeling at the 2022 ASABE Annual International Meeting, Houston, Texas, July 17-20, 2022.
- Mentor: Women's Speed Networking event in 2022 ASABE Annual International Meeting, Houston, Texas, July 17-20, 2022
- Session co-moderator: Vulnerability Assessment of Land Resources for Sustainable Development Oral Invited Session at the 2019 ASABE Annual International Meeting, Boston, Massachusetts, July 7-10, 2019.
- NRES-21 Committee representative on NRES- 07 (Nomenclature), ASABE – 2020 onwards

- **Judge/Proposal Reviewer**

- Proposal reviewer, NASA FINESST20 WEC Panel, April 6-9, 2021
- Judge, Gunlogson Open Format Environmental Competition, ASABE 2020 (July 14, 2020: Virtual Platform).
- Judge, Outstanding Student Presentation Awards (OSPA), AGU Fall Meeting 2019, Washington DC. December 2019.
- Proposal reviewer, Spellman High Voltage Electronics Clean Tech Competition (Theme: Solving Climate Change) (May 2018)

- Judge, State Science Day organized by Ohio Academy of Science, Columbus Ohio (May, 2017)
- Judge, 2017 Denman Undergraduate Research Forum, The Ohio State University, Columbus Ohio (March 2017)
- Judge, 16th Annual American Meteorological Society Student Conference, Seattle Washington (January 2017)

- **Professional Memberships**

- American Society of Agricultural and Biological Engineers (ASABE) – [2017-present]
- American Geophysical Union (AGU) – [2018-present]
- American Society of Ecological Engineering (ASEE) – [2020-present]
- American Society of Meteorology (AMS) – [2017-2018]
- American Society of Engineering Education (ASEE) – [2019]

RELEVANT CERTIFICATIONS AND TRAININGS COMPLETED

- Legacy Phosphorus modeling workshop sponsored by USDA - to identify and implement improved model (phosphorus modeling routines in APEX, APLE, AnnAGNPS, SWAT, SPARROW and The Chesapeake Bay Model) algorithms for the simulation of Legacy Phosphorus. December 2021 -
- Using Environmental data on the Cloud with Open-Source Tools at AGU 2021
- Agricultural Conservation Planning Framework (ACPF) Technical Cohort Training (Virtual) organized by university of Wisconsin, Iowa State University September-October 2021.
- Supercomputing resources at Ohio State University, 2016, 2021
- Tutorial on Machine Learning and Deep Learning for the Environmental and geosciences at AGU Fall meeting 2020
- Agricultural and Biological Engineering Data Handling Using R at ASABE AIM 2020
- College Teaching in Engineering at Food, Agricultural and Biological Engineering, The Ohio State University, Columbus Ohio. January-May 2019.
- Responsible Conduct of Research: Social and Behavioral Research by Collaborative Institutional Training Initiative (CITI Program). June 2017.
- Grant proposal writing workshops organized at OSU for NSF and USDA grants, 2016
- Writing research proposal in Anthropology, audit course at OSU, 2016
- ‘High Impact Principles and Practices for STEM education’ online course offered by The Center for Research on Learning and Teaching, The Office of Digital Education & Innovation, and Rackham Graduate School at The University of Michigan. June-July 2016.
- Human Research Course: Social and Behavioral Research by Collaborative Institutional Training Initiative (CITI Program). July 2016.
- ‘Changing weather and climate in the Great lakes region’ organized by University of Wisconsin-Madison (Online course through Coursera). March 2015.
- ‘Advance Soft Computing Techniques’ at National Institute of Hydrology, Roorkee, Uttarakhand, India (20th to 24th June 2011).
- ‘Climate Change and Water Management’ at Indian Institute of Technology, Bombay, Maharashtra, India (28th February to 4th March 2011).

AWARDS AND RECOGNITIONS

- 5-years’ service recognition award, CFAES, Ohio State University 2022
- 2020 Staff Career Development Award (\$1750) from Ohio State University, Columbus Ohio

- Representative of the Postdoctoral Association (PDA) member on University Research Committee at the Ohio State University (OSU), Columbus Ohio (2018 and 2019)
- Member of Policy and Advocacy committee of the Postdoctoral Association (PDA) at the Ohio State University (OSU), Columbus Ohio (2018-2019)
- Member of board of directors and Head of Program Management for [Scholar Foundation](#)- Non-profit organization, Aurangabad India (2015-present)
- Postdoctoral member of the Translational Data Analytics Institute (TDAI), The Ohio State University
- Member of Toastmaster, Hilliard Ohio 2019
- Chief Guest at the 2nd International Conference on Food and Agriculture, Dhanbad, Jharkhand, India. March 29-31, 2018
- Postdoctoral Association (PDA) 2017 Travel Award (\$500) to present research work at the 2018 American Meteorological Society (AMS) Annual Meeting, Austin, Texas
- CUAHSI Student Travel Grant (\$500) at 11th International Conference on Hydroinformatics (HIC), New York, USA
- IITR Research Assistantship (Rs. 18,000/month for first two year and Rs. 20,000/month for last two years) for PhD by Ministry of Human Resource Development, Govt. of India (July 2009 to June 2013)
- Research fellowship (Rs. 20,000/month for a year) from Bharat Singh Chair for Water Resources, Indian Institute of Technology (IIT) Roorkee (India). July 2013 to June 2014
- University Gold Medal awarded by Tamil Nadu Agricultural University, Coimbatore, India, 2010
- Gold Medal Award for the best Student in Agricultural Engineering in recognition of performance in M.Tech (Master of Technology) programme of TamilNadu Agricultural University, Coimbatore, TamilNadu (India).
- Certificate of Appreciation for Event Management in COGNIZANCE 2010 (Technovating India) March 26-28, 2010 at Department of Hydrology, IIT Roorkee, Uttarakhand, India
- Certificate of Appreciation in National Service Scheme during 2004-2006 at College of Agricultural Engineering, Marathwada Agricultural University, Parbhani, Maharashtra, India
- Maharashtra Talent Search certificate, 1999 & 2000, India
- High School Scholarship Certificate, 1998, India
- Languages known: English, Hindi, Marathi, Tamil (Can speak little bit for communication)
- Hobbies: Reading, Traveling, Cooking, Drawing and Painting

CONFERENCE PAPERS AND POSTER PRESENTATIONS

1. **Murumkar A.**, Martin J., Kalcic M., Brandt B. and Wilson M. (2023). Integrating precision conservation and high-resolution watershed modeling for nutrient runoff reduction in the sub-basin of Ohio River basin, USA. Annual International Meeting of American Society of Agricultural and Biological Engineers. July 9-12, 2023. (Oral).
2. **Murumkar A.**, Martin J., Kalcic M., King K., Shedekar V.S., Mehan S., and Kujawa H. (2022). Simulating the watershed-scale water quality impacts of Drainage Water Management in the Western Lake Erie Basin, USA. 2022 Annual International Meeting of American Society of Agricultural and Biological Engineers. July 17-20, 2022. (Oral).
3. Mehan S., Kujawa H., **Murumkar A.**, Shedekar V.S., Kalcic M., King K. (2022). Using Soil and Water Assessment (SWAT) for simulating drainage water management: Lessons learned. 2022 Annual International Meeting of American Society of Agricultural and Biological Engineers. July 17-20, 2022. (Oral).

4. **Murumkar A.**, Martin, J., Kalcic M., Goering D., Thorstensen A., Shedekar V., Boles, C., Redder T., Confesor R. (2021). Simulating the water quality impacts of nutrient application timing based on risk of rainfall events in western Laker Erie basin, USA. 2021 AGU Fall Meeting. December 1-17, 2021. (Enlightening Oral - Virtual).
5. **Murumkar A.**, Martin, J., Kalcic M., Goering D., Thorstensen A., Shedekar V., Evenson G., Apostel A., Kast J., Boles C., Redder T., and Confesor R. (2021). Simulating impact of NOAA-NWS Runoff Risk Advisory Forecast (RRAF) tool on water quality impacts in western Lake Erie basin, USA. 2021 Annual International Meeting of American Society of Agricultural and Biological Engineers. July 11-14, 2021. (Oral -Virtual).
6. Himanchal. Meena A., Duhan S., Ahmad M., Jakhar P., Puthukkulam A., Shedekar V., **Murumkar A.**, Plappally A. (2021). Modelling of Jojari river in semi-arid western Rajasthan, India using the geospatial techniques and 1D flow model analysis. International Conference BRICS Nus: Water Resources and Pollution Treatment (WRPT-21), July 6 –8, 2021. (Oral -Virtual).
7. Mehan S., King K., Kujawa H., Shedekar V.S., **Murumkar A.**, Kalcic M. (2021). Evaluating the effectiveness of SWAT (Soil and Water Assessment Tool) in simulating the impact of drainage water management (DWM) system on water quality. 2021 Annual International Meeting of American Society of Agricultural and Biological Engineers. July 11-14, 2021. (Oral -Virtual).
8. **Murumkar A.**, Martin, J., Kalcic M., Stow C., Goering D., Shedekar V., Thorstensen A. King K., Evenson G., Kast J. and Apostel A. (2020). Comparing flow predictions of five multi-scale hydrologic models with edge-of-field data in western Laker Erie basin, USA. 2020 AGU Fall Meeting. December 1-17, 2020. (Oral -Virtual).
9. **Murumkar A.**, Martin, J., Kalcic M., Stow C., Shedekar V., Goering D., King K., Evenson G., Apostel A., Kast J. and Thorstensen A. (2020). Comparing SWAT predicted flows at field-scale with edge-of-field (EOF) data in western Lake Erie Basin. 49th Annual Water Management Association of Ohio (WMAO) Fall Conference. November 2-5, 2020. Columbus Ohio. (Oral - Virtual).
10. **Murumkar A.**, Martin, J., Kalcic M., Stow C., Goering D., King K., Shedekar V., Evenson G., Apostel A., Kast J. and Thorstensen A. (2020). Flow comparison: Hydrologic models with edge-of-field observed data. 2020 Annual International Meeting of American Society of Agricultural and Biological Engineers. July 12-15, 2020. Omaha, Nebraska (Oral - Virtual).
11. **Murumkar A.**, Martin, J., Kalcic M., Evenson G., Apostel A., Kast J., Goering D., Thorstensen A., Boles C., Redder T., Confesor R., Stow C., King K. and Shedekar V. (2019). Evaluating a decision support tool to guide the timing of fertilizer application. 3rd Annual All Partners Meeting, The Cooperative Institute for Great Lakes Research. September 24-25, 2019. Ann Arbor, Michigan (Poster).
12. **Murumkar A.**, Martin, J., Kalcic M., Evenson G., Apostel A., Kast J., Goering D., Thorstensen A., Shedekar V.S. Boles C., Redder T. and Confesor R. (2019). Overview of RRAF work at the Ohio State University. 3rd Annual Regional Runoff Risk Meeting, Columbus Ohio. August 29, 2019. (Oral).
13. **Murumkar A.**, Martin, J., Kalcic M., Evenson G., Apostel A., Kast J., Goering D., Thorstensen A., Shedekar V.S. Boles C., Redder T. and Confesor R. (2019). Impact of fertilizer application timings on water quality. Maumee Watershed modeling stakeholder advisory group meeting 2019, Columbus Ohio. May 16, 2019. (Oral).
14. Kujawa H., Kalcic M., Martin J., Apostel A., Kast J., **Murumkar A.**, Evenson, G., Aloysius, N., Boles, C., Redder, T., Confesor, R., Becker, R., Muenich, R., Dagnew, A. and Wang, Y. (2019). Importance of the watershed model in simulating future water quality under a changing climate. 74th Soil and Water Conservation Society (SWCS) International Annual Conference. July 28-31, 2019, Pittsburgh, Pennsylvania. (Poster).

15. **Murumkar A.**, Martin, J., Kalcic M., Evenson G., Apostel A., Kast J., Goering D., DaSilva A., Thorstensen A., Boles C., Redder T. and Confesor R. (2019). Predicting impacts of the NOAA-NWS Runoff Risk Advisory Forecast (RRAF) on water quality with multiple SWAT watershed models in the western Lake Erie basin, USA. Annual International Meeting of American Society of Agricultural and Biological Engineers. July 06-10. Boston, Massachusetts. (Oral)
16. Shedekar V.S., **Murumkar A.**, King K., Kalcic M., Islam R. and Brown L.C. (2019). Irrigation considerations for grain crops in Ohio. Annual International Meeting of American Society of Agricultural and Biological Engineers. July 06-10. Boston, Massachusetts. (Oral)
17. Shedekar V.S., **Murumkar A.**, and Brown L.C. (2019). Water requirement trends for irrigated grain crops in Ohio. The Soil Science Society of America (SSSA) International Soils Meeting. January 6-9, 2019. San Diego, California, USA. (Oral)
18. **Murumkar A.**, Martin, J., Kalcic M., Evenson G., Apostel A., Kast J., Goering D., DaSilva A., Thorstensen A., Boles C., Redder T. and Confesor R. (2018). Modeling nutrient runoff given the Runoff Risk Advisory Forecast (RRAF) in the Great Lakes region. 2018 AGU Fall Meeting. December 10-14, 2018. Washington, D.C., USA. (Oral)
19. **Murumkar A.**, Arya D.S., Taxak A.K. and Shedekar, V.S. 2018. Climate change impact on meteorological parameters and hydrology of Bhima River basin, India. Proc. International Conference on Sustainable Water Management, December 10-11, 2018, Chandigarh, India.
20. Kujawa H., Kalcic M., Martin J., Apostel A., Kast J., **Murumkar A.**, Evenson, G., Aloysius, N., Boles, C., Redder, T., Confesor, R., Becker, R., Muenich, R., Dagnew, A. and Wang, Y. (2018). The hydrology model as a source of nutrient loading uncertainty in a future climate. 3rd Annual State of the Science Conference: Understanding Algal Blooms. September 13, 2018. Toledo, Ohio. (Poster)
21. Kujawa H., Kalcic M., Martin J., Apostel A., Kast J., **Murumkar A.**, Evenson G., Aloysius N., Boles C., Redder T., Confesor R., Becker R., Muenich R., Dagnew A. and Wang Y. (2018). The role of water management and climate change uncertainty: a case study in the Maumee River Watershed. 47th Annual Water Managers Association of Ohio Conference, October 31, 2018. Cincinnati, Ohio. (Oral)
22. Moritz M., Phang S., Laborde S., Shastry A., **Murumkar A.**, Ziebe R., Ahmadou M., Kari S., Mark B., Durand M., Fernandez A. and Hamilton I. (2018). Synthesizing data, concepts, and models in interdisciplinary research of coupled systems. International Symposium at SESYINC Boundary Spanning: Advances in Socio-Environmental Systems Research, in Annapolis, Maryland, June 11-13, 2018. (Poster)
23. **Murumkar A.**, Mark B., Fernandez A., Moritz M. and Durand M. (2018). Modeling hydrological regime of the Logone-Lake Chad River basin, Africa under CMIP5 GCMs projections. 31st Conference on Climate Variability and Change as a part of 98th American Meteorological Society Annual Meeting. January 07 -11, 2018. Austin, Texas, USA. (Oral)
24. **Murumkar A.R.** and Arya D.S. (2017). Spatio-temporal changes in rainfall and temperature of the Bhima River basin (India). Annual Meeting of American Society of Agricultural and Biological Engineers. July 16-19. Spokane, Washington. (Oral)
25. Laborde S., Fernandex A., Ahmadou M., Durand M., Hamilton I., Kari S., Mahamat A., Mark B., **Murumkar A.**, Phang S.C., Shastry A., Ziebe R. and Moritz M. (2017). How fast does the Logone floodplain dry? Social and Cultural relevance of rates of change in river discharge and floodplain water levels. International River Symposium and Environmental Flows Conference, September 18-20, 2017. Brisbane. (Oral)
26. Phang S.C., Hamilton I., Laborde S., Fernandez A., **Murumkar A.**, Shastry A., Durand M., Mark B. and Moritz M. (2017). Bridging the gap between humans, water and fish: An integrated model of a coupled

- inland fishery system to direct development policies). 147th Annual Meeting of the American Fisheries Society, August 20-24, 2017. Tampa, Florida. (Oral)
27. **Murumkar A.R.**, Michael D., Mark M., Mark B., Fernández A., Hamilton I., Scholte P., Laborde S., Shastry A. and Phang S. (2017). Spatio-temporal variability of climatic parameters in the Logone river basin (Africa). 97th American Meteorological Society Annual Meeting. January 22 -26, 2017. Seattle, Washington, USA. (Poster)
 28. **Murumkar A.R.**, Durand M., Moritz M., Mark B., Hamilton I., Fernández A., Phang S. Laborde S. C. and Shastry A. (2016). Assessing impacts of climate change on spatio-temporal variability of rainfall and temperature in the Logone river basin (Africa). 11th Annual Scholar Research Exposition, November 18, 2016. The Ohio State University, Columbus, Ohio. (Oral)
 29. Laborde S.C., Durand M., Moritz M., Mark B., Hamilton I., Fernández A., Phang S. Shastry A. and **Murumkar A.R.** (2016). Studying interactions between human and natural processes in the Logone floodplain of Cameroon. 11th Annual Scholar Research Exposition, November 18, 2016. The Ohio State University, Columbus, Ohio. (Oral)
 30. Gupta S., **Murumkar A.**, Kaurwar A., Satankar R. K., Virat J., Kumar G., Hatte S., George K. J. Shedekar V. S. and Plappally A. (2016). Identification of a matrix framework to study the life cycle of water in Indian domestic sector. Water Today's Water Expo 2016, Chennai Trade Centre, Tamil Nadu, India. (Oral)
 31. **Murumkar A. R.** and Arya D.S. (2014). Rainfall variability analysis in the Nira River Basin Using multi-model GCM ensemble. 11th International Conference on Hydroinformatics HIC 2014, New York, USA. (Oral)
 32. Arya D. S., **Murumkar A. R.** and Gareeballa A. (2014). Impact of El Niño Southern Oscillation (ENSO) on summer monsoon rainfall in Bhima Basin, Central India. 11th International Conference on Hydroinformatics HIC 2014, New York, USA. (Oral)
 33. Arya D. S., Gautam A.K. and **Murumkar A. R.** (2014). Snowmelt modeling of Dhauliganga River using Snowmelt Runoff Model (SRM). 11th International Conference on Hydroinformatics HIC 2014, New York, USA. (Oral)
 34. Taxak A. K., **Murumkar A. R.** and Arya D.S. (2014). Statistical analysis of long term temporal trends of precipitation and temperature in Wainganga sub-basin, India. 5th International Conference on Environment Science and Engineering, Dubai, UAE. (Oral)
 35. Arya D. S., Gareeballa A. and **Murumkar A. R.** (2013). ENSO and its impact on monsoon rainfall in Central India. Proceedings of National Seminar on Climate Change Impacts on Water Resources Systems 27th-29th November 2013, Vadodara, Gujarat, India. (Oral)
 36. Dhari S., **Murumkar A. R.** and Arya D. S. (2013). Meandering behaviour and flood hazard mapping of Ganges of River using remote sensing and GIS. International Conference on Challenges in Disaster Mitigation and Management Strategies, 15-17 February 2013, IIT Roorkee, India. (Oral)
 37. Arya D. S., Kabuya P.M., **Murumkar A. R.**, Rahman M. M. and Goel N. K. (2012). Impact of climate change on rainfall in Jamuneswari River Basin, Bangladesh. 10th International Conference on Hydroinformatics HIC 2012, Hamburg, Germany. (Oral)
 38. **Murumkar A. R.**, Arya D. S. and Rahman M. M. (2011). Seasonal and annual variations in rainfall pattern in Jamuneswari Basin, (Bangladesh). International Conference on Recent Advancements in Earth Resources Research: The Road to the Earth Future (Earth Future), 7-9 September 2011, Salem, Tamil Nadu (India). (Oral)

SUMMARY OF RESEARCH EXPERIENCE IN INTEGRATED MODELING AND GEOSPATIAL TOOLS

Below, is a summary of projects, locations of regions/watersheds of interest, and models, techniques, and data products used throughout my research career in (Carbon sequestration and markets, Water quality and Climate change).

Watersheds/regions of focus



- ★ Demarara Essequibo, & Mazaruni River basins, Guyana (South America)
- ★ Bhima River and Nira River Basins, India (Asia)
- ★ Maumee River Watershed, Ohio, Michigan, Indiana (USA)
- ★ Wainganga River Basin, India (Asia)
- ★ Upper Scioto River Watershed, Ohio (USA)
- ★ Ganga River Basin, India (Asia)
- ★ Logone River Basin, Cameroon (Africa)
- ★ Jamuneshwari River basin, Bangladesh (Asia)

Data Products Used

Climate data: NCDC Climate data, NOAA's gridded forecasted and observed climate and runoff risk data, CRU gridded climate data, IMD gridded climate data

Stream flow and water quality data: USGS streamflow and water quality data, Delphos water quality grab sample data EOFs flow and water quality data, 5 hydrologic models (Field-scale SWAT model, National Water Model – WRF, SACTH and SACTHET different versions) simulated surface, subsurface and total flow data, India-WRIS streamflow data

Remote sensing data: University of Toledo and OpTIS remote sensing crop management data, DEM (multiple resolutions), Soil data (global, regional and local), FAO soil survey data, land use data

Crop management survey data: field-survey Ag conservation practices data (i.e. OACI), H2Ohio practices adoptions county-level data, County level STP values representation incorporation, Manure application improvement based on recent years data, EOF crop management data

Global climate models data: 21 CMIP5 Global Climate Models output (RCP 4.5 and RCP 8.5), 15 CMIP3 Global Climate Models output (A1B, A2 and B1 emission scenarios)

ENSO indices data: MEI, SOI and Tau, Niño 3.4

Watershed models and software used

Watershed models/tools: SWAT, SWAT+, VIC, ACPF

Other tools/software: LARSWG, ArcGIS, Erdas Imagine

Acronyms used: ACPF-Agricultural Conservation Planning Framework; CMIP-Coupled Model Intercomparison Project (numbers refers to Phase 3 and Phase 5); CRU-Climate Research Unit; ENSO-El Niño–Southern Oscillation; EOF-Edge-of-Field; FAO-Food and Agricultural Organization; GCM-General Circulation Models or Global Climate Model; GIS-Geographical Information Systems; IMD-India Meteorological Department; LARSWG-Long Ashton Research Station Weather Generator; MEI-Multivariate ENSO Index; NCDC-National Climate Data Center; OACI-Ohio Agriculture Conservation Initiative; OpTIS-Operational Tillage Information System; RCP-Representative Concentration Pathway; RRAF-Runoff Risk Advisory Forecast; SAC-HTET-Sacramento Soil Moisture Accounting model with heat transfer and enhanced evapotranspiration; SOI and Tau-Southern Oscillation Index and Thermal Anomaly Index (also known as JMA SSTA); SWAT-Soil and Water Assessment Tool; USGS-United States Geological Survey; VIC-Variable Infiltration Capacity; WRF - Weather Research and Forecasting; WRIS-Water Resources Information system