Fadji Zaouna Maina, Ph.D.

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Research Interests

A hydrodynamic journey from the equations to the model application on complex large-scale systems to transcend the climate change era

- Assessing the impacts of climate extremes and wildfires on watershed hydrology using remote sensing techniques and high-resolution physically based integrated hydrologic models.
- Investigating the interconnectivity between the subsurface and lower atmosphere dynamics.
- Development of an interdisciplinary approach of hydrologic modeling, which includes not only multiphase flow and biological processes but also atmospheric dynamics.
- Development of efficient numerical algorithms for the resolution of the variably saturated flow.
- Inverse modeling and adaptive downscaling parameterization to characterize complex hydrologic systems using multiple datasets (hydrologic, gravimetric and geologic).
- Uncertainty quantification and global sensitivity analysis using polynomial chaos expansion to optimize hydrodynamic parameters estimation.

Education

Ph.D. in Hydrology, University of Strasbourg (France) 2013-2016
- Research Focus: Estimation of groundwater recharge by inversion in a complex hydrogeological system
- Thesis funded by CEA (French Alternative Energies and Atomic Energy Commission)
- Thesis deemed exceptional by an international committee
- Kepler Award 2017: “Chapitre Saint Thomas” Award for the University of Strasbourg best PhD Thesis in STEM
- Press release: A Nigerien woman received PhD in STEM at 25 years old!
- Advisors: Philippe Ackerer, PhD (University of Strasbourg, France) and Olivier Bildstein, PhD (CEA Cadarache, France)

M.S. in Environmental Engineering, University of Strasbourg (France) 2011-2013
- Research Focus: Comparison of models of pollutants transport in porous media
- Recipient of the French government excellence scholarship
- Honor Student
- Advisor: Philippe Ackerer, PhD (University of Strasbourg, France)

B.S. in Geological Engineering, University of Fes (Morocco) 2008-2011
- Recipient of the Moroccan government excellence scholarship
- Honor Student

Research Experience

Postdoctoral Researcher, Lawrence Berkeley National Laboratory (Berkeley, California, USA)

March 2018 - Present

- Investigating the impact of climate extremes on water resources using high-performance computing, remote sensing techniques, and parallelized integrated hydrologic models
- Assessing the impact of wildfires on Californian watershed hydrology
- Predicting the end of the century hydrology in California
- Understanding land surface processes using global sensitivity analysis
- Collaboration:
  - UCOP Project: 5 Universities of California, Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory

Postdoctoral Researcher, Politecnico di Milano (Milan, Italy)

February 2017 - March 2018

- Assessing the importance of gravimetric variations in the estimation of hydrodynamic parameters
- Global sensitivity analysis using first-moment order indices: application to hydrogeophysical models
- Development of an inverse model to estimate hydrodynamic parameters using geological data
- Understanding the impact of glaciation on the hydrothermodynamics in sedimentary basins
- Geostatistical analysis of compositional data to characterize the geology of sedimentary basins
- Collaborations:
  - ENI (Ente Nazionale Idrocarburi, for Italian National Hydrocarbons Company)
  - European project WE-NEED (WatEr NEEDs, availability, quality and sustainability): Politecnico di Milano (Italy), Weizmann Institute (Israel), Universidade of Aveiro (Portugal) and Universitat Politecnica of Catalunya (Spain)

Postdoctoral Researcher, Laboratory of Hydrology and Geochemistry of Strasbourg, French National Center for Scientific Research (CNRS, France)

October 2016-January 2017

- Development of an inverse model to estimate initial conditions of groundwater models
- Development of an inverse model to estimate groundwater and river interactions
- Collaboration:
  - AquiFR project: CNRS France, Meteo France and BRGM France

Graduate Research Assistant, French Alternative Energies and Atomic Energy Commission (CEA, France)

October 2013 -September 2016

- Assessing the efficiency of numerical algorithms for the resolution of the Richards equation
- Development of a coupled hydrologic model solving flow in both unsaturated and saturated zones
- Uncertainty quantification and global sensitivity analysis using chaos polynomial expansion and Hilbert Schmidt Independence Criterion
- Groundwater recharge estimation using the quasi-Newton algorithm and adjoint state method
- Development of a new adaptive downscaling parameterization for inverse models

Graduate Research Assistant, Laboratory of Hydrology and Geochemistry of Strasbourg, French National Center for Scientific Research (CNRS, France)

February-June 2013

- Assessing the accuracy of numerical models for the resolution of the advection-diffusion equation: eulerian (finite element, finite difference, mixed hybrid finite element, discontinuous finite element) and eulerian-lagrangian (ELLAM) methods

Graduate Research Assistant, Laboratory of Hydrology and Geochemistry of Strasbourg, French National Center for Scientific Research (CNRS, France)

February-April 2012

- Using radioactive isotopes of short duration to quantify soil-plant transfers

Undergraduate Research Assistant, Department of Water Resources, Zinder (Niger)

August-September 2010

- Monitoring pumping wells
- Electrical resistivity tomography

Teaching and Mentoring Experience

Co-advised the following undergraduate, graduate and Ph.D. students:

- Selene Patani, Master Student, Politecnico di Milano (Italy)
- Audrey Gervereau, Master Student, Université Paris Sud – Paris Saclay (France)
- Ved Bhoot, Graduate Student, UC Berkeley (California, USA)
- Lillian Holmes, Undergraduate Student, UC Berkeley (California, USA)
- Meléa Emunah, Undergraduate Student, Princeton University (New Jersey, USA)
- Member of the PhD thesis advisory board of Oumou Kaltoum Hama Garba - PhD thesis in hydrogeophysics at the University of Grenoble (France)

Outreach activities:

- Volunteer for Berkeley Lab K12-program: teaching physics, chemistry, and Earth science to middle and high school students
- Mentoring high school students
- Science festivals

Led the following workshops:

- "Inverse problems in hydrology", 2018, workshop at the University of Strasbourg (France)
- "Introduction to modeling in hydrology" 2018, workshop at the University of Niamey (Niger)

Achievements and Awards

- Forbes 30 Under 30, Class of 2020
- Science SLAM finalist at Berkeley Lab, 2019, link to the video
- Rising Star in Civil and Environmental Engineering, MIT, 2019
- Rising Star in Hydrology, Gordon Research Conference, 2019
- Selected to present my research at the Science Translator Showcase at the California State Capitol, 2020
- Approval from the National Council of Universities of France to teach in all higher-educational institutions in France, 2018
- Kepler Award "Chapitre Saint Thomas" Award for the University of Strasbourg' best PhD Thesis in Science and Engineering, 2017
- The youngest Nigerien women to receive a Ph.D. (at 25 years old), 2016
- Recipient of the French government excellence scholarship, 2012-2013
- Recipient of the Moroccan government excellence scholarship, 2008-2011

Publications

1. **Maina, F. Z,** Siirila-Woodburn E., Newcomer M., Xu Z., Steefel C. 2020 "Determining the impact of a severe dry to wet transition on watershed hydrodynamics in California, USA with an integrated hydrologic model", ***J. Hydrol.*** 580, 124358. https://doi.org/10.1016/j.jhydrol.2019.124358
2. Graves, A., Rosa, L., Nouhou, A.M., **Maina, F.**, Adoum, D., 2019. Avert catastrophe now in Africa's Sahel. ***Nature*** 575, 282–286. https://doi.org/10.1038/d41586-019-03445-z
3. **Maina, F. Z,** Siirila-Woodburn E., 2019 Watersheds dynamics following wildfires: nonlinear feedbacks and implications on hydrologic responses, ***Hydrological Processes***, hyp.13568. https://doi.org/10.1002/hyp.13568.
4. **Maina, F. Z.,** Guadagnini, A. 2018. Uncertainty quantification and global sensitivity analysis of subsurface flow parameters to gravimetric variations during pumping tests in unconfined aquifers. ***Water Resources Research***, 54, 501–518. https://doi.org/10.1002/2017WR021655
5. **Maina F. Z.**, Ackerer P. 2017. Groundwater flow parameter estimation using refinement and coarsening indicators for adaptive downscaling parameterization. ***Adv. Water Resour***. 100, 139–152. doi:10.1016/j.advwatres.2016.12.013
6. **Maina F. Z.**, Ackerer P. 2017. Ross scheme, Newton–Raphson iterative methods and time-stepping strategies for solving the mixed form of Richards' equation. ***Hydrol Earth Syst Sci*** 21, 2667–2683. doi:10.5194/hess-21-2667-2017
7. **Maina F. Z.**, Ackerer, P., Younes, A., Guadagnini, A., Berkowitz, B., 2017. Benchmarking numerical codes for tracer transport with the aid of laboratory-scale experiments in 2D heterogeneous porous media**. *J. Contam. Hydrol.*** doi:10.1016/j.jconhyd.2017.06.001
8. **Maina F. Z.**, Delay F., Ackerer P. 2017. Estimating initial conditions for groundwater flow modeling using an adaptive inverse method. ***J. Hydrol.*** 552, 52–61. doi:10.1016/j.jhydrol.2017.06.041

Publications (in press)

9. **Maina, F. Z**, Siirila-Woodburn E., Vahmani P. "On the sensitivity of meteorological forcing resolution on hydrologic metrics", *Hydrology and Earth Science Systems*
10. **Maina, F. Z**, Siirila-Woodburn E., "The role of subsurface flow on evapotranspiration: a global sensitivity analysis", *Water Resources Research*

Publications (under review)

11. **Maina, F. Z**, Rhoades A., Siirila-Woodburn E., Dennedy-Frank P,J,, "Pairing high-resolution global climate and integrated hydrologic models to assess the impacts of end of century climate extremes on water resources in California" *Earth's Future*
12. Li Z., Ozgen I., **Maina, F. Z,** "A conservative predictor-corrector solution of the 1D Richards' equation with adaptive time control" *Journal of Hydrology*

Publications (in preparation)

13. **Maina, F. Z**., Riva. M, Guadagnini, A. "Impact of multiple-uncertainties on gravimetric variations within heterogeneous aquifers during pumping tests"
14. **Maina, F. Z**., Riva. M. "An adaptive downscaling parameterization embedded with geological information for the estimation of groundwater flow and recharge parameters"

Invited Talks

1. **Maina F.Z.** "Feedbacks between evapotranspiration and subsurface flow: a global sensitivity analysis", SIAM Uncertainty Quantification 2020, Munich (Germany)
2. **Maina F. Z** "Introduction to modeling in hydrology" 2018, University of Niamey (Niger)
3. **Maina F. Z** "Nigerien Women in Science" Africa Science Week 2018 with the parrainage of the First Lady of Niger, (Niger)
4. **Maina F. Z** "On the use of numerical models to understand water scarcity in Zinder (Niger)" 2018, University of Zinder (Niger)
5. **Maina F. Z** "Calibrating an integrated hydrologic model using hydraulic heads" 2018, Lawrence Berkeley National Laboratory (California, USA)
6. **Maina F. Z** "Estimation of groundwater recharge by inversion" 2016, University Pierre et Marie Curie, Paris (France)
7. **Maina F. Z** "Estimating initial conditions using inverse modeling" 2016, AquiFR meeting, Paris (France)
8. **Maina F. Z** "Adaptive downscaling parameterization for inverse models" 2016, CEA Cadarache (France)

Oral Presentations

1. **Maina F. Z** "Understanding the impact of climate extremes and wildfires on Californian watersheds using an integrated hydrologic model", 2019, MIT CEE Rising Stars workshop, Cambridge, Massachusetts, USA
2. **Maina F. Z** "Sustainable water for an uncertain future", German Academic International Network meeting, 2019, San Francisco, California, USA, link to the video
3. **Maina F. Z,** Siirila-Woodburn E. "Nonlinear impacts of post-wildfire conditions on watershed hydrodynamics" Rising Star talk at Gordon Research Conference, Catchment Science, 2019, Andover, New Hampshire, USA
4. **Maina F. Z,** Siirila-Woodburn E. "Nonlinear impacts of post-wildfire conditions on watershed hydrodynamics" Gordon Research Seminar, Catchment Science, 2019, Andover, New Hampshire, USA
5. **Maina, F. Z**, Siirila-Woodburn E., Newcomer M., Xu Z., Steefel C. "Assessing the impact of climate extremes on watershed dynamics", EGU General Assembly, 2019, Vienna, Austria

6. Patani S., Porta G., Bianchi Janetti E., **Maina F. Z,** Guadagnini A. "Quantification of parametric uncertainty and calibration of basin-scale depositional models", EGU General Assembly, 2019, Vienna, Austria
7. **Maina F. Z**, Guadagnini A. "Global sensitivity analysis of subsurface flow parameters to gravimetric variations during pumping tests in unconfined aquifers", Gordon Research Seminar, Flow and Transport in Permeable Media, 2018, Newry, USA
8. Siirila-Woodburn E., **Maina, F. Z**, Newcomer M., Xu Z., Steefel C. "A new approach to predicting the effects of climate extremes on California's water supply", Computational Methods in Water Resources, 2018, Saint-Malo, France
9. **Maina F. Z.**, Bildstein O., Ackerer P. "Can we simultaneously calibrate groundwater recharge and aquifer hydrodynamic parameters?", EGU General Assembly, 2017, Vienna, Austria
10. **Maina F. Z.**, Bildstein O., Ackerer P. "Simultaneous estimation of groundwater recharge and hydrodynamic parameters for groundwater flow modeling", VIII International Conference on Sensitivity Analysis of Model Output, 2016, Le Tampon, France

Poster Presentations

11. **Maina, F. Z**, Siirila-Woodburn E., Vahmani P. "Impacts of meteorological forcing spatial resolution on hydrologic modeling", AGU Fall Meeting, 2019, San Francisco, USA
12. Dennedy-Frank, P.J., **Maina, F. Z,** Visser, A. Siirila-Woodburn E., Understanding hydrologic connectivity in a relatively unmanaged watershed by combining integrated hydrologic modeling, remote sensing, and isotope analyses", AGU Fall Meeting, 2019, San Francisco, USA
13. **Maina, F. Z**, Xu Z., Siirila-Woodburn E., "Sensitivity of simulated land surface processes to the spatiotemporal distribution of precipitation in mountainous areas: East River" Scientific Focus Area Retreat, 2019, Bodega Bay, California, USA
14. **Maina, F. Z**, Siirila-Woodburn E., Dennedy-Frank P,J "Quantifying water availability in the aftermath of a wildfire with an integrated hydrologic model", Managed Aquifer Recharge Conference, California Department of Water Resources, 2019, Sacramento, California, USA
15. **Maina F. Z,** Siirila-Woodburn E. "Watersheds dynamics following wildfires: nonlinear feedbacks and implications on hydrologic responses" Gordon Research Conference, Catchment Science, 2019, Andover, New Hampshire, USA
16. **Maina, F. Z**, Siirila-Woodburn E., Newcomer M., Xu Z., Steefel C. Watershed dynamics and connectivity from headwaters to groundwater, AGU Fall Meeting, 2018, Washington DC, USA, - elightning presentation
17. Siirila-Woodburn E., **Maina, F. Z**, Newcomer M., Xu Z., Steefel C. "Watershed responses to climate extremes: impacts on groundwater storage and stakeholder water management planning", AGU Fall Meeting, 2018, Washington DC, USA
18. Siirila-Woodburn E., **Maina, F. Z**, Newcomer M., Xu Z., Steefel C. "A New Approach to Predicting the Effects of Climate Extremes on California's Water Supply", UC Water Reimagining California Water: an exposition of research and innovation, 2018, Sacramento, USA
19. **Maina F. Z**, Newcomer M., Xu Z., Woodburn E. "Using high resolution integrated hydrologic models and uncertainty quantification tools to understand dynamic watershed behavior across scales", Gordon Research Conference, Flow and Transport in Permeable Media, 2018, Newry, USA

Relevant experience

- 2008: Vice president of the youth parliament of Niger
    - Selected to represent Nigerien youth at the National Parliament of Niger

Reviewer Experience

Hydrology Earth and System Sciences, MDPI journals

Languages

1. **English:** Fluent
2. **French:** Native
3. **Hausa:** Native
4. **Italian:** level B1 (Intermediate)
5. **Arabic:** Reading and writing
6. **Spanish:** Beginner

Informatics skills

- Languages: Fortran, Python, Matlab, C++ (basics), Linux, TCL
- Software: Arcgis, Origin, Qgis, Surfer, Modflow, Feflow, Hydrus, Latex, Tecplot, SGEMS, Parflow, Visit, CLM
- High Performance Computing
- Remote sensing platforms: GRACE, SMAP, NLDAS, SNODAS, METRIC

Memberships

- American Geophysical Union
- European Geosciences Union
- Co-Founder of Renidoc (Réseau des Nigeriens Ingénieurs et Docteurs en France)
- Lawrence Berkeley National Laboratory Postdoc Association (BLPA)
- Lawrence Berkeley National Laboratory Women Scientists Engineers Council (WSEC)

Leadership Experience

- Lawrence Berkeley National Laboratory Postdoc Association (BLPA) – Communication and outreach committee coordinator
    - Manage internal and external communications
    - Help to organize the first Berkeley Lab Career Fair
    - Interview and write '[Coffee with postdocs]' a blog post highlighting the contribution of Berkeley Lab postdocs to the breakthrough research of the Lab.
- Next Einstein Forum- Africa Science Week Niger – Communication and outreach committee coordinator

Other Experiences

- Attended the National Postdoc Association meeting, 2019, Orlando, Florida, USA
- Participated in the DWR workshop and summit "Planning For Change", 2019, Tahoe City, California, USA
- Served as a judge for master student presentations at GEM conference, 2019, Chicago, Illinois, USA
- Invited to present my research to Congress members visiting Berkeley Lab, 2019
- Invited to meet the President of National Academy of Sciences visiting Berkeley Lab, 2019

Press releases

- UC Berkeley researchers urge governments to take action in western Sahel region
- Researchers say Western Sahel investment needed to avert crisis
- Wildfires affect water resources long after the smoke clear
- NERSC powers research on post-wildfire water availability
- How wildfires affect our drinking water?
- Impact of wildfires on watersheds
- Could wildfires be good for water availability?
- Berkeley Lab study finds California wildfires increase runoff and groundwater
- Berkeley Lab study finds California wildfires increase runoff, groundwater
- Supercomputing Post-Wildfire Water Availability
- How California Wildfires Can Impact Water Availability, the news also appeared on phys.org, EurekAlert, ScienceDaily, ScienceBlog, ScienceSprings, Napawatersheds, MavenNoteBook, etc.
- EGD Postdoc represents EESA at National Postdoc Conference
- Women supporting women at Berkeley Lab
- Meet Fadji Maina
- A Nigerien woman received her PhD degree at 25 years old

Other interests

- Reading biographies, economic, leadership and intelligence books
- Traveling and Hiking
- Girls Education in Africa

Medias

- Berkeley Lab
- Google Scholar
- ResearcherID
- Researchgate
- LinkedIn
- Twitter: @yafadj

References

1. Philippe Ackerer, PhD advisor, 1 rue blessig, 67084 Strasbourg Cedex, France, +333 68 85 05 61, ackerer@unistra.fr
2. Erica Woodburn, Postdoc Supervisor, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, M.S. 74R-316C, Berkeley, CA 94720, USA, ERWoodburn@lbl.gov
3. Alberto Guadagnini, Postdoc Supervisor, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano Italia, alberto.guadagnini@polimi.it
4. Monica Riva, Postdoc Supervisor, Politecnico di Milano, Piazza Leonardo da Vinci, 32, 20133 Milano Italia, monica.riva@polimi.it
5. Olivier Bildstein, PhD advisor, 13108 Saint Paul Lez Durance cedex, France, +334 42 25 37 24, olivier.bildstein@cea.fr