Hamada S. Badr

Senior Applied Scientist
Capacity Planning Forecasting Science
Amazon Customer Service (CS)

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Today, there are many skilled and talented scientists applying their abilities to solve challenging problems in their field and contributing to the scientific literature. It is rare, however, to find interdisciplinary scientists who dynamically combine multiple disciplines, creative ideas, and innovative approaches to solve complex real-world problems using machine learning and numerical simulations. I am an applied scientist with broad and in-depth skills and over two decades of experience in statistical analysis, numerical modeling of physical processes, data visualization, and software engineering as well as project management and leadership. I am a language-agnostic software developer who can easily and quickly switch between different platforms and master new solutions. I am trained first in aerospace engineering and earth sciences, and I have developed my skills in software engineering, mathematics, statistics, machine learning, and physics to address grand challenges in aerodynamics, hydroclimate, infectious diseases, global health, and business intelligence.

Interests

- Machine Learning (ML) & Artificial Intelligence (AI)
- Natural Language Processing (NLP) & Computer Vision
- Interpretable Modeling & Uncertainty Quantification
- Computational Statistics & Bayesian Inference
- High Performance Computing (HPC)
- Computational Fluid Dynamics (CFD)
- Numerical Weather Prediction (NWP)
- Numerical Modeling & Data Assimilation
- Multiscale Hydroclimate Dynamics & Modeling
- Statistical & Dynamical Downscaling
- Satellite Remote Sensing & Earth Observation
- Spatiotemporal Analysis of Hydroclimate Variability
- Extreme Weather Events & Climate Change
- Environmental Health & Infectious Diseases
- Customer Journey Analytics & Business Intelligence

Education

2011 – 2016 Ph.D. Earth & Planetary Sciences
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Dissertation: Applications of Climate Regionalization: Statistical Prediction & Patterns of Precipitation Variability in Observations & Global Climate Models

2011 – 2013 M.A. Earth & Planetary Sciences
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA

2003 – 2011 M.Sc. Aerospace Engineering
Department of Aerospace Engineering, Cairo University, Giza, Egypt
Thesis: Ensemble Forecasting & Data Assimilation in Numerical Weather Modeling for Egypt

1997 – 2003 B.Sc. Aerospace Engineering
Department of Aerospace Engineering, Cairo University, Giza, Egypt

Employment

2024 – Senior Applied Scientist
Forecasting Science, Worldwide Capacity Planning (WWCP), Customer Service (CS)
Amazon, Seattle, Washington, USA

2022 – 2024 Senior Applied Scientist
Sales, Marketing & Global Services (SMGS) Ops – Data Platform & Infrastructure (DP&I) Science & Econ,
Amazon Web Services (AWS), Herndon, Virginia, USA

2020 – 2022 Associate Research Scientist
Department of Civil and Systems Engineering (CaSE) – Center for Systems Science and Engineering (CSSE),
Johns Hopkins University (JHU), Baltimore, Maryland, USA

2016 – 2020 Assistant Research Scientist
Department of Earth and Planetary Sciences (EPS) – Hydroclimate Research Group (HCRG),
Johns Hopkins University (JHU), Baltimore, Maryland, USA

2016 – 2016 Postdoctoral Fellow
Department of Earth and Planetary Sciences (EPS) – Hydroclimate Research Group (HCRG),
Johns Hopkins University (JHU), Baltimore, Maryland, USA

2011 – 2016 Graduate Research Assistant
Department of Earth and Planetary Sciences (EPS) – Hydroclimate Research Group (HCRG),
Johns Hopkins University (JHU), Baltimore, Maryland, USA

2011 – 2018 Assistant Research Scientist
Data Reception, Analysis, and Receiving Station Affairs Division,
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt

2005 – 2011 Group Chief Executive
Data Reception, Analysis, and Receiving Station Affairs Division,
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt

Awards

2022 – 2023 AWS Builder Award
Sales, Marketing & Global Services (SMGS) Ops – Data Platform & Infrastructure (DP&I) Science & Econ

2020 – 2023 Co-PI, *COVID-19 Supplement to "Environmental Determinants of Enteric Infectious Disease "*
Award: NNH16ZDA001N-GEO **Amount:** $200,000 **Source of Support:** NASA

2019 – 2023 Co-PI, *GMELT Ahead: Leveraging Earth Observations for Improved Climate Projections*
Award: NNH19ZDA001N-HMA **Amount:** $114,708 **Source of Support:** NASA

2019 – 2022 Co-PI, *PREEVENTS/T2: Multi-Scale Prediction of Flash Drought in the United States*
Award: NSF 1854902 **Amount:** $471,929 **Source of Support:** NSF

2019 – 2020 Co-PI, USAID/*ICBA: Improved MENA Regional Drought Monitoring System*
Award: ICBA-JHU-19097730 **Amount:** $161,487 **Source of Support:** ICBA

2017 – 2020 Co-PI, *GEO: Environmental Determinants of Enteric Infectious Disease*
Award: NNH16ZDA001N-GEO **Amount:** $598,000 **Source of Support:** NASA

2016 – 2016 Postdoctoral Fellowship
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA

2013 – 2013 Honorable Mention Award
American Meteorological Society (AMS), Boston, Massachusetts, USA

2012 – 2016 Research Assistantship
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA

2011 – 2012 Morton K. Blaustein Fellowship
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA

Skills

Programming: R > 10 years, Python > 10 years, Fortran > 10 years, C++ > 5 years, Stan > 5 years
Deep Learning: R > 10 years, Python > 10 years, Keras > 5 years, TensorFLow > 5 years, Torch > 5 years
Big Data: R > 10 years, Python > 10 years, MATLAB > 10 years, Hadoop > 3 years, Hive > 3 years, Spark > 3 years
Visualization: R > 10 years, Python > 10 years, MATLAB > 20 years, NCL > 10 years, Ferret > 7 years
Numerical Modeling: WRF > 20 years, NU-WRF > 5 years, LIS > 5 years, MM5 > 5 years
High Performance Computing: Porting > 20 years, Parallel Computing (OpenMP & MPI) > 20 years
Shell Scripting: BASH>20 years, CSH~5 years, KSH>5 years, MKSH>5 years, TCSH>5 years, ZSH>5 years
Data Tools: R > 10 years, Python > 10 years, NCL > 10 years, NCO > 10 years, CDO > 10 years, Ferret > 7 years
Version Control: Git > 10 years, SVN > 5 years, CVS > 3 years, Other Open-Source Tools 1-20 years
Databases: R > 10 years, Python > 10 years, MySQL > 5 years, PostgreSQL > 3 years, Redshift > 2 years, Spark > 2 years
Productivity: R Markdown> 10 years, LaTeX > 20 years, Office > 20 years, Web Design (HTML/CSS) > 10 years
Operating Systems: Unix/Linux > 20 years, Windows > 20 years, MacOS > 10 years, Android > 5 years
Languages: Arabic Mother Tongue, English Proficient, Turkish Beginner
General Skills: Amazon Web Services (AWS), Android Development, Code Optimization, …

Software

Lead Author & Maintainer of:

- *additive*: Bindings for Additive *TidyModels*
- *bayesian*: Bindings for Bayesian *TidyModels*
- *HiClimR*: Hierarchical Climate Regionalization

Contributor of:

- *brms*: Bayesian generalized multivariate non-linear multilevel models using *Stan*
- *EpiNow2*: Estimate Realtime Case Counts and Time-varying Epidemiological Parameters
- *LISF*: NASA Land Information System Framework
- *projpred*: Projection predictive variable selection
- *RcppParallel*: High-level functions for parallel programming with *Rcpp*
- *rstan*: The R interface to *Stan*
- *Stan*: State-of-the-art platform for statistical modeling and high-performance computing
- *tidymodels*: A collection of R packages for machine learning using *tidyverse* principles
- *torch*: Tensors and Neural Networks with 'GPU' Acceleration
- *WRF*: Weather Research and Forecasting

Some of my contributed open-source software is listed on my GitHub account at https://github.com/hsbadr.

Services

- Developer, Contributions to Open-Source Software (OSS) projects
- Peer-review, MDPI Remote Sensing – Deep Learning Applications
- Peer-review, Theoretical and Applied Climatology (TAAC)
- Peer-review, Journal of Climate (JCLI)
- Member, American Meteorological Society (AMS)
- Member, American Geophysical Union (AGU)
- Member, Geological Society of America (GSA)
- Session Chair, Geological Society of America (GSA)

Experience

2024 – Present **Customer Contact Demand Forecasting**
Forecasting Science, Worldwide Capacity Planning (WWCP), Customer Service (CS)
Amazon, Seattle, Washington, USA
Develop an automated, scalable, scientific workflow, using *Machine Learning (ML)* and *Artificial Intelligence (AI)*, that significantly enhances customer service operational efficiency and decision-making, leading to optimized resource planning and cost management.

2022 – 2024 **Customer Journey**
Sales, Marketing & Global Services (SMGS) Ops – Data Platform & Infrastructure (DP&I) Science & Econ, Amazon Web Services (AWS), Herndon, Virginia, USA
Customer Journey enables the automation of actionable insights, predictions, and recommendation strategies, using *Machine Learning (ML)* and *Artificial Intelligence (AI)*. I started with a vague idea and delivered high-quality results with long-term vision. My solution uncovered the stages, inflection points, dwell times, insights, and drivers of end-to-end customer journeys.

2020 – 2022 **Tracking and Modeling of COVID-19 Pandemic**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
COVID-19 Supplement to the "Determinants of Enteric Infectious Disease" is a project to develop an environmentally informed risk monitoring and early warning system to inform decision makers. *Machine learning* and epidemic modeling are used for generating risk maps as well as prospective tracking and modeling of the impacts of hydrometeorological factors on COVID-19 pandemic.

2019 – 2023 **Leveraging Earth Observations for Improved Climate Projections**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
GMELT Ahead: Leveraging *Earth Observations* for Improved Climate Projections in High Mountain Asia is a 3-year project to generate high-resolution projections of future climate and hydrology that grounded in best-available historical observations and understanding of atmospheric processes. Different approaches are used for downscaling, including *regionalization* and *Convolutional Neural Network (CNN)* pattern reconstruction.

2019 – 2022 **Multi-scale Prediction of Flash Drought in the United States**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
PREEVENTS Track 2: Collaborative Research: Flash droughts: process, prediction, and the central role of vegetation in their evolution is a 3-year project to advance efforts to understand and forecast flash droughts (FD) by targeting three characteristic features: (1) land surface memory is a key component of FD, (2) evaporative demand is a leading driver of FD onset, (3) vegetation plays a central role in FD development through its influence on soil moisture and turbulent heat fluxes. *Deep Learning* algorithms are used for the prediction and classification of flash droughts.

2017 – 2020 **Applications of Deep Learning to S2S Prediction & Downscaling**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Convolutional Neural Networks (CNN) are implemented and optimized with a custom loss function (based on *objective* climate *regionalization*) to improve and downscale dynamical forecasts at subseasonal to seasonal (S2S) timescales.

2017 – 2020 **Environmental Determinants of Enteric Infectious Disease**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Determinants of Enteric Infectious Disease: a GEO Platform for Analysis and Risk Assessment is a 3-year project to develop an environmentally informed risk monitoring and early warning application that will inform decision makers for appropriate interventions and investments needed to reduce enteric infectious (EID) diseases. *Regionalization* and *Machine Learning (ML)* are used to build a *predictive modeling* framework that generates risk maps and estimates variable importance and effects.

2017 – 2018 **Instructor: Advanced Seminar in Remote Sensing**
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
This seminar focused on the application, interpretation, and *visualization* of Land Data Assimilation

Systems (LDAS). Through lectures, exercises, and a semester project, students learnt the theory behind LDAS, run LDAS simulations using the NASA Land Information System (LIS).

2015 – 2018 Instructor: The NASA Land Information System (LIS)
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Contributions to the *development* and *training* workshops on the NASA Land Information System (LIS) and its applications, including a workshop at the National Authority for Remote Sensing and Space Sciences (NARSS) in Cairo, Egypt in August 2017 and a similar workshop at Korea Water Resources Corporation (K-Water) in Daejeon, South Korea in January 2018.

2015 – 2016 Porting NU-WRF to HHPC & MARCC
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Porting NASA-Unified Weather Research & Forecasting (NU-WRF) to JHU Homewood High Performance Cluster (*HHPC*) & Maryland Advanced Research Computing Center (MARCC) to facilitate weather prediction and analysis for researcher at JHU and other MARCC users.

2015 – 2016 Climate Regionalization of Africa
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Regionalizing Africa based on interannual variability of precipitation to study the impacts of climate change on patterns of rainfall variability in Africa at different times from geological periods to historical simulations and future climate projections.

2013 – 2015 Objective Climate Regionalization
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Development of an *open-source* software in R for **Hi**erarchical **Clim**ate **R**egionalization (*HiClimR*) to facilitate the application of rigorous *regionalization* for climate studies.

2011 – 2013 Seasonal Precipitation Predictions
Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland, USA
Application of different *statistical models*, including *artificial neural network* (ANN, best-performing model), to understand and predict seasonal rainfall anomalies as a function of large-scale variability from indices of temperature, pressure, and other variables.

2010 – 2011 Prediction of Dust Storms
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
Development of a framework for dust/sand-storms prediction using *numerical weather prediction* and *remote sensing* technology.

2010 – 2010 Porting WRF to EUMEDGRID
Africa 4 2010 - Joint EUMEDGRID-Support / EPIKH School for Application Porting, Cairo, Egypt
Porting the Weather Research and Forecasting (WRF) model to EUMEDGRID.

2010 – 2010 High Performance Computing (HPC)
IBM-Egypt and National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
IBM AIX 5L *system administration* and running *Code_Saturne* Computational Fluid Dynamics (*CFD*) Solver on NARSS Blue-Gene/L.

2008 – 2010 Ensemble Forecasting
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
Development of a preliminary ensemble *forecasting system* for Egypt, designed for operational use.

2008 – 2008 Estimation of Evaporative Rates
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
Evaluation of Lake Nasser water loss by evaporation using *numerical weather prediction* and *remote sensing*.

2006 – 2008 Data Assimilation
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
Implementation of conventional and remotely-sensed observational data into the numerical weather modeling system for Egypt using Four-Dimensional *Data Assimilation*.

2005 – 2006 ATOVS Data Processing and Visualization
National Authority for Remote Sensing and Space Sciences (NARSS), Cairo, Egypt
Development of automatic *processing* and *visualization* framework for NOAA/ATOVS *satellite data*.

2001 – 2003 Terrain Aerodynamics
Department of Aerospace Engineering, Cairo University, Giza, Egypt
Generation of a digital surface grid for Greater Cairo area and Giza plateau from raster maps, measuring the flow over prototypes in a wind tunnel, and comparing the numerical and experimental results.

Publications

Colston J., B. Fang, E. Houpt, P. Chernyavskiy, S. Swarup, L. M. Gardner, M. K. Nong, **H. S. Badr**, B. F. Zaitchik, V. Lakshami, M. N. Kosek, **2024**: The Planetary Child Health & Enterics Observatory (Plan-EO): A protocol for an interdisciplinary research initiative and web-based dashboard for mapping enteric infectious diseases and their risk factors and interventions in LMICs. *PLoS ONE*, **19**(2), e0297775.
DOI: 10.1371/journal.pone.0297775

Recalde-Coronel, C, G., B. F. Zaitchik, **H. S. Badr**, **2024**: Contributions of initial conditions and meteorological forecast to subseasonal-to-seasonal hydrological forecast skill in Western Tropical South America. *Journal of Hydrometeorology (JHM)*.
DOI: 10.1175/JHM-D-23-0064.1

Badr, H. S., B. F. Zaitchik, G. H. Kerr, N. Nguyen, Y. Chen, P. Hinson, J. M. Colston, M. N. Kosek, E. Dong, H. Du, M. Marshall, K. Nixon, A. Mohegh, D. L. Goldberg, S. C. Anenberg, and L. M. Gardner, **2023**: Unified real-time environmental-epidemiological data for multiscale modeling of the COVID-19 pandemic. *Nature Scientific Data*, **10**, 367.
DOI: 10.1038/s41597-023-02276-y

H. Du, E. Dong, **H. S. Badr**, M. E. Petrone, N. D. Grubaugh, L. M. Gardner, **2023**: Incorporating variant frequencies data into short-term forecasting for COVID-19 cases and deaths in the USA: a deep learning approach. *eBioMedicine*, **89**, 2352-3964.
DOI: 10.1016/j.ebiom.2023.104482

Badr, H. S., Colston et al., B. F. Zaitchik, M. N. Kosek, **2023**: Spatiotemporal variation in risk of Shigella infection in childhood: a global risk mapping and prediction model using individual participant data. *The Lancet Global Health*, **12**, E373-E384.
DOI: 10.1016/S2214-109X(22)00549-6

Kerr, G. H., **H. S. Badr**, A. F. Barbieri, Lauren M. Gardner, M. N. Kosek, and B. F. Zaitchik, **2023**: Evolving Drivers of Brazilian SARS-CoV-2 Transmission: A Spatiotemporally Disaggregated Time Series Analysis of Meteorology, Policy, and Human Mobility. *One Health*, In Review.
DOI: 10.1016/InReview

Colston et al., **H. S. Badr**, M. N. Kosek, B. F. Zaitchik, **2023**: Effects of hydrometeorological and other factors on SARS-CoV-2 reproduction number in three contiguous countries of tropical Andean South America: a spatiotemporally disaggregated time series analysis. *IJID regions*, **6**, 29-41.
DOI: 10.1016/j.ijregi.2022.11.007

Colston J., M. N. Kosek, B. F. Zaitchik, **H. S. Badr**, **2022**: Spatiotemporal variation and environmental sensitivity of childhood enteric pathogen infection risk: a Planetary Health approach to predictive modelling and risk mapping. *The Lancet Planetary Health*, **6**, S13.
DOI: 10.1016/S2542-5196(22)00275-3

Badr, H. S., Colston et al., B. F. Zaitchik, M. N. Kosek, **2022**: Spatiotemporal variation in risk of Shigella infection in childhood: a global risk mapping and prediction model using individual participant data. *MedRxiv*, 2022.08.04.22277641.
DOI: 10.1101/2022.08.04.22277641

H. Du, E. Dong, **H. S. Badr**, M. E. Petrone, N. D. Grubaugh, L. M. Gardner, **2022**: A Deep Learning Approach to Forecast Short-Term COVID-19 Cases and Deaths in the US. *MedRxiv*, 2022.08.23.22279132.
DOI: 10.1101/2022.08.23.22279132

Petrone, M. E., J. E. Rothman, M. I. Breban, I. M. Ott, A. Russel, E. Lasek-Nesselquist, **H. S. Badr**, …, N. D. Grubaugh, **2022**: Combining genomic and epidemiological data to compare the transmissibility of SARS-CoV-2 variants Alpha and Iota. *Communications Biology*, **5**, 439.
DOI: 10.1038/s42003-022-03347-3

Osman, M. A., B. F. Zaitchik, **H. S. Badr**, J. I. Christian, T. Tedesse, J. A. Otkin, Y. Zhong, David Lorenz, M. C. Anderson, T. D. Keenan, D. L. Miller, C. Hain, and T. Holmes, **2022**: Diagnostic classification of flash drought events reveals distinct classes of forcings and impacts. *Journal of Hydrometeorology (JHM)*, 10 January 2022.
DOI: 10.1175/JHM-D-21-0134.1

Colston et al., **Badr, H. S.**, **2021**: Associations between 8 Earth Observation-derived climate variables and enteropathogen infection: An Independent Participant Data Meta-Analysis of surveillance studies with broad spectrum nucleic acid diagnostics. *GeoHealth*, 17 December 2021.
DOI: 10.1029/2021GH000452

Badr, H. S., **2021**: additive: Bindings for Additive TidyModels. *Comprehensive R Archive Network (CRAN)*, *http://cran.r-project.org/package=additive*.
URL: https://hsbadr.github.io/additive/

Badr, H. S. and B. C. Bürkner, **2021**: bayesian: Bindings for Bayesian TidyModels. *Comprehensive R Archive Network (CRAN)*, *http://cran.r-project.org/package=bayesian*.
URL: https://hsbadr.github.io/bayesian/

Kerr, G. H., **H. S. Badr**, Lauren M. Gardner, J. Perez-Saez, and B. F. Zaitchik, **2021**: Associations between meteorology and COVID-19 in early studies: Inconsistencies, uncertainties, and recommendations. *One Health*, **12**, 100225.
DOI: 10.1016/J.OneHlt.2021.100225

Yang, G., B. F. Zaitchik, **H. S. Badr**, and P. Block, **2021**: A Bayesian adaptive reservoir operation framework incorporating streamflow non-stationarity. *Journal of Hydrology (HYDROL).*, **594**, 125959.
DOI: 10.1016/J.JHYDROL.2021.125959

Osman, M. A., B. F. Zaitchik, **H. S. Badr**, J. I. Christian, T. Tedesse, J. A. Otkin, and M. C. Anderson, **2021**: Flash drought onset over the Contiguous United States: Sensitivity of inventories and trends to quantitative definitions. *Hydrology and Earth System Sciences (HESS)*, **25(2)**, 565-581.
DOI: 10.5194/hess-25-565-2021

Osman, M. A., B. F. Zaitchik, **H. S. Badr**, and S. Hameed, **2021**: North Atlantic Centers of Action and Seasonal to Subseasonal Temperature Variability in Europe and Eastern North America. *International Journal of Climatology (JOC)*, **41**, E1775-E1790.
DOI: 10.1002/joc.6806

Arsenault et al., **H. S. Badr**, **2021**: Better Advance Warnings of Drought: A New NASA Hydrological Forecast System. *Bulletin of the American Meteorological Society (BAMS),* **101(10)**, 899–903.
DOI: 10.1175/BAMS-D-18-0264.A

Arsenault et al., **H. S. Badr**, **2020**: The NASA Hydrological Forecast System for Food and Water Security Applications. *Bulletin of the American Meteorological Society (BAMS),* **101(7)**, E1007–E1025.
DOI: 10.1175/BAMS-D-18-0264.1

Badr, H. S., and L. M. Gardner, **2020**: Limitations of using mobile phone data to model COVID-19 transmission in the USA. *The Lancet Infectious Diseases*, 1473-3099.
DOI: 10.1016/S1473-3099(20)30861-6

Badr, H. S., H. Du, M. Marshall, E. Dong, M. M. Squire, and L. M. Gardner, **2020**: Association between mobility patterns and COVID-19 transmission in the USA: a mathematical modelling study.

The Lancet Infectious Diseases, **20(11)**, 1247–1254.
DOI: 10.1016/S1473-3099(20)30553-3

Badr, H. S., H. Du, M. Marshall, E. Dong, M. M. Squire, and L. M. Gardner, **2020**: Social Distancing is Effective at Mitigating COVID-19 Transmission in the United States. *MedRxiv*, 2020.05.07.20092353.
DOI: 10.1101/2020.05.07.20092353

Nie, W., B. F. Zaitchik, M. Rodell, S. V. Kumar, K. R. Arsenault, and **H. S. Badr**, **2020**: Irrigation water demand sensitivity to climate variability across the Contiguous United States. *Water Resources Research (WRR)*, e2020WR027738.
DOI: 10.1029/2020WR027738

Jordan, A., B. F. Zaitchik, A. Gnanadesikan, Dongchul Kim, and **H. S. Badr**, **2020**: Strength of Linkages Between Dust and Circulation Over North Africa: results from a coupled modeling system with active dust. *Journal of Geophysical Research (JGR)*, **125(11)**, e2019JD030961.
DOI: 10.1029/2019JD030961

Satti, S., B. F. Zaitchik, **H. S. Badr**, and S. Tadesse, **2017**: Enhancing Dynamical Seasonal Predictions through Objective Regionalization. *Journal of Applied Meteorology & Climatology (JAMC)*, **56**, 1432–1442.
DOI: 10.1175/JAMC-D-16-0192.1

Dezfuli, A. K., B. F. Zaitchik, **H. S. Badr**, E. Jason, and C. D. Peters-Lidard, **2017**: The Role of Low-Level Terrain-Induced Jets in Rainfall Variability in Tigris-Euphrates Headwaters. *Journal of Hydrometeorology (JHM)*, **18**, 819–835.
DOI: 10.1175/JHM-D-16-0165.1

Badr, H. S., B. F. Zaitchik, A. K. Dezfuli, and C. D. Peters-Lidard, **2016**: Regionalizing Africa: Patterns of Precipitation Variability in Observations and Global Climate Models. *Journal of Climate (JCLI)*, **29**, 9027–9043.
DOI: 10.1175/JCLI-D-16-0182.1

Regonda, S. K., B. F. Zaitchik, **H. S. Badr**, and M. Rodell, **2016**: Using Climate Regionalization to Understand Climate Forecast System Version 2 (CFSv2) Precipitation Performance for the Conterminous United States (CONUS). *Geophysical Research Letters (GRL)*, **43**, 6485–6492.
DOI: 10.1002/2016GL069150

F. Berhane, B. Zaitchik, and **H. S. Badr**, **2015**: The Madden-Julian Oscillation's influence on Spring Rainy Season Precipitation over Equatorial West Africa, *Journal of Climate (JCLI)*, 2**8**, 8653–8672.
DOI: 10.1175/JCLI-D-14-00510.1

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2015**: A Tool for Hierarchical Climate Regionalization. *Earth Science Informatics (ESIN)*, **8**, 949–958.
DOI: 10.1007/s12145-015-0221-7

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2014**: HiCLimR: Hierarchical Climate Regionalization. *Comprehensive R Archive Network (CRAN)*, *http://cran.r-project.org/package=HiClim*R.
URL: https://hsbadr.github.io/HiClimR/

Badr, H. S., B. F. Zaitchik, and S. D. Guikema, **2014**: Application of Statistical Models to the Prediction of Seasonal Rainfall Anomalies over the Sahel. *Journal of Applied Meteorology & Climatology (JAMC)*, **53**, 614–636.
DOI: 10.1175/JAMC-D-13-0181.1

Nasr, A. H., B. M. El Leithy, and **H. S. Badr**, **2012**: Estimation of Radiometric Calibration Coefficients of Egyptsat-1 Sensor. The XXII Congress of the International Society for Photogrammetry and Remote Sensing, Melbourne, Australia, **XXXIX-B1**, 139-143.
DOI: 10.5194/isprsarchives-XXXIX-B1-139-2012

Badr, H. S., H. A. Kandil, B. M. N. Elhadidi, and A. O. Sherif, **2011**: Evaluating the Physics Options of Regional Weather Models for Areas with Complex Land-Use Characteristics. *Proceedings of IEEE*

2011 International Geoscience and Remote Sensing Symposium (IGARSS), Vancouver, Canada, 3257-3260.
DOI: 10.1109/IGARSS.2011.6049914

Badr, H. S., **2011**: Ensemble Forecasting and Data Assimilation in Numerical Weather Modeling for Egypt. *M.Sc. Thesis, Department of Aerospace Engineering, Cairo University*, Giza, Egypt.

Badr, H. S., B. M. N. Elhadidi, and A. O. Sherif, **2010**: Evaluation of Data Assimilation on Numerical Weather Prediction for Egypt. *Proceedings of IEEE 2010 International Geoscience and Remote Sensing Symposium (IGARSS)*, Honolulu, Hawaii, USA, 3526-3529.
DOI: 10.1109/IGARSS.2010.5652441

Presentations

K. Bergaoui, K., M. D. Svoboda, A. Hazra, **Badr, H. S.**, M. B. Fraj, R. Mcdonnell, K. Arsenault, B. F. Zaitchik, and C. Peters-Lidard, **2021**: Drought Monitoring and Seasonal Forecasting in the Middle East and North African (MENA) region. *35th Conference on Hydrology - Improvements to the Analysis and Prediction of Drought, 101st American Meteorological Society (AMS) Annual Meeting*, USA.

Badr, H. S., K. Bergaoui, and B. F. Zaitchik, **2020**: Applications of Deep Learning to S2S Precipitation Prediction and Downscaling for the Middle East and North Africa. *19th Conference on Artificial Intelligence for Environmental Sciences, 100th American Meteorological Society (AMS) Annual Meeting*, Boston, Massachusetts, USA.

Badr, H. S., B. F. Zaitchik, K. R. Arsenault, S. Shukla, and C. D. Peters-Lidard, **2018**: To What Extent Does High-Resolution Dynamical Downscaling Improve Seasonal Forecasts over the Ethiopian Highlands? *American Geophysical Union (AGU) Fall Meeting 2018*, Washington D.C., USA.

Badr, H. S., and B. F. Zaitchik, **2018**: On the Coherence of Sahel Region under Different Emissions Scenarios. *31st Conference on Climate Variability and Change, 98th American Meteorological Society (AMS) Annual Meeting*, Austin, Texas, USA.

Badr, H. S., B. F. Zaitchik, K. R. Arsenault, and S. V. Kumar, **2017**: Evaluation of Spatio-Temporal Variability in Land Surface Models using Objective Regionalization. *31st Conference on Hydrology, 97th American Meteorological Society (AMS) Annual Meeting*, Seattle, Washington, USA.

Badr, H. S., **2016**: NASA-Unified Weather Research and Forecasting (NU-WRF) Model. *Training Workshop, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., **2016**: Applications of Climate Regionalization: Statistical Prediction and Patterns of Precipitation Variability in Observations and Global Climate Models. *Thesis Presentation, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., N. M. Deluca, N. E. Levin, and B. F. Zaitchik, **2015**: On the Regionalization of African Precipitation for Paleoclimate Studies. *Geological Society of America (GSA) Annual Meeting 2015*, Baltimore, Maryland, USA.

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2014**: Climate Regionalization through Hierarchical Clustering: Options and Recommendations for Africa. *American Geophysical Union (AGU) Fall Meeting 2014*, San Francisco, California, USA.

A.K. Dezfuli, B.F. Zaitchik, **Badr, H. S.**, K. Bergaoui, R. Zaaboul, and P. Bhattacharjee, **2014**: Dynamical downscaling with WRF for the Middle East and North Africa. *American Geophysical Union (AGU) Fall Meeting 2014*, San Francisco, California, USA.

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2014**: Statistical and Dynamical Prediction of Seasonal Rainfall over Tropical Africa. *Graduate Board Oral (GBO) Exam, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2014**: Statistical and Dynamical Prediction of Seasonal Rainfall over Tropical Africa. *Regional Climate Modeling (RCM) Group Meeting, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2013**: Regionalization of Africa based on Interannual Variability of Precipitation: An Improved Approach and A New Software Package. *American Geophysical Union (AGU) Fall Meeting 2013*, San Francisco, California, USA.

Badr, H. S., B. F. Zaitchik, and A. K. Dezfuli, **2013**: Regionalization of Africa based on Interannual Variability of Precipitation: An Improved Approach and A New Software Package. *Journal Club, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., B. F. Zaitchik, and S. D. Guikema, **2013**: Statistical Predictive Models for Seasonal Rainfall Anomalies over Sahel. *Journal Club, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., B. F. Zaitchik, and S. D. Guikema, **2013**: Spatiotemporal Variability of Precipitation over Africa. *25th Conference on Climate Variability and Change, 93rd American Meteorological Society (AMS) Annual Meeting*, Austin, Texas, USA.

Badr, H. S., B. F. Zaitchik, and S. D. Guikema, **2012**: Statistical Predictive Models for Seasonal Rainfall Anomalies over Sahel. *11th Conference on Artificial and Computational Intelligence and its Applications to the Environmental Sciences, 93rd American Meteorological Society (AMS) Annual Meeting*, Austin, Texas, USA.

Badr, H. S., B. F. Zaitchik, and S. D. Guikema, **2012**: Statistical Predictive Models for Seasonal Rainfall Anomalies over Sahel. *Climate Dynamics of Tropical Africa: Present Understanding and Future Directions, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Nasr, A. H., B. M. El Leithy, and **H. S. Badr**, **2012**: Estimation of Radiometric Calibration Coefficients of Egyptsat-1 Sensor. The XXII Congress of the International Society for Photogrammetry and Remote Sensing, Melbourne, Australia.

Badr, H. S., **2012**: PCA-based Regionalization of Precipitation over Africa. *Journal Club, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., **2011**: Soil Moisture Response and Memory. *African Climate Group Meeting, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., **2011**: The Atlantic multidecadal oscillation and its relation to rainfall and river flows in the continental US. *270.644: Physics of Climate Variability, Department of Earth and Planetary Sciences, Johns Hopkins University*, Baltimore, Maryland, USA.

Badr, H. S., H. A. Kandil, B. M. N. Elhadidi, and A. O. Sherif, **2011**: Evaluating the Physics Options of Regional Weather Models for Areas with Complex Land-Use Characteristics. *IEEE 2011 International Geoscience and Remote Sensing Symposium (IGARSS)*, Vancouver, Canada.

Badr, H. S., B. M. N. Elhadidi, and A. O. Sherif, **2010**: Evaluation of Data Assimilation on Numerical Weather Prediction for Egypt. *IEEE 2010 International Geoscience and Remote Sensing Symposium (IGARSS)*, Honolulu, Hawaii, USA.

Badr, H. S., B. M. N. Elhadidi, and A. O. Sherif, **2007**: FDDA Enhancement of the Meso-scale Meteorological Modeling System for Egypt. *Cairo 10th International Conference on Energy and Environment (EE10)*, Luxor, Egypt.