Amy R. Hudson, Ph.D.

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I apply climate and macrosystem ecology expertise towards improving our understanding of agro-ecosystem productivity, predictive disease ecology, and pollinator resources. My research incorporates multiple disciplines (e.g. climatology, ecology, phenology, dendrochronology) and data (e.g. in situ, satellites, reanalysis, earth system models) to focus on the interactions between climate drivers and the land surface.

EDUCATION

Ph.D. in Natural Resources 2015 – 2020
Graduate Certificate in Dendrochronology 2019
University of Arizona in Tucson, AZ
Dissertation title: Spatio-temporal patterns of jet stream influence on phenology
Co-Advisors: David Moore, Ph.D. and Valerie Trouet, Ph.D.

M.S. in Environmental Science and Technology 2012
University of Maryland in College Park, MD
Thesis title: Assessing the uncertainty of emergy analyses with Monte Carlo simulations
Advisor: David Tilley, Ph.D.

B.S. in Mathematics 2009
University of Maryland in College Park, MD
Quality Enhancement Systems and Teams Honors Program, Cohort 14
College Park Scholar- Advocate for Children

RESEARCH EXPERIENCE

Postdoctoral Fellow May 2020 – Present
USDA Agricultural Research Service (ARS) Scientific Computing Initiative Network (SCINet)
Principle Investigator (PI): Debra Peters, Ph.D.

- Exploring drivers of patterns in continental-scale climate and resulting dynamics in agro-ecosystems and insect-vector borne equine diseases (Vesicular Stomatitis and West Nile)
- Leveraging remotely sensed products (UAVs, PlanetScope, Landsat, and Sentinel2) using High Performance Computing workflows to quantify floral resources at the landscape scale

Research Specialist Spring 2020
National Center for Atmospheric Research (NCAR) in Boulder, CO
PI: Danica Lombardozzi, Ph.D.

- Examined land-atmosphere feedbacks by comparing coupled and uncoupled model runs with observations; quantified variability of patterns across coupled earth system models

Research Assistant 2016 – 2019
University of Arizona in Tucson, AZ
PI: Katy Prudic, Ph.D.

- Mapped and analyzed the influence of the monthly jet stream position across North America on annual monarch migration success

PI: Dave Moore, Ph.D.

- Assembled a database of state factors of plant growth for North America
- Created a code workflow to subset global plant traits' databases
- Identified how jet stream position in the spring corresponds with plant phenophases using citizen science observations of cloned lilacs and models; investigated a global vegetation optical depth data set for possible application in data assimilation

PI: Valerie Trouet, Ph.D.

- Conducted fieldwork for tree-ring sample collection in north central Wyoming; dated, measured, and compared samples with climate to identify climate drivers and reconstruct summer temperatures in the Northern Rockies
- Explored future locations and species for sampling to reconstruct the Northern Pacific Jet Stream; applied these methods to assist in reconstructing Hadley Cell Extent
- Assisted in developing an undergraduate course in statistics at the junior level
- Explored jet stream indices which are derived from reanalysis products

Associate Extension Specialist- Natural Resources 2014 – 2015
University of Maryland in College Park, MD

PI: Robert Tjaden, Ph.D.

- Collaborated with multiple forest stakeholders to better value forest ecosystem services
- Analyzed surveys focused on Maryland loggers, forest landowners, and forest industries
- Assisted in the 1) design of a confidence index for the future of forestry in the State of Maryland, 2) development of policy recommendations to help the forest industry be profitable and sustainable, and 3) implementation of an extension outreach program to explain findings, towards better valuing ecosystem services

Department of Energy Mickey Leland Energy Fellow (MLEF) 2009 – 2010
Germantown, MD

NSF Louis Stokes Alliance for Minority Participation (LSAMP) Researcher 2008 – 2009
University of Maryland in College Park, MD

National Institute of Standards and Technology (NIST) Undergraduate Researcher 2007 – 2008
Gaithersburg, MD

PUBLICATIONS

Peer Reviewed (14)

Hudson, A.R., Peters, D.P.C., Blair, J.M., Childers, D.L., Doran, P.T., Geil, K., Gooseff, M., Gross, K.L., Haddad, N.M., Pastore, M.A., Rudgers, J.A., Sala, O., Seabloom, E.W., and Shaver, G. (2022). Cross-site comparisons of dryland ecosystem response to climate change in the US Long-Term Ecological Research network. In press at *BioScience*. 17. https://doi.org/10.1093/biosci/biab134.

Humphreys, J.M., Srygley, R.B., Lawton, D., **Hudson, A.R.**, Branson, D.H. (2022) Grasshoppers Exhibit Asynchrony and Spatial Non-Stationarity in Response to the El Niño Southern and Pacific Decadal Oscillations. *Ecological Modelling.* 471, 110043 https://doi.org/10.1016/j.ecolmodel.2022.110043.

Hudson, A.R., Smith, W.K., Moore, D.J.P., Trouet, V. (2022). Length of Growing Season is modulated by Northern Hemisphere jet stream variability. *International Journal of Climate*. https://doi.org/10.1002/joc.7553.

Humphreys, J.M., Pelzel-McCluskey, A.M., Cohnstaedt, L.W., McGregor, B.L., Hanley, K.A., **Hudson, A.R.**, Young, K.I., Peck, D., Rodriguez, L.L., Peters, D.P.C. (2021). Integrating Spatiotemporal Epidemiology, Eco-Phylogenetics, and Distributional Ecology to Assess West Nile Disease Risk in Horses. *Viruses*. 13(9), 1811. https://doi.org/10.3390/v13091811.

Peters, D.P.C., Savoy, H.M., Stillman, S., Huang, H., **Hudson, A.R.,** Sala, O.E., Vivoni, E.R. (2021). Plant Species Richness in Multiyear Wet and Dry Periods in the Chihuahuan Desert. *Climate*. 9(8), 130. https://doi.org/10.3390/cli9080130.

Xu, G., Wu, G., Liu, X., Chen, T., Wang, B., **Hudson, A.**, Trouet, V. (2020). Age-related climate response of tree-ring d13C and d18O from Spruce in Northwestern China, with implications for relative humidity reconstructions. *Journal of Geophysical Research - Biogeosciences*. 125, e2019JG005513. https://doi.org/10.1029/2019JG005513.

Smith, W.K., Dannenberg, M.P., Yan, D., Herrmann, S., Barnes, M.L., Barron-Gafford, G.A., Biederman, J.A., Ferrenberg, S., Fox, A.M., **Hudson, A.R.,** Knowles, J.F., MacBean, N., Moore, D.J.P., Nagler, P.L., Reed, S.C., Rutherford, W.A., Scott, R.L., Wang, X., Yang, J. (2019). Remote sensing of dryland ecosystem structure and function: Progress, challenges, and opportunities. *Remote Sensing of Environment*. 233, 111401. https://doi.org/10.1016/j.rse.2019.111401.

Hudson, A.R., R. Alfaro-Sanchez, F. Babst, S. Belmecheri, D.J.P. Moore, and V. Trouet (2019). Seasonal and synoptic climatic drivers of tree growth in the Bighorn Mountains, WY, USA (1654-1983 CE). *Dendrochronologia*. 58, 125633. https://doi.org/10.1016/j.dendro.2019.125633.

Xu, G., X. Liu, Q. Zhang, Q. Zhang, **A. Hudson**, and V. Trouet (2019). Century-scale temperature variability and onset of industrial-era warming in the Eastern Tibetan Plateau. *Climate Dynamics*. 1-22. https://doi.org/10.1007/s00382-019-04807-z.

Albrecht, T., and **A. Hudson** (2019). Being persuasive: Lessons from lawyers that all scientists need. *Eos*. 100. https://doi.org/10.1029/2019EO115327. Published on 04 February 2019.

Alfaro-Sánchez R., H. Nguyen, S. Klesse, **A. Hudson**, S. Belmecheri, N. Köse, H.F. Diaz HF, R. Villalba, V. Trouet (2018). Climatic and volcanic forcing of tropical belt northern boundary over the past 800 years. *Nature Geoscience*. https://doi.org/10.1038/s41561-018-0242-1.

Smith, W. K., J. A. Biederman, R.L. Scott, D.J.P. Moore, M. He, J.S. Kimball, D. Yan, **A. Hudson,** M.L. Barnes, N. MacBean, A.M. Fox, M.E. Litvak (2018). Chlorophyll Fluorescence Better Captures Seasonal and Interannual Gross Primary Productivity Dynamics Across Dryland Ecosystems of Southwestern North America. *Geophysical Research Letters*, 45, 748–757. https://doi.org/10.1002/2017GL075922.

Belmecheri, S., F. Babst, **A.R. Hudson**, J. Betancourt, V. Trouet (2017). Northern Hemisphere Jet Stream Position Indices as Diagnostic Tools for Climate and Ecosystem Dynamics. *Earth Interactions*, 21(8), 1–23. https://doi.org/10.1175/EI-D-16-0023.1.

Hudson, A.R. and D.R. Tilley. (2014). Assessment of uncertainty in emergy evaluations using Monte Carlo simulations. *Ecological Modelling*. 271, 52-61. https://doi.org/10.1016/j.ecolmodel.2013.05.018.

Theses and Other (4)

Hudson, A.R. (2020). Spatio-temporal patterns of jet stream influence on phenology (PhD Dissertation). Retrieved from Dissertations and Theses database. http://hdl.handle.net/10150/641374.

Tjaden, Bob, Dan Rider, Elliott Campbell, and **Amy Hudson** (2015). Maryland's Forest Resources in a Dynamic Environment: Assessing the future confidence and sustainability of Maryland's forest industry. Report for the Maryland Department of Natural Resources. http://dnr2.maryland.gov/forests/Documents/sfc/SFC_ConfidenceIndex.pdf.

Hudson, A.R. (2013). Assessing the uncertainty of emergy analyses with Monte Carlo simulations (Master's thesis). Retrieved from Dissertations and Theses database. http://hdl.handle.net/1903/13863.

Hudson, A.R. and L.H. Reeker (2007). Standardizing measurements of autonomy in the artificially intelligent. *Performance Metrics for Intelligent Systems Workshop*. Paper presented at PerMIS'07 Workshop, Courtyard Gaithersburg Washington Center, Gaithersburg, MD, 28-30 August (pp.70-75). New York, NY: ACM. doi: 10.1145/1660877.1660886.

PRESENTATIONS

Invited (7)

Hudson, A.R. (2022). *A climate perspective on the spread of livestock diseases with aquatic insect vectors*. Invited department seminar presentation to the Lamont Doherty Earth Observatory Paleoenvironment and Biology department.

Hudson, A.R. (2022). *Drought and vector-borne disease: thresholds, cycles, and potential futures*. Session: Nature's revenge- enduring challenges of vector-borne diseases, research, and control strategies in the United States. International Conference of Entomology in Helsinki, Finland.

Hudson, A.R. (2022). *Jet stream waves and the migratory success of the monarch butterfly*. USDA-ARS Pollinator Brown-bag Seminar.

Hudson, A.R., Browning, D., Kammerer, M., Taylor, S. (2021). *Multi-scale remote sensing to characterize flowering: a review.* Invited presentation at the SCINet Pollinator Workshop: Leveraging advances in data science to manage and conserve pollinators.

Hudson, A.R., Trouet, V., Prudic, K. (2020). *The jet stream as a driver of continental phenology and its impact on monarch migration.* Session: Understanding Phenological Responses and Feedbacks in Terrestrial Vegetation: Patterns, Mechanisms, and Consequences I. Invited Talk at the American Geophysical Union's Fall Meeting.

Hudson, A.R. (2020). *Observed patterns of jet stream influence on phenology as captured by tree-rings, satellites, and the migration of the monarch butterfly*. Climate Global Dynamics seminar at NCAR, Boulder, CO.

Hudson, A. (2012). *Valuing ecosystem services using emergy analyses: the importance of quantifying emergy uncertainty values.* Guest lecture conducted in the Department of Environmental Sciences and Technology's course: Valuing Ecosystem Services at the University of Maryland, College Park, MD.

Seminars, Conferences, and Meetings (23)

Hudson, A.R., Peters, D.P.C, Cohnstaedt, L.W., Derner, J.D., Pelzel-McCluskey, A., Swanson, D., Rodriguez, L. (2022). *Flash drought drives divergence in spread of equine viral diseases with different aquatic insect vectors*. AgriCulture Postdoc Network Seminar Series in Spring 2022.

Hudson, A.R., Peters, D.P.C, Cohnstaedt, L.W., Derner, J.D., Rodriguez, L. (2021). *A Year of Boom or Bust for Equine Viruses with Different Insect Vectors.* Session: Early Warning Systems for Infectious Disease Based on Climate and Environmental Variability. Oral presentation given at the American Geophysical Union's Fall Meeting.

Hudson, A.R., Peters, D.P.C, Humphreys, J.M., Cohnstaedt, L.W., Derner, J.D., Hanley, K., Rodriguez, L. (2021). *A cross-scale pattern-process interactions approach for predicting the spread of West Nile at regional and continental scales.* Poster presented at the remote Annual Ecological Society of America meeting.

Hudson, A.R., Peters, D.P.C., Avolio, M., Blair, J., Childers, D., Collins, S., Doran, P., Evans, S., Gooseff, M., Grimm, N., Haddad, N., Knapp, A., Litvak, M., Pastore, M., Rudgers, J., Sala, O., Seabloom, E., Shaver, G. (2020). *A multi-site synthesis of impacts of multi-year extreme events on dryland ecosystem resilience.* Session: Resilient Agroecosystems. Oral presentation given at the American Geophysical Union's Fall Meeting.

Hudson, A., Peters, D.P.C, Humphreys, J.M., Rodriguez, L. (2020). *Regional climate variability and the spatial spread of the vector-borne virus vesicular stomatitis in the United States.* Session: Impacts of Climate on Vector-Borne and Other Environmental Infectious Diseases eLightning. Poster and eLightning presentation at the American Geophysical Union's Fall Meeting.

Hudson, A. (2020). *Spatio-temporal patterns of jet stream influence on phenology*. Public defense at the University of Arizona, Tucson, AZ.

Hudson, A., Smith, W.K., Moore, D.J.P., Trouet, V. (2019). *Seasonal jet stream controls on surface climate influence the timing of plant growth: a mechanistic perspective on landscape phenology shifts in a warming world.* Session: Remote Sensing to Support Investigations in Plant-Climate Interactions. Oral presentation at the American Geophysical Union's Fall Meeting in San Fransisco, CA.

Moore, D.J.P., **A. Hudson**, N. Macbean, W.K. Smith, K.A. Novick (2019) Examining the effects of state factors on ecosystem carbon fluxes in North America. AGU Fall Meeting Abstracts.

Hudson, A. (2019). *Length of the growing season responds to the jet stream above.* Talk given at the University Libraries GIS Day, November 13, 2019, at the University of Arizona, Tucson, AZ.

Hudson, A. (2019). *Winds above as seen by plants below: the jet stream as a framework for dryland vegetation variability*. William G. McGinnies Annual Lecture at the University of Arizona, Tucson, AZ.

Hudson, A., Moore, D.J.P., Trouet, V. (2018). *When and where are plants responding to synoptic circulations?* Session: Understanding Phenological Responses and Feedbacks in Terrestrial

Vegetation: Patterns, Mechanisms, and Consequences. Poster presented at the American Geophysical Union's Fall Meeting in Washington, DC.

Hudson, A. (2018). *Tracking the unseen jet stream with tangible plant growth: a regional temperature reconstruction of the northern Rockies.* Presented for the Tree-Ring Day of Earthweek 2018 at the University of Arizona, Tucson, AZ.

Hudson, A. (2018). *Coupling the unseen jet stream with tangible plant growth.* Presented for the 2018 Grad Slam Competition hosted by the Graduate Center and GPSC at the University of Arizona, Tucson, AZ.

Hudson, A., Alfaro-Sanchez, R., Belmecheri, S., Moore, D.J.P., Trouet, V. (2017). *Summer temperature extremes in the northern Rockies: A tree-ring- based reconstruction (1670-2014) from the Bighorn Mountains, WY.* Session: Past atmospheric variability inferred from paleoclimate proxies. Poster presented at the American Geophysical Union's Fall Meeting in New Orleans, LA.

Hudson, A. (2017). *Capturing fluxes 8 miles above us with plant growth events in our backyard*. Presented for the Tree-Ring Day of Earthweek at the University of Arizona, Tucson, AZ.

Hudson, A., Trouet, V., Belmecheri, S., Moore, D.J.P. (2016). *Validating the Spring Jet Stream Indices using Extended Spring Index (SI-x) models*. Poster presented 12-16 Dec. at the American Geophysical Union's Fall Meeting in San Francisco, CA.

Hudson, A. (2015). *Trees track the shifting of the North Pacific Jet Stream.* Presented at the Institute of the Environment's Environmental Grad Blitz at the University of Arizona, Tucson, AZ.

Hudson, A. (2012). *Addressing uncertainty in emergy analyses with Monte Carlo simulations.* Presented at the 12th Annual American Ecological Engineering Society (AEES) Meeting: Coupling Natural & Human Systems, ESF Campus, Syracuse, NY.

Hudson, A. (2011). *Modeling uncertainty in emergy accounting: assessing variability in the solar transformity of corn production.* Poster presented at the 11th Annual Meeting of the American Ecological Engineering Society (AEES): Engineering for Ecosystem Services, Renaissance Hotel, Asheville, NC.

Hudson, A. (2010). *Grab-and-go system's analysis and suggestions for updates & Emergy: an accounting tool for the gulf oil spill.* Presented at the Mickey Leland Energy Fellowship annual conference in Pittsburgh, PA.

Hudson, A. (2009). *MLEF Program Application Modifications.* Presented at the Mickey Leland Energy Fellowship annual conference in Houston, TX.

Hudson, A. (2009). *Climate Sensitivity: Oceanic Heat Dispersal*. Presented at the Louis Stokes Alliance for Minority Participation Undergraduate Research Program Symposium in College Park, MD.

Hudson, A. (2008). *Why is the LBA problem so interesting and still not solved by Mathematics?* Presented at the VIP Symposia on Internet related research with elements of MIT (VIPSI) 2008 Conferences, Tivat, Montenegro.

Hudson, A. (2007). *Standardizing measurements of autonomy in the artificially intelligent.* Presented at the VIP Symposia on Internet related research with elements of MIT (VIPSI) 2007 Conferences, Bled, Slovenia.

Outreach (8)

Hudson, A. (2022). *Recent rainfall studies in the Southwest, vegetation impacts, and the power of daily records.* Presentation for the Southwest Climate Hub steering committee, given remotely via Zoom.

Hudson, A. (2020). *Climate change impacts on Dryland Long-Term Ecological Research sites*. Seminar for the USDA-Agricultural Research Service (ARS) Jornada Experimental Range in Las Cruces, NM given remotely via Zoom.

Hudson, A. (2020). *Atmospheric circulation as a (predictive?) mechanism behind regional-to-continental ecosystem growth and migration synchrony*. Seminar for the USDA-Agricultural Research Service (ARS) Jornada Experimental Range in Las Cruces, NM given remotely via Zoom.

(2019). *UArizona Research Computing 2019*. Video interview presented at Supercomputing 2019 in Denver, CO. https://vimeo.com/373316331/0b1178e17a

Hudson, A. (2019). *Dendrochronology: an overview of the field, work being done at the LTRR, and my climate focus.* Session: Wild Arizona: current topics on wildlife and natural resource conservation and management at the University of Arizona. Osher Lifelong Learning Institute in Green Valley, AZ.

Hudson, A. (2018). *Your backyard plants have big stories to tell.* Session: Wild Arizona: current topics on wildlife and natural resource conservation and management at the University of Arizona. Osher Lifelong Learning Institute in Green Valley, AZ.

Hudson, A. (2017). *The Winds above, the Flowers below: How the Jet Stream Influences Changing Seasonal Cues and Plant Growth*. Presented for University of Arizona Science Café in Tucson, AZ.

(2017). *The Power of Citizen Science*. Interviewed by Claire Rogers with the Desert Leaf: Plan of Action column for the December issue.

Hudson, A. (2017). *Climate change and dendrochronology*. Presented for NASA Space Grant Event: Hands-on, inquiry-based STEM curriculum development with high school teachers at the University of Arizona, Tucson, AZ.

TEACHING EXPERIENCE

Carpentries Workshop Instructor

USDA-ARS SCINet

- Unix Shell, Version Control with Git, and R for Reproducible Scientific Analysis (Aug 18-19, 2020)

University of Arizona in Tucson, AZ

- Geospatial Lessons in R (Nov 10-11, 2018)
- Scientific Analyses with R (Oct 27-28, 2018)

Teaching Assistant

University of Arizona in Tucson, AZ — 2015 and 2017
University of Maryland in College Park, MD — 2010 – 2012

Adjunct Faculty of Mathematics — 2013 – 2014
Howard Community College in Columbia and Laurel, MD

HONORS/ AWARDS

- ORISE Postdoctoral Fellowship — Spring 2020 – Spring 2023
- Outstanding Dissertation Award from SNRE — Spring 2020

- College of Science Graduate Scholarship Award ($100) Spring 2020
- NSF Non-Academic Research Internships for Graduate Students (INTERN)

National Center for Atmospheric Research NCAR ($23,100) Spring 2020
- Andrew Ellicott Douglass Memorial Scholarship ($750) Spring 2019
- William G. McGinnies Scholarship in Arid Lands Studies ($5,000) Spring 2019
- Dewhirst Student Award ($1,000) Summer 2018
- UA College of Science Galileo Circle Scholarship ($2,500) Spring 2018
- Nominated for an International P.E.O. Scholarship Fall 2017
- Student Leadership Award from School of Natural Resources Spring 2017
- W.F. and Margie McCaughey Student Endowment ($1,263) Spring 2017
- Alsie French & Edmund Schulman Memorial Scholarship ($700) Spring 2017
- Carson Scholar and Biosphere2 Fellowship ($5,000) Spring 2017 – Fall 2017
- Travel and Lodging Awards for AEES Conferences ($5,000) Summers 2011, 2012

WORKSHOPS, SKILLS, RELEVANT COURSEWORK

Workshops and trainings:

UAS data wrangling workshop 3/22/2022
Carpentries Python, Shell, and Git training 3/15/2022
Introduction to Atlas 1/26/2022
Leveraging advances in data science to manage and conserve pollinators, 2021
Intermediate Webinar: Using Google Earth Engine for Land Monitoring Applications, 2021
Advanced Topics in Deep Learning for Image Processing, 2020
Intro to Image Processing, Classical Machine Learning, and Deep Learning, 2020
SCINet Geospatial Research Workshop, 2020 (organized and mediated)
Carpentries Instructor Training, 2018
Open Source Framework workshop, 2018
Alan Alda Science Communication Workshop, 2018
Effectively Communicating Science- Expert Witness Training Academy, 2017
Natl. Center for Atmospheric Research (NCAR) Environmental Modeling Workshop, 2016
Natl. Ecological Observatory Network (NEON) Data Institute, 2016

Skills: Microsoft Office, MATLAB, R, Perl6, Bash, High Performance Computation, Python

Coursera courses: Climate Geospatial Analysis on Python with Xarray Project, Python Geospatial Data Analysis Project, Build a Deep Learning Based Image Classifier with R Project
Graduate coursework: climate dynamics, spatio-temporal analysis, time-series analysis, environmental statistics, dryland ecohydrology, dendrochronology, general circulation observations and modeling, valuing ecosystem services, biostatistics, uncertainty modeling and analysis, invasive ecology, wetland soils, ecological design, industrial ecology, communication
Undergraduate coursework: biology, restoration ecology, advanced calculus, differential equations, linear algebra, economics, C programming

COMMUNITY OUTREACH/ MEMBERSHIPS

Reviewer for: AoB PLANTS, International Journal of Climatology, Scientific Reports

USDA-ARS Service
- SCINet Newsletter Editor — Spring 2020 – Summer 2021
- Geospatial Common Data Library — Summer 2020 – Present
- SCINet Geospatial Workshop Planning Committee — Summer 2020
- SCINet Pollinator Workshop Planning Committee — Summer 2021

AGU Session Organizer
- (proposed but merged) B052. Multi-scale Remote Sensing to Capture and Characterize Reproductive Phenology: Innovative Approaches — Fall 2021
- B067: Integrating data from heterogeneous sources across spatial and temporal scales to advance knowledge of ecosystem structure, function and process — Fall 2019

UA GALS mentor — Fall 2018 – Spring 2019

Data Science Ambassador — Fall 2018 – Spring 2019
- Organized the 2019 Women in Data Science Tucson Regional Event

Tree-Ring Society Member — Fall 2017 – Present

American Geophysical Union Member — Summer 2016 – Present

Earth Science Women's Network — Winter 2016 – Present

National Developmental College Coordinator for USA Ultimate — Fall 2014 – Present