Tyler H. Ruggles, PhD
Research Scientist

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Research Interests

- Energy systems modeling with a focus on understanding the correlations and inter-annual variability in electricity demand and wind and solar resource availability and their potential impacts on grid stability
- Coupled electric power–transportation systems with an emphasis on studying difficult to decarbonize sectors that could benefit from hydrogen and other synthetic transportation fuels

Education

University of Wisconsin–Madison, Madison, WI   May 2018
PhD, Experimental High Energy Physics

The Colorado College, Colorado Springs, CO   May 2009
Bachelor of Arts *cum laude*, Major: Physics

Energy Research

Research Scientist, Carnegie Science, Caldeira Lab, Stanford, CA   Oct. 2020 – Present
Postdoctoral Research Scientist, Carnegie Science, Caldeira Lab, Stanford, CA   June 2019 – Sept. 2020

Laboratory Group Management
- Co-leading hiring process for new postdoctoral positions
- Planning budget for laboratory group
- Planning and facilitating group meetings

Energy Systems Modeling
- Using linear programming optimization of a least-cost energy system model to explore fundamental questions about a near-zero carbon emissions energy transition
- Analyzing inter-annual variability of wind and solar resources and their impacts on electric power capacity markets and system reliability
- Exploring power-to-gas technologies to utilize otherwise curtailed electric power using a coupled electrolysis–power system model
- Participated with Carnegie team in an inter-model comparison project with other research institutions

Data Improvement
- Led a project to clean EIA hourly demand data for use by energy modeling community
- Developed algorithms to identify outlier data values in time series of hourly demand data

Physics Research

Postdoctoral Researcher, University of Wisconsin–Madison, CMS group, CERN   May 2018 – May 2019
Research Assistant, University of Wisconsin–Madison, CMS group, CERN   Jan. 2014 – May 2018

Data Analysis
- Conducted and published numerous analyses of the Higgs boson
- Responsible for statistical modeling and production of results
- Constructed, ran, and processed the results of complex computer models
- Developed novel background estimation techniques and uncertainty models
- Collaborated closely with an international analysis team

Tau Algorithm Convener
- Coordinated and led a group monitoring and improving tau particle algorithm performance for data taking
- Implemented, calibrated, and validated new tau particle identification techniques
- Led team which measured and published 2017 & 2018 performance results

Algorithm Development
- Developed multiple identification algorithms targeting different physics scenarios
- Documented algorithms and their performance in published technical design reports

Speaking

Invited Talks
- "How many years of data is enough? Using multiple years of data to increase electricity system performance" session keynote speaker at the Applied Energy Symposium: MIT A+B 2021, https://applied-energy.org/mitab2021/session

Teaching Experience

Visiting Lecturer
Colorado College, Colorado Springs, CO   Mar. 2017 – April 2017
- Co-taught one semester worth of calculus-based introductory physics for physics majors
- Developed and lead the majority of laboratory sections
- Delivered multiple class lectures

Teaching Assistant
University of Wisconsin–Madison, Madison, WI   Aug. 2013 – Dec. 2013
- Ran discussion sections and laboratory classes for a non-calculus-based general physics class
- Received a review of "excellent" from the TA Review Committee

Community Engagement

- Organized and co-chaired the "Near-zero emissions energy systems: geophysical opportunities, constraints, and consequences" session at AGU 2020.
- Fact checked "How to avoid a climate disaster: the solutions we have and the breakthroughs we need" by Bill Gates.

Research Skills

Leadership Experience:
- Managing Calderia Lab group and leading group meetings
- Mentoring pre-doctorate student in the Caldeira Lab
- Convening and leading researchers in algorithm calibration and measurements
- Training and mentoring multiple University of Wisconsin graduate and undergraduate students

Computer Modeling:
- Linear programming and optimization
- Conducting statistical hypothesis test of multiple predicted scenarios
- Identifying and researching the largest uncertainties in models and their results

Data Analysis Experience:
- Data-mining using both small scale and grid computing resources
- Optimization of data selection increasing signal strength and reducing noise

Computation Experience:
- Python – 7 years as primary coding language
- C++ – 5 years as secondary coding language
- Using GitHub as primary version control and collaboration tool for analysis code

Publications

Ruggles T. H.; Dowling, J. A.; Lewis, N. S. and Caldeira, K. "Opportunities for flexible electricity loads such as hydrogen production from curtailed generation." *Advances in Applied Energy*, (2021) https://doi.org/10.1016/j.adapen.2021.100051.

Rinaldi, K. Z.; Dowling, J. A.; **Ruggles T. H.**, *et al*. "Wind and Solar Resource Droughts in California Highlight the Benefits of Long-Term Storage and Integration with the Western Interconnect." *Environ. Sci. Technol*. (2021) https://doi.org/10.1021/acs.est.0c07848.

Dowling, J. A.; Rinaldi, K. Z.; **Ruggles, T. H.**, *et al*. "Role of Long-Duration Energy Storage in Variable Renewable Electricity Systems." *Joule*, (2020) https://doi.org/10.1016/j.joule.2020.07.007.

Ruggles, T. H. and Caldeira, K. "Inter-annual variability of dispatchable generation required for reliable U.S. power systems with substantial wind and solar power." Applied Energy Symposium: MIT A+B, August 12-14, (2020) http://www.energy-proceedings.org/inter-annual-variability-of-dispatchable-generation-required-for-reliable-u-s-power-systems-with-substantial-wind-and-solar-power/.

Ruggles, T. H.; Farnham, D. J.; Tong, D. *et al.* "Developing reliable hourly electricity demand data through screening and imputation." *Sci Data* **7,** 155 (2020) https://doi.org/10.1038/s41597-020-0483-x.

Ruggles, T. H.; Dasu, S.; Smith, W. H.; Herndon, M. F.; Hashimoto, A.; Onellion, M. F. "A Study of the Standard Model Higgs Boson Decaying to a Pair of Tau Leptons with the CMS Detector at the LHC." PhD Dissertation (2018) https://cds.cern.ch/record/2621366.

CMS collaboration. "Search for the associated production of the Higgs boson and a vector boson in proton-proton collisions at $\sqrt{s}$ = 13 TeV via Higgs boson decays to τ leptons." *J. High Energ. Phys*. 2019, 93 (2019) https://doi.org/10.1007/JHEP06(2019)093.

CMS Collaboration. "Observation of the SM scalar boson decaying to a pair of τ leptons with the CMS experiment at the LHC." *Phys. Letters B* (2017) https://doi.org/10.1016/j.physletb.2018.02.004.

CMS Collaboration. "Measurement of the $Z\gamma^*{\rightarrow}\tau\tau$ cross section in pp collisions at $\sqrt{s}$ = 13 TeV and validation of τ lepton analysis techniques." *European Physics Journal C* (2018) http://dx.doi.org/10.1140/epjc/s10052-018-6146-9.

CMS Collaboration. "Searches for a heavy scalar boson H decaying to a pair of 125 GeV Higgs bosons hh or for a heavy pseudoscalar boson A decaying to Zh, in the final states with h to $\tau\tau$." *Phys. Letters B* (2015) https://doi.org/10.1016/j.physletb.2016.01.056.

Winter, M.; **Ruggles T. H.** et al. "Particle Identification In Camera Image Sensors Using Computer Vision." *Astroparticle Physics* (2019) https://doi.org/10.1016/j.astropartphys.2018.08.009.

Vandenbroucke, J.; **Ruggles T. H.** et al. "Measurement of camera image sensor depletion thickness with cosmic rays." *Journal of Instrumentation* (2016) https://doi.org/10.1088/1748-0221/11/04/P04019.

Lovins, Amory & Rocky Mountain Institute. *Reinventing Fire: Bold Business Solutions for the New Energy Era.* White River Junction, VT: Chelsea Green Publishing, (2011) Print.

Wierzba, A. L.; Morgenstern, M. A.; Meyer, S. A.; **Ruggles, T. H.**, and Himmelreich, J. "A Study to Optimize the Potential Impact of Residential Building Energy Audits." *Energy Efficiency* (2011) http://dx.doi.org/10.1007/s12053-011-9106-x.

Professional Memberships

American Physical Society, member since 2013
American Geophysical Union, member since 2019
INFORMS, member since 2021