Hannah Rubin, Ph.D / *Environmental Modeler*

Hannah is an earth system scientist with a background in GIS, remote sensing, and machine learning. She is passionate about exploring future climate scenarios and applying models to understand climate hazards and the risks to environmental and human health. Hannah recently earned her Ph.D. in environmental engineering from the University of Tennessee, Knoxville, where she worked on developing methods of measurement-model to improve projections of climate variables by incorporating machine learning and remote sensing.

Years of Experience / 4

Years of Experience at Stone / 1

Education

Ph.D., Environmental Engineering, Climate Impacts (Computational Science minor), 2025, University of Tennessee, Knoxville – "Mapping Global Environmental Change Under Current Conditions and Projected Future Climate Scenarios with Machine Learning"

Bachelor of Arts, Earth Science and Geography, 2020, Dartmouth College

Skills

Spatial Analysis: Google Earth Engine, R (sp, sf, ggplot2, ncdf4, raster, terra), ArcGIS Pro, Climate Data Operators (CDO), NCAR Command Language (NCL)

Data Analysis: JMP, Microsoft Excel, MATLAB, ArcGIS Geodatabases, HPC (Oak Ridge Leadership Computing Facility's Andes, National Energy Research Scientific Computing Center's Perlmutter, University of Tennessee's ISAAC Next Gen), HDFView

Web Development: Python, HTML5, CSS, Angular, Shiny, Anaconda, Jupyter Notebook, Google Colab, GitHub, Git, Bash, JavaScript, TypeScript, SSH, CMake, Docker, Windows Subsystem for Linux

Honors and Awards

Southern Section A&WMA Scholarship 2024 Award Recipient

Employment History

Stone Environmental, Inc. / Montpelier, Vermont
Environmental Modeler / August 2024

Environmental modeler responsible for modeling and technical research, developing data-driven web-based tools, and writing scripts to process large datasets, customize machine learning models, and produce meaningful visualizations. Provides high quality scientific analysis and project deliverables, including technical reports and presentations. Expertise includes geospatial data analysis, measurement-model fusion, and climate science.

University of Tennessee, Department of Civil and Environmental Engineering / Knoxville, Tennessee
Research Assistant / 2022–2024

Collaborated closely with interdisciplinary teams to publish peer-reviewed papers and share research at conferences. Built a research curriculum around measurement-model fusion techniques for climate variables and mapping the impacts of climate change, ranging from heat waves and drought to carbon cycle modifications and acid deposition. Focused research on evaluating and communicating uncertainty and risk to both humans and ecosystems. Responsibilities included model development, research presentations, organizing conference sections, submission to peer-reviewed scientific journals, and mentoring and teaching other graduate students. Rebuilt and maintained the research group website.

University of Tennessee, Department of Civil and Environmental Engineering / Knoxville, Tennessee
Graduate-level Teaching Assistant / 2020–2022

Taught the laboratory portion of Geomatics, a sophomore-level civil engineering course. Responsibilities for instructing included teaching field-based surveying methods, computer-based data processing, and introductory civil engineering topics. Supervised junior teaching assistants and graded assignments.

Related Project Experience

PWC Machine Learning Modeling / 2025–Present / Vermont/ 2025112

Created a Python Shiny graphical user interface (GUI) to run a Random Forest machine learning model and predict Pesticide in Water Calculator (PWC) estimated exposure concentration (EEC) outputs for the given sample space. Developed a machine learning approach to ingest 180 million PWC runs and accurately predict output EECs. Containerized and deployed the GUI.

TFA Atmospheric Deposition Modeling / 2024–Present / Vermont / 20241164

Reviewed and analyzed recent data and approaches for assessing trifluorocateate (TFA) from atmospheric deposition and evaluate the potential impacts of new EU regulations on fluorinated greenhouse gases. Developed and implemented an atmospheric model to simulate TFA formation and deposition and created a robust modeling framework that can predict TFA concentrations in precipitation and dry deposition for the Funne and GKb catchments in Germany.

Wardsboro Hydrologic Study / 2025 / Wardsboro, Vermont

Climate modeling for a flood mitigation and resiliency study through the Municipal Technical Assistance Program (MTAP) aimed at safeguarding community infrastructure and residential properties. Developed downscaled high-resolution Coupled Model Intercomparison Project Phase 6 (CMIP6) climate projections for the watershed for multiple future scenarios. Quantified uncertainty, helped develop an action plan for the town, and created informative graphics to communicate the level of risk based on precipitation and runoff projections.

Development of a Soil Health Calculator Tool to Quantify Impacts of Agricultural Management Practices on Soil Health in the Lake Champlain Basin / 2024–Present / 20211251

Research on developing a soil health calculator tool that provides quantitative and field-specific information about the impact of agricultural management on key soil health indicators. This is based on a modeling approach using the United States Department of Agriculture (USDA) Agricultural Policy Environmental eXtender model (APEX). The objective is that the tool can be used by a broad range of stakeholders, with farmers and agricultural/crop consultants as the primary user groups, to support adoption of conservation practices by providing a better understanding of the relative impact of those practices and evaluating management options tailored to specific farm/field conditions.

FarmPREP Climate Modification / 2024–Present / Vermont / 20231024

Research on enhancing the Farm-PREP tool with respect to agricultural health and climate resiliency indicators. Modifications will enable the state to evaluate the benefits of modified management practices on improving water quality, enhancing soil health, reducing carbon emissions, and mitigating climate change in Vermont. This project includes a comparison of greenhouse gas (GHG) models, including APEX, COMET, DayCENT, and DNDC, as well as APEX/Farm-PREP modeling of 1) carbon emissions and sinks on cropland, 2) carbon emissions and sinks on pasture, and 3) soil aggregate stability. The objective is to identify and incorporate an approach that can be implemented in the Farm-PREP tool and best suited to represent GHG and carbon sequestration on Vermont farms.

NRCS-ARS Landscape Data Commons Tools Development / 2024–Present / Vermont / 20221256

Produced visualization and data exploration tools for standard rangeland monitoring datasets that contribute to objectives of partner agencies, including the Natural Resources Conservation Service (NRCS), who use monitoring data and erosion prediction tools to inform range management. The project included a web interface for a monitoring data summary and visualization tool that links to the Landscape Data Commons and information on conceptual models of ecosystem dynamics.

GIS Analysis of Conservation Impact / 2024 / Vermont / 20241156

Development of landscape indicators to evaluate conservation potential at project sites in Honduras based on land cover, topography, proximity characteristics, and soil erosion potential. Spatial analysis for each project site to quantify conservation potential and identify underserved regions.

Estimating Soil Organic Carbon Changes from SAF Feedstock Production in the US with Integrative Satellite Data and Machine Learning / FAA Ascent Project 001 / 2022-2024 / University of Tennessee, Knoxville

Research and development of spatially and temporally continuous maps of soil organic carbon (SOC) in the US. The objective is to estimate the soil organic carbon (SOC) change from sustaible aviation fuel feedstock production, which requires baselin maps of SOC and an understanding of long-term climate and land use trends. This involves combining in-situ measurements from soil carbon networks and previous studies, incorporating satellite imagery from the Landsat archive, and comparing several machine learning techniques to generate a finer-resolution product.

Improving Estimates of Sulfur and Nitrogen Total Deposition through Measurement-Model Fusion Approaches / WMO MMF-GTAD/ 2020-2024 / University of Tennessee, Knoxville

Research and development of a measurement-model fusion approach with multiple databases of ground-based air pollution measurements with an HTAP-II multi-model ensemble. The World Meteorological Organization's Global

Atmosphere Watch Program (WMO GAW) coordinates the measurement-model fusion (MMF) Global Total Atmospheric Deposition (GTAD) project, an effort to provide high-quality deposition maps and improve model results in data-poor regions. The objective is to demonstrate a simple but global MMF approach and then to demonstrate with a case study that it is possible to incorporate satellite imagery and improve the MMF approach with machine learning.

Mapping Global Environmental Change Under Current Conditions and Projected Future Climate Scenarios with Machine Learning (Ph.D. Dissertation) 2020-2024 / University of Tennessee, Knoxville

Research on how to quantify and communicate the uncertainty of downscaled ensembles of future climate projection outputs. The objective is to project heat waves and droughts in the US under SSP5-8.5 at the regional level using dynamically and statistically downscaled climate and map which populations are most at risk. Additional research on the impacts of sulfur deposition under a stratospheric aerosol injection future climate scenario. The objective is not to call for implementation but to understand the risks of a potential climate intervention event soon and to define future research directions and current data needs for further risk analysis.

Publications (Peer-Reviewed)

Zhang, L., Rubin, H.J., Chien, R.-Y., Fu, J.S. 2025. Projected evolution of droughts and human exposure in the contiguous United States under SSP5-8.5: a regional downscaling perspective, *Environmental Research Letters, 20,* 8, doi: 10.1088/1748-9326/adf4f9

Rubin, H.J., Zhang, L., Fu, J.S., Rastogi, D., Kao, S.-C. Ashfaq, M. 2025. Dynamically downscaled seasonal heat wave projections in the CONUS. *Npj Climate and Atmospheric Science, 8,* 233. doi: 10.1038/s41612-025-01055-3

Rubin, H.J., Yang, C.-E., Hoffman, F.M., Fu, J.S., 2024. Projected global sulfur deposition with climate intervention. *Global Environmental Change Advances,* 3, 100011. doi: 10.1016/j.gecadv.2024.100011

Rubin, H. J., Fu, J. S., Dentener, F., Li, R., Huang, K., and Fu, H.: Global nitrogen and sulfur deposition mapping using a measurement–model fusion approach, *Atmos. Chem. Phys*., 23, 7091–7102, doi: 10.5194/acp-23-7091-2023, 2023.

Rubin, H. J.; Lutz, D. A.; Steele, B. G.; Cottingham, K. L.; Weathers, K. C.; Ducey, M. J.; Palace, M.; Johnson, K. M.; Chipman, J. W. Remote Sensing of Lake Water Clarity: Performance and Transferability of Both Historical Algorithms and Machine Learning. *Remote Sensing.* 2021, *13*, 1434. doi: 10.3390/rs13081434

Bridge, J. W., Rubin, H. J, Dempsey, K. M., Peterson, M. L. Determining the Water Holding Capacity of Synthetic Track Materials for Thoroughbred Horse Racing. *Materials Performance and Characterization*, 2018, *7,* 1: 202-216. doi: 10.1520/MPC20170157

Conference Presentations

Rubin, H.J., Kiesel, J., Miquez, B., Stryker, J. Simulating Greenhouse Gas Emissions, Carbon Sequestration, and Nitrogen Cycling in Vermont Agricultural Soils. Presented at 2025 A&WMA Annual Conference, Raleigh, North Carolina, June 9-12.

Chen, L. Yu., T.E., Rubin, H.J., Fu, J.S., Rejesus, R. The Impact of Adopting Cover Crops and No-Till Systems on U.S. Soil Organic Carbon. Presented at 2025 AAEA & WAEA Joint Annual Meeting, Denver, Colorado, July 27-29.

Panel - De La Torre Ugarte, D.; Guan, K.; Rubin, H.J.; Liu, X. Capturing the Benefits of Working Lands to Scale Sustainable Biomass Production through Clean Fuel Incentives.

L. Zhang; Rubin H.J.; Fu, J.S.; Chien, R.Y.; Rastogi, D.; Ashfaq, M.; Kao S.C. Accurate Risk Assessment of Drought in the US through Dynamic Downscaling Methods. Presented at 2023 Fall Meeting, AGU, 11-15 Dec.

Yu, T.E.; Rubin, H.J.; Taheripour, F.; Kemanian, A., Alternative Jet Fuel Supply Chain Analysis: Carbon Fluxes and Soil Organic Carbon. Presented at Federal Aviation Administration (FAA) Center of Excellence for Alternative Jet Fuels & Environment (ASCENT) Fall Meeting. 24-26 Oct. 2023.

Rubin, H.J.; Fu, J.S. Mapping Long-term Trends in Soil Organic Carbon with Machine Learning. Presented at Institute for a Secure and Sustainable Environment Annual Research Conference, 18 Sep. 2023.

Rubin, H.J.; Yang, C.-E.; Hoffman, F.; Fu, J.S. Impacts of Climate Intervention on Sulfur Deposition with CMIP6 Model Outputs. Presented at 2022 Fall Meeting, AGU, 12-16 Dec.

Zhang, L.; Rubin, H.J.; Fu. J.S.; Rastogi, D.; Kao, S.-C.; Ashfaq, M. Heat Wave Predictions with Dynamical and Statistical Downscaling Methods. Presented at 2022 Fall Meeting, AGU, 12-16 Dec.

Rubin, H.J.; Fu, J.S.; Dentener, F.; Li, R.; Huang, K.; Fu, H. Global Nitrogen and Sulfur Budgets Using a Measurement-Model Fusion Approach. Presented at 2022 CMAS Conference, 17-19 Oct.

Rubin, H.J.; Fu, J.S. Revisiting Global Nitrogen and Sulfur Budgets Using a Measurement-Model Fusion Approach. In Proceedings of the Proceedings; NADP, 2021.

Lutz, D.A.; Rubin, H.J.; Steele, B.; Ducey, M.J.; Cottingham, K.L.; Palace, M.W.; Weathers, K.C.; Chipman, J.W. Harnessing Machine Learning and Citizen Science Data to Improve Remotely Sensed Estimates of Lake Water Clarity and Document Regional Clarity Trends. Presented at 2019 Fall Meeting, AGU, 9-13 Dec.

Additional Honors and Awards

Southern Section A&WMA Scholarship 2024 Award Recipient

Professional and Community Activities

Graduate Student Member of the Tennessee State Energy Policy Council, 2023–2024