# BRADLEY A. GAY
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## EDUCATION

**George Mason University** | Ph.D., Earth Systems and Geoinformation Sciences               2023
*Investigating High-Latitude Permafrost Carbon Dynamics with Artificial Intelligence and Earth System Data Assimilation*
Dissertation Committee: Qu, J.J., Armstrong, A.H., Dirmeyer, P.A., Wessels, K.J., and Züfle, A.E.
**Johns Hopkins University** | M.Sc., Environmental Sciences and Policy               2012
*Investigation of wildfire dynamics in Galicia by combining remote sensing, modeling, and artificial intelligence*
**University of Nebraska** | B.Sc., Biology               2010

## PUBLICATIONS

- Gay, B.A. *et al.* (2023). Disentangling the Permafrost Carbon Feedback with Multimodal Earth Observation, Data Assimilation, and Feedback Neural Networks*. Remote Sensing of Environment.* In Progress.
- Gay, B.A. *et al.* (2023) Investigating Permafrost Carbon Dynamics in Alaska with Artificial Intelligence. *Environmental Research Letters. Permafrost Vulnerability to Climate Change.* In Revision.
- Gay, B.A. *et al.* (2022). Quantifying Feedback Sensitivities of Permafrost Degradation and Carbon Release with Earth Observation Data and Feedback Neural Networks. *Earth and Space Open Archive.* doi.org/10.22541/essoar.167252578.88217202/v1.
- Gay, B.A. *et al* (2022). Understanding Active Layer Thickness Variability Under Changing Climatic Conditions Across the North American Taiga-Tundra Ecotone, *Earth and Space Science Open Archive.* doi.org/10.1002/essoar.10509696.1.
- Gay, B.A. *et al* (2021). Examination of Current and Future Permafrost Dynamics Across the North American Taiga-Tundra Ecotone. *Earth and Space Science Open Archive.* doi.org/10.1002/essoar.10505831.1.
- Pei, Y. *et al.* (2023). Plant Water Availability Yields Key Insight into Dryland Carbon and Water Flux Variability. *Agricultural and Forest Meteorology.* Under Review.
- Dirmeyer, P.A. *et al* (2022). Evolution of Land Surface Feedbacks on Extreme Heat - Adapting Existing Coupling Metrics to a Changing Climate. *Frontiers in Environmental Sciences.* doi.org/10.3389/fenvs.2022.949250.
- Gay, B.A. *et al.* (2022). Validation of Permafrost Thaw Depth Simulations Across Vegetation Gradients in the North American Taiga-Tundra Ecotone. *Environmental Research Letters.* In Progress.
- Montesano, P.M. *et al.* (2022). Variation in Projected Forest Pattern Changes at the North American Taiga-Tundra Ecotone*. Global Ecology and Biogeography.* In Progress.

## EMPLOYMENT

**NASA Jet Propulsion Laboratory**               June 2023 – Present
NASA Postdoctoral Program Fellowship
- Circumpolar Zero-Curtain Characterization with Remote Sensing (e.g., UAVSAR, NISAR, AVIRIS-NG) and AI
- Arctic Boreal Vulnerability Experiment, Miller (TE 2021): Enhanced Methane Emissions in Transitional Permafrost Environments: An ABoVE Phase 3 Synthesis Investigation
  https://above.nasa.gov/profiles_/above_projects.html?projType=project&projID=4712&progID=6.
  - Exploit, correlate, validate, and extend geospatial relationships and biogeocryohydrologic processes to landscape-scale flux estimates and occurrence, extent, and magnitude of transitional permafrost degradation (i.e., 10m-10,000km) with SAR, AVIRIS-NG, CHARM-F, MAMAP2D $CH_4$, Circumarctic MAGT, permafrost disturbance maps, and in situ field data characterizing the North Slope, Seward Peninsula, Northwest, and Interior landscapes of Alaska for future remote sensing missions (e.g., NISAR, SBG, CHIME, MERLIN, CO2-M) at decadal-scale temporality (i.e., seasonal, interannual, and decadal).
- Arctic Methane and Permafrost Challenge (AMPAC)

**NASA Goddard Space Flight Center**               June 2020 – May 2023
Permafrost Modeling, SIBBORK-TTE Model Calibration/Validation
- Arctic Boreal Vulnerability Experiment, Armstrong (TE 2018): Vulnerability of the Taiga-Tundra Ecotone: Predicting the Magnitude, Variability, and Rate of Change at the Intersection of Arctic and Boreal Ecosystems
  https://above.nasa.gov/profiles_/above_projects.html?projType=project&projID=3983&progID=6.
  - Observe, model, and predict likelihood of changes in vegetation pattern variability across the taiga-tundra ecotone (TTE) within the ABoVE Extended Domain using a high-resolution spatially explicit individual-based forest and tundra gap model to predict the direction, rate, and magnitude of shifting variability in productivity, structure, and distribution within the TTE in parallel with airborne imagery, lidar observations (i.e., LVIS, GLiHT), CMIP6 scenario forcing data, and a Landsat-derived biome boundary map that spatially controls model application based on location, extent, and pattern of woody cover
  - Vegetation Dynamics and Distribution (Airborne Working Group) ABoVE Phase II: Improve permafrost subroutine by examining thaw depth variability generated by a spatially explicit individual-based forest gap model and evaluate the performance of the permafrost subroutine relative to below-ground drivers of change. Enhance model simulation and precision of likelihood quantification of predicted changes in forest structure patterns and productivity with ground data, remote sensing-derived observations, model simulations, and CMIP6 projections

coupled with historical and future real-world process-based dynamics and forecasted parameterizations at the intersection of Arctic and Boreal ecosystems.

**George Mason University**                                                                August 2019 – December 2022
Graduate Teaching Assistantship
- Provide research lectures, individual and group tutoring sessions, instructional resources with hybridized formatting, rubric and curriculum development, marking, and academic guidance and support delineating short-term expectations for lesson plans as well as setting long-term goals and career advancement.
- Course Assignments: Satellite Image Analysis, Earth Image Processing, Geospatial Science Fundamentals, Geographic Information Systems, Remote Sensing Natural Hazards, Advanced Geographic Information Systems, Land Use Land Cover Change Modeling, Quantitative Methods, Introduction to Geoinformation Technologies

**Future Earth**                                                                                     May 2022 – September 2022
Remote Sensing and Land Cover Graduate Research Fellowship
- Conducted analysis on water stress factors based on light use efficiency GPP modeling. Selection of sensitive biome-specific water indicators under drought conditions not only improves GPP modeling but also facilitates the generation of a global GPP product in response to GPP sensitivity analyses from new water stress response functions.

**NASA Langley Research Center**                                                              June 2021 – September 2022
Mars Sample Return Earth Entry Vehicle Utah Test and Training Range Soil Moisture Analyst
- Analyze radar and radiometrically derived surface and root zone soil moisture data acquired from the Soil Moisture Active Passive (SMAP) observatory across the Mars Sample Return Earth Entry Vehicle (MSR EEV) landing ellipse at the Utah Test and Training South Range (UTTR) in the Great Salt Lake Desert and produce a comprehensive spatiotemporal characterization of soil moisture distribution. These soil moisture products and cumulative distribution function sets serve as parameterized inputs in the development of a surrogate function material model that integrates moisture sensitivity and mechanical properties of the soil at depth (i.e., shear strength, compressibility) while outputting a probabilistic distribution of impact acceleration loads.

**APX, Inc.**                                                                                          May 2014 – January 2015
Environmental and Power Markets Research Analyst
- Research and analytics within the renewable energy, global REDD+, and carbon offset environmental marketplace, specifically REC/ACP supply-demand trend analyses and database development based on registry activity, certificate mobility, investment drivers, credit purchasing, regulatory proceedings, UNFCCC policy development, and ecosystem performance reimbursement. Other duties included carbon and power market analysis, account research and environmental management (ISONE, ACR, and CAR), SCADA telemetry (CAISO, ERCOT), and evaluation of state implementation plans, regulatory pathways, and tracking systems in accordance with §111(d) of the Clean Air Act.

**The Climate Institute**                                                                          January 2014 – May 2014
Center for Environmental Leadership Training Graduate Research Fellowship
- Investigated the anthropogenic and biogenic factors, including volcanism, solar luminosity, and terrestrial positioning, on climate change dynamics prior to the Industrial Revolution. Published articles for the Climate Alert newsletter during tenure at Center for Environmental Leadership Training.

**World Wildlife Fund**                                                                          August 2012 – December 2012
United States Government Relations Internship
- Worked in collaboration with the Department of State and the Department of Justice to curtail the prevalence of illegal wildlife trade, particularly wildlife crime and trafficking existing throughout South Africa, Vietnam, Laos, and China. Policy research, analysis, and outreach for combating international wildlife trafficking and poaching campaigns, and legislation critical for natural resource management, biodiversity preservation, domestic and international climate change mitigation and renewable energy regulation, and international species conservation initiatives. Drafted brief materials and research assessments outlining congressional hearings and markups on Capitol Hill for congressional administration and NGO coalition briefings.

**United States Fish and Wildlife Service**                                                     March 2011 – August 2011
Wetland Conservation Internship
- Administrative tasks relating to RAMSAR wetland conservation strategies in consultation with the Department of International Conservation and Wildlife Without Borders. Contacted site managers to determine if declared wetland regions' conservation offices were implementing and executing RAMSAR goals and policies efficiently while documenting each wetland sites' status to monitor the condition and address negative changes to the ecological integrity of each location facilitated by human-induced encroachment.

**University of Nebraska, Department of Biology**                                              May 2008 – August 2009
Palaeobotany Laboratory Research Associate
- Administrative support including specimen photography, electronic conversion of personal academic library, and cataloguing of reference materials. Assisted with laboratory techniques involving photographic documentation of palaeobotanical field specimens utilizing a Zeiss Ultraphot IIIB dissecting microscope, and prepared various fossilized specimens of botanical permineralizations and coal ball specimens using cellulose-acetate peeling techniques.
- Undergraduate Teaching Assistantship for an upper-level undergraduate course: BIOL 4570-001.

**University of Nebraska, Allwine Prairie Preserve**                                           May 2008 – August 2009
Vegetation Management Specialist
- Vegetation management including invasive species control (e.g., cottonwood, cedar, Russian olive, and other seed bearing, non-native trees) via application of forestry management techniques including tree removal and herbicide application. Utilized controlled burning methodologies while providing on-sight support during control burns, frequently

monitoring weather as well as issuing other fire-control precautionary duties as required. Assisted with hydrological research in collaboration with the University's Chemistry Department investigating various features of glacial till creek water, i.e. sample collection, pH analysis, conducting HPLC to determine radioactive isotope levels, implementing growth media plating methods to determine parasitic concentrations, performing the Winkler Method to assess oxygen saturation, and utilizing statistical analyses to catalogue biomass occurrence and speciation in prairie research plots.

**University of Nebraska at Omaha, Department of Biology**                                October 2008 – March 2009

Physiological Ecology and Mammalogy Laboratory Research Associate

- Examined and catalogued the physiological properties of small mammals, specifically deer mice and prairie voles in tall-grass prairie ecosystems. Performed catch methods and metabolic analysis on model species of interest and performed anatomical and biochemical assessments to catalogue exhibited species differentiation.

# PRESENTATIONS

2023 Earth System Observations and Modeling Graduate Symposium (ESOM), George Mason University
- Permafrost Carbon Dynamics in the Arctic System with Earth Observation Data and Feedback Neural Networks | Oral Presentation

NASA Arctic Boreal Vulnerability Experiment 9th Science Team Meeting (ASTM9), 2023
- Quantifying Permafrost Carbon Dynamics with Feedback Neural Networks and Ecological Memory | Author, Poster

Toolik Field Station All Scientists Meeting, 2023
- Permafrost Carbon Dynamics in the Arctic System with Earth Observation Data and Feedback Neural Networks | Author, Poster

American Geophysical Union 2022 Conference
- Quantifying Feedback Sensitivies of Permafrost Degradation and Carbon Release with Earth Observation Data and Feedback Neural Networks | Author, Oral Presentation (B067 - Vulnerability of Permafrost Carbon to Climate Change)
- Implications of Fire Disturbance on Soil Carbon Cycling and Permafrost in Black Spruce Forests of Interior Alaska: A Case Study at Hess Creek | Co-Author, Participant (B067 - Vulnerability of Permafrost Carbon to Climate Change)

NASA Arctic Boreal Vulnerability Experiment 8th Science Team Meeting (ASTM8), 2022
- Validation of Simulated Permafrost Degradation for Climate Change Response Projections in Alaska | Author, Poster (Session 2, Permafrost and Hydrology)

2022 Earth System Observations and Modeling Graduate Symposium, George Mason University
- Examination of Permafrost Thaw and Terrestrial Carbon Cycling Dynamics in the Arctic System with Earth Observation Data and AI, Oral Presentation (Session 3 Talks - Land Surface)

American Geophysical Union 2021 Conference
- Understanding Active Layer Thickness Variability Under Changing Climatic Conditions Across the North American Taiga-Tundra Ecotone | Author, Oral Presentation (B31E-08: The Resilience and Vulnerability of Arctic and Boreal Ecosystems to Climate Change IV)
- High Resolution Simulations of Forest Structure Project Heterogeneous Change Across the North American Taiga-Tundra Ecotone | Co-Author, Participant (B24D-06: The Resilience and Vulnerability of Arctic and Boreal Ecosystems to Climate Change III)

Regional Conference on Permafrost: 19th International Conference on Cold Regions Engineering 2021
- Field Validation of Simulated Permafrost Thaw Depth Across the Vegetation Gradient in Alaska from SIBBORK-TTE Modeling Infrastructure | Author, Oral Presentation/Poster (Session 10: Snow, Vegetation, and Permafrost Interactions and Advancements in Sensing/Monitoring Technologies)

International Boreal Forest Research Association 2021 Conference
- Examination of Current and Future Permafrost Dynamics Across the North American Taiga-Tundra Ecotone | Author, Oral Presentation (Session 8: Boreal Forest Under Warming-Induced Permafrost Degradation)

European Geosciences Union General Assembly 2021 vEGU21 Conference
- Examination of Current and Future Permafrost Dynamics Across the North American Taiga-Tundra Ecotone | Author, Oral Presentation (EGU21-3066: Permafrost Open Session, CR6.1)

North American Carbon Program: 7th Open Science Meeting, 2021
- Examination of Current and Future Permafrost Dynamics Across the North American Taiga-Tundra Ecotone | Author, Oral Presentation (Student Poster Speed Talks #1, March 2021)

American Geophysical Union 2020 Conference
- Examination of Current and Future Permafrost Dynamics Across the North American Taiga-Tundra Ecotone | Author, Oral Presentation (B028-03: Vulnerability of Permafrost Carbon and Environmental Drivers to Climate Change II)
- Understanding the Drivers of Variability in Forest Structure and Composition in North American Boreal Forest | Co-Author, Participant (B100-02: The Resilience and Vulnerability of Arctic and Boreal Ecosystems to Climate Change IV)

# KEY SKILLS PROFILE

- Fluency in database management and network architecture, e.g., CLI, C, Python, JavaScript, Cypher, Ruby, NoSQL, Jupyter, MATLAB, Google Colab, ArcPy, PythonWin, PostGIS, PostgreSQL, pgAdmin4, MongoDB, Neo4J
- Adept with image processing derived from active and passive remote sensing applications (brightness temperature, radar), geographic information system-integrated software, GIS customization methods, geocoding systems, and database management querying e.g., ENVI, Panoply, MultiSpec MFC, ArcGIS, QGIS, ArcGIS Flex 2.5, ArcGIS Server, ArcGIS Viewer for Flex and Silverlight, Flex SDK, Adobe Acrobat Reader X, Adobe Flash Builder 4.6
- Proficiency with Artificial intelligence (AI), machine learning (ML), and statistical methods for time series analysis (e.g., Keras, Tensorflow, Sklearn), classification and predictive modeling (See5, Cubist), multivariate singular spectrum

analysis (with/out mutation operator), generalized distance measures, latent discriminative feature learning, layer-wise relevance propagation, boosting, random forest, stacking CV regression, DBSCAN, clustering, PCA, anomaly detection, classification, association-rule-mining, frequent co-location mining, spatial and lasso regression, R, SPSS
- Familiarity with high performance cloud computing, earth system modeling, and benchmarking, e.g., AWS, Earthdata Cloud, ADAPT, ARGO/HOPPER Cluster, NCAR Cheyenne/Casper Supercomputer, CMIP6, SIBBORK, GIPL, ILAMB
- Fieldwork competencies include forest inventory for SIBBORK-TTE (FIA); landscape characterization via permafrost coring (SIPRE) and carbon flux monitoring and synthesis (LGR) for USGS-ASC 1002 Permafrost and Hydrology project; and field awareness/medical training (First Aid/CPR/AED)

## PROFESSIONAL DEVELOPMENT

- Affiliations: CalTech Postdoctoral Association, American Geophysical Union, European Geosciences Union, Ecological Forecasting Initiative, AAAS, IEEE: Geoscience and Remote Sensing Society, ESTC, Students for Environmental Action, GENRI
- Awards/Honors: George Mason University College of Science Dean's Graduate Award for Excellence in Research (2023), Toolik All Scientists Meeting Travel Award Recipient (2023), United States Permafrost Association Permafrost Young Researchers Network Education Award Recipient (2023), George Mason University Dissertation Completion Grant Recipient (2023), George Mason University Graduate Student Travel Fund Grant Recipient (2021-2023), University of Nebraska Dean's List, University of Nebraska Chancellor's List, Beta Beta Beta Biological Honor Society - Iota Omega Chapter, Delta Epsilon Iota Academic Honor Society - Lambda Epsilon Chapter, Nebraska Art Awards Golden Key Recipient
- Workshops: New Advances in Land Carbon Cycle Modeling Workshop (2021, 2022), Near-Term Ecological Forecasting Workshop (2022), NCAR Community Terrestrial Earth Systems Modeling Workshop (2022, 2023)