Fraser King, PhD

Assistant Professor Specializing in Deep Learning, Interpretable AI, Remote Sensing, & Precipitation

fraser.king@wisc.edu | www.kinglab.org | https://github.com/frasertheking | www.linkedin.com/in/fraser-king

Professional Experience

2026 **Assistant Professor**, University of Wisconsin-Madison
Leading a research group focused on interpretable machine learning and remote sensing applications in the atmospheric sciences

2025-2026 **Postdoctoral Associate**, NASA Goddard Space Flight Center
Designing and optimizing microwave land surface emissivity models and precipitation retrievals using deep learning

2023-2025 **Postdoctoral Research Fellow**, University of Michigan
Led five first-author publications on generative deep learning models and nonlinear dimensionality reduction of complex datasets

2019-2023 **Artificial Intelligence Research Intern**, Aquanty Inc.
Developed a neural-network-based Canada-wide temperature and precipitation bias correction model, reducing monthly biases by 95%

2017-2019 **Graduate Research Assistant**, University of Waterloo
Lead the development of interactive statistics-focused lab projects for students and presented course materials as a guest lecturer

Awards, Fellowships, & Grants

2026	**ML Seed Grant**, CIRCS	*$ 20,000*
2026	**NASA Unsolicited IRAD Grant**, NASA	*$ 50,000*
2026	**NVIDIA Academic Grant**, NVIDIA	*$ 650,000*
2025	**Editor Award**, American Meteorological Society (AMS), JTECH	–
2023	**Governor General's Gold Academic Medal (Finalist)**, University of Waterloo	–
2023	**Postdoctoral Fellowship**, Natural Sciences and Engineering Research Council (NSERC)	*$ 140,000*
2022	**Early Career Scientist Award**, International Precipitation Working Group	*$ 50*
2021	**Campbell Scientific Canada Award**, Eastern Snow Conference	*$ 500*
2020	**Doctoral Scholarship**, Natural Sciences and Engineering Research Council (NSERC)	*$ 63,000*
2019	**Exceptional Doctoral Student Scholarship**, University of Waterloo	*$ 10,000*
2019	**ESRI Canada GIS Centres of Excellence National Hackathon (1st)**, ESRI Canada	*$ 500*
2019	**Jack Rosen Memorial Award for Environmental Innovation (1st)**, University of Waterloo	*$ 2,000*
2019	**GRADflix Research Communication Video Winner (1st)**, University of Waterloo	*$ 1,000*
2019	**ESM-SnowMIP EGU Travel Grant**, Snow Models Intercomparison Project	*$ 1,000*

Education

University of Waterloo *Waterloo, Ontario, Canada*
PhD, Geography *2019 - 2022*
- Advisor: Dr. Christopher Fletcher
- Thesis: Developing a radar-based machine learning snowfall retrieval algorithm
- Finalist for the Waterloo 2023 Governor General's Gold Academic Medal (doctoral)

University of Waterloo *Waterloo, Ontario, Canada*
Master of Science, Geography *2017 - 2019*
- Advisor: Dr. Christopher Fletcher
- Thesis: Validating CloudSat-CPR retrievals for the estimation of snow accumulation in the Canadian Arctic

University of Waterloo *Waterloo, Ontario, Canada*
Bachelor of Computer Science (Honours) *2012 - 2017*
- Graduated with distinction on the Dean's honour list
- Participated in the honours co-op program with outstanding performance reviews

Publications

Gum, J., Caprarelli, G., Montanari, A., Stall, S., Sedora, B., **King, F.**, et al. (2026). Impactful Datasets in Earth, Space, and Environmental Sciences: Highlighting the Data that Transform Research. *AGU Advances* (in review)

King, F., & Ringerud, S. (2026). Transformer-Based Modeling of Global Microwave Land Surface Emissivity Using GPM. *IEEE Transactions on Geoscience and Remote Sensing*, 64, 5301117–5301117. https://doi.org/10.1109/TGRS.2026.3695005

King, F., Posselt, D., Pettersen, C., Ringerud, S., & Xie, Y. (2025). Leveraging Sparse Autoencoders to Reveal Interpretable Features in Geophysical Models. *JGR: Machine Learning & Computation*, 2, e2025JH000769. https://doi.org/10.1029/2025JH000769

King, F., Pettersen, C., Dolan, B., Shates, J., & Posselt, D., (2025). Decoding global precipitation processes and particle evolution using unsupervised learning. *Science Advances*, Volume 11, Issue 38. https://doi.org/10.1126/sciadv.adu0162

Richter, J., Pettersen, C., Moisseev D., Shates, J., & **King, F.**, (2025). Macro- and Microphysical Properties of Atmospheric River Snowfall: Results from Two Instrument Sites. *Journal of Applied Meteorology and Climatology*, https://doi.org/10.1175/JAMC-D-24-0220.1

Xie, Y., **King, F.**, Pettersen, C., & Flanner, M., (2025). Machine learning detection of melting layers from radar observations. *JGR: Machine Learning & Computation*, 2, e2024JH000521. https://doi.org/10.1029/2024JH000521

King, F., Pettersen, C., Dolan, B., Shates, J., & Posselt, D., (2024). Primary Modes of Northern Hemisphere Snowfall Particle Size Distributions. *Journal of Atmospheric Science*, https://doi.org/10.1175/JAS-D-24-0076.1

King, F., Pettersen, C., Bliven, L., Cerrai, D., Chibisov, A., Cooper, S.J., L'Ecuyer, T., Kulie, M.S., Leskinen, M., Mateling, M., McMurdie, L., Moisseev, D., Nesbitt, S.W., Petersen, W.A., Rodriguez, P., Schirtzinger, C., Stuefer, M., von Lerber, A., Wingo, M.T., Wolff, D.B., Wong, T., & Wood, N., (2024). A Comprehensive Northern Hemisphere Particle Microphysics Dataset from the Precipitation Imaging Package. *Earth and Space Science*, https://doi.org/10.1029/2024EA003538

King, F., Pettersen, C., Fletcher, C. G., & Geiss, A. (2024). Development of a deep full-scale connected U-Net for reflectivity inpainting in spaceborne radar clutter zones. *Artificial Intelligence for the Earth Systems*. https://doi.org/10.1175/AIES-D-23-0063.1

King, F., Kelly, R., & Fletcher, C. G. (2023). New opportunities for low-cost LiDAR-derived snow depth estimates from a consumer drone-mounted smartphone. *Cold Regions Science and Technology*, 207, 103757. https://doi.org/10.1016/j.coldregions.2022.103757

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. *Atmospheric Measurement Techniques*, 15, 6035–6050. https://doi.org/10.5194/amt-15-6035-2022

King, F., Duffy, G., & Fletcher, C. G. (2022). A Centimeter Wavelength Snowfall Retrieval Algorithm Using Machine Learning. *Journal of Applied Meteorology and Climatology*, https://doi.org/10.1175/JAMC-D-22-0036.1

King, F., Kelly, R., & Fletcher, C. G. (2022). Evaluation of LiDAR-Derived Snow Depth Estimates From the iPhone 12 Pro. *IEEE Geoscience and Remote Sensing Letters*, https://doi.org/10.1029/2021MS002836

Fletcher, C. G., McNally, W., Virgin, G., & **King, F.** (2022). Toward efficient calibration of higher resolution Earth System Models. *Journal of Advances in Modeling Earth Systems*, 19, 1–5. https://doi.org/10.1109/LGRS.2022.3166665

King, F., & Fletcher, C. G. (2021). Using CloudSat-derived snow accumulation estimates to constrain gridded snow water equivalent products. *Earth and Space Science*, e2021EA001835. https://doi.org/10.1029/2021EA001835

Duffy, G., **King, F.**, Bennartz, R., and Fletcher, C. G. (2021). Seasonal Estimates and Uncertainties of Snow Accumulation from CloudSat Precipitation Retrievals. *Atmosphere*, 12(3), 363. https://doi.org/10.3390/atmos12030363

King, F., Erler, A. R., Frey, S. K., and Fletcher, C. G. (2020). Application of machine learning techniques for regional bias correction of snow water equivalent estimates in Ontario, Canada, *Hydrol. Earth Syst. Sci.*, 24, 4887–4902, https://doi.org/10.5194/hess-24-4887-2020

King, F., & Fletcher, C. G. (2020). Using CloudSat-CPR Retrievals to Estimate Snow Accumulation in the Canadian Arctic. *Earth and Space Science*, 7(2), e2019EA000776. https://doi.org/10.1029/2019EA000776

Presentations

Invited Talks

Spring 2026. *Towards Interpretable Artificial Intelligence in the Geosciences* Invited Speaker, University of Guelph, Geography Graduate Student Society. Online.

Fall 2025. *Do we really know what our ML models are doing?* Invited Speaker, UW-Madison Guest Lecture: AI4EO. Online.

Summer 2025. *Do we really know what our models are doing?* Invited Speaker, NASA Goddard Space Flight Center. In person.

Spring 2025. *Towards Interpretable Machine Learning in the Geosciences.* Invited Speaker, AI2ES Site-Wide Meeting, University of Oklahoma. Online.

Spring 2025. *AI in Science and Engineering Symposium.* Invited Speaker, University of Michigan. In person.

Fall 2024. *Applications of Machine Learning in the Geosciences.* Invited Speaker, Argonne National Laboratory. In person.

Fall 2024. *Decoding Signals in Snowfall Observations.* Invited Speaker, AGU Precipitation Technical Committee. Online.

Fall 2024. *Primary Modes of Northern Hemisphere Snowfall Particle Size Distributions.* Invited Speaker, NASA GPM PSD Working Group. Online.

Summer 2024. *Understanding AI Models: Interpretable Artificial Intelligence Explained.* Invited Speaker, University of Cologne, Germany. In person.

Spring 2024. *Interpretable Artificial Intelligence: How do we know what our models are doing?* Invited Speaker, University of Illinois Urbana-Champaign. In person.

Spring 2024. *Documenting and Maintaining Large Geospatial Datasets.* Invited Panelist, University of Michigan Research Data Stewardship Initiative. Online.

Spring 2024. *Towards Interpretable Artificial Intelligence in the Atmospheric Sciences.* Invited Speaker, NASA Jet Propulsion Laboratory. In person.

Winter 2024. *Let it Snow! Let it Snow! Let it Snow! Climate Series Talks.* Invited Speaker, Maitland Valley Conservation Authority. Online.

Winter 2024. *A Comprehensive Northern Hemisphere Particle Microphysics Dataset from the Precipitation Imaging Package.* Invited Speaker, NASA GPM PSD Working Group. Online.

Fall 2023. *Development of a deep full-scale connected U-Net for reflectivity inpainting in spaceborne radar clutter zones.* Invited Speaker, AGU 2023. In person.

Fall 2022. *Do neural networks dream of falling snow?* Invited Speaker, Intact Financial Corporation. Online.

Summer 2022. *DeepPrecip: A deep neural network for precipitation retrievals*. Invited Speaker, PMM Land Surface Working Group. Online.

Fall 2021. *Enhancing the accuracy of current snow water equivalent products using remote sensing and machine learning*. Guest Lecture, Machine Learning Research Group, University of Guelph. Online.

Winter 2019. *Bias correcting snow water equivalent data using machine learning*. Guest Lecture, Aquanty Inc. In person.

Contributed Presentations

King, F. and Ringerud, S. (2026). Transformer-Based Modeling of Global Microwave Land Surface Emissivity Using GPM. Oral: 12th International Precipitation Working Group (IPWG). In Person.

King, F. and Ringerud, S. (2026). Transformer-Based Modeling of Global Microwave Land Surface Emissivity Using GPM. Oral: 106th Annual American Meteorological Society (AMS). In Person.

King, F., Pettersen, C., Posselt, D., Ringerud, S., and Xie, Y. (2025). Towards Interpretable Machine Learning in the Geosciences. Oral: American Meteorological Society's 41st International Conference on Radar Meteorology. Online.

King, F., Pettersen, C., Dolan, B., Shates, J., & Posselt, D. (2025). Decoding Nonlinear Signals in Multidimensional Precipitation Observations. Oral: 81st Annual Eastern Snow Conference (ESC). In Person.

King, F., Pettersen, C., Dolan, B., Shates, J., & Posselt, D. (2025). Decoding Nonlinear Signals in Multidimensional Precipitation Observations. Oral: 105th Annual American Meteorological Society (AMS). Online.

King, F., Pettersen, C., Dolan, B., Shates, J., & Posselt, D. (2024). Decoding Nonlinear Signals in Multidimensional Precipitation Observations. eLightning presentation: American Geophysical Union (AGU). In Person.

King, F., Pettersen, C., Fletcher, C. G., & Posselt, D. (2024). Towards Interpretable Artificial Intelligence in the Atmospheric Sciences. Invited oral presentation: International Precipitation Working Group (IPWG) Snowfall Focus Group. Online.

King, F., Pettersen, C., Fletcher, C. G., & Geiss, A. (2023). Development of a full-scale connected U-Net for reflectivity inpainting in spaceborne radar blind zones. Invited oral presentation: American Geophysical Union 2023. In Person.

King, F., Pettersen, C., Fletcher, C. G., & Geiss, A. (2023). Development of a full-scale connected U-Net for reflectivity inpainting in spaceborne radar blind zones. Oral presentation: American Meteorological Society's 40th Conference on Radar Meteorology. In Person.

King, F., Pettersen, C., Fletcher, C. G., & Geiss, A. (2023). Development of a deep full-scale connected U-Net for reflectivity inpainting in spaceborne radar clutter zones. Oral presentation: Eastern Snow Conference 2023. In Person.

King, F., Pettersen, C., Fletcher, C. G., & Geiss, A. (2023). Development of a deep full-scale connected U-Net for reflectivity inpainting in spaceborne radar clutter zones. Oral presentation: Vanderbilt University Machine Learning and Snowfall Workshop. In Person.

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. Oral presentation: University of Waterloo Graduate Student Conference. In Person.

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. Oral presentation: AGU Collective Madison Meeting (SatMET). Online.

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. Oral presentation: AGU Frontiers in Hydrology Meeting. Online.

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. Oral presentation: International Precipitation Working Group (IPWG). In person.

King, F., Duffy, G., Milani, L., Fletcher, C. G., Pettersen, C., & Ebell, K. (2022). DeepPrecip: A deep neural network for precipitation retrievals. Oral presentation: Eastern Snow Conference. Online.

King, F., Kelly, R., & Fletcher, C. G. (2022). What if you put a phone on a drone? Oral presentation: Canadian Meteorological and Oceanographic Society. Online.

King, F, Duffy, G., Fletcher, C. G. (2021). A Centimeter Wavelength Snowfall Retrieval Algorithm Using Machine Learning. Poster: International Summer Snowfall Workshop. Online.

King, F, Fletcher, C. G. (2021). Using CloudSat-CPR derived snow accumulation estimates to constrain gridded snow water equivalent products. Oral presentation: Canadian Meteorological and Oceanographic Society. Online.

King, F, Kelly, R., Fletcher, C. G. (2021). Evaluation of LiDAR snow depth estimates from portable consumer devices and their application for citizen science. Oral presentation: Eastern Snow Conference. Online.

King, F, Fletcher, C. G. (2021). Using CloudSat-CPR derived snow accumulation estimates to constrain gridded snow water equivalent products. Oral presentation: IEEE Geoscience and Remote Sensing Society (IGARSS). Online.

King, F, Fletcher, C. G. (2020). Bias-correction of gridded SWE products using CloudSat-CPR snowfall estimates. Oral presentation: Canadian Meteorological and Oceanographic Society. Online.

King, F, Erler, A., Frey, S., Fletcher, C. G. (2020). Application of Machine Learning Techniques for Regional Bias Correction of SWE Estimates in Ontario, Canada. Oral presentation: Climate Informatics (CI). Online.

King, F, Fletcher, C. G. (2020). Evaluation of Gridded Snow Products Using CloudSat Snowfall Estimates. Poster: Canadian Space Agency (CSA) Workshop. CSA, Montreal, Canada. In person.

King, F, Fletcher, C. G. (2019). Evaluation of Gridded Snow Products Using CloudSat Snowfall Estimates. Oral presentation: European Geosciences Union (EGU). Vienna, Austria. In person.

King, F, Fletcher, C. G. (2019). Using CloudSat-CPR Retrievals to Estimate Snow Accumulation in the Canadian Arctic. Oral presentation: Canadian Meteorological and Oceanographic Society. Halifax, Nova Scotia. In person.

Research Projects

Towards Interpretable Physical Models 2024 - Present

How do we know what our models are doing? Are they right for the right reasons? What can they teach us about the natural world? These are some of the questions we are working towards answering in this ongoing research project on developing interpretable physical models in the Geosciences. We are currently exploring these themes of mechanistic interpretability using a combination of sparse autoencoders and nonlinear dimensionality reduction techniques in toy physical models to identify meaningful latent features.

Snowfall Microphysical Dimensionality Reduction 2024 - Present

I was responsible for curating a high quality precipitation dataset containing over 1 million minutes of particle microphysical observations. This included measurements of particle size distribution, fall speed, effective density and snowfall/rainfall rates, which were standardized and packaged into an accessible online dataset. This data was then analysed using a combination of both linear and nonlinear dimensionality reduction techniques including PCA, Isomap, t-SNE and UMAP, to identify the primary modes of precipitation variability across the Northern Hemisphere. This NASA-funded work resulted in three research papers and multiple invited talks/conference presentations.

Radar Blindzone Inpainting using Artificial Intelligence 2023 - 2024

I am the primary investigator on a research project which uses deep learning to predict near surface reflectivity profiles in spaceborne radar. As the project lead, I am responsible for sourcing and processing the training data, designing and tuning the convolutional neural network, assigning tasks to other co-authors, and presenting the results at conferences and workshops. My 2-year Postdoctoral Fellowship (PDF) proposal on this topic was approved and funded by NSERC.

Deep Learning Snowfall Retrieval (DeepPrecip) 2021 - 2022

I was the primary investigator on a deep learning snowfall retrieval project where my responsibilities included algorithm design, model implementation, and performance evaluation. As the leader of a team of 5 other researchers, I was also responsible for delegating project tasks and adhering to tight deadlines. I facilitated an ongoing collaborative effort with various international partners, and our work resulted in multiple conference presentations and a journal article publication.

Teaching Experience

2026	**[ATMOCN 401] Applied Machine Learning in the Atmospheric & Oceanic Sciences**, Instructor	*University of Wisconsin-Madison*
2025	**Masters of Computational Mathematics Research Paper**, External Reader	*University of Waterloo*
2024	**[CLIM/EARTH 411] Cloud and Precipitation Processes**, Guest Lecturer	*University of Michigan*
2024	**Masters of Science Defense Committee Member**, External Examiner	*University of Waterloo*
2022	**Machine learning applications for land cover classification using Sentinel-2**, Instructor	*Aggregate Intellect*
2017-2019	**[ENVS 278] Applied Statistics for Environmental Research**, Teaching Assistant	*University of Waterloo*

Mentoring

2026	**Amanze Ejiogu**, PhD Advisor	*UW-Madison*
2026	**Sam Wingert**, Summer Research Advisor	*UW-Madison*
2023-2025	**Research Mentor (2 students)**, Department of Climate and Space Sciences and Engineering	*University of Michigan*
2017-2019	**Statistics Tutor**, Undergraduate Students in Math, Computer Science and Geography	*University of Waterloo*

Technical Skills

- **Languages**: Python, C/C++, Objective-C, R, Rust, Go, Swift, Javascript, Fortran, Bash
- **Software**: Tensorflow, scikit-learn, SciPy, Keras, PCA, t-SNE, UMAP, Xarray, Pandas, Git, SQL, HDF, netCDF, Slurm
- **Hardware**: Azure, Graphcore, Google Compute, Great Lakes, Mist GPU Cluster, Google Colab, Paperspace

Outreach & Professional Development

Service and Outreach

2026	**Journal of Atmospheric and Oceanic Technology**, Editor	*AMS*
2025	**AGU Precipitation Technical Committee**, Deputy Chair (ECS)	*AGU*
2025	**Eastern Snow Conference Research Committee**, Student Award Judge	*ESC*
2025	**Research Opportunities in Space and Earth Science (ROSES)**, Panel Reviewer	*NASA*
2025	**Snow Science Research Special Issue**, Guest Editor	*Glacies*
2024	**Committee on Artificial Intelligence Applications to Environmental Science**, Member	*AMS*
2024	**Journal of Atmospheric and Oceanic Technology**, Associate Editor	*AMS*
2024	**JGR:ML&C Editor-in-Chief Search**, Committee member	*AGU*
2024	**UM Climate Bits and Bites**, Presenter	*UM*
2023	**AGU Early Career Seminar**, Seminar organizer, host	*AGU*
2023	**AMS Radars**, Machine Learning Session Abstract Reviewer	*AMS*
2023	**Google Quantum AI**, Design Consultant	*Google*
2023	**International Precipitation Conference 14**, Session Moderator	*UO*
2023	**Eastern Snow Conference**, Executive Council Member (ongoing)	*ESC*
2022	**AGU Precipitation Technical Committee**, Executive Member (ongoing)	*AGU*
2022	**Canadian Meteorological and Oceanographic Society (CMOS) Bulletin**, Author	*CMOS*
2022	**NSERC Science Exposed**, Lead Designer	*NSERC*
2021	**Environment Building Mural Project (Canada Map)**, Creator, Designer and Project Lead	*UW*
2021	**Environment Graduate Student Recruitment**, PhD Student Panelist	*UW*
2018	**Let's Talk Science**, Student Volunteer	*UW*

Reviewer For

Science Advances, Proceedings of the IEEE, Remote Sensing of Environment, Journal of Atmospheric and Oceanic Technology, Earth System Science Data, JGR: Machine Learning and Computation, Artificial Intelligence for the Earth Systems, JGR: Atmospheres, Journal of Hydrometeorology, Hydrology and Earth System Sciences, Geoscientific Model Development, Remote Sensing, The Cryosphere, Earth and Space Science, Measurement, Cold Regions Science and Technology, Weather and Forecasting, IEEE Geoscience and Remote Sensing Letters

Collaborations

University of Maryland, University of Wisconsin-Madison, University of Cologne, University of Toronto, Vanderbilt University, University of Waterloo, University of Michigan, Pacific Northwest National Laboratory, Argonne National Laboratory, Canadian Space Agency, Environment and Climate Change Canada, National Aeronautics and Space Administration, Aquanty Inc.

Development

GraphCore AI Training: Completed an online training course to use deep learning libraries like Tensorflow and Keras with big data on the GraphCore Intelligence Processing Unit pods.

Compute Canada - High Performance Computing Course: A two day in-person course provided in-depth detail into using the Niagara super-computing cluster (i.e., submitting and parallelizing compute tasks).

3 Minute Thesis Competition: As a participant in this competition, I learned valuable techniques for communicating my research in a clear and concise manner to a wide audience.