James Andrew ("Andy") Edmond

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Education

August 2018 - Sept 2024 — **University of New Hampshire**, Durham, NH
Ph.D, Physics
Concentration in Space Physics & Magnetospheric Physics
Gpa: 3.65

August 2013 - December 2017 — **Auburn University**, Auburn, AL
B.S., Discrete Applied Mathematics, Major Gpa: 3.76
B.S., Physics, Major Gpa: 3.65

Research Experience & Training

October 2020 - Sept 2024 — Graduate Research Assistant
Advisor: Dr. Joachim Raeder
Research Topic: Unsupervised Clustering of Spacecraft Data
Used unsupervised methods to algorithmically separate distinct plasma regions from magnetospheric dayside spacecraft data via interpretable dimensionality reduction techniques, vector quantization methods, and ensemble clustering.

Summer 2023 — Los Alamos Space Weather Summer School - Vela Fellowship Recipient
Mentor: Dr. Steve Morley
Research Topic: Downscaling Methods to Predict Mesoscale Solar Wind Structure
Attended lectures on space plasma processes pertaining to the understanding and prediction of space weather.
Used statistical downscaling and MCMC methods to reconstruct high-frequency (<1 day) solar wind measurements for increasing the accuracy of solar wind-fed magnetosphere models in predicting geomagnetic storms.

January 2019 - October 2020 — Graduate Research Assistant
Advisor: Dr. Joachim Raeder
Research Topic: Determining the Entropy Distribution of the Magnetospheric Tail
Created and executed Fortran-based kinetic simulations of particle trajectories in the presence of MHD shock conditions.

July 2019 — Boulder Space Weather Summer School Attendee (2 week program)
Attended lectures on topics relevant to space weather including the solar atmosphere, solar wind generation, solar wind-magnetosphere interactions, coupling of the

	inner magnetosphere and ionosphere, and substorms and their lower atmospheric and ground effects. These lectures were paired with labs in which students learned and used various models and pre-existing empirical data.
January 2017 - June 2018	Undergraduate Research Assistant *Advisor: Dr. Joseph Perez* Created and executed programs in IDL for data analysis, became familiar with using supercomputer resources, and ran and interpreted simulations of the inner magnetosphere and ionosphere using both Fortran and IDL programs.
May 2014 - December 2016	Undergraduate Research Assistant *Advisors: Drs. Allen Landers and Michael Fogle* Operated and maintained equipment involved in generating low-pressure environments (e.g Pfeiffer TMU 1600 C turbo pumps, cold traps using liquid nitrogen).

Research Interests

Solar wind-magnetosphere coupling, magnetospheric dayside processes, bow shock modeling. More generally, machine learning techniques for space science, particularly via unsupervised methods, including the use of state space, mixture, autoregressive, clustering, and generative models (GANs, VAEs / VQ-VAEs, diffusion models). Deep learning with traditional MLP, RNN, CNN, and Transformer architectures. Incorporation of uncertainty estimation into these models. Parameter estimation via MCMC.

Publications and Presentations

Publications:

"Dynamics of a geomagnetic storm on 7–10 September 2015 as observed by TWINS and simulated by CIMI", Perez, J. D., **Edmond, J.**, Hill, S., Xu, H., Buzulukova, N., Fok, M.-C., Goldstein, J., McComas, D. J., and Valek, P., *Ann. Geophys.*, 36, 1439–1456, https://doi.org/10.5194/angeo-36-1439-2018, 2018

"Clustering of Global Magnetospheric Observations", **James Edmond**, Joachim Raeder, Banafsheh Ferdousi, Maria Elena Innocenti, Matthew Argall, *Journal of Geophysical Research: Machine Learning and Computation*, under review

Presentations:

1. "Auto-Separation of Magnetospheric Regions via Unsupervised Learning", **J. Edmond** , Joachim Raeder, Banafsheh Ferdousi, Maria Elena Innocenti , Matthew Argall, The Machine Learning Summer School in Okinawa 2024, Okinawa Institute of Science and Technology Graduate University, 6 March 2024 [Poster]

2. "Using Multi-Stage Unsupervised Clustering to Automatically Separate Plasma Regions in the Dayside Magnetosphere", **J. Edmond** , Joachim Raeder , Banafsheh Ferdousi , Maria Elena Innocenti , Matthew Argall, 2023 Geospace Environment Modeling Workshop, San Diego, CA, 15 June 2022 [Poster]

3. "Using Gaussian Mixtures to Automatically Separate Plasma Regions", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, M. Argall, 2023 American Meteorological Society Meeting, Denver, CO, 9 January 2023 [Poster]

4. "Unsupervised Clustering of Magnetospheric Dayside Data", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, M. Argall, 2022 American Geophysical Union Fall Meeting, Chicago, IL, 15 December 2022 [Talk]

5. "Unsupervised Clustering of Magnetospheric Dayside Data", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, M. Argall, 2022 Geospace Environment Modeling Workshop, Honolulu, HI, 23 June 2022 [Poster]

6. "Using Machine Learning to Create an Empirical Bow Shock Model from THEMIS Data", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, M. Argall, 2021 American Geophysical Union Fall Meeting, New Orleans, LA, 16 December 2021 [Talk]

7. "Resolving Bow Shock Crossings Using Unsupervised Machine Learning", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, M. Argall, Magnetospheric MultiScale Mission (MMS) Community Workshop, Waterville Valley, NH, 20 October 2021 [Talk]

8. "Magnetospheric Plasma Region Classification from THEMIS Data Using Machine Learning", **J. Edmond**, J. Raeder, B. Ferdousi, M. E. Innocenti, Virtual Conference on Applications of Statistical Methods and Machine Learning in the Space Sciences, Space Science Institute, Boulder, CO, 18 May 2021 [Virtual Talk]

9. "Evidence for Spatial and Time Dependent Injections into the Ring Current", **Edmond, James**, Perez, J. D., Fok, Mei-Ching, Buzulukova, Natalia Y., Valek, Phil, Goldstein, Jerry, McComas, D. J., Gulf Coast Undergraduate Research Symposium (GCURS), Rice University, Houston, TX, 4 November 2017 [Talk]

10. "The Roles of Magnetosphere-Ionosphere Coupling on Ring Current development: Comparison of TWINS Measurements and CIMI Simulations for the 7-10 September 2015 Geomagnetic Storm", **James Edmond**, Perez, J. D., Shannon Hill, Hanyun Xu, Jerry Goldstein, David J. McComas, Phil Valek, 2017 American Geophysical Union (AGU) Fall Meeting, New Orleans, LA, 11 December 2017 [Poster]

11. "Ion-Momentum Imaging of Dissociative Electron Attachment Dynamics in N_2O and C_2H_2", D. Reedy, **J. Edmond**, D Haxton, A. Orel, T. Rescigno, M. Fogle, A. Landers, A. Moradmand, Southeastern Section of APS (SESAPS) 2015, University of South Alabama, Mobile, AL, 20 November 2015 [Poster]

Computational Skills

Programming Languages: Fortran, C/C++, Python(+Cython), Linux systems, Parallelization APIs (MPI and OpenMP), MATLAB, R, IDL, Java
Deep Learning Libraries: Keras, TensorFlow, PyTorch
Etc: Git, Jupyter Notebook, LaTeX