Lucas Howard

PhD Candidate · Atmospheric and Oceanic Science

University of Colorado, Boulder

Lucas.Howard@colorado.edu | https://github.com/lucas-howard-j

Education

University of Colorado *Boulder, CO*

PhD Atmospheric and Oceanic Science (in-progress) *2021-2026 (expected)*

- Advisor: Professor Aneesh Subramanian
- Research focus: data assimilation and machine learning

University of Vermont *Burlington, VT*

MS Civil and Environmental Engineering *2014-2016*

- Advisor: Professor Donna Rizzo
- Thesis: "Leveraging the Information Content of Process Based Models Using Differential Evolution and the Extended Kalman Filter"
- Selected courses: Hydrology, Advanced Hydrology, Numerical Methods for Engineers, Applied Artificial Neural Networks, Evolutionary Computation

Reed College *Portland, OR*

BA Physics *2009-2013*

- Thesis Advisor: Professor Joel Franklin
- Thesis: "A Numerical Investigation of Water Waves"
- Selected courses: Scientific Computation, Multivariable Calculus I and II, Linear Algebra, Introduction to General Relativity, Elementary Particle Physics
- Extracurricular: Senior Reactor Operator at the on-campus nuclear research reactor

Professional Experience

University of Colorado *Boulder, CO*

Graduate Research Assistant *2021-present*

Hydrogeologic, Inc. *Reston, VA*

Staff Scientist/Leader *2020-2021*

Staff Scientist *2018-2020*

Associate Scientist *2016-2018*

- Constructed groundwater and surface water models to inform environmental remediation activities and planning at federal facilities, including both CERCLA and RCRA sites.
- Technical lead and lead author for a task order using the ensemble Kalman filter to analyze the results of an existing 1-D 2,000 realization set of flow and transport simulations. Client found the work valuable and is planning on presenting the analysis in an annual meeting with the state regulator.
- Co-led an effort to implement an Ensemble Kalman Filter calibration of a groundwater model. Calibration performance was comparable to industry-standard parameter estimation methods (PEST) and provided additional probabilistic insights to the client to inform future cleanup activities and modeling. Results presented at the 2020 Waste Management Symposium.
- Served as technical lead and lead author for a surface water modeling project and report submitted to U.S. Army Corps of Engineers. Maintained consistent communication with the client and stakeholders resulting in minimal reviewer comments on the final work product. Profit on the fixed-price contract exceeded 10%.
- Performed MODFLOW 6 and MODPATH 7 groundwater modeling and particle tracking using python. The use of automated scripts allowed many versions of the model to be run quickly giving the client valuable information about the impact of different conceptualizations on contaminant transport results. These results were key to planning the next phase of modeling at the site and resulted in an approach that was both more cost effective and accurate than previous efforts.

University of Vermont *Burlington, VT*

Graduate Research Assistant *2015-2016*

Hydrogeologic, Inc. *Redbank, NJ*

Research and Development Intern *Winter 2014/2015*

- Coupled a suite of optimization algorithms with the hydraulic modeling software HEC-RAS using Visual Basic to facilitate automated design involving the sizing of flood control storage areas. The automated design outperformed an expert design by approximately 8%.

Refereed Publications and Proceedings

Journal Articles Journal Articles

Howard, L. J., Subramanian, A., & Hoteit, I. (2024). A Machine Learning Augmented Data Assimilation Method for High-Resolution Observations. *Journal of Advances in Modeling Earth Systems*, *16*(1), e2023MS003774. https://doi.org/10.1029/2023MS003774

Ozbek, M., Voorhies, N., **Howard, L.**, Swanson, R., & Fox, T. (2024). Delineation of a PFOA Plume and Assessment of Data Gaps in its Conceptual Model Using PlumeSeeker™. *Groundwater*, *62*(1), 44–59. https://doi.org/10.1111/gwat.13373

Howard, L. J., Anderson, I. A., Underwood, K. L., Dewoolkar, M. M., Deschaine, L. M., & Rizzo, D. M. (2016). Heuristic assessment of bridge scour sensitivity using differential evolution: case study for linking floodplain encroachment and bridge scour. *Environmental Systems Research*, *5*(1), 1–12.

Akimana, R. M., Bista, H., Seo, Y., Li, L., **Howard, L. J.**, Dewoolkar, M. M., & Hu, L.-B. (2016). Multi-scale experimental and numerical study of microbially-induced calcite precipitation in sandy soils: preliminary evidence and observations. In *Geo-China 2016* (pp. 77–84).

Akimana, R. M., Seo, Y., Li, L., **Howard, L. J.**, Dewoolkar, M. M., & Hu, L. B. (2016). Exploring X-ray computed tomography characterization and reactive transport modelling of microbially-induced calcite precipitation in sandy soils. In *Geo-Chicago 2016* (pp. 62–71).

Conference Papers

Howard, L., Ross, J., Jarrett, M., and Amos, M. (2020). *Uncertainty quantification and calibration of a large subsurface flow and transport model using the ensemble Kalman filter*. Waste Management Symposium, Phoenix, AZ. March 10-14.

Presentations and Posters

** Invited talk*

December 8, 2023. *Machine Learning Radiative Transfer Emulation for Satellite Data Assimilation.* Poster. Earth System Science Poster Conference, Boulder, CO.

December 9, 2022. *A Machine Learning Augmented Data Assimilation Method*. Poster. Earth System Science Poster Conference, Boulder, CO.

June 8, 2022. *Augmenting the EnKF with a Shallow Convolutional Neural Network*. Poster. International Symposium on Data Assimilation, Fort Collins, CO.

March 13, 2020. *Uncertainty Quantification and Calibration of a Large Subsurface Flow and Transport model using the Ensemble Kalman Filter*. Waste Management Symposium, Phoenix, AZ.

February 28, 2020. *Uncertainty Quantification and Calibration of a Large Subsurface Flow and Transport model using the Ensemble Kalman Filter*. Internal company presentation.

May 16, 2018. *Introduction to QGIS*. Internal company presentation.

*June 19, 2014. *A Finite Difference Method for Modeling Water Waves*. Internal company presentation.

Teaching Experience

Spring 2022	**ATOC 1070: Weather and Atmosphere Laboratory** TA/Section Leader	*University of Colorado, Boulder*
Summer 2015	**Applied Statistics for Surface Water Hydrology,** Co-taught with Professor Donna Rizzo	*University of Vermont*

Funding

2016 **Hydrogeologic Research and Development Fund,** University of Vermont *$ 13,000*

Service

University of Colorado, Boulder, Department of Atmospheric and Oceanic Science

2023/2024 **Awards Committee,** Member
2023/2024 **JEDI Committee,** Member
2023/2024 **Space Committee,** Graduate Student Lead
2022/2023 **Student Concerns Committee,** Graduate Student Lead
2022/2023 **Prospective Student Visit Committee,** Member
2022/2023 **Curriculum Committee,** Member
2022/2023 **Space Committee,** Member
2022/2023 **ATOC Colloquium Committee,** Member
2022/2023 **REU Planning Committee,** Member
2021/2022 **Student Concerns Committee,** Member
Fall, 2021 **Graduate Application Mentor Program,** Volunteer Application Mentor

Skills

Computer Languages: Python (NumPy, Scipy, Xarray, Pandas, Keras, TensorFlow, Pytorch, PyMC), MATLab, Octave, Mathematica, VisualBasic

Software: ArcGIS, QGIS, Git, Visual Studio, HEC-RAS, MODFLOW, Groundwater Vistas

Training: 20-hour project management training, 3-day HEC-RAS, 3-day X-Ray tomography scanner operations and analysis