

# J. KEVIN PIERCE, PH.D.

Postdoctoral Research Fellow  
Department of Geography  
The University of British Columbia  
1984 West Mall  
Vancouver, BC, Canada V6T 1Z4

<https://jkpierce.github.io/>  
<https://geog.ubc.ca/profile/kevin-pierce/>  
<https://github.com/jkpierce>  
kevpierc@mail.ubc.ca

## PERSONAL SUMMARY

---

I am an environmental scientist with interdisciplinary training in geomorphology, hydrology, and physics. I have produced a variety of original research into geophysical transport phenomena, including river turbulence, granular flows, and sediment transport. My work involves both experiments and modeling, and it relies on techniques from many disciplines, including fluid dynamics, statistical mechanics, dynamical systems, image analysis, and computer vision. My ambition is to refine my interdisciplinary approach by contributing to an increasingly wider range of research topics that cross between geoscience and physics.

## EDUCATION

---

**Ph.D. Geography**, The University of British Columbia (2021)

Specializations: Geomorphology and Hydrology

Dissertation: "The stochastic movements of individual streambed grains" ([link](#)).

Supervisor: Marwan Hassan

**M.Sc. Physics**, The University of British Columbia (2016)

Specialization: Condensed Matter Theory

Thesis: "Magnetic structure of chiral graphene nanoribbons" ([link](#)).

Supervisor: Ian Affleck

**B.S. Physics**, West Virginia University (2013)

Awards: Summa Cum Laude, "Outstanding Physics Senior"

Thesis: "A quantum field theory primer"

Minor: Mathematics (Analysis, Topology, Algebra)

## PUBLICATIONS

---

### Submitted

1. **Pierce, K.** (2022). An advection-diffusion process with proportional resetting. [Submitted] *Physical Review E*, (preprint).
2. **Pierce, K.**, Hassan, M.A., & R.M.L. Ferreira (2022). Mechanistic description of the bed load sediment flux. [In Revision] *Earth Surface Dynamics*, (preprint).

### Published

3. **Pierce, K.** & M.A. Hassan (2020). Back to Einstein: Burial-induced three-range diffusion in fluvial sediment transport. *Geophysical Research Letters*, 47 (15), 1-10, doi: 10.1029/2020GL087440, (paper).
4. **Pierce, K.** & M.A. Hassan (2020). Joint stochastic bedload transport and bed elevation model: Variance regulation and power-law rests. *Journal of Geophysical Research: Earth Surface*, 125 (4), 1–15. doi: 10.1029/2019JF005259, (paper).
5. Rowley J.D., **Pierce K.**, Brant A.T., Halliburton L.E., Giles N.C., Schunemann P.G., & A.D. Bristow (2012). Broadband terahertz pulse emission from ZnGeP<sub>2</sub>. *Optics Letters*, 37 (5), 788-790. doi: 10.1364/OL.37.000788, (paper).

## RESEARCH EXPERIENCE

---

**Postdoctoral Research Fellow**, The University of British Columbia (Sep. 2021 – )

- Constructed laboratory flume experiments and mathematical models to understand fundamental linkages between flow turbulence, granular collisions, and sediment transport at the grain scale. This work builds understanding of the fluid and granular physics underlying river stability and natural disaster risk.
- Analyzed grain movements and fluid interfaces in 3D using computer vision techniques in Python, Matlab, and C++, including camera calibration, contrast equalization, perspective transformation, background subtraction, feature detection, object tracking, image matching, and contour finding.
- Resolved flow velocity fields using acoustic Doppler and particle tracking velocimetry. Determined flow depths with acoustic sensors. Despiked data. Calculated mean velocities, turbulent intensities, fluctuation spectra, and Reynolds stress profiles. Identified and classified coherent turbulent structures.

- Contributed original data analysis routines in Python, Labview, Matlab, Bash, and C++ to a lab code repository: routines clean and organize data, submit jobs to computing resources, acquire image sequences, automate linear stages, reconstruct 3D topography, measure flow velocities, and quantify sediment fluxes.
- Presented findings at one conference and two invited talks. Submitted one manuscript to a leading physics journal, and several manuscripts are in preparation. Experimental results will be presented at two leading geophysics conferences this year.
- Secured funding for laboratory experiments by co-authoring the proposal, co-designing the proposed experimental facility, and assembling one third of the itemized budget for an \$187,488 CAD grant.

**Doctoral Research**, Mountain Channel Hydraulic Experimental Lab (2016 – 2021)

- Established new quantitative descriptions for the fluid-driven transport of coarse sediment The University of British Columbia. This work fuses statistical mechanics, granular physics, and fluid dynamics knowledge to provide fundamental understanding of sediment transport phenomena in river channels.
- Produced generalized random walk models of grain-scale dynamics using stochastic processes with multiple noise sources acting simultaneously. Upscaled from this grain scale to produce continuum-scale descriptions of sediment transport based on the underlying mechanics.
- Presented research findings in two talks and two posters at the top geoscience conferences in North America and Europe, one invited talk, the Ph.D. dissertation, and numerous departmental presentations.
- Published two articles in leading geophysics journals: Geophysical Research Letters and Journal of Geophysical Research: Earth Surface. Another manuscript is currently in revision. Two manuscripts are in preparation, including an invited article for a special collection in Frontiers in Earth Science.

**Master Research**, Advanced Materials and Process Engineering Lab (2014 – 2016)

- Theoretically investigated localized edge magnetism on graphene ribbons in Ian Affleck's group at The University of British Columbia. Such localized magnetism could support information storage in future quantum devices.
- Established an expectation for edge ferromagnetism on carbon ribbons with perfect edges, using analytical solutions of the Schrodinger equation in a tight-binding approximation.
- Extended the analytical results using numerical calculations performed in Mathematica and Python, showing that graphene ribbons with imperfect edges will also support edge magnetism.

- Presented research findings in two conference presentations and a master thesis. The theoretical conclusions in the work have since been experimentally confirmed.

**Undergraduate Research, The Ultrafast Nanophotonics Lab** (2011 – 2012)

- Conducted original research into non-linear optics and laser spectroscopy in the lab of Alan Bristow at WVU. Examined (1) relaxation dynamics of excited charge carriers in semiconductors, and (2) non-linear production of high-frequency (THz) light.
- Developed optical experiments, aligned laser optics, and fabricated a lock-in amplifier from scratch, starting from circuit diagrams and components. Automated measurement routines that coordinated linear actuator movements, photo acquisition, and laser triggering events using Labview.
- Secured a competitive \$5000 USD National Science Foundation Award for summer laboratory work. Produced original experimental setups which were later used by graduate students in the lab to study photovoltaics for improved power generation.
- Co-authored a paper in Optics Letters reporting efficient optical rectification in a particular Zinc-Germanium-Phosphide crystal.

## PRESENTATIONS

---

### Invited Talks

1. **Pierce, K.**, Hassan, M.A., & R.M.L. Ferreira (2022). A statistical mechanics description of rarefied sediment transport. University of Pennsylvania, Department of Earth and Environmental Sciences.
2. **Pierce, K.**, Moragoda, N., & L. Roberge (2021). Including wildfires in a landscape evolution model. Community Surface Dynamics Modeling System, Fall Webinar Series.
3. **Pierce, K.** & M.A. Hassan (2021). Velocity distributions, particle activities, and the sediment flux. Vanderbilt University, Department of Earth and Environmental Sciences.
4. **Pierce, K.** & M.A. Hassan (2020). Collisional Langevin approach to bed load sediment transport. Simon Fraser University, School of Environmental Science & Geography.

## Conference Talks

5. **Pierce, K.** & M.A. Hassan (2021). Mechanistic-stochastic description of the bed-load sediment flux, AGU General Assembly Conference Abstracts, EP43A-02.
6. **Pierce, K.** (2021). Climate disasters and uncertain futures: Quantifying change in the environmental sciences, UBC Postdoctoral Research Day.
7. **Pierce, K.** & M.A. Hassan (2020). Collisional Langevin approach to bed load sediment velocity distributions, EGU General Assembly Conference Abstracts, EGU21-8148.
8. **Pierce, K.** & M.A. Hassan (2019). Back to Einstein: How to include trapping processes in fluvial diffusion models?, AGU Fall Meeting Abstracts, EP51B-02.

## Conference Posters

9. **Pierce, K.** & M.A. Hassan (2020). Particle shape dictates critical shear stresses for sediment motion, AGU Fall Meeting Abstracts, EP013-0007.
10. Ferreira, R.M.L., Aleixo, R.F., Ricardo, A.M., **Pierce, K.**, & M.A. Hassan (2020) Turbulence in open-channel flows over mobile beds of high hydraulic conductivity, AGU Fall Meeting Abstracts, EP003-0002.
11. **Pierce, K.**, Ferreira, R.M.L., & M.A. Hassan (2019). Three-dimensional resolution of bedload transport with binocular computer vision, AGU Fall Meeting Abstracts, EP51F-2185.
12. **Pierce, K.** & I. Affleck (2015). Edge magnetism of chiral graphene nanoribbons, CIFAR Conference in Quantum Materials.
13. **Pierce, K.** & I. Affleck (2015). A rigorous proof of edge magnetism in graphene ribbons, Workshop on Frontiers of Condensed Matter Physics.
14. **Pierce, K.** & A. Bristow (2011). Hot-carrier dynamics in GaAs, WVNano Summer Undergraduate Research Symposium.

## GRANTS AND AWARDS

---

### Grants

1. **John R. Evans Leader Fund, Canada Foundation for Innovation** (2021 – ) Secured funding for a new laboratory facility in the Mountain Channel Experimental Laboratory. Co-authored the research proposal, designed one component (among three) of the proposed facility, and prepared the itemized budget for that component (37% of the total budget). My Ph.D. work on grain-scale

sediment transport provided preliminary data and design guidelines for the proposed facility. This grant funds my ongoing postdoctoral work.

- Project: Fluvial Landscapes Platform (LegoFlume), JERF 41979
- Principal Investigator: Marwan Hassan
- Role: Co-author
- Amount: \$187,488 CAD including matching funds

#### Funded Awards

2. **Earth Surface Processes Summer Institute Travel Fund** (2021)  
Competitive National Science Foundation award for travel to a Boulder, Colorado summer school in computational Earth Science. Amount: \$800 USD.
3. **Outstanding Geography Teaching Assistant** (2020)  
Provided to two teaching assistants annually in recognition of "significant contributions to undergraduate education". Amount: \$500 CAD.
4. **Outstanding Physics Senior** (2013)  
Provided to an "outstanding undergraduate majoring in physics who will graduate this year" upon faculty nomination. Amount: \$500 USD.
5. **WV Nano Summer Undergraduate Research Experience** (2012)  
Competitive National Science Foundation award for undergraduate research in quantum materials. Amount: \$5000 USD.
6. **Edmund and Rose Rotter Endowed Scholarship** (2012)  
Provided to one undergraduate annually on the basis of "exceptional academic performance as determined by the Faculty of Science". Amount: \$1500 USD.

#### TEACHING EXPERIENCE

---

**Research Mentor, The University of British Columbia** (2020 – )

- Supervised research activities of three students: (a) one undergraduate in Summer 2019, (b) one master student in Fall 2021, and (c) one PhD student from Fall 2021 to now.
- Directed laboratory work and statistical analysis tasks which culminated in respectively (a) a poster presentation of laboratory experiments, (b) a course project on field data, and (c) preliminary data for a fluid dynamics publication.

**Course Content Developer, UBC Geography Department**

(2020-2021)

- Produced a 45 minute educational film on geoscience topics for a 4th year undergraduate Earth Science course, in collaboration with a professor and audio visual technician.
- Developed six laboratory assignments and a virtual field trip for a first year undergraduate geoscience course involving mass wasting, volcanic processes, river morphology, climate change, and glacial processes.
- Delivered video explanations of ecology and climate ideas to a virtual field trip phone application for a first year course. This work was supported by grant funding to incorporate emerging technologies into Earth Science education.
- Contributed five laboratory assignments for students in a third year "Statistics in Geography" course involving collaborative R programming, version control, cloud computing, bash scripting, and inferential statistics methods.

**Geography Teaching Assistant, The University of British Columbia** (2016 – 2021)

- Developed assignments, evaluated student work, hosted exams, conducted laboratory tutorials, performed classroom demonstrations, led paper discussions, hosted office hours, delivered guest lectures, and led field trips.
- Mentored nearly 120 students on group projects for undergraduate and graduate geoscience courses. Guided topic selection, suggested research methods, moderated conflicts, evaluated presentations, and monitored project completion.
- Planned and delivered the lab component of a 16 week graduate course on Fluvial Geomorphology with 25 students. Presented lectures, designed original laboratory assignments, guided paper discussions, and evaluated student performance.
- Evaluated student grades on assignments, exams, and projects for 20 courses spanning all ranks of undergraduate and graduate study, totaling more than 3600 hours of contracted work.
- Completed professional development courses including information security, inclusive teaching, classroom climate, lesson planning, time management, and workplace violence prevention.
- Received the UBC Geography "Outstanding TA" award in 2020 in recognition of "significant contributions to undergraduate education" in the UBC Geography department.

**Academic Coach, UBC Varsity Athletics**

(2015 – 2017)

- Advised at-risk student athletes on problem solving, academic goal setting, and effective communication strategies for six hours each week during semesters. Improved student outcomes with one-on-one and group lessons on calculus, chemistry, physics, and statistics.

**Physics Teaching Assistant**, The University of British Columbia (2014 – 2015)

- Evaluated student work, hosted office hours, provided guest lectures, and administered exams in Classical Mechanics, Electromagnetism, Statistical Physics, and Quantum Mechanics courses spanning all undergraduate levels.

**Physics Teaching Assistant**, West Virginia University (2012 – 2013)

- Evaluated and provided feedback on student work for undergraduate Mathematical Physics and Quantum Mechanics courses as a 4th year undergraduate.

## WORKSHOPS ATTENDED

---

**Earth Surface Processes Institute**, The University of Colorado, Boulder (2021)

- Attended an eight day workshop on Earth surface dynamics modeling, including numerical methods, programming practices, open source software development, collaborative coding, version control, and high performance computing.
- Developed a new computational landscape evolution model which evaluates impacts of wildfires on channel organization and sediment yields at a watershed scale in collaboration with two others.
- Contributed a Landlab-based “Education and Knowledge Transfer” lab, now hosted publicly on the Community Surface Dynamics Modeling System website ([link](#)) as an educational resource for the modeling community.
- Presented the output of a collaborative project initiated at the workshop to the “CSDMS Fall Webinar” series ([link](#)).

**Instructional Skills Workshop**, The University of British Columbia (2020)

- Participated in a week long workshop on teaching models, strategies to foster active learning, inclusive teaching practices, interactive lesson planning, and emerging technologies in education.
- Delivered three lessons to a group of peers. Peer reviews highlighted personal teaching patterns, accentuated unique strengths, and set actionable tasks to become a maximally effective educator.

**Frontiers of Condensed Matter Physics**, The University of British Columbia (2015)

- Attended a two week workshop on condensed matter physics on forefront research on topological materials, superconductivity, strange metals, and frustrated magnetism.



- Collaborated on condensed matter physics problem sets, participated in discussions around open research problems, and presented original research findings on two-dimensional magnetism.

## ACADEMIC SERVICE

---

### Professional Activity

- **Manuscript Reviewing:** Geophysical Research Letters, Earth Surface Dynamics, Journal of Geophysical Research: Earth Surface, Water Resources Research, Advances in Water Resources.
- **Award Judging:** Outstanding Student Presentation Awards, American Geophysical Union Annual Meeting (2022).
- **Conference Chairing:** Session Chair, American Geophysical Union Annual Meeting (2022 – ).
- **Seminar Organizing:** American Geophysical Union “Earth & Planetary Surface Processes Connects” seminar series (link) on a monthly basis (2021 – ).

### Institutional Activity

- **Workshop Presenting:** Produced workshops for department graduate students on scientific figure production in Inkscape and Matplotlib and manuscript preparation with L<sup>A</sup>T<sub>E</sub>X (2022).
- **Event Organizing:** Scheduled monthly department events over several years, including luncheons, “Earth-Surf Beers”, and skill-share meetings (2020 – ).
- **Seminar Organizing:** Coordinated weekly research group seminars for two years: invited monthly visiting speakers, coordinated scheduling, purchased catering, introduced speakers, led question and answer sessions, designed fliers, and sent announcements. Further established annual joint seminars between The University of British Columbia and Simon Fraser University (2019 – 2021).

## COMMUNITY OUTREACH

---

### Peer Support Volunteer, Eastside Works Tech Cafe (2022 – )

- Encouraged technology literacy in a community-led program in Vancouver’s underserved Downtown Eastside. Educated community members in life skills involving computers: job searching, resume writing, online banking, and vaccine record locating.

**Volunteer Judge**, Vancouver Regional Science Fair (2021 – 2022)

- Encouraged middle and high school science participation by evaluating and providing feedback on annual science fair presentations.

**Tutorial Leader**, Science 101 (2021 – 2022)

- Introduced adults from traditionally-excluded communities to academic coursework in a university outreach program. Led discussions and advised writing. Delivered lectures on topics ranging from tectonics to plant taxonomy.

**Program Volunteer**, Books for Me! (2016 – 2018)

- Encouraged childhood literacy at a non-profit serving at-risk children in Vancouver's downtown Eastside. Coordinated donations, hosted weekly "take-a-book" events, and guided children in selecting books at Vancouver elementary schools.

## REFERENCES

---

**Marwan A. Hassan, Ph.D.**, The University of British Columbia

Position: Professor of Geomorphology

Relationship: Ph.D. Supervisor

Email: marwan.hassan@geog.ubc.ca

Phone: 604-822-5894

**David J. Furbish, Ph.D.**, Vanderbilt University

Position: Professor of Civil and Environmental Engineering; Professor of Earth and Environmental Sciences

Relationship: Mentor

Email: david.j.furbish@vanderbilt.edu

Phone: 615-322-2137

**Michael Church, FRSC, D.Sc.**, The University of British Columbia

Position: Professor Emeritus of Geomorphology

Relationship: Educator, Ph.D. Examiner

Email: michael.church@geog.ubc.ca

Phone: 604-822-3537