PAUL NESBIT
Starkey-Robinson Award for Graduate Research on Canada

Dr. Paul R. Nesbit's doctoral thesis outlines new insight in the application of small aerial drones (or UAVs) for deciphering the history of complex landscapes. This body of work furthers the understanding of emerging geospatial techniques growing out of a need to advance knowledge and documentation of important Canadian landscapes. Key contributions include essential guidance on data collection, analysis techniques, data sharing, and re-evaluation of datasets collected by conventional field techniques. The impact of his scholarly contributions is partly illustrated by publication of all four dissertation chapters in internationally recognized peer-reviewed journals, open access to data and tools, and a growing citation record (Google Scholar: 135 citations), signaling rapid uptake in the scientific community.

The thesis is grounded in gaining a more acute understanding of the complex history of Earth surface processes and landscape development in a fluvial-dominated system uncovered in the modern badland landscape at Dinosaur Provincial Park in Alberta. Documentation of this site required a novel approach using UAV- photogrammetry and 3D analysis methods that afford new observations and measurements from areas that were difficult (or impossible) to document with conventional methods. These contributions enabled collaborative research extending the legacy research of Dr. Derald G. Smith (Massey Medal recipient) in understanding morphodynamics and development of modern and ancient river systems within present day Canada.

A unique extension from this work includes the digital preservation of geologically significant sites that can be used for teaching landscape history and Earth surface processes in a digital era. The final chapter of his thesis presents a truly innovative virtual field experience of a section of Dinosaur Provincial Park, a UNESCO World Heritage site, which is shared with the geoscience community as an open educational resource. Dr. Nesbit has developed workflows to create digital twins of landscapes from 3D drone data coupled with readily accessible visualization tools. Although similar approaches have recently been employed to improve research applications, Dr. Nesbit was one of the first to extend and demonstrate the potential value in using these digital twins to enhance geographic and geoscience education. This is a cornerstone enabler of virtual field experiences for students and the public at large and opens new learning opportunities to supplement existing field-based strategies. This became increasingly apparent with the onset of the COVID-19 pandemic as field- based courses were canceled across Canada and worldwide and geoscience educators sought alternative modes of teaching. In my view, Dr. Nesbit's PhD thesis is exceptional because it has potential to significantly influence research and teaching in Physical Geography and allied disciplines.

It is worth noting that Dr. Nesbit made other significant research contributions during his PhD. His 2017 article reviewing drone incidents in Canada resulted in national and international media attention and raised awareness of the potential danger drones pose to piloted aircraft.

Overall, Dr. Nesbit's doctoral contributions are impressive and significant in providing new insight into enigmatic Canadian landscapes and creating new digital tools for mobilizing knowledge to a wider audience.

Thesis Abstract

Outcrops are a primary source of geologic information and key in developing knowledge for teaching, training, and research. Observations from outcrop exposures provide opportunities to directly characterize detailed sedimentological composition, architectural characteristics, and link observations across various scales. Conventional field mapping techniques have remained largely unchanged for the past two centuries and are commonly limited in their ability to quantitatively constrain measurements, extend observations laterally, and document features at multiple scales. Recently, technological advances in uninhabited/unmanned aerial vehicles (UAVs) have prompted wide use in various geoscience disciplines to supplement field data with quantifiable digital information. However, application of UAVs to geologic mapping has been limited, due to unique challenges in data collection, processing, analysis, and visualization predominantly associated with intricate 3D exposures in complex topographic terrain. This dissertation is focused on detailed investigation of 3D mapping, analysis, and dissemination from UAV-derived digital outcrop models (DOMs) that can potentially provide multi-scale perspectives and quantitative measurements that were previously difficult, or impossible to achieve with conventional field methods alone.