CUTTING-EDGE SCIENCE FOR THE REAL WORLD[1]

Environmental Science at Saint Mary's University

SAINT MARY'S UNIVERSITY SINCE 1802

ENVIRONMENTAL SCIENCE

FACULTY OF SCIENCE

Three questions that make sense…

There are probably many questions you have been asking yourself when looking for the field to fit your aspirations. The following might be among them:

1. What kind of future will this degree make available to me?

After all, my future career is one of the main reasons why I want to pursue these studies.

2. What background will this degree provide for me? What skills will it help me to develop?

I don't want to end up in a narrow niche! I would like the acquired knowledge and skills to open many doors for me. I want to be able to move on – successfully – if I don't like my position or my work. I want to have a good shot at other positions if the job market changes over time. It is no secret that change occurs fast nowadays.

3. *What would it be like to work towards such a degree?*

Regardless of how brilliant the future prospects might be, if I hate my studies, I might just not choose them! I want my studies to be – well, fun would be nice! – but they should definitely be interesting, even exciting. This is my youth we are talking about, right?

Here some of the answers to these questions.

They are not just about environmental science in general, but quite specifically about the Environmental Science degree you can get from Saint Mary's University in Halifax, Canada.

…and their answers:

1. *What kind of future will this degree make available to me?*

If there are things that make one feel hopeful in these often difficult times, the job market in environmental science is one of them. This field is not just taking off and developing fast: it *already* offers plenty of job opportunities. Don't take our word for it. Go to job search websites, type "environmental science", and see how many jobs come up. Look at the requirements. Then compare them with what you get from our degree in Environmental Science. You can repeat this exercise every time you wish to feel good!

Let's face it: regardless of the changes that may take place in the future, of the way in which society will look like, people will need energy; they will need a variety of materials to use in their everyday life; they will want to breathe clean air,

CAREER OPTIONS

With an environmental science degree, you can expect a diverse range of career opportunities to open up, with the government, industry, NGOs etc., in fields such as:

- **Environmental monitoring**
- **Environmental risk assessment**
- **Sustainable development**
- **Pollution prevention and control**
- **Water quality assessment and testing**
- **Waste management and recycling**
- **Environmental management**
- **Consulting**
- **Education**
- **Forestry**
- **Health and safety**
- **Parks and natural reserves**
- **Research and development**
- **Restoration and reclamation**
- **Environmental education**
- **… and many more.**

drink clean water, and eat healthy food. One way or another, one can expect the environment to be "cool". An Environmental Science degree at Saint Mary's University (let us use "SMU" from now on to refer to our university) opens up a wide range of career options for you: many immediate professional positions with solid perspectives of growth, paths leading to positions in education, and opportunities to pursue advanced studies at the Masters or the Ph.D. level.

By completing a Bachelor of Science in Environmental Science at SMU you can become an expert in a large number of areas of specialization – areas that are sought after and recognized as increasingly important. The cutting-edge methods taught here and the **powerful software** you use in this program equip you with tools that will help you to thrive in a variety of professional positions – as well as to have a jump start in graduate programs. Moreover, if you pursue the degree at SMU, you receive the additional benefit of getting **valuable interdisciplinary experience**.

In fact, it has become clear that tough challenges – such as many of those we are facing nowadays – cannot be effectively addressed by separate disciplines anymore. There is a growing need for a different approach, an interdisciplinary approach. It comes as no surprise that challenges related to the environment are among those complex ones that require "interdisciplinary handling". However, while the merits of interdisciplinarity are indeed widely recognized and valued, from industry to government and academia, too few students are prepared today for such an approach. Here at SMU, the environmental science education is taught in an interdisciplinary framework from the very beginning. Students assimilate not just the **theoretical basis**, but also the **practical training** that makes them successfully think, work, and communicate in an interdisciplinary environment. Our professors are **interdisciplinary experts** with a long experience in interdisciplinary education. You can thus be among the not-so-many graduates able to provide brilliantly convincing answers to employers' questions about your interdisciplinary skills. And this might make a big difference, **setting you apart** from the other applicants.

Whether you delve into green chemistry, ecotoxicology, or ecosystem-based management, whether you focus on salt marsh restoration or on forest fire management, whether you want to capture the natural variability in wind patterns or to study the atmospheric transport of aerosols, you get friendly, step-by-step access to advanced and effective concepts and methods.

2. *What background will this degree provide for me, and what skills will it help me to develop*?

Here is the short answer: a background that is science-based, applied to the real world, interdisciplinary, up-to-date, and future-oriented. Quite importantly, a high degree of flexibility is built into the program: this means that while you cover the foundations of environmental science, you have a say in the way you configure your degree, to follow your chosen path in the program, to discover and pursue your passion.

How are these objectives accomplished in practice? First, the background you get in Environmental Science from SMU starts with core sciences – mathematics / computing science, physics, chemistry, biology – and continues with the fundamentals of environmental science to address ecosystems, energy, pollution, etc. Very soon – already in your second year – you can start making your own choices concerning the environmental science stream you would like to pursue. To start with, you can choose between a broader and a more specialized approach to environmental science. Examples of available specialized streams include ecotoxicology, green chemistry, atmospheric environmental processes, energy and natural resources, environmental system analysis and modeling, etc. The wide choice of courses in environmental science and other fields embedded in our program supports the flexibility of your degree. You can thus follow one of the pre-designed streams, or build your own – possibly unique – stream, combining the skills and tools you thought you could only dream of acquiring. For instance, you can focus on energy resources and add a stronger emphasis on economics, which would provide you with an excellent and not-so-common background for positions to tackle our energy-hungry future. There are so many exciting combinations you can choose from for your degree.

You are probably asking yourself now how you can make the proper course selection and optimally build the degree of your choice, when so many options are available. Good question. The answer is that you are not alone: you get continuous support from environmental science professors. In fact, as soon as you declare your major in Environmental Science, you get an advisor – a professor from our department. You can thus regularly receive advice on how to select your courses and check how your path is evolving; you explore options to find the best path for you; you can also decide if you want to make adjustments to your stream – to best match your evolving interests and your understanding of the field.

You will also want to hear in what way the science taught here is “future-oriented”. Well, we all know how fast scientific knowledge is developing. Breathtaking progress can be seen in the news every year, every month, almost every day. And yet, the foundations usually taught in university mostly refer to discoveries made many decades – even centuries – ago… This is all good and necessary, but we have to move further! In environmental science courses at SMU we teach about exciting topics using advanced principles and methods; students study and apply in practice approaches published recently in specialty academic journals.

Whether you delve in green chemistry, ecotoxicology, or ecosystem-based management, whether you focus on salt marsh restoration or on forest fire management, whether you want to capture the natural variability in wind patterns or to study the atmospheric transport of aerosols, you get friendly, step-by-step access to advanced and effective concepts and methods. All these, together with the scientific software and instruments you apply in this program, contribute to your preparation for an accomplishing career, for a continuous and effective learning of novel concepts and techniques, and, in the end, for a successful approach to the challenges of tomorrow.

One of the key values of education you receive in Environmental Science at SMU consists of effective training in interdisciplinarity. You learn hands-on how to successfully communicate and collaborate across disciplinary boundaries. How to make use of the power of interdisciplinary thinking. How to push the boundaries of creative thinking in an interdisciplinary context to find solutions to real-world problems. In other words, you learn not only how to strive in an interdisciplinary environment, but also how to boost your success – both as an individual and as a team member. You probably know already that these are skills considered priceless by employers.

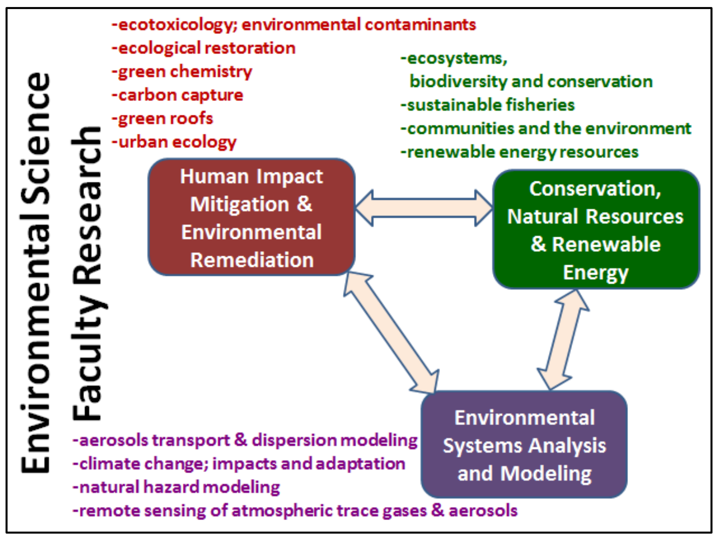
To make a long story short, the background and skills you acquire while studying Environmental Science at SMU make you a strong candidate for a very large spectrum of jobs, even far beyond the science of the environment. They offer you the confidence and career flexibility everybody would like to have in the current, fast changing social and economic context. Knowing that you would be valued in many places, that you can actually change not just employers but also job profiles, makes you see the world through different eyes. This way, the job market becomes less stressful and much more promising for you.

3) *What would it be like to work towards such a degree?*

To begin with, it is not just cutting-edge theory you should expect here: almost all environmental science courses have hands-on components. You learn how to manipulate a wide range of scientific instruments, how to professionally prepare and assess an experimental setup, how to acquire, handle and interpret the data.

These are not only a lot of fun: they expose you to many other real-world issues and ways of addressing them, so you can learn quickly and effectively, and enjoy every moment while doing it. In fact, "experiential learning" – which is extensively used in our program – was proven to provide some of the best results and most satisfaction among the advanced education methods applied worldwide.

What about class size? As you certainly know, class size may be crucial for the way you access information in class, for the quality of your interaction with the professor, and, in the end, for what you get from each course. A small class provides the ideal context for you to fully benefit from experiential learning techniques. Everybody agrees with that. But how small is "small"? Even a quick comparison can make you see that when we call our classes "small", we mean something different from what they mean at other places: the maximum student number in most courses is twenty-five… and in many cases classes are even smaller than that. You can thus benefit from the individual attention and the collaborative climate that support an ideal learning environment.



Most importantly though, our professors make all the difference. While they are world-class researchers, leading high-calibre projects and having outstanding publication records, they are dedicated teachers. They cover a wide range of areas of expertise in different disciplines – biology, chemistry, physics, geography, earth sciences, management, etc. Their research addresses key environmental challenges, such as carbon capture, green roofs, environmental contamination and remediation, atmospheric pollution, climate change, natural hazards, or natural resource management. They not only make classes exciting (you can tell right away if the professor in front of you really cares, right?), but also find the best ways of guiding you in the "space of learning". And they have time for you: you can sit down with them outside of class and go over the taught material, lab experiments, projects, or even explore topics beyond class boundaries – for instance, to start contributing to your professor's research. In fact, research that may lead to conference papers or publications can also be performed as part of your courses, not just outside of class.

Moreover, you can become a Research Assistant and perform professional, exciting research work – while being paid for it. While at many other universities Teaching Assistants must be graduate students (often Ph.D. students), here at SMU you can be a Teaching Assistant early on, and get valuable experience you can build upon later if you wish to pursue an academic career. On a practical note, having worked one-on-one in your courses with your professors and being well-known to them, you can expect to get effective and strong recommendation letters when you apply for a job or for graduate studies. The bottom line is that our students find courses great – interesting, challenging, and often fun.

Examples of areas you can explore in more depth in Environmental Science at SMU

Atmospheric Science and Environmental Physics

Environmental Science at SMU includes Atmospheric Science and Environmental Physics, represented by the Tropospheric Remote Sensing Laboratory (TRSL) and a range of undergraduate courses. On the research side of things, the TRSL investigates air pollution in the "planetary boundary layer" – the air that we breathe! State-of-the-art remote sensing equipment yields high-quality data sets of atmospheric trace gas composition, which are used to test air quality forecast predictions. Comparing field observations to model predictions tests how well we understand atmospheric processes represented in models, and ultimately influences important government tools like the Air Quality Health Index produced daily by Environment Canada.

In order to interpret air pollution measurements, researchers must use a multidisciplinary approach, which involves understanding the physics of the instruments that they are using, the chemistry of trace gases in the atmosphere, and the dynamics of atmospheric transport of air pollutants. What is important on a particular day with high carbon monoxide readings? Is it local urban emission sources trapped by a favourable weather system, a boreal forest fire thousands of kilometers away, or transport of industrial pollution from southern Ontario? All of these can be important to the quality of the air that you breathe, and only multidisciplinary approaches allow us to fully understand what is going on. At SMU you have the opportunity to participate in this exciting research as an undergrad or a graduate student researcher. Many opportunities exist for undergraduates to get involved, including a directed study course, paid summer research, fourth year honours thesis research, or a Co-op Program work term.

On the course side of things, you get to sharpen your quantitative analysis skills in ENVS 1250 (Physical Processes in the Environment), which introduces physics concepts and methods carefully selected as most relevant for Environmental Science students. ENVS 2310 (Energy, Resources and Pollution) introduces air pollution, climate change, and stratospheric ozone loss, among other topics, and quantitatively examines the environmental effects of human activities. We strive to give you the tools to quantitatively answer thorny questions like, would it help the environment if everyone unplugged their phone charger when not in use? Next, ENVS 3630 (Climate Change) takes a quantitative look at both the evidence and the uncertainty in climate change science. Building on the background established in the first two years of the program, we move from what is often an alarmist understanding of climate change as portrayed in mass media to one that is firmly rooted in the most up-to-date scientific knowledge. Finally, a third year foundational course in the Atmospheric Environment is being developed, which will include a strong laboratory and field component to help you understand both natural and human-influenced atmospheric processes, as well as remote sensing and in situ atmospheric observational techniques.

Green Chemistry

Environmental Science at Saint Mary's University is a broad arena that aims to incorporate many of the traditional, modern, and emerging sciences. One of the fields being focused on is green chemistry, and it features prominently in our research programs, under the broad leadership of the Atlantic Center for Green Chemistry. Furthermore, it is a foundation of our undergraduate teaching and courses. This focus makes us unique within the Canadian context and resonates with the University's commitment to be proactive in areas of environmental research.

The role of chemistry in modern society requires careful thought to fully comprehend. Many of the materials, pharmaceuticals, energy sources, and personal computing devices we rely on daily depend upon advanced chemical design, production, and processing. Several decades ago it became clear our future would be one where chemistry would provide the solution to many of our needs. Concomitantly, the chemical industry grew rapidly and it now employs over 800,000 workers in the United States alone.

Chemical manufacturing provides many of the materials upon which we now depend, including pharmaceuticals, fuels, agricultural chemicals such as pesticides and fertilizers, as well as synthetic materials such as plastics and fabrics. Production, use, and end of life disposal of these materials often results in harm, both environmental and to human health. As we learn more about the effect of these materials on our environment, we must appreciate that scientists and engineers are trying to respond, in order to minimize their detrimental impact. Green chemistry encompasses these broad responses and will help us proceed to a more secure future.

One of the main goals of green chemistry is to eliminate pollution by preventing it from occurring in the first place. In other words, the chemistry we use to make the materials that we want and need should be *benign by design*. With the focus on safety, both in the laboratory and as products and materials are used, students are made aware of the "cradle to grave" concept of green chemistry. They learn to consider all of the processes that are involved in the synthesis of a single product, from the production of raw materials to the final disposal of the chemicals after its useful life. Students taking green chemistry enjoy an enhanced perspective since they begin to appreciate, at a fundamental level, the changes that need to be made for a greener future. These principles can be divided into two broad groups, "minimizing the environmental footprint" and "reducing risk in the lab". They include:

--*Minimizing the Environmental Footprint*
1. Waste Minimization and Prevention – develop synthetic procedures that reduce or prevent waste.
2. Chemical Efficiency (Atom Economy) – a high yield reaction maximizes the incorporation of starting materials into the final product.
3. Design for Degradation – reduce the effect on the environment by using chemicals that are chosen or designed to be biodegradable.
4. Use Catalytic Reactions – catalytic reactions inherently use smaller quantities of chemicals to carry out a desired transformation.
5. Reduce the Use of Chemical Derivatives – the use of protecting groups or other temporary modifications of a functional group adds to the waste generated in a synthesis.
6. Establish Process Monitoring for Pollution Prevention – real-time analysis and in-process monitoring can be used to avoid the formation of hazardous substances.
7. Use Renewable Feed Stocks – use raw materials or renewable feed stocks, including waste from other processes or those derived from agriculture, when technically or economically possible.
8. Energy Efficiency – reduce the economic and environmental impact of energy use through the utilization of alternative processes.

--*Reducing Risk in the Lab*
1. Safer Chemicals – use chemicals and materials that have the lowest levels of toxicity.
2. Accident Prevention by Avoiding Hazardous Methods – choose materials and chemicals that minimize the potential for explosion, fire and chemical release into the environment; use safe synthetic or biosynthetic methods that pose little or no toxicity to humans and the environment.
3. Use Safer Solvents – use green solvents that will optimize the reaction but will also be safer for both the environment and the workplace.

Students enjoy the hands-on approach provided by studies in green chemistry. The tactile experience of working on a green chemistry problem can be very attractive. Large projects can be divided into smaller, individual components, such as special research topics or a single step in the development of a new material. For instance, our group has explored fracturing chemicals, oil dispersants, carbon capture methods, and isolation of natural products using greener techniques. Students have participated via both experiential learning topics and also as active members of the larger research program.

Finally, many people have difficulty in discerning between environmental science and green chemistry. What are the features that differentiate them? Both fields aim to make the world a better place, but they are complementary to each other. Environmental science/chemistry identifies factors that influence the environment and aims to quantify them. Green chemistry on the other hand seeks to proactively prevent and/or solve these problems by creating safer materials and more efficiently using valuable resources. Green chemistry targets pollution prevention at the source, during the design stage of a chemical product or process, and thus prevents pollution before it occurs.

Aquatic Ecosystem Health

The members of the Aquatic Ecosystem Health Laboratory carry out diverse research and study projects. Our primary focus is on aquatic ecosystems, typically freshwater lakes, although we do research on rivers, wetlands and marine ecosystems as well. Currently, we are studying mercury and metal transfer through food webs. We are particularly interested in distinguishing various environmental parameters that may accelerate or slow the rate of food web transfer of contaminants leading to accumulation in top predators.

We carry out studies on aquatic ecosystems around the world. In the Patagonia mountains of Argentina, we examine whether volcano eruptions may be an important source of metals to freshwater fish. In China, we have considered whether the formation of hydroelectric reservoirs from rivers have led to elevated mercury concentrations in fish species that are important to people. In Nova Scotia, which has a very wide gradient of acidity and organic carbon in freshwater lakes, we are currently examining the role of water chemistry on mercury biomagnification in fish food webs.

As a result, students in the AEHL group have opportunities to carry out field research collecting samples, conduct laboratory analyses of environmental samples and investigate statistical and spatial relationships in the data they collected. Many students also have published their results in peer-reviewed journals and presented their work at leading conferences, thereby continuing their development as environmental scientists and researchers.

The AEHL's work has also influenced classroom teaching. The development of a contaminants course at SMU has led to closer collaborative relationships with the university Facilities Management Department that maintains and monitors the campus. We have monitored mercury contamination around the campus and have shared our findings with the Facilities. For example, previous classes have considered the impact of long-buried coal ash piles from heritage buildings on campus that used coal for heating in the late 1800's and 1900's, which necessitated historical archive research and interviews. We also collaborated with a Biology professor to monitor mercury in starling feathers from birds living in research nest boxes around the campuses. Those efforts have led to the collaborative formation of "The Oaks Living Laboratory", a wooded lot on campus now used for outdoor teaching and research opportunities. This fall, we will be monitoring live salamanders and their insect prey for mercury biomagnification patterns in "The Oaks" forest.

Typically, when we bring up the topic of "environmental contaminants", many people think of environmental chemistry. However, as students and research members of the AEHL group have found, environmental contaminants is truly a transdisciplinary research field encompassing key concepts from geology, geography, biology, human health, physics, sociology, policy, and of course chemistry. As a result, the topic of contaminants has become a very useful way to approach complex issues surrounding the way humans live within our environment and how to mitigate those issues.

Ecology of Plants in Communities

The Ecology of Plants in Communities lab conducts research in applied and fundamental plant ecology. Projects include ecological restoration and conservation biology in coastal habitats and urban ecosystems. This group also runs green roof research facilities at four sites across the city. Our on-campus sites are also used for teaching in the environmental sciences. The green roof research quantifies the effects of plants on hydrological and thermodynamics of the plant-soil-building interface, and thus requires understanding plant biology, community ecology, and physics. Students working on these projects gain experience with sensor networks and data loggers, and work as an interdisciplinary team.

Our on-campus green roof facilities also function as an outreach tool; we run hands-on activities for summer classes, as well as workshops for visiting students of all ages. Our research students have developed teaching tools for the workshops (small versions of green roof systems to allow visitors to measure real environmental parameters, such as soil temperatures and stormwater runoff volumes) and participate in offering the workshops to our various audiences and thus gain experience teaching as well.

Natural Resource Management

Perhaps you've heard that the number of fish in the ocean has declined dramatically in recent years, or that rain forests in the Amazon and other places around the world are being lost. Perhaps you've heard that mining is causing environmental problems, or that our clean water supply is threatened, or that our energy use is adding to climate change problems. Even those who haven't heard of these issues may have thought about the fish we eat, the wood we use in homes and furniture, the metals in cell phones, and where the electricity comes from that we use every day. All these topics deal with natural resources, the 'stuff' that we take from the environment (or that we use where it is found, like hydroelectric water resources) to meet various human needs.

A feature that all these resources share is the reality that they are limited; there are only so many fish, so much land for forests, so many mineral resources in the ground, so much clean fresh water. Because the resources are limited, humans need to be careful how much they use and how that use occurs. Figuring all this out is a big job, one that is covered in a part of environmental science called ‘natural resource management’, an interdisciplinary subject which deals with the science of each natural resource (like the ecology of fish and tress, and the geology of minerals), and analyses what kinds of decisions will lead to the sustainable use of those resources.

While there are natural resources in every part of the world, some places have greater diversity of resources than others. Nova Scotia is a small province in Canada that is a very interesting place to study natural resources. While we have important forests and wildlife on land in Nova Scotia, the province is a peninsula sticking out into the Atlantic Ocean, which almost surrounds the province; this location means that the ocean is extremely important for a wide variety of fish, other living resources, minerals, and oil and gas resources.

At Saint Mary’s University, we have research underway on many of the marine resources around us, including the big industries of fisheries (and aquaculture) and oil and gas. Just off the coast here, only over twenty years ago, was one of the biggest collapses of a resource the world has seen – the ‘cod fishery collapse’ is named after the cod fish species that was a big part of the fishery. Basically, the problem was that the fishery caught too many fish, and the lesson we learned from the collapse (which is talked about around the world) is the need to be cautious in how humans use resources. Nowadays, there are other species more abundant off the coast than cod, but that lesson is still important to remember.

Meanwhile, we have found that there is natural gas and oil in deposits at the bottom of the ocean, off the shores of Nova Scotia. At Saint Mary’s, environmental scientists are working to understand the size and location of these resources. Others at the university are working on the big challenge of how to use the resources in an environmentally safe way, getting economic benefit while not harming the environment. And what do we mean by ‘harming the environment’? It used to be that just meant avoiding pollution, but now, with our minds on climate change and its impacts, we have to ask about the effects of that oil and gas on the future of the whole planet. In other words, we used to focus on local impacts but now we have to look at planetary impacts too.

Fisheries and oil and gas are just two examples of natural resources that an Environmental Science student can study at Saint Mary’s. You can take a course specifically in Natural Resource Management, which surveys a whole range of resources, as well as others that look specifically at certain resources, such as those in the nearby Bay of Fundy (which has the highest tides in the world, and where renewable tidal energy is being developed), or those relating to climate change (resources like fossil fuels around the world) or to the health of ecosystems (such as coastal wetlands). The choices are almost unlimited!

Environmental Pattern Analysis and Modeling

Have you ever tried to describe on the phone something cool you were seeing? The shape of some clouds, or eddies in a turbulent river? A certain tree perhaps, so that your friend might recognize the species from your description? It is certainly not easy. Even less easy is it to make a description using numbers… to create a quantitative picture for scientific purposes! And yet, when we wish to analyze the environment, we have to start from an objective, rigorous description.

You may say at this point – wait a minute, why is this a problem? Aren't there always courses that prepare you for something like that, courses like statistics? Well, not really – not always. In most of such "conventional" courses, you have to drastically simplify the issue before you actually analyze it. There is nothing wrong with simplification, of course: we often have to simplify things to some extent to make sense of them. Problems arise, however, when making things more simple ends up getting in the way, failing to help you reach your purpose.

For instance, let us assume that you study the impact of environmental change on the shape of a coastline; of course, the coastline on a map has quite an intricate shape, so one may want to simplify it – by assuming that it is just a straight line, or a part of a circle – but as soon as you do that, the whole point is lost! It is the change in that irregularity of the coastline that we wanted to analyze… the change from one intricate shape to another intricate shape… Similar issues arise in relation to the shape of clouds, or the spatial location of mineral resources, or the water level in a river. Or the distribution of trees in a forest. Or the variation in air temperature.

The good news is that there are powerful and beautifully simple ways of analyzing these irregular patterns. Moreover, these methods, many of which are very recent compared to those taught in intro statistics, can be effectively assimilated without an extra science background. In different courses at SMU, starting with general intro in environmental science and continuing with environmental pattern analysis and modeling, you learn hands-on how to apply a range of powerful approaches to really complex environmental variables. This is not to say that the "classical" statistics courses are not useful; they certainly have immense value – but only as long as they are applied to the proper type of data (which is obviously the case with any method of analysis); what our pattern analysis classes do is to open windows to the breathtaking beauty of natural patterns, far beyond the limits set by the mentioned approaches in statistics.

Getting such direct access to the scientific study of irregular patterns has become increasingly important nowadays. Environmental change takes place permanently, and the ways in which changes occur are often important for our understanding of the processes at work. Whether you are interested in the change in climate variables such as temperature and precipitation, in the variability of wind energy, in the irregularity of physiological variables such as heart rate or blood pressure, or in the behaviour of a volcano... the state-of-the art methods taught in our program at SMU offer you access to rigorous analysis of natural patterns, so you can apply them to real-world case studies. Eventually, you learn how to build relevant models to study complex environmental issues, to gain insights into the interactions among the processes at work.

Our application topics come from pretty much everywhere, from the “living lab” on campus, the forest and the ocean coast nearby, or the northernmost weather station in the Arctic. Research projects completed as part of the courses are so interesting and can be so advanced that they may lead right away to conference papers – or more.

Last, but not least, by completing such environmental science courses at SMU, you can develop your capability of using a multi-perspective, interdisciplinary approach to complex environmental issues, improve your problem-solving skills, boost your creative thinking as well as your analytic thinking, and strengthen your ability to distinguish fertile approaches to concrete, real environmental problems.

… to conclude:

These and many other key aspects of our program lead to an exciting learning climate and, at the same time, contribute to your solid environmental science background, opening many doors on your career path. Your education relies on cutting-edge science: you learn and apply state-of-the art concepts and methods designed not just to effectively address challenges of the present, but also to identify problems of the future – and fruitfully work towards solutions. By studying Environmental Science at SMU, you benefit from many other advantages.

…You can select an environmental stream among the diversity of options that are offered, or put together your own stream, with the help of your academic advisors. You may even further enhance your education with significant research experience: you can work as a research assistant while being a student.

…You learn from world-class professors, who are leaders in their fields. You study in very small classes, which means that you have incomparable access to instructors and lab resources and overall a completely different experience from what you may receive at most of the larger institutions. Your background and practical experience are enriched by valuable interdisciplinary training.

Meet the Department of Environmental Science

Dr. Cristian Suteanu is an Associate Professor in the Department of Environmental Science and the Department of Geography and Environmental Studies. His main interests concern information processes and the ways in which they link humans with their environment. He studies methods for the analysis and modeling of natural systems, with applications regarding a wide range of aspects of environmental change and natural hazards. His courses include Environmental Pattern Analysis and Modeling, Environmental Information Management, Environmental Science--Energy, Resources, and Pollution, Statistical Methods for Geographers, Natural Hazards, as well as graduate and post-doc courses on nonlinear analysis and modeling of environmental systems. He is the Chairperson of the Department of Environmental Science at Saint Mary's University.

Dr. Linda Campbell is a Senior Research Fellow in Environmental Sciences and the principal investigator of the Aquatic Ecosystem Health Laboratory research group. Her research interests include how trace metals and contaminants cycles in aquatic food webs across Canada and around the world. Dr. Campbell is also interested in using multi-discip

linary approaches to improve our understanding of anthropogenic and natural impacts in the environment, with a focus on aquatic ecosystems. She leads a research group working on many diverse projects and a trace-element clean-room laboratory at Saint Mary's University for advanced research in contaminant biogeochemistry. Dr. Campbell's research group has published extensively, with projects in eastern China, East Africa, Argentina, Canada and the USA.

Dr. Anthony Charles is Director of the School of the Environment, and professor of Environmental Science at Saint Mary's University. He specializes in studies of natural resource systems, and especially fisheries and coastal resources, examining how they can best be managed for sustainability, and how community-based management and ecosystem-based management play a role. Dr. Charles is author of the books *Sustainable Fishery Systems* and *Governance in Marine Fisheries and Biodiversity Conservation*. He leads the global Community Conservation Research Network (www.CommunityConservation.Net), which studies how local-level environmental conservation can work effectively. Dr. Charles is a Pew Fellow in Marine Conservation, a Gulf of Maine Visionary Award winner, a Senior Research Fellow of the International Ocean Institute, and a member of the Fisheries Expert Group in IUCN's Commission on Ecosystem Management.

Dr. Jason Clyburne holds a Canada Research Chair in Environmental Science and Materials at Saint Mary's University in Halifax, Nova Scotia, Canada. He is a Professor in the Department of Environmental Science and the Department of Chemistry. He obtained a B.Sc. (Honours) from Acadia University and a Ph.D. from Dalhousie University under the supervision of Professor Neil Burford. After a short post-doctoral project with Prof. Melbourne Schriver, he joined the research group of Prof. Alan Cowley (FRS) at the University of Texas at Austin, where he examined the coordination chemistry of main group elements. His research deals mostly with inorganic and organic materials as they apply to green chemistry, including catalysis, surface properties, and acid gas capture. He works closely with industry to solve problems associated with both waste and increased performance while maintaining a focus of the use of green chemical solutions. He is currently the co-chair of the chemistry evaluations group for NSERC.

Jeremy Lundholm Dr. Lundholm is cross-appointed in Environmental Science and Biology. He studies the ecology of plants, particularly at the community level. The main research goals of his lab are to determine how species diversity is maintained in plant communities, and how this diversity contributes to ecosystem functioning. His recent published works include: Spontaneous urban vegetation and habitat heterogeneity in Xi'an, China (2013), Environmental geometry and heterogeneity-diversity relationships in spatially explicit simulated communities (2012) and Relative importance of available energy, environmental heterogeneity and seed availability for seedling emergence on a limestone pavement (2011). Currently, Dr. Jeremy Lundholm has four research projects Green Roof Ecology, Urban Plant Communities, Species Diversity Patterns and Regeneration and Restoration Ecology.

Dr. Aldona Wiacek is cross-appointed in the Departments of Environmental Science as well as Astronomy & Physics. She is interested in remote sensing of atmospheric trace gases involved in air pollution and climate and also in the climate effects of aerosol (suspended particles) through cloud interactions. Her research includes the development of ground- and satellite-based remote sensing instrumentation and data analysis techniques (retrieval algorithms and inverse theory). She is currently establishing the Tropospheric Remote Sensing Laboratory (TRSL) to characterize atmospheric composition in the planetary boundary layer at SMU and in the field, with the end goal of improving the understanding and prediction of atmospheric processes. Dr. Wiacek helped establish the Toronto Atmospheric Observatory as part of her Ph.D. studies at the University of Toronto. She then researched aerosol-cloud interactions as a Marie Curie Postdoctoral Fellow at the Swiss Federal Institute (ETH) in Zürich. Finally, she held the position of Research Associate (remote sensing of aerosols) at Dalhousie University before joining SMU in 2013.

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Contact information:
Department of Environmental Science
Saint Mary's University
Halifax, NS, Canada
923 Robie St., B3H 3C3
Tel: +1 902 420 5737
Email: envs@smu.ca

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