WATERLOO

WATERLOO | ENVIRONMENT

Shaping our sustainable future

ENVIRONMENT
A faculty in full bloom

COOL HEADS PREVAIL
Who's watching the earth?

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A faculty in full bloom

IT'S EASY TO BE BLEAK WHEN LOOKING INTO THE FUTURE.
CLIMATE CHANGE, ENERGY CRISES,
MALNUTRITION, ECONOMIC VOLATILITY,
AND MANY OTHER PROBLEMS STALK THE WORLD.

PHOTO: CHRIS HUGHES

1962 | A personal invitation from professor **RALPH KRUEGER** convinced Bert Durst to join Waterloo's newly-created department of geography.

Faculty and students at the Faculty of Environment know these looming issues present daunting challenges. But talk to them and, for the most part, you won't hear doom and gloom.

They'll tell you that solutions will come from working together – and this faculty has always excelled at working together.

The future is being shaped here. And it will be sustainable.

The seeds for the Faculty of Environment were sown in 1962. That summer, Bert Durst, an honours geography student at Waterloo College, now Wilfrid Laurier University, received a letter from Ralph Krueger, his favourite professor.

Krueger and fellow professors Aubrey Diem and Roy Officer were moving to the University of Waterloo to create a new department of geography within the young Faculty of Arts. Did Durst want to come along?

The five-year-old university seemed composed largely of mud and temporary buildings when the young man arrived. But the three excellent professors made it worthwhile. »

2012 | **ANDRÉ ROY** began his five-year term as Dean of Environment in August 2011. Half a century after it began as the department of geography, the Faculty's influence is being felt around the globe.

TEXT **KAREN KAWAWADA** | PHOTOGRAPHY **JONATHAN BIELASKI**

TODAY, STUDENTS CAN TAKE BUSINESS, AVIATION, INTERNATIONAL DEVELOPMENT, AND MANY OTHER PROGRAMS – **ALL WITH AN ENVIRONMENTAL BENT.**

In 1963, Durst was one of Waterloo's first five geography graduates. He would go on to be a geography teacher and eventually superintendent. He still credits Krueger with inspiring him as an educator and a leader.

Even in those early days, interdisciplinary research was emphasized, says Glenn Brubacher, another of the first graduates. "My geography education was very useful because of the universal aspect of the discipline; it can be applied in so many ways. You can relate a whole bunch of different things and come up with a good solution."

A planning program was soon added to the department of geography. In 1967, the Faculty of Engineering started a pre-architectural program, but the following year, it separated from engineering. Unhappy to have an unaffiliated unit, a university committee recommended the creation of an "interdisciplinary man-environment studies group."

Planning (which separated from geography and became the School of Planning), geography (today called geography and environmental management), and architecture (now once again part of the Faculty of Engineering) joined together with the brand-new man-environment studies (now environment and resource studies). The academic unit they created in 1969 was, in all practical senses, Canada's first undergraduate faculty of environment – but they called it the Division of Environmental Studies.

"What this new group wanted to send, they thought, was a clear signal that this was not going to be a traditional faculty. It wanted to engage in interdisciplinary work," says Bruce Mitchell, one of six geography professors hired in 1969.

The "division" officially became a faculty in 1973. However, the emphasis on interdisciplinary work continued, as it does today. It has grown through partnerships with other faculties and universities, industry, and non-governmental organizations, says Mitchell, who is now Waterloo's associate provost, resources.

University of Waterloo will apply for Leadership in Energy and Environmental Design (LEED) platinum status for the faculty's newest building, Environment 3, which opened last year. That would certify it as one of the world's most environmentally-friendly buildings. Many new programs have been added, including two academic units – the Centre for Knowledge Integration in 2008 and the School of Environment, Enterprise and Development in 2009.

Today, students can take business, aviation, international development, and many other programs – all with an environmental bent. There's an increasing emphasis on international research and study, with the faculty leading the way in establishing the Sino-Canadian College in Nanjing, China.

The Faculty is world class, says Dean André Roy. It has already changed the world through its research and the contributions of its 11,000 alumni, he says. It will change it more in the future.

"There's something special here," Roy says. "There's a belief in something, a commonality of goals, a sense that we're all in it together."

Change begins at home, the saying goes. Geography professor Paul Parker has helped bring change to thousands of homes.

In 1998, Parker, with colleagues Daniel Scott, Ian Rowlands and Don Eaton, then director of the Elora Centre for Environmental Excellence, had an idea for what was supposed to be a two-year project.

The federal government had launched the EnerGuide for Houses program and evaluated 1,200 houses for energy efficiency. Considering there were 13 million houses in Canada, Parker and his colleagues saw a need to do more.

"By the second year of the project, we were doing more evaluations than all of Toronto, 10 per cent of the national total," Parker says.

Since then, the Residential Energy Efficiency Project, now called REEP Green Solutions, has conducted more than 20,000 evaluations, including follow-ups, on nearly 14,000 homes in Waterloo Region. On average, participating households reduce energy consumption by 27 per cent, says Parker.

CHANGE BEGINS AT HOME | Geography professor **PAUL PARKER**, left, **ELENA KRAKJEVSKA**, Master of Environmental Studies energy conservation specialization grad student, and **SHANE ONEILL**, PhD student in Geography and Environmental Management, explore energy efficiency at the REEP house in Kitchener.

REEP is now an independent organization but maintains strong ties to the university. Parker still sits on the board and has helped expand REEP's mandate to areas including water management and indoor air quality. The REEP House for Sustainable Living in Kitchener is a research and education space, a showcase of how green an older home can be. Its retrofits have resulted in energy savings of 80 per cent.

Rowlands, of environment and resource studies, continues to research energy efficiency. Working with colleagues in environment and engineering, he leads the Energy Hub Management System project to help households and eventually workplaces reduce their energy consumption and costs.

The project has received $2.45 million in funding, including in-kind contributions, from public and private sector partners.

The goal is to develop a computer-based system that works with a smart electrical panel and smart plugs to capture live data about a site's energy loads, demands, and perhaps production and storage.

These data are combined with information such as energy prices, air quality, weather forecasts, and personal preferences such as not wanting the temperature above or below a certain level.

After monitoring a site's energy use patterns, the system develops an optimal schedule that allows users to cut costs, reduce energy consumption, and/or reach environmental goals. Some actions, such as lowering the temperature at night, can be set to happen automatically, while in other cases the system merely suggests, via a web portal, optimal times to run the dishwasher.

A pilot project is running in Milton, Ont., and Rowlands hopes the system will be in wider use in the future.

Currently, our electricity system is built to handle peak demand times, such as hot afternoons when air conditioners are cranked. This means some infrastructure is "idle or

underutilized" the vast majority of the time, Rowlands says.

"If, through increased use of information and communications technologies, we can shift load from this peak period, perhaps four to five per cent of our energy capital stock would no longer be needed."

Transforming landscapes is as vital as transforming lifestyles when it comes to tackling pressing global challenges.

Geographer Jonathan Price is part of a multidisciplinary group from several universities that recently received $6.7 million in government and industry funding to do the unprecedented – turn post-mined land in oilsands country back into the peatland that used to cover at least half of the Athabasca landscape.

In 2003, Price was at a meeting in Fort McMurray, Alta., where a facilitator stated that, while it may be possible to recreate marshes, "we can't reclaim to peatlands because they take thousands of years to develop."

Price wasn't so sure. He had been involved in restoring damaged peatlands. Reclaiming peatlands that no longer existed would be harder but doable, he thought, given the availability of materials and big earth-moving equipment present in the oilsands industry.

Price and his colleagues have started to put a plan into action at a pilot site on Suncor land. It involves bringing in "donor" peat and fen plants and re-contouring land so enough water of adequate quality will flow onto it.

Water quality is a challenge because the team is using tailings materials to create the aquifer that supplies water to the fen. A liner will separate the old tailings dump from the fen, but the water flowing from the created aquifer will be high in sodium. Nonetheless, Price and his colleagues believe they can make it work.

"I think in 10 years we'll see a system that has many of the features of a fen peatland, though it will be a system that's still evolving and changing as the solute redistributes and the plant layer develops," says Price. "I feel optimistic."

School of Planning professor **LUNA KHIRFAN** works to balance the needs of tourists and locals in UNESCO World Heritage cities.

PHOTO: JACK YAN CHEN

Blair Feltmate believes in working to mitigate climate change. But "to ignore adaptation is like saying you'll live on in a house where the shingles are curling up on the roof and the water is starting to drip through the ceiling," he says.

As chair of the Climate Change Adaptation Project (Canada), funded by insurance company Intact Financial Corporation, Feltmate is working to identify the most important actions that can be taken to cope with climate change within Canada.

LUNA KHIRFAN HOPES HER RESEARCH WILL RESULT IN RESIDENTS OF HERITAGE AREAS GAINING MORE OF A VOICE IN PLANNING.

Feltmate, a professor in the School of Environment, Enterprise and Development, has brought together 80 top leaders from industry, government, academia, First Nations, the legal community and civil society. This group has identified what it believes are the most important areas to focus on generally in climate change adaptation, plus the most important areas that the property and casualty insurance sector should consider.

The next step has been to create a report identifying recommendations to address the chosen areas of focus. But Feltmate says the report is just the beginning. The rest of the project is convening meetings with Canada's foremost leaders in government, industry, First Nations, and other decision-making sectors, to turn recommendations into action.

The recommendations include small- and large-scale ideas. For example, one is to reconnect ecological patches, such as small forests, by building natural corridors that would enable species to migrate from one place to another as the climate changes.

Another recommendation is changing Canada's residential building codes to mandate the installation of backwater valves that would allow water to flow out of basement drains, but not into them. These valves would only cost about $300 per new home but would save millions that would otherwise be spent fixing flooded basements.

All the recommendations are "practical, meaningful and cost-effective," and backed by organizations as diverse as Suncor, the Pembina Institute and First Nations groups, says Feltmate. "You've got people who never agree on anything – agreeing."

Environment researchers are having an impact internationally too. One such person is Luna Khirfan, whose project focuses on three Middle Eastern cities on the UNESCO World Heritage list.

The trend over the last two decades has been to focus on preservation, which is expensive, says Khirfan, a professor in the School of Planning. This has tended to result in poorer residents being replaced by richer ones, and some neighbourhoods losing residents altogether in favour of tourist infrastructure.

"What I am looking at is how we can balance this," says Khirfan. "We need people to pay more taxes but we also need to maintain the socio-economic structure. I've been

trying to prove the tourists are not only interested in buildings, but in people's ways of life."

She did extensive interviews with tourists and found that, more than buildings, they enjoyed activities such as markets and drinking tea with locals. Her conclusion? "There is actually no difference between tourist needs and local needs."

Khirfan has been talking to planners in Israel, Syria and Jordan, and has a book coming out soon. She hopes her research will result in residents of heritage areas gaining more of a voice in planning.

Natural science, social science, local or international – Environment faculty and students do it all.

- **Jennifer Clapp** is one of several professors who study policy and governance. She recently published two books on global food issues, and says the rise of a global industrial food system has led to people knowing little about the origins of their food, which may include practices that are ecologically unsound and socially unjust.
- **Rob de Loë** focuses on water governance. Historically, water issues have been considered technical matters, but it's become clear that most involve organizational and relational problems that can't be solved with technology alone, he says. For example, drinking water quality on many First Nations reserves is poor "despite the fact that we have the technology to make water safe."
- **Larry Swatuk**, head of the international development program, which will be graduating its first students this year, works on international water governance. In the days of the Soviet Union, water originating in Tajikistan was largely used for cotton irrigation in Uzbekistan. Now Swatuk is helping the two countries figure out how to fairly share water.
- **Olaf Weber**, Export Development Canada Chair in Environmental Finance, studies how environmental and social justice issues can cause problems for banks, how banks' financing choices can cause environmental and social justice problems, and how some financial products can support sustainable development.
- **Tara Vinodrai** is director of the local economic development master's program. In Waterloo Region, she is leading a team of researchers studying the local food, green energy, and creative/cultural sectors, focusing in particular on how rural and urban communities integrate within those sectors.
- **Jeff Casello** has been a strong advocate of the benefits of enhanced urban public transportation. He has been working with the Region of Waterloo to upgrade its express bus service, the iXpress, and to aid in the planning and design of the rapid transit project. He has also addressed several city councils elsewhere in Ontario.
- **John Lewis** focuses on how cities can better accommodate the needs of an aging population. He trains his students in part through a simulation that puts them in wheelchairs, vision-impairing goggles, and other limiting devices so they can experience urban navigation with a physical impairment. It's an exercise many future planners find unforgettable.
- **Jean Andrey** studies road safety. She and a graduate student published one of the first papers on how much the crash rate leaps when young drivers have passengers. Her work helped influence the Ontario government in bringing in graduated licensing rules restricting passengers for new drivers.
- **Stephen Murphy** helps restore natural areas, including parks. Though parks are supposed to be protected, they often need ecological restoration due to legacies of land use or because of current recreational use, he says.

The list of ways the faculty has changed, and is changing, the world could go on and on. Professors with deep expertise in specialized fields bring ideas and people together from different disciplines, sectors and locales to come up with solutions that wouldn't arise in silos.

There is now an academic unit devoted to interdisciplinary studies – the Centre for Knowledge Integration. Environment is the natural home to the program, since environmental problems are by nature interdisciplinary, says co-founder Linda Carson. "When I walk in this building,

JEFF CASELLO, a professor in the School of Planning, is a strong advocate of better public transportation.

I don't have to fight the battle about interdisciplinarity. Everybody in this faculty is an interdisciplinary practitioner."

"The problems and issues that society is facing, most of them cannot be solved by just looking at them from one perspective," says Dean Roy. But "interdisciplinarity isn't just a question of solving problems. It's also a question of shaping minds."

Environment students turn out well-rounded – but there's more to it than that. "They're engaged in this world and they want to make a difference somehow," Roy says. "And they will. Lots of our alumni are making a difference already." W

WEB See **Green Faculty** at **alumni.uwaterloo.ca/links**

Cool heads

prevail

BIKE TO WORK, BUY GREEN, DRIVE A HYBRID VEHICLE.

WE ALL KNOW WHAT WE'RE SUPPOSED TO BE DOING TO HELP THE PLANET.

University of Waterloo professors and students are doing much more than that.

They're researching not only the effects of climate change on our planet, but finding ways to prepare communities that have the most to lose.

It's the first day of Ellsworth LeDrew's first year physical geography class, a course the eminent geography and environmental management professor has taught for years. The students, jittery and excited to finally be sitting in a lecture hall after leaving high school behind, grow quiet as LeDrew begins to flip through slides depicting something he's passionate about protecting and preserving: coral reefs.

The beauty of the reefs is unmatched by almost anything else on earth, with brilliant orange, red and blue hues created by corals – tiny animals that attach themselves to the hard calcium carbonate skeleton of the reef. They dot oceans and draw tourists and divers in droves. Often compared to tropical rainforests, reefs represent some of the most diverse ecosystems in the world, and serve to cycle carbon dioxide in the ocean.

But they're in serious trouble.

Climate change – the term used to describe when long term weather patterns are altered – is having a serious impact on reefs, turning what were once thriving bionetworks into bleached, barren wastelands. Acidic oceans, rising water levels and intense tourism are considered some of the culprits. But so is warming water.

"This is a major lesson that I'm trying to get through to my students," LeDrew says.

"Everyone really has a role to play in terms of global ecosystems. What we do in North America, in terms of climate change and ecology, can have an impact on the other side of the earth."

The impact on coral reefs is only one way large scale climate change and circulation patterns are already having an impact on things we've taken for granted. A large body of scientific studies from across the globe has examined other issues we could experience (and, most of the experts say, likely will experience) if carbon dioxide levels go unchecked and the earth's mean temperature rises long term. Although it's impossible to know exactly how serious future global warming and climate change could be for the planet, the list of consequences is cause for serious concern.

For instance, temperature changes and rising ocean levels could mean tourism patterns would shift as erosion wipes out coastal beaches in resort communities.

Submerged coastlines would also impact millions who live in places such as New York, Prince Edward Island and Shanghai. Weather pattern change could lead to stronger floods and droughts, struggling fisheries, and extinction for animals unable to adapt.

Daniel Scott, an associate professor of geography and environmental management and Canada Research Chair, Global Change and Tourism, has spent over a decade studying the implications of climate change for international tourism, which is now one of the largest economic sectors and employers in developing nations. Scott lead a scientific advisory panel on climate change for the United Nations World Tourism Organization and has also been a contributing author and expert reviewer for the United »

« Geography and environmental management professor **ELLSWORTH LEDREW** is passionate about protecting coral reefs, but his recent research has moved to colder climates.
PHOTOS COURTESY OF ELLSWORTH LEDREW

Assistant professor **JOHANNA WANDEL** explores the human cost of climate change, close to home and in coastal communities.

PHOTO: JONATHAN BIELASKI

Nations Intergovernmental Panel on Climate Change, which shared the Nobel Peace Prize in 2007.

While his work spans the globe, it is the Caribbean, which is the most tourism-dependent region in the world, that has become the focus for his research team over the last five years. "The impacts of climate change, particularly sea level rise, on tourism are a major concern to regional leaders, and there is a real thirst for information on how best to cope with these future problems," he says. Scott and many of his students have collaborated with researchers from the University of Oxford, the University of the West Indies, and the United Nations Development Program to try to provide some answers.

"Sea level rise is considered to be one of the most certain and prominent consequences of climate change. It will transform coastal communities and their economies. It's a unidirectional impact, so we know it is coming. It's just a matter of how much and when.

If you've got a dilapidated resort that has lost its beach to erosion, and the others start to look a little shoddy, the whole destination image begins to decline and prices have to drop. "It's a slippery slope to uncompetitiveness," says Scott. These are long-term challenges, but information on how to begin adapting to them is required now.

Understanding the whole picture, of course, takes many minds. Waterloo professors and students are putting the pieces of the puzzle together, one project, field trip, major study and experiment at a time.

Think global, study local

A few years ago, when Johanna Wandel first joined Waterloo as an assistant professor in geography and environmental management, she decided to look at climate in a very hands-on way. She gathered a team of graduate students and, working with a psychologist, a local shelter program and the Region of Waterloo, they took to the streets. They wanted to ask homeless people in the community: How did they deal with weird weather patterns and large- scale change in climate?

It turned out to be a perfect year for the question. The summer of 2009 was cool and rainy by day, wet and frigid by night. And because the homeless typically ditch their winter gear each year as the weather grows warmer, they were left shivering and miserable. The social service system wasn't prepared either. Who expected to run an "out of the cold" program at that time of year?

"With those horribly cold nights in June, that was actually a much bigger problem than a colder night in March," Wandel says. The project was able to shine a light on a local problem created by a much larger global issue. Waterloo Region, it turned out, is well prepared for most weather challenges, despite the summer of 2009. A large volunteer base, money, and political will prompted one homeless person to tell Wandel, "Nobody starves and nobody freezes to death in Waterloo."

Still, that's not necessarily the case in other areas of the world, where climate change can have a serious impact on not just marginalized populations, but nearly everyone who lives there.

That's why Wandel, along with numerous other Waterloo professors, including Scott, are now working on a large-scale, five-year, $2.5 million project alongside academics from Jamaica, Trinidad and Tobago, Nova Scotia and PEI. Scott is co-director of Partnership for Canadian Caribbean Community Climate Change Adaptation, (ParCA), along with Murray Simpson of Caribsave. The group is working with Caribsave, with headquarters in Barbados.

The teams will assess vulnerable communities, but this time they'll focus on those who live, work and depend on coastal regions in the Caribbean and on Canada's east coast. What would rising sea levels do to a country or community that is economically dependent

> “WHAT DOES IT MEAN IF WE HAVE A LESS SNOWY WINTER? WHAT DOES IT MEAN TO PEOPLE IN WATERLOO IN TERMS OF THEIR TAX BILLS?”
>
> **RICHARD KELLY**, geography and environmental management professor

on coastal tourism? What would happen to the fishery industries if local reefs degraded? What kind of coastal engineering would help keep beaches intact, rather than ripped apart by storm surges or slowly lost to erosion? How can communities cope with stronger storms and more variable rainfall?

This summer, teams will fan out to talk directly with residents and a wide range of planning and other professionals in these coastal communities. “This is about putting a human face on how we experience climate and how some groups are affected,” Wandel says.

Power in numbers

Waterloo is also good at putting a human face on its researchers. Part of the reason the university netted funding for the project is the wealth of professors and grad students who research climate change.

Some look at sea levels, others, snow and ice. There are those who explore physical science, while many research resource management, and still others deal with issues of environmental policy. A natural focus of this activity came with the inception of IC3 (pronounced “ice cube”), the Interdisciplinary Centre on Climate Change, that since 2009 has brought researchers from numerous faculties and departments together to understand everything from atmospheric science to the human impact of climate change, and how computers can be used to more accurately model what happens in the real world.

“Without that critical mass of scholars looking at one area, it’s tough to compete internationally,” Scott says.

Richard Kelly, a geography and environmental management professor, is a core member of IC3 who values the way Waterloo supports disciplinary perspectives and interdisciplinary ties to promote innovation. “Promoting the conversation between natural scientists and social scientists – and then handing it off to policy people – is quite a unique thing. IC3 is a very exciting, yet very challenging, endeavour,” he says.

Still, it is perhaps not as exciting as his own years in the field researching snow and ice anywhere it falls or forms. Kelly, who has also worked for NASA, has dug around in snow in places as far flung as Manitoba, the Yukon, Norway, and Colorado. In the most general terms possible, he wants to know where the snow is, and how much exists. Considering the cold climates in which he conducts field work, it’s a good thing he enjoys his work.

“One of the best places to be is after you’ve dug a two-metre snow pit and you’re sitting there having a cup of tea before you do the analysis on how the snow pit structure looks,” he says, smiling from his seat in a busy office on the first floor of an Environment building. “If it’s not too cold, that can be fantastic.”

For years, Kelly has been using satellite images to determine snow location and depth or mass. Until recently, the data were only able to reflect 25-kilometre-square areas, making accurate analysis challenging because conditions can vary widely in an area that large. "It's a bit like looking at the snow on the ground from space through out-of-focus goggles. You know it's there, but you are not quite sure how much," he says.

But new, alternative radar technologies are being developed to let Kelly gather information on a 100-metre scale. The more localized information gleaned from this complex technology is something that Canadian water management resource organizations are clamouring for in order to improve model snow estimates for basin management.

With more exact information, they would have a better idea about when snow is expected to melt or how much time a community might have before a flood.

Understanding the where, when and why of snow is incredibly important from a safety standpoint, as well as from an economic one. There's snow removal, obviously, but snow also has a dollar-and-cents impact on agricultural irrigation, industrial cooling, flood damage and the insurance industry, drinking water, and the ski industry. Not only is snow formation an indicator of how climate is changing, but getting a handle on snow means that people will have a better sense of how to manage it as a resource.

Drinking water in California is a plus. Raging floods in Winnipeg, not so much.

Getting the message out to the public about complicated technology and research – even when it has a direct impact on our lives – is not always easy, Kelly says. Add that to the fact that a sense of green fatigue may be setting in as mixed messages and good intentions compete in the media for public attention. It's up to Canada's researchers, who are looking closely at the issues, to spread the word in a way that makes sense to everyone.

"We're starting to do that better, but there's still more to be done. What does it mean if we have a less snowy winter? What does it mean to people in Waterloo in terms of their tax bills?" Kelly says.

Abstract ideas, concrete results

Christopher Fletcher, assistant professor in Geography and Environmental Management and SHARCNET Research Chair, knows how challenging it is to explain what he does and why it matters. His area of research, using computer models to simulate climate patterns and large-scale circulation of the atmosphere, can seem a bit on the esoteric side to the average person. Yet creating numerical experiments for climate systems is incredibly important for long-term thinking, particularly if you're looking for consistent data.

» YOU CAN DO SOMETHING ABOUT CLIMATE CHANGE TOO

Waterloo professors and students who study climate change are doing their part to understand it and plan for the future, but there are things anyone can do to make a difference.

Look for Energy Star-qualified appliances and computers.

Refrigerators today are much more energy efficient than they were even 10 years ago.

Walk or ride your bike to work or school.

That's what Christopher Fletcher does, even on cold days in March. If that's not an option, public transit is another green way to go.

Think before you fly.

Daniel Scott says he's much less likely to fly to a conference these days to give a 30-minute talk. "I've said no to a lot of things that would have doubled or tripled my carbon footprint," he says. Using Skype and video-conferencing is another way to go.

Get over yourself.

Studies show that many people feel paralyzed by the enormity of climate change, so they change nothing in their own lives. The reality is, there is plenty everyone can do to help. It might start with turning off the light when you leave the room, but where it ends is up to you.

“I would say I spend 95 per cent of my time looking at the model world rather than the real world. Things are generally cleaner and clearer when you’re using computer models as laboratories,” he says.

In Fletcher’s computer world, volcanoes don’t erupt, setting off a chain of weird climactic events all over Europe, unless he wants them to.

Using his models, he can test the impact of doubling carbon dioxide concentrations in the atmosphere. What would happen to the ocean, land surface, vegetation and the amount of ice and snow? Running simulations can help him see possible outcomes.

“It’s a classic physics experiment-type configuration, really. We just change one thing, while holding all other things fixed, and see what the effects are,” Fletcher says.

Sometimes that butterfly effect can lead to surprising results. The common theme of Fletcher’s research can be boiled down to two words: atmospheric circulation. He looks at how the atmosphere moves and how circulation can have a connection to other areas of the world. These connections telescope over long distances to create what are called teleconnections.

Recently, he wanted to know what would happen if he artificially warmed the ocean temperature, first in the southern Pacific Ocean and then in the Indian Ocean. What, if any, impact would warming each distant ocean have in the mid-latitudes of North America? The idea that these teleconnections exist was not new, but his results were exciting.

It turned out that even though the water in each virtual ocean was warmed by similar amounts, the resulting responses in the northern climate’s temperature and precipitation were opposite.

“That was not easy to predict ahead of time,” he says.

The upside of warmth

Sometimes it does pay to get away from computers, models and even university campuses to work out the realities behind climate change. Although LeDrew tends not to jump into the ocean to dive down to where the coral is anymore (in recent years he has left that work to stronger swimmers, he says), he has worked with students doing fieldwork in Fiji and Indonesia, matching data collected from satellites 700 kilometres above the earth with reflected solar radiation measurements from reefs up to 10 metres deep. That research has helped map damaged coral, as well as design marine protection areas.

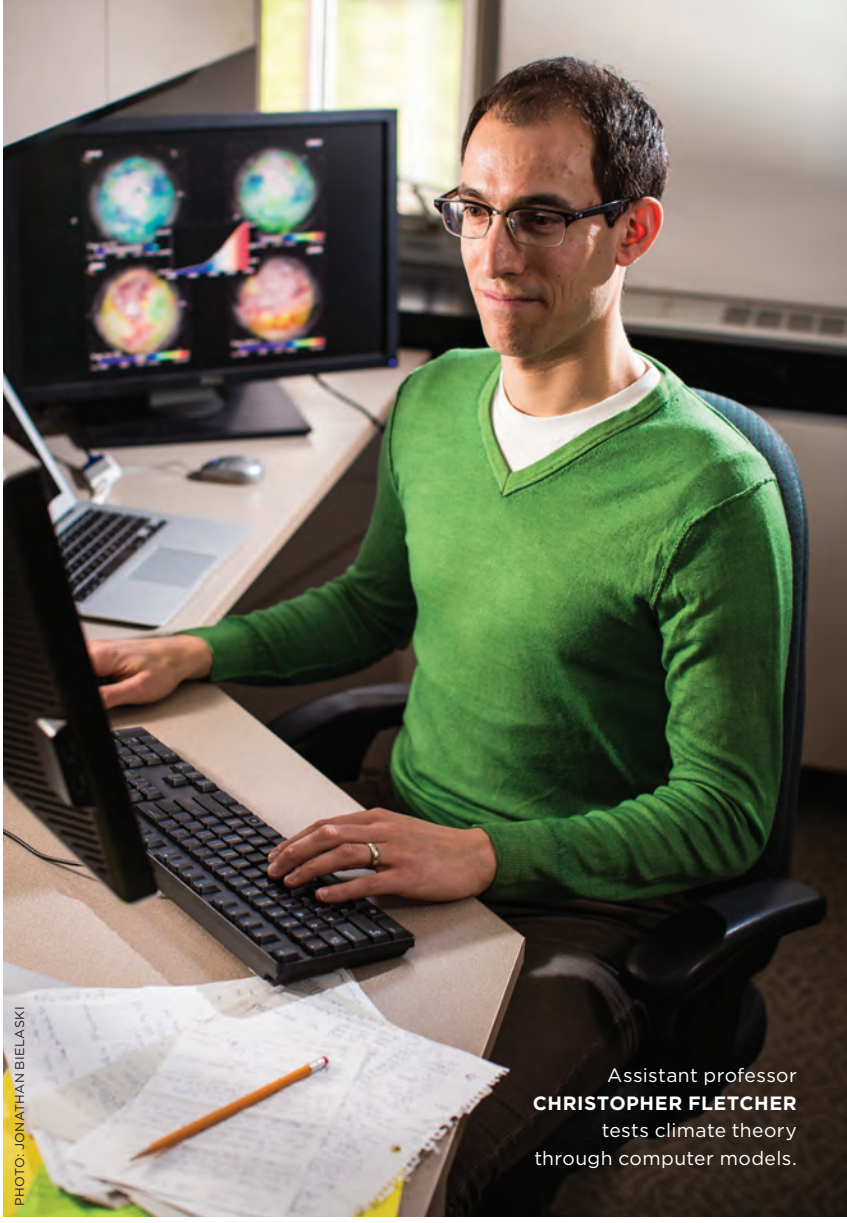

PHOTO: JONATHAN BIELASKI

Assistant professor **CHRISTOPHER FLETCHER** tests climate theory through computer models.

But over the past decade, much of LeDrew’s work has shifted away from ocean reefs to far frostier environments, where he provides data and information management infrastructure for the Canadian cryospheric community. He’s developing a polar data catalogue where Canadian physical, social and even medical scientists can log polar data so it can be used well into the future for comparison.

This is an evolution of 40 years of work modeling the interactions between climate change and shifting sea ice in the Arctic. This has involved many years of fieldwork in some of the world’s most remote, stark and beautiful places, such as north of Baffin Island in Canada’s high arctic.

He remembers arriving and setting up equipment and tents one year when everything was covered in ice. Soon, spring moved in and little tufts of vegetation appeared from under the melting snow.

“As soon as some warm air comes in, there’s a total explosion of life. Birds, animals, seals all arrive quickly,” LeDrew says. “It’s an experience I wouldn’t want to forget.”

WEB See **Climate research** at **alumni.uwaterloo.ca/links**

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- **#1 fastest** growing Faculty at the University of Waterloo.
- Over **11,000 Faculty of Environment alumni** living in 79 countries around the world.
- **52 points** for LEED Platinum certification of Environment 3, uWaterloo's greenest building.
- **4** years in a row Environment and Business has been ranked the **#1 Business program in Canada** for integrating sustainability into its curriculum – Corporate Knights.
- **200 = number of new grad students** joining ENV each year.
- **89%** of Environment students say their professors inspire them.
- **#1 environment co-op** work program in the world.

UNIVERSITY OF WATERLOO

Faculty of Environment
200 University Avenue West
Waterloo, ON, Canada N2L 3G1
519-888-4567, ext. 33463
envinfo@uwaterloo.ca

School of Planning
env.uwaterloo.ca/planning

School of Environment, Enterprise and Development
env.uwaterloo.ca/seed

Department of Environment and Resource Studies
env.uwaterloo.ca/ers

Department of Geography and Environmental Management
env.uwaterloo.ca/geography

Centre for Knowledge Integration
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