

FALL 2017

NEWSLETTER



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Message from the Executive Director:

Welcome to our inaugural newsletter. Within these pages you will see snapshots of our activities and successes over the last year. Together, we worked to develop tools and solutions for tackling challenging energy and environmental problems affecting our communities.

In the last year, our graduates have found work in their chosen fields in industry, government and academia. Several students were recognized with scholarships for their academic and research achievements. Our students were also active publishing their results and making presentations at industry events across the country. It is wonderful to see the next generation of science and engineering professionals making contributions in industry, government and academia.

IEESC continues to build a strong research team. We have faculty members from business, engineering and the social and natural sciences, and from universities and organizations around the world. We continue to build our network, with a target of placing the University at the forefront of energy, environment and sustainability research provincially, nationally and internationally. Look for updates from our members in future newsletters!

In the coming year we will continue working with our partners and members to support the University's strategic priorities: student success, research impact, and commitment to our communities. We aim to deliver high-quality research outcomes and solutions in the fields of energy and environment to address real-world issues and problems in our communities.

We look forward to sharing more about IEESC's work in the months ahead.



Dr. Gordon Huang



Feature Story: Climate Change Data Portal

The Institute for Energy, Environment and Sustainable Communities' climate models are helping to improve Canadians' understanding of the climate and helping to predict future climate changes. IEESC recently launched its projections of Canada's future climate with high temporal and spatial resolutions. The projections are accessible through the Canada Climate Change Data Portal (CCCDP), a GIS- and web-based data portal. CCCDP offers dynamically-downscaled climate data up to the year 2100. CCCDP has a spatial resolution of 25 km to 50 km which can be further statistically downscaled to 1 km, and at several temporal resolutions (annual, seasonal, monthly, daily and hourly). The portal provides access to the most current high-resolution climate data in the country.

CCCDP supports climate trends and variability analyses, and offers weather hazard projections. Such information provides a scientific basis for developing an early warning system of extreme events, including floods, droughts, rainstorms, and high winds. As an open access, easy-to-use data portal, CCCDP offers state-of-the-art tools to evaluate the impacts of climate change on various human activities and to address/quantify related risk and security issues (such as those related to human health, energy development, urban and rural infrastructure, agriculture, fisheries, and ecosystem stewardship). The CCCDP is a one-window source for climate information for policy makers and climate scientists in their efforts to make informed decisions about wide-ranging climate-related risks

Climate Change Data Portal

<http://ccdp.network>

Free and easy access to the latest climate data to improve our understanding of the climate and future climatic changes.



and to enhance security of relevant management systems such as emergency management. This technology presents opportunities for governments, academia, non-governmental organizations, and the private sector in the mitigation and prevention of disasters and to enhance community resilience.

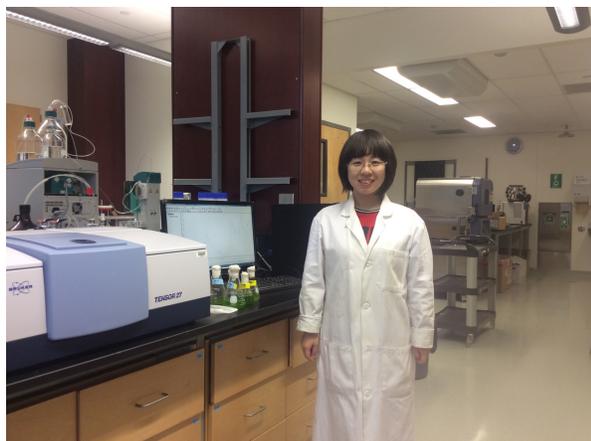
CCCDP is a new branch of the Climate Change Data Portal Network, developed by IEESC and used around the world to assess the future impacts of climate change on agriculture, ecosystems, water, infrastructure, energy development, immigration, and other human activities. Since the initial release of the Ontario CCDP, the data has been downloaded more than 23,000 times by over 330 registered users around the world, including governments, non-governmental agencies, academia, and the private sector.

IEESC's CCCDP is the first coordinated effort for providing publicly accessible Canadian climate change information using high resolution regional climate simulations. The results of this research will help decision makers to assess the impacts of climate change in different emission scenarios, and plan adaptation strategies to reduce various risks associated with climate change, and keep Canadians safe.

For more information, visit:
<http://ccdp.network>

Student Profile: Xiaying Xin

Each newsletter will profile an IEESC student, former student or researcher. The first profile is Ph.D. candidate Ms. Xiaying Xin and her synchrotron research.



1. Hi Xiaying. Tell us about your experience with IEESC. What have you learned that is most valuable?

IEESC is a big group with many professional researchers and hard-working students. They love each other and always provide assistance when someone needs help. When visiting the Canadian Light Source (CLS) in Saskatoon, we spend at least 3 shifts over the course of a 24-hour period, and at times 6 shifts (over a 48-hour period). Then, we take turns doing beamline experiments, while the others could rest and eat. The students all cooperate well and work in harmony with each other without complaint. For me, I feel really appreciative of their help and consideration. I know how to work with people and how to help others while they are working. It's a great teamwork spirit, which benefits my research a lot.

2. What research are you working on?

The first study is about the molecular toxicity of pharmaceuticals and personal care products to green algae species using synchrotron-based Fourier transform infrared spectromicroscopy (SR-FTIR).

We looked at the effects of pharmaceuticals and personal care products in the aquatic environment. We exposed the algae *Chlorococcum sp.* to *triclosan* (a common antimicrobial agent) and carbamazepine (a drug used for treating epilepsy) at various exposure times and concentrations. The toxic effects were studied using chlorophyll, an extraction assay, and synchrotron-based mid-infrared spectroscopy at the CLS. The research will help us to understand the toxicity of triclosan and carbamazepine on single living cells in vivo. The results show unique and superior features of the synchrotron Fourier transform infrared spectromicroscopy technique and provide insight on chemical toxicity research.

The other two studies looked at the short- and long-term toxicity of triclosan to green microalga *Chlorococcum sp.* using synchrotron-based Fourier transform infrared spectromicroscopy under multiple environmental conditions. Their effects and interactions on living algal cells' exposure to triclosan were explored at the molecular level for the first time using SR-FTIR at the CLS. The results can help reveal the variations of molecular components of living algae simultaneously under many

environmental stressors. The response of primary producers to emerging pollutants from biochemically relevant endpoints under multiple environmental stressors will also be examined, hopefully revealing the complexity of the toxicity amplified through the interaction of many stressors. It could also improve the accuracy in solving real-world problems through biotic biochemical component analysis using SR-FTIR spectromicroscopy.

3. Why is this research important?

The release of pharmaceuticals and personal care products into the aquatic environment is an important topic. Large quantities of these products (known as PPCPs) are used and enter the environment, even after treatment by a wastewater treatment plant. PPCPs and their metabolites are reported to be environmentally persistent and bioactive, and have the potential for bioaccumulation in living organisms through the food chain. Due to their high potency and specificity to cause negative ecological effects when interacting with the biological system, PPCPs are an increasing concern. The overall impact of these chemicals on the aquatic environment is difficult to assess as little is known about their ecotoxicological effects on aquatic organisms. By considering algae as a major primary producer in aquatic ecosystems, the toxicity of PPCPs on algae species could be taken as a breakthrough point or a model system to tackle this issue. What's more, traditionally most of the knowledge on the toxicity of pollutants to algae is based on certain environmental conditions.

However, when specific environmental conditions change, the vulnerability of algae can be affected. These changes may cause dysfunction of metabolic pathways, photosynthesis, enzyme activity and energy transmission of algae. Although algae can live in a broad range of conditions, PPCPs can be more toxic and harmful to algae as a result of a changing environment.

4. What do you find most interesting about this research?

To better understand the toxicities, we need to investigate the structures and functions of the subcellular biochemistry within single living cells after exposure to pharmaceuticals and personal care products. The most interesting thing is that synchrotron-based FTIR spectromicroscopy is a viable technique for studying the biochemical and physiological responses of various biomolecules simultaneously at the single cell level. Now we use SR-FTIR spectromicroscopy to study both structure and reactivity of biomolecules in vivo inside single algae cells exposed to emerging pollutants. The synchrotron infrared light is an ideal source that is 100-1,000 times brighter than a conventional thermal infrared source. This provides FTIR spectra of specific subcellular compartments with diffraction-limited spatial resolution and enhanced signal-to-noise ratio. SR-FTIR also enables high-throughput noninvasive spectroscopic microanalysis. Moreover, the signals obtained from single living cells can yield accurate spectrum results instead of averaged ones from bulk cells. SR-FTIR spectra can provide insight into the structure-function information from

functional groups indicating such biomolecules as nucleic acids, lipids, carbohydrates and proteins, while cells are interacting with chemical substances. Therefore, SR-FTIR spectromicroscopy is an informative technique to provide essential information to help observe the toxic state and understand the mode of toxic mechanism of PPCPs in vivo inside a single cell.

5. What advice would you give to a student considering IEESC?

- They need to have a positive attitude towards life and study, especially when facing difficulties.
- They need to work harder so that he or she could gain a lot.
- They will feel much happier and more beneficial when working with others and also giving help to others.

Thanks Xiaying!

Xiaying's research is supported by the Natural Sciences and Engineering Research Council, Canada Foundation for Innovation, Canada Research Chair program, and Canadian Light Source. Her research has been published in the journal *Environmental Pollution*:

Xin X, Huang G, Liu X, et al. *Molecular toxicity of triclosan and carbamazepine to green algae Chlorococcum sp.: A single cell view using synchrotron-based Fourier transform infrared spectromicroscopy.* *Environmental Pollution*, 2017, 226: 12-20.

News and Notes:

Student Success

- Ph.D. student Xiujuan Chen was recognized at the 2017 Canadian Society for Civil Engineering Annual Conference. Her article “Treatment of Oily Wastewater Using Ultrafiltration Membranes Modified by Nano Particles” won Best Student Paper.
- Ph.D. student Jiapei Chen and team won 1st place in a SaskPower solar workshop held at the U of R Johnson-Shoyama Graduate School of Public Policy.
- Ph.D. students Xiujuan Chen and Peng Zhang and their research on membranes used in reclaiming industrial waste water were featured by the Canadian Light Source’s On the Beamlines series.
- 3 former students won the Chinese Outstanding Student Abroad Scholarship: Dr. Shan Zhao, Dr. Yang Zhou and Dr. Guanhui Cheng.
- Dr. Xiuquan Wang was appointed Assistant Professor in the School of Geosciences, University of Louisiana at Lafayette. Dr. Wang pursued his Ph.D. at the U of R from 2010-2015.
- Dr. Shuo Wang was appointed Assistant Professor in the Department of Land Surveying and Geo-Informatics at Hong Kong Polytechnic University. Dr. Wang pursued an M.A.Sc. degree and a Ph.D. at the U of R from 2008-2015.

Research Impact

- IEESC hosted officials from the Canadian Light Source for a workshop for University faculty and students August 1-2, 2017. CLS scientists Dr. Scott M. Rosendahl and Dr. Stuart Read shared their beamline expertise and tips for successful beam time proposals.
- IEESC hosted meetings with Dr. Joy Agnew to review progress on the project “Enhanced Low-Temperature Anaerobic Digestion of Manure for Biogas Heating at Remote Farms.” The Prairie Agricultural Machinery Institute is a collaborator on the project supported by the Government of Saskatchewan.
- Three IEESC publications were classified as Highly Cited Papers in Essential Science IndicatorsSM (ESI). The Highly Cited Papers indicator shows the volume of papers that are classified as highly cited in ESI. Highly cited papers are the top 1% in each of the 22 ESI subject areas per year. They are based on the most recent 10 years of publications. Highly Cited Papers are considered to be indicators of scientific excellence and top performance and can be used to benchmark research performance against field baselines worldwide.
- IEESC’s high-resolution regional climate projections were used in the Climate Change Vulnerability Assessment Report published by the Simcoe Muskoka District Health Unit in Ontario.

- Dr. Chunjiang An had five journal papers published in 2017 related to his NSERC Discovery Grant “Risk Assessment of Endocrine Disrupting Chemicals in Prairie Surface Water under a Changing Climate.”
- Dr. Garth Pickard is a member of the project “Reorienting Education and Training Systems to Improve the Lives of Indigenous and Marginalized Youth” with UNESCO and the United Nations University Regional Centre of Expertise on Education for Sustainable Development.
- IEESC submitted a report to the Government of Saskatchewan on the project “Economic Modeling to Support the Development of Climate Change Regulations.” A SK-CGE model was developed and applied to explore the impacts of different policies on the economy.
- IEESC used the Carbon Disclosure Program-based Greenhouse Gas Emissions Database to investigate the statistical relationship between companies’ GHG emissions and their financial operations.
- Dr. Gordon Huang was the Conference Co-Chair at the 2017 International Symposium on Water Environmental Informatics, in Jinan, China. This conference is hosted by Shandong University, the U of R’s main partner in China.
- Dr. Huang delivered the keynote presentation on “Analysis and Management of Risks in Watershed Environmental Systems” at the Symposium on Integrated Environmental Science and Management for Achieving SDGs at Watershed Scale in Tokyo, Japan.
- Dr. Huang was the Program Committee Co-Chair and Keynote Speaker at the 2017 International Conference on Power and Energy Engineering in Ottawa.
- Dr. Huang was keynote speaker and conference chair of the International Conference on Environment and Industrial Innovation (ICEII 2017), in Kuala Lumpur, Malaysia.
- IEESC attended the 2017 Canadian Society for Civil Engineering Annual Conference in Vancouver. Two presentations were delivered: 1) “Biomass Waste-Derived Adsorbents for the Removal of Organic Pollutants from Water” and 2) “Treatment of Oily Wastewater Using Ultrafiltration Membranes Modified by Nano Particles.”
- Visiting scholars welcomed at IEESC: Zheng Xiao (Hunan University), Hongwen Sun (Nankai University), Wei Fang (Xi’an University of Technology), Aijun Guo (Xi’an University of Technology), and Lei Yu (North China Electric Power University).
- The new Journal of Environmental Informatics website launched. Visit: www.jeionline.org

Do you have a recent article or accomplishment that you would like promoted by IEESC? Send details to Jocelyn.Crivea@uregina.ca



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We feature stories and updates on the research activities of IEESC members and graduate students, and on topics related to energy, environment and sustainability.

Have a story idea? Please contact newsletter editor
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