SFU CLIMATE AND ENERGY RESEARCH DAY
April 14, 2015

Abstract Book
SFU Climate and Energy Research Day  
April 14 2015, 10 am – 5 pm  
Hosted by VP Research, Office and Pacific Institute for Climate Solutions

Agenda

Location: Saywell Hall, Room 10041, 8888 University Drive, SFU Burnaby Campus

10:00 am First Nations Welcome, Introduction and Overview of the Program – Carleen Thomas (Tsleil-Waututh Nation), Tim Takaro (Professor, Health Sciences), Kirsten Zickfeld (Assistant Professor, Geography) and Nastenka Calle (PICS Program Coordinator)

10:10 am En’lightening talks – First round

11:00 am Landscape of Climate and Energy research at SFU – Tim Takaro, Professor, Health Sciences and Lyn Bartram, Associate Professor, Interactive Arts and Technology

11:40 am En’lightening talks – Second round

12:15 pm Lunch and Poster Session, Saywell Hall 9082 Atrium

1:30 pm Plenary talk “Integrating Research from Natural to Social Science: The 2 degree target” – Mark Jaccard, Professor, School of Resource and Environmental Management

2:00 pm Panel session I: Examples of Interdisciplinary Climate and Energy Research at SFU – Deborah Harford (ACT - Public Policy), Andy Hira (Political Science), Erik Kjeang (Mechatronic System Engineering), Elicia Maine (Beedie School of Business), Moderator: Lyn Bartram (Interactive Arts and Technology)

2:45 pm Panel session II: Steps Forward for SFU climate and energy research – Norbert Haunerland (Associate Vice-President, Research), Ingrid Stefanovic (Dean, Faculty of Environment), Tim Takaro (Health Sciences), Kirsten Zickfeld (Geography), Moderator: Arne Mooers (Biological Sciences)

3:30 pm Reception, Museum for Archaeology and Ethnology (until 5 pm)

En’lightening talks – First round

10:10 am Jonn Axsen, Citizen acceptance of new fossil fuel infrastructure: Value theory and Canada’s Northern Gateway Pipeline

10:15 am Karen Kohfeld, Ocean Acidification in Canadian Coastal Communities: an Integrated Coastal Acidification Program (I-CAP)

10:20 am Thomas Kadyk and Michael Eikerling, Degradation in Electrochemical Energy Conversion and Storage Devices
10:25 am  Ryan W. Allen and Enkhjargal Gombojav, *Energy, Air Pollution, and Human Health in Ulaanbaatar, Mongolia*

10:30 am  Kirsten Zickfeld, *The irreversibility of sea level rise*

10:35 am  Erik Kjeang, *Energy Research at SFU FCReL*

10:40 am  Tim Takaro, *Extreme precipitation, drinking water and acute gastro intestinal illness in a Canadian surface drinking water system: putative links and future impact of climate change*

10:45 am  Discussion

**En’lightening talks – Second round**

11:40 am  Karen Kohfeld, V. Savo, H.J. Bailey, D. Lepofsky, *Filling the gaps in climate science by combining precipitation projections with observations of subsistence-oriented communities*

11:45 am  Maya Gislason, Margot Parkes, Bob Wollard, *Being the Change: Integrating social-ecological responses to climate change*

11:50 am  Robert A. Hackett, Shane Gunster, Kevin Kehoe, *From Deadlines to Lifelines: What kind of journalism is needed for global climate crisis?*

11:55 am  Juan José Alava & Peter S. Ross, *Will climate change and ocean acidification exacerbate pollutant bioaccumulation in marine food-webs? A research proposal*

12:00 pm  Discussion

**Poster Presentations**

Location: Saywell Hall 9082 Attrium, 8888 University Drive, SFU Burnaby Campus


5. Jayme Lewthwaite, *Do Roads Kill Off Species? Quantifying the Effect of LNG Development on Biodiversity in BC.*


8. Jonathan E Cripps and Tracy Brennand, *Reinterpreting the effect of climate warming on the last Cordilleran Ice Sheet over the southern interior, British Columbia.*


13. Hung Chak Ho and Anders Knudby, Evaluation of using temperature maps to estimate community risks at an extreme hot weather event.


23. Sina Salari, Claire McCague, and Majid Bahrami, Measurement and Modeling of Mass Transfer within Catalyst Layer of a PEMFC.


26. Pierayeh Vahdani, Xianzhen Li, Chi Zhang, Steven Holdcroft, Barbara J. Frisken, Improving the stability of the active layer in organic photovoltaic cells.

27. Khorshid Fayazmanesh, Claire McCague, Majid Bahrami, Composite adsorbent coating materials with increased thermal conductivity and sorption capacity for adsorption cooling systems.

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3. Dana Ehlert, Kirsten Zickfeld, Exploring the role of ocean heat and carbon uptake in determining the linear relationship between global warming and cumulative CO2 emissions.


5. Jayme Lewthwaite, Do Roads Kill Off Species? Quantifying the Effect of LNG Development on Biodiversity in BC.

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Informational poster


Proposals to build infrastructure for unconventional fossil fuels are increasingly generating controversy among citizens. This study explores the case of Canada’s proposed Northern Gateway Pipeline (NGP), which would transport unconventional oil (bitumen) 1,172 km from Alberta’s oil sands to British Columbia’s northern coast for export. The NGP has received extensive media coverage in the two most affected provinces (Alberta and BC). Critics argue that NGP proponents overstate the economic benefits and understate environmental risks such as the potential for oil spills in sensitive ecosystems, and impacts on Canada’s greenhouse gas emission goals. In this study, I implemented a web-based survey (n = 2,628) in 2013 to collect data on citizen acceptance, values and beliefs related to two common frames of the NGP: economic benefits and environmental risks. I draw from value theory to explain variations in citizen acceptance within and between the two regions, constructing value-based clusters of respondents based on survey data. NGP acceptance varies considerably among clusters in each region; the highest acceptance is among citizens with strong traditional (conservative) values and acceptance is lowest among citizens with strong biospheric-altruistic values. Contextual or regional effects are also substantial; NGP acceptance is higher in every one of Alberta’s value-based clusters relative to BC. Differences in media and stakeholder framing between the regions may help to explain why citizens with the same core values hold different perceptions of the NGP.
Ocean Acidification in Canadian Coastal Communities: an Integrated Coastal Acidification Program (I-CAP)

Author: Karen Kohfeld, Associate Professor
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Anthropogenic CO2 emissions are driving significant decreases in ocean pH and are projected to cause mean surface ocean pH to decline by 0.3-0.5 pH units by 2100. Furthermore, coastal ocean processes can amplify problems of acidification through changes in regional upwelling, hypoxia, and freshwater runoff. Coastal acidification could have huge implications for shellfish, marine ecosystems, and the coastal communities that depend on them. However, very few measurements have been made in Canadian regions that may be directly impacted by coastal acidification. This new interdisciplinary program will focus on two regions of the Atlantic and Pacific coasts and address the following questions: (1) What is the variability of acidification in near-coastal areas where shellfish harvesters are operating? (2) What are the dominant controls on observed variability in these near-coastal regions? (3) How does spatio-temporal variability affect species important to shellfish harvesters and coastal communities? (4) Given these vulnerabilities, what are the socio-economic risks to Canadian coastal communities affected by coastal acidification? The program will build upon existing government observation programs by involving end-users (i.e. local fishing industries and communities) in data collection. These new measurements will be incorporated into existing biogeochemical modeling efforts to better understand regional variability in ocean acidification. Impacts of coastal acidification on key species will be examined through directed field experiments (oysters in the Pacific) and multi-stressor laboratory experiments (lobsters in the Atlantic). Finally, an integrated socioeconomic risk analysis will assess the dependence of coastal communities on marine resources that could become negatively impacted by future acidification.
Degradation in Electrochemical Energy Conversion and Storage Devices

Authors: Thomas Kadyk\textsuperscript{1} and Michael Eikerling\textsuperscript{2}

\textsuperscript{1} Post Doctoral fellow, Department of Chemistry, Faculty of Science
\textsuperscript{2} Professor, Department of Chemistry, Faculty of Science

Presented by: Thomas Kadyk
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Today’s complex society has a substantial and growing energy demand, which is mainly met by fossil fuels. This leads to two major problems: on the one hand, fossil fuel resources are limited and their production expected to decline over the next few generations. On the other hand, utilization of fossil fuels leads to greenhouse gas emissions, which are the root cause of anthropogenic climate change with unforeseeable consequences for natural and human systems on a global scale. In this context, electrochemical energy conversion and storage plays a key role: fuel cells are very efficient and they have the ability to use a variety of fuels. Batteries can serve as energy storage for fluctuating renewable energy sources like wind and solar. Supercapacitors are able to deliver high power densities, which makes them ideal buffers for peak loads in combination with either batteries or fuel cells.

Currently, one of the main challenges for the commercialization of electrochemical devices is degradation. A major cause for irreversible performance decline are structural changes of the porous electrodes, at which the electrochemical energy conversion occurs. Those electrodes consist of microscopic particles, which undergo changes during operation: dissolution of especially smaller particles and redeposition predominantly on larger particles (Ostwald ripening), coagulation and deactivation of particles lead to a decrease of electrochemically active surface area and thus to a loss in utilization of the often expensive electrode material. This talk gives a glimpse into statistical approaches taken to understand these structural changes and their impact on performance.
Combustion to generate electricity and heat is a major source of air pollution around the world. Combustion produces a complex mixture of pollutants including fine particulate matter (PM$_{2.5}$), which is a well-established cause of mortality and cardiopulmonary morbidity and accounts for nearly 4% of the global burden of disease.

This presentation will describe links between combustion, air pollution, and health with a focus on previous and ongoing research in Ulaanbaatar, Mongolia. Ulaanbaatar is Mongolia’s rapidly growing capital and home to nearly half of the nation’s 2.7 million inhabitants. The primary sources of air pollution are coal smoke from home heating stoves in gers (Mongolian yurts) and from coal-fired power plants. Coal combustion accounts for 67% of the PM$_{2.5}$ on an annual basis and nearly all of the PM$_{2.5}$ in winter. Ulaanbaatar’s air was recently described by the WHO as the second-worst on the planet; PM$_{2.5}$ concentrations are typically over 150 µg/m$^3$ (or 15 times the WHO’s air quality guideline) in the city centre and 300 µg/m$^3$ or more in the city’s ger areas. We have conservatively estimated that 10% of the mortality in Ulaanbaatar can be attributed to ambient air pollution.

We are currently conducting a novel randomized controlled trial among pregnant women in Ulaanbaatar to evaluate the efficacy of portable high efficiency particulate air (HEPA) filtration in reducing the negative impacts of air pollution on fetal growth. In addition, we are developing spatial models of outdoor PM$_{2.5}$ and gaseous pollutant concentrations to improve exposure estimation in epidemiologic studies and risk assessments.
The irreversibility of sea level rise

Kirsten Zickfeld, Assistant Professor
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Recent research has shown that sea level will continue to rise even if greenhouse gas emissions will be halted completely, potentially exceeding levels that are detrimental to many coastal regions. Therefore the question arises of whether artificial removal form the atmosphere (CDR) – a less controversial form of geoengineering which is increasingly discussed as an alternative to emission reductions - has the potential to reverse sea level rise on timescales relevant to human civilization. Here, we investigate how much CO\textsubscript{2} needs to be removed from the atmosphere for sea level rise from thermal expansion of the ocean to be reversed and stabilized permanently. To investigate these questions, an Earth System model of intermediate complexity is forced with a range of emission scenarios entailing different amounts of CDR. Our results suggest that while sea level rise can be reversed temporarily with amounts of CDR that are currently deemed to be technologically feasible, reversal and permanent stabilization of sea level rise requires removal of all anthropogenic CO\textsubscript{2} from the atmosphere, which likely exceeds limits on the rate and scale of deployment of CDR technology.
Energy Research at SFU FCReL

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Brief synopsis/abstract: The Fuel Cell Research Laboratory (FCReL) at SFU, directed by Dr. Erik Kjeang in the School of Mechatronic Systems Engineering, focuses on research, innovation, and technology development for sustainable energy systems, in particular for transportation. In this enlightening talk, an overview of the ongoing research activities at FCReL will be provided. FCReL features three physical laboratories at SFU Surrey, Powertech Labs, and Ballard Power Systems with state-of-the-art infrastructure for design, modeling, fabrication, characterization, and testing of energy materials and devices. Major research projects that will be highlighted include hydrogen fuel cell development in collaboration with Ballard Power Systems and vehicle life cycle modeling in collaboration with City of Surrey.
Extreme precipitation, drinking water and acute gastro intestinal illness in a Canadian surface drinking water system: putative links and future impact of climate change

Presented by: Tim K. Takaro, Professor
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Introduction: Climate change is expected to increase the burden of waterborne acute gastrointestinal illness (AGI) due to the increased frequency and intensity of extreme precipitation events. Here we investigate the relationship between extreme precipitation and parasitic AGI and to project the impact of climate change on these illnesses.

Methods: We included reported cryptosporidiosis and giardiasis cases served by a municipal surface drinking water system (DWS) in Canada from 2000-2009. The association between weekly cases and modeled extreme precipitation (>90th percentile) was assessed (up to 6 week lags), using distributed lag non-linear Poisson regression models adjusted for seasonality (in lieu of temperature), secular trend, preceding dry/wet period and holiday effects. Using the best fitting model, the mean annual case counts were predicted for 2010-2069 using downscaled precipitation projections from 10 global climate models under the representative concentration pathway 8.5.

Results: Including 5738 cases, a significant increase in cryptosporidiosis and giardiasis 5-6 weeks after extreme precipitation was found during the study period 2000-2009. A greater effect was evident during the rainy season (RR, 95% CI: 1.17, 1.08-1.32 in lag 5; 1.34, 1.11-1.59 in lag 6) than the dry season (RR, 95% CI: 1.09, 1.02-1.26 in lag 5; 1.17, 1.01-1.39 in lag 6). By the 2060s, climate models indicate decrease in average weekly and extreme precipitation during dry seasons, and increase in rainy seasons compared to 2000-2009. This increases the annual disease burden by 10%-14% (ensemble mean 11%), mainly in the rainy season.

Discussion: We present a modeling framework to study the impact of extreme weather on waterborne AGI and support the hypothesis that increases in extreme precipitation may increase the burden of these AGI in future. These results show the need for increasing the adaptive capacity of vulnerable DWS through standardized infrastructure and testing of the effectiveness of these interventions.
EN’LIGHTENING TALKS
ROUND II
Filling the gaps in climate science by combining precipitation projections with observations of subsistence-oriented communities

K. Kohfeld\textsuperscript{1}, V. Savo\textsuperscript{2}, H.J. Bailey\textsuperscript{1}, D. Lepofsky\textsuperscript{2,3}

\textsuperscript{1}School of Resource and Environmental Management, Faculty of Environment
\textsuperscript{2}Hakai Institute, Simon Fraser University
\textsuperscript{3}Department of Archeology, Faculty of Environment

Presented by: Karen Kohfeld
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Shifts in precipitation regimes is a well-documented and pervasive consequence of climate change worldwide. Subsistence-oriented communities and instrumental observations identify various changes in the patterns of rainfall, droughts, and extreme events in many localities. A key question is how well instrumental observations represent changes that are most meaningful to humans affected by climate change. We compared observations of rainfall from subsistence oriented communities to instrumental data for the period 1953 – 2003 to identify areas of correspondence between these two sources of data. We also investigated reasons why mismatches between the two datasets may exist in certain parts of the world. We find that in 67% of cases, human observations of changes in amounts of rainfall match measured changes in precipitation, but that the correspondence between human observations and instrumental metrics differs among Ecozones (e.g., drought and indices of dryness match best in the Afrotropic region, 92%). One variable that is not easily captured by instrumental data is the increased variability of rainfall patterns and seasonality, which on the other end, is a key factor in planning subsistence activities such as farming. Finally, our results refute the hypothesis that human observations tend to be biased by extreme events and have difficulty representing general trends in climate.
Being the Change: Integrating social-ecological responses to climate change

Maya K. Gislason¹, Margot Parkes², Dr. Bob Wollard³
¹ Assistant Professor, Faculty of Health Sciences
² MBChB, MAS, PhD, Canada Research Chair in Health, Ecosystems and Society; Associate Professor, School of Health Sciences, UNBC; Cross Appointed, Northern Medical Program, UBC
³ Professor, Department of Family Medicine, Faculty of Medicine

Presented by: Maya K. Gislason  
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The 2014 International Association for Ecology and Health’s (IAEH) Call to Action on Climate Change emphasizes the value of developing integrated, interdisciplinary and multi-sectorial responses which address the core drivers of climate change. When responding particularly to issues of resource extraction instigated by and for the energy sector, the authors of the Call to Action recognized two key challenges that will be discussed in this presentation: 1. While myriad responses to global climate change are being developed, many are not being robustly linked to one another in a way that builds a broader sense of capacity to make significant changes to ‘business as usual paradigms’; and 2. Scientists and civic actors working on energy issues do not always see themselves as part of more widespread and upstream response to climate change – both in terms of producing problems or solutions.

This presentation will draw from the IAEH Call to Action on Climate Change to reflect in particular on a central set of principles that the IAEH proposes can meaningfully guide integrated responses to climate change and to illustrate how this thinking was expressed in the call. This presentation will conclude with a pre-launch peak at the ‘Gallery of Actions’ initiative that has emerged out of this year long, multi-stakeholder process. Participants of the Pacific Institute for Climate Solutions research day will be invited to consider how their work on energy and Climate Change could be celebrated in the Gallery of Actions as exemplars of integrated responses to climate change.
From Deadlines to Lifelines: What kind of journalism is needed for global climate crisis?

Robert A. Hackett, Professor, School of Communication, Faculty of Communication Art and Technology
With contributions from Prof. Shane Gunster (School of Communication) and Kevin Kehoe (Political Science B.A. program, SFU)
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In constructing the political will to address climate change, the journalism field comprises a key site of struggle for public engagement and mobilization. There is now substantial research on media coverage of climate change. This paper addresses a relatively unexplored relationship – between “best practices” for climate change journalism, identified in professional and academic literature; public responses to different journalistic approaches to the issue, emerging from focus group research in Vancouver; and the perceptions of Vancouver-area ‘alternative’ journalists and environmental NGOs communicators attempting to encourage publics to engage in climate change as a political issue.

We shall explore the extent to which these three vectors align with each other, in the context of British Columbia’s extractivist capitalism, media concentration, and vigorous alternative media and environmental movements. In particular, we focus on the capacity of different media practices and types of organization, to encourage collective political engagement, mobilization around climate change, and/or resistance to extractive capitalism, thereby counteracting the cynicism cultivated in hegemonic political culture. We conclude that the potential for independent and alternative media -- not only to promote critical perspectives on hegemonic economic and political structures, but also to nurture radical visions of democratic society and new models of participatory communication --, deserves more attention in relation to the imperatives of crisis-driven climate communication and politics.
Will climate change and ocean acidification exacerbate pollutant bioaccumulation in marine food-webs?
A research proposal

Juan José Alava¹ & Peter S. Ross²

¹Adjunct Professors, School of Resource and Environmental Management, Faculty of Environment, Simon Fraser University, Burnaby, Canada
²Director/Senior Scientist, Ocean Pollution Research Program, Vancouver Aquarium Marine Science Centre, Vancouver, Canada

Presented by: Juan José Alava
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Climate change and anthropogenic pollution are two 21st century threats to marine ecosystems on a global scale. Ocean acidification is likely to conspire together with other stressors on both a global scale (e.g., ocean warming, hipoxia levels) and local scale (e.g., pollution, nitrification/denitrification and eutrophication). Understanding the combined effect of climate change and pollutant impacts is crucial for those tasked with managing ecological and human health risks in the long-term. In this context, the cumulative impacts of ocean warming, acidification and marine pollution will likely be felt most poignantly by coastal aboriginal communities relying strongly on traditional seafoods. To investigate and test this task, this research proposal envisions the development and application of models to predict the impact of climate change and acidification on the biological accumulation of legacy and emerging organic chemical pollutants (i.e. organic mercury, PBDE flame retardants, perflourinated compounds (PFCs), PCBs, DDTs) in marine food webs from the eastern Pacific Ocean and equatorial Pacific (Galapagos Islands, Ecuador). The goal of this proposal is to collate available information and data related to i) climate change and ii) priority pollutants in the Pacific Ocean in support of the evaluation of a series of forward-looking risk scenarios for marine biota and human societies. Activities will consist of the development of marine food web-based models that combine contaminants and climate features as variables, and to apply these in the derivation of different scenarios into the future. The outcomes and predictions of this research will provide sound science tools (models) and knowledge for climate change mitigation, public health protection and ocean conservation efforts.
POSTER PRESENTATIONS
# Sustainable Water Allocation: A Whole System Approach in a Rapidly Developing Energy Resource Sector

**Authors:** Jennifer Brand, PhD Student, Department of Earth Sciences, jbrand@sfu.ca
Diana Allen, Professor, Department of Earth Sciences, dallen@sfu.ca

**Abstract**

In the wake of rapid development, water resource managers are faced with the difficult task of quantifying water resources and allocating the water sustainably. Surface water is often allocated without consideration of concurrent groundwater use. However, surface water and groundwater are inextricably connected, and groundwater extractions can have significant impacts on surface water flows, especially under seasonal low flow conditions. Climate change is predicted to lead to more extreme hydrologic regimes, including lower low flows, and in order to ensure sustainable water resources management, water allocation programs should take a whole system approach and consider both groundwater and surface water as one source. This research will focus on the shale gas industry expansion in northeast British Columbia as a proxy for other areas of rapid development and rapidly increasing water use. Coupled groundwater-surface water flow models will be developed for different watershed types to gain insight into how the combined effects of water extraction and climate change impact the hydrologic system as a whole. By analyzing the surface-water groundwater interactions and quantifying the potential for interbasin flow, we hope to identify topographic and hydrogeologic metrics that control the system’s hydrodynamic response to water extractions and climate change on a watershed scale. These metrics will then be used to prioritize areas for water conservation and water extraction and develop a risk-based approach to water allocation. This research will have implications for future water resource use patterns in northeast BC and may result in a new whole system approach for sustainable water allocation.
The Northern Gateway Debate: Media, PR and the Practices of Power

John Bermingham, PhD Candidate, SFU School of Communication

Abstract
As it seeks out new revenues, Canada’s beleaguered corporate media is selling itself as a conduit for clients to deliver their strategic public relations messages more extensively than ever before. For news consumers, it is increasingly difficult to distinguish what is journalism and what is PR spin. The Northern Gateway pipeline proposal, a $6.5-billion project by Enbridge Inc. would move 525,000 barrels of bitumen daily from Alberta to B.C., forms a critical component of Canada’s expansion of the oil sands. It is also a highly contested project, raising environmental concerns about its negative impacts on local ecologies and communities, as well as its effect on global climate change. The proposed Enbridge pipeline has prompted one of the biggest PR campaigns in Canadian history, where corporations, governments are outspending non-governmental organizations by millions to sway public opinion. All sides of the debate are inundating Canadians with promotional messages, while at the same time, Canada’s media companies are devoting comparatively few editorial resources to news coverage of the issue. What is the role of the media in discursive representation, negotiation and contestation? Within Canada’s public sphere, what are the implications of this mediated debate for political communication and democratic discourse?
Exploring the role of ocean heat and carbon uptake in determining the linear relationship between global warming and cumulative CO₂ emissions

Dana Ehlert, PhD Candidate
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Abstract (max 250 words):
The ratio between temperature change and cumulative CO₂ emissions, also referred to as Transient Climate Response to Cumulative CO₂ Emissions (TCRE), has been shown to be approximately constant over a wide range of cumulative emissions. This ratio can be a useful metric for setting allowable cumulative emissions to global warming targets. However, the underlying mechanisms for the approximate constancy of the TCRE are not well understood. Ocean heat and carbon fluxes have a strong effect on the transient climate and have been thought to be the main reason for the constancy. This study explores the effect of ocean mixing on ocean heat and carbon fluxes and in turn on the TCRE, but also takes land carbon fluxes into account. The University of Victoria Earth system climate Model (UVic ESCM), a climate model of intermediate complexity that is coupled to a carbon cycle and includes land scheme with vegetation, has been used. The default mixing setting includes a mixing along isopycnals due to diffusion, a Gent and McWilliams eddy thickness diffusivity, and a vertical variable mixing (Bryan and Lewis parameterization). The parameters for these mixings have been changed, the vertical mixing has been changed to a constant vertical mixing scheme, and lateral mixing has been changed from mixing along isopycnals to horizontal mixing. The TCRE remains approximately constant within each mixing setting but varies between the mixing settings. Higher or lower TCRE values between the mixing settings mostly correlate with higher or lower values in both ocean heat and carbon fluxes.
#4

Risk and resilience in the shale gas context: a water-energy nexus perspective

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Abstract
The accelerated development of unconventional gas plays has raised public concern about potential risks to the environment. In this study, a risk assessment framework for shale gas development aims to quantify and/or qualify risk and resilience within a water-energy nexus context. The risk assessment framework will be focused in northeast British Columbia where shale gas development is rapidly proceeding. The main components of risk include hazards, susceptibility and the potential consequences, which will be evaluated in space and time using a Geographic Information System (GIS). The hazards associated with shale gas development include: water, air, and soil contamination; water usage in terms of demand and disposal; and land use disturbance. Potential hazard sources for water and soil contamination include accidental spills and/or leakage during drilling, hydraulic fracturing and transportation activities; pipelines and wastewater disposal. The assessment will take into account the occurrence, frequency, duration and magnitude of the hazards. Hazard-specific susceptibility maps will be generated based on the physical characteristics of the environment as well as water source and community footprints. The resulting set of spatial risk maps can then be used for water resource management, land use planning, and industry permitting. The evaluation of resilience, which buffers risk, considers the regulatory framework and whether or not existing regulations can mitigate risk by reducing the hazard potential or consequences. If development is to continue at its current pace in northeast BC, it is imperative that decision-makers recognize the changing risk and resilience profiles and respond with appropriate policy.
#5

Do Roads Kill Off Species? Quantifying the Effect of LNG Development on Biodiversity in BC

Jayme Lewthwaite
Department of Biological Sciences

Abstract
British Columbia’s liquid natural gas reserves are often touted as a “clean” energy source since they emit much lower levels of carbon dioxide, a greenhouse gas, in comparison with Alberta’s oil sands products. What is often neglected in these considerations is the effect of the infrastructure that accompanies and surrounds LNG extraction, in particular the vast network of roads required to extract the product of interest. We examine the effect of road development on species richness over the past decade, focusing specifically on the 161 butterfly species of British Columbia. Using museum, laboratory and private collection records, we measure the change in species richness across Canada over the past decade. We predict that areas that experienced an increase in road development associated with LNG extraction have lost more species on average than other areas in BC. With over a dozen new major LNG projects proposed, there is concern that the associated habitat loss will directly result in local extirpation and even province-wide losses of many species. This study will provide insight into the magnitude of this potential loss and the conservation implications that British Columbia may face as a result of LNG development.
#6

Topographical and hydrogeological controls on spring occurrence in Northeastern British Columbia, a rapidly developing shale gas region

Ismena Bystron¹, Dirk M. Kirste² and Diana M. Allen³

¹ M.Sc candidate - ibystron@sfu.ca; ² Associate Professor, dkirste@sfu.ca; ³ Professor, dallen@sfu.ca

Department of Earth Sciences, Simon Fraser University, Burnaby BC V5A 1S6

Abstract

Northeastern British Columbia has recently gained much attention as a potential source of natural gas energy in Canada. Shale gas operations and activities increase the demand for groundwater, creating concerns regarding water supply and contamination. Natural springs are important sources for domestic water supply in the Halfway watershed, which has a unique low-relief terrain. It is critical to understand the topographical and hydrogeological controls of spring occurrence in a low-relief terrain to better understand the groundwater resource. A multi-criteria Geographic Information System (GIS) model will be constructed to identify locations of high likelihood for spring occurrence in the Halfway watershed. The GIS model criteria will include terrain characteristics (slope, aspect, elevation), geology (soil, surficial geology, bedrock geology, distance to faults) and hydrogeology (depth to aquifer, aquifer lithology/permeability, recharge) factors. The model results will be field verified, and any new spring locations will be added to documented spring locations to establish a spring database. The second part of the project will address the origin of groundwater recharge. Chemical and isotopic composition of groundwater and spring water will be used to infer groundwater flow paths and estimate mean residence time of groundwater. Springs in Northeastern British Columbia are not well documented and adequate setback distances for spring protection have not been identified. Such knowledge may be valuable for regulation and management of groundwater sources by municipal, provincial and energy industry.
#7

Environmental Dismantling

Nigel Kinney & Michael Howlett
PhD Candidate, School of Political Science

Abstract:
The newly developed field of policy dismantling is examined to understand its importance. Through the use of Bauer and Knill’s framework, a case study of policy dismantling is explored. The case, the 2012 repeal and replacement of the Canadian Environmental Assessment Act, is tested to understand the unique attributes of environmental policy in contrast to the conventional social policy analysis. The case study finds evidence of decision-makers prioritizing ideological preferences over evidence-based solutions. This finding might prove problematic for the existing theory in its current form. It concludes with proposed revisions for the Bauer and Knill framework and directions for future research in the field, while also addressing the possible impacts such dismantling may have on future attempts to combat climate change.
Reinterpreting the effect of climate warming on the last Cordilleran Ice Sheet over the southern interior, British Columbia.

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&
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Abstract
The potential retreat of the Greenland and Antarctic ice sheets is a key concern under climate change forecasts, particularly impacts on sea level and ocean circulation. Our ability to anticipate future ice sheet retreat relies on a good understanding of how ancient ice sheets responded to similar temperature forcing. The last Cordilleran Ice Sheet (CIS) which lay over British Columbia (BC) around 12,000 years ago is currently thought to have shrank vertically and stagnated, whereas reconstructions of other ice sheets of the same period show the ice withdrew systematically inwards. Stagnation implies a markedly more rapid temperature rise over BC than other regions; this hypothesis therefore requires thorough testing to establish whether this anomalously rapid regional temperature rise is valid, and to improve the understanding of the CIS retreat so that it may be better applied to predict future ice sheet dynamics.

This project has reinvestigated the recession of the CIS in the Nicola Valley, in the southern interior of BC. Receding ice margins have been reconstructed from the extent of ancient ice-dammed lakes; these margins show progressive retreat to the northwest, and the tilts of these lake surfaces implies thicker ice in this direction, both supporting a systematic retreat style. Moraine ridges were observed throughout the region, showing small readvances of this retreating margin. These results encourage the rejection of the stagnating hypothesis in favour of active retreat of a broad margin to the northwest, implying that this mode of retreat is likely for modern ice sheets.
#9

Climate Variability and Paleorecharge of the Yucatan Peninsula, Mexico

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Abstract

The Mayan civilization suffered a massive population decline throughout a 150-year series of droughts during the Terminal Classic Period (800-950 C.E.). This drought period is thought to be the result of climate cycles such as the El-Nino Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), which still affect the climate today. While previous studies have used proxy data to estimate paleoprecipitation and paleotemperature, these data have not been combined to create a paleoclimate record spanning the collapse period. In this study, a representative paleoclimate record for the Yucatan Peninsula will be generated. A daily climate time series for the Terminal Classic Period will be generated using shift-factors determined from the paleoclimate record and applied to the current climate data series. This climate data series will also be compared to raw climate data generated from a paleoclimate global climate model (past1000 experiment, CMIP5 modeling group). Paleorecharge and current recharge will be modelled using a coupled land surface – subsurface model (MIKE SHE) to estimate the water balances for a representative watershed and to explore how climate variability influences the hydrology. The study will have implications for understanding climate variability, which may lead to extreme weather conditions in future, similar to those that existed during Mayan times.
Swimming Against the Current: Valuation of White Sturgeon in Renewal of the Columbia River Treaty

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The Columbia River Treaty (CRT) between Canada and the United States was implemented in 1964 to cooperatively manage water-related issues. Treaty terms were based on flood control and hydropower generation with little consideration for ecosystem health and the benefits therein. Considering the growing and competing demands for the basin’s natural resources, climate change, and the narrow scope of the Treaty, basin management has become fragmented and deleterious to the River’s vast and complex watershed ecosystems. To ensure the Columbia River Basin (CRB) is able to absorb growing demands, while balancing environmental protection, provisions for the management of ecosystem services must be integrated into the upcoming Treaty negotiations in 2024.

This study uses the white sturgeon as an example of how undervalued ecosystem goods and services can be integrated into the CRT. While the CRB once supported productive population of white sturgeon, they are now an endangered and threatened species. Notwithstanding the methodological and data limitations, this study shows that restoring white sturgeon populations would generate substantial monetary and intangible benefits to the U.S. portion of CRB. Incorporating these values into the decision-making process can help delineate the costs and benefits of proposed management strategies, while changing the calculation of benefits, arrangements, and coordination between both countries; what were once acceptable trade-offs could reveal net costs. The layered and complex nature of governing the CRB necessitates nuanced and comprehensive policy solutions. As such, this study’s analysis yields recommendations for a portfolio of policy options to entities of the CRT.
#11

Vulnerability Assessment for Groundwater Dependent Streams

Mary Ann Middleton, Diana Allen

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**Abstract**

In many streams in British Columbia (BC), stream flow is sustained by groundwater inputs (baseflow) during the annual summer low flow period and, as a result, such “groundwater dependent streams” can be sensitive to changes in groundwater fluxes during this period. This period also coincides with peak water demands from both groundwater and streams, compounding low flow impacts, causing critical thresholds to be reached or exceeded for many aquatic species. Climate variability and climate change have the potential to impact recharge conditions as well as lead to increased water demands, which in turn will lead to changes in groundwater conditions. This research presents a methodology to evaluate the vulnerability of a groundwater dependent stream to changes in the groundwater system. The stream vulnerability assessment is a multi-step, risk-based approach, involving a three level assessment procedure. The first two levels of the assessment procedure evaluates and rates the potential vulnerability of a stream, based on the degree of connectivity between the stream and the aquifer as well as stressors acting on the system, such as groundwater pumping. The third level of assessment is a quantitative evaluation of the impacts to the stream from groundwater-related stressors. The results of second and third level assessments can be integrated into a risk assessment / risk management framework. A full risk assessment could be used to develop integrated management plans for water quantity planning for groundwater dependent streams, and to formulate solutions to water demand conflicts and mitigation measures for sensitive streams to protect aquatic habitat.
Associations between biogeoclimatic zones and five acute gastrointestinal illnesses in British Columbia from 2000-2013 and potential implications under projected climate change

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Introduction
Interactions between pathogens and the environment could influence rates of acute gastrointestinal illness (AGI) across space and time. Understanding the details of these associations would help inform policies that aim to reduce this burden of disease and increase our adaptive capacity to climate change. Here, we present findings of our study that investigates relationships of five AGIs with biogeoclimatic (BGC) zones in British Columbia in the context of a changing climate.

Methods
We included reported cases of campylobacteriosis, salmonellosis, verotoxin-producing Escherichia coli (VTEC), cryptosporidiosis and giardiasis from 2000-2013 throughout British Columbia. The home address for each case was used to calculate disease rates for five AGIs in every biogeoclimatic zone. To examine pathogen-specific climatic relationships, Poisson regression will be used with known climatic data for each BGC zone. Finally, existing projections of BGC zone distribution with climate change will be used to make crude estimates of future disease burden throughout the province.

Results
Unadjusted disease rates for five pathogens have been calculated for nine BGC zones using 38,914 cases from 2009 to 2013.

Conclusions
These preliminary results indicate a range of disease rates occurring across BGC zones among the five pathogens. The 95% confidence intervals of some zones only overlap with one or two of the others, and some do not overlap with any. Analysis will determine what portion of the variation, if any, can be associated with specific climatic variables.
Evaluation of using temperature maps to estimate community risks at an extreme hot weather event

Authors: Hung Chak Ho and Anders Knudby

Abstract:
Climate change has elevated the severity and frequency of heat waves, and urban expansion has increased the urban heat island effect in large cities. The combined effect of a warmer urban environment is likely to cause elevated mortality during future heat waves. Living in a hot neighbourhood has been demonstrated to be a health risk during heat waves, but there is no consensus on how such neighbourhoods are defined. Using the Greater Vancouver Area, we evaluate the spatial distribution of mid-morning land surface temperature derived from satellite data, and daily maximum air temperature and Humidex derived using regression modeling. Results indicate that the spatial patterns of daily maximum Humidex and air temperature are generally similar, with locally concentrated differences throughout the urban landscape, specifically Humidex values are relatively high in vegetated urban and agricultural areas. Spatial patterns of land surface temperature are markedly different, with greater extremes and stronger local dependence on surface material. Definition on the urban heat island and analysis of its influence on human health during heat waves will be influenced by the specific definition of heat.
Estimating groundwater recharge to the Gulf Islands under future climate conditions

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Abstract
Climate change has the potential to affect groundwater resources globally, principally though increases in temperature and changes in the amount and intensity of precipitation which control the replenishment (or recharge) of groundwater. This study aims estimate current and future recharge to a mountainous island bedrock aquifer. Estimating recharge in mountainous bedrock settings is challenging due to the steep topography that strongly influences runoff and infiltration dynamics. The study area is Gabriola Island in the Gulf of Islands, BC, where the inhabitants rely almost solely on groundwater for drinking water supplies. To estimate recharge to the Gabriola Island aquifer, a coupled land surface - subsurface numerical model will be developed using available climate, topographic, soil, geological and land cover data. The model will be calibrated to observed groundwater levels and relative groundwater age estimated using tritium isotopes. Projected median shifts of various climate parameters (mean daily temperature, total precipitation, solar radiation, and relative humidity) derived from an ensemble of global climate models (GCMs) will be applied to the current climate data series to generate a future climate series for input to the numerical model. The results of this study will provide an estimate of the overall water balance for the island, which can be used to inform both current and future water use planning.
Housing Preference in the Peri-urban Zone: The Prospects for Urban Containment and Smart Growth in North Cowichan

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Research Question:
What housing form and neighbourhood design characteristics appeal to residents of North Cowichan and to what extent are these preferences consistent with North Cowichan’s urban containment policy?

Research Summary
Smart Growth has emerged in response to the predominant human settlement pattern in North America: Low density, energy intensive sprawl. Broadly speaking, Smart Growth aims to create dense mixed-use neighbourhoods that are accessible by a variety of transportation modes and which offer a diversity of housing forms, including apartment and semi-detached homes. Rooted in environmental sustainability and prudent fiscal management, smart growth also addresses the threat of anthropogenic climate change by reducing automobile dependence and reducing the energy required to heat and cool homes. North Cowichan’s urban containment policy is one example of a general orientation towards smart growth contained within the municipality’s official community plan.

This research investigates housing and neighbourhood design preferences in North Cowichan, exposing a tension between what is planned in North Cowichan’s Official Community Plan and what is perceived as desirable by residents. Through a short questionnaire, semi-structured interviews with developers and realtors, and analysis of the public record, the research seeks to understand the implications of housing and neighbourhood preference for successful implementation of urban containment and smart growth.

Early analysis of survey responses reveals that the vast majority of residents prefer single family detached homes (92% of respondents) and that “privacy and separation from neighbours” is the most desirable housing characteristic among residents (42% of respondents). In order for the implementation of smart growth to be successful in North Cowichan, neighbourhood and housing design will need to recognize these values and incorporate them into design.
Lightweight look-ahead options: An Eco-Dialect between the building; its inhabitants and designers

Vinu Subashini Rajus, Robert Woodbury
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“When Jane reached home after exercise, she finds the room temperature very warm”
Let us name this scenario, ‘I feel very hot’. Here, Jane (the inhabitant) has various options to choose from: a) open windows, b) open windows and lower thermostat, c) lower thermostat, d) pre-set thermostat before activity, e) leave the building for awhile, or e) remove her jacket. Each option has its effect on the building’s energy usage and also how inhabitants (Jane and others) perceive the effect of Jane’s interactions with the controls and the building elements. Further, every action affects the future, not the present. Some time must elapse before the effects of actions become clear. Some effects, notably energy use, are notoriously hidden from view. It is hardly surprising that inhabitants do not clearly understand the effects of their comfort-seeking actions. Yet, understanding is a prerequisite to effective control. In sharp contrast to the dynamic relation between inhabitants and buildings sketched above, designers and simulators generally treat inhabitants as having fixed, rule-based or scheduled behaviors.

Building inhabitants use personal knowledge to control buildings. Post occupancy evaluation reveals that there is a vast difference between the predicted energy consumption and the actual energy usage. The literature clearly identifies that how inhabitants use buildings has a large impact on the energy consumption in all buildings. How do inhabitants' use buildings? How do inhabitants interact with and control buildings, including their elements and systems? This research explores inhabitant’s interaction by providing Light Weight Look Ahead Options (LWLALOA), a quick simulation of possible inhabitant interaction to predict how personal choices impact comfort and energy consumption in buildings. The system design has two distinct parts: interactive visualization (D3.js) and simulation (Ladybug/Honeybee/grasshopper). These tools are connected through a common database (Excel). The interactive visualization has three display modes; ‘I feel’, ‘What if?’ and ‘If buildings could speak’. In I feel, the inhabitant’s express what they feel in a room, for example, ‘I feel vey cold’. And in, What if, the inhabitant’s explore what happens when they interact with different elements, for example, turning thermostat low or opening windows. Lastly in, if buildings could speak, the building initiates interaction when it notices that the inhabitants have been inactive in interaction for a long time and the building’s environment differs from norms. For example, the system will prompt that the room temperature is turning very high, do you want to turn down the thermostat? Unlike automated buildings, the system here only prompts the messages and leaves the decision with the inhabitant’s. When these modes are interacted, the simulation tools run simultaneously to display the LWLALAO options. This research mainly focuses on designing visualization to engage inhabitant’s to make effective sustainable interaction. The study may reveal models of inhabitant’s interaction/use in the building for energy simulation tools.
Risk of Saltwater Intrusion in Coastal Aquifers due to Climate Change and Development

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Abstract
In coastal regions, fresh groundwater is in direct contact with the ocean. The quality of the groundwater can be compromised due to saltwater intrusion (SWI) caused by various hazards related to pumping (due to development) and climate change (sea level rise, storm surge, changes in recharge). The goal of this research is to develop approaches for assessing and managing risk to groundwater quality in coastal aquifers. The Gulf Islands in British Columbia is the case study area. Chemical indicators of SWI were identified based on the analysis of an extensive water chemistry database available for the Gulf Islands. Various quantitative, graphical and statistical methods were used to chemically distinguish groundwaters that are impacted by saltwater intrusion, and to identify thresholds for several chemical parameters that could be used for monitoring purposes. The most appropriate indicators, based on available data, are chloride, electrical conductivity and total dissolved solids. Climate change related hazards, including sea level rise and storm surge overwash, were combined into floodplain maps using projected sea level rise data for 2100 in combination with estimated storm surge data over a forty year period. The floodplain maps show the projected extent of coastal zone that may become inundated or impacted by storm overwash under future climate change, and thus more likely to be impacted by SWI. The combination of chemical indicators and risk assessment maps are useful tools which can be used to improve decision-making related to monitoring and community development for this particular coastal area of BC.
Extreme precipitation, drinking water and acute gastrointestinal illness in a Canadian surface drinking water system: putative links and future impact of climate change

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Abstract
With climate change, it is expected that burden of waterborne acute gastrointestinal illness (AGI) could increase with the increased frequency and intensity of extreme precipitation events. The purpose of this study was to investigate the relationship between extreme precipitation and parasitic AGI and to project the impact of climate change on these illnesses. We included 5738 reported cryptosporidiosis and giardiasis cases served by a municipal surface drinking water system (DWS) in Canada from 2000-2009. The association between weekly cases and modeled extreme precipitation (>90th percentile) was assessed (up to 6 week lags), using distributed lag non-linear Poisson regression models. The mean annual case counts were predicted for 2010-2069 using downscaled precipitation projections from 10 global climate models under the representative concentration pathway 8.5. A significant increase in cryptosporidiosis and giardiasis 5-6 weeks after extreme precipitation was found. A greater effect was evident during the rainy season (RR, 95% CI: 1.17, 1.08-1.32 in lag 5; 1.34, 1.11-1.59 in lag 6) than the dry season (RR, 95% CI: 1.09, 1.02-1.26 in lag 5; 1.17, 1.01-1.39 in lag 6). By the 2060s, climate models indicate decrease in average weekly and extreme precipitation during dry seasons, and increase in rainy seasons compared to 2000-2009. This increases the annual disease burden by 10%-14% (ensemble mean 11%), mainly in the rainy season. We present a modeling framework to study the impact of extreme weather on waterborne AGI and support the hypothesis that increases in extreme precipitation may increase the burden of these AGI in future.
Response of a Fractured Bedrock Aquifer to Recharge from Heavy Rainfall Events on the Gulf Islands, British Columbia

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Abstract
The proportion of heavy rainfall events is anticipated to increase in the 21st century according to climate change projections from global climate models (GCMs). Changes in the amount and timing of rainfall may increase recharge or decrease recharge depending on the infiltration capacity of the ground, and may subsequently influence the amount and timing of groundwater storage changes in the aquifer. Such processes have been well studied in porous media and semi-arid to arid environments, but few studies have been conducted in fractured bedrock in a temperate climate setting. Moreover, most studies on the impacts of climate change on recharge have focused on changes in total annual or monthly precipitation and have not considered how shifts in the frequency and magnitude of events could influence aquifers. In this study, the response of a fractured bedrock aquifer to heavy rainfall events on the Gulf Islands will be characterized. Historical heavy rainfall events will be correlated to groundwater level fluctuations. Associations between the occurrence of heavy rainfall events and natural climate variability (i.e. El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), Madden-Julian Oscillation (MJO), and Pineapple Express (PE) storms) will be considered. The aquifer response to a range of precipitation intensities will then be modelled using HYDRUS 1D. Results should provide useful information to determine how the occurrence of more heavy rainfall events in future could influence groundwater recharge over longer periods of time.
Educating/Mobilizing Communities for Action in a World of Changing Climate: Initiating Action on Haida Gwaii.

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Supervisor: Dr. David Zandvliet

Haida Gwaii has the largest carbon footprint per capita in Canada. Yaahguudang (respect), Tll yahdah (making things right), and the traditions will be used as guides in the work for my project: Educating/mobilizing communities in a changing climate: Initiating action on Haida Gwaii. With the impact of the various diseases, colonialization and various environmental destructions, over the past 300 years, these Haida values will be part of the tools in order to move away from attitude of consumerism when looking at the world today. The values of Yahguudang and Tll yahdah are important for reducing our carbon footprint in our village and on our islands, our world. I will use pictures and words along a time line to show the history of the Xaaydagaay (Haida) nation, our values, our lands and the possibilities.
#21

### Patching the Leaks: Reforming British Columbia’s Policy Approach to Property-Level Flood Resilience

Lisa Danielson, School of Public Policy

Keywords: Climate Change Adaptation, Flood Proofing, Flood Hazard Management

British Columbia’s existing flood risk will be intensified due to climate change. One approach to adapt to this increased risk is to encourage the floodproofing of properties in flood prone areas.

This study examines the gaps in BC’s current flood policy framework that are inhibiting the uptake of floodproofing. A literature review and interviews identify the institutional context, a lack of resources and information, and low public awareness as key barriers. A jurisdictional scan examines different options to overcome these barriers, which include the private sector response of creating an overland flood insurance market.

This study recommends a provincial floodplain-mapping scheme as a necessary precondition for further actions. In addition, a program offering floodproofing grants to vulnerable households should be piloted.
Investigating anion-conducting polymers using wide-angle x-ray scattering

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Fuel cells are one of the leading candidates to replace internal-combustion engines as the dominant energy converters in personal vehicles. The development of polymer electrolytes that are physically and chemically stable, inexpensive, and efficient is a significant challenge that must be overcome in order for fuel cell vehicles to be widely adopted. Understanding the morphology of polymer membranes is critical to their development. A strong candidate, HMT-PMBI, has been synthesized by Steven Holdcroft's group at SFU Chemistry. We have investigated its morphology using wide-angle x-ray scattering, and observed changes in the material's favoured intramolecular stacking distance.
Measurement and Modeling of Mass Transfer within Catalyst Layer of a PEMFC

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Polymer electrolyte membrane fuel cells (PEMFC) rely on a membrane-electrode assembly (MEA) constructed from multiple layers of micro/nano porous materials and associated interfaces. The MEA includes a polymer electrolyte membrane (PEM) that conducts protons, a composite nano-structured catalyst layer (CL), and a fibrous gas diffusion layer (GDL) that distributes reactant gases and collects current. Transport properties of CL are among the key parameters affecting performance of a PEMFC. Reactants reach Pt particles in the CL through a gas diffusion mechanism. As a result, deep understanding of mass transfer within CL is a necessity to design PEMFC. Because of the complex geometry of CL, the existing models with good accuracy are computationally demanding. Also, current measurement methods have high uncertainties as CL layer is a very thin layer (several microns) which is coated on a thicker substrate. The lack of accurate models and reliable measurement data for mass transfer through CL has motivated this research.

A unit cell approach is being utilized to model conduction and diffusion through the catalyst layer of carbon-supported platinum agglomerates coated with ionomer. The diffusion problems are solved analytically for the unit cell and effective properties are modeled. Experimental characterization of catalyst layers prepared at AFCC are underway both to provide parameters utilized by the models and to verify results. Structural properties are determined by porosimetry and SEM imaging. A custom-built dry diffusivity test apparatus and a modified Loschmidt cell test bed will be used to study the of diffusivity of the CL and supportive substrates.
Intermittency issues for renewables in BC: Investigating solutions from the supply and demand perspectives.

Joseph Bailey – Doctoral Candidate, School of Resource and Environmental Management

Member of the:
1) Climate, Oceans and Paleo-environments lab (COPE)
2) Energy and Materials Research Group (EMRG)

Supervisor: Dr Karen Kohfeld
Secondary Supervisor: Dr Jonn Axsen

Abstract:
In British Columbia, the hydropower and wind energy resources are subject to natural variations that cannot be controlled which often generates an intermittent energy supply. Intermittency is a problem for energy providers because consumers need a reliable supply of energy. Understanding natural resource variations and any consequent intermittency can help to ensure that the supply of energy from renewable sources is better managed. This research investigates the issues of intermittency from both the energy supply and energy demand perspectives. From the supply perspective, we look at the wind and hydropower resources in BC and investigate how they have changed over the past 30 years along with how they may change in the future. We also look at the co-variability of the wind and hydro resources in BC and identify areas of the province that may provide a more reliable supply of renewable energy both now and in the future.

From the demand perspective, we look at how Canadians might change their behaviour to help increase the use of renewables. Specifically we use the case study of plug-in electric vehicle (PEV) charging to investigate if consumers may be willing to charge PEVs when intermittent renewable energy is available. The popularity of PEVs is increasing rapidly and BC hydro expects that there will be 30,000 PEVs on BC’s roads by 2030. Further, charging PEVs with intermittent sources of renewable electricity can help to increase the use of renewables whilst decreasing the environmental impacts of vehicle operation.
Development of a Customized Life Cycle Assessment (LCA) Tool for Low Carbon Emission Vehicles to Meet Climate Goals

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Abstract:
The transportation sector is the largest source of greenhouse gas (GHG) emissions in Canada, accounting for 35% of the total emissions. In order to tackle this problem, many vehicle fleet operators are considering a switch from conventional fuels with relatively high carbon content to alternative, more environmentally benign fuels. Although these alternative fuels could be a good option in the vehicle operation stage, the GHG emissions generated in other stages must also be considered. Life cycle assessment (LCA) is a potential technique used to evaluate the environmental and economic impacts of a product or a process in their lifetime. The main goal of LCA is to compare the full range of environmental effects to products and services by quantifying all inputs and outputs of material flows. In this work, a customized LCA tool is developed for different vehicles ranging from light-duty passenger vehicles to heavy-duty trucks and buses with conventional and alternative fuel options. The “Advanced Features” of this LCA tool are developed to refine the default values of fuel consumption based on the customized drive cycles, vehicle dynamics, engine performance, degradation effects, and other applicable vehicle, engine and fuel parameters. A case study of Refuse Collection Vehicles using CNG is compared to conventional diesel fuel and the results are presented. The results for this case study show a significant GHG reduction compared to diesel powered RCVs, estimated to 23% based on the full life cycle.
Improving the stability of the active layer in organic photovoltaic cells

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Worldwide increasing energy demands and environmental concerns about global warming have made the development of devices that can harvest sustainable and clean sources of energy, an indispensable research area. Development of photovoltaic devices to harvest sunlight as the most abundant source of energy and convert it into electricity has been an attractive technology in the past decades. Organic photovoltaic (OPV) cells based on the blend of conjugated polymers as electron donor and the fullerene derivatives as electron acceptor are promising candidates for solar-energy conversion that offers the advantage of low cost, easy manufacturing and flexible devices. The registered PCE of single junction OPV cells is now approaching 10%.¹² Despite considerable improvements in the PCE of these devices, the long term stable performance is also a requirement in order for them to become commercially available. Development of macro phase separation between the blend of donor and acceptor materials in the active layer leads to the cell degradation and loss of efficiency. In this work, we have investigated the morphology of a novel polymer designed with special side-chains that is cleaved upon thermal treatment.³⁴ It is conjectured that the macro phase separation is suppressed as a result of this process and the device shows a stable performance. A stable morphology has been observed for the active layers made from the polymer with cleaved side-chains consistent with stable PCE for them. On the other hand, the decrease in the efficiency of films made from the original polymer has been attributed to the development of large macro-phase separation confirmed with morphology investigations.

Composite adsorbent coating materials with increased thermal conductivity and sorption capacity for adsorption cooling systems

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ABSTRACT

Adsorption cooling systems are an emerging sustainable technology that utilizes waste heat or solar energy to produce cooling power. An environmental friendly refrigerant, such as water, is adsorbed by composite adsorbent materials. New composite materials and coatings developed to improve the performance of adsorption cooling systems by increasing refrigerant uptake capacity and improving heat and gas transfer in the adsorber bed. In this study silica gel with surface area ($S_{\text{BET}}$) of 494 m$^2$.g$^{-1}$ was soaked with a salt and binder solution to produce composite adsorbent coatings. Thermal conductive additives such as graphite flakes and copper powder were used to improve thermal conductivity composite adsorbents. Water uptake rate and sorption cycle durability were performed under different adsorption cooling systems conditions using thermogravimetric vapour sorption analyser.
#28
Commercializing Clean Technology: What You Need To Know

Presenter: Prof. Elicia Maine, Beedie School of Business, Simon Fraser University, emaine@sfu.ca

Abstract

Many promising inventions which might improve sustainability remain in the lab for decades. Many ideas languish not due to lack of scientific merit, but due to commercialization challenges in translating the scientific discoveries into products on the market.

You may be working on a clean technology invention or development with potential to create both social and economic value. If so, you’d like to see it out there in society. But what can you do early on to increase your chances of seeing this technology incorporated into products and services? Whether you’d like to start your own venture, innovate within an existing venture, or simply better understand new product development from the perspective of a large company, you’ll learn the strategies, frameworks and perspectives that will help you achieve these goals.

The Certificate is open to graduate students, post-doctoral students, faculty and recent alumni of both SFU and UBC graduate programs in science, engineering, health and environmental sciences. Students will learn skills such as opportunity assessment, market prioritization, innovation management, profiting from uncertainty, finance, leadership, and how to develop and validate a business model. Marketing and Finance courses “ladder into” our MOT MBA.

Participants will study part-time over three semesters, with classes held one evening a week at SFU’s Segal Graduate School of Business in downtown Vancouver. Applications for the Certificate are now open, with the first cohort commencing September 2015. Deadline for scholarship applications is April 30, 2015. More information here http://beedie.sfu.ca/commercialization-certificate/apply/
Laboratory for Alternative Energy Conversion

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ABSTRACT
The Laboratory for Alternative Energy Conversion (LAEC) seeks to improve energy conversion efficiency in devices, such as compact heat exchangers, fuel cells, batteries, and refrigeration systems, by addressing fundamental problems at multiscale levels. Engaged in the development of emerging sustainable technology and environmentally friendly, sustainable energy conversion systems, LAEC researchers target critical challenges and model, design, fabricate, and experimentally evaluate prototype solutions. The LAEC’s active projects include:

- Passive cooling systems for power electronics
- No-idle battery powered air conditioning and refrigeration systems for service vehicles
- Adsorption cooling systems utilizing waste heat
- Thermal, electrical and gas transport properties of microstructured fuel cell components
- Graphite heat exchangers
- Advanced insulation materials

These projects are performed in collaboration with numerous academic and industrial partners and supported by NSERC, the Canadian Foundation for Innovation, and the Automotive Partnership Canada.