WATERLOO INSTITUTE
for COMPLEXITY & INNOVATION

2017-18 ANNUAL REPORT

MARCH 2, 2018

MADHUR ANAND, DIRECTOR; CHRIS BAUCH, ASSOCIATE DIRECTOR;
STEERING COMMITTEE MEMBERS: STEVE QUILLEY, MARK CROWLEY,
DAWN PARKER, VANESSA SCHWEIZER, PETER DEADMAN

CONTENTS

INTRODUCTION

This report summarizes key information related to WICI's activities over our financial year from May 2017 to April 2018.

The 2016-17 Financial Report is included, as well as the budget request that was submitted and approved for the 2017-18 fiscal year. We also include our budget request for 2018-19.

An up-to-date list of current Board, External Scientific Advisory Committee, and Steering Committee members can be found in Appendix A.

WICI ADMINISTRATION

Dr. Madhur Anand (Environmental Sciences, Univ. Guelph) has served as WICI Director from Fall 2015 to present, and her appointment continues through August 31, 2018 at which time she will be taking sabbatical, and thus has not sought renewal of her term. The WICI Steering Committee has recommended that WICI founding member Dr. Dawn Parker assume the role of Director for her second term beginning Fall 2018. Dr. Chris Bauch (Applied Mathematics, U. Waterloo), has served as Associate Director from Fall 2016 to present, and his appointment continues through August 31, 2018 at which time he will also be taking sabbatical. The Steering Committee has recommended that Dr. Peter Deadman (Geography, U. Waterloo) assume the role of Associate Director effective Fall 2018.

Drs. Mark Crowley (Electrical and Computer Engineering, U. Waterloo), Stephen Quilley (School of Environment, Resources and Sustainability, U. Waterloo) and Vanessa Schweizer (Department of Knowledge Integration, U. Waterloo) continued in their role as Steering Committee Members through Fall 2017-18 and will continue to fulfill that role in 2018-19. Founding member Tad Homer-Dixon served on the Steering Committee until January 2017. We are currently seeking to add 1-2 new members of the WICI Steering Committee and intend to put out a broad call to this end to the WICI community.

WICI Administrative Assistant. Noelle Valeriote-Hakim was brought on board as Program Coordinator in October 2016 and will continue in that role.

PROGRESS TOWARD STRATEGIC GOALS

At its 2015 annual meeting, the WICI Board laid out five strategic directions for 2016-2020:

1. Strengthen core networks.
    a. Continue to actively support current core projects and members through grant writing assistance and complementary activities such as talks, workshops, and working groups.
    b. Look for existing opportunities on campus to expand core membership in the areas of network science, human-environment interactions, expanding conventional economics, complexity and non-rational drivers of behavioural change, Psychological Dynamics of Catastrophic Dehumanization; Rapid Ideological Change/Ideological Conflict; and Embodied Cognition.
    c. Work with faculty units and deans to identify opportunities for new hires whose research has a complex systems focus.
    d. Seek out particular opportunities to establish core WICI members in under-represented faculties (AHS and Science).

    Progress made in 2017-18:

    - Goal 1a: The 2017-18 WICI speaker series, the May 2017 WICI Conference on Resilience, and the 2017 Workshop competition, among other activities and events, are enriching WICI core projects. The 2016-2017 WICI grant challenge helped to strengthen the research programmes of existing core members and new affiliate members, as well as to build new WICI networks through new connections with existing WICI practitioner members.
    - Goal 1b: New affiliate members and new student members in Environment and Math continue to strengthen several WICI core research areas. Two WICI student visitors, arriving in spring and summer 2018, as well as a new post-doc affiliate, have specific interests in network complexity science. Finally, we have continued to strengthen WICI's relationship with the Fields Institute, through conference and workshop sponsorship. This relationship contributes to many of the core strengths of WICI.
    - Goal 1c: We have had informal discussions with the Chairs and Deans in Engineering, Mathematics, and Environment about the possibility of a targeted complex systems hire.
    - Goal 1d: A workshop award was made to Kirpatrick (AHS) and 2 new student members joined from AHS. Patel (Pharmacy) completed her grant development award this year. While efforts to expand to the UW science faculty are still slow, networking with the Perimeter Institute has improved. WICI arranged for WICI speaker Sara Walker (Arizona) to visit, a new affiliate researcher from the Perimeter Institute has joined WICI, Nobel Laureate Roald Hoffman will visit WICI and give a lecture at PI, and a joint WICI/Perimeter public lecture for Geoffrey West is being explored.

    Focus for 2018-19: The June 2018 WICI Conference on Modelling Complex Urban Environments will support this objective (goals 1a,b). WICI will expand core membership by promoting affiliate researchers to core researcher status and by identifying recent faculty hires in relevant areas, especially in AHS and Science (goals 1b,d). WICI will continue to support relevant grant application activities.

Areas for continuing development through 2020: All of 1a-1d will be areas of continual development.

2. Facilitate interdisciplinary research.
    a. Host talks and workshops, striving to maintain a balance between bringing in global leaders in complex systems and highlighting local complex systems scholarship.
    b. Support working groups, allowing their focus and scope to evolve with the interests and needs of membership.
    c. Offer support for grant development.

    Progress made in 2017-18:

    - Goal 2a: The 2017-2018 speaker series included one UW faculty member, two local scholars, and two high-profile external scholars. There was substantive overlap between the subjects of the talks and WICI's core research activities. The May 2017 WICI Conference on Resilience brought in a variety of speakers and provided presentation opportunities to local WICI members. WICI will also co-sponsorship and co-organization a related Field's Workshop in March 2018 (see details here: http://www.fields.utoronto.ca/activities/17-18/MathBiology-human-environment-systems). WICI has continued to support graduate students research through travel awards and this year's WICI student scholar competition. Also, 66% of the participants in the 2017 WICI Conference on Resilience were from outside the University of Waterloo. In 2017 an NSERC CREATE grant LOI was put forward by Kate Larson (Computer Science) which involved new collaborations between several WICI core members (Anand, Bauch & Crowley) which was successful at the institutional level which will be reassessed next year.
    - Goal 2b: This year WICI awarded three workshop grants, which are supporting the development of the research programs of core and affiliate faculty members. A WICI student member (Ruttonsha) will lead an interdisciplinary reading group and co-author a paper with other WICI Student members.
    - Goal 2c: WICI support has facilitated several grant submissions (see challenge grant details below), and has provided matching fund for 3 WICI workshops.

    Focus for 2018-19: The June 2018 conference on Modelling Complex Urban Environments contributes to Goals 2a-2c. We will solicit speaker suggestions to continue to bring in speakers of interest to the WICI community. We plan to expand our successful student travel award program. Will further facilitate interdisciplinary research (goals 2a-c) and examine potential for more collaboration between core memberes.

    Areas for continuing development through 2020: The seed grant competition will not be run in 2017-18 but at least one further seed grant competition will be held before 2020 (goal 2c). WICI may also explore mentoring opportunities to help junior, tenure-track members with grant development (goal 2c). Workshops, the speaker series, and conferences will continue (goals 2a-c). Increase the cohesiveness and identity of WICI Student members. Create a core group of WICI PDF researchers.

3. Enhance public engagement.

a. Improve WICI's web and social media presence, including the development of web pages for WICI core research projects and a set of introductory "What are complex systems?" materials.
b. Highlight WICI work through press releases and actively engage the media when opportunities arise.
c. Offer more public talks in the community.
d. Continue informal receptions before talks with speakers and attendees.

Progress made in 2017:

- Goal 3a: WICI launched its new website (https://uwaterloo.ca/complexity-innovation/) which has been well received, and continues to gain new visitors every week. In particular, from its launch date on September 8, 2017, the WICI website received 3,200 visits to date, with its monthly visits growing dramatically, and exceeding previous performance. WICI's Twitter feed and Facebook page are being actively maintained.
- Goal 3b: WICI core members contributed op-ed pieces to major outlets such as the Globe and Mail, and core member research projects were covered in the national and international media.
- Goal 3c: WICI continues to broaden its audience through events such as the Poetry & Complexity Readings and Conversations with high profile guests such as Roald Hoffmann, Nobel Prize-winning theoretical chemist and poet, and Rae Armantrout, Pulitzer Prize-winning poet and Guggenheim Fellow
- Goal 3d: Receptions before WICI seminars continue and have been well attended.

Focus for 2018-19: WICI will continue maintaining its Twitter feed, Facebook page, and website (goal 3a). The website will also be updated to reflect new members, new projects, and evolving core research projects (goal 3a). WICI steering committee will encourage WICI members to notify faculty and university press officers of research that may garner media attention, and to mention role of WICI in the research (goal 3b). Further opportunities will be sought for WICI members to deliver public talks on topics of interest to the community (goal 3c).

Areas for continuing development through 2020: In addition to ongoing efforts, WICI will seek opportunities to host more public lectures (goal 3c), perhaps in partnership with existing lecture series such as the Bridges lecture series and the Waterloo Science public lectures. Discussions with Perimeter regarding a public lecture by Geoffrey West are an example.

4. Enhance WICI's resource base and long-term viability.
   a. Prioritize efforts to obtain higher-level, external support to establish and support initiatives such as a staffed resource lab; funding for a graduate fellows programme; a competitive post-doctoral scholar programme; and funding for short-term (sabbatical or study leave) positions for more senior complex systems scholars.

Progress made in 2017: WICI acquired $5,000 in external funding (sponsorship from The Field's Institute for Mathematical Sciences and the Canadian Applied and Industrial Mathematics Society for its 2017 Conference on Resilience, plus additional in-kind support).

WICI also obtained over 20k in matching support from international partners as part of the IPRG application to support the Urban Complexity conference. Moreover, several of the sponsored workshops being run in 2017 are seeking additional funding support from other partners. Since its inception, WICI has grown by 386%, and by 46% since its renewal in 2014, thereby building a critical mass for its long-term viability.

Focus for 2018-19: Opportunities for external support for workshops and conferences will continue to be sought.

Areas for continuing development through 2020 In addition to ongoing efforts, support for postdoctoral fellows and graduate fellows can be implemented on a matching basis with programs that accept matching funds (e.g. MITACS Elevate, some departmental postdoctoral appointments).

5. Raise our profile.
    a. Focus on academic and media outreach to highlight WICI's unique contributions on a national and global scale.

Progress made in 2017: WICI's Twitter feed and Facebook page are being actively maintained. WICI launched its new website (https://uwaterloo.ca/complexity-innovation/) which has been well received, and continues to gain new visitors every week. WICI core member W. Hipel was elected Officer of the Order of Canada.. Our activities all brought new engagement with WICI both within the University of Waterloo and externally. For example, 66% of participants in the 2017 WICI Conference on Resilience were from outside the University of Waterloo, and 13% were international.

Focus for 2018-19: WICI will continue maintaining its Twitter feed, Facebook page, and website but add some dedicated additional time to this task. The website will also be updated to reflect new members, new projects, and evolving core research projects. WICI steering committee will encourage WICI members to notify faculty and university press officers of research that may garner media attention, and to mention role of WICI in the research. WICI faculty members will be encouraged to write for The Conversation (media-outlet). Further opportunities will be sought for WICI members to deliver public talks on topics of interest to the community. Grant officers from the tri-council agencies and US NSF, as well as the national Science Policy officer, will be invited to attend the Urban Complexity Conference.

Areas for continuing development through 2020: WICI will continue activities supported in 2017 and 2018-19. Many of the first four goals will serve to raise the profile of WICI nationally and globally.

WICI-RELATED SCHOLARSHIP AND RESEARCH

2017 PRODUCTIVITY REPORT

The following table summarizes the scholarly contributions made by WICI core members from January 1, 2017 to December 31, 2017. The full list of individual contributions can be found in Appendix B.

OUTPUT TYPE	
PAPERS PUBLISHED	42
PAPERS IN PRESS	7
PAPERS IN REVIEW	2
PAPERS IN PREPARATION	15
BOOK CHAPTERS PUBLISHED	1
BOOK CHAPTERS IN PRESS	3
BOOKS	2
INVITED/KEYNOTE PRESENTATION	14
WORKSHOP/SYMPOSIUM PRESENTATION	19
OP-EDS	1
RADIO/PRINT INTERVIEW/OUTREACH	4
ORGANIZATION OF WORKSHOP	4

WICI CORE RESEARCH PROJECTS

DiD MIRACLE PROJECT. WICI core member Dawn Parker received funding from the Social Sciences and Humanities Research Council (SSHRC) via the Digging into Data Challenge (DiD) in 2013. WICI administrative support was essential for the preparation and submission of this grant. This project concluded at the end of 2016. The international DiD program was established to advance the use of computational methods to explore, analyze and visualize the rapidly expanding pool of crowd-sourced and remotely sensed "big data" from real-world systems. Unique among her year's awards, Parker's research team developed tools to analyze output from computerized simulation models and compare that output to real-world "big data."

The University of Waterloo served as the lead institution for the larger DiD $567,000 (U.S.) project titled, Mining relationships among variables in large datasets from complex systems (MIRACLE). Local WICI team members included post-doc Xiongbing Jin, graduate student Kirsten Robinson, and former student Calvin Pritchard. The international team includes participants from Arizona State University, USA (PI C. Michael Barton; lead developer Allan Lee) the University of Twente, NL (PI Tatiana Filatova) the University of Dundee, UK (PI Terence P. Dawson) and the James Hutton Institute UK (Collaborator J. Gary Pohill).

MIRACLE created a prototype community platform to support complex systems research across research communities. The software prototype, hosted on the Compute Canada platform, creates access to sample output from computational models, as well as the algorithms used for analysis. Built-in tools allow users to explore these output data and share results with local or global communities. Supporting publications reviewed analysis methods currently in use to analyze outputs from agent-based models of human-environment interactions (Lee et al, currently in the top 5 most viewed articles at JASSS), outlined metadata standards for computational model output, and described the prototype model architecture and functionality. Our research partners at Arizona State, lead by M. Barton, have obtained a large-scale NSF grant, which will support the next stage of this project, (BD Spokes: Spoke: West: Accelerating and Catalyzing Reproducibility in Scientific Computation and Data Synthesis (9/1/2016). National Science Foundation, Grant #IIS-1636796, $1,014,593). Former UW project personnel Calvin Pritchard is now a full-time member of the Arizona State research team. We also obtained a Compute Canada resource allocate grant to support development of the new prototype.

Our research group is very appreciative of SSHRC's top dollar support for our innovative new venture to create community infrastructure that will be available to local stakeholders, university researchers, and the international community to support complex systems research. We continue to promote this project as an example of what can be achieved under SSHRC's new priority to support social science computing.

COUPLED HUMAN-ENVIRONMENT SYSTEMS. This core project explores the dynamics of coupled human-environment systems and the implications of these dynamics for environmental health and sustainability. A coupled human-environment system involves a two-way interaction between human systems and our environment: what humans do influences the environment, but the resulting changes in the environment in turn influence our perceptions and behaviour. Humans and their environment together thus form a single, coupled nonlinear system.

Professors Chris Bauch and Madhur Anand have been moving this core project forward in 2017-18 through the initiation of new projects as well as the fruition of existing projects. This work has been spearheaded by their co-supervised graduate students, some of which just started in 2017, and some of which are finishing up their PhDs in 2017. The core project was also supported by seed funding from the WICI Grant Challenges, the activities of which carried over into 2017-18.

New projects with co-supervised students were started concerning human feedbacks on invasive versus native grasslands, spatial ecosystem mosaic dynamics, and early warning signals of tipping points in socio-ecological systems. Existing projects were continued concerning mining social media data for clues about dynamics of climate change; the effects of globalization and interconnectedness on civilization collapse; and further development of their long-standing collaboration on forest-grassland mosaics. Papers were accepted or published concerning dynamics of coupled coral reef/fishing systems and the impacts of shocks on agri-food trade networks, among other topics. Moreover, Bauch and Anand co-chaired the 2017 WICI event "Living on the Precipice: Interdisciplinary Conference on Resilience in Complex Natural

and Human Systems" and the core project benefitted from the opportunities at the conference to discuss ideas and recent development with colleagues.

THE URBAN GROWTH AND CHANGE RESEARCH GROUP. The outward growth of cities after the Second World War has been extensively studied and the impacts documented. As a result of this foundational research, contemporary planning policy and investments promote intensification–concentration of activities in vibrant urban cores and nodes and corridors that support accessibility and more efficient municipal expenditures. Rapid transit (RT) has potential to catalyze intensification, assuming that it causes intensification and economic vitality. However, while numerous studies have demonstrated correlation between these factors, due to data and methodological limitations, causality has not been established. Establishing causality is challenging, as some relationships may be direct–new RT investments may make adjacent lands more desirable–producing direct changes in property values. Yet, some impacts may be indirect, as RT investment might increase the density of complementary land uses, creating positive agglomerative feedbacks. Confounding the identification challenge, such feedbacks can occur independent of, and may themselves induce, RT investments. Further, RT investments often occur with complementary physical investments, higher land values, or policy changes to achieve planning goals.

Our research responds to a natural experiment to explore the causal dynamics between the pending development of light rail transit (LRT), core-area intensification and socio-economic change in Kitchener-Waterloo, Ontario, working with local government and industry partners. Research in the UGC research group has two streams: data gathering/analysis and modeling. Working in partnership with the Region of Waterloo, we are gathering and analyze qualitative and quantitative information from the pre-build stage through implementation of LRT. We are using these data to build a series of agent-based models that model the joint evolution of residential land-use change and transportation behaviour. To date we have surveyed residential land owners, renters, and developers, buyers, sellers, and real estate agents, with results reported in 3 completed and 2 ongoing student theses. We have also assisted the Region to design a long-term data gathering and monitoring strategy, and we annually contribute additional "special topics" analysis briefs to this report.

In the last year, the K-W real estate market has experience an unprecedented rise into a "hot market" and is now exhibiting significant cooling off. We have been able to gather data over this time period on price setting, bidding, and market perceptions from key actors, which is allowing us to build cutting-edge models to better understand the dynamics of market bubbles. In particular, our somewhat unique combination of qualitative and quantitative data has allowed us to characterize the key influences of shifting demographics and cultural norms on the local real estate market.

REMAKER RESEARCH GROUP. Steve Quilley (WICI/SERS), Rob Gorbet (CKI), Marcel O'Gorman (Critical Media Lab), Katie Kish (SERS), Dan McCarthy (SERS), Sarah Wolfe (SERS), Jason Hawreliak (Brock University) – Working with colleagues across several departments and three faculties, Stephen Quilley has been leading a series of research initiatives and funding applications, which centre on the possibilities of a reMaker society. Initial research involved a series of Maker workshops (working with local Maker spaces, KWARTZLab, DIYODE and the Maker Club for Kids) as well as developing links with social psychologists at Wilfrid Laurier University (for the most recent SSHRC application). Katie Kish has finished her doctoral project and we are waiting to see the outcome of various post-doc applications to see how the project might go forward. Meanwhile O'Gorman and Quilley are working on developing the CFI-funded Critical Media Prototyping Suite.

In relation to the Metcalf grant (www.remakersociety.com) this group has been exploring issues of meaning and ontology in relation to art, fabrication, making and DIY and maintenance activity. This work is framed in terms of 'terror management theory' and links to WICI's wider projects on the dynamics of ideological change and 'alternatives to conventional economic growth'. It builds also on a relation with Prof. Sheldon Solomon established in the wake of his WICI talk 'Afraid of the Dark: Humanity at the Crossroads' (http://wici.ca/new/event/sheldon-solomon/); and connects with Sarah Wolfe's agenda around water-related governance and behaviour. The intersection of the reMaker Society project with the issue of non-rational drivers is also beginning to attract interest outside academia. Following Steve Quilley's keynote presentation to the Canadian Society for Ecological Economics (Nov 2013), CANSEE President (and senior OMNR Economist) Andreas Link connected with his Ph.D. student Katie Kish with a view to involving her in the organization in an official capacity and she now serves on the Executive Committee. Link's rationale was that CANSEE needed to engage with our work on participatory fabrication and meaning frameworks. In 2017 this activity resulted in a special issue of Alternatives on the reMaker society and a workshop and presentations for the CANSEE 2017 conference in Montreal. The focus of this work is the application of complexity systems perspectives to linked issues of: (i.) rapid and non-linear environmental-political change; (ii.) ontological transformation; (iii.) a state-space model of alternative political economies defined by the domains of market, state and livelihood/reciprocity; and (iv.) material-energy throughput.

WARM PROJECT. Municipalities throughout Canada are challenged to make planning decisions to enhance economic competitiveness, the urban environment, and residents' quality of life. Commonly applied planning interventions influence location incentives, including the diversity and spatial distribution of housing provided by the development community. Location decisions are also influenced by the location, cost, and connectedness of transport networks. The distribution of activities in turn, dictates the transportation behavior of travelers. Both factors influence the environmental health of cities. The residential built environment and the land management behavior of residents affect water quality, biodiversity, and carbon sequestration; and transportation mode choice, number of trips, and trip length affect air quality and carbon emissions. Thus, planning decisions such as development incentives and major transit services upgrades influence a complex set of actions and interactions amongst the various stakeholders: developers, homebuyers, governance and the environment. The likelihood of sound planning choices is predicated upon the ability of planners to model and holistically forecast these interactions.

Researchers have made progress in the development of scientifically grounded models to support planning; yet, significant gaps remain. Our proposed research will develop an integrated agent-based simulation model that links residential land market activity, landscaping management, and transportation decisions. The Waterloo Regional Model (WARM) will extend the current state of planning tools to better represent the disaggregate behavior and interactions of three primary stakeholders: residential consumers, residential suppliers, and travelers in a metropolitan area.

Agent-based models (ABM) are social science based computer simulations that represent the decentralized motivations, constraints, decisions and interactions of system actors. ABMs can be used to investigate factors that shape the balance of urban densification and suburban expansion in rapidly growing Canadian metropolitan areas. The Regional Municipality of Waterloo is a growing, representative mid-sized city that has: implemented novel land use controls in the form of an urban growth boundary; endorsed an $818M rapid transit investment to encourage core-area densification; and seen an evolution in economic base from manufacturing to high tech/education. Working with Regional planners, we will

develop and test scenarios to investigate whether current policies and planned infrastructure investments–or potential alternatives–will lead to desired levels of urban intensification, accessibility, environmental protection and economic competitiveness. WARM builds on previous models developed by the investigators, but includes several scientifically significant innovations: incorporation of empirically informed resident and developer demand and supply models; integration of a residential ABM with a transportation mode choice model; and representation of urban core and exurban residential housing markets.

The project plans extensive multi-disciplinary, international dissemination of models and results to academics, students, educators, and policy analysts. This will make substantial contributions to needed infrastructure and outreach in this new field. Project results, models, data, and teaching materials will be distributed online through the Global Land Project, the OpenABM website, the new GLOBE land change science case-study comparison portal, and Waterloo Centre for Complexity and Innovation's website. The project will also train 3 MS students, 2 PhDs, and one post doc, who are expected to further disseminate new methods through employment in the public and academic sectors.

EMERGING COMPUTATIONAL CHALLENGES IN MODELLING AND MAINTENANCE OF FOREST FIRES. Forest wildfire management is an interesting complex-system domain involving coordination of large numbers of individuals, resources, government organizations and corporations on activities of large economic and societal importance. With the increasing severity of seasonal weather variations due to climate change, there is a growing need for powerful modelling tools and decision-support systems in this area. Prof. Mark Crowley from ECE and Prof. Kate Larson from Computer Science have been working on the idea of hosting a workshop at the University of Waterloo on this topic bringing together a small group of domain experts and researchers from around Ontario. The goal of the workshop will be to identify ambitious next steps for improving computational methods for modelling, prediction, evaluation and decision making in management of forest wildfires. Discussions continue and we have an invitation to the BIRS workshop in the fall 2018.

NEW RESEARCH FUNDING

Application for resource allocation from Compute Canada for The CoMSES Net Community Web Portal, was submitted by D. Parker (core member). This was successful.

D. Parker also applied for and successfully received the IRPG grant—$20,000.

S. Quilley received CIHR Planning & Dissemination Grant, Institute of Population & Public Health, "Improving population health in an era of social-ecological instability and economic contraction" - $19,917

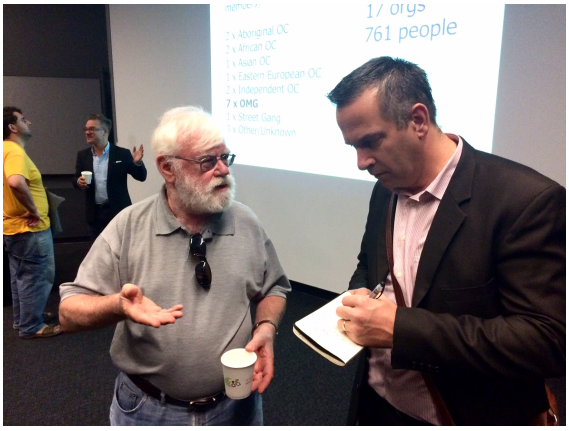
S. Quilley received CFI with Marcel O'Gorman, CFI-JELF application entitled 'Critical Media Prototyping Suite' $40,000

S. Quilley successfully arranged SSHRC post doc for Mark Hathaway starting Jan 2018: Transformative Ecological Learning in Permaculture

M. Anand: James McDonnell Foundation Complex Systems Scholar Award: $30,000

C.T. Bauch: Canada Foundation for Innovation John Evans Leadership Fund: $234,296 for 'Coupled human-and-natural systems laboratory.'

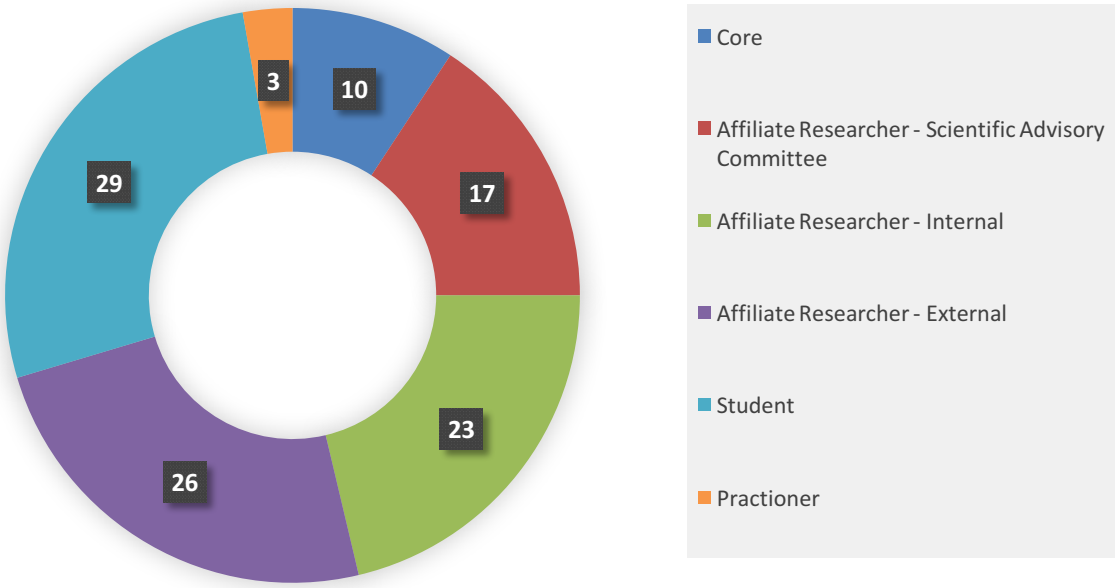
C.T. Bauch, M. Anand and K. Fair: University of Waterloo Gender Equity Grant: $10,000



MEMBERSHIP

As of February, 2018, WICI had a total of 108 members, which represents a 4.8% growth in membership. Figure 1 provides a breakdown of the number of members in each membership category.

Figure 1: WICI Membership By Category



In 2017 WICI expanded its Student Membership description to include undergraduate students working on a complexity science related degree in addition to graduate students. Our hope moving forward is to engage Student Members even more through specific initiative for them such as the WICI Student Award of Excellence this year. Student Membership saw the largest growth [11.5 % increase] in 2017.

In 2017 WICI welcomed the following members:

NAME	POSITION	MEMBERSHIP CATEGORY
Matteo Smerlak	Senior Postdoctoral Researcher, Perimeter Institute	Affiliate Researcher

Jessica Blythe	Adjunct Assist. Prof. School of Environment, Resources & Sustainability, University of Waterloo	Affiliate Researcher
Virginia Capmourteres	Postdoctoral Fellow, School of Environmental Sciences, University of Guelph [promoted]	Affiliate Researcher
Jinelle Pierder	PhD candidate in Global Governance at the Balsillie School of International Affairs, University of Waterloo	Student Member
Kirsten Lee	PhD candidate, School of Public Health and Health Systems, University of Waterloo	Student Member
Scott Janzwood	PhD candidate in Global Governance at the Balsillie School of International Affairs, University of Waterloo	Student Member
Thomas Bury	PhD candidate, Applied Mathematics, University of Waterloo	Student Member

WICI SPEAKER SERIES

2016–2017 SPEAKER SERIES

Partisan Infighting Among House Republicans: Leaders, Factions and Complex Networks of Interests
Dr. Jon MacKay
Saïd Business School, University of Oxford
October 25, 2016

Nature in a bottle - Designer ecosystems
Dr. Matt Hammond
McMaster University Complex Ecological Systems Lab
November 22, 2016

Self-Generating Economic Forecast Heterogeneity
Dr. Blake LeBaron
Abram L. and Thelma Sachar Chair of International Economics at the International Business School, Brandeis University
January 24, 2017

Deep Learning with Darwin: Evolutionary Synthesis of Operational Deep Intelligence
Dr. Alexander Wong
Canada Research Chair in Medical Imaging Systems
Department of Systems Design Engineering at the University of Waterloo
February 21, 2017

Bio from Bit: Quantifying the Origins of Life
Dr. Sara Imari Walker
Arizona State University School of Earth and Space Exploration and Deputy Director of the Beyond Center for Fundamental Concepts in Science at Arizona State University
March 7, 2017

2017-2018 SPEAKER SERIES

Analysing Covert Networks from Unstructured Sources
Dr. Johan Koskinen
University of Manchester, Department of Social Statistics
October 2, 2017

Understanding, Modeling, and Managing Interdependent Complex Systems of Systems
Dr. Yacov Y. Haimes
Lawrence R. Quarles Professor of Systems & Information Engineering and of Civil & Environmental Engineering. Founding Director (1987), Center for Risk Management of Engineering Systems
University of Virginia
October 20, 2017 – Co-sponsored with Waterloo Department of Systems Design Engineering

Using Deep Learning and Reinforcement Learning to Tame Spatially Spreading Processes
Dr. Mark Crowley
University of Waterloo, Department of Electrical and Computer Engineering
October 25, 2017

From Sandpiles to Real Mountains - Complex Dynamics of Tropical Mountainscapes Mediated by Landslides
Dr. Carla Restrepo
University of Puerto Rico-Rio Piedras, Department of Biology
February 27, 2018

Poetry & Complexity
Readings and conversations between Roald Hoffmann (Nobel prize-winning scientist & poet), Rae Armantrout (Pulitzer prize-winning poet), and Madhur Anand (Director of WICI & poet).
March 27, 2018

Synthetic Evolutionary Transitions: From Cells To Brains And Ecosystems
Dr. Ricard Solé
ICREA-Complex Systems Lab UPF-IBE, Barcelona
April 24, 2018

COMMUNICATION AND COMMUNITY ENGAGEMENT

ONLINE ENGAGEMENT

WICI launched its new WCMS website [uwaterloo.ca/complexity-innovation/] and it continues to be the primary source for information relating to the Institute. It is used to share news about upcoming events, profile WICI members, and recruit researchers and staff. From its launch date on September 8, 2017, the WICI website received **3,200 visits** to date, with its monthly visits growing dramatically, and exceeding previous performance.

By the end of 2017, WICI had **483** active subscribers on its Mail Chimp mailing list [8 % growth]. The Institute also continued to maintain three social media accounts to share news and events: a Facebook page, a Twitter feed and a LinkedIn company page. In addition, videos of WICI talks on our Vimeo page were viewed a total of **915** times in 2017 [5.7% growth].

SPONSORED EVENTS/WORKSHOPS:

2017 CONFERENCE ON RESILIENCE

WICI successfully hosted "Living on the Precipice: Interdisciplinary Conference on Resilience in Complex Natural and Human Systems", May 16-17, 2017, with partial support from the Field's Institute for Mathematical Sciences.

The resilience of complex systems to disturbances is a topic of longstanding and continuing interest in academic communities including applied mathematics, ecology, environmental sciences, and the social sciences and humanities, among others. Over the past few decades this research has led to both insights into real-world systems as well as policy improvements. However, significant theoretical and empirical challenges remain, as well as challenges in improving policy. This is particularly urgent for environmental systems where human influence is pervasive. This conference brought together researchers and scholars interested in resilience in complex systems, with a special emphasis on natural, human, and coupled natural-and-human systems. The objective was to advance the field by bringing together individuals trained in disparate disciplines working on both qualitative and quantitative approaches, so they could benefit from interdisciplinary conversations.

This conference deepened our understanding of resilience and helped identify priority areas for future research. The conference was well attended, with 85 registrants on day one, and 125 registrants on day two.

The conference included a plenary talk (Alan Hastings, University of California, Davis), eight invited talks, parallel contributed talk sessions, a poster session, and a graduate student workshop. Invited speakers included:

- Matthew Bonds, Harvard University
- Ann Kinzig, Arizona State University
- Vanessa Schweizer, University of Waterloo
- Kevin McCann, University of Guelph

- Bridie McGreavy, University of Maine
- Mark Constas, Cornell University
- Philip Beesley, University of Waterloo

Organizers: Madhur Anand (co-chair, Waterloo, Guelph); Chris Bauch (co-chair, Waterloo); Mark Crowley (Waterloo); Kathryn Fair (Waterloo); Perin Ruttonsha (Waterloo); Vanessa Schweizer (Waterloo); Andjela Tatarovic (Waterloo); Dou Yue (Michigan State University)

CONFERENCE FEEDBACK:

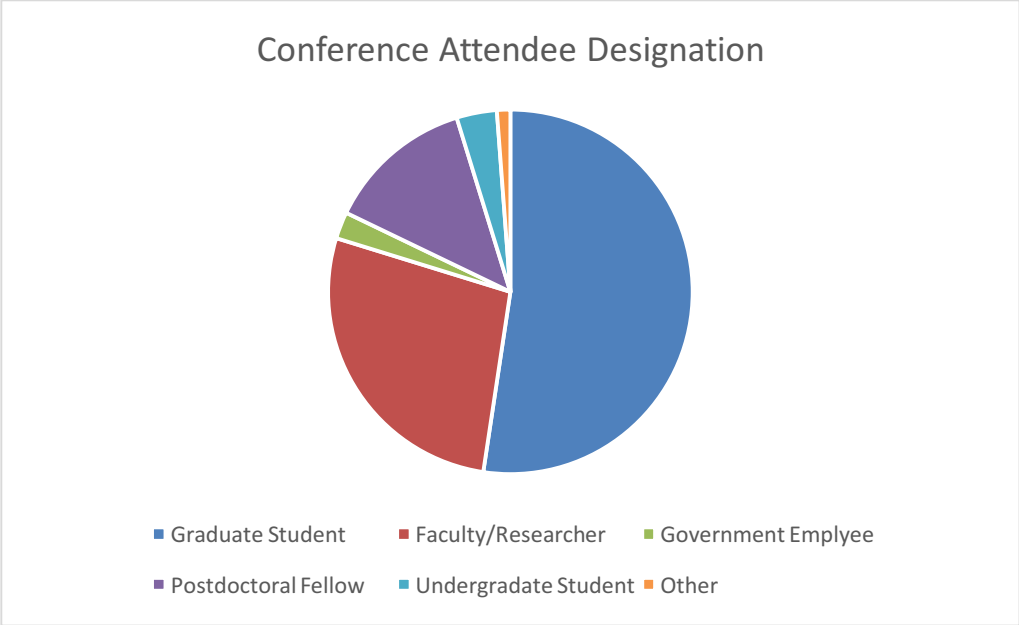
Dear Prof Anand, Yes, the conference was a lot of fun, and I've received nothing but positive feedback from participants, especially with regards to the interdisciplinary nature of the content. Such an interesting group!
We had two full workshops this afternoon (19 in the first; 23 in the second), with good discussion. Both could have run as longer sessions. About half of the participants from the first workshop decided to follow over to the second, so we ultimately did not limit this event to graduate students.
In terms of the study that we held in conjunction with the conference, we should have enough material to develop at least one decent working paper. We will aim to take this on over the course of the summer, building from the survey data, workshop outcomes, haiku activity, and notes from presentations. - Perin Ruttonsha, PhD Candidate, School of Environment, Faculty of Environment, University of Waterloo.

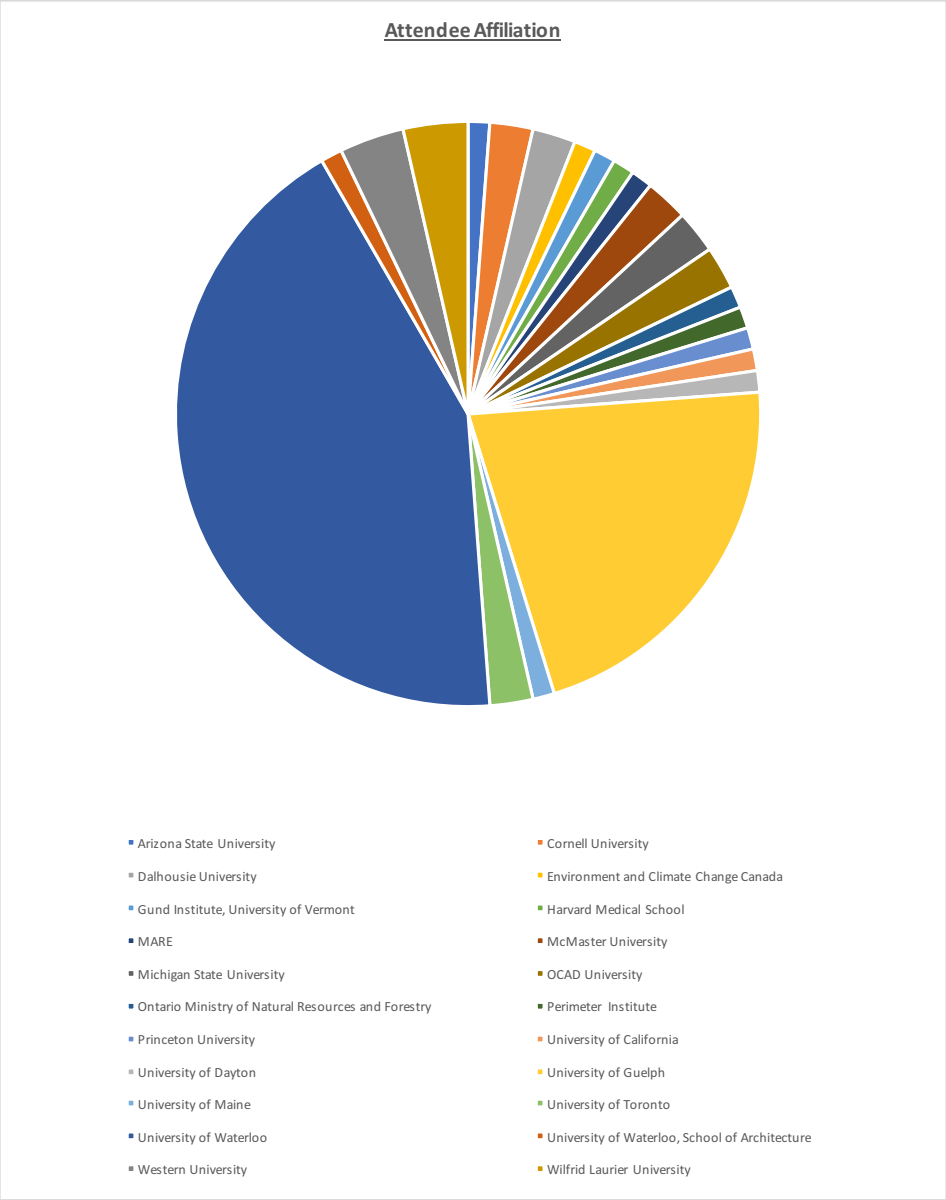
Dear Madhur, Chris and Noelle, Thanks for the wonderful treat. I really appreciate being a part of such an enjoyable and intimate gathering around these important and fascinating issues. The whole thing was lovely. And it was great to get to know you a little bit. – Matt Bond – Harvard Medical School

Hi Madhur and Chris,
I wanted to thank you for organizing and inviting me to such an amazing conference the past two days! I thoroughly enjoyed its interdisciplinary approach and the conversations I was able to have with people from extremely similar research interests to those that were much different than mine. It was one of the best conferences I've ever been to and I hope it carries on!
Cheers, Isaiah

Good morning Noelle.
First of all, I would like to congrats for the success of the WICI Conference last week. I enjoyed the talks and everything else and hopefully I can attend the next ones.
Regards, Olavo H. Menin – Brazil

Dear Chris, Madhur, and Noelle,
I would like to congratulate you for the organizational work, leadership, and hospitality associated with last week's conference. I found the event and overall discourse to be most thought provoking and generative. The conference gave me a glimpse into the kind of innovative work that that is being carried out at Waterloo and Guelph. Although many of us regularly discuss the benefits of embracing a multidisciplinary perspective, your conference took things to a higher level. Regards, Mark - Cornell


Conference Attendee Designation
Graduate Student
Faculty/Researcher
Government Emplyee
Postdoctoral Fellow
Undergradate Student
Other



2018 CONFERENCE ON MODELLING COMPLEX URBAN ENVIRONMENTS

Core/Steering committee member Dawn Parker is planning this year's WICI sponsored specialist conference, titled "**Modelling complex urban environments,"** to be held June 21-22. The intent of this small, informal conference is to bring together scholars from multiples disciplines who have activity and interests in modelling the processes that create and shape complex urban environments. Full details, including a background, aim, and scope document and the Call for Papers are available at the conference website https://uwaterloo.ca/complexity-innovation/events/wici-conference-modelling-complex-urban-environments . The program committee includes faculty and students from Planning, Economics, and Systems Design Engineering, as well as collaborators from the University of Leeds Institute for Data

Analytics. The Call for Papers includes call for participation in seven organized sessions: "Integrating "big data" and "smart cities" data with urban modelling," Social-ecological networks in the city," "Modelling and the planning process," "Artificial Intelligence & Optimization Models in Urban Environments," "Agent-Based Modelling of Urban Markets," "Measuring and Modeling the Role of Citizen Agency in the Evolution of Cities as Embedded in Multi-Scale Governance Structures and Global Networks," and "Measuring, Modelling and Interpreting Scaling/Power Laws in Urban Systems." Companion workshops will be held on the theme of two organized sessions the day after the workshop.

Three esteemed keynote speakers have confirmed their participation:

- Geoffrey West, Santa Fe Institute (https://www.santafe.edu/people/profile/geoffrey-west
- Saskia Sassen, Columbia University http://saskiasassen.com
- Alex Anas, University of Buffalo https://economics.buffalo.edu/facultyprofiles/alex-anas/

In addition to WICI support, the conference and companion workshops are supported through a $20k UW International Research Partnership Development grant, over $20k matching funds from international partners, and a Balsillie grant.

Co-Organizers: Dawn Parker, Professor, school of planning, University of Waterloo; Allison Heppinstal, Professor, Department of Geography, University of Leeds

Program committee members:

- Jeremy Pittman, Assistant Professor, School of Planning, University of Waterloo
- Kathleen Rybczynski, Associate Professor, Department of Economics, University of Waterloo
- Yu Huang, PhD candidate, University of Waterloo School of Planning
- Milton Friesen, Senior Fellow and Program Director, Social Cities, CARDUS; PhD candidate, University of Waterloo School of Planning
- Jorge Garcia, PhD student, Systems Design Engineering
- Fatemeh Jahanmiri, PhD student, University of Waterloo School of Planning
- Neluka Leanage, PhD student, School of Planning

WICI SPONSORED WORKSHOPS (COMPETITIVELY AWARDED)

Pittman & Mitchell: "Complex Institutional Systems And Urban Sustainability Outcomes" Workshop - $5,000

Kirkpatrick & Raffoul: "Enhancing Capacity To Apply Systems Approaches To Improve Human And Planetary Health" Workshop - $8,000

Homer-Dixon, Mock, Momani and Quilley: "Deconstructing the Ideological Complexity of Right-Wing Populism Across Borders" Workshop - $8,000

WICI SPONSORED STUDENT RESEARCH AND TRAVEL

Katherine Laycock:

1. Attendance at the Association of Collegiate Schools of Planning [ACSP]'s Annual Conference in Denver from October 12-15, 2017.
2. Attendance and presentation at the Urban Affairs Conference in Toronto April 4-7th, 2018.

Yu Huang: North American Meetings of the Regional Science in Vancouver from November 8th to 11th, 2017

Scott Janzwood:

1. Present at the Decision Making under Deep Uncertainty (DMDU) annual workshop at the Oxford Martin School, Oxford University November 13-15, 2017.
2. Joining the Future of Humanity Institute (FHI) at the University of Oxford as a Visiting Fellow in the Spring of 2018

Thomas Bury:

1. Attendance and presentation at the 'Dynamics Days' conference in Denver, Colorado, January 4-6, 2018
2. Workshop on Human-Environment Systems hosted at the Fields Institute, Toronto from 5-9th March 2018

WICI 2016 SEED GRANT CHALLENGE UPDATES

WICI invited applications for small grants to support development and submission of funding proposals to support complex systems research at the University of Waterloo ($5,000-$10,000, commensurate with the scope of the developed proposal). Applications were to have a substantive complex systems focus, but could be from any academic domain, and had to clearly indicate how the work would lead to a novel direction. Three applications were successful:

1. Tejal Patel, *Complexity In Medication Use: Older Adults and Capacity to Manage Medications,* $9,950.00. Update from Dr. Patel: Principal Applicant: Tejal Patel, PharmD. Co-Principal Applicants: Robert Robson MDCM, William Sutherland MD and William Wong, PhD

This short-term intention of this project was to perform a literature review to examine the research addressing complexity of medication use in the older adult. Additional objectives included the design and conduct a pilot qualitative study and design of a system level simulation model that integrates data from literature review and pilot study. Three meetings amongst the research team members were planned. The first meeting with the research team was held on 27th February at which the design and methodology of the literature review was discussed and determined. A coop student was hired in January 2017 for a period of four months to design and conduct, in collaboration with a librarian, the literature search and review. To date, search revealed few, if any research addressing medication use as a complex adaptive system. The decision to move forward with an article describing all aspects of complexity of medication use was made – the literature for this is currently being reviewed. Following the abstraction and synthesis of the data, a second meeting will be held with the applicants to review the results.

During the first meeting, the applicants also discussed investigating each aspect of medication use; therefore, the design and methodology for the qualitative study to investigate medication management

among older adults was also discussed. To fund this initiative, a letter of intent to investigate medication management capacity among older adults was submitted to the Alzheimer Association Research Grant Program (US) in March 2017; however, we were not successful in acquiring an invitation for full proposal submission. Following this, the principal applicant in collaboration with additional investigators submitted a letter of intent to investigate barriers to appropriate use of technology to improve adherence among older adults to the Drummond Foundation in May 2017. Unfortunately, we were unsuccessful in securing an invitation for a submission for a full proposal.

At the present time, we continue to search for additional funding opportunities. At the next meeting of the applicants, we will discuss strategies to improve the research questions and methodology to be successful at obtaining funds to continue the work that has been initiated on addressing medication use in the older adults.

The funds awarded by WICI were used to support the hiring of the research student during the period of January – May 2017.

2) Chris Bauch, *Using digital social data to detect early warning signals of regime shifts in coupled human-environment systems,* $ 10,000.00.

The funds from the WICI Seed Grant Challenge were used to extend the appointment of research associate Justin Schonfeld to help develop a database of tweets about climate change and vaccines. The resulting letter of inquiry for a full grant proposal was sent to the Templeton Foundation although the proposal was not accepted for further consideration. However, the seed grant funds have allowed for the development of a draft manuscript "Vaccination and Climate Change: Sentiment and Community Structure on Twitter" (Justin Schonfeld, Jeffery Cheng, Madhur Anand, Chris Bauch), and we will be seeking alternative sources of funding to build on the efforts of the seed grant. In particular, the research will be included in Bauch's NSERC Discovery Grant renewal to be submitted in Fall 2018. We will also try again to submit LOIs to the Simons Foundation and for next year's Templeton Foundation call for proposals.

3) Peter Deadman, *Impact of Tank Rehabilitation on the Resilience of Rainwater Harvesting Institutions in South India,* $ 9,200.00.

Funding from the WICI seed grant was used to provide RA funding for a doctoral student, Tejasvi Hora (TJ), during the spring 2017 term. During this term, TJ undertook an analysis of the data collected from over 70 interviews of local farmers and officials living within one cascade of irrigation tanks located southwest of Madurai, India, collected in the previous summer and fall. TJ undertook content analysis of these interviews, transcribing voice recordings and written notes to develop a database of farming practices in this watershed. This research identifies common themes surrounding the impact and reception of an irrigation tank rehabilitation project funded by the DHAN Foundation. This analysis has clarified the common cropping rotations, patterns of water use (from the tank or from bore wells), and strategies for dealing with drought seen in the watershed. In addition, the responses of farmers to the rehabilitation of the water control structures in the tank and changing climatic patterns, has been recorded.

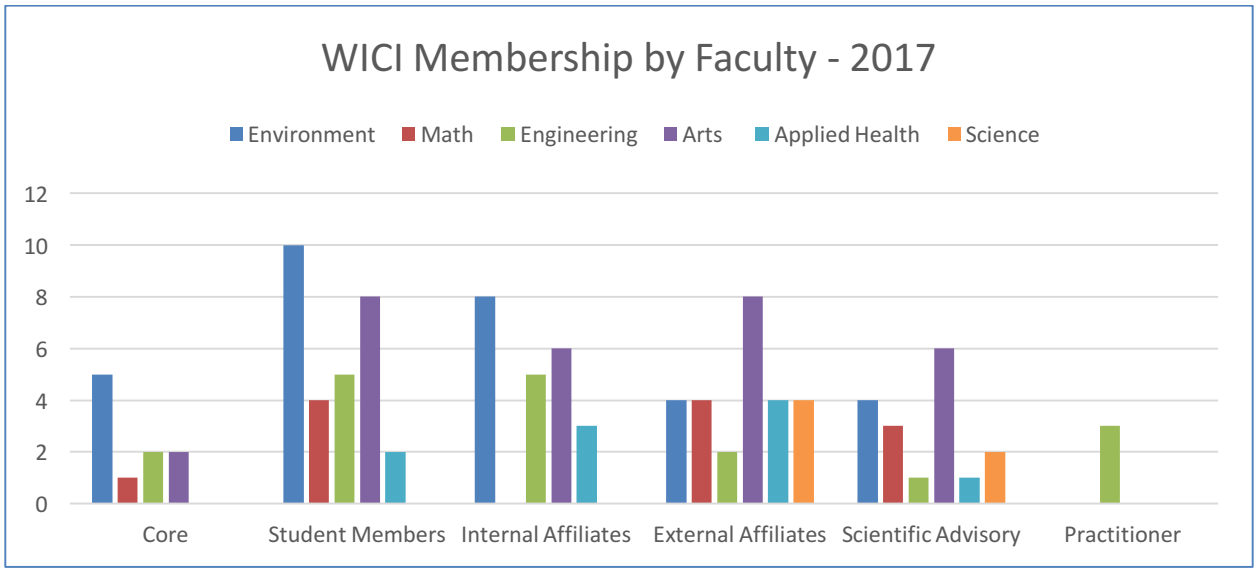
The analysis of this data is being undertaken within a social-ecological systems framework, exploring themes of resilience, equity, and sustainability in relation to the changing hydrological characteristics of the irrigation system and the watershed, and the individual and collective response of the farmers operating within this system. This analysis is ongoing, as we put together a paper with the working title

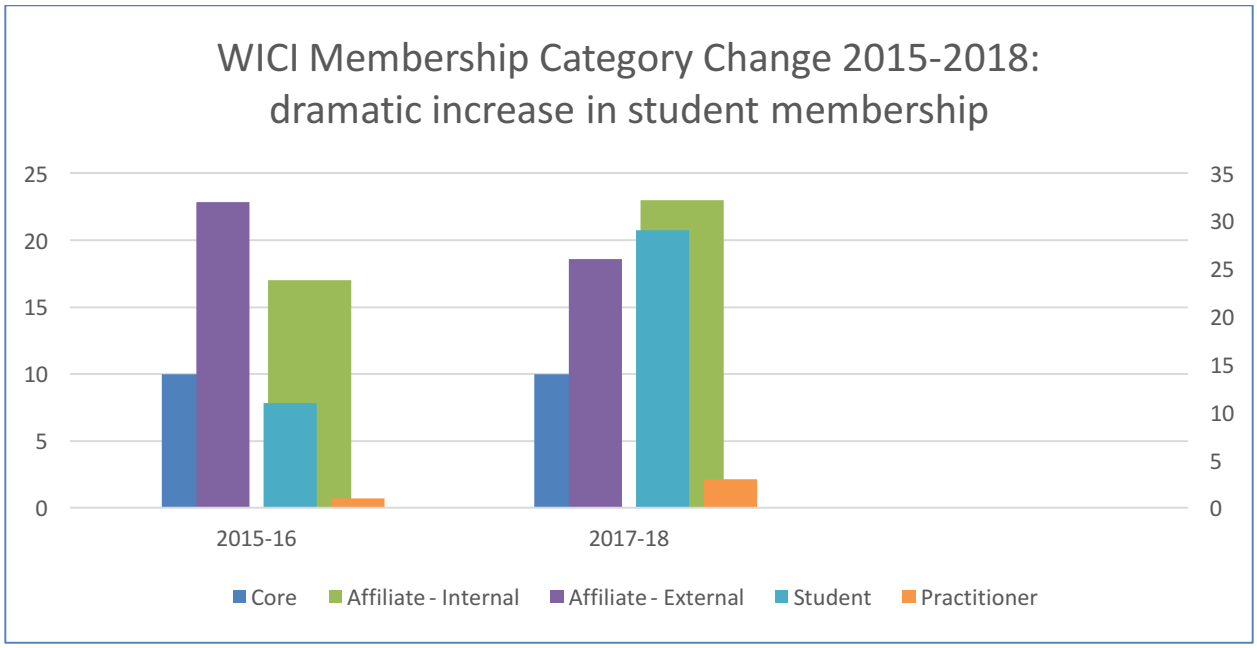
"Traditional tank rehabilitation as a panacea: change and adaptation in a social-ecological system". We anticipate that the paper will be ready for review in the spring of 2018.

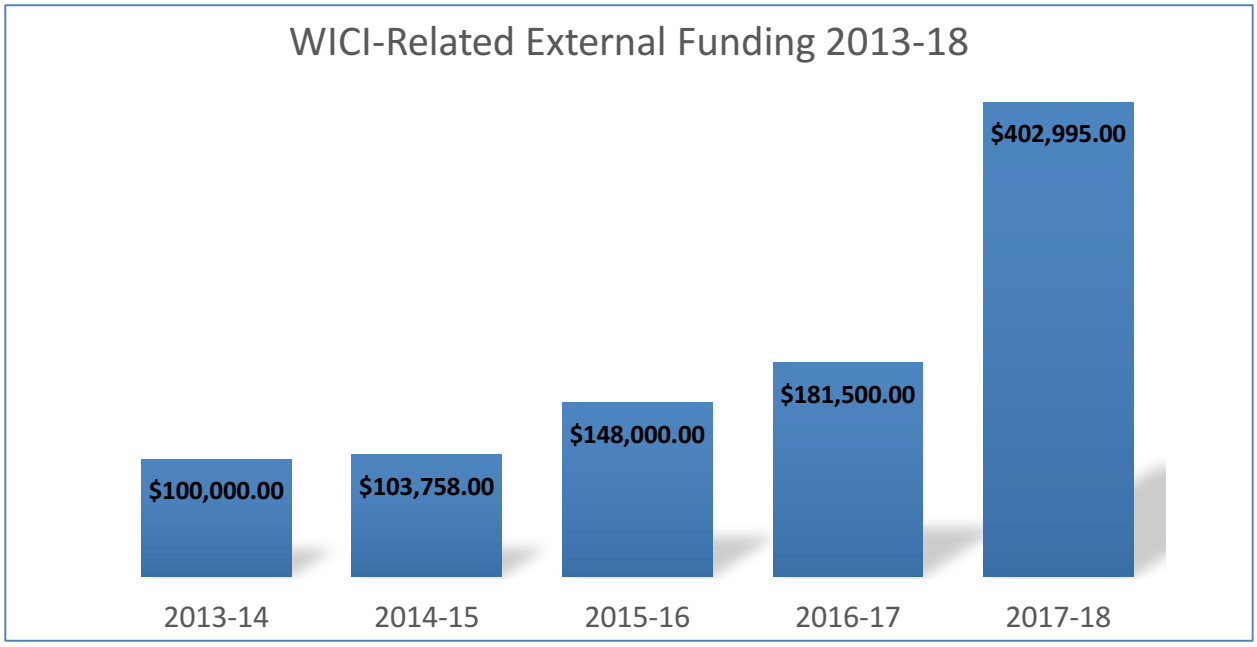
In addition to the paper under preparation, this research is informing the preparation of research funding proposals (specifically a SSHRC Insight Development Grant) led by Johanna Wandel and Peter Deadman.

DIVERSITY REPORT

WICI Diversity Report	2017 Visible Minorities %	2017 Female %
Steering Committee	14	42
Core Membership	10	30
Speaker's Series	13	37
Student Members	27	52
Affiliate Members [Internal & External]	15	17




WICI Membership Category Change 2015-2018:
dramatic increase in student membership
25
20
15
10
5
0
35
30
25
20
15
10
5
0
2015-16
2017-18
Core
Affiliate - Internal
Affiliate - External
Student
Practitioner


WICI-Related External Funding 2013-18
$100,000.00
$103,758.00
$148,000.00
$181,500.00
$402,995.00
2013-14
2014-15
2015-16
2016-17
2017-18

FINANCIAL REPORT (MAY 1, 2016 - APRIL 30, 2017)

BUDGET 2016-17	BUDGETED 2016-17	ACTUAL As of April 30, 2017	REMAINING
Anticipated income			
2016-2017 Carryforward	$66,238.00	$66,238.00	
Requested UWaterloo funding	$68,000.00	$68,000.00	
Fields Institute - Sponsorship		$4,000.00	$4,000.00
TOTAL INCOME	**$134,238.00**	**$138,238.00**	**$4,000.00**
Anticipated expenses			
SALARIES			
Admin Assistant	$16,800.00	$22,379.64	-$5,579.64
Research Honorarium for Interim WICI Director Madhur Anand	$10,000.00	$10,000.00	$0.00
IT Technician – Research Group Websites	$5,000.00	$0.00	$5,000.00
SPEAKERS SERIES, WORKSHOPS AND OTHER EVENTS			
Catering for Speakers Series and Meetings	$2,800.00	$1,630.16	$1,169.84
Travel, Accommodation and Meals for Speakers Series	$10,000.00	$8,610.46	$1,389.54
Conference	$15,000.00	$155.00	$14,845.00
Promotion and Marketing	$400.00	$444.82	-$44.82
GRANT SUPPORT EXPENSES			
Dr. Parker's Partnership Grant – Post-Doc	$8,892.00	$236.86	$8,655.14
OTHER RESEARCH FUNDING			
Core Members Travel for Conferences and Networking	$7,500.00	$3,015.25	$4,484.75
WICI Student Membership Initiative	$3,000.00	$0.00	$3,000.00
Grant challenge	$30,000.00	$29,150.00	$850.00
Student Research and Travel Grants	$3,000.00	$2,985.78	$14.22
OTHER			
IT Development and Maintenance (*includes yearly account*	$1,500.00	$4,078.11	-$2,578.11
Contracted Services (*including editing of publications*)	$500.00	$0.00	$500.00
Telephone Service	$240.00	$240.50	-$0.50
Miscellaneous	$400.00	$100.00	$300.00
Unallocate Budget Expenses	$19,206.00		$19,206.00
TOTAL EXPENSES	**$134,238.00**	**$83,026.58**	
Anticipated carryforward for 2017-2018			**$55,211.42**

WICI BUDGET 2017-18

BUDGET 2017-2018	BUDGETED 2017-18	Actuals May 1, 2017 - Feb 1, 2018	Forecast February 1- April 30, 2018	Variance
Anticipated income				
2017-2018 Carryforward	$21,530.65	$55,578.00	$0.00	$34,047.35
Requested UWaterloo funding	$70,000.00	$70,000.00	$0.00	$0.00
Fields Institute Registration Fees Collected for 2017 Conference	$4,000.00	$4,442.48	$0.00	$442.48
CAIMS Support for Resillience Conference [May 2017]	$1,000.00	$1,000.00	$0.00	$0.00
U of G: shared conference costs	$0.00	$848.00	$0.00	$848.00
TOTAL INCOME	**$96,530.65**	**$131,868.48**	**$0.00**	**$35,337.83**
Anticipated expenses				
SALARIES				
Admin Assistant	$18,000.00	$12,490.91	$7,200.00	-$1,690.91
IT Technician – Research Group Websites	$1,000.00	$0.00	$0.00	$1,000.00
SPEAKERS SERIES, WORKSHOPS AND OTHER EVENTS				
Catering for Speakers Series and Meetings	$2,000.00	$700.22	$1,300.00	-$0.22
Travel, Accommodation and Meals for Speakers Series	$10,000.00	$0.00	$11,330.00	-$1,330.00
Sponsored Workshops (3 were supported)	$16,000.00	$16,000.00	$5,000.00	-$5,000.00
Promotion and Marketing	$500.00	$159.74	$430.00	-$89.74
2018 Conference on Modelling Complex Urban Environments	$11,000.00	$0.00	$0.00	$11,000.00
Resillience Conference (Note 1)	$0.00	$15,297.92	$0.00	-$15,297.92
GRANT SUPPORT EXPENSES				
Research Honorarium for Interim WICI Director Madhur Anand	$10,000.00	$10,000.00	$0.00	$0.00
OTHER RESEARCH FUNDING				
Core Members Travel for Conferences and Networking	$7,500.00	$1,638.69	$4,000.00	$1,861.31
WICI Student Membership Initiative	$3,000.00	$0.00	$3,000.00	$0.00
Student Research and Travel Grants	$5,000.00	$3,474.33	$4,200.00	-$2,674.33
WICI Award of Excellence	$0.00	$0.00	$10,000.00	-$10,000.00
Remaining Grant for Dawn Parker (Note 1)	$0.00	$8,892.00	$0.00	-$8,892.00
OTHER				
IT Development and Maintenance (*includes yearly account*	$1,500.00	$856.00	$1,100.00	-$456.00
Contracted Services (*including editing of publications*)	$500.00	$0.00	$0.00	$500.00
Gifts for speakers			$560.00	-$560.00
Telephone Service	$240.00	$180.67	$120.00	-$60.67
Miscellaneous	$500.00	$25.59	$400.00	$74.41
Unallocated carry forward budgeted	$9,790.65	$0.00	$0.00	$9,790.65
TOTAL EXPENSES	**$96,530.65**	**$69,716.07**	**$48,640.00**	**($21,825.42)**
NET FUNDS AVAILABLE/ANTICIPATED CARRY-FORWARD		**$62,152.41**		**$13,512.41**

Note 1: Expenses expected in 2016-17, instead posted in 2017-18, therefore unallocated carry-forward budget used to fund expenditures. Actual Carryforward is $55,578. Salary: Additional hours approved for extra work required. 2 speakers and Board meeting. 2 of 4 Speaker's series were local, and we Co-sponsored Yacov Haimes. Jerremy Pittmann - Workshop $5,000
June 2018 Conference won't be expensed until after June 2018 with $1000 extra for airfare as Keynote is travelling from the UK. Resilience Conference 2016-17 expenses posted in 2017-18. Quilley's travel $974.22 was from 2016-17. Schweitzer, Anand and Bauch anticipated before April 30. Perin's reading group as GRS. $2402 for Laycock, Janzwood, Bury. $1798 for WICI Students attending Fields' event in March. Remainder of Dawn's Grant [2016-17 expense] posted in 2017-18. Set aside for Quilley editing.

APPENDIX A: WICI GOVERANCE COMMITTEES

WICI BOARD

Charmaine	Dean	UW VP, University Research
George	Dixon	UW VP, Academic and Provost
Deans or their representatives from the primary participating faculties		
Keith	Hipel	Professor, System Design Engineering, UW
Paul	Thagard	Professor of Philosophy and Director of the Cognitive Science Program, University of Waterloo
Monica	Cojocaru	Professor, Mathematics, University of Guelph
Peter	Deadman	Chair, Department of Geography
Matt	Hoffmann	Associate Professor, Political Science, University of Toronto
Anna	Lawniczak	Professor, Department of Mathematics & Statistics, University of Guelph
Sarah	Tolmie	Associate Professor, Department of English Language and Literature
Frances	Westley	JW McConnell Chair in Social Innovation - Retired in Fall 2017

SCIENTIFIC ADVISORY COUNCIL

W. Brian	Arthur	External Professor, Santa Fe Institute
Robert	Axtell	Professor and Chair, Dept. of Computational Social Science, George Mason University
Yaneer	Bar-Yam	President, New England Complex Systems Institute
Michael	Batty	Professor of Planning, Director, Center of Advanced Spatial Analysis, University College London
Eric	Beinhocker	Executive Director, Institute for New Economic Thinking at the Oxford Martin School, University of Oxford
Monica	Cojocaru	Associate professor, Department of Mathematics & Statistics, University of Guelph.
J. Doyne	Farmer	Professor of Mathematics and Director of Complexity Economics, Institute for New Economic Thinking at the Oxford Martin School, University of Oxford
Carl	Folke	Science Director, Stockholm Resilience Centre
Ian	Goldin	Director, Oxford Martin School, Oxford University
Matthew	Hoffman	Associate professor of political science, University of Toronto
Eric	Lambin	Professor, Dept. of Geography, University of Louvain; Professor, School of Earth Sciences, Stanford University
Jukka-Pekka	Onnela	Assistant Professor of Biostatistics, Department of Biostatistics, Harvard School of Public Health
Felix	Reed-Tsochas	Co-Director of the CABDyN Complexity Centre University of Oxford
Marten	Scheffer	Professor, Aquatic Ecology, Wageningen University
Lee	Smolin	Perimeter Institute; Adjunct Professor, Dept. of Physics, UW

Leigh	Tesfatsion	Professor of Economics, Mathematics, and Electrical & Computer Engineering, Dept. of Economics, Iowa State
Jan	Wouter Vasbinder	Director of the Complexity Program at the Nanyang Technological University at Singapore

STEERING COMMITTEE

Madhur	Anand	WICI Director; Professor, School of Environmental Sciences, University of Guelph
Chris	Bauch	WICI Associate Director; Professor, Applied Mathematics, University of Waterloo
Mark	Crowley	Assistant Professor, Pattern Recognition and Machine Intelligence group, Department of Electrical and Computer Engineering, University of Waterloo
Stephen	Quilley	WICI Director of Development; Associate Professor, SiG, Department of Environment and Resource Studies
Dawn	Parker	Professor, School of Planning, Faculty of Environment, University of Waterloo
Vanessa	Schweizer	Assistant Professor in Knowledge Integration, University of Waterloo
Peter	Deadman	Associate Professor, Geography and Environmental Management, University of Waterloo

APPENDIX B: 2016 PRODUCTIVITY REPORT - DETAILS OF INDIVIDUAL CORE WICI-RELATED ACTIVITIES

NAME	STATUS	CONTRIBUTIONS
Madhur Anand	WICI Director and Core	*Organization of Workshop or Conference* Organizing Committee (co-Chair), Waterloo Institute for Complexity and Innovation Conference on *'Living on the precipice: Interdisciplinary Conference on Resilience in Complex Natural and Human Systems',* 16-17 May 2017. Organizing Committee (co-Organizer), Field's Institute on *'Human-Environment Sustainability',* March 2018 (with shared WICI speaker Carla Restrepo) *Peer Reviewed Publications* Socio-ecological dynamics of Caribbean coral reef ecosystems and conservation opinion propagation VA Thampi, M Anand, CT Bauch (2018) *Scientific Reports* 8 (1), 2597 Competition between injunctive social norms and conservation priorities gives rise to complex dynamics in a model of forest growth and opinion dynamics RP Sigdel, M Anand, CT Bauch (2018) *Journal of theoretical biology* 432, 132-140 Dynamics of the Global Wheat Trade Network and Resilience to Shocks KR Fair, CT Bauch, M Anand (2017) *Scientific reports* 7 (1), 7177 Hydrological niche segregation of plant functional traits in an individual-based model MM Herberich, S Gayler, M Anand, K Tielbörger (2017) *Ecological modelling* 356, 14-24 Functional diversity loss with increasing livestock grazing intensity in drylands: the mechanisms and their consequences depend on the taxa V Chillo, RA Ojeda, V Capmourteres, M Anand (2017) *Journal of Applied Ecology* 54 (3), 986-996 Does structural connectivity influence tree species distributions and abundance in a naturally discontinuous tropical forest formation? AA Das, R John, M Anand (2017)

		Journal of Vegetation Science 28 (1), 7-18 *Current Student Supervision* Robert Gooding-Townsend (MMath in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2015. Co-supervised with Chris Bauch. Defended in Fall 2017 Kat Fair (MMath in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2014. Co-supervised with Chris Bauch Vivek Thampi (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2013. Co-supervised with Chris Bauch Peter Jentsch (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2014. Co-supervised with Chris Bauch Tom Bury (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2015. Co-supervised with Chris Bauch Awards James McDonnell Foundation Complex Systems Scholar Award - $ 30,000
Dawn Parker	Core	*Peer-reviewed Journal Articles (* denotes advisee/student author)* "A prototype cloud-based reproducible data analysis and visualization platform for outputs of agent-based models ", Jin, Xiongbing, Kirsten Robinson, Allen Lee, J. Gary Polhill, Calvin Pritchard, and Dawn C. Parker, (2017) *Environmental Modelling and Software* 96. 172-180. *Undergraduate and Graduate Research Supervision* Xinyue Pi, Univerisity of Waterloo, School of Planning, (MES, completed Oct. 2017, title:\Exploring Rental Housing Markets in Kitchener-Waterloo, Ontario") *Invited Seminars and Presentations/Keynotes* 'Agent-based Decision Models: State of the Art, Outstanding Challenges, and a Path Forward" D. Parker. Invited keynote at the Geocomputation conference, Leeds, UK, 4 Sept. 2017. *Invited Workshops and Research Consultations* Invited participant and session leader, "Design, verication, and validation of agent decision models" ABM- 17 symposium, San Diego, CA, 20-22 April, 2017. Conference Presentations (*denotes presenter) "Interpreting and Modelling the Housing Market from Individual Behaviours",Y. Huang *., D. Parker, J. Dean, J. Cook and X. Pi. Presented at the 64th Annual North American Meetings of the Regional Science Association International, Vancouver, CA, November 8-11, 2017. "Modelling atomic housing market agents: Conceptual and data challenges", D. Parker, X. Jin, K. Yeung, R. Babin, J. Casello, Y. Huang, X. Pi, A.J. Wray, and P.

		Fard. Presented at the Association of American Geographers Annual Meeting, Boston, MA, 5-9 April, 2017. *Additional Research Activities and Subcontracts* 1/2018-12/2018 International Research Partnership Development Grant (University of Waterloo Oce of Research) \Modelling Urban Complexity - A transdisciplinary approach," D. Parker, PI. 7/2017- Compute Canada Resource Allocation Grant to D. Parker
Peter Deadman	Core	*Paper* Dou, Y.; P. Deadman, D. Robinson, O. Almeida, S. Rivero, N. Vogt, M. Pinedo-Vasquez. 2017. Impacts of cash transfer programs on rural livelihoods: a case study in the Brazilian Amazon estuary. Human Ecology 45(5), 697-710. DOI 10.1007/s10745-017-9934-1. *Conference Presentations* Deadman, P., Y. Dou. Exploring development resilience dynamics: an agent based modelling approach. Annual Meeting of the Canadian Association of Geographers, Toronto, Canada. May 30, 2017. Deadman, P., Y. Dou, M. Berbes. Exploring development resilience dynamics with agent based models. Living on the Precipice: Interdisciplinary Conference on Resilience in Complex Natural and Human Systems. Waterloo, Canada, May 16, 2017. Dou, Yue, P. Deadman, M. Berbes, S. Vogt, O. Almeida, N. Vogt, Exploring the resilient strategy for smallholders? A case study of Brazilian Amazon using agent-based model. Annual Meeting of the American Association of Geographers, Boston, USA. April 7, 2017. *Grants* 2017 – Global Water Futures Program. Agricultural Water Futures in Canada: Stressors and Solutions PI: M. Macrae. Other participants: P. Deadman, R. Gordon, W. Hegelson, J. Elliott, R. de Loe, J. Wandel, D. Robinson, R. Brouwer, R. Petrone, H. Baulch, T. Fonstad, Y. Li, J. Pomeroy. $2,761,700
Mark Crowley	Core	*Submitted Publications* Sriram Subramanian, Mark Crowley. “Using Spatial Reinforcement Learning to Build ForestWildfire Dynamics Models from Satellite Images”. Frontiers in ICT: Environmental Informatics. 30 pages. Submitted October 2017. Status: Under review. *Articles in refereed conference proceedings*

		Sriram Subramanian*, Mark Crowley. "Combining MCTS and A3C for Prediction of Spatially Spreading Processes in ForestWildfire Settings". *The Canadian Conference on Artificial Intelligence,* Toronto, 2018. Submitted *January 2018. Status: Under review.* Sriram Ganapathi Subramanian*, Mark Crowley. "Learning Forest Wildfire Dynamics from Satellite Images Using Reinforcement Learning". In *The Third Conference on Reinforcement Learning and Decision Making (RLDM*), 5 pages. Ann Arbor, Michigan, USA, 2017. *Conference papers, presentations and abstracts* Mark Crowley. "AI Education Through Real World Problems". In the Seventh Symposium on Educational Advances in Artificial Intelligence. San Francisco, USA, 2017. *Invited Talks andWorkshops* Wildland fire appropriate response workshop: generating and using science, Feb. 27-28, 2018. London, ON. BIRS Workshop on Forest Management with a focus on Risk Management, Nov 2017. Banff, Alberta. Host: The Banff International Research Station for Mathematical Innovation and Discovery (BIRS). Title: "Fighting Fire with AI: Using Artificial Intelligence to Improve Modeling and Decision Making in Wildfire Management". Deep Learning for Medical Imaging Workshop, Aug 28, 2017 - University of Western Ontario. Host: Prof. Shuo Li. Title: Demystifying Deep Learning Waterloo Institute for Complexity and Innovation Invited Seminar Series, Oct 2017 - University of Waterloo. Host: Prof. Madhur Anand. Title: "Using Deep Learning and Reinforcement Learning to Tame Spatially Spreading Processes." *Other student supervision (masters essays, special projects, etc.)* ECE Fourth Year Design Project Consultant 2017/9 - 2018/4. Topic: Automating Land Surveying and Mapping Techniques - the group is building a mobile app and serverbased system to provide advanced surveying data using a mobile phone by connecting with a range of high precision base stations and city open data websites. *Service - Committees* Reviewing Judge for the IBMWatson AI XPrize - The $5 million IBM Watson AI XPrize invites teams from around the world to pitch and demonstrate results on a 'moon shot' problem and solution of benefit to society using AI/ML. In summer 2017 I was invited to review as an AI/ML expert for this prize.
Steve Quilley	Core	*Peer Reviewed Publications*

		Zywert, K & Quilley, S (2017) 'Health systems in an era of biophysical limits: the wicked dilemmas of modernity' *Social Theory & Health*. https://doi.org/10.1057/s41285-017-0051-4. Loyal, S and Quilley ,S (2017) 'The particularity of the universal: critical reflections on Bourdieu's theory of symbolic power and the state' *Theory and Society*, (), 1-34 10.1007/s11186-017-9298-y. 367 downloads in the first three months. Kish, K and Quilley, S (2017) 'Wicked Dilemmas of Scale and Complexity in the Politics of Degrowth'in *Ecological Economics* Volume 142, December 2017, Pages 306-317 [Our ecological economics paper made it into the physical book (only a few chosen ones make the physical copy) http://www.sciencedirect.com/science/article/pii/S0921800916311260] Loyal, S. and Quilley, S. (2017) 'Categories of State Control: Asylum Seekers and the Direct Provision and Dispersal System in Ireland '*Social Justice* 43/4, pp69-97 *Non-refereed papers* *Kish and Quilley (2017) DIY: How to put meaning back in your work Alternatives pp 46-51* *https://www.academia.edu/34949003/Alternatives_Journal_Special_Issue_Ecological_Economics* *Submitted or in process* *Restoration Ecology for the Anthropocene – submitted to Ecology and Society Jan 2018-01-31 – Barb Davy, K Kish, Stephen Murphy, Dan McCarthy and Stephen Quilley* *Kish,K; Quilley, S; Zywert, K;Davy, B (2017) 'Environmentalism at the Margins: Exploring existing possibilities for an alternative modernity' Submitted to Environmental politics* *Papers in Press* Loyal, **S. Quilley**, S. 2017 'The particularity of the universal: critical reflections on Bourdieu's theory of symbolic power and the State' *Theory and Society* *Non-Refereed Publications – Published, In Press or Accepted for Publications* Kish and Quilley (2017) DIY: How to put meaning back in your work Alternatives pp 46-51 https://www.academia.edu/34949003/Alternatives_Journal_Special_Issue_Ecological_Economics *Books* Steven Loyal and Steve Quilley (2018 In Press) *State Power and Asylum Seekers in Ireland* (London: Springer)

		Book Chapter in Press Quilley, S (2017) "Navigating the anthropocene: Environmental politics and complexity in an era of limits." PP 439-470 In *Handbook on Growth and Sustainability* Edited by Peter A. Victor, Brett Dolter. Cheltenham: Edward Elgar. Davy, Barbara Jane, and Stephen Quilley. 2017 'Contemporary Paganism, Environmental Politics, and the Third Way: A complex systems perspective on cross-scale ideational and behavioral change' in *Greening of Religions*, By Jonathan Leader (ed.) University of South Carolina. *Community Outreach & Workshops* Stephen Quilley with Katharine Zywert were awarded a $20K CHIR grant to run a workshop scheduled for April 2018: Medicines for the Anthropocene: Health on a Finite Planet. This involves a collaboration with Jennifer Cole Rockafeller and Martin School, University of Oxford. Stephen Quilley has been invited to become a Fellow of the Norbert Elias Foundation *Presentations* In April 2017 Quilley gave papers at the Open University in Milton Keynes and the University of Cambridge. Creative Destruction, complexity and hegemonic common sense: earth-based spirituality, everyday heroism and the political economy of livelihood' Stephen Quilley, University of Cambridge, 20th April 2017 'Environmentalism at the Margins: Exploring possibilities for an alternative modernity' Stephen Quilley (presented) Barb Davy, Katherine Zywert and Katie Kish http://www.open.ac.uk/blogs/religious-studies/?p=352 After the Milton Keynes paper he recorded a short podcast *OPEN UNIVERSITY THREE MINUTE THEORY* http://www.open.ac.uk/blogs/religious-studies/?p=500 December 5th 2017: UCD Dublin, Sociology Department. 'Education for the Anthropocene: why we need conscious, creative, cognitive dissonance Insights from Ernest Gellner, Walter Ong, Norbert Elias and Karl Polanyi' 'Liberty in the Anthropocene' – Debate with Professor Peter Brown, SSHRC-funded Economics for the Anthropocene (E4A) series, McGill University, Montreal – 23rd Jan 2017. Public lecture and Webcast. Federation of Humanities/Congress paper June 2017 *Media*

		Green Corps Interview https://twitter.com/UNACGreenCorps/status/829711674928197632 - United Nations IN Canada podcast on growth and sustainability *Funding* CIHR Planning & Dissemination Grant, Institute of Population & Public Health, "Improving population health in an era of social-ecological instability and economic contraction" - $19,917 CFI with Marcel O'Gorman, CFI-JELF application entitled 'Critical Media Prototyping Suite' $40,000 SSHRC post doc for Mark Hathaway starting Jan 2018: Transformative Ecological Learning in Permaculture *Papers by S. Quilley's research students* Katie Kish, Barb Davy, Perin Ruttonsha Special session at CANSEE in October 2017 "Uprooting our Path by Way of Discourse" Zywert, K. (2017, May). "Beyond conventional sustainability in healthcare." Environmental Studies Association of Canada. Congress 2017. Toronto, ON, May 30th 2017. Zywert, K. (2017, April). "Human Health and Long-Term Social-Ecological Systems Change: Emerging Alternatives for Health in the Anthropocene." Planetary Health Alliance Inaugural Annual Meeting. Boston, MA, April 28th-30th, 2017. Zywert, K. (2016, May). "Aging and Death in Radical Green Politics." Symposium on Aging Research (SoAR), University of Waterloo. Kish,K; Quilley, S; Zywert, K;Davy, B (2017) Stockholm Reslience conference 'Environmentalism at the Margins: Exploring existing possibilities for an alternative modernity' URL to conference website with call for abstracts: http://resilience2017.org/
Vanessa Schweizer	Core	Papers in preparation (*graduate student): Schweizer, V., Vögele, S., Weimer-Jehle, W., Poganietz, W.-R. (2016) Multi-level scenario analysis for long-term coordination of policies, 5 pp. In preparation for Environmental Science & Technology. Schweizer, V., Jamieson-Lane, A.,* Barnett, N.,* Cai, H., Lehner, S., Smerlak, M., Varga, M.* (2015) Scenario succession with cross-impact balances expressed as a Markov chain, 28 pp. In preparation for Technological Forecasting and Social Change.

		Guivarch, C., Rozenberg, J., and Schweizer, V. (2014) Enhancing the policy relevance of scenarios through a dynamic analytical approach, 12 pp. In preparation for the Proceedings of the National Academy of Sciences of the USA. Abstracts in refereed conference proceedings (*graduate student) **Schweizer, V.** and Mitchell, R.* (2017) Socio-economic challenges and conflict for climate scenarios for Sub-Saharan Africa. 2017 Annual Meeting of the Society for Risk Analysis, "The Profession, The Practitioners, The Research". Available at: http://birenheide.com/sra/2017AM/program/singlesession.php3?sessid=T3-E&order=3#3 Kurniawan, J.H.* and **Schweizer, V.** (2017) Extending Shared Socio-economic Pathways (SSPs): Scenario Linking Strategies and Techniques. 2017 Decision-making under Deep Uncertainty workshop, p. 35. Oxford: Society for Decision Making under Deep Uncertainty. Chapters in books (*graduate student; **refereed) **Scheele, R.*, Kearney, N.M.*, Kurniawan, J.H.*, **Schweizer, V.J.** (accepted) What Scenarios Are You Missing? Poststructuralism for Deconstructing and Reconstructing Organizational Futures. Book chapter in H. Krämer and M. Wenzel (Eds.) *Organizing (for) the Future: How Organizations Manage Things to Come*. Palgrave Macmillan. Manuscripts submitted for publication but not yet accepted (*graduate student) **Schweizer, V.** (2016) Experiences with global socio-technical scenarios for climate change research, 10 pp. Invited editorial essay submitted to *Climatic Change* for a Special Issue on "Integrated scenario building in energy transition research". *Addresses at conferences - invited* **Schweizer, V.** (2017) Investigating resilience and transformability in human systems. Presentation at the Waterloo Institute for Complexity & Innovation (WICI) Interdisciplinary Conference on Resilience in Complex Natural and Human Systems, "Living on the Precipice", 16 May 2017, Waterloo, ON. *Addresses at workshops or annual meetings - refereed* ****Schweizer, V.** and Mitchell, R.* (2017) Socio-economic challenges and conflict for climate scenarios for Sub-Saharan Africa. Presentation at the Annual Meeting of the Society for Risk Analysis, 12 December 2017, Arlington. ****Schweizer, V.** and Kurniawan J.H.* (2017) Local interpretation of the Shared Socio-economic Pathways: Scenario Linking Strategies and Techniques. Presentation at the 2017 Decision-making under Deep Uncertainty workshop, 15 November 2017, Oxford. *Record of research funding applications* Balsillie School of International Affairs, Seed Grant, "A complex systems approach for understanding ideological diversity" ($2230, PI, 100%)

		UW/SSHRC Seed Grant, "A complex systems approach for understanding ideological diversity" ($7000, PI, 100%) *Positions held or service to professional societies or the scientific community* Committee Member: Organizing Committee for the Waterloo Institute for Complexity & Innovation (WICI) Workshop, "Leveraging systems approaches to improve human and planetary health", Waterloo, ON, forthcoming *25-26 April 2018* Committee Member: Organizing Committee for the Waterloo Institute for Complexity & Innovation (WICI) Interdisciplinary Conference on Resilience in Complex Natural and Human Systems, "Living on the Precipice", Waterloo, ON, *16-17 May 2017* *Other external review:* United States – Israel Binational Agricultural Research and Development Fund (BARD; performed external review of research proposal to granting agency), *2018*
Chris Bauch	Core	*Refereed Journal Articles and publications* A.D. Pananos, T.M. Bury, C. Wang, J. Schonfeld, S.P. Mohanty, Brendan Nyhan, Marcel Salathe, C.T. Bauch (2018). 'Critical dynamics in population vaccinating behavior', *Proceedings of the National Academy of Sciences of the USA* 114(52): 13762-13767. V. Thampi, M. Anand, C.T. Bauch (2018). 'Socio-ecological dynamics of Caribbean coral reef ecosystems and conservation opinion propagation'. *Scientific reports,* in press. D.R. Grimes, C.T. Bauch, J.P.A. Ioannidas (2018). 'Modeling science trustworthiness under publish or perish pressure'. *Royal Society Open Science,* in press. O. Menin, C.T. Bauch (2017). 'Solving the patient zero inverse problem by using generalized simulated annealing'. *Physica A,* in press. R. Sigdel, M. Anand, C.T. Bauch (2017). 'Competition between injunctive social norms and conservation priorities gives rise to complex dynamics in a model of forest growth and opinion dynamics.' *Journal of Theoretical Biology*, in press. K. Fair, C.T. Bauch, M. Anand (2017). 'Dynamics of the global wheat trade network and resilience to shocks'. *Scientific reports*, in press. N. Ringa, C.T. Bauch (2017). 'Spatially implicit modelling of disease-behaviour interactions in the context of non-pharmaceutical interventions'. *Mathematical Biosciences and Engineering* 15(2): 461-483.

S. Tully, M. Cojocaru, C.T. Bauch (2017). *'Multiplayer games and HIV transmission via casual encounters' Mathematical Biosciences and Engineering,* 14(2): 359-376.

Submitted Publications

S. Zhao, D. He, C.T. Bauch (2018). 'Strategic decision-making on travelling during disease outbreaks: a game-theoretical approach'. *PLOS Computational Biology,* submitted.

R. Leon Cordero, A. Das, C. T. Bauch, M. Anand. 'Traditional knowledge in a changing world: current tribal perceptions of ecosystem value in natural forest-grassland mosaics of the Nilgiri Hills (India).' *Palgrave communications,* submitted.

Z. Dockstader, C.T. Bauch, M. Anand (2017). 'Interconnections accelerate collapse in a socio-ecological metapopulation. *Nature sustainability,* submitted.

S. Rizvi, C. Pagnutti, C.T. Bauch, M. Anand (2017). 'Global land use implications of dietry trends: a Tragedy of the Commons'. *Scientific reports,* submitted.

L. Skrip, C.T. Bauch, Jeffery Townsend, A. Galvani (2016). 'The frontier of infectious disease epidemiology: at the intersection of control, human behavior, microbial ecology and health policy', *Nature microbiology*, minor revisions.

T. Oraby, M. Anand, C.T. Bauch (2016). 'Strategic dimension of the environmental Kuznets curve in the era of globalization'. *Handbook of Statistics,* submitted.

P. Jentsch, C.T. Bauch (2017). 'Spatial correlation as an early warning signal of regime shifts in a multiplex disease-behaviour network.' *Journal of Theoretical Biology,* submitted

Refereed conference/workshop proceedings and short communications
A.P. Galvani, C.T. Bauch, M. Anand, B.H. Singer, S.A. Levin (2016). 'Human-environment interactions in population and ecosystem health'. Proceedings of the National Academy of Sciences of the USA 113: 14502.

In preparation
K. Jnawali, M. Anand, C.T. Bauch (2017). 'Stochasticity-induced persistence of an endangered population in a coupled socio-ecological model.

Grants and contracts

Waterloo Institute for Complexity and Innovation. Project Seed Grant. PI: Chris Bauch. $10,000.

		C.T. Bauch: Canada Foundation for Innovation John Evans Leadership Fund: $234,296 for 'Coupled human-and-natural systems laboratory.' C.T. Bauch, M. Anand and K. Fair: University of Waterloo Gender Equity Grant: $10,000 *Current Student Supervision* Peter Jentsch (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2016. Thomas Bury (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2015. Brendon Phillips (MMath in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2015. Robert Gooding-Townsend (MMath in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2015. Co-supervised with Madhur Anand. Kat Fair (MMath in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2014. Co-supervised with Madhur Anand. Vivek Thampi (PhD in Applied Mathematics, University of Waterloo, Dept. of Applied Mathematics). Start date: Fall 2013. Co-supervised with Madhur Anand. Ram Sigdel (PhD in Mathematics, University of Guelph, Dept. of Mathematics and Statistics). Start date: Fall 2013. *Undergraduate research assistants* Jeffery Cheng, Fall 2017, Work Placement Research Assistant Maliha Ahmed, Summer 2017, NSERC USRA Jason Sinn, Fall 2016, Work Placement Research Assistant *Conference, workshop and symposium organization* Chair of Organizing Committee, Waterloo Institute for Complexity and Innovation Conference on '*Living on the precipice: Interdisciplinary Conference on Resilience in Complex Natural and Human Systems*', 16-17 May 2017. *Oral presentations: seminars and colloquia* *Intelligence Systems Colloquium. Max Planck Institute for Intelligent Systems, University of Tübingen, Germany, 10 July 2017. 'Sentiment analysis of tweets to detect tipping points in vaccinating behaviour.'*

		Seminar in Plant Ecology, University of Tübingen, Germany, 16 June 2017. 'Dynamics of Scirpus Maritimus in a temporally varying environment' *Seminar in Plant Ecology, University of Tübingen, Germany, 23 June 2017. 'How to capture human behaviour in mathematical models, and why it matters for understanding socio-ecological forest ecosystems'* *MS2Discovery Seminar Series, Wilfrid Laurier University, 27 March 2017. 'Vaccine scares as critical transitions: an application of dynamical systems to data science'.* *Reviewing for journals* *2018: Proceedings of the National Academy of Sciences of the USA, Vaccine, Theoretical Ecology, Epidemics* *2017: Proceedings of the National Academy of Sciences of the USA, Bulletin of Mathematical Biology, Scientific reports (x2), Journal of Theoretical Biology, PLOS Computational Biology, Mathematical Biosciences, Theoretical Ecology*
Keith Hipel	Core	*Research Interests* Keith Hipel's major research interests are the development of conflict resolution, multiple criteria decision analysis, time series analysis and other decision-making methodologies for addressing complex interdisciplinary system of systems engineering problems lying at the confluence of society, technology and the environment, with applications in water resources management, hydrology, environmental engineering, energy, and sustainable development. Keith is Senior Fellow with the Centre for International Governance Innovation, Fellow with the Balsillie School of International Affairs, and Coordinator of the Conflict Analysis Group within the Department of Systems Design Engineering at the University of Waterloo. *Refereed Book* Xu, H., Hipel, K.W., Kilgour, D.M., and Fang, L., "Conflict Resolution Using the Graph Model: Strategic Interactions in Competition and Cooperation", Series on Studies in Systems, Decision and Control, accepted for publication on July 10th, 2017 by Springer, Cham, Switzerland, to be published in 2018. *Journal Papers Involving Complex Problems* (Accepted for Publication in 2017) Ma, J., Hipel, K.W., and Hanson, M.L., "An Evaluation of the Social Dimensions in Public Participation in Rural Domestic Waste Source-Separated Collection in Guilin, China", *Environmental Monitoring and Assessment*, DOI: 10.1007/s10661-017-6405-5, published online on December 21, 2017, 190(1): 35, 14 pp., 2018.

		Garcia, A., Hipel, K.W., and Obeidi, A., "Water Pricing Conflict in British Columbia", *Hydrological Research Letters*, accepted for publication on November 24, 2017. Ma, J., Hipel, K.W., and Hanson, M.L., "An Analysis of Influencing Factors on Municipal Solid Waste Source-Separated Collection Behavior in Guilin, China, by Using the Theory of Planned Behavior", *Sustainable Cities and Society*, DOI: 10.1016/j.scs.2017.11.037, available online on since November 28, 2017, vol. 37, pp. 336-343, 2018. Talukder, B., Hipel, K.W., and van Loon, G., "Developing Composite Indicators for Agricultural Sustainability Assessment: Effect of Normalization and Aggregation Techniques", *Resources*, accepted for publication on November 19, 2017. Xiao, Y., Fang, L., and Hipel, K.W., "An Agent-based Modeling Approach to Investigating the Impact of Water Demand Management", *Journal of Water Resources Planning and Management*, accepted for publication on September 14, 2017. Philpot, S., Johnson, P.A., and Hipel, K.W., "Analysis of a Brownfield Management Conflict in Canada", *Hydrological Research Letters*, DOI: 10.3178/hrl.11.141, Vol. 11, No. 3, pp. 141-148, 2017. Wang, J., Hipel, K.W., and Dang, Y., "An Improved Grey Dynamic Trend Incidence Model with Application to Factors Causing Smog Weather", *Expert Systems with Applications*, DOI: 10.1016/j.eswa.2017.06.012, Vol. 86, pp. 240-251, 2017. Garcia, A., and Hipel, K.W., "Inverse Engineering Preferences in Simple Games", *Applied Mathematics and Computation*, DOI: 10.1016/j.amc.2017.05.016, Vol. 311, pp.184-194, 2017. Higo, E., Okada, N., Hipel, K.W., and Fang, L., "Cooperative Survival Principles for Underground Flooding: Vitae System Based Multi-Agent Simulation", *Expert Systems with Applications*, DOI: 10.1016/j.eswa.2017.04.034, Vol. 83, pp. 379-395, 2017. He, S., Hipel, K.W., and Kilgour, D.M., "Analyzing Market Competition between Airbus and Boeing using a Duo Hierarchical Model for Conflict Resolution", *Journal of Systems Science and Systems Engineering,* DIO: 10.1007/s11518-017-5351-7, 28 pp., 2017. Bashar, M.A., Hipel, K.W., Kilgour, D.M., and Obeidi, A., "Interval Fuzzy Preferences in the Graph Model for Conflict Resolution", *Fuzzy Optimization and Decision Making*, DOI: 10.1007/s10700-017-9279-7, subject to making minor changes accepted for publication on March 27, 2017. Wang, J., Hipel, K.W., Fang, L., Xu, H., and Kilgour, D.M. "Behavioral Analysis in the Graph Model for Conflict Resolution", IEEE Transactions on Systems, Man,

		and Cybernetics: Systems, DOI: 10.1109/TSMC.2017.2689004, published online on April 24, 13 pp., 2017. Aljefri, Y.M., Bashar, M.A., Fang, L., and Hipel, K.W., "First Level Hypergame for Investigating Misperception in Conflicts", IEEE Transactions on Systems, Man, and Cybernetics: Systems, DOI: 10.1109/TSMC.2017.2690619, published online on April 26, 18 pp., 2017. Bernath Walker, S. and Hipel, K.W., "Strategy, Complexity and Cooperation: A Sino-American Climate Regime", *Group Decision and Negotiation*, DOI: 10.1007/s10726-017-9528-8, Vol. 26, No. 5, pp. 997-1027, 2017. Silva, M.M., Hipel, K.W., Kilgour, D.M., and Costa, A.P.C.S., "Urban Planning in Recife, Brazil: Evidence from a Conflict Analysis of the New Recife Project", *Journal of Urban Planning and Development*, DOI: 10.1061/(ASCE)UP.1943-5444.0000391, Vol. 143, No. 3, pp. 05017007-1-05017007-11, 2017. Talukder, B., Blay-Palmer, A., Hipel, K.W., and van Loon, G.W., "Elimination Method of Multi-Criteria Decision Analysis (MCDA): A Simple Methodological Approach for Assessing Agricultural Sustainability". *Sustainability*, DOI: 10.3390/su9020287, published online on 16 February 2017, Vol. 9(2), 287, 17 pp., 2017. You, H., Li, M., Hipel, K.W., Jiang, J., Ge, B., and Duan, H., "Development Trend Forecasting for Coherent Light Generator Technology based on Patent Citation Network Analysis", *Scientometrics*, DOI: 10.1007/s11192-017-2252-y, Vol.111, No.1, pp. 297-315, 2017. Silva, M.M., Kilgour, D.M., Hipel, K.W., and Costa, A.P.C.S., "Probabilistic Composition of Preferences in the Graph Model, with Application to the New Recife Project", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, DOI: 10.1061/(ASCE)LA.1943-4170.0000235, Vol. 9, No. 3, pp. 05017004-1-05017004-13, 2017. Ma, J., Hipel, K.W., and Hanson, M.L., "Public Participation in Municipal Solid Waste Source-Separated Collection in Guilin, China: Status and Influencing Factors", *Journal of Environmental Planning and Management*, DOI: 10.1080/09640568.2017.1281798, 18 pp., published online on February 23, 2017, Vol. 60, No. 12, pp. 2174-2191, 2017. *WICI Seminar* Professor Yacov Y. Haimes is the Lawrence R. Quarles Professor of Systems and Information Engineering, as well as the Founding Director of the Center for Risk Management of Engineering Systems, at the University of Virginia. At the invitation of K.W. Hipel, Dr. Haimes presented the seminar entitled "Understanding, Modeling, and Managing Interdependent Complex Systems of Systems" on Friday, October 20th, 2017, from 2:30 to 3:45 pm in DC 1302, under

		the joint sponsorship of the Department of Systems Design Engineering and the Waterloo Institute for Complexity and Innovation. *Awards* K.W. Hipel was elected **Officer of the Oder of Canada**. An official announcement was made on December 29th, 2017, by Her Excellency the Right Honourable Julie Payette, Governor General of Canada. K.W. Hipel was the recipient of the 2017 **Miroslaw Romanowski Medal** from the Royal Society of Canada, which is Canada's highest recognition for environmental research. "The medal is awarded for significant contributions to the resolution of scientific aspects of environmental problems or for important improvements to the quality of an ecosystem in all aspects - terrestrial, atmospheric and aqueous - brought about by scientific means." Hipel received the medal at the Induction and Award Winner Ceremony held on November 24th, 2017, during the Annual General Meeting of the Royal Society of Canada which took place at the Fairmont Winnipeg Hotel in Winnipeg from November 23rd to 26th, 2017, under the sponsorship of the University of Manitoba.
Paul Thagard	Core	*Publication* **Thagard, P.** (forthcoming). Mind, consciousness, and free will. *Frontiers of Philosophy in China*. **Thagard, P.,** & Larocque, L. (forthcoming). Mental health assessment: Inference, explanation, and coherence. *Journal of Evaluation in Clinical Practice*. **Thagard, P**. (forthcoming). *Brain-mind: From neurons to consciousness and creativity*. Oxford: Oxford University Press. **Thagard, P.** (forthcoming). *Mind-society: From brains to social sciences and professions* Oxford: Oxford University Press. **Thagard, P.** (forthcoming). *Natural philosophy: From social brains to knowledge, reality, morality, and beauty*. Oxford: Oxford University Press. *Invited Presentations/Keynotes/ Conference presentations:* Brain Mechanisms Explain Emotions and Consciousness (Burlington, Ontario; Mississaugua, Ontario) Creativity in Humans and Computers (Salamanca, Spain) The Emotional Coherence of Donald Trump (Boston, Massachusetts; San Antonio, Texas) Explaining Mental Illness (London, Ontario; Toronto, Ontario)

		The Logic and Psychology of Psychotherapeutic Assessment (Toronto, Ontario) What are Values in Public Health? (Barcelona, Spain) Why Reason? Inference, Reasoning, and Education (Berkeley, California)