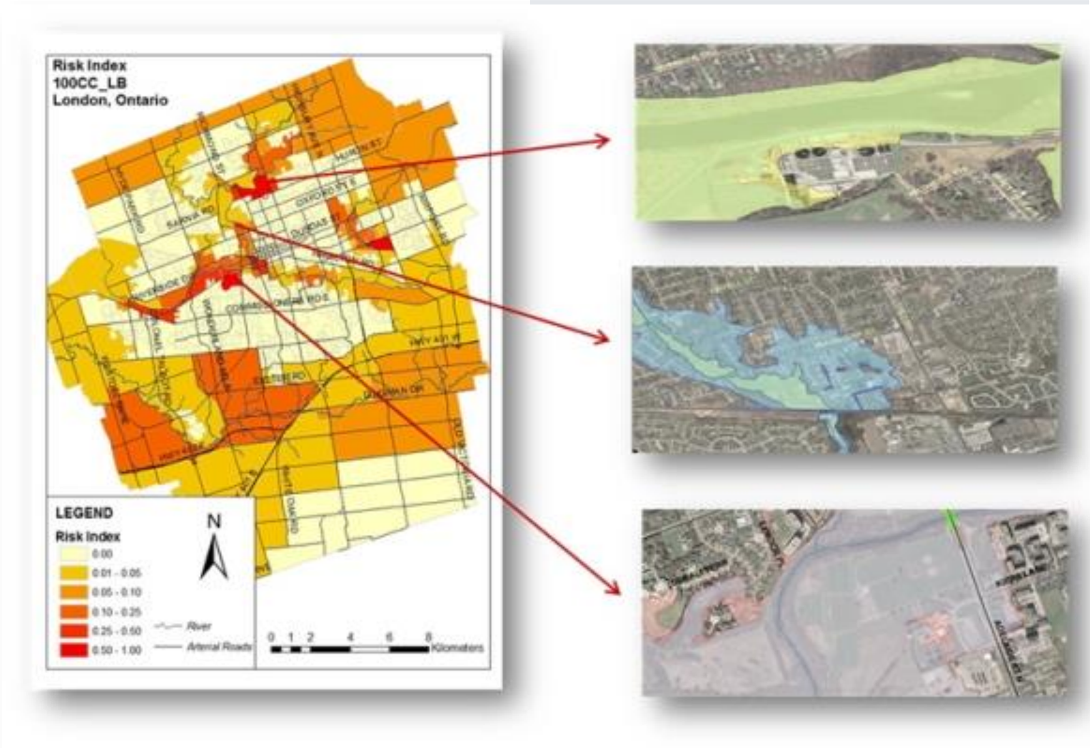
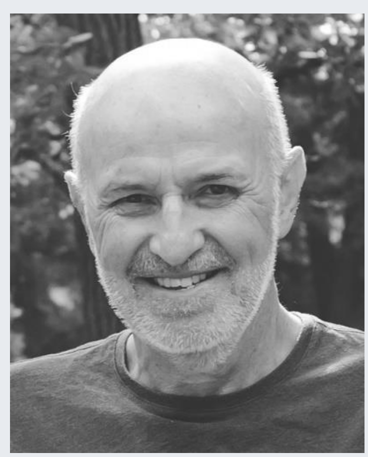
OCTOBER 15th - 17th, 2024

Water Management Under Changing Climate

workshop



HOSTED BY:
DR. SLOBODAN P. SIMONOVIC



Ready for action?

The worldwide climate is undergoing changes primarily due to human activities, and these changes are anticipated to occur at an accelerated pace. The potential outcomes of these shifts in climate could be catastrophic, as heightened concentrations of greenhouse gases in the atmosphere may lead to profound, large-scale, and impactful alterations in both physical and biological systems. This workshop is structured to encompass three presentation sessions and three discussion sessions. The morning of each day will be dedicated to presentations, while the afternoons will be reserved for discussions. The workshop will also provide participants with three illustrative examples, allowing for a hands-on learning experience. These instances will be centered around adopting a systems approach to tackle practical challenges associated with climate change and its effects on water resources management.

On the **first day**, fundamental facts about climate change will be presented, emphasizing a crucial set of feedback mechanisms that enhance our comprehension of the magnitude of the issue and stimulate proactive measures. Additionally, practical matters linked to climate change and its influence on the practice of water resources management will be explored.

Climate models serve several purposes: (a) enhancing our grasp of the physical processes steering the climate system, (b) clarifying the interplay between human activities and the Earth's system, and (c) assisting policy-makers in formulating effective strategies and initiatives to confront and adapt to climate change. However, it's important to note that these models solely concentrate on natural systems and do not encompass socio-economic systems, which both impact and are impacted by natural systems.

The first example aims to address the query: "How do the projected trajectories of climate, environmental, and economic variables shift when interactions between the economy and the environment are comprehensively integrated into modeling?" The presentation outlines the third version of the horizontally-integrated assessment model named ANEMI (developed by research group of Prof. Simonovic at Western University) – derived from an ancient Greek term referring to the four winds of change, symbolic of the four seasons. This model establishes links between physical systems such as climate, hydrological and carbon cycles, and socio-economic systems that influence them, including the economy, energy use, land utilization, population dynamics, and water use and quality. The modeling methodology employed, known as system dynamics, explicitly represents feedback loops, concentrating on the influence of system structure and feedback connections in shaping model behavior. The objective of this work is to enable simulations of the consequences of socio-economic policies or scientific uncertainties on the overall system.

The primary focus of the presentation centers on how feedback mechanisms and system structure collectively impact the progression of the society-biosphere-climate nexus. The outcome is an enhanced understanding of system architecture and operation, rather than specific predictions about the future. ANEMI encompasses dynamic representations of these systems, facilitating their reciprocal interactions with water resources systems through feedback loops. Of particular significance to water resources experts is the simulated influence of a novel water stress definition, which includes both water quality and quantity effects in assessing water scarcity. Through five simulation runs, the value of wastewater treatment and reuse initiatives is demonstrated, along with the feedback implications of irrigated agriculture and increased consumption of animal products.

The ANEMI3 (current version) model is constructed using the Vensim system dynamics simulation environment. The entire model code is archived on Zenodo (https://doi.org/10.5281/zenodo.4025424) and is accessible through open access. Participants will gain practical experience in operating ANEMI3 via the Global Change Explorer (GCE), an interactive web-based tool designed

BIOGRAPHY

Slobodan P. Simonovic is globally recognized for his unique interdisciplinary research in Systems Analysis and the development of deterministic and stochastic simulation, optimization, multi criteria analysis, and other decision-making methodologies. His work addresses challenging system of systems problems lying at the confluence of society, technology and the environment and has been applied with a sustainable development perspective in water resources management, hydrology, energy, climate change and public infrastructure. His main contributions include modelling risk and resilience of complex systems.

Professor Simonovic has influenced academia, industry and government via university teaching, publication of leading-edge research, mentoring of young people, delivering stimulating research seminars at institutions around the world, carrying out joint research projects, and consulting work. He has received awards for excellence in teaching, research and outreach.

Dr. Simonovic has published over 670 professional publications (over 270 in peer-reviewed Journals) and three major textbooks. He has delivered over 340 keynote and invited talks. He has been inducted to the Canadian Academy of Engineering in June of 2013 and Royal Society of Canada in Nov of 2020 and Serbian Academy of Sciences and Arts in Nov of 2021.

Dr. Simonovic is currently Professor Emeritus at the Department of Civil and Environmental Engineering and the Director of Engineering Works at the Institute for Catastrophic Loss Reduction, The University of Western Ontario, London, Canada. Contact:
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to explore the intricacies of global change (https://www.globalchange-uwo.ca/). The GCE is tailored to facilitate the use of ANEMI3 for simulating diverse future scenarios related to five core themes: climate change, population dynamics, food production, water quality, and water quantity. Attendees will have the opportunity to pose varied questions, select simulation runs, and assess model outputs.

The **second day** provides an example that deals with the question: What are the impacts of climate change on water resources management at a local scale – risk-based approach? An original inverse approach is developed to assess these impacts. The developed approach starts with the analysis of existing guidelines and management practices in a river basin with respect to critical hydrological exposures that may lead to failure of the water resources system or parts thereof. In the next step, the critical hydrologic exposures (flood levels, for example) are transformed into corresponding critical meteorological conditions (extreme precipitation events, for example). These local weather scenarios are then statistically linked to possible large-scale climate conditions that are available from the Global Climate Models. The developed procedure allows for the assessment of the vulnerability of river basins with respect to climate forcing. It also provides a tool for identifying the spatial distribution of the vulnerability and risk to public infrastructure to mitigate future damages. An integrated infrastructure risk assessment methodology, measuring spatial vulnerabilities, is introduced to determine the risk to each public infrastructure element (critical facilities - schools, hospitals, fire stations; barriers - dams, dykes; pollution control clants; buildings - residential, commercial, industrial, institutional; roads - arterial, primary; and bridges - footbridges, culverts), using a novel indicator: risk index. The methodology is implemented in the context of the City of London, located in Ontario, Canada, serving as a comprehensive case study. This application yields a series of risk maps across five distinct climate scenarios, offering a visual representation of the collective risk faced by the municipality, categorized by individual infrastructure types. Projections indicate that climate change is poised to amplify the risk to the city's infrastructure by an estimated 75%. Specific high-risk zones are discerned and ranked based on a climate change risk index, in conjunction with a set of socio-economic vulnerabilities. These combined factors establish the groundwork for formulating prudent and sustainable decisions pertaining to the management of municipal infrastructure. Attendees will have the opportunity to review the methodology and results of the case study, pose varied questions, and assess the utility of the approach.

The **third day** will concentrate on augmenting the analysis of climate change impacts by introducing the notion of quantitative resilience within performance-based water resources management. An illustrative example will be showcased, addressing the question: What are the consequences of climate change on water resources management at the local scale, employing a resilience-based approach? Significant practical connections exist between water management, climate change adaptation, and sustainable development, which collectively contribute to diminishing disaster risk and reenforcing resilience as a novel developmental paradigm. A perceptible shift in water management strategies has occurred, transitioning from a focus on vulnerability to one centered around resilience. The latter approach is considered a more proactive and optimistic means of engaging communities in managing water-related risks. As hazards increase, they concurrently erode resilience, thus magnifying the impact of climate change on water disaster risk. Historically, conventional water management planning emphasized documenting roles, responsibilities, and procedures. In contemporary planning, these frameworks increasingly encompass measures for prevention, mitigation, preparedness, recovery, and response. Nonetheless, substantial strides over the past decade have been made in recognizing the role of resilience in sustainable development. Numerous case studies worldwide reveal connections between resilience attributes and the capacity of intricate systems to endure disturbances while maintaining a certain level of functionality. Drawing on experience in emergency planning, there's a growing necessity to prioritize action oriented resilience planning, strengthening local capacity and competence. This entails a heightened emphasis on community involvement and a deeper comprehension of the diversity, needs, strengths, and vulnerabilities inherent in communities. The imperative for a paradigm shift in addressing the complexities of sustainable human well-being is evident. The application of resilience as an apt framework for investigation stems from its comprehensive consideration of the overlap among: (a) the physical environment (both constructed and natural); (b) social dynamics; (c) metabolic flows; and (d) governance networks. This presentation provides an innovative systems framework for quantifying resilience. Grounded in the definition of resilience as the capability of physical and social systems to absorb disturbances while maintaining functionality, the framework hinges on the interplay between spatial and temporal perspectives and the direct interaction between disturbance impacts (physical, social, health, economic, and others) and the system's adaptive capacity to absorb such disturbances. The methodology's application will be illustrated through the case study of Metro Vancouver in British Columbia, Canada. The simulation model to be presented is centered around the consequences of climate change-induced riverine flooding and sea-level rise. Attendees will have the opportunity to delve into the simulation outcomes, which suggest that diverse adaptation choices, such as securing emergency funds, establishing mobile hospital services, and implementing managed retreat strategies, can collectively enhance the flood resilience of Metro Vancouver.

Workshop Materials

Each participant will receive the following materials: (i) workshop presentations; (ii) selected literature pertaining to climate change; and (iii) chosen documentation related to the ANEMI model, the City of London's infrastructure risk assessment, and Metro Vancouver's resilience against climate-induced flooding.

Who Should Attend?

This seminar will prove valuable for practitioners in water resources management who hold an interest in climate change and its effects on water resources. Many aspects of the workshop will appeal to a broad spectrum of water professionals. The first example will particularly benefit officials engaged in climate change policy-making across various government levels. The other two examples will provide substantial insights for engineers and officials collaborating with municipal governments.

Who are we?

Dr. Slobodan P. Simonovic
Bio: Slobodan P. Simonovic

Western Water Centre
https://www.eng.uwo.ca/water-centre/

WWCTR
WesternWater Centre

Are you ready to sign up?

When: October 15th - 17th, 2024
Where: Western University ACEB 4405
Cost: $565/pp Includes Breakfast, Lunch and Snacks HST# 108162587RT0001
Sign up here: **Sign up**
Contact: Melodie Richards (mricha43@uwo.ca)

A certificate will be awarded at the end of the workshop which can be used for PEO annual professional development.

Register by September 30th 2024

Please bring your laptop