Venice International University
International PhD Academy

Water and Climate Resilience

8-12 July 2024

Faculty

Albert Chen, University of Exeter
Guangtao Fu, University of Exeter
Nav Mustafee, University of Exeter
Ralf Ludwig, LMU
Patrick Willems, KU Leuven
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Additional Transversal Skills Faculty

Ivan Sgandurra, University of Bologna/ EU-Project Unit @VIU
Neil Maiden, City, University of London/ Ca' Foscari University visiting
Ilda Mannino, Venice International University
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Agenda

Monday 08 July 2024
Day 1 – Climate change and impact on Water / Proposal development

9:00-9.15	**Registration**
9.15-9.30	**Opening and Introduction**
9.30-11.00	***Master Class 1 (MC1) - Prof Ralf Ludwig, LMU*** **Scenarios of climate and global change – Definition, Implementation and Analysis** The assessment of climate futures stems from a complex framework that encompasses both societal behaviour and dynamics according to generalized narratives, often referred to as Shared Socioeconomic Pathways (SSP), and it's consequential radiative forcing, i.e. estimates of greenhouse gas concentrations, referred to as Representative Concentration Pathways (RCPs). This session explains the rationale and primary goals of the SSP/RCP framework and informs about strategies to downscale the global storylines to regional contexts, making them applicable to scientific and practical questions of climate change impacts on integrated water resources management. In a workshop-

	style format, participants will exercise the implementation of the SSP/RCP framework in a river basin context.
11.00-11.15	**Coffee break**
11.15-12.45	***Master Class 2 (MC2) - Prof Albert Chen, University of Exeter*** **Water-related impacts due to climate change** Climate change is a global phenomenon that has significantly altered various environmental attributes, such as increased temperature, precipitation pattern, rising sea level, more extreme hydrometeorological events, etc. These changes have direct and indirect effects on the water cycle. As a result, water resource management faces various challenges, including water scarcity, floods and droughts, water quality and pollution, water-energy-food-nexus, public health and transboundary water governance. The session will present scientific evidence of how climate change influences the water cycle and discuss the associated impacts of these changes on the human and natural environments. The session will aim to provide insights and recommendations for sustainable and adaptive water resource management in the face of climate change.
12.45-13.45	**Lunch**
13.45-15.00	Student self-introduction and presentation of their own research projects, each 3 mins **Students**
15.00-15.15	**Break**
15.15-17.15	***Transversal Skills Session 1 (TS1) – Ivan Sgandurra, Università di Bologna, EU Project Management Training Center @VIU*** **How to develop a project proposal for funding**
17.00-18.00	***Workshop 1 (WS1)*** **Group Project Proposal Development – Team building & Brainstorming** In the first workshop session, students will team up to identify a potential funding opportunity and brainstorm the ideas of a project proposal for seeking support in scientific research and/or innovation collaboration.

Tuesday 09 July 2024
Day 2- Climate Modelling / Creativity and management

9.15-10.45	***Master Class 3 (MC3) - Prof Ralf Ludwig, LMU*** **Modelling of Climate Change** Climate models are one of the primary means for scientists to understand how the climate has changed in the past and may change in the future. They are suitable tools for depicting natural and human-influenced climate changes over decades to centuries. These models simulate the physics, chemistry and biology and their interactions between the atmosphere, land and oceans in great detail, and typically require large supercomputers to generate their climate projections. This session provides a comprehensive overview on the modeling of climate change, ranging from most basic energy balance models, via first generations of general circulation models (GCMs) to the latest generation of fully coupled Earth System Models (ESMs), now incorporating biogeochemical cycles, which are capable of simulating the carbon and nitrogen cycle or changes in vegetation and land use, all affecting how climate responds to human-caused greenhouse gas emissions. The session will further focus on common practice scaling or large ensemble techniques, will highlight persisting challenges with regard to model uncertainties, and will illustrate a selection of applications with regard to water resources management on various spatio-temporal scales.
10.45-11.00	**Coffee break**
11.00-12.30	***Master Class 4 (MC4) - Prof Patrick Willems, KU Leuven***

	Methods for downscaling of climate model outputs and climate change scenario building for local impact analysis This session will discuss the need to downscale and possibly conduct bias correction to the climate model outputs before these are applied for impact analysis at the local scale. The different types of statistical downscaling methods will be presented and illustrated based on applications in the water sector. The pitfalls of the methods will also be discussed. After downscaling of the ensemble of available global and/or regional climate model outputs, a reduced set of climate change scenarios could be developed for local impact investigation. Examples will be shown for extreme precipitation intensities, catchment rainfall-runoff, fluvial and pluvial flooding, and drought applications.
12.30-13.30	**Lunch**
13.30-14.45	***Transversal Skills Session 2 (TS2) – Neil Maiden, Ca' Foscari University of Venice visiting professor/ City University of London*** **Design thinking and creativity**
14.45-15.00	**Break**
15:00-16:00	***Workshop 2 (WS2)*** **Group Project Proposal Development –** In the workshop session, students will develop ideas in a creative way for their research project proposal.
16.00-17.15	***Transversal Skills Session 4 (TS4) – Prof Ralf Ludwig, LMU*** ***Open Science Practices*** Transparency and reproducibility lie at the core of scientific integrity. Pursuing these goals through open practices, for example by preregistering studies, and by providing open data, open materials, analysis scripts for computational reproducibility, and open access versions of the published results increases the efficiency, validity, and credibility of research. Such practices are subsumed under the term "Open Science". Furthermore, independent replications are vital to establish the robustness and generalizability of research findings. Very recently, open science is promoted as an integral part of research culture and is about to become a prerequisite for the successful submission of research proposals and even in the context of job applications in science and academia. The workshop is intended to offer a basic training workshop for early career researchers to inform about the usefulness of open science in public talks, the development of core curricula on open research practices, and original research on meta-science and reproducibility. It shall be discussed, how alternative incentive structures in science can be developed and implemented that support the adoption of open science practices.

Wednesday 10 July 2024
Day 3- Assessment of climate impact on water / Communicating Research Outcome

9.15-10.45	***Mater Class 5 (MC5) - Prof Albert Chen, University of Exeter*** **Hydrological and hydraulic modelling of climate change on extreme hydrometeorological events** To understand how the changing climate affects the water cycle and the occurrence and intensity of floods and droughts, especially for extreme weather condition, hydrological and hydraulic modelling are useful tools to analyse the possible situations under various scenarios. Hydrological model can assess the movement and storage of water in different components between different water systems, such as rivers, lakes, groundwater, soil, and vegetation. Hydraulic models can evaluate the flow and transport of water in water bodies, such as channels, pipes, reservoirs, and coastal areas. The session will introduce the modelling approaches to simulate the dynamic of water at different scales and to estimate possible consequences of water-related hazards under different climate scenarios.

10.45-11.00	**Coffee break**
11.00-12.30	***Master Class 6 (MC6) - Prof Albert Chen, University of Exeter*** **Compound disaster and cascading impact assessment** During extreme hydrometeorological events, multiple disasters may occur simultaneously, or one disaster could trigger other disasters. Either combined or compound disaster will deepen the negative impact of hazards to communities that have been or being affected by an earlier event. Disasters may damage properties or harm human being directly and such impact could further propagate to other areas due to the secondary disasters and the disrupted critical infrastructure or services, leading to wider impacts including the regions that do not suffer direct hazard impact. The session will first discuss about the interrelationships between hazards and the interconnectivities among different sectors, followed by the introduction of the approaches to analyse the knock-on effect of compound disasters to support decision makers and crisis manager setting up strategies and actions to safeguard communities.
12.30-13.30	**Lunch**
13.30-14.45	***Master Class 7 (MC7) - Prof Guangtao Fu, University of Exeter*** **The role of artificial intelligence in sustainable and resilient water management** Artificial intelligence (AI) is emerging as a disruptive technology with the potential to transform global economies, environments and societies. AI methods have been applied to planning and management problems of water systems in general. This lecture will provide a systematic review of the current state of AI applications and an examination of potential directions where AI can contribute to solving urban water challenges, in particular improving system resilience and sustainability. This lecture will also discuss the challenges in the digitization of water and how AI can transform water research – building a new research paradigm – data-centric water engineering.
14.45-15.00	**Break**
15.00-16.15	***Transversal Skills Session 5 (TS5) – Prof Nav Mustafee, Guangtao Fu & Albert Chen, University of Exeter*** **How to write and review papers, and respond to comments** This session aims to discuss the process of journal publication exercise, with a focus on manuscript writing and reviewing. We will also share the evaluation experience as reviewers and editors of academic journals to help the participants strengthening capacity in effective paper writing and peer reviewing.
16.15-17.15	***Workshop 3 (WS3)*** **Group Project Proposal Development** In the workshop session, students will develop structure and workplan for a research project proposal.
Evening	**Social Dinner – practice of networking soft skills**

Thursday 11 July 2024
Day 4 – Climate Resilience / Communication skills

9.15-10.45	***Master Class 8 (MC8) - Prof Guangtao Fu, University of Exeter*** **Interventions and planning for climate resilience** In recent years, water resources and urban water infrastructure are under increasing pressure from future uncertainty, as evidenced by increasing floods, droughts and pollution events around the world. This lecture will introduce a new paradigm for sustainable and resilient water management, which represents a step change from the conventional reliability-based paradigm. Following the introduction of resilience concepts and definitions, the lecture will first explain an intervention framework to link the emerging threats such as climate change, urbanization and tightening environmental regulation through

	to their consequences on social, economic and environmental recipients. The paradigm allows identification of the role and need for mitigation, adaptation and coping strategies. The lecture will then introduce a middle-state based approach for global resilience analysis, and demonstrate its application using case studies in water distribution systems, urban drainage systems, and urban wastewater systems.
10.45-11.00	**Break**
11.00-12.30	***Master Class 9 (MC9) - Prof Haifeng Jia, Tsinghua University*** **Can flood resilience of green-grey-blue system cope with future uncertainty** Urban flooding is becoming a great global concern due to growing cities, while climate change and urbanization may pose daunting challenges to both environment and humans. The integrated green-grey-blue (IGGB) system has gained interests worldwide to mitigate flood issues, however, how IGGB system acts in urban flood resilience and whether it can address future uncertainties have not been fully understood. In this part, the framework, which combined an evaluation index system and coupling model, is presented to quantify urban flood resilience (FR) and its responses to future uncertainties. And a case study in Beijing will be discussed in detail.
12.30-13.30	**Lunch**
13.30-15.00	***Master Class 10 (MC10) - Prof Nav Mustafee, University of Exeter*** **Framework for resilience modelling and assessment** This talk will present a generic framework for resilience modelling and assessment focusing on climate change and extreme weather hazards. It conceptualises modelling approaches frequently used within disciplines such as Climate Science, Conservation Ecology, Engineering and Operations Research to model distinct types of interaction between natural and man-based systems (socio-environmental systems). Through the combined representation of the disciple-specific approaches, the overarching framework identifies specific modelling methods (including cross-disciplinary conjoined/hybrid modelling approaches) to perform various forms of resilience assessment. The modelling methods represented in the framework align to five tiers, e.g., tier on socioeconomic projections and climate change models, human and operational systems, and strategic decision-making. The second part of the talk will present a case study that has implemented several of the frameworks' tier-level models, including a hybrid simulation that helps decision-makers determine resource allocation and prioritisation to respond to multiple flooding incidents.
15.00-15.15	**Break**
15.15-16.30	***Transversal Skills Session 6 (TS6) – Ilda Mannino & Alessandra Fornetti, VIU*** **How to communicate science to a wide audience and presentation skills**
16.30-17.30	***Workshop 4 (WS4)*** **Group Project Proposal Development – Presentation preparation** In the fourth workshop session, students will prepare a presentation for the proposal interview panel.

Friday 12 July 2024
Day 5 - Climate adaptations / Proposal assessment

9.15-10.45	***Master Class 11 (MC11) - Prof Patrick Willems, KU Leuven*** **Climate adaptation for flood and drought management in urban environments (incl. nature based or blue-green solutions)** An overview will be given on the concept of climate adaptation, the types of solutions, both technical and nature based, for mitigating the impacts of extreme precipitation events, fluvial and pluvial flooding and droughts. Examples will be given from flood and drought related cases in different regions

	of the world. It will be shown how the climate scenarios and impact investigations, as discussed in previous sessions, can be applied to design a climate proof adaptation plan.
10.45-11.00	**Coffee break**
11.00-12.30	***Master Class 12 (MC12) - Prof Haifeng Jia, Tsinghua University*** **Sponge city and low Impact development for urban runoff and water quality control** In recent years, China has been committed to strengthening environmental governance and trying to build a sustainable society in which humans and nature develop in harmony. As a new urban construction concept, sponge city uses natural and ecological methods to retain rainwater, alleviate flooding problems, reduce the damage to the water environment, and gradually restore the hydrological balance of the construction area. In this part, the lecture will first present a review of sponge city construction from its inception to systematic demonstration. Research gaps are discussed and future efforts are proposed.
12.30-13.30	**Lunch**
13.30-14.45	***Transversal Skills Session 7 (TS7) – Prof Nav Mustafee, University of Exeter*** **Mock Funding Panel Exercise** The session is a mock exercise on grant funding panels. There is some preparation for the workshop whereby students are expected to familiarise themselves with one proposal and the reviews received (these will be provided in advance). Students will be divided into workshop groups, with each student introducing one proposal. The group will then debate the proposals and rank them. The objective of the session is to provide students with some familiarity with funding panels. The proposals considered will be from EPSRC (UK funding body), however the learning is more general.
14.45-15.00	**Break**
15.00-16.15	***Workshop 5 (WS5)*** **Group Project Proposal Development – Mock interview** In the final workshop session, students present the project idea to a mock interview panel.
16.15-17.15	**Final discussions, feedback and wrap-up**

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Bios Faculty

Prof Albert Chen is Professor at the Centre for Water Systems, University of Exeter, with over 20 years of experience in Water and the Human Environment field. His research interests include water resources, hydrology and hydraulic modelling, urban drainage, flood forecasting and early warning, innovation technology applications, water-food-energy-ecosystems nexus, climate change impact to critical infrastructure and services, cascading effects of disasters, prediction of water-borne disease, hazard impact assessment, mitigation and resilience strategies. He has participated in more than 40 international projects, and published over 200 peer-reviewed journal and conferences papers. Prof Chen is currently an Associate Editor in Urban Water Journal and Journal of Hydroinformatics.

Prof Guangtao Fu is a professor of Water Intelligence at the Centre for Water Systems, University of Exeter and a Turing fellow at the Alan Turing Institute, the UK's national institute for data science and artificial intelligence. He is currently a fellow of the International Water Association (IWA) and was a Royal Society Industry Fellow working with Northumbrian Water Limited (2017-2022). He is currently serving as an Associate Editor for the ASCE Journal of Water Resources Planning and Management and H2Open Journal, and an editorial board member for Hydrology Research and Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences. Prof Fu's research focuses on developing and applying new computer models, data analytics and artificial intelligence tools to tackle water challenges in reservoir operation, water supply resilience, network leakage, flood risk and resilience, sewer blockage, urban stormwater and wastewater management.

Prof Nav Mustafee is Professor of Analytics and Operations Management at the Centre for Simulation, Analytics and Modelling (CSAM) at the University of Exeter Business School. His research focuses on Modelling and Simulation methodologies and their application in areas such as healthcare, supply chain management, the circular economy and disaster response. A particular area of interest is Hybrid Modelling and Simulation. He received the UK OR Society's Lyn Thomas Impact Medal for 2022 for developing a platform informing attendance choices for urgent care. He has published over 150 peer-reviewed journal and conference papers. Nav is a Joint Editor-in-Chief of the Journal of Simulation and Vice-President of Publications at the Society for Modelling & Simulation International (SCS). He is the Associate Editor for the journals: *Simulation Transactions of the SCS* and *Health Systems*.

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Prof. Dr. Ralf Ludwig is Professor in Applied Physical Geography and Environmental Modeling at LMU's Department of Geography. His research is focused on process-based and spatially distributed hydrological modeling at the catchment scale. He applies data assimilation techniques and model integration for water resources, land use and climate change impact assessment from Mediterranean to subarctic environments, with a particular interest on the cause and dynamics of extreme (compound) events. Recent works further include an integrated perspective on energy system and environment interactions. He has led or participated to numerous international course programs on various academic levels, field schools and summer school across Europe, in Northern Africa, China, Central America and Canada. He has published over >150 articles (> 100 peer-reviewed).

Prof Patrick Willems is a full professor in Urban and River Hydrology and Hydraulics, and the Head of Hydraulics and Geotechnics Section at the Department of Civil Engineering, KU Leuven, Belgium. He is also the Director of the Arenberg Doctoral School for Science, Engineering and Technology. Professor Willems has more than 25 years of experience in research and teaching in the fields of urban and river hydrology and hydraulics, with a focus on statistical analysis and stochastic modelling of hydrological extremes, such as floods, droughts and water scarcity. He is also an expert on the impact of climate change on water resources and infrastructure, and on climate adaptation planning and management. He has authored or co-authored more than 300 peer-reviewed publications in international journals or books. He has an h-index of 67 on Google Scholar and more than 20000 citations.

Prof Haifeng Jia is a full professor in the Division of Environmental System Analysis at the School of Environment of Tsinghua University, China. With an interdisciplinary academic background, he has concentrated on the research of urban water system, especially on the interactive mechanisms among hydrodynamics, water quality, ecology, urban runoff, and land. He has made major scholastic contributions in the areas of urban river restoration theory and technical system, coupling simulation of water-ecology-land-air system, and uncertainty analysis of complex water quality models. Prof Jia has published over 180 peer-reviewed journal papers, 120 conference papers, and 17 books & journal special issues. He has also obtained 18 patents and software copyrights, and 39 different level academic and engineering Awards and Honors.