CLIMATE ADAPTATION AND RESILIENCE CONFERENCE 2024

CARE 2024

6 & 7 May

Surviving the Heat

Research Advances and Resilience Strategies to Urban Heat Extremes

PROGRAM & ABSTRACTS

The Physical Science

6 May

LT-B 0900-1230 **LT-C** 1400-1600 **LT-B** 1600-1800

Risk, Impacts, and Adaptation

7 May

LT-B 0900-1230. **LT-A** 1400-1800

香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

ACADEMY OF 跨學科學院 INTERDISCIPLINARY STUDIES

Division of Environment and Sustainability

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The Physical Science

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LT-B 0900-1230 **LT-C** 1400-1600 **LT-B** 1600-1800

CHAIR

Prof Eun Soon Im HKUST

Understanding the changes
in atmospheric circulations
related to East Asian extreme events

Prof Sang-Wook Yeh Hanyang University

Unveiling the dynamics and mechanisms
of compound heat extremes
under a warming climate

Prof Shuo Wang Hong Kong Polytechnic University

The changing nature of heatwaves

Prof Sarah Perkins-KirkPatrick Australian National University

Spatiotemporal extension
of extreme heat stress over East Asia under
different emission pathways

Prof Seung-Ki Min Pohang University of Science and Technology

MODERATOR

Prof Fei Chen HKUST

Risk, Impacts, and Adaptation

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Projection of Future Heatwaves
in the Pearl River Delta

Prof Jimmy Fung HKUST

Reducing climate-driven risks
through climate-resilient development
within tropical cities: The Singapore example

Prof Winston Chow Singapore Management University and IPCC

Climate and (mental) health in cities:
Exploring the intersection of schizophrenia and
atmospheric science in an urbanizing world

Prof Peter Crank University of Waterloo

The Cooling Solution:
Adapting to high temperatures and humidity

Prof Enrica De Cian Ca'Foscari University of Venice

Rising Temperatures, Rising Challenges:
Navigating the Path to Socially Inclusive Response
in Southeast Asia's Extreme Urban Heating

Dr Albert Salamanca Stockholm Environment Institute

ROUNDING UP

Prof Alexis Lau HKUST

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CLIMATE ADAPTATION AND RESILIENCE CONFERENCE 2024

The Physical Science

6 May

Venue: **Lecture Theatre B**

0900 Registration

0930 Opening Remarks **Prof Alexis Lau** HKUST

0945 Group Photo

SESSION 1: El Nino and Compound Extremes

Chair: **Prof Eun Soon Im** HKUST

0950 **Prof Sang-Wook Yeh** Hanyang University

Keynote: *Understanding the changes in atmospheric circulations related to East Asian extreme events*

1050 Cofee Break

1120 **Prof Shuo Wang** The Hong Kong Polytechnic University

Keynote: *Unveiling the dynamics and mechanisms of compound heat extremes under a warming climate*

1220 Lunch Break

Venue: **Lecture Theatre C**

SESSION 2: Future Projection of Heat Extremes

1400 **Prof Sarah Perkins-Kirkpatrick** The Australian National University

Keynote: *The changing nature of heatwaves*

1500 Cofee Break

1530 **Prof Seung Ki Min** Pohang University of Science and Technology

Keynote: *Spatiotemporal extension of extreme heat stress over East Asia under different emission pathways*

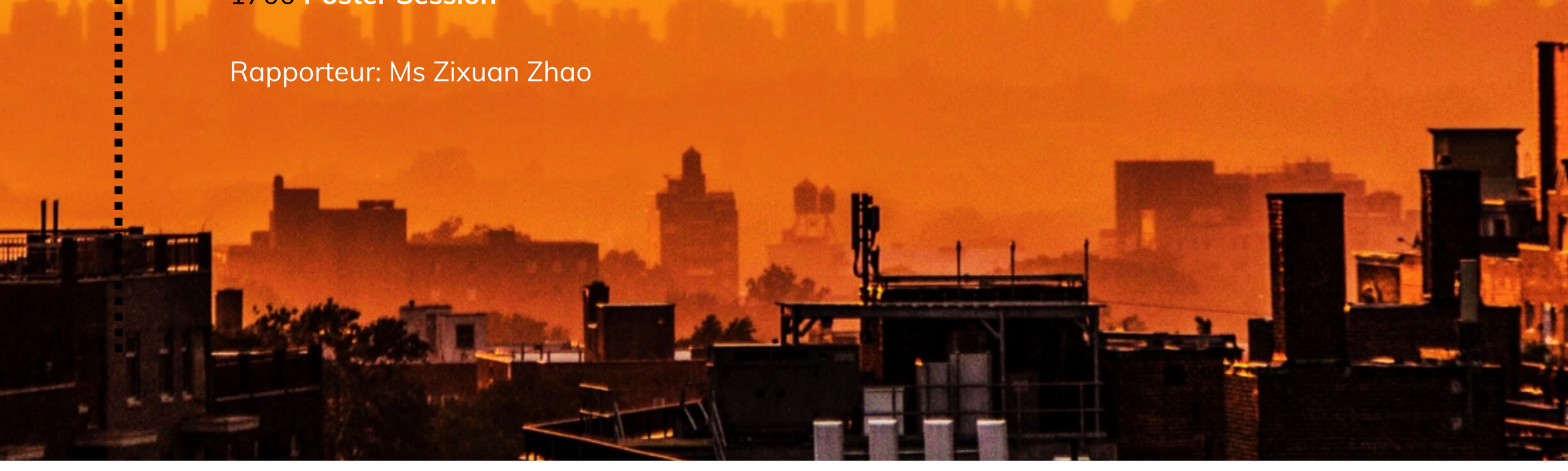
1600 Coffee Break

Venue: L**ecture Theatre B**

1630 **Panel Discussion** moderated by **Prof Fei Chen** HKUST

1700 **Poster Session**

Rapporteur: Ms Zixuan Zhao



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Risk, Impacts, and Adaptation

7 May

Venue: **Lecture Theatre B**

0900 Registration

0930 Chair: **Dr Laurence L Delina** HKUST

0940 **Prof Jimmy Fung** HKUST

Keynote: *Projection of Future Heatwaves in the Pearl River Delta*

1040 Cofee Break

1100 **Prof. Winston Chow** Singapore Management University and IPCC

Keynote: *Reducing climate-driven risks through climate-resilient development within tropical cities: The Singapore example*

1200 Poster Session

1230 Lunch Break

Venue: **Lecture Theatre A**

1400 **Dr. Peter Crank** University of Waterloo

Keynote: *Climate and (mental) health in cities: exploring the intersection of schizophrenia and atmospheric science in the context of an urbanizing world*

1500 Cofee Break

1530 **Prof. Enrica De Cian** Ca'Foscari University of Venice

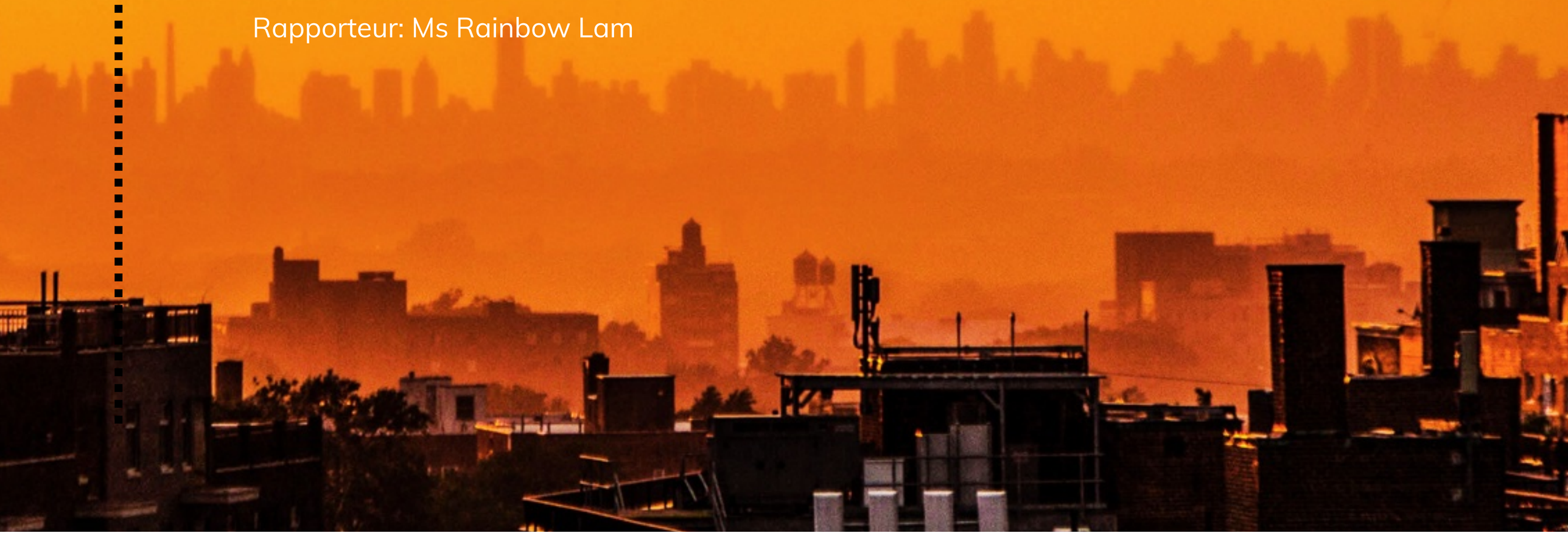
Keynote: *The Cooling Solution: Adapting to high temperatures and humidity*

1630 **Dr. Albert Salamanca** Stockholm Environment Institute

Keynote: *Rising Temperatures, Rising Challenges: Navigating the Path to Socially Inclusive Response in Southeast Asia's Extreme Urban Heating*

1730 **Rounding Up** by **Prof Alexis Lau** HKUST

Rapporteur: Ms Rainbow Lam



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The Physical Science

6 May

Understanding the changes in atmospheric circulations related to East Asian extreme events

Dr Sang-Wook Yeh is a professor in the Department of Marine Science and Convergent Engineering, Hanyang University, ERICA, South Korea. He received his BS (1992), MS (1994), and PhD (2001) degrees from Seoul National University, South Korea. He teaches undergraduate and graduate courses on climate dynamics and climate change. His research interests focus on climate variability and climate change related to coupled ocean-atmosphere processes, including El Niño, the hydrological cycle, and climate-chemistry interactions. Prof. Yeh is currently serving as a member of the Presidential Advisory Council on Science and Technology in South Korea. To date, he has published more than 220 scientific papers in various outstanding journals, including Nature and Nature's sister journals. Recently, he is dedicated to understanding how the climate system is changing under a carbon neurality using climate model experiments.

A number of studies indicate that there are significant changes in atmospheric circulations, including atmospheric teleconnections, from the tropics to the mid-latitudes. Such changes in atmospheric circulation are also associated with changes in the characteristics of extreme weather/climate events in many regions, including East Asia. Indeed, the frequency of extreme hot days in East Asia during the boreal spring and summer has not only shown an increasing trend, but also a significant increase in regime shift since the late 1990s. However, it is still debated whether these changes are due to natural variability or anthropogenic forcing, or a combination of both. Therefore, understanding this issue is a long-standing problem in the climate community and it is worthy to exmaine the details based on analyzing the observational datasets and climate models. This talk will present this issue in the context of the long-term change in extreme hot days in East Asia along with changes in the associated ENSO teleconnections.

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Unveiling the dynamics and mechanisms of compound heat extremes under a warming climate

Dr. Shuo Wang is an Associate Professor leading the Hydroclimate Extremes Lab at Hong Kong Polytechnic University. His research explores the dynamics and mechanisms of hydroclimatic extremes, such as floods, droughts, heatwaves, and extreme sea levels, and their devastating impacts on human societies and natural systems using remote sensing technologies and physically-based models. Prior to joining the Hong Kong Polytechnic University, Dr. Wang was a Research Assistant Professor in the Department of Geosciences and was an affiliate faculty member of the Climate Science Center at Texas Tech University, USA. His research has been funded by various sources, including the National Natural Science Foundation of China (NSFC), the Research Grants Council (RGC) of Hong Kong, the Environment and Conservation Fund (ECF), the Public Policy Research (PPR) Funding Scheme, the Natural Sciences and Engineering Research Council of Canada (NSERC), and Environment and Climate Change Canada (ECCC). Dr. Wang has published over 80 peer-reviewed articles with h-index of 30 (Google Scholar) in prestigious international journals, including Nature Communications, Communications Earth & Environment, Geophysical Research Letters, and Water Resources Research. His research has received widespread media coverage from hundreds of news outlets worldwide and was selected as 'Research Highlight' in Nature. Additionally, Dr. Wang has received the 2023 Tianhe Star Award, the NSERC Postdoctoral Fellowship Award, and the Chinese Government Award for Outstanding Self-Financed Students Abroad. He currently serves as an Associate Editor for Water Resources Research (AGU) and the Journal of Hydrology.

Climate change is not only altering the spatiotemporal characteristics of individual weather and climate extremes, but it is also intensifying their dependencies and interactions. This leads to the more frequent occurrence of compound extremes, which are defined as combinations of multiple climate drivers and/or hazards. The escalating risk of compound weather and climate extremes has garnered significant attention in recent years due to their devastating impacts on human and natural systems. In this talk, Dr. Wang will present his recent work on uncovering the emerging risk of compound events associated with heat extremes under climate change. He will discuss the spatiotemporal characteristics and dynamics of such emerging extreme events, as well as the associated driving mechanisms. His research findings not only advance our understanding of the increasing risk of weather and climate extremes in a warming world, but also provide scientific evidence and guidelines for the development of climate adaptation and resilience policies.

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Prof Sarah Perkins-Kirkpatrick completed her PhD at the University of New South Wales in 2010. She has previously held an Australian Research Council (ARC) Discovery Early Career Researcher Award (DECRA) and Future Fellowship. She is currently a professor at the Australian National University in Canberra, Australia, where is also a deputy director on the ARC Centre of Excellence for 21st Century Weather, and a chief investigator on the ARC Centre of Excellence for Climate Extremes. Sarah is also the Vice President of the Australian Meteorological and Oceanographic Society.

Sarah's work investigates past and future trends in heatwaves globally and in Australia, as well as exploring the role of human activity behind these changes. Her current projects include researching comprehensive methods of attributing heatwaves to climate change, how we might be able to attribute the health impacts of heatwaves to climate change; future projections of heat and humidity; and heatwaves in a net-zero world.
Sarah was the recipient of the 2013 Young Tall Poppy Award, the 2014 Director's Prize from the ARC Centre of Excellence for Climate System Science and the 2016 Australian Meteorological and Oceanographic Society Early Career Researcher Award. In 2016 she was named one of 'UNSW's 20 rising stars who will change the world', and in 2021 she won the Australian Academy of Science Dorothy Hill Medal, as well as the Australian Meteorological and Oceanographic Society Communications and Outreach Award. She has been named a Clarivate highly cited researcher for 2021, 2022 and 2023.

The changing nature of heatwaves

Heatwaves, defined as prolonged periods of excessive heat, impose disastrous impacts to human health and well-being, infrastructure, and the natural environment. Whilst there is no universal definition of a heatwave, There is extensive scientific evidence that the intensity, frequency and duration of heatwaves has increased almost everywhere since at least the 1950's, with these trends continuing to increase as the planet continues to warm. This talk will explore the underpinning physical mechanisms of heatwaves, their observed trends, and how recent record-breaking events are no match for the heatwaves of the future. Moreover, projections of hot and humid conditions will be explored, and what heatwaves might look like under different "net zero futures".

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Spatiotemporal extension of extreme heat stress over East Asia under different emission pathways

Dr Seung-Ki Min is a Professor of Division of Envirionmental Science and Engineering at the Pohang University of Science and Technology (POSTECH), South Korea. After studying meteorology for his PhD at the University of Bonn in 2006, he worked as a research scientist at the Environment Canada and as a senior research scientist at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) before joining the POSTECH in 2013. His expertise is in attributing the causes of observed climate changes and projecting future climate changes at global and regional scales. A particular research focus is on high-impact weather and climate extremes including heatwaves, heavy precipitation, tropical cyclones, and Arctic sea-ice melting. He is an Editor of Journal of Climate since 2018 and has served as a lead author on the IPCC Sixth Assessment Report Working Group I.

To understand the effects of heatwaves more accurately, it is important to consider the spatial expansion and persistence of heatwaves, in addition to their frequency and intensity. This talk will illustrate how the spatiotemporal characteristics of extreme heat stress will change over East Asia under different future emission pathways. The daily maximum Wet Bulb Globe Temperatures (WX) are analyzed using the CORDEX East Asia Phase II multiple regional climate model simulations performed under Shared Socioeconomic Pathways (SSP) scenarios. The summer mean WX in East Asia is projected to increase by 3.2°C (SSP1-2.6: low emission) to 7.6°C (SSP5-8.5: high emission) in the late 21st century. Most of the heat stress increases are dominated by temperature increases, but changes in relative humidity are found to enhance or alleviate heat stress depending on the region and scenario. To understand extreme heat stress at sug-regions, extreme heat stress day (EHD) is analyzed, which is defined when WX exceeds its 95th percentile in at least 10% of the area. According to the high-emission scenario, EHDs in all sub-regions are expected to be 10 times more frequent in the late 21st century than at present. The intensity and spatial extent of EHDs are also expected to increase, leading to a significant impact throughout East Asia. Further, EHDs are projected to start earlier and end later, lasting much longer (85-140 days) than in current condition (5-6 days). Our results indicate that the whole East Asia will be affected by severe heat stress throughout and beyond the summer season and, in particular, southern sub-regions will be affected by more-intense and longer-lasting extreme heat stress events.

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Projection of Future Heatwaves in the Pearl River Delta: An Analysis Using Bias-Corrected Multi-model CMIP6-WRF Dynamical Downscaling

Ziping Zuo, Zhenning Li, and Jimmy Fung

The frequency and severity of heatwaves have become critical concerns, as evidenced by the record-breaking high temperatures in 2023 that exacerbated heat-related health issues and resource strain globally. Our research addresses the urgent need for an improved understanding of heatwave patterns in urban centers to bolster resilience against extreme heat. This study utilizes a Weather Research and Forecasting (WRF) model to dynamically downscale a bias-corrected ensemble dataset from the Coupled Model Intercomparison Project Phase 6 (CMIP6) to project future heatwaves specifically in the Pearl River Delta (PRD), a region noted for its dense urbanization. We advance beyond the traditional approach of defining heatwaves solely based on daily maximum temperatures. Instead, we introduce an Excess Heat Factor (EHF) that incorporates both daily maximum and minimum temperatures. This allows for a more nuanced reflection of heat anomalies, both short-term and long-term, thus enabling a more accurate comparison of heat waves over time and space.
Our projections reveal a concerning trend for the PRD. Under the SSP2-4.5 scenario, heatwaves are expected to increase in frequency, intensity, and duration and begin earlier in the year. Currently, heatwaves affect approximately 3% of annual days. This is anticipated to rise to 10% by the 2040s and to a staggering 24% by the 2090s. The duration of heatwaves is also expected to increase markedly, from the longest event currently lasting 5 days to an estimated 14 days by the 2040s and exceeding a month with an average of 41 days by the 2090s. Furthermore, the onset of the first heatwave of the year is projected to occur earlier, moving from late June in the 2010s to mid-June by the 2040s and to mid-May by the 2090s.
This study underscores the critical importance of adaptive strategies in urban planning and public health to mitigate the escalating impacts of heatwaves in densely populated regions.

Prof. Jimmy Fung is a chair of the Division of Environment and Sustainability at the Hong Kong University of Science and Technology (HKUST). An expert in atmospheric sciences, he has dedicated his career to advancing our understanding of air quality modeling, regional climate modelliing, and remote sensing technologies. Through his extensive research, particularly focused on the air pollution challenges faced by Hong Kong and the broader Pearl River Delta Region, Professor Fung has developed a comprehensive approach to analyzing and solving complex meteorological and atmospheric pollution issues in urban and coastal areas.

His innovative mesoscale modeling system is renowned for its application in a range of educational and research initiatives. These include exploring the nuances of regional climate change, investigating the wind patterns driven by monsoon circulations, and assessing the effects of severe rainstorms, typhoons, and the intricate thermally induced land-sea breeze circulations. Professor Fung's expertise is not limited to large-scale environmental phenomena. He also excels in applying sophisticated atmospheric and chemical models, such as the Community Multiscale Air Quality (CMAQ) model, to dissect and understand air quality issues at the granular level of street scales. His work not only pushes the frontiers of science but also provides critical insights for the development of sustainable solutions in the face of global environmental changes.

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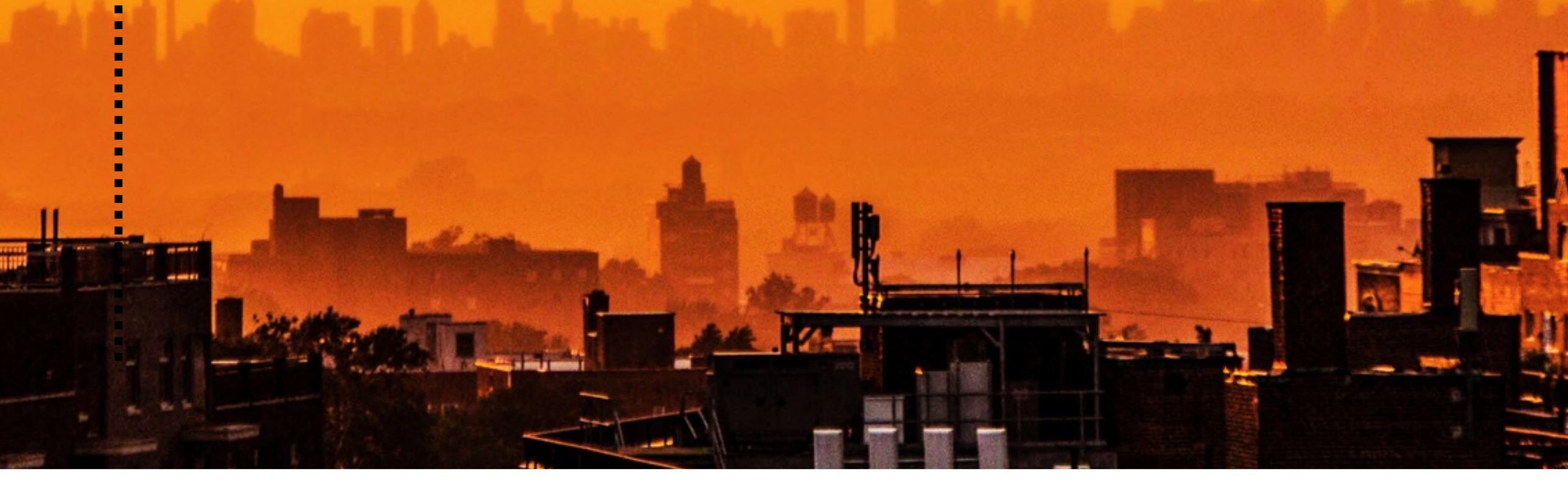
Dr Winston Chow is a Professor of Urban Climate and Lee Kong Chian Research Fellow based at Singapore Management University's (SMU) College of Integrative Studies (CIS), and also is the research pillar lead for urban infrastructure at SMU's Urban Institute. He has been a Principal Investigator for the multi-institute Cooling Singapore initiative since 2017, and currently leads inter-disciplinary research on how Singapore's urban climate risks will change as its climate warms, as well as examining measures to reduce these risks. He teaches Undergraduate and Executive Development courses on climate change and urban sustainability at CIS, and is also mentoring CIS students interested in sustainability issues and also developing courses for SMU's Master of Sustainability programme. In 2023, he was elected as Co-Chair of the Intergovernmental Panel on Climate Change's (IPCC) Working Group II on Impacts, Adaptation and Vulnerability, and he will help lead the Seventh Assessment Cycle for the IPCC during a critical decade of global climate action.

Reducing climate-driven risks through climate-resilient development within tropical cities: The Singapore example

More frequent heat extremes, combined with rapidly developing tropical settlements, often result in complex climate-driven risks emerging in cities within these regions. These include issues of urban overheating – the combination of extreme heat events driven by global warming with locally-driven warmer temperatures from the urban heat island – and other hazards such as more variable precipitation, more intense tropical cyclones, and increasing rates of sea level rise affecting coastal cities. These climate-driven hazards often lead to further chronic risks that compound and cascade within and across cities, such as that of disrupted supply chains and decay of social infrastructure. Using examples from the Cooling Singapore Initiative and the Singapore Green Plan 2030, this talk will illustrate how urban policymakers in tropical cities can attempt to manage these urban heat and other climate-driven risks via the approach of climate resilient development, in which sustainability is aligned with current biodiversity conservation, climate adaptation and mitigation goals. Consideration of factors enabling climate resilient development will also be suggested.



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Climate and (mental) health in cities: exploring the intersection of schizophrenia and atmospheric science in the context of an urbanizing world

Dr. Peter J. Crank is an Assistant Professor in the Department of Geography and Environmental Management at the University of Waterloo. His work on urban heat particularly in the spaces of urban microclimatology and mental health includes locations known for their heat (e.g., Phoenix, Arizona and Singapore), but has recently begun transitioning to locations where heat is a new threat (Canada). He holds a Ph.D. in Geography from Arizona State University specializing in microclimate measurement and modeling methods as well as statistical environmental epidemiology relating to extreme heat impacts on older adults and on mental health.

Health implications from a rapidly warming and urbanizing world have become a driving force behind public health research globally. Yet, the understanding of human psyche and mental health as it relates to environmental factors is nascent and poorly understood. In this talk, Dr. Peter Crank will highlight some of the pathways through which we've explored the effects of urbanization and heat on mental health as well as opportunities for positive change through urban design.

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The Cooling Solution: Adapting to high temperatures and humidity

Prof Enrica De Cian is professor in environmental economics at Ca' Foscari Unversity of Venice in Italy and ERC Starting Grant grantee with the project ENERGYA – Energy use for Adaptation (www.energy-a.eu). She coordinates Ca' Foscari's PhD in Science and Management of Climate Change. She is deputy coordinator of the research unit on Economic analysis of Climate Impacts and Policy at Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC) in Italy. She is also principal investigator of the Research Cluster Energy humanities at The New Institute Center for Environmental Humanities (NICHE), Ca' Foscari University of Venice, Italy. She has collaborated with several research organizations in Europe (CEPS, ZEW) and in the US (JP at MIT, Boston University). In 2012, she was visiting researcher at BU funded by the European Commission Global Marie Curie Research Fellowship. She has published in the fields of climate change economics, integrated assessment modelling, and energy economics

The talk will discuss the phenomenon of the rising AC demand in its various facets, addressing its numerous shortcomings and drawbacks, as well as the reasons for its use, which are often related to the necessity of protecting the most fragile members of society from health hazards. As AC becomes cheaper and more efficient, it may end up being used in places where heat stress could instead be adequately tackled by alternative cooling solutions. As a result, humanity is facing the risk of being trapped in a new, vicious cycle created by consolidated behaviors and urban environments shaped by the ubiquity of AC. It is now clear that the era of energy-intensive material comfort must come to an end. What is perhaps less clear is that sacrificing this way of living doesn't mean sacrificing thermal comfort, a concept whose parameters are determined not only by climate, but also by habits, culture, and socio-economic dynamics. In the frame of a broader scientific research, Brazil, India, and Indonesia have been chosen to represent populous, tropical countries whose economies are growing, while Italy serves as a western counterpart. While these countries, however different, are following a similar trend driving them towards a homogenized notion of thermal comfort. The Cooling Solution also examines vernacular architecture, alternative cooling methods, innovation, and dedicated research efforts.

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Rising Temperatures, Rising Challenges: Navigating the Path to Socially Inclusive Response in Southeast Asia's Extreme Urban Heating

Dr. Albert M Salamanca is a Senior Research Fellow at the Stockholm Environment Institute's Asia Centre, where he leads its Climate Change, Disasters and Development cluster. Albert has over 20 years of experience working on climate change adaptation, natural resources management, conservation, development, and sustainable livelihood issues in several Southeast Asian countries. His research interests are resilience, risk and vulnerabilities, traditional ecological knowledge, mobility and spatial linkages, disaster displacement, and sustainable livelihoods. He is a UK GCRF Living Deltas Hub member and the WIM Loss & Damage Expert Group on Slow Onset Events. He also contributes to weADAPT, an adaptation portal. His co-edited volumes entitled "Climate Change, Disasters, and Internal Displacement in Asia and the Pacific" and "The Routledge Handbook of Global Development" were published recently.

He previously led SEI's global Transforming Development and Disaster Risk initiative, the Regional Climate Change Adaptation Knowledge Platform (AKP) and the Partnership in Governance Transition: the Bali Cultural Landscape. He has a PhD in Geography from Durham University (UK).

The uncontrolled rise in global temperatures has led to unprecedented and prolonged periods of excessive heat in many areas. The issue of justice is very much implicated in the problem of extreme urban heating, particularly in cities in Southeast Asia. Certain groups are more affected than others due to their social, demographic and economic characteristics. The solutions should ensure that justice is at the core of our response. We need to recognise the differentiated impacts of extreme heating on certain groups. We also need to be mindful that there are power imbalances in their ability to adapt. Technological solutions to heating could also have justice implications because the sources of energy that power these technologies are not sustainable and, hence, problematic. If responses do not consider justice concerns, they might become maladaptive; in other words, they will lead to unintended consequences, especially for vulnerable groups and communities. Thus, this presentation will discuss how to respond to extreme urban heating in a socially inclusive manner and responsive to the needs of vulnerable groups and communities from the lens of adaptation governance and maladaptation.

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SESSION CHAIRS

Prof. Eun-Soon Im is an Associate Professor in the Division of Environment and Sustainability and Department of Civil and Environmental Engineering at The Hong Kong University of Science and Technology. Prior to her current position, she worked as a research scientist at the National Institute of Meteorological Research (Korea), International Centre for Theoretical Physics (Italy), and Singapore-MIT Alliance for Research and Technology (Singapore). Dr. Im specializes in developing and improving the Regional Climate Model (RCM) and has conducted research on regional climate changes in various regions worldwide. Her research aims to advance understanding of potential changes in regional climate due to anthropogenic forcings (such as greenhouse gas emissions and land-use changes) and to produce high-quality climate information for comprehensive impact assessment, particularly in regions with complex physiographical features.

LProf. aurence L Delina, an Assistant Professor of Environment and Sustainability at the Hong Kong University of Science and Technology, specialises in sustainable development with a focus on rapid mitigation of climate change, accelerating sustainable and just energy transitions, and adaptation and resilience of vulnerable populations to climate extremes. He has authored over fifty peer-reviewed journal articles and four books on these topics. Laurence serves as an associate editor for Energy Research & Social Science, PLOS Climate, and the Journal of Environmental Studies and Sciences. He has worked as a consultant on energy and climate issues for the United Nations, Oxfam, and Heinrich-Böll-Stiftung. Laurence has previously been a Rachel Carson Fellow and a Visiting Fellow at Harvard Kennedy School. He received his PhD from the University of New South Wales Sydney.

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