



IC2UHI 2026



The 7th International Conference on Countermeasures to Urban Heat Islands
IC2UHI 2026

CONFERENCE BROCHURE

September 22-25, 2026
Jinling Hotel, Nanjing, China

Organizer: Southeast University

Co-organizers: Xi'an Jiaotong University
Chongqing University
Northwest A&F University
China United Engineering Corporation Limited

COUNTERMEASURES TO URBAN HEAT ISLANDS

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Conference Information

Conference 7th International Conference on Countermeasures to Urban Heat Islands (IC2UHI 2026)

Date September 22-25, 2026

Venue Jinling Hotel Nanjing, Nanjing, China
(Address: No. 2 Hanzhong Road, Gulou District, Nanjing, Jiangsu, China)

Organizer Southeast University

Co-organizers Xi'an Jiaotong University
Chongqing University
Northwest A&F University
China United Engineering Corporation Limited

Sponsors Cool Roof Rating Council (CRRC)
Frontiers of Architectural Research
NIKKEN SEKKEI Ltd.
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MDPI
Beijing Everloyal Technology Co., Ltd.

Chairs **International Chair:** Prof. Hashem Akbari, Concordia University, Canada
Local Chair: Prof. Yupeng Wang, Southeast University, China
Local Co-chairs: Prof. Baojie He, Chongqing University, China
Prof. Bo Hong, Northwest A&F University, China

Planning Committee Prof. Priya Rajagopalan, RMIT University
Prof. Hideki Takebayashi, Kobe University
Prof. Matthaios Santamouris, UNSW Sydney
Prof. Steve Kardinal Jusuf, Singapore Institute of Technology
Prof. Vishal Garg, Plaksha University
Prof. Tomohiko Ihara, The University of Tokyo
Prof. Shi-jie Cao, Southeast University
Prof. Chunping Miao, Chang'an University
Associate Prof. Poh Hee Joo, National University of Singapore
Associate Prof. Duo Xu, Xi'an Jiaotong University
Associate Prof. Elmira Jamei, Victoria University
Dr. Kurt Shickman, Global Cool Cities Alliance
Dr. Sarah Schneider, CRRC

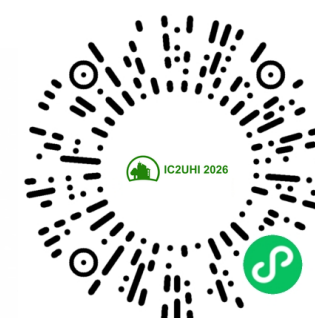
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Tri Harso Karyono
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Xiaodong Xu
Xilian Luo
Zhaolin Gu

Contact ic2uhi@ic2uhi2026.com

Registration <https://www.ic2uhi2026.com/registration.html>



Scan on WeChat for conference details and photos

Program Schedule

TIME	PROGRAM		VENUE
Monday, September 21, 2026			
11:00-21:00	Registration		Chake Laozhan, 1F, Asia Pacific Tower
Tuesday, September 22, 2026			
7:00-8:30	Registration		Kunlun Ballroom, 2F, Asia Pacific Tower
8:30-9:00	Opening Ceremony	Prof. Tong Zhang, Dean of the School of Architecture, Southeast University, China Representative of Southeast University Leadership	
		Dengyun Wang, Director of the Science and Technology Development Center of Jiangsu Housing and Urban-Rural Development Department <i>Speech Title: <u>Reflections and Recommendations on Technology-enabled Climate Change Mitigation</u></i>	
9:00-9:20	Opening Speech	Prof. Hashem Akbari, Concordia University, Canada <i>Speech Title: <u>A Road Map to Cooling the Cities and the World</u></i>	
9:20-9:50	Plenary Speech	Prof. Edward Ng, Chinese University of Hong Kong, China <i>Speech Title: <u>Serve the People</u></i>	
9:50-10:30	Keynote Speech	Prof. Matthaios Santamouris, UNSW Sydney, Australia <i>Speech Title: <u>Impacts of Urban Overheating and Recent Developments on Heat Mitigation Technologies</u></i>	
		Prof. Nyuk Hien Wong, National University of Singapore, Singapore <i>Speech Title: <u>CoolNUS BEAM Initiative - Use of NUS Campus as Living Laboratory for UHI Assessment and Mitigations</u></i>	
10:30-10:45	Coffee Break		
10:45-12:05	Keynote Speech	Prof. Davide Del Curto, Politecnico di Milano, Italy <i>Speech Title: <u>Climate Changes Architecture</u></i>	
		Prof. Chao Ren, HongKong University, China <i>Speech Title: <u>My 20 Years (2006-2026) Urban Heat Island Research</u></i>	
		Prof. Zhaolin Gu, Xi'an Jiaotong University, China <i>Speech Title: <u>Understanding the Spatiotemporal Differentiation of Local Heat Islands — Observation and Multi-scale Numerical Simulations</u></i>	
		Prof. Alberto Muscio, Università degli studi di Modena e Reggio Emilia, Italy <i>Speech Title: <u>The M-Cycle at 50: From Dew-Point Cooling to Heat-Resilient Cities</u></i>	
12:05-14:00	Lunch		Jia Restaurant, 56F, Asia Pacific Tower
14:00-15:20	Keynote Speech	Prof. Xing Shi, Tongji University, China <i>Speech Title: <u>Radiative Cooling Materials for Urban Buildings: Energy and Carbon Implications Across Building, District, and City Scales</u></i>	
		Prof. Priya Rajagopalan, RMIT University, Australia <i>Speech Title: <u>Emerging Anthropogenic Heat Sources-Characterization and Countermeasures</u></i>	
		Prof. Hideki Takebayashi, Kobe University, Japan <i>Speech Title: <u>Adaptation Measures for Extreme Heat in Urban Core Redevelopment: A Case Study from Kobe City</u></i>	
		Prof. Jian Hang, Sun Yat-Sen University, China <i>Speech Title: <u>High-Resolution Measurements and Multi-scale Simulation toward Sustainable Urban Climate Design</u></i>	
15:20-15:40	Coffee Break		Purple Mountain Ballroom, 2F, Jinling Tower
15:40-18:00	Technical Session 1: Scaling Cool Surface Solutions: Insights from Finance, Policy, and Industry		
18:30-20:00	Welcome Event		

TIME	PROGRAM		VENUE
Wednesday, September 23, 2026			
9:00-10:20	Keynote Speech	Prof. Alexander Baklanov, University of Copenhagen, Denmark & Russian State Hydrometeorological University <i>Speech Title: <u>Climate-Smart and Resilient Cities: from UHI Mitigation to Integrated Urban Climate Services and Sustainable Solutions</u></i>	Kunlun Ballroom, 2F, Asia Pacific Tower
		Prof. Andreas Matzarakis, Universität Freiburg, Germany <i>Speech Title: <u>Heat in Cities – Quantification, Warning Systems and Heat Health Action Plans to Protect Humans</u></i>	
		Prof. Anna Laura Pisello, University of Perugia, Italy <i>Speech Title: <u>Climate-Proof Is Not Enough: Cities for a Hotter Future From Urban Resilience to Human Wellbeing through Adaptation and Mitigation by Design</u></i>	
		Prof. Ning Zhang, Nanjing University, China <i>Speech Title: <u>Numerical Studies of Urban Heat Island and Wind Risk</u></i>	
10:20-10:40	Coffee Break		
10:40-11:40	Keynote Speech	Dr. Sarah Yuko Schneider, Cool Roof Rating Council (CRRC), USA <i>Speech Title: <u>The Key to Scaling Cool Surface Deployment</u></i>	
		Dr. Aijun Yan, Xi'an Thermal Power Research Institute Co., Ltd., China <i>Speech Title: <u>Research on Surface Albedo Modification for Climate Mitigation and Market Design</u></i>	
		Technical Director, Taro Hongo, NIKKEN SEKKEI Ltd., Japan <i>Speech Title: <u>Mitigating Urban Heat Islands with Greenery: Energy-Saving Technology and Applications of Sweet Potato Greening for Rooftop Air-Conditioning Units</u></i>	
12:05-14:00	Lunch		Jia Restaurant, 56F, Asia Pacific Tower
14:00-15:40	Parallel Sessions 1 (1.1-1.5)		Meeting Room 3&6-9, 3F, Asia Pacific Tower
15:40-16:00	Coffee Break		
16:00-17:40	Parallel Sessions 2 (2.1-2.5)		
17:40-19:00	Dinner		Jia Restaurant, 56F, Asia Pacific Tower
19:00-20:30	Society Meeting: Preparatory Meeting of International Society on Countermeasures to Urban Heat Islands (ISCUHI)		Meeting Room 3, 3F, Asia Pacific Tower
Thursday, September 24, 2026			
8:30-10:10	Parallel Sessions 3 (3.1-3.4)	9:00-12:00 Technical Session 2: Surface Albedo Modification Technology	Meeting Room 3&6-9, 3F, Asia Pacific Tower
10:10-10:30	Coffee Break		
10:30-12:10	Parallel Sessions 4 (4.1-4.4)		
12:20-14:00	Lunch		Golden Bay Buffet Restaurant, 1F, Jinling Tower
14:00-15:40	Parallel Sessions 5 (5.1-5.4)		Meeting Room 6-9, 3F, Asia Pacific Tower
15:40-16:00	Coffee Break		
16:00-17:30	Closing Ceremony		
Friday, September 25, 2026			
9:00-18:00	Free Activities		Nanjing

| Opening Speech

9.22
9:00-9:20 **Prof. Hashem Akbari, Concordia University, Canada**
Speech title: A Road Map to Cooling the Cities and the World



Prof. Hashem Akbari is a Professor in the Department of Building, Civil and Environmental Engineering at Concordia University, Canada. In 1983, he established the Heat Island Group at Lawrence Berkeley National Laboratory and led it for more than two decades, helping make it a leading international center for urban heat island research. As a contributor to the Intergovernmental Panel on Climate Change (IPCC), he participated in global climate change research recognized by the 2007 Nobel Peace Prize. Professor Akbari is a pioneer of cool-roof technologies, and his “Cool Roof Time Machine” received an R&D 100 Award in 2016. He has also founded and supported several international nonprofit organizations, including GCCA, CRRC, and ECPR. He previously served as Editor-in-Chief of Energy and Buildings and has contributed to major building energy standards, including ASHRAE 90.1/90.2 and California Title 24. He is widely recognized for his international contributions to urban heat mitigation, building energy efficiency, and climate-responsive design.

| Plenary Speech

9.22
9:20-9:50 **Prof. Edward Ng, Chinese University of Hong Kong, China**
Speech title: Serve the People



Prof. Edward Ng is Professor of Architecture in the School of Architecture of The Chinese University of Hong Kong (CUHK). He is the first incumbent of the Yao Ling Sun Endowed Chair in Architecture. He specializes in Green Building, Environmental and Sustainable Design, and Urban Climatology for City Planning. As an environmental consultant to the Government of the Hong Kong Special Administrative Region, Professor Ng developed the performance-based daylight design practice note, the Air Ventilation Assessment Technical Guidelines, and the Urban Climatic Maps for City Planning. Professor Ng has published over 500 papers and 3 books. He has twice received the International Award from the Royal Institute of British Architects (RIBA) and twice been honoured by the UNESCO Asia Pacific Heritage Jury Commendation for Innovation Award. He was the recipient of the 2010 Red Cross Humanitarian Award. His design project won the World Building of the Year Award at the 2017 World Architecture Festival (WAF) in Berlin. He has been honoured by Cambridge University with a prestigious Doctor of Science (DSc) degree.

| Keynote Speech

9.22
9:50-10:10 **Prof. Matthaios Santamouris, UNSW Sydney, Australia**
Speech title: Impacts of Urban Overheating and Recent Developments on Heat Mitigation Technologies



Prof. Mat Santamouris is a Professor of High Performance Architecture at UNSW, and past Professor at the University of Athens, Greece. Visiting Professor of Cyprus Institute, Metropolitan University London, Tokyo Polytechnic University, Bolzano University, Brunel University, Seoul National University, National University of Singapore, and UITM Univ Malaysia. Past President of the National Center of Renewable and Energy Savings of Greece. Editor-in-Chief of the Energy and Buildings Journal, Past Editor-in-Chief of the Advances in Building Energy Research, Associate Editor of the Solar Energy Journal, E-Prime, Journal of Low Carbon and Sustainable Energy, and Member of the Editorial Board of 24 Journals. Prof. Santamouris is a Highly Cited Researcher in the Clarivate ranking for 4 consecutive years.

9.22
10:10-10:30 **Prof. Nyuk Hien Wong, National University of Singapore, Singapore**
Speech title: CoolNUS BEAM Initiative - Use of NUS Campus as Living Laboratory for UHI Assessment and Mitigations



Prof. Nyuk Hien Wong is the Vice Dean of the School of Design and Engineering, National University of Singapore, Singapore. Prof. Wong has carried out extensive research on the Urban Heat Island effect in Singapore and explored various mitigation measures such as the effective utilization of urban greenery and cool roof materials. Prof. Wong's honors include the Local Merit Scholarship, Public Service Commission, Singapore, Building Science Gold Medal, National University of Singapore. He has published 151 research articles in journals, and 21 book/monograph contributions as author/co-author. He is a member of many national and international advisory boards and editor board.

9.22
10:45-11:05 **Prof. Davide Del Curto, Politecnico di Milano, Italy**
Speech title: Climate Changes Architecture



Professor Davide Del Curto is Vice Rector of the Mantua Campus and a Full Professor of Architectural Conservation at the Politecnico di Milano. His research currently focuses on the preventive conservation and restoration design of the architectural heritage as well as the relationship between heritage preservation and environmental sustainability, as part of the REACT EUPON 2014-2020 program. He has managed national and international research programmes. He has also taken part in conservation and restoration activities for monuments in Europe, Asia and South America, from antiquity to modern times, such as St. Andrew's Basilica in Mantua, the National Art Schools of Cuba and the Modernist Architecture of Tashkent.

9.22 Prof. Chao Ren, The University of Hong Kong, China
11:05-11:25 Speech title: My 20 Years (2006-2026) Urban Heat Island Research



Prof. Chao Ren is a Professor at the University of Hong Kong. She specializes in climate responsive design, applied climatology, and urban-scale climate change and health. She has contributed to several international collaborative research reports as a lead author, including the IPCC AR6, Climate Change and Cities ARC3.3, the 7th Global Environment Outlook, The United in Science 2023, the China Annual Report of the Lancet Countdown on Health and Climate Change and the 5th China National Assessment Report on Climate Change. She has been named in the World's Top 2% of Scientists List by Stanford University and Top 1% Scholars by Clarivate. Chao is co-Chief Editor for Urban Climate since 2024. She serves on the management committee of the Global Heat Health Information Network, a joint initiative of the World Health Organization and the World Meteorological Organization, and the steering committee of the Health Knowledge-Action Network of Future Earth.

9.22 Prof. Zhaolin Gu, Xi'an Jiaotong University, China
11:25-11:45 Speech title: Understanding the Spatiotemporal Differentiation of Local Heat Islands — Observation and Multi-scale Numerical Simulations



Prof. Zhaolin Gu is currently working as a Professor in Environmental Science and a previous Executive Dean of the School of Human Settlements and Civil Engineering, Xi'an Jiaotong University, and Director of the Joint Center of Urban Climate and the Built Environment Research. He is an Associate Editor of Indoor and Built Environment and a member of the editorial board of Aerosol and Air Quality Research and Journal of Xi'an Jiaotong University. His current area of research focuses on multiple-phase flow in Chemical and Environmental Engineering, Environmental Fluid Mechanics, Building Energy Consumption Integration, and Technology Development of Potential Energy Savings and Renewable Energy.

9.22 Prof. Alberto Muscio, Università degli studi di Modena e Reggio Emilia, Italy
11:45-12:05 Speech title: The M-Cycle at 50: From Dew-Point Cooling to Heat-Resilient Cities



Prof. Alberto Muscio from the University of Modena and Reggio Emilia is the director of the Energy Efficiency Laboratory (EELab) of the University of Modena and Reggio Emilia and president of the Italian Association for Thermophysical Properties (AIPT). He graduated cum laude in Engineering of Materials at Modena and then got a Ph.D in Thermal Fluids from the University of Bologna. His research is focused on energy efficiency of buildings and HVAC systems, measurement of thermophysical properties, and development and testing of surfaces with high solar reflectance.

9.22 Prof. Xing Shi, Tongji University, China
14:00-14:20 Speech title: Radiative Cooling Materials for Urban Buildings: Energy and Carbon Implications Across Building, District, and City Scales



Prof. Xing Shi is a tenured Professor and PhD Supervisor, Vice Dean of the College of Architecture and Urban Planning at Tongji University, and Director of the Key Laboratory of Ecology and Energy-saving Study of Dense Habitat, Ministry of Education. He also serves as Vice President of the Building Physics Branch of the Architectural Society of China and as an Editorial Board Member of Journal of Building Physics. He has been named among Stanford University's World's Top 2% Scientists for both career-long and annual impact, recognized as an Elsevier Highly Cited Chinese Researcher, and selected for the Shanghai Oriental Talent Program. His research focuses on urban microclimate, urban building energy and carbon emissions, and green building performance and optimization.

9.22 Prof. Priya Rajagopalan, RMIT University, Australia
14:20-14:40 Speech title: Emerging Anthropogenic Heat Sources-Characterization and Countermeasures



Prof. Priya Rajagopalan is the Director of the Post Carbon Research Centre for Infrastructure and the Built Environment and Associate Dean in the School of Property, Construction and Project Management. Her research interests span from sustainable building design, energy benchmarking and labelling, urban heat island, building performance simulation, indoor air quality, lighting and acoustics to citizen science in urban microclimate monitoring, mitigation and adaptation. As an internationally recognized expert in the field of building energy and indoor environmental performance and urban climatology, she has secured large competitive grants, led multidisciplinary teams and developed new knowledge and innovative methods for climate change mitigation and adaptation which are adopted by the industry, communities and governments.

9.22 Prof. Hideki Takebayashi, Kobe University, Japan
14:40-15:00 Speech title: Adaptation Measures for Extreme Heat in Urban Core Redevelopment: A Case Study from Kobe City



Prof. Hideki Takebayashi's research interests include climate analysis for urban planning and studies on the cooling effect of built-up areas by cold drainage flow on summer nights. Prof. Takebayashi has published more than 170 research papers, 20 books, and 480 conference papers. He is currently a scientific member of Japan Heat Island Society, Japan Agricultural Meteorological Society, Japan Association for Wind Engineering, The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan, and Architectural Institute of Japan. Prof. Takebayashi has received research prizes from Japan Heat Island Society, The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan, and Architectural Institute of Japan.

9.22
15:00-15:20

Prof. Jian Hang, Sun Yat-Sen University, China

Speech title: High-Resolution Measurements and Multi-scale Simulation toward Sustainable Urban Climate Design



Prof. Jian Hang is a professor and Vice Dean of the School of Atmospheric Sciences at Sun Yat-sen University, and named among the World's Top 2% Scientists in 2023. His research focuses on urban microscale turbulence, thermal environments, and surface energy balance, with contributions spanning field observations, numerical modeling, theoretical development, and mechanism analysis. He has published over 130 SCI-indexed papers, including six highly cited papers, with more than 4,500 citations and an H-index of 41. He has led six projects funded by the National Natural Science Foundation of China, including the Excellent Young Scientists Fund, as well as several national and provincial research projects. He currently serves as an Associate Editor of Urban Climate.

9.23
9:00-9:20

**Prof. Alexander Baklanov, University of Copenhagen, Denmark
& Russian State Hydrometeorological University**

Speech title: Climate-Smart and Resilient Cities: from UHI Mitigation to Integrated Urban Climate Services and Sustainable Solutions



Prof. Alexander Baklanov has more than 30 years of experience in environmental and atmospheric research, in particular in developing a new generation of online coupled meteorology-chemistry models, especially for urban applications. He has published about 400 scientific publications, including 14 books and almost 200 peer-reviewed papers. He led many international research projects, supervised 12 PhD students, and is a visiting/adjoint/honour professor in four European universities, a member of the Academy of Europe and the International Eurasian Academy of Sciences, organiser of international scientific conferences and young scientist summer schools, Editor in chief of the Urban Climate journal. Worked in international research teams in Russia, Austria, Sweden, Denmark, Switzerland.

9.23
9:20-9:40

Prof. Andreas Matzarakis, Universität Freiburg, Germany

Speech title: Heat in Cities – Quantification, Warning Systems and Heat Health Action Plans to Protect Humans



Prof. Andreas Matzarakis wrote his habilitation on the "thermal component of the urban climate". Between October 2001 and July 2015, he was senior research associate at the University of Freiburg, where he was appointed Adjunct Professor in October 2006. From August 2015 to March 2024, he was head of the Research Centre Human Biometeorology of the German Meteorological Service. Between 1996 and 2014, he chaired the commission for climate, tourism and recreation of the International Society of Biometeorology, and he was vice-president of the International Society of Biometeorology between 2006 and 2009. Since 2016, he is the chairman of the German Society for the advancement of medical-meteorological research.

9.23
9:40-10:00

Prof. Anna Laura Pisello, University of Perugia, Italy

Speech title: Climate-Proof Is Not Enough: Cities for a Hotter Future From Urban Resilience to Human Wellbeing through Adaptation and Mitigation by Design



Prof. Anna Laura Pisello is Professor of building physics and energy systems at the University of Perugia and founder of the Environmental Applied Physics Lab. She is the author of more than 150 international refereed journal articles. She won seven international academic awards and European projects under the framework of the Horizon 2020 program. She is the Associate Editor of Solar Energy, an editorial board member in several international journals, e.g., Energy and Buildings, Energy Research and Social Science, etc. Her research interests cover innovative smart materials for building envelope multifunctional optimization and thermo-physics characterization, and indoor-outdoor microclimate for environmental comfort and energy saving, with dedicated attention to dense urban areas and city resilience to climate change.

9.23
10:00-10:20

Prof. Ning Zhang, Nanjing University, China

Speech title: Numerical Studies of Urban Heat Island and Wind Risk



Prof. Ning Zhang is a Professor at the School of Atmospheric Sciences, Nanjing University, China, and Deputy Director of the Key Laboratory of Urban Meteorology, China Meteorological Administration (CMA). He previously worked at the Zhejiang Institute of Meteorological Sciences and conducted postdoctoral research at Jackson State University. His research focuses on atmospheric boundary-layer meteorology, urban air quality, and urban meteorology and climate. He has developed numerical models for urban microscale climate and pollutant dispersion using empirical approaches, large-eddy simulation, and Reynolds-averaged methods, and is a major contributor to the urban canopy model developed at Nanjing University.

9.23
10:40-11:00

Dr. Sarah Yuko Schneider, Cool Roof Rating Council (CRRC), USA

Speech title: The Key to Scaling Cool Surface Deployment



Dr. Sarah Yuko Schneider is the Deputy Director of the Cool Roof Rating Council (CRRC). She joined the CRRC in 2013 and oversees policy and standards development, maintains the organization's accreditations to ANSI and ISO/IEC 17065, and conducts outreach and education in the U.S. and internationally. Ms. Schneider is also the CRRC Quality Manager, Lead Internal Auditor, and Authorized Representative for codes and standards advocacy. Prior to the CRRC, she supported California energy utilities in the development of energy and water efficiency codes and standards, developed stakeholder outreach materials for California's Marine Protected Areas, and managed a municipal energy program in Northern California. Ms. Schneider has a Master's degree in Public Policy with a focus on Environmental Justice and a B.S. in Environmental Science.

9.23
11:00-11:20

Dr. Aijun Yan, Xi'an Thermal Power Research Institute Co., Ltd., China
Speech title: Research on Surface Albedo Modification for Climate Mitigation and Market Design



Dr. Aijun Yan serves as an ISO Chinese Expert and IET Chartered Engineer. He has long been engaged in research and engineering application covering power system materials science as well as energy and power technologies for climate change mitigation. He has led and participated in the formulation and issuance of six international standards and has been awarded two ISO Excellence Awards. He has presided over multiple research projects related to Surface Albedo Modification (SAM) and proposed a surface albedo modification method based on high-albedo photovoltaic systems and initiated and completed the world's first transaction of solar radiation albedo. As the principal organizer, he initiated and hosted the International Conference on Solar Radiation Modification.

9.23
11:20-11:40

Technical Director, Taro Hongo, NIKKEN SEKKEI Ltd., Japan
Speech title: Mitigating Urban Heat Islands with Greenery: Energy-Saving Technology and Applications of Sweet Potato Greening for Rooftop Air-Conditioning Units



Dr. Taro Hongo is an Associate in the Global Business Development Group, Global Business Department at Nikken Sekkei. He joined the firm in 2007 after completing his master's degree at Waseda University, where he specialized in machine and facility design. His work focuses on creating buildings that are enjoyable to experience, practical to use, and widely appreciated. He has managed a range of architectural and renovation projects, including the bicycle parking facility at Oshiage Station, the Bank of Chengdu Main Office, the Ebisu Subaru Building, the Sumitomo Corporation next-generation office, and the YKK80 Building, as well as facility renovations for the National Museum of Western Art and the Chubu Electric Power Chiyoda Building. He also continues to explore innovative approaches to greening air-conditioning condenser units using sweet potatoes.



Technical Sessions

Technical Session 1

Topic: Scaling Cool Surface Solutions: Insights from Finance, Policy, and Industry

Time: 9.22, 15:40-18:00

Venue: Kunlun Ballroom

Session Chair: Kurt Shickman, World Resources Institute / Climate Resolve, U.S.

Abstract:

Cool surfaces have existed for decades as modern technologies and for thousands of years as building thermal comfort interventions. Yet, in many of the regions most exposed to heat risk that would most benefit from passive heat resilience, it has been challenging to advance from demonstrations to deployment at scale. This panel, moderated by Xiaoyi Jin, Program Officer at the ClimateWorks Foundation Clean Cooling Collaborative, will explore one of the central challenges to scaling up: a disconnect between the benefits of cool surfaces and the perception and valuation of those benefits by investors and risk managers. The misperception of value and risk associated with passive cooling investments creates funding gaps at every level, affecting developers seeking project financing and cities seeking to utilize proceeds from bond issuances. It has also constrained innovative business models for passive interventions that have shown promise in bringing sustainable active cooling to markets. Panelists will discuss the challenge of scaling cool surfaces and offer insights on how to effectively address those barriers going forward.

Panelists:

- Frank Klink, Climate Resolve, U.S.
- Huhe Chen, Dow Construction Chemicals China
- Hua Wen, World Resources Institute China
- Emilia Garcia Arteaga Molinar, Climate Resolve
- Sarah Schneider, Cool Roof Rating Council, U.S.
- Xiaoyi Jin, ClimateWorks Foundation
- Wenhong Xie, Climate Bonds Initiative China

Technical Session 2

Topic: Surface Albedo Modification Technology

Time: 9.24, 9:00-12:00

Venue: Meeting Room 3

Session Chair: Fu Chang, Xi'an Thermal Power Research Institute, China

Abstract:

In recent years, global temperatures have been rising steadily, and it is becoming difficult to achieve the established goals of the Paris Agreement relying solely on carbon emission reduction. Solar Radiation Modification (SRM), as a potential and auxiliary technology for carbon emission reduction, has become an international cutting-edge and hot research topic in addressing global climate change, and has attracted attentions from the United Nations and countries all over the world.

In May and September 2025, the United Nations Environment Programme (UNEP) held two joint consultation and science-policy workshops on SRM, aiming to establish a common understanding on the status of SRM and support a balanced, inclusive, and evidence-informed discussion on the potential implications, uncertainties, and governance considerations about SRM research and deployment.

Xi'an Thermal Power Research Institute Co., Ltd. (TPRI) has actively carried out research on SRM-related technologies and hosted the International Symposium on SRM in 2025 and 2026, with experts from UNEP and countries including China, the United States, Canada, Singapore, Indonesia, and Sierra Leone. This technical session will be organized for preparing the international standard project "Technical Report on Surface Albedo Modification".

Panelists:

- Hashem Akbari, Concordia University, Canada
- Zhen Sun, Former deputy director of the Climate Department of the Ministry of Ecology and Environmental Protection
- Ye Tao, Founder & Executive Director of MEER, Canada
- Aijun Yan, Xi'an Thermal Power Research Institute, China

Society Meeting

Preparatory Meeting of International Society on Countermeasures to Urban Heat Islands (ISCUHI)

Time: 9.23, 19:00–20:30

Venue: Meeting Room 3

Meeting Chair: Hashem Akbari, Concordia University, Canada

Proposal:

The advent of climate change, global warming, and extreme heat affect urban population the most. Urban areas are also affected by the cumulative effects of urban heat islands. Currently more than 55% of the world population live in urban areas. By mid-century, that fraction is projected to rise to 70%. Policy makers have been struggling to develop policies to effectively counter this rapid change in urban environment. Having an institution to provide specific regional guidelines and information is necessary to fill this gap. We propose to establish an International Society on Countermeasures to Urban Heat Islands (ISCUHI) (or in another similar name) to gather parties interested in discussing, analyzing, and developing effective implementation policies to address urban heat islands (UHIs) in this era of climate change. It is anticipated that ISCUHI will be an independent member-supported organization.



Meeting Agenda:

1. Review of the draft charter
2. Review of the name ISCUHI
3. Review of membership benefits
4. Election of interim Council members
5. Tasks for the interim Council



Parallel Sessions

Parallel Session 1.1

Topic: UHI and Urban Energy

Time: 9.23 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 9

Chair: Priya Rajagopalan

Paper	Paper ID	Presenter
Causal Analysis and Quantification of Urban Heat Island Dynamics in Osaka Prefecture Using Hindcast Simulations Driven by Land Use and Anthropogenic Heat <u>Authors:</u> Zhiheng Zhou, Natsu Terui, Daisuke Narumi <u>Institute:</u> Okayama University	18	Zhiheng Zhou
Impacts of Residential Block Morphology and Microclimate on Operational Carbon Emissions: Evidence from Xi'an, China <u>Authors:</u> Minye Zhang, Yupeng Wang, Xilian Luo <u>Institute:</u> Xi'an Jiaotong University	25	Minye Zhang
From Mapping to Mitigation: A Street-View Decision-Support Framework for Managing Pedestrian-Scale Heat from Air-Conditioner Exhaust <u>Authors:</u> Ruiheng Li, Zhen Xu <u>Institute:</u> Nanjing Forestry University	32	Ruiheng Li
Urban Heat Challenges under Future Climates: Energy and Comfort in an Osaka Office Building <u>Authors:</u> Xinying Xue, Zhichao Jiao, Fatemeh Salehipour Bavarsad, Mostafa Mohajerani, Jihui Yuan <u>Institute:</u> Osaka Metropolitan University; Yantai University; Technical University in Prague; Shahrood University of Technology	81	Xinying Xue
Surface Energy Partitioning and Urban Heat Island Dynamics in Three Temperate Italian Cities: A Decade-Long Satellite-Based Assessment (2015–2025) <u>Authors:</u> Hafiz Adnan Ahmad Baig, Alberto Muscio <u>Institute:</u> University of Modena and Reggio Emilia	105	Hafiz Adnan Ahmad Baig
Impacts of Rooftop Photovoltaics Panels on Urban Thermal Environment: A study in Singapore with WRF and Local Climate Zones <u>Authors:</u> Puyang Liu, Xianxiang Li, Rui Xin, Lup Wai Chew <u>Institute:</u> National University of Singapore; Sun Yat-sen University	23	Puyang Liu

Parallel Session 1.2

Topic: Climate Adaptive Building Design

Time: 9.23 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 8

Chair: Davide Del Curto

Paper	Paper ID	Presenter
Influence of Ground-level and Mid-level Building Porosity on Pedestrian-Level Wind Speed <u>Authors:</u> Jinjun Ye, Lup Wai Chew <u>Institute:</u> Hunan University; National University of Singapore	11	Lup Wai Chew
Assessing the effects of climate warming on future thermal discomfort in naturally ventilated hot-humid housing <u>Authors:</u> Mark Cel Gonzaga, Tomohiko Ihara <u>Institute:</u> The University of Tokyo	20	Mark Cel Gonzaga
Analysis of Diurnal and Nocturnal Vertical Profiles of Air Temperature in an Urban Canyon – A Tropical Campus Case Study <u>Authors:</u> May Lwin Oo, Nyuk Hien Wong, Shanshan Tong, Jun Chung Daniel Hii, Erna Tan, Joie Lim, Marcel Ignatius <u>Institute:</u> National University of Singapore; Kajima Technical Research Institute Singapore	27	May Lwin Oo
A Machine Learning-based Framework for Optimizing Air Conditioning Scheduling to Mitigate Anthropogenic Heat Emission for High-Rise Offices in China Great Bay Area <u>Authors:</u> Yuxiao Gu, Maoping Wang, Zheng Tan <u>Institute:</u> The Hong Kong Polytechnic University	264	Yuxiao Gu
Impact of Solar Radiation on Indoor Thermal Performance of School Classrooms with Different Roof Insulation Strategies in a Tropical Climate <u>Authors:</u> Sheikh Ahmad Zaki Shaikh Salim, Naja Aqilah, Yasir Arafat, Teh Khar San, Manoj Kumar Singh, Hom Bahadur Rijal, Fitri Yakub <u>Institute:</u> Universiti Teknologi Malaysia; San Miguel Yamamura Woven Products Sdn. Bhd.; Shiv Nadar Institution of Eminence; Tokyo City University; Malaysia-Japan International Institutes of Technology, University Technology Malaysia	40	Sheikh Ahmad Zaki Shaikh Salim
Preliminary Study on Machine Learning for the Preventive Conservation of Earthen Heritage: A Case Study on Rammed Earthen Wall Monitoring <u>Authors:</u> Xinyu Jiang, Sok Yee Yeo <u>Institute:</u> Xi'an Jiaotong University; Tongji University	151	Xinyu Jiang

Parallel Session 1.3

Topic: Urban Design and Micro-Climate

Time: 9.23 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 7

Chair: Nyuk Hien Wong

Paper	Paper ID	Presenter
Investigating the interaction between Urban Heat and Pollution Islands: evidence from in-situ observations in Rome (Italy) <u>Authors:</u> Annalisa Di Bernardino, Stefania Argentini, Erika Brattich, Monica Campanelli, Giampietro Casasanta, Andrea Cecilia, Margherita Erriu, Andrea Faggi, Serena Falasca, Anna Maria Siani <u>Institute:</u> Sapienza University of Rome; National Research Council of Italy; University of Bologna; Italian National Agency for New Technologies; Sapienza Università	15	Annalisa Di Bernardino
Spatiotemporal Heterogeneity of Local-Scale Heat Islands in Coastal Cities during High-Temperature Seasons Based on Mobile Measurements <u>Authors:</u> Jin Bai, Hongchi Zhang, Jun Cai <u>Institute:</u> Dalian University of Technology	28	Jin Bai
Spatiotemporal Variations in Urban Heat Island Effects Across Local Climate Zones Based on Long-Term Fixed-point Observations: The Case of Dalian <u>Authors:</u> Hongchi Zhang, Jin Bai, Shizheng Ren, Jun Cai <u>Institute:</u> Dalian University of Technology	29	Hongchi Zhang
Urban Heat Risk and Vegetation Cooling: Morphology Insights for Resilience <u>Authors:</u> Chunping Miao <u>Institute:</u> Chang'an University	213	Chunping Miao
Investigating the dynamic cooling effects of Blue-green spaces during extreme heat <u>Authors:</u> Wanlu Ouyang, Meng Cai <u>Institute:</u> Nanjing University; Wuhan University	83	Wanlu Ouyang
Integrating life-circle accessibility and institutional governance in neighborhood-scale urban heat vulnerability assessment <u>Authors:</u> Junyi Hua <u>Institute:</u> Ocean University of China	237	Junyi Hua

Parallel Session 1.4

Topic: UHI and Human Comfort

Time: 9.23 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 6

Chair: Andreas Matzarakis

Paper	Paper ID	Presenter
Thermal Comfort in Different Urban Geometry: The Role of Urban Parks during Extreme Heat Events in Melbourne <u>Authors:</u> Maryam Norouzi, Hing-Wah Chau, Elmira Jamei <u>Institute:</u> Victoria University	7	Maryam Norouzi
Street Trees and Pedestrian Stopping Across Seasons: Evidence from Adelaide Main Streets <u>Authors:</u> Linglue Xia, Ehsan Sharifi, David Kroll <u>Institute:</u> University of Adelaide	13	Linglue Xia
Multi-scale Evaluation of Shading Effectiveness and Morphological Thermal Effects in Old Neighborhoods from the Perspective of Elderly Spatiotemporal Behavior <u>Authors:</u> Xukun Yan, Yupeng Wang, Xilian Luo <u>Institute:</u> Xi'an Jiaotong University	22	Xukun Yan
Effects of Residential Siting on Outdoor Thermal Comfort in Plateau Mountain Villages: A Traditional Feng Shui Perspective <u>Authors:</u> Yuan Chen, Yupeng Wang, Xilian Luo <u>Institute:</u> Southeast University; Xi'an Jiaotong University	26	Yuan Chen
Activity-Aware Outdoor Heat Stress Assessment in Tropical Cities: Extending PET Modelling for Urban Environments and Climate in Singapore <u>Authors:</u> Qiubo Chen, Like Gobeawan, Wee Kee Phua, Wee Shing Koh, Huizhe Liu <u>Institute:</u> Agency for Science Technology and Research	37	Qiubo Chen
Projected Urban Heat Island Amplification in Osaka under Climate Change <u>Authors:</u> Xiong Xiao, Yafeng Gao, Rui Guo, Chaoqun Zhuang, Craig Farnham, Jihui Yuan <u>Institute:</u> Osaka Metropolitan University; Chongqing University; Huazhong University of Science and Technology; Nanjing Tech University	74	Xiong Xiao

Parallel Session 1.5

Topic: UHI Mitigation Strategies

Time: 9.23 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 3

Chair: Bo Hong

Paper	Paper ID	Presenter
Urban Vegetation Configurations and Surface Albedo Effects on Pedestrian Thermal Comfort: ENVI-met Simulations in Osaka <u>Authors:</u> Erlin Zou, Zhichao Jiao, Craig Farnham, Jihui Yuan <u>Institute:</u> Osaka Metropolitan University; Yantai University	89	Erlin Zou
Thermal Spillover Effects of Different Green Space Layout Scenarios at Urban Intersections: A Numerical Simulation Study <u>Authors:</u> Sijie Zhu <u>Institute:</u> Nanjing Forestry University	16	Sijie Zhu
Meta-Holistic Orientation-Guided Cross-Scale Strategic Framework for Urban Heat Island Governance in the Guangdong-Hong Kong-Macao Greater Bay Area <u>Authors:</u> Yage Liu, Hongyang Wang, Le Yu <u>Institute:</u> Nanjing University	58	Yage Liu
Research on the Renewal of Historic Cultural Districts in Northern China Based on Microclimate Field Measurement for Urban Heat Island Mitigation - Taking the Qianmen Area of Beijing as an Example <u>Authors:</u> Wen Zhang, Xiaohua Cheng, Shisheng Chen, Wei Zhang, Jie Zheng <u>Institute:</u> Beijing Jiaotong University; Fuzhou University; China Architecture Design & Research Group	63	Xiaohua Cheng
Heat-Exposure Assessment Within Pedestrian Isochrones of Metro Stations and Morphology-Based Mitigation: A Case Study of Nanjing <u>Authors:</u> Siwen Cao, Ziyu Tong, Xiyun Tong, Wenborui Liu <u>Institute:</u> Nanjing University	78	Siwen Cao
The Urban Heat and Pollution Islands InterAction in Rome and Possible Mitigation Strategies (RESTART) Project: Final Outcomes and Policy Recommendations <u>Authors:</u> Annalisa Di Bernardino, Erika Brattich, Stefania Argentini, Francesco Barbano, Monica Campanelli, Giampietro Casasanta, Andrea Cecilia, Silvana Di Sabatino, Margherita Erriu, Andrea Faggi, Serena Falasca, Tiziano Maestri, Anna Maria Siani <u>Institute:</u> Sapienza University of Rome; University of Bologna; National Research Council of Italy; Italian National Agency for New Technologies	14	Annalisa Di Bernardino

Parallel Session 2.1

Topic: UHI Simulation Method Development

Time: 9.23 16:00-17:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 9

Chair: Kurt Shickman

Paper	Paper ID	Presenter
Overheating impacts of reflective glazing vs opaque facades – experimental & numerical comparison with upgraded UBEM-Microclimate platform with raytracing <u>Authors:</u> Delia Valledor, Emmanuel Bozonnet, Anne Penillard, Samuel Carré, Georgios Kyriakodis <u>Institute:</u> LaSIE UMR CNRS 7356	9	Delia Valledor
Underground Space Utilization for Natural Cooling and Air Purification via Hybrid Earth-Air Tunnel (EAT) and Two-stage Electrostatic Precipitation (ESP) System <u>Authors:</u> Jingwen Chen, Zhuangbo Feng <u>Institute:</u> Southeast University	260	Jingwen Chen
A Novel Framework for Assessing Outdoor Thermal Comfort: Coupling Raytracing and Computational Fluid Dynamics <u>Authors:</u> Huizhe Liu, Derrick Low, Zhengwei Ge, Po-Yen Lai, Qiubo Chen, Jian Cheng Wong, Wee Shing Koh, Daniel Wise <u>Institute:</u> Agency for Science Technology and Research	44	Huizhe Liu
DSHET: A Diurnal Surface Heat Evaluation Tool for Typology-Sensitive Urban Heat Mitigation <u>Authors:</u> Emal Ahmad Hussainzad, Zhonghua Gou <u>Institute:</u> Wuhan University	45	Emal Ahmad Hussainzad
Spectral Proper Orthogonal Decomposition of Coherent Structure and Energy Transfer in Urban Convective Boundary Layers <u>Authors:</u> Lei Yan, Chun-Ho Liu <u>Institute:</u> The University of Hong Kong	53	Lei Yan
Ventilation Mechanism in Idealized Urban Wind Corridors: A Large-Eddy Simulation Approach <u>Authors:</u> Mofan Qiu, Chun-Ho Liu <u>Institute:</u> The University of Hong Kong	88	Mofan Qiu

Parallel Session 2.2

Topic: Cooling Technology

Time: 9.23 16:00-17:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 8

Chair: Hashem Akbari

Paper	Paper ID	Presenter
Assessing carbon footprint reduction efficiency of a dynamic photovoltaic shading system under extremely hot weather in Hangzhou, China <u>Authors:</u> Juejun Ge, Jicheng Wang, Yupeng Wang <u>Institute:</u> China United Engineering Corporation Limite; Southeast University	21	Juejun Ge
Study on Relationship between Mist Spraying Conditions and Thermal Environment Improvement Effects <u>Authors:</u> Hideki Takebayashi, Momoka Mizuta <u>Institute:</u> Kobe University	62	Hideki Takebayashi
Multi-Scale Assessment of Urban Form Transformation and Heat Exposure in Melbourne’s Western Suburbs <u>Authors:</u> Jingliang Dong, Yashwanth Kaushal Ediriweera, Gokul Thirunavukkarasu, Lin Yang, Allison Kealy, Elmira Jamei <u>Institute:</u> Victoria University; Swinburne University of Technology	218	Gokul Thirunavukkarasu
An Integrated Simulation Approach for Evaluating Urban Cool Spot Performance with Longwave Radiation Considerations <u>Authors:</u> Xingyu Li, Minako Nabeshima, Masatoshi Nishioka <u>Institute:</u> Osaka Metropolitan University	94	Xingyu Li
Green roofs in informal settlements of a tropical city in Brazil <u>Authors:</u> Henrique Francisco Dos Reis, Eleonora Sad de Assis, Rafael Silva Brandão <u>Institute:</u> Federal University of Minas Gerais; Federal University of São João del Rei	146	Henrique Francisco Dos Reis
Social Variables Influencing Outdoor Thermal Comfort: A Scoping Review <u>Authors:</u> Jiajian Chen, Edward Ng <u>Institute:</u> The Chinese University of Hong Kong	266	Jiajian Chen

Parallel Session 2.3

Topic: UHI and Urban Energy

Time: 9.23 16:00-17:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 7

Chair: Dayi Lai

Paper	Paper ID	Presenter
Thermal impact of the photovoltaic on the urban microclimate <u>Authors:</u> Dongyu Lian, Chengliang Fan, Meirong Pan, Yundan Liao <u>Institute:</u> Guangzhou University	192	Dongyu Lian
Tire and Road Wear Particles under Urban Heat: A Narrative Review of Generation, Transport, Exposure, and Mitigation <u>Authors:</u> Cheng Yang, Tianxiang Liu, Mingdong Jiang, Zixuan Li, Junqi Wang <u>Institute:</u> Southeast University; Suzhou University of Science and Technology	228	Cheng Yang
The gray tail of urban heating: tire-wear particles are emerging as an amplified traffic related pollution risk <u>Authors:</u> Tianxiang Liu, Junqi Wang, Cheng Yang <u>Institute:</u> Southeast University	229	Tianxiang Liu
Microclimate-integrated urban building energy modeling for heat-resilient urban planning: evidence from Shanghai and Singapore <u>Authors:</u> Pengyu Jie, Xing Shi <u>Institute:</u> Tongji University	250	Pengyu Jie
Research on the Impact Weight Evaluation of Design Factors for Green Energy-Saving Renovation of Old Residential Communities Based on Microclimate–Energy Coupled Simulation <u>Authors:</u> Zhichao Yu, Ziyu Tong <u>Institute:</u> Nanjing University	253	Zhichao Yu
Design Considerations for Balancing the Effects of Wind and Solar Radiation on Indoor Thermal Comfort under Heat Extremes: A Parametric Study of Public Rental Housing Using urban Microclimate Foam <u>Authors:</u> Xinrui Guo, Yueyang He, Negin Nazarian, Edward Ng <u>Institute:</u> The Chinese University of Hong Kong; University of New South Wales	261	Xinrui Guo

Parallel Session 2.4

Topic: Climate Adaptive Building Design

Time: 9.23 16:00-17:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 6

Chair: Fanhua Kong

Paper	Paper ID	Presenter
Effects of Building Enclosure Layouts on Courtyard Ventilation under Coupled Wind and Thermal Conditions <u>Authors:</u> Wenrui Yang, Wei You <u>Institute:</u> Nanjing Tech University	160	Wenrui Yang
Study on the Influence of Building Height Variation on Outdoor Space Ventilation Efficiency in Urban Residential Areas under Coupled Wind and Thermal Conditions <u>Authors:</u> Yiyu Zhu, Wei You <u>Institute:</u> Nanjing Tech University	161	Yiyu Zhu
Material-Driven Urban Heat Island Mitigation: Evaluating Current vs. Next-Generation Options in Amaravati's Current Urban Form <u>Authors:</u> Shambhavi Kale, Sujata Karve, Prajakta Kulkarni <u>Institute:</u> Dr. Bhanuben Nanavati College of Architecture for Women	181	Shambhavi Kale
Color-Based Estimation of Solar Reflectance: A Material-Calibrated Conceptual Framework <u>Authors:</u> Karime Costa, Lorena Couto, Kelen Dornelles <u>Institute:</u> University of São Paulo	38	Karime Costa
Socio-Environmental Predictors of Heat-Related Quality of Life in Cairo Megacity <u>Authors:</u> Tania Sharmin, Heba Allah Essam El-Din Khalil, Sherin Gammaz, Nowf Maaith, Yasmina Mohamed, Davis Juliet, Zhiwen Luo, Simon Lannon, Lisa Hurt <u>Institute:</u> Cardiff University	136	Tania Sharmin
Campus as a Living Lab: Using the BEAM Framework and Digital Twin to Address Urban Microclimate Challenges <u>Authors:</u> Marcel Ignatius, Shanshan Tong, Ruohan Xu, Yijun Lu, Joie Lim, Yu Qian Ang, Lup Wai Chew, Filip Biljecki, Nyuk Hien Wong <u>Institute:</u> National University of Singapore	179	Marcel Ignatius

Parallel Session 2.5

Topic: Urban Design and Micro-Climate

Time: 9.23 16:00-17:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 3

Chair: Baojie He

Paper	Paper ID	Presenter
Indoor Heat in Hospitals – The case of the Medical Centre Freiburg <u>Authors:</u> Andreas Matzarakis <u>Institute:</u> University of Freiburg	47	Andreas Matzarakis
Outdoor Thermal Environments in Two Historic University Campuses: A Cross-Climate Comparison between Milan and Xi'an <u>Authors:</u> Yuxin Zhang, Siyuan Miao, Zetong Wang, Duo Xu, Yunyan Xue, Yupeng Wang, Barbara Galli <u>Institute:</u> Xi'an Jiaotong University; Southeast University; Politecnico di Milano	57	Yuxin Zhang
Impact Mechanism and Spatial Optimization Strategies of Local Climate Zones on Land Surface Temperature in the Historic District of Jinan, China <u>Authors:</u> Chang Xu, Yilin Wang, Deqing Lin, Xiaodong Xu <u>Institute:</u> Southeast University	75	Chang Xu
Thermal Environment Characteristics and Passenger Comfort in a Metro Station Area in Jinan, China <u>Authors:</u> Jianlu Xuanyuan, Ruihan Wei, Zhen Ren <u>Institute:</u> Shandong Jianzhu University	109	Jianlu Xuanyuan
Surface and Canopy Layer Urban Heat Island Studies of Bangkok Local Climate Zones <u>Authors:</u> Pattaranan Takkanon, Natrada Boonthad, Rathphum Pakarnseree, Arthit Limpiyakorn <u>Institute:</u> Kasetsart University	119	Pattaranan Takkanon
Impacts of Blue-Green Space Patterns on Land Surface Temperature across Different Functional Zones: A Case Study of Shanghai <u>Authors:</u> Yuncong Weng, Yao Xu, Wenshan Su, Jiawei Yao <u>Institute:</u> Tongji University; Beijing Forestry University	145	Yuncong Weng

Parallel Session 3.1

Topic: UHI and Human Comfort

Time: 9.24 8:30-10:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 9

Chair: Yupeng Wang

Paper	Paper ID	Presenter
A Quantitative Evaluation of the Sleep-Improving Effects of Air Conditioners Using Epidemiological Data and Machine Learning <u>Authors:</u> Tomohiko Ihara, Seiki Sugimoto, Alvin Christopher Galang Varquez, Norihiro Itsubo <u>Institute:</u> The University of Tokyo; Institute of Science Tokyo; Waseda University	43	Tomohiko Ihara
Mapping Schoolyard Heat Exposure through Machine Learning and Satellite Data: A Case of Sub-Saharan Africa <u>Authors:</u> Rodrigue Samb, Uttam K. Roy, Mannavi Suneja <u>Institute:</u> Indian Institute of Technology	122	Rodrigue Samb
Does lower urban heat island intensity always mean thermally comfortable? An empirical investigation of Hankou central urban area <u>Authors:</u> Qiu Jin, Xinyi Hu, Qinyu Wang, Wenjian Pan <u>Institute:</u> Huazhong University of Science and Technology	130	Qiu Jin
Climate simulation of nature-based solutions to mitigate the effects of the Urban Heat Island in the coastal city of Valparaíso <u>Authors:</u> Pamela Muñoz Ossandón, Massimo Palme <u>Institute:</u> Universidad Técnica Federico Santa María; Universidad Católica del Norte	87	Massimo Palme
Spatio-temporal Differentiation of Heat Exposure Risk and the Role of Built-up Environment in Hangzhou <u>Authors:</u> Jun Zhao, Liping He, Yun Wu <u>Institute:</u> Zhejiang A&F University	61	Jun Zhao
Utilizing urban vegetation to simultaneously achieve air cooling and pollutant purification: “ multi-physics-media ” model development and systematical optimization <u>Authors:</u> Ruiming Nie, Zhuangbo Feng, Shuai Liu <u>Institute:</u> Southeast University	267	Ruiming Nie

Parallel Session 3.2

Topic: UHI Mitigation Strategies

Time: 9.24 8:30-10:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 8

Chair: Lup Wai Chew

Paper	Paper ID	Presenter
Heat Island Mitigation Strategies for High-Density Residential Superblocks: A Case Study of Nanjing <u>Authors:</u> Jiajie Lu, Jingjin Li, Xinxuan Yan <u>Institute:</u> Southeast University	113	Jiajie Lu
Climate-Adaptive Design Strategies for Heat-Resilient Urban Greenways in Mountainous Cities <u>Authors:</u> Ke Xiong, Dangshen Yang, Baojie He, Peilin Luo <u>Institute:</u> China Three Gorges University; China Southwest Architectural Design and Research Institute Corp.Ltd.; Chongqing University	118	Ke Xiong
Study on Thermal Benefit of Vertical Greening on Outdoor Environment under Cold Climate <u>Authors:</u> Xiaodi Zuo <u>Institute:</u> Xi'an Jiaotong University	246	Xiaodi Zuo
A Novel Multi-Objective Optimization Approach to Urban Design for Adapting and Mitigating Urban Heat Island Effects in High-Density Built Environments <u>Authors:</u> Yuqi Tian, Jingjin Li, Ying Li <u>Institute:</u> Southeast University	126	Jingjin Li
Blue-green coupling effects on urban surface heat: Explainable ML and GWR analysis in Hangzhou, China <u>Authors:</u> Yiting Huang, Can Zhu, Guiwei Wang, Siru Chen, Qiduo He, Yue Cai, Feng Shao <u>Institute:</u> Zhejiang A&F University	165	Qiduo He
Research on the Temporal and Spatial Distribution of Vegetation Phenology in Suzhou City based on Local Climate Zones and Urban-Rural Gradients <u>Authors:</u> Mengning Hu, Xiangdong Xiao, Hao Wang <u>Institute:</u> Soochow University	168	Mengning Hu

Parallel Session 3.3

Topic: UHI Simulation Method Development

Time: 9.24 8:30-10:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 7

Chair: Mikhail Varensov

Paper	Paper ID	Presenter
Adaptation and Calibration of the Eixample Model from Barcelona for Urban Climate in Valparaíso, Chile Authors: Claudio Carrasco, Massimo Palme, Antoni Isalgue, Clemente Ferrer Institute: Universidad de Valparaíso; Universidad Técnica Federico Santa María; Polytechnic University of Catalonia; Pontificia Universidad Católica de Chile	98	Claudio Carrasco
Predicting Urban Vertical Wind Speed Profiles Using Multi-Location Doppler LiDAR Observations and Explainable Machine Learning Authors: Yueyang He, Shisheng Chen, Weijie Sun, Edward Ng Institute: The Chinese University of Hong Kong; Fuzhou University; The Chinese University of Hong Kong; The Chinese University of Hong Kong	140	Yueyang He
Validation of EnergyPlus Simulation for Outdoor Radiative Environment with External Shading Components Authors: Jiayu Zhou, Shi Yin, Bin Yu, Zijian Wang, Yueyang Zhang, Wei Liao, Yiqiang Xiao Institute: South China University of Technology; Guangdong University of Technology	231	Jiayu Zhou
Spatiotemporal Characteristics of Vertical Microclimate in Urban High-Rise Residential Buildings: A Case Study in Zhengzhou Authors: Jingjing Jia, Di Wu Institute: Zhengzhou University	235	Di Wu
Categorical evaluation of aerodynamic parameters estimation methods for urban wind profiles: A systematic review with implications for dense urban environments Authors: Weijie Sun, Yueyang He, Janet Barlow, Chao Ren, Chi Yung Tam, Chao Yuan, Jimmy Chi Hung Fung, Edward Ng Institute: The Chinese University of Hong Kong; University of Reading; The University of Hong Kong; National University of Singapore; Hong Kong University of Science and Technology	243	Weijie Sun
Dynamic Topology for Autonomous Disassembly: A GAT-Based Reinforcement Learning Framework for Industrial Building Joint Deconstruction Authors: Xu Yeyang Zhang, Siying Liang, Yurong Li, Yu Zhang Institute: Southeast university; Key Laboratory of Urban and Architectural Heritage	251	Xu Yeyang Zhang

Parallel Session 3.4

Topic: Cooling Technology

Time: 9.24 8:30-10:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 6

Chair: Anna Laura Pisello

Paper	Paper ID	Presenter
Evaluating facade reflectance strategies for balancing outdoor thermal comfort and building energy performance in LCZ-based residential neighborhoods Authors: Duo Xu, Qiankang Nie, Zhe Gao, Hashem Akbari, Juejun Ge, Yupeng Wang Institute: Xi'an Jiaotong University; Concordia University; China United Engineering Corporation Limited; Southeast University	170	Duo Xu
Engaging Market-based Mechanisms to Fund Community Cooling Projects Authors: Emilia Garcia, Seth Jacobson, Kurt Shickman Institute: Climate Resolve	60	Emilia Garcia Arteaga Molinar
Advancing Radiative Cooling Coatings for Urban Heat Island Mitigation Authors: Xinxian Yu, Chun Chen Institute: Guangdong Polytechnic Normal University; The Chinese University of Hong Kong	124	Xinxian Yu
A Porous Hydrogel Coating Integrating Radiative and Evaporative Cooling for Building Thermal Regulation Authors: Yu Wang, Yaohan Mai, Cheng Liu Institute: Southeast university	255	Yu Wang
Assessing the Thermal Performance of Green and Cool Roof Strategies in Sendai City, Japan Authors: Vinayak Bhanage, Han Soo Lee, Mahesh Mohan Institute: Hiroshima University; Mahatma Gandhi University	262	Vinayak Bhanage
Technical assessment of the negative solar radiative forcing and atmospheric cooling benefits of surface brightening projects Authors: Ronnen Levinson, Pouya Vahmani, Frank Klink, Hashem Akbari Institute: Lawrence Berkeley National Laboratory; Climate Resolve; Concordia University	41	Frank Klink

Parallel Session 4.1

Topic: Climate Adaptive Building Design

Time: 9.24 10:30-12:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 9

Chair: Ziyu Tong

Paper	Paper ID	Presenter
Cost-Benefit Analysis of Rooftop Urban Heat Island Mitigation Measures at Different Implementation Scales: Impacts on Energy Consumption and Human Health in Osaka Prefecture, Japan <u>Authors:</u> Natsu Terui, Daisuke Narumi <u>Institute:</u> Okayama Universty	17	Daisuke Narumi
Policy-Driven Pathways for Passive Cooling Adoption in Australian Low-Rise Housing: Building Capacity for Climate-Resilient Buildings <u>Authors:</u> Ali Fathalizadeh, Ehsan Sharifi, Daniel Oteng <u>Institute:</u> The University of Adelaide	19	Ehsan Sharifi
Contrasting Effects of Urban Resilience on Night-time Surface Urban Heat Island Mitigation in Old and New Urban Areas of Chengdu <u>Authors:</u> Xiaoxiao Gao, Xue Zhong, Yuanjian Teng, Jiaye Li, Xiaocheng Huang, Siting Chen, Genyu Xu <u>Institute:</u> Southwest Jiaotong University; South China Normal University; Yunnan University	258	Xue Zhong
Assessment of green roof cooling performance and operational carbon potential based on roof cooling unit <u>Authors:</u> Xin Dong, Baojie He <u>Institute:</u> Chongqing University	115	Xin Dong
Numerical investigation of sky radiation cooling in different climatic conditions <u>Authors:</u> Paolo Magazzeni, Gianmarco Sciurti, Michele Cossu, Claudia Fabiani, Anna Laura Pisello, Alberto Muscio <u>Institute:</u> University of Modena and Reggio Emilia; University of Perugia	128	Alberto Muscio
New Insights and Modifications into the RF-meter system for albedo monitoring and CO2 Compensation Evaluation <u>Authors:</u> Abdul Rehman Soomro, Alessia Di Giussepe, Beatrice Castellani, Federico Rossi <u>Institute:</u> University of Perugia	194	Abdul Rehman Soomro

Parallel Session 4.2

Topic: Urban Design and Micro-Climate

Time: 9.24 10:30-12:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 8

Chair: Pattaranan Takkanon

Paper	Paper ID	Presenter
Interactive and Adaptive Effects of Thermal Comfort on Exercise Behavior in Urban Parks: Evidence from a Subtropical City <u>Authors:</u> Jingyi Ye, Tinggang Fu, Baojie He <u>Institute:</u> Yunnan University; Chongqing University	153	Tinggang Fu
Understanding the Impact of Anthropogenic Heat on Local Microclimate: Current Limitations in Measurement and Modelling <u>Authors:</u> Li Yin, Tania Sharmin <u>Institute:</u> Welsh School of Architecture	158	Li Yin
Machine Learning-Driven Prediction of Diurnal and Seasonal Outdoor Thermal Comfort in Subtropical High-Density Cities <u>Authors:</u> Siqi Jia, Yuhong Wang <u>Institute:</u> The University of Hong Kong; The Hong Kong Polytechnic University	163	Siqi Jia
Is LCZ D a Stable Reference for UHI Assessment? Quantifying Microclimatic Heterogeneity and Evaluation Bias Among Low-Plant Prototypes <u>Authors:</u> Yuanyuan Li, Boze Huang, Baojie He <u>Institute:</u> Chongqing University	183	Yuanyuan Li
Identifying inter-monthly evolution patterns and driving factors of the urban heat island effect in Xi'an using remote sensing data <u>Authors:</u> Yuejing Gao, Xudong Wang, Li Han, Wei Ding <u>Institute:</u> Xi'an University of Science and Technology	221	Yuejing Gao
Diurnal cooling dynamics of urban wetland parks based on spatiotemporal fusion of ECOSTRESS and GOES-R data <u>Authors:</u> Tingting Guo, Huan Wang, Zhisong Liu, Chao Chen, Zhijiang Zhang <u>Institute:</u> Zhejiang Ocean University; Tangshan Normal University; Suzhou University of Science and Technology	265	Tingting Guo

Parallel Session 4.3

Topic: UHI Mitigation Strategies

Time: 9.24 10:30-12:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 7

Chair: Elmira Jamei

Paper	Paper ID	Presenter
A Multivariate Analysis of Greenery Impacts on Urban Heat Across Temporal Scales: A Case Study of a Tropical Campus <u>Authors:</u> Yun Yee Soh, Yijun Lu, Ziyuan Zhang, Marcel Ignatius, Nyuk Hien Wong <u>Institute:</u> National University of Singapore	190	Yun Yee Soh
Mitigating Urban Heat: A Local Climate Zone Strategy for Heat-Intensive Zones in Hyderabad <u>Authors:</u> Faiz Ahmed Chundeli, Vijesh Kumar Valiyappurakkal, Kapil Natawadkar, Ramesh Srikonda, Ayon Kumar Tarafdar, Nakka Sunny, Fathima Shouheen, Jyoti Kushwaha, Sakshi Agarkar <u>Institute:</u> School of Planning and Architecture, Vijayawada	205	Faiz Ahmed Chundeli
Flower Color as a Potential Contributor to Urban Microclimates: Thermal Imaging of Herbaceous Vegetation <u>Authors:</u> Sevgi Yilmaz, Hüsna Gülkar, Adeb Qaid, Solen Koseoglu <u>Institute:</u> Ataturk University; Kingdom University	208	Şölen Köseoğlu
The Effects of Herbaceous Plants on Surface Temperatures Along Pedestrian Pathways During The Summer Season <u>Authors:</u> Mehmet Akif Irmak, Betül Nur Bayraktar, Şölen Köseoğlu <u>Institute:</u> Atatürk University	211	Şölen Köseoğlu
Can City Climate Action Plans Translate Heat Risk into Implementable Actions? An LLM-Assisted Analysis of 81 C40 Cities <u>Authors:</u> Yang Chen, Qi Dong, Cheng Sun <u>Institute:</u> Harbin Institute of Technology	257	Yang Chen
Revealing the Cooling Potential of Urban Herbaceous Vegetation through Thermal Imaging and Slope Analysis <u>Authors:</u> Hasan Yilmaz, Solen Koseoglu, Feyzanur Aksak <u>Institute:</u> Ataturk University	210	Şölen Köseoğlu

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Topic: UHI Simulation Method Development

Time: 9.24 10:30-12:10 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 6

Chair: Zhuangbo Feng

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Quantifying Landscape Drivers of Street-Scale Heat Exposure Using Mobile Transects and Machine Learning <u>Authors:</u> Pengkun Zhu, Zhihao Wang, Yuchen Dong <u>Institute:</u> Faculty of Civil Engineering and Mechanics, Kunming University of Science and Technology	67	Yuchen Dong
Parameterization on thermal environments of a playground experiment using the Grasshopper plug-ins <u>Authors:</u> Jing Xiao, Ruixuan Li, Takaya Yuizono, Yiao He, Binbin Yao <u>Institute:</u> Zhejiang Normal University; Dalian Polytechnic University; Japan Advanced Institute of Science and Technology; Henan Agricultural University	99	Jing Xiao
Mapping 20 years of Persistent Urban Heat Islands in Hyderabad Sindh <u>Authors:</u> Abdul Rehman Soomro, Alessia Di Giuseppe, Beatrice Castellani, Federico Rossi <u>Institute:</u> University of Perugia	199	Abdul Rehman Soomro
Mesoscale Modeling of the City-Wide Cooling Effect of Urban Green Infrastructure for the Moscow Megacity <u>Authors:</u> Mikhail Varentsov,, Maria Tarasova, Timofey Samsonov, Vlada Okuneva, Viacheslav Vasenev <u>Institute:</u> Lomonosov Moscow State University; Peoples' Friendship University of Russia	203	Mikhail Varentsov
Urban Heat Islands in the Cities of North-Eurasian Arctic According to in situ Observations <u>Authors:</u> Mikhail Varentsov, Pavel Konstantinov, Marina Slukovskaya, Maria Korneykova, Viacheslav Vasenev, Igor Esau, Alexander Baklanov <u>Institute:</u> Lomonosov Moscow State University; Russian Academy of Sciences; Peoples' Friendship University of Russia; The Arctic University of Norway; University of Copenhagen	198	Mikhail Varentsov

Parallel Session 5.1

Topic: Cooling Technology

Time: 9.24 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 9

Chair: Alberto Muscio

Paper	Paper ID	Presenter
Integration of Shading Devices, Fan-Assisted Cooling and Energy Storage to Support Resilient Outdoor Thermal Comfort <u>Authors:</u> Shisheng Chen, Weiwei Yang, Zhongqi Yu, Ruohan Xu <u>Institute:</u> Fuzhou University; Tongji University; National University of Singapore	39	Weiwei Yang
Develop and test a fluorine-free water-based radiative cooling paint for urban heat island mitigation <u>Authors:</u> Jiashuo Wang, Riccardo Paolini, Ioannis Kousis, Matthaïos Santamouris, Teng Xiong <u>Institute:</u> The University of New South Wales	134	Jiashuo Wang
Spatiotemporal Variations and Model-Based Conversion of Air–Surface Temperature from a Morphological Perspective: A Case Study of an Urban Block in Chongqing <u>Authors:</u> Xuecheng Fu, Baojie He <u>Institute:</u> Chongqing University	154	Xuecheng Fu
The influence of urban surfaces on the energy consumption of underground buildings:A case study <u>Authors:</u> Yaning Li, Runnan Sun, Yue Chang, Weijun Li, Guoxin Wang, Xilian Luo <u>Institute:</u> Xi'an Jiaotong University; Moganshan Geospatial Information Laboratory; China Construction Silk Road Construction Investment Co., Ltd.; China Construction Eighth Engineering Division Corporation	148	Yaning Li
Sustainable Renovation Strategies: Enhancing Quality and Energy Efficiency in Existing Buildings <u>Authors:</u> Sara Nam Sook Rampoldi <u>Institute:</u> Politecnico di Milano	150	Sara Nam Sook Rampoldi
Performance of Reflective Road Coatings in a Humid Continental Climate: Case-Study in Philadelphia <u>Authors:</u> Zhan Shi, Colby Snyder, Nafisa Bangura, Angelica Dadda, Julia Chiang, Russell Composto, Dorit Aviv <u>Institute:</u> University of Pennsylvania	177	Zhan Shi

Parallel Session 5.2

Topic: Climate Adaptive Building Design

Time: 9.24 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 8

Chair: Jingjin Li

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A Study on Microclimate Monitoring and Preventive Conservation Strategies for Historic Timber Structures under Climate Change <u>Authors:</u> Ruo Lan Zhang, Sok Yee Yeo, Duo Xu, Liao Youhan, Xiao Long Wang <u>Institute:</u> Xi'an Jiaotong University; Shanxi Academy of Ancient Building and Painted Sculpture& Fresco Preservation	125	Youhan Liao
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Spatial Supply-Demand Matching Analysis of Blue-Green Spaces Cooling Effects: A study of three major urban agglomerations in China <u>Authors:</u> Jing Yang, Shanshan Chen, Yingjie Li, Sihan Zhou, Liding Chen <u>Institute:</u> Yunnan University	76	Yingjie Li
Integrating Urban Heat Island Impacts into City Planning: Workflow for Informing Early Stage Urban Design Decisions <u>Authors:</u> Cheney Chen, Tyrone Marshall, Sina Rahimi, Jessica Nguyen, Zhongming Shi <u>Institute:</u> Perkins&Will; Georgia Institute of Technology; Toronto Metropolitan University; ETH Zurich	33	Tyrone Marshall
ENVI- met Assessment of Shaded Cap Designs: Outdoor Comfort Reductions and Exposure Mitigation for Vulnerable Users <u>Authors:</u> Tyrone Marshall, Erika Eitland, Cheney Chen, Sarah Kellerman <u>Institute:</u> Perkins&Will; Georgia Institute of Technology	36	Tyrone Marshall

Parallel Session 5.3

Topic: Urban Design and Micro-Climate

Time: 9.24 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

Venue: Meeting Room 7

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Paper	Paper ID	Presenter
Machine learning-based analysis of urban morphological impacts on winter thermal comfort in severe cold regions <u>Authors:</u> Chenlu Shan, Dong Yao, Gan Qin <u>Institute:</u> Tongji University; Harbin Institute of Technology	49	Chenlu Shan
Identifying Urban Shade-Deficient areas: Evidence from Barcelona and Phoenix <u>Authors:</u> Yingjie Li, Shanshan Chen, Jing Yang, Sihan Zhou, Liding Chen <u>Institute:</u> Yunnan University	70	Yingjie Li
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Designing Quieter Caps: Passive Acoustic Shielding and Integrated Multi-Benefit Design <u>Authors:</u> Tyrone Marshall, Cheney Chen, Sarah Kellerman, Paul Ward, Erika Eitland <u>Institute:</u> Perkins&Will; Georgia Institute of Technology	35	Tyrone Marshall
Vegetated Cap Designs and Near-Field Pollutant Dynamics: ENVI-Met Dispersion Assessment <u>Authors:</u> Tyrone Marshall, Erika Eitland, Cheney Chen, Sarah Kellerman, Paul Ward <u>Institute:</u> Perkins&Will; Georgia Institute of Technology	34	Tyrone Marshall

Parallel Session 5.4

Topic: UHI and Human Comfort

Time: 9.24 14:00-15:40 (12 mins for each presentation, 28 mins for discussion)

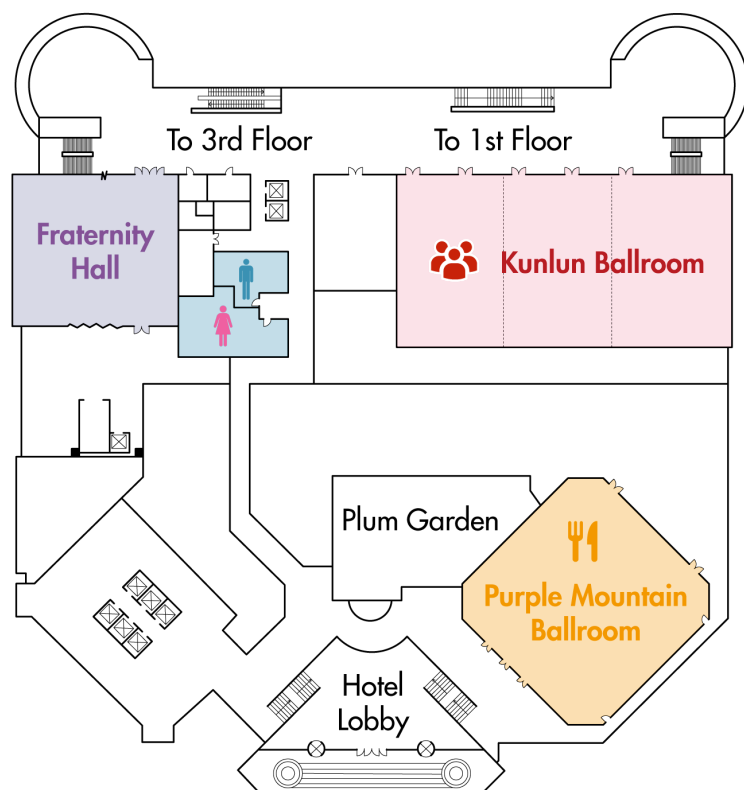
Venue: Meeting Room 6

Chair: Tomohiko Ihara

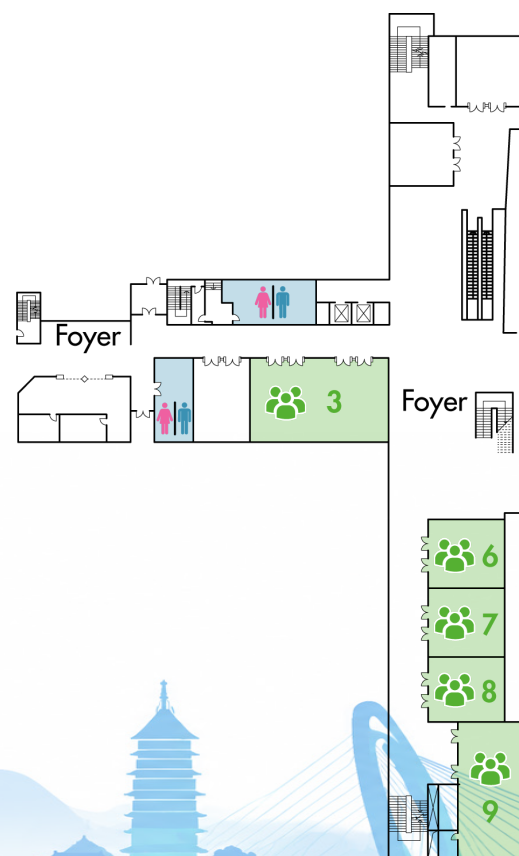
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Optimized design for elderly users in urban parks under dynamic thermal comfort modeling in hot subtropical area <u>Authors:</u> Ge Ge, Wu Deng <u>Institute:</u> University of Nottingham Ningbo China	138	Ge Ge
Urban Mortality Risks of Ambient Temperature and Extreme Events: A Multi-City Analysis in Japan <u>Authors:</u> Yijia Chen, Ruihang Li, Ruiyan Liu, Tomohiko Ihara <u>Institute:</u> The University of Tokyo	239	Yijia Chen
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Investigating the potential of pocket parks in mitigating thermal stress during heatwaves in high-density urban areas <u>Authors:</u> Lingye Yao, Kevin Lau, Man Yin Chung, Kai Gao, Edward Ng <u>Institute:</u> The Chinese University of Hong Kong; Luleå University of Technology; Royal Melbourne Institute of Technology	54	Lingye Yao
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Influence of Low-Level Jet on the Urban Heat Island intensity and the variability of atmospheric pollutant concentrations in São Paulo megacity <u>Authors:</u> Maciel Piñero Sánchez, Adalgiza Fornaro, Amauri Pereira de Oliveira, Bruna Lüdtke Paim, Yendry Jomolca Parra, Lucas Cardoso da Silveira, Georgia Codato, Lucas Covre Chiare, Leticia Prado Lima, Ávila Benaya dos Santos Sousa, Agnès Borbon <u>Institute:</u> University of São Paulo; Université Clermont Auvergne	215	Amauri Pereira de Oliveira

Venue Guide

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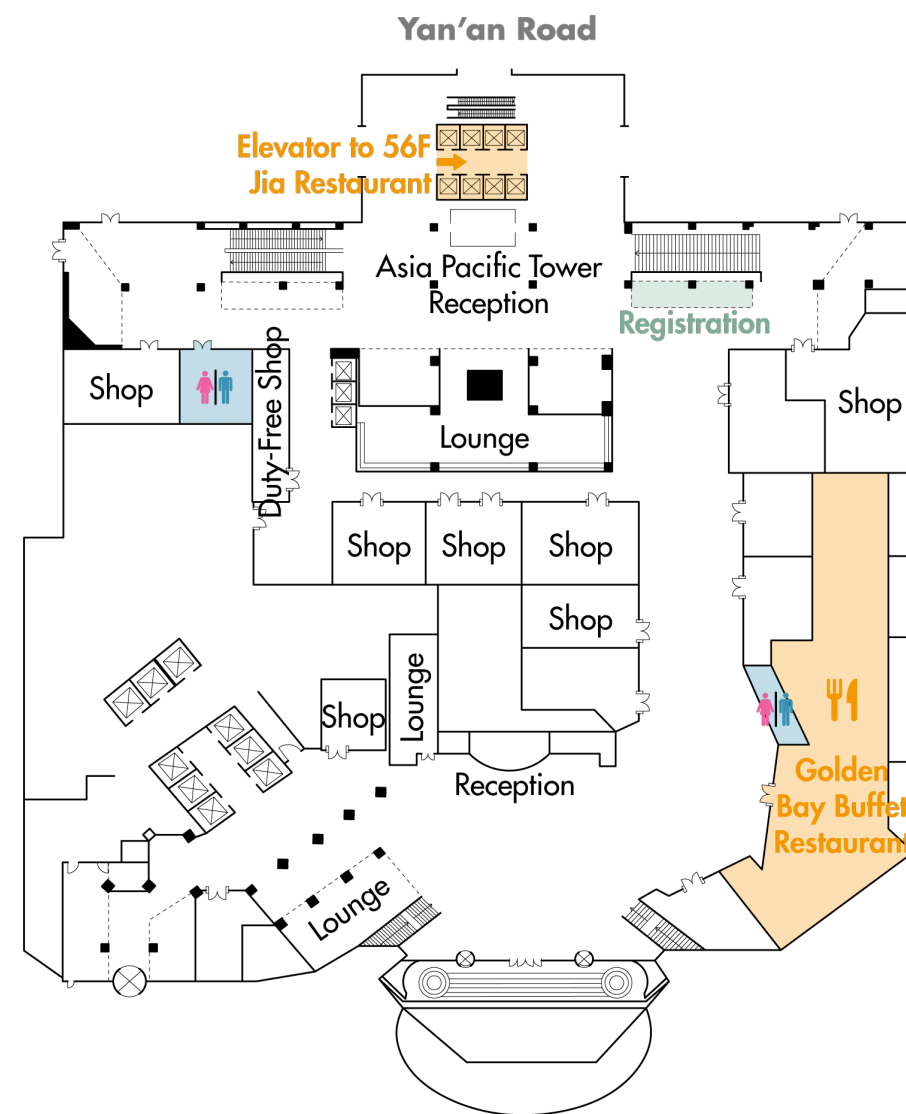


3F



Guanjiaqiao

1F



Zhongshan Road

Hanzhong Road

Registration

Dining

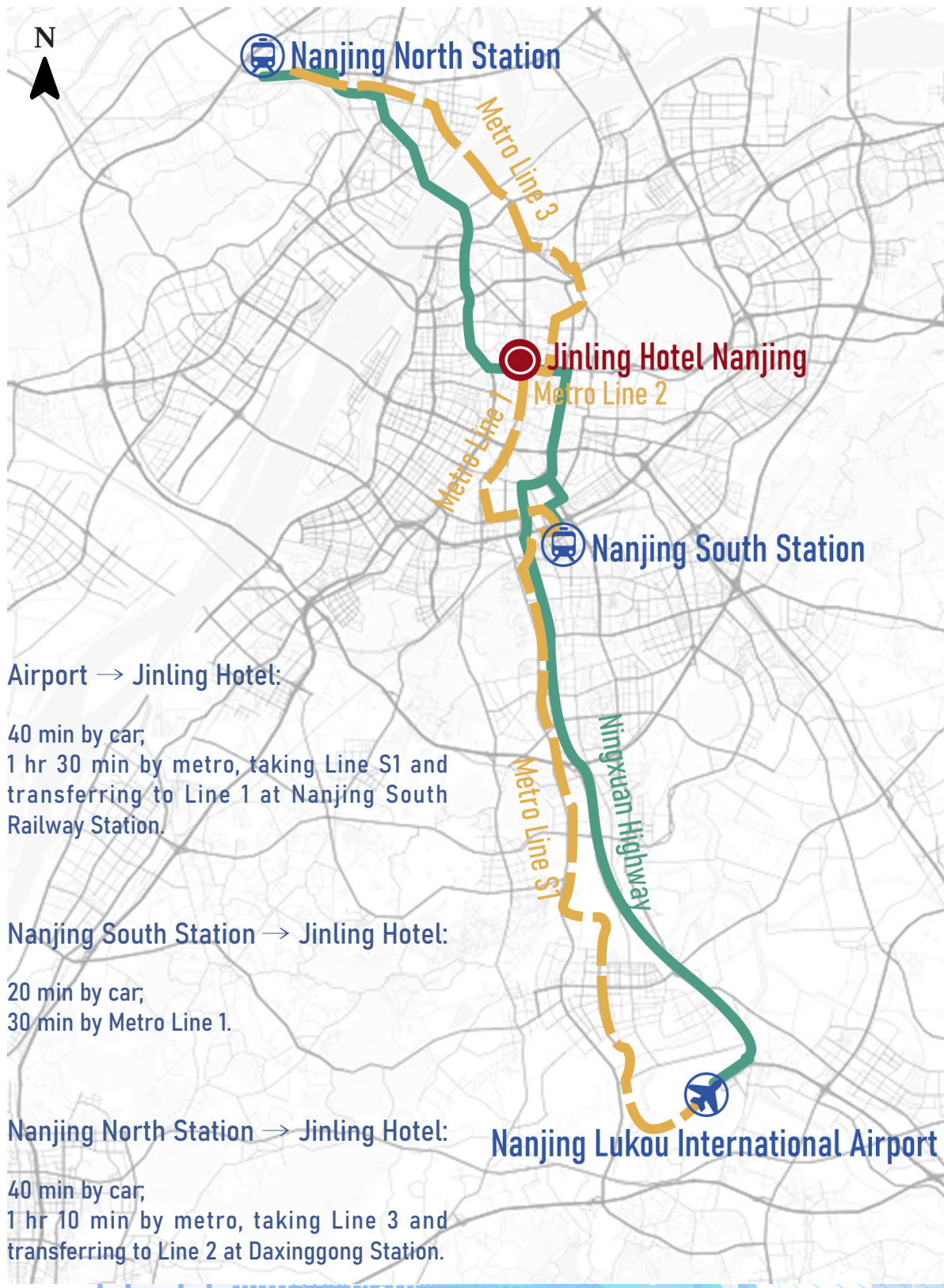
Main Venue

Meeting Rooms

Closing Ceremony

Restrooms

Travel Guide



Reminders

1. To ensure the smooth running of the conference, please observe the conference schedule and relevant regulations.
2. Please wear and carry your conference badge when entering and leaving the venue.
3. Please bring the meal voucher for the day and dine according to the conference arrangements.
4. Please attend the academic sessions and activities as scheduled.
5. During the conference, please do not hold press conferences, distribute publications or promotional materials, or promote products at the hotel or conference venue without prior approval from the Organizing Committee.
6. Please set your mobile phone to silent mode during conference sessions.
7. Please take good care of your personal belongings.

Weather During the Conference

09/20	Sunday		Cloudy	19° – 29°C
09/21	Monday		Cloudy to Sunny	21° – 29°C
09/22	Tuesday		Cloudy	22° – 28°C
09/23	Wednesday		Overcast with Light Rain	23° – 29°C
09/24	Thursday		Light Rain to Cloudy	22° – 27°C
09/25	Friday		Cloudy with Light Rain	24° – 30°C
09/26	Saturday		Light Rain	24° – 29°C

ID: 7

Thermal Comfort in Different Urban Geometry: The Role of Urban Parks during Extreme Heat Events in Melbourne

Maryam Norouzi¹, Hing-Wah Chau², Elmira Jamei³

^{1,2,3}Institute for Sustainable Industries and Liveable Cities, Victoria University, Melbourne, Australia.

ABSTRACT

Rapid urbanization, coupled with global warming and the intensification of urban heat islands (UHIs), poses significant challenges to urban sustainability. Variations in urban geometry can produce distinct heat exposure patterns, influence pedestrian thermal comfort, and alter the cooling effectiveness of urban parks as heat mitigation elements. Using the Local Climate Zone (LCZ) framework, this study investigates how thermal comfort and park cooling performance vary when an identical park layout is embedded within contrasting urban forms in Melbourne. Air temperature (AT), wind speed (WS), mean radiant temperature (MRT), and physiological equivalent temperature (PET) were used as the main indicators of thermal comfort.

During the day, LCZ1 was cooler in both the park and surrounding area, with AT, MRT, and PET up to 3.5 °C, 10 °C, and 3.7 °C lower than in LCZ3 and LCZ6. At night, LCZ1 exhibited higher thermal stress, with AT, MRT, and PET up to 1.5 °C, 10 °C and 12 °C higher, respectively. Nocturnal warming extended into the park, with elevated AT reaching about 50 m from the boundary and edge zones up to 1.1 °C warmer than the park center. Regression analysis identified land surface temperature (LST) as the dominant predictor of daytime MRT, while daytime PET was mainly influenced by LST in LCZ1 and by AT in low-rise urban areas. At night, AT and LST became the strongest predictors of both MRT and PET. These findings highlight the importance of considering urban geometry in heat mitigation and park planning strategies during extreme heat.

Keywords: Park cooling island (PCI), extreme heat event, urban form, local climate zone (LCZ).

Conference Abstracts

ID: 9

Overheating impacts of reflective glazing vs opaque facades – experimental & numerical comparison with upgraded UBE-Microclimate platform with raytracing

Delia Valledor¹, Emmanuel Bozonnet², Anne Penillard³, Samuel Carré⁴, Georgios Kyriakodis⁴

¹*Saint-Gobain Recherche, CSTB, LaSIE UMR CNRS 7356*

²*LaSIE UMR CNRS 7356*

³*Saint-Gobain Recherche*

^{4,5}*CSTB*

ABSTRACT

The influence of material properties on urban overheating is well documented in the literature. Multiple researchers have studied the impact of innovative materials on roofs or open-sky surfaces, but the impact of building facades on the surrounding environment is not yet well understood. We aim to compare buildings with a high window-to-wall ratio with traditional buildings with a low window-to-wall ratio in terms of solar trapping and thermal comfort. We will present our dual experimental & numerical approach.

We present an experimental comparison between opaque and reflective glazing facades in a N-S twin urban canyon configuration (scale 1:5) in a hot-summer Mediterranean climate. The facility is equipped with a reference weather station; and each canyon is equipped with a local weather station, a 4--component net radiometer, a local pyranometer and a black globe. We show that glazed facades decrease the canyon albedo by 7 %. In terms of pedestrian irradiance, specular reflection increases peak irradiance by 38 % (+320 W/m²) and average daily exposure by 19 % (+0.5 kW/m²).

We also present the last upgrade of our 3D UBE-Microclimate modelling platform. We have incorporated a raytracing model that considers the directional, spectral and angular properties of urban surfaces. This is required to model spectrally selective glazed facades. We show strong correlation with the experimental data for the three-week test period ($R^2 > 0.85$) for solar trapping and pedestrian irradiance evaluation. We showcase the need to consider the optical properties of building facades when large glazed surfaces are present.

Keywords: urban microclimate, glazing, experimental, modeling, raytracing

ID: 11

Influence of Ground-level and Mid-level Building Porosity on Pedestrian-Level Wind Speed

Jinjun Ye¹, Lup Wai Chew²

^{1,2}*National University of Singapore, Singapore, Singapore*

ABSTRACT

The blockage effects of buildings lead to reduced wind speed in urban areas, while ground-level building porosity, or void decks, has been demonstrated to significantly enhance pedestrian-level wind speed. In recent years, sky gardens, a form of mid-level building porosity integrating functionality and aesthetics, have attracted increasing attention. This study employed CFD simulations to investigate the influence of sky garden floor location on pedestrian-level wind speed in three-dimensional urban street canyons under two scenarios: with and without void decks. The results indicated that, in the absence of void decks, lower-floor sky gardens contributed to enhanced pedestrian-level wind speed inside the canyon. However, as their floor location increased, the positive effect diminished and eventually turned negative. The influence of the sky garden floor location on pedestrian-level wind speed outside the canyon exhibited a different pattern. Specifically, only lower-floor sky gardens enhanced pedestrian-level wind speed; mid-floor sky gardens produced adverse effects, while high-floor sky gardens increased wind speed in downstream building zones but reduced it in upstream zones. In the presence of void decks, the existence of sky gardens did not significantly alter the wind fields at the pedestrian level, which were dominated by the strong flows in the void decks. These findings suggest that sky gardens can affect pedestrian-level wind speed positively or negatively. Therefore, the floor location of sky gardens should comprehensively consider both pedestrian comfort and architectural aesthetics.

Keywords: Pedestrian-level wind speed, sky garden, void deck, urban street canyon.

ID: 13**Street Trees and Pedestrian Stopping Across Seasons: Evidence from Adelaide Main Streets***Linglue Xia¹, David Kroll², Ehsan Sharifi³**^{1, 2, 3}School of Architecture and Civil Engineering, The University of Adelaide, Adelaide, Australia***ABSTRACT**

Urban heat is increasingly affecting the ability of main streets to support everyday outdoor use. While pedestrian counts are often used to describe street activity, they do not show whether pedestrians stop and remain in a street. This conference paper presents a selected analysis from a larger observational study of street trees and pedestrian dwell time in Adelaide, Australia. It focuses on one core behavioural outcome: pedestrian stopping, defined as remaining in the same 20 m observation segment for 2 minutes or longer. Systematic observations were conducted on four main streets across winter, spring and summer, producing 138,873 valid pedestrian observations. Street-tree exposure was measured using a 5 m buffer around individual street trees, and logistic regression was used to compare stopping behaviour inside and outside tree-buffer areas while adjusting for season, time period, day type and street. The selected results show that tree-buffer exposure was not significantly associated with stopping in winter, but was positively associated with stopping in spring and summer. Pedestrians inside tree-buffer areas were 1.60 times more likely to stop in spring and 1.36 times more likely to stop in summer than pedestrians outside tree-buffer areas. These findings suggest that street trees may support short-term pedestrian staying under warmer conditions. The results are interpreted as observational and context-specific, and the paper does not claim that all streets should be evaluated primarily by stopping behaviour. Instead, it shows that stopping can complement pedestrian counts when the planning objective is to assess public-life use and climate-sensitive street usability.

Keywords: Street trees, Urban heat, pedestrian stopping, dwell time, main streets, Adelaide.

ID: 14**The Urban Heat and Pollution Islands Inter Action in Rome and Possible Mitigation strategies (RESTART) Project: Final Outcomes and Policy Recommendations**

Annalisa Di Bernardino¹, Erika Brattich², Stefania Argentini³, Francesco Barbano⁴, Monica Campanelli⁵, Giampietro Casasanta⁶, Andrea Cecilia⁷, Silvana Di Sabatino⁸, Margherita Erritu⁹, Andrea Faggi¹⁰, Serena Falasca¹¹, Tiziano Maestri¹², Anna Maria Siani¹³

*^{1,9,11,13}Sapienza University of Rome, Rome (Italy)**^{2,4,8,10,12}University of Bologna, Bologna (Italy)**^{3,5,6,7}CNR, Institute of Atmospheric Sciences and Climate (ISAC), Rome (Italy)**⁴University of Trento, Trento (Italy)**¹¹Italian National Agency for New Technologies, Energy and the Environment (ENEA), Rome (Italy)***ABSTRACT**

This contribution presents the final outcomes and actionable policy frameworks of the “Urban hEat and pollution iSlands inTerAction in Rome and possible mitigation strategies” (RESTART) project, funded by the Italian Ministry of University and Research under the PRIN2022 (Projects of National Interest) program. Moving beyond standalone assessments, this study investigates the complex thermodynamic and chemical co-evolution of the Urban Heat Island (UHI) and Urban Pollution Island (UPI) phenomena in Rome (Italy). Multi-year (2018-2023) ground-based meteorological and air quality observational datasets from institutional monitoring networks are combined with a high-resolution, one-way coupled numerical modeling chain (WRF-ADMS-Urban), providing a comprehensive, state-of-the-art analysis of the coupled dynamics between urban climate and air quality, overcoming the constraints of single-approach studies. Numerical simulations also enabled the assessment of large-scale Nature-Based Solutions under constant anthropogenic emission setups, thereby isolating purely meteorology-driven interactions. The empirical evidence reveals that severe heatwaves amplify the nocturnal UHI by up to 30-40% and induce afternoon ozone surges of 20-35%. Simulations indicate that doubling the urban green fraction across all Local Climate Zones provides widespread cooling of 5% during the heatwave period (locally exceeding 7.5%) during extreme heat events, alongside a simultaneous 5-20% reduction in nitrogen oxides and particulate matter concentrations driven by enhanced ventilation and boundary-layer mechanics. These findings can be translated into a socio-spatially stratified policy framework designed to integrate coupled thermo-chemical criteria into municipal planning, offering a replicable blueprint for climate resilience across Mediterranean coastal environments.

Keywords: Nature-based solutions, ground-based observations, WRF model, ADMS-Urban.

ID: 15**Investigating The Interaction Between Urban Heat and Pollution Islands: Evidence from In-Situ Observations in Rome (Italy)**

*Annalisa Di Bernardino¹, Stefania Argentini², Erika Brattich³, Monica Campanelli⁴,
Giampietro Casasanta⁵, Andrea Cecilia⁶, Margherita Errui⁷, Andrea Faggi⁸,
Serena Falasca⁹, Anna Maria Siani¹⁰
^{1,7,9,10}Sapienza University of Rome, Rome (Italy)
^{3,8}University of Bologna, Bologna (Italy)
^{2,4,5,6}CNR, Institute of Atmospheric Sciences and Climate (ISAC), Rome (Italy)
⁹Italian National Agency for New Technologies, Energy and the Environment
(ENEA), Rome (Italy)*

ABSTRACT

Urban Heat Island (UHI) and Urban Pollution Island (UPI) are two critical phenomena impacting urban livability and sustainability, increasing vulnerability to climate change. UHI Intensity (UHII) denotes higher urban air temperatures primarily caused by extensive built environments, while UPI Intensity (UPII) refers to elevated concentrations of atmospheric pollutants in urban areas compared to rural surroundings without significant pollutant sources. Although their interaction is recognized, the atmospheric mechanisms responsible for triggering or weakening the UHII-UPII relationship remain under investigation.

This contribution aims to quantify and characterize UPII in Rome (Italy) using in-situ measurements of particulate matter (PM10, PM2.5) and key gaseous pollutants (NO₂, NO, O₃) collected by the regional air quality monitoring network. Meteorological data from quality-controlled, WMO-compliant instrument networks support the analysis. The analysis spans the 2019-2023 period and includes both seasonal and wind-based classification to isolate meteorological regimes and assess the dynamical modulation of the UPII-UHII relationship.

Findings reveal a pollutant-specific and ventilation-dependent coupling between UHII and UPII, characterized by negative correlations for particulate matter and nitrogen oxides, and positive correlations for ozone. The coupling strengthens under weak winds and weakens under moderate ventilation, pointing to boundary-layer and chemical controls. These results suggest that the UHII-UPII relationship is influenced by the combined effects of boundary-layer dynamics, atmospheric ventilation, and pollutant-specific chemical processes. Heat and pollution anomalies therefore emerge as a coupled urban atmospheric system, highlighting the need for integrated climate- and air-quality-oriented mitigation strategies.

Keywords: In-situ observations, urban pollution island, aerosol, gaseous pollutants.

ID: 16**Thermal Spillover Effects of Different Green Space Layout Scenarios at Urban Intersections: A Numerical Simulation Study**

Sijie Zhu¹

¹College of Landscape Architecture, Nanjing Forestry University, Nanjing, China

ABSTRACT

Small corner green spaces can cool intersections, but their benefit to adjacent streets depends on vegetation design and airflow. Using a coupled computational fluid dynamics (CFD) model of urban microclimate, this study compared downwind and upwind corner green spaces at an idealized four-leg intersection in Nanjing under different tree layouts, canopy coverages, and parcel sizes. The model was evaluated against reduced-scale canyon measurements of air temperature, relative humidity, and wind speed. Downwind green spaces carried cooling into the receiving street, whereas upwind spaces concentrated cooling near the planted corner. In the downwind group, high canopy coverage produced the strongest street response, with a peak mean reduction of 1.43 °C and a 40-120 m mean of 0.97 °C. Larger parcels widened the cooled area. Tree-layout effects depended on the metric: the central layout produced the largest cooled area, the building-side layout the highest corridor-average cooling, and the street-side layout a higher local peak. Across the downstream corridor, all downwind scenarios maintained positive mean cooling, while most upwind scenarios were weak or negative. The findings show how corner position and vegetation configuration can be matched to either street-canyon cooling or local thermal relief at pedestrian waiting areas.

Keywords: Urban green space, thermal spillover, street canyon, computational fluid dynamics.

ID: 17

Cost-Benefit Analysis of Rooftop Urban Heat Island Mitigation Measures at Different Implementation Scales: Impacts on Energy Consumption and Human Health in Osaka Prefecture, Japan

Natsu Terui¹, Daisuke Narumi²

¹*Graduate School of Environmental, Life, Natural Science and Technology, Okayama University, Okayama, Japan*

²*Graduate School of Environmental, Life, Natural Science and Technology, Okayama University, Okayama, Japan*

ABSTRACT

This study quantitatively evaluates the impacts of area-scale implementation of rooftop Urban Heat Island (UHI) mitigation measures on energy consumption and human health and assesses their cost-effectiveness. Osaka Prefecture, Japan, was selected as the study area, and the evaluation year was 2015.

First, the Weather Research and Forecasting (WRF) model was used to simulate the effects of rooftop mitigation measures on urban air temperature. The indirect impacts of temperature changes on energy consumption and health were then estimated using temperature sensitivity coefficients. Direct impacts on building energy consumption were evaluated using the building energy simulation software DesignBuilder. Three mitigation measures—high-reflectivity roofing (HR), rooftop greening (GR), and rooftop water sprinkling (WR)—were examined at three implementation scales: prefecture-wide, city-wide, and central-area levels.

Results indicate that the benefit–cost ratio (B/C) increases as the implementation scale decreases, reaching a maximum of 0.88 for HR at the central-area level. The public utility ratio, defined as the proportion of indirect benefits to total benefits, also increases with smaller implementation scales, with a maximum value of 95.3% for WR. High-reflectivity roofing implemented in areas with concentrated office and commercial buildings achieved the highest cost-effectiveness. The findings suggest that targeted interventions combined with public financial support can enhance the efficiency of UHI mitigation strategies.

Keywords: Urban heat island, rooftop countermeasures, cost-benefit analysis, WRF.

ID: 18

Causal Analysis and Quantification of Urban Heat Island Dynamics in Osaka Prefecture Using Hindcast Simulations Driven by Land Use and Anthropogenic Heat

Zhiheng Zhou¹, Natsu Terui², Daisuke Narumi^{3,}*

¹, *Graduate School of Environmental, Life, Natural Science and Technology, Okayama University, Okayama, Japan*

², *Graduate School of Environmental, Life, Natural Science and Technology, Okayama University, Okayama, Japan*

^{3*}, *Graduate School of Environmental, Life, Natural Science and Technology, Okayama University, Okayama, Japan*

ABSTRACT

Urbanization increases land development, anthropogenic heat emissions, and energy consumption, intensifying global warming (GW) and the urban heat island (UHI) effect. These transformations have triggered a series of adverse impacts, including deteriorating human health, ecological degradation, and rising energy demand, all of which pose potential risks to urban sustainability.

This study investigates the mechanisms of the UHI effect and aims to propose strategies to mitigate urban risks induced by UHI. Using Geographic Information Systems (GIS) and Weather Research and Forecasting (WRF) model, we developed spatial and meteorological databases for Osaka Prefecture for 1973, 1999, and 2015. Under consistent meteorological conditions, land use and anthropogenic heat were key variables. Three simulation scenarios were established: (1) combined impacts of land use and anthropogenic heat emissions, (2) impacts of land use alone, and (3) impacts of anthropogenic heat emissions alone.

Comparative analysis shows that from 1973 to 1999, the UHI intensified, with local nighttime warming reaching 2.0–3.0 °C and type-averaged warming peaking at 1.2–1.3 °C in low-rise high-density areas, compared with 0.3–0.8 °C in low-density areas. These changes were driven mainly by land-use change, while anthropogenic heat emissions dominated in the urban core. From 1999 to 2015, warming generally declined to 0.1–0.3 °C. Their joint effects were mostly offsetting in both periods, with stronger morphology-dependent divergence: daytime-to-evening synergy emerged in high-rise dense areas, while low-density areas remained nighttime-offsetting. These findings highlight the importance of integrating land-use planning and anthropogenic heat control into urban climate adaptation strategies.

Keywords: Urban heat island (UHI), hindcast simulation, geo-meteorological database, weather research and forecasting (WRF) model.

ID: 19

Policy-Driven Pathways for Passive Cooling Adoption in Australian Low-Rise Housing: Building Capacity for Climate-Resilient Buildings

*Ali Fathalizadeh¹, Ehsan Sharifi², Daniel Oteng³
^{1,2,3}The University of Adelaide*

ABSTRACT

The external envelope of Australian low-rise housing stock is poorly suited to outdoor thermal comfort, contributing to increased urban heat island (UHI) effects and associated health risks. Passive cooling solutions, such as cool roofs, reflective materials, and innovative glazing technologies, offer significant potential to mitigate overheating while reducing reliance on active mechanical cooling indoors. However, their adoption remains limited in existing Australian residential buildings. This study investigates the systemic barriers to passive cooling implementation in the Australian low-rise residential sector, with implications for suburban UHI mitigation. A three-stage mixed-method approach was applied: a list of known solutions and barriers are extracted from a systematic literature review; interviews with key stakeholders explored contextual and market-specific challenges; and an extensive survey of construction professionals quantitatively examined interactions among policy, economic, knowledge, and technical factors. Synthesised findings reveal that policy effectiveness is highly dependent on its ability to improve both knowledge and technical readiness, while direct economic incentives alone fail to drive sustained adoption. These findings suggest that UHI mitigation strategies in housing must prioritise policy sequencing – strengthening awareness, training, and technical capacity before or alongside financial measures. Furthermore, by providing evidence-based pathways towards adoption this study offers a scalable approach to embedding passive cooling into urban planning and building design, reducing cooling demand and enhancing climate resilience in hot urban environments.

ID: 20

Assessing the Effects of Climate Warming on Future Thermal Discomfort in Naturally Ventilated Hot-Humid Housing

Mark Cel Estopare Gonzaga^{1,}, Tomohiko Ihara²,
¹Graduate Program in Sustainability Science, The University of Tokyo, Kashiwa, Japan
²Department of Environmental Systems, The University of Tokyo, Kashiwa, Japan
²UTokyo Center for Climate Solutions (UTCCS), The University of Tokyo, Kashiwa, Japan
²Collaborative Research Organization for Comprehensive Energy Sciences (CROCES), The University of Tokyo, Kashiwa, Japan*

ABSTRACT

Urban heat intensification and climate change raise concerns regarding future thermal discomfort and cooling demand in hot-humid regions. In Southeast Asia, natural ventilation is often considered limited under present conditions and expected to further decline in effectiveness under warming climates. However, the extent to which projected outdoor temperature increases translate into indoor discomfort remains insufficiently quantified. This study evaluates thermal comfort in a representative residential building in the Philippines under present and future climates using building energy simulation coupled with adaptive comfort assessment. Future weather files for 2035 and 2050 were generated through hourly morphing of typical meteorological year weather data based on climate model projections. Results show that while natural ventilation effectiveness decreases when applied in isolation, insulation and combined passive strategies remain robust under future warming. Importantly, projected increases in outdoor temperature do not uniformly produce proportional increases in indoor discomfort. Outdoor temperatures rise faster than indoor operative temperatures, and adaptive comfort thresholds shift upward under warmer conditions. In many scenarios, this combination offsets temperature increases, resulting in stable or reduced discomfort despite higher absolute indoor temperatures. These findings indicate a nonlinear relationship between climate warming and indoor discomfort in hot-humid housing. Assessments based solely on outdoor temperature increases or static comfort thresholds may therefore overestimate future cooling demand. Integrating building-scale simulation with adaptive comfort models is essential for accurately evaluating sustainable cooling pathways under climate change.

Keywords: Adaptive thermal comfort, Passive cooling strategies Hot-humid climate, Climate change adaptation.

ID: 21

Assessing Carbon Footprint Reduction Efficiency of A Dynamic Photovoltaic Shading System Under Extremely Hot Weather in Hangzhou, China

Juejun Ge^{1,2}, Ye Guo¹, Jicheng Wang¹, Yupeng Wang³, Sibozhang¹, Tianjun Wu¹

¹China United Engineering Corporation Limited, Hangzhou, China

²Xi'an Jiaotong University, Xi'an, China

³Southeast University, Nanjing, China

ABSTRACT

Photovoltaic (PV) shading systems can lower building cooling energy while providing clean electricity in summer, thereby synergistically reducing urban carbon emission intensity through two pathways. However, the carbon footprint reduction efficiency of this concept in high-density urban scenarios has not been fully validated. In this study, a dynamic PV shading (DPVS) system and a methodology for evaluating its carbon footprint reduction benefits were developed. The carbon footprint reduction efficiency when the system is applied to typical office buildings in 48 scenarios in Hangzhou, China, were then predicted. With the same installed capacity, the DPVS system leads to a 0.9%–7.5% reduction in building cooling energy consumption, while its PV power generation is 34.2%–79.7% lower compared to the traditional rooftop PV scheme. Considering both mechanisms, the DPVS system achieved a carbon emission reduction of 220.8–789.0 gCO₂/m² (per unit area of PV panels). For most scenarios, the carbon footprint reduction benefits derived from the application of DPVS system are not as good as those of the rooftop PV scheme. However, when the solar radiation intensity on the located facade is high, the DPVS system can provide carbon footprint reduction effect close to that of traditional rooftop PV scheme. Based on prediction results, this study proposed a regression equation for anticipating the carbon footprint reduction of DPVS systems per unit area of PV panel during an extremely hot day, which can assist planners in weighing the costs and benefits of adopting such technology in practice.

Keywords: Photovoltaic shading, carbon footprint, building energy, heat wave.

ID: 22

Multi-scale Evaluation of Shading Effectiveness and Morphological Thermal Effects in Old Neighborhoods from the Perspective of Elderly Spatiotemporal Behavior

Xukun Yan¹, Yupeng Wang², Xilian Luo³

^{1, 3}Xi'an Jiaotong University, Xi'an, China

²Southeast University, Nanjing, China

ABSTRACT

High-density cities globally are facing the dual challenges of population aging and extreme heat due to climate change. Current urban renewal strategies often focus on the spatial accessibility of the 15-minute life circle while neglecting quality accessibility under heat stress, particularly for vulnerable groups like the elderly. This study aims to reveal the spatiotemporal differences in shading effectiveness and the physical constraints of urban morphology in high-density old districts in Xi'an, China. A dual-scale assessment framework was established. Phase 1 utilized questionnaires to identify elderly behavioral patterns and heat exposure risks. Phase 2 involved micro-scale Universal Thermal Climate Index (UTCI) experiments and meso-scale continuous monitoring to quantify the cooling efficacy of different shading types (trees, buildings, artificial structures) and surrounding urban morphological constraints. Results indicate that elderly, especially those aged 75 and above, are highly dependent on street spaces, which currently present a thermal contradiction of high frequency use and low environmental quality. While tree shade is the most preferred, artificial shading proved most effective for morning activities. Morphological analysis revealed that Green Coverage Ratio (GCR) has a diurnal heterogeneity, cooling during the day but trapping heat at night. These findings support age-adapted urban renewal strategies oriented towards continuous thermal comfort.

Keywords: Urban renewal, elderly behavior, shading effectiveness, microclimate.

ID: 23

Impacts of Rooftop Photovoltaics Panels on Urban Thermal Environment: A study in Singapore with WRF and Local Climate Zones

Puyang Liu¹, Xianxiang Li², Rui Xin³, Lup Wai Chew⁴

^{1,4}National Univeristy of Singapore

^{2,3}Sun Yat-sen University

ABSTRACT

Singapore exhibits pronounced urban heat island (UHI) characteristics due to rapid urbanization. To achieve net-zero emissions by 2050, Singapore has been steadily increasing its solar energy capacity. However, the interaction between photovoltaics (PV) and UHI effect remains understudied. This study assesses the heterogeneity of PV-induced thermal and dynamical effects using the coupled Weather Research and Forecasting (WRF) model/multi-layer urban canopy and building energy model (BEP/BEM), with a high-resolution Local Climate Zone (LCZ) map as urban land-use/land-cover data. An urban-increment design is adopted with five numerical experiment sets: (i) sensitivity to urban drag coefficients, (ii) maximum feasible rooftop PV coverage, (iii) LCZ-heterogeneous deployment strategies, (iv) idealized full coverage, and (v) counterfactual baselines (No-Urban/No-Anthropogenic-Heat). Results reveal a distinct diurnal signature: PV deployment produces robust daytime cooling over urban LCZs, with spatial variability governed by urban morphology. Maximum reductions are found over LCZ 10 (Heavy Industry) and LCZ 8 (Large Low-rise), consistent with roof availability and thermal-inertia contrasts. Meanwhile, properly setting air-conditioning temperatures can effectively prevent the enhancement of the UHI phenomenon at night by the anthropogenic heat released from air-conditioning. At 14:00 LT, PV systems lower roof sensible heat flux and modulate the sea-breeze convergence, yielding localized wind perturbations of about 0.25-0.70 m s⁻¹ collocated with cooling cores; nocturnal impacts are negligible under the tested scenarios. These findings clarify the mechanisms by which PV reshapes tropical urban microclimates and demonstrate the value of LCZ-based classification for predicting thermal responses and guiding city-scale PV siting and optimization.

ID: 25

Impacts of Residential Block Morphology and Microclimate on Operational Carbon Emissions: Evidence from Xi'an, China

Minye Zhang¹, Yupeng Wang², Xilian Luo³

^{1,3}Xi'an Jiaotong University, Xi'an, China

²Southeast University, Nanjing, China

ABSTRACT

Residential blocks are fundamental spatial units of urban energy consumption and operational carbon emissions, and their spatial morphology influences energy use and carbon emission intensity through the regulation of local microclimate conditions. However, field-validated simulation-based evidence remains limited for understanding the coupled relationships among urban morphology, microclimate, and carbon emissions. In this study, a total of 127 residential blocks in Xi'an, China, were clustered, from which three major morphological types comprising 114 blocks were retained for typology-based analysis. Six typology-consistent blocks were selected for field microclimate measurements to support the validation of a multi-scale simulation framework integrating the Urban Weather Generator (UWG) with building energy modelling (URBANopt). The result shows that differences in microclimate and carbon emission responses among morphological block types were more pronounced in summer than in winter, and hourly analysis further revealed that carbon emission variations were more closely related to nighttime microclimate perturbations. Partial least squares regression identifies building shape factor (BSF), mean building height (MBH), floor area ratio (FAR), and frontal area index (FAI) as the key variables associated with nighttime air temperature, with an explanatory power of 0.854. Furthermore, random forest models with Shapley interpretation demonstrate that nighttime relative humidity changes made the largest statistical contribution to carbon emission variations. In the context of district heating in cold regions, residential block morphology affects operational carbon emissions mainly by regulating summer nighttime thermal and moisture environments, providing quantitative evidence for low-carbon residential block design and urban renewal.

Keywords: Urban morphology, microclimate, carbon emission intensity, low-carbon strategies.

ID: 26

Effects of Residential Siting on Outdoor Thermal Comfort in Plateau Mountain Villages: A Traditional Feng Shui Perspective

Yuan Chen¹, Yupeng Wang², Xilian Luo³

^{1,2,3}School of Human Settlement and Civil Engineering, Xi'an Jiaotong University, Xi'an, China

ABSTRACT

In highland mountain regions, village residential siting often relies on traditional Feng Shui principles because of natural and geographical constraints, yet their scientific basis remains insufficiently verified. This study investigates how Feng Shui-based site selection affects outdoor thermal comfort in villages of the Loess Hilly-Gully Region of northern Shaanxi, China. The concepts of “Dragon,” “Site,” and “Sha” are translated into measurable indicators, including terrain openness, building density, elevation, and slope. PHOENICS is used to simulate wind environments, while EnergyPlus and Ladybug Tools are integrated to calculate the Universal Thermal Climate Index (UTCI). The results show that terrain is the dominant factor shaping the local microclimate. Elevation and terrain openness are significantly correlated with UTCI, whereas building density has a weaker influence. Overall, 86.7% of ideal Feng Shui sites fall within the comfortable thermal zone, and none of the selected sites occur in uncomfortable zones. Northern valley-side sites are particularly sensitive to terrain openness in winter, with a correlation coefficient of 0.958. These findings suggest that Feng Shui siting reflects a “harm-avoidance” strategy that balances terrain enclosure and openness to regulate solar radiation and wind exposure. Although focused on rural settlements, the identified terrain-based mechanisms also provide transferable insights for urban heat island mitigation and climate-responsive planning in topographically complex urban and peri-urban areas.

Keywords: Feng Shui Theory, thermal comfort, village planning, microclimate.

ID: 27

Analysis of Diurnal and Nocturnal Vertical Profiles of Air Temperature in an Urban Canyon – A Tropical Campus Case Study

May Lwin Oo^{1,}, Nyuk Hien Wong², Shanshan Tong³, Jun Chung Daniel Hii⁴, Erna Tan⁵, Joie Lim⁶, Marcel Ignatius⁷*

^{1,2,3,5,6,7}Department of the Built Environment, National University of Singapore, Singapore, 117566.

⁴Kajima Corporation, Kajima Technical Research Institute Singapore, Singapore, 489690

ABSTRACT

Urban geometry and surface properties strongly affect diurnal and nocturnal air-temperature variations in urban canyons. This study examines vertical air temperature profiles in a southeast-northwest (SE–NW) oriented urban canyon ($H/W = 2.5$, $SVF = 0.2$) located on the tropical campus of the National University of Singapore using field measurements and Computational Fluid Dynamics (CFD) simulations. Seven weather stations, a meteorological tower, and an infrared thermal camera were used for model input and validation, while air temperature, surface temperature, and radiative heat flux were simulated at 10 AM and 2 PM during the daytime and at 10 PM, 12 AM, 4 AM, and 6 AM during the night and early morning. The results show that daytime air temperature increases with height due to solar heating of façades and ground surfaces under strong buoyant mixing. At night, the profiles evolve toward a stable negative vertical gradient under weakly convective conditions dominated by longwave radiative cooling, reflecting greater heat trapping in the lower canyon and more efficient cooling toward the open atmosphere above. Radiative cooling weakens around 4 AM and approaches near-zero net loss by 6 AM as surfaces reach thermal equilibrium. These findings elucidate heat trapping and release mechanisms in tropical high-density canyons and inform strategies for reducing outdoor heat stress.

Keywords: Vertical profiles of diurnal and nocturnal air temperature, urban canyon, surface properties, shortwave and longwave radiation.

ID: 28

Spatiotemporal Heterogeneity of Local-Scale Heat Islands in Coastal Cities during High-Temperature Seasons Based on Mobile Measurements

Jin Bai¹, Hongchi Zhang^{1,}, Jun Cai¹*

¹Dalian University of Technology, Dalian, China

ABSTRACT

The complex morphology of high-density cities shapes diverse spatiotemporal patterns of the urban heat island (UHI) phenomenon, whose dynamic changes continuously impact urban livability and public health. Coastal cities are more susceptible to heatwaves and, coupled with their unique background climate, exhibit even more intricate UHI characteristics. Taking the central urban area of Dalian, a typical coastal city, as a case study, this research employs mobile measurement methods to collect air temperature data at the block level for representative local climate zone (LCZ) types. It then analyses the spatiotemporal characteristics of the urban heat island intensity (UHII) and employed machine learning models to identify its underlying influencing mechanisms. The results indicate that (1) the UHII is higher in densely built-up areas (LCZ1, LCZ2) and heavy industrial zones (LCZ10); (2) diurnal UHII variations follow a “W”-shaped trend; (3) except for LCZ1 and LCZ2, other LCZs show insignificant diurnal UHII differences; and (4) Distance from mountain (DFM) and distance from coastline (DFC) are primary factors explaining UHII spatial variability. This study reveals UHI characteristics and regulatory mechanisms from an LCZ perspective, providing a scientific basis for climate planning and thermal mitigation strategies in coastal cities.

Keywords: Mobile measurement, urban heat island, local climate zone, coastal city.

ID: 29

Spatiotemporal Variations in Urban Heat Island Effects Across Local Climate Zones Based on Long-Term Fixed-point Observations: The Case of Dalian

Hongchi Zhang^{1,}, Jin Bai¹, Shizheng Ren¹, Jun Cai¹*

¹Dalian University of Technology, Dalian, China

ABSTRACT

Against the backdrop of global climate change and rapid urbanization, the impact of urban heat island (UHI) effects on the living environment has become increasingly severe. However, current studies often rely on short-term observations or focus on a single season, and a comprehensive understanding of the annual dynamics of the thermal environment based on long-term continuous observations remains relatively limited, particularly in temperate coastal cities. To address this gap, this study takes Dalian as a case study, selects eight typical spatial types based on the Local Climate Zone (LCZ) scheme, deploys fixed meteorological observation stations, and acquires one-year hourly air temperature data. Statistical analysis methods are then employed to examine the spatial heterogeneity, seasonal variations, and diurnal patterns of urban heat island intensity (UHII). The results indicate that (1) significant spatial differentiation in the UHII exists, with dense built-up areas (LCZ1, LCZ2) maintaining a strong UHI effect throughout the year; (2) most LCZs exhibit stronger UHII during summer and autumn, yet LCZG displays a reversed pattern, peaking in autumn and winter; (3) daily variations reveal a typical ‘weak-daytime, strong-nighttime’ pattern across most LCZs, although sites with dense vegetation and higher local wind speeds exhibit opposite characteristics; and (4) only the LCZ1, LCZ2, and LCZG demonstrate significant diurnal variations in the UHI effect. The identified heat island patterns provide scientific support for coastal cities to formulate and implement differentiated thermal environment mitigation strategies.

Keywords: Urban heat island, fixed observation, full annual cycle analysis, coastal city.

ID: 32

From Mapping to Mitigation: A Street-View Decision-Support Framework for Managing Pedestrian-Scale Heat from Air-Conditioner Exhaust

Ruiheng Li¹, Zhen Xu²

^{1,2}Nanjing Forestry University, Nanjing, China

ABSTRACT

Low-level air-conditioner external units (ACEUs) discharge heat directly into pedestrian spaces but remain poorly represented in conventional urban thermal assessments. This study develops a street-view-based thermal-environment assessment and decision-support tool integrating YOLOv8 detection, monocular depth estimation, and geographic coordinate inversion to identify and map these dispersed heat sources at the city scale. Applied to Jiande, China, the tool detected 1,068 potentially pedestrian-relevant ACEUs from 8,560 images and revealed management blind spots in older neighborhoods and ground-floor commercial areas. The mapped evidence supports targeted actions, including regulating installation height and exhaust direction, coordinating ACEU layouts along commercial frontages, and prioritizing retrofits in aging communities. Requiring only widely available street-view imagery, the approach is readily transferable across cities and provides a rapid, low-cost tool for fine-scale thermal assessment, urban renewal, heat-resilient planning, and pedestrian thermal-comfort management.

Keywords: Street-view deep learning; air-conditioner exhaust; urban thermal assessment; heat-risk governance.

ID: 33

Integrating Urban Heat Island Impacts into City Planning: Workflow for Informing Early Stage Urban Design Decisions

Cheney Chen¹, Jessica Nguyen², Zhongming Shi³, Sina Rahimi⁴, Tyrone Marshall⁵

^{1,2}Perkins&Will, Vancouver/Toronto, Canada

³ETU Zurich, Zurich, Switzerland

⁴Toronto Metropolitan University, Toronto, Canada

⁵Perkins&Will, Atlanta, USA

ABSTRACT

As extreme heat events intensify, Urban Heat Island (UHI) effects increasingly influence energy demand, microclimate, and urban livability, yet remain underrepresented in planning workflows. This study presents an integrated workflow that combines UHI-adjusted weather files generated by the Urban Weather Generator (UWG), city-scale energy analysis in City Energy Analyst (CEA), and microclimate simulation with ENVI-met. Applied to a site in Toronto, Canada, the workflow enables spatiotemporal assessment of surface and air temperatures, building energy demand, and mitigation strategies during early design stages. The results demonstrate a scalable, data-driven approach that supports urban designers in balancing urban growth, thermal comfort, and energy efficiency.

Keywords: Urban Heat Island, sustainable urban development, integrated workflow, UWG, CEA, ENVI-met.

ID: 34

Vegetated Cap Designs and Near-Field Pollutant Dynamics: ENVI-Met Dispersion Assessment

Tyrone Marshall¹, Cheney Chen², Erika Eitland³, Sarah Kellerman⁴, Paul Ward⁵

¹Perkins&Will, Atlanta, GA, United States

²Perkins&Will, Vancouver, BC, Canada

³Perkins&Will, Boston, MA, United States

⁴Perkins&Will, Austin, TX, United States

⁵Perkins&Will, Austin, TX, United States

ABSTRACT

Highway caps alter the dispersion of traffic emissions and can influence user exposure to PM and gaseous pollutants. Using observational inputs and ENVI-met dispersion modeling that includes City of Austin background concentrations (PM_{2.5} 9.3 µg/m³; PM₁₀ 32.5 µg/m³; SO_x/SO₂ 1.41 ppb; CO 0.4 ppm; NO₂ 1.54 ppb), we compared Baseline and Enhanced cap designs across representative summer wind cases. Modeled maxima remain below National Ambient Air Quality Standards (NAAQS) thresholds (PM_{2.5} max 9.42 µg/m³; PM₁₀ max 32.74 µg/m³; SO_x max 1.45 ppb; CO max 0.40 ppm; NO₂ max 4.99 ppb) with no exceedances in any scenario. Vegetated and shaded zones generally lower near-surface particulate concentrations, strategically place and dense vegetation can redistribute pollutants if airflow is impeded. Recommendations emphasize pairing vegetation with clear ventilation corridors, staggered geometries, and post-installation air monitoring to validate modeled gains and help cities justify investments that deliver verified health benefits to surrounding communities.

Keywords: ENVI-met, air quality, air pollutant, vegetation, pollutant dispersion.

ID: 35

Designing Quieter Caps: Passive Acoustic Shielding and Integrated Multi-Benefit Design

Tyrone Marshall¹, Cheney Chen², Sarah Kellerman³, Paul Ward⁴, Erika Eitland⁵

¹Perkins&Will, Atlanta, GA, United States

²Perkins&Will, Vancouver, BC, Canada

³Perkins&Will, Austin, TX, United States

⁴Perkins&Will, Austin, TX, United States

⁵Perkins&Will, Boston, MA, United States

ABSTRACT

Noise from the I-35 express lanes undermines the usability and health benefits of cap public spaces. Traffic Noise Model (TNM) acoustic simulations demonstrate that vegetated and amenity-rich caps can reduce outdoor noise to as low as 53 dB—achieving ~5 dB reductions with modest passive measures and up to ~10 dB with larger barriers or partial enclosures. Parallel ENVI-met modeling indicates that vegetation and shade placement reduce mean radiant temperature by roughly 20 °F (≈11 °C) in shaded zones, improving pedestrian thermal comfort and supporting a coordinated multi-benefit approach. We present placement and geometry rules—solid/semi-enclosed shields, staggered openings, vegetative buffers, and dense absorptive linings—that balance acoustic attenuation with ventilation and cooling. Incorporating acoustic performance metrics into cap design standards and funding applications can strengthen the case for multi-benefit public spaces, ensuring noise reduction is valued alongside other health and environmental benefits.

Keywords: FHWA TNM, noise mitigation, cap design, acoustic shielding.

ID: 36**ENVI-met Assessment of Shaded Cap Designs: Outdoor Comfort Reductions and Exposure Mitigation for Vulnerable Users***Tyrone Marshall¹, Erika Eitland², Cheney Chen³, Sarah Kellerman⁴**¹Perkins&Will, Atlanta, GA, United States**²Perkins&Will, Boston, MA, United States**³Perkins&Will, Vancouver, BC, Canada**⁴Perkins&Will, Austin, TX, United States***ABSTRACT**

With extreme heat events increasing in frequency and intensity, urban highway caps with continuous shade and vegetation can substantially lower outdoor thermal stress for vulnerable populations, especially pedestrians of different ages, genders, and mobility status. This study developed mitigation scenarios based on built ENVI-met models and ran paired simulations comparing a baseline paved cap deck to an enhanced design with amenity buildings, grass, sidewalks, trees, and large canopy structures. We computed Physiological Equivalent Temperature (PET) and Mean Radiant Temperature (MRT) for four demographic profiles (adult male age 35, female child age 10, pregnant female age 30, older adult, chronic condition, 65) under representative summer wind cases (dominant peak-afternoon, 3–5 PM). Results show up to 40% reduction in MRT (with corresponding PET reductions) in shaded and vegetated zones, with the largest relative benefits for children and older adults. Short-wave (reflected solar) mapping identified priority locations for additional shading and cool pavements. Cap designs should account for potential users and prioritize continuous shade, distributed vegetation, and cool materials to reduce heat exposure. Quantitative evidence for climate adaptation can yield more tailored public-health decision-making.

Keywords: Outdoor comfort metrics, ENVI-met, urban heat island, vulnerable populations.

ID: 37**Activity-Aware Outdoor Heat Stress Assessment in Tropical Cities: Extending PET Modelling for Urban Environments and Climate in Singapore**

Qiubo Chen¹, Like Gobeawan, Wee Kee Phua, Wee Shing Koh, Huizhe Liu²
*Institute of Advanced Intelligence and Computing (IAIC), Agency for Science, Technology and Research (A*STAR), Singapore, Republic of Singapore*

ABSTRACT

Outdoor thermal comfort studies commonly neglect variations in human physical activity, despite their strong influence on heat stress in tropical climates. This study develops an activity-aware Physiological Equivalent Temperature (PET) assessment framework by coupling the AmbiEnv microclimatic simulator with an extended PET-based toolbox for representative urban environments in Singapore, including residential precincts and urban parks. The framework integrates (i) multiple metabolic activity levels ranging from standing to vigorous activities (80–500 W), (ii) contrasting land-cover typologies such as open lawns, pavements, buildings, and trees, and (iii) historical and future climate scenarios derived from Singapore's Third National Climate Change Study (V3).

Results reveal strong spatiotemporal variations in outdoor heat stress driven jointly by activity intensity and urban morphology. In residential precincts, the heat-stressed area ratio increases from below 20% at 80 W to above 80% at 500 W during peak daytime conditions. Tree planting substantially reduces thermal stress at low-to-moderate activity levels, although its relative cooling benefit decreases under high metabolic intensities. In urban parks, open lawn areas consistently exhibit higher heat-stressed area ratios than tree-shaded pavements due to stronger solar exposure and limited shading availability. Under future climate projections, the annual mean heat-stressed area ratio at 300 W increases from approximately 18% in the historical climate to about 60% under the late-century SSP5-8.5 scenario.

The proposed framework provides a scalable approach for activity-aware thermal risk assessment and supports climate-adaptive urban planning in tropical cities.

Keywords: Heat stress, outdoor activity, physiological equivalent temperature (PET), tropical climate.

ID: 38**Color-Based Estimation of Solar Reflectance: A Material-Calibrated Conceptual Framework***Karime Costa¹, Lorena Couto², Kelen Dornelles²*¹*University of São Paulo (USP)*^{2,3}*University of São Paulo***ABSTRACT**

Solar reflectance of opaque surfaces directly influences the amount of radiation absorbed by buildings, affecting surface temperatures, urban microclimates, and cooling demand. Although its determination is essential for thermal performance assessment and climate-responsive design, direct measurement requires specialized spectrophotometric equipment that is not always accessible in many regions. Over the past two decades, experimental studies have identified statistically robust relationships between standardized color parameters and solar reflectance across different material domains. However, these models are typically calibrated for specific material classes and experimental conditions, limiting their transferability and generalization. This study maps and critically analyzes published quantitative models relating color parameters, particularly those from the CIELAB color space, to solar reflectance. Based on this synthesis, a material-calibrated conceptual framework is proposed. The framework organizes estimation models into progressive levels of complexity, ranging from lightness-based approximations to multivariate formulations that incorporate additional chromatic axes and material-related variables. Rather than proposing a universal equation, the framework establishes a structured methodological architecture for developing domain-specific, calibratable models. This approach supports the creation of accessible estimation tools while preserving technical rigor, contributing to more informed material specification and climate-adaptive building design.

Keywords: Solar reflectance, Urban Heat Island, Color parameters, Simplified estimation methods

ID: 39**Integration of Shading Devices, Fan-Assisted Cooling and Energy Storage to Support Resilient Outdoor Thermal Comfort***Shisheng Chen¹, Weiwei Yang², Zhongqi Yu³, Ruohan Xu⁴*^{1,2}*Fuzhou University*³*Tongji University*⁴*National University of Singapore***ABSTRACT**

This study conducted a field experiment of a prototype urban cooling system that integrated shading device, fan-assisted evaporative cooling, and energy storage system (ESS) under high temperature condition in Fuzhou, China, with a maximum ambient dry-bulb air temperature (AT) of 41.9 °C. Fuzhou has a humid subtropical climate and is one of the three hottest cities in China in 2024. The experiment was conducted on a large-scale sunshade installed at an intersection. An electric fan with a 60 W input power was connected to a 2048 Wh battery. The fan generated a wind speed of approximately 3 m/s at a distance of 1 m in high-speed mode and operated continuously from 11:00 to 16:00 consuming approximately 0.45 kWh of electricity. The measurements show that the mean radiant temperature (MRT) was significantly lower in shaded spaces compared to those in direct sunlight, primarily due to the significant reduction in radiant heat loads caused by shading. AT and relative humidity (RH) varied slightly between shaded and sun exposed spaces. Mean air velocity (V) of natural convection ranged from 0.7 to 1 m/s, while mean V of forced convection was approximately 2.7 m/s. Consequently, compared to a sun exposed location, a location equipped with shading fabric that has an UPF of 50+ and supplemented with fan cooling can achieve a reduction in mean physiologically equivalent temperature (PET) by 20.8 °C. This study also evaluated the effect of additional ultraviolet protective parasol on exiting sunshade revealing that the mitigation effect was as good as fan-enhanced convective cooling.

ID: 40

Impact of Solar Radiation on Indoor Thermal Performance of School Classrooms with Different Roof Insulation Strategies in a Tropical Climate

Yasir Arafat¹, Sheikh Ahmad Zaki¹, Naja Aqilah¹, Fitri Yakub¹, Teh Khar San²,
Manoj Kumar Singh³, Hom Bahadur Rijal⁴

¹Malaysia Japan International Institute of Technology, Universiti Teknologi
Malaysia, Kuala Lumpur, Malaysia

²San Miguel Yamamura Woven Products Sdn. Bhd., Melaka, Malaysia

³ESBD Laboratory, Department of Civil Engineering, Shiv Nadar Institution of
Eminence, Greater Noida, India

⁴Graduate School of Environmental and Information Studies, Tokyo City University,
Yokohama, Japan

ABSTRACT

Indoor temperatures in naturally ventilated school classrooms in a tropical climate often exceed comfort levels during periods of intense solar radiation. However, research on the effectiveness of different roof insulation methods in real school environments remains limited. This study observed three classrooms on the fourth floor of a secondary school in Kuala Lumpur. The classroom roofs had three types: non-insulated roof (NI), radiant barrier roof (RB), and radiant barrier paired with an ACC weathering membrane (RB with ACC). Field data were collected from July to September 2025. During this period, environmental conditions inside the classrooms, temperatures at different roof levels, heat flux, and outdoor climate data were measured regularly. The analysis mainly considered the time of high solar radiation and the indoor-outdoor temperature difference (ΔT). The highest solar radiation was observed between 10:00 and 15:00. During this time, the indoor temperatures in NI, RB, and RB with ACC classrooms were recorded at 32.0°C, 31.7°C, and 31.6°C, respectively. The results show that roof insulation helps to reduce indoor temperatures in classrooms. In particular, using an ACC weathering membrane with a radiant barrier can reduce thermal stress from solar radiation to some extent. Therefore, it can be a realistic passive retrofit method to improve the indoor environment of school classrooms in tropical climates.

Keywords: Classroom insulation, solar radiation, thermal performance, tropical climate.

ID: 41

Technical Assessment of The Negative Solar Radiative Forcing and Atmospheric Cooling Benefits of Surface Brightening Projects

Ronnen Levinson¹, Pouya Vahmani², Frank Klink³, Hashem Akbari⁴

^{1,2}Lawrence Berkeley National Laboratory

³Climate Resolve

⁴Concordia University

ABSTRACT

Brightening the Earth's surface can increase the outflux of sunlight to space. This diminishes the net (downward minus upward) solar flux into the Earth's radiative system, providing negative solar radiative forcing that can cool the atmosphere. We are quantifying the extent to which surface-brightening projects, such as installing solar-reflective roofs and pavements, can raise bottom-of-atmosphere (BOA) albedo, increase top-of-atmosphere (TOA) solar outflux, and reduce regional and global atmospheric temperatures. We compared four approaches to assessing BOA albedo: roof- or pavement-product documentation; local measurements with albedometers (opposing pyranometers); extrapolation from extended-color aerial images (blue, green, red, and near-infrared); and multispectral satellite images sharpened by convolution with aerial images, selecting the last. It developed a technique to calculate the atmosphere's upward solar transmittance anywhere in the Earth's tropical and temperate zones based on analysis of BOA irradiances reported in the National Solar Radiation Database, then computed radiative forcing factors relating the increase in TOA solar outflux (negative radiative forcing) to the rise in BOA albedo (surface brightening). We identified atmospheric modeling experiments using both regional and global circulation models to quantify the atmospheric cooling potential of reflective surfaces at regional and global scales. These activities provide regional estimates of the atmospheric cooling benefits of reflective roofs and pavements.

ID: 43**A Quantitative Evaluation of the Sleep-Improving Effects of Air Conditioners Using Epidemiological Data and Machine Learning***Tomohiko Ihara¹, Seiki Sugimoto¹, Alvin Christopher Galang Varquez², Norihiro Itsubo³**^{1,2}The University of Tokyo**³Institute of Science Tokyo**⁴Waseda University***ABSTRACT**

Rising nighttime temperatures due to climate change and urban heat islands are increasingly disrupting sleep, posing a significant public health challenge, as poor sleep quality increases the risk of cardiovascular and psychiatric disorders. While air conditioning (AC) is a primary adaptation strategy, its real-world effectiveness based on large-scale, daily data remains under-quantified, a knowledge gap left by laboratory experiments that often fail to capture real-life behavioral diversity. This study addresses this gap through an extensive epidemiological survey in Nagoya, Japan, collecting over 18,000 longitudinal sleep records from more than 2,000 residents during summer and winter periods. We gathered daily reports on sleep quality using the SQIDS2 index, alongside self-reported indoor environmental conditions, detailed AC usage patterns, and a wide range of factors including stress, alcohol consumption, and personal attributes. The complex, non-linear relationships between these variables and sleep disturbances were analyzed using a machine learning model (LightGBM) with SHAP for enhanced interpretability. The results indicate that while psychological factors are major contributors, appropriate AC management can significantly mitigate sleep problems, reducing the prevalence of sleep disturbances by over 10%. In summer, an AC setting of approximately 27.5°C was most effective, while continuous overnight operation was beneficial in winter. These findings provide quantitative, evidence-based guidance for season-specific AC strategies, offering a crucial climate adaptation measure to empower both individual decision-making and public health policymaking for building resilient and healthy urban environments.

Keywords: Sleep Quality, Air Conditioning, Machine Learning, Epidemiological Study, Thermal Environment

ID: 44**A Novel Framework for Assessing Outdoor Thermal Comfort: Coupling Raytracing and Computational Fluid Dynamics***Huizhe Liu^{1,*}, Derrick Low, Zhengwei Ge, Po-Yen Lai, Qiubo Chen, Jian Cheng Wong, Wee Shing Koh, Daniel Wise**Institute of Advanced Intelligence and Computing (IAIC), Agency for Science, Technology and Research (A*STAR), Singapore, Republic of Singapore***ABSTRACT**

With climate change intensifying urban heat, accurate and efficient outdoor thermal comfort (OTC) modelling is crucial for evaluating heat mitigation strategies, yet existing models rarely capture the combined influence of convective and radiative heat fluxes. This paper presents a framework coupling a raytracing-based Ambient Environment Simulator (AmbiEnv) with a boundary-condition-driven computational fluid dynamics (CFD) solver. AmbiEnv, developed for tropical climates, computes dynamic surface temperatures from the surface energy balance; these serve as boundary conditions for the CFD model, which resolves urban air temperature and wind fields without a time-intensive fully transient solver. Combining AmbiEnv's mean radiant temperature (MRT) with CFD air temperature and wind speed yields an efficient pedestrian-level OTC assessment. Applied to a tropical residential estate assessing cool paint, green walls and evaporative paint, the framework shows these materials affect OTC through distinct radiative–convective pathways, providing a more accurate assessment of heat mitigation than standalone models for designing cooler, climate-resilient cities.

Keywords: Outdoor thermal comfort (OTC), raytracing, computational fluid dynamics (CFD), urban heat mitigation, tropical climate.

ID: 45**DSHET: A Diurnal Surface Heat Evaluation Tool for Typology-Sensitive Urban Heat Mitigation***Emal Ahmad Hussainzad¹, Zhonghua Gou^{2,*}**^{1,2}School of Urban Design, Wuhan University, Wuhan, China***ABSTRACT**

Urban heat presents a growing environmental and equity challenge in rapidly urbanizing cities, particularly where limited data constrain climate adaptation planning. This paper introduces the Diurnal Surface Heat Evaluation Tool (DSHET), a transferable framework designed to structure long-term satellite-derived land surface temperature (LST) into interpretable, planning-relevant indicators. DSHET integrates daytime and nighttime LST into three composite metrics—daytime heat stress, nocturnal heat retention, and cumulative heat burden—to explicitly capture diurnal asymmetry in urban surface heat behavior. The tool is demonstrated using Kabul, Afghanistan, for the period 2000–2020, a data-scarce city characterized by rapid expansion and mixed settlement typologies. Results show clear diurnal and typology-dependent contrasts: informal settlements exhibit 13–17% higher daytime heat stress, while formal areas retain up to 14% more nighttime heat due to compact and thermally massive urban form. When combined, informal settlements record a mean heat burden approximately 12% higher than formal areas, indicating that daytime exposure is the dominant contributor to cumulative surface heat risk. DSHET further classifies urban areas into four heat–ecology regimes—Day-Hot/Night-Cool, Day-Moderate/Night-Warm, Dual-Stress, and Cool Refuge—revealing that over half of informal areas fall within high-risk regimes. By linking these regimes with settlement typology, the tool generates a typology-sensitive mitigation prioritization structure that distinguishes intervention zones from areas where existing cooling capacity should be preserved. Overall, DSHET provides a lightweight, indicator-based approach for translating long-term diurnal LST patterns into actionable guidance for equitable urban heat mitigation, with direct relevance for data-scarce cities facing rapid urbanization.

Keywords: LST, heat-ecology regimes, mitigation prioritization, climate-resilient urban planning.

ID: 47**Indoor Heat in Hospitals – The case of the Medical Centre Freiburg***Andreas Matzarakis¹**¹University of Freiburg***ABSTRACT**

Although indoor heat is linked to outdoor heat, the former is of particular importance due to the length of time spent indoors, especially at night. In hospitals, this affects not only patients but also clinical staff. Considering that indoor heat is influenced not only by air temperature but also by humidity, the built structure, exposure to sun radiation, air conditioning and ventilation conditions in hospitals, measurements were carried out at the University Medical Center Freiburg (UMCF) in the summer of 2023 using 60 distributed integral measuring devices to determine heat stress. Significant differences were found, influenced by different exposure, year of construction, floors, and presence of air conditioning systems. The results can be helpful in evaluating and improving heat warnings and can be viewed as a contribution to heat action plans in hospitals.

Keywords: Indoor Heat, Hospital, PET, mPET

ID: 49**Machine Learning-Based Analysis of Urban Morphological Impacts on Winter Thermal Comfort in Severe Cold Regions***Chenlu Shan¹, Dong Yao², Gan Qin³**^{1,2}Tongji University**³Harbin Institute of Technology***ABSTRACT**

Urban open space is an important carrier for residents to carry out daily life and neighborhood communication. The establishment of a correlation model between its thermal environment characteristics and thermal comfort is of great significance for enhancing the cities' vitality in winter in severe cold regions. Field measurements were conducted to collect data on air temperature, humidity, black globe temperature, and wind speed at selected 20 points. Combined with machine learning methods (Random Forest algorithm), a universal thermal climate index (UTCI) prediction model was developed to analyze the influence of urban open space morphological factors on winter thermal comfort. Research has found that: (1) The Random Forest-based prediction model for winter thermal comfort demonstrated high reliability, with minimal predictive error, and effectively explained variations in UTCI. (2) Streets and squares exhibited higher thermal comfort levels compared to other types of open spaces. (3) A pronounced nonlinear relationship was observed between morphological parameters and UTCI. total exterior wall surface area (WALL), distance to park (DP), and height-to-building density ratio (HBDG) have a significant impact on UTCI and can serve as critical design parameters for thermal comfort optimization; sky view factor (SVF), percentage of pavement area (PAVE), and distance to water body (DW) have limited influence and may be considered secondary; green plot ratio (GnPR) and percentage of building area (BDG) have minimal impact and could be disregarded in practical design.

ID: 53**Spectral Proper Orthogonal Decomposition of Coherent Structure and Energy Transfer in Urban Convective Boundary Layers***Lei Yan¹, Chun-Ho Liu²**^{1,2}Department of Mechanical Engineering, The University of Hong Kong, Hong Kong, China***ABSTRACT**

Urban boundary layers (UBLs) are shaped by thermal instability and surface-mounted roughness elements that generate multi-scale turbulence, yet the nonlocal effects within urban canopy layers (UCLs) remain underrepresented in current models. Building-resolved large-eddy simulations (LESs) are performed over idealized urban morphologies in which the thermal stratification is varied from neutral to nearly free-convective conditions. Using spectral proper orthogonal decomposition (SPOD), we examine the multi-scale interaction among turbulence intensities, fluxes, and large-scale motions (LSMs) in UBLs. As instability increases, coherent structures transit from streamwise rolls to open cellular patterns. LSMs gain energy and modulation strength, and the dominant frequency shifts to lower values. Besides, correlation scales contract and structures align more vertically aloft. Results demonstrate that, as unstable stratification increases, the inclination angle of surface layer structures (as determined from the two-point correlation of streamwise velocity) increases from 46° in weakly convective conditions to nearly vertical in highly convective conditions. SPOD reconstructions based on a compact set of high-energy modes recover the dominant LSMs across regimes and closely match the original flows under strong instability. LSMs exhibit height-dependent footprints: greater vertical extent and larger inclination at higher elevations. The role of unstable stratification in intensifying near-ground turbulence and enhancing the organizational influence of LSMs is clarified, informing reduced-order modeling (ROM) and the parameterization of nonlocal transport in UCL schemes.

Keywords: Urban canopy layer, large-scale motions, spectral proper orthogonal decomposition, convective boundary layer.

ID: 54**Investigating the Potential of Pocket Parks in Mitigating Thermal Stress During Heatwaves in High-Density Urban Areas***Lingye Yao^{1,*}, Kevin Lau², Man Yin Chung³, Kai Gao⁴, Edward Ng⁵**^{1,3,5}School of Architecture, The Chinese University of Hong Kong, Hong Kong, China**²Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Luleå, Sweden**⁴School of Property, Construction and Project Management, Royal Melbourne Institute of Technology, Melbourne, Australia***ABSTRACT**

Climate change, urban densification, and land scarcity in compact high-density cities exacerbate the Urban Heat Island effect, leading to severe outdoor thermal discomfort. This study investigates the potential of small-scale green infrastructure, specifically pocket parks, as a strategic tool for mitigating elevated temperatures and improving human thermal comfort in high-density urban contexts. Taking Hong Kong as a case study, field measurements of microclimatic variables, including air temperature, relative humidity, wind speed, and globe temperature, were conducted within four selected pocket parks and the nearby urban reference in Mong Kok on a heatwave day. These data were used to calculate the Physiological Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI) to evaluate objective thermal comfort. Concurrently, a questionnaire survey was administered to capture park users' subjective thermal perceptions. Microclimate measurement results demonstrate that pocket parks induced significant cooling effects, reducing mean ambient air temperature by up to 2°C and globe temperature by up to 10°C compared to the urban reference, primarily through shade provision and evapotranspiration. Shaded locations within parks consistently outperformed sunlit urban reference sites, with mean PET and UTCI reductions reaching up to 15°C and 7°C, respectively. Subjective thermal perceptions corroborated these findings, with parks featuring denser vegetation, advanced shading, and better ventilation receiving more favorable TSV and TCV ratings. These findings provide evidence-based insights that support policy-relevant design interventions of pocket parks, advocating for their integration as a key component of climate-resilient planning in high-density cities.

Keywords: Outdoor thermal comfort, street parks, field measurement, questionnaire survey, heat mitigation, high-density urban areas.

ID: 56**Revealing Thermal–Pollution Synergy and Seasonal Reversals in Industrial–Residential Interfaces towards Environmental Equity in Xi'an, China***Xukun Yan¹, Yupeng Wang², Xilian Luo³, Minye Zhang⁴**^{1,3,4}Xi'an Jiaotong University, Xi'an, China**²Southeast University, Nanjing, China***ABSTRACT**

Rapid industrialization creates stark environmental inequities at the industrial–residential interface, where adjacent communities face disproportionate health risks from co-occurring thermal stress and air pollution. Existing city-scale studies often overlook the localized, asymmetric pollution diffusion and thermal trapping driven by micro-topography and urban morphology. This study investigates the spatiotemporal coupling mechanisms of land surface temperature (LST) and PM_{2.5} concentrations across 816 blocks in a representative transition zone in Xi'an, China, utilizing multi-source remote sensing and bivariate spatial analysis. Results reveal a persistent environmental influence radius of approximately 3 km around the industrial core, dominated by a "thermal–pollution synergy" where industrial waste heat alters local convection, trapping pollutants and forming enduring High-High (H-H) coupling clusters. Furthermore, a distinct seasonal role reversal dictates the interface's microclimate: while summer is characterized by intense heat–pollution co-occurrence, winter exhibits a "cold–polluted" (High-Low) pattern in western residential sectors, exacerbated by atmospheric inversions and concentrated heating emissions. Pearson correlation analysis further confirmed that Normalized Difference Vegetation Index (NDVI) consistently mitigated both thermal stress and PM_{2.5} accumulation, whereas Normalized Difference Built-up Index (NDBI) strengthened their spatial coupling. Crucially, the analysis demonstrates that traditional 2D metrics (e.g., road density) insufficiently explain local stagnation, pointing to critical morphological thresholds where green spaces lose their regulatory capacity under excessive density. These findings elucidate the physical processes of compound environmental stress, offering empirical guidance for 3D morphological optimization and climate-responsive planning to advance environmental justice in rapidly urbanizing regions.

Keywords: Thermal-pollution synergy, industrial-residential interface, environmental equity, morphological thresholds, PM_{2.5}.

ID: 57

Outdoor Thermal Environments in Two Historic University Campuses: A Cross-Climate Comparison between Milan and Xi'an

Yuxin Zhang¹, Siyuan Miao¹, Zetong Wang¹, Duo Xu^{1,}, Yunyan Xue¹, Yupeng Wang²,
Barbara Galli^{3,*}*

¹*Xi'an Jiaotong University, Xi'an, China*

²*Southeast University, Nanjing, China*

³*Politecnico di Milano, Milano, Italy*

ABSTRACT

Historic university campuses often combine long-established spatial structures, historically significant buildings, and intensive outdoor use, making large-scale thermal-environment modification difficult. To compare outdoor thermal environments under contrasting climates, this study examined the main campus of Politecnico di Milano and the Xingqing Campus of Xi'an Jiaotong University. Based on summer and winter measurements at ten monitoring points in each campus, background-relative thermal indicators were linked with spatial morphology indicators extracted at 25, 50, 75, and 100 m buffer scales. The results show clear inter-campus differences. In summer, Politecnico di Milano was characterized mainly by positive urban heat island and thermal–humidity deviations, whereas Xingqing showed predominantly negative urban heat island and thermal–humidity deviations. In winter, both campuses shifted toward positive deviations, but Politecnico di Milano showed stronger fluctuations, while Xingqing exhibited more persistent nighttime enhancement. Thermal exposure within both campuses was spatially heterogeneous and further amplified during the critical daytime period. Morphology–thermal relationships showed significant scale dependence. At Xingqing, some land-cover indicators showed more stable associations, and distance to cooling source provided the strongest explanation for summer UHI deviation. At Politecnico di Milano, several relationships changed direction across scales, and no statistically stable dominant-factor combination was identified. These findings indicate that thermal-environment improvement in historic campuses should prioritize critical periods, high-exposure spaces, and context- and scale-sensitive interventions.

Keywords: Historic university campus, outdoor thermal environment, background-relative thermal exposure, spatial morphology.

ID: 58

Meta-Holistic Orientation-Guided Cross-Scale Strategic Framework for Urban Heat Island Governance in the Guangdong-Hong Kong-Macao Greater Bay Area

*Yage Liu¹, Hongyang Wang², Le Yu³
^{1,2,3}*Nanjing University, Nanjing, CHINA**

ABSTRACT

Under high-density urbanization, more frequent extreme heat events and deepening regional integration, the urban heat island has moved beyond a localized thermal issue and become a composite governance problem involving public health, energy systems, spatial form and institutional capacity. Existing studies have produced rich knowledge on monitoring, simulation, cooling technologies, local climate zones and heat vulnerability, yet bay-area governance still lacks a planning framework that can connect mechanism diagnosis, regional coordination and place-specific action. Drawing on holistic planning theory, this study constructs a cross-scale strategic framework through a focused review of heat-island mechanisms and heat-resilience planning, together with an interpretive reading of climate-adaptation and GBA policy documents. The framework is composed of a meta-holistic layer, a regional holistic layer and a place-specific layer. It first condenses the heat-island process into six analytical directions: natural substrate, built environment, operational metabolism, ecological regulation, social exposure and governance implementation capacity. It then identifies shared regional substrates and locally dominant heat-risk mechanisms, and translates them into differentiated strategies. In the Guangdong-Hong Kong-Macao Greater Bay Area, this means combining region-wide ecological resilience and institutional coordination with locally tailored pathways, including fine-grained adjustment for high-density mature areas, source-oriented heat reduction for manufacturing expansion zones and preventive locking-in for ecologically potential areas. The framework is intended as a planning-oriented diagnostic and translation method that remains open to iterative adjustment.

Keywords: Holistic planning, urban heat island, Guangdong-Hong Kong-Macao Greater Bay Area, heat resilience, cross-scale governance.

ID: 60**Engaging Market-based Mechanisms to Fund Community Cooling Projects***Emlia Garcia¹, Seth Jacobson¹, Kurt Shickman¹
^{1,2,3}Climate Resolve***ABSTRACT**

High-albedo cool surfaces (roofs, walls, pavement) provide climate adaptation, resilience, and mitigation benefits. They reduce local urban heat island (UHI) effects, which helps community residents adapt to the impacts of climate change. By reflecting more sunlight to space than traditional building materials, cool surfaces also foster negative radiative forcing, which promotes global cooling. In addition to these climate adaptation and mitigation benefits, cool surfaces reduce electricity usage and peak power demand, reduce morbidity and mortality during heat waves, improve local air quality, and increase thermal comfort. The Shine On initiative is developing innovative approaches to conducting impact assessments that meet the reporting requirements of market-based mechanisms. Through the Technical Working Group (TWG) of the Shine On initiative, the Lawrence Berkeley National Laboratory (LBNL) and other scientific experts are developing a cost-effective approach to estimate, measure, and verify (EMV) the negative radiative forcing of cool surface projects worldwide as well as a framework to establish equivalency between atmospheric cooling potential of cool surfaces and CO₂ concentration in the atmosphere. Shine On has also formed a Research Advisory Committee (RAC) that consists of technical experts from the physical, social, and health sciences and representatives from community-based organizations (CBOs) and Indigenous tribal entities to co-produce a research framework of best practices that integrate community perspectives into impact assessments. Figure 1 illustrates how impact assessments can quantify the benefits of cool surfaces. The impact assessments evaluate metrics and key performance indicators (KPIs) that meet the reporting requirements of specific types of project funding sources. By demonstrating the economic value of high-albedo products, these project-level assessments can help local communities and real estate owners obtain funding for projects that provide both local and global cooling benefits. Figure 1. Aligning Impact Assessments with Reporting Requirements for Project Funding Our paper will present Shine On's impact assessment methods in the context of attracting funding from two innovative market-based mechanisms: a Cooling Bond and a Cooling Credit. The Cooling Bond is a debt-for-cooling swap instrument that the Shine On initiative is developing with partners to support a project under development in Nuevo Leon, Mexico. Shine On is also working with the Global Heat Reduction (GHR) registry to create an albedo-based methodology to award GHR's tradable credits for negative radiative forcing from albedo management in the built environment (AMBE). Project developers will be able to use these Cooling Credits to raise investment for implementing high-albedo cool surfaces with community cooling projects. Moreover, the paper will describe how project developers may pair these innovative market-based mechanisms with traditional public funding in public-private partnerships (PPPs) that support the implementation of community cooling projects.

Keywords: Negative radiative forcing, Market mechanism, Cooling bond, Cooling credit, Sustainable finance, Atmospheric cooling

ID: 61**Spatio-temporal Differentiation of Heat Exposure Risk and the Role of Built-up Environment in Hangzhou***Jun Zhao¹, Liping He², Yun Wu³
^{1,2,3}Zhejiang A&F University***ABSTRACT**

Under climate change and urbanization, cities in humid subtropical regions face growing threats from compound heat-humidity events. However, most studies rely on static analyses, unable to capture spatio-temporal dynamics and miss fine-grained assessment of synergistic heat-moisture island effects. To address this, our study conducts a multi-temporal, multi-factor heat risk assessment in Hangzhou, focusing on spatio-temporal differentiation of heatwave exposure under heat-humidity coupling. Extreme heat events are identified using temperature data, combining surface temperature and humidity to compute a neighborhood-scale thermal comfort index for hazard evaluation. Spatio-temporal population, socio-economic, and infrastructure data are incorporated to assess dynamic heat exposure in central Hangzhou. Finally, a hybrid XGBoost and MGWR model quantifies built-up environment impacts on thermal hazard and suggests adaptation strategies for high-risk areas. The results indicate that the superposition of urban heat island and moisture islands significantly amplifies heat exposure risk in the urban core. The risk pattern exhibits clear diurnal variation: high-risk areas are concentrated in commercial districts and transportation hubs during the day, while shifting to old high-density residential areas at night. This distribution is closely related to population movement and surface thermal properties. Nonlinear analysis indicates that although blue-green spaces have a local cooling effect, their impact is limited and the uneven spatial distribution exacerbates the inequality of heat exposure. Therefore, targeted adaptation measures need to be taken to alleviate this issue. These findings provide spatial-temporally precise scientific basis for urban heat adaptation planning.

ID: 62

Study on Relationship between Mist Spraying Conditions and Thermal Environment Improvement Effects

Hideki Takebayashi¹, Momoka Mizuta²

^{1,2}Kobe University, Kobe, Japan

ABSTRACT

A simulation method was studied to evaluate the effectiveness of mist spraying, which varies with temporal wind velocity fluctuations, from the perspective of optimal placement for countermeasures against extreme heat in the street canyons and urban open spaces. By utilizing the unsteady wind velocity distribution calculation results by a LES model as a database, simulations can be easily performed with any mist spray location and spray volume. It was confirmed that air temperature reductions tend to be smaller when wind velocity is high and distance from the mist nozzle is large. However, the distribution of air temperature reduction varied unsteadily due to the mist nozzle position, wind velocity, and wind direction. Therefore, while the relationship between mist spray conditions and spray effects cannot be expressed by a linear correlation, the cooling effect due to mist spraying may be explained using wind velocity, distance from the mist nozzle, and wind direction as indicators.

Keywords: Mist spraying, air temperature, wind velocity, street canyon.

ID: 63

Research on the Renewal of Historic Cultural Districts in Northern China Based on Microclimate Field Measurement for Urban Heat Island Mitigation - Taking the Qianmen Area of Beijing as an Example

Wen Zhang¹, Xiaohua Cheng², Shisheng Chen³, Wei Zhang⁴, Jie Zheng⁵

^{1,2}Beijing Jiaotong University, Beijing, China

³Fuzhou University, Fujian, China

^{4,5}China Architecture Design & Research Group, Beijing, China

ABSTRACT

Existing research shows a deficiency in urban microclimate studies of historic and cultural districts, especially hutong districts, in the context of the urban heat island (UHI) effect, with few studies that incorporate UHI mitigation into renewal design strategies. Focusing on the Qianmen Hutong Tourist Area in Beijing, this study investigated the microclimate through 8-point field measurements (monitoring air temperature, relative humidity, wind speed, and land surface temperature) during the 2025 extreme heat events. It analyzed the thermal environment characteristics of hutongs across distinct spatial contexts. Measured results were adopted as meteorological boundary conditions for ENVI-met simulations. Simulation accuracy was validated against field measurements using statistical metrics, and the validated findings were converted into actionable design strategies for UHI-adaptive renewal of historic districts. This research aims to mitigate UHI-induced impacts in the regional microenvironment, enhance outdoor thermal comfort, and offer references for microclimate optimization and renewal practices in analogous UHI-prone traditional districts.

Keywords: Microclimate, urban renewal, urban heat island (UHI), historic districts.

ID: 67**Quantifying Landscape Drivers of Street-Scale Heat Exposure Using Mobile Transects and Machine Learning***Pengkun Zhu¹, Zhihao Wang², Yuchen Dong**^{1,2}Faculty of Civil Engineering and Mechanics, Kunming University of Science and Technology***ABSTRACT**

Mobile transect observation effectively captures real-world human thermal perception in urban environments and is indispensable for studying street-scale heat exposure. However, existing research remains largely limited to temperature trajectory analysis, lacking quantifiable and comparable landscape morphological parameters. In this study, we conducted multiple mobile surveys along a fixed 15 km route, deploying a network of fixed meteorological stations coupled with vehicle-mounted sensors for synchronous measurement of temperature, humidity, and panoramic imagery. A time-varying background temperature field was reconstructed and calibrated using data from the fixed stations, based on which a multi-anchor relative temperature index ($\Delta T_{\text{multi-anchor}}$) was proposed as the response variable. Panoramic images were semantically segmented to extract landscape metrics—including sky view factor (SVF), tree canopy coverage, impervious surface ratio, building facade density, and shadow proportion—as explanatory variables. A random forest model was employed to decipher their non-linear impacts, with SHAP analysis used to identify thresholds and interpret variable contributions. The results indicate that low SVF and high impervious surface ratio significantly exacerbate thermal exposure. Both tree canopy and shadows demonstrate notable cooling effects, subject to diminishing marginal returns, with a threshold in cooling efficiency observed at approximately 30% canopy coverage. This study introduces a "fixed-station calibration + mobile transect modeling" framework that effectively resolves spatiotemporal synchronization challenges in mobile observation and enables quantifiable and interpretable analysis of thermal-landscape relationships, thereby providing actionable insights for urban heat mitigation strategies.

ID: 70**Identifying Urban Shade-Deficient areas: Evidence from Barcelona and Phoenix***Yingjie Li¹, Shanshan Chen^{2,*}, Jing yang³, Sihan Zhou⁴, Liding Chen⁵**^{1,2,3,4,5}School of Ecology and Environmental Science, Yunnan University, Kunming 650091, PR China***ABSTRACT**

Shade is an efficient and low-cost strategy to block solar shortwave radiation, reduce air temperature and total radiation exposure, and alleviate human heat stress, making it a key approach to mitigating urban heat-related health risks. However, many cities still contain areas lacking shade, namely regions with insufficient shade resources. This study compares Barcelona, Spain, and Phoenix, USA, to precisely identify shade-deficient areas and evaluate the optimization potential of critical areas. Results show that Intersections were identified as priority areas with low shade resources. This study achieves precise identification of shade-deficient areas, locates critical nodes, providing decision support for shade enhancement and heat-health risk mitigation in cities across different climate zones.

Keywords: Urban thermal environment, urban shading, street features, tree canopy cover.

ID: 74**Projected Urban Heat Island Amplification in Osaka under Climate Change***Xiong Xiao¹, Yafeng Gao², Rui Guo³, Chaoqun Zhuang⁴, Craig Farnham¹, Jihui Yuan^{1,*}*¹*Osaka Metropolitan University, Osaka, Japan*²*Chongqing University, Chongqing, China*³*Huazhong University of Science and Technology, Wuhan, China*⁴*Nanjing Tech University, Nanjing, China***ABSTRACT**

This study investigates the projected evolution of the Urban Heat Island (UHI) effect in Osaka, Japan, focusing on its implications for outdoor thermal comfort in the late 21st century. Using historical (2011–2020) and future (2077–2095) climate datasets derived from statistically downscaled global climate models under RCP 8.5, we analyzed changes in air temperature, humidity, wind speed, and derived thermal indices, including the Simplified Comfort Index (SCI) and the Advanced Thermal Index (ATI). Results reveal that Osaka’s annual mean ATI is projected to increase by 4.5°C, with summer maximum values exceeding thresholds critical for human health and outdoor livability. The combined influence of global warming and UHI amplification leads to a notable intensification of nighttime heat stress, reducing opportunities for thermal recovery. Seasonal analyses indicate that the most severe impacts will occur in July and August, when the interaction of elevated temperatures, high humidity, and reduced wind speeds magnify heat exposure risks. These findings highlight the urgent need for adaptive strategies tailored to Osaka’s dense urban fabric, including large-scale greening, high-albedo and reflective surface materials, and water-based cooling systems. Furthermore, integrating localized climate projections with urban planning is essential for safeguarding public health, reducing energy demand, and improving urban resilience. This research underscores Osaka’s vulnerability to compounded climate and UHI impacts while offering critical insights for designing climate-responsive and sustainable urban environments.

Keywords: Urban heat island (UHI), thermal comfort, simplified comfort index (SCI), advanced thermal index (ATI).

ID: 75**Impact Mechanism and Spatial Optimization Strategies of Local Climate Zones on Land Surface Temperature in the Historic District of Jinan, China***Chang Xu, Yilin Wang, Deqing Lin, Xiaodong Xu**
*School of Architecture, Southeast University, Nanjing, China***ABSTRACT**

This study quantifies how urban spatial morphology affects land surface temperature (LST) in a high-density historic district. Using a single clear-sky Landsat-9 daytime scene, a 100 m Local Climate Zone (LCZ) grid was developed for Jinan Old Town and linked to building density (BD), sky view factor (SVF), impervious surface fraction (ISF), and other morphological indicators. Ordinary Least Squares (OLS) provided a global benchmark, while Geographically Weighted Regression (GWR) was used to identify spatially varying relationships. Compact built types, especially LCZ 2 and LCZ 3, showed higher daytime LST, whereas LCZ G water bodies generated a marked cooling spillover. SVF was generally positively associated with LST because greater sky exposure increased short-wave heating in open spaces, although the effect depended on street orientation, surface properties, and surrounding building form. The GWR results further showed that the strength of morphological effects varied across the district. These findings support targeted micro-renewal strategies that combine shaded historic alleys, cool and permeable materials, and connected blue-green infrastructure. The conclusions apply to summer daytime surface conditions and should not be interpreted as evidence of nighttime or seasonal performance.

Keywords: Local climate zone, land surface temperature, urban spatial morphology, geographically weighted regression.

ID: 76

Spatial Supply-Demand Matching Analysis of Blue-Green Spaces Cooling Effects: A study of three major urban agglomerations in China

*Jing Yang¹, Shanshan Chen¹, Yingjie Li¹, Sihan Zhou¹, Liding Chen¹
^{1,2,3,4,5}Yunnan University*

ABSTRACT

Against the background of global climate change and rapid urbanization, this study focuses on the Beijing-Tianjin-Hebei, Yangtze River Delta, and Pearl River Delta urban agglomerations. It establishes a framework to evaluate cooling demand, supply capacity, and their spatial matching of urban blue-green spaces. Results indicate significant spatial heterogeneity: cooling demand is concentrated in core urban areas, while supply capacity is higher in peripheral ecological zones, resulting in an overall imbalanced “low supply, high demand” pattern in urban cores. This research enriches macro-scale studies on cooling service matching and supports blue-green space optimization and thermal environment improvement in large urban agglomerations.

Keywords: Blue-green spaces, Supply capacity, Demand level, Spatial relationship, Urban agglomerations

ID: 78

Heat-Exposure Assessment Within Pedestrian Isochrones of Metro Stations and Morphology-Based Mitigation: A Case Study of Nanjing

*Siwen Cao¹, Ziyu Tong², Xiyun Tong³, Wenborui Liu⁴
^{1,2,3,4}School of Architecture and Urban Planning, Nanjing University*

ABSTRACT

Heat exposure poses a growing challenge in urban areas, severely affecting human health and well-being. Although built-environment modifications can mitigate outdoor thermal stress, pronounced spatial heterogeneity across cities complicates the development of broadly applicable strategies. Pedestrian zones near metro stations, as high-exposure transit spaces, subject commuters to prolonged summer heat stress, potentially compromising health and discouraging public transport use. Pedestrian isochrones, as walking-time-based analytical units, can authentically reveal the spatial heterogeneity of pedestrian accessibility and heat exposure, thus providing more precise spatial delineation for targeted thermal risk assessment. This study examines Nanjing, a representative high-temperature Chinese city, using 0-5 min, 5–10-min, and 10–15-min pedestrian isochrones around 184 metro stations as primary analytical units. Multi-temporal Landsat data were employed to derive land surface temperature (LST) and calculate heat exposure risk (HER). K-Means clustering was applied based on LST, HER, and isochrone areas, identifying five distinct clusters. Results reveal marked spatial heterogeneity in LST and HER across metro station isochrones. High-HER clusters correspond to Urban Core Commercial and Old Town Residential station areas, whereas low-HER clusters align with Near-Suburb Residential and Peripheral Residential station areas. These thermal patterns are closely linked to urban functional types, differing in building density, POI count, land-use mixture, and passenger flow. The findings offer a scientific foundation for targeted urban thermal management and transit-oriented development (TOD) planning.

Keywords: Pedestrian isochrones, metro station areas, k-means clustering, heat exposure risk.

ID: 81**Urban Heat Challenges under Future Climates: Energy and Comfort in an Osaka Office Building***Xinying Xue¹, Zhichao Jiao², Fatemeh Salehipour Bavarsad³, Mostafa Mohajerani⁴, Jihui Yuan^{1,*}*¹*Osaka Metropolitan University, Osaka, Japan*²*Yantai University, Yantai, China*³*Czech Technical University in Prague, Buštěhrad, Czech Republic*⁴*Shahrood University of Technology, Shahrood, Iran***ABSTRACT**

This study evaluates the thermal performance and energy demand of a six-story office building in Osaka, Japan, under present (2020s) and future (2090s) climate conditions. By the late 21st century, Osaka is projected to experience pronounced warming and an increase in extreme hot days (“Moushobi”), amplifying both indoor overheating risks and cooling energy requirements. Using EnergyPlus simulations, we analyzed indoor air temperature, operative temperature, predicted mean vote (PMV), and the cooling demand of a variable refrigerant flow (VRF) heat pump system.

Results reveal substantial overheating in unconditioned zones, where summer operative temperatures may exceed 36 °C by the 2090s. Even in conditioned spaces, cooling set-points are frequently surpassed during “Moushobi” events, leading to thermal discomfort. Energy analysis shows a sharp rise in cooling demand, increasing from 3,323 kW in the 2020s to 3,983 kW in the 2090s. These outcomes emphasize the dual challenge of maintaining thermal comfort while managing energy efficiency under future climate scenarios.

The findings highlight the urgent need for integrated adaptation strategies. Passive cooling measures, advanced insulation, reflective and dynamic shading systems, and climate-responsive design principles can alleviate overheating and reduce peak loads. Future research will incorporate adaptive thermal comfort models and resilient building design approaches to ensure occupant well-being and energy sustainability in Osaka’s evolving urban climate.

Keywords: Urban heat island (UHI), thermal comfort, building energy demand, climate change adaptation, variable refrigerant flow (VRF) system, passive cooling strategies.

ID: 82**Emotional mediation between activity intensity and outdoor thermal perception of older adults in winter***Liang Li¹, Yanhan Li²*^{1,2}*School of Landscape Architecture, Beijing Forestry University, Beijing, China*¹*School of National Park, School of Ecology and Nature Conservation, Beijing Forestry University, Beijing, China***ABSTRACT**

Creating thermally comfortable outdoor activity spaces is important for older adults’ well-being, and emotional responses influence outdoor thermal comfort. However, evidence remains limited on how emotional responses influence older adults’ outdoor thermal perception during winter physical activity (PA). Using meteorological measurements and questionnaire surveys, this study comprehensively investigated elderly individuals’ thermal perception and emotions during winter outdoor activities in Beijing. This study examined the effects of activity intensity on thermal sensation votes (TSV), thermal comfort votes (TCV), and thermal acceptability votes (TAV). Adopting the three-dimensional PAD framework, the mediating roles of Pleasure, Arousal, and Dominance in this form were tested. Results show that: 1) In winter, increasing PA intensity can effectively improve older adults’ thermal comfort. 2) The effects of activity intensity on the three emotion dimensions differed, and higher intensity mainly increased pleasure. 3) Emotions partly explained the association between activity intensity and thermal responses, with different patterns across emotion dimensions. Pleasant–Annoyed mediated the association between activity intensity and both TCV and TAV, accounting for 13.12% and 17.67% of the total effects, respectively, and was positively related to TCV and TAV. For TSV, Excited–Unexcited showed a significant indirect effect, accounting for 13.47% of the total effect, and was positively related to TSV. These findings highlight emotional experience as an important psychological factor in older adults’ outdoor thermal experience during physical activity. This study aims to clarify the emotional mechanism shaping older adults’ winter outdoor thermal perception and to inform outdoor space optimization that supports physical activity.

Keywords: Outdoor thermal perception, older adults, emotion, mediating role.

ID: 83

Investigating the Dynamic Cooling Effects of Blue-Green Spaces During Extreme Heat

Wanlu Ouyang¹, Meng Cai²

¹Nanjing University

²Wuhan University

ABSTRACT

With the increasing intensity and frequency of extreme heat, urban blue-green spaces are widely recognized for their cooling effects. However, their roles in shaping the spatial organization and intra-urban variability of thermal environments remain insufficiently understood. This study constructed a block-level panel dataset for Nanjing, China, covering 2013–2025 and integrating remotely sensed land-cover, surface-condition, and meteorological data. We distinguished between quasi-static blue-green configuration, represented by land-cover fractions, and dynamic surface conditions, represented by NDVI and NDWI, and examined their associations with mean land surface temperature, upper-tail thermal exposure, and intra-block thermal variability. Results show that mean and upper-tail LST exhibit strong spatial clustering, and the locations of hot and cool blocks become more persistent under extreme heat. Blocks with higher green and blue land-cover fractions generally have lower thermal levels, while vegetation greenness and water-related surface conditions show stronger cooling associations during extreme heat. In addition, greater water-related spatial heterogeneity is associated with larger temperature differences within blocks, particularly under extreme heat. A sensitivity test using Dynamic World annual summer fractions for 2016–2025 produces broadly consistent results. These findings highlight the need to consider blue-green configuration, functional surface conditions, and spatial heterogeneity jointly in climate-adaptive urban planning.

ID: 87

Climate Simulation of Nature-Based Solutions to Mitigate the Effects of the Urban Heat Island in the Coastal City of Valparaíso

Pamela Muñoz Ossandón¹, Massimo Palme²

¹Universidad Técnica Federico Santa María

²Universidad Católica del Norte

ABSTRACT

The climate change effects manifest differently worldwide, yet one phenomenon consistently affecting major cities is the Urban Heat Island (UHI); its impacts reach multiple dimensions of society. The effects on the microclimate create an increasing energy demand to maintain thermal comfort; it also can severely affect the health of at-risk people, including mortality. Furthermore, the lack of mitigation strategies is often linked with socioeconomic vulnerability, underlining the urgent need for adaptable approaches that consider cultural, social, economic, and climatic contexts.

This study examines the UHI effects and nature-based solutions in “El Almendral”, a historic neighborhood in the city of Valparaíso, on the coast of Chile, inserted in the Latin American context. A key challenge was to explore the compatibility of interventions in the microclimate within a heritage setting, aiming not only to enhance environmental performance but also to strengthen the cultural identity and values of the area.

The methodology had three stages: (i) research and assessment; this includes the historical analysis, evaluation of the current state, proposal assessment, field measurements, and satellite image analysis; (ii) scenario simulation, including scenarios definition, modeling, calibration, and results acquisition; and (iii) results analysis, comparative evaluation of environmental changes under the different scenarios.

The findings point out that vegetation integration significantly reduces air temperature, while water presence plays a regulatory role in microclimate dynamics beyond just cooling. Remarkably, the combination of strategies yielded the most effective outcomes, validating that integrated, context-sensitive solutions can mitigate UHI effects while contributing to urban resilience and heritage revitalization.

Keywords: urban heat island, nature-based solutions, mitigation strategies, climate simulation, ENVI-met

ID: 88

Ventilation Mechanism in Idealized Urban Wind Corridors: A Large-Eddy Simulation Approach

Mofan Qiu, Yidi Hou, Lei Yan, and Chun-Ho Liu

Department of Mechanical Engineering, The University of Hong Kong, Hong Kong, China

ABSTRACT

Rapid acceleration of global urbanization has intensified environmental challenges in densely built areas, including urban heat island (UHI) and air pollution. Urban wind corridors (UWCs) play vital roles in improving thermal comfort and air quality by channeling clean, cool air into built-up districts and enhancing pollutant removal. Urban morphology is a primary determinant of the near-surface wind environment, including ventilation efficiency within UWCs. However, the fundamental ventilation mechanisms in UWCs and the specific influence of urban morphology on ventilation efficiency remain insufficiently understood. To address this issue, large-eddy simulations (LESs) were carried out for eight roughness-element configurations to examine how the UWC width l_{wc} affects ventilation efficiency and the underlying flow mechanisms. The effects of corridor width on turbulence statistics are quantified and compared across different roughness-element configurations. Quadrant analysis is applied to evaluate the impulse contributions of turbulent events, showing that narrower UWCs are associated with relatively longer ejection durations but weaker quadrant impulses. Spectral analysis is further conducted to examine scale-dependent changes in turbulence, revealing the coexistence of small-scale motions () and very-large-scale motions, while the characteristic wavelength of small-scale vortical structures decreases as the corridor width narrows. In addition, four quantitative indicators are employed to assess ventilation efficiency across the idealized urban morphologies.

Keywords: Large-eddy simulation, turbulent boundary layer, pedestrian-level ventilation.

ID: 89

Urban Vegetation Configurations and Surface Albedo Effects on Pedestrian Thermal Comfort: ENVI-met Simulations in Osaka

Erlin Zou¹, Zhichao Jiao², Craig Farnham³, Jihui Yuan^{4,*}

^{1,3,4}Osaka Metropolitan University, Osaka, Japan

²Yantai University, Yantai, China

ABSTRACT

This study evaluates how vegetation configuration and building-surface solar reflectance influence pedestrian thermal comfort in compact low-rise neighborhoods in Osaka using ENVI-met.

A standardized block was used to test 54 scenarios that combine ground greenery from 5% to 30% with wall and roof reflectance from 0.1 to 0.9 while varying tree and grass shares. Potential air temperature (PAT), a street-level indicator of near-surface air heating, was evaluated with Universal Thermal Climate Index (UTCI) and Physiological Equivalent Temperature (PET). Increasing reflectance reduced PAT by about 0.7 to 0.9°C but increased UTCI by about 0.2 to 0.25°C and PET by about 0.7 to 0.8°C, implying higher reflected short-wave exposure. Under fixed reflectance, trees were the primary driver, while additional grass caused only minor changes once tree provision was unchanged. Keeping total greenery constant, the 10% trees + 5% grass case outperformed the 5% trees + 5% grass + 5% rooftop shrubs case during peak heat hours, with UTCI about 0.3 to 0.6°C lower and PET about 0.2 to 0.4°C lower, while PAT differences remained small.

Applying the preferred strategy to a 200 m × 200 m residential district near Minami-Tatsumi Station in Osaka City yielded modest yet consistent improvements: PET decreased by approximately 0.42 °C and UTCI by about 0.24 °C, while PAT showed minimal change. Overall, the results suggest prioritizing street-level tree shading, coordinating albedo interventions with shading and street-canyon geometry, and considering rooftop greening as a supplementary measure where ground space is limited. These findings provide a practical and implementable basis for heat-mitigation planning in dense residential districts.

Keywords: Urban heat island (UHI), urban greenery, rooftop greening, surface albedo, universal thermal climate index (UTCI), physiological equivalent temperature (PET), ENVI-met.

ID: 94**An Integrated Simulation Approach for Evaluating Urban Cool Spot Performance with Longwave Radiation Considerations***Xingyu LI¹, Minako NABESHIMA², Masatoshi NISHIOKA³**^{1,2,3}Osaka Metropolitan University, Osaka, Japan***ABSTRACT**

Although urban cool spots are effective UHI countermeasures, conventional simulations often overlook longwave radiation from heated surroundings. This study introduces the SolairL model, which treats shading devices as two-layer elements and calculates their upper and lower surface temperatures separately. The model also explicitly incorporates longwave contributions from building walls. Field measurements on a membrane tent were used for validation (cvRMSE <10%). Key findings show that changing the tent's geometry from flat to pyramid shape alters view factors. This reduces the amount of longwave radiation received by the bottom surface from 69 W/m² to 22 W/m² and produces a morning surface temperature difference of 1.4°C. These results demonstrate that longwave design must account for surrounding geometry. The SolairL model provides an extensible simulation framework for evaluating cool spots.

ID: 98**Adaptation and Calibration of the Eixample Model from Barcelona for Urban Climate in Valparaíso, Chile***Claudio Carrasco¹, Massimo Palme², Antoni Isalgué³, Clemente Ferrer⁴**¹Universidad de Valparaíso, Valparaíso [Chile]**²Universidad Técnica Federico Santa María, Valparaíso [Chile]**³Polytechnic University of Catalonia, Barcelona [Spain]**⁴Pontificia Universidad Católica de Chile, Santiago [Chile]***ABSTRACT**

Human activities, urban morphology, construction materials, and traffic have significant effects on urban climate and are key variables for understanding local thermal conditions. Urban climate models provide useful tools for describing and predicting these effects, but their transferability from one city to another requires local adaptation and validation, especially in coastal environments where sea-breeze penetration influences canyon-scale thermal behavior. This study adapts the Eixample urban climate model, originally developed for Barcelona, to the financial district of Valparaíso, Chile, a coastal Mediterranean city on the South Pacific. The adaptation incorporates a zonal frontal permeability descriptor, Perm_{fz}, to represent the capacity of the urban fabric to allow horizontal wind penetration under sea-breeze conditions. Field measurements were collected at 12 urban canyon points at pedestrian level during clear-sky winter conditions and used as the validation benchmark. Air temperature, relative humidity, wind speed, and surface temperature were recorded at 10:00, 14:00, and 20:00, while meteorological boundary conditions were obtained from a reference weather station. The adapted model showed strong agreement with field measurements, with $R^2 = 0.81$ and $r = 0.9007$ for air temperature, and $R^2 = 0.84$ and $r = 0.9145$ for air temperature variation. A Bayesian calibration framework was then applied to assess parameter transferability and uncertainty. The results show that topographic, radiative, and permeability-related parameters remain relatively transferable, whereas activity and traffic coefficients require local recalibration due to the influence of sea-breeze ventilation and urban morphology.

Keywords: Urban climate model, urban morphology, bayesian calibration, sea-breeze permeability.

ID: 99

Parameterization on Thermal Environments of A Playground Experiment Using the Grasshopper Plug-Ins

Jing Xiao¹, Ruixuan Li², Takaya Yuizono³, Yiao He⁴, Binbin Yao⁵

^{1,4}*School of Design and Innovation, Zhejiang Normal University*

²*School of Art and Design, Dalian Polytechnic University*

³*School of Advanced Science and Technology, Japan Advanced Institute of Science and Technology*

⁵*School of Landscape Architecture and Art, Henan Agricultural University*

ABSTRACT

Parametric building simulation is little based on their effect on microclimate; most software engines primarily address energy consumption within indoor spaces and overlook the impact of the Urban Heat Island (UHI) phenomenon on outdoor sports areas. Within this framework, this paper presents a comparative simulation workflow for the built environment, where Dragonfly is integrated into the Grasshopper interface with the assistance of Ladybug (LB) and Honeybee (LB&HB) to model the co-relationships between urban microclimate and outdoor thermal comfort. A playground modeled the effect of different plug-ins on outdoor thermal comfort using microclimate parameters and the Universal Thermal Climate Index (UTCI). The microclimate results indicated strong accuracy for wind speed and air temperature predictions (STDE: 0.10 m/s, 0.20 °C). For relative humidity, MAE and MBE (MAE: 11.14–11.91%, MBE: 7.44–8.40%) showed higher error values compared to STDE (0.93–1.03 %), with exhibiting negative bias in humidity predictions. Analysis of urban heat island intensity showed LB (R2=0.9) effectively captured overall patterns across different urban morphologies, while LB&HB (R2=0.6-0.7) performed well during simulation periods. These findings highlight the importance of parameterization Plug-in cross-comparison to address model-specific uncertainties and provide comprehensive insights into extreme heat events. Also, these results have driven the authors to a critical insight into the algorithms implanted in new workflows that greatly improve efficiency and provide practical design insights to facilitate parametric analysis of precise indoor and outdoor environmental strategies.

ID: 105

Surface Energy Partitioning and Urban Heat Island Dynamics in Three Temperate Italian Cities: A Decade-Long Satellite-Based Assessment (2015–2025)

Hafiz Adnan Ahmad Baig¹, Alberto Muscio²

^{1,2}*Dipartimento di Ingegneria "Enzo Ferrari", University of Modena and Reggio Emilia (UNIMORE) Modena, Italy*

ABSTRACT

Urban Heat Islands represent a great challenge concerning sustainable urban planning in temperate European cities, which are experiencing climatic changes reflected in an increase in thermal stress. Although satellite remote sensing has significantly improved UHI monitoring, the role of surface-atmosphere energy partitioning in urban warming is still not fully understood. This research is conducted by combining Landsat satellite data and ground-based meteorological observations respectively to study the dynamics of UHI in Modena, Carpi and Reggio Emilia in 2015-2025. Land Surface Temperature was extracted from thermal bands while NDVI, NDBI, albedo and evapotranspiration, latent heat flux and Heat Stress Index were used to describe surface - atmosphere energy exchanges. Time-series analysis reveals stability of thermal hierarchy with a constant variability of Modena, Carpi and Reggio Emilia, despite same climate conditions of the region. Dominant temperatures in Modena are associated with low albedo, high imperviousness, low vegetation abundance and low evapotranspiration favouring sensible heat storage. In contrast, albedo, imperviousness, vegetation cover and evapotranspiration in the study area are much higher in Reggio Emilia, which will improve latent heat dissipation and cooling. Ground data show that atmospheric forcing is very similar in the cities. The results thus provide evidence that long-term UHI intensity is governed primarily by urban surface properties, and not regional climate, highlighting specific urban areas where mitigation strategies focusing on materials, vegetation and urban morphology could be prioritised.

Keywords: Urban heat island, thermal remote sensing, surface energy balance, urban climate.

ID: 109**Thermal Environment Characteristics and Passenger Comfort in a Metro Station Area in Jinan, China***Jianlu Xuanyuan¹, Ruihan Wei^{2,*}, Zhen Ren^{3,*}
^{1,2,3}Shandong Jianzhu University, Jinan, China***ABSTRACT**

Metro stations are semi-enclosed underground environments in which passenger thermal comfort is influenced by the combined effects of air temperature, humidity, air movement, and local spatial conditions. This study investigated summer thermal conditions and passenger comfort at Olympic Sports Center Station in Jinan through field measurements and questionnaire surveys, yielding 277 valid responses. Linear regression identified a neutral temperature of 21.23 °C, while nonlinear regression yielded an 85% acceptable temperature range of 25.7–27.9 °C. Among 216 respondents with near-neutral thermal sensation votes ranging from –1 to +1, 42.6% perceived insufficient air movement and 18.1% reported humid sensations. Environmental differences were also observed among the concourse, transfer-passage entrance, and platform areas affected by train-induced airflow. These findings indicate that air temperature alone cannot fully represent passenger comfort, as humidity, airflow perception, and local spatial conditions are also relevant to residual discomfort. The results support a more integrated assessment of metro thermal environments and provide an empirical basis for future evaluation of operational strategies that account for temporal variability and spatial differences.

Keywords: Metro thermal comfort, thermal acceptability, air movement, underground microclimate.

ID: 113**Heat Island Mitigation Strategies for High-Density Residential Superblocks: A Case Study of Nanjing***Jiajie Lu¹, Jingjin Li², Xinxuan Yan³
^{1,2,3}Southeast University, Nanjing, China***ABSTRACT**

In the context of climate change and rapid urbanization, high-density residential superblocks face increasing thermal stress. This study proposes a capacity-constrained urban renewal framework to improve pedestrian thermal conditions through coordinated morphological adjustment. A typical 800 × 800 m superblock in Nanjing was selected, and an integrated workflow combining virtual plot generation, rule-based renewal, multi-objective optimization, and UTCI simulation was developed. Three renewal scenarios were constructed using different demolition, new-construction, and green-space ratios. Under extreme summer conditions, increasing renewal intensity reduced daytime Mean UTCI and Mean Maximum UTCI by up to 0.40°C and 0.58°C, respectively. Maximum local cooling reached 3.59°C, while renewed areas were up to 1.56°C cooler than non-renewed areas. However, slight nighttime warming was observed. The proposed framework provides an operational and quantifiable approach for coordinating development capacity and thermal improvement in high-density urban renewal.

Keywords: High-density residential superblock, urban renewal, heat mitigation, outdoor thermal comfort.

ID: 115

Assessment of Green Roof Cooling Performance and Operational Carbon Potential Based on Roof Cooling Unit

Xin Dong¹, Bao-Jie He²

^{1,2}Chongqing University

ABSTRACT

Cities, the main human settlement, carry dual responsibilities of decarbonization and resilience building under (local) climate change. However, many built-up areas, especially in high-density cities, have limited space for additional mitigation and adaptation interventions. Green roof (GR) is an alternative strategy that synergizes decarbonization and cooling benefits, showing great potential for urban renewal and low-carbon development. The decarbonization benefits are associated with insulating building envelopes and cooling local environments. While the latter is critical for mitigating heat islands, this performance is often assessed by black-box simulations, leaving the mechanisms and performance thresholds poorly understood and hindering accurate energy assessments. This study characterizes a roof cooling unit and develops a hybrid assessment framework to overcome the research gaps. Based on heat transfer principles and calibrated model, an analytical model was built for spatial cooling process investigation. This approach shows a complete workflow, from elucidating the generation mechanism and creating a predictive model to conducting assessments across diverse scales. The analytical solutions showed a good performance to parameterize surface (canopy) temperature dynamics of the test subjects under three typical weather conditions. The upper threshold for clear-day spatial cooling (ΔT) was revealed, 3.46°C under variable building-environmental parameters. Moreover, cooling exceeding 2.00°C lasted for 13 hours (13:00–01:00), and cooling above 3.00°C lasted for 3 hours (21:00–00:00), with the maximum ΔT sensitivity (2.3°C) occurring during 21:00–0:00. In comparison, the ΔT upper threshold was 1.96°C under variable maintenance parameters. A multi-scenario assessment of operational carbon benefits revealed the maximum carbon reduction from insulation and spatial cooling was 30.82 and 55.65 g·CO₂·m²·d⁻¹, respectively, corresponding to daily average energy savings of 0.44% and 0.73%. Furthermore, the advantages and scalability of this hybrid method were verified. Overall, this study contributes to a parameterized framework for GR large-scale decarbonization and cooling assessments.

ID: 118

Climate-Adaptive Design Strategies for Heat-Resilient Urban Greenways in Mountainous Cities

Ke Xiong¹, Dangshen Yang², Peilin Luo³, Bao-Jie He^{4,*}

^{1,3}Hubei Engineering Technology Research Center for Disaster Prevention and Mitigation, China Three Gorges University, Yichang, China

²China Southwest Architectural Design and Research Institute Corp.Ltd., Chengdu, China

⁴Centre for Climate-Resilient and Low-Carbon Cities, School of Architecture and Urban Planning, Ministry of Education, Key Laboratory of New Technology for Construction of Cities in Mountain Area, Chongqing University, Chongqing, China

ABSTRACT

Against the backdrop of intensifying heat risks under climate change, mountainous cities offer distinctive topographic and spatial resources for microclimate regulation, yet most existing design approaches remain grounded in flatland settings. This study develops a three-dimensional climate-adaptive framework for heat-resilient urban greenways by integrating site-element utilization, bioclimatic regulation, and material and structural optimization. Using the cliff-line greenway in Fotuguan Park, Chongqing, as a case study, field measurements and parametric simulations were combined to evaluate the individual and synergistic effects of these strategies. The results show that air-raised shelters and multi-tier cliff-side platforms function as localized cool sources and climate refuges, while trellis greening and elevated permeable walkways further reduce heat exposure. Combined interventions generally produced complementary thermal benefits, although the magnitude of improvement varied across seasons and scenarios. However, dense vegetation may impede nocturnal heat dissipation and increase winter cold discomfort, highlighting the need for deciduous planting and seasonally adaptive design. The main contribution of this study is an empirically supported framework that translates mountainous topography and site-specific spatial elements into actionable climate-adaptive design strategies, providing methodological and practical guidance for heat-resilient public spaces in high-density mountainous cities.

Keywords: Climate-adaptive design, urban greenways, mountainous cities, built environment, thermal comfort.

ID: 119

Surface and Canopy Layer Urban Heat Island Studies of Bangkok Local Climate Zones

Pattaranan Takkanon¹, Natrada Boonthad², Rathphum Pakarnseree³, Arthit Limpiyakorn⁴

^{1,2,3,4}Faculty of Architecture, Kasetsart University, Bangkok, Thailand

ABSTRACT

Bangkok Metropolitan Area (BMA) can be classified into 17 classes of Local Climate Zone (LCZ) based on WUDAPT criteria. Studies of surface urban heat island (SUHI) and canopy layer urban heat island (CLUHI) show discrepancy due to time of occurrence and magnitude. The current paper focuses on LCZ 1-LCZ 10 of built-up areas to study how urban geometry affects their thermal condition and cooling potential. Research methods include local climate zones (LCZ) classification based on data from remote sensing technology and seasonal field investigations in 30 areas representing all 10 LCZs. The study investigates variables that shape the urban geometry including Sky View Factor (SVF) and Aspect Ratio and their impact on thermal conditions in the city. Relationships between urban geometry variables are established after analyzing all results. Results show different trends of the relationship between urban geometry and land surface temperatures studied through thermal maps and the relationship between urban geometry and seasonal urban heat island effect obtained from the field measurement. While the results from macro-scale study show that area mainly consists of LCZ 9 (Sparsely built) gives lowest temperature, the results from micro-scale study show that LCZ 4 (Open high-rise) gives the lowest. Areas with mid-rise and low-rise buildings tend to show high temperatures especially during summer afternoon. These results at pedestrian level show unique characteristics of Bangkok as low SVF and high aspect ratio can be beneficial in providing shade in urban canyon, thus reducing amount of heat absorbed in urban canyon surfaces.

Keywords: Surface urban heat island, canopy layer urban heat island, local climate zone, Bangkok.

ID: 122

Mapping Schoolyard Heat Exposure through Machine Learning and Satellite Data: A Case of Sub-Saharan Africa

Rodrigue Samb¹, Uttam Kumar Roy², Mannavi Suneja³

^{1, 2, 3}Department of Architecture and Planning, Indian Institute of Technology

Roorkee, 247667, India

¹School of Engineering and Architecture, University of The Gambia, P.O.Box 3530, The Gambia

ABSTRACT

Surface Urban Heat Island (SUHI) effects are increasingly impacting rapidly urbanizing regions, with schoolyards emerging as vulnerable microenvironments for children's heat exposure. This study quantifies SUHI intensity across 20 public and private schoolyards in the Greater Banjul Area, The Gambia, during the peak warm season (June–August 2024). Concentric buffers (50 m, 100 m, 500 m, 1000 m) were generated around each school to assess localized and neighborhood-scale thermal conditions. Sentinel-2 and Landsat imagery were used to derive land-cover maps, including vegetation, impervious surfaces, bare soil, and water, and to retrieve land surface temperature (LST). Supervised machine learning models, Random Forest (RF) and XGBoost (XGB), were applied to predict LST based on land-cover composition and spatial features. Results indicate significantly higher variability at smaller buffers (50–100 m), suggesting localized thermal effects on land surface temperature in schoolyards; mean LST was consistent across buffers (27.1–27.5°C), though observed values ranged more widely from 18.8°C to 32.8°C across the 20 schoolyards. Heat-reducing vegetation was limited to 18.8% ± 7.9% of these schoolyards, which were instead dominated by impervious surfaces (36.7% ± 14.1%) and bare soil (39.8% ± 12.4%). Random Forest (27.38 °C ± 1.20 °C) and XGBoost (27.34 °C ± 1.23 °C) performed well at predicting LST with small residuals across all 20 sites, indicating that land cover is a primary driver of micro-scale heat exposure in schools. These insights provide practical guidance for climate-resilient, vegetation-inclusive schoolyard design in sub-Saharan Africa and transferable evidence for urban heat mitigation that benefits schools in fast-growing cities.

Keywords: Schoolyard, urban heat island (UHI), machine learning, sub-saharan africa (SSA).

ID: 124**Advancing Radiative Cooling Coatings for Urban Heat Island Mitigation***Xinxian Yu¹, Chun Chen²*¹*Guangdong Polytechnic Normal University*²*The Chinese University of Hong Kong***ABSTRACT**

Radiative cooling coatings represent a promising class of cool materials for mitigating urban heat island effects and reducing building energy demand. By passively dissipating heat without electricity or greenhouse gas emissions, these coatings offer a scalable and sustainable strategy for urban applications. Recent studies have suggested that incorporating broken hollow microspheres can improve the cooling performance of such coatings, yet the mechanisms underlying this enhancement remain unclear.

In this paper, we combined experimental analysis with numerical simulations to investigate whether the cooling improvement arises from the altered geometry of microsphere fragments or from the formation of air voids. Our results demonstrate that the dominant factor is the generation of new air voids, approximately 6 μm in diameter, created around the microsphere fragments during ball-milling. These air voids act as additional scattering centers, significantly increasing solar reflectivity and thereby enhancing the coating's cooling performance.

This study clarifies the physical mechanisms governing radiative cooling coatings with hollow microsphere additives and highlights air void engineering as a critical design principle. The findings provide valuable guidance for developing high-performance, low-cost cool materials, with potential to advance urban heat island mitigation strategies and sustainable building envelope technologies.

Keywords: Radiative cooling coatings, Cool materials, Urban heat island mitigation, Solar reflectivity

ID: 125**Mapping Schoolyard Heat Exposure through Machine Learning and Satellite Data: A Case of Sub-Saharan Africa***Ruo Lan Zhang¹, Sok Yee Yeo², Duo Xu³, Xiao Long Wang⁴*^{1,2,3}*School of Human Settlements and Civil Engineering, Xi'an Jiaotong University*⁴*Shanxi Academy of Ancient Building and Painted Sculpture & Fresco Preservation***ABSTRACT**

Surface Urban Heat Island (SUHI) effects are increasingly impacting rapidly urbanizing regions, with schoolyards emerging as vulnerable microenvironments for children's heat exposure. This study quantifies SUHI intensity across 20 public and private schoolyards in the Greater Banjul Area, The Gambia, during the peak warm season (June–August 2024). Concentric buffers (50 m, 100 m, 500 m, 1000 m) were generated around each school to assess localized and neighborhood-scale thermal conditions. Sentinel-2 and Landsat imagery were used to derive land-cover maps, including vegetation, impervious surfaces, bare soil, and water, and to retrieve land surface temperature (LST). Supervised machine learning models, Random Forest (RF) and XGBoost (XGB), were applied to predict LST based on land-cover composition and spatial features. Results indicate significantly higher variability at smaller buffers (50–100 m), suggesting localized thermal effects on land surface temperature in schoolyards; mean LST was consistent across buffers (27.1–27.5°C), though observed values ranged more widely from 18.8°C to 32.8°C across the 20 schoolyards. Heat-reducing vegetation was limited to $18.8\% \pm 7.9\%$ of these schoolyards, which were instead dominated by impervious surfaces ($36.7\% \pm 14.1\%$) and bare soil ($39.8\% \pm 12.4\%$). Random Forest ($27.38\text{ }^{\circ}\text{C} \pm 1.20\text{ }^{\circ}\text{C}$) and XGBoost ($27.34\text{ }^{\circ}\text{C} \pm 1.23\text{ }^{\circ}\text{C}$) performed well at predicting LST with small residuals across all 20 sites, indicating that land cover is a primary driver of micro-scale heat exposure in schools. These insights provide practical guidance for climate-resilient, vegetation-inclusive schoolyard design in sub-Saharan Africa and transferable evidence for urban heat mitigation that benefits schools in fast-growing cities.

ID: 126

A Novel Multi-Objective Optimization Approach to Urban Design for Adapting and Mitigating Urban Heat Island Effects in High-Density Built Environments

*Yuqi Tian¹, Jingjin Li², Ying Li³
^{1,2,3}Southeast University, Nanjing, China*

ABSTRACT

The Urban Heat Island (UHI) effect is particularly pronounced in high-density built environments, posing severe challenges to public health and urban sustainability. This study proposes a generative modeling-based and multi-objective optimization urban design framework, using Nanjing as a case study, that integrates construction capacity, urban morphology, and green infrastructure. A three-stage parametric model was developed on the Rhino–Grasshopper platform, and building energy efficiency and mean radiant temperature (MRT) were evaluated using Dragonfly and Ladybug simulations. Pearson correlation analysis was applied to identify key morphological parameters influencing performance. The results highlight that the proposed workflow achieves a solar energy substitution rate of 18.5%. On average, each tree reduces site radiation by 415.5 kWh, optimized tree placement lowers daytime MRT by 0.6 °C. Construction capacity has a greater impact on energy efficiency than morphological configuration. Among all indicators, average building height (AvH) exhibits the strongest negative correlation with solar utilization ($r = -0.83$), while height difference ratio (DifHR) shows the strongest correlation with energy use intensity (EUI) ($r = -0.66$). The findings demonstrate that this performance-driven framework enables synergies between UHI adaptation, energy efficiency, and renewable energy potential, offering actionable tools and strategies for heat-resilient and low-carbon urban planning in high-density cities.

Keywords: Urban heat island, high-density built environment, multi-objective optimization, parametric modeling.

ID: 128

Numerical Investigation of Sky Radiation Cooling in Different Climatic Conditions

*Paolo Magazzeni¹, Gianmarco Sciurti¹, Michele Cossu¹, Claudia Fabiani², Anna Laura Pisello², Alberto Muscio¹
^{1,2,3,6}University of Modena and Reggio Emilia
^{4,5}University of Perugia*

ABSTRACT

This work presents a numerical study of sky radiation cooling applied to multilayer surfaces, with particular emphasis on the temperature difference between the surface and the ambient air under different climatic conditions. The investigated configuration consists of a bilayer system, where TiO₂ and SiO₂ are deposited on an aluminum substrate, selected for its favorable optical and thermal properties. The analysis considered three distinct climatic scenarios: tropical, tropical arid, and mid-latitude summer. The thermal response was assessed by coupling radiative exchange in the infrared range (2.5–20 μm) with convective heat transfer, modeled under two ventilation levels—low and medium—corresponding to different convective coefficients. The simulation framework accounted for the spectral emissivity of the materials and the corresponding incoming atmospheric radiation, enabling a detailed evaluation of the cooling potential across climates. Results highlight that the surface-to-air temperature difference strongly depends on both the optical response of the multilayer structure and the atmospheric transparency characteristic of each climate. More favorable cooling performance was observed under arid conditions due to reduced atmospheric emission, while tropical climates showed comparatively lower cooling effectiveness. Mid-latitude summer scenarios provided intermediate outcomes. The quantitative evaluation confirms that specific material-climate pairings can significantly enhance or limit the achievable cooling potential.

Keywords: sky radiation cooling, radiative cooling, passive cooling, multilayer coatings, infrared radiation, spectral emissivity, atmospheric transparency

ID: 130

Does Lower Urban Heat Island Intensity Always Mean Thermally Comfortable? An Empirical Investigation of Hankou Central Urban Area

Qiu Jin^{1,2}, Xinyi Hu^{1,2}, Qinyu Wang^{1,2}, Wenjian Pan^{1,2,3,*}

¹*School of Architecture and Urban Planning, Huazhong University of Science and Technology, Wuhan, 430074, China*

²*Hubei Engineering & Technology Research Center of Urbanization, Wuhan, 430074, China*

³*Key Laboratory of Low-Altitude Urban-Rural Construction Technology, Hubei Provincial MOHURD, Wuhan, 430074, China*

ABSTRACT

Urban heat island (UHI) is a widely observed dynamic climatic phenomenon and index for urban thermal environmental evaluation that fluctuates diurnally and seasonally. It does not always correspond to ideal thermal comfort conditions due to the integrated impacts of multiple objective and subjective factors. This study carried out on-site measurement during typical summertime in Wuhan's Hankou central urban area to examine local-scale UHI intensity (UHII), physiological equivalent temperature (PET), and universal thermal climate index (UTCI). It then conducted computational simulations on ENVI-met to assess performances and dynamics of thermal environments in Hankou, to explore the trade-offs among UHII, PET and UTCI. The findings indicate that at micro-scale, UHII does not demonstrate the anticipated linear or synchronous relationship with PET and UTCI, but instead, reveals considerable discrepancies. The duration of daily coverage for significant UHII typically exceeds that of PET heat stress (PET>35°C) and UTCI heat stress (UTCI>32°C). A significant discrepancy exists between the maximum value of UHII and the maximum value of PET and UTCI, potentially resulting in a "heat island-thermal comfort divergence", meaning PET and UTCI have attained the heat stress thresholds, whilst UHII indicates a negative value (namely, urban cool island effect). This paper brings attention to the biases caused by oversimplification of thermal environmental indices for urban environmental evaluations and the potential assessment errors arising from their mixed application. The paper also provides insights into more effective low-carbon (re)development and climate adaptive urban governance.

Keywords: Urban heat island, thermal comfort, climate adaptability, central urban area.

ID: 134

Develop and Test A Fluorine-Free Water-Based Radiative Cooling Paint for Urban Heat Island Mitigation

Jiashuo Wang¹, Riccardo Paolini², Ioannis Kousis³, Matthaios Santamouris⁴, Teng Xiong⁵
^{1,2,3,4,5}UNSW

ABSTRACT

Passive daytime radiative cooling (PDRC) is a potential passive energy cooling solution for buildings and cities, enabling heat dissipation to outer space through the atmospheric window. A variety of PDRC materials have been developed, evaluated, and tested in numerous studies. For the widespread adoption of PDRC technologies in buildings, scalable and eco-friendly PDRC paints are particularly desirable and practicable as they can be easily sprayed or brushed on building surfaces. In this study, we developed a scalable fluorine-free water-based PDRC paint by introducing SiO₂ microparticles and glass bubbles into a pure acrylic emulsion. The developed white-color PDRC paint exhibits a solar reflectance of 0.91 and an average broadband infrared emissivity of 0.96. The agitation-based synthetic method is simple, eco-friendly and affordable, without any VOC emissions. On-site experiments were conducted in Sydney, Australia, which is characterized by high humidity and hot climates. Furthermore, energy simulations were performed to evaluate the cooling performance of the developed PDRC paint across various cities under different climatic conditions. The simulation results highlight the significant potential of this PDRC paint in building cooling and urban heat island mitigation, supporting its practical implementation in building applications.

ID: 136

Socio-Environmental Predictors of Heat-Related Quality of Life in Cairo Megacity

Tania Sharmin¹, Heba Allah Essam El-Din Khalil², Sherin Gammaz², Nowf Maaith³, Yasmina Mohamed², Davis Juliet⁴, Zhiwen Luo⁴, Simon Lannon⁴, Lisa Hurt⁵

¹*Cardiff University*

^{2,3,5}*Department of Architectural Engineering, Faculty of Engineering, Cairo University.*

⁴*Welsh School of Architecture Cardiff University*

^{6,7,8}*Welsh School of Architecture, Cardiff University*

⁹*School of Medicine, Cardiff University*

ABSTRACT

Extreme heat poses escalating public health risks in Cairo, a rapidly warming desert megacity characterised by high urban density and limited green infrastructure. While heat-health research often focuses on meteorological exposure, less attention has been paid to the integrated socio-environmental determinants shaping perceived well-being during heat stress. This study investigates predictors of perceived Quality of Life (QoL) under extreme heat conditions using a pedestrian-based survey (n=550) conducted in August 2024. To contextualise perceived thermal conditions, microclimatic and air-quality measurements were collected across the study area, including air temperature, relative humidity, wind speed, PM2.5, PM10, and CO₂ concentrations. A multivariate linear regression model incorporating socio-environmental predictors (e.g. thermal perception, socio-demographic characteristics, behavioural exposure) was developed to examine determinants of perceived QoL under extreme heat conditions. The integrated model explained 31.5% of the variance in QoL. Significant predictors included environmental health perceptions, green infrastructure preferences, shading strategies, leisure opportunities, exercise frequency, heat-avoidance behaviours, perceptions of economic vulnerability, and health-related limitations. Results demonstrate that QoL under heat stress is not driven solely by environmental exposure, but by a broad interplay of environmental perceptions, behavioural adaptation, and health vulnerability factors. The findings support integrated, health-responsive urban adaptation strategies in hot-arid megacities.

Keywords: Heat-health Survey, Desert Megacity, Outdoor Thermal Comfort, Quality of Life, Health Status

ID: 138

Optimized Design for Elderly Users in Urban Parks Under Dynamic Thermal Comfort Modeling in Hot Subtropical Area

Ge Ge¹, Wu Deng²

^{1,2}*University of Nottingham Ningbo China*

ABSTRACT

The twin challenges of an increasing urban heat island and an ageing population suggest the need for research on outdoor thermal comfort for vulnerable groups such as the elderly. However, traditional thermal comfort studies have relied on static environmental parameters. This study goes beyond static analyses and evaluates the dynamic thermal comfort (DTC) of the elderly in parks during summer and winter in a typical subtropical region. Within the conceptual framework of ‘Thermal Walking’, this research investigates the dynamic thermal comfort of elderly users in urban parks within subtropical regions, integrating mobile microclimate measurements with physiological parameters and park environmental features. A "Stop-and-Go" strategy is employed to capture spatially varying thermal conditions along park pathways. Using statistical analysis and machine learning techniques, an optimized predictive model of elderly thermal comfort was developed. The model accurately estimates dynamic thermal perception and generates thermal comfort distribution maps to identify critical hotspots. The results provide evidence-based design recommendations for improving pedestrian pathways and overall park layouts to enhance thermal adaptability for aging populations. The results can provide theoretical basis and intelligent decision-making tools for climate-adaptive landscape design and age-friendly urban park planning.

ID: 140**Predicting Urban Vertical Wind Speed Profiles Using Multi-Location Doppler LiDAR Observations and Explainable Machine Learning***Yueyang HE¹, Shisheng CHEN², Weijie SUN³, Edward⁴**^{1,3,4}School of Architecture, The Chinese University of Hong Kong, Hong Kong, China**²School of Architecture and Urban-Rural Planning, Fuzhou University, Fuzhou, China***ABSTRACT**

Accurate prediction of urban vertical wind speed profiles is fundamental to understanding the urban atmospheric environment and provides essential inputs for building performance simulation, urban microclimate modeling, and climate-responsive urban design. However, vertical wind profiles vary substantially with atmospheric stability and the surrounding surface characteristics, making reliable prediction challenging.

This study develops an explainable machine learning framework for predicting vertical wind speed profiles in high-density urban environments using observations collected from three ground-based Doppler LiDAR stations across Hong Kong. The observed wind profiles are first classified according to atmospheric stability conditions and subsequently represented using a power-law relationship. XGBoost models are then developed to predict the corresponding power-law parameters from a comprehensive set of variables, including building morphology, street configuration, vegetation characteristics, terrain, and meteorological conditions. To improve model interpretability, SHapley Additive exPlanations (SHAP) are employed to quantify the relative importance of individual predictors and reveal how urban morphology and meteorological factors jointly influence vertical wind profiles.

By integrating multi-location Doppler LiDAR observations with explainable machine learning, the proposed framework enables efficient prediction of vertical wind speed profiles across diverse urban environments and atmospheric conditions. The predicted power-law parameters provide realistic inflow boundary conditions for building performance and urban microclimate simulations, while the reconstructed wind profiles serve as valuable reference data for climate model evaluation and planning and design practices.

Keywords: Doppler LiDAR, vertical wind speed profile, machine learning, power-law model.

ID: 145**Impacts of Blue–Green Space Patterns on Land Surface Temperature across Different Functional Zones: A Case Study of Shanghai***Yuncong Weng¹, Yao Xu², Wenshan Su³, Jiawei Yao^{4,*}**^{1,3,4}College of Architecture and Urban Planning, Tongji University, Shanghai, China**²School of Landscape Architecture, Beijing Forestry University, Beijing, China***ABSTRACT**

Under global warming, intensified urban heat islands have made spatial variations in land surface temperature (LST) an important indicator of urban thermal environments. Although blue–green spaces play a key role in heat regulation, their cooling mechanisms across functional zones and the non-linear interactions among blue–green elements remain insufficiently understood. Taking Shanghai as a case study, this study uses urban blocks as the analytical unit, constructs a multi-dimensional blue–green morphology indicator system, and applies the Gradient Boosting Regression Trees (GBRT) model to model block-scale LST. SHapley Additive exPlanations (SHAP) are then used to interpret the importance, non-linear responses, and interaction effects of blue–green indicators.

The results show that urban thermal environments are jointly shaped by major waterway cooling corridors, heterogeneous green-space morphology, and blue–green connectivity, with cooling effects strongest within 0–2 km of major waterways. The optimal patch morphological complexity varies with vegetation coverage levels, while patch area expansion shows diminishing marginal returns. High-density fragmented patches are less effective in further reducing LST, highlighting the importance of connectivity. Functional zone analysis shows that residential and public service areas exhibit convergent and relatively stable LST response patterns, whereas industrial and commercial areas show stronger heterogeneity, reflected in more divergent dominant indicators and response directions under different blue–green configurations. By revealing functional differences, spatial heterogeneity, and multi-factor synergies, this study improves the understanding of urban blue–green cooling mechanisms and supports refined thermal regulation and blue–green space optimization.

Keywords: Urban thermal environment, blue-green space, functional zones, cooling mechanisms.

ID: 146**Green Roofs in Informal Settlements of A Tropical City in Brazil***Henrique Francisco dos Reis¹, Eleonora Sad de Assis², Rafael Silva Brandão³**^{1,2}Federal University of Minas Gerais**³Federal University of São João del Rei***ABSTRACT**

Green roofs are widely recognized as a nature-based solution for mitigating urban overheating and improving climate resilience. However, their thermal performance in densely built informal settlements under tropical conditions remains insufficiently investigated. This study evaluated the influence of extensive green roofs on the microclimate of Conjunto Paulo VI, an informal settlement in Belo Horizonte, Brazil, using the ENVI-met microclimatic model. Simulations were performed for a representative dry-season day under clear-sky conditions using the Full Forcing approach and locally measured meteorological data. Model reliability was validated through calibration against field measurements, yielding satisfactory performance (MBE = 0.35°C, RMSE = 2.05°C, $r = 0.965$ and $d = 0.913$). Two scenarios were simulated: the current urban configuration and a retrofit scenario in which conventional fiber-cement roofs were replaced by extensive green roofs. The calibrated simulations showed that green roofs primarily reshaped the spatial distribution of surface temperatures by reducing the concentration of thermal hotspots and promoting a more homogeneous thermal field, while producing comparatively smaller changes in air temperature and relative humidity. These effects were associated with increased evapotranspiration, greater thermal inertia and enhanced latent heat exchange. The findings demonstrate the potential of extensive green roofs to improve thermal resilience in tropical informal settlements and provide scientific evidence to support urban climate adaptation strategies.

Keywords: Urban microclimate, informal areas, green roofs, thermohygro-metric simulation.

ID: 147**The Synergistic Effects of Surface Radiative and Vegetation Parameters on the LST and Cooling performance of Campus Green Spaces***Wei Dong¹, Jinxiu Wu²**^{1,2}Southeast University***ABSTRACT**

With the intensification of climate change, frequent heat events have threatened the quality of the urban built environment and public health. As a distinct type of urban functional zone, university campuses play a crucial role in mitigating urban heat islands and enhancing climate adaptability. However, existing studies have primarily focused on the cooling effects of campus vegetation, while the impact of surface radiative conditions on campus cooling performance remains insufficiently explored. Therefore, this study selects the typical surface radiation factors (surface emissivity, albedo, and roughness) and green factors (green area (GA), landscape shape index (LSI), and fraction of vegetation cover (FVC)). Multiple linear regression and random forest models are utilized to explore their impacts on LST and cooling effects. The results reveal that surface emissivity and albedo are significantly correlated with LST and cooling effects, indicating high sensitivity to surface thermal dynamics. GA demonstrated a strong negative correlation with LST, while FVC can exhibit the highest interpretability for both LST and cooling effects. Moderately complex green space shapes can enhance ventilation and heat dissipation, while fragmented green space distribution will weaken the overall cooling capacity. These findings suggest that the cooling performance of campus greenery depends not only on the quantity of green space but also on the integrated influence of surface radiative properties and spatial configuration. Future research should consider optimizing the configuration and spatial distribution of campus green spaces, selecting surface materials with high albedo, and appropriately increasing the complexity of green space morphology to reduce the heat island effect and achieve thermal comfort.

ID: 148

The Influence of Urban Surfaces on the Energy Consumption of Underground Buildings: A Case Study

Yaning Li¹, Runnan Sun², Yue Chang³, Weijun Li⁴, Guoxin Wang⁵, Xilian Luo⁶
^{1,2,6}*School of Human Settlements and Civil Engineering, Xi'an Jiaotong University, Xi'an(China)*

³*Moganshan Geospatial Information Laboratory, Hangzhou, Zhejiang Province(China)*

⁴*China Construction Silk Road Construction Investment Co., Ltd. Xi'an(China)*

⁵*China Construction Eighth Engineering Division Corporation, Shanghai(China)*

ABSTRACT

As urbanization advances, the scarcity of above-ground construction space has driven the rapid expansion of underground developments. Among the factors influencing underground building energy consumption, the characteristics of the underlying surface play a dominant role; however, their quantitative impact mechanisms remain insufficiently verified. This study integrates remote sensing analysis and building energy simulation, using the Xi'an Happiness Forest Belt underground complex as a case study, to examine how different underlying surface conditions and soil cover depths influence underground building energy consumption and to propose corresponding optimization strategies. Results reveal that variations in underlying surface types lead to significant differences in land surface temperature (LST), which subsequently alter soil temperature profiles and, ultimately, the energy demand of underground buildings. Under constant Normalized Difference Vegetation Index (NDVI) conditions, underground building energy consumption shows a decreasing trend with greater overburden depth. As soil cover increases from 1.0 m to 8.0 m, total building load decreases from 2037.2 kW to 1927.1 kW—a 5.4% reduction. The rate of decline gradually diminishes with depth, and 3.0 m represents a critical inflection depth. For a given soil depth, higher NDVI values are associated with lower soil temperatures. When NDVI rises from 0.25 to 0.75, the mean soil temperature within the 1.0–8.0 m range decreases by 3.3 °C, while total building load declines from 2032.6 kW to 1996.6 kW, representing an overall reduction of 1.8%. This research offers insights for reducing underground building energy consumption, lowering carbon emissions, promoting sustainable urban development and spatial resource utilization, and supporting climate change mitigation strategies.

ID: 150

Sustainable Renovation Strategies: Enhancing Quality and Energy Efficiency in Existing Buildings

Sara Nam Sook Rampoldi¹
¹*Politecnico di Milano*

ABSTRACT

This paper analyzes and compares two case studies to explore how the renovation of existing buildings, when designed with attention to material quality and selection, can achieve the dual objectives of reducing land consumption and improving energy efficiency.

Methodology.

We will examine differences in construction details, material usage, and design/technological solutions. The study presents both qualitative assessments of user comfort and quantitative indicators based on current EU energy regulations, allowing for a comprehensive evaluation of performance.

Objectives.

Renovated buildings demonstrate higher overall quality, with durability assessed over medium, long, and very long-term horizons. This study emphasizes the importance of prioritizing high-quality materials and workmanship, reflecting the European tradition of enduring architecture. Such an approach naturally reduces land consumption by focusing on the redevelopment and reuse of existing structures.

Additionally, the paper will highlight operational strategies applicable to sustainable renovation projects. These strategies extend beyond design considerations to include effective site management and organization, ensuring that construction practices align with sustainability goals.

By combining material excellence, thoughtful design, and strategic construction management, this research illustrates how sustainable renovation can create buildings that are not only energy-efficient but also culturally and functionally resilient. The findings aim to inspire architects, engineers, and policymakers to adopt renovation practices that reconcile environmental responsibility with architectural heritage.

ID: 151

Preliminary Study on Machine Learning for the Preventive Conservation of Earthen Heritage: A Case Study on Rammed Earthen Wall Monitoring

Xinyu Jiang¹, Sok Yee Ye^{2,}*

¹*School of Human Settlements and Civil Engineering, Xi'an Jiaotong University, China*

²*College of Architecture and Urban Planning, Tongji University, China*

ABSTRACT

In the context of increasingly frequent extreme weather events, such as heatwaves and heavy rainfall, the wall is facing growing environmental pressures. To address this challenge, deriving valuable information from monitoring data and applying preventive conservation has become an effective approach to mitigating the deterioration of earthen heritage. Therefore, this study combines long-term monitoring with machine learning to evaluate the protective effects of natural capping on the temperature and moisture conditions of the wall and to predict the heritage micro-environment. Two scaled-down rammed earthen walls were constructed at a 1:10 scale using local traditional techniques and soil materials to simulate the structural characteristics of the actual Great Wall. Bare wall B served as the control, while Wall D was provided with a natural capping on the top, consisting of soil and *Cynodon dactylon* (L.) Pers. Internal wall conditions and environmental parameters were simultaneously monitored over one year at 10-minute intervals. Based on the monitoring data, the XGBoost machine learning model was selected. The model was trained and validated to assess its predictive performance for wall temperature and volumetric water content under different protection conditions and at different depths. The results indicate that the XGBoost model enabled more reliable predictions, with better performance for the temperature metric and at the wall core position. Natural capping played a protective role by reducing environmental fluctuations and improving prediction stability. Overall, machine learning demonstrates the potential in predicting changes in heritage bodies, thereby providing a preliminary reference for integrating natural capping into the conservation of heritage sites located in urban environments.

Keywords: The Ming Great Wall, natural capping, long-term monitoring, machine learning, heritage conservation.

ID: 153

Interactive and Adaptive Effects of Thermal Comfort on Exercise Behavior in Urban Parks: Evidence from a Subtropical City

Jingyi Ye^{1,}, Tinggang Fu¹, Baojie He^{2,*}*

¹*Yunnan University, Kunming, China*

²*Chongqing University, Chongqing, China*

ABSTRACT

This study explores the seasonal influence of thermal comfort on exercise behavior in Xiamen's urban parks, a subtropical city with a unique monsoon climate. A total of 1,183 valid questionnaires were collected (766 in spring, 417 in winter), complemented by micrometeorological measurements of Tmrt, Ta, Tg, WBGT, Va and RH. Results revealed significant seasonal differences, with spring exhibiting higher solar radiation (197 W/m²), median Tmrt (22.4°C), and PET (25.6°C), contributing to increased thermal stress compared to winter (154 W/m², Tmrt 18.3°C, PET 23.7°C). Weak linear correlations between TSV and exercise behavior concealed pronounced interaction effects, whereby visitation frequency, and seasonal context jointly mediated thermal perception and physical activity. These findings indicate that thermal comfort is both a determinant and an outcome of exercise behavior through adaptive processes. The findings offer actionable insights for creating seasonally adaptive parks that enhance thermal comfort and promote physical activity year-round.

Keywords: Thermal comfort; urban parks; exercise behavior; seasonal variations.

ID: 154

Spatiotemporal Variations and Model-Based Conversion of Air–Surface Temperature from a Morphological Perspective: A Case Study of an Urban Block in Chongqing

*Xuecheng Fu¹, Baojie He¹
^{1,2}Chongqing University*

ABSTRACT

Understanding the relationship between air temperature (Ta) and land surface temperature (LST) is fundamental for fine-scale assessment of urban heat conditions. However, existing studies often rely on single data sources and fail to capture their spatial heterogeneity and morphological drivers. This study focuses on representative urban blocks in Chongqing, integrating UAV-based thermal imagery, field measurements, and Envi-met microclimate simulations. The objectives are to: (1) compare the spatial patterns and diurnal evolution of Ta and LST at the block scale; (2) identify key morphological factors influencing the ground–air temperature relationship; and (3) develop machine learning–based conversion models for estimating Ta from LST. The study aims to provide methodological support for refined urban thermal assessment and climate-responsive urban design.

Keywords: Air temperature, Land surface temperature, Spatiotemporal variation, Urban morphology, Model-based conversion

ID: 158

Understanding the Impact of Anthropogenic Heat on Local Microclimate: Current Limitations in Measurement and Modelling

Li Yin^{1,}, Tania Sharmin²
^{1,2}Cardiff University, Cardiff, United Kingdom*

ABSTRACT

Anthropogenic heat (AH) is a major contributor to the urban heat island effect, particularly in high-density cities where compact morphology and intensive activities enhance heat accumulation. However, most studies estimate AH at regional or city scales, while pedestrian-level microscale investigations remain limited.

This study reviews current approaches for measuring and modelling AH. A structured literature review of research conducted between 2000 and 2025 identified 21 studies focusing on microscale thermal environments. The review indicates that building related emissions, particularly from air conditioning systems, dominate microscale AH research, while traffic heat receives comparatively limited attention. Small scale commercial sources, such as restaurant exhaust, remain largely overlooked despite their potentially intense and concentrated heat release at pedestrian level. Existing measurement and modelling approaches also present several limitations, including restricted spatial coverage in field observations, simplified assumptions in inventory based methods, and insufficient representation of source specific and vertical heat release characteristics in numerical models. These findings highlight the need for source-specific, street-scale investigations to better understand anthropogenic heat accumulation in compact mixed use environments.

Keywords: Anthropogenic heat, urban heat island, microclimate.

ID: 160**Effects of Building Enclosure Layouts on Courtyard Ventilation under Coupled Wind and Thermal Conditions***Wenrui Yang¹, Wei You²**^{1,2}Nanjing Tech University, Nanjing, Jiangsu, China***ABSTRACT**

In traditional and modern buildings, the enclosed courtyard serves as an important spatial organization method, whose enclosure significantly influences spatial ventilation. However, existing studies mainly focus on a single environmental wind force, overlooking wind-thermal coupling under low wind speeds—a key research gap. This study employed Computational Fluid Dynamics (CFD) to investigate three enclosure forms (fully enclosed layout, two-opening layout, four-opening layout) on outdoor ventilation under varying wind-thermal conditions, seasons (summer/winter), and time periods (LST0800, LST1200, LST1600). Ventilation efficiency was evaluated using wind speed ratio (V^*) and normalized air change rate (Q^*). Results indicate the two-opening layout exhibited the highest $\langle V^* \rangle$ (2.214), 1.12 times that of the four-opening layout. Low-wind $\langle V^* \rangle$ was significantly higher than high-wind, maximizing 5.62 times that of pure wind. Summer $\langle V^* \rangle$ was generally higher than winter; specifically, noon (LST1200) $\langle V^* \rangle$ significantly outperformed LST0800 and LST1600. Under high wind, two/four-opening Q^* values were significantly better than the fully enclosed layout.

Keywords: Building enclosure layout, courtyard space, wind-thermal coupling effects, spatial ventilation condition.

ID: 161**Study on the Influence of Building Height Variation on Outdoor Space Ventilation Efficiency in Urban Residential Areas under Coupled Wind and Thermal Conditions***Yiyu Zhu¹, Wei You²**^{1,2}Nanjing Tech University, China***ABSTRACT**

Building height variation is a key factor shaping the spatial morphology of residential areas and significantly influences ventilation conditions. Existing research on the impact of residential building height variation on ventilation conditions has primarily focused on single wind force effects, with limited exploration of the influence of building height variation on ventilation under coupled wind and thermal conditions. This study employs Computational Fluid Dynamics (CFD) numerical simulations to investigate the effects of residential morphologies comprising multi-story, high-rise, and combined multi-story high-rise buildings on outdoor spatial ventilation efficiency, evaluated by the velocity ratio (The ratio of local wind speed to reference wind speed reflects the wind sheltering effect of buildings. Under the same ambient wind conditions, a lower ratio indicates a stronger sheltering effect and poorer ventilation), at different times of the day (8:00, 12:00, 16:00) under various combinations of wind and thermal conditions. Simulation results indicate that the impact of building height combination patterns on outdoor spatial ventilation efficiency varies considerably under different wind conditions.

Keywords: Building height variation, wind-thermal coupling, CFD numerical simulation, residential microclimate.

ID: 163

Machine Learning-Driven Prediction of Diurnal and Seasonal Outdoor Thermal Comfort in Subtropical High-Density Cities

Siqi Jia¹, Yuhong Wang²

¹The University of Hong Kong

²The Hong Kong Polytechnic University

ABSTRACT

Outdoor thermal comfort is pivotal for designing sustainable, health-focused urban environments; however, urban thermal comfort in subtropical high-density cities remains inadequately understood due to limited high-resolution, temporally dynamic models that integrate multi-dimensional environmental drivers. To address this gap, this study developed an integrated machine learning framework using long-term meteorological, geographic, and urban morphological data to predict hourly thermal comfort. A multilayer perceptron artificial neural network (MLP ANN) achieved exceptional accuracy ($R^2 = 0.970$) in modeling hourly thermal stress dynamics. Results revealed severe diurnal extremes: summer net effective temperature (NET) peaked at 30.29°C (15:00 PM) and remained elevated (21.76–24.89°C) at night, sustaining “warm to hot” stress, while winter nights dropped to -4.02°C (03:00 AM), shifting from “cold” to “very cold” stress. Daytime summer NET correlated strongly with impervious surfaces (Percentage of impervious land - P_impervious: 0.234**); Normalized Difference Built-up Index - NDBI: 0.231**), while winter NET linked to urban geometry (Building density - BD: 0.153**; Building height - BH: 0.166**) and patch complexity (SHAPE: 0.236**). Mitigation strategies highlighted the cooling efficacy of large green/water patches with AREA up to -0.352**, shallow water features with P_water up to -0.245**, and evergreen vegetation with Normalized Difference Vegetation Index - NDVI up to -0.277**. In summary, this study offers a scalable framework for high-density regions combating urban heat islands and provides actionable insights for optimizing thermal resilience through data-driven urban design with high temporal resolution.

Keywords: Outdoor thermal comfort, Urban heat island, Heat mitigation, Subtropical climate

ID: 165

Blue-Green Coupling Effects on Urban Surface Heat: Explainable ML and GWR Analysis in Hangzhou, China

Yiting Huang, Can Zhu, Guiwei Wang, Siru Chen, Qiduo He, Yue Cai, Feng Shao*

Zhejiang Agriculture and Forestry University, Hangzhou, China

ABSTRACT

Urban heat risk is intensifying under climate change and rapid urbanisation, yet interpretable evidence on how coupled blue-green conditions regulate land surface temperature remains limited. Using multi-temporal clear-sky summer satellite observations for Hangzhou, China (2016–2024), this study builds a pixel-level dataset incorporating vegetation greenness, canopy structure, surface moisture, built-up intensity and interaction effects. Interpretable machine-learning analysis identifies vegetation cover, surface moisture and their coupling effects as dominant nonlinear cooling drivers, whereas built-up intensity consistently amplifies warming in compact built-up areas. A unified upper-decile temperature threshold enables cross-year hazard comparability, revealing strong warm-year amplification in 2024 and distinguishing persistent hotspot cores from anomaly-driven expansions. Spatially varying regression confirms pronounced spatial non-stationarity, with stronger cooling effects along riparian corridors and more heterogeneous responses in compact districts. The integrated machine-learning and spatial analysis framework supports canopy-and moisture-informed heat-mitigation planning in subtropical cities.

Keywords: Land surface temperature, blue-green infrastructure, explainable machine learning, geographically weighted regression.

ID: 168

Research on the Temporal and Spatial Distribution of Vegetation Phenology in Suzhou City based on Local Climate Zones and Urban-Rural Gradients

Mengning Hu¹, Xiangdong Xiao^{2,*}, Hao Wang³

^{1,2,3}College of Architecture, Soochow University, Suzhou City, China

ABSTRACT

Vegetation phenology acts as a key indicator reflecting how urban ecosystems respond to urbanization and climate change, yet fine-scale intra-city phenological patterns are poorly documented. This research adopted 2003–2022 MOD13Q1 satellite data to derive three core phenological metrics: the start (SOS), end (EOS), and length (LOS) of the growing season for Suzhou's vegetation. Two zoning methods, Local Climate Zones (LCZ) and Urban-Rural Gradients (URG), were integrated to examine phenological spatiotemporal patterns. One-way ANOVA and Tukey's HSD test were further applied to contrast their analytical performance. The results revealed consistent citywide trends: SOS advanced by 1.02 days annually, EOS delayed by 0.55 days annually, and LOS lengthened by 1.57 days annually. Built LCZ categories displayed earlier leaf-out, later leaf senescence and longer growth cycles than natural land cover. Moving outward from the urban center along URG transects, SOS was postponed, EOS shifted earlier, and LOS shrank. Statistical tests showed complementary sensitivity: URG produced more significant pairwise differences for SOS and LOS, whereas LCZ was more discriminating for EOS and supplied morphological context unavailable from concentric URG zoning. This study clarifies urban heat island-induced phenological shifts and offers technical references for resilient city construction and refined urban ecosystem governance.

Keywords: Landscape architecture, local climate zones, urban-rural gradients, vegetation phenology, urbanization.

ID: 170

Evaluating Facade Reflectance Strategies for Balancing Outdoor Thermal Comfort and Building Energy Performance in LCZ-Based Residential Neighborhoods

Duo Xu¹, Qiankang Nie¹, Zhe Gao¹, Hashem Akbari², Juejun Ge³, Yupeng Wang^{4,*}

¹Xi'an Jiaotong University, Xi'an, China

²Concordia University, Montreal, Canada

³China United Engineering Corporation Limited, Hangzhou, China

⁴Southeast University, Nanjing, China

ABSTRACT

Against the backdrop of rapid urban expansion, facade albedo optimization has emerged as a promising low-intervention strategy to mitigate the urban heat island effect and reduce space-conditioning loads. However, its regulatory efficacy is fundamentally constrained by urban geometry and inherently entangled in seasonal thermal-energy trade-offs. Focusing on Xi'an—a representative cold-climate city—this study quantifies the coupled impacts of facade reflectance ($\rho=0.1-0.9$) on the outdoor radiant environment and building energy demands across five prototypical Local Climate Zone (LCZ) residential blocks (LCZ2I, LCZ3, LCZ4, LCZ5I, LCZ5II). Beyond conventional LCZ comparisons that examine morphology or material effects separately, this study integrates outdoor thermal and building-energy assessments in a controlled LCZ–reflectance matrix and introduces a Material–Morphology Contribution Ratio (R) to compare within-LCZ material responses with between-LCZ morphological baseline differences. Results demonstrate that elevating facade albedo significantly mitigates summer heat; pedestrian-level mean radiant temperature (T_{mrt}) decreases, and peak daytime facade surface temperatures decline by approximately 20–30 °C. Nevertheless, a pronounced seasonal trade-off emerges: the reduction in summer cooling loads is consistently overshadowed by substantial winter heating penalties, culminating in a net increase in annual energy consumption. Furthermore, effect decomposition reveals that morphological baseline variations structurally dominate the maximum regulatory capacity of material adjustments. Albedo sensitivity also exhibits profound typological heterogeneity: compact blocks govern radiant thermal environments, whereas open typologies dictate energy consumption dynamics. Ultimately, these findings confirm that optimal facade retrofits demand LCZ-specific configurations rather than a uniform "one-size-fits-all" approach. By elucidating morphology-material coupling mechanisms and seasonal trade-offs, this study delivers an evidence-based decision framework for urban planning, renewal, and climate-resilient design in cold-region cities.

Keywords: Facade albedo, local climate zones (LCZ), urban microclimate, building energy performance.

ID: 177

Performance of Reflective Road Coatings in a Humid Continental Climate: Case-Study in Philadelphia

Zhan Shi¹, Colby Snyder², Nafisa Bangura³, Angelica Dadda⁴, Julia Chiang⁵,
Russell Composto⁶, Dorit Aviv⁷

^{1,7}Weitzman School of Design, University of Pennsylvania

^{2,3,4,5,6}School of Engineering and Applied Science, University of Pennsylvania

ABSTRACT

Reflective pavement coatings have been studied in relation to the potential lowering the paving's surface temperature and in relation to their impact on the urban heat island (UHI). However, most empirical evaluations have been limited to arid regions. This study presents a field campaign in Philadelphia, a humid continental city with high summer humidity and seasonal freeze–thaw cycles, to assess the effectiveness and durability of CoolSeal in a high heat-vulnerability neighborhood. Portable weather stations recorded surface, near-surface air, and mean radiant temperature (MRT) across the reflective coating and asphalt control sites between fall 2024 and summer 2025. Results show statistically significant reductions in surface temperature—up to 5.4 °C cooler than asphalt ($p < 0.01$)—particularly during morning and midday, though the cooling diminished later in the day. Air temperature at 1.5 m showed little consistent change, while MRT responses were more variable: lower in the morning and midday but often elevated in the late afternoon, depending on sky conditions. Durability assessments revealed severe wear, peeling, and cracking within six months of a single-coat application in Philadelphia, contrasting with Phoenix findings where reflectivity degraded gradually but structural integrity remained intact. Taken together, the results highlight both the benefits and climate-specific limitations of reflective pavements. While effective at moderating surface heat loads, their air temperature and comfort impacts remain limited and variable, and durability challenges are intensified in humid, freeze–thaw environments. Reflective coatings to urban surfaces should therefore be implemented selectively, in conjunction with greening and other heat mitigation measures, as part of an equity-focused urban heat resilience strategy.

ID: 179

Campus as a Living Lab: Using the BEAM Framework and Digital Twin to Address Urban Microclimate Challenges

Marcel Ignatius¹, Shanshan Tong², Ruohan Xu³, Yijun Lu⁴, Joie Lim⁵, Yu Qian Ang⁶,
Lup Wai Chew⁷, Filip Biljecki⁸, Nyuk Hien Wong⁹

^{1,2,3,4,5,6,7,8,9}National University of Singapore

ABSTRACT

The BEAM (Baseline–Evaluating–Action–Monitoring) initiative is a living-lab framework developed at a Singapore campus to address escalating urban heat island (UHI) challenges in the tropics. Over 40 weather stations, infrared cameras, and meteorological towers monitor microclimate variables; the resulting data are analyzed using machine learning and geospatial interpolation to generate climatic maps and identify heat-stress hotspots. These insights guide mitigation testbeds, including tree planting and cool paint, implemented with campus infrastructure stakeholders, supported by a digital-twin platform (BEAM-DT) for scenario simulation and decision-making. Field validation demonstrates statistically significant temperature reductions in treated zones ($p < 0.001$) and measurable improvements in outdoor thermal comfort. BEAM exemplifies how universities can serve as living laboratories for UHI mitigation, bridging research, operations, and education.

ID: 181

Material-Driven Urban Heat Island Mitigation: Evaluating Current vs. Next-Generation Options in Amaravati's Current Urban Form

Shambhavi Kale¹, Dr. Sujata Karve², Dr. Prajakta Dalal-Kulkarni³

^{1, 2, 3}Dr. Bhanuben Nanavati College of Architecture for Women, Pune, India, SPPU

ABSTRACT

Amaravati, the new capital city of Andhra Pradesh, is emerging as a model for sustainable development. The rapid development and urbanization in the city may produce higher levels of anthropogenic heat, creating extreme thermal stress and environmental degradation. This study investigated how the current material trends and next generation materials impact the microclimate of the city. By maintaining the proposed building forms, this study considered materials as the primary variable. Using ENVI-met v5.6.1 for simulations, this research aims to analyze the conventional materials like AAC blocks and concrete to understand their effect on microclimatic parameters like air temperature, mean radiant temperatures and relative humidity. Comparative simulations analyzed materials like cool reflective coatings and bio-based insulators as strategies for façade and roof. The simulation considered the projected future climatic conditions of Amaravati, generated using Future Weather Generator v3.0.2, characterized by high temperatures which can reach up to 46.9°C on the hottest summer day and humidity levels above 50% for 8 months of the year. The iterative urban design modifications progressively reduced near-surface air and mean radiant temperatures, with nocturnal cooling (up to 0.36°C and 3–7% MRT reduction). Small increases in relative humidity (1.2% on average) confirmed improved cooling without excessive moisture addition. The inferences aim to provide comparative insights into the influence of building envelope material strategies on the simulated urban microclimate. The results are intended to guide strategies that may contribute to improving outdoor thermal conditions in tropical regions by identifying efficient building materials.

Keywords: Urban heat island, building materials, sustainable cities, microclimate analysis.

ID: 183

Is LCZ D a Stable Reference for UHI Assessment? Quantifying Microclimatic Heterogeneity and Evaluation Bias Among Low-Plant Prototypes

Yuanyuan Li¹, Boze Huang², Baojie He^{3,*}

^{1,2,3}School of Architecture and Urban Planning, Chongqing University, Chongqing, China

^{1,2,3}Centre for Climate-Resilient and Low-Carbon Cities, Key Laboratory of New Technology for Construction of Cities in Mountain Area, Ministry of Education, Chongqing, China

ABSTRACT

The Local Climate Zone (LCZ) framework is widely used in urban heat island (UHI) research, and LCZ D is commonly selected as a rural or low-vegetation reference for estimating UHI intensity. In practice, LCZ D includes several low-plant prototypes, including unmanaged rough grassland, farmland, and maintained lawn, but their thermal comparability has rarely been tested. This study conducted a 7-day microscale field campaign to compare three LCZ D prototypes under a shared weather background: unmanaged rough grassland (Group 1), maintained lawn (Group 2), and building-adjacent lawn (Group 3). Overall differences were detected across the three prototypes for all 17 variables at the hourly scale, although effect sizes varied substantially among metrics, indicating within-class heterogeneity across the observed microclimate. Reference choice also changed the UHI estimate. During daytime, estimates ranged from −0.055 K for Group 1 to 0.463 K for Group 2, a range of approximately 0.52 K that crossed zero. At night, the UHI range was 0.611 K, with estimates from 0.177 to 0.788 K. Excluding the building-adjacent prototype left the daytime range almost unchanged at approximately 0.52 K but reduced the nighttime range to approximately 0.01 K. LCZ D should therefore not be treated as a thermally interchangeable reference based on the class label alone. Studies using LCZ D should report site metadata and, where possible, test sensitivity to multiple reference sites.

Keywords: Local climate zones, urban heat island, LCZ D, microscale observation.

ID: 190**A Multivariate Analysis of Greenery Impacts on Urban Heat Across Temporal Scales: A Case Study of a Tropical Campus**

Yun Yee Soh¹, Yijun Lu², Ziyuan Zhang³, Marcel Ignatius⁴, Nyuk Hien Wong⁵
^{1, 2, 3, 4, 5}*National University of Singapore, Singapore*

ABSTRACT

Urban vegetation is increasingly adopted as an effective strategy for heat mitigation, especially in tropical cities. Most studies rely on two-dimensional indices, with systematic comparisons of diverse greenery metrics and their relationships with ambient temperature remaining limited. Recognising the interplay between vegetation and built structures, this study evaluates two- and three-dimensional greenery and urban morphology metrics and their relative contributions to typical air temperature dynamics. Using the National University of Singapore (NUS) campus as a case study, air temperature data from 12 stations were recorded at 10-minute intervals and aggregated into nine monthly averages for maximum (Tmax) and average daytime temperature (Tday), reducing fine-scale variability and improving interpretability. Correlation screening, generalised additive models (GAMs), and principal component analysis (PCA) were applied to identify key structural components influencing temperature. Results show that overall greenery and tree structural metrics outperform built metrics, though built form remains a secondary factor. Temperature extremes are more strongly governed by persistent structural characteristics than average daytime conditions. A parsimonious combination of one two-dimensional and one three-dimensional metric per urban feature category adequately represents urban thermal environments. These findings emphasise the value of complementary metrics for robust assessment of temperature variability and provide guidance for climate-responsive planning and landscape design in dense tropical cities.

Keywords: Urban heat mitigation, ambient air temperature variability, urban vegetation, urban morphology.

ID: 192**Thermal Impact of the Photovoltaic on the Urban Microclimate**

Dongyu Lian¹, Chengliang Fan¹, Meirong Pan¹, Yundan Liao^{1,}*
¹*Guangzhou University, Guangzhou, China*

ABSTRACT

Photovoltaic (PV) systems provide distributed renewable electricity while modifying rooftop heat exchange with the urban atmosphere. Current understanding of PV-induced thermal impacts on block-scale microclimate remains limited, with inconsistent results reported across studies. These effects are influenced by the characteristics of photovoltaic roof surfaces and the layout of the surrounding streets and buildings. In this study, rooftop surface temperatures for PV modules and conventional roofs were estimated using temperature prediction models and imposed as thermal boundary conditions in CFD simulations of urban street canyons. The framework was validated against field measurements of conventional roof temperature, PV surface temperature, and near-array air temperature. Representative urban blocks spanning the Local Climate Zone (LCZ) typology were selected, with building density and height used to characterize neighborhood morphology. Simulations assess how PV deployment alters rooftop thermal conditions and how urban form controls the spatial propagation of these effects within street canyons. For Guangzhou, PV deployment reduces rooftop sensible heat flux and produces a measurable cooling at pedestrian level during summer daytime. Cooling is morphology-dependent, with compact blocks showing a median reduction of -0.38 °C (LCZ2.5), while open high-rise forms exhibit a near-zero response of -0.03 °C (LCZ3.5). The proposed model framework can further support differentiated PV installation strategies under similar climatic conditions.

Keywords: Rooftop photovoltaic, urban microclimate, local climate zone.

ID: 193

The Impact of Feng Shui "Qi-Gathering" Layout on Outdoor Thermal Comfort: A Case Study of a Plateau River Valley Village

Yuan Chen¹, Yupeng Wang², Barbara Galli³

¹*Southeast University, Nanjing, China, Key Laboratory of Urban Meteorology,*

China ¹*Meteorological Administration, Beijing, China*

²*Southeast University, Nanjing, China*

³*Politecnico di Milano, Milano, Italy*

ABSTRACT

Traditional Feng Shui is often regarded as a cultural custom and lacks quantitative validation using modern meteorological methods. Existing studies remain largely qualitative, making it difficult to identify its climate-regulation mechanisms under complex terrain conditions. Using Liangqu Village on the Loess Plateau of northern Shaanxi as a case study, this research quantitatively evaluates the climatic adaptability of the Feng Shui concept of “Ju Qi” (Qi gathering) in village planning through computational fluid dynamics (CFD) simulations and field measurements. Three key indicators were examined: windward porosity, household density, and block building density. Results show that block building density is significantly positively correlated with winter outdoor thermal comfort (UTCI), with each 0.1 increase raising winter UTCI by 0.81°C. By contrast, household density is significantly negatively correlated with thermal comfort in both summer and winter. Windward porosity has a particularly strong winter effect, with each 0.1 increase improving winter UTCI by 2.14°C. Regression analysis further shows that topography significantly moderates the effectiveness of Feng Shui principles, with stronger correlations on sunny slopes. To improve the living environment of cold-region river valley settlements, block building density should be maintained at 0.7–1.0, household density at 0–0.36, and windward porosity at 0.65–0.88. The findings confirm that thermal responses to Feng Shui principles vary with topography, quantify the applicable ranges of spatial-layout principles, and provide practical design thresholds for rural planning on the Loess Plateau.

Keywords: Feng Shui theory; thermal comfort, village planning and design, microclimate.

ID: 194

New Insights and Modifications into the RF-Meter System for Albedo Monitoring and CO2 Compensation Evaluation

Abdul Rehman Soomro¹, Alessia Di Giuseppe², Beatrice Castellani³, Federico

Rossi⁴

^{1,2,3,4}*CIRIAF, University of Perugia, Italy*

ABSTRACT

The quantification of equivalent CO2 compensation achieved by high albedo solutions HAS been critical for their formal integration into emission trading schemes, yet traditional models frequently overestimate these offsets by relying on static surface parameters and simplified vertical atmospheric transmittance. This study introduces an empirical RF meter methodology utilizing continuous yearlong monitoring and rigorous hemispherical diffuse reflection model to dynamically evaluate instantaneous radiative forcing. Our findings reveal a critical transmittance paradox: while the improved model increases the unweighted daily average transmittance from 0.652 to 0.757 by capturing low energy dawn and dusk scattering, it correctly restricts outward transmittance During high energy midday awards due to lateral slant path atmospheric absorption. The interactive python dashboard shows the CO2 compensation value of a high albedo surface 75.55 kg CO2 eq/m2 by original model and 73.26 kg CO2 eq/m2 by improved model approximately with change in albedo value $\Delta\alpha$ equals to around 0.261 of a 900m2 surface at CIRIAF roof top in University of Perugia, Italy. The application of HAS is also expanded for Africa and regional counterparts. This method provides the economic benefits in terms of emission trading scheme, for example 1 ton CO2 equals to 100 €. This system benefits not only in terms of CO2 compensation but also in terms of water saving through mulching membrane for crop production, a benefit for agricultural sector.

ID: 198

Urban Heat Islands in the Cities of North-Eurasian Arctic According to in Situ Observations

Mikhail Varensov¹, Pavel Konstantinov¹, Marina Slukovskaya², Maria Korneykova³, Viacheslav Vasenev³, Igor Esau⁴, Alexander Baklanov⁵
^{1,2}*Lomonosov Moscow State University*
³*Kola Science Centre, Russian Academy of Sciences*
^{4,5}*Peoples' Friendship University of Russia (RUDN University)*
⁶*UiT – the Arctic University of Norway*
⁷*University of Copenhagen*

ABSTRACT

The urban heat island (UHI) effect is now well studied from different points of view. Various approaches to monitoring it have been developed, along with numerous models for simulating and forecasting it at various scales. It is generally considered a negative phenomenon for populations and economies, making the development of mitigation measures of great scientific and public interest. This is true for most of the Earth, with the exception of one region: the Arctic. First, the Arctic—a large and unique region—was largely overlooked in urban meteorological observations and urban climate studies until recently. Second, for cities in cold Arctic climates, it is less clear whether the heat island has a negative or positive effect on humans, as impacts of both signs may be expected; however, a lack of observations has hindered more detailed studies. To address this knowledge gap, we established the Urban Heat Island Arctic Research Campaign (UHIARC) in several Russian Arctic cities (Konstantinov et al., 2018, <https://doi.org/10.1088/1748-9326/aacb84>; Varentsov et al., 2018, <https://doi.org/10.5194/acp-18-17573-2018>). Here, we present the results of long-term meteorological observations from the UHIARC campaign conducted over the past decade (since 2015) in seven cities in the North-Eurasian Arctic: Murmansk, Apatity, Vorkuta, Salekhard, Nadym, Novy Urengoy, and Norilsk. Many sites were monitored for several years, resulting in a harmonized observational dataset. The collected data offers new insights into UHI climatology in the Arctic. We demonstrate that Arctic UHIs are significantly stronger in winter, with mean winter intensities ranging from 0.8 to 1.8 K, while mean summer intensities do not exceed 0.5 K. Extreme UHI intensities also peak in winter, reaching 5–6 K at the 95th percentile and 7–8 K at the 99th percentile. These extremes typically occur under a strongly stable atmospheric boundary layer (ABL) with intense temperature inversions (Varentsov et al., 2023; <https://doi.org/10.1016/j.uclim.2022.101351>). Among the studied cities, Norilsk and Nadym exhibited the strongest UHIs, while Murmansk, the largest Arctic city, showed the weakest UHI effect. This is due to its coastal position near an unfreezing sea inlet, which leads to less stable atmospheric stratification in winter. The collected dataset will be valuable for an in-depth understanding of urban climate processes in the Arctic, for model evaluation and development, and for investigating the social and environmental impacts of the urban heat island in this unique environment. The study was supported by Russian Science Foundation, project no. 23-77-30008, and by Ministry of Science and Higher Education of the Russian Federation, project no. FSSF-2024-0023.

Keywords: urban heat island, cold climate cities, in situ observations, harmonized dataset

ID: 199

Mapping 20 Years of Persistent Urban Heat Islands in Hyderabad Sindh

Abdul Rehman Soomro¹, Alessia Di Giussepe², Beatrice Castellani³, Federico Rossi⁴
^{1,2,3,4}*CIRIAF, University of Perugia, Italy*

ABSTRACT

Rapid urbanization in semi-arid environments drives severe urban heat islands UHIs. Traditional satellite derived absolute land surface temperature LST processing often compromises localized microclimatic monitoring due to regional climate noise and bare soil confusion. This study establishes a dual target modeling framework over a 20-year timeline (2006–2025) in Hyderabad, Pakistan, evaluating absolute LST alongside isolated relative urban heat island intensity UHII. To eliminate bare soil signatures, a novel cross seasonal temporal logic masking sequence was introduced to isolate stable rural baselines. Predictive models, Extreme Gradient Boosting XGBoost and Deep Neural Network DNN were systematically evaluated using 5-fold spatial block cross-validation (Scenario 1) and future chronological forecasting for the 2025 horizon scenario 2. Empirical mapping shows that Hyderabad's industrial zone and city core act as persistent thermal anchors, with core anomalies exceeding ambient backgrounds up to 8°C. Quantitative benchmarking under scenario 1 revealed XGBoost's spatial superiority, explaining more spatial variance ($R^2=0.5935$ vs. 0.3859 for UHII) and avoiding the severe spatial smoothing penalties that degraded the DNN. In Scenario 2 chronological testing, absolute LST projections suffered from unlearned regional macroclimatic warm shifts, causing negative R^2 scores across both models. However, by targeting relative UHII anomalies, XGBoost achieved a definitive prognostic triumph, capturing 69.47% of the unseen 2025 spatial variance ($RMSE=1.5869^\circ C$) compared to the DNN's weak 46.84% ($RMSE=2.0942^\circ C$). Ultimately, this demonstrates that tree-based ensembles excel at memorizing localized microclimatic morphology, serving as robust tools for targeted urban heat mitigation planning.

ID: 203**Mesoscale Modeling of the City-Wide Cooling Effect of Urban Green Infrastructure for the Moscow Megacity**

*Mikhail Varensov¹, Maria Tarasova², Timofey Samsonov³, Vlada Okuneva⁴,
Viacheslav Vasenev⁵
^{1,2,3,4}Lomonosov Moscow State University
⁵Peoples' Friendship University of Russia*

ABSTRACT

Urban green infrastructure (UGI) is a key nature-based solution for climate adaptation and urban heat island mitigation. While many studies assess UGI cooling through observations and modeling, most focus on local microscale effects, with less attention to non-local and city-scale impacts. This study evaluates the local, non-local, and city-wide cooling effects of different UGI types for the Moscow megacity using the COSMO regional atmospheric model coupled with urban canopy schemes (TERRA_URB and TEB) at 250-m grid spacing. The cooling effect is quantified by comparing realistic land cover scenarios against those where specific UGI types are replaced by impervious surfaces.

We address two tasks. First, we categorize UGI by size (S, M, L, XL) and show that cooling effectiveness increases logarithmically with area. The largest parks and urban forests (XL) exhibit cooling effects exceeding those of small UGI (S) by more than 20% locally, 40–90% in surrounding buffer zones, and 35% city-wide. Second, we compare UGI located within the urban canopy (e.g., courtyards) versus those outside built-up zones (e.g., urban parks) using the more sophisticated single-layer urban canopy model TEB recently implemented in COSMO and supplemented with the “garden” module to represent vegetation inside street canyons. Results indicate that UGI outside built-up areas provides significantly stronger cooling due to differences in surface heat balance. However, small and medium-sized urban parks, as well as UGI inside urban canopy offers localized cooling precisely where people live and work, highlighting trade-offs in assessing the value of different UGI types for urban populations.

ID: 205**Mitigating Urban Heat: A Local Climate Zone Strategy for Heat-Intensive Zones in Hyderabad**

*Faiz Ahmed Chundeli¹, Vijesh Kumar Valiyappurakkal², Kapil Natawadkar³,
Ramesh Srikonda⁴, Ayon Kumar Tarafdar⁵, Nakka Sunny⁶, Fathima Shouheen⁷,
Jyoti Kushwaha⁸, Sakshi Agarkar⁹
^{1,2,3,4,5,6,7,8,9}School of Planning and Architecture, Vijayawada, Andhra Pradesh,
India*

ABSTRACT

Rapid urbanization has intensified urban heat, posing significant challenges to environmental sustainability, thermal comfort, and public health. Understanding the relationship between urban morphology and land surface temperature (LST) is essential for developing climate-responsive planning strategies. This study investigates the spatial and temporal distribution of LST across the Greater Hyderabad Municipal Corporation (GHMC) using a Local Climate Zone (LCZ)-based framework. Sentinel-2 Level-2A imagery was used to classify 16 LCZ classes, while multi-temporal Landsat (30 m) and MODIS (1 km) datasets for May 2004, 2014, and 2024 were analysed to examine fine-scale spatial and city-scale temporal thermal patterns. The analysis was conducted at the native spatial resolution of each dataset, with LCZs serving as the common analytical framework for evaluating thermal characteristics. The results reveal pronounced thermal variability among LCZ classes, with compact and highly impervious urban forms consistently exhibiting the highest LST. LCZ 8 (Large Low-Rise), LCZ 3 (Compact Low-Rise), and LCZ 2 (Compact Mid-Rise) emerged as the most heat-intensive urban typologies, recording average daytime LSTs of approximately 40°C, whereas vegetated and water-dominated LCZs maintained substantially lower temperatures. Multi-temporal analysis further indicates a steady increase in daytime and nighttime LST between 2004 and 2024, reflecting the thermal impacts of rapid urban expansion. The findings demonstrate the usefulness of integrating LCZ classification with satellite-derived LST for identifying priority areas for urban heat mitigation. The proposed framework provides practical guidance for planners and policymakers to implement targeted interventions such as urban greening, reflective materials, and climate-responsive urban design to enhance urban resilience.

Keywords: Local climatic zones, urban heat island, land surface temperature, UHI mitigation.

ID: 207

Agglomeration of Strategic Emerging Industries, Urban Renewal, and Urban Eco-efficiency: An Empirical Study Based on China's Provincial Panel Data

Xuan Tang¹, Tianfa Yang², Ying Xie³, Tianfa Yang⁴
^{1,2,3,4}*Guangzhou University*

ABSTRACT

Amidst the global push for high-quality development and green transitions, understanding how industrial upgrading and urban renewal synergistically enhance eco-efficiency has become a critical imperative. Based on provincial panel data from China spanning 2008 to 2023, this study employs the location quotient to measure the agglomeration level of strategic emerging industries (SEIs), applies the super-efficiency Slack-Based Measure (SBM) model to assess urban eco-efficiency, and incorporates urban renewal as a mediating variable. An analytical framework of "industrial agglomeration–urban renewal–urban eco-efficiency" is constructed and empirically tested. The findings are as follows: First, the agglomeration of SEIs significantly enhances urban eco-efficiency, a conclusion that remains robust across multiple robustness checks, indicating that the expansion of emerging industries generates robust green spillover effects. Second, urban renewal plays a significant partial mediating role between industrial agglomeration and urban eco-efficiency, with approximately one-third of the ecological effects realized through this pathway, suggesting a synergistic green effect between industrial upgrading and urban renewal. Third, the ecological effects exhibit pronounced regional heterogeneity: the promoting effect is most prominent in western China, where late-developing regions demonstrate stronger green catch-up potential driven by SEI agglomeration. This study systematically reveals both the direct effects of SEI agglomeration on urban eco-efficiency and the mediating mechanism of urban renewal, providing empirical evidence for the coordinated design of industrial policy and urban renewal initiatives. The findings carry significant theoretical and practical value for advancing urban green transition and high-quality development.

ID: 208

Flower Color as a Potential Contributor to Urban Microclimates: Thermal Imaging of Herbaceous Vegetation

Sevgi Yilmaz¹, Hüsna Gülkar², Adeb Qaid³, Solen Koseoglu⁴
^{1,2,4}*Ataturk University*
³*Kingdom University*

ABSTRACT

Urban heat island (UHI) mitigation has become a major challenge in climate-responsive urban planning, with vegetation recognized as an effective nature-based solution for improving urban microclimates. Although numerous studies have examined the cooling effects of vegetation, the influence of flower color on the thermal behavior of herbaceous plants remains insufficiently investigated. This study aimed to evaluate the relationship between flower color, surface temperature, and local microclimatic conditions in herbaceous vegetation using thermal imaging, in situ microclimate measurements, and Sky View Factor (SVF) analysis. Field measurements were conducted under stable summer weather conditions in June 2025 on the Western Campus of Atatürk University. Thermal images were acquired using a high-resolution Optris PL Connect infrared camera, while SVF values were obtained from hemispherical photographs captured with a Nikon D5200 camera equipped with a ProHD fisheye lens. The results indicated that dark-colored flowers, particularly purple and red species (*Salvia verticillata* var. *amplexicaulis*, *Anchusa azurea*, and *Papaver rhoeas*), generally exhibited higher surface temperatures than light-colored flowers. In contrast, white (*Gypsophila paniculata*) and yellow (*Melilotus officinalis* and *Achillea millefolium*) flowers showed relatively lower surface temperatures. While soil temperatures remained comparatively stable, adjacent asphalt surfaces reached a maximum temperature of 55.5°C, representing a temperature difference of up to 28.0°C compared with the coolest vegetated surfaces. These findings suggest that flower color is an often-overlooked factor influencing local microclimatic conditions. The results further indicate that incorporating light-colored herbaceous species into urban landscapes may help improve outdoor thermal conditions as part of broader climate-sensitive landscape design strategies.

Keywords: Herbaceous vegetation, thermal camera; color, sky view factor (SVF), global warming.

ID: 210

Revealing the Cooling Potential of Urban Herbaceous Vegetation through Thermal Imaging and Slope Analysis

Hasan Yılmaz^{1,*}, Şölen Köseoğlu², Feyzanur Aksak³

¹Atatürk University, Architecture and Design Faculty, Department of Landscape Architecture, Erzurum, Türkiye

²Atatürk University, Architecture and Design Faculty, Department of Architecture, Erzurum, Türkiye

³Atatürk University, Institute of Sciences, Department of Landscape Architecture, Erzurum, Türkiye

ABSTRACT

This study investigates the influence of naturally growing herbaceous vegetation on microclimatic conditions and outdoor thermal comfort within urban environments, emphasizing sustainability-based landscape design. The analysis focuses on areas with self-sustaining herbaceous plants that require no irrigation or maintenance yet possess aesthetic value. The research was conducted on the sidewalks of Atatürk University's Western Campus, which accommodates a high student population and features zones with varying slope gradients. The selected sites were categorized as nearly flat (<4%), moderate (4–10%), steep (10–15%), and very steep (>20%) areas. To assess the thermal behavior of these slopes, field measurements were performed using an Optris PL Connect thermal camera, a Nikon 5200 camera with a fisheye Pro HD lens for Sky View Factor (SVF) analysis, and various microclimatic measurement instruments. The findings revealed that vegetation density and slope conditions influenced surface temperature and local microclimatic conditions. In nearly flat areas (<4%), surface temperatures ranged from 25–28°C on shaded or vegetated surfaces to above 50°C on directly sun-exposed surfaces, while vegetated surfaces in moderate areas (4–10%) ranged between 25–30°C. In steep areas (10–15%), temperatures reached approximately 48°C, while south-facing surfaces in very steep areas (>20%) reached 55–62°C; herbaceous vegetation reduced surface temperatures by 15–25°C compared with surrounding hard surfaces. Impermeable hard surfaces displayed higher temperature contrasts, emphasizing the cooling potential of vegetated areas. This study suggests that local authorities should incorporate naturally occurring herbaceous vegetation into urban designs to enhance thermal comfort, ecological sustainability, and low-maintenance greening.

Keywords: Herbaceous vegetation, slope gradient, thermal comfort, urban microclimate.

ID: 211

The Effects of Herbaceous Plants on Surface Temperatures Along Pedestrian Pathways During the Summer Season

Mehmet Akif Irmak¹, Betül Nur Bayraktar², Şölen Köseoğlu³

^{1,2,3}Ataturk University

ABSTRACT

Rapid urbanization, increasing building density, and the reduction of urban green spaces intensify the urban heat island effect, particularly during summer, and adversely affect outdoor thermal comfort. These conditions highlight the need for sustainable and climate-sensitive urban design strategies. Previous research has demonstrated that vegetation along pedestrian routes can improve microclimatic conditions and thermal perception; however, most studies have focused primarily on shade trees, while the role of herbaceous plants has received less attention.

This study investigates the influence of herbaceous vegetation along sidewalks on thermal comfort on the campus of Atatürk University in Erzurum, Türkiye. Field measurements were conducted in July 2025 in six representative areas covering approximately 10,000 m² of pedestrian routes, including plant-free sections and sidewalks with varying plant densities. Surface temperatures were recorded using a high-resolution thermal camera equipped with a Pro HD lens. Sky View Factor values were determined for each site, and Physiological Equivalent Temperature was calculated using the RayMan Pro 2.1 model. Measurements were repeated at different times of the day to capture diurnal variation.

Results indicate that sidewalks with herbaceous vegetation were significantly cooler than plant-free areas. Average surface temperatures reached 45–46°C in unvegetated zones, whereas vegetated areas averaged around 30°C. PET analyses confirmed that increased plant density corresponded to improved thermal comfort, even under the continental climatic conditions of Erzurum.

The findings demonstrate that micro-scale greenery can substantially mitigate heat stress and should be integrated into pedestrian-oriented urban design and landscape planning processes to support resilient and livable cities.

Keywords: Pedestrian areas, thermal comfort, herbaceous plants, urbanization.

ID: 213

Urban Heat Risk and Vegetation Cooling: Morphology Insights for Resilience

Chunping Miao¹, Lihua Huang¹

¹*School of Architecture, Chang'an University, Xi'an, 710061, Shaanxi, China*

ABSTRACT

Under the combined pressures of global warming and rapid urbanization, extreme high temperatures are occurring more frequently in cities, posing serious threats to residents' thermal health. Based on remote sensing and statistical data from 320 Chinese cities from 2000 to 2020, the average urban extreme land surface temperature threshold was 35.24°C, with higher values concentrated in northwestern and developed cities. Over the past two decades, the urban population exposed to extreme high temperatures increased by approximately 115 million, and the Urban Extreme Heat Exposure Risk (UEHER) index rose by 52.5%. Risks deteriorated in 97.19% of cities: moderately developed and high-population-density areas faced the dual pressure of “high risk + rapid growth”, while less developed areas were trapped in the dilemma of “high risk + low GDP”. Vegetation is key to mitigating extreme high temperatures, yet its cooling capacity (CCV) is regulated by climatic backgrounds and landscape patterns. A comparison between dry-hot (Beijing) and humid-hot (Guangzhou) cities revealed that humid-hot cities exhibit stronger CCV, with commercial districts showing the lowest cooling benefits and green spaces the highest under extreme high temperatures. 2D/3D landscape metrics contributed significantly, but the influence of building morphology weakened under extreme heat; once vegetation cover exceeded 30–40% (dry-hot) or 60–80% (humid-hot), cooling benefits no longer increased substantially. Although high-population-density cities had higher land surface temperatures, their capacity to mitigate thermal environments was also stronger. Quantitative research on 2D/3D building morphology and green spaces in Xi'an showed that their relative contributions, interactions, and marginal effects on the thermal environment were nonlinear: a critical threshold exists for green space coverage, beyond which the marginal cooling benefit diminishes; 3D building morphology (e.g., building height, sky view factor) affects the thermal environment by altering ventilation and shading, and interacts significantly with green spaces. In summary, clarifying the mechanisms by which multi-dimensional urban morphology affects the thermal environment and identifying high-risk areas can provide a scientific basis for differentiated heat island mitigation strategies and climate-resilient planning.

ID: 215

Influence of Low-Level Jet on the Urban Heat Island Intensity and the Variability of Atmospheric Pollutant Concentrations in São Paulo Megacity

Maciel Piñero Sánchez¹, Adalgiza Fornaro², Amauri Pereira de Oliveira³, Bruna Lüdtke Paim⁴, Yendry Jomolca Parra⁵, Lucas Cardoso da Silveira⁶, Georgia Codato⁷, Lucas Covre Chiare⁸, Leticia Prado Lima⁹, Ávila Benaya dos Santos Sousa¹⁰, Agnès Borbon¹¹

^{1,2,3,4,5,6,7,8,9,10}*University of São Paulo*

¹¹*Université Clermont Auvergne*

ABSTRACT

There is evidence that turbulent mixing induced by Low-Level Jet (LLJ) modulates Urban Heat Island (UHI) intensity and reduces surface pollutant concentrations in the Metropolitan Region of São Paulo (MRSP). This study aims to characterize the main properties of LLJ in the MRSP and investigate their relationship with atmospheric pollutant concentrations and UHI intensity using rawinsondes carried out regularly twice daily over a three-year period from 2023 to 2025. LLJs were identified on at least 60% of days every month, with a mean intensity of 8.8 ± 0.1 m s⁻¹ and a mean height of 658 ± 7 m, predominantly from east, southeast, north and northeast components. LLJ intensity was negatively correlated with UHI intensity and with particulate matter (PM_{2.5} and PM₁₀) and carbon monoxide (CO) concentrations. These results suggest that LLJ-related ventilation may contribute to reducing nighttime pollutant concentrations and UHI intensity through enhanced vertical turbulent mixing and horizontal advection of cleaner air.

ID: 216

Adapting the Environmental Indicators from Global to Local Level within the Quality of Life Initiative: The Case of the City of Kragujevac, Serbia

Branislav Antonić¹, Ivan Radulović²

¹*University of Belgrade – Faculty of Architecture, Department of Urbanism, Bulevar kralja Aleksandra 73/2, 11000 Belgrade, Serbia*

²*City of Kragujevac – Chief Planner Office, 34000 Trg Slobode 3, Kragujevac, Serbia*

ABSTRACT

Improving the quality of local life is among the main denominators of successful cities. Nevertheless, understanding, measuring and implementing it through decision-making process is always a policy challenge. This was the reason why the United Nations recently launched the Quality of Life Initiative (QoLI). The core of this innovative global project is to develop the mechanism based on Sustainable development goals (SDGs) that evaluates and accelerates progress on local and global policy agendas relating to improving the quality of life in cities.

Kragujevac in Serbia is one of the first cities which passed through the QoLI process. The city project team had to check the quality of local life through two types of indicators: globally promoted and local-level developed. The evaluation of all indicators to achieve their final values differs between four data sources: statistical data, geodata measurement, mobile-ping data, and social media survey.

The focus of this research is on the indicators related to environment, one of nine domains in the QoLI analysis. There are eight such indicators in the Kragujevac case, covering the different spheres of urban environment, such as air quality, pollution, urban greenery, public awareness about climate changes, etc. The research aim is to present the QoLI process – how these indicators are determined, measured, and implemented through participation. This is exemplified by explaining an indicator for an “urban heat island” effect. The acquired results are useable for local decision makers to actively engage with community in shaping more human-driven urban policies. In Kragujevac, the main outcome from environmental QoLI indicators is a general refocus to improving local urban mobility in city.

Keywords: Quality of life, urban indicators, environmental evaluation, global-local.

ID: 218

Multi-Scale Assessment of Urban Form Transformation and Heat Exposure in Melbourne’s Western Suburbs

Jingliang Dong¹, Yashwanth Kaushal Ediriweera², Gokul Thirunavukkarasu³, Lin Yang⁴, Allison Kealy⁵, Elmira Jamei⁶

¹*Institute for Sustainable Industries & Liveable Cities (ISILC), Victoria University, Melbourne, VIC*

^{2,3}*Department of Engineering Technologies, School of Engineering, Swinburne University of Technology, Melbourne, VIC*

⁴*Aula Energy, Melbourne, VIC*

⁵*Swinburne University of Technology*

⁶*Victoria University*

ABSTRACT

Rapid urban growth in Melbourne’s western suburbs has transformed land cover and urban morphology, intensifying urban heat exposure in an area with existing socio-environmental vulnerability. This study investigates how urban form changes influence Land Surface Temperature (LST) across multiple spatial scales by integrating Local Climate Zone (LCZ) mapping, and computational fluid dynamics (CFD) modelling. First, LCZ maps were generated for 2014, 2019, and 2024 to examine urban form change across Melbourne’s western suburbs. The results reveal a clear increase in compact built forms, particularly compact low-rise and compact mid-rise classes, alongside a decline in open low-rise and sparsely built areas. These transitions correspond with a general increase in LST, with built LCZs consistently recording higher temperatures than natural land-cover classes. Second, three representative LCZ canyon typologies, compact high-rise, compact mid-rise, and compact low-rise, were modelled under extreme summer conditions to assess microscale thermal behavior. Results show canyon geometry strongly influences airflow and pedestrian-level temperature. Compact high-rise forms promote greater ventilation and reduce near-ground heat accumulation despite higher density, whereas mid-rise and low-rise forms exhibit weaker airflow penetration, greater stagnation, and higher pedestrian-level temperatures. The findings demonstrate the value of the LCZ framework for tracking urban morphological change and linking it to thermal conditions. These findings highlight the value of LCZ-based multi-scale analysis for informing climate-sensitive urban design and heat mitigation in rapidly developing suburbs.

ID: 221**Identifying Inter-Monthly Evolution Patterns and Driving Factors of The Urban Heat Island Effect in Xi'an Using Remote Sensing Data**

*Yuejing Gao¹, Xudong Wang², Li Han³, Wei Ding⁴
^{1,2,3,4}*Xi'an University of Science and Technology, Xi'an, China**

ABSTRACT

The urban heat island (UHI) effect poses a critical ecological and environmental challenge to urban sustainability, particularly in rapidly urbanizing regions. Although numerous studies have examined UHI characteristics, the fine temporal dynamics of UHI in cold-climate cities remain insufficiently understood, largely due to the widespread reliance on seasonal or annual averages. Thus, focusing on Xi'an, a representative cold-climate city in northwestern China, this study quantifies both the temporal patterns of UHI and the season-dependent effects of key surface factors using LST retrieval, block-based spatial analysis, and regression modeling. The results show that (1) the urban thermal environment exhibits pronounced monthly variability, with LST peaking in June (41.31 °C) and July (37.79 °C) and reaching its minimum in January (0.99 °C); (2) UHI displays strong intra-annual fluctuations, with maximum intensity occurring in early summer and substantially weaker effects in winter; and (3) impervious surfaces and vegetation jointly regulate urban thermal patterns, but their thermal effects are highly non-stationary at the monthly scale, with vegetation-induced cooling strongest in summer and negligible in winter. These findings demonstrate that seasonal averages can obscure critical month-specific thermal extremes, highlighting the importance of incorporating fine temporal dynamics into urban climate assessments and heat mitigation planning in cold-climate cities.

Keywords: Urban heat island, land surface temperature, monthly variation, driving factors.

ID: 228**Tire and Road Wear Particles under Urban Heat: A Narrative Review of Generation, Transport, Exposure, and Mitigation**

*Cheng Yang¹, Tianxiang Liu², Mingdong Jiang³, Zixuan Li⁴, Junqi Wang⁵
^{1,2,3,5}*Southeast University, Nanjing, China*
⁴*Suzhou University of Science and Technology, Suzhou, China**

ABSTRACT

Tire and road wear particles (TRWPs) are a major source of urban non-exhaust particulate pollution. This focused narrative review examines how urban heat conditions may affect TRWP generation, environmental transport, exposure, and mitigation. Web of Science, Crossref, and PubMed were searched in two stages for publications available up to 30 June 2026. Of 3,752 records identified, 26 studies were selected for detailed synthesis according to their relevance to TRWP generation, transport, exposure, or mitigation. Controlled tire and pavement studies indicate that tread and surface temperature can influence tire-wear emissions and particle composition, while aging experiments show temperature-dependent oxidation and release of tire-associated constituents. Urban observations document wind-dependent resuspension, airborne occurrence in traffic-dominated microenvironments, and transport through road runoff and stormwater systems. However, current evidence does not quantify the incremental effect of urban heat islands on citywide TRWP emissions, exposure, or health risk. Studies of heat and mixed traffic pollution, together with in vitro TRWP toxicology, indicate potential health relevance but do not establish heat-TRWP disease causality. Potential mitigation measures include traffic management, durable pavement and tire materials, targeted street cleaning, stormwater treatment, and ventilation-aware urban design. Their effectiveness should be evaluated using paired temperature and TRWP measurements.

Keywords: Tire and road wear particles (TRWPs), urban heat island, non-exhaust emissions, urban exposure.

ID: 229

The Gray Tail of Urban Heating: Tire-Wear Particles Are Emerging as An Amplified Traffic Related Pollution Risk

Tianxiang Liu¹, Cheng Yang², Junqi Wang³

^{1,2,3}Southeast University, Nanjing, China

^{1,2,3}Jiangsu Provincial Engineering Research Center for Synergistic Control of Heat and Pollution

ABSTRACT

Road transport electrification is widely viewed as a key pathway to deep decarbonization, yet it can increase non-exhaust emissions such as tire-wear particles (TWPs), potentially amplifying traffic-related microplastic loads in cities under a warming thermal environment. Microplastics persist for long periods, can carry toxic additives and co-contaminants, and accumulate through food webs, posing substantial risks to ecosystems and human health. We develop a scenario-driven, spatially explicit framework to quantify TWP emissions across China and project their future evolution under combined electrification and urban warming. We find that national TWP emissions are already substantial, and that electrification, when coupled with warmer road surfaces, produces higher emissions than a non-electrified baseline. Emissions cluster in major urban agglomerations and along key transport corridors, with a relatively small set of large cities contributing a disproportionate share. Looking ahead, the additional contribution from electrification plus warming increases toward end-century under both SSP245 and SSP585, indicating that climate and technology transitions can jointly intensify microplastic burdens. Our results show that decarbonization does not necessarily reduce microplastic risks, underscoring the need to integrate tire-wear control and road thermal management into future transport electrification policies.

Keywords: Tire wear particles (TWPs), urban heat island (UHI), road surface temperature (RST), electric vehicles.

ID: 231

Validation of EnergyPlus Simulation for Outdoor Radiative Environment with External Shading Components

Jiayu Zhou¹, Shi Yin², Bin Yu³, Zijian Wang⁴, Yueyang Zhang⁵, Wei Liao⁶, Yiqiang Xiao⁷

^{1,2,3,4,5,7}School of Architecture, South China University of Technology, Guangzhou, China

^{2,7}State Key Laboratory of Subtropical Building and Urban Science, South China University of Technology, Guangzhou, China

⁶School of Architecture and Urban Planning, Guangdong University of Technology, Guangzhou, China

ABSTRACT

While optimizing surface materials to improve outdoor thermal environments has been widely studied, research on the role of building morphology remains insufficient. Addressing the intensified outdoor heat loads caused by glass curtain walls, this study validates the mitigation effects of external shading facilities in Guangzhou's hot and humid climate. The methodology combines EnergyPlus simulations with empirical data from a 1:10 scaled model, utilizing a "dummy zone" approach for parameter calibration. Results indicate that EnergyPlus accurately reproduces incident radiation ($R^2 > 0.90$) using reconstructed weather files. Furthermore, by refining virtual sensor geometry, the software effectively simulates the interception of short-wave reflections by shading facades. However, due to inter-zone calculation mechanisms, the tool fails to directly simulate long-wave radiation exchange between outdoor surfaces. This study clarifies both the capabilities and algorithmic limitations of EnergyPlus in assessing façade morphology, providing a scientific basis for urban heat resilience design.

Keywords: outdoor thermal comfort, external shading facility, heat resilience, Energyplus.

ID: 235**Spatiotemporal Characteristics of Vertical Microclimate in Urban High-Rise Residential Buildings: A Case Study in Zhengzhou***Di Wu¹, Jingjing Jia², Mengze Fu³**^{1,2,3}School of Architecture, Zhengzhou University, Zhengzhou 450001, China***ABSTRACT**

Rapid global urbanization has cemented high-rise residential buildings as the dominant urban living typology. Due to their massive and complex building volumes, high-rise residential near-wall microclimates exhibit pronounced variations across the vertical dimension. However, most studies focus on the horizontal scale, and research on the spatiotemporal characteristics of vertical near-wall microclimates in high-rise residential buildings is still limited. This study bridges this gap by introducing Dynamic Mode Decomposition (DMD) frameworks, which has the advantage of decode the complex computational fluid dynamics (CFD) outputs and extracted coherent spatiotemporal modes. A typical high-rise residential building was selected as the case study. High-resolution numerical simulations of the vertical near-wall microclimate were subsequently executed using ENVI-met, followed by dynamic mode decomposition. The study reveals three key patterns in the near-wall microclimate of high-rise residential buildings. First, a significant "diurnal reversal" occurs in the vertical temperature gradient. Second, humidity decreases with height. Third, wind speed increases with height. DMD analysis further confirms that architectural features, such as balcony protrusions and window recesses, strongly influence microclimatic variations. This research provides a novel analytical paradigm for understanding vertical microclimatic differentiation, and offering critical insights for mitigating vertical environmental inequality, optimizing building energy performance, and advancing climate-resilient urban design.

Keywords: High-rise residential buildings, vertical near-wall microclimate, ENVI-met, DMD.

ID: 237**Integrating Life-Circle Accessibility and Institutional Governance in Neighborhood-Scale Urban Heat Vulnerability Assessment***Junyi Hua¹**¹Ocean University of China***ABSTRACT**

In the context of accelerating urbanization and the increasing frequency and intensity of heatwaves under climate change, fine-scale assessments of urban heat vulnerability are a critical imperative for healthy city development. This study argues that residential settlements constitute the fundamental unit of both daily life and risk governance in cities. We present a comprehensive settlement-scale heat vulnerability assessment of Jinan, China, a representative inland city in Northern China. Our investigation encompasses over 1,600 settlements, employing an integrated exposure-sensitivity-adaptive capacity framework. A key methodological innovation lies in the construction of pedestrian-based 5- to 15-minute life circles from settlement entrances, within which we precisely quantify hyperlocal heat exposure and the spatial distribution of critical adaptive resources using points of interest data. Furthermore, we incorporate often-overlooked institutional dimensions, namely property management and housing ownership. Through factor analysis, we distilled four primary vulnerability drivers: thermal environment, basic living services, building quality, and housing price with enhanced amenities. Our findings reveal a pronounced disparity in vulnerability, pinpointing that settlements lacking professional property management and those with non-market housing tenure are significantly more vulnerable. This is acutely manifested in old, elevator-less settlements without professional management, which endure severe heat exposure despite having some adaptive resources in their immediate surroundings. Consequently, this study concludes that urban heat resilience strategies must evolve beyond a sole focus on physical infrastructure and environmental greening. It is imperative to integrate institutional factors such as property management and housing policy into the core of urban climate adaptation planning to enable targeted and effective interventions for the most at-risk communities.

Keywords: urban heat vulnerability, neighborhood-scale, institutional governance, life-circle accessibility

ID: 238

The Cozzi Swimming Pool (1934) as a “Historical Laboratory” for Environmental Evaluation: Ventilation, Hygiene, Light and Governance in Urban Devices

Barbara Galli¹, Emilio Faroldi², Yupeng Wang³

^{1,2}Politecnico di Milano, Milan, Italy

³Southeast University, Nanjing, China

ABSTRACT

Contemporary architectural debate relies on concepts shaping a vocabulary—green building, tool development, heat-resilient planning, and urban environmental evaluation—often associated with simulation and standardised indicators. This vocabulary also rests on technical genealogies: devices, constraints, and operational practices that can be reconstructed from historical construction and archival records. Yet systematic procedures to support design decisions remain limited. Building on this premise, the essay proposes architectural history as an operational method to reconstruct the material and social conditions shaping technical solutions and to translate them into variables and proxies for design and management decision support. The argument is developed through the Cozzi indoor pool (Milan, 1934). Documentation shows that this public infrastructure addresses issues central today: ventilation and indoor air quality, thermo-hygrometric control, natural and artificial light, hygiene and water treatment, durability and maintenance, and the relationship between layout and performance—whose effectiveness depends on use patterns, crowding, and operating rules.

The analysis highlights how history can provide performance evidence for contemporary practice: (1) sustainability as the outcome of an integrated system (air–water–heat–light); (2) the centrality of use and governance in in-use performance; and (3) the conversion of historical readings into operational criteria and variables, particularly in the context of heat-adaptation policies and networks of public refuge spaces. The paper demonstrates an evidence—phenomenon—variable—proxy/KPI—tool/policy matrix and proposes an urban operationalisation—accessibility, peak-capacity management, and governed microclimate—with SSH indicators (equity, acceptability, and adherence to operating rules) relevant to cooling-shelter networks.

Keywords: Heritage, environmental evaluation, governance.

ID: 239

Urban Mortality Risks of Ambient Temperature and Extreme Events: A Multi-City Analysis in Japan

Yijia Chen¹, Ruihang Li², Ruiyan Liu³, Tomohiko Ihara⁴

^{1,2,3,4}Department of Environment Systems, Graduate School of Frontier Sciences,
The University of Tokyo, Japan

ABSTRACT

This study examined the impacts of ambient and percentile-defined extreme temperatures on cause-specific mortality in 12 major Japanese cities (1995–2022), providing new evidence on urban health under climate change and urban heat island conditions. Daily mortality from circulatory (I), respiratory (J), endocrine and metabolic (E), mental and behavioral (F), neurological (G), and all-cause deaths was analyzed using a two-stage quasi-Poisson distributed lag non-linear modeling framework with meta-analysis.

Results showed clear U-shaped temperature–mortality associations, with city-specific minimum mortality temperatures ranging from the 52nd to 99th percentiles. Cold effects were generally stronger than heat effects, particularly for circulatory (I), respiratory (J), and endocrine diseases (E), where relative risks exceeded 2 under extreme cold exposure. Cold exposure accounted for most temperature-attributable mortality, whereas neurological mortality showed a comparatively greater contribution from heat. Heat effects were typically acute, with elevated risks under extreme heat ($\geq P95$ – $P99$) for endocrine (E) and circulatory diseases (I), while mental (F) and neurological (G) outcomes showed weaker or delayed associations.

These findings demonstrate disease-specific vulnerabilities to non-optimal temperatures and confirm that cold remains the dominant contributor to mortality burden in temperate urban settings. The results highlight the need to strengthen cold-season preparedness while incorporating health considerations into urban climate adaptation planning.

ID: 243

Categorical Evaluation of Aerodynamic Parameters Estimation Methods for Urban Wind Profiles: A Systematic Review with Implications for Dense Urban Environments

Weijie Sun¹, Yueyang He², Janet Barlow³, Chao Ren⁴, Chi Yung Tam⁵, Chao Yuan⁶,
Jimmy Chi Hung Fung⁷, Edward Ng⁸

^{1,2,5,8}The Chinese University of Hong Kong, Hong Kong, China

³University of Reading, Reading, UK

⁴The University of Hong Kong, Hong Kong, China

⁶National University of Singapore, Singapore

⁷Hong Kong University of Science and Technology, Hong Kong, China

ABSTRACT

For urban heat islands (UHI) studies, accurate representation of urban wind profiles requires reliable aerodynamic parameters: roughness length (z_0), zero-plane displacement (z_d) in the logarithmic law (LOG), and wind shear exponent (α) in the power law (PL) model. However, inconsistent classifications of urban morphological types and atmospheric stability have hindered comparison and transferability of estimation methods and empirical parameter values across the literature. This study systematically reviews more than 130 cases worldwide to develop mapping schemes linking surface roughness to urban morphological types, and stability indicators to atmospheric conditions, enabling a categorical evaluation of estimation methods and empirical values. Five methodological categories are identified: anemometric, physical/numerical modeling, morphometric, mathematical and reference-based methods. Comparative analysis includes reported z_0 and α values across urban morphologies, and α values across stability classes. Morphometric models are most widely applied, yet empirical values remain scarce in high-density or high-rise settings. Discrepancies persist both within and across cases, as parameter estimations are constrained by coarse value ranges and terrain definitions in the original studies. For stability-related conditions, anemometric methods dominate but lack cross-verification, especially under non-neutral atmospheres. Empirical z_0 and α values are largely restricted to neutral cases. These deviations arise from the absence of standardized definitions and thresholds, also the limited case numbers and cross-regional data. The proposed classification schemes and synthesized recommendations provide guidance for selecting context-appropriate references, particularly for dense urban areas facing increasing UHI challenges. These findings provide insights for urban wind research, meteorology, and environmental planning in contemporary metropolitan environments.

Keywords: Urban wind profiles, aerodynamic parametrization, urban morphology, atmospheric stability.

ID: 246

Study on Thermal Benefit of Vertical Greening on Outdoor Environment under Cold Climate

Xiaodi Zuo

Department of Architecture, School of Human Settlements and Civil Engineering,
Xi'an Jiaotong University, Xi'an 710049, China

ABSTRACT

Vertical greening plays an important role in regulating the outdoor microclimate around buildings. To enhance the thermal benefits of vertical greening in cold regions, this study investigates the impact of ivy-covered walls on the summer outdoor microclimate of buildings in Xi'an through a combination of field measurements and software simulations. Field test results confirm the cooling effect of ivy walls, with a maximum temperature reduction of about 2°C in summer. The cooling effect becomes more pronounced closer to the ivy-covered surface, where outdoor temperature fluctuations are also more stable. ENVI-met simulations were further conducted to compare scenarios with and without vertical greening, as well as different greening types. The results show that the cooling influence of vertical greening decreases with height, with a maximum horizontal impact distance of 9 m and a vertical impact range of approximately 8 m. Finally, OpenStudio® was used to evaluate building energy performance, showing that vertical greening can reduce energy consumption by up to 1.67% under the measured conditions. This study provides scientific evidence for the application of vertical greening in cold regions and offers a useful reference for mitigating urban heat island effects in areas at similar latitudes.

Keywords: Thermal benefit, vertical greening, ENVI-met simulation, energy-consuming simulation.

ID: 247

A Study on the Sensitivity of Urban Ecological Performance Based on Multi-Factor Interactions

Jie Yang¹
¹Tongji University

ABSTRACT

Eco-city development pursues multiple objectives, yet planning factors differ greatly in their ecological impacts with complicated interactions. Blindly stacking control indicators raises costs with poor outcomes. This paper establishes a global sensitivity analysis framework considering multi-factor synergies. Six morphological parameters are selected: intersection density, average street segment length, urban density, building height, road aspect ratio and urban interface continuity. Three ecological performance metrics are adopted: unit-area energy consumption, day-night equivalent continuous sound level, and General Thermal Climate Index. The Extended Fourier Amplitude Sensitivity Test (EFAST) is applied to quantify factor sensitivity, supporting urban planning shifting from indicator compliance to performance optimization. The results show that interface continuity dominates ventilation, heat exchange and sound propagation. Road aspect ratio and density create contradictory enclosure effects: shading mitigates heat stress, while poor ventilation traps heat and amplifies noise. Urban form strongly regulates wind-thermal conditions, whereas noise is mainly driven by external interference with weak morphological control. Factor importance rankings differ substantially under multi-factor interaction compared with single-factor local analysis. Raising building height alongside lowering road aspect ratio achieves energy-saving synergy. Lower height plus higher interface continuity intensifies noise. Shorter street segments and higher aspect ratios consistently improve wind-thermal environments, and denser road intersections deliver the best comprehensive ecological benefits.

ID: 248

A Study of Cutting-Edge International Academic Literature on Ecological Cities

Jie Yang¹
¹Tongji University

ABSTRACT

With the continuous advancement of urbanization, the urban ecological environment, as a key issue in sustainable urban development, has garnered widespread attention. In recent years, the construction of green ecological cities has been incorporated into overall urban development goals, creating favorable conditions for sustainable social development. The development of eco-cities is not merely an extension of green building; it places greater emphasis on maintaining harmony and unity among environmental, economic, and social dimensions. This paper employs a literature review approach to examine cutting-edge research on eco-cities, identifying their overall framework and trajectory. Based on this analysis, it summarizes and distills current research trends, noting that eco-city planning is moving toward intelligent systems and that the utilization of various resources is shifting toward dynamic cycles, with the aim of providing a reference for research on green eco-cities.

ID: 250**Microclimate-Integrated Urban Building Energy Modeling for Heat-Resilient Urban Planning: Evidence from Shanghai and Singapore***Pengyu Jie¹, Xing Shi²**^{1,2}College of Architecture and Urban Planning, Tongji University, China***ABSTRACT**

Urban heat islands and local microclimates can substantially alter building energy demand, yet most urban building energy modeling (UBEM) workflows still rely on uniform weather inputs that underrepresent neighborhood-scale thermal and humidity variations. This study develops a microclimate-integrated UBEM (MUBEM) framework combining multi-source building data fusion, fast archetype-based energy simulation, Weather Research and Forecasting (WRF) downscaling, Local Climate Zone (LCZ) interpretation, spatial autocorrelation analysis, and climate-driver attribution. The framework is applied to Shanghai and Singapore, two dense Asian megacities representing humid subtropical and tropical rainforest climates. It covers 592,795 buildings in Shanghai and 118,782 buildings in Singapore. Baseline UBEM validation in Singapore achieved 29.1% CV-RMSE after archetype-specific calibration, while Shanghai was evaluated using aggregate and archetype-level benchmarks. Replacing typical meteorological year weather with local WRF-adjusted microclimate inputs produced energy deviations exceeding 20% in parts of Shanghai, while Singapore showed more stable deviations around 5%. Shanghai exhibited strong seasonal sensitivity, including a 40.6% residential transition-season discrepancy, whereas Singapore showed deviations of 0.4%-6.5%. Climate-driver attribution revealed distinct regimes: Shanghai shifted between temperature-dominated heating responses and coupled temperature-humidity cooling responses, while Singapore remained year-round cooling dominated. The framework identifies where microclimate coupling most affects urban energy estimates and supports spatially targeted low-carbon urban renewal.

ID: 251**Dynamic Topology for Autonomous Disassembly: A GAT-Based Reinforcement Learning Framework for Industrial Building Joint Deconstruction***Xu Yeyang Zhang¹, Siying Liang², Yurong Li³, Yu Zhang⁴**^{1,2,3,4}School of architecture, Southeast University, Nanjing (China)***ABSTRACT**

Industrial building joint deconstruction requires planners to reason about changing geometry, degraded connections, and component accessibility rather than relying on static BIM topology alone. This paper revises and clarifies a closed-loop framework that translates joint degradation and spatial constraints into dynamic graph topologies and learns disassembly policies with a Graph Attention Network trained by policy-gradient reinforcement learning. Each joint is represented by node features describing component role, fixation condition, degradation state, relative degradation ranking, simulation-derived risk, and dynamic removal state, together with edge features summarizing contact strength, directional occlusion, and combined bond condition. A Rhino-based simulation pipeline validates candidate removals through connectivity and six-direction ray-casting checks. Across the generated benchmark, the learned policy performs well on two moderately complex joint types, reaching 59.9% and 76.0% success, but fails on deeply nested topologies and on one trivial topology where fixed safety rules may have over-regularized the policy. On six unseen roof-joint typologies, the corrected average success rate is 45.5% across all cases and 68.3% over the four transferable cases. These mixed results show that dynamic topology is a useful intermediate representation, while also revealing clear limits of shallow message passing and static reward safeguards.

Keywords: Disassembly sequence planning, dynamic topology, graph attention network, reinforcement learning.

ID: 252

Refining Morphological Descriptions for Thermal Performance: A Clustering Approach Integrating Spatial Context

Zihao Wu¹, Ziyu Tong²

^{1,2}*School of Architecture and Urban Planning, Nanjing University, Nanjing, China*

²*Key Laboratory of Urban AI and Green Built Environment of Provincial Higher Education Institutes, Nanjing University, Nanjing, China*

²*International Research Centre on Green Building and Urban Morpho-Science, Nanjing University, Nanjing, China*

ABSTRACT

Data-driven clustering provides an effective way to interpret the relationship between urban form and the thermal environment. However, most conventional clustering approaches rely only on the self-morphological features of individual spatial units and therefore overlook the regulatory role of the surrounding built environment. To address this gap, this study proposed an urban form representation framework that integrates local features and regional spatial context. The framework modeled the urban form as a graph and used a graph convolutional network (GCN) to aggregate multi-order neighborhood information, thereby generating a context-aware representation embedded with the broader built-environment setting. Using Nanjing, China, as a case study, we compared clustering based on self-feature representations with clustering based on GCN context feature representations. The results show that the GCN approach substantially improved the explanatory power of clustering results for land surface temperature (LST) and produced spatially more continuous urban form types. Finally, ten urban form types were identified, showing different thermal environment performance. The results demonstrated that incorporating spatial context can refine morphological descriptions for thermal performance analysis and provide a more reliable basis for heat-risk assessment, climate-adaptive zoning and sustainable urban regeneration.

Keywords: Urban form, spatial context, graph convolutional network, thermal environment.

ID: 253

Research on the Impact Weight Evaluation of Design Factors for Green Energy-Saving Renovation of Old Residential Communities Based on Microclimate–Energy Coupled Simulation

Zhichao Yu¹, Ziyu Tong²

^{1,2}*School of Architecture and Urban Planning, Nanjing University, Nanjing, China*

²*Key Laboratory of Urban AI and Green Built Environment of Provincial Higher Education Institutes, Nanjing University, Nanjing, China*

²*International Research Centre on Green Building and Urban Morpho-Science, Nanjing University, Nanjing, China*

ABSTRACT

Old residential communities green and energy-saving retrofits have become an important approach for advancing low-carbon transformation and enhancing climate adaptability. However, existing retrofit practices are often limited to patch-based updates under a single climate condition, lacking a systematic and coordinated assessment of design factors across multiple levels. To address this, this study divides the retrofit process into three hierarchical levels: outdoor space, building form, and material components, and establishes an evaluation framework comprising 13 core design factors. Based on microclimate-energy coupled experiments, the study quantifies the influence strength of each design factor on both microclimatic conditions and building energy consumption. The results show that tree crown size and vegetation coverage ratio are the primary factors affecting outdoor high-temperature areas. Increasing tree crown size can reduce the proportion of outdoor high-temperature zones by up to 25.3%. In addition, tree crown size and the installation of elevators are key factors influencing outdoor ventilation performance; the installation of elevators increases the proportion of outdoor calm wind zones by up to 13.7%. For building energy use, balcony configuration, window parameters, and the thermal transmittance of walls are the main design factors. Adjusting the balcony configuration can reduce the summer noon cooling energy consumption per dwelling by up to 28.4 kWh. This study clarifies the impact weights and directional effects of design factors, providing methodological support for shifting old residential community retrofits from experience-based decision-making toward performance-oriented design.

Keywords: Old residential, energy-saving renovation, microclimate-energy coupling, design elements.

ID: 255**A Porous Hydrogel Coating Integrating Radiative and Evaporative Cooling for Building Thermal Regulation***Yu Wang¹, Yaohan Mai¹, Cheng Liu^{1,*}**¹School of Materials Science and Engineering, Southeast University, Nanjing, China.***ABSTRACT**

Radiative-evaporative cooling offers a low-energy strategy for reducing building surface temperatures and mitigating the urban heat island effect. However, hydrogel-based cooling materials often suffer from insufficient solar reflectance, performance degradation under wet conditions, and uncontrolled water release. These limitations restrict their practical use in building envelopes. Here, we propose a porous hydrogel coating for climate-adaptive passive cooling of building surfaces. By introducing Al₂O₃, an open porous network was formed during drying. This structure enhanced multiple solar scattering and improved structural stability. The optimized coating exhibited a solar reflectance of 93.6% and an emissivity of approximately 96% in the 8-13 μm atmospheric window. Wet-state measurements showed that water uptake reduced part of the near-infrared reflectance, but had only a limited effect on visible reflectance and mid-infrared emissivity. Meanwhile, evaporation provided an additional latent-heat dissipation pathway. Water uptake, moisture sorption, and evaporation tests further confirmed that the coating could store, retain, and controllably release water. Outdoor measurements showed that the dry hydrogel achieved a sub-ambient cooling of about 4 °C, while the wet hydrogel reached a temperature reduction of about 8 °C through evaporation-enhanced cooling. This work demonstrates a hydrogel coating design that integrates spectral regulation, moisture management, and building surface heat mitigation.

Keywords: Radiative-evaporative cooling, hydrogel coating, passive cooling.

ID: 257**Can City Climate Action Plans Translate Heat Risk into Implementable Actions? An LLM-Assisted Analysis of 81 C40 Cities***Yang Chen¹, Qi Dong^{2,*}, Cheng Sun³**^{1,2,3}School of Architecture and Design, Harbin Institute of Technology, Harbin, China**^{1,2,3}Key Laboratory of Cold Region Smart Human Settlement Environment Science and Technology, Ministry of Industry and Information Technology, Harbin, China***ABSTRACT**

City climate action plans (CAPs) are key instruments for organizing urban heat adaptation, yet it remains unclear whether risk recognition is translated into implementable governance arrangements. We analyzed 132 CAPs and related documents from 81 C40 cities using large language model (LLM)-assisted coding. From 5,052 candidate segments, we identified 4,675 heat-related segments and extracted 2,368 action units, evaluated across policy attention, strategy portfolios, and action operationalization. Although 97.7% of documents recognized heat risk and 87.1% proposed actions, only 15.2% included financial information and 12.9% monitoring mechanisms. Spatial cooling accounted for 54.9% of actions, dominated by green-blue infrastructure, but responsibilities, timelines, and monitoring were often unspecified. Heat exposure showed no stable association with policy attention, whereas greater attention was associated with clearer operationalization and targeting. Heat monitoring, emergency preparedness, and heat-health warning actions were more likely to specify implementation arrangements. The primary gap in C40 heat adaptation has therefore shifted from risk recognition and action formulation to an implementation-institutionalization gap characterized by inadequate finance, monitoring, responsibility, and coordination.

Keywords: Urban heat adaptation, climate action plans, large language models, policy implementation.

ID: 258

Contrasting Effects of Urban Resilience on Night-time Surface Urban Heat Island Mitigation in Old and New Urban Areas of Chengdu

Xiaoxiao Gao¹, Xue Zhong², Yuanjian Teng³, Jiaye Li⁴, Xiaocheng Huang⁵, Siting Chen⁶, Genyu Xu⁷

^{1,2,4,5,6}Southwest Jiaotong University

³South China Normal University

⁷Yunnan University

ABSTRACT

Under rapid urban expansion, surface urban heat island (SUHI) restricts urban sustainability with distinct intra-city thermal disparities. Urban resilience (UR), defined through size, density, and morphology dimensions, offers a potential pathway for SUHI mitigation, yet the lack of high-resolution thermal data restrict intra-city, multi-season comparisons between old and new urban zones. This study adopts two single-date nighttime SDGSAT-1 thermal infrared images from autumn and winter 2024 to analyze heterogeneous UR and built-environment impacts on Chengdu's nocturnal SUHI across old and new township-level urban units, via interpretable automated machine learning and Geographically and Temporally Weighted Regression models. Under the two sampled dates, nighttime SUHI intensity was higher in winter than autumn, and new townships had higher URS, URD and URM values overall. Autumn SUHI was mainly governed by gross domestic product and URS, with exploratory cooling thresholds of 0.04-0.06. In winter, URD became the leading factor, with thresholds of 0.47 in new township-level urban units and 0.49 in old areas. URM produced effective cooling mainly in new township-level urban units, with thresholds of 0.97 in autumn and 0.67 in winter. Based on the above research, we propose exploratory targeted planning advice for old and new township-level urban units: Early developed western and northwestern new urban areas should prioritize ecological construction in autumn, while eastern new urban areas should optimize blue-green space allocation and control expansion intensity in winter. For old urban areas, improving URD and promoting micro-renewal with embedded blue-green spaces can strengthen connected ecological networks and mitigate heat accumulation in built-up environments.

ID: 259

Diurnal Response Differences between Land Surface Temperature and Human Thermal Stress in High-Density Residential Areas: An Explainable Analysis Based on Three-Dimensional Morphological Indicators

Xinya Kong¹, Junjie Luo²

^{1,2}College of Landscape Architecture, Zhejiang A&F University, Hangzhou, China

^{1,2}Zhejiang Province Key Think Tank: Institute of Ecological Civilization, Zhejiang A&F University, Hangzhou, China

ABSTRACT

Land Surface Temperature (LST) is widely used to evaluate urban cooling performance and optimize spatial morphology. However, residents' thermal exposure is characterized by human thermal stress, which integrates radiation, air temperature, humidity, and wind conditions. Whether LST-based design recommendations remain valid at the human scale represented by the Universal Thermal Climate Index (UTCI) requires further verification, especially under consistent spatial and temporal conditions. This study conducted paired attribution analyses of LST and UTCI using identical three-dimensional geometries, a unified 2 m grid, and continuous hourly daytime outputs. Six high-density residential communities in Hangzhou, China, were analyzed by integrating UAV-LiDAR reconstruction, ENVI-met simulation, and hourly Random Forest-SHAP analysis. The simulated LST and UTCI were validated against UAV thermal infrared imagery and meteorological observations, achieving R^2 values of 0.91 and 0.93, respectively. Results showed generally consistent morphological responses under strong solar radiation, with phase-dependent shifts in the effects of shadow area and sky view factor. Tree canopy coverage provided stable cooling effects, while canopy proximity offered additional benefits when shading weakened. However, impervious surface proportion and building proximity showed different responses between LST and UTCI. These findings demonstrate that surface cooling cannot be directly equated with reduced human thermal stress. A time-resolved LST-UTCI framework is therefore recommended for heat-adaptive design in high-density residential areas.

Keywords: UAV-LiDAR, land surface temperature (LST), universal thermal climate index (UTCI), SHAP.

ID: 260

Underground Space Utilization for Natural Cooling and Air Purification via Hybrid Earth-Air Tunnel (EAT) and Two-stage Electrostatic Precipitation (ESP) System

Jingwen Chen¹, Zhuangbo Feng²
^{1,2}Southeast University

ABSTRACT

The earth-air tunnel system (EAT), which utilizes underground natural cooling resources to pre-condition outdoor air before it enters buildings, has been proven to obviously reduce electricity consumption of HVAC systems. However, outdoor-originated airborne particles need to be removed when EAT system is in operation. Due to large airflow rate in EAT, widely used fibrous filter causes considerate electricity consumption. In contrast, two-stage electrostatic precipitators (ESP) can achieve high particle removal efficiency with low electricity consumption by fully utilizing long tunnel space as dust collection zone. Hence, this study proposes a hybrid EAT+ESP system to ensure effective air cooling and particle removal while minimizing electricity consumption. To quantitatively optimize the EAT+ESP system, multiple-physics numerical models have been proposed, including turbulent airflow and heat transfer model, corona discharge model, particle dynamic model, and inverse design model of EAT. The optimal EAT+ESP system ($L = 27$ m, $Q = 9.6$ m/s, $L_c = 25$ m, $R_d = 60$ mm, $V_a = 25$ kV, 1×1 m²) can simultaneously achieve multiple objectives: air temperature reduction due to tunnel cooling is 9.03 °C in summer; purification efficiencies for 0.1-2.458 μ m particles are higher than 99.8%; optimal ESP can save 67% of electricity consumed by HEPA, and its quality factor are more than twice that of HEPA. The ozone concentration increase is 0.018 ppb. The influences of two-stage ESP with dense collection plates on air cooling can be negligible. This study provides a new approach for integrated optimization of air cooling and particle removal in energy-efficient buildings.

ID: 261

Design Considerations for Balancing the Effects of Wind and Solar Radiation on Indoor Thermal Comfort under Heat Extremes: A Parametric Study of Public Rental Housing Using Urban Microclimate Foam

Xinrui Guo¹, Yueyang He², Negin Nazarian³, Edward Ng⁴
^{1,2,4}The Chinese University of Hong Kong, [China]
³University of New South Wales, [Australia]

ABSTRACT

Indoor overheating poses direct health risks to occupants, especially under extreme heat conditions. Existing policies and technical guidelines in Hong Kong for indoor thermal comfort may have limited effectiveness under heat extremes. The combined effects of wind and solar radiation on building complexes in hot climates remain insufficiently understood. This knowledge gap is particularly significant for high-rise buildings. To investigate the impacts of natural ventilation and mutual shading between buildings, a computational fluid dynamics (CFD) parametric study is conducted, with the aim of improving indoor thermal comfort under extreme heat conditions and strengthening urban resilience to climate change. Public Rental Housing (PRH), as one of the most representative high-rise building types in Hong Kong, is used as a research prototype. The CFD simulation matrix comprises 144 housing unit scenarios, encompassing six building distances, three unit levels, and eight unit orientations. The results reveal evident distance-dependent variations in the thermal performance of PRH units, with direct implications for design considerations and insights into indoor thermal comfort assessment. Specifically, the design of building facades and unit openings should respond to the impacts of natural ventilation and shading. Moreover, units exposed to windward and oblique-windward airflow generally achieve better thermal comfort than those under other wind-incidence angles. It is recommended that future thermal assessments incorporate explicit overheating-risk indicators alongside conventional comfort criteria.

Keywords: Heat extremes, CFD, Indoor thermal comfort, PRH.

ID: 262

Assessing the Thermal Performance of Green and Cool Roof Strategies in Sendai City, Japan

Vinayak Bhanage¹, Han Soo Lee², Mahesh Mohan³

^{1,2}*Hiroshima University*

³*Mahatma Gandhi University, Kerala, India*

ABSTRACT

This study assesses how green and cool roof strategies affect thermal conditions across Sendai, Japan. The Weather Research and Forecasting (WRF) model was used to perform nine high-resolution simulations, including a control run, green roof scenarios featuring sedum and grass under various irrigation schedules, and cool roof scenarios with albedo values of 0.50 and 0.80. Results reveal distinct cooling mechanisms between the two strategies. Grass-based green roofs produced stronger daytime cooling than sedum roofs, lowering surface air temperature by up to 0.6 °C, compared to 0.3 °C for sedum roofs. However, both vegetation types showed slight nighttime warming that constrained their overall net cooling benefit. Grass roofs consistently outperformed sedum across configurations, while adjusting irrigation timing had a negligible effect on cooling performance. Cool roofs, by contrast, delivered more balanced day–night reductions; the moderate-albedo case (0.50) lowered daytime and nighttime surface air temperatures by 0.27 °C and 0.12 °C, respectively, while the high-albedo case (0.80) achieved reductions of 0.63 °C and 0.22 °C, respectively. The results demonstrate that cool roofs offer stronger and more sustained urban heat mitigation than green roofs across Sendai's varied urban forms.

ID: 264

A Machine Learning-based Framework for Optimizing Air Conditioning Scheduling to Mitigate Anthropogenic Heat Emission for High-Rise Offices in China Great Bay Area

Yuxiao Gu¹, Maoping Wang¹, Zheng Tan¹

^{1,2,3}*The Hong Kong Polytechnic University*

ABSTRACT

Air conditioning (AC) is a major energy end use in commercial buildings and a significant source of anthropogenic heat. Although cooling-related electricity use and condenser heat rejection largely cease after AC shutdown, indoor temperature and humidity can continue to rise overnight in glazed high-rise offices. This overnight heat-and-moisture accumulation increases the sensible and latent loads that must be removed when AC restarts the next morning. In dense office clusters such as the Guangdong-Hong Kong-Macao Greater Bay Area (GBA), high-humidity conditions can amplify moisture accumulation and may concentrate cooling demand and condenser heat rejection during morning restart periods. Therefore, determining shutdown and restart schedules that balance energy savings, overnight heat-and-moisture accumulation, and comfort at re-occupancy is important. However, this dynamic process remains poorly quantified. To address this gap, this study developed a rapid prediction framework. A parametric EnergyPlus model of a representative glazed office building in the GBA was simulated across 83 valid design, operation, and weather scenarios. A two-stage XGBoost surrogate model was then trained: Model A predicts overnight temperature and humidity drift after AC shutdown, whereas Model B predicts next-morning cooling recovery after AC restart. Both stages achieved high accuracy within comfort-relevant error limits under group-based cross-validation. The results show that indoor humidity at shutdown time, rather than envelope design alone, strongly affects overnight temperature evolution. Air infiltration also controls humidity accumulation more strongly than glazing properties. In the reference case under an extreme summer condition, AC could be shut down 35 min earlier and restarted 5 min before occupancy, saving approximately 21.9 kWh per floor per day. Applied across the GBA office stock, this data-driven scheduling approach may reduce both building energy use and the timing of waste heat released to the urban environment.

Keywords: urban heat island, anthropogenic heat, machine learning, air conditioning scheduling

ID: 265

Diurnal Cooling Dynamics of Urban Wetland Parks Based on Spatiotemporal Fusion of ECOSTRESS And GOES-R Data

Tingting Guo¹, Huan Wang², Zhisong Liu³, Chao Chen⁴, Zhijiang Zhang⁵

^{1,3}Zhejiang Ocean University

²Tangshan Normal University

^{4,5}Suzhou University of Science and Technology

ABSTRACT

In this study, we integrated Geostationary Operational Environmental Satellites (GOES-R) and Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) observations through a spatiotemporal fusion approach to reconstruct hourly land surface temperature (LST) at 70 m spatial resolution. Based on the reconstructed LST, we characterized the diurnal cooling dynamics of six urban wetland parks in Stockton, California, USA, and investigated their potential driving factors. The fused LST showed good agreement with reference observations, with an average R^2 of 0.83 and an RMSE of 1.49 °C. All wetland parks exhibited persistent cooling effects throughout the diurnal cycle, with generally stronger cooling during the daytime and weaker cooling at night. Attribution analysis further showed that Shannon's Diversity Index (SHDI) and the normalized difference vegetation index (NDVI) were the dominant factors associated with cooling intensity, whereas dew point temperature showed a negative association. Our research highlights the potential of using spatiotemporal fusion to obtain hourly LST for exploring the diurnal cooling effect in urban wetland parks, and improves the understanding and assessment of their cooling services for urban heat island mitigation.

ID: 266

Social Variables Influencing Outdoor Thermal Comfort: A Scoping Review

Jiajian Chen¹, Edward Ng¹

^{1,2}School of Architecture, The Chinese University of Hong Kong

ABSTRACT

As climate change and urban heat islands intensify extreme weather, outdoor thermal comfort assessment has become essential for indication in urban planning and design for mitigation and adaption. However, assessments relying solely on physical environmental parameters are insufficient, as individual thermal experiences are deeply influenced by personal social, economic and cultural background. A significant research gap currently exists for the delineation of the influence of social background in outdoor thermal comfort assessment. To address this, this study conducts a scoping literature review analysing 123 distinct studies to examine how variables of social backgrounds affect thermal comfort in outdoor environment through physical, physiological, psychological and behavioural pathways. The findings reveal that the influence of social variables is varied and sensitive across various climatic and social contexts. Social variables can be described in demographic, economic or cultural domains. Variables such as age, gender, income, and local cultural norms have been found intrinsically associated with physiological response, psychological appraisal and behavioural adaptation process. These individual-level modulation processes for thermal comfort enable personal decision making for adaptation to physical exposures dynamically. In relation to this modulation process, single-variable analyses are found limited to understand the influence of compound social profiles on thermal comfort. This review underpins the necessity for aggregated intersectional analytical frameworks across social variables in future research. Therefore, understanding thermal comfort with human social backgrounds will further lead to heterogenous, adaptable climatic urban planning and design that provide distinct adaptive opportunities, fostering truly equitable and inclusive urban environments.

Keywords: outdoor thermal comfort, adaptation, socioeconomic status, cultural background, scoping review

ID: 267

Utilizing urban vegetation to simultaneously achieve air cooling and pollutant purification: “multi-physics-media” model development and systematical optimization

*Ruiming Nie¹, Zhuangbo Feng², Shuai Liu³
^{1,2,3}Southeast University*

ABSTRACT

Urban vegetation is widely recognized for mitigating extreme heat and enhancing human thermal comfort. Moreover, vegetation can remove air pollutants and modify their transport trajectories, thereby reducing human exposure and decreasing pollutant fluxes from the atmosphere to other environmental media (e.g., soil). Most existing studies primarily focus on the cooling effects of vegetation, whereas the combined functions of thermal regulation and air pollutant control remain insufficiently investigated. To address this gap, this study proposes a multi-physics and multi-media coupled numerical model to investigate the effects of urban vegetation on microclimate regulation and traffic-emitted pollution control. The multi-physics module simulates vegetation-driven cooling, humidification, and pollutant removal, whereas the multi-media module predicts pollutant transport in the atmosphere and their subsequent migration into soil and vegetation. After experimental validation, the numerical model is employed to elucidate the relationships between key vegetation design parameters (e.g., LAD) and evaluation metrics (e.g., effective temperature, pollutant concentration, and exposure risk). Numerical results indicate that the hybrid configuration of shrub-tree consistently outperform single-vegetation configurations. The hybrid configuration with tree LAD value of 2.5 m²/m³ achieves the best balance between thermal regulation and pollutant purification performance: reducing effective temperature by up to 1.39 K and attaining removal efficiencies of 19.81-79.86 % for 1 nm UFP and PM₁. Air temperature, solar radiation intensity, and wind speed are negatively correlated with cooling and purifying functions of urban vegetation. The traffic-emitted particulate matter concentrations accumulated across multiple environmental media (air-vegetation-soil system) follow the sequence: soil > shrubs > trees. Overall, the newly proposed “multi-physics-media” numerical model is a powerful tool for urban vegetation design, from the perspectives of heat mitigation and air pollutant control.

Keywords: Urban vegetation, Microclimate regulation, Pollutant purification, Multi-media migration



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