Urban Climate News

Quarterly Newsletter of the IAUC

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From the IAUC President

Dear IAUC community,

Our quarterly newsletter is back from its break after the release of the longest IAUC Newsletter in history (61 pages) last November. We surely missed engaging with all of you! A lot has happened in the last five months…

If you have visited our website recently (at https://urban-climate.org), you will have noticed a fresh look! A big THANK YOU to **Matthias Demuzere** who led this effort. As part of this update, we will soon transition our membership list to a new email distribution system that will retire the temporary Uni Bochum list and the meturb-clim list. Please watch out for emails through these two lists that will have instructions on how to confirm your membership and sign up for the new system.

The **ICUC-12** organizing team, led by **Gert-Jan Steeneveld** and **Marjolein van Esch**, hit the ground running! ICUC-12 will take place in Rotterdam, NL, from July 7-11, 2025, and I hope to see you all there! The conference website will launch later this month with a call for special sessions, which will close on June 1, 2024. The call for abstracts will open September 1, 2024, with an anticipated closing date of December 31, 2024. Please mark your calendars!

Another relevant deadline to take note of is **May 10, 2024**. The **Board on Urban Environment (BUE) at the American Meteorological Society (AMS) currently seeks nominations for two new board members and one student member for a 2-year term**. If you are interested (self-nominations are welcome), please email a 1-page expression of interest and a CV to Negin Nazarian (n.nazarian@unsw.edu.au). BUE will not have a symposium at AMS 2025 due to ICUC-12 happening in the same year but hopes to co-organize urban climate sessions with other symposiums. Again, if you have ideas for session topics, please email Negin (deadline is April 25).

Last but not least, please join me in congratulating Prof. **Matthias Roth** for receiving the **2023 YOSHINO Award** from the Association of Japanese Geographers for new developments in the field of urban climatology and for contributing to the international research community. This is well deserved!

Inside the March-April issue...

You can read more about the significance of the award and the upcoming ceremony on page 49 of this newsletter.

Issue No. 90 is packed with urban climate news, including a feature on CO_2 and moisture fluxes, urban project summaries by ICUC-11 student award winners, and a special report on the AGU Fall meeting in San Francisco. THANK YOU, **David Pearlmutter and the IAUC News Team**, for putting together a fantastic issue!

Aloha from AAG,

Ariane Middel

President, International Association for Urban Climate

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Make the upcoming IPCC Cities Special Report count

November 2023 — Cities are receiving increasing attention in global assessments over the past two decades. It has been a hard-fought shift for many urban researchers, but the biggest impetus stems from the pivotal role cities play both as drivers and bearers of impacts of global environmental change. Notably, cities are home to 57% of the world's population, responsible for over 70% of global consumption–related carbon emissions and contributing to over 80% of gross domestic product in many countries. Within the Intergovernmental Panel for Climate Change (IPCC), cities have shifted from the periphery to center stage, which culminated in the decision to produce a dedicated special report on cities in its next assessment cycle. Expectations are high that this upcoming special report will substantially enhance awareness, shape policy, and catalyze actions across mitigation and adaptation within cities and beyond. With the scoping process expected to begin in early 2024, now is a critical time to consider what should be the focus of the upcoming special report.

It's important to acknowledge that IPCC reports primarily synthesize existing literature, and as such, will be largely influenced by the existing body of knowledge. To mobilize the research community to generate a substantial knowledge base to inform the special report, the IPCC took proactive steps by sponsoring a Science Conference on Cities and Climate Change in 2018. The Scientific Committee of the conference identified six research priorities, including to expand observations, understand climate interactions, study informal settlements, harness disruptive technologies, support transformation, and recognize the global sustainability context.

Knowledge advanced around these six priorities (and a subsequent expanded set of research agendas from the conference), albeit at varying rates and with emergence of new themes. Notably, there has been a sharp increase in literature on nature-based solutions in urban environments since 2020. There has been an increasing interest in urban-level policies and planning tools toward achieving low-carbon or net-zero emissions. The rapid advancement of artificial intelligence technology has given rise to an array of projects and journal special issues focusing on digitalization and climate change in cities. Yet, many of the knowledge gaps identified above remain as challenges.

In addition, one critical area that demands immediate and heightened attention is the escalating vulnerability and risks faced by cities, and how to address them. There are at least three main concerns in this regard. First is the intensifying frequency and magnitude of climate impacts, manifested in the "extremeness" of recent extreme weather events occurring worldwide. The year 2023 witnessed the hottest summer on record. I personally experienced this extreme heat went I travelled to Tianjin, China, at the end of June to attend the World Economic Forum "Summer Davos"–Annual Meeting of the New Champions. At 39°C, it felt like breathing inside a furnace, but the local organizer regarded this as a relief compared to the few days prior. Cities in Portugal, UK, Middle Eastern nations, and others have also grappled with record-breaking heat waves, with temperatures surpassing 40°C. Simultaneously, New York and Hong Kong suffered from torrential floods, and parts of Chile and Africa confronted the worst drought in their history.

The extremity of such events often surpasses the worst-case scenarios that been previously envisaged, rendering existing defense mechanisms powerless. The growing frequency and magnitude of these unprecedented extreme events, largely attributable to climate change, necessitate drastically different, transformative approaches in both the science and practice of urban mitigation and adaptation. For example, in July 2021, after intensive downpours that had been said to be a once-in-a-millennium incident, Zhengzhou City in China was inundated, resulting in considerable casualties. Notably, Zhengzhou City is said to have invested RMB 50 to 60 billion in the Sponge City initiative, a nation-wide endeavor aimed at drastically reducing urban flood incidents by making urban surfaces more permeable, through a combination of green infrastructure and new technologies in construction materials. Some raised doubt about the effectiveness of the scheme and whether these investments were futile, whereas others defended the approach, arguing that the magnitude of the event exceeded the intended capacity. These point to the need to reexamine the planning scope, and reassess the roles, effectiveness, and limitations, of different approaches in light of the escalating severity of extreme events.

Second, our understanding of how major demographic, social, and economic centers will endure and react to the heightened levels of extreme shocks remains inadequate. The IPCC AR6 report has sounded a warning on the escalating vulnerabilities of rapidly expanding informal settlements and urban areas in low- and middle-income countries. Cities or city regions that often serve as the economic powerhouses of their nations are characterized by highly concentrated production systems, critical infrastructures, and a densely populated demographic spanning across a wide socioeconomic spectrum. Many of these urban centers are located in coastal areas, which are particularly susceptible to climate-related hazards. This means, in addition to the research focus on more vulnerable population and settlements (see, for example, the extensive work conducted by African Center for Cities, and by the International Institute for Environment and Development), that there is also a need to place renewed emphasis on managing risks, maintaining the functionality, and building resilience of major cities as pivotal socioeconomic hubs.

Third, with increasingly complex connectivity and interdependence both within and across cities, vulnerability and risks are also interconnected, nested, compounding, and amplifying. Examples such as recent wildfires in Canada leading to severe air pollution in New York, or Hurricane Sandy causing extended power outages with cascading impacts, highlight the interconnectedness. Existing policies and planning are not ready for complex and geographically interconnected or cascading chains of risks. Multiple, interdependent critical infrastructure systems and associated cascading risks would require cities to be anticipatory and conduct foresight planning. C40, a global network of cities tackling climate change, is building and sharing knowledge on how to manage such risks. Yet, research shows the vast majority of responses to compounding hazard are reactive or maladaptive. National emergency declarations can mobilize resources that are not available otherwise, but the performance of such schemes is too often suboptimal even when addressing a single hazard. It is daunting to imagine what will happen if multiple hazards hit simultaneously.

Cities are complex systems that require a comprehensive, integrated approach. The upcoming report on cities should avoid the pitfall of dividing cities up into sectors and assessing them separately. It should not simply repeat urban chapters of previous assessment cycles, but aim to break new ground. So how to go about it? Here are three suggestions: Emphasize integration, ask new questions, and bring in new expertise.

Thus, a strong emphasis should be put on integration across the three IPCC Working Groups to understand the systemic and compounding drivers, impacts, and vulnerabilities of climate change, and mitigation options in cities. Siloed approaches in science or assessments do not provide proper guidance to policy and practice, and can be misleading. In practice, an integrated systems approach could mean finding the leverage point that can address multiple challenges simultaneously. For example, policy design aimed at reducing transportation energy through densification should consider implications for urban green space and associated biodiversity and ecosystem services, as well as the health and well-being of citizens. Climate change policy interventions must not inadvertently undermine efforts to tackle other challenges.

Asking new questions will broaden the horizon and venture beyond the comfort zones. It is important to look beyond current cities, and put the climate challenges that cities are facing now in the context of rapid urbanization. By 2050, more than 2 billion people will be added to cities, about 90% of them to cities in the Global South. It will be essential to reconsider how to build these cities and provide necessary housing and infrastructure—building up these urban stocks in conventional ways would entail large carbon consequences, and the built infrastructures must withstand exacerbating climate hazards and disasters. This hasn't received sufficient attention in the previous assessment round.

It will also be necessary to face the unsettling and, at times, alarming prospect that some of our cities may prove untenable in the face of ongoing climate change, rendering them unsuitable for human habitation. Research warns that if climate change is not adequately mitigated, regions that are currently too hot to be habitable may expand, forming a continuous belt around the globe. An exit strategy that includes managed retreat will become an inevitable necessity. Although discussions surrounding small-scale, community-based retreat strategies are found in adaptation literature, albeit remaining at the periphery, very little research can be found on how to manage the massive population displacement into or out of megacities, and how such transitions may intersect with other critical systems such as agriculture. Pros, cons, and unintended consequences of various exit strategies must be openly deliberated, and multiple options with foresight need to be developed. It would be a complex and prolonged process—Indonesia's ongoing plan to relocate its capital out of flood-prone Jakarta to Nusantara in East Kalimantan is expected to take place by 2045.

Engaging researchers beyond the urban field will be beneficial. As discussed above, addressing systemic risk and building resilience under climate change often means asking and answering new types of questions. In addition to the dedicated urban mitigation and adaptation experts, the scoping and actual assessment process for the special report should actively seek the involvement of researchers from a diverse array of disciplines. Economists, ecologists, anthropologists, and complex system scientists, among others, can offer invaluable perspectives. The first ever joint workshop between IPCC and IPBES (Intergovernmental Panel of Biodiversity and Ecosystem Services) in 2021 is a good example of how new scientific insights can be generated by bringing together intellectual forces across disciplinary or domain divides. The workshop findings underscore the interconnectedness of climate change mitigation, adaptation, and biodiversity conservation as mutually supporting goals. It calls for an integrated biodiversity-climate-society nexus approach, and transformative governance to enable such an approach.

In summary, cities must urgently equip themselves with the knowledge and strategies required to achieve net-zero emissions while mitigating systemic risks and enhancing resilience. The IPCC upcoming report should help cities achieve this goal. — XUEMEI BAI, Australian National Univ. *Source:* https://www.science.org/doi/10.1126/science.adl1522

Greater climate engagement in urban areas brings more climate justice

High climate engagement appears to positively influence the inclusion of a social dimension in the implementation of climate policies, a JRC analysis of 362 cities shows.

November 2023 — Cities can be key agents of change in addressing global warming, being "natural" sites for innovative and experimental climate action in a progressive direction. They are responsible for a substantial portion of global greenhouse gas (GHG) emissions, making them key players in climate change mitigation and adaptation.

They are also recognised as hubs for innovation and as places with many opportunities for collaboration with civil society. However, cities can also be hotspots of injustice, leading to displacement, inequality, marginalisation, poverty. To fully leverage cities' potential as agents of change, they must thus be "justice-aware" when developing climate policies.

A JRC study evaluating justice concerns in climate decision-making processes finds that the more cities exert efforts in addressing climate change goals, the more they are likely to take climate justice concerns on board when designing and implementing climate efforts, regardless of geographical categorisation.

It sheds light on the awareness of the social justice aspects of climate action, evaluated across its recognitional, distributive, procedural, and intergenerational dimensions. Climate justice can be a useful policy lever to develop measures that promote simultaneously greenhouse gas emissions reductions and their social justice dimension, thus reducing the risk of adverse impacts.

What differences among various categories of cities?

The results suggest that wealthier cities could more likely attain social justice goals when planning and implementing climate action. Cities that consider their economic, financing, and communication strategies as favourable city-specific features are also more likely to be climate justice-aware. The findings also suggest that cities that receive cross-sectoral support from higher governance levels are more likely to consider justice dimensions in planning their climate action.

However, city authorities' perception of favourable geo-climatic conditions is negatively related to climate justice awareness. This suggests that a favourable climate might reduce the perceived urgency of climate action and the consideration of the social issues associated with it.

These linkages can be read as assistance needs that cities perceive in their pathway to just climate neutrality and highlight where future efforts in research and policy-making should focus in the following years to pave the way to a just transition.

Cities account for a substantial share of global GHG emissions: they can be agents of change for climate change mitigation and adaptation actions. Source: https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/greater-climate-engagement-urban-areas-brings-more-climate-justice-2023-11-17_en

This study uses data from the EU Mission on 100 Climate Neutral and Smart Cities by 2030, an initiative involving local authorities, citizens, businesses, investors as well as regional and national authorities.

Thanks to the dataset – collated through the answers provided by the cities through a dedicated questionnaire – the authors built an unprecedented portray of where hundreds of European cities stand in terms of climate mitigation and climate ambition; and developed a scientifically robust index of climate justice awareness.

This index not only helps us compare different cities, but also find out what makes them more aware of the need to achieve social justice goals when planning their climate actions.

The study also investigates the different approaches different cities adopt in dealing with climate change, and it considers factors like the size of the city, the national context, and the local GDP per capita. Overall, the study's quantitative assessment of climate justice awareness can help cities consider how and where to reach more social justice goals when planning their climate policies.

Background

The need for this study arises from the growing importance of climate justice in the context of climate change discussions and the urgency of addressing this issue at the local, particularly urban, level.

Climate justice, defined as justice in relation to the effects of responses to climate change, is a concept that has gained prominence in recent years, but its operational value remains a subject of debate. The study aims to fill a crucial gap by evaluating the operational value of climate justice in climate decision-making processes, specifically at the urban level.

Other initiatives focusing on climate action and climate justice:

• the Global Covenant of Mayors for Climate & Energy, the largest global alliance for city climate leadership. Covenant cities commit to climate mitigation, climate adaptation, and energy access. Climate justice is a critical guiding principle across all the three pillars of the initiative.

• the Commission Recommendations on Energy Poverty (2020 and 2023), the Council Recommendation on ensuring a fair transition towards climate neutrality, and the Regulation of the European Parliament and of the Council establishing a Social Climate Fund. *Source:* https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/greater-climate-engagement-urban-areas-brings-more-climate-justice-2023-11-17_en

https://www.globalcovenantofmayors.org/journey/

Meet the landscape architect turning cities into sponges

Designer Kongjian Yu's sponge city concept is saving cities from too much rain. He just won the field's biggest prize for his work.

October 2023 — In a corner of the fast-growing northeastern Chinese city of Harbin, a vast landscape of blue and green is conspicuous among the housing blocks and high rises of a metropolis that's home to 10 million people. The site, an 80 acre park, is a rare bit of nature in a dense urban setting that nearly choked this pocket of natural wetland out of existence. But a design intervention by one of the most innovative landscape architects of the 21st century brought the site back from the brink. By filtering storm water into the park from the urbanity that surrounds it, and using natural plantings, habitats, and water-retaining ponds, the park has become a living landscape able to absorb the city's rainfall. Elevated platforms and walking paths offer visitors views of this recreated wetland that is, perhaps without them realizing it, helping protect the city from disastrous floods.

The park was designed by the Chinese landscape architecture firm Turenscape and its founder, Kongjian Yu, who has worked for decades to integrate this kind of water absorbent public space into cities across China. Calling them "sponge cities," these designs integrate nature-inspired flood and stormwater management systems into city parks and urban developments in a way that's both seamless and effective. With hundreds of projects across China, Yu's large-scale works have turned cities into climate-adapted sponges, and his ideas have influenced urban policy all the way up to the national level in China.

For this work and influence, Yu has just been awarded the top honor in the field of landscape architecture. He is the second laureate of the Cornelia Hahn Oberlander International Landscape Architecture Prize, a $100,000 award issued every two years by the Cultural Landscape Foundation (TCLF), a non-profit focused on landscape heritage and education. Created as a landscape-focused counterpart to the Pritzker Architecture Prize, the Oberlander Prize seeks to honor living landscape architects who've had outsized influence on the field through their talent, creativity, courage, and vision. In Yu, the prize's jury has chosen a designer who has shown that landscape architecture can be a central part of the way cities are redesigned to combat climate change.

Dong'an Wetland Park, Sanya, Hainan Province, China, 2021. Source: https://www.fastcompany.com/90967819/meet-the-landscape-architect-turning-cities-into-sponges

Yu is a giant in the field, and his selection as this year's laureate cements his status as one of the most influential landscape architects since the profession was created by Frederick Law Olmsted in the 1800s. Yu is often referred to as the Olmsted of China, where his 400-person firm Turenscape has somewhat surprisingly managed to build hundreds of environmentally sensitive public spaces and parks that have provided the soft infrastructural and ecological services of recreated wetlands in the face of the breakneck urbanization of China over the past three decades.

Yu is the founder of graduate school of landscape architecture at Peking University, as well as a prolific author of books, academic articles, and landscape treatises that are accessible to a general reader. He has the ear of President Xi Jinping, who has publicly supported the sponge city concept since 2003, and many of the city-level officials and mayors who are empowered to hire his firm and implement his ideas. This fall he was named one of the winners of the 2023 National Design Awards, on top of dozens of design recognitions he and his firm have received over the years. Through a career that's balanced formal design excellence with climate advocacy and the realities of getting things done in a top-down political system, Yu has proven to be a singular and effective force.

"I think his influence is perhaps greater than any living landscape architect," says Elizabeth Mossop, dean of the University of Technology Sydney's School of Design, Architecture and Building, and chair of the 2023 Oberlander Prize jury.

Yu says this project and others like it simply apply the lessons of natural systems to urban environments that have too often replaced ecological resilience with hard infrastructure. This concrete-centric gray infrastructure, he argues, has only exacerbated the flooding and extreme weather impacts of climate change, and is arguably one of climate change's root causes. Using the sponge city approach, Yu aims to inject natural water management systems back into cities to counter everything from groundwater depletion to flash flooding to sea level rise. "My hypothesis is that if we as a globe soak up this excess amount of water, filling the aquifer with a porous landscape, we can solve the problem of sea level rise," he says. "It's not so difficult, it's not so expensive, and it can be fast."

His work is already taking hold across China, with more than 600 built projects and newly adopted national policies that have seen sponge city projects built in dozens of major Chinese cities. If he can, he's hoping to spread this movement beyond China to the rest of the world.

Yu's appreciation and understanding of natural systems comes largely from his youth. Born in 1963, Yu spent the first 17 years of his life in a small agrarian village in Zhejiang Province, south of Shanghai, never venturing more than about 10 miles away. "The village is a universe," he says. "To me, it's a cosmos." His village sat along a creek that had been carefully managed through a series of subtle dams called weirs, tended for more than 2,000 years, that slow the water's flow enough for fishermen and farming irrigation, but which also capture the extreme downpours and prevent floods during seasonal monsoons. Life in the village, and many others like it, was built around this cycle of extreme downpours and the reliance on what water could be held onto for irrigation during the dry months.

"Climate change, to me, is nothing new. It was nothing new to all those people living in that area in China, in India, in Malaysia," he says. "Most agricultural societies all depend on following and adapting to the monsoon climate." Yu left the village in 1980 when he was one of only a few students nationally to be selected to study landscape gardening at Beijing Forestry University, which was then mostly focused on the design of formal grounds and the vernacular Chinese gardens of the 17th century. He eventually earned a master's degree.

But this was also a time of major change in China, with the state-centric Mao era leading into the more open economic reforms of the late 1970s and '80s. Capital flowed and development boomed, refashioning China's largely agrarian society into modern towns and cities. After about a decade away, Yu returned to his village for the first time and found that along with the new wealth and material possessions that development brought, the natural cycles of life had been completely disrupted. "I saw this dramatic change. The creek itself had been channelized in concrete," he says.

Sanya Mangrove Park, Sanya, Hainan Province, China, 2018. Source: https://www.fastcompany.com/90967819/meet-the-landscape-architect-turning-cities-into-sponges

Yu recalled a boyhood experience of falling into the rushing waters of the creek. He could have easily drowned, but vegetation in the stream slowed the current and trees alongside it gave him branches to grab and pull himself to safety. Now covered in concrete, the creek was essentially a high-volume drain, effective at preventing floods from monsoons but devoid of life and no longer the carefully tended tool of farmer and fisher alike. Seeing the creek covered in concrete, Yu realized his new profession had the potential to offer an alternative.

"That made me think: how can we reclaim agricultural societies' good relationship between man and nature," he says. "Can we integrate industrial technology so that it will minimize the impact on nature and maximize the gain?"

Shortly after, he moved to the U.S. to explore these ideas at Harvard, earning his doctorate in 1995. In 1998, he returned to China and founded Turenscape. By this point, China was headlong into a vast campaign of urban development, mostly modeled on Western ideas of large-scale master planning and car-oriented grids. New districts were popping up seemingly overnight. Yu once again watched his homeland paved over with concrete and the kind of gray infrastructure that transformed his village.

Through Turenscape, he began to suggest a different approach. Not standing in the way of the steamroller of development, Yu instead began designing proposals for parks and public spaces within these new developments that could effectively replicate the ecosystem services and flood protection conventional construction was paving away. "They are ecological infrastructures which can maximize natural surfaces, and meanwhile you still have space for development," he says. Using the landscape to provide habitat and recreation while cleaning urban runoff and preventing floods, his proposals were a significant departure from the status quo.

Government officials began to take notice. In the late 1990s he was invited to give a lecture to a mayor's forum, where hundreds of government officials would cram into a state banquet hall to listen to various speakers and central government propaganda. Yu detailed his vision for this more ecological approach to urban design and development, ditching the gray infrastructure of concrete for what he calls blue and green infrastructure of natural water systems and ecosystems. "Luckily enough, one mayor agreed with me," he says. "So I built a couple projects there."

The city of Zhongshan, in China's soggy Pearl River Delta, became home to Turenscape's first major built project, Zhongshan Shipyard Park. A 27-acre landscape built on the site of (and with many structures from) an abandoned riverside shipyard in the center of the city, the new park preserved elements of its industrial past while injecting garden-like spaces and plantings that help clean the site's water. Remnant railroad tracks still emerge from the ground, and the steel trussed canopies over loading docks have become new focal points. Yu used the project to show that a living landscape could accommodate social purposes while also dealing with the highly fluctuating river levels that would have otherwise caused an unmanaged area to flood.

The project was a sensation, luring crowds, spurring development on its fringes, and winning Turenscape a prestigious Design Honor Award from the American Society of Landscape Architects. Other mayors in China began calling his office. "He became very influential and a lot more people in China started engaging in this kind of work. But initially it was such a departure," says Mossop, who first encountered Yu's work in the early 2000s when she was on a jury advising the preparations for the 2008 Summer Olympics in Beijing and potential landscape designs for its main venues and Olympic village. "You looked at all of these proposals and they all looked like versions of the same thing," she says. "Kongjian Yu's proposal was completely different." (He did not win that project, to Mossop's chagrin.)

But his unconventional approach has carried through in other work. Mossop points to a standout project from 2008 in the northeastern city of Tianjin, where Turenscape turned a former shooting range and dumping ground into an ecosystem-rich constructed wetland covering 54 acres, where dozens of ponds of water rehabilitate the soil and the city's collected storm water while providing walking paths in an increasingly crowded city. "It's just the most magical landscape," Mossop says. "It's the repetitive form of these ponds, but they're all slightly different from one another, and they show what is happening with the management of water."

Turenscape's designs, now built or in development across 200 cities in China, repeatedly strike this balance of environmental remediation, aesthetic excellence and cultural attraction. It's also key, in Yu's mind, to combatting the biggest impacts of climate change in cities. "All of this work has been really in service of his big ideas about the potential of landscape architecture and the kind of landscape architectural thinking that he feels is absolutely essential in trying to address the big existential issues that we face around climate adaptation, around the relationship between cities and nature," Mossop says.

Calling Yu the Frederick Law Olmsted of China is no exaggeration, according to Charles A. Birnbaum, president and CEO of TCLF, which created the Oberlander Prize. Olmsted, who's known for designing New York's Central Park, as well as hundreds of major public parks across the U.S. through his successor firms throughout the 19th and 20th centuries,

Nanchang Fish Tail Park, Nanchang, Jiangxi Province, China, 2021. Source: https://www.fastcompany.com/90967819/meet-the-landscape-architect-turning-cities-into-sponges

defining how the U.S. created public space. Yu is doing something similar today in China. "It's important to recognize that like Olmsted, Kongjian Yu has affected national policy at a monumental scale," Birnbaum says.

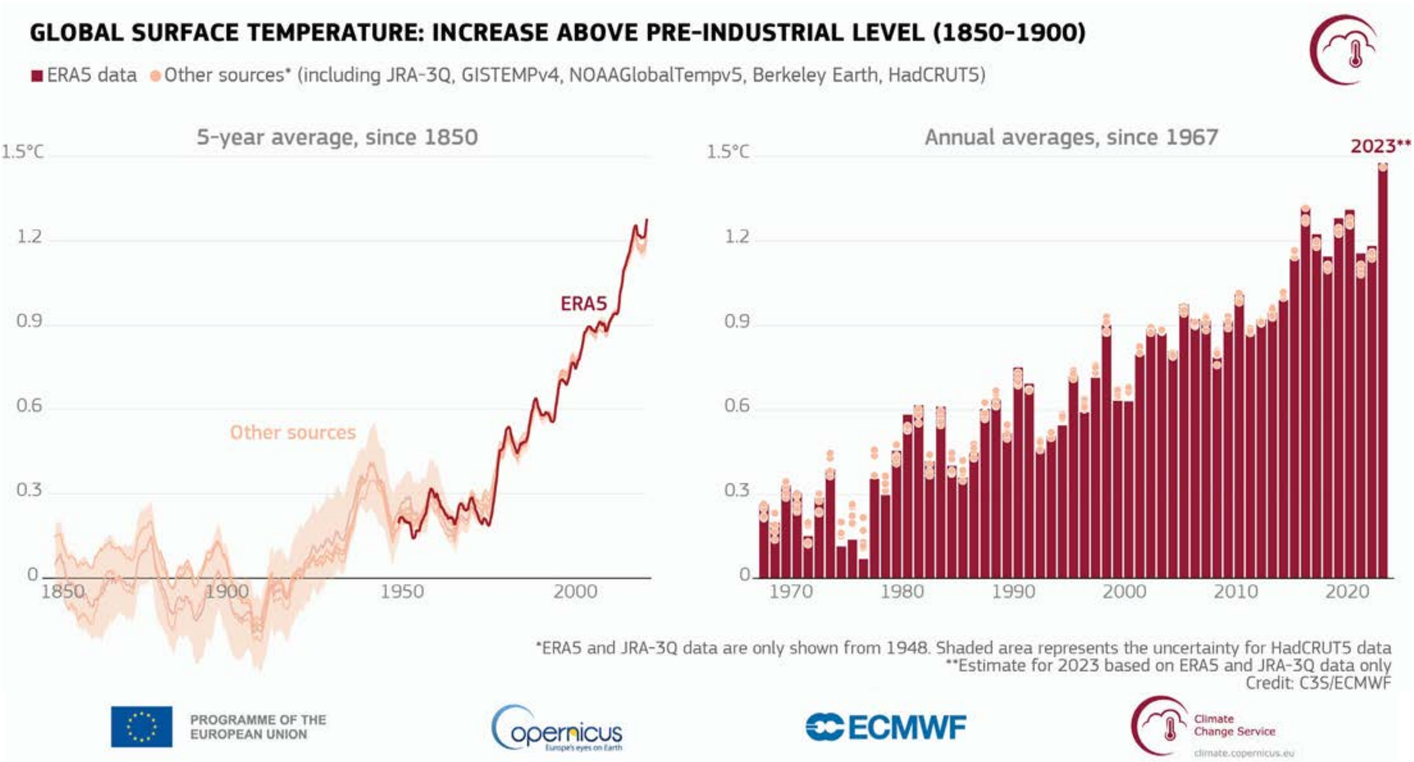
In 2013 China made the sponge city concept a national policy for urban development in flood-prone areas. More than 70 cities across the country have implemented sponge city projects since then, and the national government has set a goal that by 2030 80% of China's cities would be able to absorb at least 70% of their rainfall. The central government in China has made implementing some of Yu's ideas more feasible, and he's grown adept at understanding how to make his case to the decision makers in the top-down system. "You have to make use of it, otherwise you cannot do anything," he says.

TCLF has found evidence of more than a dozen other countries around the world either building or planning projects based directly on Yu's sponge city idea, including Bangladesh, Egypt, Kenya and Singapore. One sponge city project by Turenscape has been built in central Bangkok, Thailand, turning an industrial brownfield into a series of four large lakes dotted with small islands and wetlands that provide habitat while safeguarding the floor-prone city from extreme rains. The lakes, which are surrounded by a densely planted forest, are capable of holding more than 35 million cubic feet of storm water in a heavily populated urban setting. "What we see with Kongjian Yu unequivocally is that the landscape architect is the natural leader for combatting the climate crisis," Birnbaum says.

Yu still sees much work to be done. Sponge cities that can absorb and rainwater and manage flooding through natural systems are still in the minority. "People are still doing business as usual, still paving, still channelizing, still building dams," he says. "It is a long march. It's not so easy."

In the face of climate change, the conventional approach will only exacerbate the flooding and extreme weather impacts the sponge city concept was designed to offset. "If places keep doing this urban gray infrastructure, they will fail," Yu says. "My ambition, my vision is that this model can transform the whole globe. I'm confident that there's no better way." — *NATE BERG.* https://www.fastcompany.com/90967819/meet-the-landscape-architect-turning-cities-into-sponges

Copernicus: 2023 is the hottest year on record — with global temperatures close to the 1.5°C limit

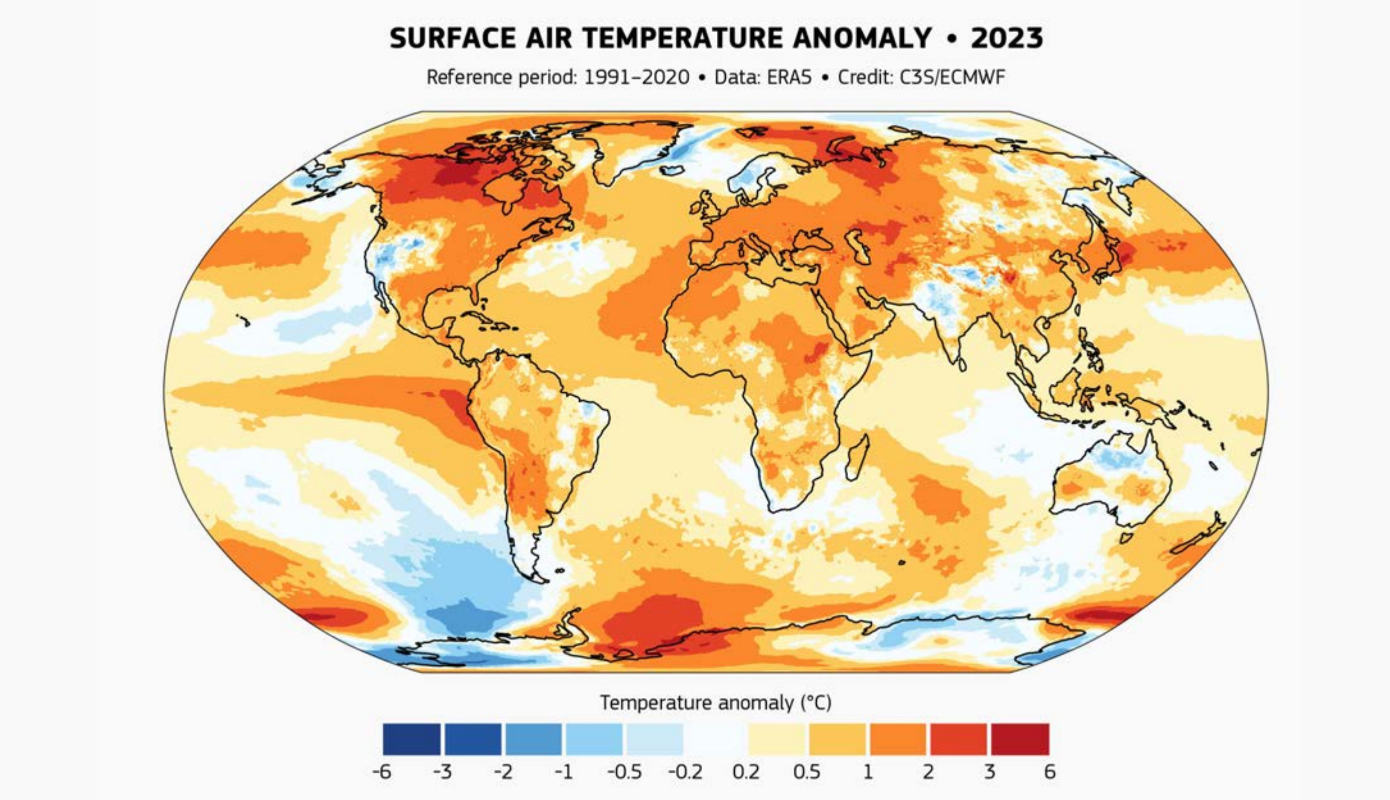


Global surface air temperature increase relative to the average for 1850-1900, the designated pre-industrial reference period, based on several global temperature datasets shown as 5-year averages since 1850 (left) and as annual averages since 1967 (right). Credit: C3S/ECMWF. *Source:* https://climate.copernicus.eu/copernicus-2023-hottest-year-record

January 2024 — Global temperatures reached exceptionally high levels in 2023. The Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts on behalf of the European Commission with funding from the EU, monitored several key climate indicators throughout the year, reporting on record-breaking conditions such as the hottest month on record and daily global temperature averages briefly surpassing pre-industrial levels by more than 2°C. Unprecedented global temperatures from June onwards led 2023 to become the warmest year on record – overtaking by a large margin 2016, the previous warmest year. The 2023 Global Climate Highlights report based mainly on the ERA5 reanalysis dataset presents a general summary of 2023's most relevant climate extremes and the main drivers behind them, such as greenhouse gas concentrations, El Niño and other natural variations.

Global surface air temperature highlights:

- 2023 is confirmed as the warmest calendar year in global temperature data records going back to 1850
- 2023 had a global average temperature of 14.98°C, 0.17°C higher than the previous highest annual value in 2016
- 2023 was 0.60°C warmer than the 1991-2020 average and 1.48°C warmer than the 1850-1900 pre-industrial level
- It is likely that a 12-month period ending in January or February 2024 will exceed 1.5°C above the pre-industrial level
- 2023 marks the first time on record that every day within a year has exceeded 1°C above the 1850-1900 pre-industrial level. Close to 50% of days were more than 1.5°C warmer then the 1850-1900 level, and two days in November were, for the first time, more than 2°C warmer.
- Annual average air temperatures were the warmest on record, or close to the warmest, over sizeable parts of all ocean basins and all continents except Australia
- Each month from June to December in 2023 was warmer than the corresponding month in any previous year
- July and August 2023 were the warmest two months on record. Boreal summer (June-August) was also the warmest season on record
- September 2023 was the month with a temperature deviation above the 1991–2020 average larger than any month in the ERA5 dataset
- December 2023 was the warmest December on record globally, with an average temperature of 13.51°C, 0.85°C above the 1991-2020 average and 1.78°C above the 1850-1900 level for the month. You can access information specific for December 2023 in our monthly bulletin



Surface air temperature anomaly for 2023 relative to the average for the 1991-2020 reference period. Data source: ERA5. Credit: C3S/ECMWF. https://climate.copernicus.eu/copernicus-2023-hottest-year-record

Ocean surface temperature highlights:

• Global average sea surface temperatures (SSTs) remained persistently and unusually high, reaching record levels for the time of year from April through December

• 2023 saw a transition to El Niño. In spring 2023, La Niña came to an end and El Niño conditions began to develop, with the WMO declaring the onset of El Niño in early July.

• High SSTs in most ocean basins, and in particular in the North Atlantic, played an important role in the record-breaking global SSTs

• The unprecedented SSTs were associated with marine heatwaves around the globe, including in parts of the Mediterranean, Gulf of Mexico and the Caribbean, Indian Ocean and North Pacific, and much of the North Atlantic

European temperature highlights:

• 2023 was the second-warmest year for Europe, at 1.02°C above the 1991-2020 average, 0.17°C cooler than 2020, the warmest year on record

• Temperatures in Europe were above average for 11 months during 2023 and September was the warmest September on record

• European winter (December 2022 – February 2023) was the second-warmest winter on record

• The average temperature for the European summer (June-August) was 19.63°C; at 0.83°C above average, it was the fifth-warmest on record

• European autumn (September-November) had an average temperature of 10.96°C, which is 1.43°C above average. This made autumn the second-warmest on record, just 0.03°C cooler than autumn 2020

Other remarkable highlights:

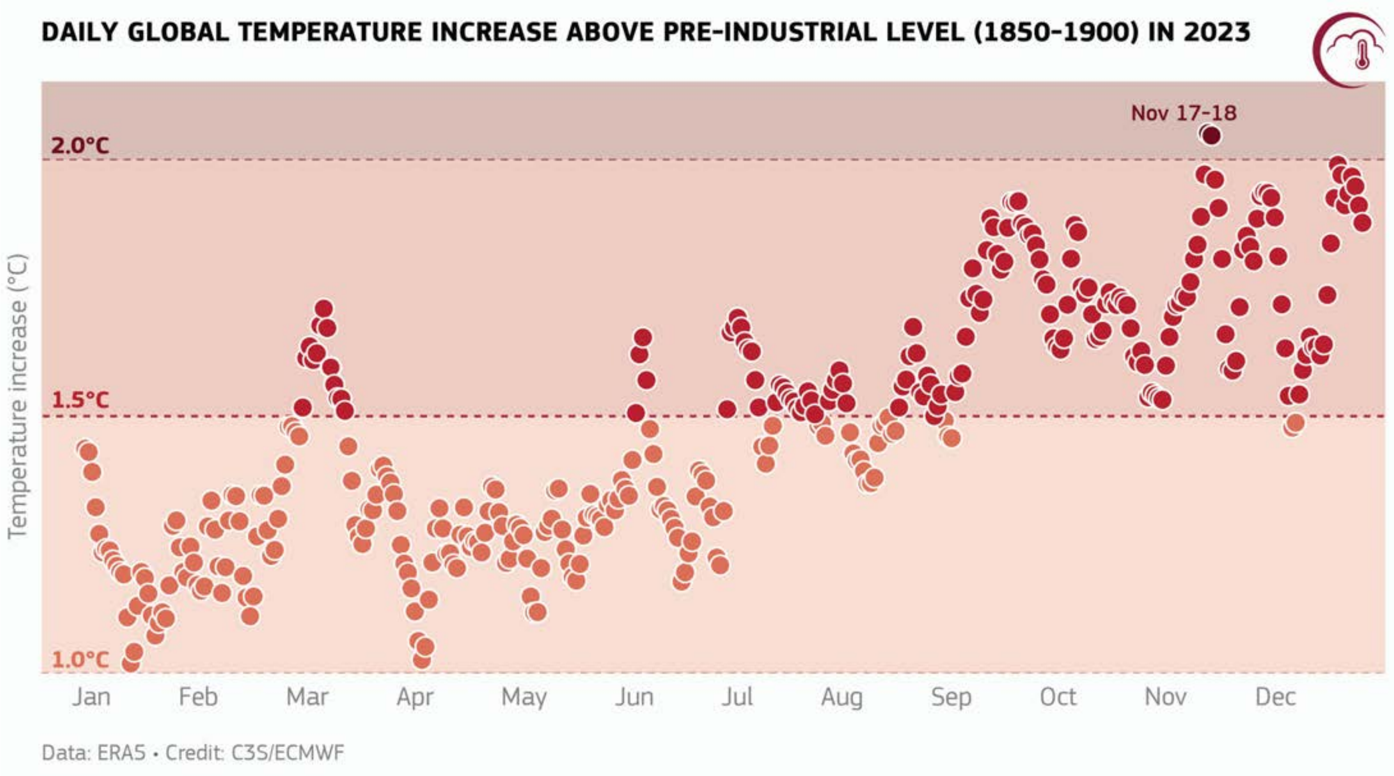
• 2023 was remarkable for Antarctic sea ice: it reached record low extents for the corresponding time of the year in 8 months. Both the daily and monthly extents reached all-time minima in February 2023

• Arctic sea ice extent at its annual peak in March ranked amongst the four lowest for the time of the year in the satellite record. The annual minimum in September was the sixth-lowest

• The atmospheric concentrations of carbon dioxide and methane continued to increase and reached record levels in 2023, reaching 419 ppm and 1902 ppb respectively. Carbon dioxide concentrations in 2023 were 2.4 ppm higher than in 2022 and methane concentrations increased by 11 ppb.

• A large number of extreme events were recorded across the globe, including heatwaves, floods, droughts and wildfires. Estimated global wildfire carbon emissions in 2023 increased by 30% with respect to 2022, driven largely by persistent wildfires in Canada

Mauro Facchini, Head of Earth Observation at the Directorate General for Defence Industry and Space, European Commission, comments: "We knew thanks to the work of the Copernicus programme throughout 2023 that we would not receive good news today. But the annual data presented here provides yet more evidence of the increasing impacts of climate change. The European Union, in line with the best available science, has agreed on an emission reduction of 55% by 2030 – now just 6 years away. The challenge is clear. The Copernicus Programme, managed by the Europe-



Daily global surface air temperature increase relative to the average for 1850–1900, the designated pre-industrial reference period, for 2023. The plot highlights temperature increases within three ranges: 1–1.5°C (orange), 1.5–2°C (red), and above 2°C (crimson). Source: ERA5. Credit: C3S/ECMWF. https://climate.copernicus.eu/copernicus-2023-hottest-year-record

an Commission, is one the best tools available to guide our climate actions, keep us on track with the goals of the Paris Agreement and accelerate the green transition."

Samantha Burgess, Deputy Director of the Copernicus Climate Change Service: "2023 was an exceptional year with climate records tumbling like dominoes. Not only is 2023 the warmest year on record, it is also the first year with all days over 1°C warmer than the pre-industrial period. Temperatures during 2023 likely exceed those of any period in at least the last 100,000 years."

Carlo Buontempo, Director of the Copernicus Climate Change Service, comments: "The extremes we have observed over the last few months provide a dramatic testimony of how far we now are from the climate in which our civilisation developed. This has profound consequences for the Paris Agreement and all human endeavours. If we want to successfully manage our climate risk portfolio, we need to urgently decarbonise our economy whilst using climate data and knowledge to prepare for the future."

Surface air temperatures broke several records globally in 2023

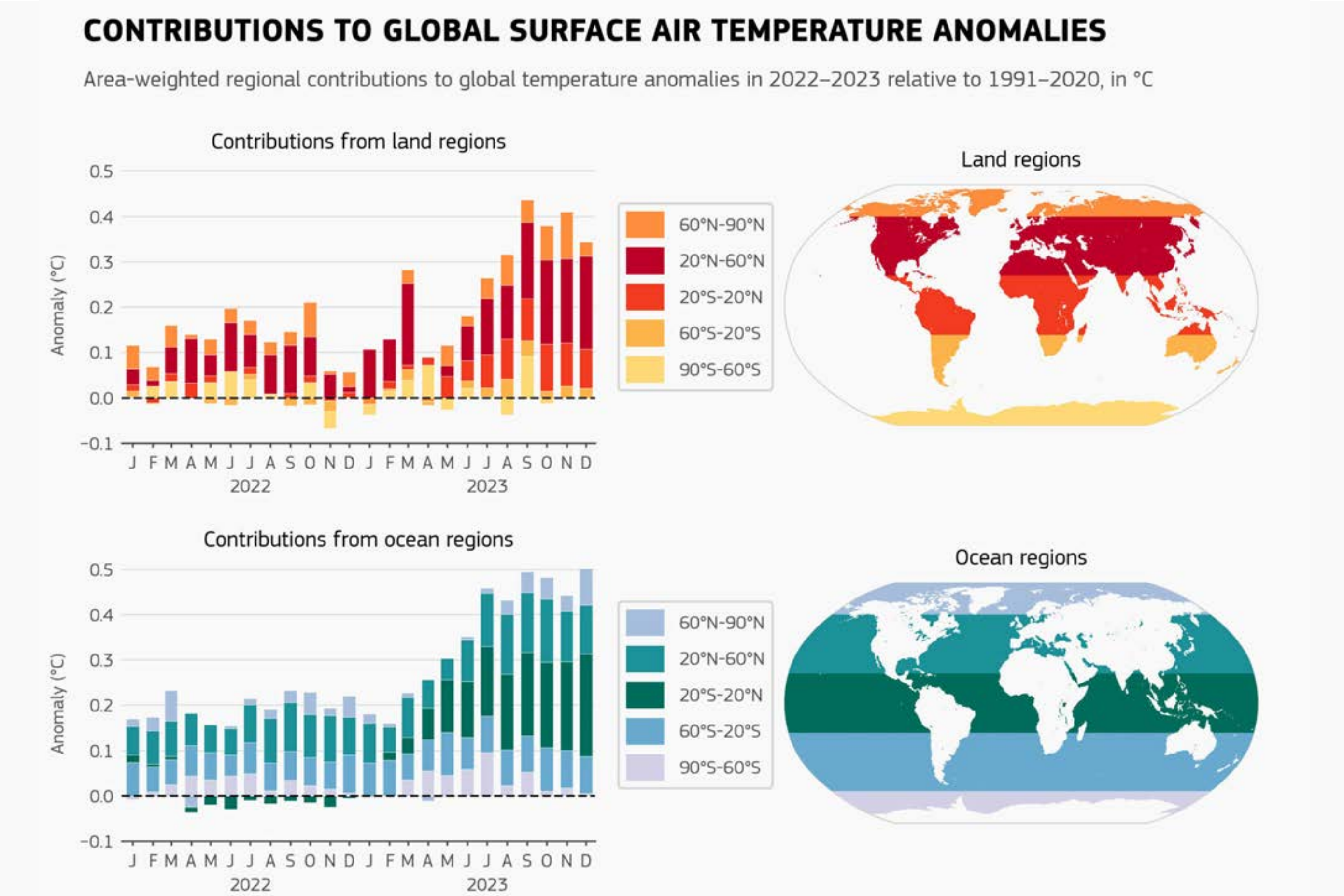
The earliest signs of how unusual 2023 was to become began to emerge in early June, when temperature anomalies relative to 1850-1900 pre-industrial level reached 1.5°C for several days in a row. Although this was not the first time daily anomalies had reached this level, this had never previously happened at this time of the year. For the rest of 2023, global daily temperature anomalies above 1.5°C became a regular occurrence, to the point where close to 50% of days in 2023 were in excess of 1.5°C above the 1850-1900 level. This does not mean that we have surpassed the limits set by the Paris Agreement (as they refer to periods of at least 20 years where this average temperature anomaly is exceeded) but sets a dire precedent.

Sea Surface Temperatures (SST): beyond El Niño

A critical driver of the unusual air temperatures experienced throughout 2023 were the unprecedented high surface temperatures in the ocean. The global average SSTs(2) for the period between April and December were the highest for the time of year in the ERA5 dataset.

The main long-term factor for high ocean temperatures is the continuing increase in concentrations of greenhouse gases, but an additional contributing factor in 2023 was the El Niño Southern Oscillation (ENSO). ENSO is a pattern of natural climate variability that sees ocean temperatures in the central and eastern tropical Pacific switch between cooler (La Niña) and warmer (El Niño) than average conditions. These ENSO events influence temperature and weather patterns around the world. After La Niña concluded in early 2023 and El Niño conditions began to develop, the WMO declared the onset of El Niño in July, and conditions continued to strengthen through the rest of the year.

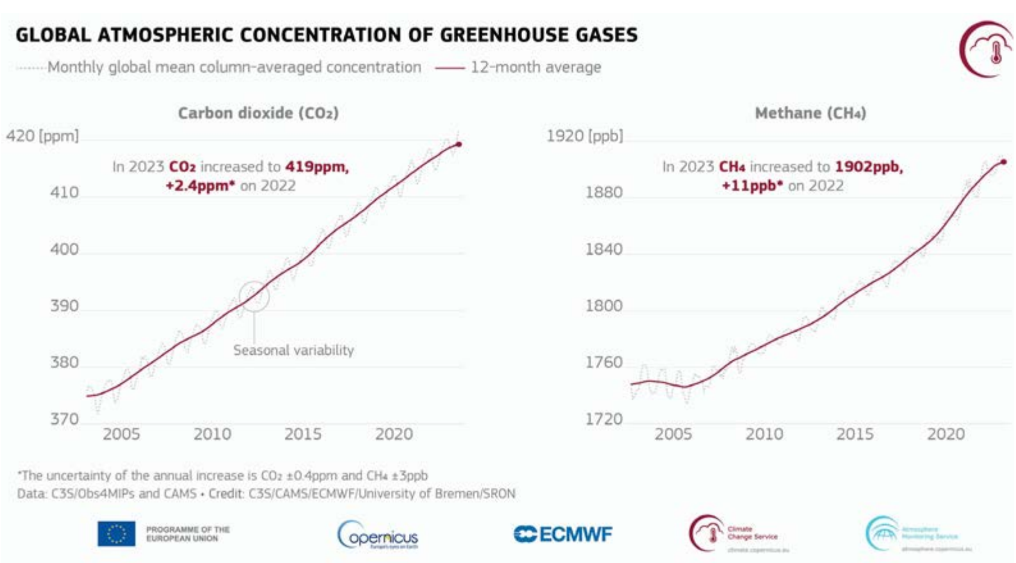
However, the transition to El Niño alone does not explain all of the increase in ocean surface temperatures at a global scale in 2023, as high SSTs outside of the equatorial Pacific contributed significantly to the record-breaking global SSTs.



Latitudinal contributions to the monthly global surface air temperature anomalies relative to the 1991–2020 reference period, shown separately for land and ocean regions. The contribution from each region is weighted by its area on the Earth's surface and is highlighted with a specific colour in the bar charts. Source: ERA5. Credit: C3S/ECMWF. https://climate.copernicus.eu/copernicus-2023-hottest-year-record

Greenhouse gases

Greenhouse gas concentrations in 2023 reached the highest levels ever recorded in the atmosphere according to C3S and the Copernicus Atmosphere Monitoring Service (CAMS). Carbon dioxide concentrations in 2023 were 2.4 ppm higher than in 2022 and methane concentrations increased by 11 ppb. For 2023, the annual estimate of the atmospheric concentration of carbon dioxide is 419 ppm, and for methane the concentration is 1902 ppb. The rate of increase of carbon dioxide was similar to the rate observed in recent years. The rate of increase of methane remained high but was lower than in the last 3 years. *Source:* https://climate.copernicus.eu/copernicus-2023-hottest-year-record



Monthly global mean atmospheric CO2 (left) and CH4 (right) column-averaged concentration from satellites for 2003-2023 (grey curve) and 12-month average (red curve). Data source: C3S/Obs4MIPs (v4.5) consolidated (2003–2022) and CAMS preliminary near real-time data (2023) GOSAT (CH4) and GOSAT-2 (CO2) records. Spatial range: 60S - 60N over land. Credit: C3S/CAMS/ECMWF/University of Bremen/SRON. https://climate.copernicus.eu/copernicus-2023-hottest-year-record




Total eclipse of the sun

Solar eclipse seen in the sky above Kerrville, Texas at 1:35 pm on April 8, 2024. Through a thin layer of high clouds, the sun's corona appears as a glowing ring around the moon's silhoutte. Just as totality is reached and the moon fully masks the sun, a momentary 'Diamond Ring Effect' is created with one dazzling spot of sunlight shining through. Photo: David Pearlmutter

Measuring CO_2 and moisture fluxes at the scale of blocks, buildings, and roads



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As urban climatologists, we understand that reliable and useful data on the exchange of carbon dioxide (CO_2) between the urban surface and its overlying atmosphere is key for developing effective climate change mitigation measures. These data must report CO_2 fluxes at multiple spatial and temporal scales, ranging from annual city-wide to hourly at the level of individual blocks, buildings, and roads, in order to identify emission sources and sinks at scales that are directly related to our activities and the landscapes of our cities.

The same is true for mitigating urban warming, where we need to understand heat exchanges at such scales. We can use bottom-up approaches (i.e., emissions factors applied to activity and fuel consumption data) to estimate emissions of CO_2 and anthropogenic heat, as well as meteorological models coupled with urban land-surface schemes to assess the exchange of sensible heat (Q_H) and latent heat (Q_E) at fine spatial and temporal resolution, but with inherent uncertainties arising from lack of data representativeness and model performance. This is an issue that field measurements can help to solve.

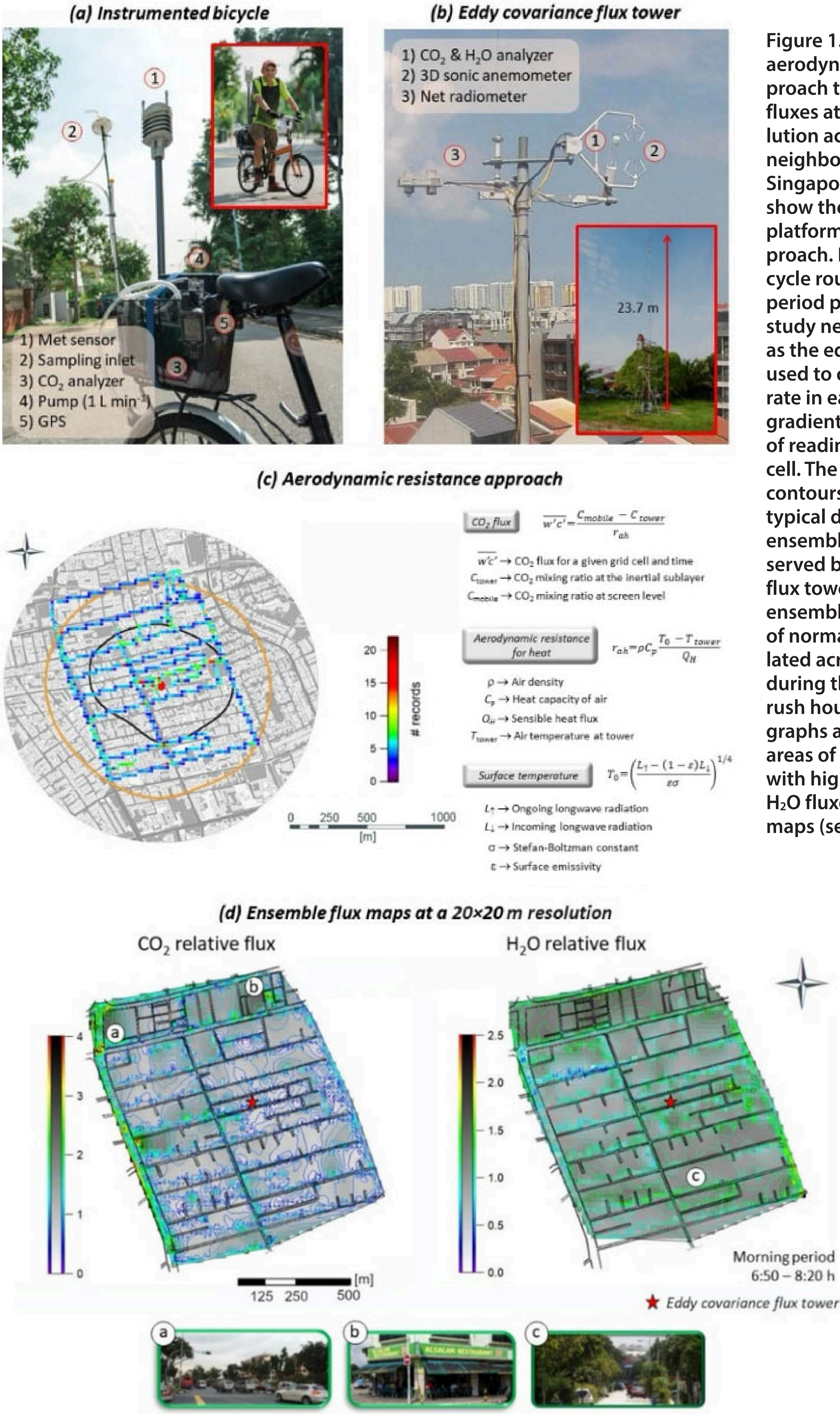
There is a suite of measurement methods available to evaluate CO_2 and heat exchange at various scales, including the use of eddy covariance flux towers. Special sensors mounted on these towers directly measure the vertical exchange of any scalar entity through turbulent motions (eddies) within the mean air flow. These flux measurements include contributions from all major and minor natural and anthropogenic sources and sinks; they are *in situ*, non-intrusive, quasi-continuous and with proper selection of the footprint can represent a large upwind extent similar to the size of a complete neighborhood. Flux measurements at this scale allow us to validate the accuracy of CO_2 gridded emission inventories constructed using bottom-up aggregation processes at grid sizes of 250×250 m to 1×1 km, as well as heat fluxes predicted by urban land-surface models at similar spatial resolutions.

However, eddy covariance flux towers cannot assess the carbon or heat exchange at higher spatial resolutions, such as those of individual buildings or blocks mentioned above, nor can they identify individual hotspots of heat or CO_2. To overcome this limitation, based on Monin-Obukhov similarity theory and challenging Reynolds analogy, we used the aerodynamic resistance approach to estimate the transfer of Q_H as a proxy to evaluate the surface-atmosphere exchange of CO_2 and moisture (H_2O) at fine spatial resolution across a residential neighborhood of Singapore where we ran a flux tower for over seven years.

We instrumented a bicycle to measure georeferenced mixing ratios of CO_2 and H_2O every second along a fixed route in the vicinity of the flux tower during ~1.5 hour periods. These measurements were used in conjunction with readings of incoming and outgoing longwave radiation, and fluxes of Q_H measured at the flux tower to derive exchange rates of CO_2 and H_2O along the transect route considering the bulk aerodynamic resistance to Q_H or thermal resistance in short (r_H), as equivalent to the resistance to moisture or CO_2 transfer. An interpolation subroutine based on the original Delaunay triangulation was then applied to interpolate the observed fluxes across the neighborhood for 20×20 m grid cells. The method is described in detail in Velasco et al. (2023). Fig. 1 summarizes the methodology and shows the resulting flux maps.

The method was able to identify hotspots of CO_2 emissions, and areas of evapotranspiration or anthropogenic moisture directly associated with the energy channeled into Q_E (see Fig. 1d). CO_2 emission rates were higher at traffic intersections along major roads, as well as in a block having many eateries and coffee shops. In terms of H_2O fluxes, high evapotranspiration rates were observed along a drainage channel at one end of the neighborhood and along blocks with narrow and densely tree-lined streets. As shown in Fig. 2, the sum of the interpolated fluxes from all grid cells for each individual set of measurements agrees within one standard deviation with the long-term CO_2 and H_2O fluxes measured by eddy covariance over the entire neighborhood.

The method yielded realistic and consistent results, and demonstrated its ability to map fluxes of CO_2 and H_2O, that according to our knowledge no other method based on field measurements can do at such fine spatial resolution. However, the method is not without uncertainties. The aerodynamic resistance approach is sensitive to the variables that are used to derive r_H, in addition to the assumption that the urban surface behaves as a homogeneous surface regarding the distribution of sources and sinks of the scalars studied in order to



$$\overline{w'c'} = \frac{C_{mobile} - C_{tower}}{r_{ah}}$$

$$r_{ah} = \rho C_p \frac{T_0 - T_{tower}}{Q_H}$$

$$T_0 = \left(\frac{L_\uparrow - (1-\varepsilon)L_\downarrow}{\varepsilon\sigma}\right)^{1/4}$$

Figure 1. Application of the aerodynamic resistance approach to map CO_2 and H_2O fluxes at high spatial resolution across the residential neighborhood of Telok Kurau, Singapore. Panels (a) and (b) show the two measurement platforms used for this approach. Panel (c) shows the bicycle route during a sampling period plotted on a map of the study neighborhood, as well as the equations that were used to calculate the exchange rate in each grid cell. The color gradient indicates the number of readings collected in each cell. The black and orange contours depict the respective typical day- and nighttime ensemble footprint areas observed by the eddy covariance flux tower. Panel (d) shows the ensemble spatial distribution of normalized fluxes interpolated across the neighborhood during the weekday morning rush hour period. The photographs at the bottom show areas of the neighborhood with higher CO_2 emissions or H_2O fluxes, as indicated on the maps (see the text for details).

apply Reynolds analogy. The method works best under conditions of atmospheric instability, so its application should be limited to daytime, when vertical mixing is vigorous and the Monin-Obukhov similarity theory is valid.

The net fluxes obtained during each sampling round at the neighborhood scale were somewhat variable when compared to one another (see Fig. 2), so the fluxes resulting from individual measurements should be viewed as reflecting a particular time only. A sensitivity analysis of random errors revealed that 30 measurement repetitions are needed for each sampling period to obtain mean fluxes similar to those measured by the neighbourhood-scale eddy covariance approach. It is a feasible task, but quite demanding. Fortunately, no significant variation was observed in the spatial distribution among the interpolated fluxes for each sampling round within the same period. This allowed the merging of the fluxes obtained for each cell in each measurement round based on the sampling period (i.e., morning, noon, and evening). This was done by normalizing the calculated fluxes for each grid cell with respect to the median over the entire area evaluated during each repetition. The flux maps in Fig. 1d show the relative fluxes of CO_2 and H_2O across the entire neighborhood during the morning rush hour on weekdays when flux features would be more visible.

The method can theoretically be extended to measure fluxes of any other non-reactive pollutant and greenhouse gas. A pair of accurate analytical sensors with a temporal resolution of 1 second or less would be required. The sensors should preferably be battery-powered and of a practical size to be mounted on a bicycle and on top of a flux tower. Larger instruments could also be used, but different arrangements would be needed on both platforms. Similarly, a second or third instrumented bicycle would reduce the time needed to cover the area to be surveyed. Alternatively, the use of electrical motorbikes could increase the size of the area to be evaluated. In previous work using a similar approach, Lee et al. (2017) used five electrical vehicles to derive hourly emissions for 100×100 m grid cells across five neighborhoods and one urban park in Vancouver, Canada. In our case, we were cautious about expanding the method beyond the footprint observed by the eddy covariance flux tower, limiting the measurements to a single local climate zone to avoid changes in land cover and urban morphology that could affect r_H.

It is worth noting that advances in data-driven modeling have already made it possible to combine remote sensing with machine learning algorithms and eddy covariance flux data to map fluxes at high spatial and temporal resolution, as Vulova et al. (2023) recently did for the case of Q_E across Berlin, Germany, using data from two eddy covariance flux towers as reference fluxes.

In closing, we encourage colleagues who are running eddy covariance flux towers to replicate and improve the method presented here. It is not an expensive addition in the case of CO_2 and H_2O since the flux tower is already present, but it improves the ability to visualize the spatial distribution of the fluxes at high resolution. The method identifies the location of CO_2 emission sources, as well as moisture spots that

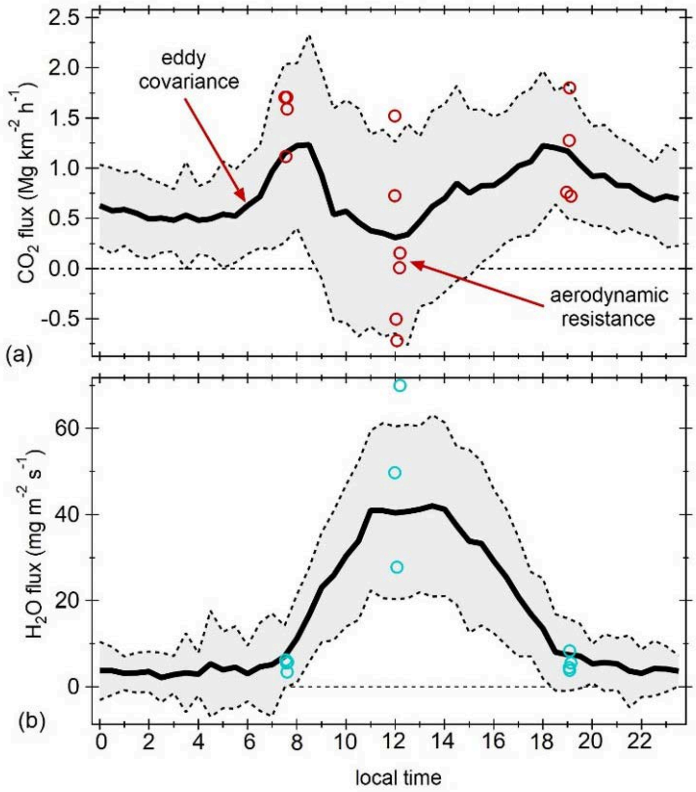


Fig. 2. Neighborhood-wide mean fluxes using the aerodynamic resistance approach (symbols) and mean diurnal variability of fluxes measured by eddy covariance (solid line) for (a) CO_2 and (b) H_2O on weekdays during the two-month period (October–November 2016) when bicycle measurements were made. The dashed lines represent ±1 standard deviation from the average flux and give an indication of the day-to-day variability.

alter the energy balance at the scale of households, buildings, roads, and traffic intersections. Flux maps at this scale are meaningful for practical policy applications and can motivate citizens to engage in collective actions to improve the urban environment. CO_2 emissions and heat fluxes would be less abstract, citizens would know where the emission sources are and learn about factors that alter humidity on scales relevant to their daily lives, and they would be more likely to participate in mitigation and adaptation efforts.

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Impact of urban morphology and surface heating on COVID-19 airborne infection risk in a 2D street canyon

Introduction

There is a widely accepted consensus in the literature that the potential risk for airborne transmission in outdoor environments is generally low (e.g. Bulfone et al., (2021). Factors such as abundant natural ventilation, adequate physical distancing among individuals and limited exposure time reinforce this consensus, which stands in contrast to the increased risks associated with indoor settings. However, outdoor ventilation rates and patterns are diverse because of the many urban morphologies across and between cities. Research on the extent of the infection risk associated with outdoor spaces remains limited, particularly in outdoor urban areas with poor ventilation, such as street canyons (Chen et al., 2021).

Therefore, in our recent publication (Lavor et al., 2023), we propose a modified Wells-Riley model based on the purging flow rate (Q_{PFR}), utilizing computational fluid dynamics (CFD) simulations to better understand the role of aspect ratio, wind velocity and surface heating on outdoor airborne infection risk in street canyons.

Methodology

The study modelled a 2D domain with a single street canyon with an axis oriented perpendicular to the approaching wind direction, situated within an urban boundary layer (Fig. 1). The simulations were conducted using the Reynolds-averaged Navier–Stokes equations (RANS) with the RNG *k*-ε turbulence model.

Our proposed model for estimating outdoor infection risk is based on Eq. 1, adapted from the Wells-Riley model for indoor environments (Eq. 2). We calculate the infection risk for 10 street canyon aspect ratios (AR = 0.33 → 5.0), three approaching wind speeds (0.5, 2, 4 m s^{-1}) and three heated facets, based on the facet-approaching wind temperature differences (ΔT = 2, 5 and 10 K).

The conventional Wells-Riley model (Eq. 2) (Riley et al., 1978) is used to quantify the infection risk for typical indoor scenarios, while the purging flow rate (Eq. 3) is used to calculate the risk in street canyons (Bady et al., 2008).

$$P_{outdoor} = 1 - exp\left(-\frac{Iqpt}{Q_{PFR}}\right) \quad (1)$$

$$P_{indoor} = 1 - exp\left(-\frac{Iqpt}{Q}\right) \quad (2)$$

$$Q_{PFR} = \frac{S_c \cdot V}{\langle \bar{c} \rangle} \quad (3)$$

For both the indoor and outdoor risk calculations, the epidemiological parameters are kept constant to allow comparison between the cases: number of infectors (I) = 1 person, quanta emission rate (q) = 1.4 x 10^{-3} quanta (s person)$^{-1}$, pulmonary ventilation (p) = 1.4 x 10^{-4} m^3 s^{-1} and exposure time (t) = 3600 s.

Results

The key findings from our study (Fig.1) are as follows:

(1) Deep street canyons experience a consistent increase in outdoor infection risk as the aspect ratio (AR) rises. Notably, deep canyons with AR ≥ 3 show significantly reduced ventilation near the ground, comparable to poorly ventilated indoor spaces.

(2) Surface heating can lead to significant reductions in outdoor infection risk, primarily driven by temperature differences between incoming airflow and the ground and leeward wall. However, windward wall heating can potentially lead to poor in-canyon ventilation and higher infection risk.

Our findings challenge the conventional belief that outdoor environments are inherently safer than indoors. We demonstrate that deep street canyons experience inadequate ventilation, leading to a high airborne infection risk. Recognizing and addressing these risks is vital to improve public health and safety.

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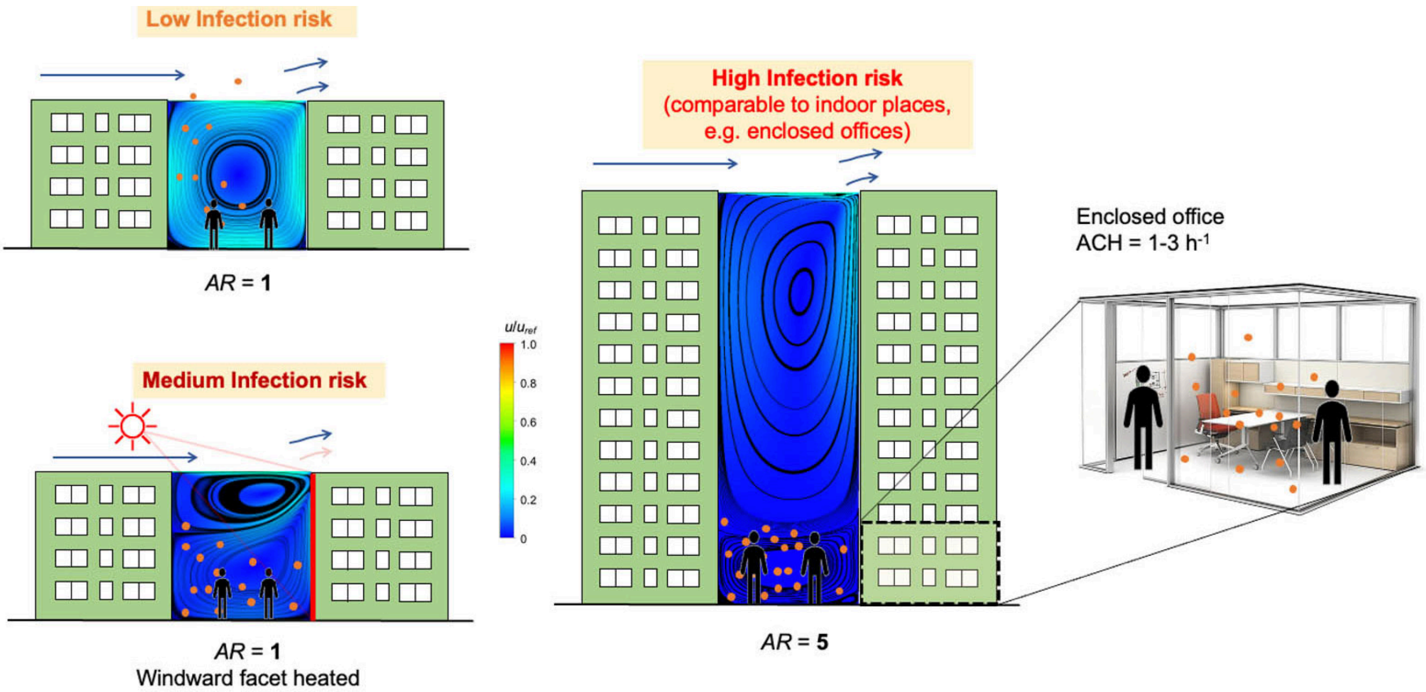

Figure 1. Airflow streamlines inside a street canyon from CFD simulations for AR = 1 and 5. Modified from Lavor et al., (2023).

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The Urban-PLUMBER land surface model evaluation project: the water balance representation

Background

Urban land surface models (ULSM) simulate the interaction of the urban surface with the overlaying atmosphere. When they are combined with numerical weather prediction models, ULSMs provide a lower boundary layer with the aim to improve model performance in urban areas. These ULSMs come in many different types with varying degrees of complexity. Commonly, they are categorized by their representation of urban geometry: a single homogeneous, impervious slab; multiple, individually homogeneous slabs; two-dimensional canyons; or 3D streets with individual buildings (Grimmond et al., 2011). Additionally, each ULSM may include or not various processes, such as anthropogenic heat, irrigations and snow processes.

ULSMs have been systematically evaluated to create a consistent comparison of schemes in two projects: PILPS-urban (Grimmond et al., 2011) and more recently Urban-PLUMBER (Lipson et al., 2023). Where PILPS-urban evaluated 32 models at two sites, Urban-PLUMBER looked at 30 models at 20 sites. PILPS-urban concluded that increased model complexity did not necessarily benefit model performance, but did find indications that the modeling of certain processes could be improved to benefit model performance (Grimmond et al., 2011). A decade later, Urban-PLUMBER found that overall model performance had improved for the majority of the fluxes (Lipson et al., 2023).

While both projects found vegetation and hydrology to be important for model performance, neither project explicitly evaluated the water balance. The water balance is, however, directly linked to the energy balance through the latent heat flux (Q_E)/evapotranspiration (ET). Due to this direct link, we hypothesize that an improved water balance could benefit the energy balance modeling skill as well. Therefore, we focus on the water balance in the models that are part of the Urban-PLUMBER project.

Evaluating the water balance does pose one challenge that needs to be tackled: a lack of observations at the appropriate spatiotemporal scales. Even though precipitation is routinely measured for many urban areas with rain gauges and radars, ET, runoff, irrigation and water storage changes are not. ET is observed at all 20 Urban-PLUMBER sites, but these observations contain many gaps after quality control, hampering the quantification of its part in the water balance. For runoff, the challenge is the spatial instead of the temporal availability, as runoff observations do not have the same source area as the ET observations. The often micro-scale nature of urban irrigation complicates its estimation, which relies on neighborhood piped water supplies but varies with cultural practices, weather, vegetation, and soil. Lastly, water storage change is logistically hard to measure, as it consists of many smaller and bigger elements, e.g. soil moisture, interception, surface water and groundwater.

Here, we show the very first results of the evaluation of 19 Urban-PLUMBER models that provided model output of all entire water balance variables (Figure 1). We are developing an alternative approach to evaluate water balance dynamics in ULSMs without a need for direct or site-specific observations.

Water balances

The water balances show a large variation across the 19 models at all sites (Figure 1). In general, the variation increases with the magnitude of the fluxes and is more pronounced for ET than runoff. While the ensemble mean input (left bars) almost matches the output (right bars), for individual models, we find a discrepancy between input and output of more than 3% of the input in over 43% of the model runs.

Outlook

These water balance results indicate we can learn more from the dynamics of each of these fluxes. Currently, we are zooming in on each flux to uncover how models represent the water balance. The gained insights we will summarize using a score assessing the water balance performance for a model run. In the end, this score will help to identify how ULSMs can be further improved.

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This report summarizes a paper with the same title, currently published as a preprint at: http://dx.doi.org/10.22541/essoar.170688849.94066619/v1

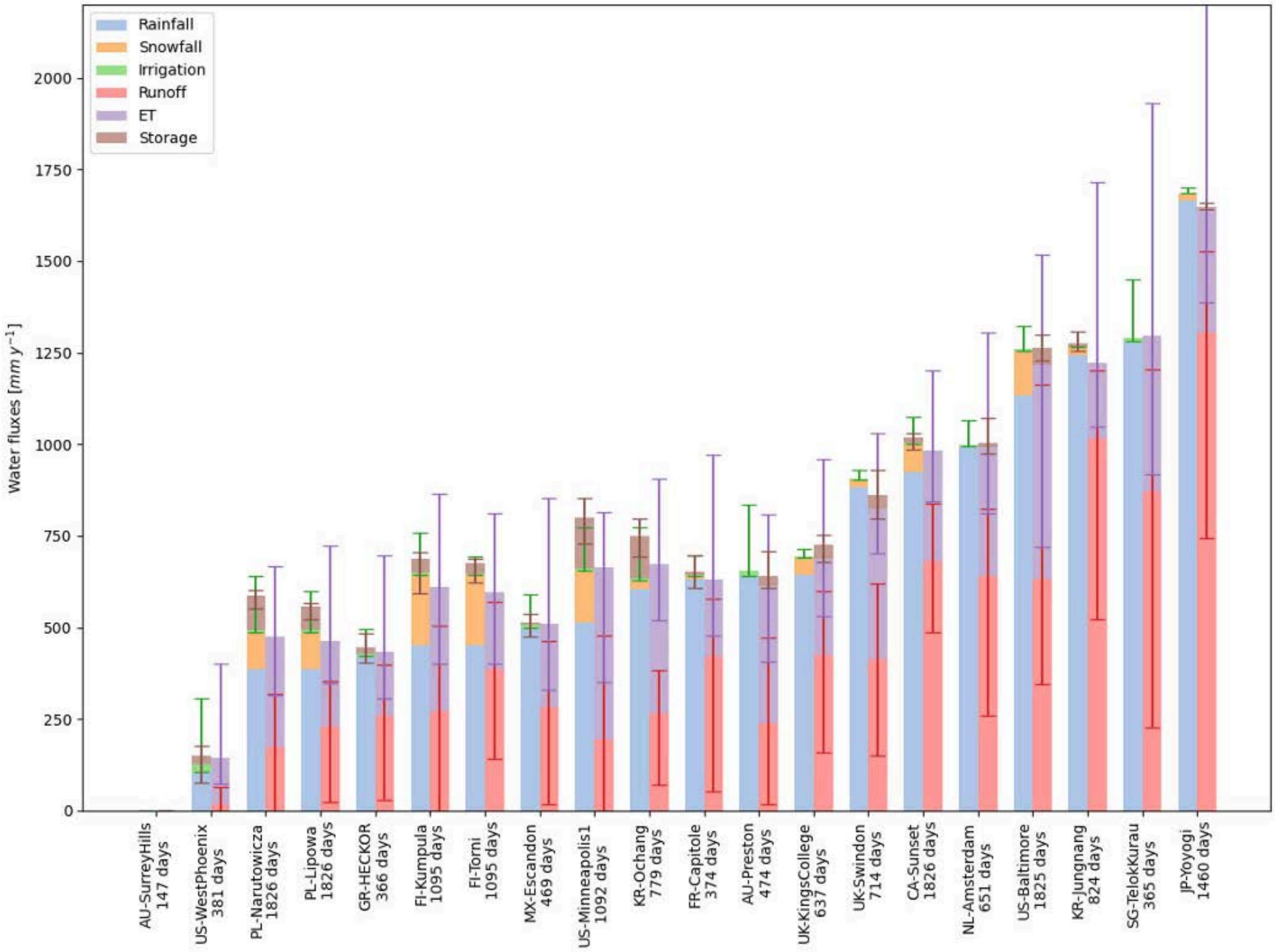

Figure 1. Ensemble mean of 19 models and range (whiskers) of the modeled annual water fluxes for 20 (Lipson et al., 2022) sites ordered by increasing average yearly precipitations. Modeled storage flux (brown) appears on the left if a net input (or right if a net loss). Values are annual means for complete years in a data set (e.g. NL-Amsterdam: 01-05-2018 19:00 - 01-05-2019 19:00, 01-05-2018 20:00 - 01-05-2019 20:00, etc.). As AU-Surreyhills has less than a year of observations, it is not analyzed.

Harro Jongen*

Mathew Lipson, Ryan Teuling, Sue Grimmond, Jong-Jin Baik, Martin Best, Matthias Demuzere, Krzysztof Fortuniak, Martin de Kauwe, Ruidong Li, Joe McNorton, Naika Meili, Keith Oleson, Seung-Bu Park, Ting Sun, Aristofanis Tsiringakis, Mikhail Varentsov, and Gert-Jan Steeneveld

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Study of the urban effect of Paris on a convective case in 2022, using hectometric ensemble simulations

Summary

The "Paris Olympics" international Research and Demonstration Project, supported by WMO, aims to improve the understanding of urban weather processes and weather forecasting systems at a hectometric resolution. The focus is on extreme weather events, such as urban heat islands and thunderstorms, which are major challenges in the context of climate change, urban sprawl and population growth.

Many studies have shown that cities can influence precipitation (see Liu and Niyogi, 2019) for a detailed review of all these studies). In this context, our main focus is on analyzing the influence of the urban environment of the Paris region on convection. For this purpose, we designed an ensemble of numerical simulations at 300 m horizontal resolution using the Meso-NH research model (Lac et al., 2018), coupled with SURFEX (Masson et al., 2013) and the latest version of the multi-level coupled urban surface model TEB (Schoetter et al., 2020). The simulations were initiated and forced by members of the AROME-EPS ensemble prediction system (Bouttier et al., 2016), with a horizontal resolution of 1.3 km.

To explore the interactions between the urban environment and thunderstorms, we have run two ensembles of simulations for each case study. The first ensemble takes into account a detailed description of the urban surfaces using Ecoclimap-I Land Cover database (Masson et al., 2003) and OpenStreetMap databases (OpenStreetMap, 2021), and is called URB. The second ensemble replaces the urban surfaces with the prevailing vegetation of the Paris region, called the NOURB ensemble. This ensemble approach, which is innovative at this resolution, to the authors' knowledge, allows us to assess the variability of the weather situation and the degree of confidence we can place in the results.

To test this methodology, a first case study was selected for the Paris region, on May 7, 2022. On this day, several convective cells were observed, one of which initiated over, or even slightly downwind of the capital. This event is an opportunity to study the interactions between Paris urban environment and the atmosphere, in order to understand the potential impact of the urban surfaces on convection and the dynamic and physical processes involved.

The results show a relatively good representation of the convective phenomena, with some members of the ensemble initiating convection predominantly over the urban area. However, the high variability within the ensemble underscores the complexity of the mechanisms involved. An analysis of the 6-hour rainfall accumulation showed a significant increase in precipitation over and slightly downwind of the city of Paris in the scenario simulating the presence of the urban environment, compared to the scenario without the urban environment (see Figure 1). An increase in precipitation of up to 70% is simulated for the URB ensemble in the sector above the city, although accumulations are of the order of a few millimeters on average in this weather situation. This trend towards higher precipitation over the urbanized area is confirmed when a bootstrapping method is applied to the difference in precipitation accumulation over 6 hours between the two ensembles.

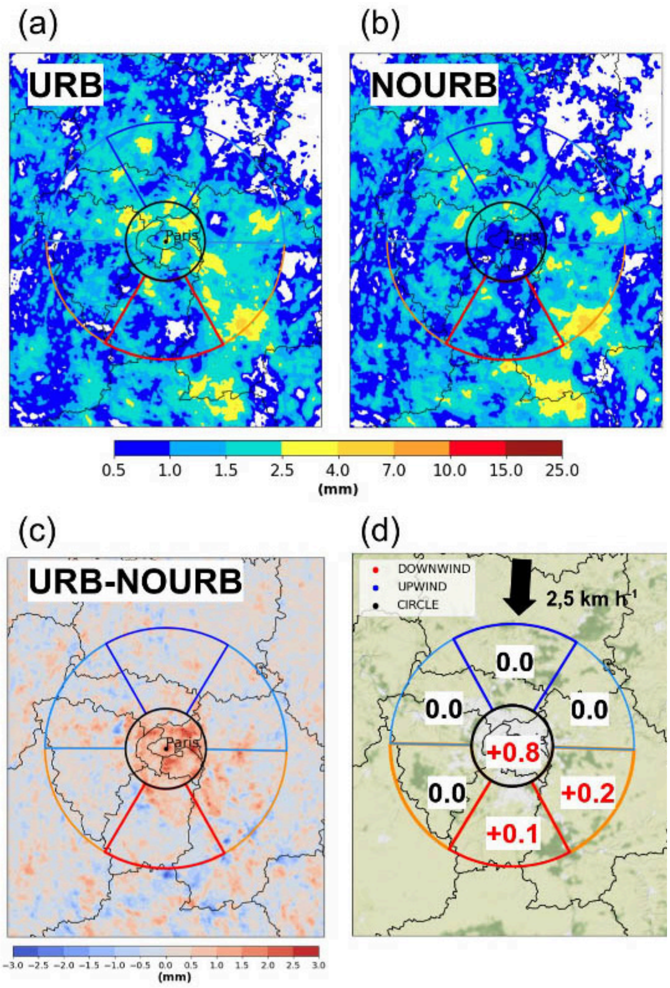

Figure. 1 Averaged rainfall accumulation over 6h (12-18 UTC) over Paris region for URB ensemble (a), NOURB ensemble (b) and sectors around and over the city. The difference between (a) and (b) is displayed on (c) and the average accumulated precipitation computed in each sector is shown on (d). The blue and red sectors represent the upwind and downwind areas, respectively.

A detailed analysis of the results shows that higher temperatures and a drying of the air mass in the urban environment of Paris lead to an increase in the sensible heat flux and a decrease in the latent heat flux. These changes induce an increase in the updrafts and in the height of the boundary layer for the URB ensemble, with a concomitant increase in the amount of water present over the Paris region. This mechanism leads to a significant intensification of precipitation over the urban area and its immediate surroundings for the URB ensemble. This illustrates the significant influence of the urban environment on the convective dynamics in the situation of May 7, 2022.

The same methodology will be applied to other cases to distinguish weather situations in which the Paris region has an impact on precipitation, and to understand the processes involved in the interaction between the urban environment and convection.

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Urban areas and urban climate modeling sessions at the AGU Fall Meeting in San Francisco

By Chenghao Wang (University of Oklahoma) and
Lei Zhao (University of Illinois Urbana-Champaign)

The 2023 American Geophysical Union (AGU) Fall Meeting was held in San Francisco, CA, USA from December 11-15 in a successful hybrid format. This annual meeting featured nearly 3,000 scientific sessions and 23,000 oral and poster presentations. Multiple sessions related to urban areas and urban climate research were well attended by global researchers both within and beyond the IAUC community.

One notable session series was “Urban Areas and Global Change”, convened by Dr. Tirthankar Chakraborty (Pacific Northwest National Laboratory), Prof. Lei Zhao (University of Illinois Urbana-Champaign), Prof. Galina Churkina (Technische Universität Berlin), and Prof. Burak Güneralp (Texas A&M University). This series explored the multifaceted interactions within human-land-atmosphere systems in urban settings, including biogeochemical, biophysical, and ecological aspects, as well as the socio-institutional and technological drivers of urbanization and carbon emissions. Featuring two oral sessions with 16 talks and one poster session with 14 posters on Wednesday, it included two invited presentations by Dan Li (Boston University) on "Persistent Urban Heat" and William Eliott Foust (The Pennsylvania State University) on "Baltimore Social-Environmental Collaborative (BSEC): A Community-Integrated Approach to Urban Climate Research". Topics ranged from urban heat stress and coastal infrastructure to land cover composition, with notable introductions of new datasets such as a 10-m resolution building height dataset by Xin Yan (University of Georgia), an hourly urban weather database by Chenghao Wang (University of Oklahoma), and a South Korean urban noise map by Taeho Park (Korea Environment Institute).

Another set of sessions on “Representing Urban Processes and Dynamics in Models Across Scales” was convened by Prof. Lei Zhao (University of Illinois Urbana-Champaign), Dr. Tirthankar Chakraborty (Pacific Northwest National Laboratory), Prof. Scott Krayenhoff (University of Guelph), Prof. Chenghao Wang (University of Oklahoma), and Xinchang Li (University of Illinois Urbana-Champaign) on Wednesday. This series aimed at fostering discussions on the advancements in urban modeling, from process-based to data-driven approaches, including new parameterizations, new datasets, model improvement, and model validation across various spatial scales: from large-eddy simulations to mesoscale models to Earth system models. The sessions comprised 7 oral and 8 poster presentations on topics including urban morphology, building energy modeling, and urban flooding. Two invited talks were presented by Negin Nazarian (University of New South Wales) on “An extensive Large Eddy Simulations (LES) dataset of turbulent airflow to inform Urban Canopy Parameterizations (UCPs)” and by Huidong Li (Chinese Academy of Sciences) on “Understanding the impact of roof techniques on urban sustainability through a new urban dataset for WRF/UCM”. Additionally, the session showcased advancements in the Community Earth System Model (CESM), such as Xinchang Li’s (University of Illinois Urbana-Champaign) work on air conditioning adoption rates and Yifan Cheng’s (University of Illinois Urbana-Champaign) introduction of a global 1-km urban surface properties dataset.

These sessions were representative of the cutting-edge urban climate research presented at this world leading Earth and space sciences conference. The organizers of both series expressed their eagerness to reconvene during the 2024 AGU Fall Meeting, set to take place in Washington, DC, from December 9-13, 2024. They invite and look forward to the continued, robust engagement of the international urban climate community at the 2024 meeting.

Song Jiang (University of Illinois at Urbana-Champaign) presented a study that quantified the urban heat island effect in 6,022 cities worldwide and the disparate impacts of urban size and vegetation cover.

Exhibit Hall crowded with attendees.

Recent Urban Climate Publications

Abbasi M, Golbabaei F, Yazdanirad S, Dehghan H, Ahmadi A (2023) Validity of eighteen empirical heat stress indices in predicting the physiological parameters of workers under various occupational and climatic conditions. *Urban Climate* **52** 101708.

Abou Samra RM (2023) "Investigating and mapping day-night urban heat island and its driving factors using Sentinel/MODIS data and Google Earth Engine. Case study: Greater Cairo, Egypt". *Urban Climate* **52** 101729.

Acosta MP, Vahdatikhaki F, Santos J, Jarro SP, Doree AG (2024) Data-driven analysis of Urban Heat Island phenomenon based on street typology. *Sustainable Cities and Society* **101** 105170.

Ács F, Kristóf E, Zsákai A (2023) Individual local human thermal climates in the Hungarian lowland: Estimations by a simple clothing resistance-operative temperature model. *International Journal of Climatology* **43** 1273-1292.

Adams K, Knuth CS (2024) The effect of urban heat islands on pediatric asthma exacerbation: How race plays a role. *Urban Climate* **53** 101833.

Addison-Atkinson W, Chen A, Memon FA, Anta J, Naves J, Cea L (2024) Investigation of uniform and graded sediment wash-off in an urban drainage system: Numerical model validation from a rainfall simulator in an experimental facility. *Journal of Hydrology* **629** 130561.

Agnese S, Maria K (2023) Urban microclimate and climate change impact on the thermal performance and ventilation of multi-family residential buildings. *Energy and Buildings* **294** 113224.

Ahmed I, van Esch M, van der Hoeven F (2023) Heatwave vulnerability across different spatial scales: Insights from the Dutch built environment. *Urban Climate* **51** 101614.

Ai D, Wang H, Kuang D, Zhang X, Rao X (2024) Measuring pedestrians' movement and building a visual-based attractiveness map of public spaces using smartphones. *Computers, Environment and Urban Systems* **108** 102070.

Al-Aizari AR, Alzahrani H, Althuwaynee OF, Al-Masnay YA, Ullah K, Park H-J, Al-Areeq NM, Rahman M, Hazaea BY, Liu X (2024) Uncertainty Reduction in Flood Susceptibility Mapping Using Random Forest and eXtreme Gradient Boosting Algorithms in Two Tropical Desert Cities, Shibam and Marib, Yemen. *Remote Sensing* **16** 336.

Alam B, Soppi RN, Feiz A-A, Ngae P, Chpoun A, Kumar P (2024) CFD simulation of pollutant dispersion using anisotropic models: Application to an urban like environment under neutral and stable atmospheric conditions. *Atmospheric Environment* **318** 120263.

In this edition, we present a list of publications in the field of urban climate mainly published between **November 2023 and February 2024**. *Featured papers,* denoted by an asterisk symbol (*), are recommended by members of the Bibliography Committee. If you believe your articles are missing from this compilation, please send the references to my email address below with the subject line "IAUC publications" and the following format: Author, Title, Journal, Year, Volume, Issue, Pages, Dates, Keywords, DOI, and Abstract.

We are always seeking researchers at all career stages, particularly early-career professionals, to join our committee and actively contribute to the IAUC community. If you are interested in joining or would like to acquire further details, please do not hesitate to contact me via email.

Happy reading,

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Huidong Li


Mathew Lipson


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Martina Petralli


Aditya Rahul


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Ali M, Mahmood S (2024) Geo-spatial assessment of pluvial floods in city district Lahore, Pakistan. *Environmental Monitoring and Assessment* **196** 189.

Ali-Taleshi MS, Riyahi Bakhtiari A, K. Hopke P (2024) Meteorologically normalized spatial and temporal variations investigation using a machine learning-random forest model in criteria pollutants across Tehran, Iran. *Urban Climate* **53** 101790.

Alizadehtazi B, Stolper J, Singh K, Montalto F (2024) Microclimatic implications of a large-scale green roof and high-rise redevelopment in New York City. *Building and Environment* **250** 111113.

Almulhim AI, Cobbinah PB (2024) Framing resilience in Saudi Arabian cities: On climate change and urban policy. *Sustainable Cities and Society* **101** 105172.

An N, Chen Y, Zhai P, Li J, Wei Y (2023) Compound hot and ozone extremes in urban China. *Urban Climate* **52** 101689.

Anders J, Sebastian S, Tobias S, Siiri T, Christoph S, Mohamed S (2023) Modelling the impact of an urban development project on microclimate and outdoor thermal comfort in a mid-latitude city. *Energy and Buildings* **296** 113324.

Araminienė V, Sicard P, Černiauskas V, Coulibaly F, Varnagirytė-Kabašinskienė I (2023) Estimation of air pollution removal capacity by urban vegetation from very high-resolution satellite images in Lithuania. *Urban Climate* **51** 101594.

Arora T, Reddy CS, Sharma R, Kilaparthi SD, Gupta L (2023) Greenhouse gas emissions of Delhi, India: A trend analysis of sources and sinks for 2017–2021. *Urban Climate* **51** 101634.

Arriazu-Ramos A, Germán RR, Juan JPI, Ana S-OG, Aurora M-B (2023) From urban microclimate to indoor overheating: Analysis of residential typologies during typical climate series and extreme warm summer. *Energy and Buildings* **299** 113620.

Arshad A, Mirchi A, Vilcaez J, Akbar MU, Madani K (2024) Reconstructing high-resolution groundwater level data using a hybrid random forest model to quantify distributed groundwater changes in the Indus Basin. *Journal of Hydrology* **628** 130535.

Arthur RS, Lundquist KA, Wiersema DJ, Bao J, Chow FK (2020) Evaluating Implementations of the Immersed Boundary Method in the Weather Research and Forecasting Model. *Monthly Weather Review* **148** 2087-2109.

Arya S, Kumar A (2023) Evaluation of stormwater management approaches and challenges in urban flood control. *Urban Climate* **51** 101643.

Asibey MO, Appiah-Kusi F, Kissiwaa NA, Bilson MA, Abdulai ASJ (2024) Local multilevel governance arrangements for climate change planning and management in Kumasi, Ghana. *Environmental Science and Policy* **153** 103680.

Asif M, Bhatti MS, Dhuria RS, Yadav S (2024) Source apportionment of metal ions in ambient air (PM2.5) during firecracker bursting: A case study of Amritsar Diwali on 24 October 2022. *Urban Climate* **53** 101796.

Assaf G, Assaad RH (2023) Models and methods for quantifying the benefits of engineered heat mitigation initiatives: A critical review. *Urban Climate* **51** 101654.

Bagyaraj M, Senapathi V, Karthikeyan S, Chung SY, Khatibi R, Nadiri AA, Asgari Lajayer B (2023) A study of urban heat island effects using remote sensing and GIS techniques in Kancheepuram, Tamil Nadu, India. *Urban Climate* **51** 101597.

Bai X, Yu Z, Wang B, Zhang Y, Zhou S, Sha X, Li S, Yao X, Geng X (2024) Quantifying threshold and scale response of urban air and surface temperature to surrounding landscapes under extreme heat. *Building and Environment* **247** 111029.

Bamola S, Goswami G, Dewan S, Goyal I, Agarwal M, Dhir A, Lakhani A (2024) Characterising temporal variability of PM2.5/PM10 ratio and its correlation with meteorological variables at a sub-urban site in the Taj City. *Urban Climate* **53** 101763.

Ban Y, Liu X, Yin Z, Li X, Yin L, Zheng W (2023) Effect of urbanization on aerosol optical depth over Beijing: Land use and surface temperature analysis. *Urban Climate* **51** 101655.

*Bansal P, Quan S (2024) Examining temporally varying nonlinear effects of urban form on urban heat island using explainable machine learning: A case of Seoul. *Building and Environment* **247** 110957.

Bedi S, Katiyar A, Krishnan NMA, Kota SH (2024) Utilizing LSTM models to predict PM2.5 levels during critical episodes in Delhi, the world's most polluted capital city. *Urban Climate* **53** 101835.

Benavente NR, Vara-Vela AL, Nascimento JP, Acuna JR, Damascena AS, de Fatima Andrade M, Yamasoe MA (2023) Air quality simulation with WRF-Chem over southeastern Brazil, part I: Model description and evaluation using ground-based and satellite data. *Urban Climate* **52** 101703.

Best L, Schwarz N, Obergh D, Teuling AJ, Van Kanten R, Willemen L (2023) Urban green spaces and variation in cooling in the humid tropics: The case of Paramaribo. *Urban Forestry & Urban Greening* **89** 128111.

Bienvenido-Huertas D, de la Hoz-Torres M, Aguilar A, Tejedor B, Sánchez-García D (2023) Holistic overview of natural ventilation and mixed mode in built environment of warm climate zones and hot seasons. *Building and*

Environment **245** 110942.

Błażejczyk K, Twardosz R (2023) Secular changes (1826–2021) of human thermal stress according to UTCI in Kraków (southern Poland). *International Journal of Climatology* **43** 4220-4230.

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Bopp E, Douvinet J, Carles N, Foulquier P, Péroche M (2024) Spatial (in)accuracy of cell broadcast alerts in urban context: Feedback from the April 2023 Cannes tsunami trial. *Computers, Environment and Urban Systems* **107** 102055.

Borg MA, Xiang J, Anikeeva O, Ostendorf B, Varghese B, Dear K, Pisaniello D, Hansen A, Zander K, Sim MR, Bi P (2023) Current and projected heatwave-attributable occupational injuries, illnesses, and associated economic burden in Australia. *Environmental Research* **236** 116852.

*Browning M, McFarland J, Bistline J, Boyd G, Muratori M, Binsted M, Harris C, Mai T, Blanford G, Edmonds J, Fawcett AA, Kaplan O, Weyant J (2023) Net-zero CO2 by 2050 scenarios for the United States in the Energy Modeling Forum 37 study. *Energy and Climate Change* **4** 100104.

Burayu DG, Karuppannan S, Shuniye G (2023) Identifying flood vulnerable and risk areas using the integration of analytical hierarchy process (AHP), GIS, and remote sensing: A case study of southern Oromia region. *Urban Climate* **51** 101640.

Calaixo MRC, Ribeirinho-Soares S, Madeira LM, Nunes OC, Rodrigues CSD (2023) Catalyst-free persulfate activation by UV/visible radiation for secondary urban wastewater disinfection. *Journal of Environmental Management* **348** 119486.

Camporeale PE, Pilar M-M (2023) Retrofit strategies to mitigate overheating linking urban climate modeling and urban building simulations with outdoor comfort. An urban sector in Malaga (Spain). *Energy and Buildings* **298** 113531.

Cano-Suñén E, Ruiz-Varona A, Pérez-Bella J (2024) GIS-based application to calculate directional wind-driven rain exposure on residential buildings at an urban scale: The case study of Zaragoza, Spain. *Building and Environment* **249** 111152.

Cao M, Zhang Y (2024) Reductive sequestration of Cr (VI) by phosphorylated nanoscale zerovalent iron. *Journal of Environmental Management* **352** 119987.

Cao S, Wu D, Liu L, Li S, Zhang S (2024) Decoding the effect of demographic factors on environmental health based on city-level PM2.5 pollution in China. *Journal of Environmental Management* **349** 119380.

Cao X, Wang H, Zhang B, Liu J, Yang J, Song Y (2024) Land use spatial optimization for city clusters under changing climate and socioeconomic conditions: A perspective on the land-water-energy-carbon nexus. *Journal of Environmental Management* **349** 119528.

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Carlo O, Fellini S, Palusci O, Marro M, Salizzoni P, Buccolieri R (2024) Influence of obstacles on urban canyon ventilation and air pollutant concentration: An experimental assessment. *Building and Environment* **250** 111143.

Carton C, Barbecot F, Birks J, Hélie J-F (2024) Improved understanding of the impact of urbanization on the temperature, precipitation, and air quality of major eastern Canadian cities. *Urban Climate* **53** 101781.

Chalakkal JB, Mohan M (2023) Impact of AWiFS derived land use/land cover over the intensely urbanised domain of National Capital Region (NCR) - Delhi in simulating monsoon weather. *Urban Climate* **52** 101686.

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Chen F, Li Y, Ma X (2023) Is the city low-carbon because of its compactness? An empirical study in Shanghai, China. *Urban Climate* **52** 101690.

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Chen K, Tian M, Zhang J, Xu X, Yuan L (2023) Evaluating the seasonal effects of building form and street view indicators on street-level land surface temperature using random forest regression. *Building and Environment* **245** 110884.

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Upcoming Conferences...

ASIA OCEANIA GEOSCIENCES SOCIETY (AOGS) Annual Meeting 2024 (session on "Asian Urban Growth and Its Impact on Urban Climate")
Pyeongchang, South Korea • June 23-28, 2024.
https://www.asiaoceania.org/aogs2024/

20TH INTERNATIONAL DAYS ON THERMAL SCIENCE AND ENERGY (Journées internationales de thermique, JITH 2024)
Paris, France • October 29-31, 2024
http://www.jith.eu/index.php/jith-2024

Matthias Roth receives the Masatoshi YOSHINO Award 2023

We are delighted to report that Professor **Matthias Roth** of the National University of Singapore, Singapore, is the winner of the Masatoshi YOSHINO Award 2023 given by the Association of Japanese Geographers (AJG) for "new developments in the field of urban climatology by clarifying the characteristics of urban climate in tropical regions and the characteristics of turbulence within the urban canopy layer, and for contributing to the international research community of urban climatology" (https://www.ajg.or.jp/award_grant/yoshino-award/; in Japanese). An award ceremony and award commemorative lecture will be conducted at a meeting to be held in September 2024 in Nagoya, Japan.

IAUC members will remember Professor Masatoshi Yoshino, a Japanese physical geographer and urban climatologist, author of 'Climate in a Small Area: Introduction to Local Meteorology' published by the University of Tokyo Press in 1975, winner of the 2007 Luke Howard award and Professor Emeritus of the University of Tsukuba. Prof Yoshino died in 2017 and The Association of Japanese Geographers is giving a yearly award in his name for research done in the following sub-fields of geographical climatology / climate geography: micro climatology; historical climatology; disaster climatology; climate change; and climatology related to human activities, monsoons, or geoecology (https://www.ajg.or.jp/en/20230414/489/).

True to Professor Yoshino's urban climate research legacy, it is fitting that with Matthias an urban climatologist has for the first time received this award. Matthias is recognized for making significant contributions to new developments in the field of urban climatology through research on satellite-based remote sensing of urban surface temperatures, the understanding of turbulence characteristics over cities, in tropical urban climatology, as well as outstanding service to the international urban climate community, including serving as the third IAUC President (2007-2009) (https://www.ajg.or.jp/award_grant/yoshino-award/toshin/; in Japanese).

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The next edition of *Urban Climate News* will appear in late June. Contributions for the upcoming issue are welcome, and should be submitted by May 31, 2024 to the relevant editor.

Submissions should be concise and accessible to a wide audience. The articles in this Newsletter are unrefereed, and their appearance does not constitute formal publication; they should not be used or cited otherwise.

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