Urban Climate News

Quarterly Newsletter of the IAUC

ISSUE NO. 74 DECEMBER 2019 • www.urban-climate.org • INTERNATIONAL ASSOCIATION FOR URBAN CLIMATE

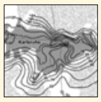
From the IAUC President

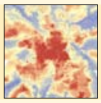
Season's greetings from the southern hemisphere where sadly drought, fire and extreme heat dominate the landscape and the conversation as we end 2019. Severe drought is impacting much of southern Africa and most of Australia with the catastrophic impacts of famine in parts of Africa and impacts of bushfires and extreme heat in Australia. Indeed, fires have been occurring more or less continuously in eastern Australia since the middle of winter with ~3 million hectares burnt thus far, a pretty much unheard-of situation. In Australia, public concern is mounting about climate change along with increased disgust at the lack of action on climate change at the national and global level. This has been exacerbated by the perceived lost opportunities at COP25 in Madrid earlier this month.

The last week has seen record-breaking heat and fire activity across Australia, with the official record for the average national temperature broken twice by large margins, even though it is still early summer. The previous average maximum temperature, averaged across 700 stations covering the 7.7 million km2 of Australia was 40.3°C, recorded in 2013. Tuesday 16th and Wednesday 17th December saw the record broken by 0.6°C (40.9°C) and 1.6°C (41.9°C) respectively, with Thursday and Friday also above the old 2013 record. Adelaide, Melbourne and Sydney each saw temperatures in the 45-47°C range. The Bureau of Meteorology has attributed the extreme heat to three key factors, two of them natural and one of them not. A strong positive Indian Ocean Dipole (IOD) and negative Southern Annular Mode (SAM) have both contributed to the extreme dryness, leaving no moisture to evaporatively cool the air. However, underlying all of this this is anthropogenic climate warming of close to 1.2°C in Australia that makes it easier to achieve these new records.

Why is this important for urban areas and urban climate science? Australian cities, with ~90% of Australia's population are in the frontline of impact, with issues of water scarcity, population and infrastructure heat vulnerability and fire on the urban periphery, all huge issues requiring innovative solutions. We as urban climate experts can contribute much to climate proofing our cities for the future.

Inside the December issue...





Once again, this *Urban Climate News* Issue No. 74 is packed full of useful information for our membership, thanks to David Pearlmutter and the efforts of his contributors (Paul Alexander, Helen Ward, Joe McFadden and Matthias Demuzere). This is also an opportunity to again celebrate the work of Janet Barlow whose Luke Howard Award was first circulated on the met-urbclim list a couple of months back.

All the very best wishes for the New Year 2020.

– Nigel Tapper,
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TIME magazine Person of the Year: Greta Thunberg

December 2019 — Greta Thunberg sits in silence in the cabin of the boat that will take her across the Atlantic Ocean. Inside, there's a cow skull hanging on the wall, a faded globe, a child's yellow raincoat. Outside, it's a tempest: rain pelts the boat, ice coats the decks, and the sea batters the vessel that will take this slight girl, her father and a few companions from Virginia to Portugal. For a moment, it's as if Thunberg were the eye of a hurricane, a pool of resolve at the center of swirling chaos. In here, she speaks quietly. Out there, the entire natural world seems to amplify her small voice, screaming along with her.

"We can't just continue living as if there was no tomorrow, because there is a tomorrow," she says, tugging on the sleeve of her blue sweatshirt. "That is all we are saying."

It's a simple truth, delivered by a teenage girl in a fateful moment. The sailboat, La Vagabonde, will shepherd Thunberg to the Port of Lisbon, and from there she will travel to Madrid, where the United Nations [hosted] this year's climate conference. It is the last such summit before nations commit to new plans to meet a major deadline set by the Paris Agreement. Unless they agree on transformative action to reduce greenhouse gas emissions, the world's temperature rise since the Industrial Revolution will hit the 1.5°C mark—an eventuality that scientists warn will expose some 350 million additional people to drought and push roughly 120 million people into extreme poverty by 2030. For every fraction of a degree that temperatures increase, these problems will worsen. This is not fearmongering; this is science. For decades, researchers and activists have struggled to get world leaders to take the climate threat seriously. But this year, an unlikely teenager somehow got the world's attention.

Thunberg began a global movement by skipping school: starting in August 2018, she spent her days camped out in front of the Swedish Parliament, holding a sign painted in black letters on a white background that read Skolstrejk för klimatet: "School Strike for Climate." In the 16 months since, she has addressed heads of state at the U.N., met with the Pope, sparred with the President of the United States and inspired 4 million people to join the global climate strike on September 20, 2019, in what was the largest climate demonstration in human history. Her image has been celebrated in murals and Halloween costumes, and her name has been attached to everything from bike shares to beetles. Margaret Atwood compared her to Joan of Arc. After noticing a hundredfold increase in its usage, lexicographers at Collins Dictionary named Thunberg's pioneering idea, climate strike, the word of the year.

For decades, researchers and activists have struggled to get world leaders to take the climate threat seriously. But this year, an unlikely teenager somehow got the world's attention.

Climate activist Greta Thunberg photographed on the shore in Lisbon, Portugal December 4, 2019. ***Source:*** https://time.com/person-of-the-year-2019-greta-thunberg/

The politics of climate action are as entrenched and complex as the phenomenon itself, and Thunberg has no magic solution. But she has succeeded in creating a global attitudinal shift, transforming millions of vague, middle-of-the-night anxieties into a worldwide movement calling for urgent change. She has offered a moral clarion call to those who are willing to act, and hurled shame on those who are not. She has persuaded leaders, from mayors to Presidents, to make commitments where they had previously fumbled: after she spoke to Parliament and demonstrated with the British environmental group Extinction Rebellion, the U.K. passed a law requiring that the country eliminate its carbon footprint. She has focused the world's attention on environmental injustices that young indigenous activists have been protesting for years. Because of her, hundreds of thousands of teenage "Gretas," from Lebanon to Liberia, have skipped school to lead their peers in climate strikes around the world.

"This moment does feel different," former Vice President Al Gore, who won the Nobel Peace Prize for his decades of climate advocacy work, tells TIME. "Throughout history, many great morally based movements have gained traction at the very moment when young people decided to make that movement their cause."

Thunberg is 16 but looks 12. She usually wears her light brown hair pulled into two braids, parted in the middle. She has Asperger's syndrome, which means she doesn't operate on the same emotional register as many of the people she meets. She dislikes crowds; ignores small talk; and speaks in direct, uncomplicated sentences. She cannot be flattered or distracted. She is not impressed by other people's celebrity, nor does she seem to have interest in her own growing fame. But these very qualities have helped make her a global sensation. Where others smile to cut the tension, Thunberg is withering. Where others speak the language of hope, Thunberg repeats the unassailable science: Oceans will rise. Cities will flood. Millions of people will suffer.

Thunberg is not a leader of any political party or advocacy group. She is neither the first to sound the alarm about the climate crisis nor the most qualified to fix it. She is not a scientist or a politician. She has no access to traditional levers of influence: she's not a billionaire or a princess, a pop star or even an adult. She is an ordinary teenage girl who, in summoning the courage to speak truth to power, became the icon of a generation.

"I want you to panic," she told the annual convention of CEOs and world leaders at the World Economic Forum in Davos, Switzerland, in January. "I want you to feel the fear I feel every day. And then I want you to act."

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Along the way, she emerged as a standard bearer in a generational battle, an avatar of youth activists across the globe fighting for everything from gun control to democratic representation. Her global climate strike is the largest and most international of all the youth movements, but it's hardly the only one: teenagers in the U.S. are organizing against gun violence and flocking to progressive candidates; students in Hong Kong are battling for democratic representation; and young people from South America to Europe are agitating for remaking the global economy. Thunberg is not aligned with these disparate protests, but her insistent presence has come to represent the fury of youth worldwide. According to a December Amnesty International survey, young people in 22 countries identified climate change as the most important issue facing the world. She is a reminder that the people in charge now will not be in charge forever, and that the young people who are inheriting dysfunctional governments, broken economies and an increasingly unlivable planet know just how much the adults have failed them.

"She symbolizes the agony, the frustration, the desperation, the anger—at some level, the hope—of many young people who won't even be of age to vote by the time their futures are doomed," says Varshini Prakash, 26, who co-founded the Sunrise Movement, a U.S. youth advocacy group pushing for a Green New Deal.

Thunberg's moment comes just as urgent scientific reality collides with global political uncertainty. Each year that we dump more carbon into the atmosphere, the planet grows nearer to a point of no return, where life on earth as we know it will change unalterably. Scientifically, the planet can't afford another setback; politically, this may be our best chance to make sweeping change before it's too late.

Next year will be decisive: the E.U. is planning to tax imports from countries that don't tackle climate change; the global energy sector faces a financial reckoning; China will draft its development plans for the next five years; and the U.S. presidential election will determine whether the leader of the free world continues to ignore the science of climate change.

"When you are a leader and every week you have young people demonstrating with such a message, you cannot remain neutral," French President Emmanuel Macron told TIME. "They helped me change." Leaders respond to pressure, pressure is created by movements, movements are built by thousands of people changing their minds. And sometimes, the best way to change a mind is to see the world through the eyes of a child.

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Thunberg is maybe 5 ft. tall, and she looks even smaller in her black oversize wet-weather gear. Late November is not the time of year to cross the Atlantic Ocean: the seas are rough, the winds are fierce, and the small boat—a leaky catamaran—spent weeks pounding and bucking over 23-ft. seas. At first, Thunberg got seasick. Once, a huge wave came over the boat, ripping a chair off the deck and snapping ropes. Another time, she was awakened by the sound of thunder cracking overhead, and the crew feared that lightning would strike the mast.

But Thunberg, in her quiet way, was unfazed. She spent most of the long afternoons in the cabin, listening to audiobooks and teaching her shipmates to play Yatzy. On calm days, she climbed on deck and looked across the vast colorless sea. Somewhere below the surface, millions of tons of plastic swirled. Thousands of miles to the north, the sea ice was melting.

Thunberg approaches the world's problems with the weight of an elder, but she's still a kid. She favors sweatpants and Velcro sneakers, and shares matching bracelets with her 14-year-old sister. She likes horses, and she misses her two dogs, Moses and Roxy, back in Stockholm. Her mother Malena Ernman is a leading Swedish opera singer. Her father Svante Thunberg is distantly related to Svante Arrhenius, a Nobel Prize–winning chemist who studied how carbon dioxide in the atmosphere increases the temperature on the earth's surface.

More than a century after that science became known, Thunberg's primary-school teacher showed a video of its effects: starving polar bears, extreme weather and flooding. The teacher explained that it was all happening because of climate change. Afterward the entire class felt glum, but the other kids were able to move on. Thunberg couldn't. She began to feel extremely alone. She was 11 years old when she fell into a deep depression. For months, she stopped speaking almost entirely, and ate so little that she was nearly hospitalized; that period of malnutrition would later stunt her growth. Her parents took time off work to nurse her through what her father remembers as a period of "endless sadness," and Thunberg herself recalls feeling confused. "I couldn't understand how that could exist, that existential threat, and yet we didn't prioritize it," she says. "I was maybe in a bit of denial, like, 'That can't be happening, because if that were happening, then the politicians would be taking care of it.'"

At first, Thunberg's father reassured her that everything would be OK, but as he read more about the climate crisis, he found his own words rang hollow. "I realized that she was right and I was wrong, and I had been wrong all my life," Svante told TIME in a quiet moment after arriving in Lisbon. In an effort to comfort their daughter, the family began changing their habits to reduce their emissions. They mostly stopped eating meat, installed solar panels, began growing their own vegetables and eventually gave up flying—a sacrifice for Thunberg's mother, who performs throughout Europe. "We did all these things, basically, not really to save the climate, we didn't care much about that initially," says Svante. "We did it to make her happy and to get her back to life." Slowly, Thunberg began to eat and talk again.

Thunberg arrives in Madrid for the last U.N. climate summit before a crucial deadline in 2020. *Source:* time.com

Thunberg's Asperger's diagnosis helped explain why she had such a powerful reaction to learning about the climate crisis. Because she doesn't process information in the same way neurotypical people do, she could not compartmentalize the fact that her planet was in peril. "I see the world in black and white, and I don't like compromising," she told TIME during a school break earlier this year. "If I were like everyone else, I would have continued on and not seen this crisis." She is in some ways grateful for her diagnosis; if her brain worked differently, she explained, "I wouldn't be able to sit for hours and read things I'm interested in." Thunberg's focus and way of speaking betrays a maturity far beyond her years. When she passed classmates at her school, she remarked that "the children are being quite noisy," as if she were not one of them.

In May 2018, after Thunberg wrote an essay about climate change that was published in a Swedish newspaper, a handful of Scandinavian climate activists contacted her. Thunberg suggested they emulate the students from Marjory Stoneman Douglas High School in Parkland, Fla., who had recently organized school strikes to protest gun violence in the U.S. The other activists decided against the idea, but it lodged in Thunberg's mind. She announced to her parents that she would go on strike to pressure the Swedish government to meet the goals of the Paris Agreement. Her school strike, she told them, would last until the Swedish elections in September 2018.

Thunberg's parents were less than thrilled at first at the idea of their daughter missing so much class, and her teachers suggested she find a different way to protest. But Thunberg was immovable. She put together a flyer with facts about extinction rates and carbon budgets, and then sprinkled it with the cheeky sense of humor that has made her stubbornness go viral. "My name is Greta, I am in ninth grade, and I am school-striking for the climate," she wrote on each flyer. "Since you adults don't give a damn about my future, I won't either."

On Aug. 20, 2018, Thunberg arrived in front of the Swedish Parliament, wearing a blue hoodie and carrying her homemade school-strike sign. She had no institutional

NORTH AMERICA: High school and middle school students in NY City perform a "die-in" to demand a Green New Deal; ANTARTICA: Scientists support the climate strikers from the West Antarctic Peninsula in September. ***Source:*** **time.com**

support, no formal backing and nobody to keep her company. But doing something—making a stand, even if she was by herself—felt better than doing nothing. "Learning about climate change triggered my depression in the first place," she says. "But it was also what got me out of my depression, because there were things I could do to improve the situation. I don't have time to be depressed anymore." Her father said that after she began striking, it was as if she "came back to life."

On the first day of her climate strike, Thunberg was alone. She sat slumped on the ground, seeming barely bigger than her backpack. It was an unusually chilly August day. She posted about her strike on social media, and a few journalists came by to talk to her, but most of the day she was on her own. She ate her packed lunch of bean pasta with salt, and at 3 o'clock in the afternoon, when she'd normally leave school, her father picked her up and they biked home.

On the second day, a stranger joined her. "That was a big step, from one to two," she recalls. "This is not about me striking; this is now us striking from school." A few days later, a handful more came. A Greenpeace activist brought vegan pad thai, which Thunberg tried for the first time. They were suddenly a group: one person refusing to accept the status quo had become two, then eight, then 40, then hundreds. Then thousands.

By early September, enough people had joined Thunberg's climate strike in Stockholm that she announced she would continue every Friday until Sweden aligned with the Paris Agreement. The Fridays for Future movement was born. By the end of 2018, tens of thousands of students across Europe began skipping school on Fridays to protest their own leaders' inaction. In January, 35,000 schoolchildren protested in Belgium following Thunberg's example. The movement struck a chord. When a Belgian environmental minister insulted the strikers, a public outcry forced her to resign.

By September 2019, the climate strikes had spread beyond northern Europe. In New York City, 250,000 reportedly marched in Battery Park and outside City Hall. In London, 100,000 swarmed the streets near Westminster Abbey, in the shadow of Big Ben. In Germany, a total of 1.4 million people took to the streets, with thousands flooding the Brandenburg Gate in Berlin and marching in nearly 600 other cities and towns across the country. From Antarctica to Papua New Guinea, from Kabul to Johannesburg, an estimated 4 million people of all ages showed up to protest. Their signs told a story. In London: The World is Hotter than Young Leonardo DiCaprio. In Turkey: Every Disaster Movie Starts with a Scientist Being Ignored. In New York: The Dinosaurs Thought They Had Time, Too. Hundreds carried images of Thunberg or painted her quotes onto poster boards. Make the World Greta Again became a rallying cry.

Her moral clarity inspired other young people around the world. "I want to be like her," says Rita Amorim, a 16-year-old student from Lisbon who waited for four hours in December to catch a glimpse of Thunberg.

In Udaipur, India, 17-year-old Vidit Baya started his climate strike with just six people in March; by September, it was 80 strong. In Brasilia, Brazil, 19-year-old Artemisa Xakriabá marched with other indigenous women as the Amazon was burning, then traveled to the U.N. climate summit in New York City. In Guilin, China, 16-year-old Howey Ou posted a picture of herself online in front of city government offices in a solo act of climate protest; she was taken to a police station and told her demonstration was illegal. In Moscow, 25-year-old Arshak Makichyan began a one-man picket for climate, risking arrest in a country where street protest is tightly restricted. In Haridwar, India, 11-year-old Ridhima Pandey joined 15 other kids, including Thunberg, in filing a complaint to the U.N. against Germany, France, Brazil, Argentina and Turkey, arguing that the nations' failure to tackle the climate crisis amounted to a violation of child rights.

In New York City, 17-year-old Xiye Bastida, originally

ASIA: Fridays for Future activists protest climate inaction in September in Lahore, Pakistan; AUSTRALIA: Demonstrators bring Greta Thunberg masks to an environmental protest in Melbourne in September. ***Source:*** **[time.com]**

from an indigenous Otomi community in Mexico, led 600 of her peers in a climate walkout from her Manhattan high school. And in Kampala, Uganda, 22-year-old Hilda Nakabuye launched her own chapter of Fridays for Future after she realized that the strong rains and long droughts that hurt her family's crops could be attributed to global warming. "Before I knew about climate change, I was already experiencing its effects in my life," she says.

The activism of children has also motivated their parents. In São Paulo, Isabella Prata joined a group called Parents for Future to support child activists. Thunberg, she says, "is an image of all of this generation."

It all happened so fast. Just over a year ago, a quiet and mostly friendless teenager woke up, put on her blue hoodie, and sat by herself for hours in an act of singular defiance. Fourteen months later, she had become the voice of millions, a symbol of a rising global rebellion.

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On Dec. 3, La Vagabonde docked beneath a flight path to Portugal's largest airport. Thunberg and her father stood on the deck, waving to the hundreds of people that had gathered on a cold, sunny day to welcome them back to Europe. Above their heads, planes droned, reminders of how easily Thunberg could have crossed the ocean by air, and of the cost of that convenience: the roughly 124,000 flights that take off every day spill millions of tons of greenhouse gases into the atmosphere. "I'm not traveling like this because I want everyone to do so," Thunberg told reporters after she walked, a little wobbly at first, onto dry land for the first time in weeks. "I'm doing this to send a message that it is impossible to live sustainably today, and that needs to change."

Taking her place in front of a bank of television cameras and reporters, she went on. "People are underestimating the force of angry kids," she said. "We are angry and frustrated, and that is because of good reason. If they want us to stop being angry then maybe they should stop making us angry." When she was done speaking, the crowd erupted in cheers.

Her speeches often go straight to the gut. "You say you love your children above all else," she said in her first big address at the U.N. Climate Change Conference in Poland last December. "And yet you are stealing their future in front of their very eyes." The address went viral almost immediately. Over the course of the past year, she has given dozens of similar admonitions—to chief executives and heads of state, to thought leaders and movie stars. Each time, Thunberg speaks quietly but forcefully, articulating the palpable sense of injustice that often seems obvious to the very young: adults, by refusing to act in the face of extraordinary crisis, are being foolish at best, and corrupt at worst. To those who share her fear, Thunberg's blunt honesty is cathartic. To those who don't, it feels threatening. She refuses to use the language of hope; her sharpest weapon is shame.

In September, speaking to heads of state during the U.N. General Assembly, Thunberg pulled no punches: "We are in the beginning of a mass extinction, and all you can talk about is money and fairy tales of eternal economic growth," she said. "How dare you."

Mary Robinson, the former President of Ireland who served as the U.N. climate envoy ahead of the Paris climate talks, spent years arguing that climate change would destroy small island nations and indigenous communities. The message often fell on deaf ears. "People would just sort of say, 'Ah yeah, but that's not me,'" she tells TIME. "Having children say, 'We have no future' is far more effective. When children say something like that, adults feel very bad."

Cutting through the noise has earned Thunberg plenty of detractors. Some indigenous activists and organizers of color ask why a white European girl is being celebrated when they have been working on these same issues for decades. Thunberg herself sometimes appears frustrated at the media attention placed on her, and often goes out of her way to highlight other activists, especially indige-

AFRICA: Leah Namugerwa, 15, and Hilda Nakabuye, 22, lead a climate protest near Kampala, Uganda, in September; SOUTH AMERICA: Thousands march in Santiago, Chile, during a Fridays for Future protest in March. ***Source:*** **time.com**

nous ones. At a press conference in Madrid just before the mass march, she implores journalists to ask questions "not just to me," but to the other Fridays for Future organizers on stage with her. "What do you think?" she asks the others, in an effort to broaden the conversation.

Some traditional environmental groups have also complained that the radical success of a teenage girl playing hooky has overshadowed their less flashy efforts to write and pass meaningful legislation. "They want the needle moved too," says Rachel Kyte, dean of the Fletcher School at Tufts University and a veteran climate leader. "They would just want to be the ones that get the credit for moving it." On the record, no major environmental group would say anything remotely negative.

Some of her opponents have attacked her personally. Online trolls have made fun of her appearance and speech patterns. In Rome, someone hung her in effigy off a bridge under a sign reading Greta is your God. In Alberta, the heart of Canada's oil-drilling region, police had to step in to protect her after she and her father were followed by men yelling, "This is oil country." Maxime Bernier, leader of the far-right People's Party of Canada, tweeted that Thunberg is "clearly mentally unstable." (He later walked back his criticism, calling her only a "pawn.") Russian President Vladimir Putin dismissed Thunberg entirely: "I don't share the common excitement," he said on a panel in October. President Donald Trump mocked her sarcastically on Twitter as "a very happy young girl looking forward to a bright and wonderful future." After she tweeted about the killings of indigenous people in Brazil, the country's President Jair Bolsonaro called her an insulting word that roughly translated to "little brat." Thunberg has taken those criticisms in stride: she has co-opted both Trump and Bolsonaro's ridicule for her Twitter bio.

It's not always easy. No one, and perhaps particularly a teenage girl, would like to have their looks and mannerisms mocked online. But for Thunberg, it's a daily reality. "I have to think carefully about everything I do, everything I say, what I'm wearing even, what I'm eating—everything!" she tells TIME during a train ride to Hamburglast spring. "Everything I say will reach other people, so I need to think two steps ahead." Sitting next to her father, she scrolls past hateful comments—the head of a Swedish sportswear chain appeared to be mocking her Asperger's—then shrugs them off. So many people have made death threats against her family that she is now often protected by police when she travels. But for the most part, she sees the global backlash as evidence that the climate strikers have hit a nerve. "I think that it's a good sign actually," she says. "Because that shows we are actually making a difference and they see us as a threat."

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It's hard to quantify the so-called Greta effect partly because it's mostly been manifest in promises and goals. But commitments count as progress when the climate conversation has been stuck in stasis for so long. In the U.S., Democrats have long given lip service to addressing global warming even as they prioritized other issues, while many Republicans have simply denied the science altogether. In countries now establishing a middle class, like China and India, leaders argue they should be allowed to burn fossil fuels because that's how their richer counterparts got ahead.

Those debates end up papering over what is an urgent challenge by nearly every measure. Keeping global temperature rise to 1.5°C would require elected officials to act both immediately and dramatically. In the developed world, a rapid transition away from fossil fuels could sharply raise gas and heating prices and disrupt industries that employ millions of people. In the global south, reducing emissions means rethinking key elements of how countries build their economies. Emissions would have to drop 7.6% on average every year for the next decade—a feat that, while scientifically possible, would require revolutionary changes.

But the needle is moving. Fortune 500 companies, facing major pressure to reduce their emissions, are realizing that sustainability makes for good PR. In June, the airline KLM launched a "Fly Responsibly" campaign, which encouraged customers to consider abstaining from non-essential air travel. In July, the head of OPEC, the cartel that controls much of the world's oil production, called climate strikers the "greatest threat" to his industry, according to the AFP. In September, workers at Amazon, Facebook and other major companies walked out during the climate strikes. And in November, the president of Emirates airline told the BBC that the climate strikers helped him realize "we are not doing enough." In December, Klaus Schwab, the founder and CEO of the World Economic Forum, published a manifesto calling on global business leaders to embrace a more responsible form of capitalism that, among other things, forces companies to act "as a steward of the environmental and material universe for future generations."

Hans Vestberg, the CEO of the telecom giant Verizon, says that companies are feeling squeezed about climate from all sides. "It's growing from all the stakeholders," he says. "Our employees think about it much more, our customers are talking much more about it, and society is expecting us to show up."

Governments are making promises too. In the past year, more than 60 countries said they would eliminate their carbon footprints by 2050. Voters in Germany, Denmark, the Netherlands, Austria and Sweden—especially young people—now list climate change as their top priority. In May, green parties gained seats in the European Parliament from Germany, Austria, the Netherlands and more. Those victories helped push the new European Commission president to promise "a Green Deal" for Europe. In the U.S., a recent Washington Post poll found that more than three-quarters of Americans now consider climate change a "crisis" or a "major problem." Even Republican lawmakers who have long denied or dismissed climate science are taking note. In an interview with the Washington Examiner, Republican House minority leader Kevin McCarthy acknowledged that his party "should be a little bit nervous" about changing attitudes on climate.

At the individual level, ordinary people are following Thunberg's example. In Sweden, flying is increasingly seen as a wasteful emission of carbon—a change of attitude captured by a new word: *flygskam*, meaning "flight-shame." There was an 8% drop in domestic flights between January and April according to Swedavia, which runs the nation's airports, and Interrail ticket sales have tripled over the past two years. More than 19,000 people have signed a pledge swearing off air travel in 2020, and the German railway operator Deutsche Bahn reported a record number of passengers using its long-distance rail in the first six months of 2019. Swiss and Austrian railway operators also saw upticks on their night train services this year.

The Greta effect may be growing, but Thunberg herself remains unmoved. "One person stops flying doesn't make much difference," she says. "The thing we should look at is the emissions curve—it's still rising. Of course something is happening, but basically nothing is happening."

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Last spring, before she became a global icon, Thunberg enjoyed a semblance of calm and privacy. Now it's bedlam wherever she goes. On the night train from Lisbon, she hides in the on-board kitchen to escape the lenses of dozens of cameras; when she is finally able to sneak into her cabin, she uses the moment of peace to write in her journal. When her train arrives in Madrid the next morning, the platform is again packed cheek-to-jowl with television cameras and reporters. Before stepping off the train and facing the pack, she wonders out loud how she can navigate the chaos. Even after she makes it inside the U.N. climate summit, she's swarmed. Photographers jostle through throngs of teenagers in green face paint chanting "Gre-TA, Gre-TA!" while others erupt in a spirited call-and-response: "What do we want? Climate justice! When do we want it? Now!"

A few yards away from the commotion, in one of the official conference spaces, a speaker stands in front of a handful of other adults and chuckles. Behind her, a screen shows a PowerPoint presentation: "How do we empower young people in climate activism?"

Thunberg's lonely strike outside Sweden's Parliament coincided with a surge of mass youth protests that have erupted around the world—all in different places, with different impacts, but fueled by a changing social climate and shifting economic pressures. In Hong Kong, young activists concerned by Beijing's tightening grip on the territory sparked a furious pro-democracy movement that has been going strong since June. In Iraq and Lebanon, young people dominate sweeping demonstrations against corruption, foreign interference and sectarian governance. The Madrid climate summit was moved from Chile because of huge protests over economic inequality that were kicked off by high school students. And in the U.S., young organizers opposed the Trump Administration on everything from immigration to health care and helped elect a new wave of equally young lawmakers.

The common thread is outrage over a central injustice: young people know they are inheriting a world that will not work nearly as well as it did for the aging adults who have been running it. "It's so important to realize that we are challenging the systems we are in, and that is being led by young people," says Beth Irving, 17, who came from Wales to demonstrate for sweeping changes on climate policy outside the U.N. summit. Thunberg is not aligned with any of these non-climate youth movements, but her abrupt rise to prominence comes at a moment when young people across the globe are awakening to anger at being cut a raw deal.

The existential issue of climate puts everyone at risk, but the younger you are, the greater the stakes. The scale of addressing climate change—the systemic transformation of economic, social and political systems—-animates young progressives already keen to remake the world. Karin Watson, 22, who came to the climate summit as part of a delegation from Amnesty International Chile, describes a tumultuous, interconnected and youth-led "social explosion" worldwide. She cannot disentangle her own advocacy for higher wages from women's rights and climate: "This social crisis is also an ecological crisis—it's related," she says. "In the end, it's intersectional: the most vulnerable communities are the most vulnerable to climate change."

In the U.S., Jaclyn Corin, 19, one of the original organizers of the March for Our Lives anti-gun violence movement, framed the challenges at stake. "We can't let these problems continue on for future generations to take care of," she says. "Adults didn't take care of these problems, so we have to take care of them, and not be like older generations in their complacency."

These disparate youth movements are beginning to see some wins. In Hong Kong, after months of sometimes-violent protests by young people resisting Beijing's authoritarian rule, the pro-democracy parties won major victories in the local elections in November. In the U.K., young people are poised to become one of the most decisive voting blocs, and political battle lines are drawn by age as well as class. One poll shows that more than half of British voters say the climate crisis will influence their votes in the coming elections; among younger voters, it's three-quarters. In Switzerland, the two environmentalist parties saw their best results ever in the elections in October, and much of that support came from young people who were voting for the first time. In the U.S., the Sunrise activists have helped make climate change a central campaign issue in the 2020 presidential election. In September, the top 10 candidates for the Democratic nomination participated in a first-of-its-kind prime-time town hall on the issue.

By clarifying an abstract danger with piercing outrage, Thunberg became the most compelling voice on the most important issue facing the planet.

In August 2018 Thunberg first sat in front of Swedish Parliament to demand climate action; on Dec. 6 tens of thousands flooded Madrid to join her call. ***Source:*** time.com

"Young people tend to have a fantastic impact in public opinion around the world," U.N. Secretary-General António Guterres told TIME. "Governments follow."

On Dec. 6, the tens of thousands of people flooding into Madrid to demonstrate for climate action pour off trains and buses and sweep in great waves through the heart of the city. Above their heads, the wind carries furious messages—Merry Crisis and a Happy New Fear; You Will Die of Old Age, I Will Die of Climate Change—and the thrum of chants and drumming rise like thunder through the streets. A group of young women and teenage girls from Spain's chapter of Fridays for Future escort Thunberg slowly from a nearby press conference to the march, linking their arms to create a human shield. Once again, Thunberg was the calm in the eye of a hurricane: buffeted and lifted by the surging crowd, cacophonous and furious but also strangely joyful.

It takes them an hour just to reach the main demonstration. When Thunberg finally approaches the stage, she climbs in her Velcro shoes to a microphone and begins to speak. The drums fall silent, and thousands lean in to listen. "The change is going to come from the people demanding action," she says, "and that is us." From where she stands, she can see in every direction. The view is of a vast sea of young people from nations all over the world, the great force of them surging and cresting, ready to rise.

— By Charlotte Alter, Suyin Haynes & Justin Worland. Photos: Evgenia Arbugaeva for TIME. With reporting by Ciara Nugent/Copenhagen; Dan Stewart and Vivienne Walt/Paris. Source: https://time.com/person-of-the-year-2019-greta-thunberg/

Sydney Choking on the Most Toxic Air on Earth

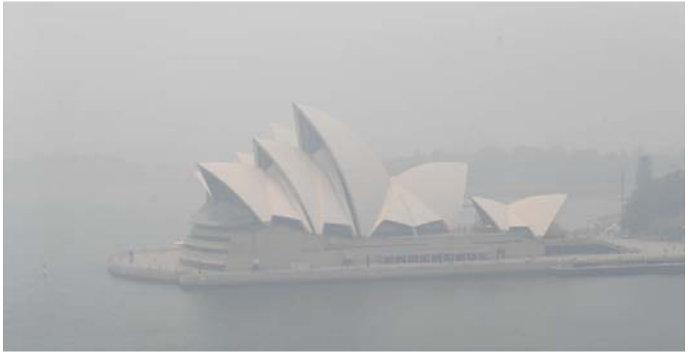
December 2019 — Australia was on fire for more than a month, but the flames were hardly the only impact. Smoke from Australia's bush fires engulfed Sydney in a smoke, creating the most toxic air on the planet.

Scientists measure air quality using an index that measures major pollutants and uses them to rate how unhealthy the air is. The bushfire smoke on Tuesday (Dec 10) pushed Sydney's air quality index rating to 2,552. That's 11 times higher than the level considered hazardous. And it's well below air quality index readings in cities in China, India, and other places known as hotbeds of air pollution.

For context, a healthy air quality index is under 50 or so. A hazardous level is between 301 to 500. Last Fall, the Camp Fire in northern California created what was then the most dangerous air quality levels on the planet—levels reached 246 in Oakland. Right now, Sydney's not even on the same scale.

The smoke created surreal scenes across the city. Fire alarms rang out across the city. Ferries were cancelled, buildings were evacuated, and schools kept kids inside during recess. The toxic air caused face mask sales to spike.

Unions New South Wales—which represents 600,000 workers in the state—said it considers it illegal for workers to be forced to work until air quality improves. Health officials have advised people to stay inside, but air quality levels indoors might not be all that much better, an expert told Australian news network 9 News.



The Sydney Opera House enveloped in smoke. *Photos:* gizmodo.com

Some people are trying to get on with their lives, but air quality levels are particularly dangerous for elderly people, children, babies, pregnant people, and people who have asthma or are in poor cardiovascular health. Choking down the toxic air is made even worse by soaring temperatures and a drought.

Dozens of climate change-fueled bushfires are still burning. To-date, the blazes have burned 6.67 million acres across Australia, leaving a trail of destruction in their path. And with one fire too big to put out, the smoke plaguing Sydney may be here to stay for months.

Put simply, Sydney is in a climate emergency, and it's not over yet. *Source:* https://earther.gizmodo.com/sydney-is-choking-on-the-most-toxic-air-on-earth-1840337199

What It's Like Living in One of the Hottest Cities on Earth – Where It May Soon Be Uninhabitable

September 2019 — It's just after 7 in the morning in the Pakistani city of Jacobabad, and donkey-cart driver Ahsan Khosoo is already drenched in sweat. For the past two hours, the 24-year-old laborer has been hauling jugs of drinking water to local residences. When the water invariably spills from the blue jerricans, it hits the pavement with an audible hiss and turns to steam. It's hot, he agrees, but that's not an excuse to stop. The heat will only increase as the day wears on, and what choice does he have? "Even if it were so hot as if the land were on fire, we would keep working." He pauses to douse his head with a bucket of water.

Jacobabad may well be the hottest city in Pakistan, in Asia and possibly in the world. Khosoo shakes his head in resignation. "Climate change. It's the problem of our area. Gradually the temperatures are rising, and next year it will increase even more."

The week before I arrived in Jacobabad, the city had reached a scorching 51.1°C. Similar temperatures in Sahiwal, in a neighboring province, combined with a power outage, had killed eight babies in a hospital ICU when the air-conditioning cut out. Summer in Sindh province is no joke. People die.

To avoid the heat, tractor drivers in this largely agricultural area till the fields at night and farmers take breaks from noon to 3, but if life stopped every time the temperature surpassed 40°C, nothing would ever get done. "Even when it's 52°C to 53°C, we work," says Mai Latifan Khatoom, a young woman working in a nearby field.

The straw has to be gathered, the seeds winnowed, the fields burned, the soil turned, and there are only so many hours in the day. She has passed out a few times from the heat, and often gets dizzy, but "if we miss one day, the work doesn't get done and we don't get paid."

If the planet continues warming at an accelerated rate, it won't be just the people of Jacobabad who live through 50°C summers. Everyone will. Heat waves blistered countries across the northern hemisphere this summer. In July, all-time heat records were topped in Germany, Belgium, France and the Netherlands. Wildfires raged in the Arctic, and Greenland's ice sheet melted at a record rate. Globally, July was the hottest month ever recorded.

Climate scientists caution that no spike in weather activity can be directly attributable to climate change. Instead, they say, we should be looking at patterns over time. But globally, 18 of the 19 warmest years on record have occurred since 2001. I asked Camilo Mora, a climate scientist at the University of Hawaii at Manoa who in 2017 published an alarming study about the link between climate change and increased incidences of deadly heat waves, if this was the new normal for Europe. He laughed. The new normal, he says, is likely to be far worse. It's likely to look something like Jacobabad.

A man carries a charpoy on his head while finding a cool area to sleep for the night in Sehwan Sharif on July 1. ***Source:*** **time.com**

Scientists estimate the probable increase in global average temperature will be at least 3°C by the end of the 21st century. That, Mora says, would mean three times as many hurricanes, wildfires and heat waves. People won't be able to work outside in some places, and there will be increased cases of heatstroke, heat-related illness and related death. In the U.S., extreme heat already causes more deaths than any other severe weather event, killing an estimated 1,500 people each year.

A 2003 heat wave in Europe is estimated to have caused up to 70,000 deaths. Yet we still don't think of heat as a natural disaster on a par with, say, an earthquake, or even akin to a terrorist attack, says Mora. "Heat kills more people than many of these disasters combined. Europe [in 2003] was like a 9/11 every day for three weeks. How much more disaster do you want before we start taking it seriously?"

"If you want to report on heat, this is the right place to be," Anees, a security guard working for my hosts in Jacobabad, cheerfully informs me as I arrive on a scalding June afternoon. Pakistan holds the heat record for Asia, he says proudly, though he has heard that it gets hotter elsewhere. It does, but the world's highest recorded temperatures—in California's Death Valley, for example—usually occur far from human habitation. Urban enclaves, where dense construction, a lack of green space and traffic congestion combine to create a heat-island effect, are rapidly catching up.

While Pakistanis regularly claim Jacobabad as the hottest city in the world, it depends on how you measure it. Various atmospheric-science organizations use different metrics, and record-breaking highs have ping-ponged between Iran, Pakistan and Kuwait over the past couple of years. After extensive research, the World Meteorological Organization announced earlier this year that Turbat, Pakistan, 900 km (560 miles) to the southwest, could claim the title with a temperature of 53.7°C on May 28, 2017. Jacobabad may very well win the endurance round, though, regularly surpassing 50°C in the summer months.

Most days, the Jacobabad district, population 1 million, suffers from power outages that can last as long as 12 hours. Even when there is electricity, few households can afford an air conditioner. Locals rely on traditional remedies, like thadel, a supposedly cooling tonic made from ground poppy seeds mixed with spices, rose-flavored syrup and iced water. They also dress right for the weather, the women wearing shalwar kameez suits made of cotton lawn, a light, airy fabric. The loose trousers billow out from the waist, the long-sleeved tunic protects the arms, and a scarf covers the head. The men wear something similar, though without the vibrant patterns.

Khosoo, the donkey-cart driver, soaks his clothes in water several times a day, while tractor driver Nabi Bux swears that the Sindhi pop tunes blaring from his open cab take his mind off the heat. Sixty-something Mohammad Ayub, who sports a red cap sprinkled with tiny winking mirrors in the traditional Sindhi style, recommends taking frequent rests under a tree. The only problem is that most of the trees in the area have been chopped down for firewood. “Sometimes, when it gets above 52°, I feel like my brain is rolling around in my head.” It was never that hot when he was a child, he complains. “We had more trees then. Now the trees are gone.”

The only real remedy, says a local doctor, Abdu Hamim Soomro, is to stay hydrated and get out of the heat. Thadel is pure superstition, he says. Still, he drinks it. “Maybe it’s the opium from the poppy seeds,” he jokes. “It makes us feel better, and everyone is addicted to it.”

Not even the night air offers much respite. The digital thermometer I had been carrying around with me registered 41.1°C at 10 p.m. Instead of mattresses, most people sleep on charpoys—low cots of woven leather that allow the air to circulate underneath the body. The solar panels that run fans during the day don’t work at night. Khosoo is one of the lucky ones; at night he puts his donkey back to work, treading a circle that powers his ceiling fan. But someone has to stay awake to keep the donkey going, he says, so either way, nights are rarely restful in the summer months.

Police in Jacobabad serve punch to locals, to prevent heatstroke on the hottest days. *Source:* time.com

What seems like the minor inconvenience of a restless night has widespread ramifications, however. Nick Obradovich, a research scientist at the Massachusetts Institute of Technology Media Lab, started looking at the mental-health impact of climate change when colleagues noted a correlation between increased nighttime temperatures and suicide rates in the U.S. and Mexico. In tracking more than a billion social-media posts across multiple platforms from people living in varying climatic conditions, his team found that hotter-than-usual temperatures correlated with worse moods and an increase in reported mental-health difficulties. “If I were to say that climate change simply makes you grumpy, it doesn’t sound all that catastrophic,” Obradovich says. “But if grumpiness is one of myriad social changes that result, regularly, from unusually warm temperatures, we should be concerned about the cumulative effects of these changes over time on the long-term well-being of our society.”

Humans are incredibly adaptive, but when it comes to heat, there is a limit. When the ambient air exceeds the normal body temperature of 37°C, the only way to keep from overheating is by evaporative cooling—a.k.a. sweating. But when the humidity is high, sweating is less effective because the air is already saturated with moisture. As a result, the body’s core temperature increases, triggering a series of emergency protocols to protect vital functions.

First, blood flow to the skin increases, straining the heart. The brain tells the muscles to slow down, causing fatigue. Nerve cells misfire, leading to headache and nausea. If the core temperature continues to rise past 40°C to 41°C, organs start shutting down and cells deteriorate. Mora, at the University of Hawaii, described 27 different ways the body reacts to overheating, from kidney failure to blood poisoning when the gut lining disintegrates. All can result in death within a few hours.

Mora's team analyzed data on 783 lethal heat waves spanning 35 years, in order to quantify which weather conditions posed the greatest mortality risk. It turns out the old cliché that it's not the heat but the humidity holds true. Even relatively mild heat waves with daytime temperatures of 38°C-39°C turn deadly when humidity exceeds 50%. In Jacobabad, it rarely does, but by 2100, some 74% of the global population will experience at least 20 days per year when heat and humidity reach that deadly intersection, according to some studies. The U.S. National Oceanic and Atmospheric Administration estimates that increased heat and humidity has already reduced the amount of work people can do outdoors by 10% globally, a figure that will double by 2050. "I don't think people quite grasp the seriousness of the situation," says Mora. "An entire set of livelihoods depends on being outside. Imagine being a construction worker who can't work for two months of the year."

In Pakistan, evidence of a climate crisis is easy to find. For the past few years, Pakistanis say, every summer has felt hotter, every drought longer, and every monsoon shorter and later in the season. "Before, it used to be one or two weeks of 50° days," says the nation's climate-change minister, Malik Amin Aslam. "Now it is months." These kinds of temperatures are not just deadly but also economically devastating. In a country surrounded by hostile neighbors, frequently targeted by terrorist groups and perpetually on the brink of nuclear war with India, Aslam ranks climate change as the "most severe existential threat facing Pakistan today." His office estimates that climate change could cost the country anywhere from $7 billion to $10 billion a year in disaster response alone, never mind lost economic activity. And Pakistan is no different than anywhere else, he warns. "With a temperature increase of three to five degrees that we are now looking at, the survival of the world is at stake. We cannot run away from it."

But to a certain extent, you can prepare for it. During the summer months, the Pakistani airwaves are full of public-service announcements warning residents about the dangers of heat, symptoms of heat exhaustion, and how to take precautions. Hospitals have dedicated wards for treating heat victims, and packets of oral rehydration salts can be found at any convenience-store cash register, next to the candy.

The only way to reduce heat waves would be to reduce global carbon emissions. But cities can make them safer by providing more green spaces. Anyone who has stepped under the shade of a tree on a hot day doesn't need science to prove that it's cooler, but according to the U.S. Environmental Protection Agency, the microclimate created by a few trees can reduce ambient temperatures by up to 5°C. Pakistani businessman turned environmentalist Shahzad

Himmat Ali relaxes on his charpoy, a traditional woven bed, on June 28. *Source:* time.com

Qureshi has taken that idea a step further by planting what he calls "urban forests" in the country's two largest cities, Lahore and Karachi. He says these microparks help a city breathe, and serve as natural recovery wards from the urban heat-island effect. Right now Qureshi's urban forests are privately funded, but he hopes they can become an example for smaller cities like Jacobabad, where government officials will see the benefit of growing urban forests over building yet another heat-trapping concrete behemoth.

In the meantime, Jacobabad's Imam Medical Center sees up to 10 heat-exhaustion and heatstroke patients a day, a number head physician Hamid Imam Soomro expects to rise in the coming years. "People will have to find a way to adapt," he says. "But some will die, especially the weak and the elderly." He's particularly worried about children, who often have to walk long distances without shade to get to school.

Even healthy adults can suffer the effects. Halima Bhangar, a 38-year-old widow who lives in a small village not far from Jacobabad, lost her husband to heatstroke in May 2018. He had gone to town to sell some cattle when he started feeling dizziness and heart palpitations. He went to a pharmacy to pick up some rehydration salts, but it was too late. He collapsed in the street. "It was the heat that killed him," she says. "We were not aware of its repercussions."

We had crowded into Bhangar's one-room mud-brick house to escape the midday sun, and the heat was stifling. A solar panel propped up in the courtyard ran a ceiling fan that seemed to do little more than push the hot air around. I glanced down at the thermometer, which registered an outside temperature of 52.1°C, just a degree and a half shy of the country's record high. Bhangar followed my gaze. "How can we protect ourselves from this heat?" she asked. "For how much longer can we survive here?" She has considered moving, but where in the world is immune from the rising temperatures? "We can't run away from nature."

Source: https://time.com/longform/jacobabad-extreme-heat/

The relevance of history in contemporary urban heat island research

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This article summarizes a recently published paper and related work: Stewart ID (2019) Why should urban heat island researchers study history? *Urban Climate* 30, 100484. https://doi.org/10.1016/j.uclim.2019.100484

Introduction

In scientific paper-writing, history is normally acknowledged through literature reviews and citation of influential works. This is the normative theory of citation: scientists are expected to cite prior publications that they found to be useful in their research, and to list those citations in bibliographic format. Citation is thus an acknowledgment that published works are forever embedded in a history of ideas. However, as historical materials and influential works accumulate over time, those of the distant past tend to be cited with less frequency, despite the trend for modern scientific papers to carry increasingly large bibliographies (de Solla Price, 1965).

A modern problem

In the scientific fields of meteorology and climatology, formal observations of the urban atmosphere originate from the early 19th century. This work began a long and gradual process of discovery into the "city temperature effect" – or "heat island effect" – eventually to steer urban climatology toward a modern and progressive science. However, despite the importance of heat island studies to environmental work in all cities, scientific rigor in modern observations of the phenomenon is critically lacking (e.g., Peterson and Owen, 2005; Oke, 2006, 2009; Stewart, 2011). Factors contributing to this problem are related mainly to weaknesses in experimental design and communication of results.

In this article, I elaborate this same problem, but propose a different contribution: the systemic ignorance of history. This circumstance is not unusual in science. Scholars in physics and biology, too, have called attention to the power of historical thinking and the integration of past perspectives into current scientific approaches (e.g., Maienschein, 2000; Stanley, 2016). This is equally true of urban climatology. Its classic writings are largely unknown to modern researchers despite many good reviews on the history of the subject (e.g., Steinhauser, 1934; Brooks, 1952; Kratzer, 1956; McBoyle, 1968; Oke, 1974; Yoshino, 1975; Landsberg, 1981; Jáuregui, 1986; Roth, 2007; Jankovic, 2013; Mills, 2014). Had these classic writings been more accessible, and had modern workers a greater awareness and curiosity for them, the study of urban climates might have advanced beyond where it is today.

Methods

This inquiry into historical ignorance and modern progress in urban climatology consists of two parts. In the first, I identify the classic heat island studies (pre-1980) that made unparalleled contributions to the development of the field. In the second part, I examine a sample of modern heat island studies (post-2000) for their bibliographic references to the classic work of part one. The frequency of modern citations to the classic work is then used to assess the level of historical awareness among contemporary researchers, and the effects of historical awareness on disciplinary progress.

Sourcing the historical classics

Three criteria were used to source the urban heat island classics. The first criterion restricts the classics to city temperature and heat island studies published before 1980, by which time the heat island effect had been described by two of its most conscientious observers to be a "common" and "predictable" event in most cities (Chandler, 1965; Landsberg, 1979). The second criterion specifies the measurement of urban

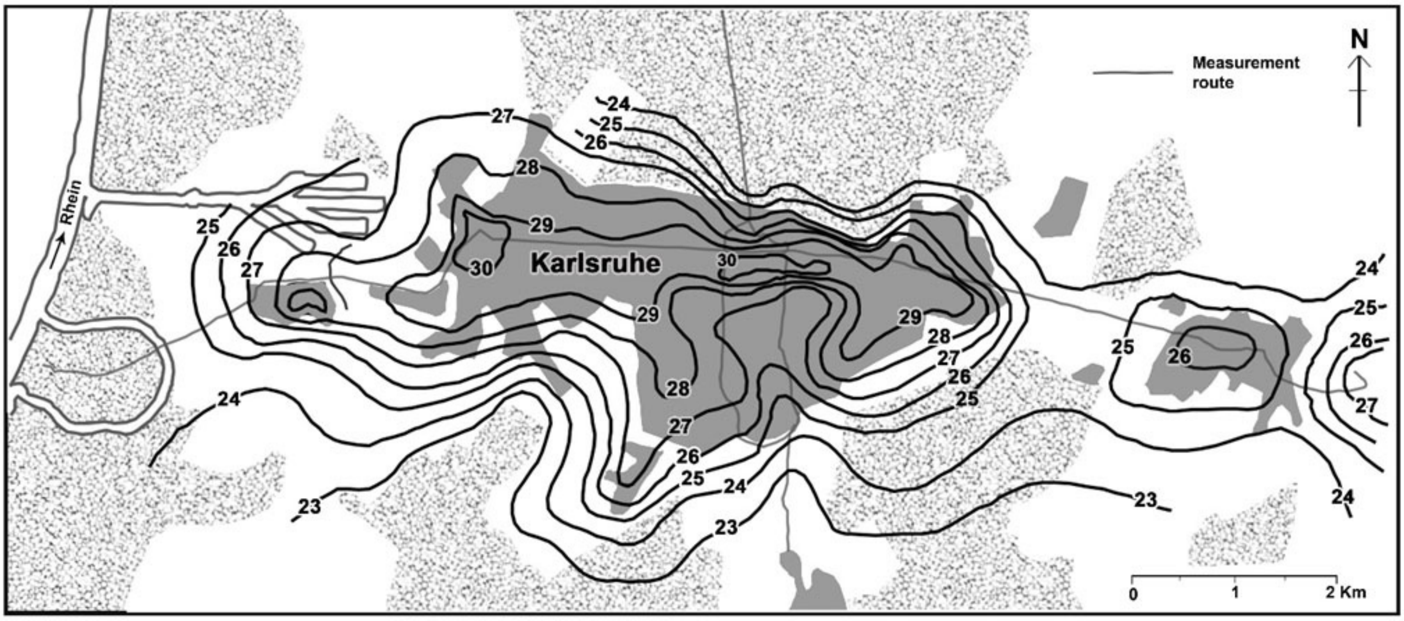

Figure 1. Albert Peppler's (1929) hand-drawn map of the canopy-layer heat island in Karlsruhe, Germany, on 23 July 1929, 19:00–22:00 hr. Together with Wilhelm Schmidt's (1927) isothermal maps of Vienna, Austria, these works are classics of the highest order for pioneering new methods to collect urban temperature data, and for coining an original term to describe the urban temperature effect. See Stewart (2019) for details. Redrawn from Peppler (1929).

air temperatures at or below the mean roof height of buildings (in the canopy-layer atmosphere; Oke [1976]). Third, only those studies that offer major theoretical, methodological, and/or regional advances in the field were eligible for inclusion. All studies meeting this third criterion pioneered a novel idea or approach, or otherwise made a lasting contribution to the body of knowledge that defines "local (urban) meteorology and climatology."

Sampling the modern literature

A sample of 75 modern heat island studies was obtained for citation analysis. The studies were published in scholarly journals between 2000 and 2017, with the explicit aim to quantify – through instrumented observations – the nocturnal urban heat island effect in the canopy-layer atmosphere of a specified city or town.

Results

The urban heat island classics

After extensive review of 19th and 20th century urban climate literature, 40 heat island classics were identified for their outstanding contributions to the field (Table 1, Figure 1). From this literature, the following generalisations on heat islands of the canopy layer emerged:

- Heat islands occur in cities of any size
- Heat islands occur by differential heating and cooling in urban and rural areas
- Heat island magnitude varies with urban form, population density, industrial activity, land covering, surface wetness, rural soil type, synoptic weather, regional climate, time of day, and season of year
- Heat island magnitude increases with calm, clear and dry weather; its nighttime value exceeds that of the day, and its mid-latitude value exceeds that of lower latitudes
- Heat islands are sometimes manifest as "cool islands" during the day
- Heat islands raise the daily minimum air temperature in cities, and lower the diurnal temperature range
- Heat islands contain "thermal zones" coinciding with the city core (warmest), the area surrounding the core (cooler), and the area surrounding the city (coolest)
- Heat islands have practical implications for weather forecasting, land-use planning, human health, urban design, and urban agriculture

Citation frequencies in the modern literature

In nearly one-half of the modern sample studies (31 of 75 studies), none of the 40 heat island classics is cited. Moreover, of the total 2331 citations related to climates and/or human settlements in the modern sample, only 4% (or 92 citations) are linked to the classic work, while less than 10% are linked to historical work of any kind. The modal class (by author) for the 92 classic citations is Tim Oke (1973, 1976) with 35 citations, followed by Tony Chandler (1965) with 10,

Table 1. The urban heat island classics and their citation frequencies in a sample of modern heat island studies (*N* = 75). Table ordered by year of publication. Review and full bibliography of the classic works is provided in Stewart (2019).

Author name	Year of publication	Language of publication	City or region studied	Citation frequency
L. Howard	1833	English	London (U.K.)	8
É. Renou	1868	French	Paris (France)	1
J. Hann	1885	German	Europe, India, USA	0
M. Moreno	1899	Spanish	Mexico City (Mexico)	0
W. Hammon & F. Duenckel	1902	English	St. Louis (USA)	0
W. Schmidt	1927	German	Vienna (Austria)	1
A. Treibich	1927	German	Berlin (Germany)	0
A. Peppler	1929	German	Karlsruhe (Germany)	0
C. Brooks	1931	English	Springfield (USA)	0
L. Besson	1931	French	Paris (France)	0
K. Sasakura	1931	Japanese	Tokyo (Japan)	0
A. Budel & J. Wolf	1933	German	Munich (Germany)	0
H. Berg & H. Metzler	1934	German	Hanover (Germany)	0
W. Middleton & F. Millar	1936	English	Toronto (Canada)	0
E. Fukui & N. Wada	1941	Japanese	Tokyo, Osaka, Nagoya (Japan)	0
W. Balchin & N. Pye	1947	English	Bath (U.K.)	0
Å. Sundborg	1951	English	Uppsala (Sweden)	5
F. Duckworth & J. Sandberg	1954	English	San Francisco (USA)	7
E. Einarsson & A. Lowe	1955	English	Winnipeg (Canada)	1
H. Shitara	1957	Japanese	Hiroshima (Japan)	0
M. Takahashi	1959	Japanese	Ogaki, Kumagaya (Japan)	0
T. Chandler	1960	English	London (U.K.)	0
I. Kayane	1960	Japanese	Tokyo (Japan)	1
T. Sekiguti	1963	Japanese	Ogaki (Japan)	0
T. Kawamura	1964	Japanese	Kumagaya (Japan)	0
T. Chandler	1965	English	London (U.K.)	10
S. Nieuwolt	1966	English	Singapore	3
K. Nakamura	1966	Japanese	Nairobi (Kenya)	1
E. Fukui	1968	Japanese	Japan	0
F. Ludwig	1970	English	Dallas (USA)	2
Y. Goldreich	1970	English	Johannesburg (South Africa)	1
S. Sham	1972	English	Kuala Lumpur (Malaysia)	0
C. Daniel & K. Krishnamurthy	1973	English	Pune, Mumbai (India)	2
E. Jáuregui	1973	English	Mexico City (Mexico)	4
T. Oke	1973	English	St. Lawrence Lowland (Canada)	26
T. Oke & G. Maxwell	1975	English	Vancouver, Montreal (Canada)	10
T. Oke	1976	English	Vancouver (Canada)	9
F. Hannell	1976	English	Quito (Ecuador)	0
S. Bowling & C. Benson	1978	English	Fairbanks (USA)	0
H. Landsberg	1979	English	Columbia (USA)	0

Oke and Maxwell (1975) with 10, Luke Howard (1833) with 8, Duckworth and Sandberg (1954) with 7, and Åke Sunborg (1951) with 5 (Table 1). All other classic authors are cited fewer than 5 times by the 223 contributing authors of the modern sample.

Discussion

The forgotten classics: Causes of historical ignorance

I consider four causes of historical ignorance in modern heat island studies (note: my use of the word *ignorance* is not meant to be pejorative, but rather to convey a general *unawareness* of history among heat island workers). The first cause is rooted in the sociology of science. Sciences, more so than the humanities, build upon recent contributions in the field. This is the selective accumulation of knowledge in science and it is deliberately short-sighted so that progress can be efficient and effective. Added to science's "memory loss" are problems of communication, namely barriers to language and literature access (Smith, 1981). If historical documents cannot be retrieved, read, and understood, they will not be cited. These problems are paramount to contemporary heat island workers because many of the classics were printed in sources not widely distributed or indexed, and in languages not understood by all researchers today. Facing these barriers, workers (in the main) rely on the common practice of "lifting" historical references and digital titles from one study to another, without ever having to read or reflect critically on the content of the work. When passed from one generation of workers to the next, the habit of citation lifting shortens a community's collective memory of its own history and its contribution to science.

The second cause of historical ignorance is that all scientific papers pass through a lifecycle of citation frequencies as they age and their topics mature. The number of citations received by a paper tends to peak several years after publication, followed by a long period of citation decay and eventual "death" (Aksnes, 2003). Many high-quality papers eventually succumb to the phenomenon of "obliteration," which occurs when a scientist's work from the past becomes so bounded up in its accepted paradigms that it is no longer cited (Merton, 1968). For the heat island classics, problems of obsolescence, obliteration, literature access, and end of citation lifecycle are coincident and compounding. This can lead to problems of biased citing or excessive self-citation, or to poor judgement of scientific progress by workers not close to the subject or its history (MacRoberts and MacRoberts, 1989).

The third cause is the overriding pressure for all scholars to publish their work lest they perish in job searches, grant applications, and career promotions. This publish-or-perish system emphasises research quantity over quality, and it leads to overspecialisation of topics and fragmentation of papers and journals (Maienschein, 2000; Gad-el-Hak, 2004). Oversupply of literature has been noted in science for many decades: Glass (1955), for example, went so far as to describe the "flood" of published scientific research as "a grave threat to the international character of science and the integration of scientific knowledge." His point is perhaps overstated but its essence is valid: with more output of material – and less time to absorb it – researchers are faced with the impossible task of comprehensive reading (and careful citing) of scholarly work.

The final cause of historical ignorance relates to the influx of new skills, technologies, and scholarly backgrounds to the field of urban climatology. This is owed partly to the fashionable nature of the urban heat island, and to the perception that heat islands are relatively simple phenomena (Oke, 2009). Admittedly, the arrival of external specialists and technologists to heat island studies has benefited the field immensely, bringing new capacity and clarity to our understanding of the phenomenon, and helping to bridge urban climate science with urban design and land-use planning. However, it has also brought a degree of indifference toward the complexities of heat island causation, observation, and experimentation, mainly with issues of scale, measurement, definition, and communication. In many heat island studies, a careful review and examination of the historical literature is avoided, meaning that "new" output is divorced from its own history. Evidence of this problem is most obvious in published articles (or submitted manuscripts) with sloppy literature reviews, unsupported claims to "novel" outcomes, and irrelevant, inappropriate, or unverifiable citations.

Lessons from the past: The need for historical thinking

In a prior assessment of the modern heat island literature, I reported that nearly one-half of heat island magnitudes in a sample of 190 studies (published between 1950 and 2007) were scientifically indefensible (Stewart, 2011). I have met this same outcome in the work at hand, using a smaller but more recent sample of 75 heat island studies (published between 2000 and 2017). This raises a difficult but valid question: Is our ignorance of history to blame, in part, for the recurrence of low-quality heat island observations in the modern literature? To frame a response, I revisit the contributing factors to the low-quality outcomes in the literature, and relate those factors to the intellectual content of the historical classics.

The first contributing factor relates to two areas of universal weakness: controlled measurement and openness of method (Stewart, 2011). Workers who do not control their temperature measurements for the confounding influences of weather, soils, relief, and water bodies cannot properly discriminate an urban effect. Fewer than 30% of modern investigators adequately control their heat island measurements for a proper urban effect. Furthermore, 50% of investigators seem unaware of historical work related to controlled measurement: many of the classic authors openly discussed the interference of non-urban effects on observed heat island magnitudes, and in some cases successfully regulated those effects through manipulative experiments.

Openness of method is a second area of universal weakness in the modern heat island literature. This involves the communication of metadata on instrumentation (e.g., type, accuracy, shielding), observing practices (times, locations), site exposure (aspect ratios, sky view factors), land cover (wetness, pervious fraction), and heat sources and sinks (Aguilar et al., 2003; Oke, 2004). In the modern literature, 75% of investigators fail to communicate these basic metadata for the temperatures used to quantify heat island magnitude. In contrast, communication of site metadata was common practice among the classic authors of the historical period – a practice that helps to convey the suitability (or spatial representativeness) of measurement sites for heat island studies.

A serious problem to arise from poor communication of metadata is that locally representative sites for temperature measurement and heat island assessment cannot be identified. This is a second contributing factor to the low-quality outcomes in recent heat island literature. Unrepresentative siting is a major pitfall in modern heat island work, with nearly 80% of workers using measurement sites of low, inappropriate, or unknown spatial validity. The classic workers confronted this problem head-on, exchanging ideas and practices to find representative sites for deploying meteorological instruments. Many of the workers were creative and constructive thinkers on the issue of representative siting, exchanging ideas to improve the measurement standards and quality of data in urban temperature studies.

Evaluating modern progress

To fully evaluate progress in modern heat island studies, one must consider the purpose for conducting such a study. The motivation today has shifted from what it was in the historical period, when workers sought to observe heat islands in all cities, and to describe the causes of their effects. Case studies with this same purpose today serve mainly local interests, although exceptions exist. Progress is more likely to come with increases in data resolution and advances in technology, as history shows us, but this too is limited because heat islands will always be observable with only a basic thermometer. Workers should therefore be cautious with modern technology and with calls for increasingly large datasets. These calls are often supported by opportunistic arguments: the data exist, or technology allows them to exist, and so we are compelled to use them. Instead, workers might first improve the quality of their data (and then the quantity) by learning from the practices and attitudes in the classic literature (Table 1), and the guidelines, frameworks, and recommendations in the modern literature (e.g., Oke, 1976, 2004, 2006, 2009; Lowry, 1977; Goldreich, 1984; Wanner and Filliger, 1989; Aguilar et al., 2003; Peterson and Owen, 2005; WMO, 2008; Stewart, 2011; Stewart and Oke, 2012). Progress can then be measured not only by the development and use of methodological standards, but also by the effective transfer of heat island data to robust planning tools (e.g., Ng and Ren, 2015; Lindberg et al., 2018) and design guidelines (e.g., Ng, 2012) for urban heat mitigation, ecological protection, and climate change adaptation.

However, most contemporary researchers have not engaged the classic work beyond a brief encounter with its bibliographic record, mainly for barriers to literature access and for hurried attitudes to scholarly publication. Outcomes are consequently being repeated in ways that lack scientific impact, with researchers meeting independent "discoveries" that are merely "rediscoveries" of previous (i.e., unknown) work. Research participants therefore need to be aware of subject history, and especially of preceding pathways to discovery. While our knowledge of heat island patterns and processes is today highly sophisticated—supported by innovative uses of modern technology and by collections of literature that are geographically rich—the methodological rigor in heat island observations has not kept pace with these parallel advances, nor has the delivery of reliable heat island data to whom and where it is needed most. The opportunity to extract lessons from the heat island classics, and to move the field beyond its most serious methodological challenges, has so far been missed.

Recommendations for change: Reviving the field

I offer five recommendations to instigate greater awareness of the heat island classics. These recommendations inspire basic changes to our system of scholarship in urban climatology, beginning with shifts in the habits of individual workers, namely those who have a hand in the publication of research materials, and extend to the actions of institutions that disseminate that material.

1. Read before citing. This may seem like a humbling request, but it is not. Urban climate researchers today are under pressure to publish their work and to use technological rather than philosophical approaches to identify and solve problems. This leaves little time or interest for reading of historical literatures. When balanced with original and experimental thinking, historical literacy can enable the distinguished success of an urban climate scientist.

2. Acknowledge original thinkers in the field. Researchers should acknowledge original thinkers who were involved in the process of discovery relevant to their current work. The usual practice of citing very recent work, or one's own work, or that of a colleague or well-known scholar in the field (rather than the original thinker) serves a dubious purpose. If the original thinkers are not known to the citing author, a search to identify them should be attempted.

3. Increase the call for historical papers. Calls for journal papers in science are usually inspired by topics that are fashionable or associated with cutting edge technologies. While such calls are mostly warranted, scholars sometimes "latch on" to these topics only to expedite a publication agenda. This practice tends to overshadow the history of research on a topic, such that foundational views are forgotten, despite their importance to inform and educate modern workers. For example, although current discussions in urban climatology around the use of crowd data are helping to increase the spatial and temporal resolution of heat island measurements (which is needed for some applications), these discussions could benefit from an influx of past viewpoints on instrument siting and disclosure of site metadata. Journals should therefore call for papers to celebrate the heat island classics and their achievements that remain relevant today.

4. Make the classics publicly available. Each of the first three recommendations is dependent upon the success of the fourth, which is the fundamental task of institutions. For heat island researchers to read primary materials and revisit foundational views, they first need to retrieve the historical literature. Scholarly societies and professional associations should make the classics publicly (and electronically) available at no cost to the user. The *International Association for Urban Climate* (IAUC) is the ideal body through which to gather and disseminate this work, and that process has begun: the IAUC provides free access on its website to re-published texts of Howard (1833), Kratzer (1956), and Chandler (1965). Other classic texts should be added to the IAUC website, along with commentaries and English translations that relate the work to modern activities in the field.

5. Reduce the emphasis on literature quantity. It has become increasingly common for young scholars (e.g., graduate students, junior faculty) to publish their work with hurried perspective. This problem is both a cultural and institutional one, and is encouraged partly by the proliferation of open-access publishers who solicit and accept the work for a fee, but who do not enforce stringent reviews of that work (Beall, 2013). Reducing literature quantity may not be a popular request, but it can be met without any loss to modern progress or scientific impact in the field. Editors and reviewers can help to alleviate the perceived need for rapid research and publication by ensuring that accepted manuscripts meet rigorous standards for methodological quality, novelty of outcomes, conceptual advances, *and* historical motives.

Concluding the matter

Despite the abundance of heat island studies published in the modern literature, very few of these have been reported with experimental rigor or essential metadata. For its part, the classic literature has made unparalleled contributions to urban climatology, and it has done so with eloquence, consequence, and deference to the admired successes of a small scientific community. This exposes an unfortunate paradox in the urban climate literature: the classic works that are so necessary to teach and inspire new generations of urban climate researchers, and to set historical benchmarks for modern progress in the field, are hardly accessible and almost entirely forgotten. It is now the responsibility of individuals and institutions to revive the classics and to involve historical and philosophical perspectives in the search for modern solutions. In this process, we must not forget the distinguished role of a scientist to produce good (even if scarce) data, and to gain critical (even if limited) knowledge of history.

Acknowledgements

I thank Professor Tim Oke (University of British Columbia, Canada), who involved me for many years in discussions on the history and methodology of urban heat islands. I also thank Professor Gerald Mills (University College Dublin, Ireland) for inspiring this paper and commenting on its text. This research was funded by the Global Cities Institute at the University of Toronto, Canada.

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Analysis of the spatial distribution of urban cold-air paths using numerical modelling and geospatial methods

This article summarizes a recently published paper and related work:

Grunwald L, Kossmann M, Weber S (2019) Mapping urban cold-air paths in a Central European city using numerical modelling and geospatial analysis. *Urban Climate* 29, 100503. DOI: 10.1016/j.uclim.2019.100503

Introduction

Urbanization leads to an increase in impervious surfaces and artificial building materials, both of which influence heat and mass transfer between the earth surface and atmosphere. The urban heat island (UHI) is a prominent phenomenon mainly resulting from the modified urban surface energy balance (Landsberg 1981, Oke, 1982, Oke et al., 2017).

To decrease UHI related excess heat load and ensure thermal comfort of residents, different methods for mitigation and adaption exist. One planning-based approach is the implementation of urban cold-air paths, i.e. low-roughness open areas that support cold-air drainage or transport from rural into urban areas (Mayer et al., 1994). Cold-air flows can be induced either by thermal urban-rural differences (local pressure differences) or by drainage in hilly terrain (local buoyancy forces, e.g. Blumen et al., 1999; Mahrt et al., 2001). As a result, they are prevalent during clear and calm nights, which are characterized by low cloud cover and low wind speeds (Stewart et al., 2002; Vogt, 1997; Hartenstein, 2000).

Different methods to identify cold-air paths in urban areas have been reported. These can be classified into empirical methods such as wind tunnel tests (e.g. Bächlin and Theurer, 1995), measurements of wind velocity and direction, or tracer experiments (e.g. Arnfield and Mills, 1994). Mayer et al. (1994) established a method to identify ventilation paths by defining thresholds for aerodynamic roughness length and geometrical properties (length, width). Furthermore, the use of morphological parameters in combination with geoinformation systems (e.g. Gal and Unger, 2009; Suder and Szymanowski, 2014; Wicht et al., 2017) and numerical modelling (Chang et al., 2018; Ng et al., 2011) are used for identification of cold-air paths.

Despite different identification methods, the spatial connectivity between cold-air reservoir areas (production) and warm urban areas (impact) has not yet been considered as a criterion in scientific literature. Additionally, efficiency assessments of urban cold-air paths regarding cold-air volume, magnitude of cold-air production or impact area were not included. However, an efficiency classification helps to prioritize cold-air paths and supports decision-making in urban planning.

Data and Methodology

Study area and KLAM_21 model description

The city of Braunschweig, Northern Germany (250,000 inhabitants, 52°16'28 N, 10°30'38 E, Köppen-Geiger climate Cfb), was chosen as study area. It comprises a city area of 192 km² with a built-up surface fraction of 23%. The lowest ground elevation is 62 m above sea level (asl), the highest reaches 111 m asl.

The simulations of cold-air transport were performed using the two-dimensional (single-layer) numerical cold-air drainage model KLAM_21 of the German Meteorological Service (DWD, Sievers, 2005; Sievers and Kossmann, 2016). Temporal and spatial distribution of cold-air flows driven by differential cooling at the earth surface during clear and calm nights were simulated. The model outputs the spatial distribution of the height of the cold-air layer, its heat deficit, mean flow velocity and direction. Terrain heights and information on land use are needed as input data. Each land use class is assigned with specific roughness, morphometric and thermal properties. KLAM_21 applies the nocturnal surface energy balance to estimate the near-surface cold-air production by using a local heat loss rate of the surface types to calculate the vertically integrated heat deficit of the cold-air layer (COCA, quantified in J m^{-2}), which was used for further analysis in this study.

The study area is classified into an equidistant grid (1651 X 1951 cells) of 10 m horizontal resolution. A land use classification, a ground elevation map derived from airborne laser scanning with 1 m resolution and a 3D building model of Braunschweig (geodata was available from the Environmental Agency of the city administration) were used as input parameters. We used a simulation period of eight hours with a predefined start of the simulation set to shortly before sunset.

Identification of POTCAIR and CARA

In this study cold-air paths are defined as open areas with low surface roughness which connect cold air reservoir areas (CARA, areas in which cold-air is accumulated due to cold-air production and/or inflow), with urban cold-air impact regions (CAIR, Fig. 1a). We distinguish between potential cold-air impact regions (POTCAIR, warmer areas of the city, where cold-air is needed) and

CAIR, which are actually reached by cold-air flow. The surface area of CARA and CAIR and the area connecting both are defined as cold-air path.

Simulation results of COCA were used to identify POTCAIR and CARA. First, the hourly output of COCA estimates were standardized, i.e. $z = (x-\mu)/\sigma$ where z is the standardized value of COCA, x is the raw score of COCA, μ is the spatial mean of the population and σ is the spatial standard deviation. Subsequently, thresholds for the upper and lower 15 percentile were used to identify the spatial distribution of CARA and POTCAIR. Hence, negative z scores (indicating areas with little cooling) below the threshold were defined as POTCAIR, and positive z scores (indicating areas with strong cooling) above the threshold as CARA.

Identification of cold-air paths

Information on the flow field is necessary to determine the spatial distribution of cold-air paths (connectivity between CARA and POTCAIR). We used a trajectory approach by calculating the path of a simulated particle from a point source through a velocity field (Konikow and Bredehoeft, 1978; Tauxe, 1994). Simulated wind speed and direction of KLAM_21 were vector averaged for the simulation timespan and used to generate the flow field. Therefore, the tool "Particle Track" (ArcMap Software, 10.4) was used to calculate trajectories (polylines) with each grid cell of CARA functioning as a point source. Resulting trajectories were aggregated to a 100 m grid raster, defining every grid cell as a cold-air path if at least one trajectory crossed it. The areas of POTCAIR, which overlap with cold-air paths. are defined as CAIR. Cases in which cold-air paths had overlapping boundaries were separated subjectively.

To evaluate the results of our study, a recent urban climate analysis of Braunschweig (GEONET, 2017) was used for comparison. The climate analysis is based on a numerical simulation using the three-dimensional model FITNAH 3D (Groß et al., 1996) which runs with a horizontal resolution of 10 m and needs land use and elevation data as input, similar to KLAM_21 input.

Efficiency classification

Efficiency classification was based on spatial properties of the paths by defining the following criteria:

(1) surface area of CARA,

(2) surface area of cold-air path,

(3) cold-air volume of CARA, i.e. surface area times cold-air layer height (CAV),

(4) cold-air volume of cold-air path,

(5) surface area of CAIR

(6) effective cold-air volume (CAV) change in CAIR ($CAV_{End\ of\ simulation}$-$CAV_{Start\ of\ simulation}$).

For each criterion a ranking order is estimated, e.g. for a set of 7 cold-air paths the path with the largest CARA surface area (criteria 1) would be valued at rank 7, and the path with the lowest surface area at rank 1. Subsequently, the ranks for all six criteria are summed up. Cold-air paths with the highest overall ranks are considered as most efficient and could be prioritized in urban planning processes.

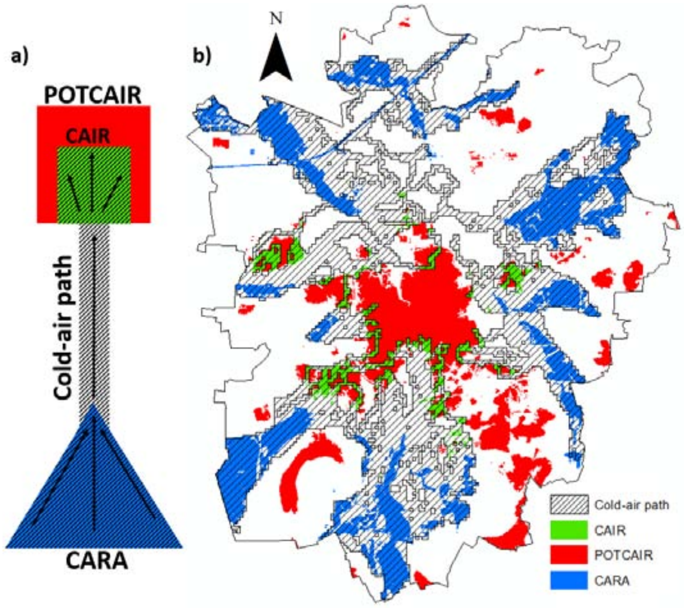

Figure 1. Concept of cold-air path definition, where cold-air reservoir areas (CARA, blue) are connected to potential cold air impact regions (POTCAIR, red) via cold-air paths (striped areas). The area that is reached by cold-air flow is defined as cold-air impact regions (CAIR, green) (a). Overview of identified CARA, POTCAIR, CAIR and cold-air paths in the city area of Braunschweig (b).

Results

POTCAIR and CARA were analyzed based on the simulated heat deficit in the cold-air layer (COCA, see Fig. 2). Their spatial distribution and resulting cold-air paths are depicted in Fig. 1b. CARA are mainly situated in less sealed and more rural locations, near water bodies and in areas of lower surface elevation. POTCAIR can be found in the built-up areas, especially in the dense inner city.

In total, 8 cold-air paths were identified (Fig. 3a) with cold-air flow mainly directed toward the city core. The cold-air paths differ strongly in their properties with regards to the efficiency classification (Table 1) and are characterized by different widths (0.8 – 3.4 km), lengths (2.4 – 8.5 km), surface areas (1.7 – 18.0 km^2) and cold-air volumes (0.04 – 0.53 km^3). In general, higher efficiency ranking of cold-air paths results from greater surface area and a larger cold-air volume.

In a recent climate analysis, 13 cold-air production areas (vegetated spaces with a high cold-air flow volume) and cold-air paths (1-13, Fig. 3b) were identified

(GEONET, 2017). Except for production area 9 all paths are situated within a 100 m distance to CARA. Several cold-air production areas from the FITNAH 3D model study can be related to a CARA (e.g. 2 and 3 to VIII, Fig. 3). The spatial distributions of cold-air paths in both studies are in agreement.

Discussion

CARA, POTCAIR and cold-air paths

The identification of CARA and POTCAIR in combination with trajectory analysis represents a new methodological approach to map the spatial distribution of cold-air paths. The identified locations of CARA and POTCAIR are reasonable. CARA are mainly located in non-built and rural areas with lower ground elevation in which cold-air production and accumulation are promoted.

The comparison of our results with the climate analysis of Braunschweig (GEONET, 2017) documented overall agreement in terms of location and distribution of cold-air paths. Also in comparison to previous studies, similarities can be detected. Mayer et al. (1994) defined ventilation paths to have a width of at least 50 m and a length of 1 km. These criteria are clearly met for all cold-air paths in the present study. Our method primarily identifies larger cold-air paths due to the spatial connection between CARA and POTCAIR as one important criterion. Mayer et al. (1994) further proposed that obstacles should be < 10 m, and their width < 10 % of the ventilation path width. Our results differ from these criteria, because ventilation paths might be identified in areas with larger aerodynamic roughness, e.g. residential areas. Possibly, the criteria of Mayer et al. (1994) are too strict as our results indicate that sufficient cold-air flow is possible in regions with higher roughness.

Benefits of the introduced methodology

With the present approach, urban cold-air paths can be identified and assessed. Similar methods to identify urban ventilation paths were reported previously (e.g. Chen et al., 2016; Gal & Sümeghy, 2007; Gal & Unger, 2009; Suder & Szymanowski, 2014; Wong et al., 2010). However, in our study we applied airflow trajectory analysis to determine the connectivity between cold-air reservoir areas (strong cold-air production or inflow) and areas with a deficit of cold air (impact). Furthermore, the classification of the efficiency of cold-air paths is a benefit, which has not been considered in similar studies. The additional information of CARA and POTCAIR alongside the efficiency assessment might support decision-making and urban planning. By identification and prioritization of urban cold-air paths, planners can assure that these paths will be protected from further development. Planners can apply the overall ranking based on multiple criteria and provide an integrated assessment of cold-air

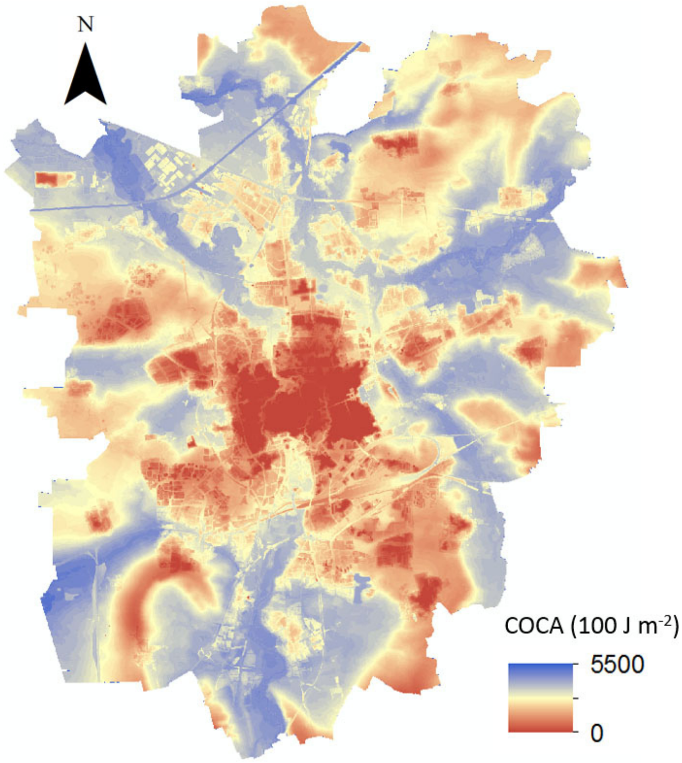

Figure 2. Average distribution of COCA (integrated over the 8 simulated hours) from the simulation results of KLAM_21.

Table 1. Criteria for classification of the 8 cold-air paths (I – VIII). The last column shows the resulting ranking order. The higher the score, the higher the efficiency of the cold-air path. (CAV: Cold-air volume)

	Area CARA [km^2]	Area cold-air path [km^2]	CAV CARA [km^3]	CAV cold-air path [km^3]	Area CAIR [km^2]	CAV difference CAIR [km^3]	Overall ranking order
I	6.4	15.4	0.23	0.51	0.4	0.30	**36**
II	0.5	6.6	0.02	0.16	1.8	0.45	**24**
III	0.3	1.7	0.01	0.04	0.5	0.09	**9**
IV	3.8	7.6	0.14	0.23	1.7	0.48	**33**
V	5.4	18.0	0.19	0.53	2.4	0.77	**44**
VI	1.8	5.3	0.06	0.16	0.6	0.13	**22**
VII	1.5	5.2	0.05	0.15	1.1	0.37	**20**
VIII	5.9	11.0	0.21	0.37	0.1	0.05	**28**

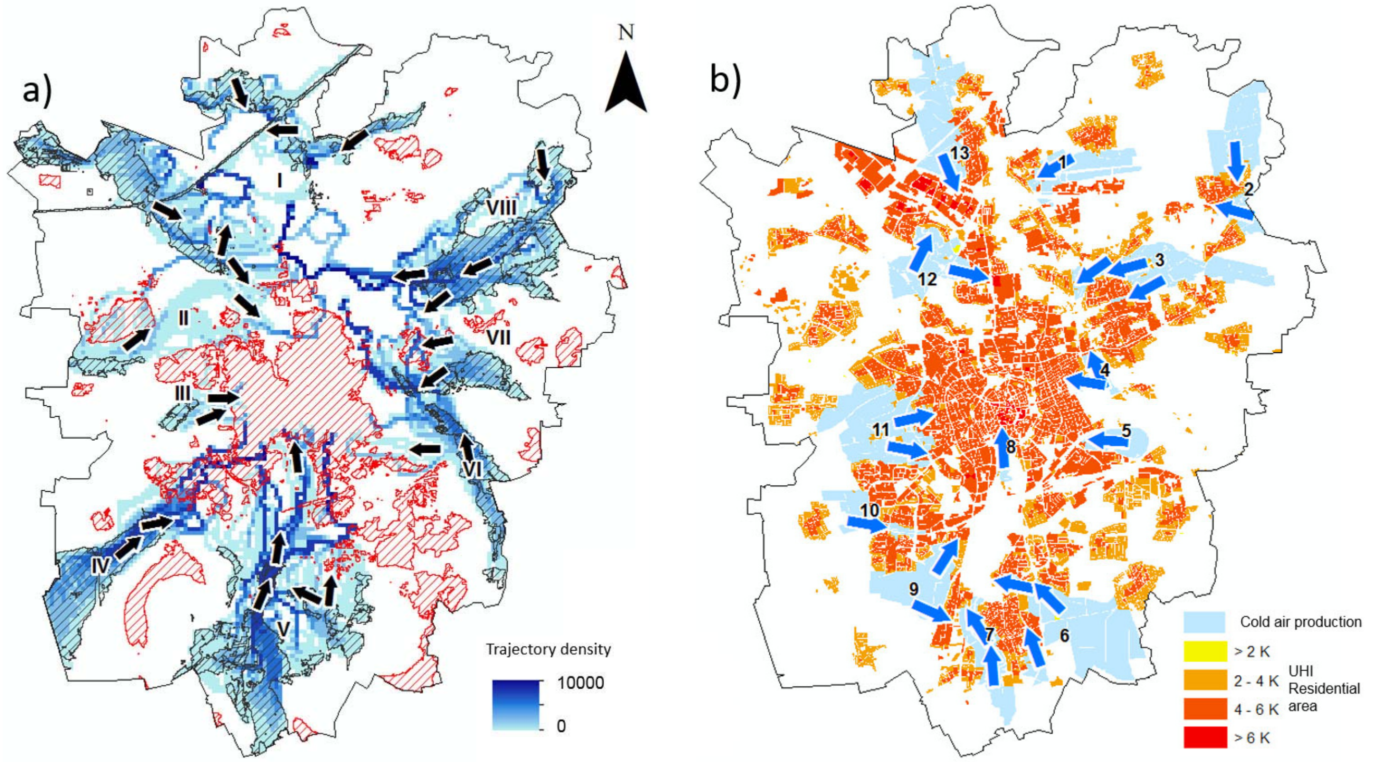

Figure 3. Spatial distribution of cold-air paths (blue, I – VIII) (a). Blue colors indicate the trajectory density per raster cell. Arrows indicate the prevalence of cold-air flow direction (arrows were placed subjectively but represent the predominant wind direction). CARA are outlined in striped dark grey, POTCAIR in striped red. For comparison purposes, results of urban climate analysis (GEONET, 2017) are shown (b).

path efficiency. However, they also might prioritize cold-air paths by using single criteria in cases in which these are thought to be most relevant for the specific planning purpose, e.g. cold-air volume.

Conclusion and future work

In the present study a method to identify urban cold-air paths to assess their efficiency is proposed. City planners and environmental authorities might benefit from this method, as its helps to prioritize cold-air paths and supports decision-making in planning-based urban heat island mitigation.

Future work will focus on the identifications of predictors for cold-air path occurrence such as land use and morphological properties. For example machine-learning techniques, such as boosted regression trees can be considered to estimate the spatial distribution of cold-air paths and quantify the most important predictor variables for cold-air path occurrence.

Acknowledgements

The study was funded by MWK Lower Saxony Niedersächsisches Vorab as part of the collaborative project “METAPOLIS – an inter- and transdisciplinary research platform for the sustainable development of urban-rural relations”, funded by the Federal State of Lower Saxony (Grant No. ZN3121). The geodata of the urban climate analysis of Braunschweig (GEONET, 2017) used in this study was kindly provided by the Environmental Protection Department of the city administration of Braunschweig, Germany. We thank Dipl.-Ing. M. Sc. Thomas Gekeler and Dipl.-Geogr. Andreas Bruchmann (Environmental Agency, City of Braunschweig) for providing the data.

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"ZeroPlus Energy Settlements" envisioned at the 6th Jeffrey Cook Workshop in Desert Architecture

Buildings and settlements are increasingly expected to meet higher levels of performance: they should be sustainable, use zero-net energy, and be healthy and comfortable yet economical to build and maintain. Improving the energy performance of the building stock is crucial, not only to achieve the targets of EU 2020, but also to meet the longer term objectives of the climate strategy as laid down in the low carbon economy roadmap 2050.

The aim of the Horizon2020 "ZERO-PLUS" project is to search for designs that meet these expectations. Towards this goal, a comprehensive, cost-effective modular system for Net Zero Energy (NZE) settlements has been developed and implemented in a series of case studies across Europe covering different geoclimatic regions – Cyprus, Italy, France and the UK.

In ZERO-PLUS, the challenge of significantly reducing the costs of NZE settlements is achieved through the implementation of three parallel strategies:

- Increasing the efficiency of the components directly providing the energy conservation and energy generation in the NZE settlement.
- Reducing the "balance of system" costs through efficient production and installation processes.
- Reducing operational costs through better management of the loads and resources on a district scale rather than on the scale of a single building.

The project aims to achieve an annual Operational Energy use of less than 20kWh/m^2 and energy production from Renewable Energy Sources of at least 50kWh/m^2, and an overall Investment Cost Reduction of at least 16% compared to conventional nearly Zero Energy Buildings. To date three of the four case studies have been constructed and monitored, and are surpassing the targets set.

Progress on this project, and the challenge of zero-energy settlements in general, provided the focus for a two-day International Workshop that was held at the Marcus Family Campus of Ben-Gurion University of the Negev on November 25-26 in Beer-Sheva, Israel. Speakers from Australia, Canada, Cyprus, Greece, Israel, Italy, Luxemburg, The Netherlands and the UK included partners in the ZERO-PLUS consortium, as well as other acknowledged authorities in the fields of Zero Energy Buildings, sustainability and construction, assessment tools, principles and practices.

Prof. Isaac Meir (left) presented the Jeffrey Cook Prize to Archs. Tanya Saroglou and Arie Rahamimoff (right).

The event was held within the framework of the Jeffrey Cook Workshop in Desert Architecture, a biennial event commemorating Prof. Jeffrey Cook, a pioneer of sustainable architecture. The Workshop traditionally includes the award of the Jeffrey Cook Prize to outstanding professionals and academics who have made a significant and sustained contribution, and this year's prize was awarded to Archs. **Arie Rahamimoff** for his lifetime contribution to environmentally responsive architecture in Israel, and **Soultana-Tanya Saroglou** for her outstanding PhD research on "Design Strategies Towards more Energy Efficient High-rise Buildings".

Attendance reached approximately 80 people over the two days, and included the Chief Architect and senior staff members of the Israel Ministry of Construction and Housing, as well as academics, undergraduate and research students, and professionals, including overseas participants.

The Workshop's second day was closed by a Round Table which brought together representatives of the Ministries of Construction and Housing; National Infrastructure, Water and Energy Resources; Environmental Protection; the Chief Planner of the District Planning and Building Committee, Ministry of Finance, Southern District; the Ministry of Defense – IDF; the Israel Green Building Council; and the Association of Green Building Consultants. Each of the speakers was asked to address questions on the potential of implementing concepts and practices towards Zero Energy Settlements, as well as the current barriers to success.

We take this opportunity to thank all those who contributed to the success of the Workshop, first and foremost the speakers for their efforts and significant contribution. The event was organized under the auspices of the Jeffrey Cook Charitable Trust, in collaboration with the ZeroPlus Consortium, the Israel Green Building Council – ILGBC, BGU Green Campus, and BGU VP for R&D.

— Prof. Isaac A. Meir and Dr. Shabtai Isaac, Workshop Chairs

Urban Climate News: A brief review of the last 18 months

Following our custom here at *Urban Climate News*, the time has come for a short recap of contributions made to our pages in the last year and a half (previous 18-month reviews can be seen in the June 2009, December 2010, June 2012, December 2013, June 2015, December 2016, and June 2018 issues).

First of all, great thanks are in order to our dedicated editorial staff: **Paul Alexander** ("In the News"), **Helen Ward** (Features and Urban Projects), **Joe McFadden** (Recent and Upcoming Conferences), and **Matthias Demuzere** (Compiler-in-Chief of the Bibliography Committe). These devoted volunteers are just the tip of the iceberg, which consists of countless contributors working day to day on research and other activities that eventually make their way to the newsletter. My special gratitude to IAUC President **Nigel Tapper** and Secretary **Andres Christen** for facilitating and encouraging the ongoing publication of the newsletter and indeed for ensuring the vitality of this worldwide urban climate network.

There is a sense that in the final months of the decade, we have seen a turning point in the way society relates to climate – and to our collective impact upon it. In this year's March issue we reported on the "Fridays for Future" climate strikes, which represent a generational shift in attitudes about the urgency of global climate change. With millions of young (and even not-so-young) demonstrators taking to the streets and city squares to demand that the decision-makers pay attention to the scientists, it is fitting that this month TIME magazine named as its Person of the Year the teenage climate activist who made the first lone strike (read more about Greta on page 2). As Nigel points out on page 1 of this issue with regards to Australia, the impacts of long-term warming trends on our cities are no longer vague or abstract, but extremely tangible. For the latest record-breaking examples, read about Sydney on page 10 and Jacobabad, Pakistan on page 11 – and I invite you to browse the News sections of our recent issues for many others that have been culled from the media in order to bring them to the attention of researchers and professionals.

In the tables that follow you will find listings of the diverse research endeavors that have been presented in these latest editions of the newsletter. As always, they demonstrate how award-winning students and other members of the IAUC community are taking the initiative to improve our knowledge of urban climatic phenomena and pave the way for more climatically responsive urban planning. As you go back to these Feature articles and Urban Project reports, take note of the Special Reports on the many conferences and other events which showcased this type of work, as well as the exceptional individuals like Wilhelm Kuttler and Janet Barlow who have been recognized by the IAUC Board for their outstanding contributions to the field.

Finally, best wishes to all for a year of fulfillment and creative vision in 2020.

— *David Pearlmutter, Editor*

Feature Articles	Author(s)	Issue
Similarity in the daily cycle of air temperature in a natural stone "city" and a human-made concrete city	Yuguo Li and Kai Wang	September 2018
A dedicated experiment to infer energetic and hydrological behaviours of an asphalt concrete parking lot	Jean-Martial Cohard et al.	December 2018
Estimating gross primary productivity with high spatial resolution satellite imagery over Minneapolis-St. Paul	David Miller and Joe McFadden	March 2019
The Effect of Micro-Scale Self-Shading Building Geometries on Wall Surface Temperatures	Rainer Hilland and James Voogt	June 2019
A comprehensive review of indoor thermal comfort in the tropics	Carolina Rodriguez and Marta D'Alessandro	September 2019
The relevance of history in contemporary urban heat island research	Iain Stewart	December 2019

Urban Project Reports	Author(s)	Issue
Rapid drop of surface temperature in urban terrain during rainfall: Physical representation and reduced models	Hamidreza Omidvar et al.	September 2018
Integrating Planning and Climate: A Collaborative Framework to Address Heat Vulnerability	Mariana Fragomeni et al.	December 2018
Stable stratification effects in a spatially-developing urban boundary layer	Vincenzo Sessa et al.	December 2018
Refinement of the roughness length for the WRF Model based on an understanding of Local Climate Zones	Pak Shing Yeung et al.	December 2018
Evaluation of uWRF Performance and Modeling Guidance Based on WUDAPT & NUDAPT UCP Datasets for Hong Kong	Michael Wong et al.	March 2019
Selection and application of appropriate thermal indices for urban studies	Andreas Matzarakis	March 2019
On the use of local weather types classification to improve climate understanding: an application in Toulouse	Julia Hidalgo and Renaud Jougla	June 2019
Call for Contributions to an Outdoor Thermal Comfort Database	Kevin Ka-Lun Lau et al.	June 2019
Cities in eastern China facing larger loss in sunshine hours than rural areas	Zhiying Song et al.	September 2019
Analysis of the spatial distribution of urban cold-air paths using numerical modelling and geospatial methods	Laura Grunwald et al.	December 2019

A major focus of the Special Reports in the past 18 months was ICUC-10 in New York City, which included a special session on the WUDAPT project, a tribute to Jason Ching, and a Town Hall meeting on "Diversity and Women in Urban Climate" – a prominent issue taken up by the IAUC since the conference.

Recent Urban Climate Publications

Aboelata A, Sodoudi S (2019) Evaluating urban vegetation scenarios to mitigate urban heat island and reduce buildings' energy in dense built-up areas in Cairo. *Building and Environment* 166 UNSP 106407.

Aboubakri O, Khanjani N, Jahani Y, Bakhtiari B (2019) The impact of heat waves on mortality and years of life lost in a dry region of Iran (Kerman) during 2005-2017. *International Journal of Biometeorology* 63 1139-1149.

Adaji MU, Adekunle TO, Watkins R, Adler G (2019) Indoor comfort and adaptation in low-income and middle-income residential buildings in a Nigerian city during a dry season. *Building and Environment* 162 UNSP 106276.

Ahn YJ, Sohn DW (2019) The effect of neighbourhood-level urban form on residential building energy use: A GIS-based model using building energy benchmarking data in Seattle. *Energy and Buildings* 196 124 - 133.

Al Senafi F, Anis A, Menezes V (2019) Surface Heat Fluxes over the Northern Arabian Gulf and the Northern Red Sea: Evaluation of ECMWF-ERA5 and NASA-MERRA2 Reanalyses. *Atmosphere* 10

Ao X, Wang L, Zhi X, Gu W, Yang H, Li D (2019) Observed Synergies between Urban Heat Islands and Heat Waves and Their Controlling Factors in Shanghai, China. *Journal of Applied Meteorology and Climatology* 58 1955-1972.

Arghavani S, Malakooti H, Bidokhti AA (2019) Numerical evaluation of urban green space scenarios effects on gaseous air pollutants in Tehran Metropolis based on WRF-Chem model. *Atmospheric Environment* 214

Aristodemou E, Arcucci R, Mottet L, Robins A, Pain C, Guo YK (2019) Enhancing CFD-LES air pollution prediction accuracy using data assimilation. *Building and Environment* 165 UNSP 106383.

Badas MG, Ferrari S, Garau M, Seoni A, Querzoli G (2019) On the Flow Past an Array of Two-Dimensional Street Canyons Between Slender Buildings. *Boundary-layer Meteorology*

Bahlali ML, Dupont E, Carissimo B (2019) Atmospheric dispersion using a Lagrangian stochastic approach: Application to an idealized urban area under neutral and stable meteorological conditions. *Journal of Wind Engineering and Industrial Aerodynamics* 193 UNSP 103976.

Baker ME, Schley ML, Sexton JO (2019) Impacts of Expanding Impervious Surface on Specific Conductance in Urbanizing Streams. *Water Resources Research* 55 6482-6498.

Bala R, Prasad R, Yadav VP (2019) Disaggregation of modis land surface temperature in urban areas using improved thermal sharpening techniques. *Advances in Space Research* 64 591-602.

Balogun IA, Daramola MT (2019) The outdoor thermal comfort assessment of different urban configurations within Akure City, Nigeria. *Urban Climate* 29 100489.

Bande L, Afshari A, Al Masri D, Jha M, Norford L, Tsoupos A,

In this edition is a list of publications that have generally come out between **August and November 2019**. If you believe your articles are missing, please send your references to the email address below with a header "IAUC publications" and the following format: Author, Title, Journal, Year, Volume, Issue, Pages, Dates, Keywords, URL, and Abstract. Important: do so **in a .bib format.**

Note that we are always looking for (young) researchers to join and contribute to the Committee. If you are interested to join or would like to receive more information, please let me know via the email address below.

Happy reading,

Matthias Demuzere
Chair IAUC Bibliography Committee
Ruhr University Bochum (Germany)
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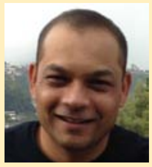
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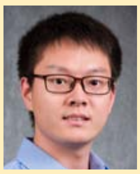
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Marpu P, Pasha Y, Armstrong P (2019) Validation of UWG and ENVI-Met Models in an Abu Dhabi District, Based on Site Measurements. *Sustainability* 11

Baniassadi A, Sailor DJ, Ban-Weiss GA (2019) Potential energy and climate benefits of super-cool materials as a rooftop strategy. *Urban Climate* 29 100495.

Bartesaghi-Koc C, Osmond P, Peters A (2019) Spatio-temporal patterns in green infrastructure as driver of land surface temperature variability: The case of Sydney. *International Journal of Applied Earth Observation and Geoinformation* 83

Baruti MM, Johansson E, Astrand J (2019) Review of studies on outdoor thermal comfort in warm humid climates: challenges of informal urban fabric. *International Journal of Biometeorology* 63 1449-1462.

Bayat R, Ashrafi K, Motlagh M-S, Hassanvand M-S, Daroudi R, Fink G, Kuenzli N (2019) Health impact and related cost of ambient air pollution in Tehran. *Environmental Research* 176

Bechtel B, Demuzere M, Mills G, Zhan W, Sismanidis P, Small C, Voogt J (2019) SUHI analysis using Local Climate Zones- A comparison of 50 cities. *Urban Climate* 28 100451.

Bender A, Freitas ED, Toledo Machado LA (2019) The impact of future urban scenarios on a severe weather case in the metropolitan area of Sao Paulo. *Climatic Change* 156 471-488.

Bokwa A, Geletic J, Lehnert M, Zuvela-Aloise M, Hollosi B, Gal T, Skarbit N, Dobrovolny P, Hajto MJ, Kielar R, Walawender JP, Stastny P, Holec J, Ostapowicz K, Burianova J, Garaj M (2019) Heat load assessment in Central European cities using an urban climate model and observational monitoring data. *Energy and Buildings* 201 53 - 69.

Bonatti M, Lana MA, D>Agostini LR, de Vasconcelos ACF, Sieber S, Eufemia L, da Silva-Rosa T, Schlindwein SL (2019) Social representations of climate change and climate adaptation plans in southern Brazil: Challenges of genuine participation. *Urban Climate* 29 100496.

Bonney MT, He Y (2019) Attributing drivers to spatio-temporal changes in tree density across a suburbanizing landscape since 1944. *Landscape and Urban Planning* 192

Cai H, Ma K, Luo Y (2019) Geographical Modeling of Spatial Interaction between Built-Up Land Sprawl and Cultivated Landscape Eco-Security under Urbanization Gradient. *Sustainability* 11

Campos FS, Rodrigues Sarnighausen VC, Riccardi CdS (2019) Outdoor environment management through air enthalpy analysis. *International Journal of Biometeorology* 63 1525-1532.

Cao B, Liu Q, Du Y, Roujean J-L, Gastellu-Etchegorry J-P, Trigo I, Zhan W, Yu Y, Cheng J, Jacob F, Lagouarde J-P, Bian Z, Li H, Hu T, Xiao Q (2019) A review of earth surface thermal radiation directionality observing and modeling: Historical development, current status and perspectives. *Remote Sensing of Environment* 232

Cao C, Dragicevic S, Li S (2019) Short-Term Forecasting of Land Use Change Using Recurrent Neural Network Models. *Sustainability* 11.

Cao L, Gao M, Li S, Yi Z, Meng X (2019) Sensitivity analysis of the dependence of the Carbon Bond Mechanism IV (CBM-IV) on the initial air composition under an urban condition. *Atmospheric Environment* 215

Chan SY, Chau CK (2019) Development of artificial neural network models for predicting thermal comfort evaluation in urban parks in summer and winter. *Building and Environment* 164 UNSP 106364.

Chapa F, Hariharan S, Hack J (2019) A New Approach to High-Resolution Urban Land Use Classification Using Open Access Software and True Color Satellite Images. *Sustainability* 11

Chauhan BP, Joshi G, Parida P (2019) Car following model for urban signalised intersection to estimate speed based vehicle exhaust emissions. *Urban Climate* 29 100480.

Cheung PK, Jim CY (2019) Differential cooling effects of landscape parameters in humid-subtropical urban parks. *Landscape and Urban Planning* 192

Cheung PK, Jim CY (2019) Effects of urban and landscape elements on air temperature in a high-density subtropical city. *Building and Environment* 164 UNSP 106362.

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Ciardini V, Caporaso L, Sozzi R, Petenko I, Bolignano A, Morelli M, Melas D, Argentini S (2019) Interconnections of the urban heat island with the spatial and temporal micrometeorological variability in Rome. *Urban Climate* 29 100493.

Collado JRN, Wang H-H, Tsai T-Y (2019) Urban Informality in the Paris Climate Agreement: Content Analysis of the Nationally Determined Contributions of Highly Urbanized Developing Countries. *Sustainability* 11

Cui X, Li S, Wang X, Xue X (2019) Driving factors of urban land growth in Guangzhou and its implications for sustainable development. *Frontiers of Earth Science* 13 464–477.

Dai J, Wang X, Dai W, Chang M (2019) The impact of inhomogeneous urban canopy parameters on meteorological conditions and implication for air quality in the Pearl River Delta region. *Urban Climate* 29 100494.

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Urban Climate 29 100482.

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Fan YF, Hunt JL, Wang Q, Yin S, Li YG (2019) Water tank modelling of variations in inversion breakup over a circular city. *Building and Environment* 164 UNSP 106342.

Fan YF, Wang Q, Yin S, Li YG (2019) Effect of city shape on urban wind patterns and convective heat transfer in calm and stable background conditions. *Building and Environment* 162 UNSP 106288.

Fang Z, Feng X, Xu X, Zhou X, Lin Z, Ji Y (2019) Investigation into outdoor thermal comfort conditions by different seasonal field surveys in China, Guangzhou. *International Journal of Biometeorology* 63 1357-1368.

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Upcoming Conferences...

AMERICAN METEOROLOGICAL SOCIETY (AMS) 15TH SYMPOSIUM ON THE URBAN ENVIRONMENT
Boston, USA • January 12-16, 2020
https://annual.ametsoc.org/index.cfm/2020/

SYMPOSIUM ON CHALLENGES FOR APPLIED HUMAN BIOMETEOROLOGY
Freiburg, Germany • March 2-3, 2020
https://www.medizin-meteorologie.de/index.php/16-register

DAYLIGHTING RIVERS: INQUIRY BASED LEARNING FOR CIVIC ECOLOGY
Florence, Italy • May 14-15, 2020
http://www.daylightingrivers.com/final-conference/

EUROPEAN GEOPHYSICAL UNION (EGU) GENERAL ASSEMBLY – URBAN CLIMATE SESSIONS
Vienna, Austria • May 3-8, 2020
https://www.egu2020.eu

- *"Urban Air Quality and Greenhouse Gases" (AS3.22)*
- *"Impacts of emissions from major population centres on tropospheric chemistry and composition" (AS3.23)*
- *"Urban Climate, urban biometeorology, and science tool for cities" (CL2.5)*

PLANNING POST CARBON CITIES: 35TH PLEA CONFERENCE ON SUSTAINABLE ARCHITECTURE AND URBAN DESIGN
A Coruña, Spain • September 1-3, 2020
https://www.plea2020.org/

IAUC honors Professor Janet Barlow with the 2019 Luke Howard Award

We are delighted to announce Janet Barlow, Professor of Environmental Physics at the University of Reading, as the winner of the 2019 Luke Howard Award for Outstanding Contributions to the Field of Urban Climatology.

Through her deep theoretical understanding, Janet has made major contributions to urban meteorology over the last twenty years. She has undertaken innovative research that is of extremely high quality, and authored many groundbreaking and influential publications addressing a broad range of topics. She has inspired and mentored many students and young scientists and is an enthusiastic and engaged member of the international urban climate community.

Janet Barlow of the University of Reading is this year's recipient of the Luke Howard Award, in recognition of her outstanding contribution to urban climatology.

A physicist by training, Janet's early work concerned fundamental studies of turbulence and pollutant dispersion in the highly complex roughness sublayer – i.e. within street canyons and around buildings. Through innovative field observations, sophisticated laboratory studies and numerical models, her work has substantially advanced our understanding of turbulent exchange and its relation to air quality. She has devised and led major field campaigns, for example the DAPPLE and ACTUAL projects, and has pioneered new techniques to improve analysis and interpretation of LiDAR and wind tunnel data. Her research areas have grown to include the whole of the urban boundary layer where novel application of remote sensing instruments combined with eddy covariance instrumentation has enabled investigation of the vertical structure of the urban boundary layer and led to the discovery of new phenomena, such as the stable nocturnal boundary layer over central London. Recently, Janet's work has expanded in breadth to include topics such as wind engineering, building ventilation and indoor climate, among others. She is internationally recognised for her extremely impressive range and depth of expertise.

Besides her impressive academic record, collaborations developed with energy scientists, engineers and policymakers have ensured that her research is put to practical use. She has served on the IAUC Board and the AMS Board for the Urban Environment as well as several advisory committees. She is supportive of young scientists and actively promotes equality and diversity. Her strong mentoring record demonstrates her substantial contributions to urban climate through teaching and training and her rich experience has been passed on through her many national and international invited presentations. Janet is an excellent role model for many (female) students and scientists and thoroughly deserves the recognition of the 2019 Luke Howard Award.

ICUC-11 in Sydney

The next International Conference on Urban Climate **(ICUC-11)** will take place in **Sydney, Australia from August 30 to September 3, 2021**. The Board of the IAUC selected the team in Sydney with its proposal "Cities as Living Labs: Climate, Vulnerability, and Multidisciplinary Solutions."

The University of New South Wales (UNSW), who will host ICUC-11, has also received support from the American Meteorological Society (AMS) Board on the Urban Environment (BUE) to run ICUC-11 together with the Symposium on the Urban Environment (AMS-BUE). UNSW will collaborate with other Australian Universities and Research Institutes in hosting this conference. Dr. Negin Nazzarin, who leads the organising committee, welcomes the IAUC community to Sydney: "We greatly appreciate the vote of confidence from the IAUC members. We truly believe that Sydney is an ideal venue for bringing in the diverse and international Urban Climate community, and look forward to welcoming all members in Sydney, Australia, for the 11th International Conference on Urban Climate (ICUC-11) in 2021."

ICUC-11 will be hosted on the campus of UNSW. The Sir John Clancy auditorium offers tiered seating for up to 945 participants in plenary sessions. The adjacent Matthews Pavillions will provide a contemporary semi-enclosed space for exhibitions, poster display and catering. A number of nearby theatres and lecture rooms will offer spaces for concurrent sessions and workshops.

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- **Secretary**: Andreas Christen (Albert-Ludwigs Universität Freiburg, Germany), 2018-2022.
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- James Voogt (University of Western Ontario, Canada), *Past President*: 2014-2018.*
- Helen Ward (University of Innsbruck, Austria), 2019-2022.

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The next edition of ***Urban Climate News*** will appear in late March. Contributions for the upcoming issue are welcome, and should be submitted by February 29, 2020 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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