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ABSTRACT BOOK – MONDAY, MAY 15

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Oral Presentation Abstracts

MONDAY, MAY 15

Morning Parallel Sessions [10:30-12:00] **VENTANA ROOMS A, B, C**

Urban Biometeorology 1	**VENTANA A**
Tugba Dogan	The effect of the COVID-19 lockdown on the surface urban heat island in Prague, Czech Republic City dwellers are at higher risk for heat-related illnesses due to a phenomenon called the urban heat island effect. It refers to higher temperatures in denser parts of the cities compared to the greener surrounding parts. This temperature difference can be observed by using thermal satellite images, which show the thermal footprint of the urban surfaces, thus called the surface urban heat island effect (SUHI). The COVID-19 lockdown in 2020 offered a unique opportunity to investigate the effect of decreased emissions of air pollution and anthropogenic heat on SUHI. Although several studies suggested that decreased anthropogenic heat released during the lockdown resulted in a reduction in SUHI, these results contain inherent uncertainties due to weather variability and land cover changes that should have been considered. In this study, we introduce a novel approach to quantify changes in SUHI intensity (SUHII), taking into account the modifying effects of weather variability and land cover changes. We employed MODIS-Aqua satellite images to analyze the change in SUHII during the lockdown in April 2020 in Prague, Czech Republic, compared to analogical periods in the spring seasons of 2017–2019. SUHII was calculated as a relative ratio of land surface temperature between urban and reference rural areas that adequately reflect year-to-year weather variability. SUHI was defined as urban areas with positive SUHII. Our results suggest that the reduction of anthropogenic heat released during the lockdown weakened typical spring SUHI in Prague by 13%. Our research encourages policymakers to target initiatives to reduce anthropogenic emissions, highlighting that these measures could mitigate SUHI effects in addition to improving air quality. Further studies are needed to establish a connection between the amount of anthropogenic heat released and corresponding SUHII changes.
Kamila Pawłowska	Modelling of the Urban Heat Island effect with special regard to natural base solutions The aim of the proposed research was to test possible reduction of Urban Heat Island effect (UHI) via green roofs in the city using the ENVI-met software on a microscale. The constantly observed climate change increase formation of dynamic changes in a microclimate for which actual

	urban and rural infrastructure is not prepared. Existing urban infrastructure is often hard to remove and replace by green infrastructure (GI) create possibility to mitigate the effects caused by dynamic phenomena such us heavy rainfalls and heat waves with natural or semi-natural solutions. Taking into account the above, it is important to relate the extent of the changes in the climatic environment to the agglomeration of urban areas. Our research base on 5th class scale valorisation and hierarchy of the most exposed areas in a district, propose different scenarios of how potentially increase active surface and natural terrain retention in a microscale. Based on recommendations a 3-d simulation of UHI with and without GI was perform in ENVI-met. The result of a model were used to calculate the bioclimatic conditions and analyse the possible differences in thermal comfort on a microscale. The valorisation methodology as well operating framework is demonstrated on example of the city located in central Europe (Wrocław SW Poland).
Balogun Ifeoluwa Adebowale	Surface thermal characteristics and energy fluxes over different Local Climate Zones in Akure, Nigeria This study therefore assessed the surface thermal condition and energy flux distribution within the urban area of Akure City, Nigeria, using remote sensing technique. Surface Energy Balance Algorithm for Land (SEBAL) model was used to estimate net radiation, soil heat flux, sensible and latent heat flux over the city. Sky-view factor (SVF), impervious surface and vegetation cover information were utilized to detect variation of heat fluxes and Land Surface Temperature (LST) in sixteen urban Local Climate Zones (LCZ). Results showed that heat flux distribution at the LCZs differed distinctly in magnitude and intensity according to the sky-view and surface characteristics. Areas with highest Sensible Heat flux (H) and Land Surface Temperature (LST) are areas with higher sky-view factor and lower vegetation cover abundance. Furthermore, LCZ_3 and 6 with highest impervious surface cover (over 50 %) had the highest sensible heat flux intensities while other zones with lower impervious surface percentage cover such as LCZ_6 and 9 had lower sensible heat flux intensities. The mean sensible heat flux at the built-up zones ranged between 196 W/m2 and 349 W/m2 while the latent heat flux ranged between 78 W/m2 and 295 W/m2. The latent heat flux was lower over the built-up zones compared to the zones with intense vegetation. Correlation analysis revealed that over the city, surface features had more contribution to the variation of heat fluxes as well as LST compared to the sky-view factor. It is concluded that urban surface characteristics have impact on the surface energy fluxes distribution within the city as the components were altered differently and at dissimilar intensities at each zone. The study not only presents the usefulness of remote sensing in investigating the energy distribution in an urban area, it also provides information applicable in urban planning context.
Hitenkumar Motiyani (VIRTUAL)	Remotely Sensed Land Surface Temperature and its relationship with thermal comfort

	Thermal comfort is highly influenced by Urban Heat Island (UHI) effect and is usually assessed by conducting questionnaire survey of random people and measuring simultaneous micrometeorological parameters. Measurements of micrometeorological data is often time consuming, requires to carry the sensors and data-loggers on the field; but are highly accurate. Estimation of Land Surface Temperature (LST) and other spectral indices from satellite data are widely used to study the UHI effect from micro to large geographical scale. It is still unclear whether LST and other spectral indices can be used to predict the thermal comfort. The aim of this study is to evaluate the relationship between LST and other spectral indices like Urban Thermal Field Variance Index (UTFVI) derived from remotely sensed data with the thermal comfort indices in the city of Ahmedabad, India. LST and UTFVI were derived from LANDSAT-8 images using Google Earth Engine. Derived LST was compared against the in-situ measurements of air temperature (~1.1 m agl) for purpose of validation. A strong correlation was found between the two parameters. Furthermore, the LST was evaluated for various thermal comfort indices like Physiological Equivalent Temperature (PET), Standard Effective Temperature (SET) and Universal Thermal Climate Index (UTCI) giving an insight on predicting the thermal comfort of a location remotely.

Human Health and Epidemiology 1	**VENTANA B**
Mary Wright	A meta-analysis of social factors predicting individual and household-level heat-related illness We conducted a meta-analysis of seven residential social surveys in the Phoenix Metropolitan Area in Arizona, United States (representing a total of 2,346 respondents) to examine the impact of various measures of household and individual level heat vulnerability on incidence of heat-related illness. We sought to form a more complete understanding of what these surveys may collectively tell us about the extent and drivers of heat-related illness. By using social surveys that were designed to examine the impacts of heat on people, we could analyze some variables that are rarely investigated in heat vulnerability research (e.g., cost restrictions on AC (air conditioning) use, being too hot in one's home). The meta-analyses often revealed a consistent trend across surveys, providing confidence in the true association of various survey measures with heat-related illness. For instance, residents that reported being too hot in their home during the summer had a higher incidence of heat-related illness (OR [95% CI] = 2.34 [1.76, 3.10]). Similarly, restrictions on AC use due to concerns about the cost of using AC was associated with higher rates of heat-related illness (OR [95% CI] = 2.28 [1.70, 3.06]). Interestingly, we found the association of income with heat-related illness had a lower magnitude than the effect of other measures of material hardship. Households that made less than $40,000 USD annually were 1.5 times more likely to experience heat-related illness OR [95% CI] = 1.57 [1.02, 2.40], while households that struggled to afford essentials were four times more likely to experience heat-related illness, OR [95% CI] = 4.04 [1.77, 9.24], and households that always had enough food to eat

	were only one quarter as likely to experience heat-related illness OR [95% CI] = 0.25 [0.13, 0.48]. These results illuminate the importance of the indoor environment and material hardship in shaping heat-health outcomes.
Alindomar Lacerda Silva	Heat and Cold Waves in the Cleveland Metropolitan Area and its relationship with mortality: an overview from 1975 to 2018 In a changing climate, extreme events are likely to increase in frequency, intensity and duration. Heat waves and cold blasts are extreme events that have been well studied, mainly in regards to their impacts in human health. In the US, most of the studies have been done at the country scale, with few studies focusing on the local/regional scale. Therefore, this study investigates heat and cold waves and its relationship with mortality in the Metropolitan area of Cleveland. The temperature data was acquired at the NCEI mortality data at the NCHS. Temperature data is used to calculate single extreme heat and cold days (EHE and ECE) and to compute heat and cold waves (HW and CW). Mortality data was combined with temperature data using a distributed non-linear model (DLNM) for the period of 1975 to 2018. The results show a total of 652 EHE and 673 ECE. The number of EHE increased by 200% in three decades and the number of ECE decreased by -36%. The number of cold waves decreased by almost -60%, and the number of heat waves increased by 181%. Cold events have a lagged impact in mortality, more evidently at Lag 5 to Lag 30 (up to 7% increase in RR). In contrast, heat events have an immediate impact (16% increase in RR). This study has important implications for the general public, who should be aware of the increasing trends in heat events, so they can adopt strategies, such as implementing cooling systems in their homes
Aleš Urban	Do early heat warning systems reduce the risk of heat-related mortality in Europe? The study was conducted on behalf of the MCC Collaborative Research Network (http://mccstudy.lshtm.ac.uk/) and Task Group 3.11 of the COST Action PROCLIAS (https://proclias.eu/). Early heat warning systems and heat-health action plans (HWSs) have been considered as one of the crucial adaptation measures to prevent heat related mortality. However, previous studies showed that beneficial effects of HWSs are not consistent across cities and more research is needed to assess the efficiency of HWSs. The aim of this study is to better understand the ability of HWSs to prevent heat-related mortality across Europe. Via MCC network, we obtained daily mortality time series from 245 locations across 16 European countries in the period 1990-2018. Via partners in COST Action PROCLIAS, we collected information about HWSs from selected European countries. Based on the WHO criteria, we developed a classification of HWSs in individual cities and countries, regarding their complexity. We employed a two-stage longitudinal study design, to assess the temporal changes in heat-mortality in individual countries and to quantify beneficial effects of HWS implementation. In the first stage, we used quasi-Poisson regression models coupled with distributed lag non-linear models to calculate an exposure-response function in each location in each three-year window of the study period. In the second stage, we employed a random effect mixed meta-regression model, to quantify the effects of implementation, methodological updates, and overall complexity of HWSs. Modifying effects of the spatial-temporal variability in heatwave intensity were also considered. Preliminary results suggest that South and Western European countries with the most complex HWSs, that include detailed heat and health action plans, experienced the largest reduction of the heat-related mortality risk after HWS's implementation.

	Findings of this study are extremely important for further development of heat warning systems in Europe.
Dragan Milosevic	Extreme heat, mortality and hospital admissions in Serbia “Extreme Heat in Serbia” is a short-term project realized in 2022 and financed by the American Red Cross and the Global Disaster Preparedness Center. Before the project, there were only a limited number of studies investigating heat-related mortality and hospital admissions in Serbia. The project filled this research gap by identifying the heat-health conditions in Serbia. This analysis is supplemented with a detailed analysis of hospitalization in the second largest city in the country (Novi Sad). The main results and findings are as follows. Climate and bioclimate reports at the national level were created assessing changes in air temperature, relative humidity, wind speed, cloudiness, and outdoor thermal comfort indices (HUMIDEX, PET and UTCI) for the period 2000-2020. Three research studies have been written that deal with extreme heat and other meteorological impacts on mortality and/or hospitalization in Serbia. These studies indicated an increased occurrence of heat stress during the summer in Serbia with extreme heat occurring during the midday period throughout the country during heat waves. The analysis showed that 1 °C increase in air temperature is associated with about 2% increase in crude death rate in Serbia. Furthermore, for the city of Novi Sad, statistically significant correlations were observed for minimum temperatures and all-cause hospital admission subgroups with a negative value, and maximum temperatures and hospital admissions in the population below 65 with positive value. In other words, the hospital admissions increased by 1.0% due to a 1 °C increase in maximum temperatures in the city of Novi Sad, Serbia. Finally, a hybrid workshop on extreme heat impacts was organized for stakeholders and citizens, and a YouTube channel, project website, social media profiles and an extreme heat leaflet were created to increase the project’s visibility and outreach.
Samuel H. Gunther	Chronic extreme heat during pregnancy is associated with increased risk of gestational diabetes and small for gestational age birth, but decreased risk of preterm birth, in Singapore Background: Pregnant women and their fetuses are particularly vulnerable to the health impacts of extreme heat exposure. Previous studies have reported associations between heat exposure during pregnancy and higher risk of adverse birth outcomes. However, these studies were mainly conducted in temperate countries, which experience different climatic conditions than tropical countries. We aimed to determine the association between chronic extreme heat in a tropical country, Singapore, and risk of preterm birth (PTB), gestational diabetes (GDM), and small for gestational age birth (SGA). Methods: Birth records from 2013 to 2020 from a large public hospital in Singapore were analyzed alongside daily climate records from the Singapore Changi Airport weather station. Multivariable logistic regression was used to estimate the association between occurrence of extreme heat across the three trimesters of pregnancy and the risk of PTB, GDM, and SGA, with stratification by maternal race according to the three main racial groups in Singapore – Chinese, Malay, and Asian Indian. Results: We observed an association between chronic extreme heat during the second trimester and higher risk of GDM (relative risk: 1.23; 95% confidence interval: 1.02, 1.47; p-value = 0.022), especially in Asian Indian mothers (1.62 [1.08, 2.40]; 0.017). We also observed an association between

	chronic extreme heat in the second trimester and higher risk of SGA in Malay mothers (1.52 [1.03, 2.20]; 0.028). However, chronic extreme heat during the third trimester was associated with a reduced risk of PTB (0.57 [0.40, 0.80]; 0.001). Conclusion: Our findings on GDM and SGA are consistent with previous studies; however, our findings on PTB are in direct contrast to previous studies. We speculate that chronic extreme heat in Singapore prompts behavioral changes, such as increased air-conditioning usage, which could explain the apparent protective effect for PTB.
Claudia Di Napoli (VIRTUAL)	Monitoring human wellbeing without gaps: reanalyses at the service of climate services for health As the linkages between extreme weather events, changes in climatic conditions, and health impacts in exposed populations become clearer, so does the need for climate-smart decisions aimed at making the public health sector more responsive and resilient. By integrating climate and health information, climate services for health provide robust decision-support tools. The Lancet Countdown monitoring system uses global climate reanalyses products to track annual changes in a set of health-related outcomes. In my talk I will share my experience with the Lancet Countdown monitoring system and illustrate how multiple variables from reanalysis datasets such as ERA5 and ERA5-Land are used to capture heatwaves, precipitation extremes, wildfires, droughts, warming, and ecosystem changes across the globe and over multiple decades. I will present how this reanalysis-derived information is then input into a hazard-exposure-vulnerability framework to create worldwide “maps without gaps” of climate-related impacts to human mortality, labour capacity, physical activity, sentiment, infectious disease transmission, and food security and undernutrition. I will discuss current challenges in our reanalysis-for-health approach and share ways forward.

Climate and Society 1	**VENTANA C**
V. Kelly Turner	Shade Deserts, Shade Oases: Disparities in Shade Infrastructure Delivery in the City Disparities in heat-health burden are one of the largest public health crises and climate injustices facing cities. Limiting sun exposure through shade is critical for reducing health risks when it is hot outdoors. Yet, cities lack shade in outdoor settings such as sidewalks, public transit stops, outside workplaces, school play areas, and heat-vulnerable communities where it is needed. These ‘urban shade deserts’—defined as areas in the city lacking the shade needed to protect and support human health during outdoor activities—exacerbate heat-health burden among vulnerable communities. We assert that urban shade deserts persist because cities do not explicitly consider urban shade infrastructure systems (USISs), a collection of environmental shade elements, both green (e.g., tree canopy) and gray (e.g., buildings, walls, shade sails, awnings, photovoltaic canopies) that are strategically placed to intercept sunlight from reaching people, and the associated land use policies that control production and delivery. We call on cities and scholars to adopt USIS to center heat burden experienced by people, priorities sun blocking strategies, use a mix of green and engineered shade depending on context, build shade into urban plans and policies, and address systematic biases in shade delivery. Actively managing USISs means promoting shade from co-benefit to

	main deliverable and treating it with the same urgency as urban greening to adapt to the reality of a warming climate.
Shaylynn Trego	Evaluating urban heat mitigation across networks of plans Cities must equitably plan for heat resilience as heat risks increase, but lack integrated approaches to coordinate strategies across community plans and prioritize heat mitigation for the most vulnerable communities. We adapted the Plan Integration for Resilience Scorecard™ (PIRS™) methodology, originally developed for flood hazards, to heat and piloted it in eight geographically diverse U.S. cities. We used PIRS™ for Heat to analyze how policies across community plans would affect urban heat, and compared spatial patterns in policy attention with indicators of vulnerability. We find that heat mitigation policies are not targeting the highest heat risk areas.
Xiaojiang Li	Examining equity to heat stress in 14 US major cities using GPU-accelerated SOLWEIG modelling The increasingly frequent and intense extreme heat events in large U.S. cities cause more climate-related mortalities than any other hazardous weather event. In the context of global warming and urban heat island, heat waves are supposed to be more frequent and intense in many cities. The extreme urban heat is not distributed evenly across neighborhoods of cities, and not all populations are impacted by the extreme heat equally. A fine level of quantitative information about where and which populations are vulnerable to heat is important to identify the most vulnerable neighborhoods and populations in order to mitigate the negative impacts of heat on urban residents. Different from the previously widely used land surface temperature, this study proposed to use the mean radiant temperature (Tmrt), which is more reasonable to indicate human heat stress, to indicate the distribution of urban heat in 14 US major US cities. The SOLWEIG (SOlar and LongWave Environmental Irradiance Geometry) model was applied to map the Tmrt in Philadelphia based on the high-resolution (1m) urban 3D model and meteorological data using the Graphics Processing Unit (GPU) parallel computing. This study further investigated the different heat exposure levels of different neighborhoods and population groups. The results of this study would be directly applicable for guiding urban landscape design and urban planning for mitigating the negative impacts of extreme heat.
Kevin Lanza	Heat vulnerability and recommended adaptation responses of Latino and Black residents in a low-income U.S. community Introduction: Latino, Black, and economically disadvantaged individuals in the U.S. have been shown to disproportionately live in areas characterized by urban heat islands, yet local context to inform heat adaptation responses is lacking. We used a qualitative approach to explore the heat vulnerability of residents in a low-income community of color and what adaptation responses they recommend. Methods: In the warm climate of Austin, Texas, U.S., we used snowball sampling to recruit a convenience sample of adults from a low-income community of color with relatively high urban heat island intensity, based on air temperature modeling. From July–September 2021, we conducted one-on-one, in-person, semistructured interviews using a theory-based script asking residents to imagine it's 105°F (41°C) outside then to answer 1) "What does your day look like?" and 2) "What do you see in your community that would make it feel cooler?". We identified six themes in NVivo with data from 18 economically disadvantaged adults (female = 17, Latino = 16, Black = 2)

	at which point we had reached data saturation. Results: Heat impacted residents physically (fatigue, headaches, nausea, dizziness, trouble breathing) and mentally (uncomfortable, stress). Heat exposure was highest during active transportation, outdoor work, and recreation. Residents perceived children and those with diabetes and high blood pressure as most heat sensitive. Adjusting to heat included staying home, drinking liquids, changing schedules, and using air conditioning. Barriers to adjusting were lack of trees, shade, greenspace, and bluespace, with potential barriers of electricity cost and power outages. Residents recommended adding trees, shade structures, parks, pools, splash pads, and drinking fountains. Conclusions: Our qualitative findings can complement quantitative data to develop policies and interventions for heat health. Requiring meaningful resident involvement throughout municipal efforts on climate resilience has the potential to result in adaptation responses that are truly for the community.
João Vasconcelos	Barriers to adaptation to summer indoors heat in the elderly population. A follow-up study. The 2003 heat wave in Europe have brought to the debate the social implications of the vulnerabilities of the ageing population and the lack of tools and/or individual skills necessary for thermal adaptation inside their homes. However, contrary to what has happened at the community and population level, knowledge about adaptation to the scale of individuals has received very little attention and studies on the causes of exposure to heat, especially among vulnerable groups, are still very rare. Understanding the restrictions and limitations of the thermal adaptation process is a key element to minimize the harmful effects of heat on the vulnerable population. The IN-HALE pilot project aims to identify the indoor thermal summer conditions of residents 65+ and to identify the individual determinants of exposure to heat, as well as the barriers (material and/or immaterial) for thermal adaptation in Lisbon, Portugal. We have installed a network of outdoor thermometers and, simultaneously, thermohydrometers were installed inside 20 selected dwellings during summer. During this period, a nine-week follow-up survey was conducted to assess the following dimensions: indoor thermal perception; thermal attitudes against heat; sleeping disorders and quality of life. The output of IN-HALE is a policy brief on promoting thermal comfort indoors, a communication plan for municipal actions to promote environmental health centred on thermal comfort, and a training program aimed at raising awareness among the elderly population about the importance of thermal comfort for health.

Early Afternoon Parallel Sessions [1:30-3:00] VENTANA ROOMS A, B, C

Urban Biometeorology 2	VENTANA A
Michal Belda	Simple and complex measures for improvement of urban thermal comfort: an LES modeling study The thermal comfort of city dwellers is at the forefront of urban studies, especially in connection with climate change. Urban planners are considering various measures to improve thermal comfort in the cities, ranging from very simple (like painting surfaces bright to reflect more solar radiation) to very complex (changing the entire urban configurations with more green and blue infrastructure). In this study, a complex micro-scale modeling system PALM featuring an advanced urban model was used to analyze micro-climate sensitivity with respect to potential UHI mitigation measures in a typical densely built-up residential area in Prague, Czech Republic. The use of an integrated modeling system allowed the analysis of the effects both on physical variables and biometeorological indicators or indices (MRT, PET, or UTCI). Two types of scenario simulations were designed. First, a set of simple scenarios was performed, changing individual surface and material parameters such as albedo or emissivity. These showed the highest sensitivity to changes of surface parameters used in radiation balance equations. Second, a set of scenarios was designed to assess the limits of effects of commonly considered complex UHI mitigation measures such as adding tree alleys or introducing water channels in the streets. In this case, urban greenery is confirmed to be the most effective measure, especially when considering both physical indicators and biometeorological indices. Comparing the two sets showed that the simple measures are not as effective and in some cases can lead to adverse effects, e.g. painting surfaces white showed a decrease of air temperature but at the same time worse thermal comfort at the pedestrian level due to more radiation being reflected back to the street canyon.
Isaac Buo	High-resolution thermal exposure and shade maps for cool corridor planning Shade is crucial for thermally comfortable cities that promote physical activity. Citywide shade and thermal exposure data are important for managing heat health risks but are difficult to obtain at fine scales due to limited sensing and modeling capabilities. To address this gap and assist municipalities with “cool corridor” planning, we generated 1-m resolution shade and mean radiant temperature (TMRT) maps from LiDAR point clouds for the Phoenix metropolitan area using the SOLWEIG model. TMRT estimates were validated using 763 observations with a mobile human biometeorological 6-directional setup. SOLWEIG had an overall RMSE of 5.6°C with an error of 6.2°C at open sites, 5.4°C under trees, and 4.4°C in building canyons. Hourly TMRT and shade maps were generated from 07:00h to 20:00h for June 27, 2012, a typical clear, dry, calm summer day. We assessed sidewalk shade coverage based on the action of the Government’s Active Transportation Plan. Only 8% of all sidewalks met the recommended minimum of 20% shade coverage at all times. Less than 50% of all sidewalks met the goal, indicating that the urban area is not walkable during extreme heat. Results from this study will inform municipal cool corridor planning to optimize site selection for heat mitigation.
Jelena Dunjić	Cooling effect of evaporative misters in outdoor urban settings. Case study of Novi Sad, Serbia

	Increased intensity and frequency of extreme heat events are especially pronounced in urban areas where the majority of global population live. These events demand proper response of authorities and businesses to improve thermal comfort and mitigate the heat. In this study we discuss the effectiveness of evaporative cooling misters in improving outdoor thermal environment of the restaurants in Novi Sad, Serbia during the summer. We performed micrometeorological measurements in the different outdoor areas of five restaurants during the midday hours (1400-1700 CEST) in July and August 2022. Microclimate parameters (Ta, RH, v and Tg, 1 min. temporal resolution) were measured using Kestrel 5400 Heat Stress Trackers, in three different exposures: misted sun, misted shade, and sun only. Based on measured parameters, mean radiant temperature (Tmrt), physiological equivalent temperature (PET) and modified physiological equivalent temperature (mPET) were calculated with RayMan software, for the three exposures. Simultaneously, we conducted the survey among restaurant guest and managers to investigate their perceptions of the effectiveness of cooling misters, and motivations to use such systems. The results show that evaporative misters performed best when combined with shade, reducing the Tmrt up to 20ºC. In sun-exposed locations, the differences in Ta, Tmrt, PET and mPET between misted and non-misted locations were minimal. Occasionally, even higher values of Ta and Tmrt/PET/mPET were recorded in misted and sun-exposed locations compared to non-misted and sun-exposed locations. Significant differences in thermal comfort between the restaurants are noticed, depending on their locations in the city, urban setting, and surroundings. Both guests and managers consider that cooling misters are effective in improving the thermal comfort. The results of this and previous studies show that evaporative cooling misters can be effective in improving thermal comfort, especially when combined with shading strategies.
Magdalena Kuchcik	The role of urban parks in mitigating exposure to thermal stress of the people living nearby. Strategy, serious games could be one of the most interesting and effective educational tools in climate change action methods. This is why interdisciplinary project Co-Adapt - Communities for Climate Change Action aims to develop an integration toolkit based on a computer game to support resiliency and citizen engagement in city-communities, empowering them in responding to new climate change challenges with bottom-up involvement. The game features simulations that allow local community to transform their neighborhoods into more resilient to the climate change. The game is adapted to local environmental and spatial conditions so people can play in a group on their real neighborhoods maps what stimulate higher motivation for participation in climate change transformation. They will explore various choices available for their neighborhoods (from wide, but limited and detailed range of solutions connected with green and blue infrastructure, renewable resources, climate-friendly changes of colors of facades and roofs etc.) and consequences (costs, savings, climatic benefits). The workshop toolkit integrates best practices collected from communities that are already involved in climate change actions in Norway, Denmark, Sweden, France or USA and which were visited by project' leaders. The pilot project will be carried out for six communities in Warsaw diversified in relation to exposure to urban heat island, flood risk etc., urban structure and socioeconomic factors. They were carefully chosen after consultations with Warsaw City Council out of the most active local communities and on city-owned land. City ownership is crucial because at the end of the game each of the community will gain some amount to implement some solutions from the game. Co-

	Adapt game is completely new idea of implementing science into the behavior of local communities to improve their living environment, to adapt to climate change and to mitigate this change.
Claire Gallacher	Thermal comfort mapping for evidence-based urban planning; an interdisciplinary approach for the case study of Dresden, Germany Outdoor thermal comfort is a field of study which remains open, especially in the context of urban planning. In previous studies, mobile climate monitoring devices have been employed to measure meteorological variables contributing to outdoor thermal comfort at the hyperlocal level (10-30m resolution). However, such mobile climate monitoring devices are often costly and difficult to operate without significant technical knowledge. In response, this paper presents a novel low-cost mobile climate monitoring device, developed using a user-friendly Arduino board, which was used to map thermal comfort in the context of Dresden, Germany. Measurements of air temperature, air humidity, air pressure, surface temperature, global radiation and globe temperature were taken along a route within the city center of Dresden from June until August of 2022. This data was used to calculate a number of thermal indices using the urban climate software Rayman Pro. Thermal comfort is also addressed from a subjective perspective through the use of mobile thermal comfort surveys of pedestrians along a shorter segment of the meteorological monitoring route. Finally, land use and ownership of the most thermally uncomfortable areas are considered in order to highlight target areas for potential future redesign. A key aim of this paper is to contribute towards the formulation of an accessible, standardised approach for mapping pedestrian thermal comfort which has direct relevance for informing climate-adapted, evidence-based urban planning.
Parker King	The Contributions of Roads and Other Paved Surfaces to Heat Microenvironments in Small Cities and Towns Extreme heat is a growing public health concern that demands equitable adaptive action to ameliorate. Paved surfaces (i.e., roads, sidewalks, and parking lots) are one known driver behind the formation of extreme heat microenvironments. Compared to natural land cover, paved surfaces generally have lower albedos, greater heat storage capacity, are highly impervious, and can cover as much as 40% of metro areas. Studies have found that extreme heat disproportionately affects communities of color and low-income areas in part due to the increased occurrence of pavement and lack of vegetation. The extent of pavement coverage within a community is governed in part by transportation infrastructure and zoning design standards as well as individual landowner decisions. We here seek to understand the potential public health impact of changes to these standards, specifically evaluating the potential to mitigate exposure to extreme heat through pavement reduction strategies including removal of excess pavement from parking lots or narrowing roadways. To do this, we leverage high resolution land cover data, a novel heat observation dataset, and a novel framework to evaluate exposure to extreme heat microenvironments at the household level using a household’s exposure to paved surfaces as a proxy for their exposure to extreme heat. The heat observation dataset was collected in nine cities and towns over the Summer of 2022 and used to determine the relationship between proximal pavement extent and ambient air temperature change. The novel heat exposure framework leverages statewide high-resolution land cover, parcel, E911 and census datasets. We will present our initial findings from several pavement reduction scenarios, including their effect on lowering heat exposure and heat exposure equity. This analysis focuses on

	the urban-rural continuum present in the state of Vermont, USA, but we anticipate our findings to be broadly applicable.

Human Health and Epidemiology 2	**VENTANA B**
Aleš Urban	Links between weather and seasonal influenza epidemics Links between weather variability, influenza/acute respiratory infections (ARI), and human health are extremely complex in the cold season, and their explanation remains uncertain. It is not clear whether the winter mortality peak is related rather to low ambient temperatures or ARI, and how weather variability may modify transmission patterns of ARI and related mortality. This study investigates links between weather characteristics, influenza/ARI epidemics and mortality in the population of the Czech Republic (Central Europe), by employing long-term epidemiological and meteorological datasets over the 1982/83 to 2019/20 epidemics seasons. The links are analysed with respect to the predominant type of influenza virus ARI in each season (influenza virus A/H3N2 and A/H1N1 subtypes, and B lineages). We focus on i) identification of meteorological conditions associated with epidemics, ii) how timing of the epidemics and their magnitude are linked to weather characteristics, and iii) whether there are synergetic effects of cold weather and epidemics on the mortality impacts. Preliminary results suggest that high excess mortality during influenza epidemics was associated with low temperatures while above-average temperatures were linked to lower morbidity and mortality impacts. The role of other meteorological characteristics is less clear. Understanding weather conditions that increase the transmission and survival of influenza and respiratory viruses could help to better inform at-risk populations, implement preventive measures, and mitigate the negative impacts of influenza and ARI.
Ogone Motlogeloa	Exploring the role of extreme climatic events in the incidence of respiratory disease in South Africa Ecological modeling studies in South Africa have projected that each year, people of all ages die from influenza-related complications such as pneumonia, accounting for about 2,500 deaths overall. Southern Africa is susceptible to a range of extreme weather events including floods induced by severe storms, related wind- and lightning-storm damage, droughts, fires, and extreme temperature events. Extreme weather events have both a direct impact on human health, and a secondary impact on the operation of health services through the effects on built, social, and institutional infrastructures. While the mortality from extreme climate events is recorded and published, the impacts on specific medical conditions are less frequently explored. Through analyzing caseload hospitalization data from a public hospital in Greater Johannesburg, Baragwanath Hospital, and private sector medical aid claims from Discovery Health Medical Scheme this study explores changes in respiratory disease caseload following extreme climate events. Utilizing the EMDAT list of extreme climate events that have occurred in South Africa, alongside existing literature and newspaper records we will compare the timing of the extreme climate events to any peaks in incidence observed in both medical aid claims data and hospitalization data respectively. By comparing the difference in means these findings will enable the accurate anticipated change in respiratory disease that will occur after an extreme climate event. This is of crucial importance as it will result in

	preparedness amongst healthcare facilities, and precaution among the population and subsequently lessening the disease load too.
Eduardo Kruger	Investigating the relationship between air temperature and respiratory morbidity in children and the elderly in Porto Alegre, Brazil, before and during the COVID-19 pandemic This study aims to analyze air temperature versus respiratory morbidity data of children (under five years old) and the elderly (over 65 years old) in subtropical Porto Alegre, Brazil, comparing outcomes for the years 2018, 2019 and 2020, before and after the outbreak of the COVID 19 pandemic. Climatic and hospital admission (HA) data for the Brazilian state capital Porto Alegre, marked by a Cfa climate type with well-defined seasons were used in the analyses. HA for respiratory diseases (morbidity) were obtained from the Brazilian Unified Health System database, according to the International Classification of Diseases, Tenth Edition (ICD-10). Correlation analysis was performed between variables (HA versus air temperature and heat stress) in order to identify relationships also accounting for different lag-effects (between meteorological condition and morbidity). Results showed that the lag effect was present in al situations and had a negative value for the variables analyzed, with the daily mean temperature generally having the strongest correlations (r values over -0.5) to hospital admission data for respiratory diseases. Correlations were also stronger for the age group of children under 5 years old, with r values over -0.6 in 2019, peaking at -0.74 in 2018, for the daily mean, at lag6). During the first year of the COVID-19 pandemic, however, correlations dropped significantly, losing their strength and showing inverse relationships. During the pandemic, the age group under 5 showed a positive and weak correlations at lag6 (one week prior to admission) and for the daily maxima, with a Pearson's r of 0.22. For the elderly, no meaningful correlations were found (r values generally lower than 0.1), which may point to the fact that such age group preferred to stay home and avoid hospital visitation.
Robert Davis	Climate and Mortality in Virginia, 2005–2020 In this study, we examine the relationships between climate and human mortality in the Commonwealth of Virginia. We utilize an extensive database of patient-level data of every individual mortality that occurred among Virginia residents from 2005–2020, or 985,072 deaths. Virginia is divided into 12 climatically similar regions by county with each region represented by a first-order weather station. In addition to maximum and minimum temperature, four-times daily weather observations of temperature, humidity, pressure, and wind are used to compute a variety of biometeorologically-relevant indices (e.g., apparent temperature, humidex). Ozone and PM2.5 concentrations are acquired from EPA monitors for all available locations. Heat and cold days and waves are identified based on region-specific temperature thresholds. Mortality-climate relationship are modeled using a generalize additive model time series approach, with unique models developed for each region. Lagged relationships are examined for up to 21-days using distributed lag non-linear models. The optimal models for each region exhibit marked diversity in relative risk as a function of a temperature variable. Most regions have elevated risk at low temperatures, and over half of the locations show a peak at high temperatures. Every location with heat-related mortality has impacts with short lags (0–2 days) followed by a short period of lower risk that represents mortality displacement. Mortality risk at lower temperatures is lagged from 3–15 days at some locations with cold being protective at shorter lags, but this relationship is not evident across all sites. Maximum relative risks are typically around 1.04 but vary from 1.02 to

	over 1.30. The extensive variability in climate-mortality relationships across Virginia highlights the importance of developing location-specific models. Based on this 16-year mortality archive, cold conditions are more consistently associated with elevated mortality risk than warm conditions, but the relationships are not associated with climate region.
Peter J. Crank	Mental Health and Air Temperature: Attributable Risk Analysis for Schizophrenia Hospital Admissions in Arid Urban Climates Health researchers have examined the physiological impacts of extreme air temperature on the human body. Yet, the mental health impacts of temperature have been understudied. Research has shown that the environment can create circumstances that exacerbate mental health issues. This may be particularly challenging for some of the fastest growing cities, located in hot, dry climates. Given the theoretical relationship between air temperature and mental health, we seek to measure the association between temperature and schizophrenia hospital admissions in an arid urban climate and quantify the associated public health burden. We collected 86,672 hospitalization records for schizophrenia from 2006-2014 in Maricopa County, Arizona, USA. Using a distributed lag non-linear model (DLNM), we tested for a statistical association between temperature and schizophrenia hospital admissions after controlling for year, season, weekends, and holidays. We calculated the cumulative attributable risk of nighttime temperature on schizophrenia for the entire dataset as well as among demographic subgroups. The relative risk of schizophrenia hospital admissions increased with both high and low temperatures. Statistical models using daily minimum temperature were more strongly associated with hospitalization than those using mean or maximum. Schizophrenia hospital admissions increased on days with minimum temperatures above 30 °C and below 3 °C, with some subgroups experiencing higher rates of hospitalization. The total fraction of schizophrenia hospital admissions attributable to non-optimal minimum temperature is 3.45% (CI: -4.91-10.80%) and high minimum temperature is 0.28% (CI: -1.18-1.78%). We found that non-whites and males appear to be at a slightly increased risk than the general population, although there did not appear to be a statistically significant difference. A conservative estimate of healthcare costs annually from non-optimal temperature attributed schizophrenia hospitalization is $1.95 million USD. Therefore, nighttime cooling strategies and efforts could increase the accessibility of shelters to reduce overnight exposure to extreme air temperature.

Climate and Society 2	**VENTANA C**
Ariel Prinsloo	Quantifying Climate Suitability for Tourism in Réunion Island through a Multi-Index Approach Small island states are among the most vulnerable tourism destinations to the threats of climate change. Réunion Island, located in the southwest Indian Ocean, is particularly unique as a department of France located in proximity to Southern Africa. This study presents the first analysis of the climatic suitability of the island for tourism through time. Adopting a model inter-comparison approach, we present the results from the Tourism Climate Index (TCI), Holiday Climate Index Urban (HCIUrban), Holiday Climate Index Beach (HCIBeach) and the Camping Climate Index (CCI). Each index is computed for the data from Roland Garros Airport on

	Réunion Island for the period 1991-2021. While neither camping nor beach activities take place directly at the airport, given the size of the island this station is representative of the climate influencing this full range of touristic activities. Preliminary results indicate that for much of the year, for three indices, Réunion Island is classified as good but not ideal for tourism due to the high temperatures, wind speeds and relative humidity which compromise thermal comfort. As the primary attraction of the region is the hot climate and time on the beach, this raises questions regarding the suitability of the classification thresholds in a tropical island context.
Sookuk Park	Koreans' climatic index for cultural tourism To develop Koreans' climatic index for cultural tourism (CICT), microclimatic data collection and surveys were conducted in summer and fall of 2022 in Jeju, Republic of Korea. Expert survey was conducted at 26 cultural tourism offices. Tourist survey was done at 6 locations which collected information from 1,456 participants along with measurement of microclimatic data (air temperature, relative humidity, wind speed, and shortwave and longwave radiation). CICT is comprised of 7 scales, ranging from 'very poor' to 'ideal'. As a result, human thermal sensation as a thermal aspect was analyzed using physiological equivalent temperature and universal thermal climate index. Cloud cover as an aesthetic aspect showed up to 50% for optimal, 60-80% for possible, and over 90% for unfavorable. As physical aspects, precipitation was ranged from 0 mmhr-1 for optimal, 0.1-5.0 mmhr-1 for possible, and more than 5.1 mmhr-1 for unfavorable. Wind speed was also divided into up to 1.4 ms-1 for optimal, 1.5-2.0 ms-1 for possible, and more than 2.1 ms-1 for unfavorable. The scales of optimal, possible, and unfavorable were dependent on aspects, for example in cloud cover, the scales 'fairly good' to 'ideal' represented optimal, 'just ok' to 'fairly good' represented possible, and 'fairly poor' to 'just ok' represented unfavorable; whereas, in precipitation and wind speed, scales of optimal were same as those of cloud cover, but scales for possible and unfavorable were one level lower than those of cloud cover. The ideal CICT scale was shown in 'neutral' and 'slightly cool' levels in human thermal sensation with up to 50% cloud cover, no precipitation, and less than 1.4 ms-1 in wind speed. This study will be continued in winter and spring, then the results shown above can be changed. The CICT scale can be used easily for tourists and tour companies.
Jane W. Baldwin	Increasing Health Risks During Outdoor Sports Due To Climate Change in Texas: Projections Versus Attitudes This study examines projected future trends of multiple measures of extreme heat across Texas throughout the next century, and evaluates the expected climate changes alongside Texas athletic staff (coach and athletic trainer) attitudes toward heat and climate change. Numerical climate simulations from the recently published Community Earth System Model version 2 and the Climate Model Intercomparison Project were used to predict changes in summer temperatures, heat indices, and wet bulb temperatures across Texas and also within specific metropolitan areas. A survey examining attitudes toward the effects of climate change on athletic programs and student athlete health was also distributed to high-school and university athletic staff. Heat indices are projected to increase beyond what is considered healthy/safe limits for outdoor sports activity by the

	mid-to-late 21st century. Survey results reveal a general understanding and acceptance of climate change and a need for adjustments in accordance with more dangerous heat-related events. However, a portion of athletic staff still do not acknowledge the changing climate and its implications for student athlete health and their athletic programs. Enhancing climate change and health communication across the state may initiate important changes to athletic programs (e.g., timing, duration, intensity, and location of practices), which should be made in accordance with increasingly dangerous temperatures and weather conditions. This work employs a novel interdisciplinary approach to evaluate future heat projections alongside attitudes from athletic communities toward climate change.
Jennifer Fitchett	How accurate is our perception of temperature? Thermal comfort is influenced by a range of meteorological variables, including air temperature, radiant temperature, relative humidity and wind speed. It is further affected by the clothing we wear, the amount of energy that we are exerting and our metabolism. Despite the complexities, an increasing number of biometeorological indices are relying on the perceptions of the public pertaining to threshold temperatures for appropriate and inappropriate conditions for thermal comfort. These assume that the average member of the public can accurately evaluate the sensation of a range of temperatures, and attribute those to thermometer readings. In this study, we explore the perceived temperatures reported by over 800 members of the general public in locations across South Africa, and compare these to thermometer readings. We also compare the perceived versus measured relative humidity, thermal index outputs computed from each of these, and reported rankings of thermal comfort. Our findings reveal a statistically significant difference between the perceived and measured temperature and relative humidity. However, the thermal comfort classifications are, in most instances, consistent with both perceived and measured meteorological conditions. On this basis, we argue against the use of questionnaire data on threshold temperatures from the general public when developing or verifying biometeorological indices.
Surisley Torres Gutiérrez (VIRTUAL)	Worrying trend of UTCI in Cuba. The impacts of climate change on Cuba's climate have been progressively presented in the country's periodic reports to the United Nations Framework Convention on Climate Change. The air temperature is increasing, faster at night than during the day, rainfall and cloudiness are decreasing due to the greater influence of the oceanic anticyclone of the North Atlantic, therefore, the solar radiation incident on the national territory is increasing and all this has repercussions on the ecosystems, man, animals and plants. Complex climatic indices such as the UTCI (Universal Thermal Climate Index) and other models that calculate man's heat balance, to determine the Thermoregulation index (M) are ideal for evaluating the behavior of thermal sensations experienced by human beings under very diverse environmental conditions. The analysis of the multiannual behavior of these indicators in Cuba during the period 2001-2020 allows us to appreciate the magnitude of the change in thermal sensations that affect the local population in the different regions of the country under the impact of global climate variability on Cuba. The results are presented in the form of maps, tables and trend diagrams for regions and localities of health and tourist

	interest in the country, since they constitute a fundamental baseline for the development of climate-therapy in Cuba.

Late Afternoon Parallel Sessions [3:30-5:00] **VENTANA ROOMS A and B**

Urban Biometeorology 3	**VENTANA A**
Stevan Savic	The concept of microclimate monitoring in diverse urban spaces during hot summer days A combination of increasingly hot summer days and urbanization processes in cities will further modify urban thermal conditions compared to climate in rural/non-urbanized environments, and as a consequence urban-rural and intra-urban thermal differences will be amplified. Obviously, that will increase heat load in cities and will intensify problems related to public health and urban environmental conditions, in general. Therefore, the climate monitoring on regional or local level is not sufficient anymore, and further spatially detailed monitoring is necessary, i.e., monitoring on micro-scale. The Novi Sad Urban Climate Research Team has developed the Mobile Micrometeorological Carts (MMCs) that enable detailed spatial and temporal (2 minute) measurements of air temperature, relative humidity, wind speed and direction, globe temperature, global radiation, and six-directional short- and long-wave radiation. In the summer 2022, ten field measurements were performed using MMCs with defined locations in the urban area of Novi Sad. The selected locations represented densely built-up zones, greenery areas within building blocks and urban parks. The concept of microclimate monitoring was based on synchronized measurement (from 10 AM to 6/8 PM) at a selected location with two MMCs that are 20 to 50 m apart. Through these measurements in different urban spaces, we would like to see in more details the impacts of grey area – green area – blue area – sun – tree shadow – building shadow – grass surface – concrete surface on microclimate conditions during hot summer days when it is expected the surplus of the heat. A more ideas about microclimate measurement concept are welcome to be performed in the summer 2023.
Jan Geletic	Sky view factor and its effects on thermal comfort in realistic urban environment The Sky View Factor (SVF) is a commonly used indicator of urban geometry. The availability of pedestrian-level SVF measurements has been fairly limited due to the high costs of field survey. Modern modelling approaches are based on precise GIS databases combining advantages of precise SVF calculation in fine-scale resolution and simulation of thermal comfort variables. In this contribution, we would like to present SVFs modelled in the PALM modelling system using Radiative Transfer Model (RTM) version 3.0 and their effect on thermal comfort in pedestrian level. The SVF in PALM is calculated explicitly by ray tracing. The algorithm takes into account all the resolved 3-D obstacles such as terrain and buildings (fully opaque) and plant canopy (semi-transparent depending on the resolved leaf area density), and its performance benefits greatly from the fact that most scenes contain only a limited amount of overhanging structures (i.e. the rest is a so-called 2.5-D geometry). The view from each calculated grid cell is discretized by a configurable fixed number of azimuth and elevation angles for which the rays are traced. We will demonstrate different effects of SVF including transparency of plant canopy on thermal comfort during heat-wave episode in Prague-Dejvice. Moreover,

	we will to discuss principles how to maximize mitigation effects of urban greenery in a complex urban environment using the large-eddy simulation model PALM.
Michal Lehnert	Could mental maps help to improve thermal comfort and reduce heat stress in urban areas? A case study of three Central European cities With increasing urbanization and climate change, citizens are more frequently exposed to heat stress. In the current pragmatists' discourse, efforts to adapt cities to deteriorating climate conditions should reflect not only the objective (physical) effect of the proposed measures, but also citizens' preferences, which influence the perception schemata and mental image of a place. This study employs the approach of mental mapping to identify mental hotspots and coldspots in three Central European cities. Personal behavioral adaptation measures and citizens' preferences for measures ameliorating thermal comfort in thermally uncomfortable areas are further analyzed. Mental maps can be used to improve thermal comfort and reduce heat stress by helping people navigate through the city in ways that minimize their exposure to excess heat. Mental mapping can also facilitate improvement of thermal comfort and reduction of heat stress by helping people locate and access resources that provide relief from the heat, such as public fountains, parks, or air-conditioned buildings. Mental maps allow us to identify and prioritize areas of the city that are most in need of interventions to improve thermal comfort and reduce heat stress. Results of our case study show that the most preferred measures are trees and parks and a combination of greenery with blue elements. Other measures, such as temporary greenery, green roofs and facades, exterior shading elements, water spraying and misting, and street sprinkling, are substantially less frequently proposed. However, there are spatial differences between the preferred measures, which we will analyze statistically. It turns out that it will be important to reflect these relationships in effective heat stress mitigation strategies and urban planning.
Tania Sharmin	Local climate zones in Cardiff and their connections with urban heat island and outdoor human thermal comfort Recent heatwaves have highlighted the need for UK cities to be better prepared for the impacts of increasing urban warming. During heatwaves, the urban heat island (UHI) effect can further increase air temperatures in urban areas, leading to increased heat stress, air pollution, and energy consumption. This can have negative impacts on human health, infrastructure, and the local environment. Despite being the capital of Wales there has been limited research to examine the UHI and outdoor thermal comfort (OTC) conditions in Cardiff, latter being a crucial indicator of the health and well-being of people using urban spaces. In this study, we have examined the UHI and OTC for the local climate zones (LCZs) for Cardiff. UHI map for Cardiff is generated from land surface temperature using Landsat 8 satellite image. To investigate the OTC, we have calculated mean radiant temperatures (Tmrt) for each available LCZs in Cardiff using the SOLWEIG model in a GIS platform. Then using the Tmrt and weather data for Cardiff, PET (Physiological Equivalent Temperature) thermal comfort index was calculated using the RAYMAN model. The findings of this study will help to identify vulnerable areas in terms of UHI and OTC and take mitigating measures accordingly, thus helping to improve the resilience of the city in a changing climate.
Muge Unal Cilek	Effects of surface cover and shade on courtyard thermal comfort in hot-arid Phoenix, Arizona

	Courtyards have been widely used in ancient architecture due to their socio-cultural and environmental benefits but are not common in modern design. Courtyards offer unique 2D and 3D geometric features to control sun-exposure, wind, and humidity in hot climates. This study aims to determine how surface cover and shade affect courtyard thermal comfort in hot-arid Tempe, Arizona using human-biometeorological observations and microclimate modeling. Three courtyards on Arizona State University's main campus with different dimensions, aspect ratios, surface cover, and landscaping were selected as study sites. First, we assessed the base case thermal environment in the three existing courtyards for a typical hot, dry, clear summer day in June using the microclimate model ENVI-met 5.0.1. For model validation, microclimate variables including air temperature (Ta), relative humidity (RH), wind speed (WS), and mean radiant temperature (MRT) were measured in-situ with the human-biometeorological instrument platform MaRTy. Second, we developed six courtyard design scenarios that vary surface coverage (water, concrete, and vegetation) and combined these scenarios with open sky versus shade-sail coverage, yielding a total of 12 scenarios. Courtyard thermal comfort was evaluated by MRT and Physiologically Equivalent Temperature (PET). To compare scenario results, spatially averaged differences in thermal exposure and comfort were assessed using ANOVA and Tukey HSD tests. Moreover, a hot-spot analysis revealed which areas in the courtyard were most affected by MRT changes. Results will inform optimal design strategies for courtyards in hot environments considering ground surfaces, vegetation, and shade coverage.

Human Health and Epidemiology 3	**VENTANA B**
Charles Simpson	Health-impact assessment of rooftop interventions on urban heat during a heatwave in London, England Excess mortality has been attributed to heatwaves and the urban heat island in cities worldwide. Changes to the built environment to increase albedo or decrease sensible heat have been proposed to mitigate urban overheating. In this study, we simulate the impact of cool roofs, green roofs, and solar photovoltaic (SPV) panels on 2 meter air temperature in London, England, and estimate the associated impact on heat-related mortality. We used the Weather Research and Forecasting model (WRF) with a detailed building-energy and urban parameterization scheme (BEP-BEM) to model the urban climate during the hottest days of 2018 at 1 km horizontal resolution. The control run was validated against Netatmo crowdsourced citizen weather stations, to better understand model accuracy across the urban landscape. We considered idealized scenarios where roofs were 100% covered by each intervention, as well as realistic scenarios based on GIS analysis (current green roof coverage, realistic potential green roof coverage and SPV coverage, full cool roof coverage on industrial buildings). Using exposure-response functions from epidemiological regression, we estimated the impact of these changes in temperature on the burden of heat-related mortality. In the full coverage scenarios, cool roofs decreased average temperature most, follow by solar panels, while green roofs decreased temperature during the hottest part of the day but slightly increased nighttime temperature leading to a smaller change in the average temperature. In realistic scenarios with lower coverage, the effect on temperature was less. As a result of having the largest effect on temperature, cool roofs also had the largest effect on estimated

	heat-related mortality. Whilst PV panels and green roofs showed more modest cooling, and may cost more to implement and maintain, they have biodiversity, carbon saving and energy production benefits. The inclusion of health benefits represents an important dimension of the potential co-benefits of sustainable adaptation measures.
Scott C Sheridan	Reducing Heat and Emergency Room Visits With Trees and High-albedo Surfaces in Los Angeles As the planet warms, there is an increasingly urgent need for strategies to prevent the heat-health impacts of climate change. Cooling urban neighborhoods by adding trees and vegetation and increasing solar reflectance (or albedo) of roofs, pavements, and walls can mitigate urban heat — a problem that disproportionately affects low-income communities and people of color. In a previous study, the Los Angeles Urban Cooling Collaborative looked at how various tree cover and albedo scenarios would impact heat and heat-related mortality in Los Angeles, both under a present and future climate. We found that roughly one in four lives currently lost during heat waves could be saved. We also found that climate change–induced warming could be delayed approximately 40–70 years under business-as-usual and moderate mitigation scenarios, respectively. In this follow-on study, we focused on heat-related morbidity as measured by emergency room visits. Using synoptic climatology, we used meteorological data for historical summer heat waves, classifying days into discrete air mass types. We analyzed those data against historical data on emergency room (ER) visits to determine excess and heat-related morbidity. We then used the Weather Research and Forecasting model to explore the effects that tree cover and albedo scenarios would have, correlating the resultant meteorological data with standardized morbidity data algorithms to quantify potential reductions in ER visits. We tested “prescriptions” of low, medium, and high tree cover and albedo changes and found that all-cause and heat-related ER visits would be reduced substantially — especially during moderate heat waves and during hot, dry Santa Ana heat events. ER reductions in the double-digit percentages were common, meaning that between 25% and 50% of ER visits could be avoided if L.A.’s urban environment had more trees and higher-albedo surfaces.
Parker King	Heat Exposure Mitigation Through Pavement Reduction Scenarios Extreme heat is a growing public health concern that demands equitable adaptive action to ameliorate. Paved surfaces (i.e., roads, sidewalks, and parking lots) are one known driver behind the formation of extreme heat microenvironments. Compared to natural land cover, paved surfaces generally have lower albedos, greater heat storage capacity, are highly impervious, and can cover as much as 40% of metro areas. Studies have found that extreme heat disproportionately affects communities of color and low-income areas in part due to the increased occurrence of pavement and lack of vegetation. The extent of pavement coverage within a community is governed in part by transportation infrastructure and zoning design standards as well as individual landowner decisions. We here seek to understand the potential public health impact of changes to these standards, specifically evaluating the potential to mitigate exposure to extreme heat through pavement reduction strategies including removal of excess pavement from parking lots or narrowing roadways. To do this, we leverage high resolution land cover data, a novel heat observation dataset, and a novel framework to evaluate exposure to extreme heat microenvironments at the household level using a household’s exposure to paved surfaces as a proxy for their exposure to extreme heat. The heat observation dataset was collected in nine cities and towns over the Summer of 2022 and used to

	determine the relationship between proximal pavement extent and ambient air temperature change. The novel heat exposure framework leverages statewide high-resolution land cover, parcel, E911 and census datasets. We will present our initial findings from several pavement reduction scenarios, including their effect on lowering heat exposure and heat exposure equity. This analysis focuses on the urban-rural continuum present in the state of Vermont, USA, but we anticipate our findings to be broadly applicable.
Andreas Matzarakis	The Heat Health Warning System in Germany – As part of heat actions plans Heat Health Warning System (HHWS) provide information for general public and public health. In Germany, weather Forecast is used to predict heat episodes, which are associated with negative health impacts. Therefore, a heat balance model of the human body and an extracted equivalent temperature (Perceived Temperature) is applied. Thresholds for strong and extreme heat stress based on thermal perception classification are used and build the first approach of the HHWS. Furthermore, the threshold of strong heat stress includes a short term adaptation component and considers the previous thermal stress conditions of the last 30 days. The second step includes nocturnal conditions, based on forecasted minimum air temperature or a simulated maximum indoor temperature for typical houses. The indoor temperature is calculated also based on a urban heat model for cities with a population over 100.000 inhabitants. Both criteria are important for the decision about warnings for the present and next days. Warnings are generated by daily weather forecast automatically and are additionally confirmed or adjusted by a biometeorological forecaster. The warning is valid on county level considering several elevation classes. The heat warning is available as a map on the internet and registered users can receive information by a daily newsletter. A specific smartphone app is also available for general use. The main target groups are the public, nursing homes and ministries of the federal states and other authorities. The HHWS with his regional differentiation of heat stress warnings is also part of the heat health action plans in Germany. HHWS is main part of the Heat action Plans in Germany.