Publication: Eurek Alert Online
Date: 24 February 2022
Headline: Mitigating heat impacts for cooler cities

Mitigating heat impacts for cooler cities

By Alistair Jones

SMU Office of Research & Tech Transfer – The life of a researcher is not for everyone, but for Yuliya Dzyuban, a Research Fellow in the new College of Integrative Studies at Singapore Management University (SMU), it's a perfect fit.

“With time, I realised that studying is what I do best and enjoy the most. Research offers opportunities for endless learning,” she says.

“There are always new projects, new challenges, new ideas and evolving methods. I love the fact that I can learn something new at work every day, be it reading a scientific paper, developing a method, or mastering a new tool.”

Dzyuban began her studies with a degree in architecture in her native Ukraine before her academic career was boosted by a Fulbright Scholarship.

“The scholarship opened a world of possibilities for me,” she says. “First, it gave me an opportunity to obtain a master’s degree in sustainability in a US university, which would have been impossible for me otherwise for several reasons. Coming from an economically disadvantaged country, I could not afford studying abroad. [And] a degree in sustainability was not offered in my home country at the time.

“The Fulbright Scholarship exposed me to a community of brilliant scholars and inspiring individuals from all over the world. It widened my network, which helped me in my further professional development.”

Publication: Eurek Alert Online
Date: 24 February 2022
Headline: Mitigating heat impacts for cooler cities

That professional development was again boosted recently when Dzyuban was awarded one of the inaugural 2022 SMU Research Staff Excellence Awards for her work within the Cooling Singapore (CS) team — a multi-disciplinary research project dedicated to developing solutions to address the urban heat challenge in Singapore.

Smart urban design

Supported by National Research Foundation Singapore, the CS project began in 2017 and has moved through two stages to reach the present CS 2.0.

“I joined SMU to work for CS 1.5 and carried on for 2.0. All my work is done under the umbrella of the project,” Dzyuban says.

“I explore how differences in the urban environment – such as, the configuration of urban form and presence of vegetation – influence people’s perceptions of heat, behaviour and health. To do that, I design and execute research projects, analyse data, and synthesise and disseminate results through various scientific and non-scientific mediums.”

One of Dzyuban's projects, which caught the attention of the Excellence Awards evaluation committee, is a heat walk method.

“Heat walk, or thermal walk, is a relatively new method that is used in thermal comfort studies to get a better understanding of how pedestrians feel while walking outdoors. I use it to expand the knowledge of how variations in urban form and presence of vegetation influence health and perceptions of heat of pedestrians,” she says.

“To do that, urban residents are asked to walk along a defined route in the city and answer questions in relation to their thermal state. In addition, they wear wrist sensors that measure pulse rate and skin temperature, which allows us to understand the connections between their thermal experiences and body responses.

“Simultaneously, we measure microclimate variables, [and the use of] a mixed-methods approach, combining human perceptions, health and microclimate data, allows us to get a deeper understanding of how to design more comfortable cities,” Dzyuban says.

Thermal perceptions

Another of Dzyuban's noted projects looked at the use of social media to report perceptions of thermal comfort and discomfort when the weather changes.

“For this project we used seven years of weather data for Singapore and Phoenix (in the US), together with Twitter data to explore whether social media can be used for assessment of thermal comfort of residents,” she says.

“We filtered the tweets that included the word ‘weather’, and then classified them into thermal comfort sensations as hot and cold. We found that even though there is only a 3°C average difference in air temperature for Singapore annually, residents were highly sensitive to hotter months.

“In other words, there were many more tweets cursing and complaining about how hot it was. This showed that social media can be an effective tool to gauge public thermal perceptions. Future work could include the usage of geotagged social media data, then we could potentially identify the most uncomfortable areas in the city for more targeted interventions.”

Publication: Eurek Alert Online
Date: 24 February 2022
Headline: Mitigating heat impacts for cooler cities

And why is the perception of heat, rather than just temperature and humidity data, so pertinent to CS 2.0?

“Temperature and humidity do not allow a full understanding of how an individual would feel outdoors,” Dzyuban says.

“For example, the amount of solar radiation a person is exposed to, being in the sun or shade, is the most influential thermal comfort parameter in a climate such as Singapore's.

“To account for that we use more complex thermal comfort indices, which allow us to estimate the compound effect of air temperature, wind speed, solar radiation and atmospheric moisture on the thermal comfort of a person. Such an index is integrated as one of the outputs in DUCT.”

Decision support system

The creation of DUCT – or Digital Urban Climate Twin – is the ultimate goal of the CS project.

“DUCT is essentially a federation of models with an online user-friendly interface which allows experimenting with various development scenarios to assess their impact on microclimate and thermal comfort,” Dzyuban says.

“For instance, interested parties will be able to see the differences in microclimate between different shapes and types of neighbourhood parks, differences in building form and height, as well as scenarios related to the implementation of centralised cooling systems and vehicle electrification. It is developed in partnership with Singapore agencies for their future use to assist in science-informed, long-term planning.”

Dzyuban says CS 2.0 is in the final development stage.

“We are finalising data collection, modelling, analysis and scenario development. The CS 2.0 team is working on integrating all the models into a comprehensive decision support system (DUCT) which eventually will be available for use by government agencies and other selected stakeholders.”

And what will come next after CS 2.0 for this dedicated researcher?

“I want to continue my work on developing heat mitigation strategies for cities. I have experience working on projects for some of the hottest cities in the world, such as Phoenix in the US, Hermosillo in Mexico, and now Singapore. They are also very different in their approach to governance and implementation of solutions. I am looking forward to expanding my international collaborations to other locations where my experience can be useful,” Dzyuban says.