RESEARCH NEWS

PALM-4U: urban planning for climate change

A simulation model to counter the climate collapse

As climate change progresses, extreme weather events such as prolonged hot spells, storms and heavy rain are occurring ever more frequently, and cities are feeling the strain. The new urban climate model PALM-4U will allow municipal staff and city planners to simulate the effects of their planned construction projects on the urban climate, so that they can gauge the consequences of extreme weather events before they happen, improve quality of life in urban areas and protect the health of the sick and the elderly. Researchers at the Fraunhofer Institute for Building Physics IBP created the user interface for the simulator, putting their many years of expertise in fields such as hygrothermics and indoor climate to good use.

Climate change poses challenges for us all, and city planners are no exception. Researchers expect the incidence of prolonged hot spells, heavy rain and storms to increase in the future. "Densely populated urban areas are particularly susceptible to these kinds of extreme weather events, and they do more than just affect people's well-being. For individuals that are weaker or experiencing poor health, e.g., people in retirement homes, daycare centers and hospitals, extreme weather events can actually be dangerous," explains Matthias Winkler, a hygrothermics expert at Fraunhofer IBP. This is why cities and municipalities are working intensively on planning construction initiatives that could help mitigate the consequences of climate change and make city climates manageable to a certain extent, thus maintaining and improving the quality of life in urban areas.

The PALM-4U urban climate model allows users to depict and simulate how construction projects impact the urban climate, which makes it a valuable resource for planning offices and municipalities. It could be used to simulate greening a facade or planting trees, for example, in order to find out whether these measures improve the citizens' thermal comfort levels. The urban climate simulator also makes it possible to identify spaces that are particularly badly affected by high temperatures and to model the impact that construction projects such as installing green spaces or unsealing surfaces would have on the climate in the surrounding areas before implementing them. Mr. Winkler and his team made their contribution to the complex tool by developing the PALM-4U GUI, a user interface that has a straightforward, logical structure and allows users to configure all the necessary functions and parameters.

PALM-4U was designed and developed as part of the Urban Climate Under Change initiative by the German Federal Ministry of Education and Research (BMBF). "With

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PALM-4U, users can not only determine the impact that construction projects will have on the climate, but also quantify it precisely," Mr. Winkler points out. This could also allow planners to assess whether investing in a particular building project would ultimately be profitable, or whether another initiative might have the same effect at a cheaper price.

The data basis for this tool is comprised of meteorological data from sources such as the German weather service (Deutscher Wetterdienst, DWD) and regional climate models. Municipalities can also incorporate weather data — such as temperature, humidity, wind speed and even the level of fine particulate matter in specific squares in the city — from any regional measurement stations they may have. In addition, the data basis will contain extensive geodata and city maps that show streets, squares, houses, bodies of water and green spaces. The more detailed and accurate the depiction of these elements is, the more reliable the PALM-4U simulation will be.

Thermal comfort, wind comfort and pollution levels

Urban climate analyses tend to focus on three groups of topics, beginning with thermal comfort and cold air flows at night. This topic includes the thermal load in buildings, squares and streets caused by high-pressure weather conditions, and the question of whether there are enough ventilation corridors to aerate the region overnight. For the second topic, wind comfort, regions with different wind comfort criteria are identified on the basis of the simulations and local wind statistics. This information can help draw conclusions regarding potential uses for the spaces in question, such as for outdoor catering, for example. The third topic involves analyzing the airborne fine particulate matter from sources such as domestic fires and automotive traffic — provided the relevant data is available.

Where needed, the PALM-4U GUI offers an expert mode, in which users can add further simulations based on their own specifications. "The tool is scalable and can model the climate of an entire city or an individual neighborhood, district or square," explains Mr. Winkler. To give just one of many possible examples, municipal staff and city planning offices can use the tool to test what effects constructing a high-rise would have on the building next door, the surrounding streets or the entire district.

Comparing different planning variants

The system comes pre-programmed with typical meteorological conditions suitable for simulating individual problems; the users can adjust these conditions to suit their own local specifications. For example, when studying thermal comfort, users can apply a model of summertime high-pressure weather conditions.

"With PALM-4U, we can also compare different planning variants with each other. This means we can avert typical planning errors early on, which would otherwise result in situations where children at a poorly designed playground would be exposed to high

levels of heat, for example," explains Sabine Giglmeier, a business development manager in the Hygrothermics section at Fraunhofer IBP. The simulator could also be used to work out tricky climate issues from as early as the planning phase when constructing an extension for a retirement home or hospital, for example.

Support and advice for municipalities

The simulation results can be analyzed and displayed via the user interface. When developing the user interface, the Fraunhofer IBP researchers made sure to incorporate feedback from experts working in practical fields. "We collaborated with municipal staff from cities like Berlin, Stuttgart and Dresden in order to gain a deeper understanding of their specific requirements and to optimize the system's suitability for practical application," says Mr. Winkler. Fraunhofer IBP's many years of experience and know-how, especially in fields such as hygrothermics and indoor climate, are also showing their worth here. The software is cloud-based, meaning there is no need to go through the expensive process of installing it and integrating it into existing IT systems.

Fraunhofer IBP also aims to support cities and municipalities when it comes to actually using PALM-4U. "We offer training courses for users, and we also provide advice on developing individual solutions for a city during actual operation of PALM-4U. When requested, we also conduct urban climate studies," explains Ms. Giglmeier.

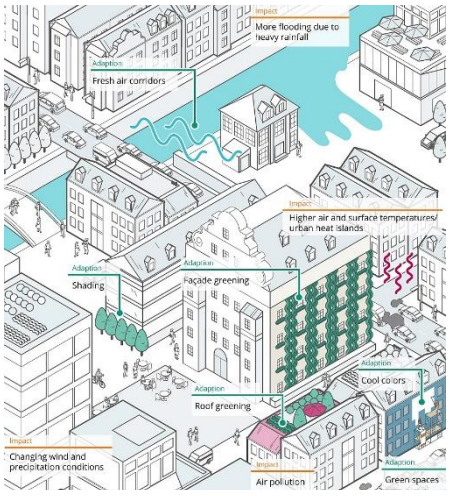

Fig. 1 The PALM-4U urban climate model analyzes the impact that urban development projects have on the local climate. This analysis can be scaled from the individual building or city neighborhood level up to entire cities.

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Fig. 2 The user-friendly operating interface PALM-4U GUI allows municipal and planning office staff to apply the model in their practical work.

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