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Impact of rivers and lakes on the thermal microclimate – a human-biometeorological perspective

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Urban areas are often located along shorelines of rivers or lakes. Those open water surfaces exchange heat and moisture with the atmosphere and influence radiation, wind and other meteorological parameters. Therefore, water surfaces influence not only temperature but all parameters that make up the thermal environment to which the human body responds. Hence, to evaluate urban water surfaces as a strategy for thermally comfortable design, a human-biometeorological assessment is necessary. To perform such an assessment for water surfaces with different characteristics and surroundings, is the aim of the current study.
To achieve this goal, the obstacle resolving MIcroscale TRansport And Stream model MITRAS is further developed. This includes a further development of the radiation scheme for both streets with and without vegetation. Additionally, an online calculation of the mean radiant temperature is implemented. The simulated values of mean radiant temperature, temperature, humidity and wind are used as input parameters for the two biometeorological indices Physiological Equivalent Temperature (PET) and Universal Thermal Climate Index (UTCI). These two indices differ in their complexity, in their treatment of clothing and in their sensitivity to the different input parameters. Therefore, this study applies both indices to perform a thorough analysis of the impact of urban open water surfaces.
Using MITRAS and the two thermal models simulations for an idealized city morphology inspired by the city of Hamburg, Germany and the river Elbe are carried out. The simulations differ in the characteristics of the water surface, such as water temperature and water depth, and in the surrounding city morphology. Using this set-up, not only the impact of the water surface on the thermal environment can be analysed but also the sensitivity of the impact on specific characteristics. Additional to the impact of the water surface on thermal microclimate in its direct proximity, also the size of the impacted area of the city will be presented. Based on the results, the value of water surfaces for thermal comfortable design in the context of human heat and cold stress will be discussed.