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Biometeorological modelling of historical centre of Prague city, Czech Republic

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Growing urban population represents, together with climatic changes, new challenge for urbanists, architects and local municipalities. People are strongly affected by their surroundings. Especially places with high percentage of impervious surfaces and concentration of people are uncomfortable for inhabitants during heat waves. In a real street, the thermal comfort of urban population is influenced by various factors, like surface materials, traffic volume, wind velocity, air temperature etc., while each surface has different physical characteristics. Historical city centres are represented by specific mixture of densely build-up areas, impervious surfaces and high concentration of people. Although there are several approaches to spatio-temporal modelling of thermal comfort, most of them use parameterizations of surroundings and a simplified meteorology.

PALM-4U is the first model based on large-eddy simulation (LES) approach which has implemented all necessary components for a very detailed modelling of urban areas. One of the key components of the urban modelling system is urban surface model (USM) which contains an energy balance solver for horizontal and vertical impervious surfaces and thermal diffusion in ground, walls and roof materials. Additionally, it includes a simple model to deal with anthropogenic heat sources.

Another fundamental part of PALM-4U is the multi-reflection radiative transfer model (RTM). It calculates interactions of radiation with land and urban surfaces for short-wave and long-wave radiation and it also has an integrated model of absorption of radiation by resolved plant canopy (i.e. trees, shrubs). The recent version 3.0 of RTM is able to calculate spatial and temporal distribution of the mean radiant temperature (MRT). The calculation is based on the same principles and discretization schemes as the calculation of radiation interactions, thus representing a methodologically correct way of MRT derivation. The values of MRT, together with other modelled meteorological values, form a basis for integrated calculation of biometeorological indices (UTCI or PET) done in a new biometeorology module. In this presentation we will show results of spatio-temporal modelling of biometeorological indices (UTCI and PET) using LES in historical centre of Prague city.