Human-biometeorological estimation of adaptation- and mitigation possibilities of urban green based on measurements and regional climate modelling in Southwest Germany

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The strongest impact on thermal bioclimate especially during summer conditions is evident by the modification of the different radiation fluxes, as well as by a modified wind field. Both are strongly dependent on the surrounding environment resp. urban morphology. Radiation in urban structures can be modified by shading, changing surface material and configuration of structures (aspect ratio, orientation). The modification of the local wind field by urban structures is more complex. Obstacles can cause stagnation that lowers wind speed, others might cause a recirculation or lead to wind channeling that increases wind speed.

The impact of the single meteorological parameters on thermal bioclimate can be best estimated by applying thermal indices, e.g. the physiologically equivalent temperature (PET) or the universal thermal climate index (UTCI). To assess thermal stress for humans, the results can be evaluated using the thermal stress classification for central Europe. This was estimated for five mid-sized to large cities in Baden-Wuerttemberg in South-West Germany for the determination of the current state conditions based on long term climate data.

For each city the thermal indices PET and UTCI have been calculated. Analysis of the results has been performed annually, seasonally, as well as for day and night pattern. Additionally the distribution of average hourly PET over the year was estimated.

To be able to predict the modification of thermal bioclimate by changes in urban morphology, first, the sensitivity of the indices to changes in air temperature (Ta), air humdidity (RH or VP), wind speed (v), and mean radiant temperature (Tmrt). Especially modifications in Tmrt and v seem to be quite promising. Both parameters are strongly driven by the urban morphology and can therefore be easily influenced by urban planning measures. Tmrt and v also show strong influence on heat stress for humans.

To get an insight on future conditions, both thermal indices have also been calculated based on data generated by regional climate model ensembles. The ensemble allows for a more precise estimation of the future climatic conditions.

Another option to assess future climate conditions is the usage of "Test Reference Years" generated by the German Weather Service (DWD). Both are used to assess future thermal bioclimate in the selected cities more accurately.