



## **Human thermal comfort modelling in urban micro scale – Application of RayMan and SkyHelios model**

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In order to analyze urban climate and bioclimate several meteorological input parameters are required (air temperature, air humidity, wind conditions and radiation fluxes) and also thermo-physiological information (metabolism and clothing). All the known thermal indices (PET, ...) require the same input parameters. In urban areas all the input parameters are modified, because of the different morphological characteristic and physical properties of the surfaces within a city. In this context the strongest modifications occur in the wind conditions and radiation fluxes. Radiation is modified mostly by the aspect ratio (height and width of streets or obstacles), orientation and physical properties (albedo, permeability and heat storage) and they have to be known for the estimation of the mean radiant temperature as well as short- and long wave radiation fluxes in general. In addition urban areas modify wind speed and direction because of increased roughness and distribution of obstacles. These two highly volatile and important factors modify the thermal comfort conditions strongly. They can be easily modified by urban planning and architectural measures in the micro scale.

The modelling is performed by RayMan model, which can calculate mean radiant temperature and thermal indices (PMV, PET, SET\*, UTCI and PT). For the calculation of mean radiant temperature RayMan is able to calculate short and long wave radiation fluxes based on several methods of spatial inputs environments (fish eye photos, geo-metrical characteristics of obstacles, free-drawing) and providing output of mean radiation temperature, shade, sunshine durations and thermal indices. Another model is the SkyHelios model. In contrast to RayMan model, SkyHelios allows for spatial calculations for thermal comfort (PET, UTCI, ...) and several input and influencing parameters. SkyHelios supports the calculation of PET, UTCI and PT. Various common spatial data formats can be used as input for the calculations.