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Contributions to urban heat island on the local neighborhood scale

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Already today around half of the global population is living in urban regions and recent studies expect a further increase until mid-21st century. Therefore, especially in the context of climate change, an increasing amount of urban inhabitants are affected by urban climate and air quality.
One special characteristic of urban climate is the urban heat island (UHI) effect, where urbanized regions are warmer than the rural surroundings. With respect to climate change and the growing urbanization it is obvious that the UHI effect will tend to be intensified. To keep our cities worth living, it is necessary to think about adaptation and mitigation strategies which refer to both, climate protection as well as utilization of chances resulting from climate changes.
One step to a more precisely adaptation, particularly on the neighborhood scale, is an improved understanding of the magnitude of bio geophysical processes (e.g.: radiation balance, convection efficiency, evapotranspiration, storage heat, anthropogenic heat etc.), which contribute to the urban warming. Considering that UHI can be expressed as temperature difference ΔT between urban and rural areas, we can interpret these processes as how they would change temperature, because of energy redistribution, from a rural area to an urbanized region. Up to now on the local scale there is a knowledge gap about these processes.
The mentioned processes are parts of a surface energy balance (based on the work of Zhao et al., 2014). That means they refer to the surface UHI effect and not to the canopy layer UHI effect. Assuming that the urban region is a volume with the top at the height of the canopy layer, we can approximately identify the surface UHI effect as the canopy layer UHI effect since the information comes from both the surface and the atmosphere inside. This assumption is not valid for Zhao's approach because they analyzed whole cities and could neglect such processes within the volume.
This contribution presents first results from my PhD project where I take micrometeorological simulations for a case study site ("Bayerischer Bahnhof" in Leipzig; Saxony, Germany; 51°20', 12°22') from the ENVI-met model and calculate the UHI as well as the contributing bio geophysical processes. The results are maps of the processes that directly quantify their contribution to the total UHI at each point in the area.
The benefits of this approach can be seen in the small resolution (3x3 m) of the simulation area which gives further insights into local UHI variances. Also, the effects of restructuring within quarters and methods to avoid adverse health impacts on the residents can be developed in a more precisely and sophisticated way.

Zhao, L., Lee, X., Smith, R.B., Oleson, K., (2014): Strong contributions of local background climate to urban heat islands. Nature 511: 216-219, doi: 10.1038/nature13462