Microclimatic characteristics of three different urban districts in a context of more frequent and intense heatwaves

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Located in the south-eastern part of France, the territory of the Greater Lyon consists in 59 communes covering an area of 524 square kilometres and housing a population of about 1.3 million. First signs of climate change have taking the form of a rise in average annual and seasonal temperatures and the number of very hot days, indicating that heatwaves can be considered as the main hazard to deal with. If the Greater Lyon has been fully involved for ten years in the national effort for a local reduction of greenhouse gases, the local adaptation policy is still being developed. It is up against several scientific obstacles in particular local climate measurement. To address this issue, this study proposes the first results of a multidisciplinary research at the crossroads between engineering sciences and humanities. It is now well known that characterising heat-related risk needs to identify the spatial components of the urban heat island phenomenon, which may amplify the impacts of coming heatwaves on citizens and urban systems (Romero-Lankao et al., 2012). A first mesoscale approach is currently led covering the whole Greater Lyon using remote-sensing and computer modelling but it does not allow to ensure an in-depth knowledge of the local microclimates.

As a first step to solve this problem, a map of human vulnerabilities has been displayed as an early result from a vulnerability index (Renard et al., 2015). This allowed identifying the most vulnerable urban districts of the Greater Lyon, which generally correspond to high density residential areas with rather different urban morphologies. Three different districts with high vulnerability values have been retained : "Lyon-Terreaux", in the historic old city ; "Lyon-Perrache", an ancient suburb in full renovation and "Rillieux-Semailles" in the residential suburbs.

A characterization of the related microclimate is completing this approach to evaluate the corresponding exposure in these three districts. Microclimatic simulations are currently performed using "SOLENE-microclimat" model, developed by the CRENAU Laboratory from the Nantes School of Architecture (Musy et al., 2015). This model has been chosen because of its capacity to take into account radiative transfers, conduction and storage in walls and soils, airflow and convective exchanges, evapotranspiration from natural surfaces (vegetation, water ponds, humidification systems) and the energy balance. A recent enhancement allows now its coupling with Code-Saturne Computer Fluid Dynamics (CFD) for a more accurate characterisation of local microclimates in terms of surface temperature, air temperature and velocity.

First results and analysis highlight some urban properties that significantly influence the local microclimatic conditions and human comfort, and which are especially challenging for urban planning, in a context of more frequent and intense heatwaves. Effects of urban morphology are especially stressed, while this factor may also be related to social and economic trends.

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