Urban weather generation: the intercomparison of three emerging models

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Cities modify the background climate through the surface-atmosphere interaction. This modification is function of urban design features, such as the configuration of buildings and the amount of vegetation. Compared to the undisturbed climate of the region, the climate of cities is characterized by higher temperature and lower wind speed. This modification is especially pronounce in dense urban areas. The climate modification of cities is not static, but varies in space and time. The spatial variations are governed by land use and built form differences, as well as by the presence or absence of green and blue infrastructures. Due to the spatial complexity of cities and the general lack of urban weather station networks in most places, the amount of available urban weather data is limited. As a consequence, planners, engineers and public health professionals can only approximate the climate impact of built environments in their respective fields.

Over the past years, several numerical simulation models have emerged that are able to model the influence of built areas on the atmosphere at the local scale and thus, deliver urban weather data for an area of interest. The aim of this study is to assess the performance of three numerical models with an ability to predict site-specific urban air temperature. The evaluated models are the Urban Weather Generator (UWG), the Vertical City Weather Generator (VCWG) and the Surface Urban Energy and Water Balance Scheme (SUEWS). Although the models differ in their scopes, modeling approaches and applications, they all derive the urban weather data from rural observations considering the land use and built form characteristics of the site.

The models are evaluated against air temperature measurements from the dense, 13th District of Budapest (Hungary). The field measurement utilized simple air temperature and relative humidity loggers placed in non-aspirated solar radiation screens at four shaded sites. The two week measurement period encompassed a five-day-long anticyclonic period with clear sky and low wind speed. Preliminary results indicate a good general agreement between modeled and observed values with root mean square error below or at 2°C and index of agreement between 0.92-0.96. During the anticyclonic period most models slightly overestimate the daily maximum and underestimated the daily minimum urban air temperature.