Cross-analysis between variability of the urban climate and the landscape heterogeneity at the scale of a neighbourhood for a subgrid parametrization in TEB model

Julien Le Bras, Noémie Gaudio, Aude Lemonsu, Dominique Legain, Valéry Masson

9th International Conference on Urban Climate – 20th-24th July 2015 (Toulouse, France)

Cross-analysis between variability of the urban climate and the landscape heterogeneity at the scale of a neighbourhood for a subgrid parametrization in TEB model

Julien Le Bras, Noémie Gaudio, Aude Lemonsu, Dominique Legain, Lina Quintero, Valéry Masson
Météo France, France;
julien.le-bras@meteo.fr

The temperature variations in urban environment are partly related to landscape characteristics. Following the recommendation of Stewart and Oke (2012), these landscapes or climate zones are defined at the scale of few hundreds of meters. Such a spatial resolution is also relevant for urban climate models, such as the Town Energy Balance (TEB) model that simulates pretty realistic temperature maps over a given city, including a spatial variability depending on urban landscapes arrangement. Nonetheless, TEB is not able to run some finer scale simulations, because of the street canyon hypothesis on which it is based. This is a limitation for urban climate studies because temperature variability at a very local scale may be of the same order of magnitude than at city scale. Thus, the aim of the study is to determine experimentally the variability of the temperature in a neighbourhood, to deduce a statistical model based on a set of explicative variables, and then to implement in the TEB model a parametrization able to quantify the subgrid temperature variability.
With this aim, three field experiments were carried out in a neighbourhood of three French cities: Paris, Marseille and Toulouse. For each city, the area covered about 1 km x 0.5 km and was composed of different urban fabrics. Five intensive observational periods were conducted in June 2013 in Marseille, in October 2013 in Paris and in January, April and June 2014 in Toulouse. For three successive days, every three hours, mobile pedestrian measurements of temperature, humidity and wind were continuously recorded along a predefined itinerary through the neighbourhood, with a GPS recording associated. A permanent network was also set up, composed of ten weather stations recording near-surface temperature, humidity, wind speed and direction, and completed by a roof-level reference station in order to document larger scale atmospheric variables including the incoming short- and long-wave radiation.
For each city, high-resolution geospatial databases have been produced in order to obtain geographical indicators relevant for the study. Thus fifteen indicators related to land-cover fractions and morphological parameters have been calculated. Each of them is calculated around each point of measurement of each city, in buffers of different sizes. The first step of the work is to determine which size is the most relevant for each indicator. Then, statistical relationships are found in order to express the temperature variability as a function of geographical indicators and larger-scale meteorological variables. Then, these relationships are implemented in the TEB model and compared with the temperature observed in each city.

Bibliography: Stewart, I. D., & Oke, T. R. (2012). Local climate zones for urban temperature studies. Bulletin of the American Meteorological Society, 93(12), 1879-1900.