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Very-high-resolution simulations with Harmonie-AROME of a heatwave case for the city of Pari with different landuse datasets.

Andrea Zonato and Natalie Theeuwes
Koninklijk Nederlands Meteorologisch Instituut, De Bilt, The Netherlands (andrea.zonato@knmi.nl)

In this work, various very-high-resolution simulations with the Harmonie-AROME Numerical Weather Prediction (NWP) model are performed for the city of Paris during an intense heatwave event in the summer of 2022, to evaluate the capability of the model to reproduce real conditions, at various resolutions and incorporating different kinds of landuse and urban morphology types.

In particular, simulations are performed using ECWMF operational forecasts at 9 km resolution as boundary conditions, for the operational 2.5 km runs. Moreover, two 500 m and 100 m resolution domains have been one-way nested in the parent one.

For considering the impact of urban areas, the state-of-the-art urban canopy parameterization Town Energy Balance (TEB, Masson et al., 2000), has been employed within the modeling system, and its single-layer and multi-layer options have been compared to evaluate the improvements brought by the multi-layer capability.

To test the impact of various urban morphologies, simulations have been run with 1) the default ECOCLIMAP-SG landuse at 300-meter resolution, which considers urban areas as 10 different categories, derived from the WUDAPT Local Climate Zones Classification, and 2) the Geoclimate urban morphology at 100-meter resolution, derived from the Open Street Map (OSM) database (Bernard et al., 2022). The latter employs the Open Street Map database to estimate close-to-reality urban geometries, with the help of a random forest technique to estimate missing building heights in the dataset.

The comparison with 79 in-situ observations shows that all the simulations are able to currently represent urban air temperature trends for homogeneous areas, such as the Paris city center and compact homogeneous areas.

On the other hand, heterogeneous and scattered urban areas temperatures are not well represented by both higher-resolution simulations and the category-based ECOCLIMAP-SG

landuse.On the contrary, the OSM-based landuse is sensible to city heterogeneity and horizontal variability.

Considering the 100-m simulations, it is clear that category-based land uses are not suitable for very-high-resolution urban canopy layer simulations, since they cannot truly capture the neighborhood-scale variation within the same city.

For this reason, it is important, with increasing NWP resolution, to employ suitable landuse datasets, coherent with the employed horizontal resolution and applicable physical parameterizations.