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Evaluating the implementation of the new urban parameterization for the ICON atmospheric model: results over Italy

Angelo Campanale[1], Marianna Adinolfi[1], Mario Raffa[1], Jan-Peter Schulz[2,1], and Paola Mercogliano[1]
[1]CMCC, REMHI Division, Caserta, Italy
[2]DWD, German Meteorological Service, Research and Development, Offenbach a. M., Germany (jan-peter.schulz@dwd.de)

The increasing in the resolution of atmospheric models for numerical weather prediction and climate simulations allows a more accurate description of the physical processes at urban scale. Furthermore, as the world continues to warm, urban areas are expected to face the brunt of the impacts due to large populations and higher temperatures.

In all this scenario, the interest in proper modelling the physical processes in urban areas has gained wide attention from the research community. In particular, the convection-permitting atmospheric models, associated with urban parameterizations, are able to resolve the heterogeneity of cities with applications for heat stress assessment and the development of urban climate adaptation and mitigation strategies. Generally, these schemes parametrize the effects of buildings, streets and other man-made impervious surfaces on energy, water and momentum exchanges between surface and atmosphere, accounting also for the anthropogenic heat flux, as a heat source from the surface to the atmosphere due to human activities.

In this perspective, a bulk urban canopy parameterization, TERRA_URB, has been developed for the multi-layer land surface scheme of the COSMO regional atmospheric model. This parameterization has already demonstrated to be able to properly take into account the overall properties of urban areas and to correctly reproduce the prominent urban meteorological characteristics for different European cities. Thus, in the framework of the transition from the COSMO model to the new Icosahedral Nonhydrostatic (ICON) Weather and Climate regional model, TERRA_URB needs to be implemented in ICON.

In this work, we present the results for TERRA_URB in the ICON-LAM (limited area model), for some cities of the Italian peninsula at 2km resolution. The main outcome of this study is that the porting of the TERRA URB scheme in ICON is satisfactorily completed, and it reasonably reproduces urban effects, like Urban Heat Islands, while improving air temperature forecasts for the investigated urban areas. The results constitute an updating of numerical weather prediction and climate simulations for urban modelling applications, although further investigations aimed at enhancing the calibration of the model parameterization and introduction of more realistic urban canopy parameters are needed.