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Simulations with COSMO-CLM over Turin including TERRA-URB parameterization

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The increase of built surfaces constitutes the main reason for the formation of Urban Heat Islands (UHIs), since urban canyons block the release of the reflected radiation. The main contribution to the formation of UHIs is the missing night-cooling of horizontal surfaces, together with cloudless sky and light winds. Of course, there is also a contribution from indoor heating, vehicles presence, and waste heat from air conditioning and refrigeration systems.
The COSMO-CLM model, even at high resolution, is currently not able to cope with this effect. Nevertheless, the increase of applications in which a high number of grid points is located over urban areas, requires that COSMO-CLM becomes able to take into account also urban climate features. In fact, they are crucial for better forecast of temperature and for a better characterization of the local patterns of several atmospherical variables (wind, surface fluxes).
Recently TERRA-URB, a bulk parameterisation scheme with a prescribed anthropogenic heat flux, has been incorporated into COSMO-CLM for the standard land-surface module TERRA-ML. It offers an intrinsic representation of the urban physics with modifications of input data, soil module and land atmospheric interactions.
In the first half of July 2015, Piemonte region and Turin in particular experienced extreme temperature values and uncomfortable conditions for the population. In Turin, the maximum temperature since 1990 (38.5°) has been recorded in July 2015. Ground stations data highlighted the presence of a UHI effect over Turin. This is the reason why this area and this period represent a suitable benchmark to test the capabilities of COSMO-CLM, and in particular of the urban parameterization. The computational domain considered is centered over Turin, discretized with 100 x 100 grid-points, employing a spatial resolution of 0.009° (about 1 km). The ECMWF IFS analysis at 0.075° have been used as forcing data. Two simulations have been performed over the period 1 to 7 July 2015, respectively activating and deactivating TERRA-URB, in order to highlight its effects on the model results. Moreover, a third simulation has been performed with TERRA-URB activated, but employing an optimized model configuration. Validation has been carried out against an observational dataset for daily values of temperature, provided by ARPA Piemonte. More specifically, Consolata and Bauducchi stations have been considered, respectively representative of urban and rural areas. Results have highlighted that in Consolata the minimum temperature is simulated better when TERRA-URB is activated, while in Bauducchi no significant differences have been recorded among the simulations. The daily maximum temperature is always overestimated in both stations. Finally, the usage of an optimized configuration allowed a slight improvement of the results.