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An assessment of urban heat island effect adopting urban parameterizations in COSMO-CLM simulations over big cities in Northern Italy

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In Europe, about 80% of people live in urban areas, which most of them can be particularly vulnerable to climate impacts (e.g. high air temperatures along with heat waves, flooding due to intense precipitation events, water scarcity and droughts). In fact, the density of people and assets within relatively small geographic areas, such as an urban settlements, mean more risk exposure than in rural areas. Therefore, reliable numerical climate models are needed for elaborating climate risk assessment at urban scale. These models must take into account the effects of the complex three-dimensional structure of urban settlements, combined with the mixture of surface types with contrasting radiative, thermal and moisture characteristics. In this respect, previous studies (e.g. Trusilova et al., 2013) have already assessed the importance to consider urban properties in very high resolution regional climate modeling to better reproduce the features of urban climate, especially in terms of urban heat island effect. In this work, two different configurations of the regional climate model COSMO-CLM at the horizontal resolution of 0.02° (about 2.2km), one including urban parameterization scheme and another without including them, have been applied in order to perform two different climate simulations covering the entire northern Italy. In particular, the present study is focused on large urban settlements such as Milan and Turin. Due to high computational cost required to run very high resolution simulations, the results of the two simulations have been compared over a period of ten years, from 1980 to 1989. Preliminary results indicate that the modification of climate conditions, due to the presence of urban areas, is present mainly in the areas covered by big cities and surrounding them, or rather the presence of urban areas induces modification mainly in their local climate. Other evidences are that the simulation including urban parameterization scheme shows, in general, higher two meter temperatures, especially in terms of maximum values; for example, a difference up to 2.5°C is found in the area surrounding Milan that is the biggest city present in the spatial domain considered. The seasons most influenced by the presence of urban schemes turn out to be spring and summer. As expected, for precipitation, instead, the differences found are very slight, without a specific correspondence with urban areas. Finally, consistently with similar literature works, a general reduction of both evaporation and 2 meter relative humidity are found. This preliminary analysis shows that the effect of urban areas is not negligible considering the current climate conditions; future works will investigate the combined effect of the modification of locale climate induced by urban effects, and of climate change conditions expected in XXI century.