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A canopy layer model to describe the urban heat island in Rome

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Rome is one of the largest towns in southern Europe. Climate change is likely to become an important aspect to be taken into account in urban planning. The model described, provides a possible starting aid for the design of urban development. The model, based on four energy balance equations at ground level and at building level, was developed to simulate and describe the urban climate and the Urban Heat Island (UHI) phenomenon. The urban setting was modelled as made of parallelepiped buildings, spaced out by street canyons. Thermal and radiative characteristics of urban and rural surfaces as well as atmospheric parameters related to the general synoptic conditions were used as data input. As output, the model provides skin temperature of buildings, air temperature and humidity within the canopy layer and hence the mean surface temperature and the air temperature at 2m above ground. The model was applied to Rome in two radiative summer and winter episodes of the year 1999. The city was divided into 23 zones of different urban density, ranging from 0.05 for rural sites (countryside or parks) to 0.7 for the high density city centre. The analysis of modelled isothermals at ground shows that the UHI is a nocturnal phenomenon, present both in winter (the greatest difference between urban and rural temperatures is about 2°C) and summer (the temperature difference is about 5°C), mainly resulting from the urban geometry and the heat storage in buildings. The horizontal shape of the heat island results characterised by two warm cores (where the urban density is bigger), divided by the parks at north and south (where temperatures are lower). The monthly nocturnal behaviour of heat island shows that the mean maximum intensity of temperature differences between urban and surrounding rural areas occurs during the heat season, when the solar input is higher, while the anthropic contribute seems to be not significant.