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Assessing the effect of wind speed/direction changes on urban heat island intensity of Istanbul.

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City or metropolitan areas are significantly warmer than the outlying rural areas since the urban fabrics and artificial surfaces which have different radiative, thermal and aerodynamic features alter the surface energy balance, interact with the regional circulation and introduce anthropogenic sensible heat and moisture into the atmosphere. The temperature contrast between urban and rural areas is most prominent during nighttime since heat is absorbed by day and emitted by night. The intensity of the urban heat island (UHI) vary considerably depending on the prevailent meteorological conditions and the characteristics of the region.
Even though urban areas cover a small fraction of Earth, their climate has greater impact on the world's population. Over half of the world population lives in the cities and it is expected to rise within the coming decades. Today almost one fifth of the Turkey's population resides in Istanbul with the percentage expected to increase due to the greater job opportunities compared to the other cities. Its population has been increased from 2 millions to 14 millions since 1960s. Eventually, the city has been expanded tremendously within the last half century, shifting the landscape from vegetation to built up areas. The observations of the last fifty years over Istanbul show that the UHI is most pronounced during summer season. The seasonal temperature differences between urban and suburban sites reach up to 3 K and roughly haft degree increase in UHI intensity is observed after 2000.
In this study, we explore the possible range of heat load and distribution over Istanbul for different prevailing wind conditions by using the non-hydrostatic $MUKLIMO_3$ model developed by DWD (Deutscher Wetterdienst). The study is focused on the spatial gradients of temperature, humidity and winds during summer. The model run by the average temperature and humidity vertical profiles over Istanbul during summer season with 200 m resolution. A series of sensitivity tests are carried out for different wind speeds (1-5 m/sec) and prevailing wind directions. Land use data are created by combining the geographical data obtained from Istanbul Metropolitan Municipality and CORINE Land Cover Raster Data. The land use table involves 25 land use types. The residential areas are classified considering the percentage of the building coverages and the average height of the buildings within the grid cell. The associated parameters in land use table of MUCLIM3 are modified accordingly. Simulations show that the urban model MUCLIM3 is able to capture typical observed characteristics of urban climate of Istanbul qualitatively. The UHI effect at night is stronger at low wind speeds, depending on the two competing factors: reduced cold advection from outlying rural areas and the magnitude of the sensible heat flux over cities which offsets the reduced advective cooling. The preliminary results of the sensitivity tests are discussed by concentrating on the changes of the hot spots in Istanbul, the diurnal cycle range over different land use types at different reference levels of 5m, 30m and 50m, and the vertical profile of the meteorological variables in relation to the sea-breeze circulation.
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