EMS Annual Meeting Abstracts
Vol. 12, EMS2015-37, 2015
15th EMS / 12th ECAM

Impact of Land-Use Types and Urban Canopy Structure on Urban Heat Island via High Resolution WRF Modeling: Istanbul Case Study

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During the last several decades, population growth accelerated urbanization around the world and currently over 54 percent of the people are living in cities. Increase in urbanization not just change the albedo by changing land use (i.e. converting green land into pavement) but also adds heat to the atmosphere via domestic heating and traffic emissions. There have beeen many studies focusing on Urban Heat Island problem either by analyzing measurements or use of modelling techniques. However, in modeling approach, generally simplifications of high complex topography cause high uncertainty. In order to reduce this uncertainty, in this work we utilized urban canopy model in high-resolution Weather Research and Forecast (WRF) modeling and quantified the impact of land use change on Urban Heat Island (UHI) problem. For this purpose, the WRF Model was used to simulate the time period from Dec, 30th 2013 to Jan, 6th 2014 due to calm wind condition. The modeling domain included 27, 9, 3 and 1 km spatial resolution and 20-Classes Modis 30s land use data. We designed four high-resolution experiments over Istanbul and surrounding areas. In the first experiment, land use (LU) type was kept the same as original Modis 30s static data. In the latter experiment urban and built-up category is changed to croplands. In the third simulation, forested area located in the Northern Istanbul was changed to Urban in order to understand the magnitude of the problem. Finally, in the last simulation, Single Urban Canopy Model (UCLM) was implemented. For each scenario, UHI index was calculated using temperature at 2-m (T2m). T2m maps and MODIS Terra/Aqua Land Surface Temperature (LST) were compared for all cases. This paper will present the findings of sensitivity analysis of UHI according to LU changes and comparison of the UHI index over the interested area.

Keywords: UHI, UCLM, WRF, land-use change, sensitivity