

## Study on the Urban Heat Island in Sofia City: Numerical Simulations with Potential Natural Vegetation and Present Land Use Data

\*Lidia Lazarova Vitanova<sup>1</sup>, Hiroyuki Kusaka<sup>2</sup>

1. Graduate School of Life and Environmental Sciences, University of Tsukuba, 2. Center for Computational Sciences, University of Tsukuba

This study is the first attempt to investigate the actual conditions of the urban heat island (UHI) and the impact of urbanisation on the temperature distribution in Sofia City. The observational network data show that in the morning at 0600 LST, the surface air temperature in the central station of Sofia City is 1.6–2.4 °C higher than those of the other suburb stations, while at 1500 LST, this temperature difference decreases to approximately 0.5 °C. To evaluate the impact of urbanisation on the temperature distribution in Sofia City, the Weather Research and Forecasting (WRF) model with a 1 km horizontal resolution was used. Three experimental cases were conducted: (i) URB2012, (ii) PNV and (iii) LU2012. Here, case URB2012 is a control case, case PNV is a potential natural vegetation experiment without any human intervention, and case LU2012 is the same experiment case as URB2012 but without anthropogenic heat (AH) release. The simulated results from the URB2012 case were compared with the observations. The WRF model well reproduces the observed temperatures in Sofia City and its surrounding stations, giving the mean biases of -0.64 °C to 1.33 °C. The simulated monthly mean temperatures in July were compared between the URB2012 and PNV cases. The results indicate a significant nocturnal (2000–0700 LST) temperature increase of 3.4 °C in the central part of Sofia City, while in the daytime (0800–1900 LST), it is only 0.3 °C. Additionally, a comparison between the URB2012, PNV and LU2012 cases was evaluated. The results show that the land use change between natural vegetation and the present case contributes by increasing the temperature at night by 2.8 °C (82%), while due to the AH release, the temperature increases only by 0.6 °C (18%) in the central part of Sofia City.

Keywords: urban heat island, urbanisation, potential natural vegetation, land use change, anthropogenic heat, Weather Research and Forecasting model