EGU23-9500, updated on 02 May 2023
https://doi.org/10.5194/egusphere-egu23-9500
EGU General Assembly 2023

Investigating links among heatwaves, precipitation, and land use types using the Convection-Permitting Model in the Southwest UK for the 2022 boreal summer

Kwok Pan Chun[1], Yasemin Ezber[2], Emir Toker[2], Michelle Simões Reboita[3], Rosmeri Porfirio da Rocha[4], Bayu Christoforus Risanto[5], Omer Yetemen[2], Thanti Octavianti[1], Nevil Quinn[1], Omer Lutfi Sens[2], and Christopher Castro[5]

[1]Department of Geography and Environmental Management, University of the West of England
[2]Eurasia Institute of Earth Sciences, Turkey
[3]Federal University of Itajubá, Brazil
[4]University of Sao Paulo, Brazil
[5]Department of Hydrology and Atmospheric Sciences, University of Arizona

To improve sub-seasonal forecasts, different global initiatives generate continental convection-permitting simulations for resolution less than 10 kilometres for multiple decades. These simulations, however, are based on land use maps with only single urban type. In this study, we explore how the density and height information of the urban canopy based on Local Climate Zones (LCZs) affect the dynamics among temperatures, precipitation and land use types for the 2022 summer heatwave in the Southwest UK. Four numerical experiments at a 3 km grid are run by switching off the parameterization of deep-convection in the Weather Research and Forecasting (WRF) models. These experiments are based on (i) the no urban scenario, (ii) the default MODIS land use scheme, (iii) the building environment parameterization (BEP), and (iv) the building energy model (BEM).

Results show that the cold advection over the UK led to downward motion according to a Q-vector analysis. The regional downward motion caused the formation of a heat dome. It is against the hypothesis that the 2022 summer heatwave was due to the hot circulation from Spain and equatorial Africa. Even though four land use schemes have similar simulated cold advection across the UK, our findings show that land use types affected water recycling due to local convection differently. These differences were related to the strength of rainstorms at the dissipating heatwave stage. Our results suggest that urban areas were more likely to have more persistent heatwaves since the intensity of rainstorms was affected by the lower local water recycling. This advanced understanding of the UK heatwave mechanism based on regional advection conditions and local convection processes will guide us on how to improve our sub-seasonal forecast in the urban area.