The influence of land use/cover types on the surface urban heat island efect. Insights from urban areas of Southern Romania

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INTRODUCTION

The current study investigates the LandSurfaceTemperature (LST) – LandUse/Cover (LUC) relationship and its contribution to the shape and size of the nighttime and daytime surface thermal environment in eight selected cities of southern Romania. The study relies on LUC data derived from the **Urban Atlas dataset** from Copernicus Land Monitoring Service to investigate the **LST** (retrieved from **MODIS** sensors) responses to the underlying urban **LUC** and to detect LST-LUC hotspots under persistent heat waves episodes registered over the 2000-2013 interval. In this approach four main LULC types have been considered to reflect both the **local exposure** (impervious areas, yellow areas/arable land) and **coping capacity** (green and blue areas) to heat waves within the administrative boundaries of selected urban areas.

NATIONAL AND LOCAL CONTEXT

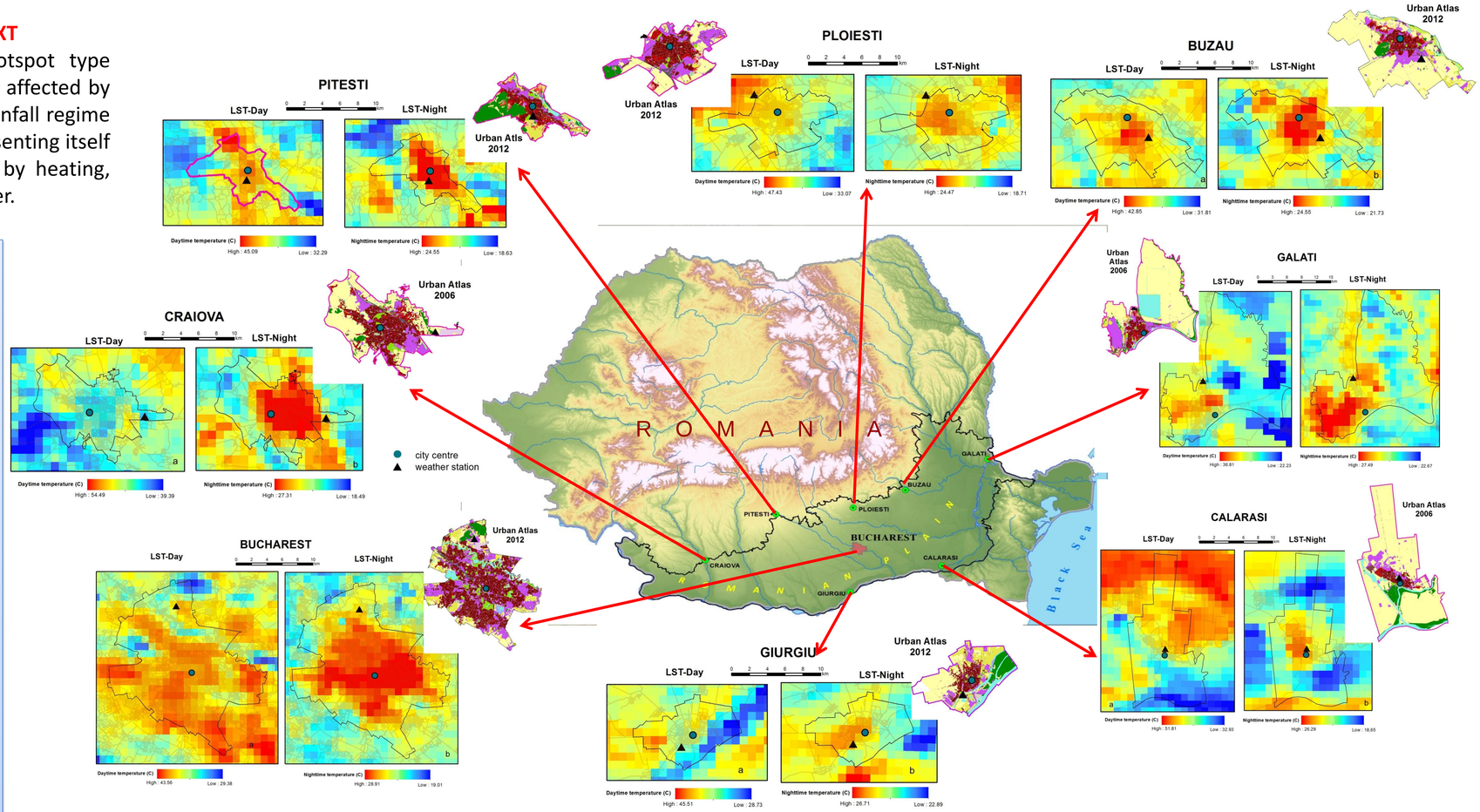
The Romanian Plain is a hotspot type region at national level, visibly affected by changes in the thermal and rainfall regime over the last two decades, presenting itself as a region strongly affected by heating, especially in winter and summer.

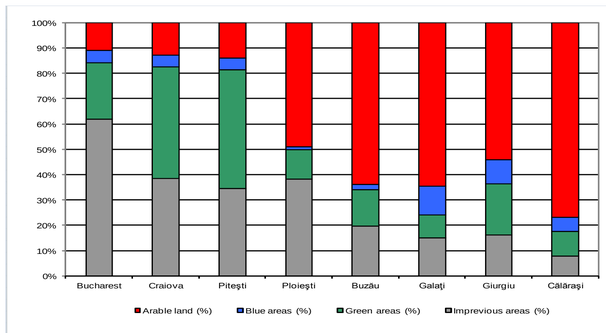
STUDY AREA

The eight cities distributed across the southern part of Romania (Romanian Plain) were selected for their regional importance as reflected by the following criteria: being the Capital-city or county residence; being important economic and commercial centres at regional scale; being under a rapid urbanization over the last decades.

In terms of land use/cover (LUC), all cities have a high share of artificial lands (impervious/built-up areas), represented by impervious areas (**IMP**) of different sealing densities. Other features comprise LUC types with green (**G**) (e.g. green urban areas, forest) and blue (**B**) (water and wetlands) footprints.

A distinct LUC feature, specific to the medium- (e.g. Călăraşi, Giurgiu, Buzău) and some large-size cities with spread-out developments (e.g. Piteşti), is given by the presence of the extensive croplands, herein generically assigned as "yellow" (**Y**) areas.





Share of LUC components relevant for defining the urban climate in the selected cities

METHODOLOGICAL APPROACH

Comprises of four steps:

1. ***Heat wave identification*** - (HW) defined as intervals when both maximum (daytime) and minimum (nighttime) temperatures exceeded the daily 95th percentile at least two consecutive days. We retained for the analysis of LST spatial variation only the most extreme HW episodes (meaning the maximum number of consecutive heat wave days).
2. ***Generate the four LUC categories (IMP, Y, G, B***) The shares of these LUC types have been estimated from the UA dataset and amended with the data available from Copernicus Street Tree Layer (STL) dataset.
3. ***Analysis of LST spatial patterns*** *and four surface UHI and three LUC-based indicators*
4. ***Identification of Urban LUC typologies*** using the proposed methodologies and research findings of previous studies documenting urban adaptation to climate change (*Swart et al., 2012; Timmerman et al., 2016*) based on European-level illustrative examples. In the current study, these typologies were adapted to the environmental conditions of the target cities, particularly the shares of the key LUC components for LST distribution. They will be further used in framing each target city into a certain typology in order to understand the LST-LUC relationship under persistent extreme temperature conditions.

RESULTS

The main findings of the study suggest a strong relationship between LUC and LST and similar spatial LST variation patterns in heat wave conditions in all target cities. E.g. cities with high degree of soil sealing (up to 60%) and reduced share of green or blue urban areas (generally below 22% and 5%, respectively) (e.g. Bucharest) are experiencing large LST suggesting a great exposure to heat stress of urban population, with likely negative heat-health effects. Also, extended arable land within the administrative boundary of some cities (e.g. Buzău, Giurgiu) linked to very high LST values (especially during daytime – e.g. in Craiova or Călărași) are driven by the thermal properties similar to the bare soil which heats faster than the vegetation-covered soil. On the other hand, in some cities, the increased shares of blue (e.g. Galați) and green (e.g. Craiova, Pitești) areas have shown significant cooling effects despite the extended impervious surfaces.

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