METEO ROMANIA

A country scale assessment of the heat hazard-risk in urban areas

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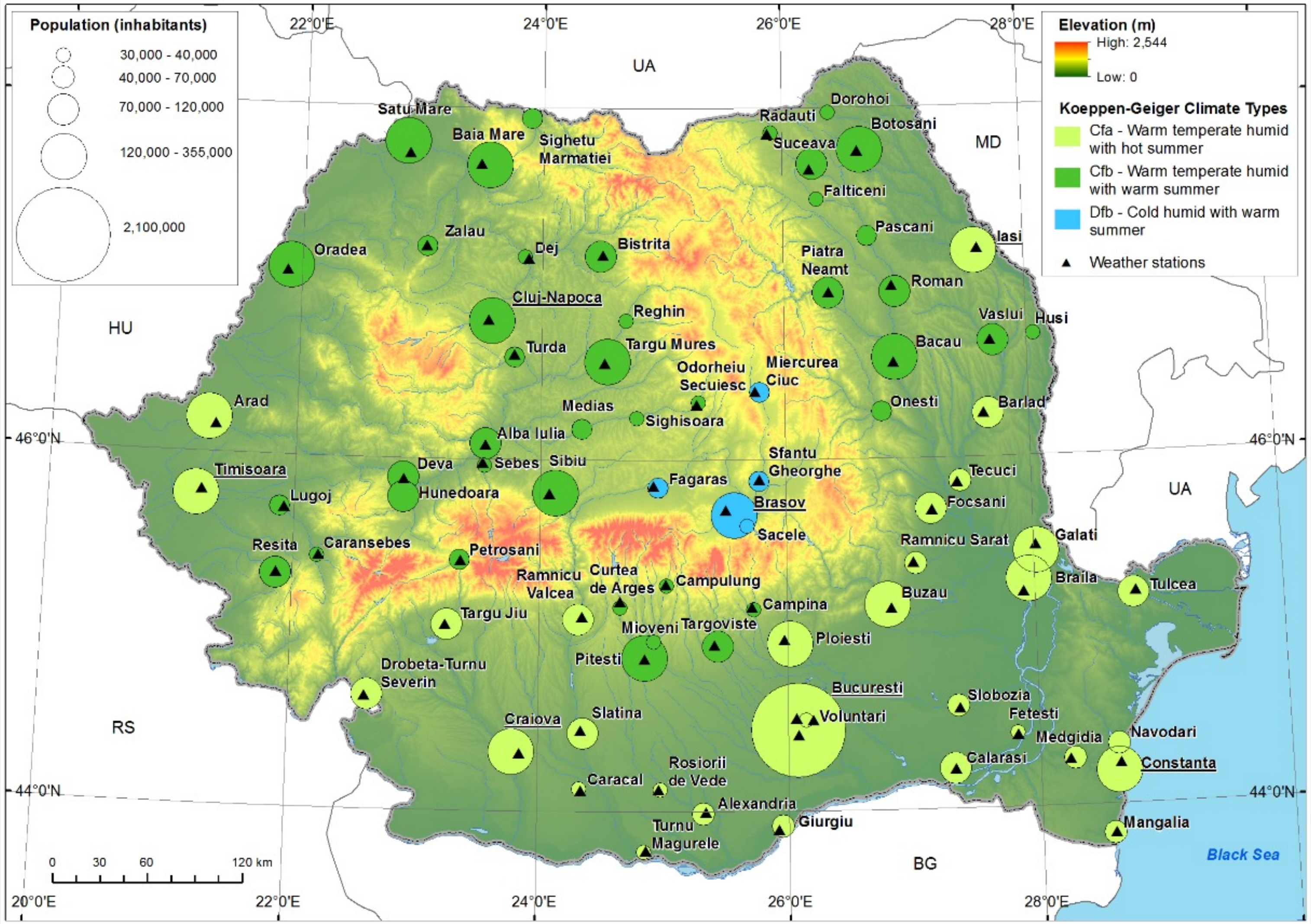
1. Objectives

- Perform a country-scale assessment of the Heat Hazard-Risk (HHR) over the most populated urban areas in Romania
- To develop an EO-based service to produce the real-time HHR monitoring and to support the urban planning at country scale.

2. Study area



- 77 cities in Romania
- at least 30,000 inhabitants

3. Data and methods

- MODIS LST_cci products (LST_cci): customised TERRA_MODIS_L3C and AQUA_MODIS_L3C produced within the project LST_cci+ (CCI LST, 2020).
- The products are available four times per day, i.e., 2 night- and 2 day-time images, at 1 km spatial resolution (Bechtel, 2015; Phan & Kappas, 2018).
- The overpass time of the images used in this study ranges between 08:01 and 12:12 UTC (daytime), and between 19:01 and 01:12 UTC (nighttime).
- Time span: 2000-2018

3. Data and methods

- **Risk matrix approach; R = HH x V**
- **heat hazard** (HH) triggered by high temperatures (i.e. LST),
- **vulnerability** (V) associated with the urban structure (i.e. LCZ), and population density (i.e. PD).

- Step 1: Computing the **heat hazard layer**
- Step 2: Computing the **vulnerability layer**
- Step 3: Computing the **Heat Hazard-Risk**

3. Data and methods

- Step 1: Computing the **heat hazard (HH) layer**
- Step 2: Computing the **vulnerability layer**
- Step 3: Computing the **Heat Hazard-Risk**

$$HH = \sum(nLST_{d40} + nLST_{n20})$$

HH = cumulated number of cases when LST > 40 °C during daytime ($nLST_{d40}$), and/or LST > 20 °C during nighttime ($nLST_{n20}$)

3. Data and methods

- Step 1: Computing the **heat hazard layer**
- Step 2: Computing the **vulnerability (V) layer**
- Step 3: Computing the **Heat Hazard-Risk**

$$V = \frac{LCZ + PD}{2}$$

Urban vulnerability (V) to HH was computed as an average between the LCZ and PD

3. Data and methods

- Step 1: Computing the **heat hazard layer**
- Step 2: Computing the **vulnerability layer**
- Step 3: Computing the **Heat Hazard-Risk**

Heat hazard-risk matrix combining HH (defined by LST_cci), and V (defined by LCZ and PD).

V (LCZ; PD)	HH (LST_cci) 1 (very low)	2 (low)	3 (average)	4 (high)	5 (very high)
5 (very high)	5	10	15	20	25
4 (high)	4	8	12	16	20
3 (average)	3	6	9	12	15
2 (low)	2	4	6	8	10
1 (very low)	1	2	3	4	5

HHR classes

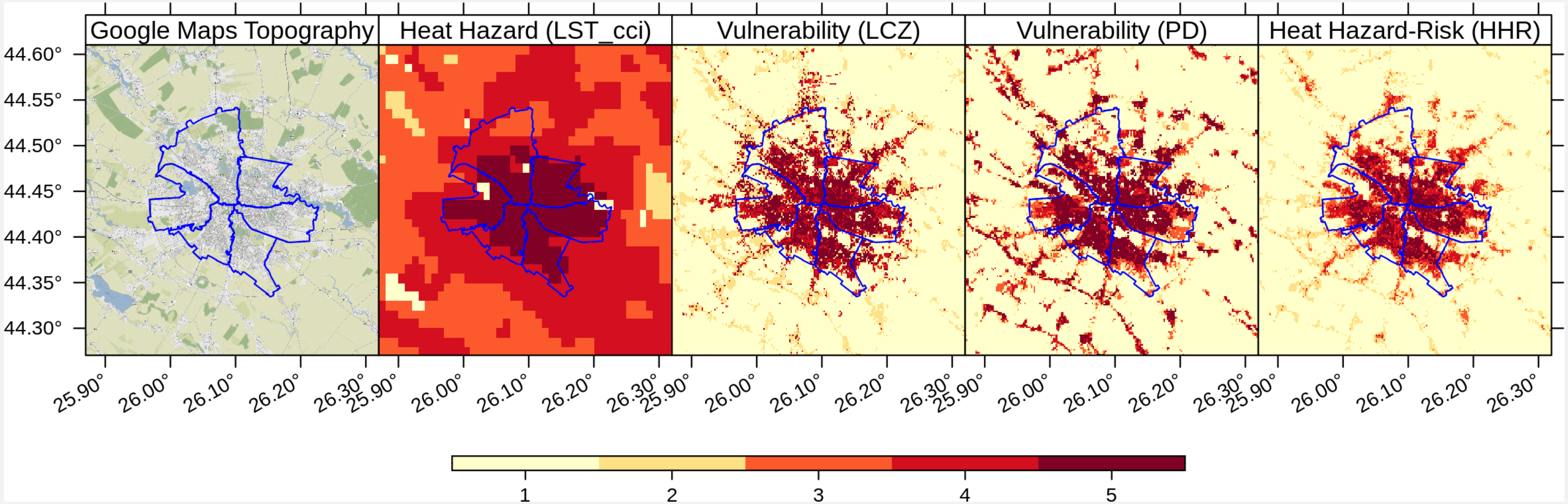
1 <= HHR <=5: very low risk (HHR=1)
6 <= HHR <=10: low risk (HHR=2)
11 <= HHR <=15: average risk (HHR=3)
16 <= HHR <=20: high risk (HHR=4)
21 <= HHR <=25: very high risk (HHR=5)

The HHR was computed for each city using a risk matrix approach, as a product between (1) HH and (2) V

$$HHR = HH \times V$$

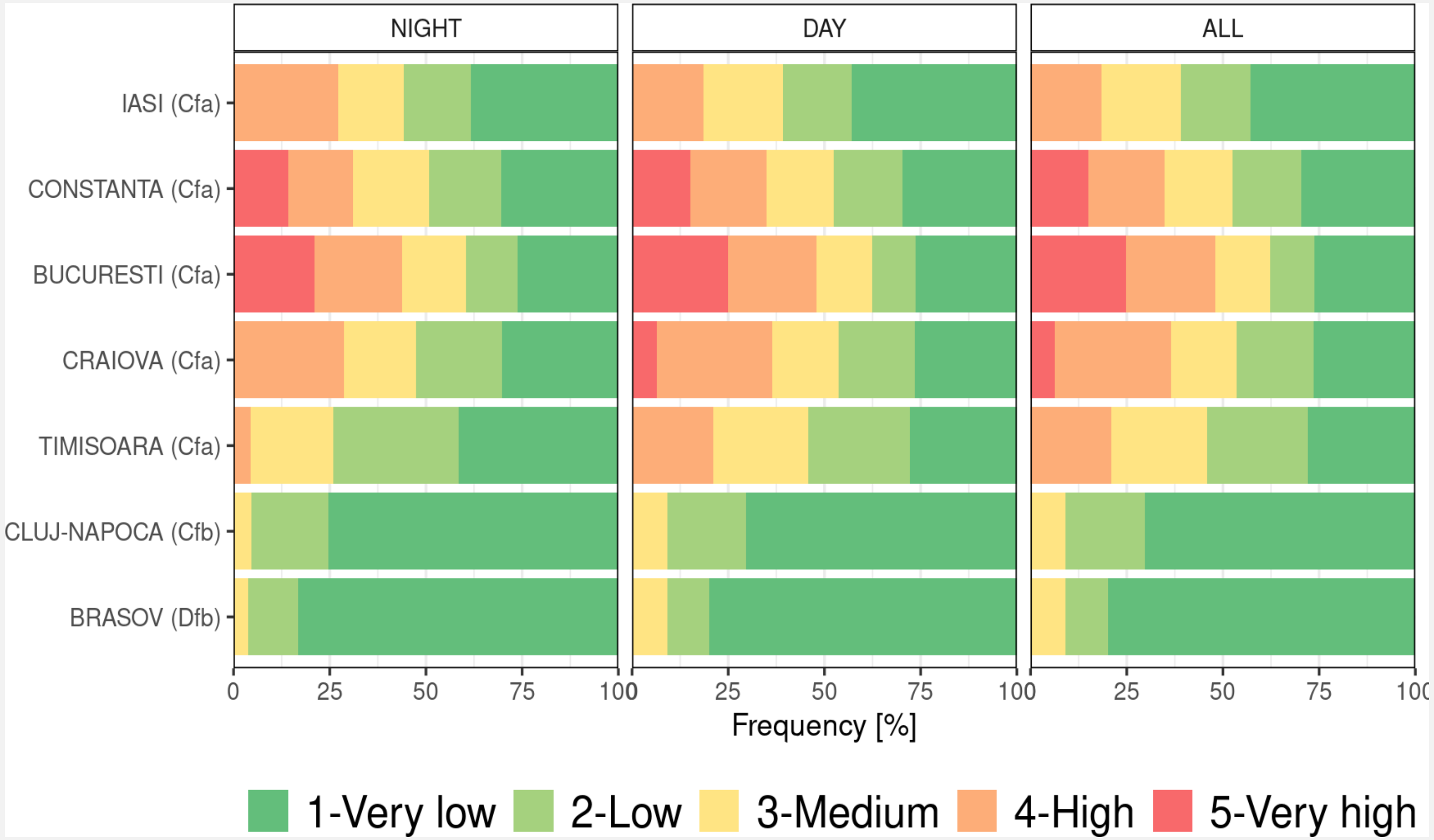
4. Results

The HHR and predictors considered in this study (HH computed as a function of LST, and V derived from LCZ and PD) in Bucharest (Romania)



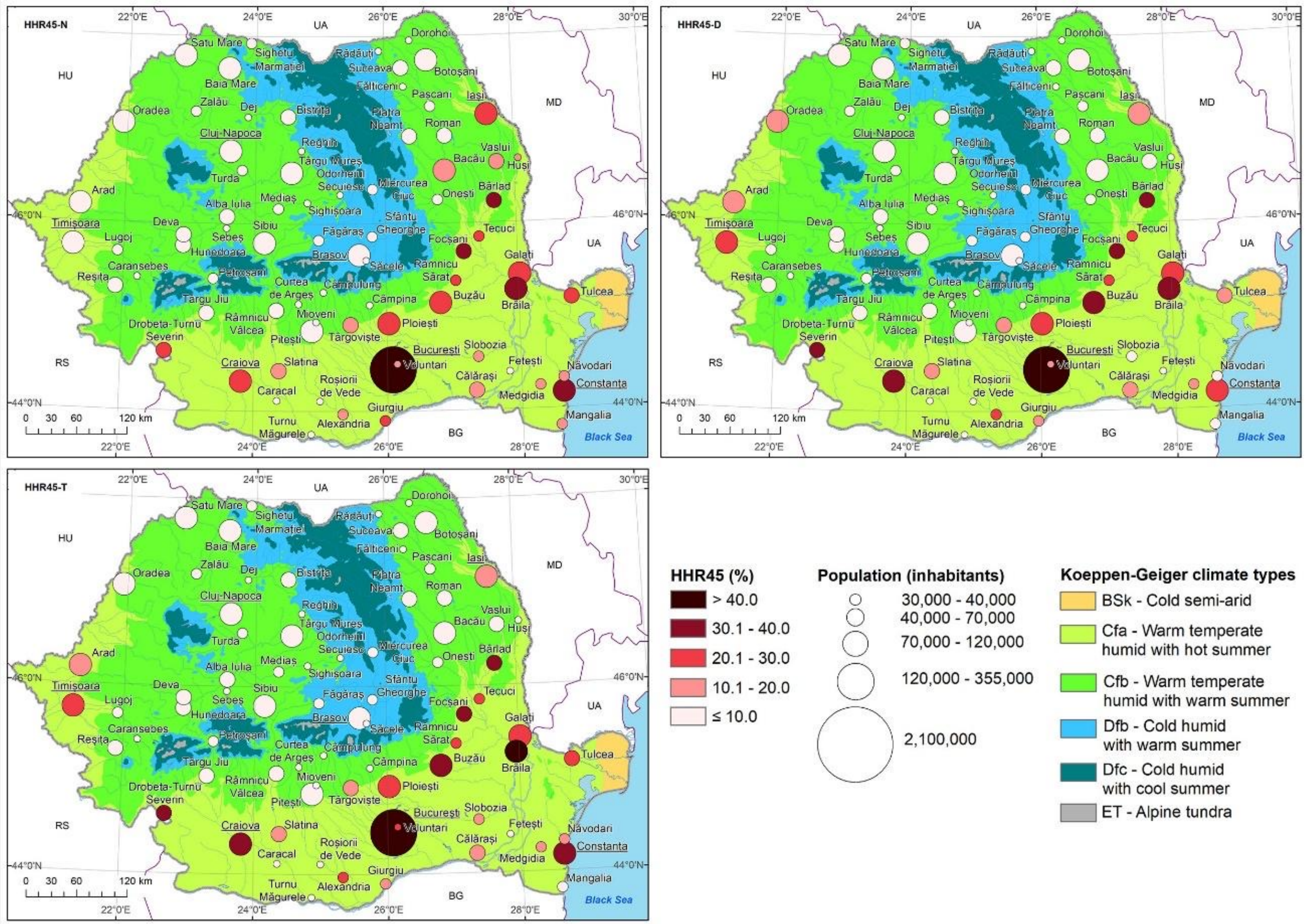
4. Results

Frequency (%) of HHR categories in selected cities



A country scale assessment of the heat hazard-risk in urban areas

Percentage of surface (%) affected by high and very high HHR, for night- (N), day-time (D), and all-day (T)

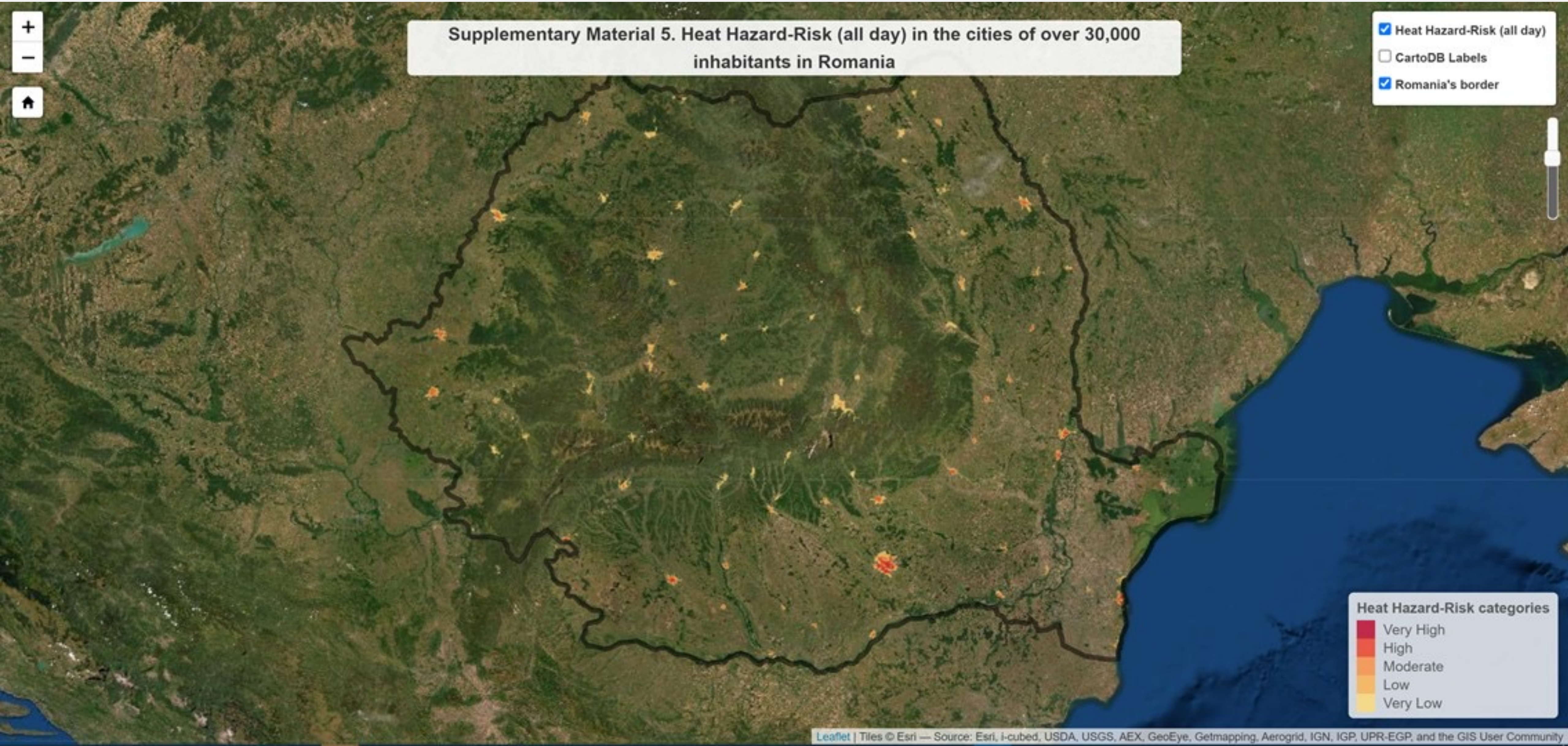


4. Results

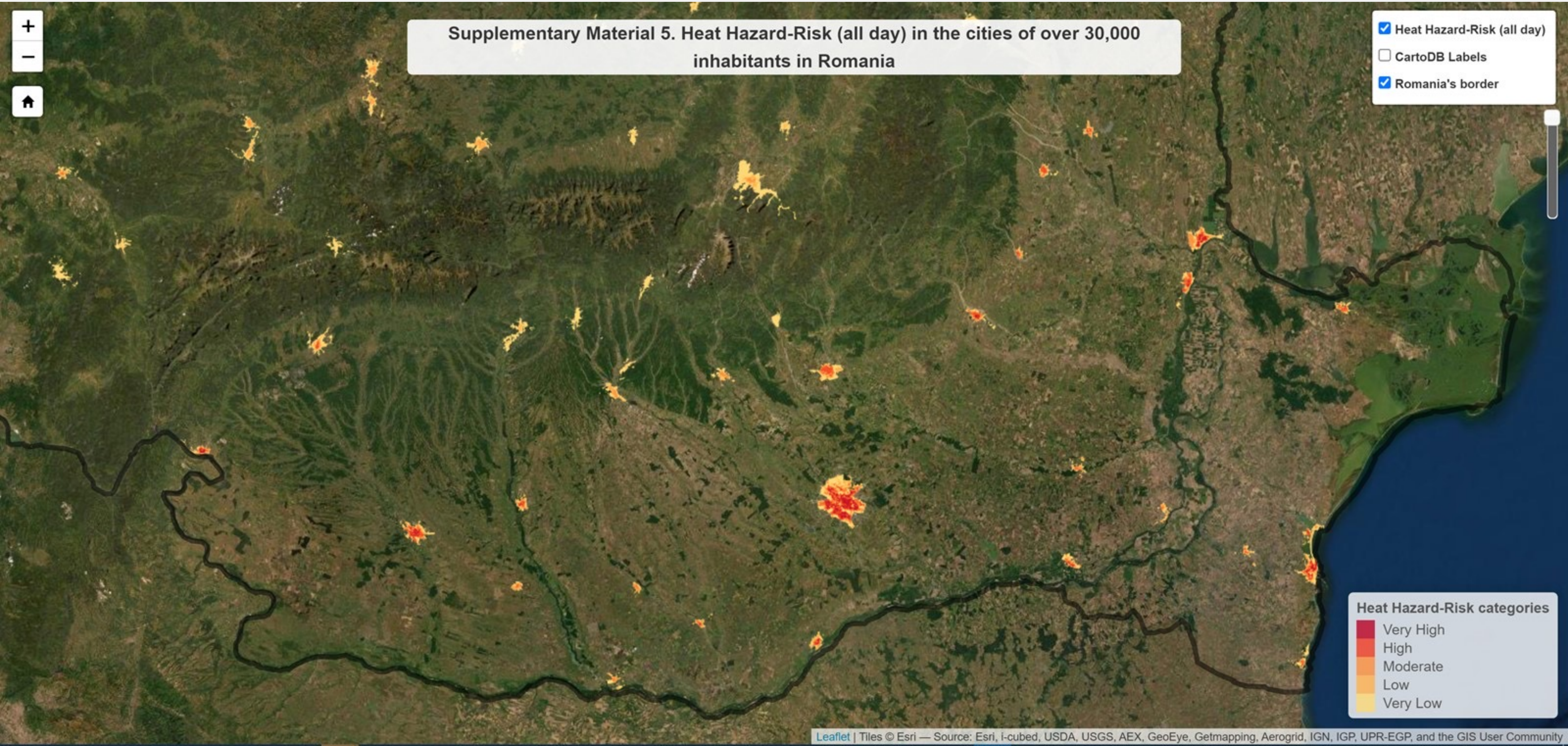
Pearson's correlation coefficient between the HHR45 (% of the cities covered by high or very high HHR) and potential triggering factors in the analysed urban areas

HHR	Altmax (m a.s.l.)	Altmin (m a.s.l.)	Area (km^2)	Pop (inhab)	LST-N (°C)	LST-D (°C)
HHR45-Night	-0.581	-0.611	0.362	0.439	0.742	0.627
HHR45-Day	-0.557	-0.583	0.426	0.459	0.666	0.702
HHR45-Total	-0.589	-0.607	0.409	0.459	0.727	0.660

4. Results


Supplementary Material 5. Heat Hazard-Risk (all day) in the cities of over 30,000 inhabitants in Romania
Heat Hazard-Risk (all day)
CartoDB Labels
Romania's border
Heat Hazard-Risk categories
Very High
High
Moderate
Low
Very Low
Leaflet | Tiles © Esri — Source: Esri, i-cubed, USDA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, UPR-EGP, and the GIS User Community

4. Results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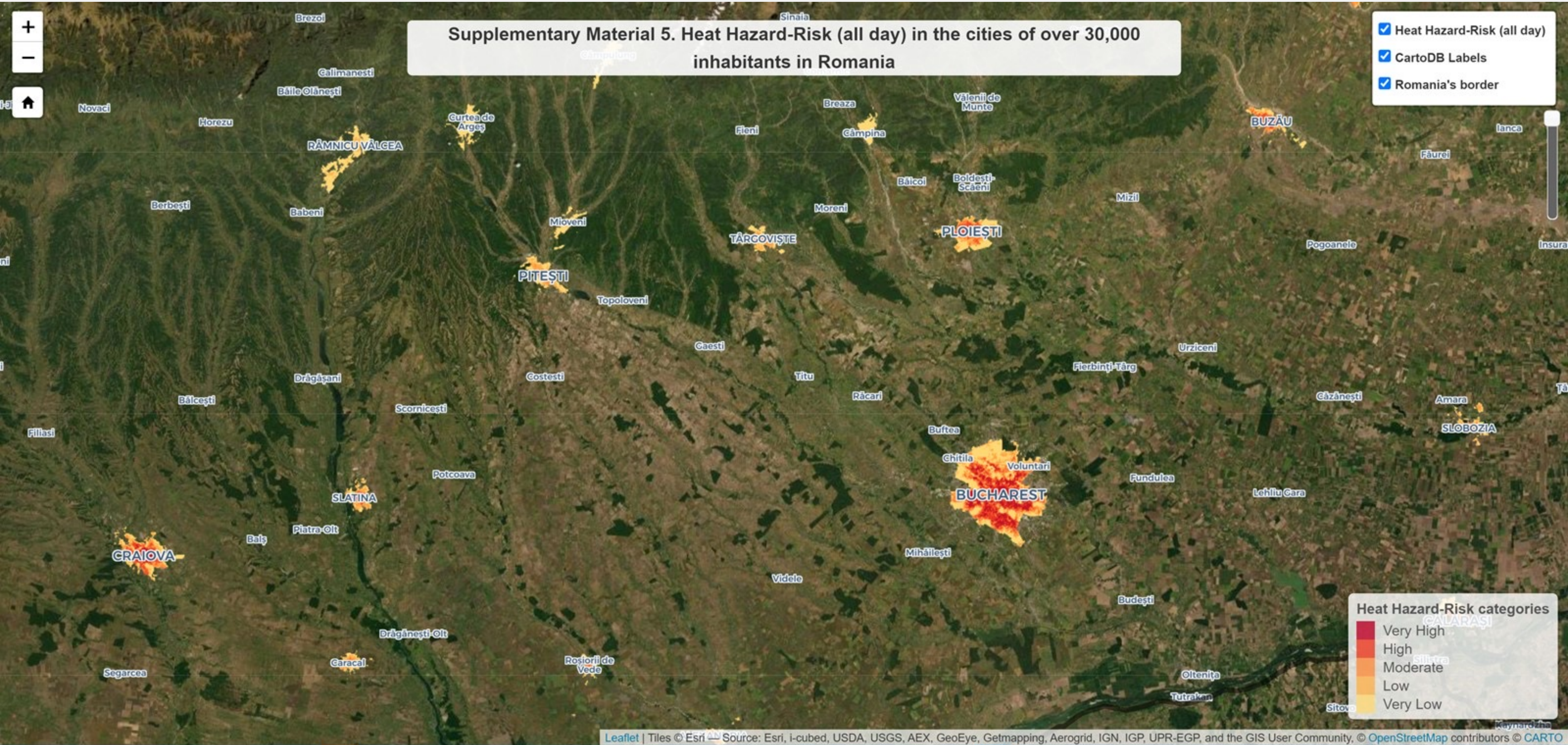
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PITEȘTI
PLOIEȘTI
TÂRGOVIȘTE
RÂMNICU VÂLCEA
BUZĂU
SLATINA
SLOBOZIA
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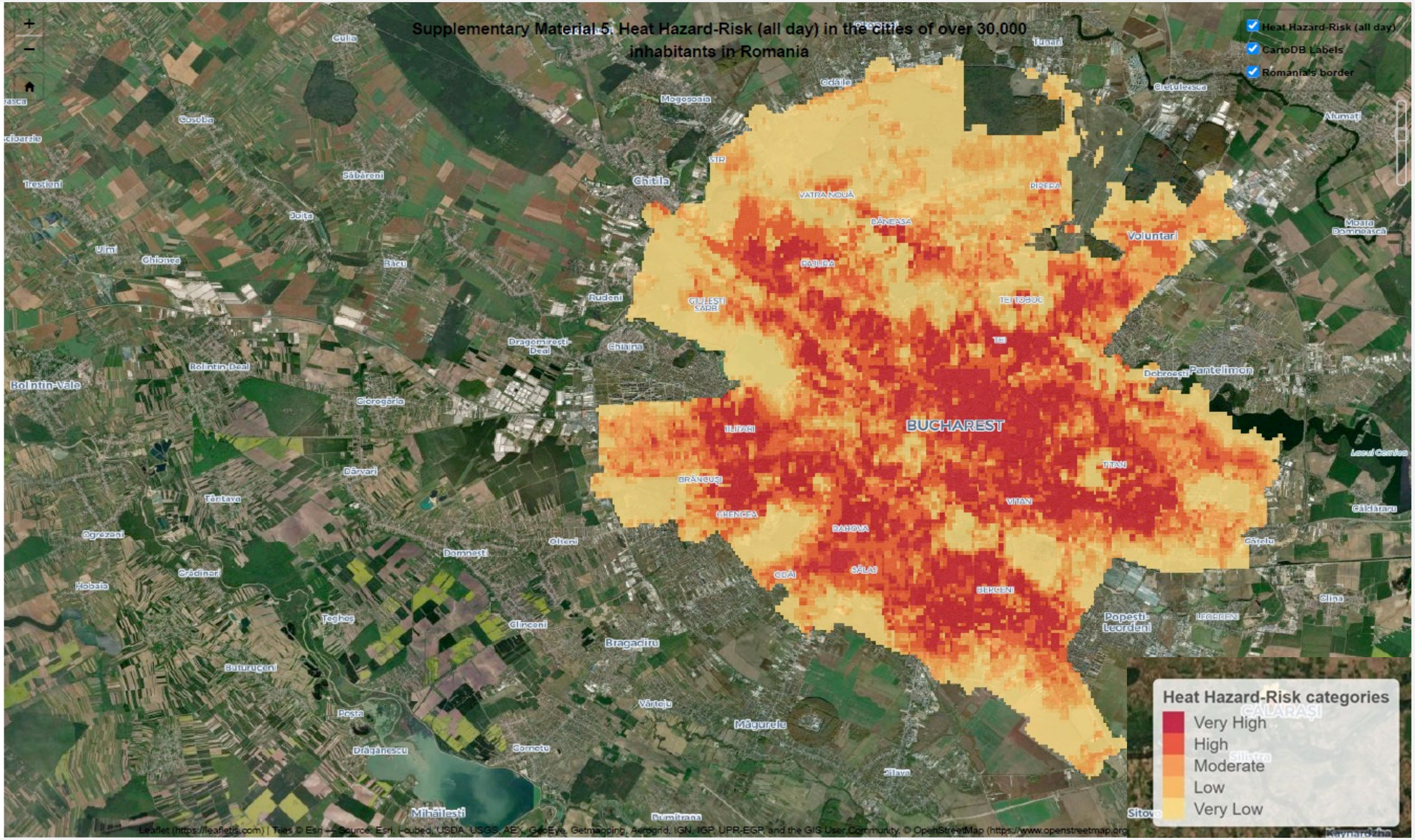
4. Results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5. Conclusion

- Satellite remote sensing has an excellent potential to (1) support the analysis of the HHR at the urban level and (2) provide results comparable and relevant at the country scale.
- The study reveals the influence of the (1) geographical context (i.e., landforms and land cover), (2) climatic factors (i.e., regional climate) and (3) urban characteristics (i.e., city size) on the HHR.

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Acknowledgement

This study has received funding from the European Space Agency (ESA) within the framework of the Land Surface Temperature project under the Climate Change Initiative (LST_cci), contract number 4000123553/18/I-NB. We particularly thank Dr. Elizabeth Good (MetOffice Hadley Centre) for the valuable suggestions provided during the project implementation. The authors are grateful to the ESA for creating the CCI program which has strengthened the consistency of the many research communities related to developing, processing, qualifying and using satellite Climate Data Records.