"Surface cold island effectiveness in surface heat island mitigation in Poland"

DESCRIPTION FOR THE GENERAL PUBLIC

Urbanization results in a continuous increase in artificial surfaces constructed of materials of high heat capacity and low albedo, often at the expense of the natural surfaces. This leads to the development and intensification of the urban heat island, i.e., the area distinguished by higher temperature compared to the surrounding areas. Excessive heat can cause heat stress, dehydration, hypothermia, or heatstroke. **Urbanization enlarges the number of people under the influence of urban heat islands**, which is particularly important for ageing societies like Polish one. Seniors due to their age susceptibility to various diseases, are more vulnerable to the harmful effects of urban heat island in the summer. What important, under the current climate change, extreme heat waves will become more frequent and intense thus increasing the effect of urban heat island in cities.

The most remarkable ability to lower the temperature in the city is provided by vegetation and water bodies, which constitute cold islands that cover the coldest areas in the city. All kinds of **water areas**, due to their high specific heat capacity and **vegetation** through the process of evapotranspiration and the shading effect, **are valuable assets of the city, supporting its cooling process**. Thus, the cold islands increase the thermal comfort and quality of life of the inhabitants of urban areas. In order to maximize the benefits of cooling, it is necessary to better understand the spatial pattern of cold island, the type of vegetation it is composed of, and its immediate surroundings. So far, research on the cold island in mid-latitudes is limited only to the location of cold islands in spatial terms without a detailed recognition of their composition and effectiveness in reducing land surface temperature and the possibility of urban heat island mitigation.

The main goal of the proposed project is to recognize the structure of cold islands in selected Polish cities and assess their potentials in cooling effect depending on the local conditions. To determine the effectiveness of cold island in urban heat island mitigating, heat island identification is also crucial for this project.

The accomplishment of the project allows us to answer the following questions:

1. Which cold island structure has the greatest potential for urban heat island mitigation? In this project the structure includes the cold island size, shape, land use type, vegetation characteristics like tree number, height and volume, and species composition of vegetation.
2. Which component(s) of the cold island structure contributes most to cold island cooling effect?
3. Does the cooling effect of cold island is regional-specific, i.e. depends on location in various regions of Poland?
4. How does the cold island cooling effect varies depend on meteorological conditions, and what is the cold island structure with most persistent cooling effect regardless of meteorological conditions?

To answer the above questions, data on the urban structure of selected urban areas (type of land cover, population structure), data on the vegetation structure within the cold island (number, volume, height of trees, and vegetation species composition), meteorological data and Landsat satellite images from the period 2013-2022 will be used. The methodology is based on the land surface temperature estimation from thermal satellite images, which is the basis for identifying cold and heat island in spatial terms. A variety of indicators, including those developed by myself for this project, will be used to assess the cooling efficiency of the cooling islands. In addition, various statistical analyses carried out in a GIS and R software will be used.

The results of the herein project will present a detailed analysis of cold islands, which considers identifying the most effective SCI composition in reducing the SUHI intensity for the first time. Moreover, the urban heat island structure for most of the cities selected in the project will also be recognized for the first time. In turn, the issue of comparing the heat and cold islands' structure for so many cities in Poland has not been addressed so far. Identification of heat and cold islands is crucial due to the most important challenge currently facing cities regarding their cooling. Due to the cooling effect of vegetation and water reservoirs forming SCI, blue-green infrastructure should be properly implemented into urban space as a key factor in adaptation to climate change. Therefore, the knowledge gained in this project can contribute to develop more effective local strategies for adaptation to climate change and urban development plans which are essential documents in the era of contemporary climate change for sustainable urban development.