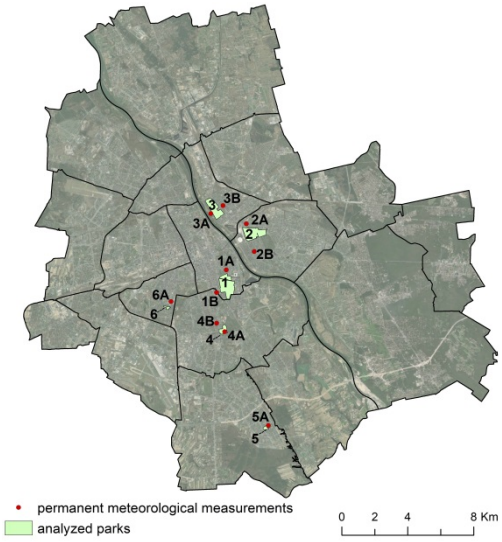
Parks are treated as oasis of cold and moisture and their role in creating and mitigating city climate grow during vegetation season, particularly during the increasingly hotter summer seasons. They gain special importance when we consider urban development, increasing area and intensity of urban heat island, growing number of citizens, climate change and raising exposure to heat stress in the city. Most of the research analyze urban parks' cooling effect distance and its intensity on the basis of land surface temperature taken from thermal satellite images. Only few previous studies were conducted with in-situ or mobile measurements of air temperature or perceived by human temperature. Those studies, analyzing one big park or few smaller green areas and basing on short-term investigations, lasting from few days to maximum 2-3 months, didn't provide universal models of the park' impact on city climate.




This is why the multidisciplinary team (climatologists, GIS-specialist, biologist, remote sensing specialist, demographer, mathematician, statistician) has undertaken the development of a project under which we plan to conduct a climate/bioclimate analyzis of 6 different urban parks in Warsaw (from 3.5 ha to 76 ha) surrounded by built-up areas of different intensity. **The basis of the project** will be 24-month in-situ meteorological and soil temperature measurements in the parks and their neighborhood but also thermal satellite images and demographic data from the censuses (2011, 2021) on people living in the vicinity of parks. Moreover short-term, biometeorological measurements and thermal perception questionnaire surveys among parks' visitors will be conducted.

**Figure 1**. Location of analyzed parks and meteorological measurement sites in Warsaw

**Main aims of CLIMPARK** are: to measure and precisely evaluate the impact of parks of different size, structure, age, arrangement etc. in Warsaw on mitigating climate/bioclimate in their surroundings, but also to study the diversity of local climate and perceptible conditions inside the parks, due to different species composition and spatial arrangement. One of the goals is developing the model of the park' impact on mitigating UHI and perceived conditions that could be used at present and under climate change scenarios. While thermal stress strongly influences human health we will also focus on the reduction in exposure to thermal stress among people living in the parks vicinity.

First, the measurement network will be installed for 24 months, which will provide the data for the assessment of climatic differences between parks in Warsaw due to their selected features and under different weather. Furthermore supplementary measurements enabling the determination of mean radiant temperature will be periodically conducted and questionnaire surveys will be carried out in the parks. These will allow us not only to evaluate bioclimatic diversity of the parks but also to establish the relationship between human thermal sensations and objective biometeorological indices. Park zones considered by visitors to be the most conducive to relaxation will also be indicated. Soil temperature measurements in the parks and their surroundings with land surface temperature (from Landsat 8 OLI/TIRS satellite images) will enable i.a. better approximation of the cooling effect distance of the analyzed parks. To estimate the impact of parks on reducing the risk of negative effects of heat on health the demographic data from the censuses (2011, 2021) including 1600 spatial units for Warsaw, will be used. The forecast of Warsaw parks impact on the climate in their vicinity up to year 2090 will be made for two climate change scenarios - RCP4.5 and RCP8.5. The obtained results will be statistically analyzed using i.a. generalized additive models (GAM), while all maps will be made using GIS techniques in the ArcGIS program.

**The results of CLIMPARK** will provide new knowledge about the scale of parks' impact on city climate in the temperate zone and about climate/bioclimate diversity inside parks. Measurements of microclimatic and perceived conditions, including thermal perception survey are exceptional. Soil temperature measurements in various types of urban vegetation in conjunction with the analysis of thermal images, will be an absolutely novelty in Polish city climate research. Evaluation of parks' impact on the thermal stress' reduction in people living nearby provide new approach in assessing living conditions in the city.