# Heat Stress of Municipal Categories in German-speaking Switzerland

## Impact Analysis using a Landsat-8-Satellite-Image and Guidance for Integration into Spatial Planning


Graduate

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Introduction: All well-founded climate scenarios assume rising summer temperatures. Currently, adaptation measures to higher temperatures tend to be implemented in urban municipalities and less frequently in agglomeration or rural municipalities. With the aim of contributing to a resource efficient approach in the field of municipal heat adaptation, this master's thesis examines the nine municipal categories of the Federal Statistical Office of Switzerland on their degree of heat stress. The chosen study perimeter includes a large part of German-speaking Switzerland (Fig. 1). The data basis for this examination is the land surface temperature (LST), generated from a Landsat satellite image on July 16, 2022 (Fig. 1/2). From there, findings and recommendations for spatial planning are derived. The characteristics of settlements with low or high heat stress and the useability of the Landsat satellite imagery in spatial planning are sub-questions in this examination. In addition, the heat stress of areas and infrastructure like hospitals or nursing homes will be investigated, because there is an increase in population groups which react particularly sensitively to high heat stress. Correlation analyses, visual and descriptive approaches, and simplified climate modeling are used to investigate the research questions.

Result: (1) The results confirm the increased heat stress in urban municipalities and those with high population density compared to rural municipalities (Fig. 2/3). (2) The heat stress of the municipal categories change degressively with increasing population density. Between municipal categories with high population densities, it changes only slightly. In addition to increased heat adaptation needs in urban municipalities, this also indicates increased needs in densely built agglomeration municipalities (Fig. 3). (3) In contrast, the degree of heat stress for very rural municipalities is low, so such municipalities can force their resources on other issues. However, due to regional features, such municipalities may also be increasingly affected by heat, which is why a supplementary analysis is appropriate (Fig. 3). (4) The simplified climate modeling shows, that the general heat stress is estimated to increase significantly in the coming years and decades, which underlines the need for adaptation measures. Nevertheless, the order of the degree of heat stress of the municipal categories does not change, so the greatest risk is still in urban municipalities. (5) Settlements characterized by low heat stress have open areas with thick vegetation and linear or punctual settlement areas. In contrast to the surrounding landscape closed, densely built settlements with a high degree of soil sealing, tend to have a higher heat stress. (6) The Landsat satellite image can contribute significantly to the classification of the heat stress on a higher scale e.g. for municipal categories. In contrast the useability on a smaller level like streets is limited. (7) Heat sensitive areas and infrastructures are on average more heat-stressed compared to the entire settlement area, which is why special consideration in spatial planning should be given to them.

Conclusion: This thesis is not a substitute for a local analysis. However, it does provide guidance about which municipal categories should prioritize heat adaptation and which ones can divert their resources to other issues. In addition it shows useful measures and where in the settlement area they are particularly effective.

**Fig. 1: Study Perimeter in German-speaking Switzerland with the GIS generated Land Surface Temperature (LST).**
Own presentment 2023; NASA and USGS 2022; swisstopo 2022

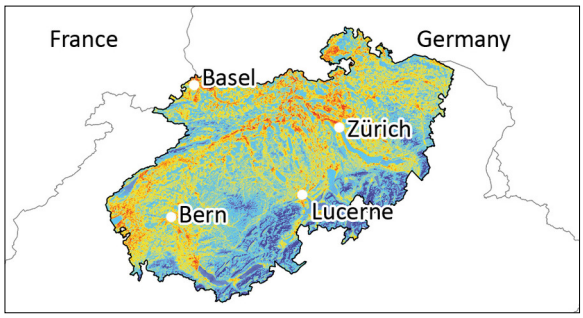



**Fig 2: The Degree of Heat Stress in the small City Sursee is higher than in the rural Environment.**
Own presentment 2023

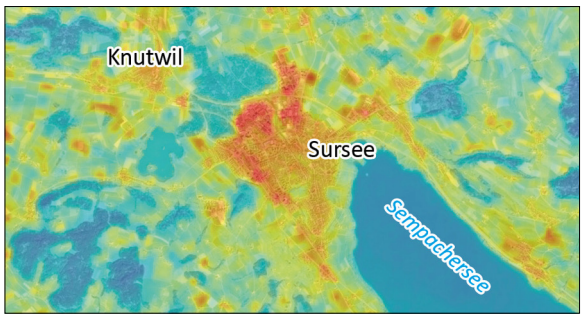
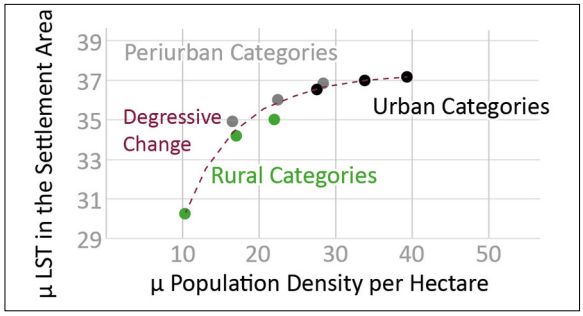



**Fig. 3: Correlation Analysis between average Population Density and average LST of the nine Municipal Categories.**
Own presentment 2023; NASA and USGS 2022; swisstopo 2022

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Subject Area
**Spatial Development and Landscape Architecture, Computer Science**