

Remote sensing-based Analyses of multi-temporal and multi-seasonal changes of Land Surface Temperatures in the Greater Graz area from 1985 to 2021

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Introduction

Urban heat islands can be identified by air temperature on the one hand and surface temperature on the other. With the help of TIR satellite images the “Surface Urban Heat Islands” (SUHI) is often recorded with a mono-temporal approach, only. The comparison of so-called multi-temporal and multi-seasonal image data can provide conclusions about the development, distribution of the SUHI compared to surrounding rural regions over a long period of time.

Data and Method

The study area (700km²) extended around the city of Graz. Land surface temperatures were calculated from Landsat-5,7 and 8 scenes with typical autochthonous weather conditions. The Google Earth Engine was used for further processing the approximately 200 scenes. In addition, pixel-by-pixel seasonal averages from all years were calculated for spring, summer, autumn and winter and were assigned to the different land cover types.

Results

The results of the study are visualised in maps and statistics. They show a clear heat island effect in the city of Graz compared to the rural surrounding area. There is also a significant increase in surface temperatures from 1985 up to 2021, which, on the one hand, corresponds to the development in the official climate statistics and, on the other hand, is reinforced by the increasing sealing (increase in the UHI) of the city of Graz. This effect is particularly noticeable in the summer months, but is somewhat weaker in autumn and spring. The winter development depends very much on the existence of a snow cover, which makes it difficult to compare with the other seasons.

Conclusion

By analysing multi-seasonal thermal images from the Landsat series over a period from 1985 to 2021, a method was developed that reflects signals from climate change in this period and the study area and also illustrates increasing sealing. The method can also be implemented in comparable (climatic) regions with newer satellite systems (e.g. Sentinel).

Keywords

Surface Urban Heat Island, Multi-temporal and multi-seasonal Analyses, Landsat TIR