Surface temperature patterns in relation to urban structure types by the example of Munich

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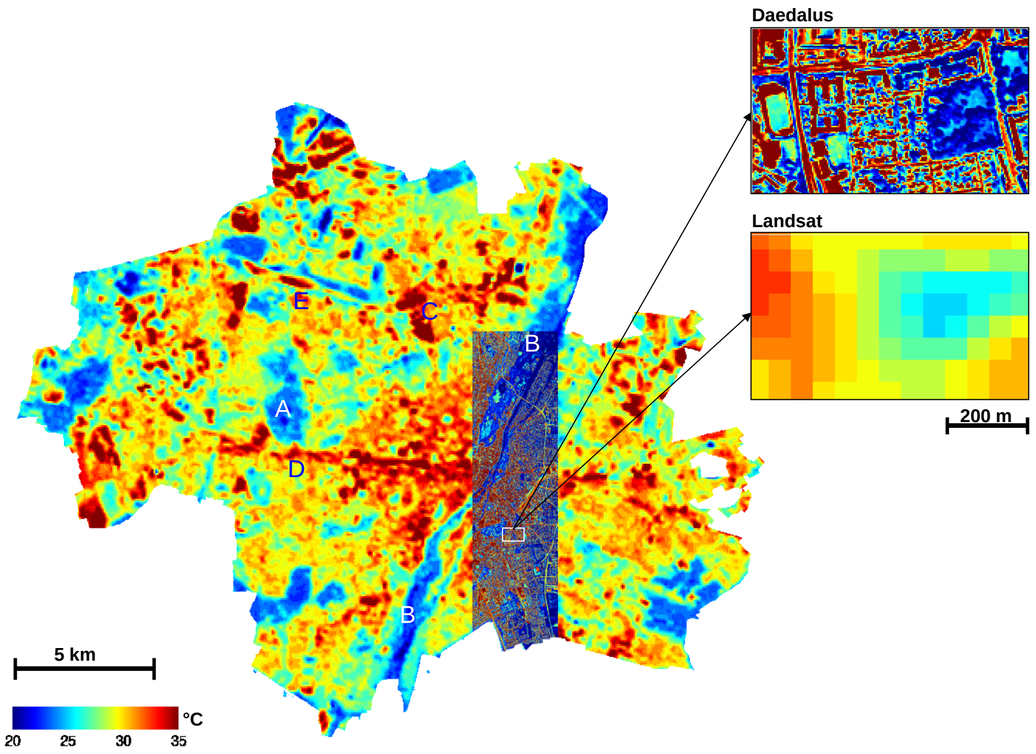


Fig. 1: Surface temperature of Munich measured by Landsat (60 m pixel size) and the airborne Daedalus sensor (5 m pixel size). The images were recorded in the summer of 2007 on June 25, 12:05 AM (Deadalus) and August 26 11:56 AM (Landsat). The LST pattern shows some key elements of the city. The large Nymphenburger Park (A) and the floodplains of the river Isar (B) are the cooler patches. Besides the city center also larger industrial areas (e.g. C) and along railway tracks (D, E) show high LST.

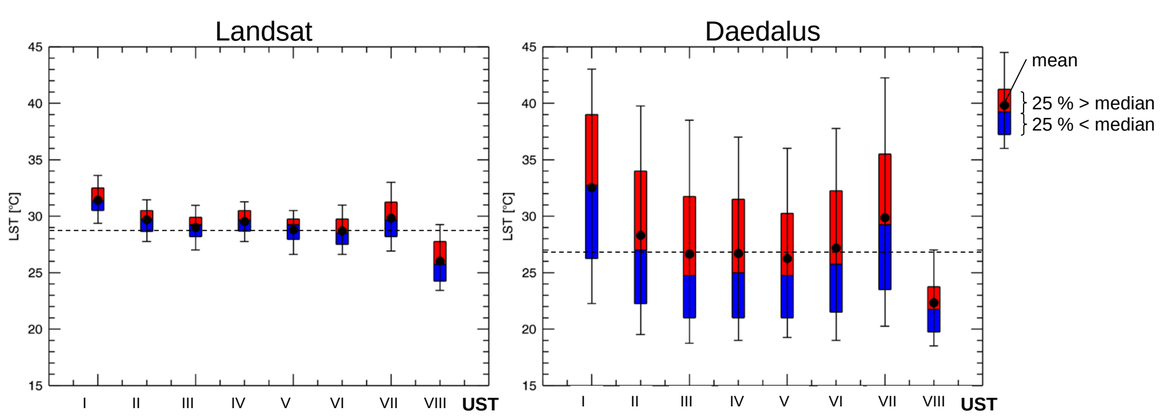


Fig. 2: Variation of LST within eight urban structure types. The figures show the LST range of 90% of the pixels within each UST type. The dotted line indicates the mean LST for the whole study area (Landsat: 28.8 °C, Daedalus 27.0 °C). The relative differences between the UST types are persistent between both sensors. Because of the higher spatial resolution, the variation within the Daedalus data is much larger.

Introduction

For urban planners it is important to know the location of local heat islands as well as the causes so they can mitigate the negative effects. Areas with similar climatic conditions require similar planning measurements [1,2], which has been implemented in the concept of local climate zones, form example [3]. Urban structure types are areas or building blocks with similar urban structures from an urban planning point of view [4]. This study shows the surface temperature patterns of Munich, Germany, as recorded by satellite and airborne remote sensing and relates these to the spatial characteristics of eight common urban structure types [5].

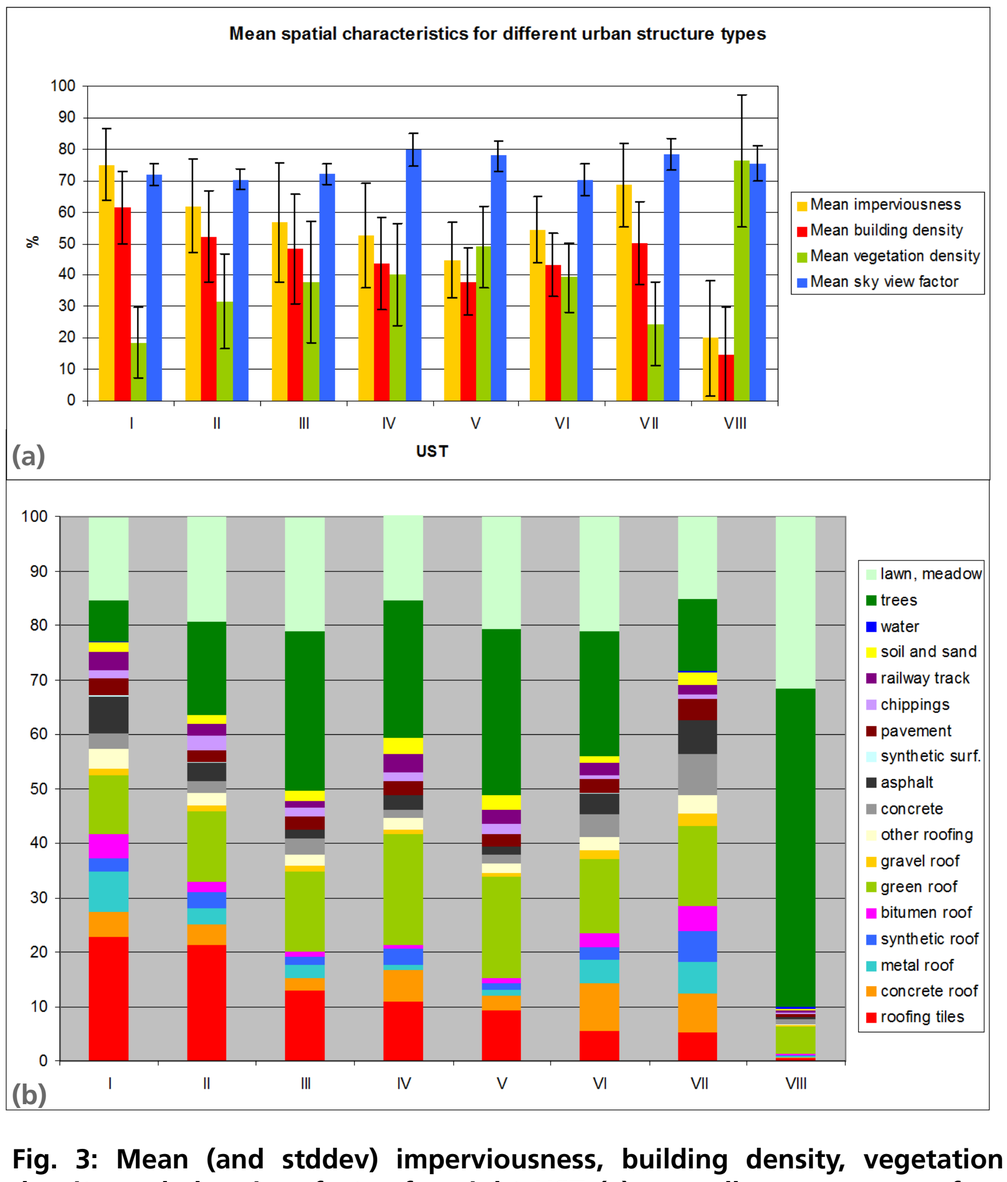
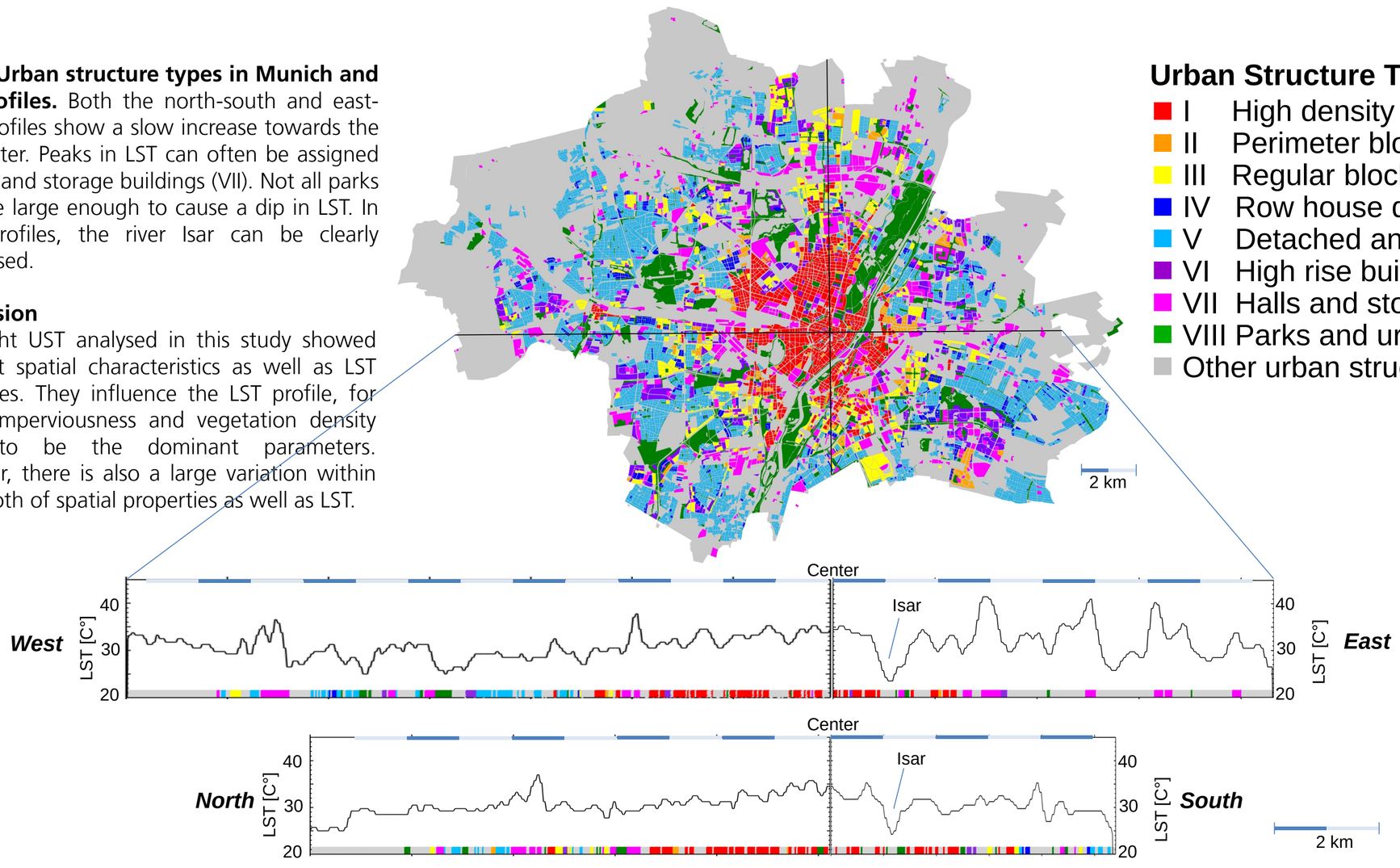


Fig. 3: Mean (and stddev) imperviousness, building density, vegetation density and sky view factor for eight UST (a) as well as average surface material composition of these UST types (b). Making use of hyperspectral airborne data with a spatial resolution of 5 m and a DEM a detailed spatial analysis of Munich has been carried out [6]. The common surface materials provide also indications on the land use: in Munich, commercial and industrial buildings are more frequently covered with synthetic and metal roofing than residential buildings, which are commonly covered with roofing tiles.

Fig. 4: Urban structure types in Munich and LST profiles. Both the north-south and east-west profiles show a slow increase towards the city center. Peaks in LST can often be assigned to halls and storage buildings (VII). Not all parks (VIII) are large enough to cause a dip in LST. In both profiles, the river Isar can be clearly recognised.

Conclusion

The eight UST analysed in this study showed different spatial characteristics as well as LST properties. They influence the LST profile, for which imperviousness and vegetation density seem to be the dominant parameters. However, there is also a large variation within USTs, both of spatial properties as well as LST.



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