Multitemporal Analysis of Urban Surface Temperature Dynamics in the City of Basel, Switzerland

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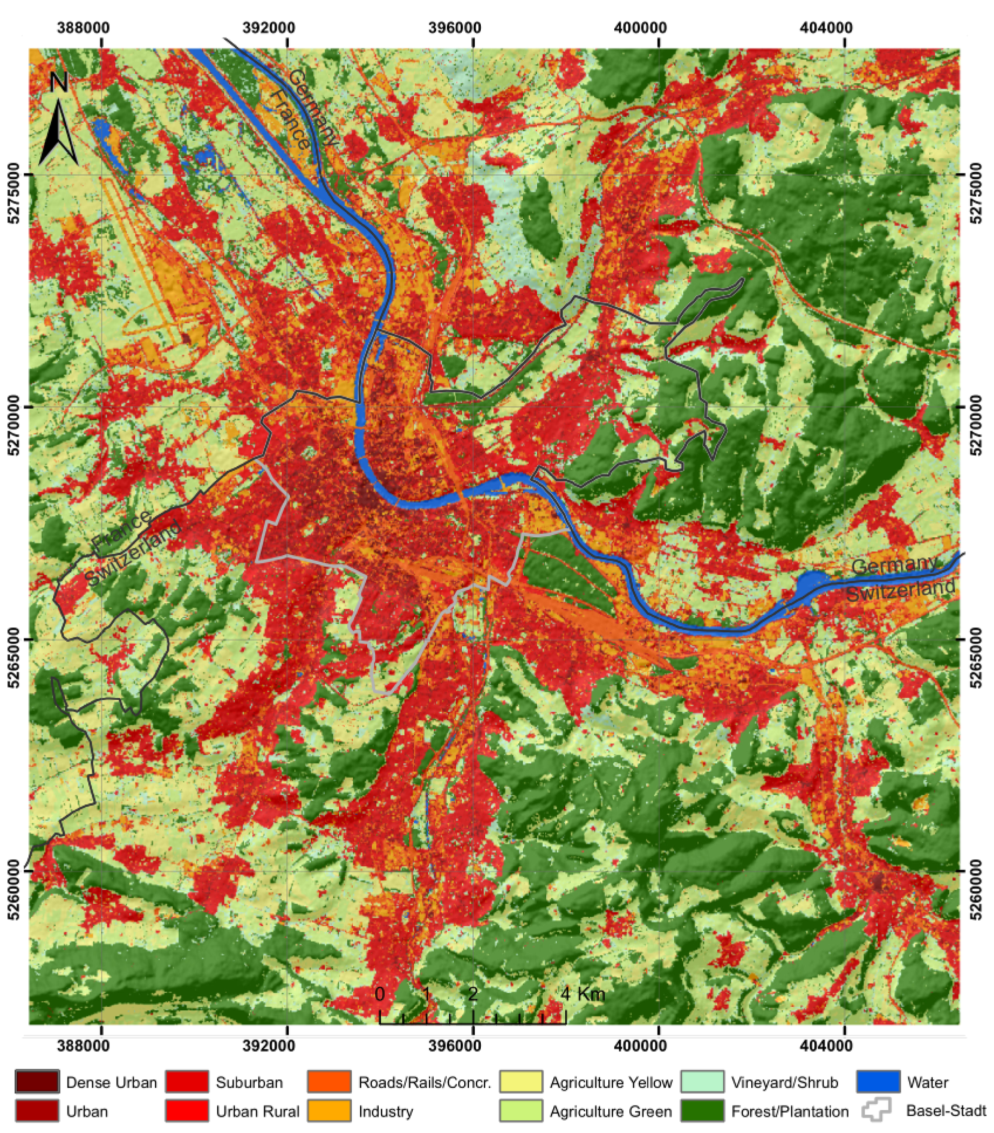
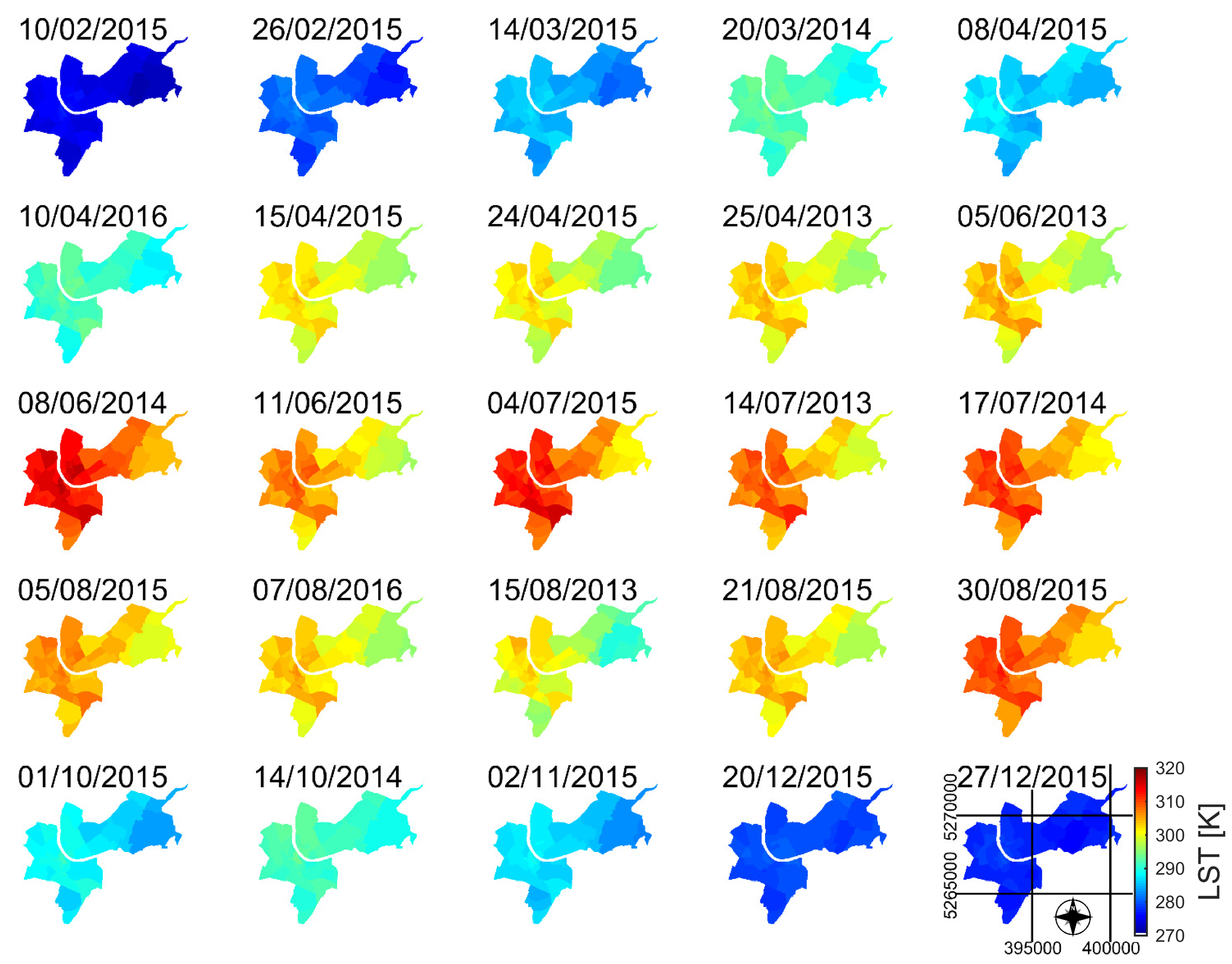
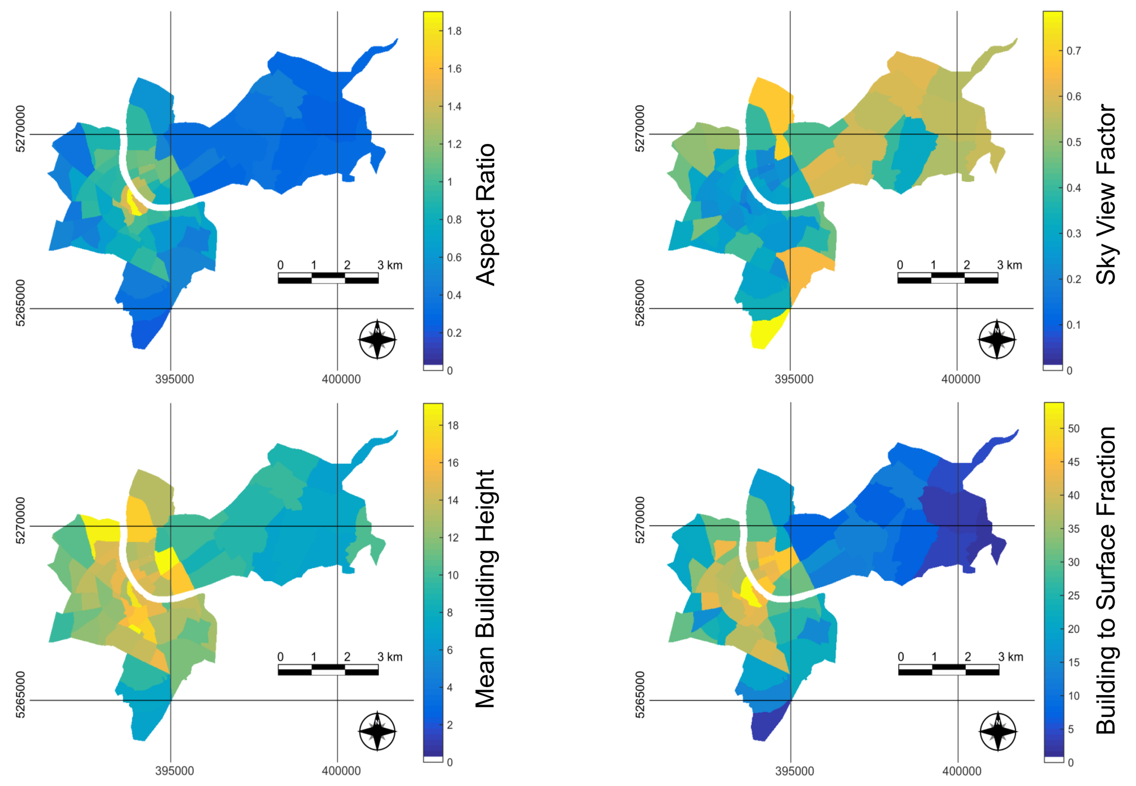
ABSTRACT

Cities have been known for a long time as heat islands, i.e. the usually higher urban ambient temperature compared to their rural surroundings. The dynamics causing this effect are controlled by land use, synoptic weather conditions and anthropogenic heat emission (large uncertainties). Beside the typical urban-rural contrast, intra-urban temperature differences due to different densification, land use and/or vegetation cover are measurable as well. In this study, urban temperature dynamics are analysed using multitemporal Landsat 8 TIR and VIS/NIR images, land use maps and high resolution GIS data to depict the urban morphology. The results represent the dependence of the urban LST on morphology and land use, and offer possible solutions for urban authorities and urban planners for improving the local urban climate.

DATA



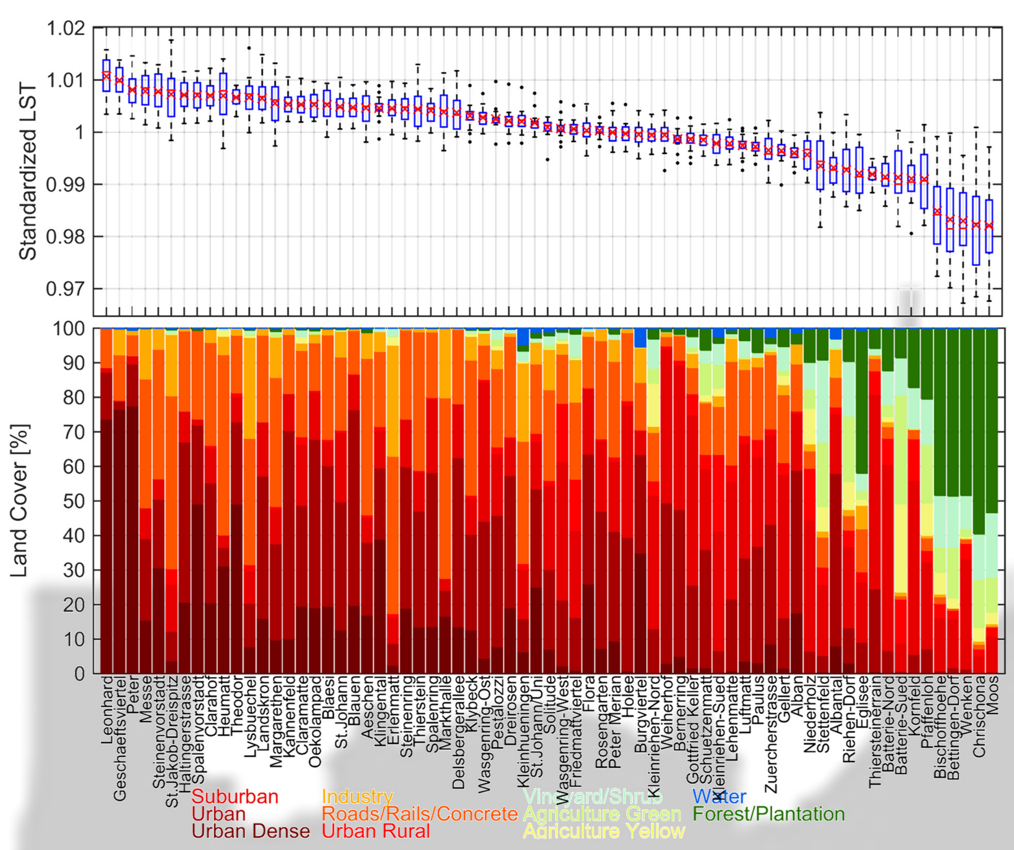




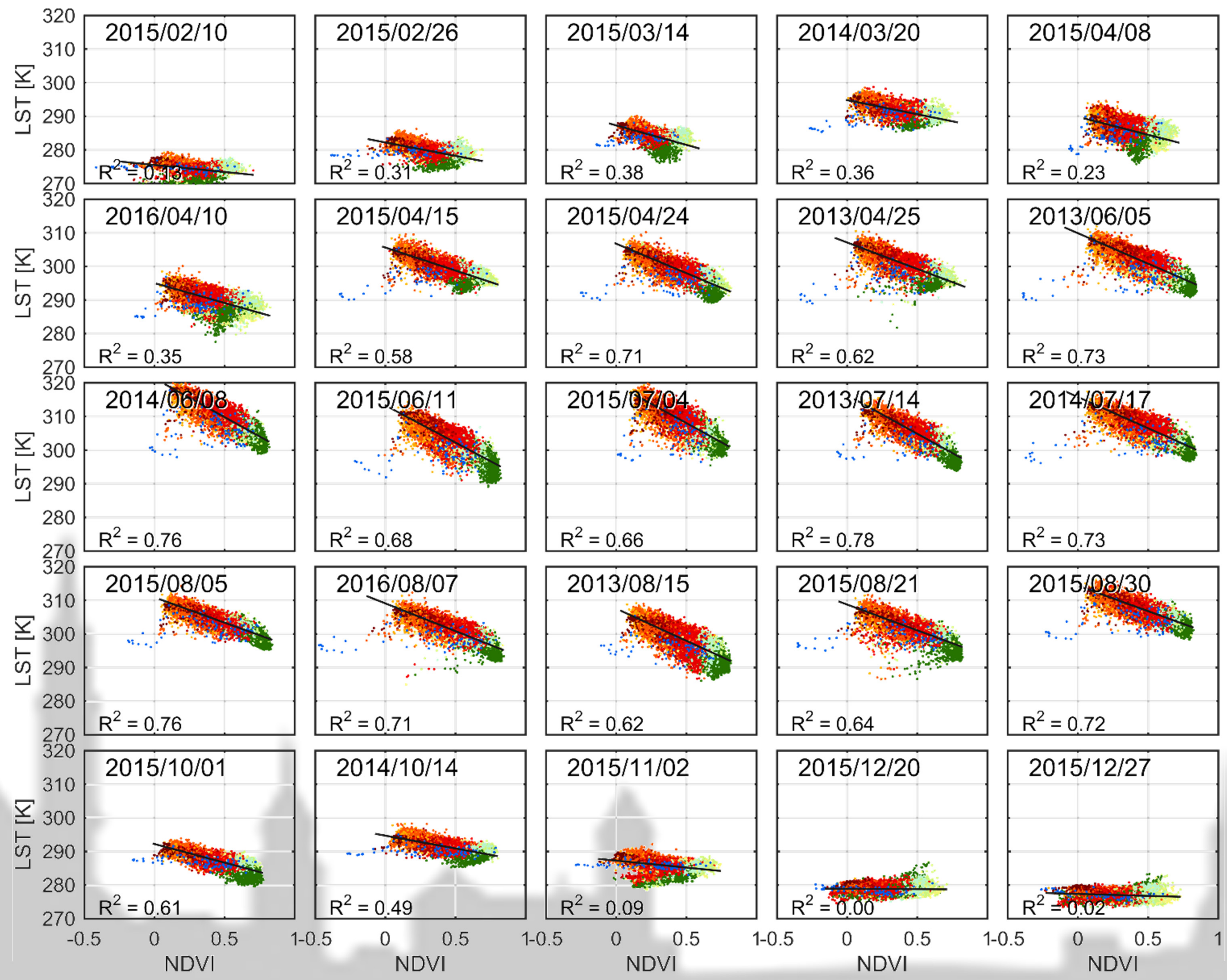
Data used in this study: Multitemporal land use map (left) and LSTs (middle), both derived from Landsat 8 data, and morphological parameters (right), derived from a high resolution vector DSM and administrative GIS-Data.

METHODS and RESULTS

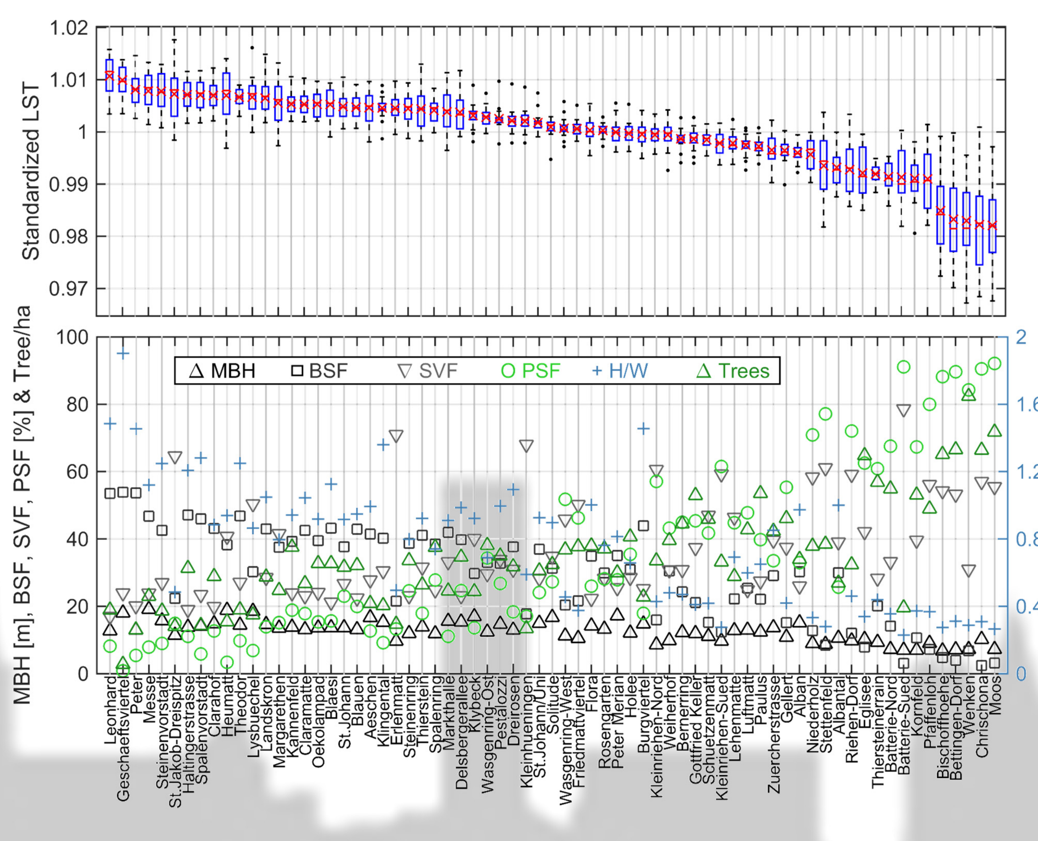
Residential districts were used to calculate statistics about the percentage surface cover and the average LST of every part of the city. 25 Landsat 8 scenes between 2013 and 2016 were atmospherically and emissivity corrected and averaged for every residential district as input data for a boxplot analysis. The surface cover was derived from seven individual land surface analyses which were combined using the most frequent class value for every pixel. The results show clear tendencies of higher surface temperature in the dense urban and industrial areas.



One of the main drivers of urban LST is the vegetation cover. The abundance of vegetation enables the use of the incoming solar energy for evaporation, rather than the heating of the surface (i.e. LST) and therefore supports the nocturnal cooling due to a loss of stored heat. The scatter plots below show LST vs. NDVI, with specific colours indicating the land use. The results show a clear seasonal tendency with low correlation in winter and increased correlation in summer months.



Morphological parameters such as e.g. mean building height (MBH), aspect ratio or sky view factor are another important cause for LST distribution. Urban buildings trap and reemit longwave radiation, which hinders the surface from cooling. The amount of radiation trapped in the urban fabric is highly dependant on the urban forms. The morphological parameters of the residential districts were compared with LSTs from 2013 to 2016 derived from Landsat 8 data. Results show a high dependence of LST on MBH, building surface fraction and perviousness.



5. gemeinsame Jahrestagung der Arbeitskreise Fernerkundung (DGfG) und Auswertung Fernerkundungsdaten (DGPF)

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