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Automated remote sensing based processing system for spatial baseline data generation in urban areas

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Rapidly changing urban environments require efficient mapping methods for keeping fundamental spatial baseline data up-to-date. In this context optical remote sensing allows the development of computer-based methods for automating the update procedure. In this study we present an automated remote sensing based processing system for the derivation of two kinds of urban spatial baseline data - urban surface cover types and urban structure types (USTs) - that can support a wide range of applications.

Urban surface cover types are of key importance due to their influence on microclimate (e.g., surface and air temperature, humidity), water balance (e.g., groundwater recharge, evapotranspiration), biodiversity and other ecological compartments. The developed automated mapping approach consists of a multi-step procedure which exploits the full spectral information content of hyperspectral image data for detailed material identification at sub-pixel level. It results in maps of material abundances forming the basis for further quantitative analysis.

USTs are regions characterized by a specific combination and arrangement of urban surface types and by a specific spatial structure including the third dimension (object height). According to the application they can be defined to reflect specific categories of, e.g. climatological or ecological conditions and, thus, USTs are a suitable means for the assessment of the spatial structure of urban agglomerations by characterizing and subdividing them into meaningful spatial units.

The developed UST classification system is based on different kinds of input information consisting of urban surface cover types, image segments, patch boundaries and optionally object heights. The automated classification of USTs is based on spatial features assessing the morphological properties of urban objects, their abundances, proportions, spatial arrangement and distribution within the patch boundaries. So far, this approach has been applied to the cities of Dresden and Berlin in Germany as well as Padang in Indonesia.

As an example for the use of the generated baseline data, we present the calculation of urban ecological indicators which provide quantitative measures for ecological functions such as climatic compensation capacity and groundwater recharge.