MULTI-SCALE RETRIEVAL OF CLIMATOLOGICALLY RELEVANT URBAN-SURFACE PARAMETERS FROM REMOTE SENSING DATA

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The urban climate is the result of complex interactions between the three-dimensional, mainly anthropogenic surface structures and the urban atmosphere. Urban morphometry, radiative and thermophysical material properties, anisotropy effects, and further surface properties influence or control the exchange of momentum, energy and mass between the surface and the urban boundary layer above. Urban surfaces are further characterized by strong heterogeneity on different spatial scales. The urban surface structures themselves vary mostly on micro-scales to local scales, while the majority of atmospheric processes take place on local scales to meso-scales.

Spatially distributed, physically based numerical atmosphere models provide the only applicable method to resolve the effects of spatial heterogeneity of urban surface structures on weather and climate in urban regions. The quality of the model output on the resolved scale depends on the physics of the model, the atmospheric boundary conditions resulting from the super-scale processes, as well as on the parameterizations of the sub-scale processes. Thus, methods for retrieval of spatially distributed land-surface parameters for use in atmosphere models are of high importance, especially for improving our knowledge on urban climates.

In the presentation, a methodology will be presented for retrieving climatologically relevant urban-surface parameters from remote sensing data. Parameters like roughness length, zero-plane displacement, mean building height, effective building height, i.e., the volume of buildings per unit area, percentage of impervious surfaces, percentage of built areas, albedo, emissivity, and further parameters closely related to or directly depending on land cover can be derived from remote sensing data at different spatial scales.

The first step is to derive land-cover data from satellite data, e.g. from Landsat-5 TM, Landsat-7 ETM+, ASTER, ERS-1/2 or other remote sensing systems. Then, spatial distributions of the fractional coverage are computed for each land-cover class using the grid geometry of the target model. Based on representative values of each parameter for each class, weighted averages are computed for each grid element of the target model using the fractional coverage values as weights. The methodology is applicable for a wide range of spatial scales starting from the scale resolved by the spatial resolution of the remote sensing data. The great improvement of this approach over other approaches using spatially aggregated land-cover data instead of fractional coverage is that land-cover units smaller than the grid scale of the target model will not be suppressed but correctly taken into account. The method, as well as examples from a study in South-West Germany will be shown demonstrating the applicability and the potential of the methodology.