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The importance of reliable land use information for urban heat island modelling with the WRF model – a case study for Budapest

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All of the operationally used numerical models include complex surface parameterisations, which calculate energy budget and fluxes at the surface. The land cover, the vegetation and the artificial surfaces all have direct influences on the incoming shortwave radiation via transferring it to sensible heat flux, latent heat flux, and turbulent kinetic energy. The resulting energy balance, which determines air movements near the surface, has a large impact on both surface and air temperatures. In order to improve the estimations of numerical models, reliable databases for surface characteristics are needed with fine resolution over the model area.
In this research our ultimate goal is to reproduce a realistic urban heat island over Budapest with 370 m resolution using the Weather Research and Forecasting (WRF) Model coupled to urban canopy model. At this grid size, it is necessary to define the surface with a subgrid resolution. To decrease the error of model simulations we integrated updated surface characteristics into the model, such as, the albedo, the land cover, the topography, and the spatial distribution of urban parameters. Databases originally created for WRF model includes only a single category of urban surface for Budapest. In order to create a new land use cover with about 100 m resolution, OpenStreetMap and CORINE were used. Based on satellite images the densely built-up downtown area, the airport with extended concrete cover, and a greenbelt area are separated. These additional classes the urban surface categories expanded to 5 in the input cover and in the model source code.
Our results show that the WRF model coupled to urban parameterisation is generally able to reproduce the urban heat island (UHI) phenomenon. The modification of the original surface characteristics lead to a substantially better representation of the spatial distribution of UHI in Budapest.