ES features mapping for the 6 ULLs at 3 different spatial scales

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To understand the major urban driver land cover/land use we undertake mapping at various scales and at different points in time. The central purpose of this scale-dependent monitoring is to capture ecosystem service features over time and in as great detail as possible.

At the urban scale of 30 meters ground resolution, we mapped land cover / land use over time to compare the urban dynamics among the 6 ULLs. This mapping product over decades is enabled by the long-term Landsat series, freely available earth observation data sources and Google Earth Engine (GEE).

The mapping across all 6 European and Chinese ULLs yielded a multi-temporal, ten-year-increment dataset containing the changes in the urban area. This work was conducted by UFZ in cooperation with FU and THU and led to a joint publication (Banzhaf et al. 2021, *RS*, doi.org/10.3390/rs13091744). Some of the extracted results given here picture the land cover transformation due to urbanisation processes. Specifically, the increase in impervious surface increased significantly in Shanghai (40.6%), Ningbo (20.8%), Aarhus (18.1%), Beijing (17.4%), Paris Region (15.6%), and least in Velika Gorica (5.2%). Noticeably, the built-up area of the three Chinese cities has grown from 4,077.5 km^2 to 7,508.7 km^2, i.e. an increase by 84% over the last two decades. At the same time the reduction of green and blue spaces occurred in the Paris Region with a loss of 646.1 km^2 of cropland, 50.5 km^2 of deciduous forest and 10.9 km^2 of grassland. Hardly any change has occurred in Aarhus and Velica Gorica. In Beijing and Shanghai, the loss resulted in 1,950.2 km^2 and 1,920.3 km^2 of cropland, respectively. As coastal cities, Shanghai and Ningbo have respectively converted 25.8 km^2 and 100.5 km^2 of water bodies into built-up surfaces.

At a finer urban scale of 10 meter ground resolution, we mapped all 6 ULLs in 2020 to explore the urban structure with its high heterogeneity. This urban land cover serves as spatial input layer for various ecosystem service models. It is made feasible by the fairly new sensors Sentinel 1 & 2 that deliver freely download.

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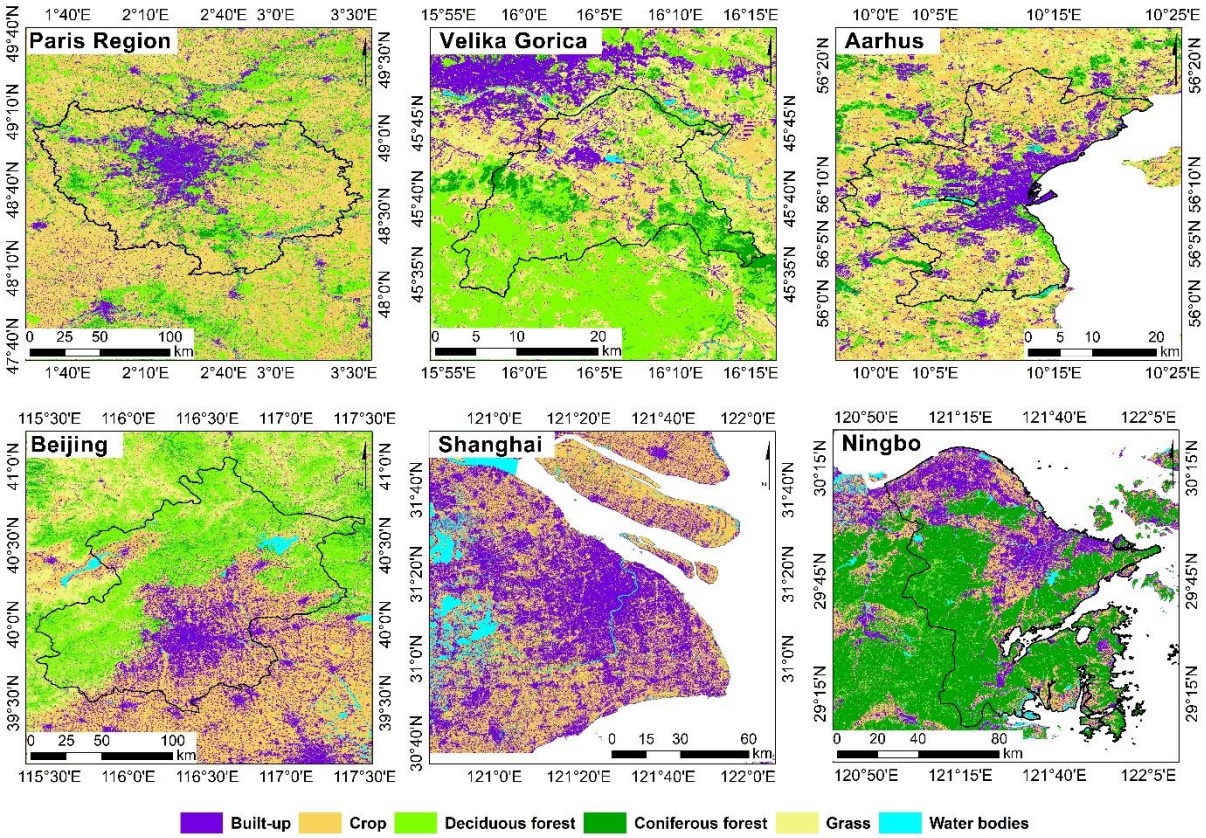

Figure 1. Finer urban scale land cover mapping for all 6 ULLs at 10 meter ground resolution (doi:10.5281/zenodo.5502635).

At refined neighbourhood scale, we collated spatially explicit land use and land cover data to give a deeper picture of ecosystem services features for the 3 European ULLs.

To start with, we set up a detailed mapping for Aarhus containing twelve distinct land cover classes at a resolution of 20cm. Land cover features were aggregated to objects containing information about the current land cover and additional parameters. This dataset will serve as a basis to create linkages to socio economic data, and to perform ES modelling at this refined scale.

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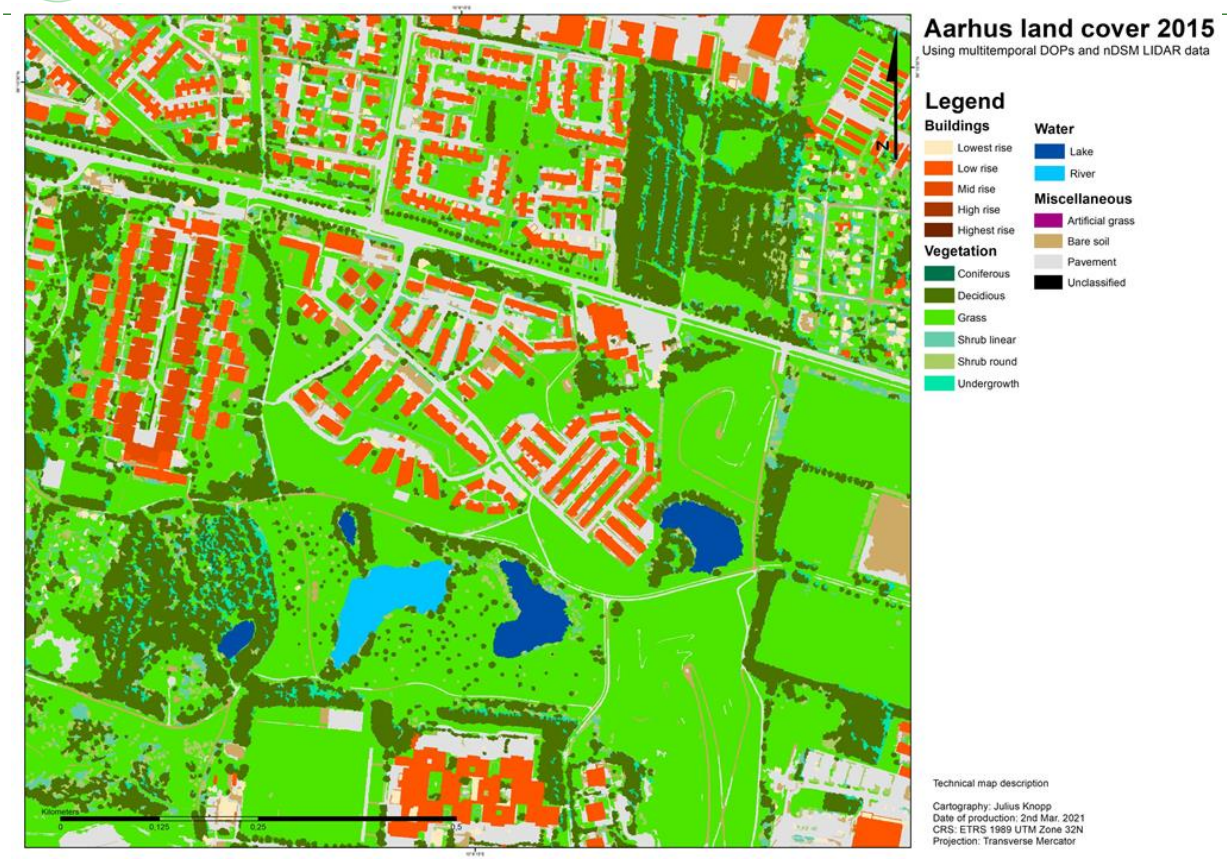

Figure 2. Refined neighbourhood scale land cover mapping exemplary for the ULL Aarhus, Denmark, at 20 cm ground resolution

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