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Geo-Spatial Analysis of Population Density and Annual Income to Identify Large-Scale Socio-Demographic Disparities

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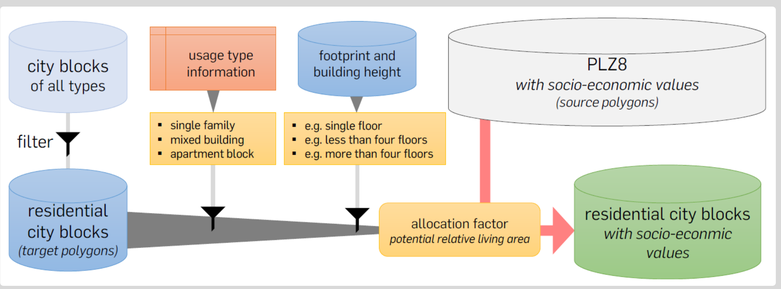
This study describes a methodological approach that analyses socio-demographic and -economic data in large-scale spatial detail.

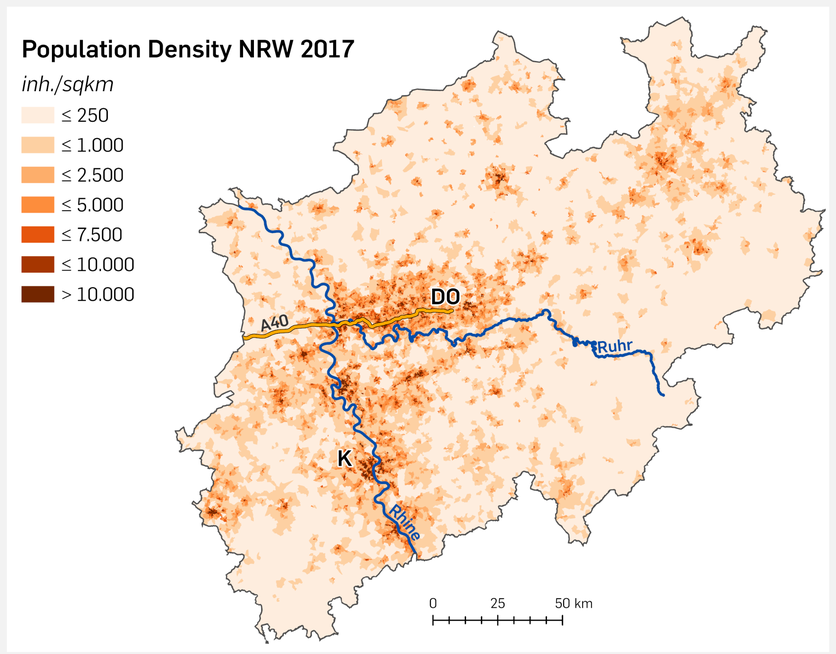
The aim is to gain a deeper insight into spatial components of socio-economic nexuses. The analysis was carried out utilizing data about population density and average annual income linked to spatially referenced polygons of postal codes (PLZ8, see figure (a) and (b)), followed by a sophisticated disaggregation using a method based on the three-class dasymetric mapping approach.

To transform two univariate maps into one bivariate choropleth map, reasonable class breaks for each attribute need to be set and a colour scheme must be selected that emphasises the essence of the analysis (figure (c)). The resulting figure (d) gives a decent insight into the spatial pattern of the two variables used. It shows less saturation in the combination of the two different colours where values tend to be lower and vice versa.

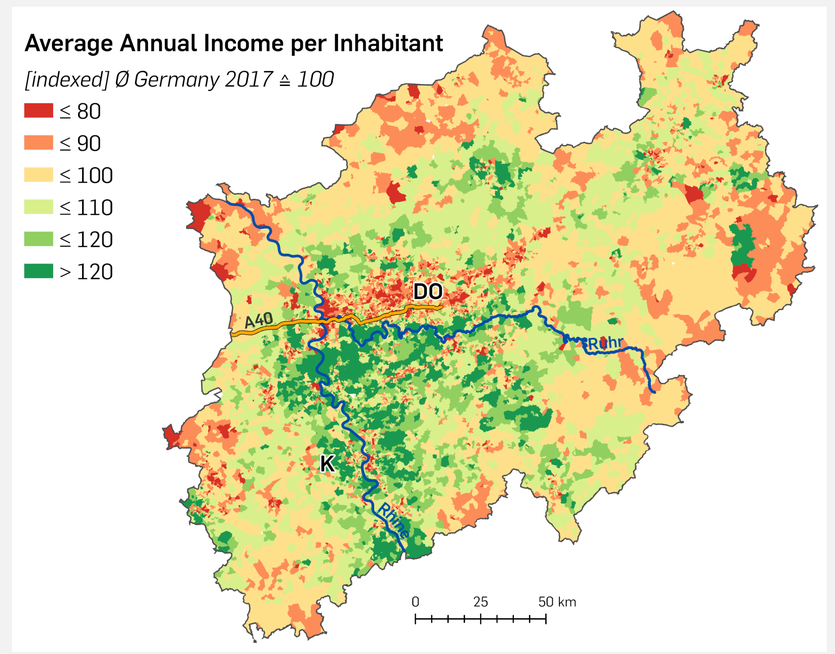
The enhancement of the spatial resolution and the respective level of detail with the PLZ8-polygons as source zones is conducted via a disaggregation into residential city block features (target zones, see figure (f)) while hierarchising the target zones according to their respective kind of apartment structure and their number of floors (figure (e)).



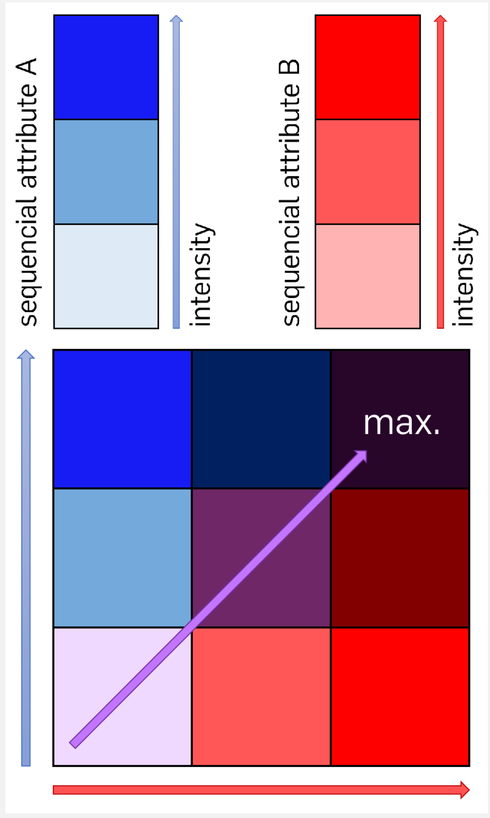
(e) Schematic flow chart of the disaggregation process



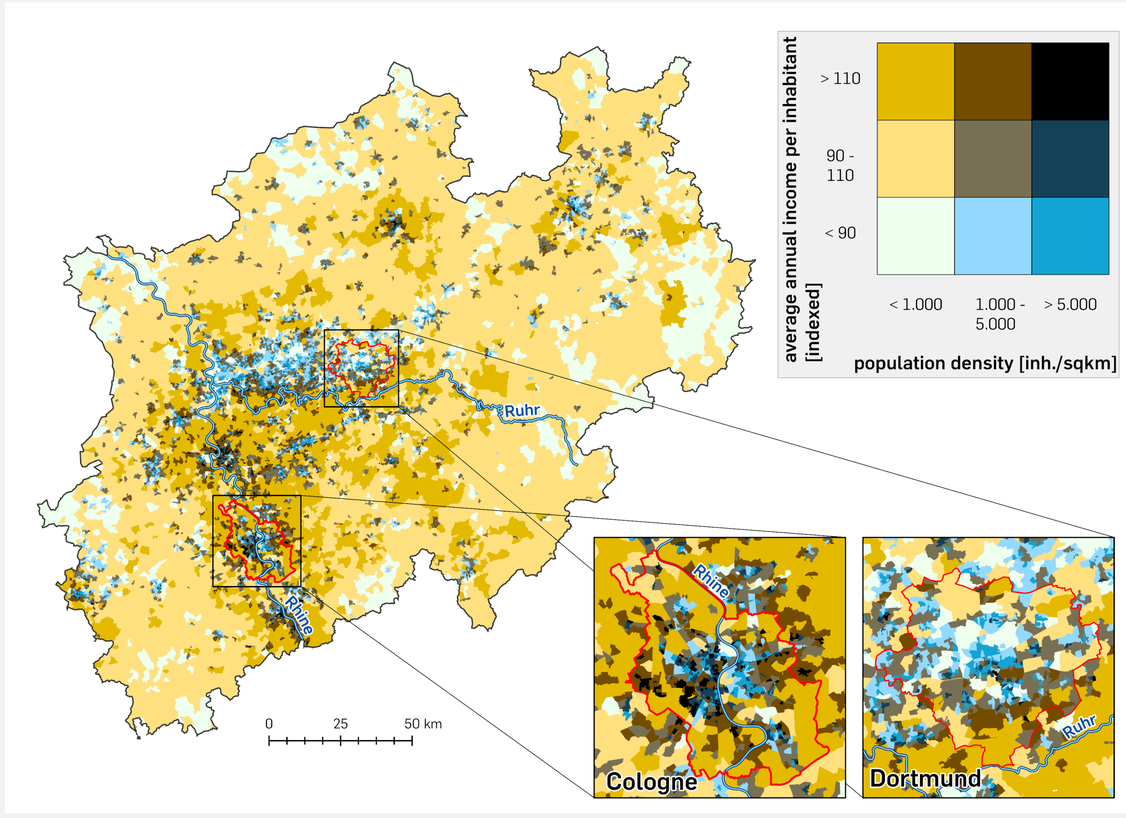
(a) Population density 2017 per PLZ8 polygon for NRW



(b) Average annual income per inhabitant 2017



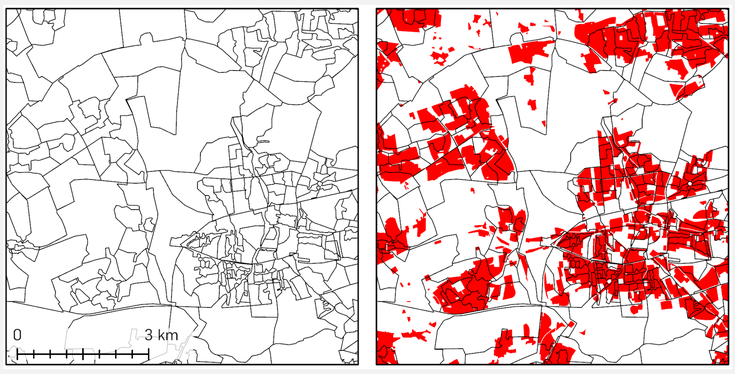
(c) Sequential matrix legend



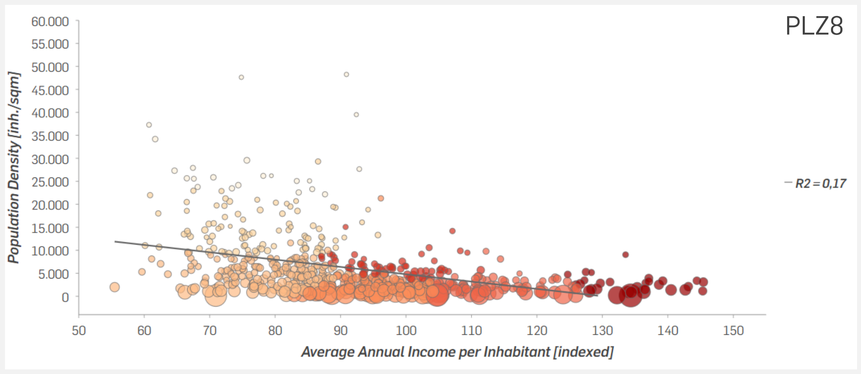
(d) Bivariate choropleth map combining figure (a) and figure (b)

Disaggregation results

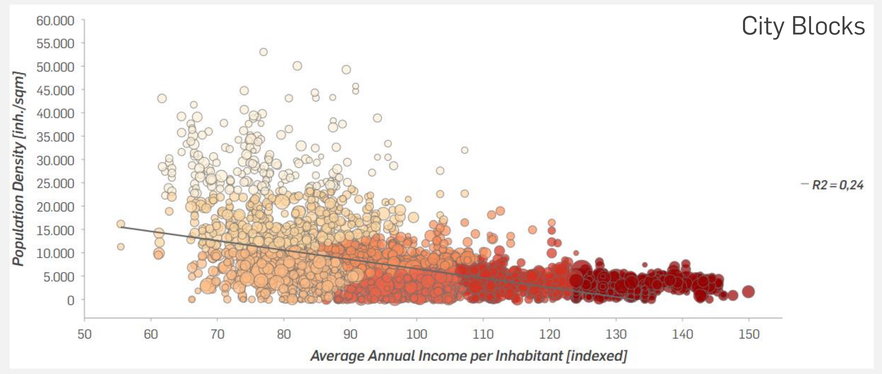
The correlations in figure (g) and (h) reveal a less scattering distribution of the features in both variables after the disaggregation. Additionally, the disaggregation enhances the perceptibility of the coherence in the clusters formed by a multivariate K-Means clustering algorithm to sharpen the borders inbetween both attributes (see also figure (k)).



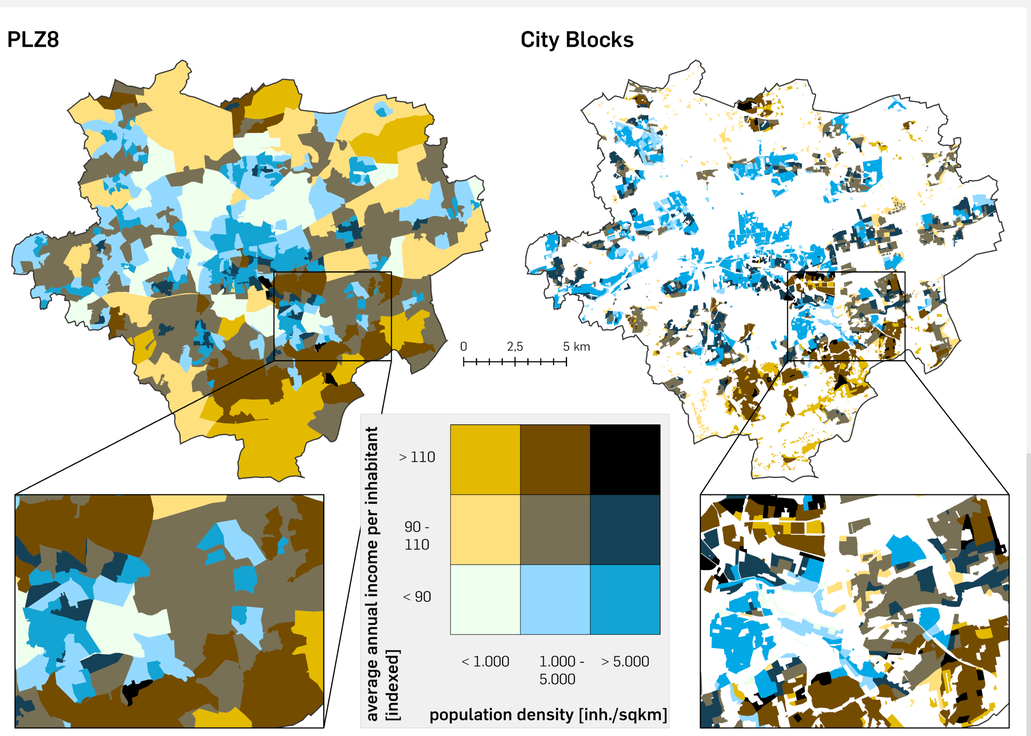
(f) Source zones (black lines) and target zones (red)



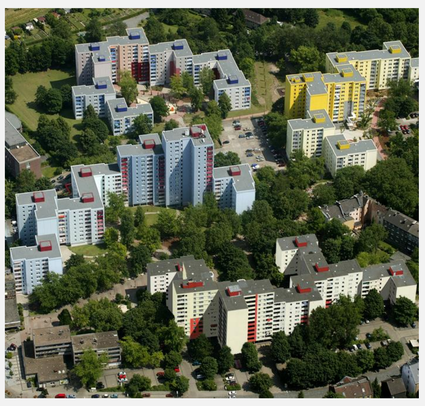
(g) Scatterplot before disaggregation (dot size proportional to area)



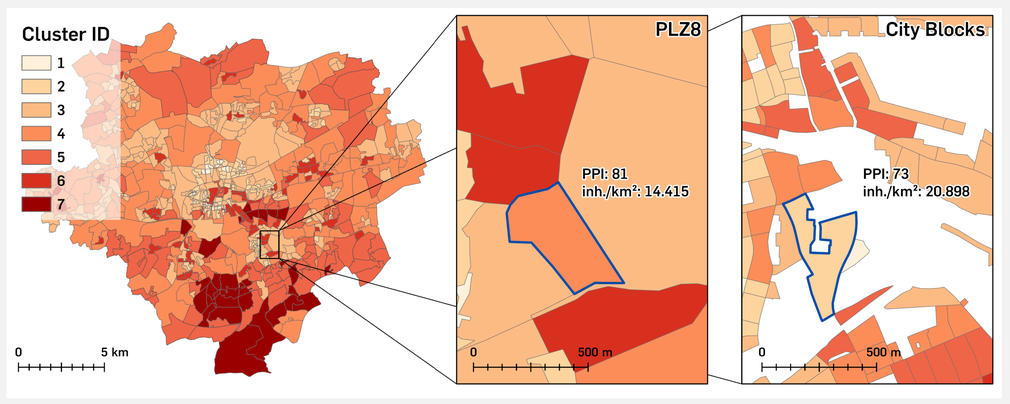
(h) Scatterplot after disaggregation (dot size proportional to area)



(i) Disaggregated values from PLZ8 (left) to city blocks (right) for the city of Dortmund



(j) Clarenberg building complex



(k) Clarenberg (blue outline) shape and values before and after disaggregation

The results show for the example of the city of Dortmund, that the disaggregation of the socio-economic data enhanced the scalability to a higher level of detail significantly (see figure (i)). The Clarenberg – a multi-residential tower block complex with a relatively high rate of child poverty and drawdowns of unemployment benefits (see figure (j)) – is now represented by a shape that suits the real outline of the complex and is attributed with socio-economic values that depict the local situation in a much more accurate way (figure (k)).

Thus, this workflow can help to use small-scale socio-economic data for studies that want to shine light on urban areas that suffer from huge socio-economic disparities in order to perspectively improve the local situation.

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Further reading: Moos, N.; Juergens, C.; Redecker, A.P. (2021): Geo-Spatial Analysis of Population Density and Annual Income to Identify Large-Scale Socio-Demographic Disparities. In: *ISPRS Int. J. Geo-Inf. 2021, 10, 432.* DOI: 10.3390/ijgi10070432

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