Classifying urban form at a national scale
The case of Great Britain

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Abstract: There is a pressing need to monitor urban form and function in ways that can feed into better planning and management of cities. Both academic and policymaking communities have identified the need for more spatially and temporally detailed, consistent, and scalable evidence on the nature and evolution of urban form. Despite impressive progress, the literature can achieve only two of those characteristics simultaneously. Detailed and consistent studies do not scale well because they tend to rely on small-scale, ad-hoc datasets that offer limited coverage. Until recently, consistent and scalable research has only been possible by using simplified measures that inevitably miss much of the nuance and richness behind the concept of urban form. This paper outlines the notion of "spatial signatures", a characterisation of space based on form and function, and will specifically focus on its form component. Whilst spatial signature sits between the purely morphological and purely functional description of the built environment, its form-based component reflects the morphometric definition of urban tissue, the distinct structurally homogenous area of a settlement. The proposed method employs concepts of "enclosures" and "enclosed tessellation" to derive indivisible hierarchical geographies based on physical boundaries (streets, railway, rivers, coastline) and building footprints to delineate such tissues in the built fabric. Each unit is then characterised by a comprehensive set of data-driven morphometric characters feeding into an explicitly spatial contextual layer, which is used as an input of cluster analysis. The classification based on spatial signatures is applied to the entirety of Great Britain on a fine grain scale of individual tessellation cells and released as a fully reproducible open data product. The results provide a unique input for local authorities to drive planning and decision-making and for the wider research community as data input.

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1. Introduction

Identification of recurring patterns in the built environment is deeply embedded within all schools of urban morphology. We can discuss Conzen's Plan Unit (REF), which evolved into Whitehand's morphological region within the British historical-geographical tradition, aiming to capture internally homogenous areas of a shared origin and spatial character. At the same time, we may talk about *tessuta urbana* or *urban tissue*, stemming from the Italian school of typo-morphology (REF), and sharing the notion of internal homogeneity, just detected by different methods reflecting the architectural perception of space more than geographic. However, it is a complicated pursuit to scale up morphological studies of these kinds without losing too much information. Traditional schools (both historical-geographical and typo-morphological) are generally not able to scale their methods to larger areas while keeping the detail. Another well-established school of urban morphology - Space Syntax, based on the work of Hillier and Hanson, is different and can be considered scalable to metropolitan (REF) or even national extents (REF). However, Space Syntax at these scales is limited to an analysis of street networks and their configuration, completely omitting patterns formed by plots, buildings, and open spaces. The same can be said about a broader range of network-based methods like Multiple Centrality Assessment - while they can be scaled, their insight is inherently limited by the limited data input.

The recent growth of purely quantitative methods of urban form analysis, often nicknamed *urban morphometrics*, and their ability to scale without losing too much detail is opening a range of opportunities to give urban morphology a toolkit to analyse recurring patterns at metropolitan and national extents. After the first explorations in the works of Gil (REF) or Hamaina (REF), the methods are starting to mature as illustrated by recent publications of Multiple Fabric Assessment by Araldi and Fusco (REFS), a series of element-based typologies by Berghauser Pont (REF), gridded classification by Jochem (REF) or hierarchical model following the biological methods of taxonomy creation by Fleischmann et al (REF). All share a similar approach, based on the an initial set of measured characters capturing the individual aspects of form-based patterns and subsequent unsupervised classification. As all methodological steps can be expressed as computer algorithms, they can potentially scale to nation-wide analyses, as already shown by Jochem in the case of Great Britain and XXX (REF). Is it to be noted that each of the existing methods has its limitations, often linked either to the a spatial unit that does not ensure internally homogenous urban patterns (Jochem, Araldi), dependency on rarely available data (Berghauser Pont) or a limited number of measured characters, which may omit some aspects of patterns and introduce selection bias in the method (Berghauser Pont).

This paper presents a method of delineation of internally homogenous areas of urban form based on an extensive set of morphometric characters across Great Britain, resulting in an exhaustive classification of the built and non-built environment. The remainder of the paper outlines the method 2, including the introduction of the Enclosed tessellation as the spatial unit, presents resulting classification 3, and discussed its implications on the analysis of urban form 4.

2. **Method**
3. **Results**
4. **Discussion**
5. **Conclusions**

References