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## Title

***Searching for the DNA of urbanisation. A material perspective***

## Abstract

Broadly accepted categorical differentiations of urbanisation understand cities as well-defined objects containing urban spaces in contrast to their hinterlands. However, urbanisation's multidimensional complexity challenges these approaches in the context of increasing social issues marked by rapid urban expansion, uneven development, ways of life, inequality, commodification, etc., that require fresh scientific answers grounded in innovative empirical evidence. Here, we analysed the population-based and the land-use/land cover-based categorical understandings of urbanisation, looking at their origins and main shortcomings. Our analysis makes a generalised description of urbanisation's spatial complexity, with an emphasis on the problematic spatial delimitation of urban boundaries; urbanisation occurring in remote wild areas; and the missing third spatial dimension. We discuss these shortcomings based on recent scientific developments, providing reasons why the categorical approach needs to be changed and how. We propose a continuous indicator of urbanisation which is based on the accumulation of anthropogenic materials, a physical, rather than a spatial or demographic characteristic. Our proposal allows the analysis of socio-ecological systems' spatial organisation, pursuing comparative studies across geographies and times, informing globally generalisable patterns of urbanisation processes and giving a material body to address claims for sustainable urban development. © 2024 The Authors

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