

Change in Artificial Land Use over time across European Cities: A rescaled radial perspective

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Seen from a satellite, whether looking at land use in the daytime or at night lights, most cities have rather circular shapes, organised around a city centre. As a consequence, the radial distance to the main centre is surely the very first spatial differentiation to consider when studying the internal structure of many cities. We conduct here a radial analysis of urban land change in order to understand what the recent changes in urbanisation are across Europe and how it relates to city size. We focus on the most fundamental differentiation regarding urban land use: has it been artificialised for human uses (residence or roads for instance) or is it natural, or at least undeveloped (Prokop et al., 2011) Using spatially detailed data from the EU Copernicus Urban Atlas, the profiles of artificial land use (ALU) are calculated and compared between two years, 2006 and 2012. Based on the homothety of urban forms found by Lemoy and Caruso (2018), a simple scaling law is used to compare cities after controlling for population and allows for the internal structure of cities, as determined by distance to the city centre, to be compared across years. Examining cities from a monocentric perspective, with respect to distance to the main centre is long established in urban geography and economics (Alonso, 1964; Clark, 1951; Fujita, 1989; McDonald, 1989; Von Thünen, 1875). One of the advantages of using a radial analysis, is the ability to examine the complex two-dimensional intra-urban structure of a city in a one-dimensional space. The land use profiles produced from the radial analysis represent ALU with respect to distance to the centre. Similar to other studies (Walker, 2018; Wilson, 2012) the location of the city hall is used as the centre point of cities. This historical location tends to coincide with the principal residential centre (Griffith and Wong, 2007). We present evidence of tilting profiles of artificial land use which shows that given total population growth, urbanisation is relatively shrinking up to a rescaled distance of ~ 20km (using London as a reference) on average across Europe between 2006 and 2012. This contrasts with further expansion and increase in artificial land use, beyond a rescaled distance of ~ 20km. Grouping cities based on population, highlights that ALU in the largest cities (population > 1.5 million) is on average flattening around the core but increasing at distances around the periphery. For cities with a population below 100,000, ALU increases across all distances to the CBD. We explore these changes focusing on similarities between cities by disentangling the role of city size. Our findings have important implications relative to the sustainability of cities as this evidence is pointing to increasing urban sprawl and stagnant growth in urban centres across cities of all sizes. It also bears theoretical implications on the nature of sprawl and its scaling with city size.

KEYWORDS

Spatial analysis / radial analysis / land use / scaling laws / urban sprawl