Urban Street Networks as an Example for Spatial Networks with Universal Geometric Features: A Case Study from Germany

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Human activity patterns have a multiplicity of direct links with contemporary geoscientific problems, for example, in terms of land-use due to growing urban areas, or greenhouse gas emissions due to transportation processes. Typically, the individual transportation processes are bound to a substrate (for example, a road system) which is organised as a complex network.

In this work, we continue our recent investigations on the specific geometric properties of urban road networks. For this purpose, we have investigated the road systems of 20 of the largest cities of Germany. We find that although the historical development of the 20 cities as well as their large-scale morphology may be very different, the distributions of characteristic quantities like road lengths and angles as well as the sizes and forms of the resulting "cells" show a high degree of universality. Our results suggest that the formation of urban road networks can be understood as a self-organisation process that is governed by a low number of deterministic rules, which are distinctively different from those controlling the network formation in most geophysical systems.