“Decoding (urban) form and function using spatially explicit deep learning”

Abstract: This paper advances our understanding of the extent to which conventional deep learning methods can be applied to satellite imagery to capture the composition of urbanised landscapes. The building blocks that make up those -the activities and agents conceptualised as urban function and the structure that supports them conceptualised as urban form- can be arranged in many ways. This paper relies on the concept of “spatial signatures”, a characterisation of space dependent on data released at a variable rate - an issue that could be resolved by remote sensing and satellite imagery. Using Sentinel-2 imagery, we explore this pathway within convolutional neural networks and predictive modelling trained to identify spatial signatures across Great Britain. While deep learning is established, its application has often ignored the geographical nature of the images. Our focus is to develop a performant model but also to learn about the effect of spatially explicit methods of doing so. The results indicate that classification of urban environments is more challenging than non-urban. However, when applying spatially explicit methods the accuracy is competitive with established models. This suggests that satellite imagery reflect form and function in greater detail than is usually present in available remote sensing products.

Key words: spatial signatures, classification, remote sensing, artificial intelligence, open data