Assessing regional green infrastructure provision

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Summary

Green infrastructure (GI) is a multifunctional resource that surrounds the built environment, connecting urban and rural areas. GI varies enormously in terms of size and composition, from village greens to Country Parks, river banks to woodland. While there are many individually-relevant databases available on aspects of GI, there is no consistent definition nor authoritative database. Using primarily open source data products, spatial data integration and analysis strategies were used to test the robustness of potential definitions and the compatibility of different data. Consistently, the proportion of green infrastructure in local authority areas is strongly associated with population density. Strong socio-economic associations also exist in the distribution of certain databases.

KEYWORDS: green infrastructure; open source; fitness for purpose; OpenStreetMap; OS Open Green Space.

1. Introduction

Green infrastructure (GI) provides a network of green spaces and environmental features essential to the health and quality of life of sustainable communities (Natural England, 2009). The typology includes formal parks and gardens, amenity greenspace, natural and semi-natural urban greenspaces, green corridors and other public spaces as diverse as allotments and city farms. These features link through the landscape, connecting the urban area to its rural hinterland. GI assets provide areas for recreation and education, habitats for wildlife and also provide ecosystem services such as flood defence or absorption of air pollution (UK-NEA, 2011). Proximity to GI has also been found to be important for health and wellbeing.

Data sources for defining GI can be identified from local, regional and national datasets of land use, land cover and land designations. While many local authorities created their own GI datasets in response to Planning Policy Guidance 17 (DCLG, 2002), consistent information at regional scales is relatively unusual and many initiatives now require updating.

This research is in part reactive to user needs, addressing a paucity of scalable GI data to support county-level and regional strategic planning. The paper presents both an assessment of GI provision in the East of England and a transferable methodology that could be applied elsewhere, without incurring prohibitively high costs.

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2. Methodology

Adapting the methodology developed by Butlin et al. (2011), a desk-based approach was taken to integrate two geographical datasets: (1) Ordnance Survey Master Map Topography (hereafter OS MM), which is available under Local Government Agreement and accessible through the Digimap EDINA portal for research purposes; and (2) OpenStreetMap (OSM), which is an example of Volunteered Geographic Information (VGI), and was employed here as a substitute for Butlin et al.'s use of local government open space data. The OS MM dataset represents a higher accuracy product (Haklay, 2010), but thematic resolution was too coarse to reveal all GI.

GI typology was initially guided by features included in PPG17 guidance (DCLG, 2002):

- Parks and gardens
- Natural and semi-natural greenspaces
- Green corridors*
- Outdoor sports facilities
- Amenity greenspace
- Provision for children and young people
- Allotments, community gardens and urban farms
- Cemeteries, disused churchyards and other burial grounds
- Civic and market squares.

* Replication of green corridors was not practical.

In a Geographical Information System (GIS), features with attributes supporting GI were extracted from the OSM and OS MM datasets. A spatial union operation was performed and the output recorded both type of feature and source.

To evaluate the completeness of this OSM-OS MM blend, a visual and quantitative inspection was performed against other datasets. Recent policy changes have allowed greater access to public sector data through an opening up of government repositories, without restrictions on data use beyond attribution. Following its recent release, the Ordnance Survey Greenspace data product was compared with the OSM-OS MM blend. While no systematic validation against aerial imagery was carried out, CORINE Land Cover 2012 (CLC 12) was reclassified and used for comparison.

3. Results

As expected, OS MM has excellent spatial accuracy and consistent coverage but limited GI-relevant detail on some types of attributes (e.g. DESCTERM). OSM completeness can be spatially variable (e.g. Haklay, 2010) but attribute detail can support GI identification. While OS Open Greenspace focuses on publically owned accessible spaces, some areas of natural greenspace, including publically accessible land, are not in the OS Open Greenspace layer. Feature boundaries in the OS Greenspace layer are often larger or more generalised than those derived from the OSM-OS MM blend.

The OSM-OS MM blend covers 255 000 ha, 19.2% of the 1 330 000 ha of the 28 local authorities in Essex, Suffolk and Norfolk. OS Open Greenspace totals 23 600 ha, 1.8% of the region and the reclassified CLC 12 data covers 158 000 ha, 11.9% of the region. The OS Greenspace layer has a strong urban focus (Figure 1) and the other two distributions are strongly correlated (+0.70).

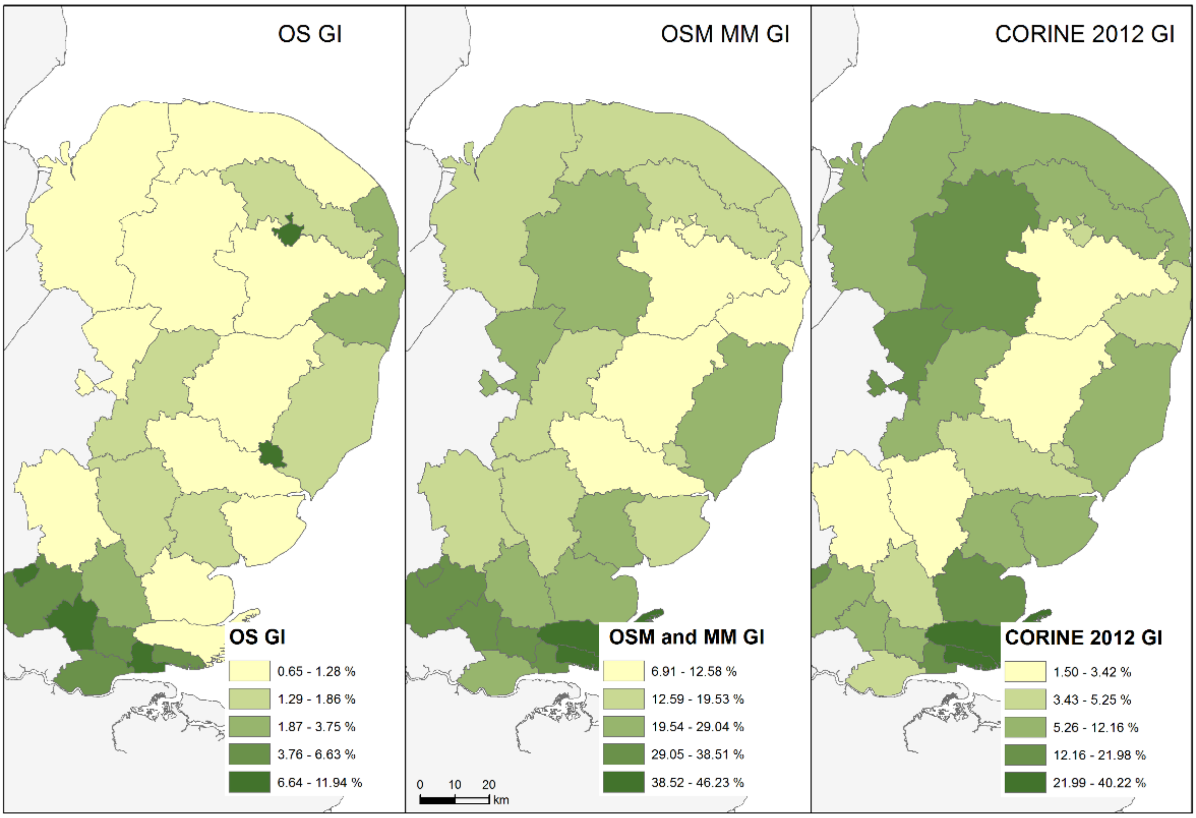

Figure 1 Percentage of areas classed as GI in local authorities across the East of England

Of the 255 000 ha in the OSM-OS MM blend layer, 117 000 ha (45.8%) is in both source layers, 65 000 ha (25.6%) just in OSM and 73 000 ha (28.6%) only in OS MM. The proportional contribution from OSM is higher in southern Essex and larger urban authorities (Figure 1).

The OSM-OS MM blended product complements the OS Open Greenspace data and, for both datasets, the extent of GI is strongly associated with population density (Table 1). The OSM-OS MM blend varies in source reliance between areas. The proportional contribution from OSM in the blended layer is lower in areas with greater Index of Multiple Deprivation (IMD) scores. Correlation with % adults with degree, however, is weaker than with the overall IMD.

Table 1 Socio-economic associations (Spearman rank correlations: significant association at 95 confidence level are in bold font).

Local Authority Characteristics	Population density (ONS 2014)	Mean overall deprivation (IMD 2015)	Mean education deprivation (IMD 2015)	% adults (16+) with a degree (IMD 2015)
OS Open Greenspace as % of LA Area	**+0.88**	**+0.33**	+0.18	-0.11
OSM-OS MM Blend as % of LA Area	**+0.40**	-0.06	-0.01	-0.21
CORINE Land Cover as % of LA Area	+0.19	+0.27	**+0.39**	**-0.38**
% from OSM Only in OSM-OS MM Blend	+0.15	**-0.42**	**-0.34**	+0.24

The combination of population density, *P*, and mean overall IMD score, *D*, can be used to predict the OSM share of the OSM-OS MM blend data, S_{OSM} (Equation 1, R^2=0.35).

$$S_{OSM} = 0.721P - 1.819D + 99.9 \qquad (1)$$

4. Discussion and conclusion

Balancing the utility, composition and value of landscape resources is difficult (Mell et al., 2013). Strategic planning and management of green infrastructure is a mechanism to integrate the environment within housing and economic agendas; as such, information on existing GI provision is increasingly important for many planning purposes. A consistent definition and methodology for assessing GI should be sufficiently simple and elegant for local authorities to employ.

It is not currently possible to generate a robust GI definition fit for regional strategic planning from open source spatial data alone. The OSM-OS MM blended product identifies more greenspace than OS Open Greenspace data or CORINE Land Cover categories, but shows socio-economic associations that need to be considered during interpretation; for example, the proportional contribution from OSM in the blended layer is higher in densely populated areas and lower in areas with greater deprivation scores.

Ongoing work is refining the GI typology and performing comparisons with other data sources, particularly in urban areas. To support a legacy of approach, whereby the dataset can be updated or augmented depending on the final purpose of the dataset, further work will develop a simple rule-based automation process on a server system.

5. Acknowledgements

This work was supported by grant number ES/LO11859/1 from the Business and Local Government Data Research Centre, funded by the UK Economic and Social Research Council to improve access to data for researchers and analysts. Ordnance Survey derived products Contain OS data © Crown copyright and database right (2017). OpenStreetMap data are available under the Open Data Commons Open Database License (ODbL) and OpenStreetMap cartography is licenced under the Creative Commons Attribution-ShareAlike 2.0 licence (CC BY-SA).

6. Biography

Dr Amii Harwood is a lecturer and researcher in GIS, with a focus on ensuring fitness for purpose when digitally representing environmental phenomena.

Professor Andrew Lovett has an academic background in Geography. He is a specialist in GIS and has undertaken university research and teaching for over 30 years.

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Dr Sarah Taigel now works as a Broadland Catchment Partnership Coordinator for the Broads Authority, Norfolk.

References

Butlin T, Chambers C, and Ellis F (2011) *The value of mapping green infrastructure.* Royal Institution of Chartered Surveyors.

DCLG (2002). *Planning Policy Guidance 17: Planning for open space, sport and recreation*. Department for Communities and Local Government.

Hacklay M (2010). How good is OpenStreetMap information? A comparative study of OpenStreetMap and Ordnance Survey datasets for London and the rest of England. *Environment and Planning B*, 37, 682-703.

Natural England (2009). *Green Infrastructure Guidance*. Natural England Report NE176.

Mell I C, Henneberry J, Hehl-Lange S, and Keskin, B (2013). Promoting urban greening: valuing the development of green infrastructure investments in the urban core of Manchester, UK. *Urban Forestry & Urban Greening*, 12, 296-306.

UK-NEA (2011). *UK National Ecosystem Assessment Technical Report.* UNEP-WCMC.