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Engineering geoprivacy using automated zone design

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Overview: Engineering geoprivacy using automated zone design

- What is zone design and what is the utility of zone design?
- Zone design for new forms of data
- Application of zone design to a “disclosive” synthetic dataset
- Initial results
- Applications to other data / the bigger picture

What is zone design?

- Depending on the purpose, size and position of boundaries may matter in many different ways.
- Geographers know this as the “Modifiable Areal Unit Problem” (Openshaw, 1984).
- Comprises “scale” and “aggregation” problems.
- Divisions of geographical space, usually defined in terms of polygons – often though of as just shaded areas on a map.
- Choice of the number and configuration of zones.

What is zone design?

- Locational information is an important key to disclosure.
- Individual census records are potentially identifiable.
- Standard approach is to aggregate over geographical areas to meet a required level of comfort for one-off release of aggregated data.
- Additional protection from other techniques (e.g. record swapping, collapsing classes, minimum thresholds).
- Examples:
  - 2011 Output Areas
  - 2011 Lower Layer Super Output Areas
  - 2011 Workplace Zones

Zone design for new forms of data

- Growth, and desire to make better use, of administrative data.
- Importance of data linkage because administrative records often domain-specific and attribute poor.
- Power of linkage across domains and to location.
- Widespread investment in access (Administrative Data Research Network, Farr Institute, VML, secure data labs…).
- Pressure and potential: to realise societal benefits and make best use of data investment.

Using Zone Design with linked data

- What is the utility of automated zone design for use with new forms of linked and administrative data?

- Create zones where there is sufficient information on the building blocks for research to proceed, yet the locations of individuals are protected.
- Potentially – quantify the process leading to the zones released to researchers.

Using Zone Design with linked data

- Middle layer super output area (MSOA) coded individual level synthetic dataset (2011 Census) with 2015 Index of Multiple Deprivation (IMD).
- Postcode Thiessen polygons.
- Health & Social Care Information Centre – location of General Practitioners (GPs) in Southampton.

Using Zone Design with linked data

Geography	N units
Households in Southampton (2011)	98,244
GP locations (November 2015)	45
MSOAs	32
LSOAs	148
OAs	766
Postcodes	5,047

Postcodes and GPs

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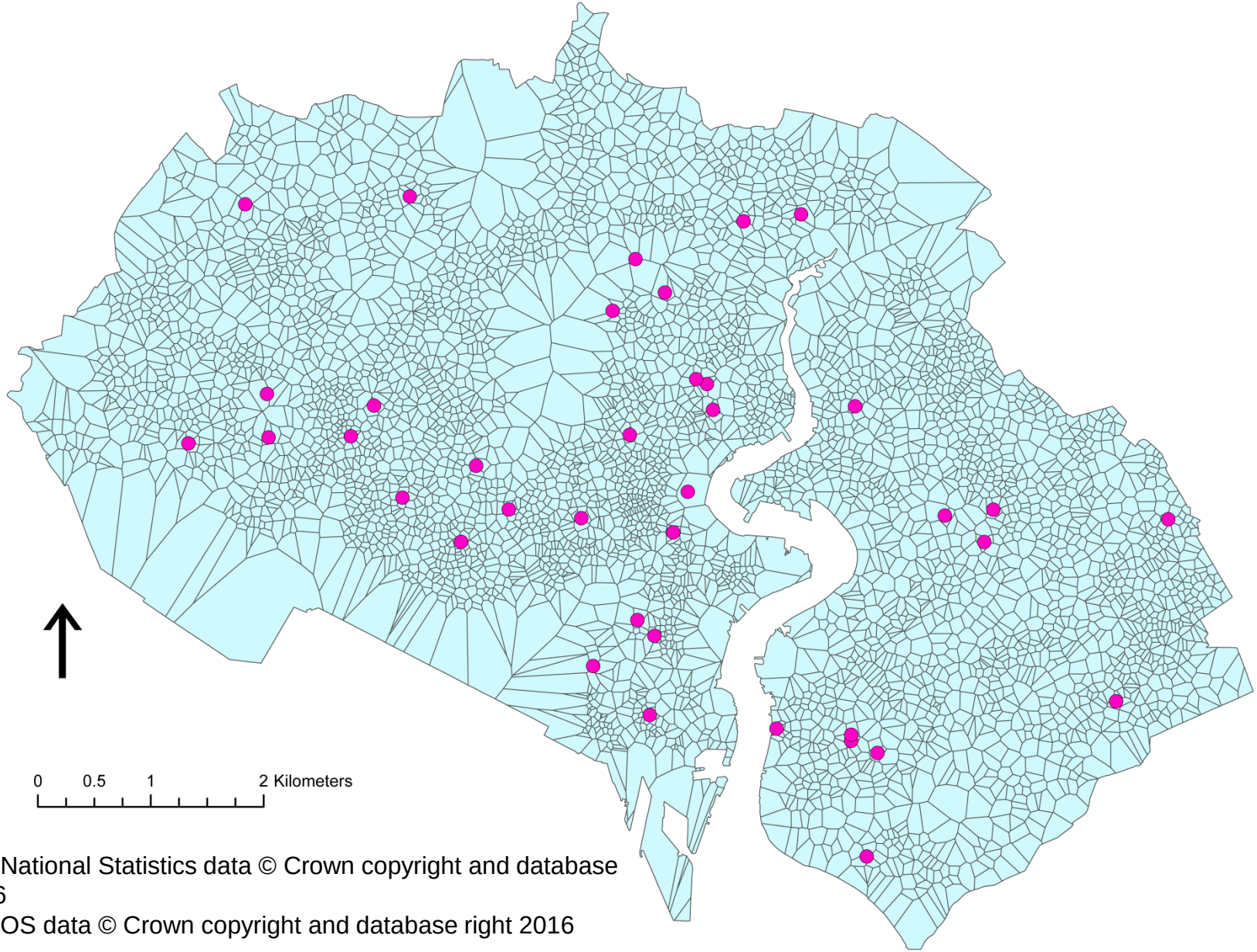

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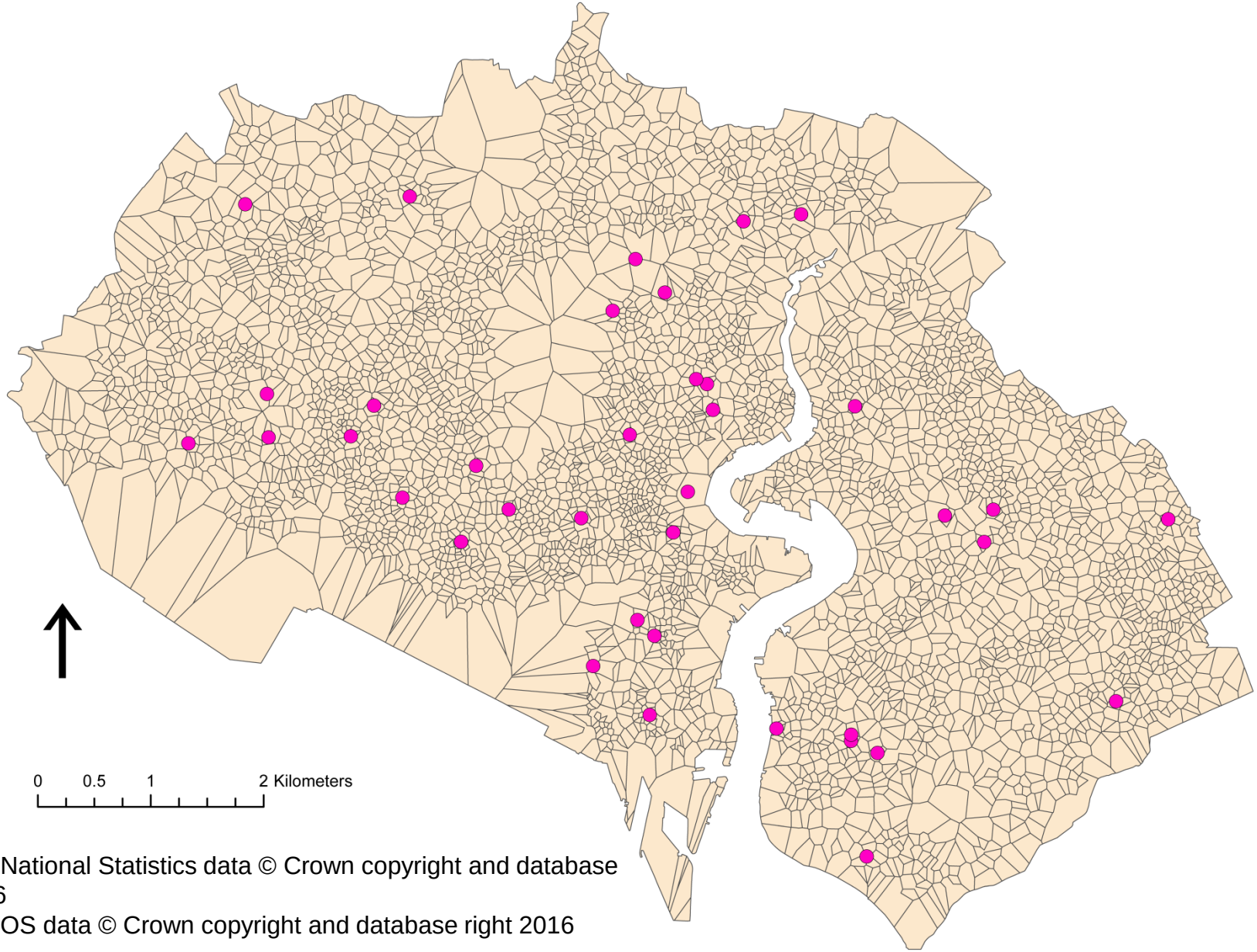

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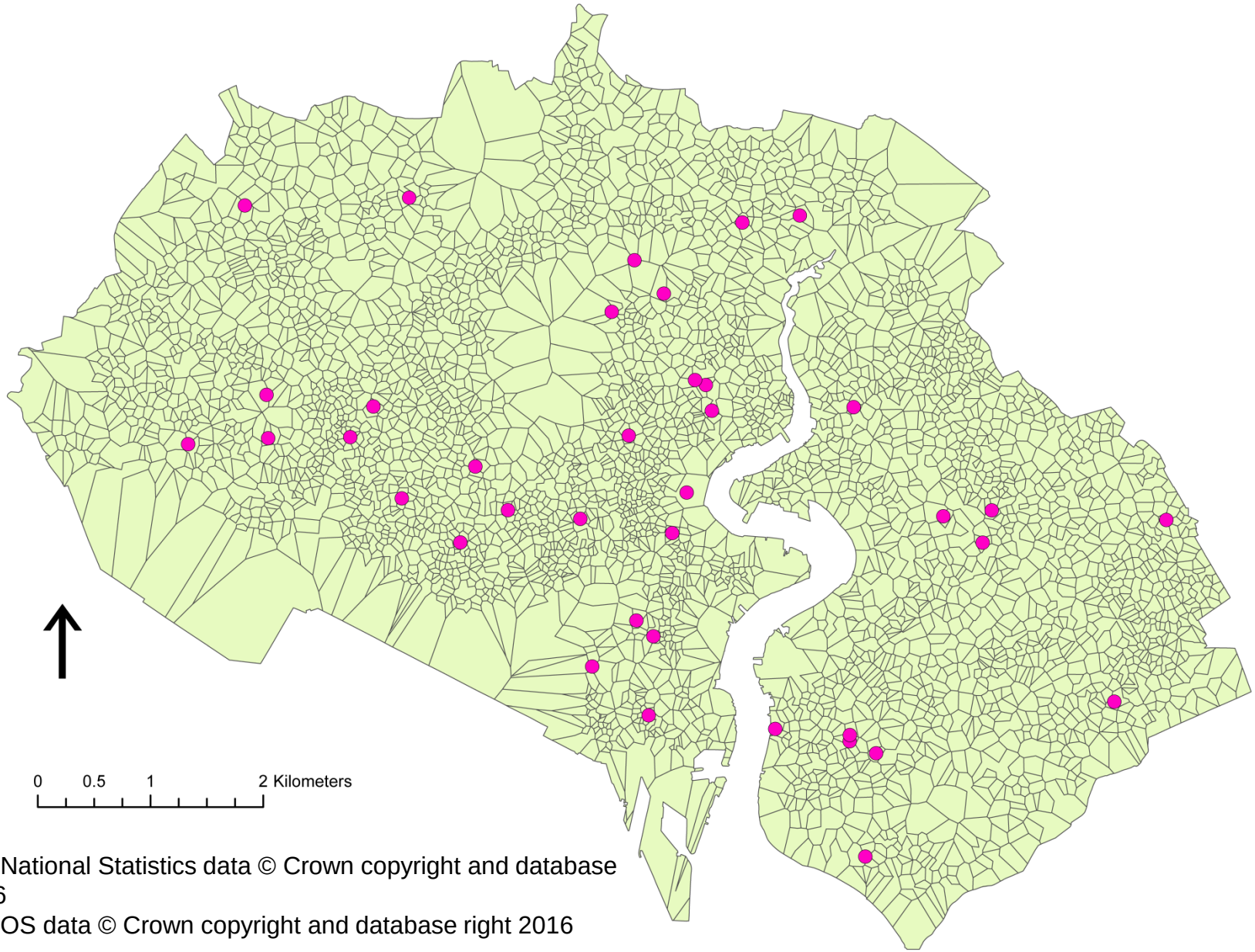

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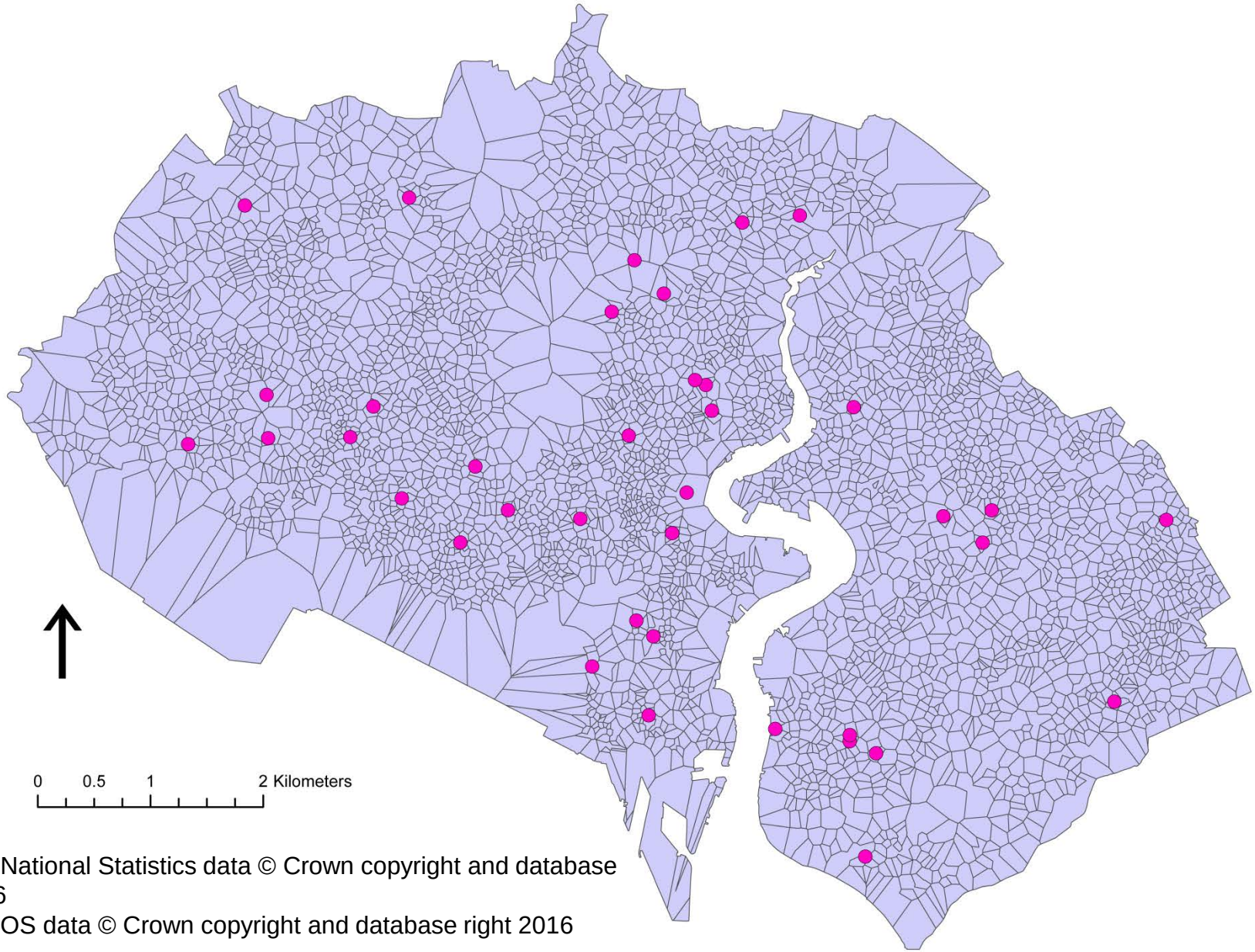
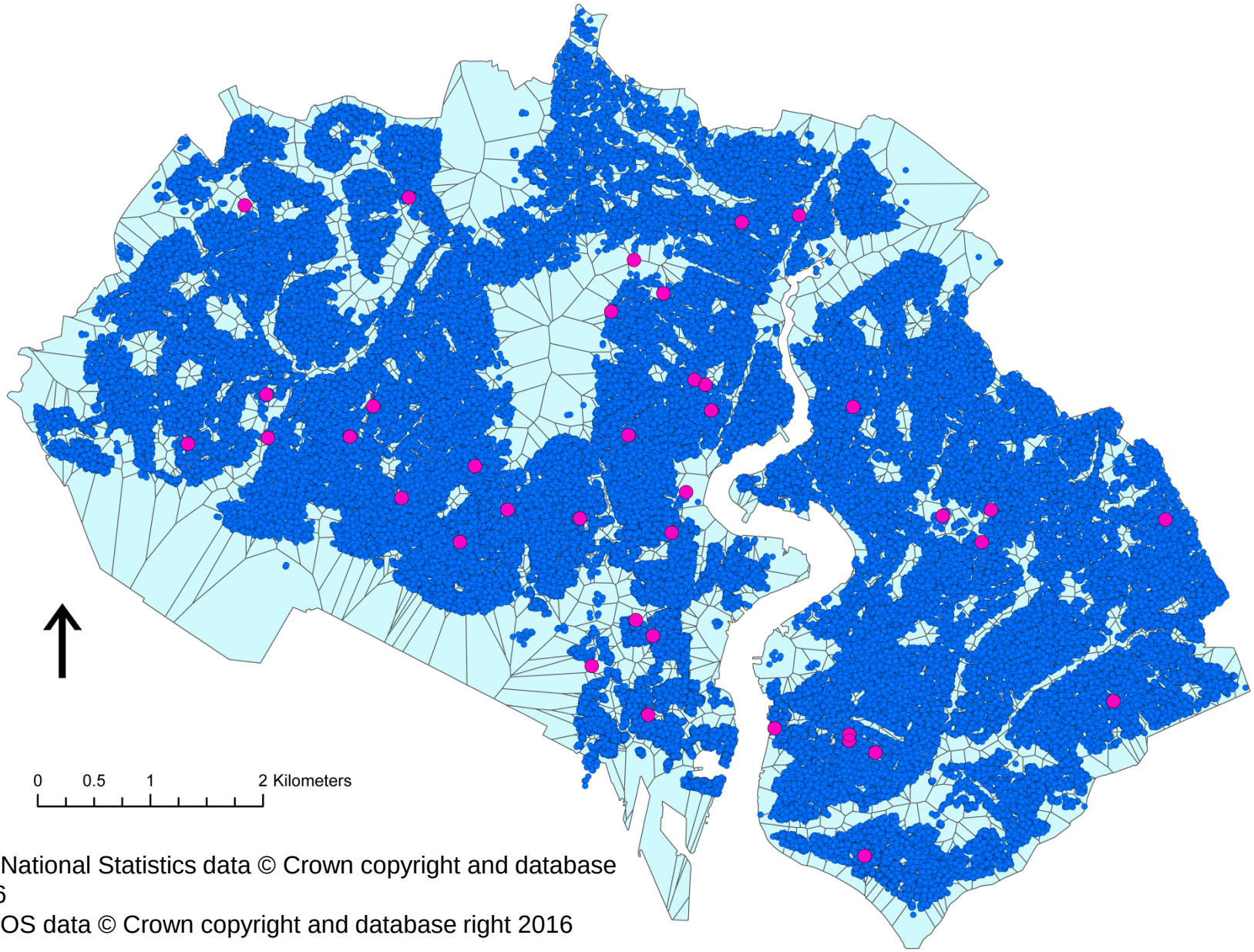


Households



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Example of using Zone Design with linked data

Geographic Unit	Number of units	Average population	Minimum population	Maximum population	Mean distance to GP (m)	Distance to GP – IMD rank score (R)
MSOA	32	47	34	70	828	0.176
LSOA	148	49	24	107	826	0.113
OA	766	53	15	246	817	0.081
Postcode	4,999	45	1	392	818	0.116
SZ 100	2,186	60	9	392	818	0.091
SZ 125	1,800	59	8	392	817	0.107
SZ 150	1,516	54	9	392	826	0.109
SZ 175	1,490	54	9	227	825	0.102
SZ 200	1,488	53	9	227	825	0.093
SZ 225	1,491	53	11	249	827	0.114

Conclusions

- Highlighting the pervasive nature of geographical units and the influence they have over analyses.
- Ongoing work. Next step is to control the lower population threshold – key disclosure constraint for data providers.

Conclusions

- Our research and technique is seeking to understand how to:
    1. Maximise protection for the data provider.
    2. Maximise data fidelity for the researcher.

- Transparency? There is the potential to quantify the zone design solution for the researcher.

- Zone design has a wider applicability to administrative and linked data.

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- The data for this research have been provided by the Consumer Data Research Centre, an ESRC Data Investment

- AZTool http://www.geodata.soton.ac.uk/software/AZTool/
- Openshaw, S. (1984) *The Modifiable Areal Unit Problem,* Geobooks, Norwich, England.