Urban Analytics: City Structure, and Function

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UNIVERSITY OF LIVERPOOL

Consumer Data Research Centre

Northern Regional Data Facility

LIFE CHANGING | World Shaping

www.cdrc.ac.uk

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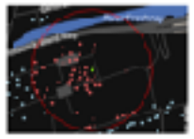
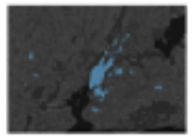
Geographic Data Science Lab

FOURSQUARE BUZZ IN AMSTERDAM



MAPPING RETAIL SECTOR BUSINESS RATE INEQUALITIES

GRID POPULATION



URBAN EMPLOYMENT CENTERS IN THE US

NORTH AMERICAN GEODEMOGRAPHICS

BROADBAND SPEED EQUITY

Consumer Data Research Centre

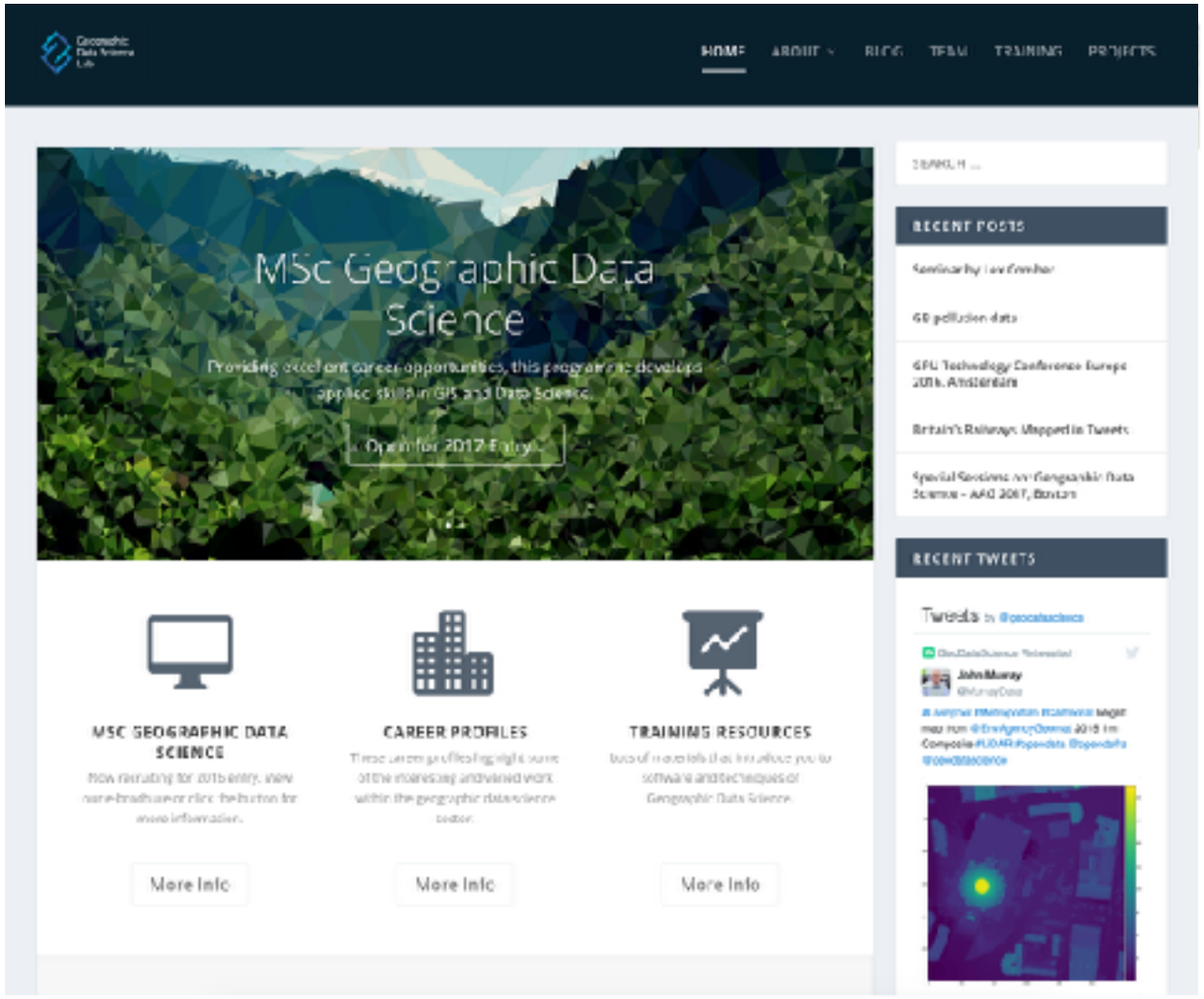
ESRC CONSUMER DATA RESEARCH CENTRE

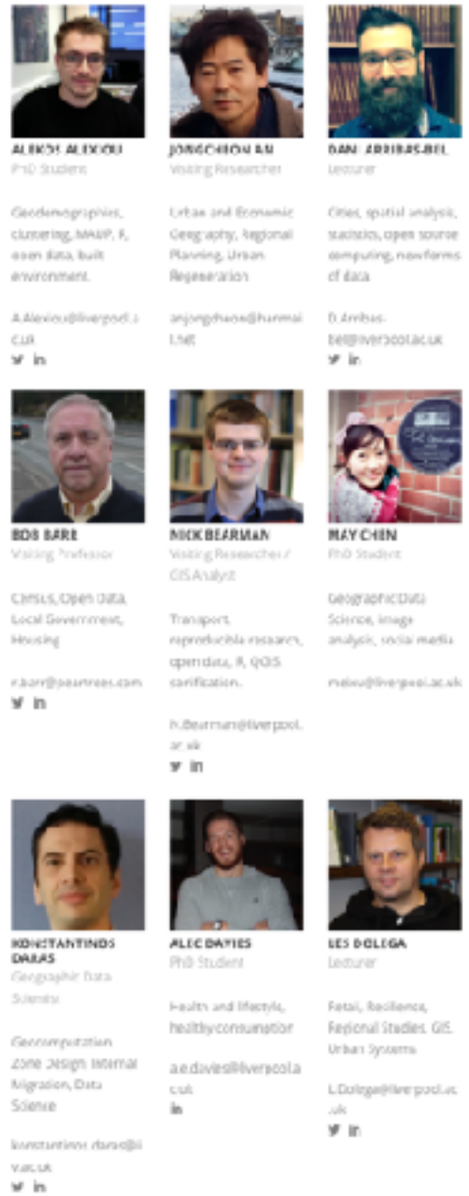
VEHICLE EMISSIONS LINKED TO THE SCHOOL COMMUTE

LONDON OUTPUT AREA CLASSIFICATION

TEMPORAL OUTPUT AREA CLASSIFICATION

E-RESILIENCE OF UK RETAIL CENTRES





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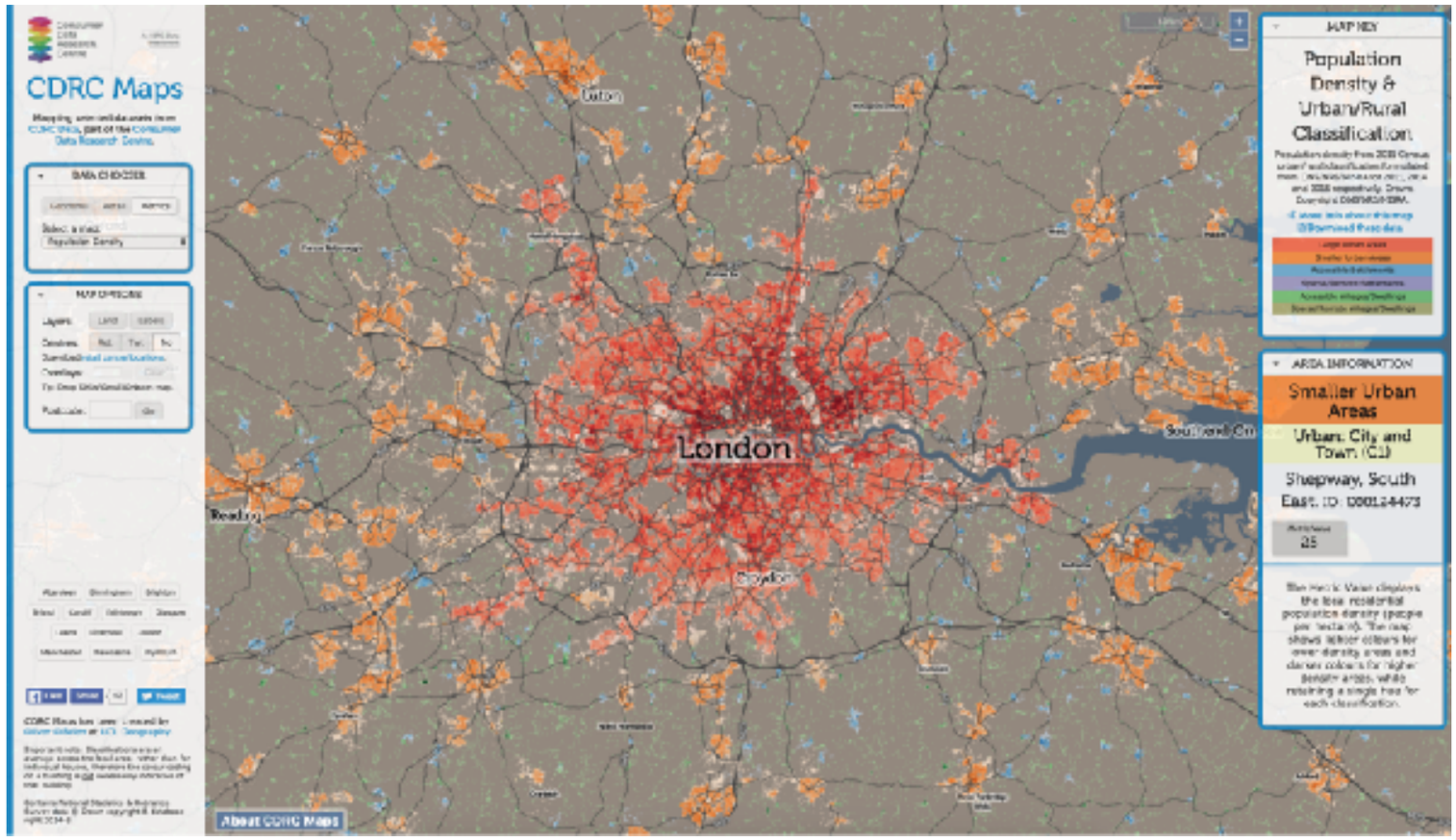

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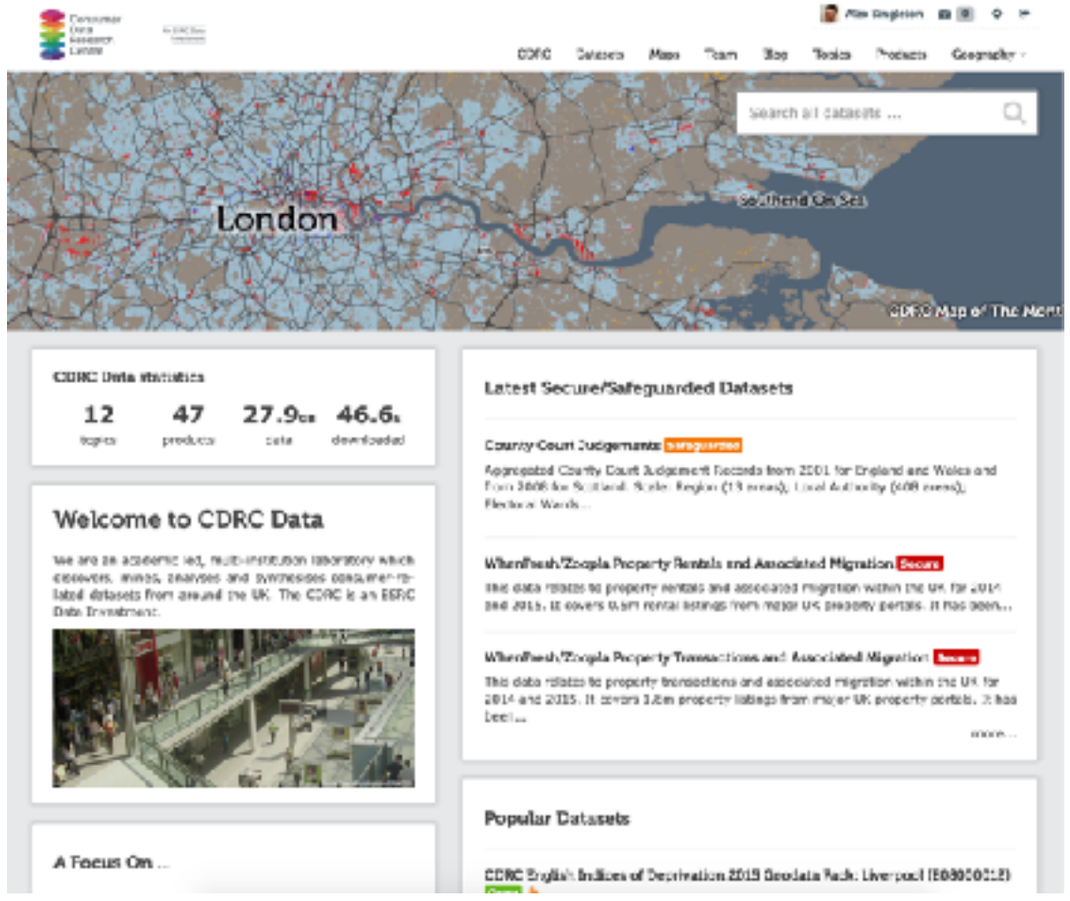

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Urban Analytics

1. Questioning the city through urban analytics
2. Sensing the city
3. **Visualizing the city**
4. **Cities and Context**
5. Explaining the city
6. Generative urban systems
7. Cities as networks and flows
8. A Collection of parts
9. Conclusion

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Due out 2017; Singleton, Spielman, Folch (Sage)

http://www.google.co.uk/intl/en_uk/earth/

how?


Liverpool
Edge Hill
Wavertree
Olive Mount
Wavertree Nook
Broad Green
Old Swan
Childwall
Toxteth
Dingle
Aigburth
Allerton
New Ferry
Edge Lane
Edge Lane Drive
Low Hill
Queensway (Mersey Tunnel)
Grove Street
Wapping
Selton Street
Smithdown Road
Picton Road
Princes Road
Park Road
Ullet Road
Aigburth Road
Queens Drive
Childwall Valley Road
Woolton Road
Menlove Avenue
Mather Avenue
Springwood Ave
Garston
River Mersey
A5036
A5058
A562
B5173
B5174
B5178
B5180
B5171
B5342
http://www.openstreetmap.org

nued

H11 What type of central heating does this accommodation have?
Tick all that apply, whether or not you use it.
Central heating is a central system that generates heat for multiple rooms
No central heating
Gas
Electric (including storage heaters)
Oil
Solid fuel (for example wood, coal)
Other central heating

H12 Does your household own or rent this accommodation?
Tick one box only
Owns outright ➡ Go to H14
Owns with a mortgage or loan ➡ Go to H14
Part owns and part rents (shared ownership)
Rents (with or without housing benefit)
Lives here rent free

H13 Who is your landlord?
Tick one box only
Housing association, housing co-operative, charitable trust, registered social landlord
Council (local authority)
Private landlord or letting agency
Employer of a household member
Relative or friend of a household member
Other

H14 In total, how many cars or vans are owned, or available for use, by members of this household?
Include any company car(s) or van(s) available for private use
None
1
2
Write in number

s accommodation self-contained?
that all the rooms, including the bathroom and toilet, are behind a door y this household can use
ll the rooms are behind a door that only household can use
o

w many rooms are available for use only by this ousehold?
Do NOT count:
bathrooms
toilets
halls or landings
rooms that can only be used for storage such as cupboards
Count all other rooms, for example:
kitchens
living rooms
utility rooms
bedrooms
studies
conservatories
ve been converted into one, count

t is:
or tenement
house
(for example, in an over a shop)
structure:
mobile or temporary structure

Ind

1 What is you
First name
Last name

2 What is your sex?
Male
Female

3 What is your date of birth?
Day
Month
Year

4 On 27 March 2011, what is your legal marital or same-sex civil partnership status?
Never married and never registered a same-sex civil partnership
Married
Separated, but still legally married
Divorced
Widowed
In a registered same-sex civil partnership
Separated, but still legally in a same-sex civil partnership
Formerly in a same-sex civil partnership which is now legally dissolved
Surviving partner from a same-sex civil partnership

5 Do you stay at another address for more than 30 days a year?
No ➡ Go to 7
Yes, write in other UK address below
Postcode
OR
Yes, outside the UK, write in country

6 What is that address?
Armed forces base address
Another address when working away from home
Student's home address
Student's term time address
Another parent or guardian's address
Holiday home
Other

9 What
England
Wales ➡ Go to
Scotland ➡ Go to 12
Northern Ireland ➡ Go to 13
Republic of Ireland
Elsewhere, write in the current name of country

10 If you were not born in the United Kingdom, when did you most recently arrive to live here?
Do not count short visits away from the UK
Month
Year

11 If you arrived before 27 March 2010 ➡ Go to 13
If you arrived on or after 27 March 2010 ➡ Go to 12

12 Including the time you have already spent here, how long do you intend to stay in the United Kingdom?
Less than 6 months
6 months or more but less than 12 months
12 months or more

13 How is your health in general?
Very good
Good
Fair
Bad
Very bad

14 Do you look after, or give any help or suppor family members, friends, neighbours or oth because of either:
long-term physical or mental ill-health
problems related to old age?
Do not count anything you do as p paid employment
No
Yes, 1 - 19 hours a week
Yes, 20 - 49 hours a wee
Yes, 50 or more hours

102605-4201

https://www.flickr.com/photos/bluesquarething/5512923662/

http://www.alex-singleton.com/r/2014/02/05/2011-census-open-atlas-project-version-two/

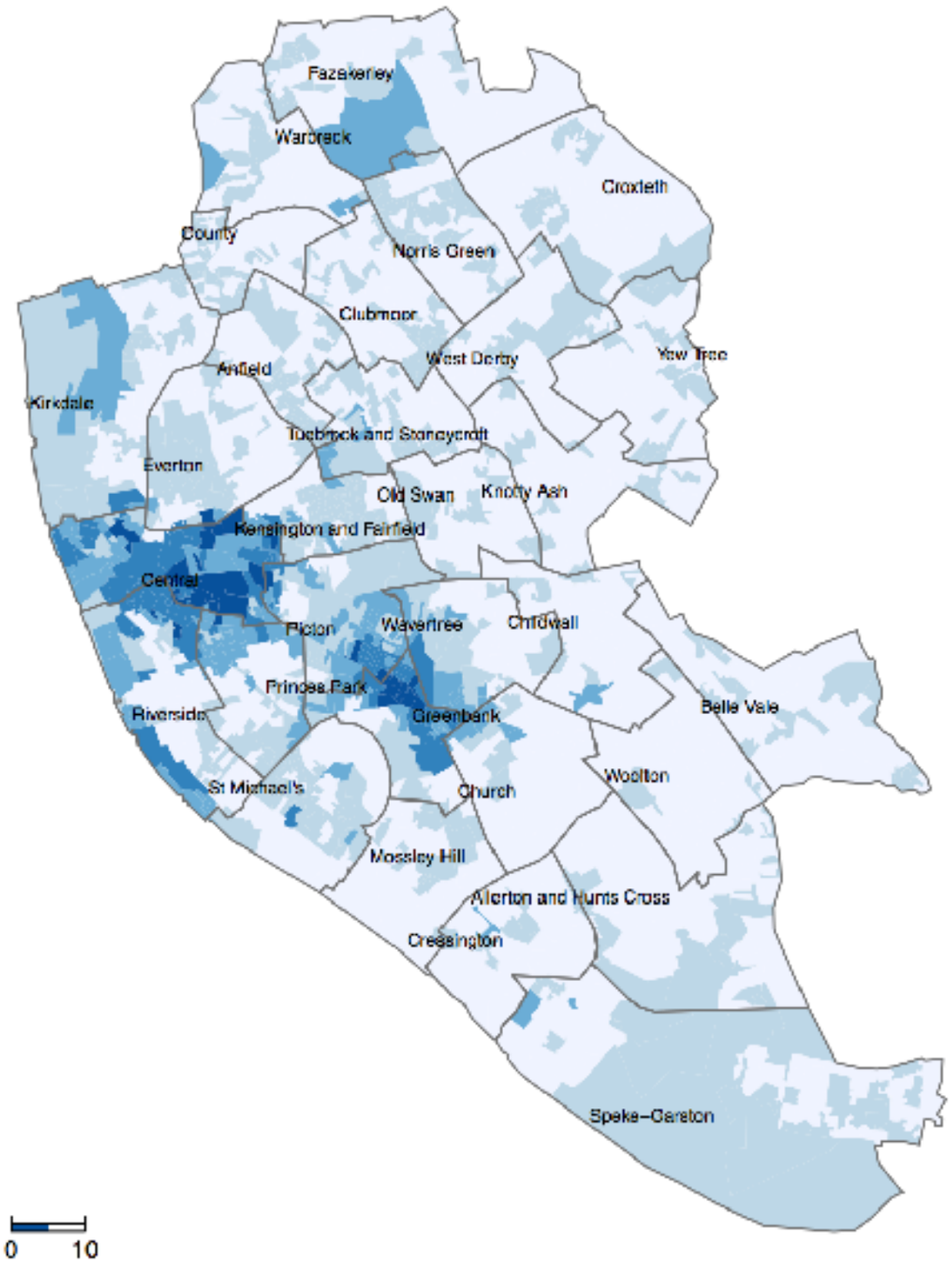
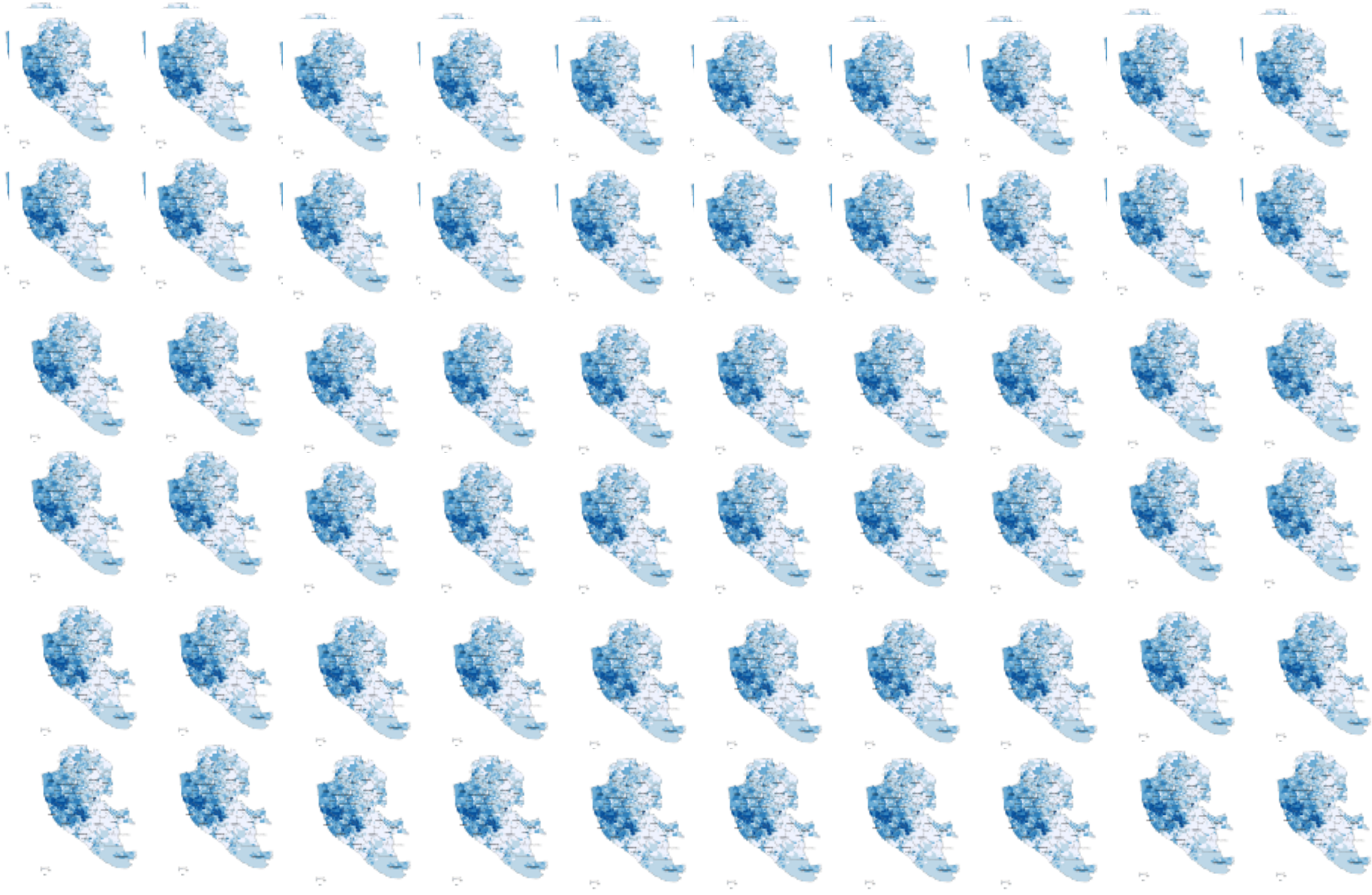


Figure 15: Age structure (Age 20 to 24)

Figure 25: Marital and civil partnership status (Married)



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134,567 maps; 6.9 years; £138,207

Hospital

School

Property

University

Retail

Banking

Police

Transport

Telecoms

“What is needed is a solution which will **pick out pattern from the detail, without loosing too much of the original information**, and which will admit more detailed examination of parts of the pattern which become relevant to a particular issue or local area as and when required”

Webber (1978, 275).

http://www.google.co.uk/intl/en_uk/earth/

52: POORER FAMILIES, MANY CHILDREN, TERRACED HOUSING

51: YOUNG PEOPLE IN SMALL, LOW COST TERRACES

Urban Adversity

Affluent Achievers

59: DEPRIVED AREAS AND HIGH-RISE FLATS

11: SETTLED SUBURBIA, OLDER PEOPLE

Charles Booth

- 30 March 1840 – 23 November 1916
- Shipping business owner & Philanthropist
- Survey:
  - “Life and Labour of the People in London”
    - First Edition
      - Life and Labour of the People, Vol. I (1889)
      - Labour and Life of the People, Vol II (1891)
    - Second Edition
      - Life and Labour of the People in London; 9 volumes 1892-97
    - Third Edition
      - Life and Labour of the People in London; 17 volumes (1902-03)
- Quantitative and Qualitative

BLACK: Lowest class. Vicious, semi-criminal.

DARK BLUE: Very poor, casual. Chronic want.

LIGHT BLUE: Poor. 18s. to 21s. a week for a moderate family

PURPLE: Mixed. Some comfortable others poor

PINK: Fairly comfortable. Good ordinary earnings.

RED: Middle class. Well-to-do.

YELLOW: Upper-middle and Upper classes. Wealthy.

Inner Area Study

LIVERPOOL

Social Area Analysis

Report by the Consultants

Published by the
Department of the Environment IAS/LI/22

Price £2·30p

Liverpool Social Area Study
1971 Data: Final Report

R. J. Webber

PRAG Technical Papers TP14

Planning Research Applications Group

33 The city of Liverpool is shown divided into five types of area in figure 2

a high status area of owner occupied houses with stable families

a rooming house area of subdivided houses providing furnished privately rented accommodation chiefly for young people

the inner council estates, mainly though not exclusively the older blocks of flats

the outer council estates, mainly houses and newer blocks of flats

an area of older terraced housing, mostly unfurnished privately rented houses many lacking an inside wc.

34 The key characteristics of each area are shown in table 4, expressed as percentages of the average for the city as a whole. Thus the ratio to the city mean for owner occupied households in the high status area is 236, meaning that 71% of all households in that area are owner occupiers as the average in the city as a whole is 30%.

35 The relative size of each social area is shown in table 5. The second and third are smaller than the others and the fourth has the largest population, the largest number of clusters and also the largest number of basic data areas. Furthermore, the average population size of basic data areas is larger in the fourth area and particularly small in the second. This implies that the outer council estates contain large tracts of housing which are socially homogeneous whereas the rooming house area is more sharply split up into small areas with different social characteristics.

36 The social areas are most strongly related with the pattern of housing tenure in the city in two important respects. Each area as a whole is characterised by a single type of tenure not only in the composition of its own housing stock but also in the extent to which it contains within its boundaries a large proportion of all houses in that category in the city. Thus the high status area contains over half the city's owner occupied houses and virtually all of its newer houses in that category. The rooming house and older terraced areas split the rest of the private houses between them, the furnished rented in one and the unfurnished rented and most of the remaining (mainly older) owner occupied houses in the other. And the inner and outer council areas contain between them virtually all of the city's council housing.

37 Another important feature of the system is that to a very large extent each social area is comparatively homogeneous in the make up of its housing stock. That is, all clusters and basic data areas in a given area are pretty similar in their housing composition, as is shown in table 1. No other characteristic is so strongly related with the system as a whole, since for no other does the amount of variation retained stay as high as for housing tenure.

38 The social areas are comparatively poorly related to the distribution of social classes in the city in the sense that

Table 4 Social areas: general characteristics

	city mean (%)	social areas (city = 100) 1	2	3	4	5
housing						
owner occupied	30.1	236	87	7	34	107
council tenant	40.0	14	21	222	211	21
private unfurnished	26.3	79	158	30	19	218
private furnished	3.5	78	674	29	14	53
shared dwelling	3.3	76	508	57	35	75
lacking inside wc	22.7	17	44	29	46	273
7 or more rooms	8.8	233	180	27	38	66
1 or 2 room	6.5	44	485	161	60	44
over 1.5 persons/room	2.7	16	170	363	101	55
under 0.5 persons/room	33.1	138	83	57	83	110
rooms/person	1.64*	122	101	71	88	106
rooms/dwelling	5.01*	115	84	80	98	102
socio-economic status						
professional/managerial	10.9	253	124	31	53	49
non manual	19.6	169	131	48	81	75
skilled manual	34.2	79	89	66	115	114
semi skilled	20.0	40	99	126	114	118
unskilled	14.4	19	68	265	106	113
age/household structure						
aged 0-4	7.8	87	109	99	84	127
5-14	17.4	87	75	119	115	94
15-14	16.2	85	135	109	104	92
25-44	21.6	107	106	95	91	105
45-64	24.5	108	88	93	103	97
65+	12.6	117	96*	86	94	99
new commonwealth born	0.8	70	495	133	18	30
over 15, married	60.7	106	90	85	99	106
2 adults, 5+ children	2.1	46	58	197	150	65
single non pensioner	7.0	82	298	109	60	93
5 year migrant	27.8	94	142	97	112	77
persons/household	3.13*	92	82	111	111	95
education/employment						
students	3.4	148	183	51	90	62
HNC/degree	5.6	280	194	16	38	28
mining/manufacturing	35.8	74	85	92	115	110
services/government	43.6	131	118	96	86	88
mar female econ active	44.3	98	104	102	102	97
male, unemployed	9.1	36	126	201	108	99
male, sick	1.9	41	130	224	93	104
travel						
walk to work	17.4	65	103	193	82	118
bus to work	48.9	72	98	108	115	102
car to work	23.7	181	97	18	86	81
cars/person	0.12*	189	105	20	81	77

*ratio

Table 5 Distribution of population, tenure and status by social area (%)

	social areas 1	2	3	4	5	city total
population	22	9	9	33	27	100
tenure						
owner occupied	51	8	1	11	29	100
council tenant	3	2	20	69	6	100
private unfurnished	17	14	3	6	60	100
private furnished	17	61	3	5	15	100
socio-economic status						
professional/managerial	55	11	3	18	14	100
non manual	37	12	4	27	21	100
skilled manual	17	8	6	38	31	100
semi skilled	10	9	11	37	32	100
unskilled	4	6	24	35	31	100

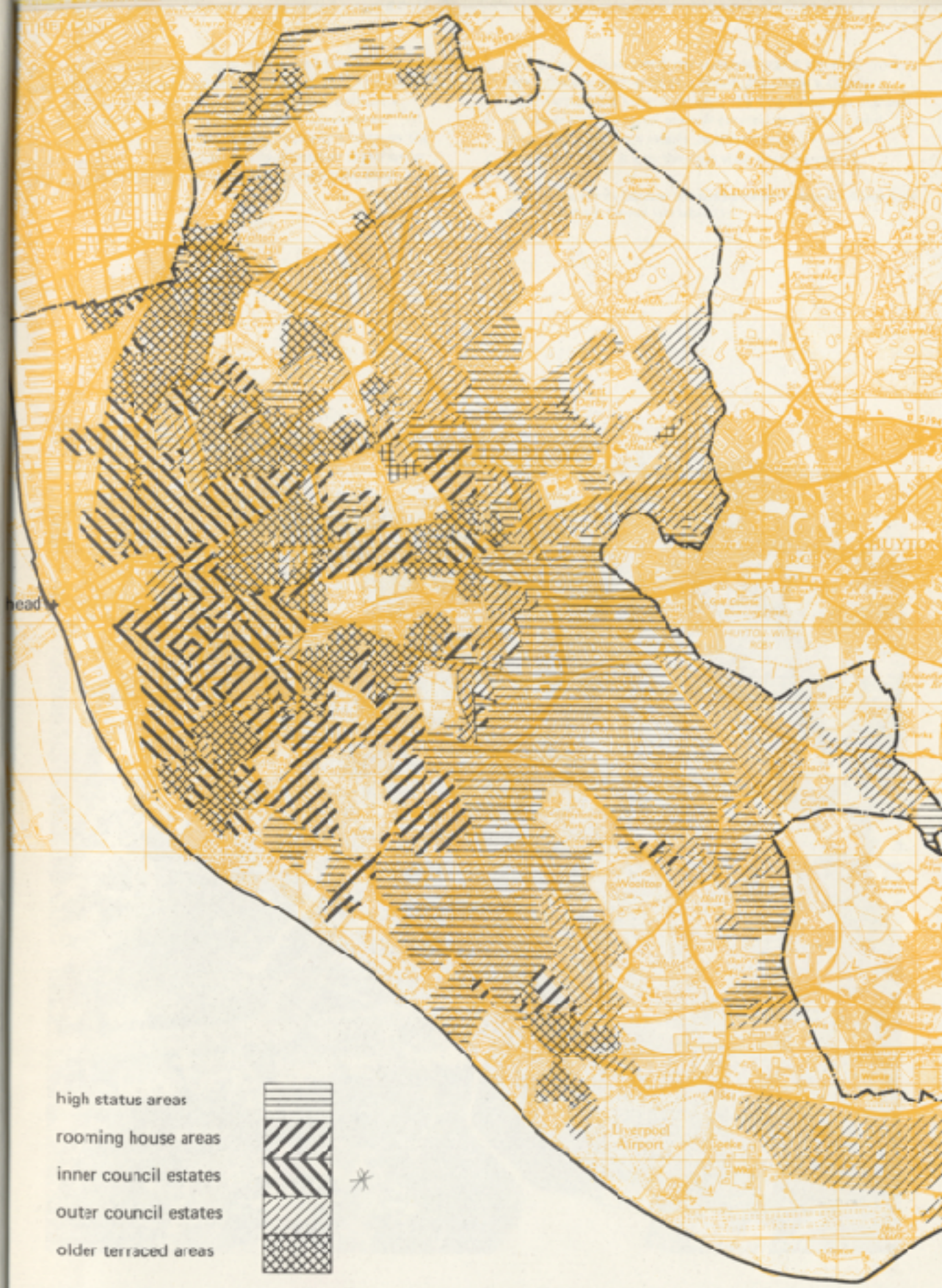


Figure 2 Social Areas

Inner Areas Study
LIVERPOOL

Openness

Feedback

4 Challenges

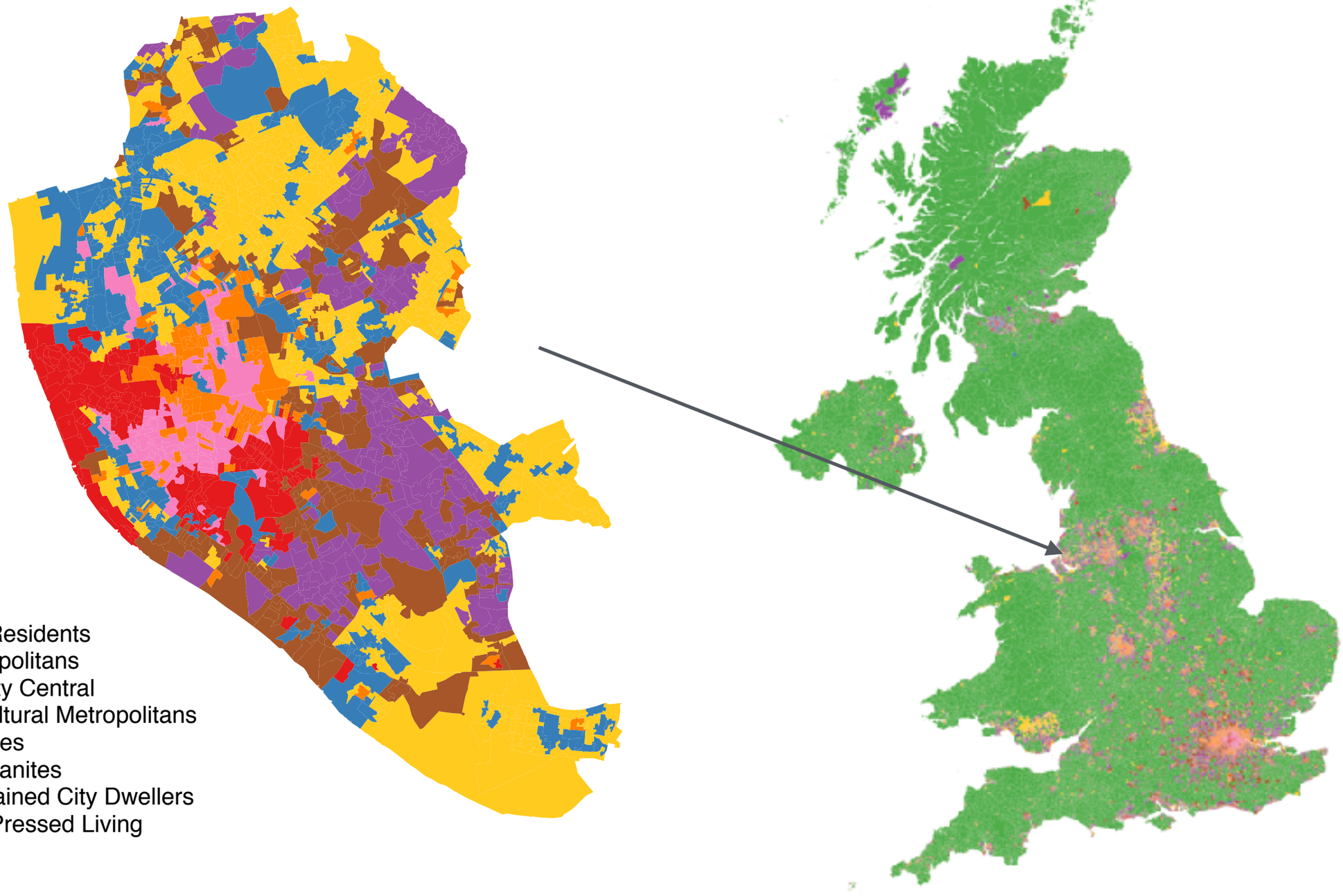
Change

Universality

How can we make models of city structure more open?

Office for National Statistics

2011 OAC



- 1 – Rural Residents
- 2 – Cosmopolitans
- 3 – Ethnicity Central
- 4 – Multicultural Metropolitans
- 5 – Urbanites
- 6 – Suburbanites
- 7 – Constrained City Dwellers
- 8 – Hard–Pressed Living

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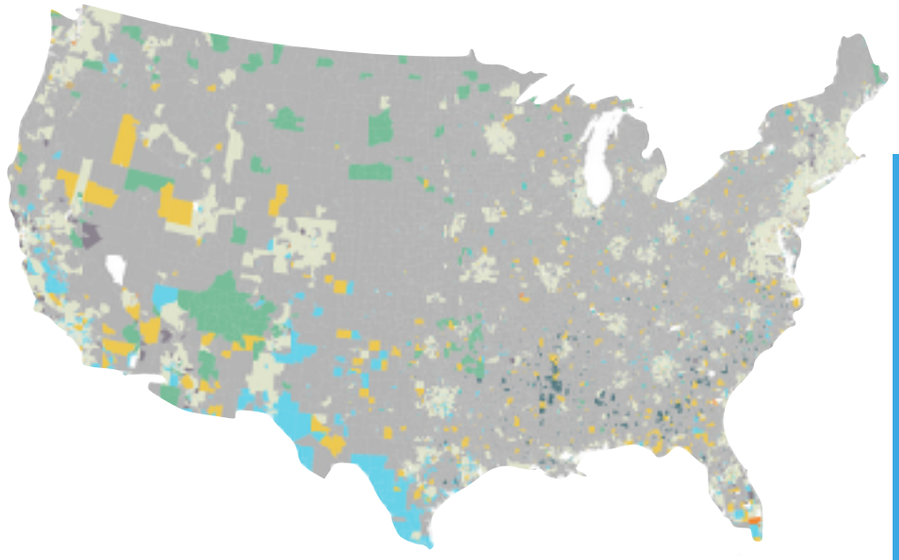
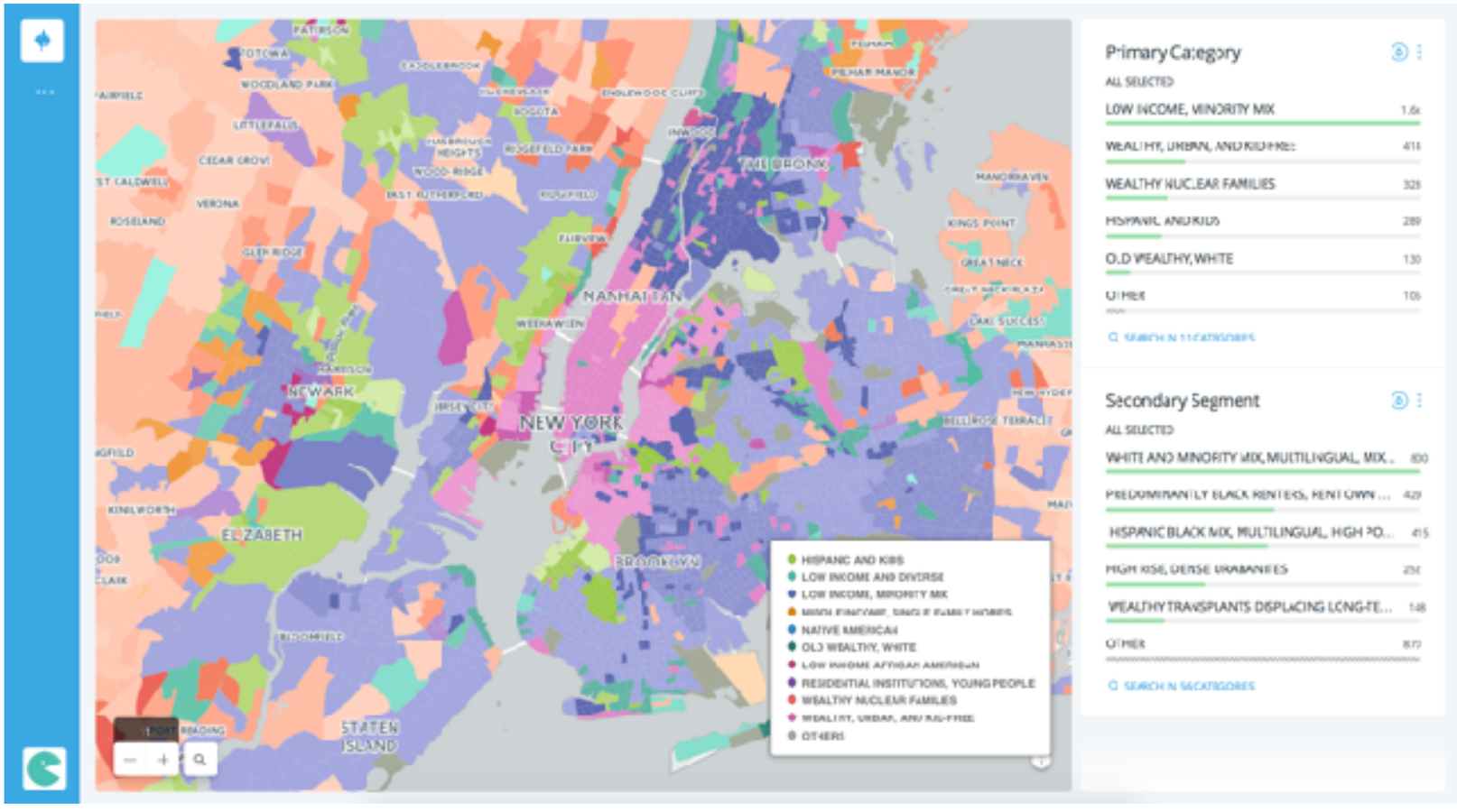
Gale, C, A. Singleton and P. Longley (2016). “Creating the 2011 area classification for output areas (2011 OAC)”. In: Journal of Spatial Information Science, pp. 1-27. URL: http://dx.doi.org/10.5311/JOSIS.2016.12.232.

New American Atlas





CARTO

https://observatory.cartodb.com

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Spielman, S. and A. Singleton (2015). “Studying Neighborhoods Using Uncertain Data from the American Community Survey: A Contextual Approach”. In: Annals of the Association of American Geographers 105.5, pp. 1003-1025. URL: http://dx.doi.org/10.1080/00045608.2015.1052335.

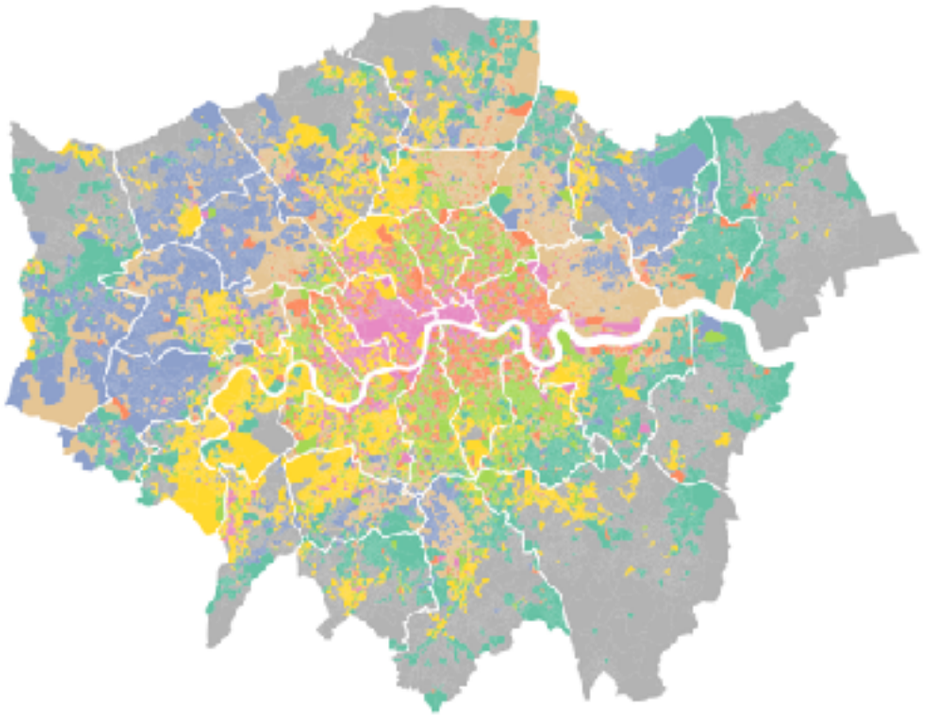
Issues with Private Classifications

- Many commercial classifications have a tendency to be “black box”
  - May know some details, but not all
  - Difficult to reproduce
    - Data Access
    - Exact Methods

One model to rule them all?

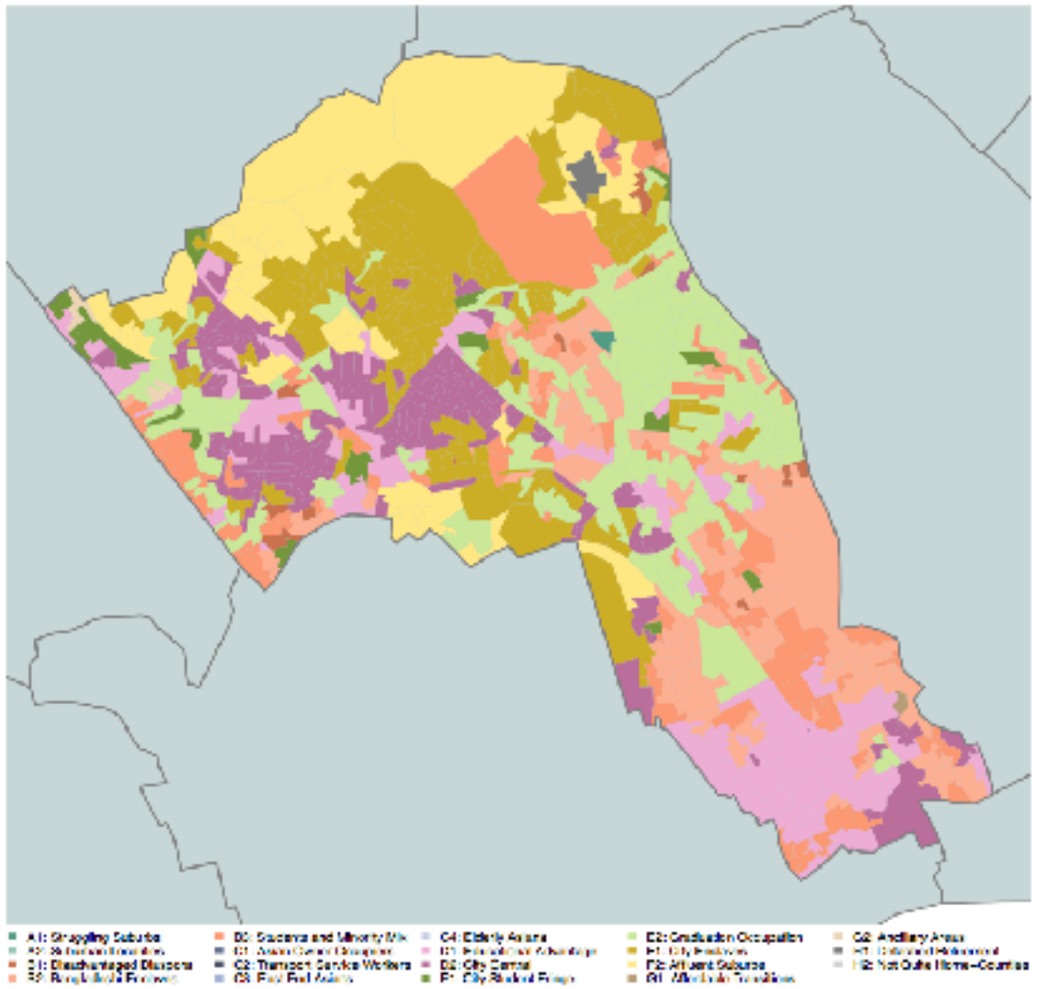
London

Output Area Classification



Census Information Scheme

Paul Longley,
Alex Singleton



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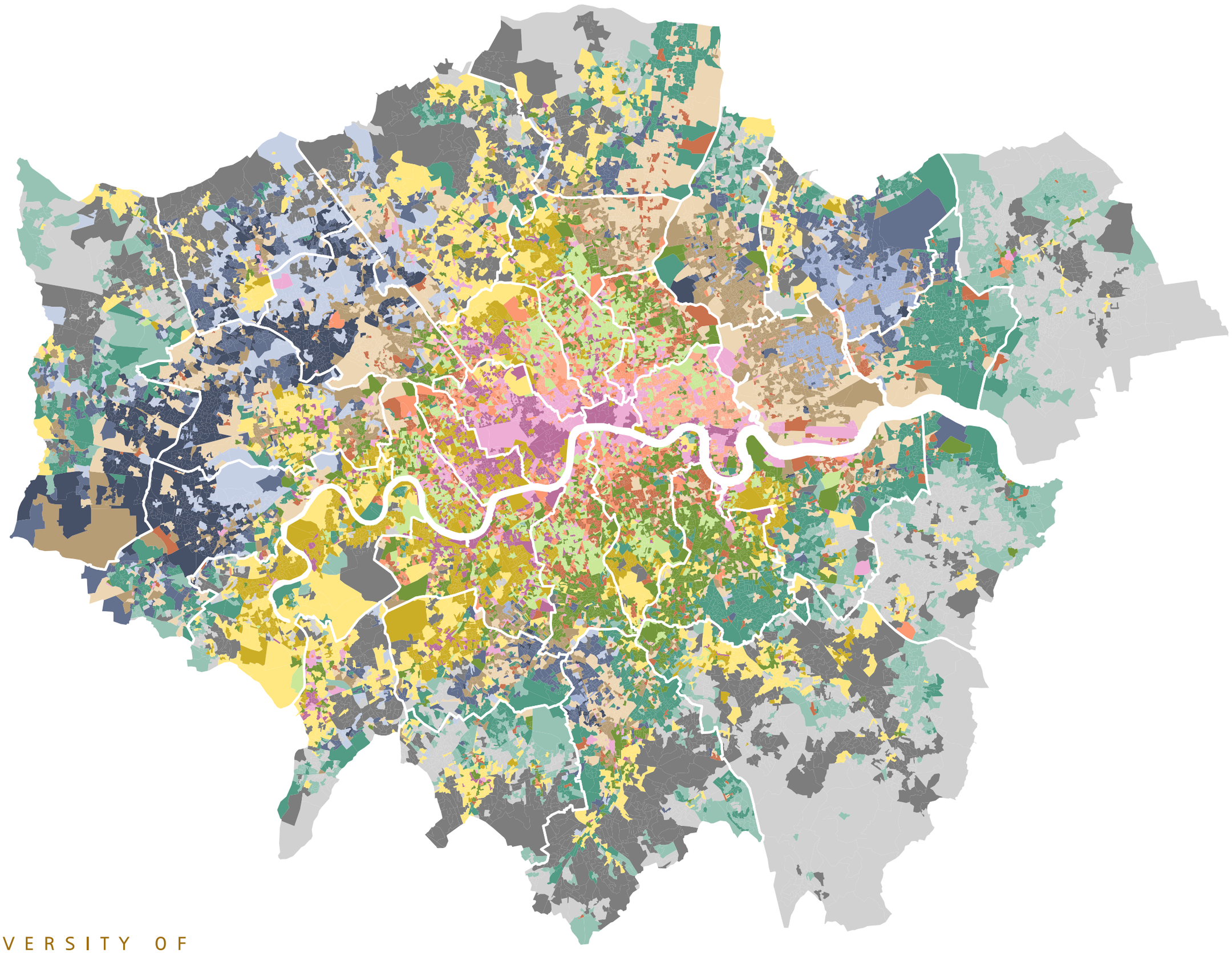
Singleton, A. and P. Longley (2015). “The internal structure of Greater London: a comparison of national and regional geodemographic models”. In: Geo: Geography and Environment 2.1, pp. 69-87. URL: http://dx.doi.org/10.1002/geo2.7.



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LOAC 2011

B: High Density and High Rise Flats

- Densely populated areas of flats.
- Families have children of school age
- Many residents Bangladeshi origins
- High Black residents or Mixed or Other ethnic groups.
- Higher spoken language is not English.
- Qualifications are below the London average
- Some residents are full-time students living in shared accommodation.
- Levels of unemployment and part-time working high
- Employment more typically in administration, or in accommodation and food services industries.

Groups

B1 Disadvantaged diaspora

B2 Bangladeshi enclaves

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E00009768; Lancaster Court, Fulham

D: Urban Elites

- Young professionals
- Working in the science, technology, finance and insurance sectors. Large numbers of students
- Many privately owned flats
- Residents are disproportionately drawn from pre 2001 EU countries,
- High of Chinese, Arab and other minority backgrounds.

Groups

D1 Educational advantage

D2 City central

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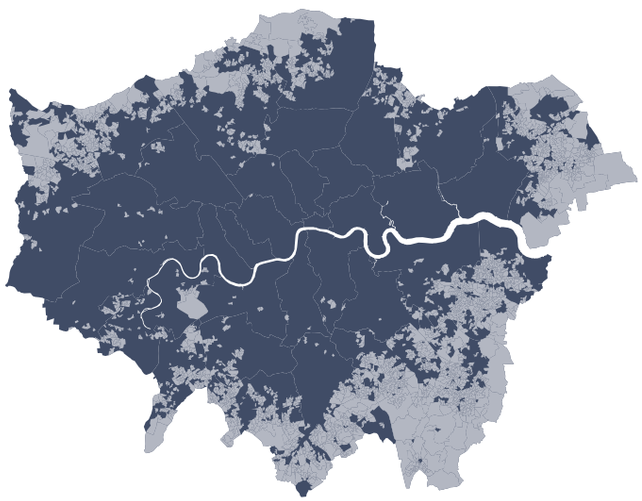
E00009327; Stoner Road, West Kensington

H: Aging City Fringe

- Many residents 45+
- Many above state pensionable age.
- High levels of marriage
- Mainly white
- Much of the dwelling stock semi-detached and detached houses
- Levels of qualifications are low
- Private vehicle ownership is high
- Levels of unemployment are very low and drawn from a range of sectors



Groups

H1 Detached retirement

H2 Not quite Home Counties

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E00005585; Peacock Gardens, South Croydon

GREATER LONDON AUTHORITY

Consumer Data Research Centre

An ESRC Data Investment

CDRC Maps

Mapping selected datasets from CDRC Data, part of the Consumer Data Research Centre.

DATA CHOOSER

Geodems | Retail | Metrics

Select a map:

2011 London OAC

Download this data

MAP OPTIONS

Layers: Land | Labels

Toggle: Retail Centres

Download retail centre locations.

Overlays: Clear

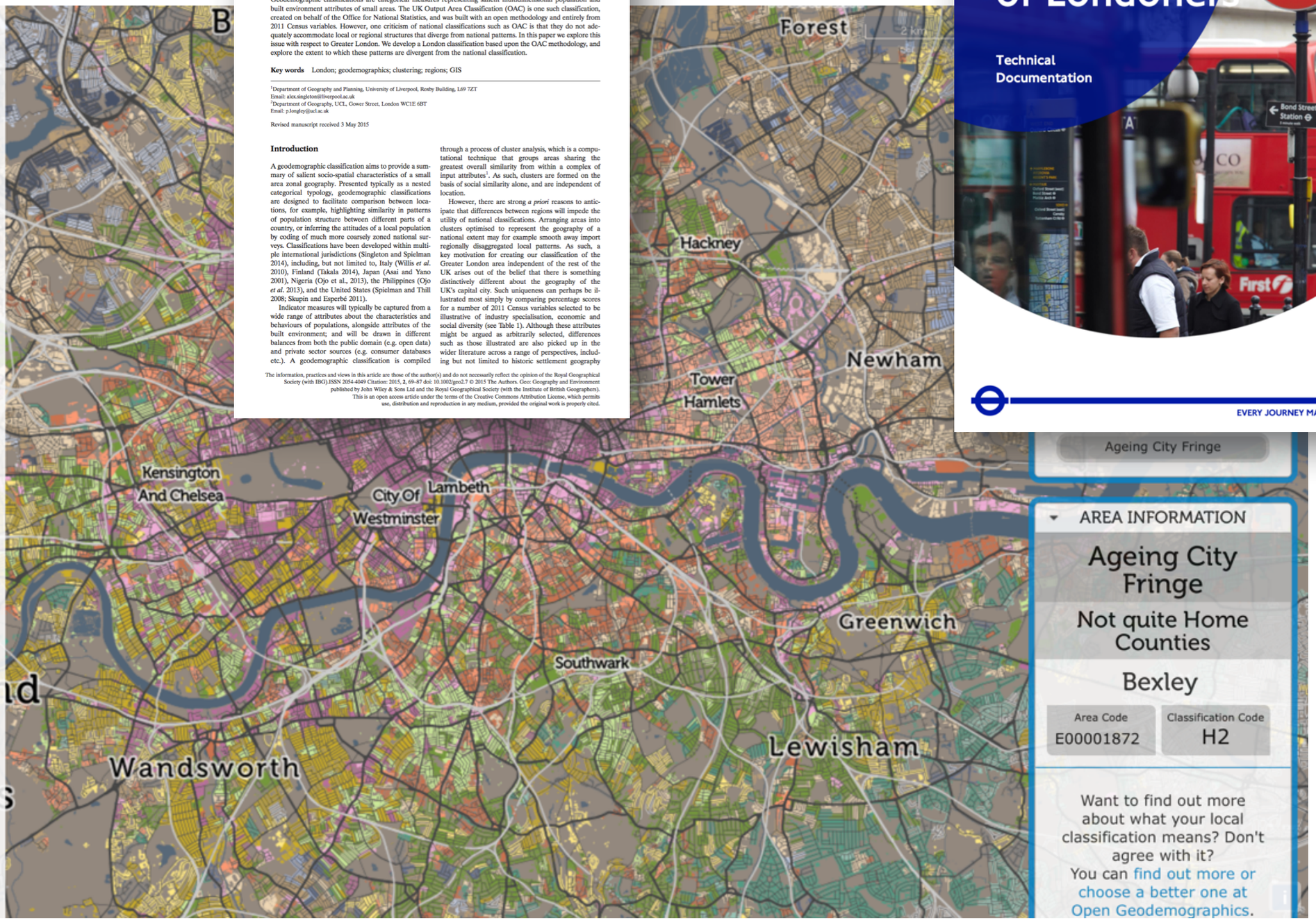
Tip: Drop KMLs/GeoJSONs on map.

Postcode: Go

Like Share 777 Tweet

CDRC Maps has been created by Oliver O'Brien at UCL Geography.

Important note: Classifications are an average across the local area, rather than for individual houses, therefore the colour coding on a building is not necessarily indicative of that building.



Geo

Open Access

Geography and Environment

The internal structure of Greater London: a comparison of national and regional geodemographic models

Alex David Singleton[1] and Paul Longley[2]

Geodemographic classifications are categorical measures representing salient multidimensional population and built environment attributes of small areas. The UK Output Area Classification (OAC) is one such classification, created on behalf of the Office for National Statistics, and was built with an open methodology and entirely from 2011 Census variables. However, one criticism of national classifications such as OAC is that they do not adequately accommodate local or regional structures that diverge from national patterns. In this paper we explore this issue with respect to Greater London. We develop a London classification based upon the OAC methodology, and explore the extent to which these patterns are divergent from the national classification.

Key words London; geodemographics; clustering; regions; GIS

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Email: p.longley@ucl.ac.uk

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Introduction

A geodemographic classification aims to provide a summary of salient socio-spatial characteristics of a small area zonal geography. Presented typically as a nested categorical typology, geodemographic classifications are designed to facilitate comparison between locations, for example, highlighting similarity in patterns of population structure between different parts of a country, or inferring the attitudes of a local population by coding of much more coarsely zoned national surveys. Classifications have been developed within multiple international jurisdictions (Singleton and Spielman 2014), including, but not limited to, Italy (Willis *et al.* 2010), Finland (Takala 2014), Japan (Asai and Yano 2001), Nigeria (Ojo et al., 2013), the Philippines (Ojo *et al.* 2013), and the United States (Spielman and Thill 2008; Skupin and Esperbé 2011).

Indicator measures will typically be captured from a wide range of attributes about the characteristics and behaviours of populations, alongside attributes of the built environment; and will be drawn in different balances from both the public domain (e.g. open data) and private sector sources (e.g. consumer databases etc.). A geodemographic classification is compiled through a process of cluster analysis, which is a computational technique that groups areas sharing the greatest overall similarity from within a complex of input attributes[1]. As such, clusters are formed on the basis of social similarity alone, and are independent of location.

However, there are strong *a priori* reasons to anticipate that differences between regions will impede the utility of national classifications. Arranging areas into clusters optimised to represent the geography of a national extent may for example smooth away import regionally disaggregated local patterns. As such, a key motivation for creating our classification of the Greater London area independent of the rest of the UK arises out of the belief that there is something distinctively different about the geography of the UK's capital city. Such uniqueness can perhaps be illustrated most simply by comparing percentage scores for a number of 2011 Census variables selected to be illustrative of industry specialisation, economic and social diversity (see Table 1). Although these attributes might be argued as arbitrarily selected, differences such as those illustrated are also picked up in the wider literature across a range of perspectives, including but not limited to historic settlement geography

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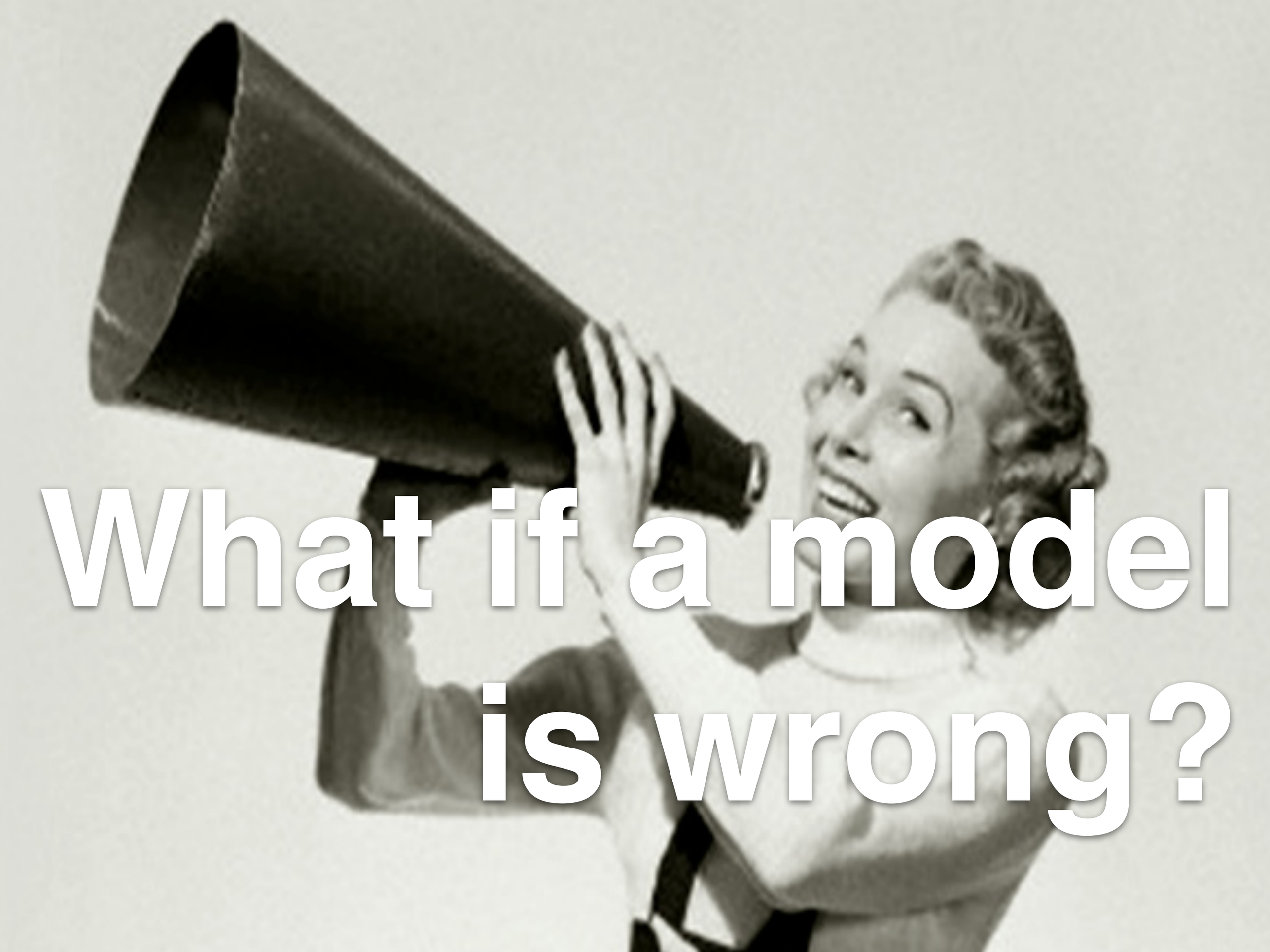
http://maps.cdrc.ac.uk/#/geodemographics/loac11/



What if a model is wrong?

Questioning Classifications

- The “e-Society”
  - 1990s – Technology Use – “Haves” & “Have-nots”
- Digital Divide
  - By *2007* things were radically different
- Usage & Engagement increasingly more complex
  - Created a classification which consisted of 8 Groups & 23 Types. – Links to Postcode.

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@society

Group A : E-unengaged	Type A01 : Low technologists
	Type A02 : Cable suffices
	Type A03 : Technology as fantasy
	Type A04 : Mobile's the limit
	Type A05 : Too old to be bothered
	Type A06 : Elderly marginalised
Group B : E-marginalised	Type B07 : The Net ; What's that?
	Type B08 : Mobile Explorers
	Type B09 : Cable TV heartland
Group C : Becoming engaged	Type C10 : E-bookers and communicators
	Type C11 : Peer group adopters
Group D : E for entertainment and shopping	Type D12 : Small time net shoppers
	Type D13 : E for entertainment
Group E : E-independents	Type E14 : Rational utilitarians
	Type E15 : Committed learners
	Type E15 : Light users
Group F : Instrumental E-users	Type F17 : Computer magazine readers
	Type F18 : E for financial management
	Type F19 : On-line apparel purchasers
	Type F20 : E-exploring for fun
Group G : E-business users	Type G21: Electronic orderers
Group H : E- experts	Type H22 : E-committed
	Type H23 : E - professionals

250k views - afternoon released

neighbours are?

ch box and **clicking "GO"**, our use in your neighbourhood and

team at UCL as an outcome of

- About the e-society
- What are the groups?
- Feedback

Enter a Postcode...

e.g. NW6 1CN GO

Before clicking "go" please read our data and data collection policy [here]

The E-Society profiler tool is solely for private, academic and public policy use only. Commercial use of these data is strictly forbidden. The E-Society profiler is not currently available under any commercial licence.

e-Society Profiler

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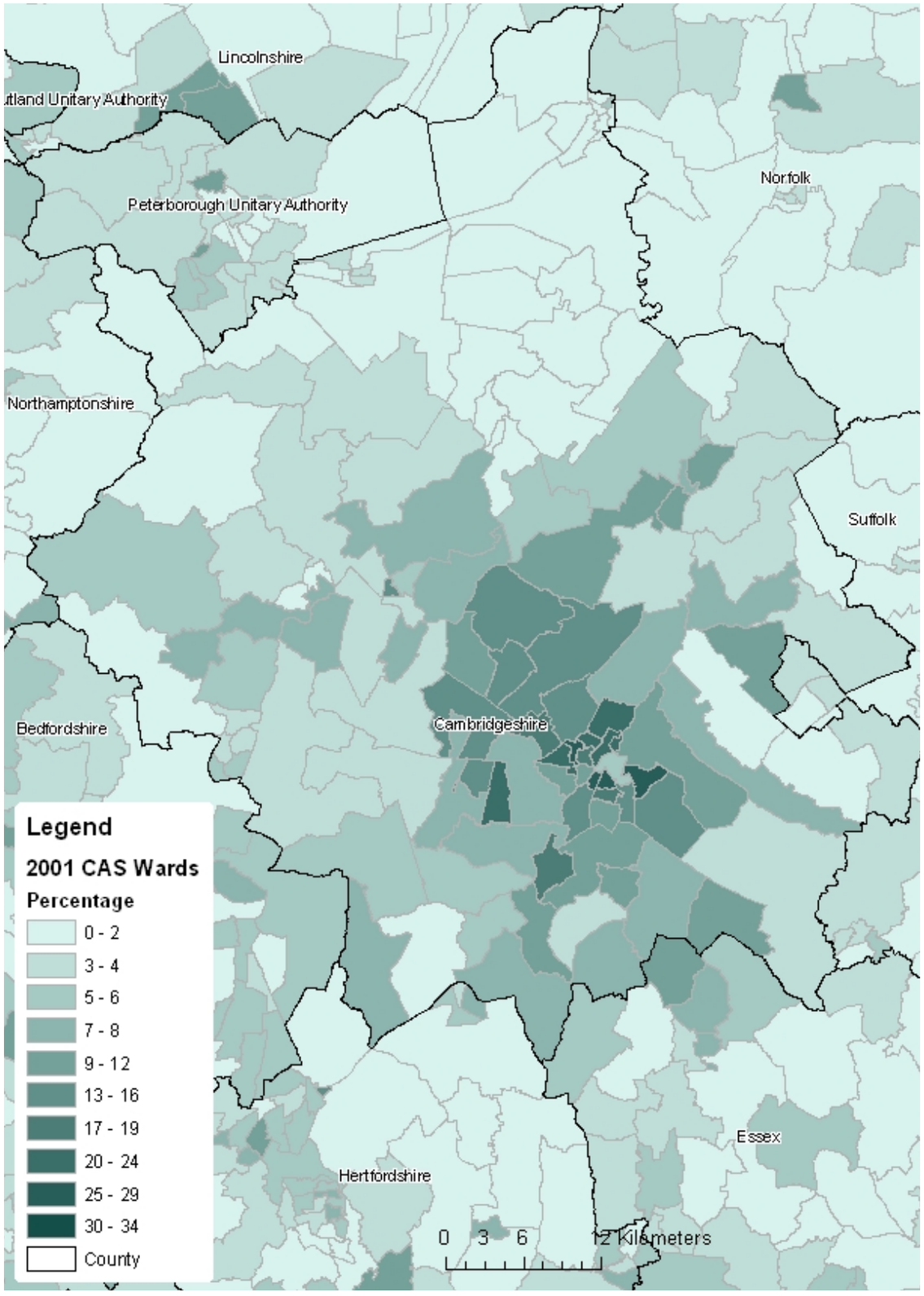
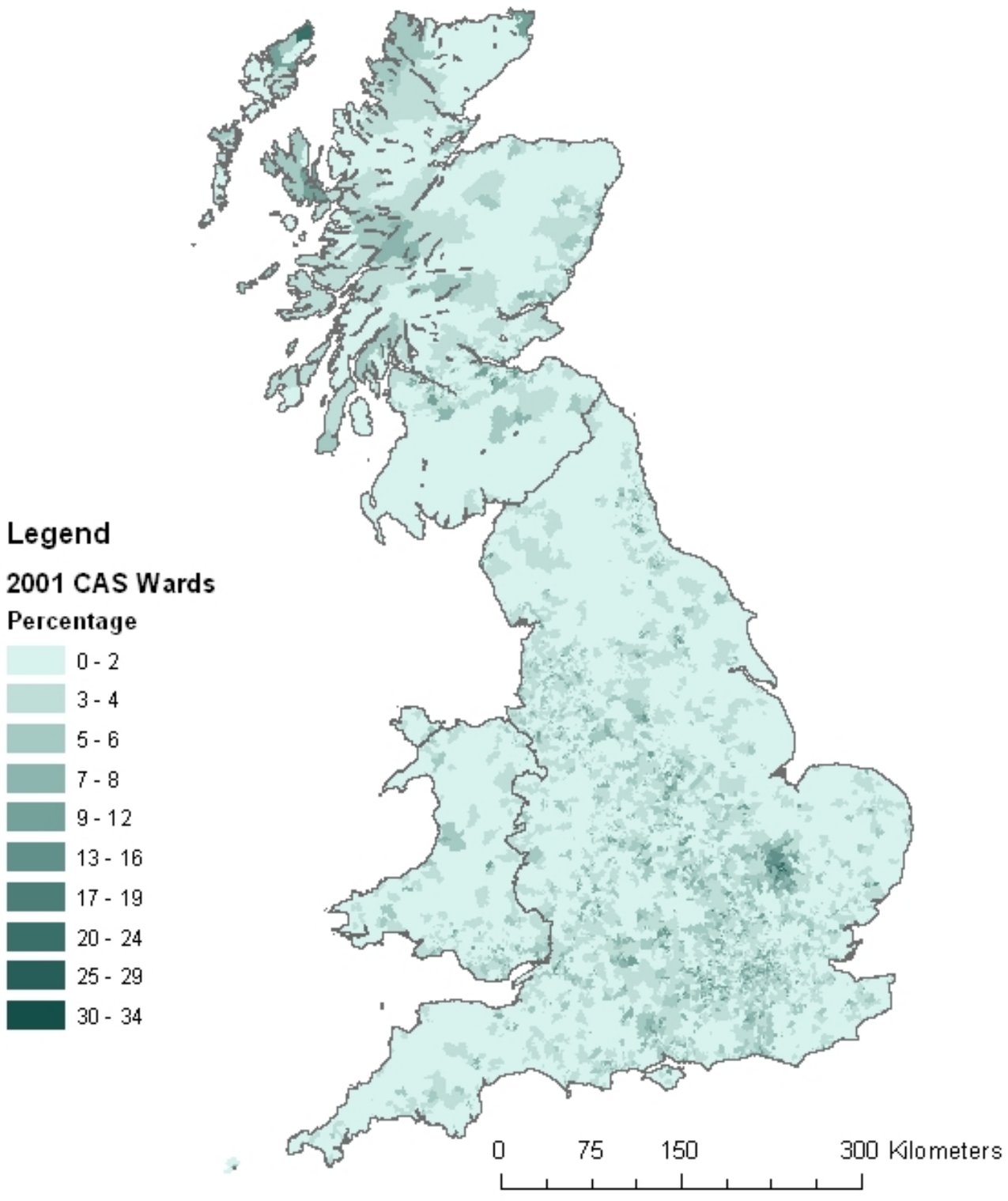
http://esociety.publicprofiler.org/





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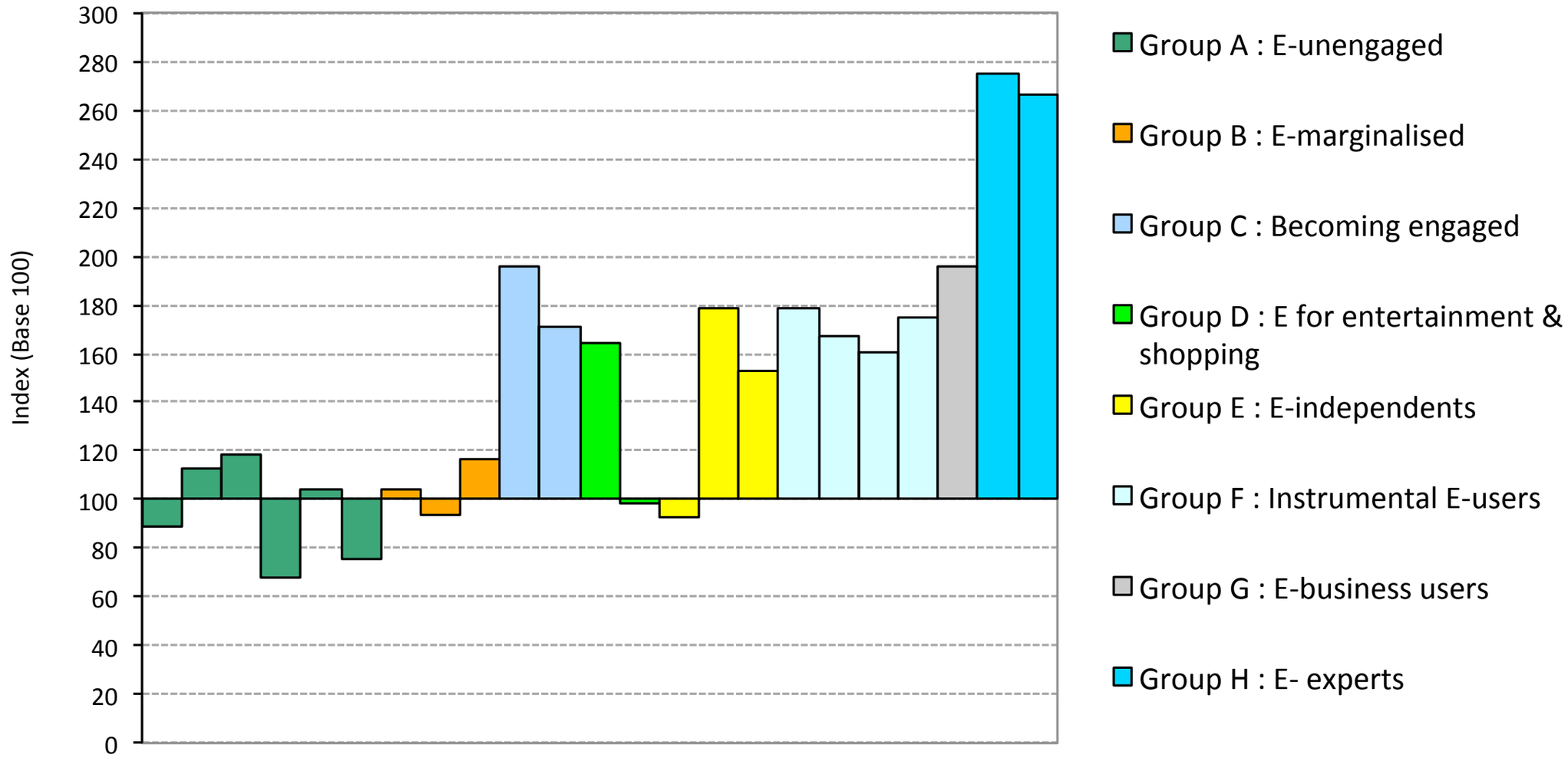
Postcode Search Propensity by e-Society Types



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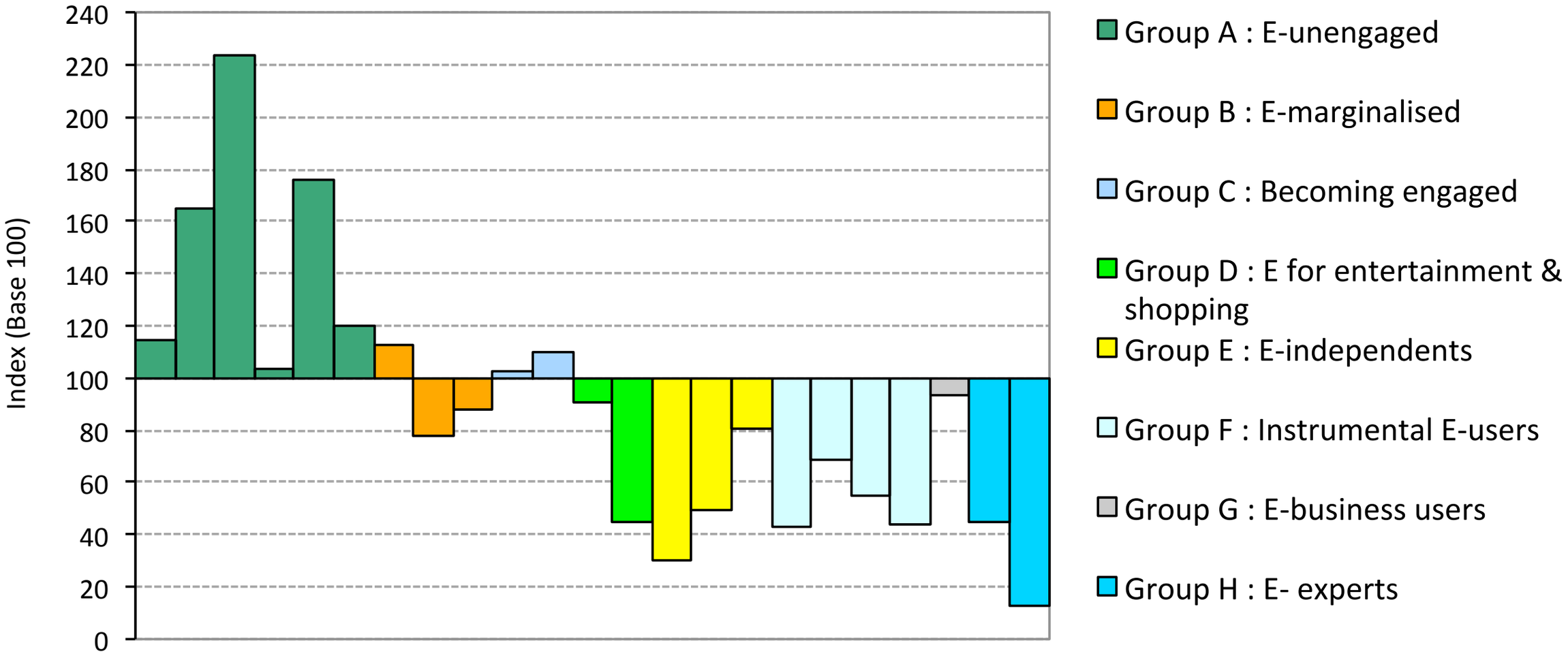
Feedback Origin



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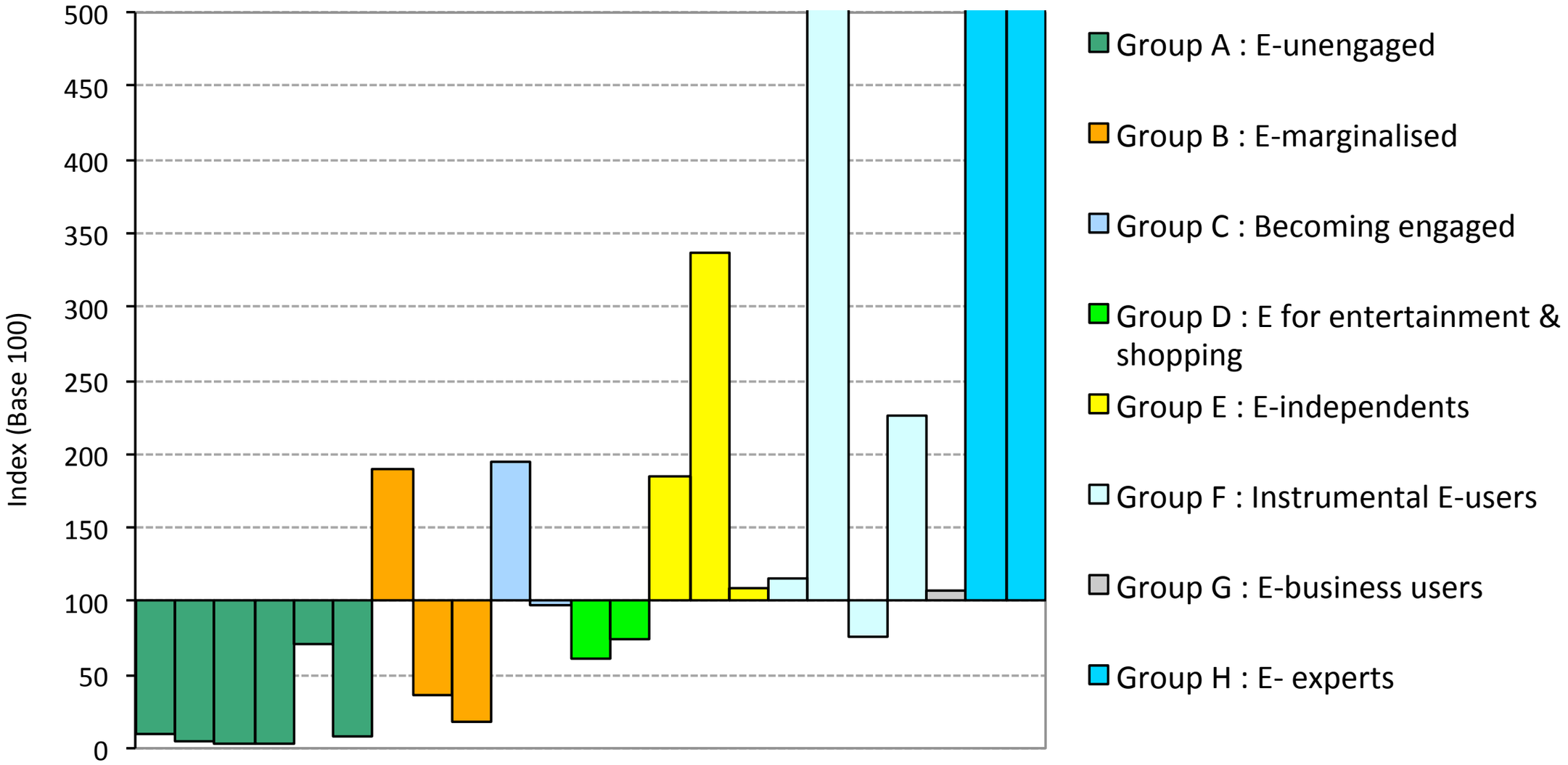
Feedback Destination



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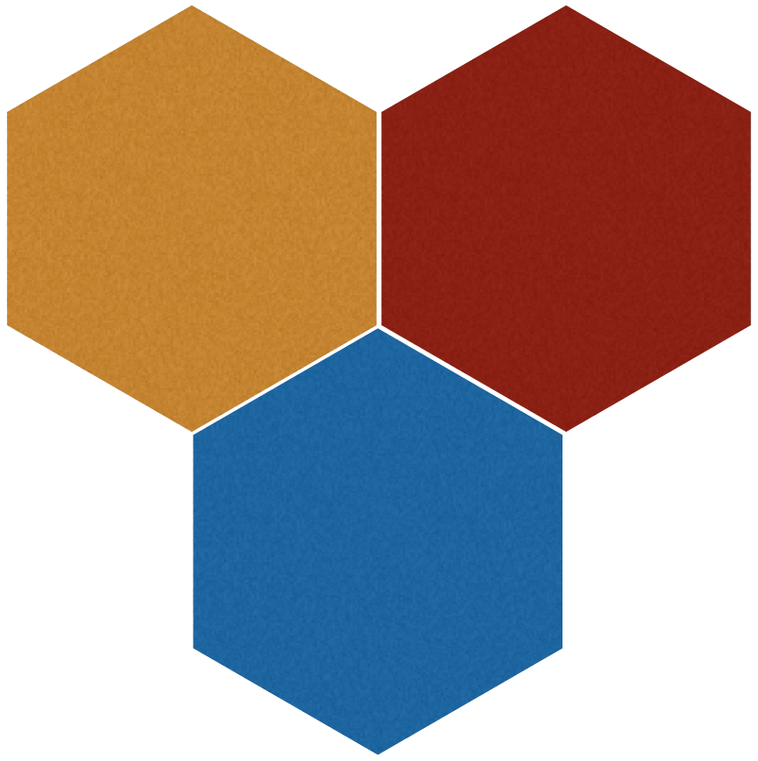
How do we make models that are more responsive?



T1 → *Tn*

Zone	Var1	Var…
A		
B		
C		
…	…	…

Zone	Var1	Var…
A		
B		
C		
…	…	…

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Methods: Parallel

T1

Zone	Var1	Var…
A		
B		
C		
…	…	…

T2

Zone	Var1	Var…
A		
B		
C		
…	…	…

Classification (T1)

Classification (T2)

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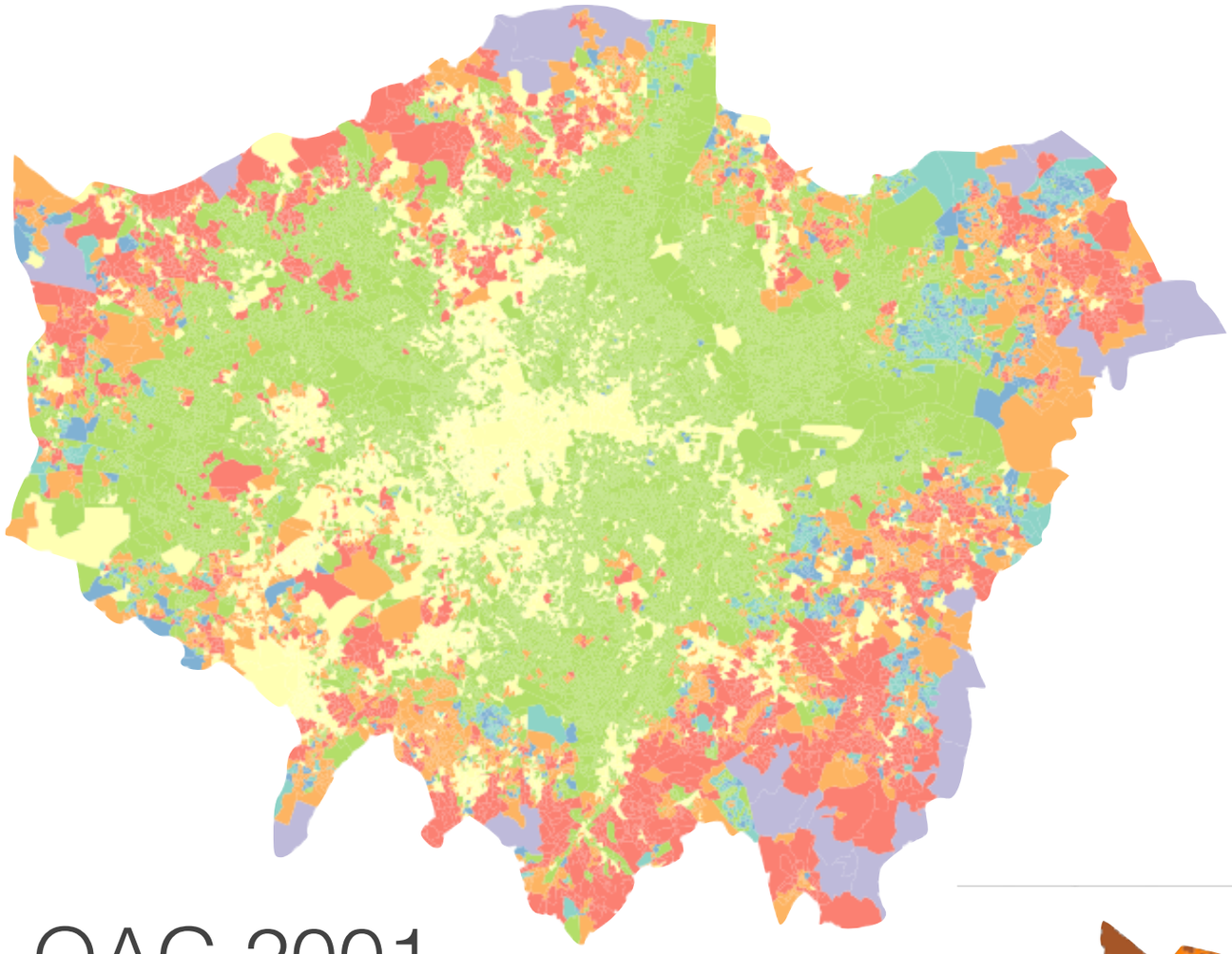
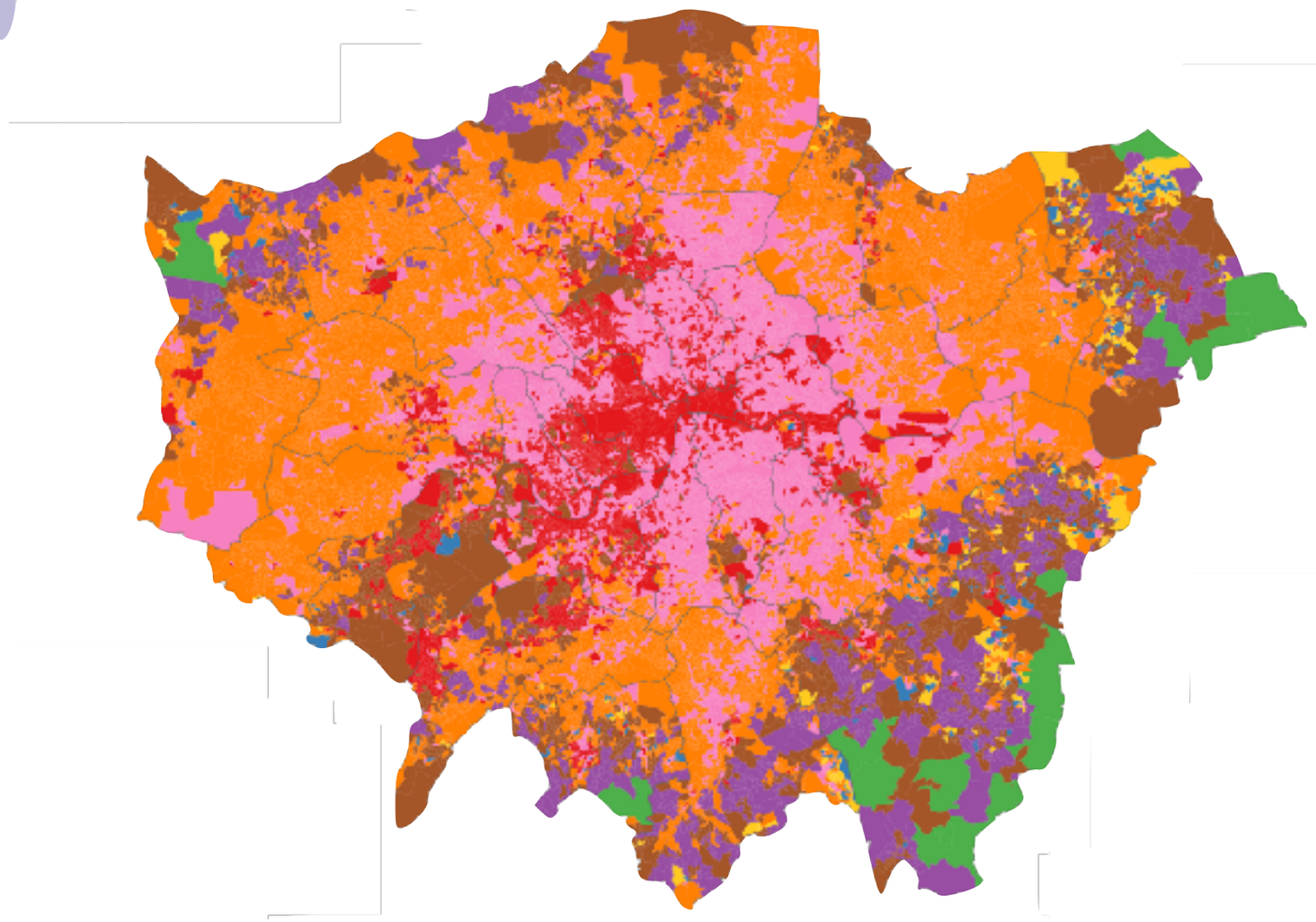


OAC 2001



OAC 2011

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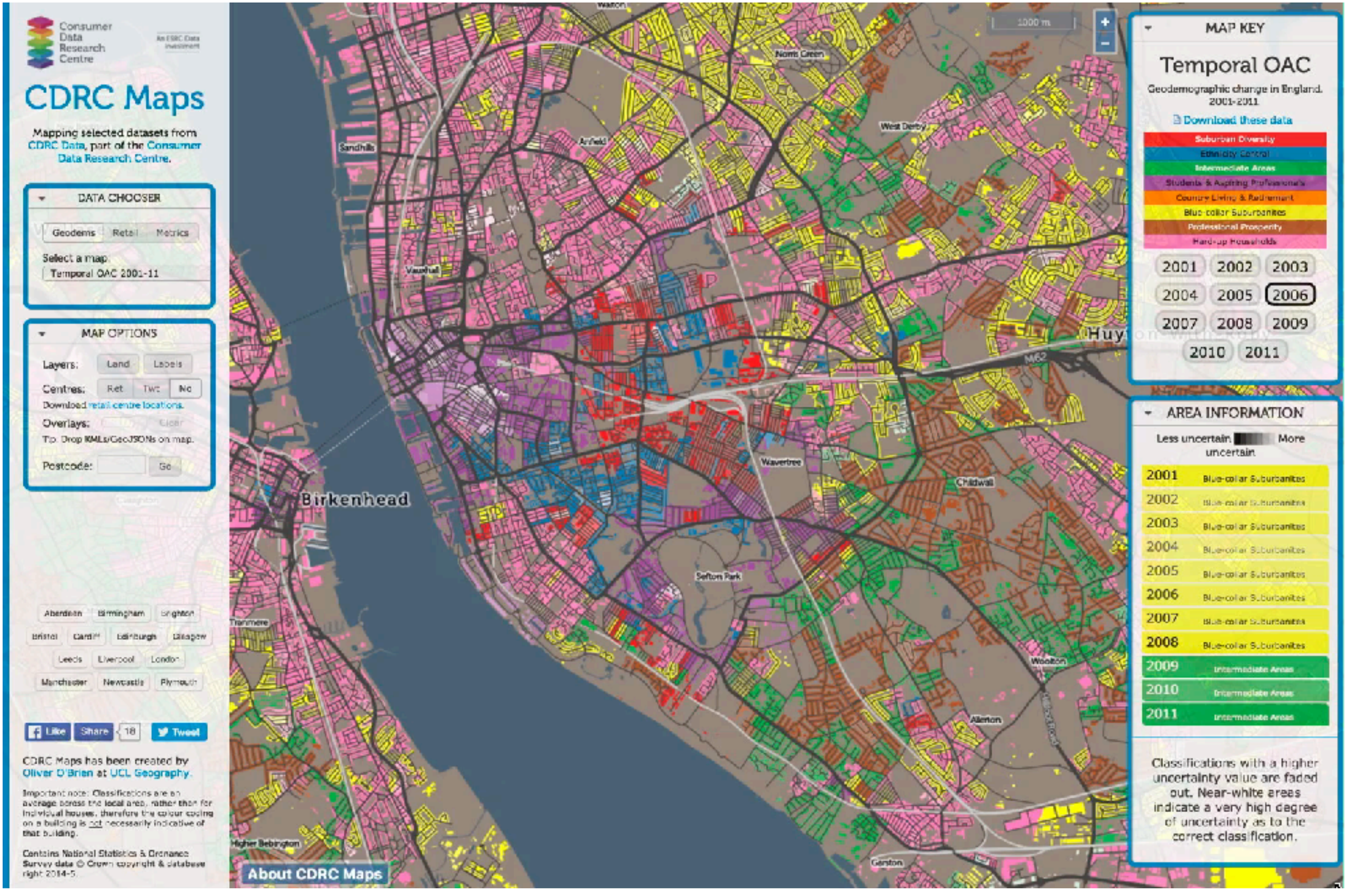
Methods: Unified

Zone	Var1	Var…
A T1		
A T2		
B T1		
B T2		
C T1		
C T2		
…	…	…

Classification (T1,T2)

T1 *T2*



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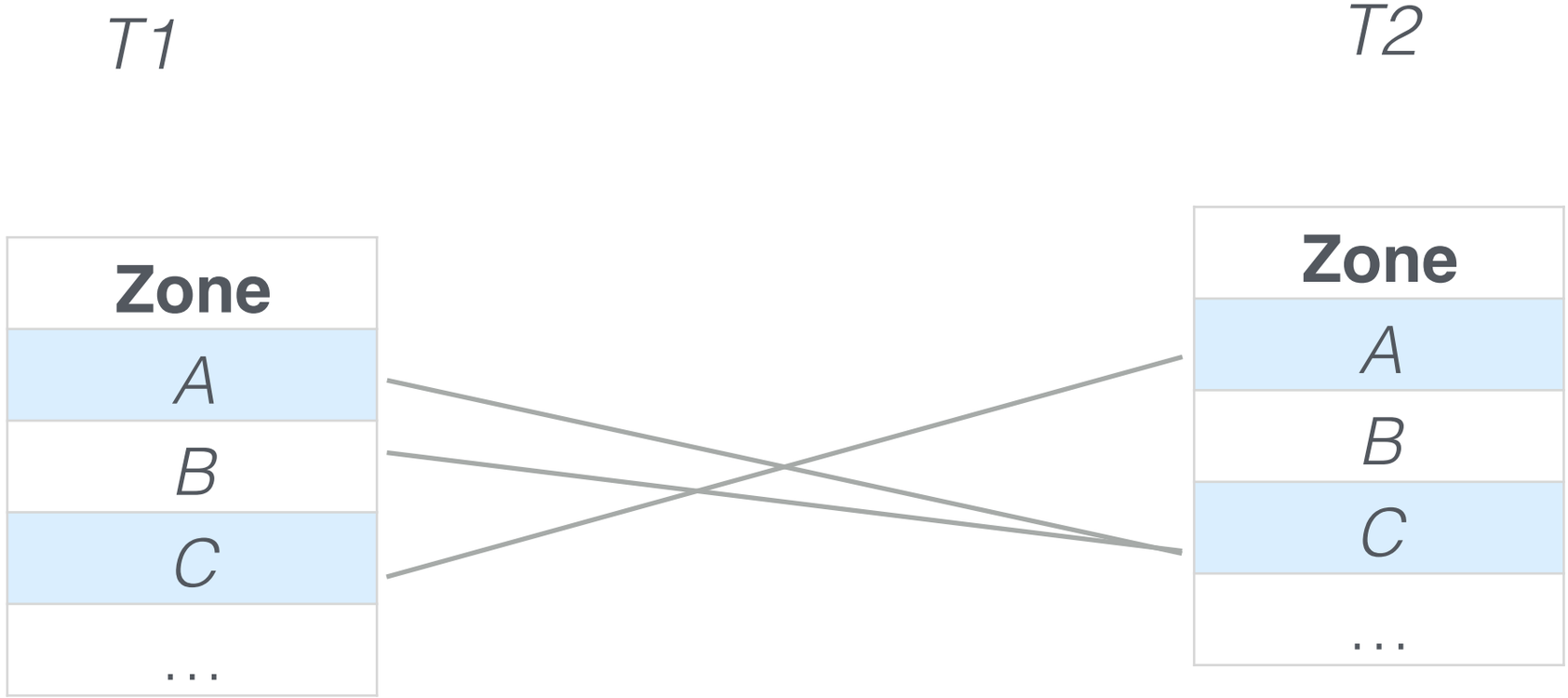
Singleton, A, P. Longley and M. Pavlis (2016). "The stability of geodemographic cluster assignments over an inter-censal period". In: Journal of Geographical Systems 18.2, pp. 97-123. URL: http://dx.doi.org/10.1007/s10109-016-0226-x.

Methods: Relational



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Flows

	Food & Leisure	Agriculture	Service Workers	Warehousing & Waterfront	Manufacturing	Education & Campus	Health and Social Care	Tech Infill	Public Services	Financial & Business Services
A: Hispanic and Kids	106	95	119	122	132	79	97	60	100	69
B: Wealthy Nuclear Families	86	71	93	103	155	96	91	132	105	113
C: Middle Income, Single Family Homes	99	189	86	110	125	101	103	83	137	69
E: Wealthy Urbanites	91	47	95	78	58	104	80	199	57	179
F: Low Income and Diverse	105	71	119	110	90	85	107	66	128	74
G: Old, Wealthy White	100	201	80	94	112	108	94	93	100	98
H: Low Income Minority Mix	115	47	104	94	50	88	112	99	57	116
I: Poor, African-American	102	59	122	110	60	89	124	46	128	68
J: Residential Institutions, Young People	95	118	82	79	117	149	92	122	88	113

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Challenges and Conclusions

- Geodemographic methods can be extended to consider time
    - How do we combine time periods for fixed geography?
        - Flows between clusters?
- Moving beyond domicile characteristics?

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Challenges and Conclusions

- Dynamic zone design / scale
    - E.g. what is an appropriate scale / zone for residential v workplace geography?
- Data availability - representativeness & uncertainty

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Many thanks…

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