Classifying urban form at a national scale

The case of Great Britain

Martin Fleischmann [@martinfleis]

Dani Arribas-Bel [@darribas]

UNIVERSITY OF LIVERPOOL

The Alan Turing Institute

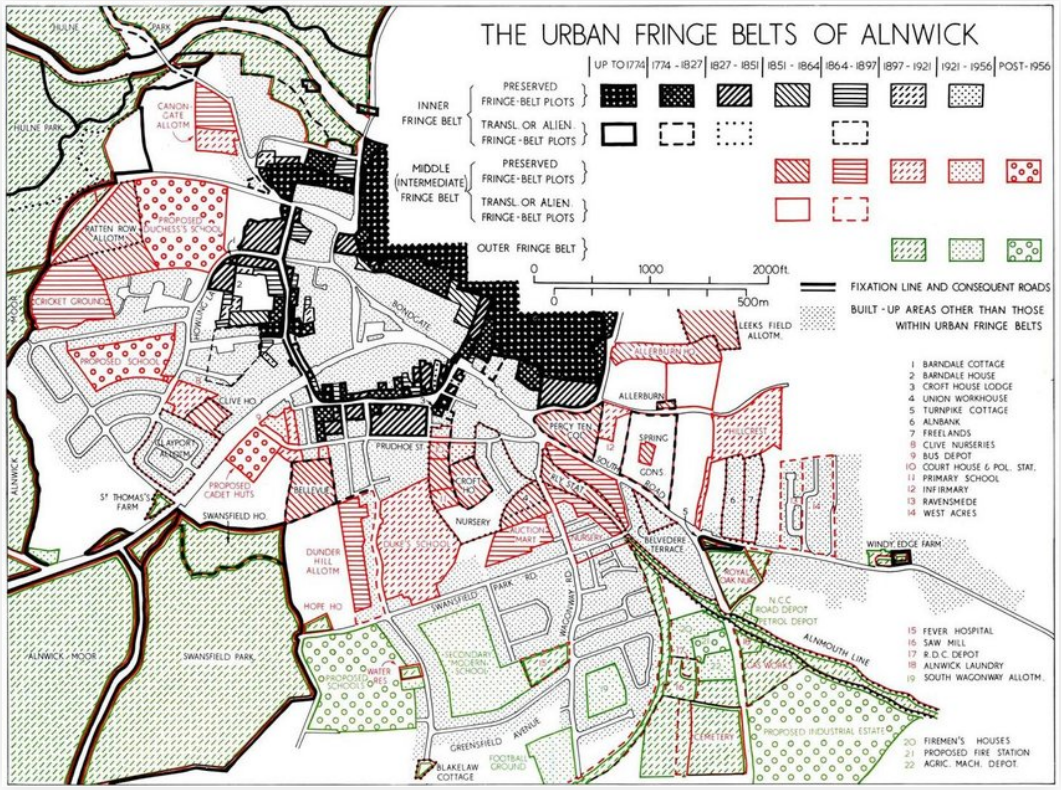
Geographic Data Science Lab

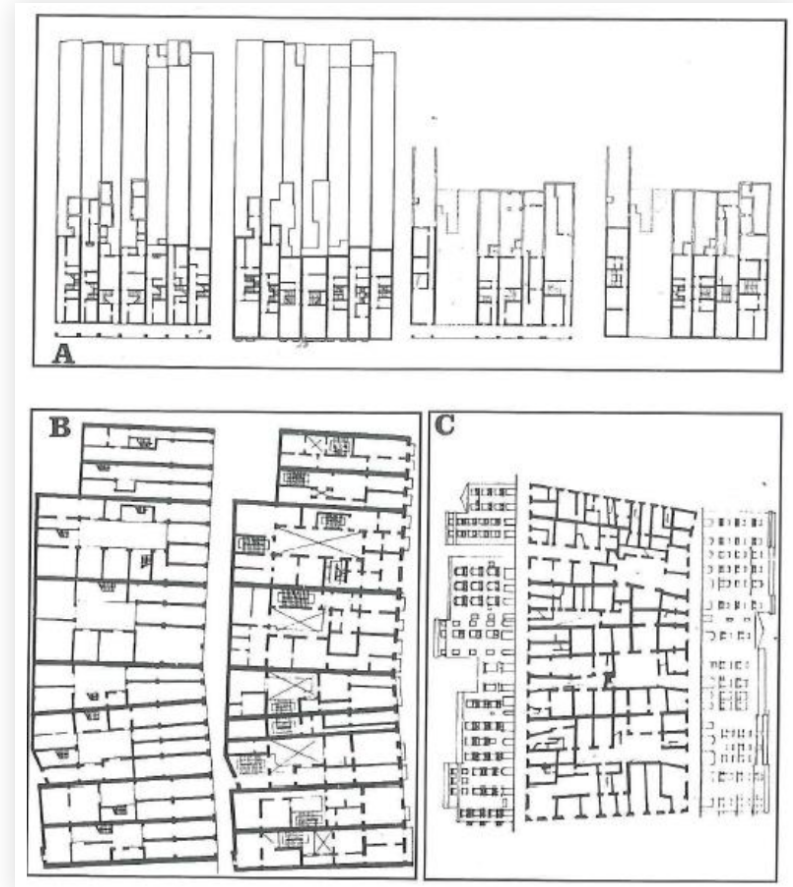
Scaling morphological studies

… can be daunting

Traditional schools

… (almost) cannot scale

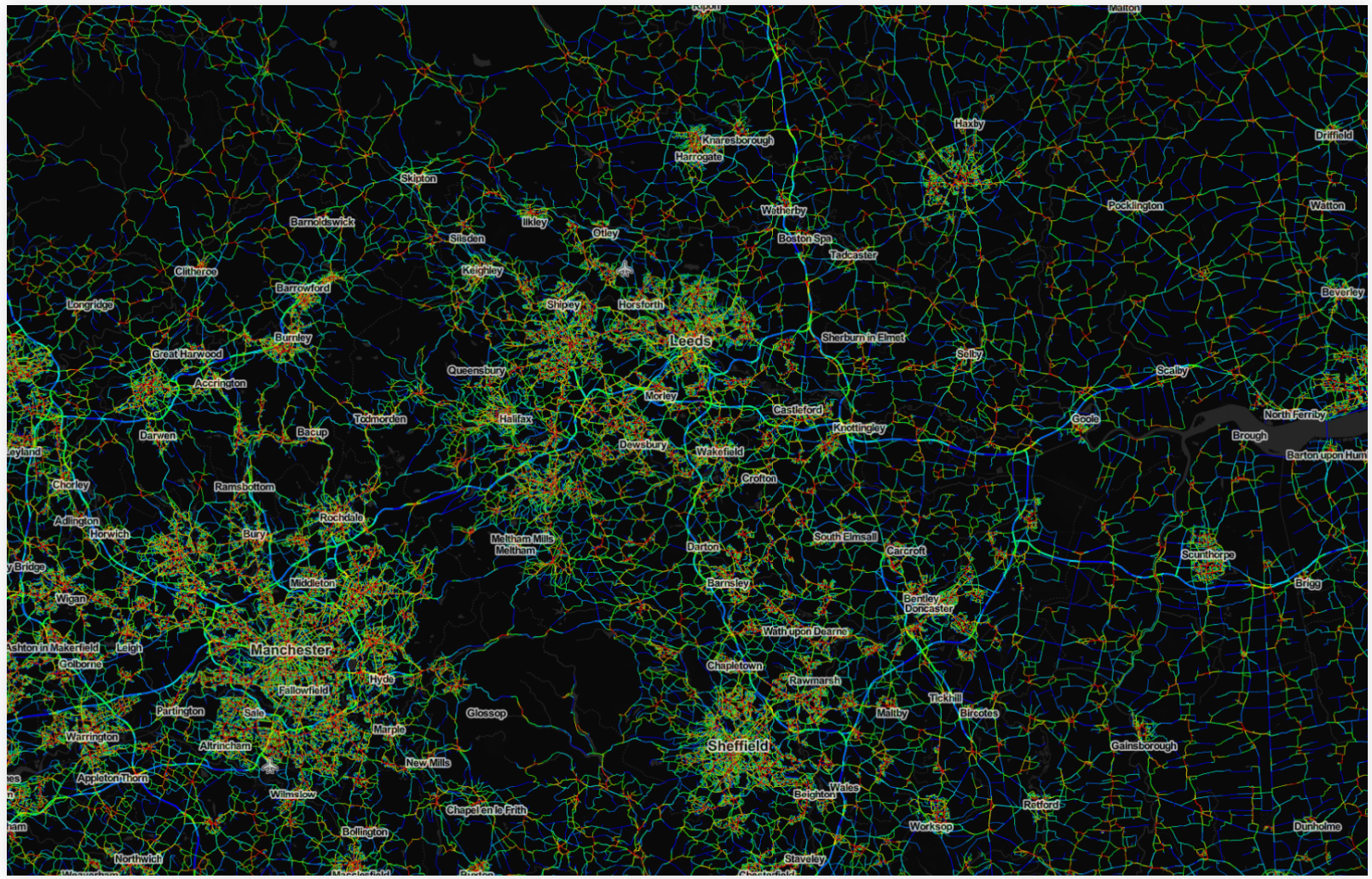




Conzen (1960), Caniggia & Maffei (1979)

Space Syntax

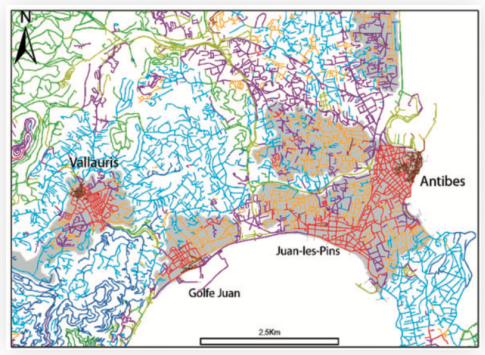
… can scale but offers limited insights

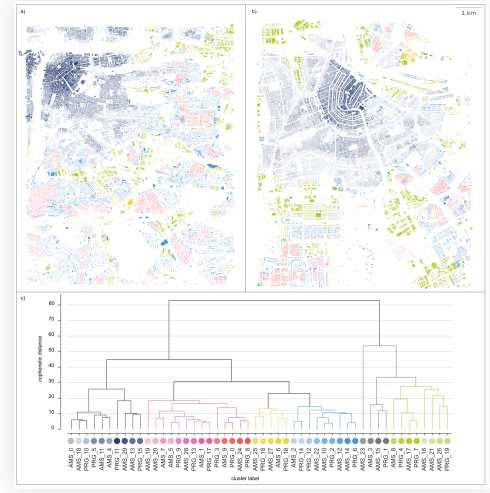


Space Syntax OpenMapping (2018)

Morphometric approaches

… are trying to find a way

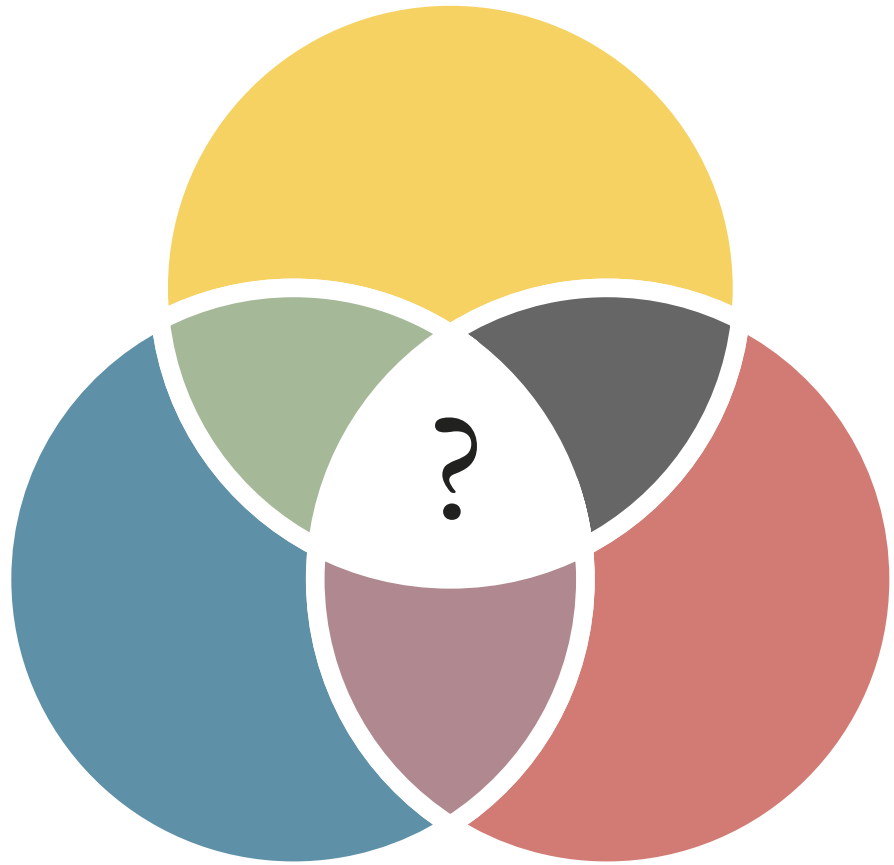




Araldi & Fusco (2019), Berghauser Pont et al. (2019), Jochem et al. (2020), Fleischmann et al. (2021)

Opportunities

detailed



scalable

consistent

Spatial Signatures

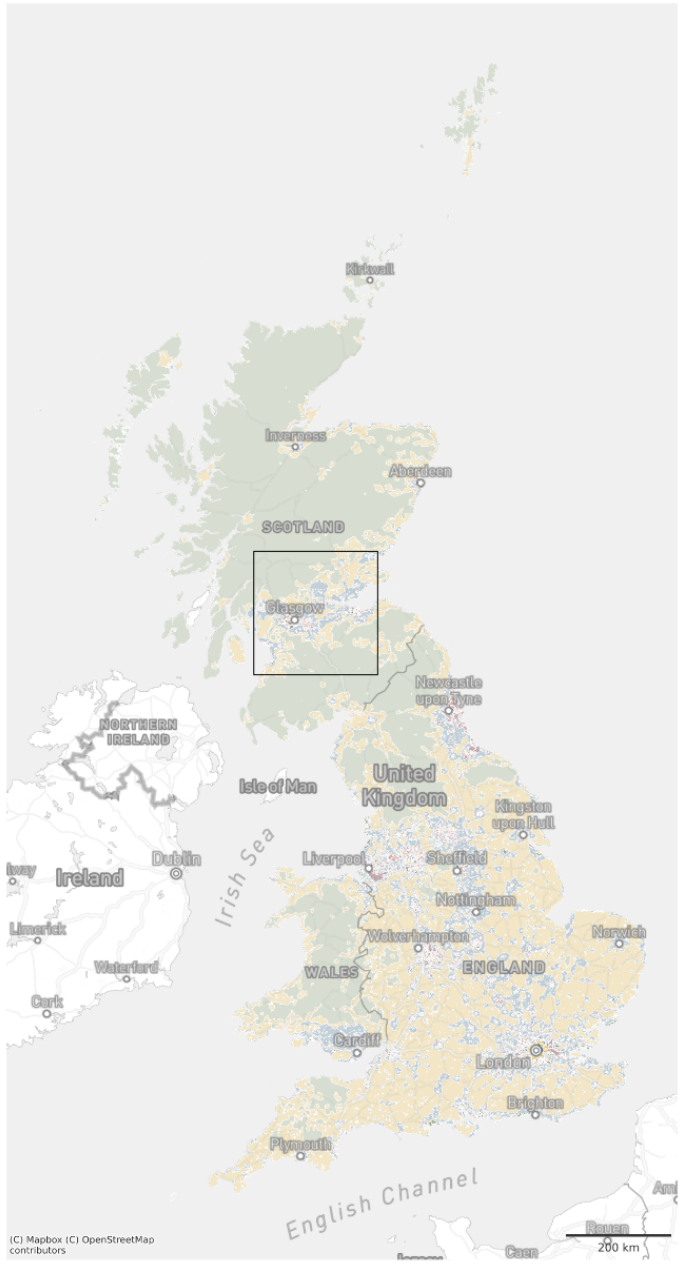
A characterisation of space based on form and function designed to understand urban environments

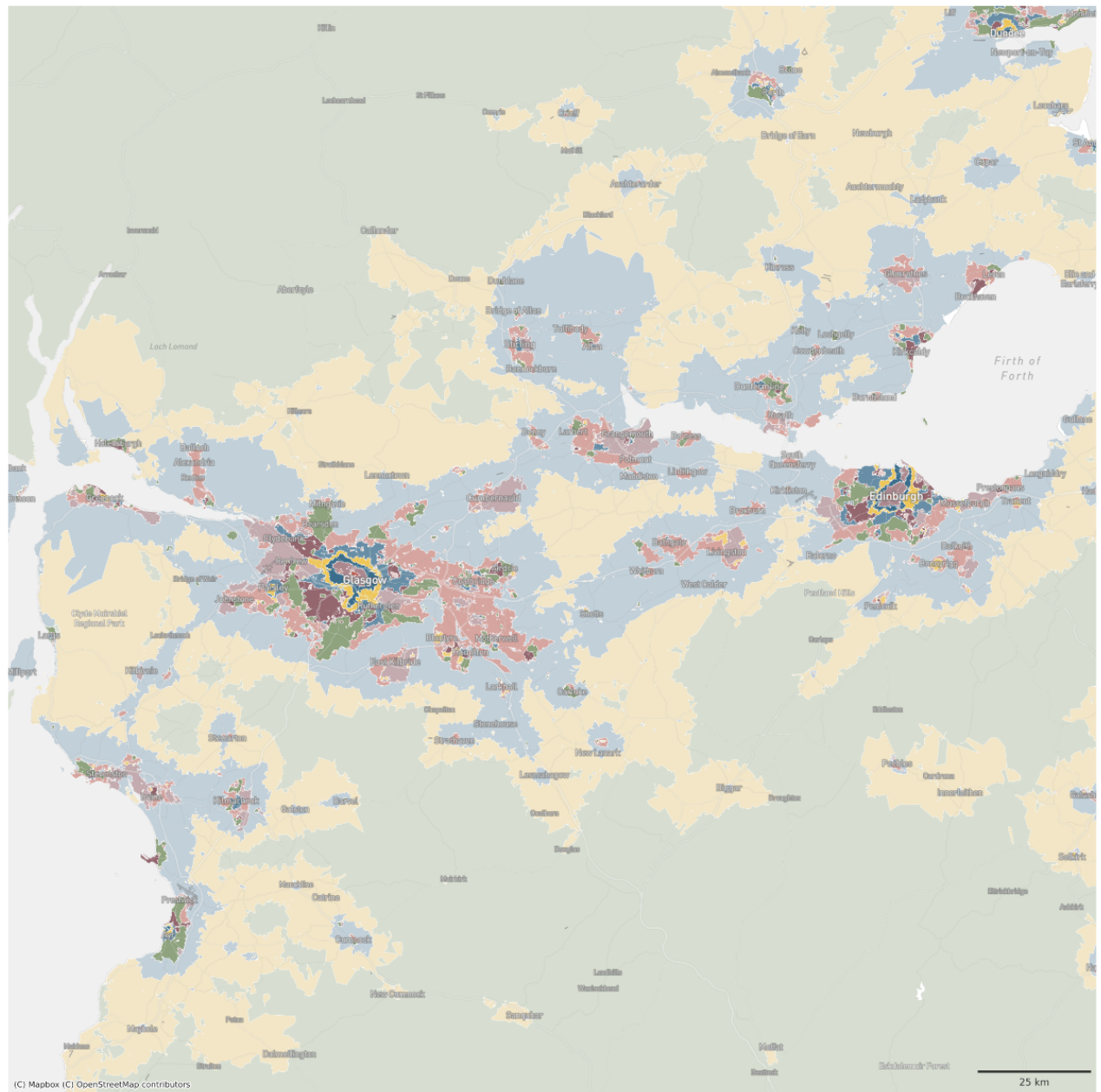
A characterisation of space based on form and function designed to understand urban environments

A characterisation of space based on form and function designed to understand urban environments

A characterisation of space based on form and function designed to understand urban environments

Spatial Signatures





Form

One of the two components of Spatial Signatures

Qualitative, quant. case studies, morphometrics, remotely sensed

Ordnance Survey Open Data

building footprints + street network

… can be a bit limited.

(c) Ordnance Survey, (c) OpenStreetMap

Spatial Unit

Enclosed tessellation

How can we describe it…

… numerically?

Urban morphometrics

“quantitative analysis of urban form”

All about measuring.

Measuring

dimension

shape

spatial distribution

intensity

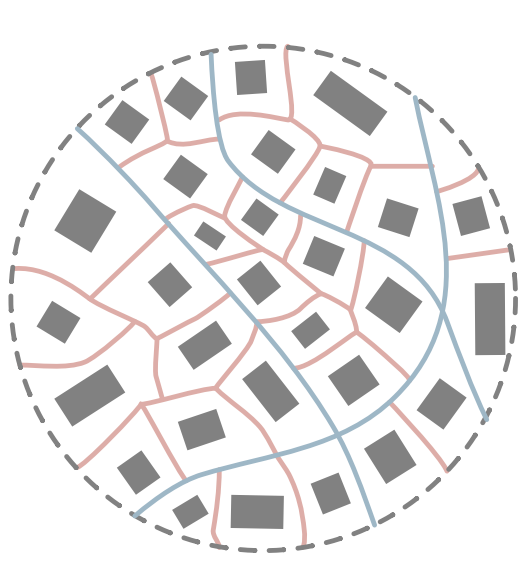
connectivity

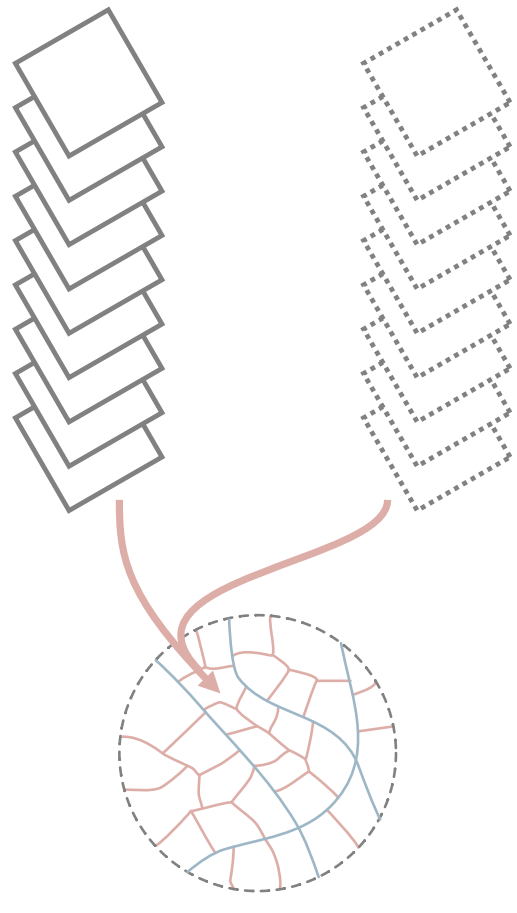
diversity

Enclosed Tessellation

Embedding *measurements*

Clustering





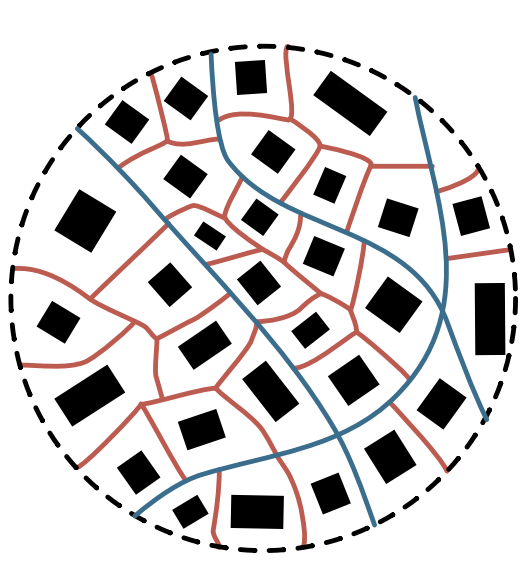
Context

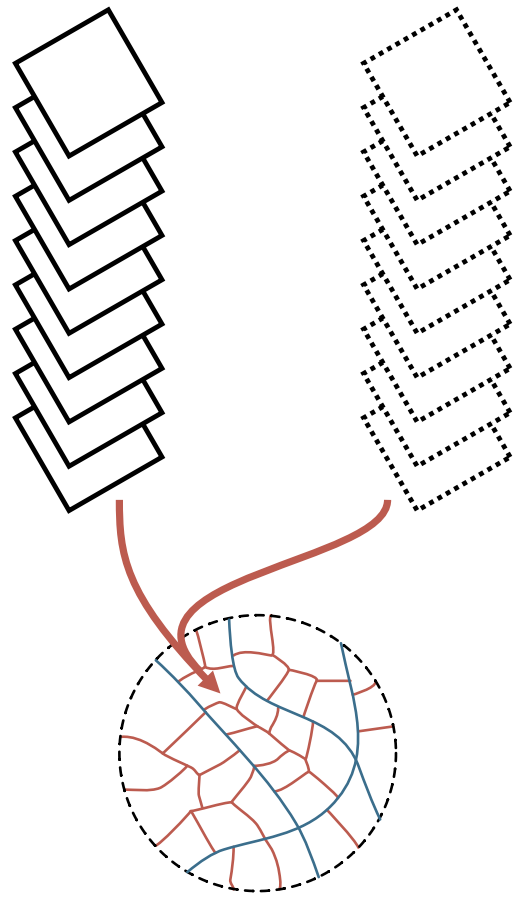
Every piece of information is considered within its spatial context

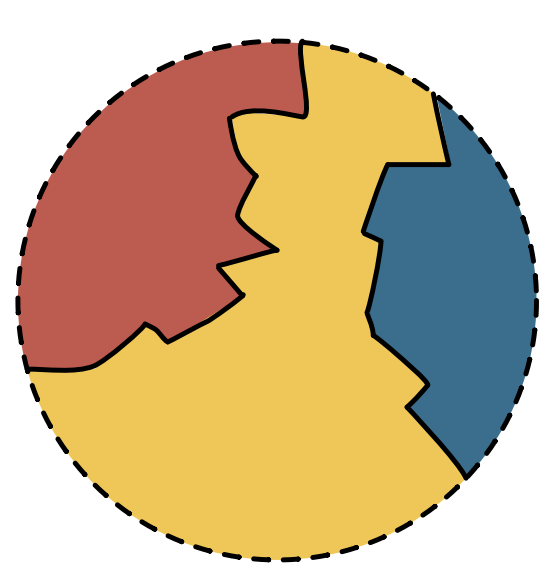
Enclosed Tessellation

Embedding *measurements*

Clustering







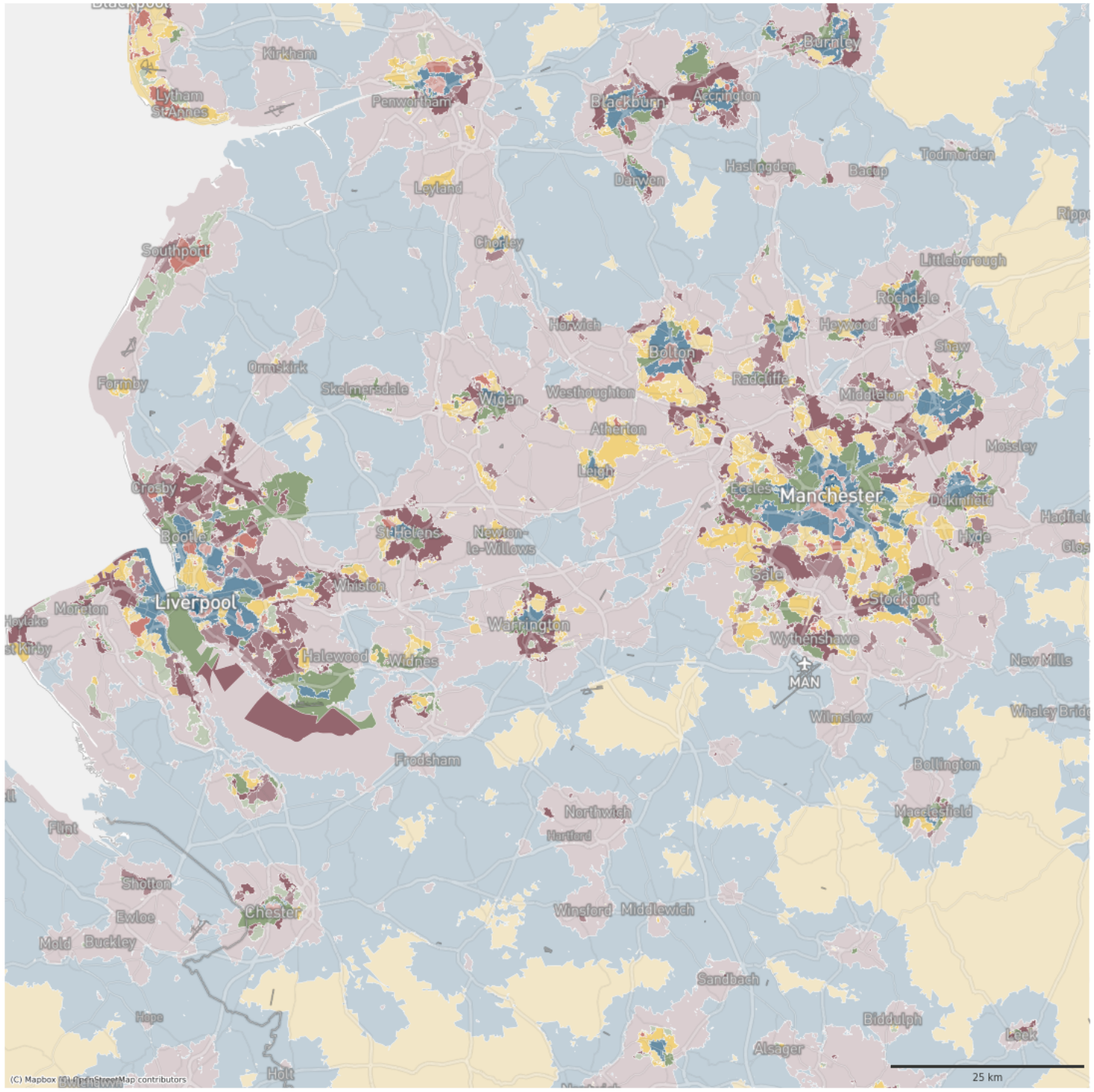
Results

19 classes in 3 main groups

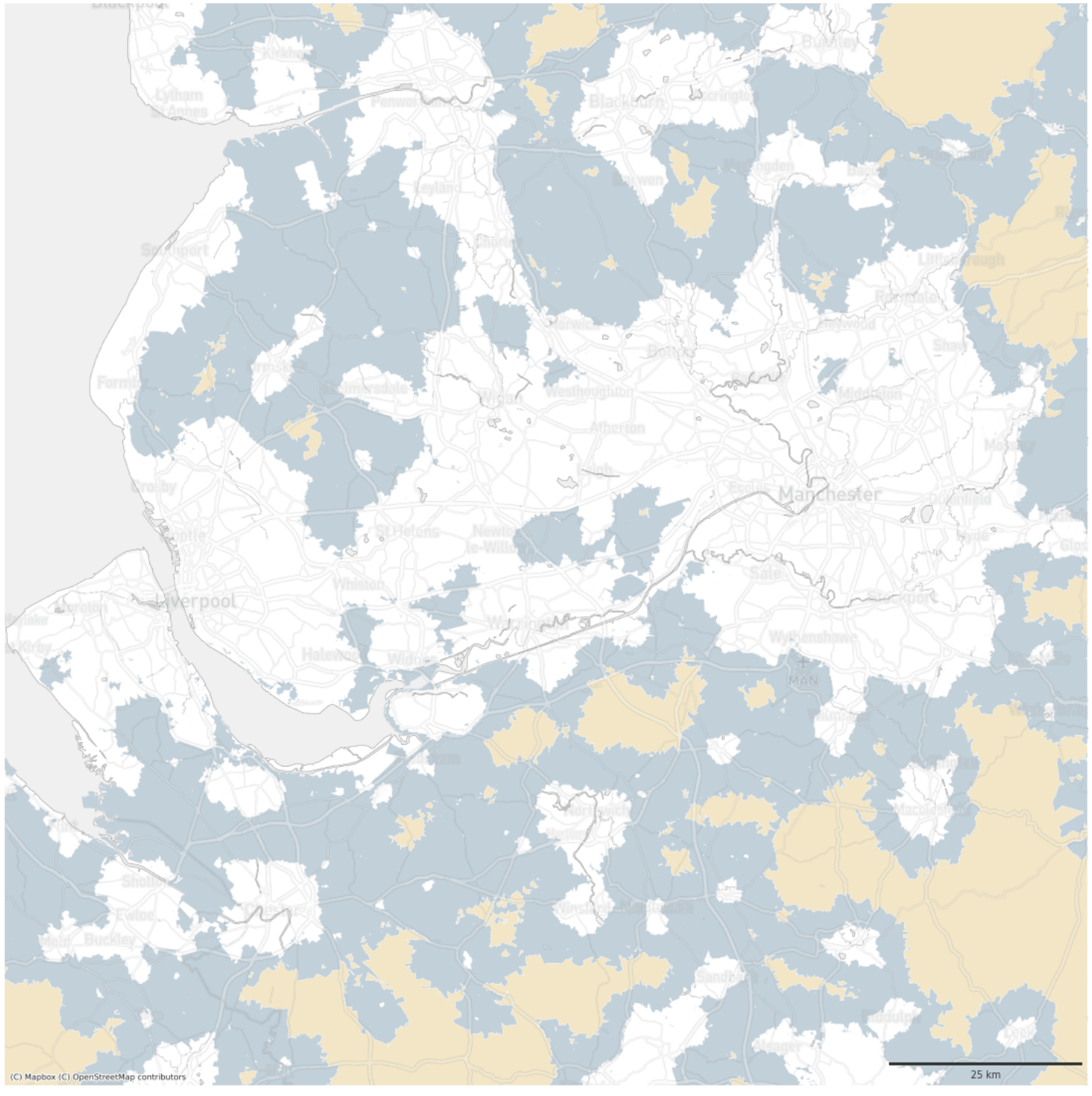
countryside

low density development

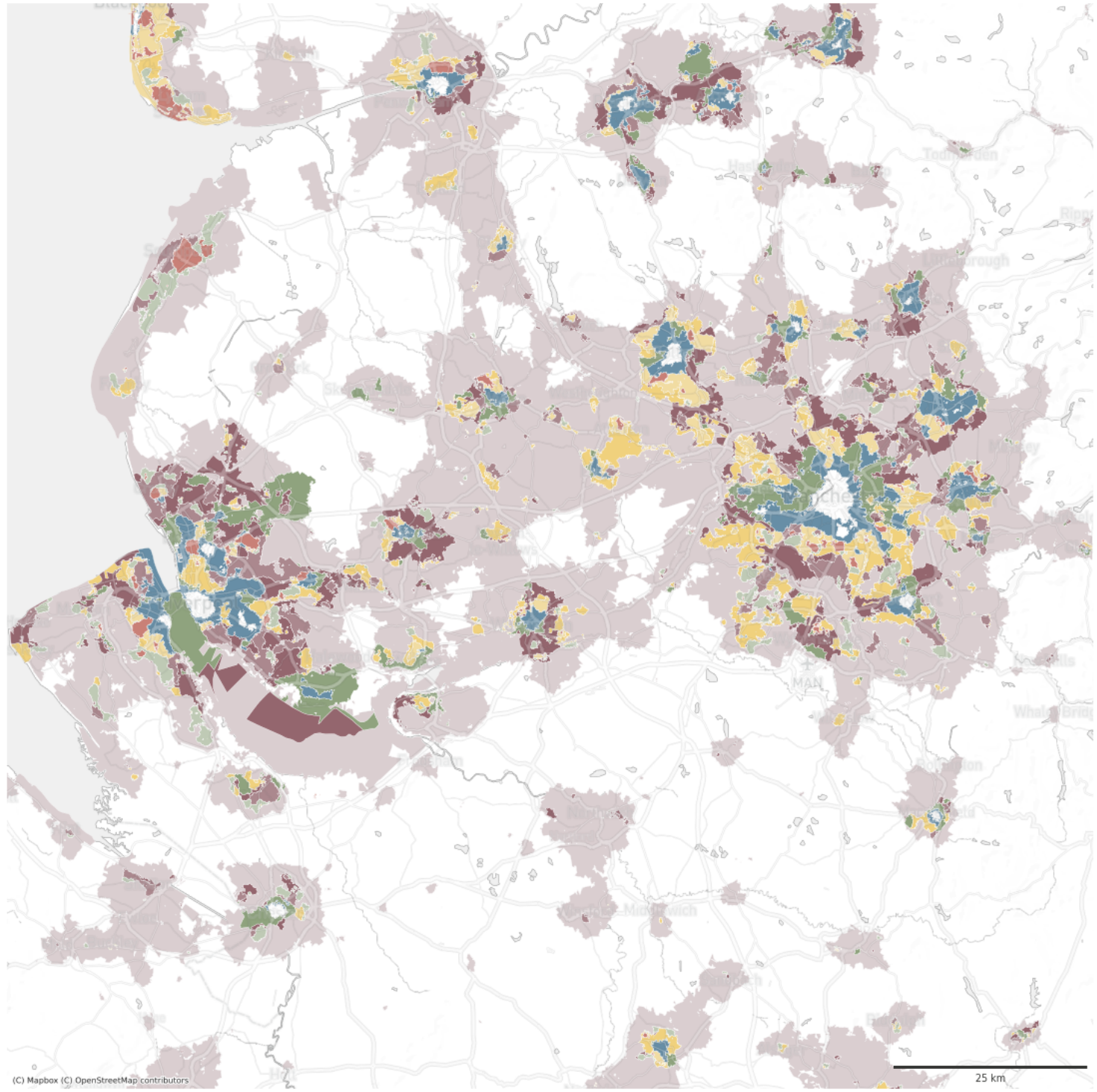
dense city centres



Liverpool - Manchester

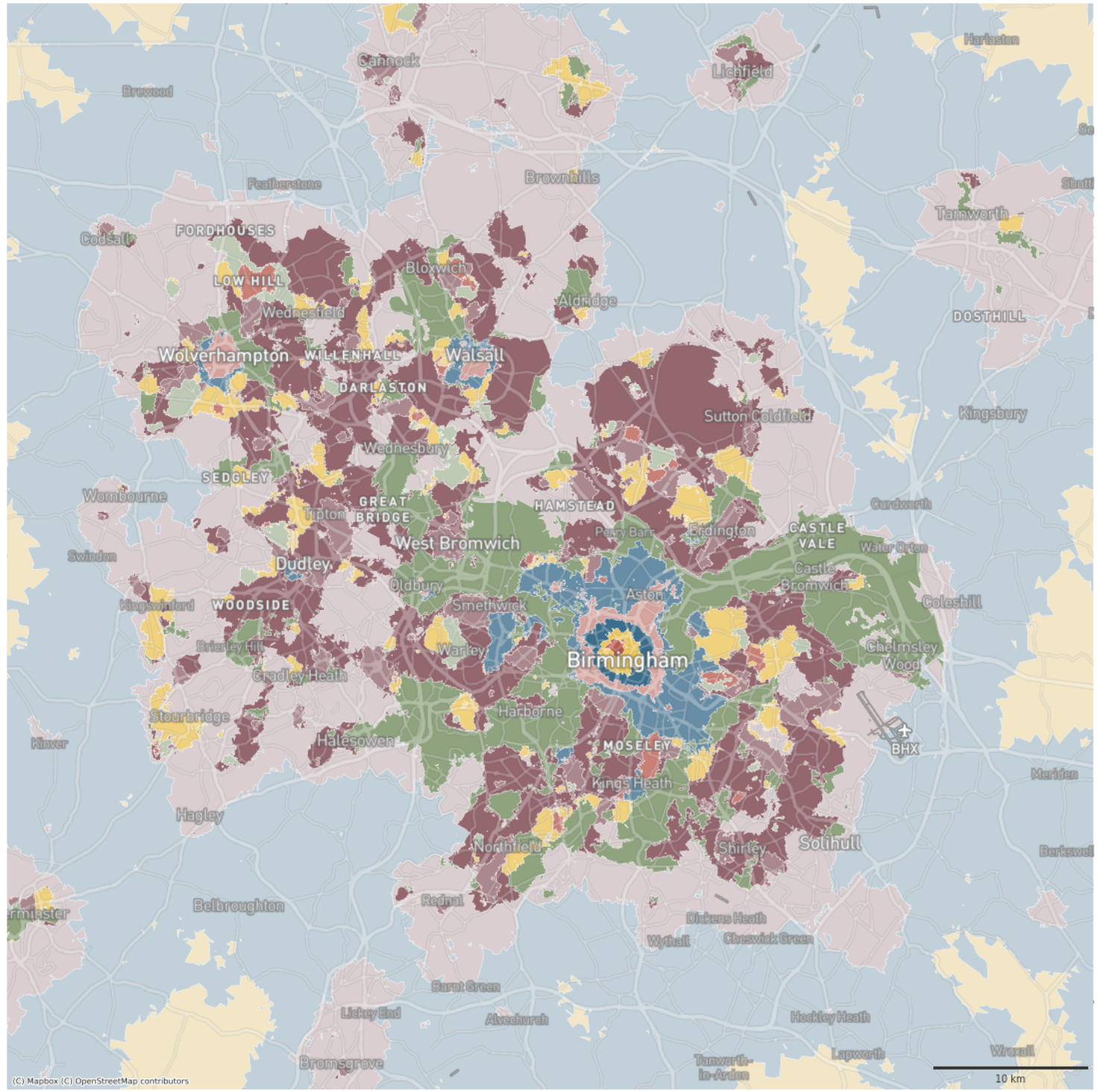


Liverpool - Manchester

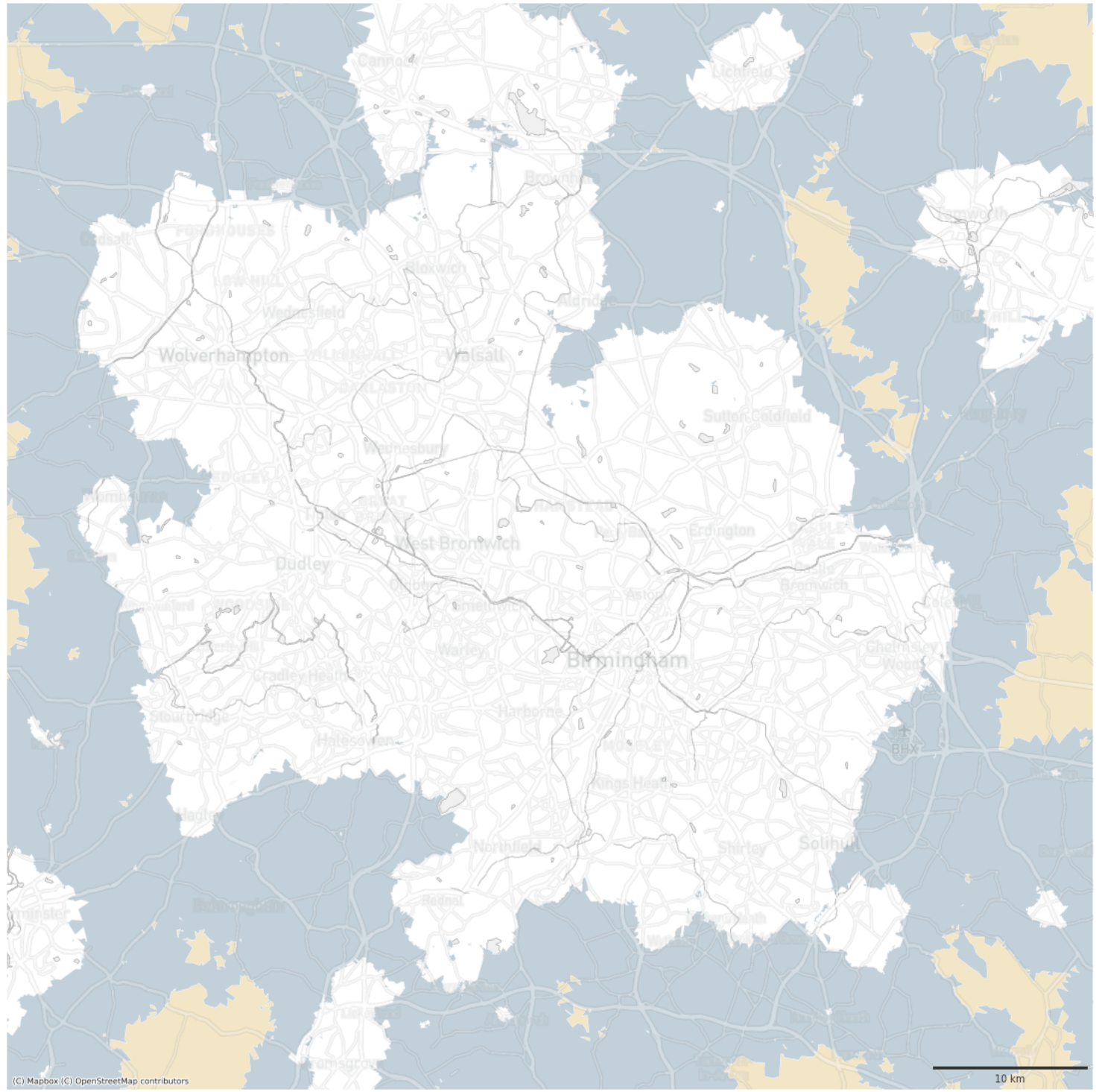


Liverpool - Manchester

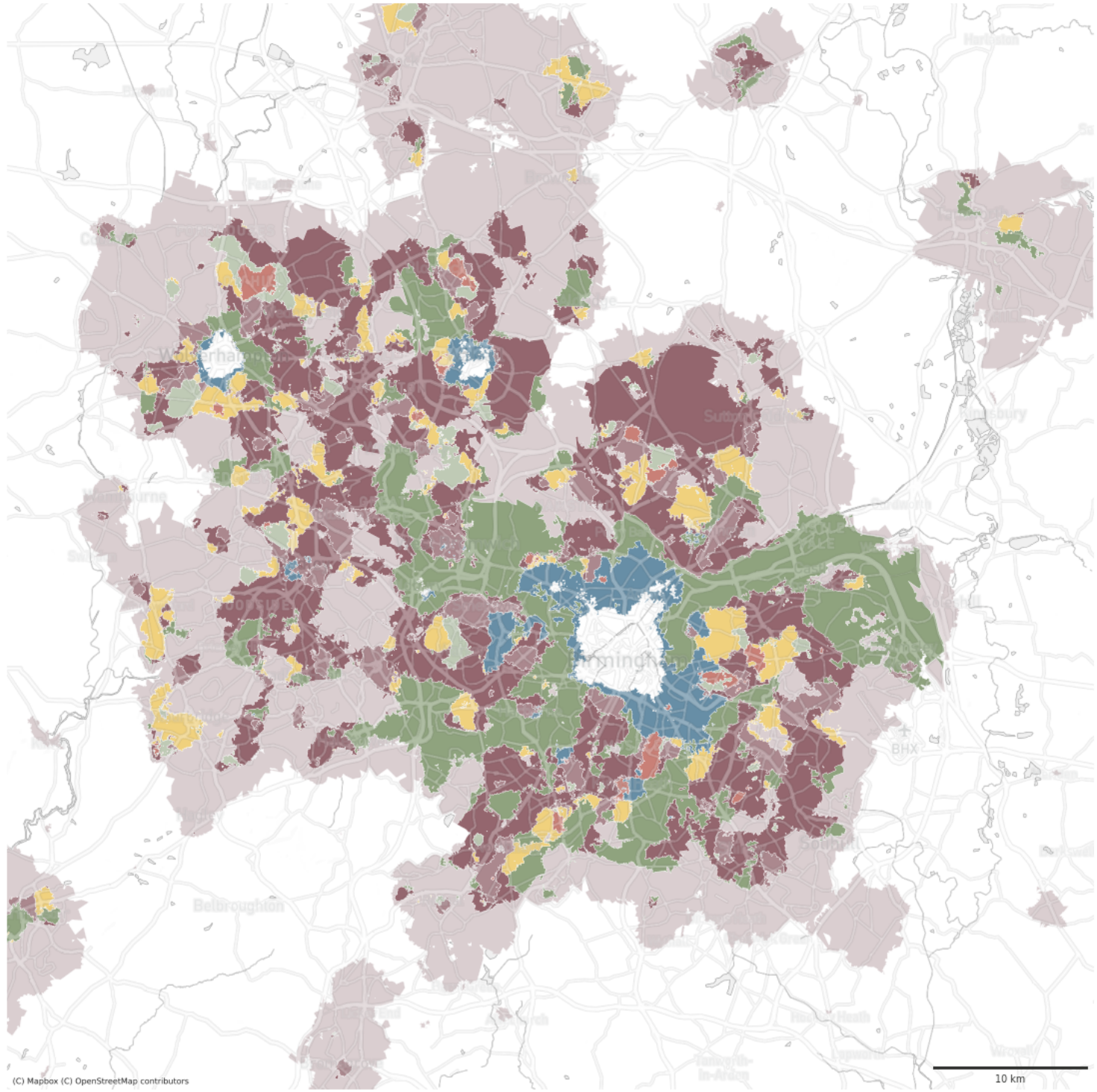
Liverpool - Manchester


Cannock
Lichfield
Harlaston
Brewood
Brownhills
Featherstone
Tamworth
FORDHOUSES
Codsall
Bloxwich
LOW HILL
Aldridge
Wednesfield
DOSTHILL
Wolverhampton
WILLENHALL
Walsall
DARLASTON
Sutton Coldfield
Kingsbury
Wednesbury
SEDGLEY
Wombourne
GREAT BRIDGE
HAMSTEAD
Curdworth
Tipton
Perry Barr
Erdington
CASTLE VALE
West Bromwich
Water Orton
Swindon
Dudley
Castle Bromwich
Oldbury
Aston
Coleshill
WOODSIDE
Smethwick
Warley
Birmingham
Chelmsley Wood
Cradley Heath
Harborne
Stourbridge
Halesowen
MOSELEY
BHX
Kinver
Kings Heath
Meriden
Hagley
Northfield
Shirley
Solihull
Belbroughton
Rednal
Dickens Heath
Wythall
Cheswick Green
Barnt Green
Lickey End
Alvechurch
Hockley Heath
Bromsgrove
Lapworth
Tanworth-in-Arden
(C) Mapbox (C) OpenStreetMap contributors
10 km

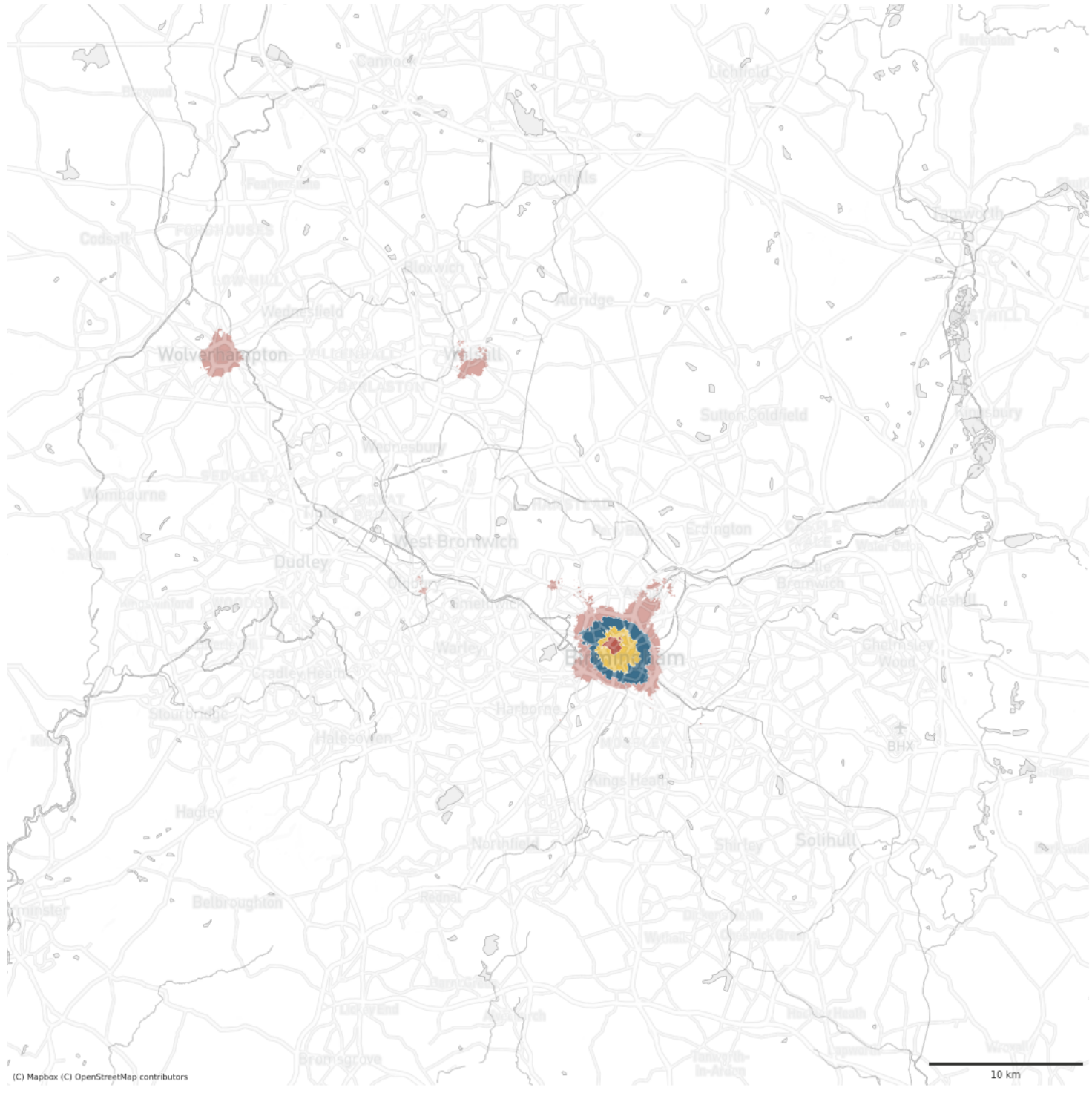
Birmingham


Cannock
Lichfield
Brownhills
Tamworth
Dudsall
FOREHOUSES
Bloxwich
LOW HILL
Aldridge
Wednesfield
Wolverhampton
WILLENHALL
Walsall
DARLASTON
Sutton Coldfield
Wednesbury
Erdington
West Bromwich
Dudley
Oldbury
Aston
Bromwich
Smethwick
Warley
Birmingham
Cradley Heath
Harborne
Stourbridge
Halesowen
Kings Heath
Northfield
Shirley
Solihull
Redhill
Bromsgrove
BHX
(C) Mapbox (C) OpenStreetMap contributors
10 km

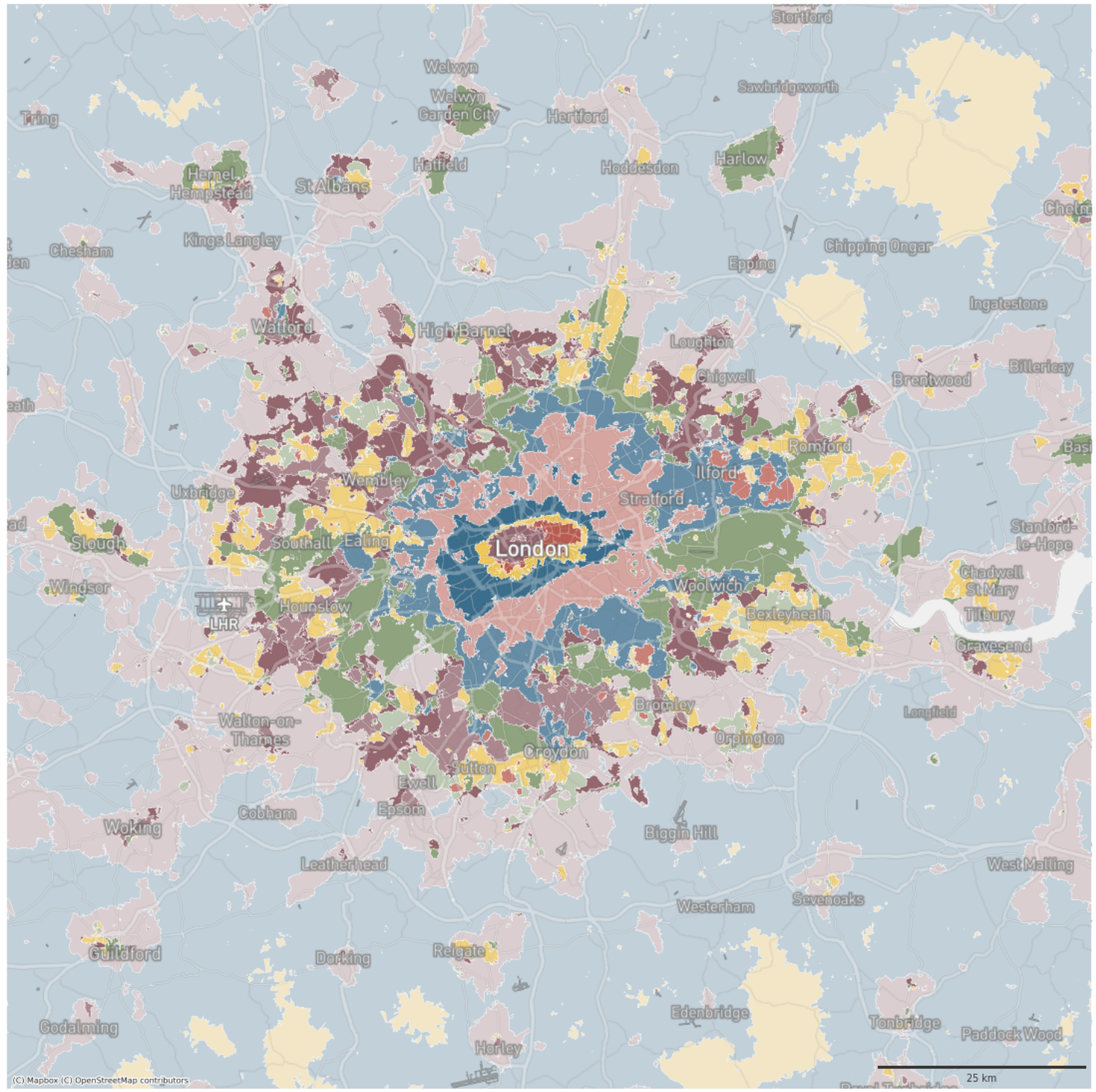
Birmingham


Walsall
Wolverhampton
Dudley
Sutton Coldfield
Solihull
Birmingham
BHX
Bromsgrove
Redditch
Halesowen
Stourbridge
Kidderminster
Bewdley
Belbroughton
Tamworth
Lichfield
Rugeley
Cannock
Burntwood
Brownhills
Aldridge
Sutton Coldfield
Coleshill
Meriden
Kenilworth
Leamington Spa
Warwick
Stratford-upon-Avon
Alcester
Henley-in-Arden
Studley
Evesham
Pershore
Droitwich Spa
Worcester
Bromyard
Ledbury
Malvern
Tewkesbury
Gloucester
Cheltenham
Stroud
Cirencester
Tetbury
Malmesbury
Chippenham
Swindon
Wootton Bassett
Marlborough
Devizes
Trowbridge
Melksham
Bradford-on-Avon
Frome
Warminster
Salisbury
Amesbury
Andover
Basingstoke
Newbury
Hungerford
Thatcham
Reading
Wokingham
Bracknell
Ascot
Windsor
Slough
Maidenhead
Marlow
High Wycombe
Princes Risborough
Thame
Wallingford
Abingdon-on-Thames
Oxford
Witney
Chipping Norton
Banbury
Brackley
Towcester
Daventry
Rugby
Nuneaton
Bedworth
Hinckley
Coventry
Market Harborough
Corby
Kettering
Wellingborough
Northampton
Rushden
Higham Ferrers
Irthlingborough
Raunds
Oundle
Thrapston
Huntingdon
St Neots
Biggleswade
Sandy
Bedford
Dunstable
Leighton Buzzard
Aylesbury
Tring
Berkhamsted
Hemel Hempstead
St Albans
Harpenden
Welwyn Garden City
Hatfield
Hertford
Ware
Bishop's Stortford
Harlow
Epping
Loughton
Chigwell
Romford
Brentwood
Billericay
Basildon
Wickford
Rayleigh
Southend-on-Sea
Rochford
Hockley
Hullbridge
Canvey Island
Benfleet
Leigh-on-Sea
Shoeburyness
Thorpe Bay
Westcliff-on-Sea
Rochester
Chatham
Gillingham
Strood
Dartford
Gravesend
Northfleet
Swanscombe
Greenhithe
Crayford
Bexleyheath
Sidcup
Orpington
Petts Wood
Chislehurst
Bromley
Beckenham
Penge
Croydon
Purley
Coulsdon
Caterham
Oxted
Godstone
Redhill
Reigate
Horley
Crawley
Gatwick Airport
East Grinstead
Uckfield
Lewes
Newhaven
Seaford
Eastbourne
Hailsham
Heathfield
Battle
Bexhill-on-Sea
Hastings
St Leonards-on-Sea
Rye
Tenterden
Ashford
Folkestone
Hythe
Dover
Deal
Sandwich
Ramsgate
Margate
Broadstairs
Whitstable
Herne Bay
Faversham
Sittingbourne
Maidstone
Tonbridge
Sevenoaks
Swanley
Edenbridge
Westerham
Oxted
Limpsfield
Lingfield
East Grinstead
Haywards Heath
Burgess Hill
Hassocks
Ditchling
Brighton
Hove
Shoreham-by-Sea
Worthing
Littlehampton
Bognor Regis
Chichester
Midhurst
Petworth
Pulborough
Billingshurst
Horsham
Guildford
Godalming
Haslemere
Farnham
Aldershot
Fleet
Camberley
Frimley
Woking
Weybridge
Walton-on-Thames
Esher
Kingston upon Thames
Surbiton
New Malden
Wimbledon
Tooting
Clapham
Battersea
Chelsea
Kensington
Hammersmith
Shepherd's Bush
Acton
Ealing
Southall
Hayes
Uxbridge
Ruislip
Northwood
Pinner
Harrow
Wembley
Willesden
Kilburn
Hampstead
Highgate
Finchley
Barnet
Edgware
Mill Hill
Stanmore
Bushey
Watford
Rickmansworth
Chorleywood
Amersham
Chesham
Beaconsfield
Gerrards Cross
Denham
Iver
Langley
Eton
Windsor
Staines-upon-Thames
Sunbury-on-Thames
Hampton
Twickenham
Richmond upon Thames
Mortlake
Barnes
Putney
Fulham
Chelsea
Kensington
Notting Hill
Paddington
Maida Vale
St John's Wood
Regent's Park
Camden Town
Kentish Town
Tufnell Park
Archway
Islington
Clerkenwell
Holborn
Bloomsbury
Fitzrovia
Soho
Covent Garden
Strand
Temple
Blackfriars
Southwark
Bermondsey
Rotherhithe
Deptford
Greenwich
Blackheath
Lewisham
Catford
Forest Hill
Sydenham
Crystal Palace
Norwood
Streatham
Brixton
Camberwell
Peckham
Dulwich
East Dulwich
Herne Hill
Stockwell
Vauxhall
Pimlico
Victoria
Westminster
Mayfair
Marylebone
Bayswater
Notting Hill
Shepherd's Bush
Hammersmith
Chiswick
Brentford
Isleworth
Hounslow
Feltham
Heathrow Airport
Ashford
Staines-upon-Thames
Egham
Virginia Water
Chertsey
Addlestone
Byfleet
Woking
Guildford
Godalming
Haslemere
Farnham
Aldershot
Fleet
Camberley
Frimley
Bagshot
Sunningdale
Ascot
Windsor
Eton
Slough
Langley
Iver
Uxbridge
Ruislip
Northwood
Pinner
Harrow
Wembley
Willesden
Kilburn
Hampstead
Highgate
Finchley
Barnet
Edgware
Mill Hill
Stanmore
Bushey
Watford
Rickmansworth
Chorleywood
Amersham
Chesham
Beaconsfield
Gerrards Cross
Denham
(C) Mapbox (C) OpenStreetMap contributors
10 km

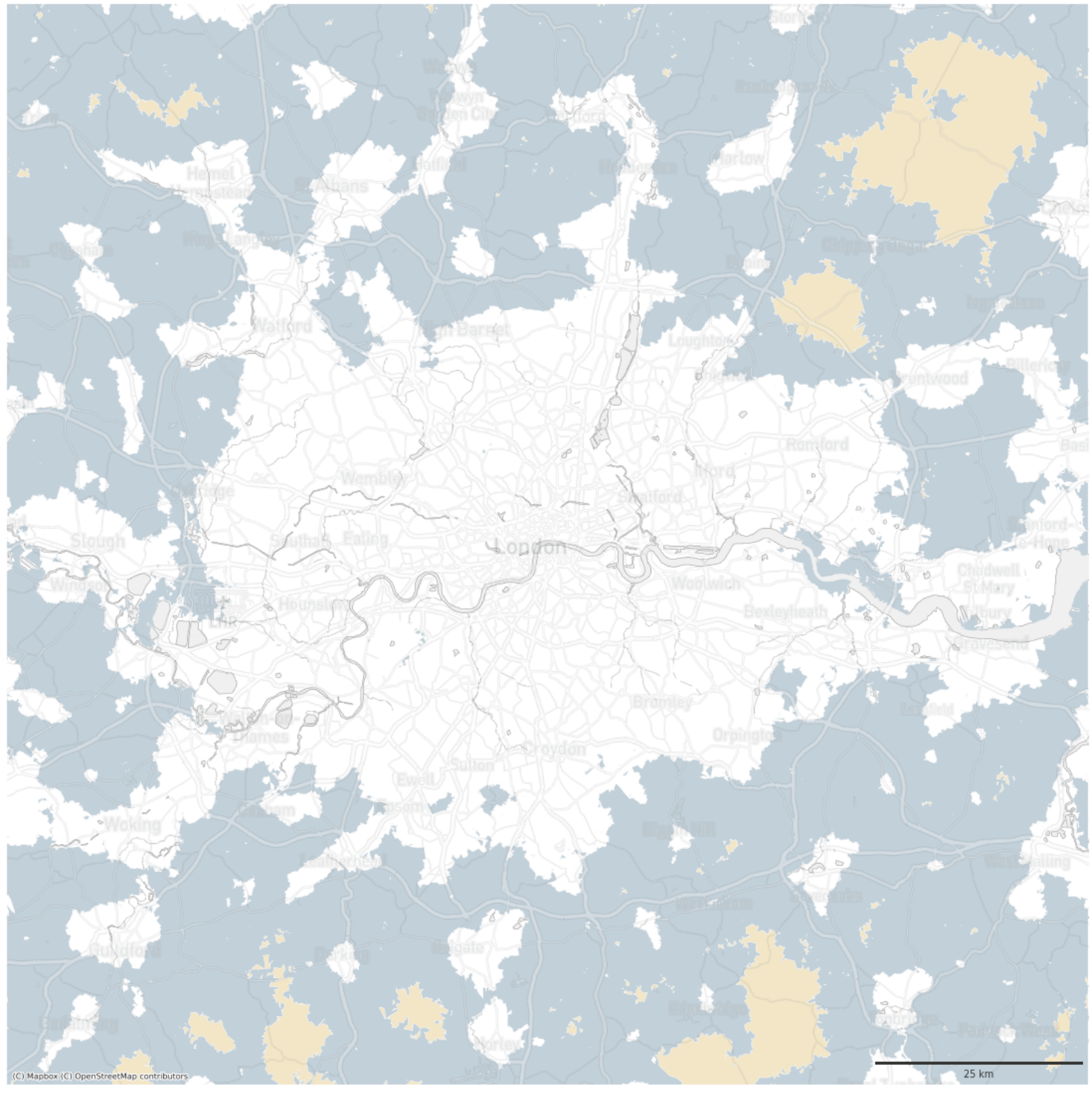
Birmingham


Cannock
Lichfield
Brownhills
Codsall
Bloxwich
Aldridge
Wednesfield
Wolverhampton
Walsall
Sutton Coldfield
Wednesbury
Wombourne
West Bromwich
Erdington
Dudley
Warley
Harborne
Halesowen
Kings Heath
Hagley
Northfield
Shirley
Solihull
Belbroughton
Bromsgrove
BHX
(C) Mapbox (C) OpenStreetMap contributors
10 km

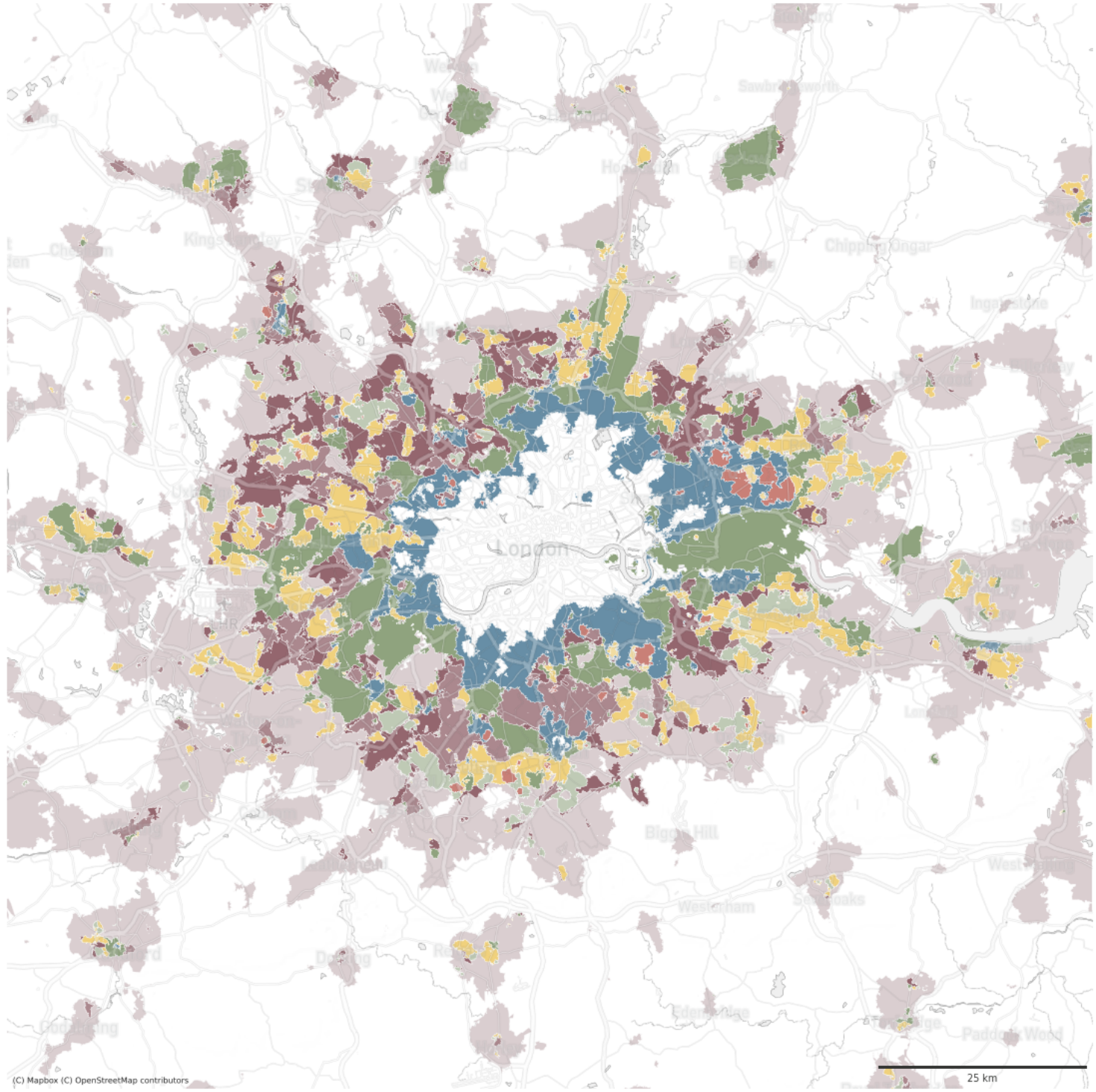
Birmingham


Stortford
Welwyn
Welwyn Garden City
Sawbridgeworth
Tring
Hertford
Harlow
Hatfield
Hoddesdon
Hemel Hempstead
St Albans
Kings Langley
Chesham
Chipping Ongar
Epping
Ingatestone
Watford
High Barnet
Loughton
Billericay
Chigwell
Brentwood
Romford
Ilford
Wembley
Uxbridge
Stratford
Slough
Southall
Ealing
London
Stanford-le-Hope
Windsor
Hounslow
LHR
Woolwich
Chadwell St Mary
Bexleyheath
Tilbury
Gravesend
Walton-on-Thames
Bromley
Orpington
Croydon
Sutton
Ewell
Epsom
Cobham
Woking
Biggin Hill
Leatherhead
West Malling
Sevenoaks
Westerham
Guildford
Dorking
Reigate
Edenbridge
Tonbridge
Paddock Wood
Godalming
Horley
(C) Mapbox (C) OpenStreetMap contributors
25 km

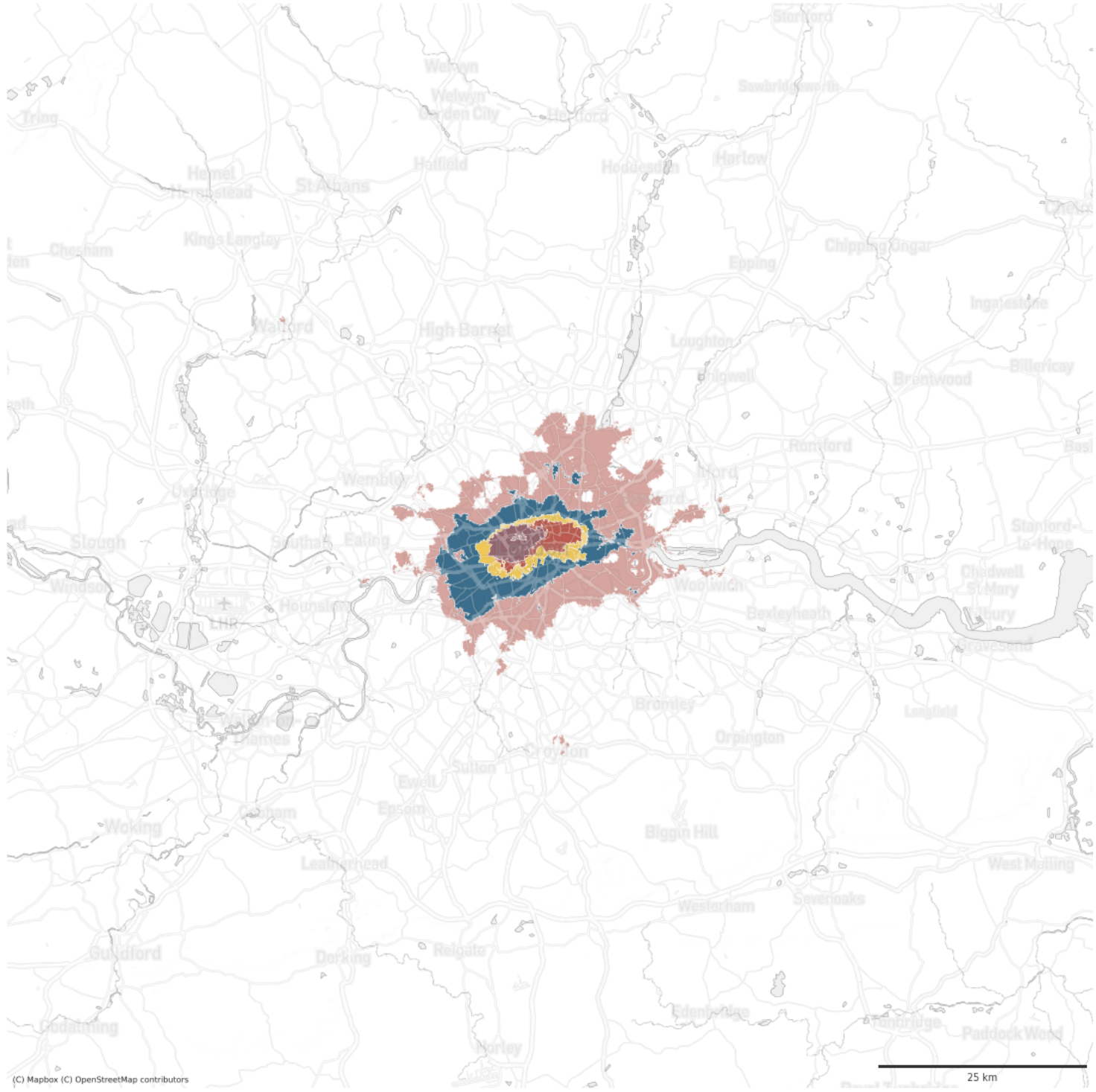
London


Hemel
St Albans
Watford
Wembley
Slough
Southall
Ealing
London
Hounslow
Woolwich
Bexleyheath
Romford
Ilford
Bromley
Croydon
Sutton
Ewell
Woking
Guildford
Dorking
Redgate
Norley
Chadwell
St Mary
Gravesend
Brentwood
Loughton
Marlow
Hoddesdon
Hatfield
Harlow
Chippenham
Ingatestone
Billericay
Basi
Tonbridge
Edenbridge
Waterham
Sevenoaks
Westerham
Bigg Hill
Epsom
Cobham
Leatherhead
Kingsbury
Hampstead
Hertford
Hertwyn
Garden City
Stortford
Sawbridgeworth
Bishop
Chipping Ongar
Ingatestone
Brentwood
Bromley
Orpington
Bexleyheath
Woolwich
Ilford
Shadford
Wembley
Ealing
Hounslow
Windsor
Thames
Woking
Guildford
Gravesend
Tonbridge
Paddock Wood
(C) Mapbox (C) OpenStreetMap contributors
25 km

London

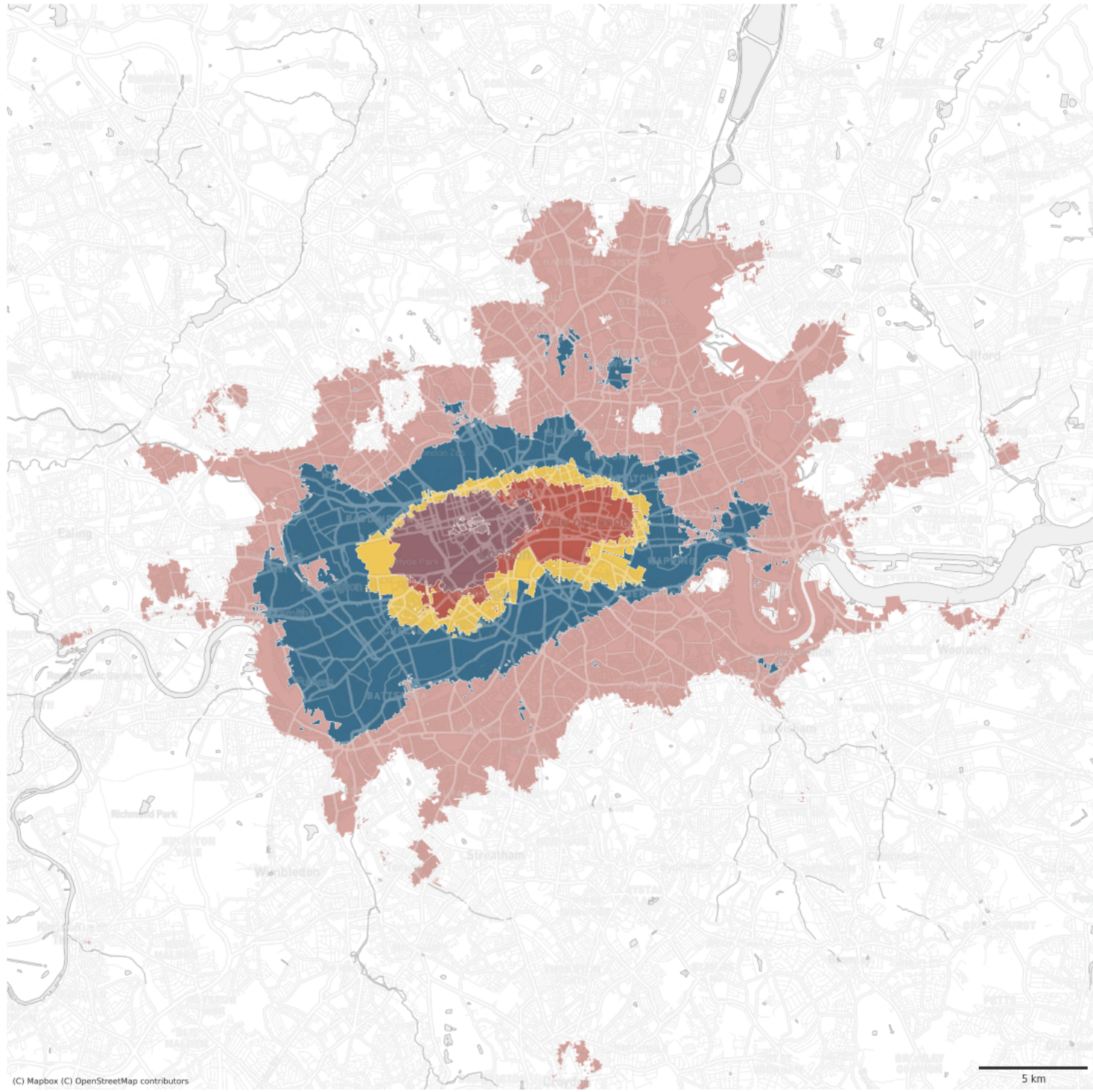

London
Chipping Ongar
Westerham
Biggin Hill
Paddock Wood
25 km
(C) Mapbox (C) OpenStreetMap contributors

London

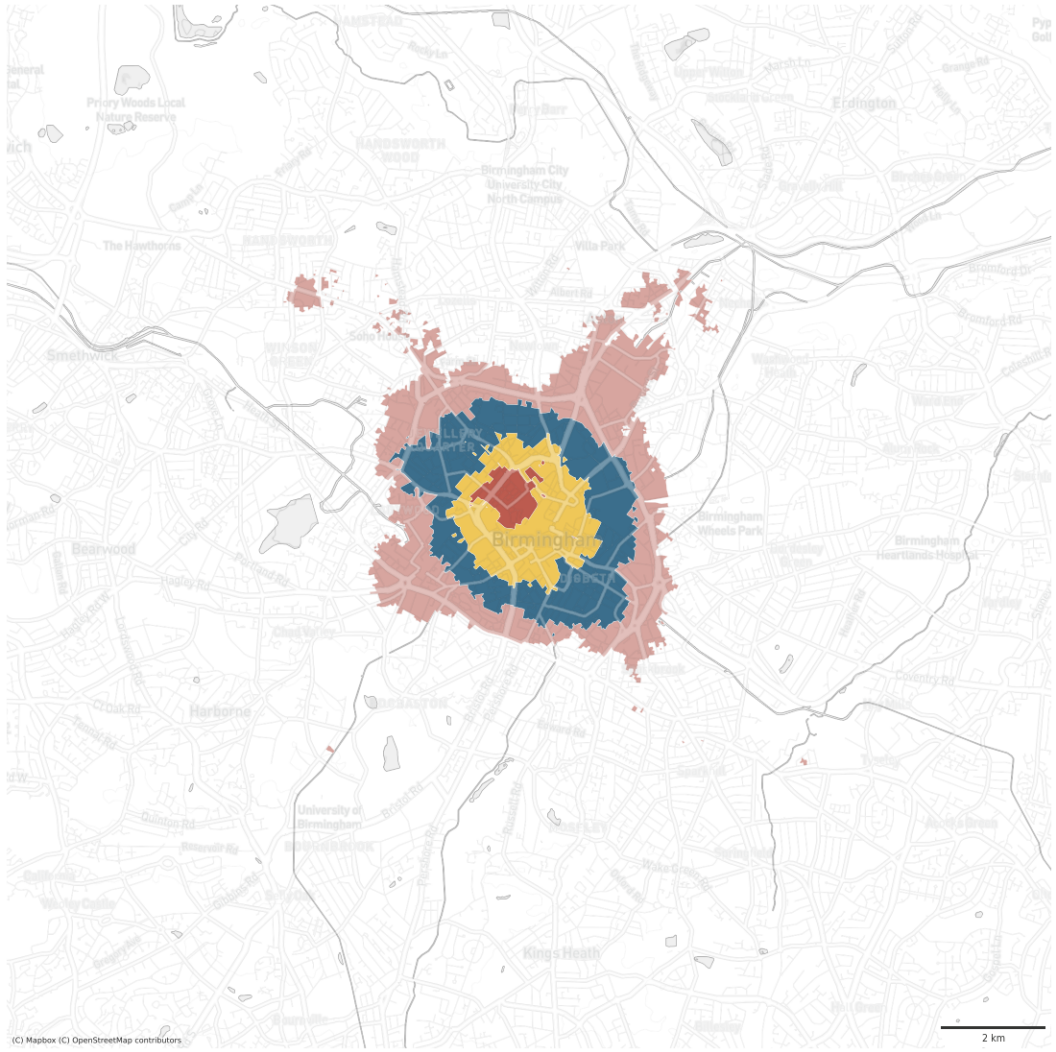

Stanford
Welwyn
Welwyn Garden City
Hertford
Sawbridgeworth
Tring
Hatfield
Harlow
Hemel Hempstead
St Albans
Kings Langley
Chesham
Epping
Chipping Ongar
Ingatestone
Watford
High Barnet
Loughton
Billericay
Brentwood
Chigwell
Romford
Wembley
Ilford
Uxbridge
Slough
Southall
Ealing
Woolwich
Stanford-le-Hope
Windsor
Hounslow
LHR
Bexleyheath
Chadwell St Mary
Grays
Gravesend
Kingston upon Thames
Bromley
Orpington
Croydon
Sutton
Ewell
Epsom
Cobham
Woking
Biggin Hill
Leatherhead
West Malling
Westerham
Sevenoaks
Guildford
Dorking
Reigate
Godalming
Tonbridge
Paddock Wood
Horley
(C) Mapbox (C) OpenStreetMap contributors
25 km

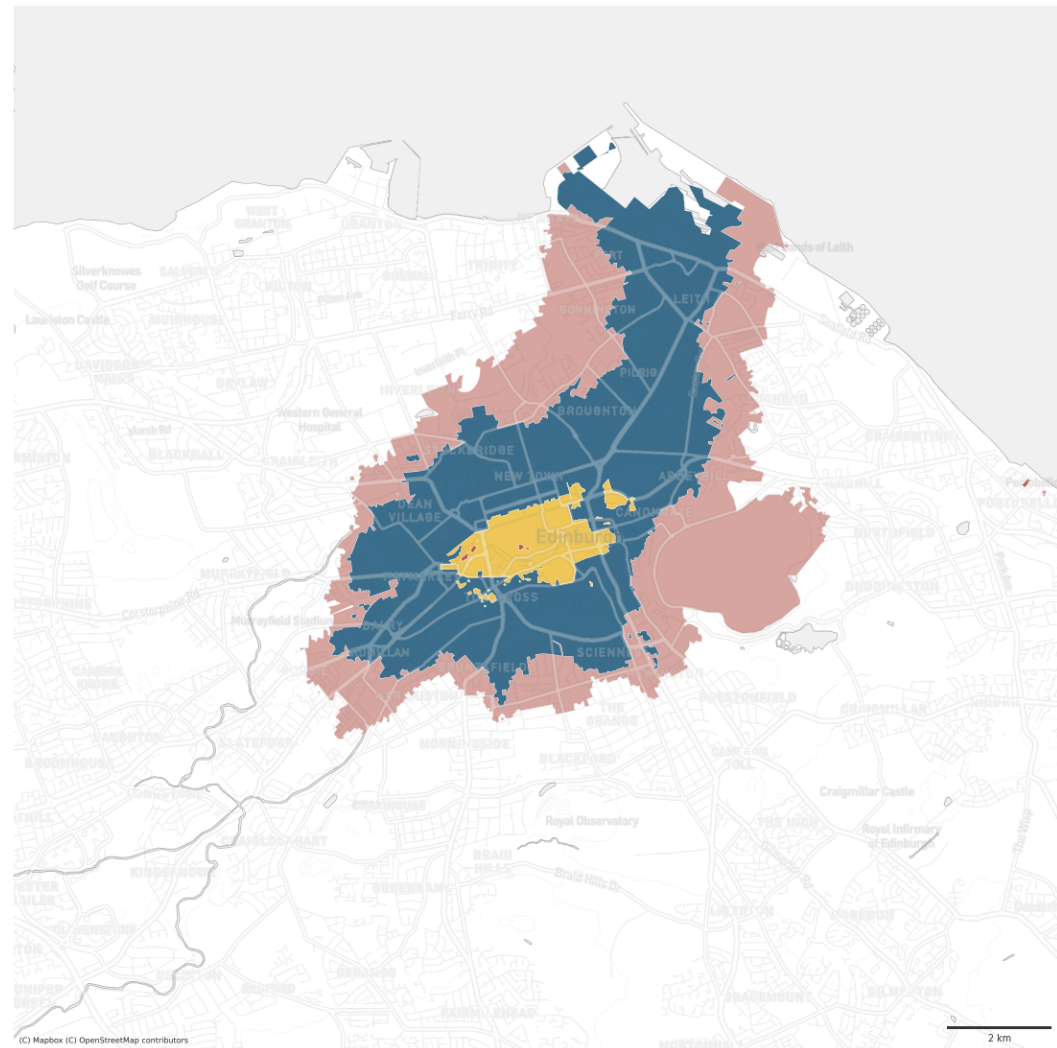
London

Concentric character of British centers and centre hierarchy

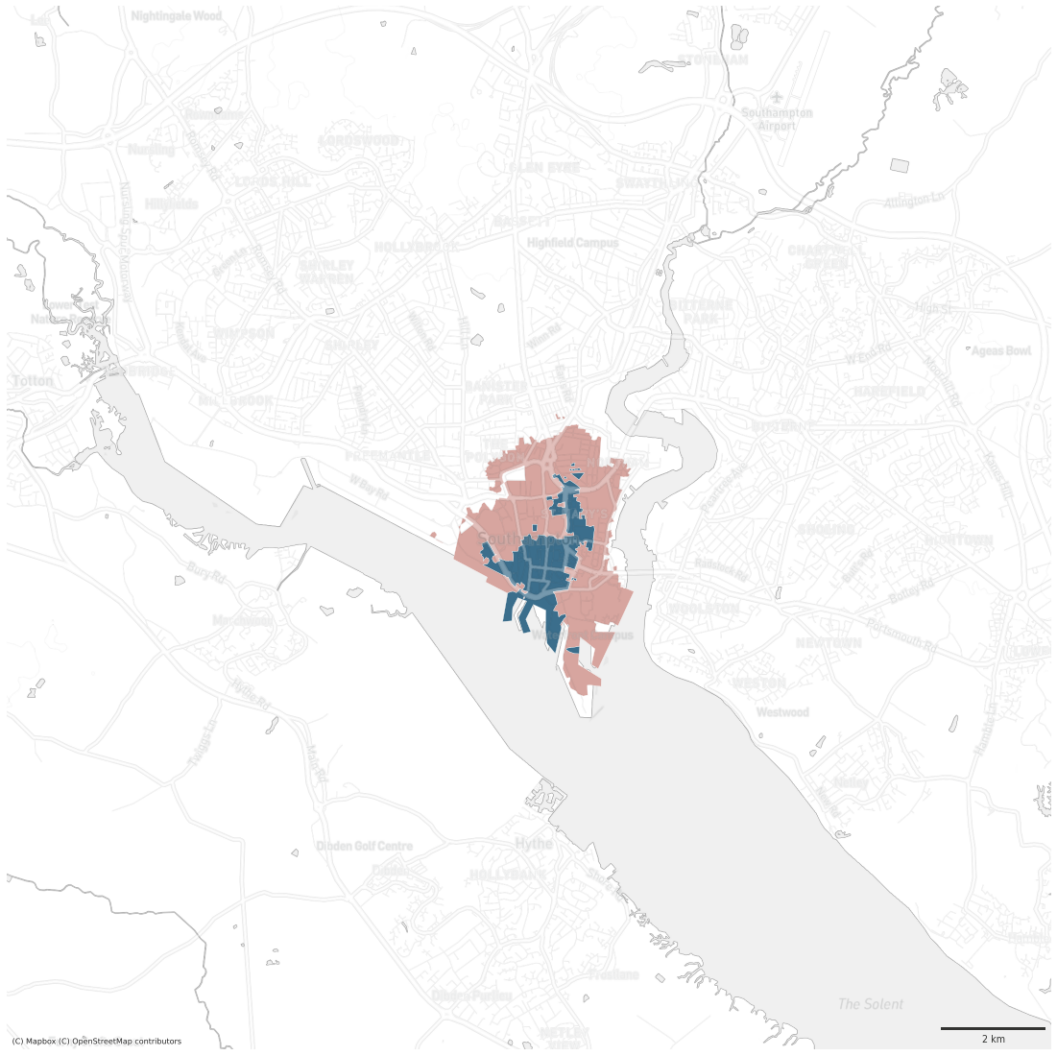

Wembley
Ealing
Richmond Park
Wimbledon
Streatham
Woolwich
Ilford
(C) Mapbox (C) OpenStreetMap contributors
5 km

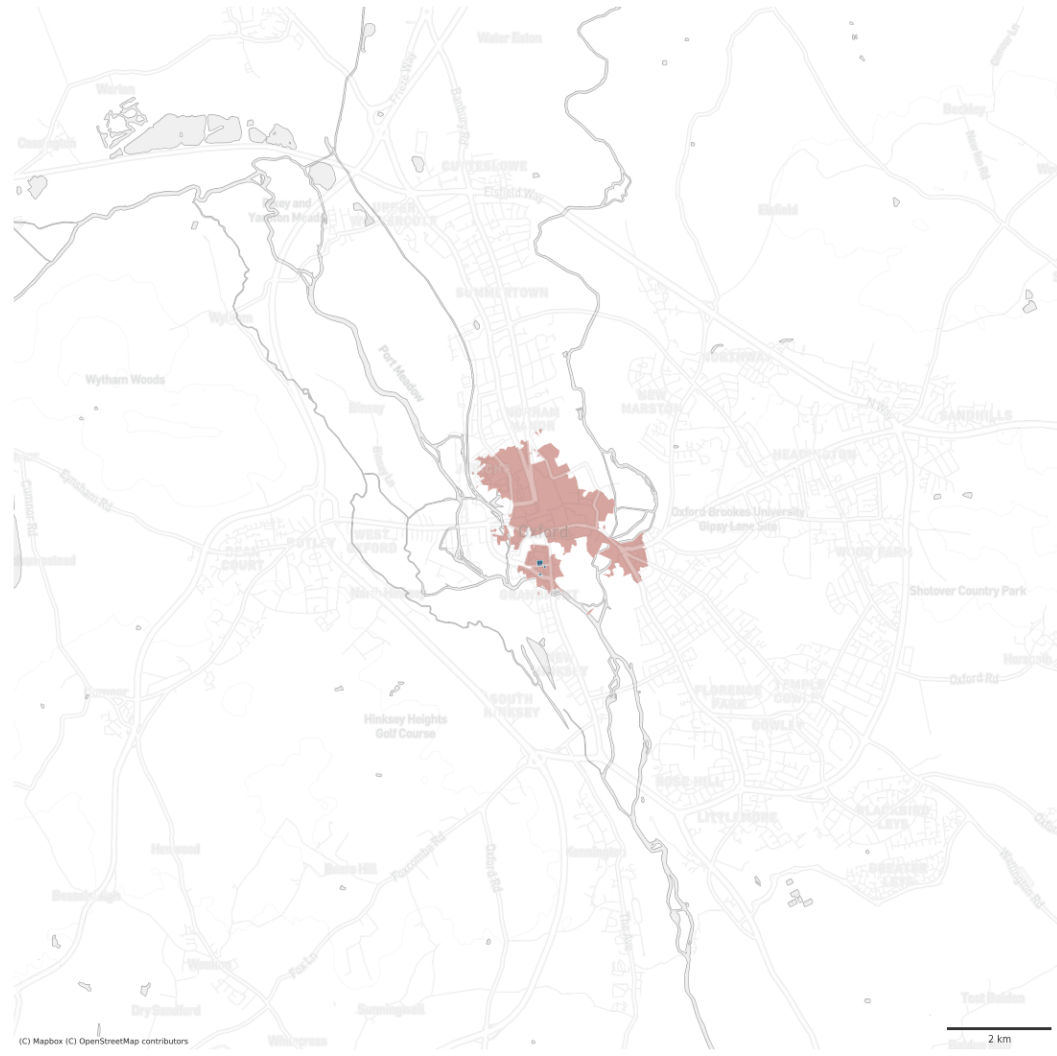
London





Birmingham, Edinburgh

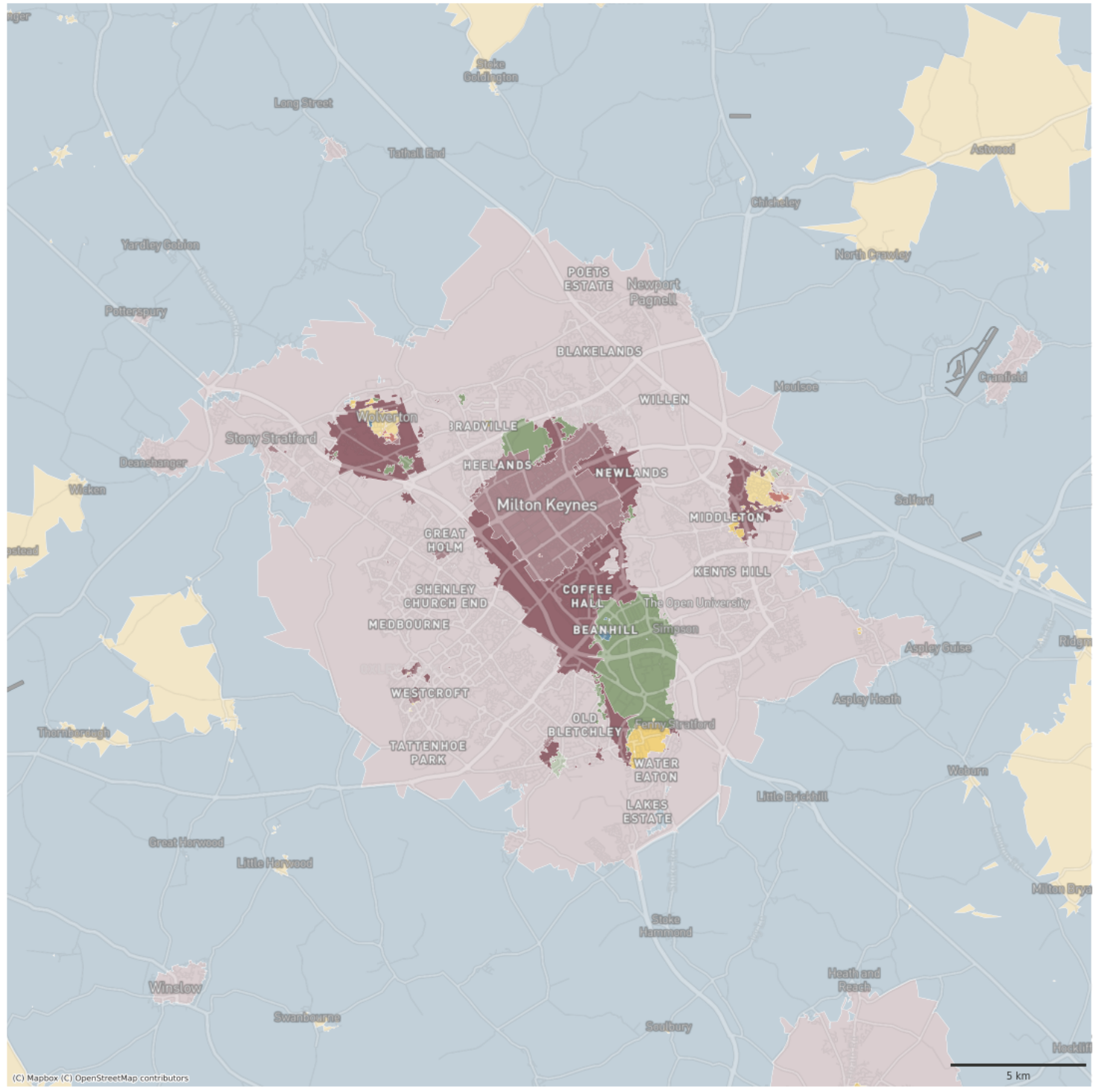




Southampton, Oxford

Milton Keynes

… does not have a (morphological) centre


Stoke Goldington
Long Street
Tathall End
Astwood
Chicheley
Yardley Gobion
North Crawley
POETS ESTATE
Newport Pagnell
Potterspury
BLAKELANDS
Cranfield
Moulsoe
WILLEN
Wolverton
Stony Stratford
RADVILLE
Deanshanger
HEELANDS
NEWLANDS
Wicken
Milton Keynes
Salford
MIDDLETON
GREAT HOLM
KENTS HILL
SHENLEY CHURCH END
COFFEE HALL
The Open University
MEDBOURNE
BEANHILL
Simpson
Aspley Guise
WESTCROFT
Aspley Heath
Thornborough
OLD BLETCHLEY
Fenny Stratford
TATTENHOE PARK
WATER EATON
Woburn
LAKES ESTATE
Little Brickhill
Great Horwood
Little Horwood
Stoke Hammond
Winslow
Heath and Reach
Swanbourne
Soulbury
(C) Mapbox (C) OpenStreetMap contributors
5 km

To take away

1. Urban morphology can be scaled
2. Form component of Spatial Signatures: classification of urban form in detail, at scale
3. Good measurement → better understanding

Classifying urban form at a national scale

The case of Great Britain

Martin Fleischmann [@martinfleis]

Dani Arribas-Bel [@darribas]

UNIVERSITY OF LIVERPOOL

The Alan Turing Institute

Geographic Data Science Lab