

# Urban Grammar

*Developing better characterisations of  
(urban) form and function*

Social Data Science

The Alan Turing Institute

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UNIVERSITY OF  
LIVERPOOL

**The  
Alan Turing  
Institute**



Geographic  
Data Science  
Lab

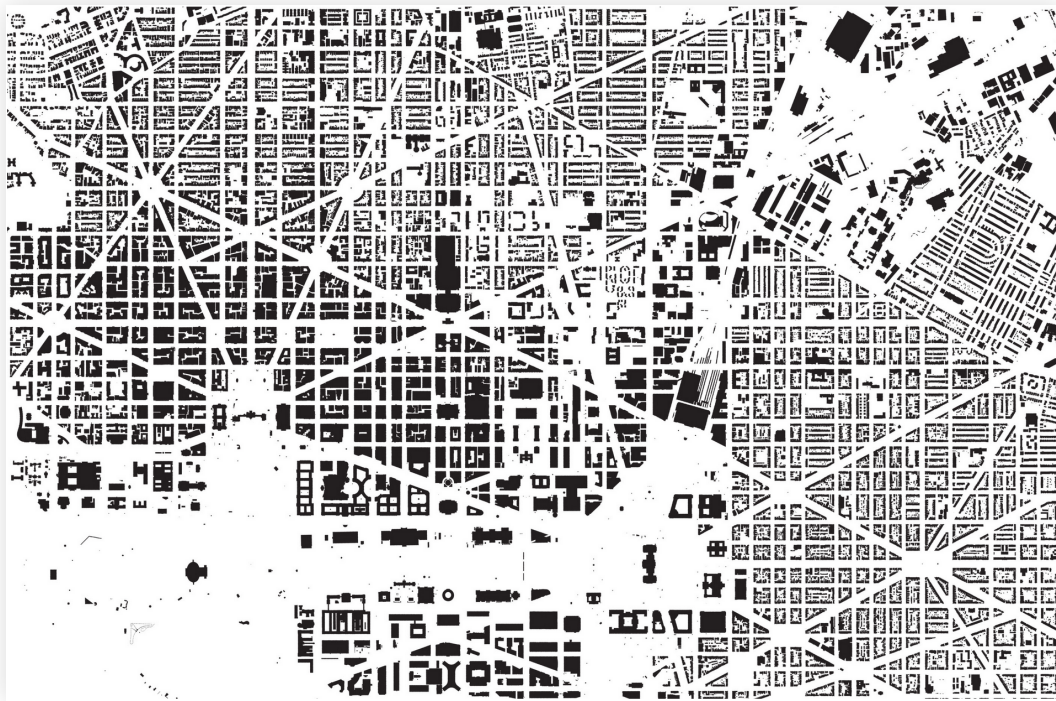
# Today

- *Urban* Form & Function
- Urban Grammar
- A peek into the future



# (Urban) Form & Function

# How we arrange “stuff” in cities matters...



Source: *A map of every building in America* (New York Times)

# Form & Function

## Form

*What does it look like?*

“Physical structure and appearance of cities”

## Function

*What is it used for?*

“Activities that take place within an environment”

# *Why* Form & Function?

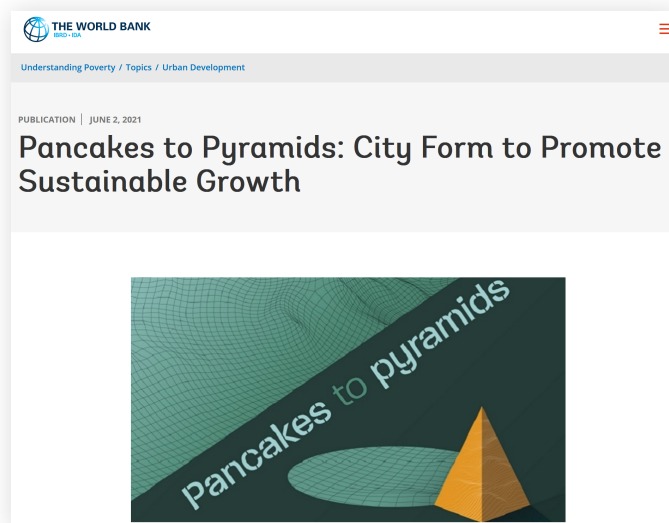
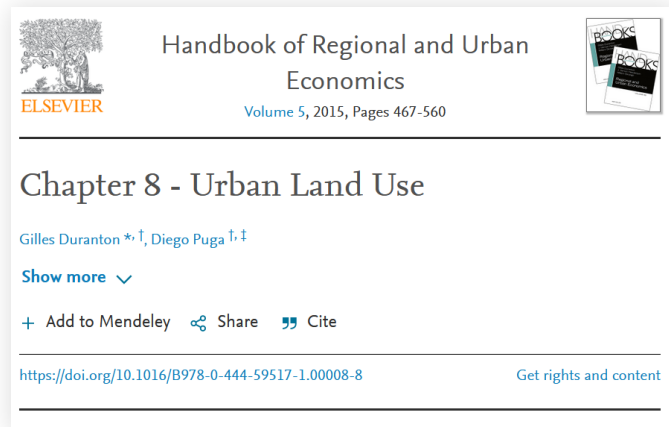
*Encodes* the past

- Geography
- History
- Technology
- ...

*Frames* the future

- Productivity
- Sustainability
- Quality of Life
- ...

# F&F in Social Science/Policy



# F&F in Social Science

**Critical** to understand:

- Agglomeration economies
- Neighborhood effects
- Environmental sustainability
- ...

**But** often:

- Coarse
- Aggregate
- Ad-hoc
- ...



# Detail matters...

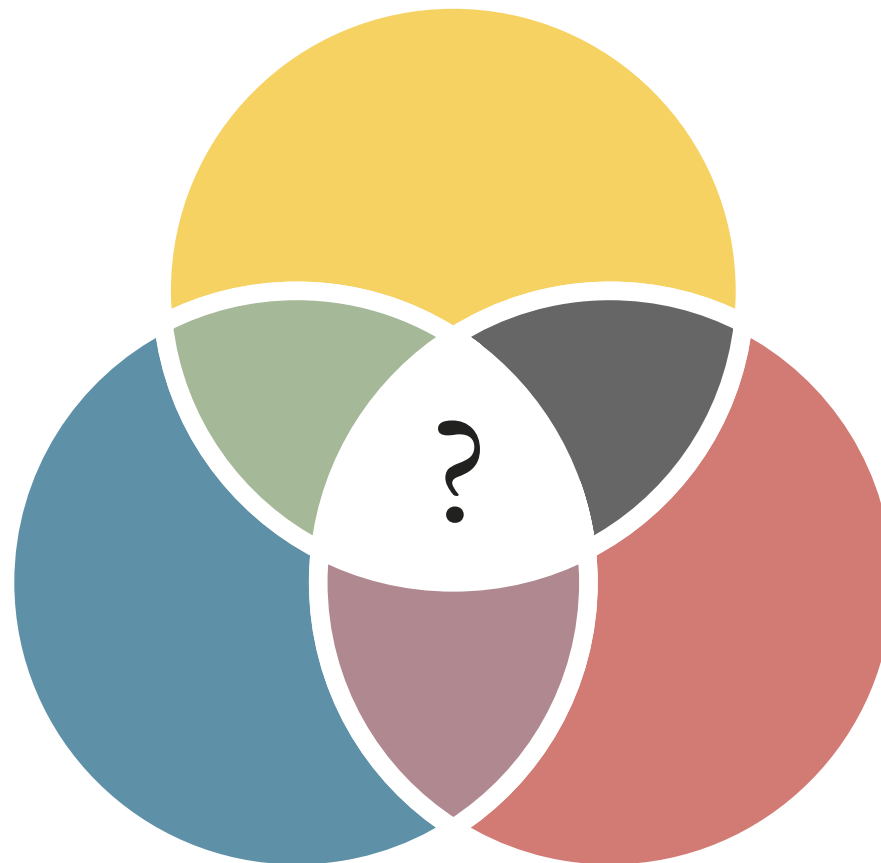


Source: *Six 15-minute walks capture the diversity, history of Houston neighborhoods* ([Urban Edge](#))

detailed

scalable

consistent





# Urban Grammar

# The Alan Turing Institute



☰ Menu

Home + Research + Research projects

## Urban Grammar

Learning an urban grammar from satellite data through AI

Learn more ↓

Project status  
Ongoing

Related  
programmes

Urban analytics



*Characterisations of space based on form and function  
designed to understand urban environments*

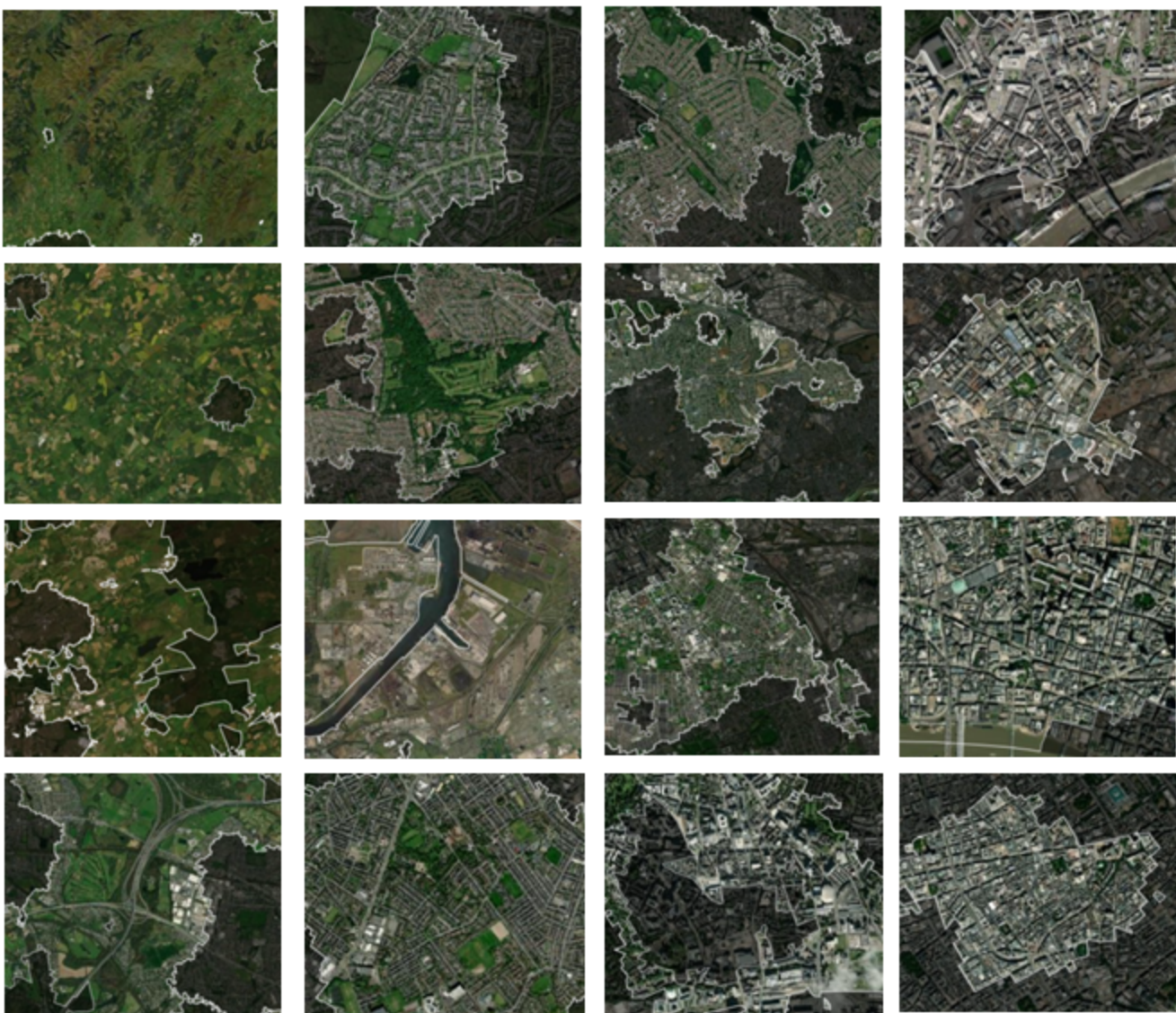
*Characterisations of space based on form and function  
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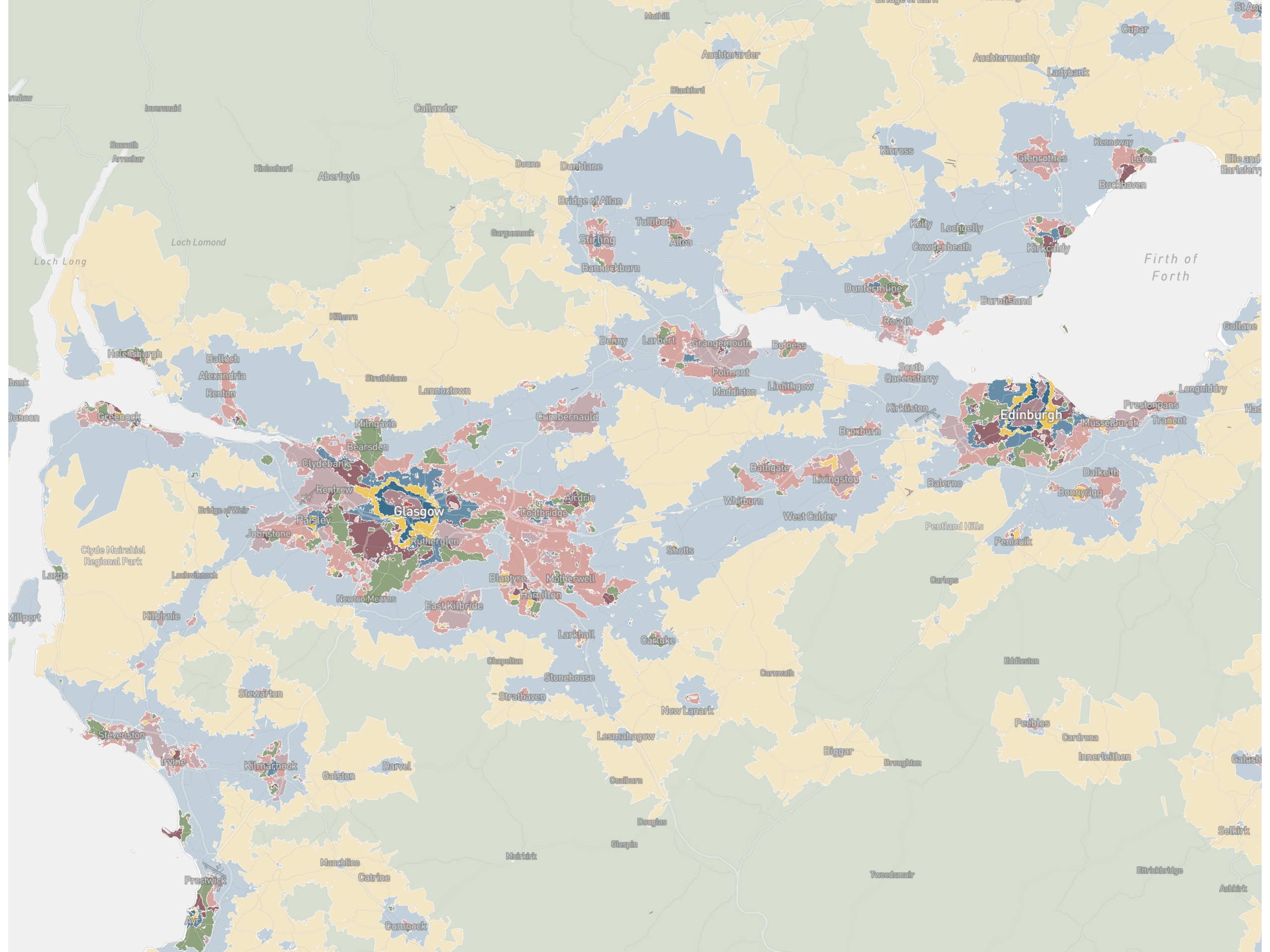
# British Signatures

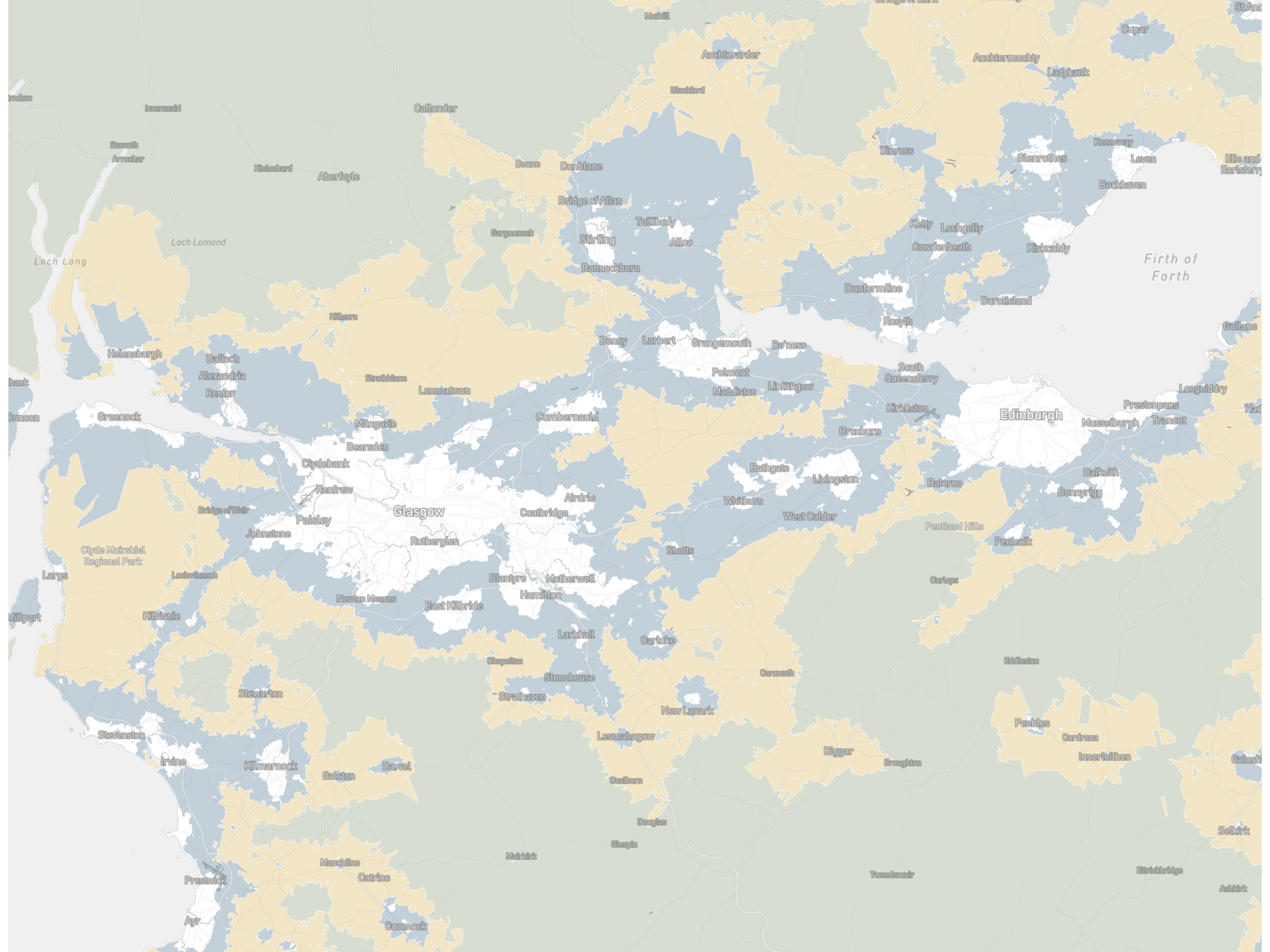




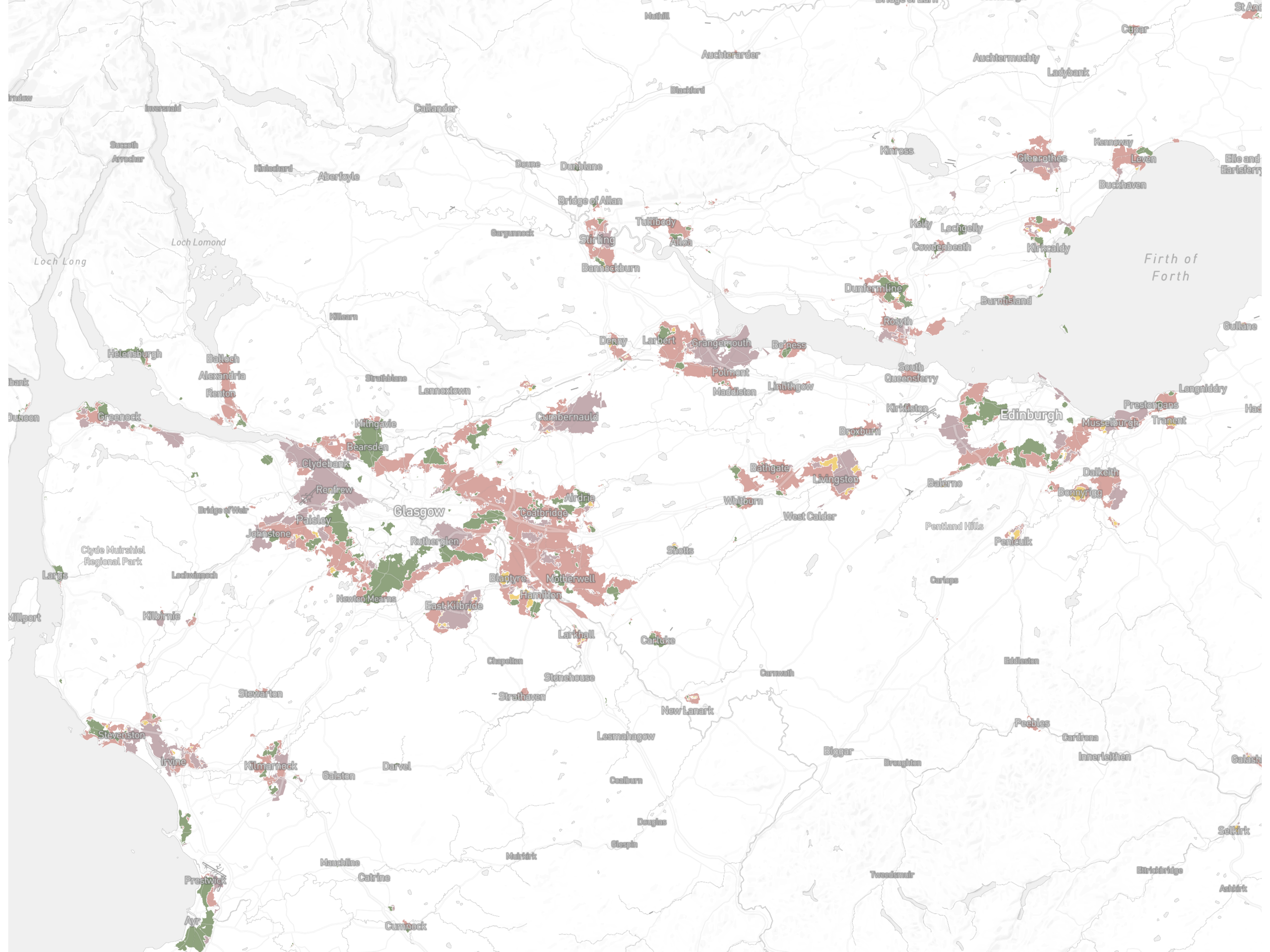
<https://urbangrammarai.xyz/story>

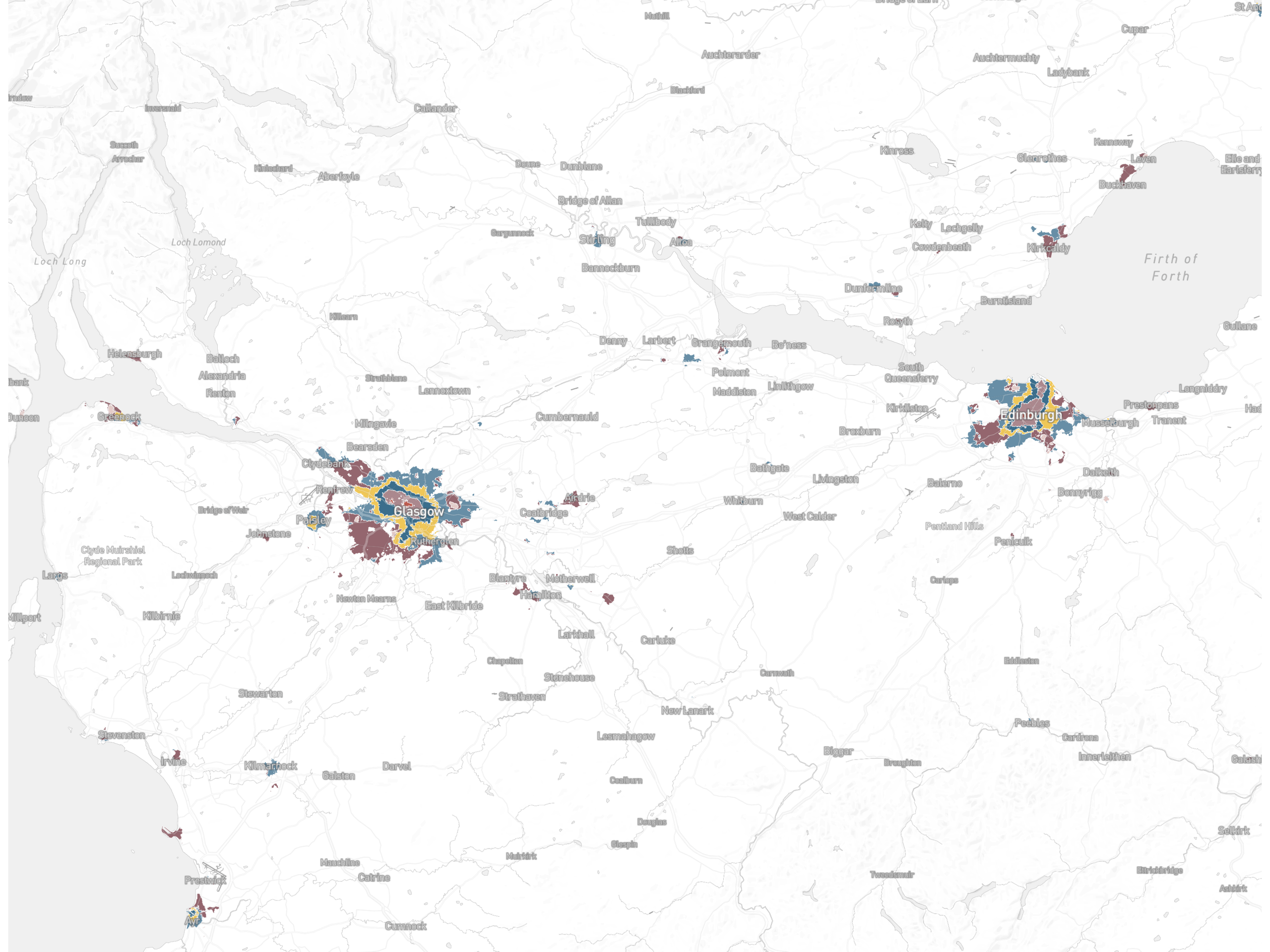




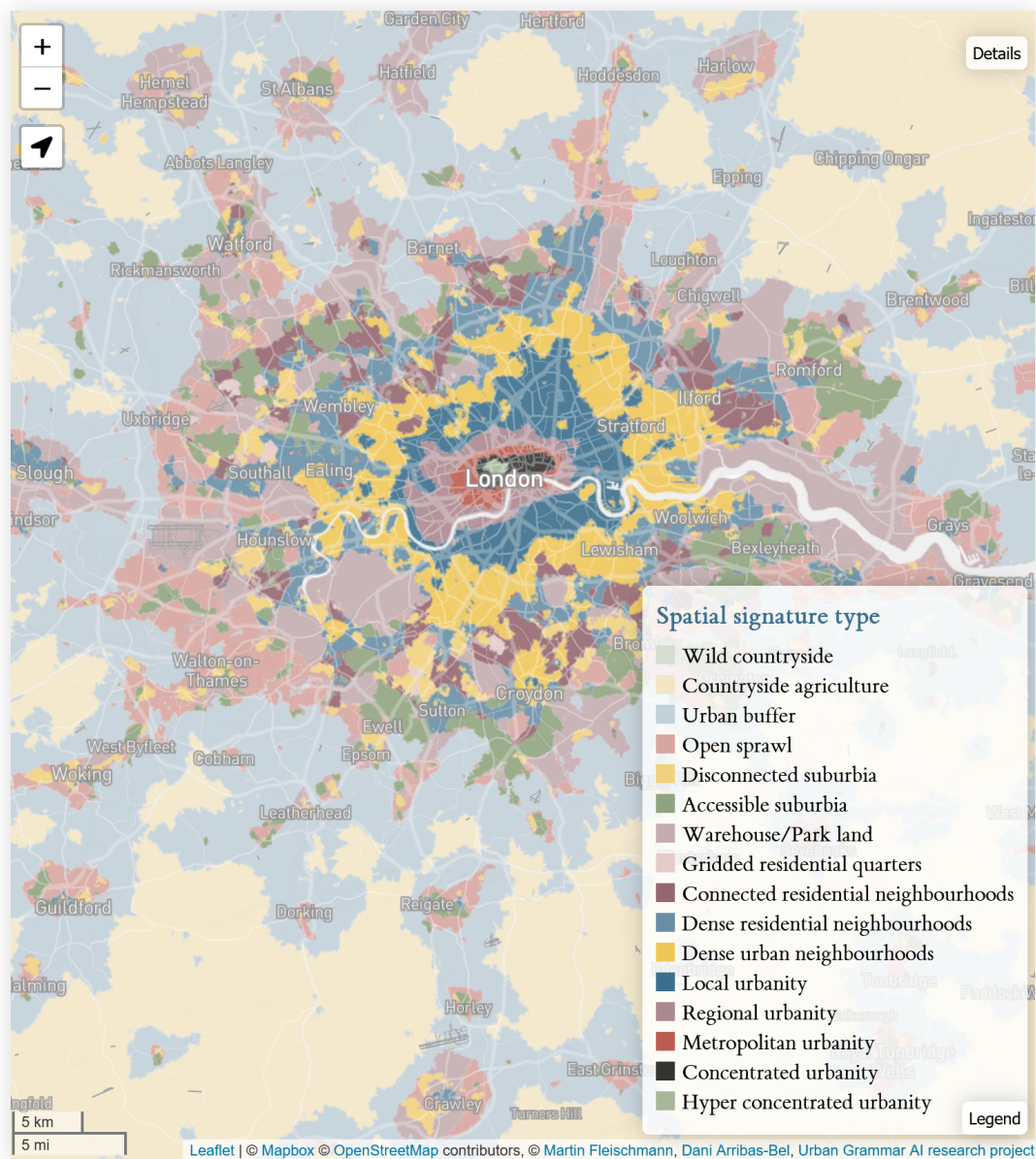












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Home » Datasets » Spatial Signatures of Great Britain

## Spatial Signatures of Great Britain

Population & Mobility
Transport & Movement

### Geographical Characterisation of British Urban Form and Function using the Spatial Signatures Framework

Spatial signatures characterise space based on form and function in a way designed to understand urban environments. This data product, part of the Urban Grammar project, contains a typology of spatial signatures in Great Britain. Each type has a distinct character capturing what the place looks like (form) and how it is used (function).

The data product contains bespoke Signature geometry with signature type, summary of input variables per each geometry and per each type, interpolation of signature types to OA and LSOA geometry and short pen portraits for the typology, shorthand descriptions of the characteristics of each signature type.

The interactive map showing the typology is available at <https://urbangrammarai.xyz/great-britain/>. More details about the project can be found at the project website <https://urbangrammarai.xyz>.

#### Data Extent

#### License

UK Open Government Licence (OGL)

Habitat International  
Volume 128, October 2022, 102641

## Spatial Signatures - Understanding (urban) spaces through form and function

Daniel Arribas-Bel <sup>a,\*, 1</sup>, Martin Fleischmann <sup>a, 2</sup>

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## Geographical characterisation of British urban form and function using the spatial signatures framework

[Martin Fleischmann](#) & [Daniel Arribas-Bel](#)

*Scientific Data* **9**, Article number: 546 (2022) | [Cite this article](#)

**1184** Accesses | **20** Altmetric | [Metrics](#)



# Sub-classifications

XXVIII International Seminar on Urban Form  
ISUF2021: URBAN FORM AND THE SUSTAINABLE AND PROSPEROUS CITIES  
29<sup>th</sup> June – 3<sup>rd</sup> July 2021, Glasgow

## Classifying urban form at national scale: The British morphosignatures

Dr Martin Fleischmann<sup>1</sup>, Dr Daniel Arribas-Bel<sup>1</sup>

<sup>1</sup> Geographic Data Science Lab, Department of Geography and Planning, University of Liverpool, UK



Data in Brief  
Volume 43, August 2022, 108335



Data Article

## Functional signatures in Great Britain: A dataset

Krasen Samardzhiev <sup>a</sup> , Martin Fleischmann <sup>a</sup> , Daniel Arribas-Bel <sup>a, b</sup> , Alessia Calafiore <sup>a</sup> ,  
Francisco Rowe <sup>a</sup>

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<https://doi.org/10.1016/j.dib.2022.108335>

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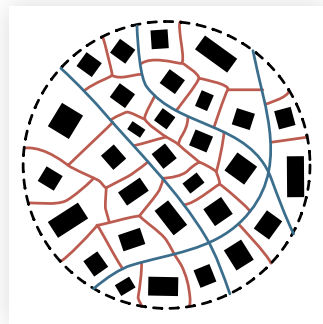
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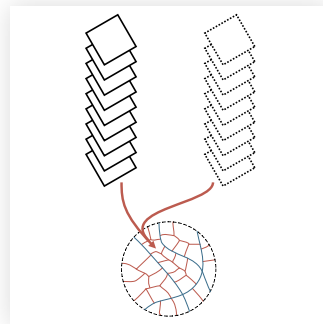
# Building *Spatial Signatures*

[STAGE] Delimiters Enclosure Anchors Encl. Tess. Characters Clusters Signatures

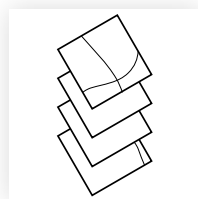
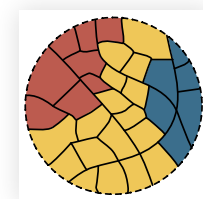
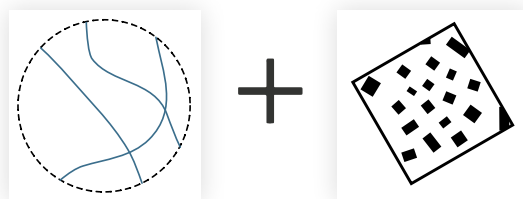
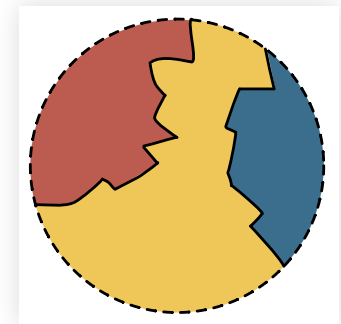
Enclosed  
Tessellation



Embedding  
*form & function*

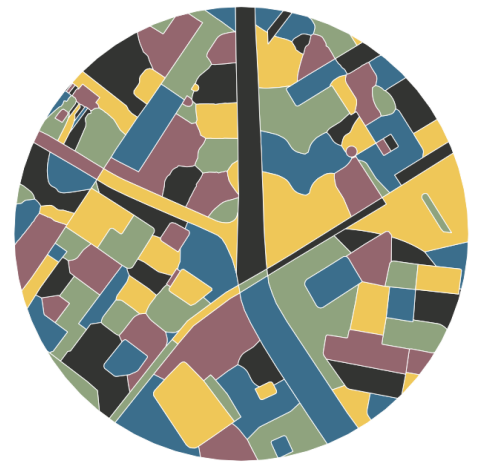
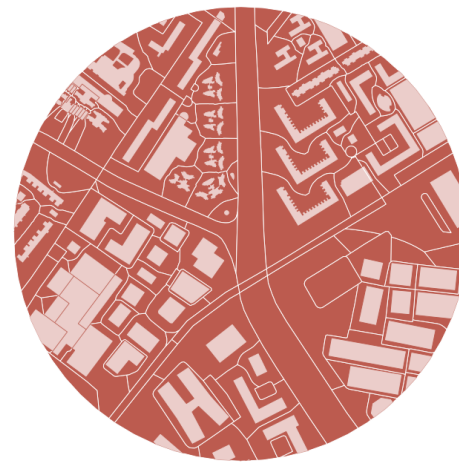


Spatial  
Signatures



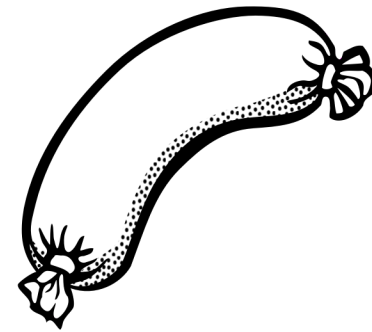
# Meaningful spatial units

Enclosed tessellation





# *“Open by default”*



- Data, data, data
- Methods, code
- Infrastructure

- Dissemination
- Open Data Products
- 

Journaling/reporting

<https://urbangrammarai.xyz>

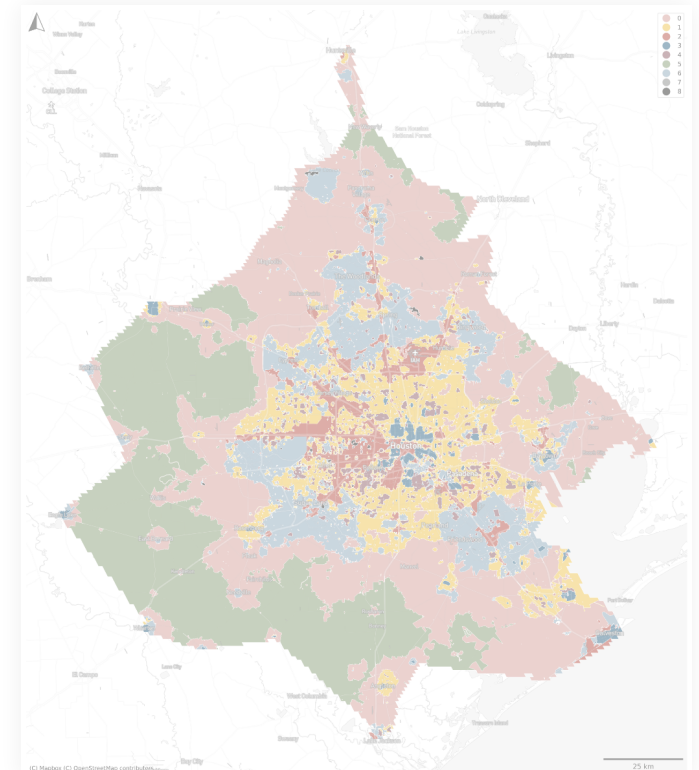
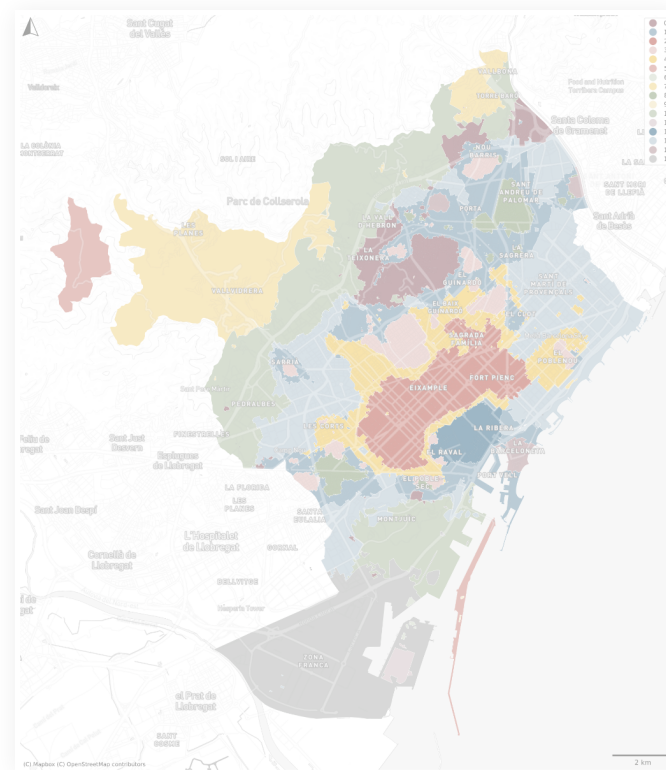
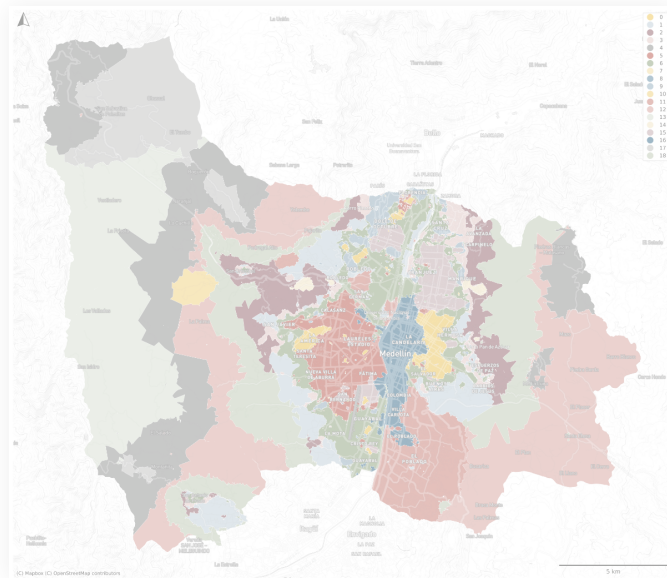
# Lessons

# *Encoding*

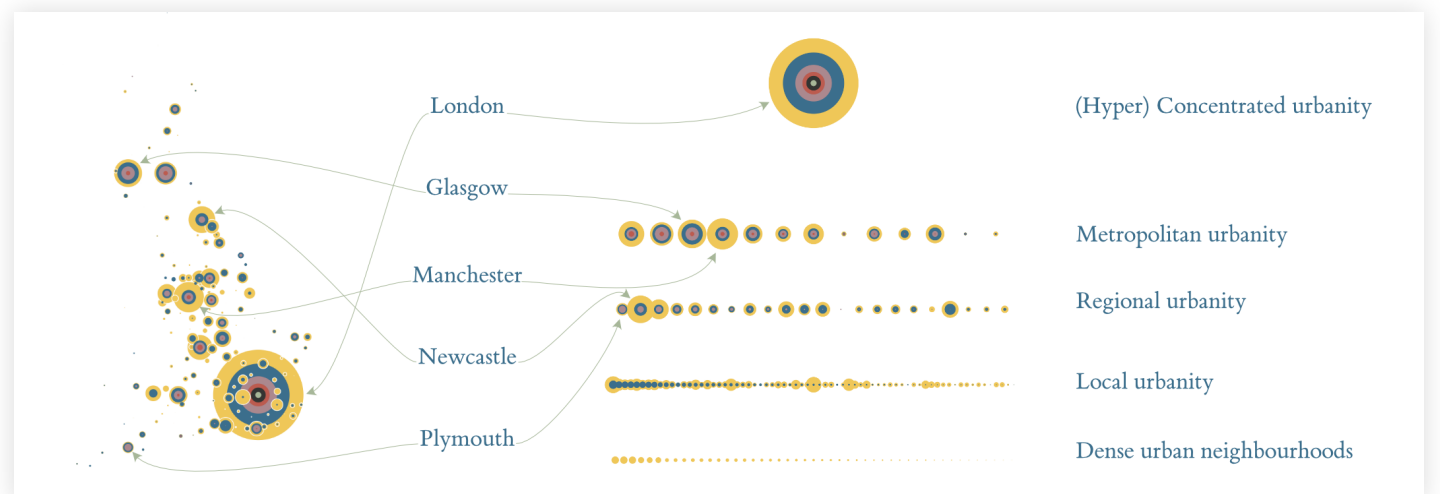
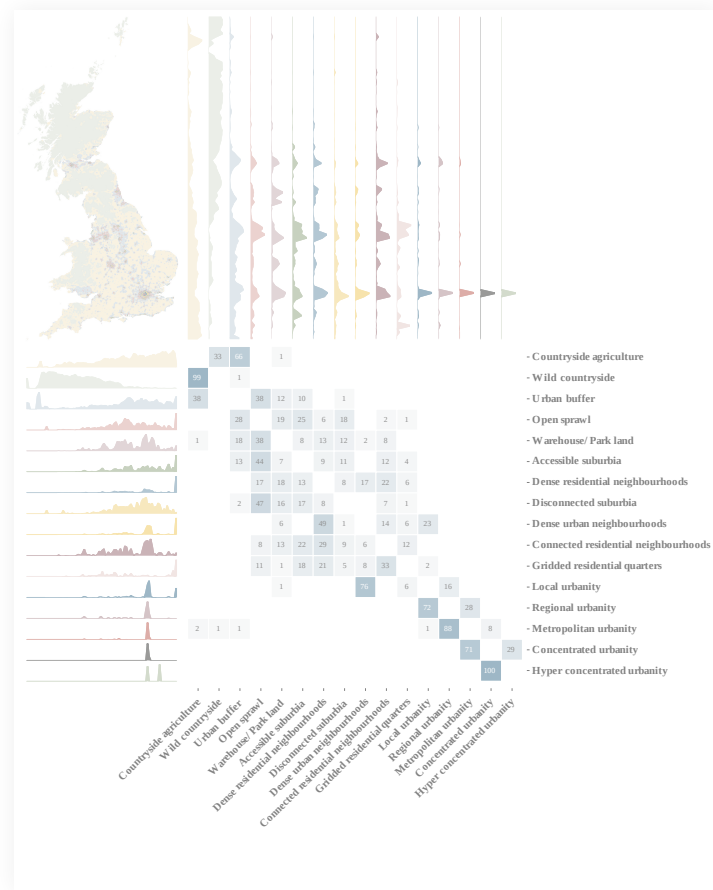
Geography

History

Technology



# Hierarchy

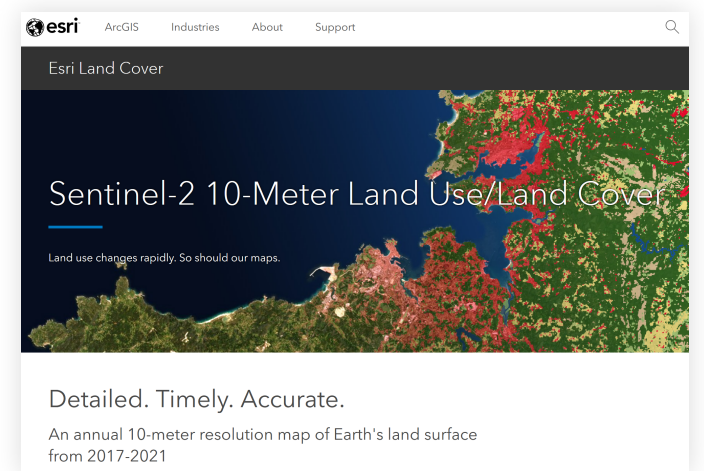
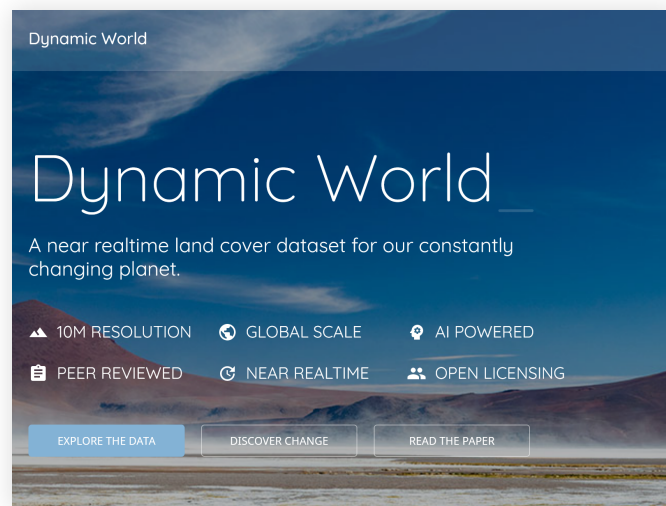
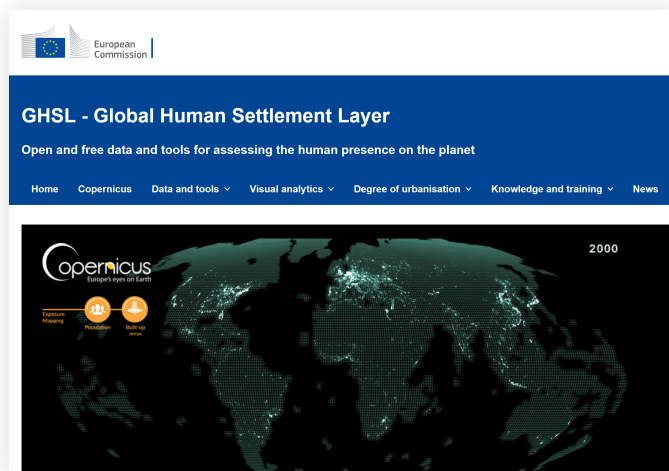
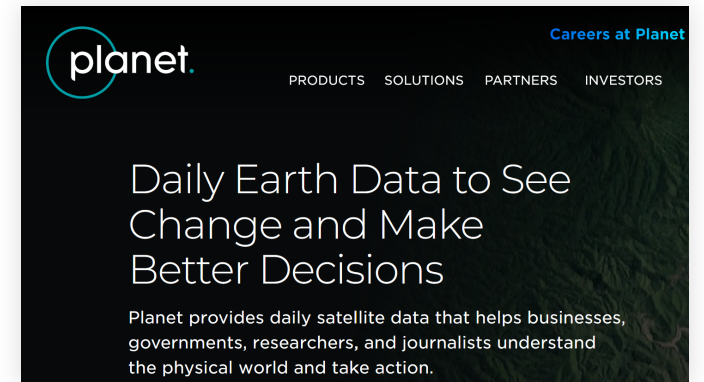
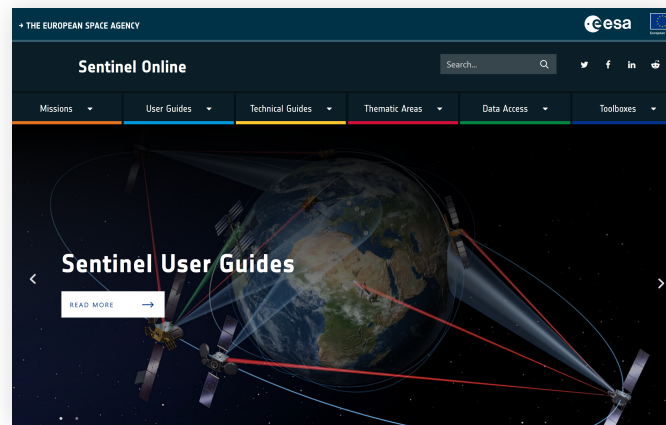
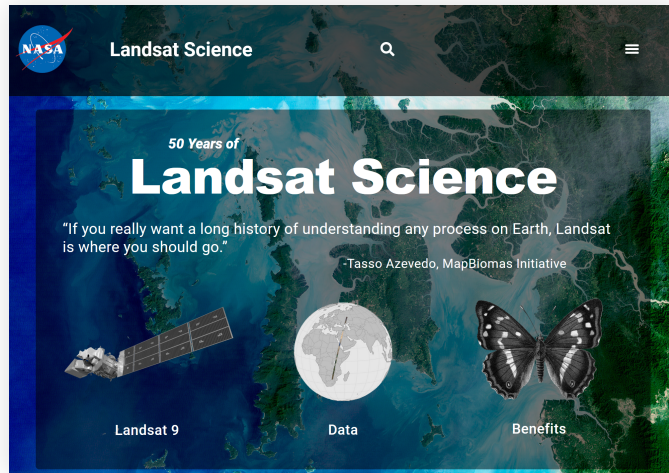


*Framing?*

A peek into the future

+

+





*Two examples on Form & Function...*



## Satellite Classification of GB Postcode Context

A map supporting the output of this paper:  
Singleton, A., Arribas-Bel, D., Murray, J., & Fleischmann, M. (2022). Estimating generalized measures of local neighbourhood context from multispectral satellite images using a convolutional neural network. Computers, Environment and Urban Systems, 95, 101802. <https://doi.org/10.1016/j.compenvurbsys.2022.101802>

Stirling

### Legend

- Postcode
- Group
- A: Inner City and Town Centres
  - B: Spacious Residential Properties
  - C: High Density Urban Core
  - D: Rural Residences
  - E: Rural Properties and Farms
  - F: Inner Suburban Townhouses and Large Terraces
  - G: Outer Suburbs



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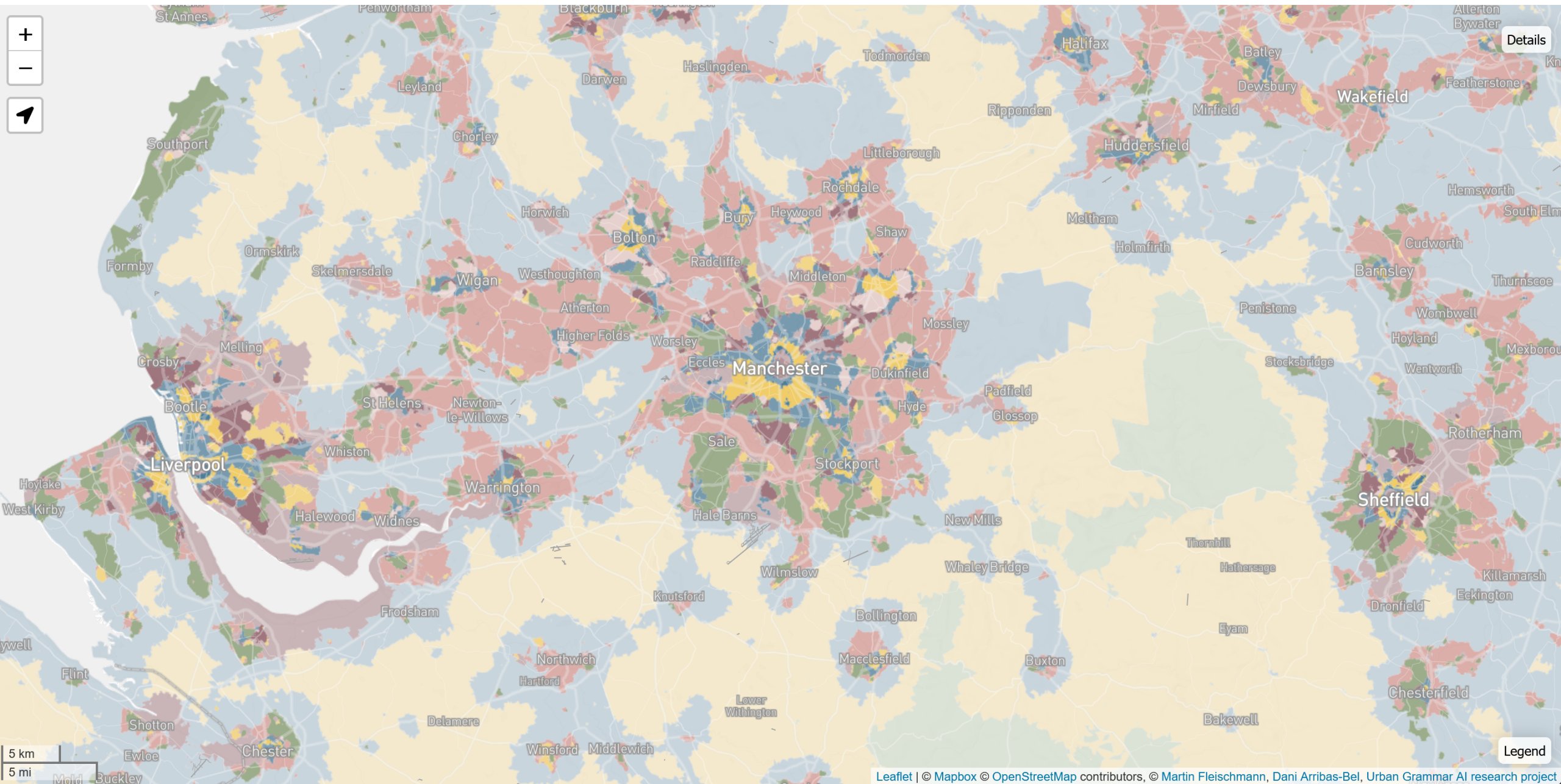
Docs



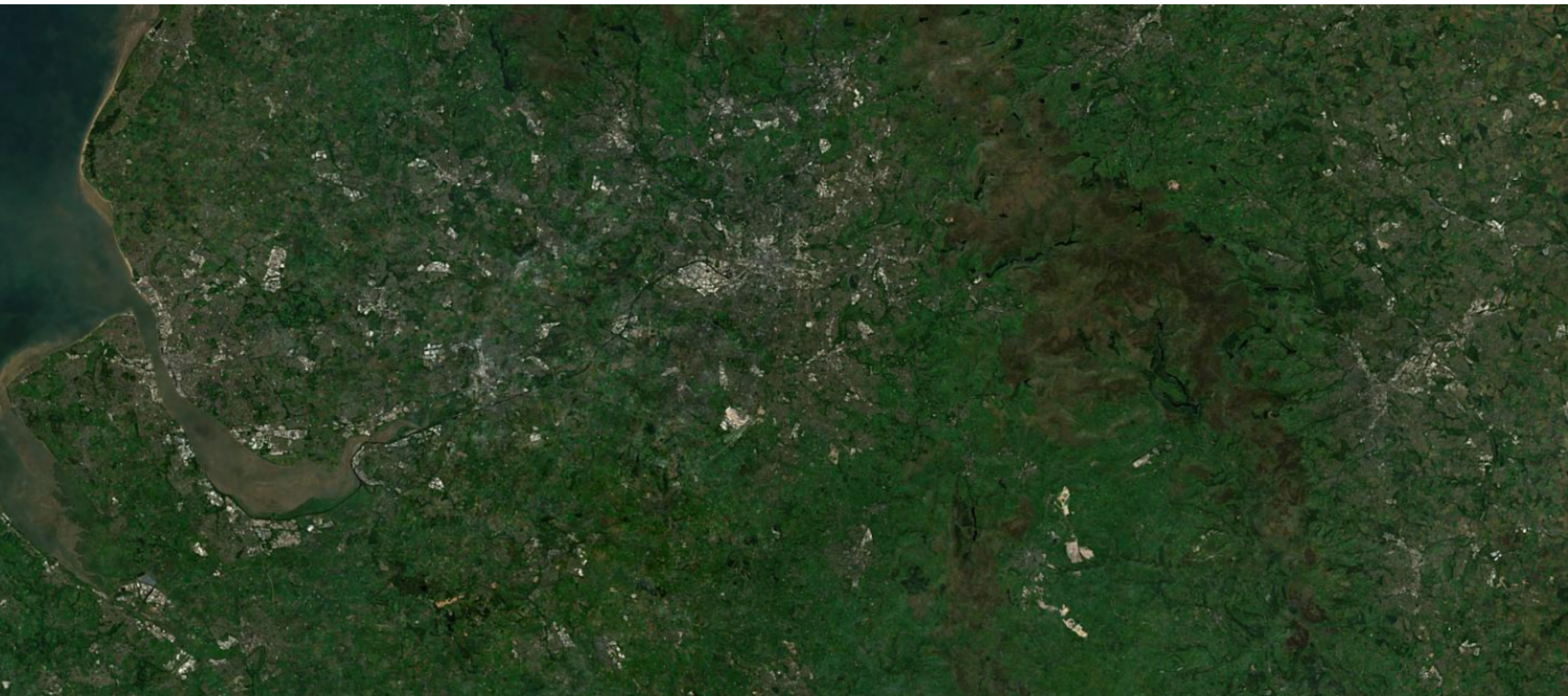
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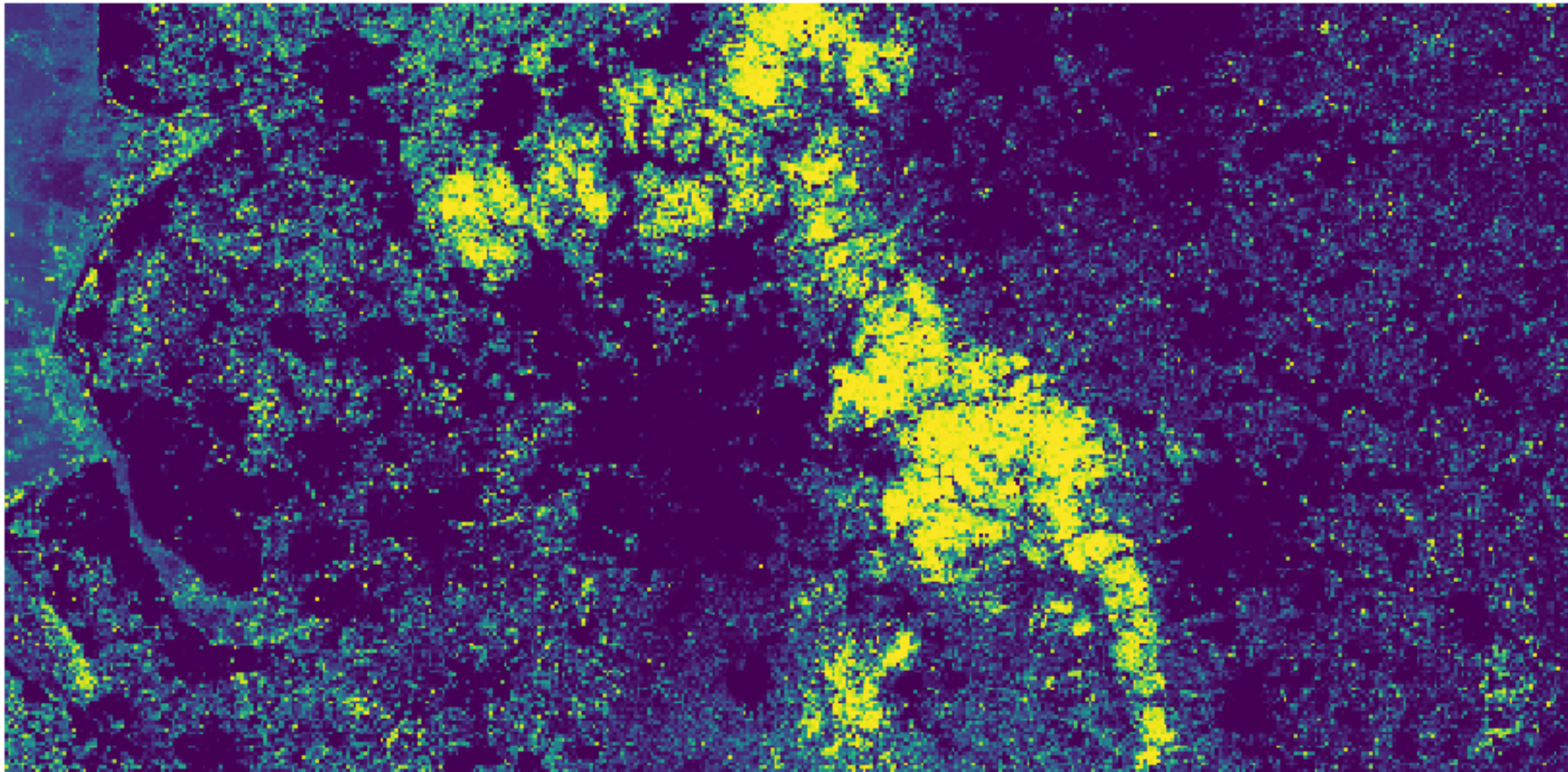




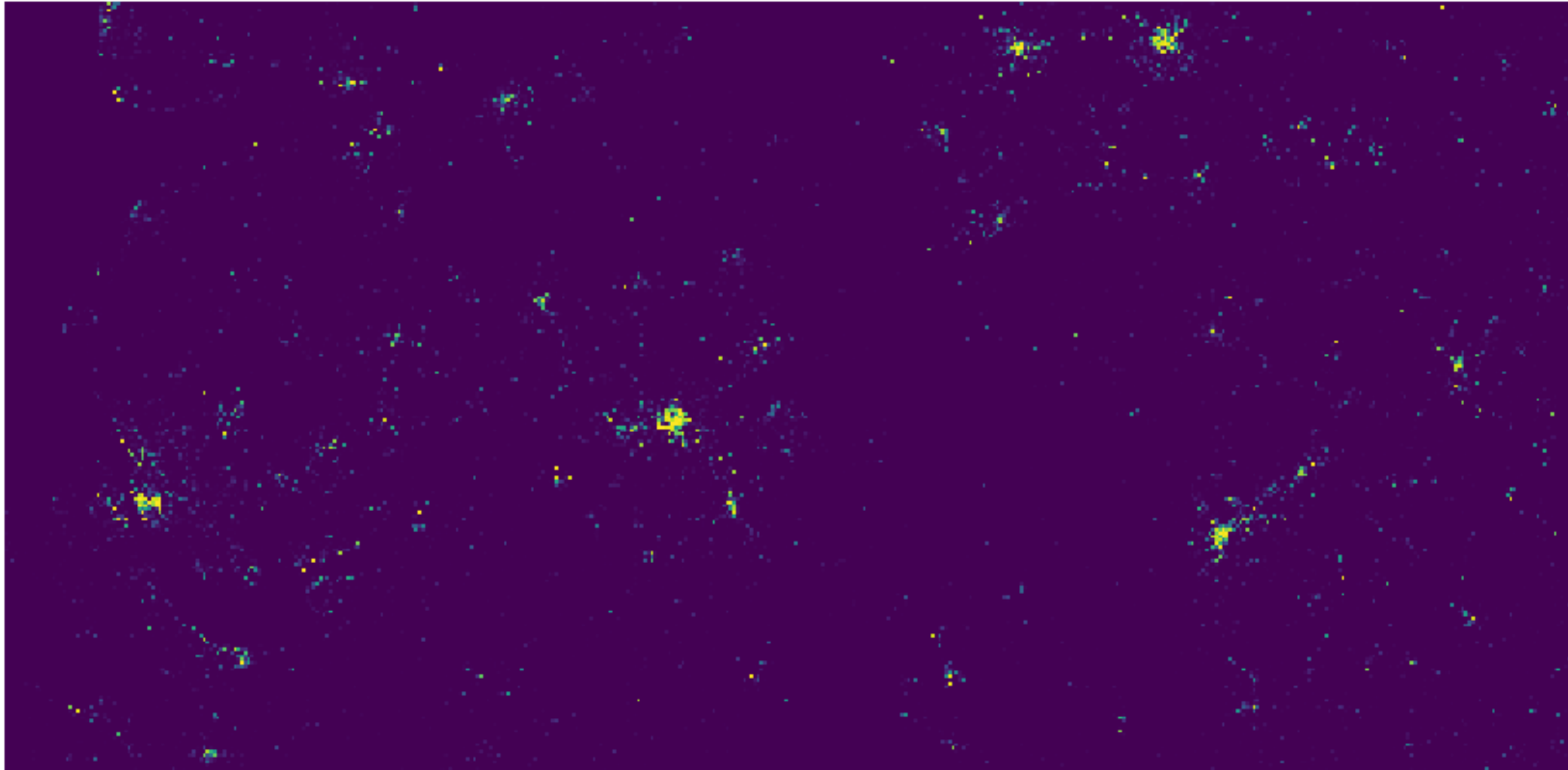


Source: Sentinel-2 cloudless



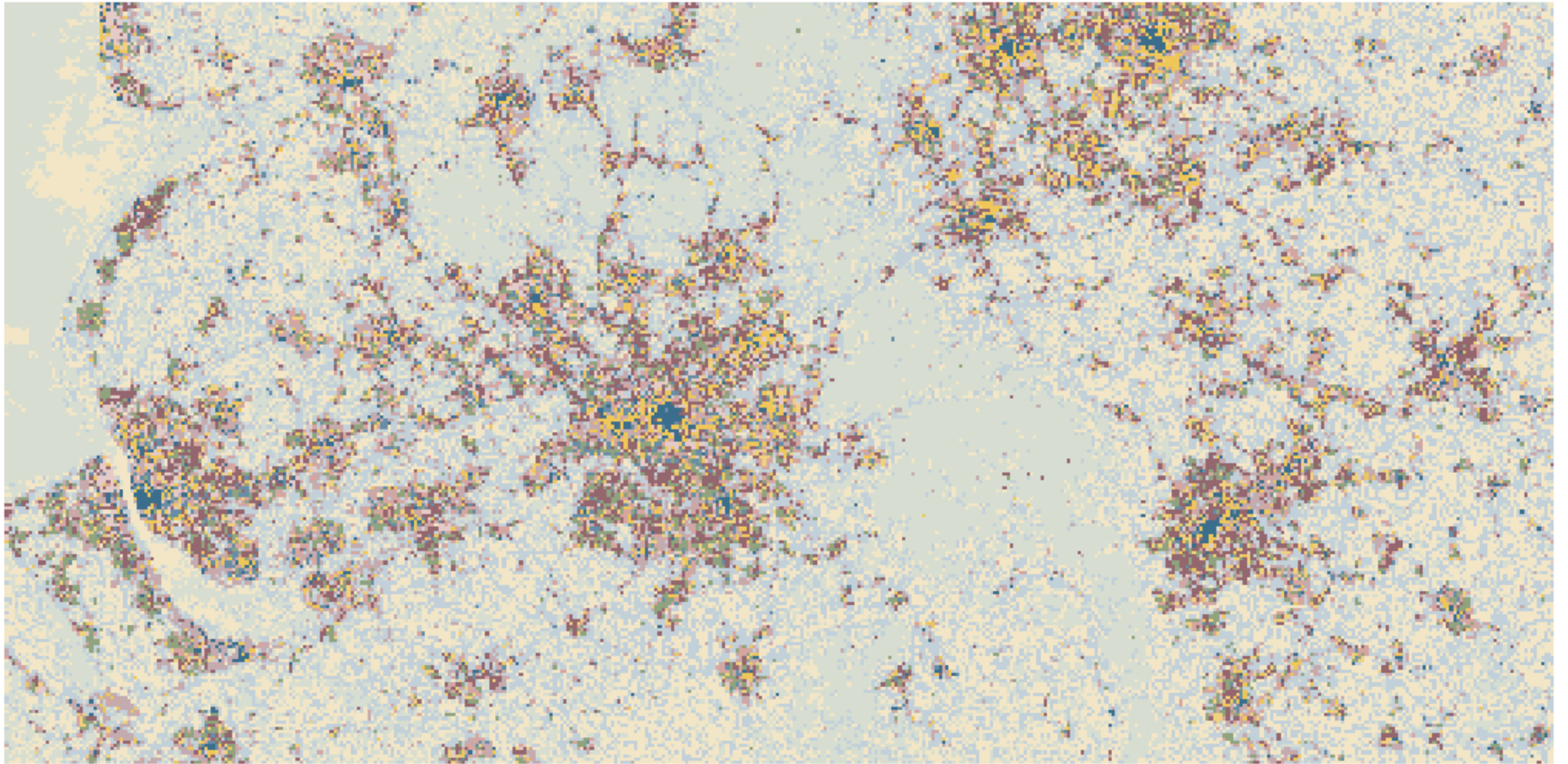


Wild countryside (320x320m)



Urbanity (320x320m)





Predicted class (320x320m)

# The Future

- *Are we there yet?* Certainly not
- *Can we even get there?* Maybe
- *Worth trying?* Absolutely!

# Wrap up

(Urban) form & function...

- underpin many social processes
- are becoming easier to measure better
- You should use them more in your work!

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