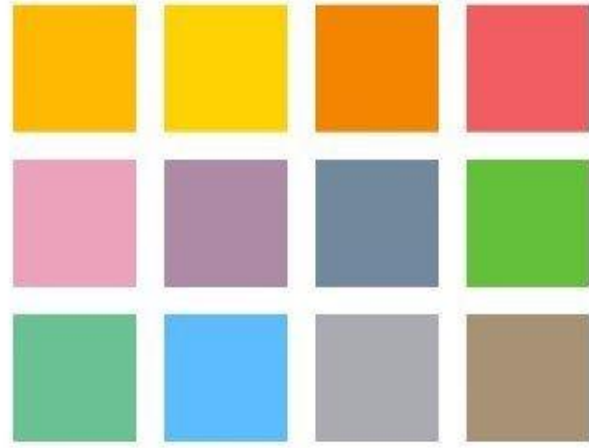




COLOURING CITIES

RESEARCH
PROGRAMME

Polly Hudson (University of Cambridge) & Robert Hecht (IOER, Dresden)

On behalf of the **Colouring Cities Research Programme**

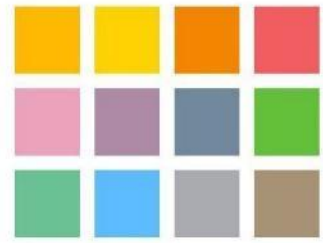
ISCN Presentation

10.6.2026

<https://colouringbritain.org/>

<https://colouring.dresden.ioer.de/>

<https://colouringcities.org/>

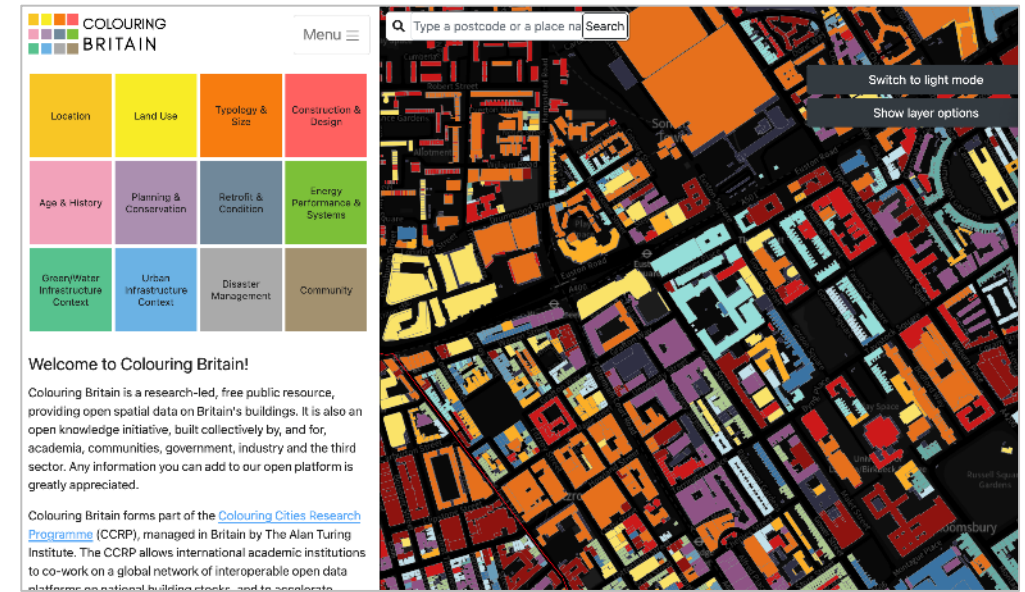


COLOURING
CITIES RESEARCH
PROGRAMME

OVERVIEW

The Colouring Cities Research Programme (CCRP)

- Interoperable decentralised open spatial data platform network
- Academia-led, decentralised, non-competitive, informal
- 20+ national partners following common protocols
- Provides research-ready microspatial data on built and green infrastructure
- Multi-modal data capture methods, cross-sector
- Mainly pools existing funded research for international co- working on common code/applications
- Initiated 2014 UCL/Alan Turing Institute, from 2020 co-built across countries



- To accelerate SDG place based problem-solving
e.g planning, energy, climate change, health, economic vitality, biodiversity
- To increase access to, standardisation & trustworthiness of open microspatial data on built & natural environment
- To address national data fragmentation/data quality for/with all sectors
- To reduce costs of, duplication of research through cross country working on common platform code and applications
- To highlight privacy and security issues of spatial data release



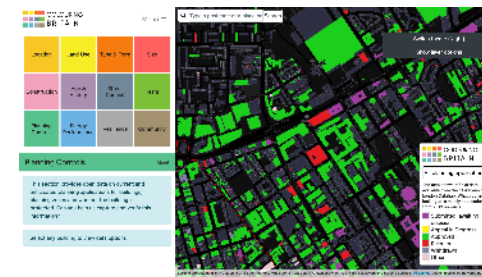
- Building/feature level spatial data
- 12 main data categories, 150+ nested classes
- Capture, collation, visualisation, verification, release)
- Characteristics, Performance, & History/dynamic behaviour (short & long-term)
- Statistical data - no free text
- Focus on data quality, reliability, updatability & completeness prioritised
- Increased work on natural environment & agriculture



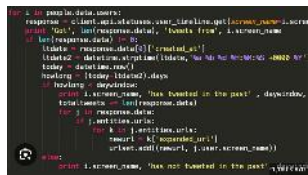
4 main methods used:

1. Open existing bulk uploads – moderated
2. Computational inference - large-scale drafts
3. Live streaming of official datasets into footprints
4. Crowdsourced corrections, enrichment, training data (building level)

1-3 moderated by academia)



NATIONAL ACADEMIC PARTNER



CCRP CODE ON GITHUB +
PROTOCOLS

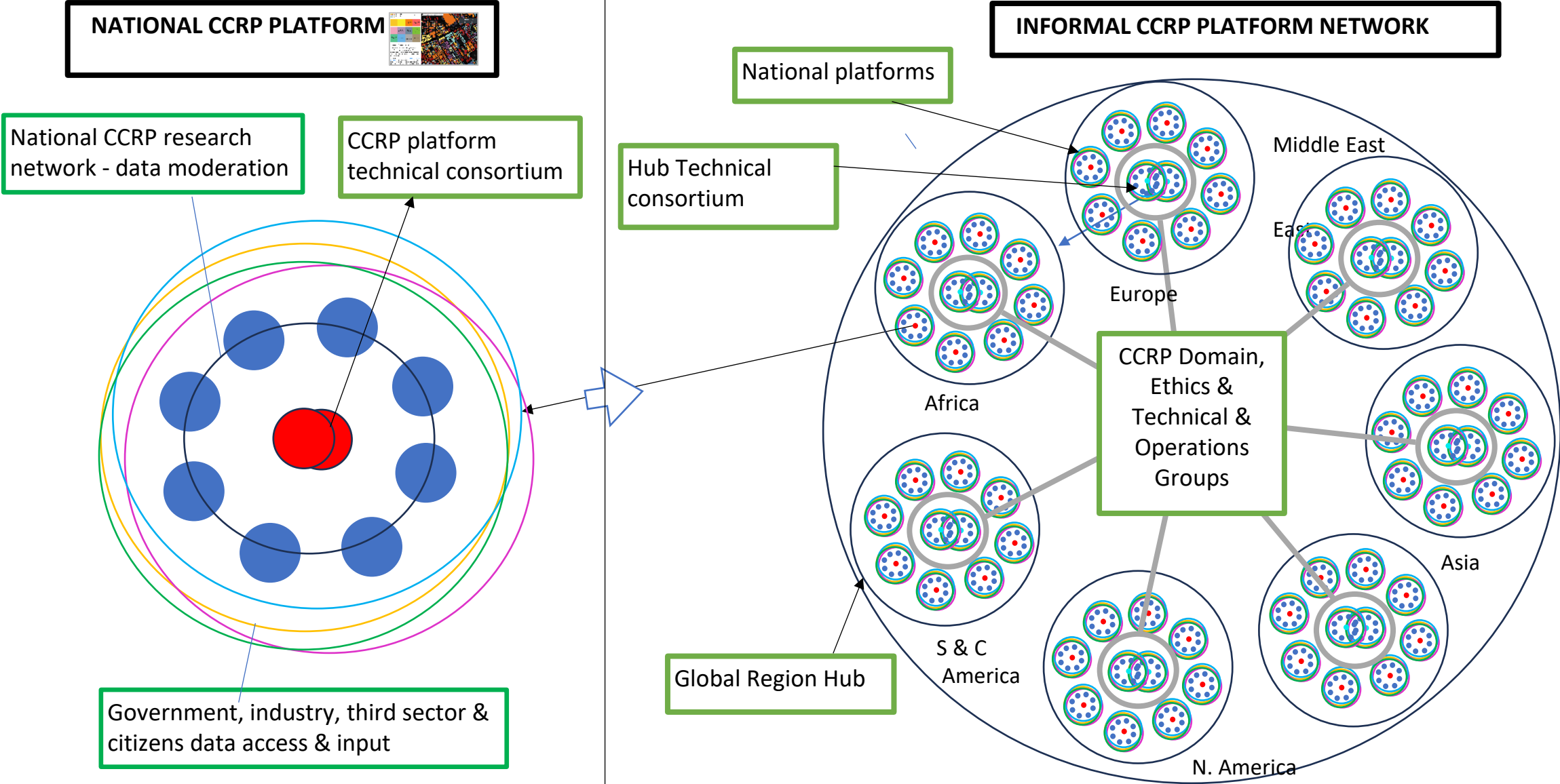


NATIONAL
BUILDING
FOOTPRINT
S



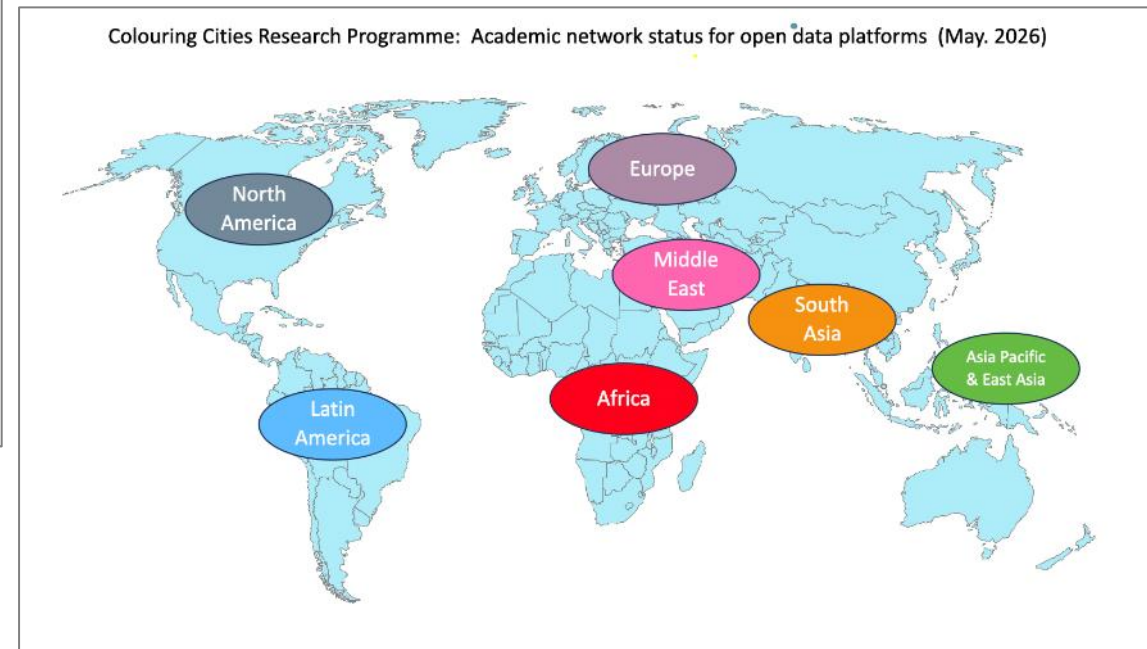
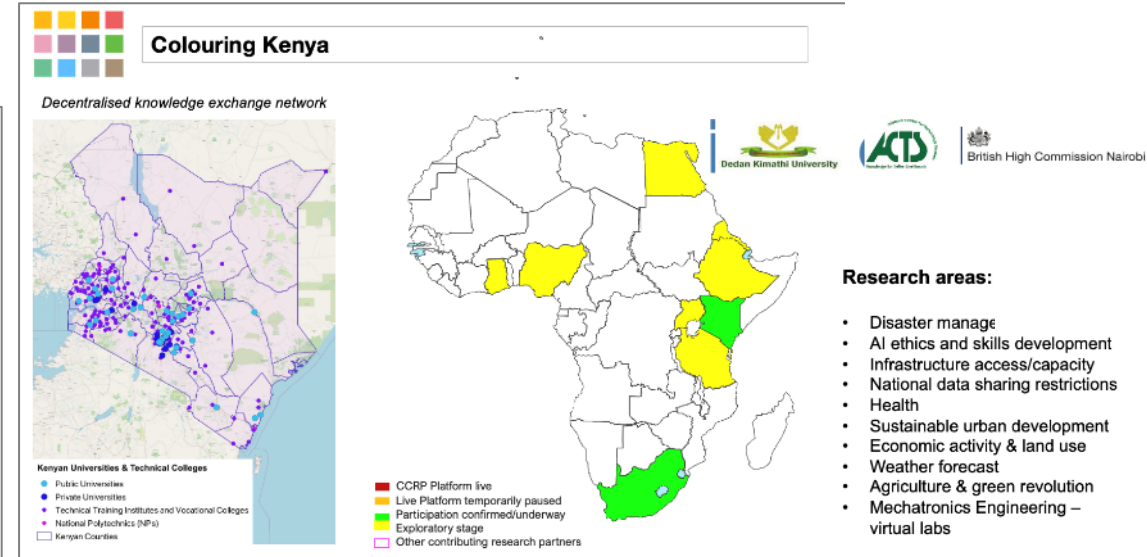
DECENTRALISED
NATIONAL CCRP
PLATFORM



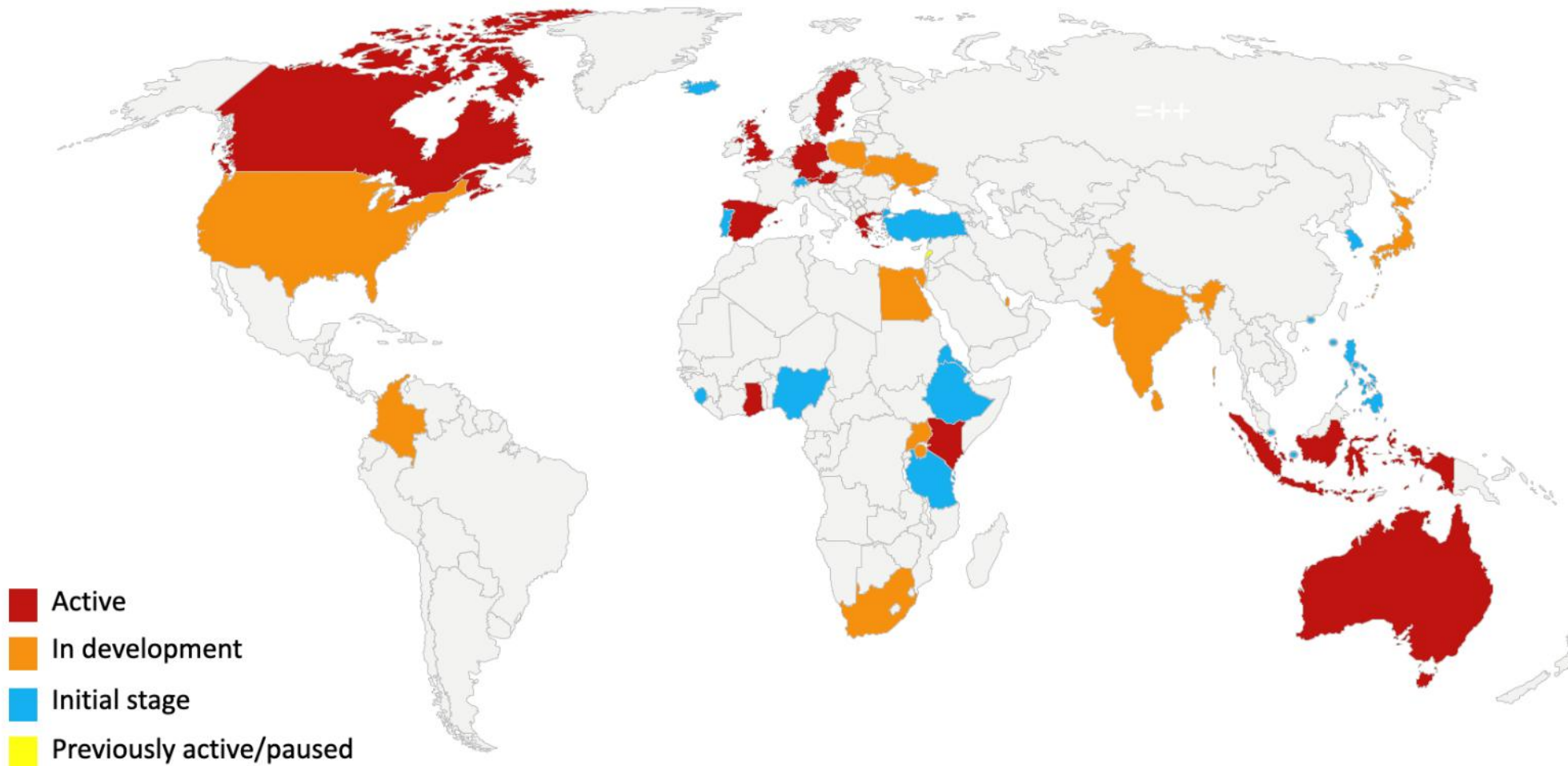


How is the CCRP managed & funded

- Decentralised to limit network failure & maintain sovereignty
- All academic platform partners follow CCRP protocols
- Pooling of funded academic time + grants, new government commissions etc
- National CCRP academic networks, CCRP Global Region Hubs & CCRP International Operations Group
- Common benefit from input to individual platforms
- Academic incentive - simple route to free national high quality data and international networking



Colouring Cities Research Programme: Academic open data platform network status (May 2026)





COLOURING BRITAIN DEVELOPMENT & FEATURES

Core code interface/Colouring Britain

COLOURING
BRITAIN

Menu ≡

Location

Land Use

Typology & Size

Construction & Design

Age & History

Planning & Conservation

Retrofit & Condition

Energy Performance & Systems

Green/Water Infrastructure Context

Urban Infrastructure Context

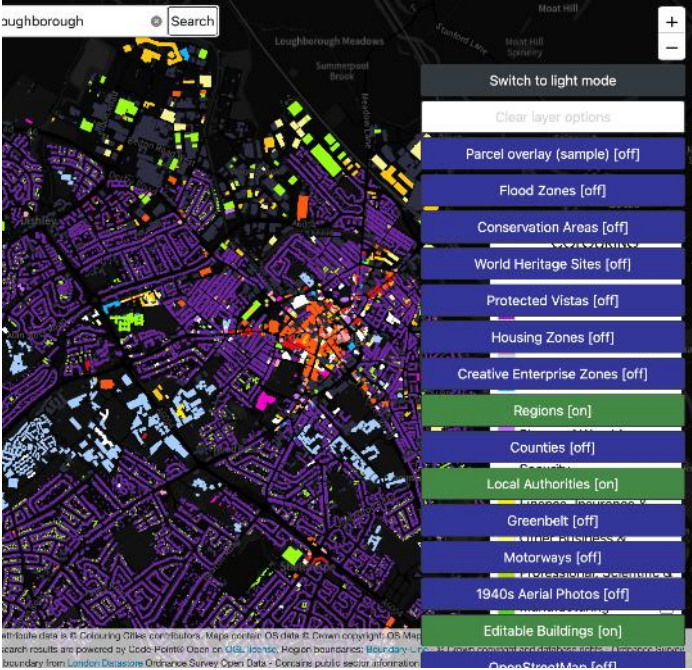
Disaster Management

Community

Welcome to Colouring Britain!

Colouring Britain is a research-led, free public resource, providing open spatial data on Britain's buildings. It is also an open knowledge initiative, built collectively by, and for, academia, communities, government, industry and the third sector. Any information you can add to our open platform is greatly appreciated.

Colouring Britain forms part of the [Colouring Cities Research Programme](#) (CCRP), managed in Britain by The Alan Turing Institute. The CCRP allows international academic institutions to co-work on a global network of interoperable open data platforms on national building stocks, and to accelerate



Building level data

Aggregated/layer
data- standard
GIS

Colouring Britain Data Collection & Visualisation

COLOURING
BRITAIN

Menu

- Location
- Land Use & Ownership
- Form & Size
- Construction & Design
- Age & History
- Planning & Conservation
- Retrofit & Condition
- Energy Performance & Systems
- Green/Water Infrastructure Context
- Urban Infrastructure Context
- Disaster Management
- Community

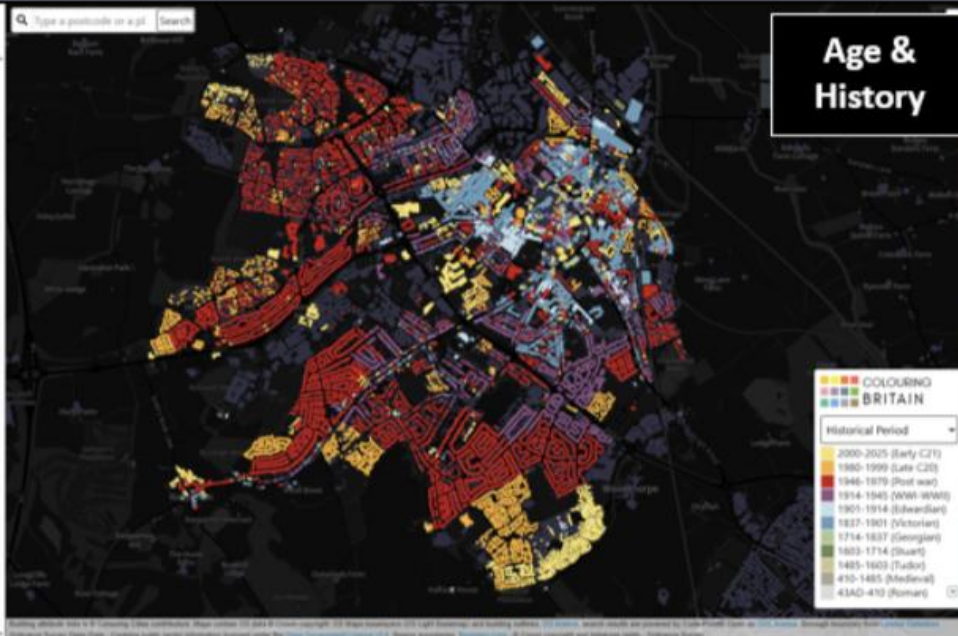
Age & History

About

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

Building last edited on Sat, 12 Jul 2025, 17:05

Select a building to add, view or amend the data



COLOURING
BRITAIN

Menu

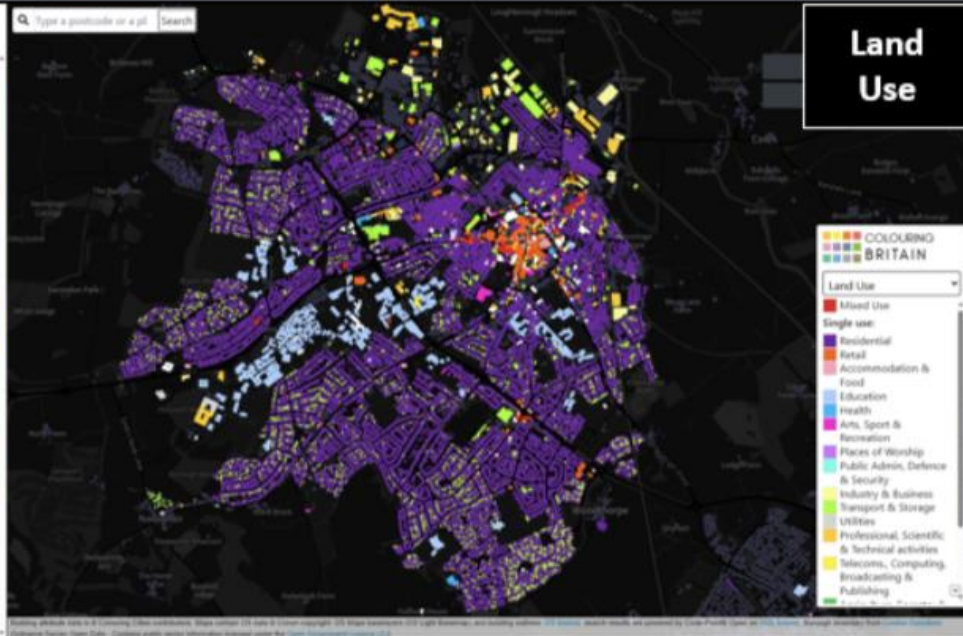
- Location
- Land Use & Ownership
- Form & Size
- Construction & Design
- Age & History
- Planning & Conservation
- Retrofit & Condition
- Energy Performance & Systems
- Green/Water Infrastructure Context
- Urban Infrastructure Context
- Disaster Management
- Community

Land Use & Ownership

About

How are buildings used, what type of ownership do they have, and how has their use changed over time? Can you help us capture and verify this information?

Select a building to add, view or amend the data



COLOURING
BRITAIN

Menu

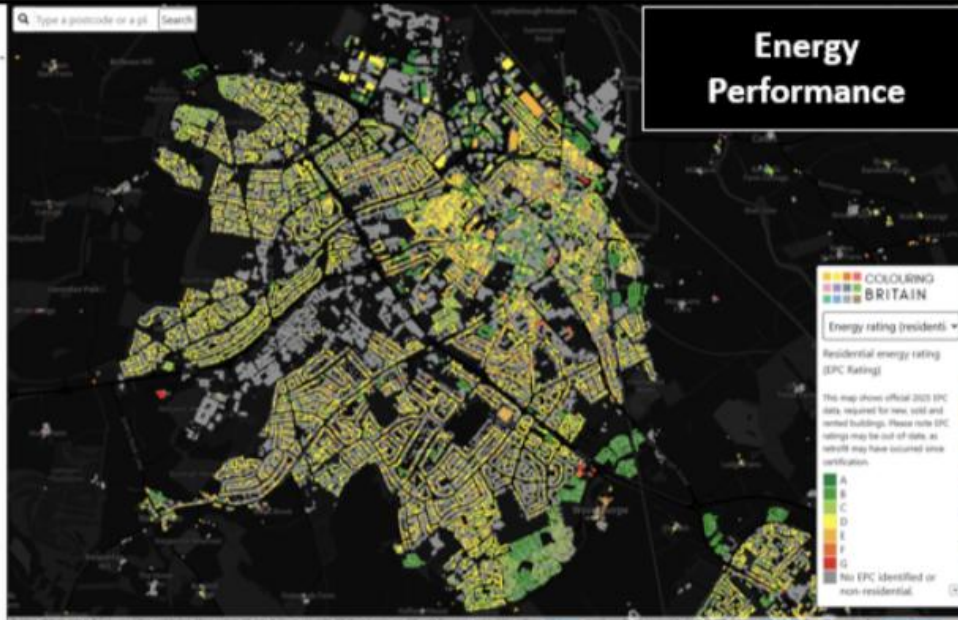
- Location
- Land Use & Ownership
- Form & Size
- Construction & Design
- Age & History
- Planning & Conservation
- Retrofit & Condition
- Energy Performance & Systems
- Green/Water Infrastructure Context
- Urban Infrastructure Context
- Disaster Management
- Community

Energy Performance & Systems

About

This section provides open data on the energy performance of the building. Can you help us capture and verify this information?

Select a building to add, view or amend the data



COLOURING
BRITAIN

Menu

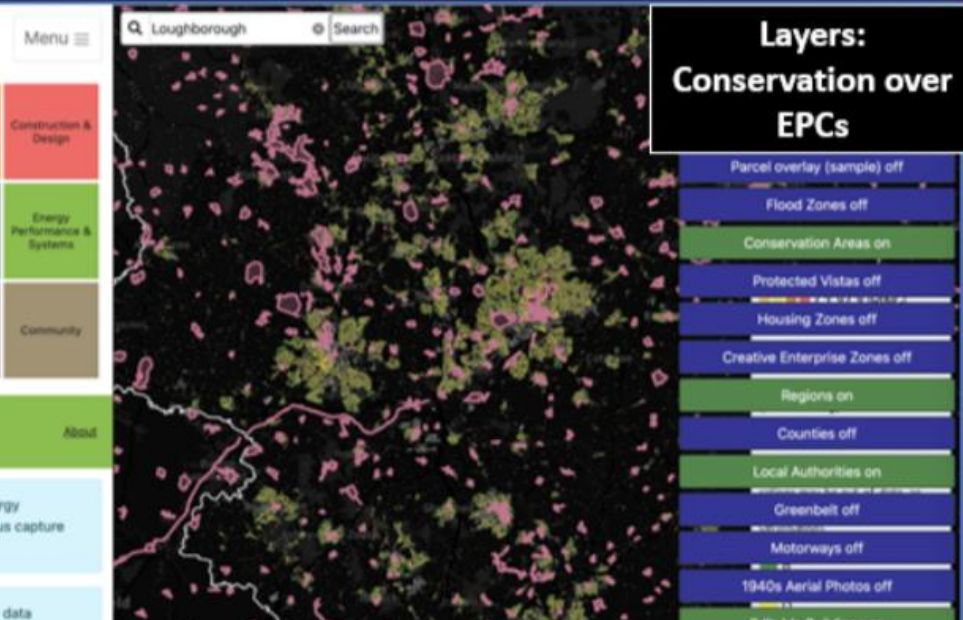
- Location
- Land Use & Ownership
- Form & Size
- Construction & Design
- Age & History
- Planning & Conservation
- Retrofit & Condition
- Energy Performance & Systems
- Green/Water Infrastructure Context
- Urban Infrastructure Context
- Disaster Management
- Community

Energy Performance & Systems

About

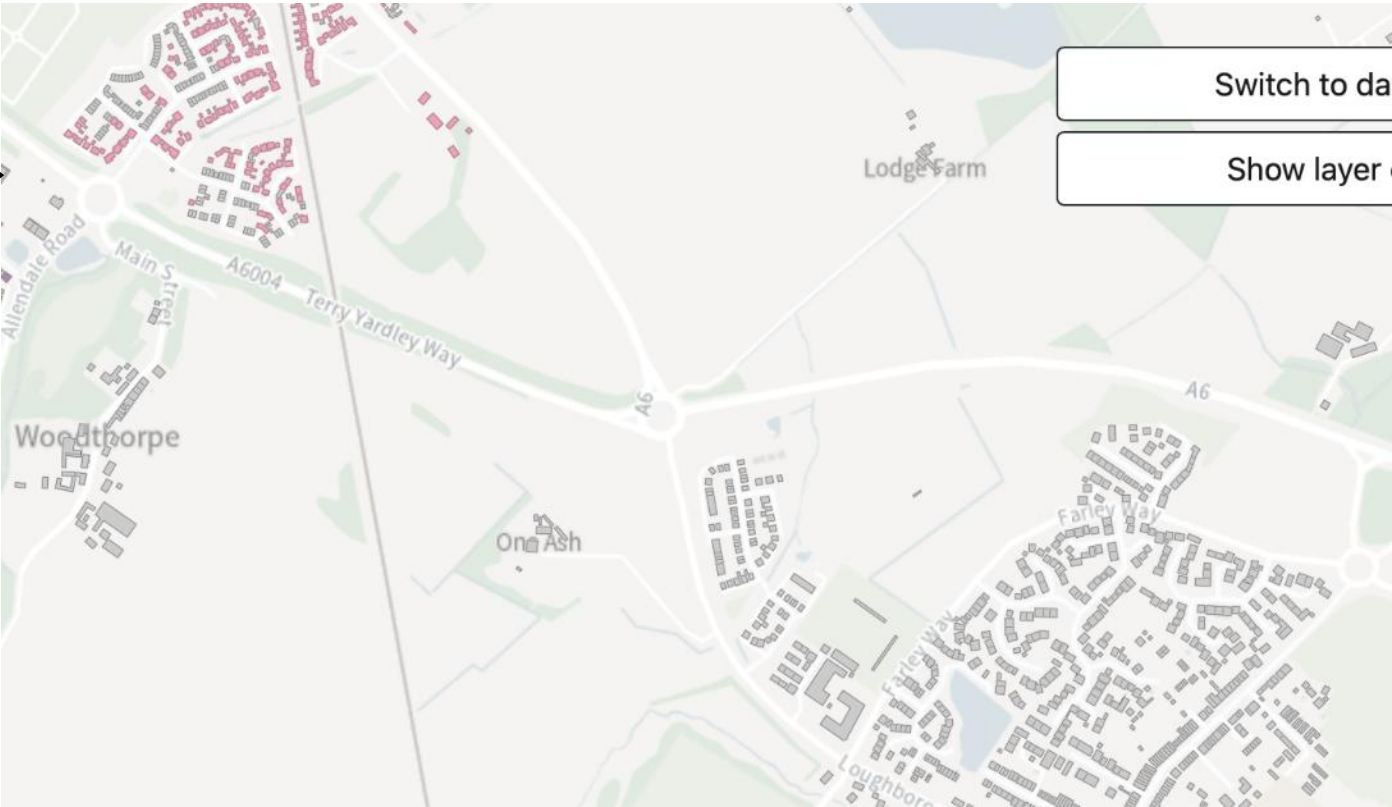
This section provides open data on the energy performance of the building. Can you help us capture and verify this information?

Select a building to add, view or amend the data



Creating & releasing first open footprint polygons for England (INSPIRE/OML merge)

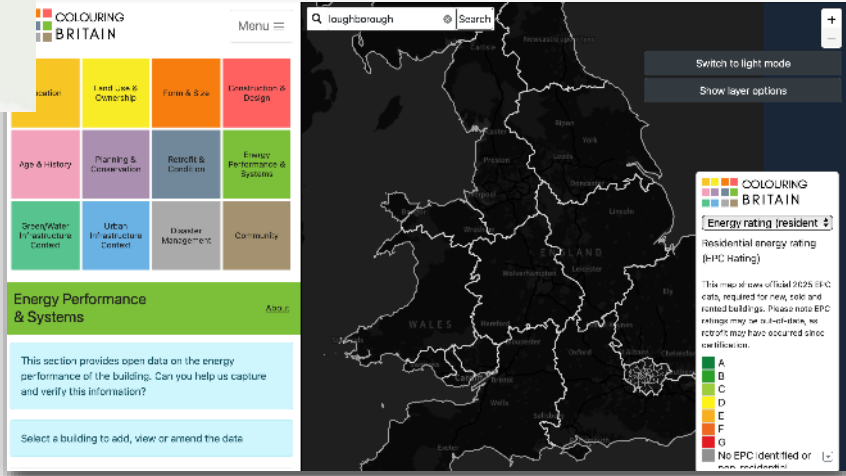
OS
MasterMap
footprints



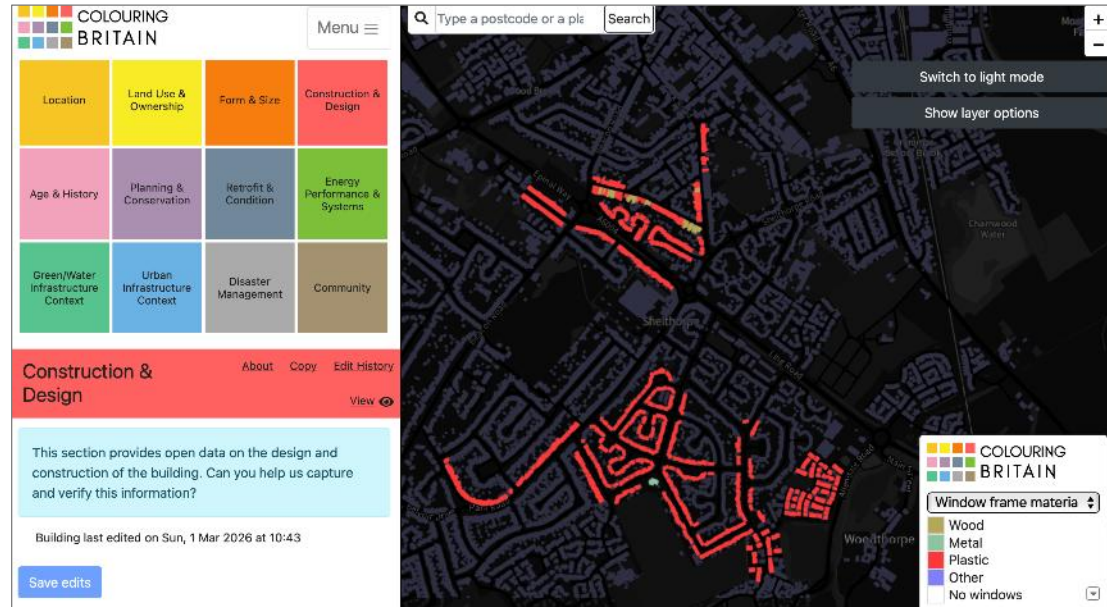
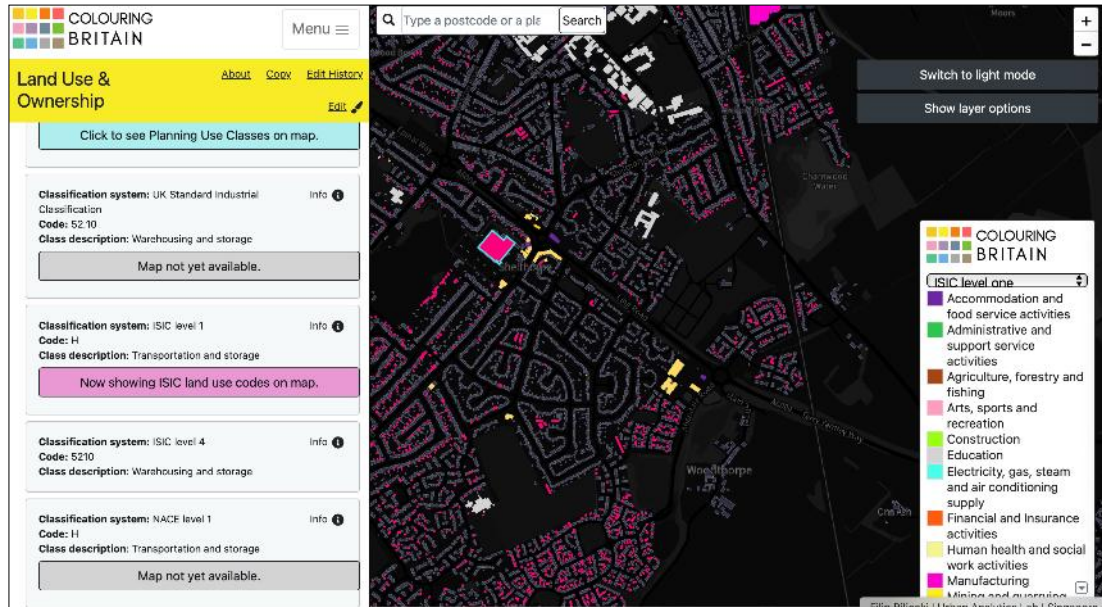
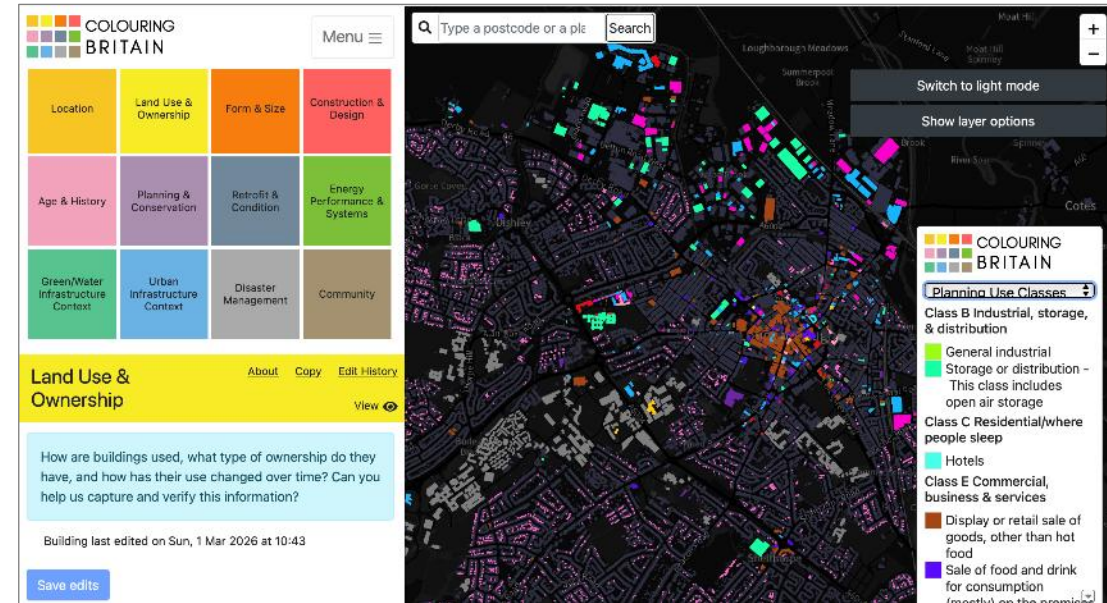
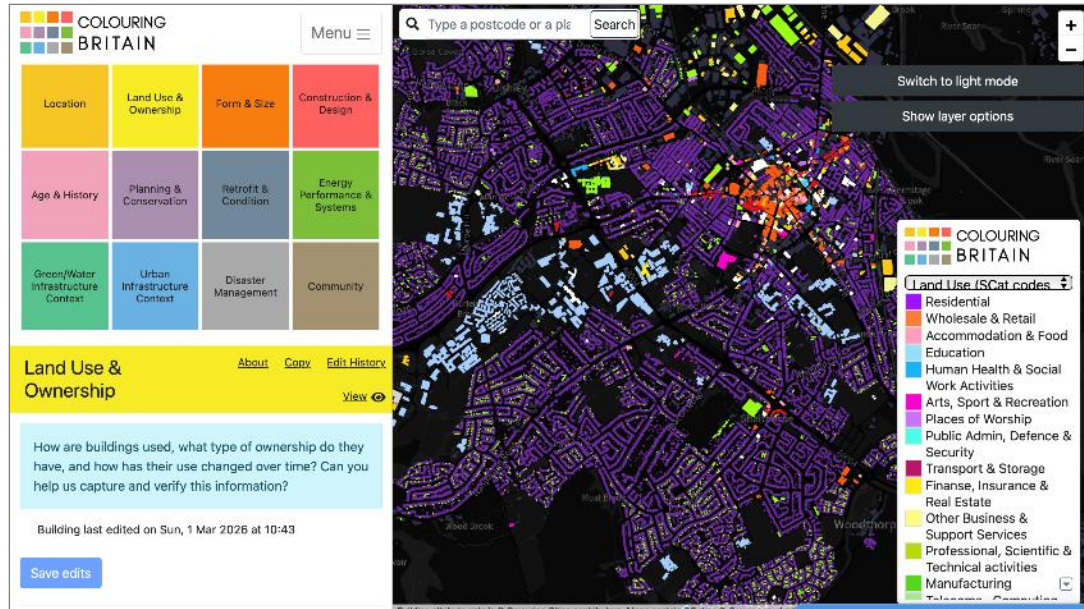
Switch to da
Show layer

New ~
Colouring
Britain
open
footprints
outside
OSMM
special
licence
areas

No comprehensive UK government open address or footprint datasets available



Mapping land use & standardisation of classification systems



Integration with standard GIS

COLOURING
BRITAIN

Menu

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Construction & Design

Age & History

Planning & Conservation

Retrofit & Condition

Energy Performance & Systems

Green/Water Infrastructure Context

Urban Infrastructure Context

Disaster Management

Community

Planning & Conservation

About

This section provides open planning and conservation data about the building. Can you help us capture and verify this information?

Building last edited on Sun, 1 Mar 2026 at 10:43

Select a building to add, view or amend the data

Type a postcode or a place name

Search

Switch to light mode

Clear layer options

Parcel overlay (sample) [off]

Flood Zones [off]

Conservation Areas [on]

World Heritage Sites [off]

Protected Vistas [off]

Housing Zones [off]

Creative Enterprise Zones [off]

Regions [on]

Counties [off]

Local Authorities [on]

Greenbelt [off]

Motorways [off]

1940s Aerial Photos [off]

Editable Buildings [on]

OpenStreetMap [off]

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COLOURING
BRITAIN

Menu

Location

Land Use & Ownership

Form & Size

Construction & Design

Age & History

Planning & Conservation

Lifecycle & Circularity

Energy & Recraft

Water Infrastructure Context

Urban Infrastructure Context

Disaster Management

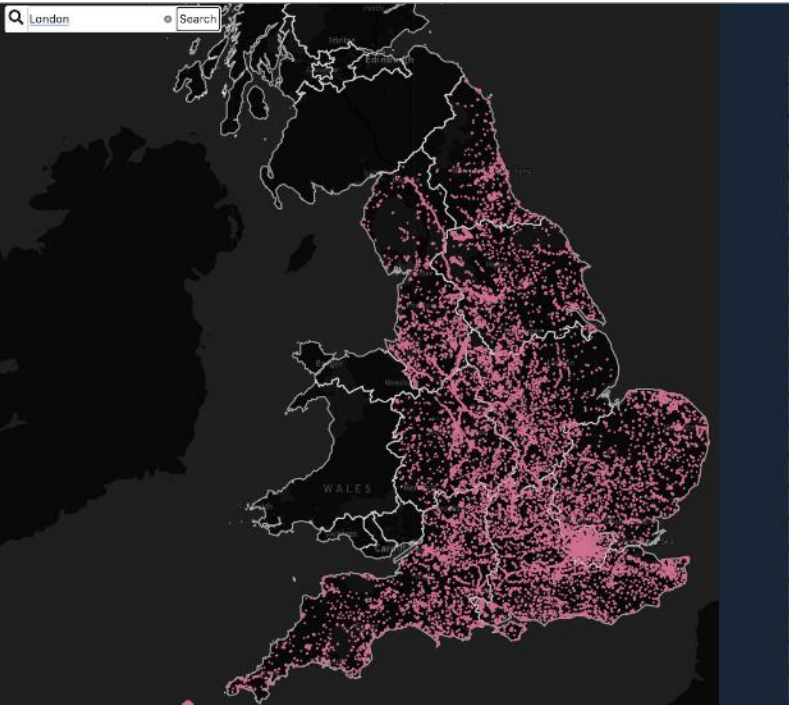
Community

Age & History

About

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

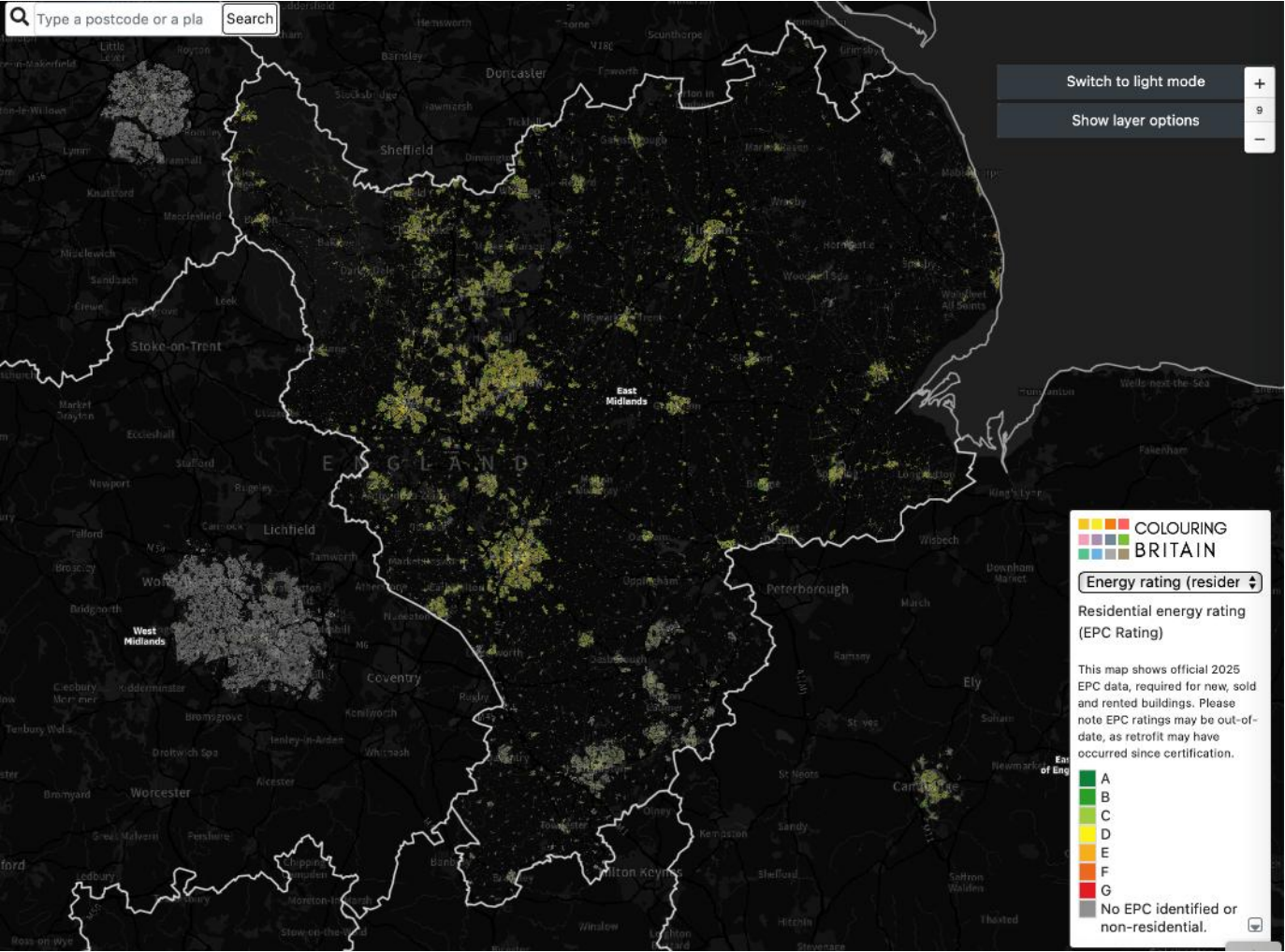
Select a building to add, view or amend the data



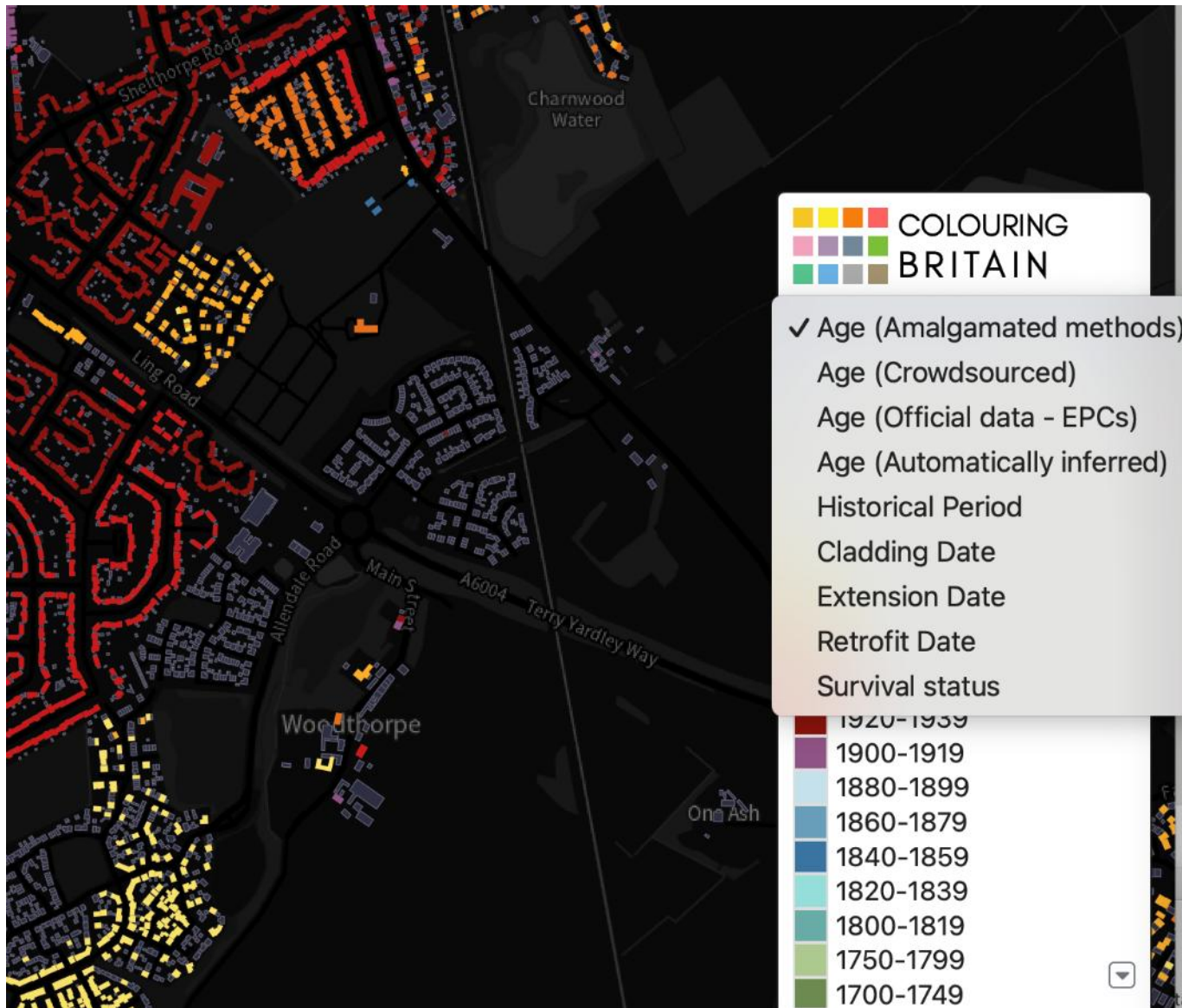
Live streaming official data and linking direct to webpages



Regional nudging



Focus on data quality, methods, sources



- ✓ Assessed by eye/personal knowledge of the building
- Assessed using professional knowledge of building or building type
- Assessed using streetview photographs, satellite imagery or maps
- Assessed by specialist emergency group
- Current government record/database
- Live streamed from a government source
- Open database
- Other independently managed public database
- Commercial database
- Inferred computationally from CCRP data
- Inferred by eye from CCRP data
- Synthetic data
- Other

- Source
- Source type
- Source links
- Method type
- Edit History
- Data Trust & Reliability
- Models in progress

Crowdsourced building age data

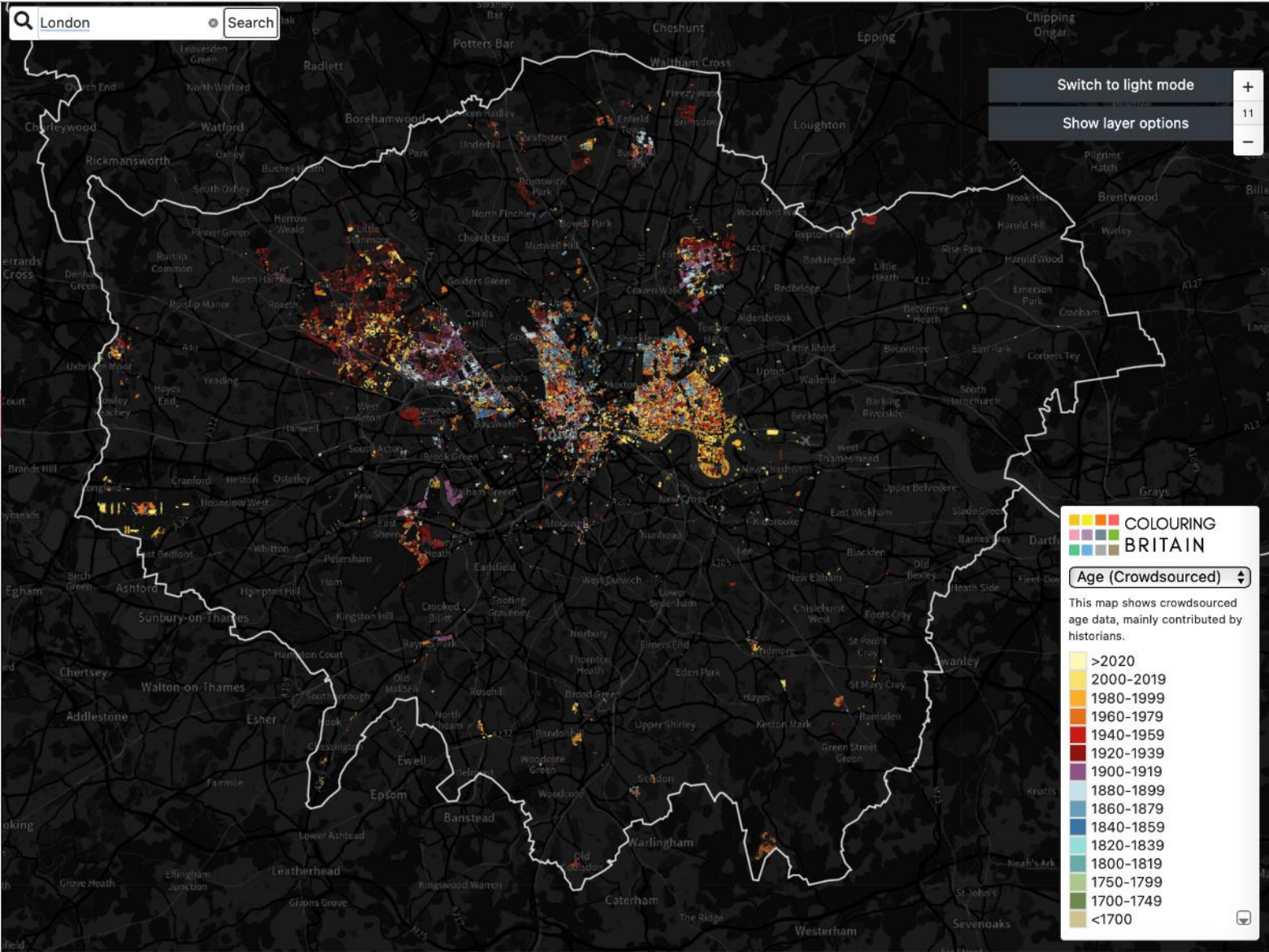
Location	Land Use & Ownership	Form & Size	Construction & Design
Age & History	Planning & Conservation	Lifecycle & Circularity	Energy & Retrofit
Green/Water Infrastructure Context	Urban Infrastructure Context	Disaster Management	Community

Age & History

About

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

Select a building to add, view or amend the data



Automatically inferred building age data using vectorised historical network

COLOURING
BRITAIN

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Form & Size

Construction & Design

Age & History

Planning & Conservation

Lifecycle & Circularity

Energy & Retrofit

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Disaster Management

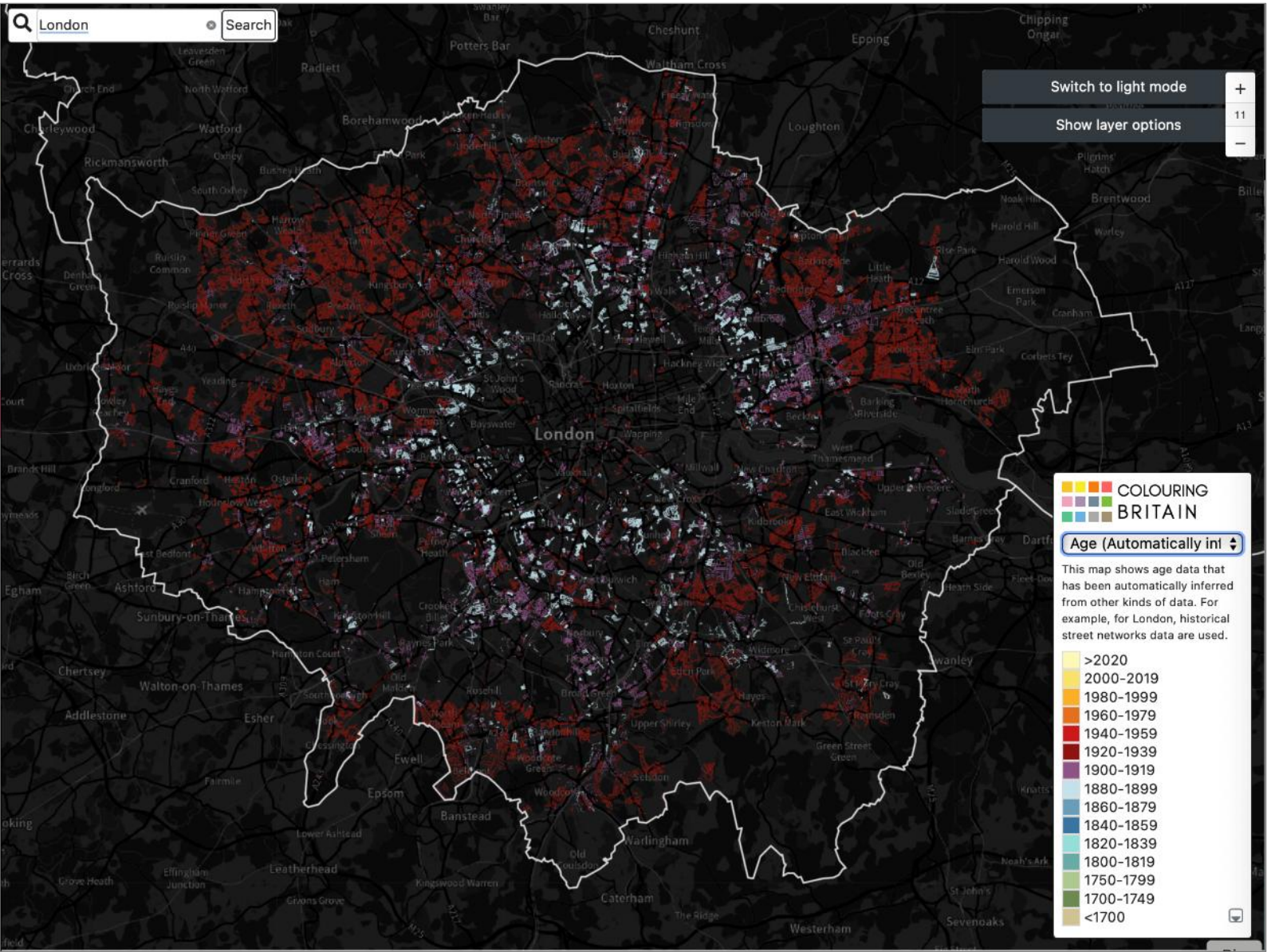
Community

Age & History

About

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

Select a building to add, view or amend the data



Amalgamation of methods

 COLOURING
BRITAIN

Menu ≡

Location

Land Use & Ownership

Form & Size

Construction & Design

Age & History

Planning & Conservation

Lifecycle & Circularity

Energy & Retrofit

Green/Water Infrastructure Context

Urban Infrastructure Context

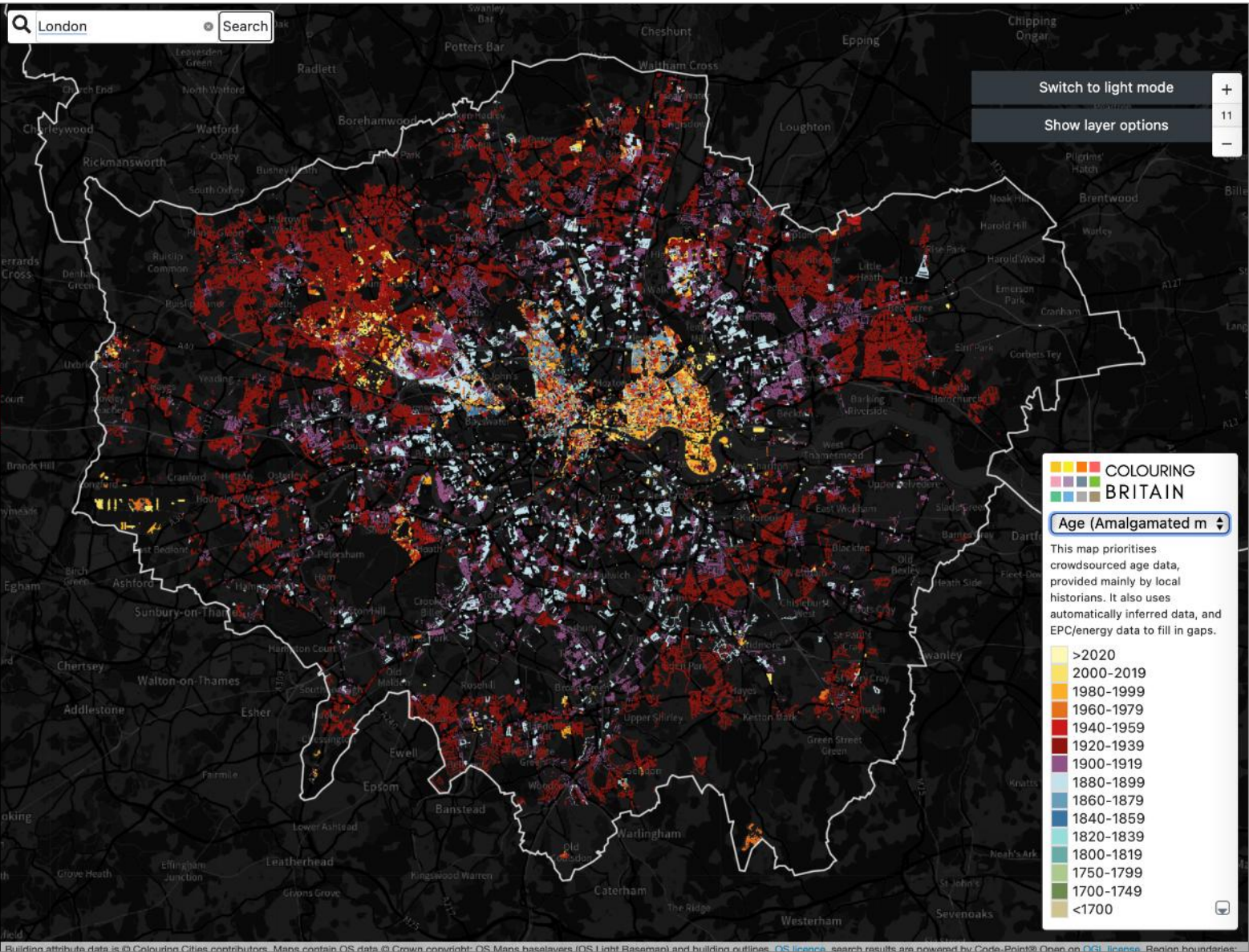
Disaster Management

Community

Age & History [About](#)

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

Select a building to add, view or amend the data



Adjacency mapping

Menu

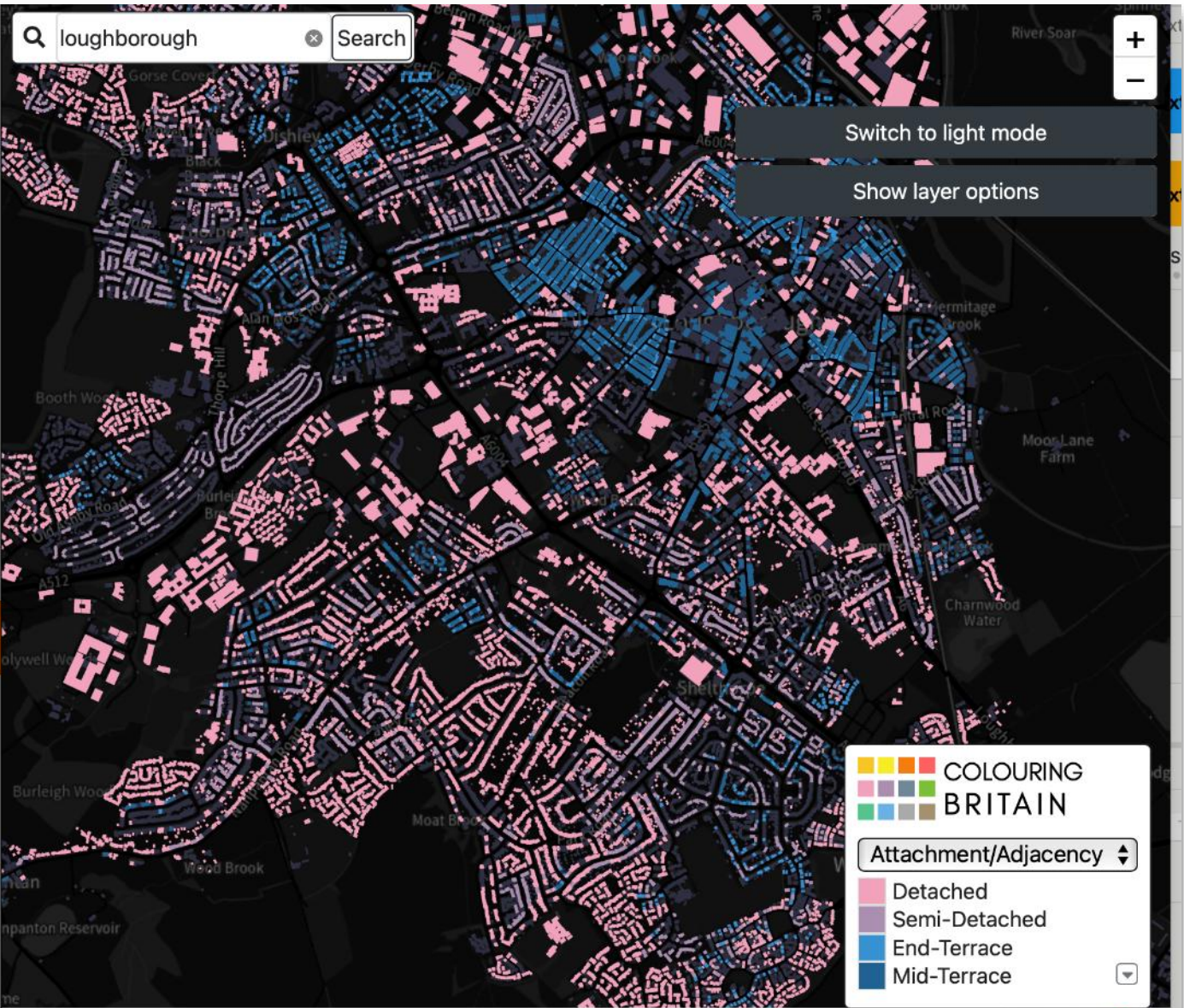
Location	Land Use & Ownership	Form & Size	Construction & Design
Age & History	Planning & Conservation	Retrofit & Condition	Energy Performance & Systems
Green/Water Infrastructure Context	Urban Infrastructure Context	Disaster Management	Community

Form & Size

About

This section provides open data on the typology and dimensions of the building. Can you help us capture and verify this information?

Select a building to add, view or amend the data



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Density and storey tracking

Menu

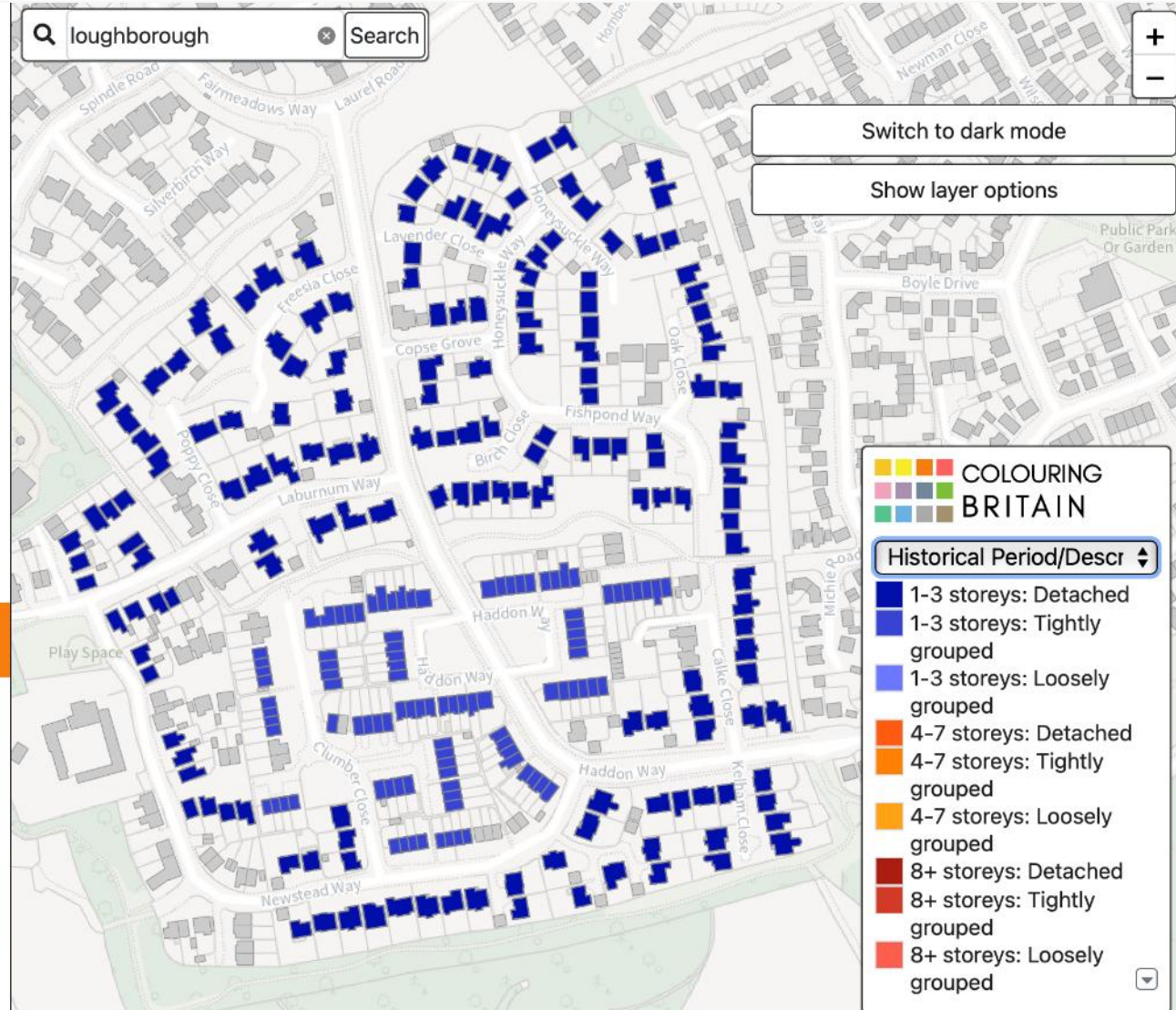
Location	Land Use & Ownership	Form & Size	Construction & Design
Age & History	Planning & Conservation	Retrofit & Condition	Energy Performance & Systems
Green/Water Infrastructure Context	Urban Infrastructure Context	Disaster Management	Community

Form & Size

[About](#)

This section provides open data on the typology and dimensions of the building. Can you help us capture and verify this information?

Select a building to add, view or amend the data



COLOURING
BRITAIN

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Disaster Management

Community

Disaster Management

About

Copy

Edit History

Edit

This section provides a tool that allows for live collection of data in disaster situations and collates data relating to building resilience. Can you help us capture and verify this information?

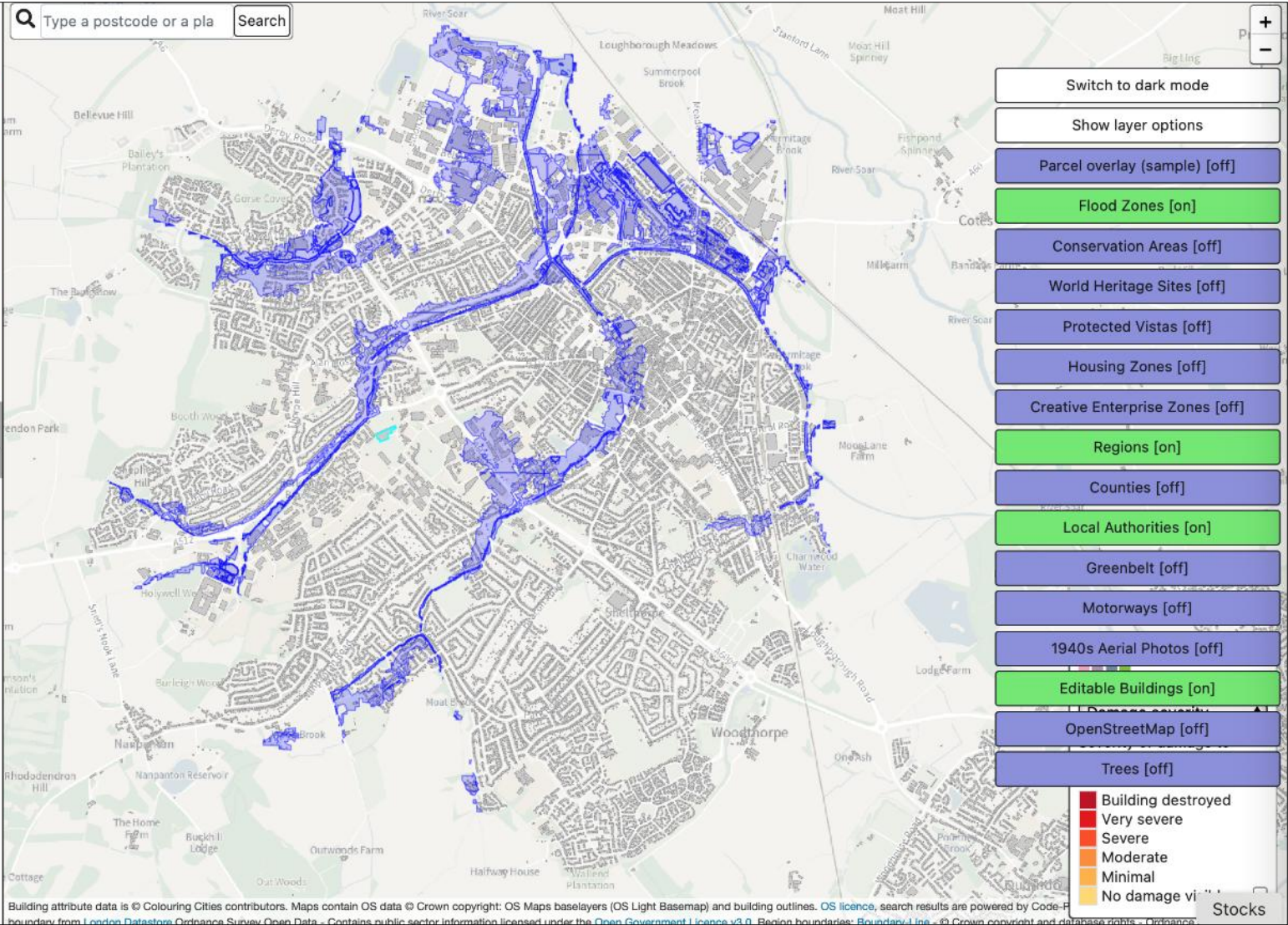
Building last edited on Mon, 23 Feb 2026 at 14:13

Disaster Management Tool

Resilience Indicators & Risk Assessment

Type a postcode or a pla

Search



Switch to dark mode

Show layer options

Parcel overlay (sample) [off]

Flood Zones [on]

Conservation Areas [off]

World Heritage Sites [off]

Protected Vistas [off]

Housing Zones [off]

Creative Enterprise Zones [off]

Regions [on]

Counties [off]

Local Authorities [on]

Greenbelt [off]

Motorways [off]

1940s Aerial Photos [off]

Editable Buildings [on]

OpenStreetMap [off]

Trees [off]

Building destroyed

Very severe

Severe

Moderate

Minimal

No damage visible

Stocks

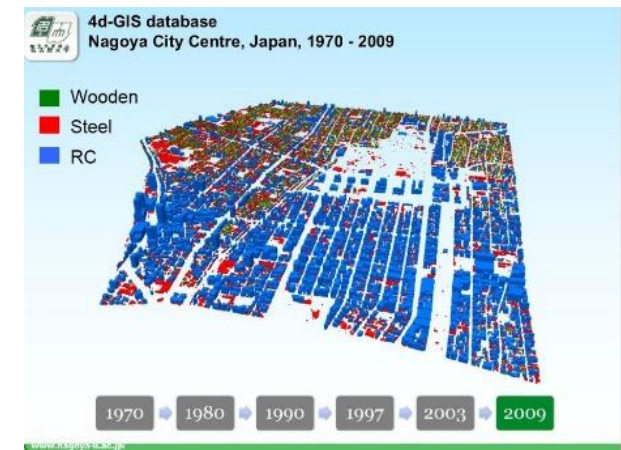
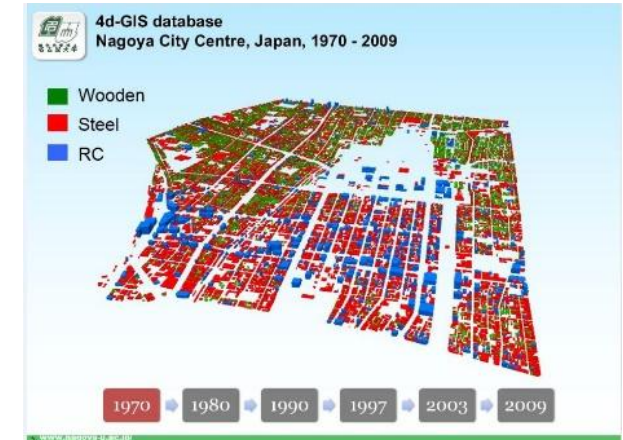
Building attribute data is © Colouring Cities contributors. Maps contain OS data © Crown copyright: OS Maps baselayers (OS Light Basemap) and building outlines. OS licence, search results are powered by Code-Point. Boundary from London Datastore Ordnance Survey Open Data - Contains public sector information licensed under the Open Government Licence v3.0. Region boundaries: Boundary Line - © Crown copyright and database rights - Ordnance



EXAMPLES OF CCRP RESEARCH COLLABORATION/
& DATA APPLICATIONS

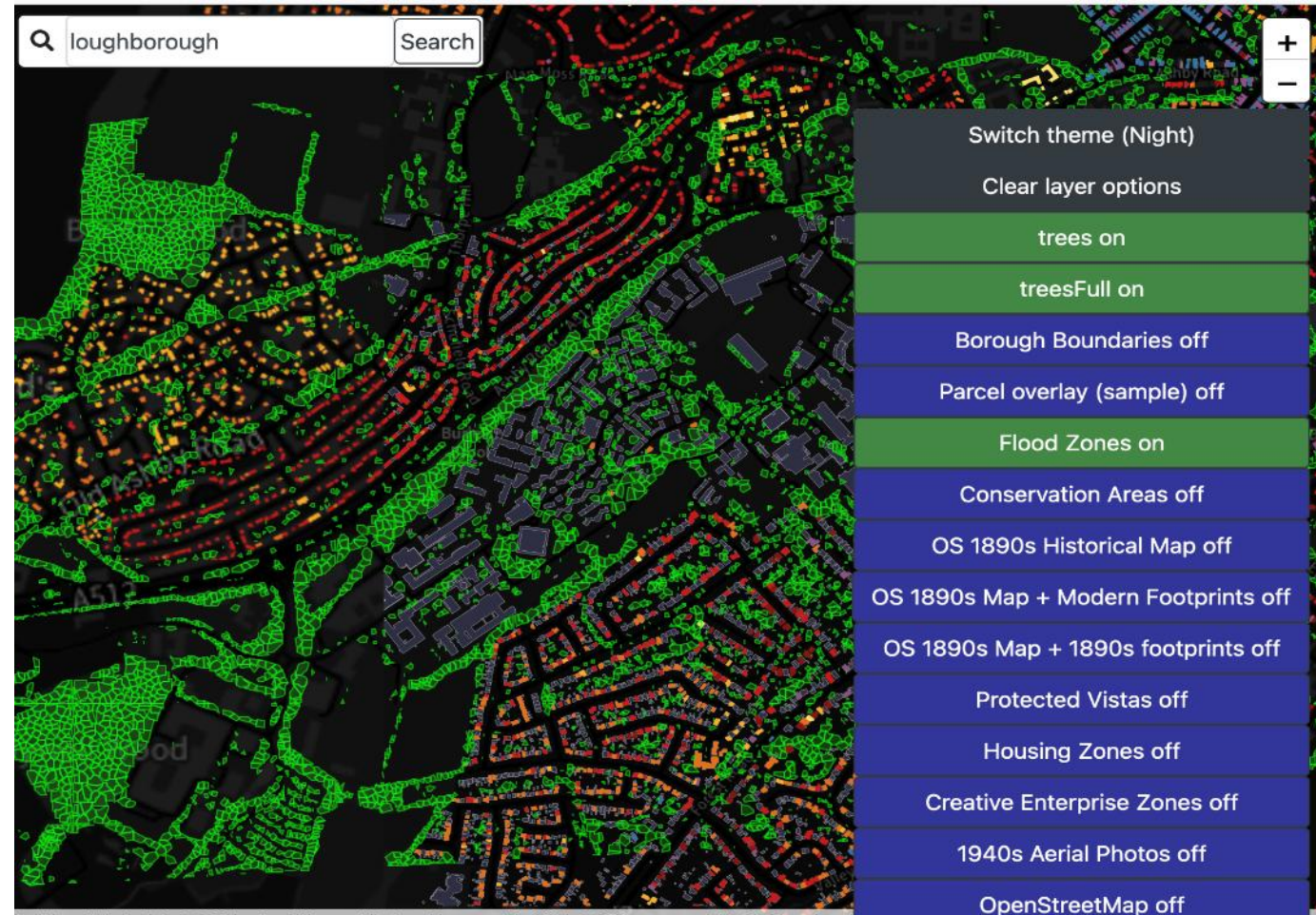
Building material circularity & WHS mapping with Colouring India

- Work with Symbiosis Institute of technology, Pune India on building material circularity
- Includes tracking plastics in building construction and impact on health
- Proposal by CEPT University, Gujarat to map the world heritage sit in Ahmedabad as demo for other CCRP platforms



Images courtesy
H. Tanikawa & S. Hashimoto;

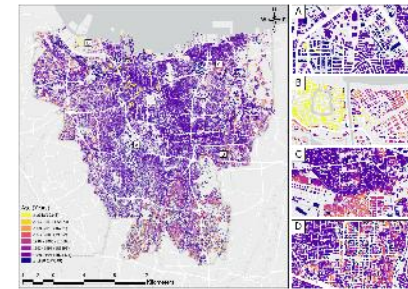
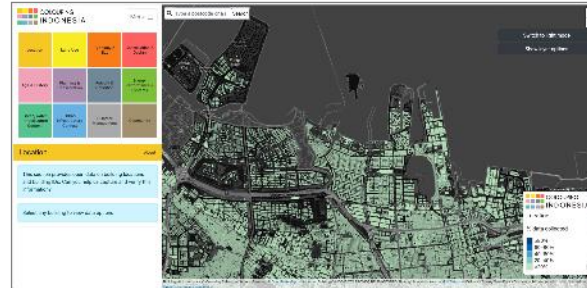
- Supporting Trees/Greenspace & deprivation analysis undertaken by Andrés C. Zúñiga-González, University of Cambridge
- Selected by CapGemini internal team to pitch for 100K of internal software engineering/AI support for CCRP as part of the company's Tech4positive non-profit global challenge - 2026 focus on biodiversity/tree data



Tree crown polygon data courtesy of Andrés C. Zúñiga-González

Disaster management with Colouring Indonesia

- Disaster management group involving US, Philippines and Indonesia
- Colouring Indonesia 300K British Academy funding for 'empowering resilience in a sinking city' lead by KCL.
- Tool based on 1940s London bomb damage maps



Courtesy Colouring Indonesia/KCL)

Disaster Management

About Copy Edit History View

Save edits

▼ Disaster management tool

This feature is designed as an assessment tool to help communities capture data on the state of buildings following major disasters. It is intended to help support emergency services, to record damage, and to aid reconstruction programmes.

✓

Flood

Earthquake

Hurricane

Fire

Extreme heat

Political/war damage

Other human (blast damage/spills etc.)

Other

✓ 0

Verify

How severe do you assess the damage to be?

Info

✓ 0

Verify

Damage assessment type

Info

Switch theme (Night)

Show layer options

COLOURING
BRITAIN

Damage severity

Severity of damage to building

Building destroyed

Very severe

Severe

Moderate

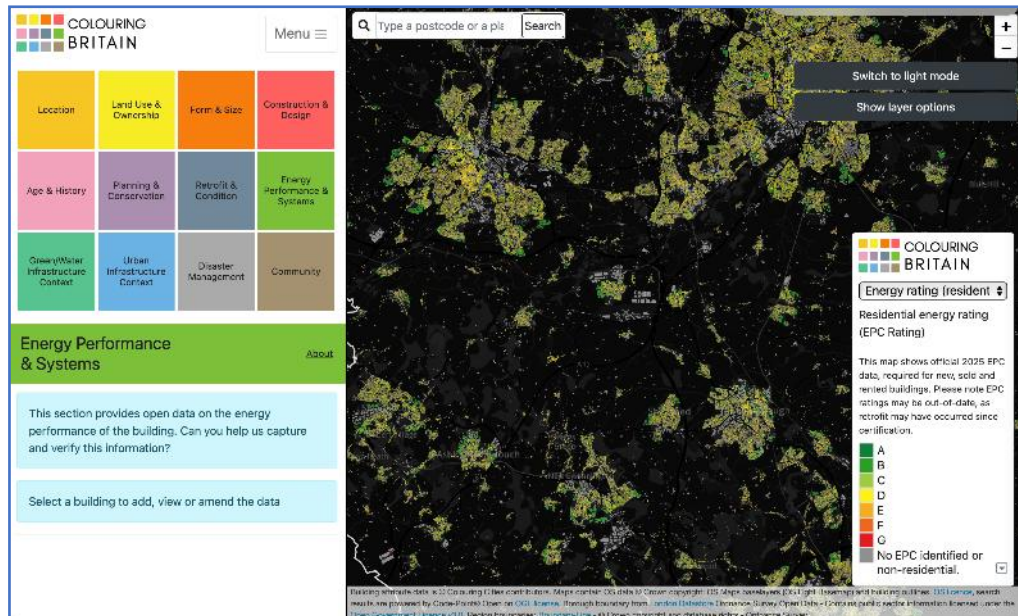
Minimal

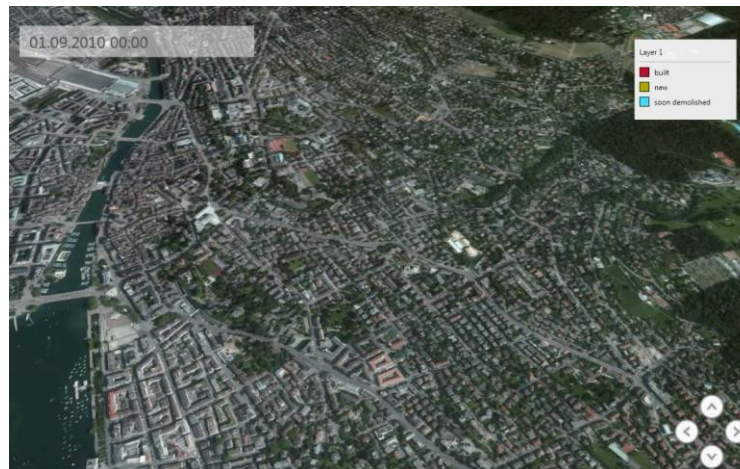
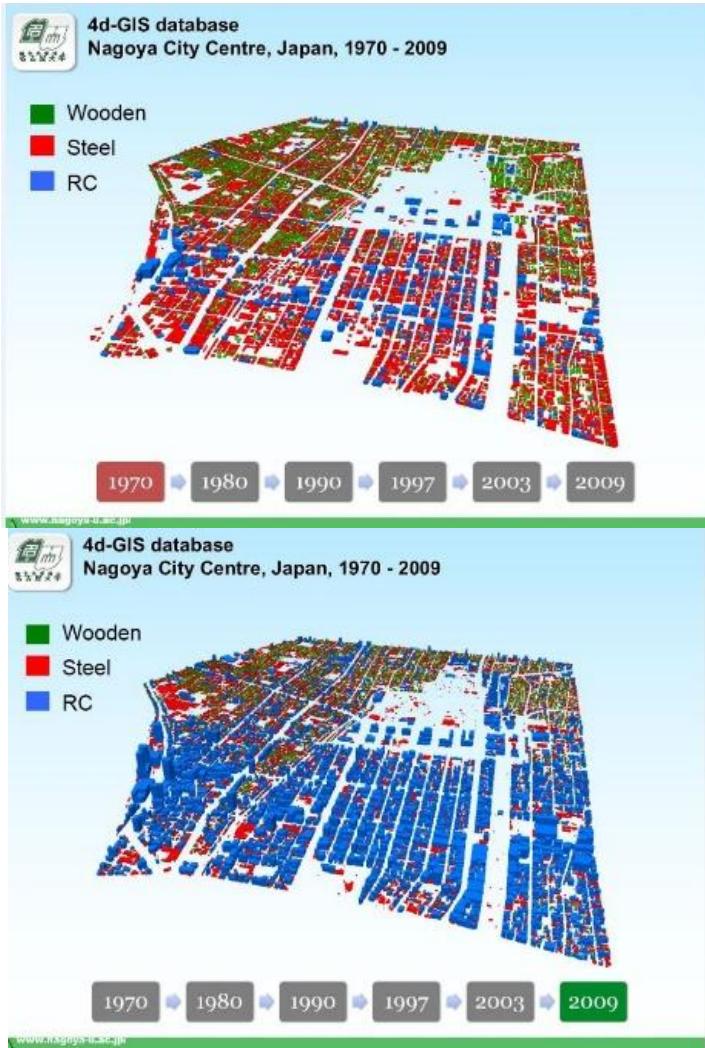
No damage visible

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Energy performance visualisation with Colouring Sweden

- EPC comparison & first EPC visualisation for Sweden and England.
- Incl. assessment of official building age data reliability
- Japan Applied Energy Conference keynote 2025
- Working with European Commission JRC



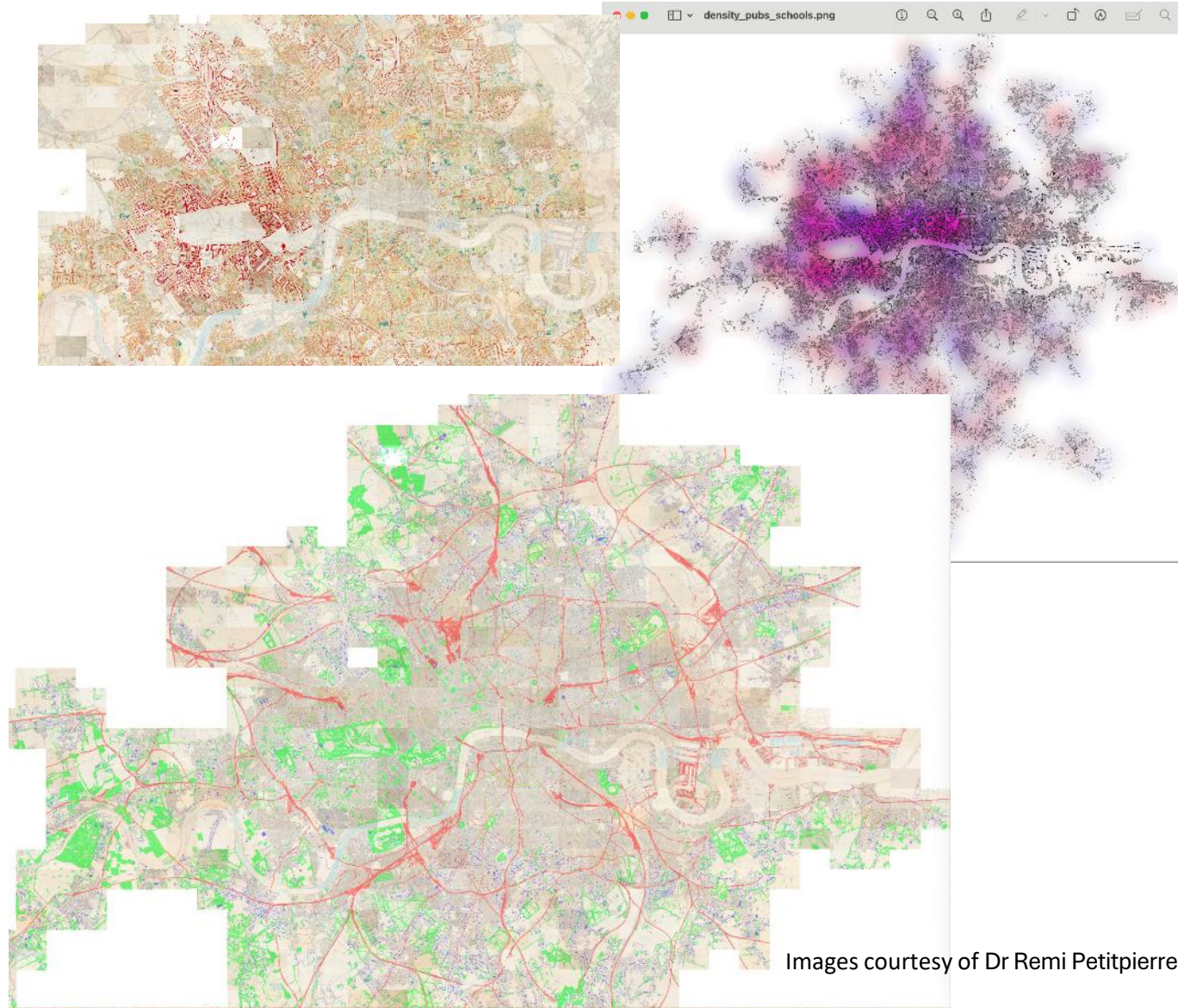


Images clockwise courtesy:

H. Tanikawa & S. Hashimoto; S.
Evans & P. Hudson; Booth
Poverty Map; M. Aksoezen, U.
Hassler and N. Kohler

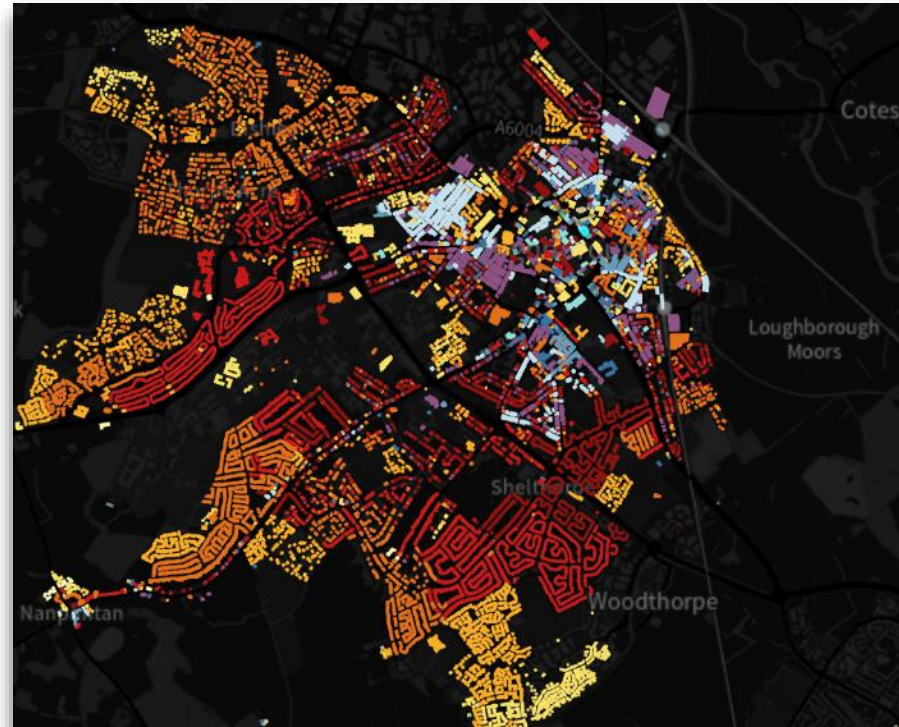
Computer Vision and historical maps

- Computer Vision group led by IOER Germany, EPFL Switzerland & Cambridge UK
- AI extraction of features from 1890 historical map- NLS open map collection used
- Vectorisation of Booth poverty but manual vectorisation now able to be used as training data - Layers of London IHS.
- Andres Zuniga Gonzalez comparison of 1890 and 2026 green spaces and deprivation data now possible



Images courtesy of Dr Remi Petitpierre, EPFL Lausanne

- Work with **ScaDS.AI** (Center for Scalable Data Analytics and Artificial Intelligence) Dresden/Leipzig
- Looking at age data reliability and issues with comparison of age data intervals.
- Conference paper comparison of UK EPC data with crowdsourced data for Loughborough submitted.



- Work with President of Ukraine's fund, UCL, Liverpool and Cambridge universities and 5 universities and Ukraine on Colouring Ukraine demo set up
- Focus on heritage/survival mapping
- Plan to co-create open spatial protocols in conflict situations
- Ukrainian network of computer science depts involved



Survival and demolition tracking

Age & History

AboutCopyEdit HistoryEdit

This section provides open data on the age of buildings and the history of buildings and sites. Can you help us capture and verify this information?

Building last edited on Thu, 13 Nov 2025 at 11:11

Historical Period/Description

Building Age/Construction Date (Crowdsourced)

Inferred Data

Official Data and CCRP Bulk Upload Data

Cladding, Extensions & Retrofits

Lifespan & Site History

Survival Tracking

Can you help us create a map that shows how many buildings in this area have survived since the 1890s? Choose a colour to indicate whether the building has survived.

Click to show OS historical map.

Click to hide the OS historical map with modern footprints and fill indicating survival status.

Click to show the OS historical map with modern footprints, without fill.

Survival statusInfo

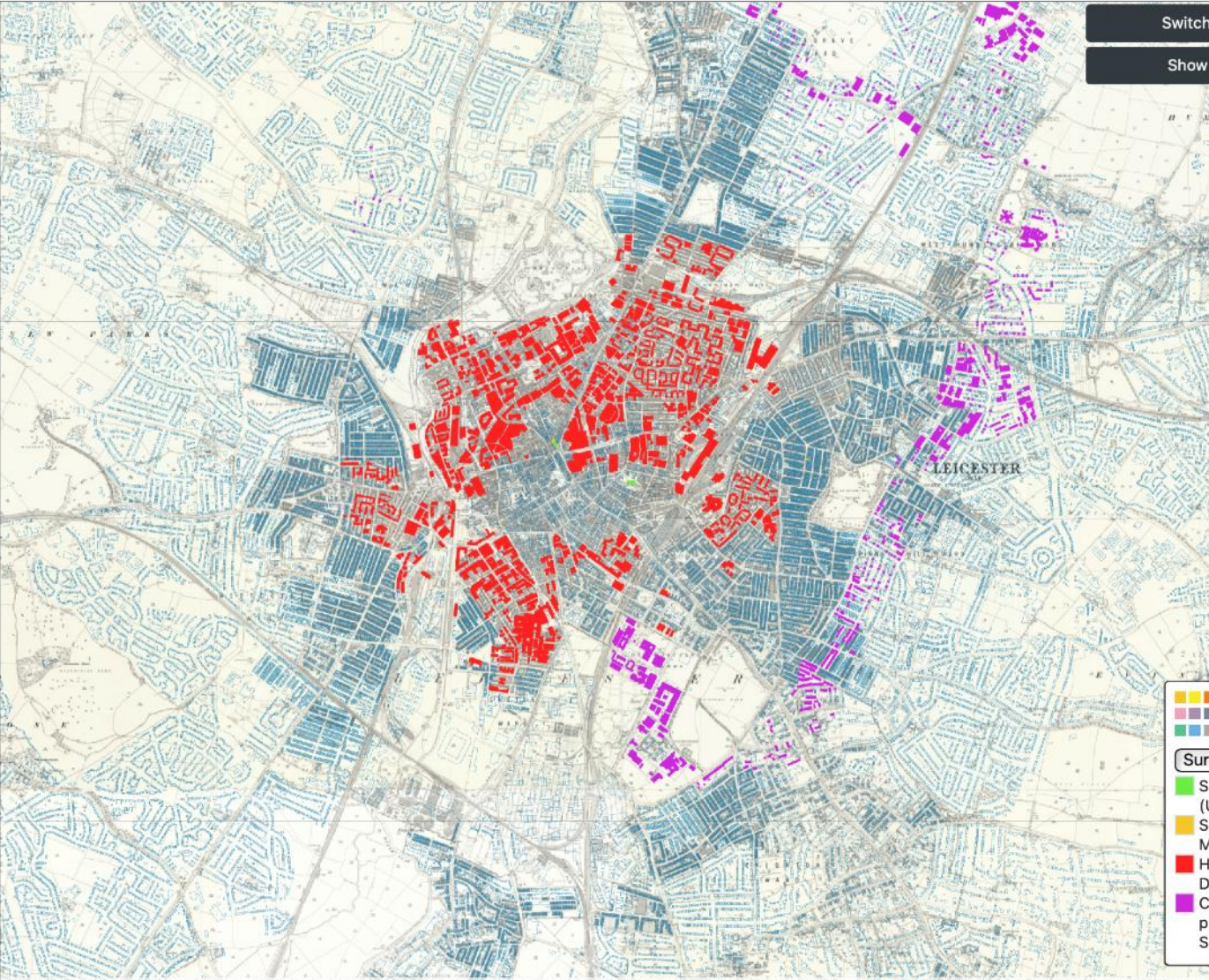
Current Building on previously Unbuilt-on Site

Method type

Matched by comparing maps

Historical Map Data Options

SwitchShow



LEICESTER

COLOURING
BRITAIN

Survival status

Same as Historical Map (Unchanged)

Similar to Historical Map (Some Changes)

Historical Building(s) Demolished

Current Building on previously Unbuilt-on Site

Building attribute data is © Colouring Cities contributors. Maps contain OS data © Crown copyright; OS Maps baselayers (OS Light Basemap) and building outlines. OS licence, search results are powered by Code-Point® Open on OGL license, Region boundaries:



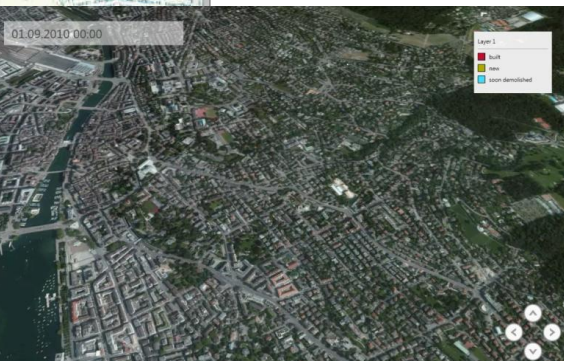
01.09.2010 00:00

Layer 1

Build

Dem

Survival Demolished



Courtesy S. Evans & P. Hudson top;
M. Aksoezen, U. Hassler and N. Kohler bottom



COLOURING GERMANY/DRESDEN & DIGITAL TWINS

Colouring Dresden as the first German CCRP Initiative

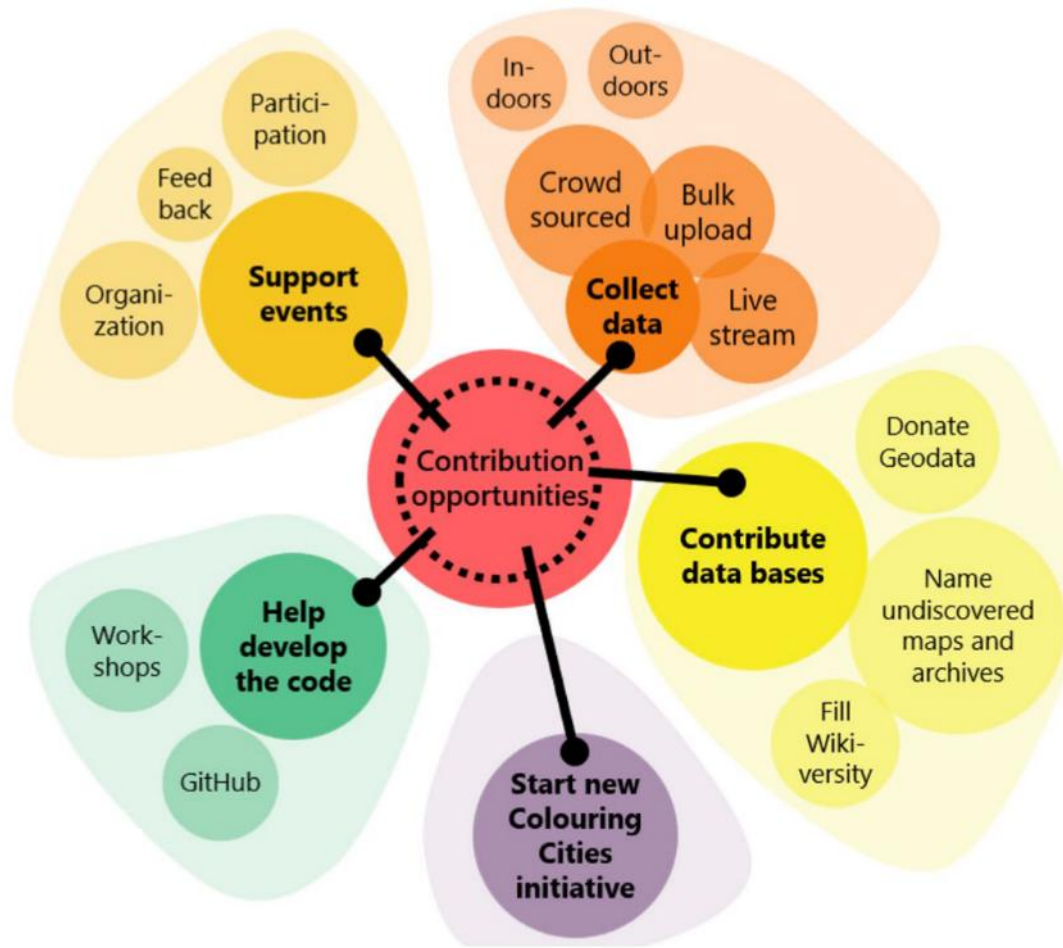


- **Kickstarted as a Citizen-science project** collecting building data in Dresden for heritage and climate-friendly planning
- **Iterative co-development** of participation formats (workshops, mapathons) with citizens
- **Live since March 2023**, integrated into **IOER Research Data Centre**
- Based on **Open Science principles**



<https://colouring.dresden.ioer.info>

How citizen scientists can contribute?



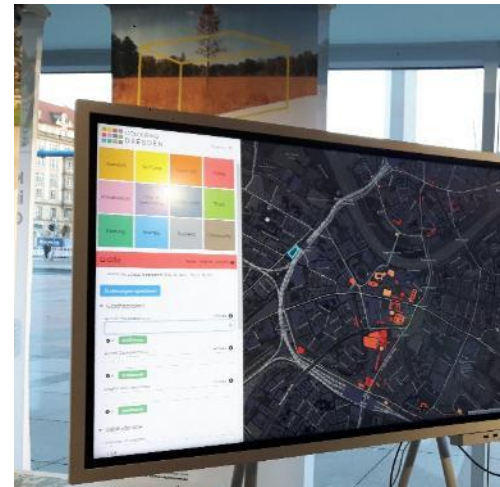
Danke et al. (2024): Closing knowledge gaps on the building stock with citizen science: introducing the Colouring Dresden platform. In: ARPHA Proceedings 6 (2024), S.159-164
<https://doi.org/10.3897/ap.e125607>



Discussion rounds



Workshops

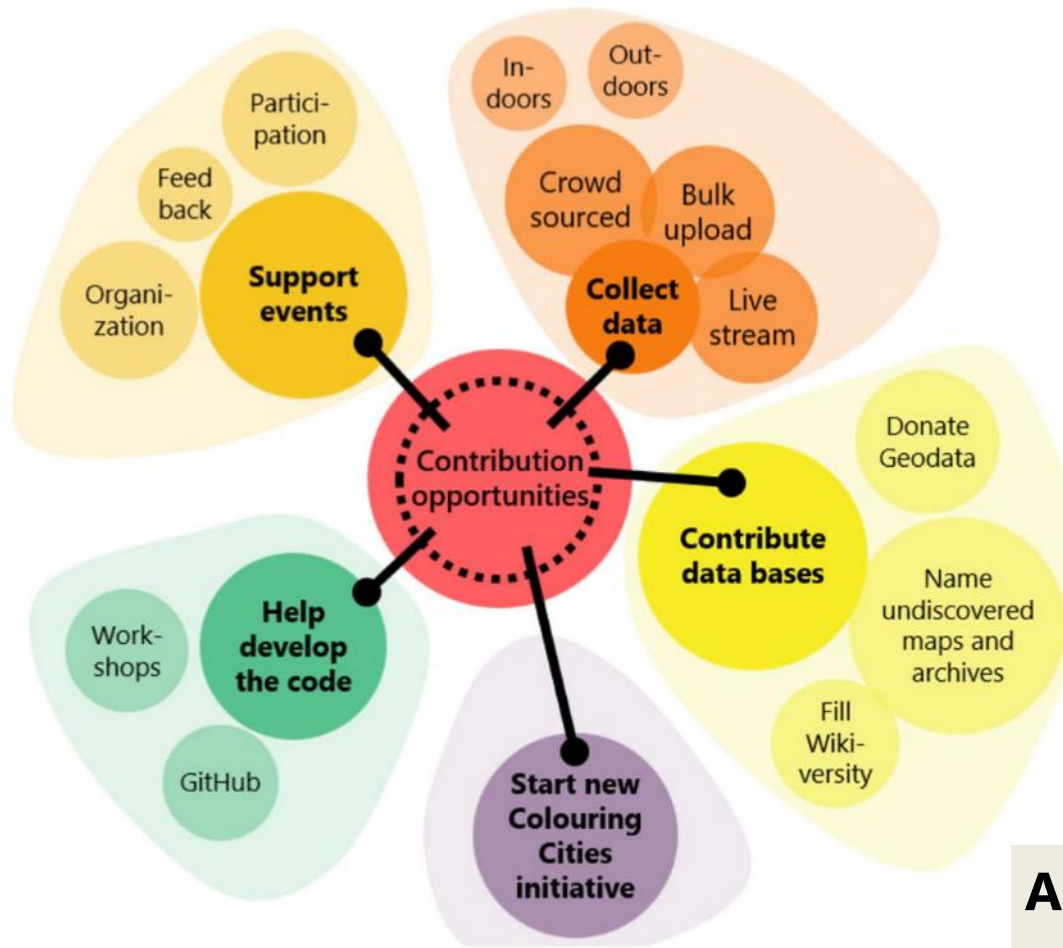


Demos / Exhibitions



City Walks / Mapathons

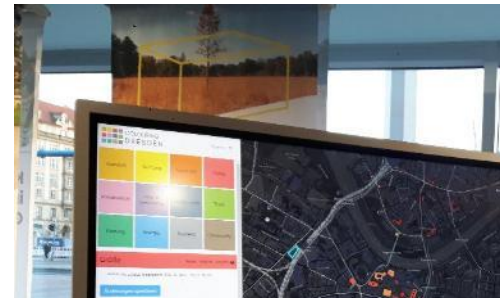
How citizen scientists can contribute?



Discussion rounds



Workshops



Achievements in 2 Years

- 50,000+ features
- from 150+ contributors
- 26+ events with 350+ participants

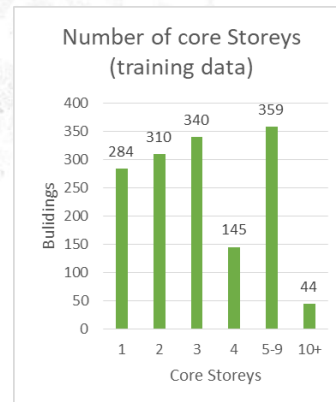
Danke et al. (2024): Closing knowledge gaps on the building stock with citizen science: introducing the Dresden platform. In: ARPHA Proceedings 6 (2024), S.159-164
<https://doi.org/10.3897/ap.e125607>

Combining Citizen Science and AI

Citizen Science data

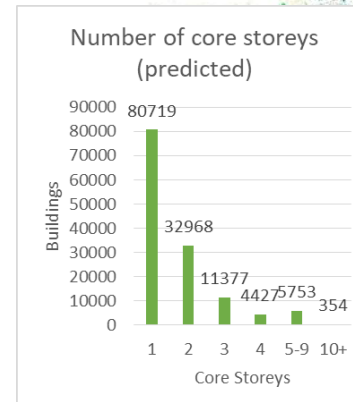
n = 1.480

Number of storeys
available in Colouring
Dresden



Prediction with XGBoost

n = 135.589



XGBoost prediction
using morphological
features

Accuracy:

Bias: -0.163

MAE = 0.356

RMSE = 0.774

Combining Citizen Science and AI

Citizen Science data

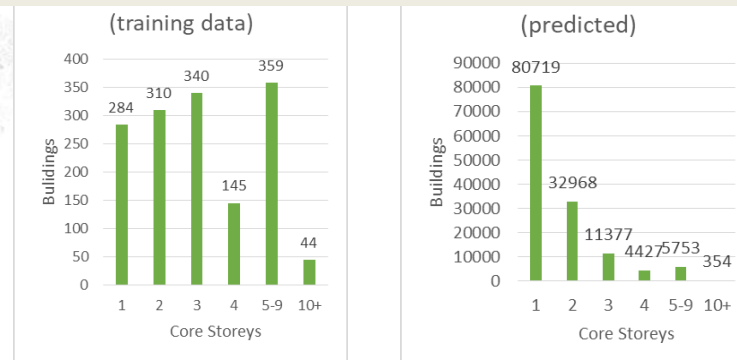
n = 1.480

Prediction with XGBoost

n = 135.589

Other recent works:

- Building age estimation
- Derivation of urban metrics for building type recognition
- AI-based automated interpretation of historical maps for generating time-series data (e.g. buildings, trees)



Predicted number of storeys

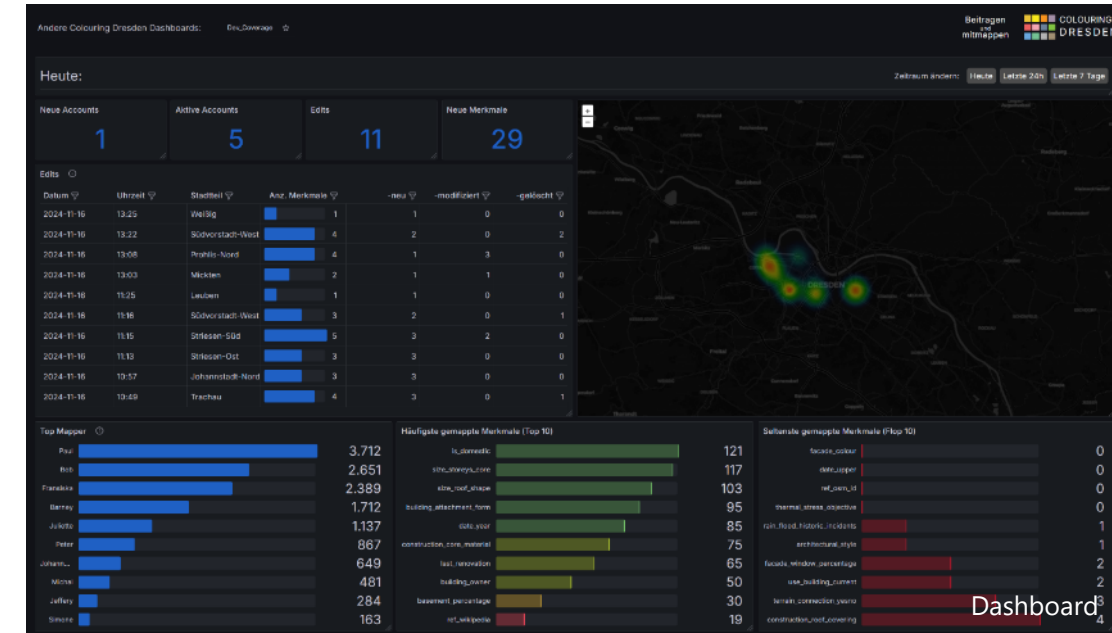
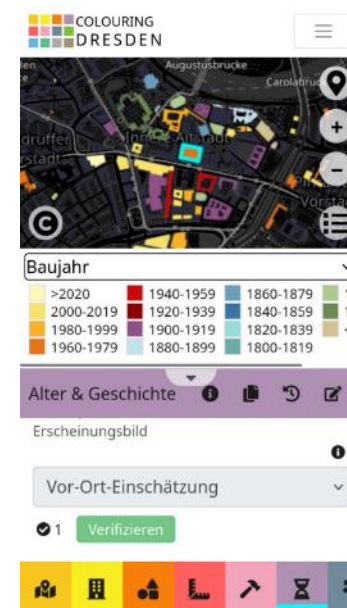
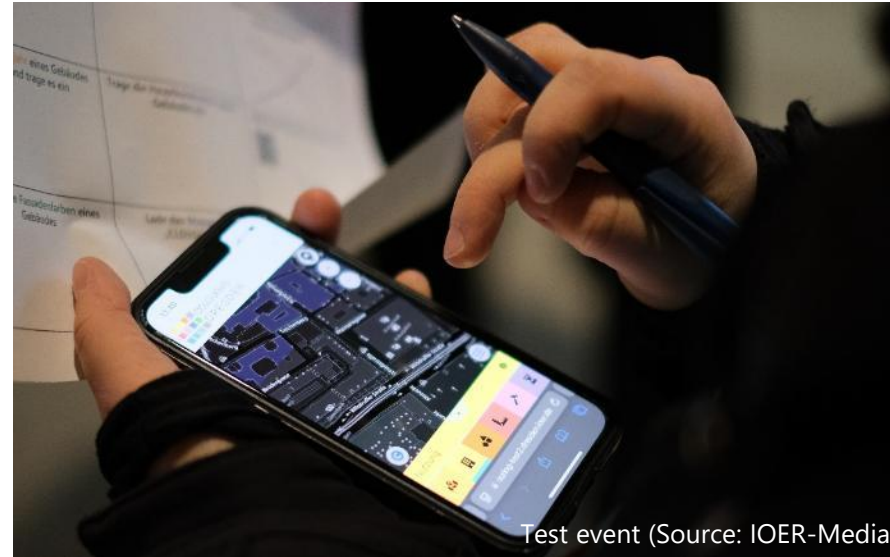
- 1
- 2
- 3 - 4
- 5 - 6
- >7

XGBoost prediction

Accuracy:
Bias: -0.163
MAE = 0.356
RMSE = 0.774

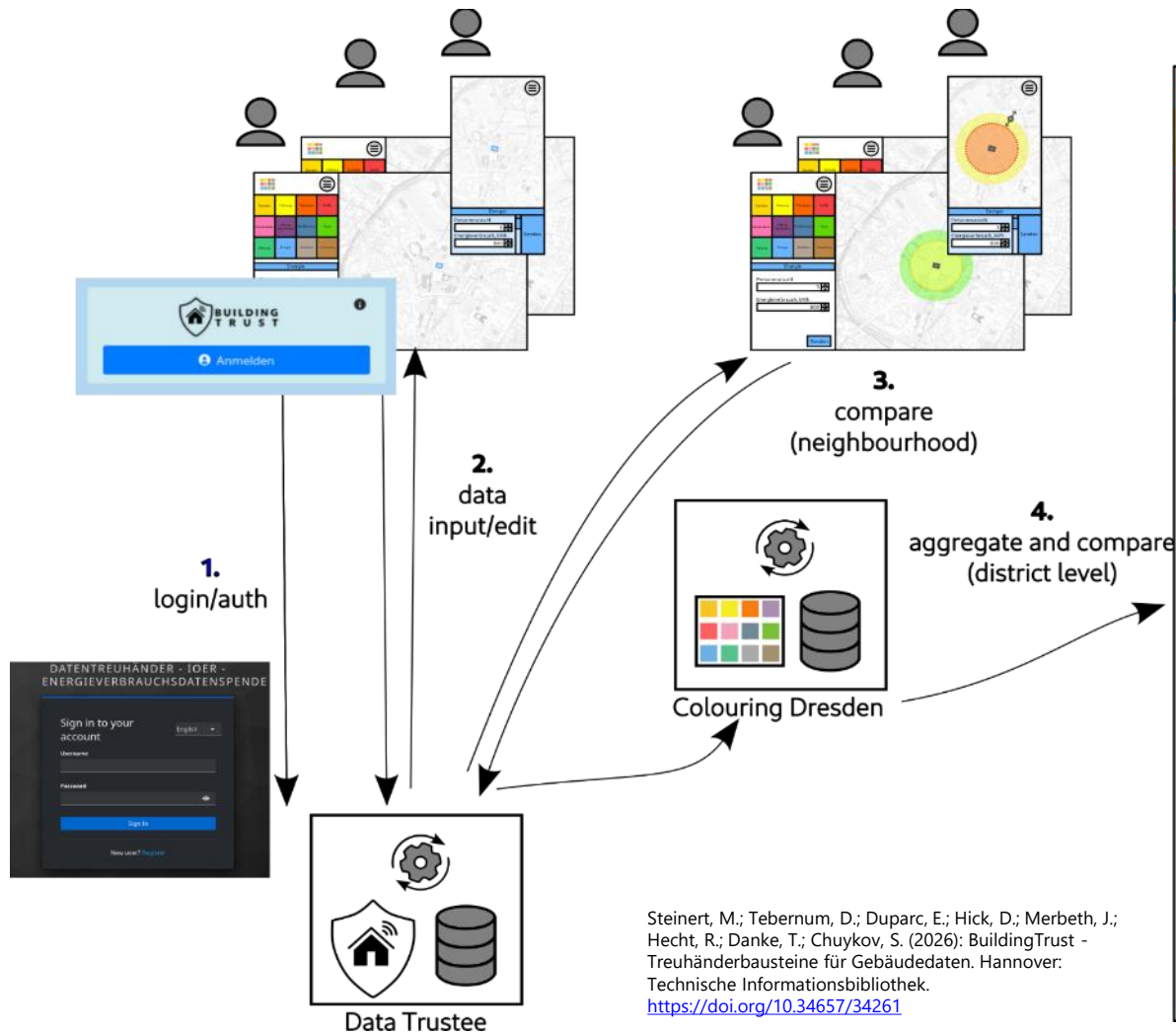
Current developments

- Research tool and research subject
- Diverse participation formats, open knowledge transfer and local partner network
- Technical developments:
 - Smart-phone optimized Front-End
 - Dashboard
 - Data Trustee Models for sensitive data
- Expansion to Colouring Germany soon

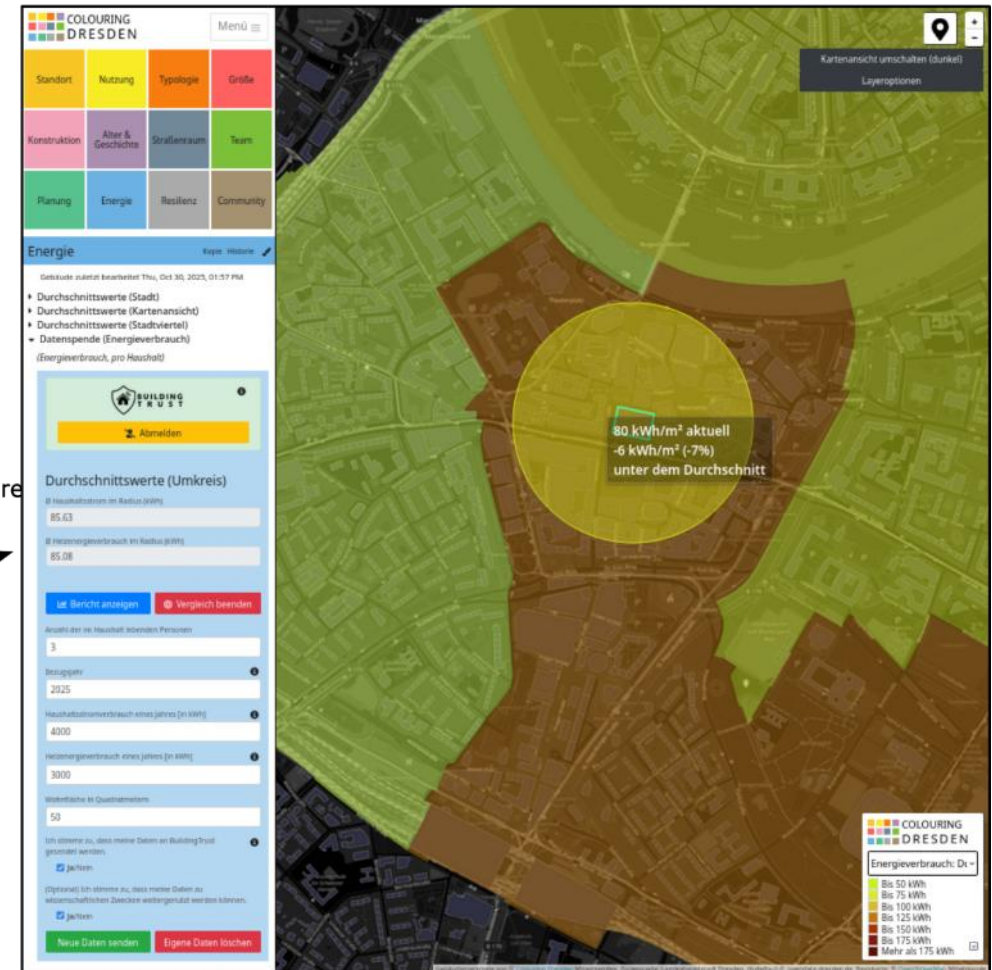


<https://colouring.dresden.ioer.info/>

Privacy-Preserving Data Donation Model



Steinert, M.; Tebernum, D.; Duparc, E.; Hick, D.; Merbeth, J.; Hecht, R.; Danke, T.; Chuykov, S. (2026): BuildingTrust - Treuhänderbausteine für Gebäudedaten. Hannover: Technische Informationsbibliothek.
<https://doi.org/10.34657/34261>



<https://www.ioer.de/projekte/buildingtrust>

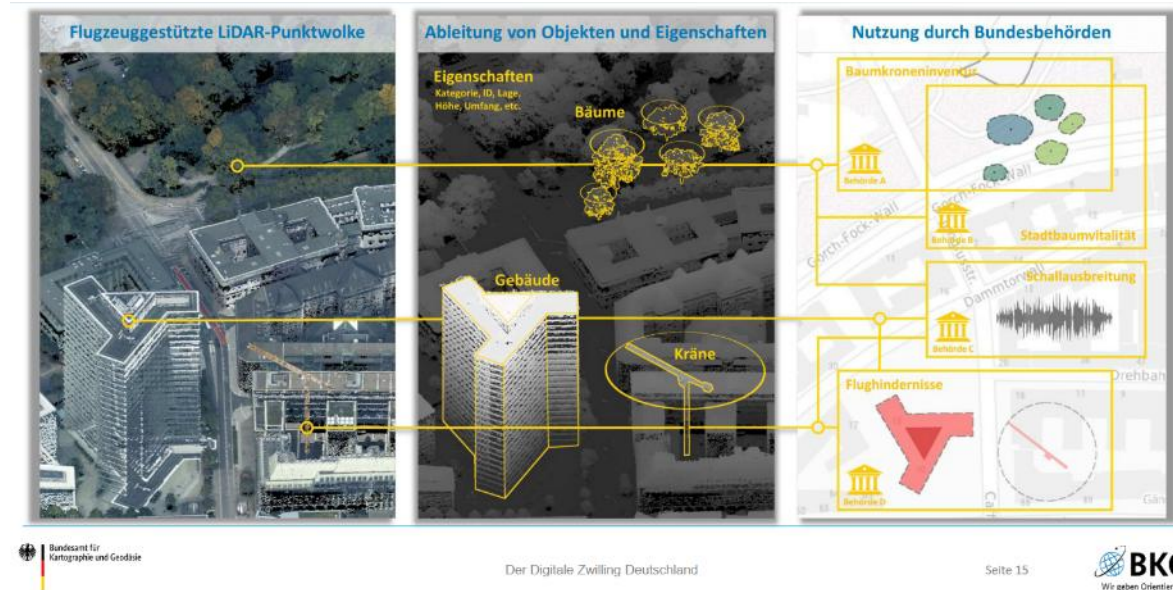
Digital Twin initiatives in Germany

Digital Twin Germany (National Level)

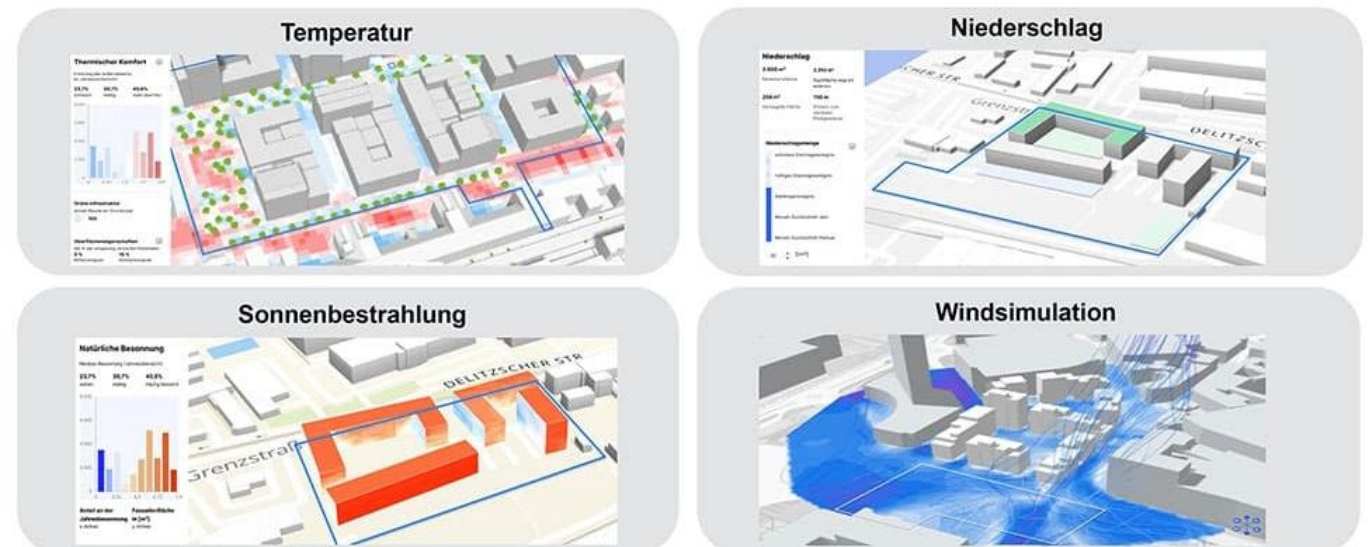
- Nationwide geospatial infrastructure providing standardized, interoperable base data
- Derived from LIDAR point clouds

Urban Digital Twins (Smart Cities initiatives)

- Models urban processes and interactions
- Supports decision-making and real-world feedback loops



Source: BKG



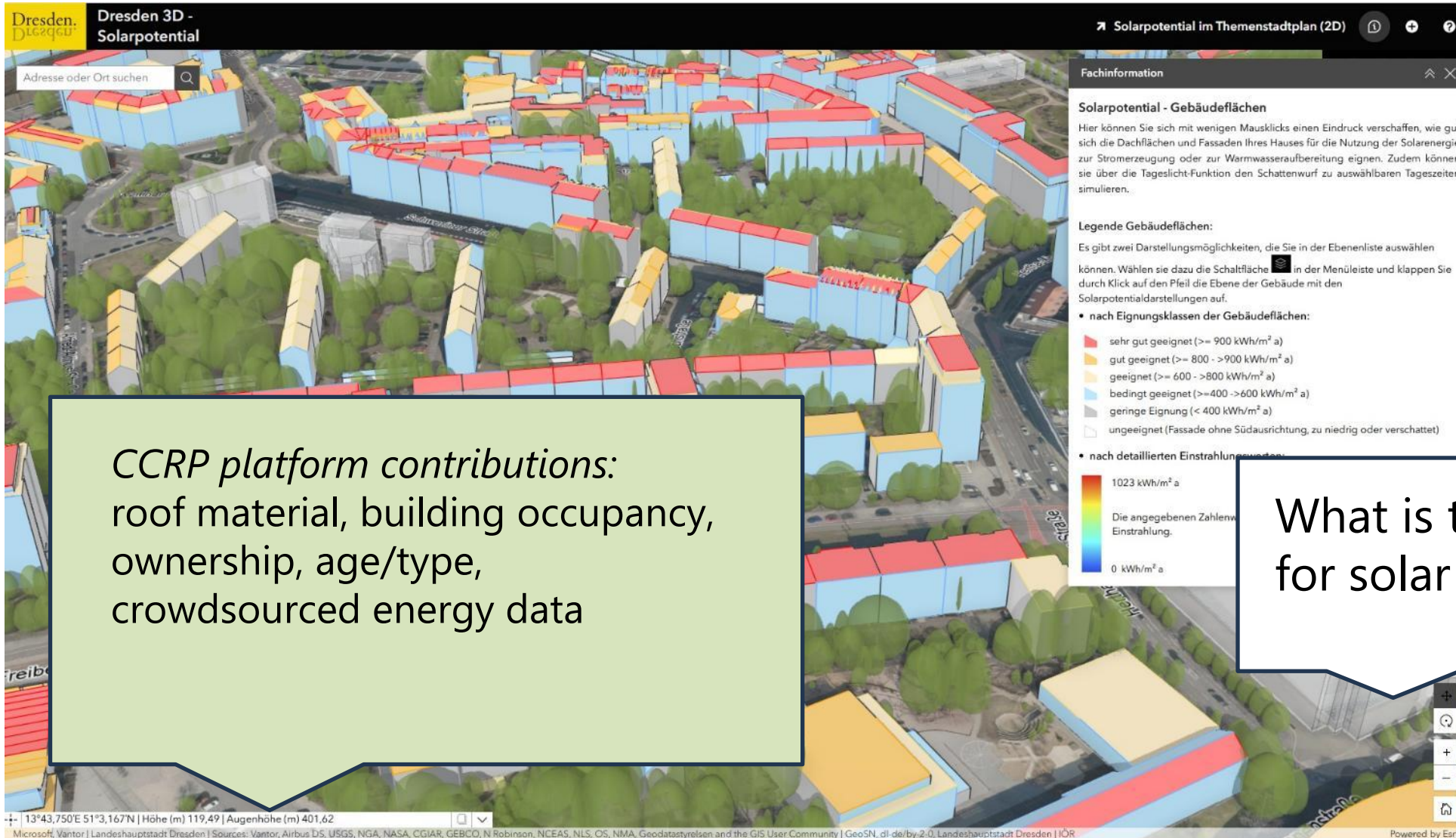
Source: Smart City Halle Saale (<https://www.smart.es.halle.de>)

Bildquellen: Click-Dummy von Form Follows You

CCRP opportunities for Urban Digital Twins

- **Integration of standardized platform data into digital twin applications** – use harmonized, interoperable datasets as a shared foundation for scalable use cases
- **Colouring Cities platform for crowdsourced validation** – enable citizen-based collection and verification of building and urban data
- **Reuse of data harmonization and processing pipelines** – apply existing data workflows to ensure consistency, efficiency, and scalability
- **Experimental prototyping of interactive front-end applications** – use Colouring Cities as a testbed for developing and evaluating user-facing digital twin interfaces
- **Using shared data trustee models for secure sharing of sensitive data** – integrate data donation services directly into portals via iframe for seamless accessibility and interaction

Example Use Case — Energy Atlas Dresden



Source: Landeshauptstadt Dresden, Energy Atlas (<https://experience.arcgis.com/experience/3b5a8c151d974fedbc201d0ab96e591f>)

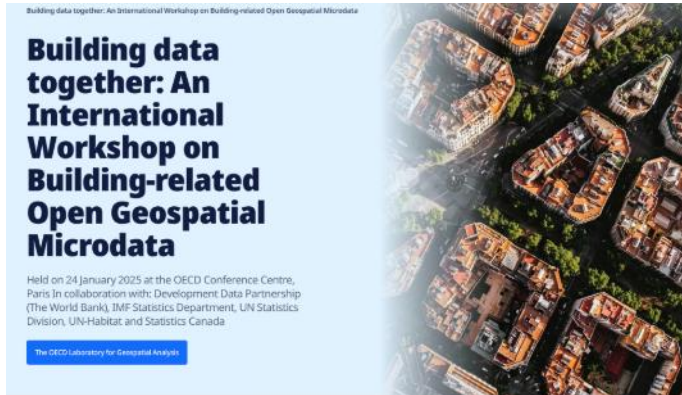
Example — Urban Digital Heavy Rain Twin Dresden



CCRP contributions:
building age/types, occupancy,
ownership, basement info, existing
precautionary measures

How does extreme
heavy rain affect my
home?

CCRP & Digital Twins



https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/06/building-data-together_431b6387/725f7274-en.pdf



Animation courtesy Dr Flora Roumpani. CCRP Procedural model demo- Colouring Britain



<https://www.github.org/articles/behind-the-case-study-how-open-capture-of-data-will-help-improve-buildings-in-line-with-the-sdgs/>