Index of Multiple Environmental Deprivation: Version 1

Approach, methodology and results

September 2024

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Design principles

- **Key objective:** produce a prototype IMED
  - **Proof of concept** approach
  - **Gauge wider interest and appetite** in v1
  - **Evolve and strengthen** in future iterations
- Use **free and open-source data** wherever possible
- Use **LSOA boundaries**, covering **England** only
- Use **universal data** covering all LSOAs
- Use **three environmental domains**
- Build in a **weighting system** to the model (but – without any evidence of best approach – kept all weights equal)
- **Limited time and budget**

Domain	Indicator
Pollution	Air pollution
	Noise pollution
Nature	Tree canopy cover
	Access to greenspace
Climate	Flooding risk
	Heat exposure risk

Methodology

IMED: Version 1

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Summary of scoring approach

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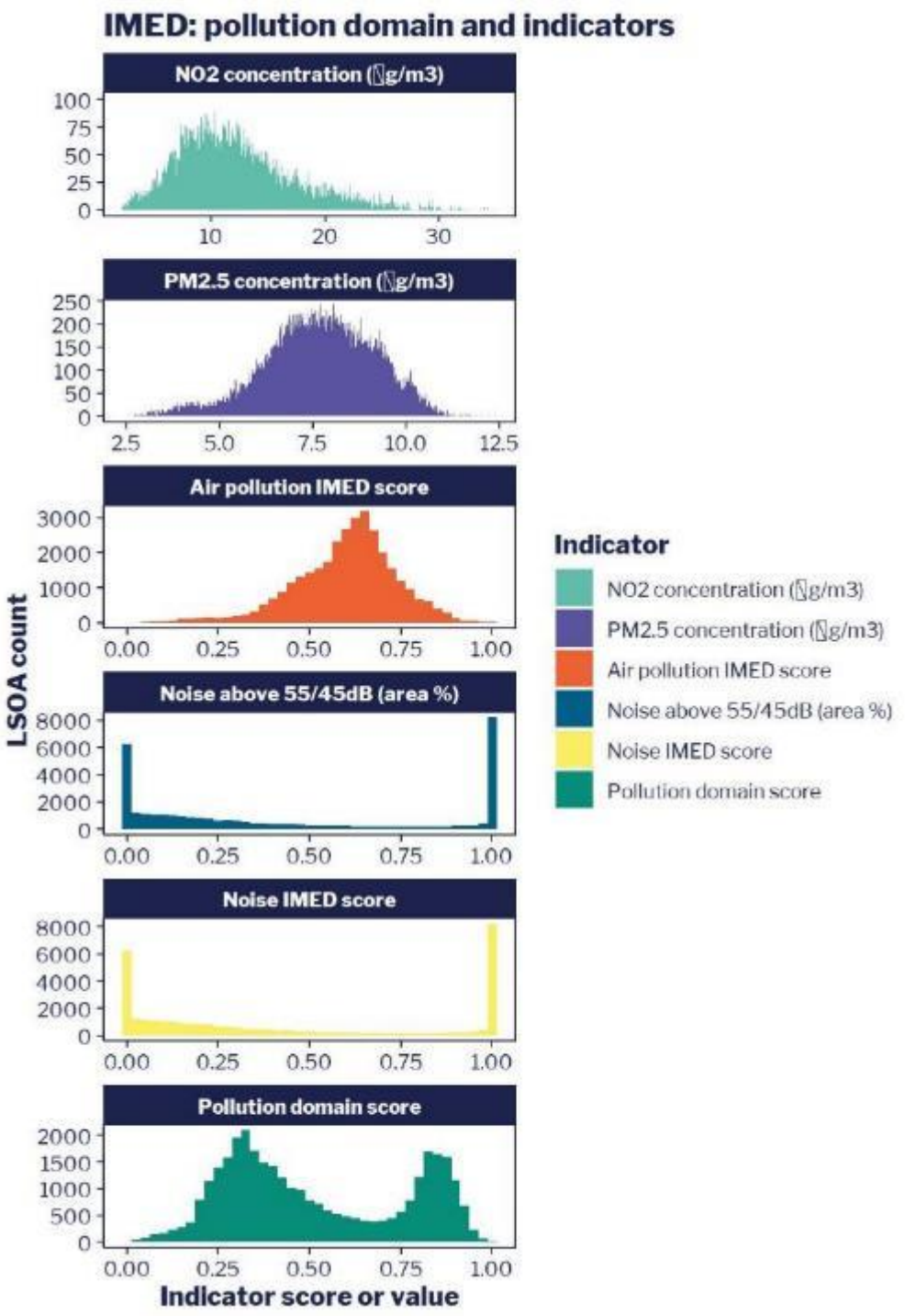
- **Processed data for each indicator** for each of the **pollution**, **nature** and **climate impact** domains.
    - **Derived an indicator score between 0 and 1** (1 = 'most environmentally deprived')
- Combined the indicator scores to **derive domain scores** (value = 0-1)

  (Added weighting options for each indicator and each domain)
- **Calculated IMED score**: sum of pollution, nature and climate domain scores.
- **Calculated IMED deciles** and domain deciles (1 = most env. deprived decile)
- **Outputs:** R program, data sets, maps and methodology document

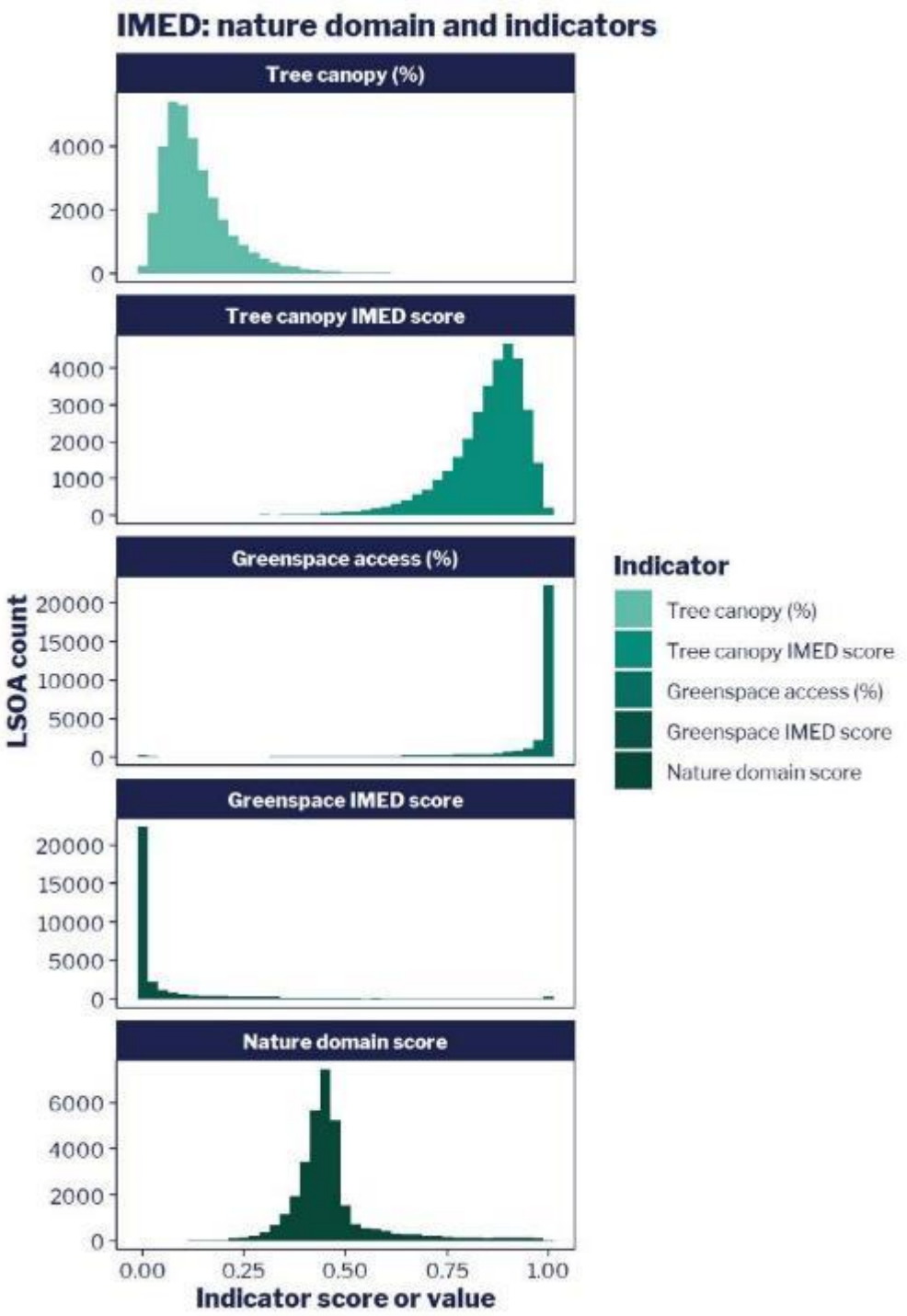
Pollution: Indicator processing summary

Indicator	Processing summary
Air pollution	**Source data:** NO_2 and $PM_{2.5}$ background concentrations at 1x1km grid (Defra), aggregated to LSOA boundaries. **Processing:** 1. Each pollution concentration rescaled to a value of between 0 and 1, with 0.5 representing WHO guidelines 2. Combined into one air pollution indicator, rescaling back to a value between 0 and 1 *(0 = lowest levels of air pollution; 0.5 air pollution at WHO guidelines; 1 = highest air pollution from NO2 and PM2.5)*
Noise pollution	**Source data:** Noise mapping of road and rail (55 db); Aircraft noise map (45 db). **Processing:** Proportion of an LSOA impacted by noise levels from road/rail above 55 dB and from aircraft above 45 dB. *(0 = 0% noise pollution; 1 = 100%)*



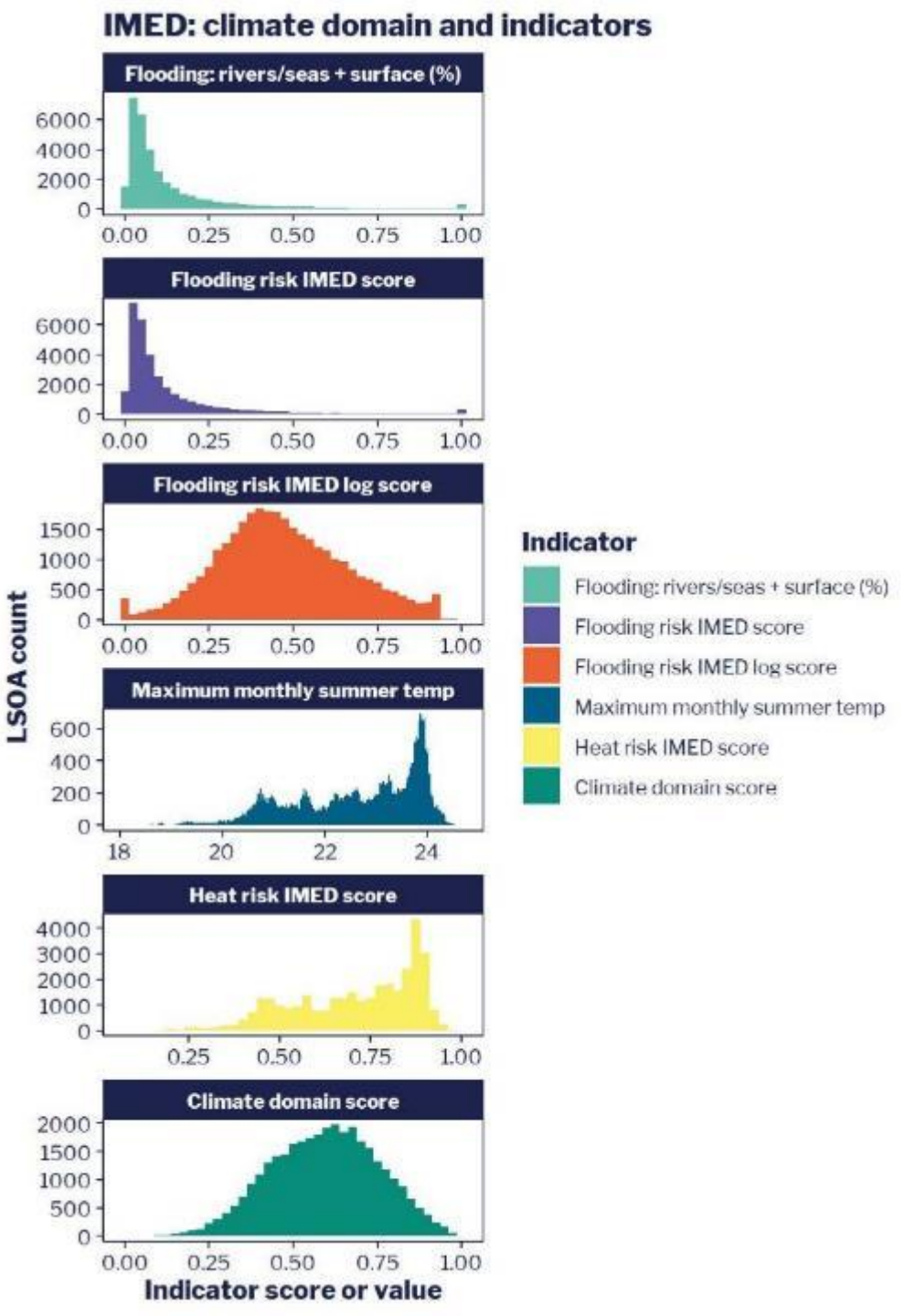
Nature: Indicator processing summary

Indicator	Processing summary
Tree cover	**Source data:** Tree canopy cover (%)(Terra Sulis) **Processing:** Inverted: *1 = 0% tree canopy cover* *0 = 100% tree canopy cover*
Greenspace	**Source data:** Access to green space in England, Scenario 2: All green space with rights of way (Defra). **Processing:** Percentage of LSOA population with access to green space (aggregated to LSOAs from output area data), inverted to a value of 0-1. *1 = 0% of population with access to greenspace* *0 = 100% of population with access to greenspace*



Climate risks: Indicator processing summary

Indicator	Processing summary
Flooding risk	***Source data:*** **Risk of flooding from rivers and seas; Risk of flooding from surface water** (Environment Agency). ***Processing:*** 1. Calculated proportion of LSOAs at risk from each type of flooding. 2. Combined into one flood pollution indicator. 3. Log transformation to normalise the distribution. *(0 = no risk of flooding; 1 = 100% of LSOA at risk of flooding)*
Heat exposure risk	***Source data:*** **Maximum average monthly summer temperature; 2020-40 20yr average** (CHESS-SCAPE) ***Processing:*** Aggregated to LSOAs then rescaled temperature distribution to a value of 0-1. *(0 = lowest monthly summer max temp across England; 1 = highest monthly summer max temp across England)*



IMED: Summary of calculation

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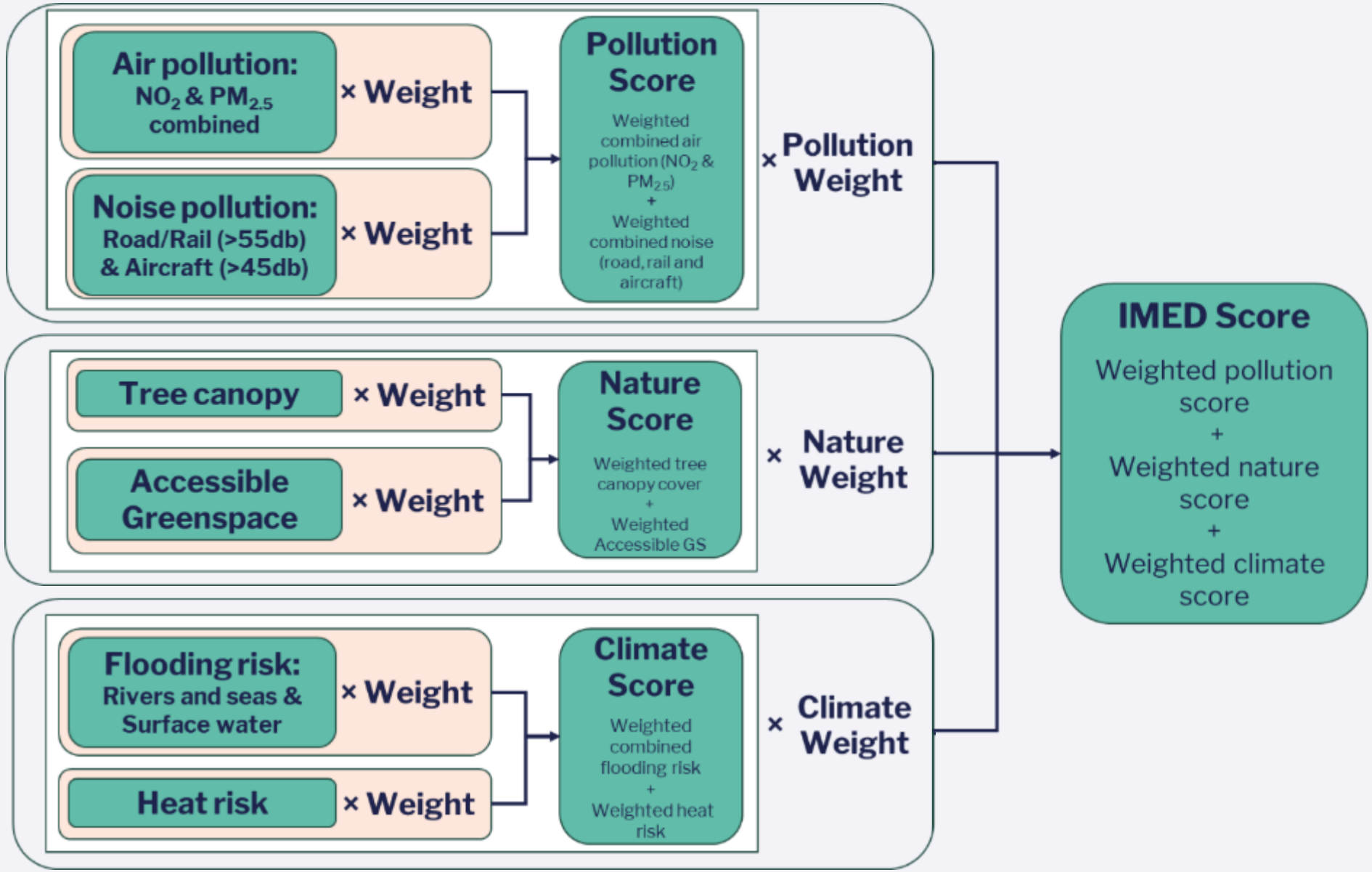

Data Caveats

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Number of indicators

- Not a comprehensive coverage of all environmental factors that contribute to pollution, access to nature and climate risks

Processing data and deriving indicators

- Nature of ‘raw’ data means some processing has been required to convert data into indicators
- Some indicator distributions are skewed
- Used thresholds for some but not all indicators
- Thus, some inconsistencies between indicators and not all with equal contributions to IMED

Additional domains

- Considered a fourth domain: “Living environment” (e.g. road accidents, housing quality, litter, derelict housing).

Summary: Version 1 should be considered ‘experimental’ and for demonstration purposes only.

Results

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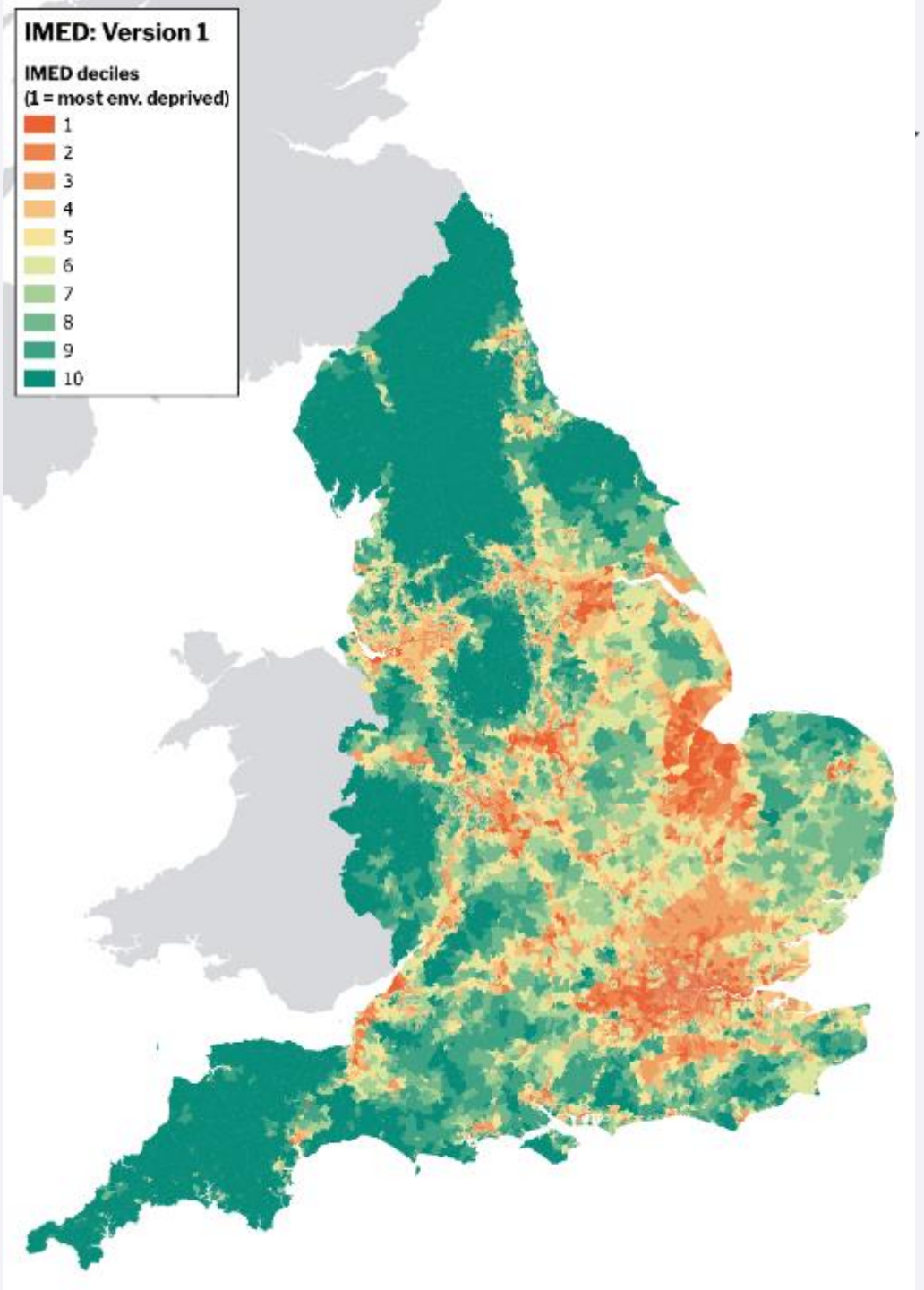
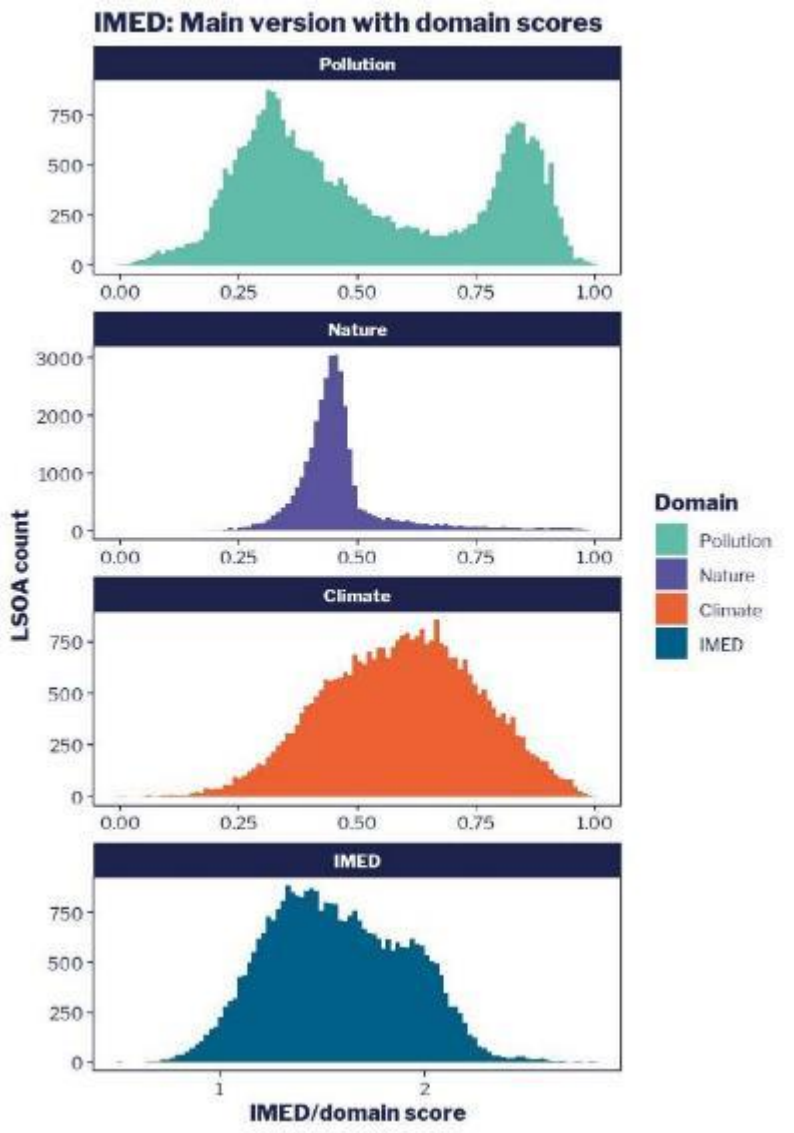
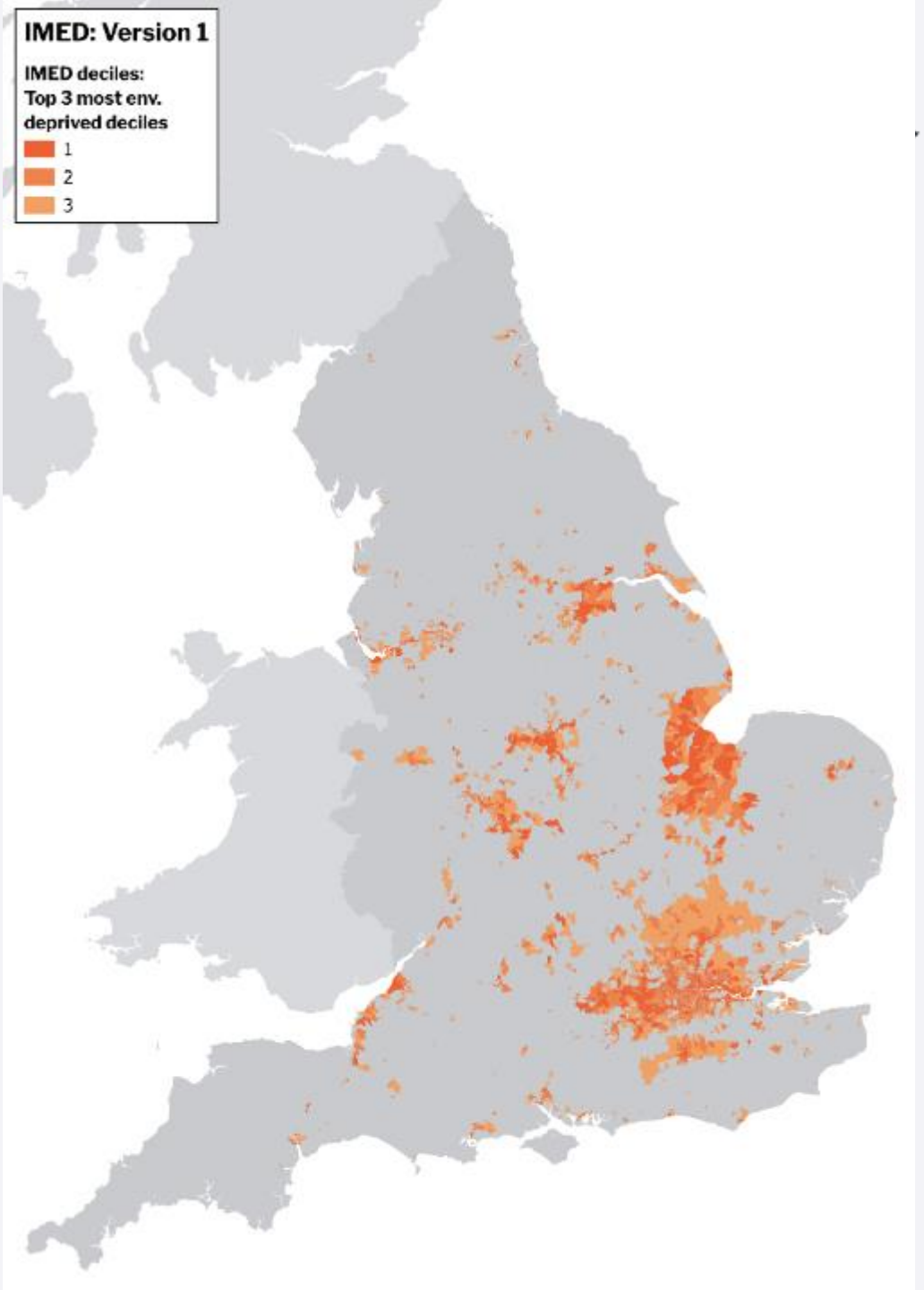
IMED Version 1: Outputs



IMED Version 1: Outputs





IMED: domain decile maps

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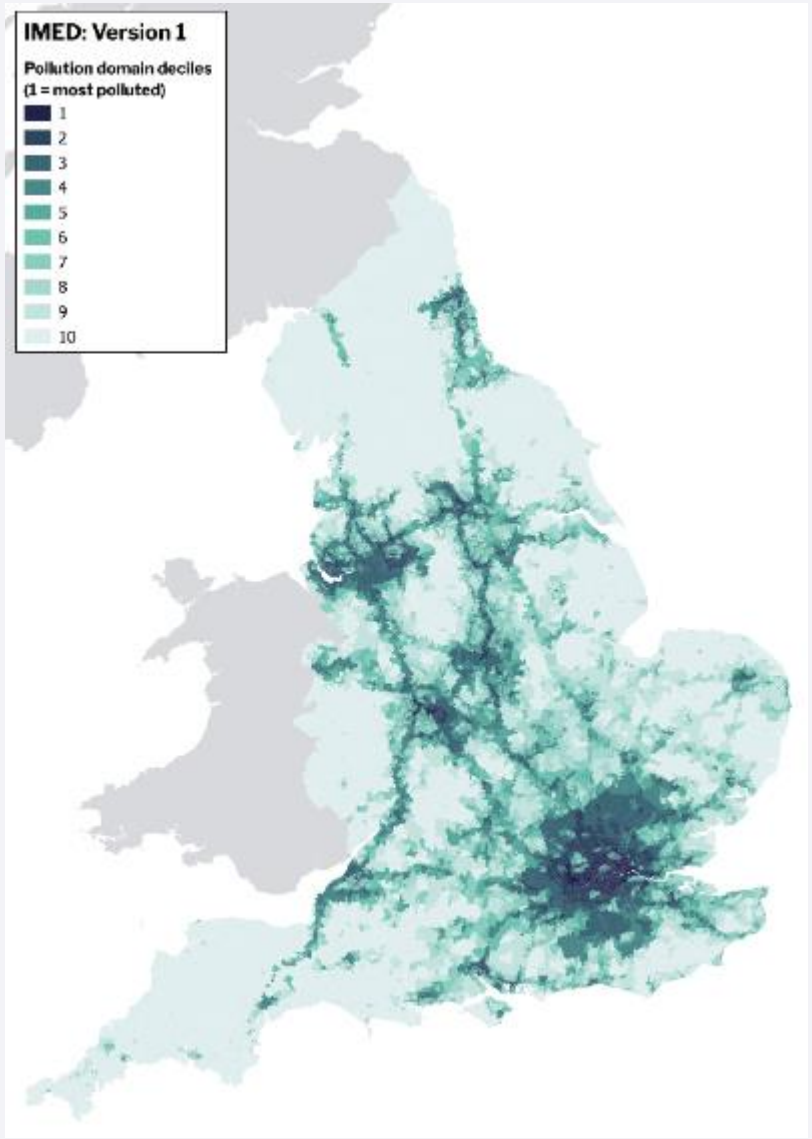

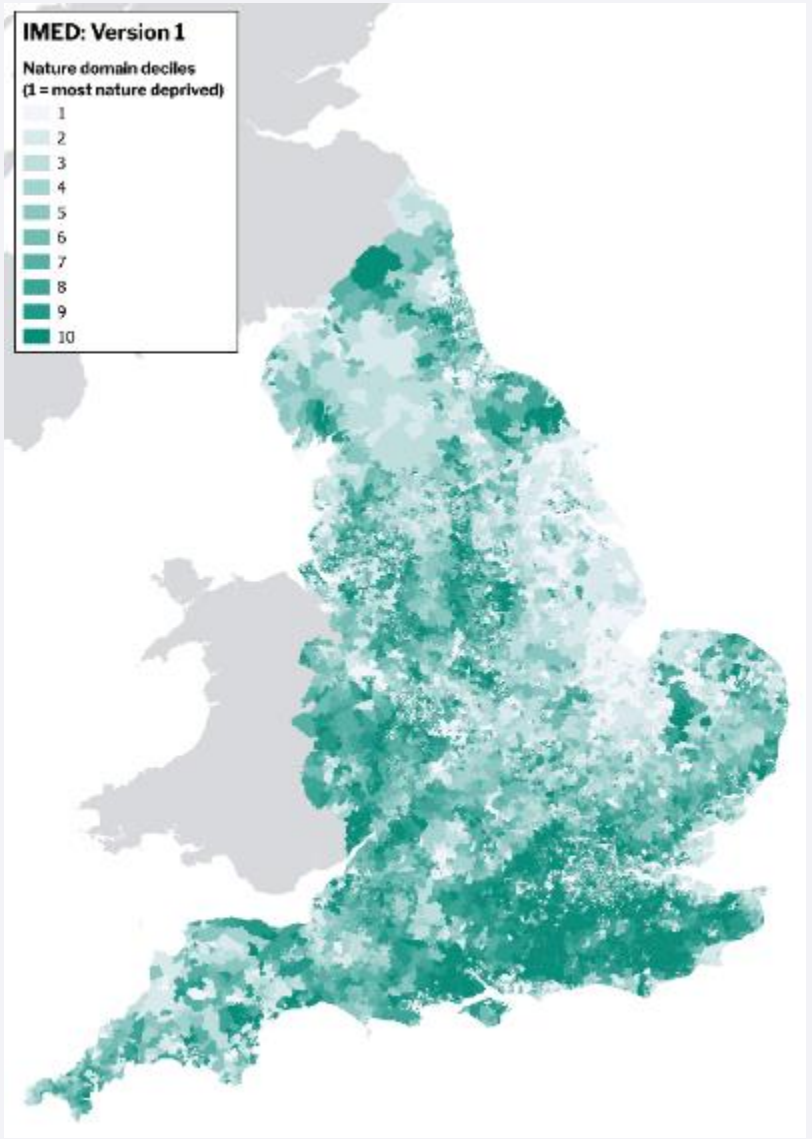

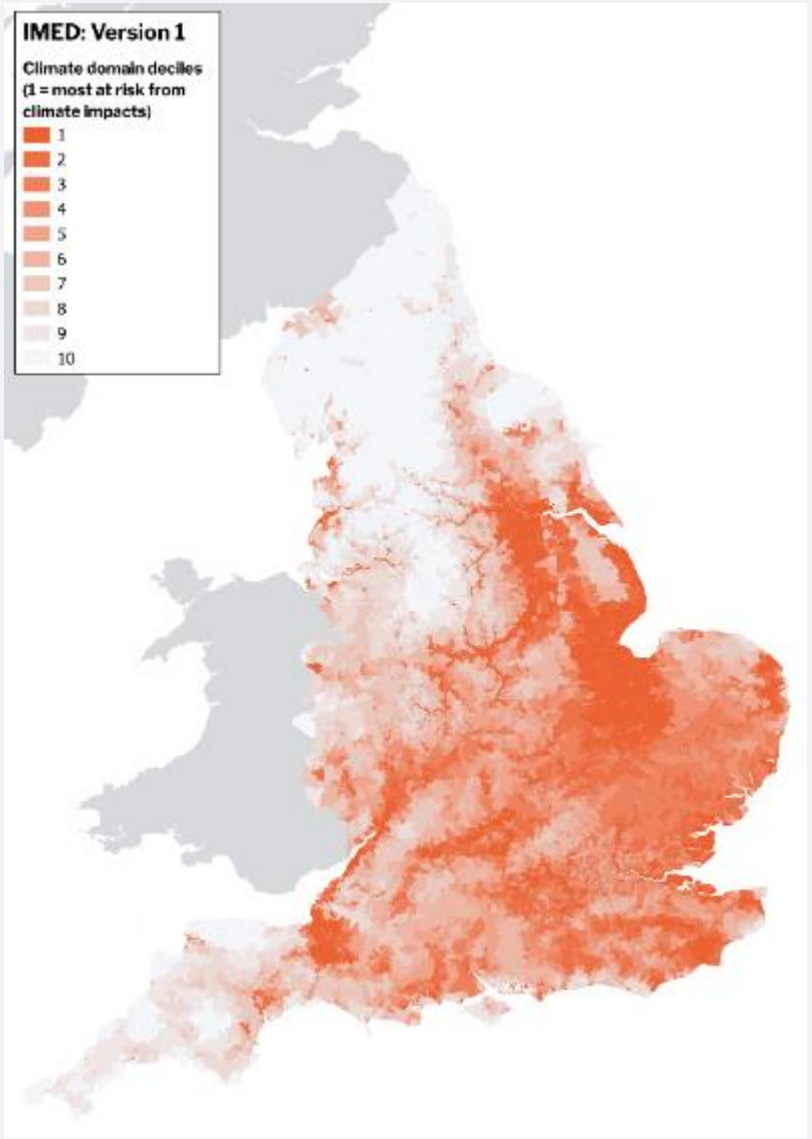

IMED deciles by rurality

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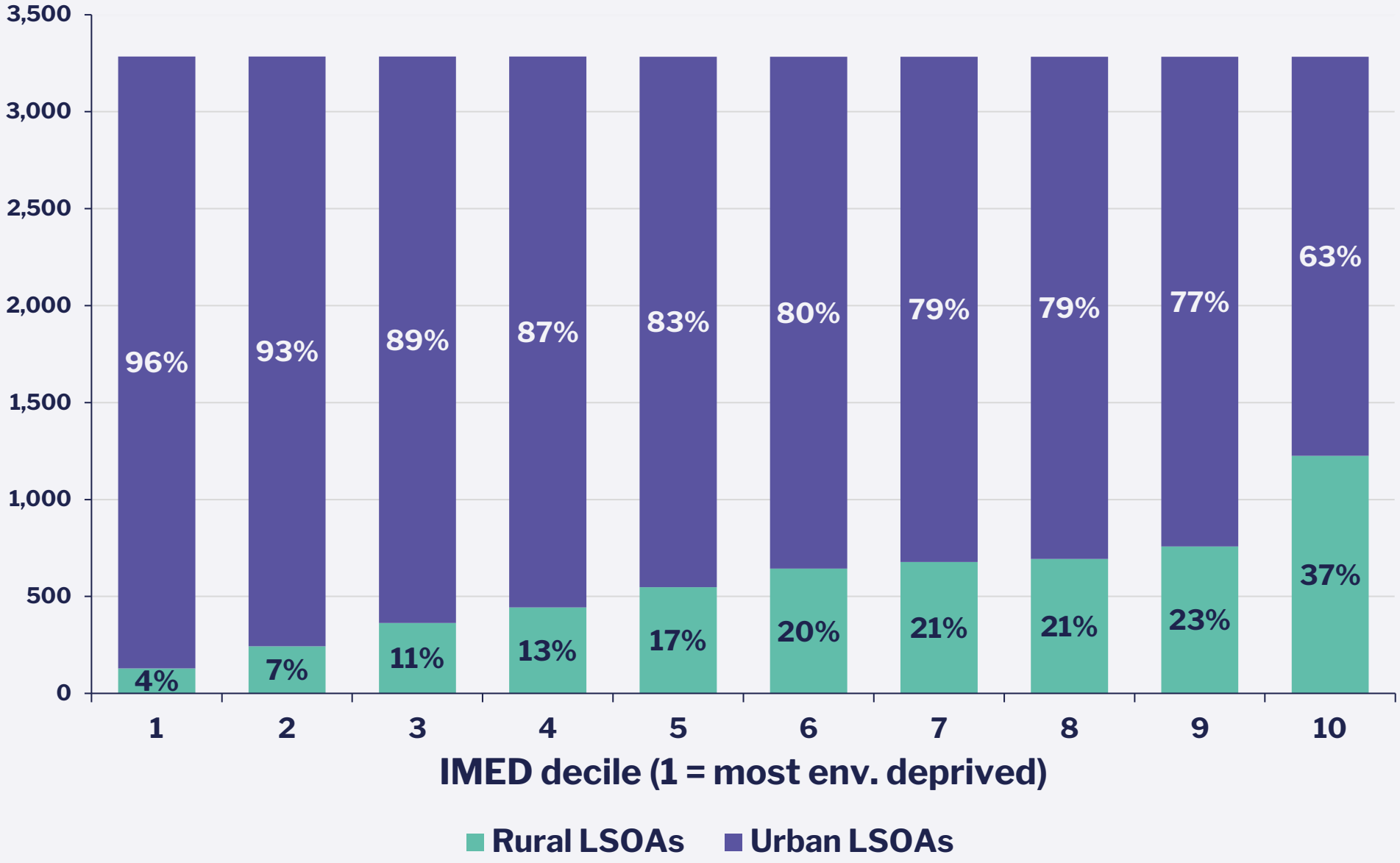

Correlation and convergence with the Index of Deprivation (IMD)

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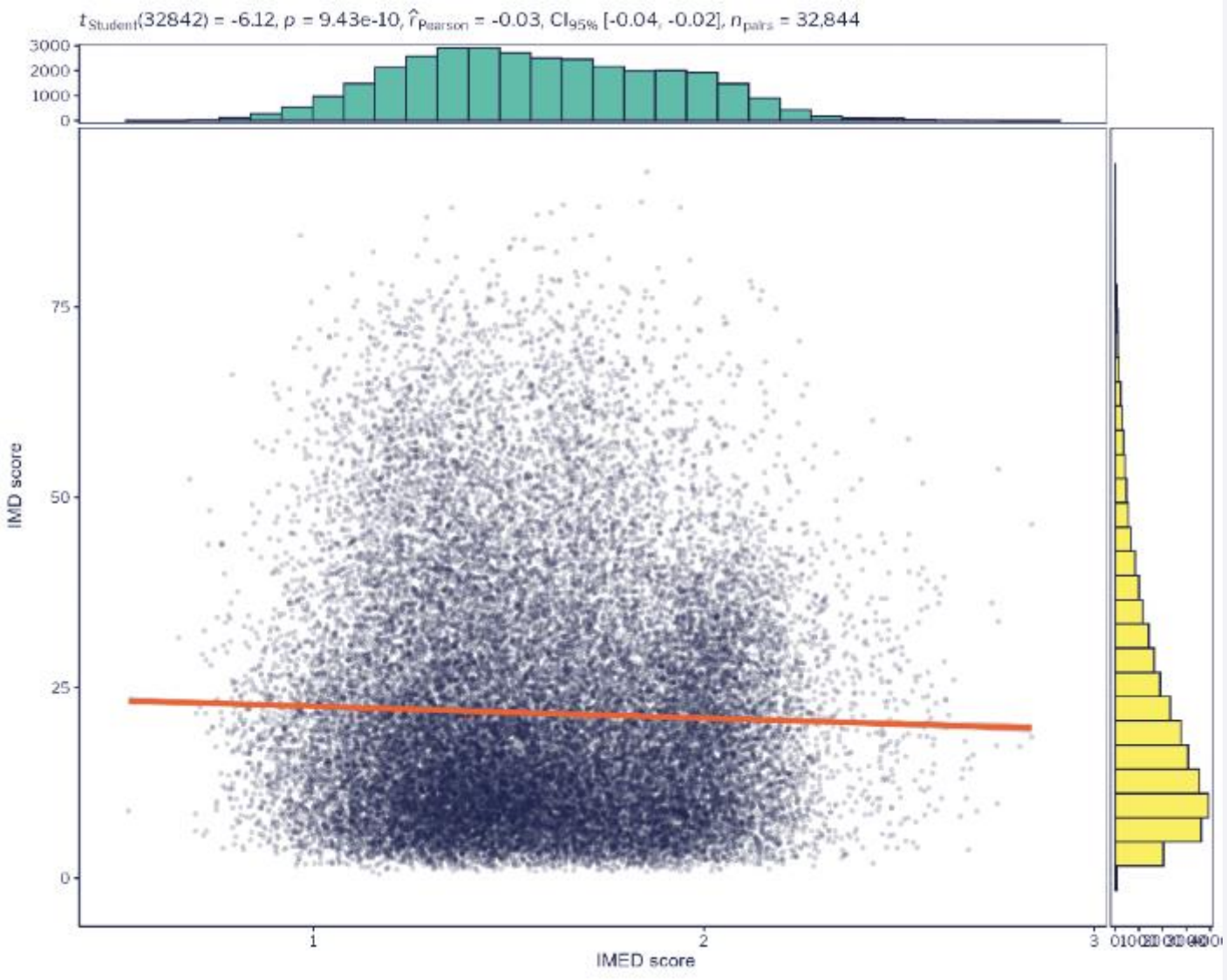

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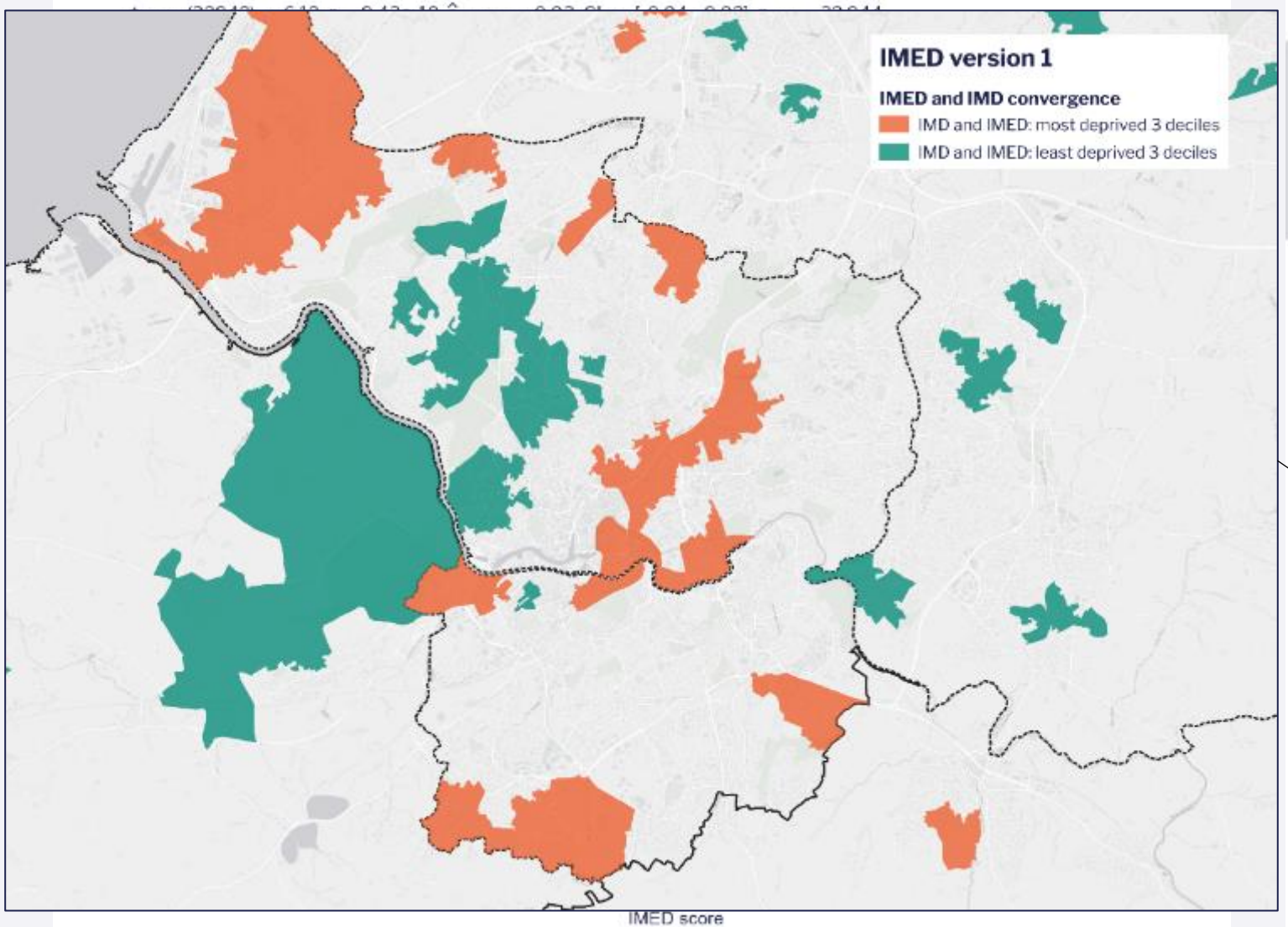

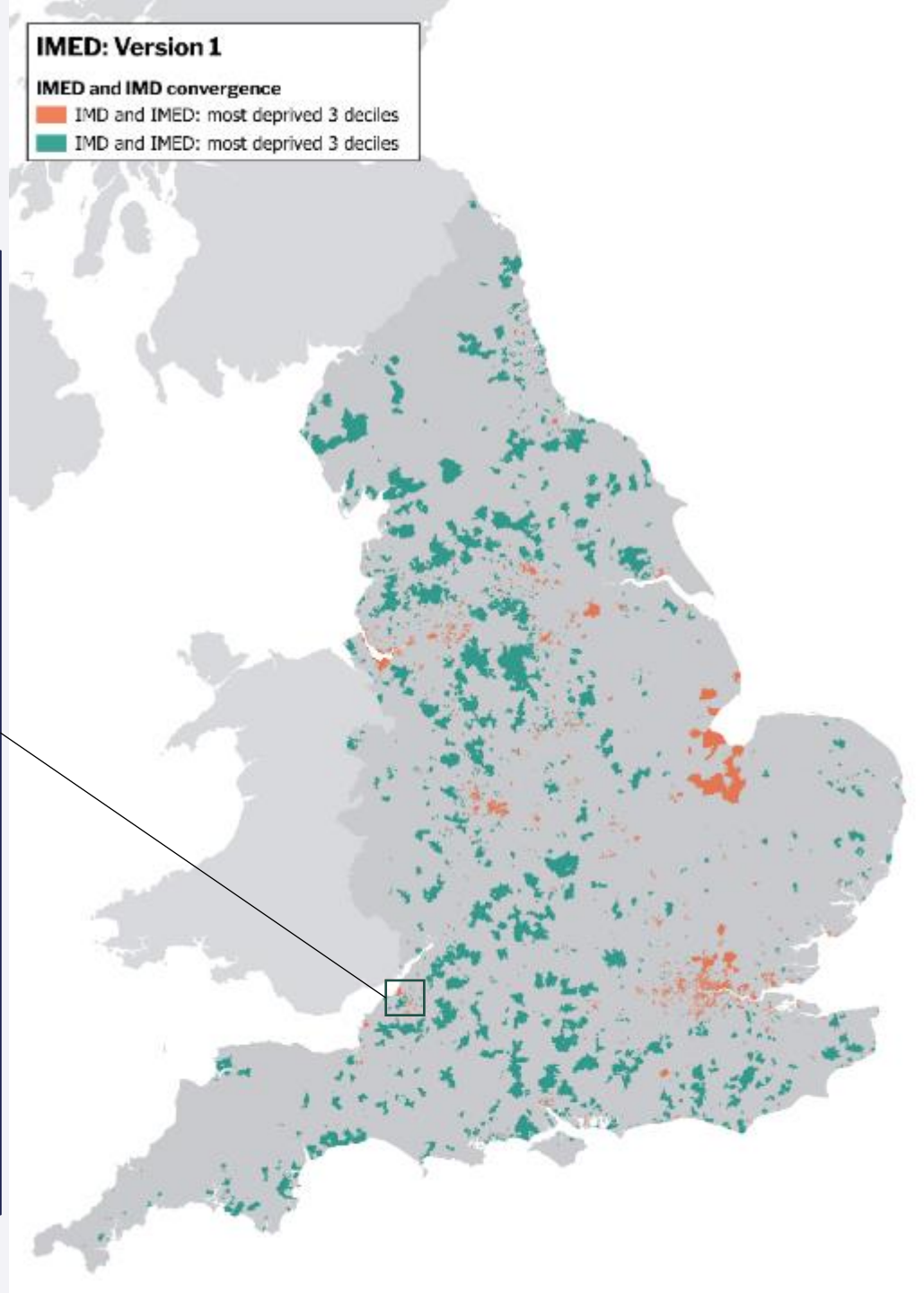

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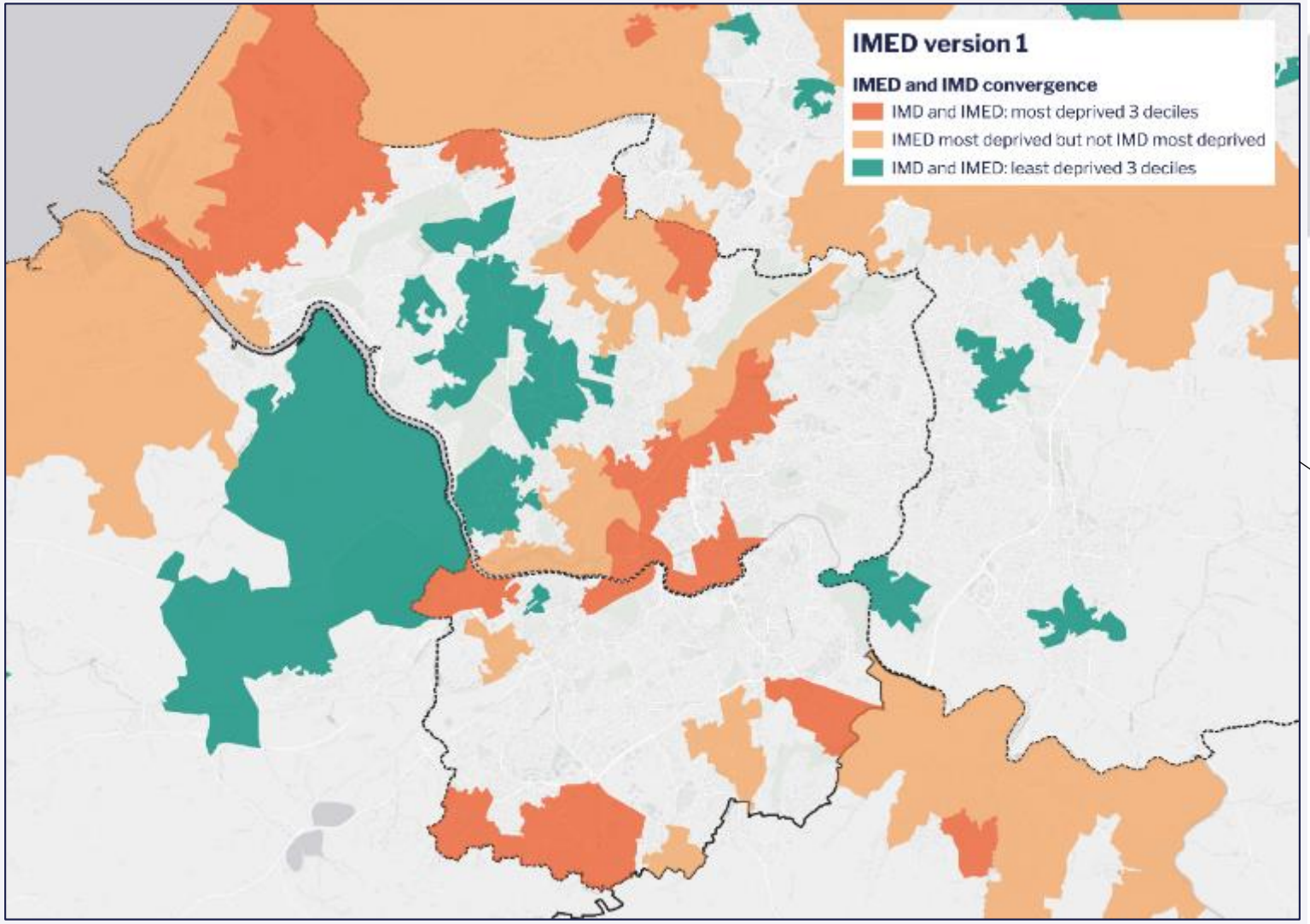

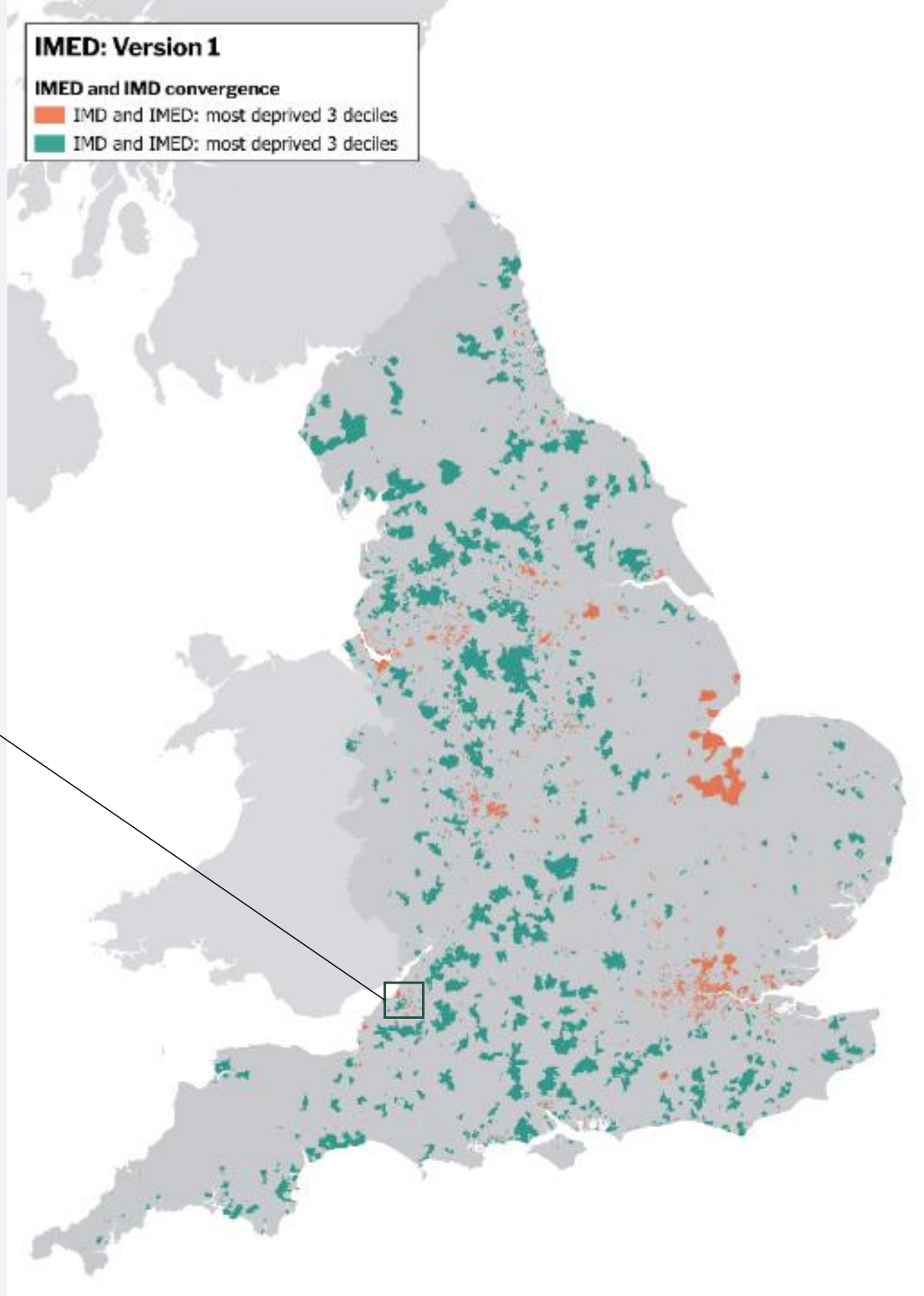

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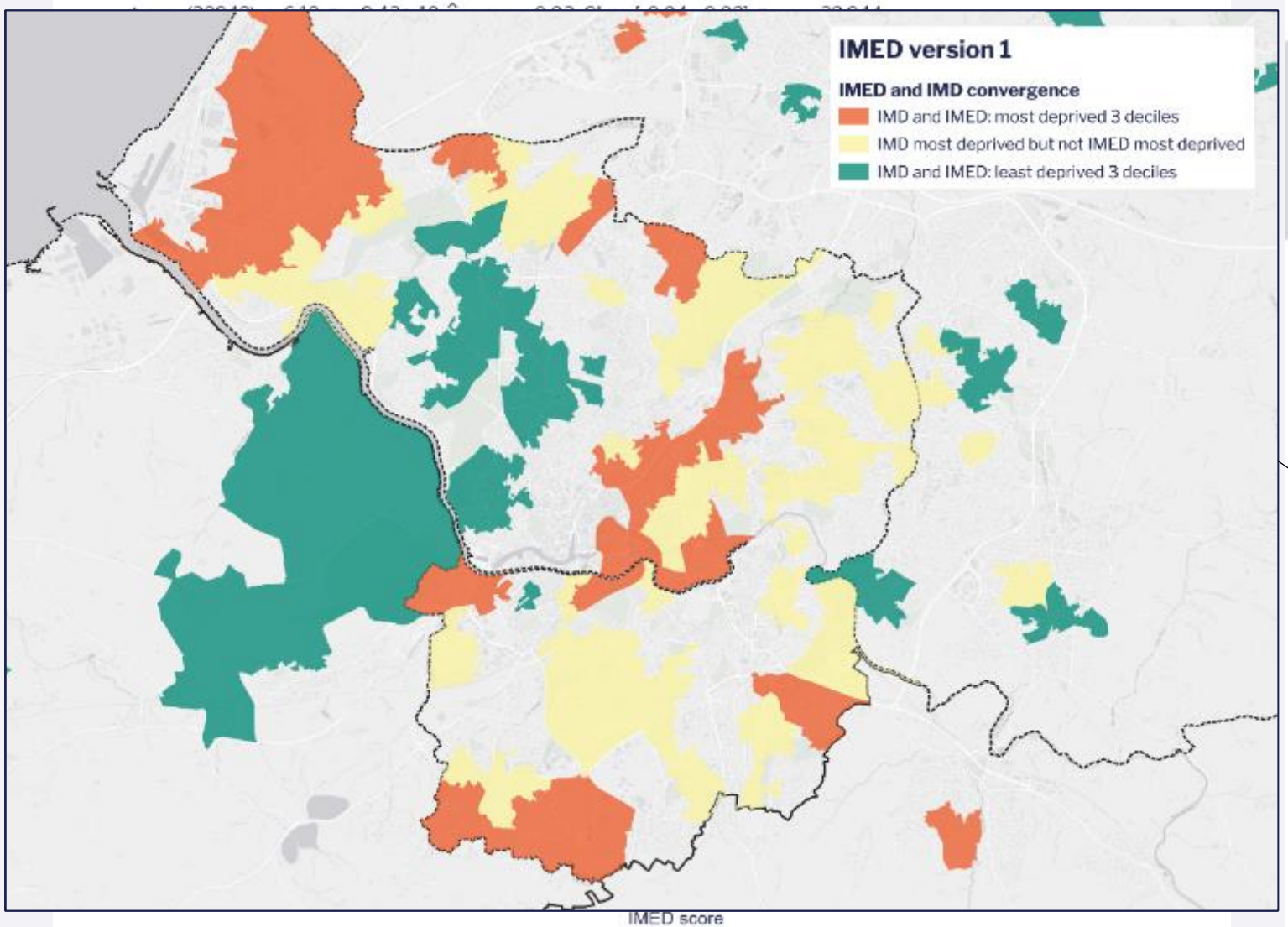

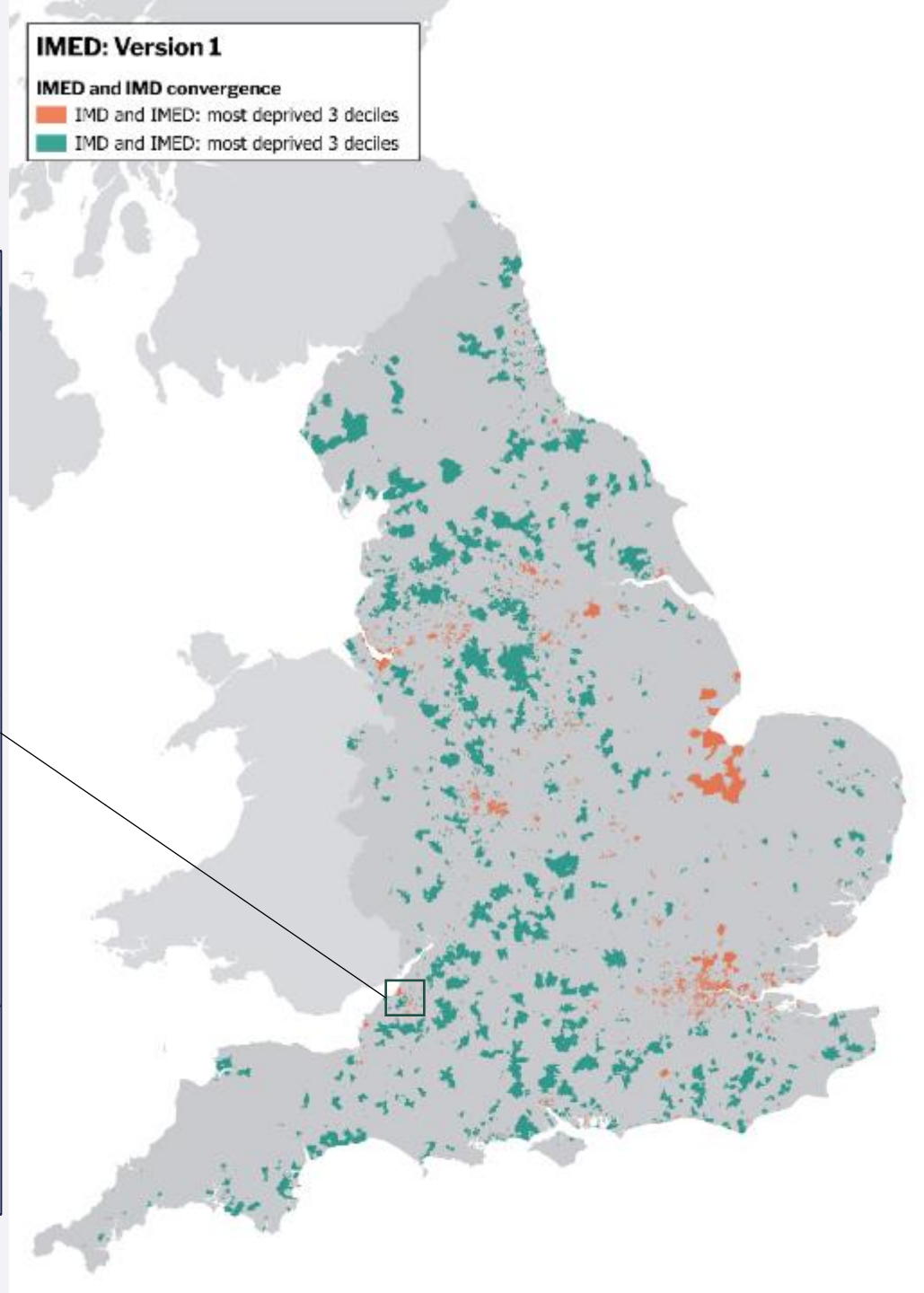

Data sources

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Data sources

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Pollution

- **Air pollution:** Neighbourhoods with NO_2 and $PM_{2.5}$ levels above WHO guidelines: Friends of the Earth analysis of Defra's modelled background air pollution data, 2022. uk-air.defra.gov.uk/data/pcm-data
- **Noise pollution:** Road and rail noise: Strategic noise mapping, Defra 2019. https://www.gov.uk/government/publications/strategic-noise-mapping-2019; Aircraft noise: Aircraft Noise Map (data provided on request) https://noise-map.com/home/.

Nature

- **Greenspace:** Access to green space in England: Scenario 2 (All green space with rights of way), Defra, Official Statistic in Development, 2024: https://www.gov.uk/government/statistics/access-to-green-space-in-england/access-to-green-space-in-england
- **Tree canopy cover:** Terra Sulis on behalf of Friends of the Earth, 2022. https://policy.friendsoftheearth.uk/insight/mapping-english-tree-cover-results-ranking-and-methodology

Climate impacts

- **Flood risk:** Risk of Flooding from Rivers and Sea, Low to High Risk Extent. Environment Agency (2024) https://www.data.gov.uk/dataset/bad20199-6d39-4aad-8564-26a46778fd94/risk-of-flooding-from-rivers-and-sea; Risk of Flooding from Surface Water – 1 in 100 year event extent. Environment Agency (2015). https://environment.data.gov.uk/dataset/51a5c4e7-10d3-4f34-bb0e-558835ab8c85
- **Heat risk:** Twenty year mean-monthly (Jan-Dec) near-surface daily maximum air temperature 2020-40 for RCP 8.5. CHESS-SCAPE: Future projections of meteorological variables at 1 km resolution for the United Kingdom 1980-2080 derived from UK Climate Projections 2018. https://catalogue.ceda.ac.uk/uuid/8194b416cbee482b89e0dfbe17c5786c

Feedback and thoughts...

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Feedback and thoughts?

- **Design:**
  - Are the current indicators selected acceptable?
  - How can we improve the indicators and calculation of domains scores?
  - What further indicators should we consider including?

- **Methods**:
  - Have the best data sets been used for the current list of indicators?
  - What other data sets should we include?
  - Would you process the data differently?
  - Is the aggregation method appropriate or are there better approaches we should consider?
  - Should we add weighting to different indicators and domains? If so, how should we apply these weights?

- **Application:**
  - What are the potential uses of the IMED?
  - Who are the key audiences and users of the IMED?
  - What would these different users need from IMED outputs?
  - What data formats should we use? And how should we make them available to users?
  - What other outputs help audience engage with and use the IMED (e.g. maps, data visualisations, etc.)

- **General:**
  - Who else should we consult and engage with?
  - Should we look to involve others in the future? Which other organisations are best placed to help?
  - What other questions should we ask?!
  - Any other comments?

Thank you

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