Indicator specification:

GroundsWell collection of geographical and population health indicators

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Unique Property Reference Number (UPRN) indicator: Satellite measures (UPRN_5_1)

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Author: Professor Mark A. Green

Overview

Indicator title

Unique Property Reference Number (UPRN) indicator: Satellite measures (UPRN_5_1)

Indicator family name

Unique Property Reference Number

Descriptor Plain English description

This indicator provides satellite derived green and blue space indices at UPRN level.

Technical description

This indicator provides satellite derived green and blue space indices at UPRN level. The following indices were estimated:

- Normalised Difference Vegetation Index (NDVI)
- Enhanced Vegetation Index (EVI)
- Normalised Difference Water Index (NDWI)

The indicators were generated using remote sensing / satellite imagery. They are based on 300m buffers around each UPRN (i.e., to represent the broader area characteristics, since one pixel may capture only the roof of a building), although one can change the size of the buffer during the process. The reduce the amount of computation required, the actual calculations were done at TOID (TOpographic Identifier, as defined by the Ordnance Survey: https://www.ordnancesurvey.co.uk/products/os-open-toid) level, then mapped to UPRNs.

Unique Identifier

UPRN_5_1

Construction

Data sources

There are two key data sources used here: (1) Household locations, and (2) Satellite imagery.

1. **Household locations**

   The target household identifiers that we want to compute the indicators for are Unique Property Reference Numbers (UPRNs). UPRNs are unique identifiers for all unique properties across Great Britain. Data were downloaded on 4th June 2024 using the Office for National Statistic's open UPRN directory. The resource is based on Ordnance Survey's 'AddressBase' data product and includes a list of all UPRNs and their geographical location (Geographic Reference System: OSGB 1936, 27700).

The population of interest for our metric is Cheshire and Merseyside. An additional ONS lookup table linked to each UPRN was used to subset only UPRNs that fall within the Local Authorities of Cheshire and Merseyside (Chester and Cheshire East, Cheshire West, Halton, Knowsley, Liverpool, Sefton, St. Helens, Warrington and Wirral). If you wanted to recreate our indicators for a different region, one would have to change this step in the code.

Using UPRNs makes the code computationally intensive and results in very large file sizes (especially once we calculate buffers for each point). To improve the time spent processing UPRNs, we initially compute the metrics for Topographic Identifiers (TOIDs) rather than UPRNs. UPRNs are nested within TOIDs, since UPRNs will give each unique property and TOIDs give the unique building. For example, a tower block or student halls accommodation will have many UPRNs for the same TOID/building (e.g., Crown Place student halls at the University of Liverpool (UK) has ~1200 UPRNs for a single TOID). Through using TOIDs, we reduce the number of computations on the assumption that they will be similar for all UPRNs (note: there will be some small differences where TOIDs have multiple entrances, but the differences should be negligible here). The result is that using TOIDs gives us a dataset which is 23% smaller than if we use UPRNs only. In the workflow described below, we first estimate each indicator for TOIDs within Cheshire and Merseyside (using the datasets described above), then link the TOID values back to UPRNs using an Ordnance Survey lookup table. If you are using the code for smaller regions of UPRNS, then you may not need to do this.

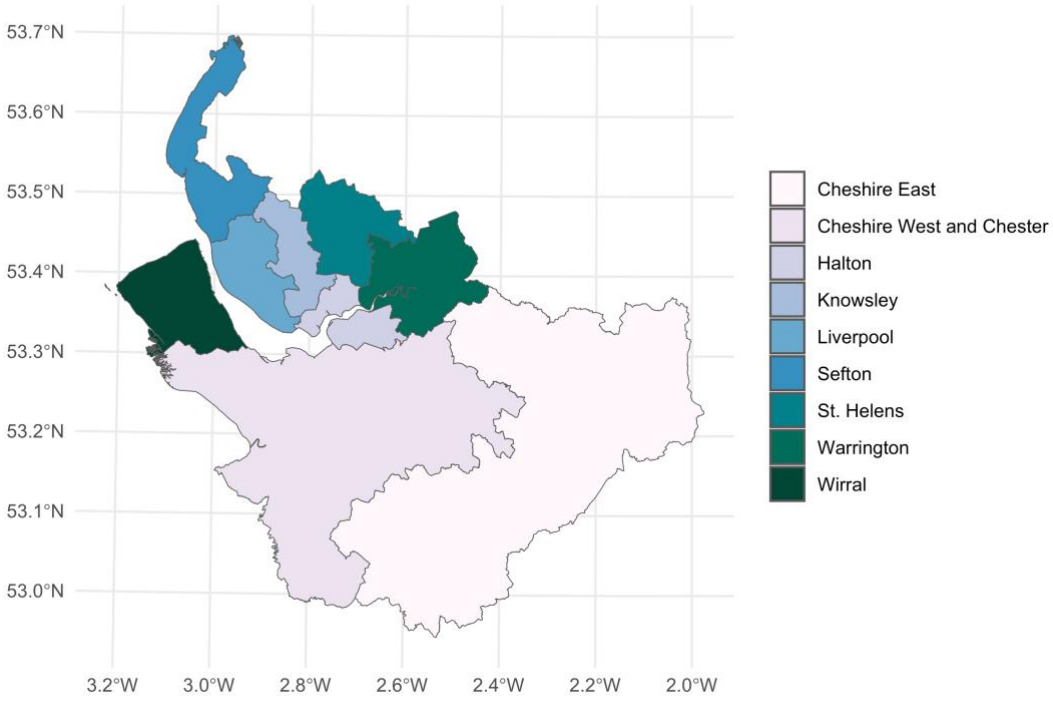

Figure 1. NHS Cheshire and Merseyside ICB region

2. **Satellite imagery**

   We use Sentinel-2 imagery to estimate green and blue space metrics. Sentinel-2 is a satellite which has been providing remote sensing imagery data since 28th March 2017 and was selected since it has the highest resolution (10 metres) of all the available open satellite datasets. One can accesses Sentinel-2 data via Google Earth Engine which is free to access for academic and not-for-profit organisations.

   Working with satellite imagery brings its own challenges. Great Britain is a temperate climate that offers frequent cloudy or overcast days. To try and minimise this issue, we mask any detected clouds within the images so that they do not count towards the generation of indicators (since cloud values will give misleading estimates). A composite image is then compiled by taking the median value across the whole time period. If we wanted to take this further, we could have only used images where <= 20% of the image does not contain clouds too. To create 2024 data here, we have used the time period of 1st May 2024 to 30th September 2024 - roughly the summer period. The final dates will be chosen to capture the spring/summer period where vegetation has grown and as it is peak, as well as to maximise the time period available to find suitable non-cloudy days of images. Once can easily adapt this time period in the code to what they need.

Methodology details and companion scripts can be found on the GitHub repository: https://github.com/groundswelluk/geographical_indicators

Presentation

Breakdowns

Time period

Cross sectional based on the Ordnance Survey Open UPRN product v2024.04.

Demographic

Not applicable

Geographic

Unique Property Reference Number (UPRN) level

Disclosure control

Not applicable. Whilst UPRNs can be used to identify unique properties, on their own they cannot be used to identify a particular individual.

Outputs:

UPRN_5_1_satellite_measures_cm.csv

Column name	Description
UPRN	Unique Property Reference Number as per the Ordnance Survey Open UPRN product v2024.04.
EVI_2024	Enhanced Vegetation Index (-1 to 1) for the following period: 1st May – 30th September 2024.
NDVI_2024	Normalised Difference Vegetation Index (-1 to 1) for the following period: 1st May – 30th September 2024.
NDWI_2024	Normalised Difference Water Index (-1 to 1) for the following period: 1st May – 30th September 2024.

UPRN_5_1_satellite_measures_cm_with_coords.csv

Column name	Description
UPRN	Unique Property Reference Number as per the Ordnance Survey Open UPRN product v2024.04.
EVI_2024	Enhanced Vegetation Index (-1 to 1) for the following period: 1st May – 30th September 2024.
NDVI_2024	Normalised Difference Vegetation Index (-1 to 1) for the following period: 1st May – 30th September 2024.
NDWI_2024	Normalised Difference Water Index (-1 to 1) for the following period: 1st May – 30th September 2024.
latitude	latitude of the UPRN, given in decimal degrees, where N is positive and S is negative.
longitude	longitude of the UPRN, given in decimal degrees, where E is positive and W is negative.

Revision history

Version	Date	Summary of changes
1.00	2024-11-11	First release