NERC SENSE CDT Research Experience Placement

Assessing the benefits of trees outside woodlands using earth observations

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Introduction

As outlined in the 2014 IPCC report, global temperature increase must be capped at 1.5°C to help mitigate against climate change (IPCC,2014). Trees have great potential to help us achieve this, as they remove carbon from the atmosphere and store it in biomass and provide a range of ecosystem services. Urban areas are expected to expand in the UK and across the world, so it is increasingly important to understand the impact of urban trees, as they, as well as large forests and woodlands, have the potential to help cap global temperature rise (UBoC, 2015).

Research has not previously been conducted on the different typologies of trees in Leeds. Identifying and analysing the different types of trees outside of woodlands, for example single trees or groups of trees is important, as different types of trees can have different heights and areas, and therefore provide different ecosystem benefits. A knowledge of the tree typologies in Leeds, and the ecosystem benefits they provide is useful for future climate change planning and management.

This project utilises remote sensing data to categorize tree typologies and to analyse height and area of trees across these typologies, across the area shown in Figure 1. It also demonstrates a comparison of tree typologies across greenspace and non-greenspace, public and private greenspace, and rural and urban areas in Leeds.

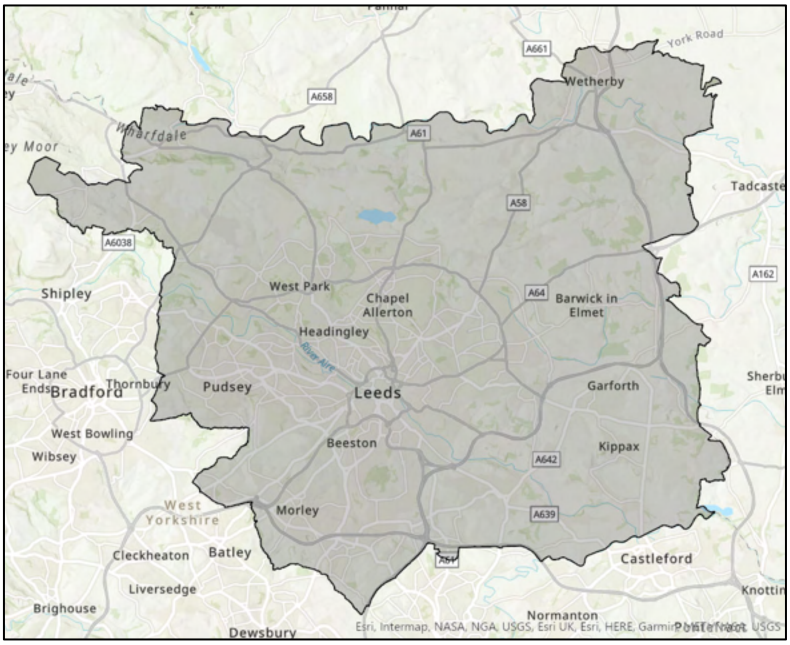

Figure 1: Boundary map of Leeds study area

Identifying tree typologies

To categorise trees in Leeds into different typology classes, Bluesky aerial data of tree point, and canopy was used, along with Forest Research Ward Canopy Cover data. Figure 2 shows the process undertaken on ArcGIS Pro to create these typologies, which initially were based upon the categories defined in ‘Tree cover outside woodland in Great Britain’ (Forest Research, 2017). An example of the canopy polygons and tree points is shown in Figure 3, where different colours indicate different tree typologies. The final categorisation is shown in Figure 4, as ‘small woodland’ mentioned in Figure 1 was merged with ‘other trees’ due to group similarities. Due to the size of the dataset, canopy polygons were split into the layers 1,2a and 2b. This subsequently created more canopy polygons than tree points as there was some overlap, but these were lost as the data was further processed back to points in the analysis across landcover. Furthermore, using the Forest Research Ward Canopy Cover (National Forest Inventory England shapefiles) also resulted in some duplicate points, due to differing spatial resolution of layers, and overlap at boundary points. However median and mean values were primarily used for statistical analysis, and thus results generated still provide a general picture of the tree typologies across Leeds.

In summary, the results show that mean and median tree height and canopy area are greatest in NFI woodland, and lowest in single trees. The difference between the average NFI woodland height and single tree height is 12.2 meters. The difference between median canopy area is 34.5 m². Therefore, it was found that there is difference in tree hight and area across typologies.

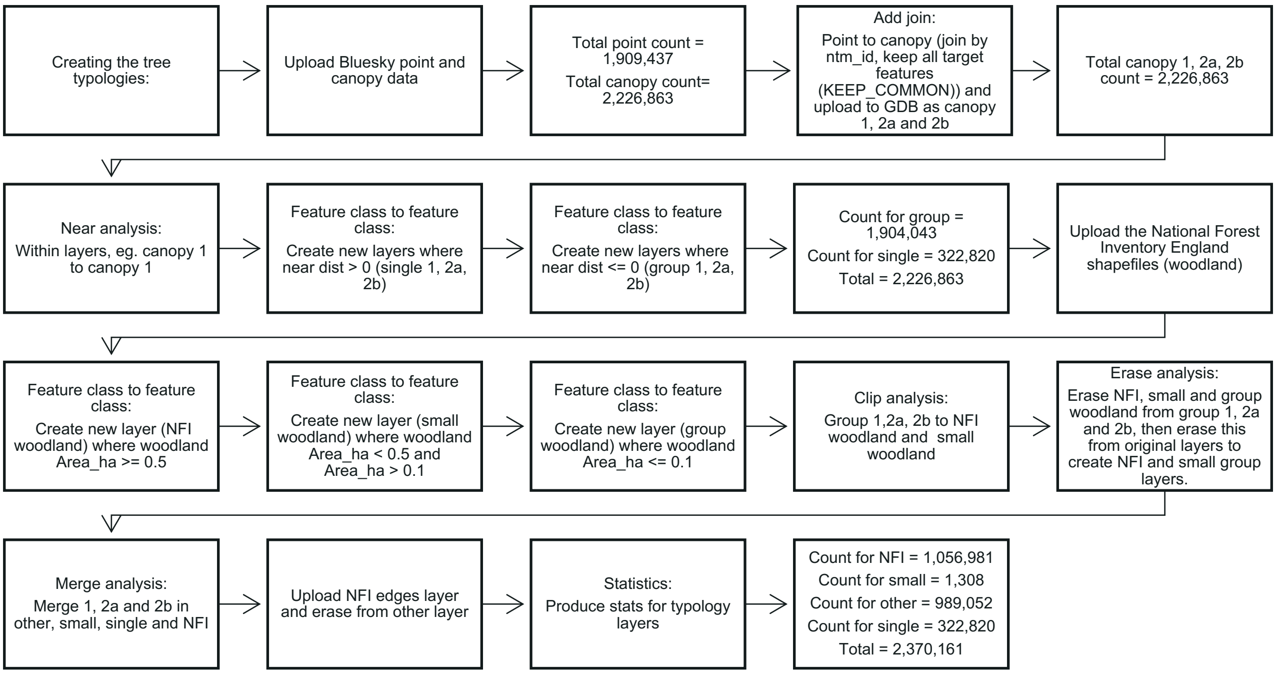

Figure 2: Flowchart of ArcGIS Pro process of identifying tree typologies

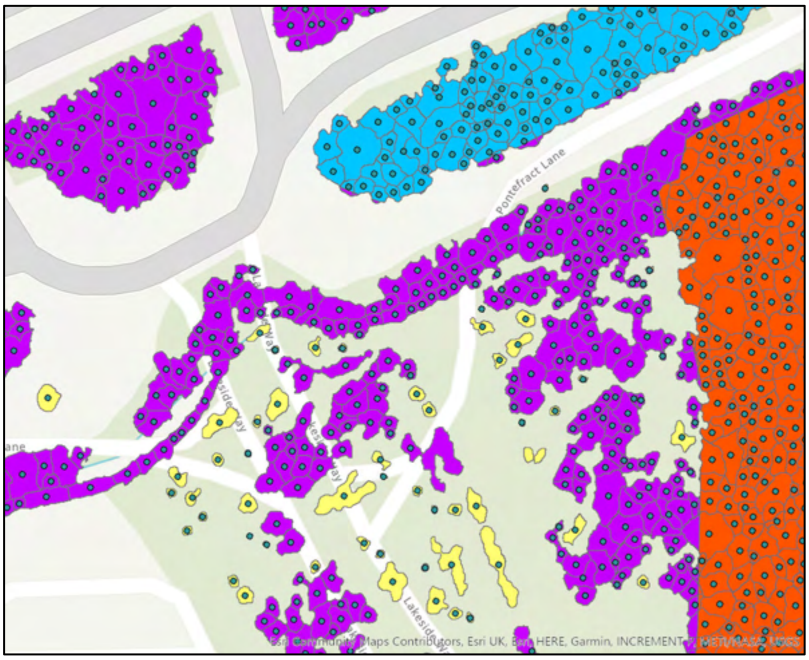

Figure 3: ArcGIS Pro image showing categorization of typologies across canopy polygons and tree points

Typology layer	Description
Single trees	Single trees where the canopy has no contact with any other tree canopy.
NFI woodland	Areas of trees with a minimum canopy cover of 0.5 hectare and minimum width of 20 meters.
Other trees	All trees where the canopy has contact with any other tree canopy, and in an area of trees where the canopy cover is less than 0.5 hectare.

Figure 4: Table of tree typology specification

Tree typologies across different land types

To compare typologies across different land types, Ordnance Survey greenspace shapefiles and 2011 census rural urban classification shapefiles were utilized. The process of this is shown in figure 3, as converted canopy point layers were merged with greenspace and non-greenspace, public and private greenspace, and rural and urban areas. This was to analyse the distribution of tree typologies across land types, and to see if there were differences in tree height and area across these land types. The greenspace land uses (public and private) were also contained within the Ordnance Survey datasets, and a map of a greenspace layer is shown in Figure 5. Due to the conversion of canopy polygons to tree points and differing spatial resolution of the added layers to the Bluesky data, there was a loss of data points. However, as it is a large dataset, the results do provide a general idea of the tree typology distribution, height and canopy area across greenspaces and urban/ rural land.

In summary, the statistical results show similar patterns across typologies, where mostly, despite changing land types, NFI woodland still has greatest mean and median height and canopy area and single trees has the lowest, with other trees falling in between the two. The average height of trees is marginally greater in greenspace compared to non-greenspace, across the typologies. Median canopy area was greater in greenspace for NFI woodland and other trees, but for single trees it was greatest in non-greenspace. Between public and private greenspace, tree height was greater in public greenspace. Median canopy area varied more, as it was greatest in public space, apart from in NFI woodland trees, which canopy area was greater in private greenspace. Mean canopy height and median canopy area was greater in rural areas to urban, across all the typologies.

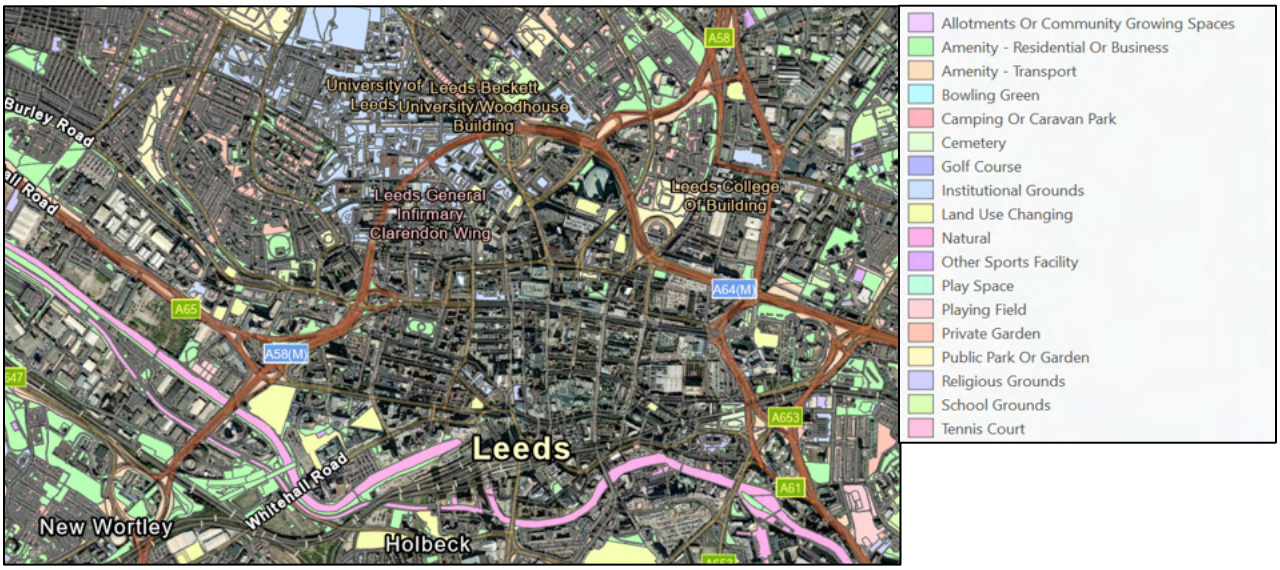

Figure 5: Greenspace map of Leeds, with land type key shown on right

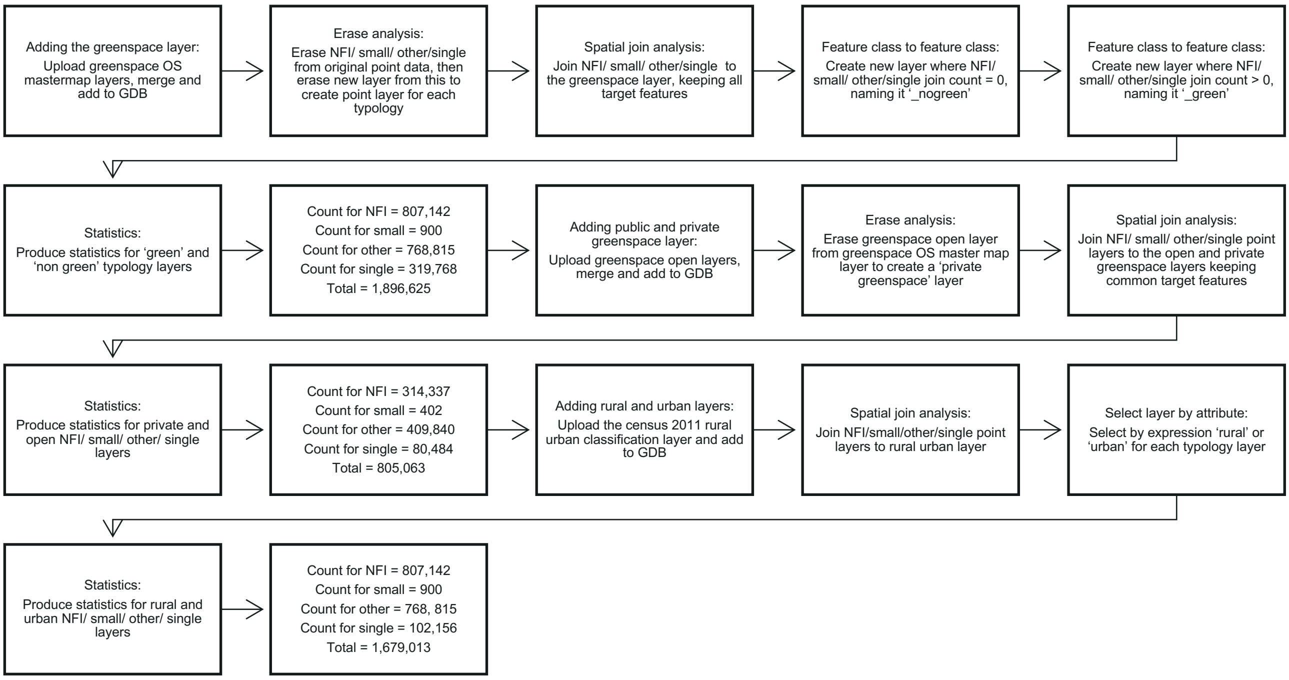

Figure 6: Flowchart of ArcGIS Pro process of creating tree typologies across different land types

Conclusions and further steps

Overall, this project demonstrates that there is a difference between in tree height and area between different typologies, and across different land types. This is useful as understanding how canopy coverage is distributed is important in the future for planning for climate adaptation, which cities are increasingly needing to consider in their development. To further develop this project, the ArcGIS Pro process should be adapted to ensure data points are not duplicated or lost, and a potential linear tree category considered. Furthermore, the identification of these typologies across Leeds enables the quantification of ecosystem services between tree types, which could provide important information on what areas and typologies provide the most benefits.

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