Transnational Network of Integrated Planning Labs: co-creating knowledge on forward-looking transdisciplinary planning perspectives addressing climate change and urban life in the post-pandemic city.

InPlaLabs

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Project: Erasmus+ 2023-1-EL01-KA220-HED-000160477
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URBAN CALCULATOR

Transnational Network of Integrated Planning Labs:
Co-creating knowledge on forward-looking transdisciplinary planning perspectives addressing climate change and urban life in the post-pandemic city

Project number: 2023-1-EL01-KA220-HED-000160477 Erasmus+

Introduction for Space Syntax Toolkit and what it measures

10 June 2025

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INTRODUCTION

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Theoretical Framework

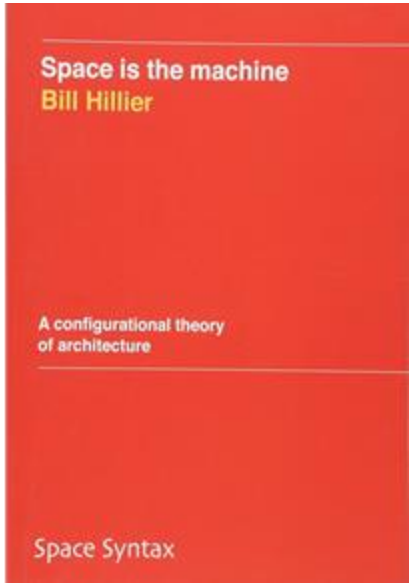
Bill Hillier's theories of:

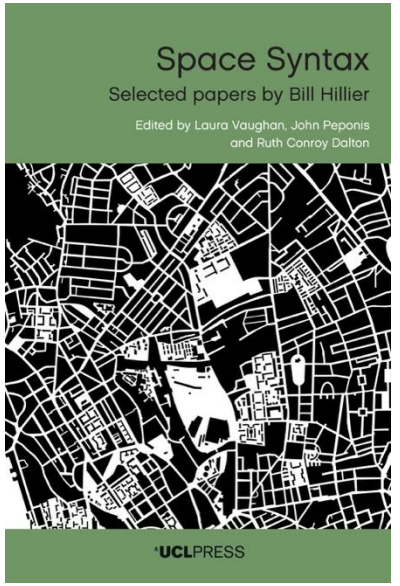
"**natural movement**" - how urban space shapes flows

the "**movement economy**" - how land uses exploit movement

"**pervasive centrality**" - how cities create multiple centres and overlapping neighbourhoods &

the "**dual grid**" - how the foreground & background street networks interrelate...





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SPACE SYNTAX TOOLKIT

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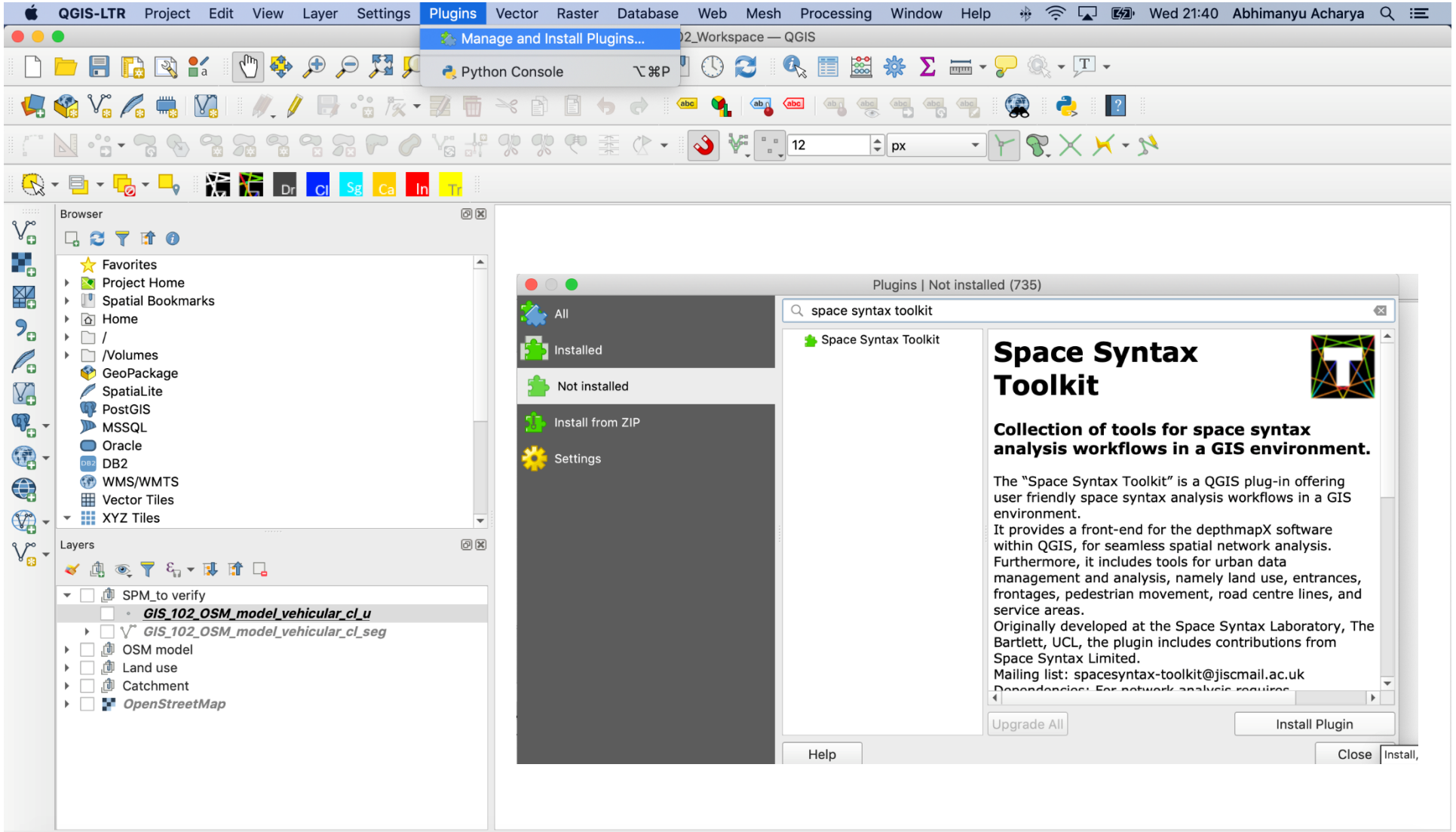
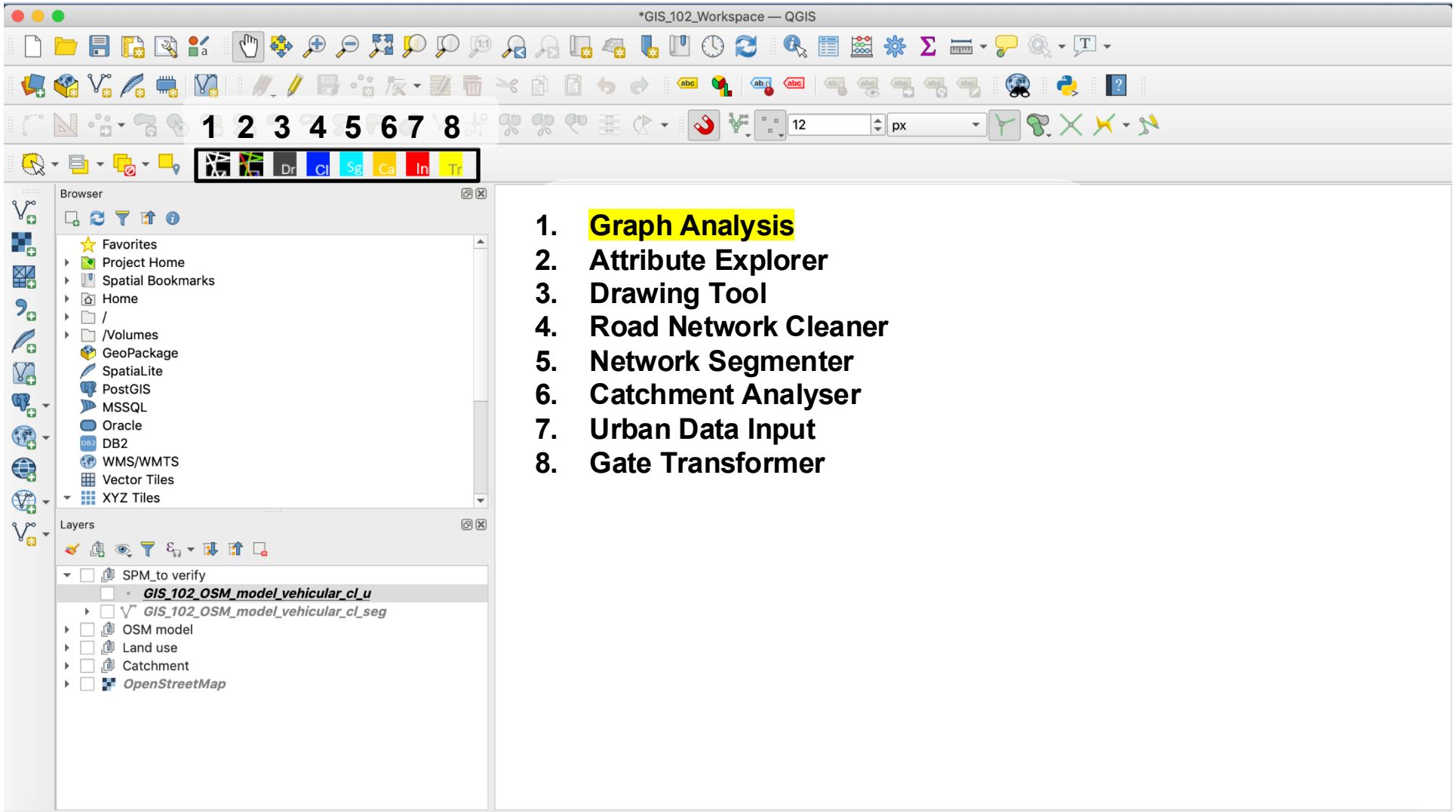
Space Syntax Toolkit



Space Syntax Toolkit



1. **Graph Analysis**
2. **Attribute Explorer**
3. **Drawing Tool**
4. **Road Network Cleaner**
5. **Network Segmenter**
6. **Catchment Analyser**
7. **Urban Data Input**
8. **Gate Transformer**

Space Syntax Toolkit

Graph Analysis
Performs Space Syntax analysis by remotely connecting to Depthmap

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Visualise results of the analysis and explore basic statistics

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Change snapping settings to draw Axial, Segment Lines and Unlinks

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SPACE SYNTAX ANALYSIS

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Spatial Analysis

what will we analyse?

1. **Basic features** of each street: length of street, number of connections to other streets

2. **Integration**: depth or ‘closeness centrality’ of each street to all the other streets at different radii, also known as to-movement

3. **Choice or betweenness**: extent to which streets are likely to be chosen as through routes from one part of the system to the next, also known as through-movement potential

What is the scale of analysis?

1. **Radius ‘N’:** understanding the connectivity of a street segment to the whole of the rest of the system (city-wide hierarchy)

2. **Choose radii:** understanding the connectivity of a street segment to all other street segments within a given radius according to your research question

- Local movement and walking 400m – 2km
- Larger scale city-wide movement (vehicular, cycling) 10km
- Region or country-wide movement 100km

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Network properties of street systems

Property 1

Streets have differential accessibility

Some streets are easier to get to from everywhere else – they are better 'integrated'

Some streets are more useful in hosting through movement – they are known as having a higher choice or betweenness value

Property 2

Cities have a dual system of streets

Cities have an integrated system comprised of a 'foreground network' supported by a 'background network' of streets

Property 3

Movement happens at different scales – which overlap to produce urban vitality

It is overlapping layers of local and place-wide movement which creates 'centrality' at different scales and a sense of "place".

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Property 1: Accessibility measures

Two key measures:

- 'Depth' or 'integration' or 'to-movement potential' (in broader network theory referred to as *closeness centrality*)
  How central a street or space is in an urban system?

- 'Choice' or 'through-movement potential' (or *betweenness centrality*)
  How likely a street or space is to be moved through as people go from one point to another within the system?

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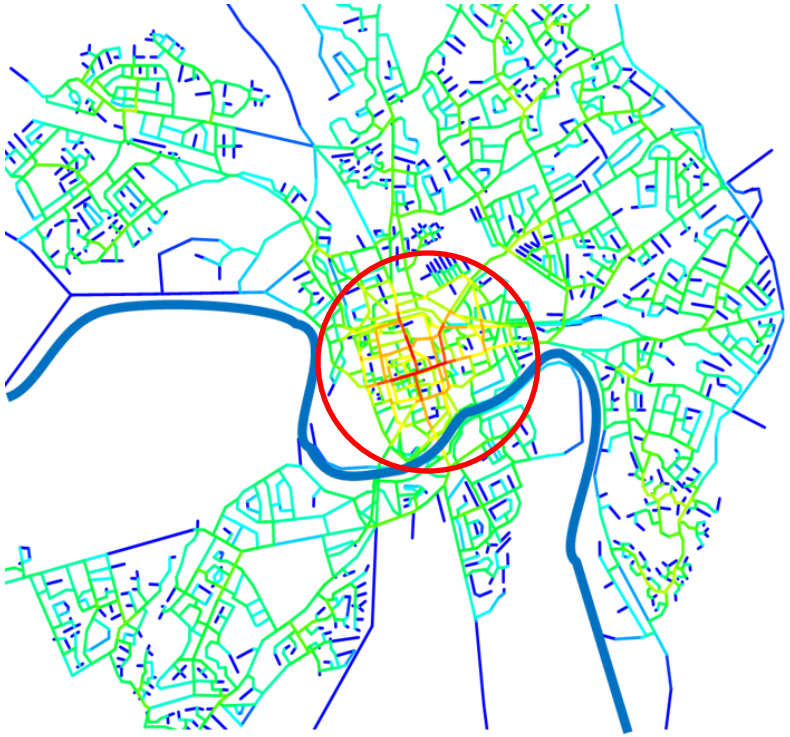
Property 1: Accessibility measures

Types of Analysis

This highlights central areas.

Highly integrated cores



Integration or “closeness” centrality

Choice or “betweenness” centrality

Highlights the routes most used to move ‘through” the city.

Often identifies high streets.

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Property 1: Accessibility measures

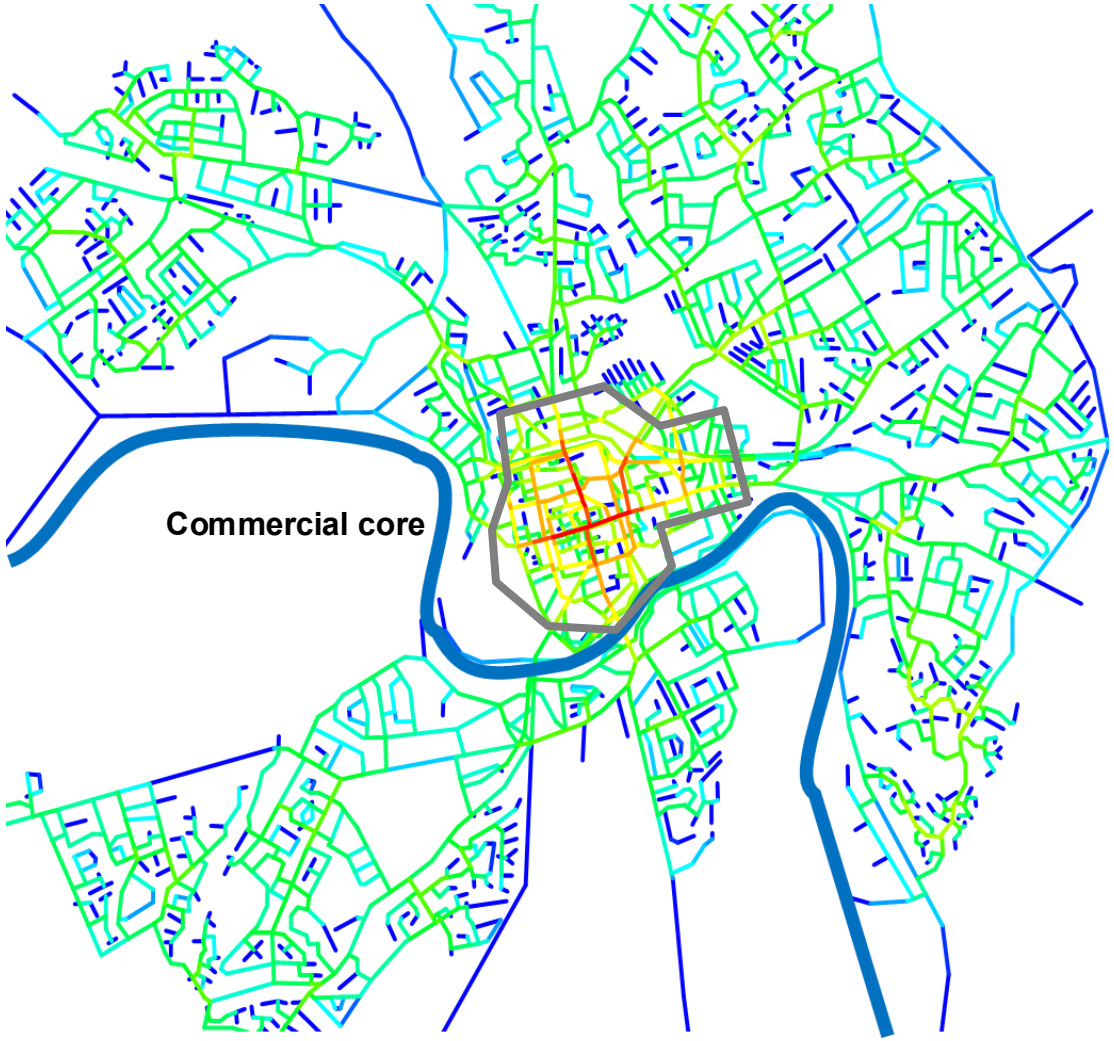
Integration

Closeness centrality "Integration"

Based an idea of spatial configuration and spatial 'depth'.

Highlights the principal commercial centre of the city and where people move 'to'.

But cities also consist of multiple smaller centres where local grid identification and structure heightens accessibility.



"To" movement

High

Low

Property 1: Accessibility measures

Betweenness centrality “Choice”

Betweenness centrality “Choice”

Highlights the routes most used to move ‘through” the city.

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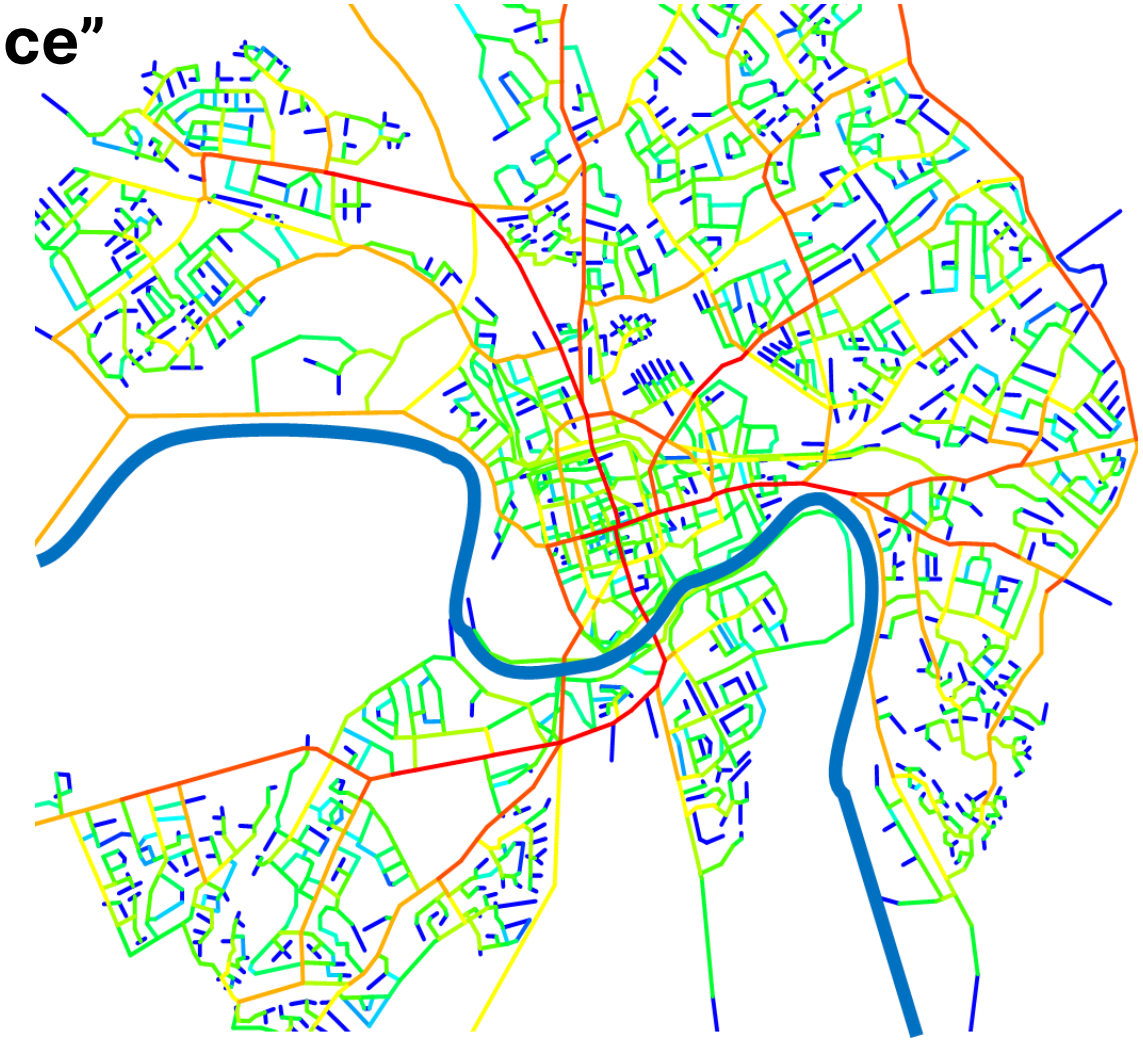
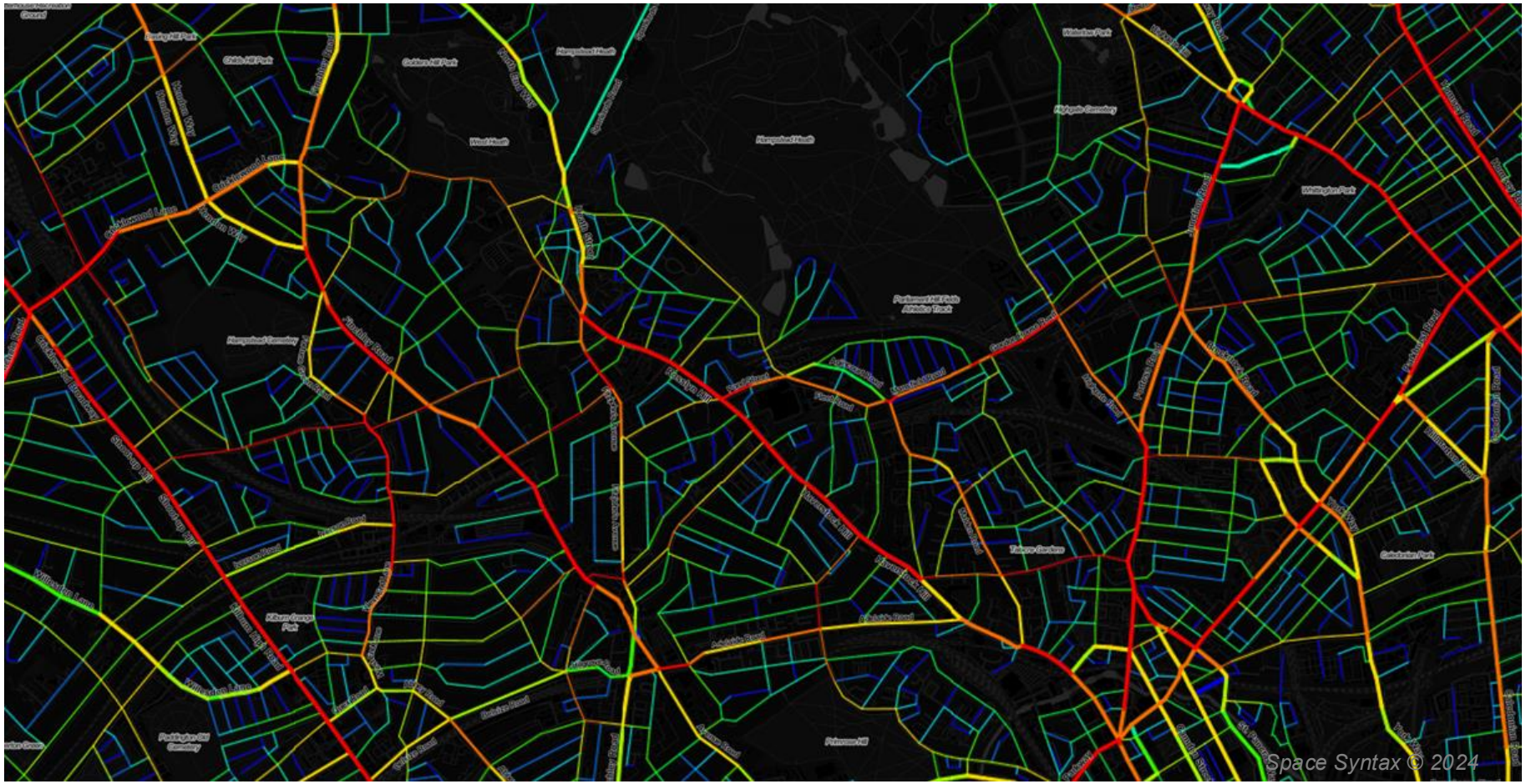


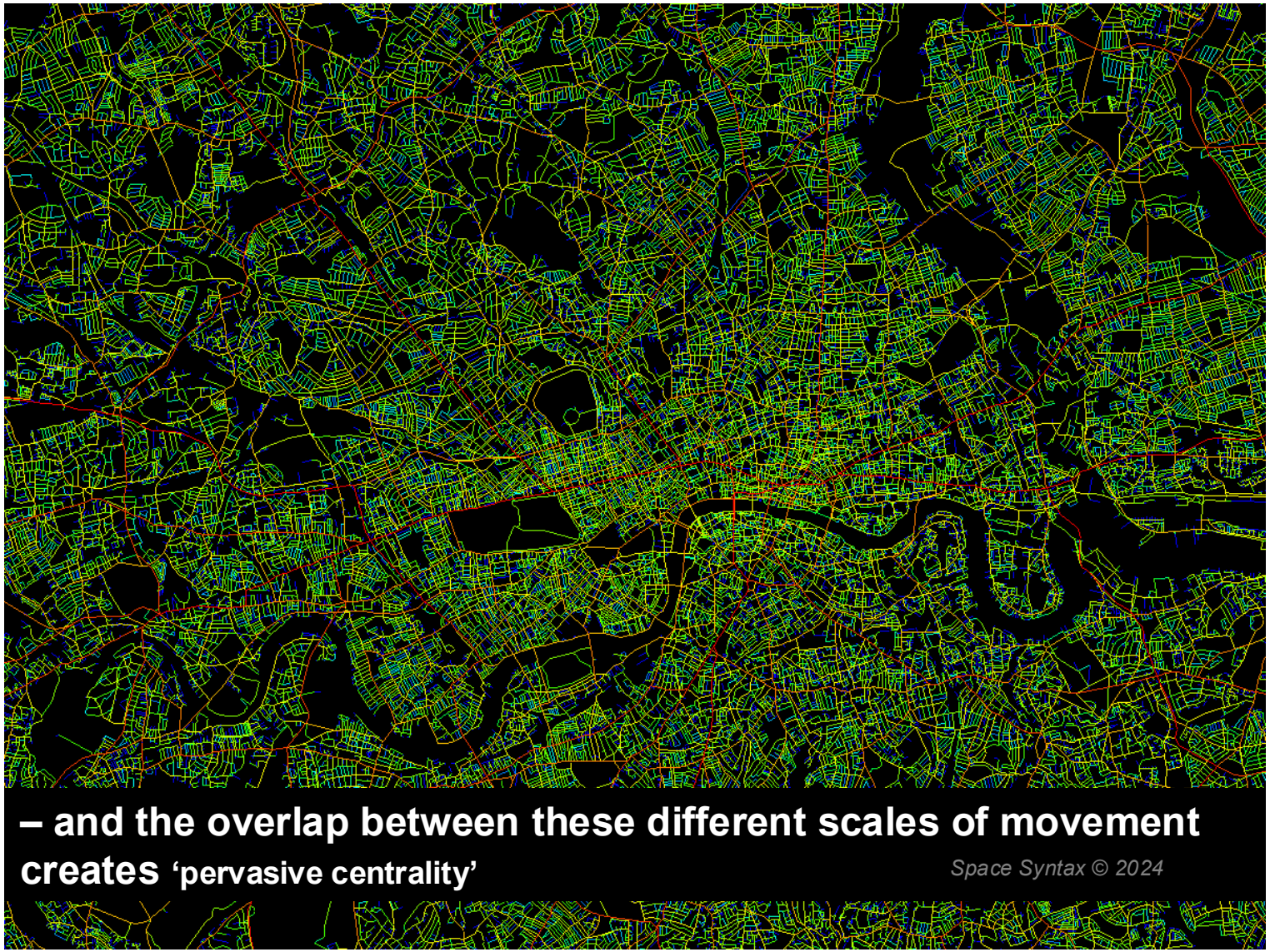
Property 2: Dual System of streets

Spatial networks typically combine a well-connected “foreground” and a less well connected “background”



Property 3: Scales of Movement

Movement happens at different scales



– and the overlap between these different scales of movement creates ‘pervasive centrality’

PROCESSING USING SPACE SYNTAX TOOLKIT

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Workshop requirements

Please install the following:

1. QGIS 3 (preferred version) or
   QGIS 2.18.18

2. DepthmapXnet (Please note that this is different from DepthmapX):
   http://archtech.gr/varoudis/depthmapX/?dir=depthmapXnet

3. Space Syntax Toolkit:
   https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/wiki/Installation

Any issues please refer to:
https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/issues

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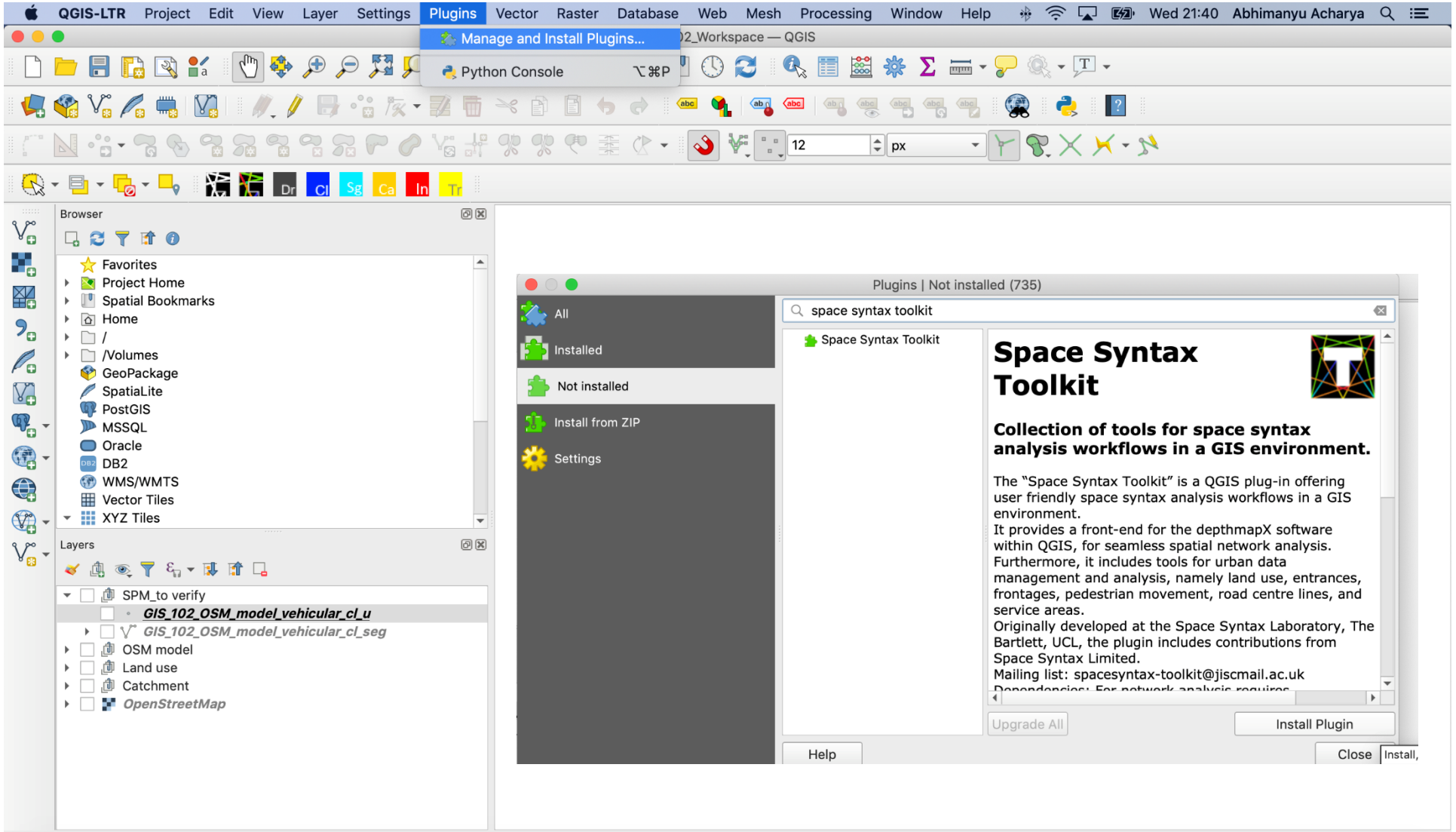
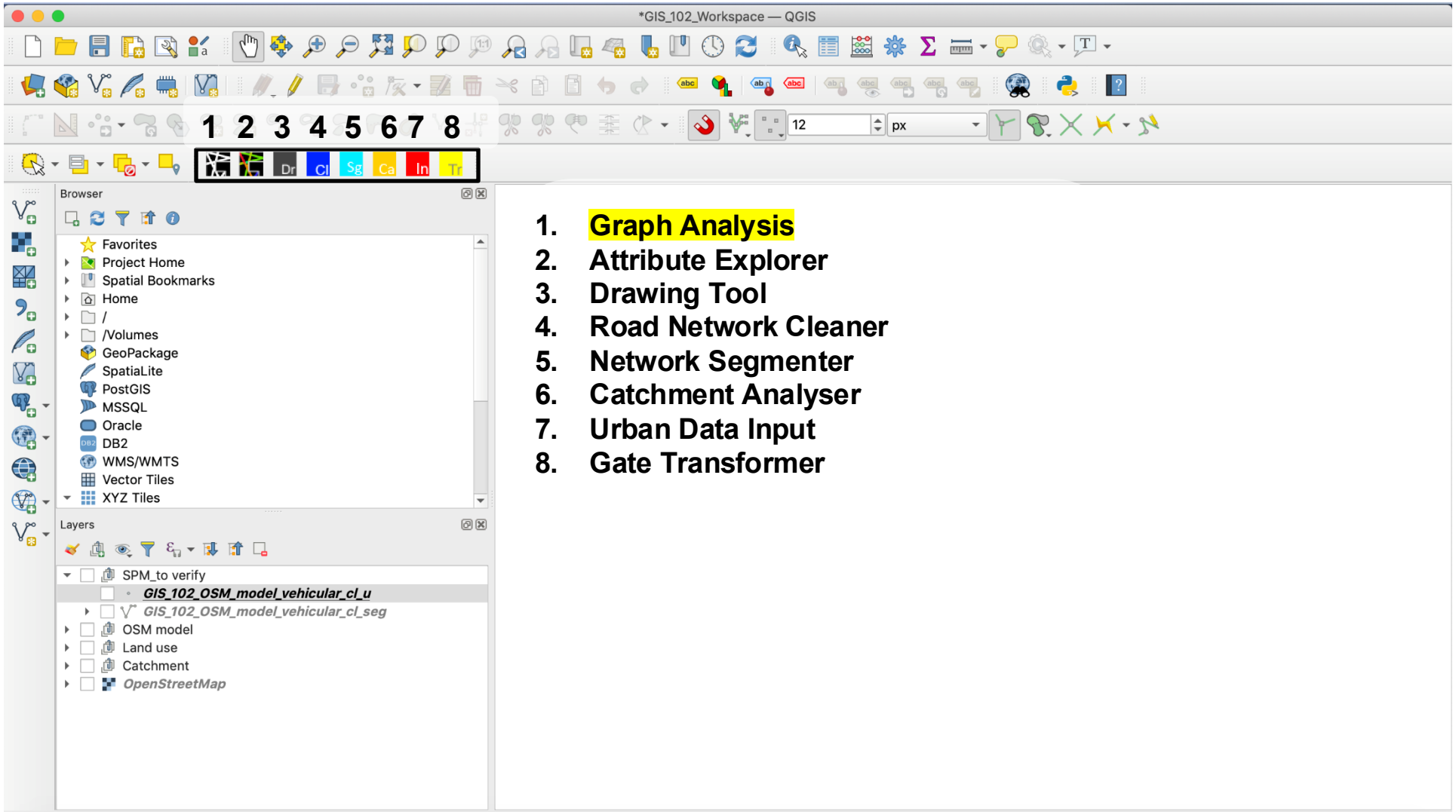
Space Syntax Toolkit



Space Syntax Toolkit



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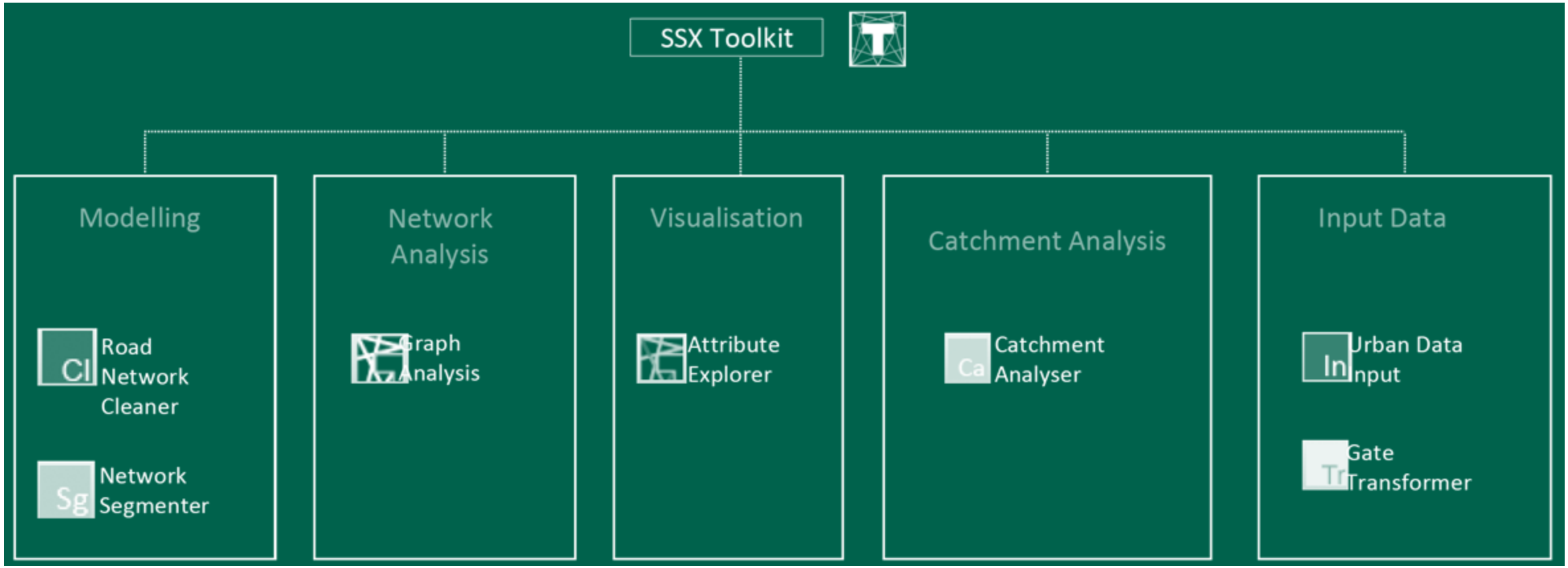
Space Syntax Toolkit Overview



Pre-analysis | **Analysis** | **Further analysis**

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Processing using QGIS SSx Toolkit

Steps for processing the model

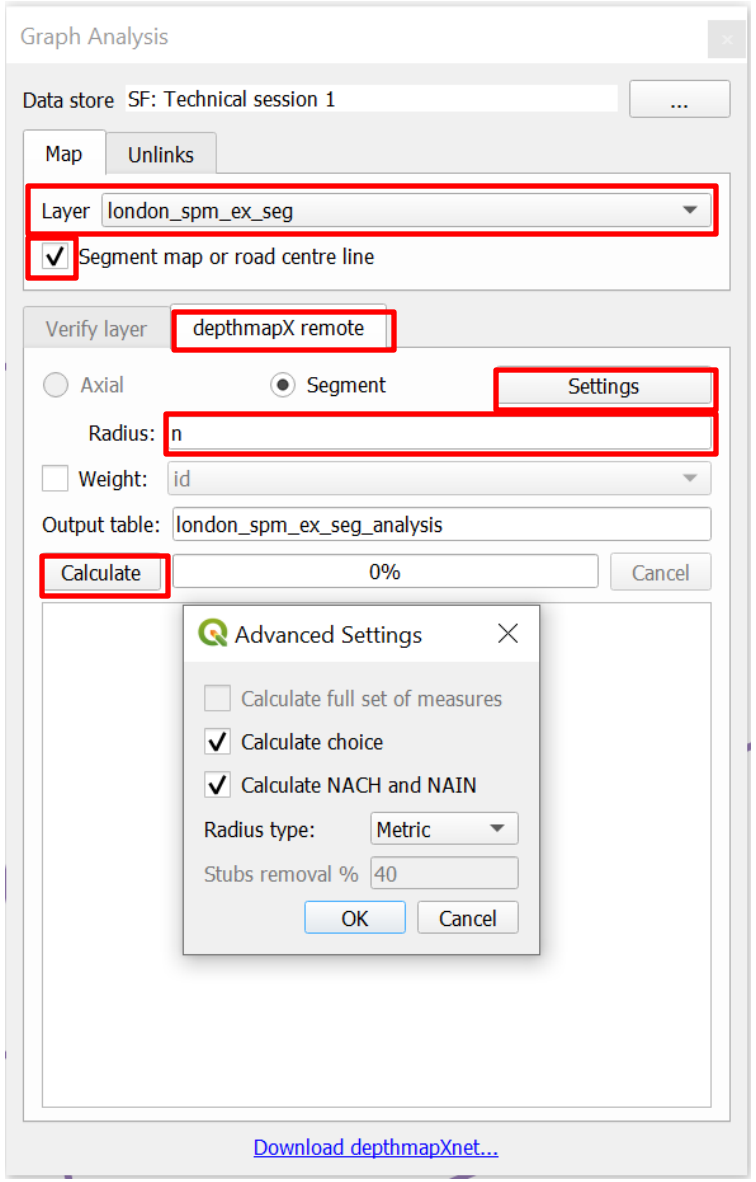
How to process a segment model

Use **Graph Analysis** in Space Syntax Toolkit.
Remember to open **depthmapXnet** in the background to process a model.

Graph Analysis
Performs Space Syntax analysis by remotely connecting to Depthmap

1. Select **the segmented model** for processing
2. Tick **Segment map or road centre line**.
   Under the depthmapX remote tab, a Segment option will be activated.
3. Put radii in Radius section.

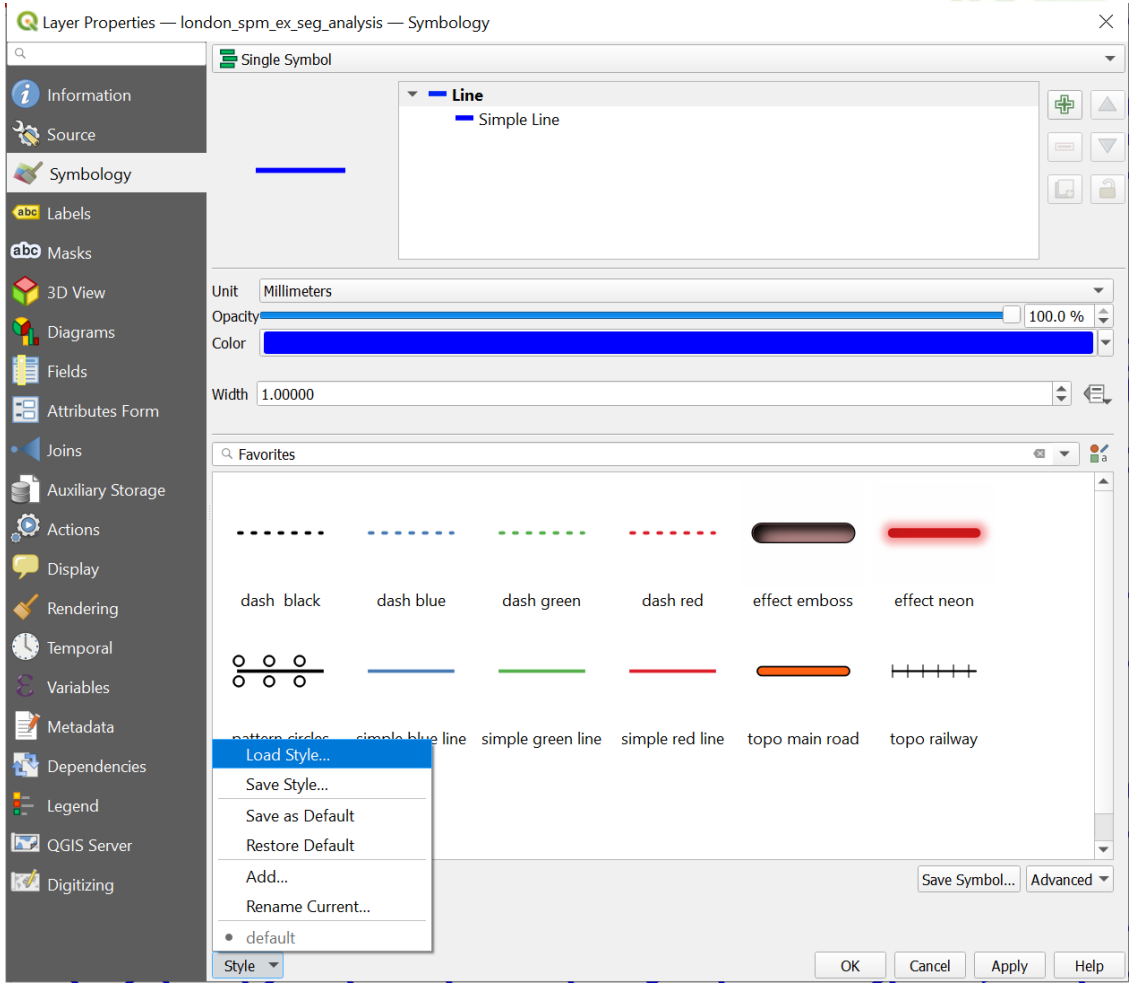
   Recommended radii for urban analysis:
   400, 800, 1200, 1600, 2000, 3000, 5000, 10000
4. Name the output layer
5. Press **Calculate. Do not close depthmapXnet while processing the model**



Visualization of the results

When the model is processed, apply a style.

1. Right click on the processed model layer to open **Properties.**
2. Select **Symbology** tab and under style click **Load Style**
3. Apply the SSx standard colour range.



Processing using QGIS SSx Toolkit

QGIS SSx Toolkit Catchment Analyser

Using the Catchment Analyser tool, to produce the Metric Catchment Analysis from various points of interest. The analysis uses the street network to assess which parts of the city are within a specific distance from the points of interest **POI** (land use, infrastructure, transport node etc).

The network layer should be the cleaned segment model.

The network cost should be length.

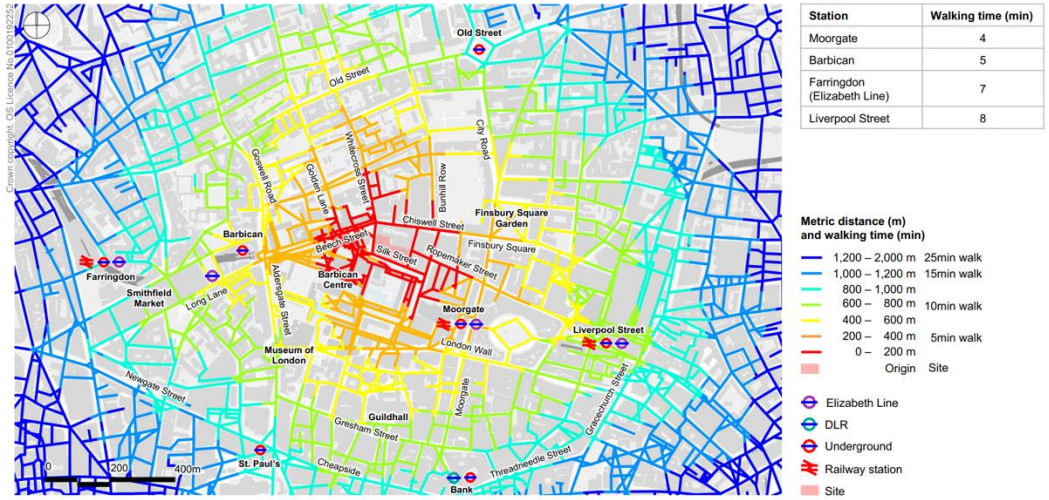
The origin layers need to be a point geometry type to run the metric catchment analysis.

Process metric catchments: 400,800,1200 and 2000.

For the output layers, always save to shapefile.

Tick Load Polygons and Run.

Transport attraction Walking distance from site



Station	Walking time (min)
Moorgate	4
Barbican	5
Farringdon (Elizabeth Line)	7
Liverpool Street	8

Example metric catchment analysis

Note: You may need to revert to a previous version of QGIS for the Catchment Analyser to work.

UNDERSTANDING OUTCOMES

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Interpreting results and using SSx toolkit in planning

The impact of spatial layout

Movement

Land use

Economic vitality and Land value

Crime and Safety

Carbon Emissions
Health and well-being

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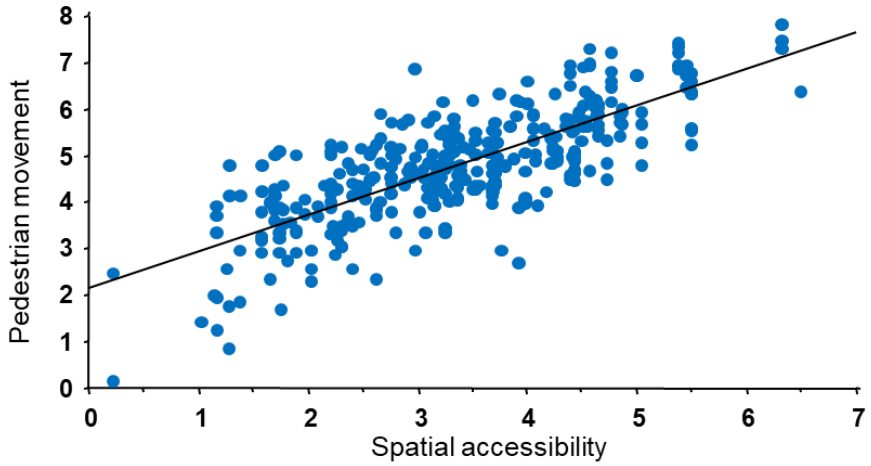
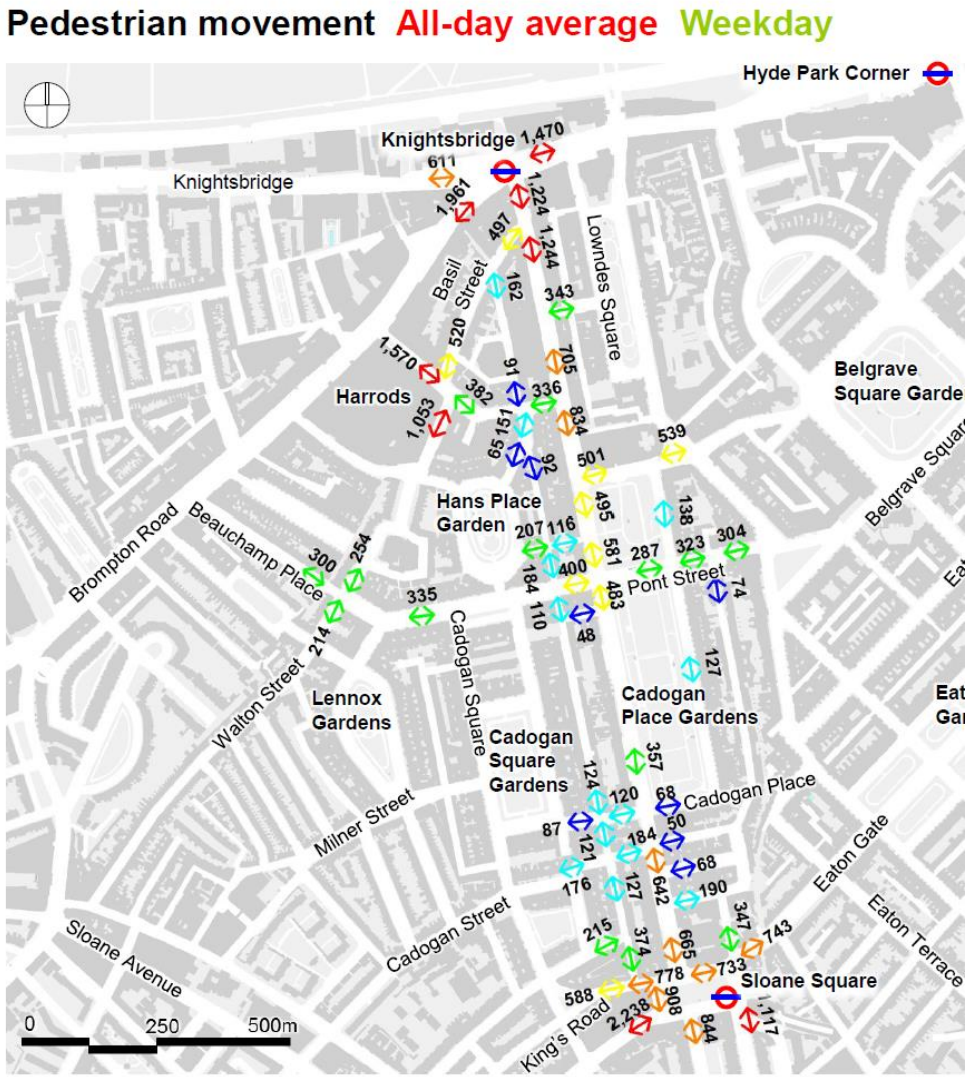
How spatial accessibility shapes movement





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How spatial networks shape the location of economic activities

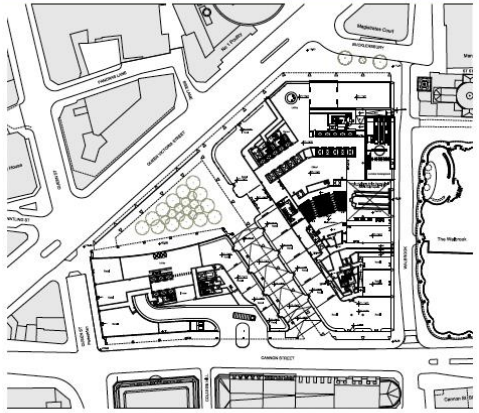
Using SSx Toolkit to test design ideas

Option testing

The pattern of spatial accessibility created in option two is very strong:

It works with existing spatial hierarchies, is well integrated with the surrounding context, and connects spaces with high levels of existing movement.

Option one

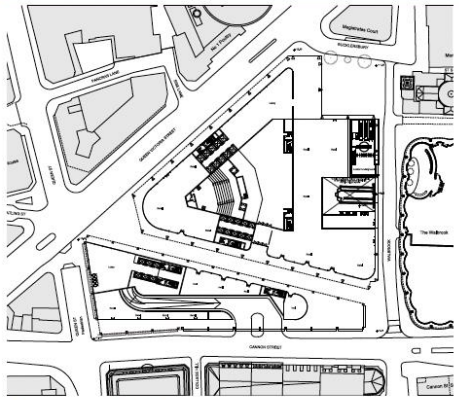


Proposed plan

Spatial accessibility at a local scale

Land use

Option two



Proposed plan

Spatial accessibility at a local scale

Land use

COMPLEX OUTCOMES

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Layering spatial network with other forms of data to answer complex questions

IUM: Integrated Urban Models

Other variables?

Walkability Index/model:

- Where do more people walk?
- Combining analysis of the street networks with other local factors - land use, ground floor frontages and public transport

Car Dependency Model:

- Car ownership
- Do I need a car to access job opportunities/green areas?
- Access to public transport?

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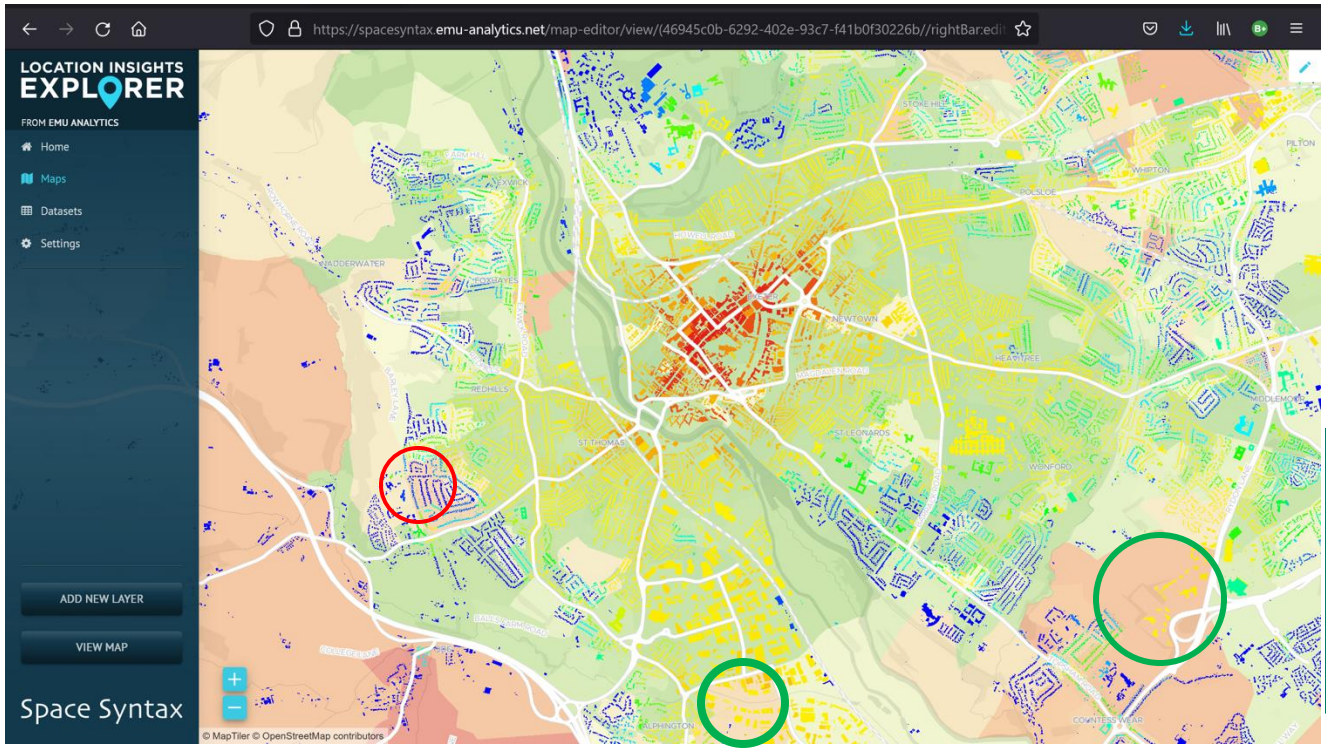
Examples: Maps as a tool for combining datasets

- **LINE: Local Insights Explorer**

https://spacesyntax.emu-analytics.net

LINE is a web-based mapping tool, accessed through a browser. Powered by Space Syntax data and analysis, LINE explains how the built environment enables daily activity and has been developed for use in the public sector.



Space Syntax LINE tool

In this case identifying opportunities for behavioural change

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Understanding Complex Outcomes

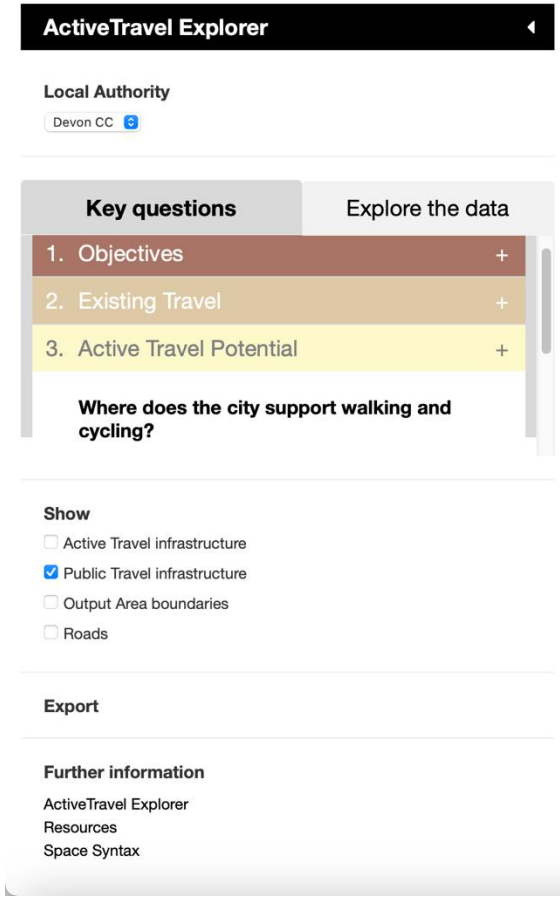
Examples

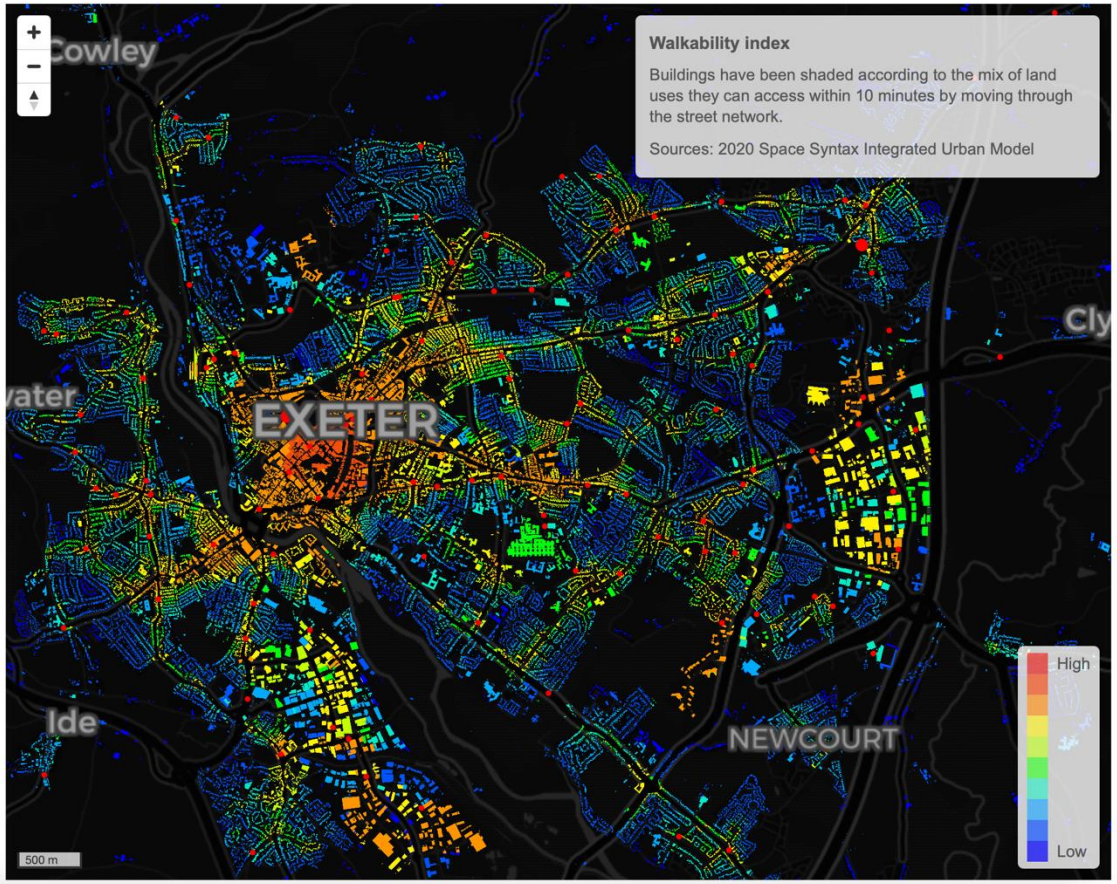
- **Active Travel Explorer:**
https://spacesyntax.com/activetravelexplorer/
https://spacesyntax.com/HERE/

It helps users understand how the built environment enables or inhibits daily activities such as walking or cycling.

Web tools developed with IUM

Applying urban planning strategies:





Understanding Complex Outcomes

Examples

- **HERE: Healthy Environment Risk Explorer**

https://spacesyntax.com/HERE/

It helps users understand links between built environment design and health outcomes, to take targeted actions to address them.

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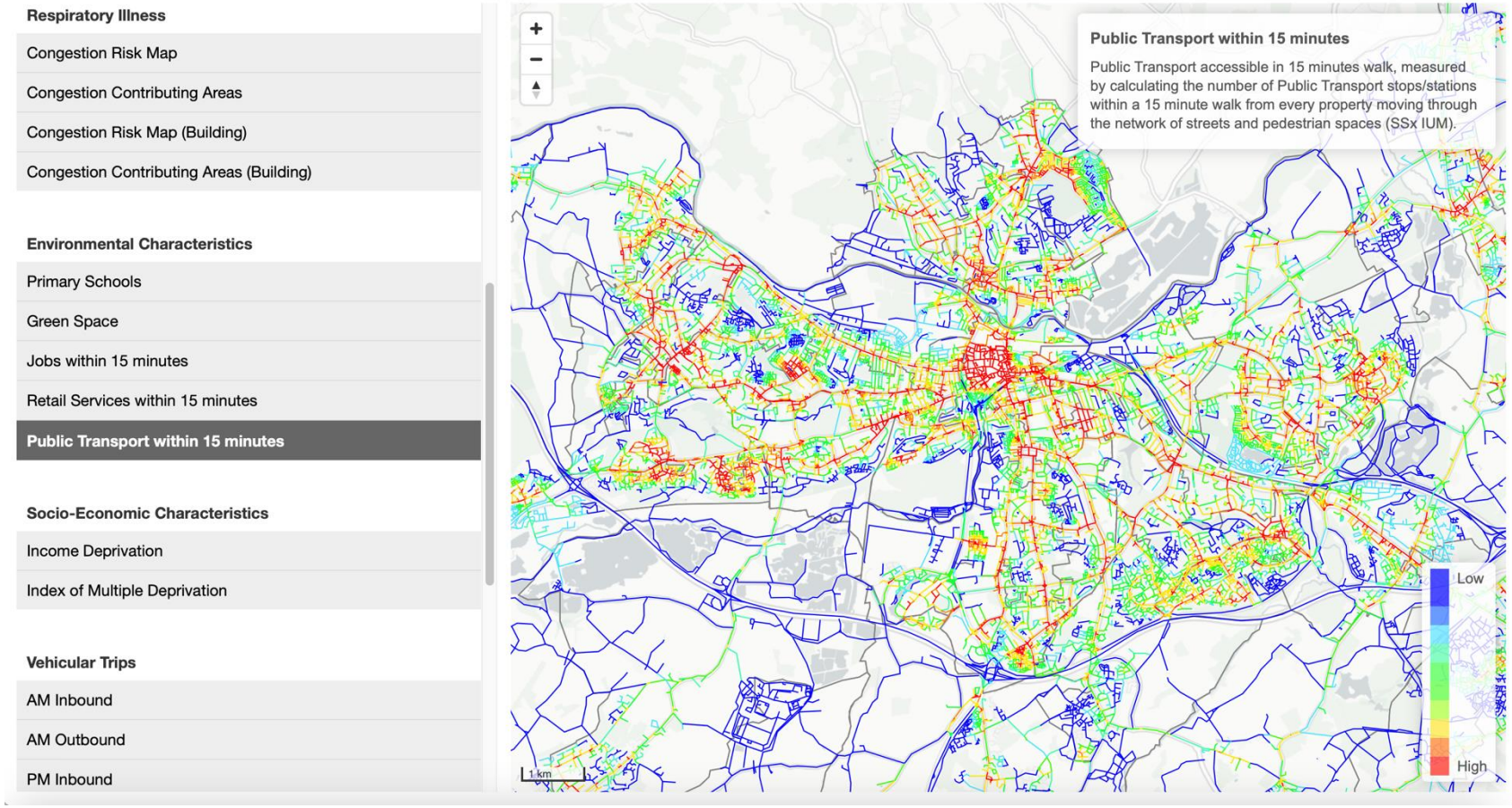

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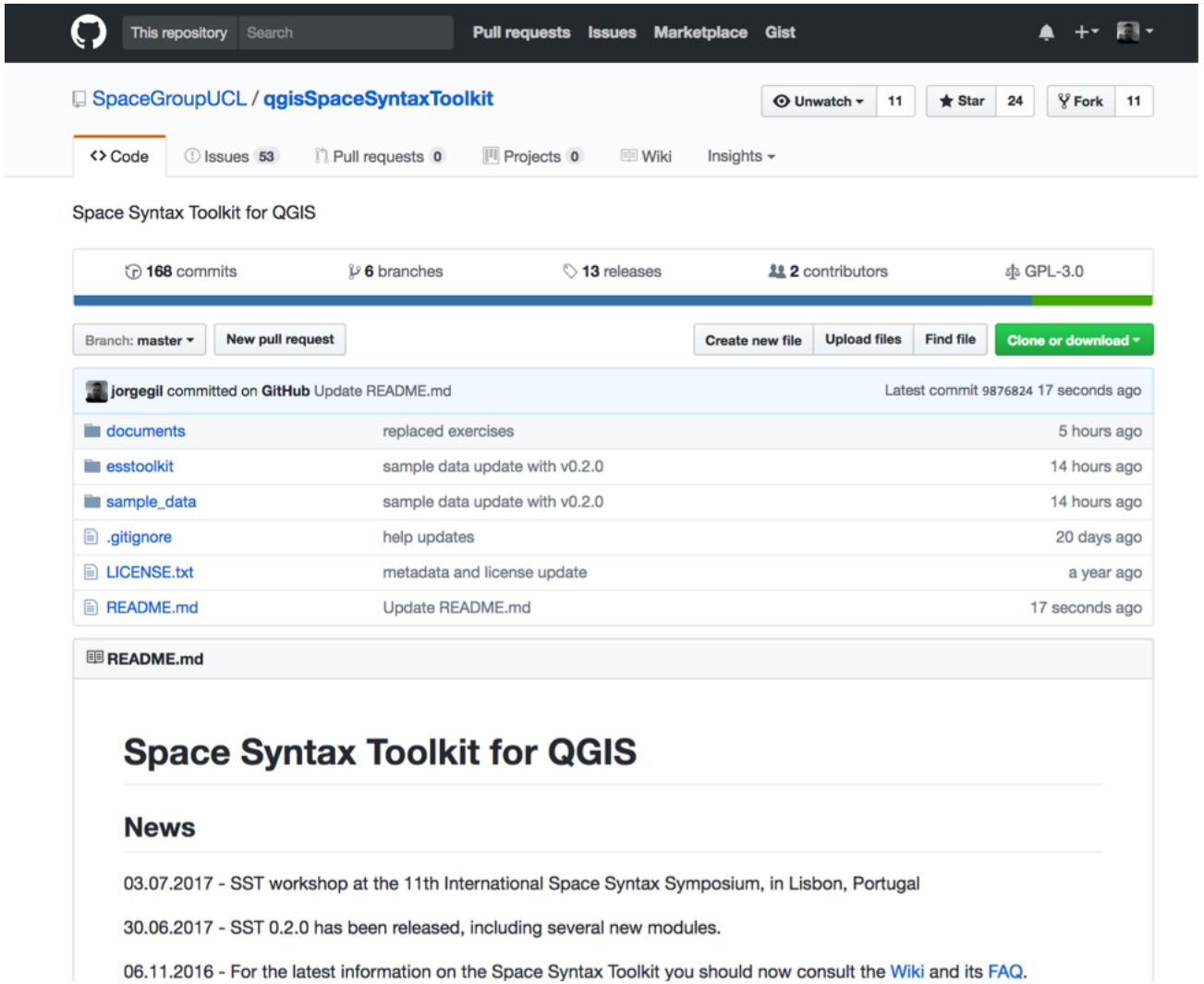
Resources and online support

SSX Toolkit Github repository

https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit



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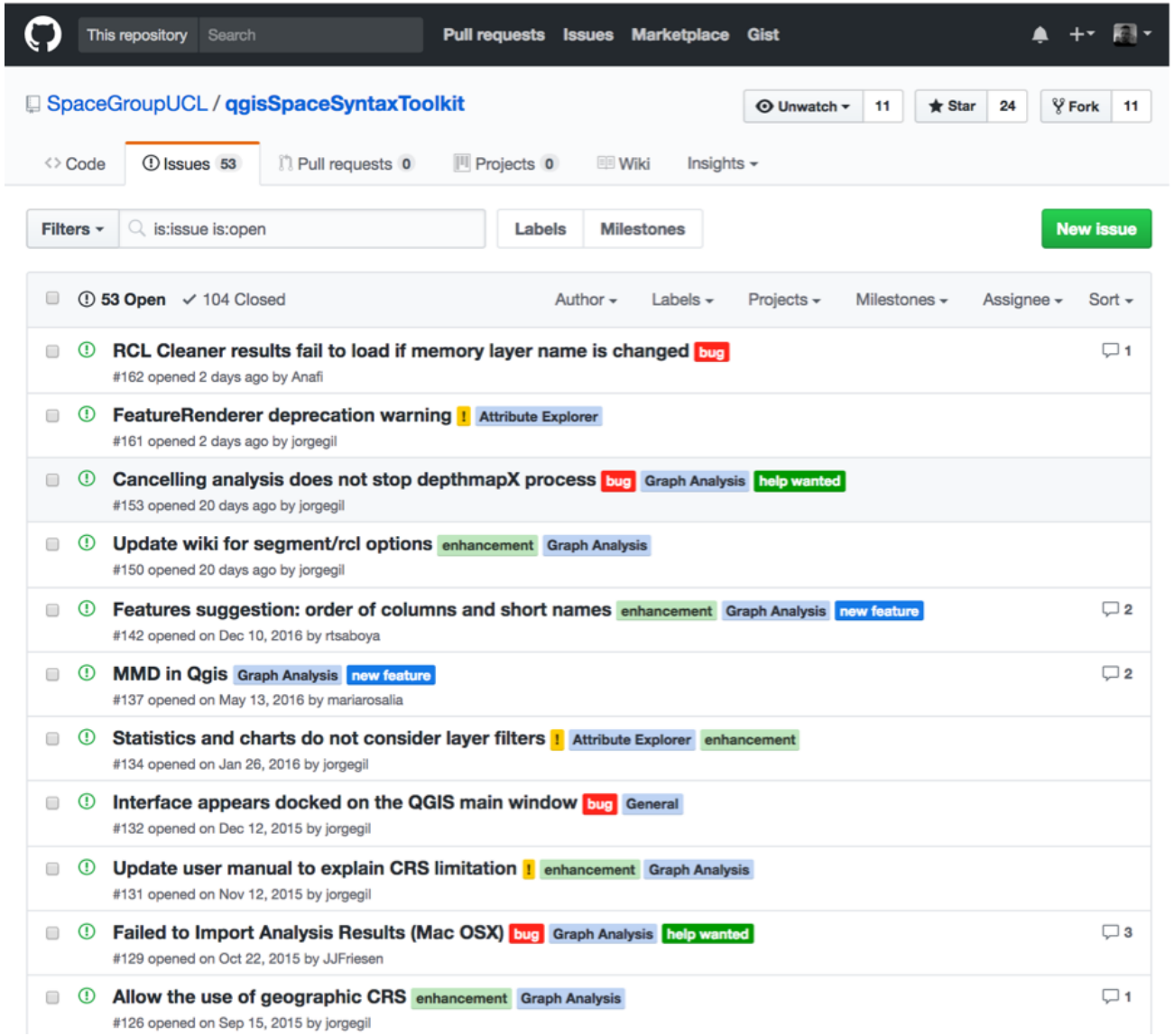

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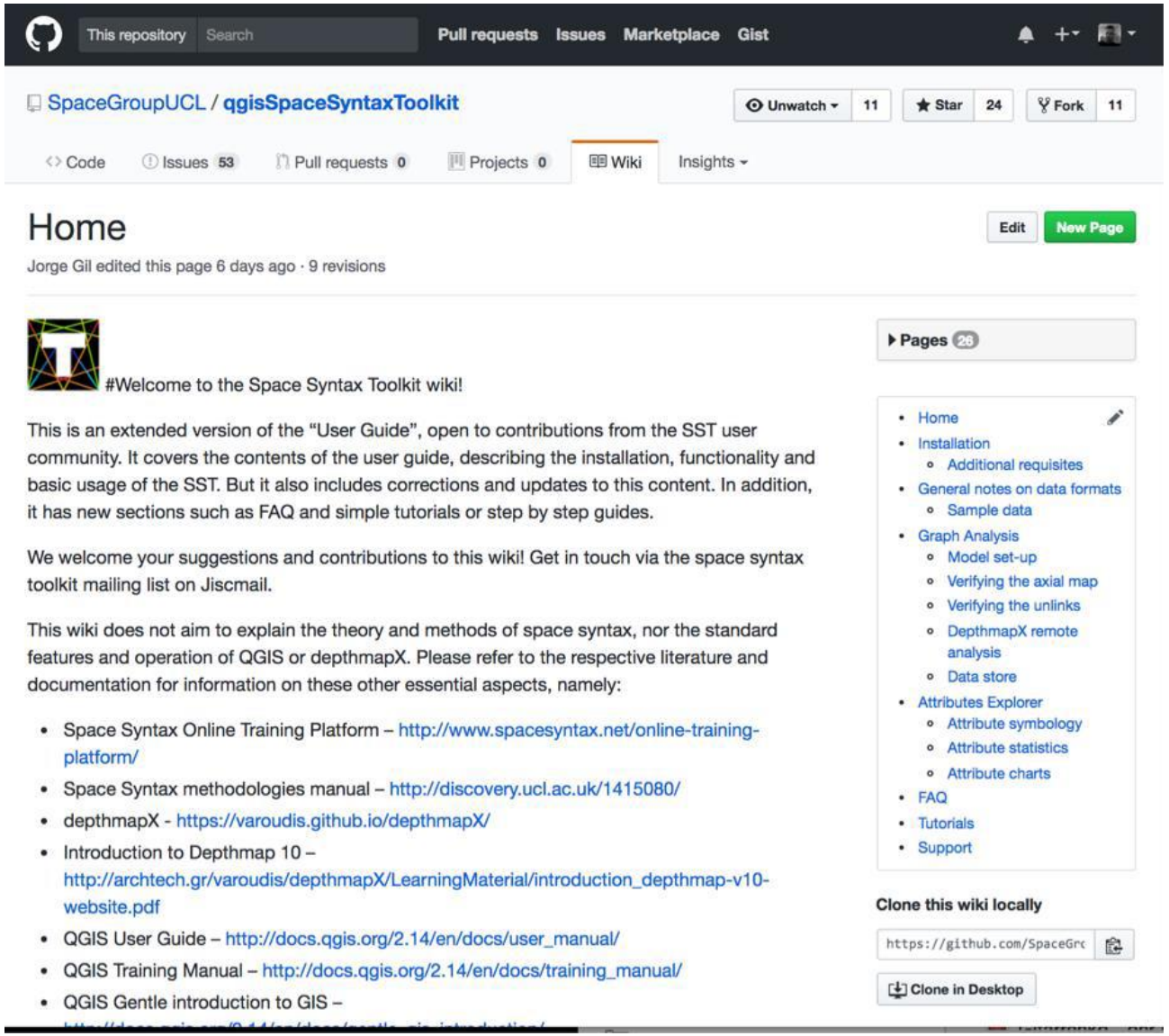

Mailing List

SSX Toolkit mailing list:
https://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=SPACESYNTAX-TOOLKIT

Space Syntax mailing list:
https://www.jiscmail.ac.uk/cgi-bin/webadmin?A0=SPACESYNTAX

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