

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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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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University  
of Cyprus



URBAN  
CALCULATOR

# INTRODUCTION

# Theoretical Framework

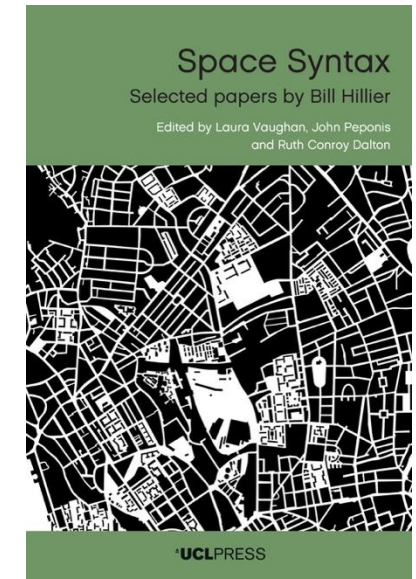
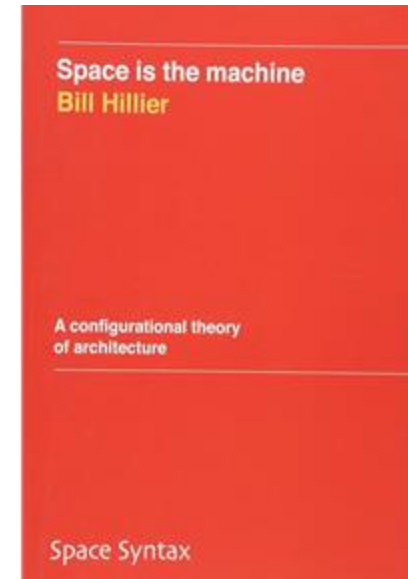
Bill Hillier's theories of:

“**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 &

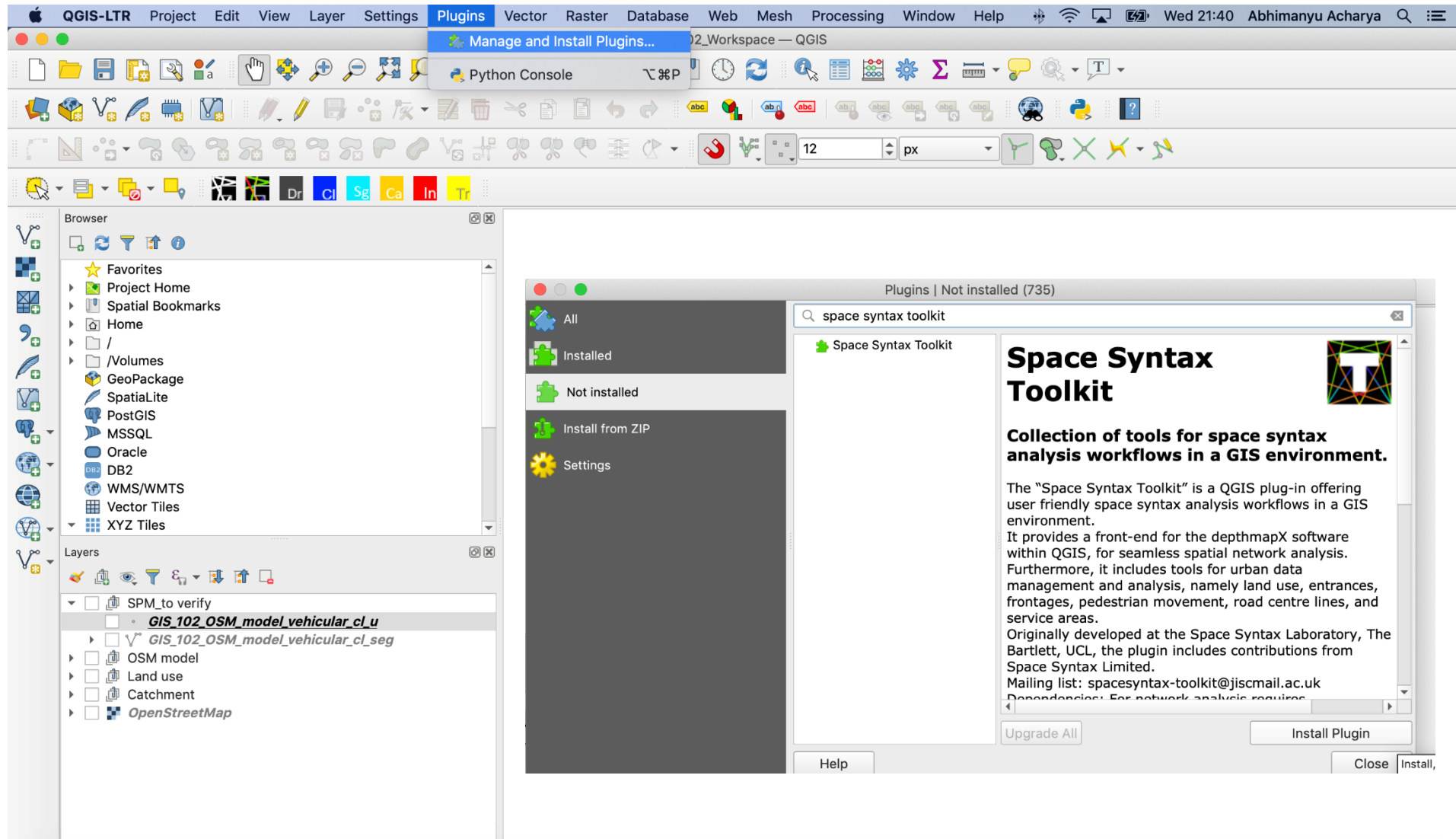
the “**dual grid**” - how the foreground & background street networks interrelate...



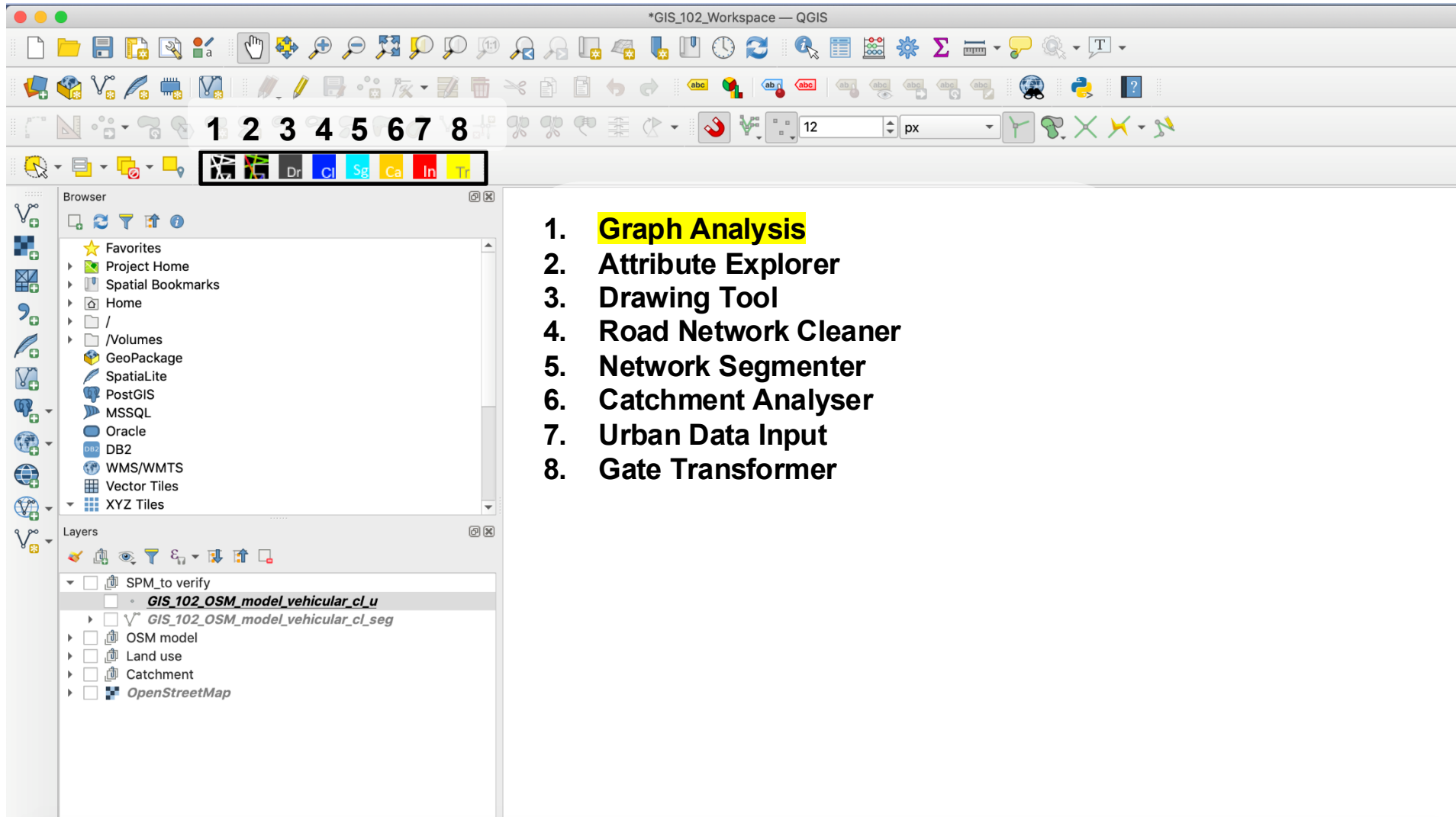


# SPACE SYNTAX TOOLKIT

# 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**



## Graph Analysis

Performs Space Syntax analysis by remotely connecting to Depthmap



## Attribute Explorer

Visualise results of the analysis and explore basic statistics



## Drawing Tool

Change snapping settings to draw Axial, Segment Lines and Unlinks



## Road Network Cleaner

Tool to help simplify OpenStreetMap Road layer to Space Syntax Segment Maps



## Network Segmenter

Segment Axial maps into Segment Maps



## Catchment Analyser

Performs Metric catchment analysis. Cost variable can be changed.



## Urban Data Input

Create Land use, Frontage and Entrance Data



## Gate Transformer

Perform Geometric transformations of geometries

# SPACE SYNTAX 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

## 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”.



## 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?

# Property 1: Accessibility measures

## Types of Analysis

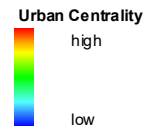


This highlights central areas.

Highly integrated cores



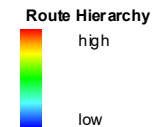
Integration or “closeness” centrality



Space Syntax © 2024



Choice or “betweenness” centrality



Space Syntax © 2024

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

Often identifies high streets.

# Property 1: Accessibility measures

## Integration

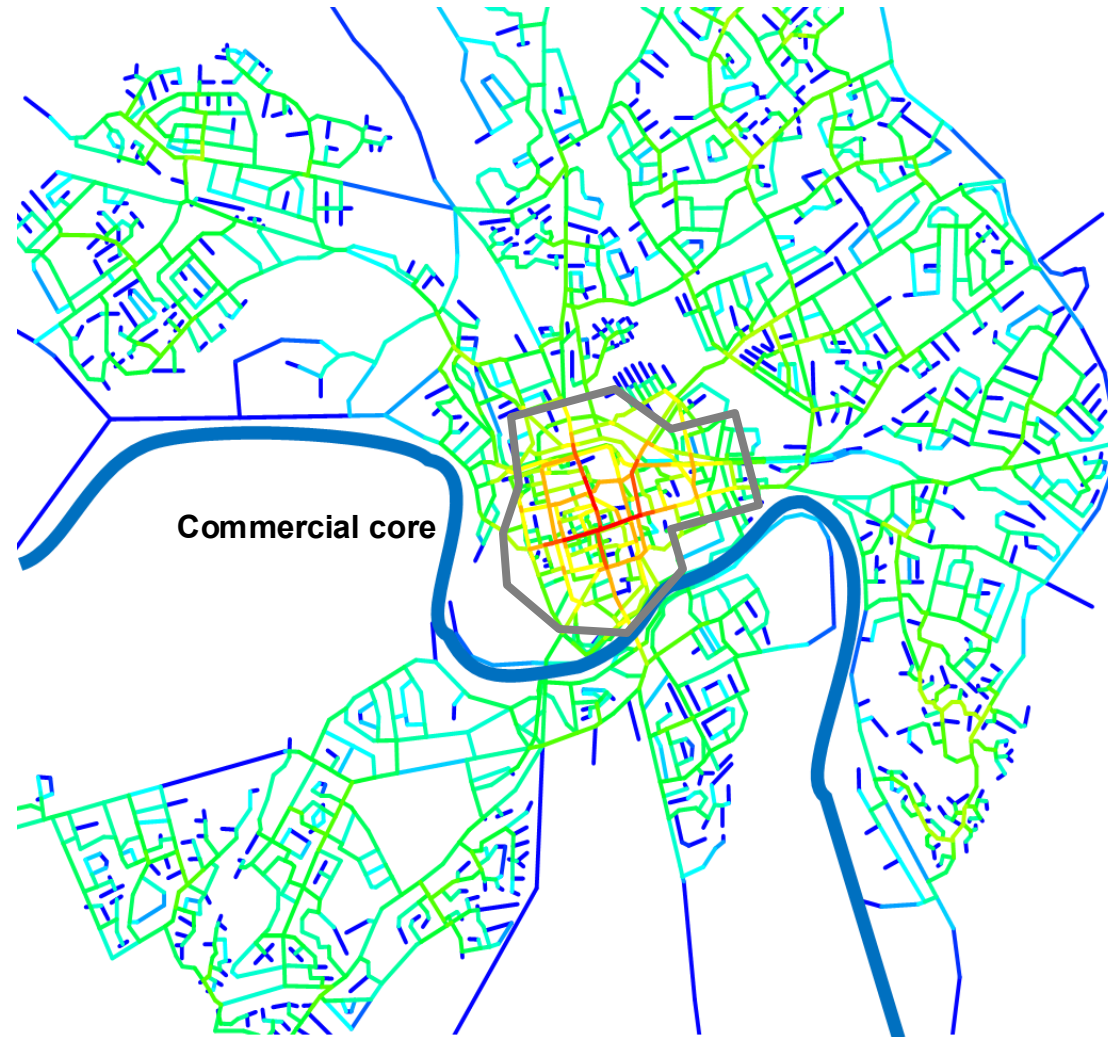
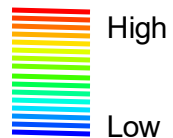
### Closeness centrality “Integration”

Based on 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



Space Syntax © 2024

# Property 1: Accessibility measures

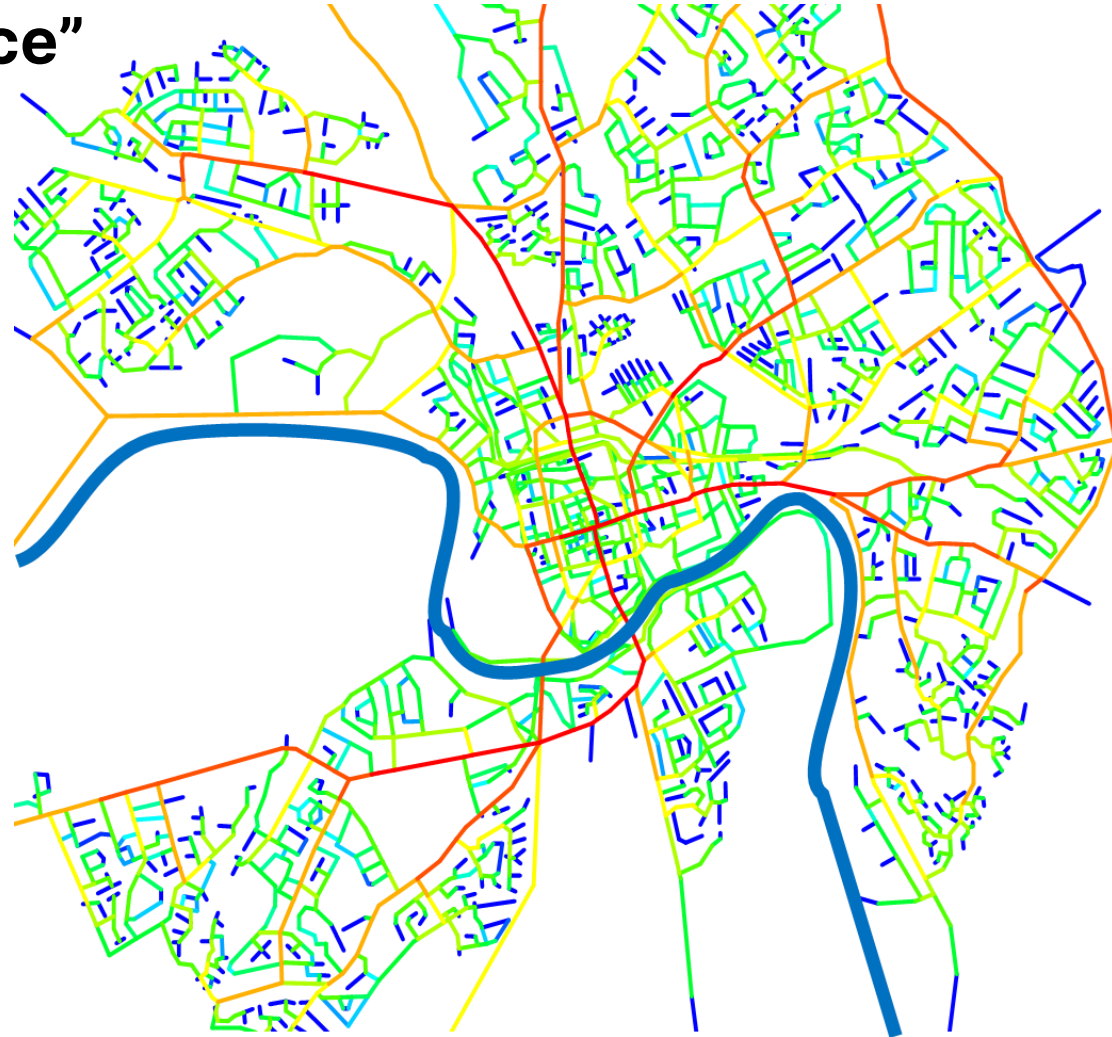
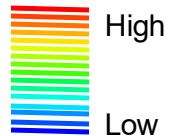
## Betweenness centrality “Choice”

Betweenness centrality “Choice”

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

Often identifies high streets.

“Through” movement

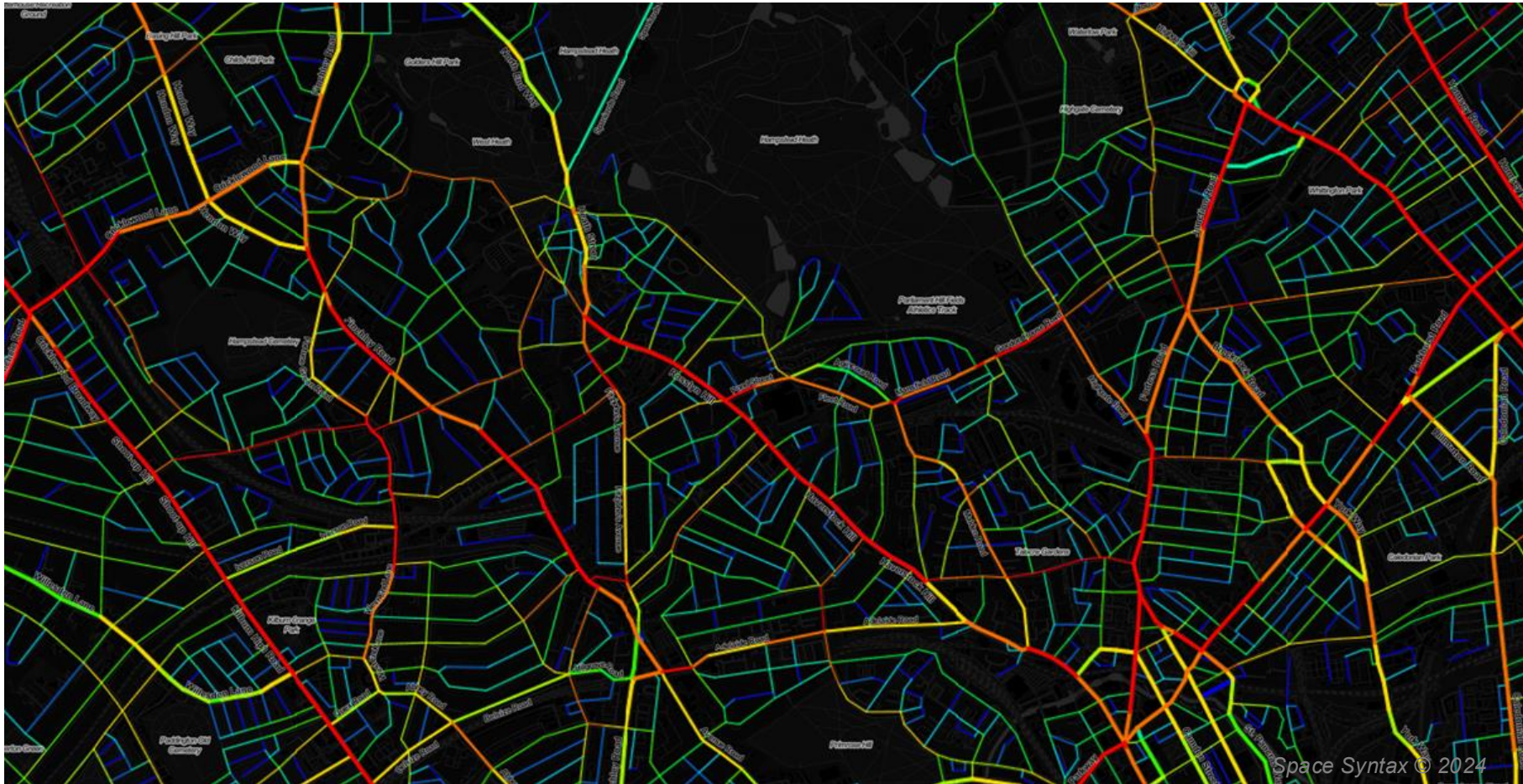


Space Syntax © 2024



## Property 2: Dual System of streets

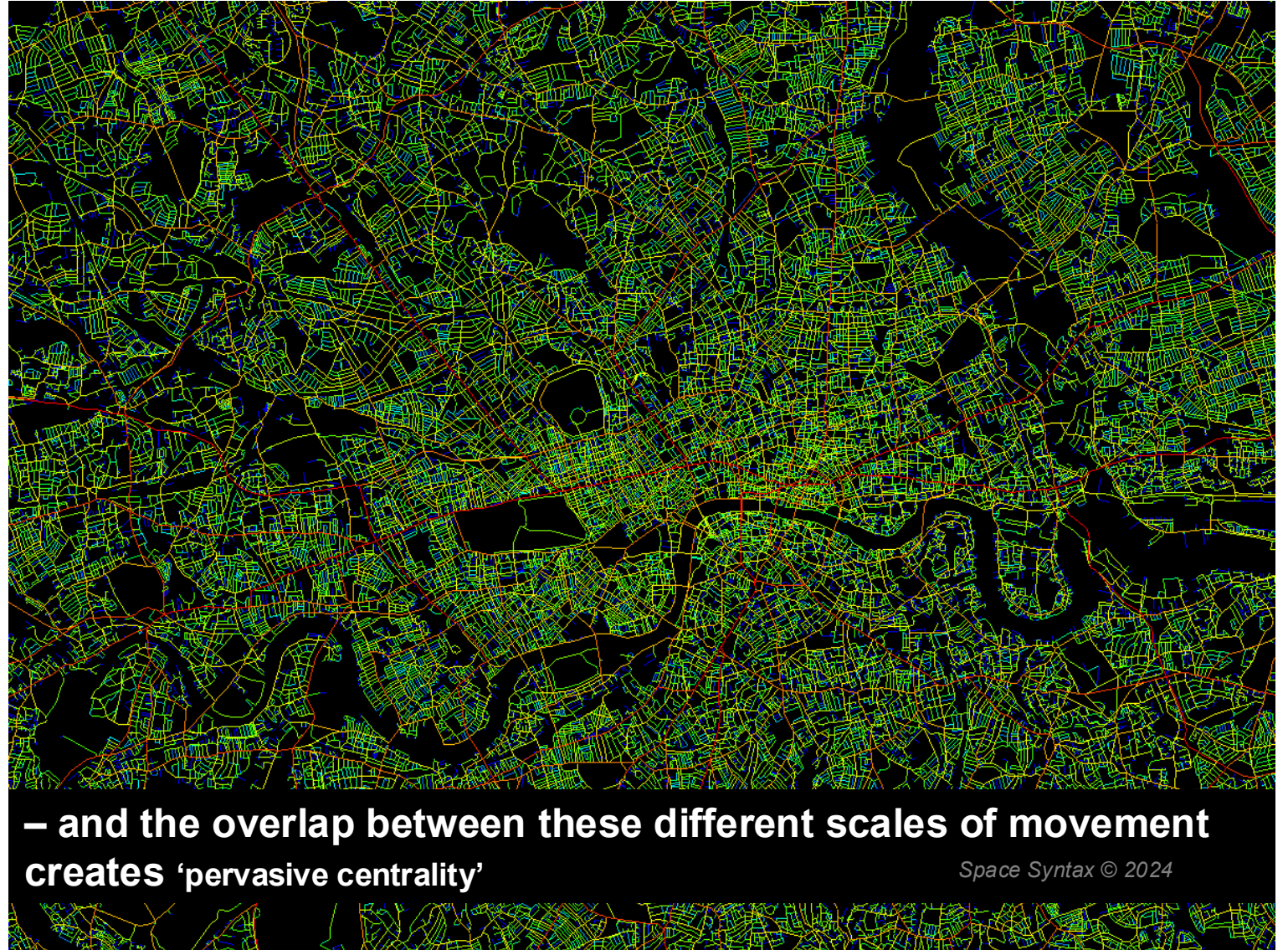
**Spatial networks typically combine a well-connected “foreground” and a less well connected “background”**





## Property 3: Scales of Movement

**Movement happens at different scales**



# PROCESSING USING SPACE SYNTAX TOOLKIT



## Workshop requirements

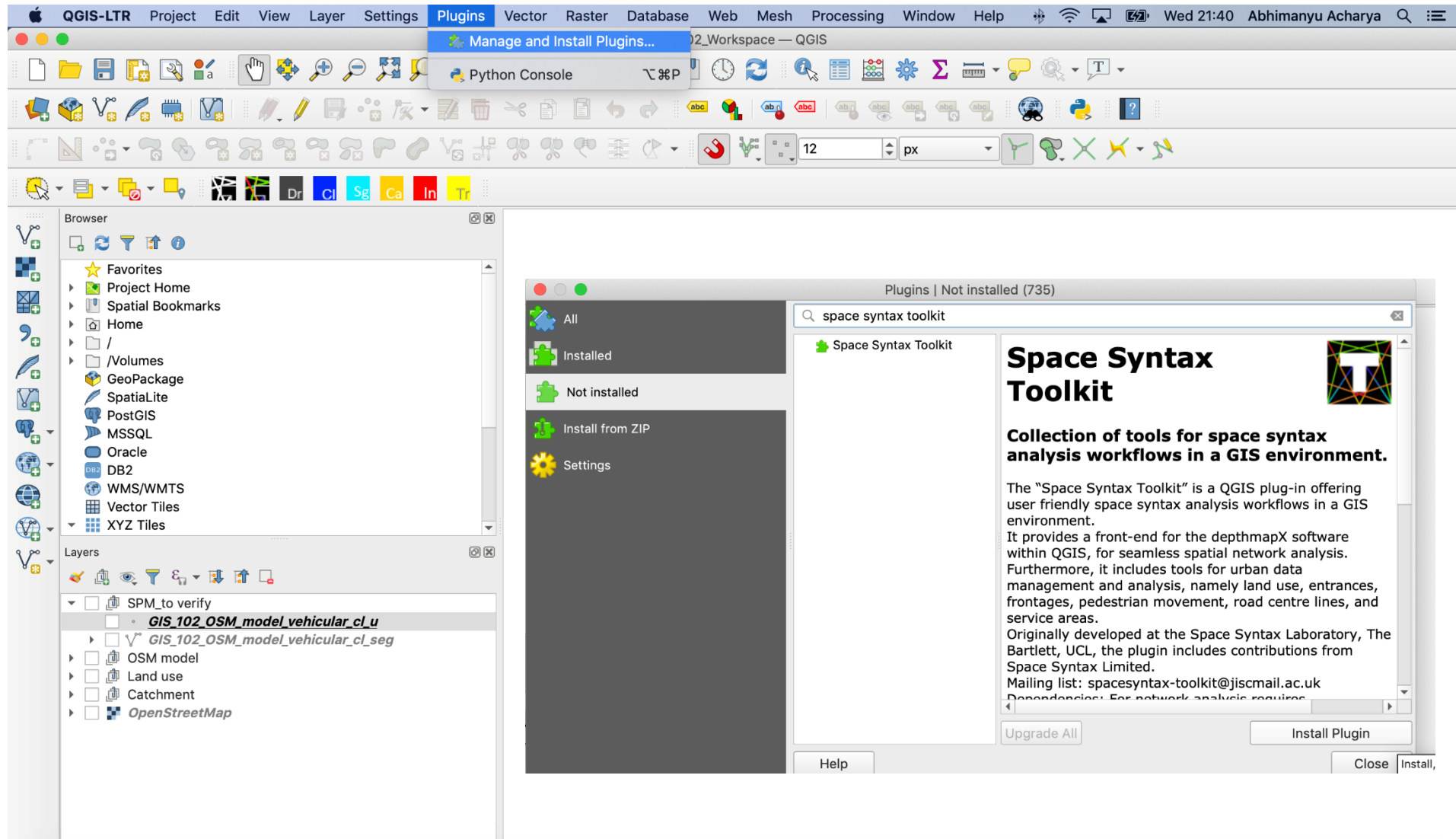
Please install the following:

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>

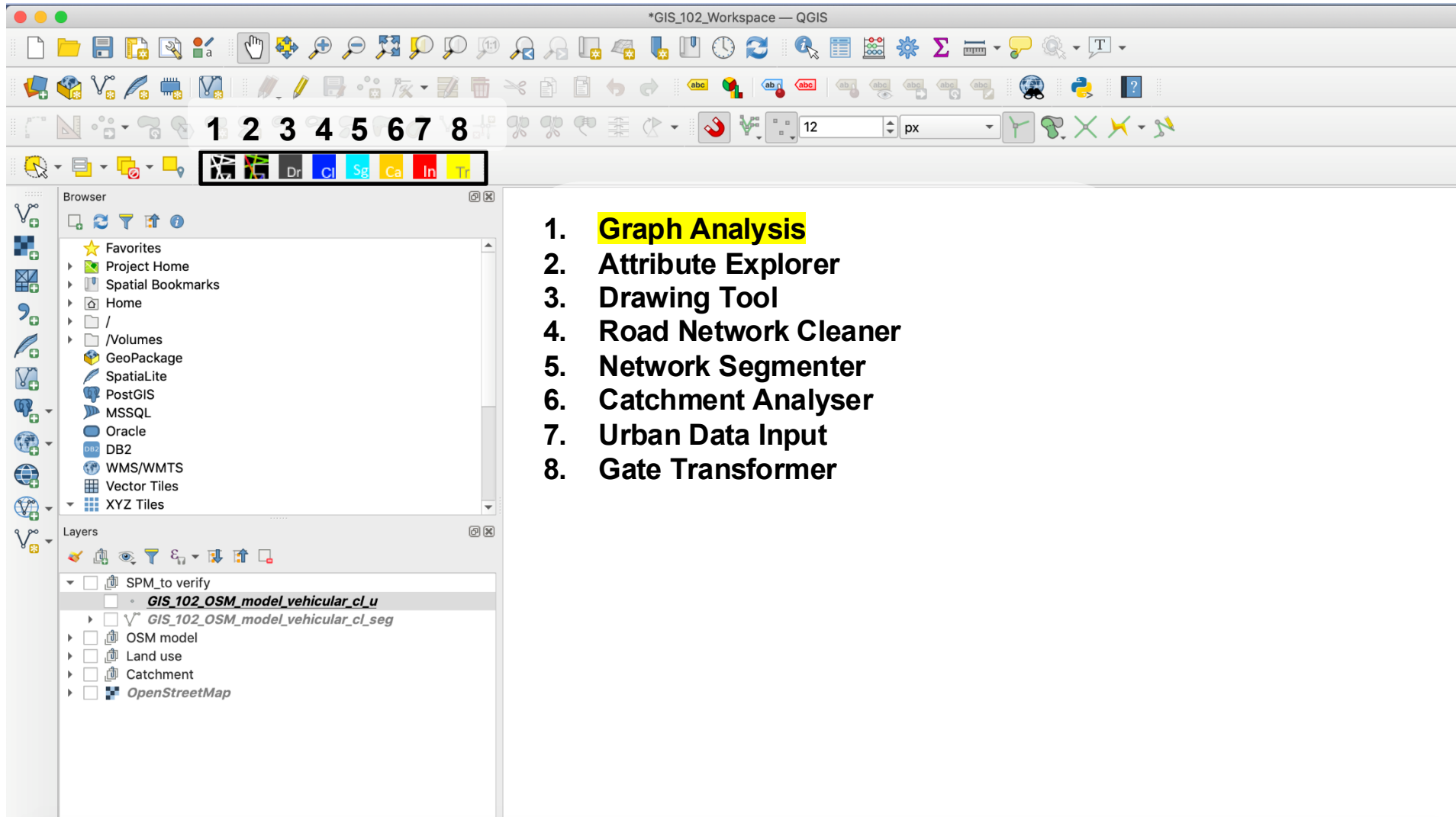
Any issues please refer to:

<https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/issues>

# Space Syntax Toolkit



# Space Syntax Toolkit



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## Urban Data Input

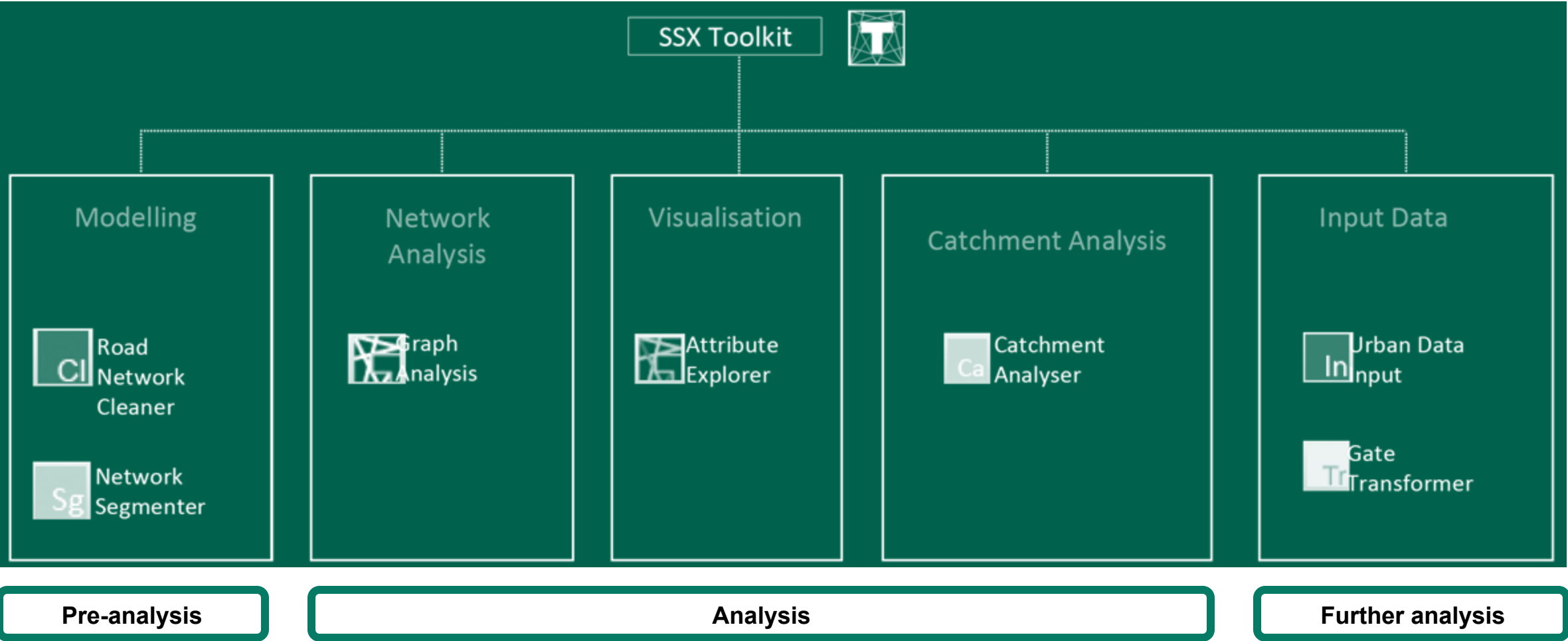
Create Land use, Frontage and Entrance Data



## Gate Transformer

Perform Geometric transformations of geometries

# Space Syntax Toolkit Overview



## Steps for processing the model



### How to process a segment model

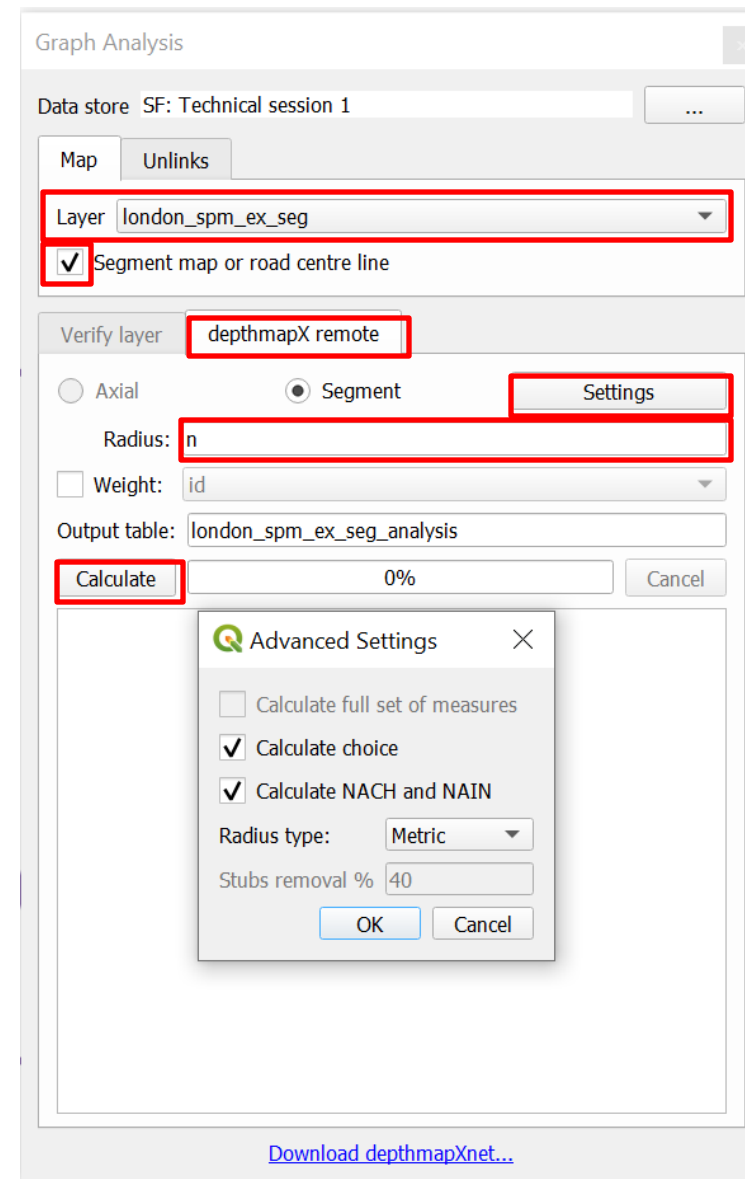
Use **Graph Analysis** in Space Syntax Toolkit.

Remember to open **depthmapXnet** in the background to process a model.

#### Graph Analysis

Performs Space Syntax analysis by remotely connecting to Depthmap

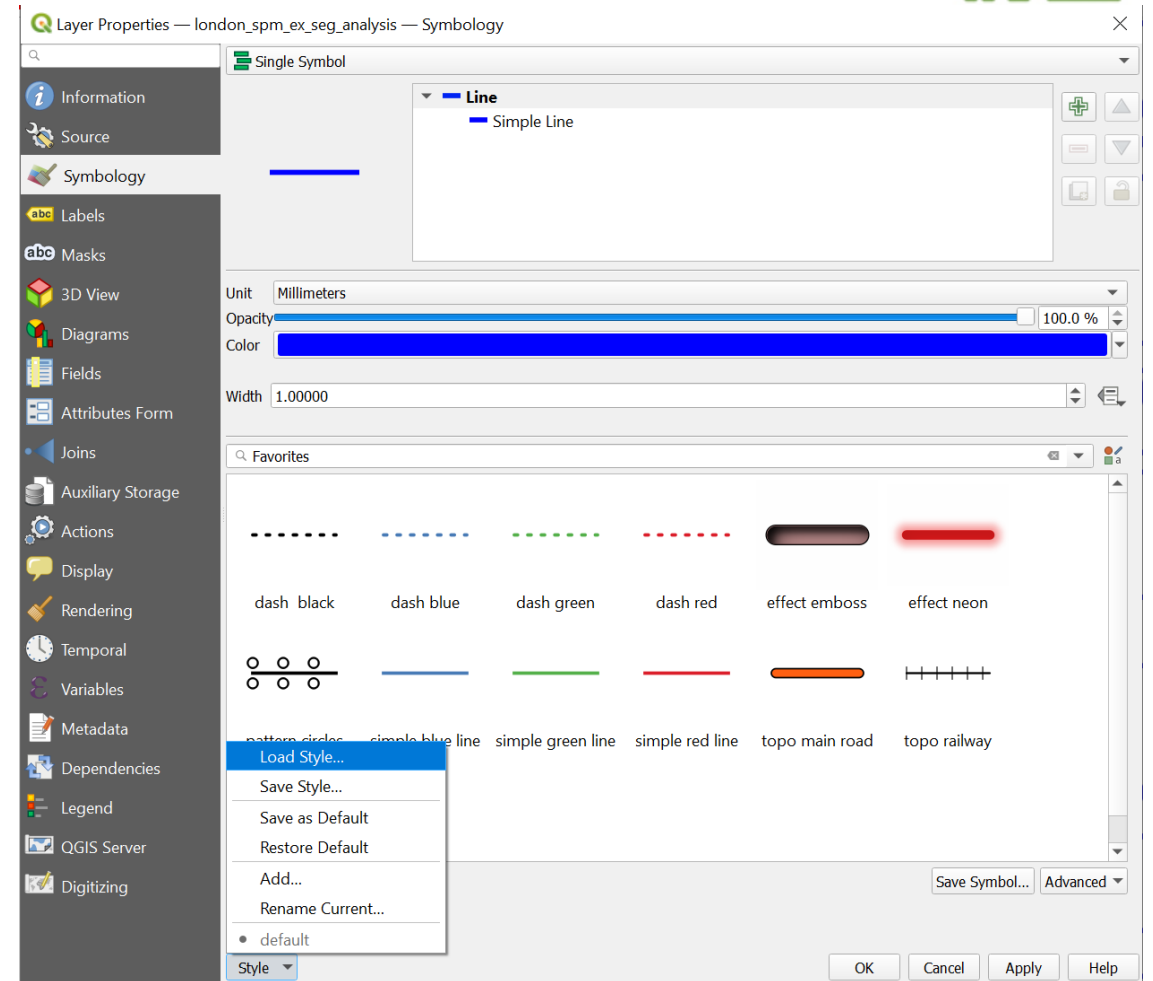
1. Select **the segmented model** for processing
2. Tick **Segment map or road centre line**.  
Under the depthmapX remote tab, a Segment option will be activated.
3. Put radii in Radius section.  
  
Recommended radii for urban analysis:  
400, 800, 1200, 1600, 2000, 3000, 5000, 10000
4. Name the output 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.





## 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.

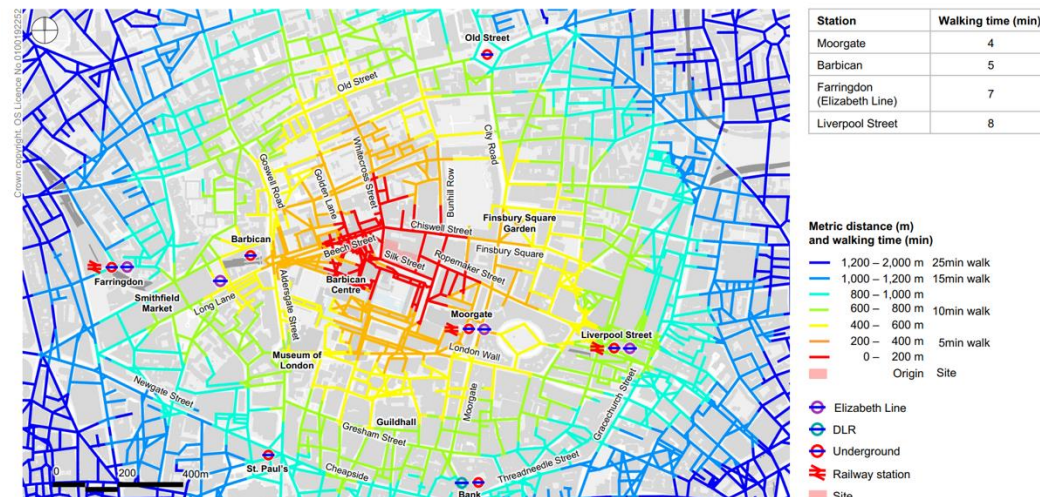
Process metric catchments: 400,800,1200 and 2000.

For the output layers, always save to shapefile.

Tick Load Polygons and Run.

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

### Transport attraction Walking distance from site



Example metric catchment analysis

Space Syntax © 2024

# UNDERSTANDING OUTCOMES

# Outcomes: Street systems and urban performance

## Interpreting results and using SSx toolkit in planning



### The **impact** of spatial layout



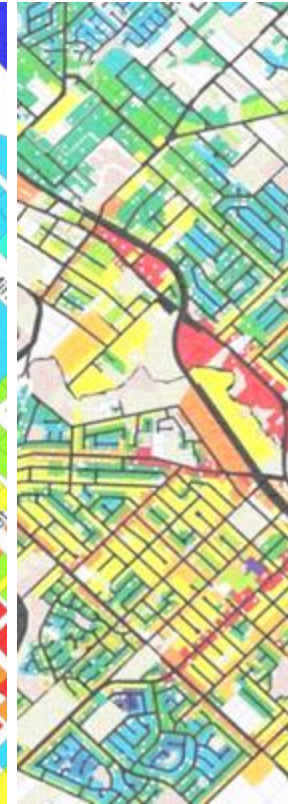
**Movement**



**Land use**



**Economic  
vitality and  
Land value**



**Crime and  
Safety**

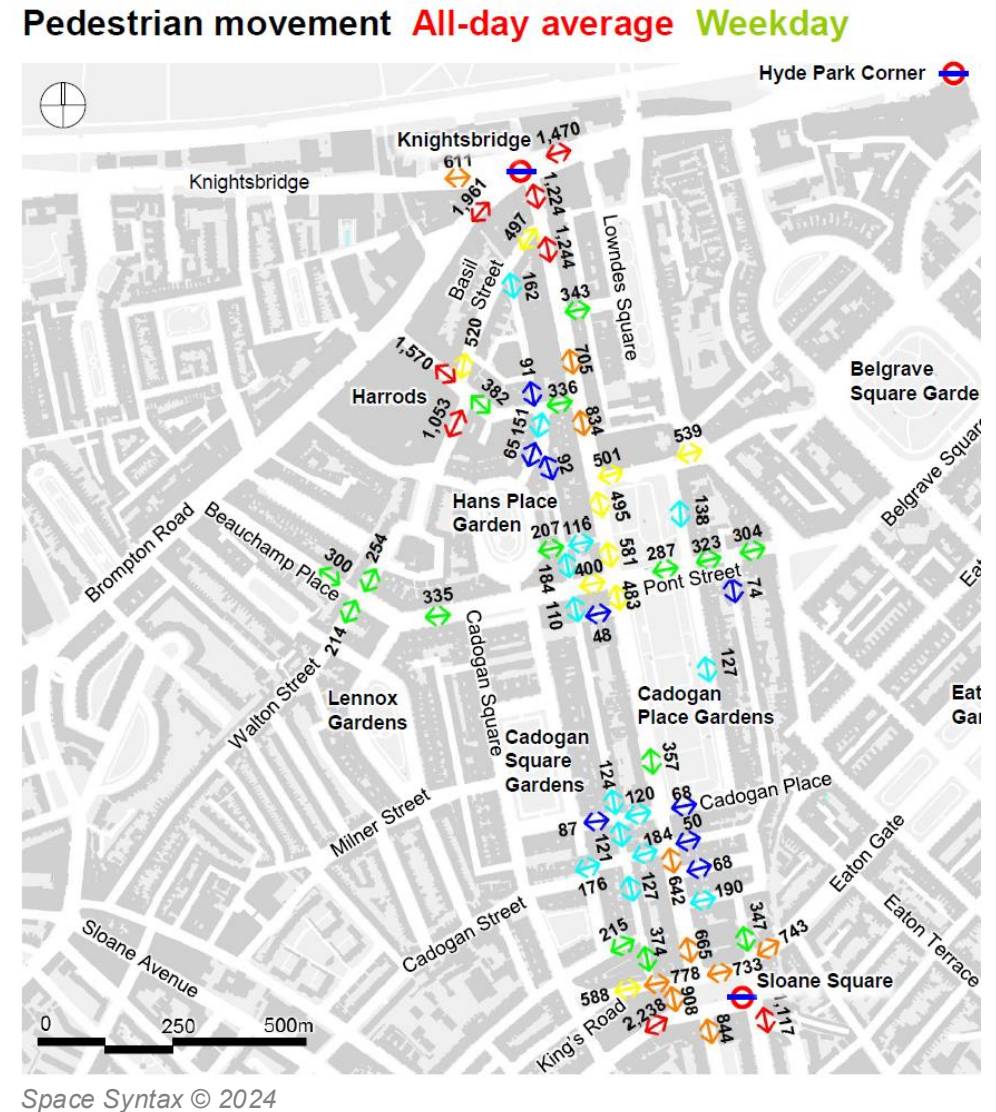
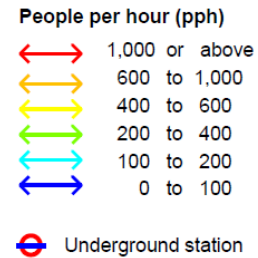
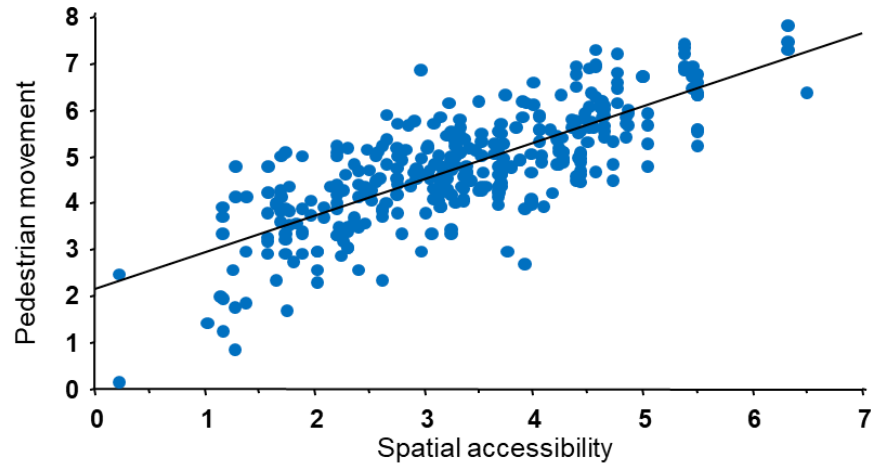


**Carbon Emissions  
Health and well-being**

*Space Syntax © 2024*



## How spatial accessibility shapes movement





# How spatial networks shape the location of economic activities



Space Syntax © 2024





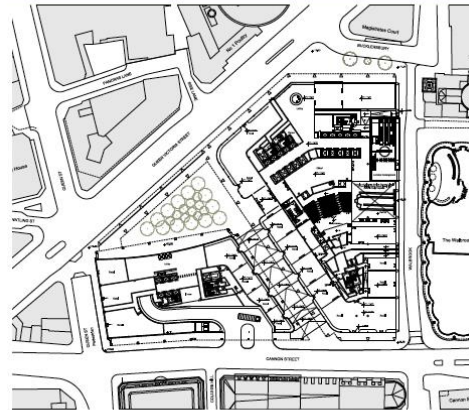
## Using SSx Toolkit to test design ideas

### Option testing

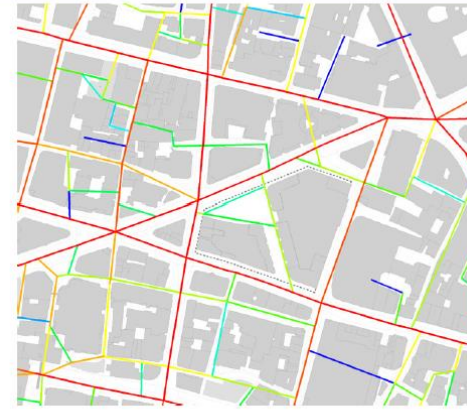
The pattern of spatial accessibility created in option two is very strong:

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

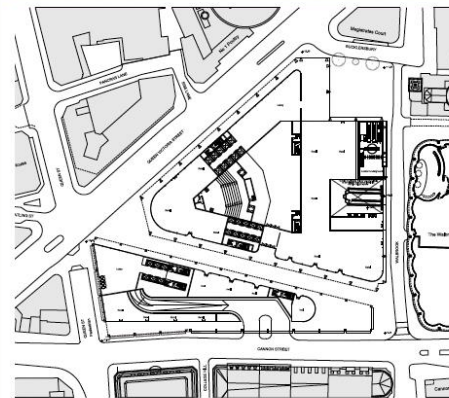


Spatial accessibility at a local scale



Land use

Option two



Proposed plan



Spatial accessibility at a local scale



Land use

Space Syntax © 2024

# COMPLEX OUTCOMES



# 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?

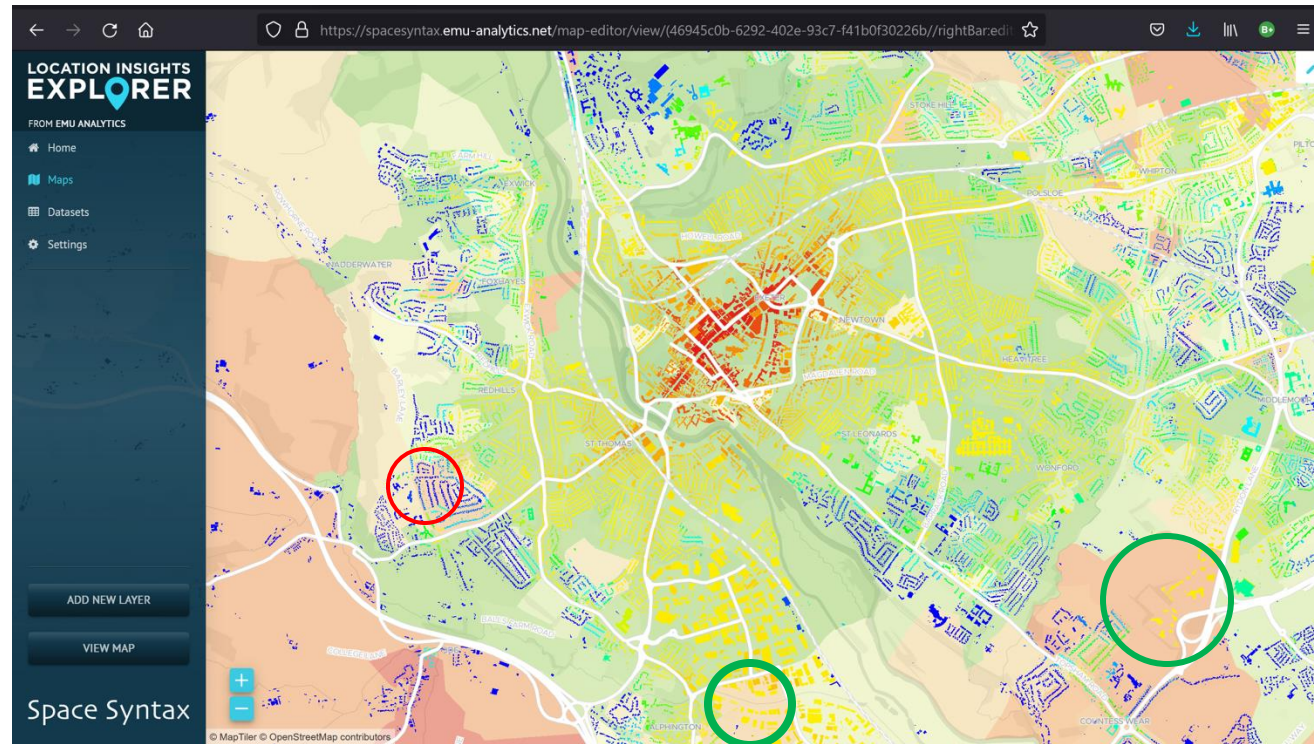
# Understanding Complex Outcomes

## 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

# Understanding Complex Outcomes

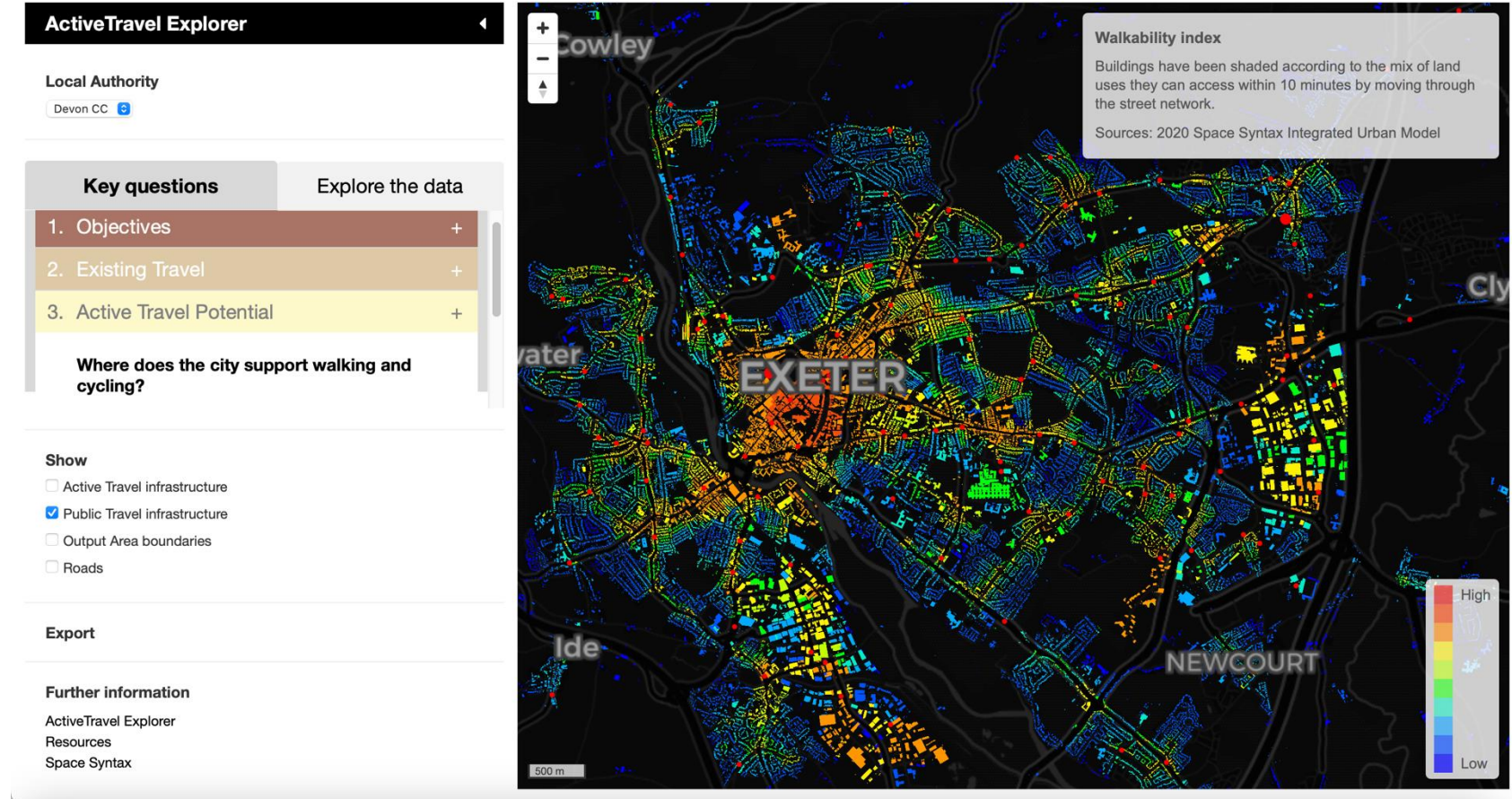
## Examples

- **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

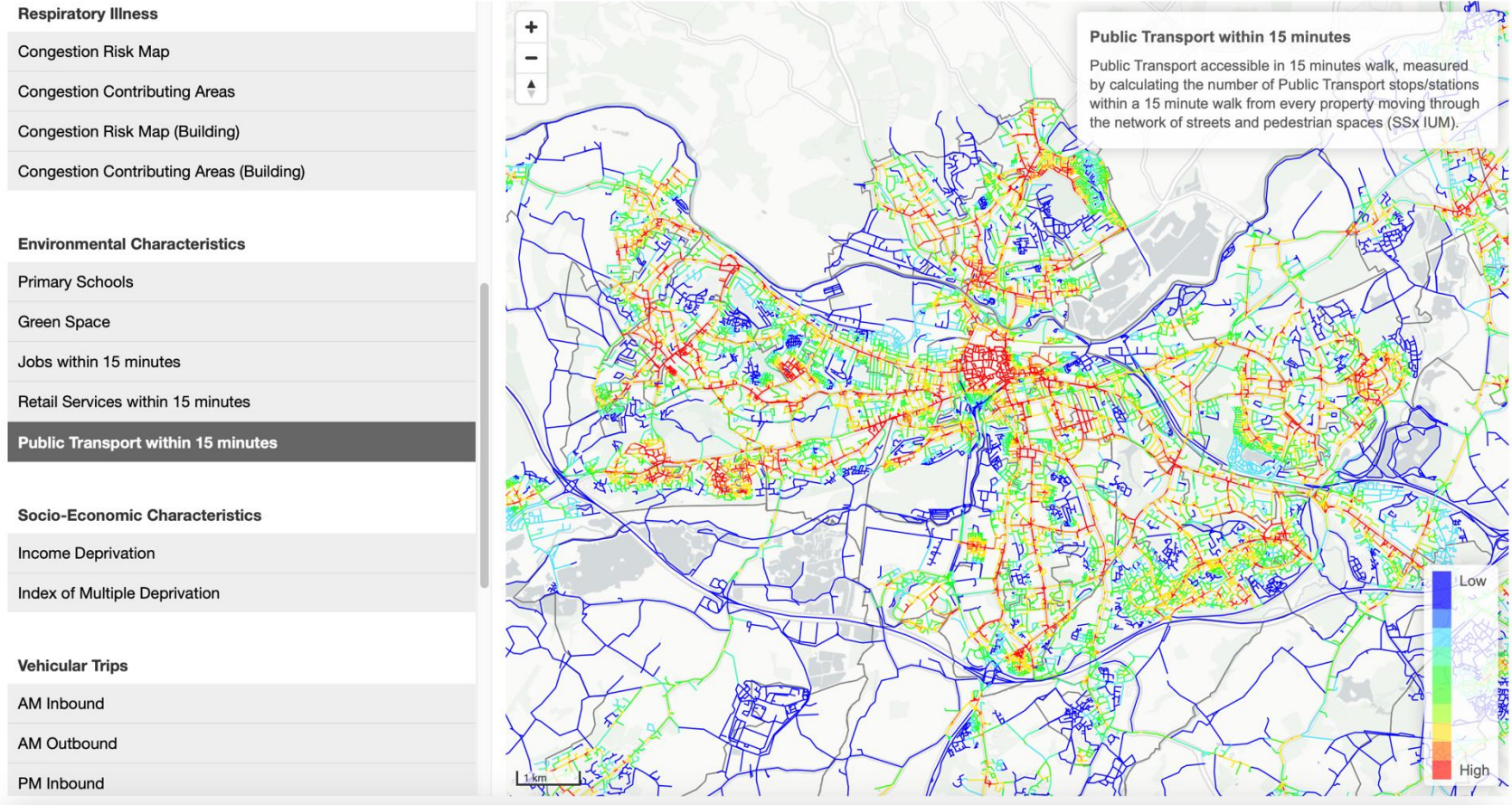
## Examples

- **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.

## Web tools developed with IUM

Applying urban planning strategies:



# Resources and online support

## SSX Toolkit Github repository

<https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit>

The screenshot shows the GitHub repository page for **SpaceGroupUCL / qgisSpaceSyntaxToolkit**. The repository has 11 stars, 24 forks, and 11 watchers. It is licensed under GPL-3.0 and has 168 commits, 6 branches, 13 releases, and 2 contributors. The repository is currently on the **master** branch. A recent commit by **jorgegil** is shown, updating the README.md file. The repository contains several files and folders, including **documents**, **esstoolkit**, **sample\_data**, **.gitignore**, **LICENSE.txt**, and **README.md**. The README.md file is displayed, showing the title **Space Syntax Toolkit for QGIS** and a section titled **News** with three entries: 03.07.2017 - SST workshop at the 11th International Space Syntax Symposium, in Lisbon, Portugal; 30.06.2017 - SST 0.2.0 has been released, including several new modules; and 06.11.2016 - For the latest information on the Space Syntax Toolkit you should now consult the [Wiki](#) and its [FAQ](#).

Space Syntax Toolkit for QGIS

168 commits 6 branches 13 releases 2 contributors GPL-3.0

Branch: master New pull request Create new file Upload files Find file Clone or download

jorgegil committed on GitHub Update README.md Latest commit 9876824 17 seconds ago

documents	replaced exercises	5 hours ago
esstoolkit	sample data update with v0.2.0	14 hours ago
sample_data	sample data update with v0.2.0	14 hours ago
.gitignore	help updates	20 days ago
LICENSE.txt	metadata and license update	a year ago
README.md	Update README.md	17 seconds ago

README.md

### Space Syntax Toolkit for QGIS

#### News

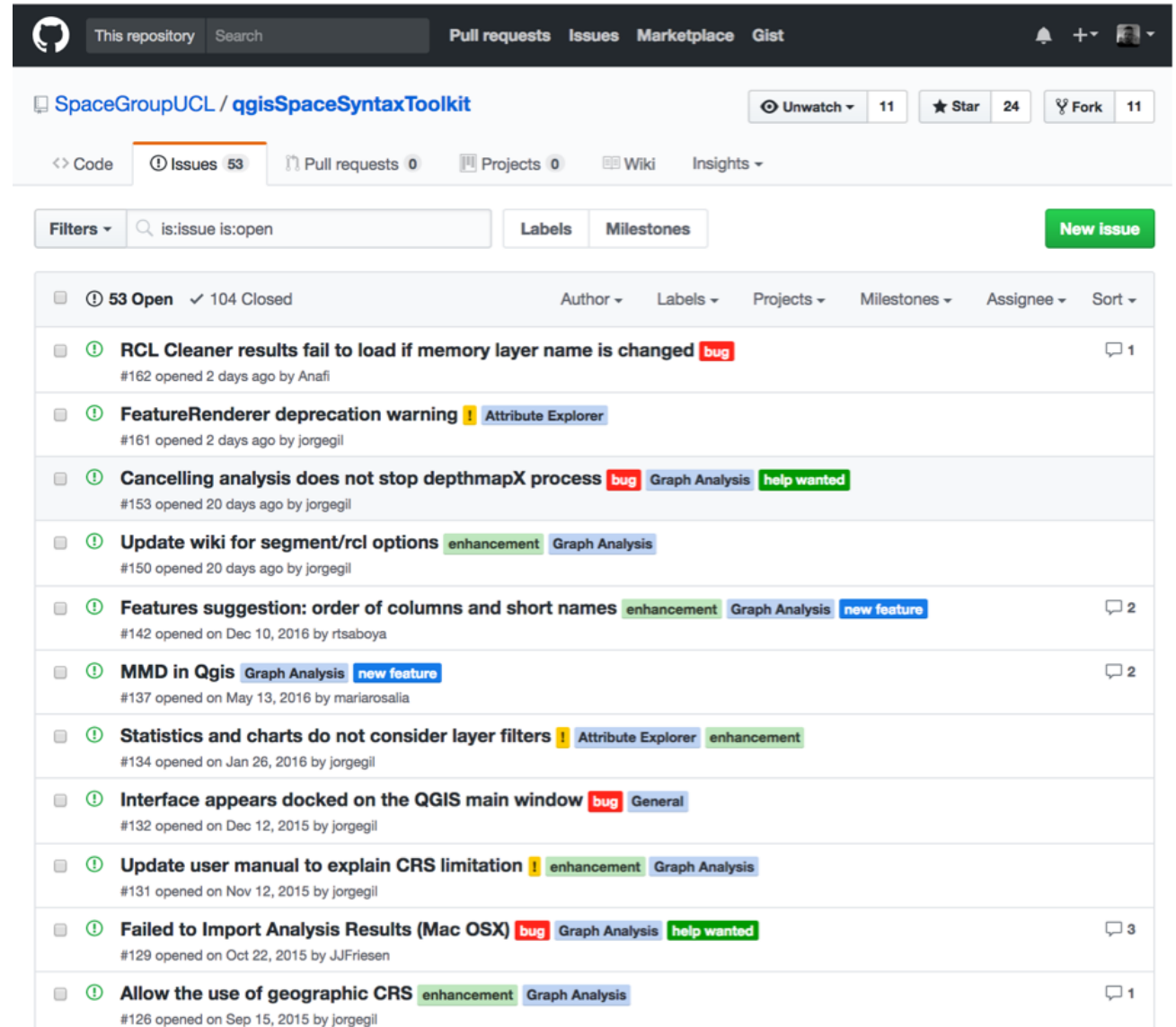
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## SSX Toolkit issues

<https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/issues>



The screenshot displays the GitHub interface for the repository `SpaceGroupUCL / qgisSpaceSyntaxToolkit`. The top navigation bar includes links for `This repository`, `Search`, `Pull requests`, `Issues`, `Marketplace`, and `Gist`. The repository statistics show 11 stars, 24 forks, and 11 issues. The `Issues` tab is selected, showing 53 open issues and 104 closed issues. The issues are listed with their titles, labels, and comment counts.

Issue Title	Labels	Comments
<b>RCL Cleaner results fail to load if memory layer name is changed</b>	bug	1
<b>FeatureRenderer deprecation warning</b>	Attribute Explorer	
<b>Cancelling analysis does not stop depthmapX process</b>	bug, Graph Analysis, help wanted	
<b>Update wiki for segment/rcl options</b>	enhancement, Graph Analysis	
<b>Features suggestion: order of columns and short names</b>	enhancement, Graph Analysis, new feature	2
<b>MMD in Qgis</b>	Graph Analysis, new feature	2
<b>Statistics and charts do not consider layer filters</b>	Attribute Explorer, enhancement	
<b>Interface appears docked on the QGIS main window</b>	bug, General	
<b>Update user manual to explain CRS limitation</b>	enhancement, Graph Analysis	
<b>Failed to Import Analysis Results (Mac OSX)</b>	bug, Graph Analysis, help wanted	3
<b>Allow the use of geographic CRS</b>	enhancement, Graph Analysis	1



# Resources and online support

## SSX Toolkit wiki

<https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/wiki>

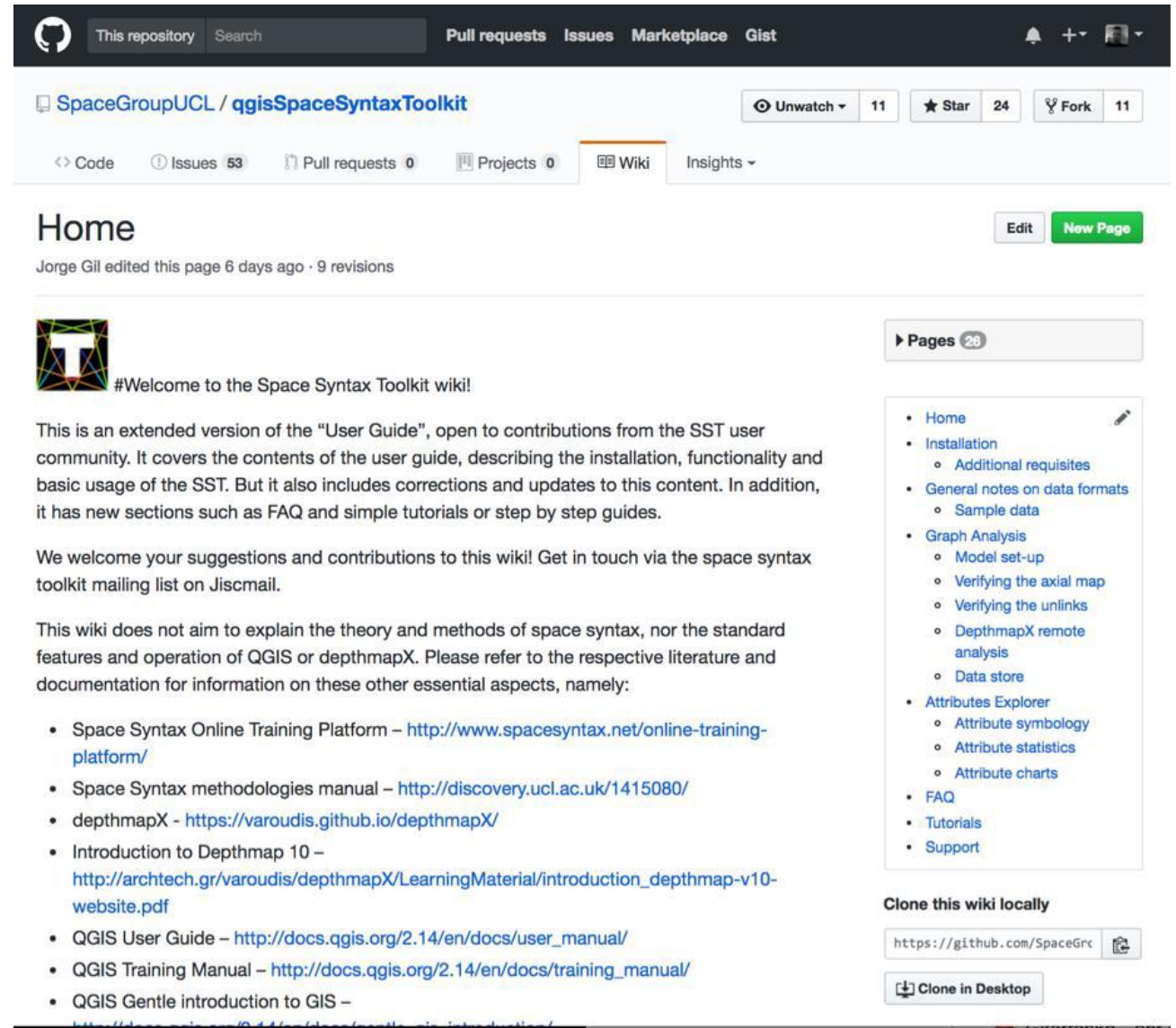
## Mailing List

### 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>



This repository

Search

Pull requests Issues Marketplace Gist


SpaceGroupUCL / qgisSpaceSyntaxToolkit

Unwatch 11 Star 24 Fork 11

Code Issues 53 Pull requests 0 Projects 0 Wiki Insights

## Home

Jorge Gil edited this page 6 days ago · 9 revisions



#Welcome to the Space Syntax Toolkit wiki!

This is an extended version of the "User Guide", open to contributions from the SST user community. It covers the contents of the user guide, describing the installation, functionality and basic usage of the SST. But it also includes corrections and updates to this content. In addition, it has new sections such as FAQ and simple tutorials or step by step guides.

We welcome your suggestions and contributions to this wiki! Get in touch via the space syntax toolkit mailing list on Jiscmail.

This wiki does not aim to explain the theory and methods of space syntax, nor the standard features and operation of QGIS or depthmapX. Please refer to the respective literature and documentation for information on these other essential aspects, namely:

- Space Syntax Online Training Platform – <http://www.spacesyntax.net/online-training-platform/>
- Space Syntax methodologies manual – <http://discovery.ucl.ac.uk/1415080/>
- depthmapX - <https://varoudis.github.io/depthmapX/>
- Introduction to Depthmap 10 – [http://archtech.gr/varoudis/depthmapX/LearningMaterial/introduction\\_depthmap-v10-website.pdf](http://archtech.gr/varoudis/depthmapX/LearningMaterial/introduction_depthmap-v10-website.pdf)
- QGIS User Guide – [http://docs.qgis.org/2.14/en/docs/user\\_manual/](http://docs.qgis.org/2.14/en/docs/user_manual/)
- QGIS Training Manual – [http://docs.qgis.org/2.14/en/docs/training\\_manual/](http://docs.qgis.org/2.14/en/docs/training_manual/)
- QGIS Gentle introduction to GIS – <http://docs.qgis.org/2.14/en/docs/gentle-introduction-to-gis/>

Pages 28

- Home
- Installation
  - Additional requisites
- General notes on data formats
  - Sample data
- Graph Analysis
  - Model set-up
  - Verifying the axial map
  - Verifying the unlinks
  - DepthmapX remote analysis
  - Data store
- Attributes Explorer
  - Attribute symbology
  - Attribute statistics
  - Attribute charts
- FAQ
- Tutorials
- Support

Clone this wiki locally

<https://github.com/SpaceGroupUCL/qgisSpaceSyntaxToolkit/wiki>

Clone in Desktop



# thank you!

Transnational Network of Integrated  
Planning Labs: co-creating knowledge on  
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