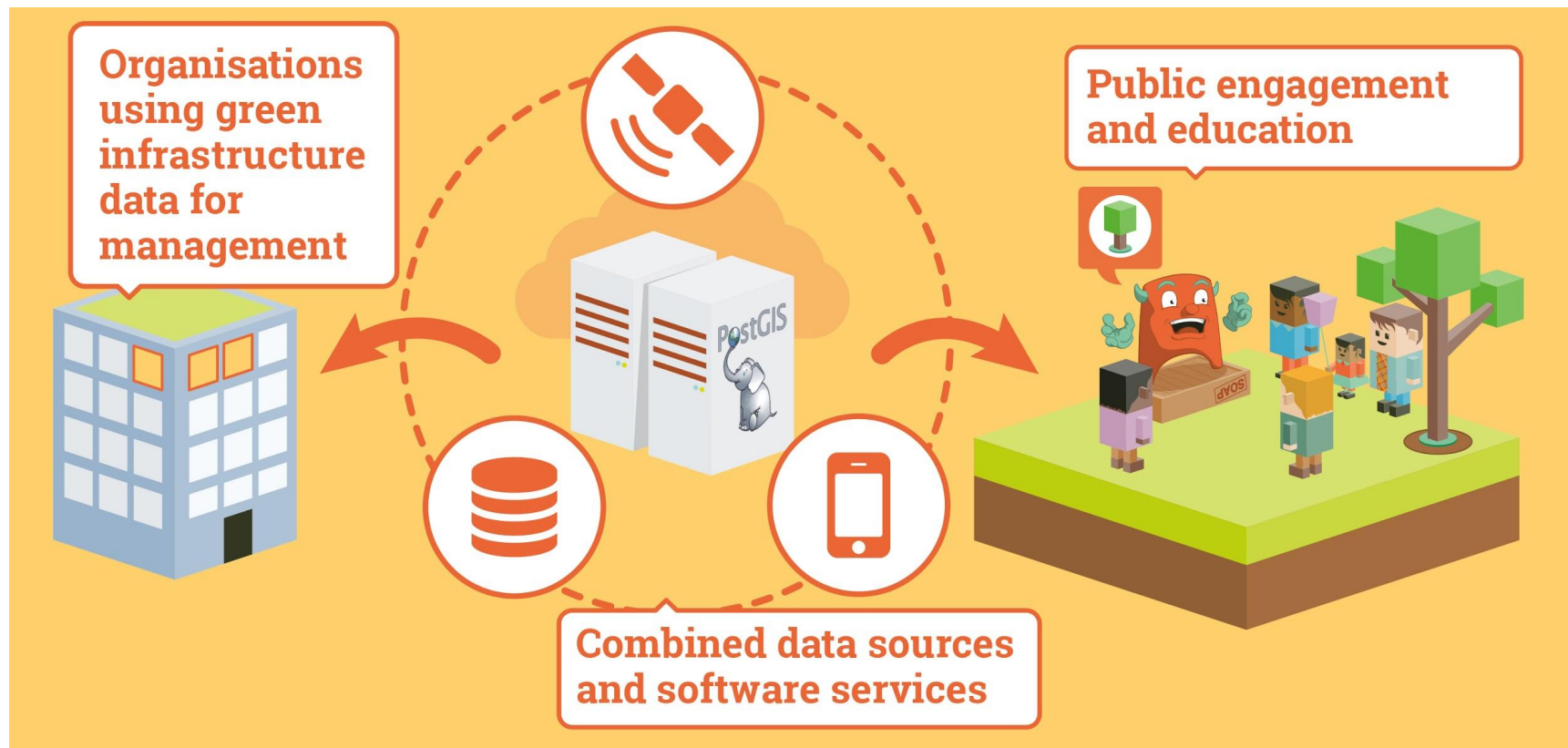




Building a London-wide tree canopy layer,
using the Google Earth Engine platform
as a collaborative, code sharing tool

Paul Hickey

Curio



Greater London Authority (GLA) project

- Working with the GLA to produce support data for London Environment Strategy
- Tree canopy cover analysis using high-res Colour Infrared Imagery (CIR)
- Vegetation cover monitoring using both CIR imagery and the European Space Agency's Sentinel 2 satellite system
- Change detection using Sentinel 2 imagery
- Implemented entirely using Google Earth Engine (GEE)

GREATER
LONDON
AUTHORITY



Google Earth Engine

Inputs & resources

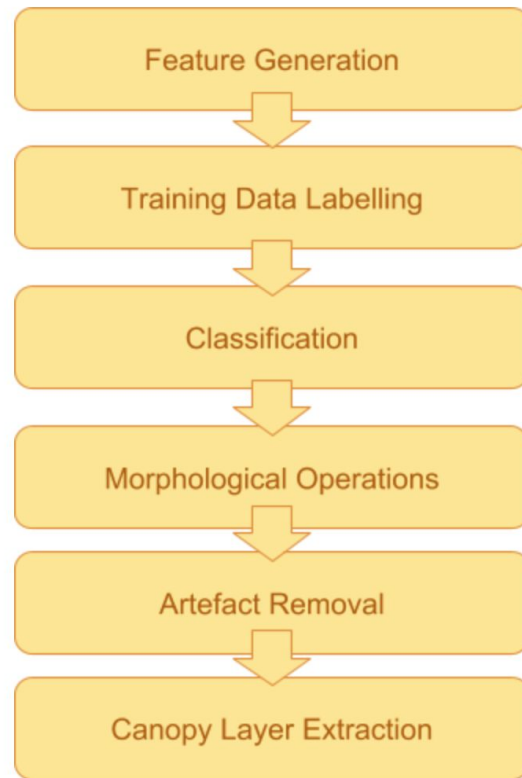
What we had

467 imagery tiles covering the entire Greater London area (25cm/px, 3 bands: red, green and NI) \Rightarrow 3.5TB processed

What GEE provided to us

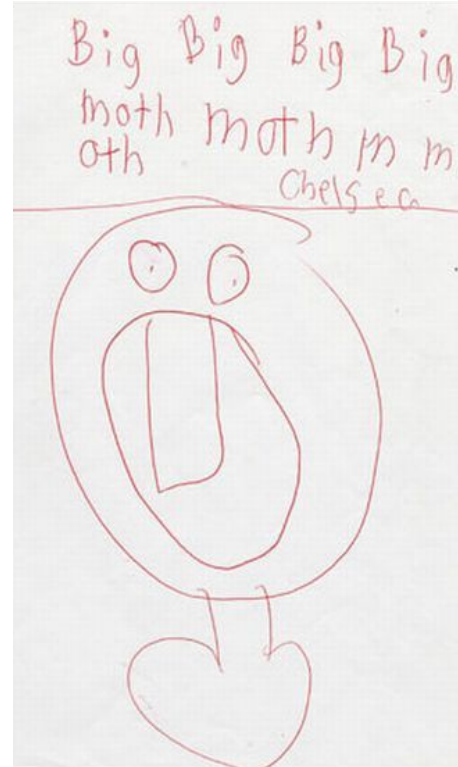


- INFRASTRUCTURE
- Collaborative coding IDE with JS & Python APIs
- Image processing, statistical analysis, machine learning, texture analysis, controlled data labelling...
- Sentinel 2 integration
- Excellent community and documentation
- 5TB of project storage



Collaborative workflow

- Easy distribution of tasks for better results
- Training and validation data labelling by multiple contributors (to mitigate bias)
- Sharing of ongoing work and results for support, transparency and validation



The GEE developer console

The screenshot displays the Google Earth Engine developer console. At the top, the Google Earth Engine logo is on the left, a search bar with the placeholder text "Search places and datasets..." is in the center, and "Help" and "pahickey" links are on the right. Below the header, the interface is divided into several panels. On the left is the "Scripts" panel with tabs for "Docs" and "Assets", showing a list of script files like "add-new-features.js" and "canopy-model.js". The central panel shows a code editor for a file named "canopy-mo...". It includes buttons for "Get Link", "Save", "Run", and "Reset", along with a settings gear icon. The code in the editor defines a map layer and sets various parameters like resolution and scale. On the right is the "Inspector" panel with tabs for "Console" and "Tasks". The "Console" tab is active, showing a message: "Use print(...) to write to this console." Below this, it lists 15 elements, including "extract training data: 9396", "extract rebalanced training data: 9396", and "building classifier...". The bottom of the interface features a map view showing a satellite image of a forested area with buildings. Map controls like zoom in (+) and zoom out (-) buttons are on the left. On the right of the map are buttons for "Layers", "Map", and "Satellite". A white text box is overlaid on the bottom right of the map area, containing the URL: <https://code.earthengine.google.com/>. At the very bottom, there is a Google logo on the left and map data information on the right, including "Map data ©2018 Google", a scale bar for "20 m", and links for "Terms of Use" and "Report a map error".

Google Earth Engine

Search places and datasets...

Help pahickey

Scripts Docs Assets

canopy-mo... Get Link Save Run Reset

```
6 var training_image = ee.ImageCollection.fromImages([
7
8   Map.addLayer(training_image, {'min': 0, 'max': 1}, 'training_image'),
9   //the line below is a legacy of a split training
10  //Map.addLayer(validation_image, {'min': 0, 'max': 1}, 'validation_image'),
11
12
13  var imageResolution = 0.25;
14  //var tileSize = 16;
15  var tileSize = 1;
16  var classificationThreshold = 0.50;
17  var proj = random_image.projection();
18
19  //initialize map
```

Inspector Console Tasks

Use print(...) to write to this console.

► List (15 elements) JSON

extract training data: 9396 JSON

extract rebalanced training data: 9396 JSON

building classifier... JSON

Layers Map Satellite

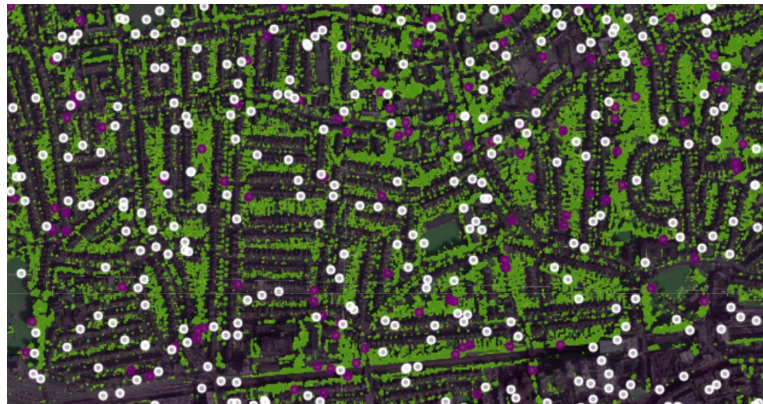
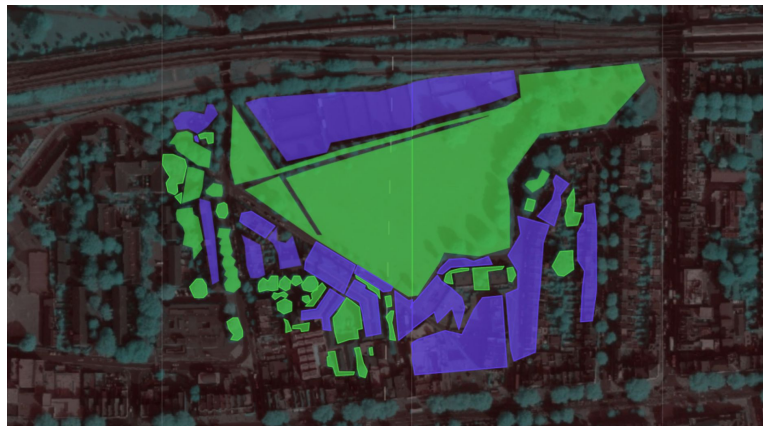
<https://code.earthengine.google.com/>

Google

Map data ©2018 Google 20 m Terms of Use Report a map error

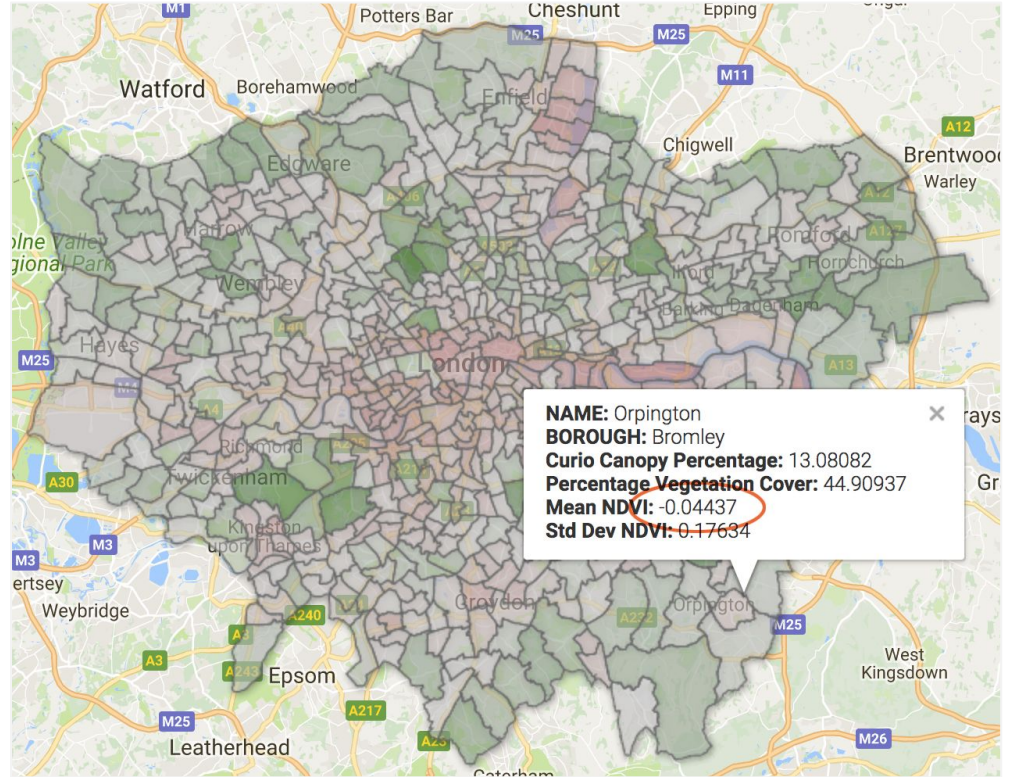
Data labelling

- Allowed collaborative labelling of training & validation data
- Developed random points on a plane app to recreate prior GLA study
- Enabled further work on Active Learning improvements with research partners



Fusion tables analysis

- Simple map, table and chart based presentation of results
- Easily shared by URL



GEE project outputs

- Tree canopy vector and raster layers for entire Greater London region

Average Accuracy 94.87%

Standard Deviation 3.72%

- Green infrastructure identification and delta layers
- Results to be open sourced



@curioxyz
#OSGeoIE2018

www.curio.xyz

Thanks!

