A remote sensing view of urban forest

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

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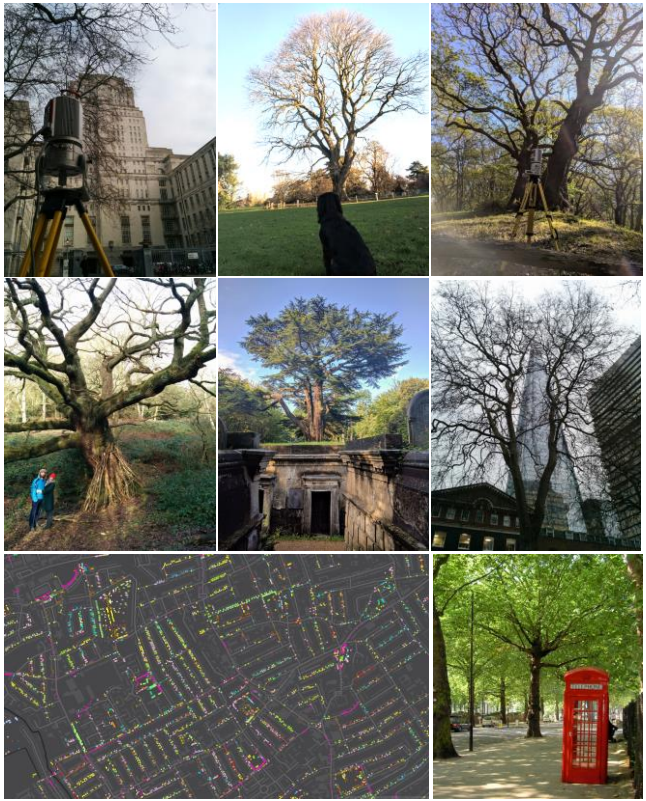
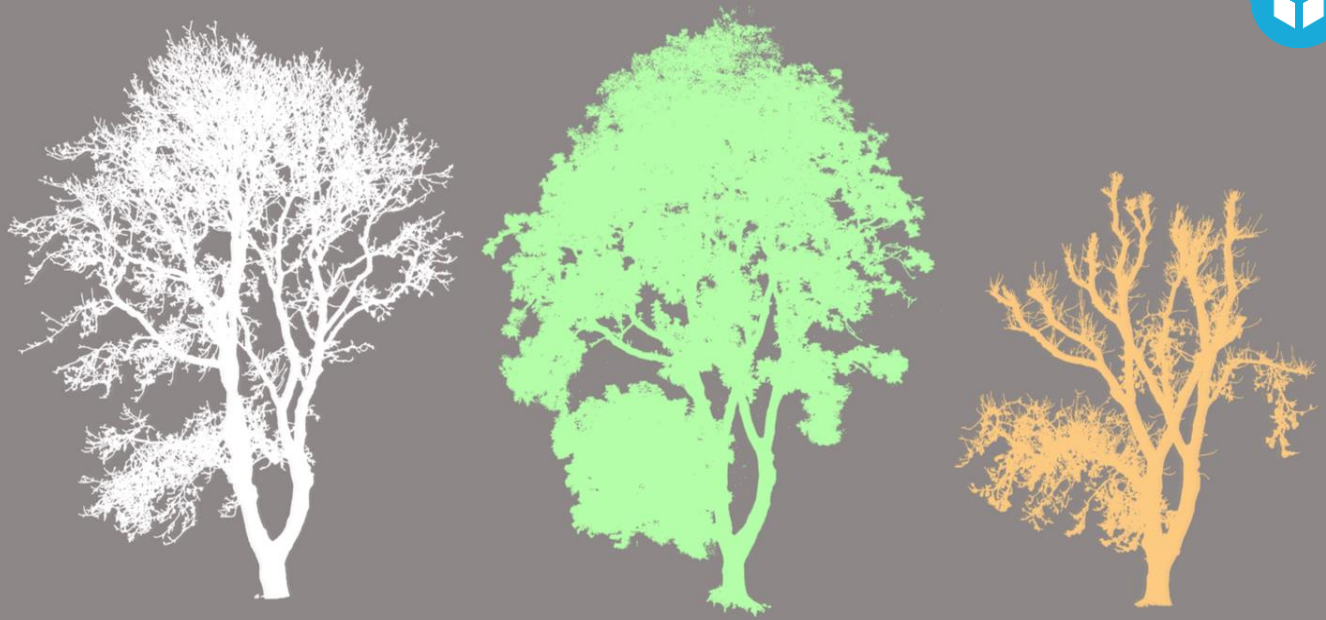
Natural Environment Research Council

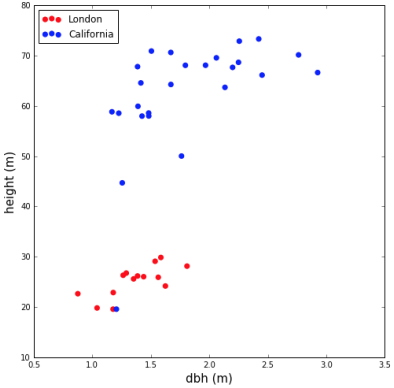
Urban forest laboratory

- Heterogeneous forest types
  - Isolated trees to dense forest
  - Age structures
  - Species diversity
  - Management strategies
  - Resource availability
- Available data
  - Inventory data
  - Open-access data
- Proximity / logistics
  - Techniques for the field can be tested closer to home
- New ways to value urban trees

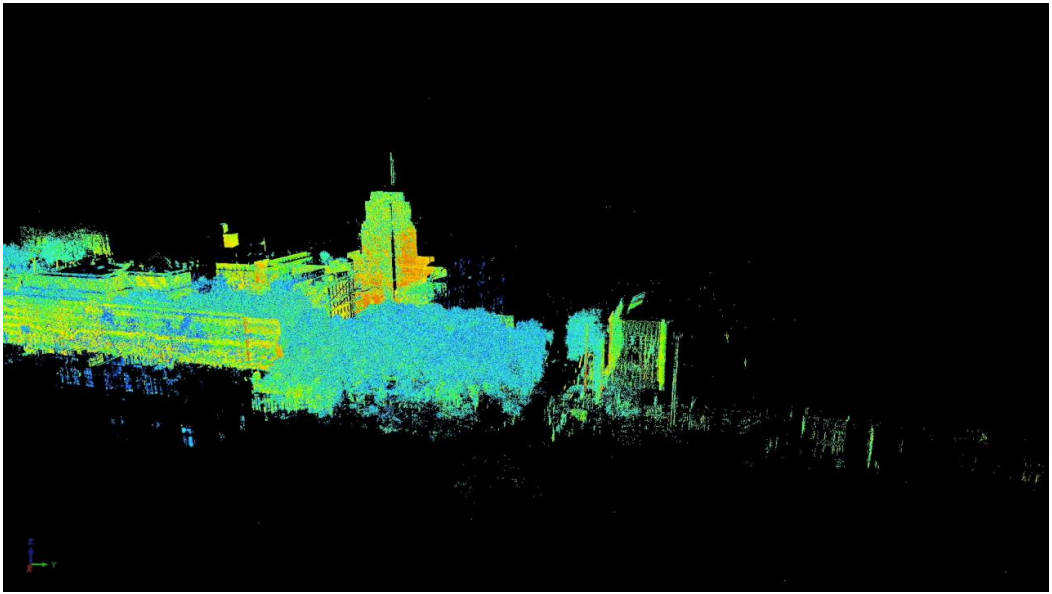


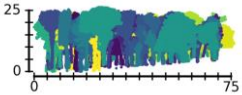
Terrestrial LiDAR

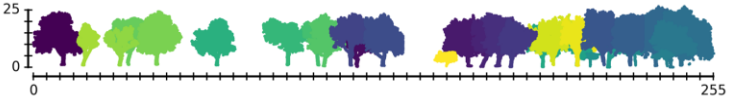

Winter 2017
Summer 2017
Winter 2019


London
California
height (m)
dbh (m)
80
70
60
50
40
30
20
10
0.5
1.0
1.5
2.0
2.5
3.0
3.5

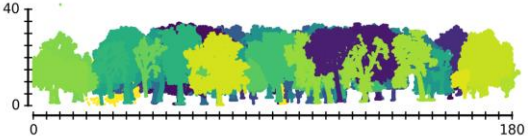
Estimating the urban biomass sink: Camden

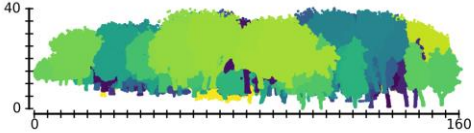






Location	Area (m^2)	Number of trees	Mean / Max Height (m)	Mean / Max crown area (m^2)	Mean / Max Volume (m^3)	Biomass (Mg ha^{-1})
Highgate	4,664	180	12.2 / 30.6	27.6 / 260.1	1.4 / 12.1	276.3 ± 10.1
Malet St	7,786	30	19.9 / 29.1	168.3 / 353.0	5.4 / 12.0	124.8 ± 1.1

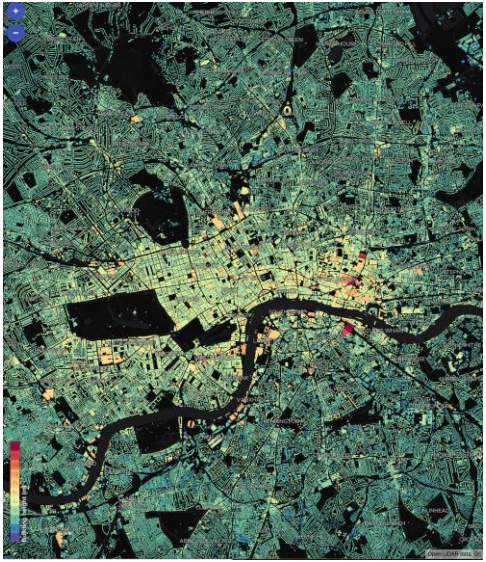




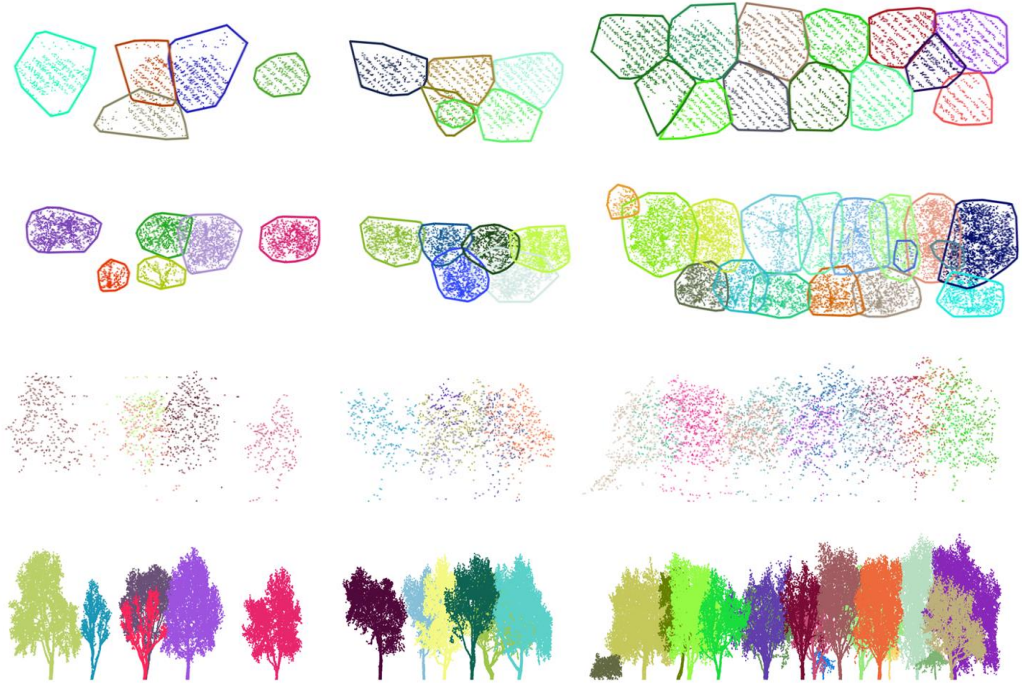
Location	Area (m^2)	Number of trees	Mean / Max Height (m)	Mean / Max crown area (m^2)	Mean / Max Volume (m^3)	Biomass (Mg ha^{-1})
Russell Sq	25,616	81	20.2 / 33.2	218.7 / 694.0	11.6 / 46.8	201.6 ± 2.2
St Pancras	25,392	97	21.3 / 30.2	214.4 / 871.9	13.3 / 50.7	244.7 ± 10.5

Airborne LiDAR data capture

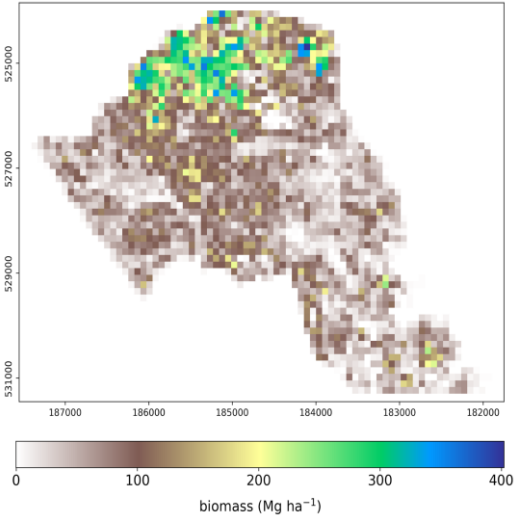
- UK Environment Agency LiDAR data
  - Distributed under ***Open Government Licence***
- London data
  - Captured winter 2015/16
  - 2 pulses per m^2
  - 4 returns per pulse



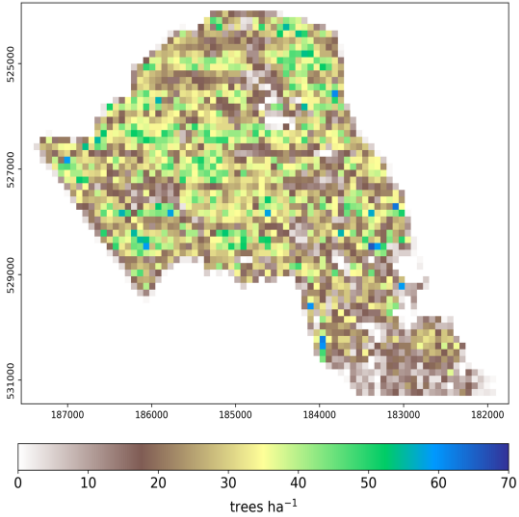
Individual tree detection from ALS



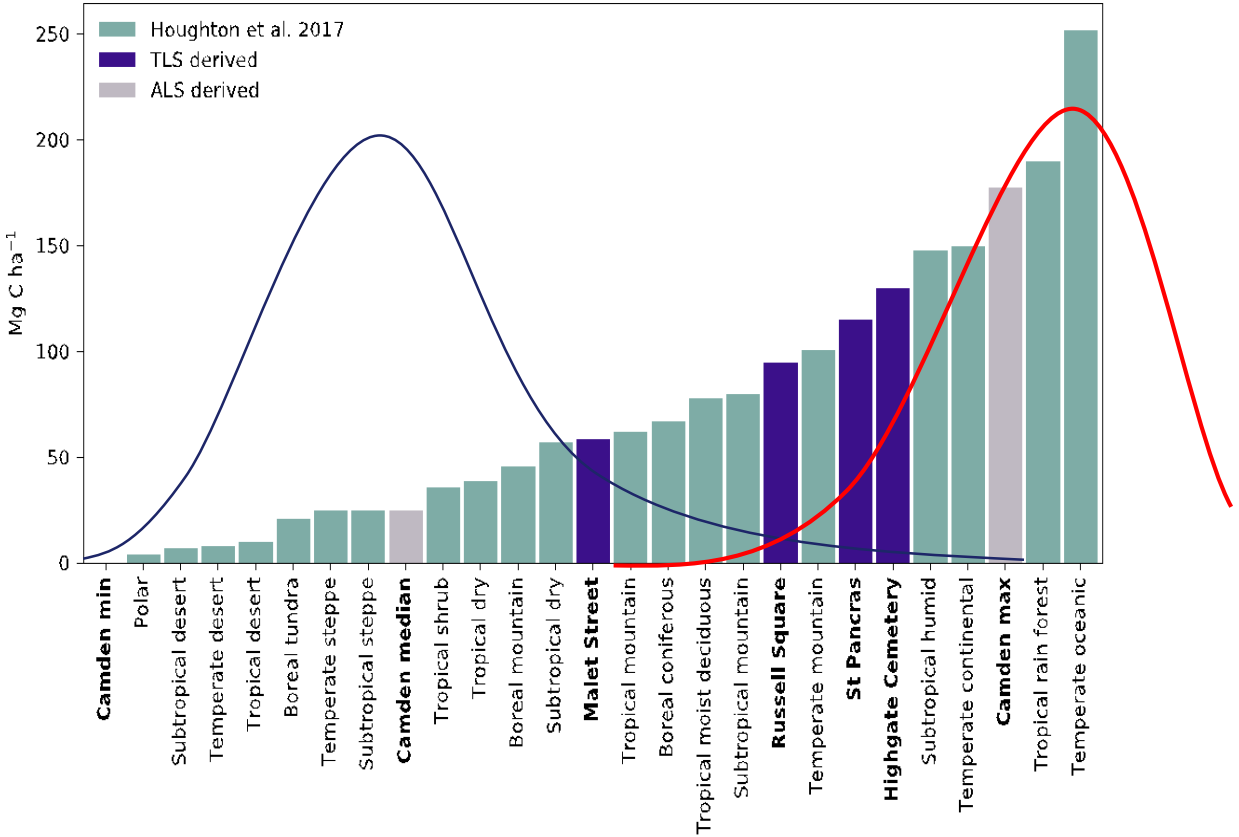
Camden wide biomass and tree count



Mean biomass of 51.7 Mg ha^{-1}



Median tree count of 36 trees ha^{-1}



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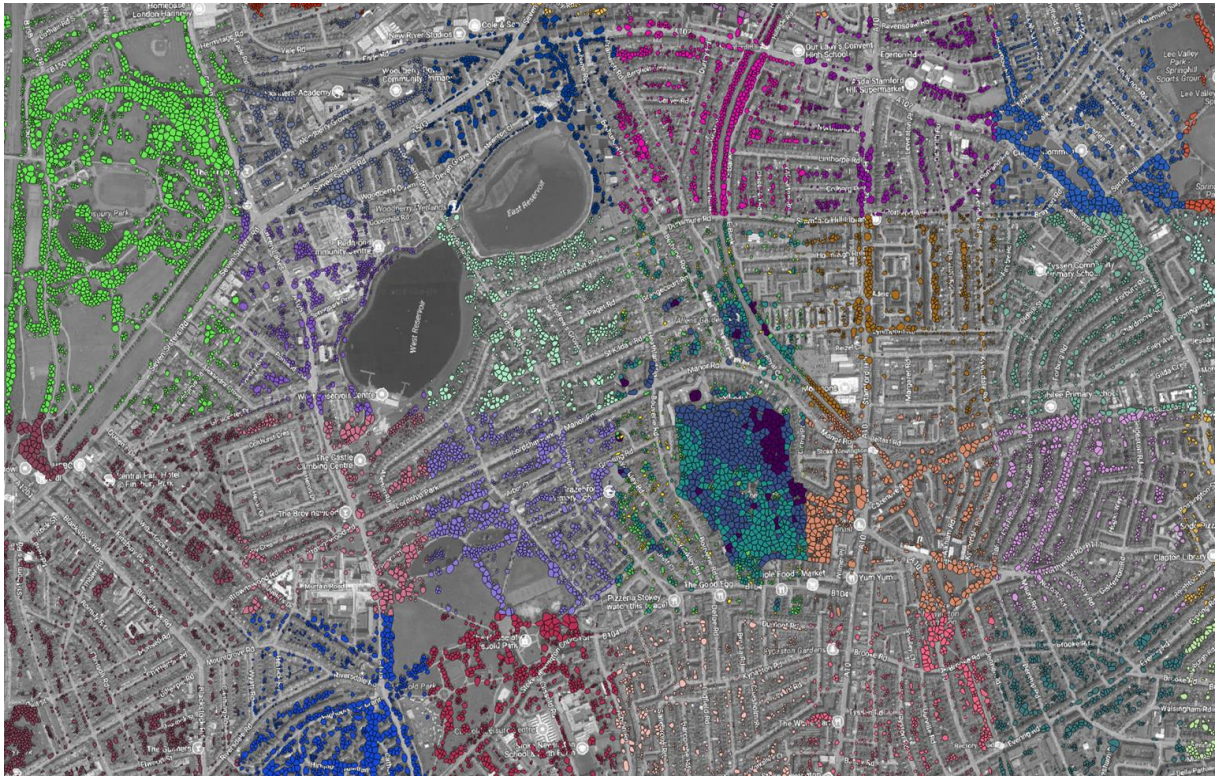

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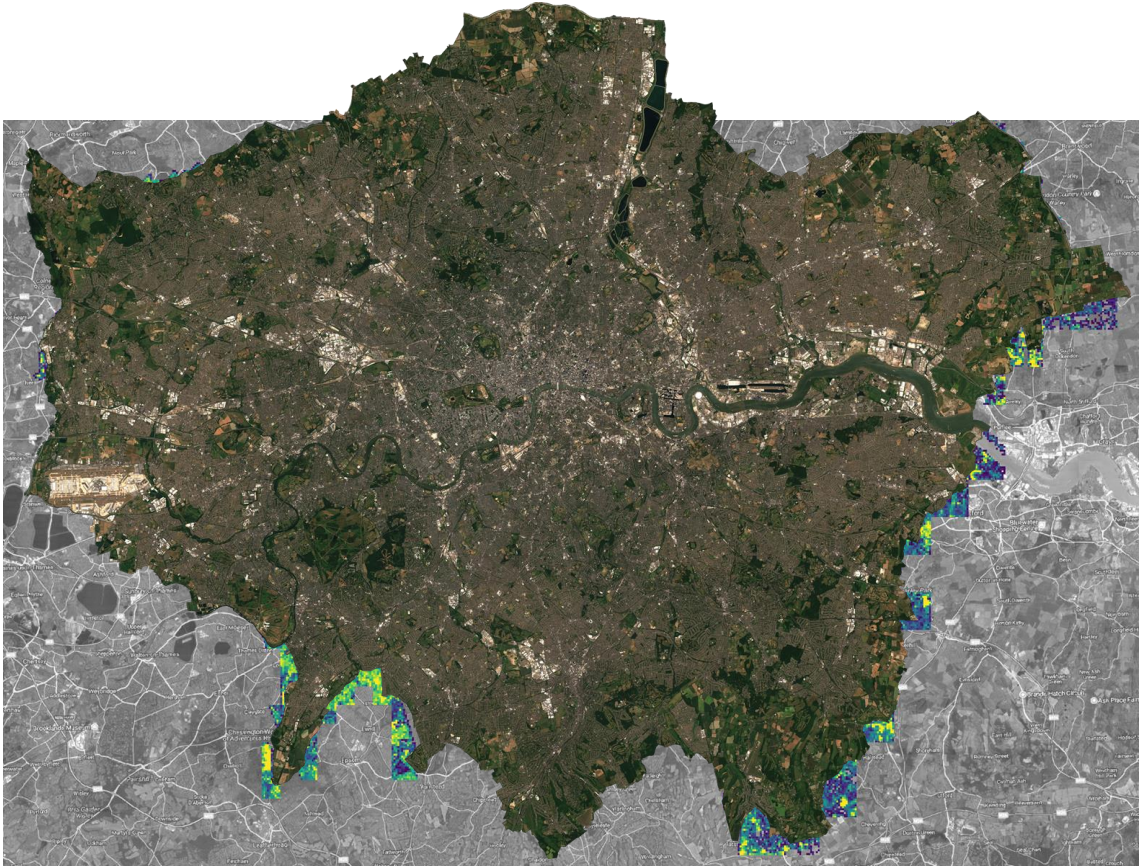
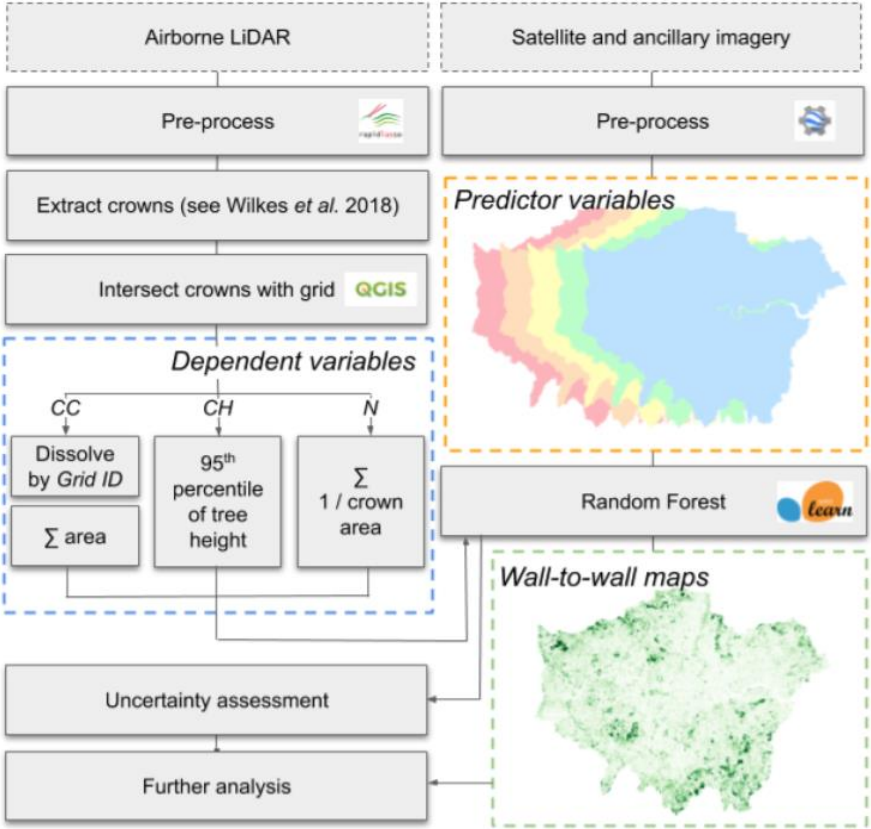
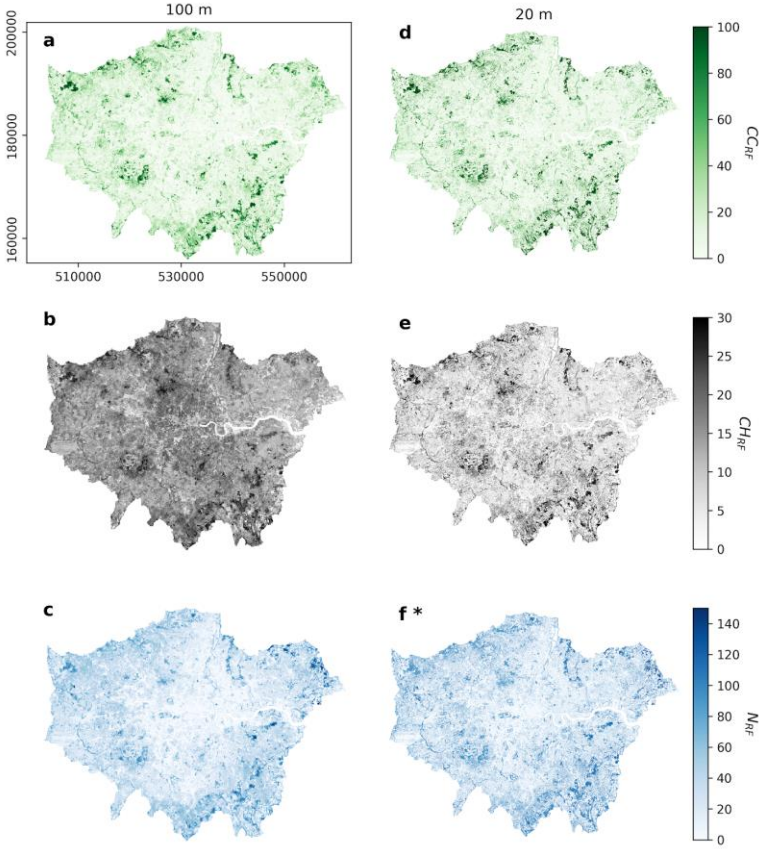



Airborne LiDAR
Satellite and ancillary imagery
Pre-process
Pre-process
Extract crowns (see Wilkes et al. 2018)
Predictor variables
Intersect crowns with grid
QGIS
Dependent variables
CC
CH
N
Dissolve by Grid ID
95th percentile of tree height
∑ 1 / crown area
∑ area
Random Forest
learn
Wall-to-wall maps
Uncertainty assessment
Further analysis



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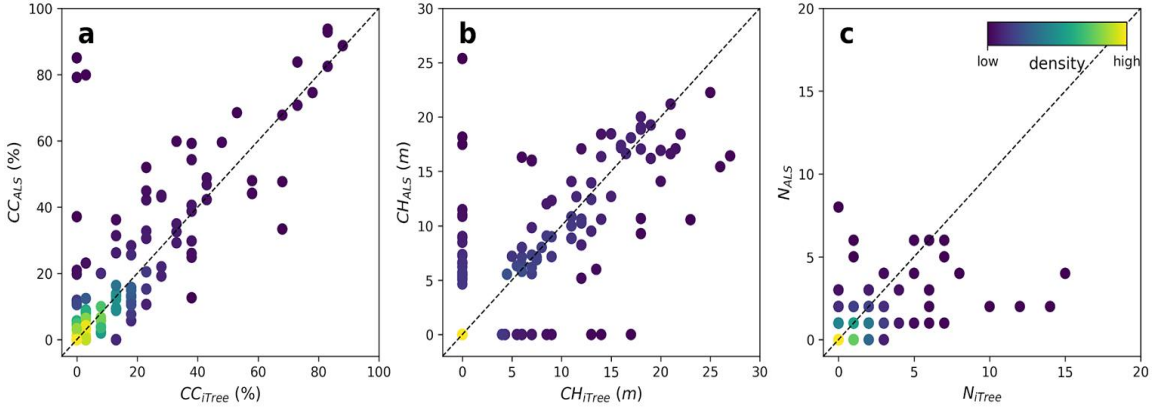
LiDAR / RF

- 4.6M large trees (~29 trees ha-1)
- 8.8 m mean height
- 16.5% canopy cover

iTree Eco Estimate (removing <0.15m DBH)

- 5.2M trees (~38 trees ha^{-1})
- 5.8 m mean height
- 15.9% Canopy cover



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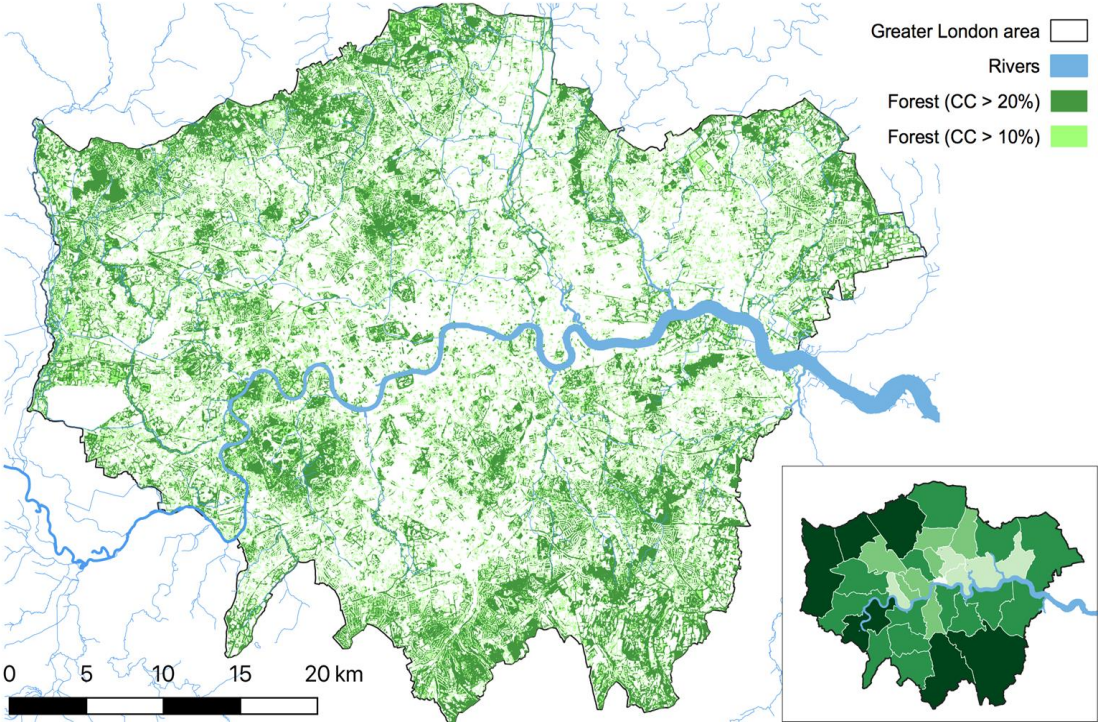
The *Forest of London*



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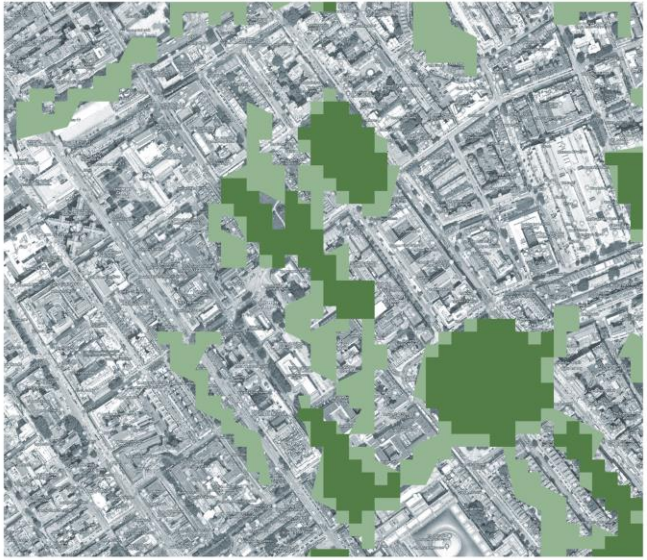
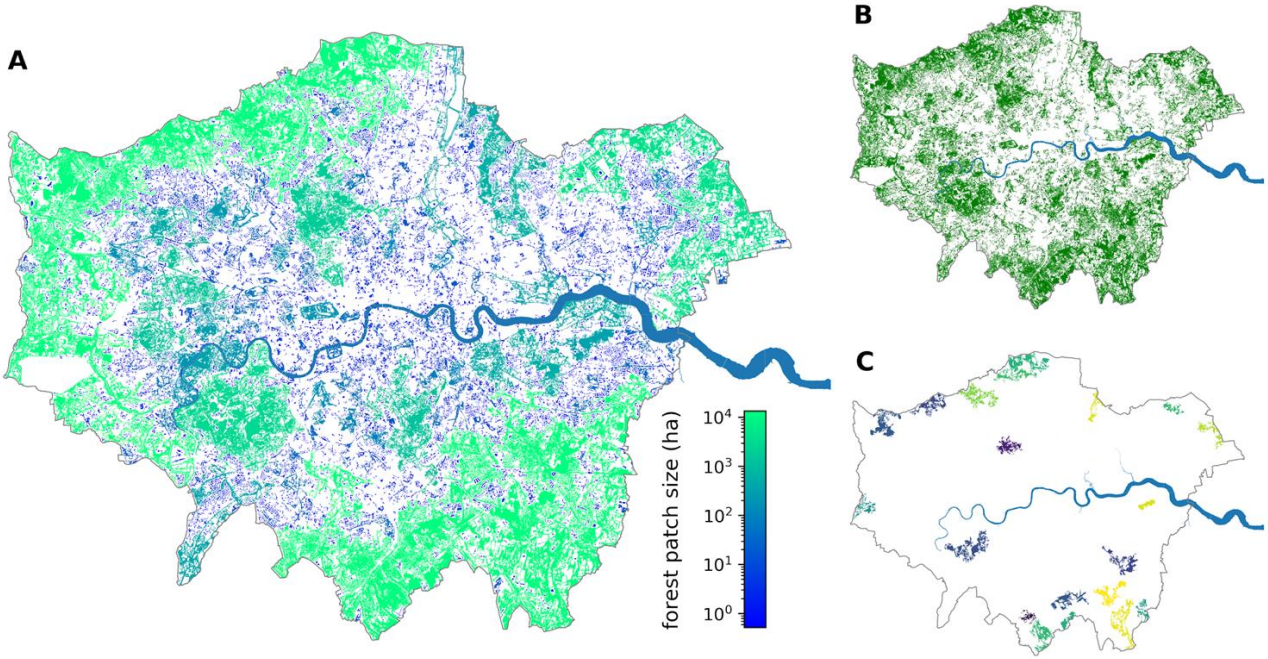
The *Forest of London*



The *Forest of London*



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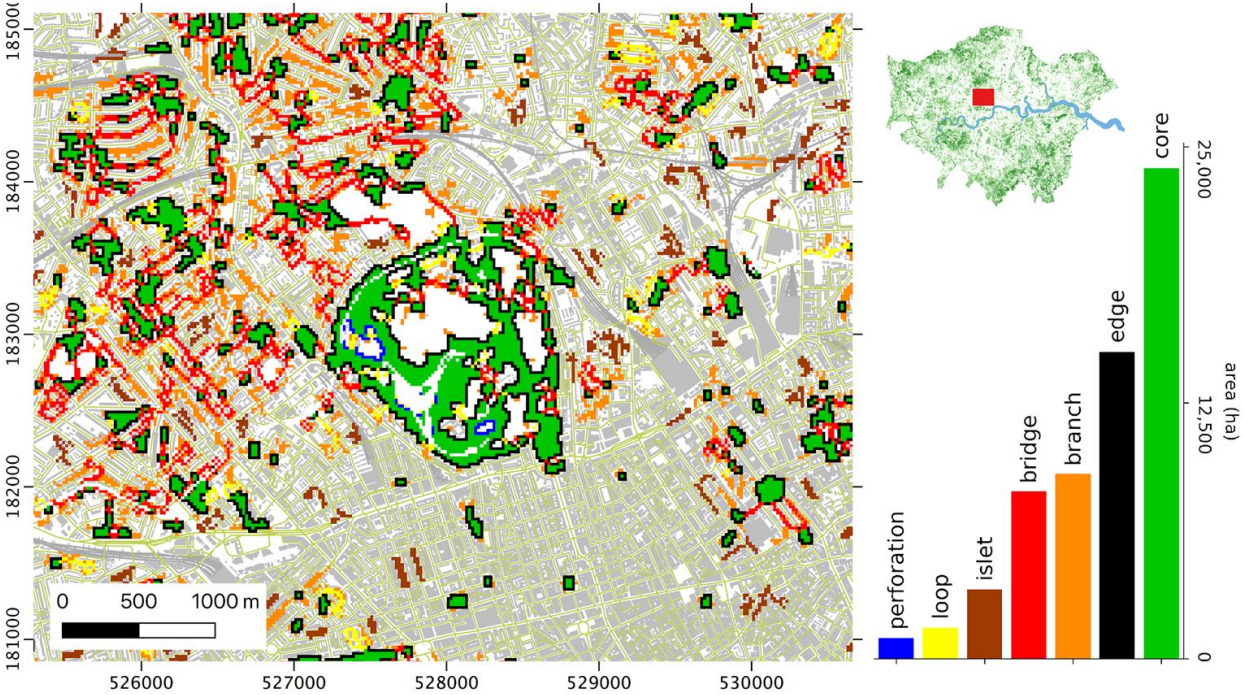
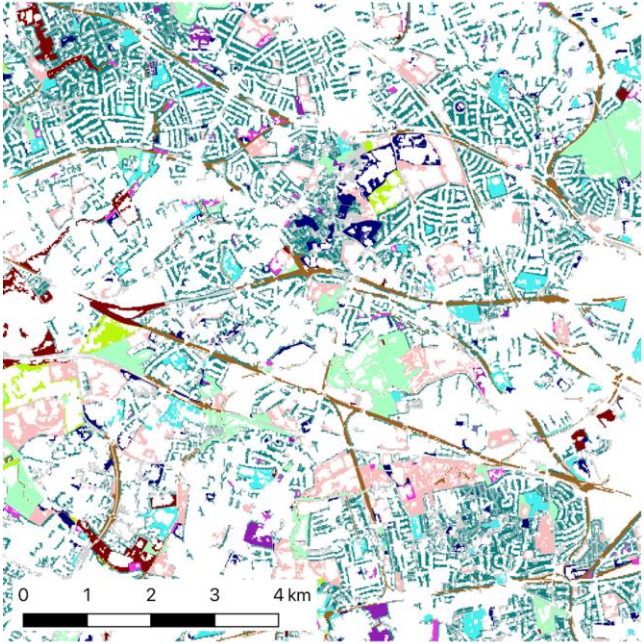
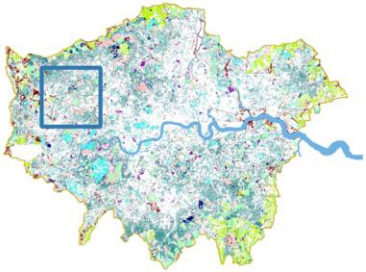
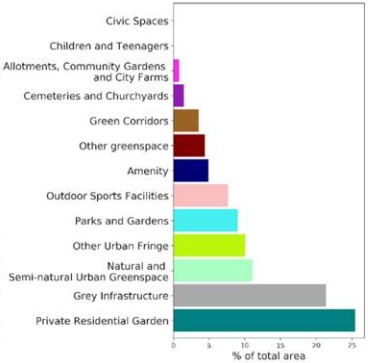
FoL configuration



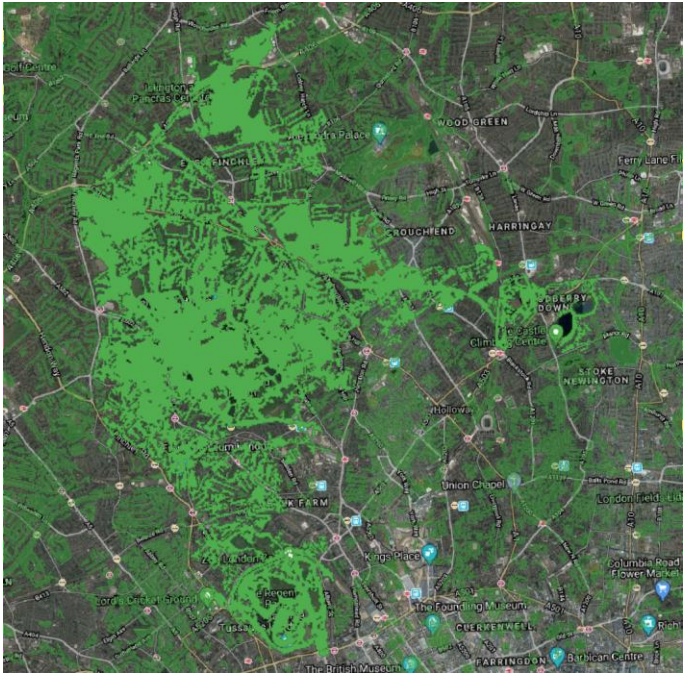
FoL ownership



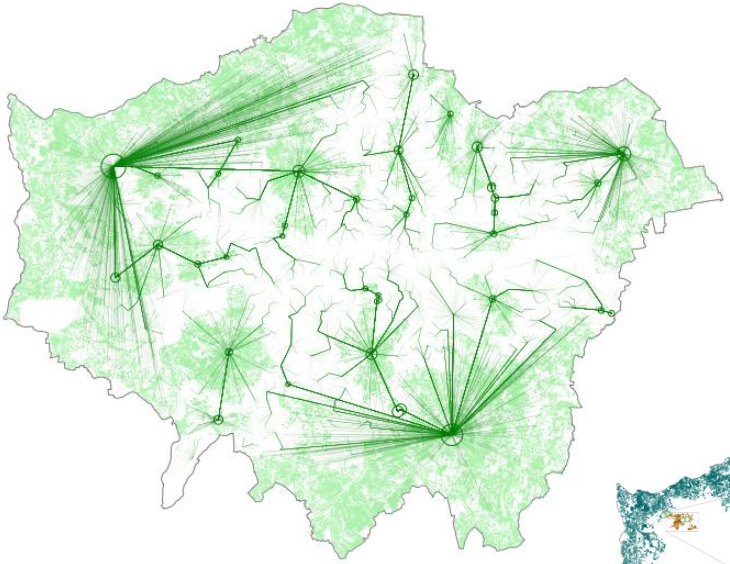


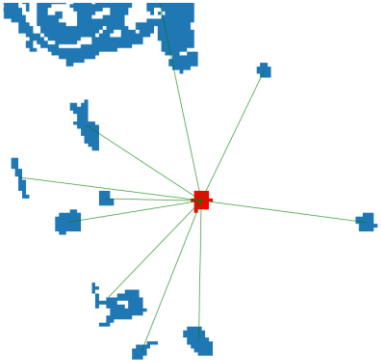


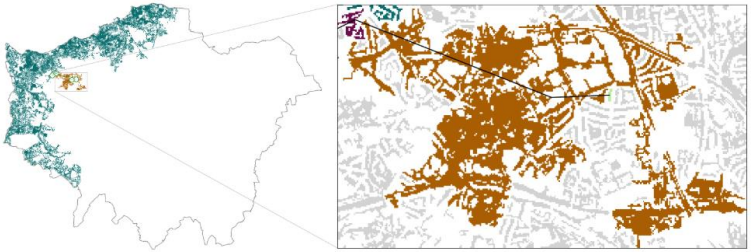
FoL configuration



FoL a connected forest







“Impact”

- Greater London Authority
- Forest Research
- Trees For Cities
- Learning Through Landscapes
- Camden Council
- Sussex Community Development Agency
- Greenhavens