

A competitive model for determining air pollution in urban areas: The potential for vegetation for air pollution mitigation

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Australian Air Pollution



Air pollution across Sydney, hazing the Opera House

Australian Air Pollution



Morning air pollution across Sydney's city and the Harbour Bridge

Investigation in question

▶ Pollutants:

- ▶ CO
- ▶ NO₂
- ▶ SO₂
- ▶ PM₁₀

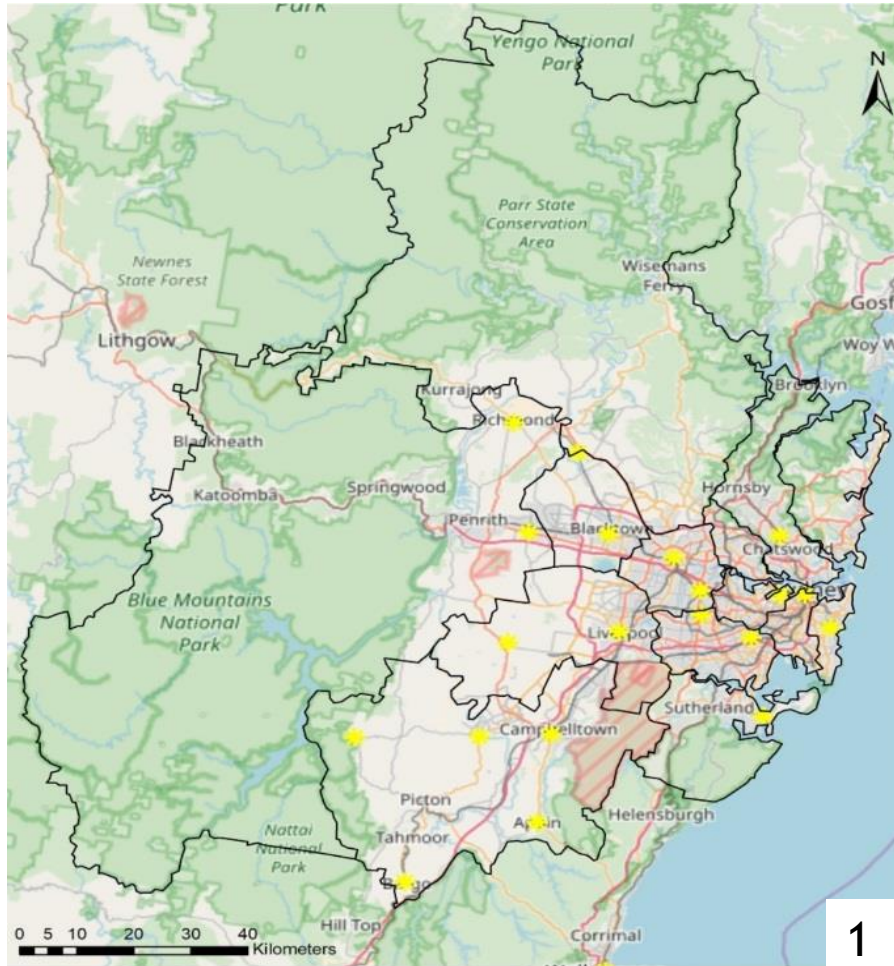
▶ Location:

- ▶ Sydney

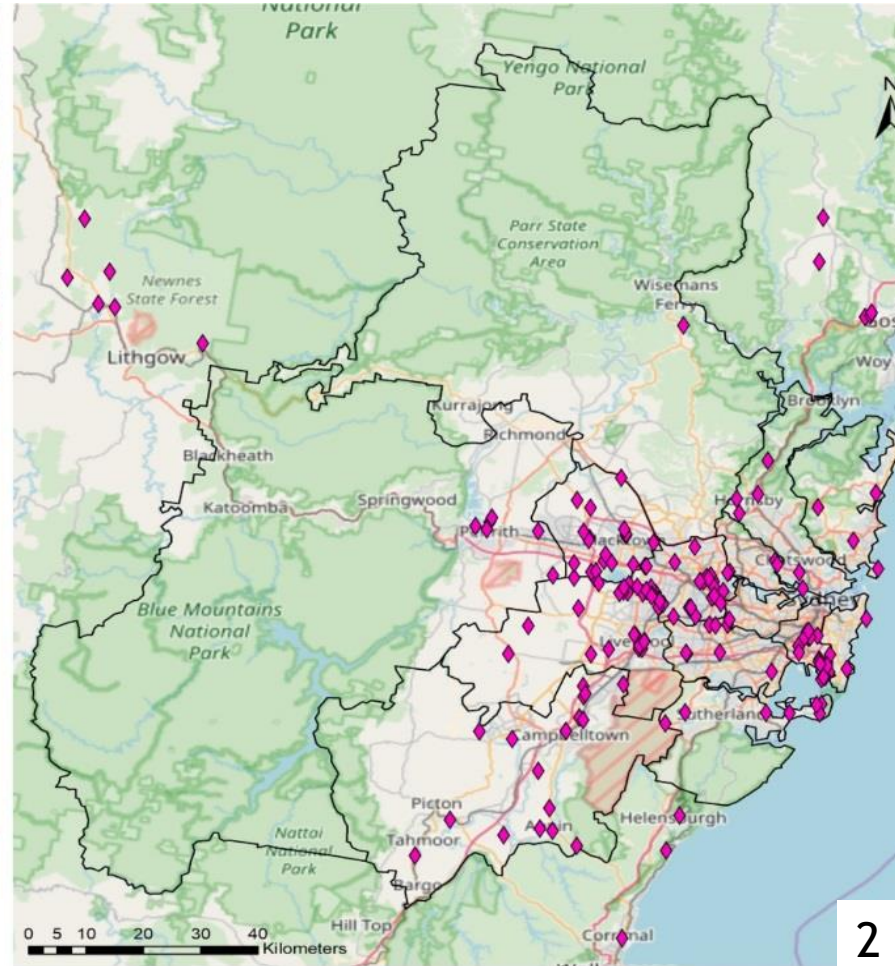


Sydney's sprawl on a fine day with good air quality.

Variables

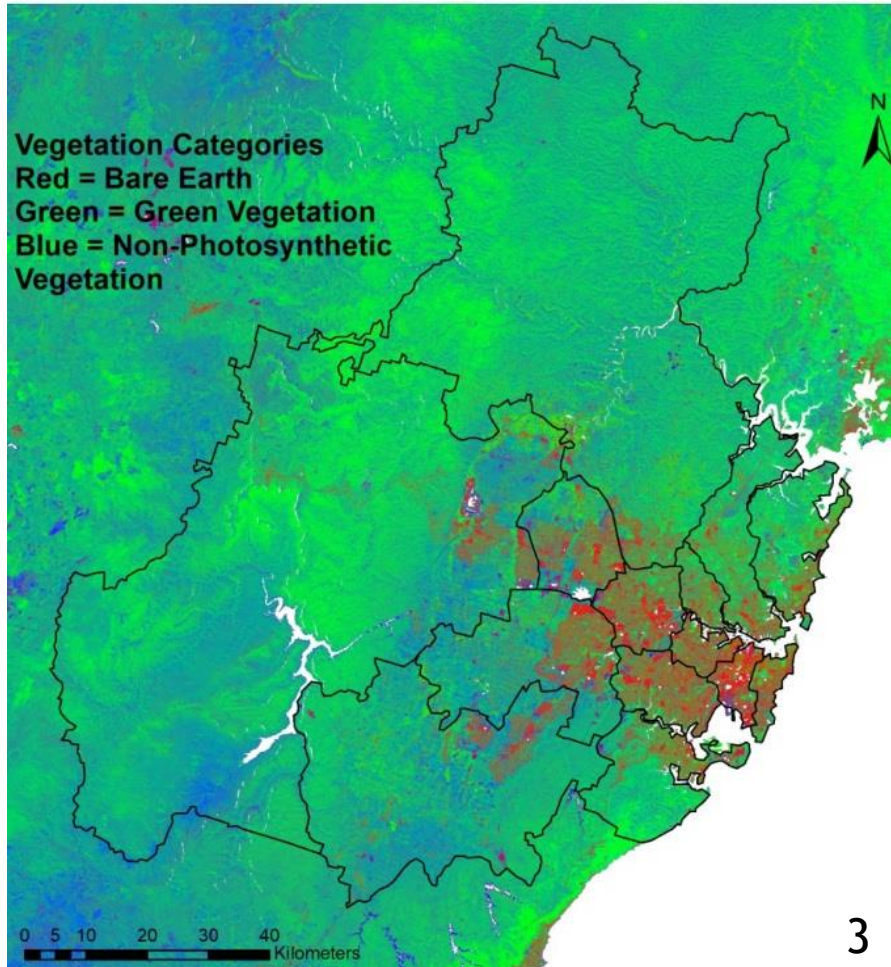


1. Air quality monitoring sites across Sydney.



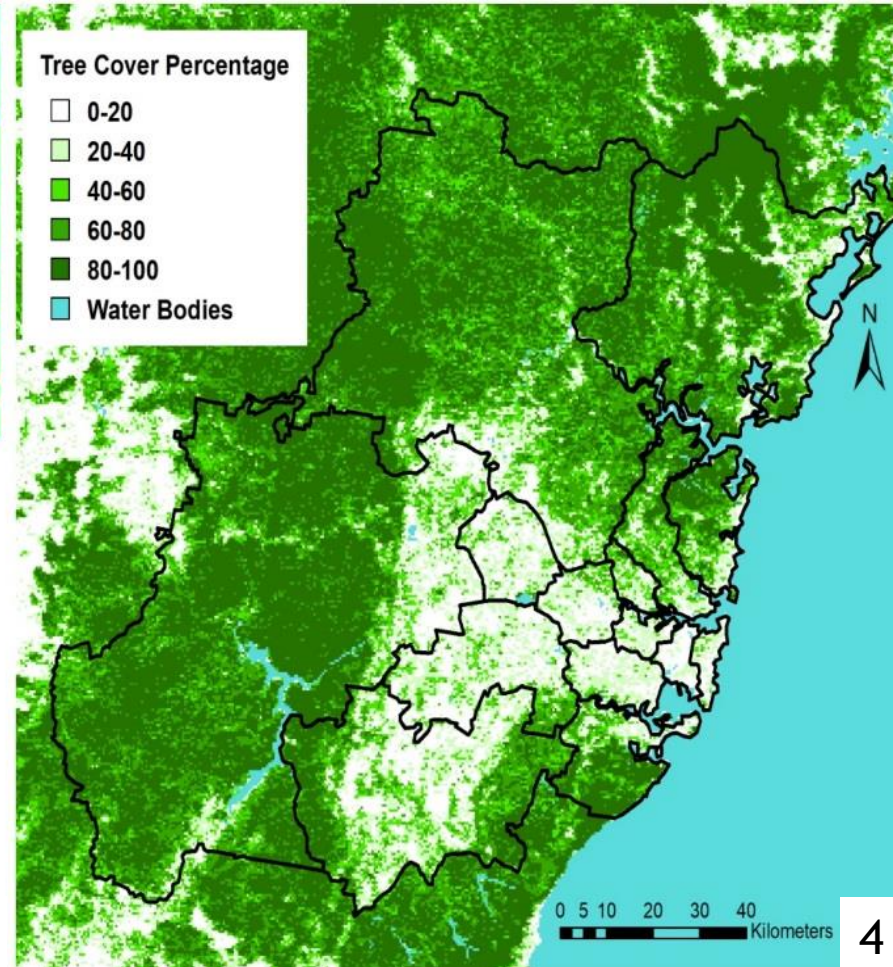
2. Sites monitored by the National Pollutant Inventory.

Variables



3

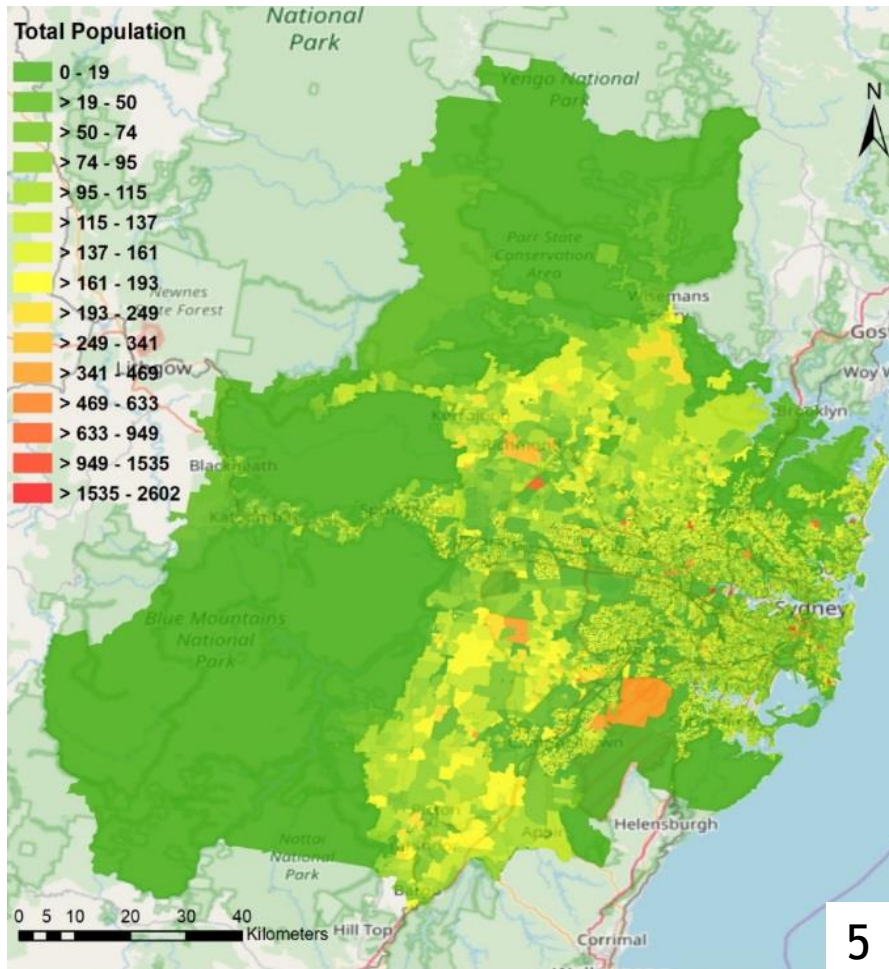
3. Land cover types in the form of urban forestry cover types.



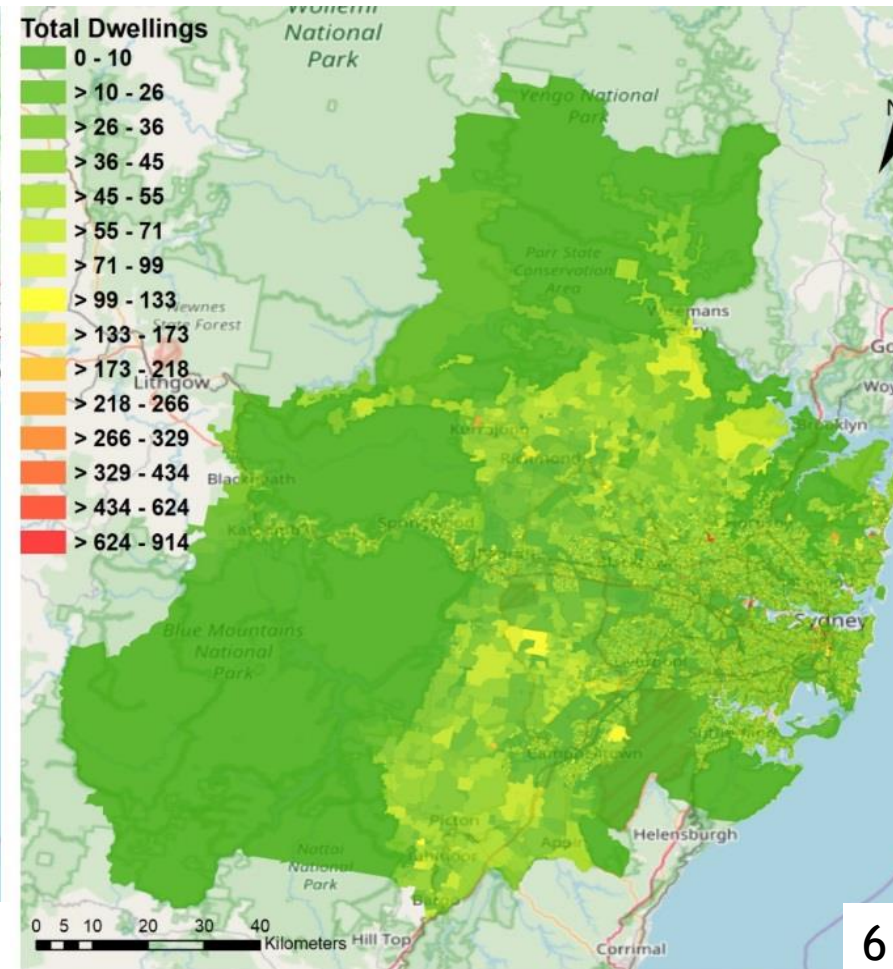
4

4. Percentage of tree cover developed by Global Mapping Project collaboration.

Variables

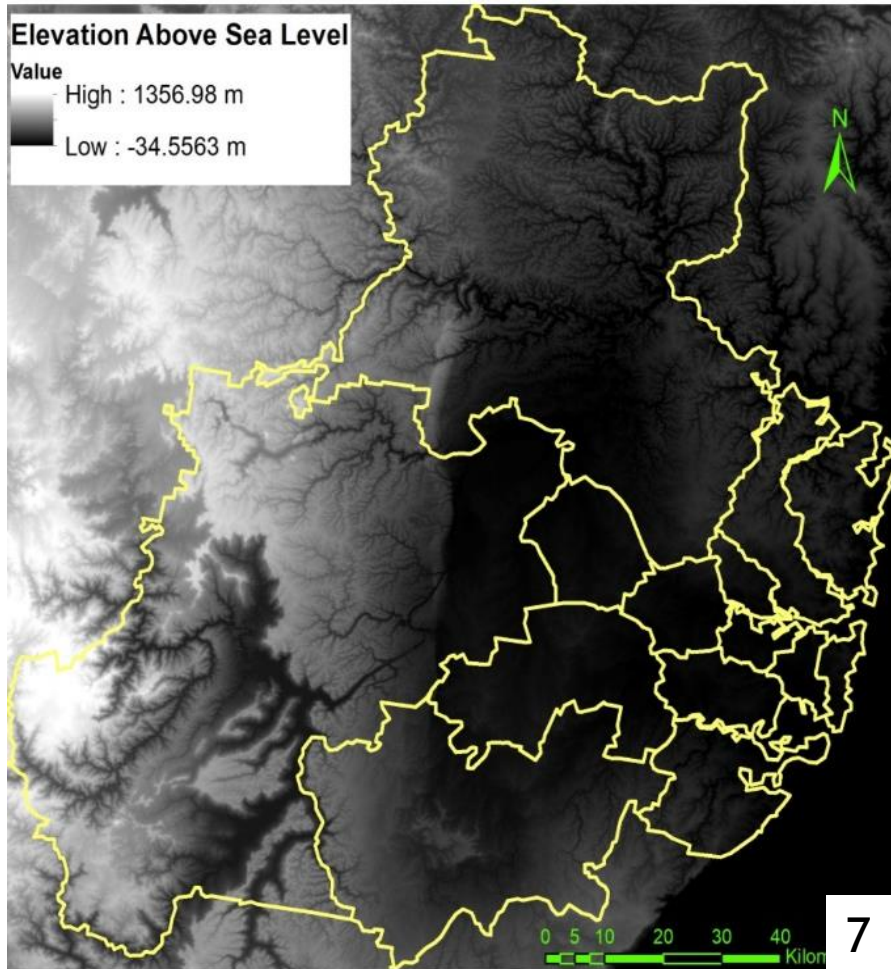


5. Population data derived from the Australian Bureau of Statistics.

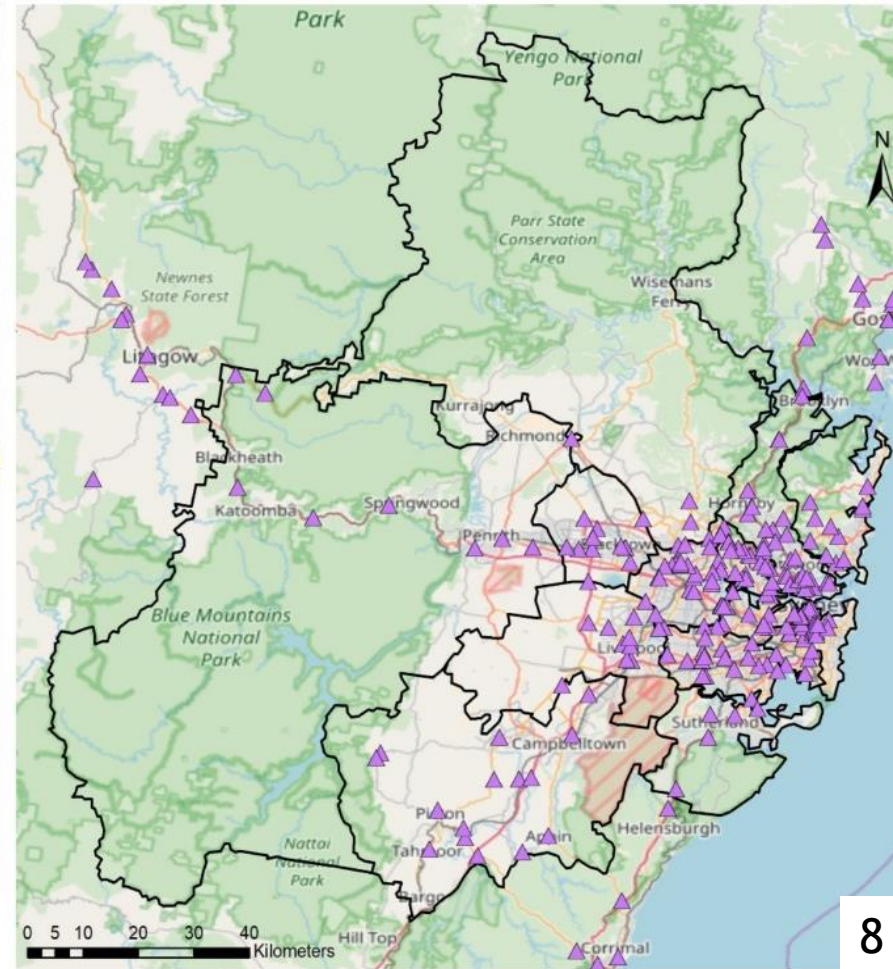


6. Dwelling data derived from the Australian Bureau of Statistics.

Variables



7. Elevation in the form of a Digital Elevation Model for Sydney.

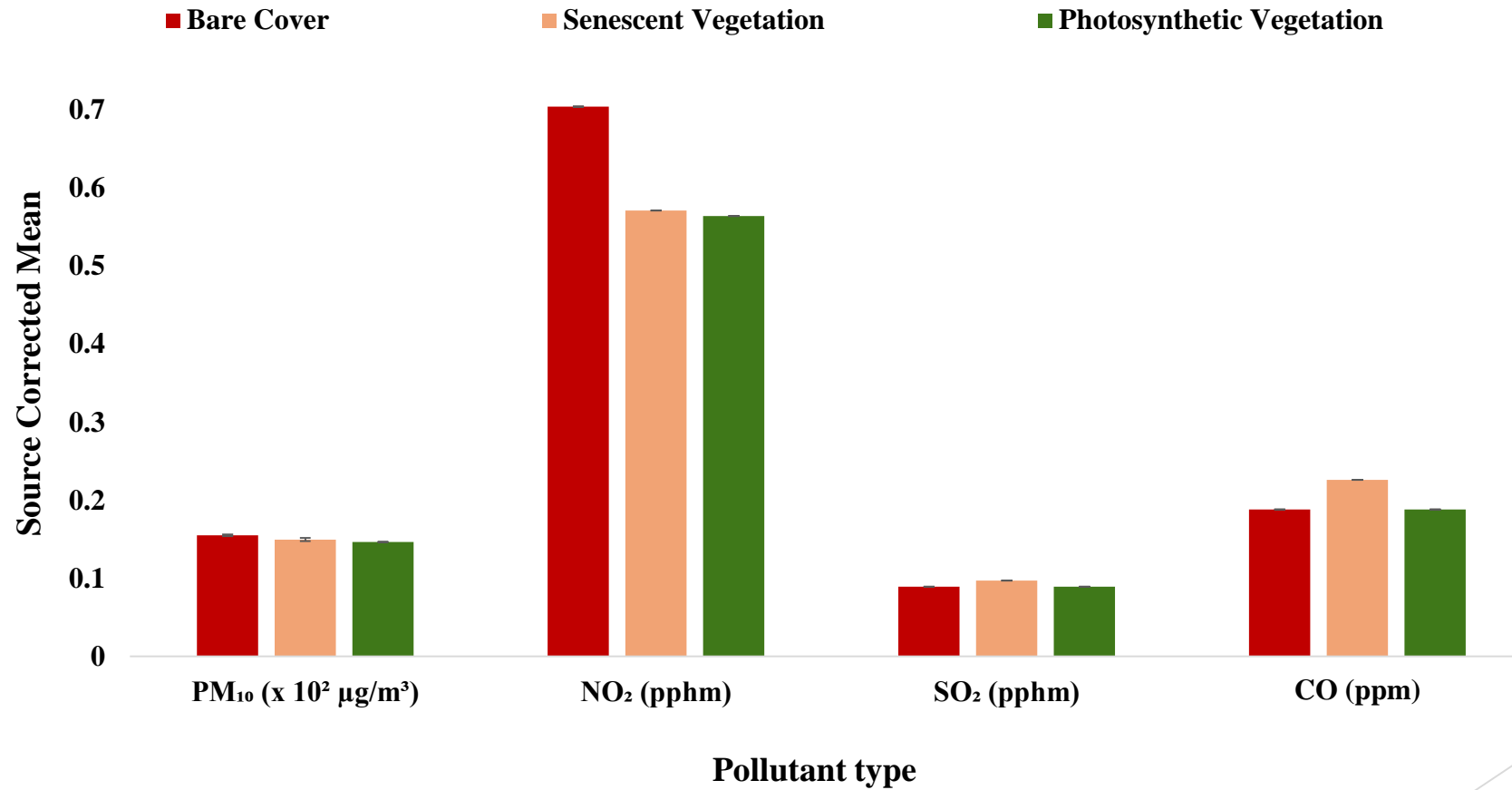


8. Traffic collection sites for all vehicle types across Sydney.

Analysis

- ▶ ANCOVAs were performed for each air pollutant
 - ▶ Data was pollutant source corrected with the covariables: traffic and industry emissions
 - ▶ Source corrected estimated marginal means were derived from the ANCOVAs
- ▶ Pearson correlations were conducted between each predictor variable and the four air pollutants
- ▶ Multiple stepwise linear regressions were performed on each air pollutant to develop a predictive model for each air pollutant in Sydney

Relationship between Urban Forestry and Air Pollution - ANCOVAs



Source corrected air pollutant means for the three land cover types across Sydney.

Relationship between Urban Forestry and Air Pollution - Correlations

The influence of the predictor variables on the four air pollutants determined by Pearson correlation (r values shown). All correlations were significant ($p < 0.05$).

Pollutant	Predictor variables				
	Traffic	Dwelling Density	Population Density	Elevation	Canopy Cover
PM ₁₀	0.693	0.357	0.378	-0.618	-0.506
NO ₂	0.770	0.315	0.335	-0.625	-0.448
SO ₂	0.669	0.177	0.184	-0.444	-0.194
CO	0.436	0.255	0.279	-0.454	-0.267

Relationship between Urban Forestry and Air Pollution - Predictive Models

- ▶ NO₂ model (pphm) - 64.4% Variability Explained
= $1.487 \times 10^{-5}A - 0.002B + 0.240$
- ▶ Where A = Daily Traffic Count (number of vehicles per unit area), B = Canopy Cover (%)
- ▶ PM₁₀ model (µg/m³) - 58.7% Variability Explained
= $8.550 \times 10^{-5}A - 0.015B + 0.007C + 12.934$
- ▶ Where A = Daily Traffic Count (number of vehicles per unit area), B = Canopy Cover (%), C = Dwelling Density (number of dwellings per unit area)

Relationship between Urban Forestry and Air Pollution - Predictive Models

- ▶ SO₂ model (pphm) - 44.8% Variability Explained

$$= 2.198 \times 10^{-6} A - 0.087$$
- ▶ Where A = Daily Traffic Count (number of vehicles per unit area)
- ▶ CO model (ppm) - 25.0% Variability Explained

$$= 1.0 \times 10^{-6} A + 2.369 \times 10^{-6} B + 1.0 \times 10^{-6} C + 0.136$$
- ▶ Where A = Elevation (m asl), B = Daily Traffic Count (number of vehicles per unit area), C = Population Density (number of people per unit area)

What's next?



The Interlace, Singapore. An apartment complex next to the Southern Ridges Trail and features rooftop gardens, green communal areas create and garden courtyards.

What's next?

- ▶ Used to increase urban forestry
- ▶ Used to develop and support planning policies and greening policies



A sunken park in Sydney's Paddington Reservoir.

What's next?

- ▶ City of Sydney has developed their own urban greening policies
- ▶ Examples have cropped up across the City of Sydney
- ▶ Central Park One is one of those examples



Central Park One, Sydney's green building across from UTS.

The future of this work



A public display of green wall experiments in HortPark, Singapore.