Attachment A: Comparative analysis of density

The following is a simple example of the type of analysis that could be undertaken to usefully compare density across different cities.

The figures show that Sydney's density compares well in the inner areas (10 x 10 kilometres) but less well in the middle ring of suburbs (30 x 30 kilometre). Sydney's density pattern, like many others, is heavily influenced by its rail network. The denser cities have denser rail networks with a greater number of stations.

The graphs on the right-hand side of each page analyses the inner 10 x 10 kilometre scale. The median density square indicated by a red dot, with the number of rail stations arranged underneath. This allows for an easier visual comparison between the inner areas of each city

Finally, a summary graph is derived from the 10 x 10 kilometre inner areas of each city arranged vertically in relation to the number of rail stations. Each inner city area is represented by a line that ranges from the 25th to 75th percentile density square with the median density marked by a dot.

The summary graph reveals that that the inner area of Sydney has fewer rail stations than Melbourne and even Brisbane. The strong correlation between the number of rail stations and the density of cities is the dominant feature of the graph.

Inner Sydney's median density is in the upper half of the sample and only those cities with considerably more rail stations have noticeably more density. The comparative study shows that to markedly increase Sydney's density more rail stations are essential.

This is a quick exercise, undertaken in-house by the City of Sydney and based on easily available data. Comparison of a greater number of cities and further analysis would reveal other factors of interest for housing policy development. Selective use of density data, comparing cities at different scales with only a small number of cities compared is of limited value.

Notes on the methodology

For the cities
Cities are selected from those noted in the Productivity Commissions report *Building more homes where people want to live.* Perth, Canberra, Adelaide, Auckland and Wellington are excluded and are known to be significantly less dense than inner Sydney. Dublin, Geneva, Luxembourg, Montreal and Stockholm are not included as data for an earlier exercise in the city's submission to the low and mid rise housing explanation of intended effects was not easily available.

For the figures
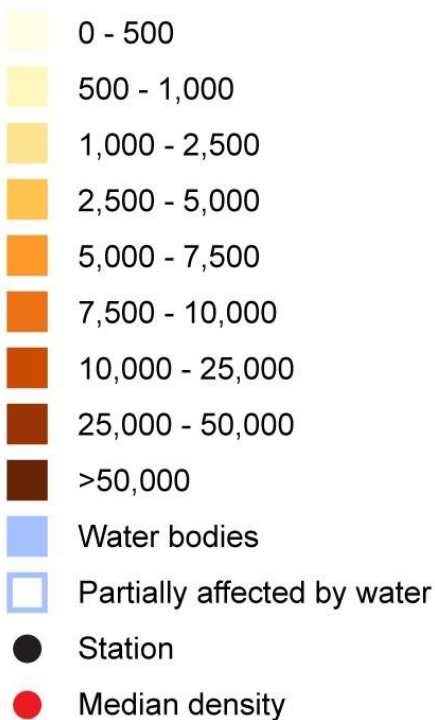- The figure comparisons are on a one kilometre grid scale across constant geographic areas for each city.

- Each city is compared at the scale of the inner 10 x 10 kilometres, 30 x 30 kilometres, and 60 x 60 kilometres.
- The density calculation of the grid squares include the unoccupied water areas. The seemingly lower densities at the waters edge would be corrected by weighting to exclude the water areas.
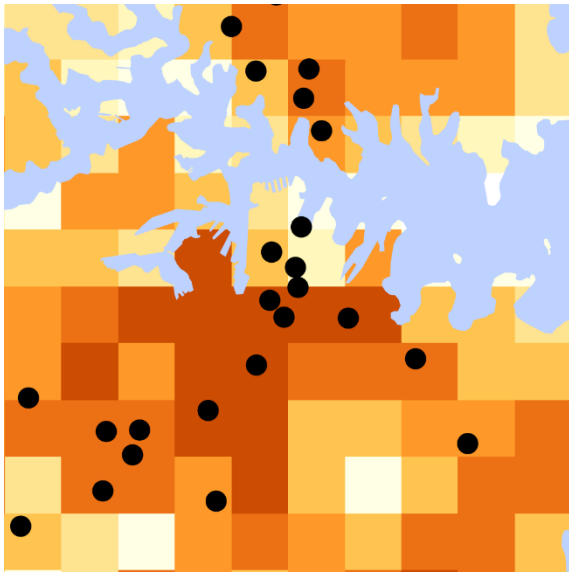
For the graphs

- The number of square kilometres in each density grade is grouped and
- Unoccupied water areas are represented by blue squares, and those squares that are partially occupied by water are indicated by a blue border, and while remaining in the density group shown on the maps, the colour of the next higher density group is applied to these squares to indicate that the weighted density [measured without the water area] would be higher

Key for the density analysis

Population Density (ppl/Km²)

	0 - 500
	500 - 1,000
	1,000 - 2,500
	2,500 - 5,000
	5,000 - 7,500
	7,500 - 10,000
	10,000 - 25,000
	25,000 - 50,000
	>50,000
	Water bodies
	Partially affected by water
	Station
	Median density
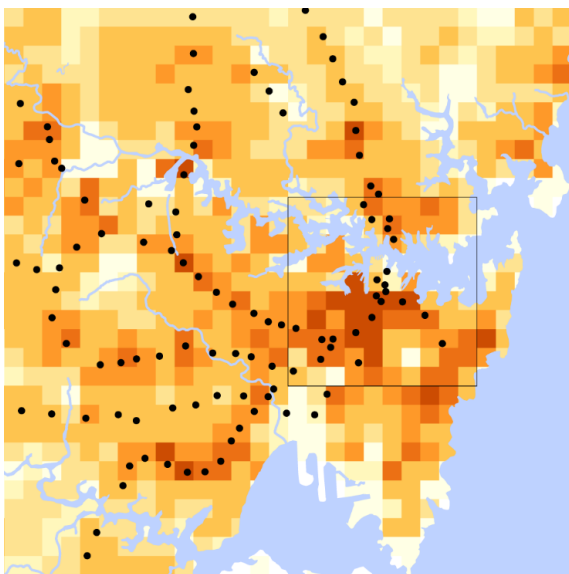
Sydney 10km x 10km

Sydney 30km x 30km
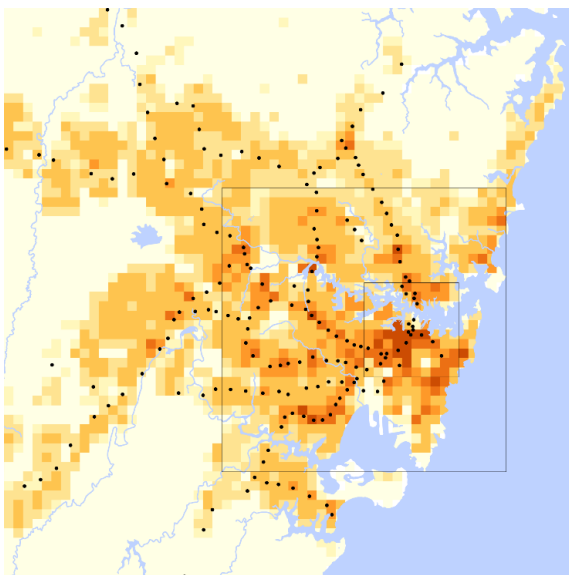
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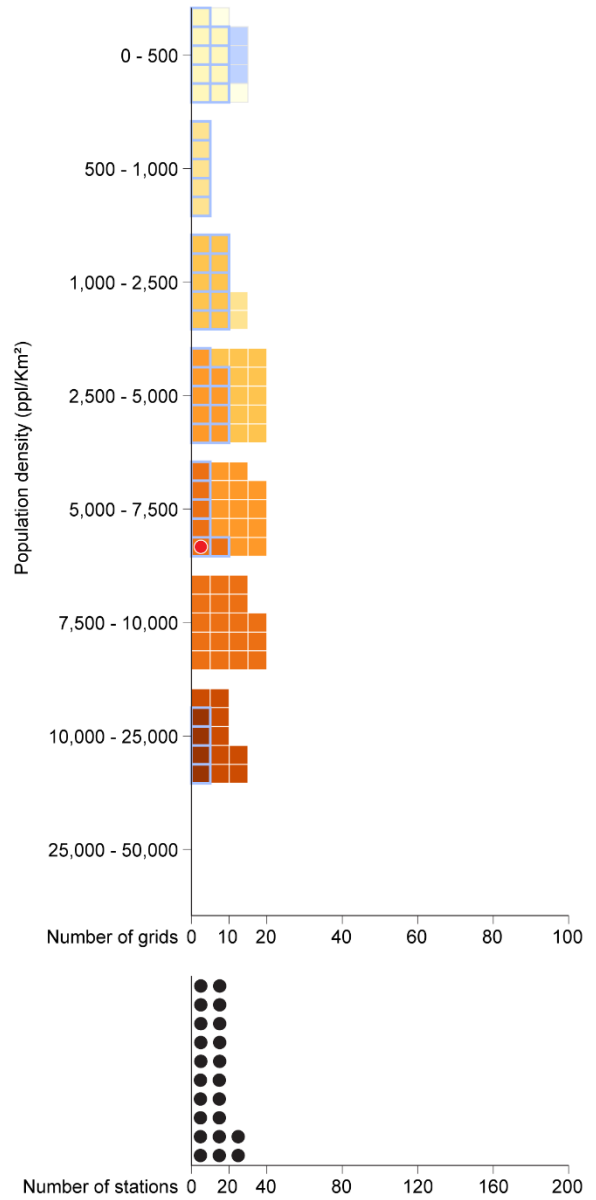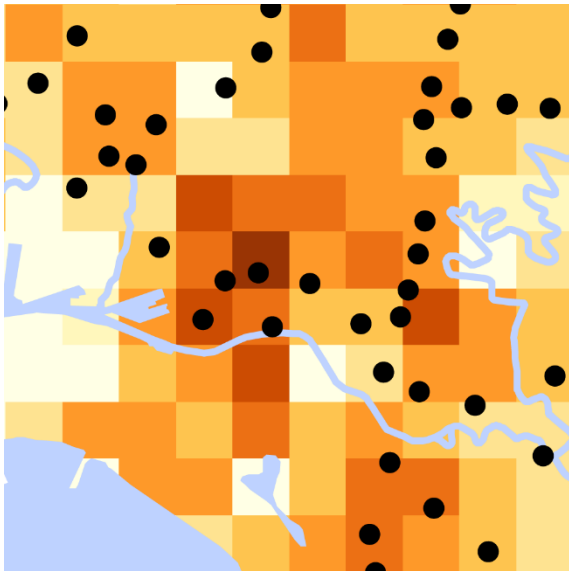
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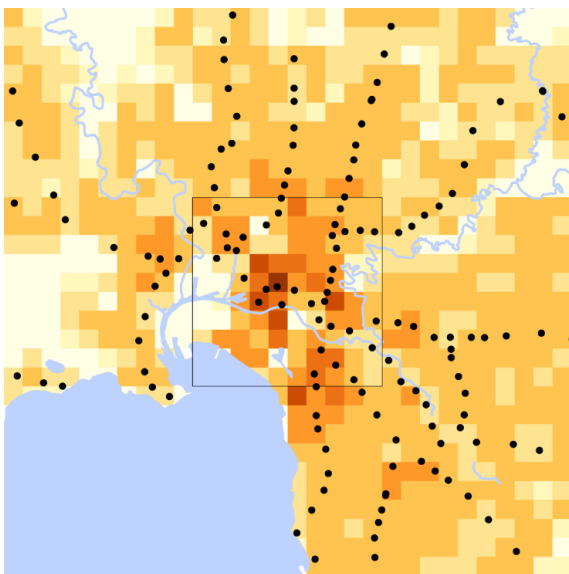
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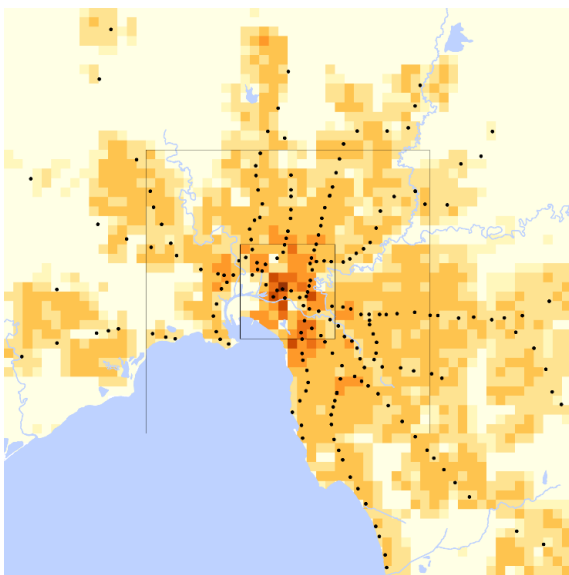
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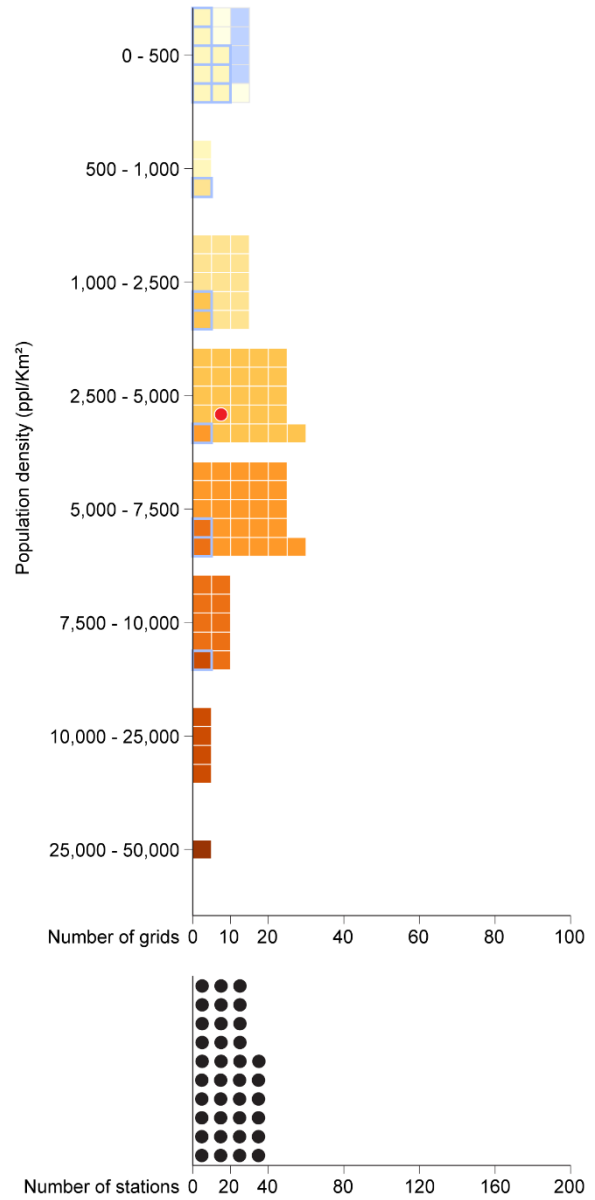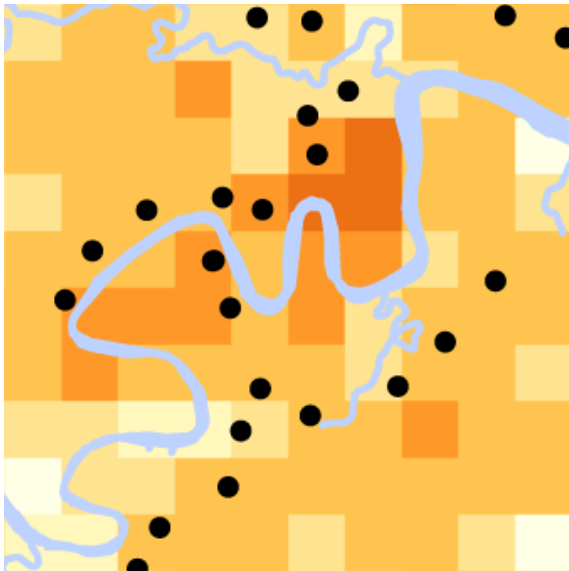
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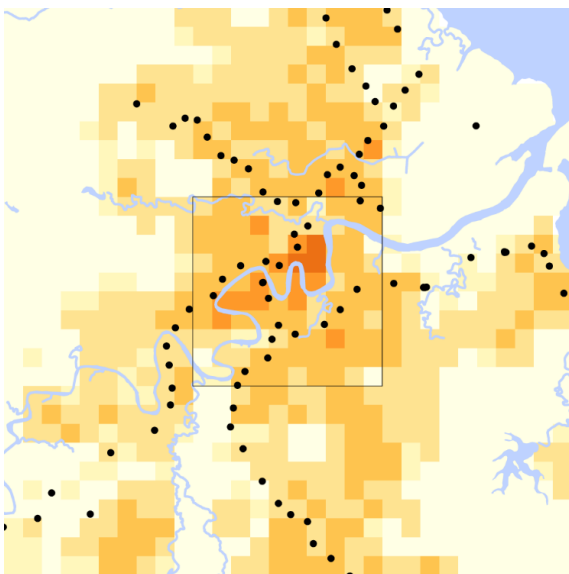
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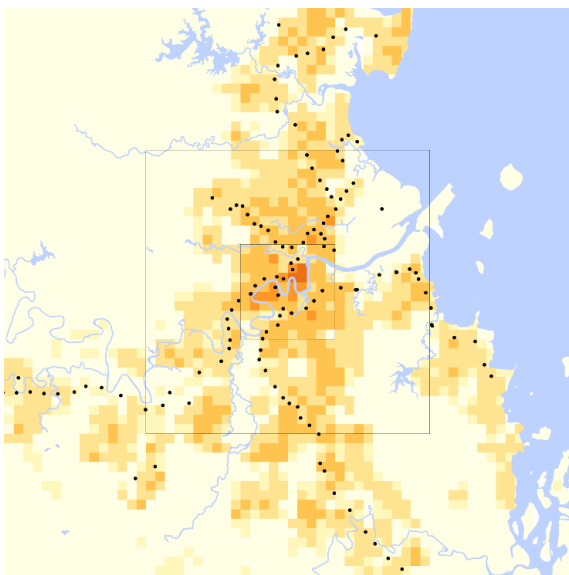
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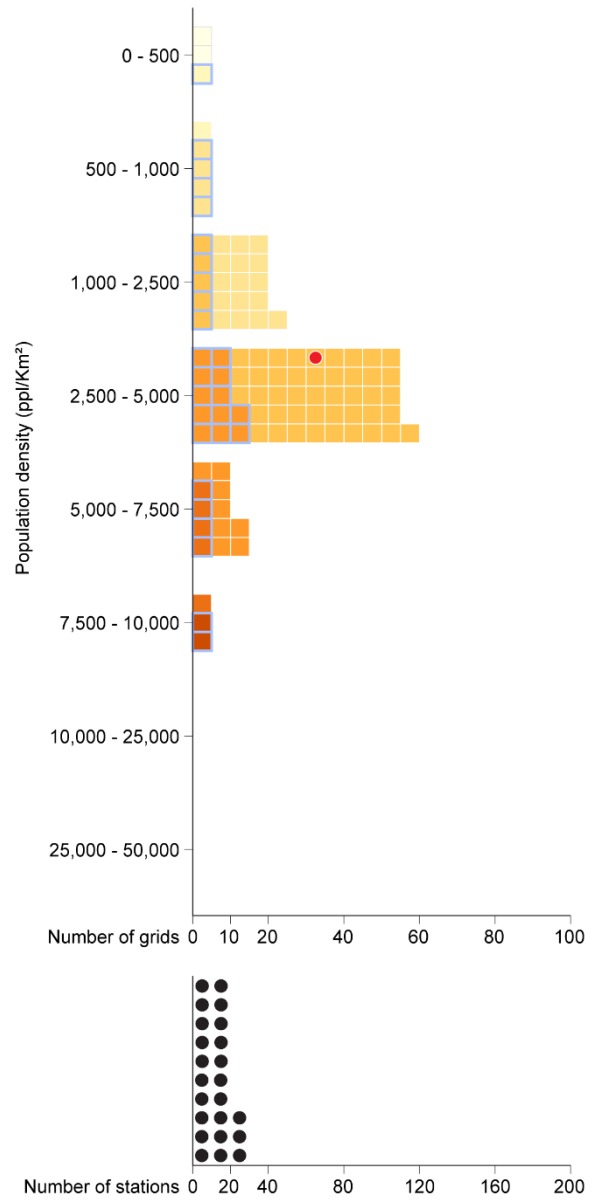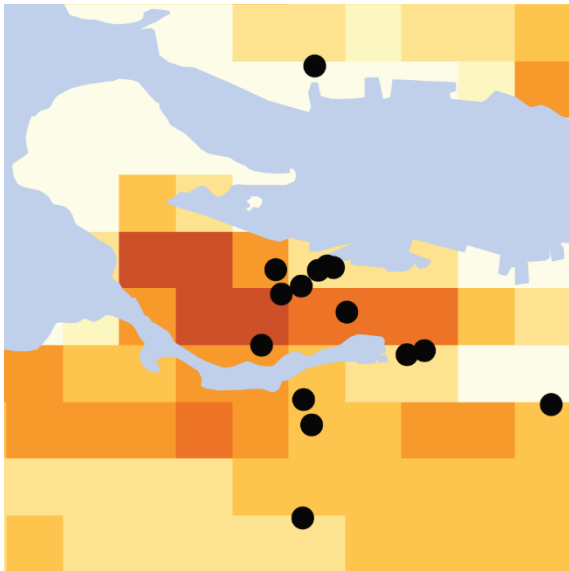
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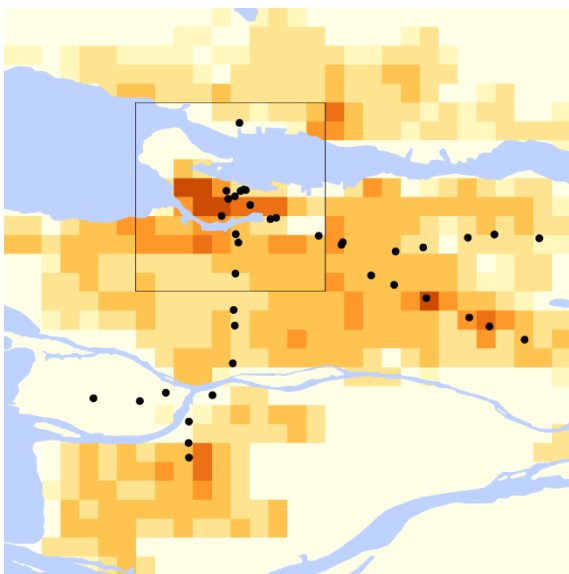
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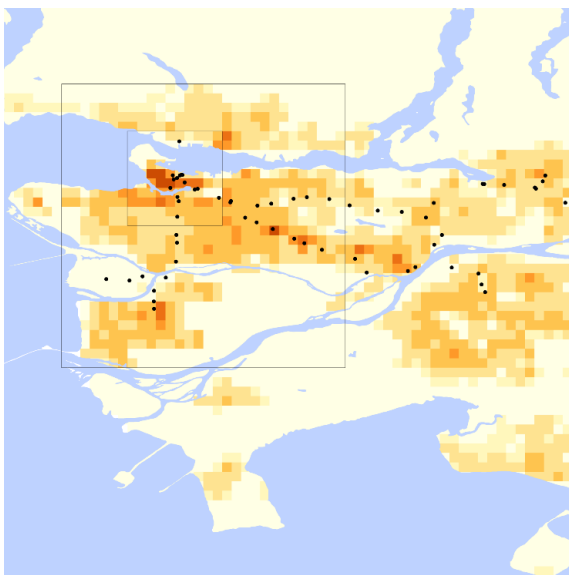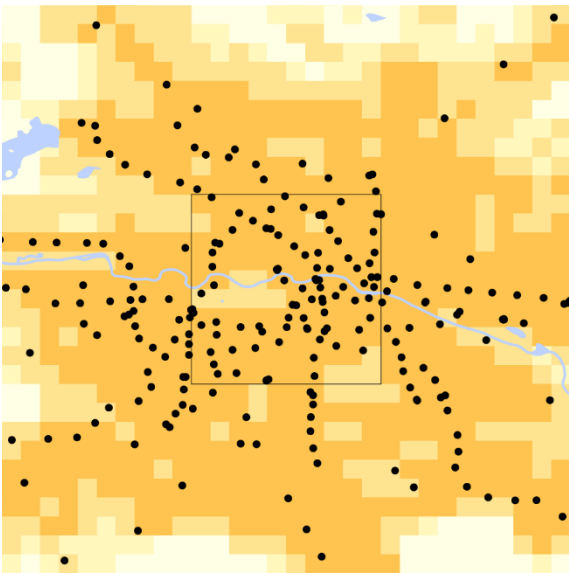

Vancouver 60km x 60km
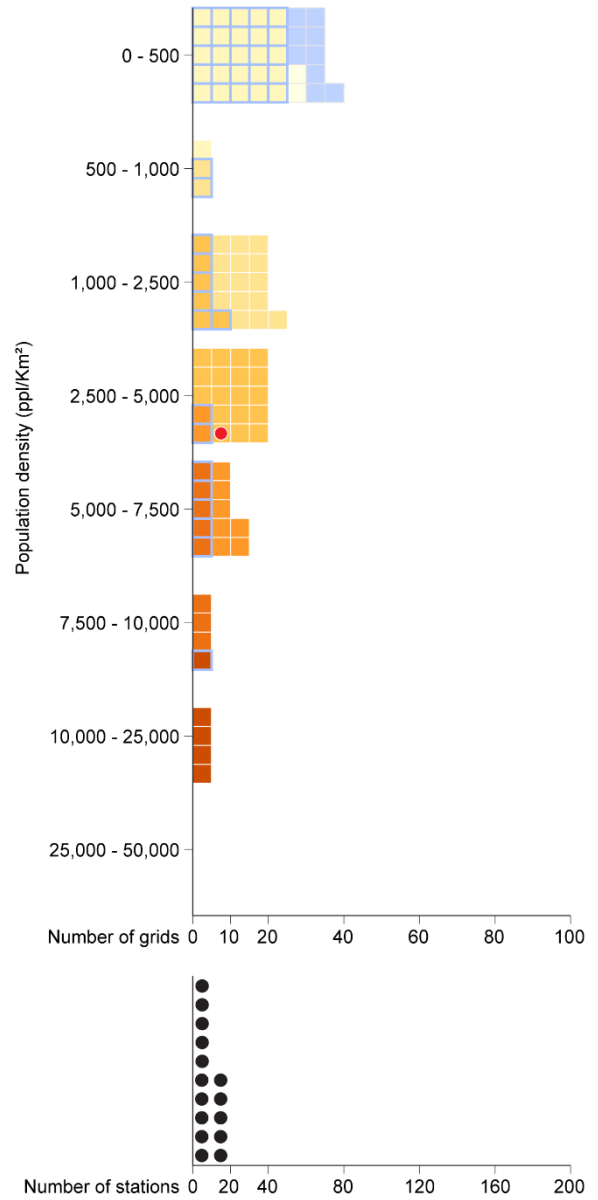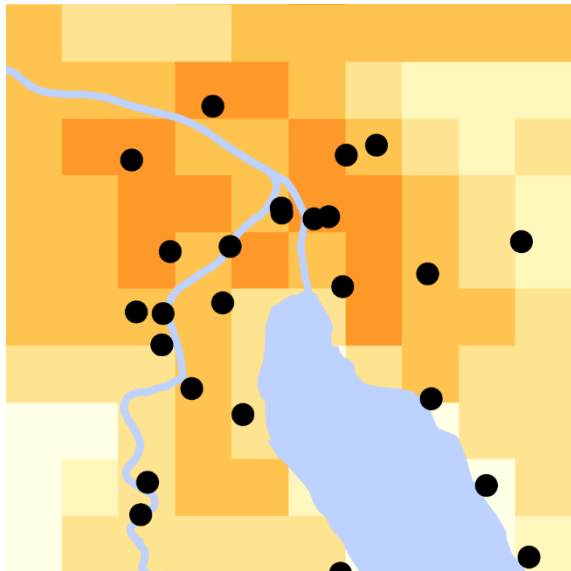
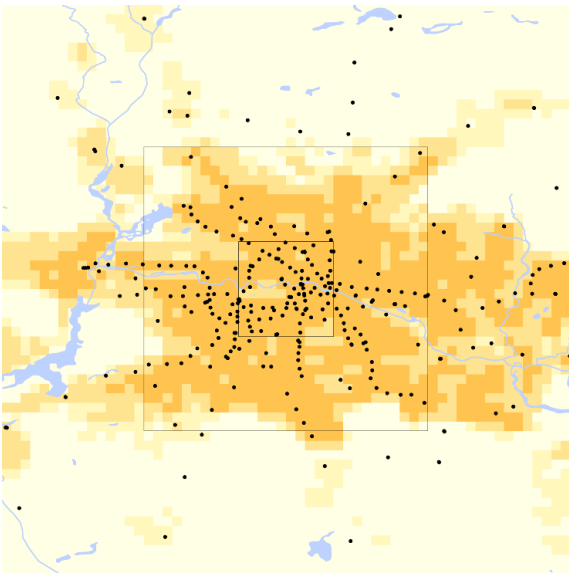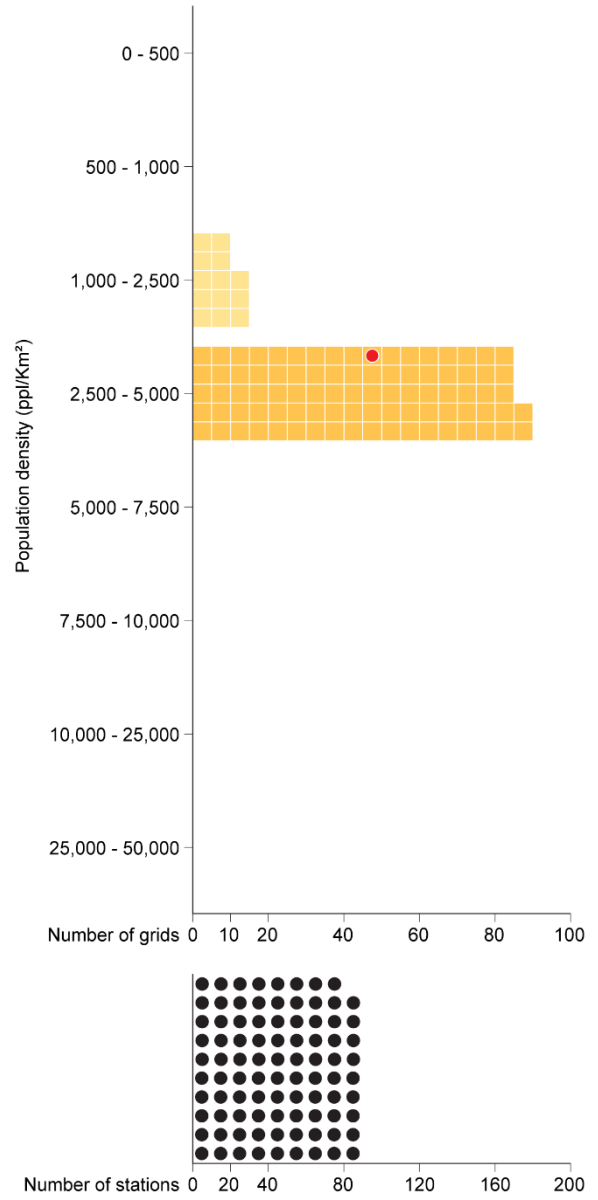**Zurich 10km x 10km**
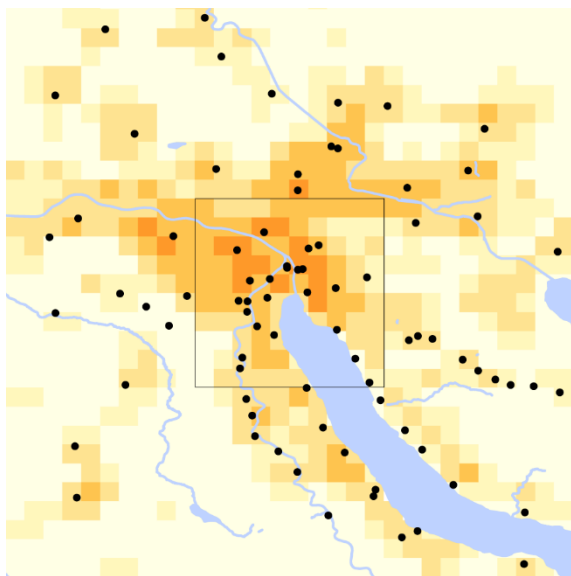
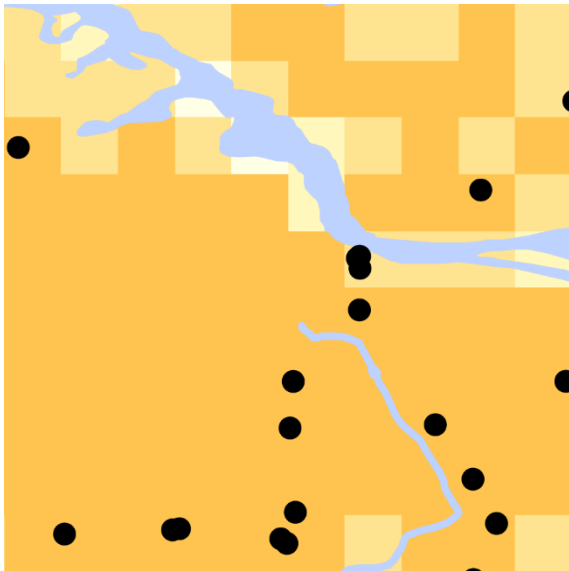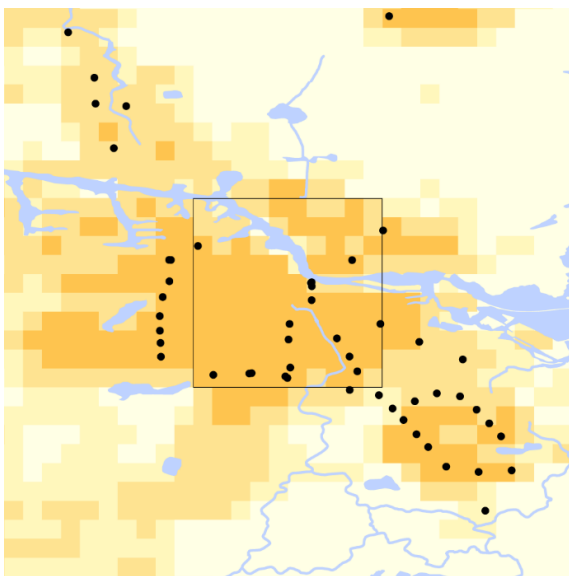**Zurich 30km x 30km**
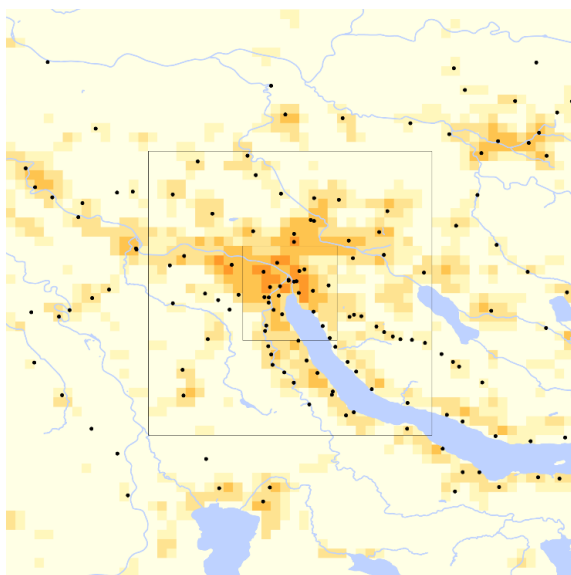
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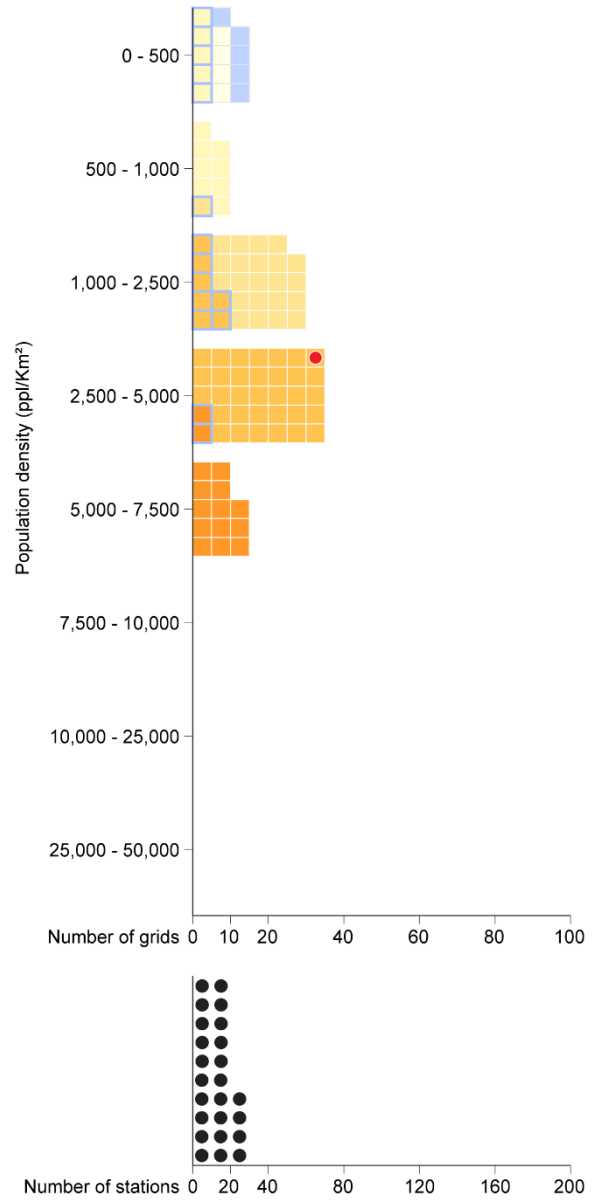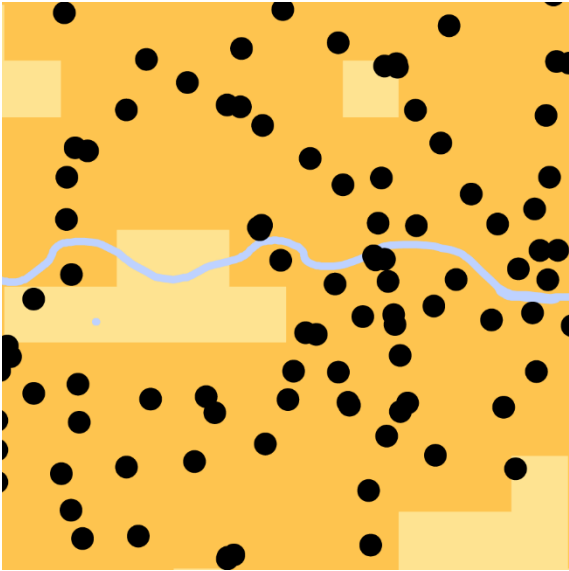
Berlin 10km x 10km

Berlin 30km x 30km

Berlin 60km x 60km

Amsterdam 10km x 10km

Amsterdam 30km x 30km
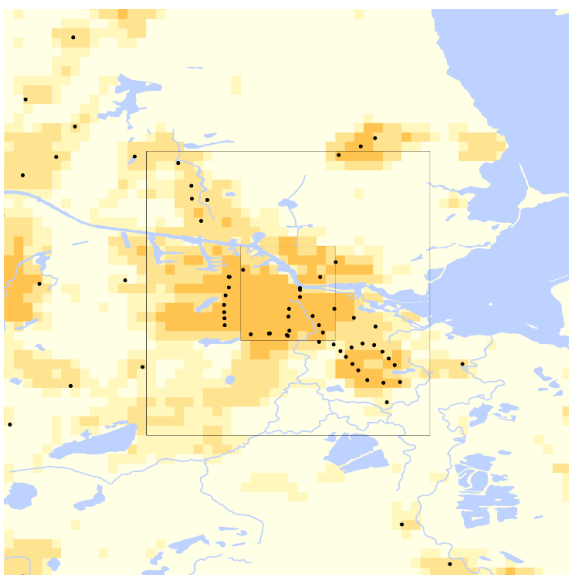
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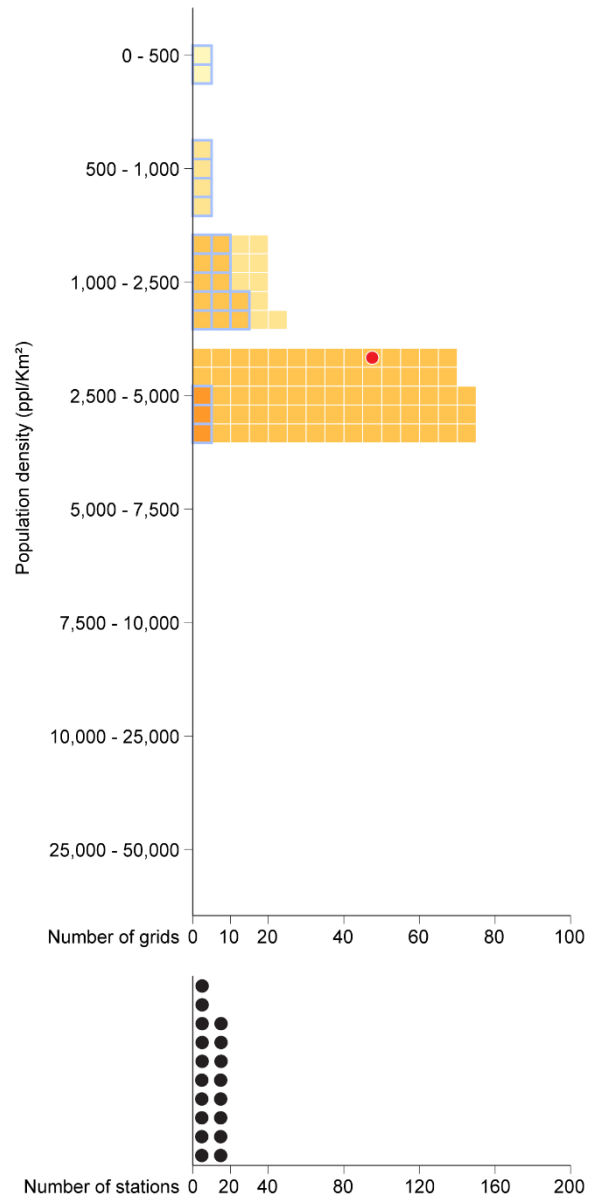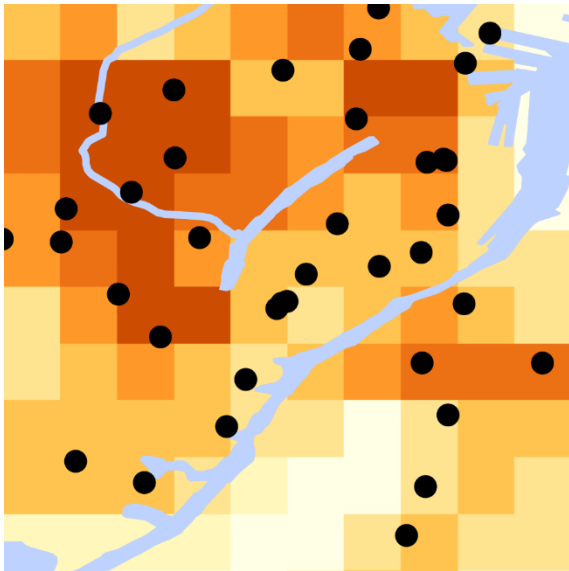
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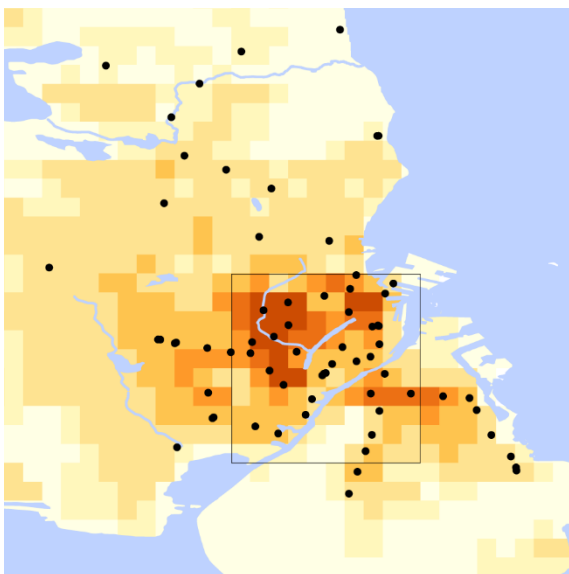
Copenhagen 30km x 30km

Copenhagen 60km x 60km

Population density (ppl/Km²)

| 0 - 500 |
| 500 - 1,000 |
| 1,000 - 2,500 |
| 2,500 - 5,000 |
| 5,000 - 7,500 |
| 7,500 - 10,000 |
| 10,000 - 25,000 |
| 25,000 - 50,000 |

Number of grids 0 10 20 40 60 80 100

Number of stations 0 20 40 80 120 160 200
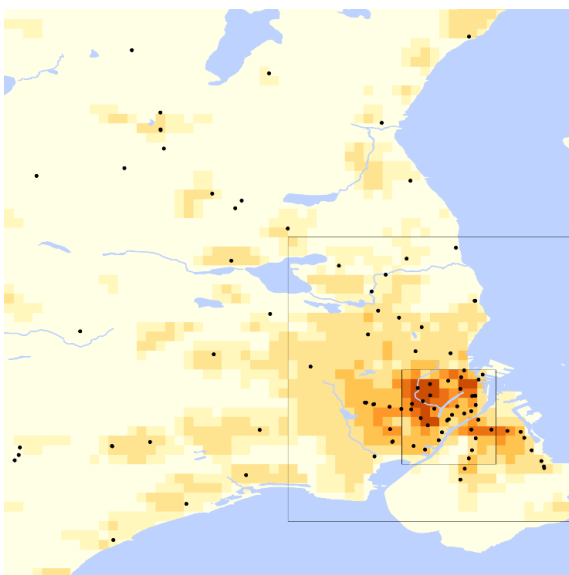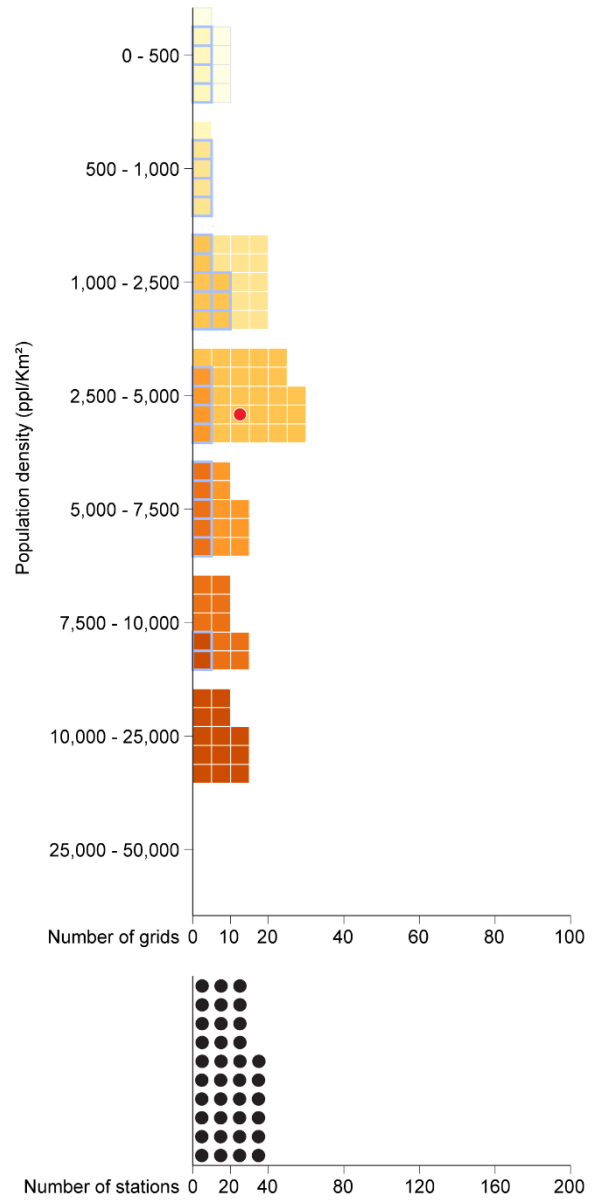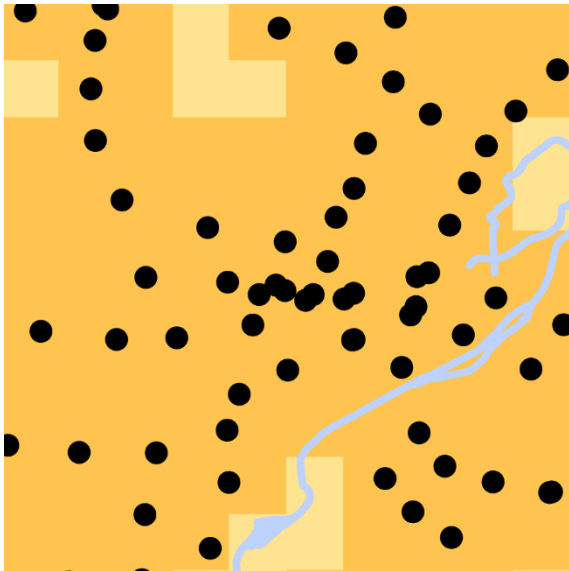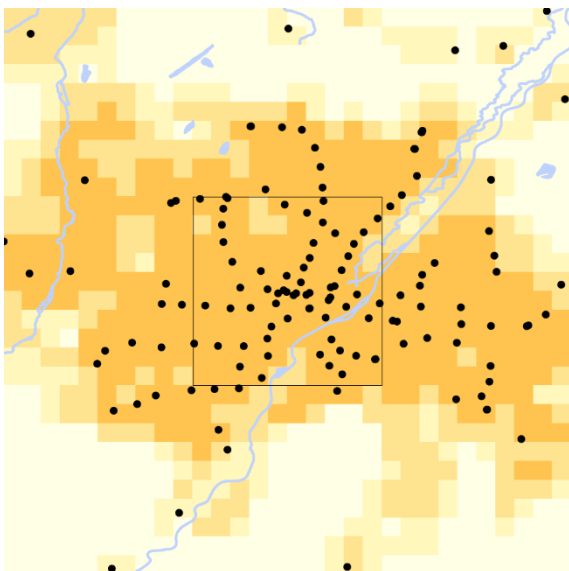
Munich 10km x 10km

Munich 30km x 30km
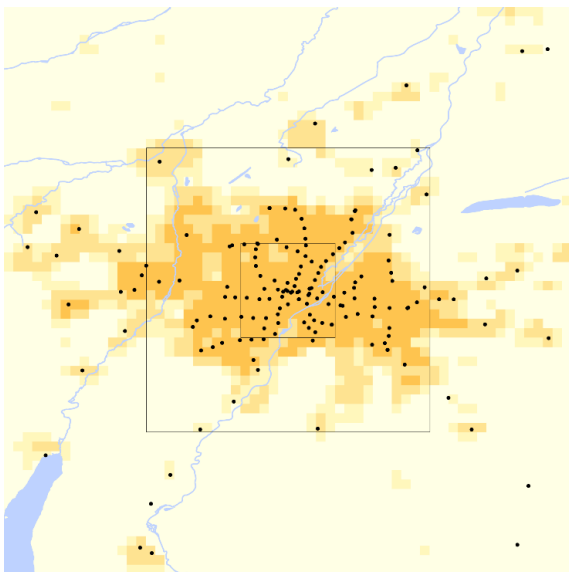
Munich 60km x 60km
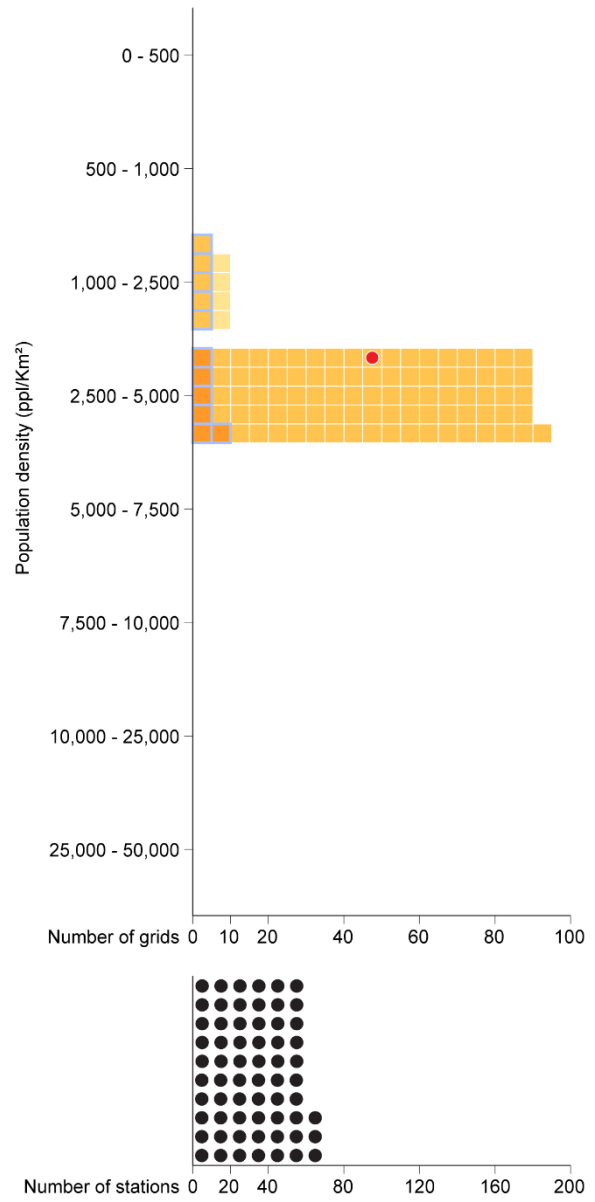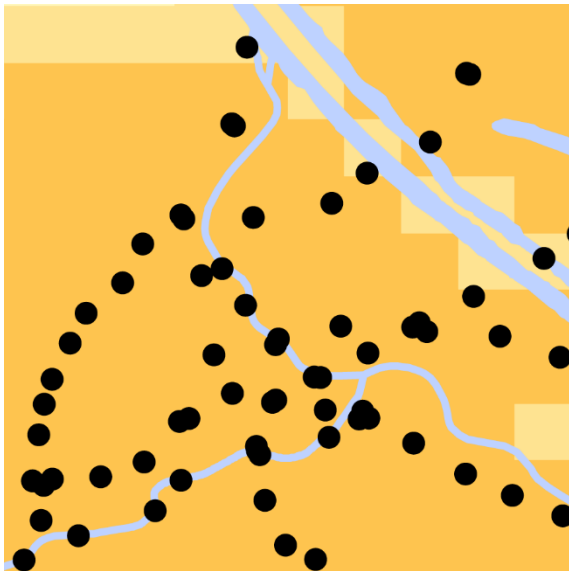
Vienna 10km x 10km
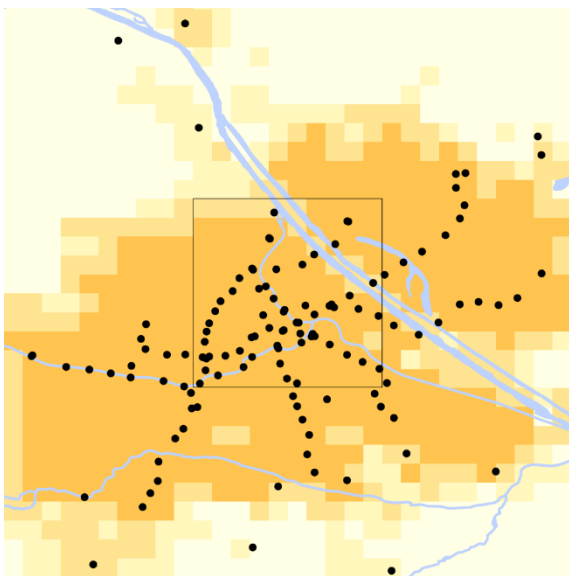
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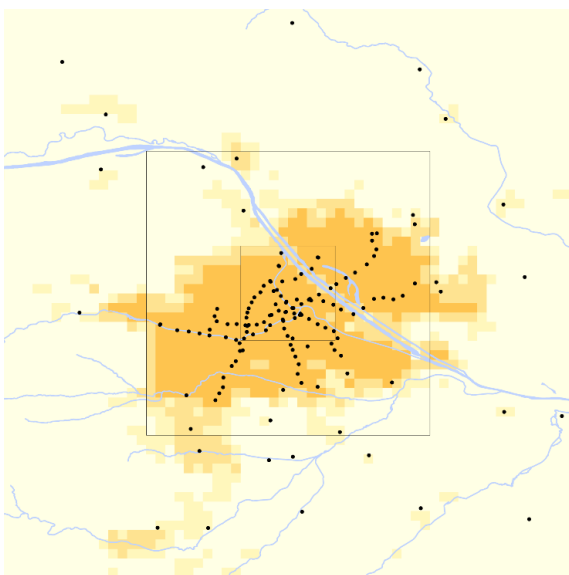
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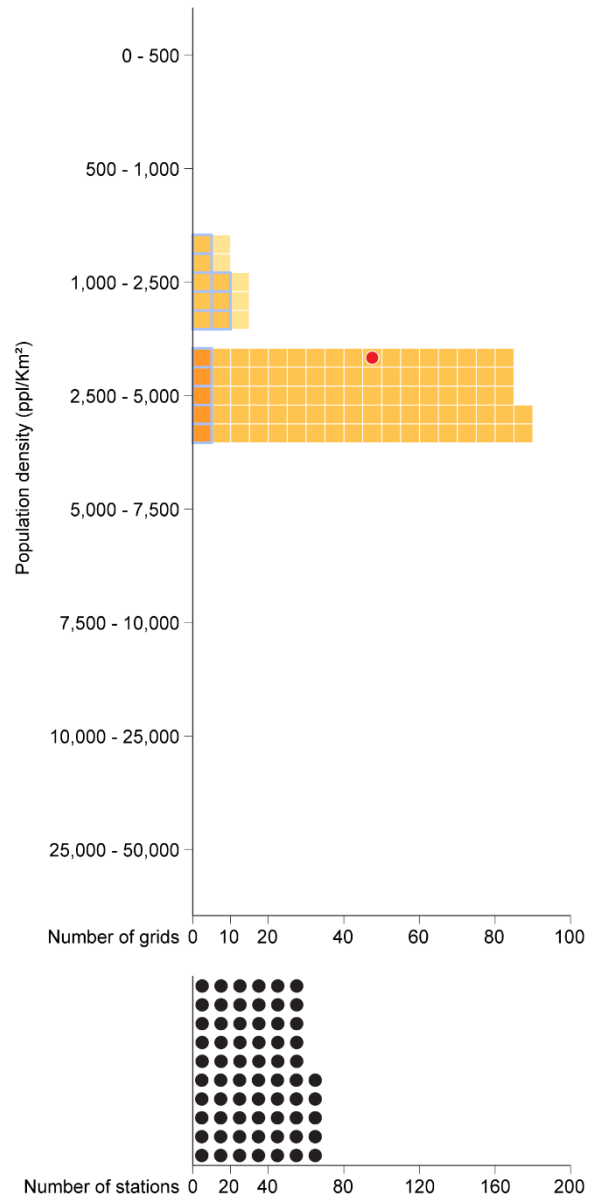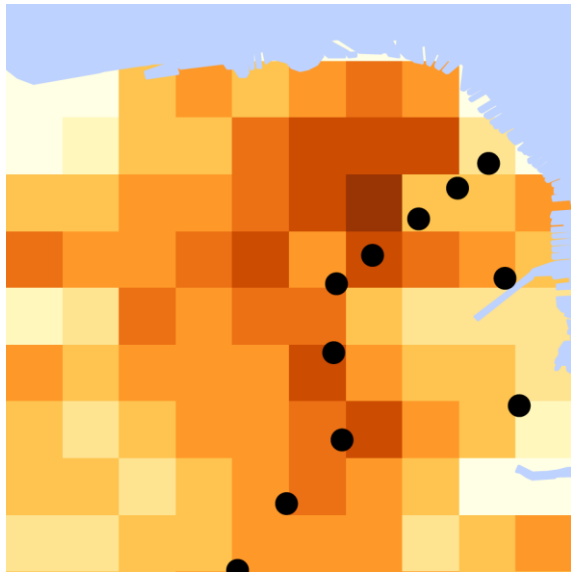
San Francisco 10km x 10km
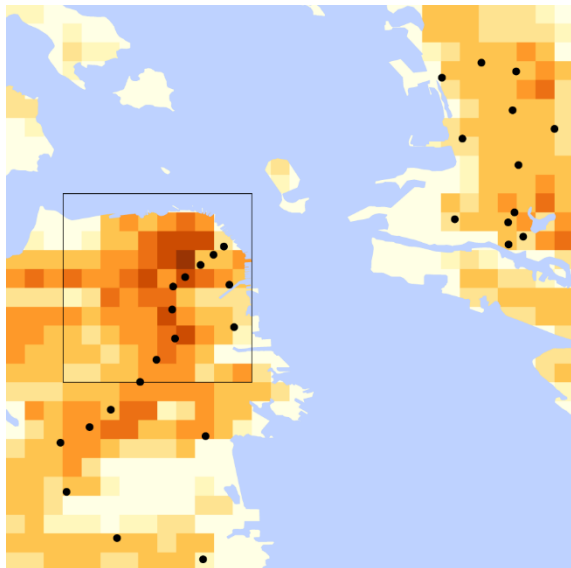
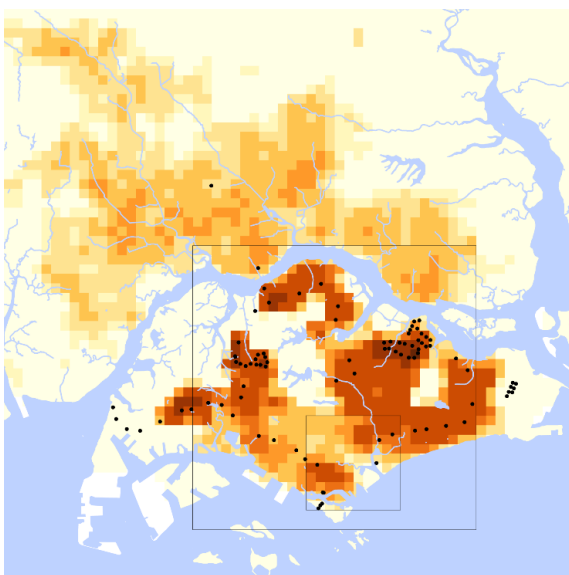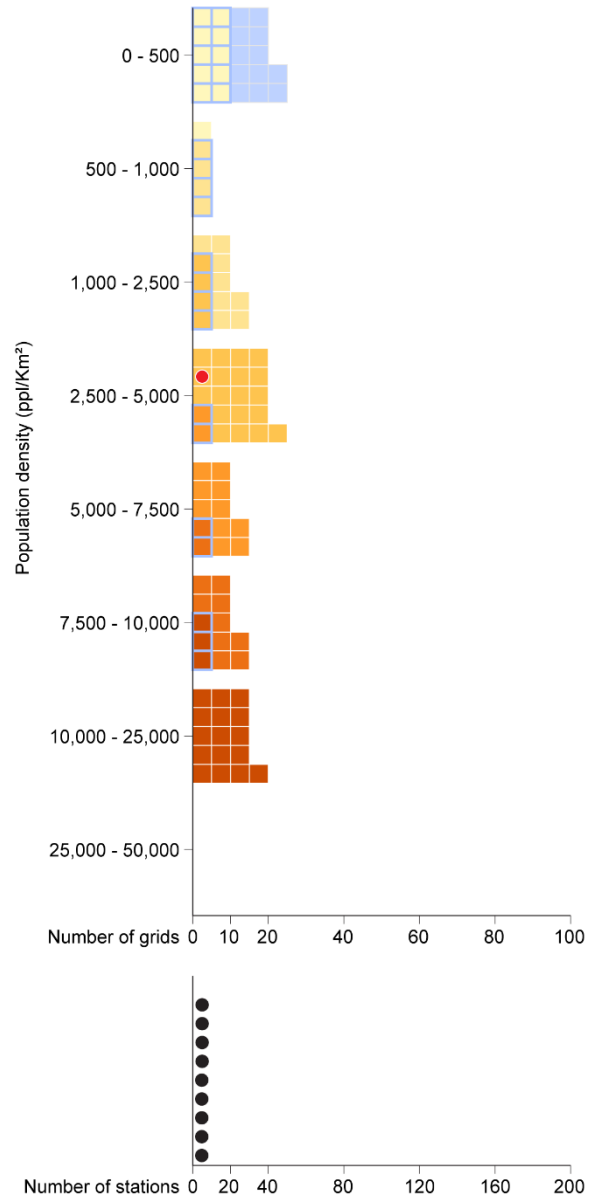**San Francisco 30km x 30km**
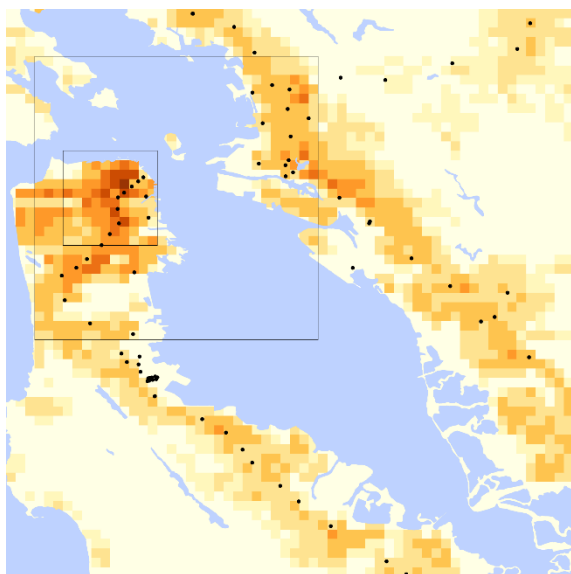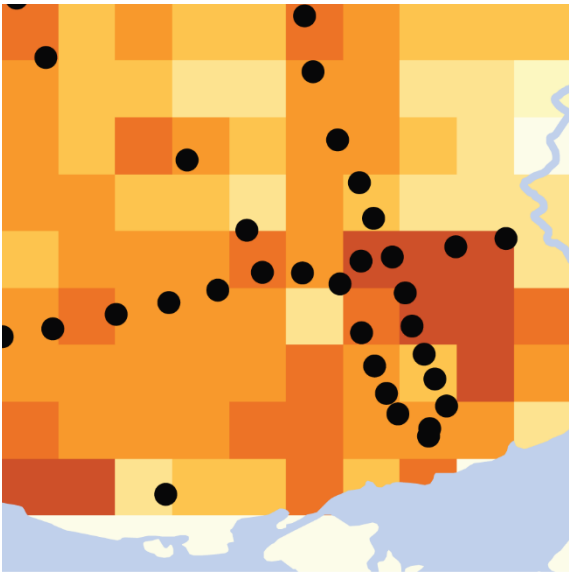

San Francisco 60km x 60km
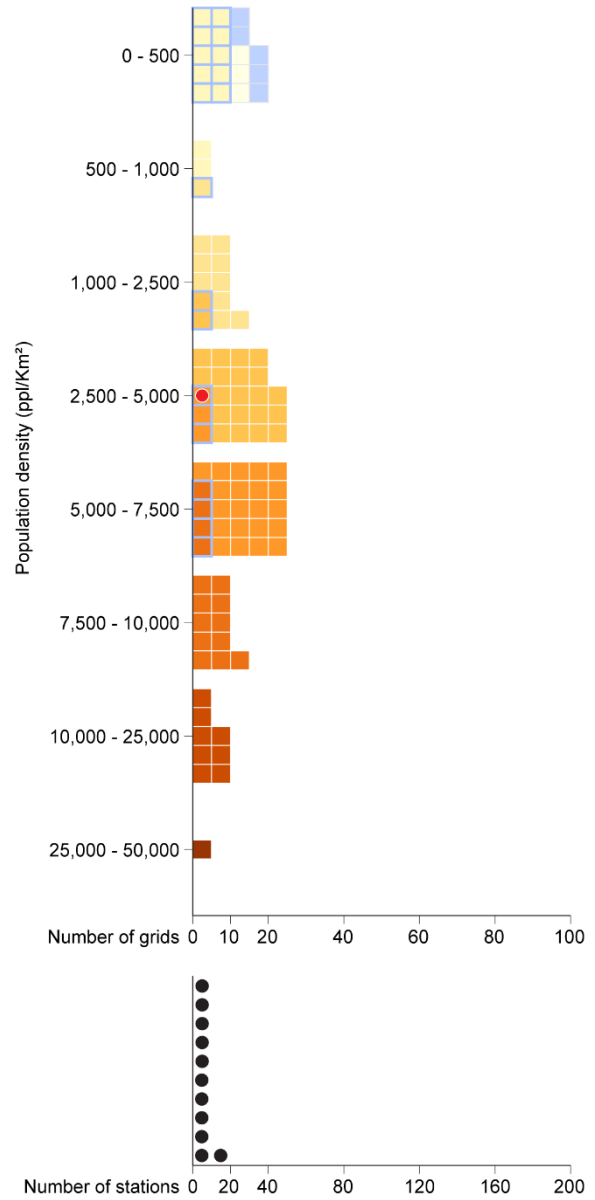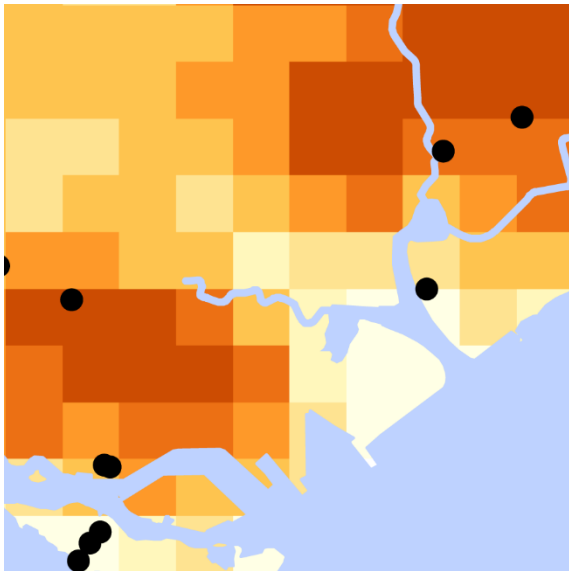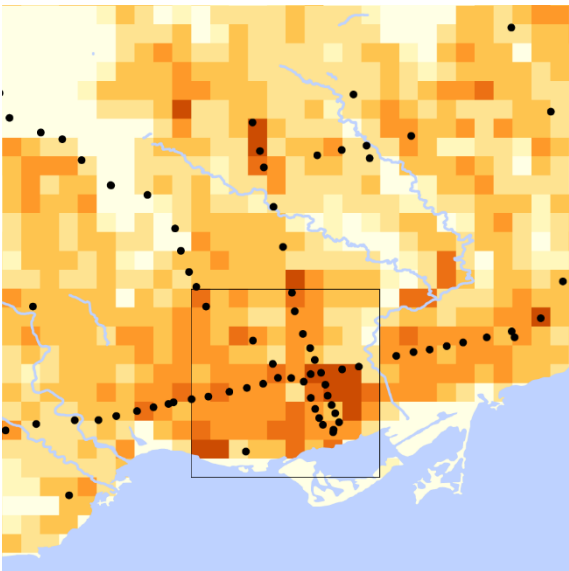
Singapore 10km x 10km
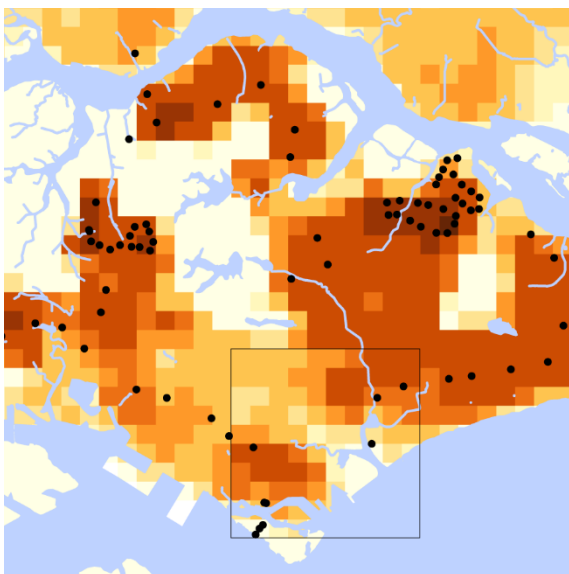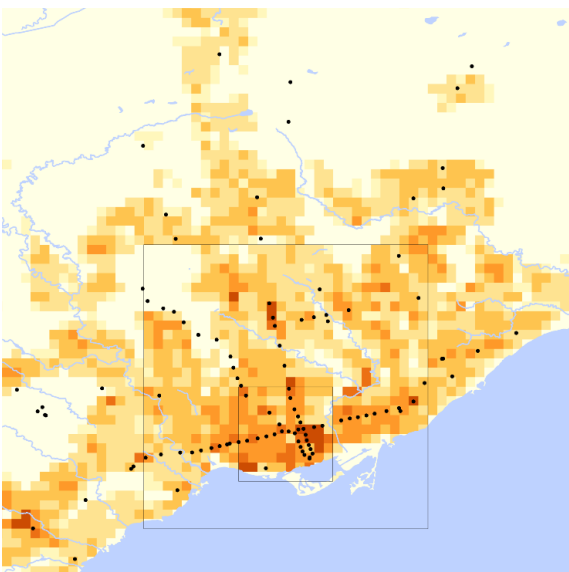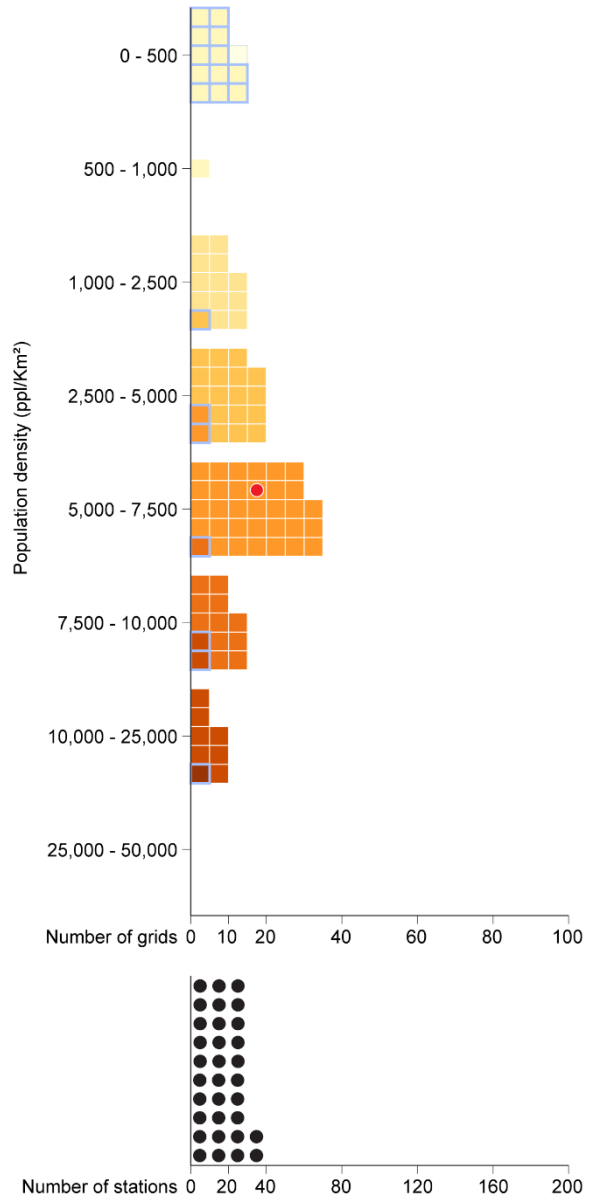

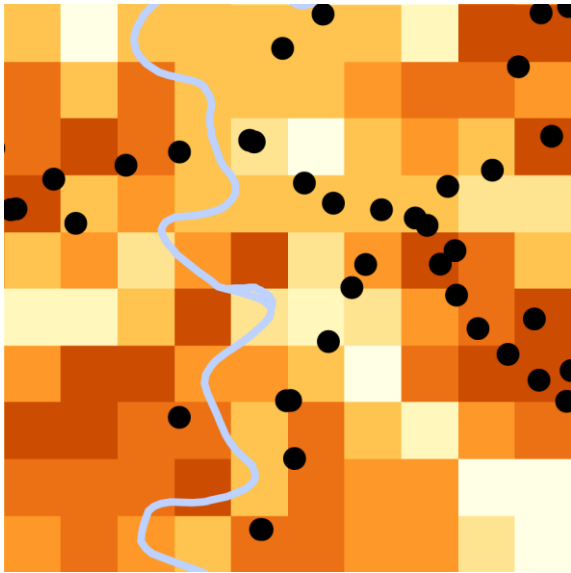**Singapore 30km x 30km**

Singapore 60km x 60km
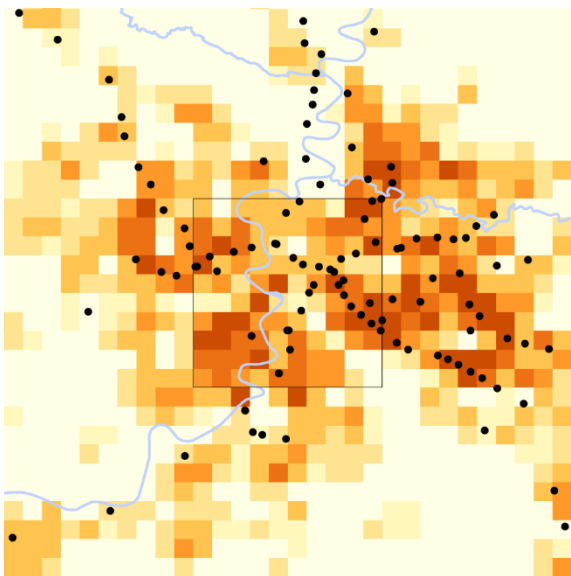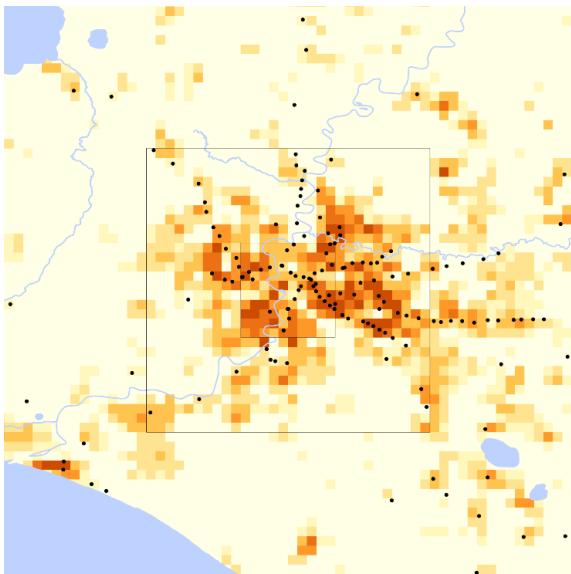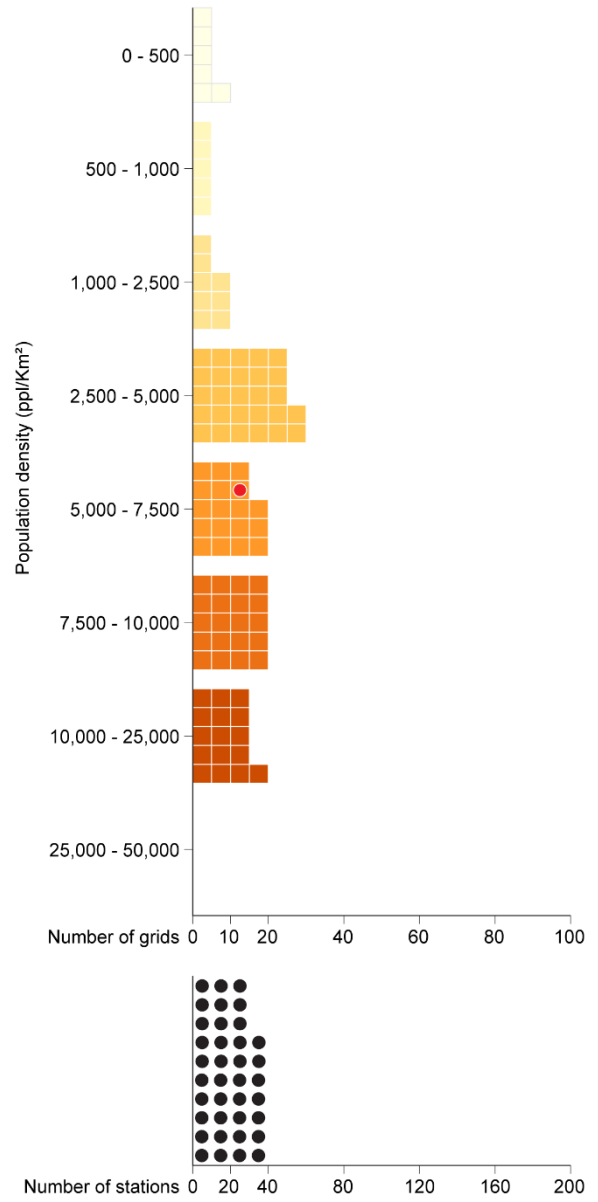
Toronto 10km x 10km

Toronto 30km x 30km
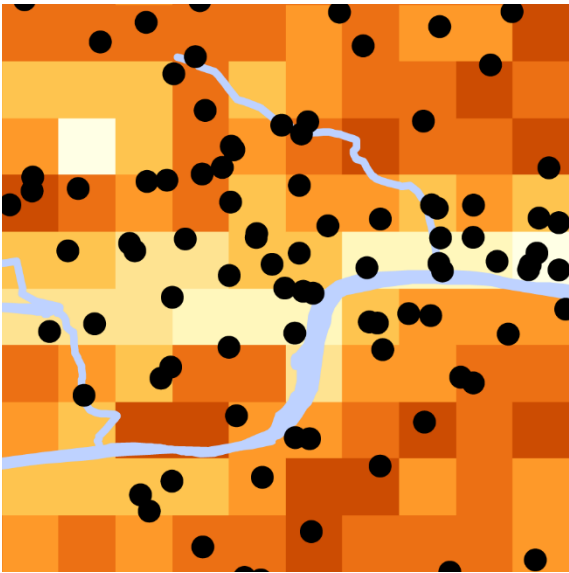

Toronto 60km x 60km
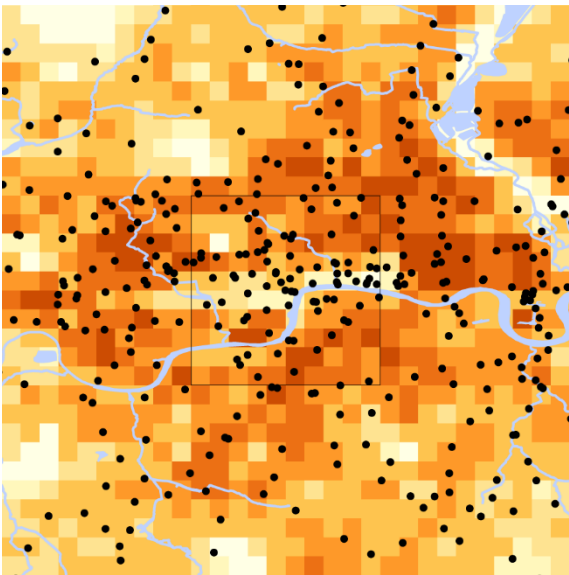
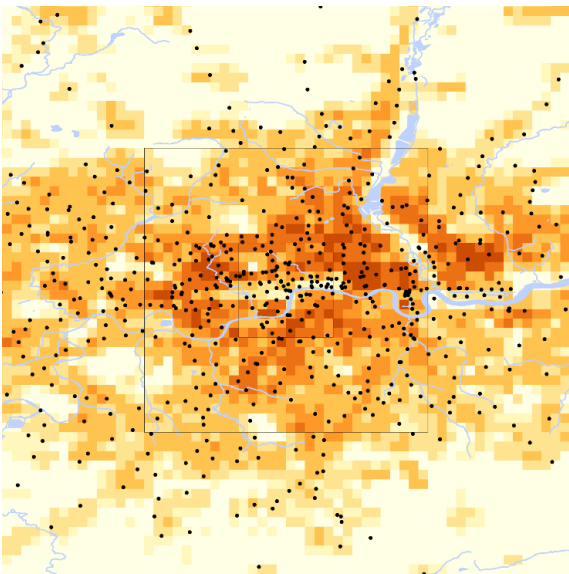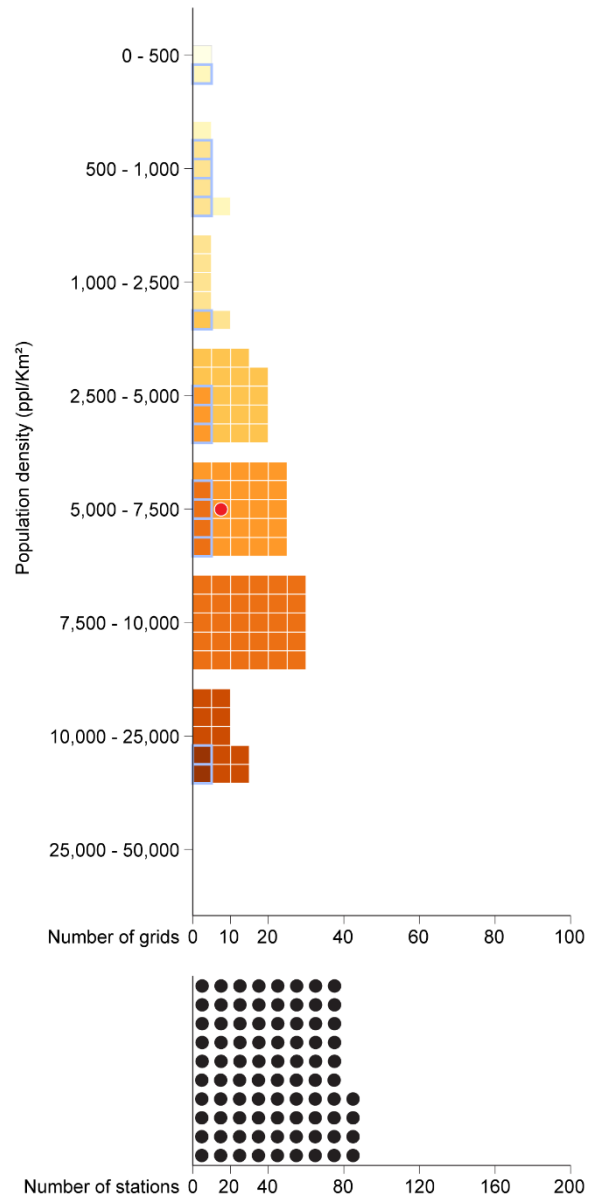**Rome 10km x 10km**

Rome 30km x 30km

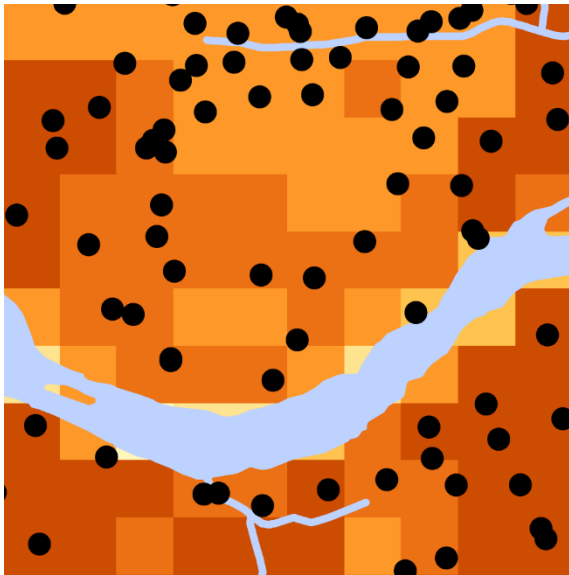
Rome 60km x 60km
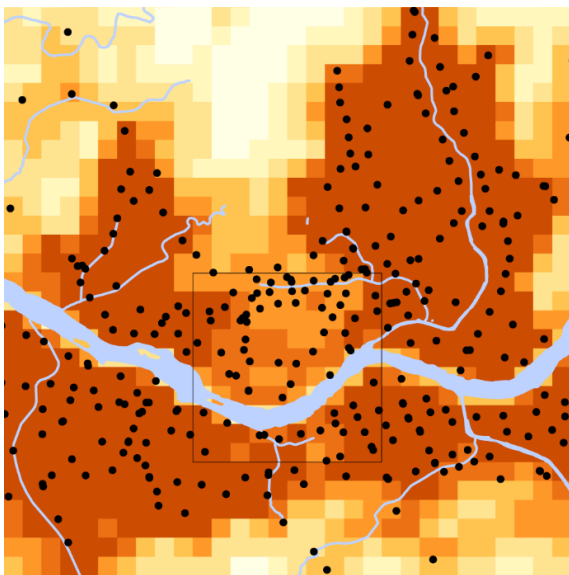
London 10km x 10km

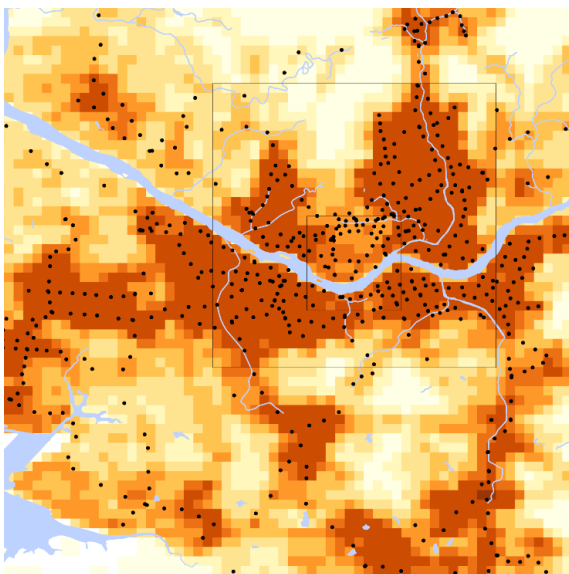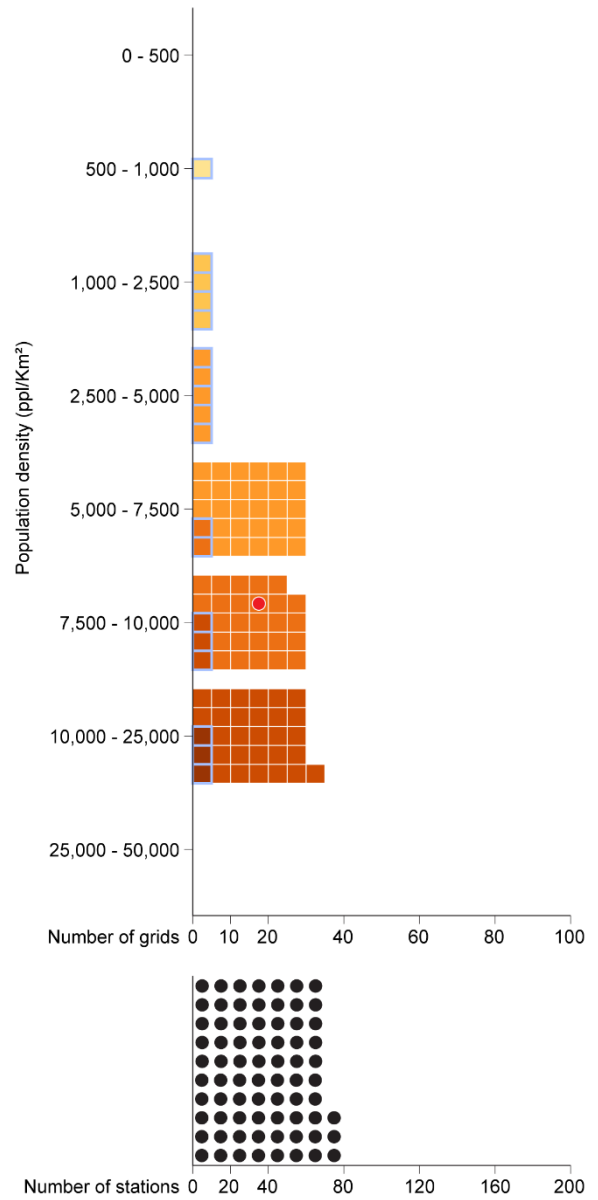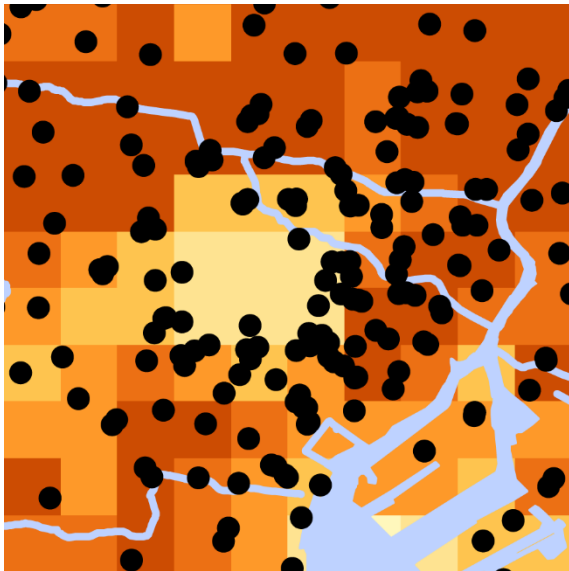**London 30km x 30km**

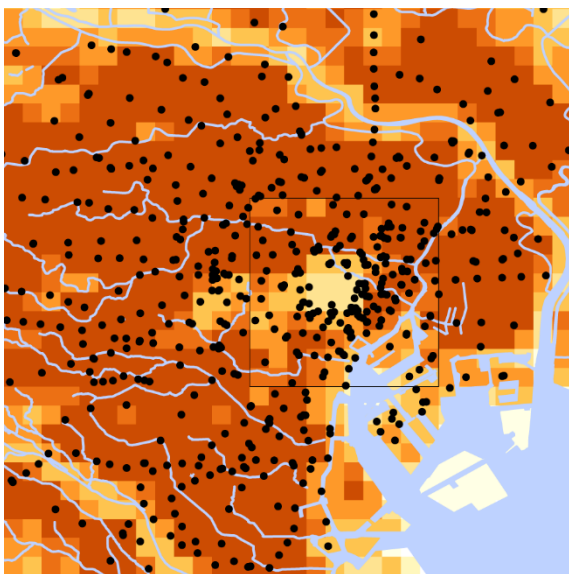**London 60km x 60km**

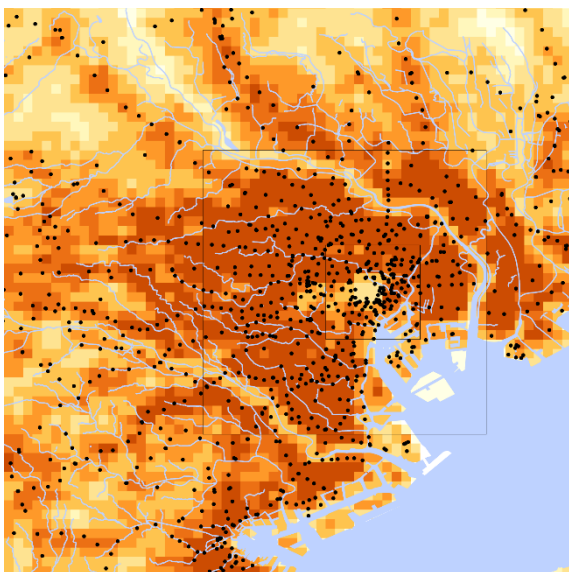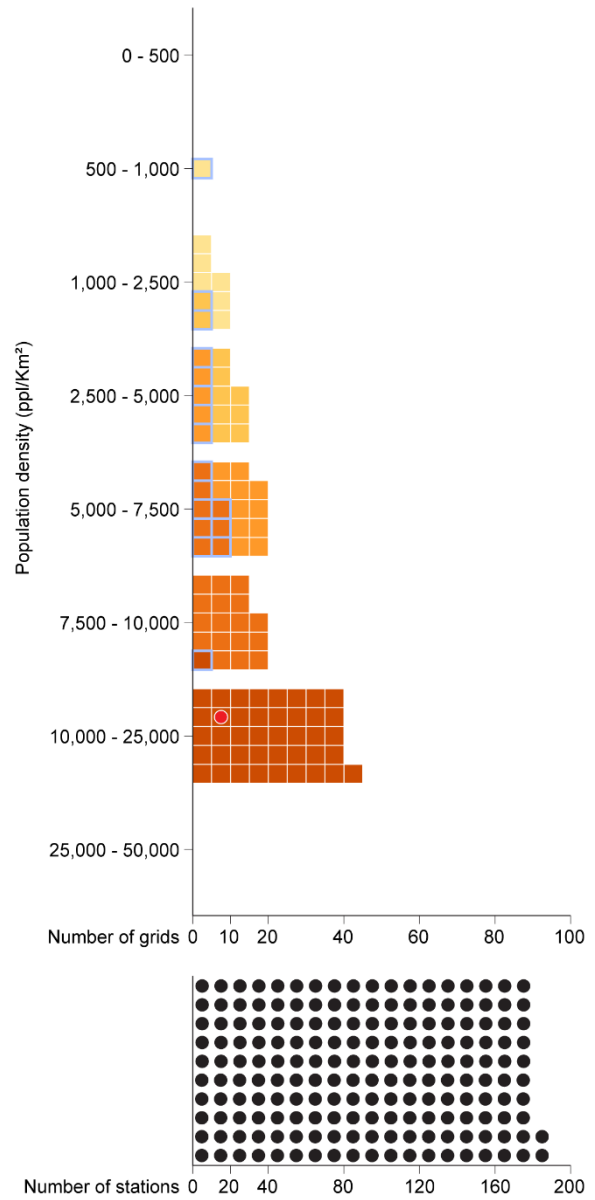**Seoul 10km x 10km**

Seoul 30km x 30km

Seoul 60km x 60km
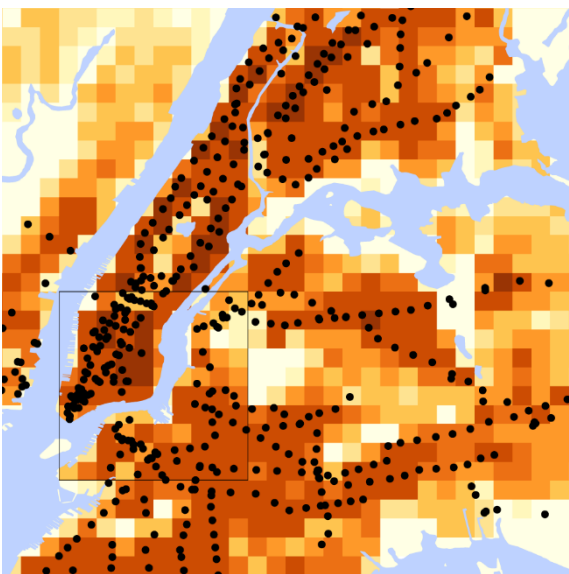
Tokyo 10km x 10km

Tokyo 30km x 30km

Tokyo 60km x 60km

New York 10km x 10km

New York 30km x 30km
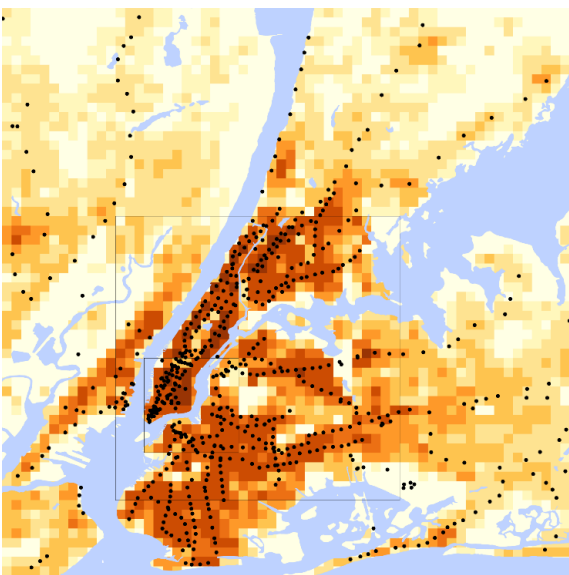
New York 60km x 60km
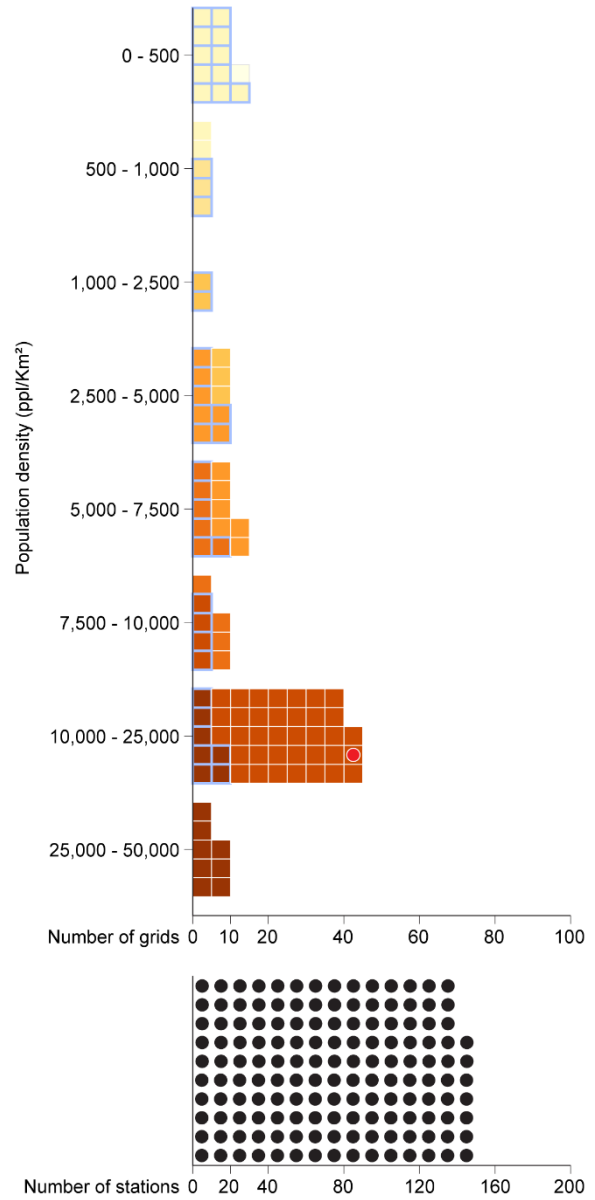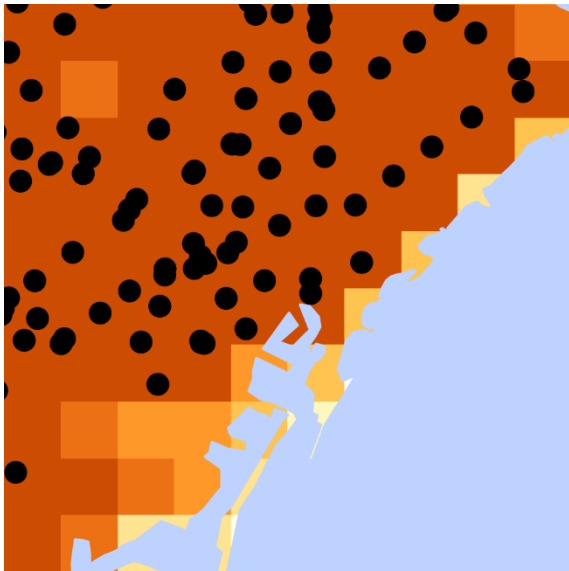
Barcelona 10km x 10km
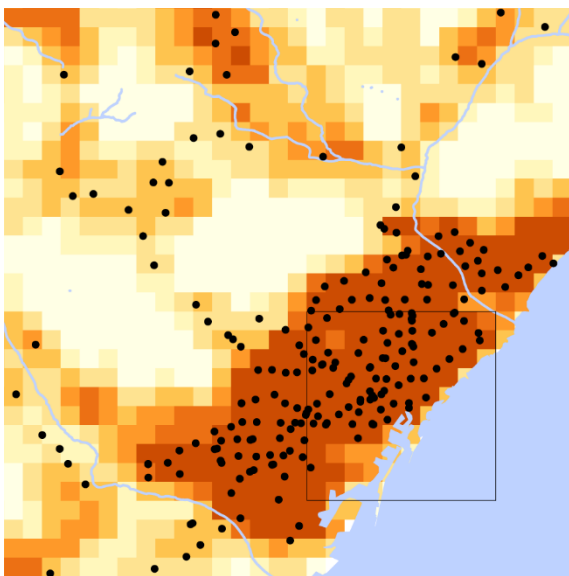
Barcelona 30km x 30km

Barcelona 60km x 60km

Population density (ppl/Km²)

| 0 - 500 |
| 500 - 1,000 |
| 1,000 - 2,500 |
| 2,500 - 5,000 |
| 5,000 - 7,500 |
| 7,500 - 10,000 |
| 10,000 - 25,000 |
| 25,000 - 50,000 |

Number of grids   10 20   40   60   80   100

Number of stations 0 20 40   80   120   160   200
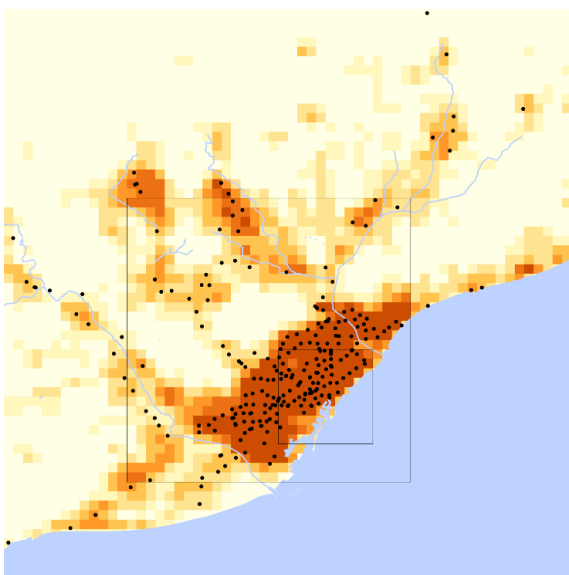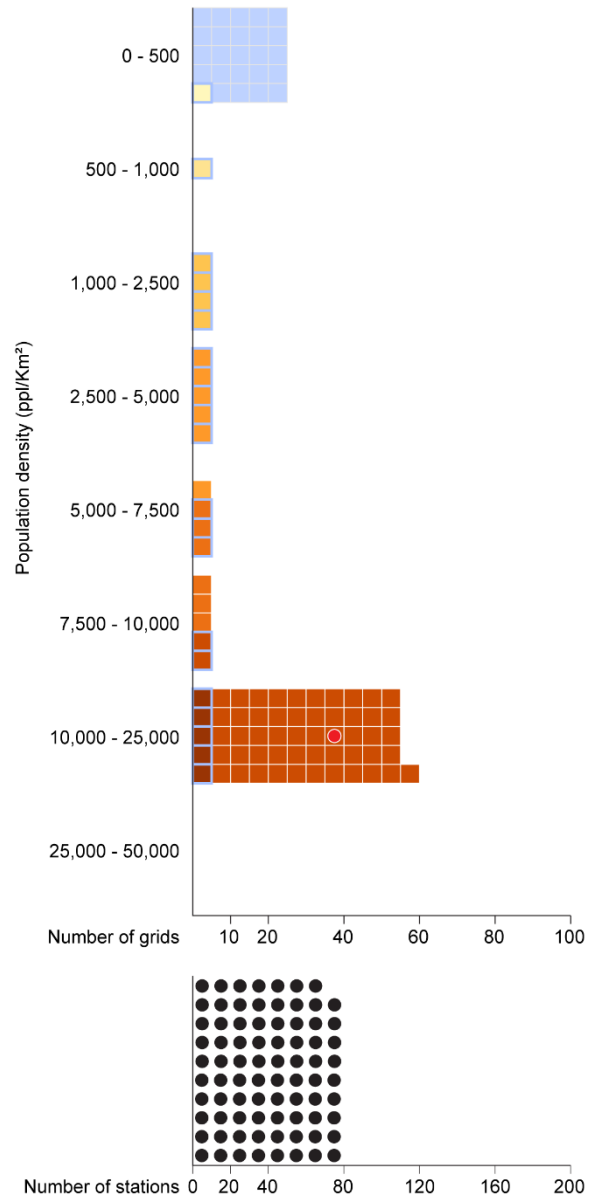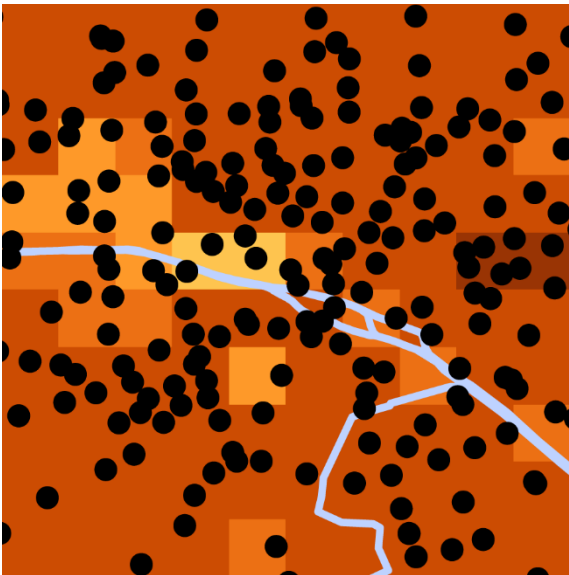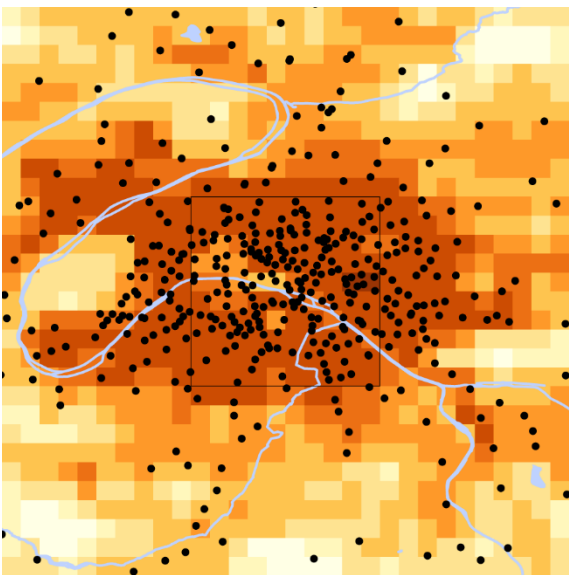
Paris 10km x 10km

Paris 30km x 30km

Paris 60km x 60km

Figure 1. Summary chart - density of inner 10km x 10km area compared to number of train stations. Cities to the left of Sydney are less dense, cities higher in the graph than Sydney have more stations.

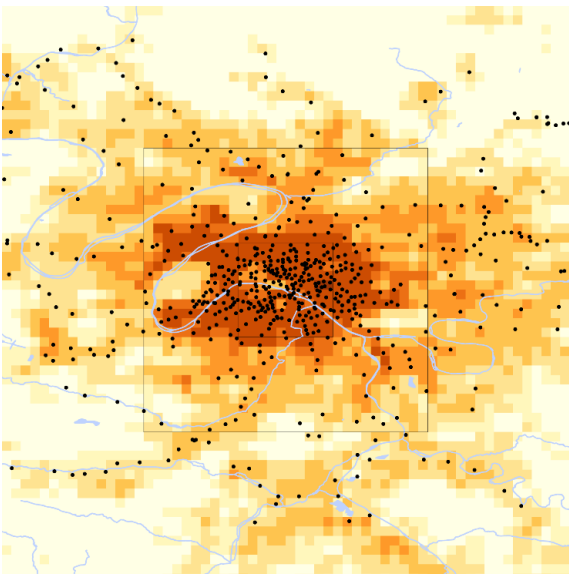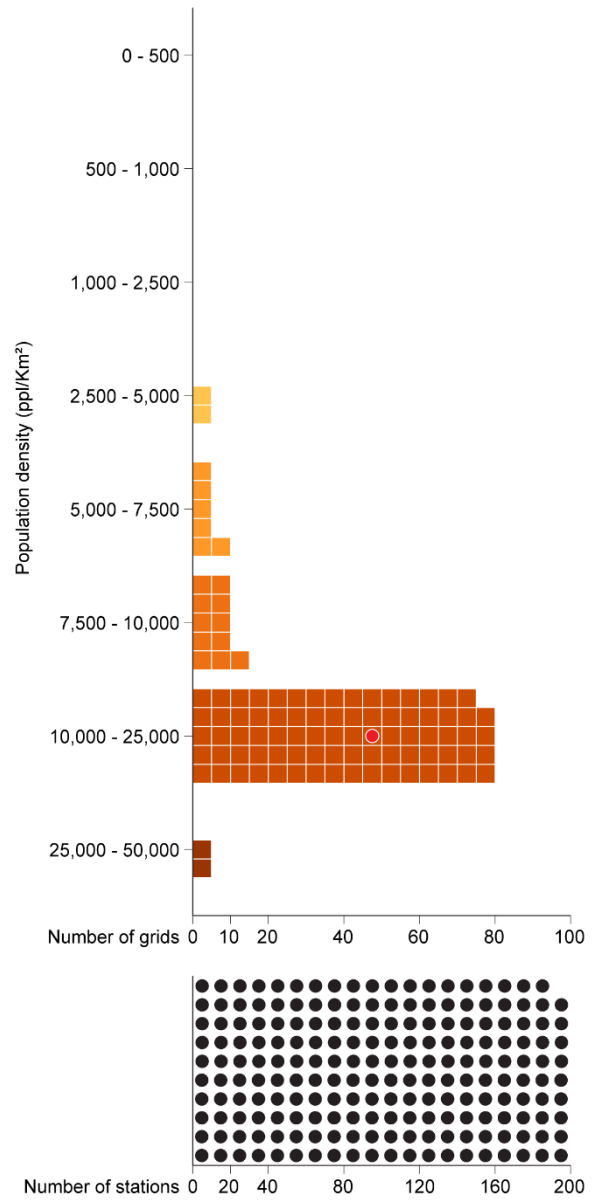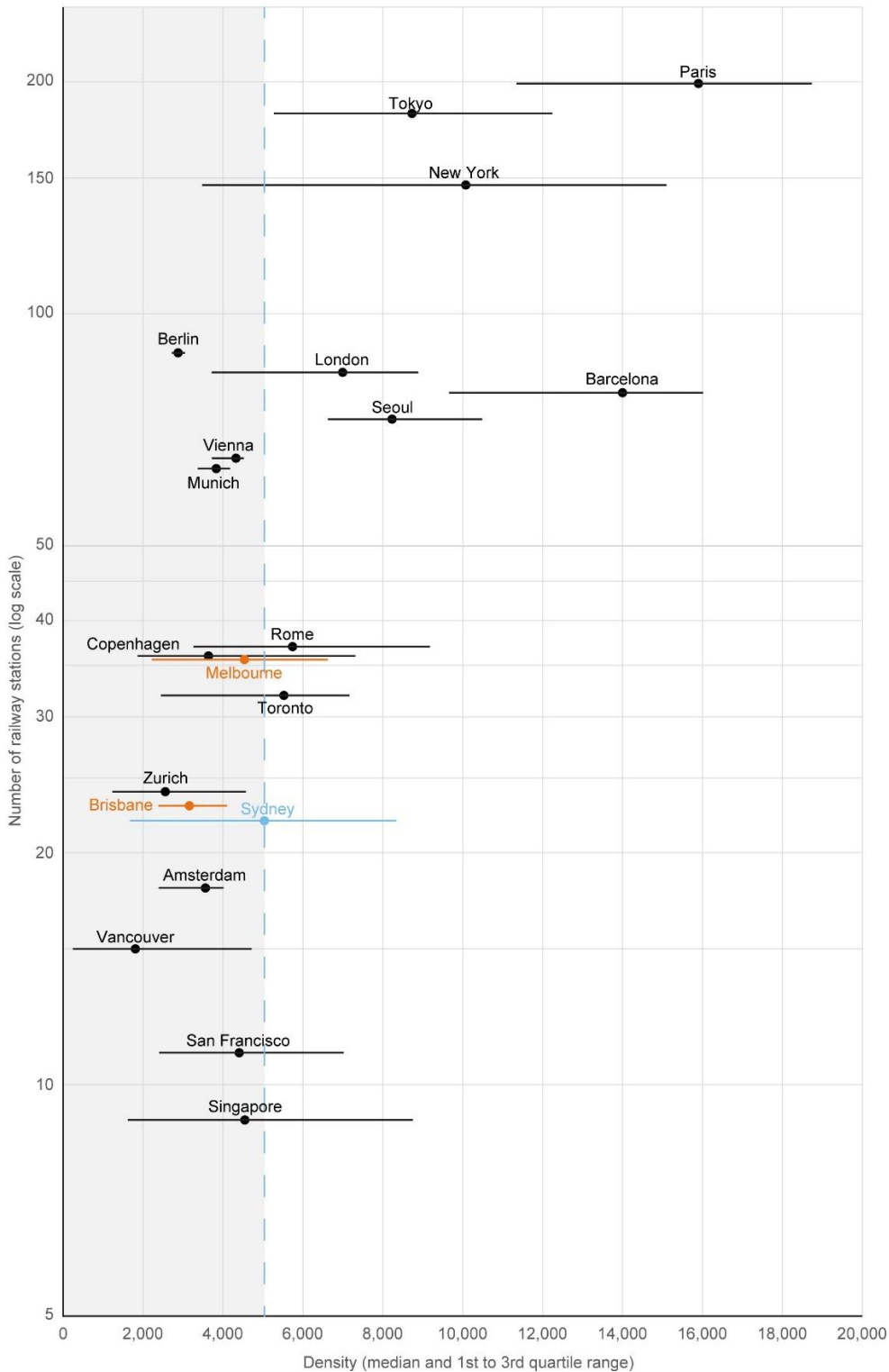| City	Median density	Number of rail stations
Vancouver	1,806	15
Zurich	2,558	24
Berlin	2,876	89
Brisbane	3,157	23
Amsterdam	3,558	18
Copenhagen	3,638	36
Munich	3,829	63
Vienna	4,322	65
San Francisco	4,409	11
Melbourne	4,537	36
Singapore	4,545	9
Sydney	**5,038**	**22**
Toronto	5,526	32
Rome	5,739	37
London	6,993	84
Seoul	8,229	73
Tokyo	8,729	182
New York	10,074	147
Barcelona	13,999	79
Paris	15,901	199

Red represents substantially more rail stations than Sydney

Table 1. List of cities compared in order of median density of inner 10km x 10km area – most dense is at the bottom.