

# Modelling NO<sub>2</sub> Exposure in Greater Glasgow

Jonathan Gillespie

Jonathan.gillespie.100@strath.ac.uk

University of Strathclyde

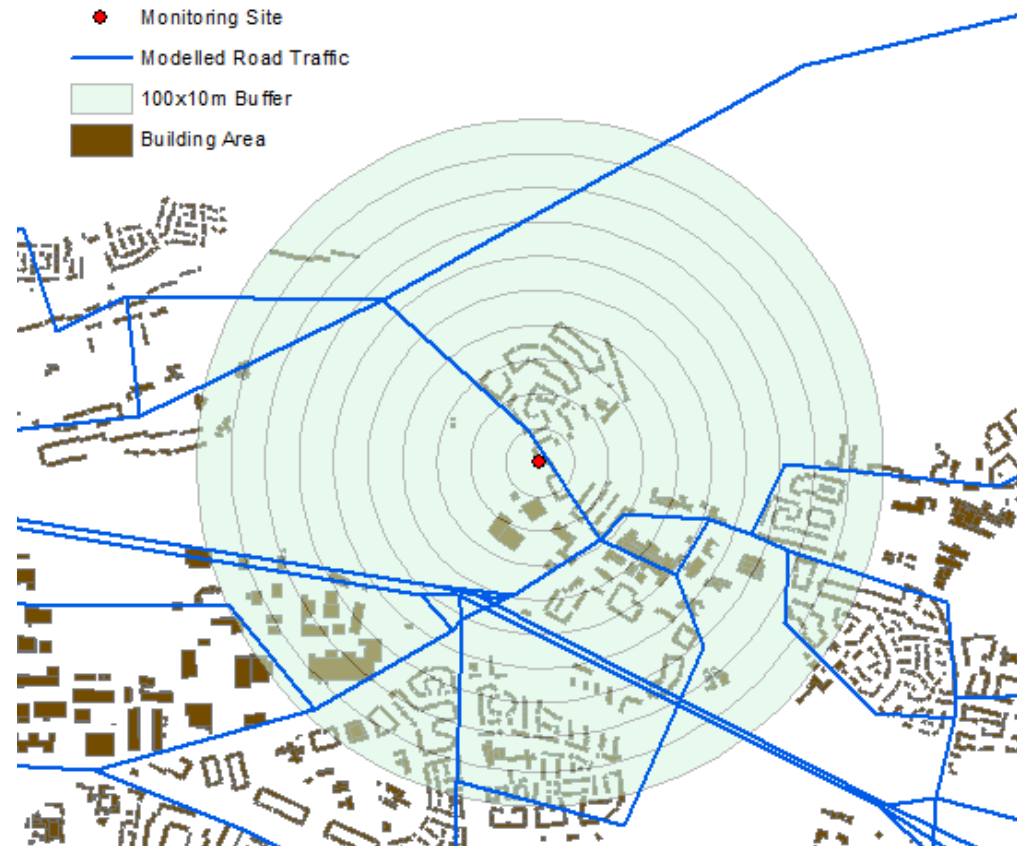
# Aims

- To develop a land use regression model for nitrogen dioxide in Greater Glasgow
- To apply this model to estimate residential exposure in a cohort group

# What is Land Use Regression Modelling?


Statistical approach based on nearby features and measured concentrations

- ✓ Very low cost
- ✓ Good spatial prediction
- ✓ Applicable to multiple pollutants/  
scales
- ✓ Easy to apply and understand
- ✓ No emission/met. data required
- ✗ Sampling prior to modelling
- ✗ Network design crucial
- ✗ May be temporally/spatially limited
- ✗ **No physical basis**
- ✗ **Subjective**

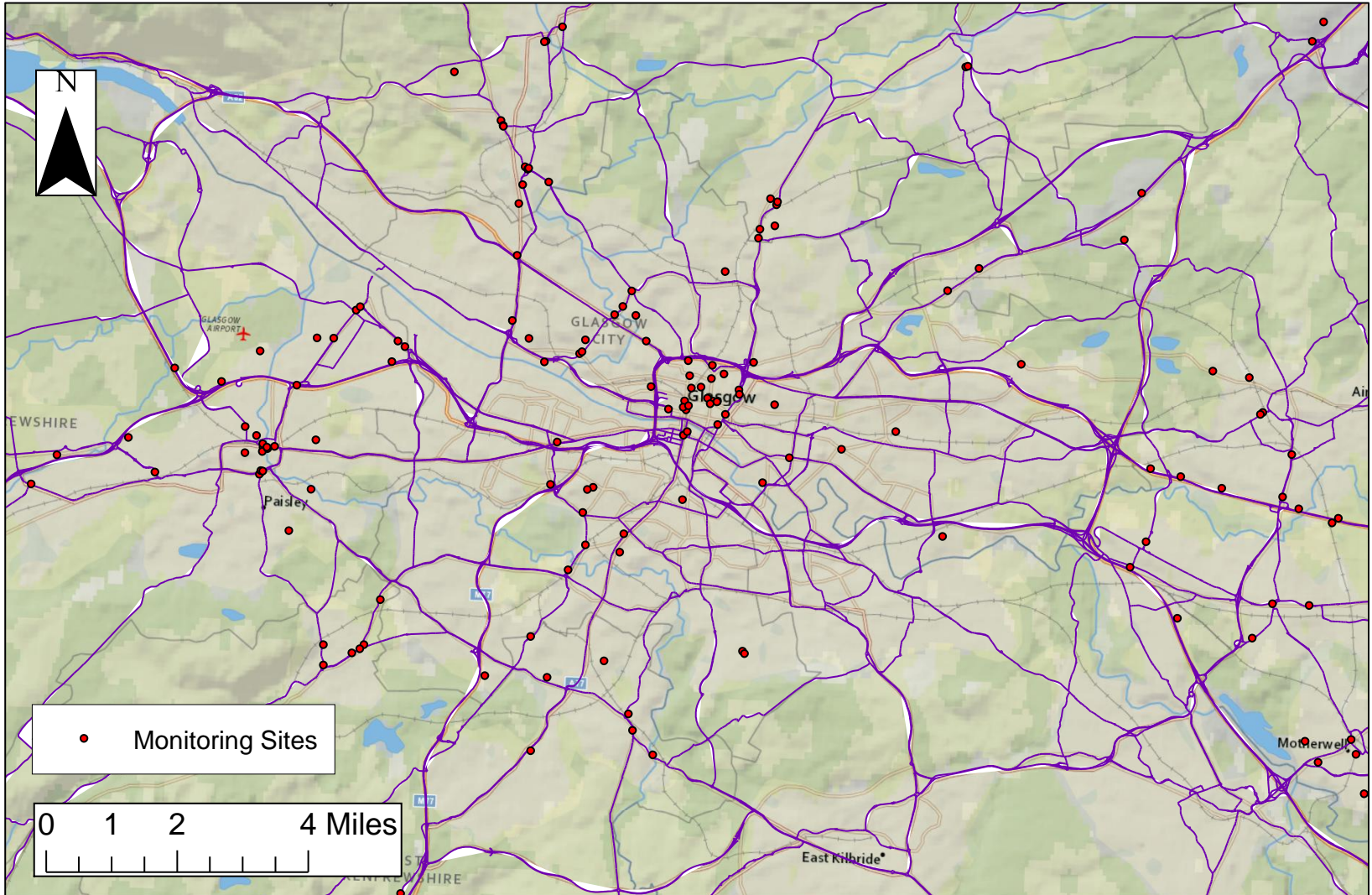


Extensively used in epidemiological studies

# Building and applying a Land Use Regression Model

1. Design monitoring network
  2. Measure pollutant
- 
- 5 Local Authority monitoring networks
  - 181 monitoring locations

# Monitoring Site Locations

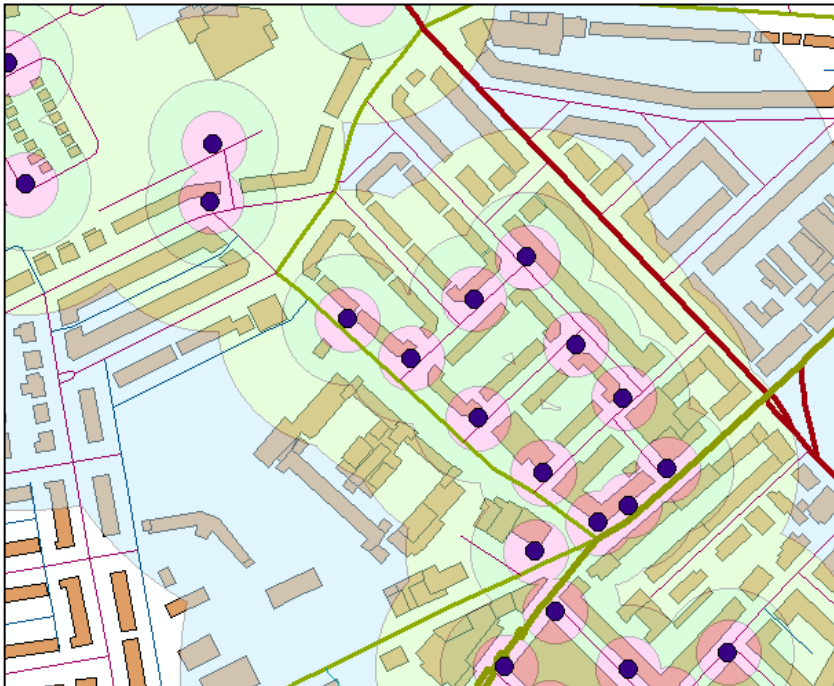


# Building and applying a Land Use Regression Model

1. Design monitoring network
  2. Measure pollutant
  3. Calculate proximal features in GIS
- 5 Local Authority monitoring networks
  - 181 monitoring locations

# Building and applying a Land Use Regression Model

1. Design monitoring network
  2. Measure pollutant
- 5 Local Authority monitoring networks
  - 181 monitoring locations
3. Calculate proximal features in GIS



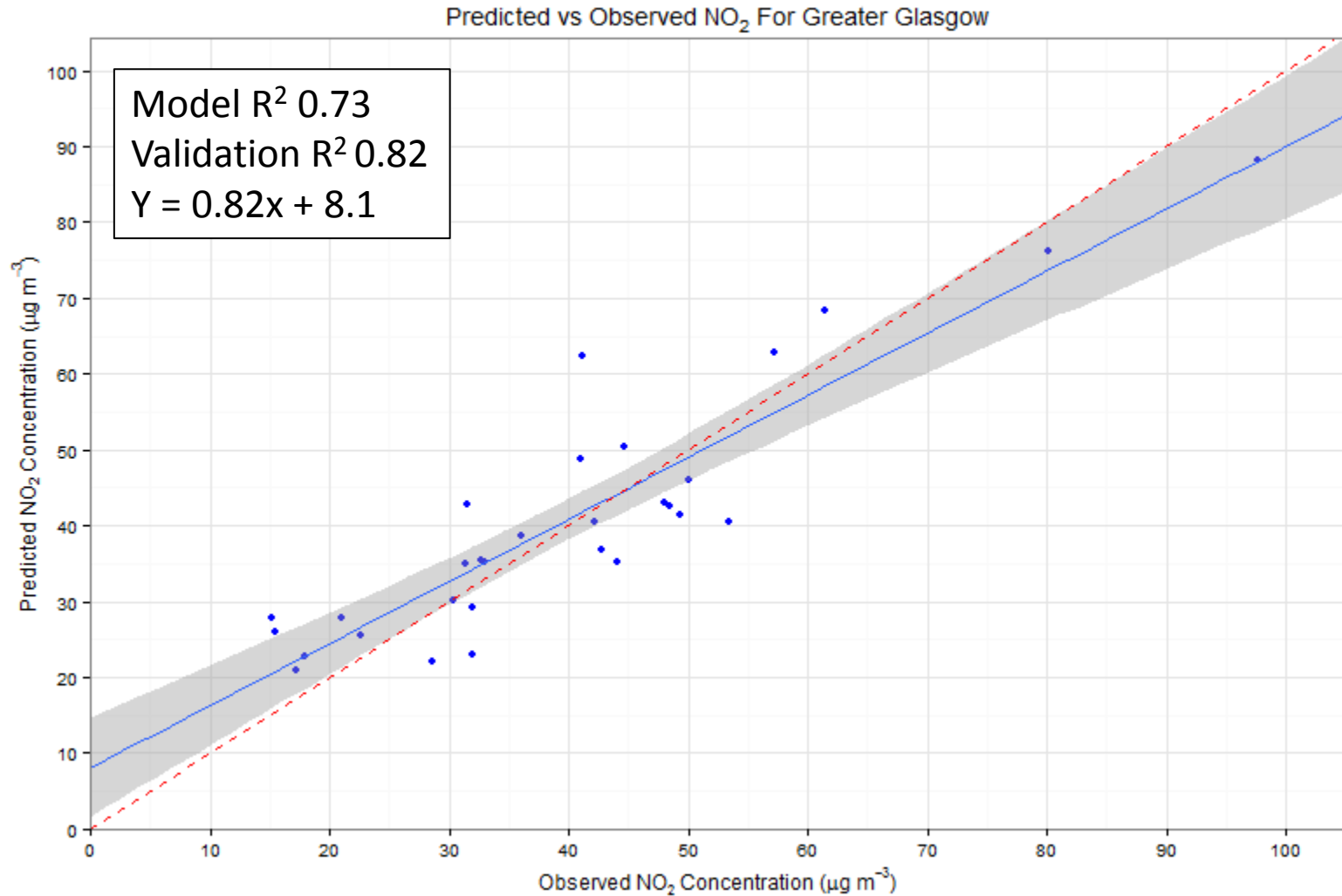
- Length of roads
- Traffic (HGV/Total Traffic)
- Influence of Buildings
- Population
- Altitude
- Land use class

# Building and applying a Land Use Regression Model

1. Design monitoring network
  2. Measure pollutant
  3. Calculate proximal features in GIS
  4. Perform linear regression
- 5 Local Authority monitoring networks
  - 181 monitoring locations



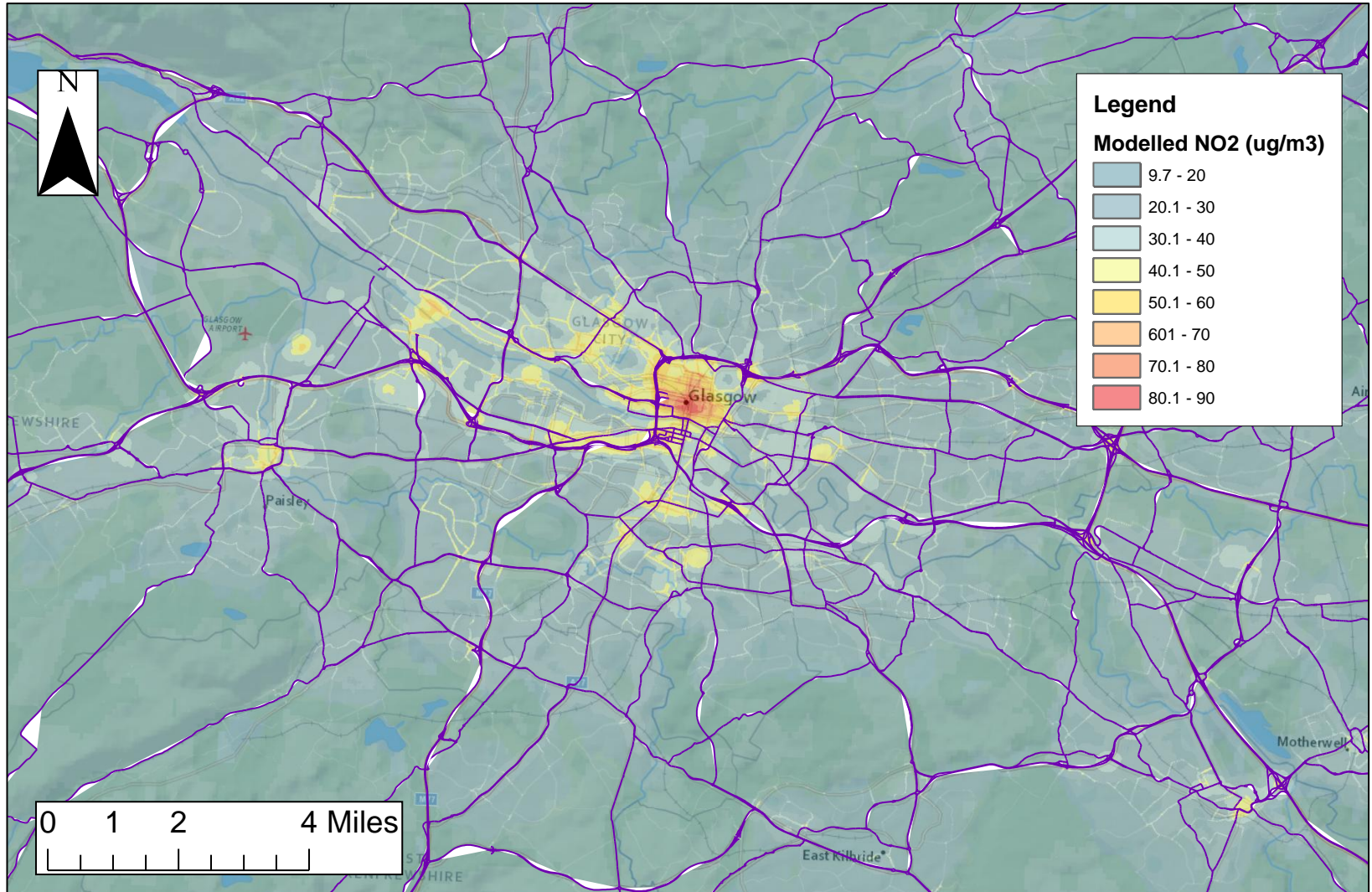
# Evaluation of Model on Hold-Out Data



# Building and applying a Land Use Regression Model

1. Design monitoring network
  2. Measure pollutant
  3. Calculate proximal features in GIS
  4. Perform linear regression
  5. Create pollution surface in GIS
- 5 Local Authority monitoring networks
  - 181 monitoring locations

# Modelled NO<sub>2</sub> Concentration in Greater Glasgow



# Building and applying a Land Use Regression Model

1. Design monitoring network
2. Measure pollutant
3. Calculate proximate features in GIS

4. Perform linear regression

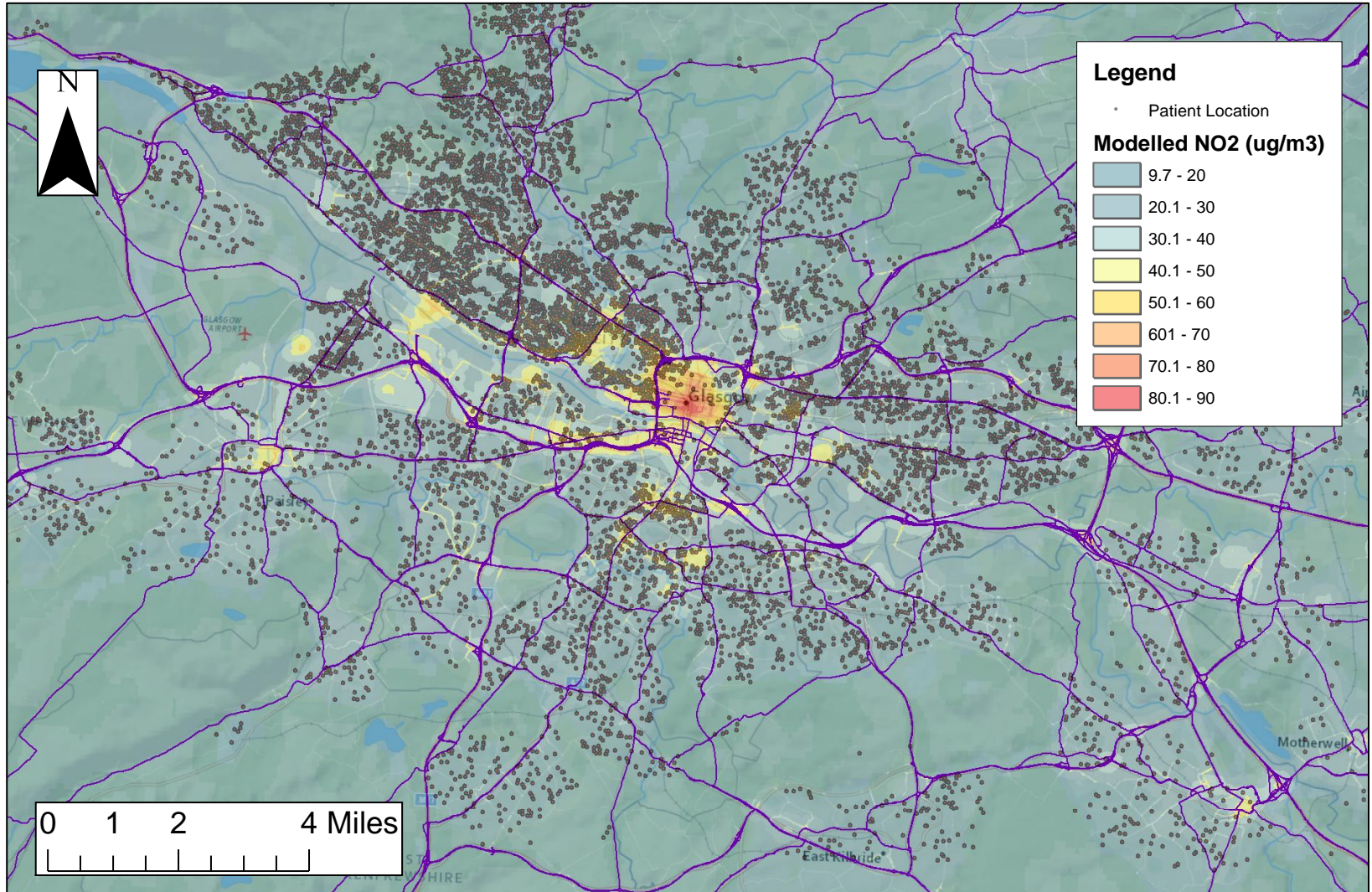
5. Create pollution surface

6. Geocode participant locations and estimate exposure

- Participant locations from Glasgow blood pressure clinic
- Health data available for follow up study

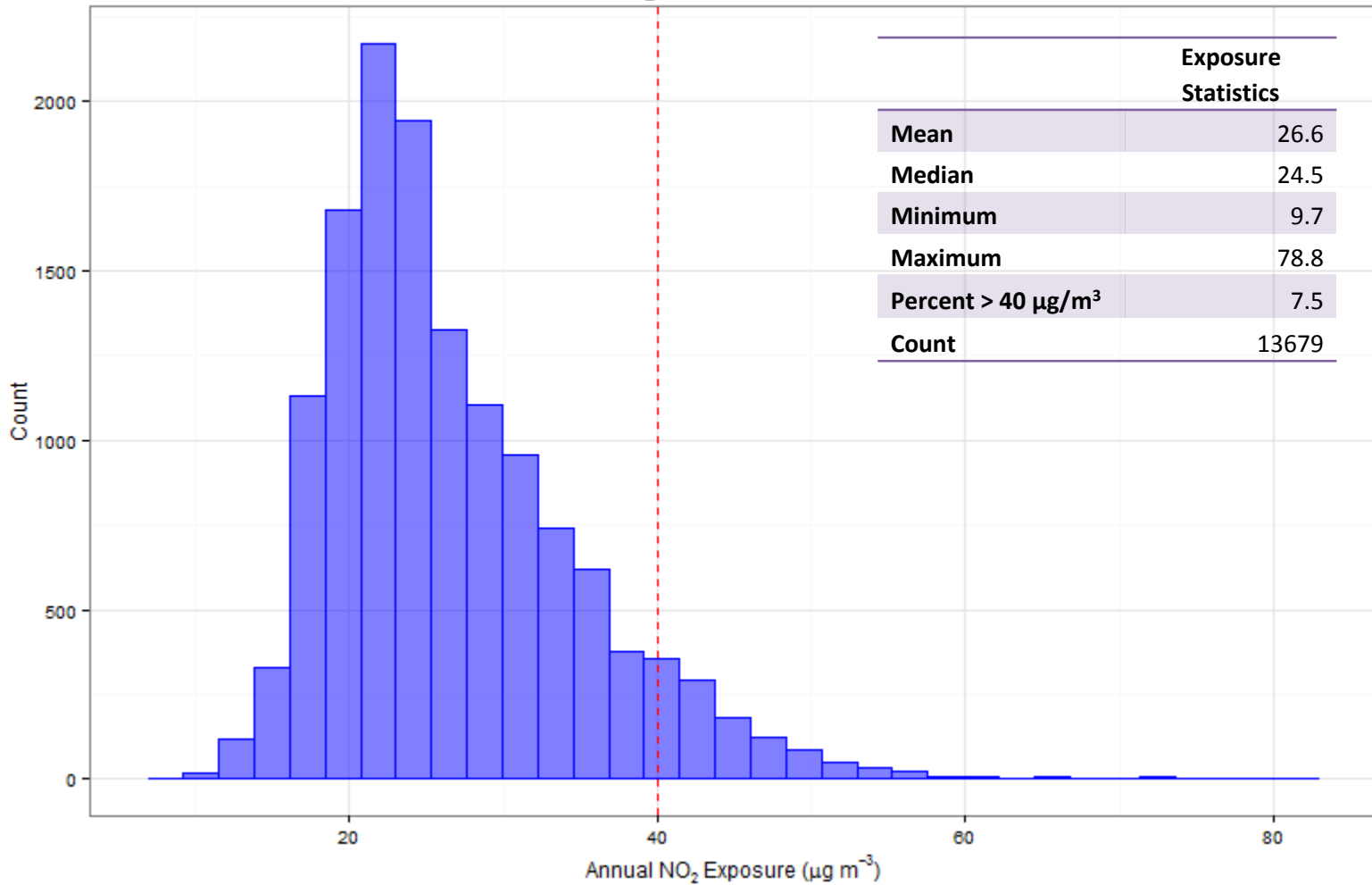


# Patient Distribution



# Exposure Estimation for Cohort

Histogram of Estimated NO<sub>2</sub> Exposure in Greater Glasgow Participants



# Model Limitations

- Networks designed and run by 5 local authorities
  - Sampling bias from preferential sampling – 25% background sites?
  - Accuracy of GPS coordinates?
  - Consistency of measurements
- Only annual average for single year
  - Extrapolation is possible
- Exposure assessment limited to outdoor exposure at the home
  - Personal exposure may differ

# Summary

- Developed a simple LUR model for Greater Glasgow based on Local Authority data
- Highest concentrations were found in City Centre and localised hotspots
- ~7 % of participants exposed to  $> 40 \mu\text{g m}^{-3} \text{NO}_2$
- Participant health statistics are available for follow up work



# Acknowledgments

- Dr Iain Beverland (University of Strathclyde)
- Dr Scott Hamilton (Ricardo-AEA)
- Professor Sandosh Padmanabhan (University of Glasgow)

**RICARDO-AEA**

