GIS methods: use and misuse

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What can GIS do in epidemiology and health risk assessment?

- Capture geographic data
- Integrate data into a common geographic form
- Provide a means for data validation & quality control
- Enable modelling of unmeasured characteristics
- Allow linkage or integration of models
- Provide a basis for health risk assessment

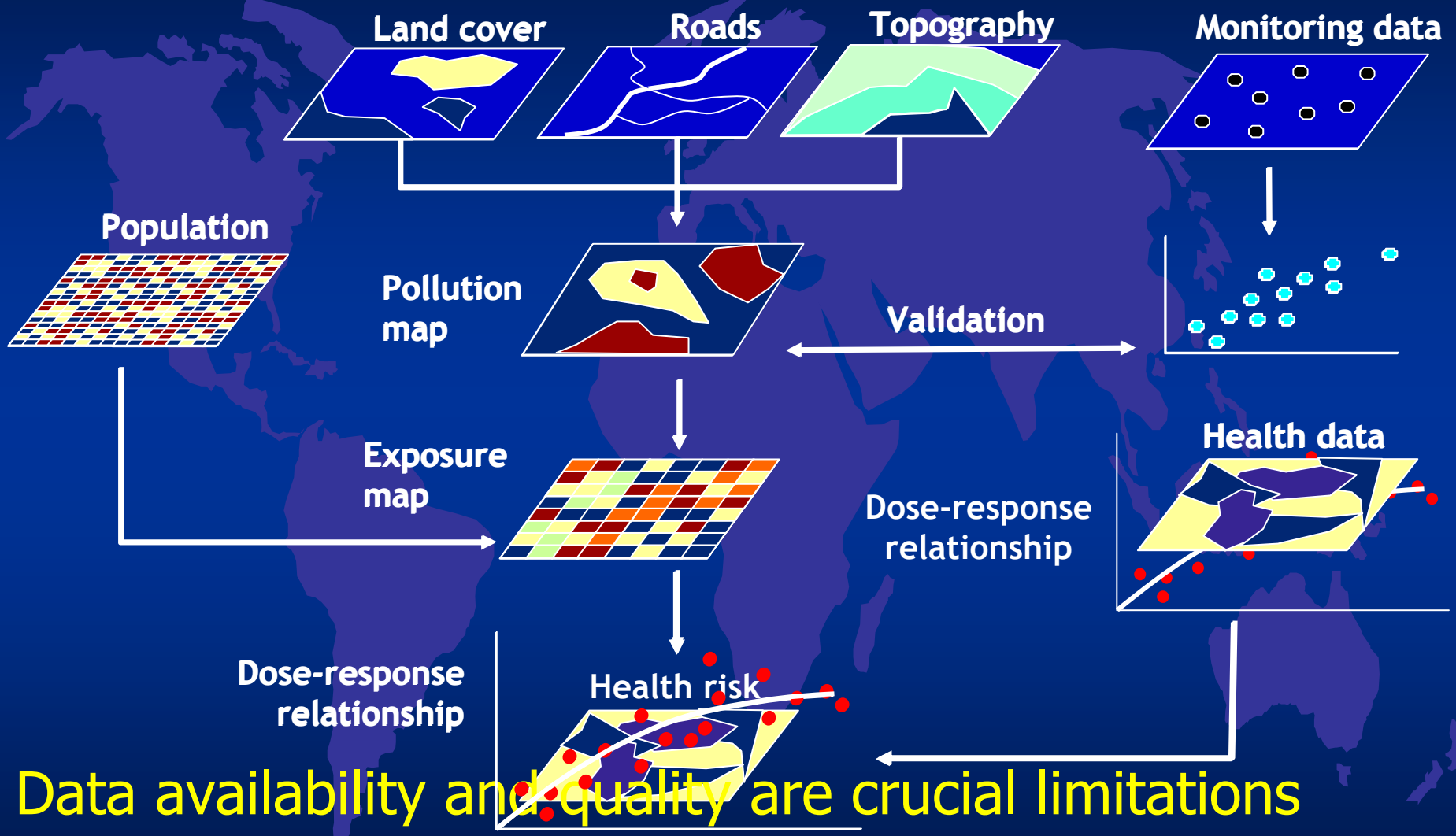
Geographical data

Geographical features can be represented as:

- Points (e.g. address locations, chimneys, pollution monitoring stations)
- Lines (e.g. roads, streams, disease vectors)
- Areas (e.g. administrative areas, land use zones, exposure zones)
  - Regular (grids) or irregular (polygon)
  - Uniform zones (single value) or gradient

Spatial representation is usually the decision of the analyst, not an inherent characteristic of the feature!

GIS and epidemiology



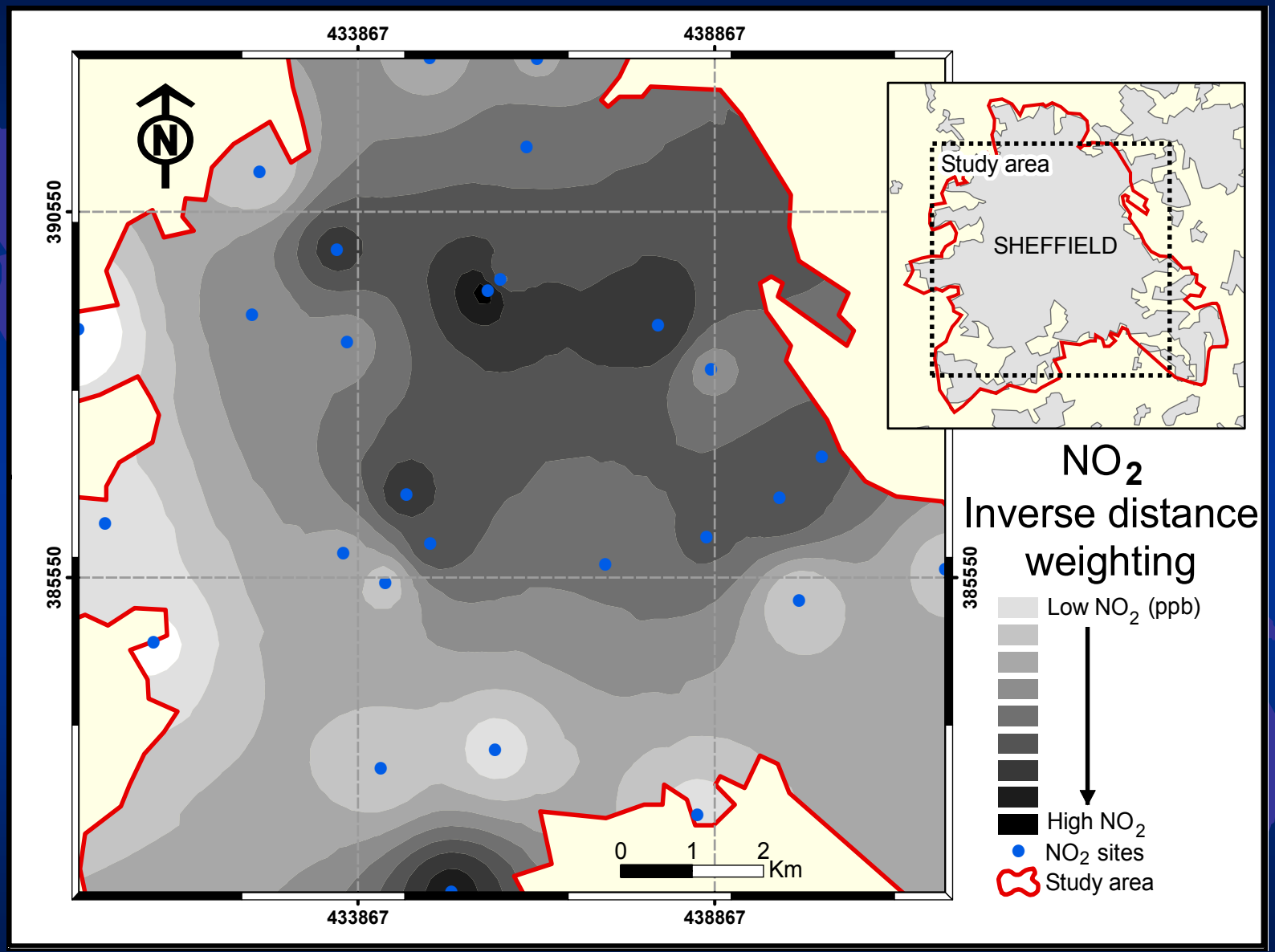
Data availability and quality are crucial limitations

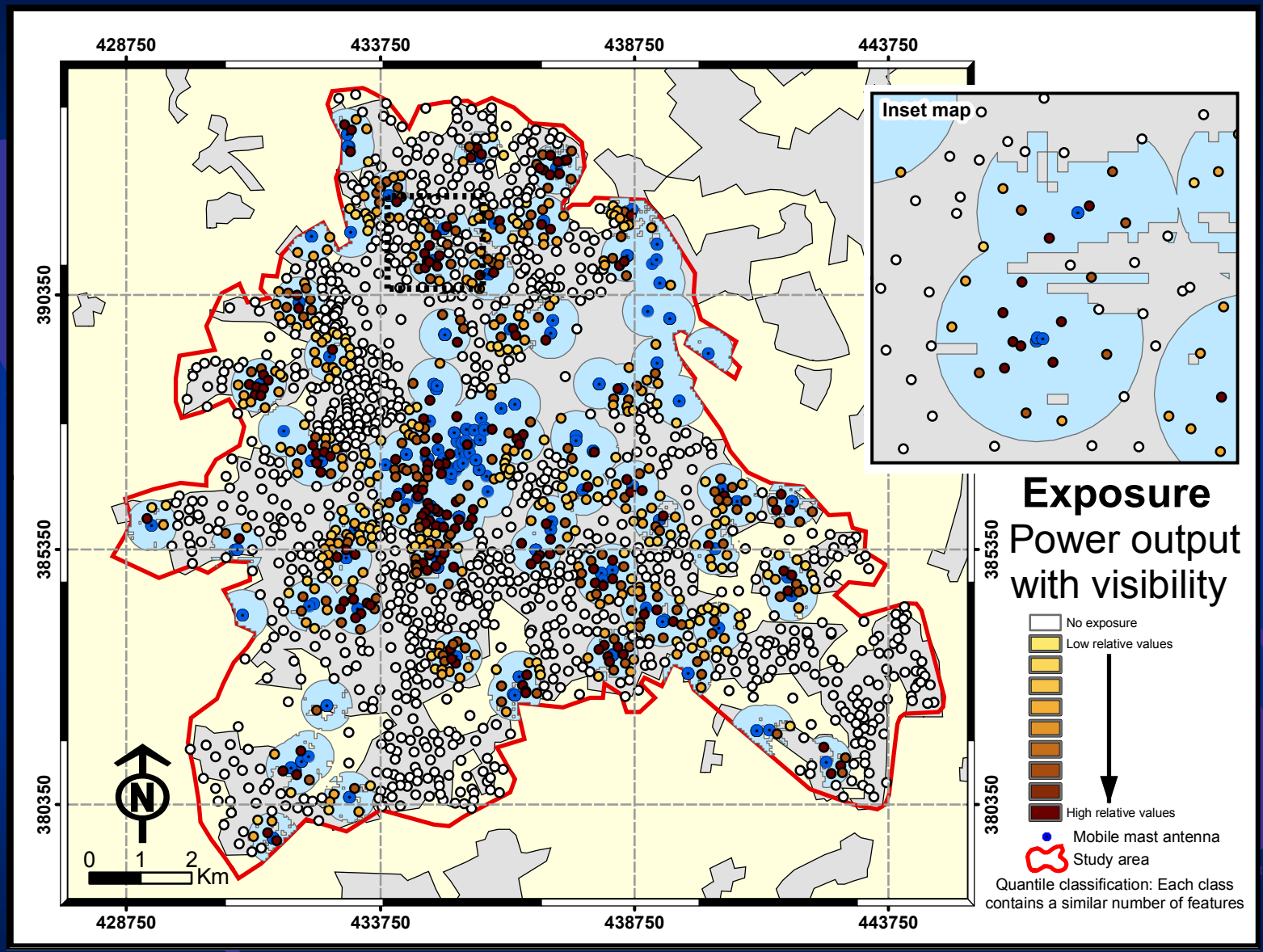
Designing valid geographical studies needs special care

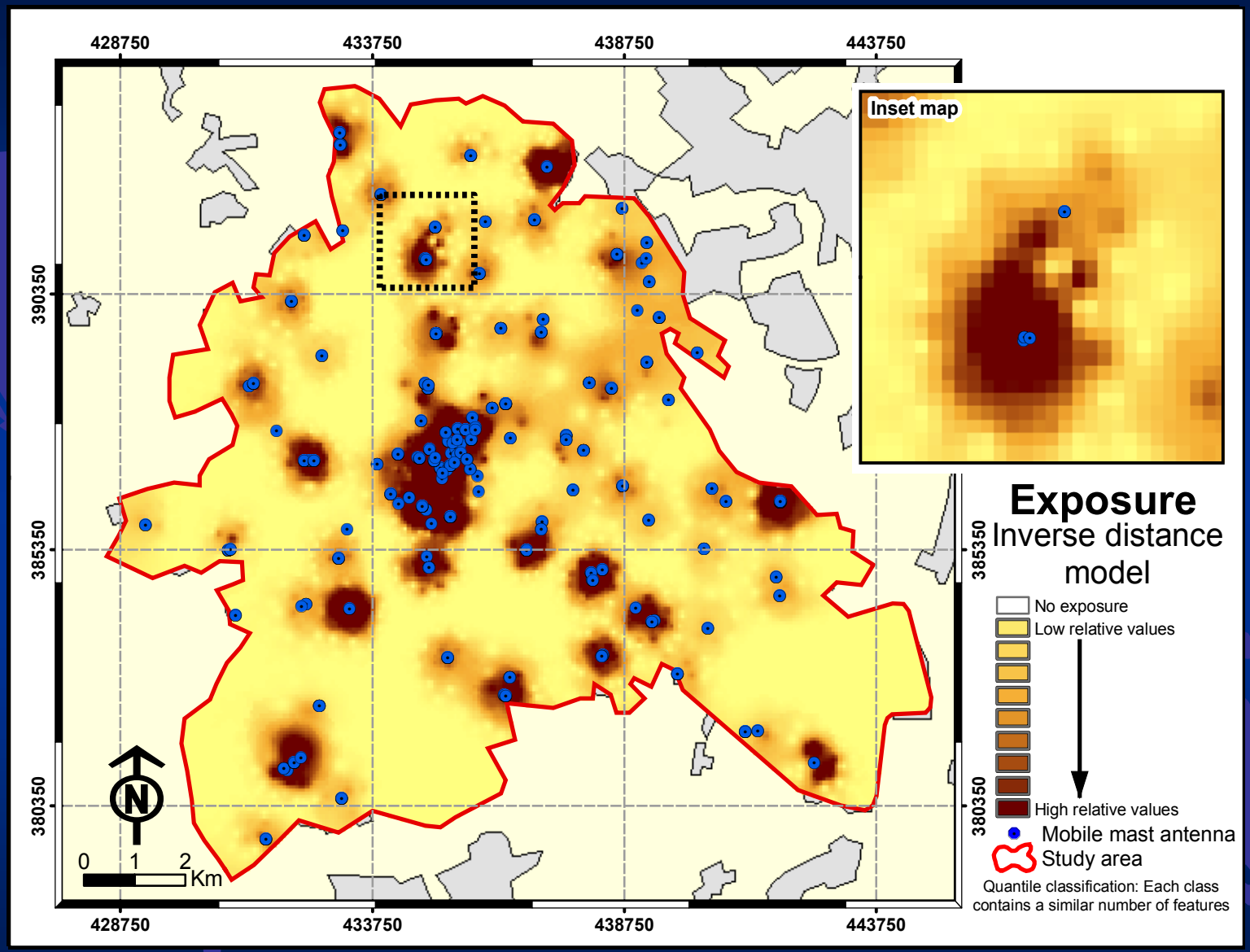
Exposure assessment with GIS

Approach	Description
Overlay	Overlay of e.g. pollution map onto population
Interpolation	Prediction at unsampled locations on basis of measured values in surrounding/nearby areas
Covariate	Prediction at unsampled locations on the basis of relevant covariates for those locations
Dynamic	Prediction of exposures for individuals/groups including time-space variations in pollution & the distribution (or time-activity) of exposed populations

Tobler's first law of geography:
All things are related to everything else, but near things are more related than those far apart


433867
438867
390550
385550
N
Study area
SHEFFIELD
NO_2
Inverse distance weighting
Low NO_2 (ppb)
High NO_2
NO_2 sites
Study area
0 1 2 Km


428750
433750
438750
443750
390350
385350
380350
Inset map
Exposure
Power output with visibility
No exposure
Low relative values
High relative values
Mobile mast antenna
Study area
Quantile classification: Each class contains a similar number of features
N
0 1 2 Km



$$G\left(d_{ij(500)},\theta_{ij} \mid d_{\max,j},\sigma_j,\phi_j^l,\phi_j^u\right)=\frac{1}{\sigma_j \cdot d_{ij(500)}\sqrt{Pvis.}\sqrt{\sum_{j-1}^{n}\pi}Pout_j w_j t_j}\cdot\exp\left[-\frac{\left(\ln[d_{ij(500)}]-\ln[d_{\max,j}]-\sigma_j^{\,2}\right)^2}{2\cdot\sigma_j^{\,2}}\right]\cdot 1_{\{\phi_j^u \le \theta_{ij} \le \phi_j^l\}}$$

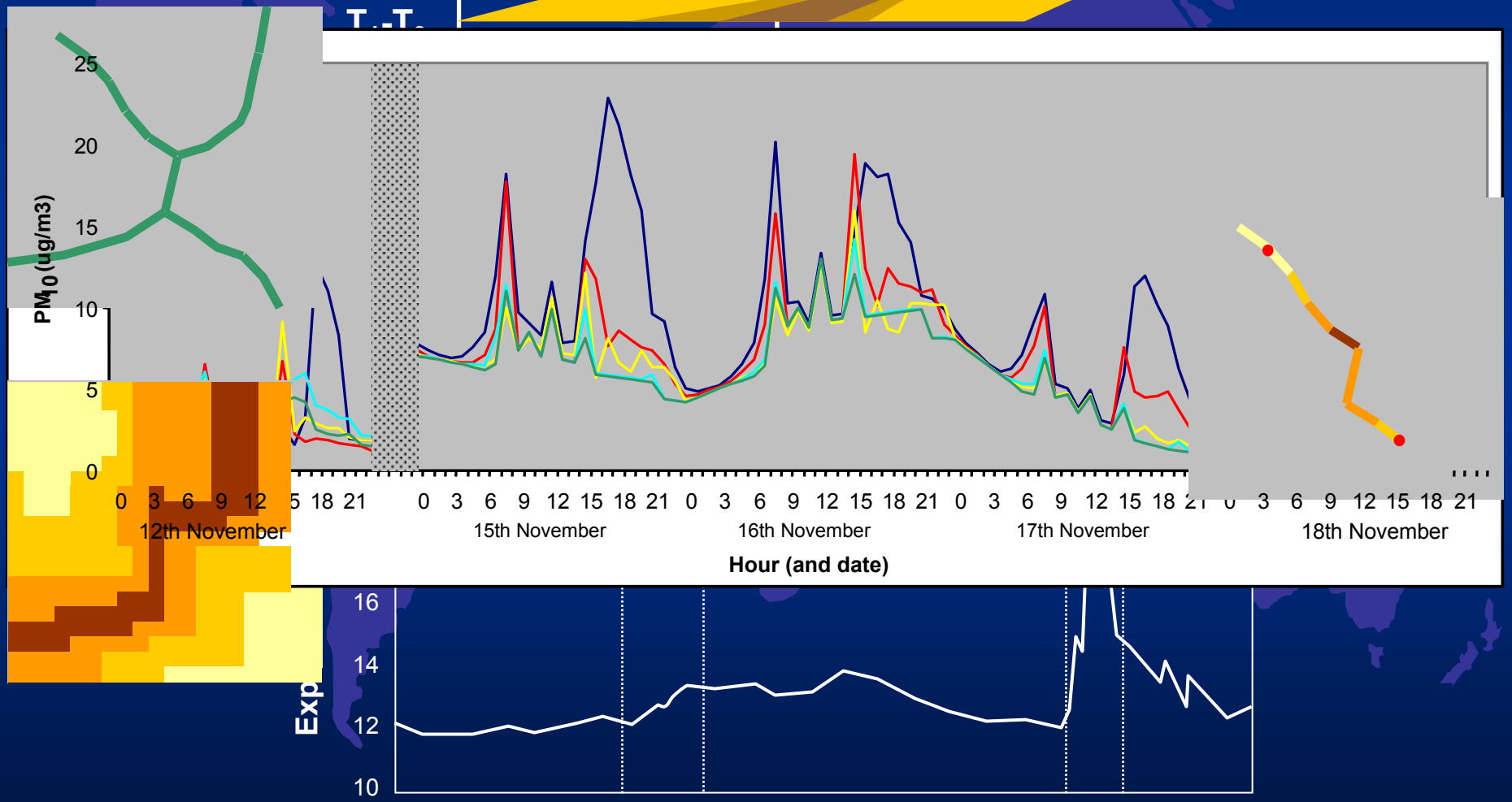
Selected modelled exposure profiles

1. Select route type and pollution surface

2. Intersect routes with pollution surface

3. Select start / end locations and assign to network

4. Extract route



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GIS offers many methods and techniques

But…

It is important to consider the approach!

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