



Multi-Layer Multi-Class Dasymmetric
--- Reconstructing population Distribution
from Aggregated Population Data

MeiChun Lin, MingDaw Su

National Taiwan University



Population Distribution Pattern

- *Regional planning and management*
 - *Land use zoning and planning*
- *Infrastructure planning*
 - *Education, security, public health, transportation,*
- *Accessibility and Social equity*
- *And a lot more*





Population Data

■ *Census*

➤ *Individual data*

- ✓ *Privacy concern*

➤ *Aggregated data*

- ✓ *Unit may be too large*

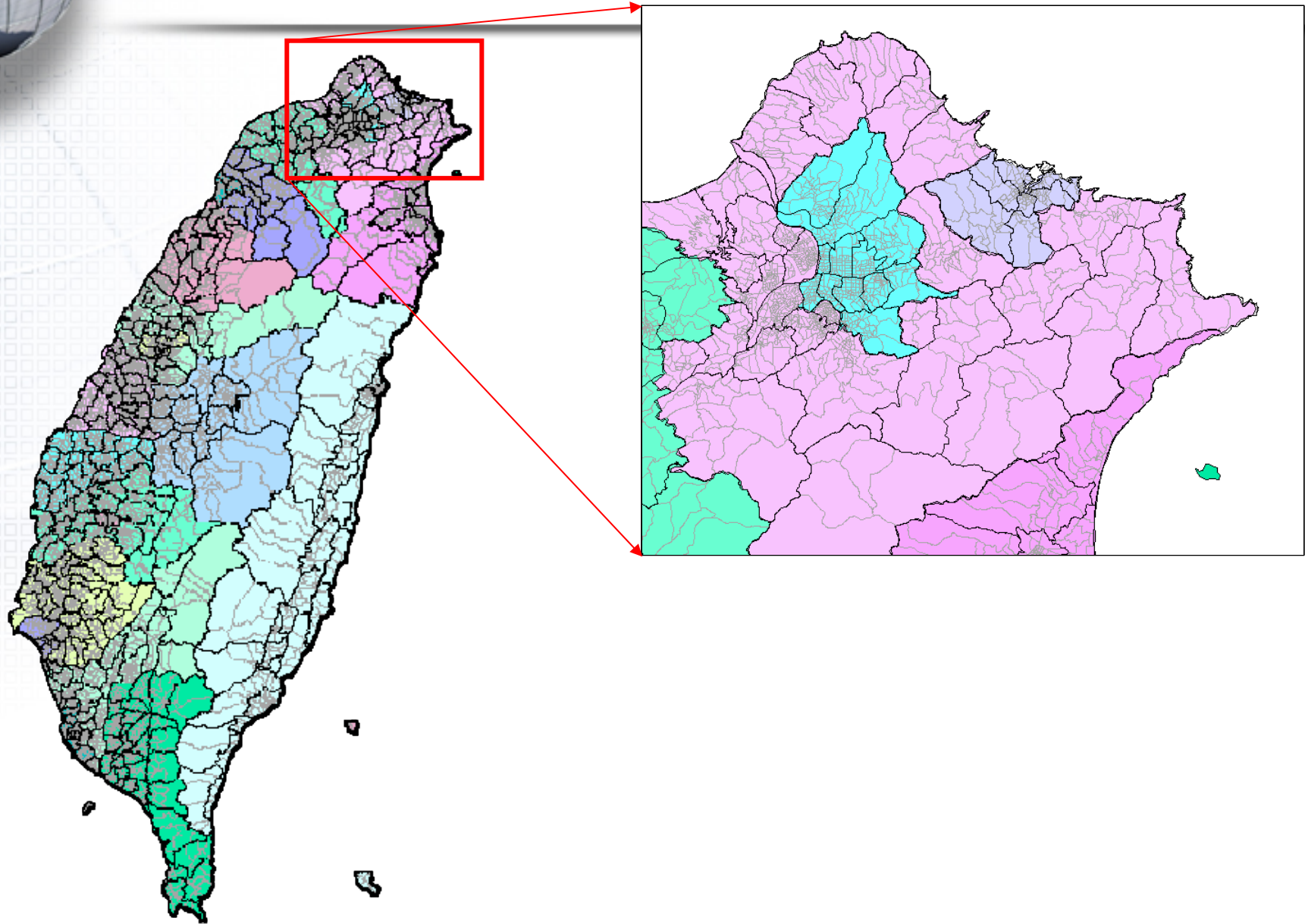
- *MAUP*

- ✓ *The boundary may change over time*

- *Difficult to do temporal study*

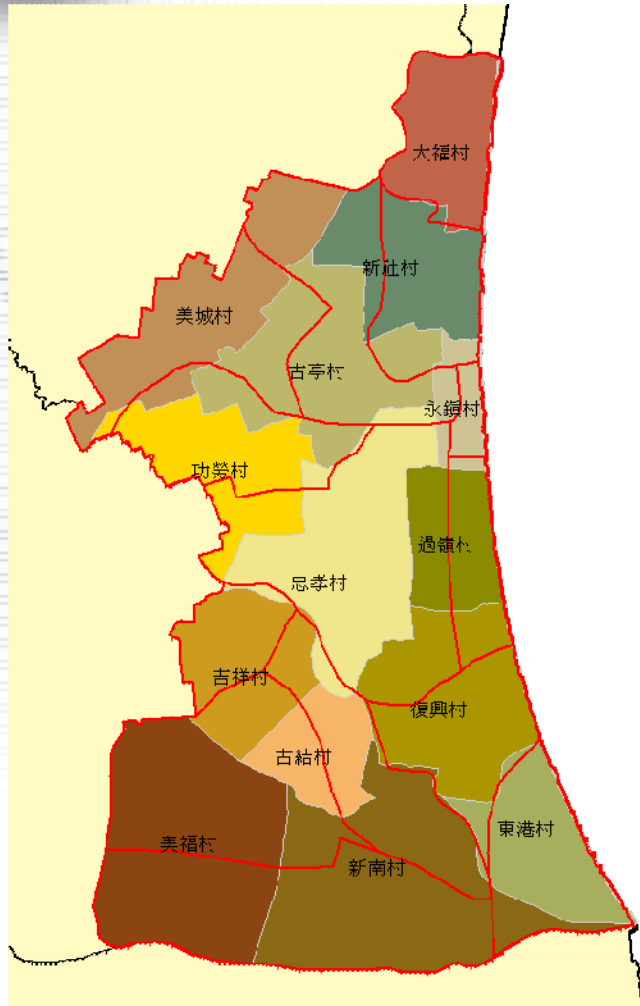


Geo-political units

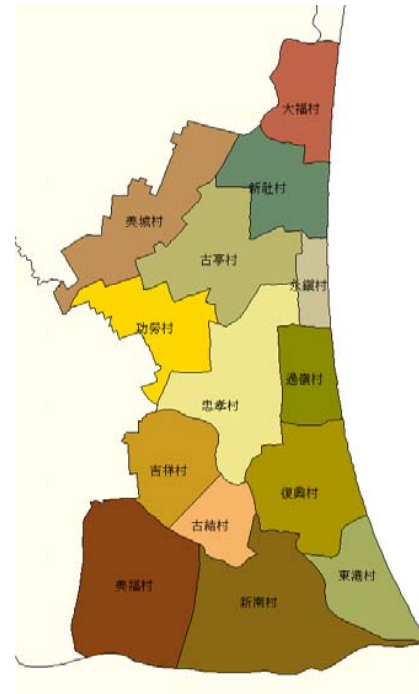




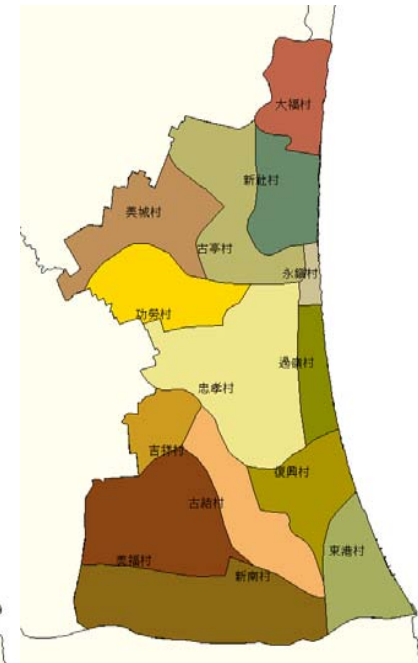
Boundary change



2004



1990



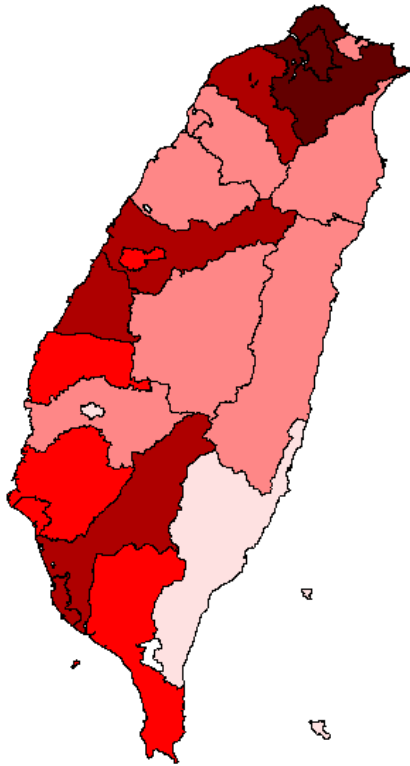
2004



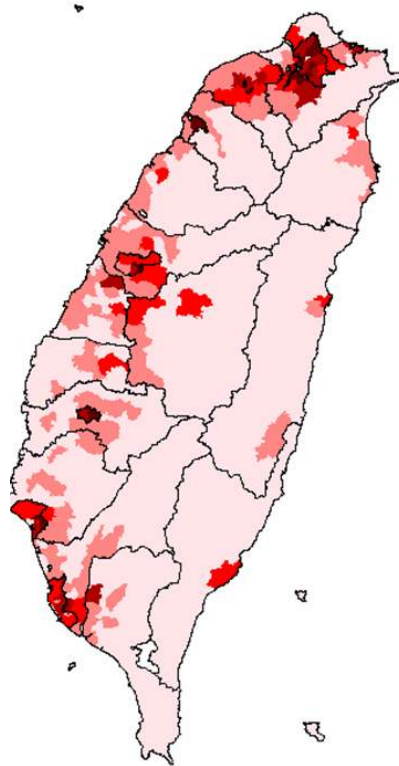
Modifiable Area Unit Problem (MAUP)

-- Spatial homogeneity / heterogeneity

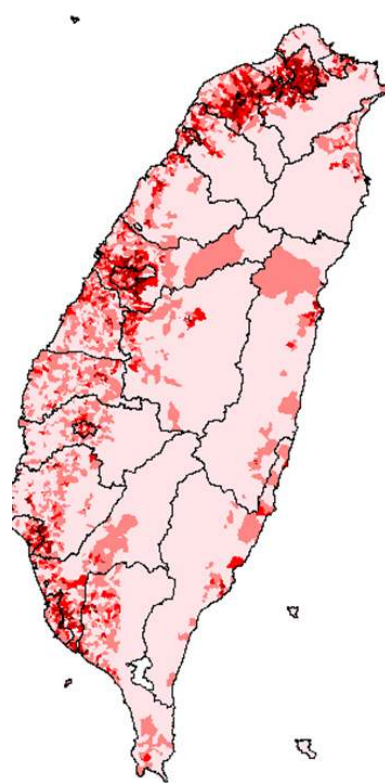
Population of Taiwan



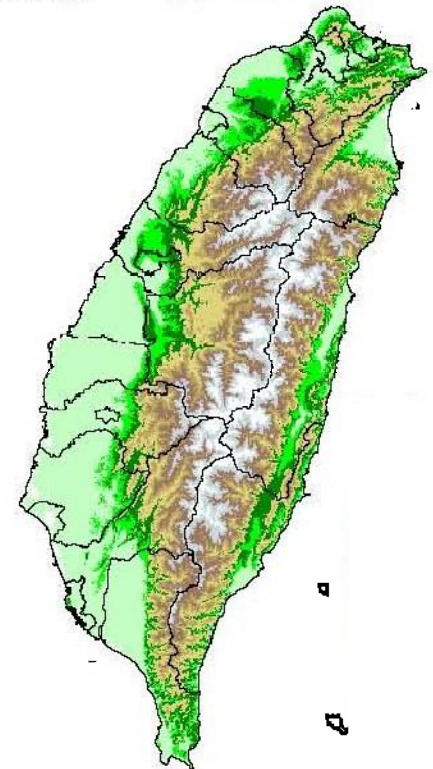
County



Township



Village



DTM

Choropleth Mapping

*Original data
(individuals
living in households)*

2	4	6	1
3	6	3	5
1	5	4	2
5	4	5	4

Village

Zoning

Township

3	3.5
4.5	4
3	3
4.5	4.5

2.5	5	3
	4.5	
	4.5	
3	4.5	3

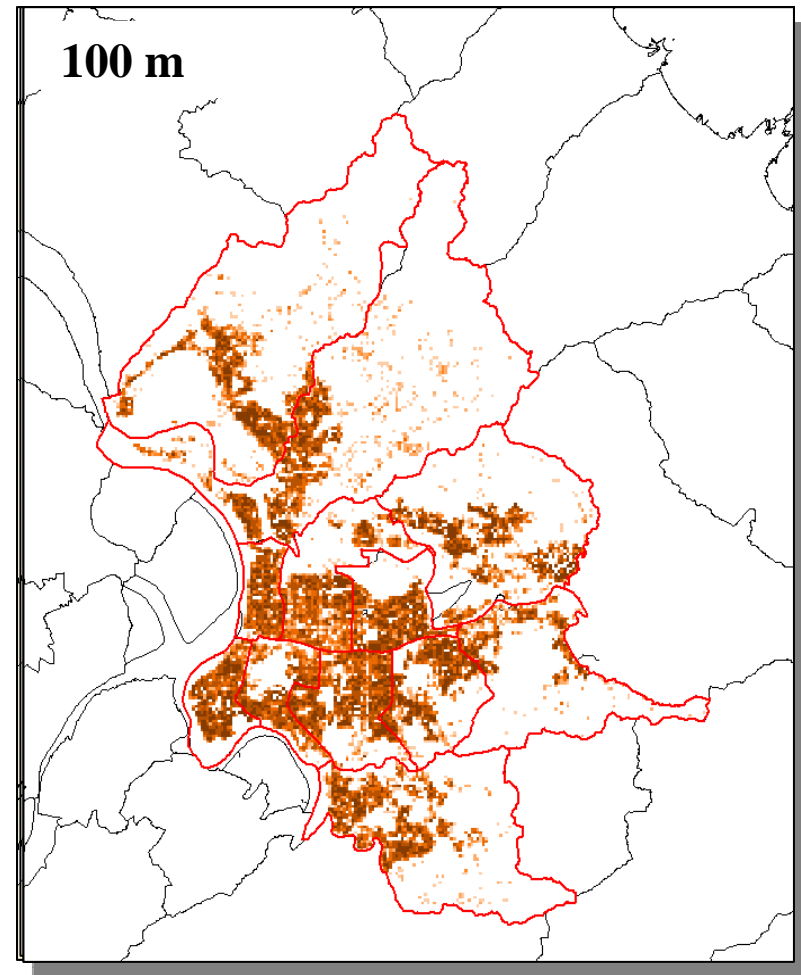
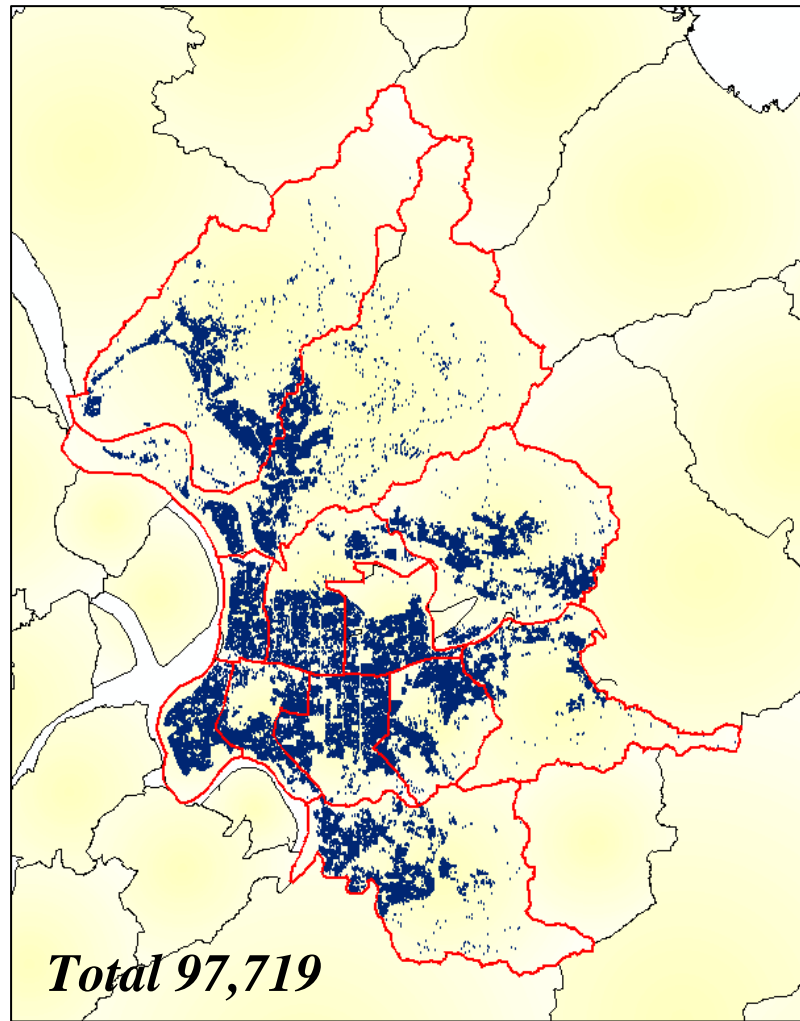
County

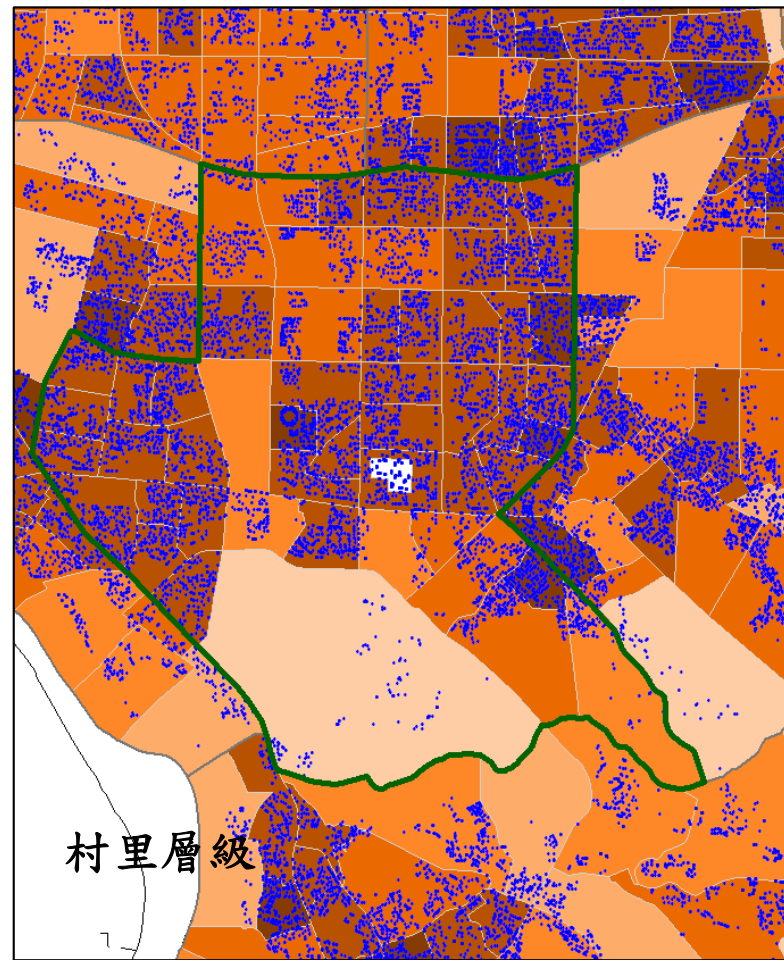
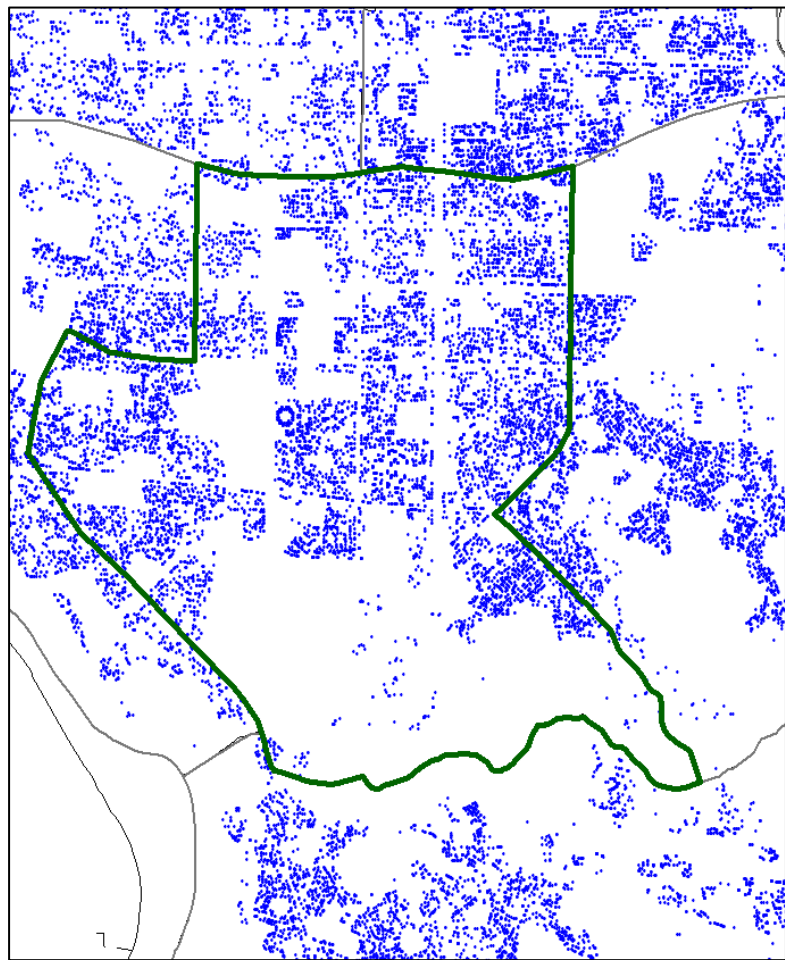
3.75	3.75
3.75	3.75

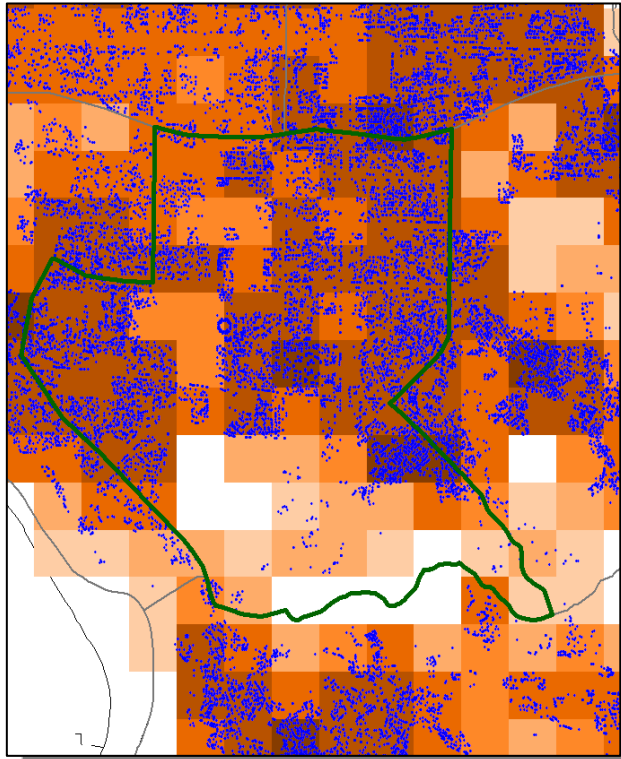
4	1
4	3.7

Scaling

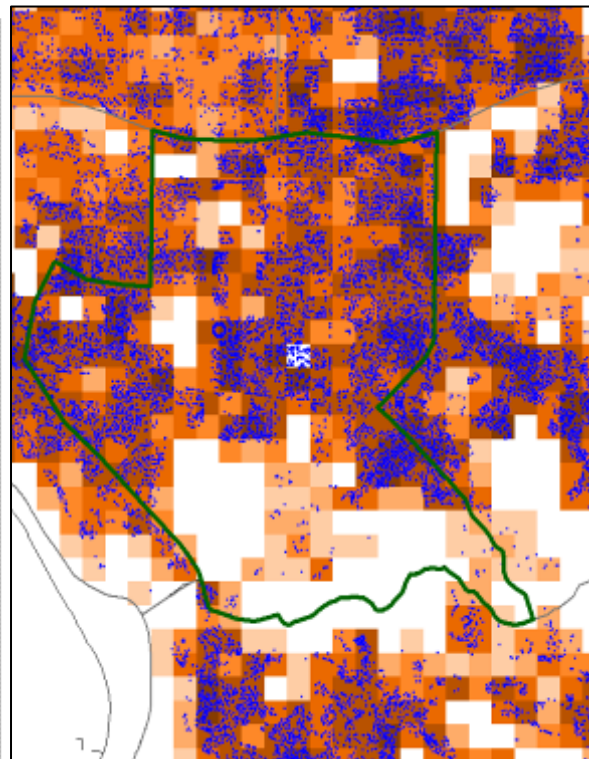
High school Students (Taipei)



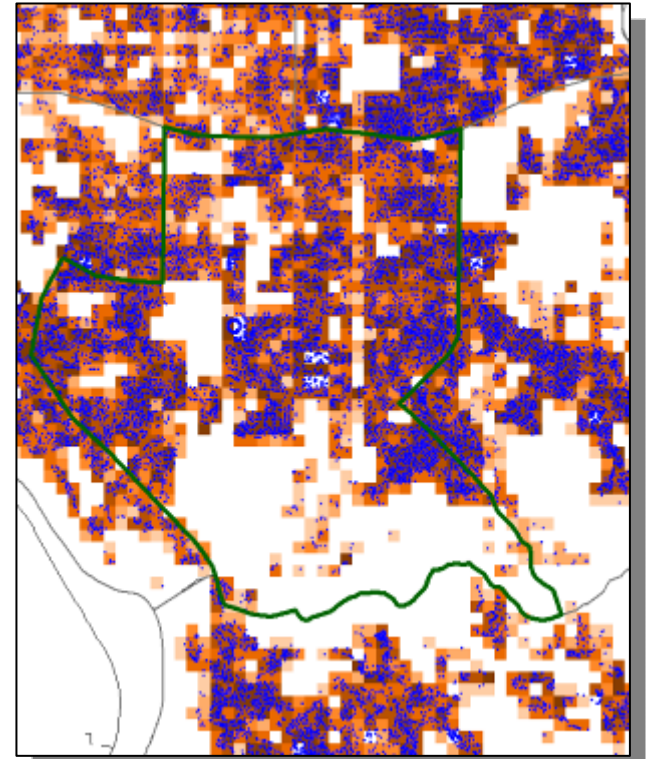




400米網格



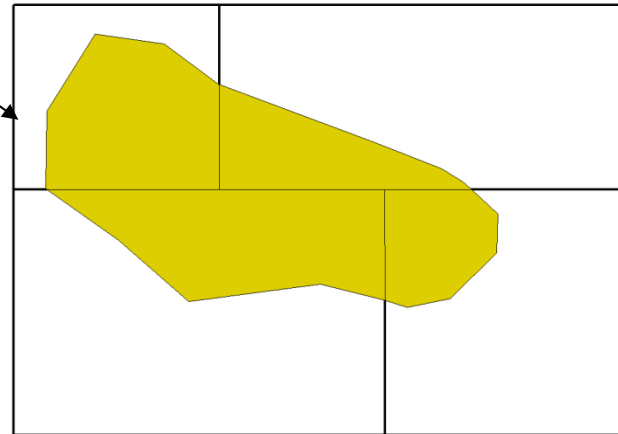
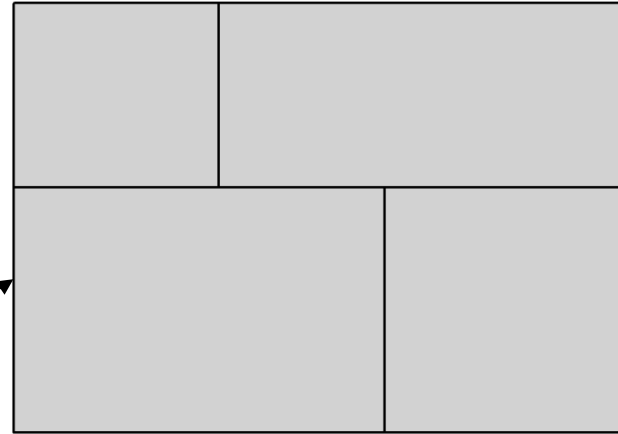
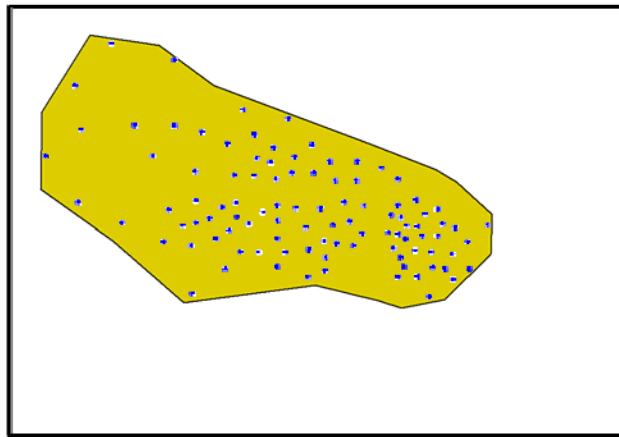
200米網格



100米網格

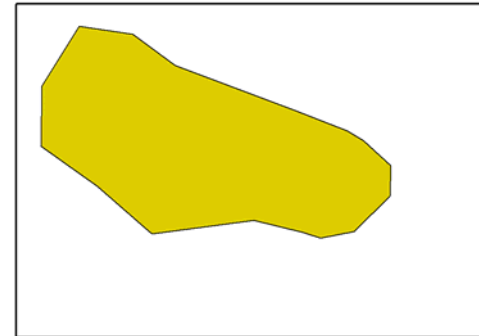


Dasymetric Mapping

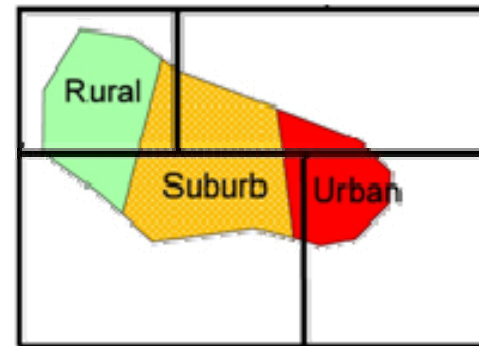




Multiclass Dasymetric



Populated



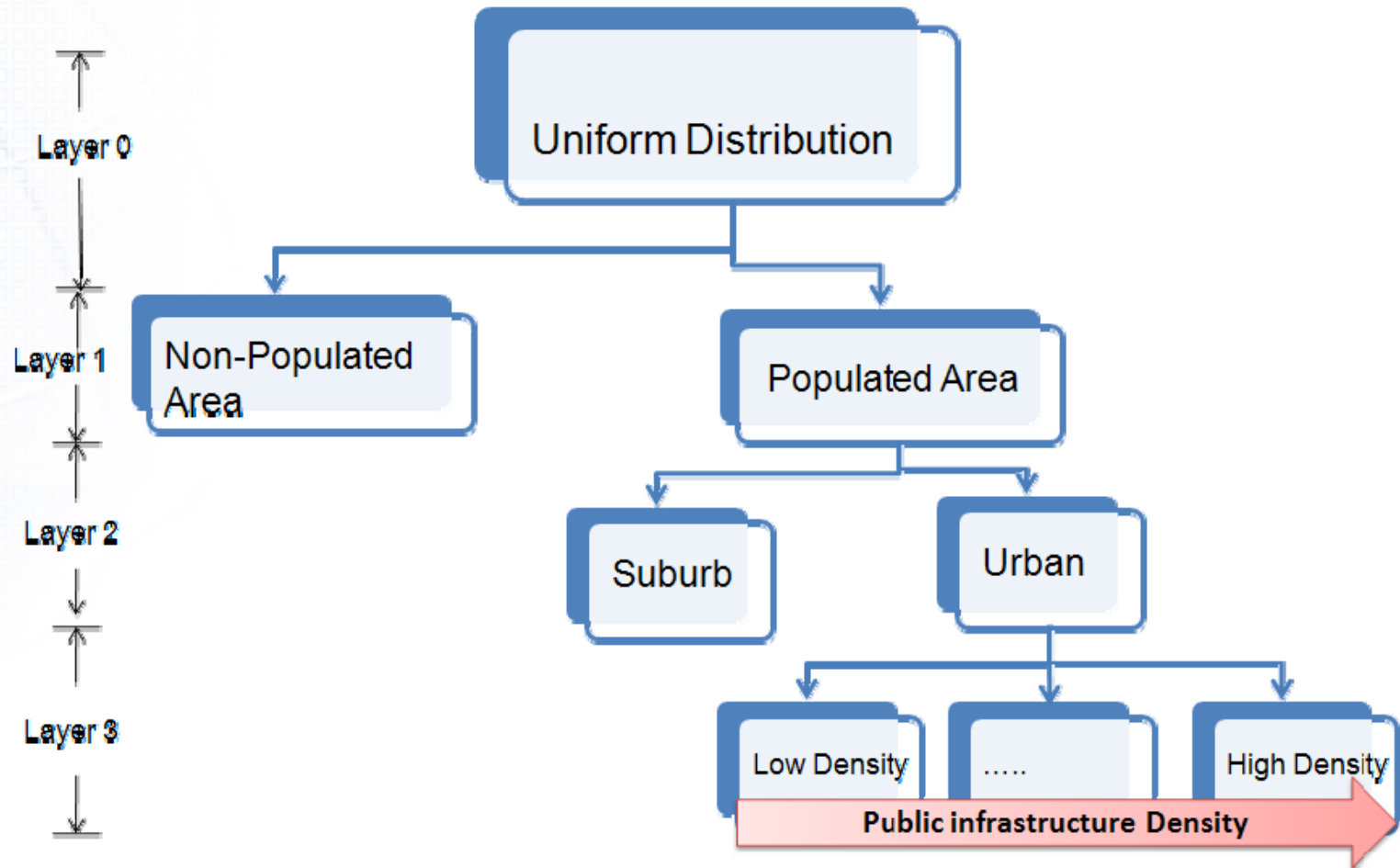
Land use



Accessibility



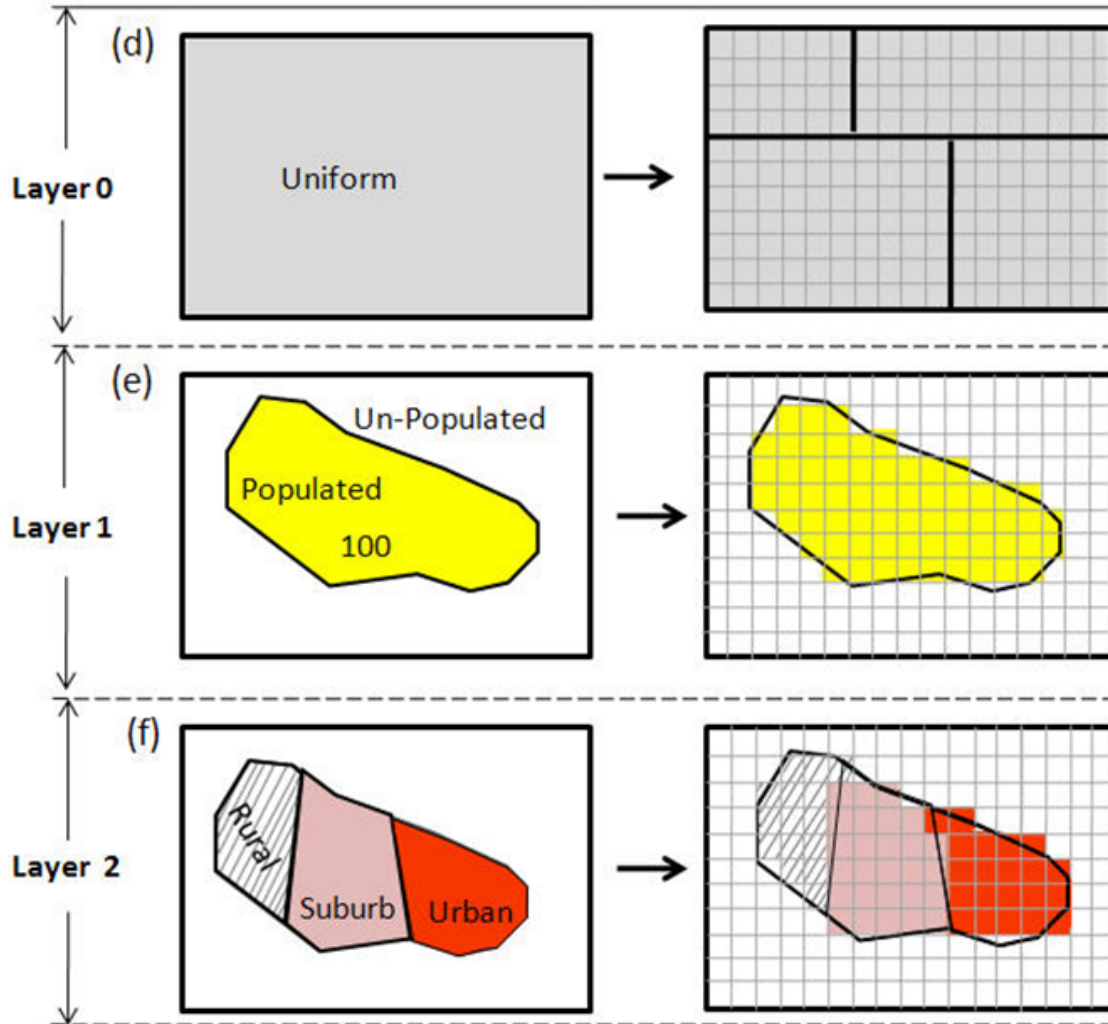
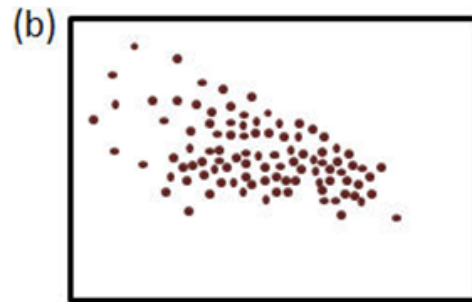
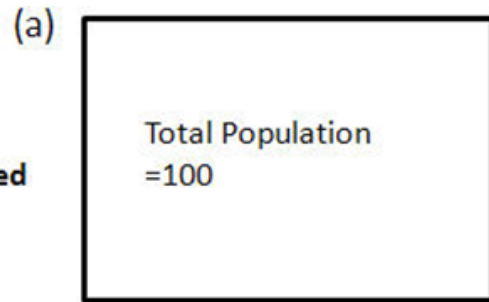
Multilayer-Multiclass Dasymetric



Progressive Framework

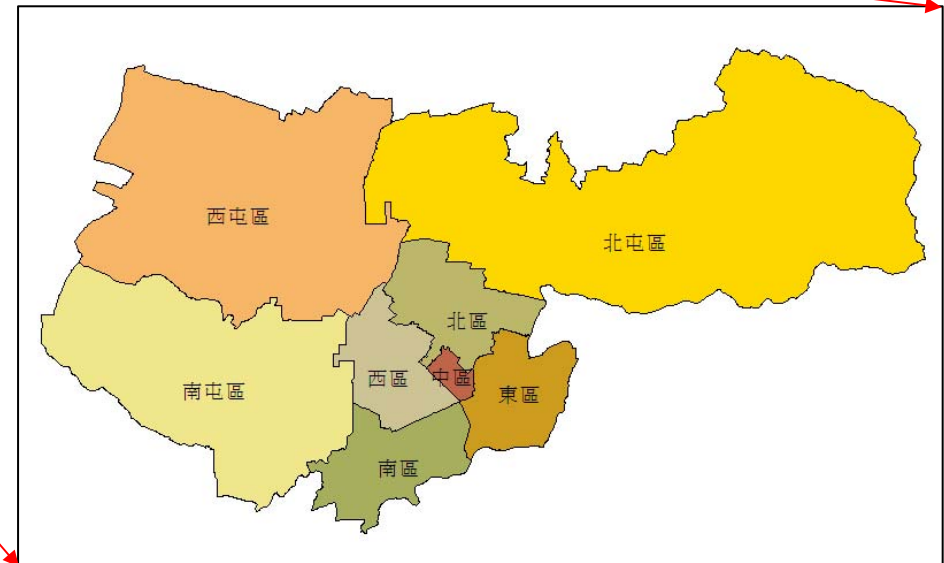
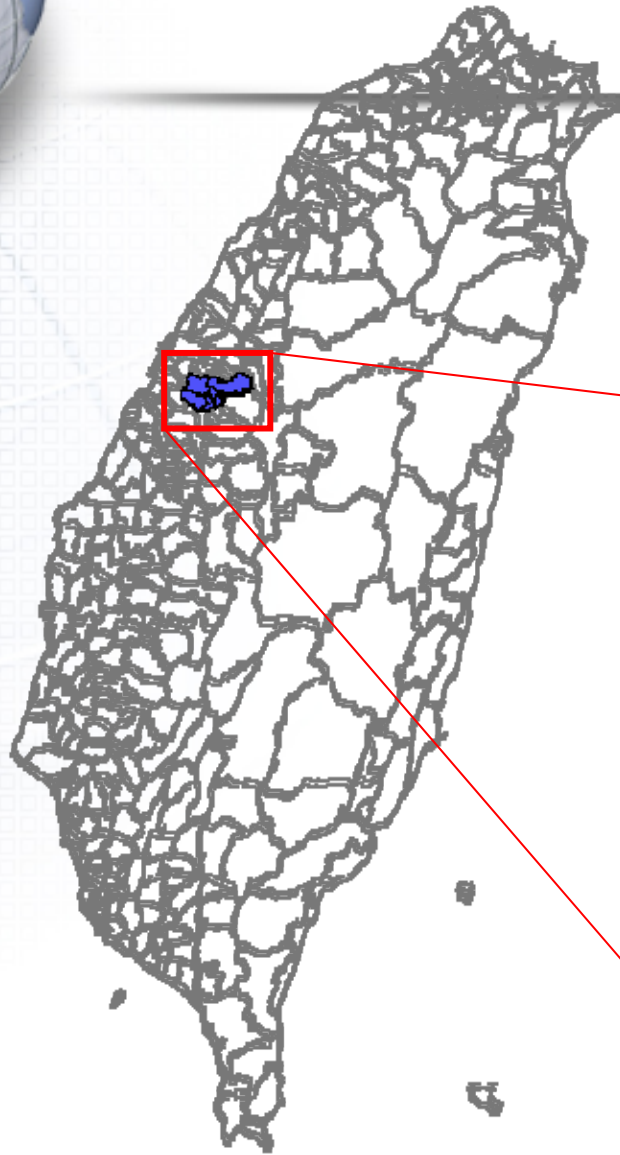


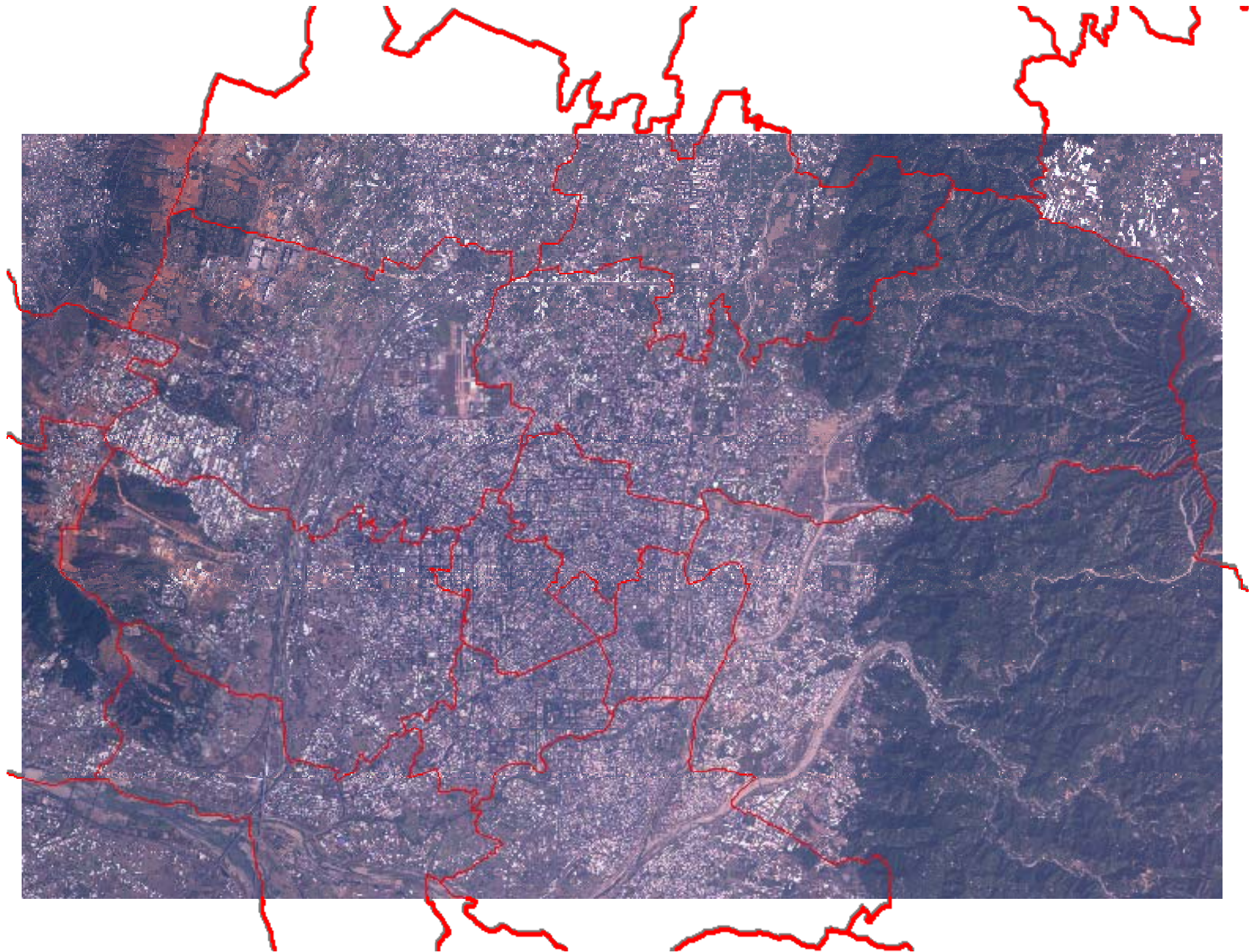
Published data



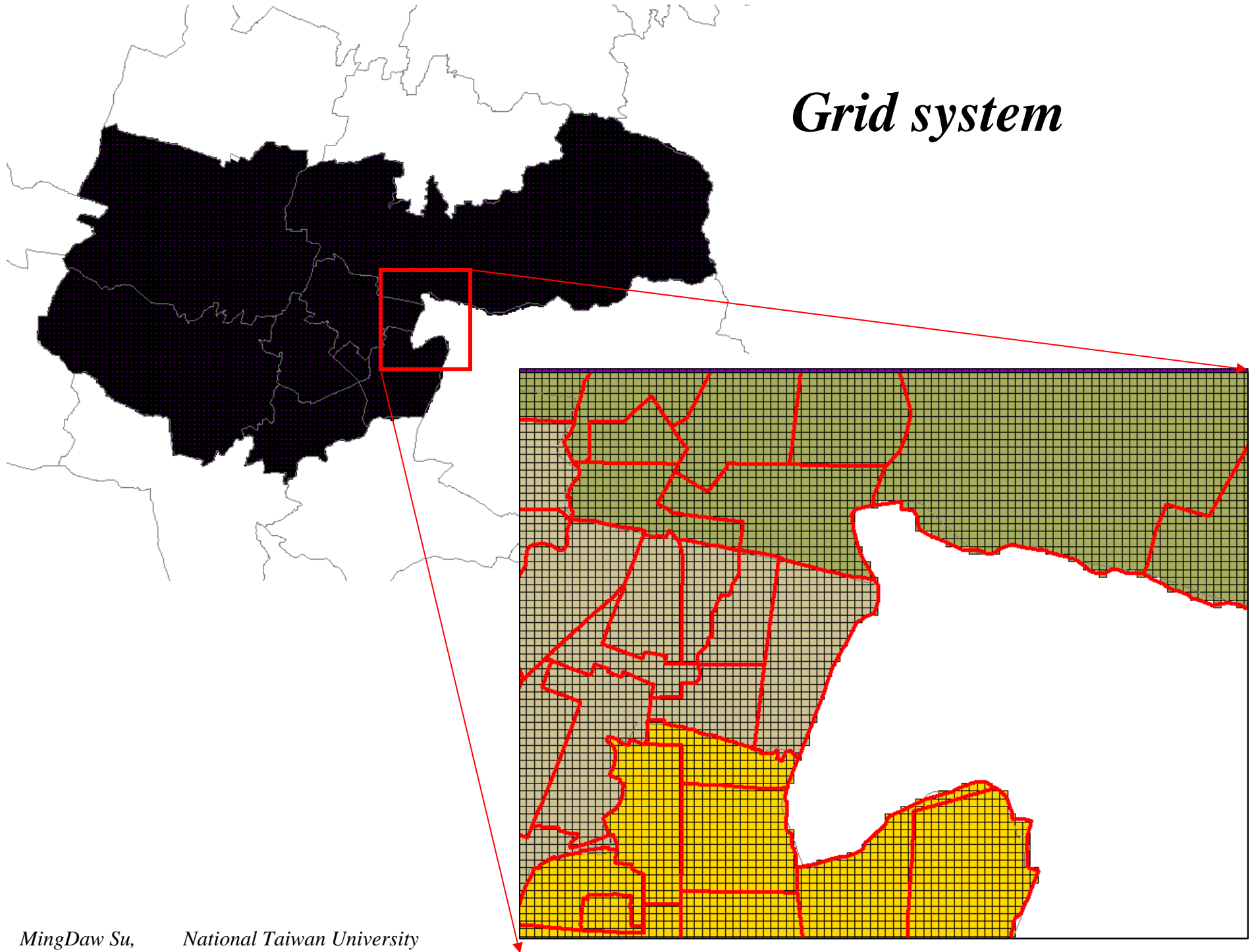


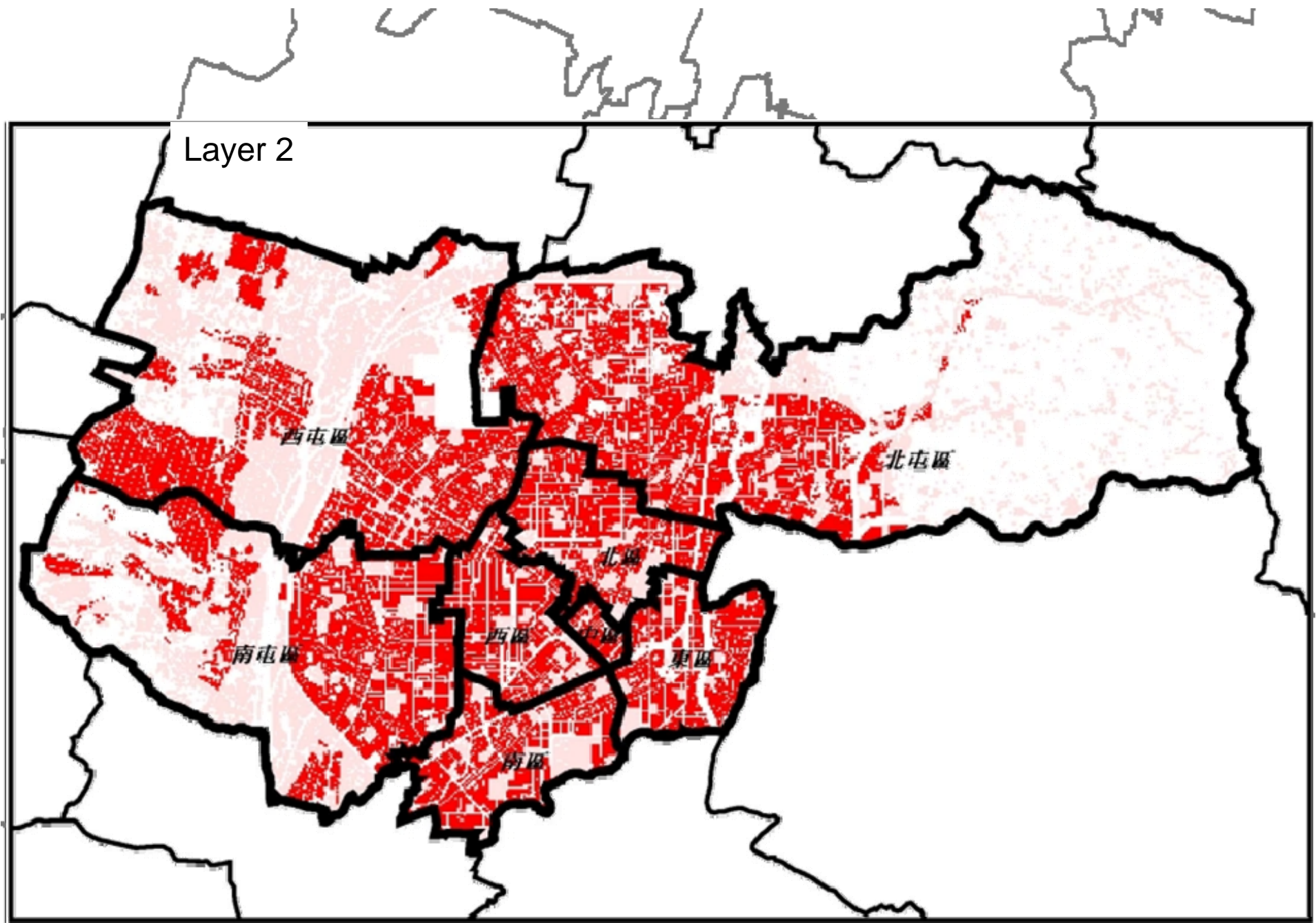
TaiChung City, Taiwan

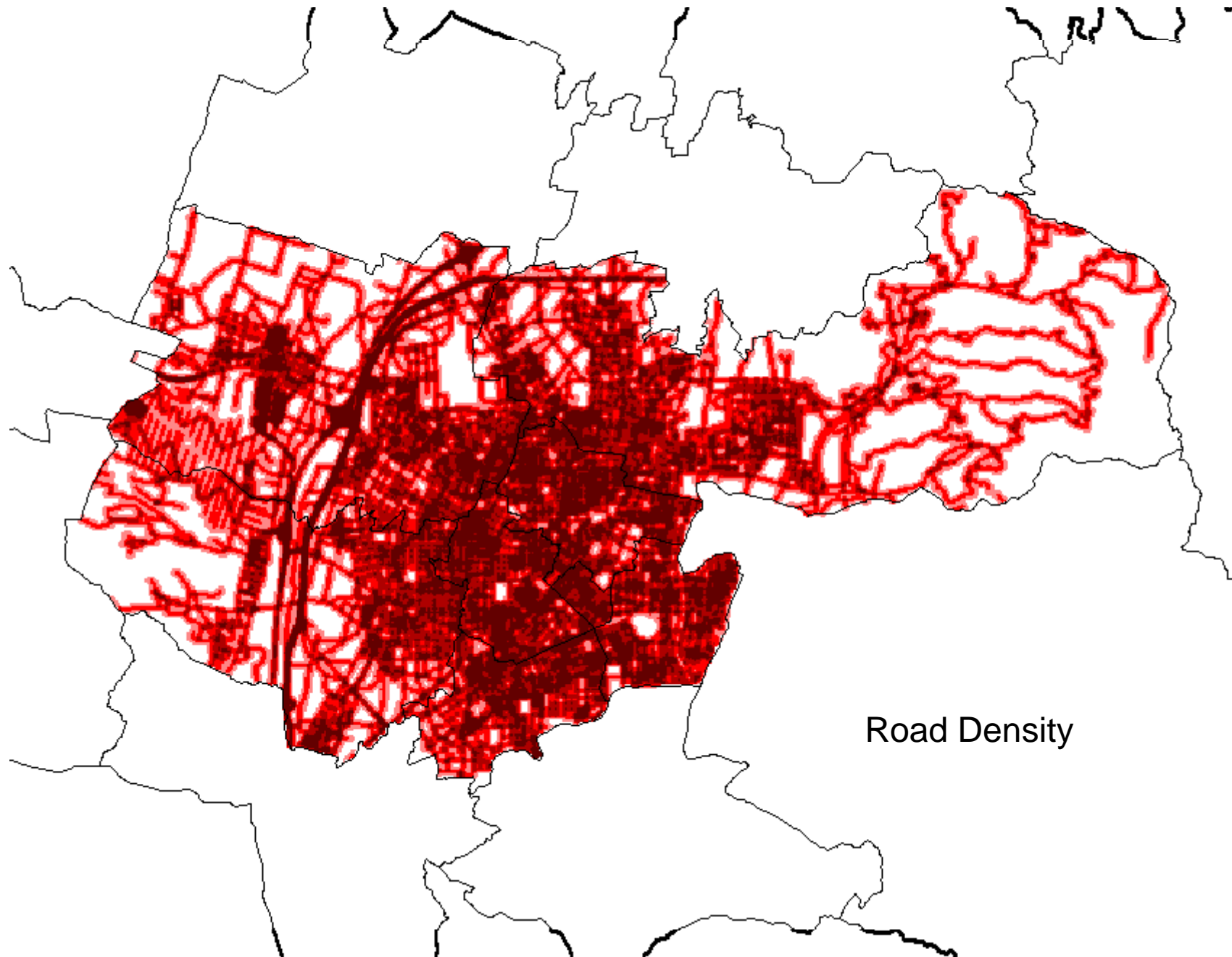


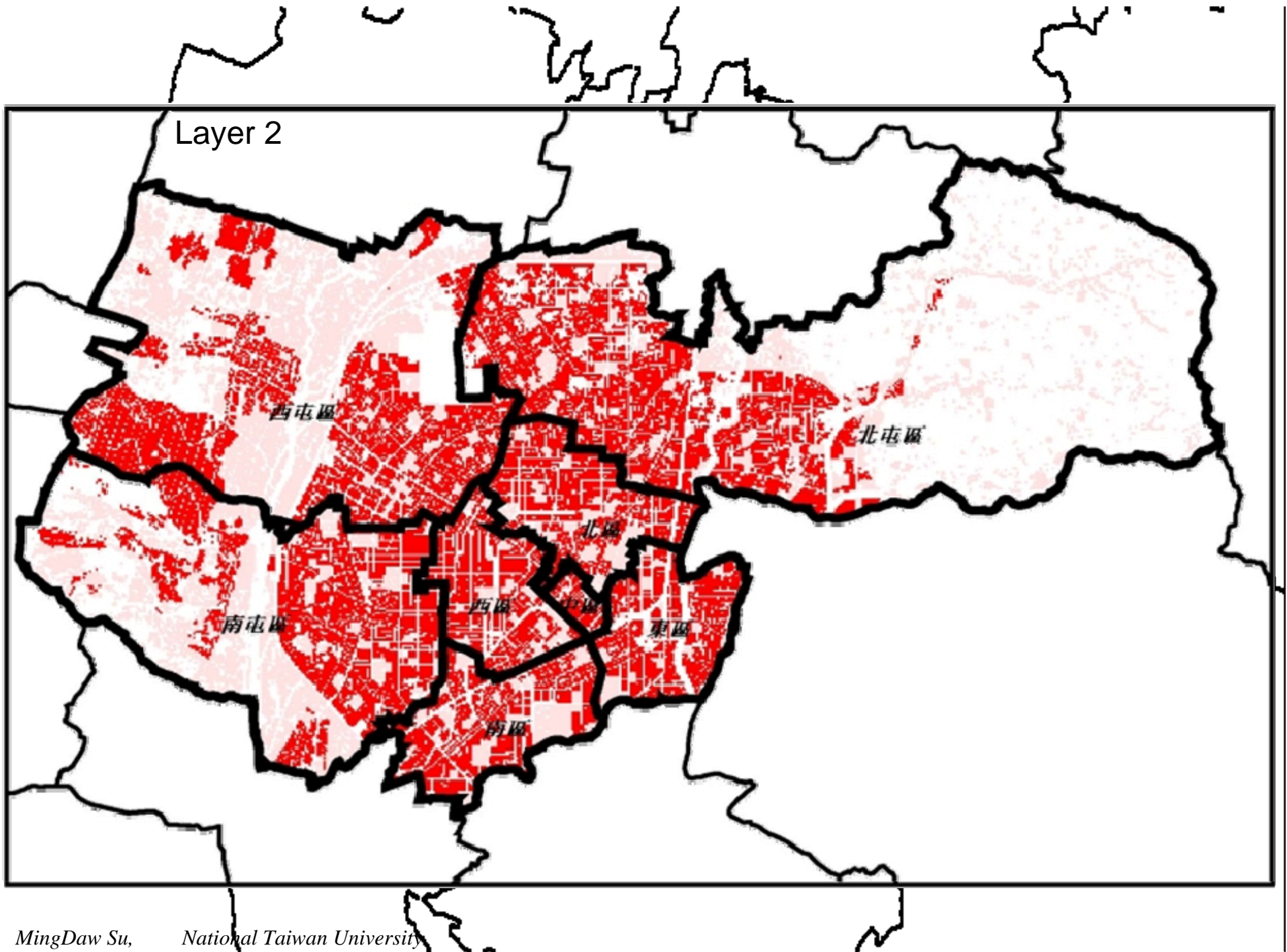


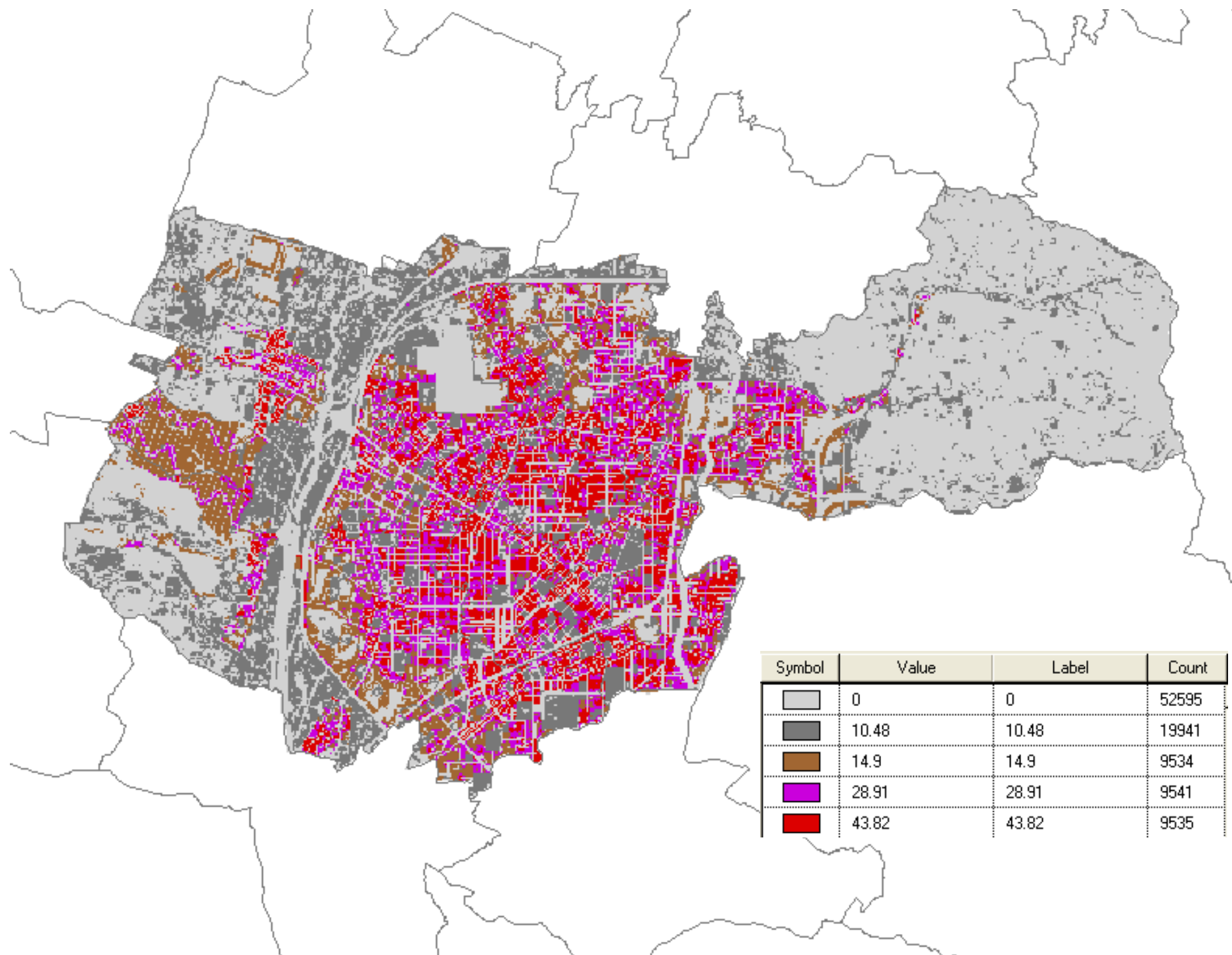
Grid system

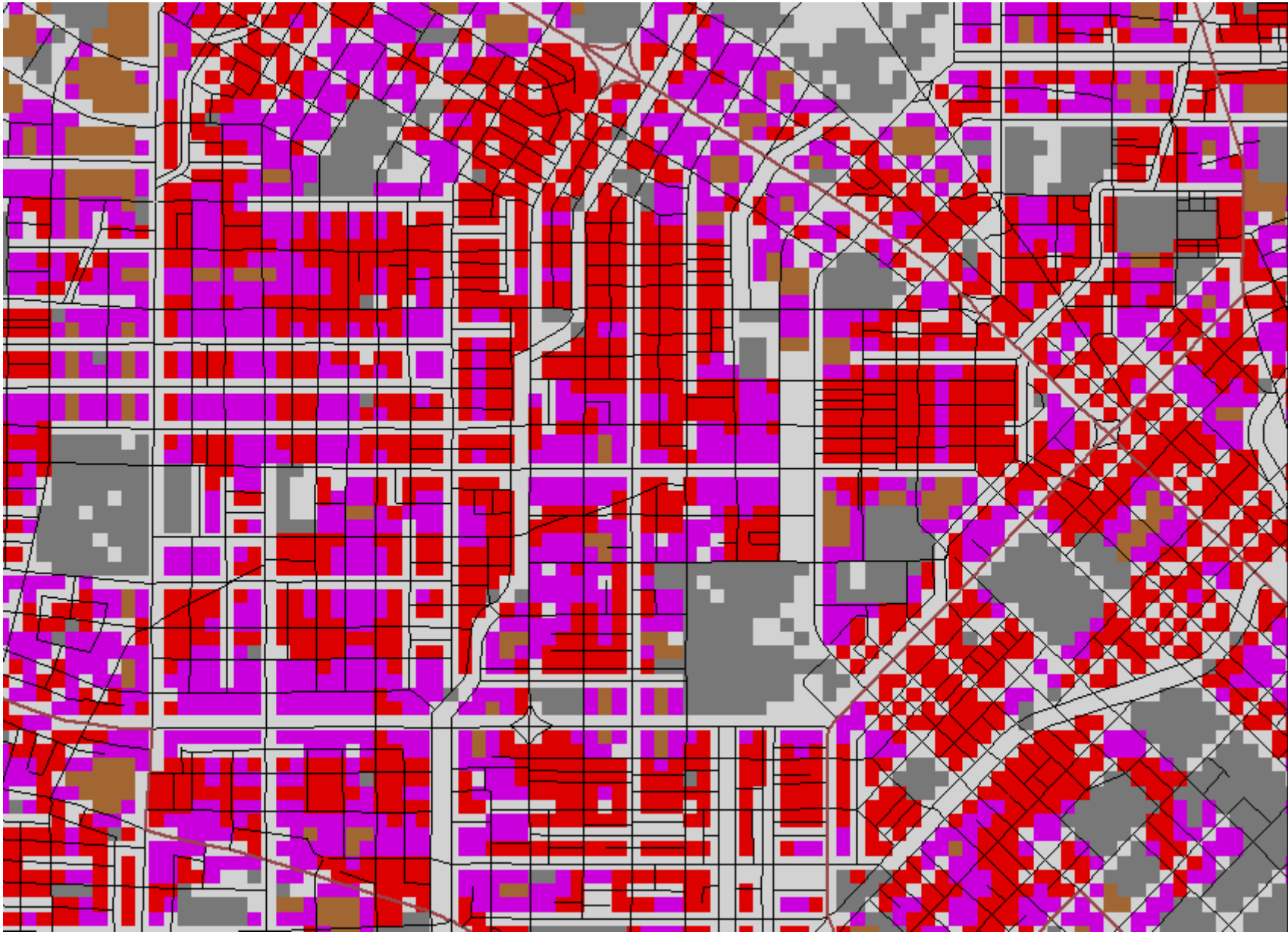


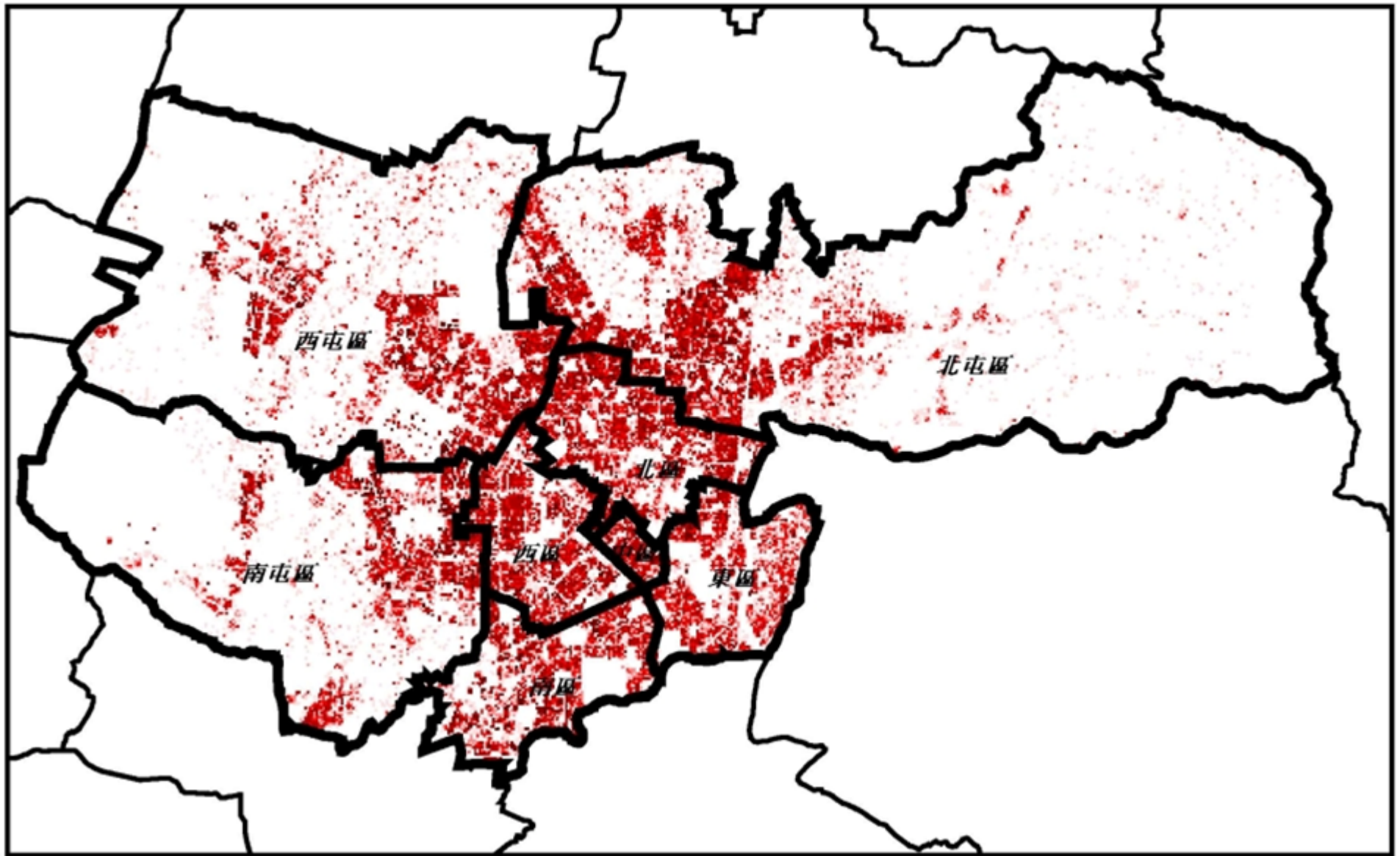










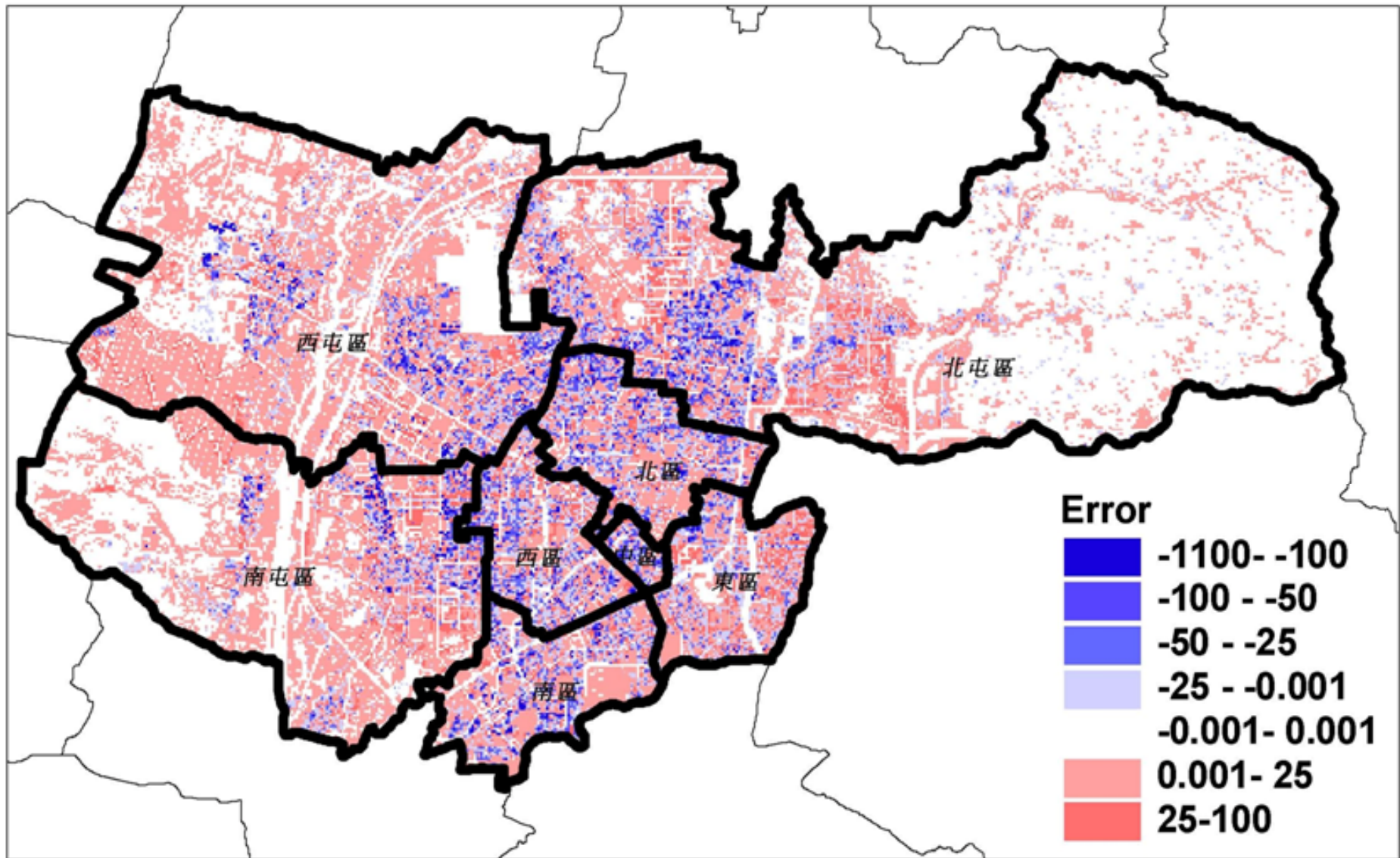




Error comparisons

$$MAD = \frac{\sum_{i=1}^n |x_i - \hat{x}_i|}{n}$$
$$RMSE = \sqrt{\frac{\sum_{i=1}^n (x_i - \hat{x}_i)^2}{n}}$$

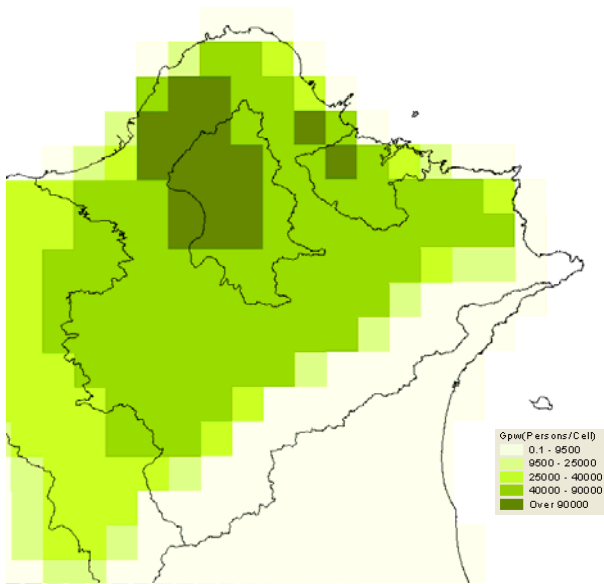
	Layer 0	Layer 1	Layer 2	Layer 3
MAD	15.6 (100%)	13.7 (88%)	12.6 (81%)	11.5 (74%)
RMSE	29.8 (100%)	29 (97%)	28.4 (95%)	27.5 (92%)



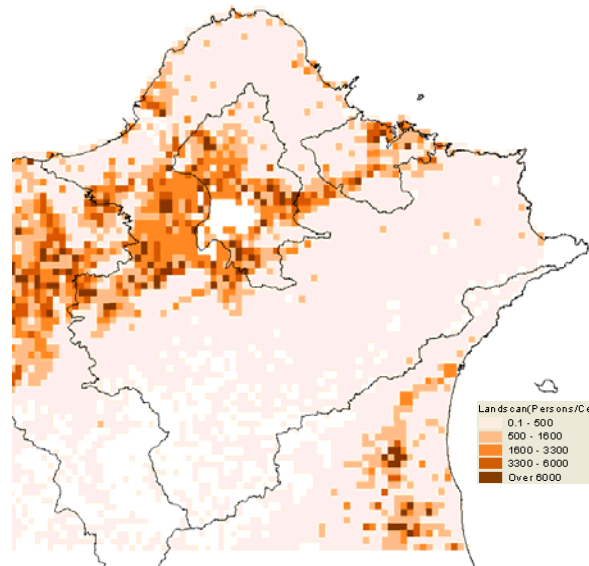


Comparison with other data sets

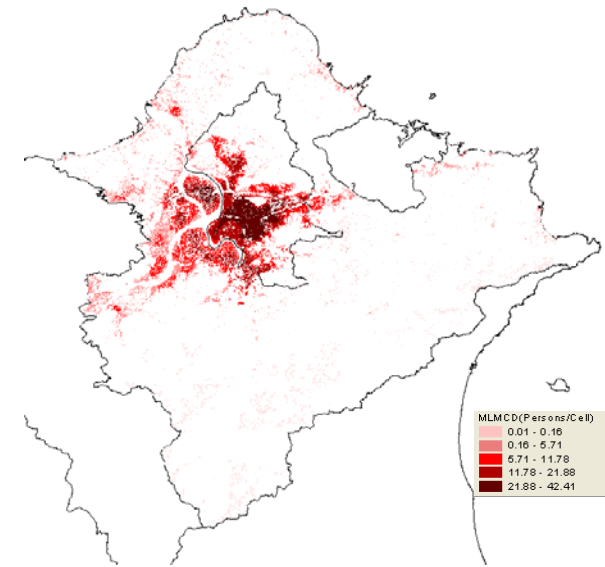
GPW



LandScan



MLMCD





Conclusions

- *The concept of multi-layer multi-class dasymmetric modeling was **both useful and flexible** in this case study,*
- *Useful to adapt to different **data availability and budget limitation***



Thanks, comments welcome
