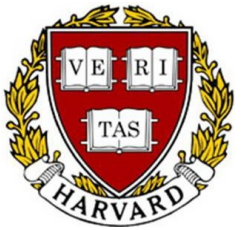
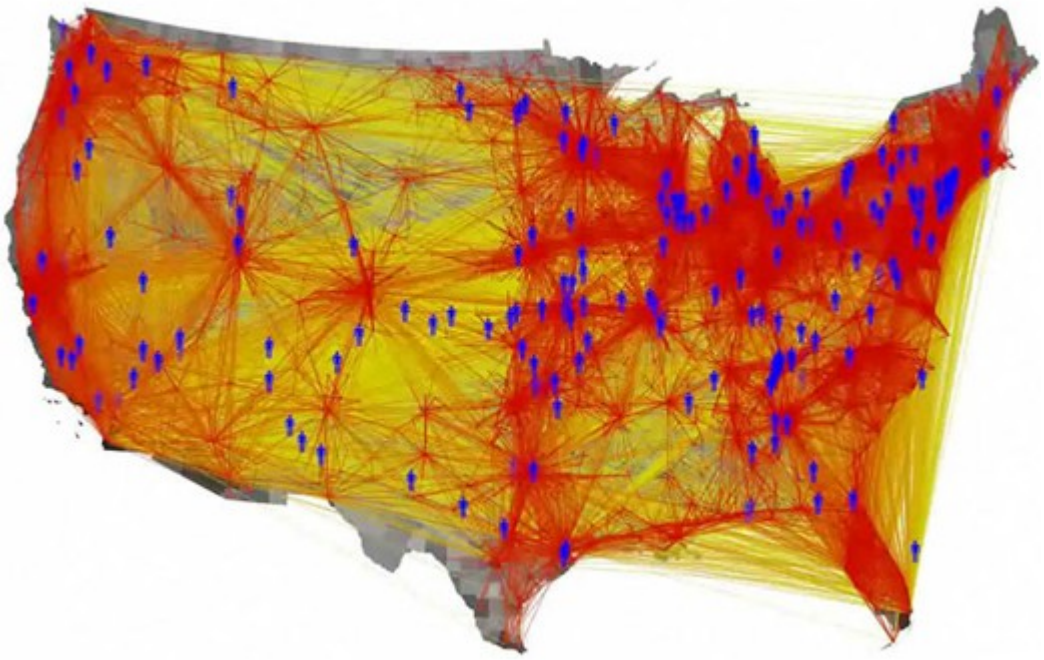
Optimal Spatial Resolution for the Analysis of Human Mobility

Michele Coscia[2], Salvatore Rinzivillo[1], Fosca Giannotti[1], Dino Pedreschi[3]

[1] KDDLab ISTI-CNR, Via G. Moruzzi, 1, Pisa, Italy, Email: rinzivillo@isti.cnr.it
[2] CID - Harvard Kennedy School, 79 JFK Street, Cambridge, MA, US, Email: michele coscia@hks.harvard.edu
[3] KDDLab University of Pisa, Largo B. Pontecorvo, 3, Pisa, Italy, Email: pedre@di.unipi.it



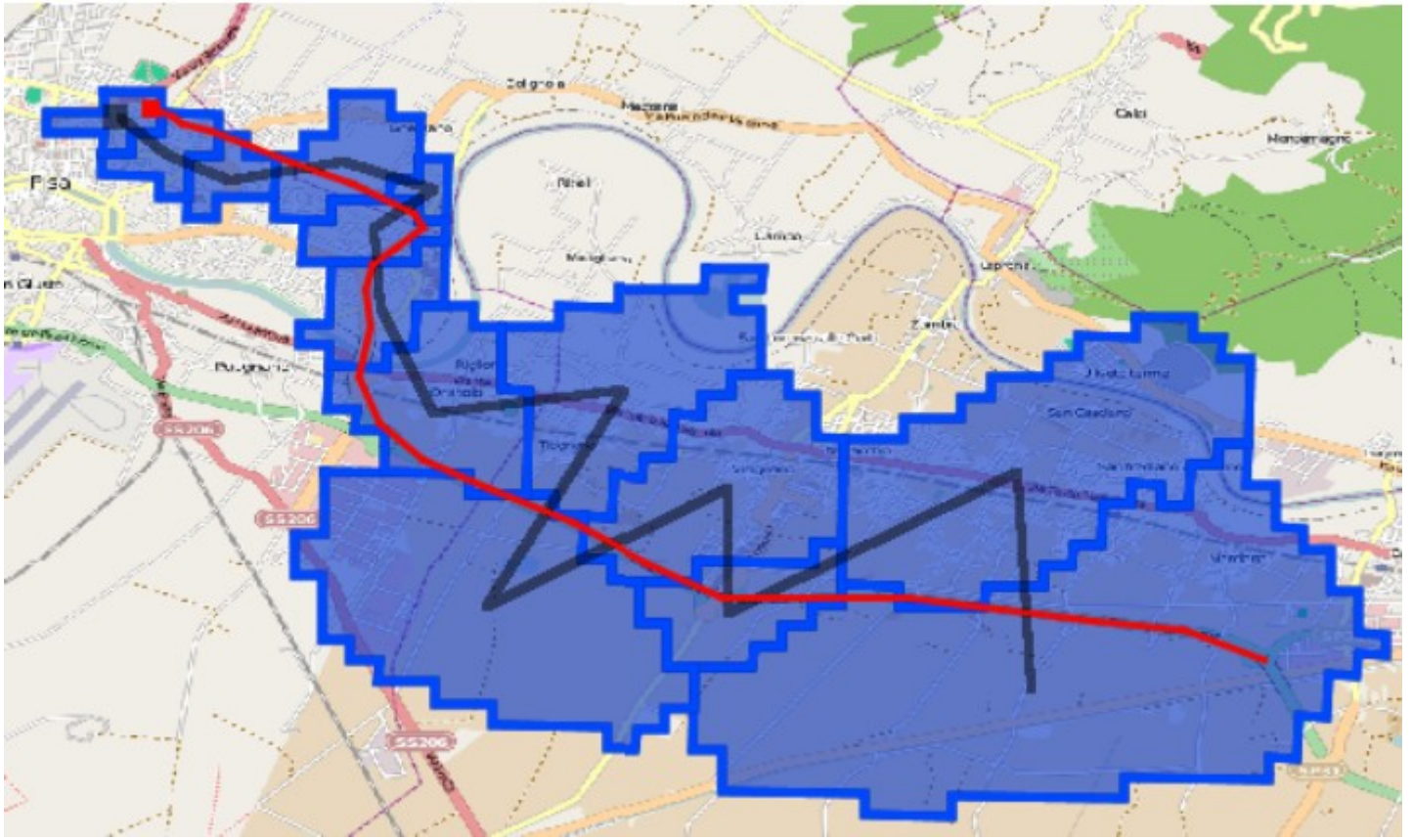
Human Mobility Studies



Macro Level:
- Borders
- Migration flows
- ...

Micro Level:
- City traffic
- Evaluation of the value of the territory
- ...

Data Granularity Problem

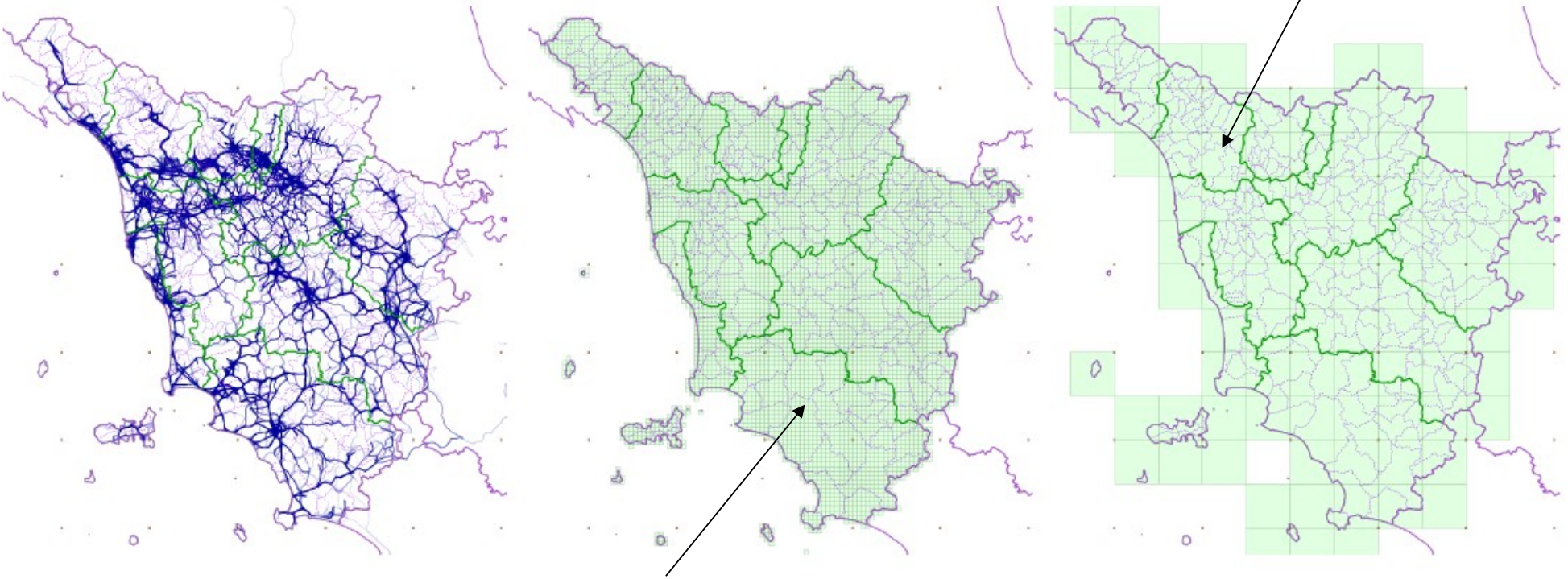


On one hand
Rough granularity (or GSM vs GPS data)
yields to not accurate results

On the other hand
We need to reduce GPS granularity to
connect it with the territory with a grid

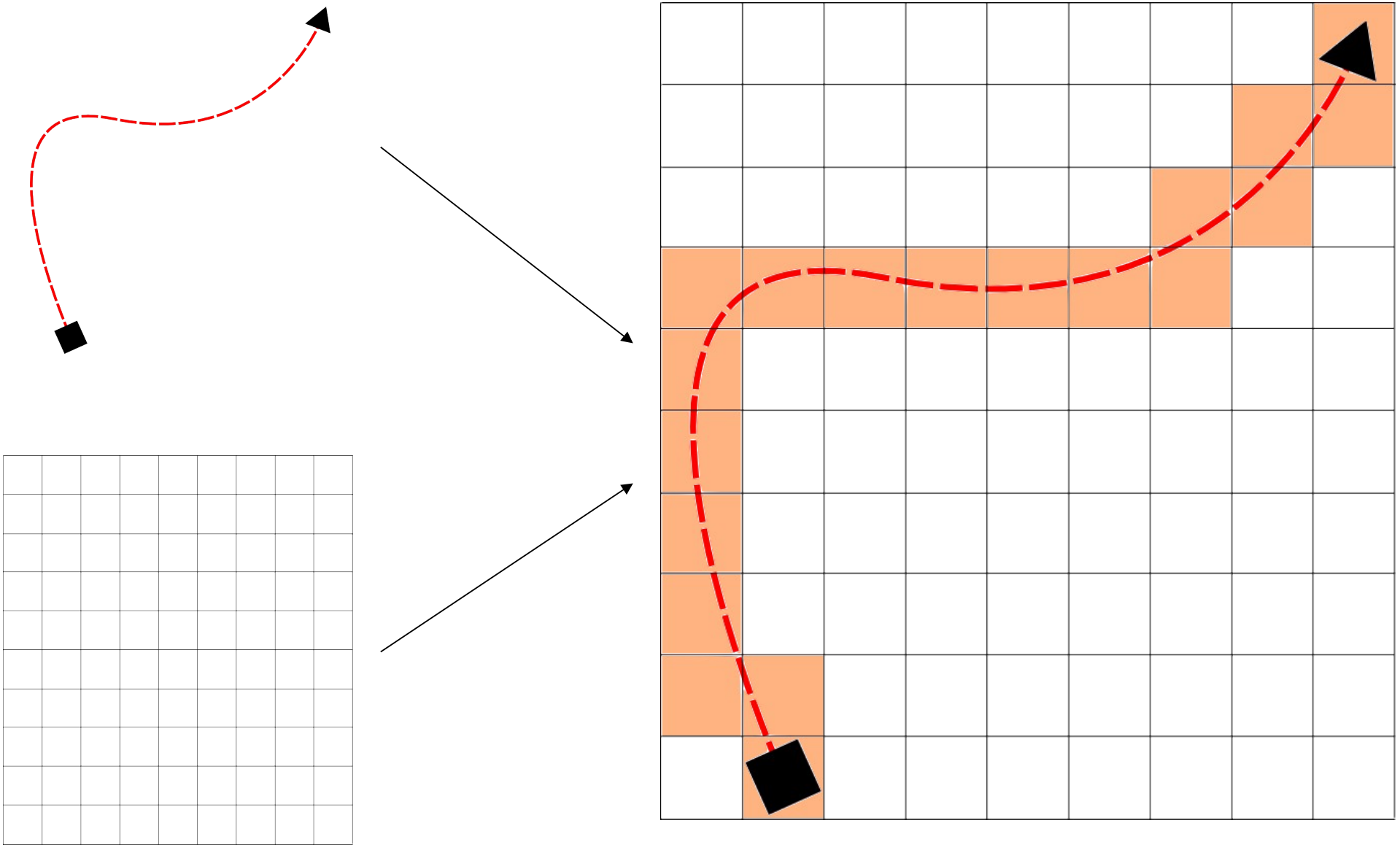
The Grid

We generate several versions
Of the grid using
Multiple resolutions

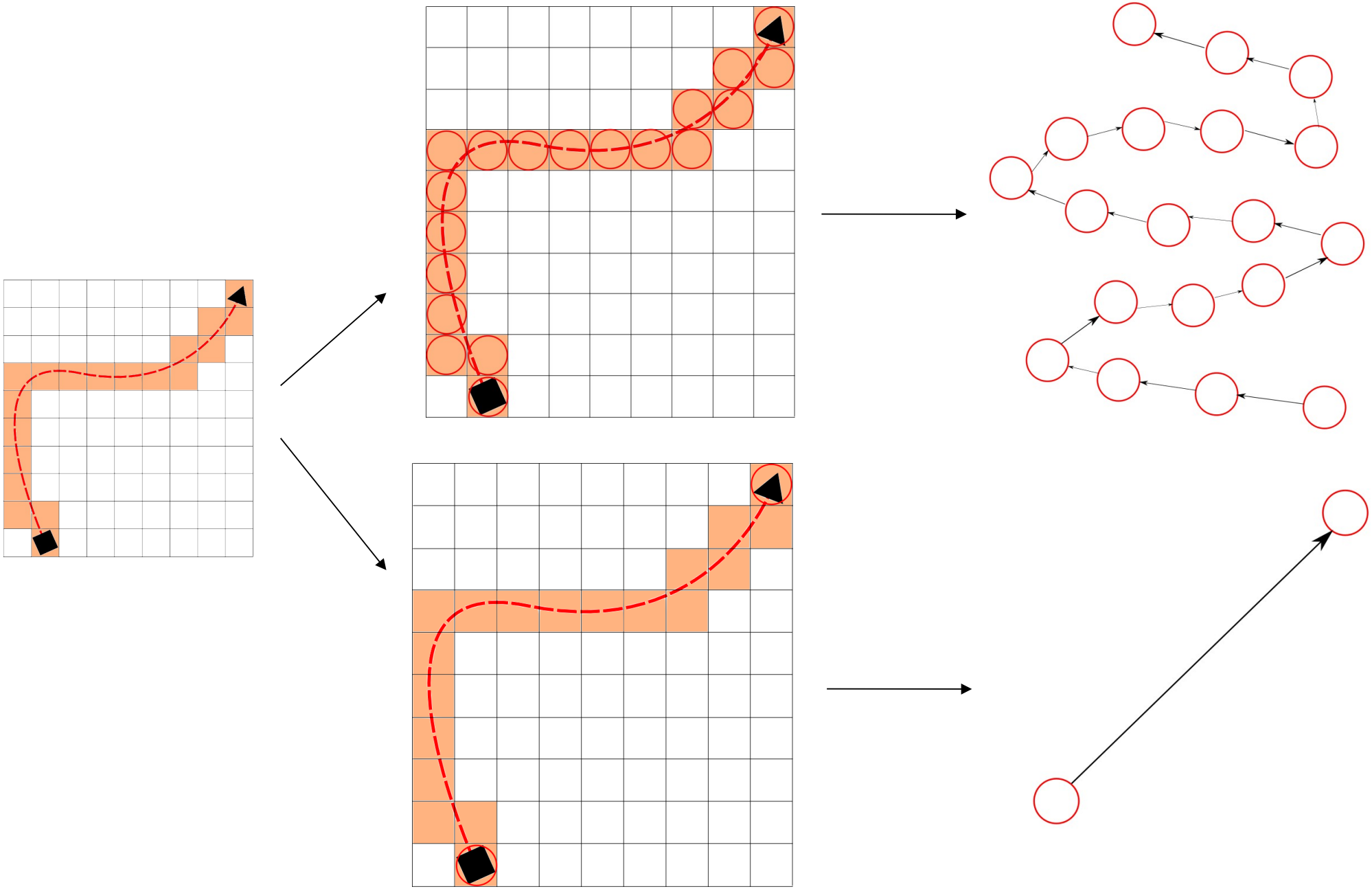


Every movement is approximate
With the corresponding square
On the grid

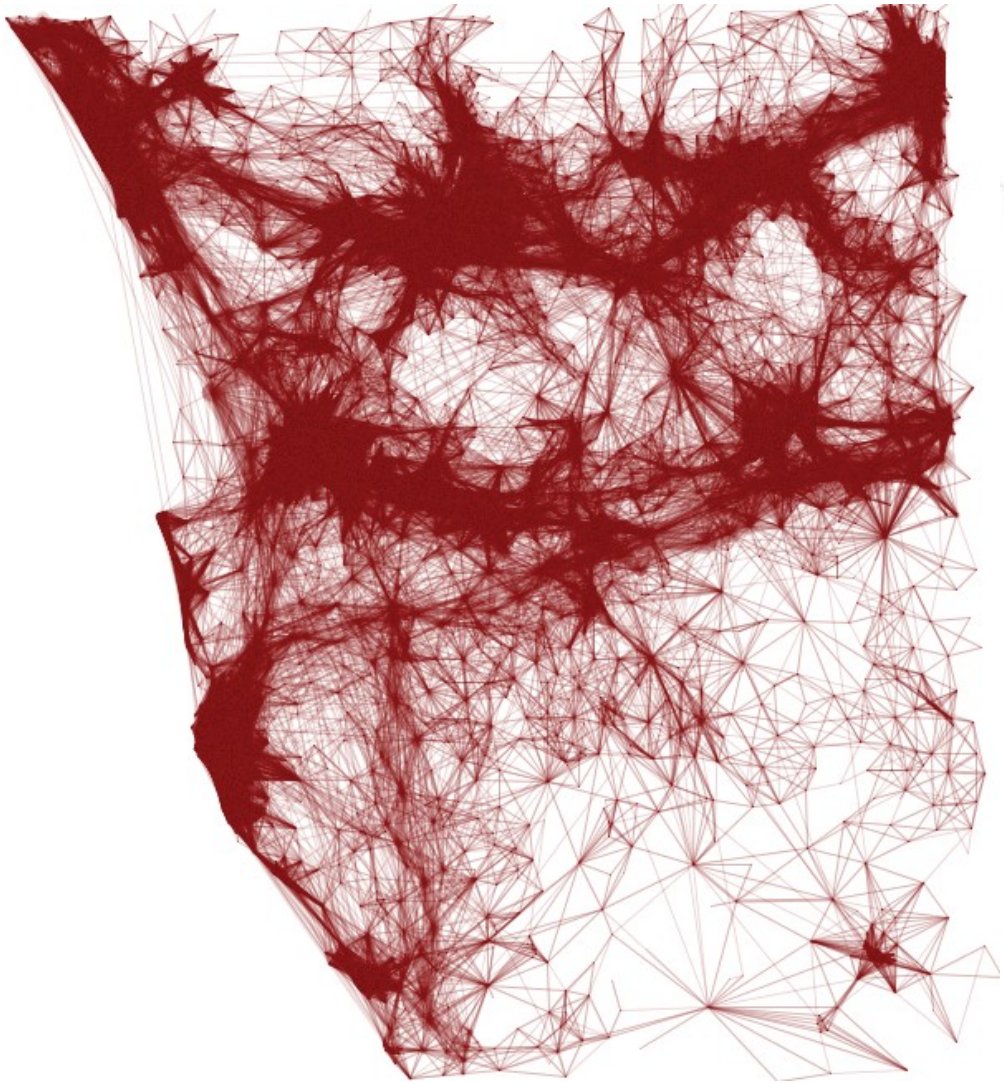
From the GPS to the Grid

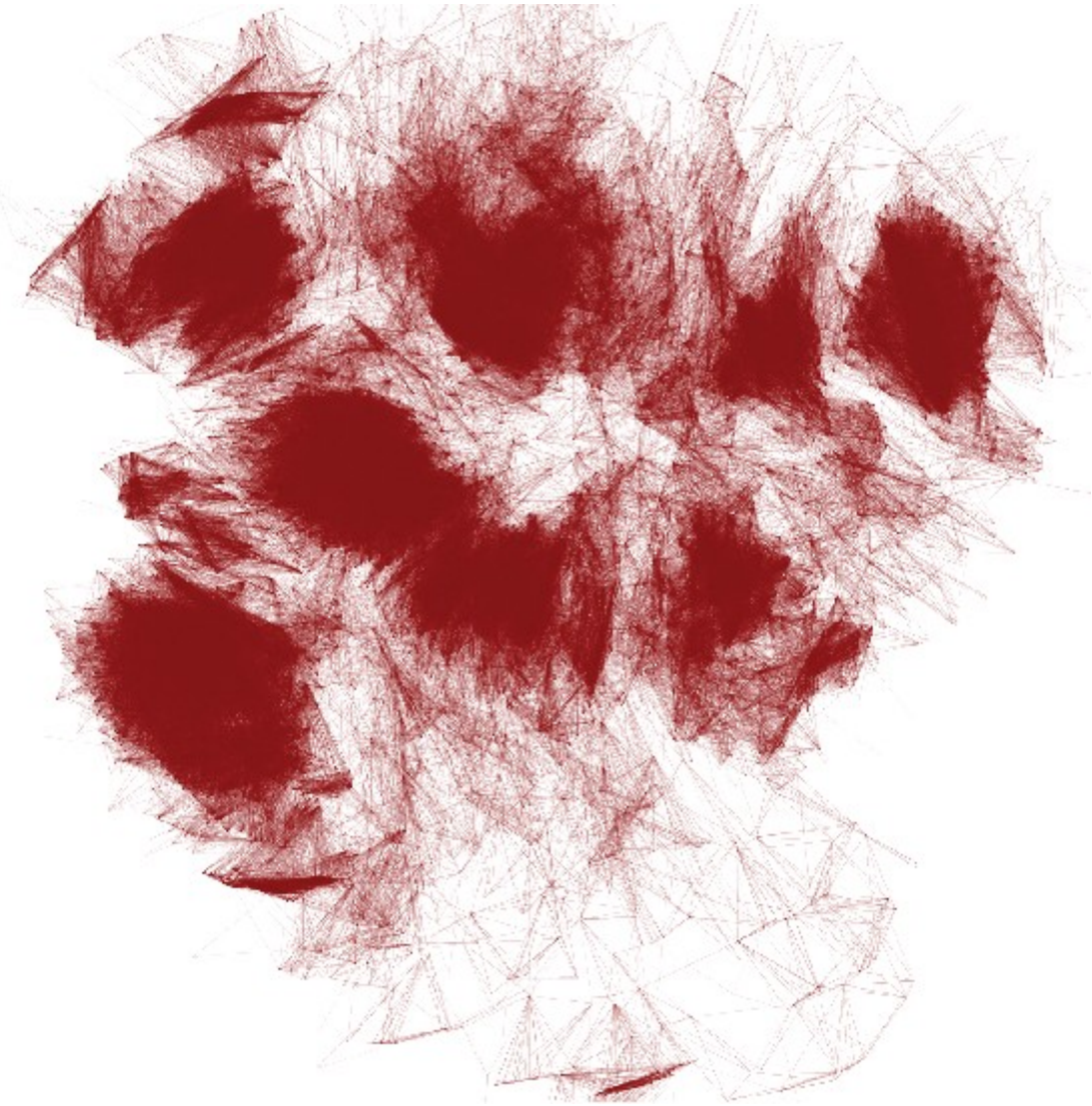


From the Grid to the Network

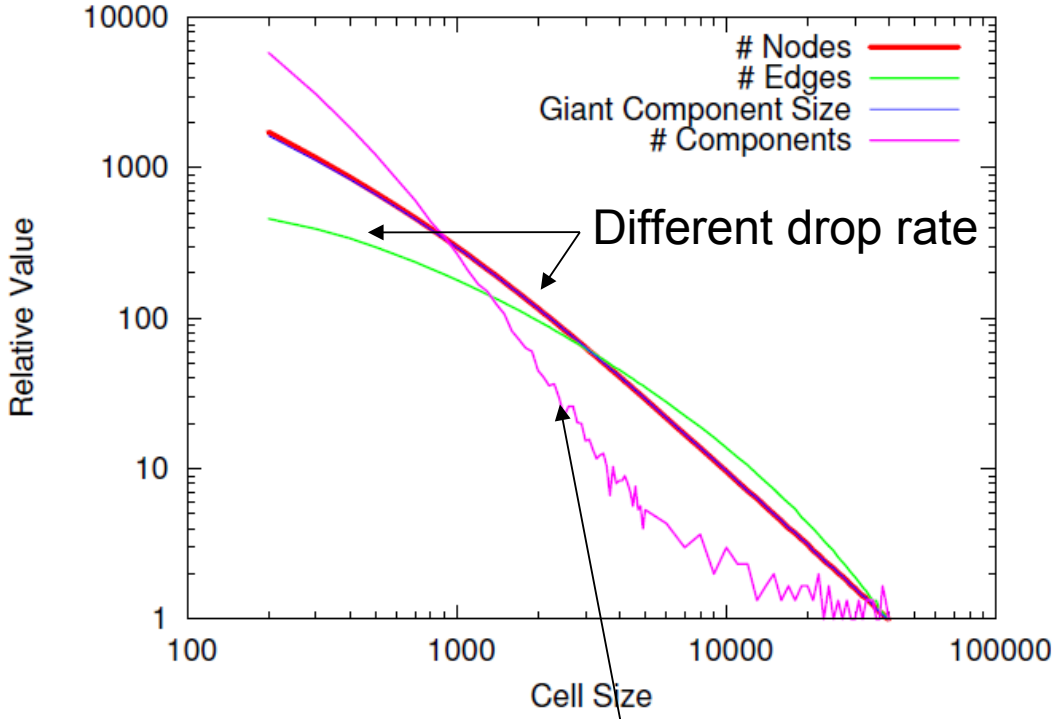


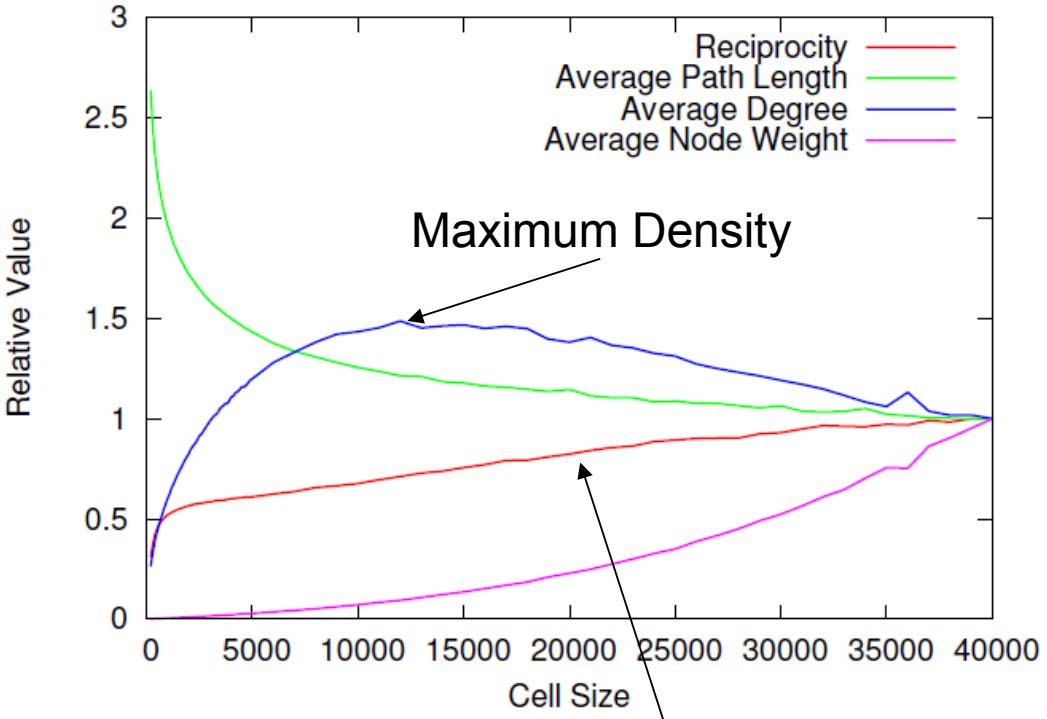
The Result





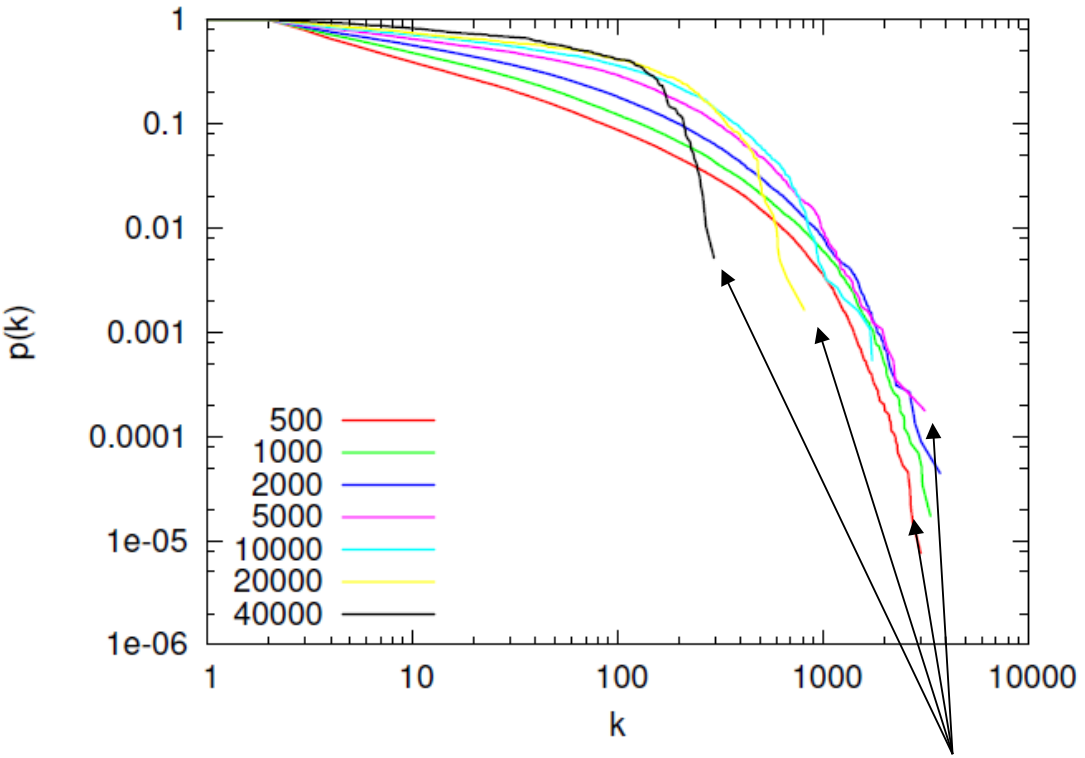
Network Properties



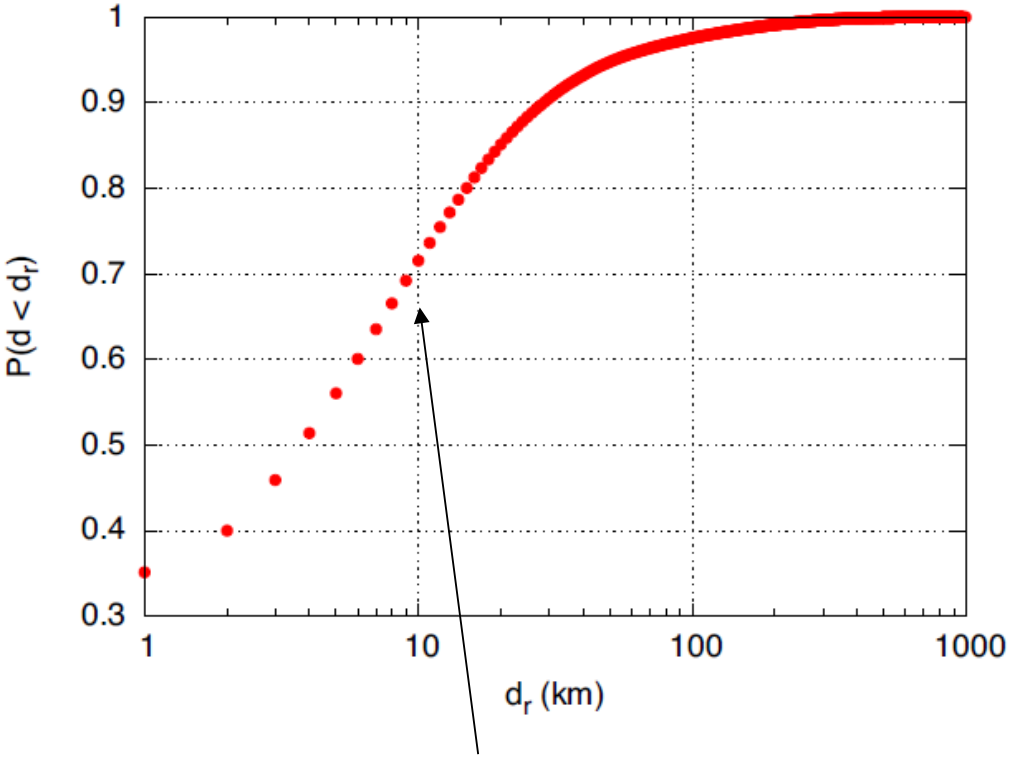


Larger Cells = More Aggregate Trips = More Reciprocity

Network Properties

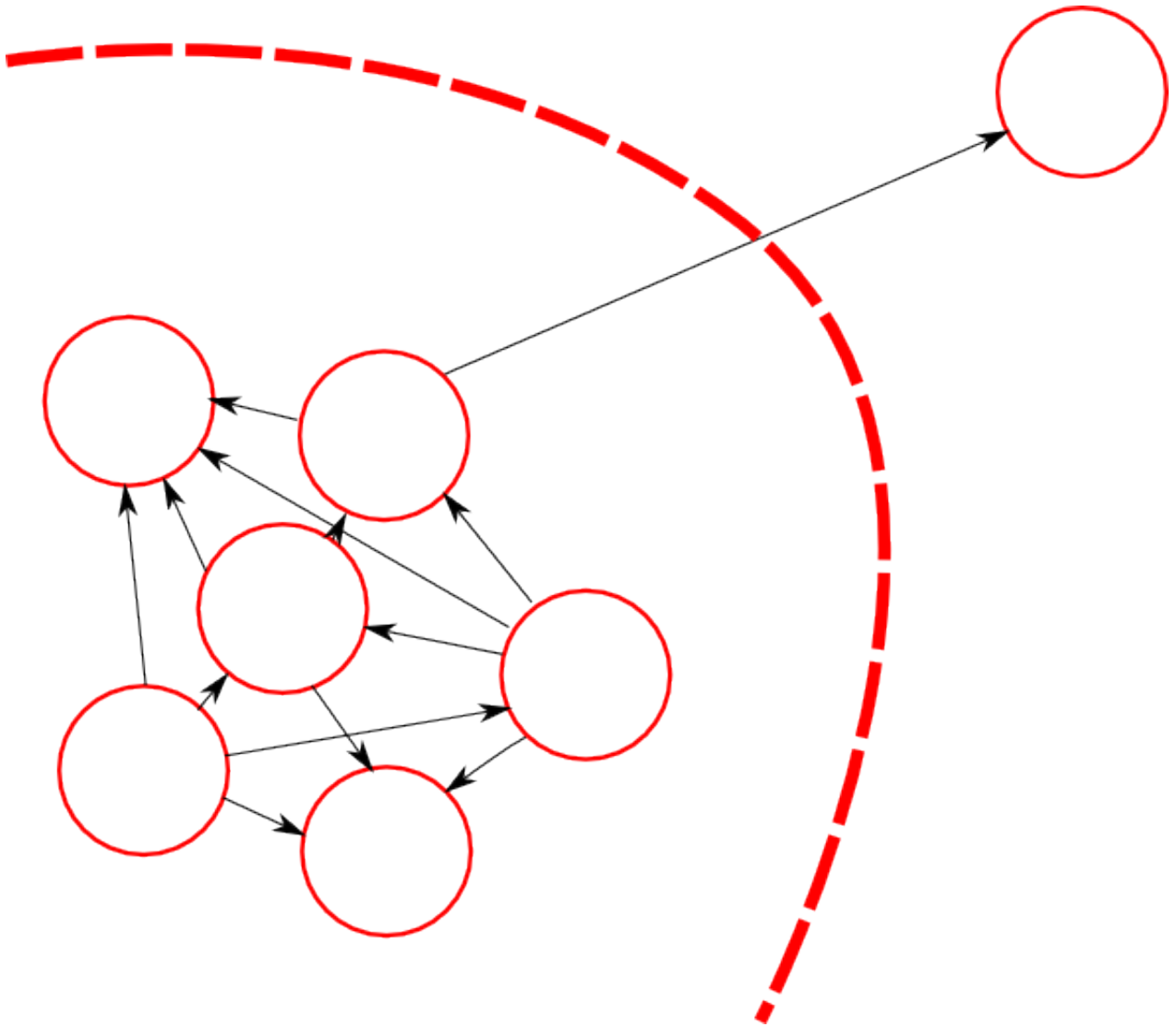


Stronger and stronger exponential cutoff

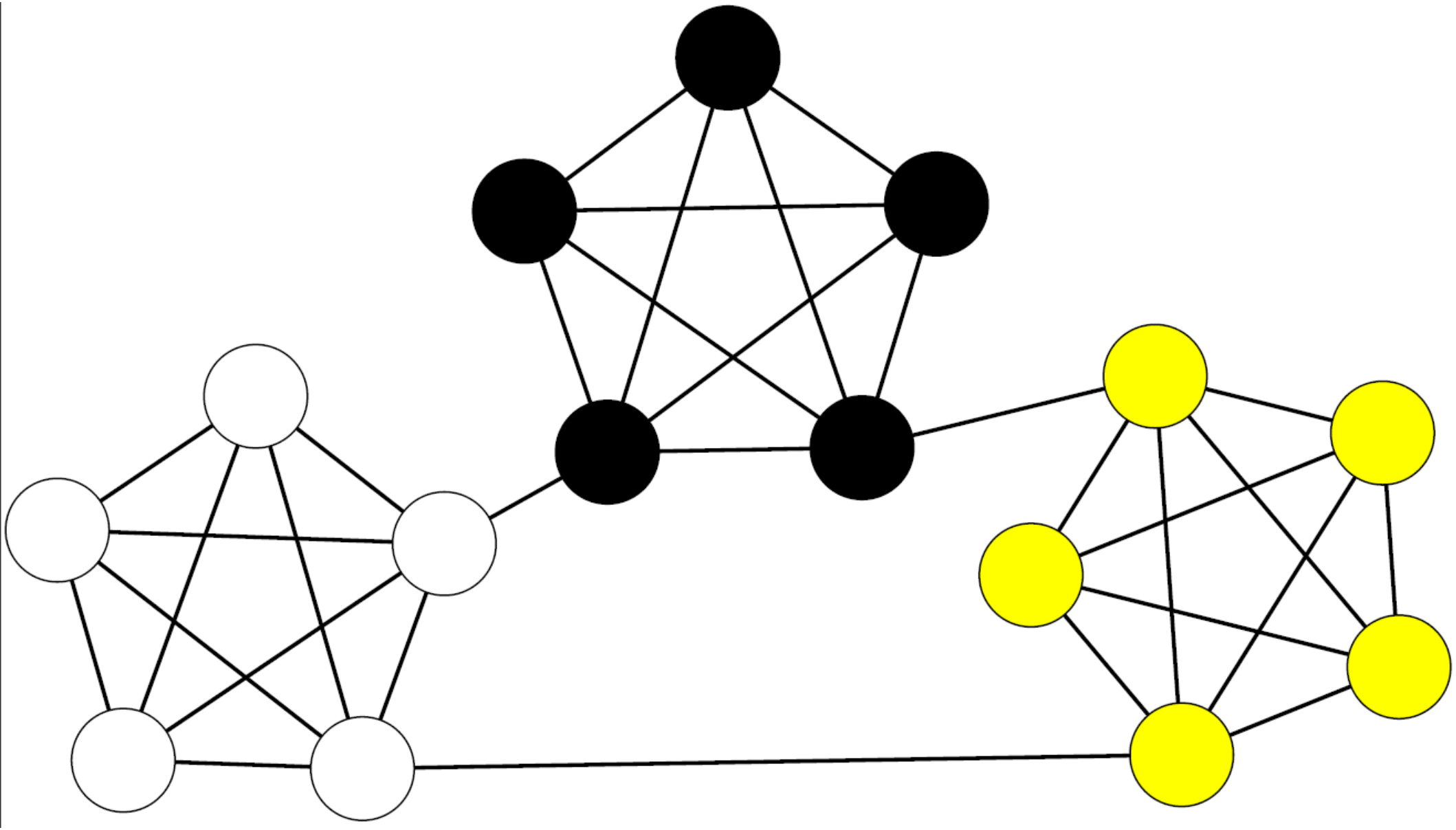


Most trips are less than 10km

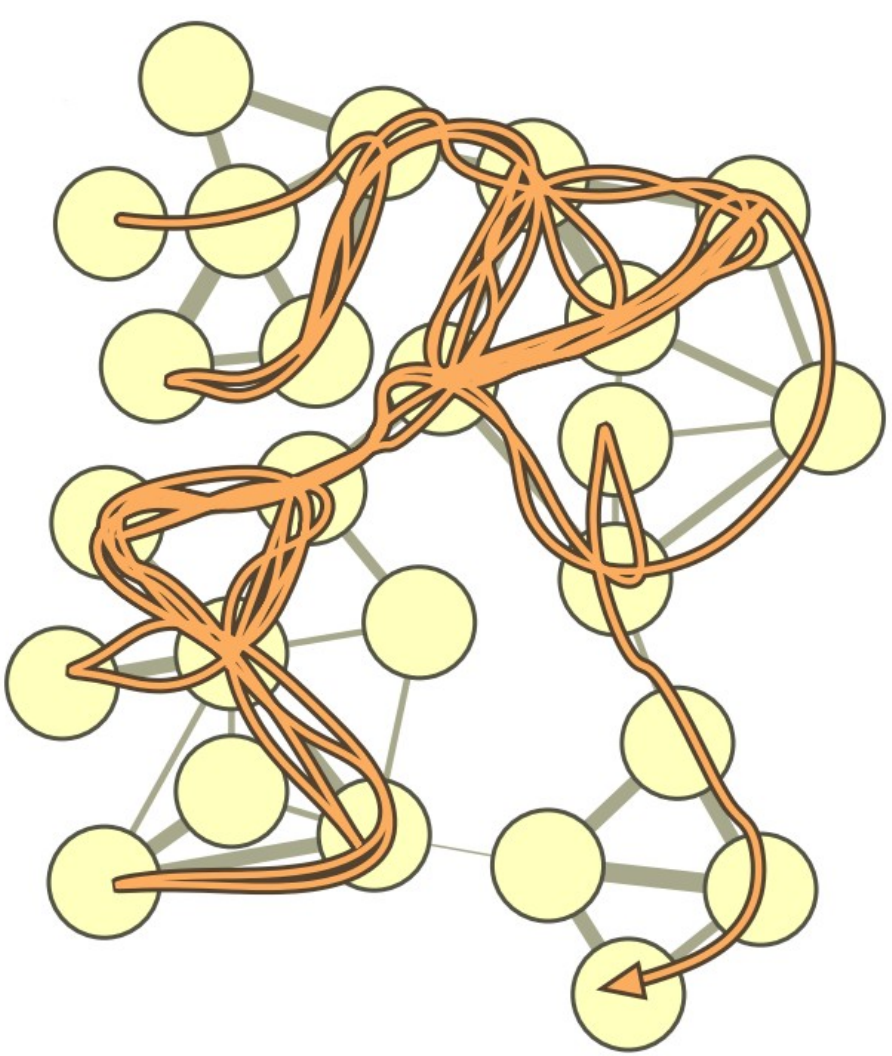
Detecting Borders

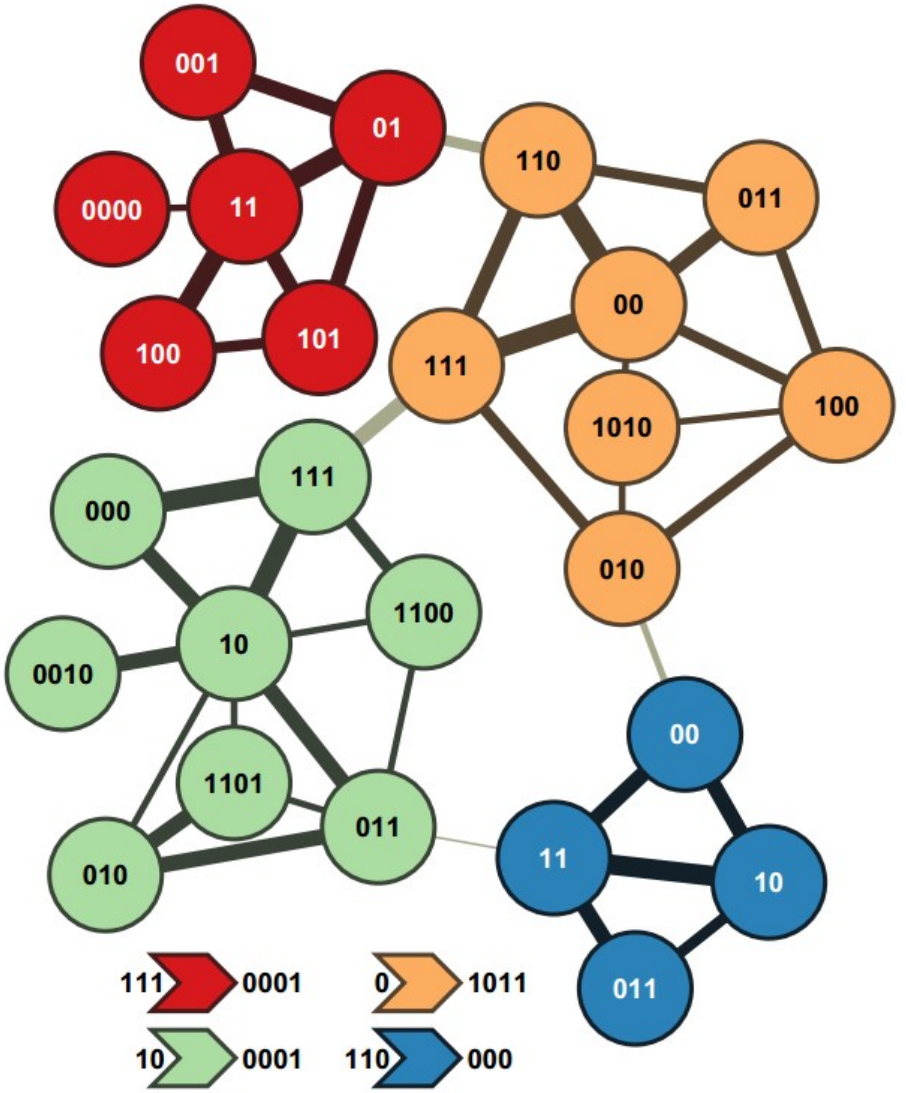


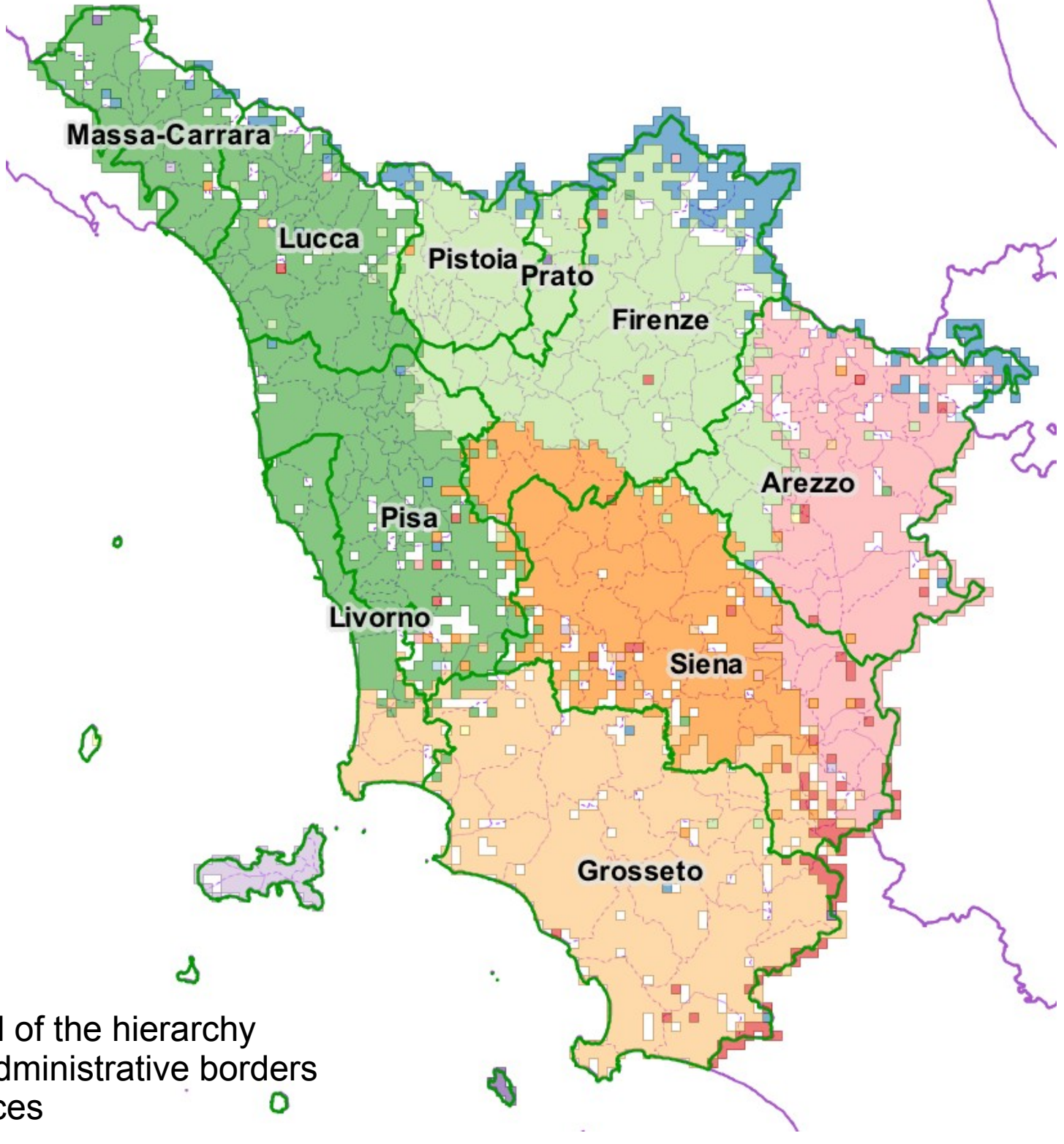
Community Discovery



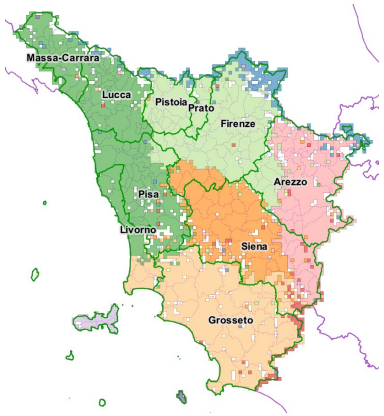
Our Choice: Infomap







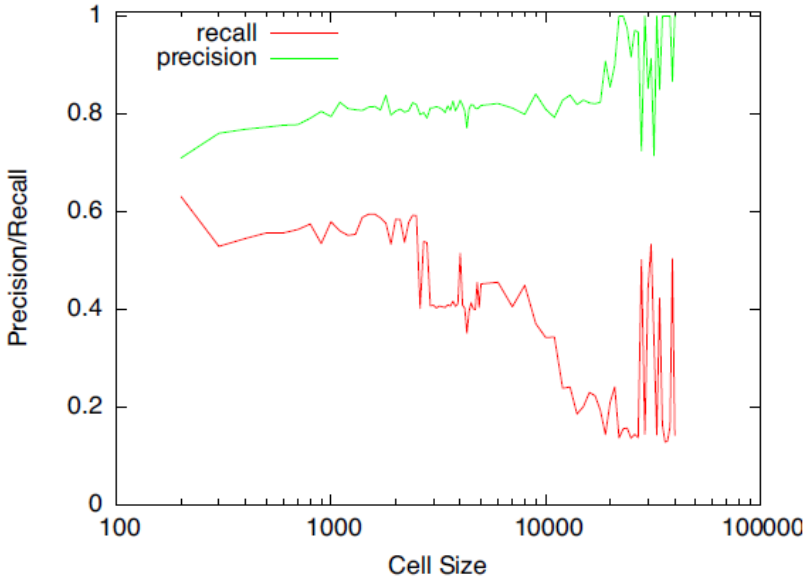
The first level of the hierarchy unveils the administrative borders of the provinces



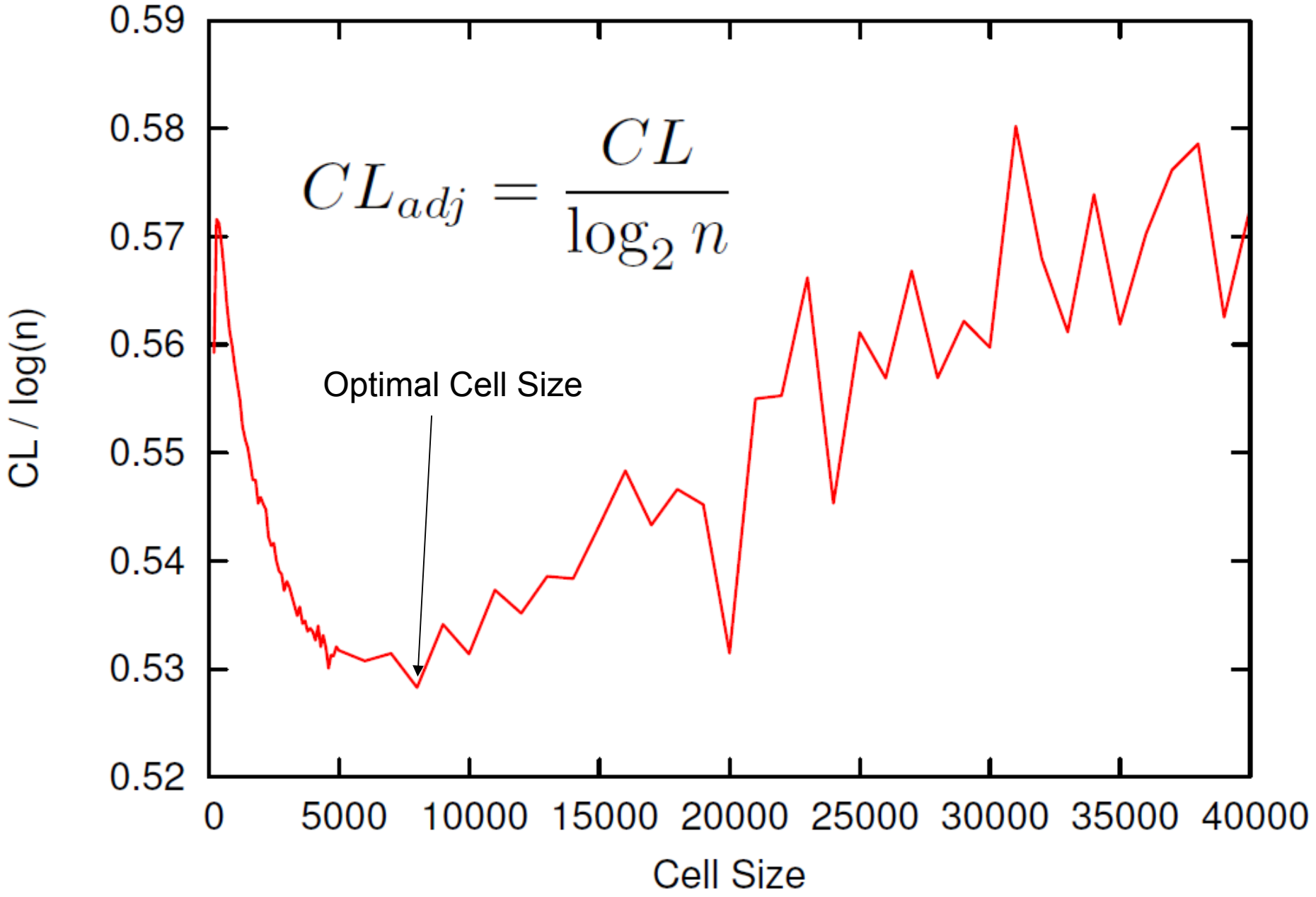
The second level of the hierarchy unveils the urban centers

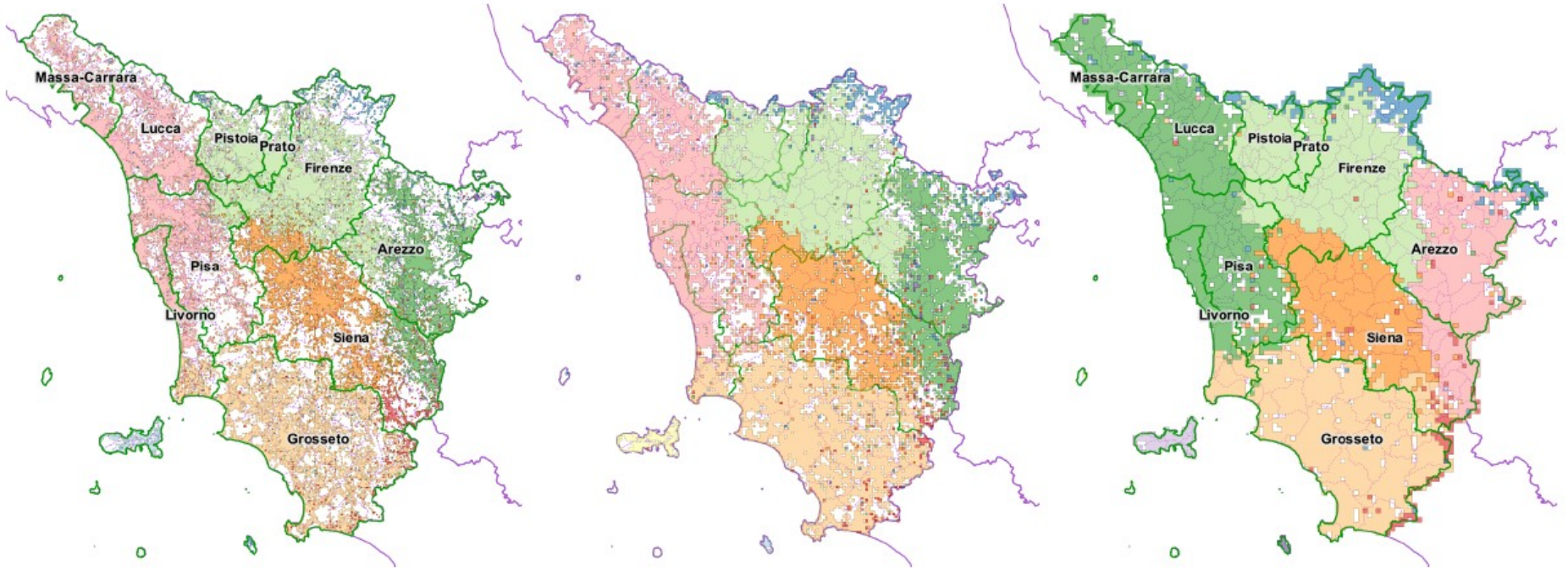
Massa-Carrara
Lucca
Pistoia
Prato
Firenze
Arezzo
Pisa
Livorno
Siena
Grosseto

Evaluation against the administrative borders

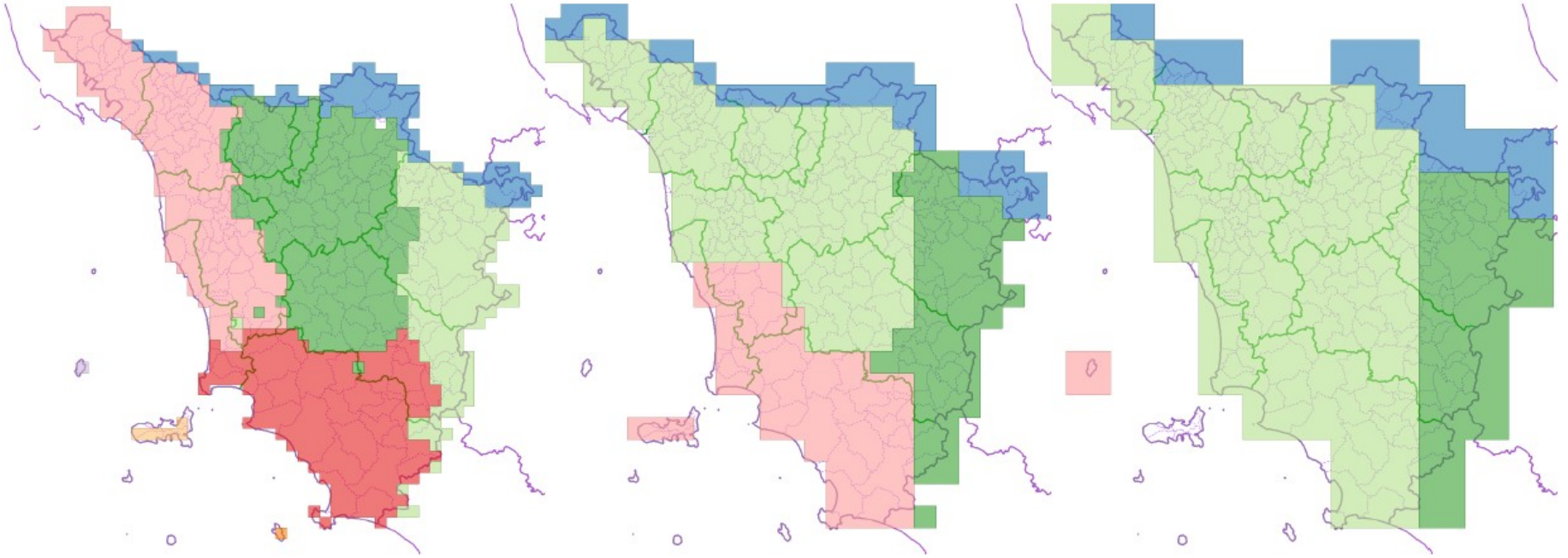


Community Quality





(a) $500m$ (b) $1000m$ (c) $2000m$



(d) $5000m$ (e) $10000m$ (f) $20000m$

Conclusions

Finer resolutions create over detailed networks where smaller components are associated to several small clusters

Large cell sizes, on the contrary, generate an excessive aggregation of local movements

We derived a process to identify the optimal cell size for real world problems

Future directions: A multiresolution grid

Thank you for your attention

(a) $500m$ (b) $1000m$ (c) $2000m$

Questions?

(d) $5000m$ (e) $10000m$ (f) $20000m$