lero THE IRISH SOFTWARE ENGINEERING RESEARCH CENTRE

PEL

Can Road Traffic Volume Information Improve Partitioning for Distributed SUMO?

Ulrich Dangel, Quentin Bragard, Patrick McDonagh, Anthony Ventresque and Liam Murphy

Ulrich Dangel

@mr_ud | ulrich@dangel.im
http://dangel.im

TRAFFIC

- Software Engineering issues within Intelligent Transportation Systems
  - VANET (NS3 & SUMO)
  - Global Route balancing (SUMO)
  - Distributed Simulation (SUMO)

Why SUMO?

- TAPAS, rl-world scenario, not 100x100 grid
- dSUMO
- TraCI

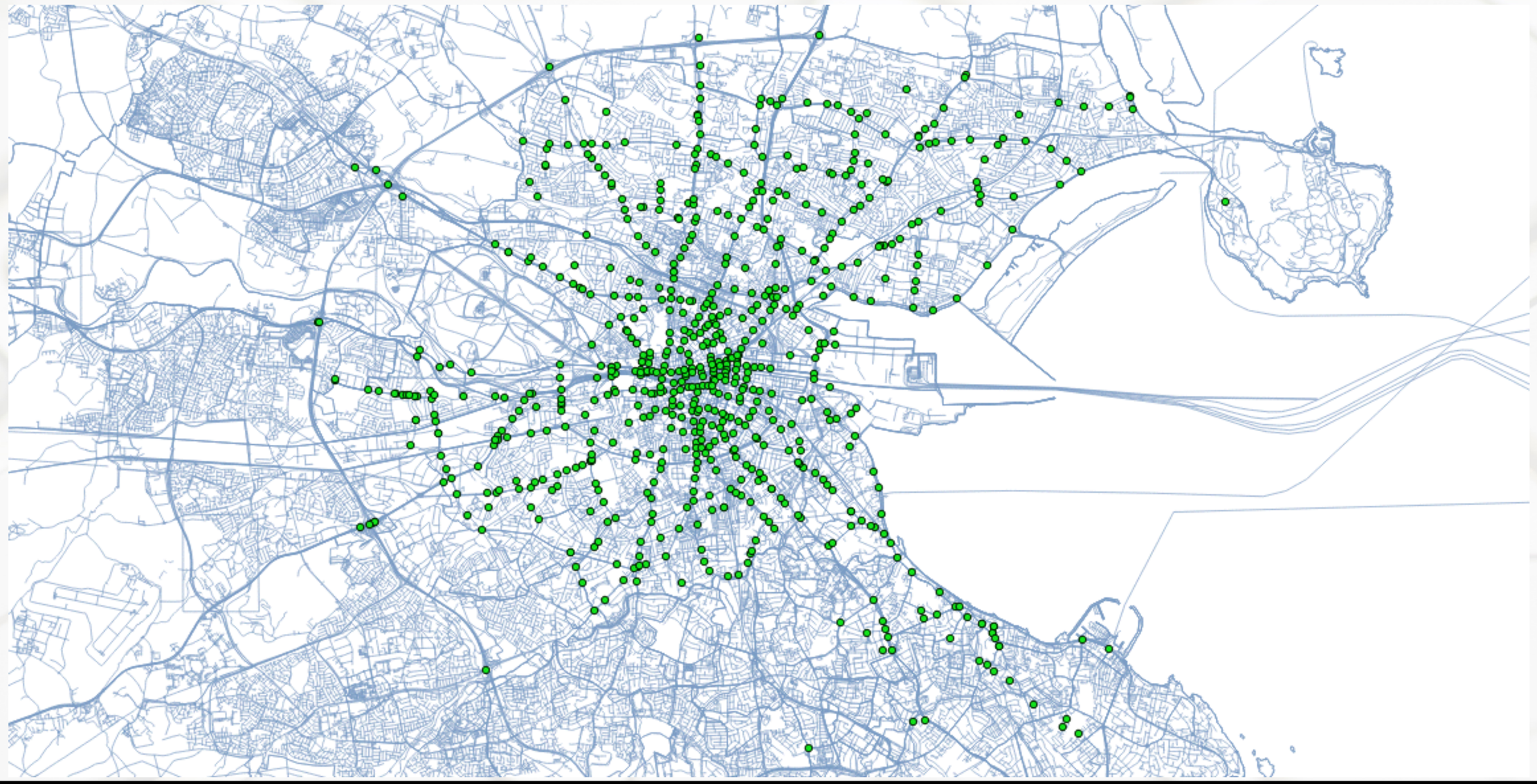
Objective

- Use traffic information to improve map partitioning
  - Unbalanced partitions cause delay/waiting time

Datasets / Open Data

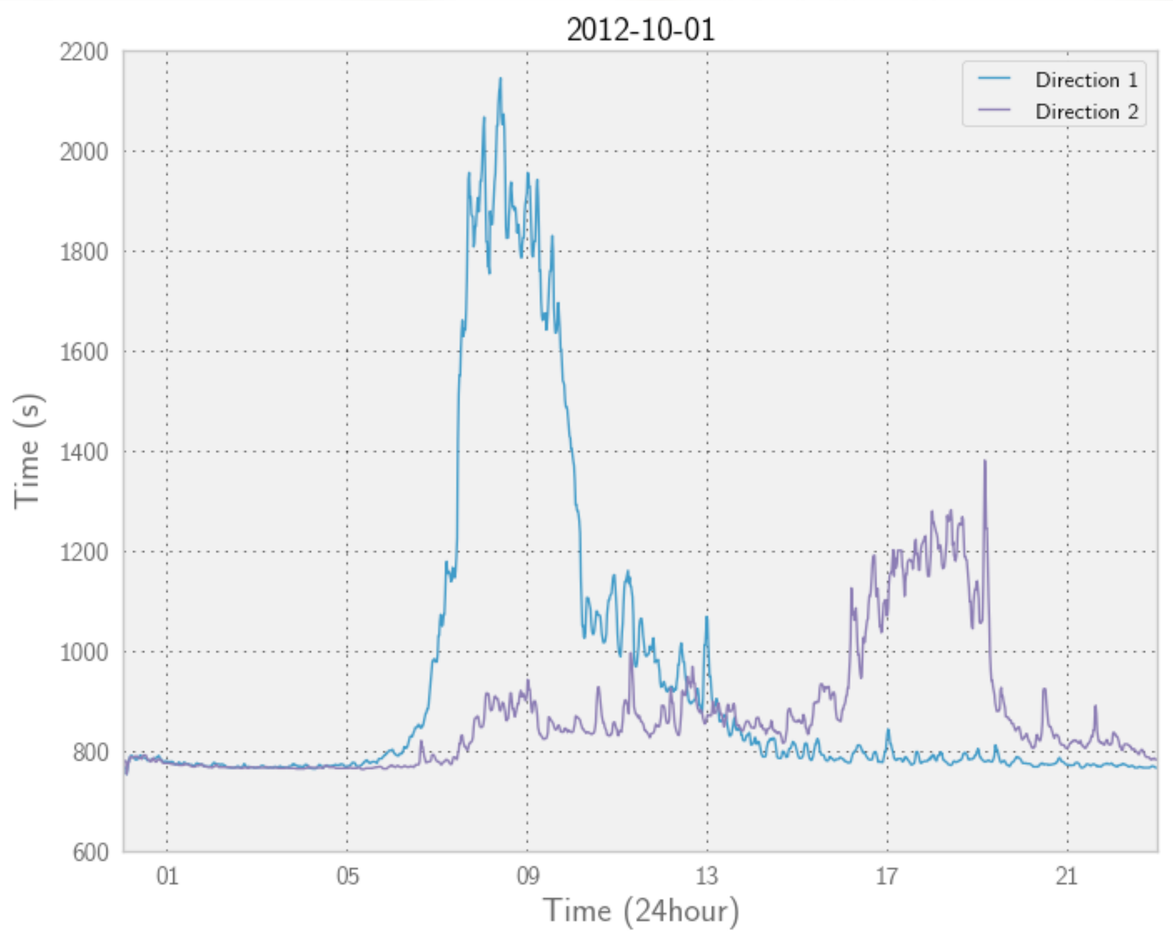
- Dublin - SCATS & TRIPS via dublinked
  - SCATS preliminary data
  - TRIPS - realtime

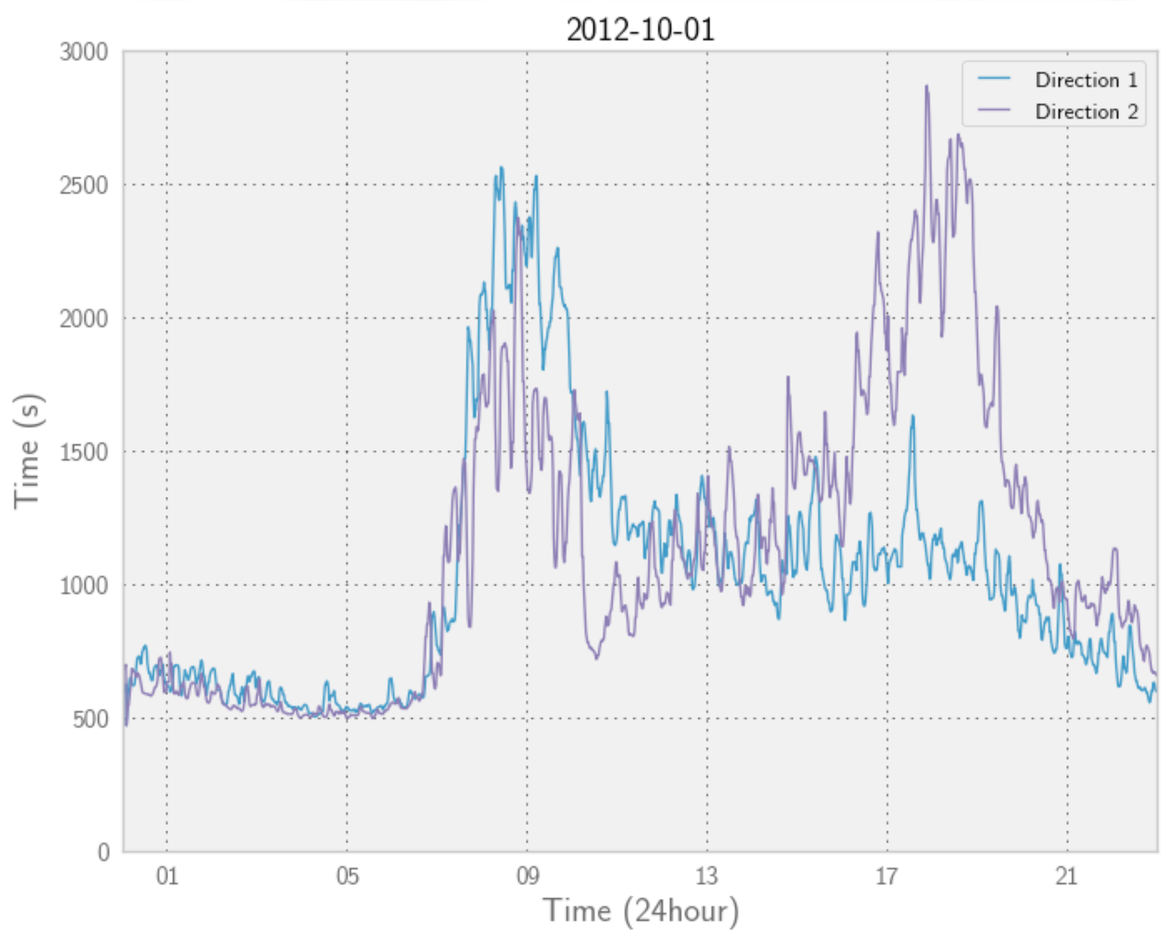
Dublin SCATS



Dublin TRIPS

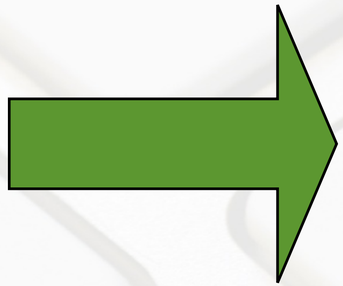
Dublin TRIPS





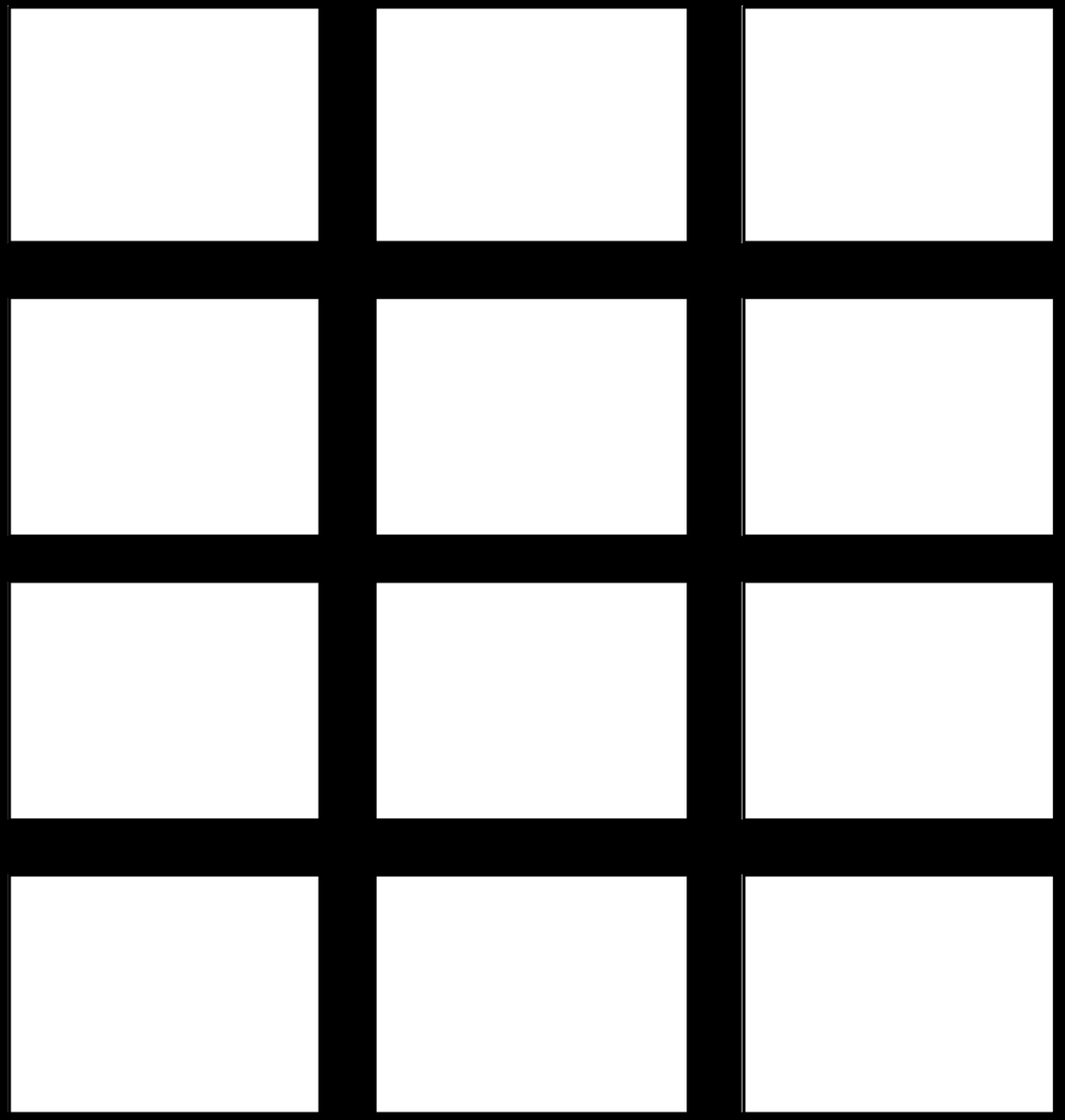
Datasets / Open Data

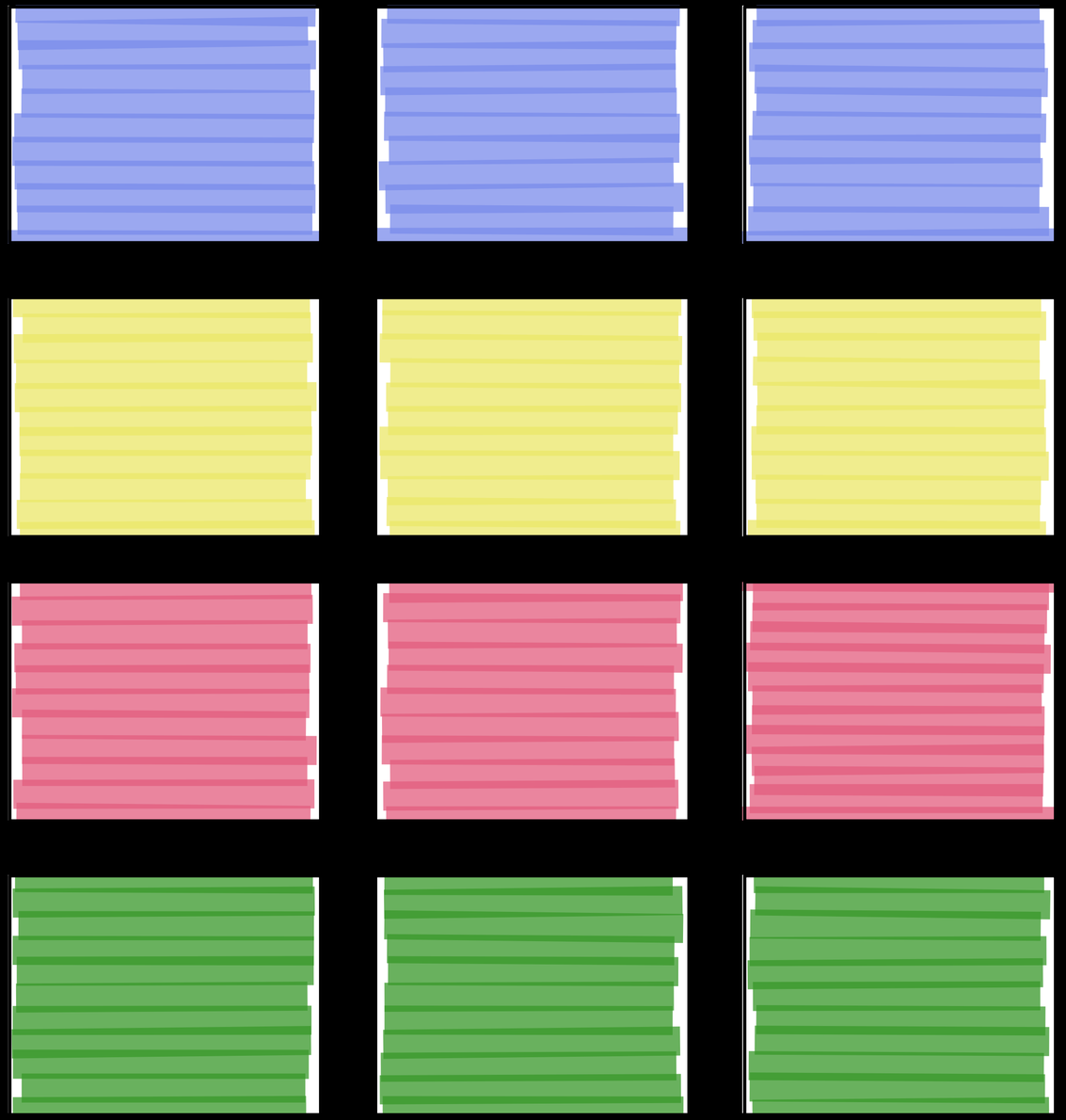
- Dublin - SCATS & Trips via dublinked
  - SCATS preliminary data
  - TRIPS - realtime
  - Census data
  - Manual vehicle count

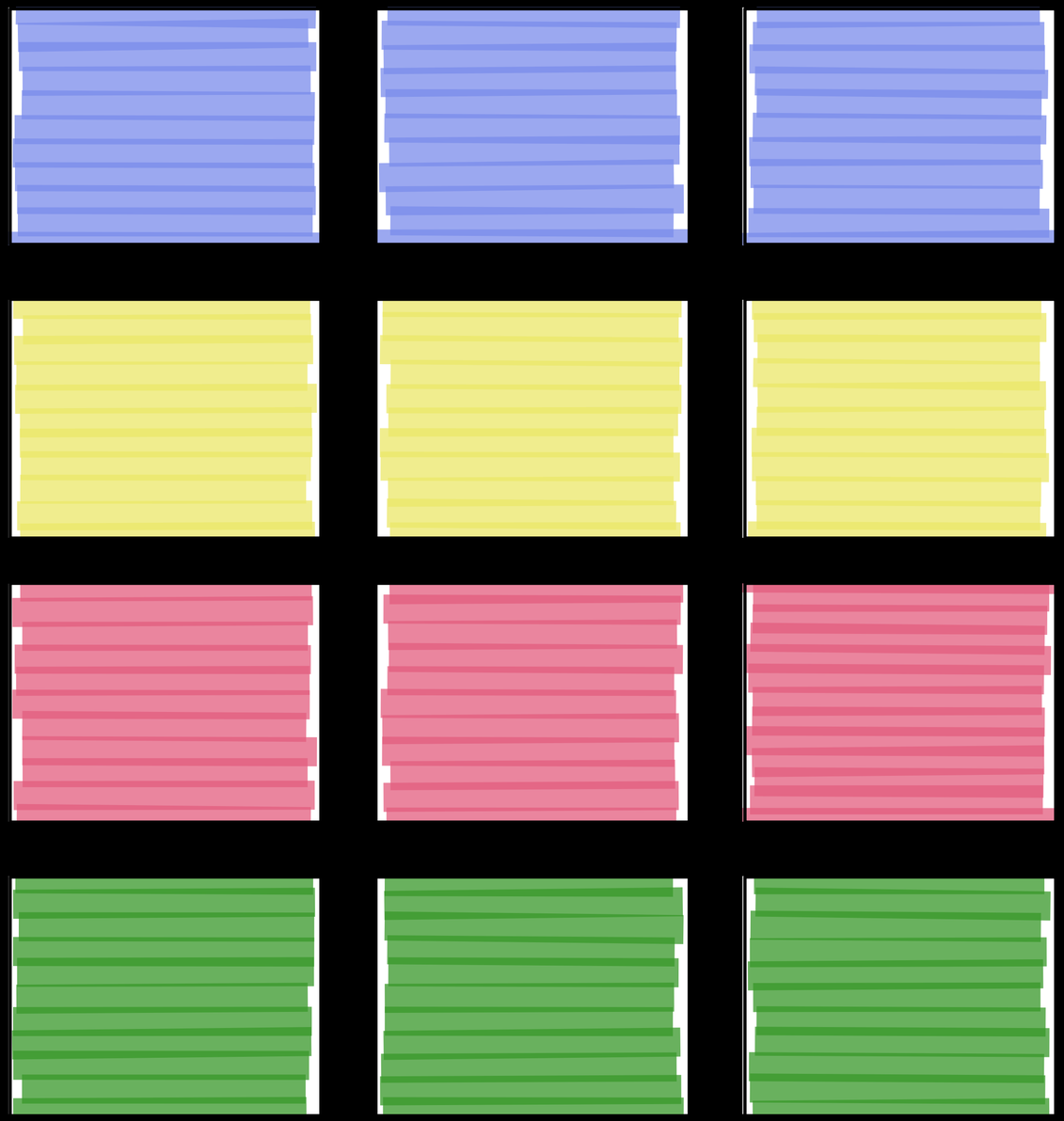


Scenario for inner city Dublin by Ronan Doolan

Partitioning







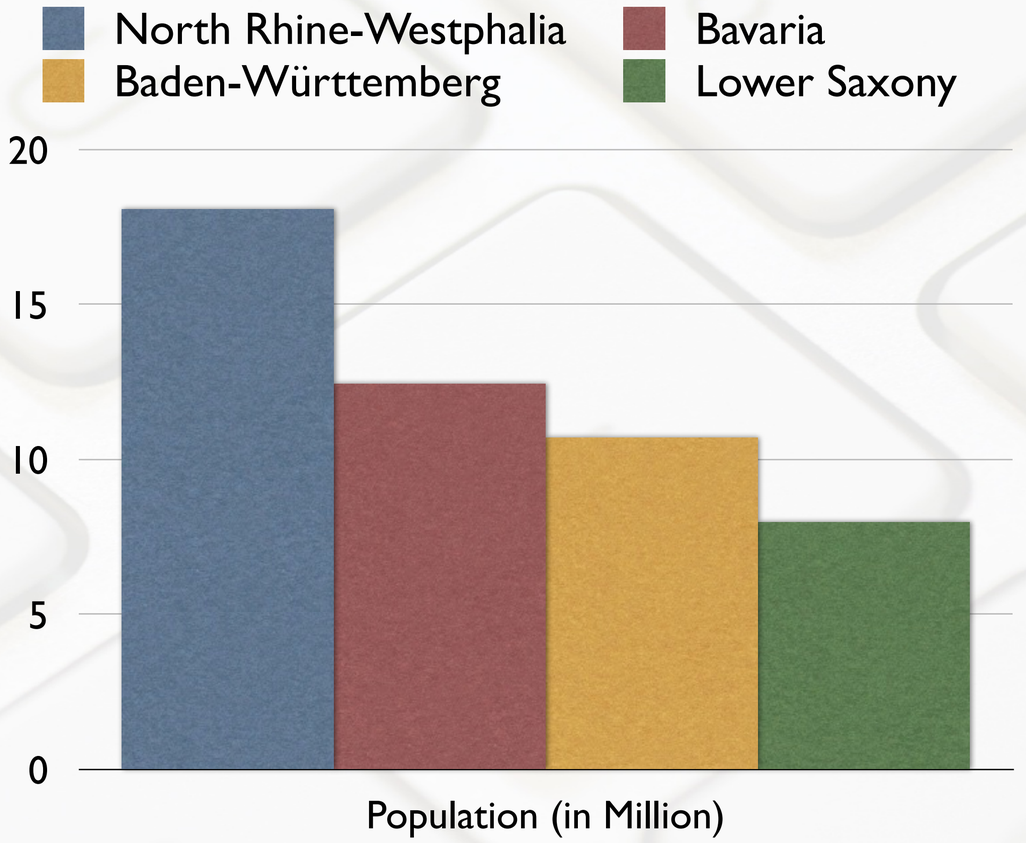
map & reduce

Map Partitioning

Quadtree

Quadtree

Quadtree

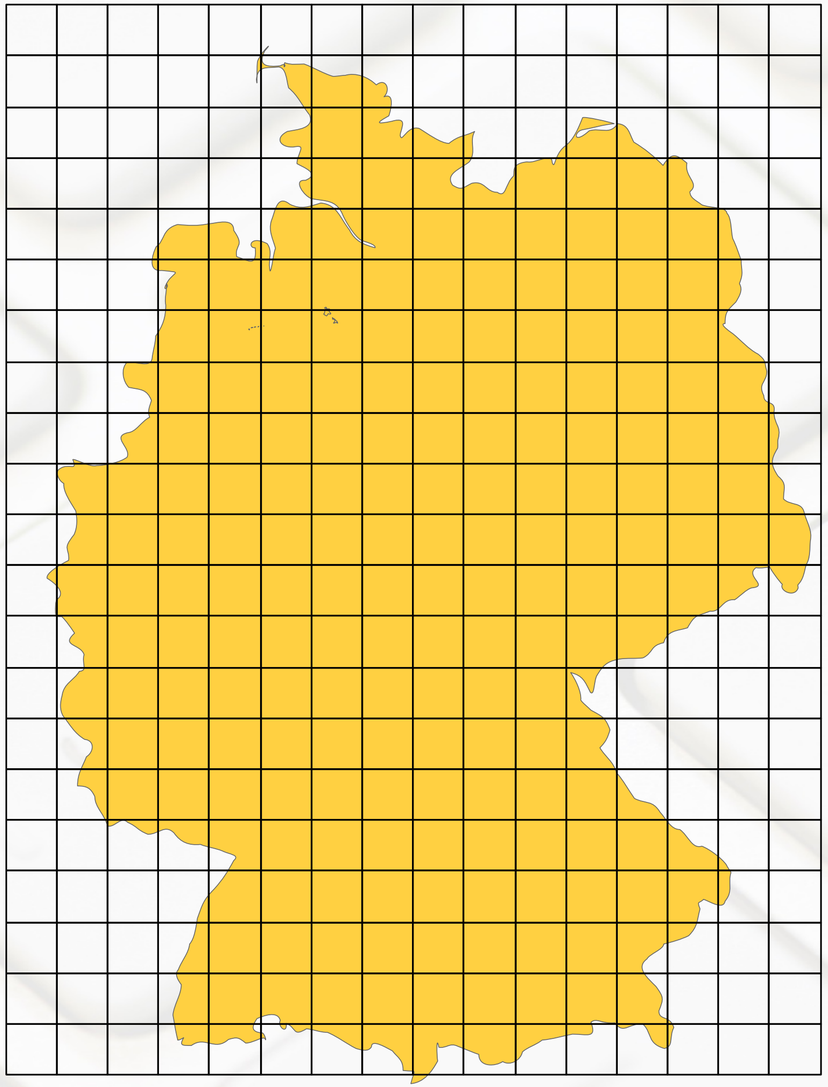

North Rhine-Westphalia
Bavaria
Baden-Württemberg
Lower Saxony
20
15
10
5
0
Population (in Million)

Region Growing

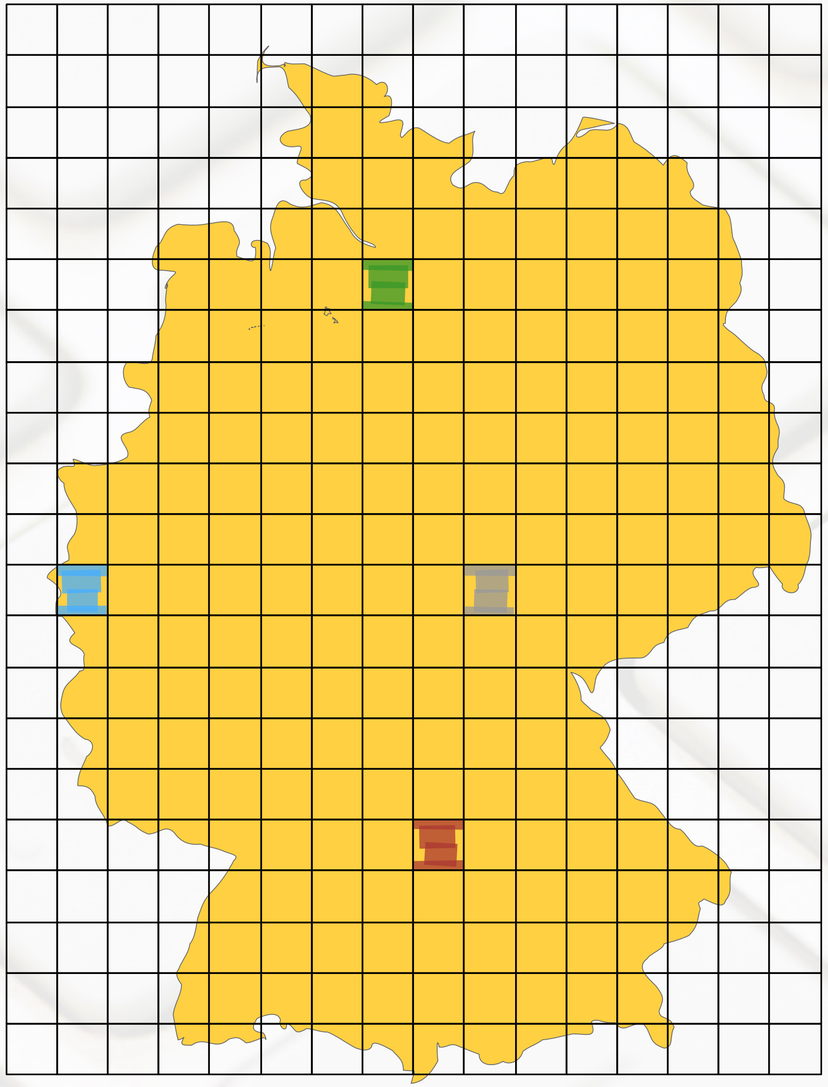
Region Growing

Region Growing

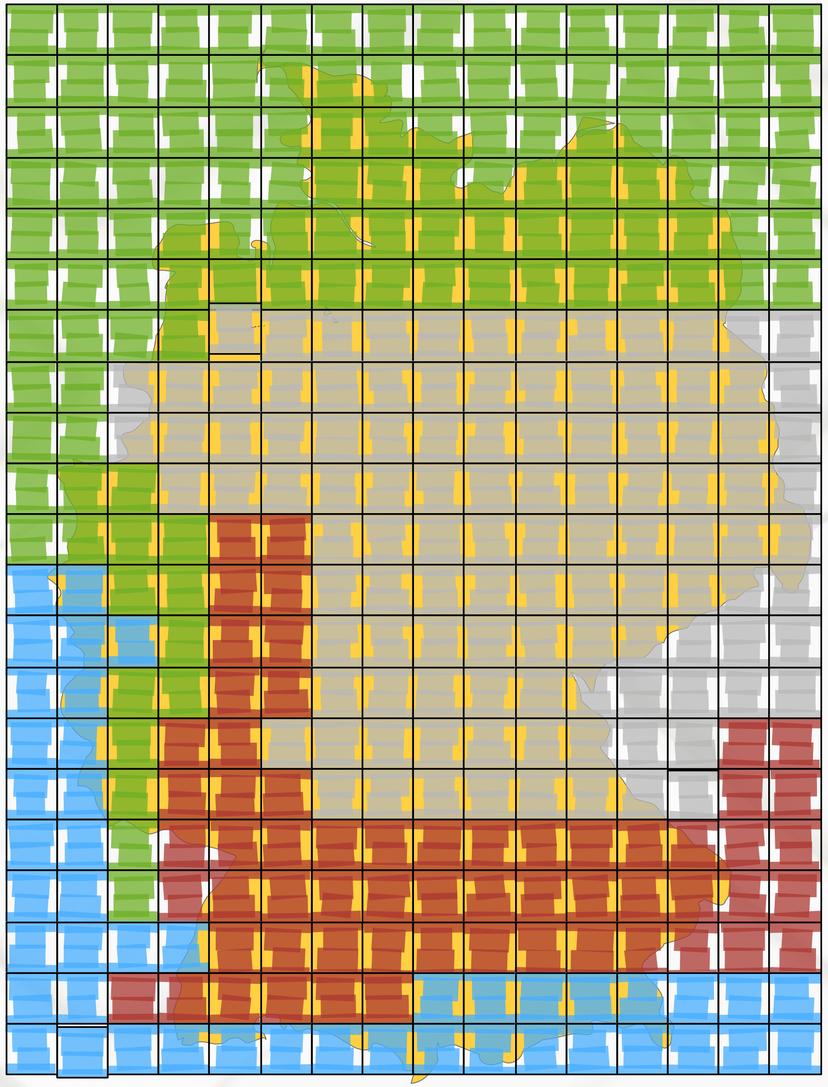
Smart Quadtree



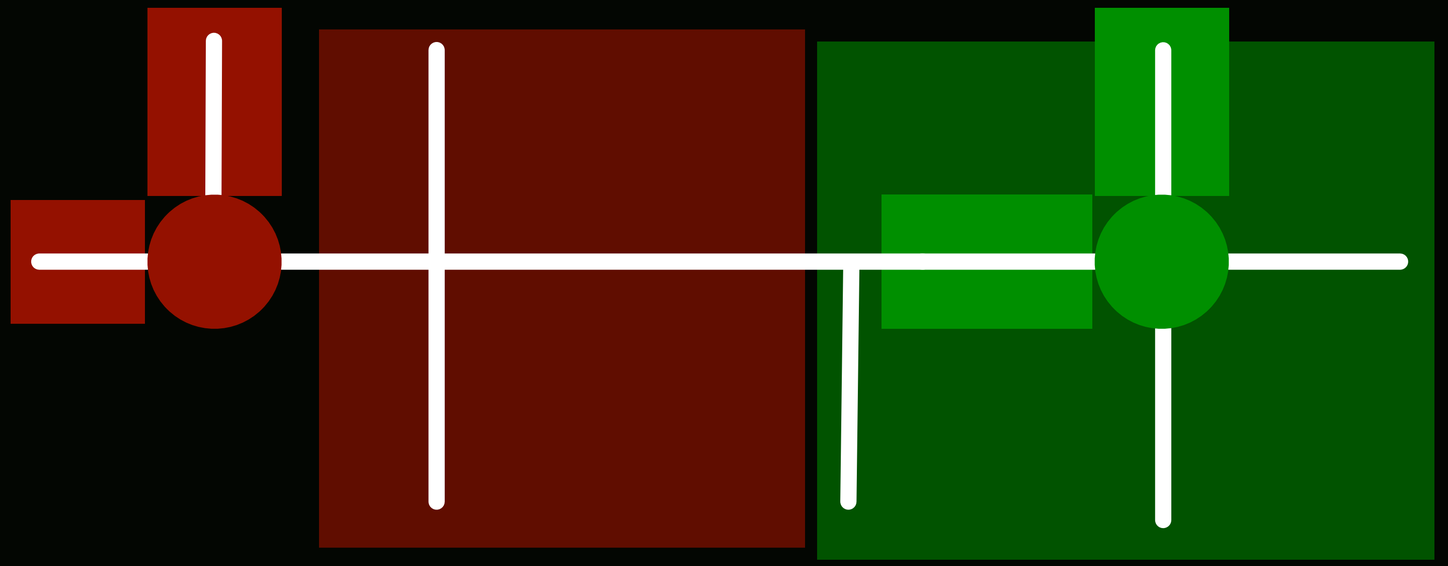
Smart Quadtree



Smart Quadtree

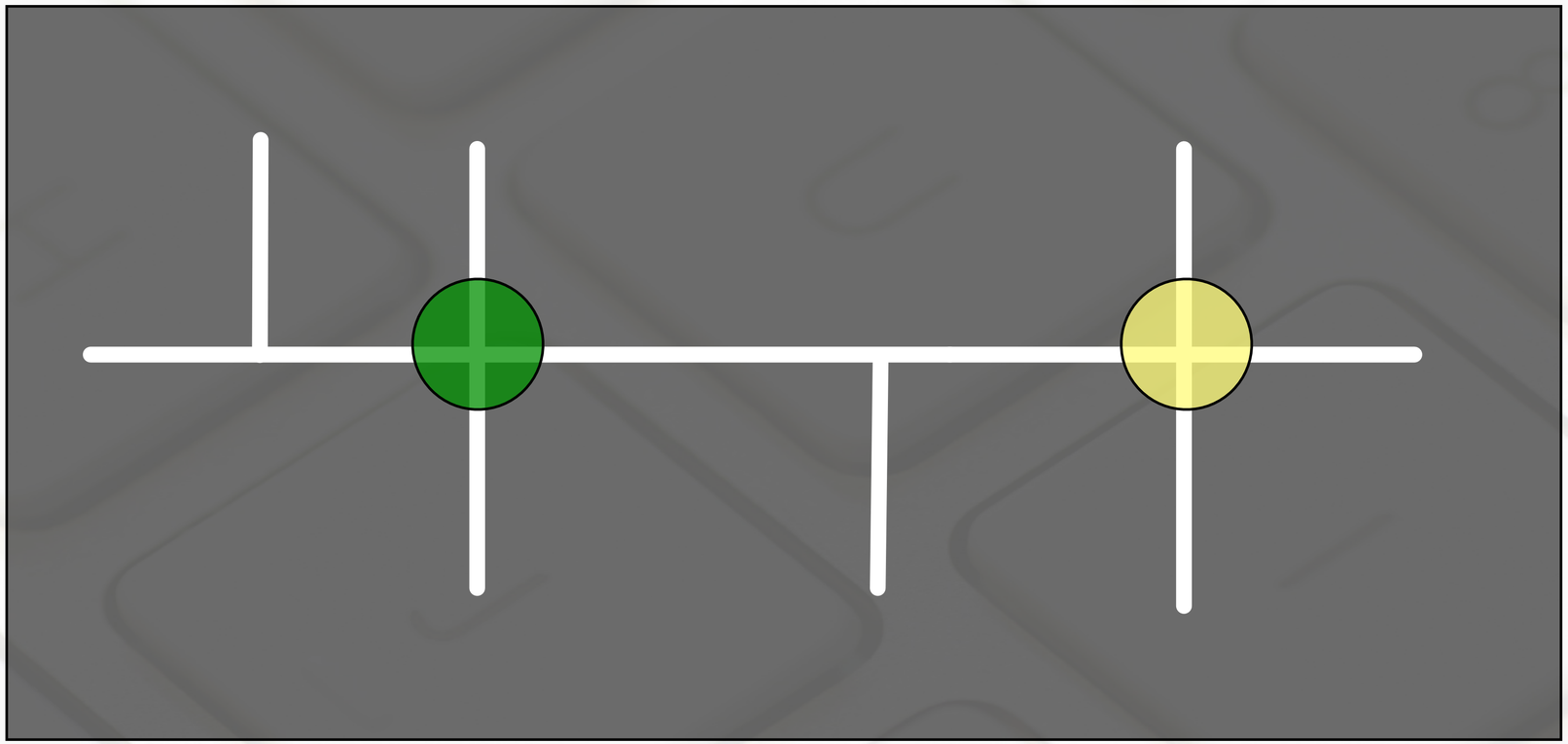


Region Growing

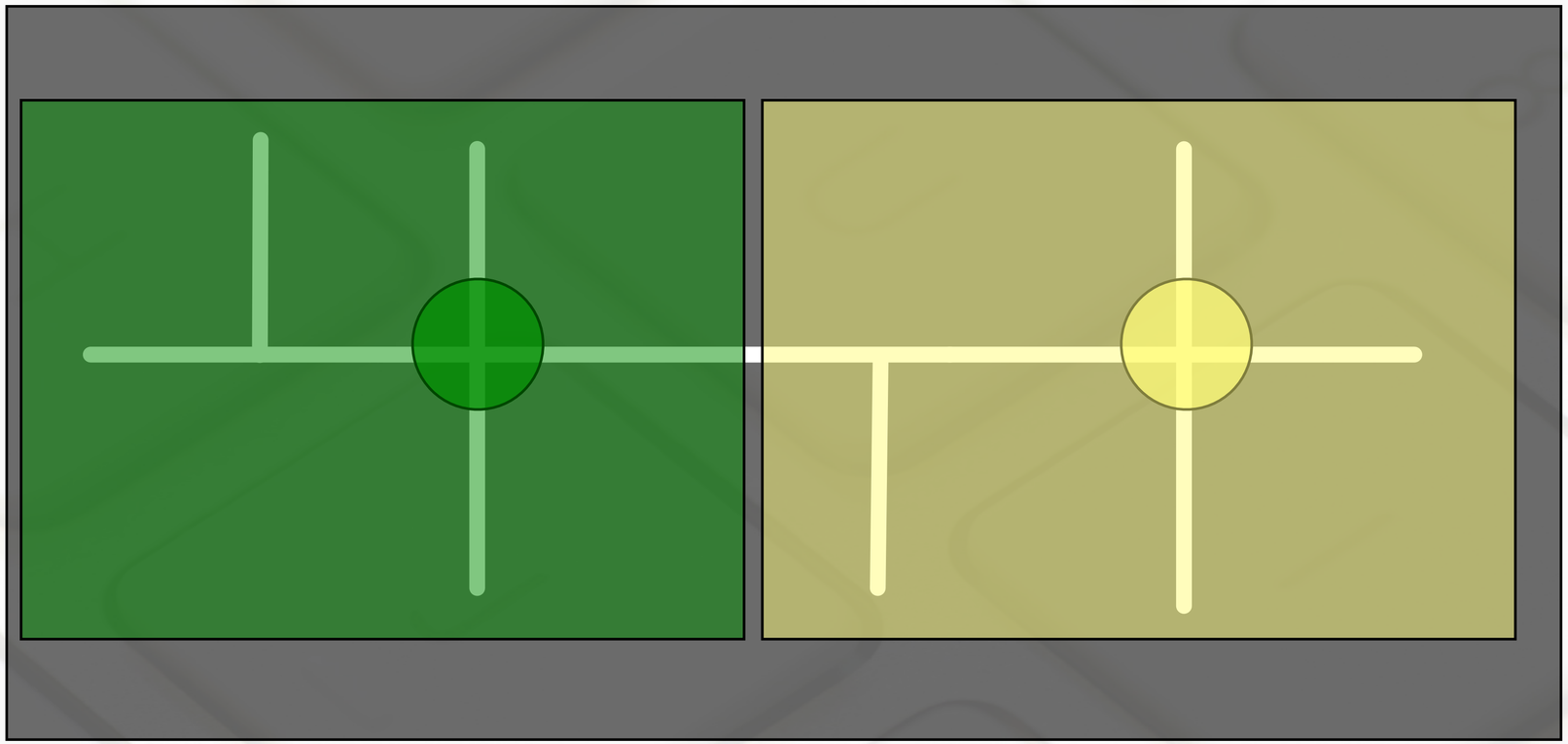


SParTSim

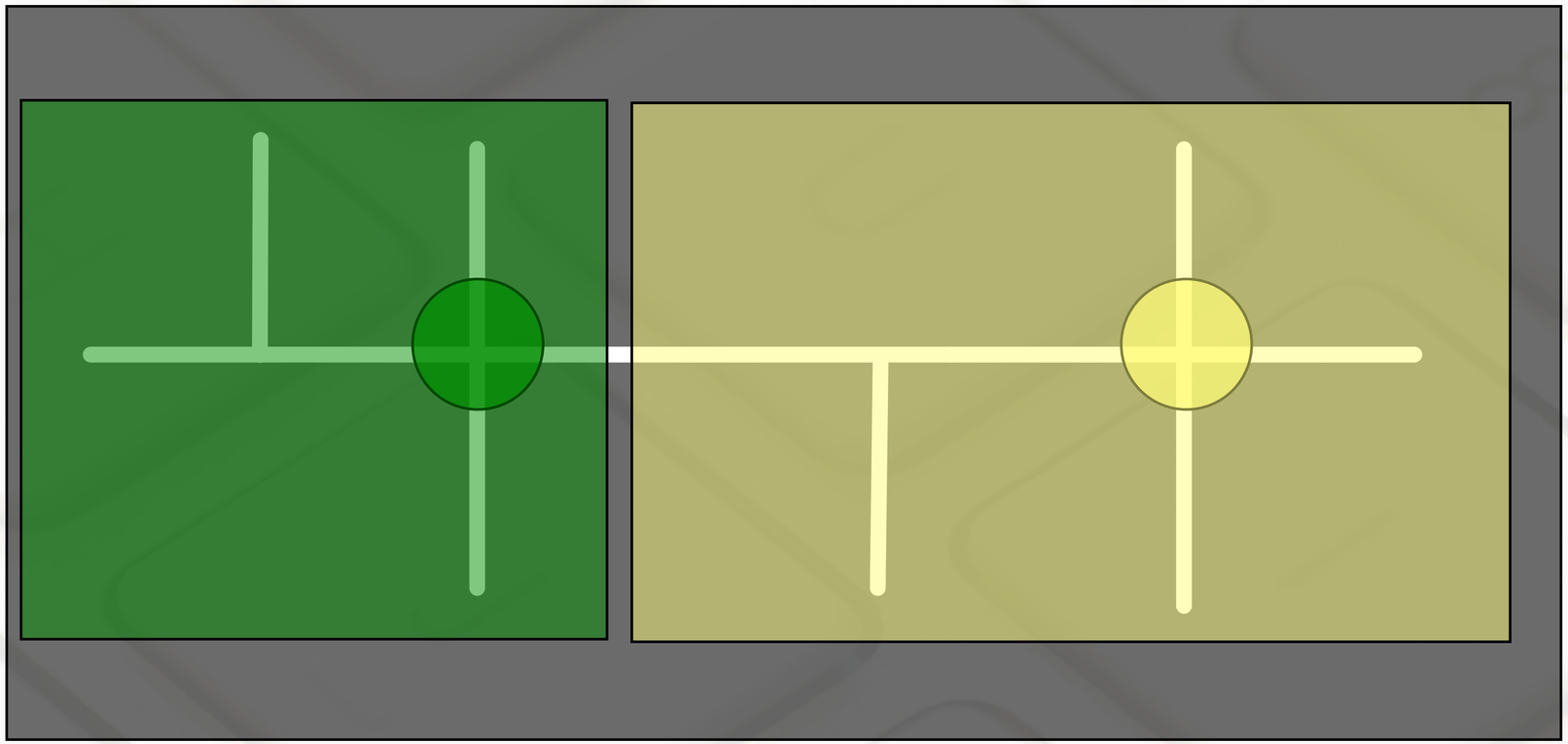
SParTSim



SParTSim



SParTSim



Heuristic

Heuristic

$$H(e) = dist(e)lanes(e)$$

Usage Data

Change Heuristic

- Use real-data / runtime data to improve partitioning
- Use volume data - TAPASCologne
- Can be calculated offline

Usage Data

$$N_w = \sum w_t \frac{c_{tn}}{c_t}$$

N_w Node weight

$$w_t = \frac{c_{tn}}{c_{max}}$$

c_{tn} cars at node

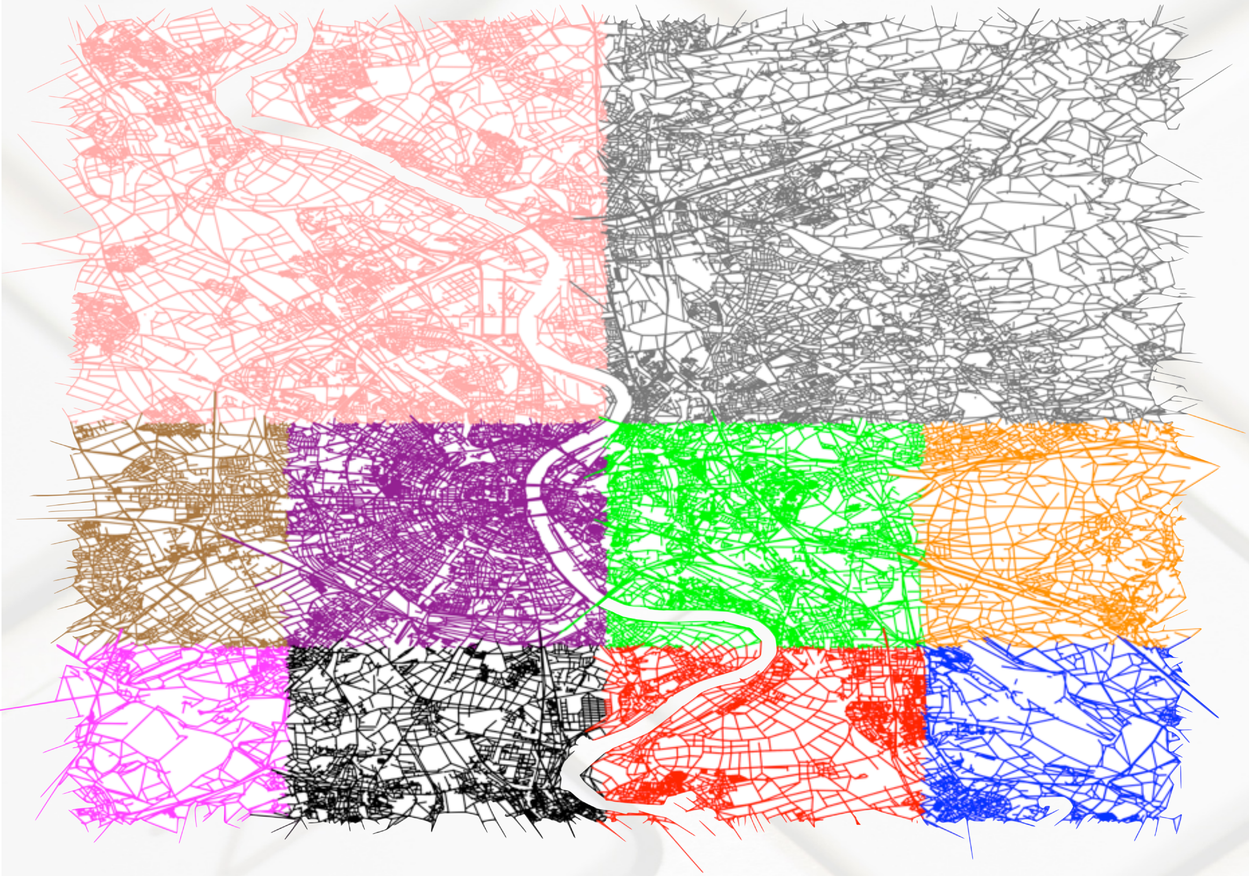
c_t total number of cars

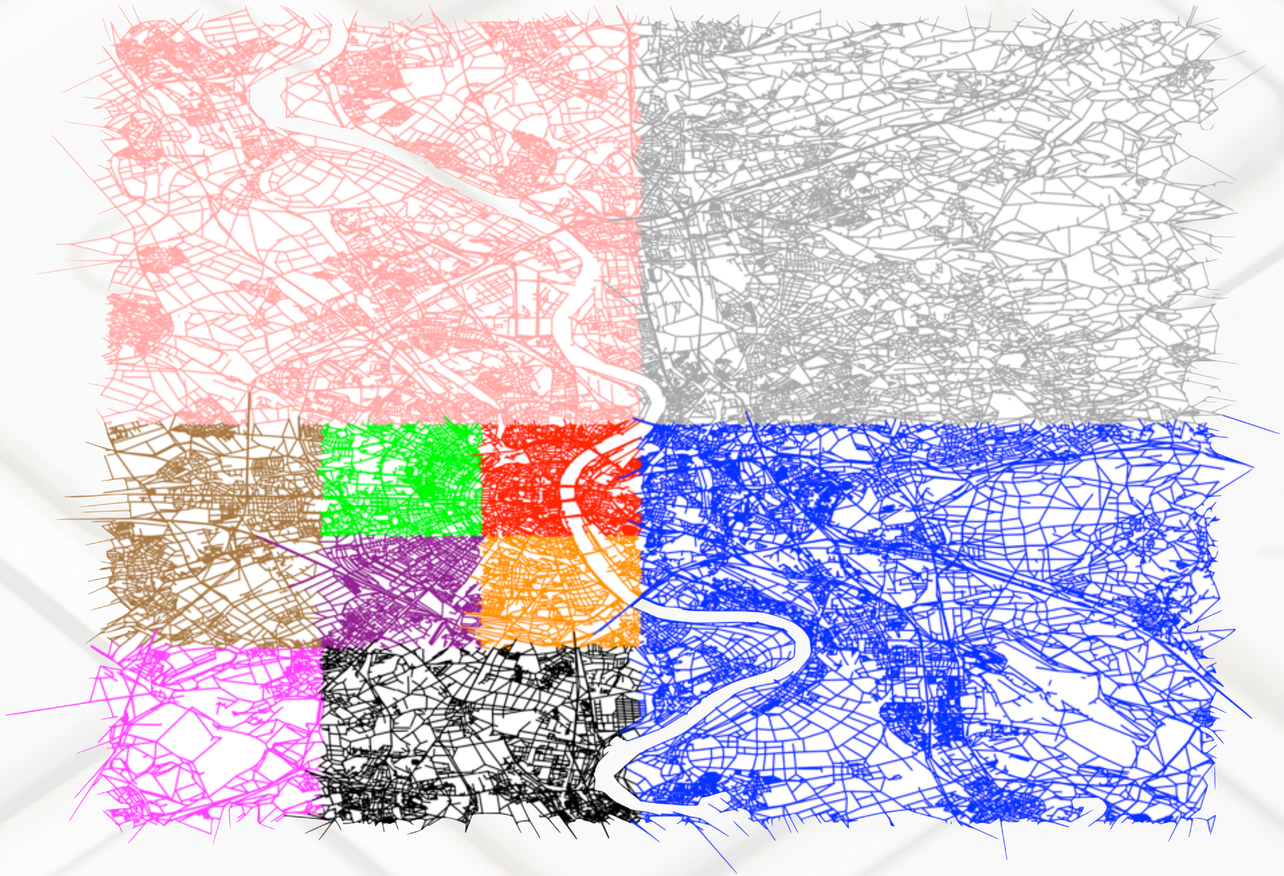
Extensions

Extension Quadtree

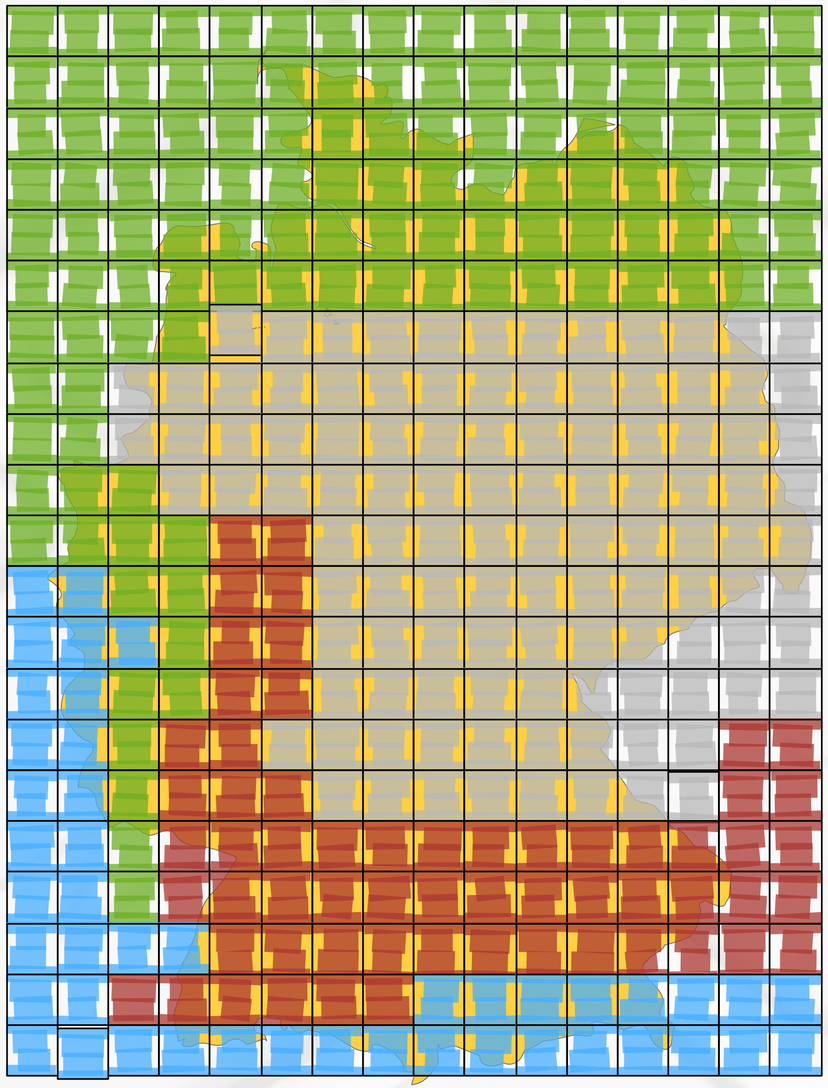
$$W_p = \sum N_{wp}$$

Extension Quadtree



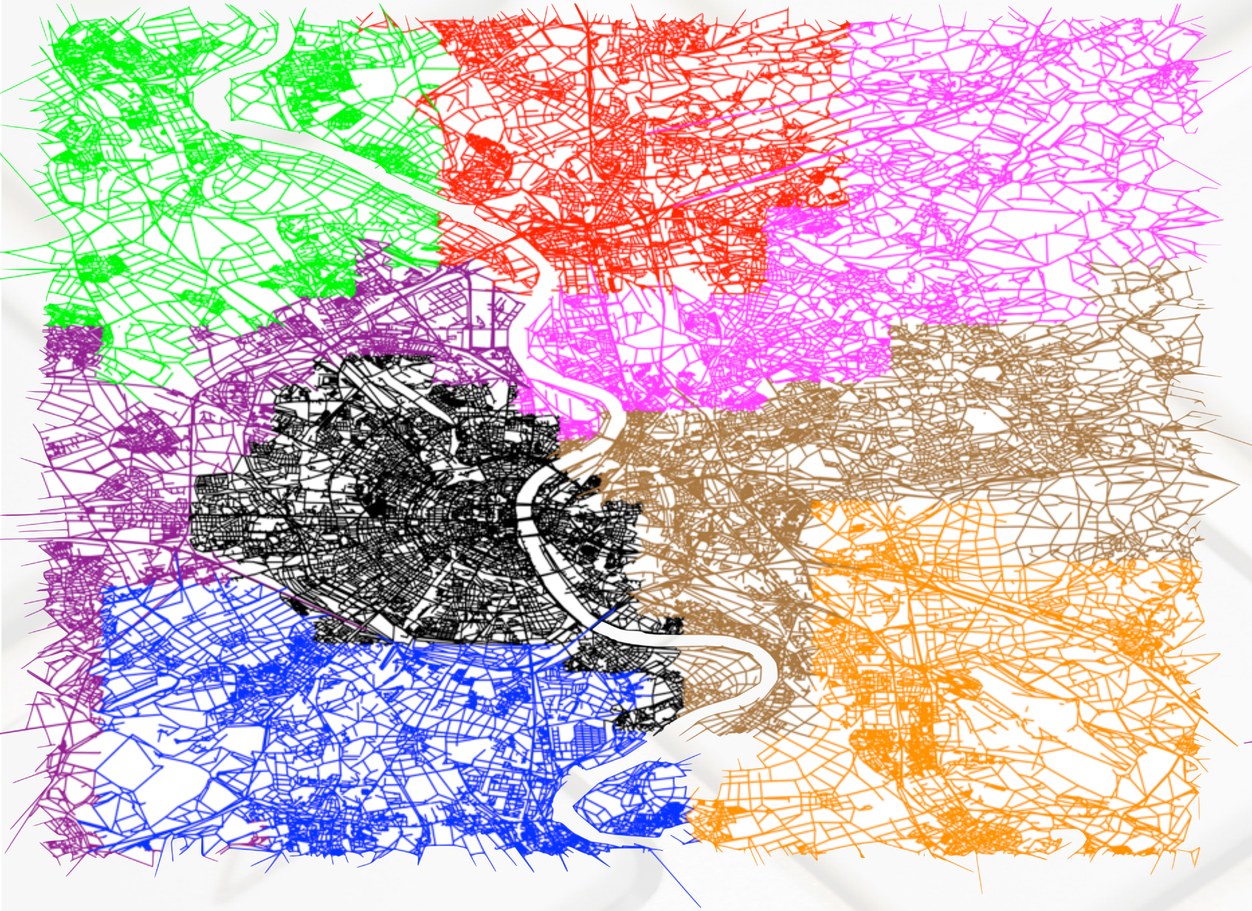


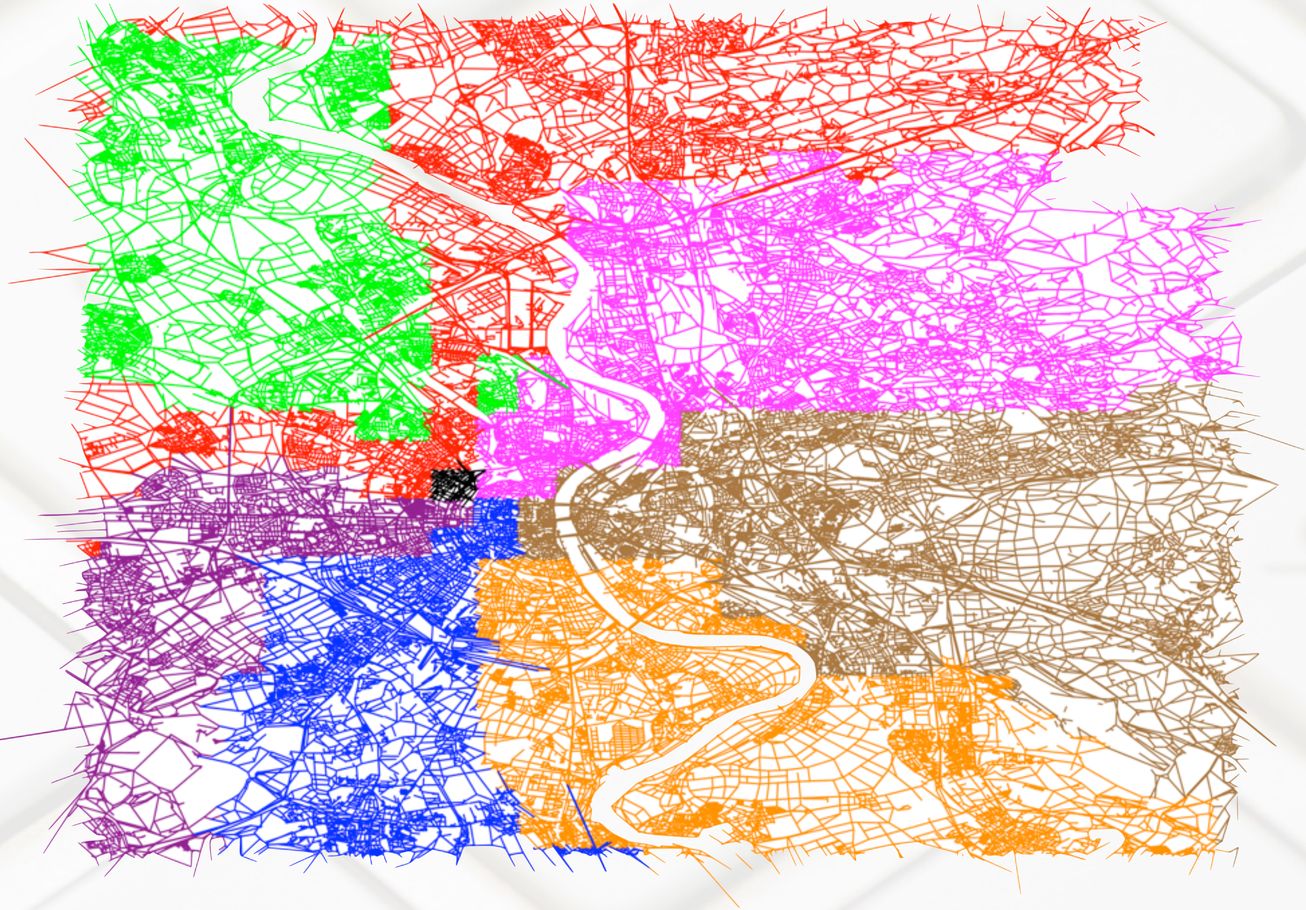
Extension Smart Quadtree



partition to join = $\sum N_{wp}$

Extension Smart Quadtree

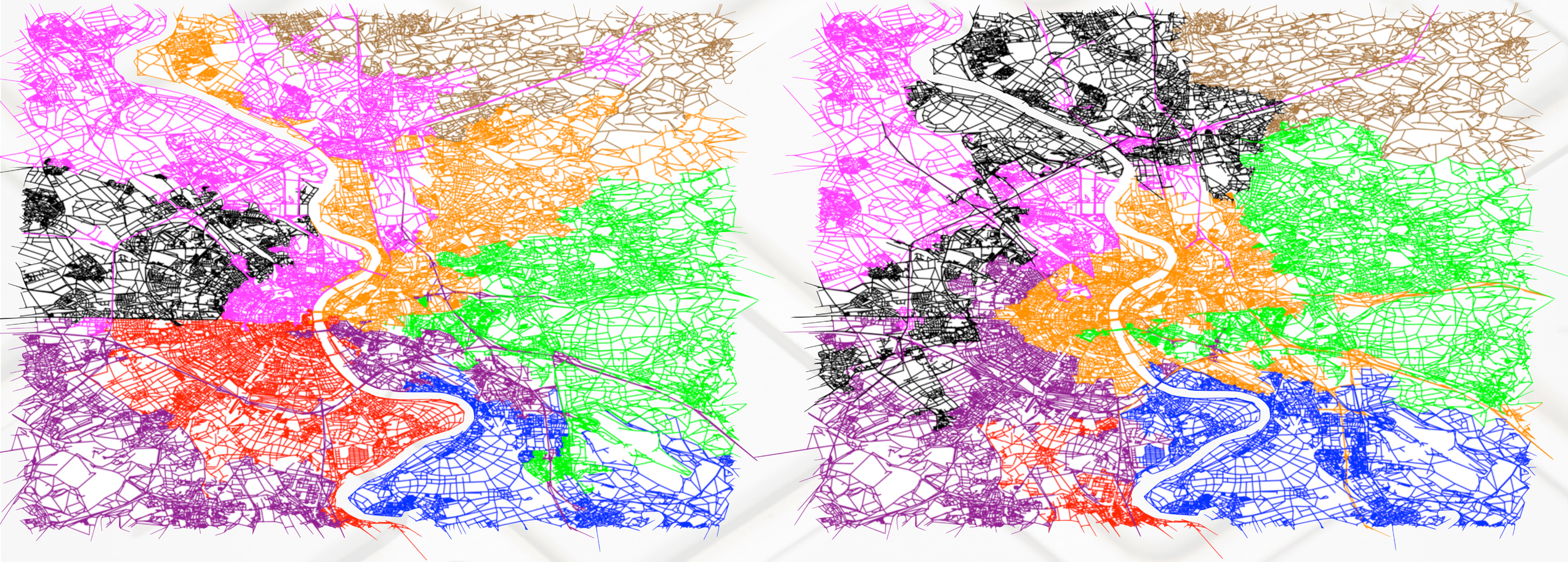




Extension SParTSim

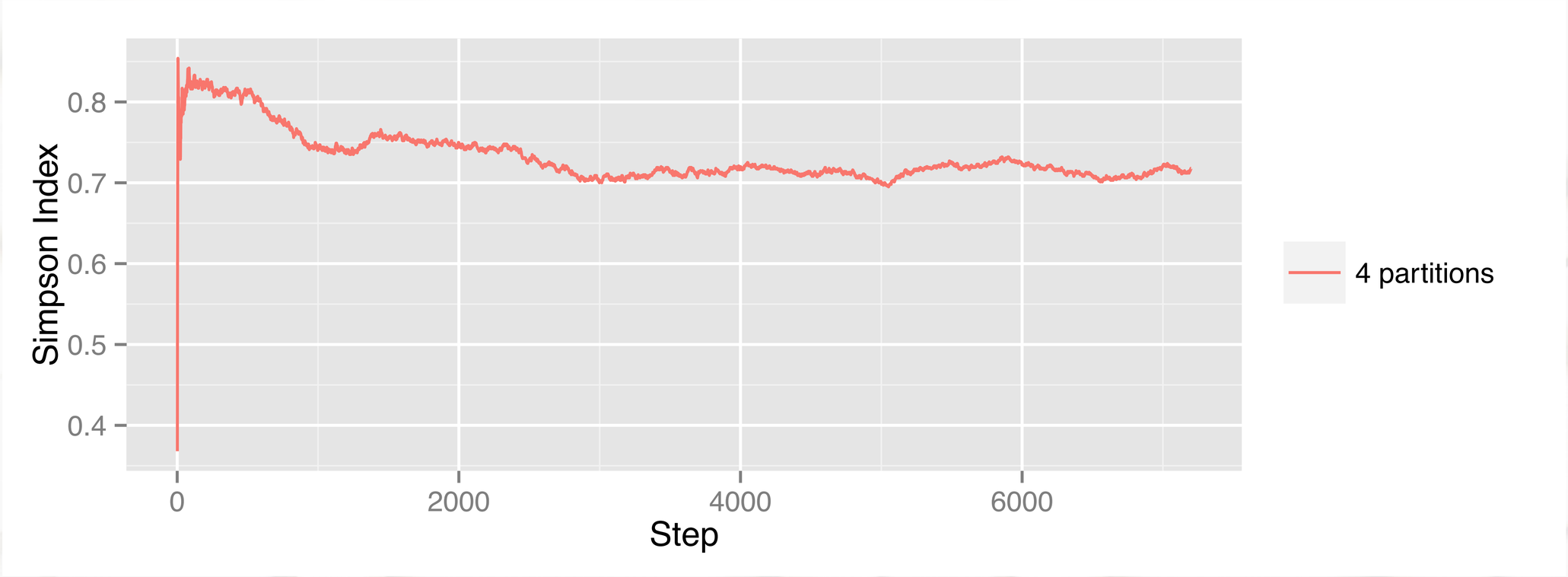
- Only start node selection was modified
- Trading phase uses the existing, established method
- Identify impact of starting node

Extension SParTSim

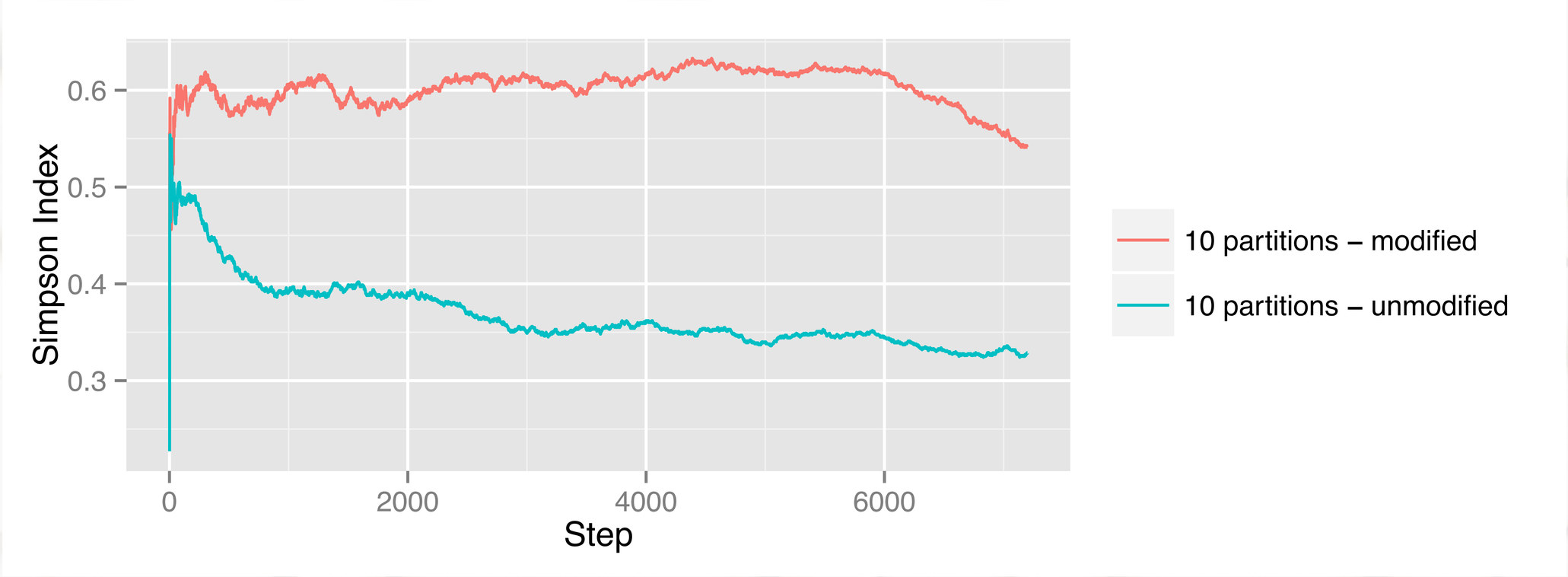


Equality

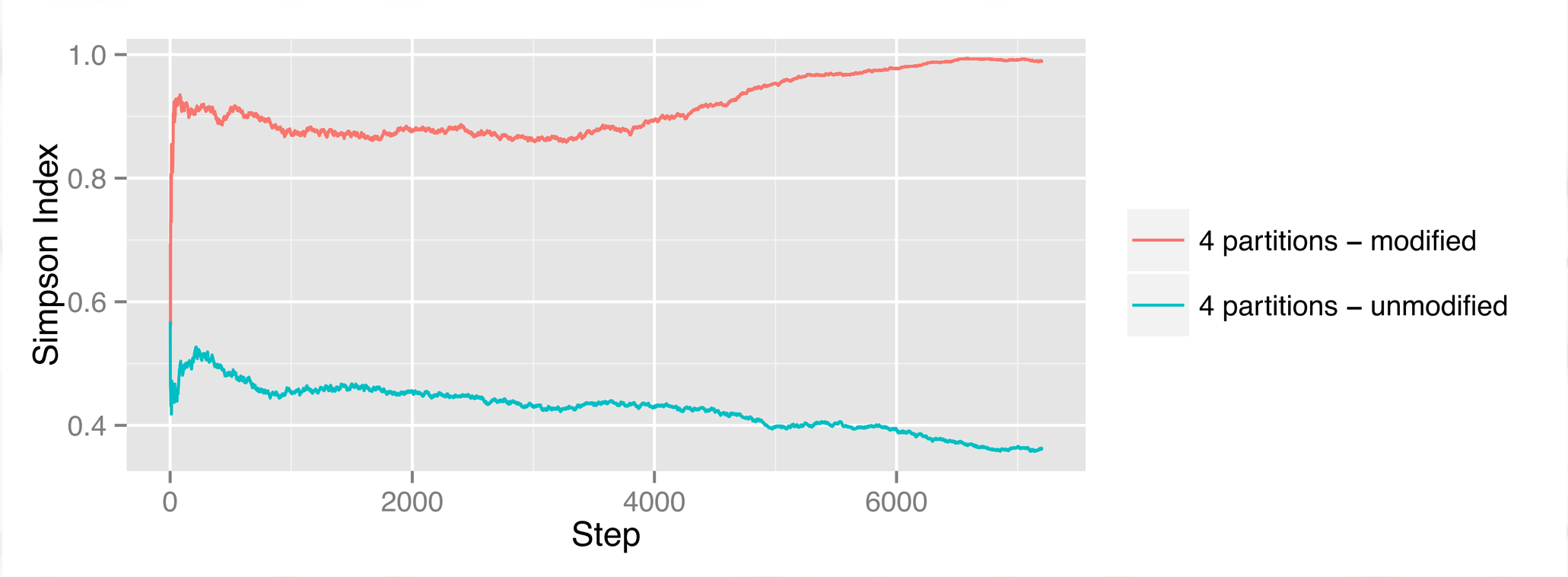
Equality QuadTree - 4



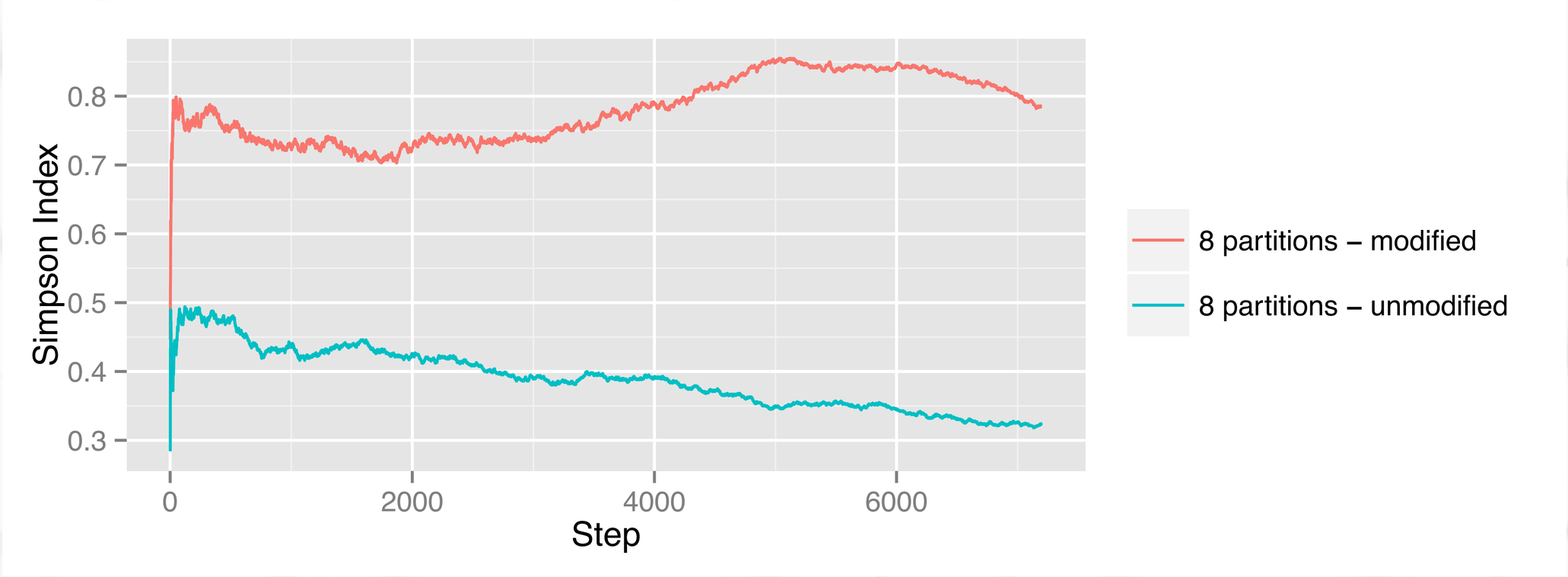
Equality QuadTree - 10



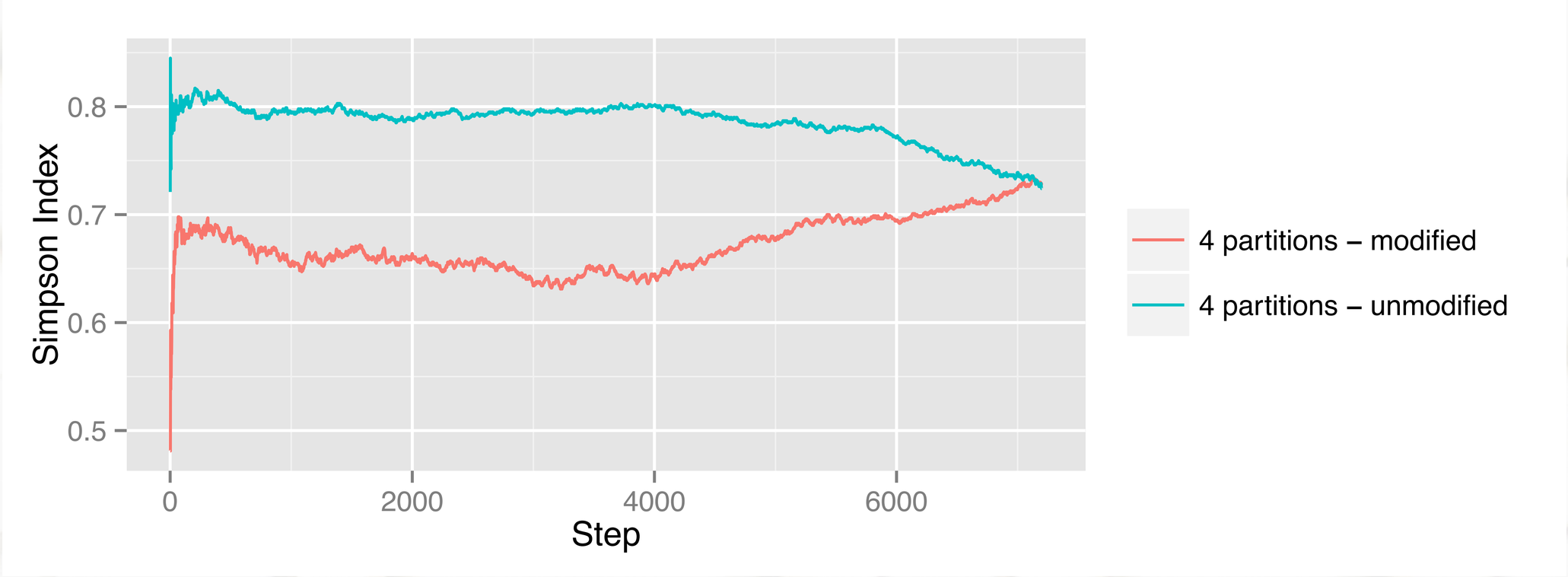
Equality - Smart QT - 4



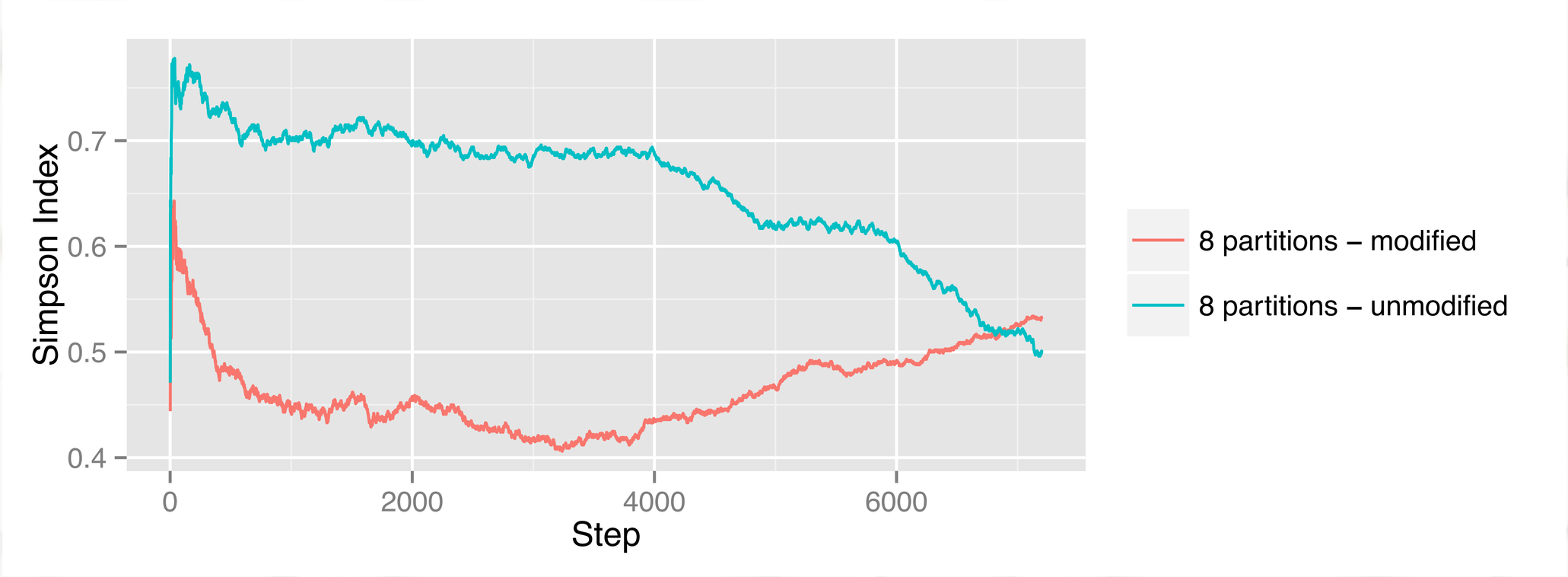
Equality - Smart QT 8



Equality - SParTSim - 4



Equality - SParTSim 8



Conclusion

- Using volume data can improve partitioning
- Smart Quadtree (modified) can achieve better results than SParTSim

Questions?

Ulrich Dangel

@mr_ud
ulrich@dangel.im

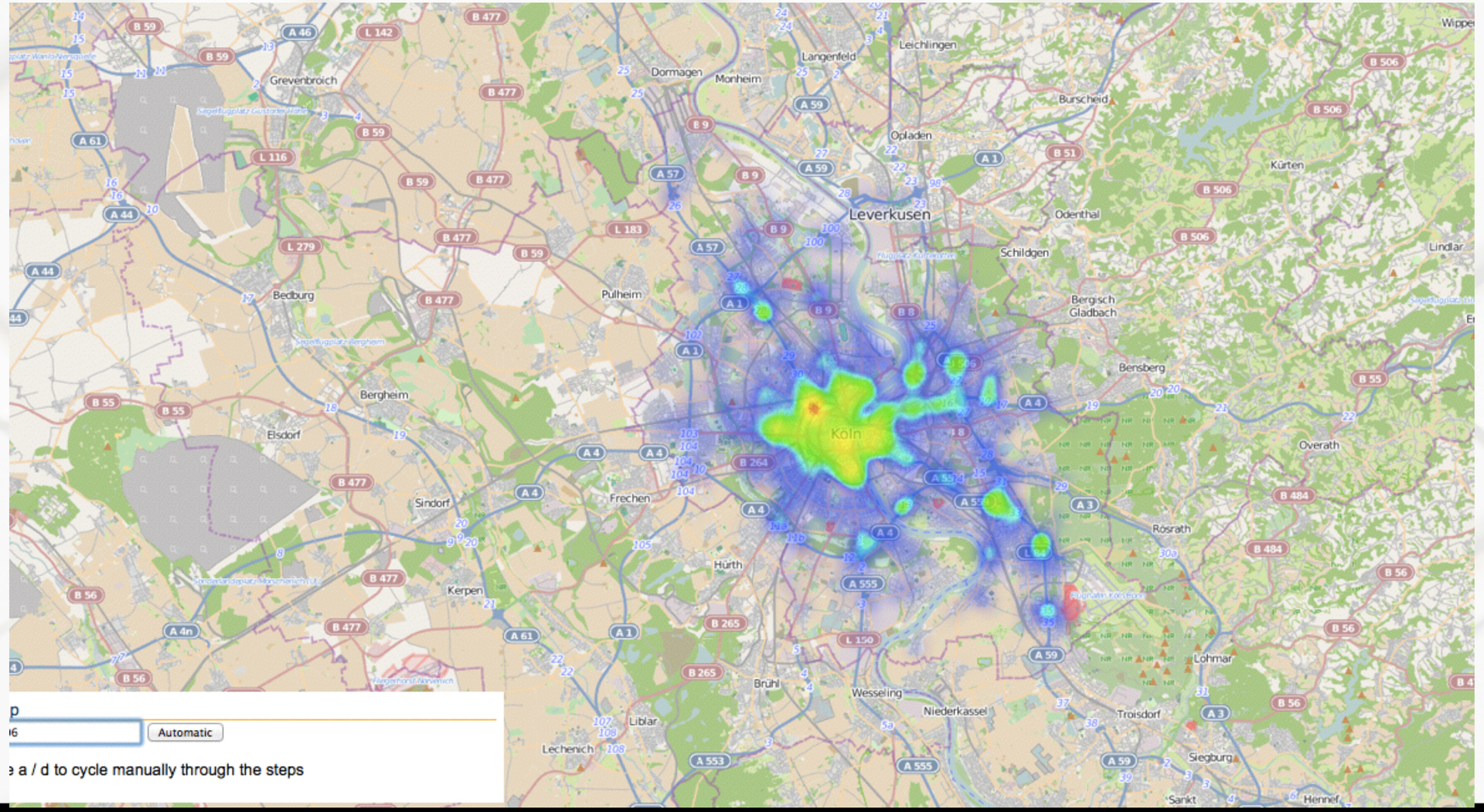
Outlook

- Update dSUMO to support latest SUMO
  - Switch to embedded Python
- Evaluate repartitioning strategies

Wishlist ;)

- Speed up TRaCI
- Maybe luas scripting interface?

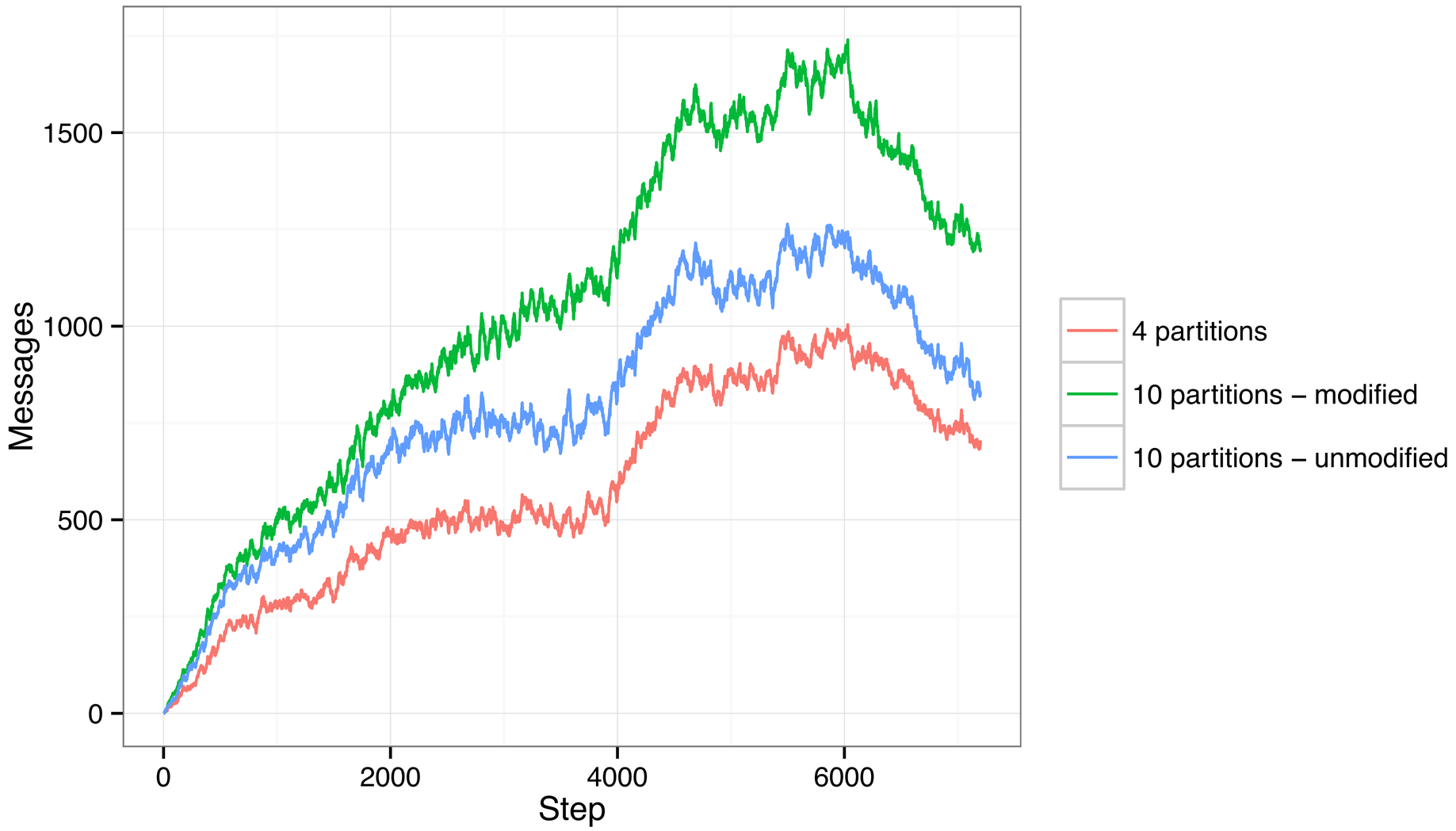
Visualisation



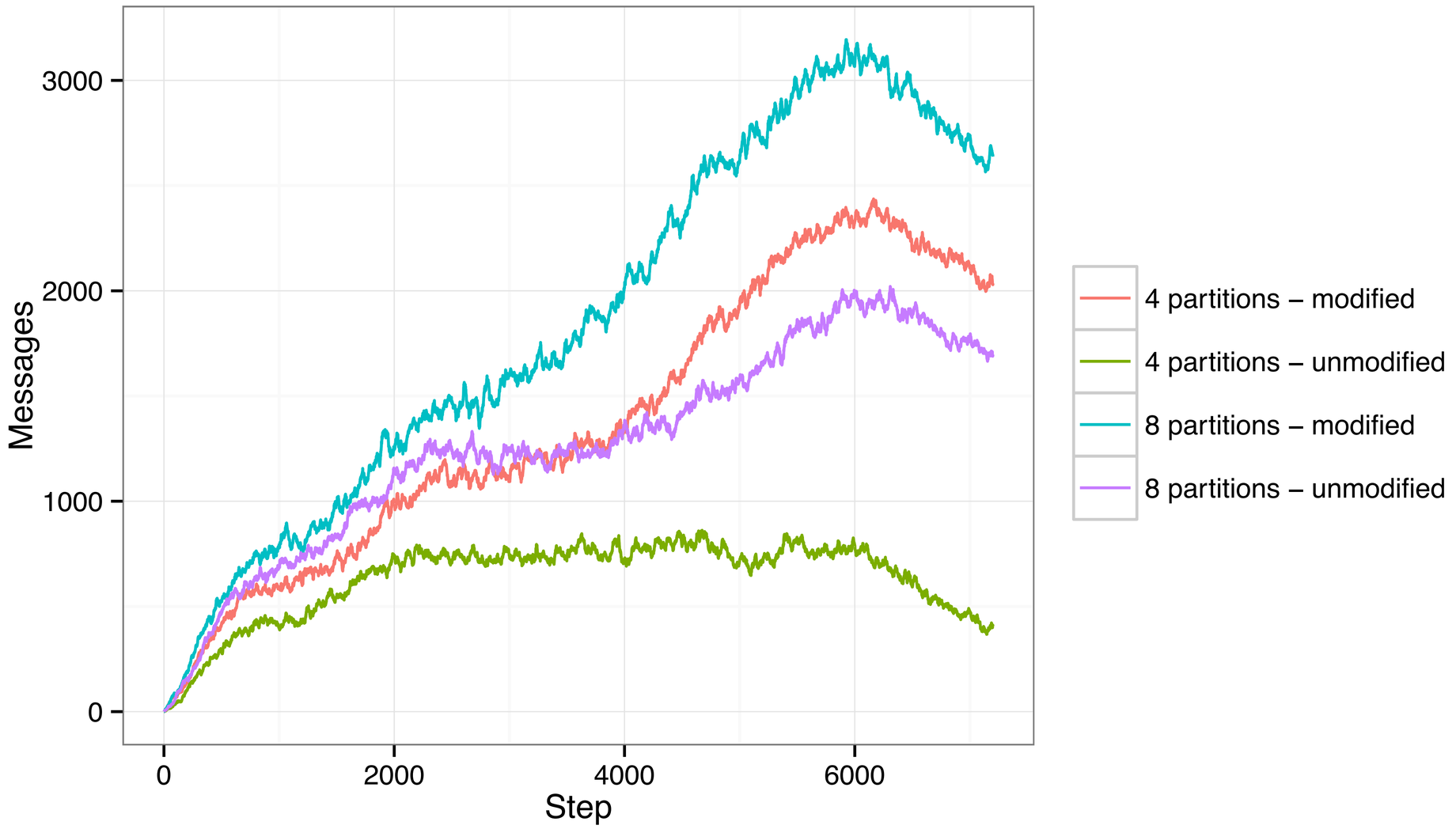
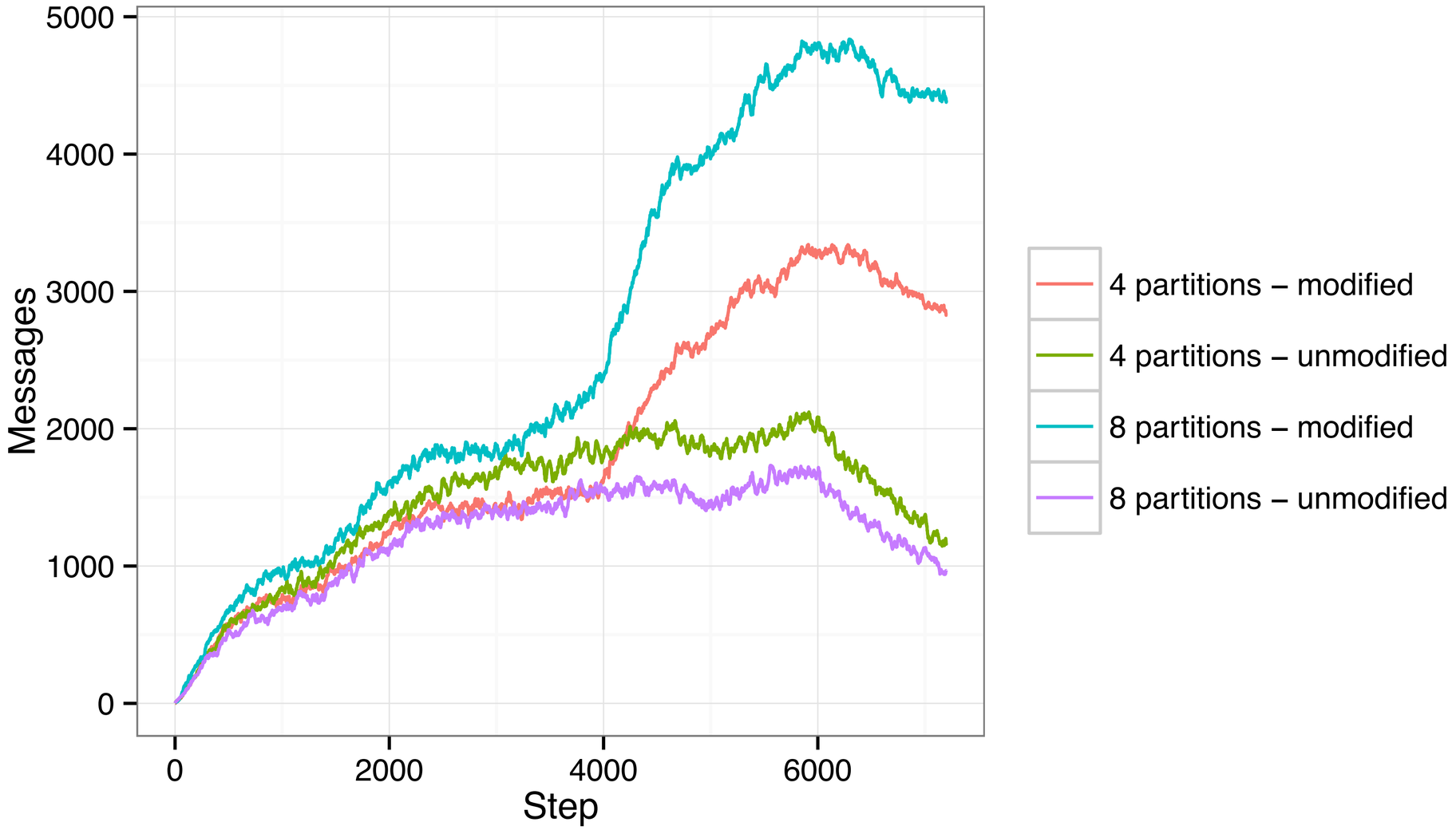
Simpson Diversity Index

$$D_t = \frac{1}{\sum_{p=0}(C_p/C_t)^2 p}$$

Communication - QT



Communication - Smart QT



Communication