A multi-dimensional percolation approach to characterize sustainable mega-city regions

J. Raimbault[1,2,*]

juste.raimbault@polytechnique.edu

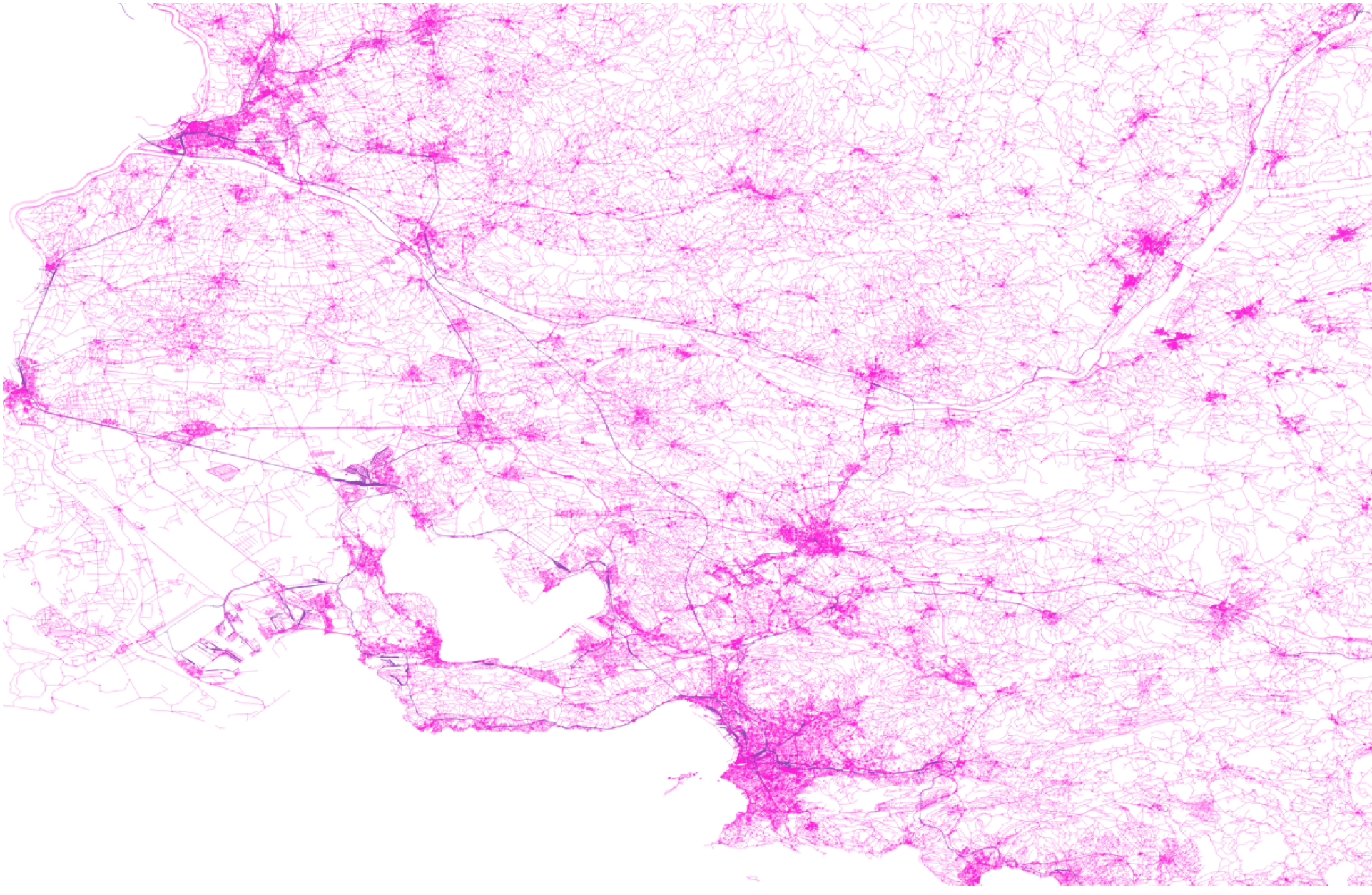
[1]Complex Systems Institute, Paris, UPS CNRS 3611 ISC-PIF
[2]UMR CNRS 8504 Géographie-cités

MARAMI 2018

Avignon

October 18th 2018

Morphologies of networks and territories



Source: OpenStreetMap

Characterizing Road networks

Multiple dimensions to characterize road networks

Lagesse, C., Bordin, P., & Douady, S. (2015). A spatial multi-scale object to analyze road networks. Network Science, 3(1), 156-181. [Lagesse et al., 2015]

Network percolation

Network percolation: *progressive occupation/connection of nodes of a network* [Callaway et al., 2000]

Application to the study of cities:

- modeling urban growth [Makse et al., 1998]
- endeogenous determination of regions [Arcaute et al., 2016]
- characterization of spatial point patterns [Huynh et al., 2018]

Towards complementary dimensions to condition road network percolation
$\rightarrow$ similar to [Cottineau et al., 2018] to define urban areas

Multidimensional percolation

$\rightarrow$

$\rightarrow$

Research objective :

Formalization

Empirical data and variables

Experience plan

Results: endogenous mega-regions

Characterizing sustainibility

Results: Pareto fronts

Extrapolating transportation flows

Calibration

Discussion

Implications

→

→

Developments

→

Conclusion

→

→

→

Related works

Raimbault, J. (2018). Calibration of a density-based model of urban morphogenesis. PloS one, 13(9), e0203516.

Raimbault, J. (2018). An Urban Morphogenesis Model Capturing Interactions between Networks and Territories. *Forthcoming in Mathematics or Urban Morphogenesis.* arXiv:1805.05195.

Raimbault, J. (2018). Caractérisation et modélisation de la co-évolution des réseaux de transport et des territoires (Doctoral dissertation, Université Paris 7 Denis Diderot). `https://halshs.archives-ouvertes.fr/tel-01857741`

Open repository at `https://github.com/JusteRaimbault/UrbanMorphology`

Acknowledgments: thanks to the *EGI* for access to the infrastructure.

Reserve Slides

References I


Arcaute, E., Molinero, C., Hatna, E., Murcio, R., Vargas-Ruiz, C., Masucci, A. P., and Batty, M. (2016).
Cities and regions in britain through hierarchical percolation.
Royal Society open science, 3(4):150691.


Callaway, D. S., Newman, M. E., Strogatz, S. H., and Watts, D. J. (2000).
Network robustness and fragility: Percolation on random graphs.
Physical review letters, 85(25):5468.


Cottineau, C., Finance, O., Hatna, E., Arcaute, E., and Batty, M. (2018).
Defining urban clusters to detect agglomeration economies.
Environment and Planning B: Urban Analytics and City Science, page 2399808318755146.

References II


Huynh, H. N., Makarov, E., Legara, E. F., Monterola, C., and Chew, L. Y. (2018).
Characterisation and comparison of spatial patterns in urban systems: A case study of us cities.
Journal of computational science, 24:34–43.


Lagesse, C., Bordin, P., and Douady, S. (2015).
A spatial multi-scale object to analyze road networks.
Network Science, 3(1):156–181.


Makse, H. A., Andrade, J. S., Batty, M., Havlin, S., Stanley, H. E., et al. (1998).
Modeling urban growth patterns with correlated percolation.
Physical Review E, 58(6):7054.