# Building simulation models coupling territorial and network dynamics at the interface of disciplines and scales

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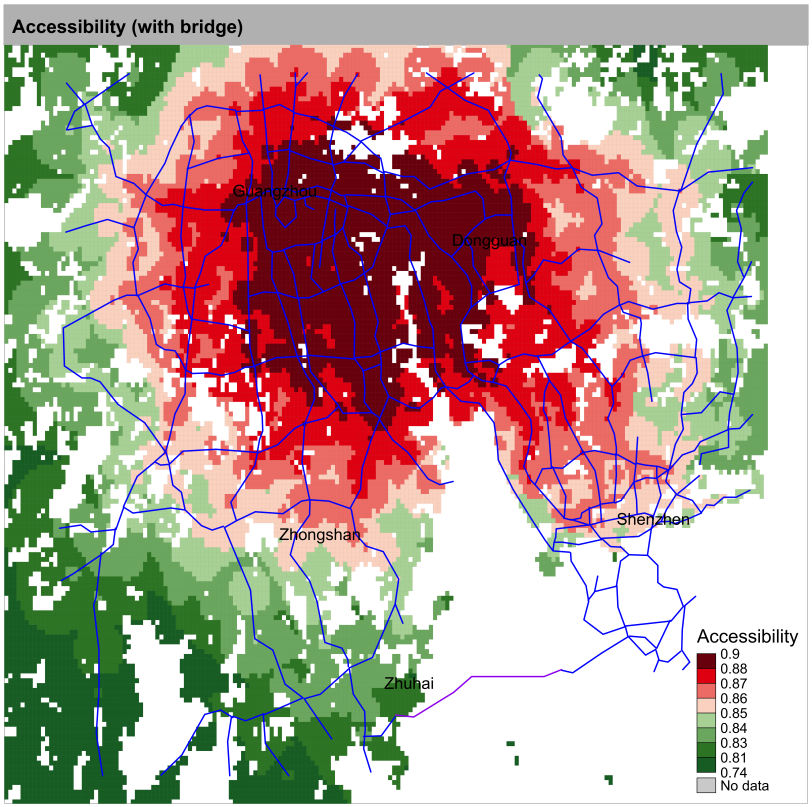
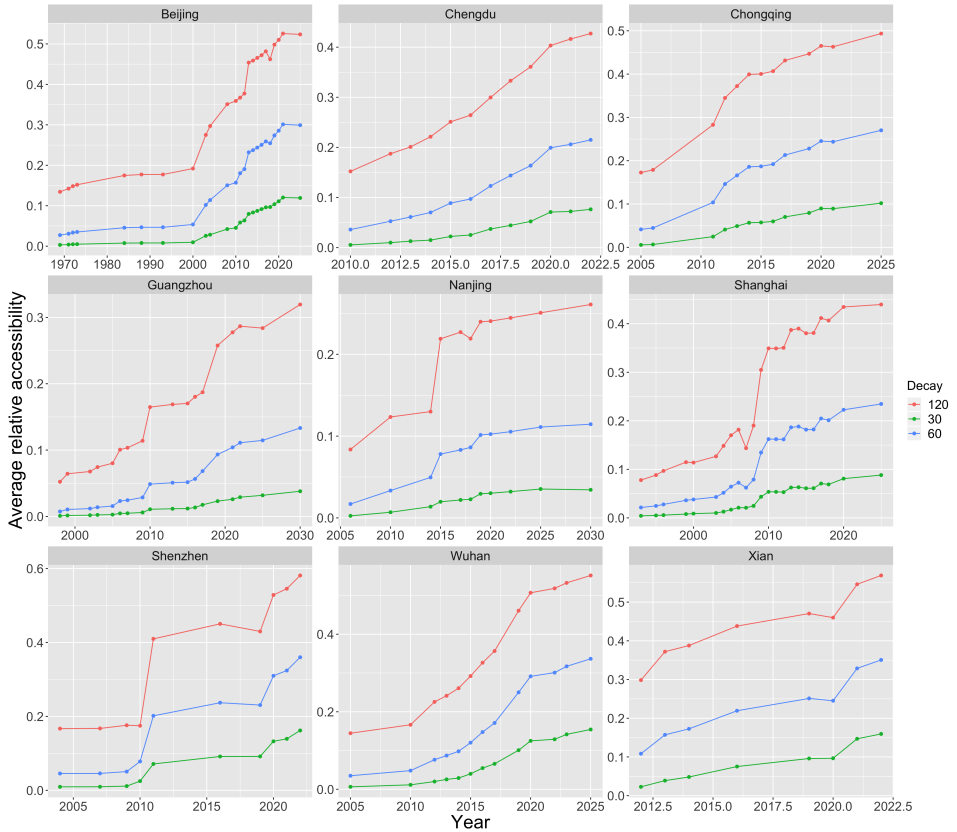
# Interactions between networks and territories



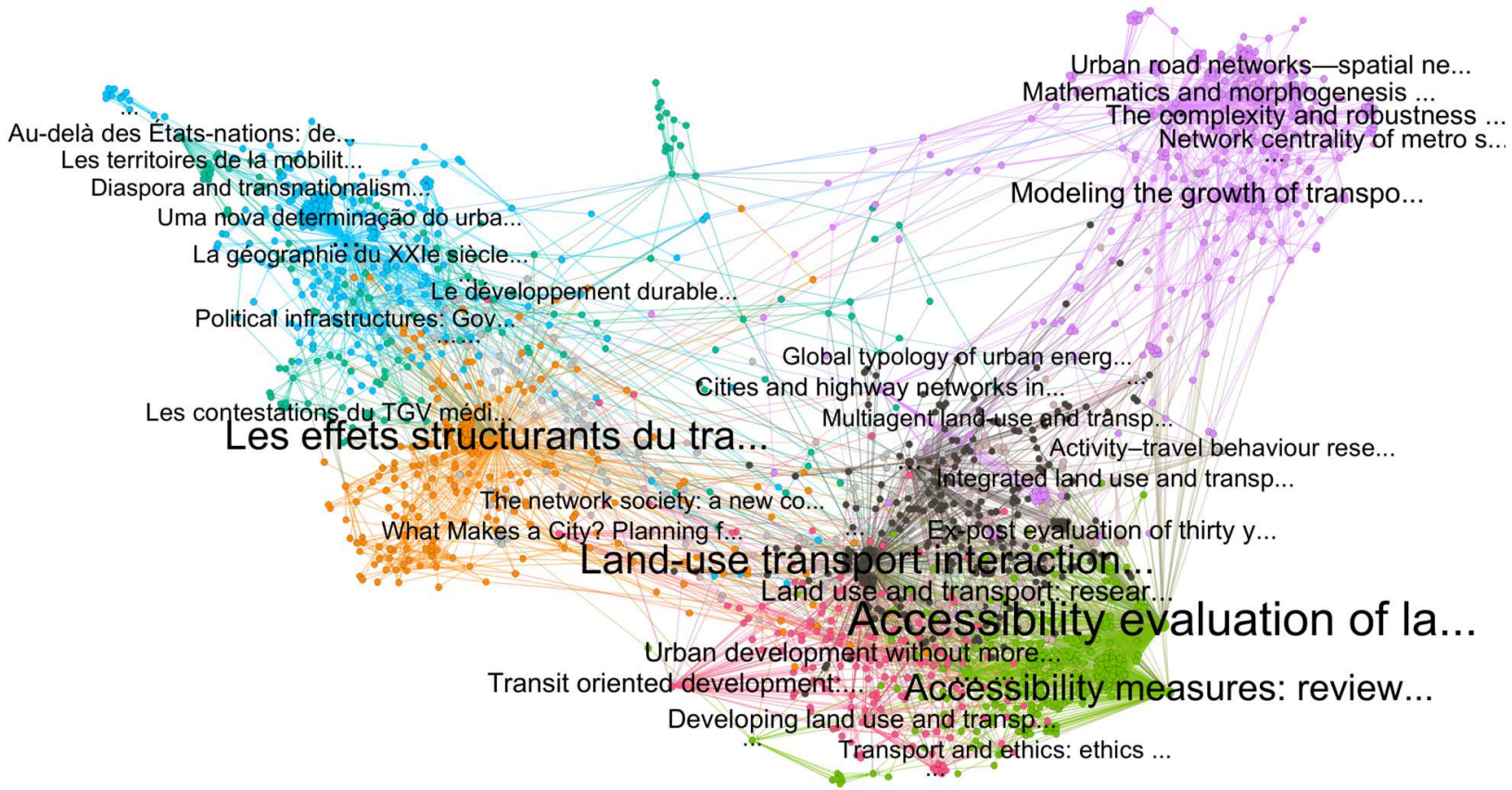




*Accessibility as part of complex processes of co-evolution between transportation networks and territories.*

Raimbault, J. (2019). Evolving accessibility landscapes: mutations of transportation networks in China. In Aveline-Dubach, N., ed. *Pathways of sustainable urban development across China - the cases of Hangzhou, Datong and Zhuhai*, pp 89-108. Imago. ISBN:978-88-94384-71-0

# Literature mapping

*Interdisciplinarity and interactions between networks and territories*




Raimbault, J. (2019). Exploration of an interdisciplinary scientific landscape. Scientometrics, 119(2), 617-641.

Raimbault, J. (2021). An interdisciplinary bibliometric analysis of models for land-use and transport interactions. arXiv preprint arXiv:2102.13501.

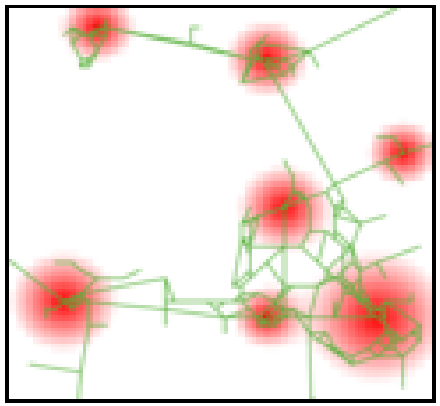
# Defining co-evolution

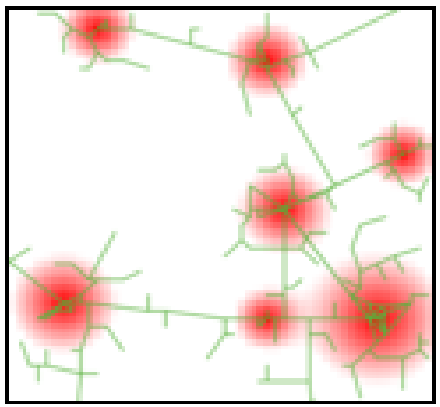
# Characterising co-evolution

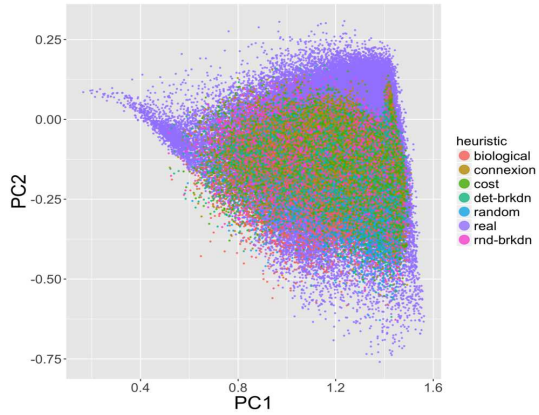
# Mesoscopic scale

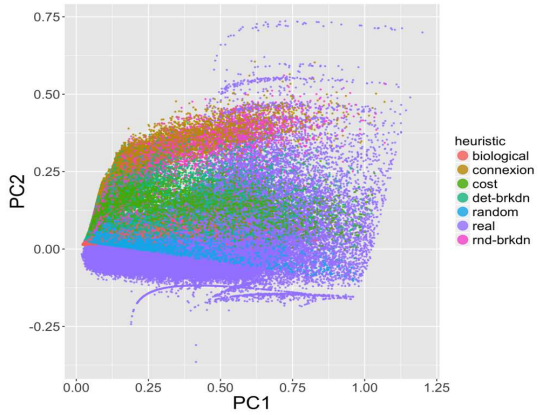
# Mesoscopic models: morphogenesis

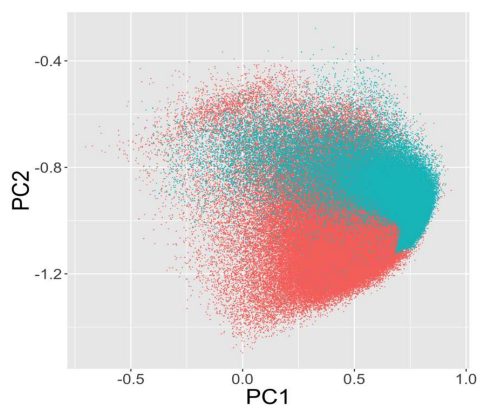
*A morphogenesis model with reaction-diffusion and multi-modeling of network growth: complementarity of heuristics, calibration for Europe on forms and their correlations*

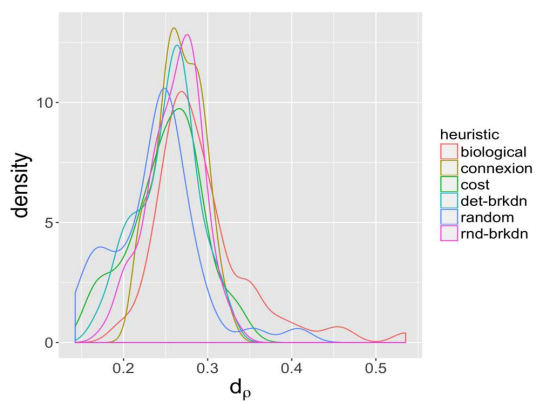




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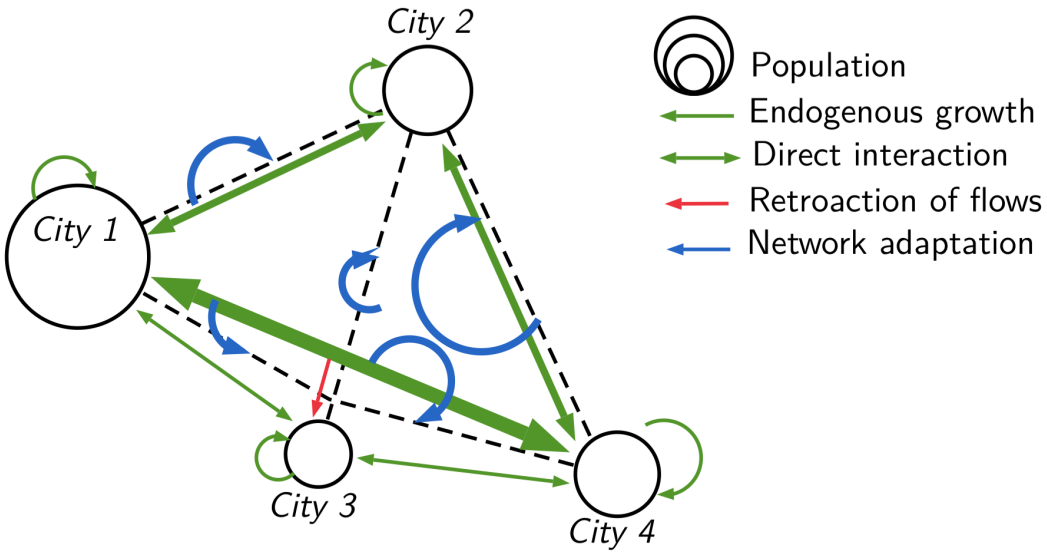
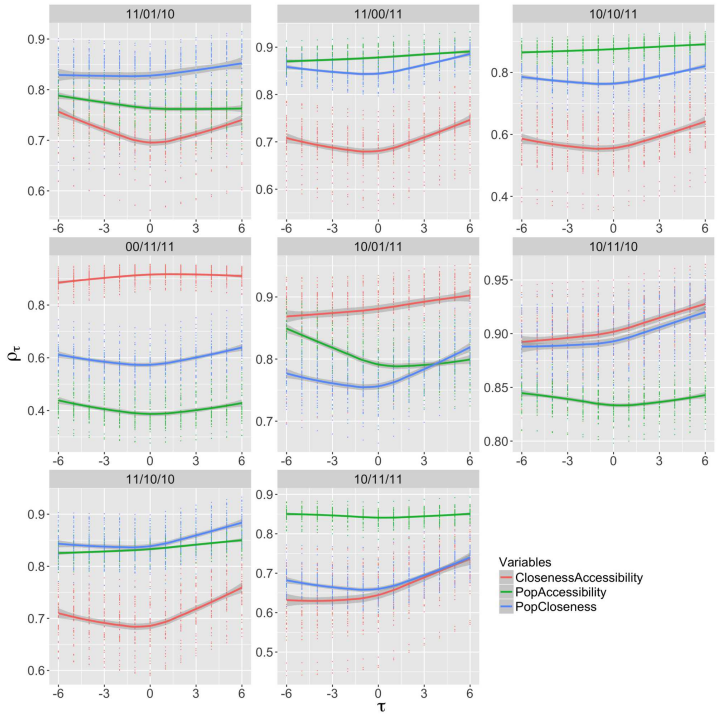
Raimbault, J. (2019). An urban morphogenesis model capturing interactions between networks and territories. In The Mathematics of Urban Morphology (pp. 383-409). Birkhäuser, Cham.

# Macroscopic interaction models

*System of cities interaction model including network evolution; production of multiple co-evolution regimes and calibration for France.*





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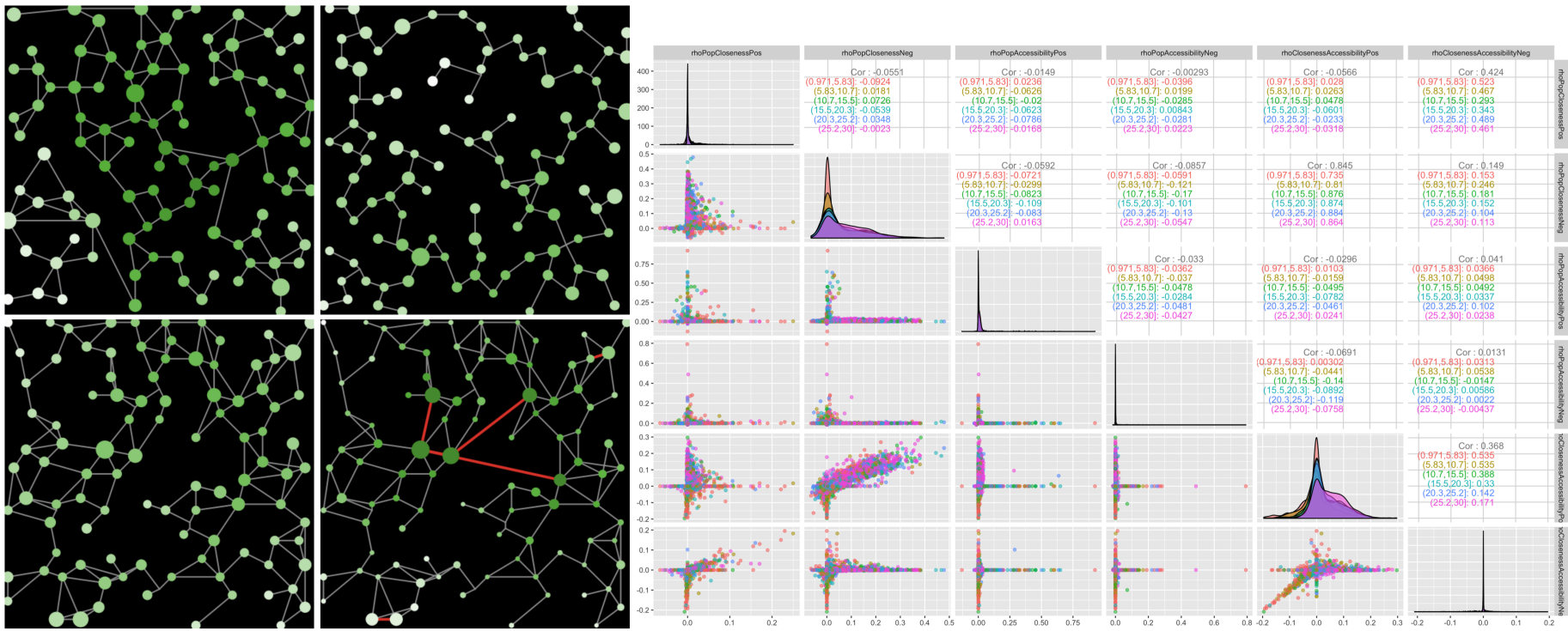
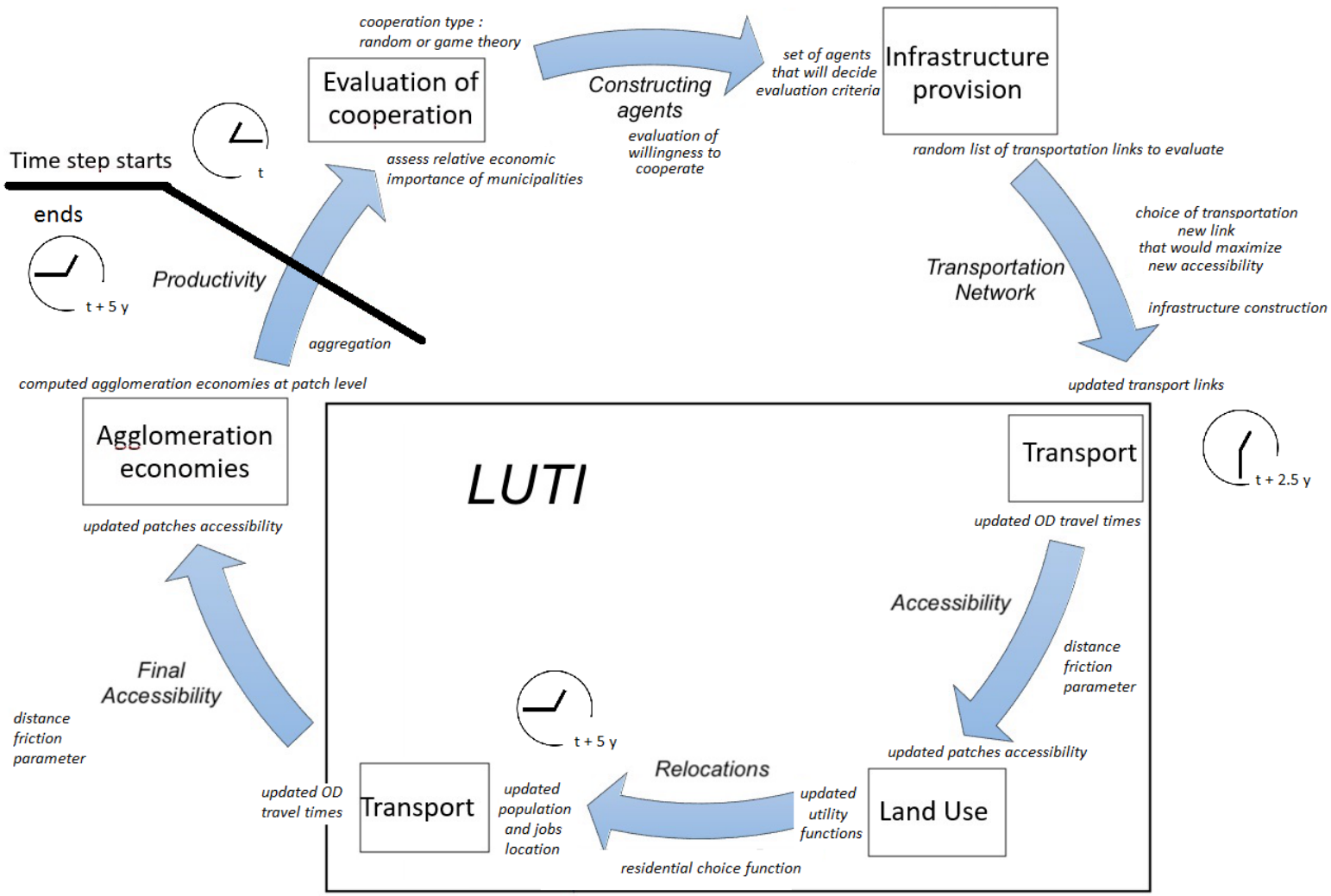
Raimbault, J. (2021). Modeling the co-evolution of cities and networks. In Niel, Z., Rozenblat, C., eds. *Handbook of Cities and Networks*, Edwar Elgar Publishing, *in press*.

# Capturing co-evolution at the macro scale



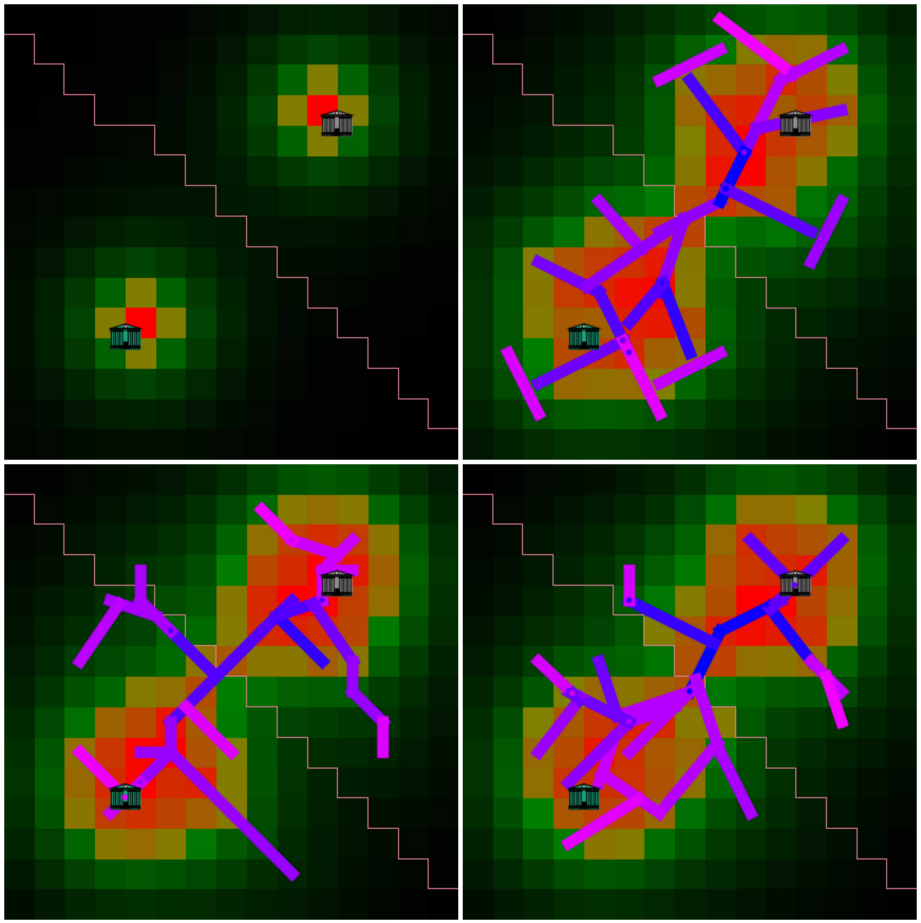

Raimbault, J. (2020). Unveiling co-evolutionary patterns in systems of cities: a systematic exploration of the simpopnet model. In Theories and Models of Urbanization (pp. 261-278). Springer, Cham.

# Extending LUTI models




Raimbault, J. & Le Nechet F. (2021, forthcoming). Introducing endogenous transport provision in a LUTI model to explore polycentric governance systems. Journal of Transport Geography.

# Transportation governance

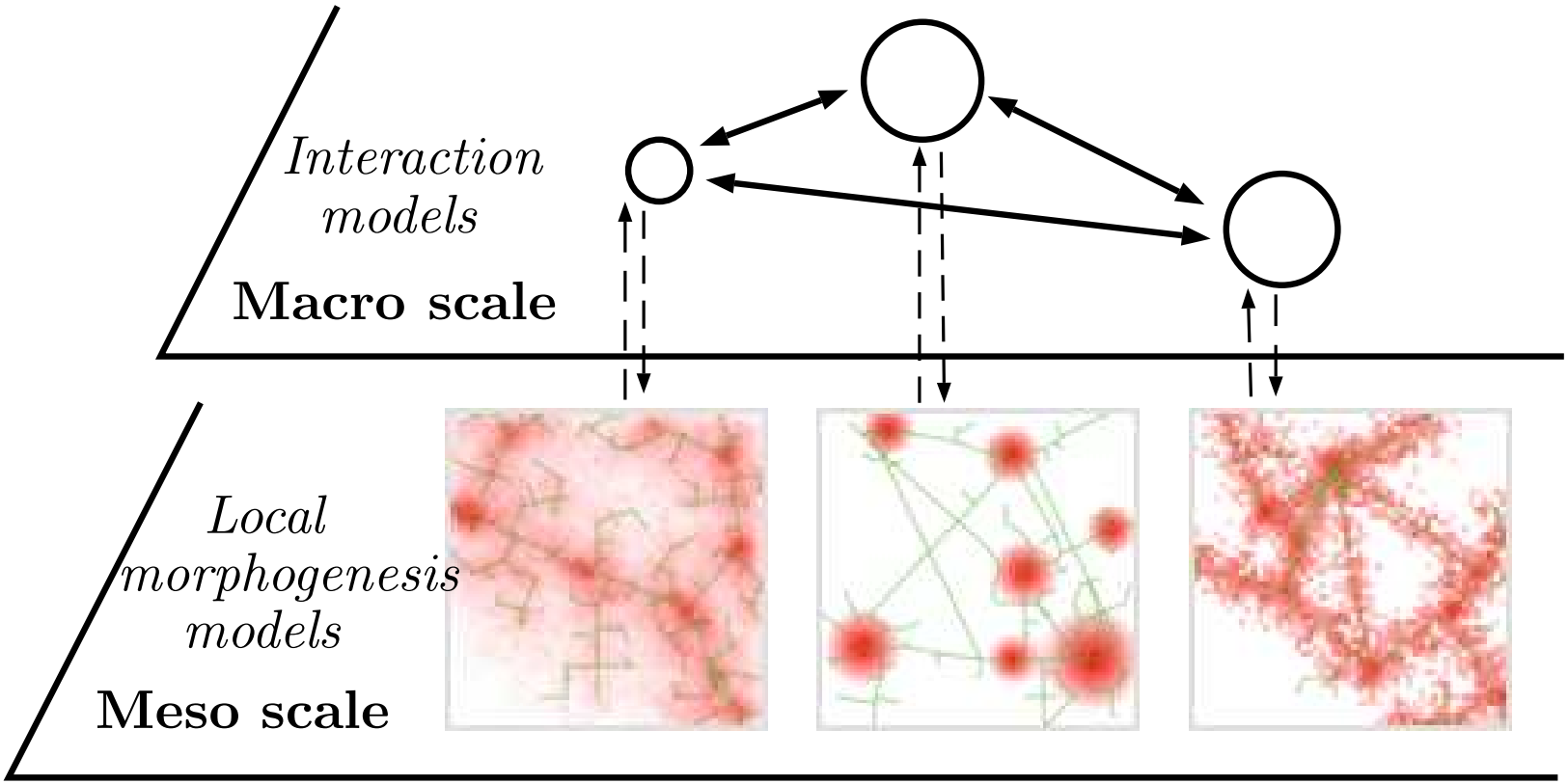


*Impact of governance parameters on network topology*

Raimbault, J. & Le Nechet F. (2021, forthcoming). Introducing endogenous transport provision in a LUTI model to explore polycentric governance systems. Journal of Transport Geography.

# Towards multi-scale models

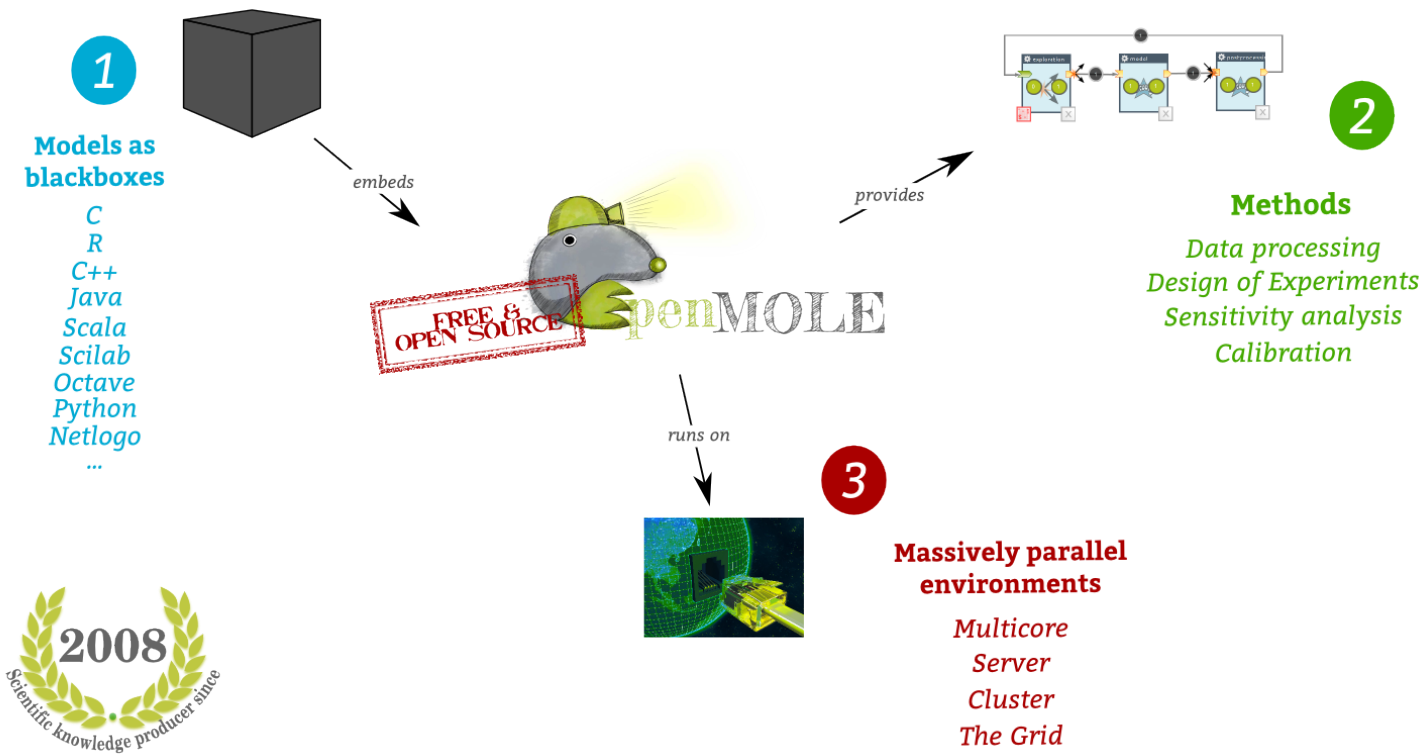
*Processes specific to scales, coupling requires dedicated ontologies*



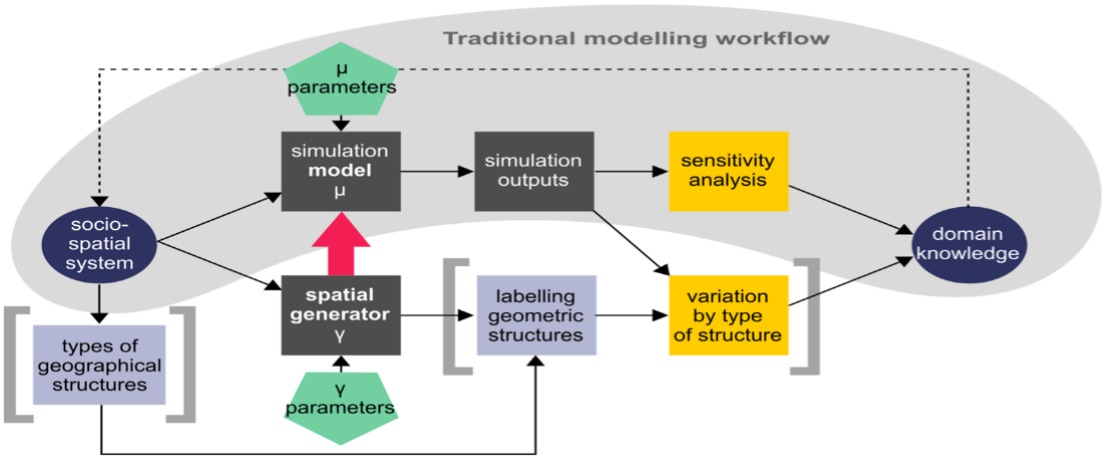

Raimbault, J. (2021). Strong coupling between scales in a multi-scalar model of urban dynamics. arXiv preprint arXiv:2101.12725.

# Model exploration methods to foster knowledge

OpenMOLE software [Reuillon et al., 2013]: *(i) Innovative exploration methods; (ii) Scaling of methods on high performance computing environments; (iii) Scripts to embed and couple models.*



# Validation: spatial sensitivity analysis

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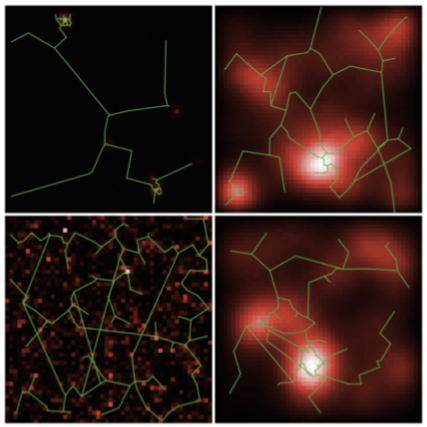
Raimbault, J., Perret, J., & Reuillon, R. (2020). A scala library for spatial sensitivity analysis. *GISRUK 2020 Proceedings, 32.*



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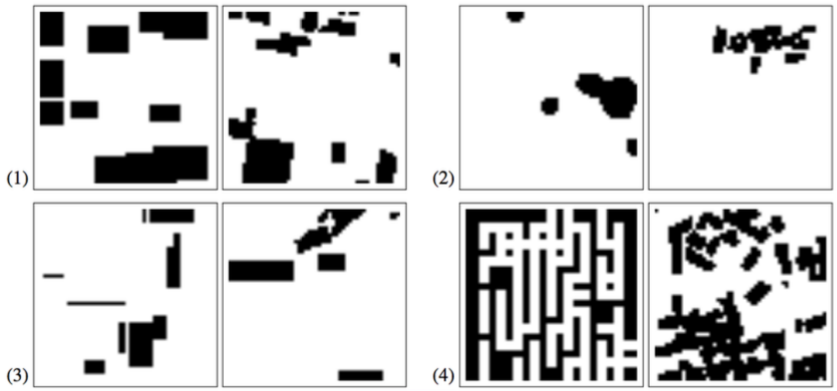


Raimbault, J., Perret, J. (2019). Generating urban morphologies at large scales. In *Artificial Life Conference Proceedings* (pp. 179-186).

# Conclusion

→ Multiple ways to model urban systems: **towards more interdisciplinary coupling and comparison of models.**

→ At which scale? **Towards multi-scale models.**

→ Which knowledge from simulation models? **Model exploration and validation methods.**

**To use OpenMOLE (free and open software) and contribute:**
`https://next.openmole.org`

**All models open source at**
`https://github.com/JusteRaimbault/CityNetwork`

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*PloS one*, 13(9):e0203516.

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In Aveline-Dubach, N., editor, *PATHWAYS OF SUSTAINABLE URBAN DEVELOPMENT ACROSS CHINA: THE CASES OF HANGZHOU, DATONG AND ZHUHAI*, pages 89–108. Imago Editor.

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*Scientometrics*, pages 1–25.

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*In Niel, Z., Rozenblat, C., eds. Handbook of Cities and Networks, Edwar Elgar Publishing, in press.*

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