Tolérance à la perturbation spatiale : une piste pour une ville durable

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Durable pour les institutions

https://sdgs.un.org/goals

17 Objectifs de development durable définis par les Nations Unies

L’objectif 11: ville durable

(i) Disaster risk reduction,
(ii) Sustainable transports,
(iii) Sustainable cities and human settlements,
(iv) National strategies and SDG integration.

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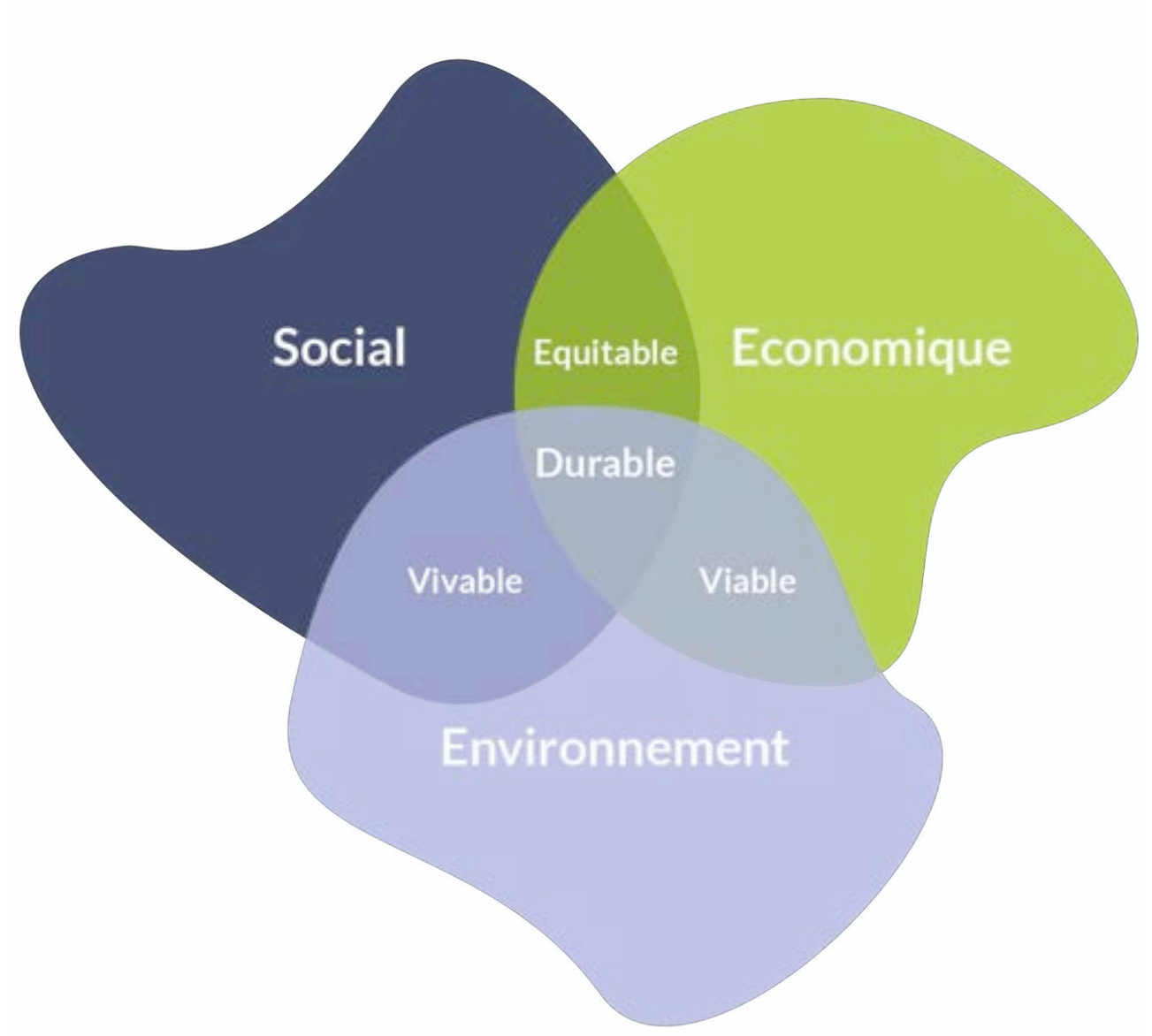
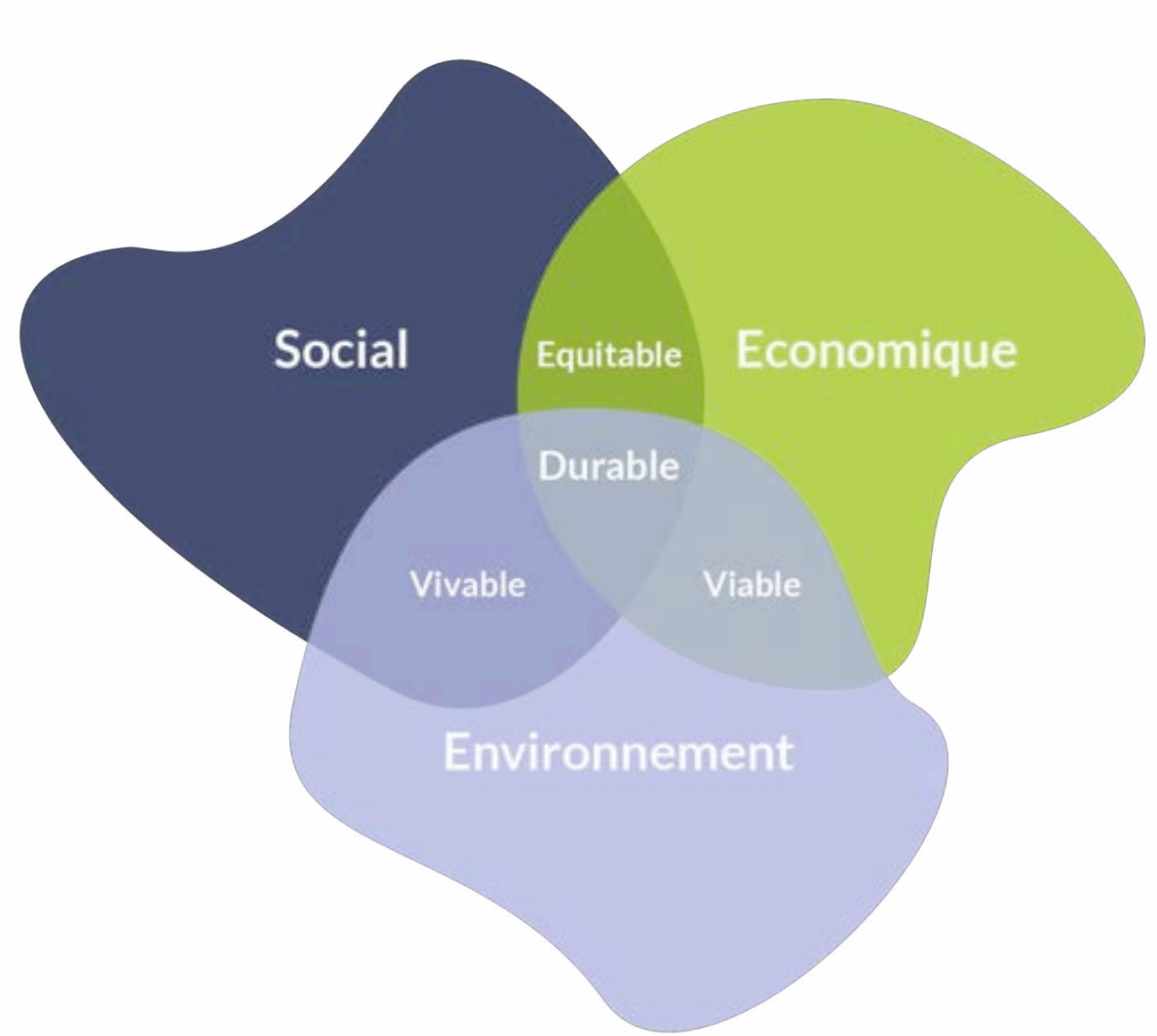
(i) Disaster risk reduction,
(ii) Sustainable transports,
(iii) Sustainable cities and human settelments,
(iv) National strategies and SDG INTEGRATION.

L’objectif 11: les 3 socles de la ville durable

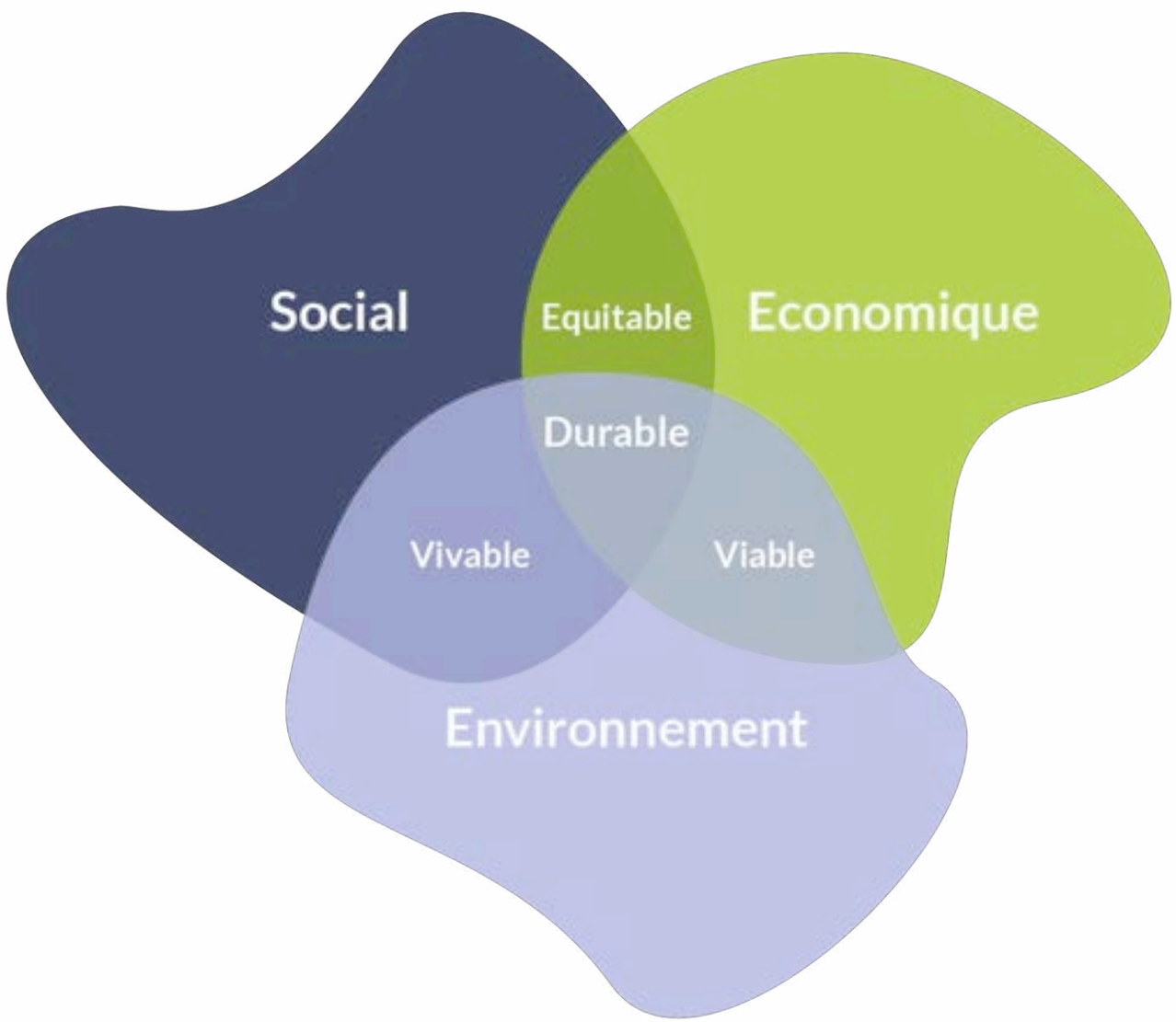


L’objectif 11: et la definition de la ville durable



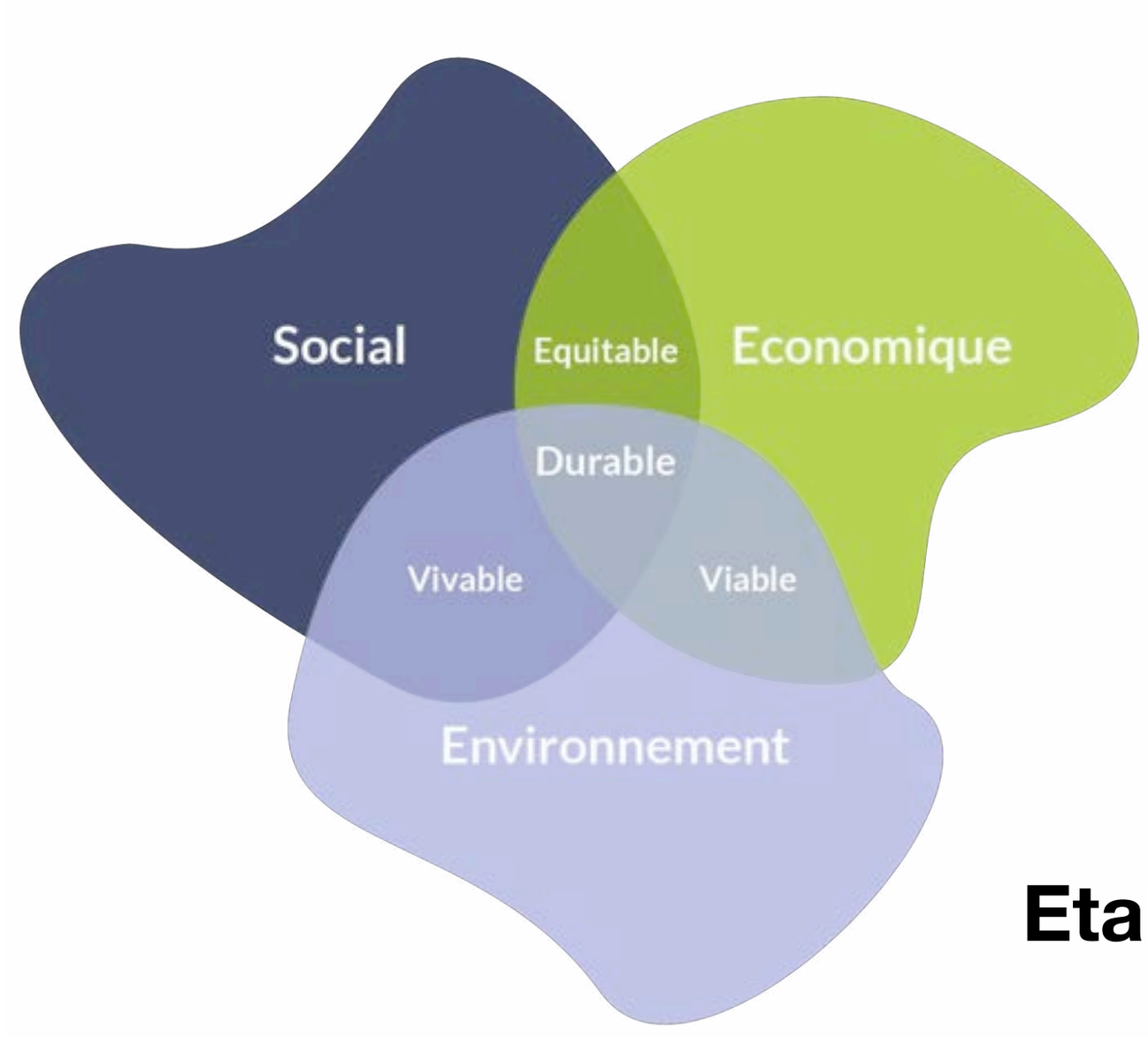
Ville qui est conçue pour resister aux perturbations dans le temps

L’objectif 11: ville durable et perturbations



Perturbation spatiale: croissance urbaine

L’objectif 11: et la definition de la ville durable

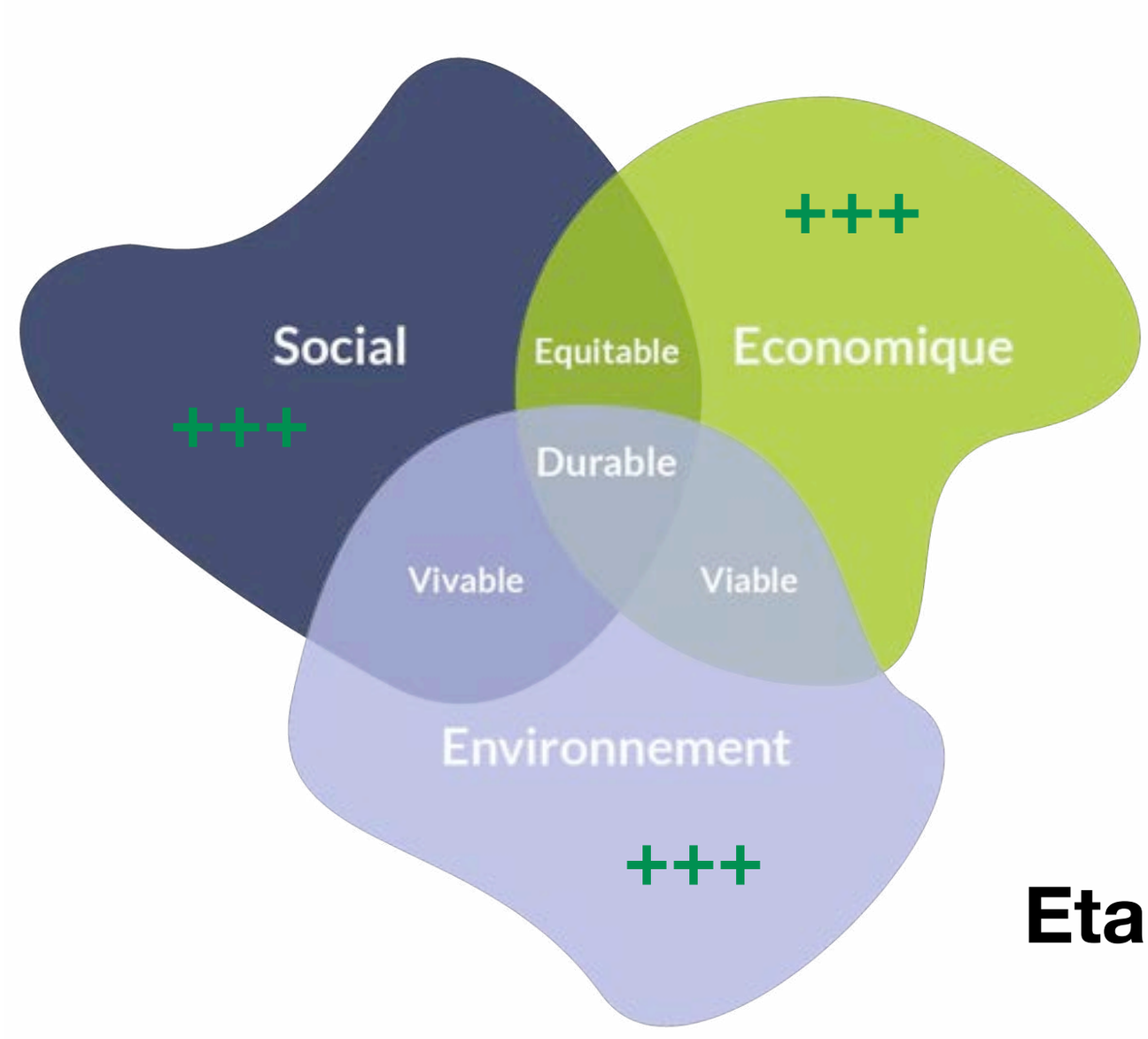


Perturbation spatiale: croissance urbaine

Etalement

Densification

L’objectif 11: et la definition de la ville durable



Perturbation spatiale: croissance urbaine

Etalement

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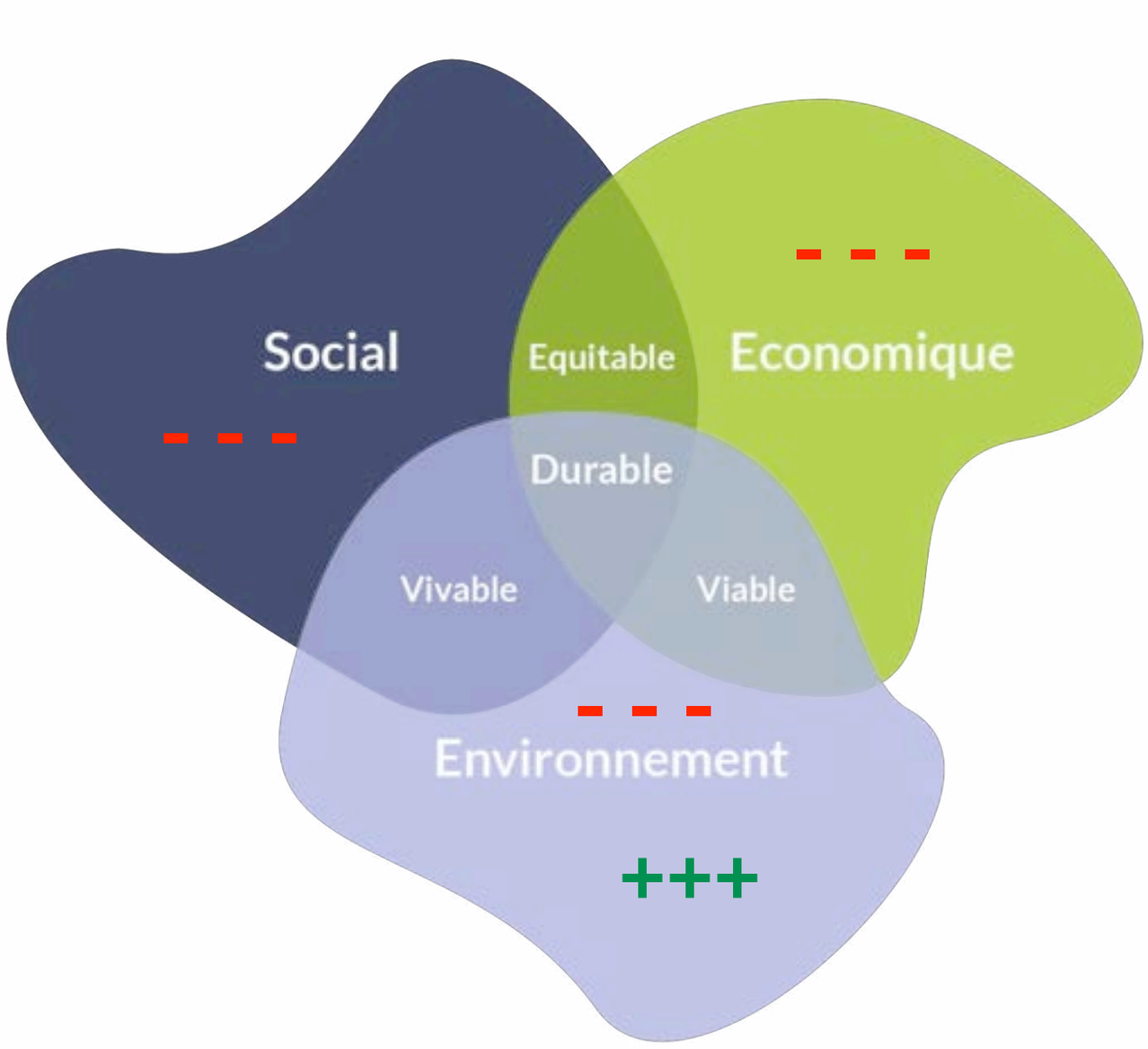


Perturbation spatiale: croissance urbaine

↓

Densification

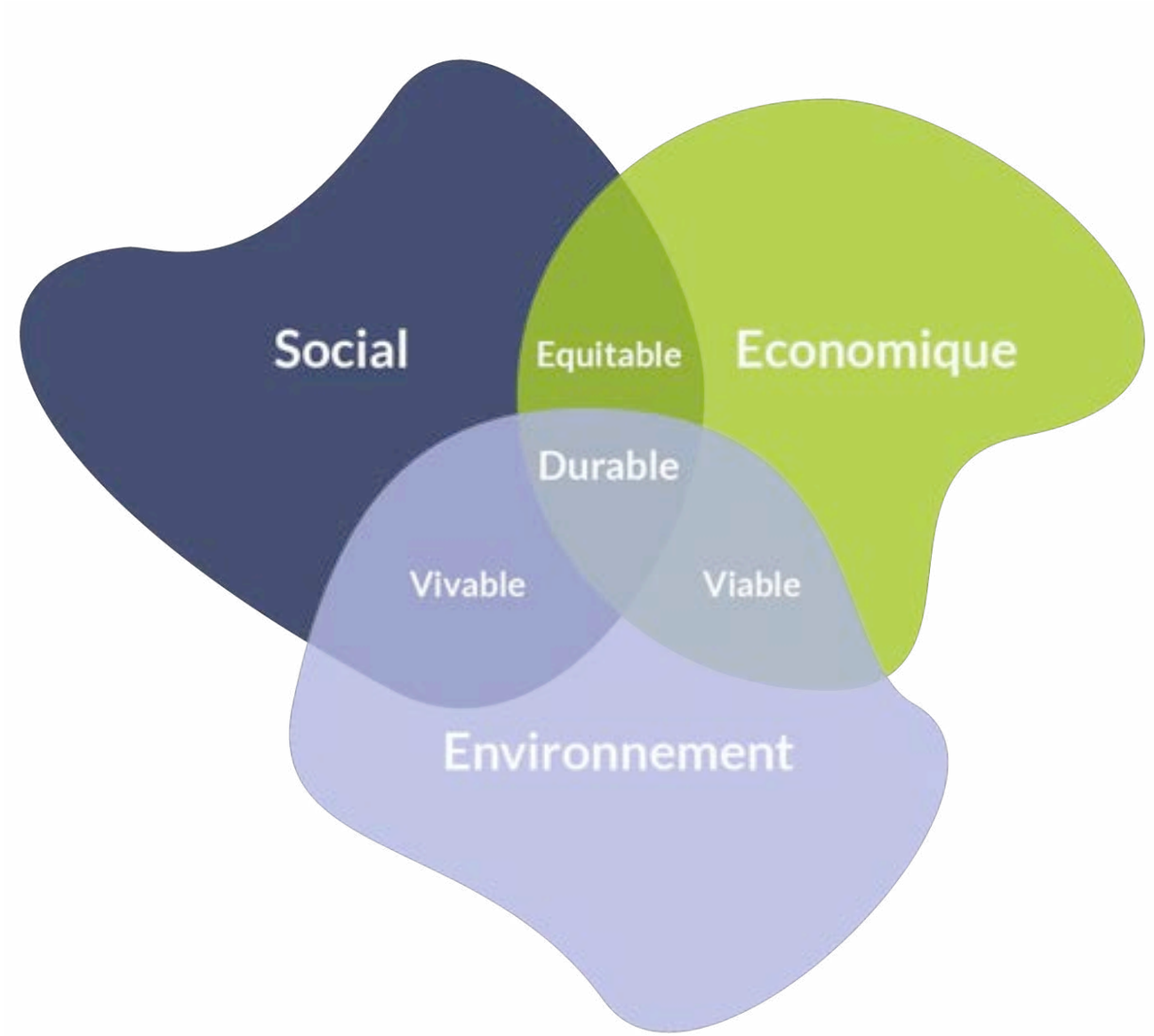
↓

Moins d’espace
Plus de traffic
Canyon urbain
Sky view diminue

↓

Perturbations: sociale , environmentale et économique: Pollution-Chaud-Santé

La ville durable : Verrou



Incompatibilité

Construire un espace urbain durable, dense et fluide ???

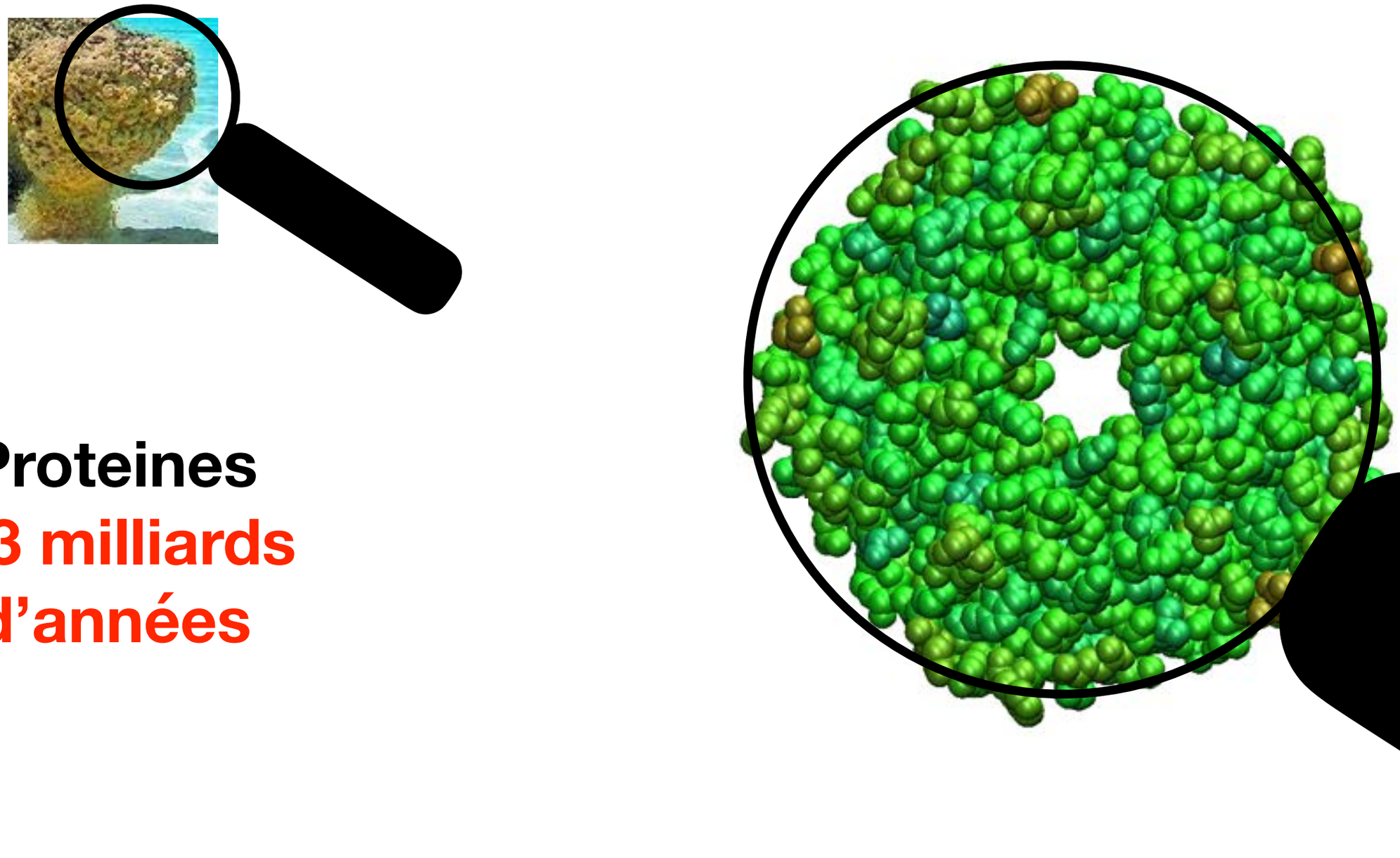
Solutions bioinspirées

DURABLE

Stromatolithes
Shark bay
(Australie)
> 3 milliards d’années

Solutions bioinspirees

Les protéines: DURABLE ET DENSE

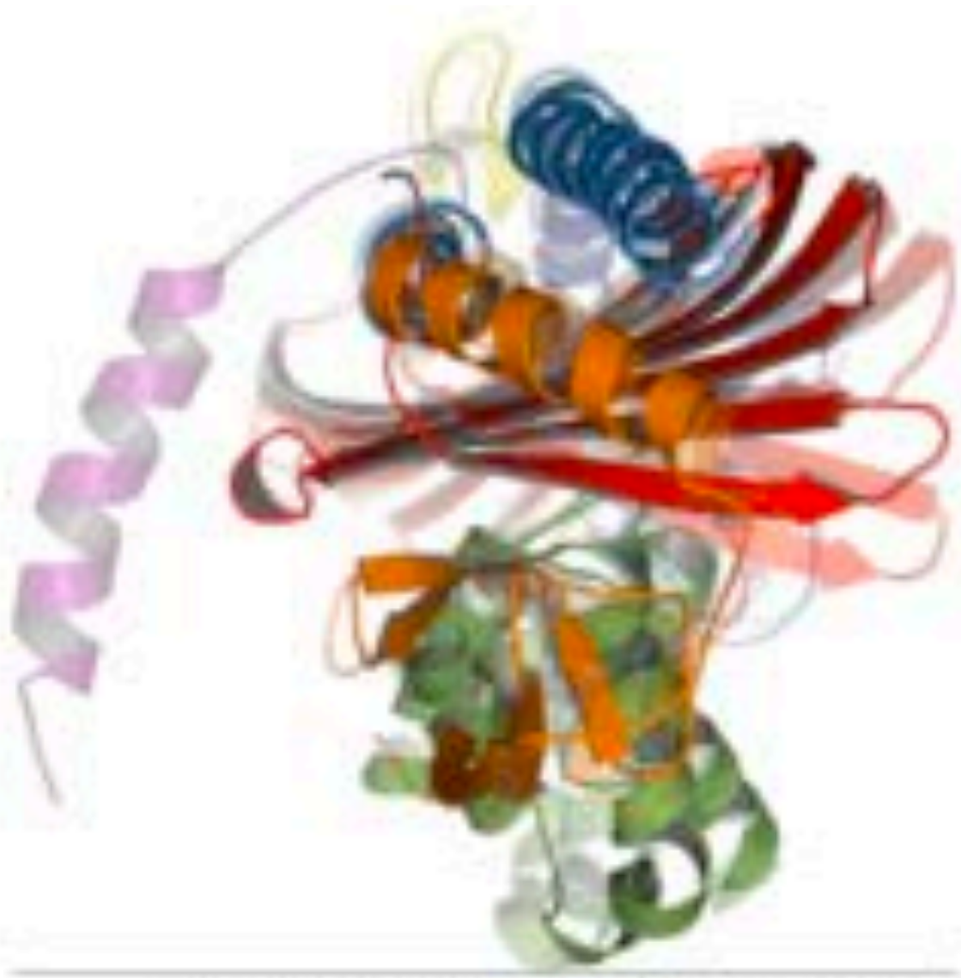


Proteines

> 3 milliards d’années

Solutions bioinspirees

Les protéines: DURABLE ET DENSE ET DYNAMIQUE



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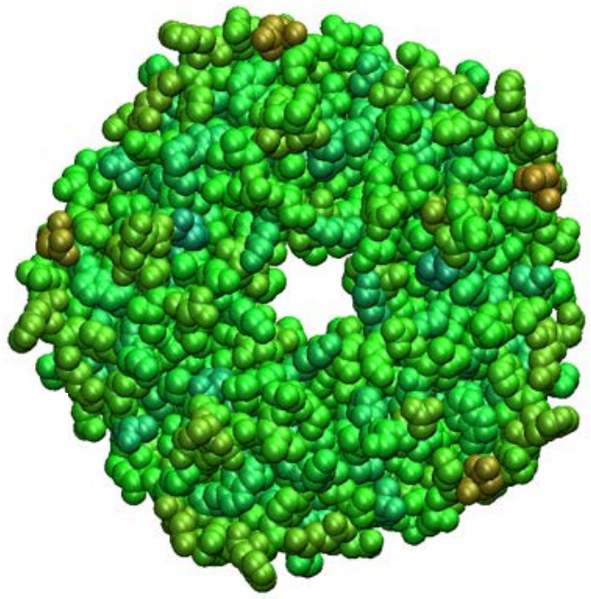
Strategie

Les protéines: DURABLE ET DENSE ET DYNAMIQUE

Protéine



10^{-9} m

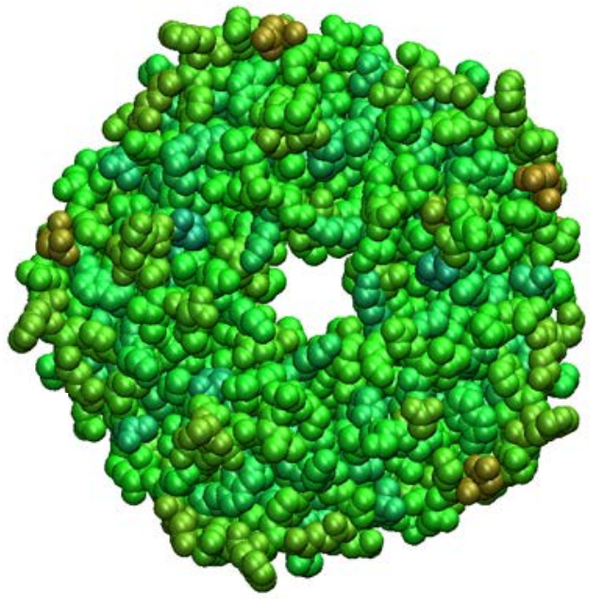
Lyon

5 km

Issues

Les protéines: DURABLE ET DENSE ET DYNAMIQUE

Protéine

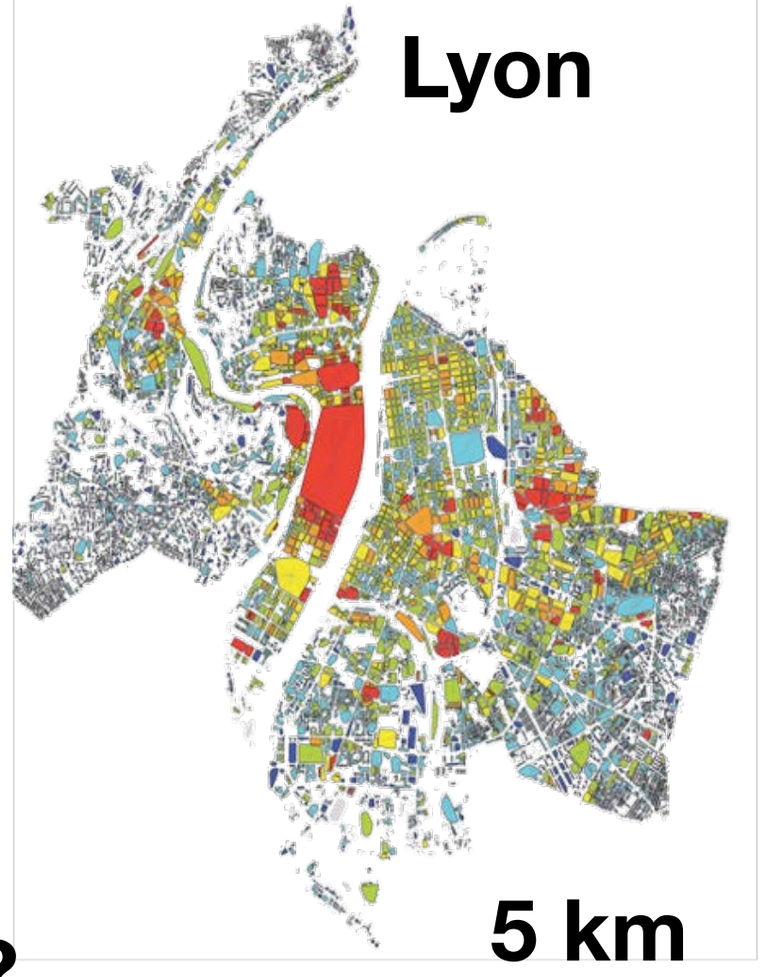


10^{-9} m

Quelle modélisation?

Echelle?
Espace?
Mouvements?
Liens espace-mouvement?

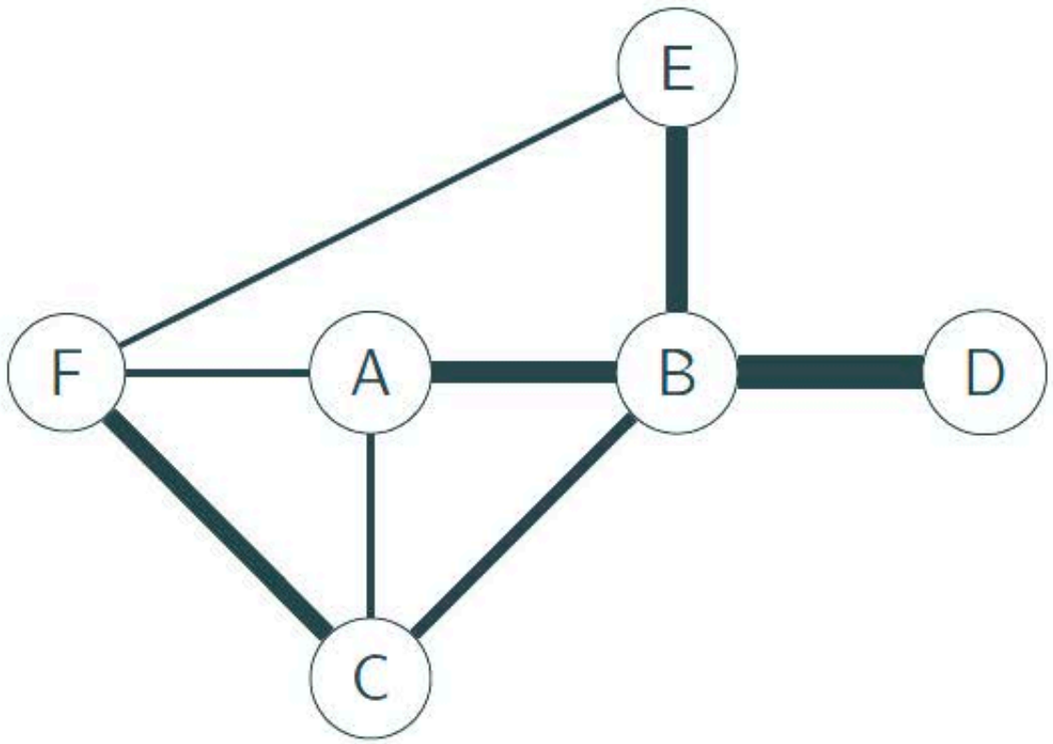
Lyon



5 km

Modélisation système complexe

Definition: Elements en relation

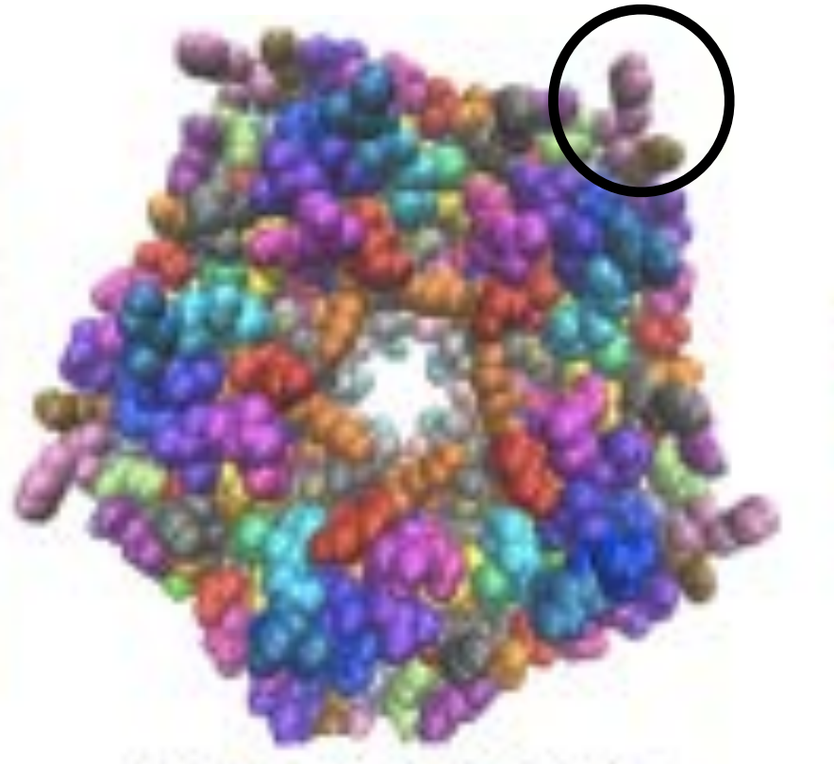


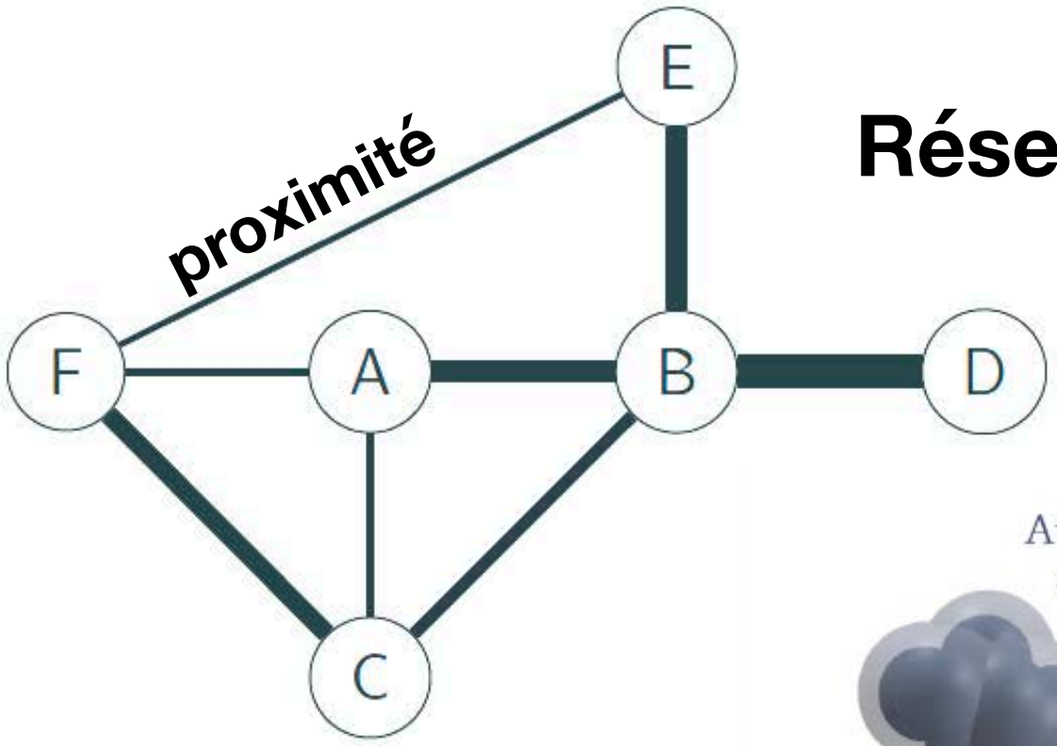
Graph: $G = (V, E)$

Nodes: $V = \{i \mid i \text{ is a component}\}$

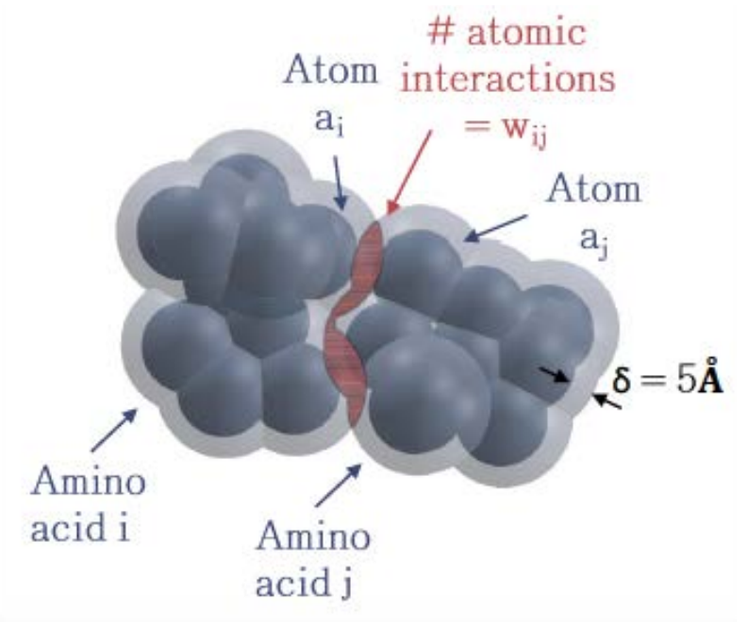
Links: $E = \{(i, j) \mid i, j \in V \text{ and } \exists \text{ an } i - j \text{ relation}\}$ **Link weights:** w_{ij}

Modélisation système complexe





Réseau spatial



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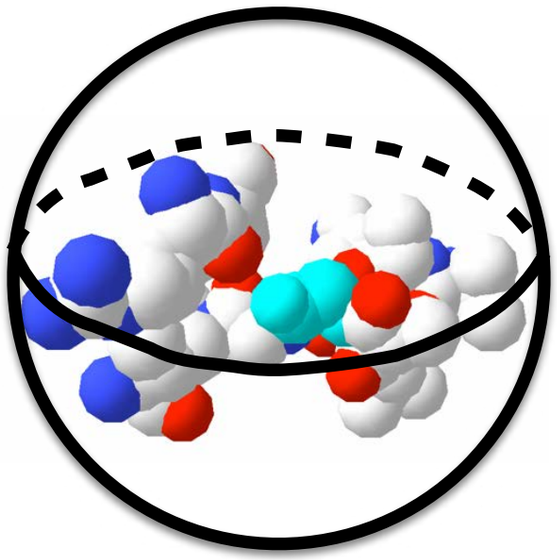
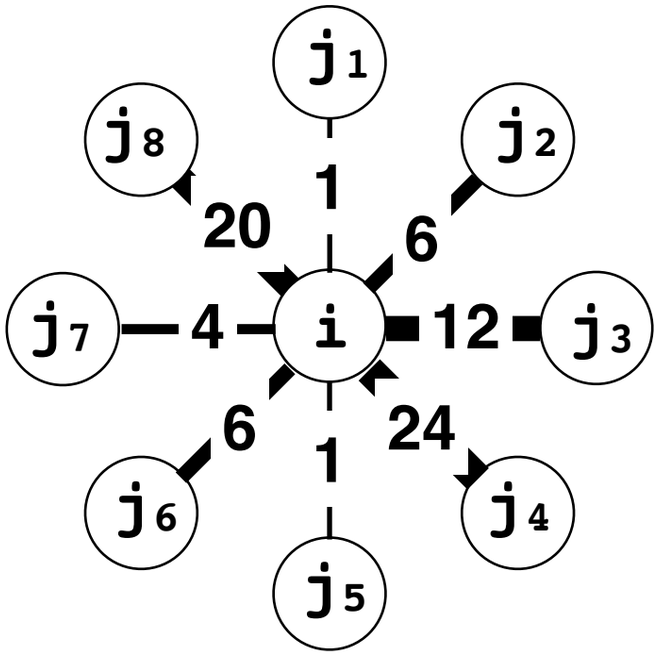
Modélisation système complexe

Echelle locale: un element central et ces 1er voisins





Degree du noeud $k_i = 8$

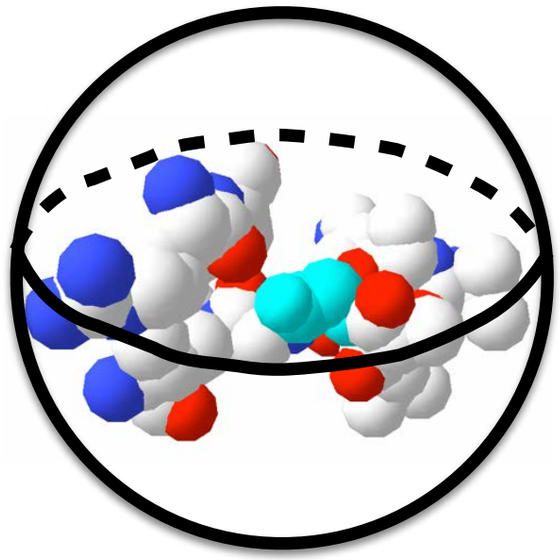
Poids du lien $w_{ij8} = 20$

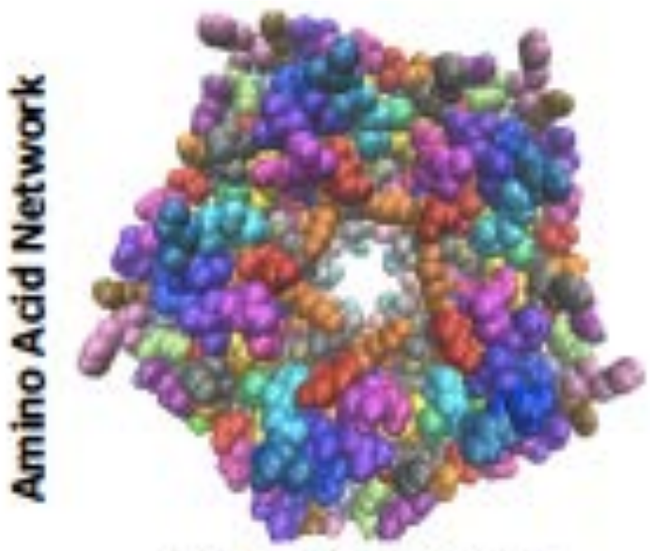
Poids du noeud $w_i = 1 + 6 + \ldots + 20 = 72$

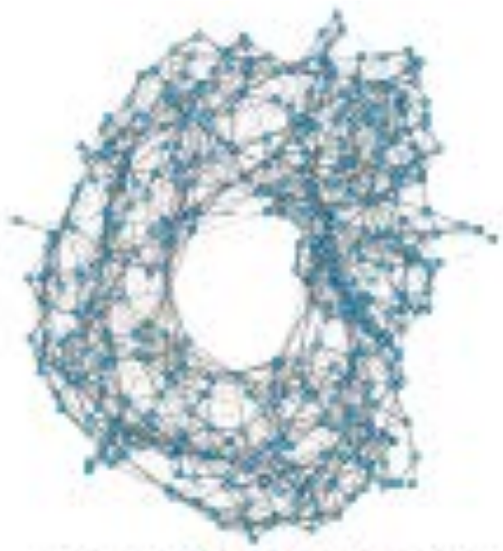
Neighborhood watch $N_{Wi} = wi/ki = 9$

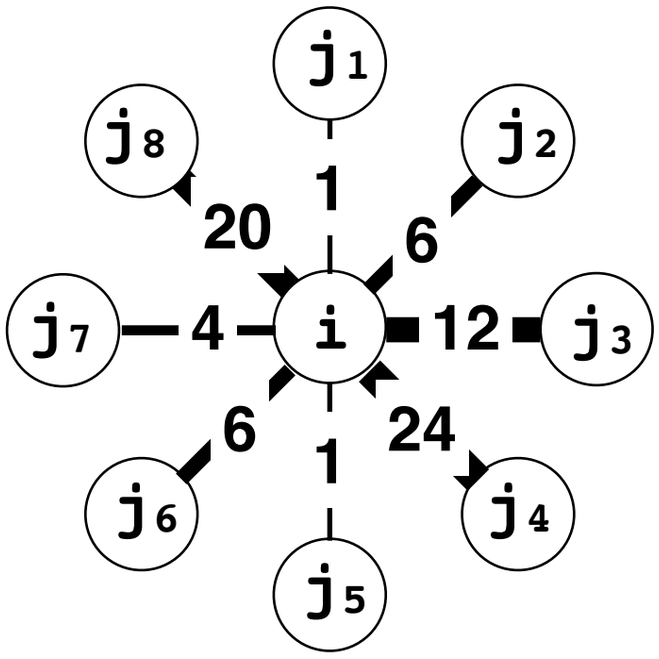
Modélisation système complexe

Echelle globale: tous les elements du système









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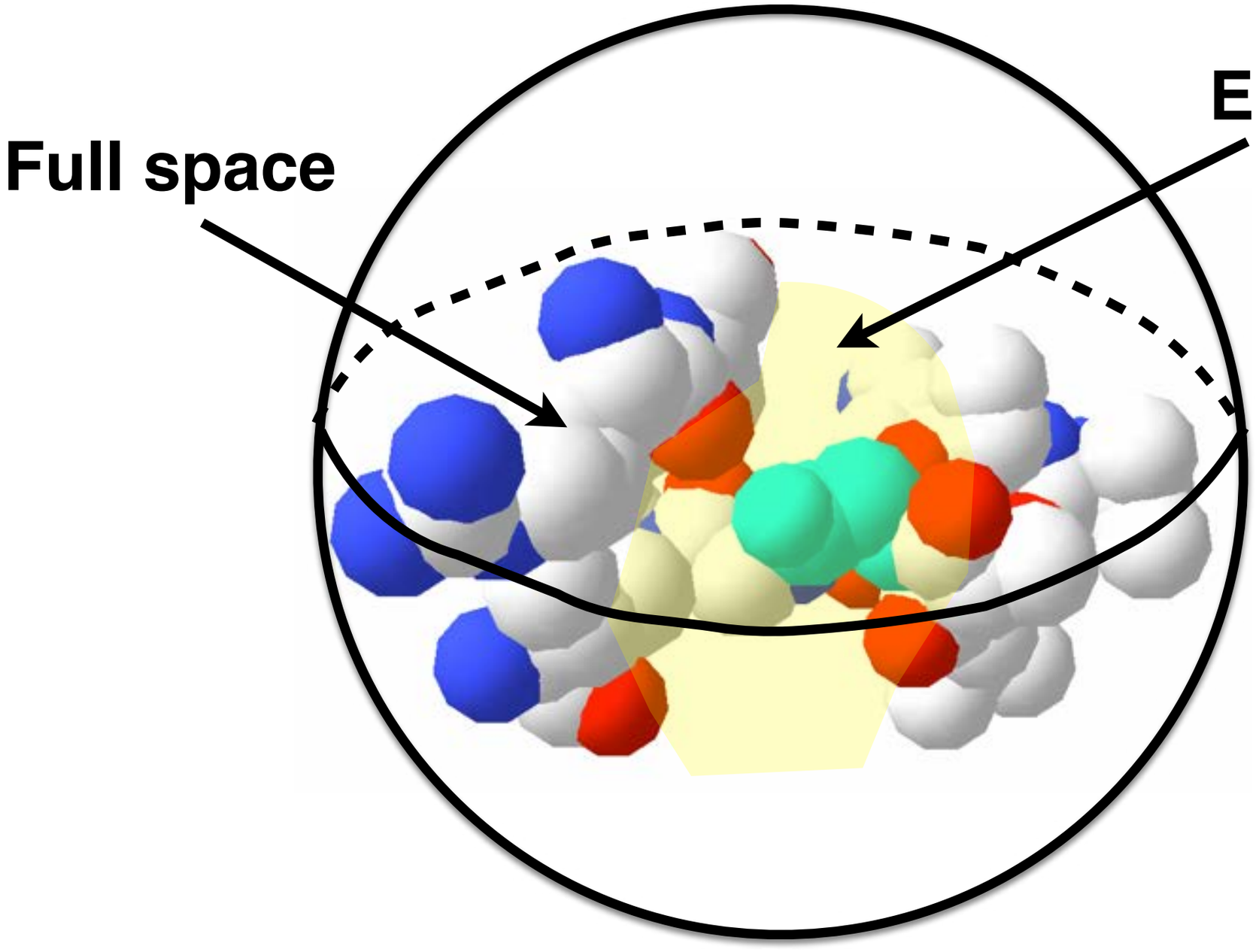
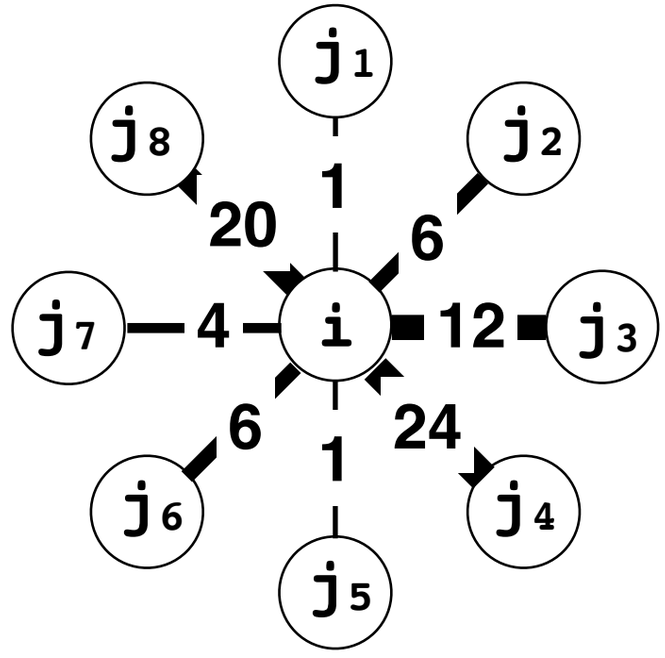
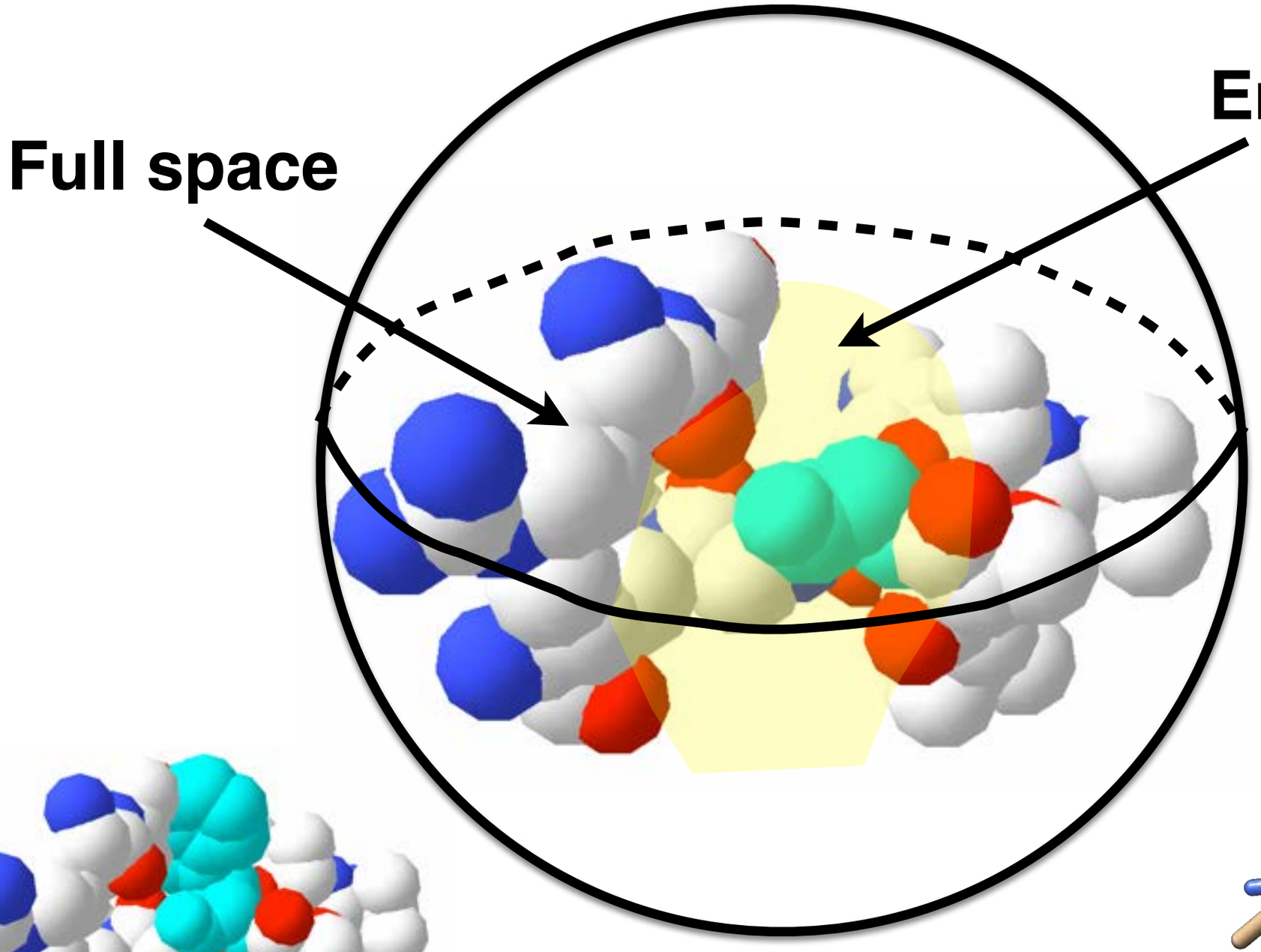
Poids du noeud	$w_i = 1+ 6 +…+ 20 = 72$
Neighborhood watch	$N_{Wi} = wi/ki = 9$

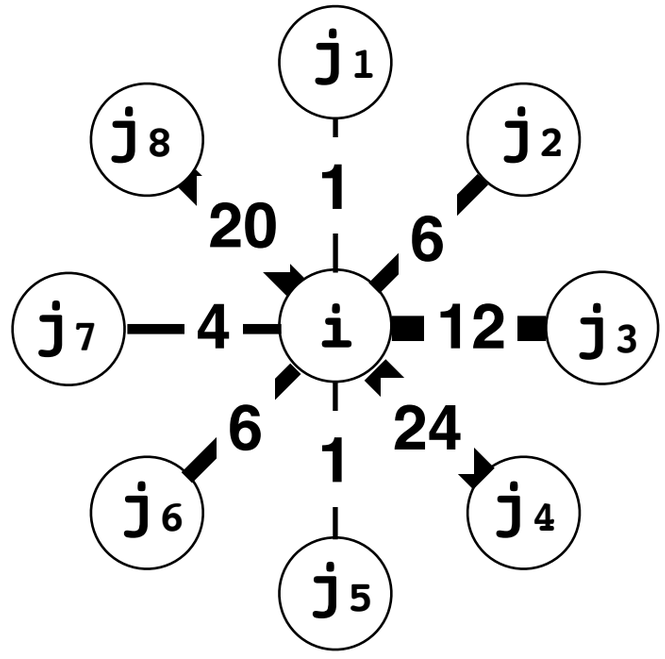
Dense-durable-dynamique

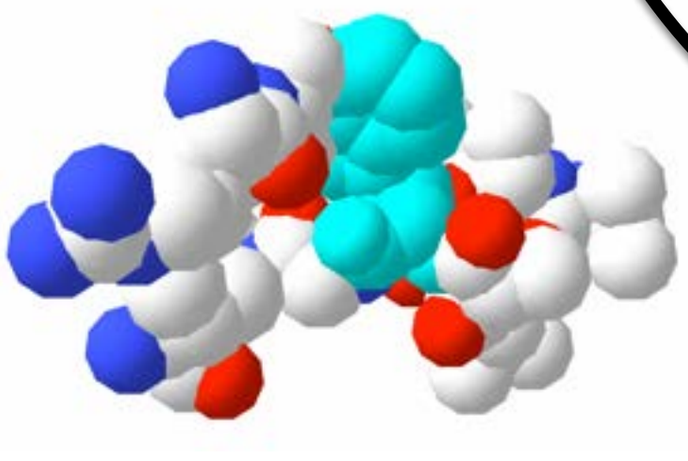


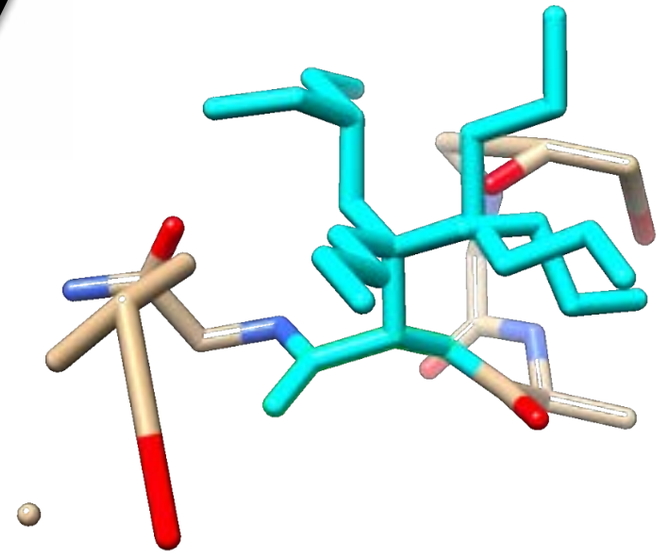


Dense-durable-dynamique



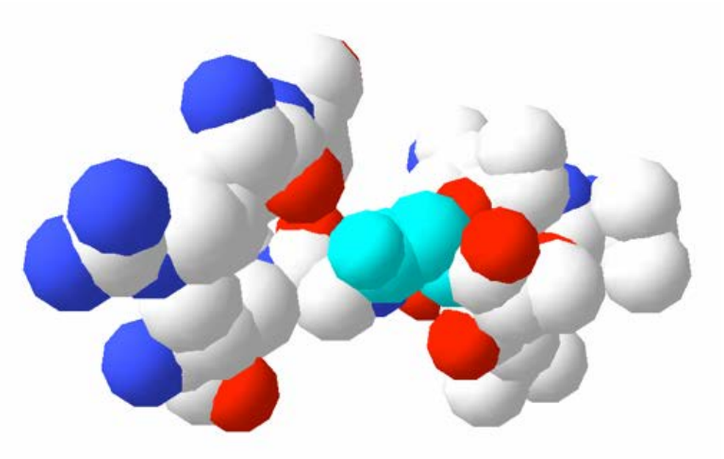


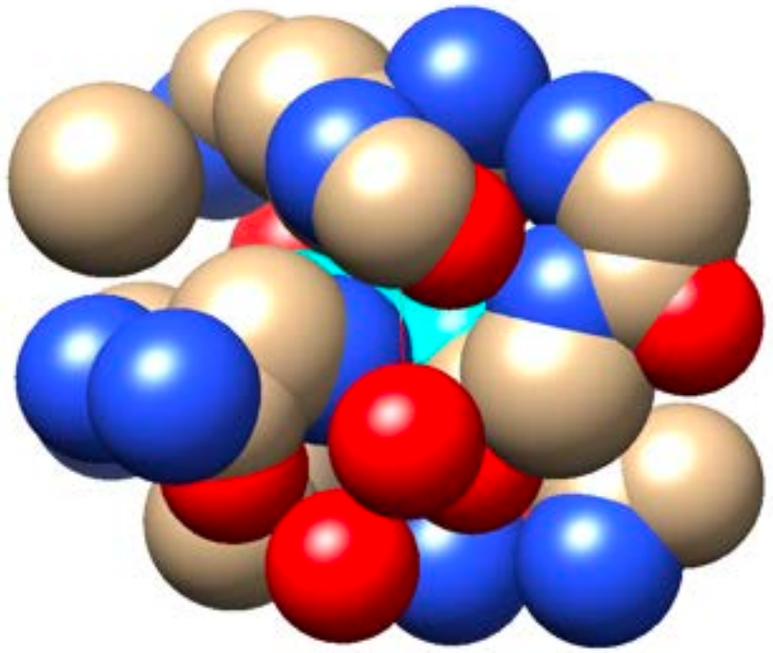




Tolerance aux perturbations spatiales

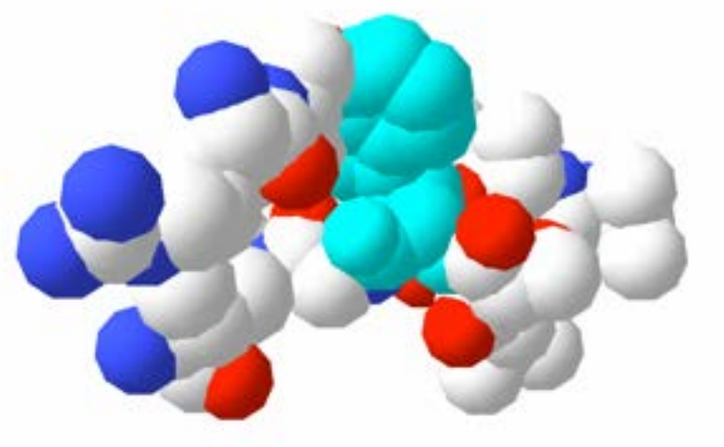
N_{Wi} : poids moyen du noeud = proximité moyenne





N_{Wi}

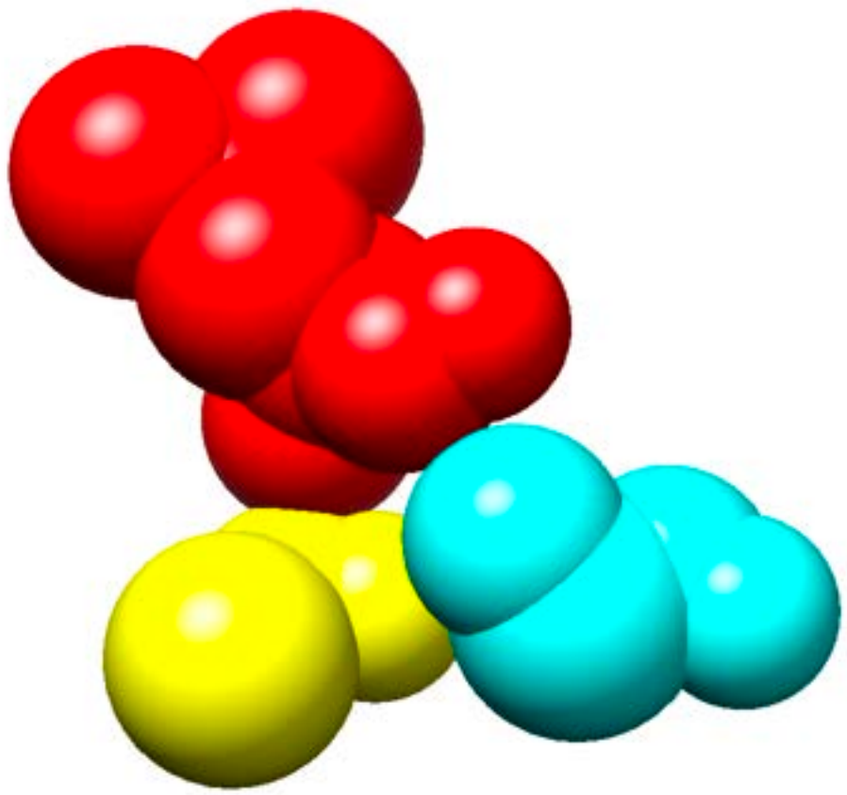
Durable **Non durable**

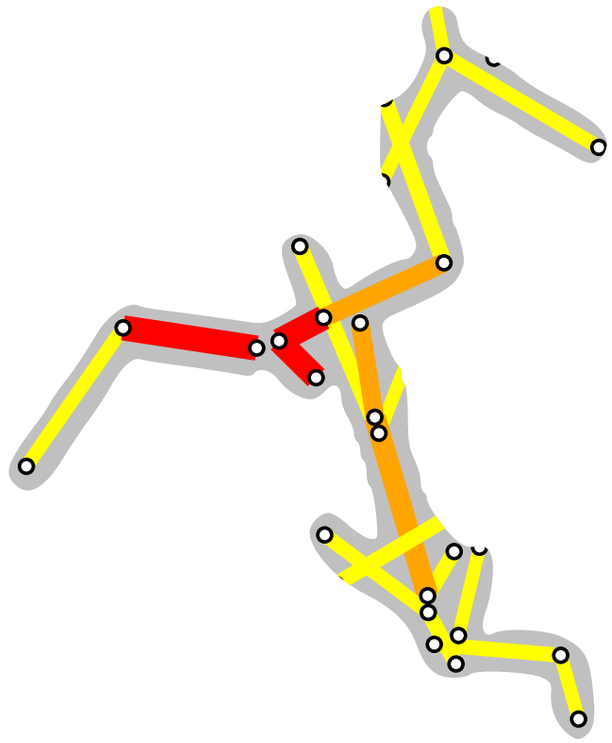


Neighborhood watch

Mesures appropriées

w_{ij8} : poids du lien = proximité entre l'element central et un des voisins





W_{ij}

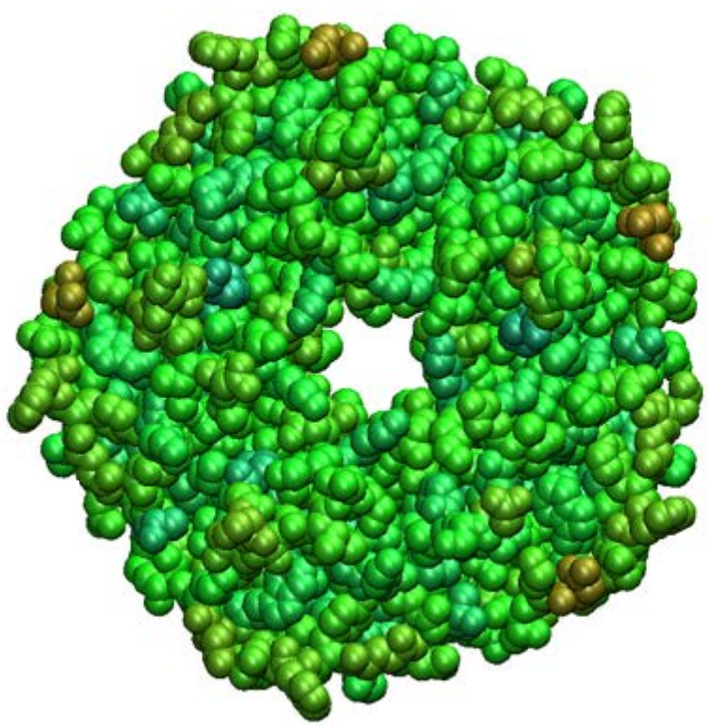
Durable **Non durable**

Gestion de l'espace chez les protéines

Echelle globale: tous les elements du système

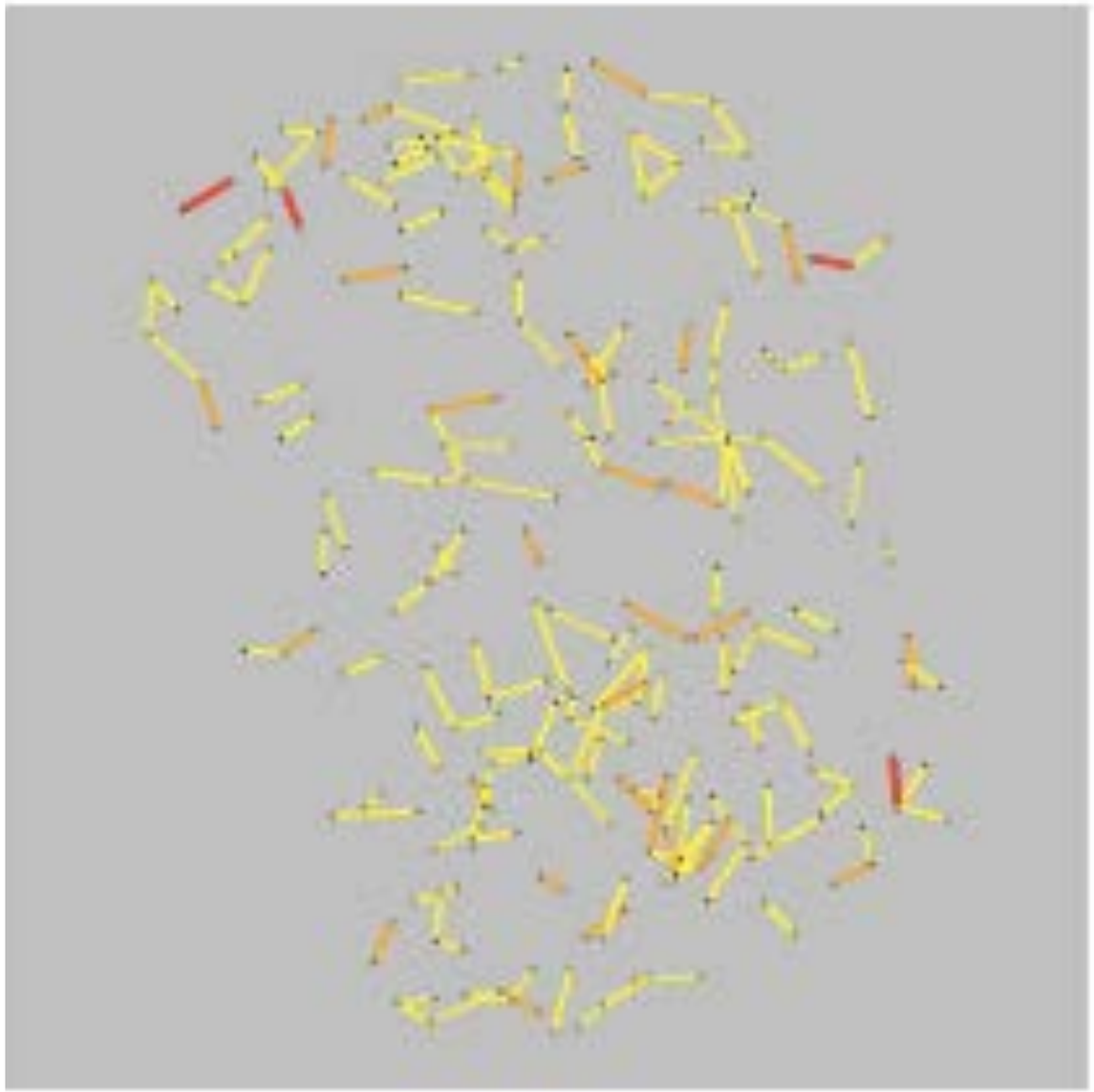
L'espace est géré à l'échelle locale

Non durable



N_{wi}

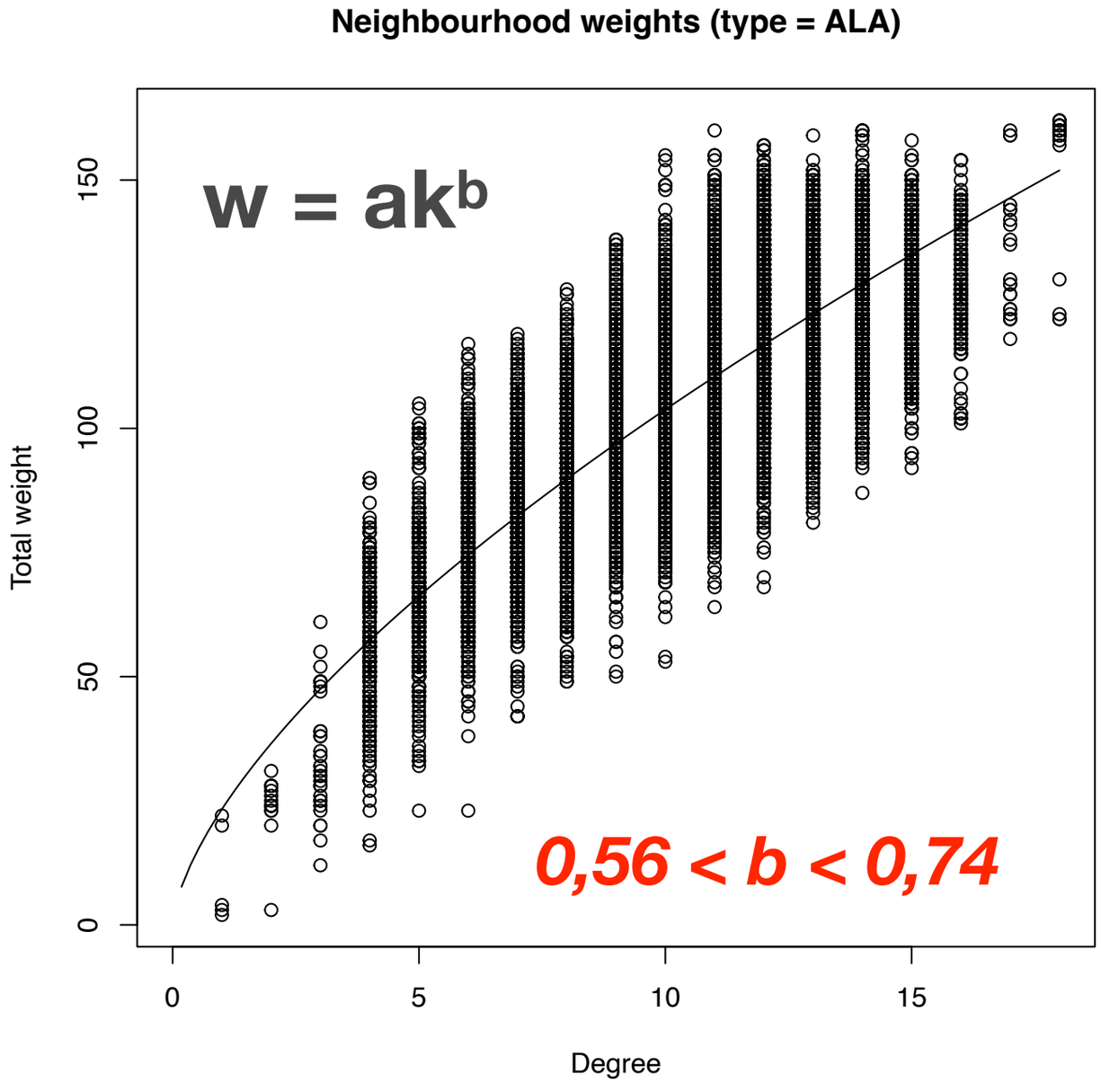
Durable

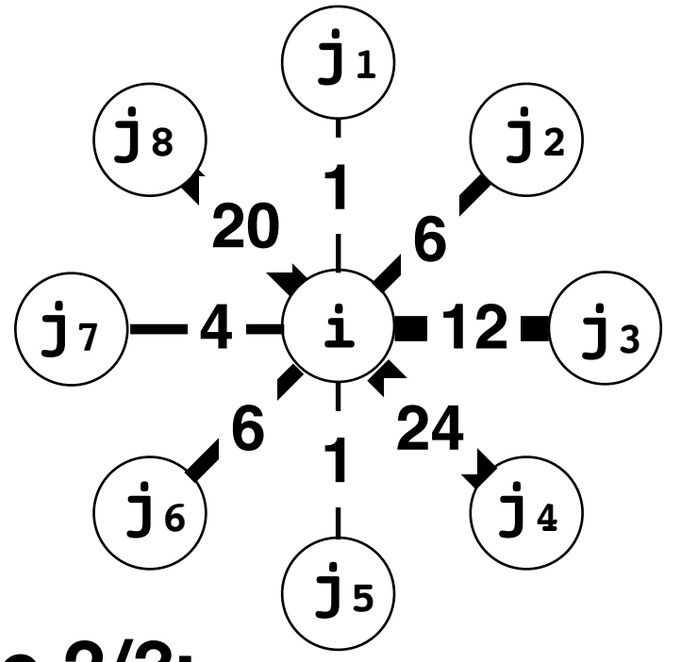


W_{ij}

Du cas individuel à la base de données

L'espace à l'échelle locale suit une loi de puissance deux-tiers





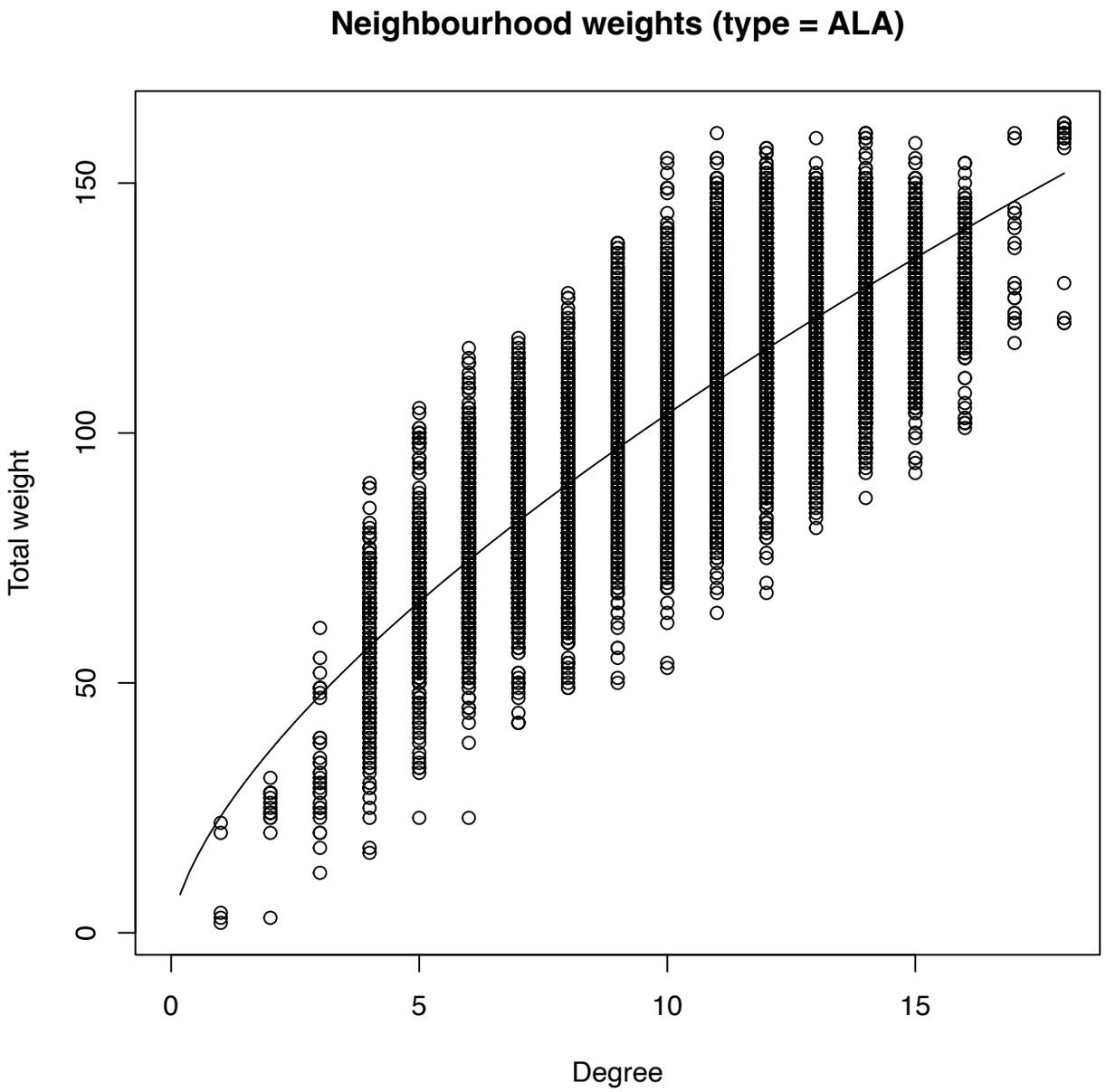
Loi de puissance 2/3:
=> frugalité de la resource

Loi de puissance:
=> interdependence

Loi de puissance:
=> diversité de solutions

Du cas individuel à la base de données

Frugalité : espace disponible localement autour de chaque element



Loi de puissance 2/3:
=> frugalité de la resource

Loi de puissance:
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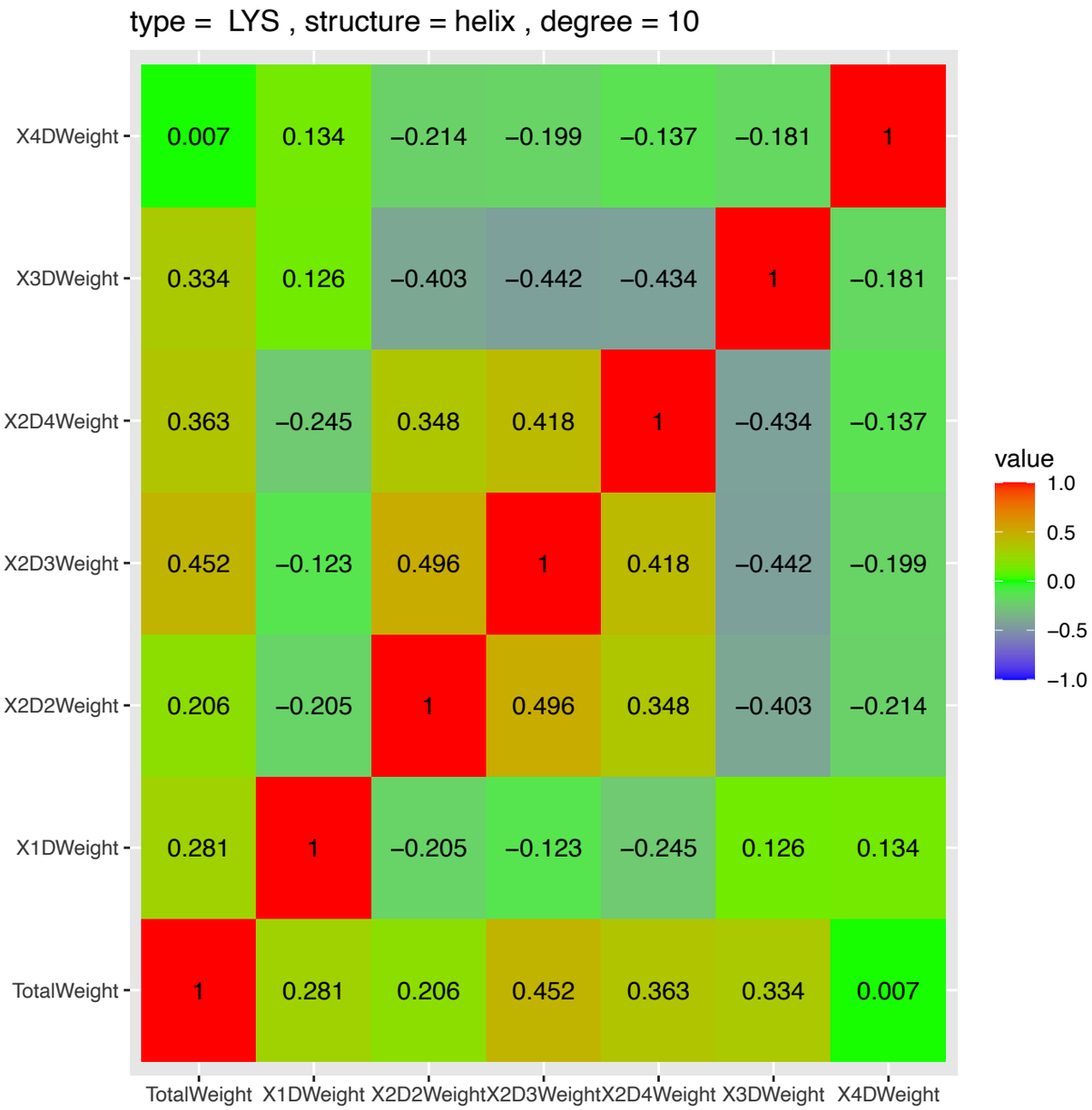
Loi de puissance:
=> diversité de solutions

Du cas individuel à la base de données

Système complexe dans sa conception:

EMERGENCE: le tout est plus grand que la somme des parties



Loi de puissance 2/3:
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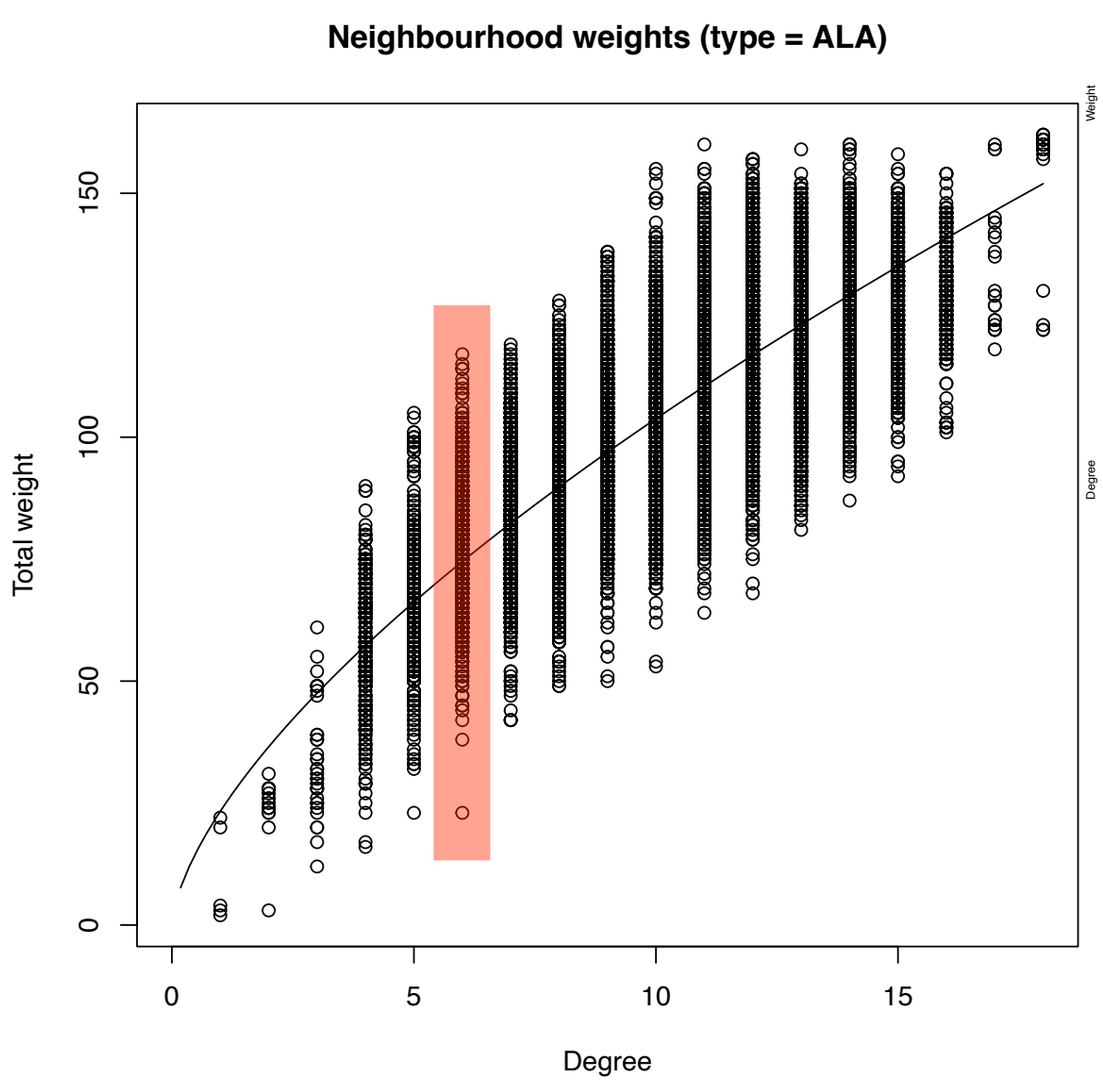
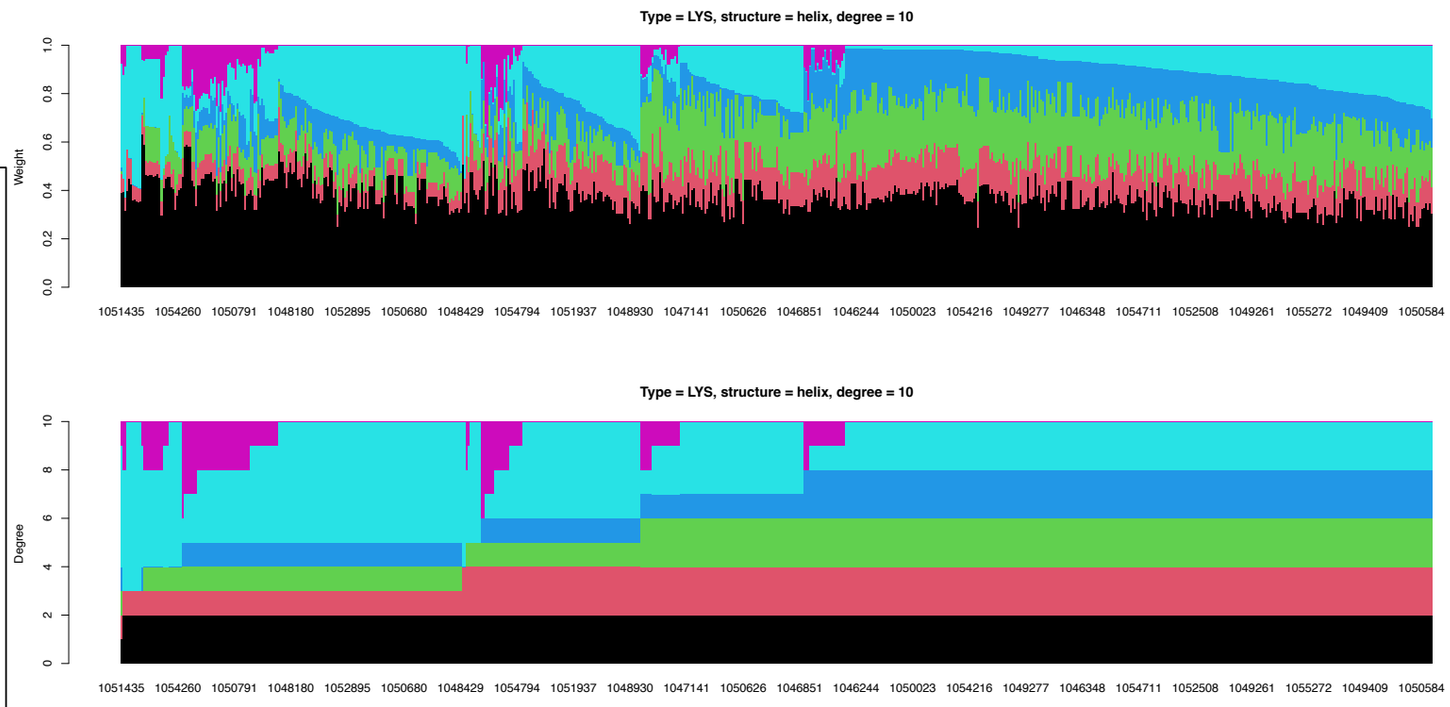
Loi de puissance:
=> diversité de solutions

Du cas individuel à la base de données

Diversité : solutions alternatives



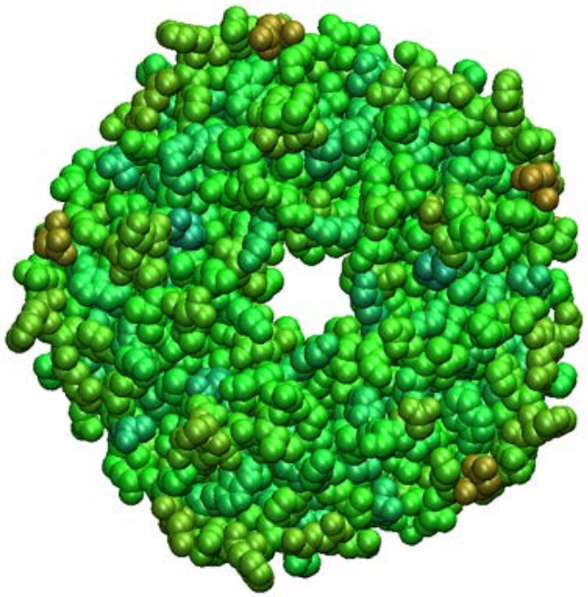


Loi de puissance:

=> diversité de solutions

Des protéines aux villes

Protéine



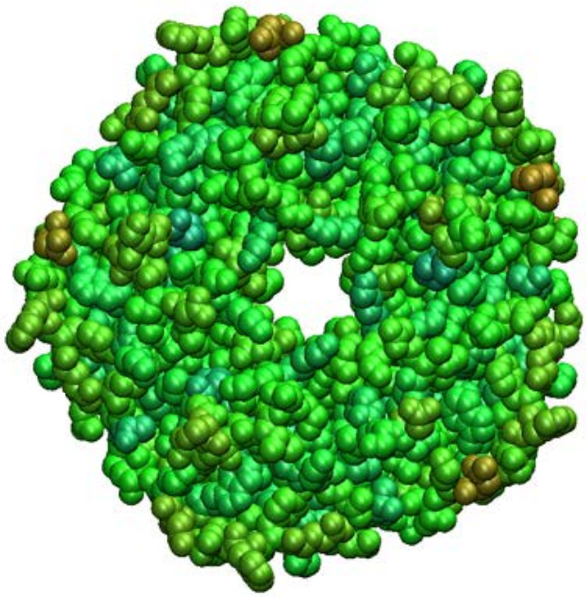
10^{-9} m

Lyon

5 km

Tolerance aux perturbations spatiales

Protéine



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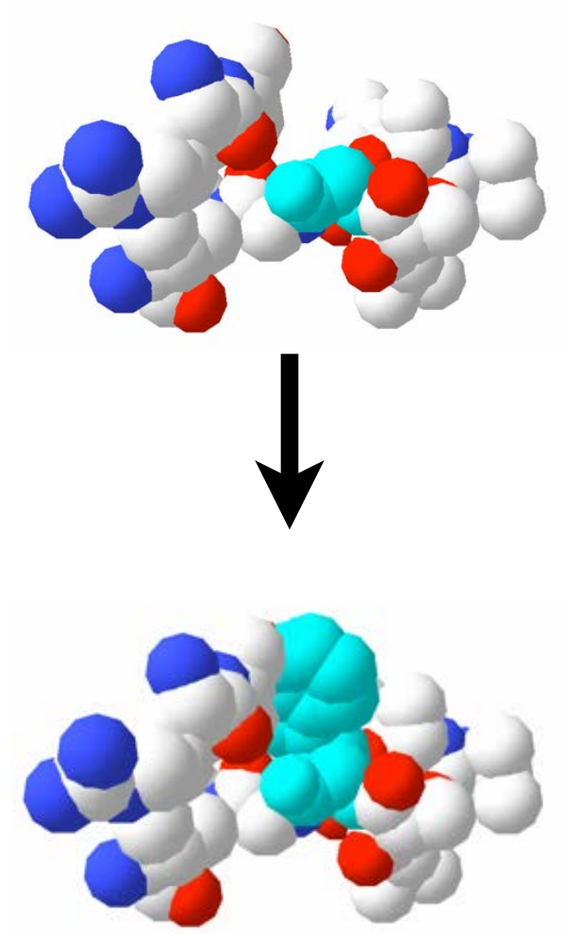

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Tolerance aux perturbations spatiales

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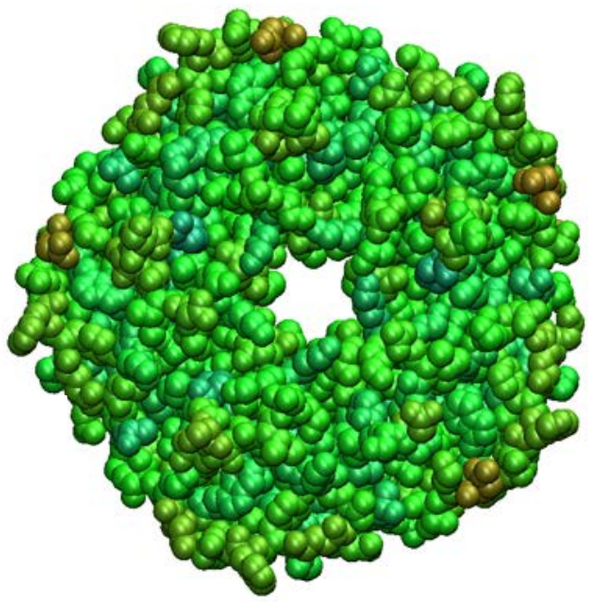

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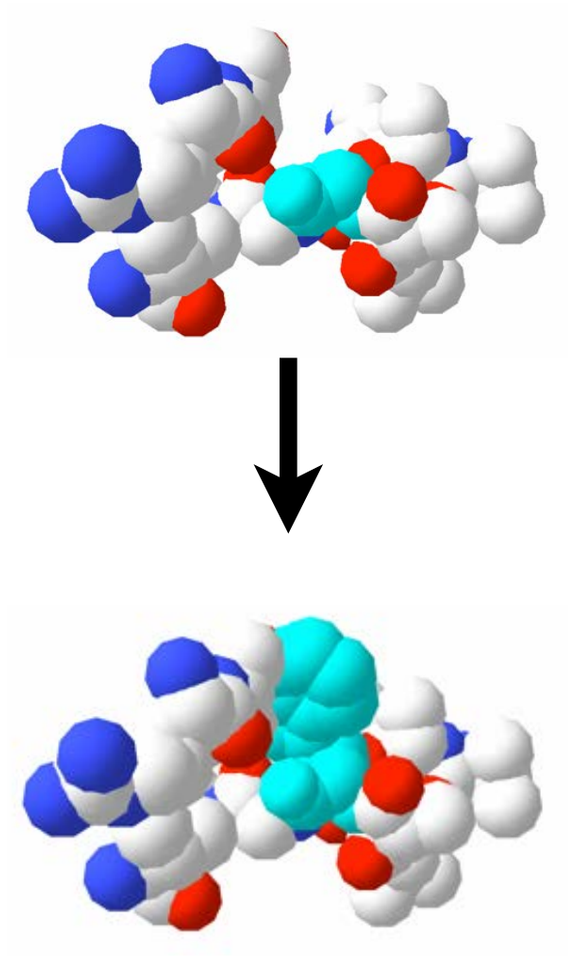
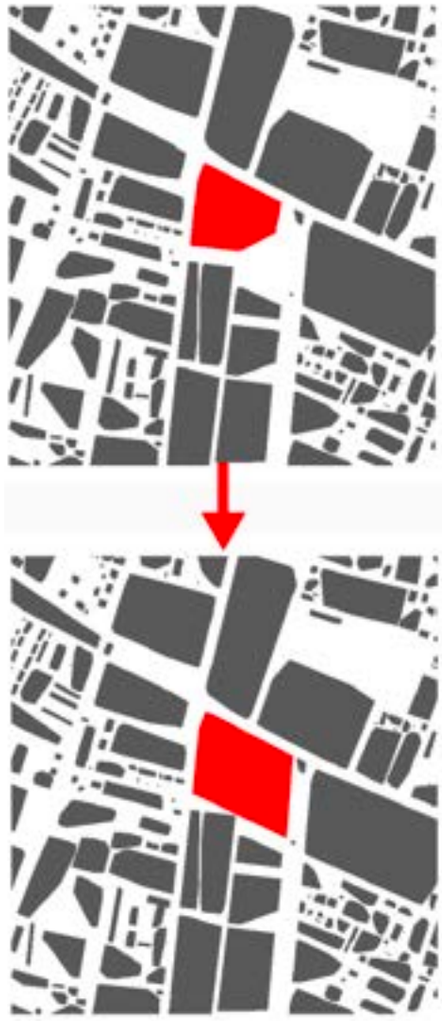
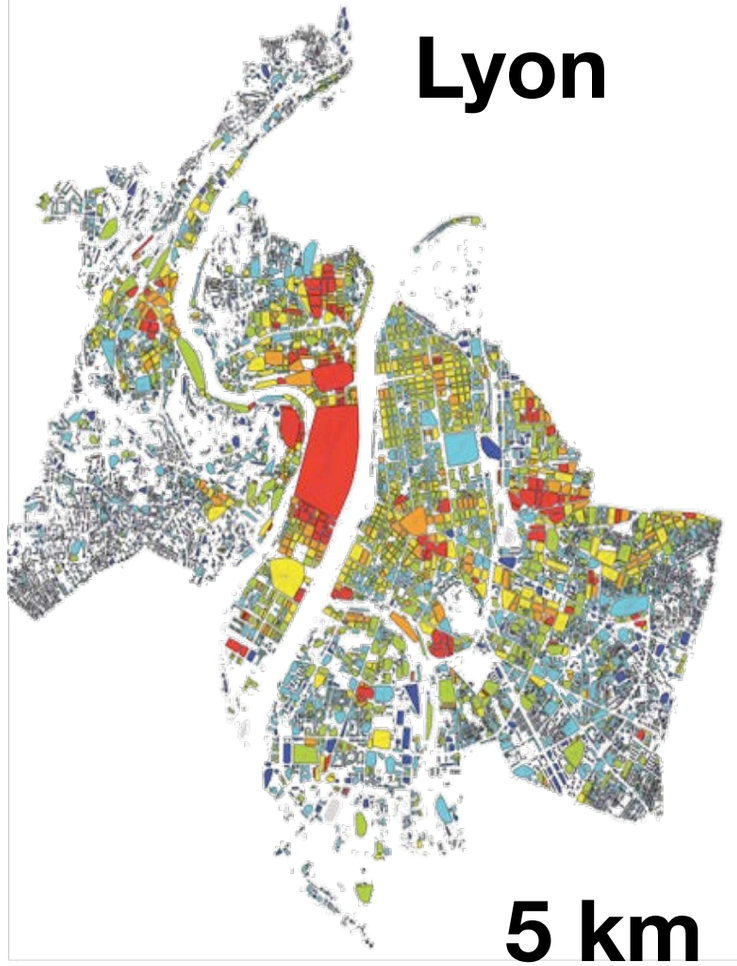


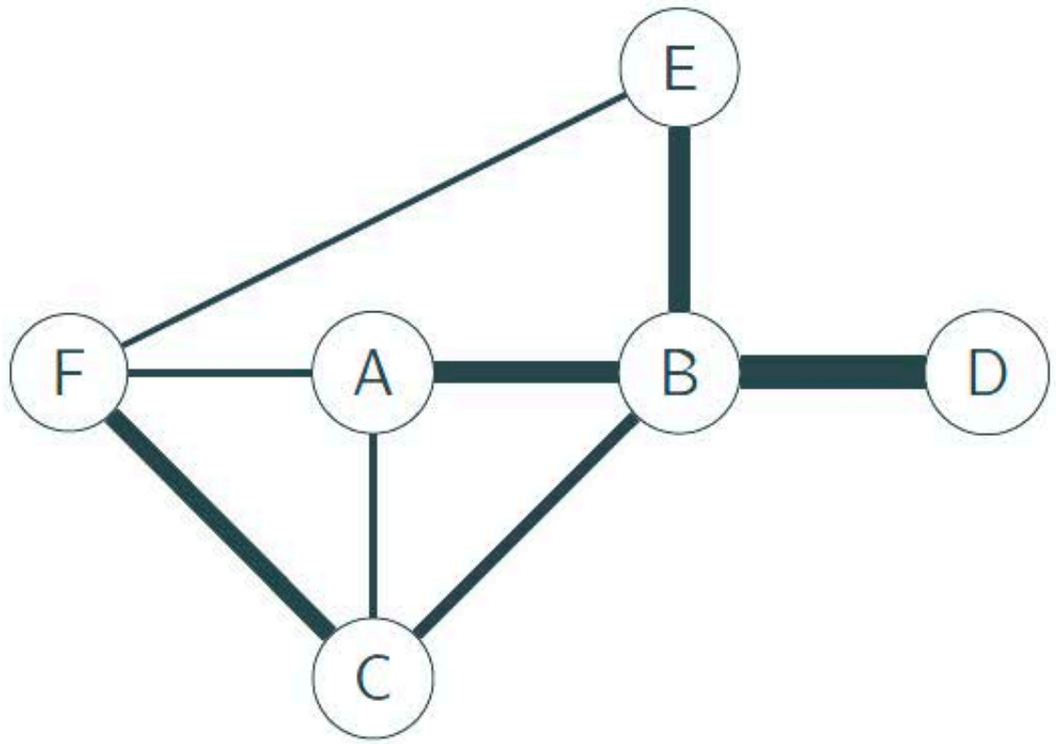


Lyon



5 km

Modélisation système complexe



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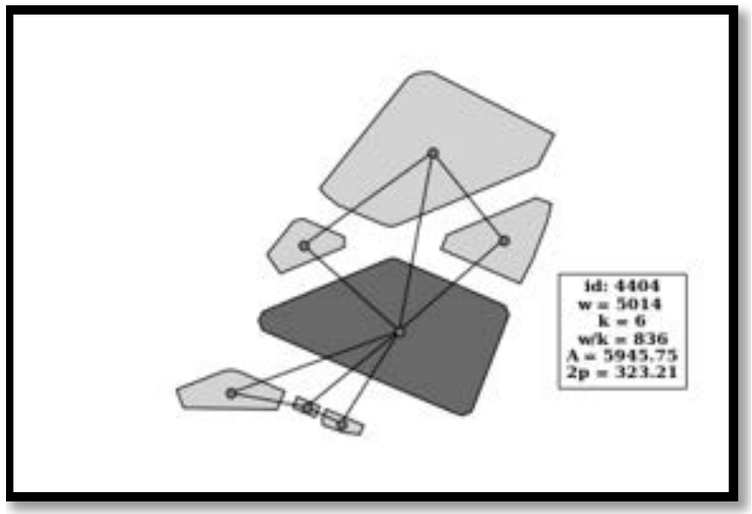
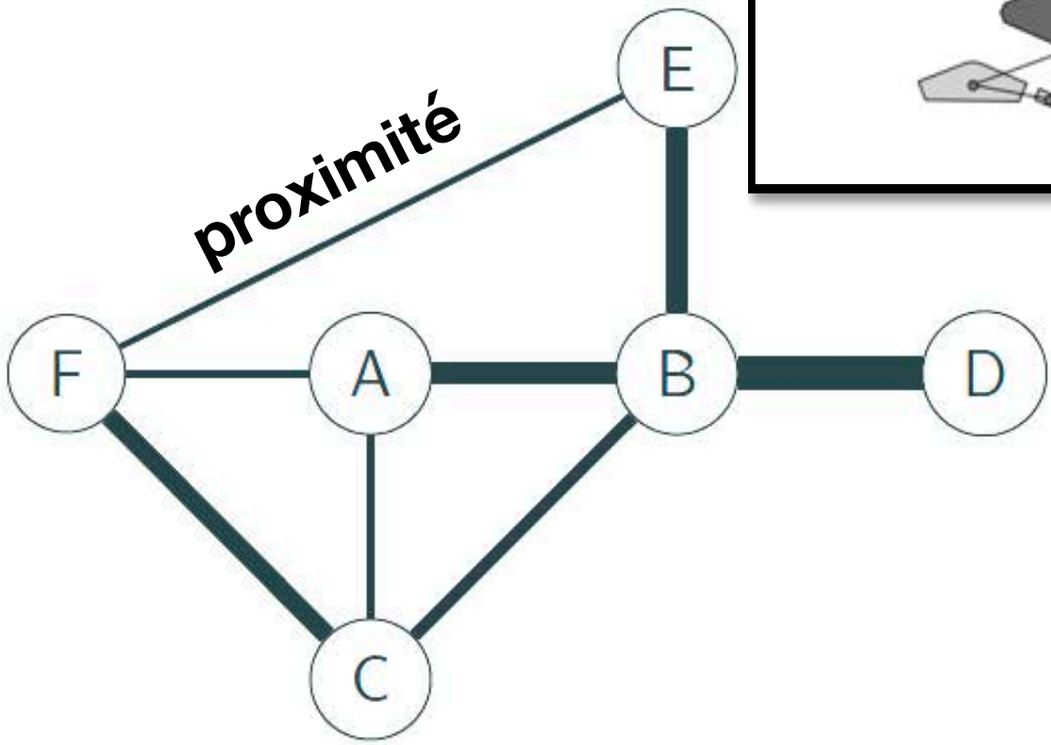
Modélisation système complexe

OpenStreetMaps data



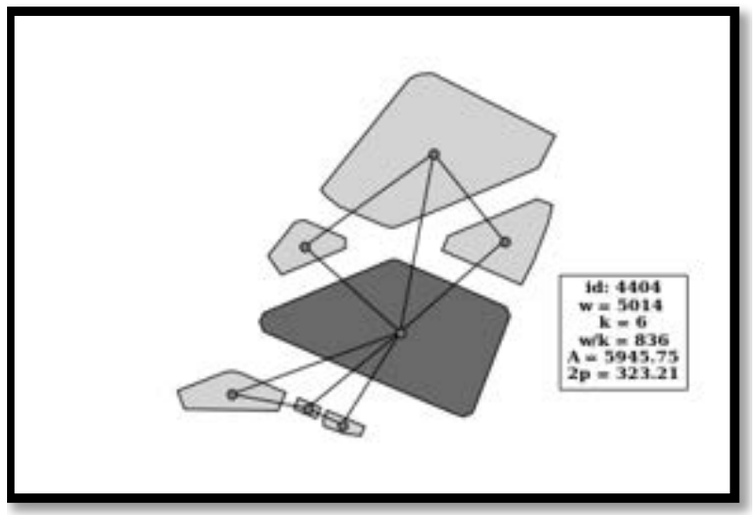


Graph: $G = (V, E)$

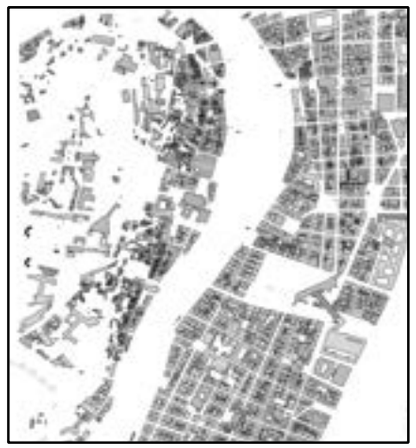
Nodes: $V = \{i \mid i \text{ is a component}\}$

Links: $E = \{(i, j) \mid i, j \in V \text{ and } \exists \text{ an } i - j \text{ relation}\}$ **Link weights:** w_{ij}

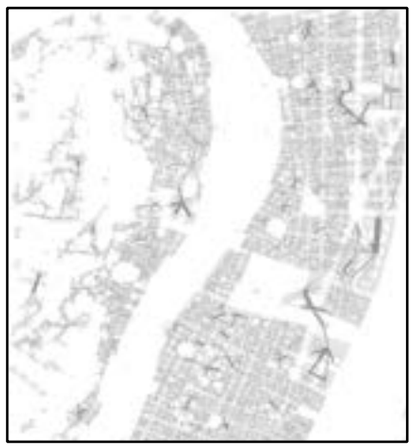
Inspiration des Protéines: l'échelle LOCALE



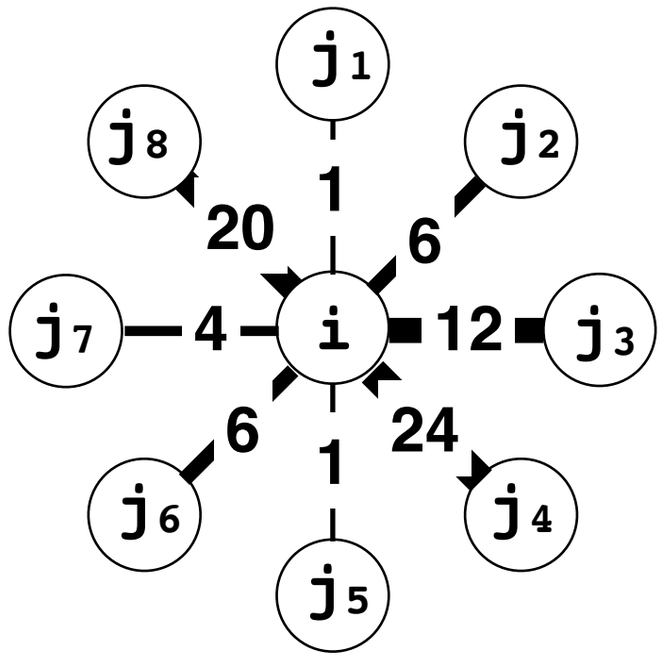
OpenStreetMaps data



Building nodes



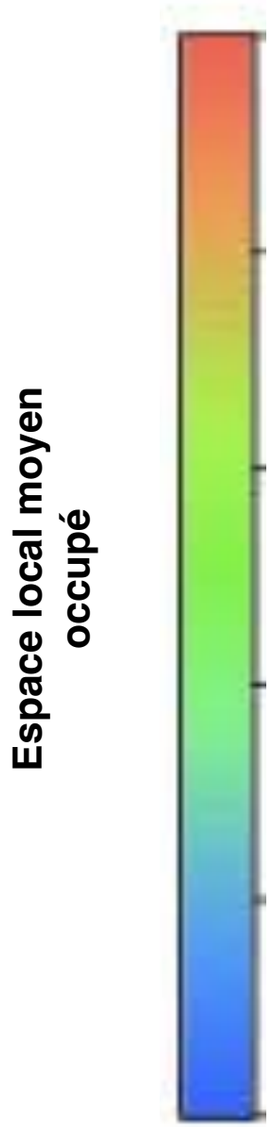
Linked building nodes



Gestion durable de l'Espace: croissance urbaine

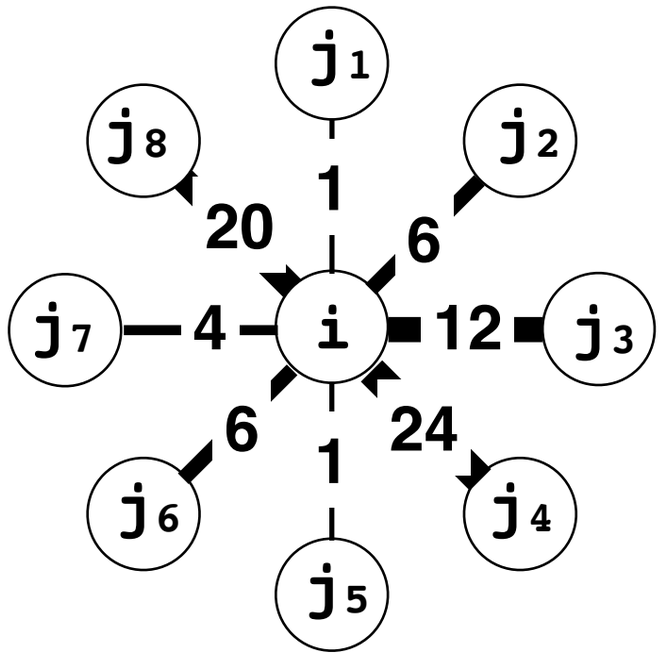
Echelle locale: un bâtiment et ses voisins

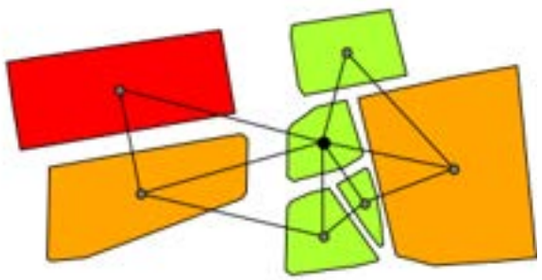
Non durable

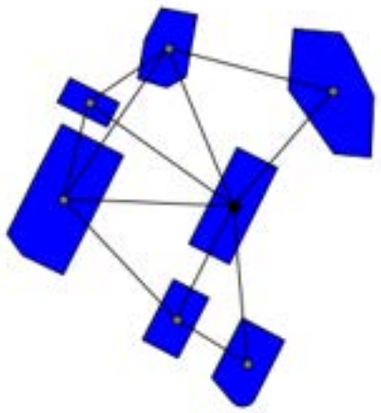


Durable

Neighborhood watch







Gestion durable de l'Espace: croissance urbaine

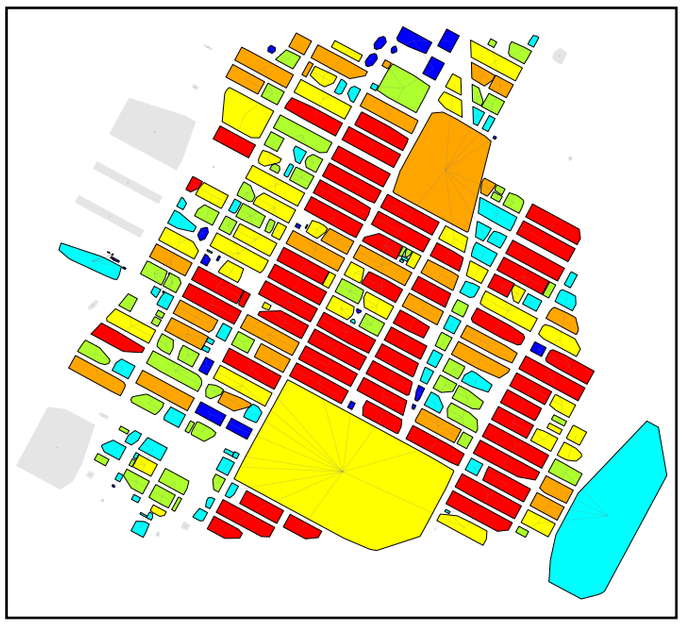
Echelle du quartier

Unsustainable

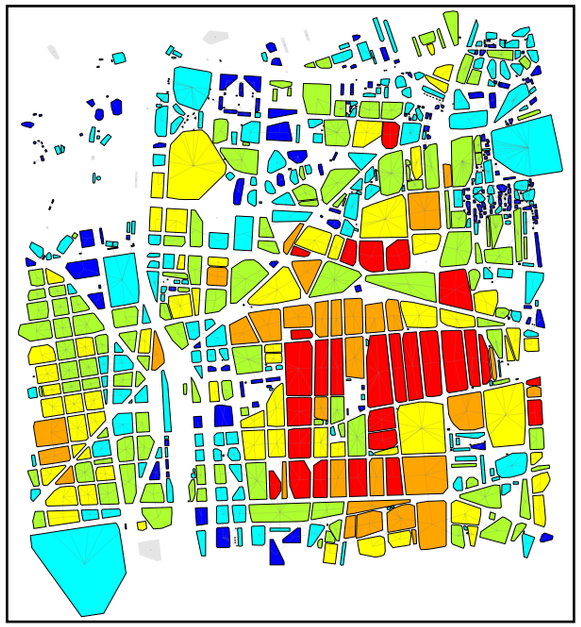
Espace local moyen occupé

Sustainable

Manhattan



Charpennes

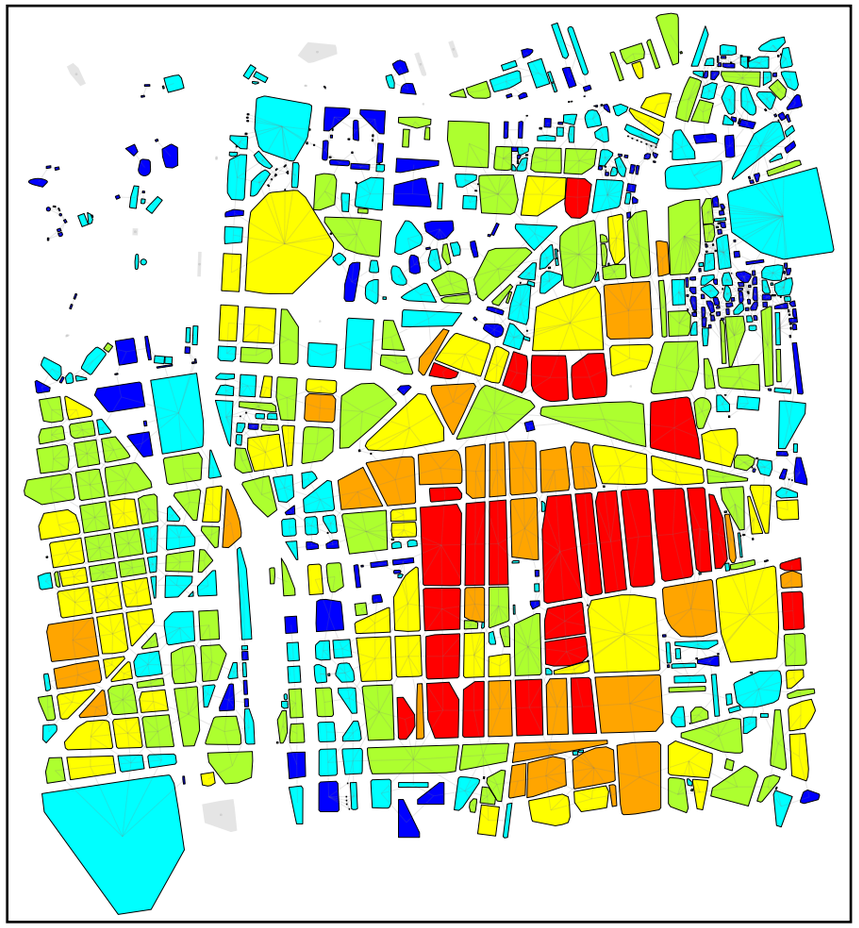


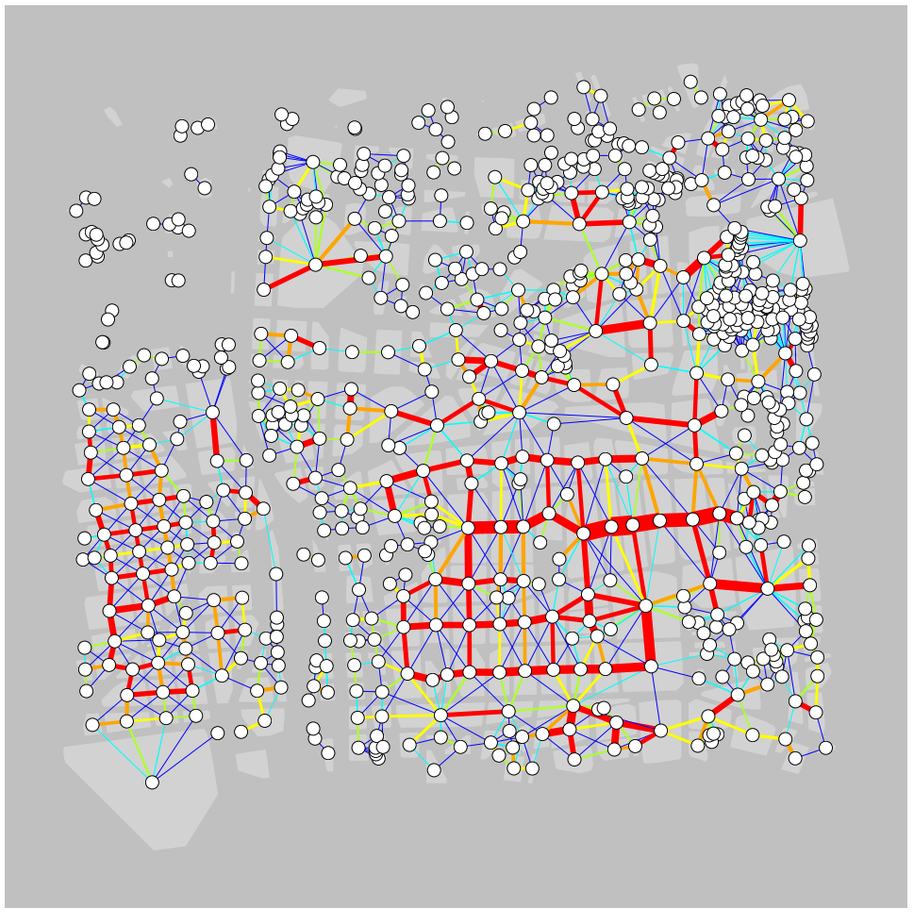
Monplaisir

Neighborhood watch

Gestion durable de l'Espace pour se déplacer

Charpennes



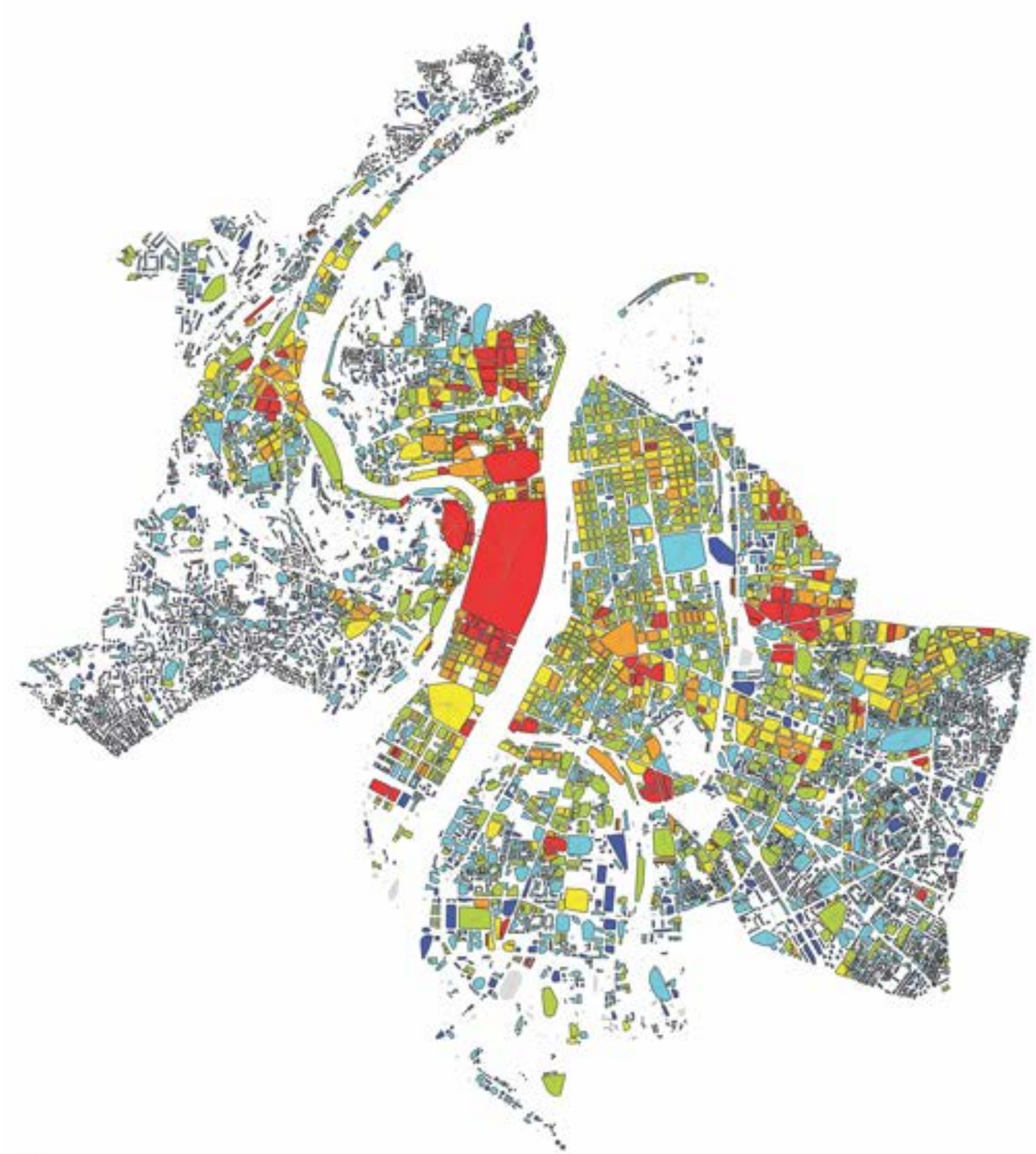


W_{ij}

Durable — Non durable

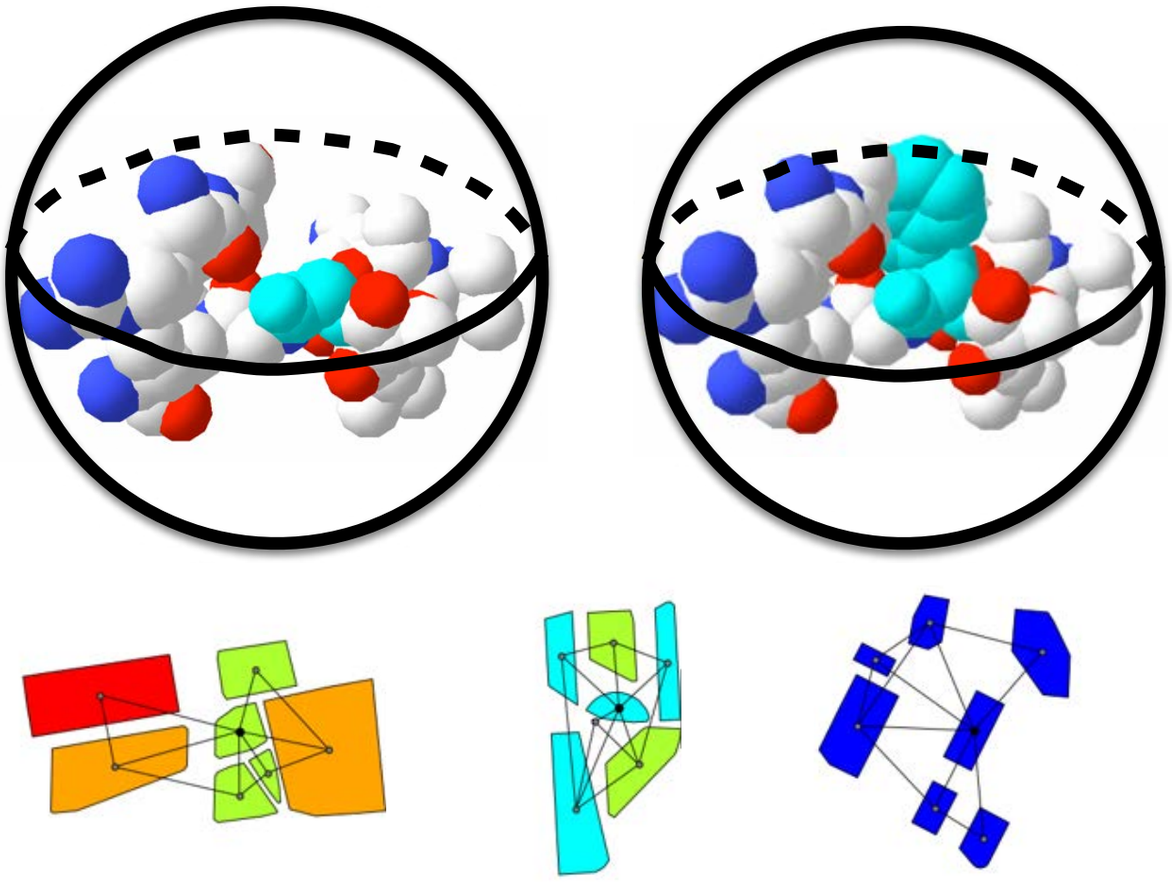
Gestion durable de l’Espace: croissance urbaine

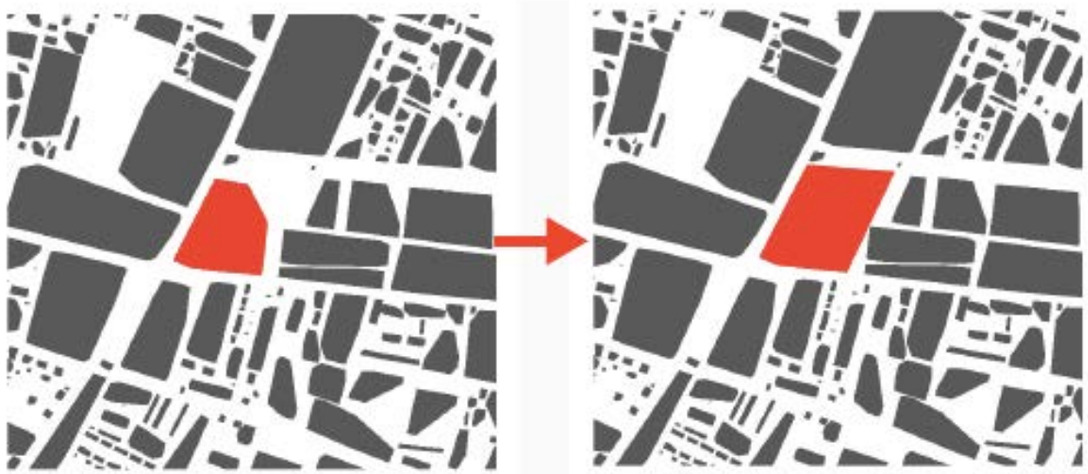
Echelle de la ville

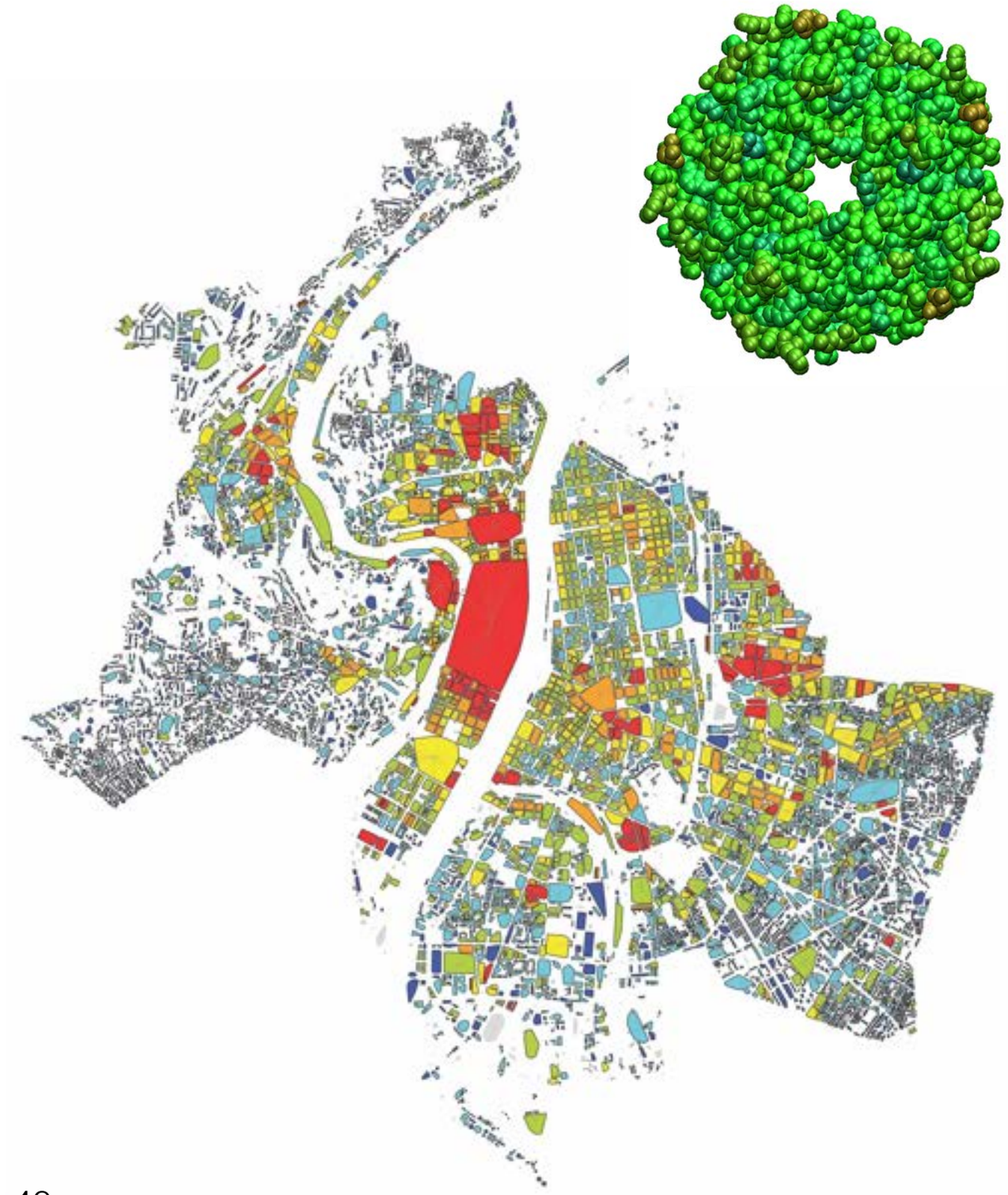


Gestion durable de l'Espace: croissance urbaine

Echelle du local au global

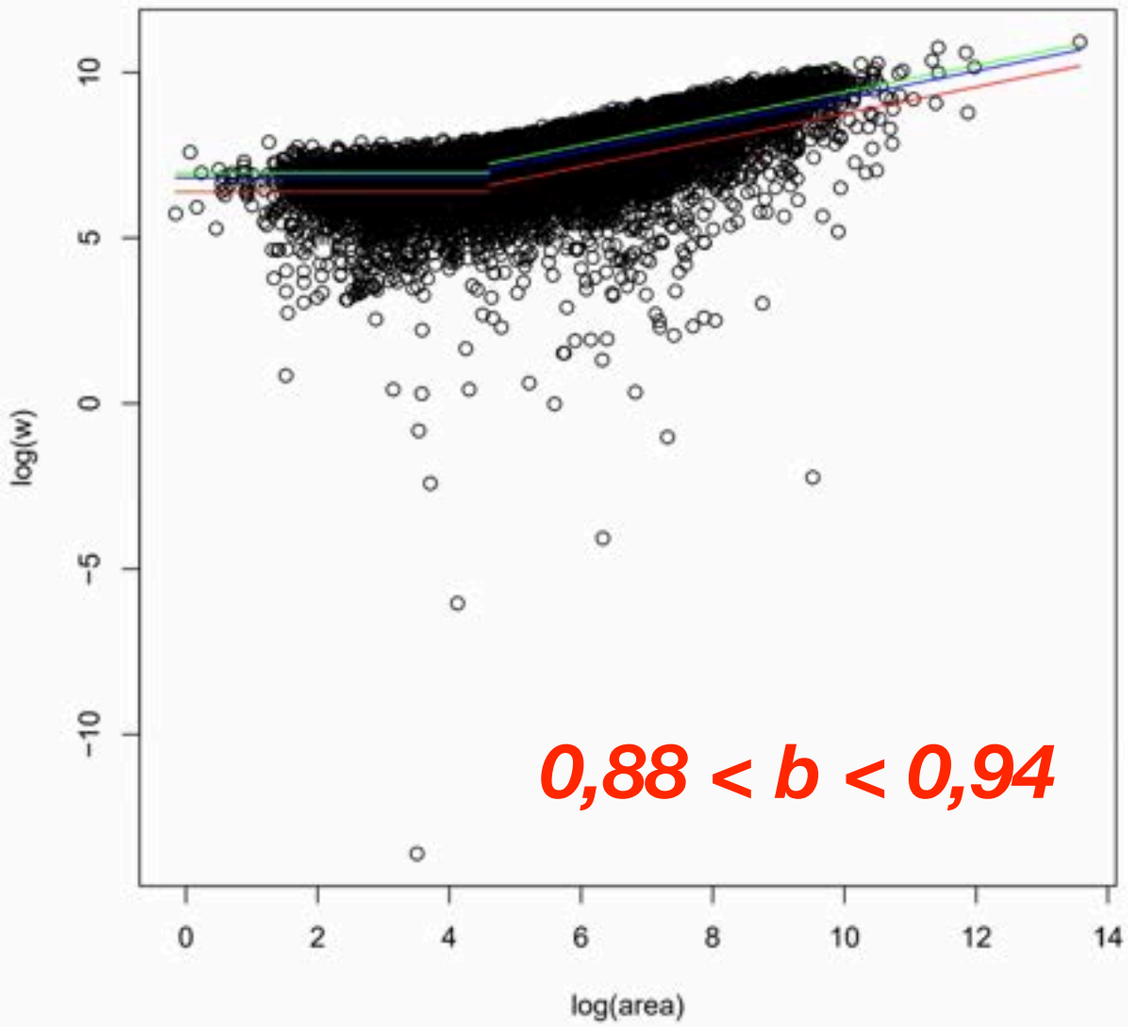




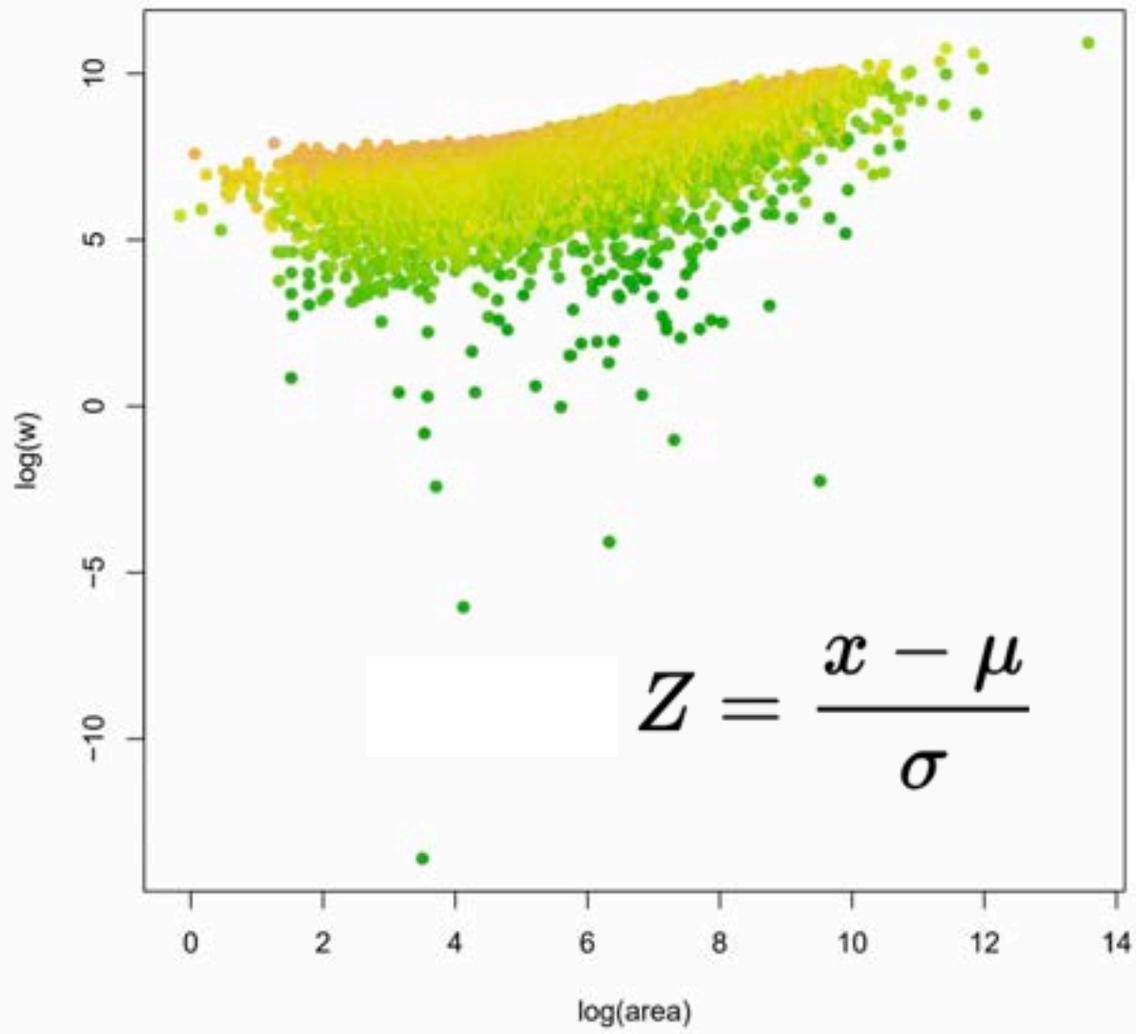


Du cas individuel à la base de données

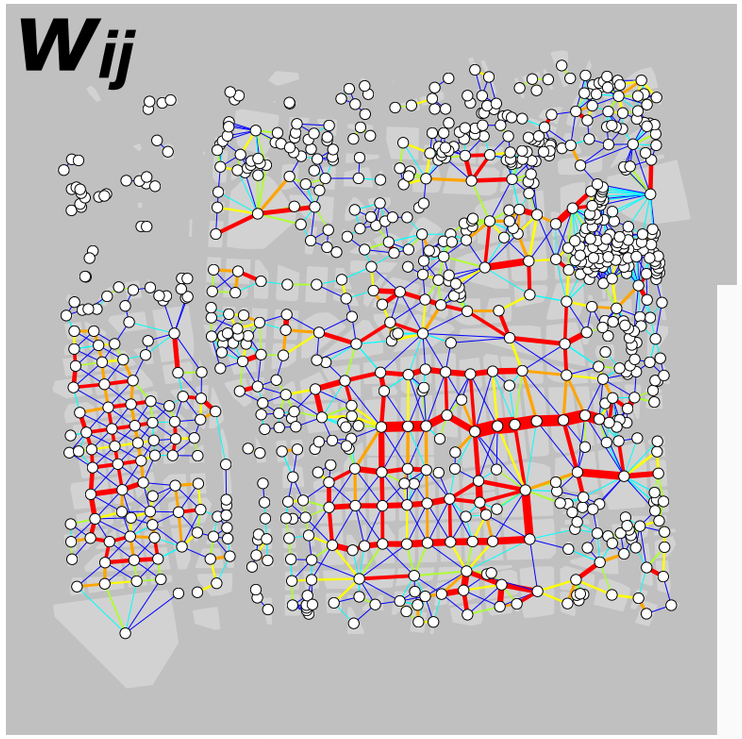
$w = ak^b (area)^c$

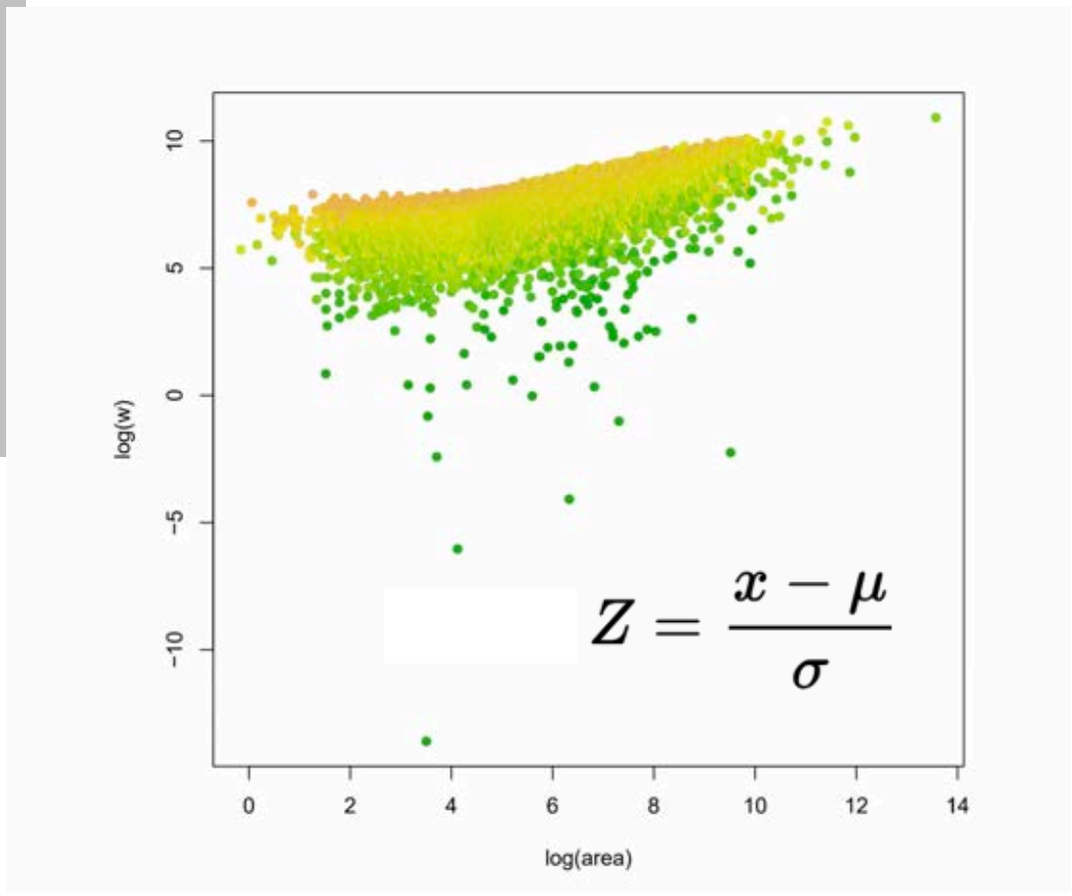


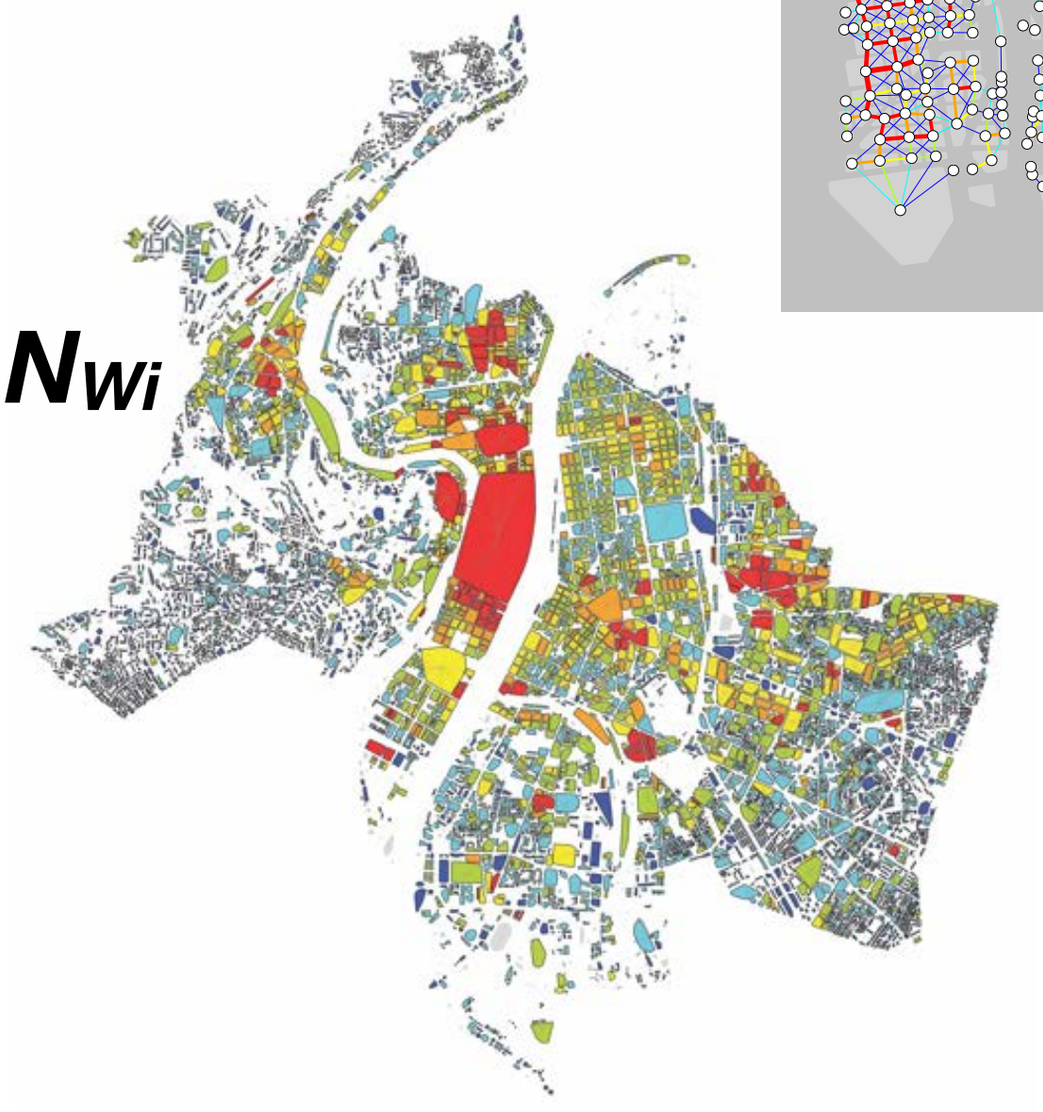
z-score



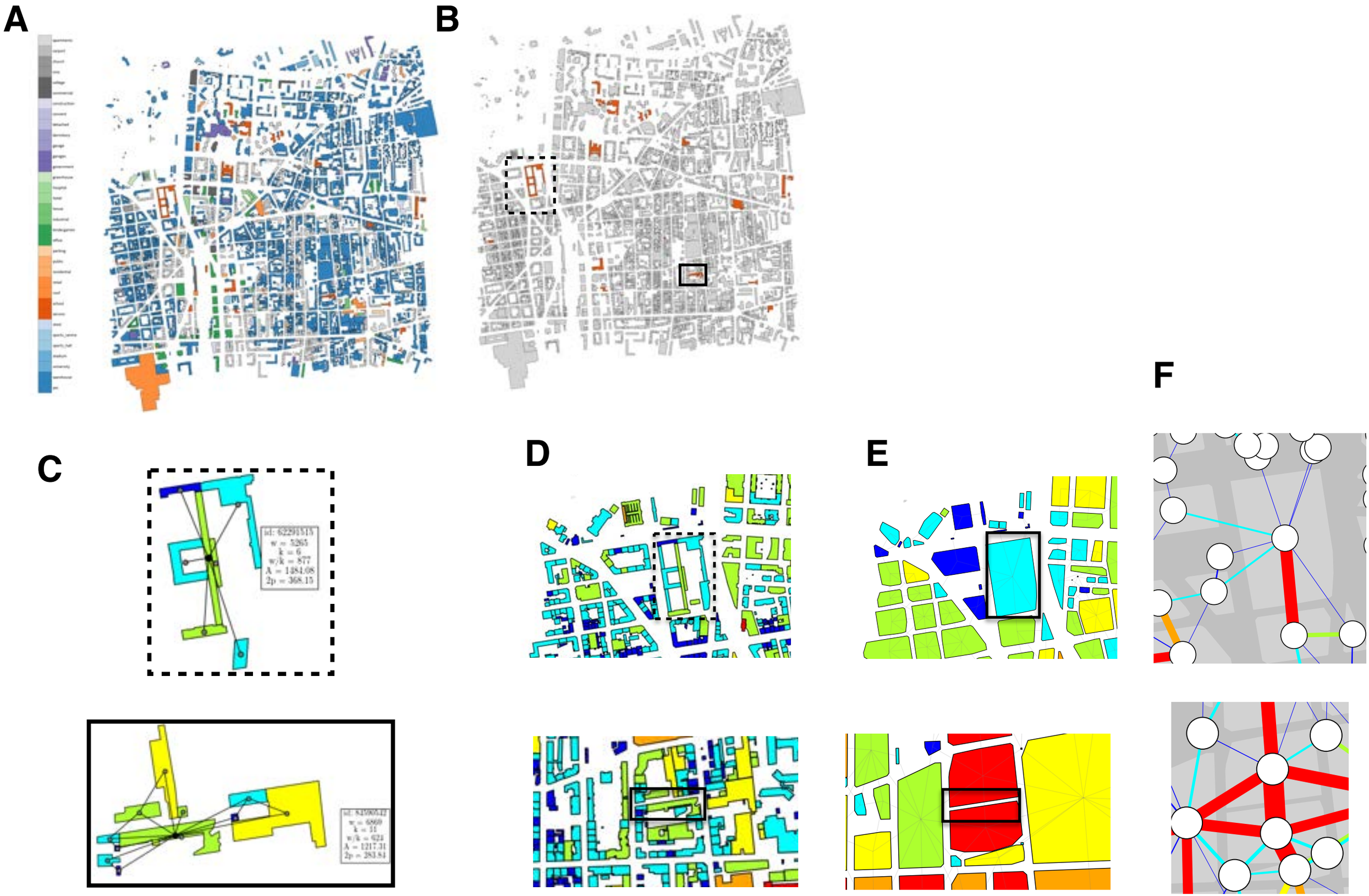
Mesures de tolerance aux perturbations spatiales





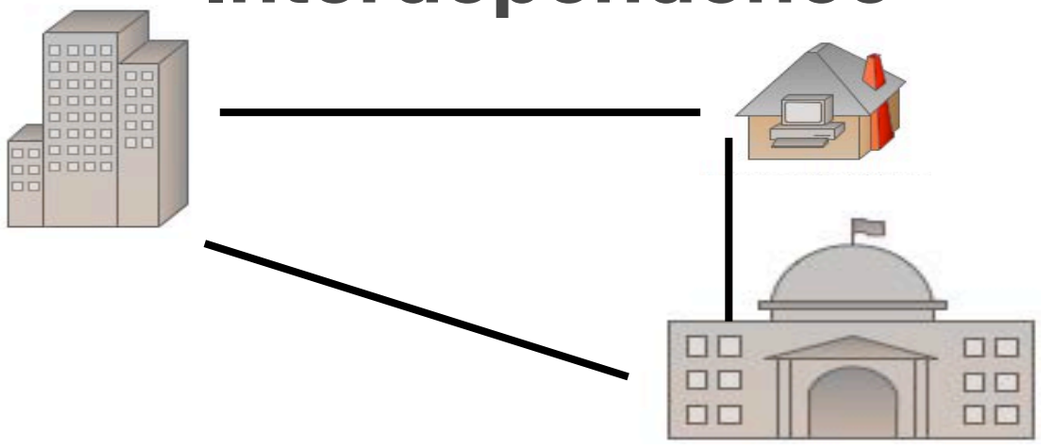


Applications

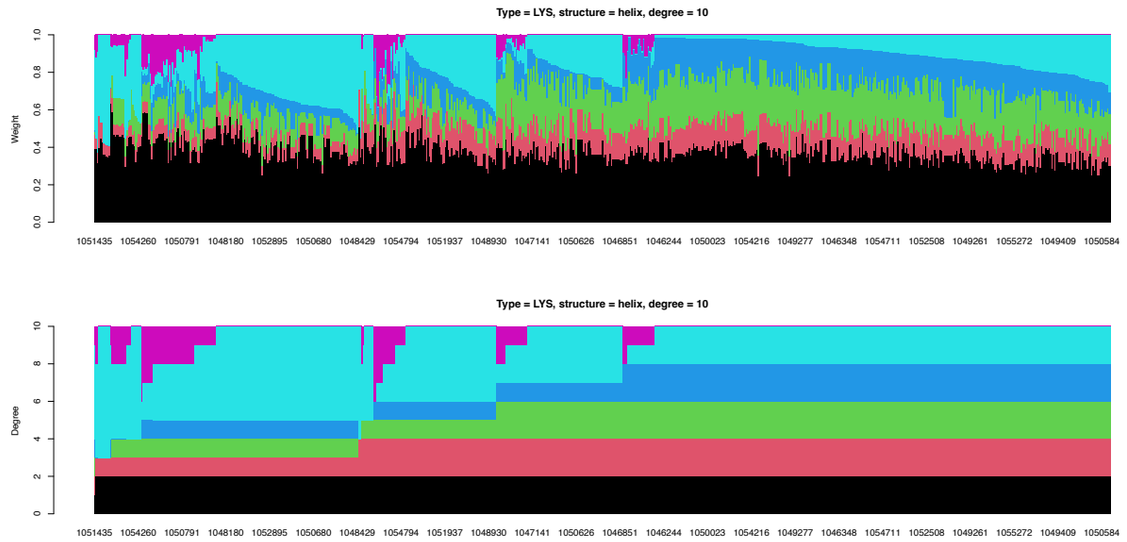


Les PISTES s’inspirant du vivant

Interdependence

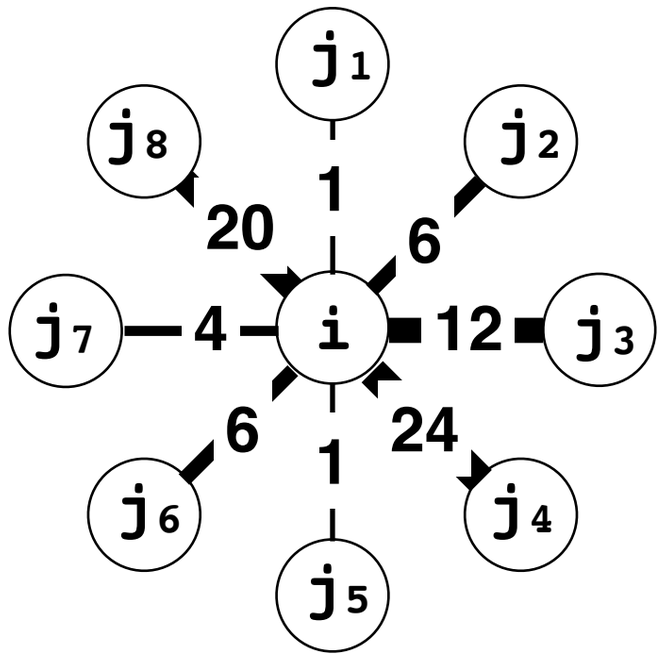


Diversité



Echelle locale: le lot

Echelle locale: le voisinage



La diversité

PLEA2006 - The 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland, 6-8 September 2006

Urban Form, Density and Solar Potential

Vicky Cheng[1], Koen Steemers[1], Marylene Montavon[2] and Raphaël Compagnon[3]

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[2] Solar Energy and Building Physics Laboratory (LESO-PB), Ecole Polytechnique Fédérale de Lausanne, Switzerland
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ABSTRACT: Rapid urbanization in recent years has exerted tremendous pressure on urban development. In the face of the largely unexamined fashion for densification, it is vital that the environmental impact of compaction be researched. This study comprises solar simulation of eighteen generic models; each represents a particular combination of built form and density. This paper examines the relationships between built forms, density and solar potential, with reference to three design criteria i.e. openness at ground level, daylight factor on building façade and PV potential on building envelope. The result shows the different effects of horizontal and vertical randomness on urban solar potential and it also reveals the interrelation between randomness, plot ratio and site coverage, which can provide helpful insights for planning solar cities.

Keywords: Urban Form, Density, Solar Potential

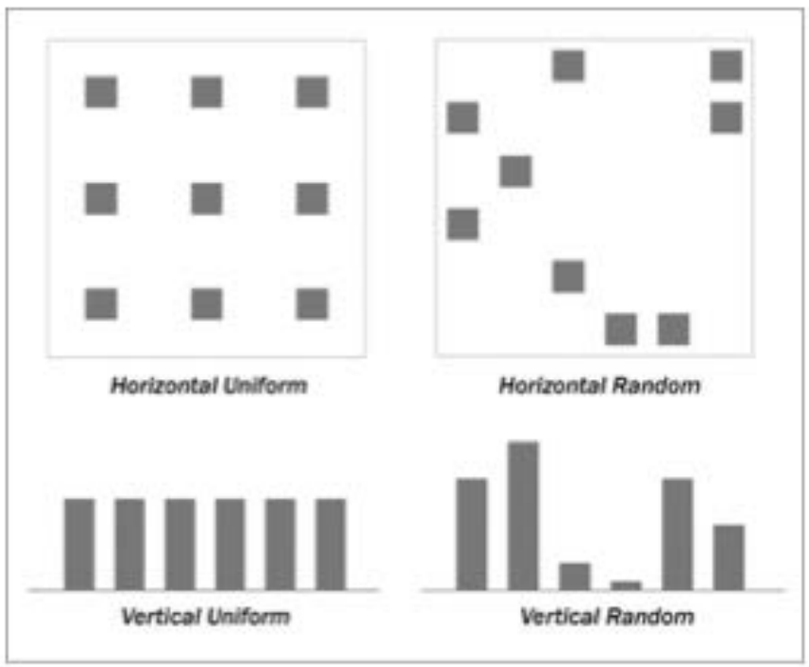
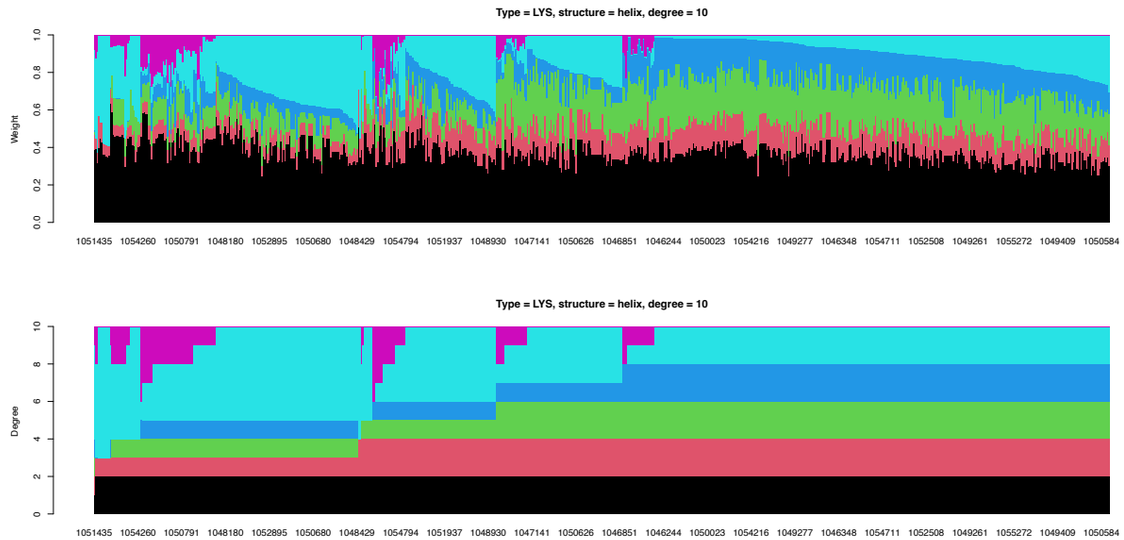
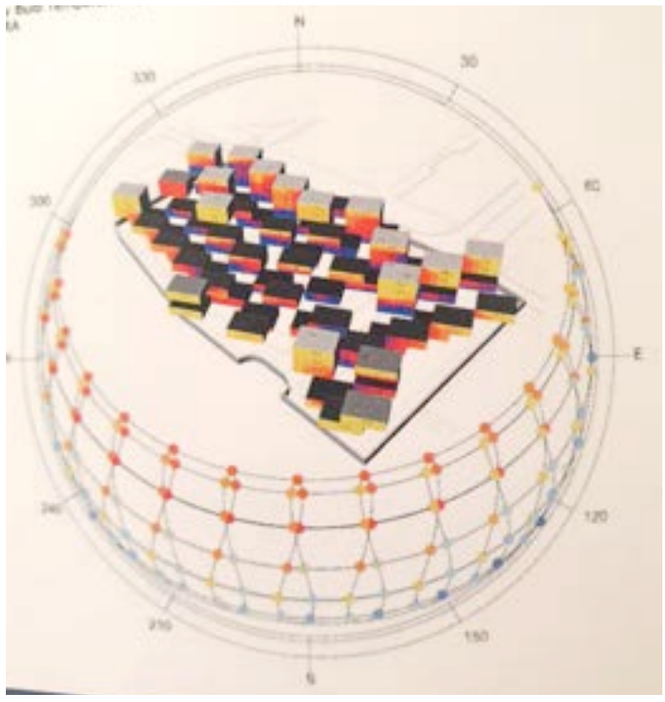


Figure 1: Horizontal and vertical urban layouts

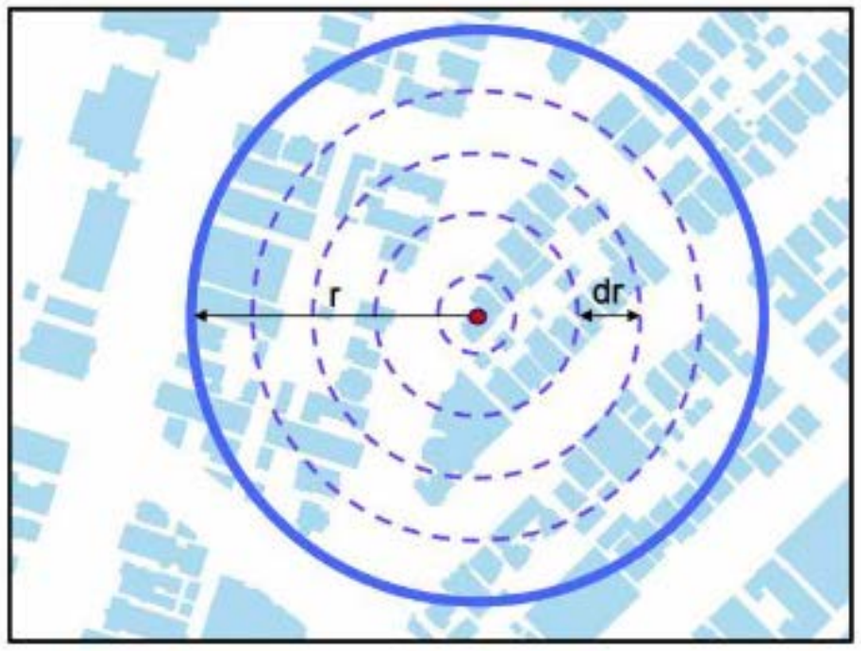




In Situ cabinet d'architecture

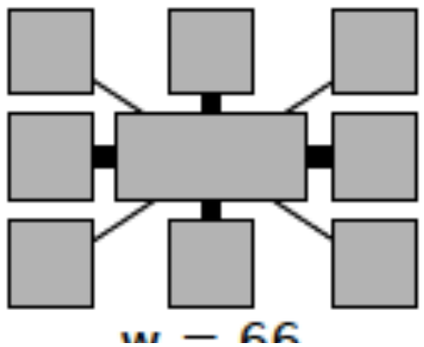
Autre modélisation et comparaison

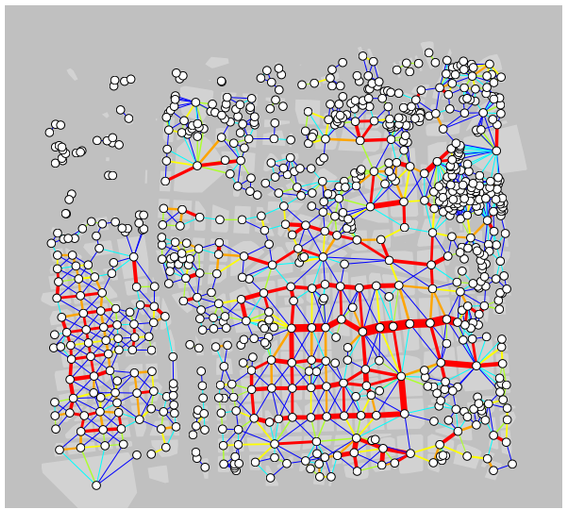
Densité-Radial distribution function

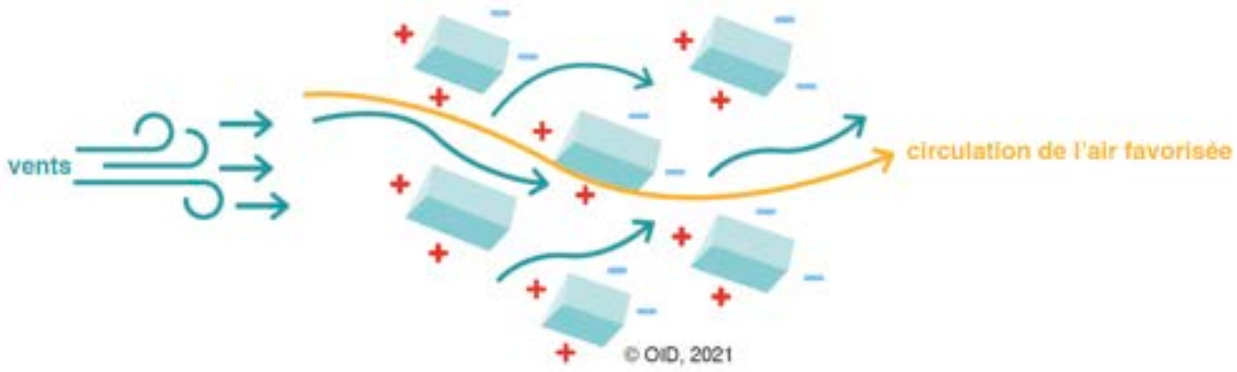


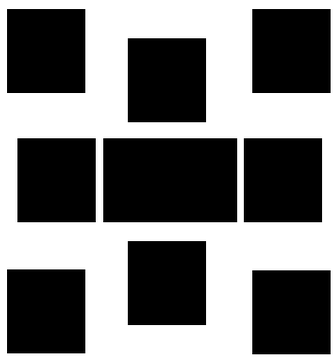
Sobstyl, J.M., Emig, T., Qomi, M.A., Ulm, F.J. and Pellenq, R.M., 2018. Role of city texture in urban heat islands at nighttime. *Physical review letters*, *120*(10), p.108701.

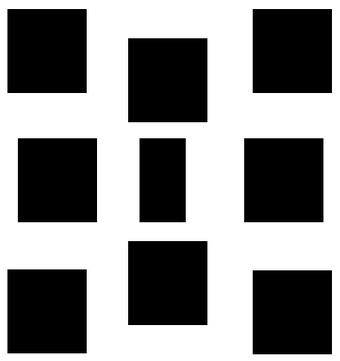
w_{ij}











Collaborateurs et Collaboratrices

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Giovanni Feverati (Physics)

Lorenza Pacini (Complex systems)

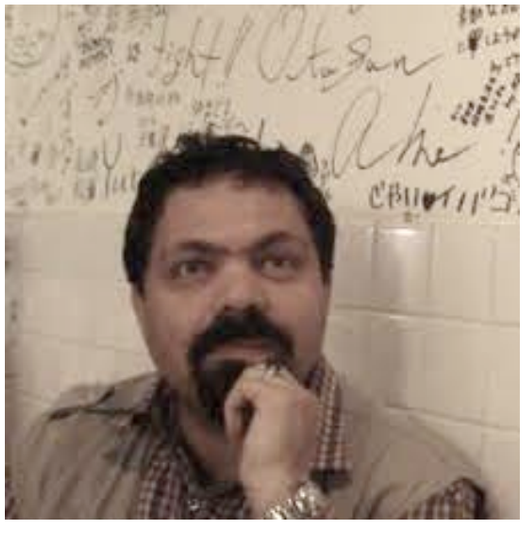
Remy Cazabet (Computer science)

La durabilité du vivant repose sur la diversité et le fonctionnement collectif

Natasha HEIL CHAYAAMOR (Architecture-Biomimestime)

Yao-ban Chan Mathematics and Statistics

Kave Salamatian (Computer science)



Juste Raimbault (Geomathics)

Claire Lagesse (Geomathics)