

Towards a 3D geographic information system for the exploration of urban rules : - application to the French LUPS -



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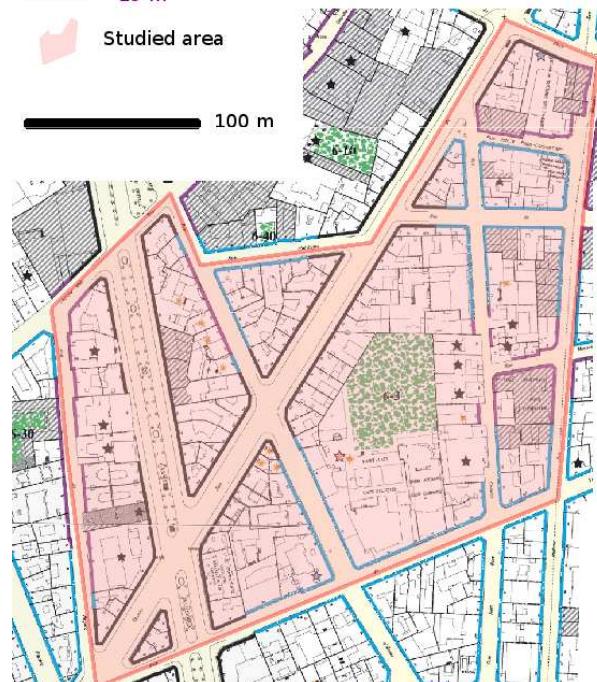


Prospect distance (Slope = 2)

Height against road :

- 25 m
- 20 m
- 15 m
-  Studied area

100 m



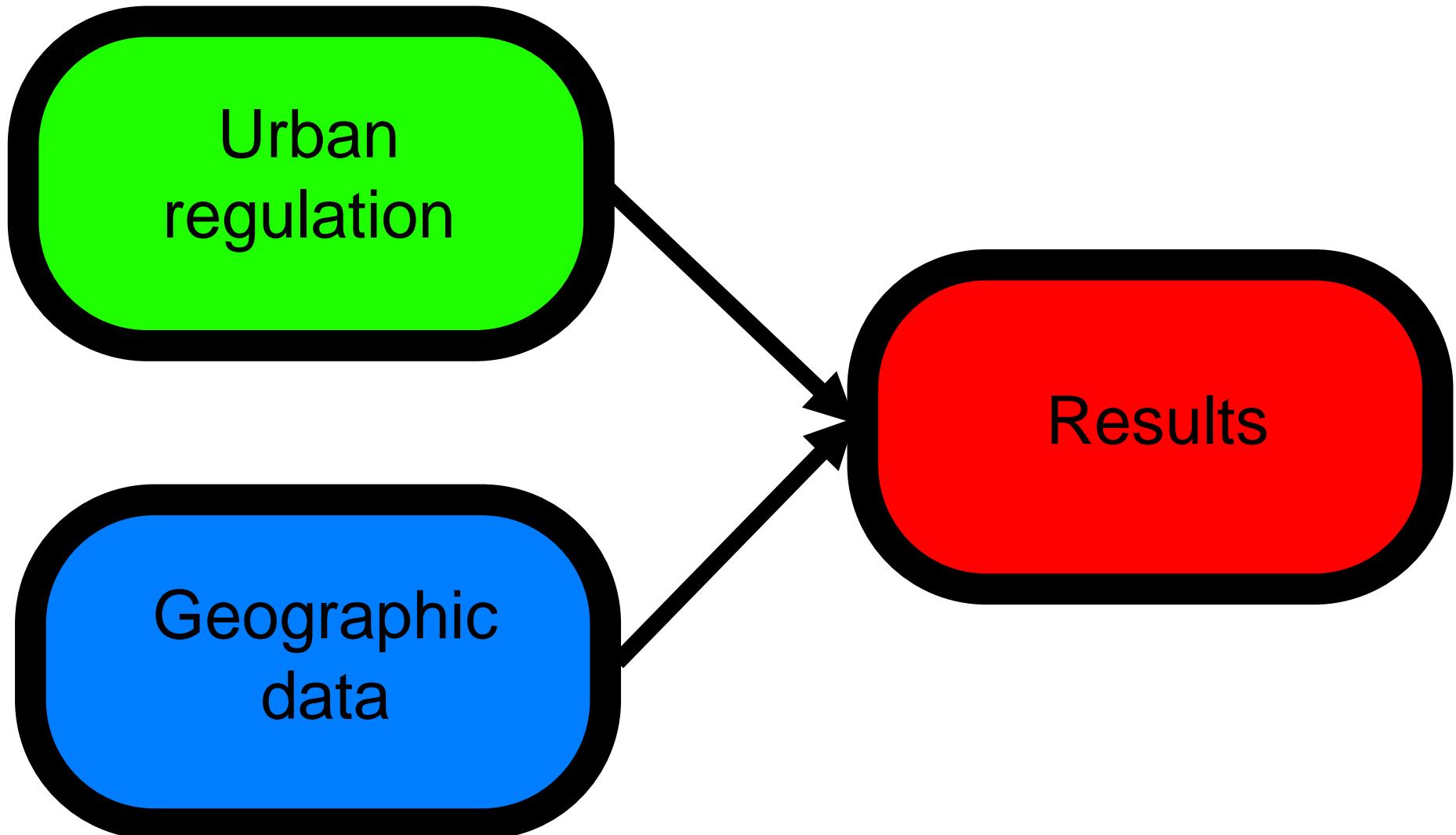


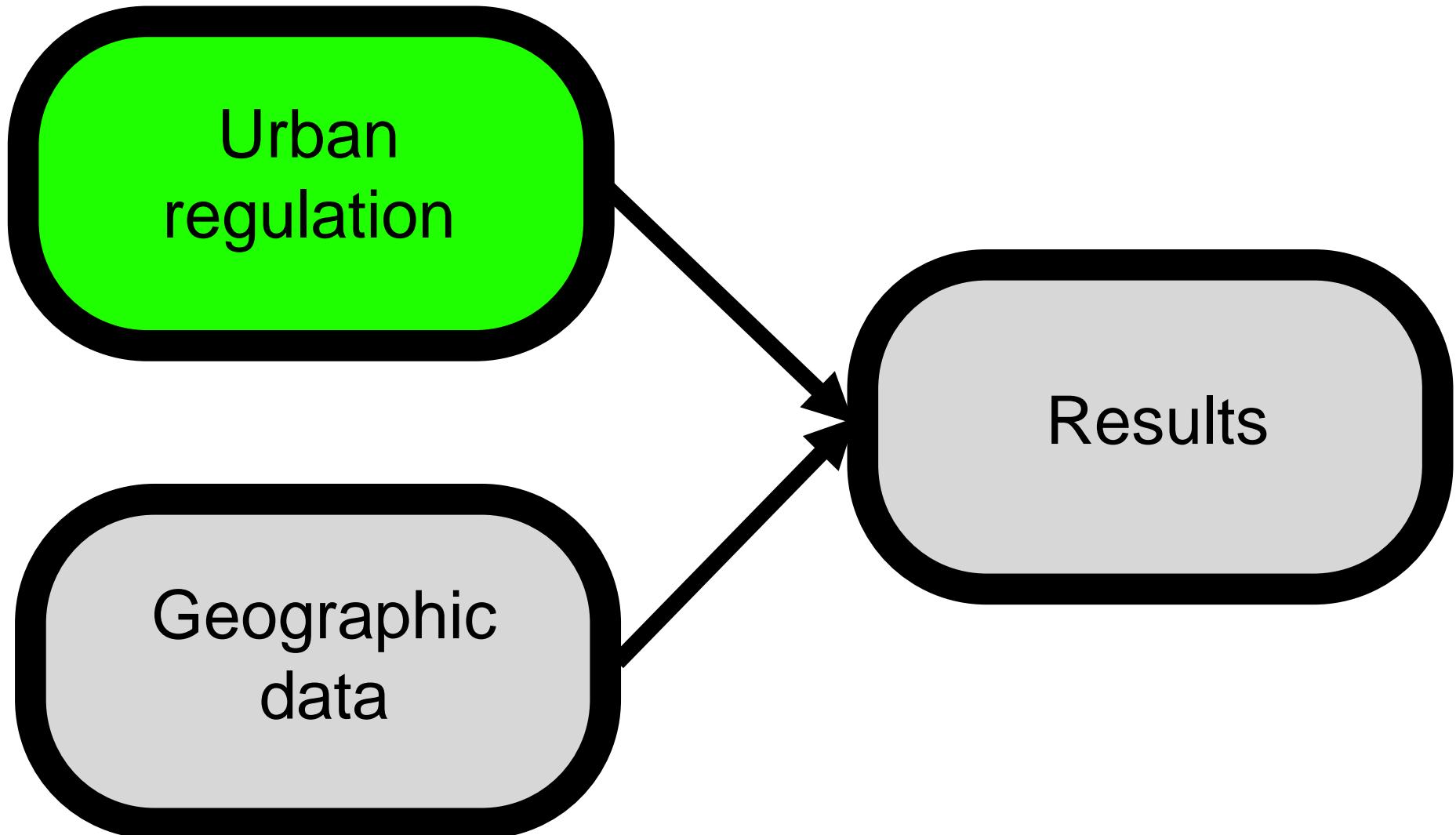
- French territorial development expressed through a large set of plans
 - Different levels of detail,
 - Different disciplines
- ... contains lots of useful information to study territorial evolution
 - ... but only in textual format

↳ integrate knowledge included in a regulation scheme in a 3D GIS



- Study of the use of a 3D dataset and urban rules :
 - Check if the regulation is respected
 - Assess constructability potential according to an effective or virtual regulation





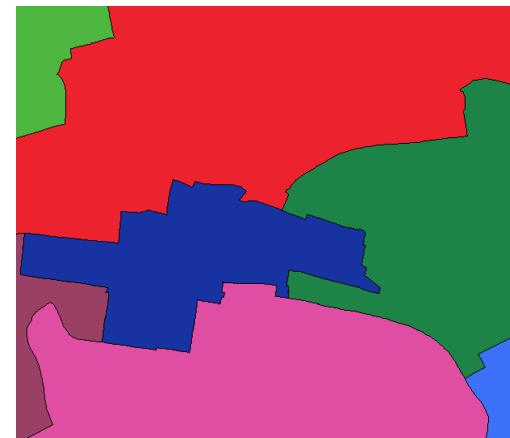
The LUPS



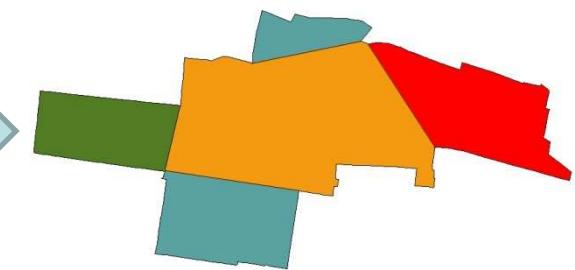
French territory



Districts or groups of districts



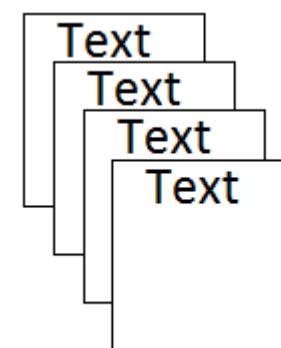
Zones



14 rules with
standardized
title



Regulation text



Types

- U : Urban zone
- UA : To be built
- N : Natural zone
- A : Agricultural zone

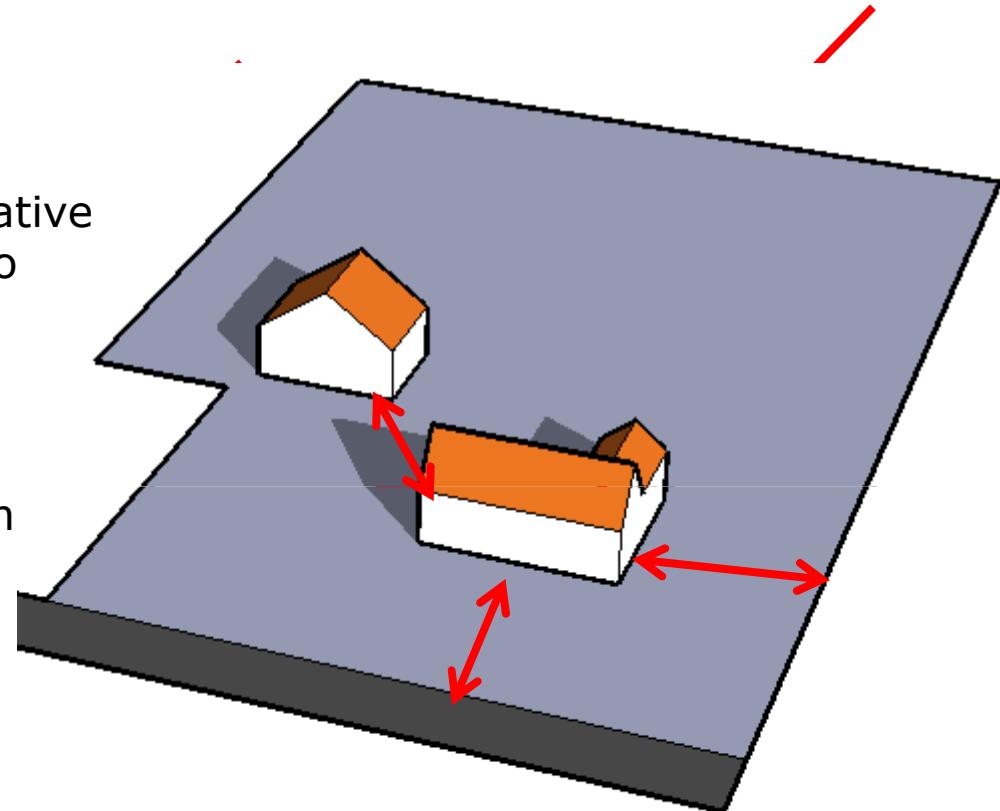
Articles 1, 2 : Land use restrictions

Articles 6, 7, 8 : Position of buildings relative
to parcel borders, to other buildings or to
roads

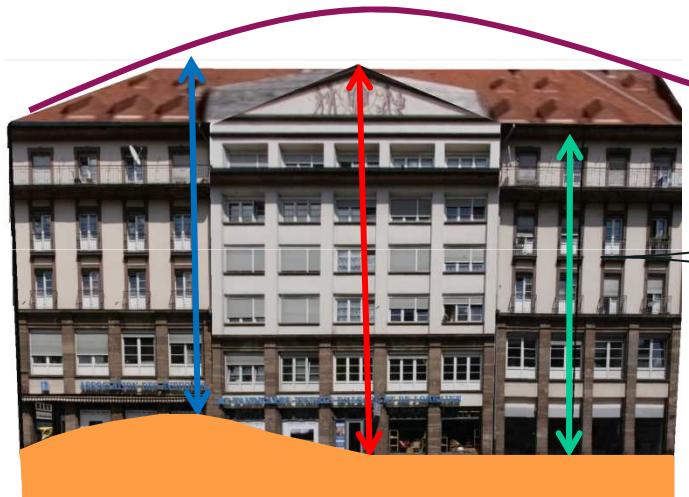
Articles 9, 14 : Ratio of parcel occupation

Article 10 : Maximal height

Article 11 : Exterior aspect



- Title is standardized but not the content....
 - Article #10 : Maximal height of buildings



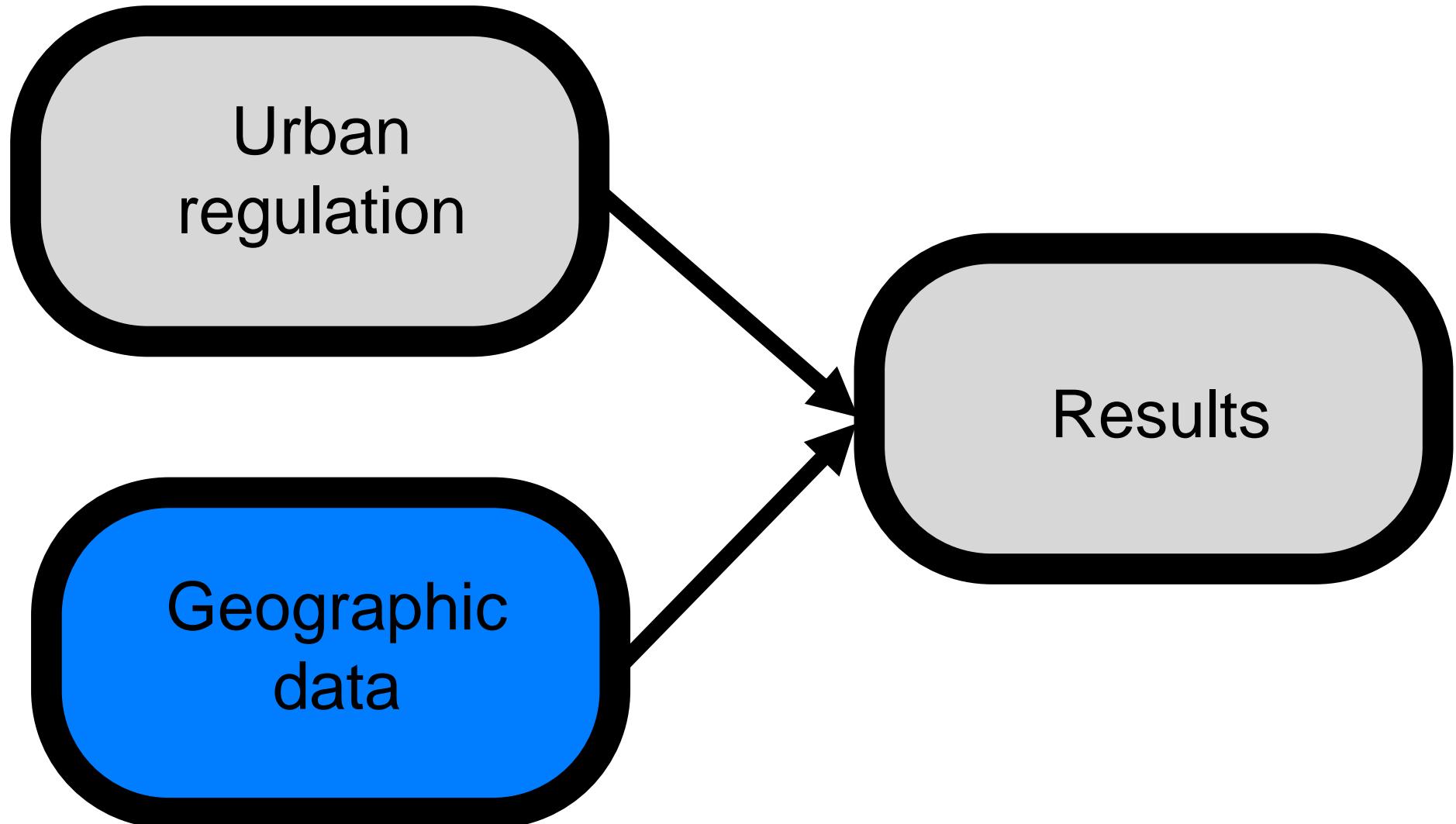
Terrain

- Number of floors (with or without roof)
- **Maximal height**
- Maximal height to the highest terrain point
- Maximal height to the roof border
- According to a hull

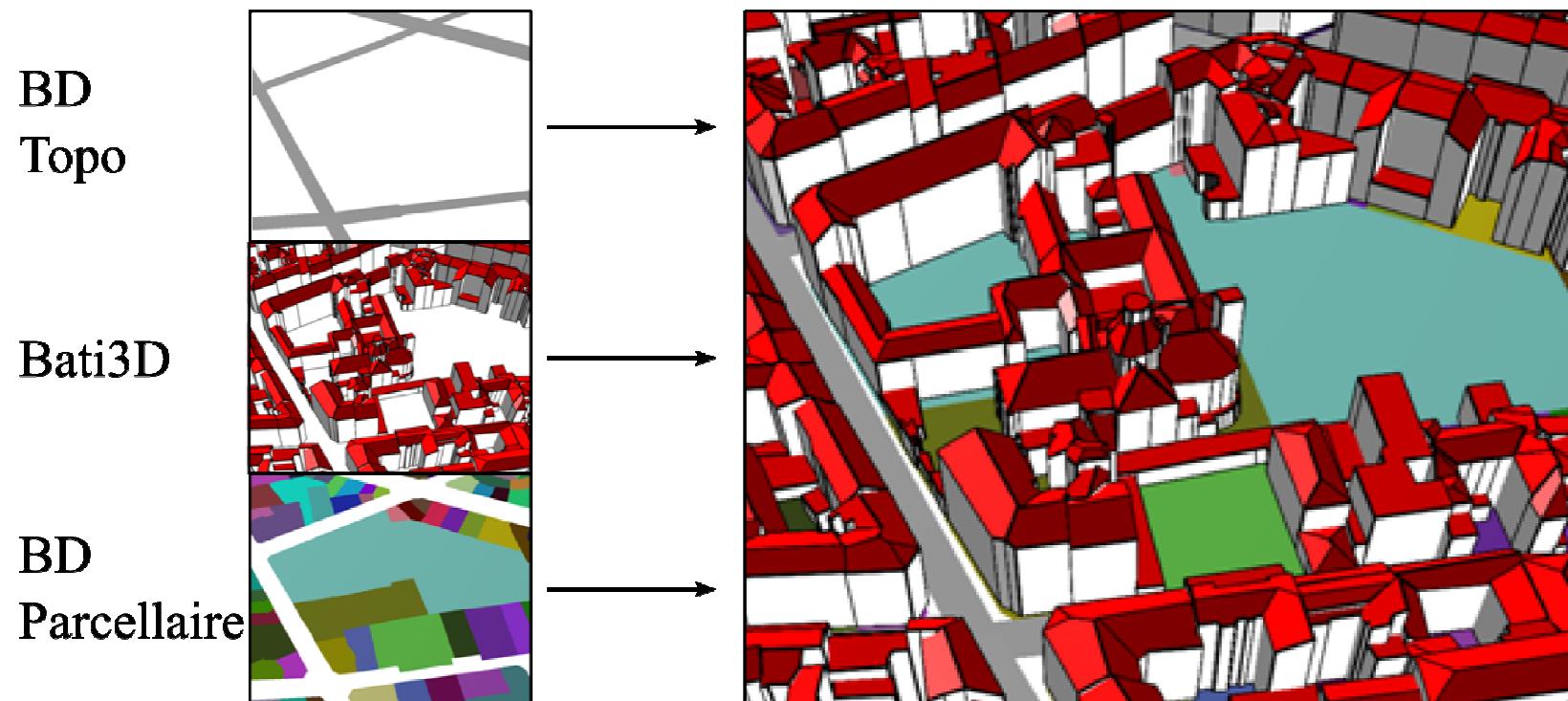
- Selection of rules :
 - Rules relevant with our data,
 - Most common formulations



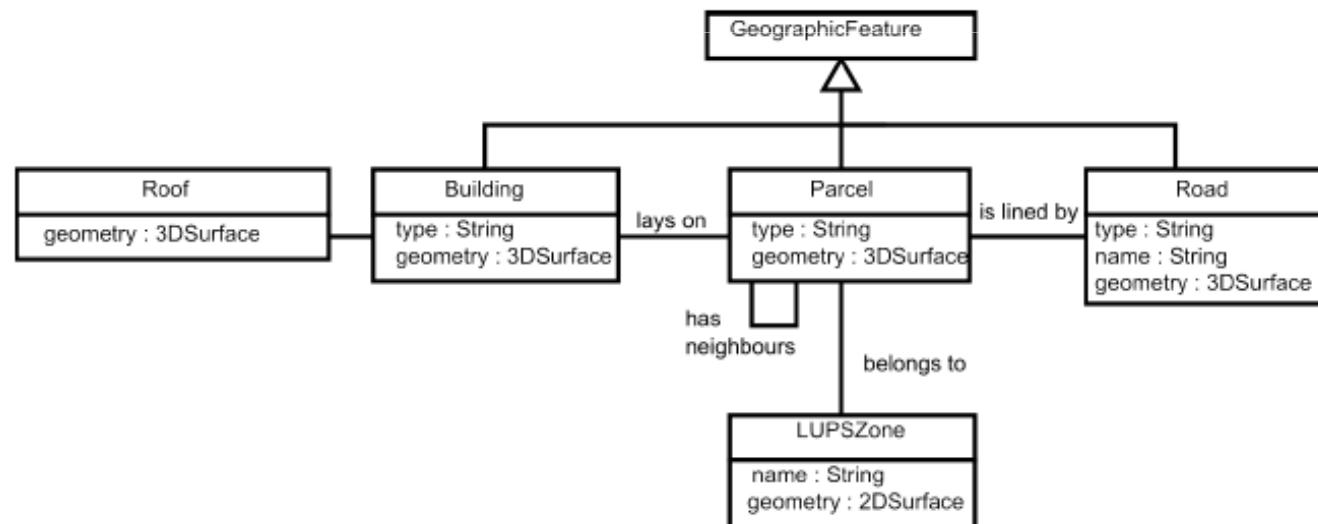
- Specific model :
 - Rules decomposed into conditions/constraints (conditions checked then constraints have to be applied)
 - Can be captured through a GUI
 - Export XML
- In the future : use of a standard model
 - OGC filter ?



- Data used for our experimentations



- Specific model
 - Information concerning buildings can be exported in CityGML format

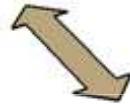


- Create necessary relationships between :

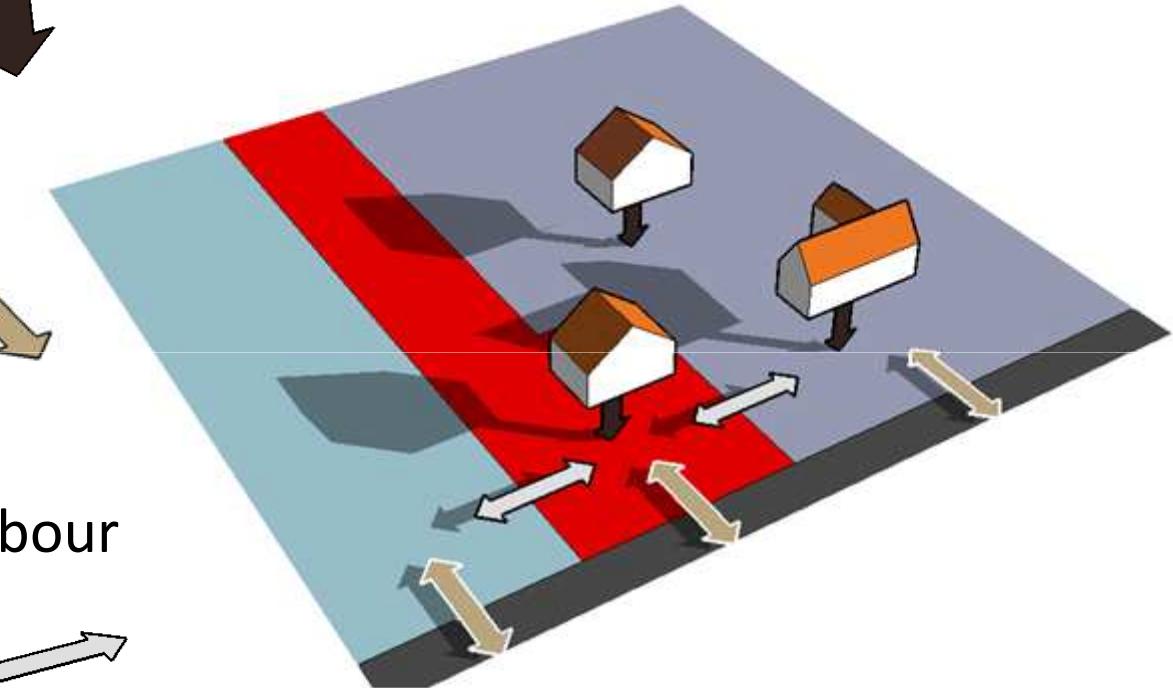
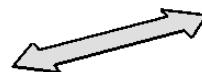
Buildings and parcels

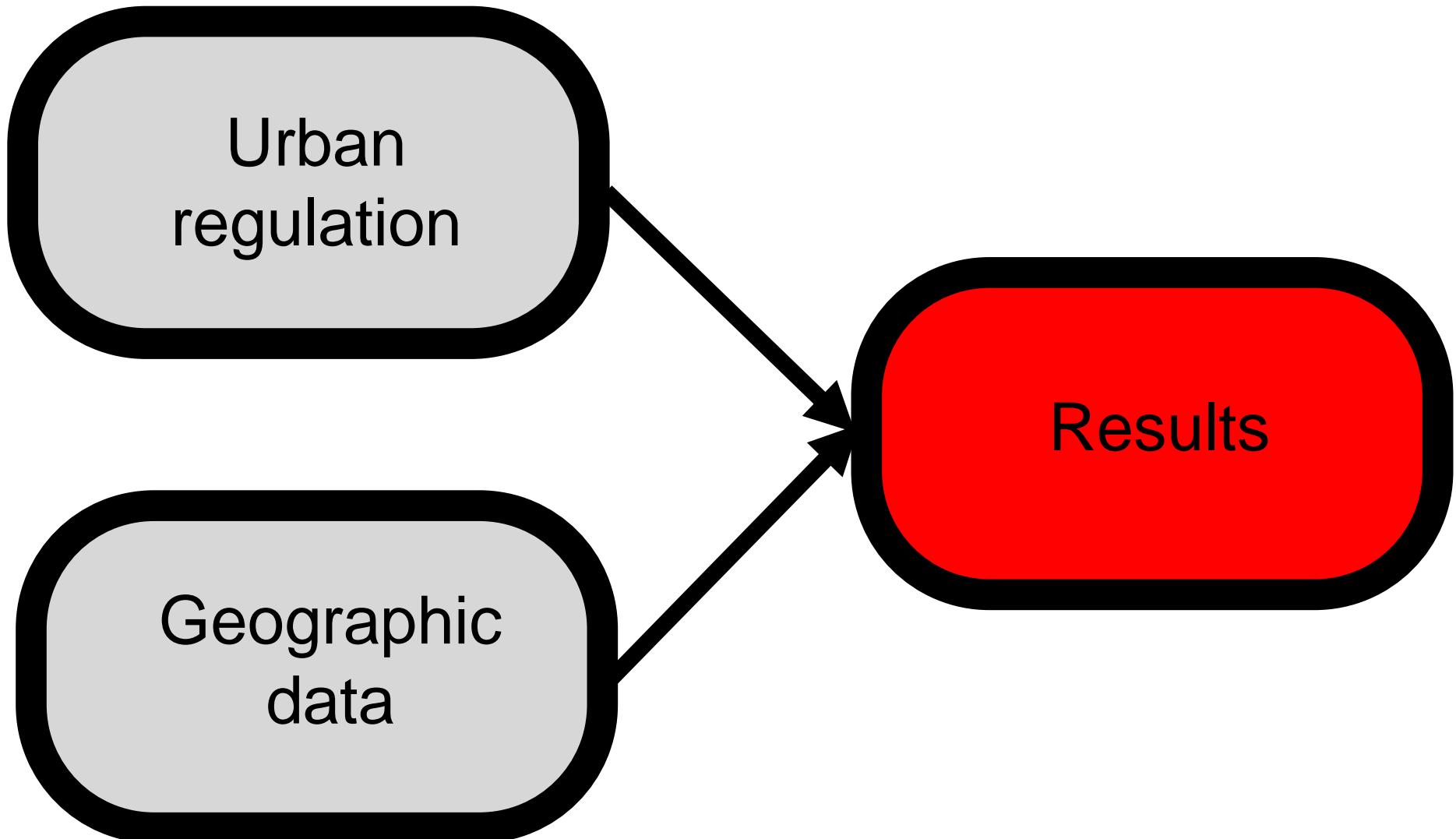


Parcels and their
neighbour roads



Parcels and their neighbour
parcels

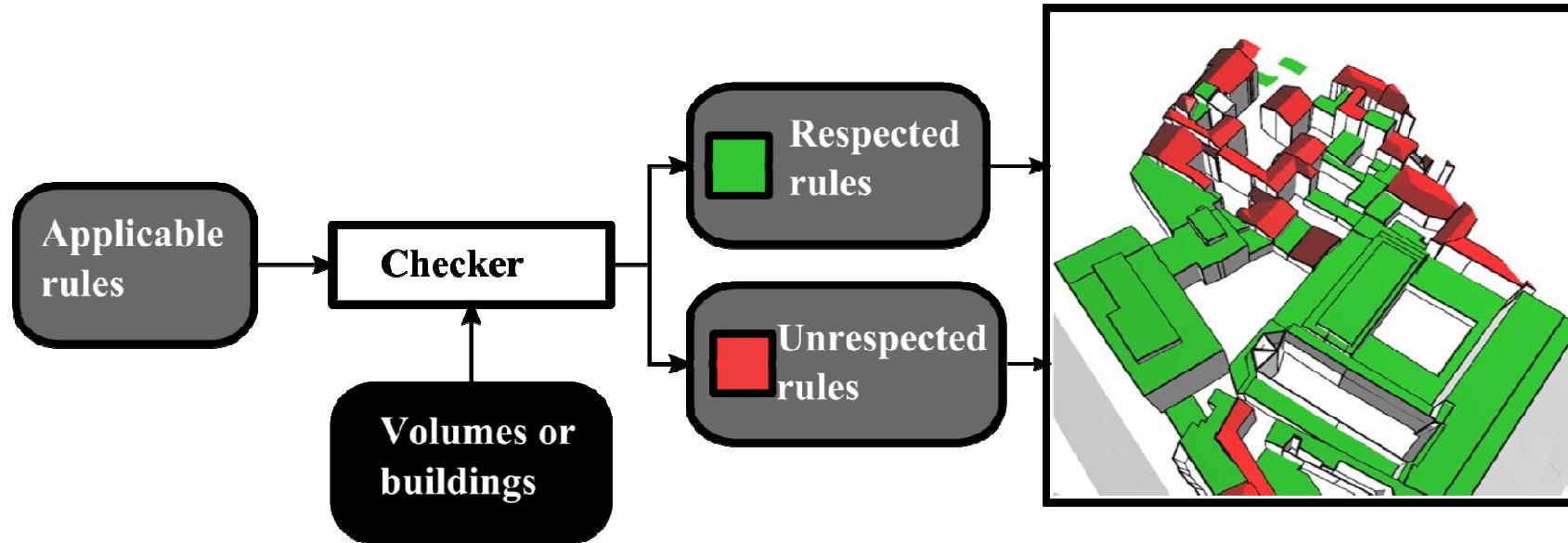






- Check the respect of a set of rules on parcels
- Visualize constraints inferred by rules
- Application case : assessment of a potential of constructability

Check of the respect of urban rules

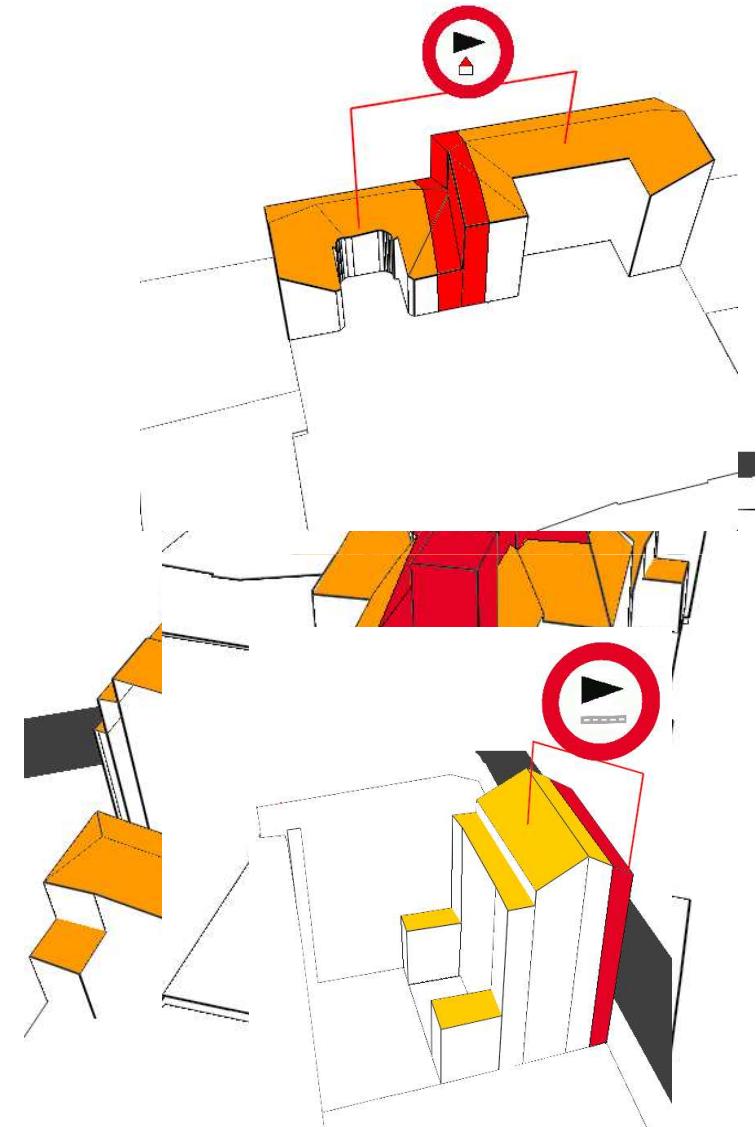
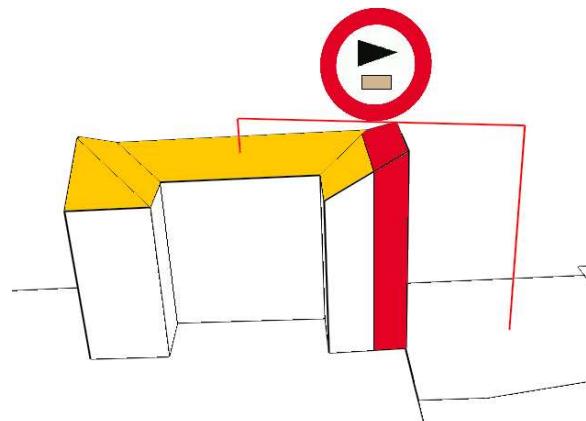


- 2 types of generated results :
 - The list of respected and unrespected rules
 - Inconsistencies visualisation
 - How to represent them ?

Incoherencies representation

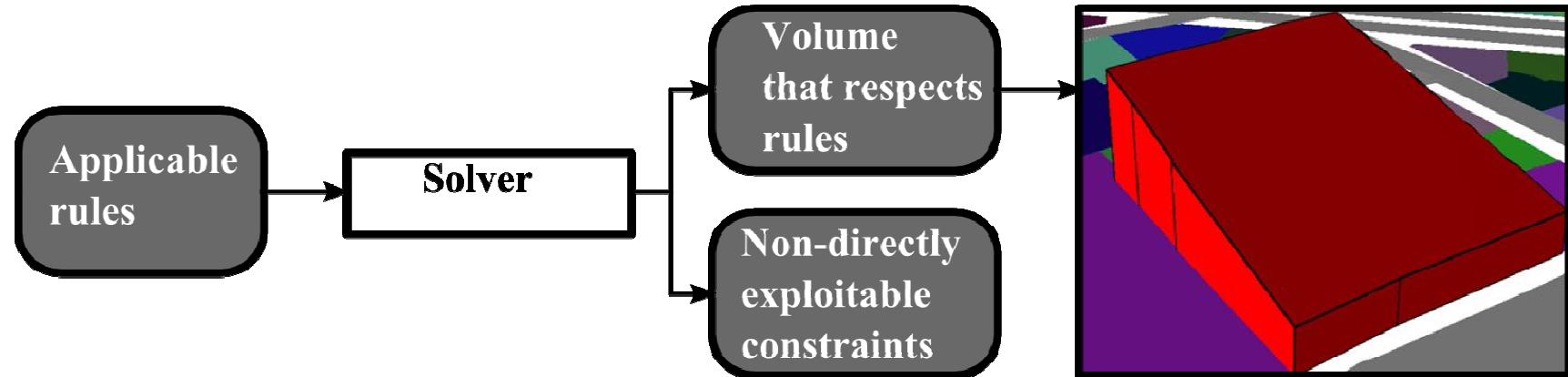


- Based on road signs :
 - FAR (Floor Area Ratio) not respected
 - Maximal height not respected
 - Distance between features not respected



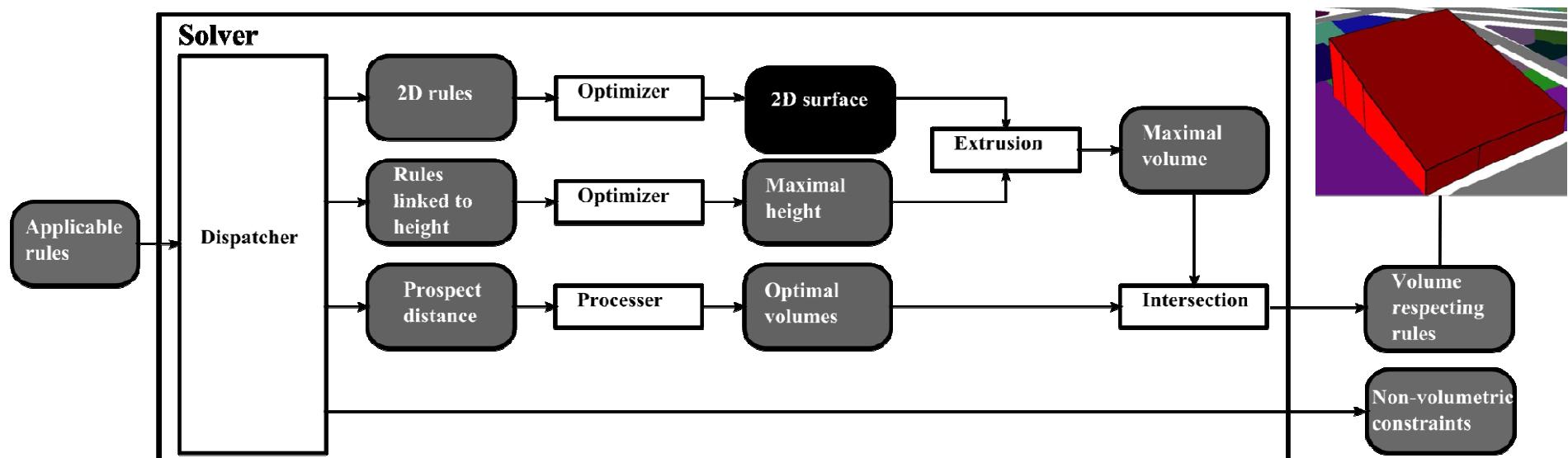


- Check the respect of a set of rules on parcels
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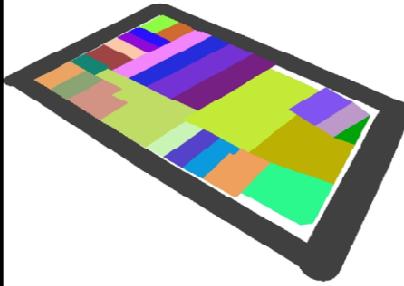
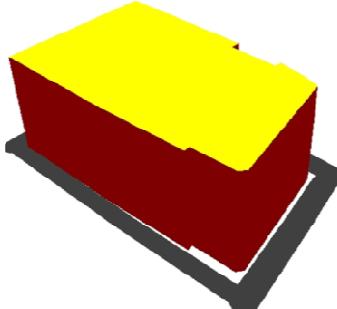
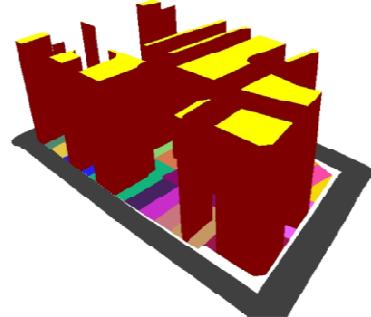
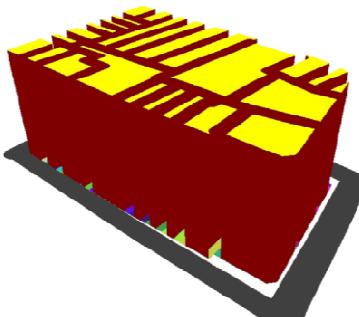
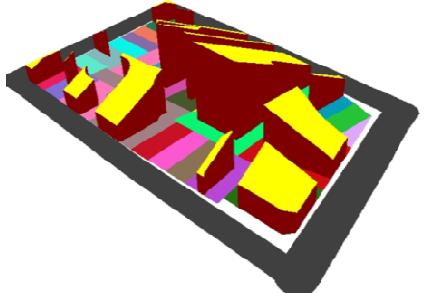
- From a set of rules :
 - Generate the maximal volume according these rules
 - List of non-directly exploitable constraints (ex : FAR)
 - Can be reused in the checker

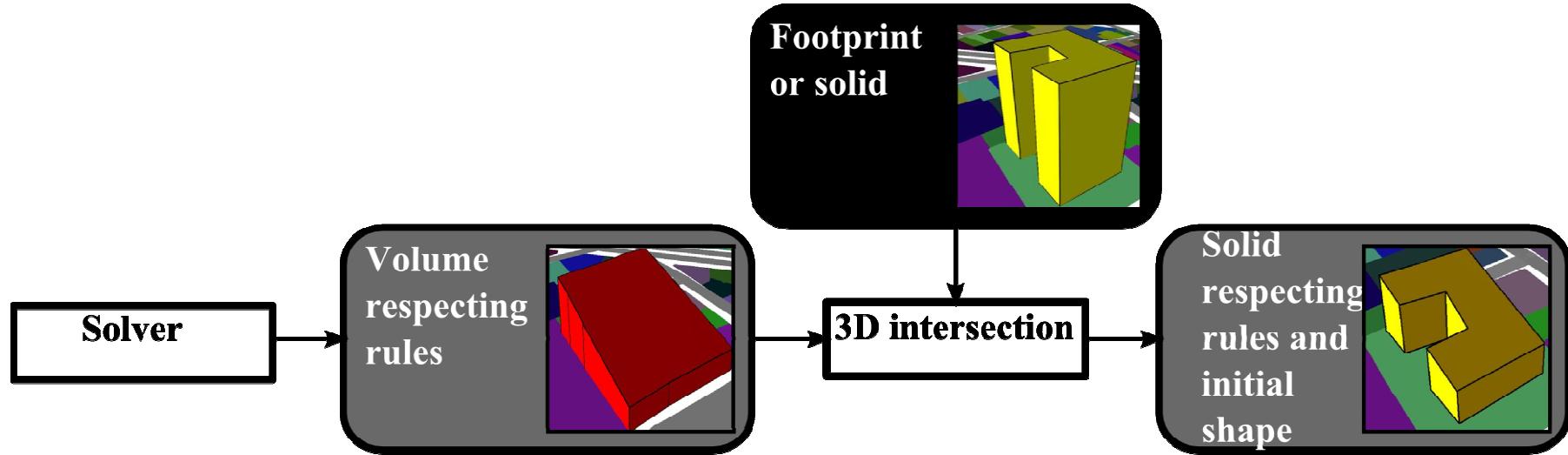
- Minimize 3D calculations
 - Apply first 2D calculations



Results



Initial dataset		Constraints	Volumes
Constraints		Volumes	
$\text{height}(S) < 35$		$\text{height}(S) < 35$ $\text{distance}(P,S) < 4$	
$\text{height}(S) < 35$ $\text{distance}(P,S) < 2$		$\text{prospect}(R,2,5) > S$ $\text{height}(S) < 35$ $\text{distance}(P,S) < 4$	



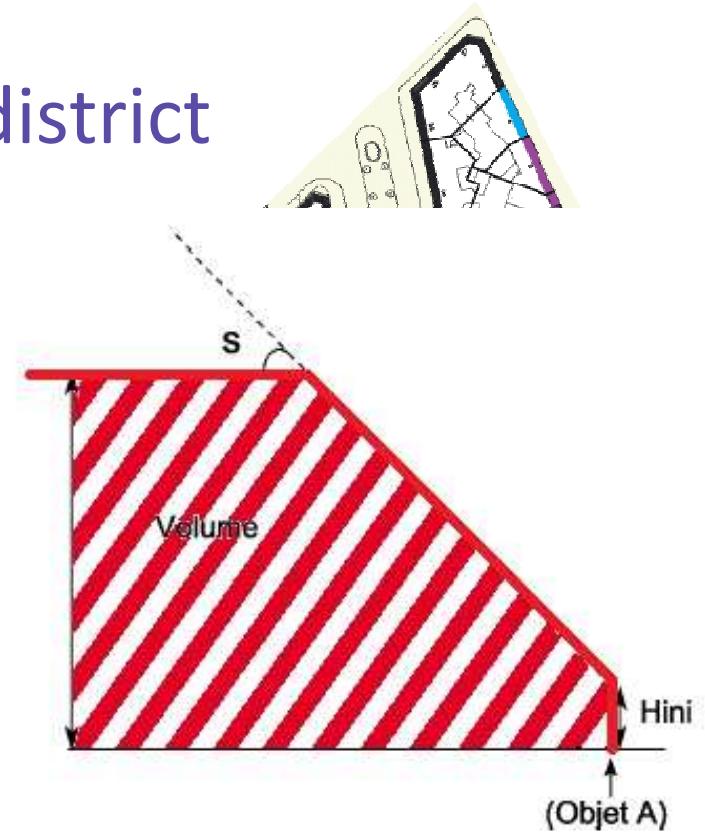
- From a buildable volume and a shape
 - Generate a solid in accordance with a buildable volume and an input shape :
 - 2D Footprint
 - 3D Volume



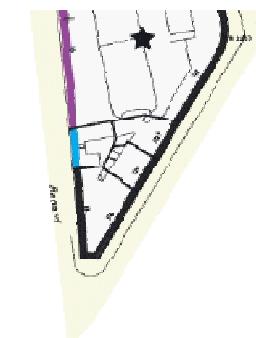
- Check the respect of a set of rules on parcels
- Visualize constraints inferred by rules
- Application case : assessment of a potential of constructability

- Centre of Paris : part of the 5th district

- Maximal FAR : 3.0,
 - Minimal distance to border : 0m,
 - Maximal height : 25m
 - Prospect : according to the 1:2000 map



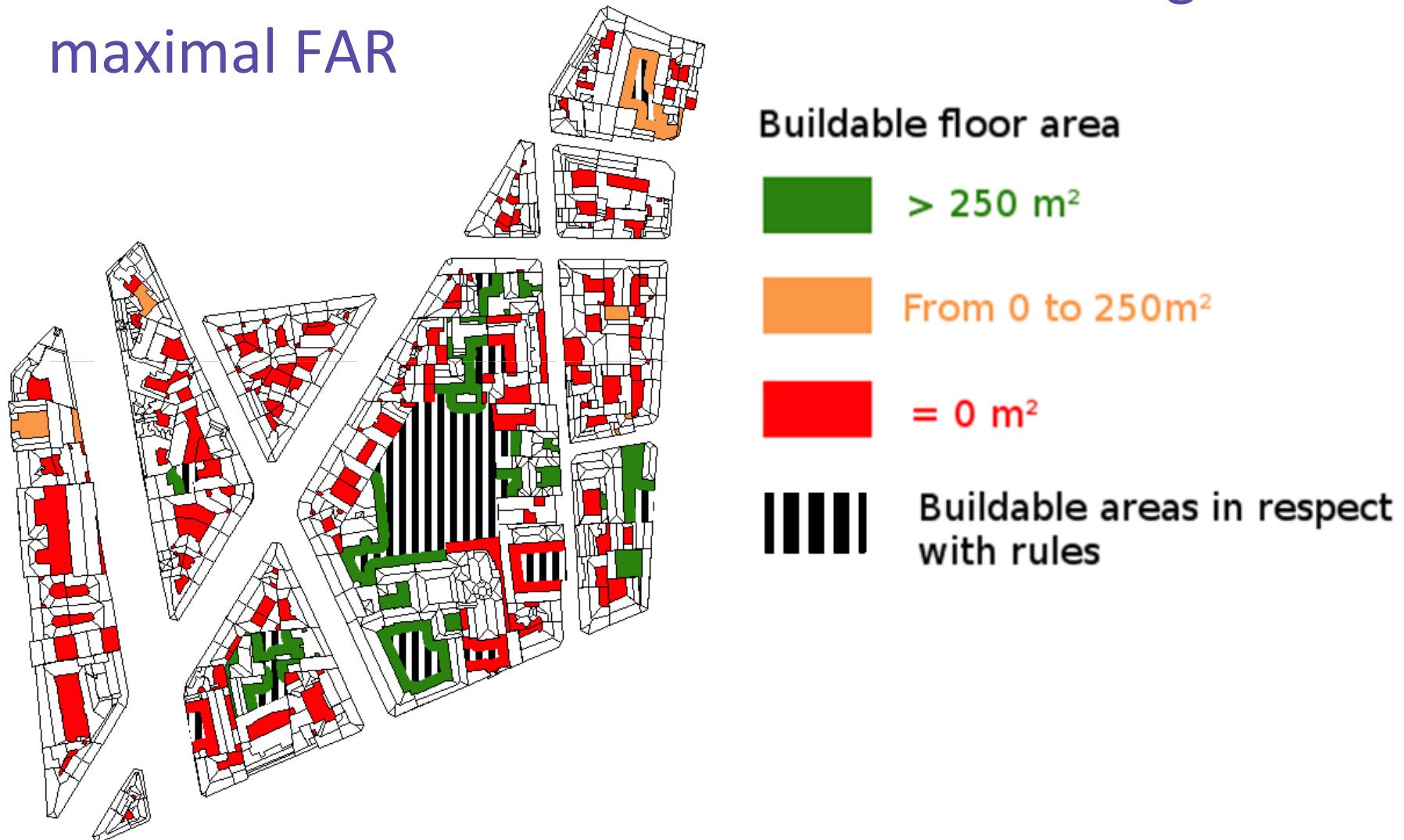
- How can we densify according to urban regulation ?



Determination of buildable surface



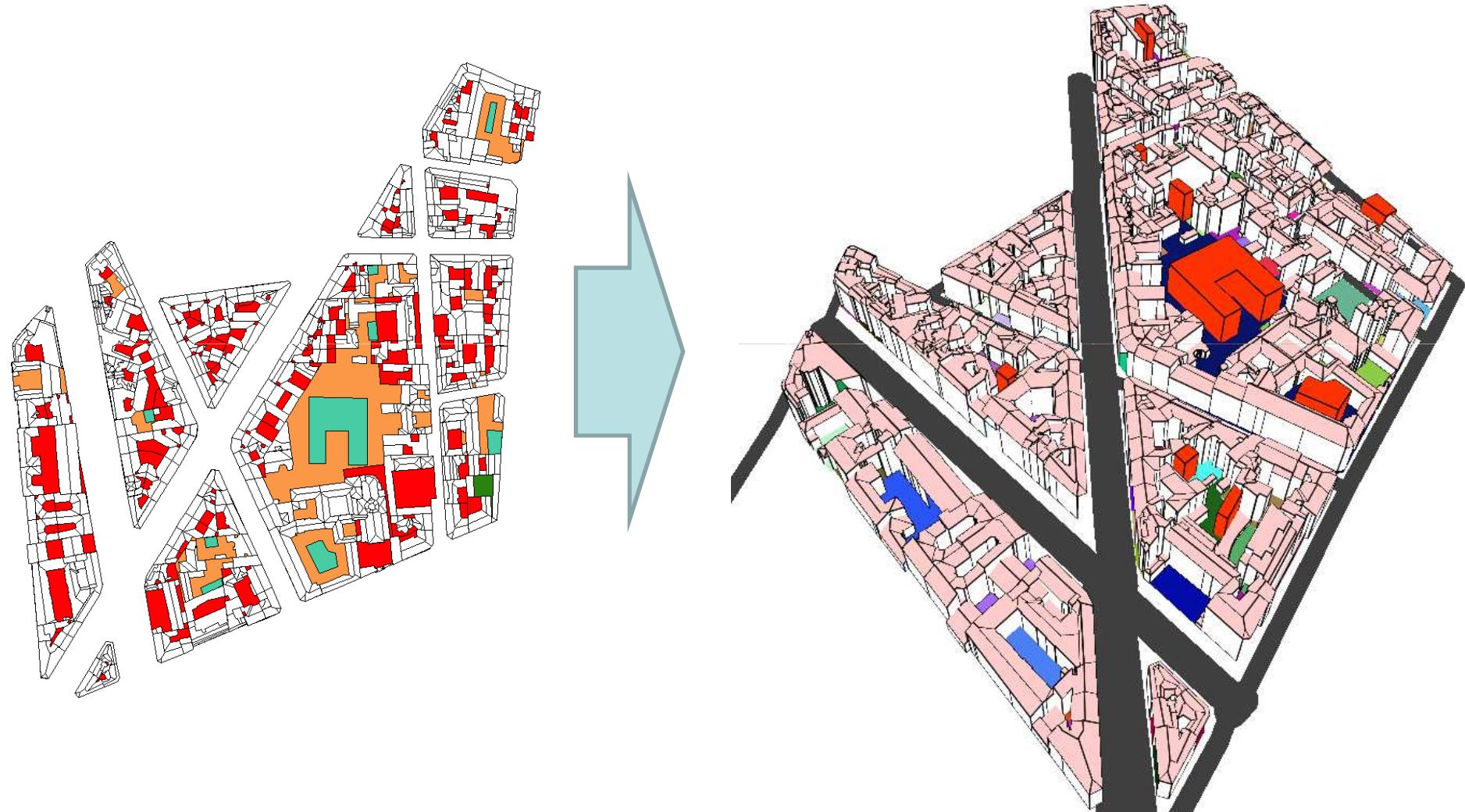
- Assessment of buildable surface according to maximal FAR



Determination of possible buildings



- Generation of buildings from footprints



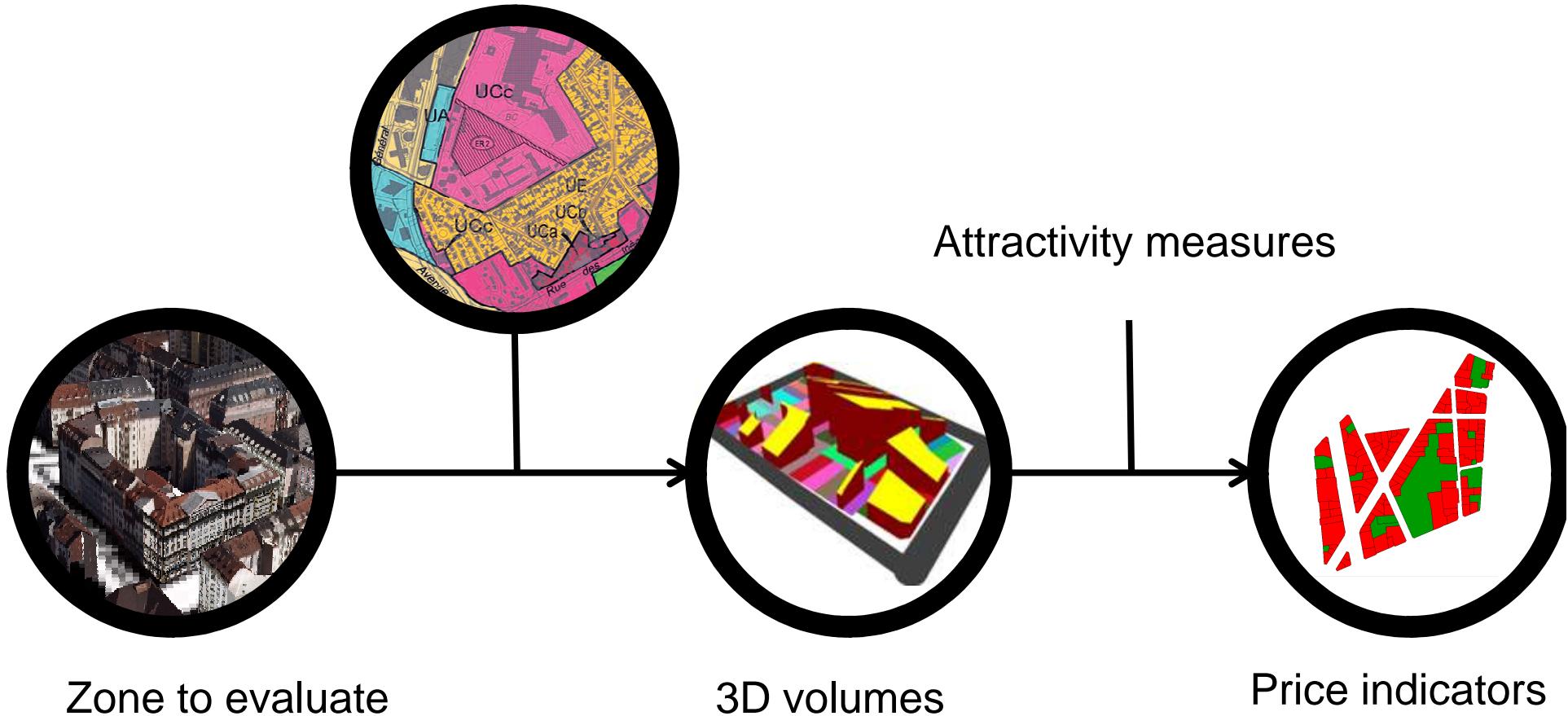


- A method to represent LUPs contents into 3D GIS
 - Rules modeller
 - Checks a set of rules
 - Generates 3D buildable volume
 - Propose LOD2 buildings
- Approximation to evaluate
 - The impact of data quality
 - The use of non-directly interpretable constraints
- Possible improvements
 - Integrate rules about vegetation or architectural elements (LOD3 buildings)
 - Expert validation
- Future uses

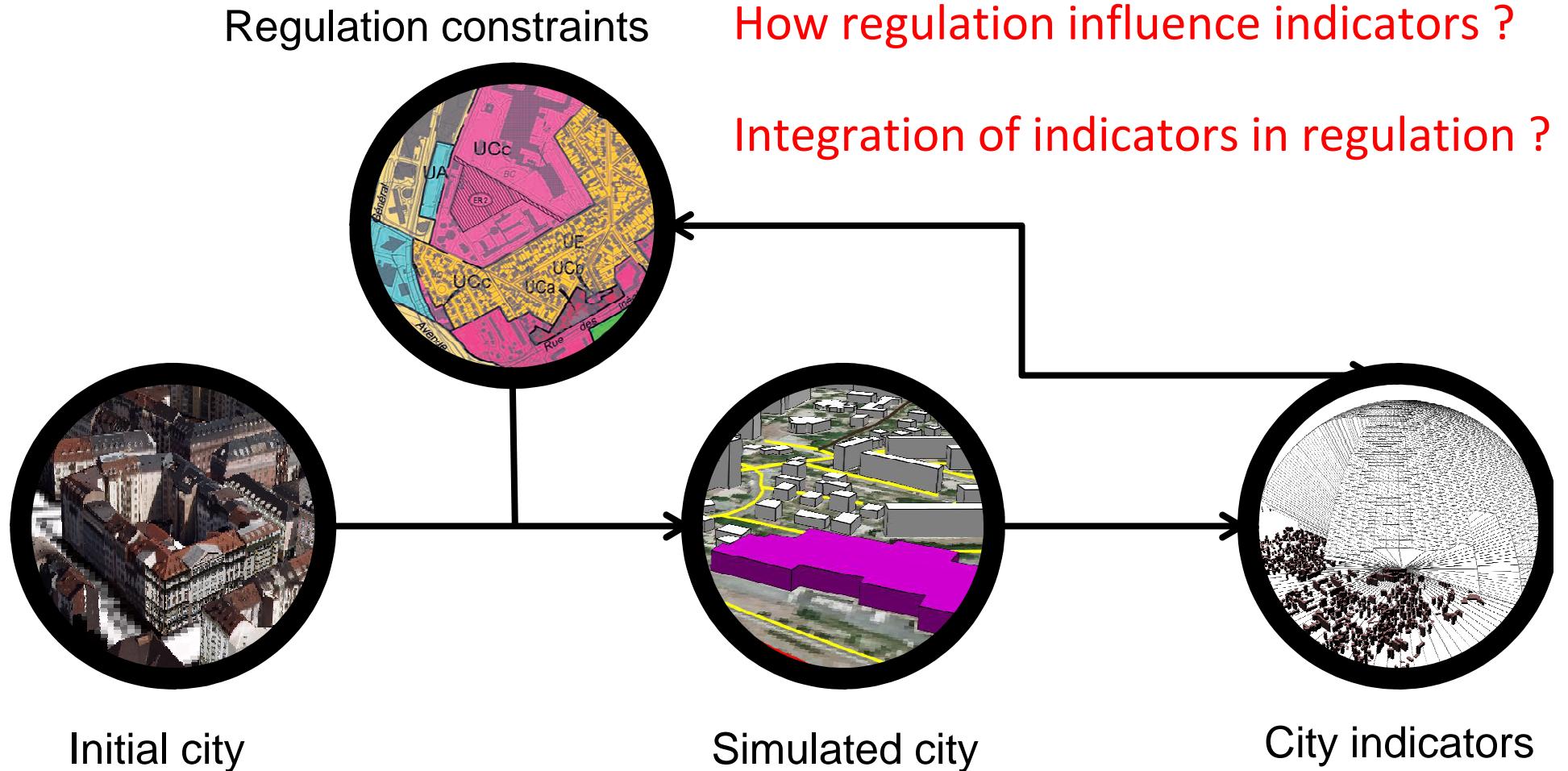
- Constructability assessment

Regulation constraints

– Market prices simulation



- Urban simulation



Thanks for your attention



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