

# 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 :

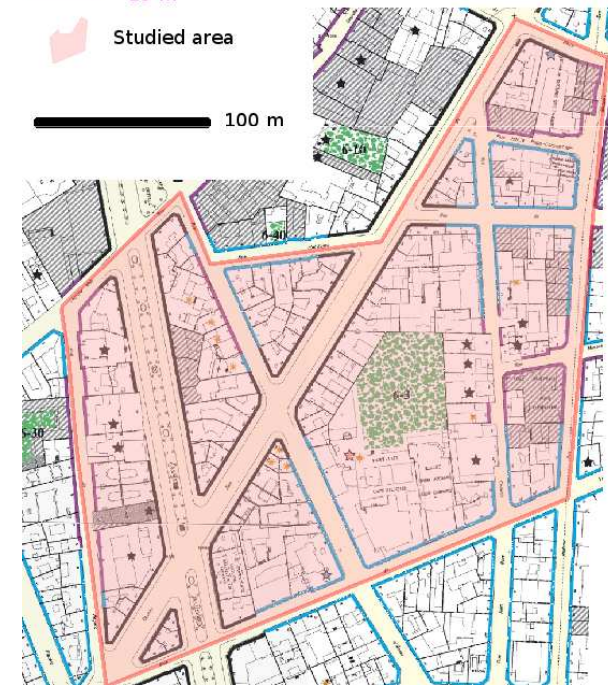
— 25 m

— 20 m

— 15 m

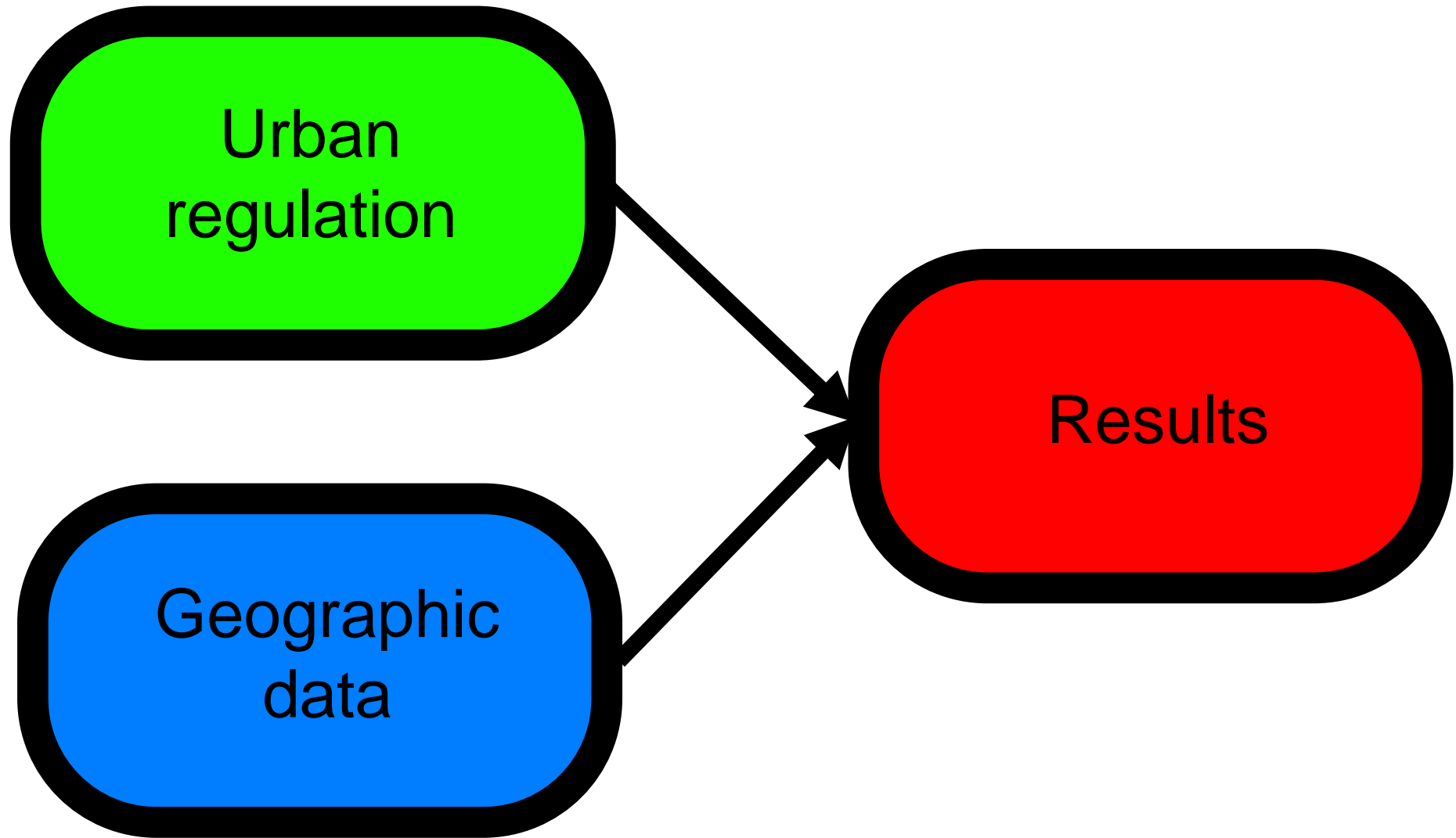
Studied area

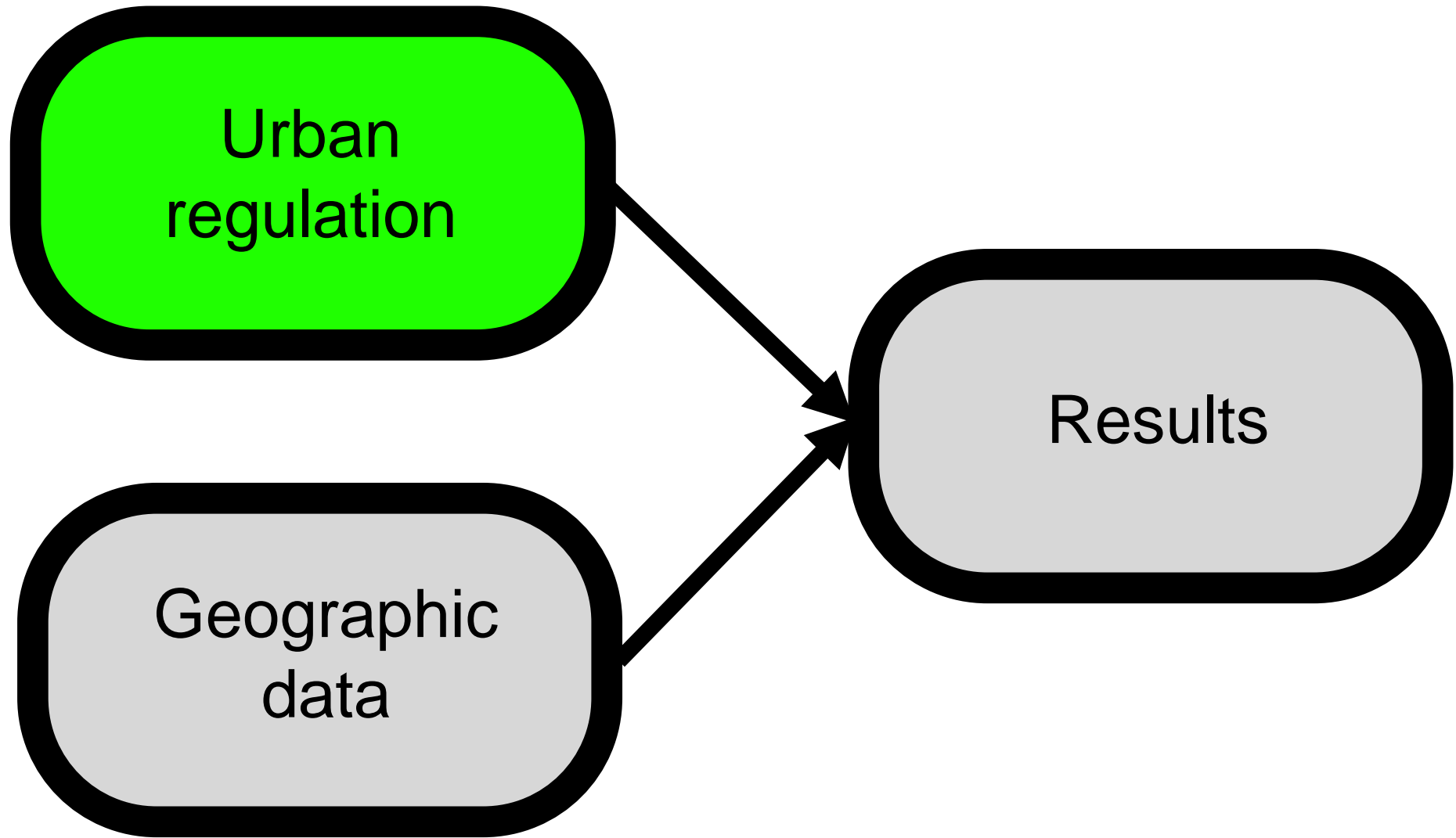
100 m



- 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

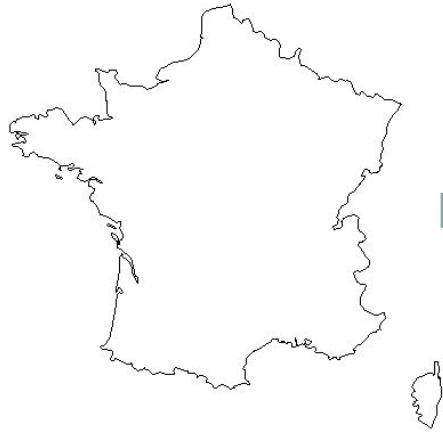




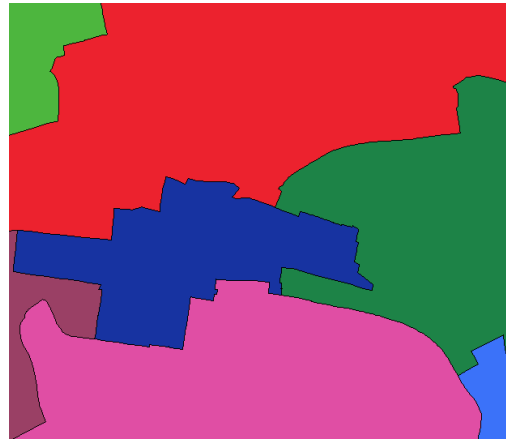
# The LUPS



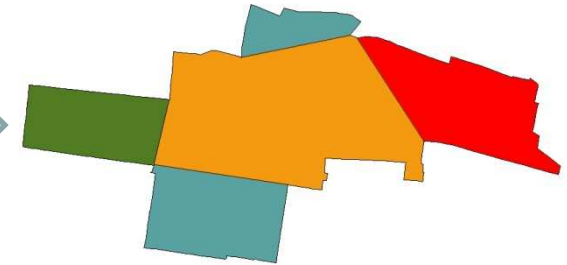
French territory



Districts or groups of districts



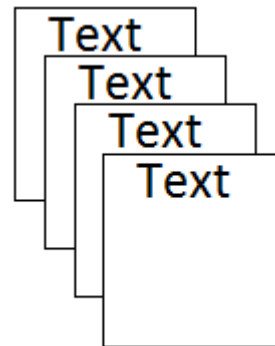
Zones



14 rules with standardized title



Regulation text



Types

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

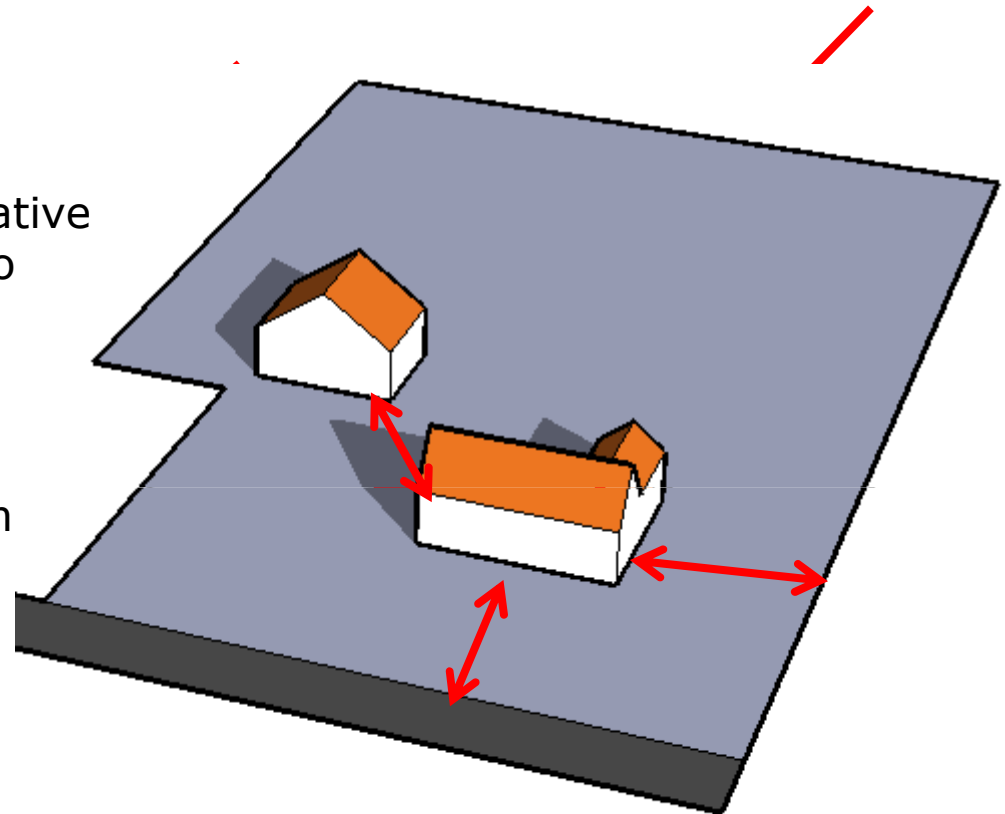
Articles 1, 2 : Land use restrictions

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

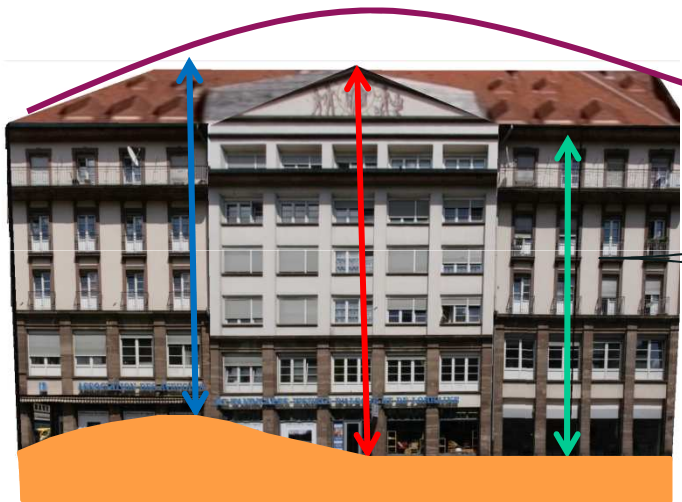
Articles 9, 14 : Ratio of parcel occupation

Article 10 : Maximal height

Article 11 : Exterior aspect



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



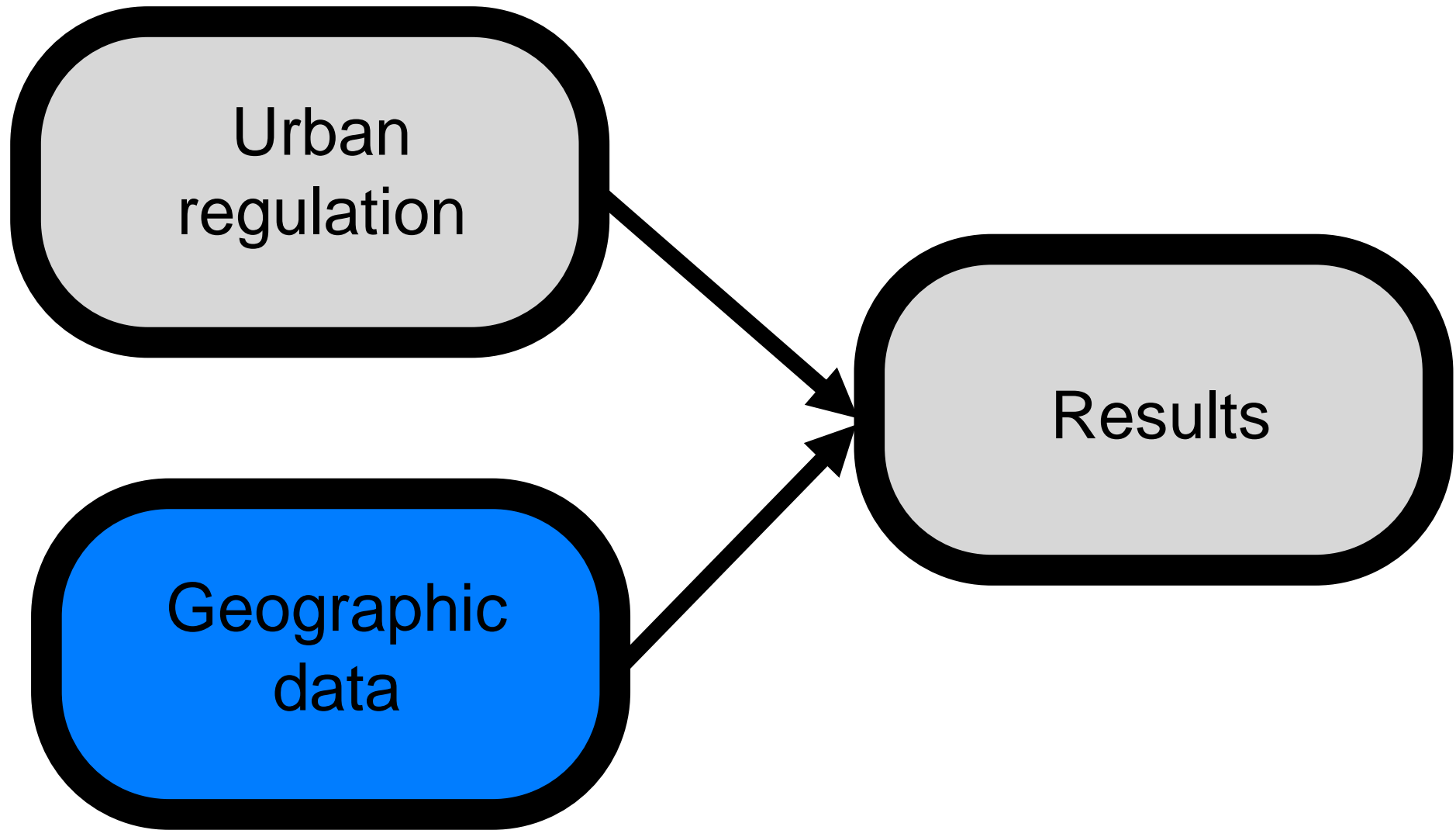
Terrain

- 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

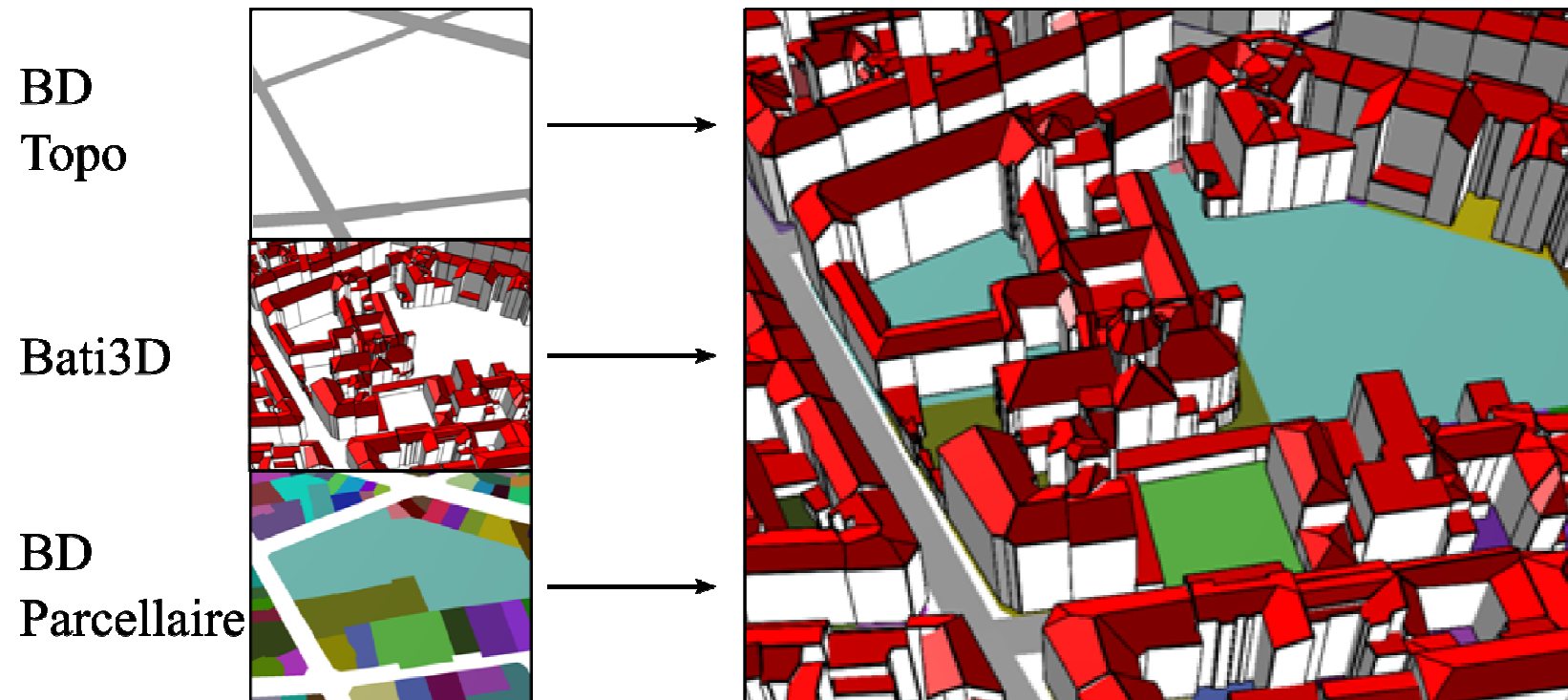
- Selection of rules :
  - Rules relevant with our data,
  - Most common formulations



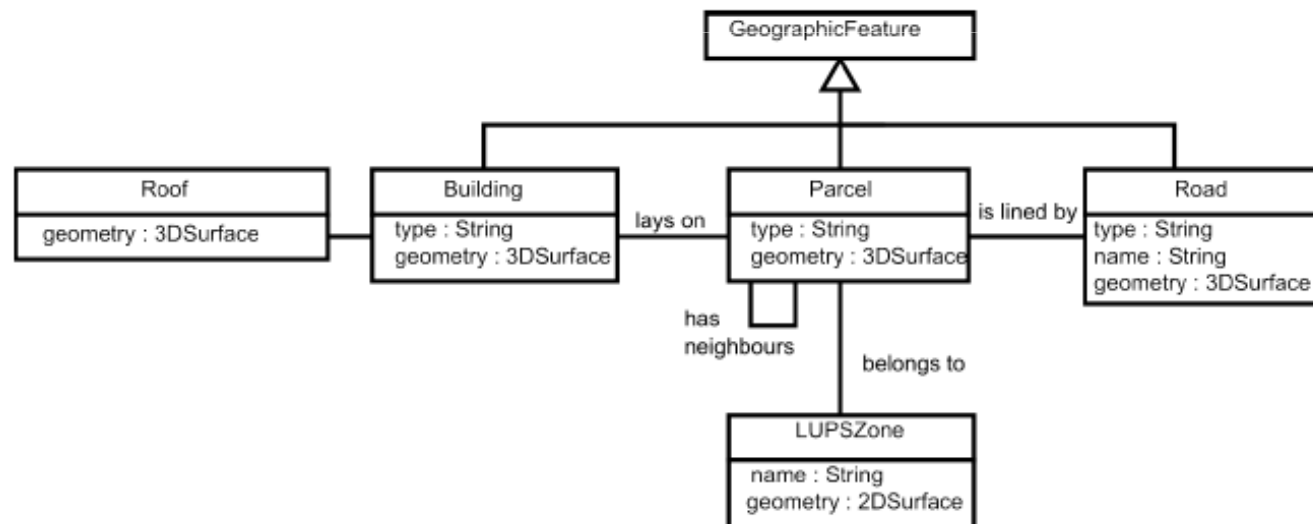
- Specific model :
  - Rules decomposed into conditions/constraints (conditions checked then constraints have to be applied)
  - Can be captured through a GUI
  - Export XML
- In the future : use of a standard model
  - OGC filter ?



- Data used for our experimentations



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



- Create necessary relationships between :

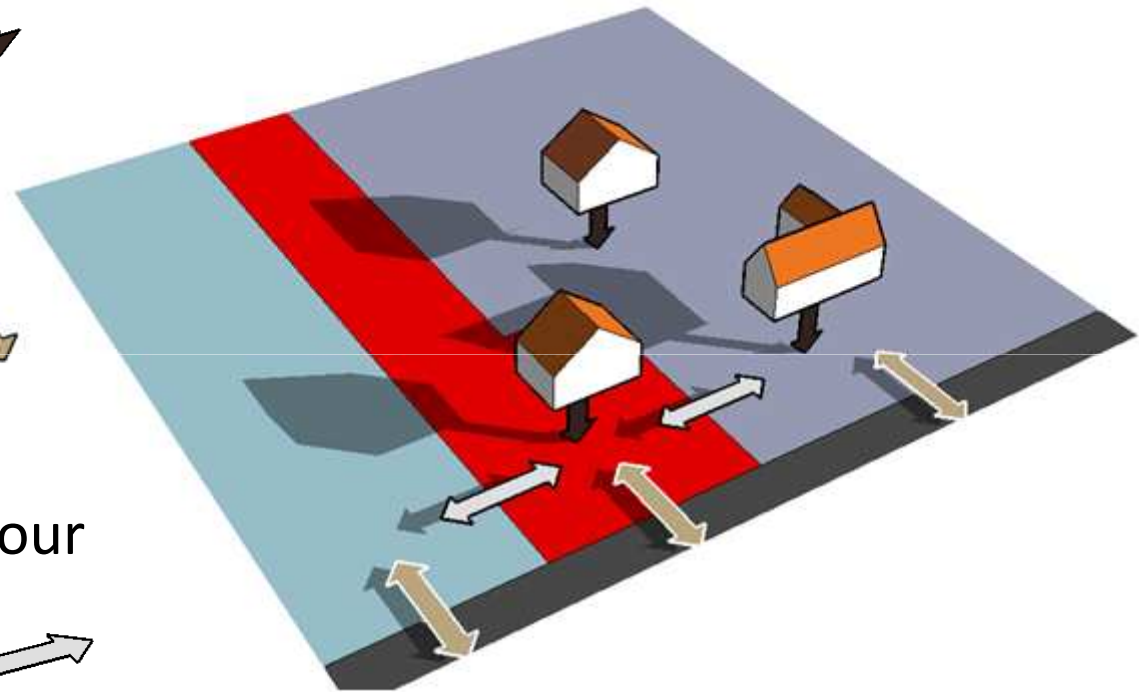
Buildings and parcels

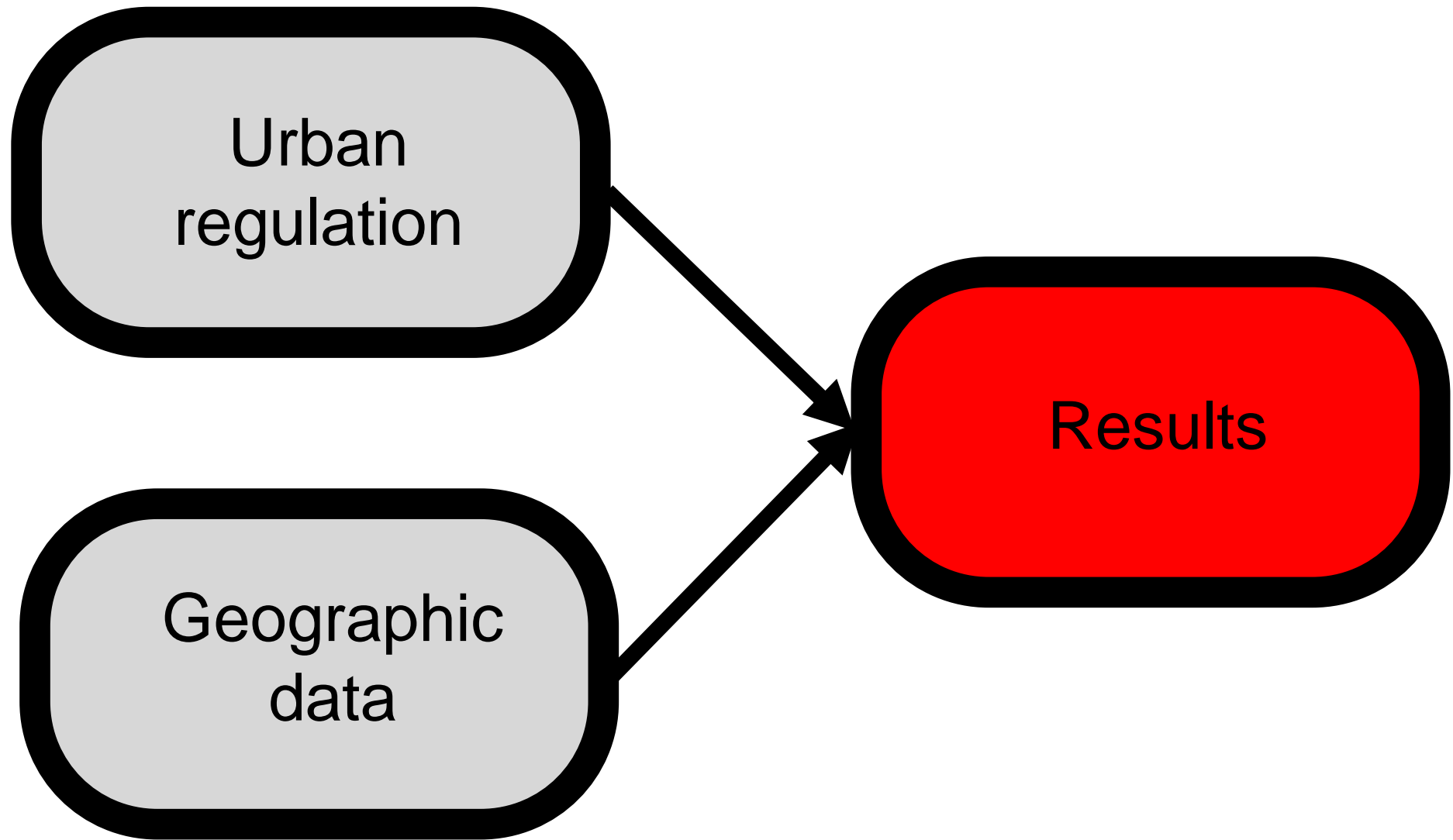


Parcels and their neighbour roads

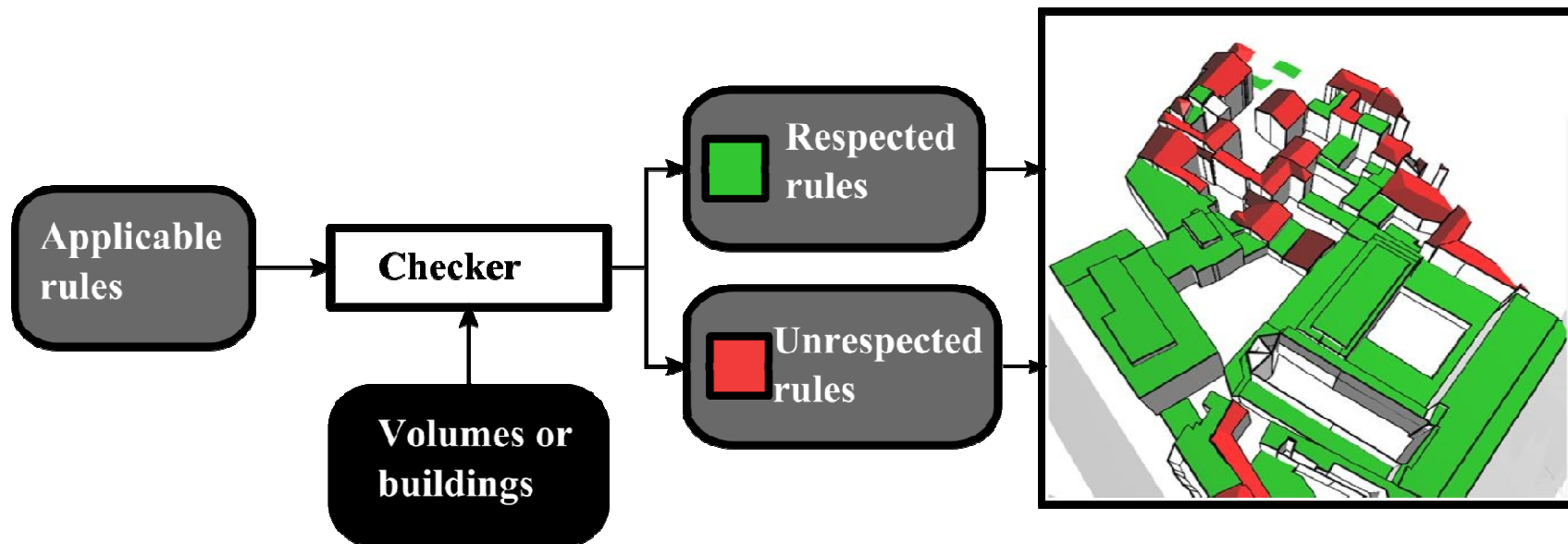


Parcels and their neighbour parcels





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



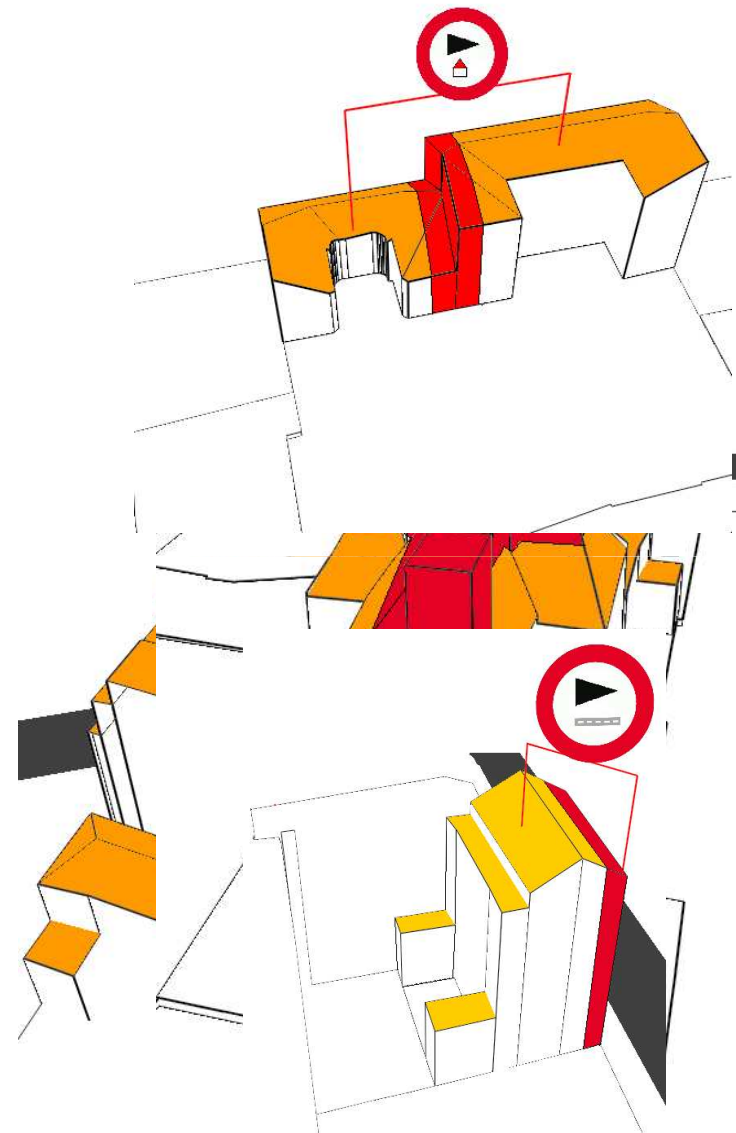
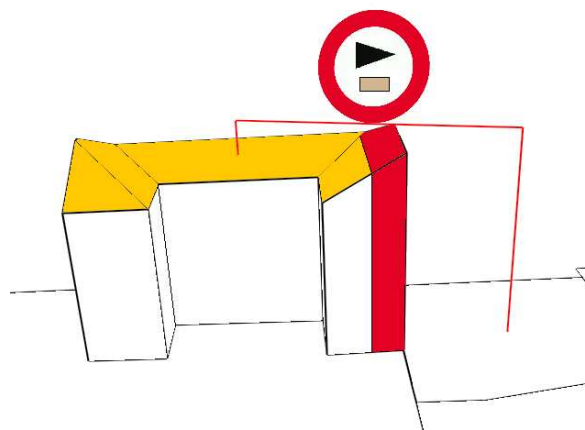
- 2 types of generated results :
  - The list of respected and unrespected rules
  - Inconsistencies visualisation
    - How to represent them ?



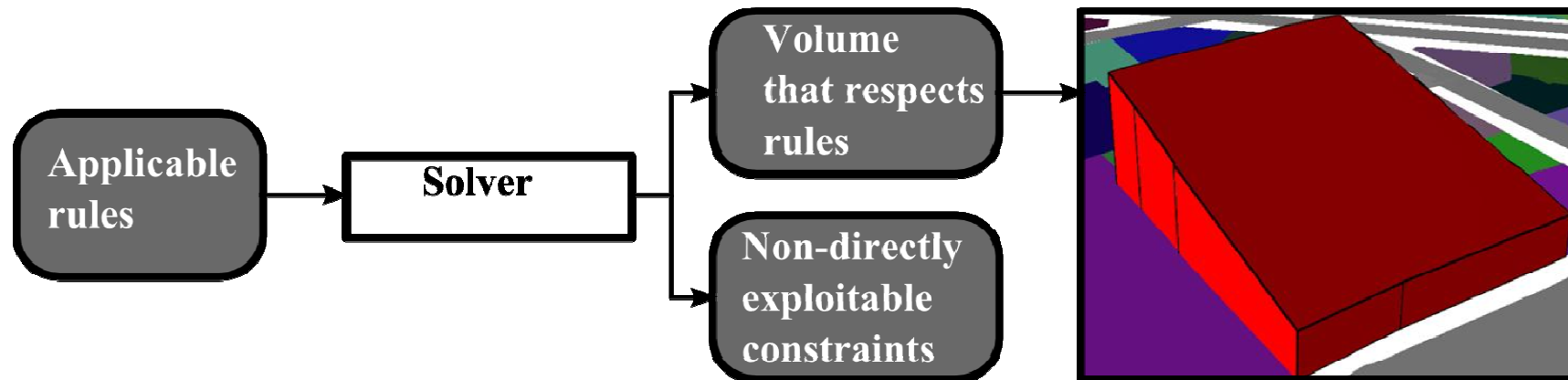
# Incoherencies representation



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

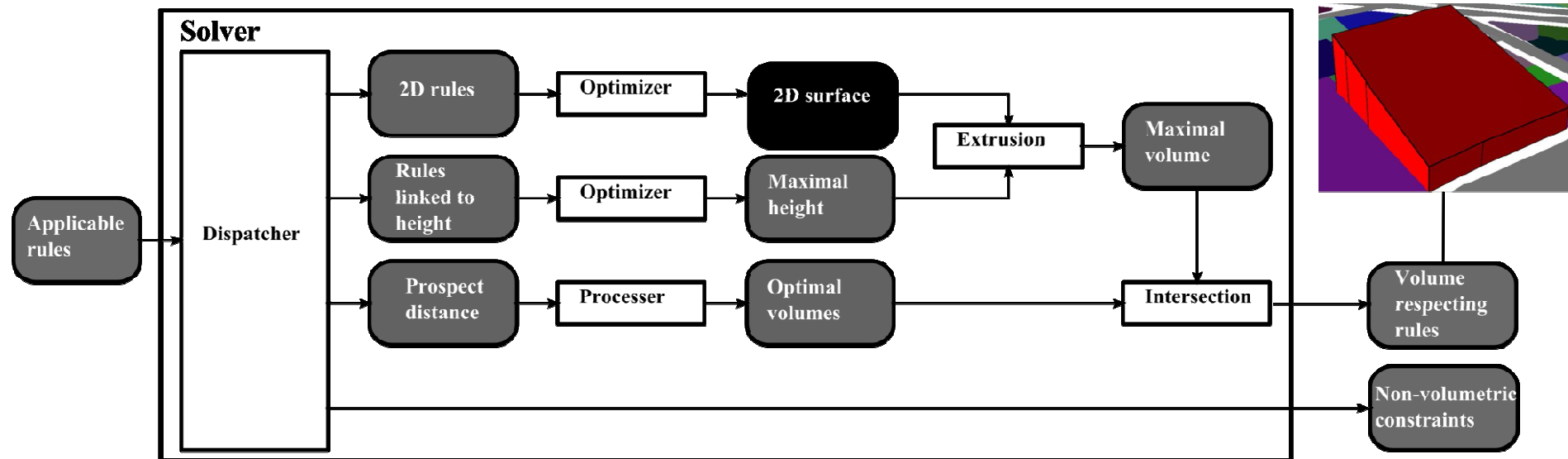


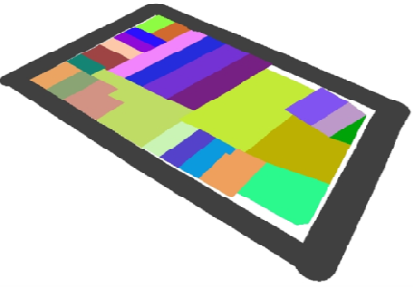
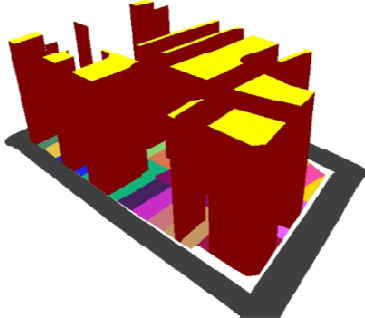
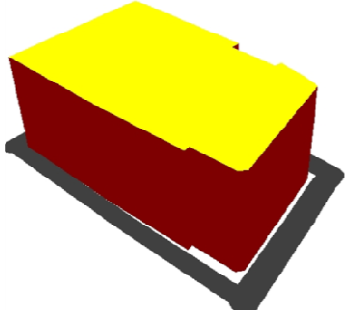
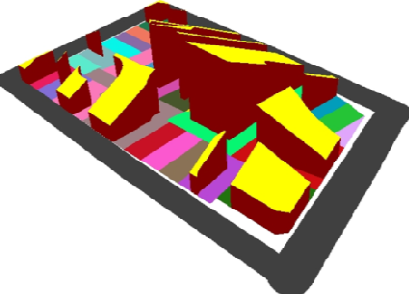
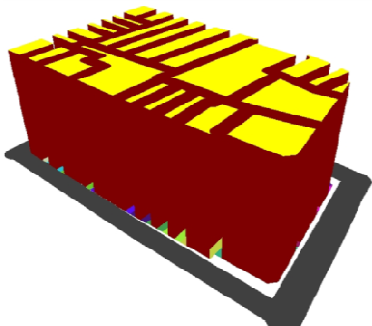
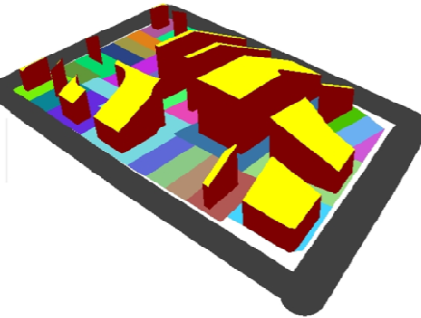
- Check the respect of a set of rules on parcels
- Visualize constraints inferred by rules
- Application case : assessment of a potential of constructability

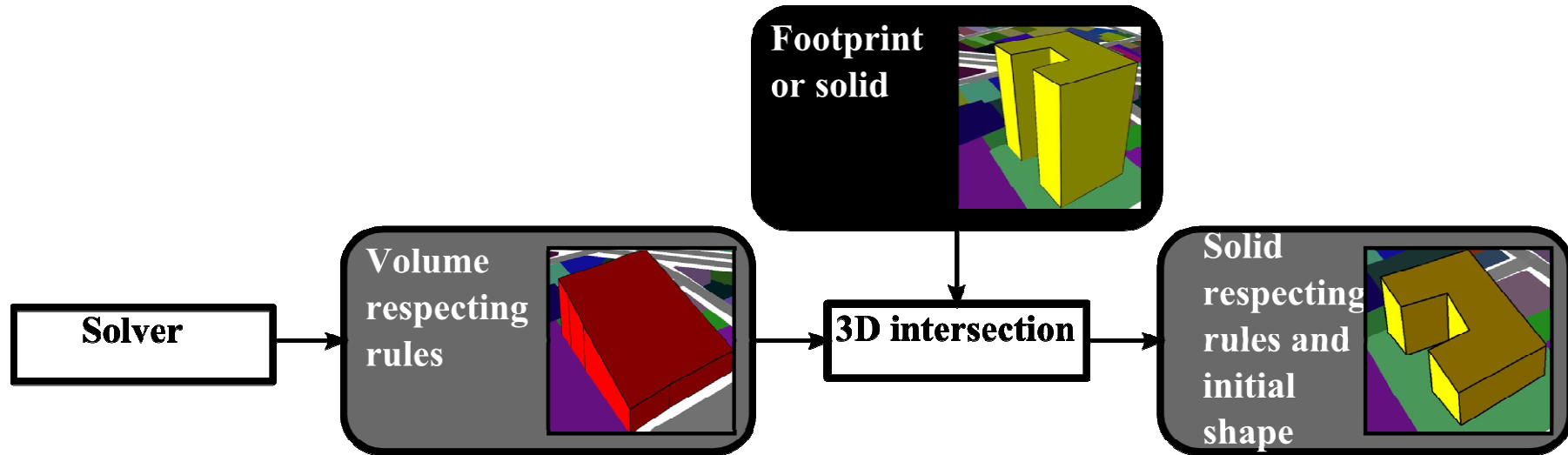


- From a set of rules :
  - Generate the maximal volume according these rules
  - List of non-directly exploitable constraints (ex : FAR)
    - Can be reused in the checker

- Minimize 3D calculations
  - Apply first 2D calculations



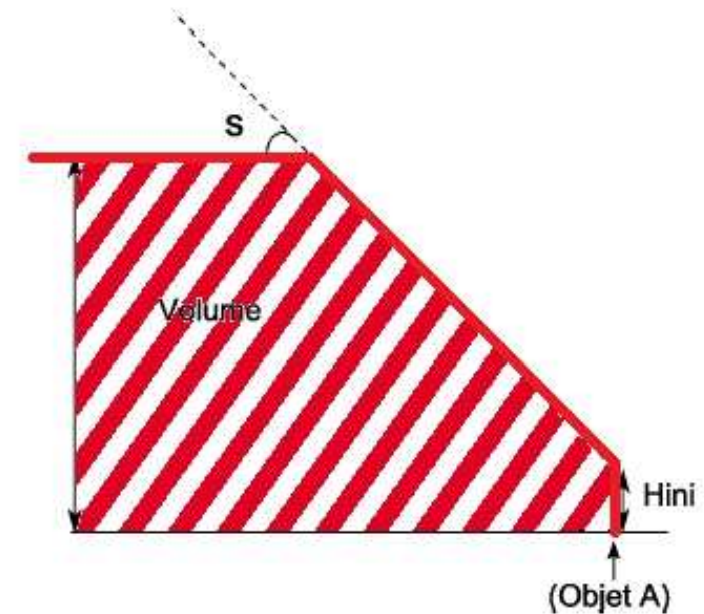
Initial dataset		Constraints	Volumes
Constraints	Volumes	$height(S) < 35$ $distance(P,S) < 4$	
$height(S) < 35$		$prospect(R,2,5) > S$ $height(S) < 35$ $distance(P,S) < 4$	
$height(S) < 35$ $distance(P,S) < 2$		$prospect(R,2,5) > S$ $height(S) < 15$ $distance(R,S) < 2$ $distance(P,S) < 4$	



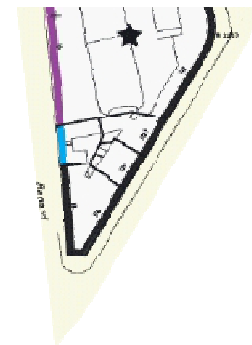
- From a buildable volume and a shape
  - Generate a solid in accordance with a buildable volume and an input shape :
    - 2D Footprint
    - 3D Volume

- 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 5<sup>th</sup> district
  - Maximal FAR : 3.0,
  - Minimal distance to border : 0m,
  - Maximal height : 25m
  - Prospect : according to the 1:2000 map

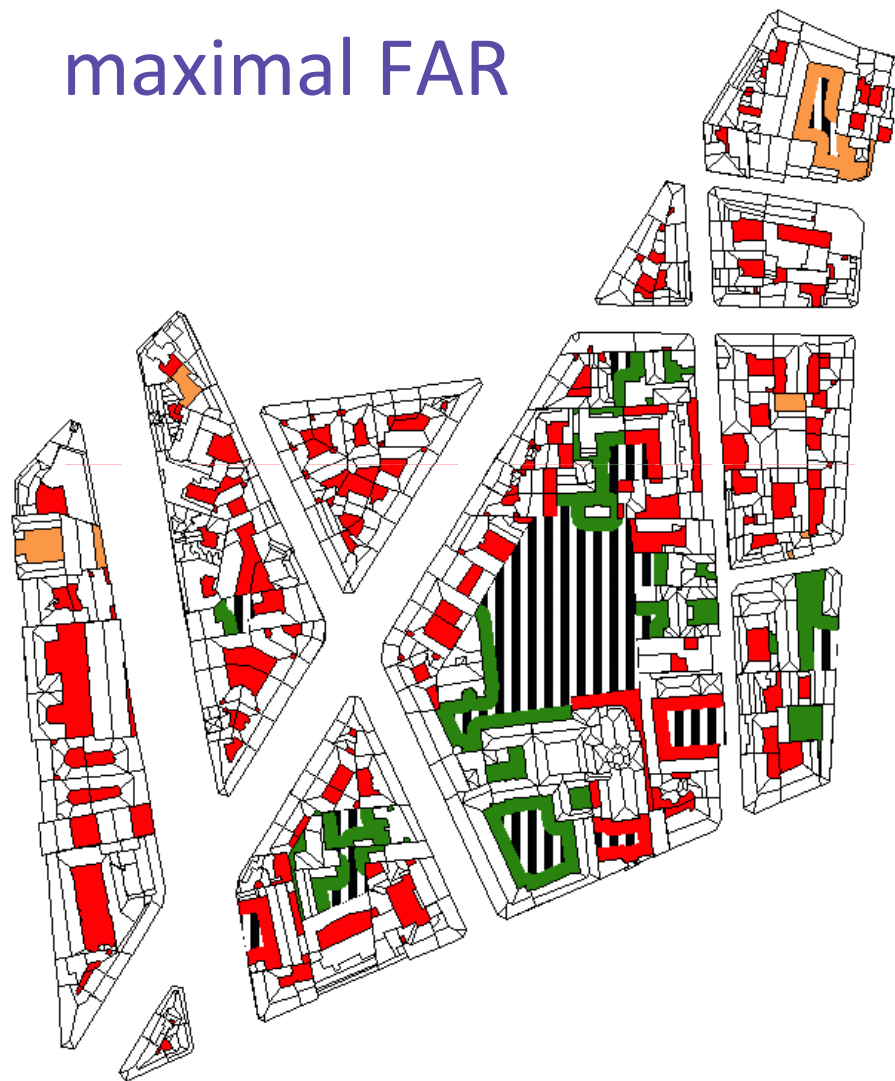


- How can we densify according to urban regulation ?





- Assessment of buildable surface according to maximal FAR



## Buildable floor area



> 250 m<sup>2</sup>



From 0 to 250m<sup>2</sup>

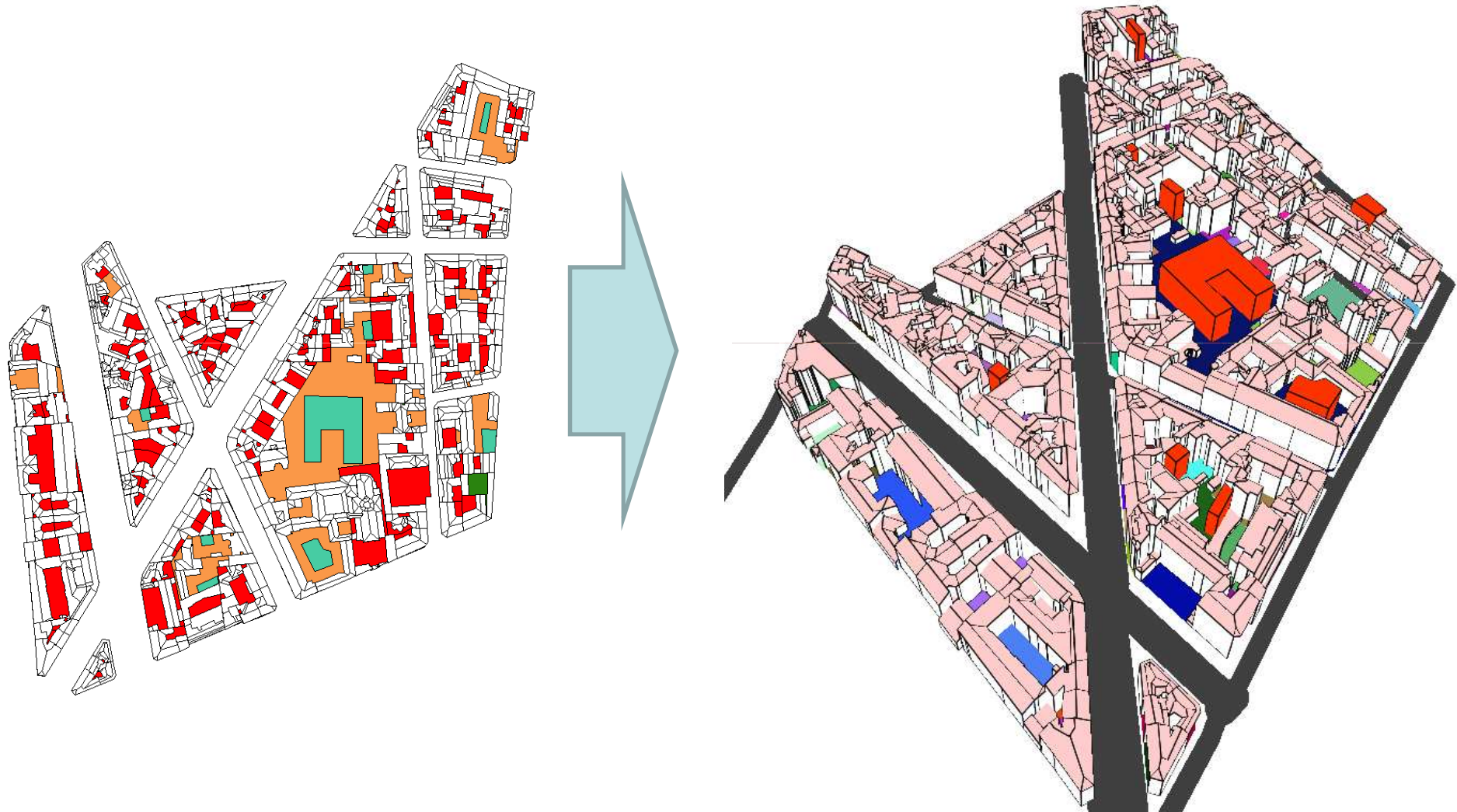


= 0 m<sup>2</sup>



Buildable areas in respect with rules

- Generation of buildings from footprints

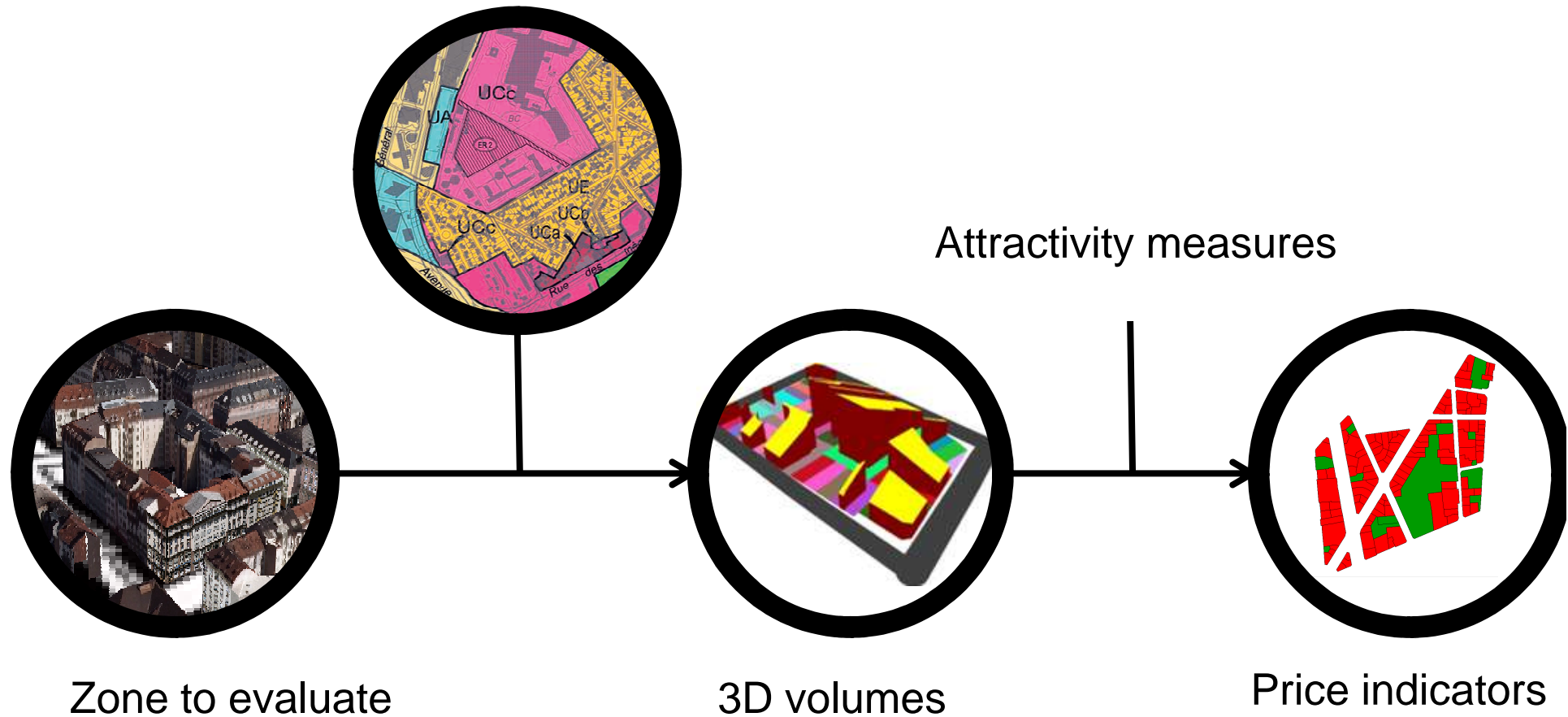


- A method to represent LUPs contents into 3D GIS
  - Rules modeller
  - Checks a set of rules
  - Generates 3D buildable volume
  - Propose LOD2 buildings
- Approximation to evaluate
  - The impact of data quality
  - The use of non-directly interpretable constraints
- Possible improvements
  - Integrate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

- Constructability assesment

Regulation constraints

– Market prices simulation

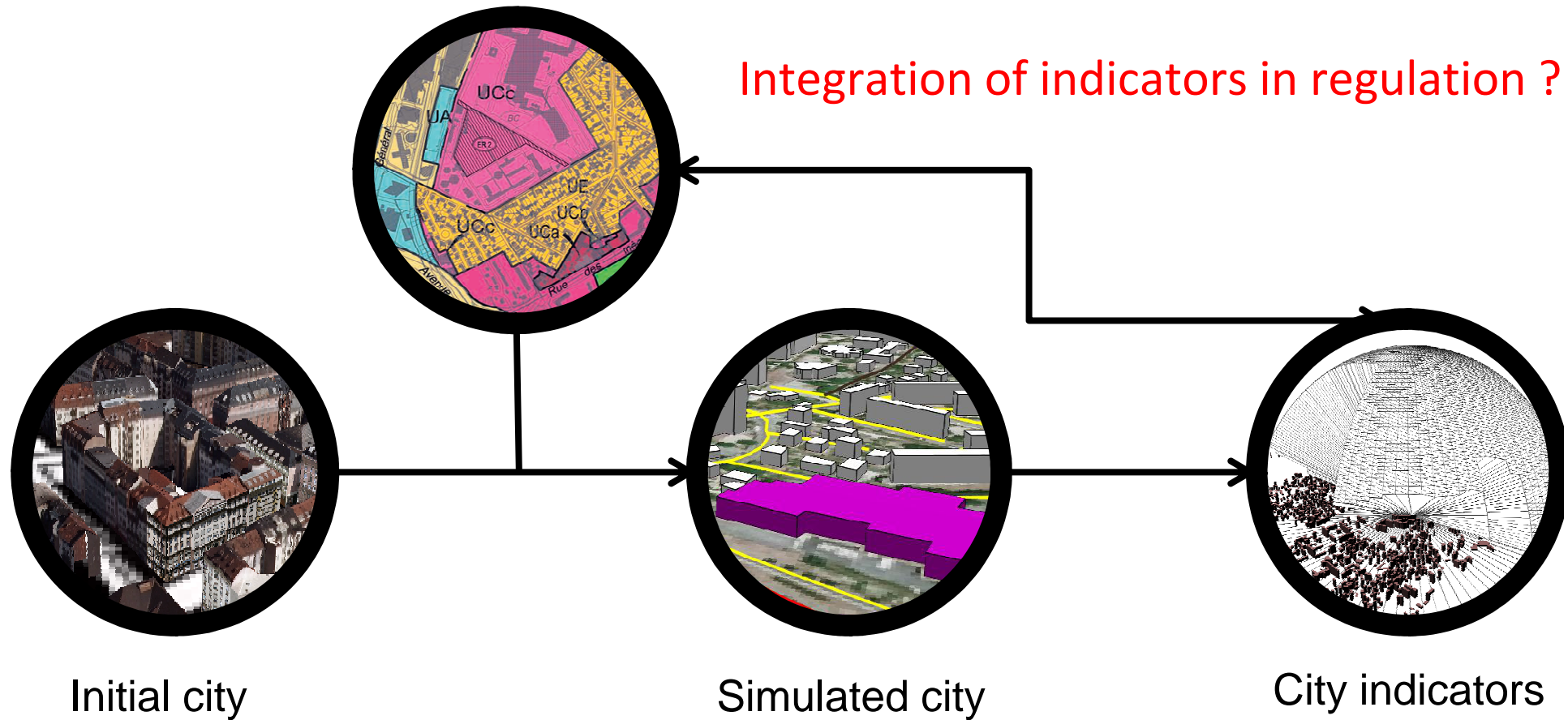


- Urban simulation

Regulation constraints

How regulation influence indicators ?

Integration of indicators in regulation ?





# Thanks for your attention



- COGIT lab : [recherche.ign.fr/labos/cogit/](http://recherche.ign.fr/labos/cogit/)
- About me :  
[recherche.ign.fr/labos/cogit/cv.php?nom=Brasebin](http://recherche.ign.fr/labos/cogit/cv.php?nom=Brasebin)
- Email : [mickael.brasebin@ign.fr](mailto:mickael.brasebin@ign.fr)

