SMARTPOP

Earth Observation and Geospatial Modelling for Sustainable Urban Planning

January 30th, BEODAY 2018

For the consortium: Benjamin Beaumont

ISSeP

vito vision on technology

ULB UNIVERSITÉ LIBRE DE BRUXELLES

Wallonie service public SPW

RESEARCH PROGRAMME FOR EARTH OBSERVATION STEREO III (SR/00/313)

belspo

STEREO III addition to SmartPop

CORE OPERATIONAL PROJECT

MOERMAN'S FUND

ISSeP
Institut scientifique de service public

belspo

+ Reinforce scientific methods related to EO and regional modelling
+ New research activities
+ International Committee
+ Access to EO data (e.g. Pléiades)
+ Visibility of the project

09/2015 -> 01/2019

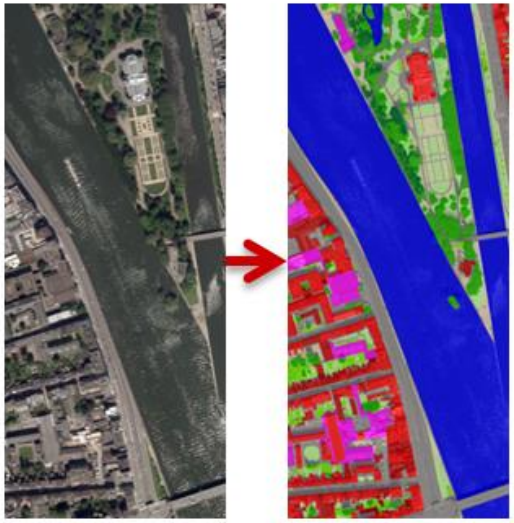
From fine-scale geospatial data...

LULC

Remote Sensing & GIS

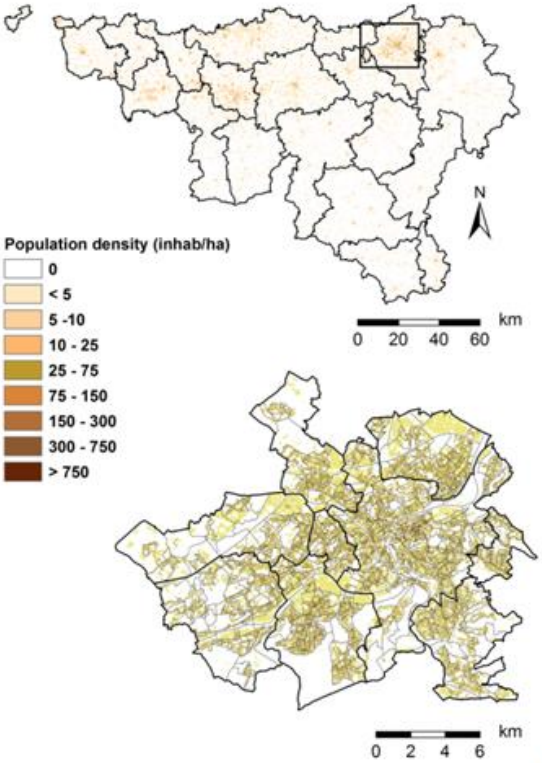
↓

New LC & LU maps, focus on urban classes



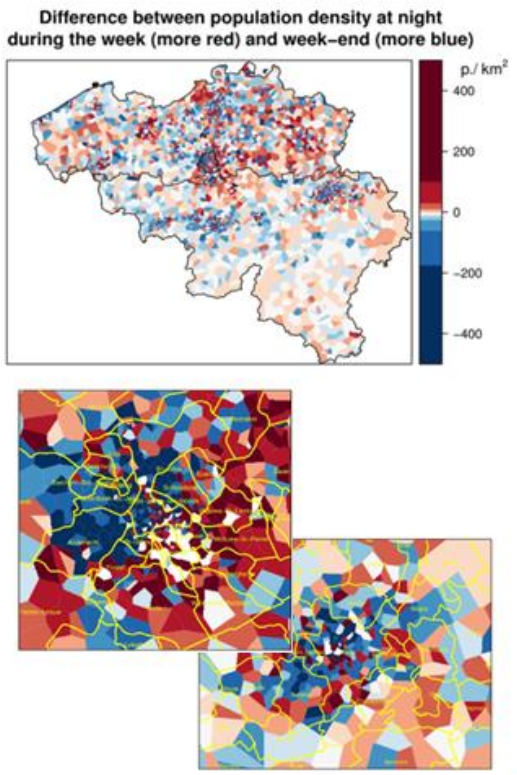
Population

Population Density per ha

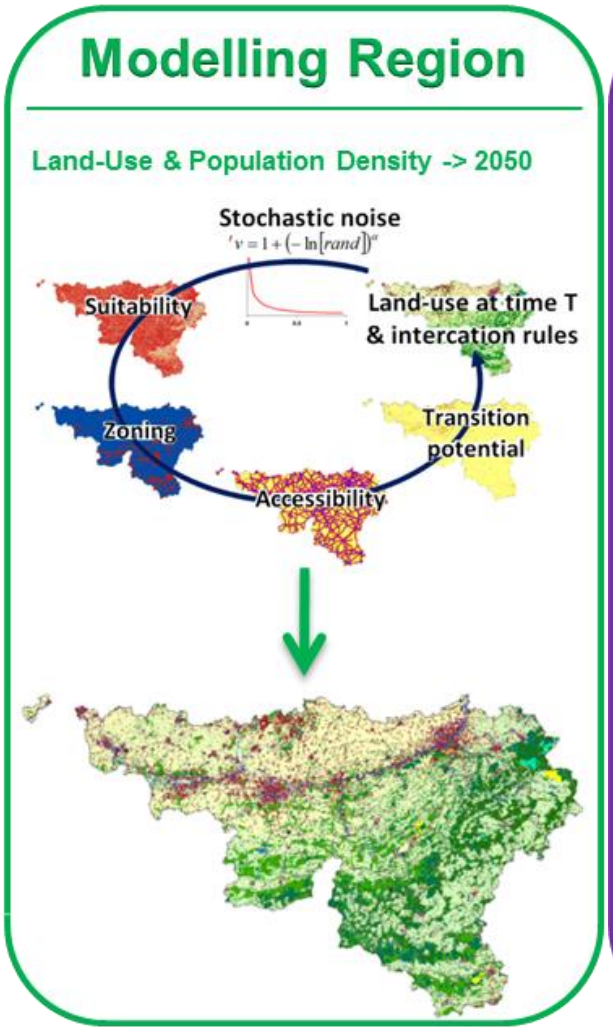


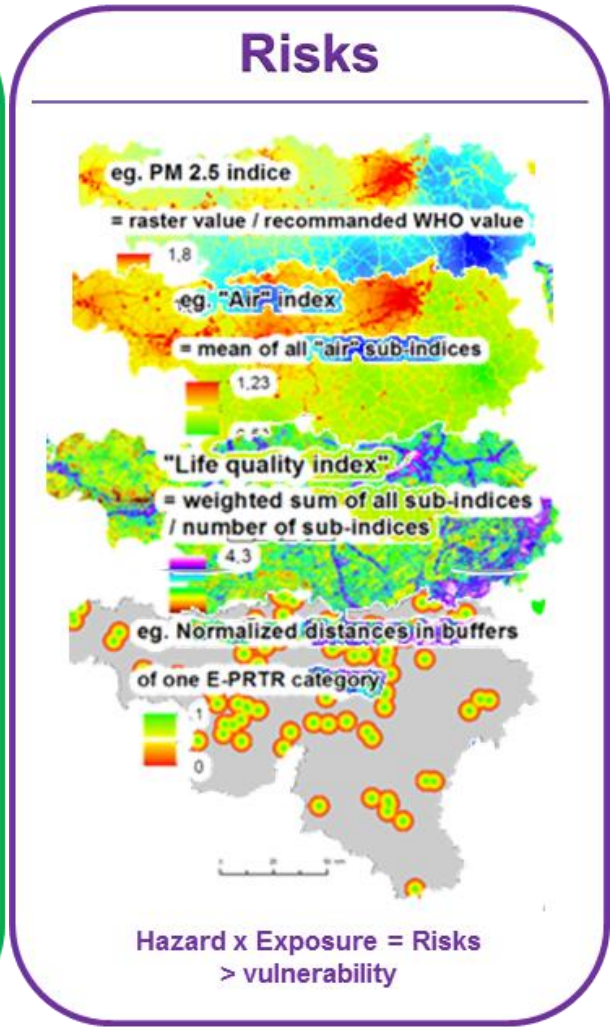
Dynamic

Population Density per day or hours



...to improved risk analysis



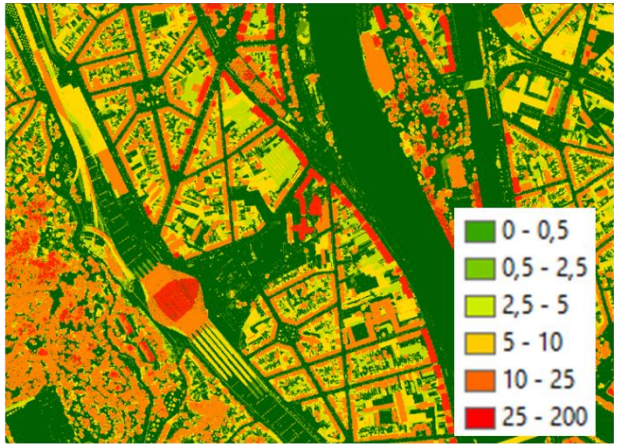


Participative project

LC & LU mapping > Integration of EO & GIS data

Aerial orthophotos (0,25 m)
(SPW, 2013)

Pleiades Imagery (0,5 m)
(© CNES / Astrium Services / Spot Image)



Normalized Digital Surface Model [m] (nDSM - 1 m) ***(SPW, 2013) & Ulg - GxABT***

- Ancillary vector data:
  - *Topographic DB (PICC)*
  - *Cadaster*
  - *Agricultural parcel (SIGEC)*
  - *Others DB (Coal heaps, Landfills …)*

PICC (points, lines, polygons)
(SPW, 2017)

Two methods compared for Land-Cover

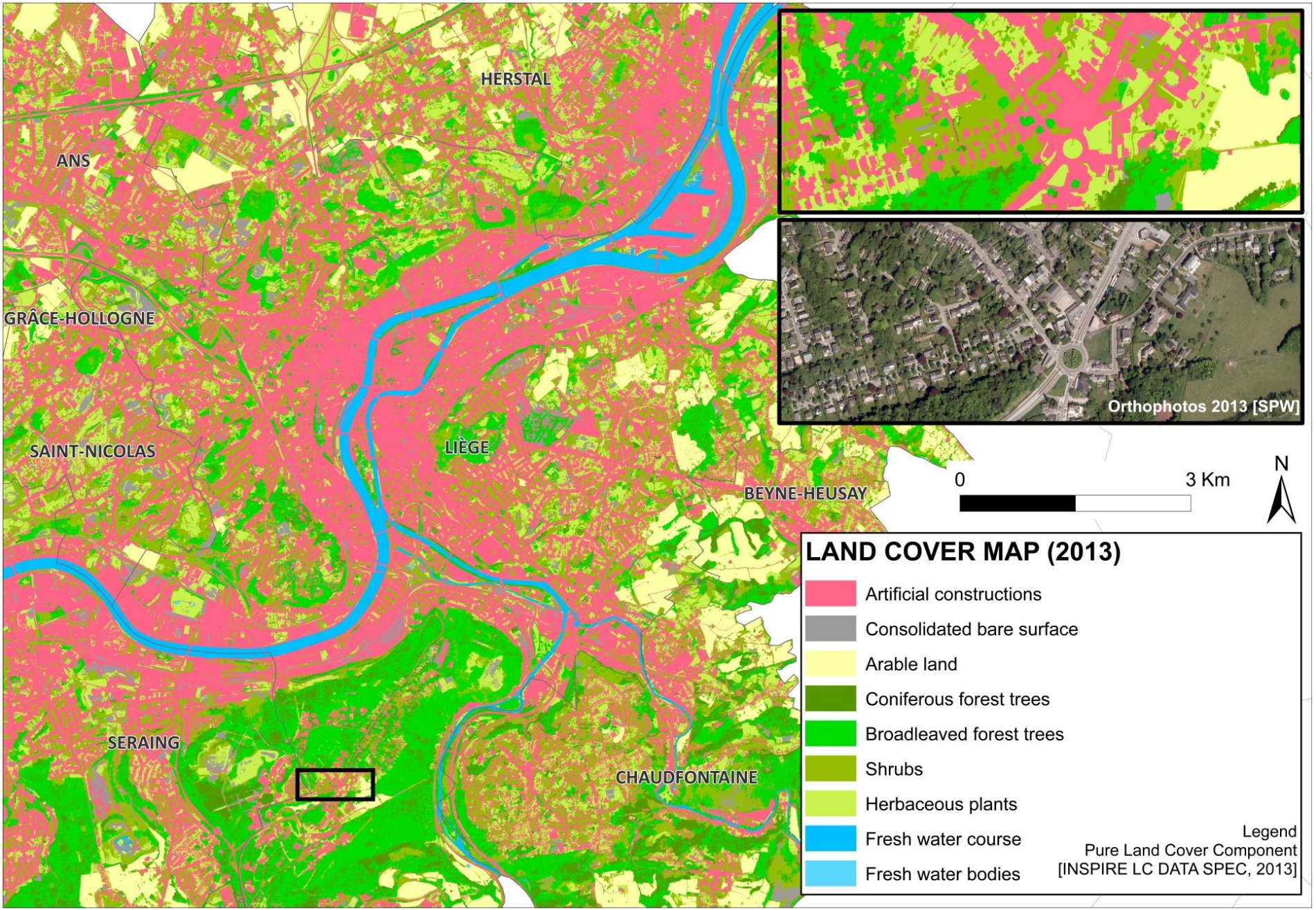
1. Rule-based OBIA in eCognition

2. Semi-automatic OBIA (classifiers-based) in Open Source

Beaumont B., T. Grippa, M. Lennert, S. Vanhuysse, N. Stephenne, E. Wolff, 2017. **Toward an operational framework for fine-scale urban land-cover mapping in Wallonia using submeter remote sensing and ancillary vector data**. J. Appl. Remote Sens. 11(3), 036011 (2017), doi: 10.1117/1.JRS.11.036011.

Grippa, T., Lennert, M., Beaumont, B., Vanhuysse, S., Stephenne, N. & Wolff, E. (2017). **An open-source semi-automated processing chain for urban object-based classification**. Remote Sens. 2017, 9, 358. doi :10.3390/rs9040358.

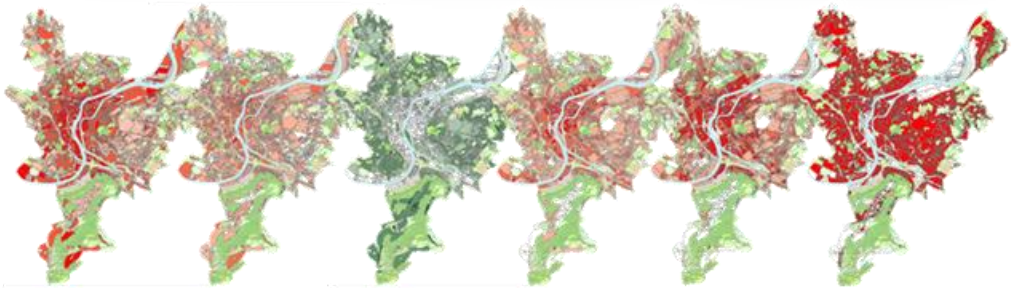
CODE -> https://github.com/tgrippa/Opensource_OBIA_processing_chain


HERSTAL
ANS
GRÂCE-HOLLOGNE
SAINT-NICOLAS
LIÈGE
BEYNE-HEUSAY
SERAING
CHAUDFONTAINE
Orthophotos 2013 [SPW]
0
3 Km
N
LAND COVER MAP (2013)
Artificial constructions
Consolidated bare surface
Arable land
Coniferous forest trees
Broadleaved forest trees
Shrubs
Herbaceous plants
Fresh water course
Fresh water bodies
Legend
Pure Land Cover Component
[INSPIRE LC DATA SPEC, 2013]

LU mapping > modular methodology

(1) Mapping units

(2) Spatial variables

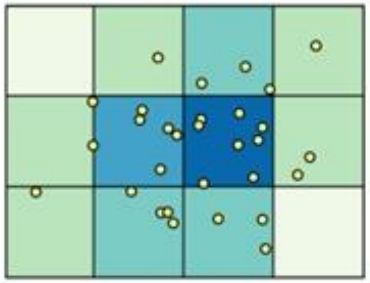


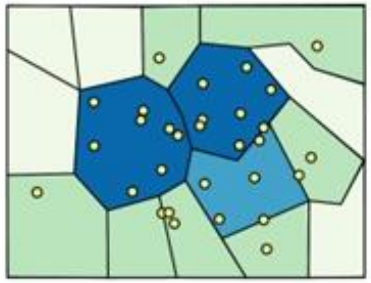
(3) Classification

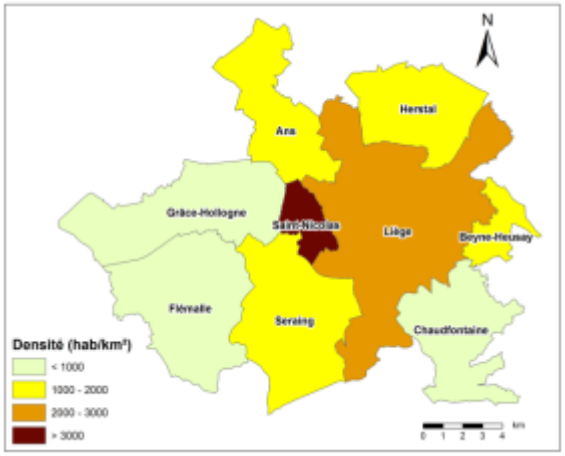
Fine-scale population distribution mapping…

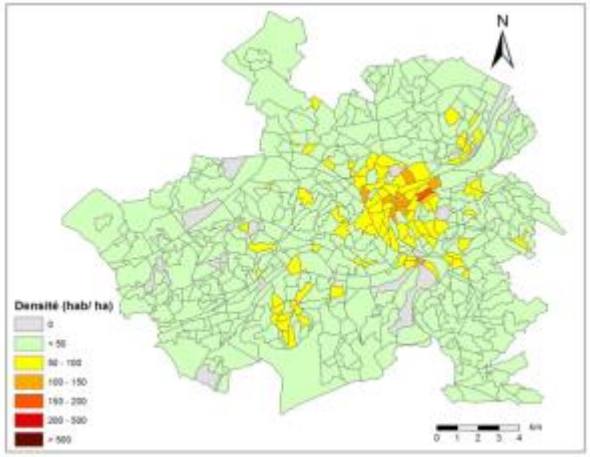
Dasymetric mapping = disaggregating pop. data from the census areas (National Statistical Institute) using ancillary data (LU, Sealing…) (Poelmans *et al.*, 2015, Hallot *et al.*, 2016))

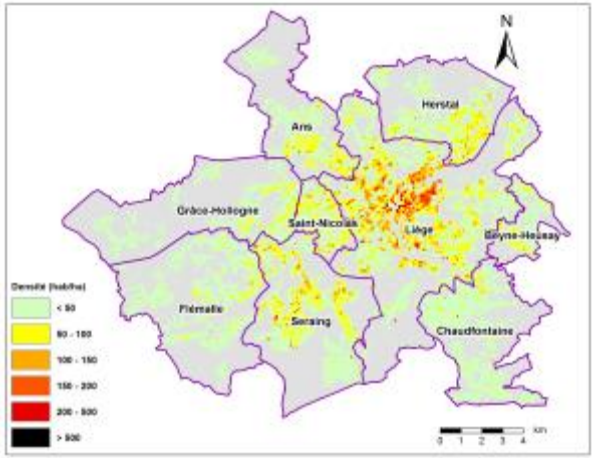
- Homogeneous and complete coverage of population data avoiding MAUP











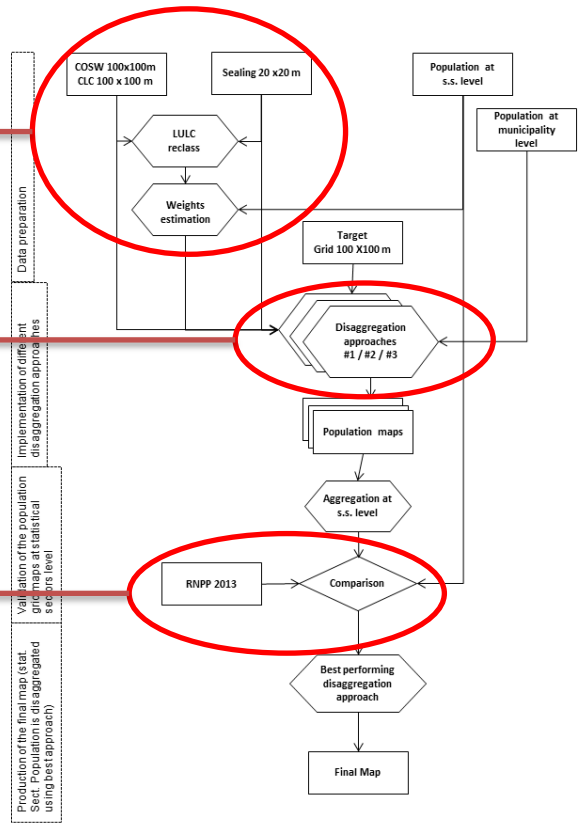
Different models tested

3 disaggregation methods :

Where are people ? Densities ?

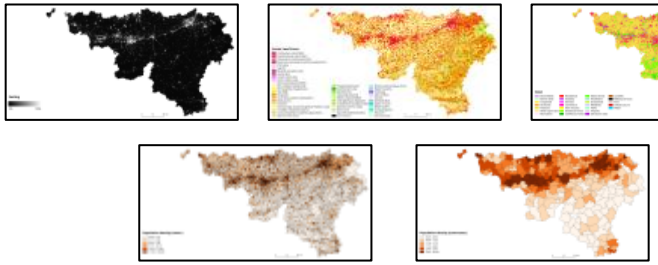
Different dasymetric methods

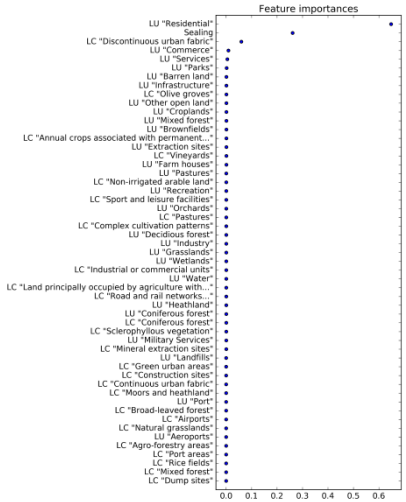
Validation

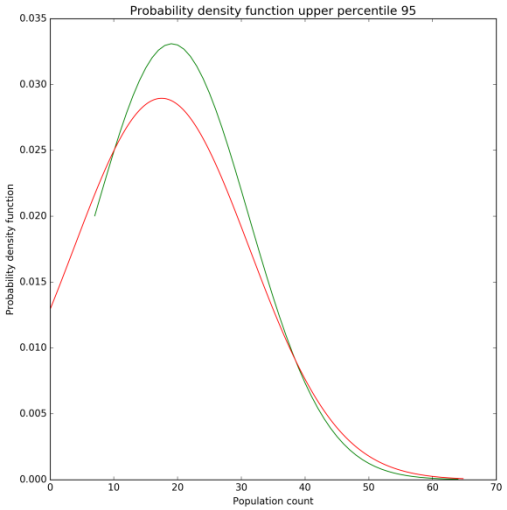


Modified from Batista et al. 2013 and implemented in WEISS (VITO)

"Random forest" regression model







In collaboration with:

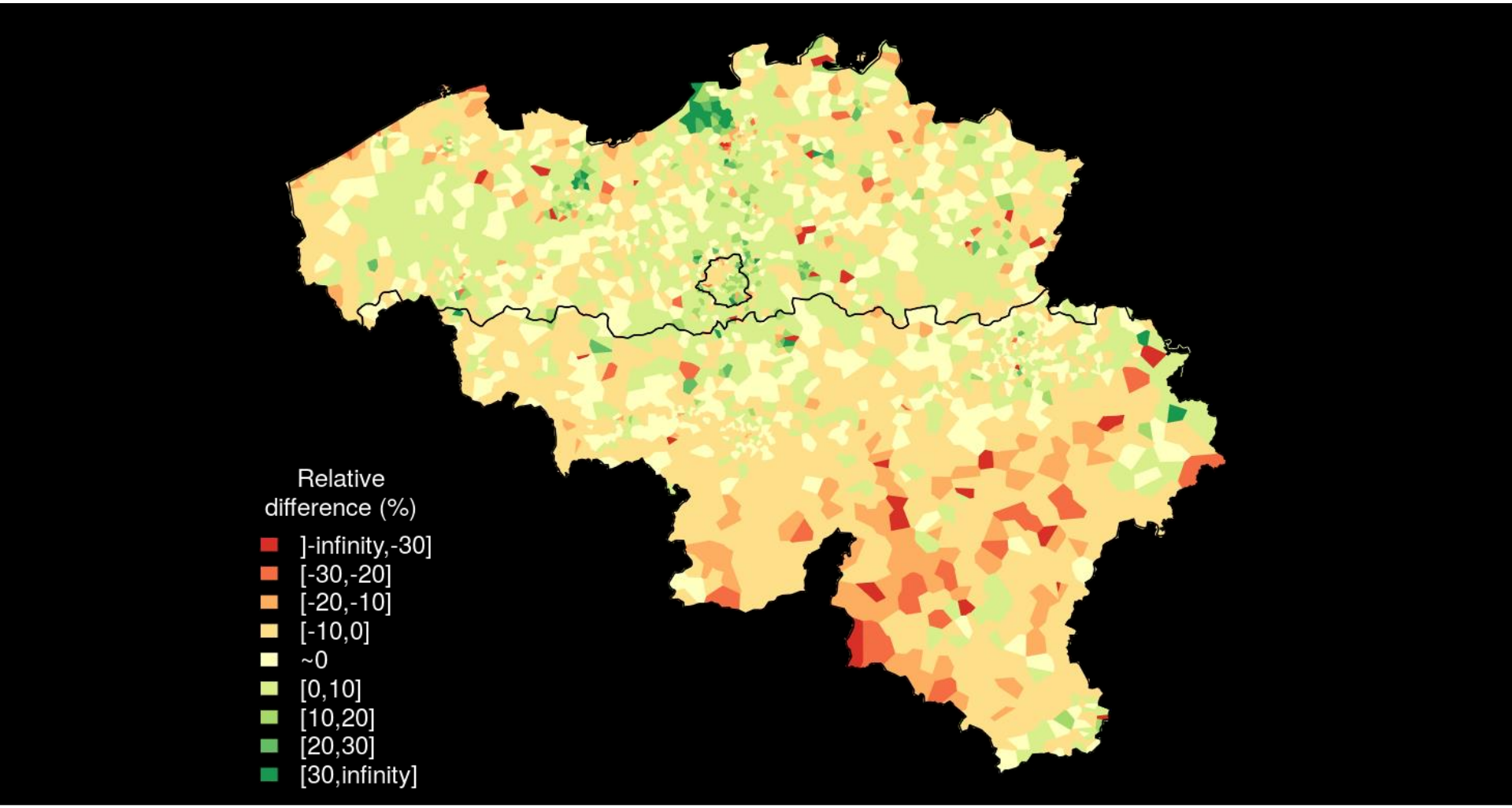
Dynamic Population Mapping with Mobile Phone Data

- **Number of SIMs / antenna / hour during 1 year (may 2014 - april 2015) for BELGIAN and ROAMERS**

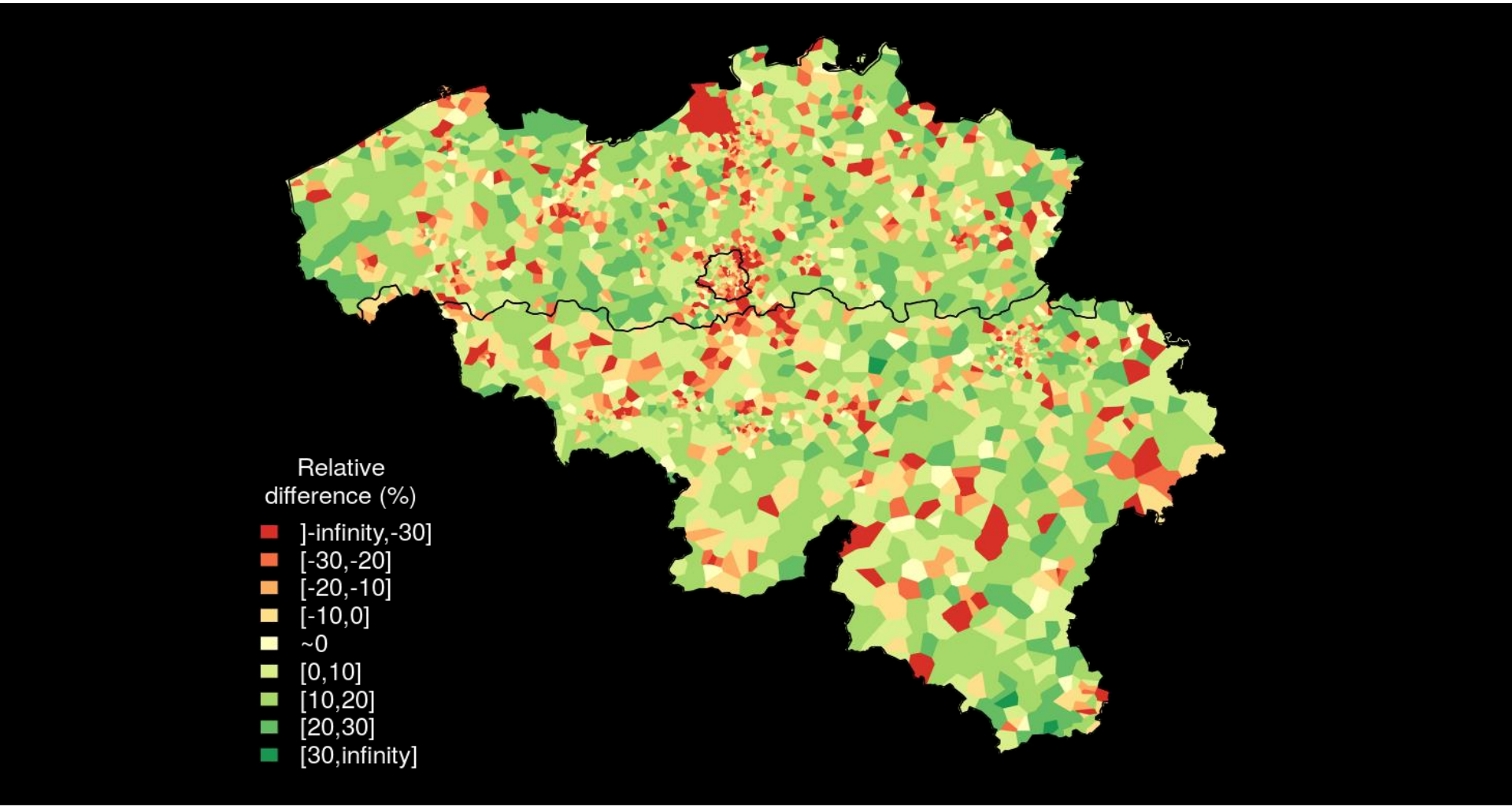
- **Estimation of population density at night (~residential population) validated with National Register Data.**
  -> correlation 0.9 with highest resolution of 1km²

- **Extrapolation for day-time ?**
  -> MOBILE PHONE USAGE is not independent of TIME and SPACE

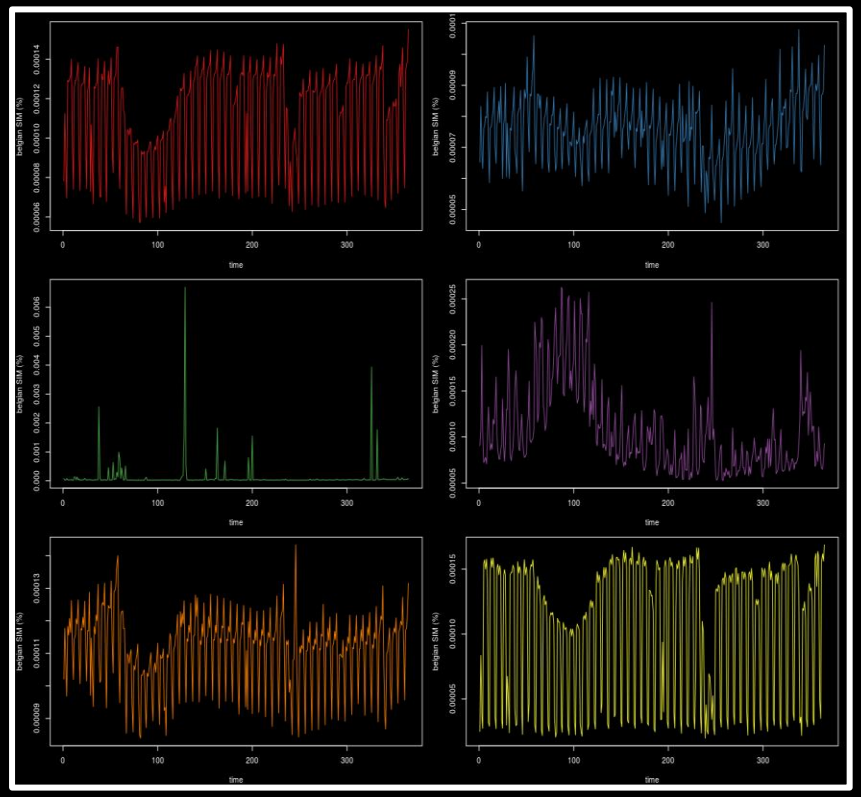
Relative difference between population density at night during the WEEK and the WEEK-END

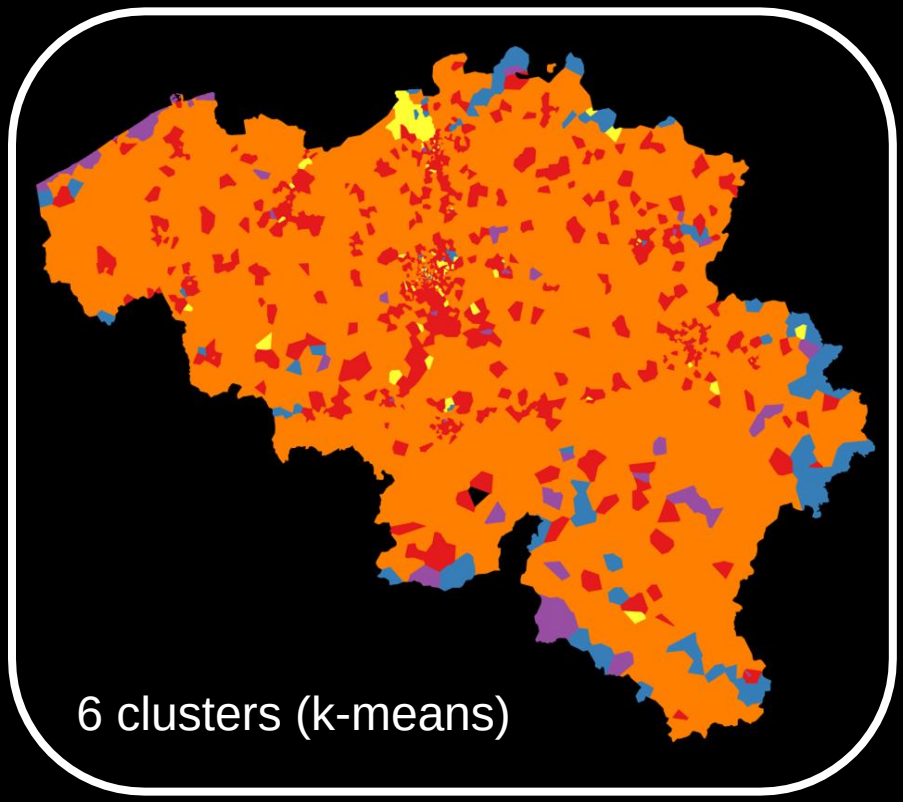


Relative difference between population density during the EVENING (19-22h) and the DAY (9-17h) for week days



Antenna can be CLUSTERED using the temporal profiles of activity (Land Use Classification)






One-time Events


Residential Areas


Regular Events

Transit Areas

Industrial Areas

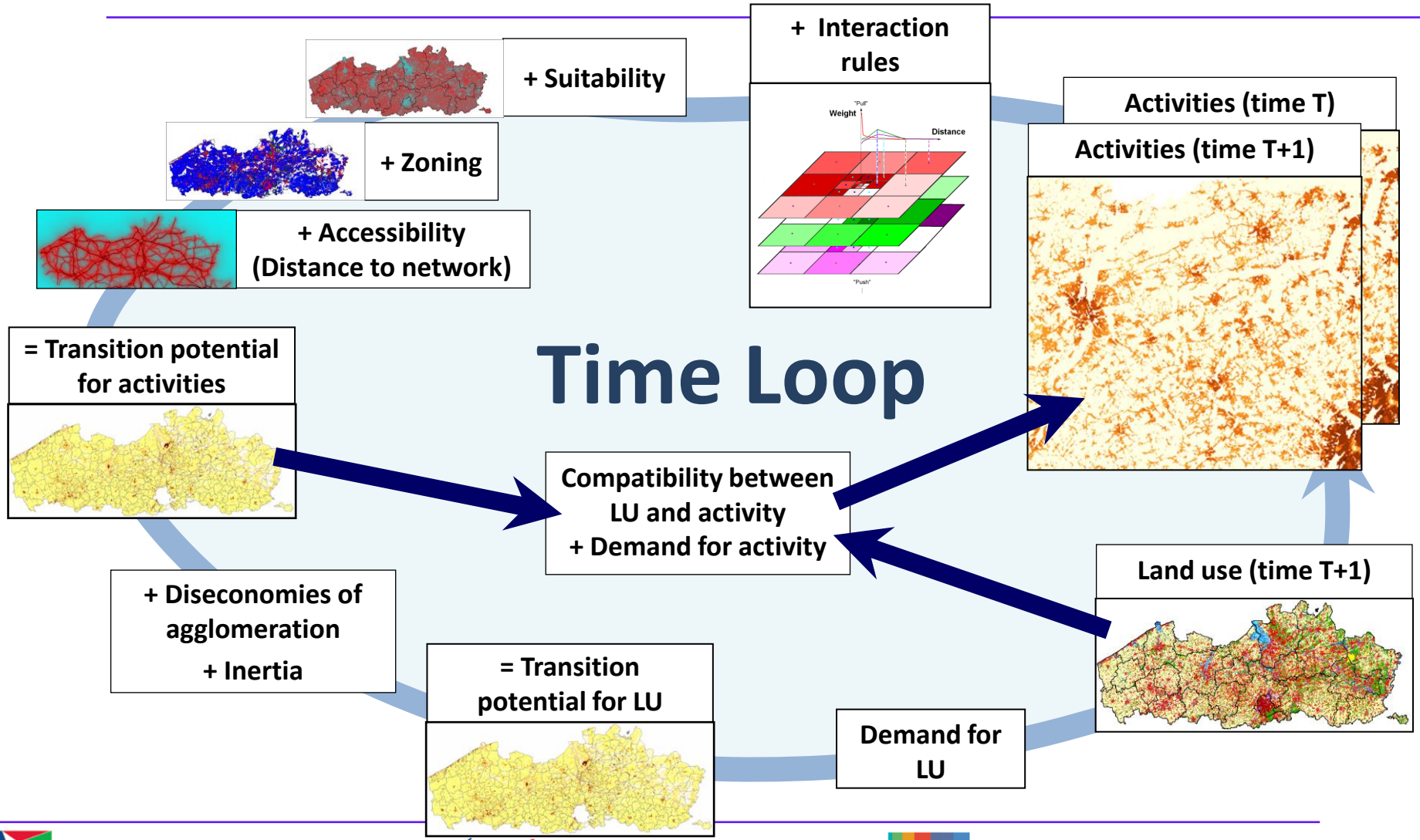

International Institutions


Touristic Areas

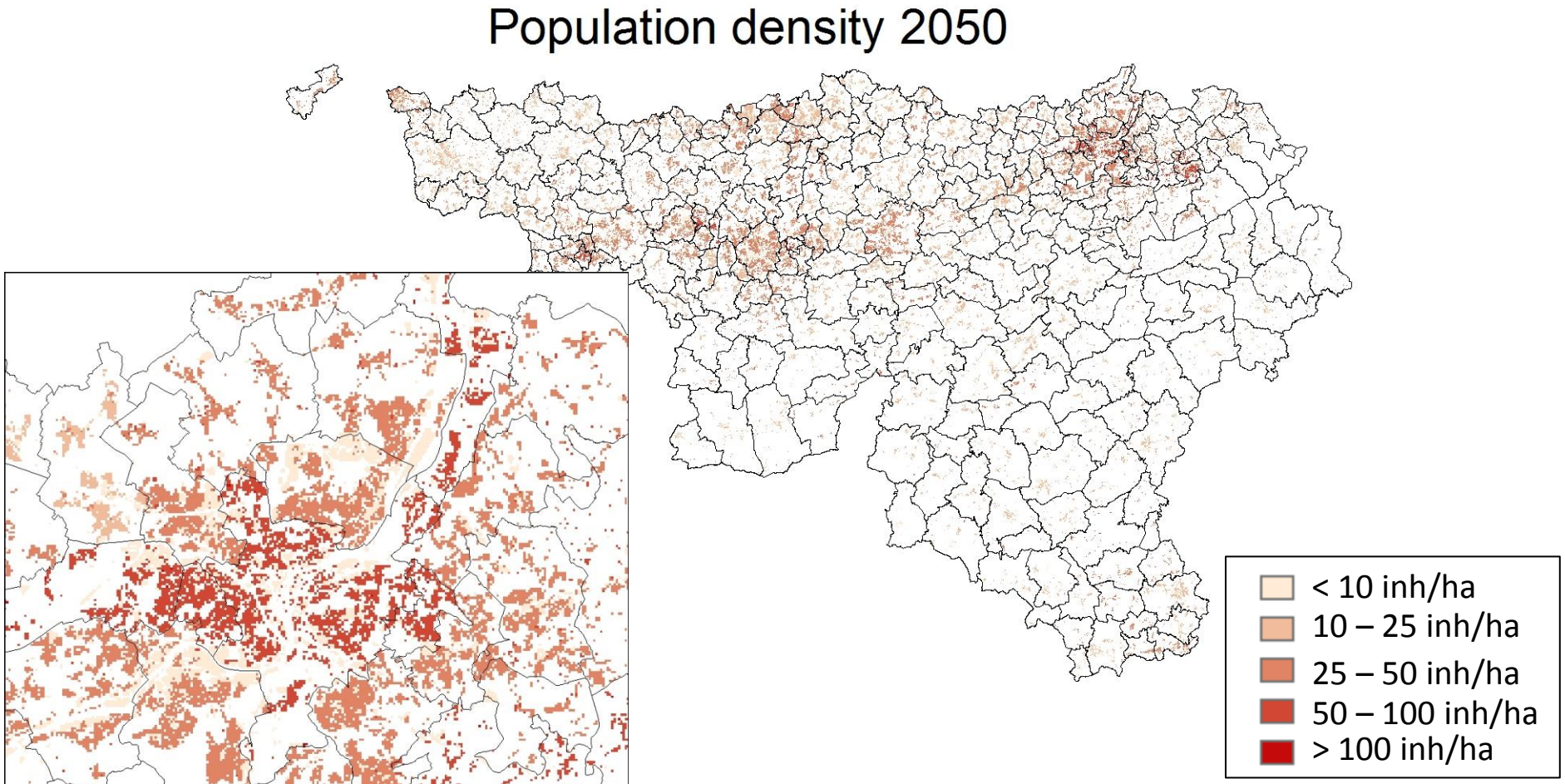

Business Areas


Nightlife Areas

Activity-based land use modelling

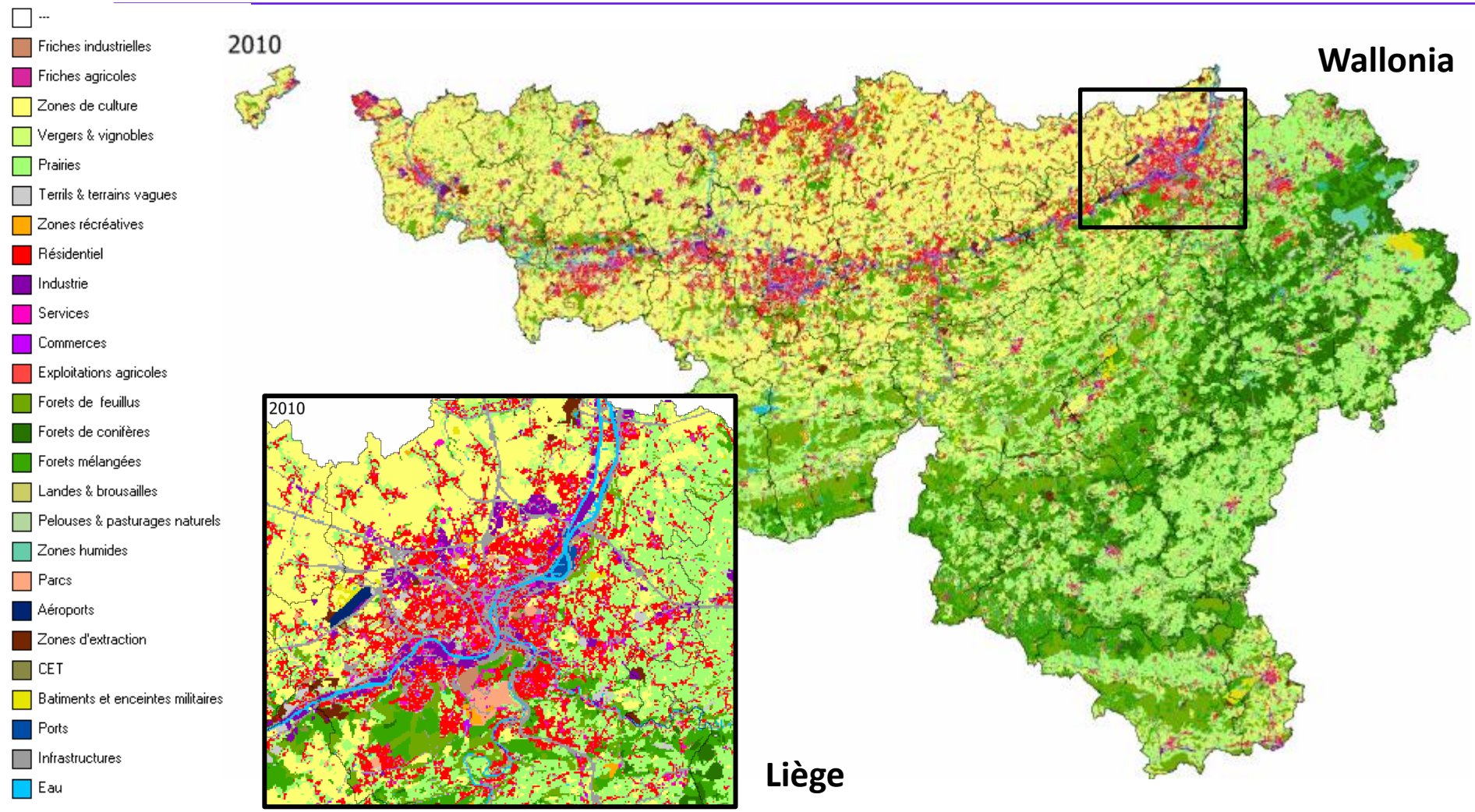


Population density 2010 > 2050

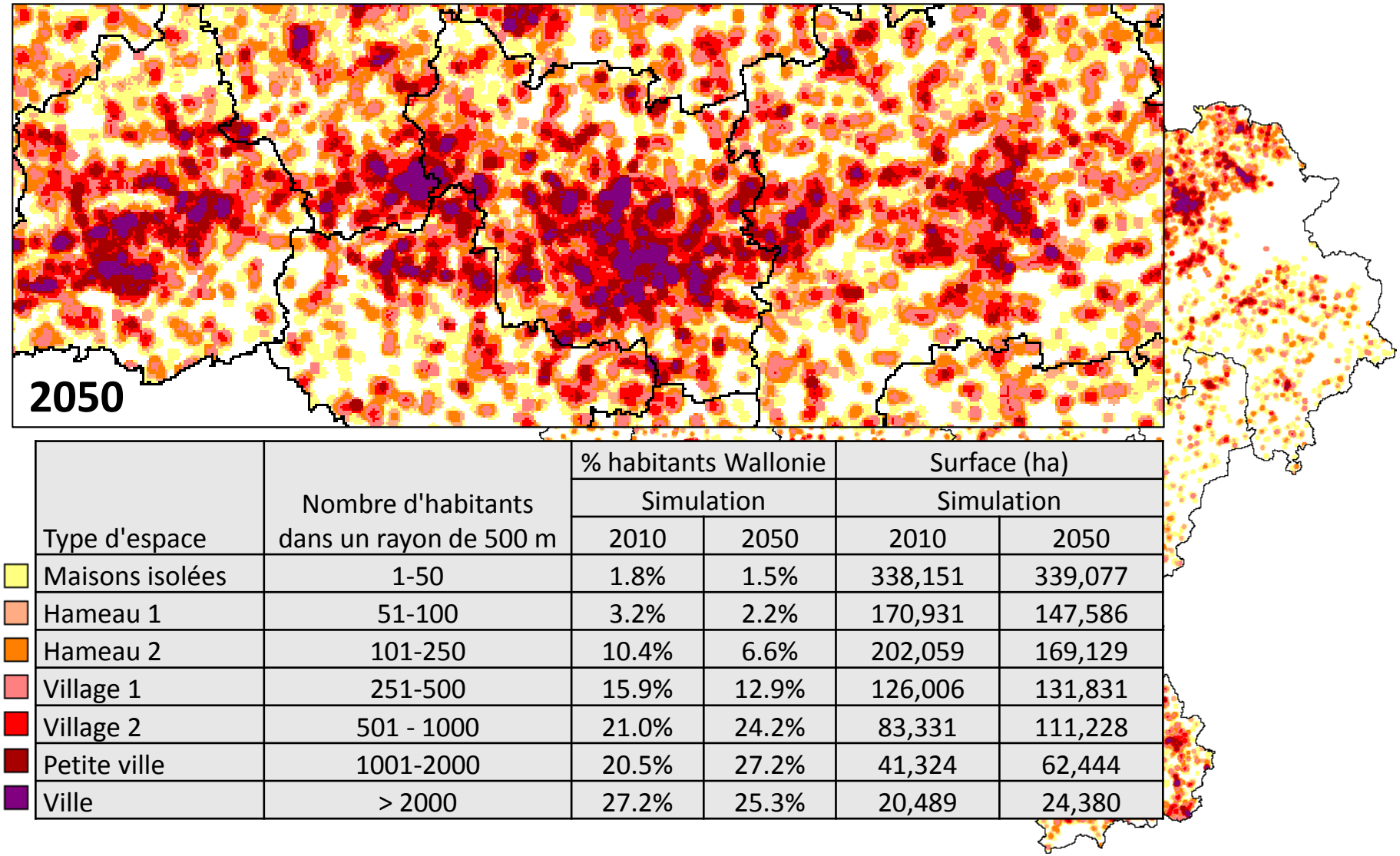


RESEARCH PROGRAMME
FOR EARTH OBSERVATION
STEREO III (SR/00/313)

Land Use 2010 > 2050



Land Use > Spatial indicators



Type d'espace	Nombre d'habitants dans un rayon de 500 m	% habitants Wallonie Simulation		Surface (ha) Simulation	
		2010	2050	2010	2050
Maisons isolées	1-50	1.8%	1.5%	338,151	339,077
Hameau 1	51-100	3.2%	2.2%	170,931	147,586
Hameau 2	101-250	10.4%	6.6%	202,059	169,129
Village 1	251-500	15.9%	12.9%	126,006	131,831
Village 2	501 - 1000	21.0%	24.2%	83,331	111,228
Petite ville	1001-2000	20.5%	27.2%	41,324	62,444
Ville	> 2000	27.2%	25.3%	20,489	24,380

SMARTPOP

Thank you

b.beaumont@issep.be

http://www.issep.be/smartpop/

Crédit photo Slide 1:
http://www.greisch.com

ISSeP
vito vision on technology
ULB UNIVERSITÉ LIBRE DE BRUXELLES
Wallonie service public SPW
RESEARCH PROGRAMME FOR EARTH OBSERVATION STEREO III (SR/00/313)
belspo