



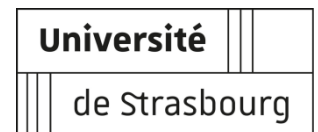
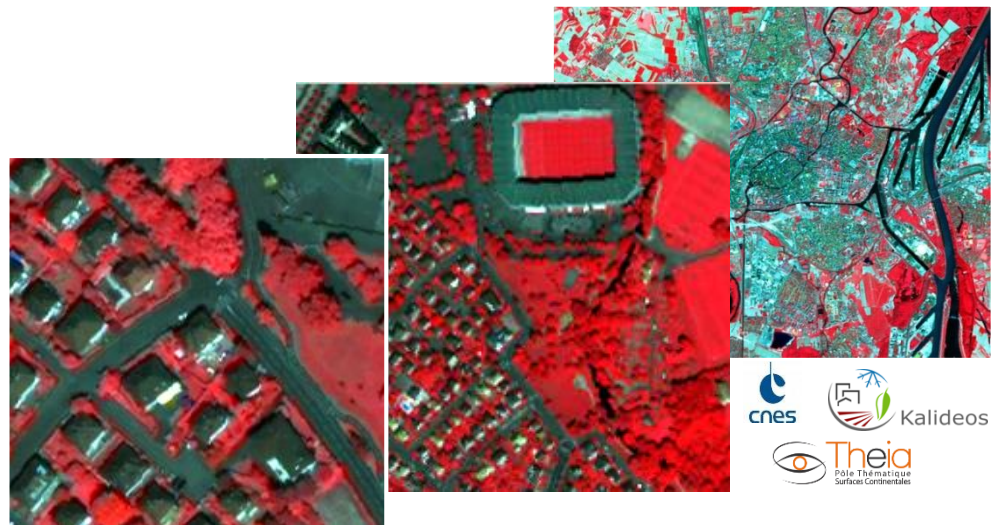
Contributions of HR and VHR satellite imagery for urban studies

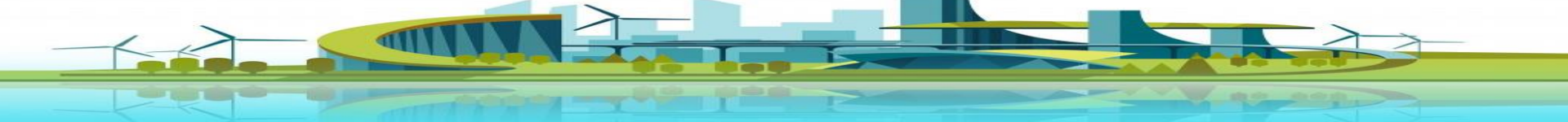
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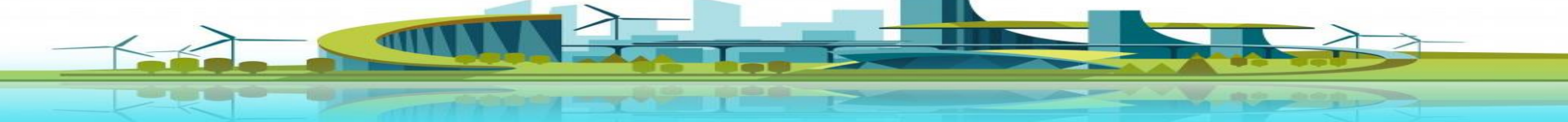




Relevance of Earth Observation data for urban studies

The national context in France:

- Spatial sector sustained by two ministries: “Transition Ecologique et Solidaire” and “Cohésion des Territoires” (PAS 2018)
- Need to develop the ‘downstream’ sector of satellite imagery
- towards an “*Open Space*” to respond to this challenge
- with a first step:
 - Develop more friendly access to spatial data: e.g. *DINAMIS* (Dispositif Institutionnel National d’Approvisionnement Mutualisé en Imagerie Satellitaire) and *PEPS* (Operating Platform for Sentinel Products - CNES) → ***on-going projects***
 - Develop Spatial Data Infrastructure linking processing platforms, products and tools → *THEIA* (for continental surfaces), part of the Research Infrastructure (IR) « *Système Terre* »



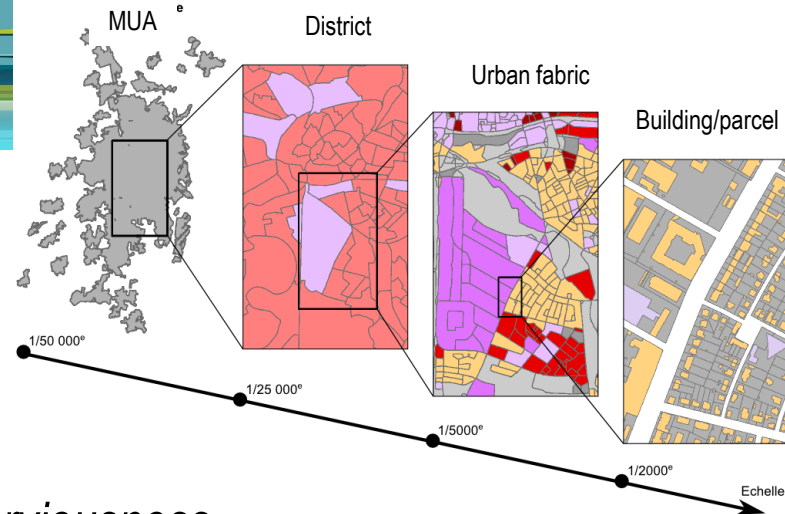
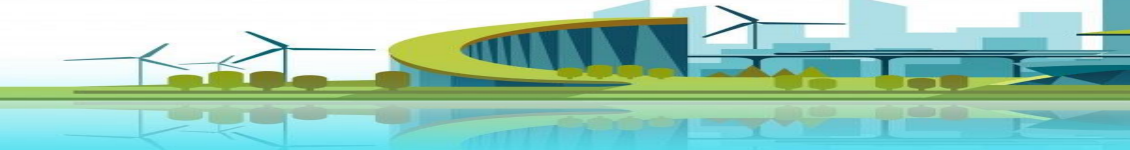
Major issues

Actions listed in the PAS 2018-2022 (Plan d'Application Stellitaire)

e.g. key actions for which the spatial sector is a valuable source of information

- EO for improving the knowledge of decision makers during crisis management,
- EO for anticipating the level of atmospheric pollution,
- EO for improving transport safety and efficiency,
- EO for protecting the fauna and flora,
- EO for monitoring climate change,
- EO for knowing the environment to appreciate its services,
- EO for quantifying the **dynamic of landcover/use**





Users' needs for urban analyses

Landcover/use maps for monitoring

..... not exhaustive:

- 1) Housing consumption → *urban footprint, imperviousness*
- 2) Housing transformation → *urban fabrics/blocks*
- 3) Biodiversity → *'structural' and 'functional' green/blue networks*

(1) Urban Footprint

- at large scale: +/- 10 m resolution
- with a frequent update: one product per year
- Coverage of the national territory: Once (twice) per year

(3) Structural green network

- at large scale : +/- 1 m resoution
- with a frequent update : one product per year
- Coverage of the national territory : Once (twice) per year



(1) Urban footprint with HSR

Several products with different specifications:

➤ Globe/European scale

- ✓ GUF – Global Urban Footprint
- ✓ GHSL - Global Human Settlement Layer

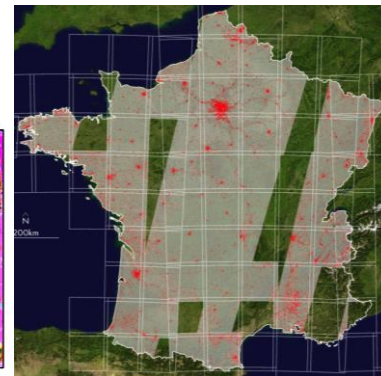
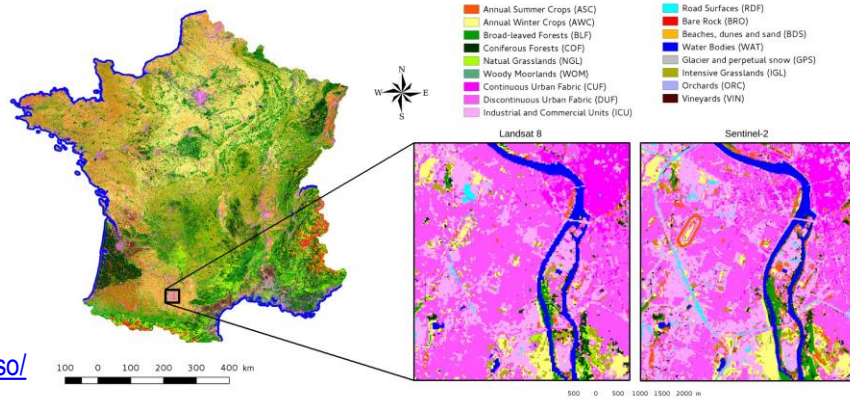


➤ National scale

- ✓ OSO 'Landcover' SEC (Scientific Expert Centre)
- ✓ URBA-Opt 'Urban' SEC



France land cover classification, from Landsat 8 to Sentinel-2.



UMC: 0,01 to 0,1ha
1 product per year
Binary Map (10m)
In addition confidence map
<http://a2s-earthobservation.eu>
(ongoing website)

UMC: 0,01 to 0,1ha
17 landcover classes
1 product per year
In addition confidence map
4 urban classes
Raster / vector
<http://osr-cesbio.ups-tlse.fr/~oso/>

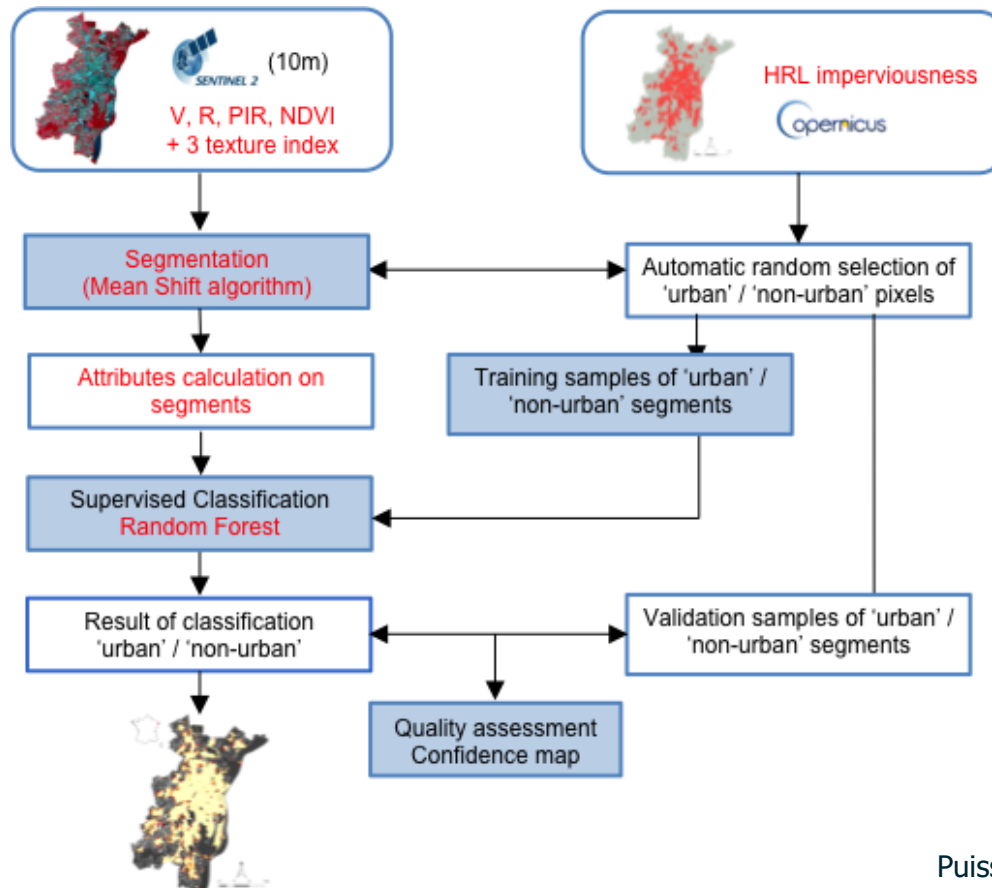


(1) Urban footprint with HSR

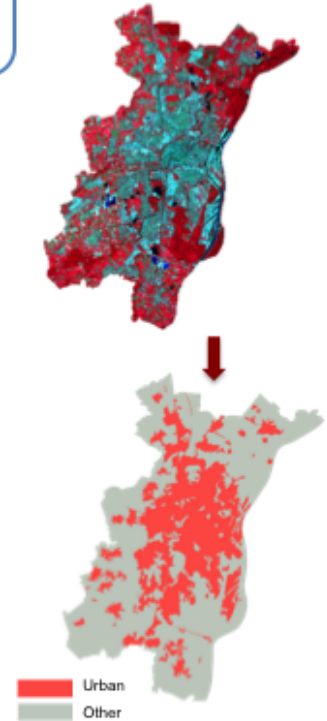


URBA-OPT ... a science-driven processing chain to map urban footprint

➤ 2016/2017



First test case:
Strasbourg



Puissant et Poterek (2017)

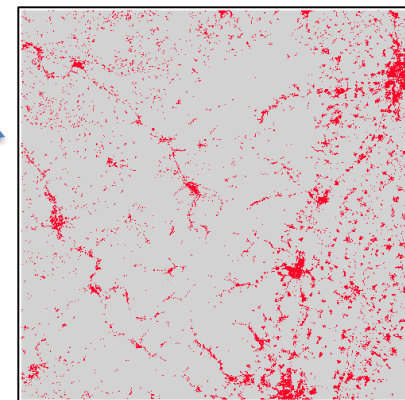
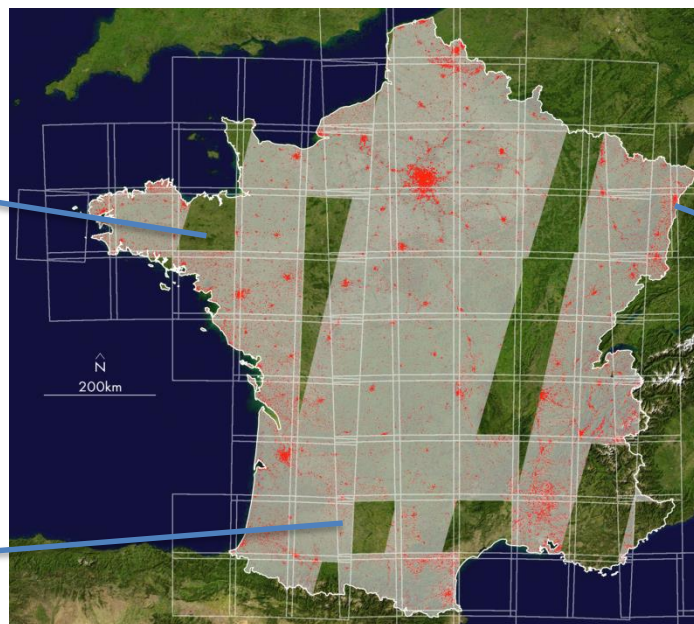
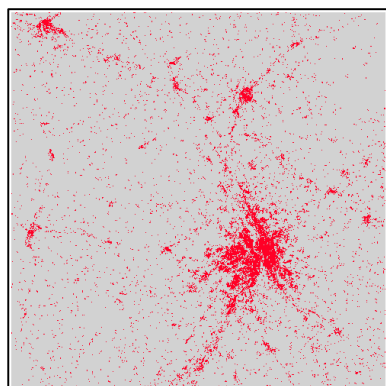
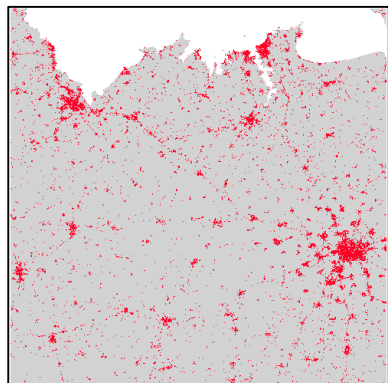


(1) Urban footprint with HSR



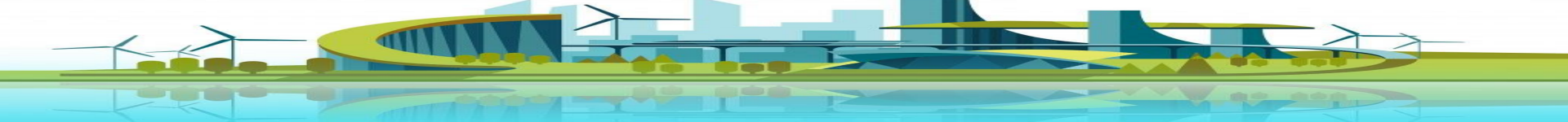
URBA-OPT ... deployment on HPC infrastructure

- Ongoing 2018: multi-temporal images to remove 'gaps'

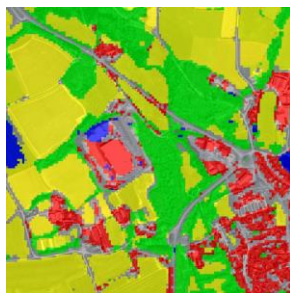


First application : Mono-dates S2 (year 2016)
-> in production year **2017** (with multi-temporal images)

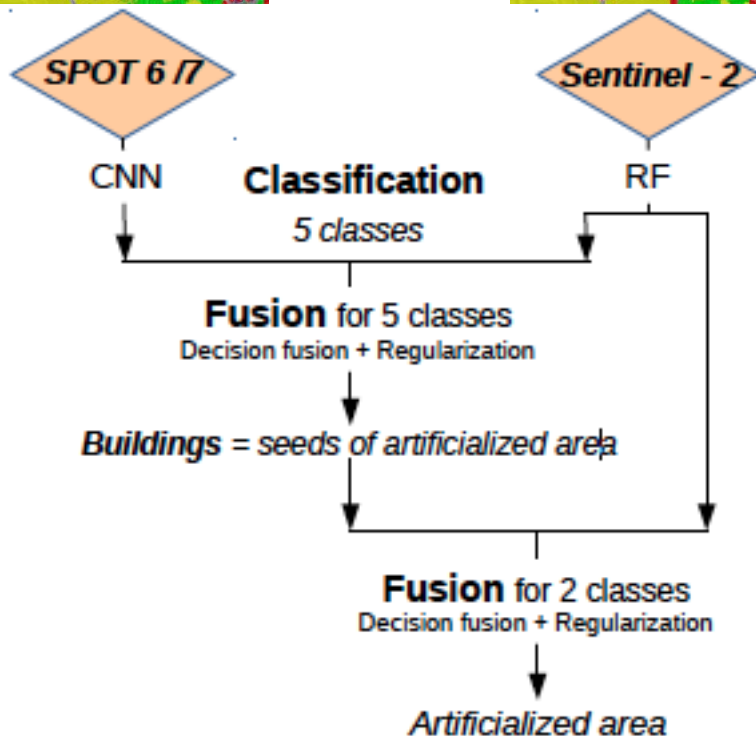
Puissant, Michéa, Poterek (2018)



(1) Urban footprint by combining HSR and VHSR



Ongoing research



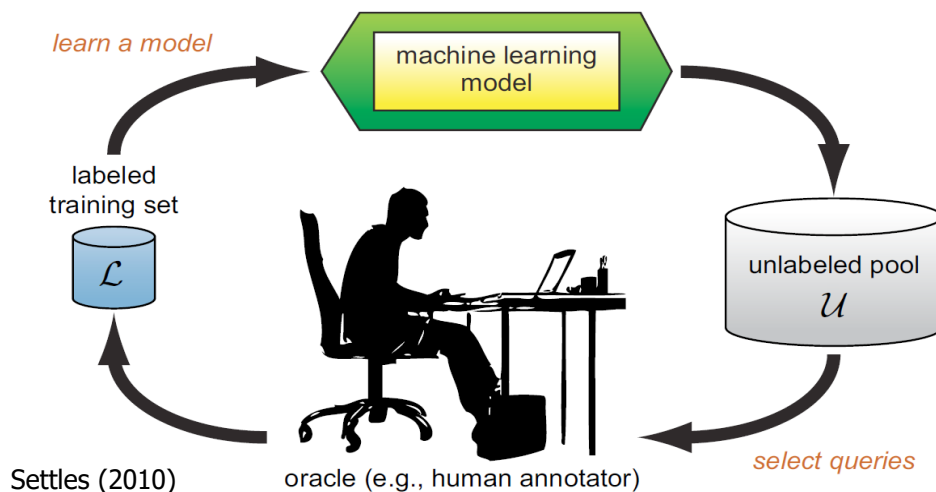
C. Wendl, Y. Kotrsi, A. Le Bris, N. Chehata, C. Mallet, T. Postadjian, Puissant A. (LaSTIG/IGN, LIVE)



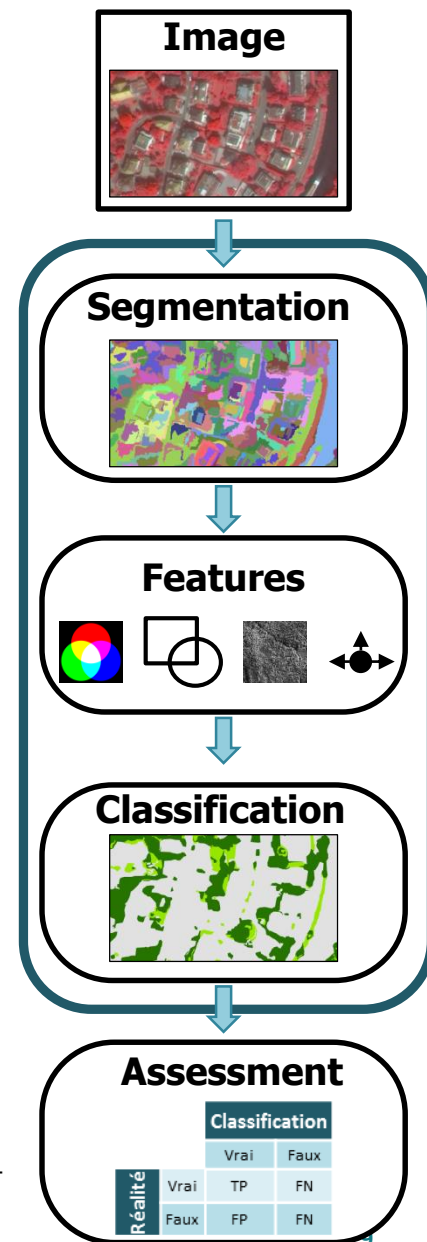
(2) Green network with VHSR



OBIA approach based on a supervised active learning



OBIA



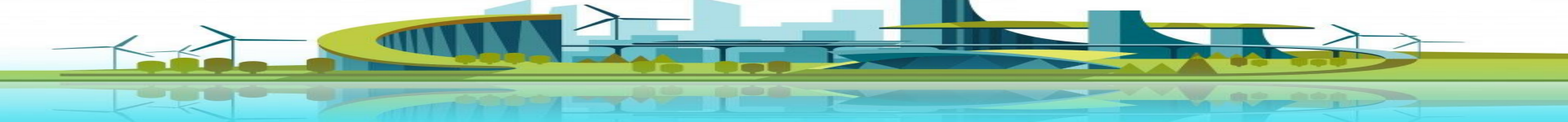
Spatial multi-class active learning approach based on:

- Uncertainty
- Uncertainty + diversity
- Uncertainty + stratification

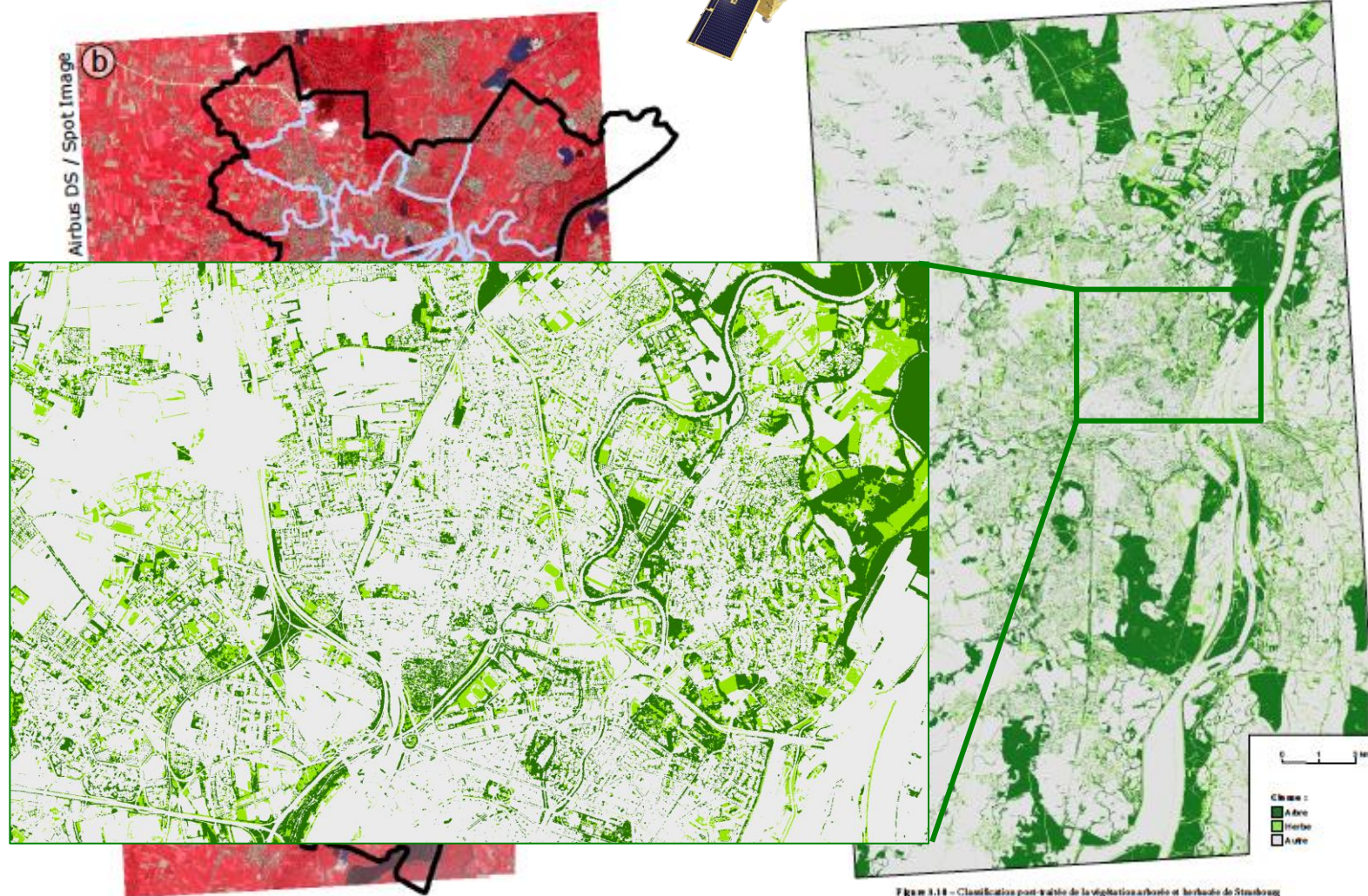
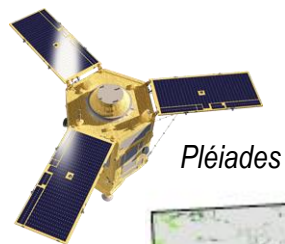
Comparison of
sampling strategies
(random/stratified)

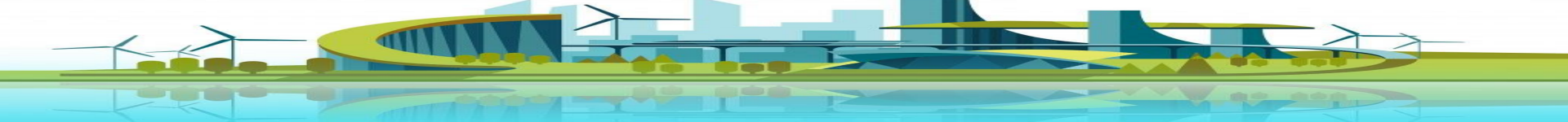


Rougier S., Puissant A., Stumpf A., 2014



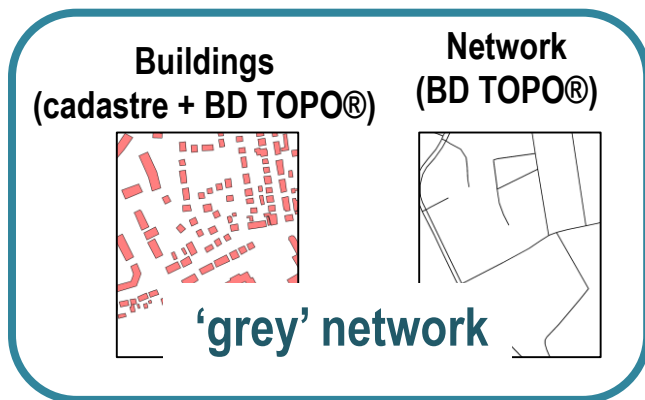
(2) Green Network with VHSR





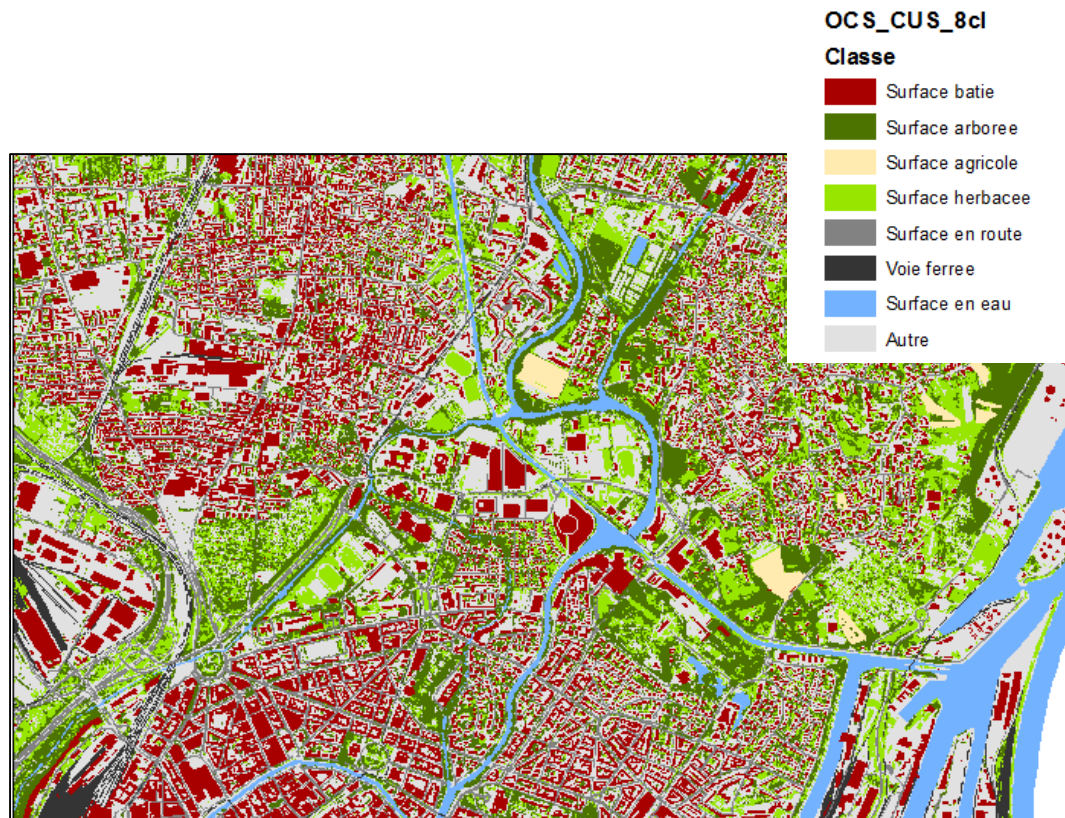
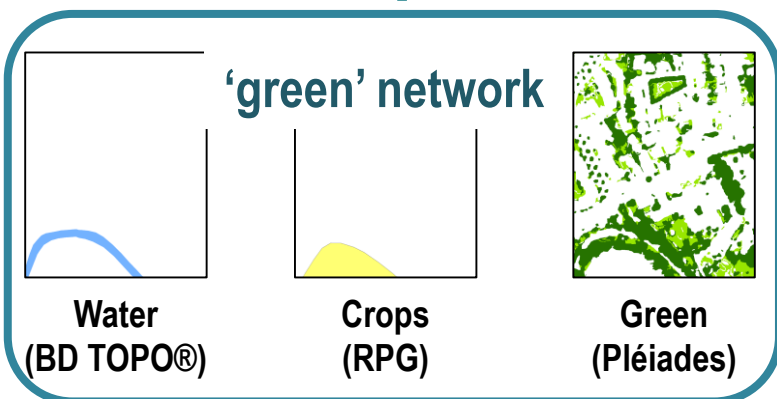
(3) High-Res landcover maps at large scale (1:5000 – 1:10,000)

By combining:

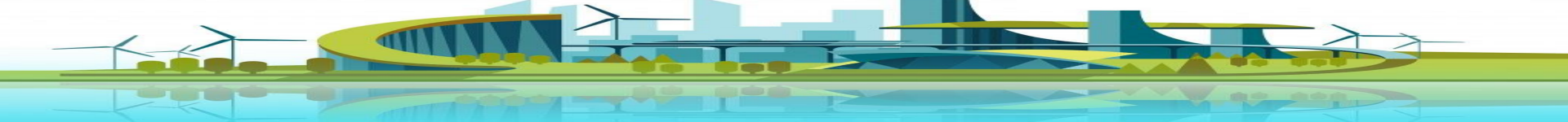


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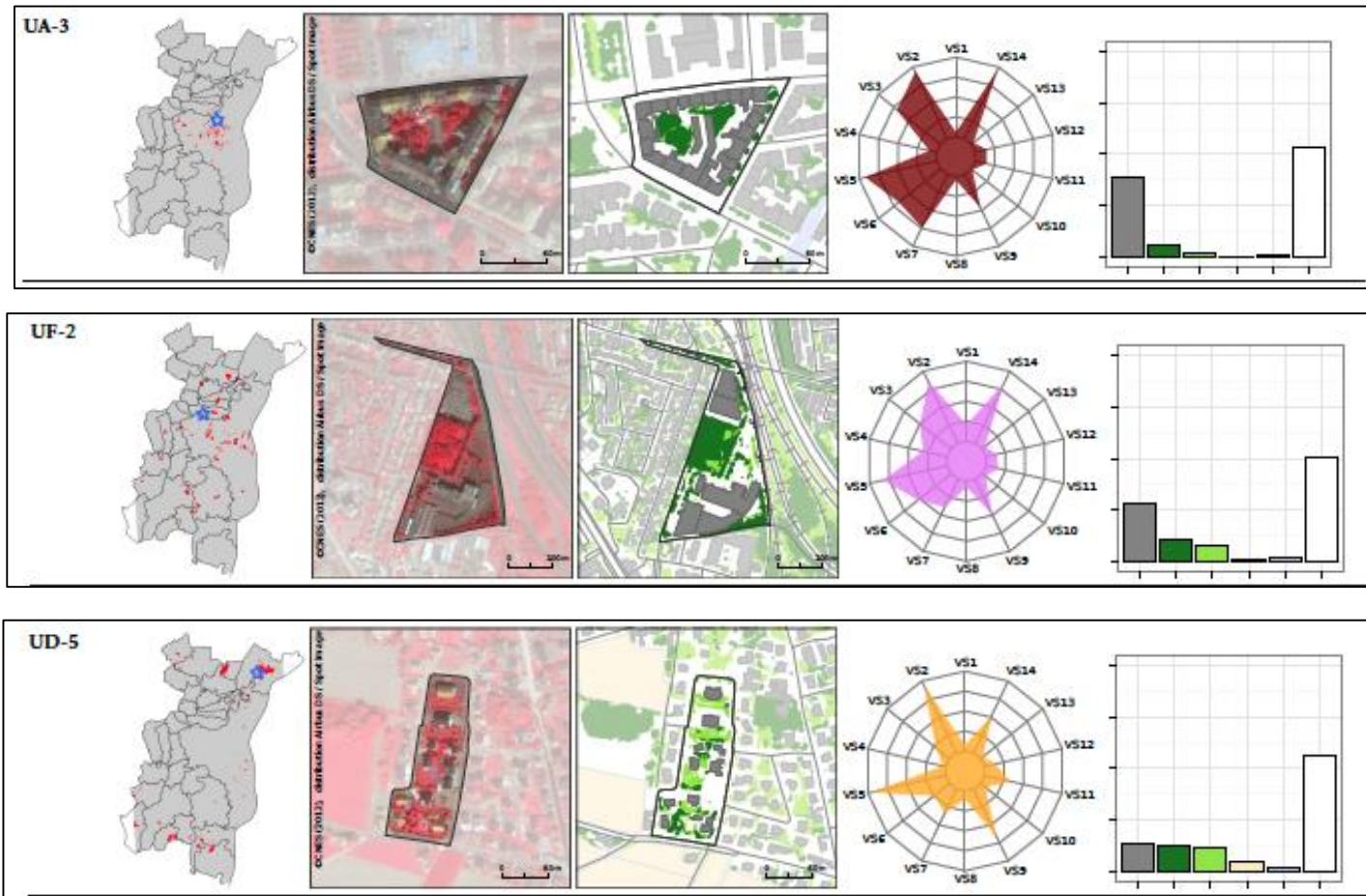
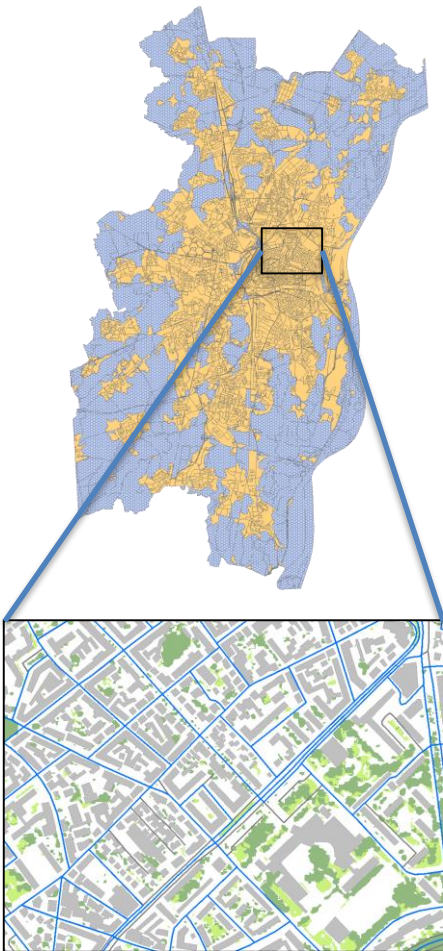


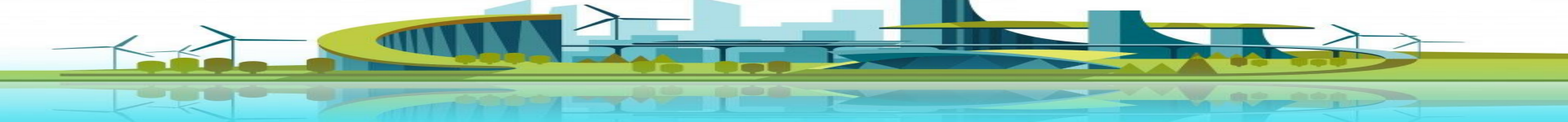
PhD S. Rougier, 2016



(4) Structural and spatial organization of Urban Fabric (UF)

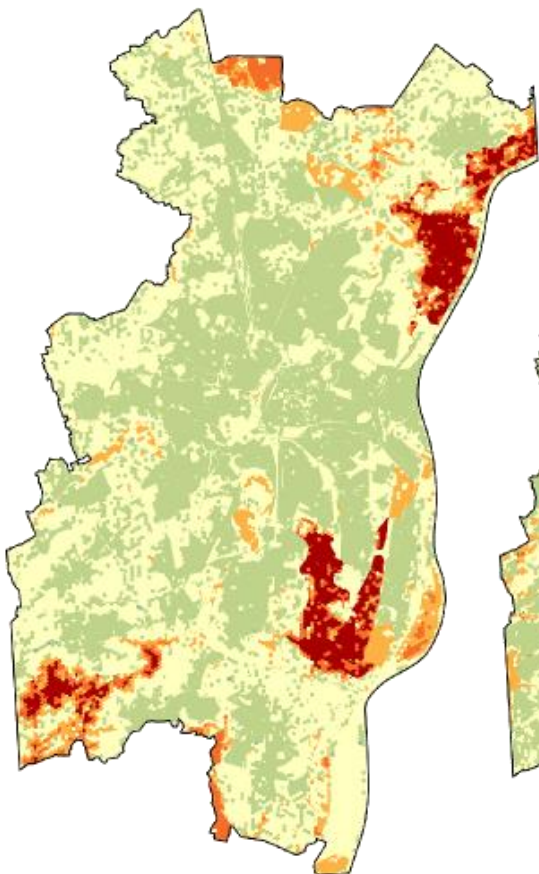
Analysis by urban blocks (delimited by networks) -> *typologies of UF*



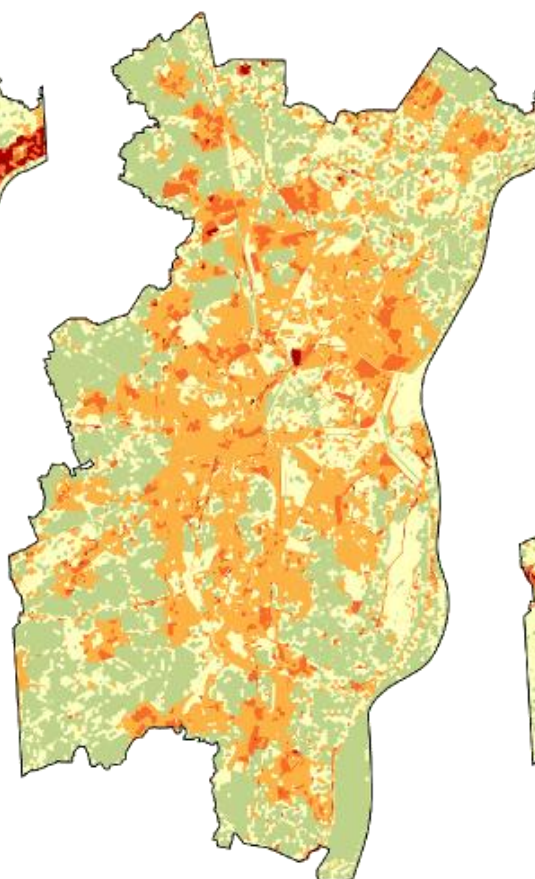


(4) Indicators of urban properties

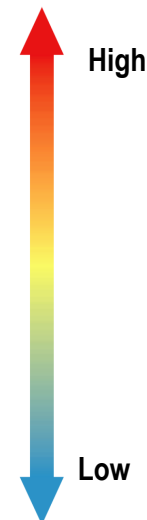
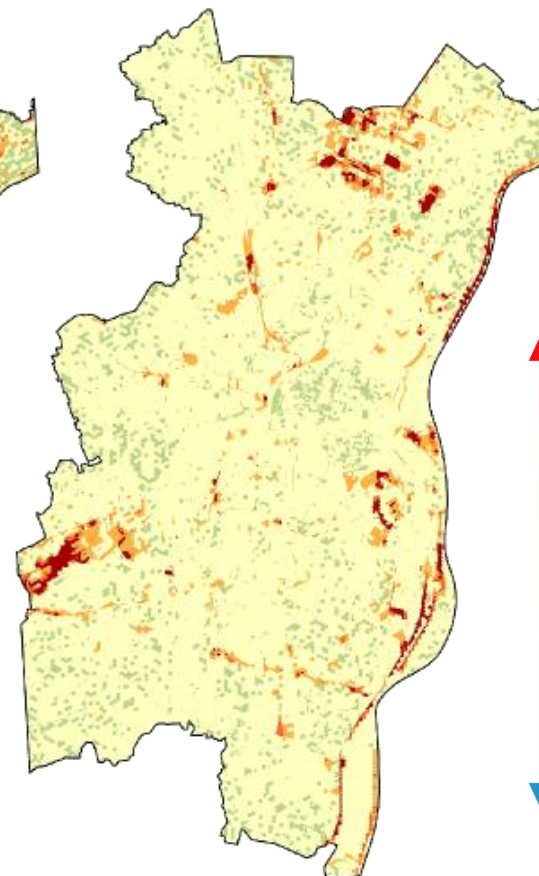
VS8: Area and abundance
of high vegetation (trees)



VS9: Green density



VS10: Area and abundance
of low vegetation (grass)

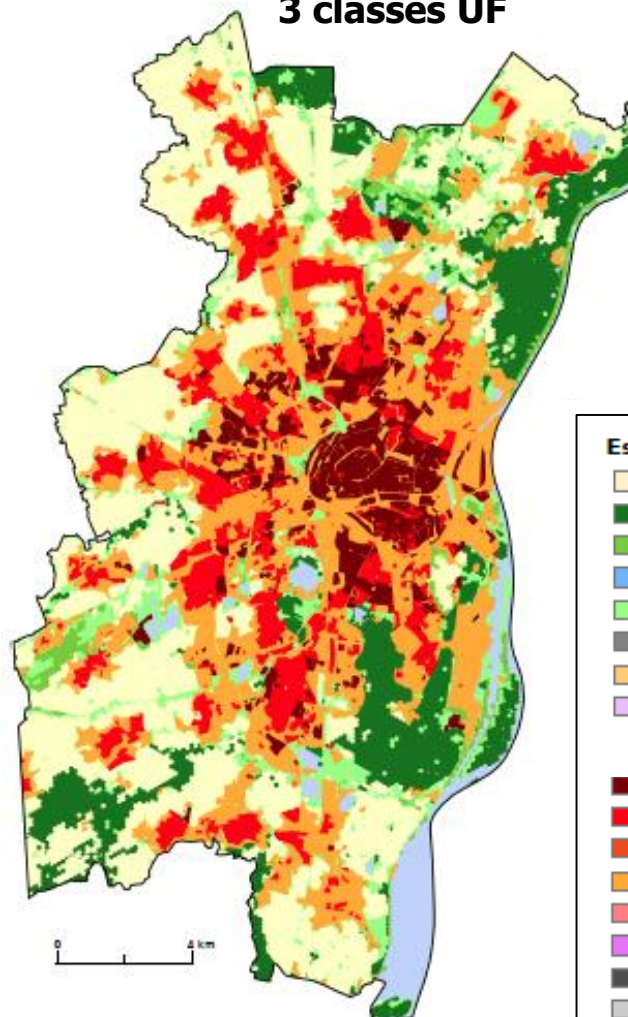


PhD S. Rougier, 2016

-> Possibility to monitor evolution

(4) Classification of urban fabrics (UF)

3 classes UF



Espace non urbain

- NA (surface agricole)
- NB (surface arborée)
- NC (surface herbacée)
- ND (surface en eau)
- NE (forte densité de végétation)

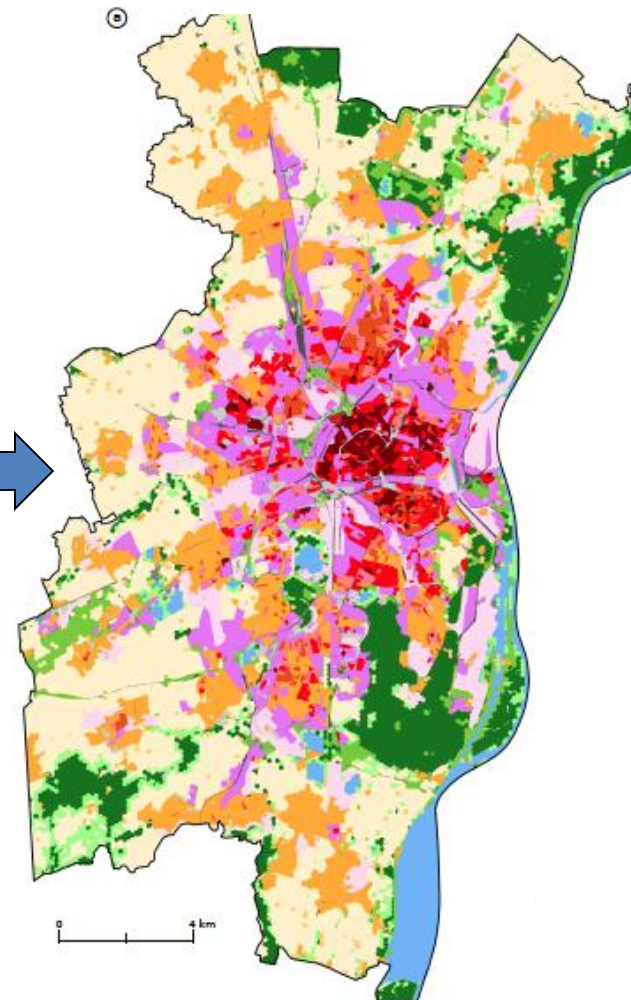
Espace urbain

- UA (urbain très dense)
- UB (urbain dense)
- UC (urbain peu dense)

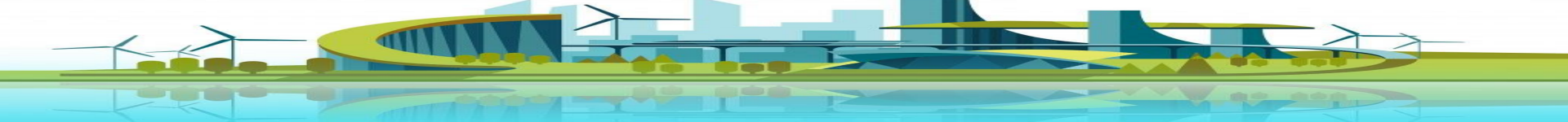
Espace non urbain

- NA (surface agricole)
- NB (surface arborée)
- NC (surface herbacée)
- ND (surface en eau)
- NE (zone lisière)
- NF (emprise réseau routier / ferré)
- NG (bâti isolé)
- NH (zone spécialisée bâtie)
- UA (bâti de type centre ville)
- UB (bâti de type collectif)
- UC (bâti de type centre bourg / individuel dense)
- UD (bâti de type individuel)
- UE (bâti de type mixte individuel / collectif)
- UF (zone spécialisée bâtie)
- UG (emprise réseau routier / ferré / hydrographique)
- UH (espace peu ou pas bâti)
- UI (îlot mixte de très grande dimension)

9 classes UF

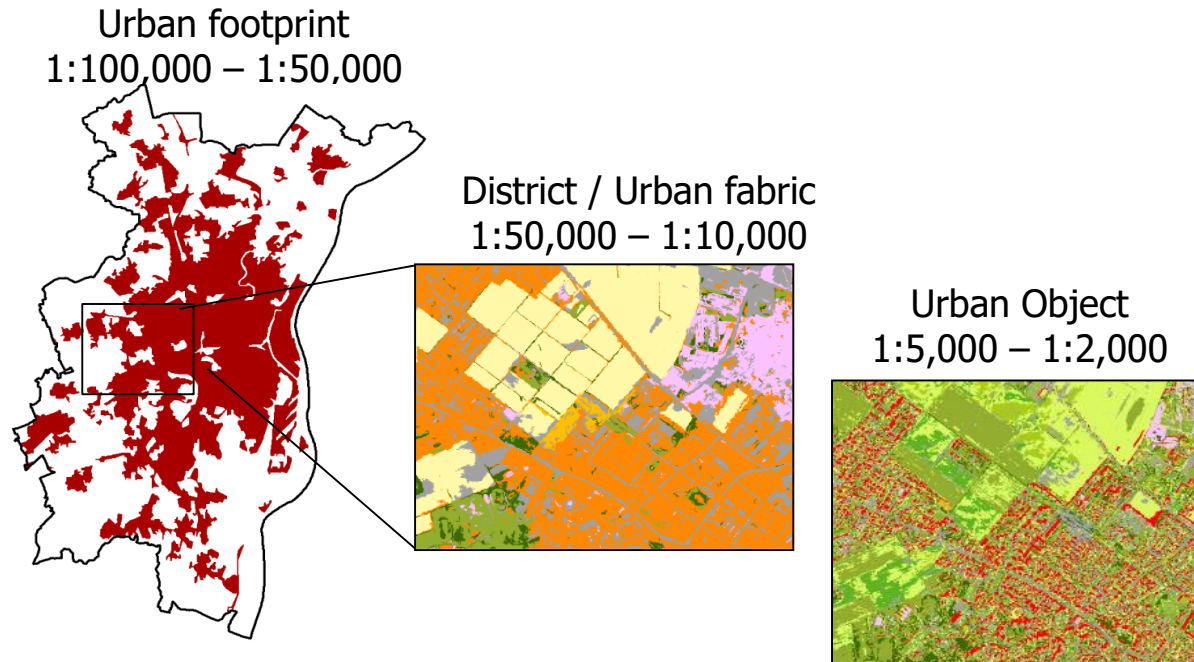


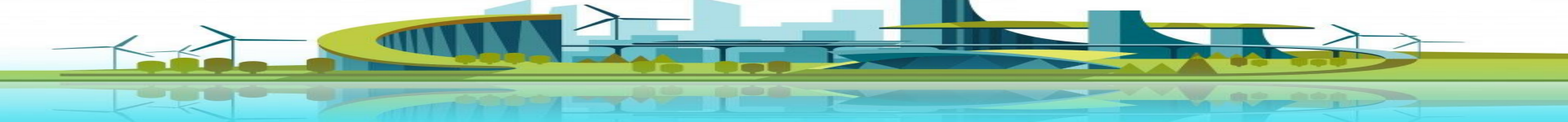
PhD S. Rougier, 2016



Conclusion

- Several urban products can be derived from optical satellite data
 - At several scale, with different levels of complexity,
 - In France, several users are interested (State Authorities, Regions, Municipality, etc)
- **Proposed methods are generic and can be applied to others contexts**





Perspectives

- On-going research developments

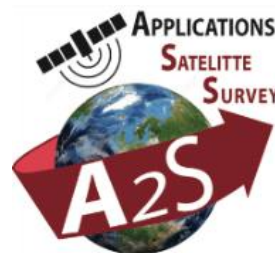
- To combine multi-source data (S1, aerial or terrestrial lidar, Hi-Res DSM from Pléiades imagery)
- To test deep learning and/or transfer learning approaches
- To better exploit the high temporal frequency of S2 imagery -> towards typology of changes

- Transfer of research developments to urban services in relation to users' needs

A2S platform of services (University of Strasbourg) part of THEIA IDS

Focused on the calculation of massive streams of earth observations data

- Research laboratories
- Spatial agencies
- Public or private structures



Contact:
plateforme-a2s@unistra.fr



Thanks for your attention.

