

Starlab Space

# Space Applications in Support of Future urban development in Armenia

Earth Observation Support for  
Asian Development Bank  
Activities

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**Starlab**  
Living Science







## An Overview: Urban growth

- Nearly half of the world's population lives in cities
- As results most urban growth falls outside formal planning controls and many cities suffer poor urban services management, traffic, and congestion, loss of green areas, poor air quality, and noise.

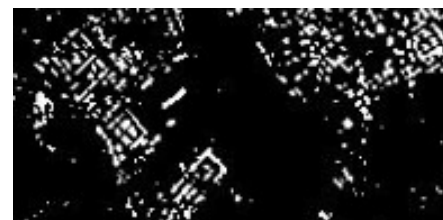
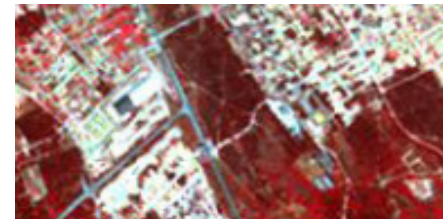
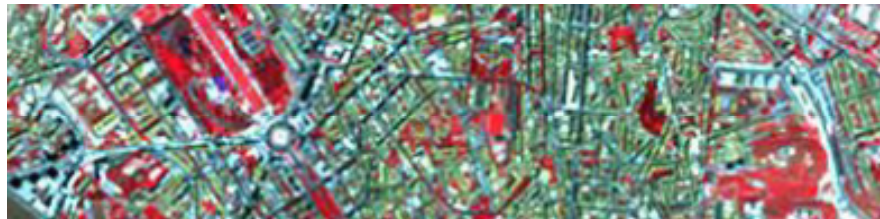






## An Overview: Earth Observation

EO products can be used to help local authorities in development assessing the future growth of urban areas in order to manage their geo-information needs.







## Secondary cities urban development in Armenia

The pilot presented here is a demonstration in the framework of the collaboration between **ESA** and **ADB**, called **EOTAP** “*Earth Observation for a Transforming Asia Pacific*” with aim to:

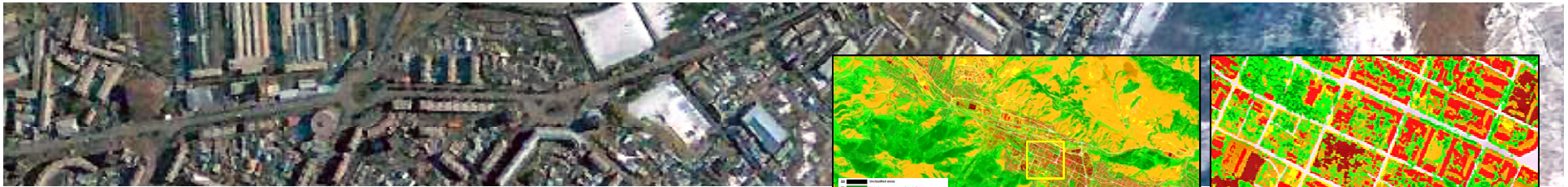
- Exploit satellite Earth observation data for sustainable growth;
- prepare a series of city development and investment plans.

These plans, spanning a 10-year period in order to improve the urban sector in *Gyumri*, *Vanadzor*, *Dilijan* and *Jermuk* .



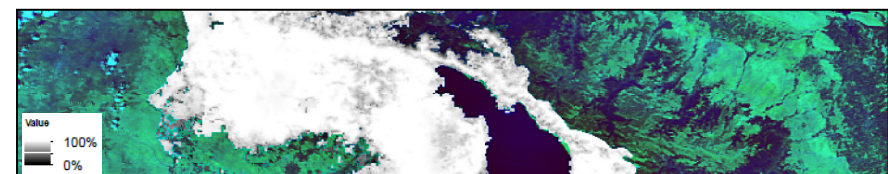
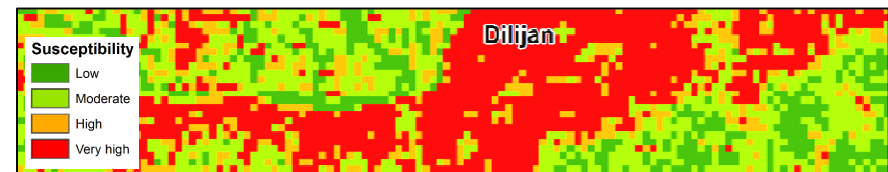
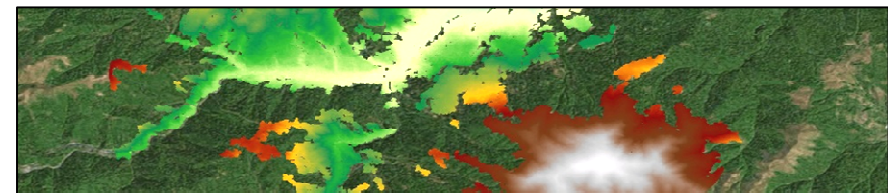
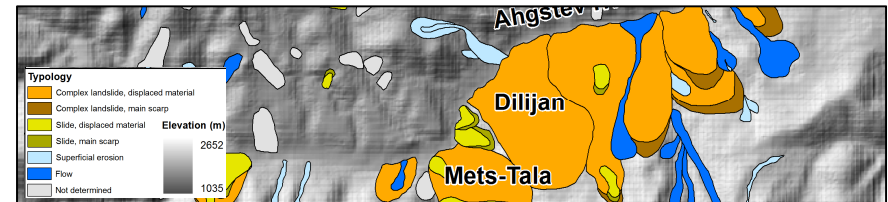
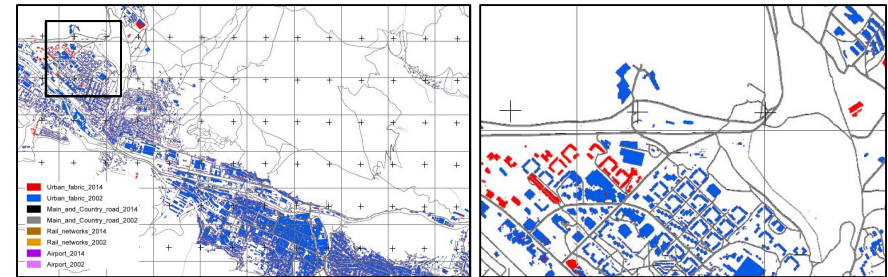
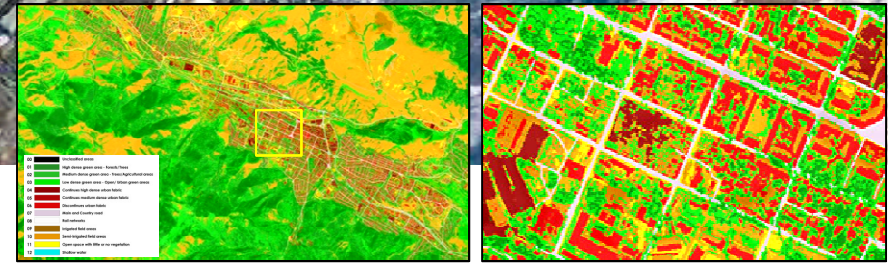
- **Gyumri** (approx. 220 km<sup>2</sup>), the second-largest city in Armenia.
- **Vanadzor** (approx. 230 km<sup>2</sup>), the third-largest city in Armenia.
- **Dilijan** (approx. 110 km<sup>2</sup>), the spa town in the Tavush Province. It is one of the most important resorts of Armenia.
- **Jermuk** (approx. 60 km<sup>2</sup>), a mountain spa town in the southern Armenian province of Vayots Dzor.





## Objectives

- Generate **baseline urban classification and change maps**, with a high spatial resolution
- Produce a **Landslide inventory map**,
- Extract a **Digital Elevation Model (DEM)** of the area of study;
- Provide a **Landslide susceptibility map** estimating risk for important individual urban infrastructure elements;
- Create maps of **snow coverage** over the area surrounding the city of Jermuk.

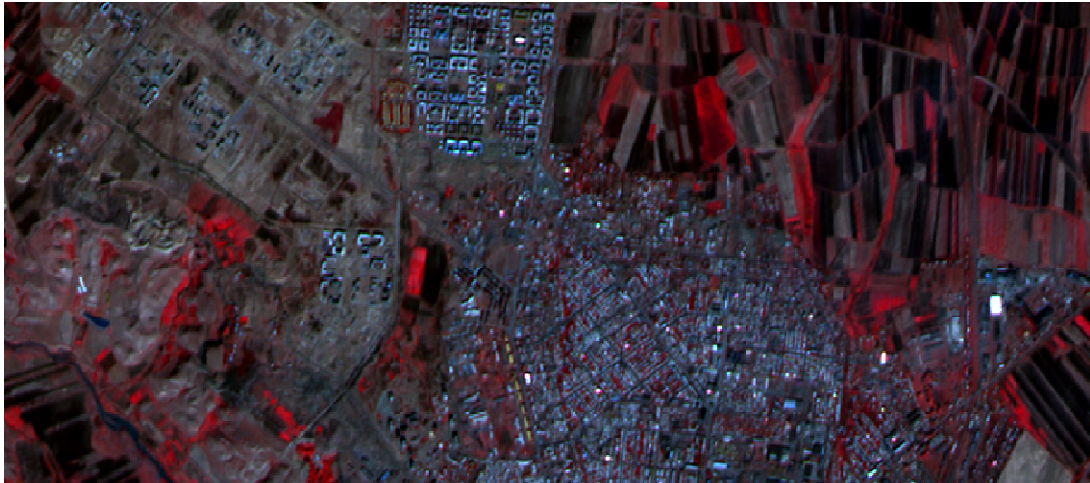






# Earth Observation Data

| EO data                            |                |  |
|------------------------------------|----------------|--|
| Service                            | Sensor         | Resolution                               |
| Baseline urban classification maps | Pléiades ORTHO | Bundle: 50 cm PAN & 2 m MS (Pan-sharpen) |
| Urban land use change              | Spot 4&5 ORTHO | Bundle: 5&10 m PAN and MS (Pan-sharpen)  |







## Baseline urban classification maps

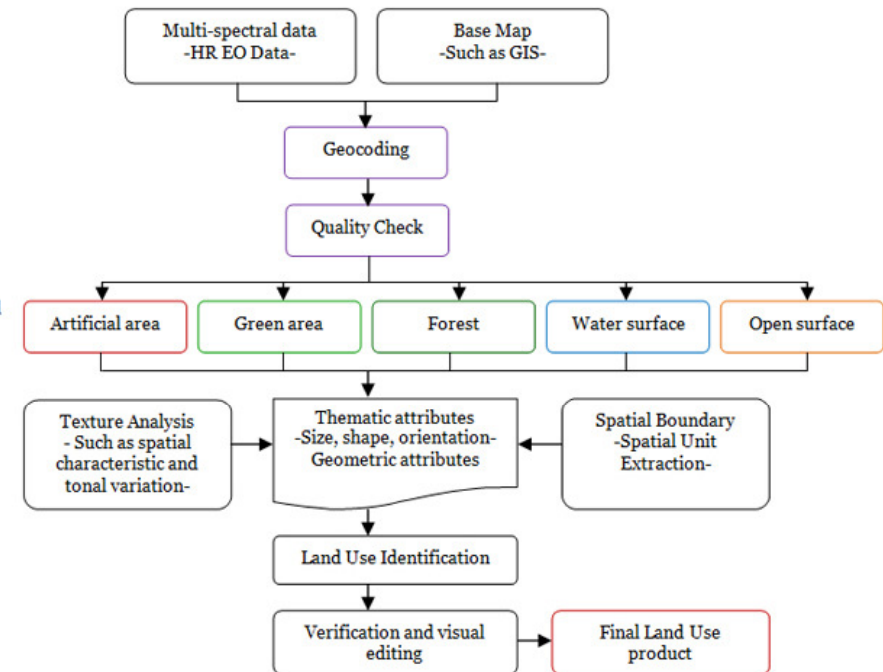
The broadest level of categorization:

- **(Level I):** Urban, agricultural, forest, water, wetlands, etc. For urban land, the second level of categorization;
- **(Level II):** residential, commercial and industrial.

Image Object:  
Pixel level

Image Object: Land  
Cover level

Image Object:  
Land Use level

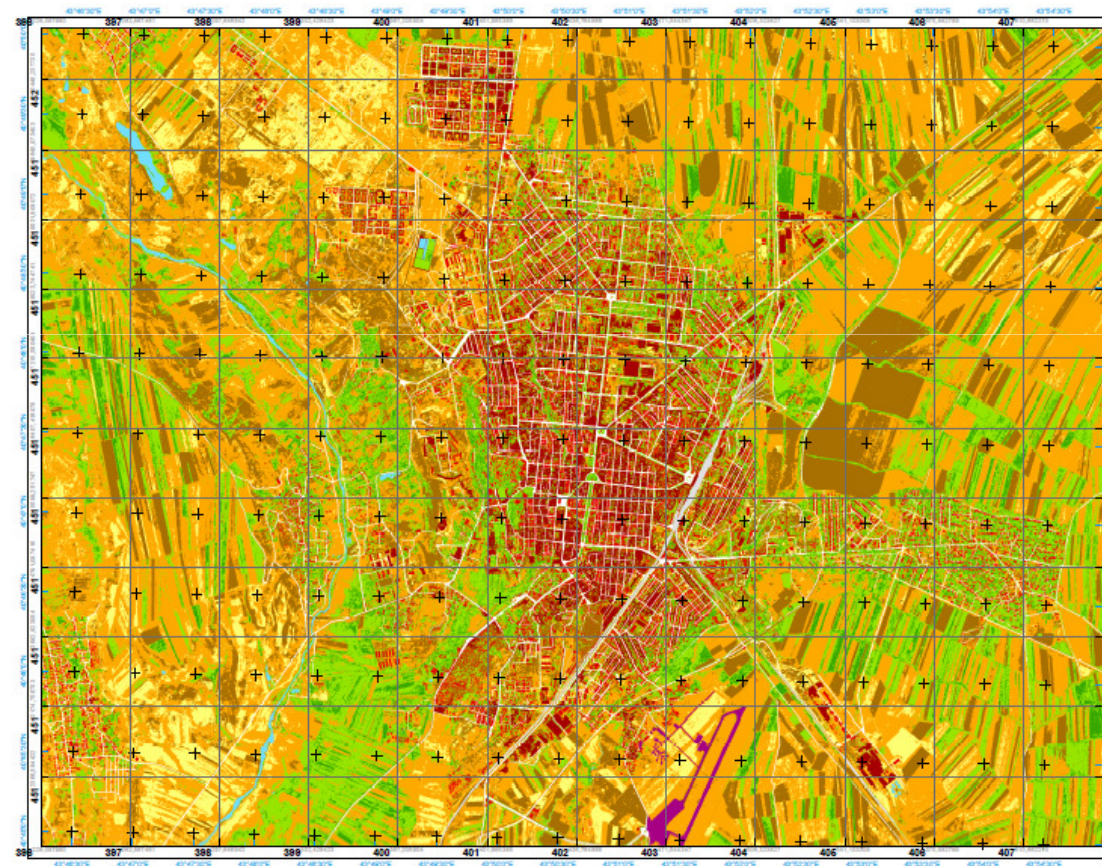


|    |  |
|----|--|
| 00 | Unclassified areas                                 |
| 01 | Medium dense green area - Trees/Agricultural areas |
| 02 | Low dense green area - Open/ Urban green areas     |
| 03 | Continues high dense urban fabric                  |
| 04 | Continues medium dense urban fabric                |
| 05 | Discontinues urban fabric                          |
| 06 | Airport  |
| 07 | Main and Country road                              |
| 08 | Rail networks                                      |
| 09 | Irrigated field areas                              |
| 10 | Semi-Irrigated field areas                         |
| 11 | Open space with little or no vegetation            |
| 12 | Shallow water                                      |





# Baseline urban classification maps



**Gyumri city and surroundings, Armenia**  
Baseline urban classifications map

Coordinate System: UTM Zone 38N  
Projection: Transverse Mercator  
Datum: WGS 1984  
False Easting: 500,000,000  
False Northing: 0,000  
Central Meridian: 45,0000  
Scale Factor: 0,9996  
Latitude of Origin: 0,0000  
Units: Meter

Printed on 21/04/2015

1:40,000  
1 cm = 400 m

0 0,25 0,5 1 1,5 2 km



EOTAP project:  
**Earth Observation Support for Asian Development Bank Activities**  
**"Secondary cities urban development in Armenia- SCUDA"**  
Contractors: Contractors: Starlab Limited (UK) and Tele-Riservanto Europa - T.R.E (Italy).

Interpretation: The Baseline Urban Classifications (BUC) provides maps and data of urban land use such as artificial surfaces, non-artificial surfaces and other natural and semi-natural areas. The broadest level of categorization (Level I) distinguishes among broad land-cover type: Urban, agricultural, forest, water, wetlands, etc. For urban land, the second level of categorization (Level II) distinguishes among thematically detailed land uses: Urban fabric occupation and densities.

Image data: Pliades Image (2014), Pan-sharpened (PMS), 50cm (colour merged)  
> Pan-sharpened: 4 bands (B, G, R, NIR).

Vector data: Administrative boundaries © GADM (2011), OSB (2011).

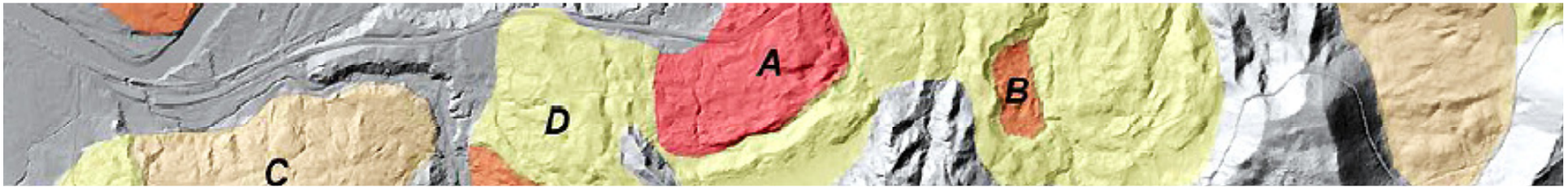
Base map: SRTM DEM © NASA (2004).

- Medium dense green area - Trees/Agricultural areas
- Low dense green area - Open/ Urban green areas
- Continuous high dense urban fabric
- Continuous medium dense urban fabric
- Discontinuous urban fabric
- Airport
- Main and Country road
- Rail networks
- Irrigated field areas
- Semi-irrigated field areas
- Open space with little or no vegetation
- Shallow water

EOTAP is a set of twelve projects with the purpose to produce, deliver and assess the benefits of information services based on Earth Observation (EO), in support of ongoing Asian Development Bank (ADB) projects. This work is part of the European Space Agency's efforts to raise awareness within International Financial Institutions and Multilateral Development Banks of the capabilities of EO to provide information customised to the needs of individual bank projects, with emphasis on using data from European and Canadian EO satellite missions.





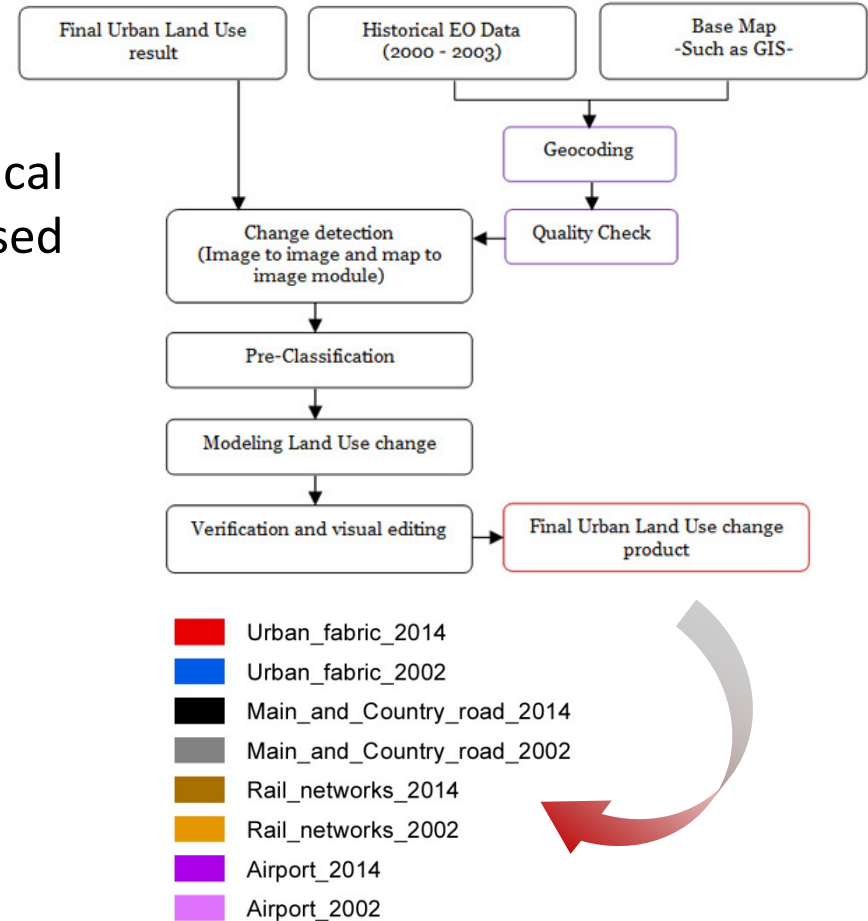


## Urban Land use change maps

- Population data, timelines of historical events, and related information are all used to explain the mapped changes.



Growth of Las Vegas 1973 to 2007

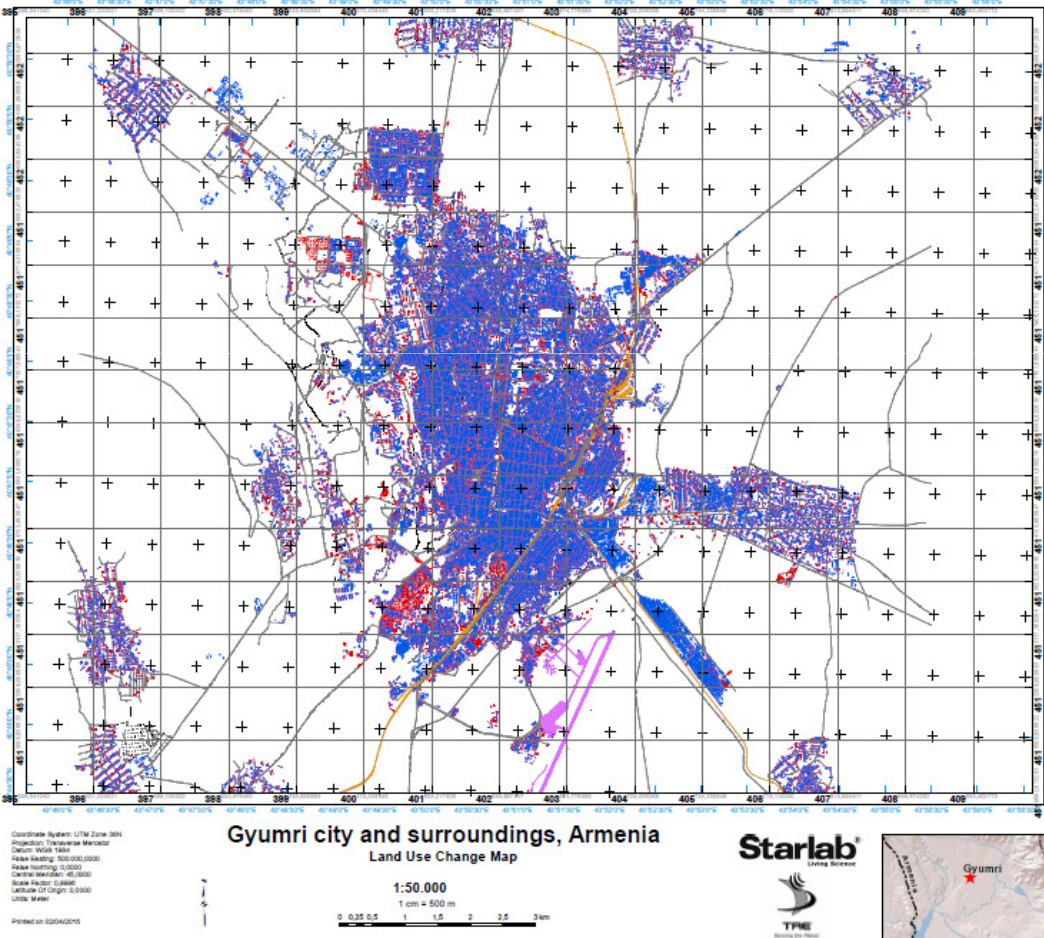
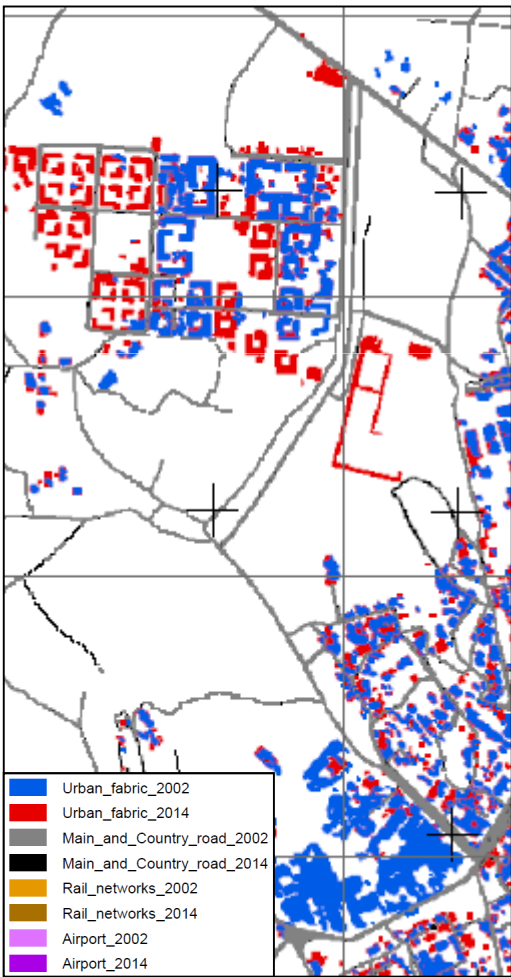


- Land use change model. Changes within urban land use, historical land use patterns, present urban extent, major transportation routes, topography, and protected lands.





# Urban Land use change maps



EOTAP project:  
**Earth Observation Support for Asian Development Bank Activities**  
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Contractor(s): Contractors: Starlab Limited (UK) and Tele-Terraviva Europa - T.T.E (Italy).

Interpretation: The Land use evolution or Land use change (LUC) requires understanding a region's urban land use history, timelines of historical events, and related information are all used to explain the mapped changes. Based on Baseline Urban Classifications (BUC, 2014), historical land use patterns (2002) and major transportation routes change detection approach detect the change occur on the BUC classes

Image data:  
Pleiades Image (2014), Pansharpened (PMS), 50cm (colour merged);  
> Pansharpened 4 bands (B, G, R, NIR)

Spot5 Image (2002), Pansharpened (PMS), 5m (colour merged);  
> Pansharpened 4 bands (B, G, R, NIR)

Vector data: Administrative boundaries © GADM (2011), OSM (2011)  
Base map: SRTM DEM © NASA (2004)

- Blue: Urban\_fabric\_2002
- Red: Urban\_fabric\_2014
- Grey: Main\_and\_Country\_road\_2002
- Black: Main\_and\_Country\_road\_2014
- Yellow: Rail\_networks\_2002
- Brown: Rail\_networks\_2014
- Purple: Airport\_2002
- Pink: Airport\_2014

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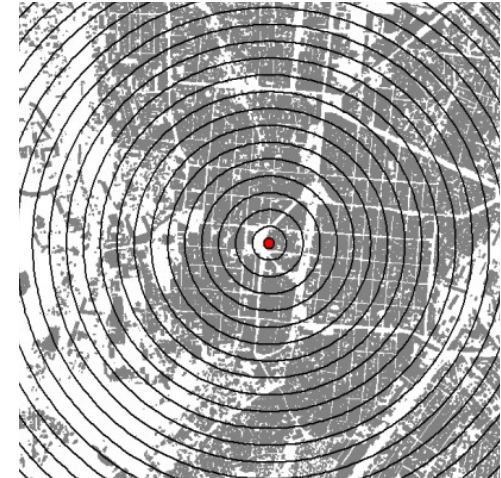




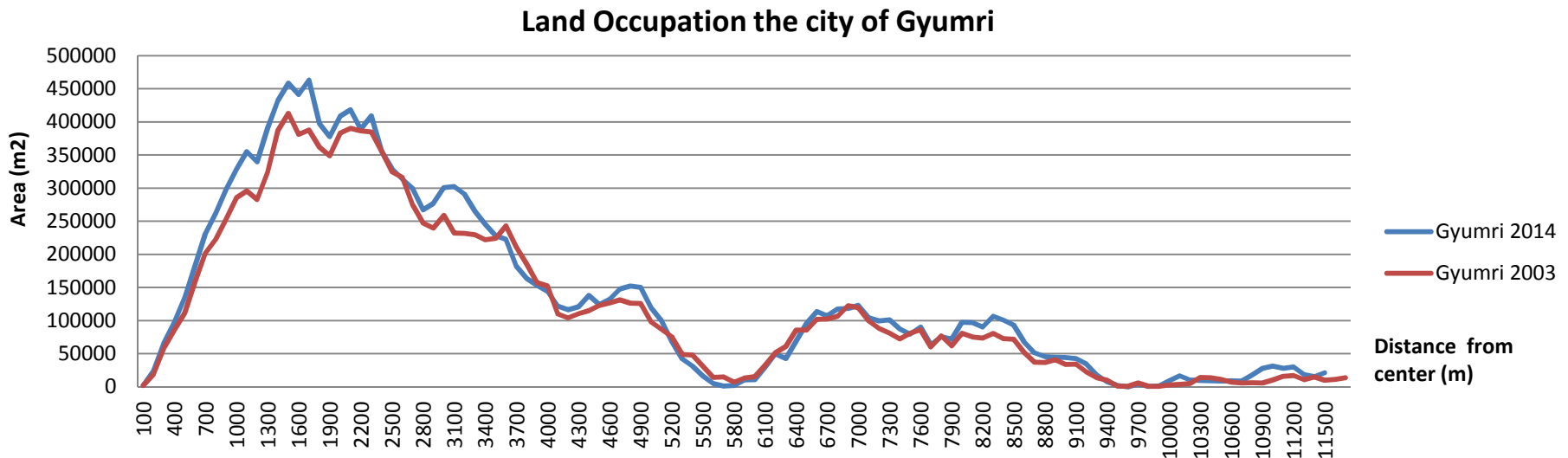
## Urban Land use change maps

Land Occupation Change, 2003 - 2014

Monitoring land occupation change in order to estimate the future changes of the cities, helping decision-makers to take the appropriate decisions for the future development.



- The geometric city centre has been estimated by calculating the urban geometric weight.
- Land occupation calculated by grouping the patches of the built up areas between buffers of 100 meters



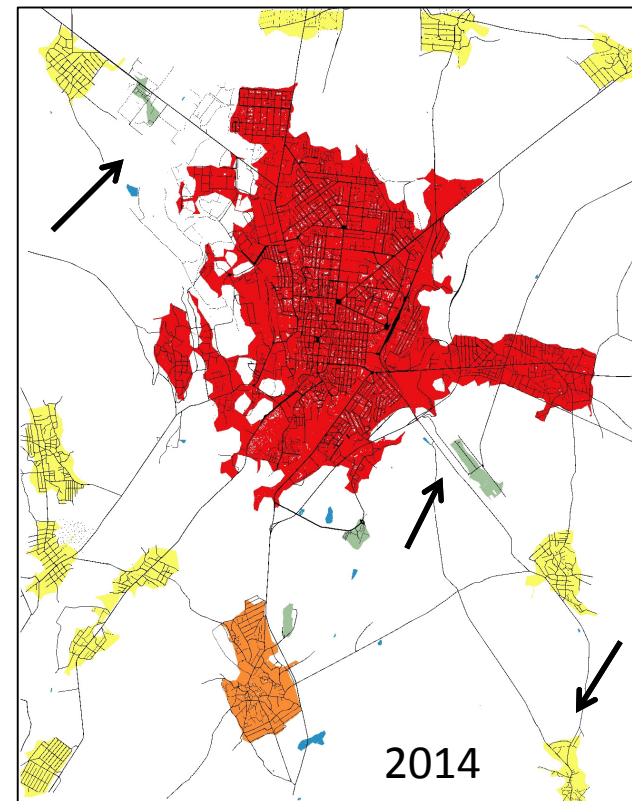
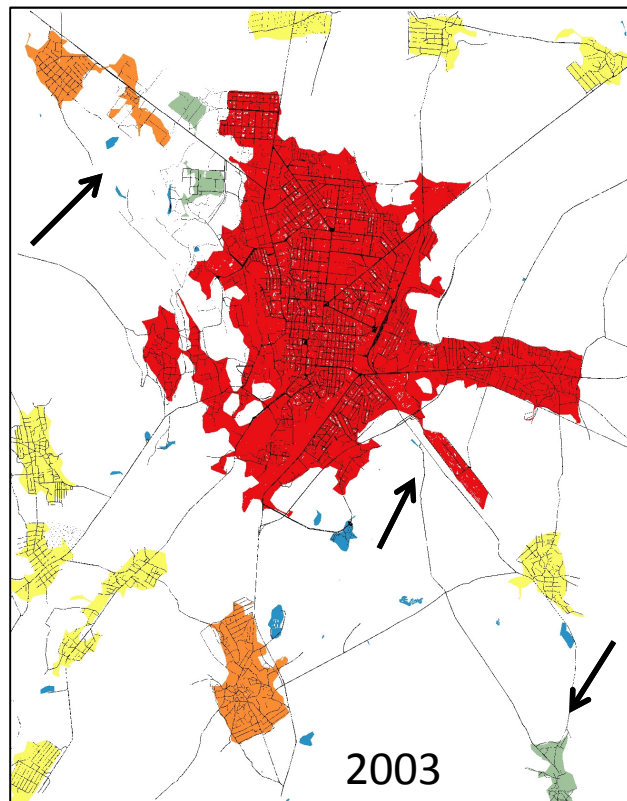




## Urban Land use change maps

↳ Change in the Continuity and Discontinuity

The aim is to measure the degree of physical continuity of urban settlements by grouping the patches of the built up areas in a distance of 200 meters

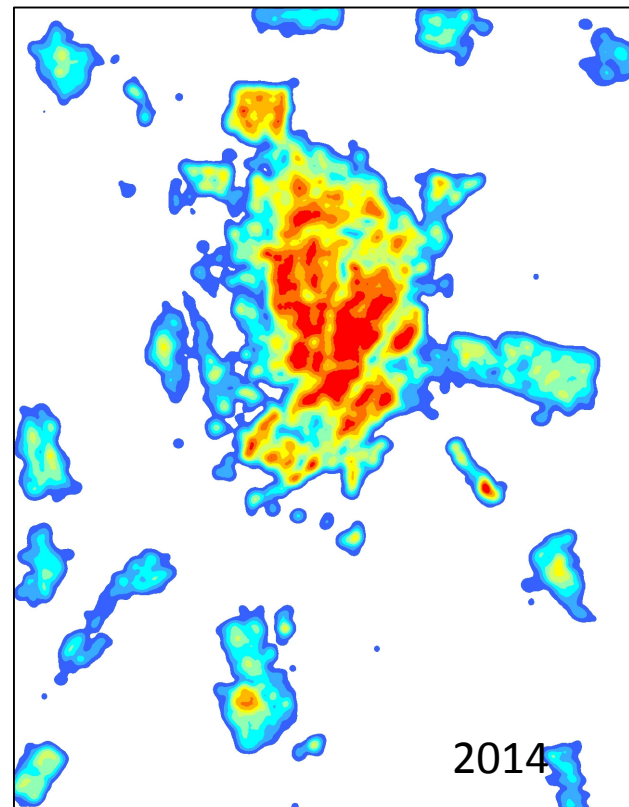
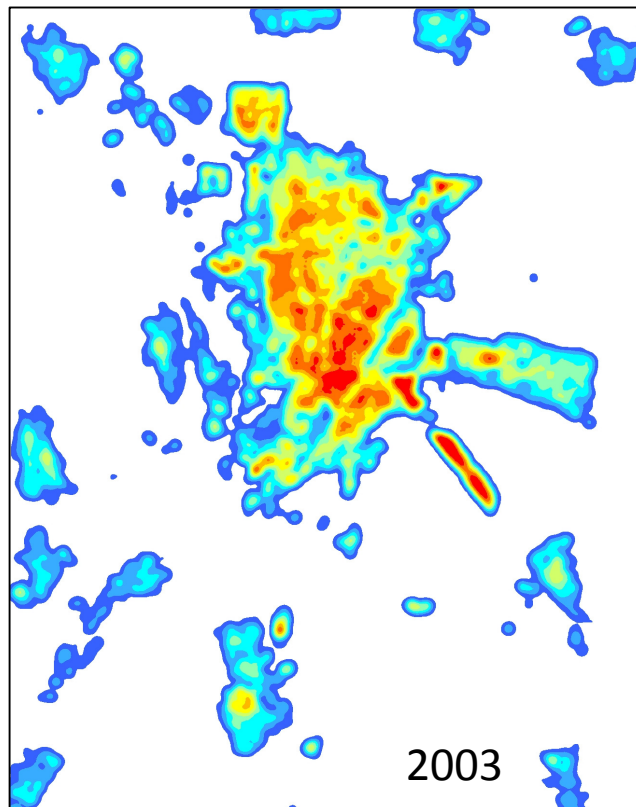




## Urban Land use change maps

↳ Monitoring Entropy in Urban Sprawl

Entropy is a useful concept that has been used to describe the structure and behavior of different urban systems.



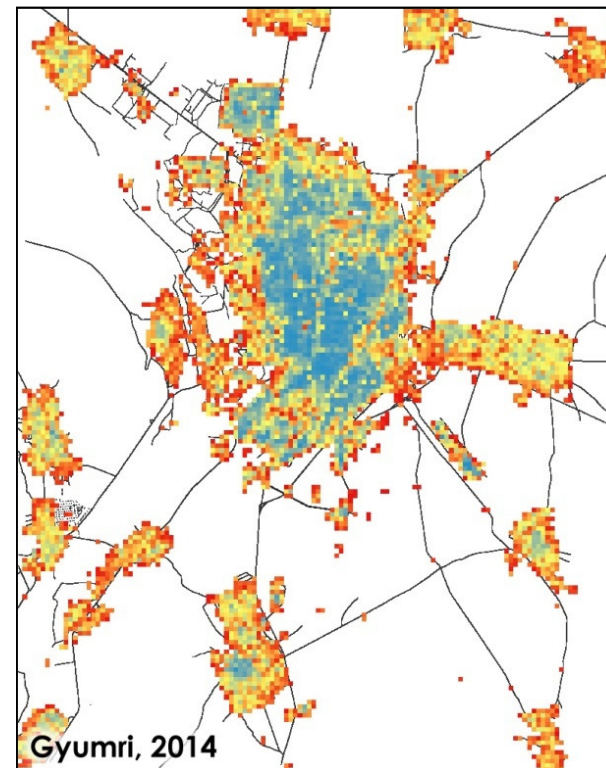
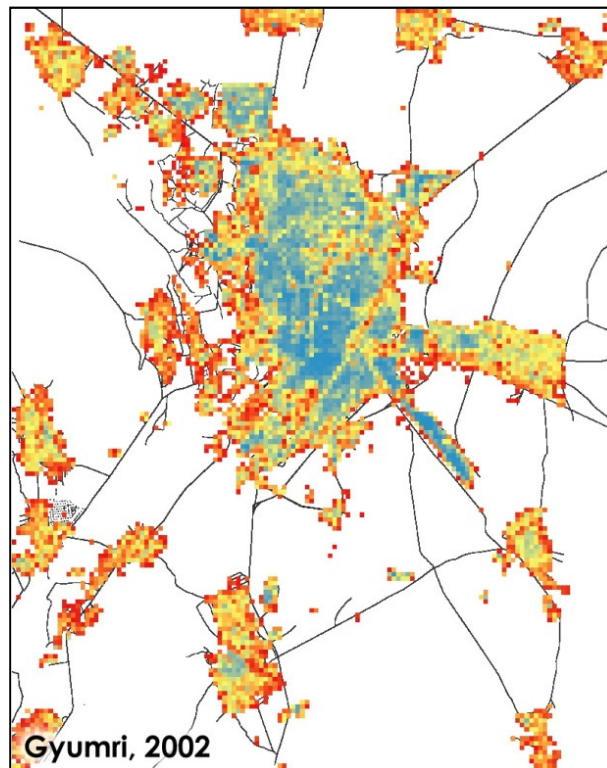




## Urban Land use change maps

### Monitoring Entropy in Urban Sprawl

The spatial distribution of the entropy shows how there is a greater fragmentation of urbanization in the periphery (**red** colour) while in urban centres and rural areas (**blue** colour) is lower.

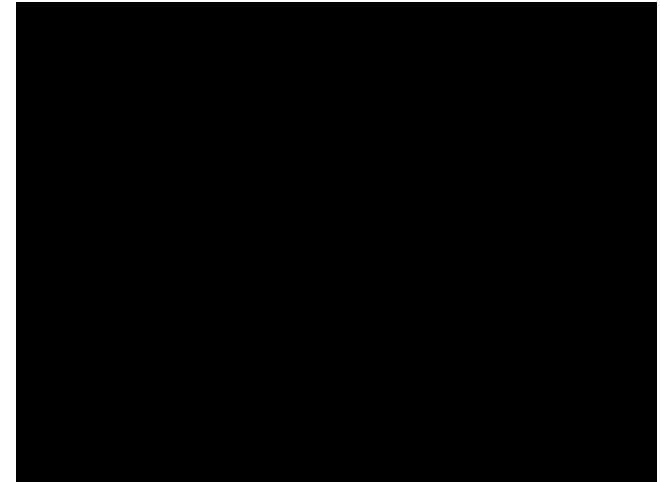




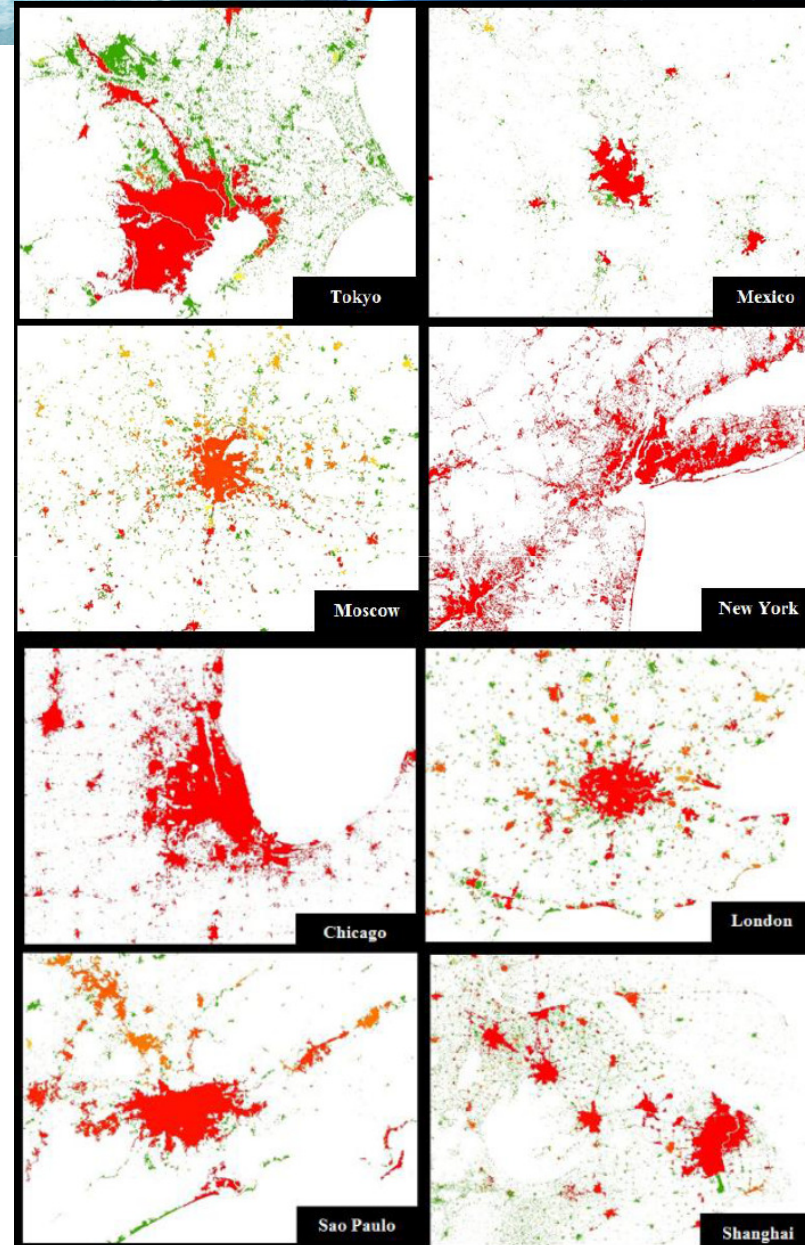
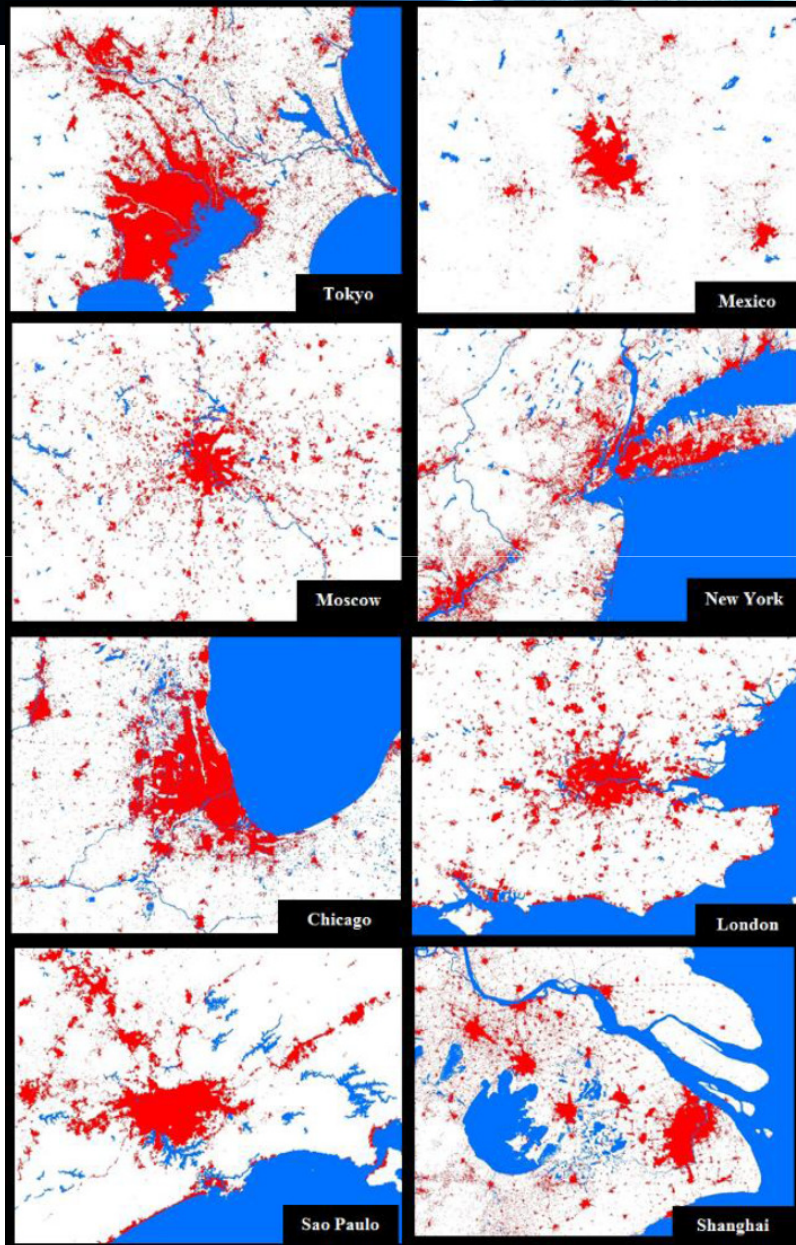
## Conclusions: do space applications and urban development have a common future?

- What defines the city?
- How is the city arranged spatially?
- How dynamic is the urban environment changing over time?
- Where are traffic hot spots?
- Where are climatologically and socially the best neighbourhoods?
- How many people live there? etc.

Space applications has the unique capability to support of future urban development , from **the extraction of urban morphology to the detection of urban growth, surface temperatures, to monitoring of traffic or assessment of population.**









**Thanks for your attention**

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