What can Earth Observation provide for Urban Applications?

Amelie Broszeit, GAF AG
What can Earth Observation provide for Urban Applications?

1) EO products for Urban Development
2) EO based Solutions for Urban Planning
3) EO products and application fields
4) Value of EO products
EO Products for Urban Development

Satellite Data: HR, VHR

Preprocessing:
- Geometric Validation
- Atmosphere Correction
- Cloud Masking
- ...

Ancillary Data:
- OSM Data
- User Data

Semi-Automatic/Automatic Classification

Transport Network

Land Use / Land Cover

With VHR Data:
- Up to 30 classes
- Accuracy > 85%
- MMU = 0.25 ha

With HR Data:
- Up to 10 classes
- Accuracy > 85%
- MMU = 0.5 to 1 ha

Urban Extent, Imperviousness and Change
Building Footprint and Heights
Elevation Models
Landslide Risk
Flood Risk
Terrain Motion
Urban Green Areas
Informal Settlements
Population Distribution

Advanced Spatial Analytics
Indicators of Sustainable Development Goal 11, Urban Planning Metrics
EO Based Solutions for Urban Planning

- Analysis of the effectiveness of Urban Master Plans
- Urban Growth Analyses

- Infrastructure Planning (e.g. Road Network Analysis, Accessibility Analysis)

- Assessment and monitoring of slums areas and informal settlements (e.g. EO-Monitoring of unplanned urban sprawl)
EO Based Solutions for Urban Planning

- Urban green areas planning
- Population distribution and density estimations
- Building heights data for tax estimation
- Risk / Disaster assessment
e.g. Flood risk, land subsidence monitoring
- Monitoring of urban indicators
e.g. SDG Goal 11 indicators
Urban Growth Analysis
Abidjan, Ivory Coast
Urban Growth Analysis
Abidjan, Ivory Coast
1985
Urban Growth Analysis
Abidjan, Ivory Coast
1990
Urban Growth Analysis
Abidjan, Ivory Coast
1995
Urban Growth Analysis
Abidjan, Ivory Coast
2000
Urban Growth Analysis
Abidjan, Ivory Coast

2010
Urban Growth Analysis
Abidjan, Ivory Coast
2015
Urban Growth Analysis
Abidjan, Ivory Coast
Urban Growth Analysis
Dar Es Salaam, Tanzania
Urban Planning
Land Use / Land Cover Maps of Tanzanian Cities

Mwanza
Kigoma
Dodoma
Arusha
Tanga
Mbeya
Mtwarra
Urban Planning
Arusha – Tanzania: Land Use/Land Cover 2015

Legend

- Agricultural Area
- Airport
- Arterial Line
- Bare Soil
- Cemeteries
- Collector Line
- Commercial Area,
- Construction Site
- Forest and Shrublands
- Government
- Hospitals
- Industrial Area
- Land Without Current Use
- Military
- Mining/Quarry Areas/DumpSites
- Natural areas (non-forested)
- Public Buildings
- Railway
- Recreation Facilities
- Residential, 0 - 10% Sealed
- Residential, 10 - 30% Sealed
- Residential, 30 - 50% Sealed
- Residential, 50 - 80% Sealed
- Residential, 80 - 100% Sealed
- Schools
- University
- Urban Parks
- Water
- Wetlands

Subset

Image Data: Worldview 2 © Digital Globe, Inc. (2016),
(acquired on 17/09/2016, GSD 0.5 m);
Band combination: Natural, Color 3, 2, 1 (Red, Green, Blue)
Urban Planning
Spatial Analytics for Urban Planning

Urban Size and Expansion
Understand and visualise different patterns of urban footprint growth including a visualisation of edge, infill and leapfrog developments. Statistical evaluation that quantifies the relative importance of each of the two categories, in terms of area increase.

Results:

Pronounced Scattering in North-East

Leapfrog Islands

Linear Development along major roads

Leapfrog Islands

\[\begin{array}{c}
\text{Edge and Infill Growth Rate} \\
\text{Leapfrog Growth Rate} \\
\text{Combined Growth Rate}
\end{array}\]

\[\begin{array}{c}
42.2\% \\
35.3\% \\
34.1\%
\end{array}\]

\[\begin{array}{c}
35.0\% \\
28.7\% \\
29.6\%
\end{array}\]

\[\begin{array}{c}
7.2\% \\
6.5\% \\
4.5\%
\end{array}\]

\[\begin{array}{c}
2000-2005 \\
2005-2010 \\
2010-2015
\end{array}\]
Improvement for Master Plans and NUPS:

- EO4SD-Urban provided additional LU / LC classes, improved overall accuracy and higher granularity over existing Master Plans.
- Additionally the geo-spatial data provided a major input for urban growth analytics.
Infrastructure Planning

2006

2016

Change Layer 2006 - 2016

Arterial Roads
Collector Roads
Local Roads
Changes between 2006 and 2016

Arterial Roads
Collector Roads
Local Roads
Changes between 2006 and 2016

MAPTHREE.
Open Source Map
and the GAF AG community

EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT
Urban development
Risk and Disaster Assessment
Indonesia: City of Semarang – Terrain and Infrastructure Motion
Saint-Louis
Senegal

Risk and Disaster Assessment
Senegal: Saint-Louis – Flood Risk Assessment
3 Main Flood Scenarios:
• Fluvial floods of Senegal river after heavy rainfall in the upper part of the catchment area (typically August – November)
• Local floods from direct heavy rainfall – often connected to blocked drainage systems
• Coastal floods (tidal waves, coastal erosion)
Risk and Disaster Assessment
Senegal: Saint-Louis – Flood Risk Assessment

Opening of the Longue de Barbarie (2003)

2003
Opening of the Longue de Barbarie (2003)
Opening of the Longue de Barbarie (2003)

2006
Opening of the Longue de Barbarie (2003)
Opening of the Longue de Barbarie (2003)

2010
Risk and Disaster Assessment
Senegal: Saint-Louis – Flood Risk Assessment

Opening of the Longue de Barbarie (2003)

2013
Opening of the Longue de Barbarie (2003)

2014
Opening of the Longue de Barbarie (2003)
Risk and Disaster Assessment
Senegal: Saint-Louis – Flood Risk Assessment
Risk and Disaster Assessment
Peru: City of Lima – Flood Risk Assessment
Building Footprints and Heights
Abidjan, Ivory Coast
Building Footprints and Heights (Beijing)

Tri-Stereo DSM Beijing, China © 2017, GAF AG, © CNES (2017) Distribution AIRBUS DS visualized in GAFmap
Value of the EO Products

EO-products are based on:

- Verified user requirements
- Harmonised and standardised state-of-the-art methodologies
- Comprehensive and transparent documentation
- Application of statistically sound accuracy assessment
- Stringent Quality Control to ensure:
  - transparency
  - repeatability
  - completeness
  - validity
- User feedback needed (and some already given) to improve the services
Thank you for your attention!

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