MAPPING AND MODELLING URBAN PATTERNS IN SUB-SAHARAN AFRICA THROUGH REMOTE SENSING AND DATA FUSION

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RESEARCH PROGRAMME FOR EARTH OBSERVATION “STEREO III”
Urban pop. growth is fast in Africa

Data source: United Nations, 2014
Population distribution in Africa in 2010

Limitation:
Low intra-urban variations in densities

Low intra-urban variations in population densities

GRUMP  

LandScan  

WorldPop

Ouagadougou, Burkina Faso
How can intra-urban predictions of population densities be improved using remote sensing and data fusion?
Urban mapping in Africa

- **Challenges**
  - Heterogeneity of the build-up structures, and corresponding human population density
  - Similarity between the man-made materials and the natural environment
  - Lack of good quality training datasets

- **Objectives**
  - Data fusion methods used to overcome some of the issues
  - Produce and test a built-up density layer for population mapping
Built-up probability for the period 1994-2015 using HR SAR data

Ouagadougou, Burkina Faso
Built-up density map of Ouagadougou

- Fusion of optical and SAR data
- OSM data used as training data

Forget et al. forthcoming
Built-up density vs. population density
Morphological zones in Ouagadougou

- Small high-density buildings
- Medium-size high-density buildings
- No building
- Large low-density buildings
- Small low-density buildings

Grippa et al. forthcoming
Population density model without built-up density

Small high-density buildings

No building

Medium-size high-density buildings

Variable importance

% increase MSE

- roa_dst
- lan_dst:BLT
- lan_dst011
- lig
- pla_dst
- wat_dst
- pro_dst
- pop_dst
- bui_dst
- lan_cls011
- lan_dst:130
- wr dst
- poi_dst
- elo_slope
- roa_cls
- lan_dst:040

61 - 70
> 70
Roads as main predictor

Small high-density buildings

No building

Large low-density buildings

Medium-size high-density buildings

Small low-density buildings
Population density model without built-up density

- Small high-density buildings
- No building
- Medium-size high-density buildings
- Large low-density buildings
- Small low-density buildings

Population density (people/ha):
- < 10
- 10 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 61 - 70
- > 70
Population density model with built-up density

Small high-density buildings

No building

Medium-size high-density buildings

Variable importance

% increase MSE

Population density (people/ha)

- < 10
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- > 70
The complementarity of VHR SAR and optical data

RF optical classification

- Buildings
- Swimming pools
- Asphalt surfaces
- Brown/red bare soil
- White/grey bare soil
- Trees
- Mixed bare soil/vegetation
- Dry vegetation
- Other vegetation
- Inland waters
- Shadow

RADARSAT-2 GLCM Second moment feature
Summary and perspectives

- Data fusion is essential for a more accurate mapping of African urban areas.

- Built-up density appears as key data for mapping intra-urban heterogeneities in population density at HR.

- VHR optical and SAR data are complementary for mapping inner-urban neighbourhoods.
Further information

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