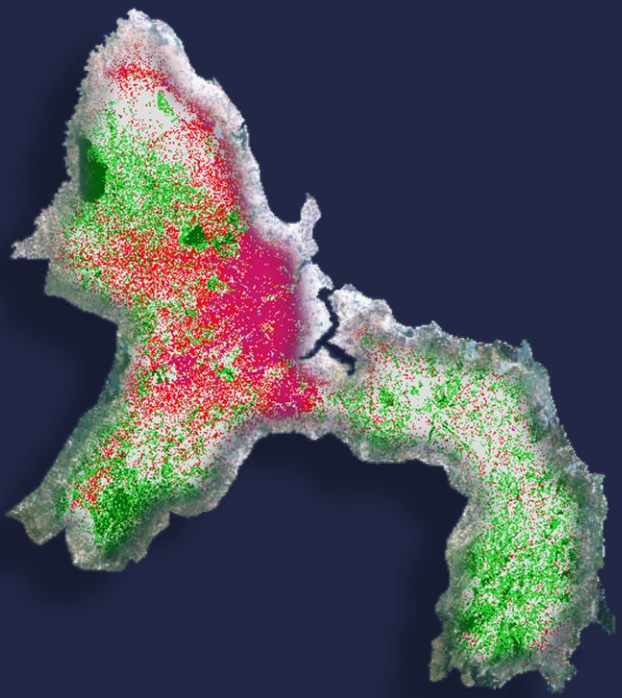
Urban impact of climate change in Africa / Impact urbain du changement climatique en Afrique
Turin, November 16, 2011

LAND COVER CHANGE AND URBAN VULNERABILITY TO CC IN DAR



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FORWARD

The study is part of the activities of the ACC Dar project, a three year project co-funded by the European Commission

ACC DAR Adapting to Climate Change in Coastal Dar es Salaam

Centro Interuniversitario di Ricerca per lo Sviluppo sostenibile - CIRPS

Sapienza Università di Roma

This project is co-funded by the European Union

OVERVIEW

- Introduction
- Objective
- Approach and Methods
- Findings
- Conclusion

INTRODUCTION

- Dar is facing a fast growth in population
- Great expansion of the built-up area of the city
- Informal peri-urban settlements grow relentlessly at the fringe

Very fast changes in land cover and land use patterns

- Heavy effects on the living environment for people who rely on natural resources for their livelihood
- High vulnerability to climate change, increased by land cover changes effects

OBJECTIVE

The development of methodologies for monitoring spatial changes through Remote Sensing and GIS techniques

- These methodologies should be tailored to needs and resources of Dar City Council's planning services

APPROACH AND METHODS

First stage of the study:

- Develop of a methodology for Semi-automatic Land Cover classification using LANDSAT imagery

A workflow has been designed in order to:

- generate land cover maps of Dar es Salaam
- analyze spatial variations during the last years with a set of Landscape Metrics Indices calculated for Land Cover maps

APPROACH AND METHODS:
LANDSAT IMAGERY

Available for free at USGS LANDSAT archive (http://landsat.usgs.gov/):

- About 60 images acquired from 1984 to 2011 were downloaded
- Images have 6 multispectral bands with a spatial resolution of 30 m

Problems with imagery:

- LANDSAT 7 images acquired after 2003 have SLC-off gaps
- Cloud cover is often present in most of LANDSAT images

APPROACH AND METHODS:
MAIN STEPS IN LAND COVER CLASSIFICATION

- Image preprocessing:
  - Convert DN to reflectance, applying atmospheric correction (DOS1 image based model)
  - Georeferencing images
  - Create clouds mask and shadows mask
  - Apply clouds and shadows masks
  - Mosaic multiple images in order to obtain a cloud-free image
  - Calculate vegetation indices (NDVI, EVI)

APPROACH AND METHODS:
MAIN STEPS IN LAND COVER CLASSIFICATION

- Image classification:
  - Definition of the Training Areas identifying the classes
  - Classification with the Maximum Likelihood (ML) algorithm
  - Refining ML classification with ancillary data in Knowledge Engineer

APPROACH AND METHODS: LANDSCAPE METRICS

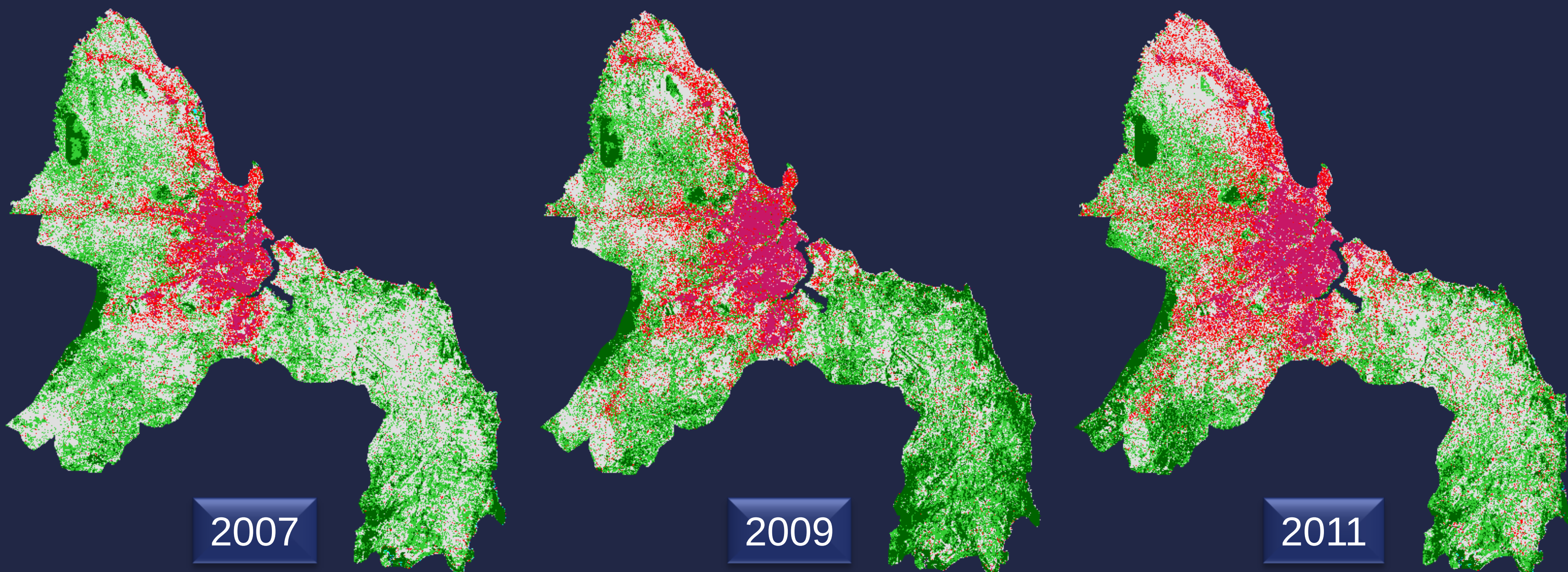
Class level metrics:

- The class area [ha]
- The number of patches [n°]
- The mean patch area [ha]
- The largest patch index [%]
- The area-weighted mean shape index [≥ 1; without limit]
- The area-weighted mean patch fractal dimension index [≥ 1 ; ≤ 2]
- The edge density [m/ha]

Landscape level metric:

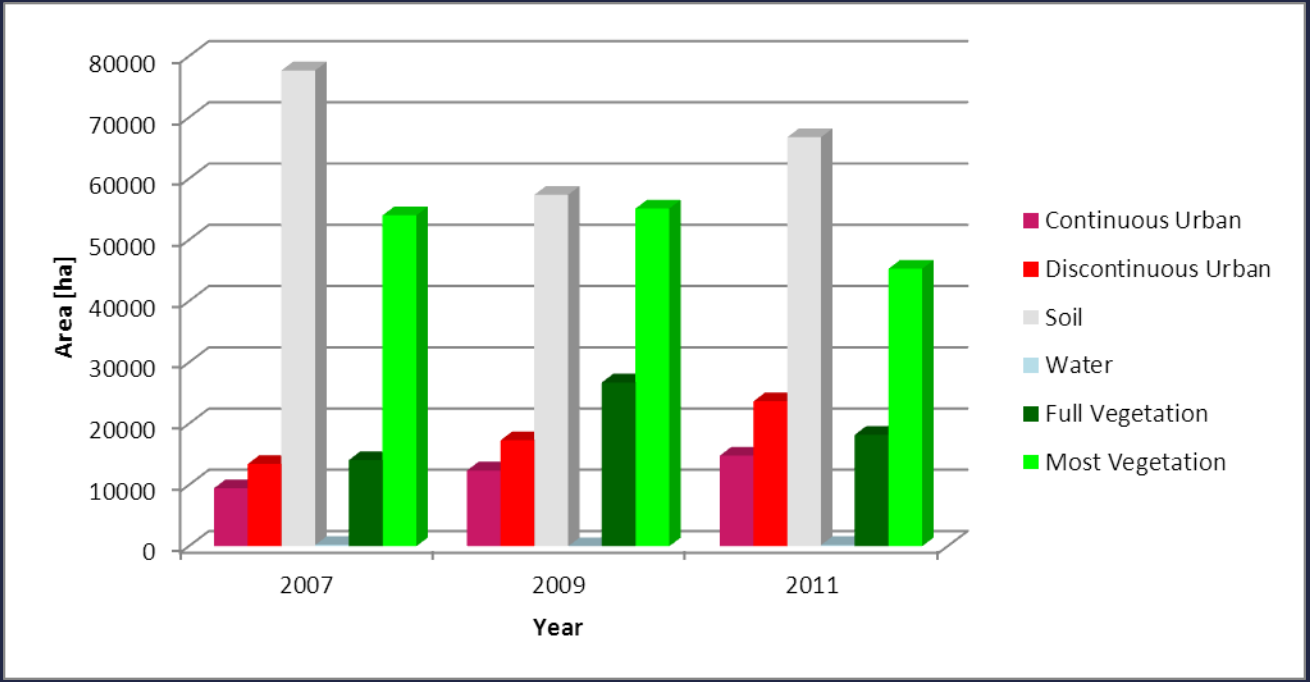
- The contagion index [%]

FINDINGS
LAND COVER CLASSIFICATIONS



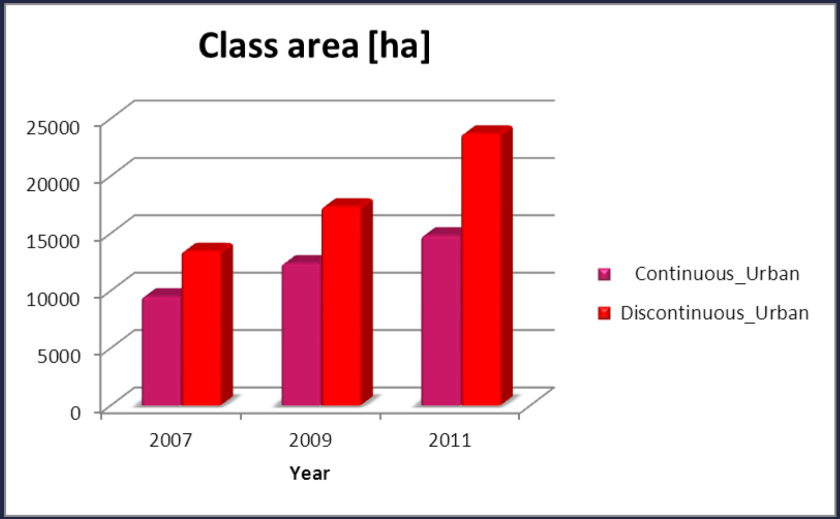
Class	Color
Continuous Urban	
Discontinuous Urban	
Soil	
Water	
Full Vegetation	
Most Vegetation	

FINDINGS
LAND COVER CLASSIFICATIONS

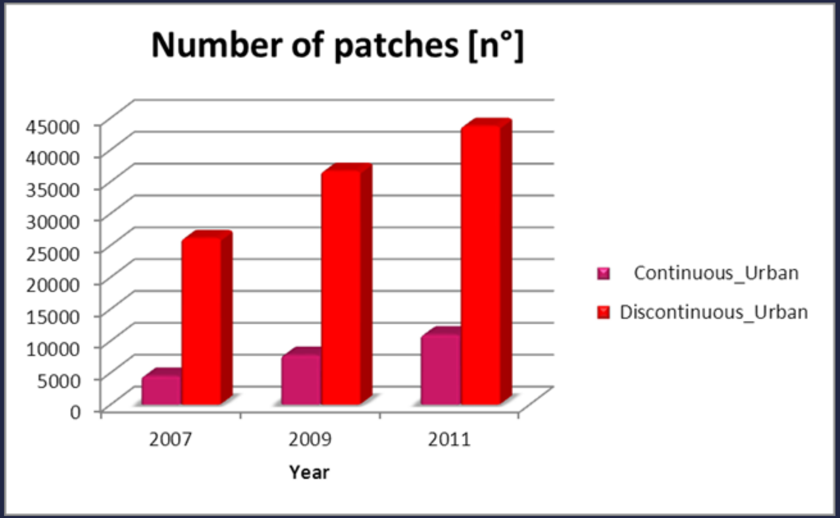


- Urban classes are growing through the years
- Fluctuation of vegetation and soil classes are also caused by different seasonality in image acquisition

FINDINGS
LANDSCAPE METRICS

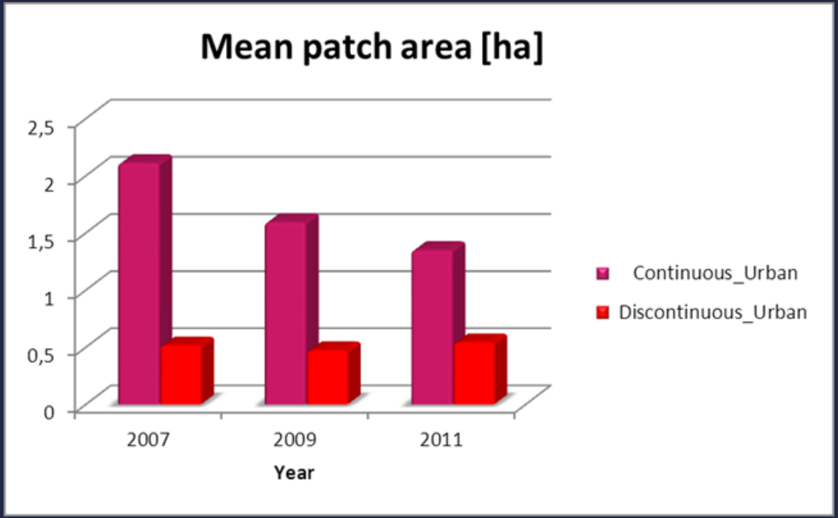


This metric indicates the growth of both continuous and discontinuous urban in the last years

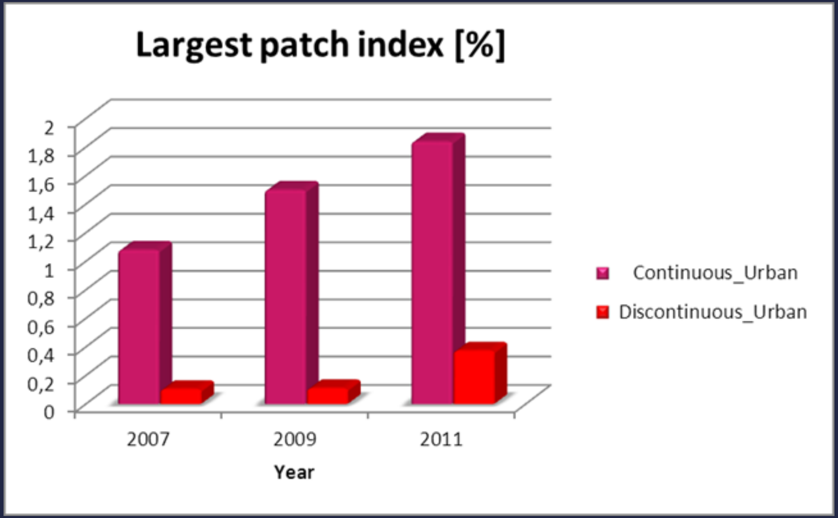


This metric indicates that the fragmentation of urban areas is increasing

FINDINGS
LANDSCAPE METRICS

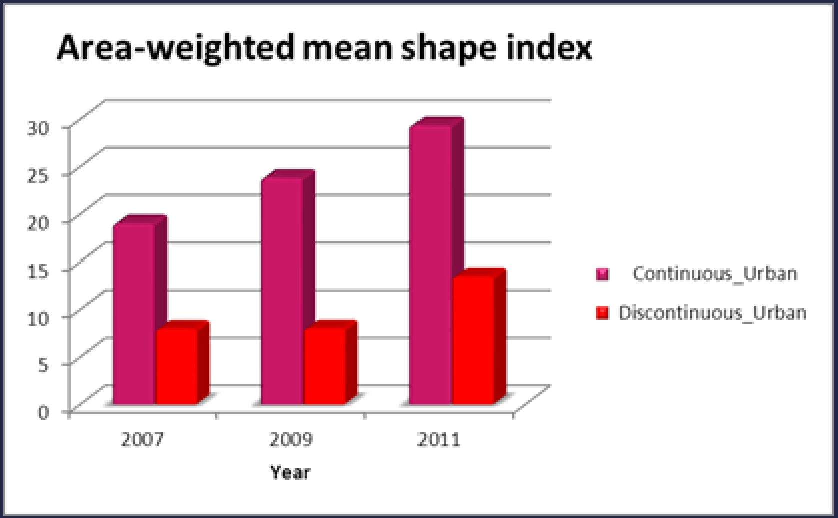


This decreasing metric indicates the growing of new built-up areas

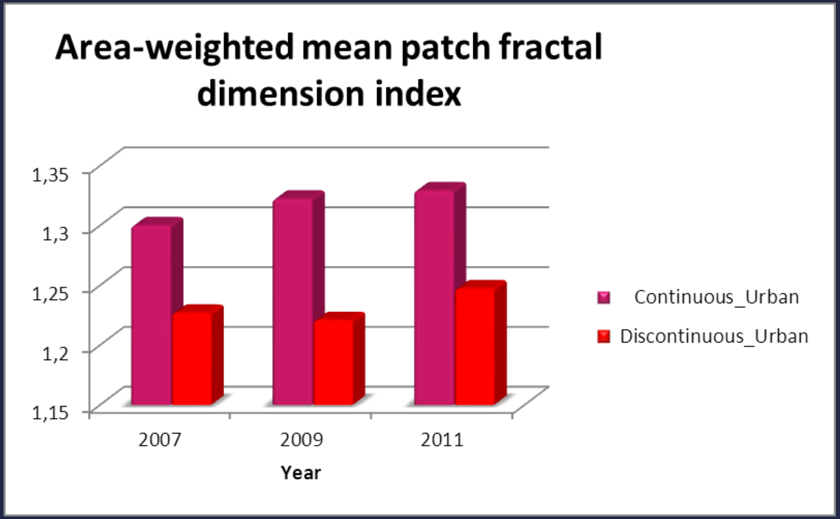


This metric indicates a growing degree of urban dominance in the landscape

FINDINGS
LANDSCAPE METRICS



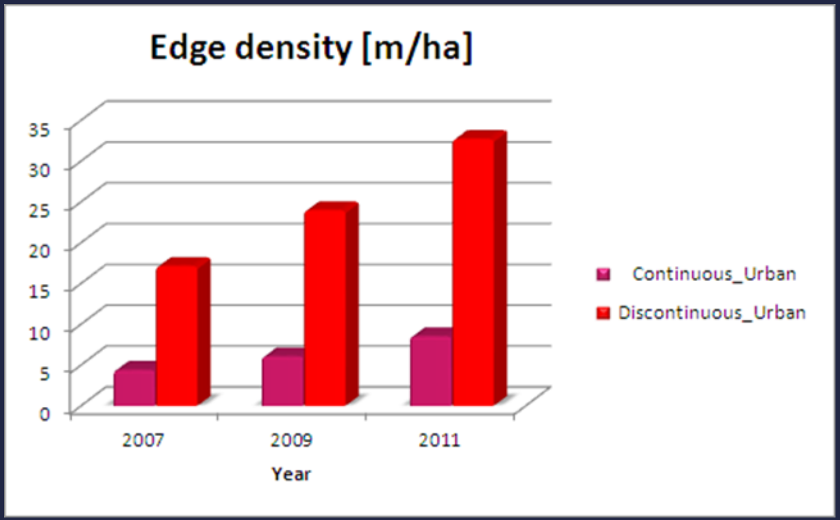
This increasing metric indicates a more irregular shape of urban areas



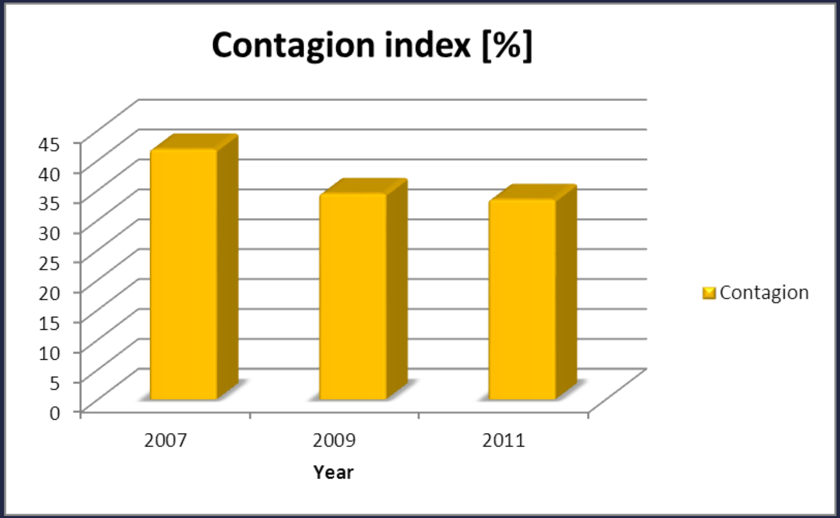
The increasing values of this metric indicates a more complex and irregular shape of urban areas

FINDINGS

LANDSCAPE METRICS



This metric indicates a fast growing of new built-up areas



This decreasing landscape metric indicates a spatial disaggregation of patches; is inversely related to edge density metric

CONCLUSION

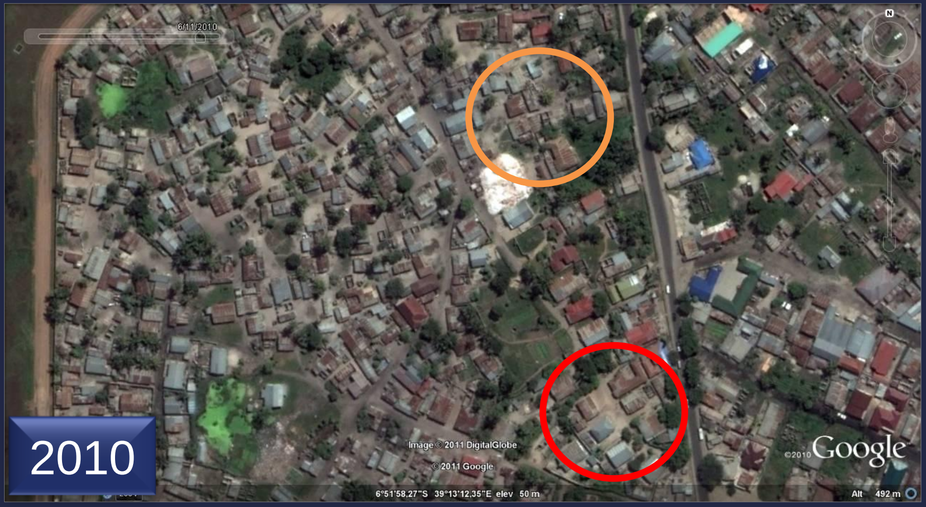
RESULTS OF THE STUDY

- Development of a low cost methodology for monitoring Land Cover Change during the last years
- Assessment of the urban sprawl with multitemporal Landscape metrics
- Dar sprawl is increasing very fast, both for continuous and discontinuous urban
- Urban shape irregularity is increasing constantly in the last years

CONCLUSION
ISSUES IN THE METHODOLOGY

Problems encountered in classification process:

- Difficulty in identifying pixels in LANDSAT images representing classes because of:
  - The very fast change in Land Cover
  - The lack of reference images (high spatial resolution) for the past years

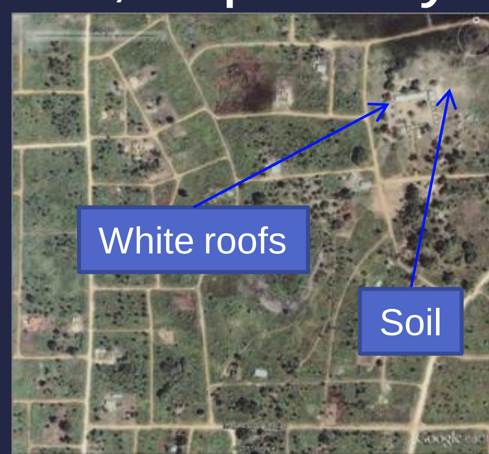


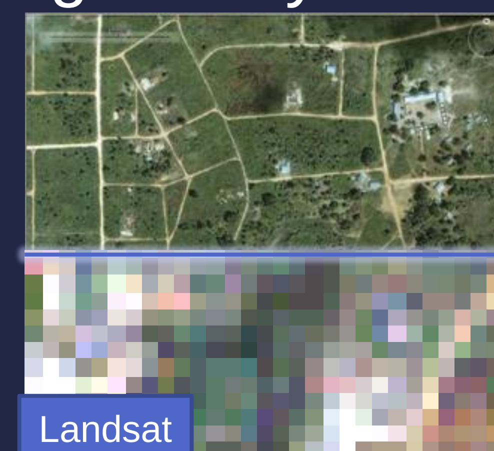
Example of high resolution images showing the change in Land Cover (images from Google Earth)

CONCLUSION
ISSUES IN THE METHODOLOGY

Sources of classification errors:

- The high cloud cover, and the need to mosaic different images adds spectral variability to Land Cover classes
- Spectral similarity between soil and white roofs
- In low density urban the pixel is mixed (made of urban, soil and vegetation) causing spectral confusion with soils, especially during the dry season





High resolution images from Google Earth

CONCLUSION

NEXT TOPICS OF STUDY

- Assess classification accuracy
- Develop the same methodology using open source software (GRASS GIS), without the cost of proprietary software
- Improve the methodology with other Remote Sensing data (SPOT images) at higher spatial resolution
- Assess correlation between soil sealing and groundwater salinization or other natural phenomenon related with Climate Change

Thank you for your attention