MAUPP
Modelling and forecasting African Urban Population Patterns for vulnerability and health assessments

MAPPING URBAN AREAS FROM SPACE CONFERENCE
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An urban expansion model for African cities using combined multi temporal SAR and optical data

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1 - INTRODUCTION

The population of Africa is predicted to double over the next 40 years, driving exceptionally high urban expansion rates. However, the forecast of human population distribution in Africa is limited by the lack of spatial urban expansion model and the quality of its data sources. One way to overcome this shortcoming is to integrate multi-source and multi-temporal data for improving the delineation and the characterization of human settlements.

2 - THE MAUPP PROJECT

The **MAUPP** project addresses the **M**odelling and forecasting of **A**frican **U**rban **P**opulation **P**atterns for vulnerability and health assessments. One of the objectives of the study is to produce an urban expansion model for African cities in three steps:

I. The development of automatic and effective method for the delineation of urban extent using optical and SAR data;
II. The creation of temporal data base of urban extent and land cover for large set of African cities over the period 1995-2015;
III. The generation of urban expansion models based on Boosted Regression Trees (BRT) method and using remote sensing, statistical and contextual data.

3 - DELINEATION OF URBAN EXTENT CHAIN PROCCESS

This poster presents the processing method for the delineation of urban extent at a continental scale. The urban extents of about 50 Sub-Saharian African (SSA) cities of different sizes and functions (Figure 1), will be automatically delineated using combined SAR and optical data for allowing the exploitation of redundancy and for improving certainty and precision.

Multi-temporal processing is conducted for the period 1995 to 2015 in sequence of 3-6 years. Due to the large multi-temporal dataset of 50 SSA cities, we developed an entirely automatic approach to extract human settlement from the SAR and optical HRRS data. As illustrated in Figure 2, this multi-feature fusion method uses SAR texture feature, multispectral statistics and fusion based supervised support vector machine model.

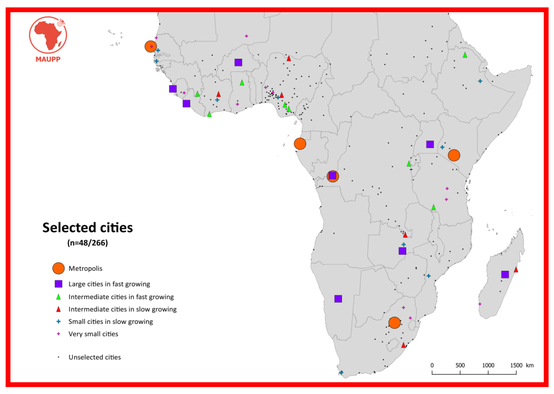


Figure 1

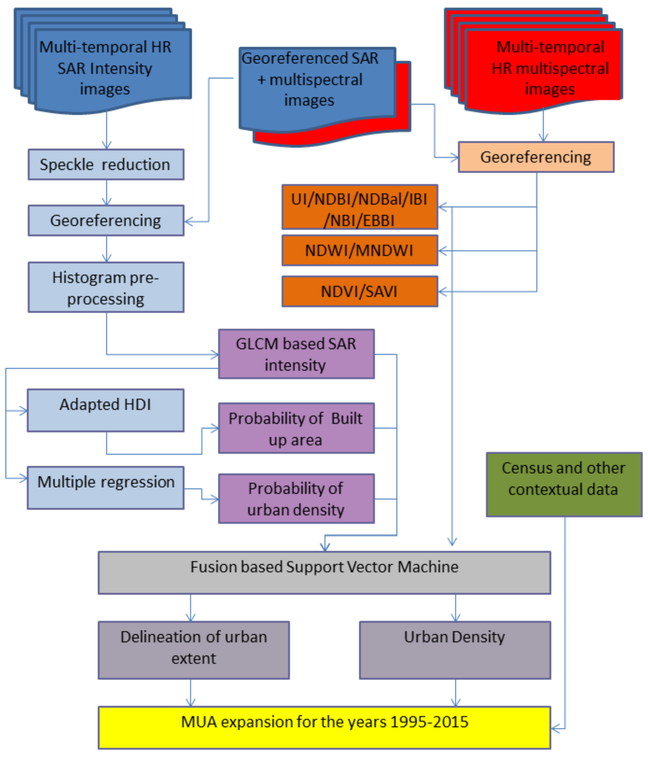


Figure 2

4 - A TEST CASE – OUAGADOUGOU (BURKINA FASO)

For presenting the capability of our proposed image processing and fusion procedure, several optical and SAR images of Ouagadougou, Burkina Faso (Figure 3), from different years were selected (Table 1).

Table 1

	SAR data 12 res m/p			Optical HR
year	Sensor	Orbit	Pol	
1994	ERS-1	Des	VV	TM
2001	ERS-2	Des	VV	SPOT/TM
2004	ERS-2	Des	VV	SPOT/TM
2009	ASAR	Des	VV	TM
2015	Sentinel-1	Asc	VV/VH	SPOT/TM

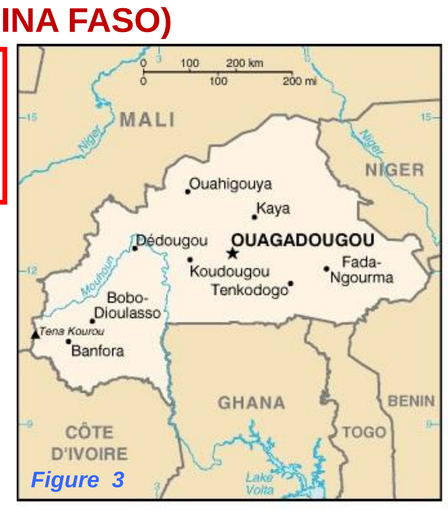
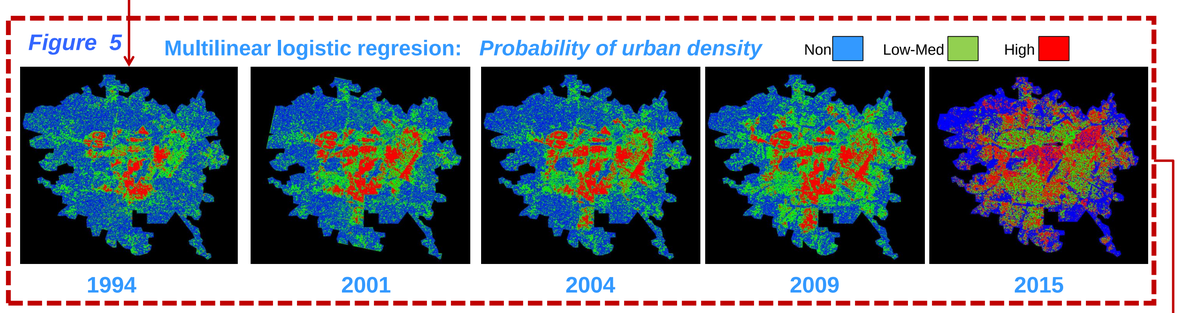
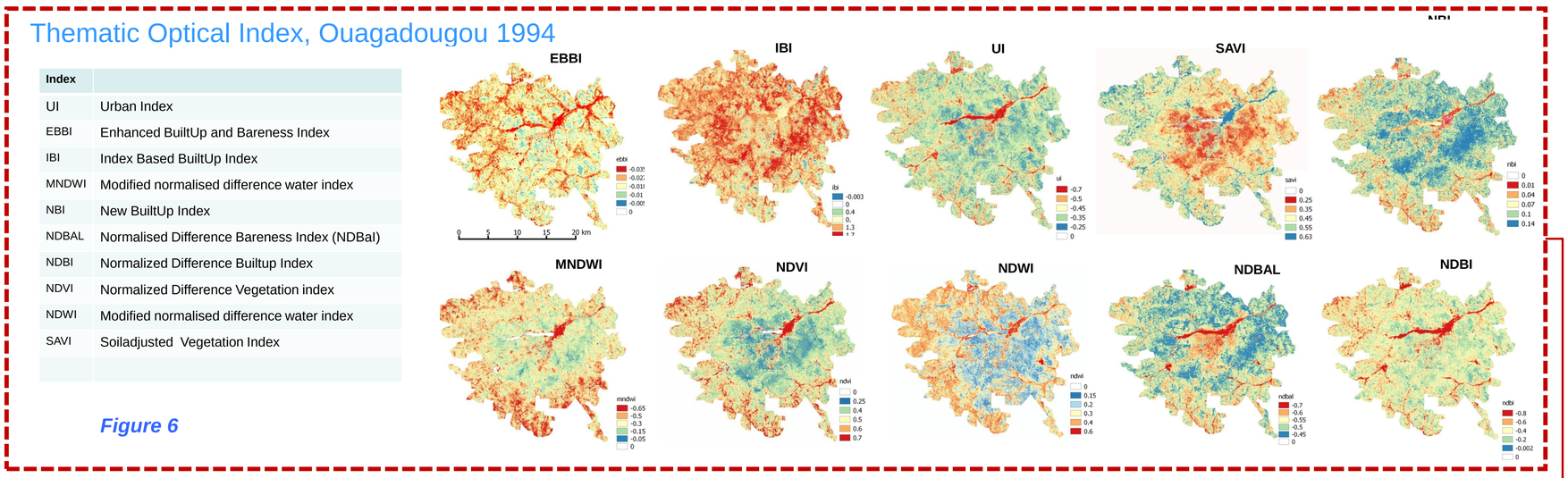


Figure 3

Figure 4





Index	
UI	Urban Index
EBBI	Enhanced BuiltUp and Bareness Index
IBI	Index Based BuiltUp Index
MNDWI	Modified normalised difference water index
NBI	New BuiltUp Index
NDBAL	Normalised Difference Bareness Index (NDBaI)
NDBI	Normalized Difference Builtup Index
NDVI	Normalized Difference Vegetation index
NDWI	Modified normalised difference water index
SAVI	Soiladjusted Vegetation Index

Figure 6

5 - FUSION BASED SUPPORT VECTOR MACHINE

By integrating the optical and the SAR data sets using the support vector machine, we mapped the estimated built-up density of Ouagadougou in 1994 and 2009. Figure 7 shows an extensive growth of the built up area with a centralization of the city. In 13 years, the city developed in all the direction but mainly in the southern part were high density built-up areas are observed. The integration of the entire data sets reduced the ambiguities in the processing of 2009 for the periphery. However, the processing should be validated with extra data set and information for 1994.

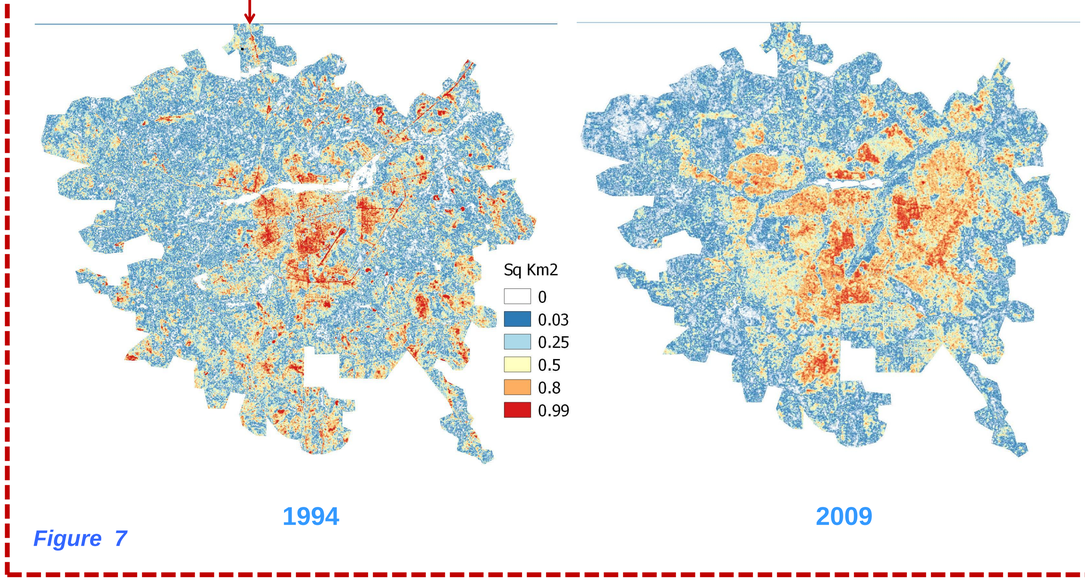


Figure 7

6 - CONCLUSIONS

The proposed processing scheme produces new valuable input that will allow the improving of available urban growth models for Africa. This processing scheme also indicates that multi-source data sets may contribute to the evaluation of density in the peri-urban regions, a valuable input for population distribution models.

7 - REFERENCE

For other complementary information M. Shimoni, J.F. Lopez, Y. Forget, E. Wolff, C. Michellier, T. Grippa, C. Linard and Marius Gilbert, "*An urban expansion model for African cities using multi temporal optical and SAR data"*, In Proc. IGARSS2015, Milano, Italy, 26-30 July 2015.

8 - ACKNOWLEDGMENTS

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