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



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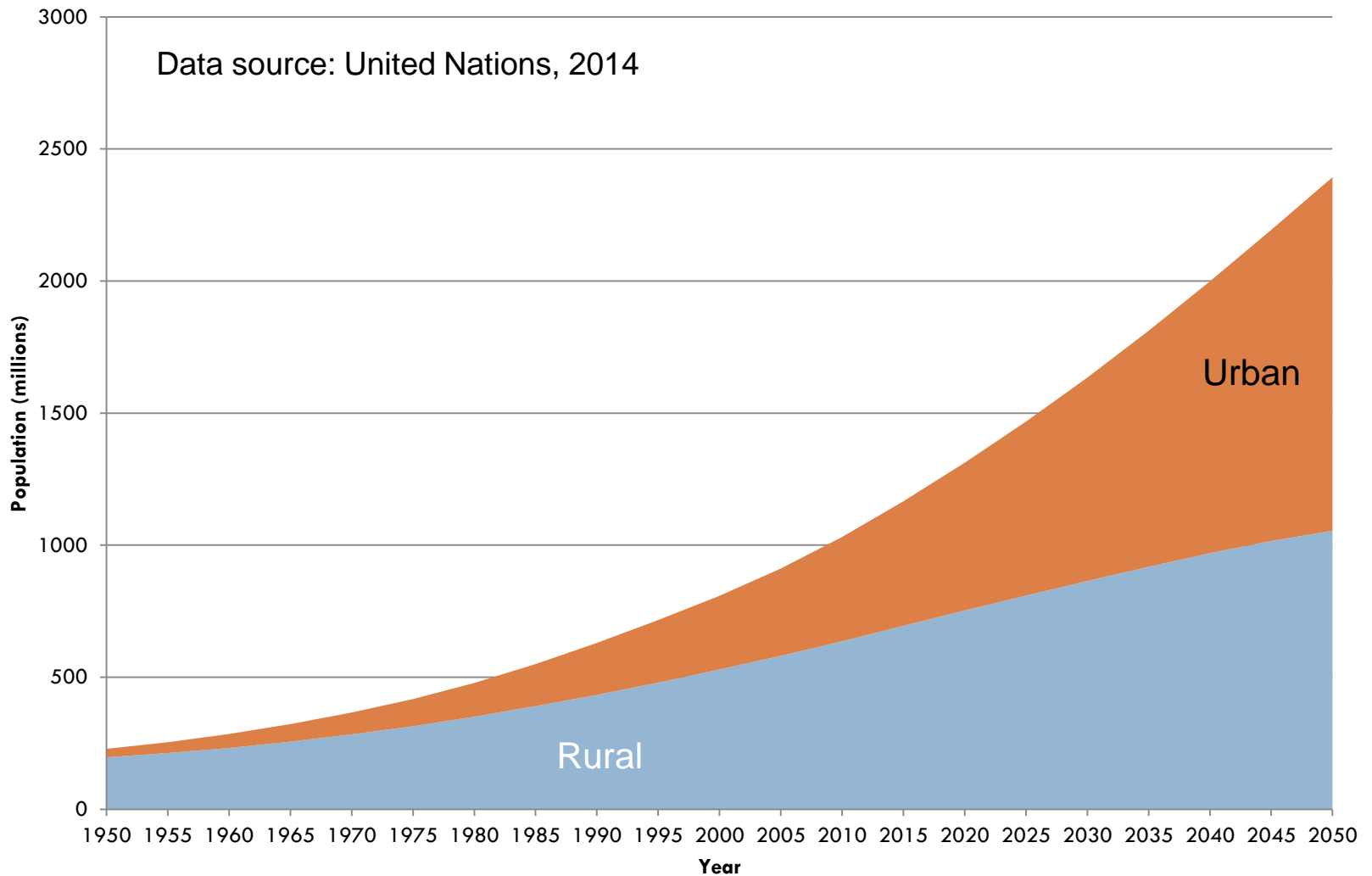
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RESEARCH PROGRAMME FOR EARTH OBSERVATION "STEREO III"

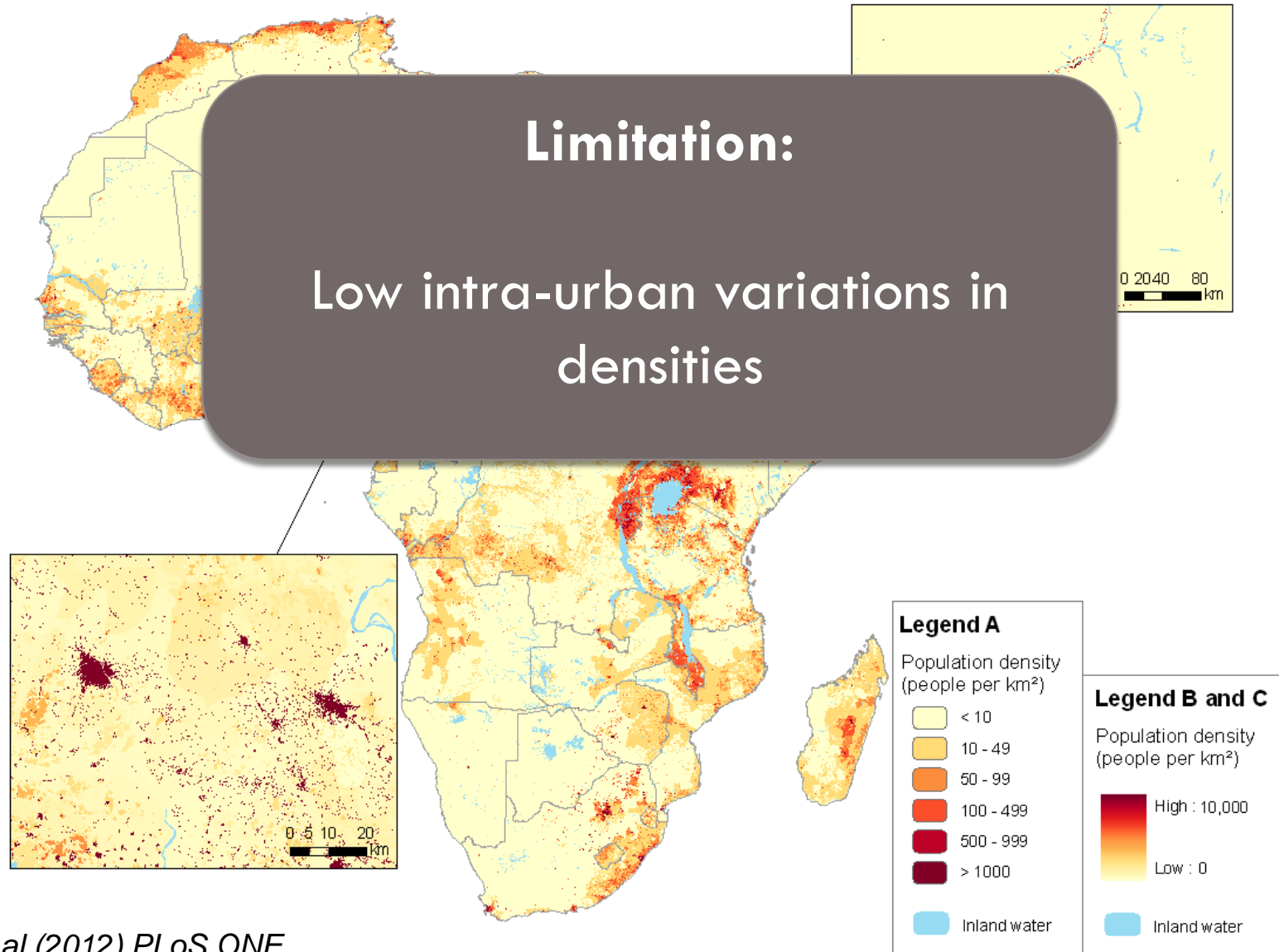
# Urban pop. growth is fast in Africa



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# Population distribution in Africa in 2010

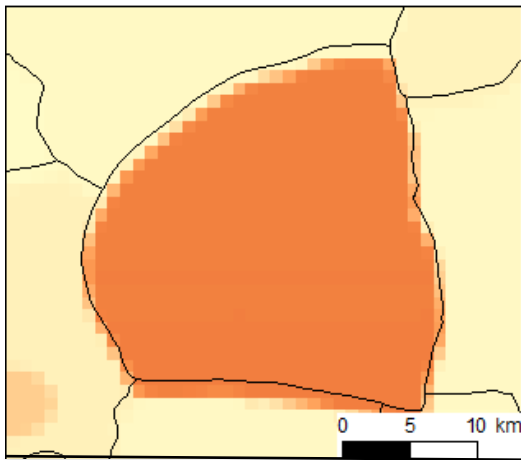


# Low intra-urban variations in population densities

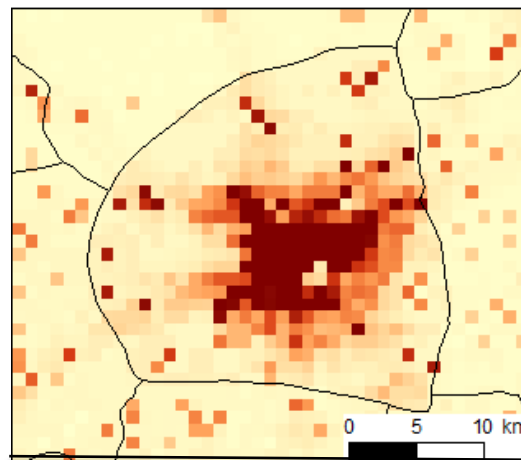


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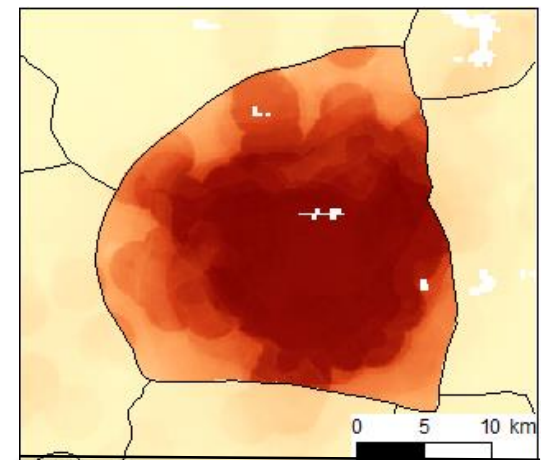
GRUMP



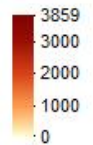
LandScan



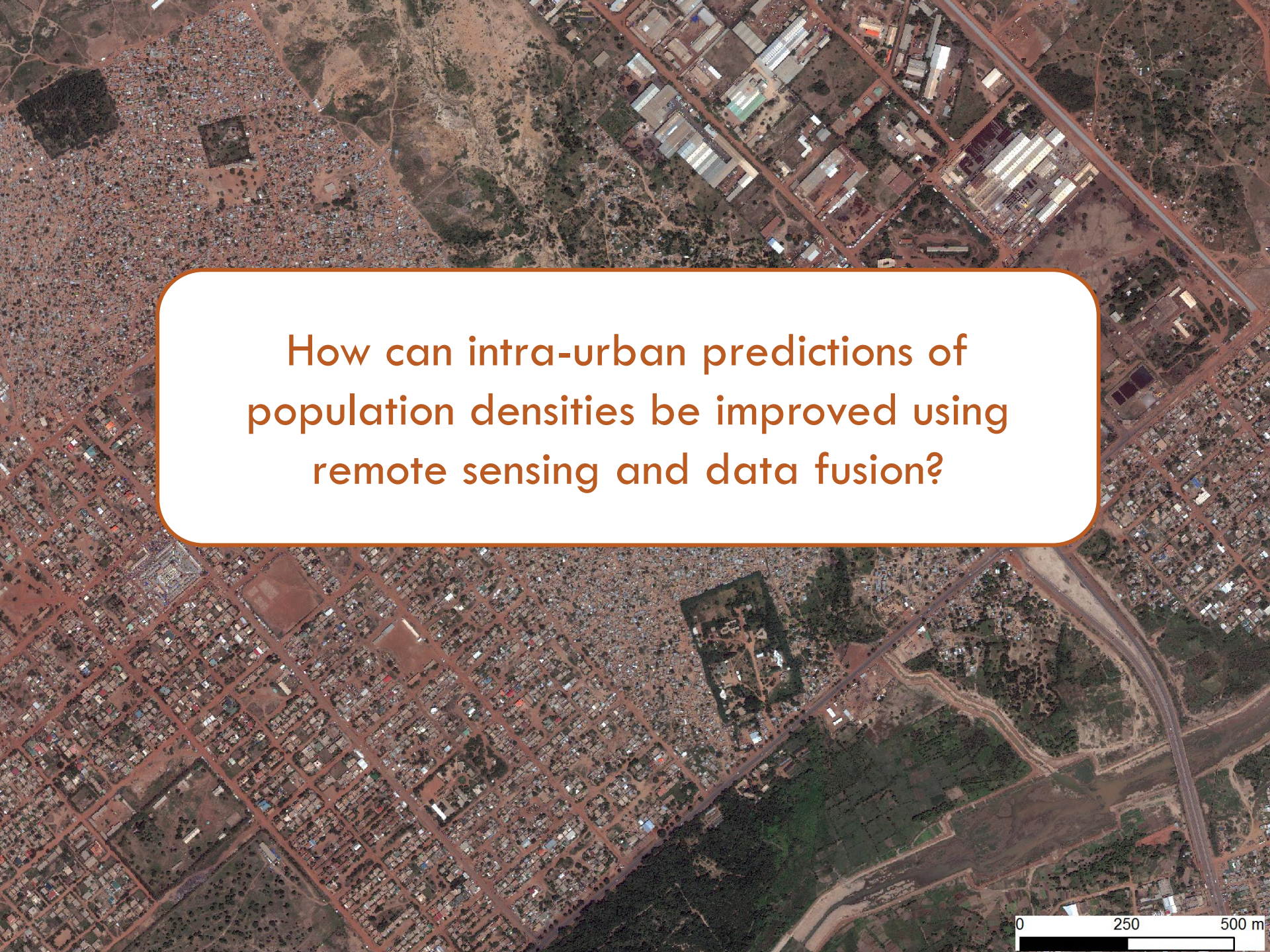
WorldPop



Population density  
(people/km<sup>2</sup>)



*Ouagadougou, Burkina Faso*

An aerial photograph of a city, likely in an arid region, showing a dense urban grid. A central white text box with an orange border contains the main question. In the bottom right corner, there is a scale bar with markings for 0, 250, and 500 meters. The city features a mix of residential areas, industrial zones with large buildings, and some green spaces. A river or canal is visible in the lower right quadrant.

How can intra-urban predictions of population densities be improved using remote sensing and data fusion?

0 250 500 m

# 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

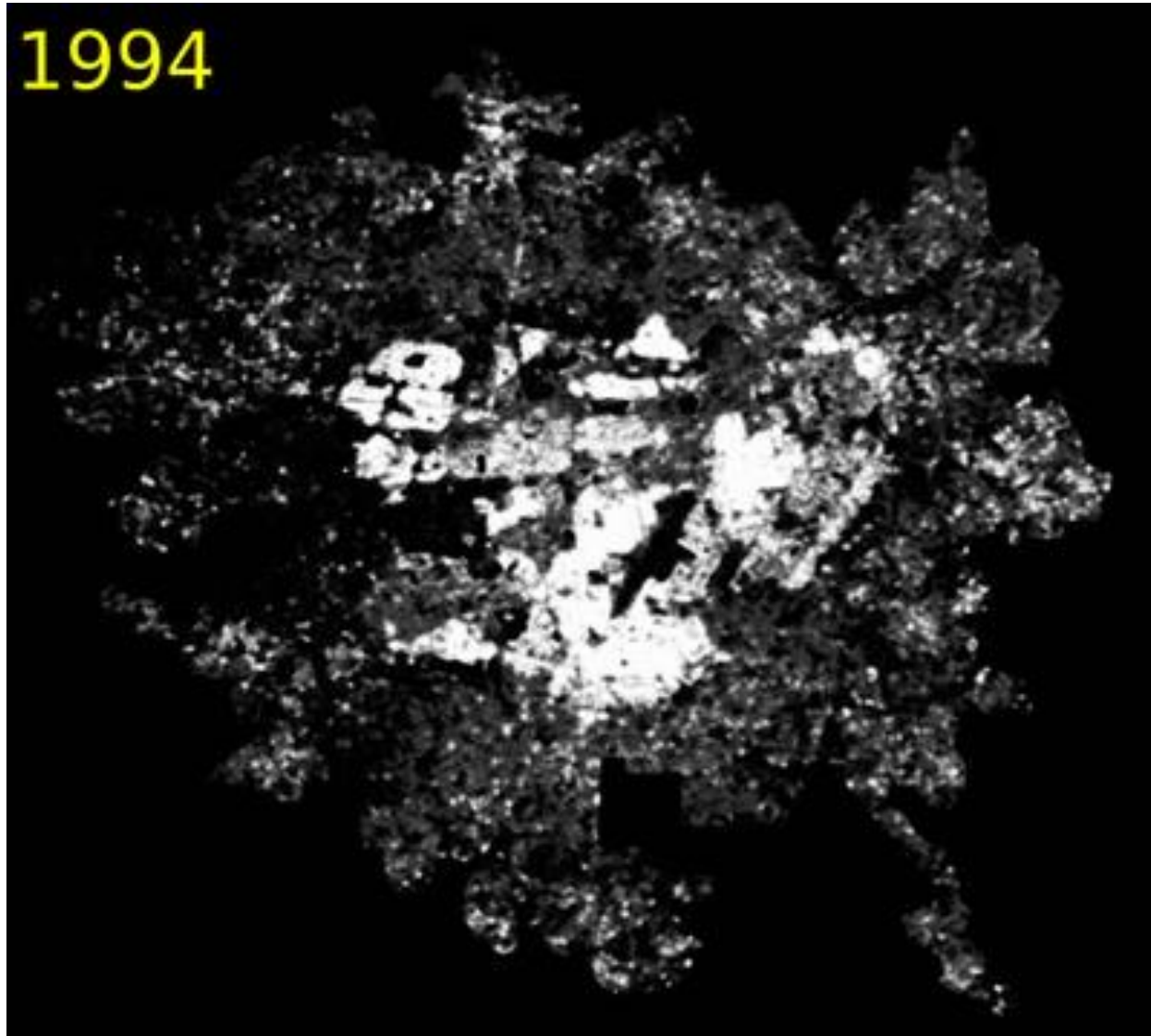
- Data fusion methods used to overcome some of the issues
- Produce and test a built-up density layer for population mapping



# Built-up probability for the period 1994-2015 using HR SAR data



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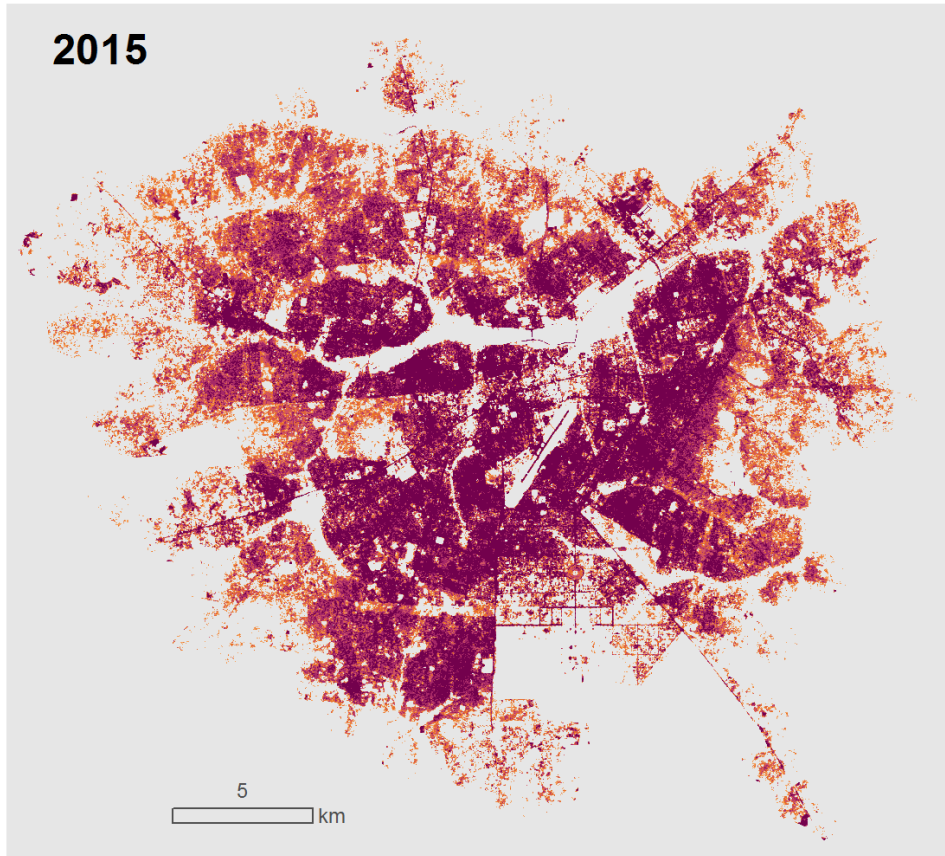


*Ouagadougou,  
Burkina Faso*

# Built-up density map of Ouagadougou



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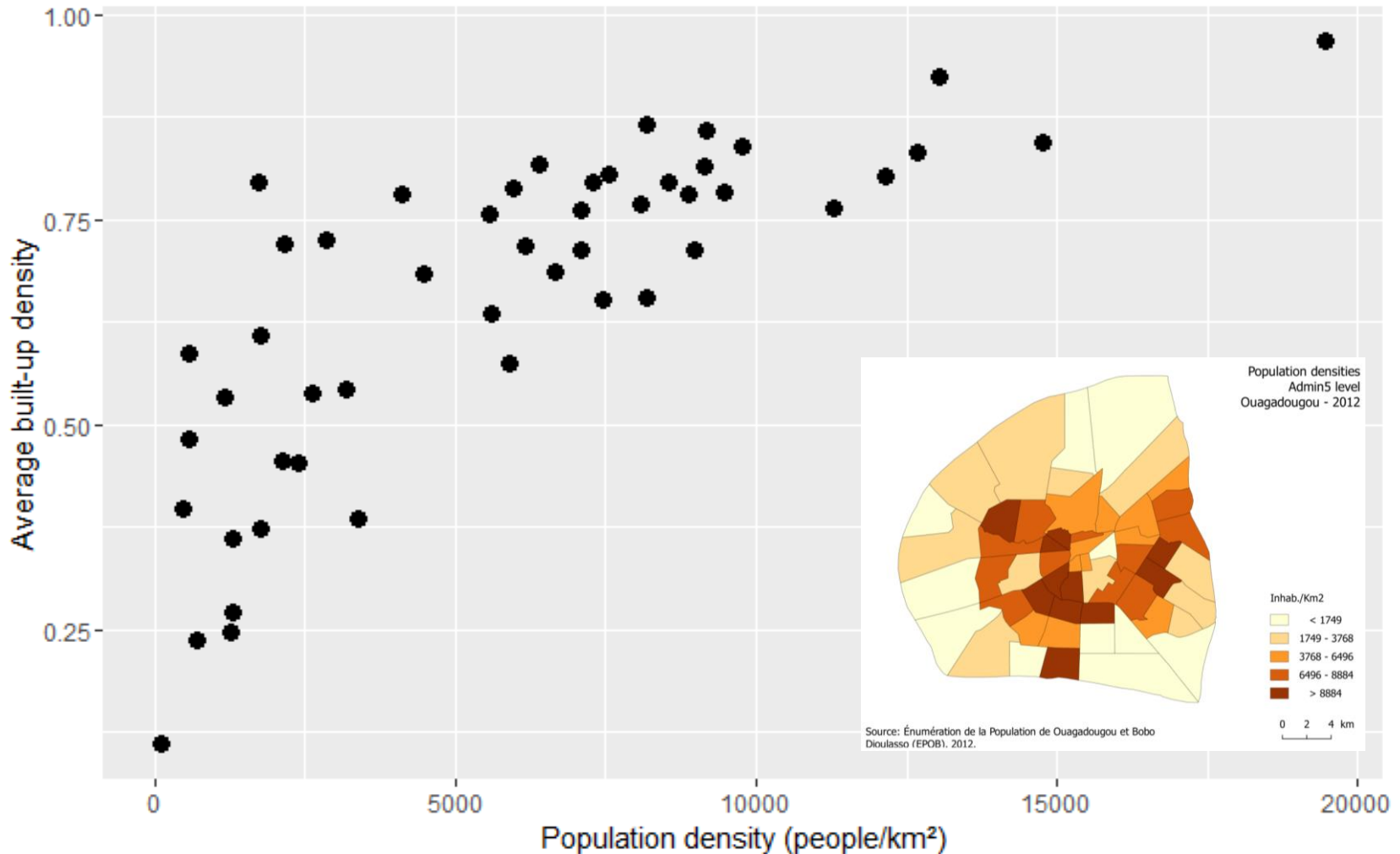
- Multi-temporal: 1995, 2000, 2005, 2010, 2015
- Fusion of optical and SAR data
- OSM data used as training data



# Built-up density vs. population density



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# Morphological zones in Ouagadougou

Small high-density buildings

No building

Large low-density buildings



Medium-size high-density buildings

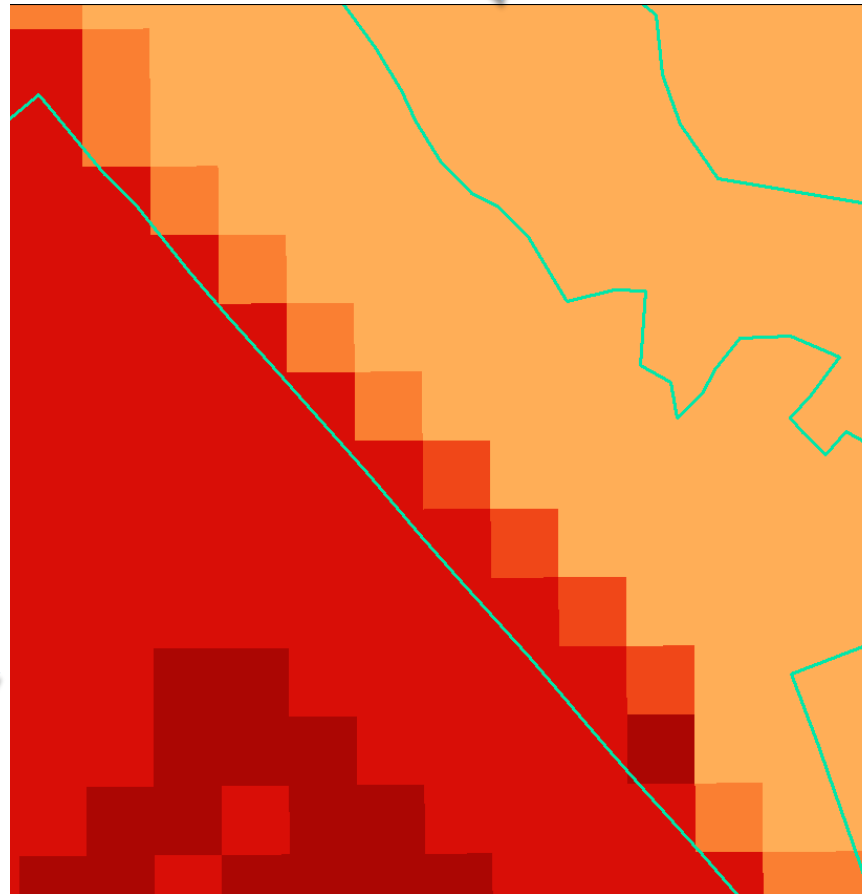
Small low-density buildings

# Population density model without built-up density

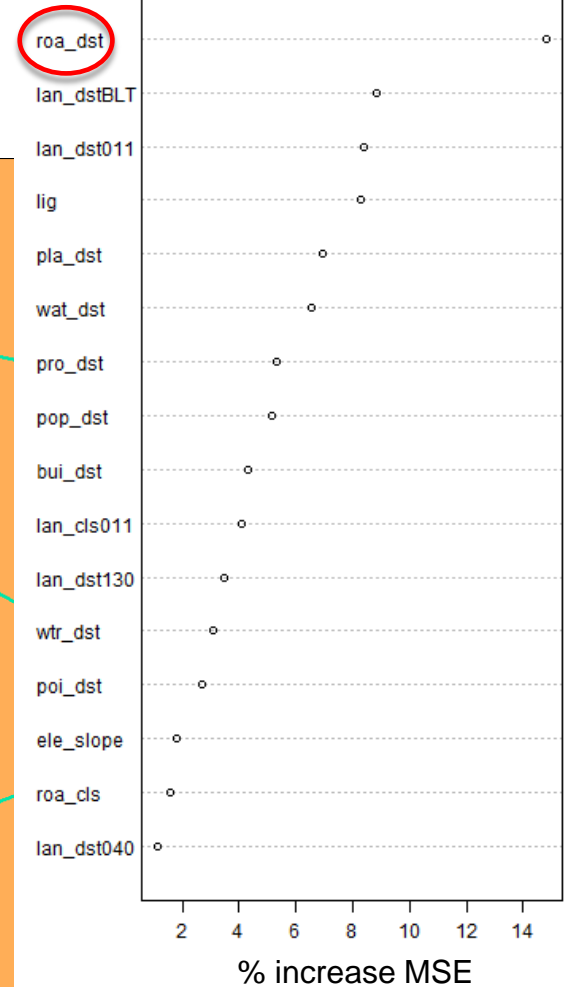
Small high-density buildings

No building

Medium-size high-density buildings



## Variable importance

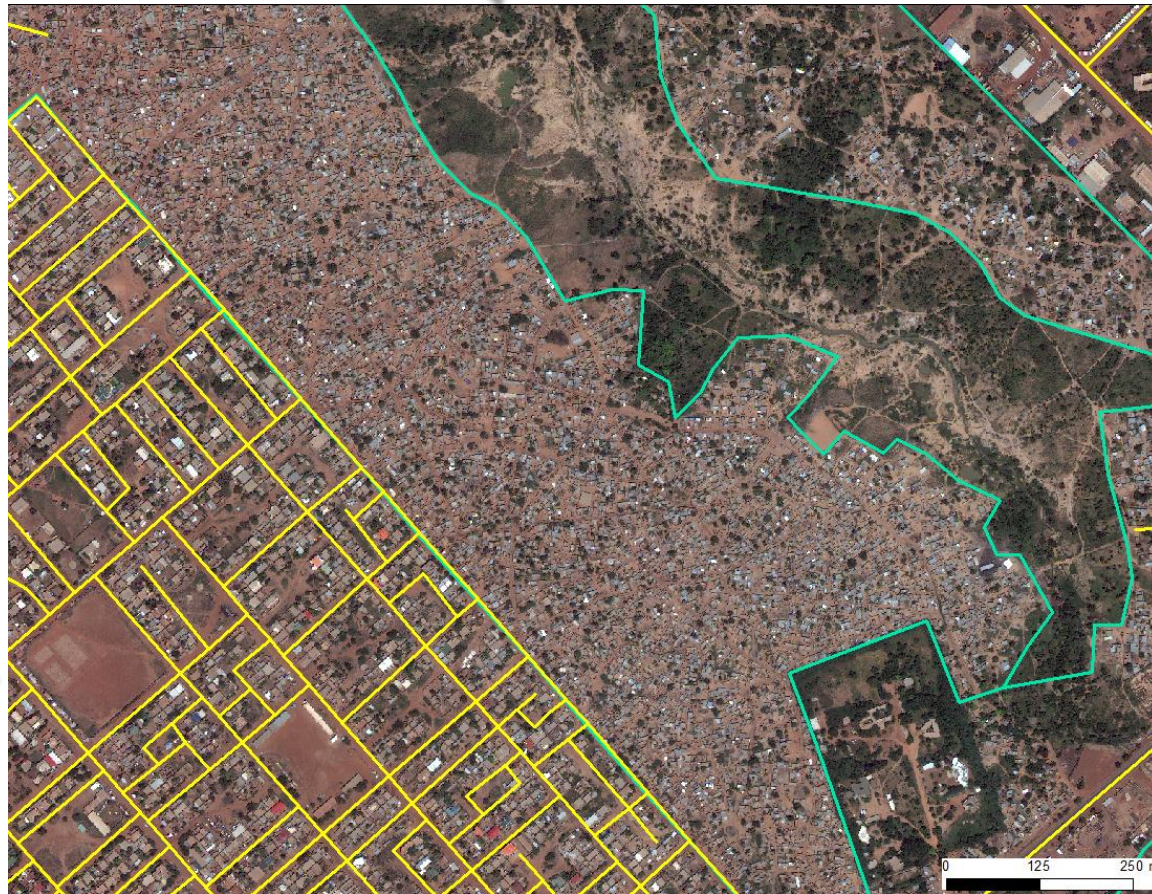


# Roads as main predictor

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

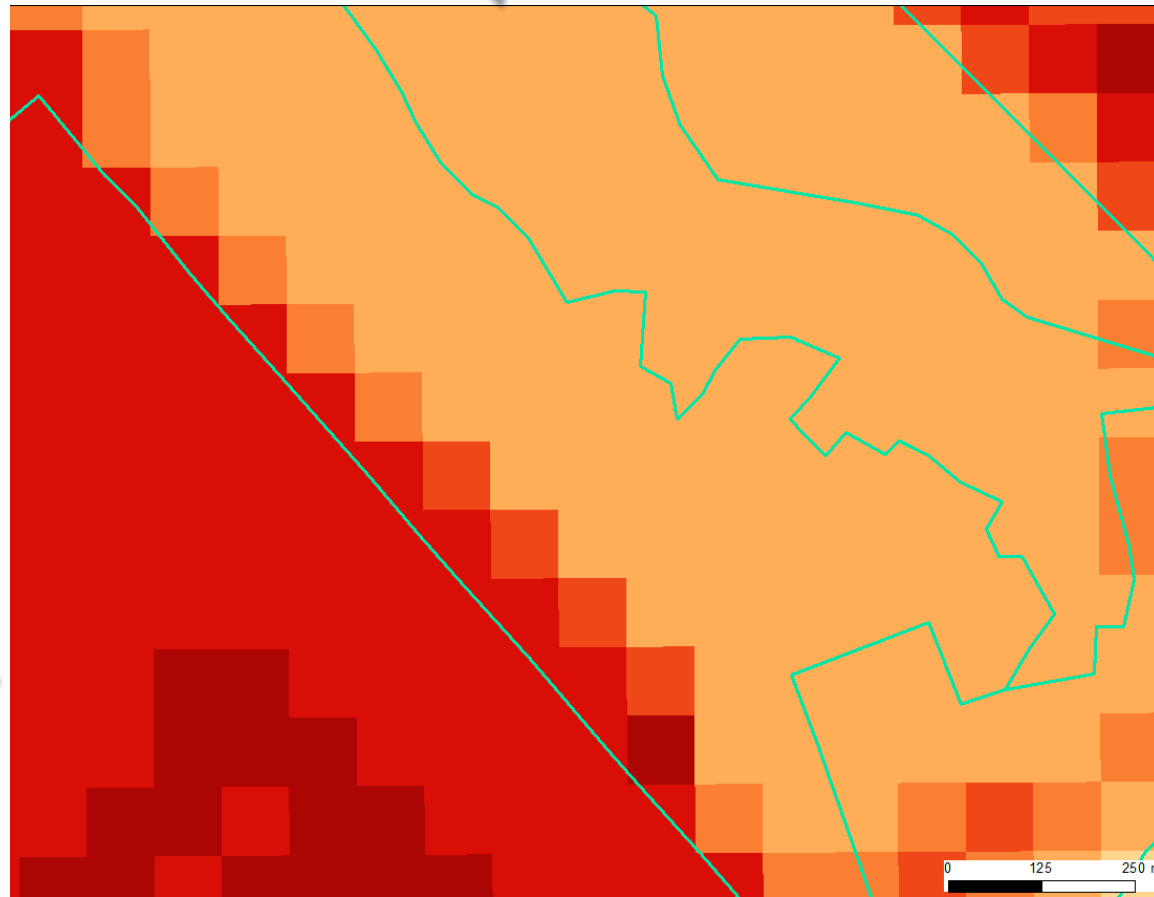
Small high-density buildings

No building

Large low-density buildings

Small low-density buildings

Medium-size high-density buildings

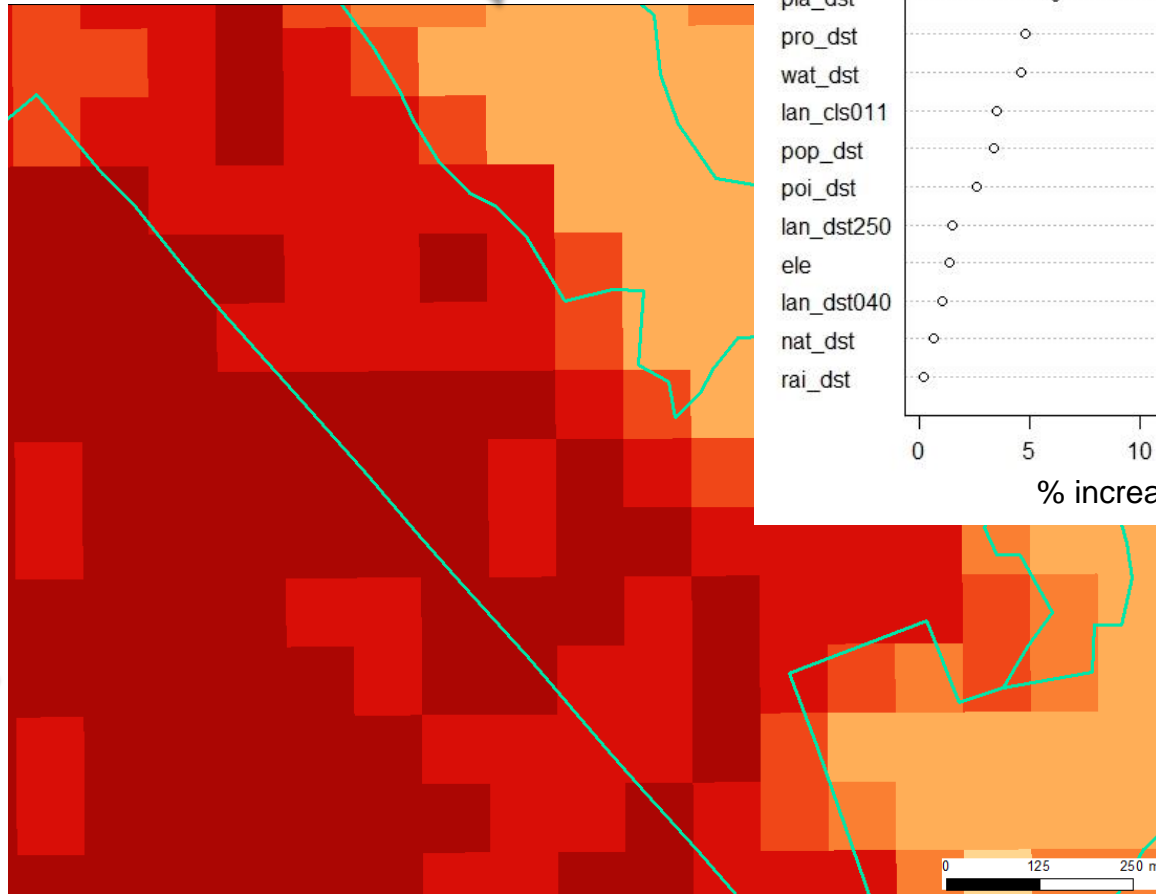


# Population density model with built-up density

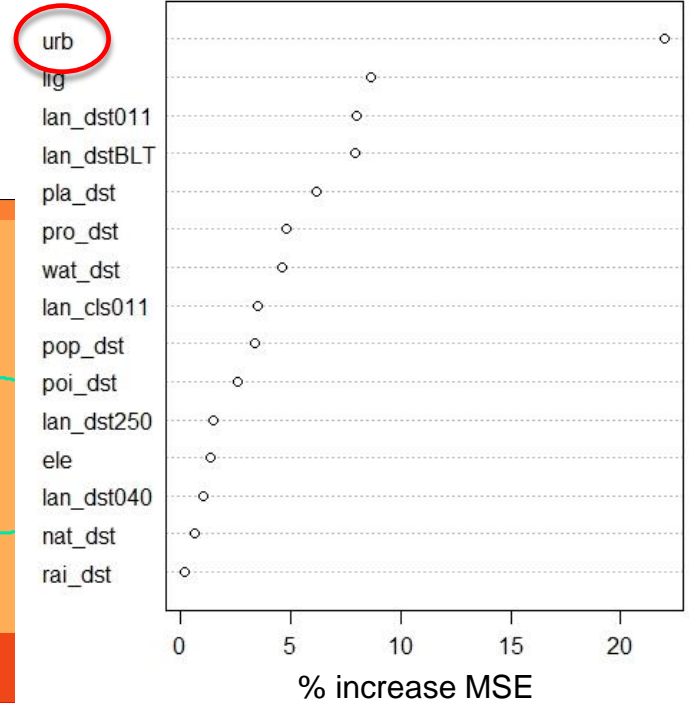
Small high-density buildings

No building

Medium-size high-density buildings



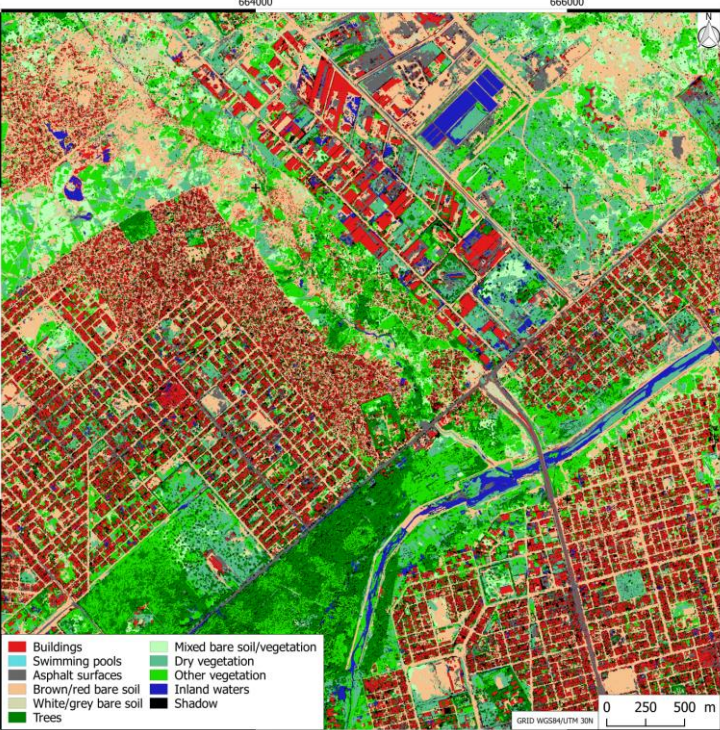
## Variable importance



## Population density (people/ha)



# The complementarity of VHR SAR and optical data



RADARSAT-2 GLCM Second moment feature

RF optical classification



# Summary and perspectives



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- 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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[maupp.ulb.ac.be](http://maupp.ulb.ac.be)

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Belgian Science Policy Office



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