Postcolonial Urban Planning

# City pattern as a factor influencing the impact of urbanization on ecosystems

A diachronic analysis of the dynamic of two cities: Kisangani and Lubumbashi (Democratic Republic of Congo)
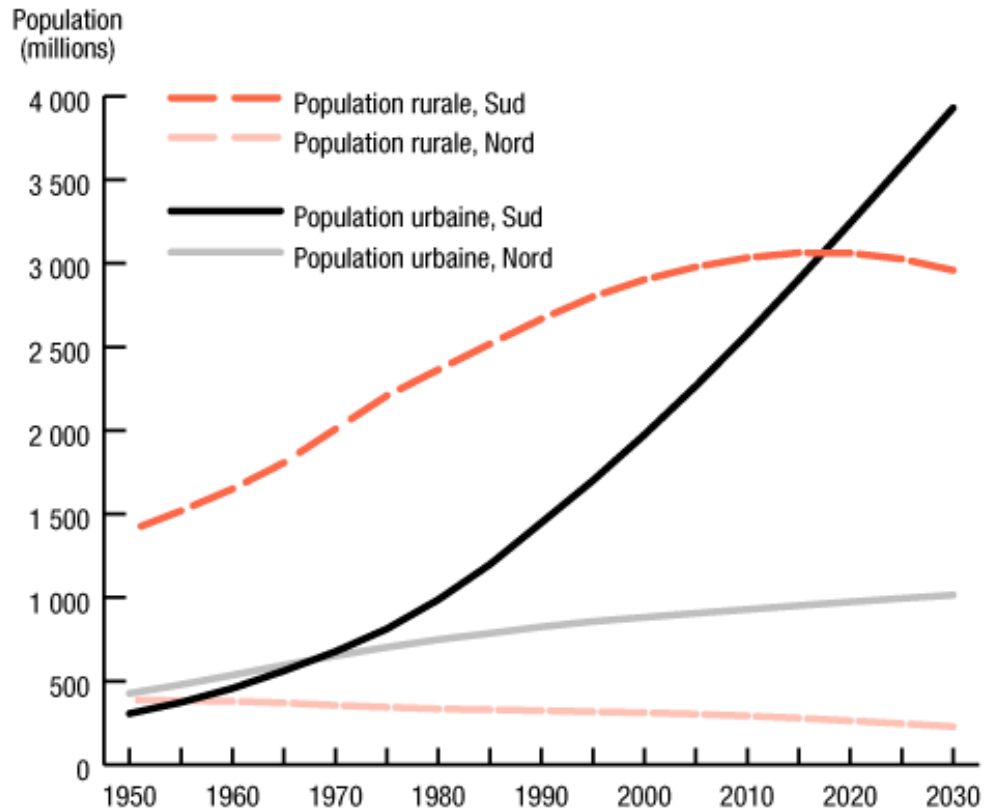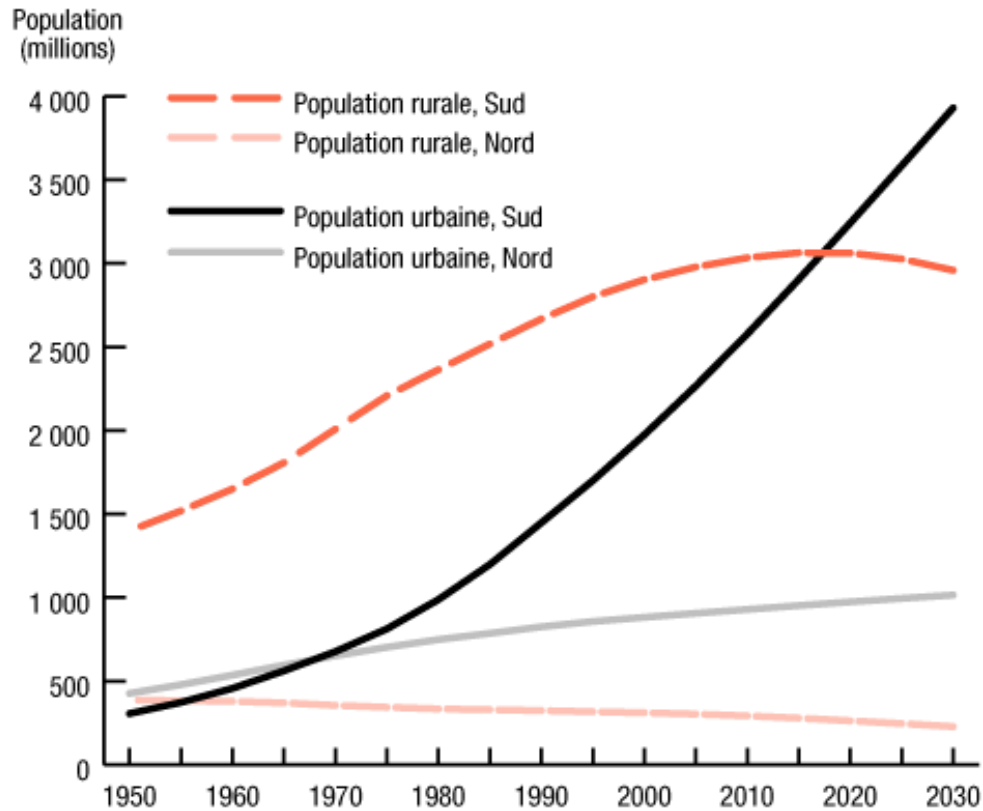
André M., Mahy G., Lejeune P., Bogaert J.

AGRO BIO TECH

1/5

# Introduction
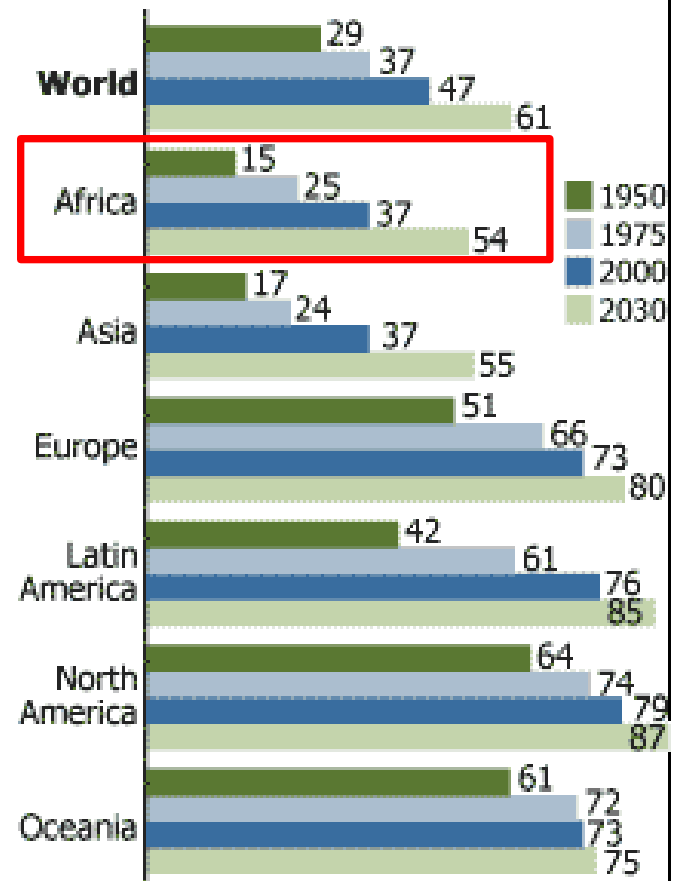
# Introduction: a growing urban population

Population (millions)

- **— —** Population rurale, Sud
- **— —** Population rurale, Nord
- **———** Population urbaine, Sud
- **———** Population urbaine, Nord

ONU, 2004

# Introduction: a growing urban population

Population (millions)

Population rurale, Sud
Population rurale, Nord

Population urbaine, Sud
Population urbaine, Nord

ONU, 2004

Adapté de UN, 2012

**Percent urban**

| | 1950 | 1975 | 2000 | 2030 |
|---|---|---|---|---|
| World | 29 | 37 | 47 | 61 |
| Africa | 15 | 25 | 37 | 54 |
| Asia | 17 | 24 | 37 | 55 |
| Europe | 51 | 66 | 73 | 80 |
| Latin America | 42 | 61 | 76 | 85 |
| North America | 64 | 74 | 79 | 87 |
| Oceania | 61 | 72 | 73 | 75 |

# Introduction: a lack of data and of maps

Lubumbashi

Legend:
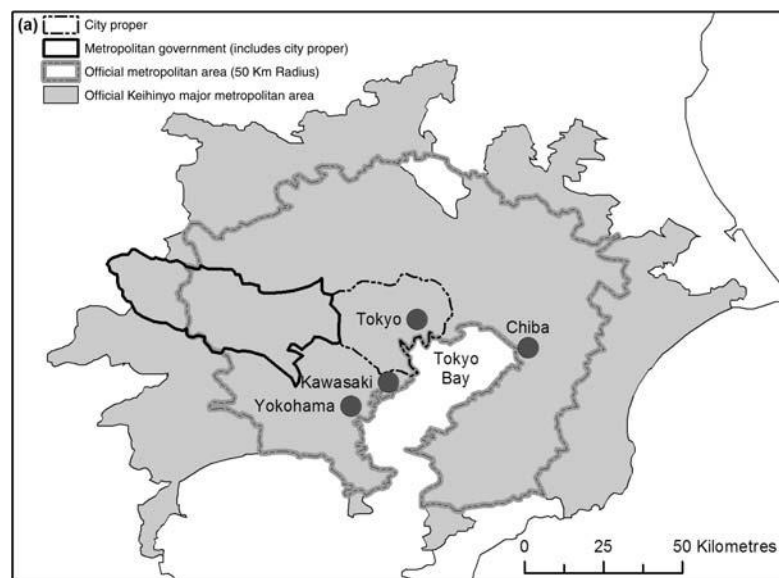- Avant 1958
- Entre 1958 et 1973
- Entre 1973 et 1984
- Depuis 1984
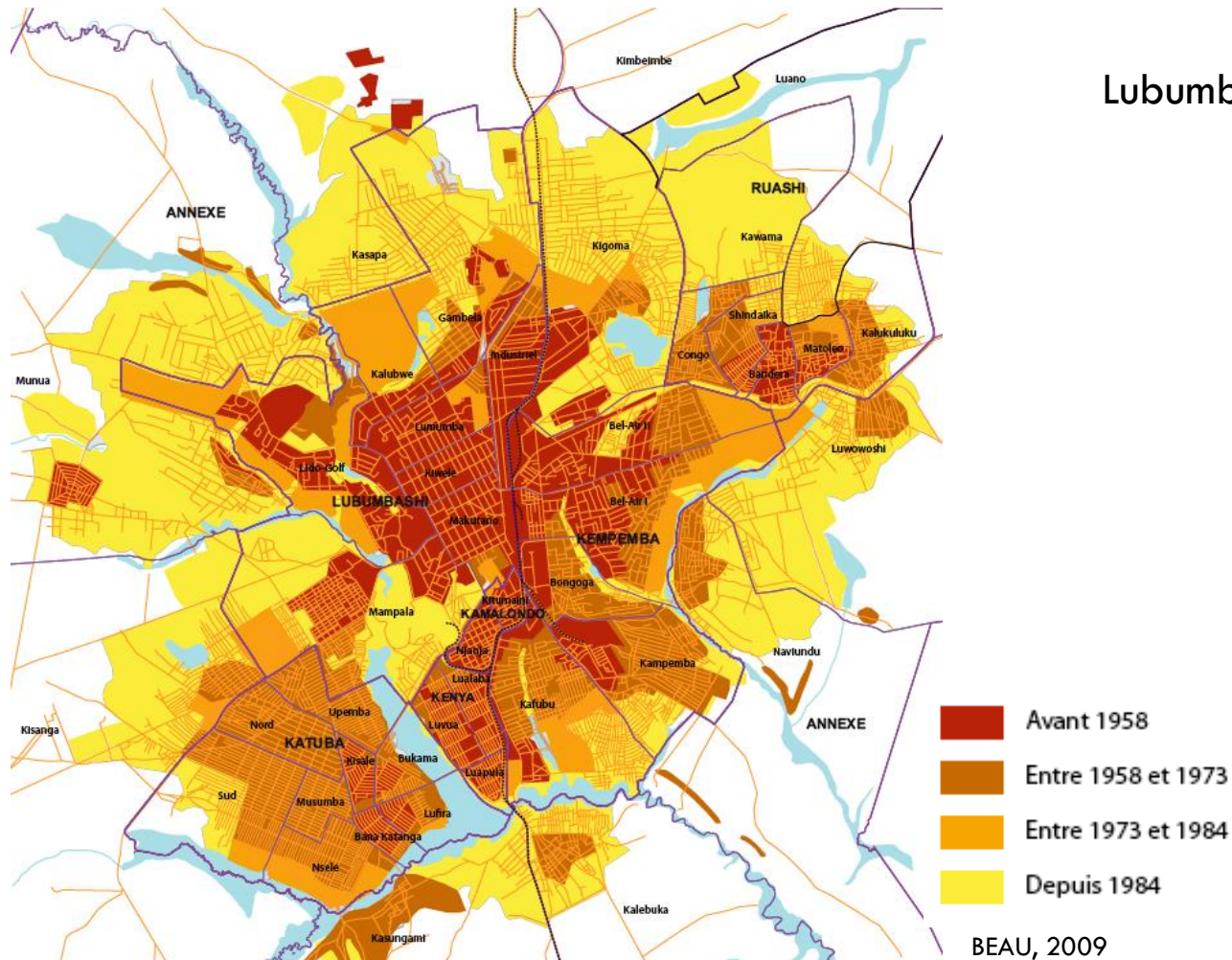
BEAU, 2009

# 1/5 Introduction: variable definitions



Forstall et al, 2008

| *Official UA or MA definition [WUP]: Definition used by UN | Type of definition (see Table 2) | Population 2000 | Area (km$^2$) 2000 | Population per km$^2$ 2000 | Annual average | |
|---|---|---|---|---|---|---|
| | | | | | Population change | Percent change |
| Tokyo (2000 and 1995 censuses) | | | | | | |
| City proper | I | 8,134,688 | 621 | 13099.3 | 33,000 | 0.41 |
| Administrative area | II | 12,064,101 | 2,187 | 5516.3 | 58,000 | 0.49 |
| Urbanised area* | III | 28,271,210 | 3,084 | 9167.1 | 169,000 | 0.61 |
| UA (administrative boundaries) | IV | 30,402,132 | 6,657 | 4566.9 | 165,000 | 0.55 |
| Metropolitan area (1)* [WUP] | V | 34,493,466 | 13,504 | 2554.3 | 179,000 | 0.53 |
| Metropolitan area (2)* | V | 30,724,311 | 7,628 | 4027.8 | 170,000 | 0.56 |
| Consistently defined metropolitan area | CDMA | 31,865,900 | 8,014 | 3976.3 | 175,000 | 0.56 |

# Introduction: the sustainability triangle

Wordpress, 2009

2/5

# Objectives

# Objectives

1. **Quantify the dynamic of the different areas** (urban, suburban, rural) in the urban-rural gradient **during the last decade**

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Growth: how much?

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Growth: how much?

City: which exact extent?

# Objectives

1. **Quantify the dynamic of the different areas** (urban, suburban, rural) in the urban-rural gradient **during the last decade**

2. **Quantify the effect of a decade of urban and suburban growth on ecosystems**

# Objectives

Urbanization: to the detriment of what?

2. **Quantify the effect of a decade of urban and suburban growth on ecosystems**

# Objectives

## SENSITIVE ECOSYSTEMS TO PRESERVE?

2. **Quantify the effect of a decade of urban and suburban growth on ecosystems**

# Objectives

# SENSITIVE ECOSYSTEMS TO

## integrate as green spaces?

2. **Quantify the effect of a decade of urban and suburban growth on ecosystems**

# Objectives

# ECOSYSTEMS

# Unsuitable for urban development?

2. **Quantify the effect of a decade of urban and suburban growth on ecosystems**
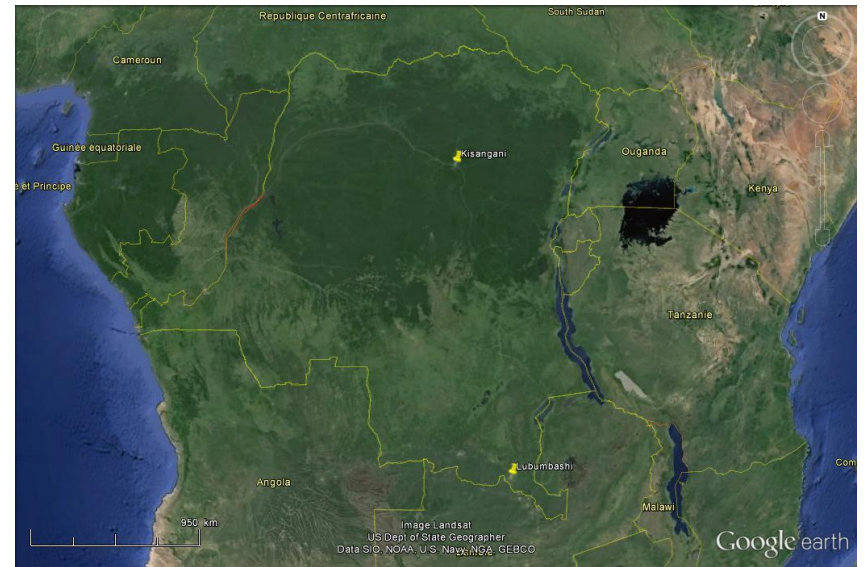
3/5

# Material & method

# Material

- SPOT 5 images
- Two years:
  - 2002 and 2008 (2009) for Lubumbashi
  - 2002 and 2010 for Kisangani

Study zone of Lubumbashi, SPOT Image, July 17, 2002

0   5 000  10 000        20 000 Meters
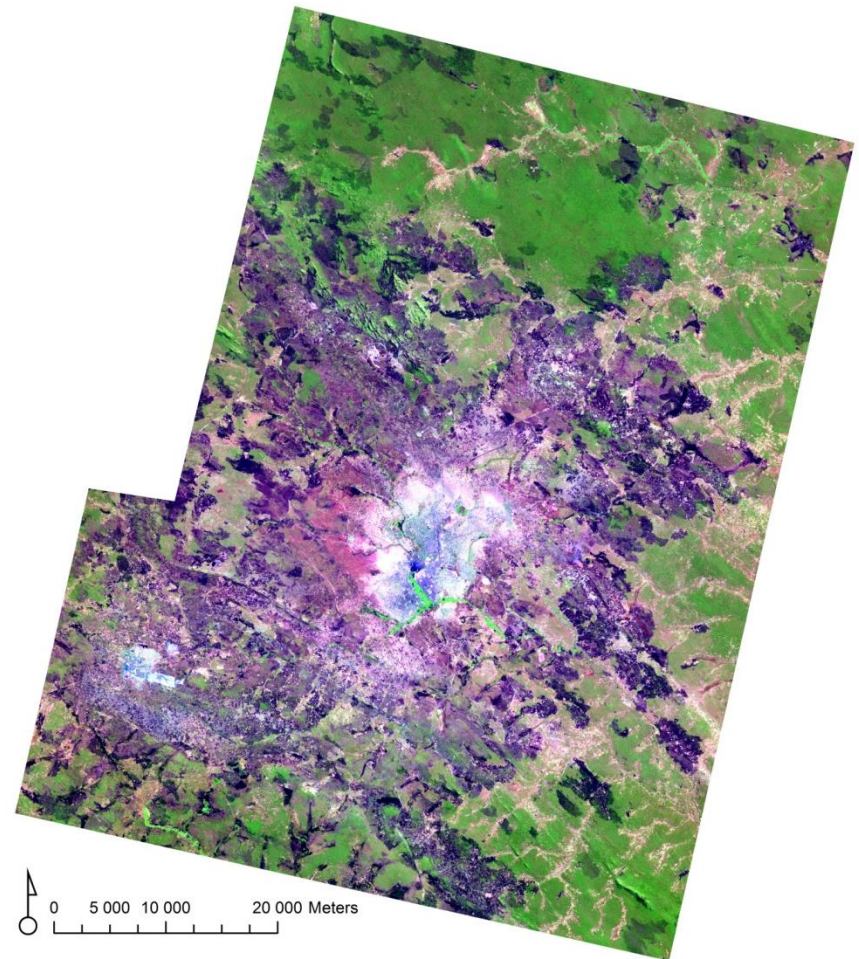
# Material: localisation of the two study cases

Munyemba 2010, Google Earth 2013

# Material: localisation of the two study cases
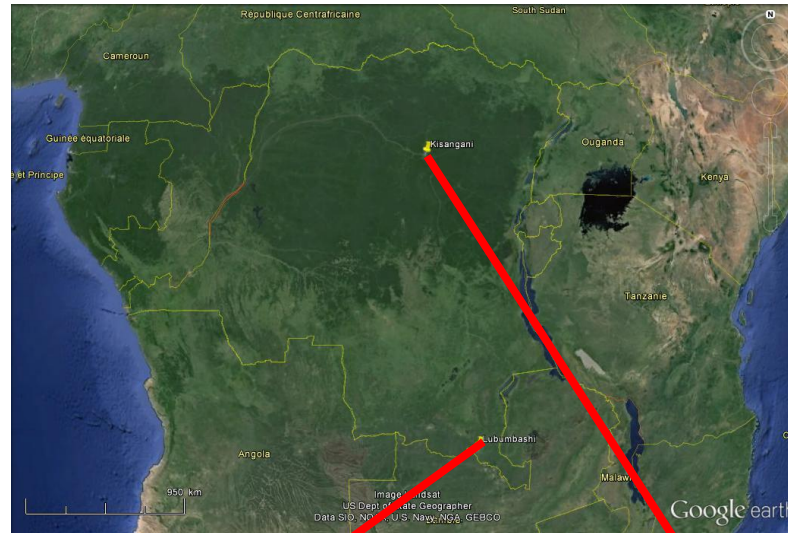
Lubumbashi

Kisangani

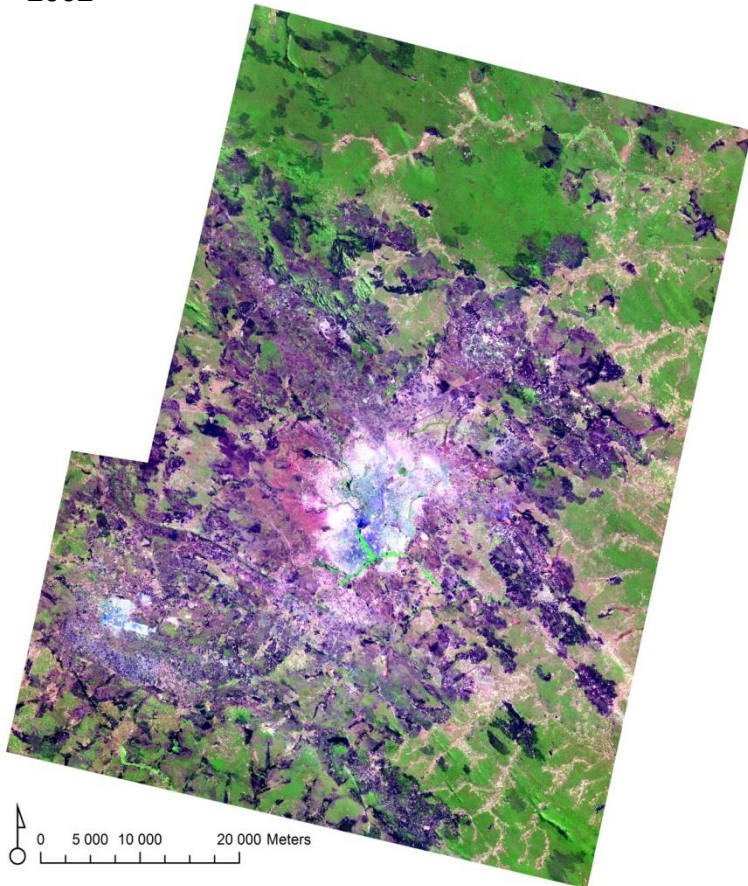# Material: localisation of the two study cases



Lubumbashi



Kisangani

# Method

1. ## Oriented-object classification
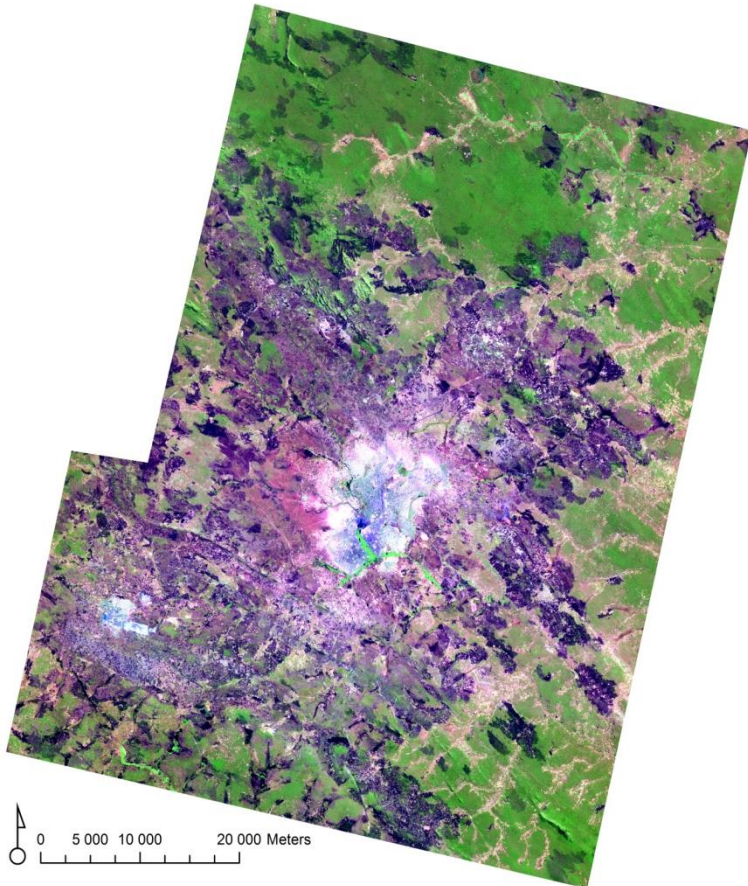
Study zone of Lubumbashi, SPOT Image, July 17, 2002
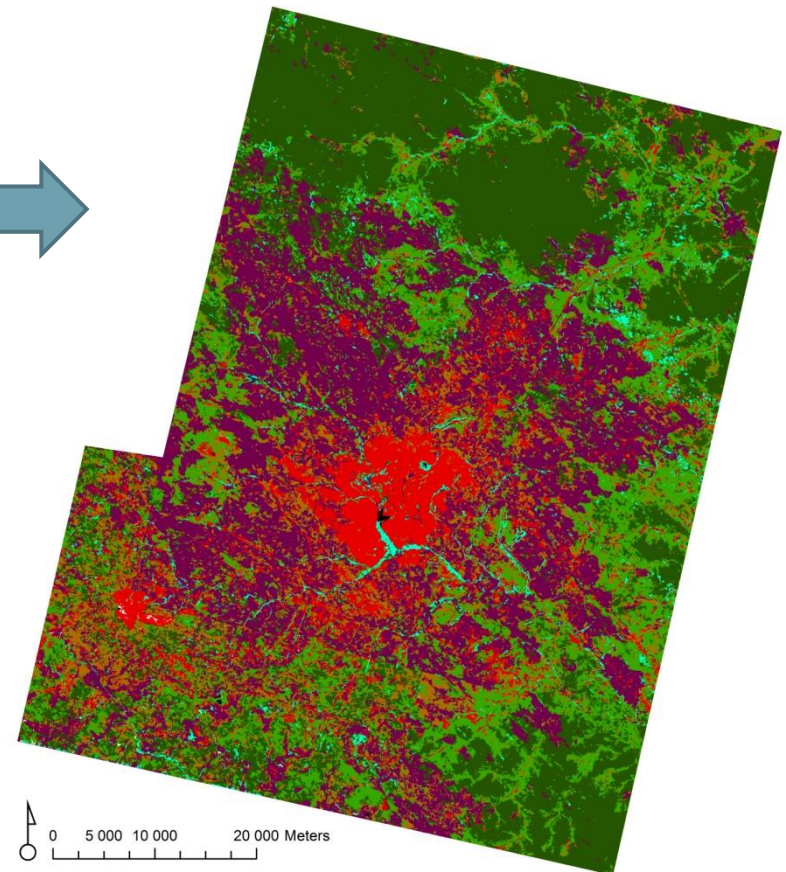


0    5 000  10 000        20 000 Meters

# Method

1. ## Oriented-object classification

**Study zone of Lubumbashi, SPOT Image, July 17, 2002**

Classification, 2002

# Method

1. ## Oriented-object classification

Classification, 2002
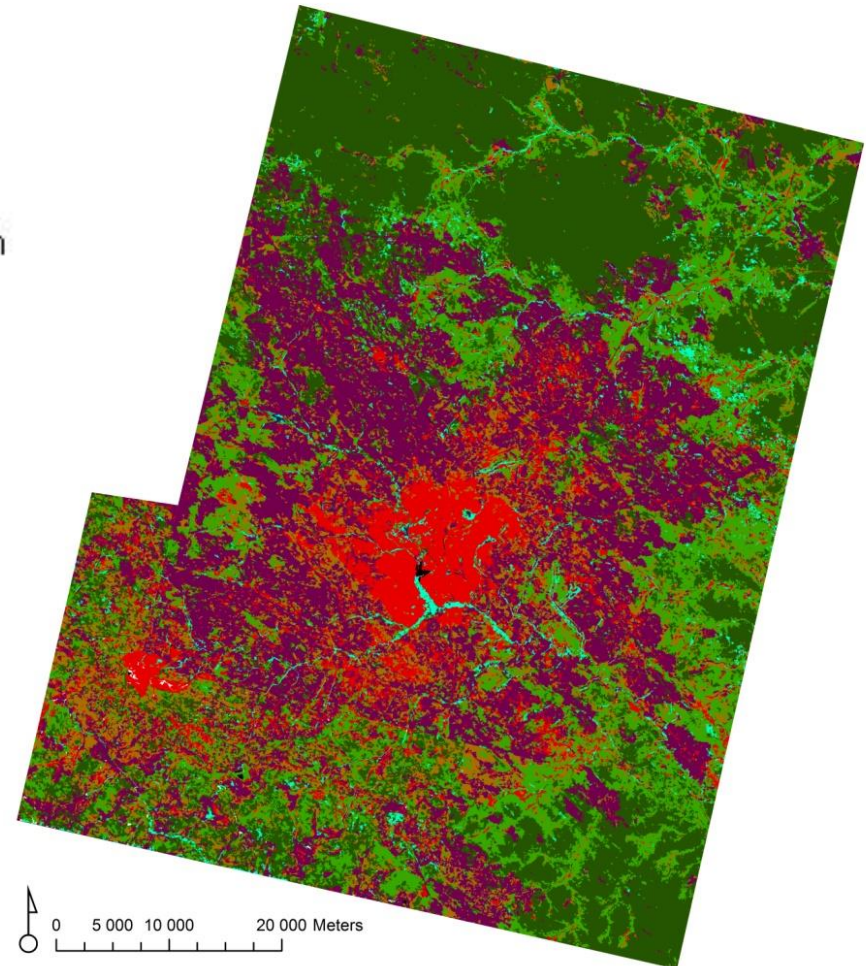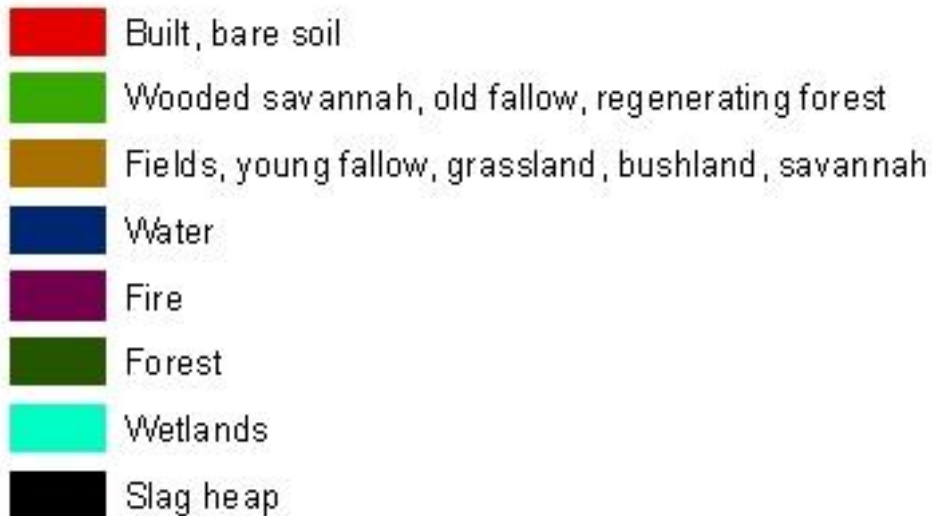
| | |
|---|---|
| 🟥 | Built, bare soil |
| 🟩 | Wooded savannah, old fallow, regenerating forest |
| 🟫 | Fields, young fallow, grassland, bushland, savannah |
| 🟦 | Water |
| 🟪 | Fire |
| 🟩 | Forest |
| 🟦 | Wetlands |
| ⬛ | Slag heap |



0    5 000  10 000          20 000 Meters

# Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics



Study zone of Lubumbashi, SPOT Image, July 17, 2002

0    5 000  10 000           20 000 Meters
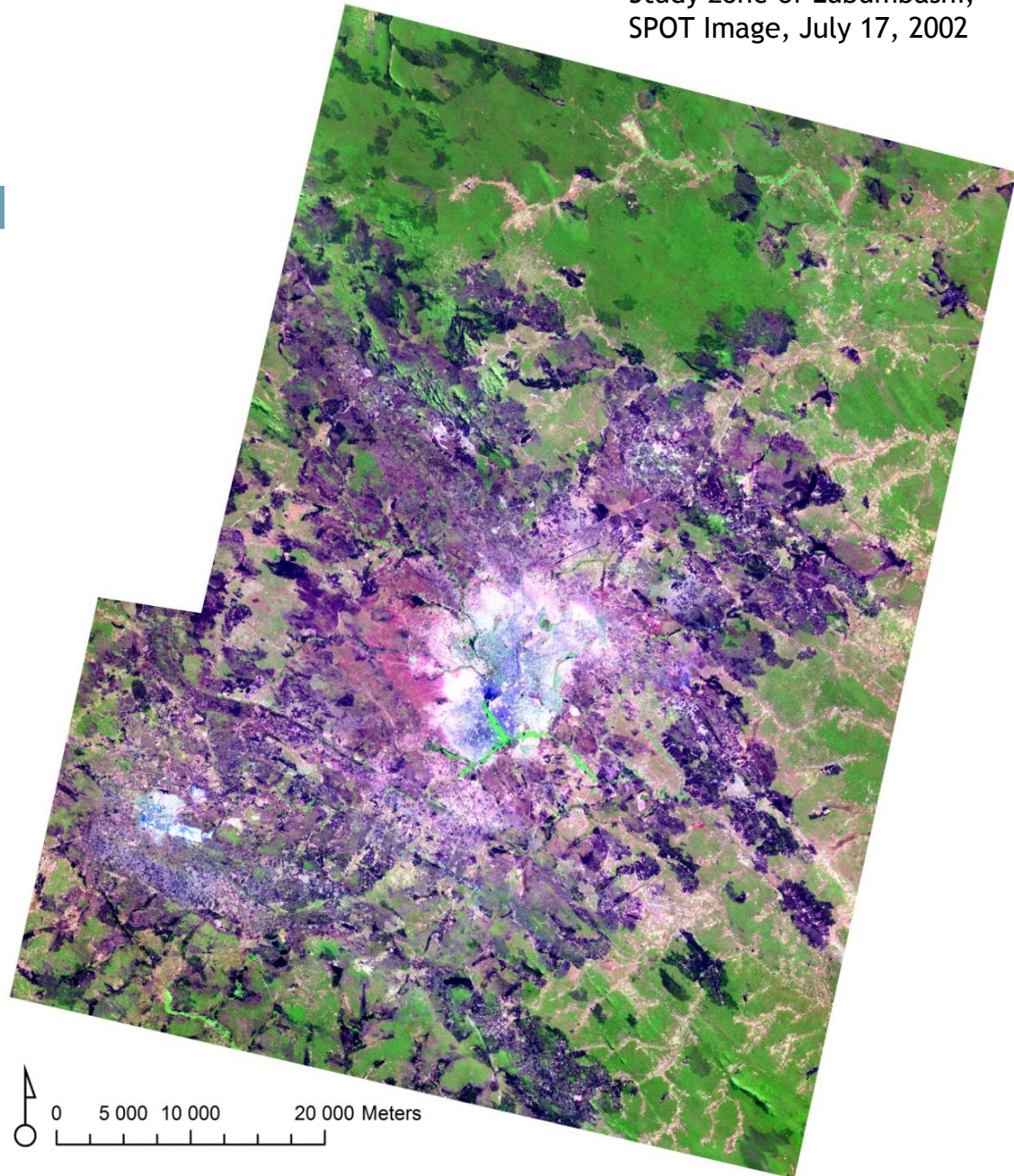
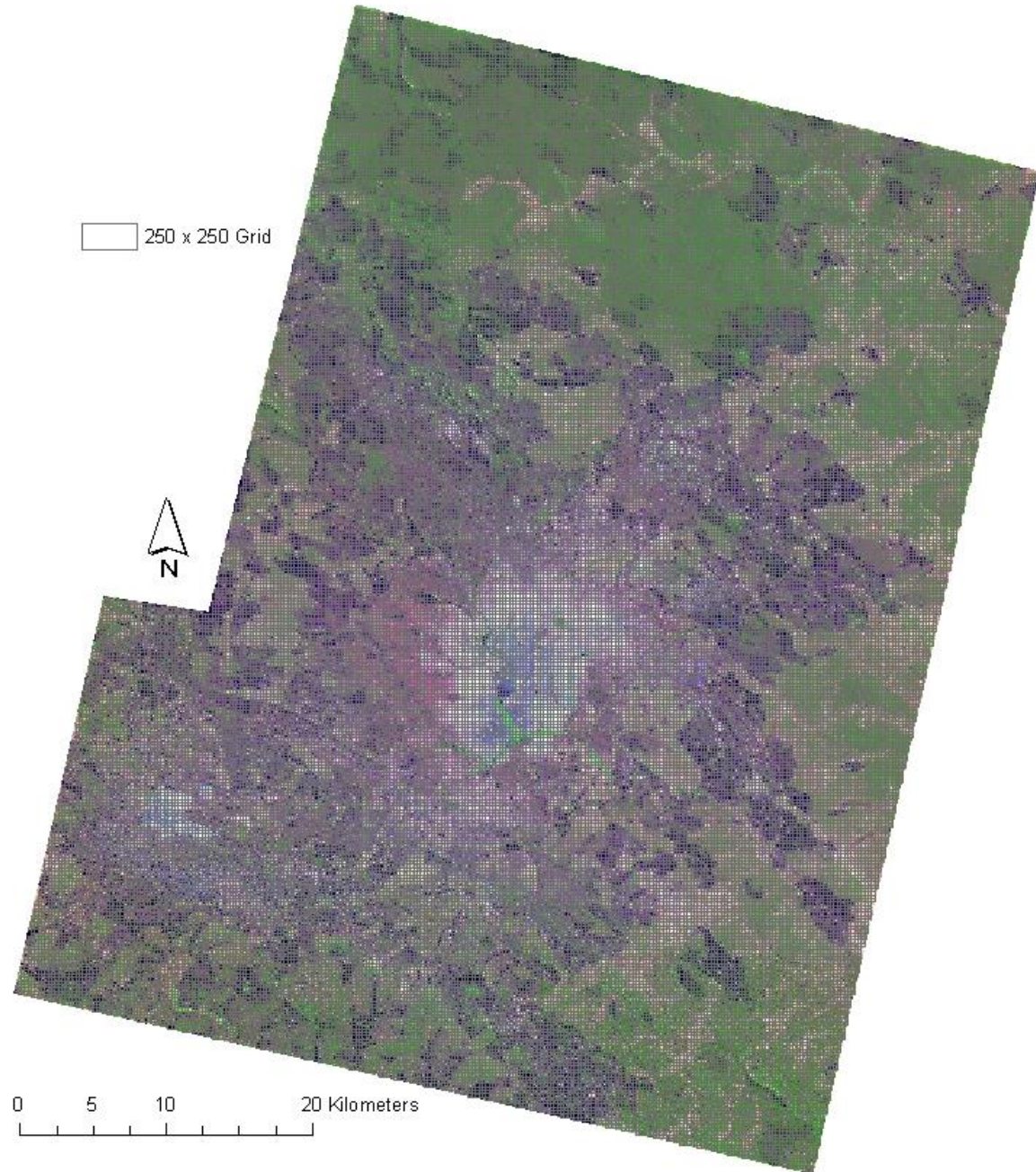# Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

2.1 **Gridding**



250 x 250 Grid

N

0   5   10            20 Kilometers

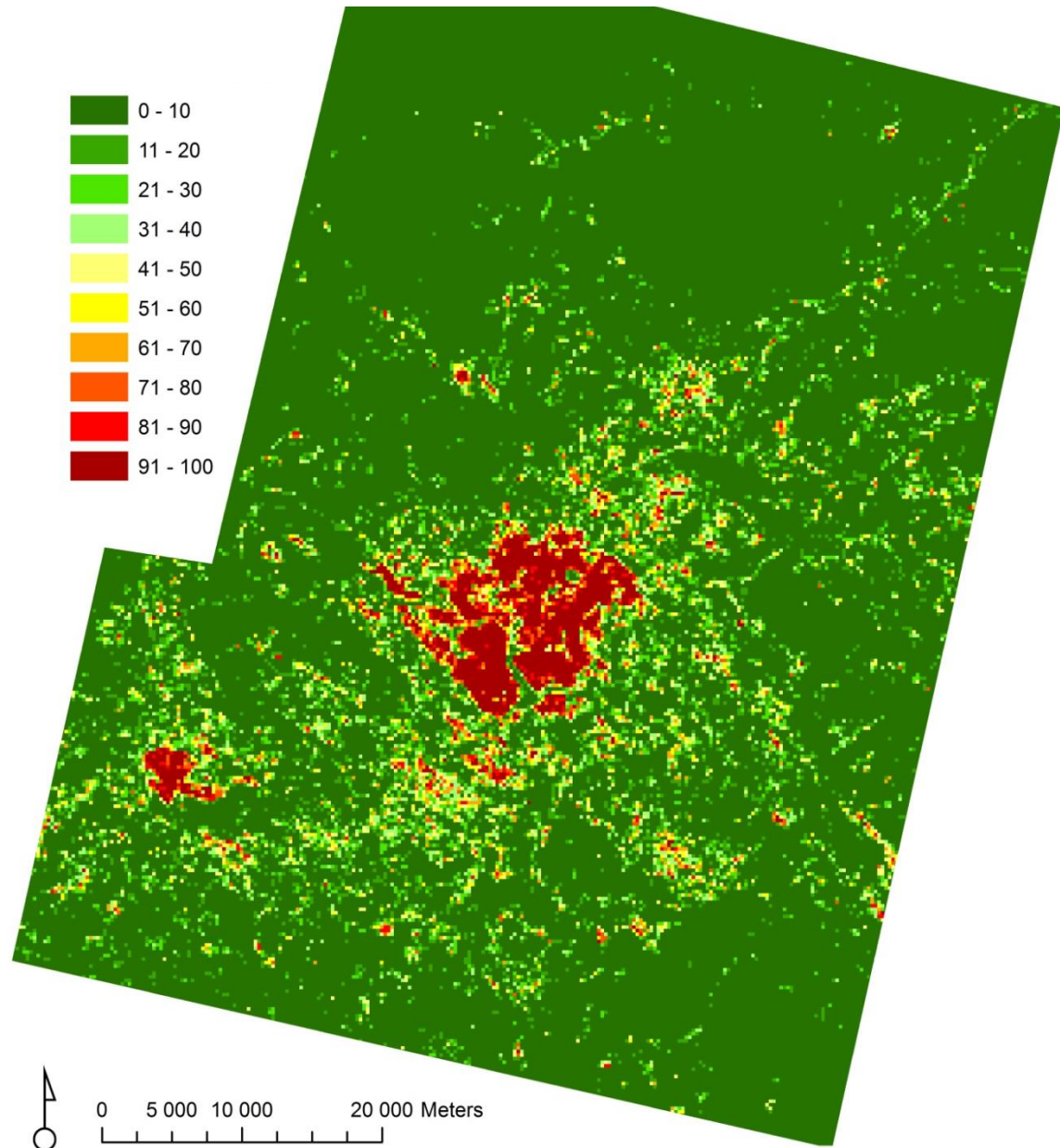# Method

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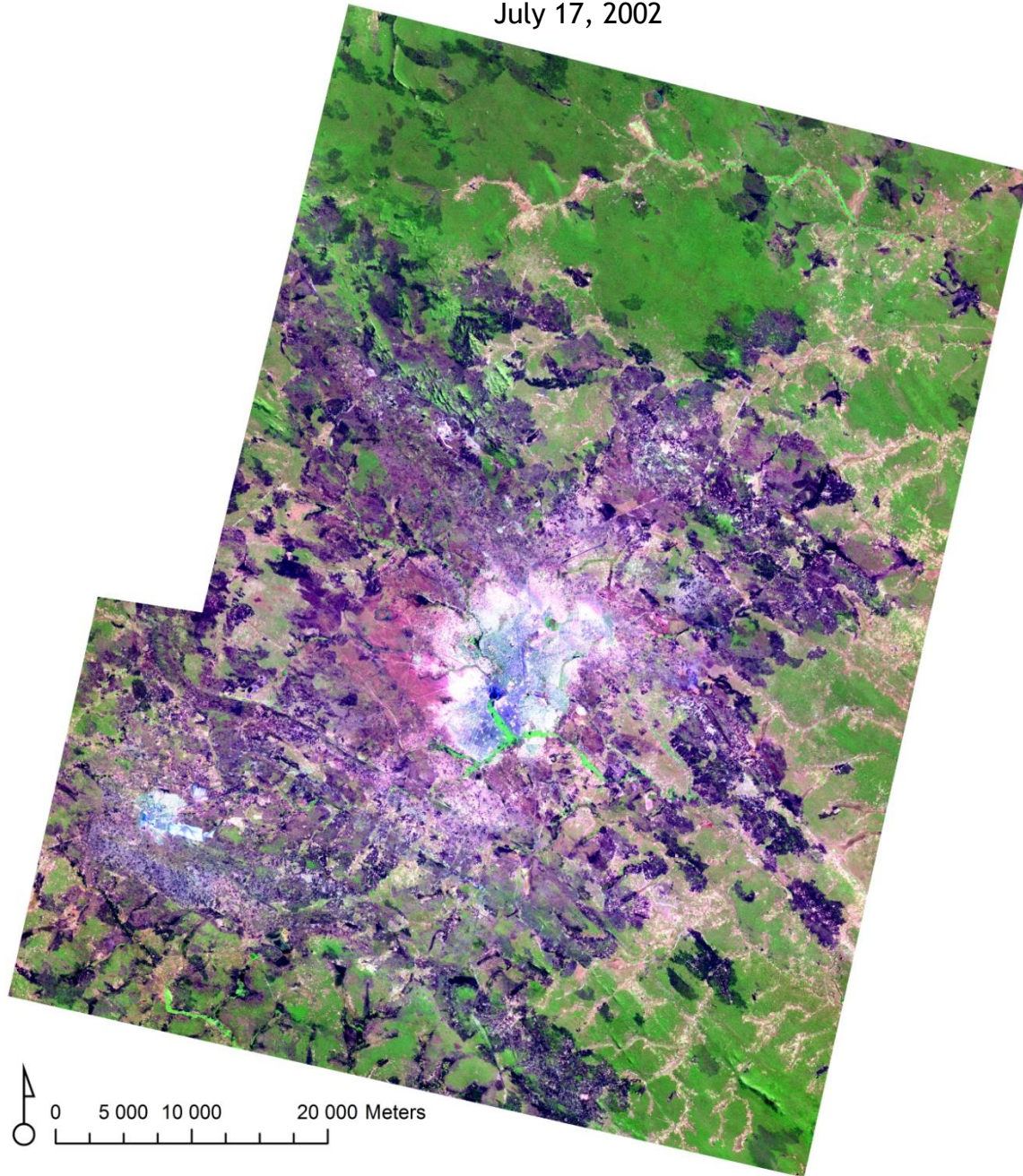
2.2 **Landscape metrics calculation**

Built area proportion (%), 2002



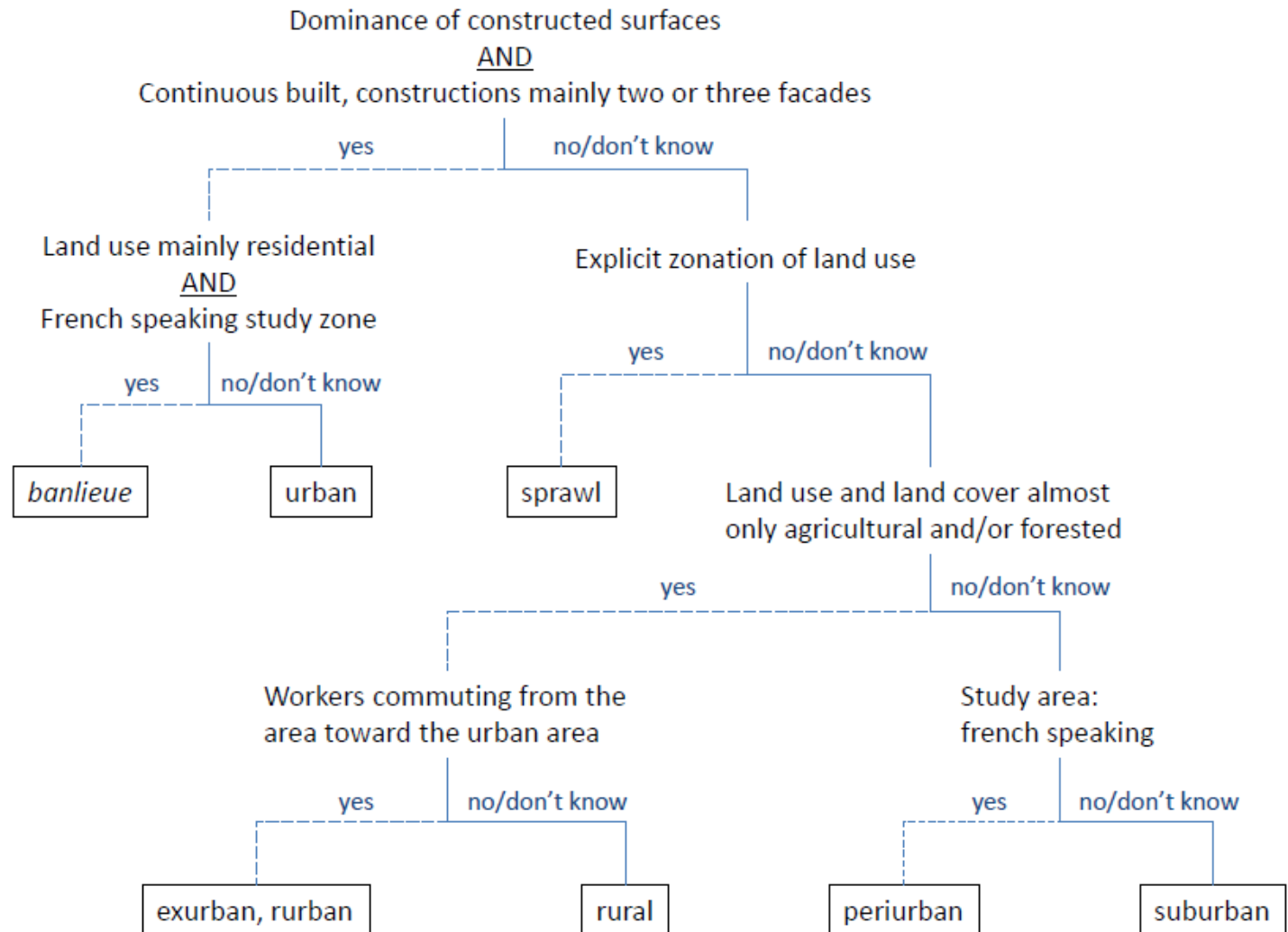| | |
|---|---|
| | 0 - 10 |
| | 11 - 20 |
| | 21 - 30 |
| | 31 - 40 |
| | 41 - 50 |
| | 51 - 60 |
| | 61 - 70 |
| | 71 - 80 |
| | 81 - 90 |
| | 91 - 100 |

0    5 000  10 000        20 000 Meters

# Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

2.3 **Field work: reference points for each area**



Study zone of Lubumbashi, SPOT Image, July 17, 2002

0    5 000  10 000        20 000 Meters
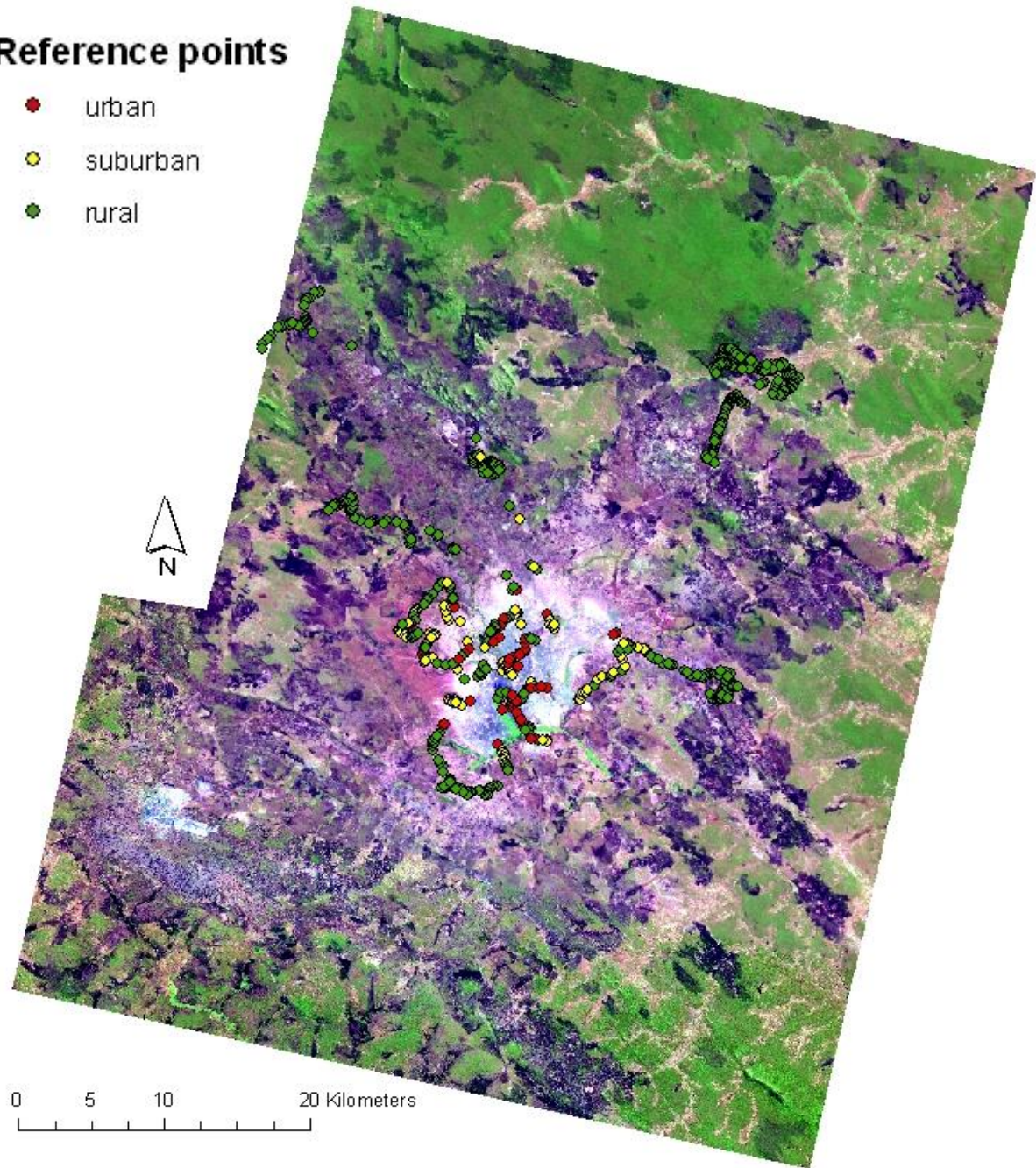
# Method

André *et al.*, in press

# Method

2. Describe each area (urban, suburban, rural) within the urban-rural gradient with morphological characteristics

   2.3 **Field work reference points for each area**
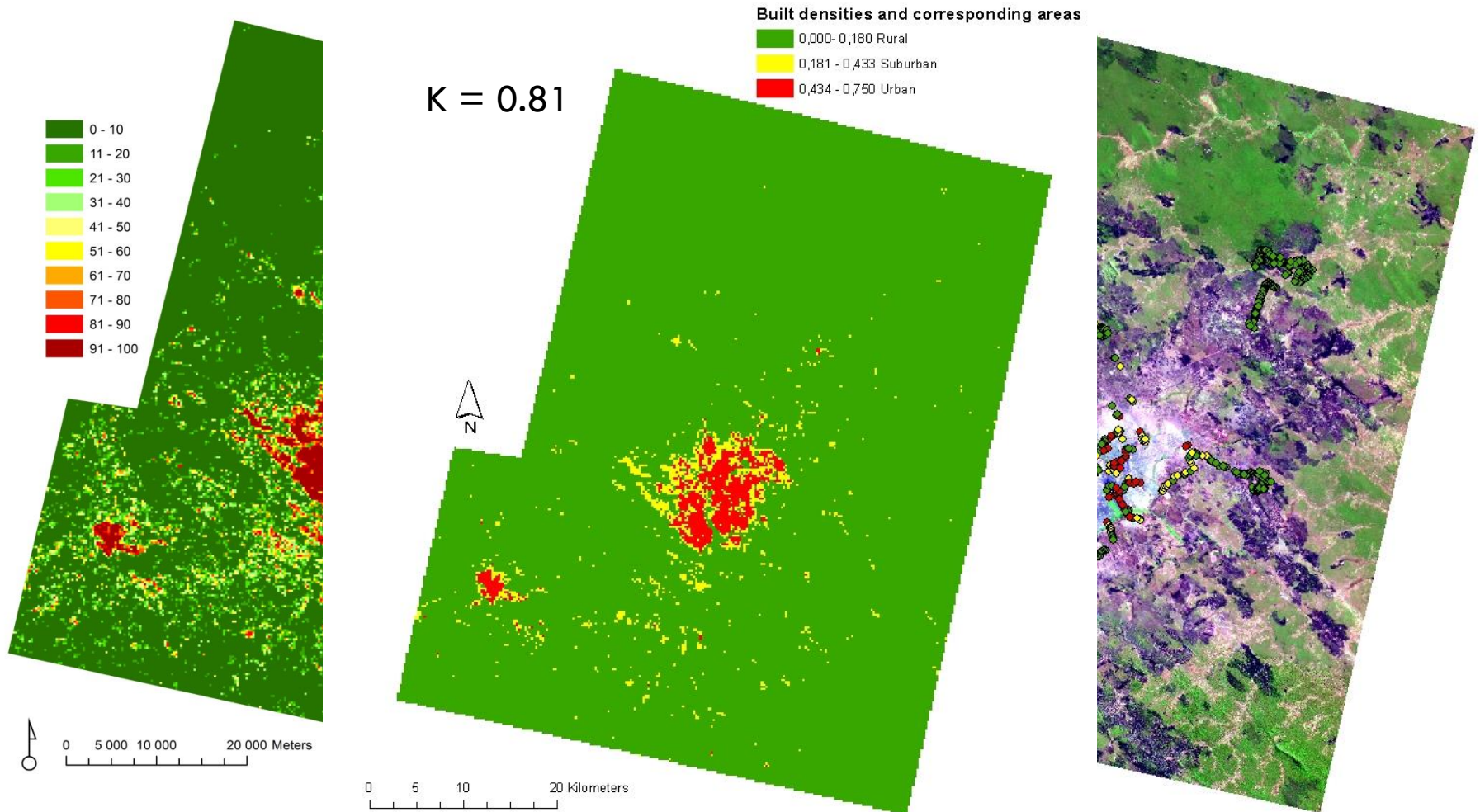


Reference points
- urban
- suburban
- rural

N

0    5    10         20 Kilometers
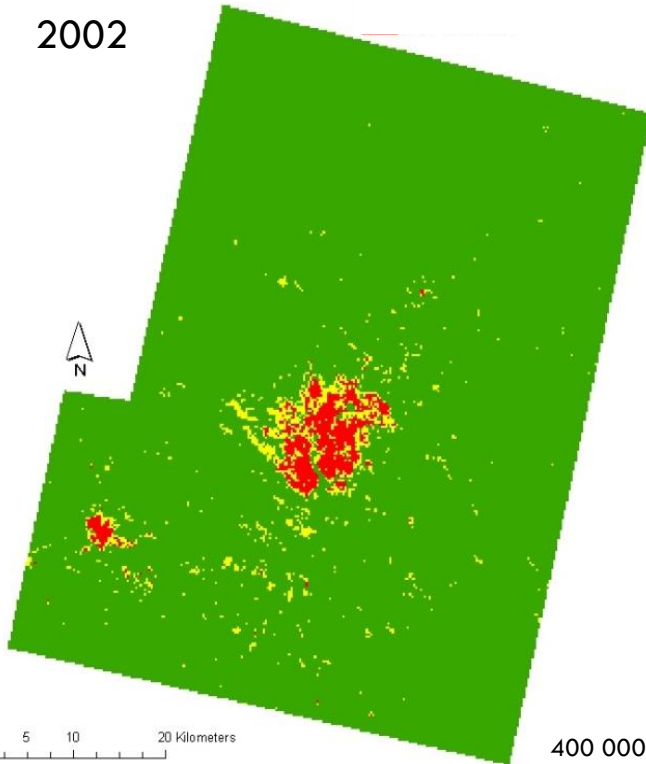
# Method

2.4     **Recursive segmentation**



K = 0.81

Built densities and corresponding areas
- 0,000- 0,180 Rural
- 0,181 - 0,433 Suburban
- 0,434 - 0,750 Urban

0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100

N

0   5 000  10 000      20 000 Meters

0      5      10        20 Kilometers

3/5

# Results

# Results - Lubumbashi

2002

2008(09)

Built densities and areas



0,000- 0,180 Rural
0,181 - 0,433 Suburban
0,434 - 0,750 Urban

- 2.2 %

+ 1.5 %

+ 0.7 %

400 000

300 000

200 000

100 000

0

rural    suburban    urban
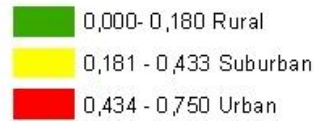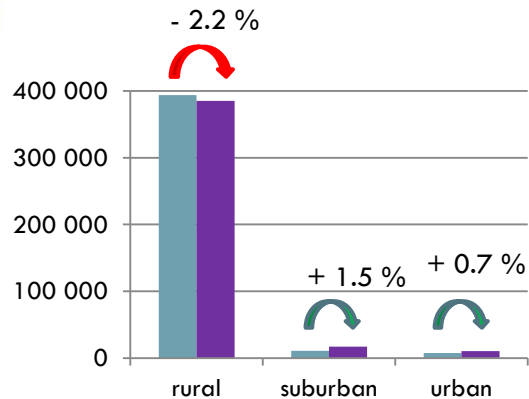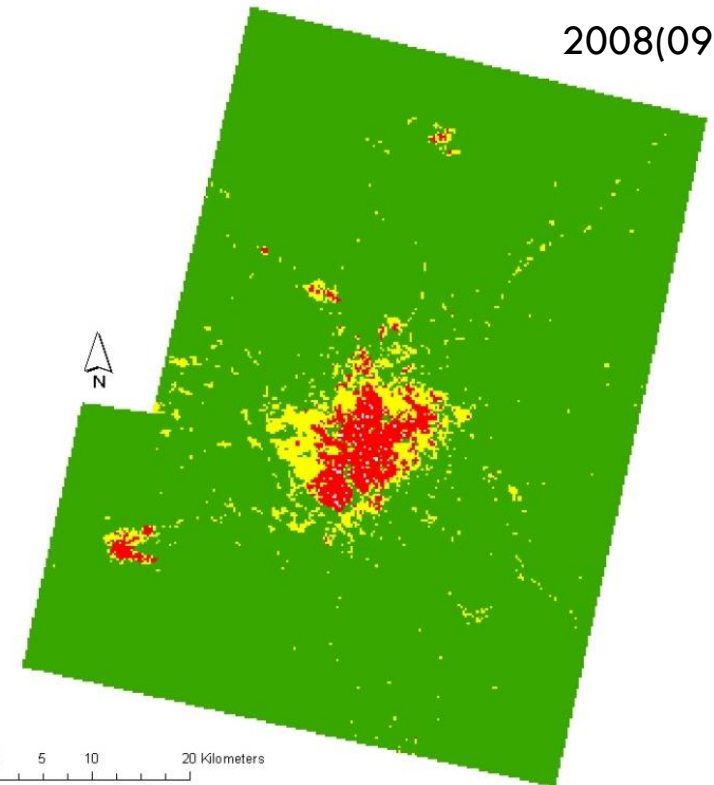
Area 2002 (Ha)
Area 2008&09 (Ha)

# Results - Lubumbashi

2002 - 2008(09) New suburban



0    5    10         20 Kilometers
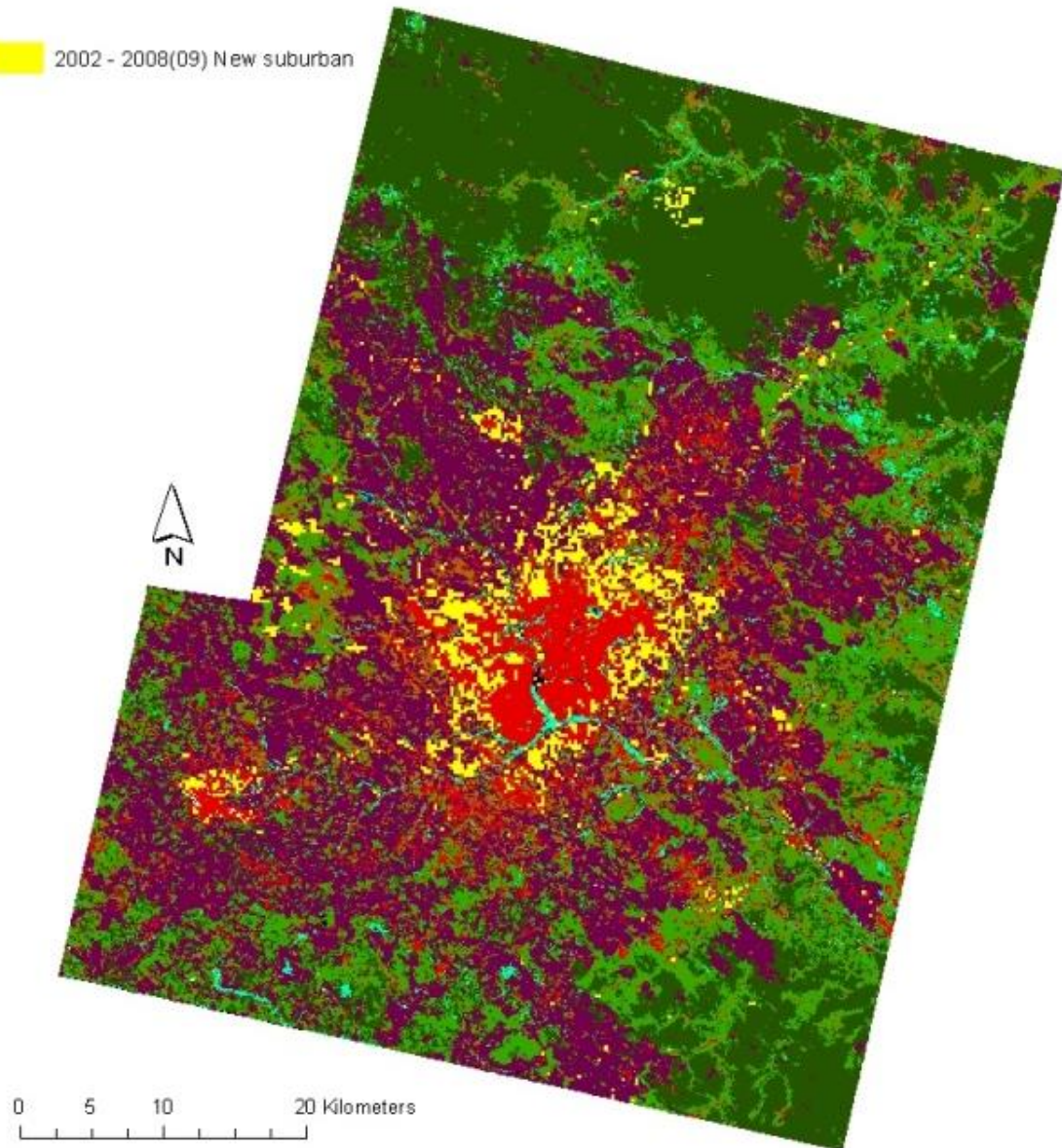
# Results - Lubumbashi

2002 - 2008(09) New Urban
2002 - 2008(09) New suburban
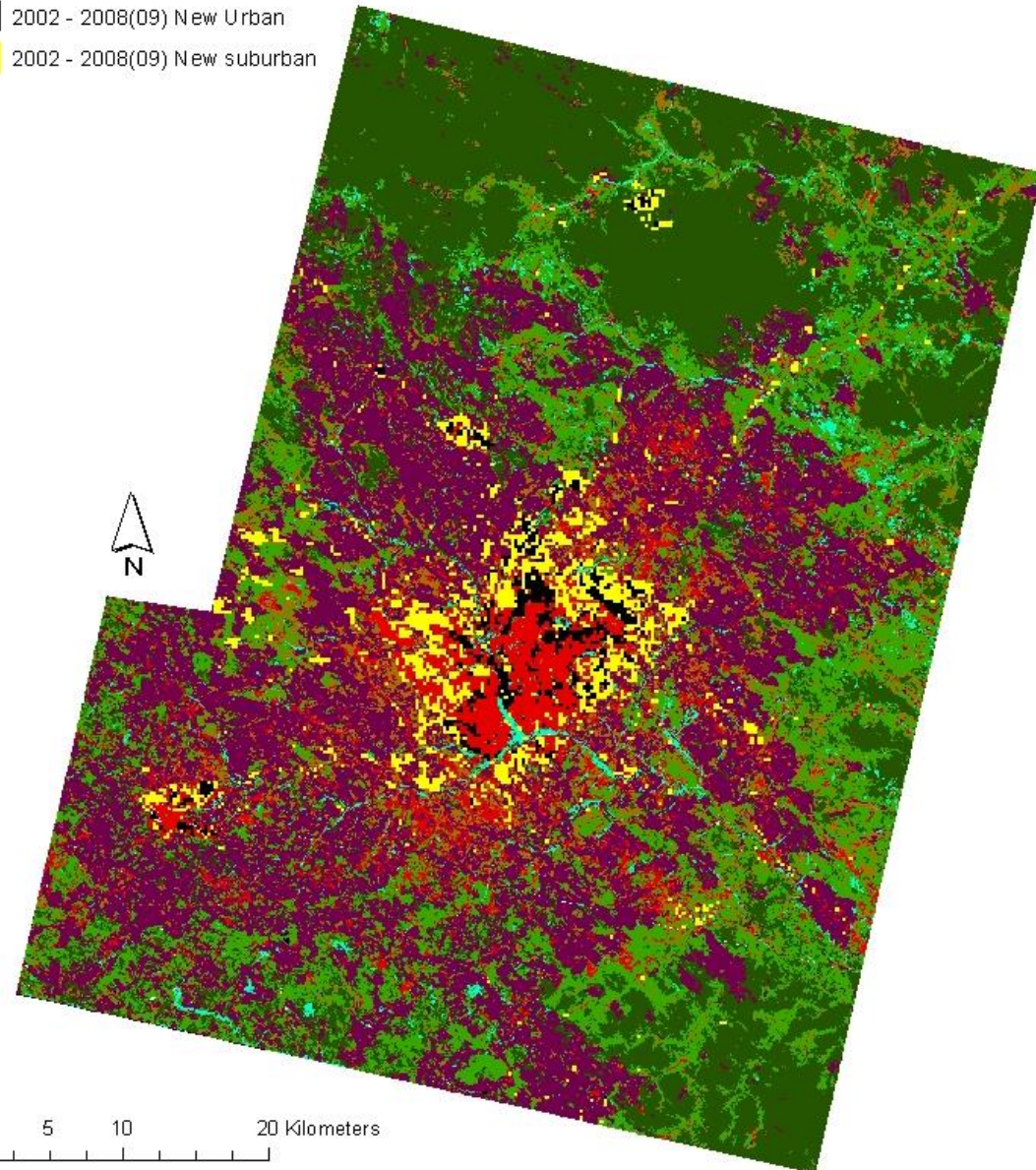
N

0    5    10         20 Kilometers

# Results - Lubumbashi

**Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)**



- Burned areas
- Built
- Fields, young fallow, grassland, bushland, savannah
- Wooded savannah, olf fallow, regenerating forest
- Forest
- Wetlands
- Water
- Slag heap
- Unclassified

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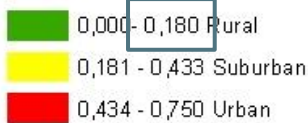- Forest
- Wetlands
- Water
- Slag heap
- Unclassified
- urban

# Results - Kisangani

2002

2010

**Built densities and areas**



Legend:
- 0,000 - 0,180 Rural
- 0,181 - 0,433 Suburban
- 0,434 - 0,750 Urban

- 0.2 %

- 0.1 %    + 0.3 %

rural    suburban    urban

■ Area 2002 (Ha)
■ Area 2010 (Ha)
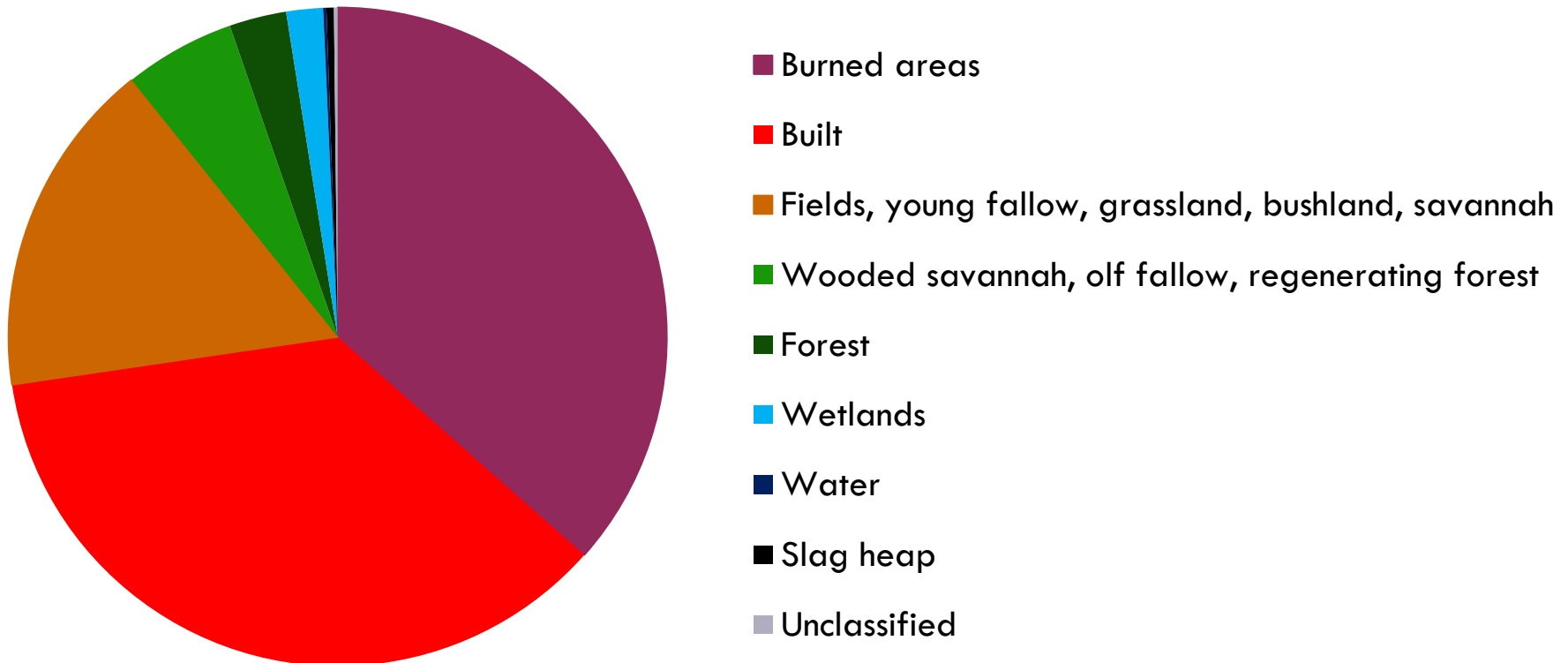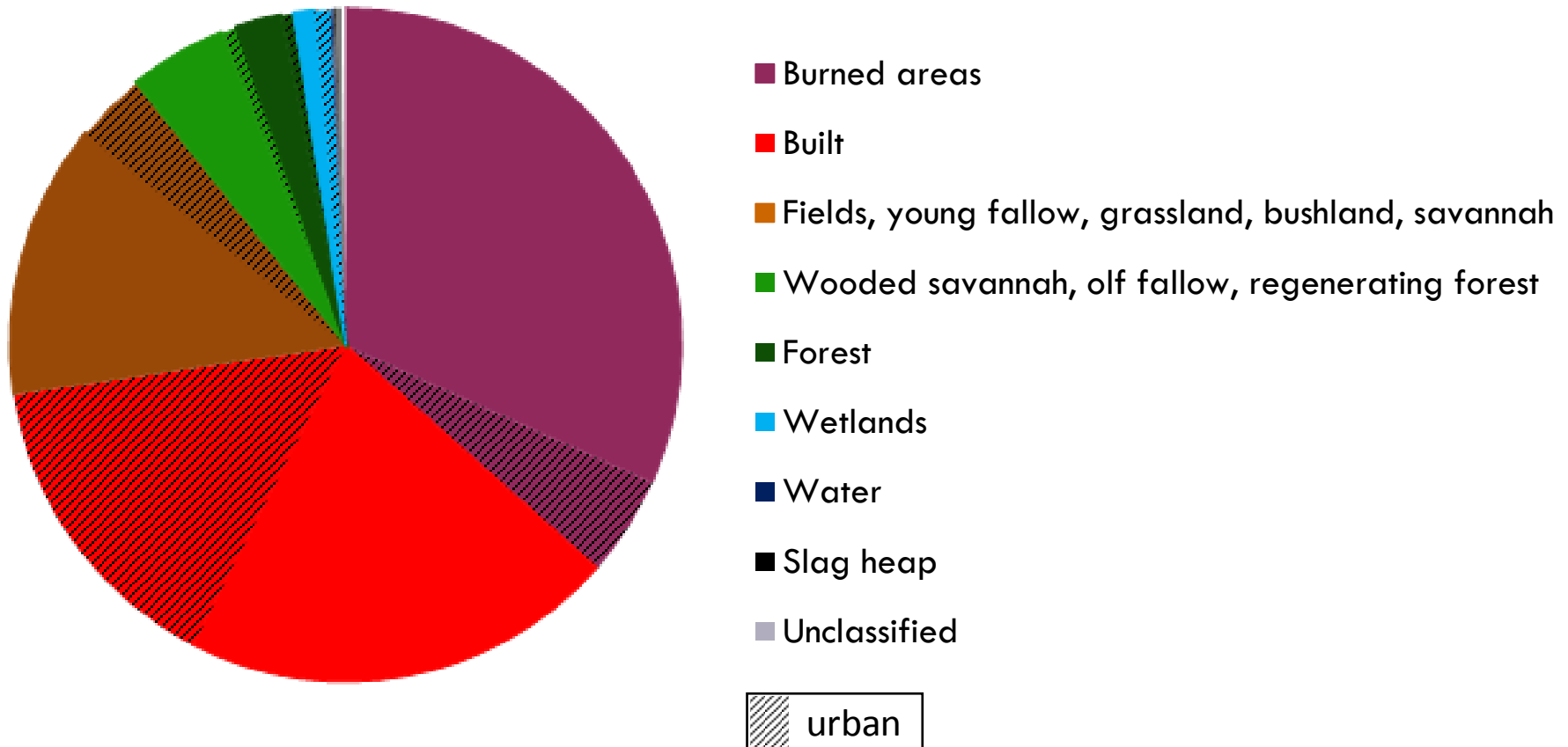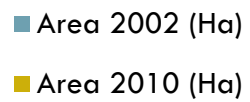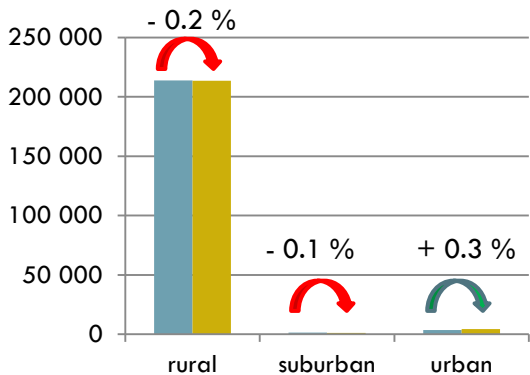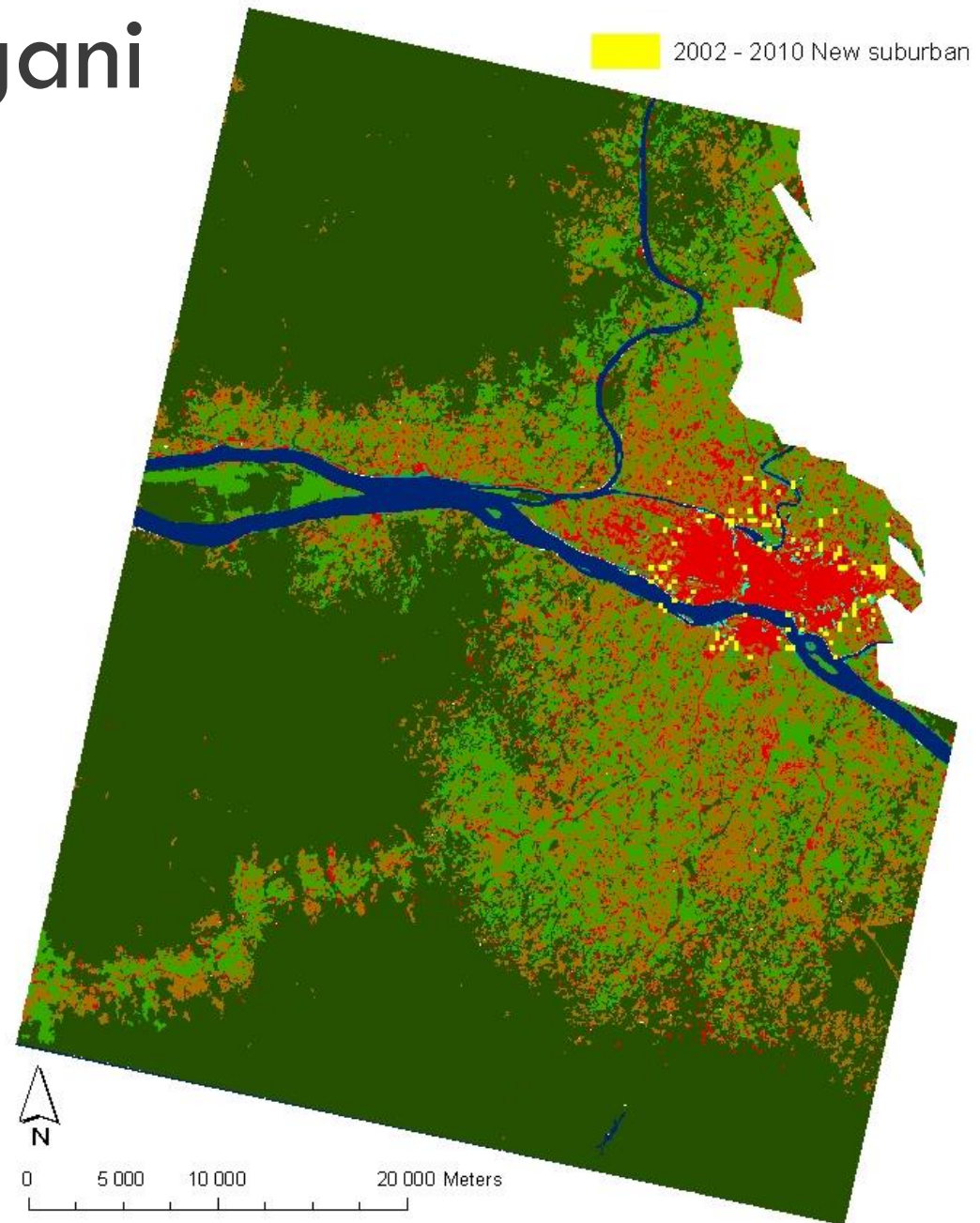
# Results - Kisangani

2002 - 2010 New suburban
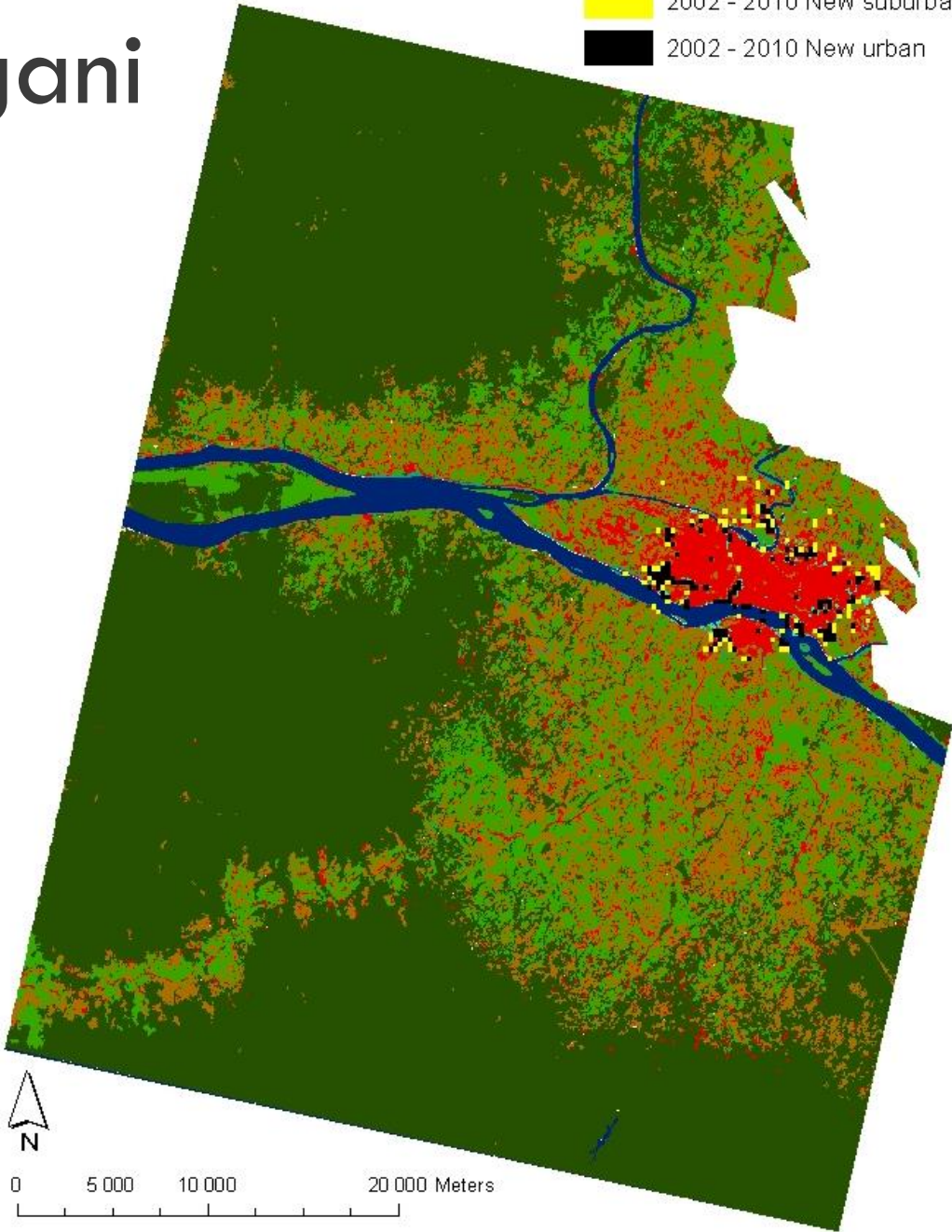
N

0     5 000     10 000          20 000 Meters

# Results - Kisangani

Legend:
- 2002 - 2010 New suburban (yellow)
- 2002 - 2010 New urban (black)

0    5 000    10 000    20 000 Meters

# Results - Kisangani

**Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)**



- ■ Fields, young fallow and bamboos
- ■ Built
- ■ Ponds and wetlands
- ■ Water
- ■ Old fallow and secondary forest
- ■ Burned areas and bare soil
- ■ Floating vegetation
- ■ Unclassified
- ■ Primary forest

# Results - Kisangani

**Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)**



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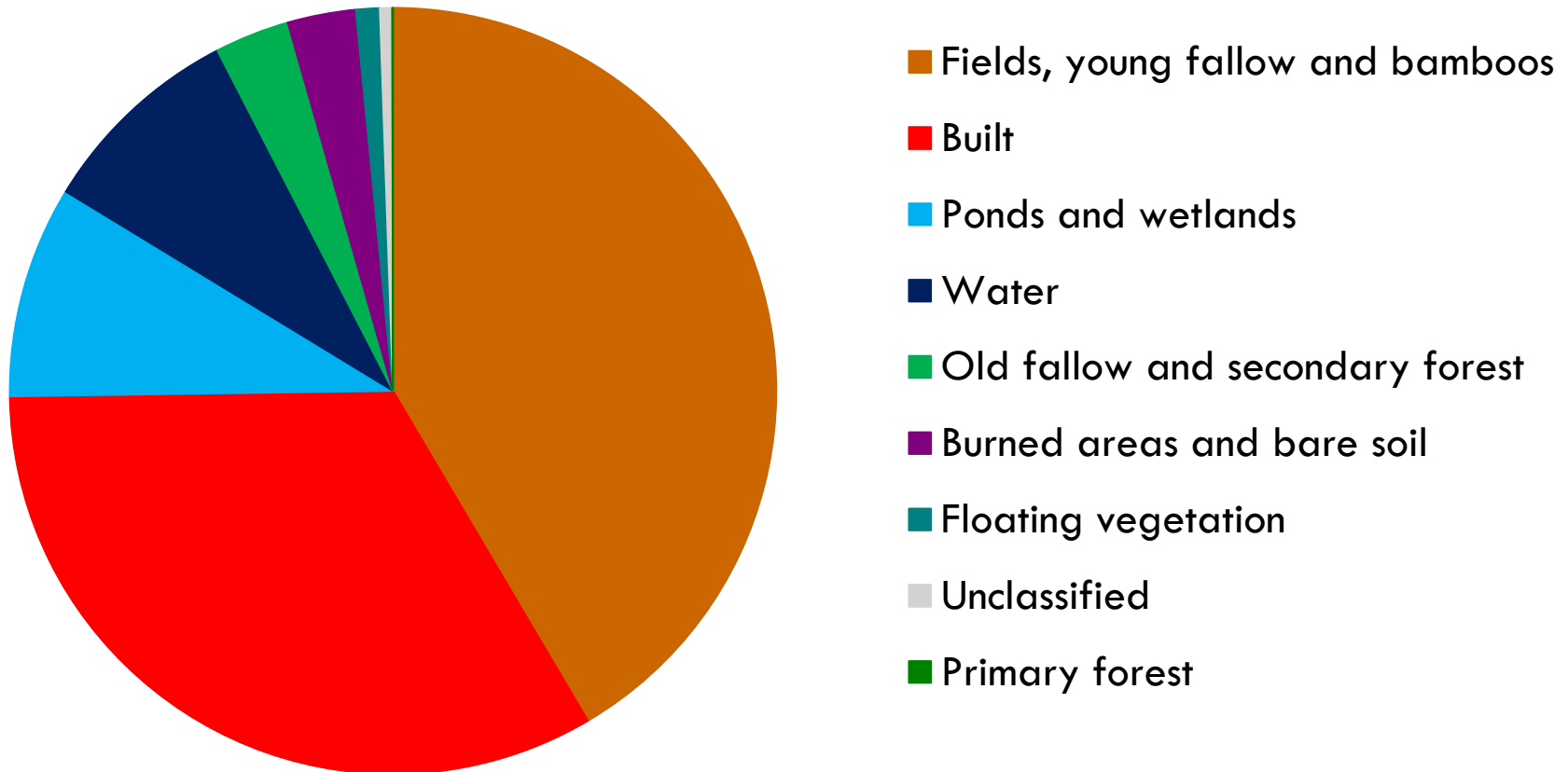
urban
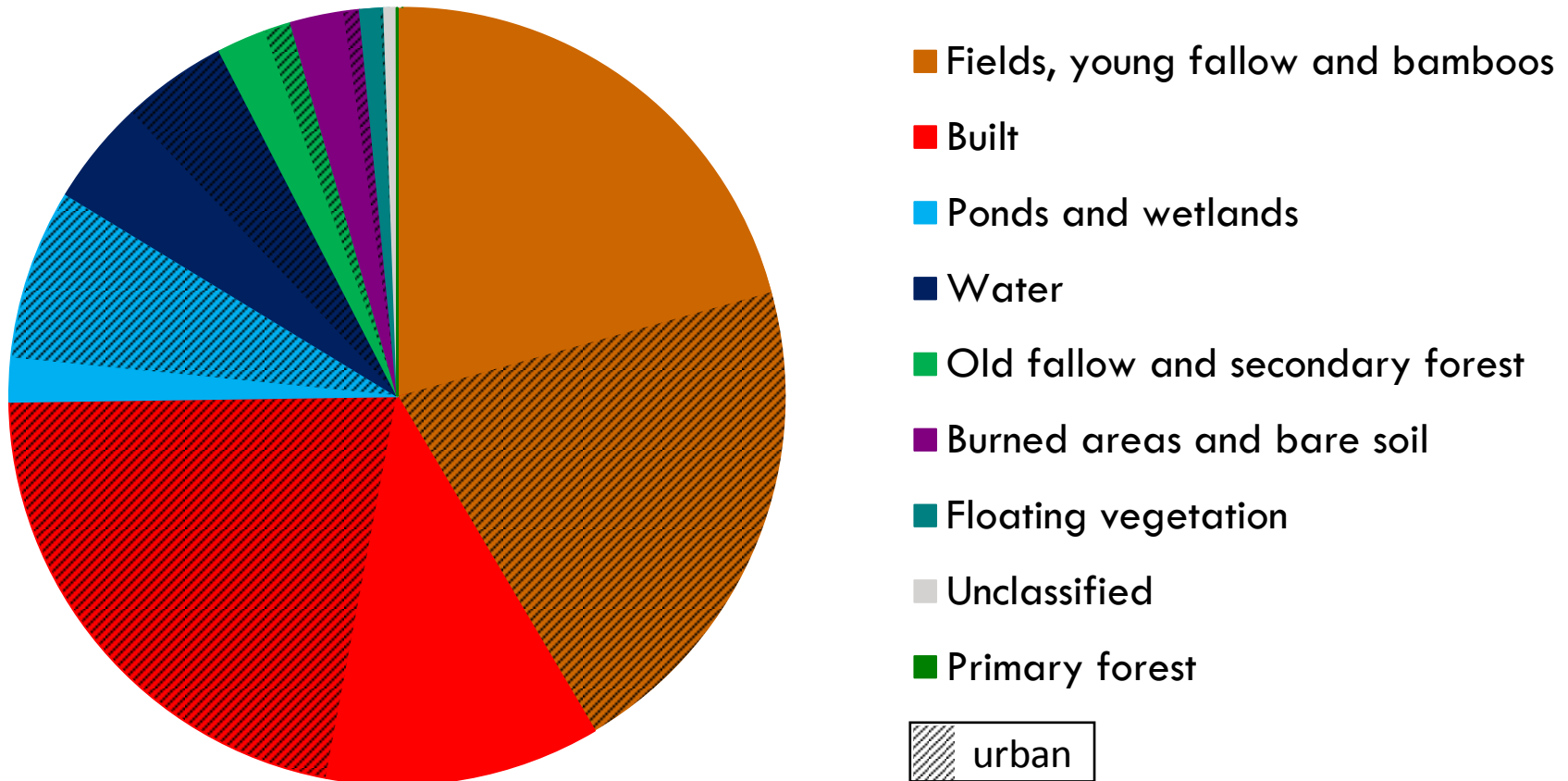
$5/5$ Discussion and conclusions

# Discussion and conclusion

- Thresholds depend on the spatial resolution of the images and on the accuracy of the classification

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- ☐ Burned areas = fields and fallow land?

# Discussion and conclusion

□ Thresholds depend on the spatial resolution of the images and on the accuracy of the classification

□ Burned areas = fields and fallow land?

□ Different cities, different dynamics

# Discussion and conclusion

1. **Quantify the dynamic of the different areas** (urban, suburban, rural) in the urban-rural gradient **during the last decade**
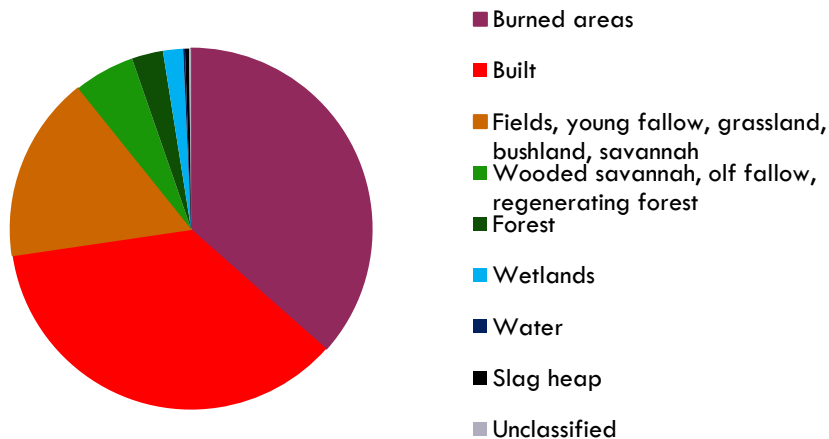
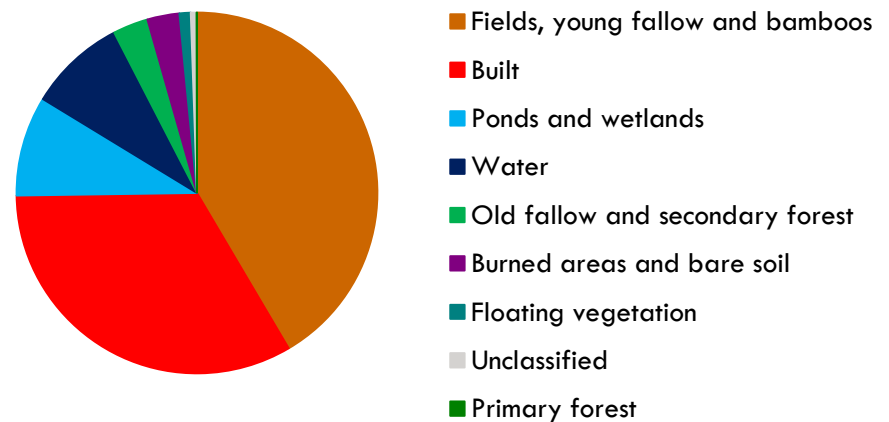| Diff (Ha) | Lubumbashi | Kisangani |
|---|---|---|
| rural | -9 013 | -431 |
| suburban | 6 256 | -275 |
| urban | 2 756 | 706 |

# Discussion and conclusion

2. **Quantify the effect of a decade of urbanization on ecosystems**

**Lubumbashi: Repartition of the landscape classes in the surface of expansion of the urban and suburban areas (%)**



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# Thanks for your attention!

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