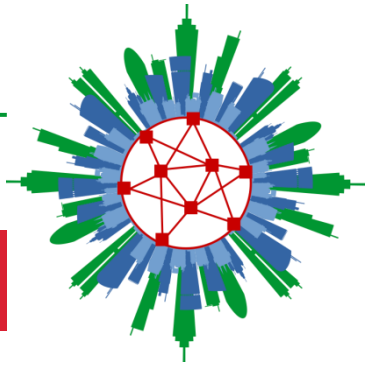
SuMoCoS

Sustainability and Mobility in the Context of Smart Cities



Green area change study in Central Ulaanbaatar using very high resolution QuickBird images

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Introduction

- At present, nearly half of the world's population lives in urban areas.
- 2050:
  - 68% of the world's population
  - 43 megacities
  - 10 million < inhabitants (United Nations).

Introduction

- Major environmental concerns
  - quality of air
  - limited land resources
  - loss of green areas.
- Green areas → impervious surfaces (asphalt, road highways, and roofs) → Serious environmental problems

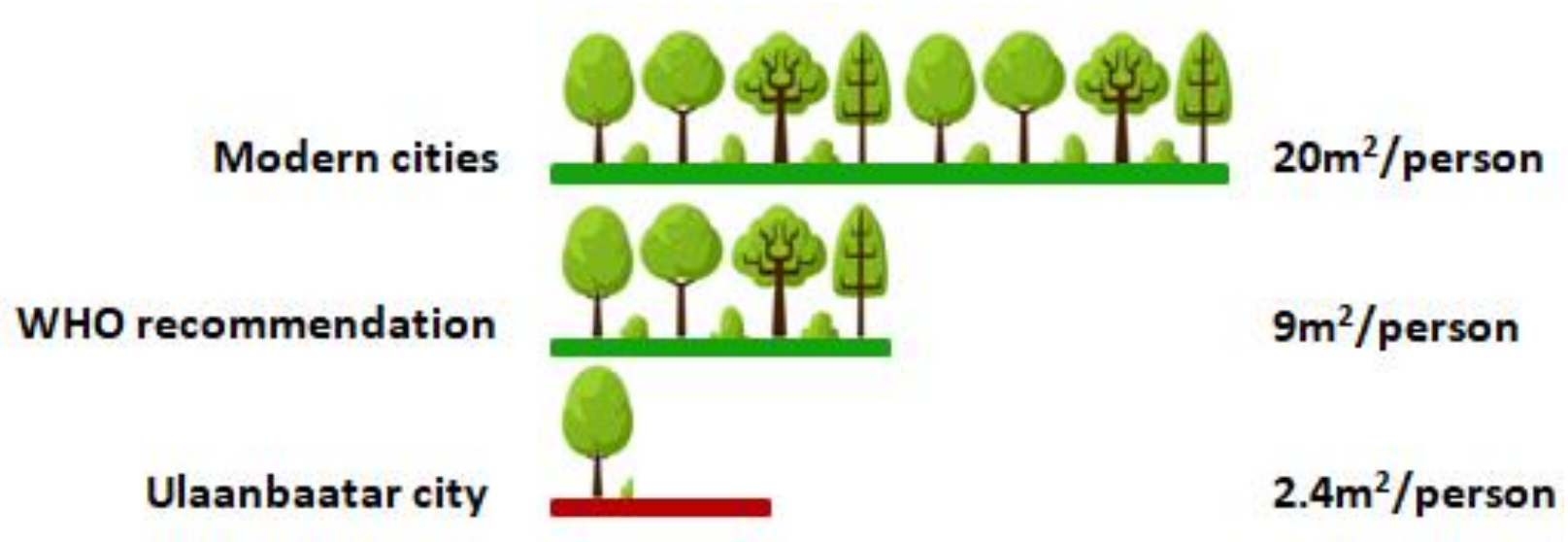
Introduction

- **Green roofs act as sinks for CO2**
- 100m2 green roof:
  - Reduce 1.8 tones of gas per year
  - Produce the oxygen needed by 100 people in a year
  - Retain 40% of rainwater

https://www.governmentnews.com.au/urban-forests-melbournes-plan-to-green-the-city

Green spaces can reduce the ambient temperature of cities by 1°C, thus reducing the urban heat island and harmful city smog.

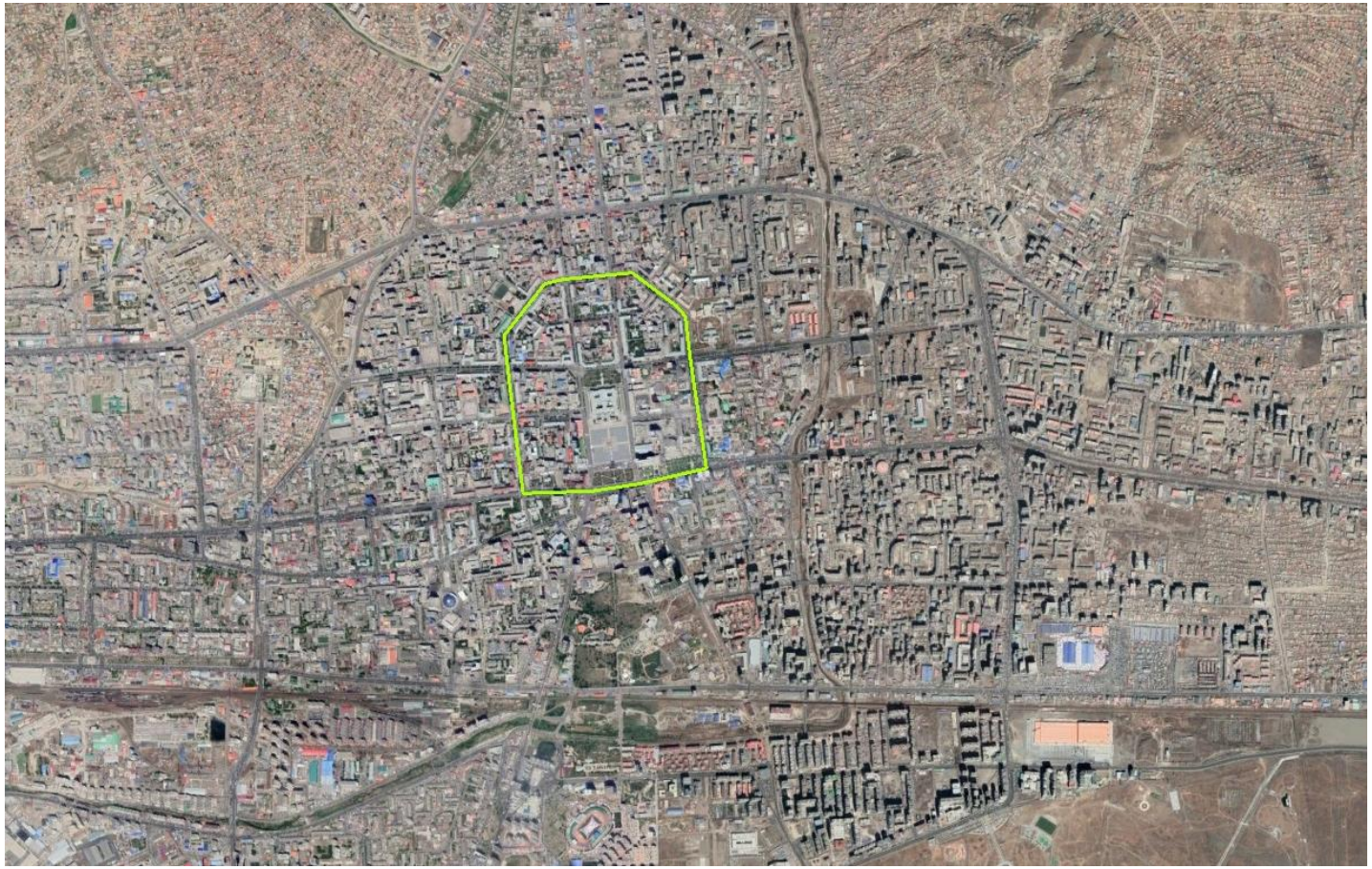
Introduction



- Conduct a green area change study in central area of Ulaanbaatar, the capital city of Mongolia using multitemporal very high resolution remote sensing images.

Study area

- Central Ulaanbaatar
  - Area: 85 ha

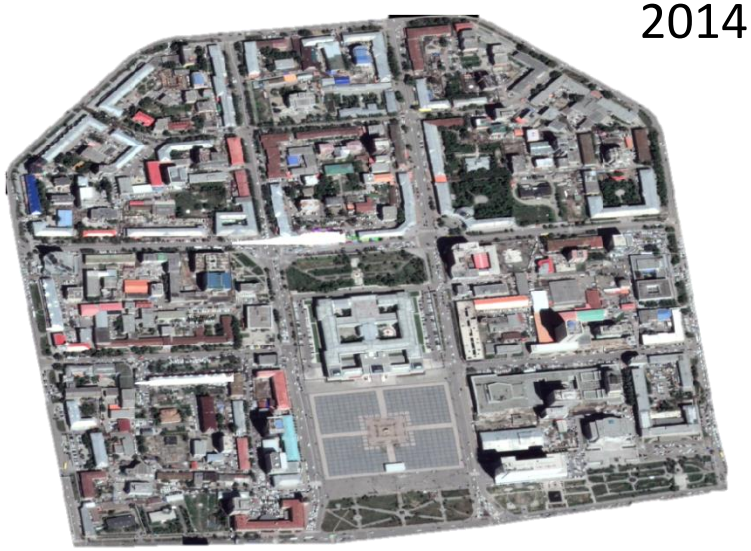


Dataset

2006

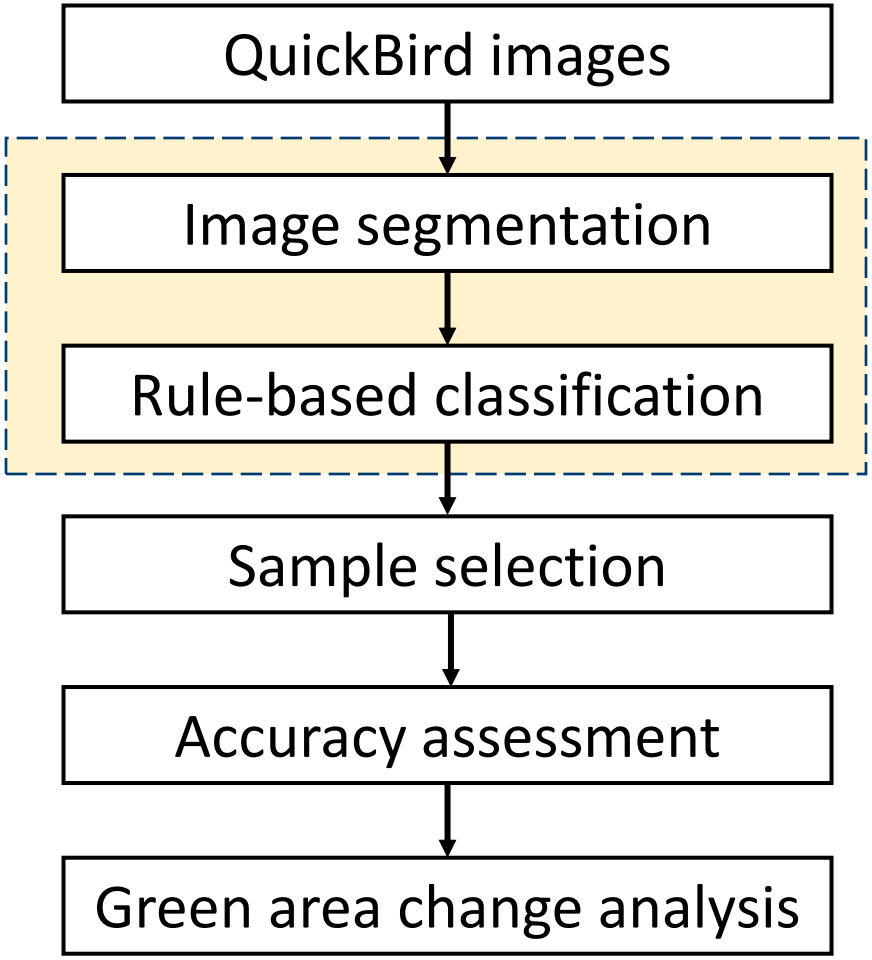
2009

2014



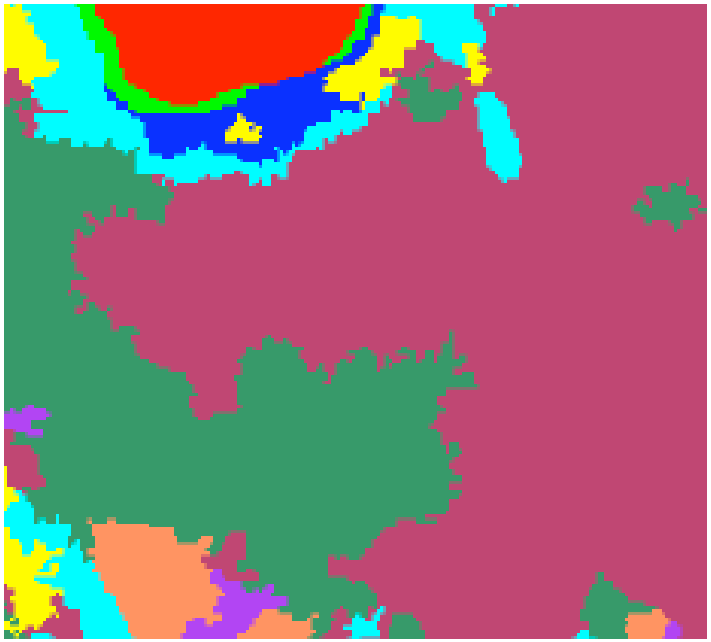
2019

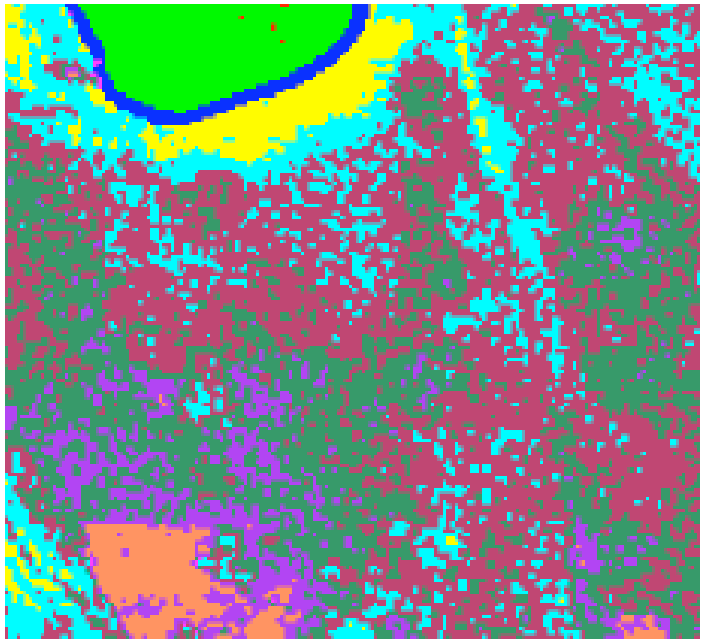
Methodology



Methodology

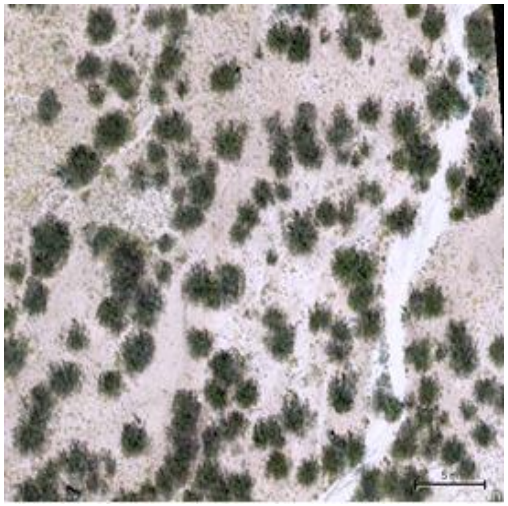
- In contrast to pixel-based classification methods that classify individual pixels directly, object-based classification first aggregates image pixels into spectrally homogenous image objects using an image segmentation algorithm and then classifies the individual objects.

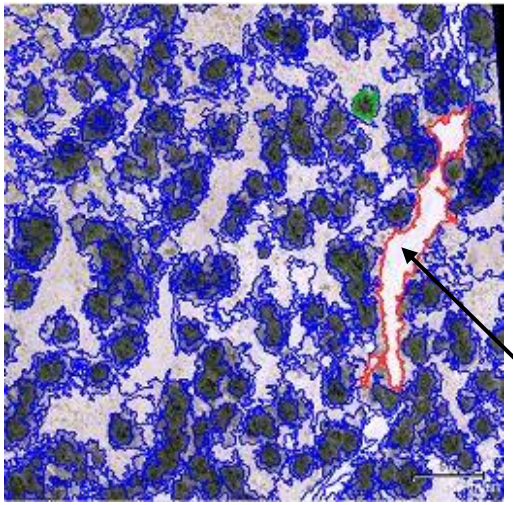




Methodology

- **Segmentation:** Break the image up into objects representing land-based features.





- Chessboard segmentation
- Quadtee based segmentation
- Contrast split segmentation
- **Multiresolution segmentation** etc.

Methodology

- **Multiresolution segmentation:** Produce homogenous image objects by grouping pixels.

- **Parameters:**
  - ✓Scale
  - ✓Shape
  - ✓Compactness

  - The Estimation of Scale Parameter (ESP) tool iteratively generates image-objects at multiple scale levels in a bottom-up approach.

Methodology

- **Classification:** Classify those objects using their shape, size, spatial and spectral properties.
  - Green area
  - Impervious surface

Name	Description	Reference
Brightness	Mean value of the means of band 1–4 and intensity among pixel	
CIVE (Color Index of Vegetation Extraction)	0.441 * Red – 0.811 * Green + 0.358 * Blue + 18.78745	Katoka et al, 2013
GLI (Green Leaf Index)	(2 * Green – Red – Blue) / (2 * Green +Red + Blue)	Louhaichi et al, 2001
ExG	2 * G – R – B (G, R and B are the normalized red, green and blue band values)	Woebbecke, 1995

Methodology

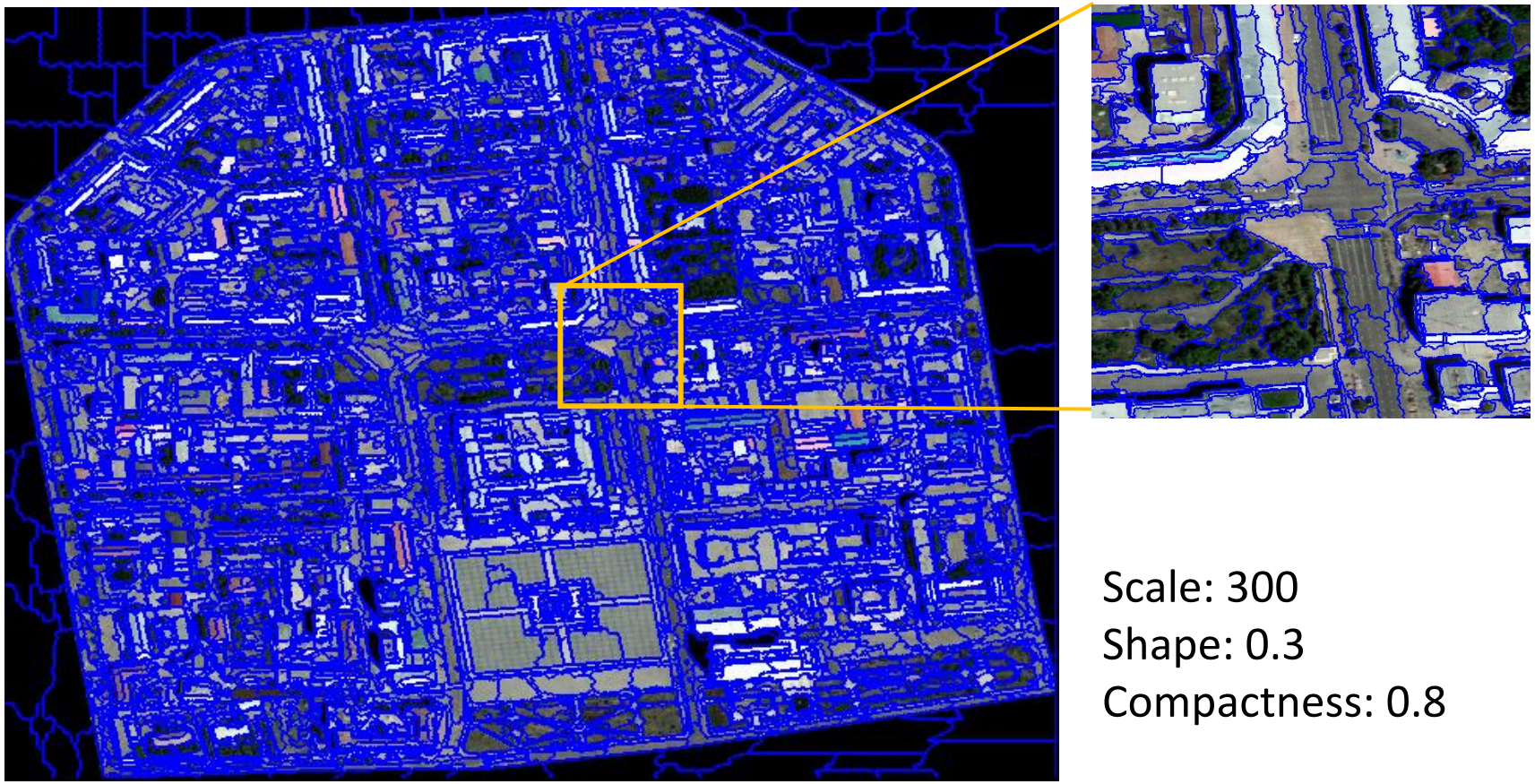
- **Accuracy assessment**
  - Confusion matrix
  - Number of the training samples

Class	2006	2009	2014	2019
Green area	28	29	28	26
Impervious surface	29	26	25	28
Total	57	55	53	54



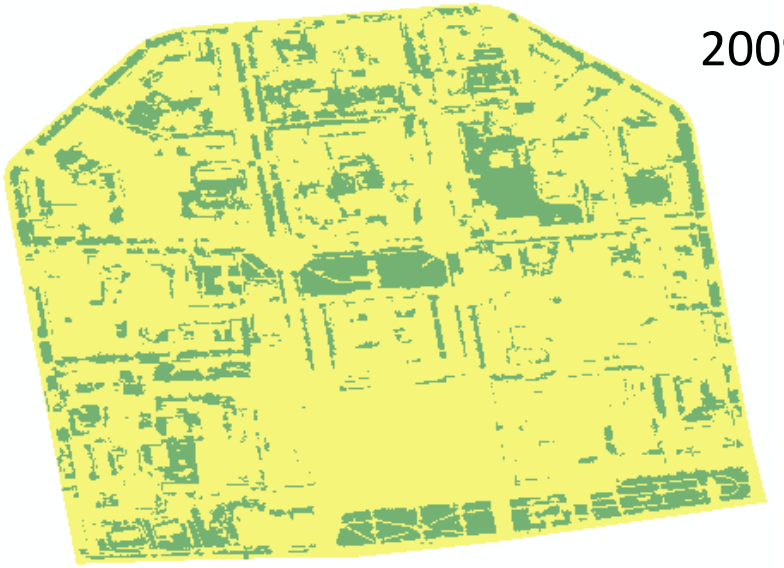

Results

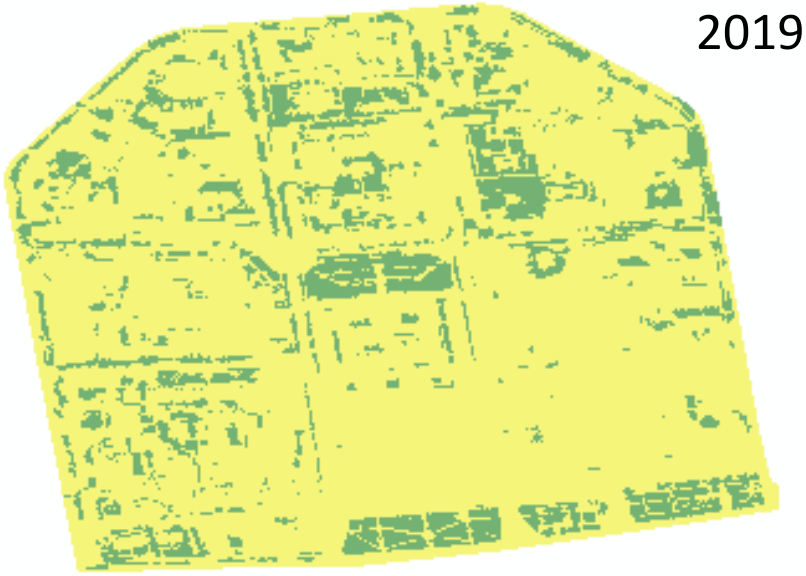
- **2009**



Scale: 300
Shape: 0.3
Compactness: 0.8

Results





Results

2006				
	Green area	Impervious surface	Producer's Accuracy	User's Accuracy
Green area	635 346	37 560	0.869	0.944
Impervious surface	96 006	470 995	0.926	0.831
Total	731 352	508 555		
Overall Classification Accuracy = 0.892 Kappa Coefficient = 0.781				

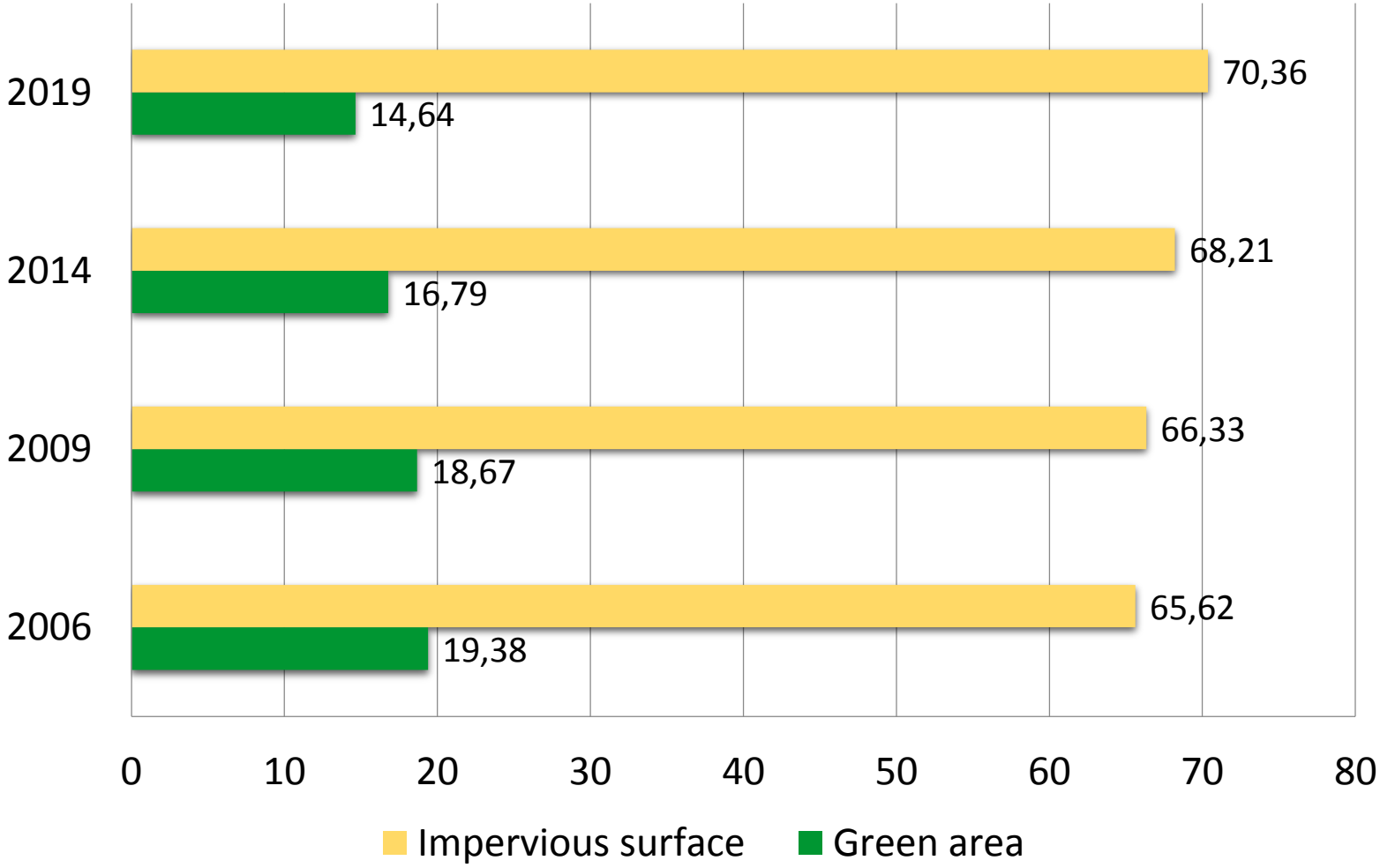
2009				
	Green area	Impervious surface	Producer's Accuracy	User's Accuracy
Green area	528 809	9 300	0.904	0.983
Impervious surface	55 834	612 592	0.985	0.916
Total	584 643	621 892		
Overall Classification Accuracy = 0.946 Kappa Coefficient = 0.892				

Results

2014				
	Green area	Impervious surface	Producer's Accuracy	User's Accuracy
Green area	553 918	34 970	0.857	0.941
Impervious surface	92 454	656 325	0.949	0.876
Total	646 372	691 295		
Overall Classification Accuracy = 0.905 Kappa Coefficient = 0.809				

2019				
	Green area	Impervious surface	Producer's Accuracy	User's Accuracy
Green area	551 686	38 365	0.872	0.935
Impervious surface	80 974	819 152	0.955	0.910
Total	632 660	857 517		
Overall Classification Accuracy = 0.920 Kappa Coefficient = 0.835				

Results


2019
70,36
14,64
2014
68,21
16,79
2009
66,33
18,67
2006
65,62
19,38
0
10
20
30
40
50
60
70
80
Impervious surface
Green area


2019


2006

Conclusion

- Gardens and green spaces: important resources in the sustainable development and contribute to improve the quality of life in urban and suburban areas in many ways.
- To analyze spatial-temporal changes of green area from 2006-2019 in central Ulaanbaatar using VHR images
- Green areas have been reduced by 4.74 ha in CBD.
- How much of green spaces in uptown have changed?
- Implementation of green city policy and related thorough planning are necessary in Ulaanbaatar.

Contact

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