APLADYN STEREO II project (SR/00/132)

Urbanisation as a threat for heritage and archaeology, the case of Cairo

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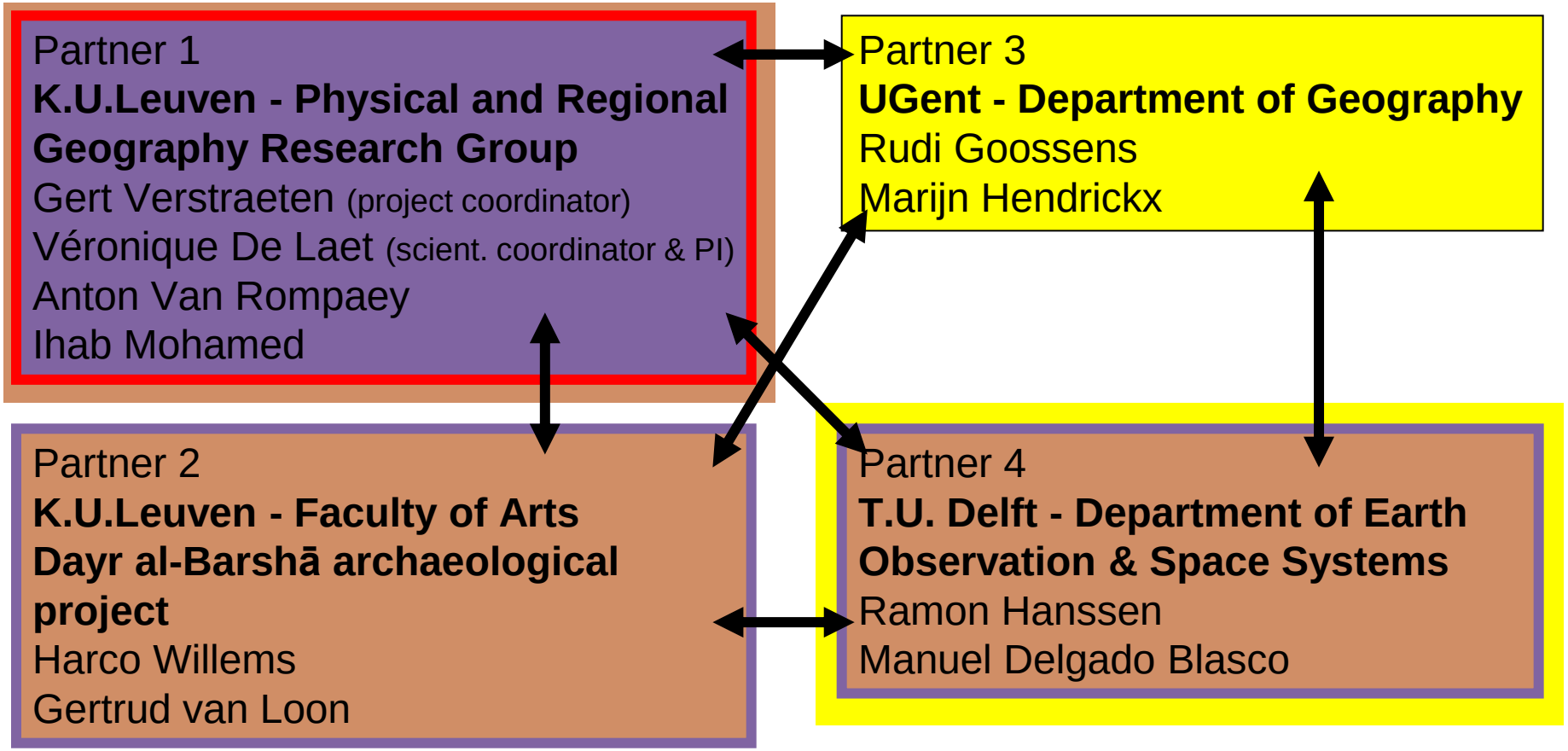
What's the project context?

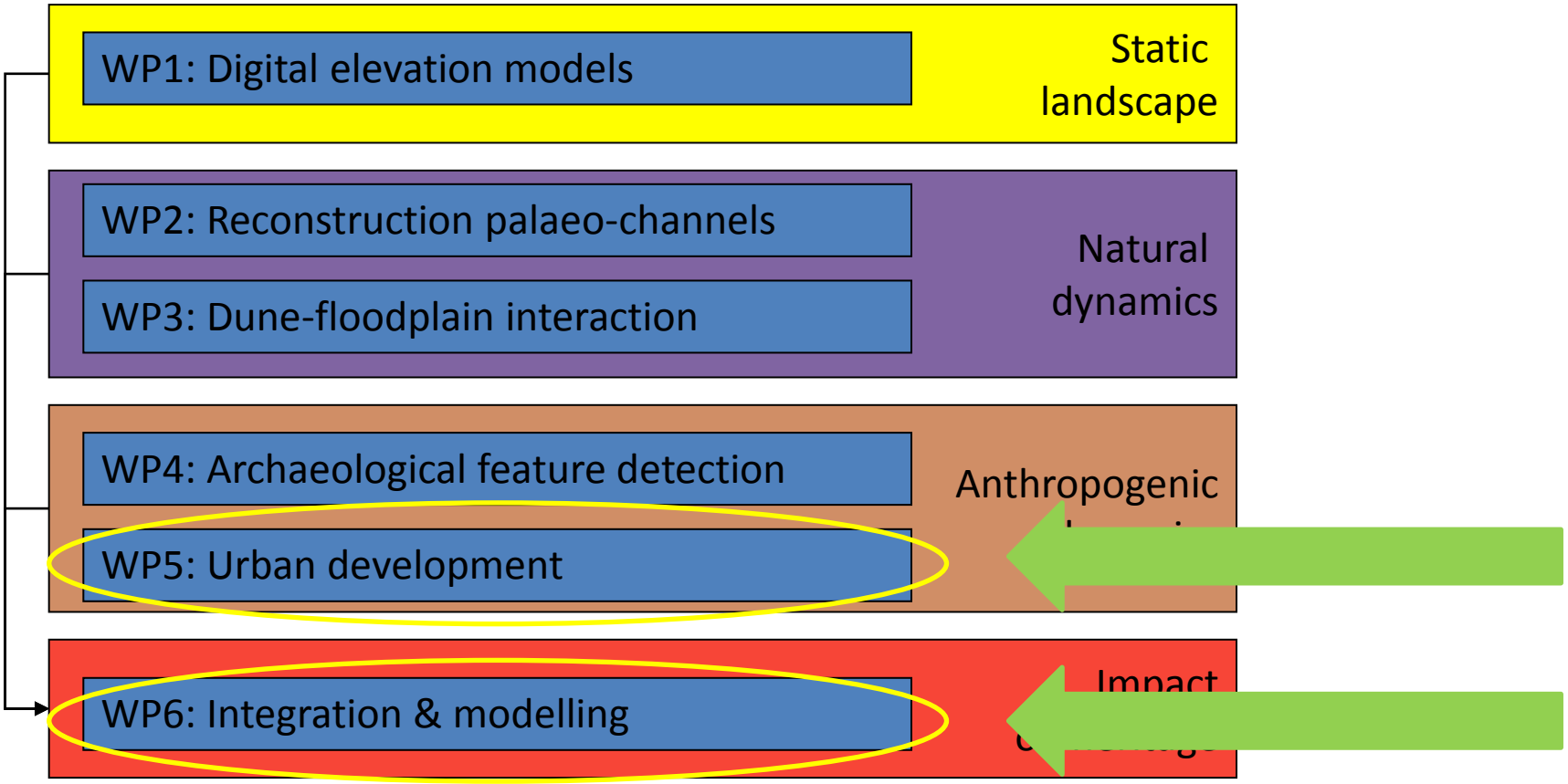
Anthropogenic and physical landscape dynamics in large fluvial systems

Aim is to explore and evaluate the possibilities of a **variety** of existing and recently developed **RS sources** and RS analysis methodologies to map the long-lasting **interaction** between the **anthropogenic** landscape and the **physical** environment in large **fluvial systems**, and the **impact** of these interactions on the natural and cultural **heritage**.

Who are the different partners?



What are the different WPs?



The case of the Ghiza plateau

Is the Giza pyramid plateau under pressure?

How can we analyse this urban expansion?

Accurate and detailed geographic data delivered from recent high resolution satellite images

RS has already proven to be very useful for analysing and visualising urban sprawl and land use however mainly in 2D and on large scale high resolution aerial images

Complement this data with accurate height information from DSMs for

A. **2.5D change detection**
B. **Viewshed analyses**

Which data has been used?

2.5D change detection

2005 Ikonos panchromatic stereo images (GSD 1m – Acq. date = 9th January)

2009 & 2011 GeoEye panhcromatic stereo (GSD 0.5m – Acq.date : 1 pair 2nd July '09 – 2 pairs 24th June '11)

22 GCP's measured in January 2011 with dGPS (C-Nav) with subpixel accuracy

Photogrammetric processing software: Leica Photogrammetric Software (LPS) and enhanced digital terrain extraction (eATE) module of Erdas Imagine®

Which data has been used?

Viewshed analysis

1970 Corona panchromatic stereo images (theoretical GSD 1.8m – Acq. date = 23th Nov)

2005 Ikonos panchromatic stereo images (GSD 1m – Acq. date = 9th January)

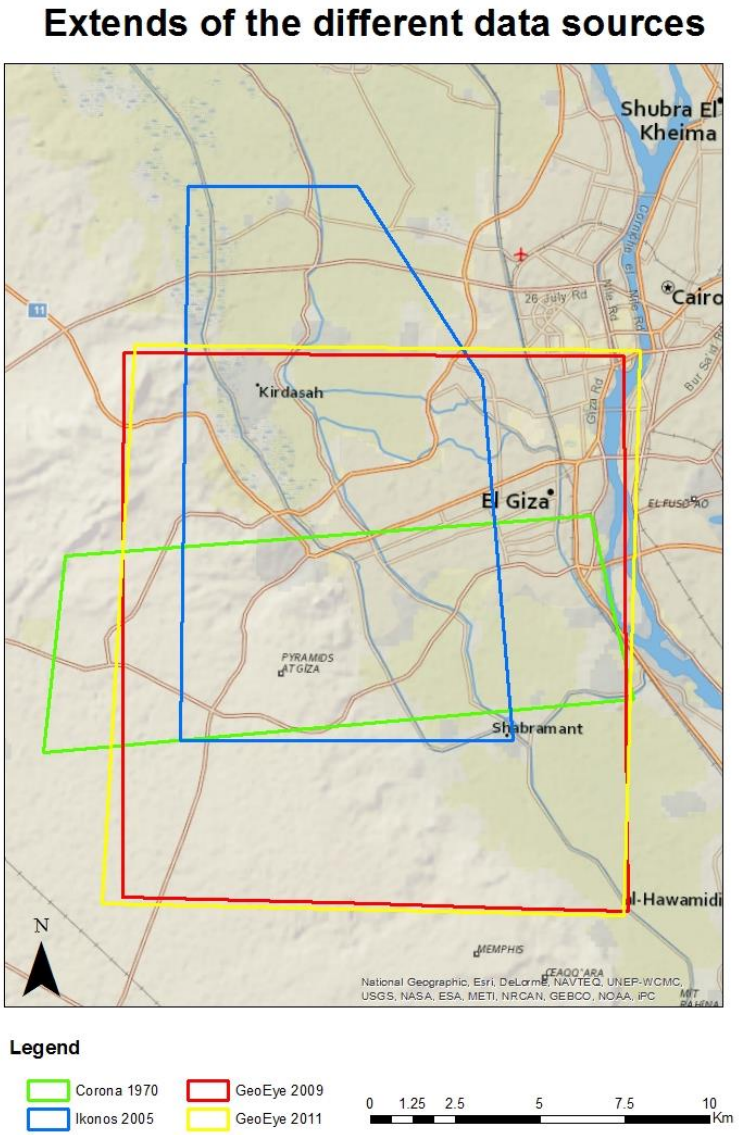
2009 & 2011 GeoEye panchromatic stereo (GSD 0.5m – Acq.date : 1 pair 2nd July '09 – 2 pairs 24th June '11)

22 GCP's measured in January 2011 with dGPS (C-Nav) with subpixel accuracy

=> accompanied with extra gcp's generated out of triangulated GeoEye'11 images

Photogrammetric processing software: Leica Photogrammetric Software (LPS) and enhanced digital terrain extraction (eATE) module of Erdas Imagine®

Which data has been used?



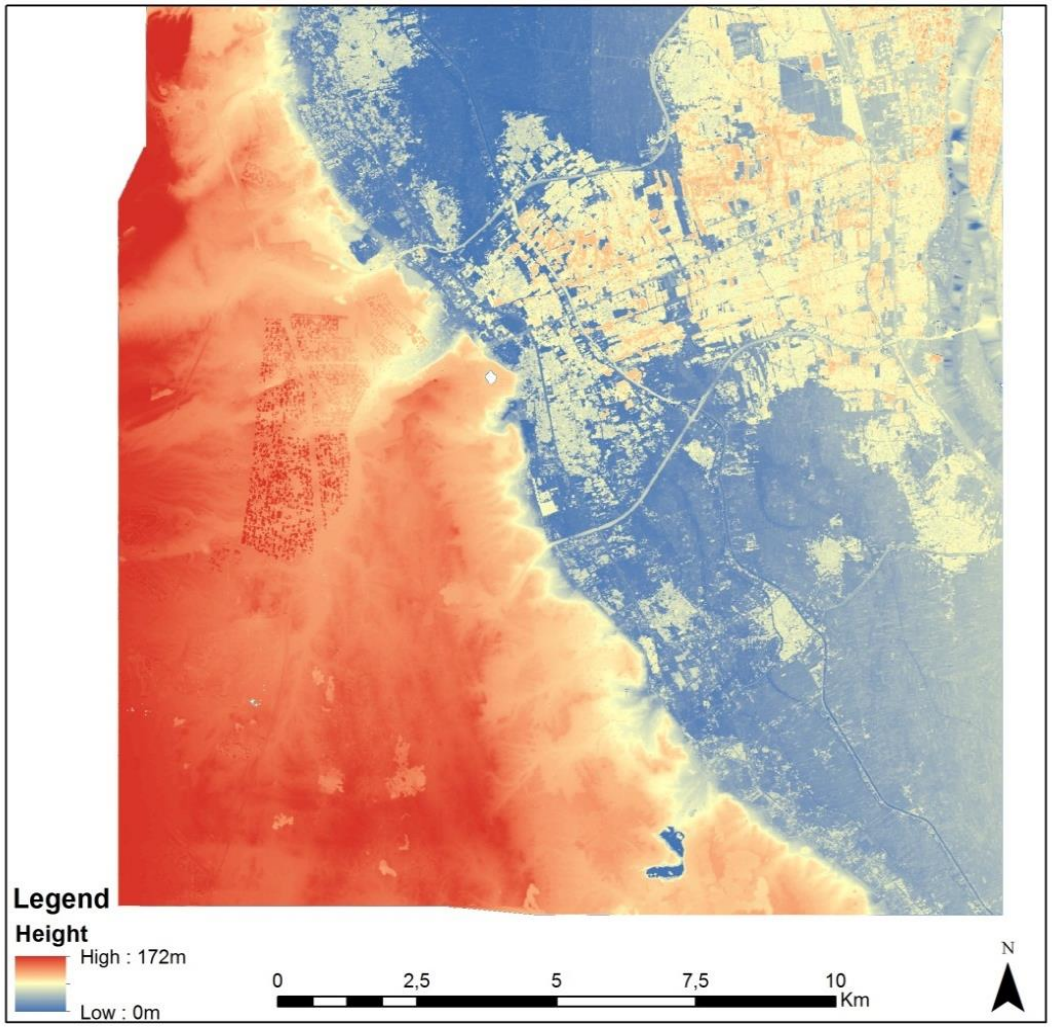
Data processing – accuracies DSMs

TABLE II ACCURACIES OF THE OUTPUT SURFACES

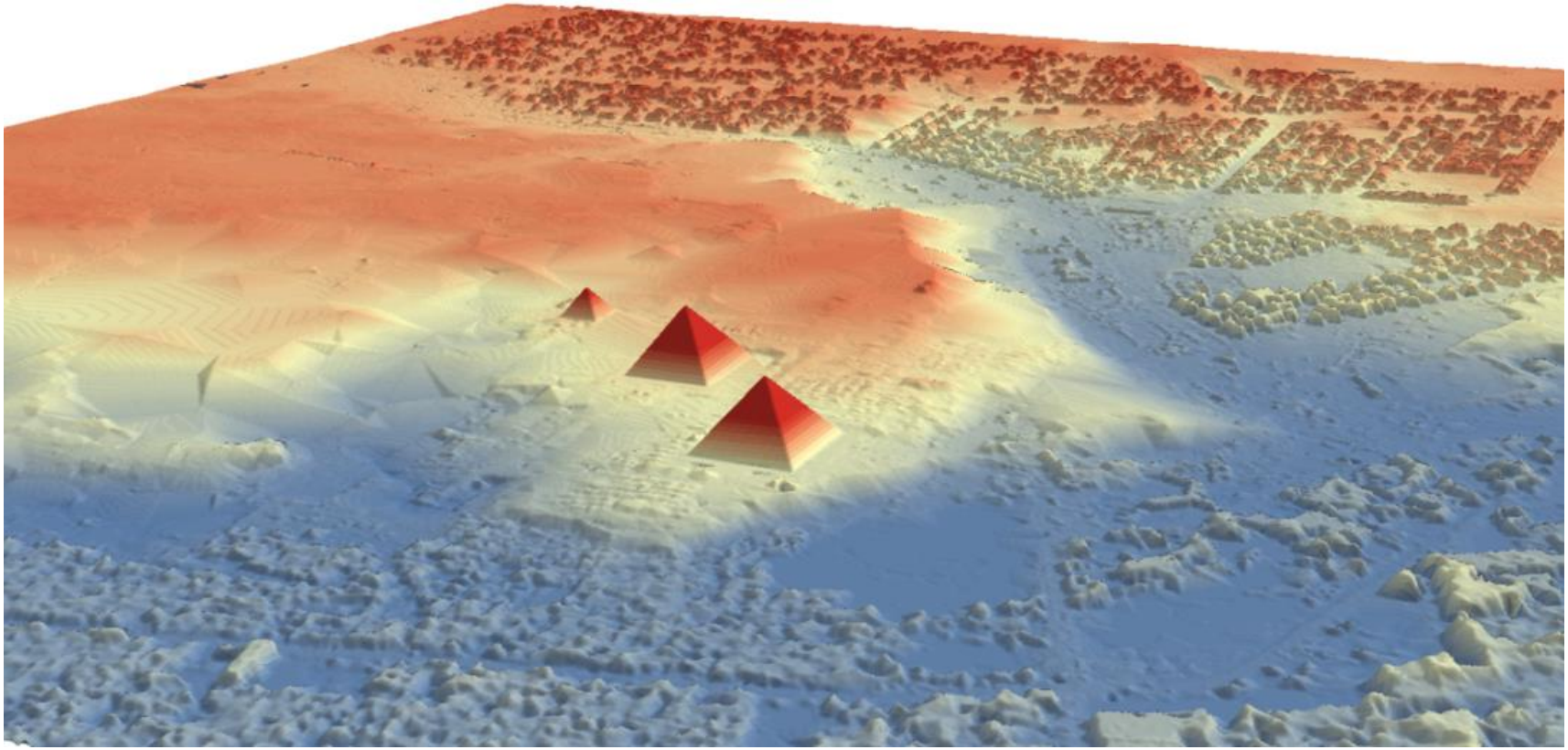
	Statistics (m)		
	RMSE	*Mean Error*	*LE90*
2005	0.522	0.020	0.858
2009	0.380	0.004	0.625
2011	0.366	-0.035	0.601

Data processing - example

DSM based on 2011 stereo images



Data processing –example oblique view



Study areas change detection

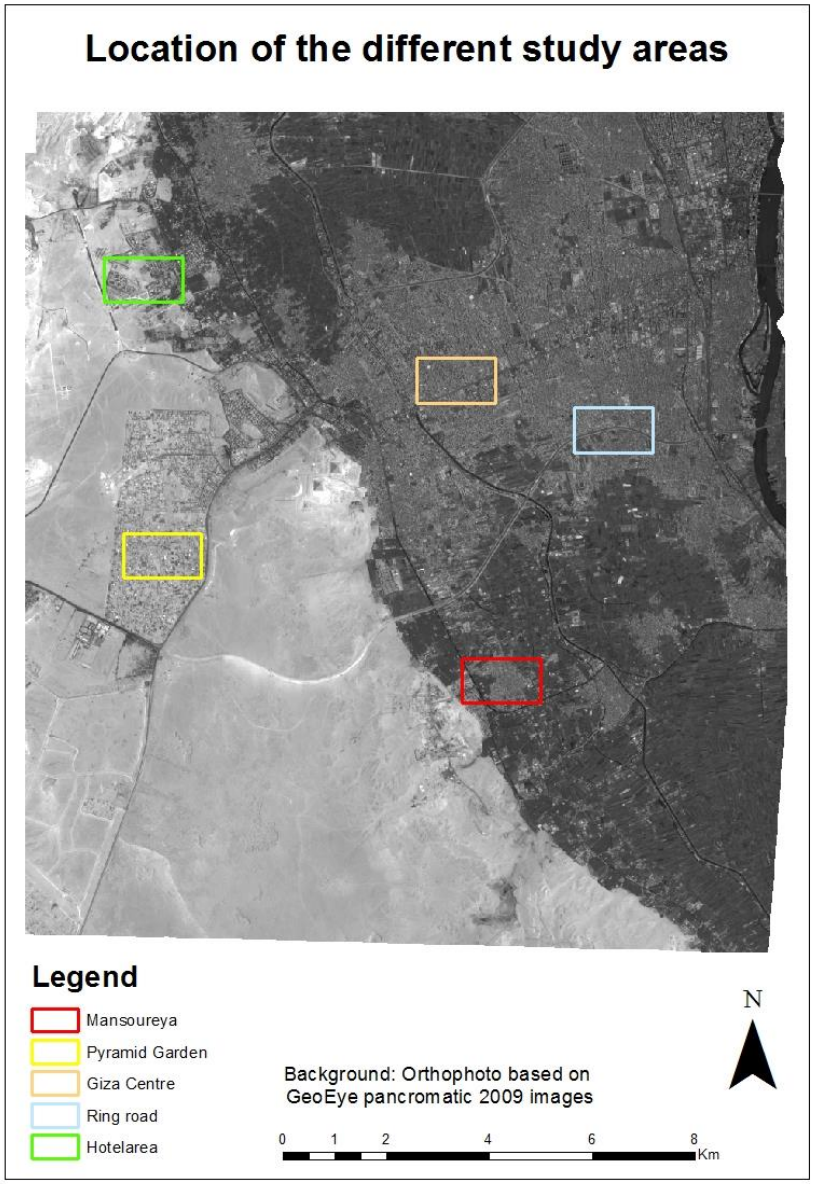
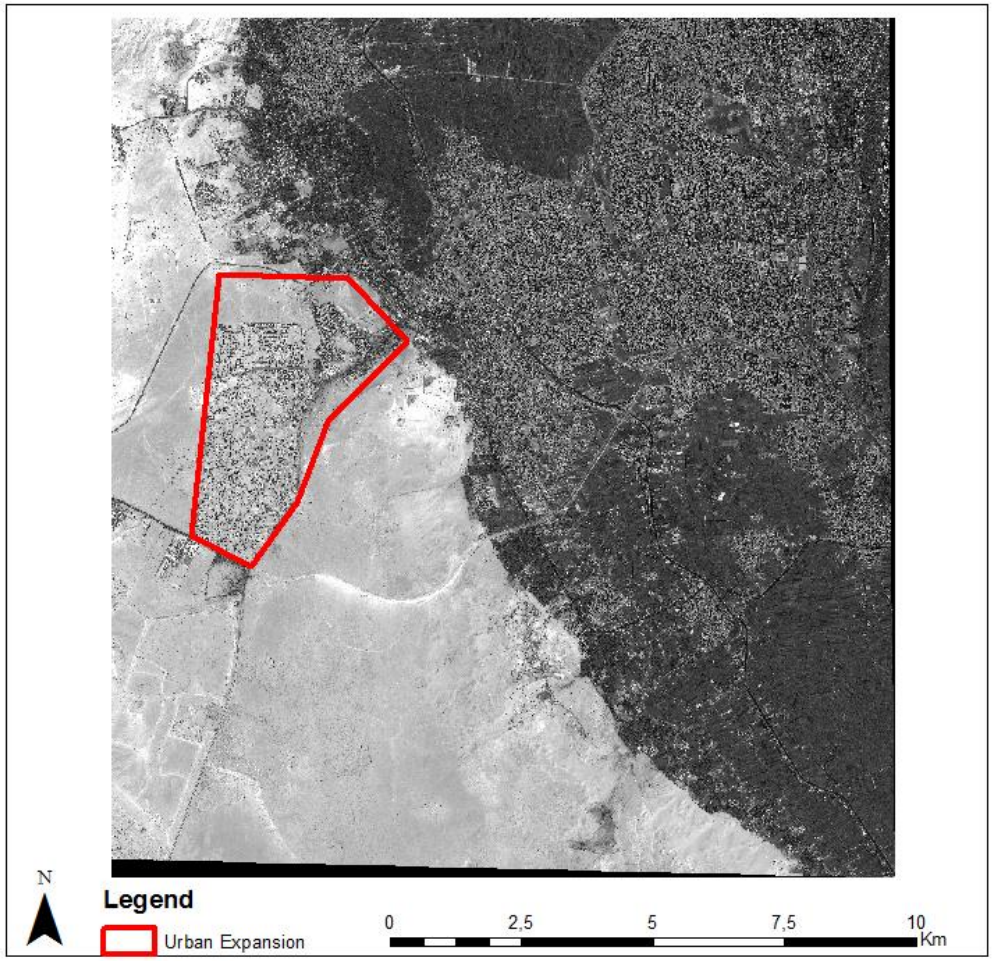


TABLE I STATISTICS OF THE NEIGHBOURHOOD DATA ANALYSIS

Area	Statistics (m)		
	Maximum	*Mean*	*Standard dev.*
Mansoureya	40.56	19.85	4.33
Pyr.Garden	128.68	97.08	9.04
Giza centre	71.94	33.74	11.45
Ringroad	66.87	27.41	8.83
Hotelarea	111.63	64.93	21.10

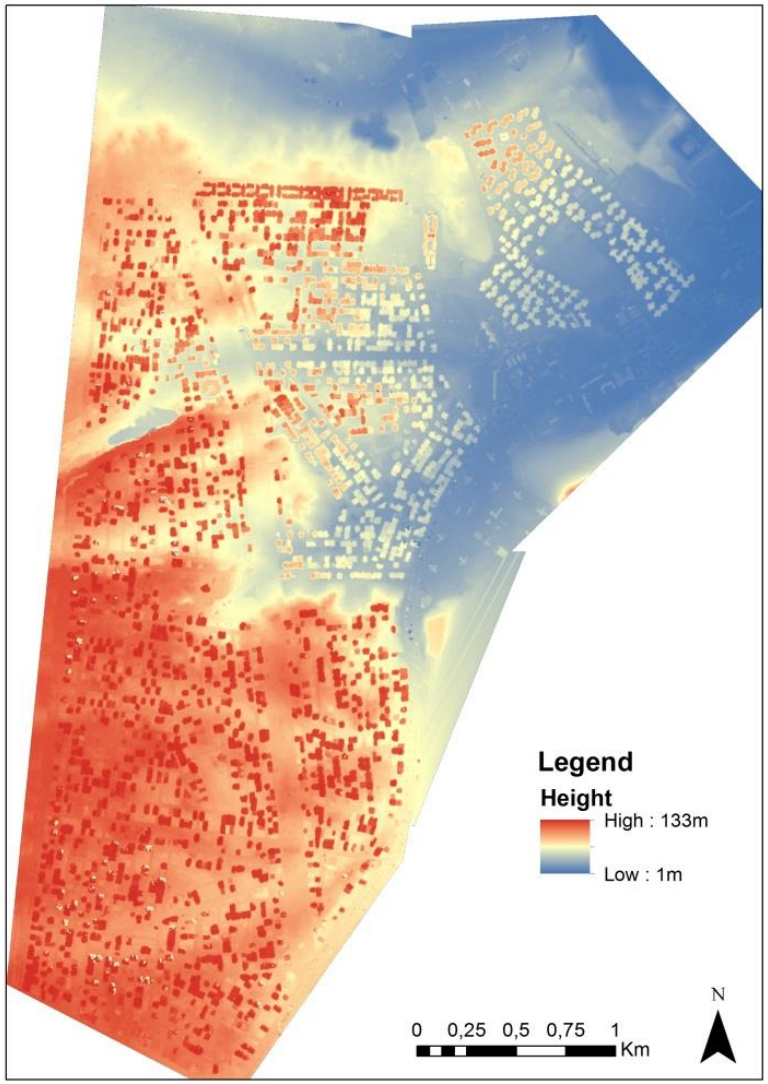
Change detection – Pyramid Garden

Urban Expansion - Background: image of 2009

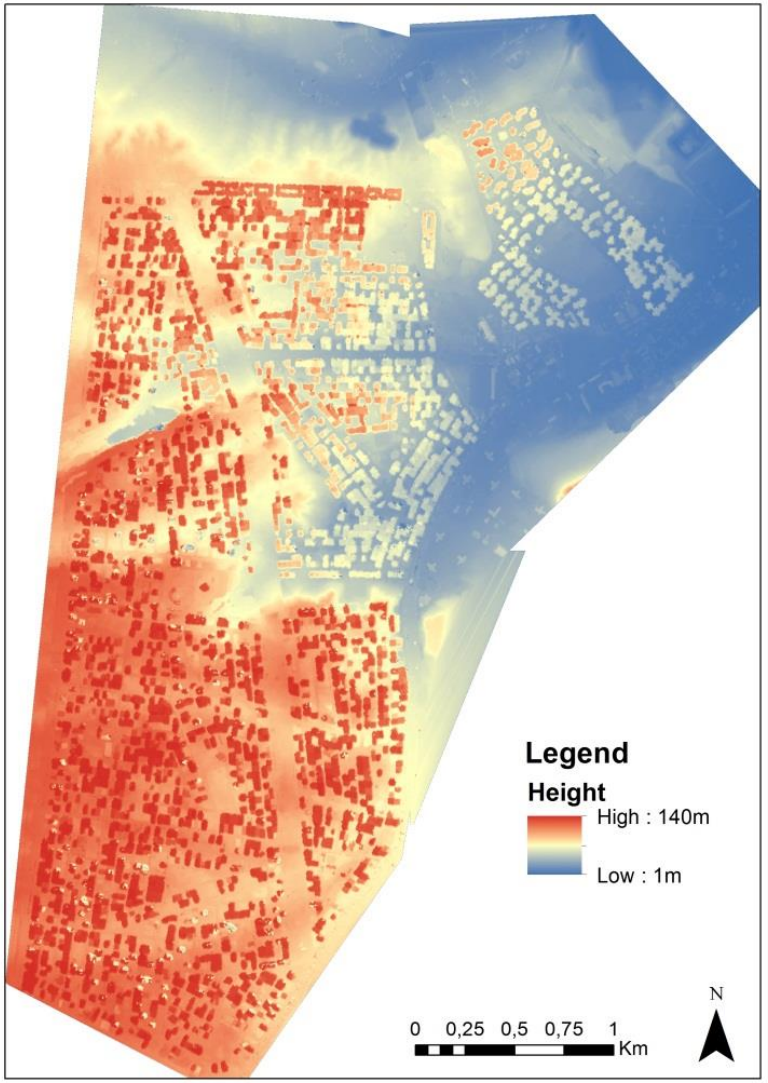


Data processing – Pyramid Garden

DSM urban expansion (2009)



DSM urban expansion (2011)



Data processing – 2.5D change detection

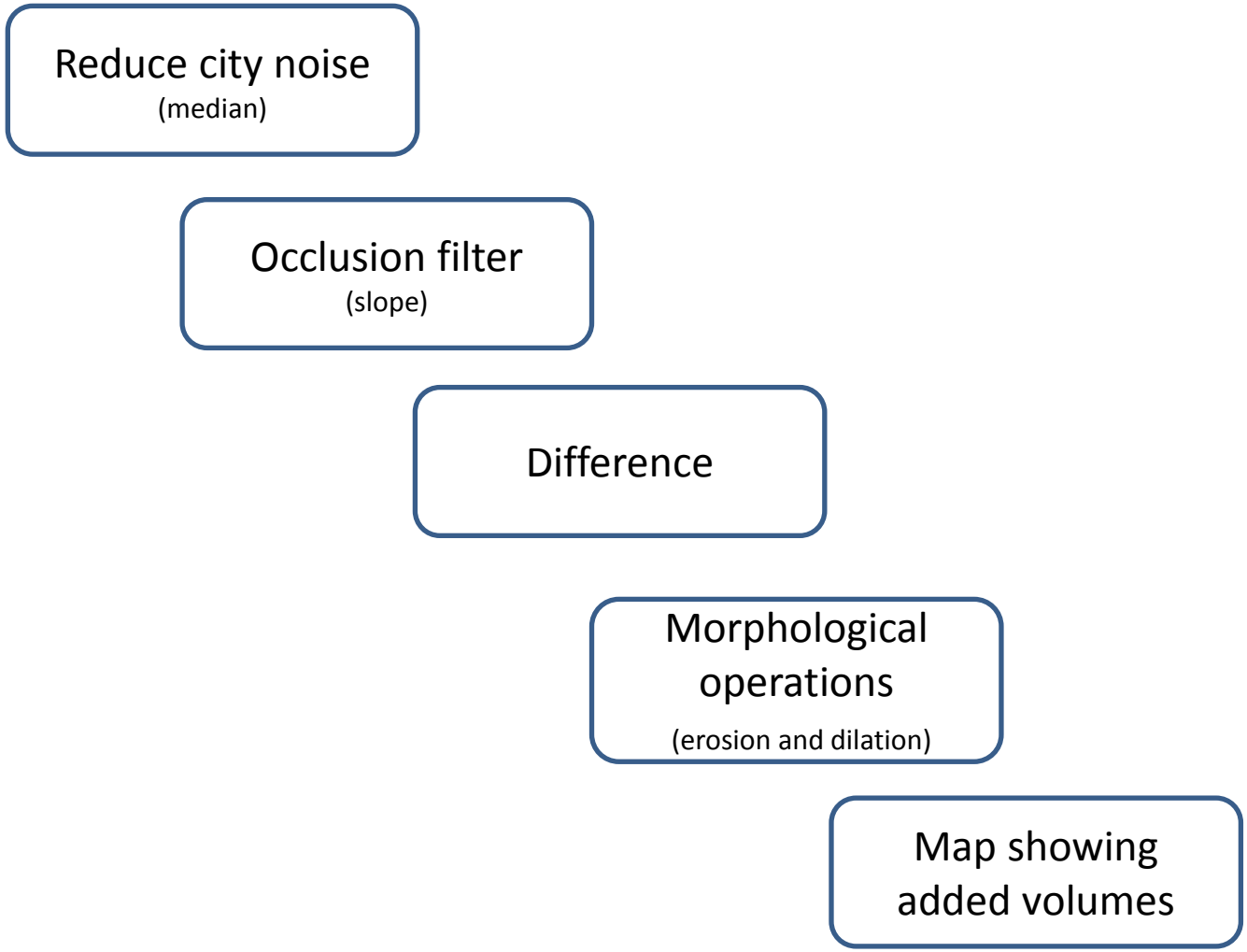
1. Median filter kernel 5 * 5 to reduce noise
2. Assumptions

   One floor = 3m high

   100m^2 building floor for this area (Sims, 2010)

Method adapted and modified from Stal et al. (2013)

Data processing – 2.5D change detection methodology



Data processing – 2.5D change detection methodology

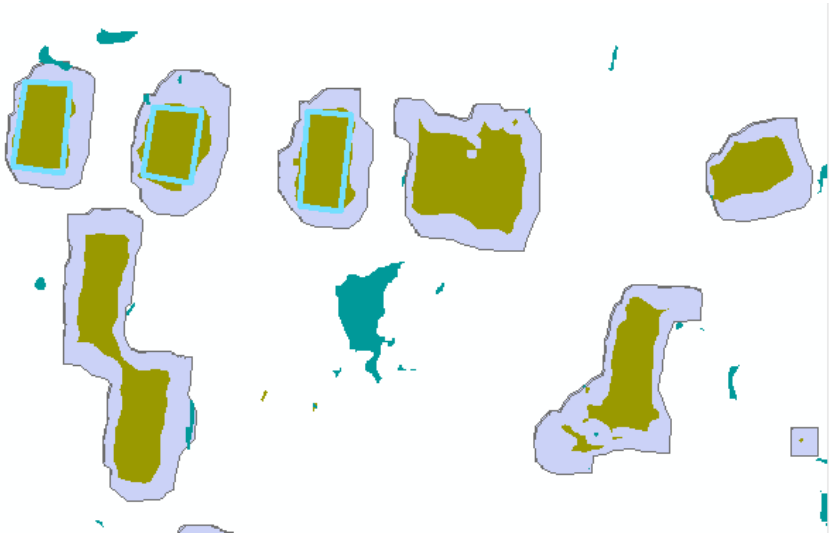
Reduce city noise
(median)

Occlusion filter
(slope)

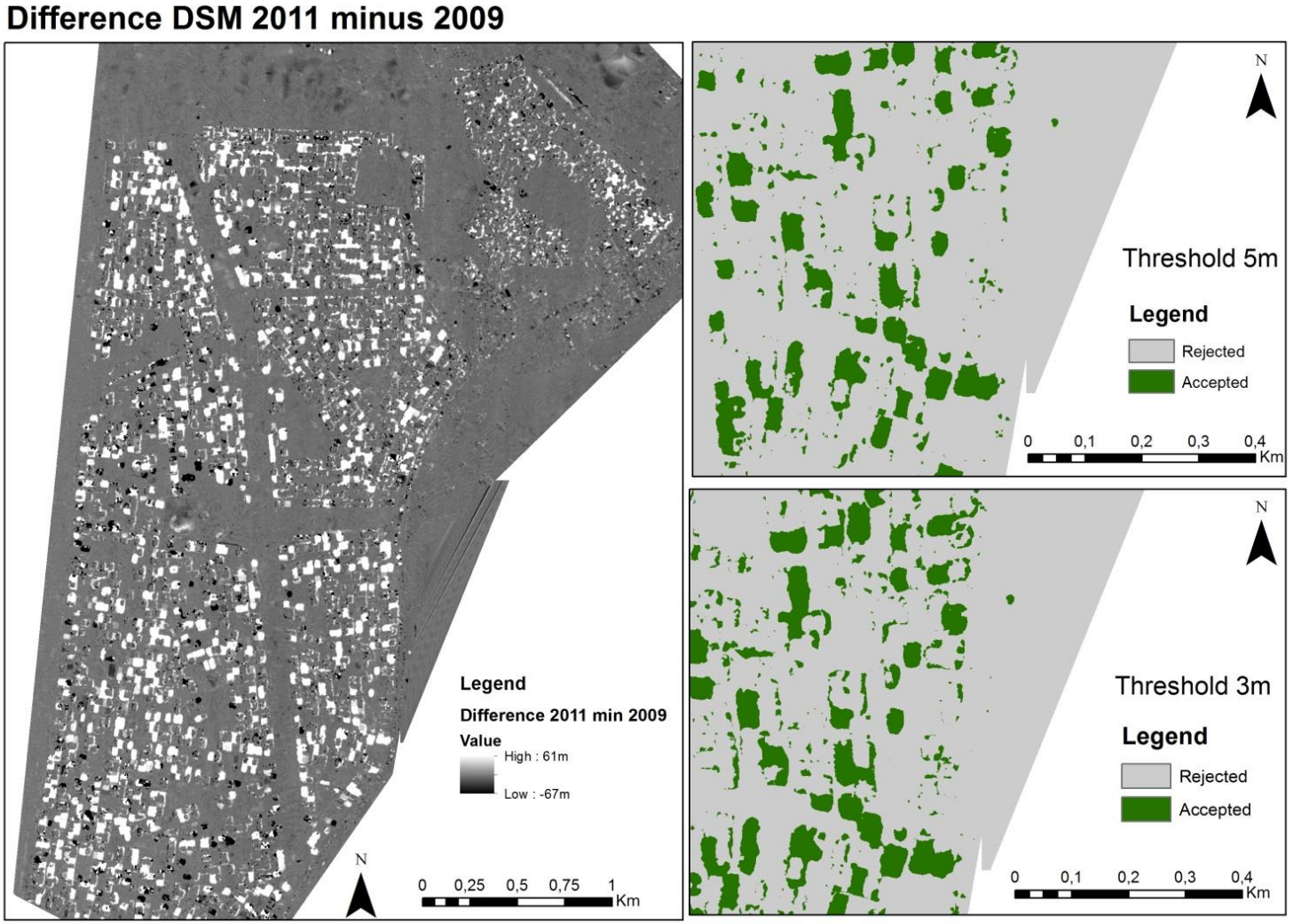
Difference

Morphological operations
(erosion and dilation)

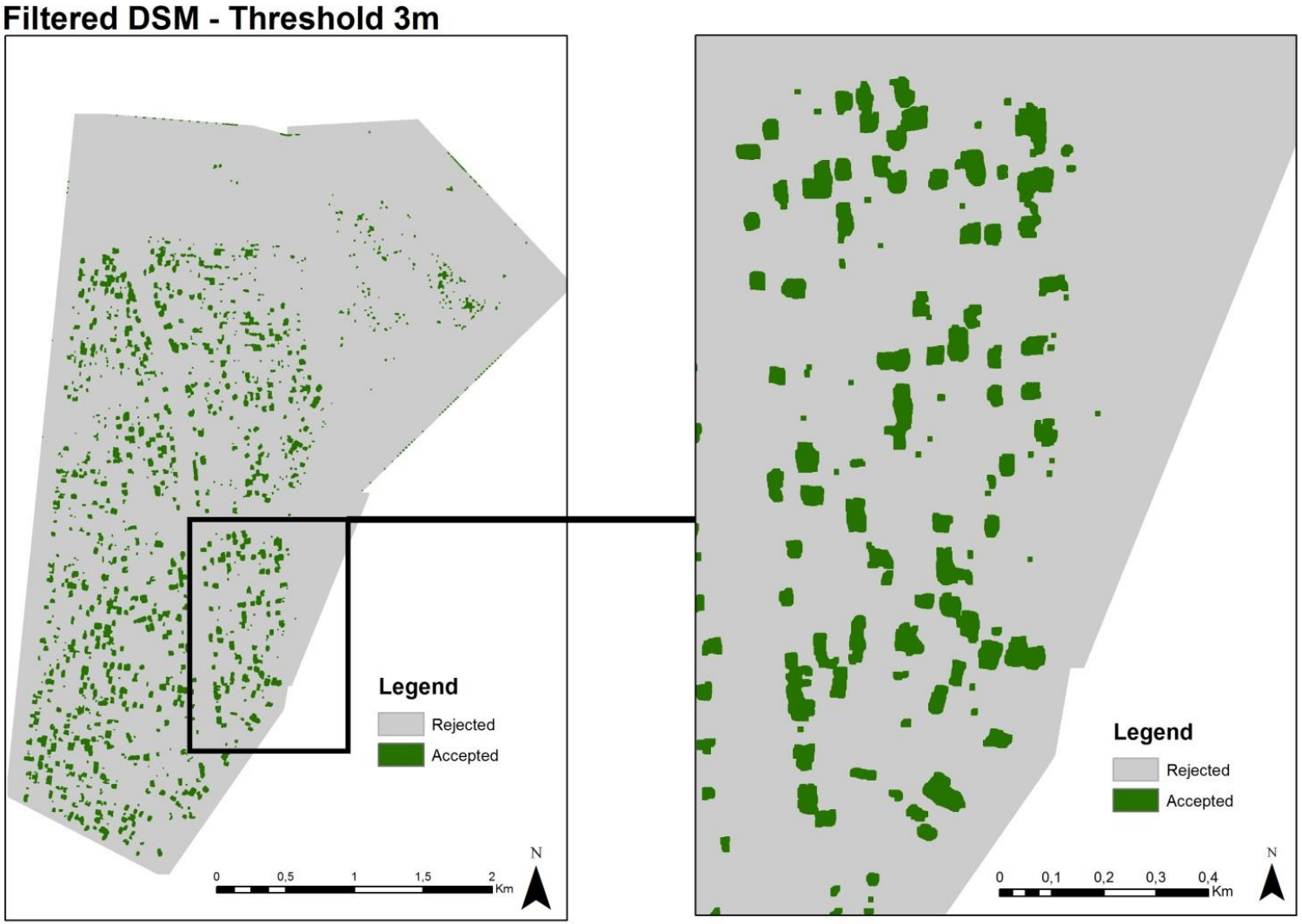
Map showing added volumes



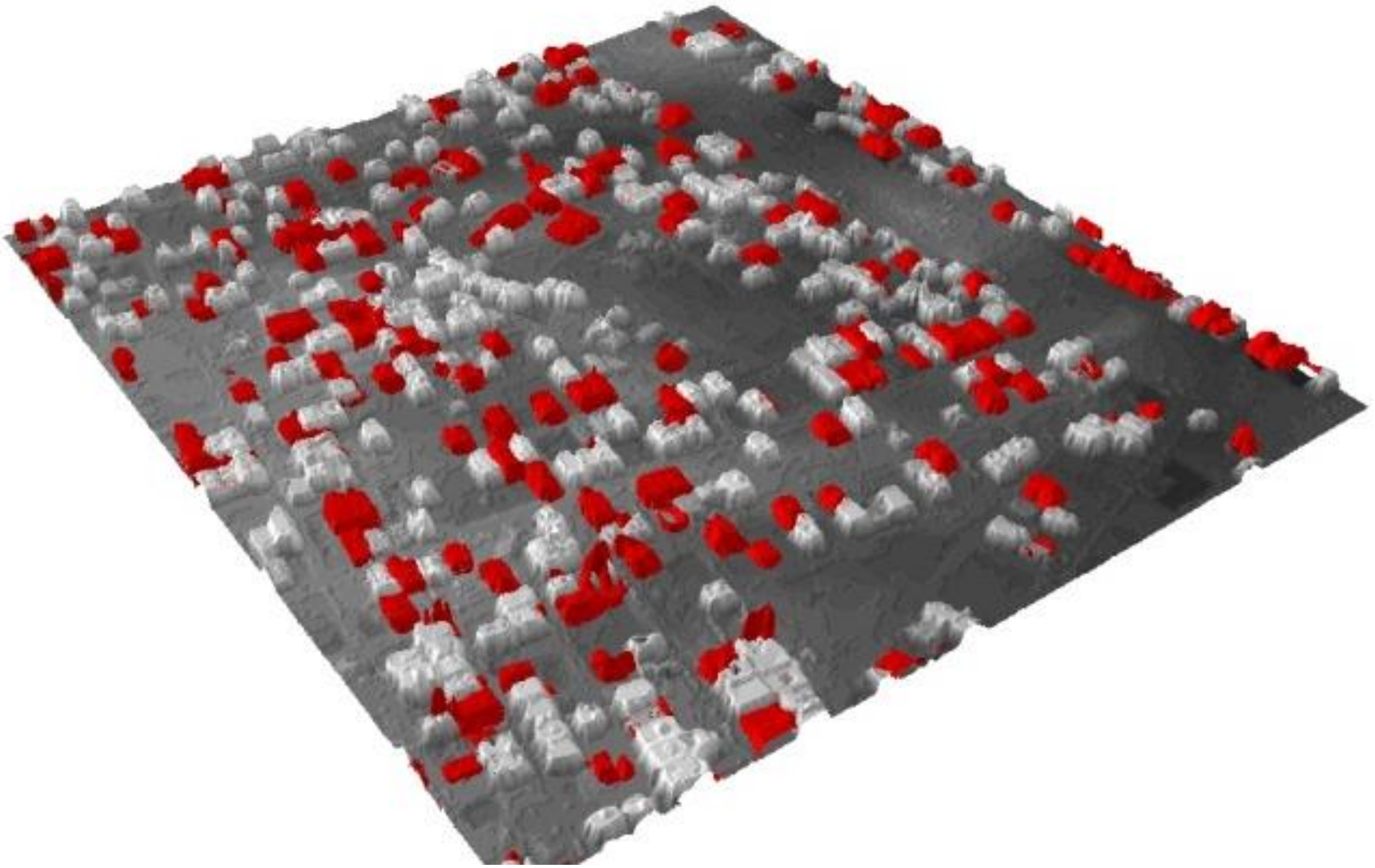
Data processing – 2.5D change detection



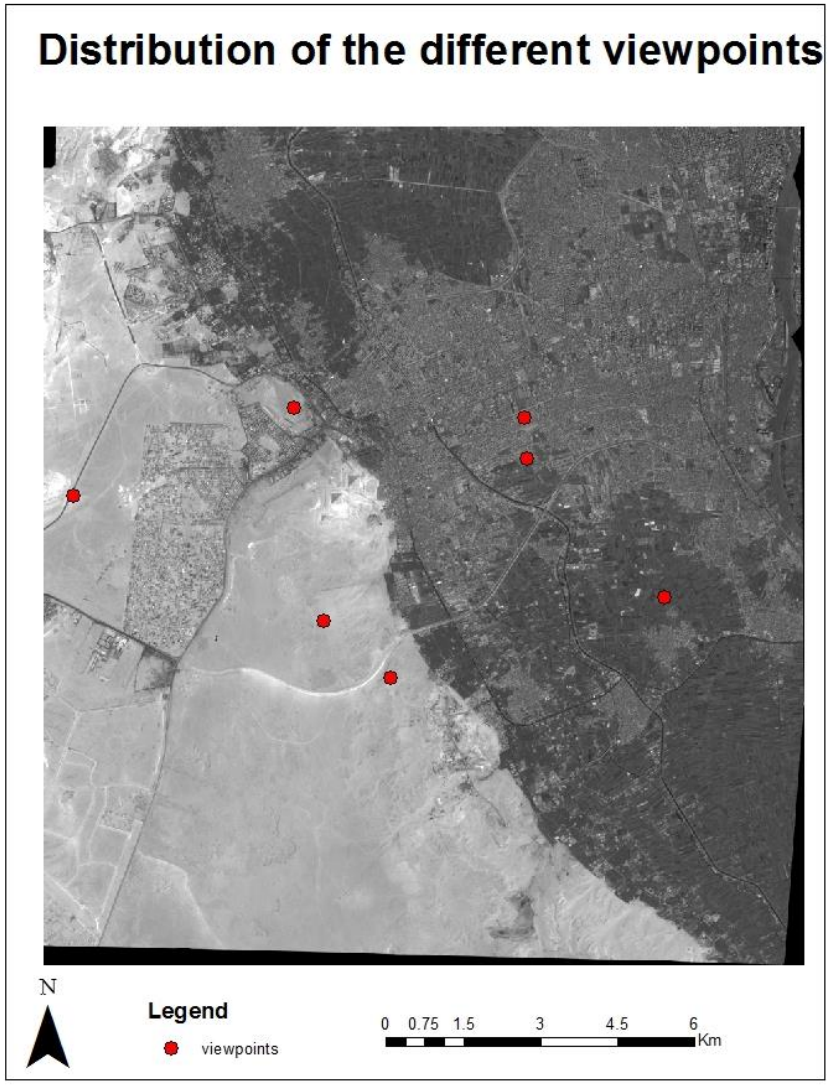
Data processing – 2.5D change detection



Where are the new buildings and floors?



How did the view towards the pyramids evolved?

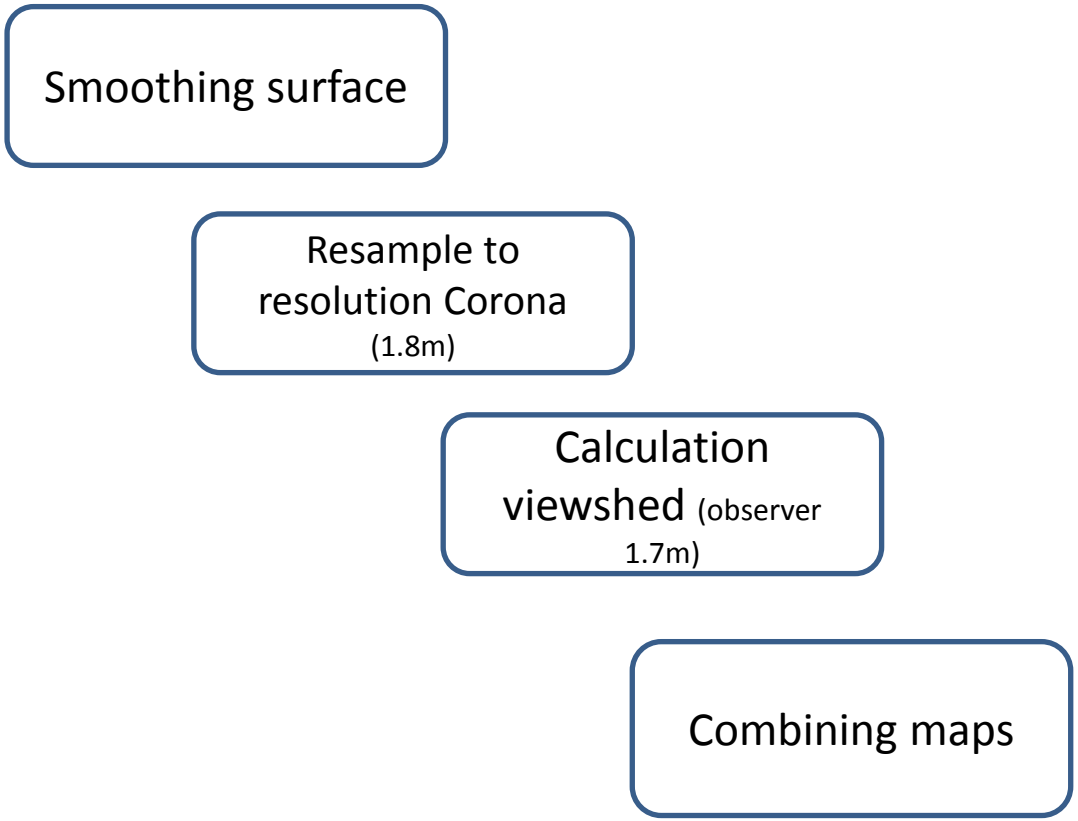


Why these points?

Distribution in the overlapping area in relation to the Pyramid Plateau

Height value +- same over 4 decades.

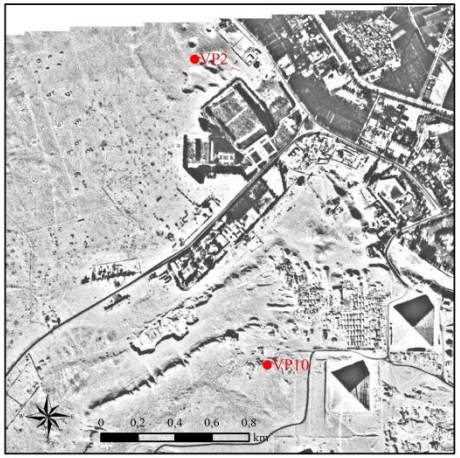
How did the view towards the pyramids evolved?



How did the view towards the pyramids evolved?

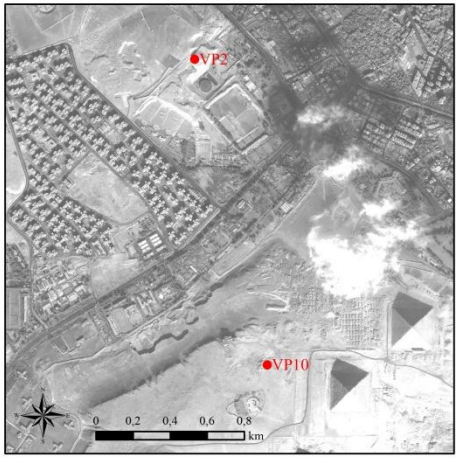
1970

Achtergrond: orthofoto CORONA KH-4B met Wallisfilter (1970)



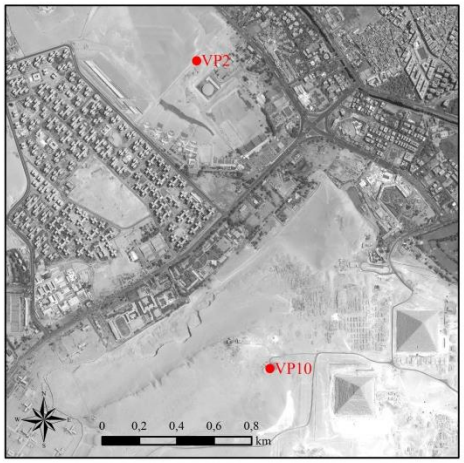
2005

Achtergrond: orthofoto Ikonos-2 (2005)



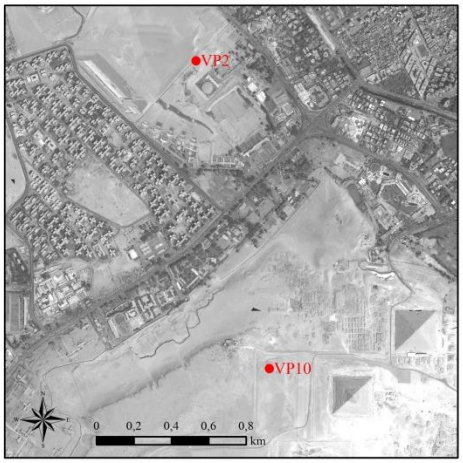
2009

Achtergrond: orthofoto GeoEye-1 (2009)

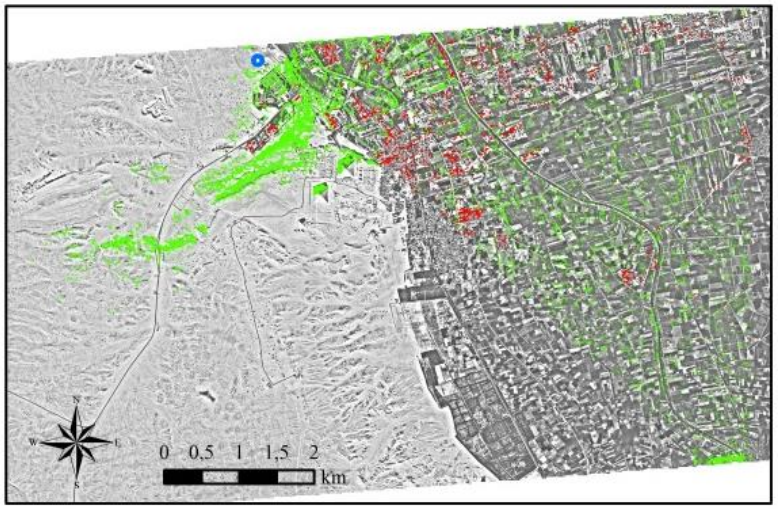


2011

Achtergrond: orthofoto's GeoEye-1 (2011)



How did the view towards the pyramids evolved?



Viewshed 1970

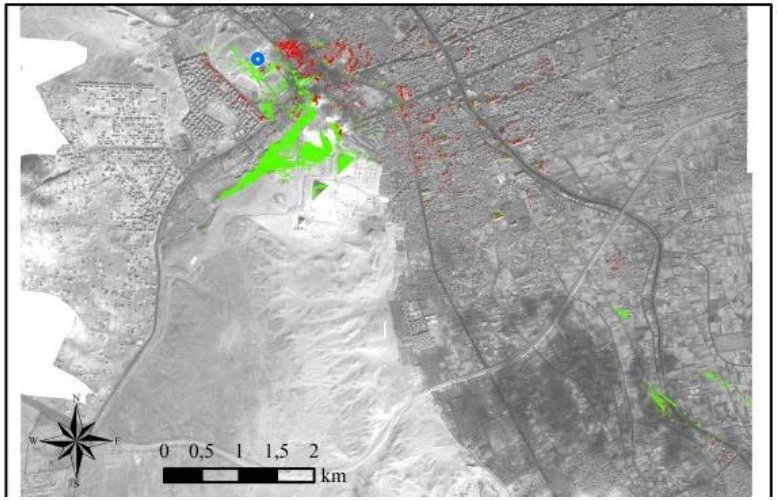
- Aantal pixels zichtbaar in 1970: 1011334
  - waarvan woestijn/natuur: 863414
  - waarvan bebouwing: 147920

Piramides zichtbaar vanaf viewpoint

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto CORONA KH-4B met Wallisfilter (1970)



Viewshed 2005

- Aantal pixels zichtbaar in 2005: 310856
  - waarvan woestijn/natuur: 226195
  - waarvan bebouwing: 84661
- Aantal pixels ook zichtbaar in 1970: 119820

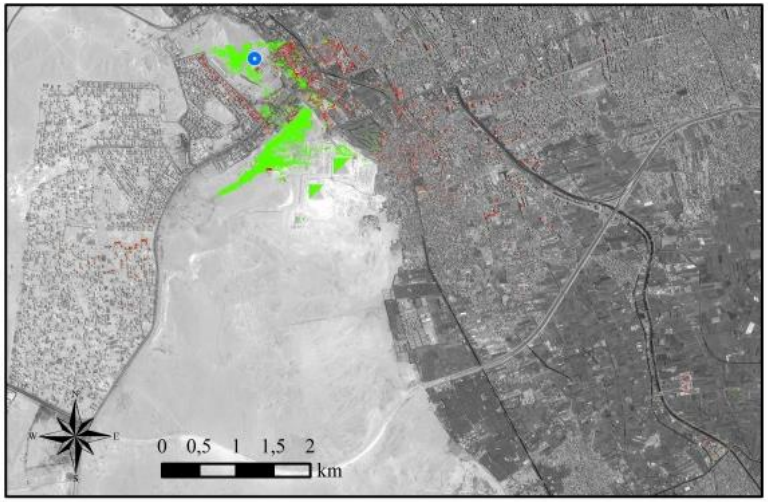
Piramides zichtbaar vanaf viewpoint

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto Ikonos-2 (2005)

How did the view towards the pyramids evolved?



Viewshed 2009

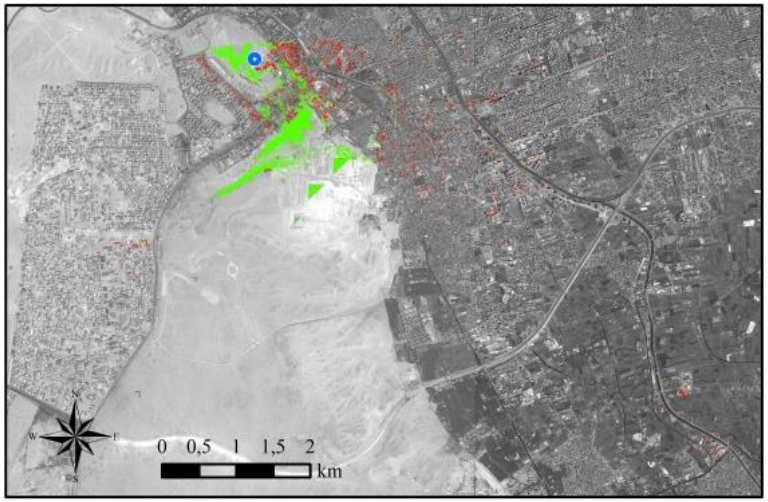
- Aantal pixels zichtbaar in 2009: 275830
  - waarvan woestijn/natuur: 199863
  - waarvan bebouwing: 75967
- Aantal pixels ook zichtbaar in 1970 & 2005: 75603

Piramides zichtbaar vanaf viewpoint

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto GeoEye-1 (2009)



Viewshed 2011

- Aantal pixels zichtbaar in 2011: 281104
  - waarvan woestijn/natuur: 183864
  - waarvan bebouwing: 97240
- Aantal pixels ook zichtbaar in 1970, 2005 & 2009: 59411

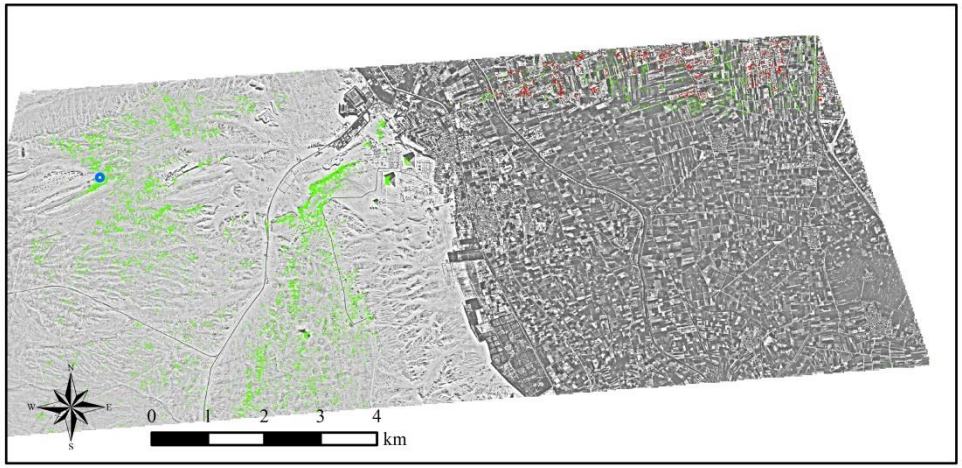
Piramides zichtbaar vanaf viewpoint

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto's GeoEye-1 (2011)

How did the view towards the pyramids evolved?

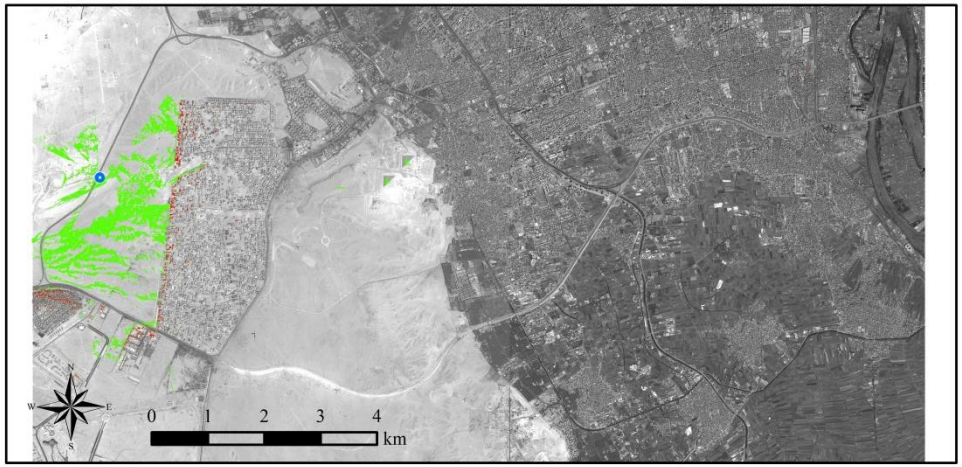


***Viewshed* 1970**

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto CORONA KH-4B met Wallisfilter (1970)



***Viewshed* 2011**

Legende

- *Viewpoint*
- Zichtbare woestijn/natuur
- Zichtbare bebouwing

Achtergrond: orthofoto's GeoEye-1 (2011)

Conclusions

We managed to create accurate and comparable DSMs from different time periods

2.5D change detection method can be used to estimate/analyse the urban sprawl in areas without (population) statistics

However

An individual vector layer is not possible

Reference data is not available for validation

> Digitalisation roof buildings

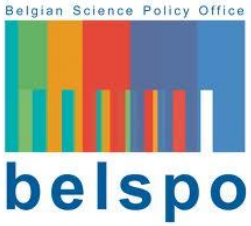
Viewshed analyses provide view into the past how the landscape around the world heritage site changed throughout the last 40 years and can/should thus be used as a management tool

Conclusions

Conclusions

And…what it is

Thanks for your attention!



Contact and information:

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