METRIC AND QUALITATIVE EVALUATION OF QUICKBIRD ORTHOIMAGES FOR A LARGE SCALE GEODATABASE CREATION

Maurizio Barbarella, Michela Zanni
DISTART – Università di Bologna
maurizio.barbarella@mail.ing.unibo.it,
michela.zanni@mail.ing.unibo.it

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PRELIMINARY REMARKS

PREVIOUS RESEARCHES

demonstrated that high resolution satellite imagery, such as QuickBird or Ikonos, could get to accuracy suitable to map updating up to 1:5000 scale, depending, basicly, on

- ✓ geometric correction model for orthorectification
- ✓ number, distribution and accuracy of Ground Control Points (GCPs) over the scene
- ✓ accuracy of DTM

....but....

geometric accuracy, even if evaluated over a large number of Check Points, is not sufficient to guarantee a correct detection and interpretation of objects in the image

TOPICS

PURPOSE

- ✓ EVALUATION ON DIFFERENT TEST SITES OF THE EFFECTIVE USE OF ORTHOIMAGES FOR CREATION OR UPDATING OF LARGE SCALE STRUCTURED GEODATABASE, PARTICULARLY ADDRESSED TO BUILDING DETECTION

METHOD

- ✓ IMAGE ANALYSIS AND ENHANCEMENT
- ✓ VECTORIZATION OF TEST SITES
- ✓ COMPARISON AMONG DIFFERENT VECTORIZATIONS
- ✓ GROUND INSPECTION AND RECONAISSANCE
- ✓ FIELD SURVEYS

LARGE SCALE GEODATABASE

Regione Emilia-Romagna, first in Italy, started a project for a **1:5000 GeoDataBase** creation, that implies the updating of topographic data (i.e. raster Technical Map) of the whole region, their complete vectorization and the structuring of the data on the basis of national standards for GeoDataBase.

Three steps for the GeoDataBase creation: 'modalità A', 'modalità B', **'modalità C'**.

MODALITÀ C

- ✓ from 1:5000 analogic map to raster map
- ✓ from raster map to vector map
- ✓ **updating of vector map using high resolution satellita data (QuickBird) and integration with local data**
- ✓ creation of a structured object-GeoDataBase

MAP BECOMES A PRODUCT OF THE GEODATABASE

LARGE SCALE GEODATABASE

CONTENTS OF GEODATABASE

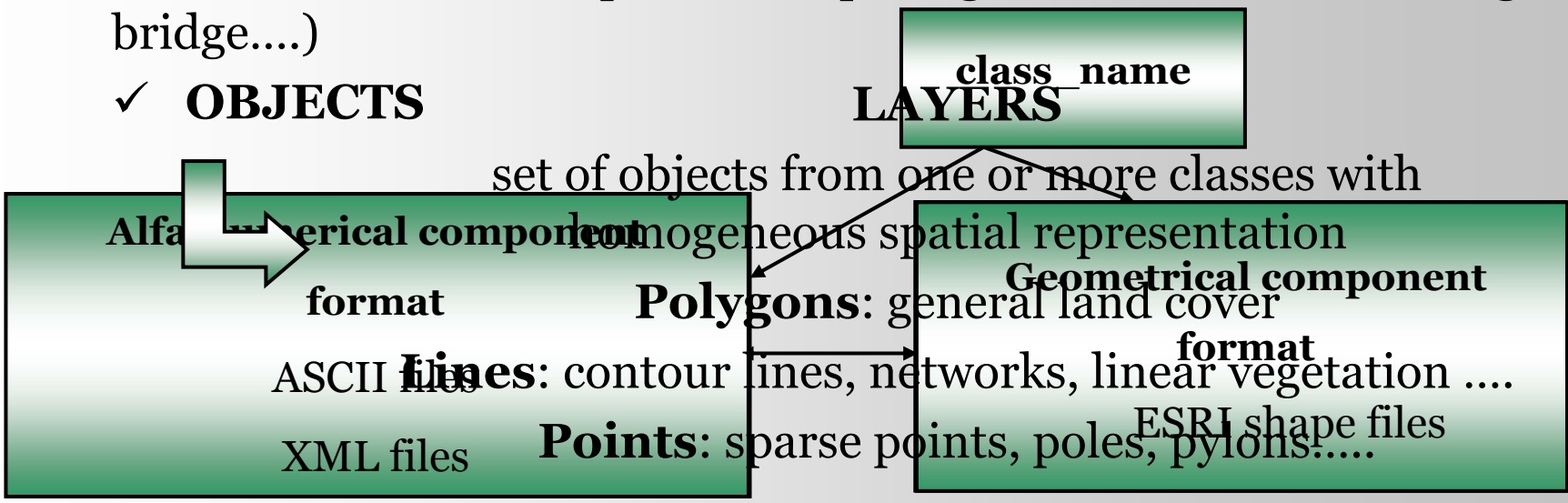
- ✓ Objects of reality (buildings, road, rivers…)
- ✓ Networks (road, drainage, electrical….)
- ✓ Altimetry (contour lines, points)
- ✓ Names
- ✓ Graphic elements for representation

ORGANIZATION OF GEODATABASE

- ✓ **CLASSES**

(road circulation area, pedestrian passage area, wet area, building, bridge….)

- ✓ **OBJECTS**



TOLERANCES

The DataBase geometrical component partially comes from the vectorization of Technical Map and must be useful to produce new maps of differents themes at a scale 1:5000. For this reason, it must respect the rules for numerical maps at this scale. Particularly, in the frame of the use of high resolution QuickBird images for the map updating, it must respect more strict tolerances than those required for 'quick' updating of Technical Map.

Positional tolerance for traditional Technical Map:

0.4 mm * scale = **2 m** at 1:5000 scale

Positional tolerance for 'quick' updating of traditional Technical Map:

0.8 mm * scale = **4 m** at 1:5000 scale

Positional tolerance for 'quick' updating of Technical Map through satellite orthoimages:

3 m

TEST SITE LOCATION

Castenaso – Bologna, Northern Italy

QUICKBIRD IMAGE

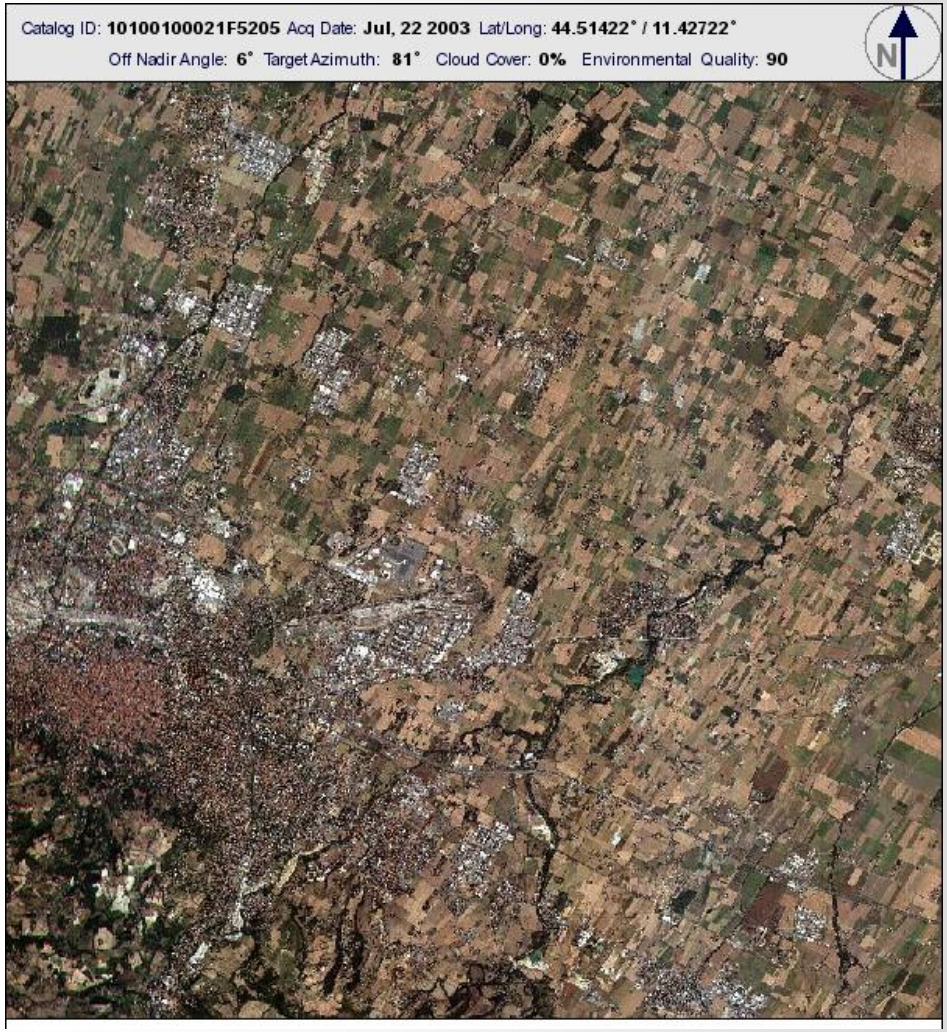
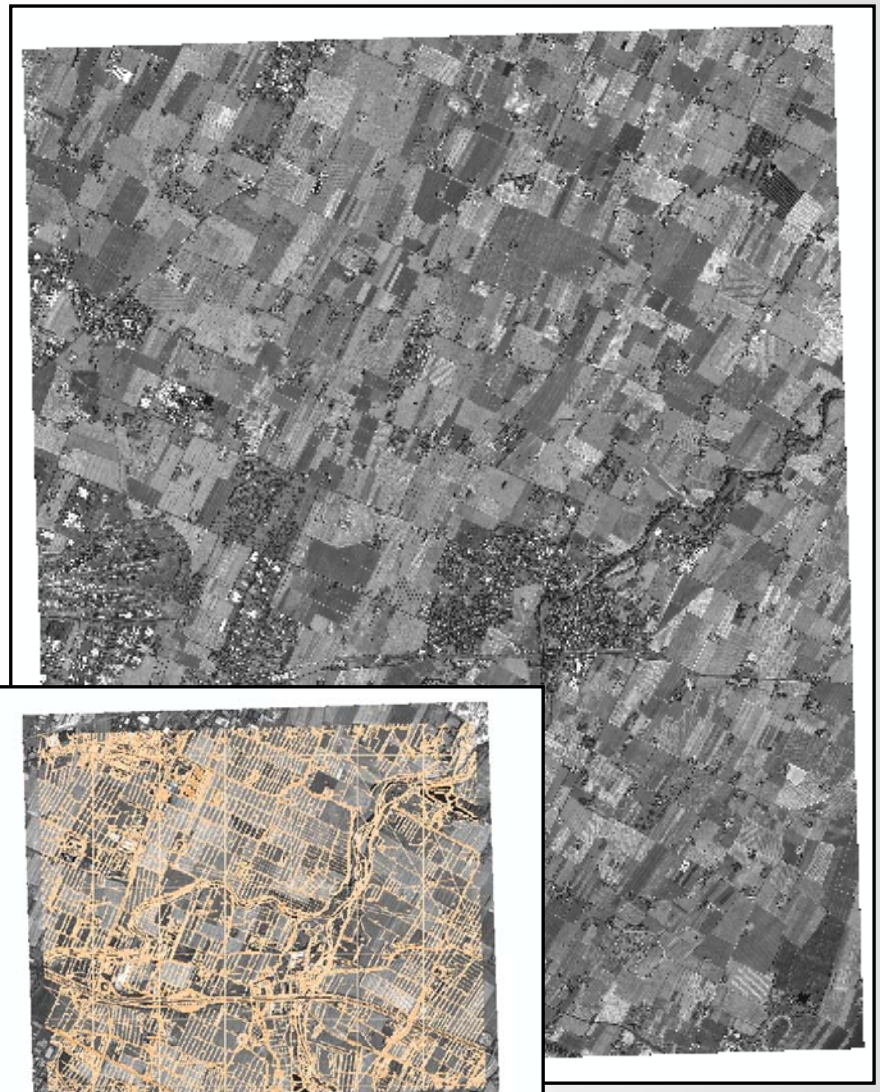


IMAGE METADATA	
ACQUISITION DATE	2003-07-22
CLOUD COVER	0%
PAN RESOLUTION	0.62 meters
ENVIRONMENTAL QUALITY	90 - Excellent
OFF-NADIR	6°
SUN AZIMUTH	≈ 140°
SUN ELEVATION	≈ 62°

IMAGE PRICE	
BASIC (1 PAN layer + 4 MS layers)	4800 €
ORTHORECTIFICATION + DATAFUSION	2400 €

QUICKBIRD ORTHOIMAGES



6 PANCHROMATIC ORTHOIMAGES

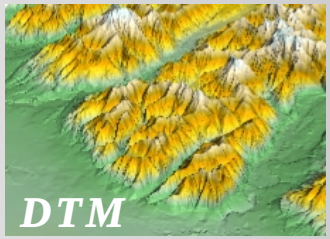
GSD 70 cm

UTM ED50

Gauss-Boaga National Grid System

Cut along Technical Scale Map 1:5000 (CTR5) extents

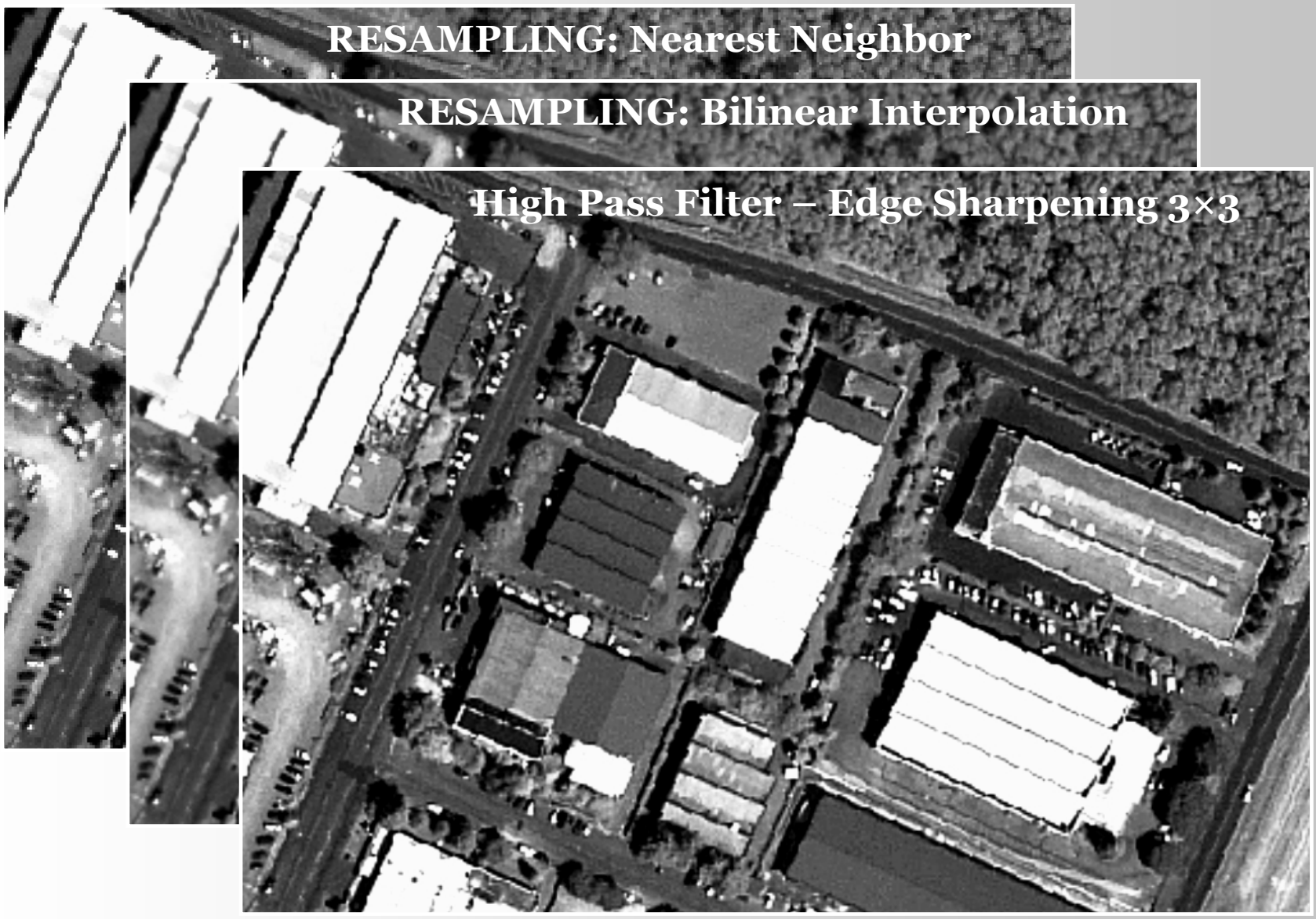
Certified Accuracy: <± 4 m compared with CTR 1:5000



from CTR 1:5000
UTM ED50

Geometric correction model: ?
GCP: ?
Software: ?

IMAGE ENHANCEMENT



SHADOWS

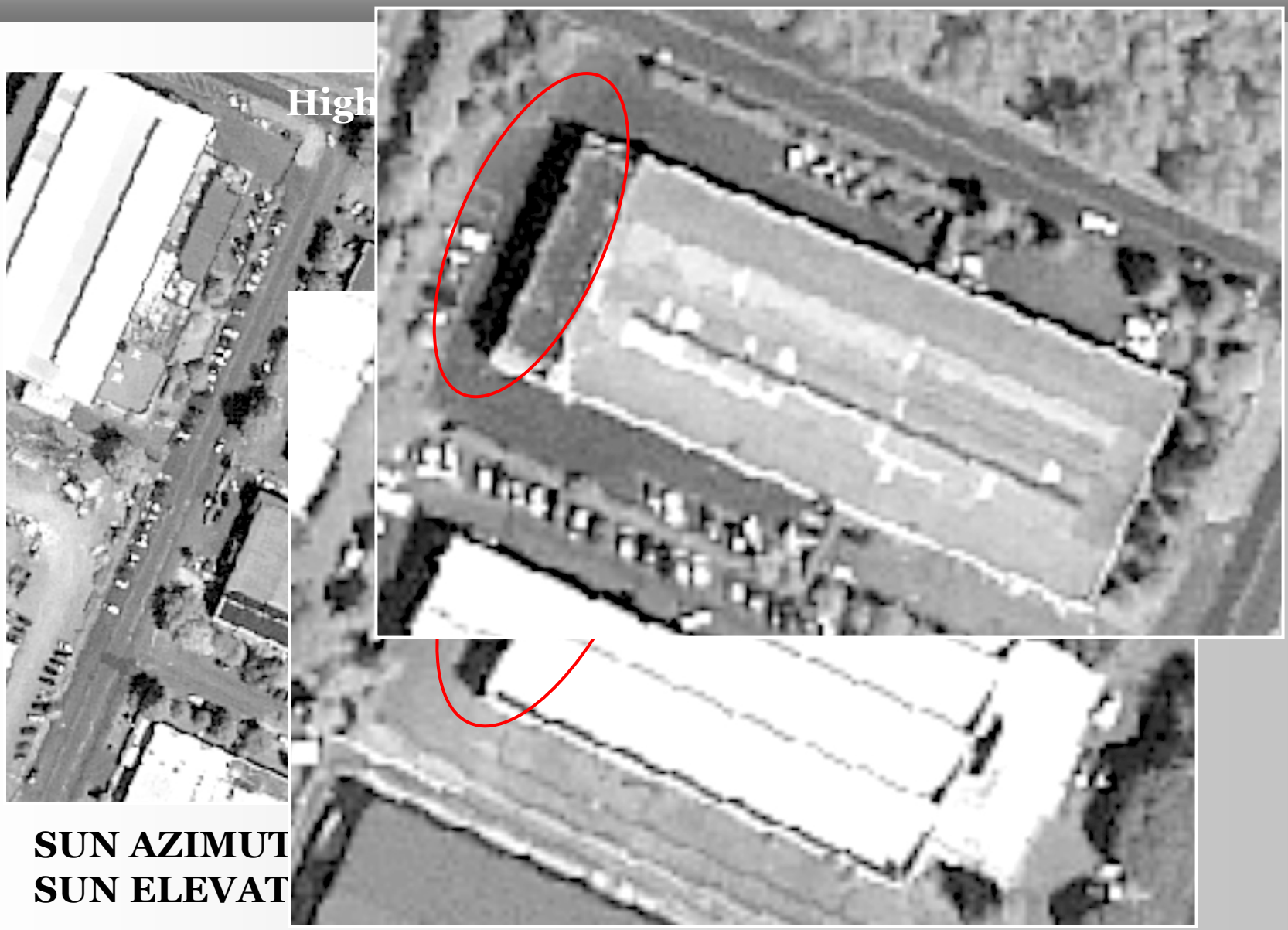


IMAGE VECTORIZATION – 1

PANCHROMATIC IMAGE

2 industrial areas ⟶ 43 buildings

1 urban area ⟶

Scale

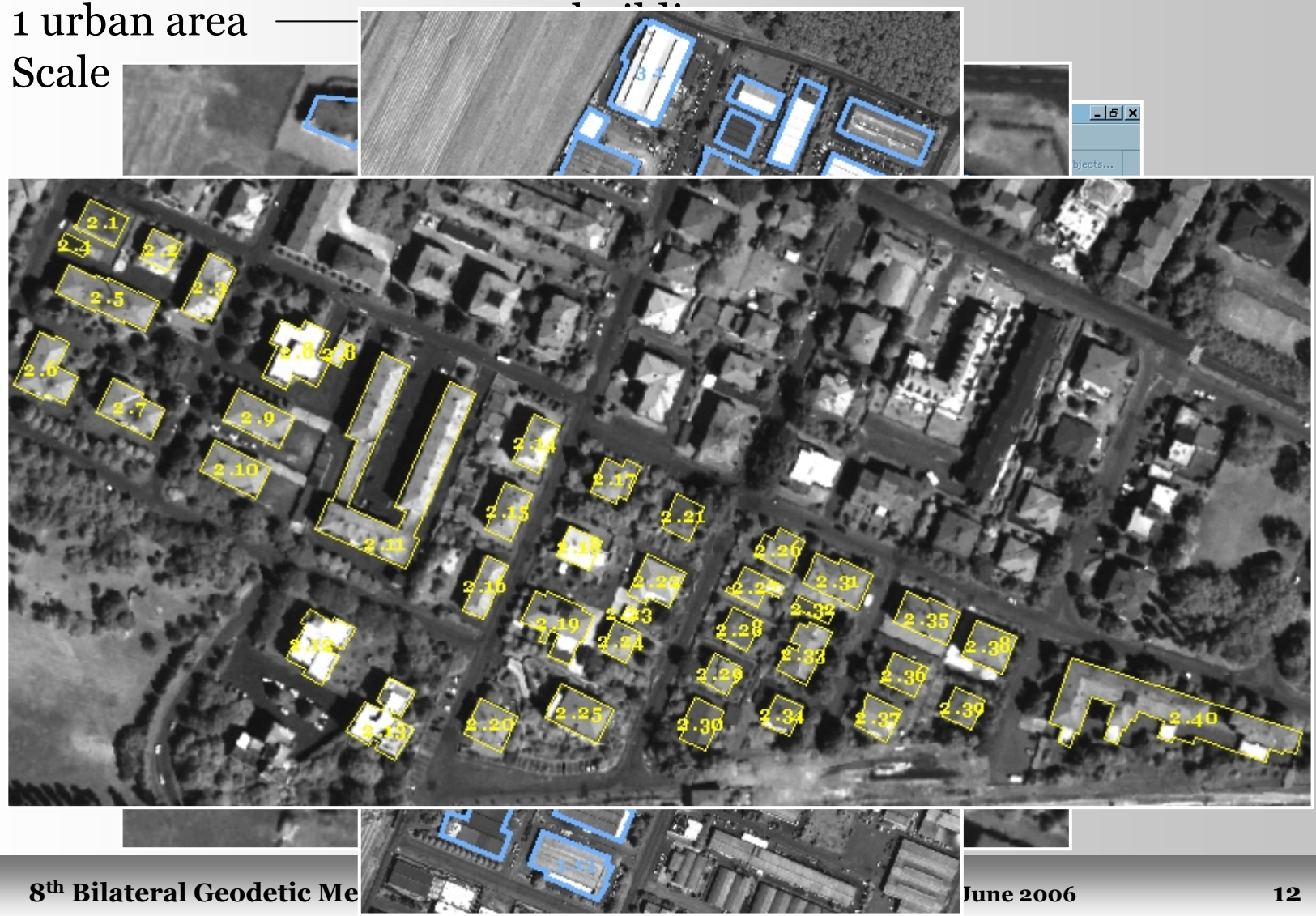


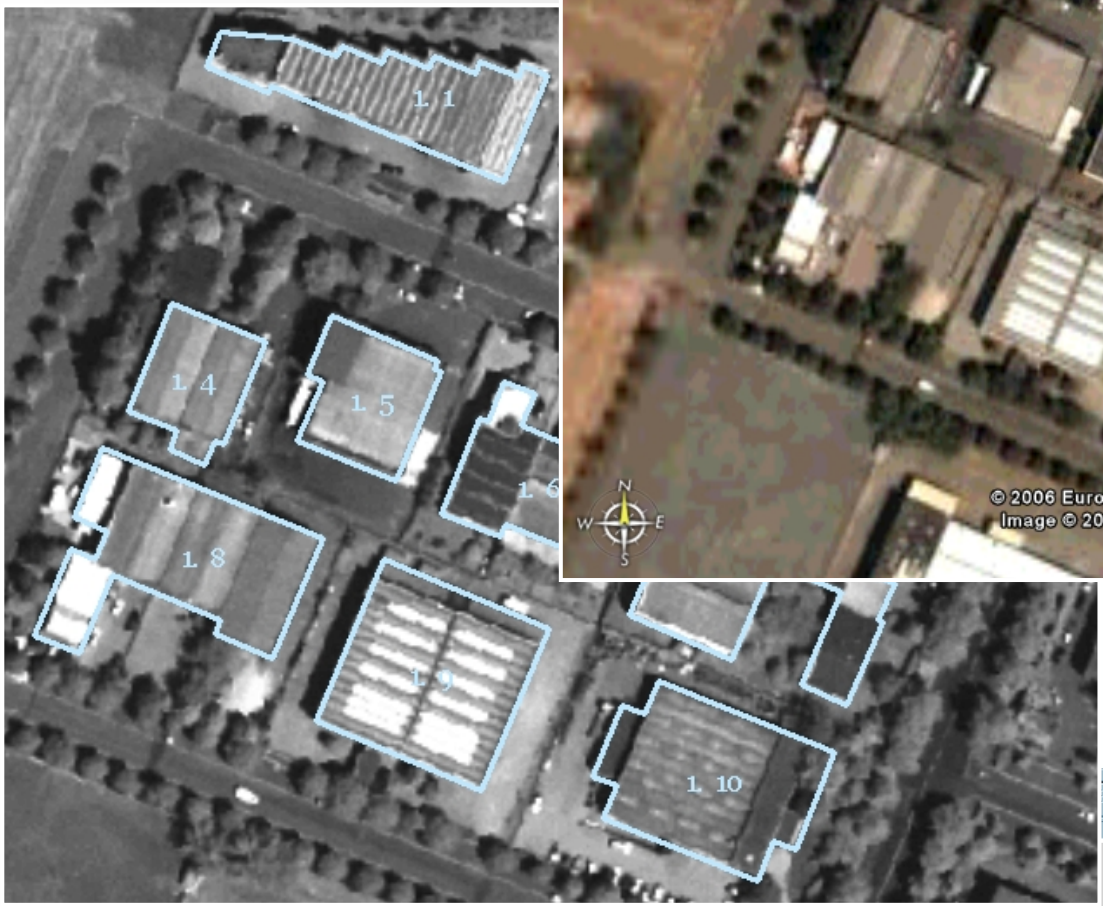
IMAGE VECTORIZATION – 2

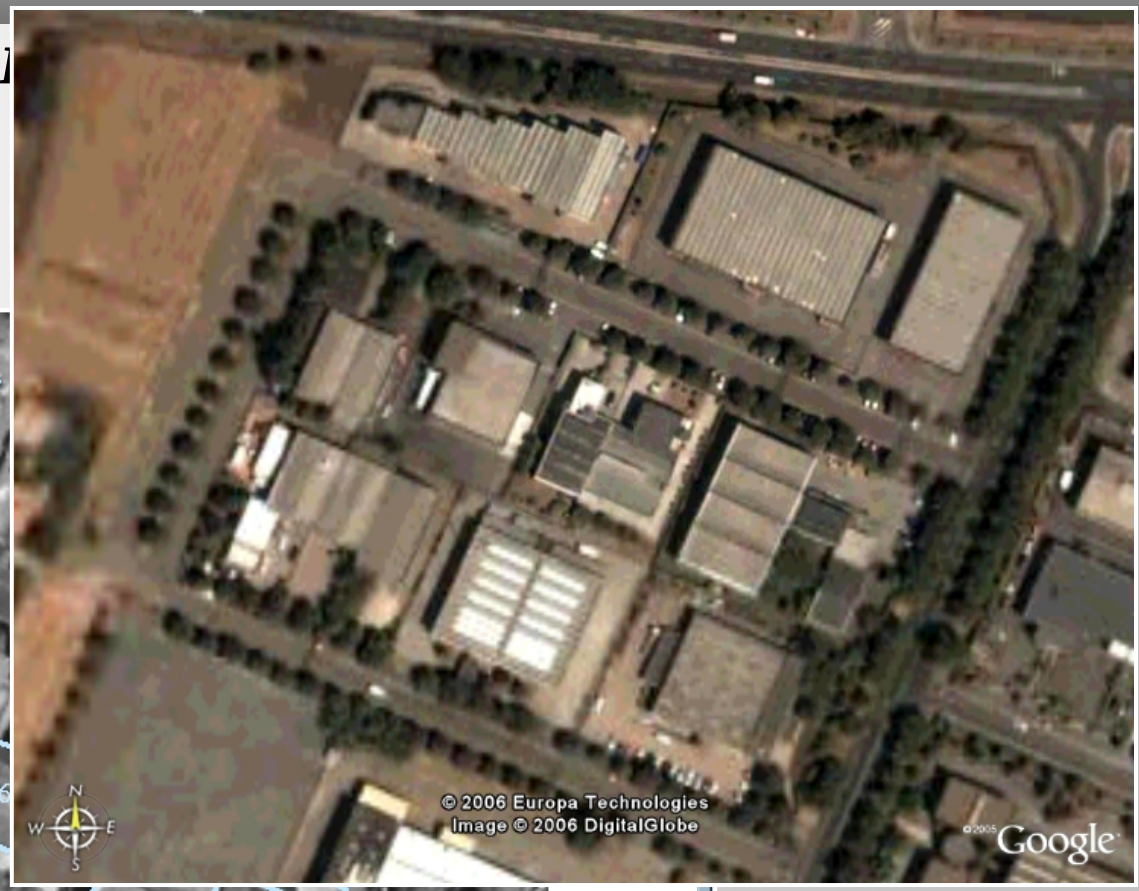
PANCHROMATIC I

2 industrial areas

1 urban area

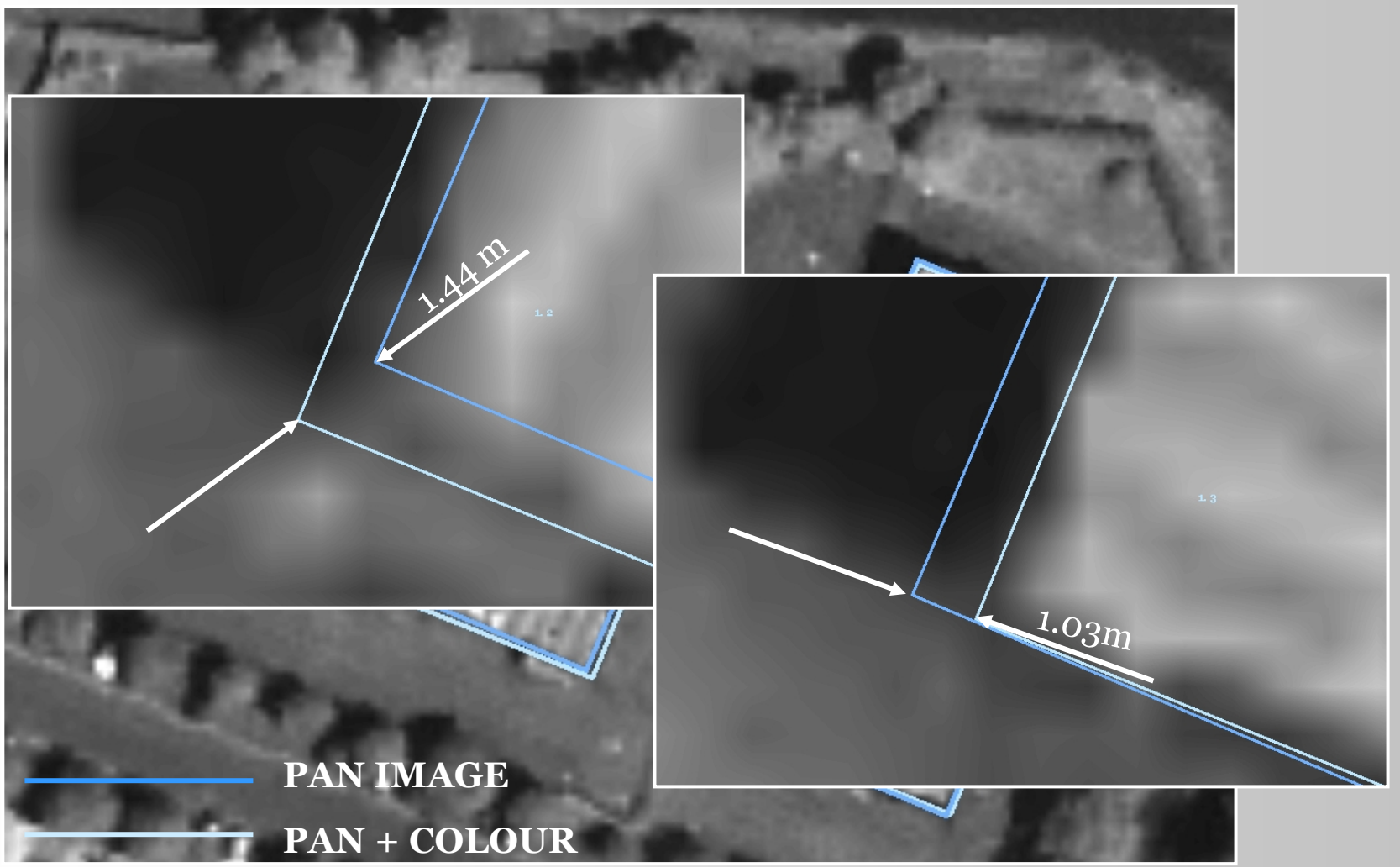
Scale 1:500 – 1:300





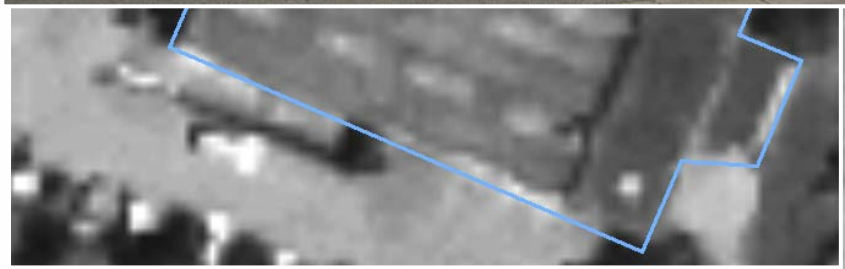
COMPARISON OF VECTORIZATION

INDUSTRIAL BUILDINGS - SIMPLE GEOMETRY



COMPARISON OF VECTORIZATION

INDUSTRIAL BUILDINGS

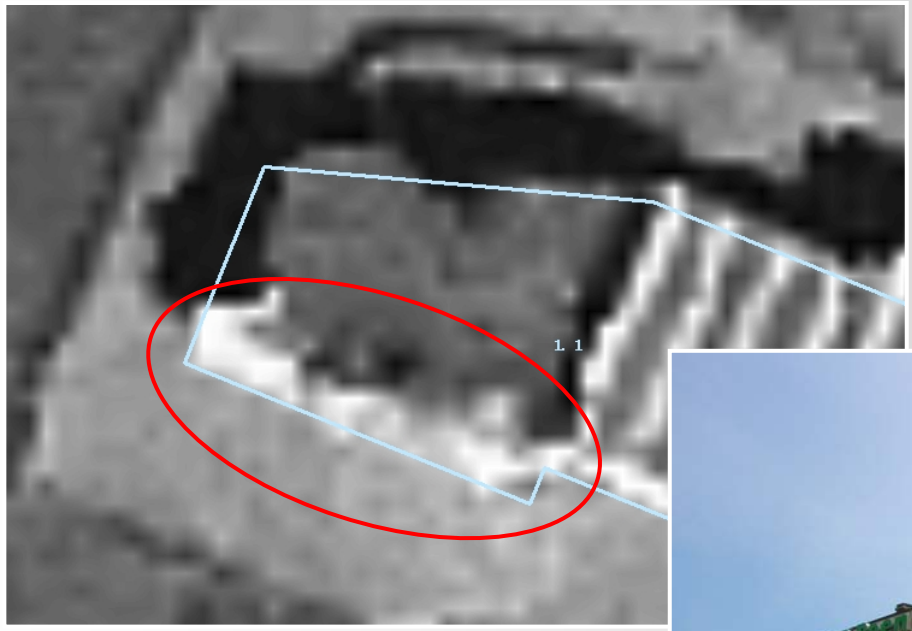


PAN IMAGE

PAN + COLOUR

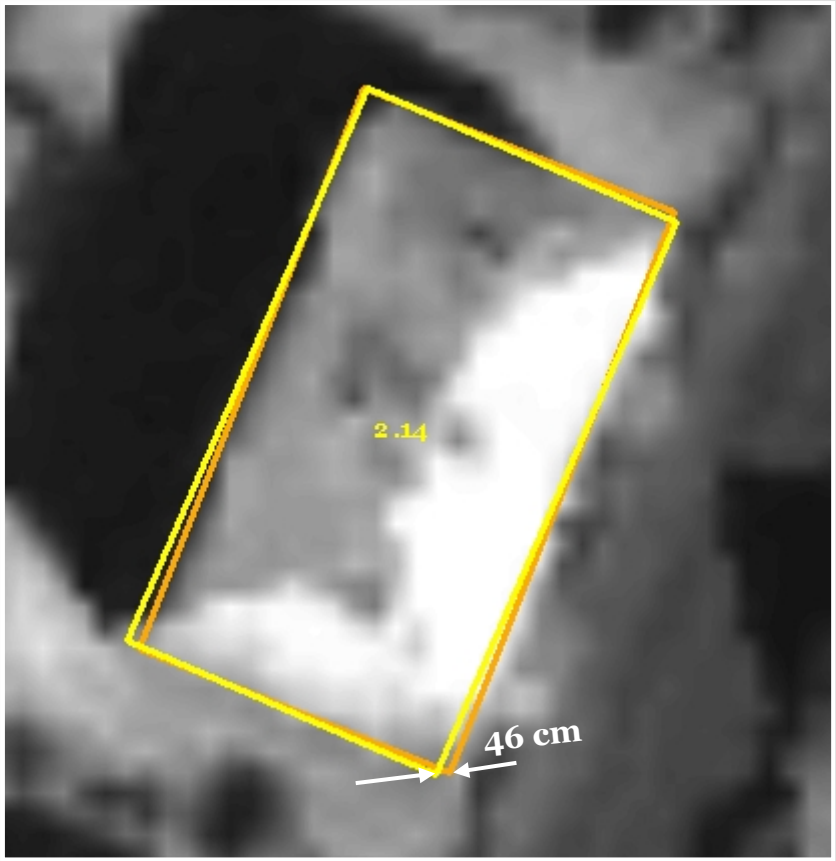
QUALITATIVE ACCURACY

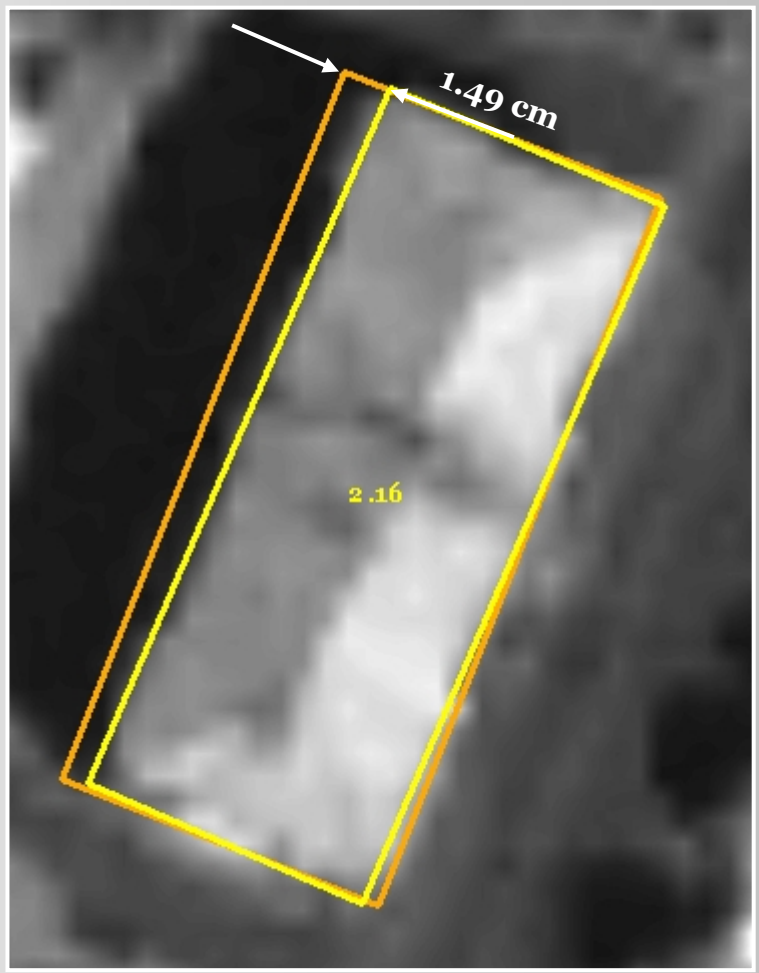
INDUSTRIAL BUILDINGS



COMPARISON OF VECTORIZATION

URBAN BUILDINGS – SIMPLE GEOMETRY



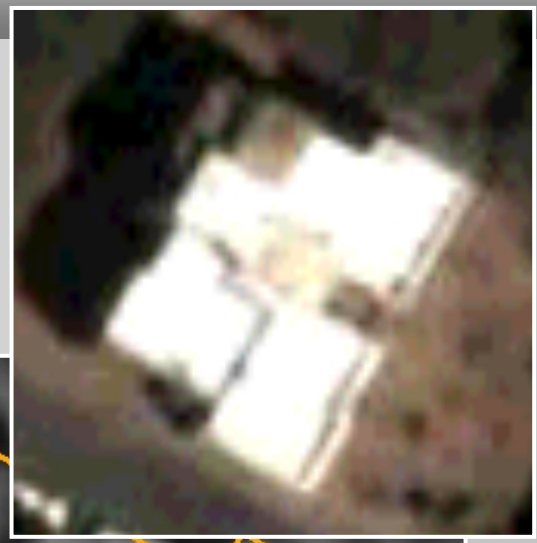


PAN IMAGE

PAN + COLOUR

COMPARISON OF VECTORIZATION

URBAN BUILDINGS
COMPLEX GEOMETRY



PAN IMAGE

PAN + COLOUR

GROUND INSPECTION

URBAN BUILDINGS

COMPARISON OF VECTORIZATION

	PAN IMAGE		PAN +COLOUR	
	Urban	Industrial	Urban	Industrial
Number of buildings	40	43	39	43

SHAPE DIFFERENCES	Urban		Industrial	
	Number of buildings	%	Number of buildings	%
	25	64.1	21	48.8

COMPARISON BETWEEN COORDINATES OF CORNERS

	Urban			Industrial		
Number of points	226			342		
	D_EST (m)	D_NORD (m)	Delta (m)	D_EST (m)	D_NORD (m)	Delta (m)
Mean	-0.08	0.11	0.65	0.00	0.16	0.62
RMS	0.61	0.44	0.39	0.48	0.53	0.39
Max	1.45	1.22	1.84	1.48	2.08	2.18
Min	-1.76	-1.49	0.03	-1.20	-1.19	0.03

IMAGE VECTORIZATION – 3

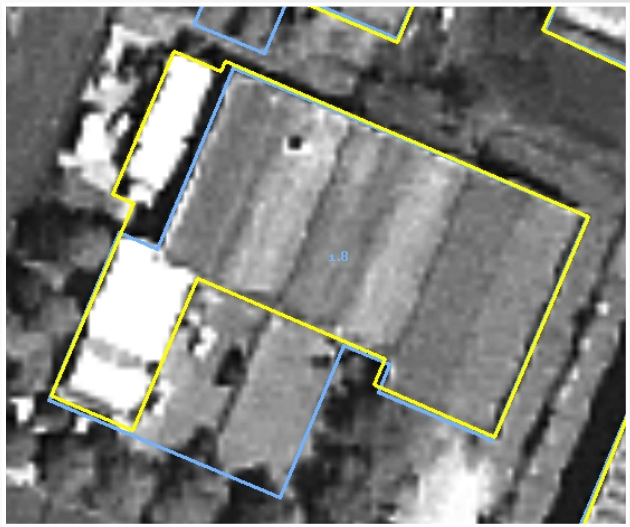
VECTORIZATION REPEATABILITY – PAN IMAGE

	VECT 1		VECT 2	
	Urban	Industrial	Urban	Industrial
Number of buildings	40	43	40	43

SHAPE DIFFERENCES	Urban		Industrial	
	Number of buildings	%	Number of buildings	%
	14	35	15	34.9

VECT1

VECT2



VECT1

VECT2

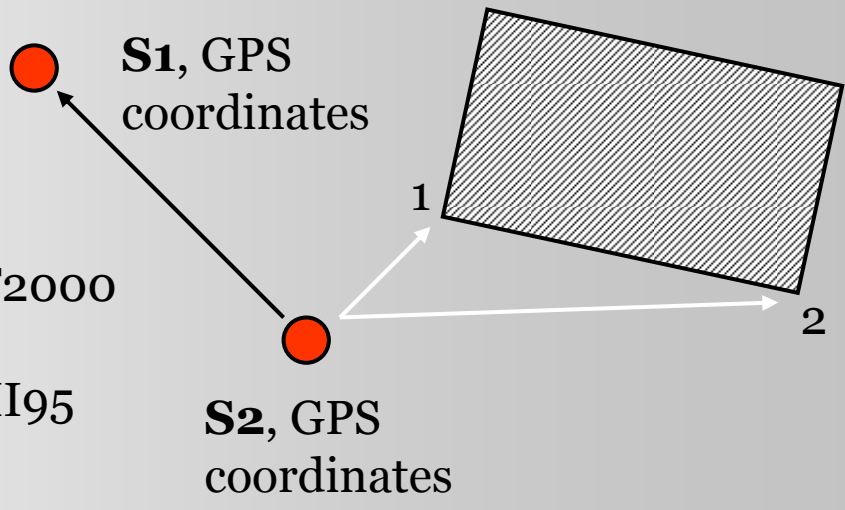
FIELD SURVEY

Field survey in the industrial area

INSTRUMENT: **SmartStation Leica** (Total station + GPS)

SURVEY METHOD:
Position of two GPS receivers on S1 and S2 station from Network RTK
Bearing of second station to the first one
Survey by total station and traverses from second station

SURVEYED POINTS: buildings corners, without prism



SURVEY COORDINATES: WGS84-ITRF2000
COORDINATES TRANSFORMATION:
from WGS84-ITRF2000 to WGS84-IGMI95
from WGS84-IGMI95 to GaussBoaga

GROUND SURVEYS

Stations
Surveyed points

METRIC ACCURACY

Comparison between coordinates of surveyed points and coordinates of correspondent vectorized corners

	PAN IMAGE			PAN +COLOUR		
	Delta EST (m)	Delta NORD (m)	Delta (m)	Delta EST (m)	Delta NORD (m)	Delta (m)
Mean	-0.95	-0.41	1.20	-0.93	-0.16	1.29
RMS	0.64	0.54	0.58	0.73	0.70	0.48
Max	0.43	0.64	2.61	1.44	1.85	2.11
Min	-2.58	-1.54	0.22	-1.80	-1.27	0.19

CONCLUSIONS

- Geocoding and orthoprojection of supplied orthoimages result correct
- Analysis of geometrical accuracy proved that orthoimages could be used for 1:5000 – 1:10000 technical scale map updating: accuracy is always whithin fixed tolerances
- the use of panchromatic images is not sufficient for a correct detection and interpretation of objects and their shape: the use of projected orthoimages generated by data fusion is very expensive but it is not possible a correct photo-interpretation process without the information from colour
- field survey and integration can be performed in an economic and accurate mode through the combined use of GNSS receivers and total station, using NRTK network