# Use of Pan image only for the CwRS

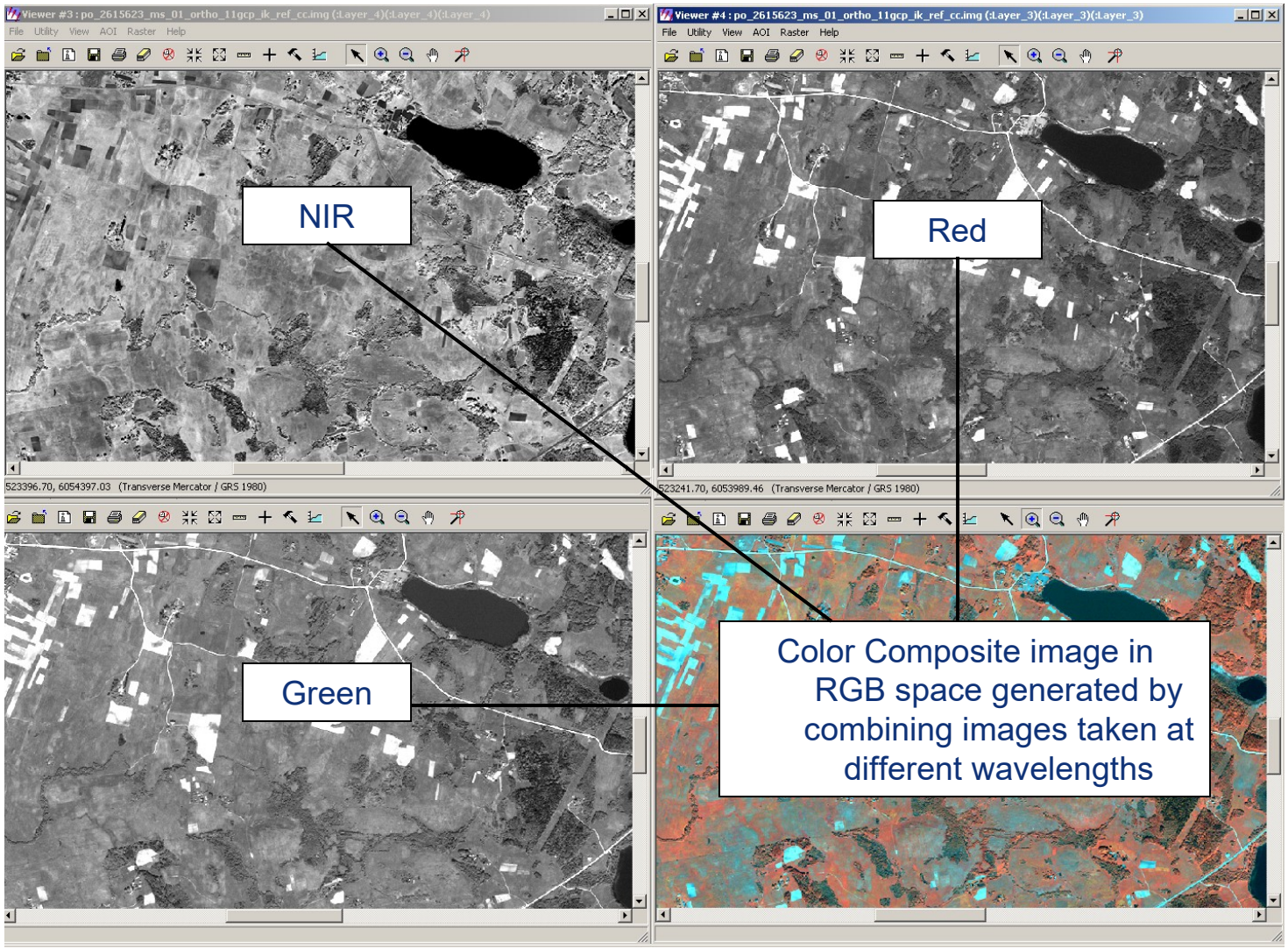
**Agriculture Unit, JRC Ispra**

# Rationale

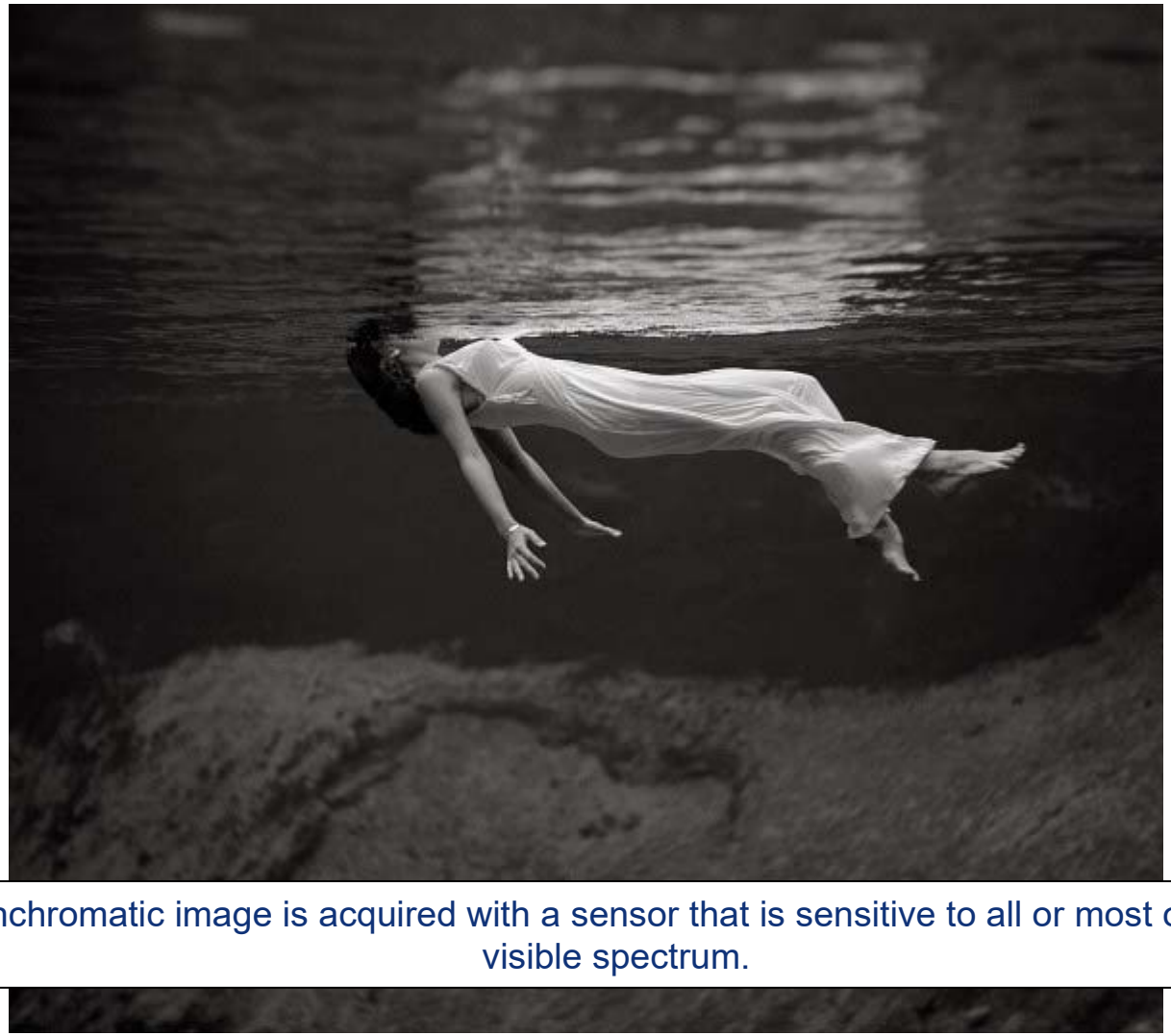
- VHR prime sensors used in CwRS (IK and QB) close to acquisition limits
  - New VHR (PAN+MS) sensors with GSD < 1m still under evaluation (Kompsat -1, GeoEye - 1)
- New VHR (PAN only) sensors with GSD < 1m (EROS B, WV-1)
- Could these new VHR PAN be used for CwRS as VHR prime sensors?
  - Limitation due to lack of multispectral (MS) component for the VHR
  - Possible combination with appropriate HR image

But what is the impact on the parcel measurements? Is it significant enough?

# What is PAN? What is MS?

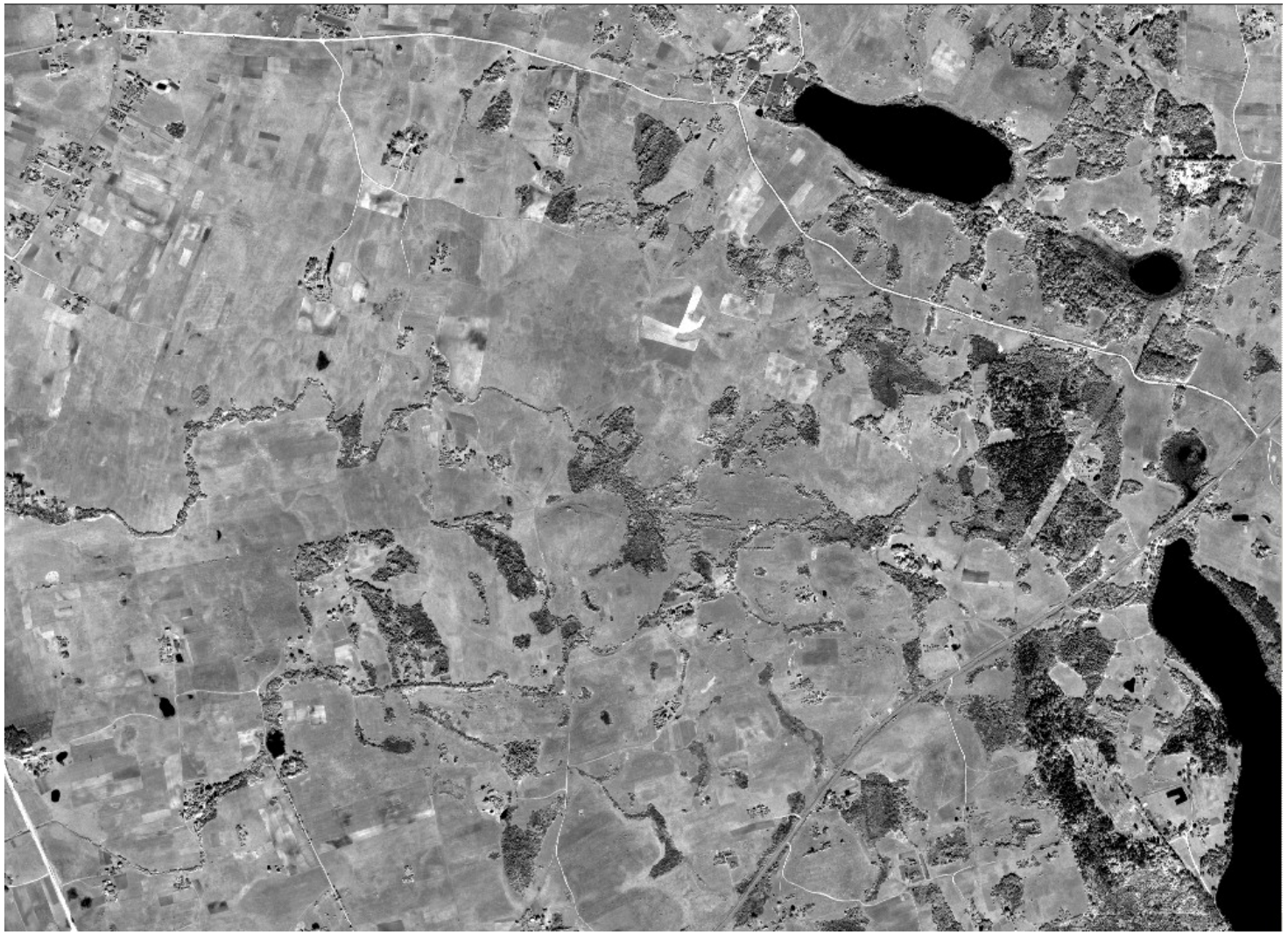


# The panchromatic of Toni Frissell



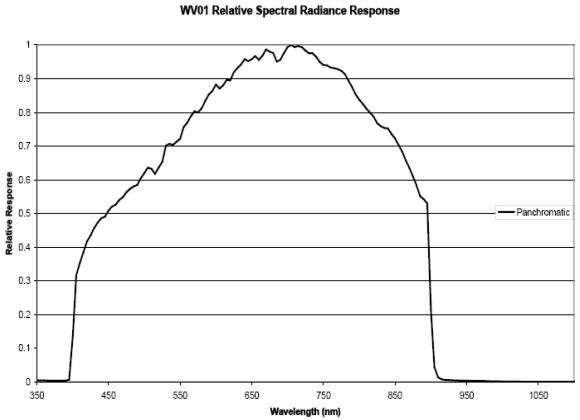
A panchromatic image is acquired with a sensor that is sensitive to all or most of the visible spectrum.

# The panchromatic of IKONOS and Quickbird

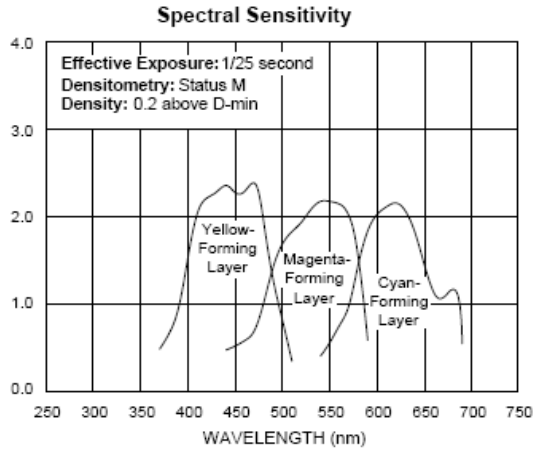


# VHR Panchromatic vs. Panchromatic

## PAN range of VHR satellites




WV1 Relative spectral Radiance Response



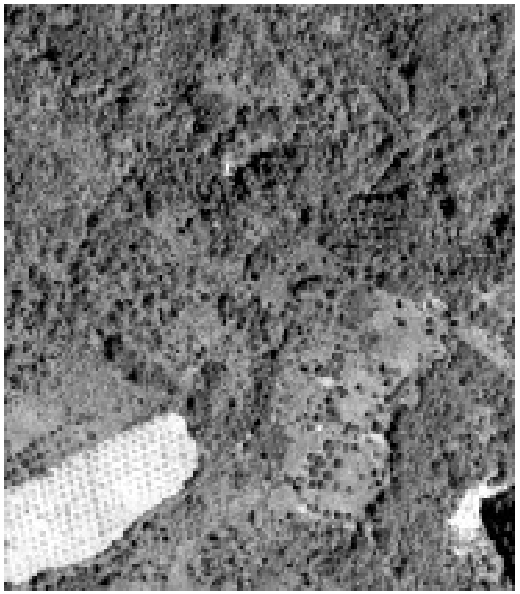

KODAK AEROCOLOR III Negative Film 2444

## Different spectral range

VHR PAN, GSD 0.6m

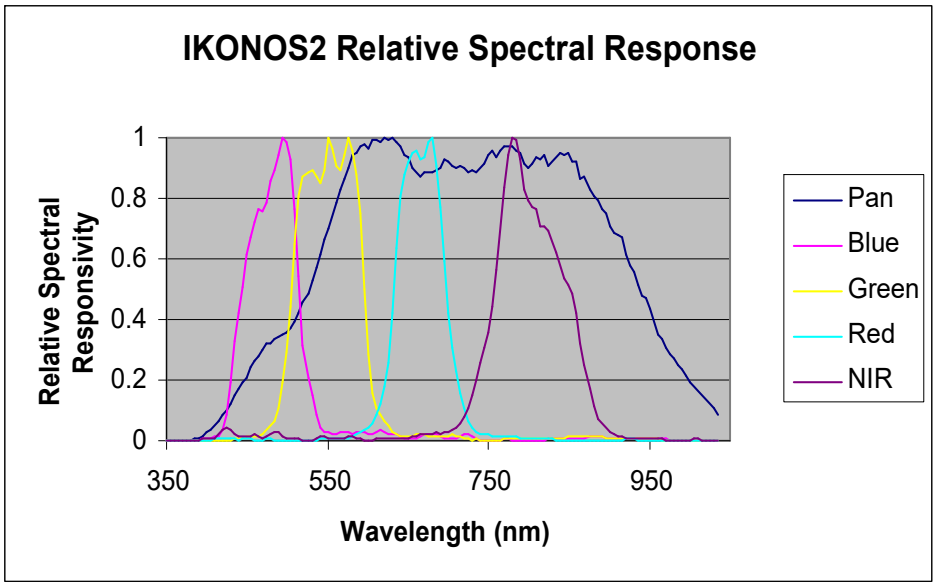
400 ηm — 900 ηm

Aerial B&W, GSD 1.0m

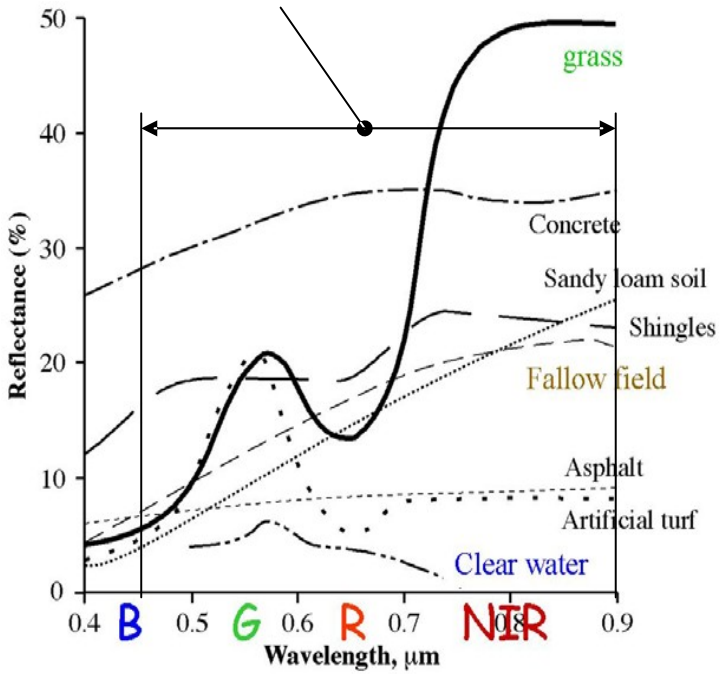


400 ηm — 700 ηm

# PAN and MS - Definitions




PAN range of VHR satellites

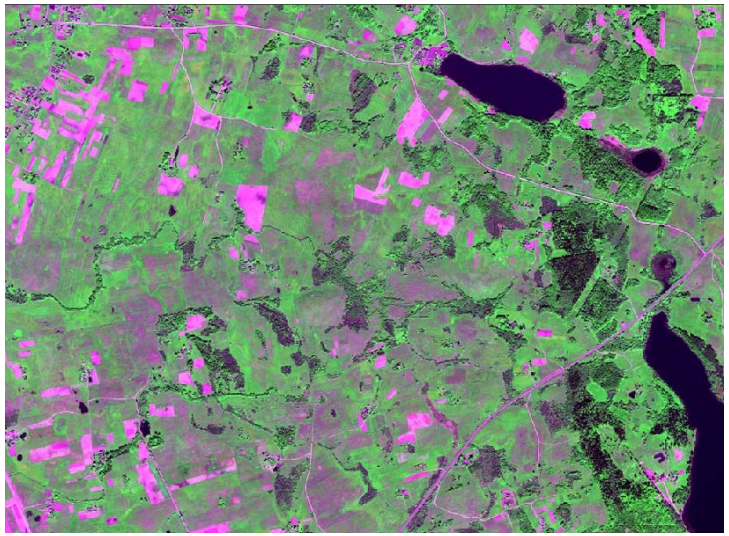



- The multispectral image represents the reflectance data in several discrete spectral bands.
- The panchromatic image contains only one wide band of reflectance data.

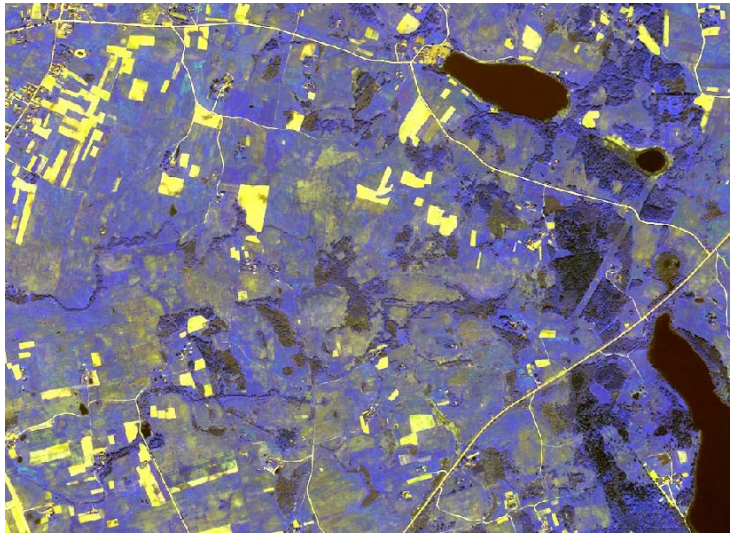
Panchromatic images are collected with higher spatial resolution than the multispectral image, due to the broad spectral range (more light energy)

# The Color Composite – A Trick for the Eye

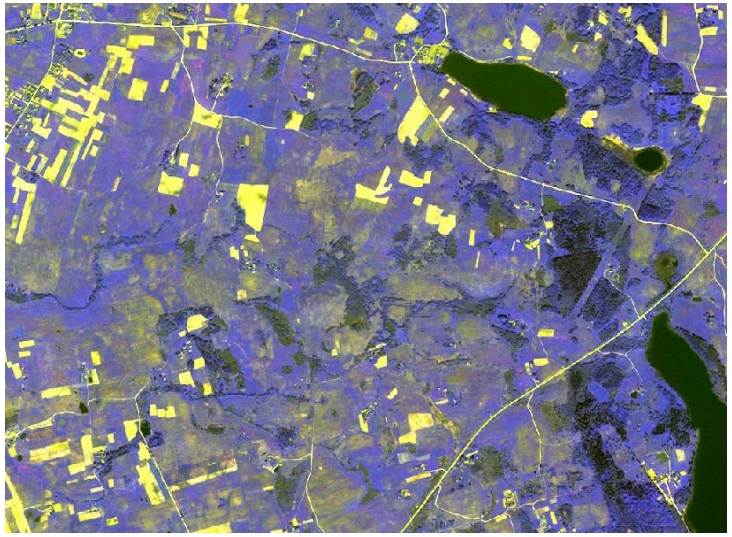
R NIR
G Red
B Blue



R Red
G NIR
B Blue



R Blue
G Red
B NIR



R Red
G Blue
B NIR

# Spatial and Spectral Resolution

QB PAN 0.6 m GSD

QB XS 2.4 m GSD

# Image Resolution and Information Content

## VHR PAN

**Good spatial resolution**

High detail, more objects are resolved

Texture more visible

Smoothness of objects preserved

**Poor spectral resolution**

Spectral variations are difficult to detect

Low sensitivity to change of reflection

Compactness of objects is less evident

## VHR MS

**Poor spatial resolution**

Low detail, less objects are resolved

Texture less visible

Smoothness of objects decreased

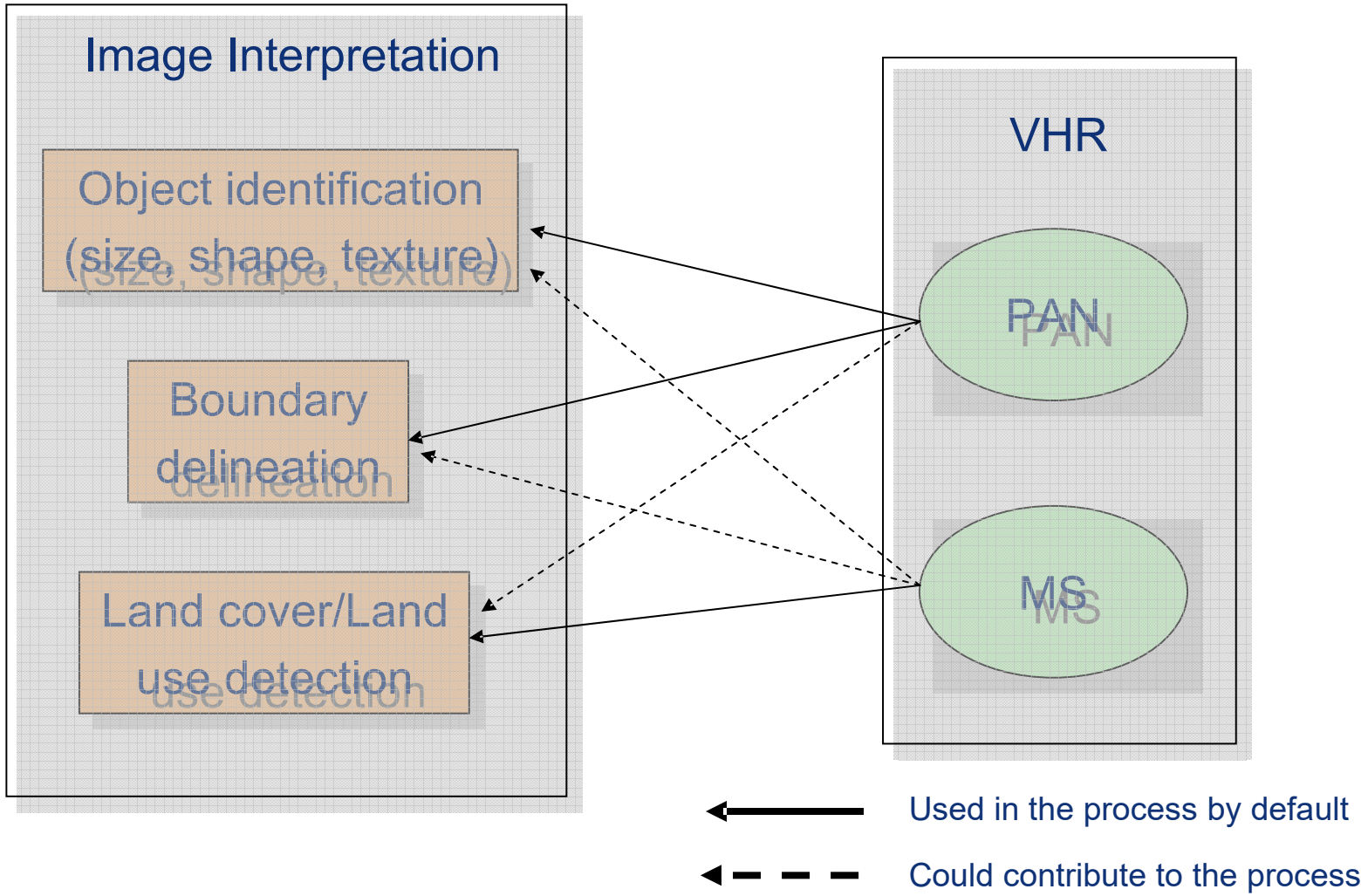
**Good spectral resolution**

Spectral variations are easy to detect

High sensitivity to change of reflection

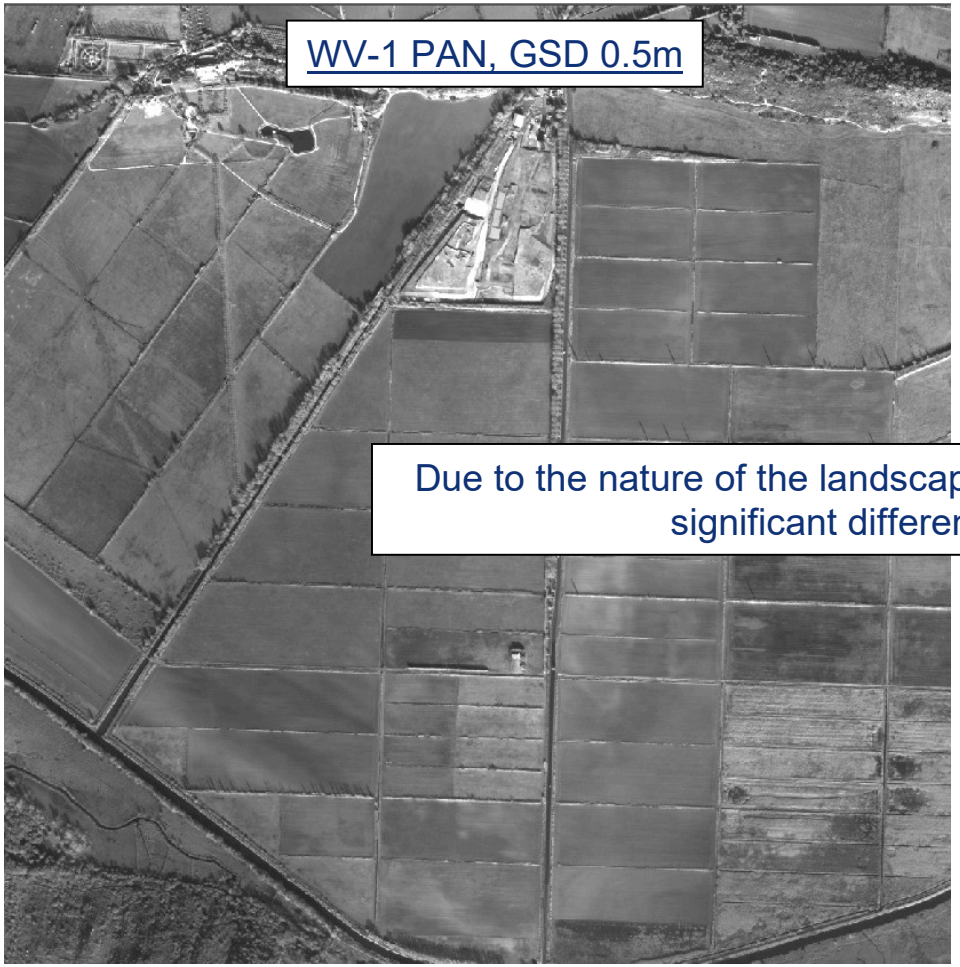
Compactness of objects is better presented

# PAN + MS in the context of CwRS



# Examples – WV-1 over Mausanne (FR)

Note: Images acquired in different years and seasons!

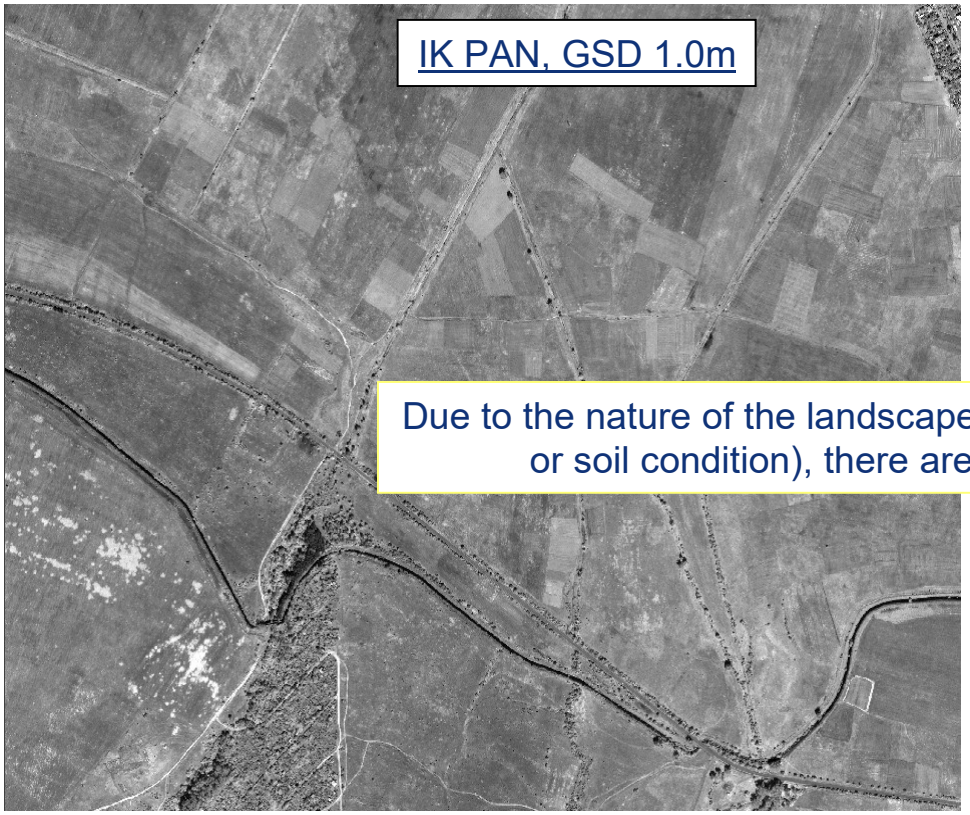


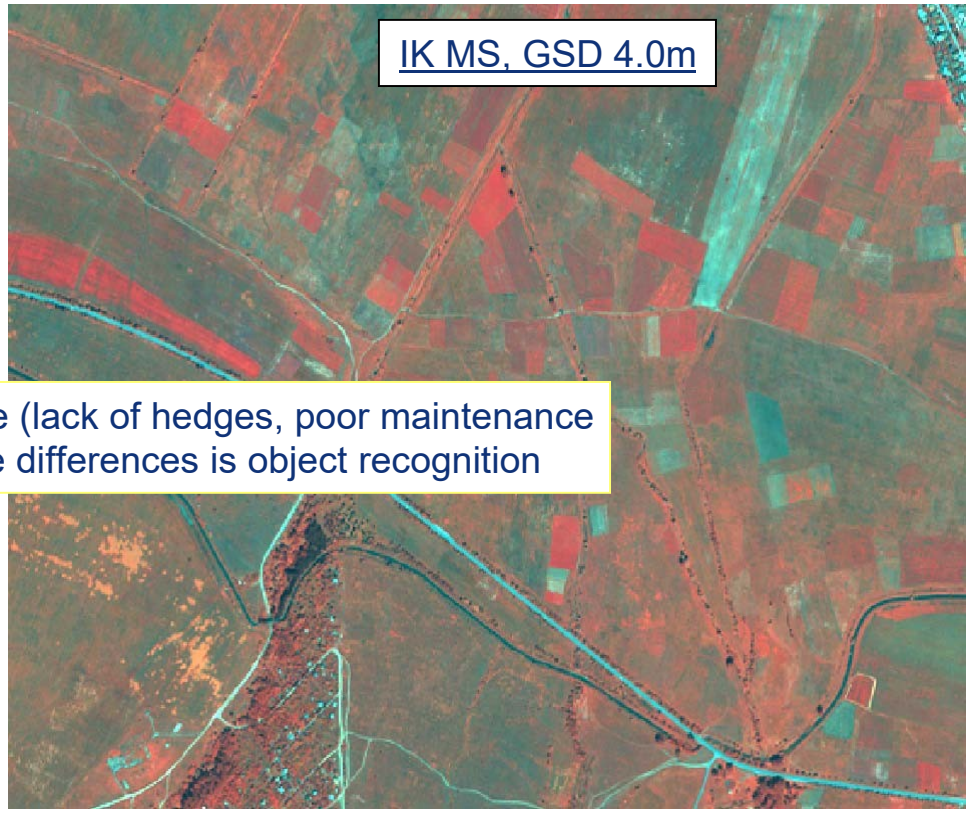


Due to the nature of the landscape (hedges, trees rows), there is no significant difference is object recognition

# Examples – IK over Sofia (BG)

Images acquired simultaneously (bundle product)




Due to the nature of the landscape (lack of hedges, poor maintenance or soil condition), there are differences is object recognition

# The Case Study

## Test Area:

## QC site from CwRS 2007: STAK (LT)

Primary sensor: IKONOS (PAN+MS)

Backup sensor: EROS B (PAN only)

Backup is acquired a day after the dedicated.

## QC vector data available

Measured parcels from Contractor and LPIS data

## Why this site?

- Prime and Backup were acquired almost simultaneously (one day difference). Same phenological conditions for the vegetation
- Parcels structure without hedges or rows of trees, where the role of MS might be decisive.

# The Case Study (2)

¾ Objective of the study

- to identify a set of agricultural parcels on both IKONOS and EROS B
- to assess the measurement tolerance thought the reproducibility limit (see Session T3, ID 18)

¾ How to do that?

- With 4 Operators
- Working independently on both image datasets (first EROSB, then IKONOS)
- Delineating 3 times (through CAPI) the same set of parcels in random sequence
- Analyzing the results and computing the statistics (see see Session T3, ID 18)

¾ Preparatory work

- Initial image data analysis and pre-processing
- Parcel Sample Selection, from the CwRS vector dataset
- Definition of methodology and interpretation rules (see Session T3, ID 18)

# Initial image data analysis and pre-processing

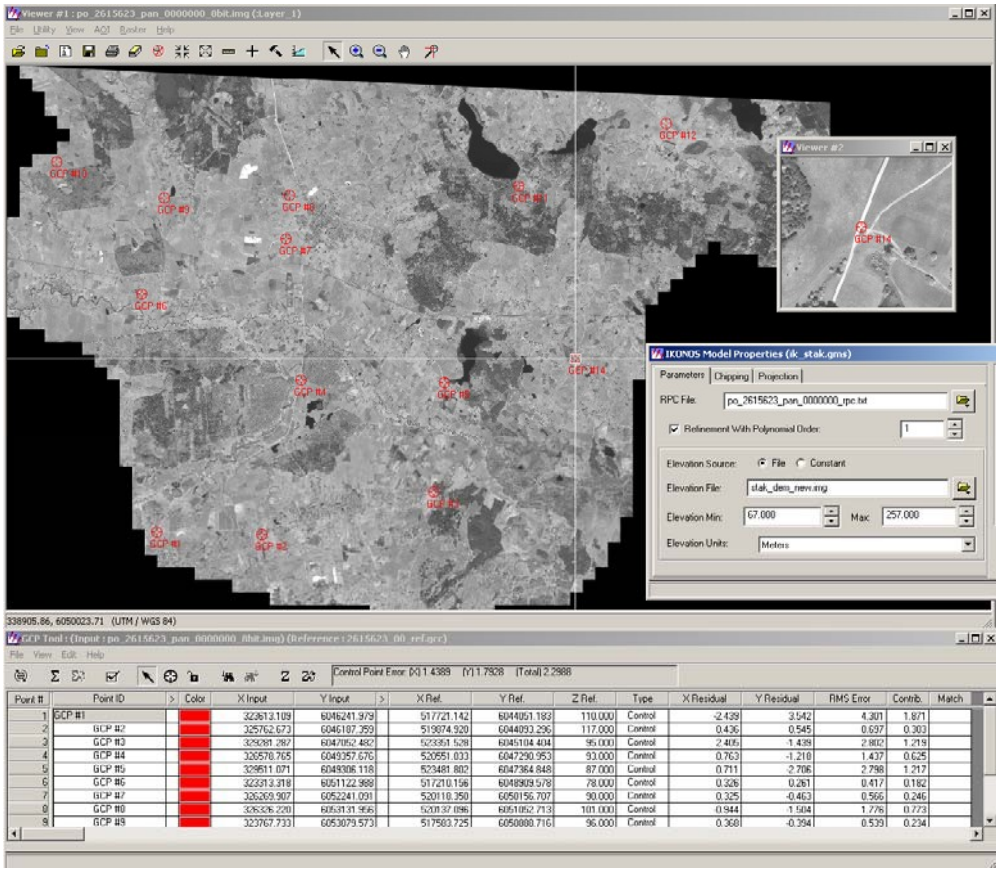
Poor quality of the pansharpened "reference" image of IKONOS

- Due to slight improper registration of the PAN and MS components of the Bundle product

New pansharpened image produced

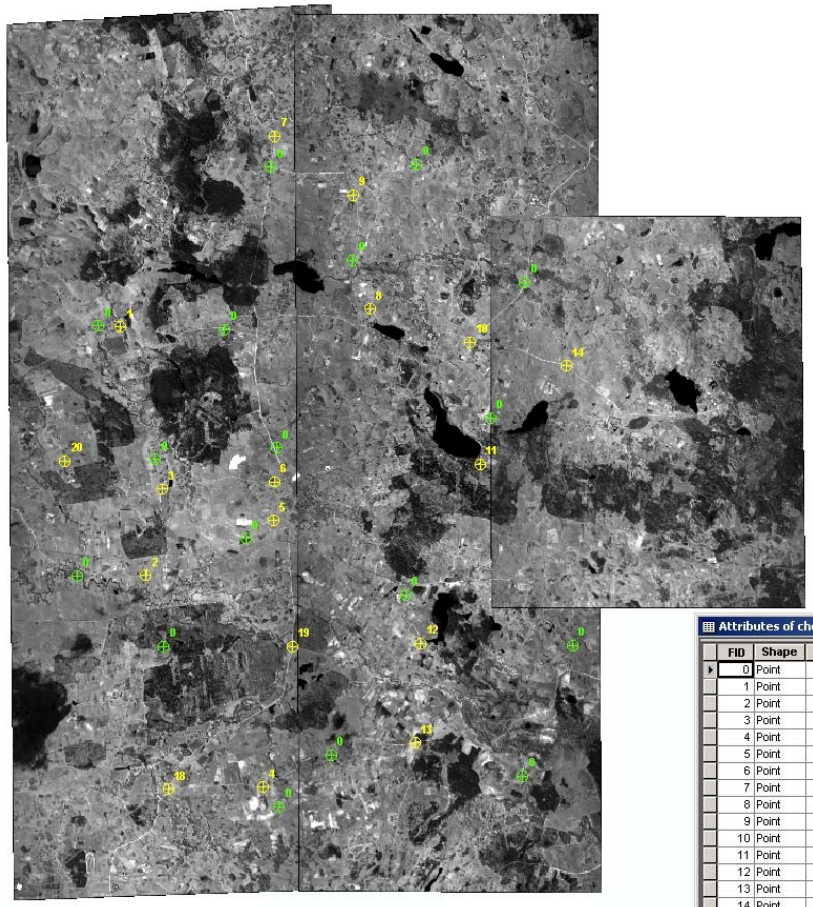
- After new orthorectification of both PAN and MS

# Pre-processing – Orthorectification of the IKONOS




- With the same ground control points and DEM used for the correction of EROS B
- With the same Geometric model (RPC file and poly order) for both PAN and MS
- Image fusion using:
  - Principal Component Method
  - Cubic Convolution

# Pre-processing – Accuracy checks of EROSB



With the ground control points and the PRESS method

RMSE1d between 1.5 and 3 meters for the different scenes

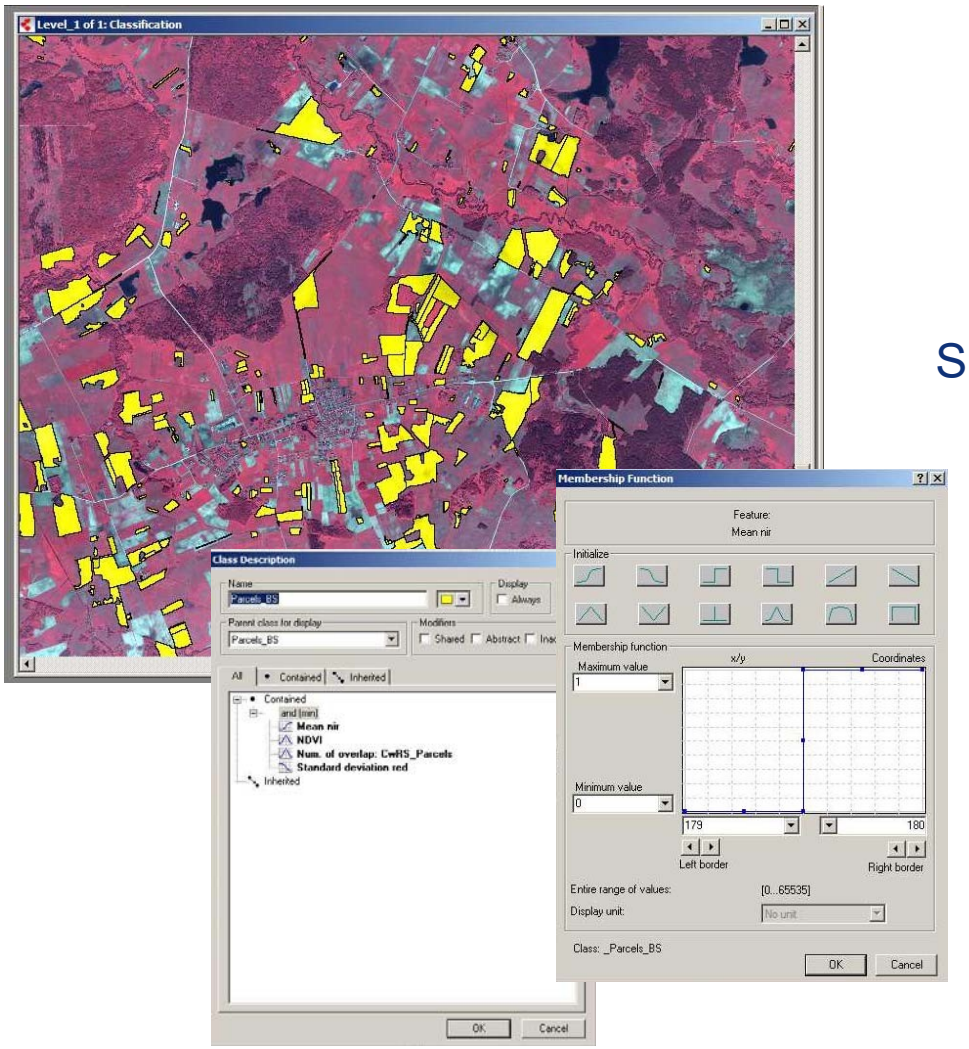
Some scenes and areas excluded from the test

Attributes of checkpoints_EROSB_pan_ortho_vsLPIS_STAK

| FID | Shape | ID | X | Y | Xref | Yref |
|---|---|---|---|---|---|---|
| 0 | Point | 0 | 521435.711342 | 6044830.28586 | 521437.988765 | 6044830.64546 |
| 1 | Point | 0 | 526930.720352 | 6047321.83924 | 526933.960945 | 6047320.75904 |
| 2 | Point | 0 | 523131.691673 | 6048468.1295 | 523133.642201 | 6048469.75494 |
| 3 | Point | 0 | 525795.906195 | 6044355.52407 | 525798.590715 | 6044354.92751 |
| 4 | Point | 0 | 519490.450523 | 6049743.40672 | 519487.655383 | 6049744.26676 |
| 5 | Point | 0 | 515642.02333 | 6048901.36146 | 515641.015145 | 6048902.08159 |
| 6 | Point | 0 | 520185.301096 | 6051826.48397 | 520183.646194 | 6051826.10148 |
| 7 | Point | 0 | 520247.999971 | 6043662.94293 | 520247.687228 | 6043661.06647 |
| 8 | Point | 0 | 517419.357258 | 6051564.86228 | 517417.300875 | 6051566.2332 |
| 9 | Point | 0 | 525062.190452 | 6052504.97088 | 525057.228383 | 6052502.94638 |
| 10 | Point | 0 | 517620.39636 | 6047297.64716 | 517620.128749 | 6047294.98708 |
| 11 | Point | 0 | 519007.722094 | 6054522.82935 | 519002.349124 | 6054521.38782 |
| 12 | Point | 0 | 520053.283419 | 6058210.27637 | 520049.413226 | 6058210.80412 |
| 13 | Point | 0 | 525846.187499 | 6055590.13831 | 525845.567913 | 6055591.76407 |
| 14 | Point | 0 | 523379.16342 | 6058276.26395 | 523377.72616 | 6058275.96137 |
| 15 | Point | 0 | 521916.144929 | 6056092.3723 | 521912.968053 | 6056094.75496 |

Record: 1 Show: All Selected Records (0 out of 17

# Parcel Sample Selection




Identification of potential candidates on the base of selected spectral characteristics

- Parcels with DN values in certain range of the mean red and NDVI

Spatial intersection with the vectors from the CwRS

- Initial selection of 230 parcels from the CwRS dataset

Stratification of the selected CwRS parcels based on their size

- Random selection in each strata (150 parcels)
- Final set for the current test: 56 parcels

# Definition of methodology and interpretation rules

Operators delineate the parcel on the base of the image only (IK or EROSB), following the shape of the measured parcels from the CwRS (displayed on separate screen)

The crop boundaries of the parcel were delineated, excluding any other type of land cover.

In case of multiple crops, the vector contour from the CwRS should be considered.

# First Results

## Feedback from Operators

- In general no problem for identification of the parcels on EROS B
- In few cases even easier than the IKONOS
- Many of the problematic cases on EROS B were found difficult also on IKONOS

## Statistics

- Reproducibility limit for EROS B – **1.34** meters
- Reproducibility limit for IKONOS – **1.35** meters

Reproducibility limits calculated base on mean buffer using mean area and mean perimeter

# First Conclusions

EROS B shows similar capability for parcel measurements like IKONOS

- Smaller tolerance expected for EROSB, considering its GSD of 0.7 m

The higher spatial resolution of EROS B is able to compensate the lower spectral resolution.

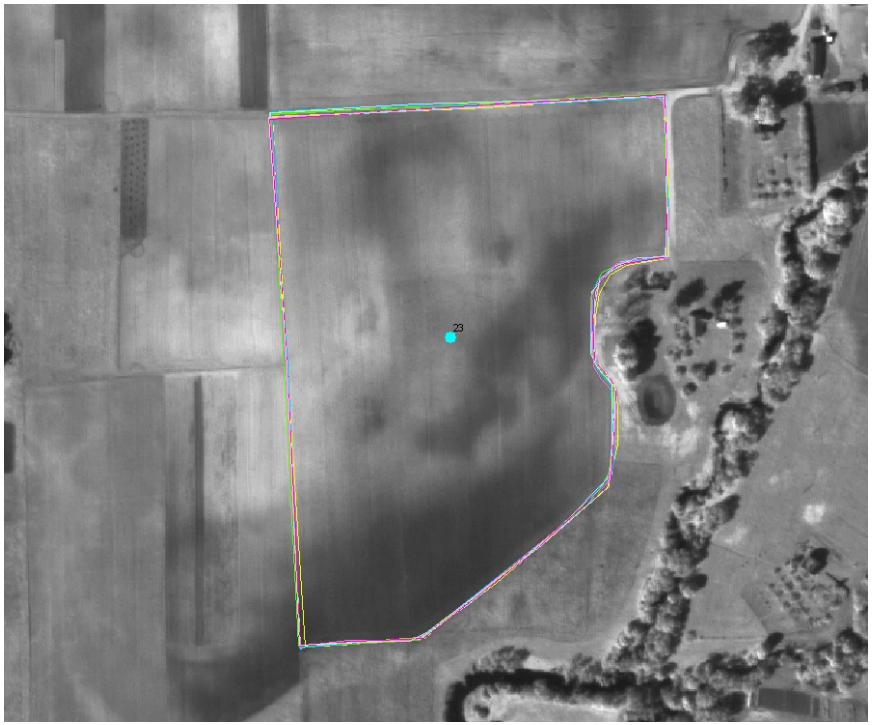
Pan-sharpening might have adverse effects on the spatial resolution (fuzzy boundaries, blurring, poor resampling, etc.)

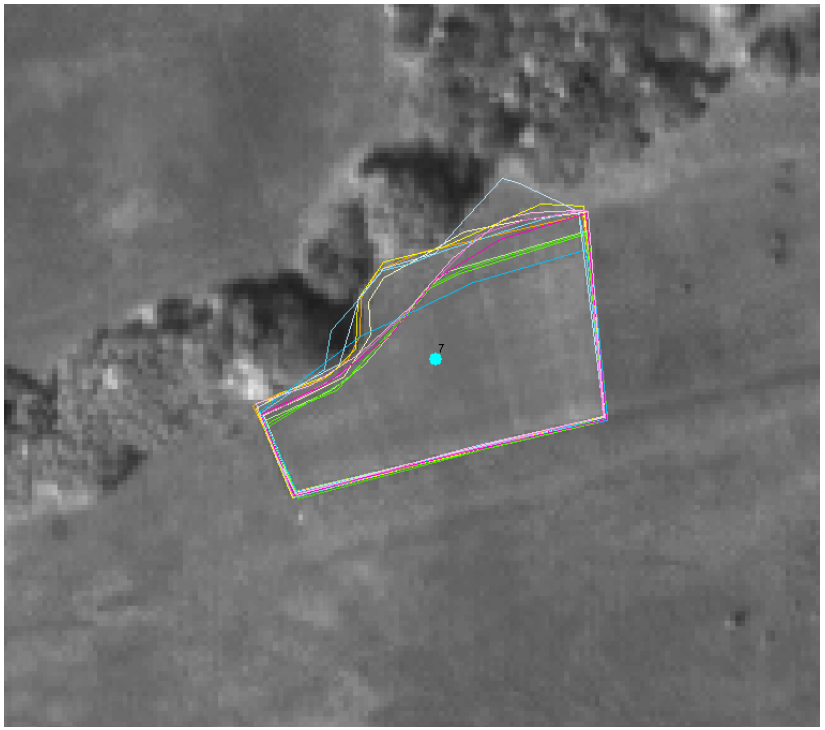
Follow-up:

1. Larger sample
2. Comprehensive statistics (including Normality tests, outlier detection, etc.)
3. Another test area

# Some examples


# Some examples (2)



# Some examples – Same parcel on both images

EROS B

IKONOS


Thank you for your attention