Joint Research Centre

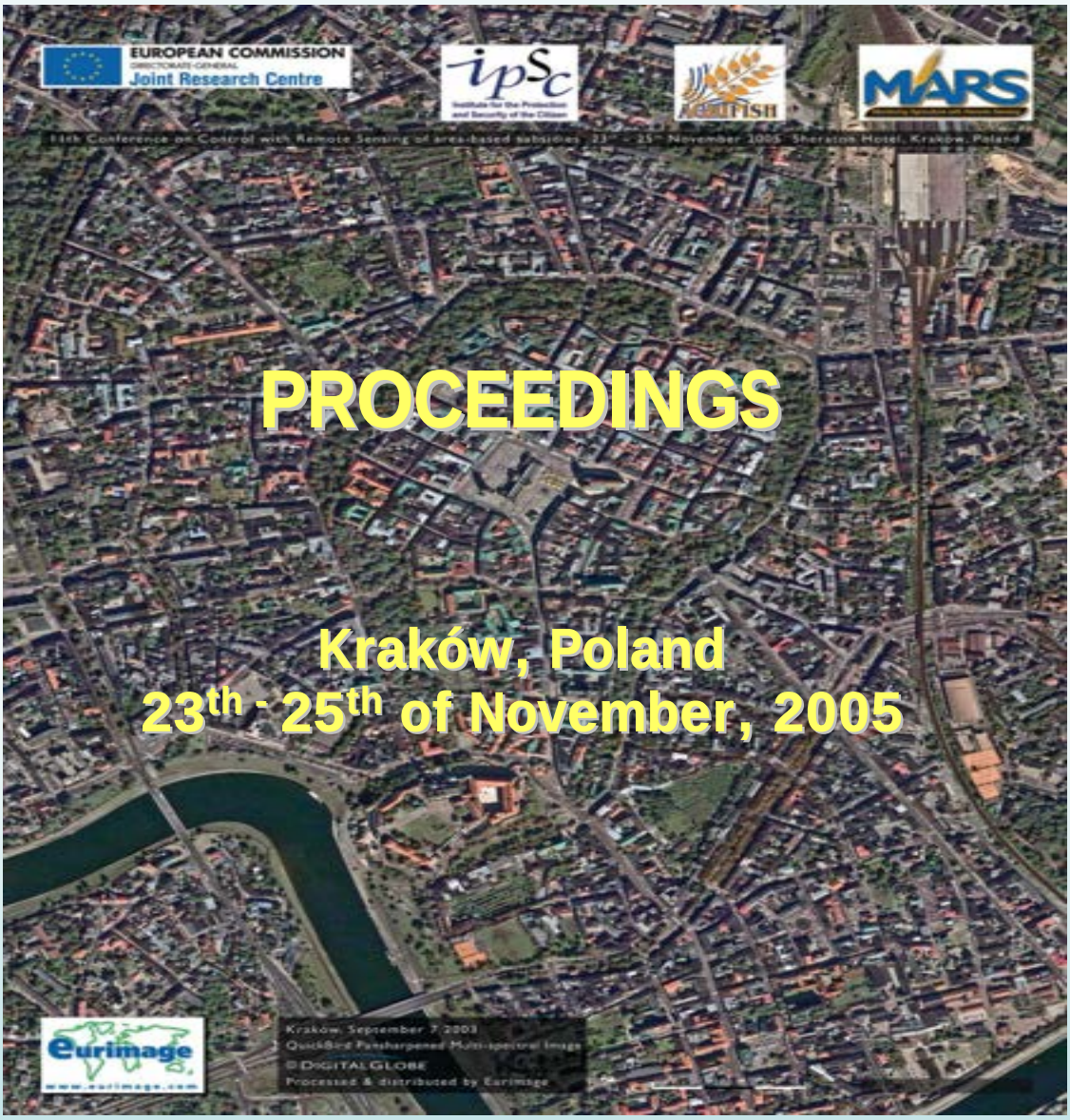
EUROPEAN COMMISSION
DIRECTORATE-GENERAL
Joint Research Centre

Institute for the Protection
and Security of the Citizen

11th ANNUAL CONFERENCE ON CONTROL WITH REMOTE SENSING OF AREA-BASED SUBSIDIES

VOLUME 2

PARALLEL TECHNICAL SESSIONS (T1 - T6)



AGRIFISH

MARS

ARiMR

EUR 22351 EN

European Commission
Directorate-General Joint Research Centre
Institute for the Protection and Security of the Citizen

Contact information
Address: Via E. Fermi 1 - 21020 Ispra (Varese) - Italy , TP 266
E-mail: par-johan.astrand@jrc.it

Tel: +39-0332-786215
Fax: +39-0332-786369

http://www.jrc.cec.eu.int
http://agrifish.jrc.it/marspac/CwRS/default.htm

EUR 22351 EN
Luxembourg: Office for Official Publications of the European Communities

Printed in Italy

EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE – ISPRA
Institute for the Protection and Security of the Citizen
Agrifish Unit

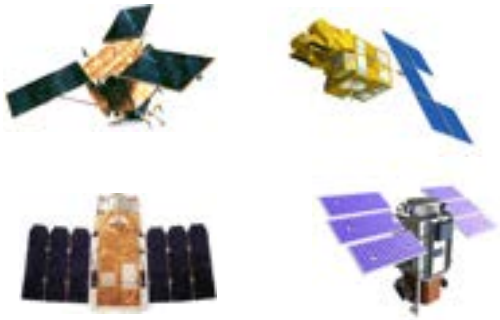
11th Annual Conference on Control with Remote Sensing of Area-based Subsidies
23th – 25th of November, 2005
Kraków, Poland

11th Annual Conference on Control with Remote Sensing of Area-based Subsidies Kraków, Poland

23th - 25th of November, 2005

Volume 2

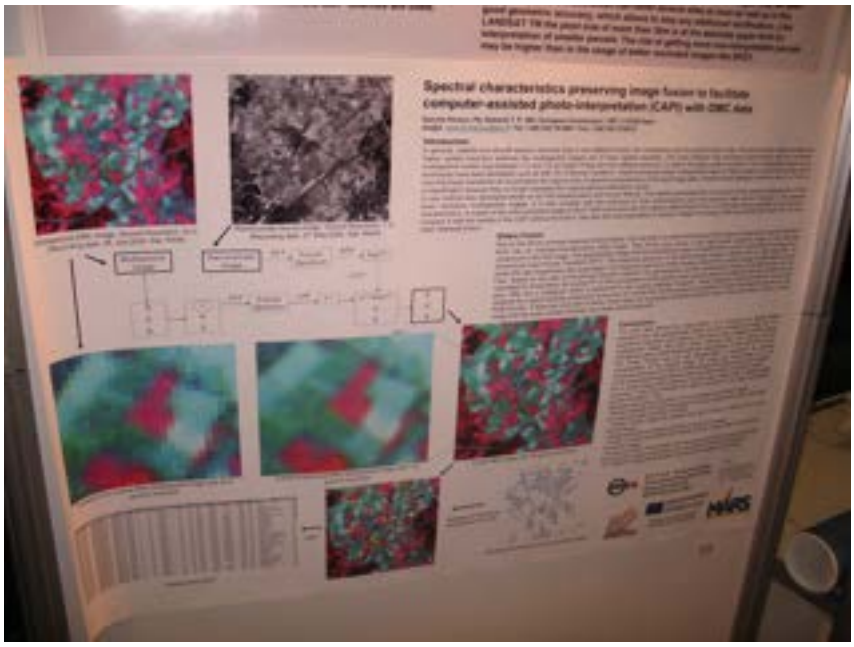
Parallel Technical Sessions (T1 – T6)



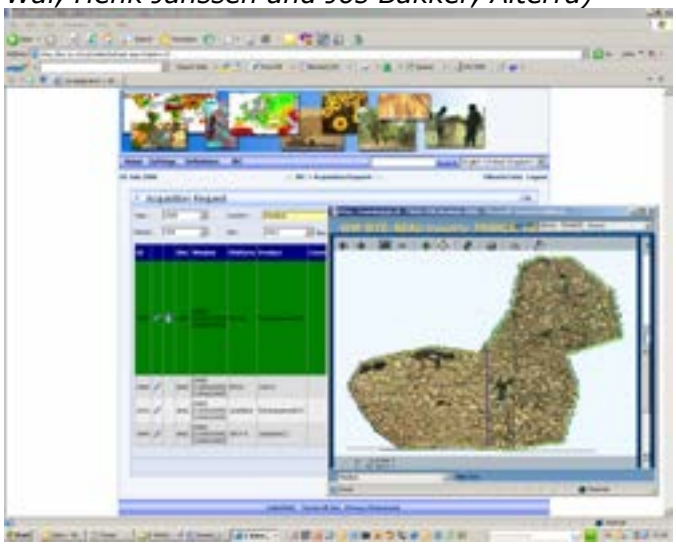
Prepared by:	Mihaela Fotin	Status:	Proceedings of Conference
Approved by:	Pär-Johan Åstrand, Jacques Delincé	Diffusion:	Internal: JRC, Agrifish Unit/ DG AGRI National Administrations Participants to the Conference

Date: August 2006

LIST OF CONTENTS



Software demonstrations 534



Parallel Session T1 – RS, IACS GIS and Parcel

Chairman:

Miguel Miranda, Geometral, PT

Presentation 1 – Validation of methods for measurement of land parcel areas

Beata Hejmanowska
AGH University of Science and Technology, PL

Simon Kay
Agrifish Unit, IPSC, JRC

Abstract

Control procedure in IACS concerns measurements of land parcel area. Measured and declared parcel areas are compared according so called technical tolerance of measurement. Technical tolerance is defined by width of the buffer around the parcel border (1.5 m for ortophotomap in scale of 1:10000, 1.25m for GPS, 0.35 for total station). Technical tolerance should reflect measurements accuracy and therefore validation measurements are needed. Some validation techniques proposed by JRC in Ispra, Italy was developed in 2005 in the project: "Validation of methods for measurement of land parcel areas".

Two measurement experiments were performed: remote sensing (RS) and GPS. RS experiment was made at AGH - UST Kraków, and GPS at UWM Olsztyn. The experiment was prepared and statistical analyzed at USI Gembleux. In paper the following issues are presented:

- review of existing approaches and discuss the Polish experience in the possibility of adapting cadastre regulation
- description of experimental design, workflow of measurements and statistical data analyze
- results of RS and GPS experiment

The point position error as an area accuracy parameter, proposed by authors is in the paper discussed. Proposal of validation method for measurements of land parcel area is daftly presented, describing some accruing problems.

Keywords: technical tolerance of parcel area measurement, remote sensing, GPS

AGH University of Science and Technology

Validation of methods for measurement of land parcel areas

Beata Hejmanowska

AGH University of Science and Technology

Validation of methods for measurement of land parcel areas

- State of art:
  - Control procedure in IACS concerns measurements of land parcel area
  - Measured and declared parcel areas are compared according so called technical tolerance of measurement (max. 5% of relative area error)
  - Technical tolerance is defined by width of the buffer around the parcel border (1.5 m for ortophotomap in scale of 1:10000, 1.25m for GPS, 0.35 for total station)
  - Technical tolerance should reflect measurements accuracy and therefore validation measurements are needed
  - Surveying formulas couldn't be adapted
- Aim of the project was elaboration of validation methods for measurement of land parcels areas *(main and supplementary study)*

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Validation of methods for measurement of land parcel areas

Background:
- *elaboration validation method appying ISO norm*
- *performing measurement experiment*
- *propose ev. alternative to buffer accuracy parameter*

Coordination institution :
- AGH-University of Science and Technology, Kraków Poland **(AGH UST Kraków)** Remote Sensing
  - **Dr Eng. Beata Hejmanowska**

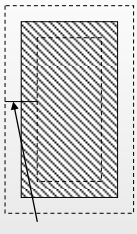
Subcontractors:
- University of Warmia and Mazury in Olsztyn, Olsztyn, Poland **(UWM Olsztyn)** GPS
  - **Prof. Dr hab. Eng. Stanisław Oszczak**
  - **Dr Eng. Adam Ciećko**
- Unite de Statistique et Informatique, Faculte universitaire des Sciences agronomiques, Gembloux, Belgique **(USI Gembloux)** Statistics
  - **Prof. Rudy Palm**

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Existing approaches JRC

Area measurement tolerance for maps and ortophotomaps



Tolerance

Map scale	Pixel size [m]	Tolerance [%]	Tolerance [m]
1: 10 000	1	5	1.5
1: 5 000	0.5	2.5	0.75
1: 2 500	0.25	1.25	0.4

Area measurement tolerance for direct measurements

1. *What buffer value should be assumed?*
2. *If not buffer that what?*

Map scale	Tolerance [%]	Tolerance [m]
GPS standalone	-	1.25
Geodetic surveying	2	0.35
Wheel, tape	2 (up to 50m) or 5	0.4

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Existing approaches cadastre Poland

1) 2003 $\Delta P = 0.001 \cdot P + 0.2 \cdot \sqrt{P}$

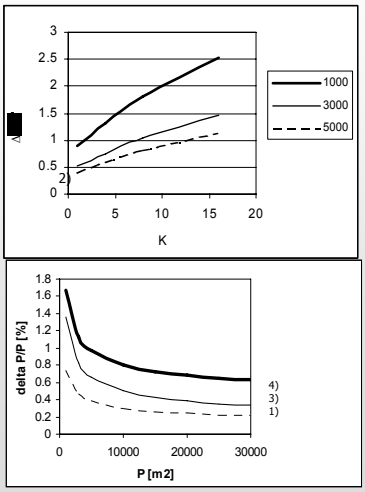
2) 1992 $\Delta P = 0.4 \cdot \sqrt{2P} \cdot \sqrt{\frac{1+K^2}{2K}}$

3) 1992 $\Delta P = 0.001 \cdot P + 0.0002 \cdot M \cdot \sqrt{P}$

4) 1998 $\Delta P = 2 \cdot (0.002 \cdot P + 0.2 \cdot \sqrt{P})$

ΔP – allowed discrepancies between area in cadastre and area measured during control measurement [m²],
P – land parcel area [m²]

- *empirical formulas*
- *accuracy much below IACS limit 5%*



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

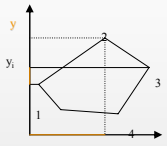
AGH University of Science and Technology

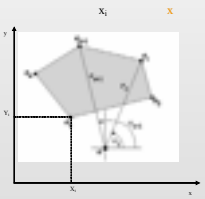
Area accuracy - point position error

- Coefficient calculations for accuracy estimations
  - (Hejmanowska B. 2003, Bogaert P., Delince J., Kay S. 2005):

$$m_p = m_{pkt} \sqrt{\sum_{i=1}^{n} \frac{(y_{i+1} - y_{i-1})^2 + (x_{i-1} - x_{i+1})^2}{8}}$$

$$m_P = m_{pkt} \sqrt{\frac{1}{2} \sum_{i=1}^{n} (r_i^2 - r_i r_{i+2} \cos(\alpha_{i+2} - \alpha_i))}$$





where:
m_P – area error,
m_{pkt} – point position error
x, y – Cartesian coordinate of parcel vertices
r, a - polar coordinate of parcel vertices.
n – number of parcels vertices.

m_P= m_{pkt} Area_error_cofficient

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Area error calculation

1	
7415098.04	5557121.93
7415122.02	5557120.95
7415132.21	5557002.98
7415103.29	5556997.39
7415098.04	5557121.93

→ m_p=2.8%

m_{pkt}=1m

HB

$$m_p = m_{pkt}\sqrt{\sum_{i=1}^{n}\frac{(y_{i+1}-y_{i-1})^2+(x_{i-1}-x_{i+1})^2}{8}}$$

$$m_P = m_{pkt}\sqrt{\frac{1}{2}\sum_{i=1}^{n}(r_i^2 - r_i r_{i+2}\cos(\alpha_{i+2}-\alpha_i))}$$

BDK

$m_p=m_{pkt}$* AEC $m_{pkt}=m_p$/AEC

1	
7415103.6576	5556996.5879
7415103.6605	5556996.7736
7415103.6605	5556996.7736
7415103.6635	5556996.9594
7415103.5405	5556996.9613
7415103.6635	5556996.9594
7415103.6635	5556996.9594
7415103.5405	5556996.9613
7415103.4256	5556997.1489
7415103.6753	5556997.7001
7415104.0475	5556998.8078
7415104.0711	5557000.2892
7415104.0947	5557001.7725
7415103.9967	5557003.0716
7415104.0173	5557004.3695
7415104.0380	5557005.6674
7415103.9407	5557006.9661
7415103.8464	5557008.4516
7415103.8700	5557009.9342
7415103.7707	5557011.4198
7415103.6734	5557012.7196
7415103.4604	5557014.2059
7415103.3631	5557015.5057
7415103.1458	5557016.9921
7415103.0486	5557018.2919
7415102.9506	5557019.5917
7415102.9712	5557020.8885
7415102.8697	5557022.1884
7415102.8903	5557023.4863
7415102.7952	5557024.9697
7415102.8159	5557026.2865
7415102.7186	5557027.5663
7415102.6213	5557028.8661
7415102.5233	5557030.1648
7415102.4247	5557031.6504
7415102.4483	5557033.1329
7415102.3533	5557034.6185
7415102.3769	5557036.1022
7415102.2826	5557037.5866
7415102.3062	5557039.0702
7415102.2118	5557040.5536
7415102.1175	5557042.0380
7415102.0182	5557043.5236
7415101.9238	5557045.0080
7415101.8288	5557046.4936
7415101.6115	5557047.9800
7415101.5172	5557049.4655
7415101.1863	5557050.9526
7415100.8481	5557052.2562
7415100.6352	5557053.7425
7415100.5336	5557055.0424
7415100.4385	5557056.5268

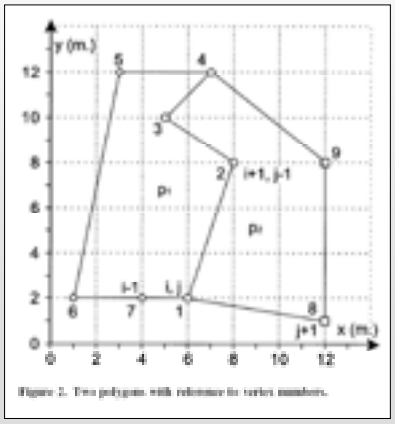
m_p=0.4%

2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

AGH University of Science and Technology

New approach in cadastre

- Correlation between parcels
  - „A Variance and Covariance Equation for Area Estimates with a Geographic Information System" P. A. J. van Oort, A. Stein, A. K. Bregt, S. de Bruin, and J. Kuipers



$$\mathrm{cov}(A(p_1), A(p_2)) = \frac{1}{8}\cdot\sum_{i=1}^{n_1}\sum_{j=1}^{n_2}\delta(x_1(i), x_2(j)) \cdot \left[\sigma_1^2(i)\cdot(x_1(i+1)-x_1(i-1))\cdot(x_2(j+1)-x_2(j-1)) + \sigma_2^2(j)\cdot(x_1(i+1)-x_1(i-1))\cdot(x_2(j+1)-x_2(j-1))\right] \quad (12)$$

$$-\frac{1}{8}\cdot\sum_{i=1}^{n_1}\sum_{j=1}^{n_2}\delta(x_1(i), x_2(j))\cdot\sigma_1^2(i) \cdot\left[\delta(x_1(i+1), x_2(j-1))\cdot\sigma_2^2(i+1) + \delta(x_1(i-1), x_2(j+1))\cdot\sigma_2^2(i-1)\right].$$

$$\mathrm{var}(A(p_1)) = \frac{1}{4}\cdot\sum_{i=1}^{n_1}[\sigma_1^2(i)\cdot(x_1(i+1)-x_1(i-1))^2 + \sigma_2^2(j)\cdot(x_2(j+1)-x_2(j-1))^2] \quad (9)$$

$$+\frac{1}{4}\cdot\sum_{i=1}^{n_1}[\sigma_1^2(i)\cdot(\sigma_2^2(i+1)+\sigma_2^2(i-1))].$$

2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

AGH University of Science and Technology

Plan of measurement's experiment Remote Sensing and GPS

- GPS, remote sensing - 3 type of „equipment"
- 12 operators - 2 groups: specialists and beginners
- Object: reference parcels and agriculture parcels
- 36 parcels
- Good, medium, bad edge
- Good, medium, bad measurements conditions
- 36 parcels x 12 operators x 3 repetitions x 3 type of „equipment" = 3888 measurements

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Two test sites

GPS

Olsztyn
Warmińsko-Mazurskie

Kraków
Małopolskie

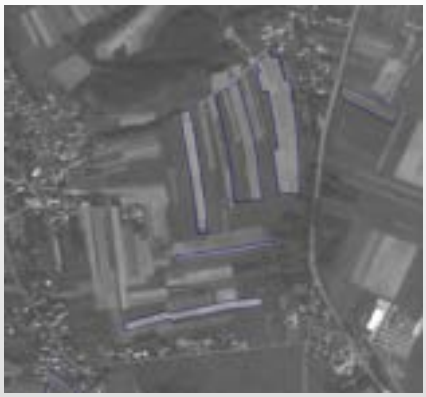
Remote Sensing

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Parcels

- Size
  - S : small (0.3 – 0.5 ha)
  - M : medium (0.8 – 1.2 ha)
  - L : large (2.4 – 4 ha)
- Shape - Shape Factor (SF) = (perimeter/4)^2 / parcel area)
  - S1 : SF < 1:3
  - S2 : SF < 1:6
  - S3 : SF > 1:6
- Border
  - Good
  - Bad



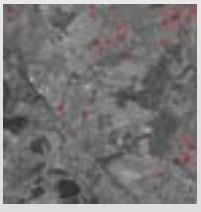
2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Remote sensing experiment

- OP_1_0 IKONOS Panchromatic pixel size 1m
- OP_0_5 Ortohotomap from color images
  - 1: 26 000, pixel size 0.75m
- OP_0_2 Ortophoto from panchromatic images
  - 1:13 000, pixel size 0.25m
  - ARIMR

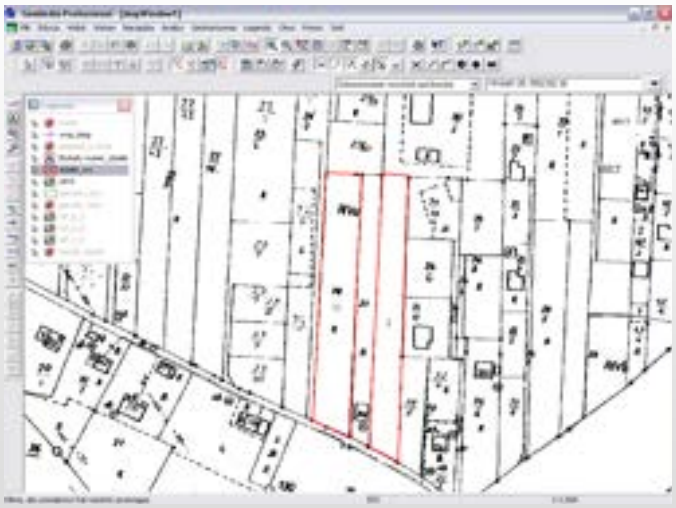




2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Reference parcels = cadastre parcels



- One cadastre parcel

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Reference parcels = cadastre parcels

- few cadastre parcels

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Reference parcels digitized on cadastre raster map

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Measurements assumption

- ISO 5725 - especially prepared parcel sequences measured by each operator in all experiment period
- Parcels are independent - not sharing any border with other parcel

ISO International Organization for Standardization

ISO 5725 Accuracy (trueness and precision) of measurement methods and results

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

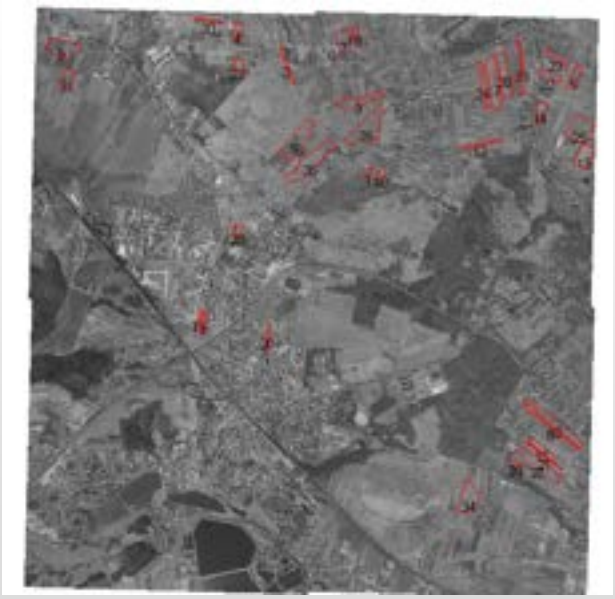
AGH University of Science and Technology

WORKSHEET operators.xls

Beata Hejmanowska

AGH University of Science and Technology

OP_0_2



Airborne photo
1:13000
Pixel – 0.25 m
RMS – 0.75 m

If we assumed:
RMS = 2.5 x piksel size

2005 CwRS conference, Kraków 23-25 Oct 2005

Beata Hejmanowska

AGH University of Science and Technology

OP_0_5

Airborne photo
1:26000
Pixel – 0.5 m
RMS – 1.5 m

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

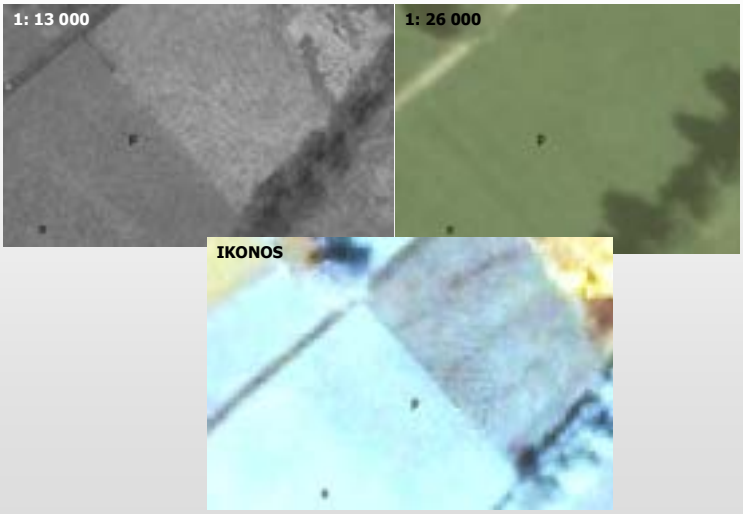
OP_1_0

IKONOS
Pansharpening image
1:26000
Pixel – 1.0 m
RMS – 2.5 m

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Different parcel border recognition

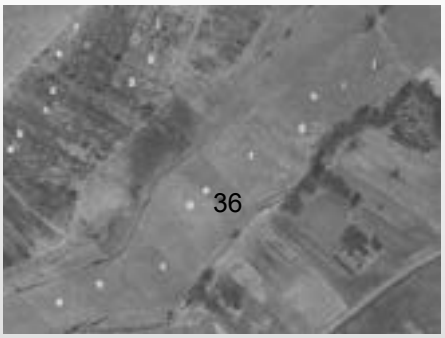


2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Measurements - workflow

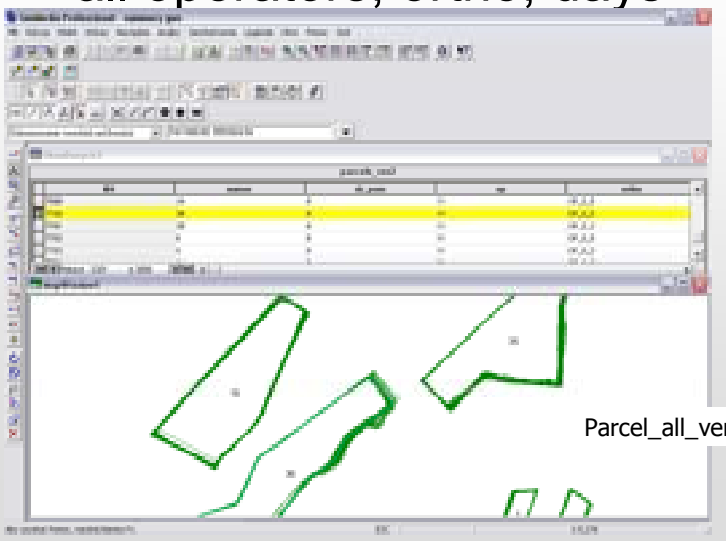
- Measurements using Geomedia (Integraph)
- Each operator
  - list of parcels to be measured on which orto
  - geoworkspace: *.gws,
    - with configured ready to display images
    - number of all parcels (without reference parcels)
    - letters marking parcels building reference parcel
  - warehouse: *.mdb
    - empty feature class – in the feature class operator digitized parcels according list of parcels to be measured on which orto



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

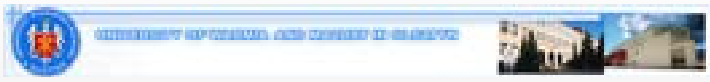
GIS data base of all measurements: all operators, ortho, days



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GPS experiment



Prof. Dr hab. Eng. Stanisław Oszczak

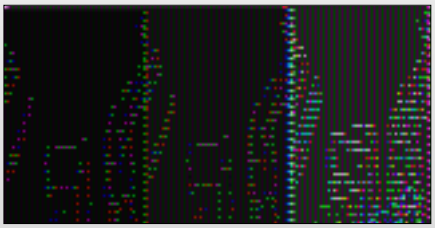
Dr Eng. Adam Ciećko

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GPS experiment

- 36 parcels
- 4 Thales Mobile Mapper
- 4 Satcon
- 1 Garmin GPSMap 76S



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GPS experiment

- 36 parcels
- 4 Thales Mobile Mapper
- 4 Satcon
- 1 Garmin GPSMap 76S

2250 km of walking!!!

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Steps in the statistical analysis

- ISO 5725-2 gives the "basic method for the determination of repeatability and reproducibility of a standard measurement method"
- several land parcels are measured on different days by different operators

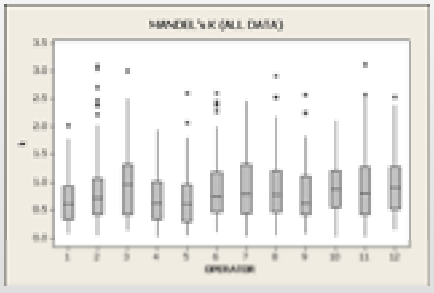
AGH University of Science and Technology

Establishing a functional relationship between precision values and the characteristics of the parcels

INITIAL DATA PROCESSING

Statistical tools for critical examination of the data

- Mandel's h and k statistics
- Cochran's test
- Grubbs' test for one outlying observation
- Grubbs' test for two outlaying observations

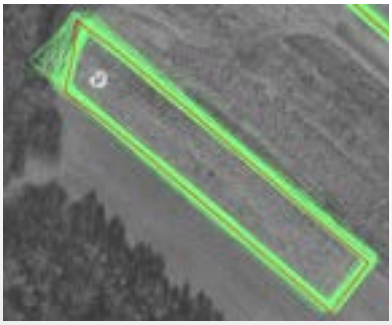


RESULTS

Standard deviation of the parcel area (m_p)

AGH University of Science and Technology

RS experiment



Point Position Method

$m_p = m_{pkt} * AEC$
$m_p = StD$
$m_{pk} = StD/AEC$

Buffer Method

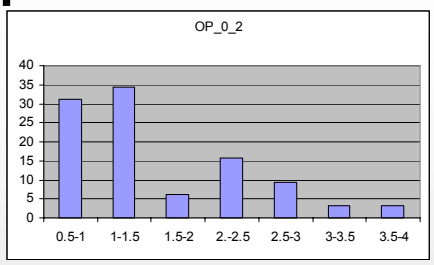
Buffer Area = Buffer * Perimeter
Buffer Area = StD
Buffer = StD/Perimeter

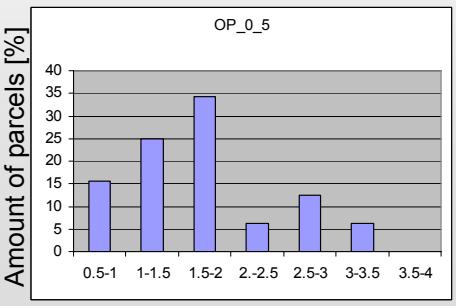
2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

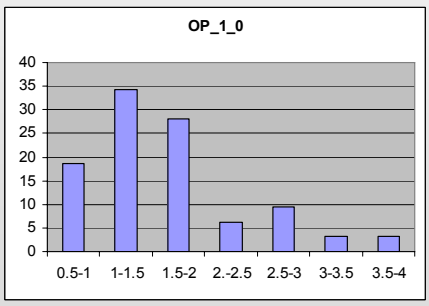
AGH University of Science and Technology

RS experiment

- Value of buffer:
  - OP_0_2 – 0.37m +/- 0.26m
  - OP_0_5 – 0.44 m +/- 0.25m
  - OP_1_0 – 0.44 m +/- 0.33m
- Value of point position error:
  - OP_0_2 – 1.86m +/- 1.85m
  - OP_0_5 – 2.14 m +/- 1.39m
  - OP_1_0 – 2.12 m +/- 1.65m







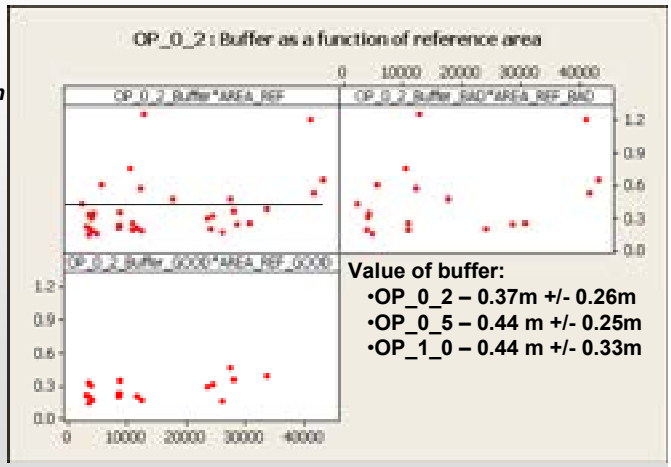
Point position error [m]

2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

AGH University of Science and Technology

RS buffer

Parcel area error parameter:
- ***shouldn't be influenced by area***
- ***should be constant for each ortophoto***

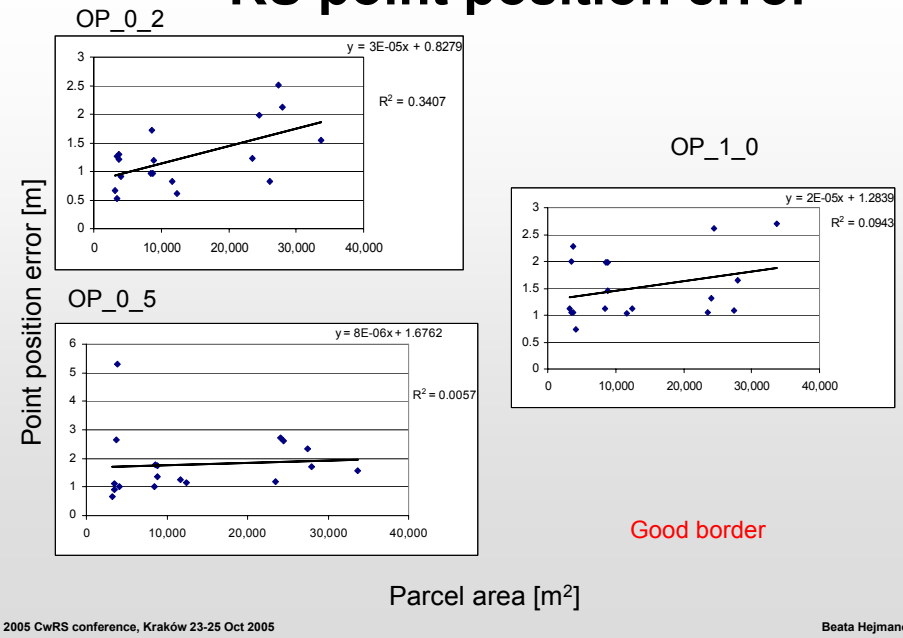


Value of buffer:
- **OP_0_2 – 0.37m +/- 0.26m**
- **OP_0_5 – 0.44 m +/- 0.25m**
- **OP_1_0 – 0.44 m +/- 0.33m**

2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

AGH University of Science and Technology

RS point position error

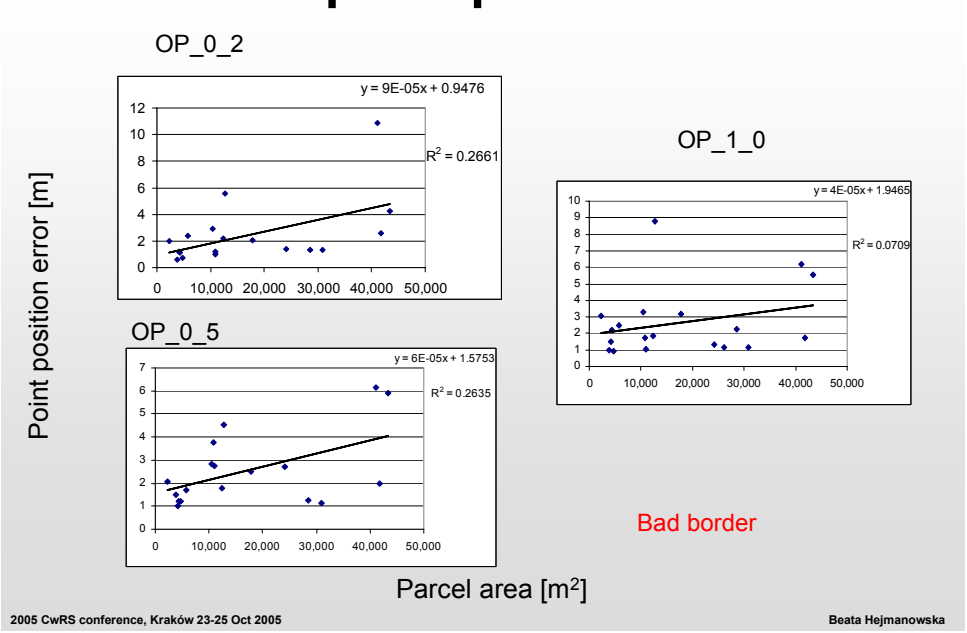


Good border

2005 CwRS conference, Kraków 23-25 Oct 2005 — Beata Hejmanowska

AGH University of Science and Technology

RS point position error

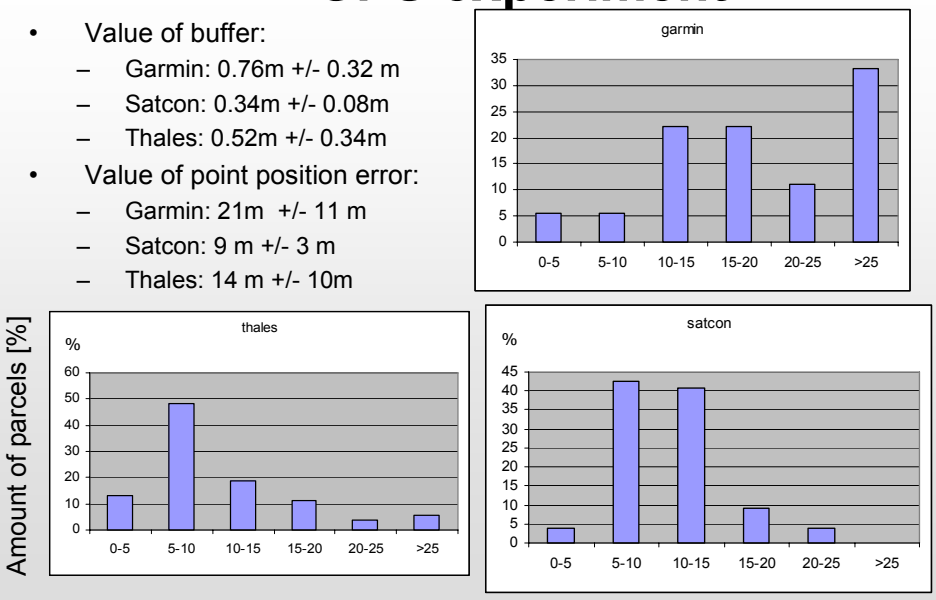


2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GPS experiment

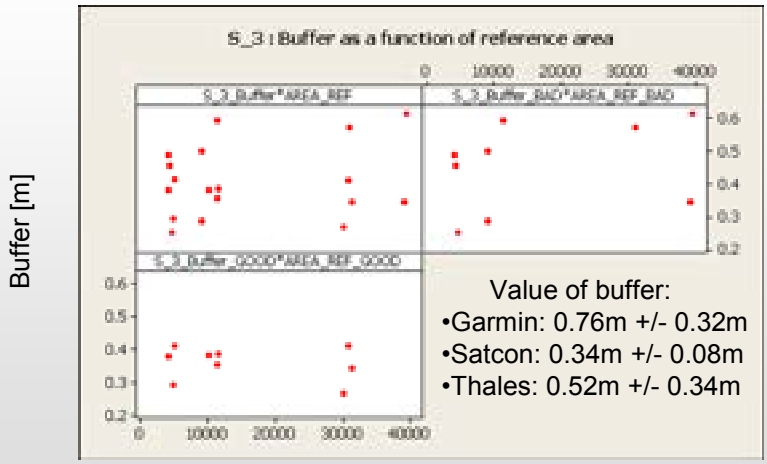
- Value of buffer:
  - Garmin: 0.76m +/- 0.32 m
  - Satcon: 0.34m +/- 0.08m
  - Thales: 0.52m +/- 0.34m
- Value of point position error:
  - Garmin: 21m +/- 11 m
  - Satcon: 9 m +/- 3 m
  - Thales: 14 m +/- 10m



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

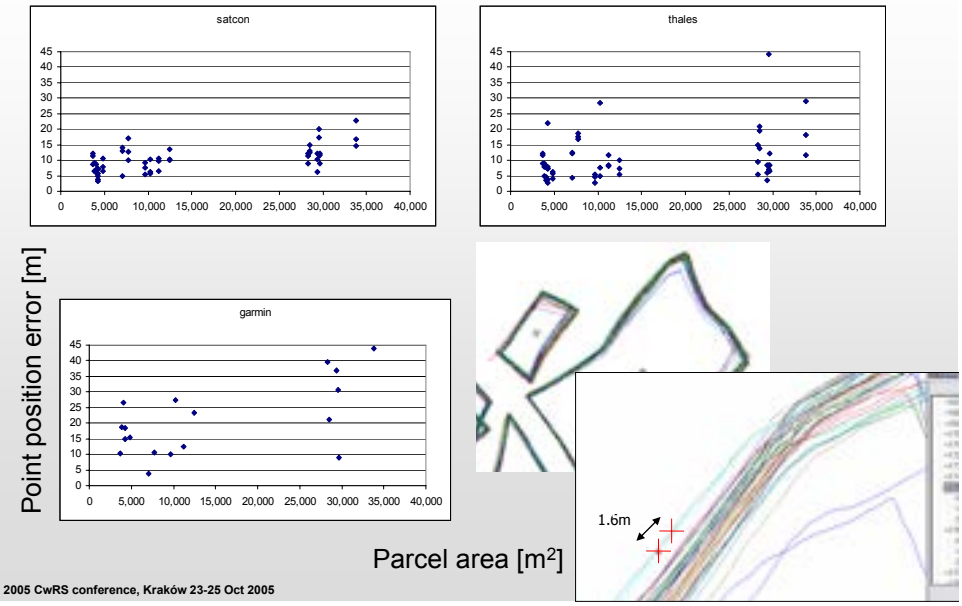
GPS buffer



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GPS point position error



2005 CwRS conference, Kraków 23-25 Oct 2005

AGH University of Science and Technology

Buffer for all measurements

Ortho	Buffer [m]	Standard deviation [m]	Relative area error (%)
OP_0_2	0.37	0.26	3.2
OP_0_5	0.44	0.25	6.3
OP_1_0	0.44	0.33	5.4
Garmin	0.76	0.32	4.9
Satcon	0.34	0.08	2.6
Thales	0.52	0.34	3.7
Satcon S3	0.41	0.11	2.5 (42)
Satcon S4	0.36	0.12	2.3 (21)
Thales T3	0.34	0.16	2.3 (2.4)
Thales T4	0.31	0.13	2.7 (2.2)
average	0.429	0.21	3.6

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Point position error on the basis of the real measurements

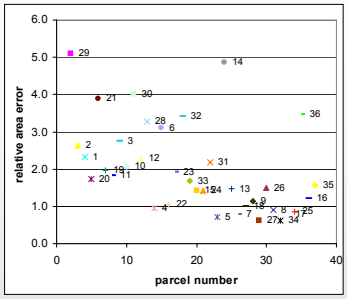
Ortho	m_{pkt} [m]	Standard deviation [m]
OP_0_2	1.86	1.85
OP_0_5	2.14	1.39
OP_1_0	1.89	1.78
average	**2.04**	**1.63**

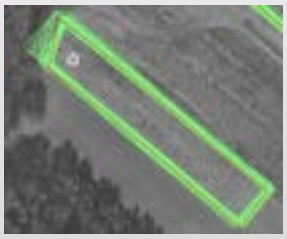
Equipment	m_{pkt} [m]	Standard deviation [m]
Garmin	11	11
Satcon	9	3
Thales	14	10
Satcon S3	11	5
Satcon S4	10	4
Thales T3	10	6
Thales T4	9	5
average	**12**	**6**

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

GIS analysis



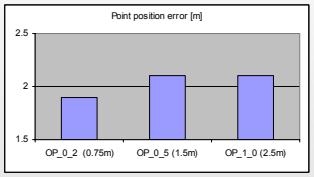


2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Main study RS summary

- Data
  - aerial from photos: 1: 13 000 (panchromatic), 2004
    pixel size 0.2m, RMS=0.75m
  - aerial from photos: 1: 26 000 (color), 1999 (or earlier)
    pixel size 0.75m, RMS=1.5m
  - IKONOS (pansharpening), 2004
    pixel size 1m, RMS=2.5m



- Results
  - area error is only slightly increasing with increasing pixel size
  - area measurements are not influenced by operator (skilled and unskilled provide similar results)
  - buffer is less influenced by parcel area in compare to point position error (PPM could easy apply for parcel area prediction)

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Plan of measurement's experiment supplementary study

- Remote sensing - 2 type of „equipment"
- 6 operators
- 36 parcels - almost the same parcel sets (one parcel was changed - clouds)
- 1296 observations = 36 parcels × 2 photos × 6 operators × 3 days
- The same workflow of measurements

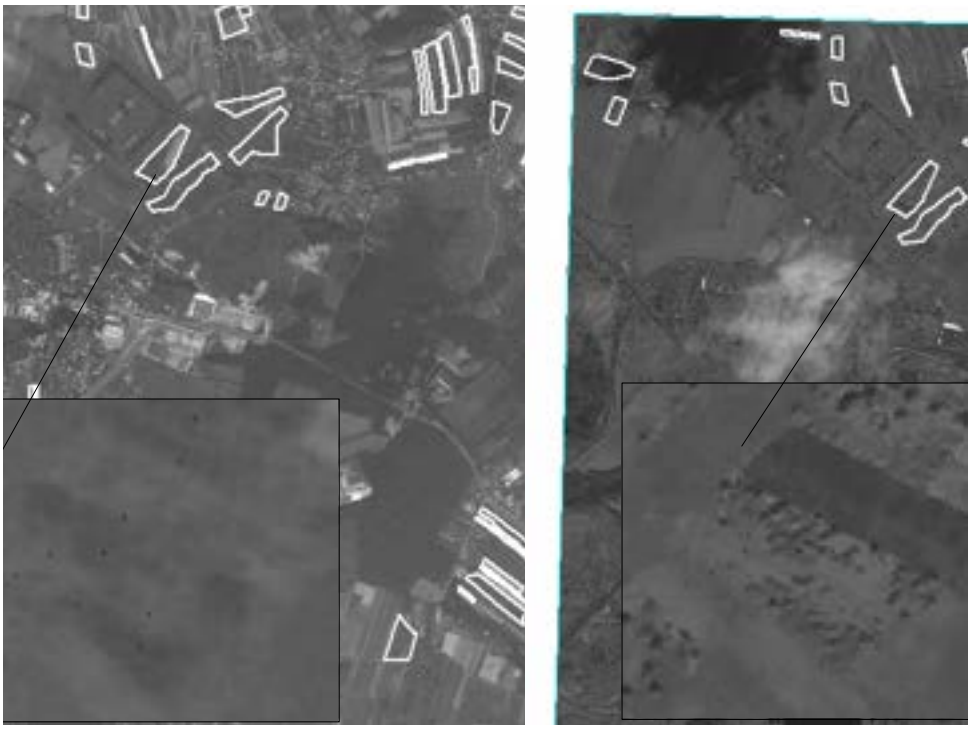
2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Images

- RS data were obtained from JRC and orthofotomap were generated at AGH UST Kraków, Poland:
  - Panchromatic ortofotomap generated from SPOT image (3m):
    - Registered: 29.08.2005
    - With pixel size: 2.5 m
  - Panchromatic ortofotomap generated from EROS image (2m)
    - Registered: 3.07.2005
    - With pixel size: 2.0 m

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska



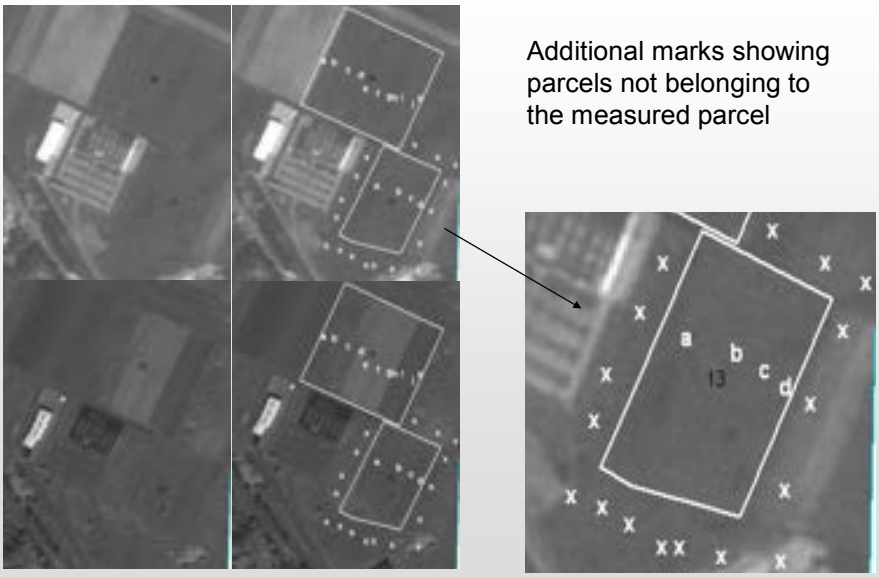
AGH University of Science and Technology

RS supplementary study

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

RS supplementary study



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

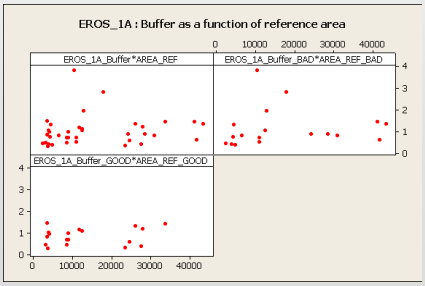
Modelling buffer

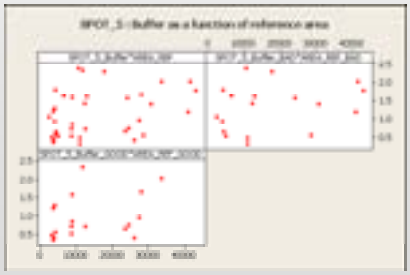
EROS

All	Buffer = 1.007 (0.704)
Good border	Buffer = 0.859 (0.387)
Bad border	Buffer = 1.155 (0.908)

SPOT

All	Buffer = 1.142 (0.635)
Good border	Buffer = 0.972 (0.594)
Bad border	Buffer = 1.312 (0.645)

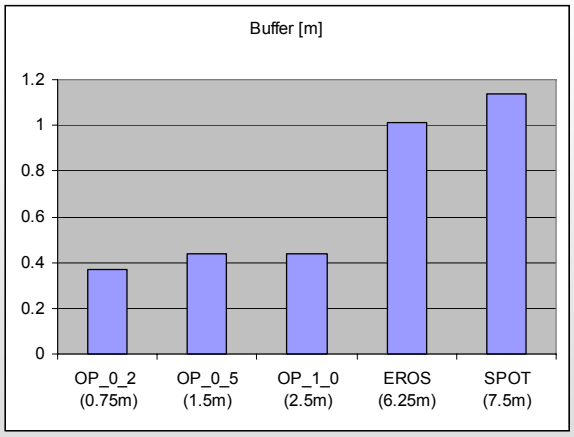




2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Buffer for all RS data

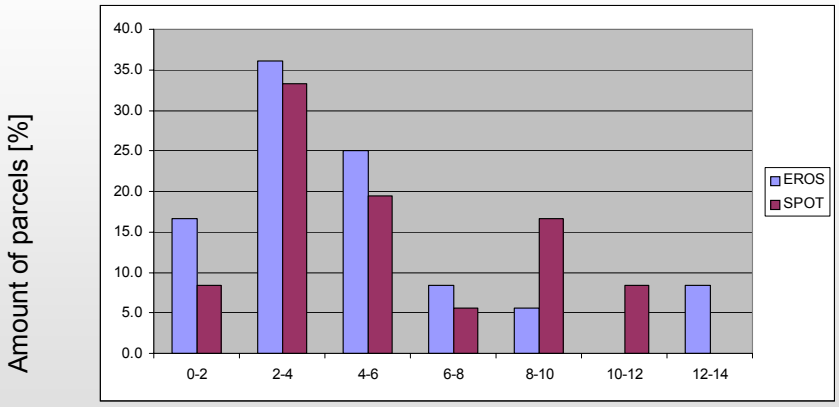


RMS

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

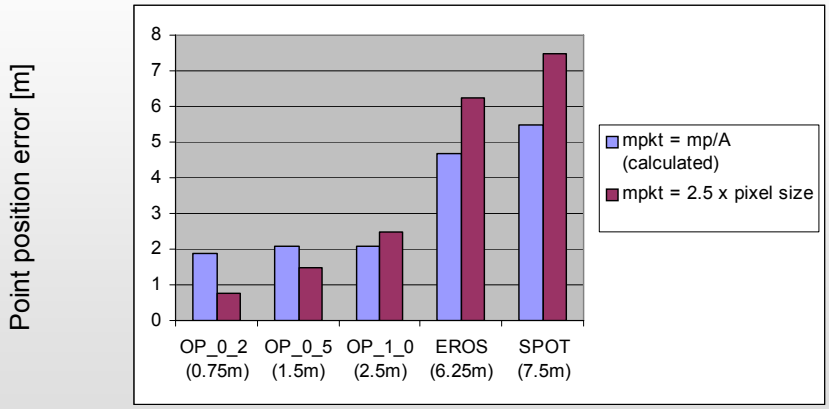
Point position error analysis



2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

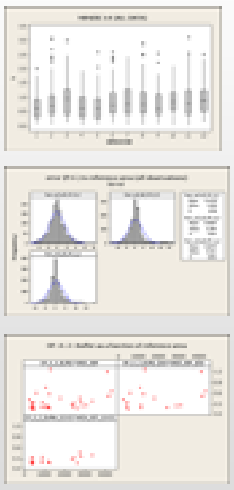
Point position error for all RS data

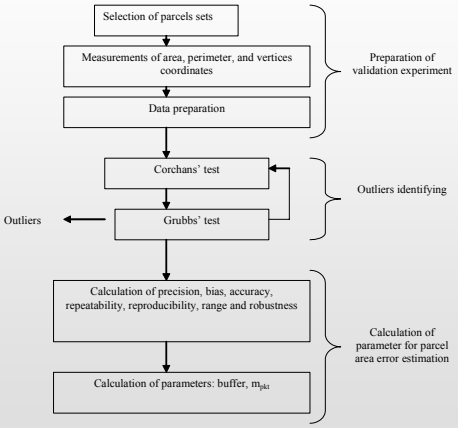


2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Validation method - proposed workflow





2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

How many measurements

- *(Earlier recommendations were 16 to 60 measurements)*
- From Chp 9 of report:
- The numbers of parcels needed to reach a precision (half of the length of the 0.95 confidence interval) of 10 % of the mean values of the buffer are:
  - parcels = 10 rep. = 37 (370 observations)
  - parcels = 4 rep. = 67 (268 observations)
  - parcels = 1 rep. = 217 (217 observations)
- *Several approximations have been made to obtain these results and it could be useful to check them by using MC simulation.*

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Parcel sets - amounts of operators repetitions

- two groups of six operators
- three groups of four operators
- four groups of three operators

So, the sequence has been repeated 972 times (36 parcels × 3 photos × 9 groups of operators)

The different groups of operators can be considered as replications

Mean values of the ratios (standard deviation/reference buffer)

Number of operators	OP_0_2	OP_0_5	OP_1_0
6	0.20	0.12	0.19
4	0.33	0.25	0.26
3	0.37	0.40	0.34

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

AGH University of Science and Technology

Parcel sets - amounts of operators repetitions

- *(Earlier recommendations were 16 to 60 measurements)*

- Main study: 36 parcels x 12 operators x 3 repetitions = 1296
- Middle variant: 36 parcels x 6 operators x 3 repetitions = 432
- Or 10 parcels x 12 operators x 3 repetitions = 360

December deadline for final proposal

2005 CwRS conference, Kraków 23-25 Oct 2005 Beata Hejmanowska

Presentation 2 – Re-designing validation of area measurement methods

Simon Kay

European Commission Joint Research Centre, IPSC/AgriFish Unit

Abstract

The feasibility of using GNSS for high accuracy area estimates, and the parallel use for maintaining geo-spatial data infrastructures such as IACS and cadastral mapping, has been examined theoretically and statistically in studies managed by the JRC. This presentation will introduce the approaches and results of these studies and help define requirements and priorities for geo-data collection in these areas.

Furthermore, the presentation will summarise a possible approach for validating and certifying methods for parcel area measurement.

Keywords: GPS, GNSS, validation, area measurement

EUROPEAN COMMISSION DIRECTORATE GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Re-designing validation of area measurement methods

Simon Kay
Joint Research Centre of the European Commission

EUROPEAN COMMISSION DIRECTORATE GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Outline

- Introduction to Area measurement method validation project
- Area measurement system validation study – *Beata Hejmanowska*
- Reminder of validation objectives
- Certification? Measurement directive?

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Measuring a field, simulation using Galileo EGNOS signal

$$\sigma_S^2 = \frac{1}{2}\sigma_r^2\left(\sum_{i=1}^{n}\left(\hat{r}_i^2 - \hat{r}_i\hat{r}_{i+2}\cos(\hat{a}_{i+2} - \hat{a}_i)\right)\right)$$

- Variance of measurement can be modelled as function of vertices
- Hypothesis – observed empirically – that under certain conditions, variance of area estimate is weakly influenced by perimeter length

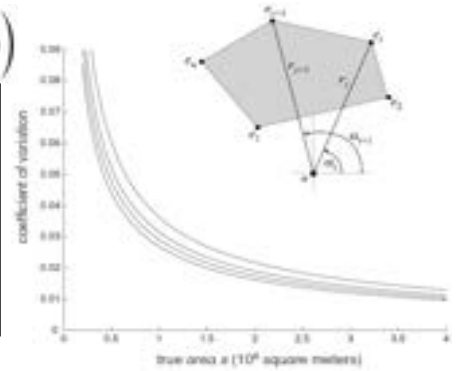


Figure 8. Evolution of the coefficient of variation CV_S for the area estimation of a rectangular parcel as a function of the parcel area and side length ratios r, with r equal to 1:1 (square parcel, bottom curve), 1:3, 1:5 and 1:10 (top curve).

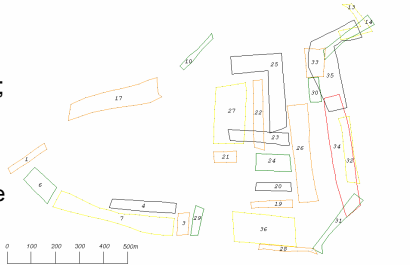
Bogaert, P., Delincé, J., Kay S. (2005)
Assessing the error of polygonal area measurements: a general formulation with applications to agriculture, Meas. Sci. Technol. 16 (2005) 1170–1178

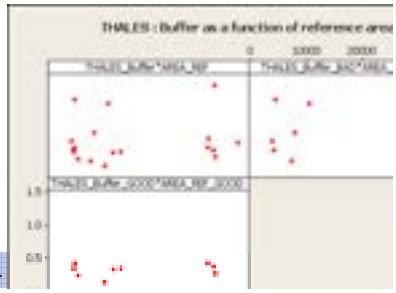
EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Study objectives

- Review of existing approaches to validation of measurement methods;
- Statistical analysis and recommendations;
- Detailed presentation of the validation approach to be applied;
- Example applications of this approach,
  - collected using the approach defined in the study,
  - based upon a GNSS/GPS system and a VHR orthoimage system
- Analysis of a trial datasets collected
- Specification of the mathematical (computational) algorithm to be applied in the analysis of the data,
  - including statistical outlier identification,
  - suitable for input for programming and coding.
- Supplementary study: further testing on EROS-1A and SPOT 5 *supermode* imagery



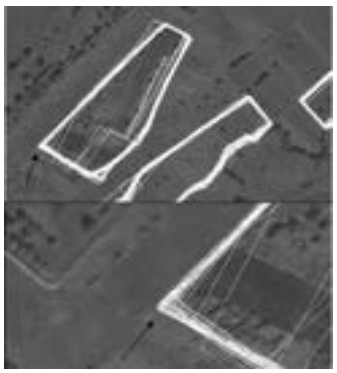


EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Scope

- GPS based receivers
  - with augmentation technology capability (e.g. EGNOS);
  - Although use of EGNOS abandoned for this study
- VHR (<1m pixel size) orthoimagery
  - airborne or spaceborne.
  - 25cm, 75cm archive, 1m Ikonos
  - ***extended*** to include EROS 1a and SPOT 5 supermode



EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Study contractors

Consortium of three Universities:

- Dr Beata Hejmanowska
  - AGH University of Science and Technology, Cracow, Poland
- Prof Stanisław Oszczak, Dr Adam Ciećko
  - UWM University of Warmia and Mazury in Olsztyn, Olsztyn, Poland
- Prof Rodolphe Palm
  - Unité de Statistique et Informatique, USI Gembloux, Belgium

Task	Place	Data/Duration
Kick-off meeting	**AGH UST Kraków, Poland**	**25.02.2005**
Preparation of measurements	AGH UST Kraków, Poland UWM Olsztyn, Poland	4 days
Measurements of test parcels	AGH UST Kraków, Poland UWM Olsztyn, Poland	10 days
Initial results preparations	AGH UST Kraków, Poland UWM Olsztyn, Poland	9 days
Kick-off meeting + 1 month	**AGH UST Kraków, Poland**	**31.03.2005**
Statistical analysis of area measurements	AGH UST Kraków, Poland UWM Olsztyn, Poland USI Gembleux, Belgique	7 days
Elaboration of draft of method of parcel area validation	AGH UST Kraków, Poland UWM Olsztyn, Poland USI Gembleux, Belgique	10 days
Kick-off meeting + 2 month	**AGH UST Kraków, Poland**	**04.05.2005**
Elaboration of final version of validation of methods for measurement of land parcel areas	AGH UST Kraków, Poland UWM Olsztyn, Poland USI Gembleux, Belgique	20 days
Final presentation meeting	**JRC Ispra, Italy**	**30.05.2005**

Re-designing validation of area measurement methods Part 2

Simon Kay
Joint Research Centre of the European Commission

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Validation - concept

Check that the method works →	Check that the method is reliable →	Check that operators can use the method
Performance measurement	***Validation***	***Proficiency testing***
System providers	**JRC**	**Member States**

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Introduction

- Purpose of the scheme
  - **to define an approach for the validation of area measurement methods for agricultural parcels,**
  - **mainly using (but not restricted to) GPS equipment.**
- Motivation
  - **The availability of relatively low-priced GPS tools**
  - **However, both the Commission and Member States need assurance that the tools on offer are able to perform to acceptable standards.**
  - **A standard approach permitting participation of all stakeholders – equipment suppliers, technical bodies, users – would enable these issues to be addressed**

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Introduction

- **Until now, most trials based on a series of repeat measurements of parcels with reference areas.**
- **Whilst serving individually a useful purpose, however, these data suffer from a number of shortcomings:**
  - **Various data have been collected by various organisations, but are not directly comparable.**
  - **Results are frequently limited to interpretation of particular parcel sizes (e.g., error estimates on area percentage) or shapes.**
  - **Since the experiments were not designed statistically, rigorous analysis becomes difficult if not impossible.**
  - **Current analysis approaches focus on the precision of the measurement method (variability of the result) to the exclusion of other parameters (bias, range, etc).**
  - **Analysis may not include standardised procedures for the identification and treatment of outliers, reference data, calculation of statistical parameters, etc.**

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Framework

- Statistical framework for the validation of measurement methods
  - laid out in ISO-5725, “Accuracy (trueness and precision) of measurement methods and results”.

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Validation parameters

Term	Description
Precision	Can be described as the range of values that might occur with a certain level of probability, for example a buffer calculated from the Standard Deviation or RMSE of differences between a reference area and measured areas.
Bias	The instrument should, when following the standardised measurement protocol, produce a result that is on average very close to the expected result, and not consistently larger or smaller.
Repeatability	The variability of a parcel area estimate if it was measured by the same inspector in quick succession.
Reproducibility	The variability of a parcel area estimate if it was measured by the different inspectors, on different occasions.
Range	In terms of parcel size, the minimum and maximum sizes that can be measured and achieve a certain level of accuracy
Robustness	The sensitivity of an instrument to various extraneous effects, such as battery low power conditions, rain, tree cover, electric power cables, satellite constellation changes etc.

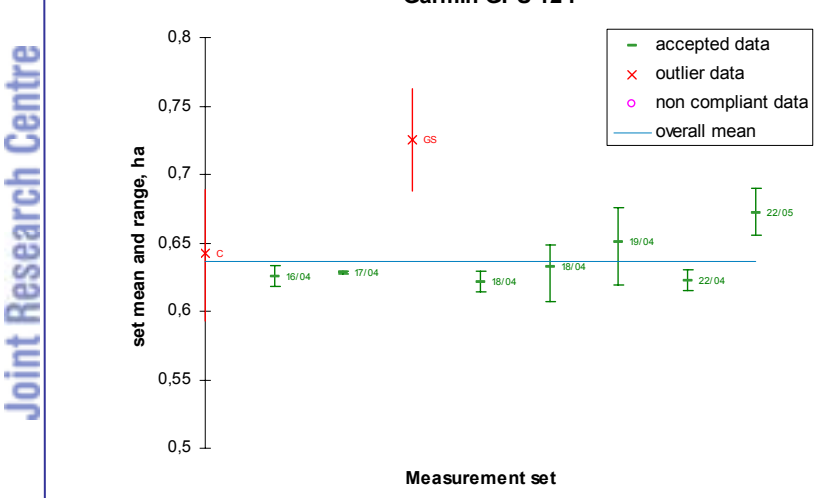
EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Measuring a field: the CAP way

- GNSS (GPS, Galileo) or VHR
- Area measurement
  - Not boundary survey
- Trace of absolute position
- Integration with other data
  - Orthoimage, existing boundaries
- Real time
  - Decision in the field or on-screen

Example: Garmin 12



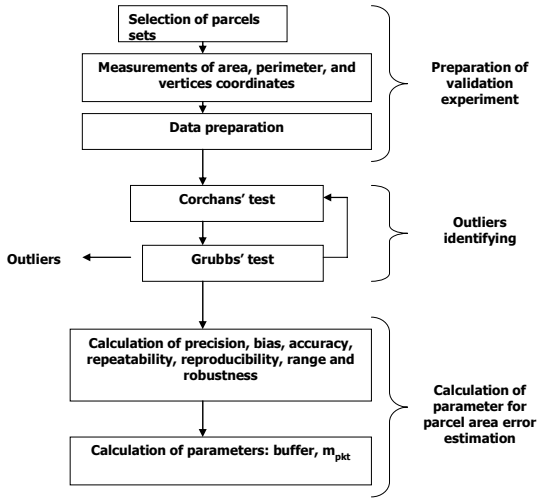
Key points of revised approach

- It is not necessary to test skilled and unskilled operators
  - the obtained results are similar for both, but unskilled operators must be more detailed trained in compare to the unskilled).
- Parcels of different areas should be measured.
  - But two kinds of parcel size seems to be enough (instead of three kinds as used in the project)
- Parcels sets should comprise parcels with: good and bad borders.
  - In RS measurements bad border can be understood as borders with trees, or bad brightness and contrast of the image.
  - In GPS measurements trees are also obstruction because of availability satellites.
- Reference parcels should be measured using geodetic instruments
  - for example Total Station, GPS-RTK,
  - cadastre parcel can be used with especially caution.
- Storing all data in GIS data base is strongly suggested

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Proposed scheme



EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Workflow

- Relative area error analysis before and after suppression of observations.
- Assessment of bias of the method.
- Variance components and reproducibility.
- Calculation of standard deviation for all parcels.
- Calculation of buffer and point position error
  - (SDev/BH or SDev/BDK).
- Analysis of relationship between buffer and/or point position error and area of the parcels.
- Modeling of buffer or/and point position error of the method.

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

How many measurements

- *(Earlier recommendations were 16 to 60 measurements)*
- From Chp 9 of report:
- The numbers of parcels needed to reach a precision (half of the length of the 0.95 confidence interval) of 10 % of the mean values of the buffer are:
  - parcels = 10 rep. = 37 (370 observations)
  - parcels = 4 rep. = 67 (268 observations)
  - parcels = 1 rep. = 217 (217 observations)
- *Several approximations have been made to obtain these results and it could be useful to check them by using MC simulation.*

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Measurement directive

Specifically: Annex MI-009

30.4.2004 EN Official Journal of the European Union L 135/1

I

(Acts whose publication is obligatory)

DIRECTIVE 2004/22/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 31 March 2004
on measuring instruments
(Text with EEA relevance)

EUROPEAN COMMISSION DIRECTORATE-GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Procedure

ANNEX C1

DECLARATION OF CONFORMITY TO TYPE BASED ON INTERNAL PRODUCTION CONTROL PLUS PRODUCT TESTING BY A NOTIFIED BODY

1. 'Declaration of conformity to type based on internal production control plus product testing by a notified body' is the part of a conformity assessment procedure whereby the manufacturer fulfils the obligations laid down in this Annex and ensures and declares that the measuring instruments concerned are in conformity with the type as described in the EC-type examination certificate and satisfy the appropriate requirements of this Directive.

Manufacturing

2. The manufacturer shall take all measures necessary to ensure conformity of the manufactured instruments with the type as described in the EC-type examination certificate and with the appropriate requirements of this Directive.

EUROPEAN COMMISSION DIRECTORATE-GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Procedure, 2

Product checks

3. A notified body, chosen by the manufacturer, shall carry out product checks or have them carried out in appropriate intervals determined by it, in order to verify the quality of the internal checks of the product, taking into account inter alia the technological complexity of the instruments and the quantity of production. An adequate sample of the final products, taken by the notified body before the placing on the market, shall be examined and appropriate tests, as identified by the relevant documents referred to in Article 13, or equivalent tests, shall be carried out to check the conformity of the product with the type as described in the EC-type examination certificate and the appropriate requirements of the Directive. In the absence of a relevant document, the notified body concerned shall decide on the appropriate tests to be carried out.

In those cases where a relevant number of instruments in the sample do not conform to an acceptable quality level, the notified body shall take appropriate measures.

EUROPEAN COMMISSION DIRECTORATE-GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Procedure, 3

Written declaration of conformity

4.1. The manufacturer shall affix the 'CE' marking, the supplementary metrology marking and, under the responsibility of the notified body referred to in paragraph 3, the latter's identification number, to each measuring instrument that is in conformity with the type as described in the EC-type examination certificate and satisfies the appropriate requirements of this Directive.

4.2. A declaration of conformity is drawn up for each instrument model and shall be kept at the disposal of the national authorities for 10 years after the last instrument has been manufactured. It shall identify the model of the instrument for which it was drawn up.

A copy of the declaration shall be supplied with each measuring instrument that is placed on the market. However, this requirement may be interpreted as applying to a batch or consignment rather than individual instruments in those cases where a large number of instruments is delivered to a single user.

EUROPEAN COMMISSION DIRECTORATE-GENERAL Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Actions

- Integrate protocol into regulation?
  - Provides better assurance for field measurements – for all parties.
  - Precedent: Annex 1 of 796/04
  - Requires expression of interest from Member States and dialogue with DG AGRI
  - Support assured from DG-TREN/Galileo
- Certification of instruments - from JRC
  - New software ready at JRC, ISO 5725 compliant
  - Again, AGRI/TREN + industry support required
- Training: no scope for EC – but other initiatives possible?

Presentation 3 – EGNOS status report

Peter Spruyt
European Commission Joint Research Centre,
IPSC/AgriFish Unit

Abstract

Since beginning 2005 the Joint Research Centre, Agrifish Unit, is monitoring the EGNOS signal using CSI Wireless receiver. The Agrifish unit is in parallel monitoring a GPS reference station for RTK measurements. The positions of both antennas are calculated based on trigonometric points of the Italian network.
The results of this monitoring exercise are available via internet and give a 24Hr status of the signal quality. The presentation focuses on the analysis over a more or less one year period, thus from the start of the tracking (March 2005) till now (November 2005). The analysis focuses basically on the EGNOS correction quality, reliability and functionality.

Keywords: EGNOS, GPS, PRN, monitoring

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

EGNOS MONITORING
Performance and prospects for 2006

Peter SPRUYT/Christian HANSEN
EUROPEAN COMMISSION
DG JRC

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

- What is EGNOS ?
  - Principles, how it works
- EGNOS Monitoring
  - Problems encountered
  - Reliability of the signal during monitoring
  - Set up
- Statistics

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

- What is egnos ?
  - SBAS (satellite Based Augmentation system) covers both :
    - WAAS (Wide Area Augmentation system
    - EGNOS (European Geostationary Navigation Overlay System)
    - MSAS (Multifunctional Satellite Augmentation System)
    - GAGAN (GPS Aided Geo Augmented Navigation)
  - These 4 augmentation systems are Similar and compatible
  - Simplified :
    - EGNOS is a satellite based augmentation system.
    - The difference is that no long-wave receiver is necessary to receive the correction
    - there is no need for an endless number of DGPS beacons that transmit these correction data
  - For the corrections, the European area will be served by :
    - two Inmarsats
      - AOR-E (Atlantic Ocean Region-East)
      - IOR (Indian Ocean Region)
    - the European Space Agency satellite, ARTEMIS
  - The following PRNs have been allocated to the EGNOS system:

Satellite	Satellit location	GPS PRN No.
INMARSAT 3 F2 (AOR-E), (Atlantic Ocean Region East)	Western Africa	120
INMARSAT 3 F1 (IOR), (Indian Ocean Region)	Indian Ocean	131
INMARSAT IOR-W (III-F5), (Indian Ocean Region West)	Africa (Kongo)	126
Artemis	Africa (Kongo)	124

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

- How it works :
  - ***Ground segment***
    - composed of 4 Mission Control Centres (MCC),
      - Central Control Facility (CCF), providing monitoring and controlling of the EGNOS ground segment as well as mission monitoring and archiving of EGNOS data
      - Central Processing Facility (CPF), providing the real-time software computation of EGNOS Wide Area Differential corrections, ranging corrections for geostationary satellites and an integrity checking facility.
    - 34 Ranging and Integrity Monitoring Stations (RIMS),
      - The main functions of the RIMS are to
        - » perform pseudo range code/phase measurements towards Satellites in View (GPS L1 and L2 + GEO/GLO L1),
        - » demodulate EGNOS SIS messages
        - » mitigate local multipath and interference,
        - » support the detection of anomalies in signals from space (e.g. Evil Waveforms),
        - » packet and transmit data to the MCCs via the EGNOS Wide Area Network (EWAN),
        - » provide monitoring and control capabilities and provide a time offset between UTC (k) and EGNOS Network Time (UTC RIMS).
    - 6 Navigation Land Earth Stations (NLES),
      - to uplink EGNOS messages to the Inmarsat III Atlantic Ocean Region – East (AOR-E) and Indian Ocean Region – West (IND-W) satellites and the ESA Artemis satellite.
      - The main functions of the NLES will be
        - » to generate a GPS-like signal and transmit this to the geostationary satellite transponder,
        - » synchronizes this signal to EGNOS Network Time (ENT) at the output of the geostationary L1-band antenna,
        - » control the code/carrier coherency and transmit the geostationary Integrity Channel (GIC) and Wide Area Differential (WAD) messages to satellites in geostationary orbit.
    - the EGNOS Wide Area Network (EWAN) and
      - The EGNOS Wide Area Network (EWAN) interconnects all EGNOS sites and sub systems. The EWAN is a Wide Area Network based on frame relay technology.
    - 2 support facilities (PACF, ASQF).
  - ***Space Segment***
    - The geostationary satellites

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

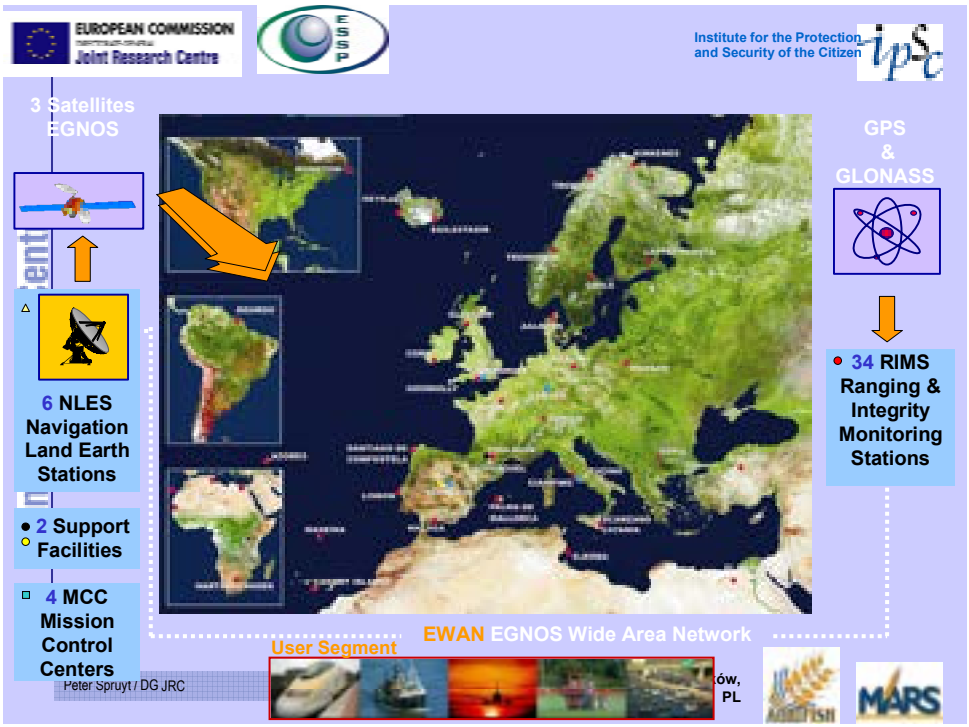
Institute for the Protection and Security of the Citizen

Joint Research Centre

– At location of these ground stations corrections are calculated for
  • Ionosferic errors, Clock errors and Ephemerides
– These corrections are sent to the geostationary satellites, who then provides a signal very similar to that of the GPS satellites and on the same frequency.
  • Therefore these satellites may be used for position calculation and correction data sent out to improve the position calculation.

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL



EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

- Current situation of ESTB (EGNOS satellite Test Bed)
  - ESTB tests on satellite IOR (PRN 131; ID 44) have been stopped on May, 27 th.
  - At the moment ESTB signals are being transmitted through AOR-E (PRN 120; ID 33).
- EGNOS
  - The final EGNOS constellation will consist of the satellites ARTEMIS (PRN 124; ID 37) , Inmarsat AOR-E (PRN 120; ID 33) and Inmarsat IOR-W (PRN 126; ID 39).
    - Until the official start of EGNOS these satellites do send signals from time to time that will not be evaluated by end-user receivers

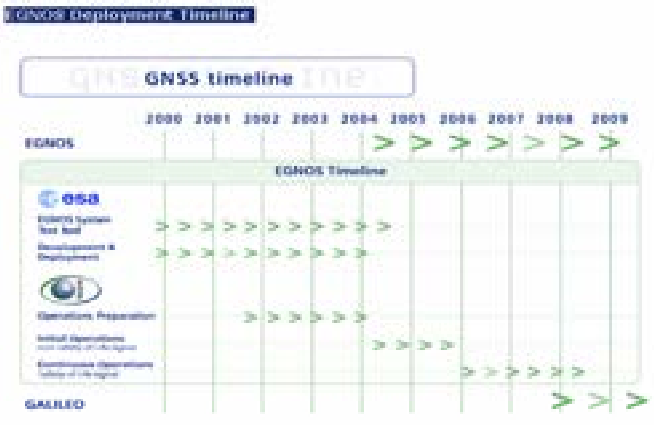
Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre



Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

- Egnos monitoring
  - Go to our website :
- Problems encountered are basically linked to the PRN numbers we used.
  - In the beginning not clear which PRN's were active…..

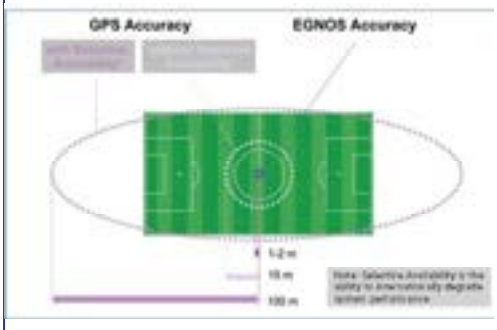
EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

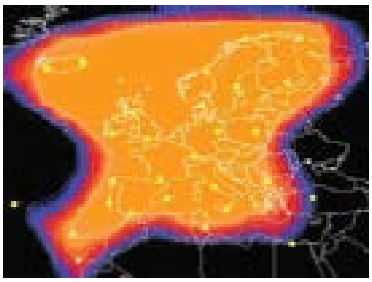
Joint Research Centre

What we should expect when using EGNOS

On accuracy



On availability



EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Estimated requirements for GNSS (global Navigation satellite system) services

Policy area	*Point Horizontal precision (m, conf. interval)*	*Point Vertical precision (m, 95%)*	*Availability*
Field location	10m, 95%	n/a	Not critical
Fisheries vessels	500m, 99%	n/a	Not critical
Statistical survey	5m, 95%, ideally 2m, 95%	Commensurate with horizontal precision	Not critical, but system failure warning required
Air survey in support of large scale projects (e.g. IACS LPIS)	1m, 95%	1m, 95%	Critical, 99.9%
Parcel area measurements	<10m, 95%; ideally <2m, 95%	Commensurate with horizontal precision	Not critical, but system failure warning required
IACS LPIS boundary updating	5m, 95% or better (depends upon survey scales)	Commensurate with horizontal precision	Not critical, but urban environments possible
Land register, rural	<2.5m, 95% or better (1:5,000 scale)	Commensurate with horizontal precision	Not critical, but system failure warning required
Land register, urban, provisional fixing of boundaries	<1m, 95% or better (1:2,000 scale)	Commensurate with horizontal precision	Not critical, but system failure warning required
Land register, urban, definitive boundary adjudication	Not worse than 50cm, 95% (1:1,000 scale)		

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Test Methodology

For known position, continuously receiving

- GPS signal
- EGNOS correction

Checking for:

- *Corrected positional accuracy*
- *Precision (assessment over time)*
- *Availability of Corrections*

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

JRC EGNOS Monitoring

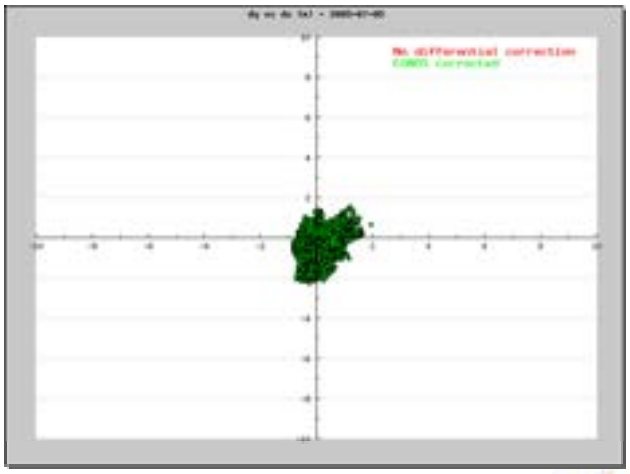
- Initiated in March 2005
- PRN 120, ESTB until 27 May 2005
- EGNOS 27 May – till today
- Registering 1/sec,
- Sampling (statistics) every 60th

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

Example of normal situation using EGNOS PRN 126



Peter Spruyt / DG JRC

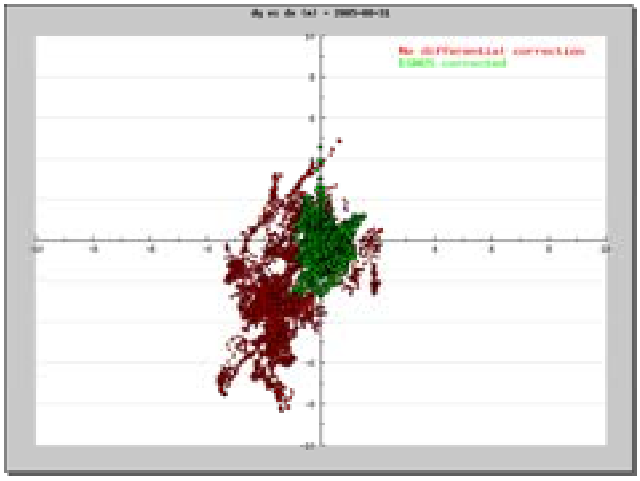
11th Annual CwRS Conference, November 2005, Kraków, PL

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

Exemple of normal situation (corrected/non corrected) EGNOS PRN 124



Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

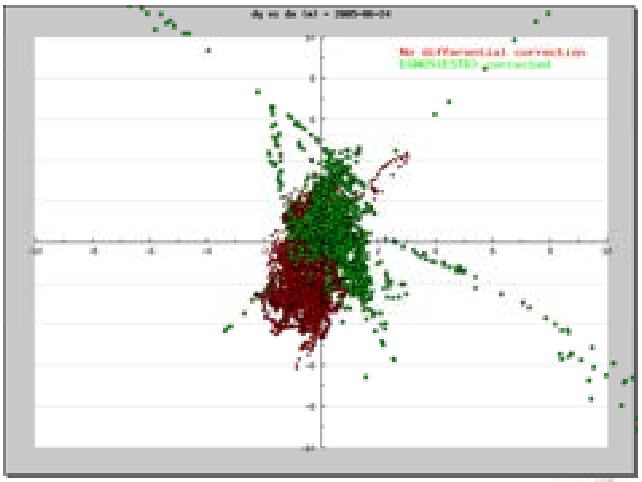
AGRIFISH MARS

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen ipsc

Joint Research Centre

Strange behaviour ESTB PRN 120



Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

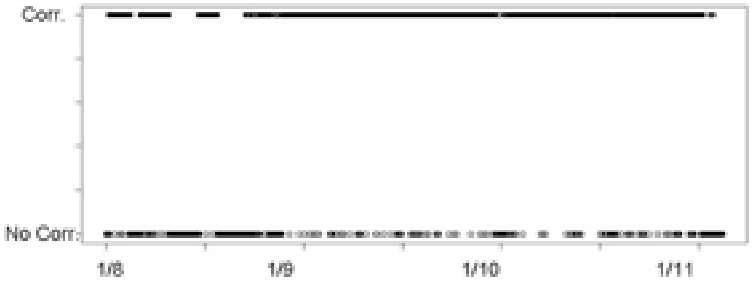
AGRIFISH MARS

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Correction Availability for PRN 124



77 % availability of the EGNOS PRN 124

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Ispra monitoring station results PRN 124
1st Augustus till 8 November 2005

- Accuracy

RMSE	Easting	Northing	Height
EGNOS 124	0.911	0.612	1.440
No Correction	1.524	1.079	3.111

- Precision

Standaard Deviation	Easting	Northing	Height
EGNOS 124	0.675	0.558	1.170
No Correction	1.332	1.072	3.108

Amount of corrected positions with an deviation greater than (x,y):

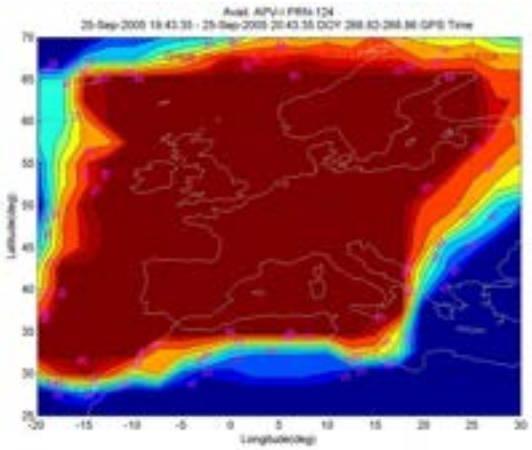
(Egnos corrected only)	Deviation (x,y) < 1	79.20%
	Deviation (x,y) < 2	98.50%
	Deviation (x,y) < 3	99.70%

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Correction Availability



EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Monitoring summary (user perspective)

- **Corrections working**
  - **with some "teething problems"**
- **Availability still below operational levels?**
- **Accuracy and precision seems OK**
  - **but still adrift of the promised performance?**

General Comments

- **Lack of information about planned interruptions**
- **Archive of corrections, but not any other information archived**

Peter Spruyt / DG JRC

11th Annual CwRS Conference, November 2005, Kraków, PL

Presentation 4 – Evolution of remote-sensing method in Poland

Jacek Podlewski

Agency for Restructuring and Modernisation of Agriculture (ARMA), PL

Abstract

The presentation includes information about the evolution of the remote-sensing control (M5 method) in Poland with reference to year 2004:

- Selection of control sites,
- Information about tenders and contractors,
- Information about ortophotomaps used in control in years 2004 and 2005,
- Supplement of control by classical field inspections,
- Extended directories for Quality Control,

The presentation shows the differences between control method used in years 2004 and 2005, for example: meetings with farmers, new codes and comparison of cost.

Keywords: the spot checks, rapid field visits (RFV), farm selection

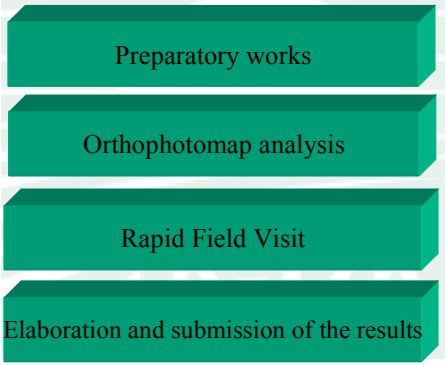
Evolution of the RFV in Poland

Variety of remote sensing method used in Poland (acc. to CTS):

M5 – up-to-date orthophotomap and RFV

RFV Evolution

CONTROL STAGES IN 2004 AND 2005



RFV Evolution

Basis for RFV implementation in 2004

External contractor for control implementation selected under tendering procedure for 1 year.

RFV evolution

Basis for control implementation in 2005

The external contractor who was awarded with the contract for control implementation over the period 2005 - 2006 should fulfil the organizational and technical conditions which allow to carry out the services using inspection on the spot and RFV methods.

RFV Evolution

Basis for RFV implementation in 2004

RFV Method

- 1 tender – ARMA Headquarters
- 5 external contractors (consortia)

- area to be controlled: set of sites
- unit to be controlled: 1 farm
- unit to be paid for: 1 farm

RFV Evolution

Basis for control implementation in 2005

Method of inspection on the spot and RFV method

- 6 ARMA regional tenders
- 6 external contractors (consortia)

RFV method

- control area: set of sites
- unit to be controlled: 1 farm
- unit to be paid for: 1 farm

RFV Evolution

Selection of sites to be controlled using RFV method in 2004

Site selection criteria:

- availability of the vectoral database,
- low multiannual average overcast,
- advantageous structure of agricultural parcels – low fragmentation of the agricultural parcels,
- size of agricultural land area exceeds 30% of the controlled area,
- Availability of archive ortophotomap.

RFV Evolution

Selection of sites to be controlled using RFV method in 2005

Site selection criteria:

• more then 20% of anomalies (regions) from field inspection made in 2004,
• available cadastral vector data,
• number of farms (from field inspection made in 2004),
• ratio of the declared area in 2004 to the total site area should be 40% (the declared area is a sum of the area of farms situated on the site to be controlled).

RFV Evolution

Ortophotomaps used in control RFV in 2004:

	Mazowieckie GROI/GARI	Opolskie KLUI	Łódzkie LOWQ	Podkarpackie LEZA	Warmińsko Mazurskie BARI
Ortophotomap	IKONOS (500 km²)	IKONOS (250 km²)	QuickBird (730 km²)	Archive ortophotomap	IKONOS/ QuickBird (500 km²)
Date of photo acquistion	14-15 IV.	15 IV	01 V-20 V	Archive ortophotomap 2003 r.	14 IV-20 IV.

Including:

IKONOS/QuickBird 1980 km²

Archive ortophotomap c.a. 500 km²

RFV Evolution

RFV Evolution

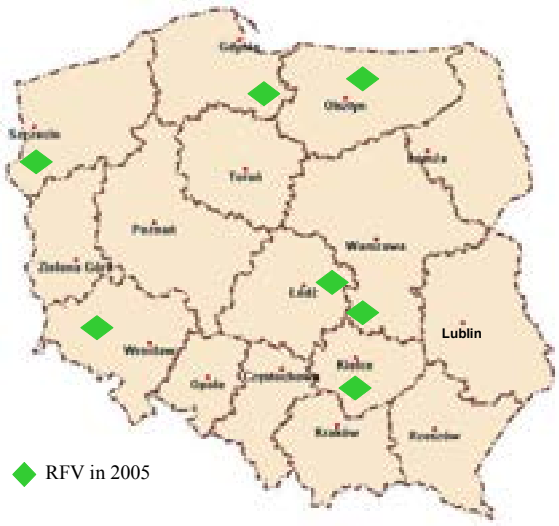
Sites controlled in 2005

18 sites in 7 voivodships were selected for control in 2005 :

- 17 sites with an area of 280 km2
- 1 site with an area of 784 km2

Ortophotomap for all sites will made using QiuckBird images.

RFV Evolution



RFV Evolution

Ortophotomaps used for RFV control in 2004:

Dates for satellite images acquired

- 14 April – 20 May 2004

Dates for ortophotomaps handed over to the contractors

- 26 July - 9 August 2004

Dates for ortophotomaps handed over to the contractors are imposed by the time needed for their preparation and quality control.

RFV Evolution

Ortophotomaps used for RFV control in 2005:

Dates for the satellite images acquired

- 25 April – 30 May 2005

Dates for ortophotomaps handed over to the contractors

- 16 - 29 August 2005

Dates for ortophotomaps handed over to the contractors are imposed by the time needed for their preparation and quality control.

RFV Evolution

Ortophotomaps used for RFV control in 2004:

Format of the received satellite images

QuickBird:

- Standard Ortho-Ready, Bundle

IKONOS:

- GEO OrthoKit Bundle

Format of the ortophotomap

- Pan-sharpened

RFV Evolution

Ortophotomaps used in control RFV in 2005:

Format of the received satellite images

QuickBird:

•Standard Ortho-Ready, Bundle

Format of the ortophotomap

•Pan-sharpened

Because of a long production time of ortophotomaps it is recommended for JRC to hand over the ready ortophotomaps instead of satellite images.

RFV Evolution

Number of checks carried out in 2004 and 2005:

The area of the controlled area and number of farms checked in 2004:

• 2000 km^2,

• 9964 of farms.

The area of the controlled area and number of farms checked in 2005:

• 5550 km^2,

•12153 of farms.

Ewolucja FOTO

Differences between RFV method used in 2005 and that used in 2004:

- the contractor has to arrange meetings with farmers,
- the scope of control is complemented with inspections on the spot,
- list of non-conformity codes extended,
- verification of the consistency of descriptive and vector data by comparison of the area and site sizes,
- introduction of the more detail formal check of the control results as a preliminary assessment of data obtained during the control implementation

RFV Evolution

Contractor has to arrange meetings with farmers

If the declared area on a given farm exceeds the area checked by more than 3% or 1 ha (if the declared area is assumed to be 100%) the contractor has to arrange a meeting with the farmer to show the check results and establish the reasons of discrepancies.

RFV Evolution

Scope of control complemented with inspections on the spot

When 80% of the declared farm area cannot be checked using RFV method, this condition has to be fulfilled by inspecting on the spot the parcels.

RFV Evolution

List of non-conformity codes extended

The list is completed with non-conformity codes which should be used when the agricultural parcel is found to be:
• incompatible,
• checked after the harvest of the declared crop,
• situated on within the ortophotomap area covered with clouds,
• situated within a group of agricultural parcels on which the same crop is grown,
• not checked because of missing documentation.

RFV Evolution

Verification of the consistency of submitted data

The areas and perimeters of agricultural parcels are compared with the vector and descriptive data submitted (kept in the database). The comparison is made for 100% of data submitted.

RFV Evolution

More detailed formal check

The results of controls are more detailed formally checked – the check consists of the verification of:

vector data,
databases
paper materials handed over by the contractors.

In order to provide check evidence a check list i filled in for each farm.

RFV Evolution

Comparison of unit costs incurred for the check of 1 farm in 2004, 2005-2006

Tender Region	Unit price 2004	Unit price 2005-2006	Proportion of 2005-2006 price to 2004 price.
Pomorskie, zachodniopomorskie	-	147,62	
Kujawsko-pomorskie warmińsko-mazurskie	392,69	200,02	50,94%
Łódzkie, opolskie, śląskie, świętokrzyskie	391,96	213,50	54,47%
Małopolskie, lubelskie, podkarpackie	372,1	-	
Podlaskie, mazowieckie	444,05	280,60	63,19%
Wielkopolskie, lubuskie, dolnośląskie	-	195,20	
Poland	**411,55**	**206,30**	**50,13%**

RFV Evolution

Changes planned for 2006

• increased precision of the co-ordinates of the bending points of parcel boundaries,

• establishment of permissible divergences for the parcel areas and perimeters in the databases and vector data.

RFV Evolution

Thank you for your attention

jacek.podlewski@arimr.gov.pl

RFV Evolution

Presentation 5 – Mixing sources of geo-information for agricultural user community support

Jos Bakker - Vexcel, NL

Tamme van der Wal – Alterra, NL

Henk Janssen – Alterra, NL

Abstract

Recent advancements in geoICT bring the integration of Earth Observation (EO), Global Navigation Satellite Systems (GNSS) and GIS within reach of every day use. Protocols and standards however are scarce. This is hampering the cross-organisational implementation. Collaboration between the Dutch payment agency, research institutes, industry and service providors has lead to a successful pilot for mixing sources.

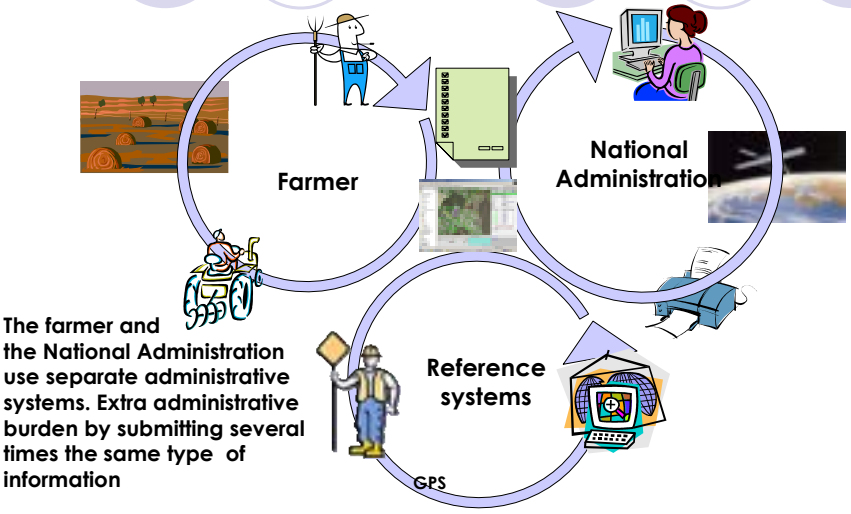
Within the Galileo programme of EC and ESA research is initiated to promote the use of GNSS. The FieldFact project focuses on mixing sources of geo-information for agricultural user community support. This presentation focuses on a first critical analysis of the integration of GNSS with EO and GIS and provides an outlook to developments like geo-enabled farm management systems, updating LPIS with GPS and LBS for farm advice.

Keywords: Galileo, EO, agricultural user community, farm advice, LPIS update, LBS

Outline

- Combining Earth Observation and GNSS in agriculture
- The 'Fieldfact' project; introduction of GNSS in the EU agri-sector

Current situation



The farmer and the National Administration use separate administrative systems. Extra administrative burden by submitting several times the same type of information

GNSS in the agri-sector; Challenges…

Why is GNSS not (yet) widely used in agriculture:

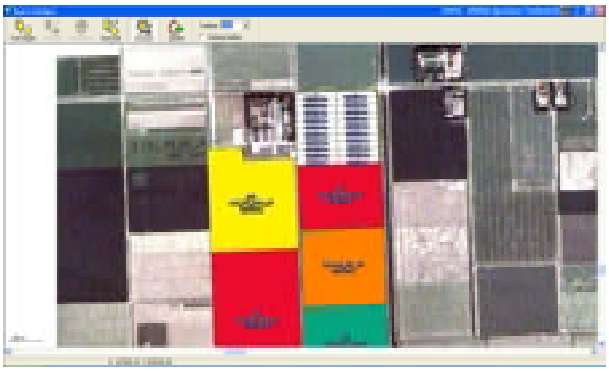
1. High investment for equipment, software, services
2. Lack of beneficiary applications

What is different today:

1. Increased demand for (digital) documentation;
   1. From the production chain
   2. From the government
2. Equipment is cheaper, more accurate, etc.
3. Farmer Management Systems (FMS) with geo-modules

FMS; more then figures….

More and more FMS incorporate parcel based geo-modules; from 'simple' parcel boundary measuring functions…….

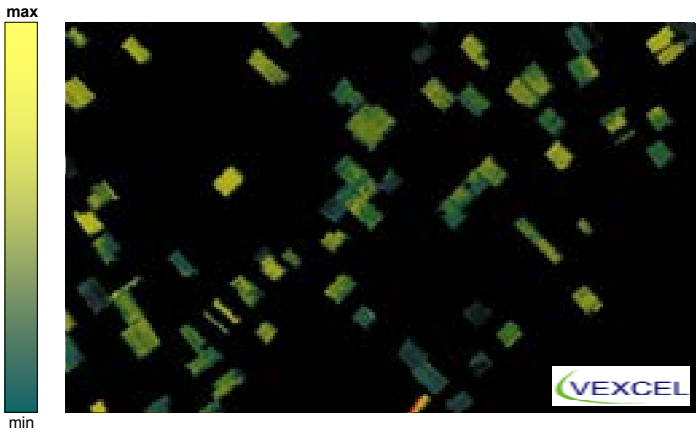


FMS; more then figures….

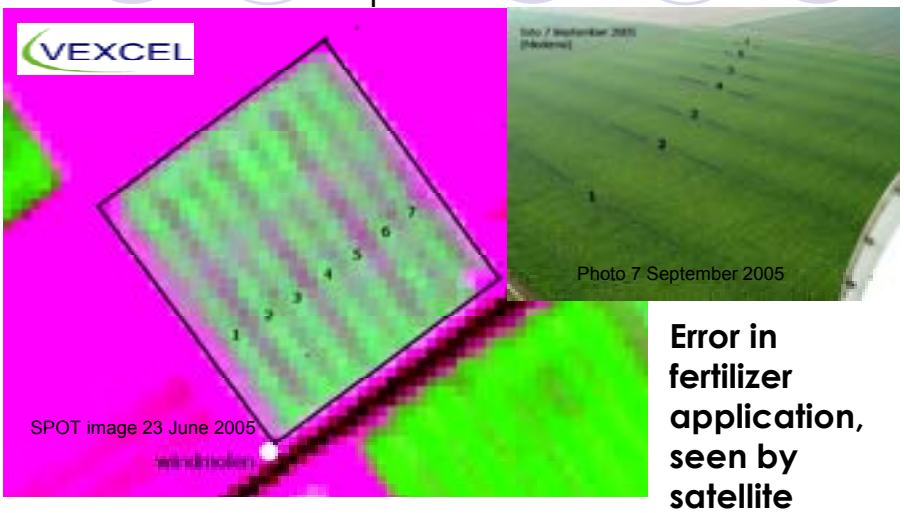
Increasing request of farmers of satellite based crop growth information to be integrated in their FMS…..

Earth Observation products

Biomass (LAI) of potato fields throughout the growing season (SPOT 23 June 2005, Netherlands)



Earth Observation products

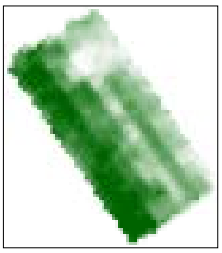


Error in fertilizer application, seen by satellite

Earth Observation products

max

min

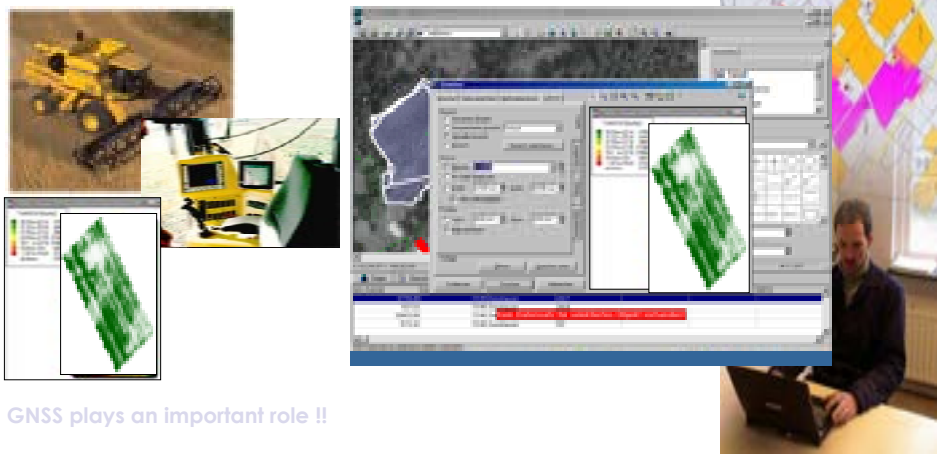


Biomass (LAI) determined form space (23 June, 2005)

Biomass determined on the ground by the N-Sensor (16 June 2005)

FMS; more then figures....

....as input to high level, position related, daily/weekly/monthly crop growth monitoring management system



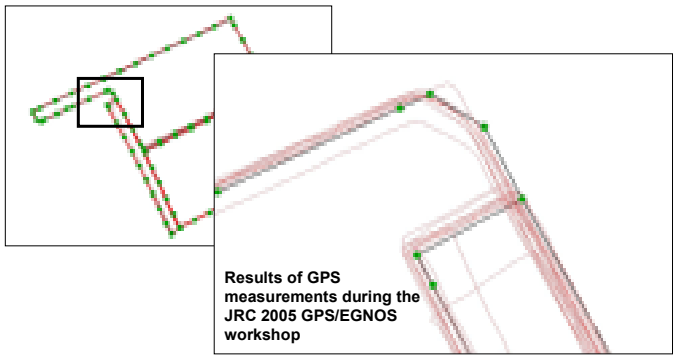
GNSS plays an important role !!

Issues to be solved…

- Approx. 5.5 million farmers in EU25 deal with GI now
  - Farmers will start using GNSS to include in their FMS
  - Exchange of FMS information with National Authorities
  - Possible error introduction in parcel measurements
- Emergence / resurrection of precision agriculture.
  - FMS linked to machine providers; ISO-bus standards

GNSS in the agri-sector; Threats…

Use of GNSS by farmers and controllers can introduce discrepancies in parcel measurements due to…..

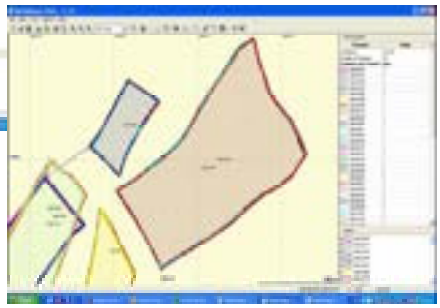


Results of GPS measurements during the JRC 2005 GPS/EGNOS workshop

Different instruments.....

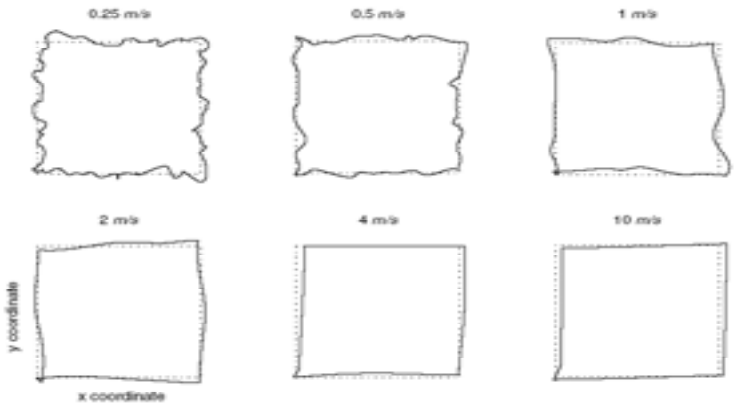
Equipment 1

Equipment 2



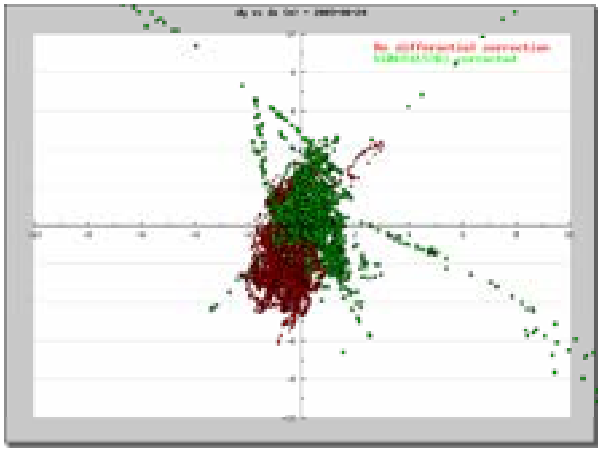
Source: University of Warmia & Mazury, Olstzyn (Poland)

Different methodology....



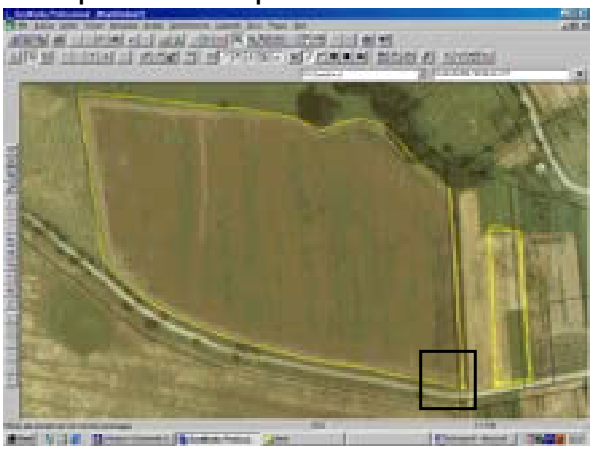
Bogaert, P., Delincé, J., Kay S. (2005) *Assessing the error of polygonal area measurements: a general formulation with applications to agriculture*, Meas. Sci. Technol. 16 (2005) 1170–1178

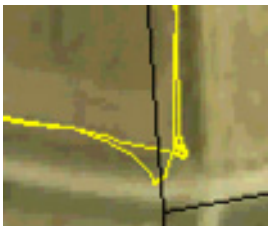
Signal related error....



Source: DG JRC, Italy

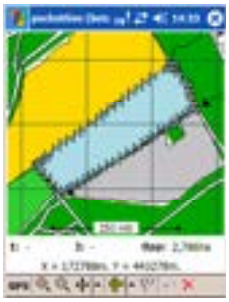
Operator protocol error....





Source: DG JRC, Italy

Farmer measuring error....



LPIS errors.....

GPS used for OTS leads to discrepancies with the LPIS. What is the source ?

- Error in LPIS ?
- Error in GPS/EGNOS signal ?
- Error in methodology ?
- Error made by controller ?
- Error made by farmer ?

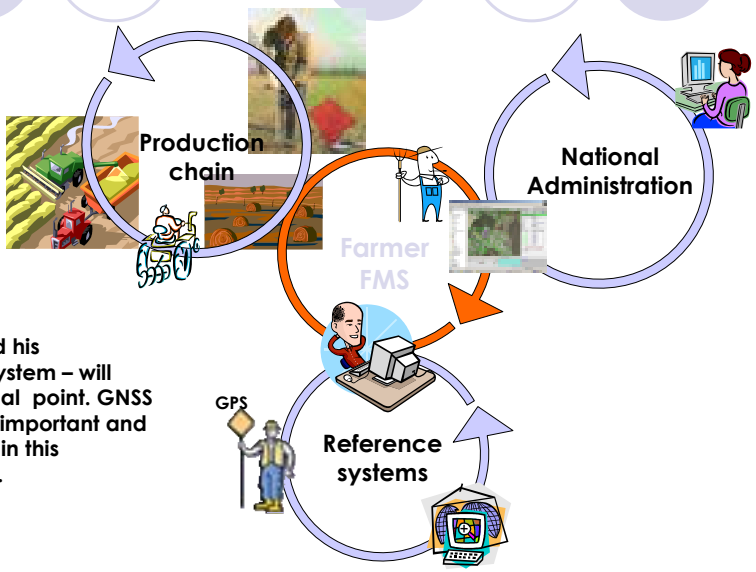
Source: SZIF, National administration Czech Republic

Conclusion

… and/or a combination of all the previous….

(Practical) guidelines/protocol/standardization about the use of GPS by the farmers is needed !

Future situation



The farmer – and his administrative system – will become the focal point. GNSS will become an important and critical element in this communication.

FieldFact (2006-2007)

A new initiative about the introduction and promotion of GNSS in the European agricultural sector with emphasis on the use of EGNOS/Galileo.

Supported by the Galileo Joint Undertaking (GJU)

Consortium & expertise in Fieldfact

- **Alterra** (lead): GNSS application in education, research and agriculture;
- **University of Warmia & Mazury**: Geodesy;
- **JRC**: GNSS Application in EC regulations;
- **Vexcel Netherlands**: GNSS application and Earth Observation;
- **PPO**: Farm application and integration with management, tradeshows;
- **Ekotoxa**: Stakeholders feedback.

Focus of FieldFact

- Develop a useful / simple application for on-farm GNSS use with emphasis on EGNOS/Galileo;
- Integrate documentation with farm management (less work on administration etc.);
- Spread the word through professional networks such as farm-research, national administration and extension services;
- Stimulate Spatial Data Infrastructure (SDI) for useful content / content sharing

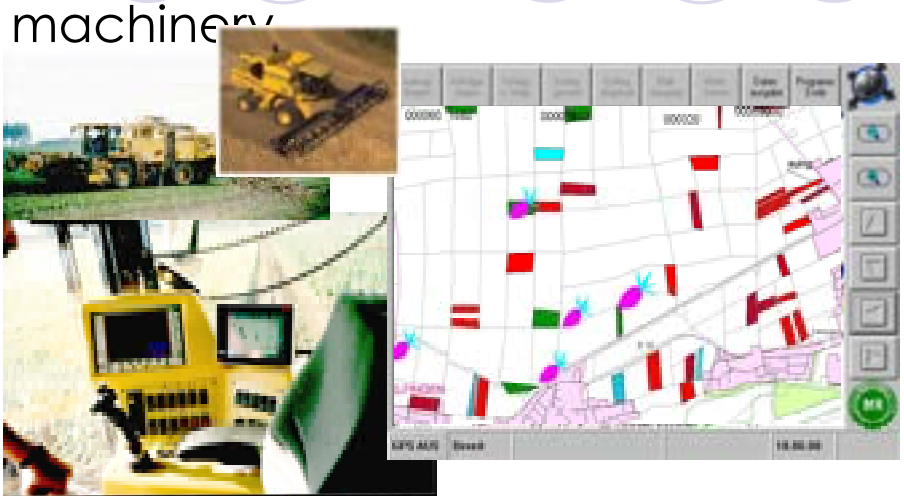
Fieldfact 'low end' GNSS application

- **Notification / registration of activity**
  - Field / location
  - Time
  - User adds attribute data such as activity, equipment etc.
- **PDA based applications**
  - Field boundaries from IACS
  - Position/time with GPS (later Galileo)
  - Exportable data (to FMS)

'Low end' additions…

- Extra functionality:
  - Get History from field (when did I mow this last time?)
  - Alert (you are moving from field 1 to field 2 without disinfection of equipment)
  - Work planning (today you are going to plough field 3)
  - …

Fieldfact 'high-end'; GNSS and machinery



'High-end' additions...

- On-Farm Data acquisition, Management and Analysis
- Integration of GNSS signals from harvesters etc.

with

- Field boundaries and farm plan from IACS
- digital CAP declaration

'High-end' additions...

- Open standards, communication with different manufacturers
- Internet connection with IACS WMS
- Certification of geo-features
- Portal c.q. server
- Collection and use of high-precision GNSS data
  - (included field boundary measurement)

Fieldfact Trade Fair….

During the project a trade fair will be held for the different stakeholders at three different locations in Europe.

Stakeholders….

Call for stakeholders !!!

An important activity in the first quarter of 2006 is the induction of a stakeholders platform. This can be administrative bodies as well as organisations that represent farmer communities.

Please contact **Simon Kay** (simon.kay@jrc.it) if you are interested to take seat in the platform.

Presentation 6 – IACS-GIS Implementation (GERK project)

Alenka Rotter
Ministry of Agriculture, Forestry and Food, SI

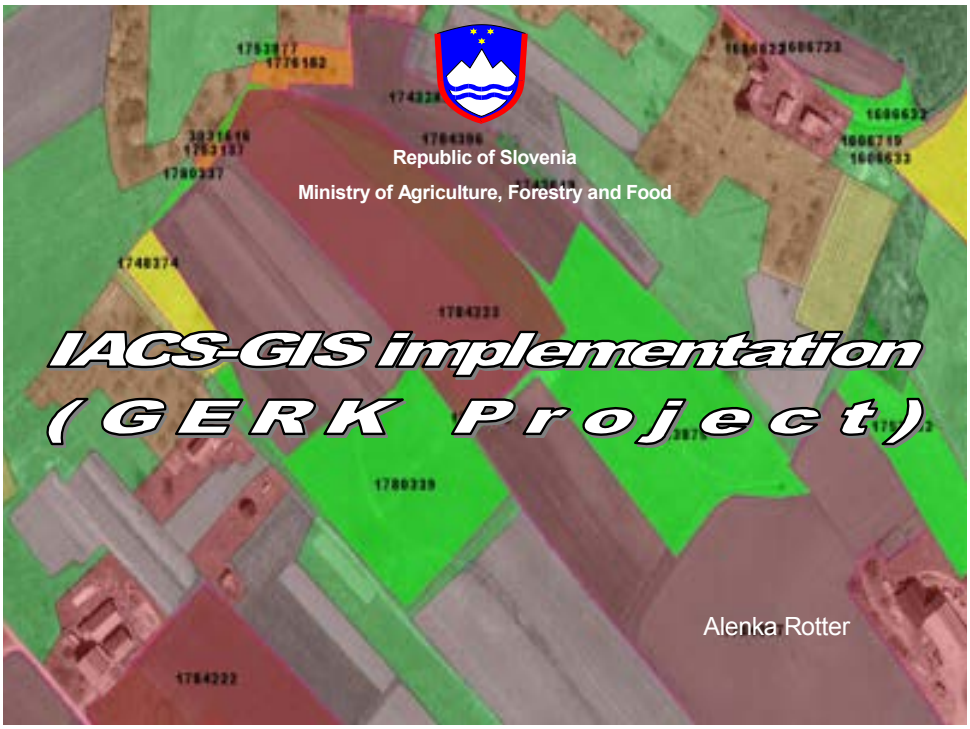
Abstract

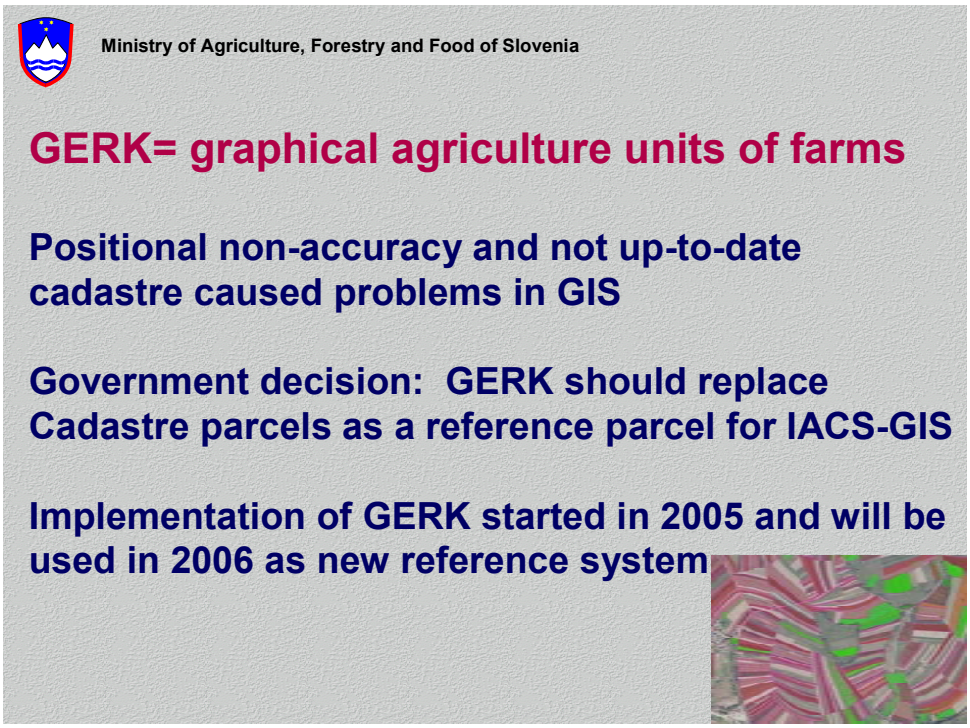
Ministry of Agriculture, Forestry and Food of Slovenia started with the implementation of GERK project (graphical agriculture units of farmers) in the year 2005. Positional non-accuracy and not up-to-date cadastre caused problems in GIS system. The Government of Slovenia took decision to move on better reference parcel- GERK for the purpose of IACS-GIS.

Slovenian IACS reference parcel was from the year 2000 the cadastral parcel. The farmers declared the agriculture units (farm blocks) formed by cadastral parcels or their parts.

Digital cadastre maps, land use, farmer's declarations from year 2004 and data from registers of permanent crops was used to create the initial GERKs. All initially calculated GERKs has to be corrected in the presence of farmers. The special graphical application was made for this purpose. Implementation is done on the field with approx. 750 specially trained workers. The project will be successfully finished for approx. 74.00 farmers at the end of the year 2005. GERKs will be delivered to farmers who applied for the subsidies 2005 as graphical and numerical pre-print and will serve as future reference parcel for IACS-GIS.

Keywords: LPIS, GERK, IACS-GIS, digital cadastre maps, agriculture unit


Republic of Slovenia
Ministry of Agriculture, Forestry and Food
IACS-GIS implementation
(GERK Project)
Alenka Rotter


Ministry of Agriculture, Forestry and Food of Slovenia
GERK= graphical agriculture units of farms
Positional non-accuracy and not up-to-date cadastre caused problems in GIS
Government decision: GERK should replace Cadastre parcels as a reference parcel for IACS-GIS
Implementation of GERK started in 2005 and will be used in 2006 as new reference system

Ministry of Agriculture, Forestry and Food of Slovenia

GERK definition:

- continuous piece of agricutural land,
- with the same land use,
- in use of one single farm,
- on which grows usually one crop

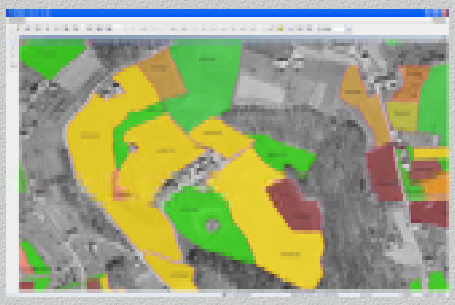
(exceptions on arable land: rye, wheat, maes,…there could be more crops on one GERK)

Permanent crops- GERK is following rules from registres.

3

Ministry of Agriculture, Forestry and Food of Slovenia

ATTRIBUTES OF THE GERK



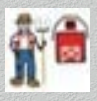
- **identification number,**
- **domestic name,**
- **land use code,**
- **ID of the permanent crop**
- **Area**
- **Remark of the farmer or qualified person**
- **date, hour of consultancy taken**

4

Ministry of Agriculture, Forestry and Food of Slovenia

The GERK establishing Process-1

- Overlay DCM + Land Use + farmer's declarations from 2004 + data from permanent crop registers
- Approx 74.000 farmers were or will be invited to consult the GERKs in year 2005
- Farmers are reciving an invitation from consultants



- MAFF had trained over 750 consultants
- By first consultancy overlaps between different farmers GERKs is allowed, but it is clear to the farmers that area of overlaped GERKs will be excluded from any payment in 2006
- Each farmer have to confirm the GERKs on the printed form of numerical atributes about GERK

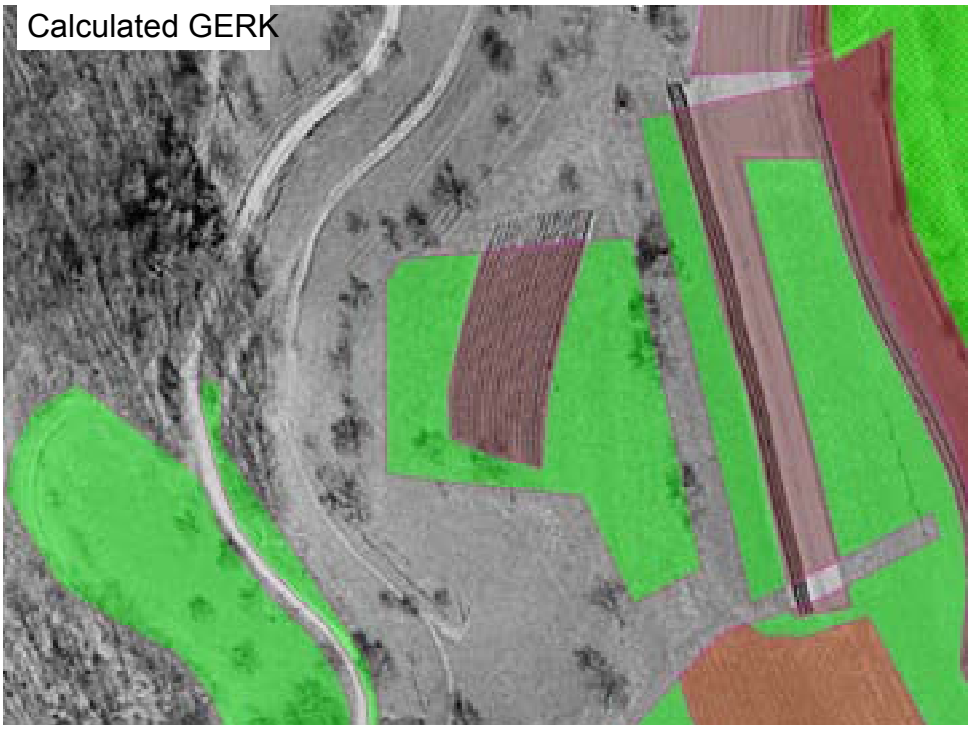
5

Ministry of Agriculture, Forestry and Food of Slovenia

The GERK establishing Process-2

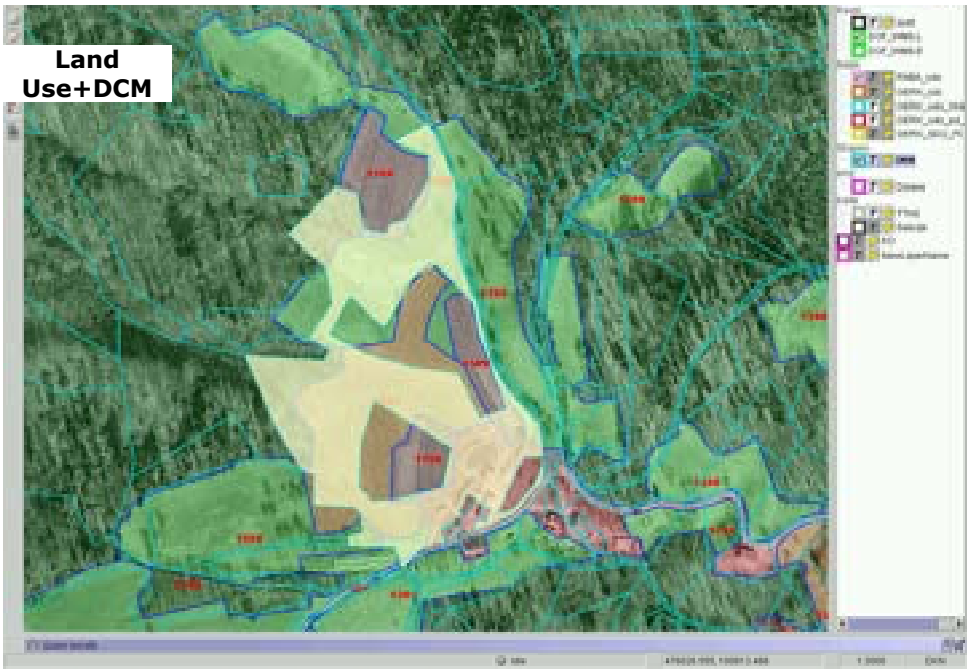
- At the end of consultancy with all the farmers, the farmers with overlaping areas of the GERKs will be invited to solve the problems
- If there will be no agreement between the farmers , the oficial area of GERK will be reduced for overlaping area
- Graphical preprint for year 2006 will show the GERKs on DOP
- Farmers will come to advisory service to apply for the subidies directly via internet application

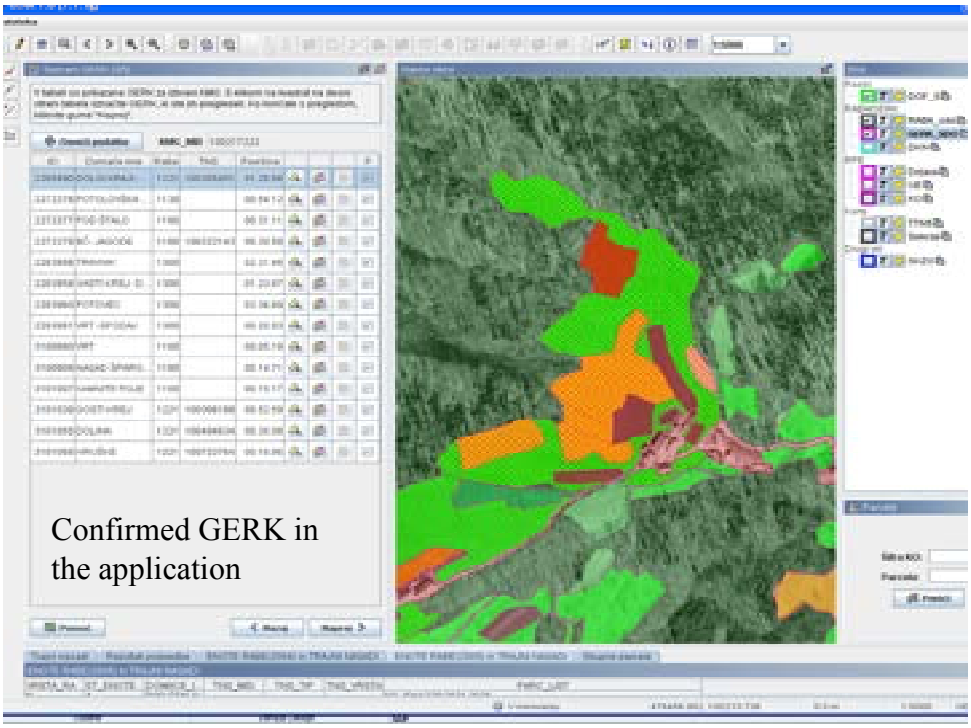
6

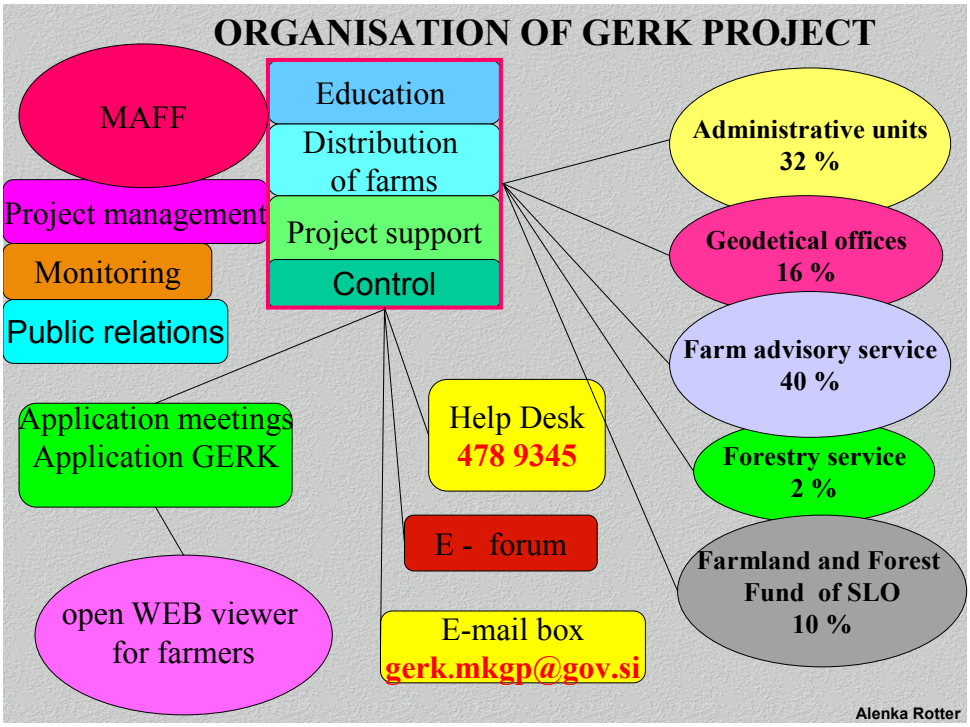

Calculated GERK


Confirmed GERK after consultancy taken

One cadastral parcel – more different land uses

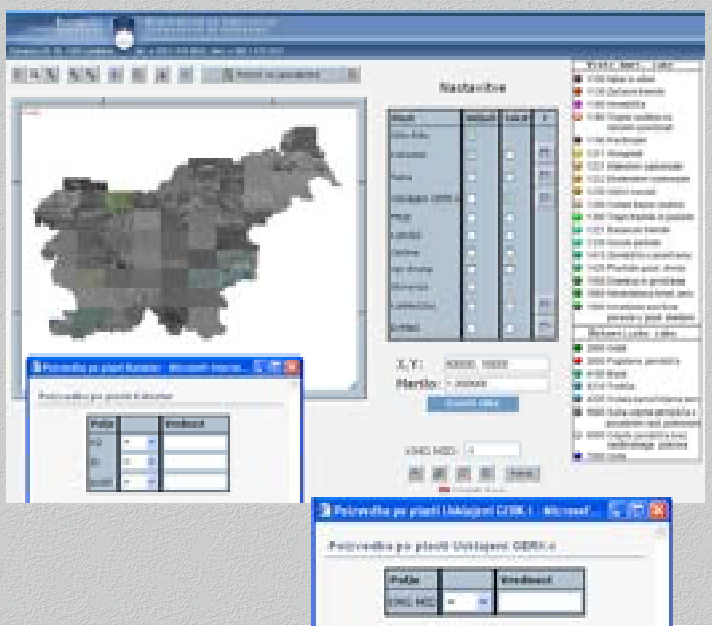





ORGANISATION OF GERK PROJECT
MAFF
Education
Distribution of farms
Project support
Control
Project management
Monitoring
Public relations
Application meetings
Application GERK
Help Desk
478 9345
E - forum
E-mail box
gerk.mkgp@gov.si
open WEB viewer for farmers
Administrative units
32 %
Geodetical offices
16 %
Farm advisory service
40 %
Forestry service
2 %
Farmland and Forest Fund of SLO
10 %
Alenka Rotter


Ministry of Agriculture, Forestry and Food of Slovenia
WEB VIEWER: http://rkg.gov.si/GERK/
RABA - RABA KMETIJSKIH ZEMLJIŠČ
GERK - GRAFIČNE ENOTE RABE KMG
HMO - HIDROMELIORACIJKA OBMOČJA
DOKUMENTI o RABI:
SPLETNE APLIKACIJE - Pregledovalniki : (Vstop prost)

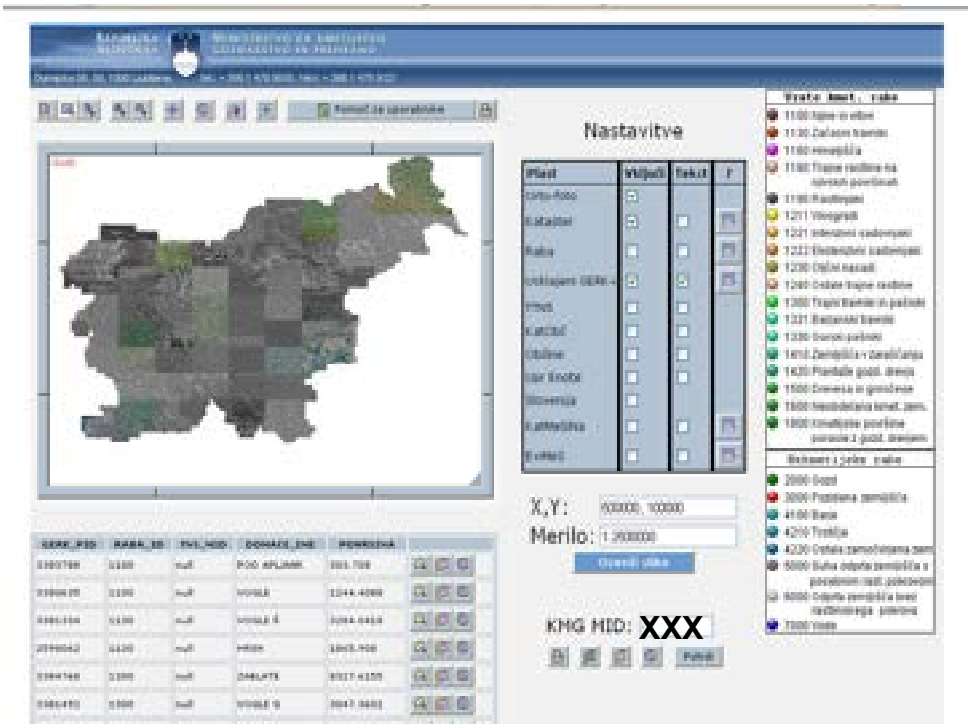
WEB viewer for farmers: http://rkg.gov.si/GERK/



Enable to view land by GERK ID, by FARM_ID, by the land cadaster and land use and get the information about it.

Farmers can measure distances and areas.

Alenka Rotter



Thank You for your attention!

Alenka Rotter

Parallel Session T2 – Control of GAECs and other schemes

Chairman:
Philippe Loudjani, Olivier LÉO
JRC, IPSC, Agrifish Unit)

Presentation 1 – Definition of GAEC by Member States. Controlling GAEC with Remote Sensing

Philippe LOUDJANI, Olivier LÉO,
JRC, IPSC, Agrifish Unit

Abstract

In the frame of the Common Agricultural Policy (CAP) reform, farmers are asked (among other) to keep their land in Good Agricultural and Environmental Condition (GAEC) to obtain their payments. The CAP Regulations set out a framework for GAEC standards within which each MS decides its own detailed rules. A summary of GAEC defined by MS in 2005 is given in the presentation.

MS have to control a sample of dossiers to check the GAEC compliance. In 2005, the Commission proposed MS to test the use of RS as a support to select samples to be controlled and/or as objective GAEC control tool. Some examples of candidate GAEC controllable with RS are given and partly discussed in the presentation.

In 2005, most of MS have planed to use RS for the control of GAEC. Also, satellite images have been acquired specifically for that purpose.

The conclusions consist in questions and discussions open to the audience in order to evaluate lessons and learning of the use of Remote Sensing for GAEC control. These exchanges will provide inputs for improvements and recommendations for next control campaigns.

Keywords: GAEC, Control, Remote Sensing, VHR, HR, legislation

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Definition of GAEC by Member States

Controlling GAEC with Remote Sensing

Philippe LOUDJANI
Olivier LEO
DG JRC IPSC AGRIFISH Unit

EUROPEAN COMMISSION Joint Research Centre

Institute for the Protection and Security of the Citizen

Joint Research Centre

Good Agricultural and Environmental Condition

- ✓ Issued from the CAP Reform (CR (EC) No 1782/2003)
- ✓ Compulsory for all farmers receiving direct payments
- ✓ Requirements for Good Agricultural and Environmental Condition (GAEC) are to be defined by Member States, on the basis of the common framework set out in Annex IV of CR (EC) No 1782/2003
- ✓ 2004: 8 new MS implemented GAEC under SAPS
- ✓ 2005: GAEC implementation obligatory for EU 25 MS

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Annex IV (+ Article 5 of 1782/2003)

✓ **4 issues and 11 standards**

SOIL EROSION - protect soil with appropriate measures

1 Minimum soil cover
2 Minimum land management reflecting site specific conditions
3 Retain terraces

SOIL ORGANIC MATTER – Maintain soil organic matter through appropriate practices

4 Standard for crop rotation where applicable
5 Arable stubble management

SOIL STRUCTURE - Maintain soil structure through appropriate machinery use

6 Appropriate machinery use

MINIMUM LEVEL OF MAINTENANCE AND AVOIDING DETERIORATION OF HABITATS

7 Minimum livestock stocking rates and/or appropriate regimes
8 Protect permanent pastures
9 Retention of landscape features, including, where appropriate, the prohibition of the grubbing up of olive trees
10 Avoiding the encroachment of unwanted vegetation on agricultural land
11 Maintenance of olive groves in good vegetative condition

Measures

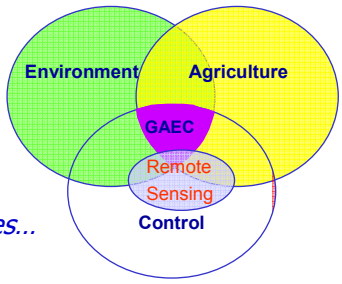
Areas Themes Categories

✓ **+ Maintenance of ratio of Permanent Grasslands**
more a 5th issue at regional level, independent of standard 8

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

General Recommendation to define GAEC



✓ GAEC have to be
- ***Relevant for Environment***
- ***Acceptable for Farmers***
- ***Controllable*** *by the control agencies…*

✓ 3 points of view to combine
- It's not an easy target : requires a lot of pragmatism

✓ MS may or may not use Remote Sensing for GAEC control

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Overview of GAEC defined by Member States

- ✓ 2005: GAEC implemented in EU 25
- ✓ Difficult overview and synthesis
  - ➢ Els De Roeck, May 2005
  - ➢ Information from MS through JRC network of contacts

Soil organic matter & soil structure

standard	GAECS	AT	BE-FL	BE-W	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	SE	SI	SK	UK-ENG	UK-NI	UK-SC	UK-W	TOTAL
5	No burning stubble/ stubble management		1	1	1	1	1			1	1	1	2		1	1						1	1		1		3		1		20
4	Conditions for clearing up fields	1								1																	1				3
4	Soil Struc+ Organic matter		1		1													1	2												5
4	Crop rotation						1			1		1	1		1			1												1		6
?	Correction structure/ irrigated soils			1																1				1						1	4
?	Soil Struc+ ditches										1					1													1		3
Gen	Soil management requirements		1																									1			2
6	restrictions machinery use	1								1			1		1												1		1		6

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Most recurrent standards

ISSUE	STANDARD	TOTAL
4 - MLM	*Minimum (meadows) mowing / grazing*	22
2 - SOM	*No burning stubble/ stubble management*	20
4 - MLM	*Min maintenance /encroachment scrub - trees*	19
1 - SE	*Protect soil / erosion*	18
4 - MLM	*Over-grazing nor under grazing*	15
4 - MLM	*Avoid Weed infestation*	14
1 - SE	*(Winter) soil coverage*	11
4 - MLM	*Maintenance of permanent pasture*	11
4 - MLM	*Non-destruction of Habitats*	10
1 - SE	*Maintenance (Conservation) of Terraces*	8

- ✓ number of standards per country: 3 to 24

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Possible use of Remote Sensing for GAEC
Present guidance of JRC

- ✓ RS is only a tool in support to OTSC
- ✓ Not fully replaces on-the-field inspection
- ✓ To be tested in 2005:
  - ➢ Use as support to select samples to be controlled
    - As a support to risk analysis (1% samples)

    (Filter possibly fraudulent parcels)
  - ➢ As an objective control tool
    - Focus on GAEC

    (DG AGRI request, link to parcel: agriculture practice, land use, maintenance...)
    - But depends on GAEC defined by MS

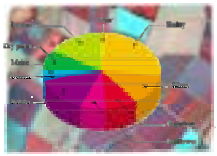
EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

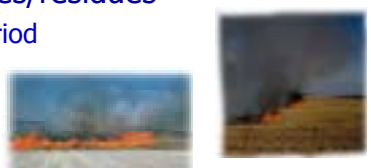
Candidate GAEC for CWRS ?

- ✓ Minimum soil cover
  - ➢ Often to be checked in Winter period
  - ➢ Maintenance of Set aside or Non cultivated land
    - Black fallows (bare soil forbidden)

- ✓ Crop rotation – crop pattern
  - ➢ Rotation of crop (year n & n-1 images)
  - ➢ or % crop and land cover / whole farm (year n)



- ✓ No burning of Stubbles/residues
  - ➢ Short and specific period

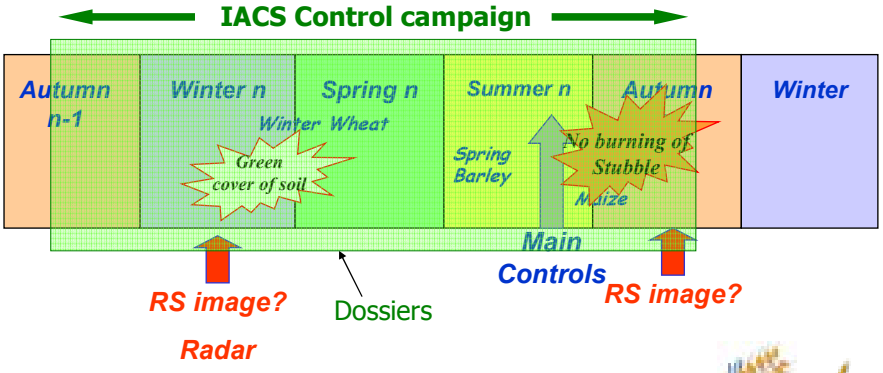


EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Possible use of R-Sensing to Control GAEC ?

- ✓ Out-of-season requirements
  - ➢ Ex: Winter cover/ soil; No burning of stubble, etc…
    - Reduce on-the-field visits
    - Define strategy for winter check



EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Candidate GAEC for CWRS ?

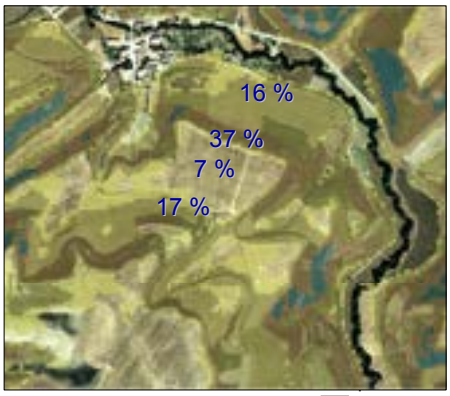
- ✓ Minimum level of maintenance
  - ➢ Avoiding encroachment of unwanted vegetation
  - ➢ Depends on detailed requirements
    - Cut every year, Cut every 4-5 years all ligneous
    - Avoid weed seed production, avoid specific Species
  - ➢ A concern already present in IACS (for Set aside)

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Candidate GAEC for CWRS ?

✓ Soil erosion – terrace maintenance



0 40 80 160 240 320 Meters

Orthophoto (Macerata, Italy)

0 40 80 160 240 320 Meters

0 - 10 %
10 - 15 %
15 - 30 %
30 - 50 %
50 - 100%

Slope image

Slope values derived from DTM 10x10 m

(Silvia CASTELLI, 2005)

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

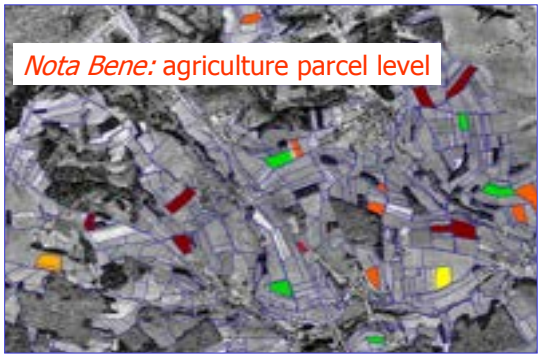
Joint Research Centre

Candidate GAEC for CWRS ?

✓ Double filtering for high erosion risk parcels selection

Courtesy of B. Tychon *et al.*
SAGRIWATEL project
Belgium Wallonia

- Intermediary Index = f (slope, parcel length, slope versus length direction)
  - Input data : IACS, DTM
- Final index for the control of the ploughing direction
  - Input data : Aerial photography or VHR imagery



Erosion risk Level

- No risk based on final index
- Weak based on intermediary index
- Weak based on final index
- Middle based on intermediary index
- Middle based on final index
- High based on intermediary index
- High based on final index

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Candidate GAEC for CWRS ?

- ✓ Retention of landscape Features
  - ➢ CwRS may detect removal by farmer of Features
    - (Edges, terraces, etc)
  - ➢ Original situation to be maintained? 2 possibilities
    - An independent exhaustive inventory in the LPIS (from ortho imagery)

Pan sharpened Quickbird Image Site GLAU (DE) 2003

- **Woods**
- **Hedges**
- **Isolated trees**

- A compulsory declaration by Farmers in 2005, followed by a validation

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Proposal of the Commission for 2005 CwRS

- ✓ Test both approaches
  - ➢ RS as a support for selection of GAEC sample
  - ➢ RS for a partial control of some GAEC
- ✓ Provision of extra HR images for the control out of season requirements
- ✓ Results to be evaluated end of 2005
  - ➢ Workshop on GAEC (Ispra – October 2005)
  - ➢ Kraków conference
  - ➢ Modifications, decisions for 2006?

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Plan of Member States for 2005

- ✓ Cf. info provided at the kick-off 2005

Country	CY	EL	DE 5 land.	HU	IT	NL	UK	FR	LU	PT	DK	SK	CZ	IE	LT	DE 2 land.	BE WA	BE FL	DE 9 land.	EE	ES	LV	MT	PL	SE	SI	FI	AT
No of GAECs	6	4	4	3	7	2	11	5	3	6	6	2	2	7	5	4	4	8	4	4	4	4	5	8	4	4	?	
Field visit	0	0	0	0	0	0	0	1	1	2	3	1	1	4	3	3	3	7	4	4	4	4	5	8	4	4	?	
Field visit + RS	6	4	4	3	7	2	11	4	2	4	3	1	1	3	2	1	1	1	0	0	0	0	0	0	0	0	0	
% of RS	100%	100%	100%	100%	100%	100%	100%	80%	67%	67%	50%	50%	50%	43%	40%	25%	25%	13%	0%	0%	0%	0%	0%	0%	0%	0%		

- ➢ IE ➔ combined with GFP - RS = support for field visit
- ➢ FR ➔ One additional (Perm. Pasture checked on declarations)
- ➢ DE ➔ Use of RS depends on Länder

- ✓ 16 MS out of 25 intended to use RS
- ✓ To control 13 to 100% of GAEC defined
- ✓ 7 MS requested extra images

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Details of extra images ordered

COUNTRY	CONTRACTOR	SITE[S]	ACQUISITION DATE	IMAGE TYPE	DESCRIPTION
BELGIUM	CRIG	HERV	15/01/2005	SPOT 4	ploughing, bare soil detection
		FERN		radar	ploughing, bare soil detection
CYPRUS	APIK	LARN	27/02/2005	SPOT 4	unsure if GAEC purpose
		LARN	16/12/2004	LANDSAT5	unsure if GAEC purpose
		NICO	27/02/2005	SPOT 4	unsure if GAEC purpose
CZECH REPUBLIC	**Autumn**	ROUD	14/09/2005	LANDSAT5	GAEC no burning of residues
GERMANY	EFTAS	GRAM	01/02/2005	SPOT 4	erosion
	Winter	GUTE	07/02/2005	SPOT 2	erosion
		JABE	05/02/2005	SPOT 4	erosion
ITALY	AGRISIAN	AVEE	16/09/2005	SPOT 2	stubble burning, and other
		AVEW	03/09/2005	SPOT 5	stubble burning, and other
		BAR2	01/09/2005	SPOT 2	stubble burning, and other
		BAR1	01/09/2005	SPOT 2	stubble burning, and other
		CATA	02/09/2005	SPOT 5	stubble burning, and other
		ENNA	03/09/2005	SPOT 5	stubble burning, and other
PORTUGAL	GEOMETRAL	ALC5	05/03/2005	SPOT 4	AEMs and GAECs
	Spring	BRA5	15/03/2005	SPOT 5	AEMs and GAECs
		BRI5	07/03/2005	SPOT 2	AEMs and GAECs
		CAV5	17/03/2005	SPOT 4	AEMs and GAECs
		COR5	04/03/2005	SPOT 5	AEMs and GAECs
		FIG5	07/03/2005	SPOT 2	AEMs and GAECs
		MAR5	15/03/2005	SPOT 5	AEMs and GAECs
		MAT5	04/03/2005	SPOT 5	AEMs and GAECs
		NOS5	05/03/2005	SPOT5	AEMs and GAECs
		SAN5	04/03/2005	SPOT5	AEMs and GAECs
		SEB5	FAILED	FAILED	AEMs and GAECs
		VEN5	15/03/2005	SPOT 5	AEMs and GAECs
SPAIN	TRAGSATEC	ALMO	23/12/2004	SPOT5	differentiation between almonds/olives
SPAIN (ANDALUSIA)	DAP	JERE	19/09/2005	SPOT5	cereal, stubbles

Total = 68 700€

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Presentations by MS in this session

- Implementation and control of GAEC in France
- VHR/HR data for GAEC control in Italy
- Potential contribution of RS to GAEC control in England
- Use of the GIS-LPIS for GAEC control in Czech Republic
- DeCOVER Multipurpose National Land Cover Database Germany

EUROPEAN COMMISSION Joint Research Centre — Institute for the Protection and Security of the Citizen

Joint Research Centre

Questions and discussions open to the audience

- ✓ Spatial resolution of imagery sufficient?
  - Landsat - SPOT2,4 – SPOT5
- ✓ Type of sensor relevant?
  - Optical, Radar
- ✓ Pertinent acquisition dates?
  - Autumn, winter, spring
- ✓ Decisions for next years
  - Continue, stop?
  - adjust GAEC, adjust method (winter cover…)?
    - VHR + systematic Rapid Field Visit
- ✓ What about use for risk analysis?
- ✓ What about Cost efficiency study (Control with and without RS)?
- ✓ Parcel definition (Extension when non compliant → soil erosion)


EUROPEAN COMMISSION
Joint Research Centre
Institute for the Protection and Security of the Citizen
Joint Research Centre
If it is GAEC,
imagery can spot it !!
Thank you for your attention!
11th Conference on Control With Remote Sensing of area-based subsidies – Kraków 23rd – 25th November 2005
19 / 19
MARS

Presentation 2 - Potential Contribution of Remote Sensing to GAEC Control in England

Mike Wooding, Bob Blakeman
RS Applications Consultants Ltd, UK

Abstract

In England the Cross Compliance requirements for keeping land in Good Agricultural and Environmental Condition include 17 specific GAECs concerning the management of soils, habitats and landscape features. GAECs have been defined by the Administration in consultation with relevant industry and interest groups to give wide ranging and important environmental benefits.

A pilot project has been undertaken to determine the potential contribution of remote sensing to GAEC control. This has focussed on two of the 2005 control zones (BRIG and KILN) which together contain a good range of the landscape features covered by the GAECs. Changes have been examined by comparing archival aerial photography from 1999/2000 with 2005 VHR satellite images. From the beginning it is clear that remote sensing is only capable of making a partial contribution to GAEC control, because some GAECs involve specific treatments with associated narrow timing requirements. Attention has concentrated on GAECs involving the maintenance of habitats and landscape features, rather than those concerning soil management and protection. A series of examples will be presented showing the type of landscape feature change able to be detected using VHR images. The detection of tree and hedgerow removal is relatively straightforward, although there is some potential for mistakenly identifying hedgerow changes after severe cutting back. The identification of deforestation and farming operations on Sites of Special Scientific Interest (SSSIs) or Protected Monuments is also shown to be possible. The maintenance of public rights of way is another requirement which may be able to be monitored using remote sensing because footpaths can be easily seen crossing agricultural fields. Detection of overgrazing, heather and grass burning, disturbance of uncultivated/semi natural land, and poor maintenance of eligible land not in agricultural production have also been investigated.

Potential Contribution of Remote Sensing to GAEC Control in England

Mike Wooding, Bob Blakeman
Remote Sensing Applications Consultants, UK

& Christopher Lee
Rural Payments Agency, Defra, UK

GAEC Specifications

17 Specific GAECs defined to give wide ranging environmental benefits

Soil Management and Protection	GAEC 1	General requirements
	GAEC 2	Post-harvest management of land after combinable crops (from harvest to 1 march)
	GAEC 3	Waterlogged soil
	GAEC 4	Burning of crop residues
Maintenance of Habitats and Landscape Features	GAEC 5	Environmental Impact Assessment – uncultivated land and semi-natural areas & forestry
	GAEC 6	Sites of Special Scientific Interest (SSSI)
	GAEC 7	Scheduled monuments
	GAEC 8	Public rights of way
	GAEC 9	Overgrazing and unsuitable supplementary feeding
	GAEC 10	Heather and grass burning
	GAEC 11	Control of weeds
	GAEC 12	Eligible land which is not in agricultural production
	GAEC 13	Stone walls
	GAEC 14	Protection of hedgerows and water courses
	GAEC 15	Hedgerows
	GAEC 16	Felling of trees
	GAEC 17	Tree preservation orders

Soil Management and Protection

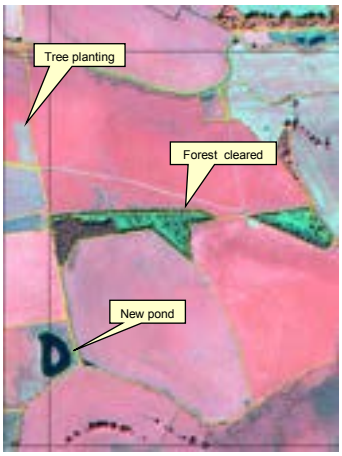
GAEC No.	Requirement	Potential for RS Check
1. General requirements.	Farmers must retain a copy of the Administration's Guidance for Soil Management booklet, draw up a risk-based soil management plan and implement it.	Office requirement to draw up plan. Contents of plan are farm specific. Possibly some potential to identify evidence of soil erosion, flooding related to soil compaction, etc.
2. Post harvest management of land after combinable crops.	After harvesting oilseeds, grain legumes or cereals by combine or mower, a farmer must, until 1 March in next year, ensure either stubble is left, a rough surface is left, or a crop cover is sown.	Need to be able to identify fine seed beds. Impractical to monitor contraventions.
3. Water logged soil	Mechanical field operations are prohibited on areas of waterlogged soil.	Impractical to identify soil moisture status except where surface water.
4. Burning of crop residues	Farmers must not burn cereal straw/stubble, residues of oilseed rape, peas or field beans harvested dry. Linseed residues may be burned under restrictions.	Some potential using images in the period directly after harvest. Difficult to catch contraventions because ploughing normally takes place very soon after burning.

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No.5 - Environmental Impact Assessment

No construction or farming operations affecting the landscape, including intensification of semi-natural areas, scrub clearance, drainage, forestry

© UK Perspectives



© Space Imaging, Ikonos 2005

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No.6 & 7 Sites of Special Scientific Interest (SSSI)/Ancient Monuments and Archaeological Areas No Damage or disturbance

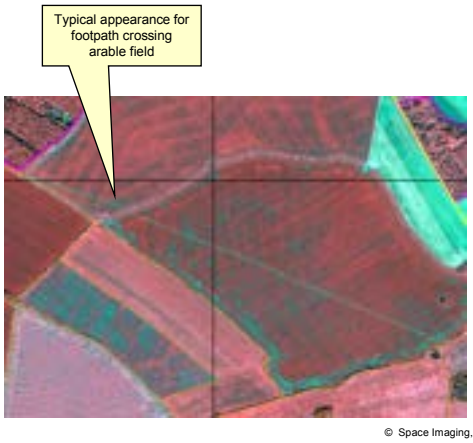
© UK Perspectives

© Space Imaging, Ikonos 2005

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No. 8 Public Rights of Way

Maintain access to footpaths/bridleways



© Space Imaging, Ikonos 2005

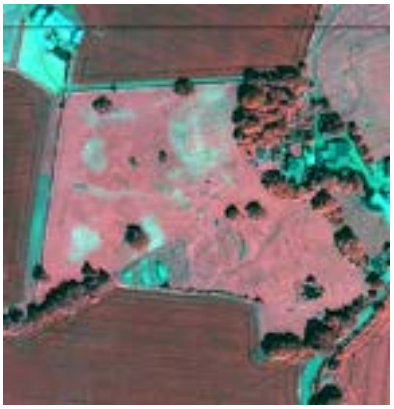
Mapped footpath

No sign of footpath crossing field

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

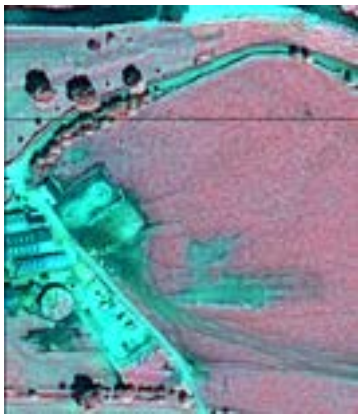
GAEC No. 9 Overgrazing

Avoid damage to natural or semi-natural vegetation used for grazing



© Space Imaging, Ikonos 2005

Permanent pasture showing signs of overgrazing



© Space Imaging, Ikonos 2005

Signs of damage due to intensive machinery movement, and/or livestock supplementary feeding

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No. 10 Heather and grass burning

No burning outside permitted dates and must comply with code of practice

© UK Perspectives

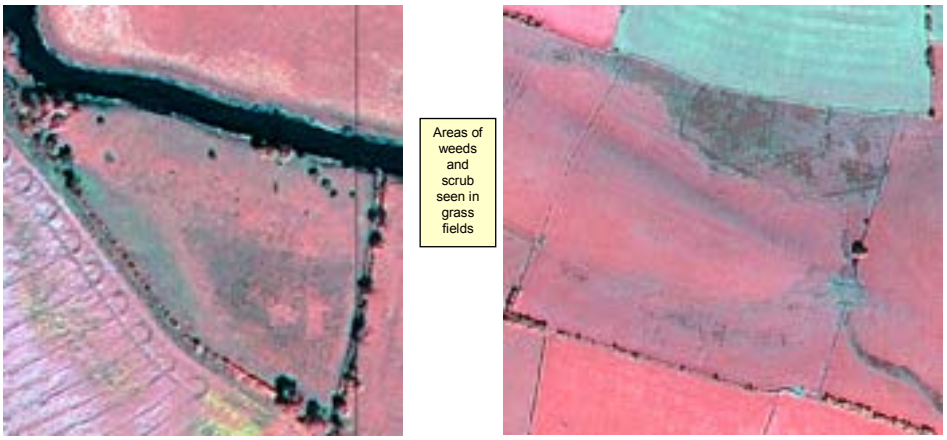
© Space Imaging, Ikonos 2005

New heather burns clearly visible

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No. 11/12 Control of weeds and maintenance of eligible land not in agricultural production

Prevent spread of weeds and scrub encroachment



© Space Imaging, Ikonos 2005

© Space Imaging, Ikonos 2005

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No. 13 Stone Walls

No removal of stone walls

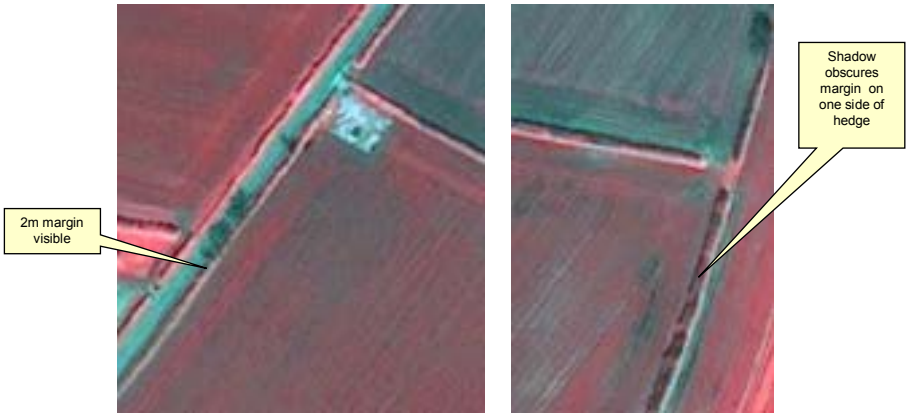
© UK Perspectives

© Space Imaging, Ikonos 2005

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

GAEC No. 14 Protection of Hedgerows and Watercourses

No cultivation within 2m of the centre of a hedgerow or watercourse



GAEC No. 15 Hedgerows

No removal of hedgerows or cutting between 1 March and 31 July

GAEC No. 16 & 17 Felling of Trees and Preservation Orders

No felling of trees, or damage to protected trees

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

Summary of Capability of Remote Sensing for the Management of Habitats and Landscape Features

- Excellent for identifying changes in physical landscape features such as hedgerows, trees, wall, buildings (by comparing different year images)
- Some potential to identify non compliance in relation to the condition of habitats and landscape e.g. the maintenance of public rights of way, avoiding overgrazing, and maintaining the condition of eligible land and protected features
- Unrealistic for the identification of short term operations related to husbandry, such as spraying and fertiliser application, and the date of hedge cutting

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

Possible Role of Remote Sensing in GAEC Checks

- Remote sensing has a unique role to play in identifying changes by comparing features on 2 dates
- Able to identify a significant proportion of non-compliance data relating to GAEC 5 to 16 conditions to target and assist field inspection effort
- Remote sensing could be used as a first stage check on a sample of farms selected by the administration within the control zone
- Multi-year images needed (archival aerial photography or VHR)
- Interpretation and reporting process will require specific software development

11th Annual Conference on Control with Remote Sensing, Krakow 23-25 November 2005

Presentation 3 - VHR/HR data for GAEC controls: the Italian experience in 2005 Campaign

Maurizio Piomponi, Paolo Tosi, Livio Rossi
AGEA, AGRISIAN S.P.A., IT

Abstract

One of the most important tests for a sustainable and correct control activity for GAEC (Good Agricultural Environmental Conditions) is to answer the following questions:
- How is correct detection possible? (What is the best tool?)
- When can the control task be judged sufficient? (What frequency?)
- Where must the control samples be correctly allocated? (Risk analysis and sampling)

The new EU policy addressed to GAEC controls needs integrated tools, often available throughout the whole agronomic year.
In 2005, the Italian Administration started the GAEC control phase, considering more than 9,000 farms and 300,000 parcels (1.27% of the national declarations). For this job, particular emphasis was given to the contribution from VHR/HR multi-spectral satellite data, available for 9 sites scattered over the entire territory for more than 13,000 km^2.
VHR data, with its radiometric and geometric resolution, enables larger scale detection, for a comprehensive and multidisciplinary analysis of the environmental parameters. The presentation will show several examples of this capability for each environmental parameter, while underlining the operational limitations.

Keywords: ….. VHR, HR, GAEC, soil erosion, soil structure, organic matter, level of maintenance

VHR/HR data for GAEC controls: the Italian experience in 2005 campaign

Italy

Maurizio Piomponi- AGEA

Livio Rossi, Paolo Tosi – Agrisian

Kraków, 25 November 2005

Summary

- **Cross-compliance controls and sample extraction in Italy**
- **Risk analysis and GAEC definition**
- **Satellite VHR/HR use in 2005: availability and detection capability**
- **Results and examples of issues**
- **Conclusions and recommendations**

Cross-compliance

Population and sample

- **In Italy applications for the Single Payment System in 2005, were 714,000.**
- **The number of on the spot checks for Cross Compliance was first fixed at 1% of the Single Payment System demands, including the total farm land use (olive groves, tobacco, etc.);**
- **The 2005 sample for check campaign was 9,021 farms for the whole national territory, equivalent to 1.27% of the total.**

GAEC check

- **9,021 farms selected**
- **308,000 land register parcels**
- **402,000 hectares**
- **4 issues; 7 standards to be checked**
- **200 on-the-spot inspectors and satellite interpreters**
- **2 months to perform the on-the-spot checks**

GAEC definition in Italy

ISSUES	STANDARDS
1. ***Soil erosion***: *protect soil through appropriate measures*	**1.1 Temporary channelling of surface water on sloping terrain**
2. ***Soil organic matter***: *maintain soil organic matter levels through appropriate practices*	**2.1 Ban on burning of stubbles and vegetable residues (using HR data in September)**
3. ***Soil structure***: *maintain soil structure through appropriate practices*	**3.1 Defence of ground structure through maintenance of surface water drainage**
4. ***Minimum level of maintenance***: *ensure a minimum level of maintenance and avoid deterioration of habitats*	**4.1 Protection of permanent pasture** **4.2 Management of set-aside areas** **4.3 Maintenance of olive groves** **4.4 Maintenance of distinguishing landscape and habitat features**

AGEA/Agrisian 5

GAEC definition in Italy

ISSUES	STANDARDS	REQUIREMENTS
1. Soil erosion: **protect soil through appropriate measures**	1.1 Temporary channelling of surface water on sloping terrain	Temporary superficial channelling
		Realization of green bands (in case of higher slopes)
2. Soil organic matter: **maintain soil organic matter levels through appropriate practices**	2.1 Ban on burning of stubble and vegetable residues	Ban on burning of stubble and vegetable residues
3. Soil structure: **maintain soil structure through appropriate practices**	3.1 Defence of ground structure through maintenance of surface water drainage	Maintenance of the water drainage system Realization of ditches for water surface channelling
4. Minimum level of maintenance: **ensure a minimum level of maintenance and avoid deterioration of habitats**	4.1 Protection of permanent pasture	Correct management of the permanent pasture surfaces Ban on converting permanent pastures into arable land
	4.2 Management of set-aside areas	Ploughing and mowing restriction time (not after 15 March, not before 15 July) Maintenance of the natural or sown cover (at least one mowing per year)
	4.3 Maintenance of olive groves	Good maintenance of the trees (at least one pruning every 5 years)
	4.4 Maintenance of distinguishing landscape and habitat features	Good maintenance of agricultural terraces

Non-compliance weighting system

Cross-compliance parameters used for GAEC

- **Extent:** always linked to the definition of non-compliance areas. The Extent evaluation is linked with the % of non-compliance area in respect to the total surface declared
- **Severity:** linked to the identification of quality parameters to be defined during the on-the-spot check
- **Permanence:** medium level in general. It can assume a high level for particularly high % of infraction (extent)

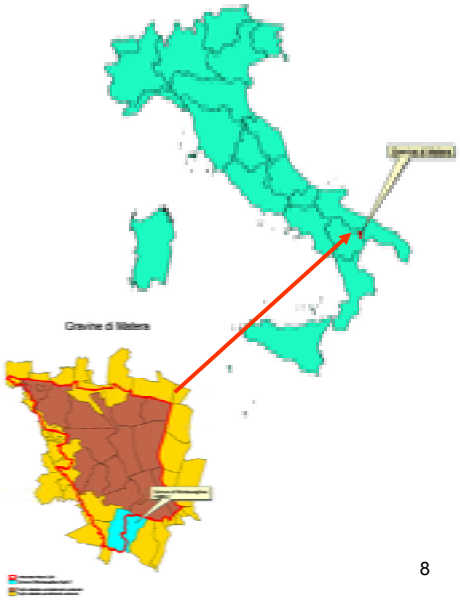
AGEA/Agrisian 7

Integration of Natura 2000 data into the LPIS

Integration of N2K data into the LPIS evidenced:

- difference of scale between land register (1:2,000/1:4,000) and N2K zoning (1:25,000/1:50,000);
- Short time available.

A quick way to define the N2K boundaries inside the LPIS, is to define if a single parcel is inside or outside the area.



AGEA 8

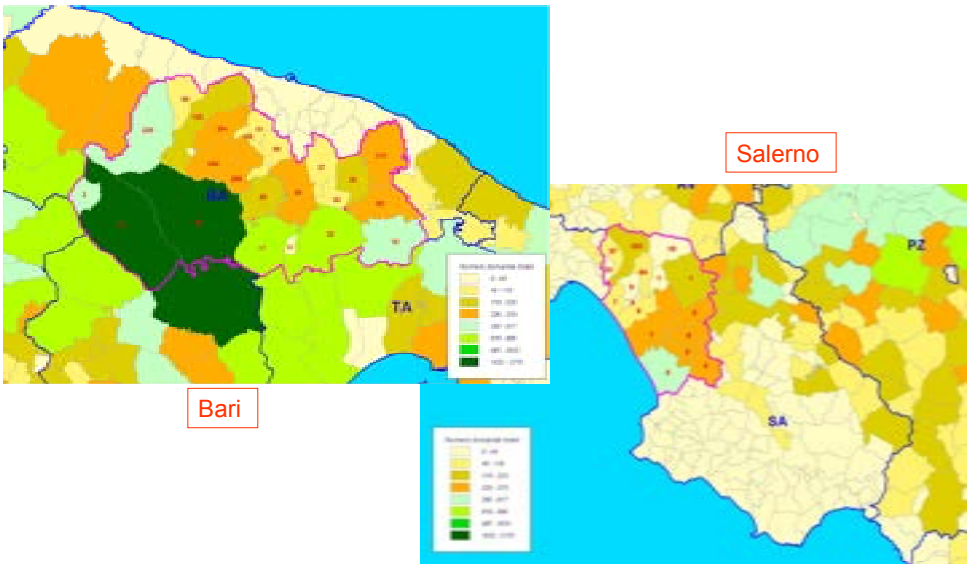
Use of VHR/HR data

CwRS 2005 with VHR:

sample site selection criteria

- **Updated "flight table 2004" through:**
  - control outputs 2002-2003
  - eligible area 2004 vs. the total in %;
- **Farm declarations geographic concentration through GIS AGEA (2004 data)**
- **Nut area claims distribution for 2004, at municipality level inside the provinces**
- **GAEC condition analysis through environmental parameters**
  - erosion, soil maintenance, pastures, olive groves, terraces): high, medium, low presence.

VHR planning phase: municipality groups, considering number of dossier and Nut claims (2004)

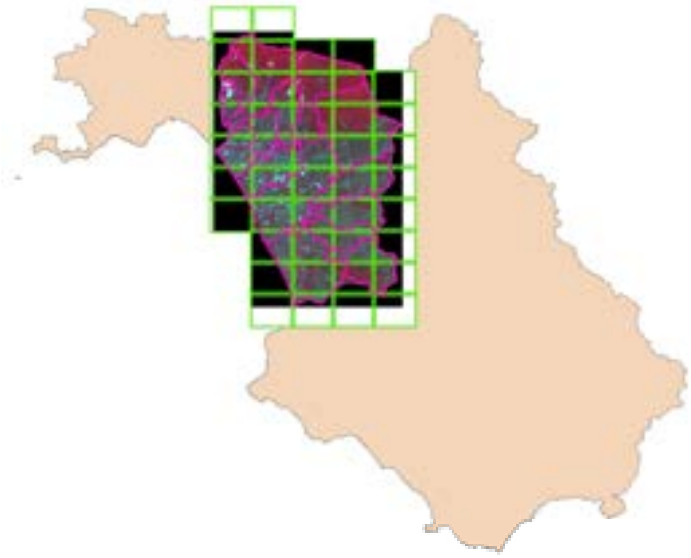


2005 campaign selected and acquired VHR images (100%)

municipal multiples of:

Cuneo
Lodi
Perugia
Viterbo
Avellino
Salerno
Bari
Catania
Enna

Salerno VHR 2005 : pansharpened Quickbird 0,6m, ortho-corrected, mosaicked into the Italian map grid 1:10,000



13

Crop parcel eligibility and analysis

VHR interpretation main purposes were:

1. **Find relationship between the declared crop and the actual land use, through the multiwindow imagery**
2. **Measure the different crop areas inside the observed parcels**
3. **Extract useful elements aimed at the verification of cross-compliance (4 issues and 7 agri-environmental standards)**

AGEA/Agrisian 14

Type of Check and Tools Used

STANDARDS	TOOLS (field visits for negative situations are always foreseen)
1.1 **Temporary channelling of surface water on sloping terrain**	**Detection of landslides and soil erosion = VHR**
2.1 **Ban on burning of stubbles and vegetable residues**	**Detection of vegetable residues and burned stubble = VHR+ HR (in September)**
3.1 **Defence of ground structure through maintenance of surface water drainage**	**detection of water stagnation damages and ditches = VHR**

Type of Check and Tools Used

STANDARDS	TOOLS (field visits for negative situations are always foreseen)
4.1 **Protection of permanent pasture**	**Detection and monitoring of meadows/pastures moving from their 5 years permanence = VHR+ HR**
4.2 **Management of set-aside areas**	**Detection and monitoring of ploughing restriction time for Set Aside = VHR + HR**
4.3 **Maintenance of olive groves**	**Detection and monitoring of olive groves maintaining (minimum pruning) = VHR**
4.4 **Maintenance of distinguishing landscape and habitat features**	**Detection and monitoring of agronomic landscape maintaining (terraces) = VHR**

Quickbird/Ikonos (VHR) allow:

- **Morphologic and paleo-morphologic analysis, landslides and local subsidence detection, even without stereoscopic view, detecting:**
  - humidity and capillarity differentiation,
  - water stagnation,
  - soil conditions and grassland movements (depletion/accumulation)

Because…..

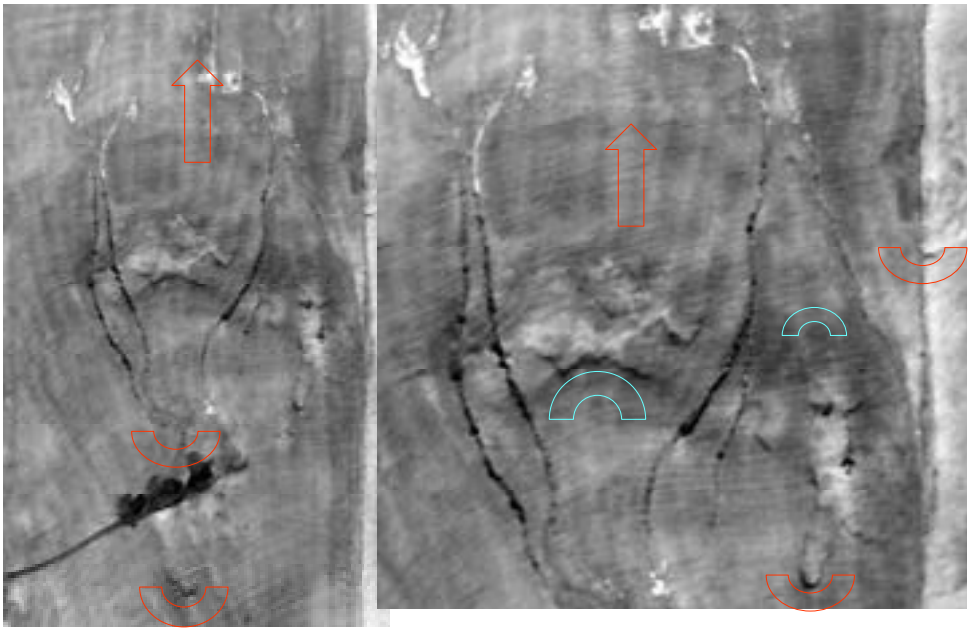
Quickbird/Ikonos (VHR)

…because of the original digital data,

- **11 bit radiometry (2048 levels of grey),**
- **panchromatic extension up to 1 micron,**
- **near IR**

that improves information content, but … only in the countryside!!

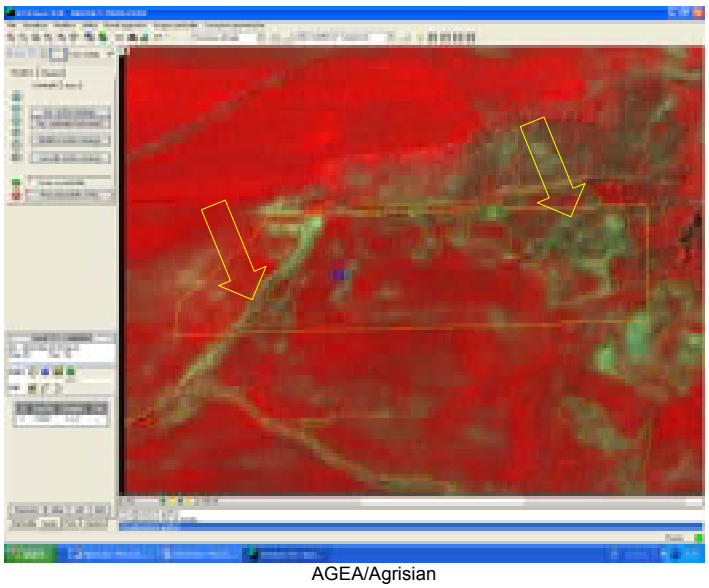
Sicily: Enna/Catania; landslide detection without stereoscopic view
QB pan: niche, depletion, accumulation definition



Controls 2005
VHR examples

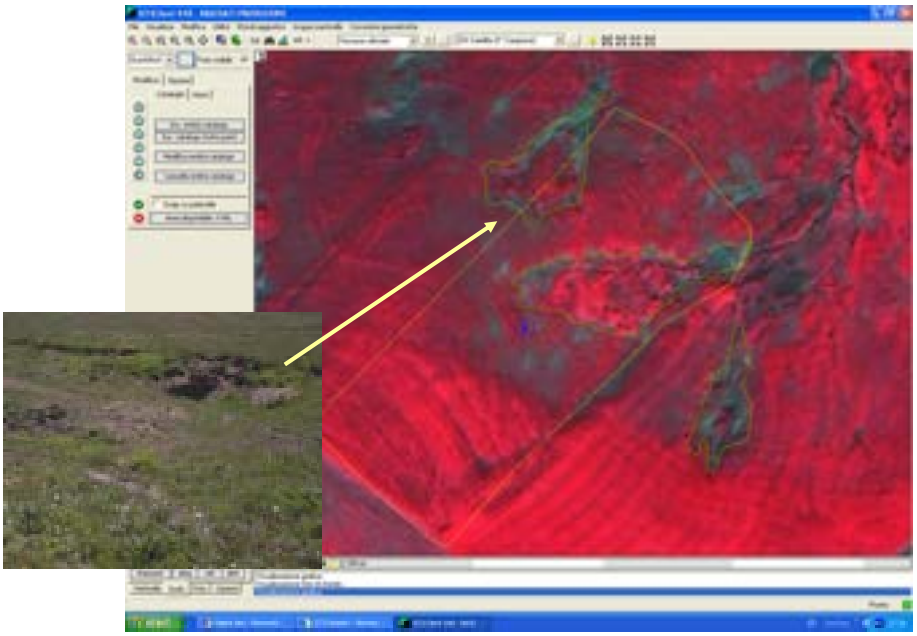
Standard 1.1

Standard 1.1: Bari – Gravina di Puglia – map n° 45 – parcel n° 54
claim for durum wheat: accepted as durum wheat, reduced for landslides and rill erosion



AGEA/Agrisian 21

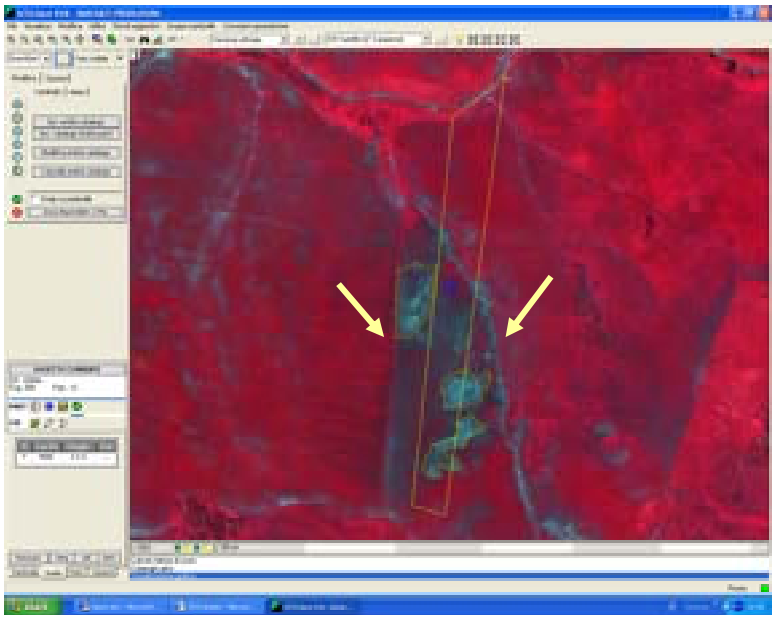
Standard 1.1: Enna – Enna – map n° 109 – parcel n° 9 Declared annual grass (vetch): accepted as vetch, reduced for diffused landslides



Standard 1.1: GAEC, Enna 2005: landslide occurred after sowing:
wheat field, several parcels, absence of protection structures

AGEA/Agrisian 23

Standard 1.1: Enna – Enna – map n° 209 – parcel n°12 claim for durum wheat:
accepted as durum wheat, reduced for diffused erosion (bedrock skeleton in evidence)

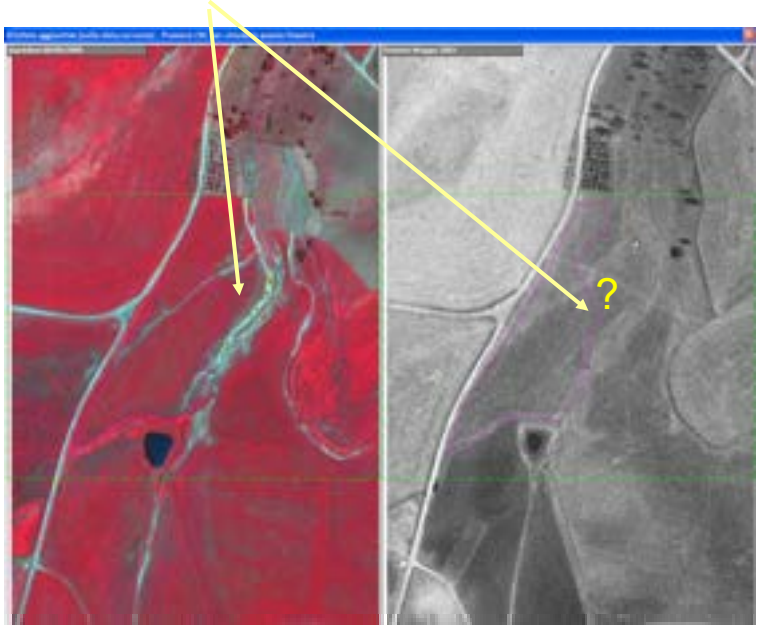


24

Standard 1.1: GAEC, Catania-Sicily 2005:
linear erosion on wheat, absence of protection canals and ditches

Standard 1.1: GAEC, Enna 2005: gully erosion, clear damaged area

Standard 1.1: Enna – Aidone – map 54 – parcel 47: declared set aside (sown but not harvested): verified mixed annual grassland, gully erosion > 30 cm
comparison between 2005 imagery with ortho-photo 2003 enhancing the increased erosion

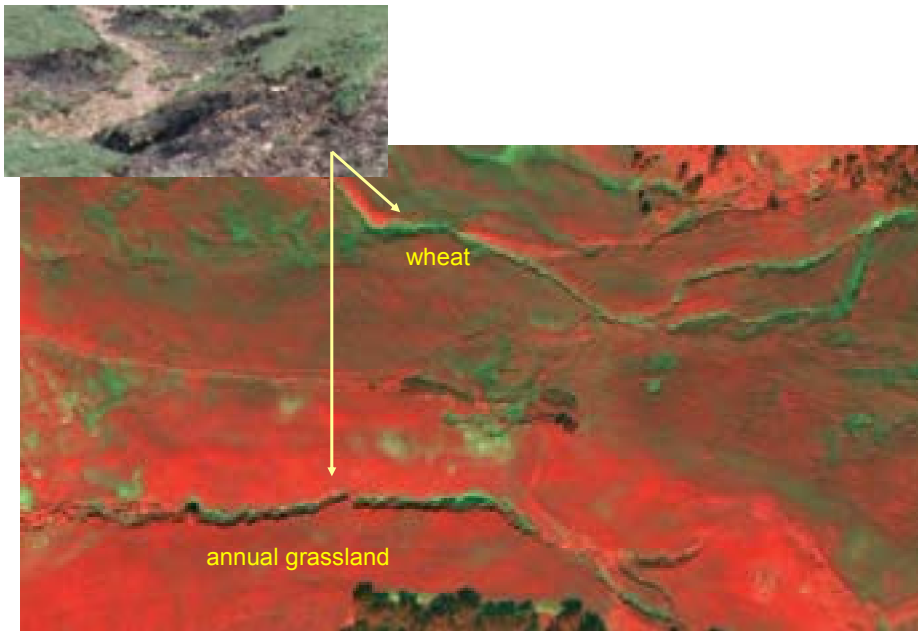


27

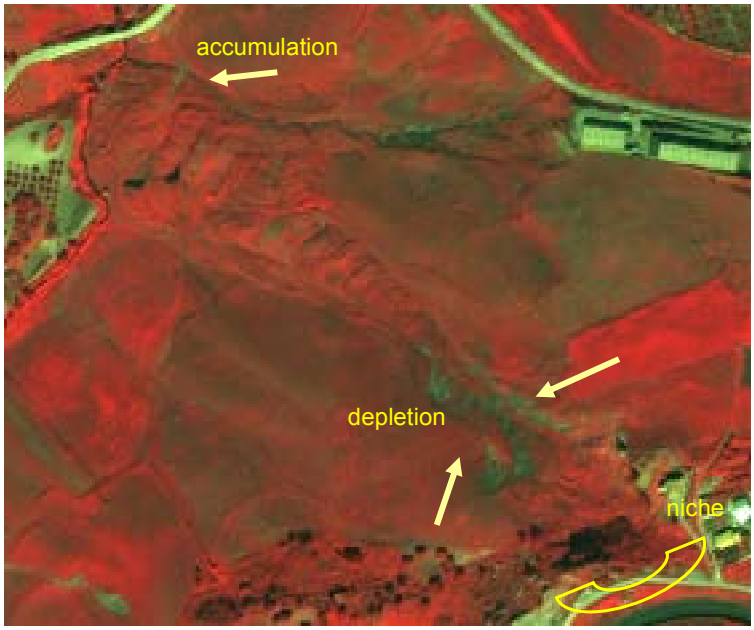
Standard 1.1: Enna – Aidone – map n° 95 – parcel n° 35
claim for durum wheat: accepted as durum wheat, pasture and not ordinary wheat:
landslides and rill erosion - comparison with orthophoto 2003, with evidence of the increasing phenomena

28

Standard 1.1: Wheat and annual grassland:
rill erosion for both crops and beginning scattered landslides...

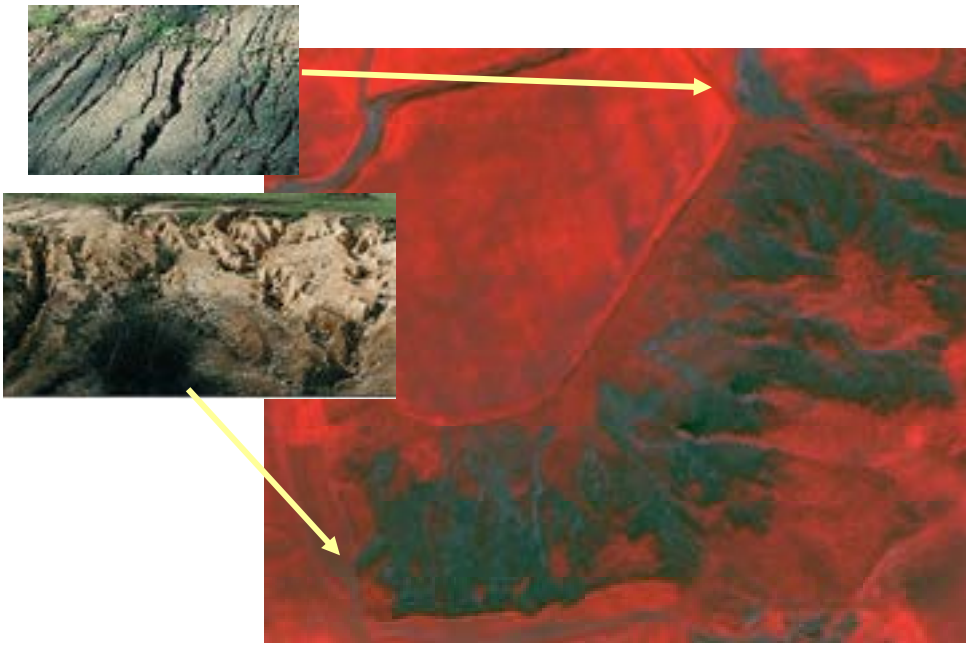


Standard 1.1: Re-activated landslide in intensive agricultural area



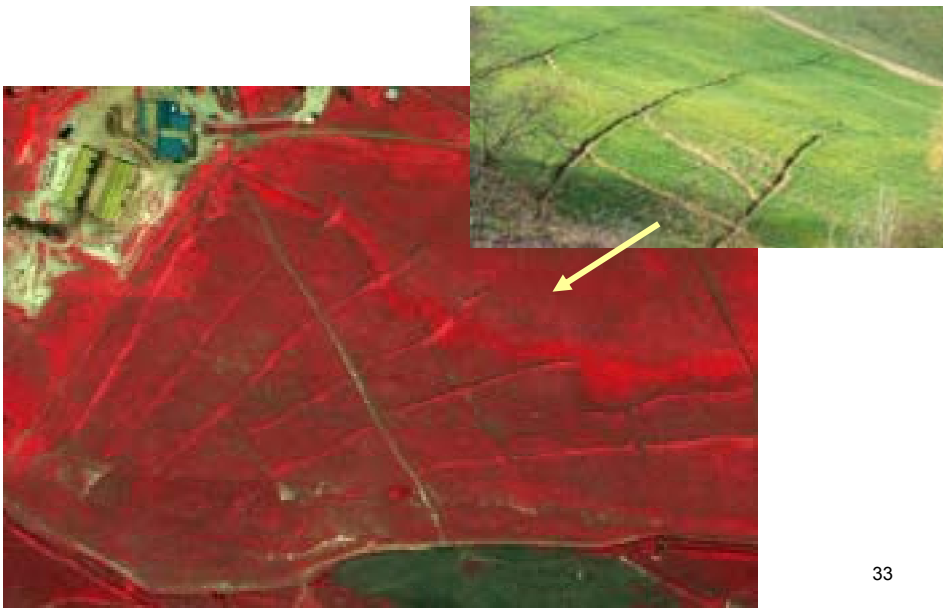
30

Standard 1.1: Growing calancoes and linear erosion detection and monitoring



Standard 1.1: Diffused landslides and landslips in intensive agricultural area: evident crop damage

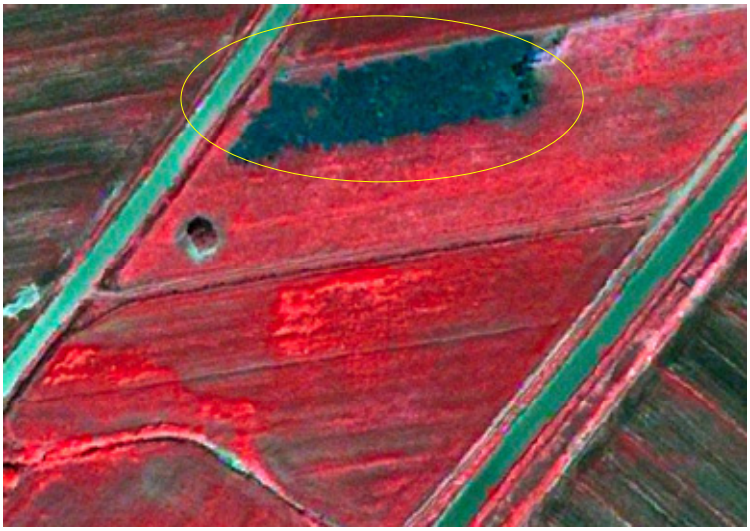
Standard 1.1: Corrected temporary channelling for protecting...farm!?!



33

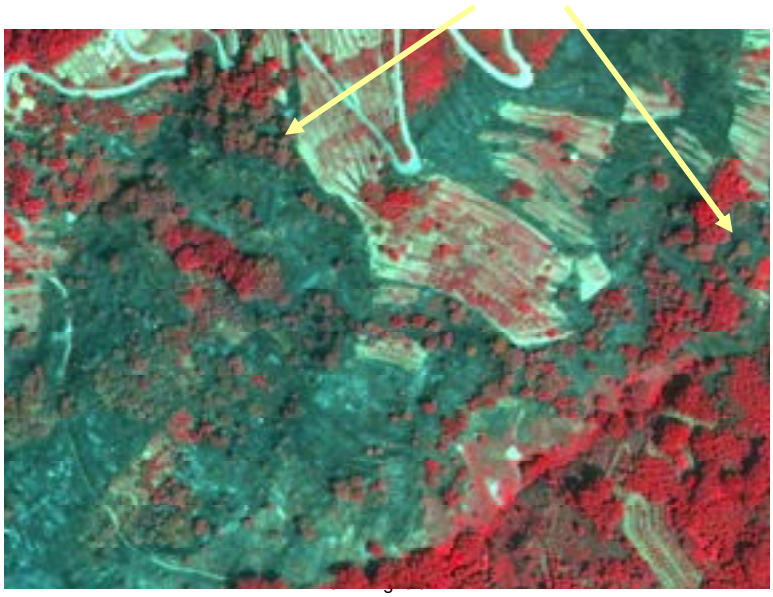
Standard 2:1
VHR/HR examples

Standard 2.1: VHR satellite data: clear and well defined burnt zone inside a crop parcel



AGEA/Agrisian 35

Standard 2.1: Burnt damage differentiation (up to crown/only grass) by VHR



36

Standard 2.1: Loss of organic matter
burnt stubble/vegetation residual detection by HR (1)

Agrisian, in agreement with JRC, performed a test for late summer HR analysis through the following steps:

- **10 HR data (Spot 2 and 5) of September 2005, provided by JRC**
- **6 southern areas of Italy covered (Viterbo, Salerno, Avellino, Bari, Catania, Enna)**
- **Processing, ortho-rectification and ingestion of Spot imagery into SITIsw (used for eligibility controls)**
- **Multi-window analysis and interpretation of burnt fields; overlap with the 2005 sample**
- **Burnt parcel classification, considering crop/land use types**

HR data received for Standard 2.1 analysis

PROVINCE	SCENE	ACQ. DATE	SENSOR
BARI1	075-267/6	01/09/05	SPOT 2
BARI2	076-267/7	01/09/05	SPOT 2
CATANIA	073-275/1	02/09/05	SPOT 5
AVELLINO (east)	072-267/7	03/09/05	SPOT 5
AVELLINO (west)	072-267	16/09/05	SPOT 5
VITERBO	064-264/6	01/09/05	SPOT 5
SALERNO	072-268/3	02/09/05	SPOT 5
ENNA	073-274/8	03/09/05	SPOT 5

Standard 2.1: Loss of organic matter
burnt stubble/vegetation residual detection by HR (2)

- **In the provinces Viterbo, Avellino, Salerno burning activity was scarce and consequently few parcels found;**
- **Bari area presented several parcels with the phenomena. Interesting comparison between summer 2004-2005, due to bad 2005 meteo-conditions and/or the awareness of the possible ban;**
- **Enna and Catania presented the worst situation (a comparison with 2004 was also done): in those areas the study showed the diffusion and the large extent of the phenomena and the reliability of the method**

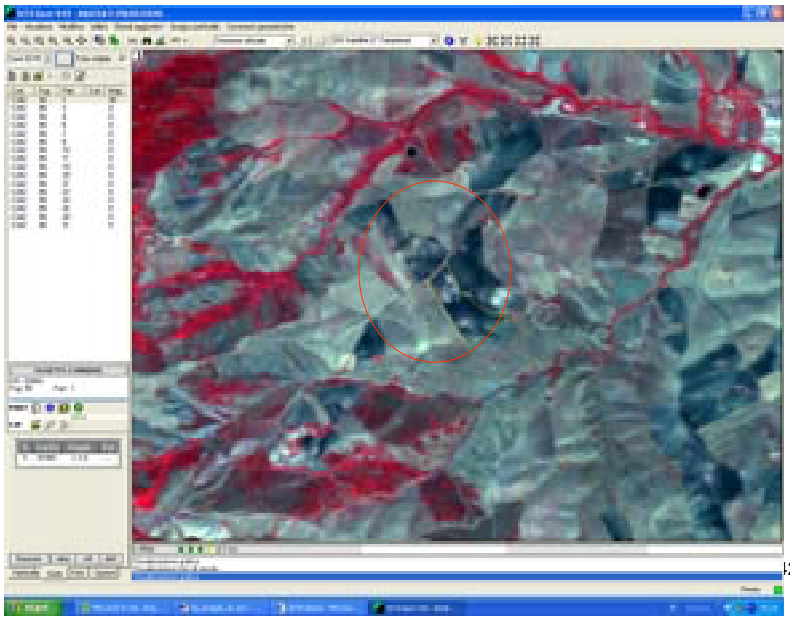
Standard 2.1: Loss of organic matter
burnt stubble/vegetation residual detection by HR (3)

PROVINCE	MUNICIPALITY	interpreted maps	analyzed surface (ha)	maps with burnt fields detected	burnt map surface detected (ha)	average burnt surface (ha)	real burnt surface (ha)	maps without scars	clouds presence
BARI	ALATAMURA	265	42.640	12	1.085	40%	**434**	227	26
CATANIA	RAMACCA	91	23.304	25	7.117	40%	**2.847**	66	0
AVELLINO (EAST)	ARIANO IRPINO	124	18.552	0	0	0	**0**	124	0
AVELLINO (WEST	AVELLINO	3	311	0	0	0	**0**	3	0
AVELLINO (WEST	AVELLA	7	1.301	0	0	0	**0**	6	1
VITERBO	VITERBO	247	36.274	10	1.809	20%	**362**	235	2

Catania province
first phase analysis: overlapping of cadastral maps on the Spot imagery

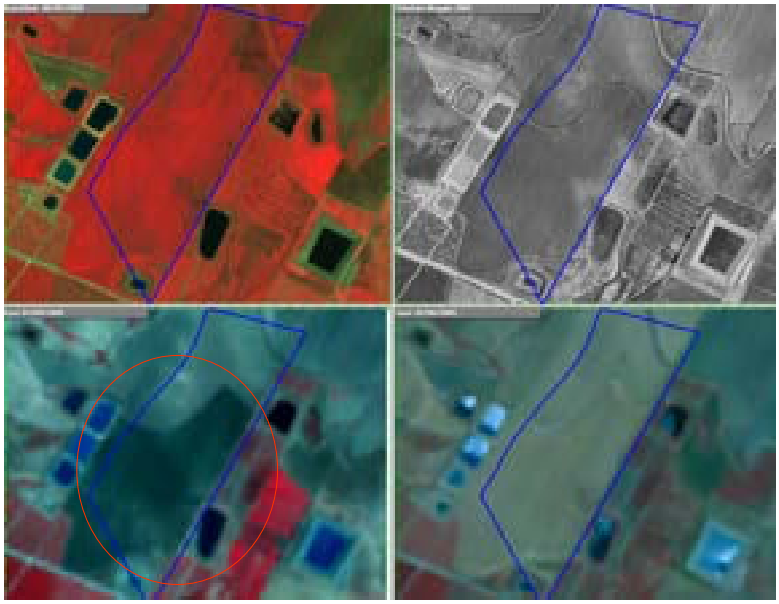
AGEA/Agrisian 41

Standard 2.1: Enna province – Enna – map n° 90 – parcel n°1
claim for durum wheat: accepted as durum wheat – burned like the adjacent fields



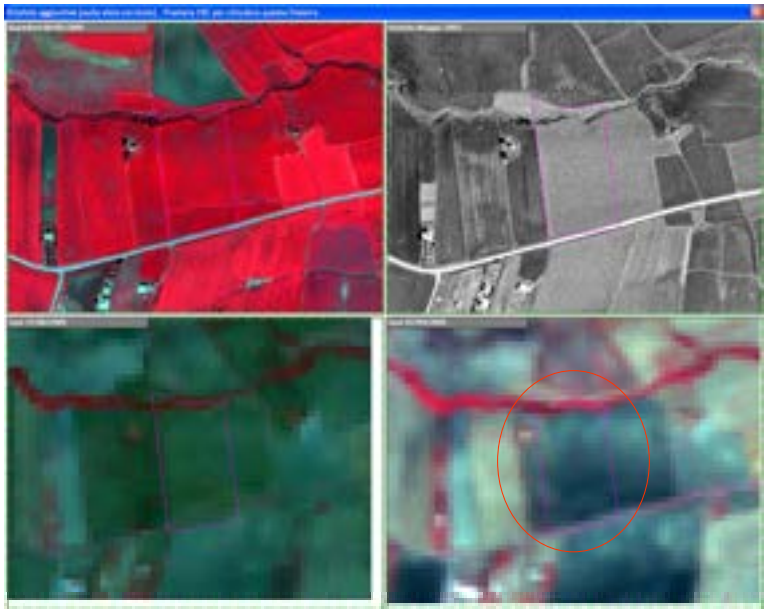
42

Standard 2.1: Catania province
claim for durum wheat: accepted as durum wheat – only a parcel portion burned



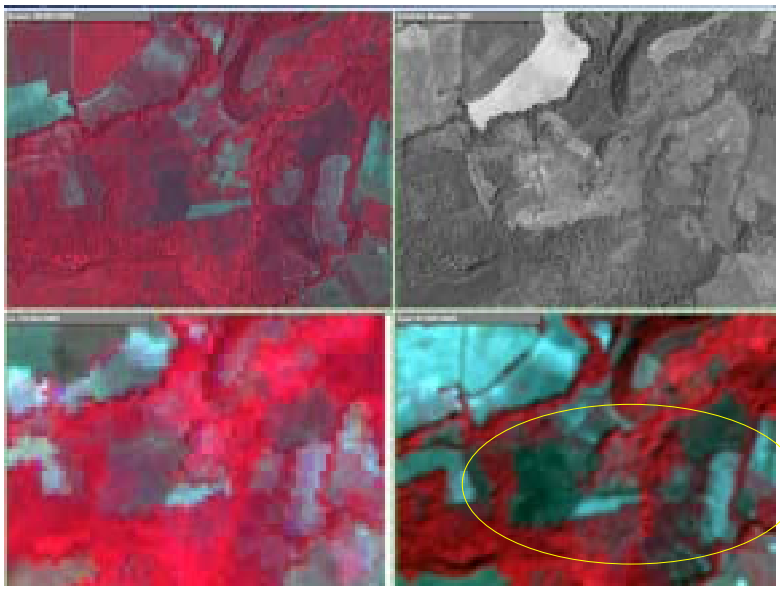
43

Standard 2.1: Enna province – Enna – map n° 52 – parcel n° 5
claim for durum wheat; accepted as durum wheat: multiwindow analysis example



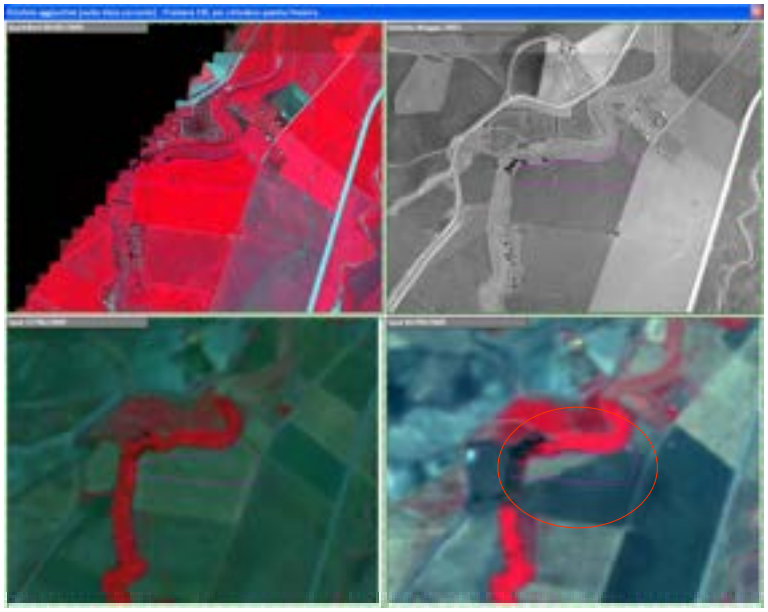
44

Standard 2.1: Viterbo province – Viterbo
dangerous burning near woodland areas; note improved Spot 5 resolution



45

Standard 2.1: Enna province – Enna – map n° 122 – parcel n° 78
claim for durum wheat; accepted as durum wheat: partial burning on the checked parcel;
note improved Spot 5 resolution



46

Standard 2.1: Loss of organic matter
burnt stubble/vegetation residual detection by HR (4)

The most representative area was ENNA municipality:

- **806 parcels were identified with fire scar boundaries**
- **255 of the total were in the sample (32%), separated as follows:**
- **45 parcels belonged to durum wheat class**
- **23 to different set-aside typologies**
- **178 to annual grassland (mixed, leguminous, vetch, broad bean)**
- **9 to meadow class**
- **8 parcels appeared doubtful (not confirmed by multitemporal analysis)**

Standard 2.1: Loss of organic matter
burnt stubble/vegetation residual detection by HR (5)

Province	Municipality	Spot	Cadastral maps with scar (sample)	vs. total of sample	Parcels with scar (sample)	vs. total of sample	Crop types	Reliability of fire scar evaluation
Enna	Enna	2;5	67	133	255	746	9	8 doubtful

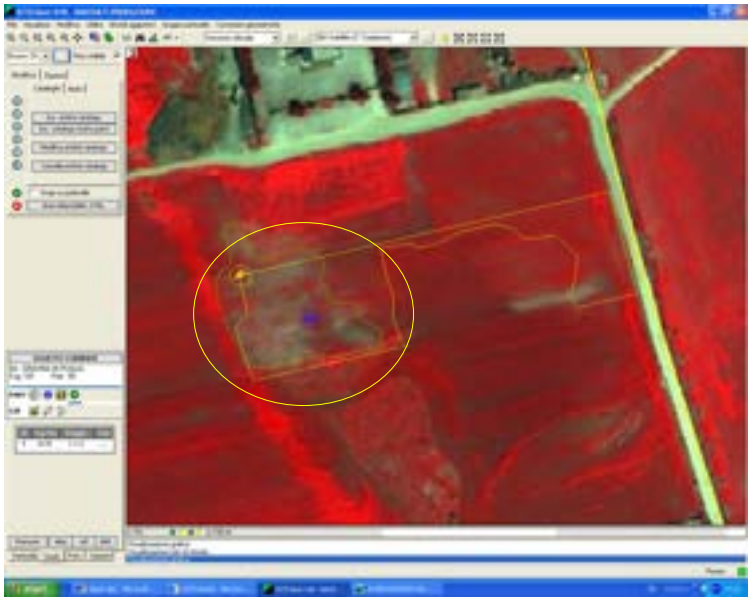
ENNA municipality: HR evaluation	
crop type (nomenclature) 2005 codes	N° of parcels detected with scar
2	45
97	1
98	1
100	21
104	109
105	27
109	9
206	2
208	40
total parcels	255

Reccomendations for a possible operational phase:

- Accurate definintion of the best periods for HR acquisition (for detecting fires and clearer spectral signs)
- Accurate management of the short time for ground truth verification
- Prefer satellites with 2 infrared bands
- Use previous year HR as reference layers for risk analysis aimed at future sample extraction

Standard 3:1
VHR examples

Standard 3.1: Bari – Gravina di Puglia – map n° 107 – parcel n° 59
claim for durum wheat; accepted as durum wheat
- no surface water drainage: absence of ditches



51

Sicily-Catania:possible dual standard detection: water stagnation and no ditches present; low sloping:
Standard 3.1: (incorrect drainage)
or **Standard 1.1:** rill erosion for no channelling?