
Images
SPOT IMAGE
Kozluduy
Bulgaria
2-m Pan
DC/MKG/Cco – Nov 2005
7


J1
J2
J3
J4
J5
J6
J7
J8
Djibouti – 2-m Pan
: P 3 ORION
: C 160 Transall
DC/MKG/Cco – Nov 2005
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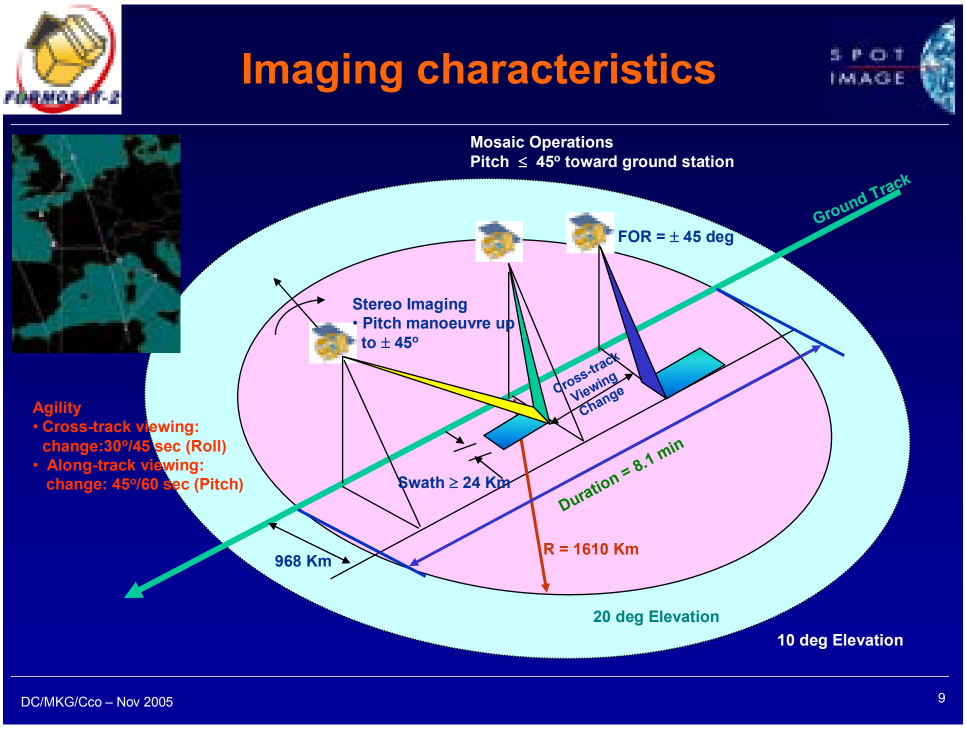

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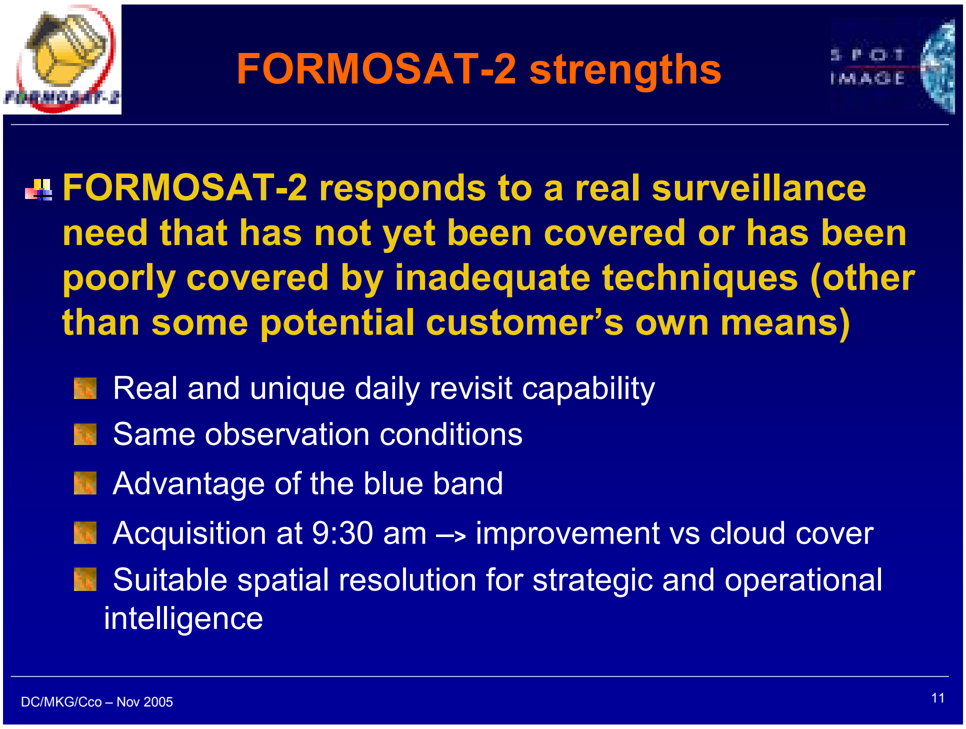
FORMOSAT-2 strengths
FORMOSAT-2 responds to a real surveillance need that has not yet been covered or has been poorly covered by inadequate techniques (other than some potential customer's own means)
Real and unique daily revisit capability
Same observation conditions
Advantage of the blue band
Acquisition at 9:30 am –> improvement vs cloud cover
Suitable spatial resolution for strategic and operational intelligence
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FORMOSAT-2 strengths
At last it offers serious guarantees of service
Belongs to the SPOT family
Low Shutter control risks
Suitable in management or anticipation of crises
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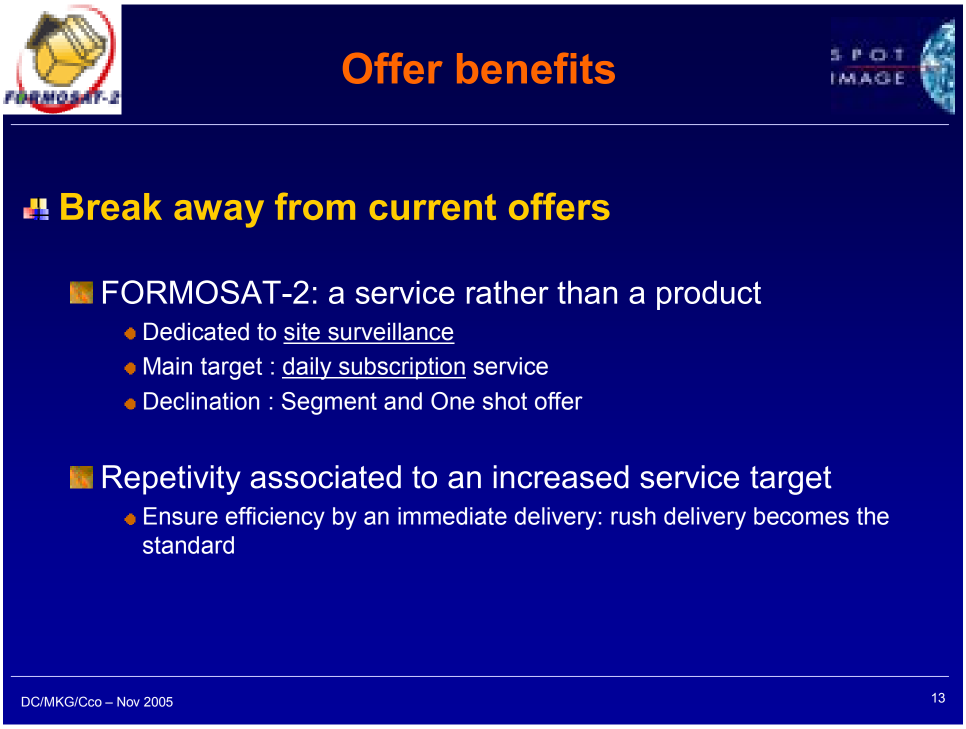
Offer benefits
Break away from current offers
FORMOSAT-2: a service rather than a product
Dedicated to site surveillance
Main target : daily subscription service
Declination : Segment and One shot offer
Repetivity associated to an increased service target
Ensure efficiency by an immediate delivery: rush delivery becomes the standard
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Your needs
Intelligence gathering for strategic purposes:
Anticipation, crisis identification and evaluation
Evaluation of proliferation activities
Verification of compliance with disarmament agreements Application of international treaties
Intelligence gathering for operational purposes:
Surveillance of the war theatres and troop movements
Compiling files on targets
Protection plans for vulnerable areas or sites
Intelligence gathering for tactical purposes:
Evaluation of the level of threat
Initial operations design
Preparing the mission
Simulating the mission
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Your needs

- **Supply of alternative media information**
- **Geographic production:**
  - Production of databases and satellite image maps
  - Database updating
  - Refining DTMs/DSMs
  - Data quality control

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The range

- **Telemetry and ground segment**
  - Direct and independent access to FORMOSAT-2 imagery in real time (within the receiving station visibility circle)
- **Resource Booking / TOO Time On Orbit**
  - In anticipation of needs, have the priority on acquisition to ensure resource availability
- **Standard offer**
  - Set of revisit subscriptions: from daily revisit to multitemporal datasets
  - Strip offer – to cover large sites
  - One shot offer – to cover small targets

Offer distributed by the Channel Partner network

- An exclusive right to distribute FORMOSAT-2 products and services over a defined market or area
- From distribution exclusivity to exclusivity on acquired images

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Presentation 7 - RapidEye - The Global Geo-Information Expert

Dr. Frederik Jung-Rothenhäusler
RapidEye AG, DE

Abstract

RapidEye AG incorporated in December 1998 and located in Brandenburg near Berlin in Germany, is getting ready to begin full scale operations in summer 2007. The five satellite constellation will regularly monitor the Earth surface and will record a minimum of 4,000,000km² imagery data per day. The integrated data processing facility will be able to produce multi-spectral ortho-rectified imagery (5m pixel spacing) and derived information products within 24hours after image take.

RapidEye will use the capacity of the satellite system to provide value added products and services to clients world wide. By working closely with partners, RapidEye will provide information services for both agriculture and forestry industry, government and individuals.


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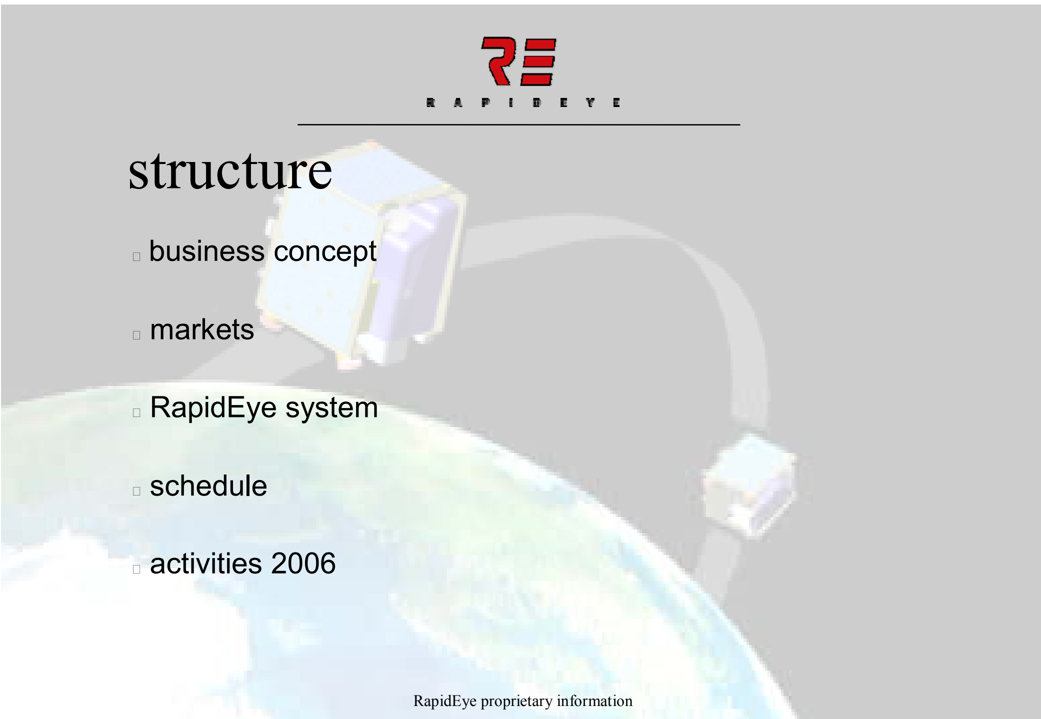
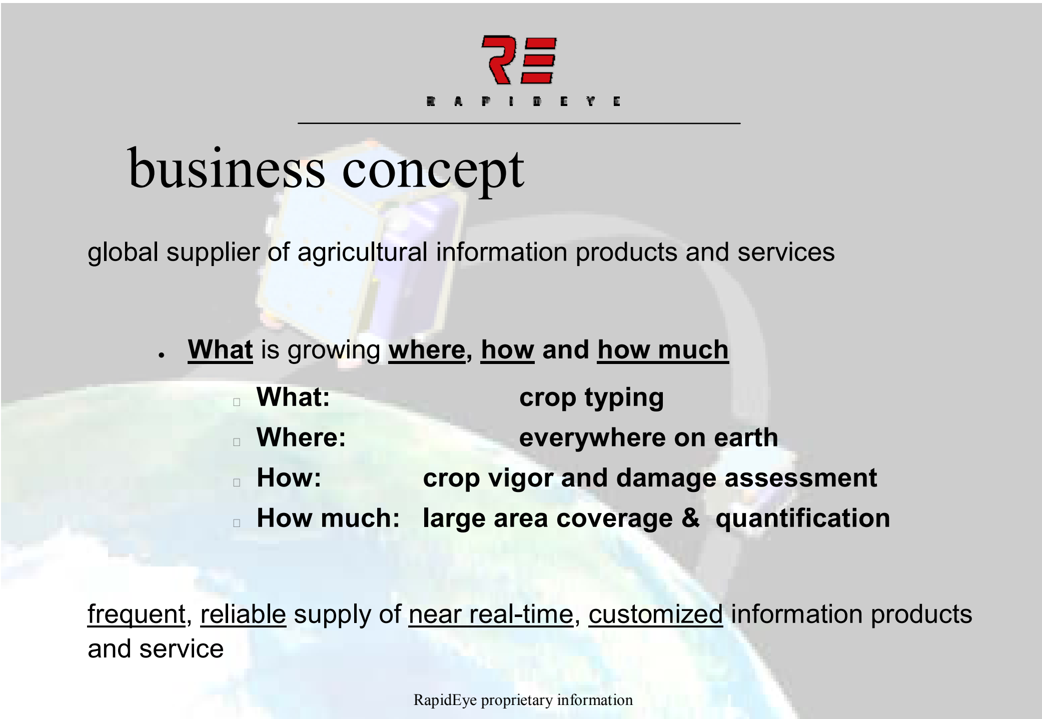
The Global Geo Information Expert
RapidEye
CwRS November 2005
Kraków, Poland
RapidEye proprietary information


R A P I D E Y E
structure
business concept
markets
RapidEye system
schedule
activities 2006
RapidEye proprietary information


RAPIDEYE
vision
what you see is what you get -> data products
we find out what you are looking for -> services
we image when you need it -> daily accessibility
RapidEye proprietary information


RAPIDEYE
business concept
global supplier of agricultural information products and services
What is growing where, how and how much
What: crop typing
Where: everywhere on earth
How: crop vigor and damage assessment
How much: large area coverage & quantification
frequent, reliable supply of near real-time, customized information products and service
RapidEye proprietary information


RAPIDEYE
RapidEye markets
focus on specific customer groups
agriculture
ag-insurance co's
producers
food co's
ag-chemical co's
cartography
national & internat'l agencies (agriculture, environment)
cartography
products and services based on high-quality geo-coded images
crop mapping
crop monitoring
damage assessment
yield prediction
cartography
change detection
using fast and reliable multi-temporal image analyses
RapidEye proprietary information


RAPIDEYE
approach to market
RapidEye
large customers
joint service development
service
RapidEye & Partners
fragmented and restricted markets
form service consortium
joint service development
service
RapidEye proprietary information

RAPIDEYE

customer-driven system requirements

guaranteed data availability

- daily revisit of every point on earth
- proven technology and system redundancy

rapid response after unforeseen events (< 7 days)

- integrated system from data to products

continuous monitoring of agricultural areas around the world

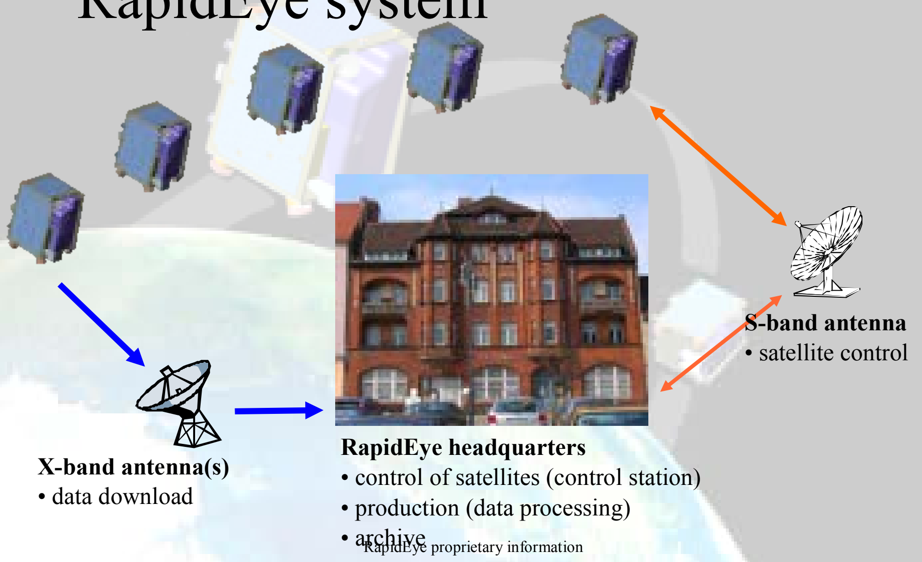
- large area coverage (~ 4 million sqkm per day)
- multispectral sensors

customer-specific, low cost information

RapidEye proprietary information

RAPIDEYE

RapidEye system



RapidEye proprietary information

RAPIDEYE

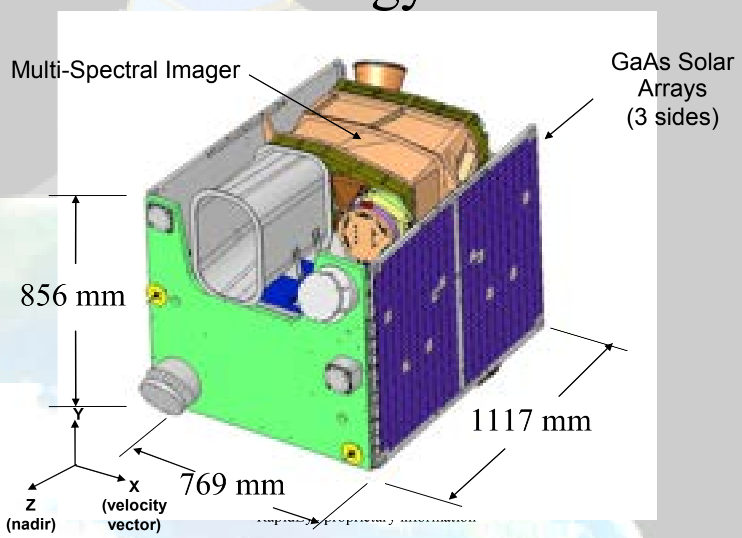
mission characteristics

launch date:	Q1, 2007
spacecraft lifetime :	7 years
orbit:	622 km altitude
	11:00 a.m. ECT, sun synchronous
	15 orbits per day per satellite
camera:	multi-spectral pushbroom imager
no. of optical bands:	5 (blue, green, red, red edge, NIR)
ground sampling distance:	6.5 m at nadir
swath width:	77.25 km
revisit time:	1 day (from –75 to +75 deg lat)
image capture capacity:	up to 4.9 M km^2 / day
onboard data storage:	1500 km of image data

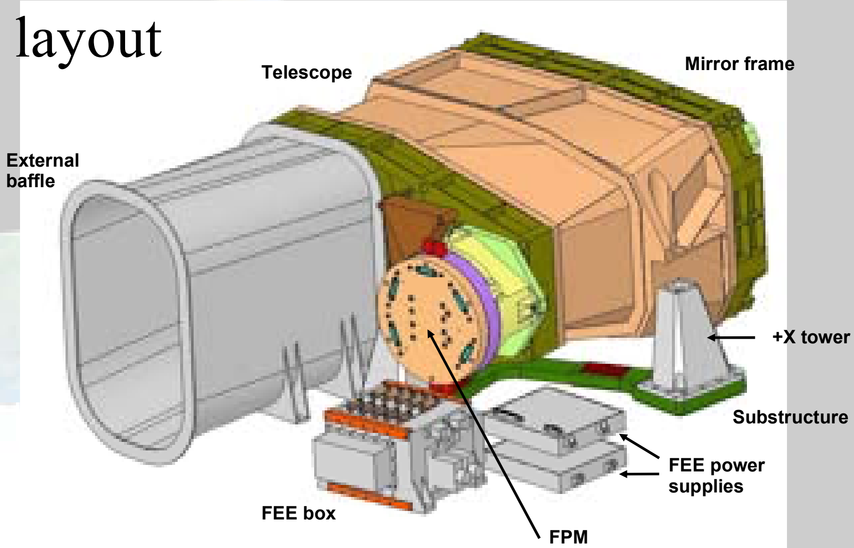
RapidEye proprietary information

RAPIDEYE

satellite technology



camera architecture and physical layout

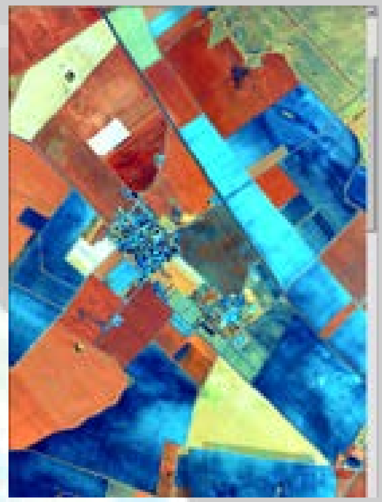


camera spectral bands

Camera Details

- blue	440 - 510 nm
- green	520 - 590 nm
- red	630 - 685 nm
- red-edge	690 - 730 nm
- NIR	760 - 850 nm

12 bit imagery



RapidEye proprietary information


RAPIDEYE
schedule
July 2004
fully financed, project start
2005-2007
preparation phase
• product development with key customers in Europe, North America
• direct marketing to key customer segments
• build up of partnerships (marketing, development)
mid 2007
delivery of system (satellite constellation, processing chain)
start of operations
RapidEye proprietary information


RAPIDEYE
activities 2006
satellite and ground processing systems
• assembly
• integration &
• test
customer and market development
• continue development projects
• establish business collaboration with partners
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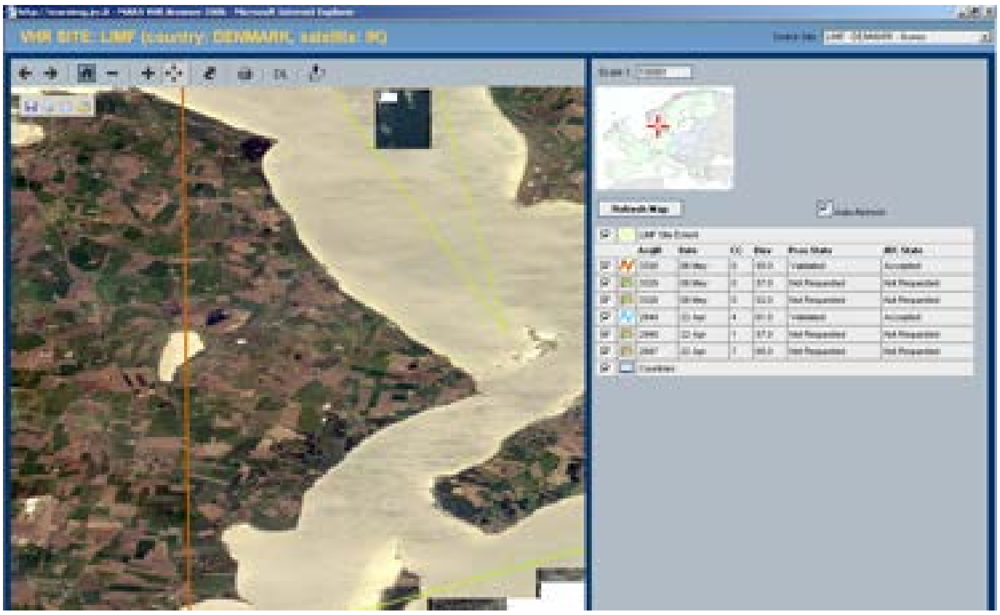
Parallel Session T4 – Image Acquisition and LIODOTNET

Chairman: Pär Johan ÅSTRAND – JRC, IPSC, Agrifish Unit



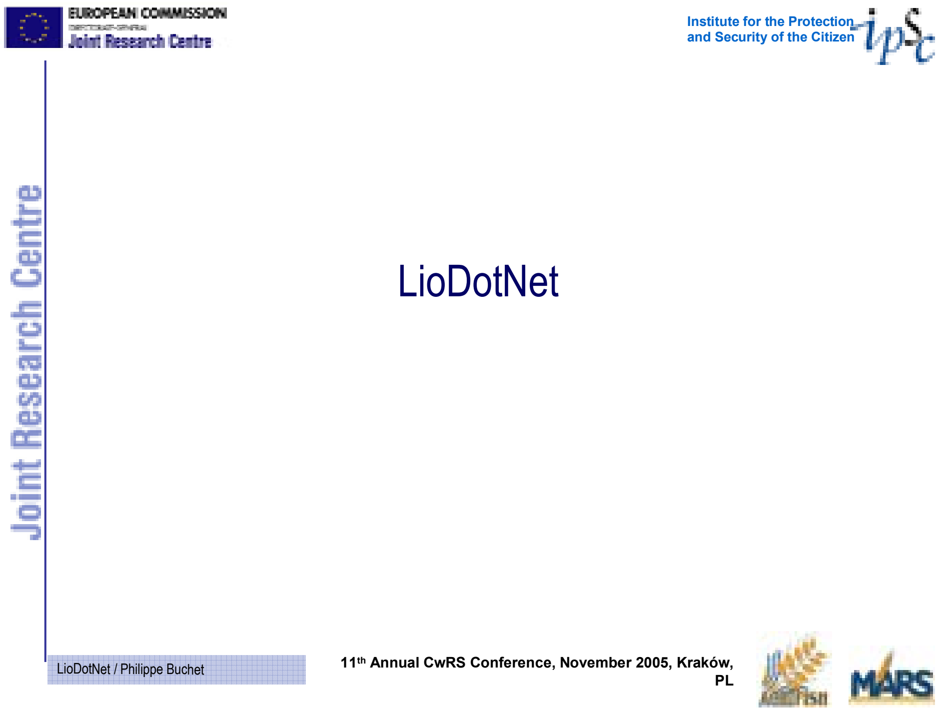
Presentation 1 – The LioDotNet WEB Application

Philippe Buchet
JRC, IPSC, Agrifish Unit

Abstract

LioDotNet is a WEB based informatics application to manage request, validation, ordering and invoicing of satellite images.
There is an automatic Email exchange to synchronize the actions between different actors; contractors, image providers and the Joint Research Centre (JRC).
This system allows, in an easy way, a permanent control of the image acquisition status during the campaign.
After publishing an acquisition request, the provider can upload images controlled and accepted by the contractors and the Joint Research Centre (JRC).
The web application is based on a portal (DotNetNuke) using the Microsoft dot net framework and the data repository is a Microsoft SQL database.

Keywords: WEB based, DotNetNuke, SQL database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Institute for the Protection and Security of the Citizen
Joint Research Centre
LioDotNet
LioDotNet / Philippe Buchet
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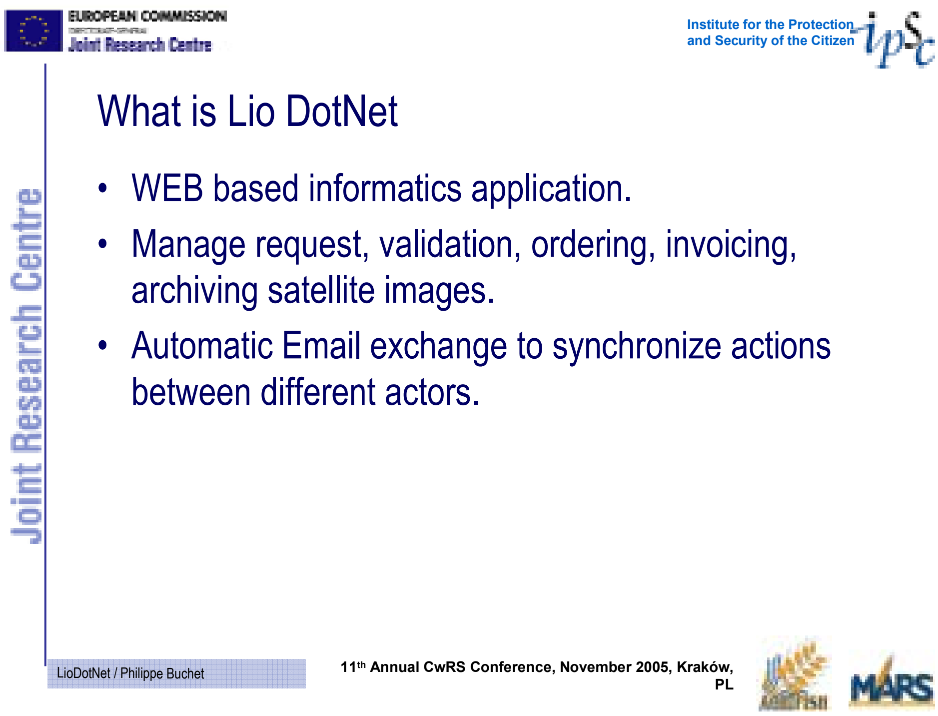
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Joint Research Centre
What is Lio DotNet
• WEB based informatics application.
• Manage request, validation, ordering, invoicing, archiving satellite images.
• Automatic Email exchange to synchronize actions between different actors.
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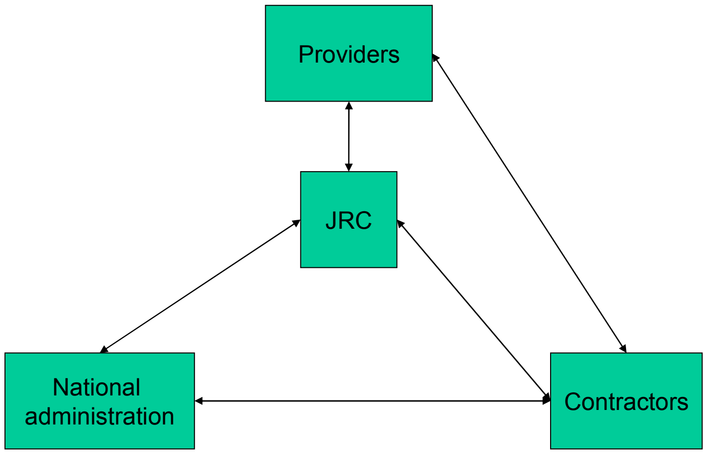
Actors in LioDotNet



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LioDotNet

Image request

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AGRIFISH MARS

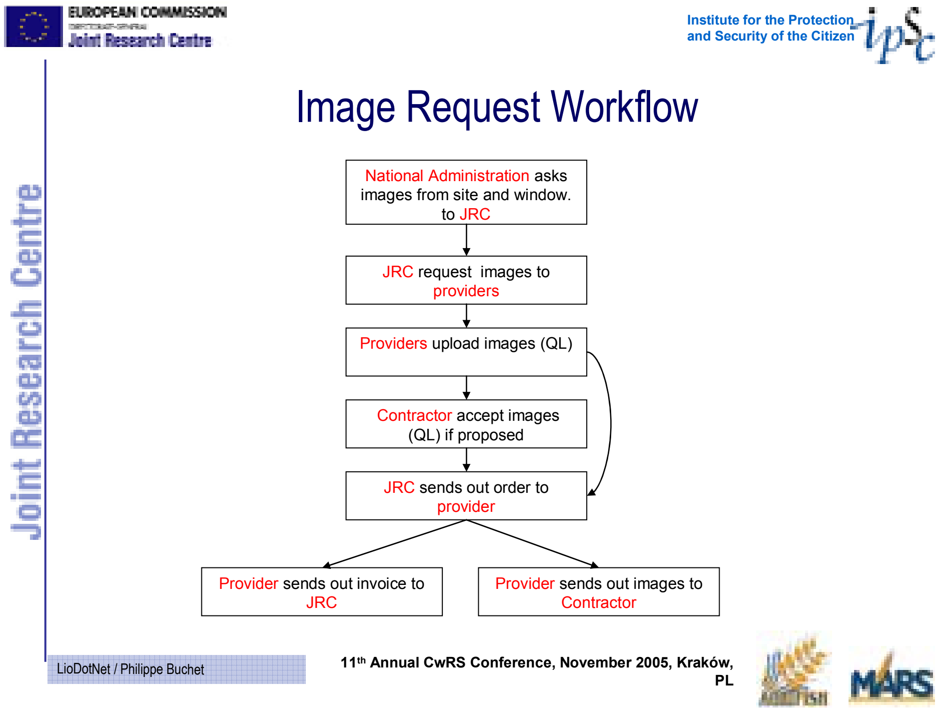
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Image Request Workflow
National Administration asks images from site and window. to JRC
JRC request images to providers
Providers upload images (QL)
Contractor accept images (QL) if proposed
JRC sends out order to provider
Provider sends out invoice to JRC
Provider sends out images to Contractor
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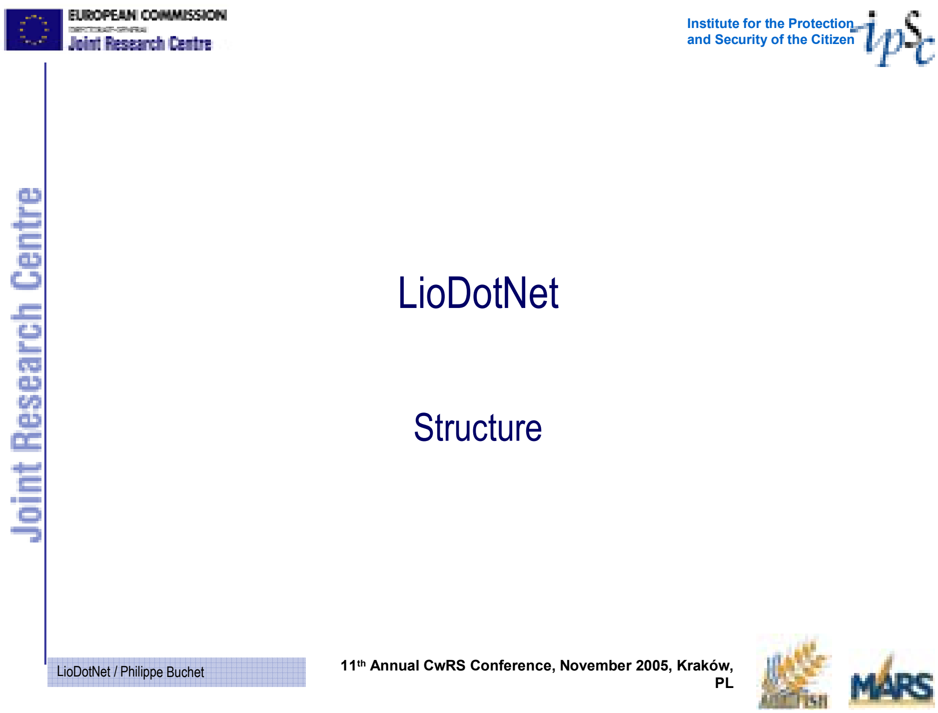
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LioDotNet
Structure
Joint Research Centre
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Defining data

- Windows (Only period information)

Windows

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Defining data

- Sites (only geographic information)

Windows   Sites

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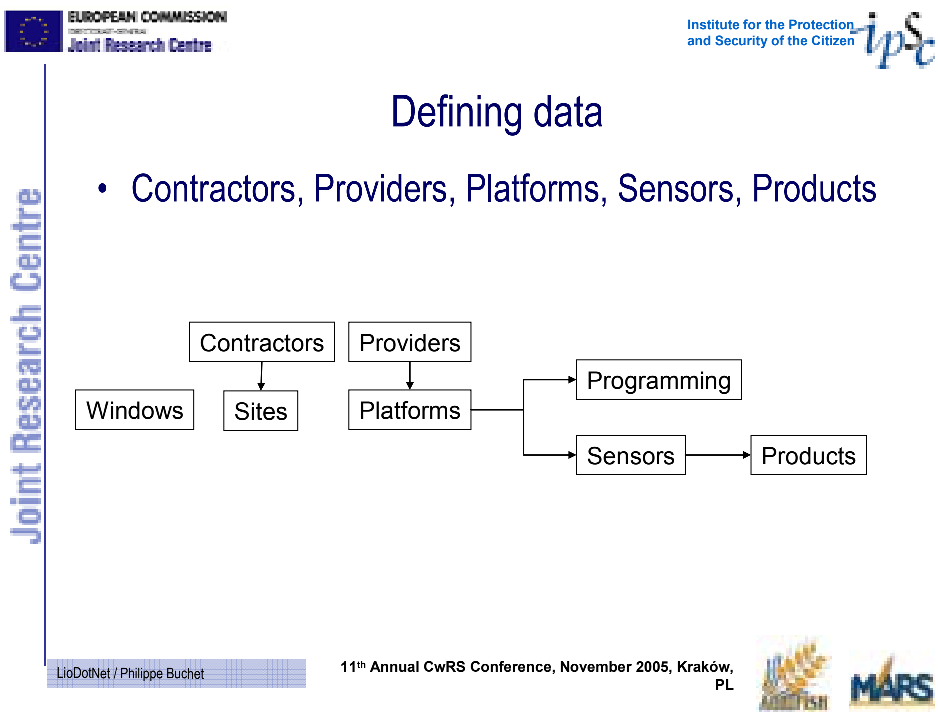
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ipsc
Joint Research Centre
Defining data
• Contractors, Providers, Platforms, Sensors, Products
Contractors
Providers
Windows
Sites
Platforms
Programming
Sensors
Products
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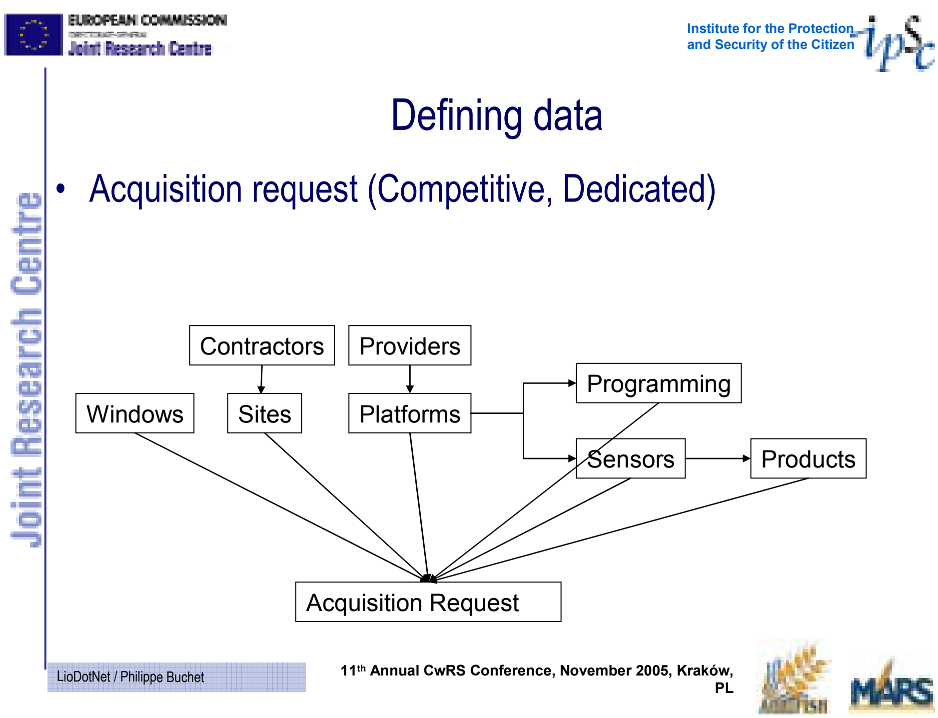
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Institute for the Protection and Security of the Citizen
ipsc
Joint Research Centre
Defining data
• Acquisition request (Competitive, Dedicated)
Contractors
Providers
Windows
Sites
Platforms
Programming
Sensors
Products
Acquisition Request
LioDotNet / Philippe Buchet
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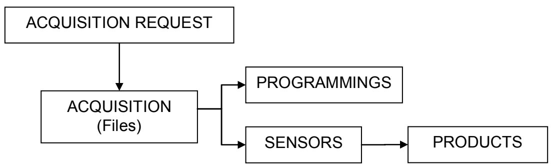
Upload Acquisitions

- Each providers upload acquisition (quick look) for the acquisition request



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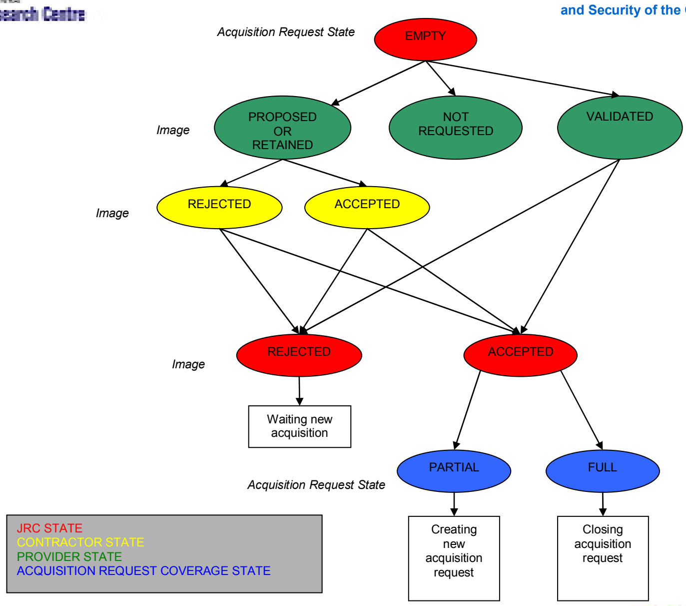

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Image Orders

- An Image Order is send out when the acquisition is accepted.

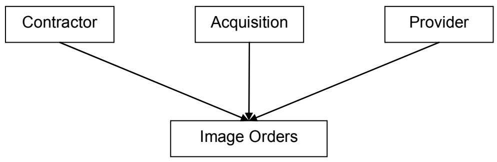

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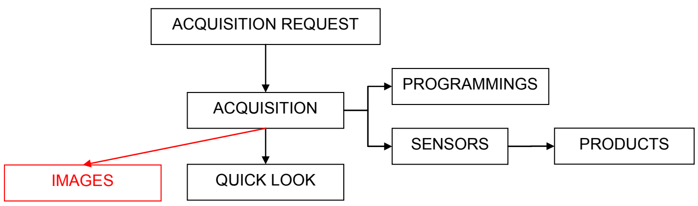
Image reception and archive

- The image are received and archived



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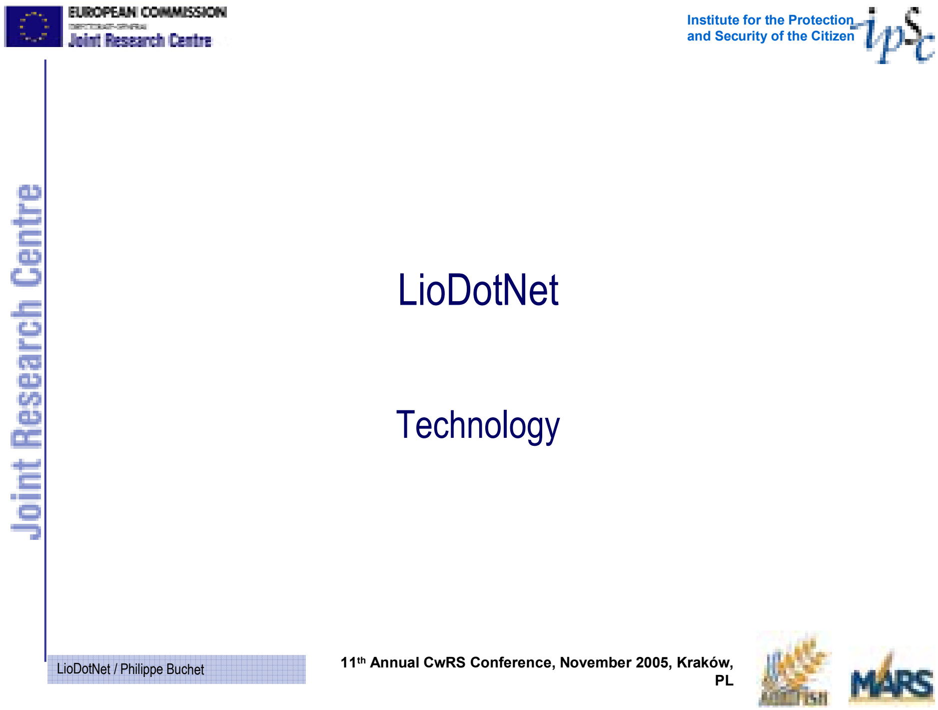
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Technology
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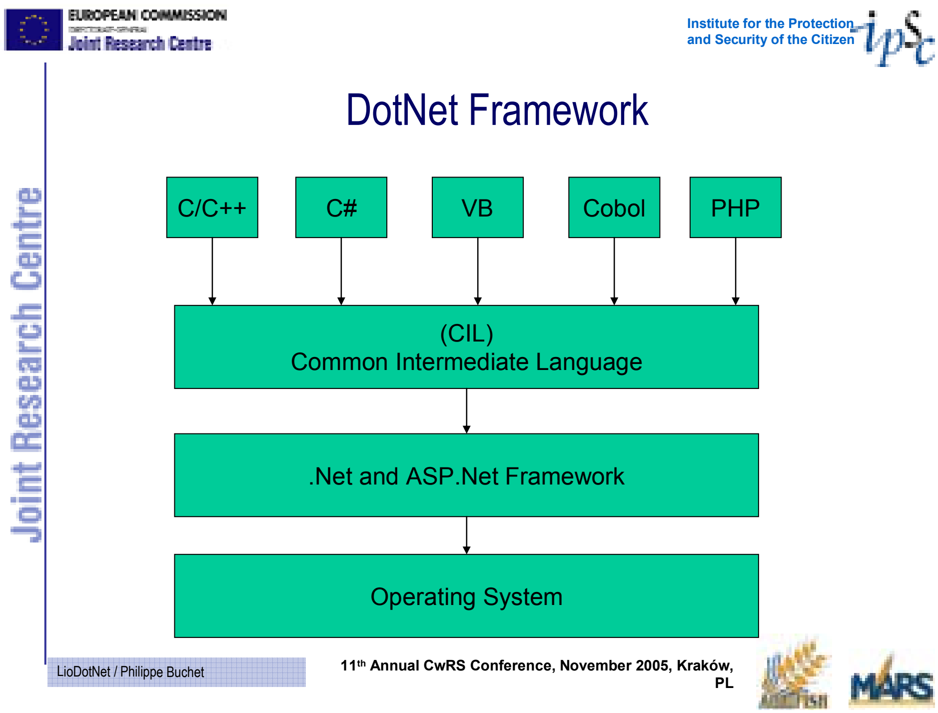
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DotNet Framework
C/C++
C#
VB
Cobol
PHP
(CIL)
Common Intermediate Language
.Net and ASP.Net Framework
Operating System
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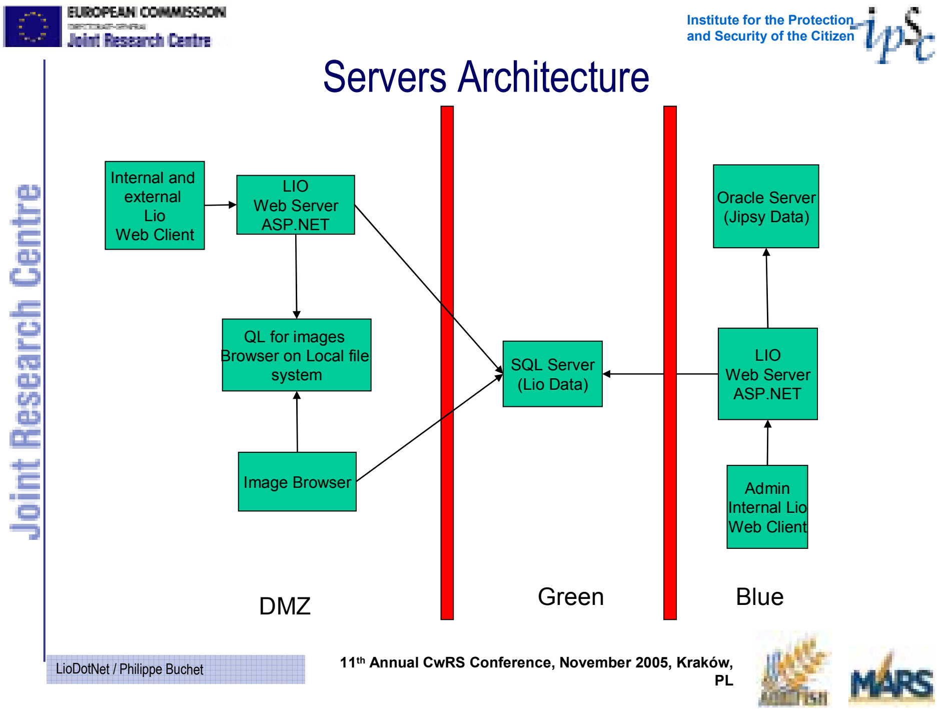
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Servers Architecture
Internal and external Lio Web Client
LIO Web Server ASP.NET
QL for images Browser on Local file system
Image Browser
SQL Server (Lio Data)
Oracle Server (Jipsy Data)
LIO Web Server ASP.NET
Admin Internal Lio Web Client
DMZ
Green
Blue
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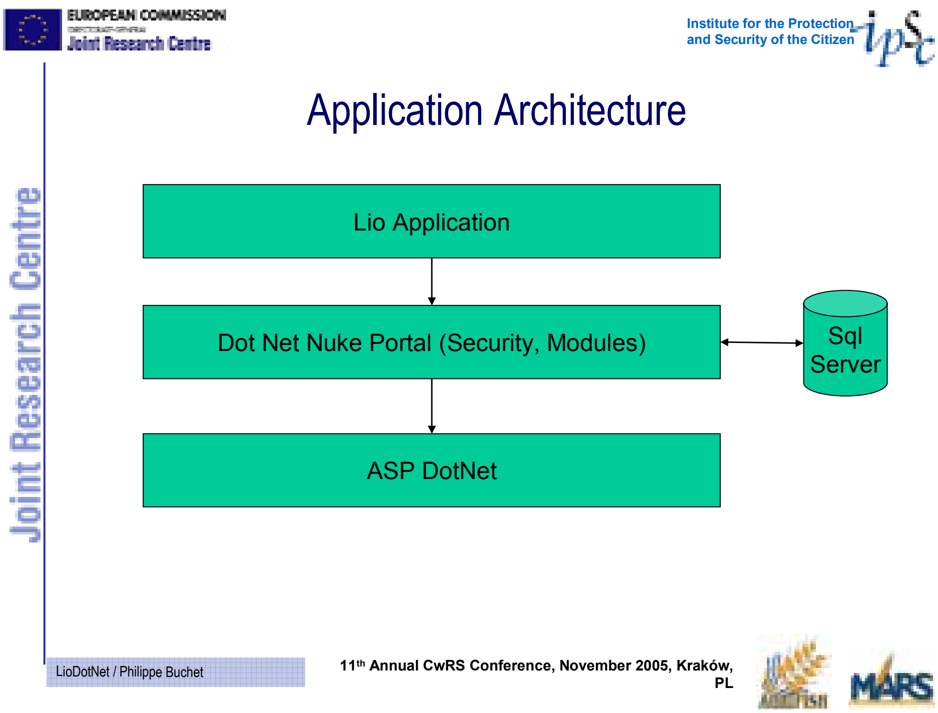
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Application Architecture
Lio Application
Dot Net Nuke Portal (Security, Modules)
ASP DotNet
Sql Server
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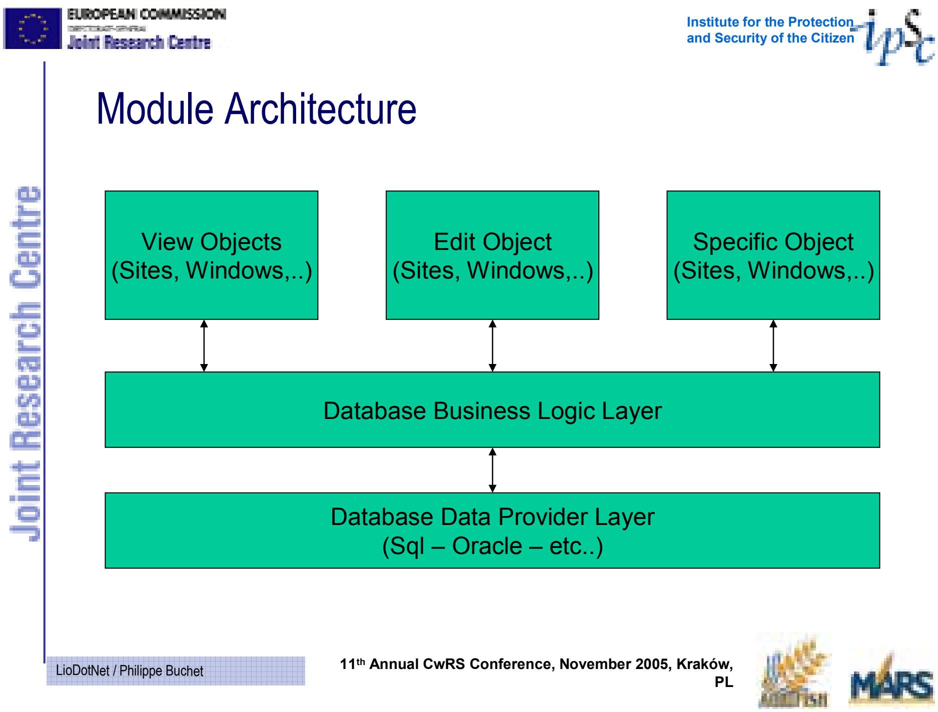
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Module Architecture
View Objects (Sites, Windows,..)
Edit Object (Sites, Windows,..)
Specific Object (Sites, Windows,..)
Database Business Logic Layer
Database Data Provider Layer (Sql – Oracle – etc..)
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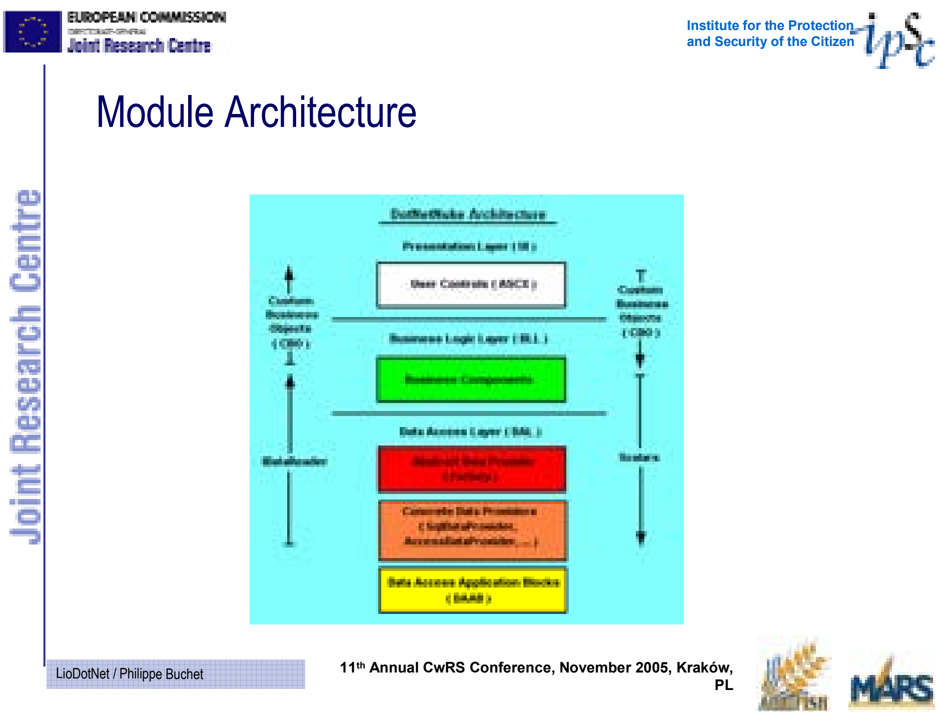
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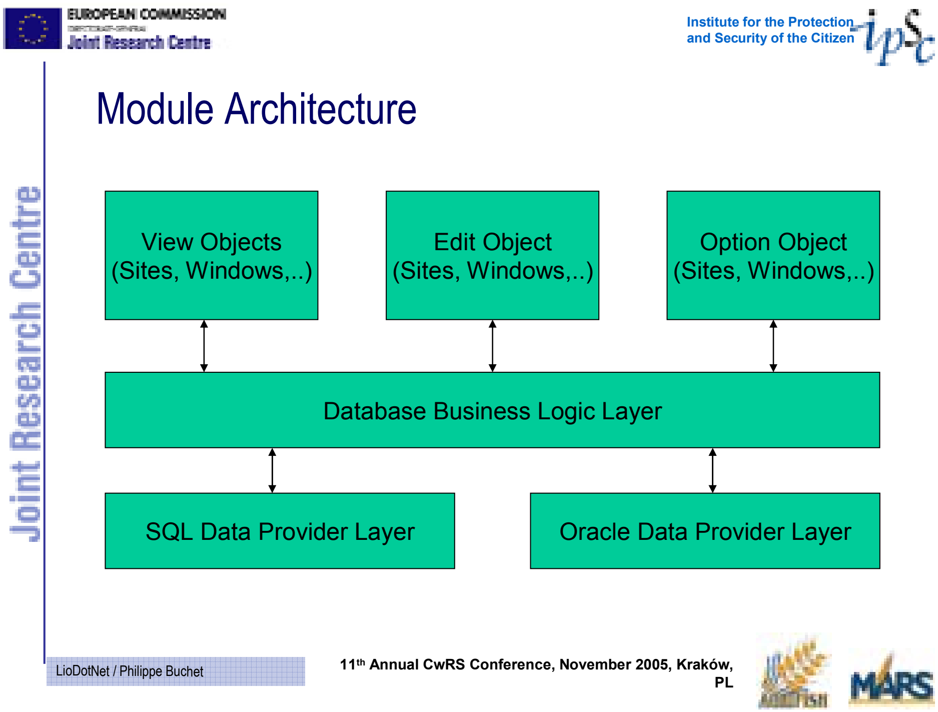
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Module Architecture
View Objects (Sites, Windows,..)
Edit Object (Sites, Windows,..)
Option Object (Sites, Windows,..)
Database Business Logic Layer
SQL Data Provider Layer
Oracle Data Provider Layer
LioDotNet / Philippe Buchet
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Presentation 2 – The VHR Browser 2005

Mihaela Fotin - JRC, IPSC, Agrifish Unit

Abstract

The MARS VHR Browser is an online application for displaying and browsing VHR quick looks and shape files from the image acquisitions. It offers the possibility to search for images via attribute (acquisition year, satellite type, site, etc) and spatial filters via a web interface. The images found can be directly visualized on-screen and loaded via various protocols into GIS or image processing software and also into office applications. The raw images can be downloaded for further processing and analysis.

The VHR Browser is set up as a system for browsing and viewing the VHR quicklooks for the available sites. It reads the contents for a site (quicklooks, shapefiles) from LioDotNet database after the uploading with XML metadata.

The image providers upload the quicklooks of their image acquisitions and enable to immediately browse and visualize the provided quicklooks.

Keywords: online archive, image server, image metadata, WebGIS, VHR, quicklooks

The MARS VHR Browser

Online viewer and download tool for VHR quicklooks

- Tool for displaying, browsing and downloading the VHR quick looks (QL).
- Includes functionality of zoom, pan, print, and switch on/off quick looks layers, download browse (QL) images and relevant shape files.

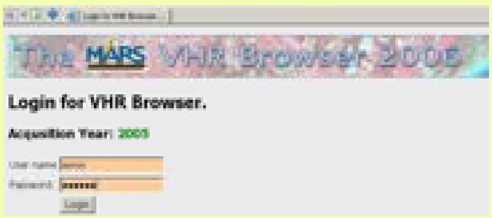
The VHR Browser is a separate application from the LIO system.

All data entries/uploads and settings are done via the LIO application.

The VHR Browser reads the content for a site (QuickLook, shape file) from the LioDotNet database after the uploading of data with the metadata XML and applies them automatically for the data visualisation.

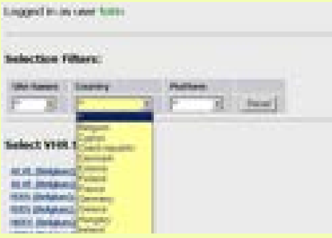
It offers a direct control of results (and possible modifications) by image providers.

Login:
https://imageserver.jrc.it/pub/vhrbrowser06



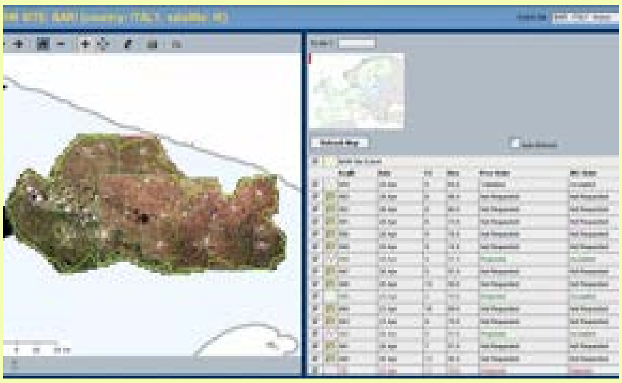
Selection of the sites VHR site.

Only the sites defined in the LIO system for an user can be seen in Lio (i..e. a contractor sees only the sites relevant to him).



The user can use different Selection Filters:
- **Site Name**
- **Country**
- **Platform**

VHR Browser reads the layer definitions from the LIO database and creates the corresponding layers on-the-fly



Navigation tools and buttons for print and download.

Zoom to site extent

Reload Site. Useful after adding new data into LIO or modification of existing settings (e.g. display order) to reflect changes in the VHR Browser

Move map (pan)

\+ Zoom in

\- Zoom out

Zoom with mouse wheel

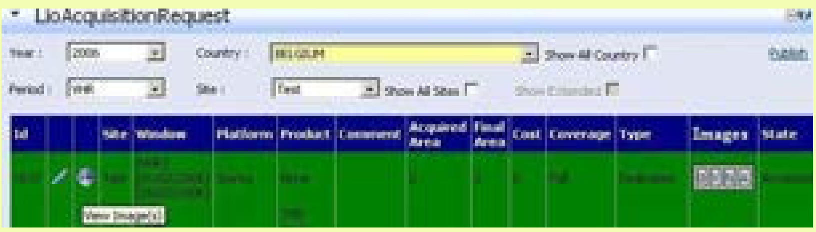
Pan with right mouse button or cursor keys

DL Download function for QuickLooks/ shape files.
Creates a ZIP file (containing all the image quick looks and shape files selected in the VHR Browser)

The VHR Browser can be called directly within LioDotNet.

If an image has been uploaded in the AR a link to the VHR browser is available.

The users can click on the tool which links directly to the VHR Browser



Presentation 3 – LIODOTNET: Contractor's experience (2005 campaign)

Fernando Gragera Ibáñez
Tecnologías y Servicios Agrarios S.A . (TRAGSATEC), ES

Abstract

During the 2005 Campaign, the JRC of the European Commission has developed a new tool called LIODOTNET which is used to keep in contact providers, contractors and JRC and provide them all kind of data about acquisition and order of imagery.

In the session taking place on November 24th, Tragsatec, as one of the biggest users of this tool, is going to explain in a short presentation the following points:

- Introduction
- LIODONET information flow
- Advantages and difficulties found
- Conclusions

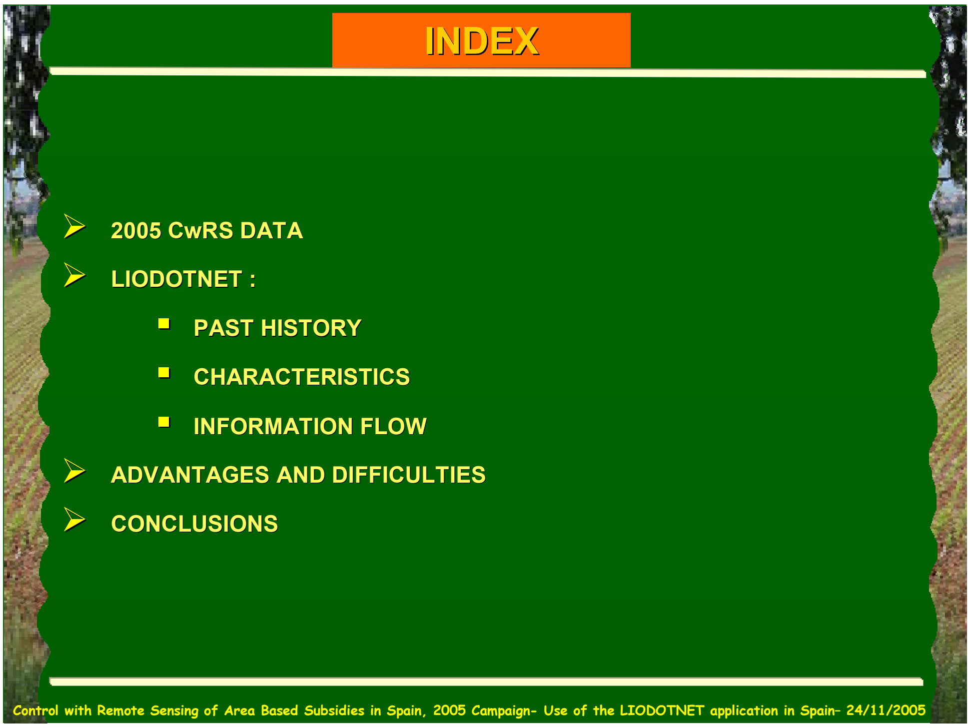
First of all, we are going to make a little introduction about the characteristics of the Control with Remote Sensing in Spain which help understand why we are one of the biggest users of this new tool due to the great amount of images that Tragsatec manages, and the play of LIODOTNET in their management.

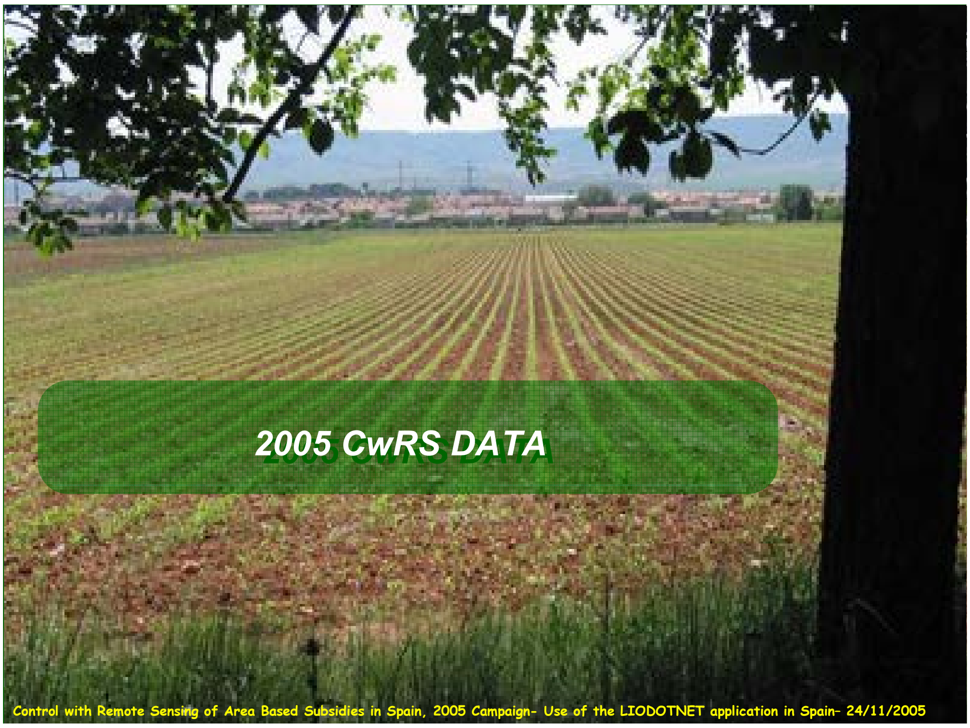
In the LIODONET information flow point we are going to explain, easily, the flow of information between providers, contractors and JRC and the use of LIODOTNET application by Tragsatec.

Sure enough, this application is useful, but always there are things that can be improved. For this reason in the third point of our presentation we are going to explain the advantages and difficulties found in the use of it.

And to crown this short presentation, some conclusions derived from the use of LIODOTNET.


CONTROL WITH REMOTE SENSING OF AREA BASED SUBSIDIES IN SPAIN, 2005 CAMPAIGN
Tragsatec
USE OF THE LIODOTNET APPLICATION IN THE CwRS OF SPAIN
24/11/2005


INDEX
2005 CwRS DATA
LIODOTNET :
PAST HISTORY
CHARACTERISTICS
INFORMATION FLOW
ADVANTAGES AND DIFFICULTIES
CONCLUSIONS
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005



2005 CwRS DATA

In the 2005 CwRS Campaign, 10 sites have been controled, distributed into 7 Autonomous Communities and 12 Counties. All the sites had the same size, 40 x 50 Km².

AUTONOMOUS COMMUNITIES	SITE	COUNTY
ANDALUCIA	NIEB	HUELVA
ARAGÓN	CADA	TERUEL/ZARAGOZA
CASTILLA-LA MANCHA	LAGI	ALBACETE
	ALCZ	CIUDAD REAL
	OLME	CUENCA
CASTILLA Y LEON	LABA	LEÓN
	VISO	SEGOVIA
EXTREMADURA	BADA	BADAJOZ/CÁCERES
MADRID	CHIN	MADRID
LA RIOJA	SDOM	LA RIOJA

Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

2005 CwRS DATA

The following images have been used per site

- A 2004 autumn multi-spectral image, acquired between November and December (Autumn image)
- A 2005 early spring multi-spectral image, acquired between February and April (Spring1 image)
- A 2005 late spring VHR bundle (multi-spectral + pancromatic) image, acquired between April and May (Spring2 image)
- A 2005 late spring multi-spectral image, as VHR back-up, acquired between April and May (Spring2_backup)
- A 2005 summer multi-spectral image, acquired between June and August (Summer image)

Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

2005 CwRS DATA

HR IMAGES DATA

The following table shows the number of:

- Validated images: Need only the JRC validation
- Proposed images: The contractor and the JRC must make a validation
- Disable images: The acquisition is disable due to a wrong upload

Image	Validated	Proposed		Disable	**Total**
		Total	Accepted		
Autumn	9	1	1	0	**10**
Spring1	9	2	1	0	**11**
Sprin2_backup	8	4	2	0	**12**
Summer	9	3	1	2	**14**
Total	**35**	**10**	**5**	**2**	**47**

Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

2005 CwRS DATA

VHR IMAGES DATA

For VHR imagery, the data upload is made independently for each pass.

The following table shows the number of:

- Validated passes: Need only the JRC validation
- Proposed passes: The contractor and the JRC must make a validation
- Disable passes: The acquisition is disable due to a wrong upload

Image	Validated passes	Proposed passes		Disable passes	Total
		Total	Accepted		
Spring2_VHR	41	3	1	2	46

Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

2005 CwRS DATA

Summary table of acquired/supplied imagery for 2005 Campaign in Spain:

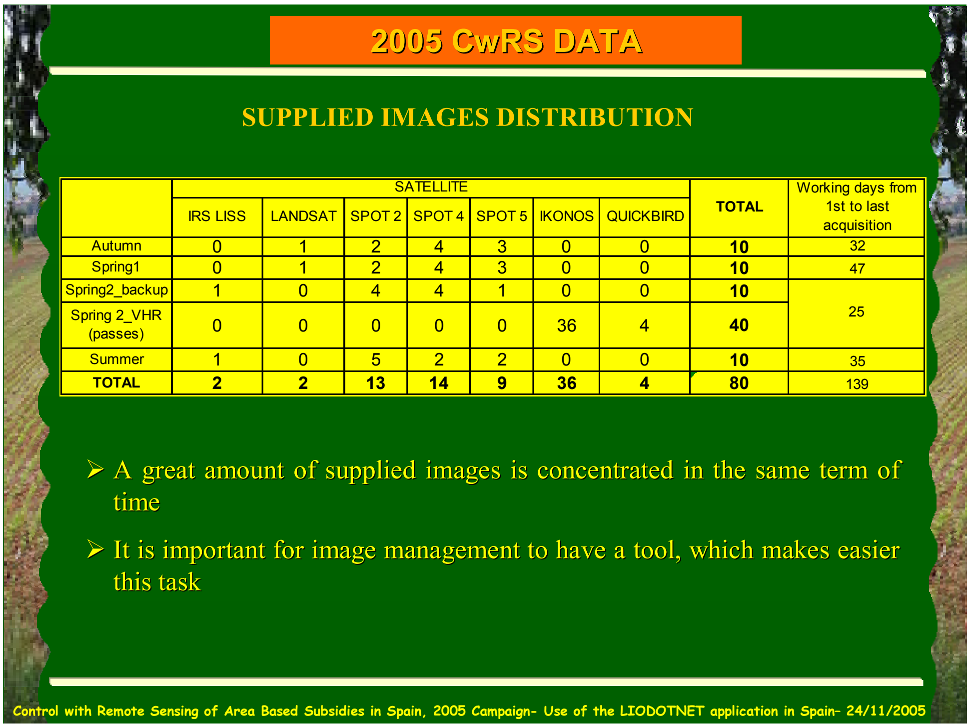
HR	Total acquired **images**	Supplied **images**
	47	40

VHR	Total acquired **passes**	Supplied **passes**	Supplied **images** (4 passes per image)
	46	40	10

Total HR acquired images + VHR acquired passes = 93

Total HR supplied images + VHR supplied passes = 80

Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005



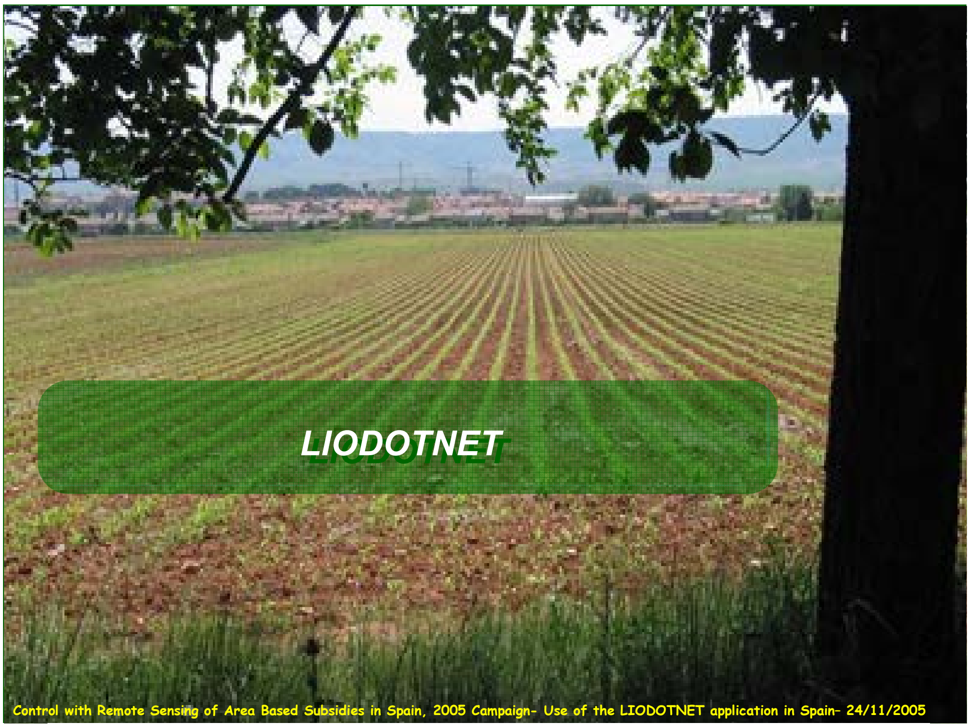
2005 CwRS DATA

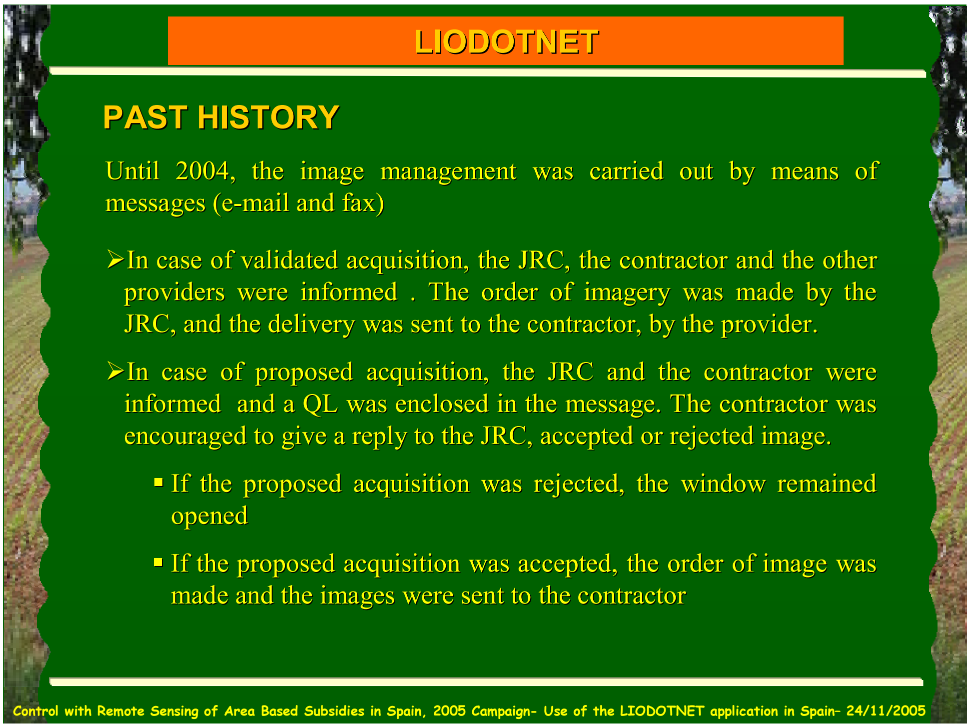
SUPPLIED IMAGES DISTRIBUTION

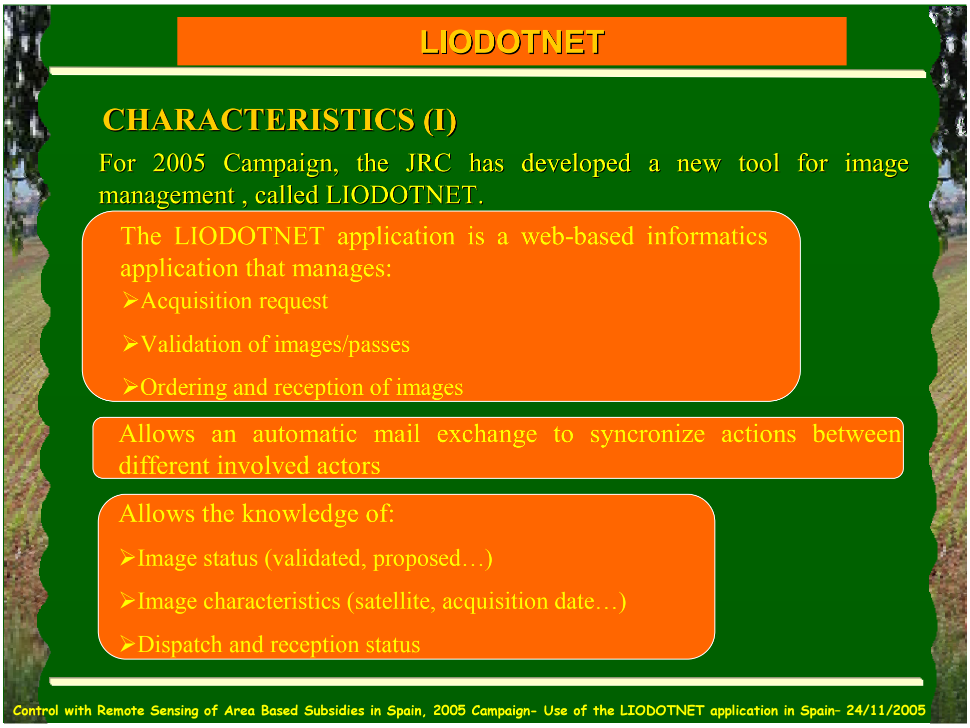
	SATELLITE							TOTAL	Working days from 1st to last acquisition
	IRS LISS	LANDSAT	SPOT 2	SPOT 4	SPOT 5	IKONOS	QUICKBIRD		
Autumn	0	1	2	4	3	0	0	**10**	32
Spring1	0	1	2	4	3	0	0	**10**	47
Spring2_backup	1	0	4	4	1	0	0	**10**	25
Spring 2_VHR (passes)	0	0	0	0	0	36	4	**40**	
Summer	1	0	5	2	2	0	0	**10**	35
TOTAL	**2**	**2**	**13**	**14**	**9**	**36**	**4**	**80**	139

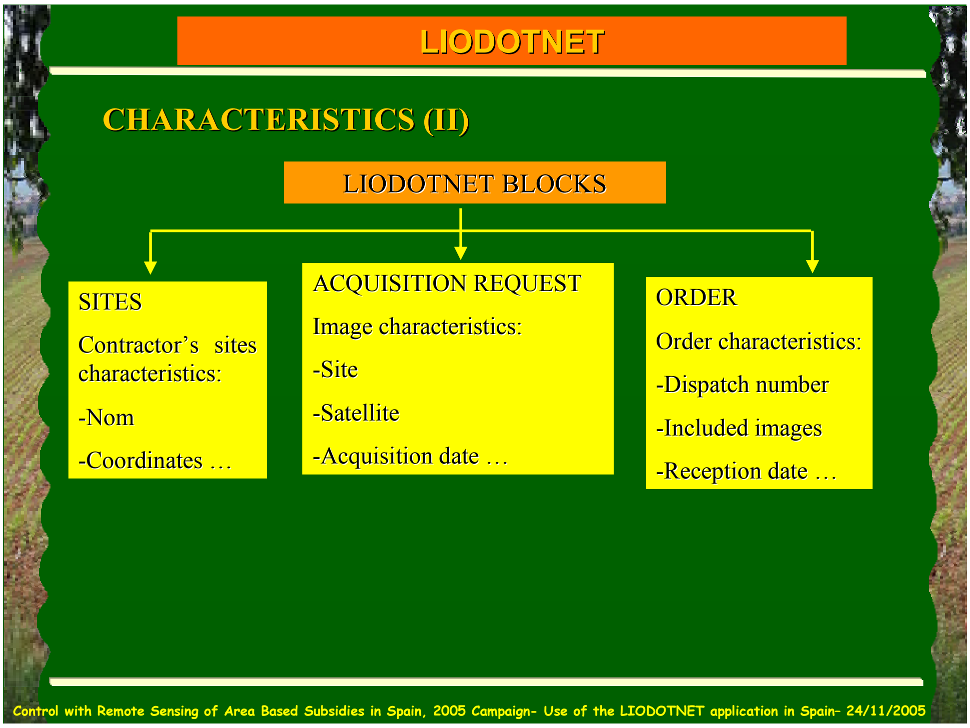
- A great amount of supplied images is concentrated in the same term of time
- It is important for image management to have a tool, which makes easier this task

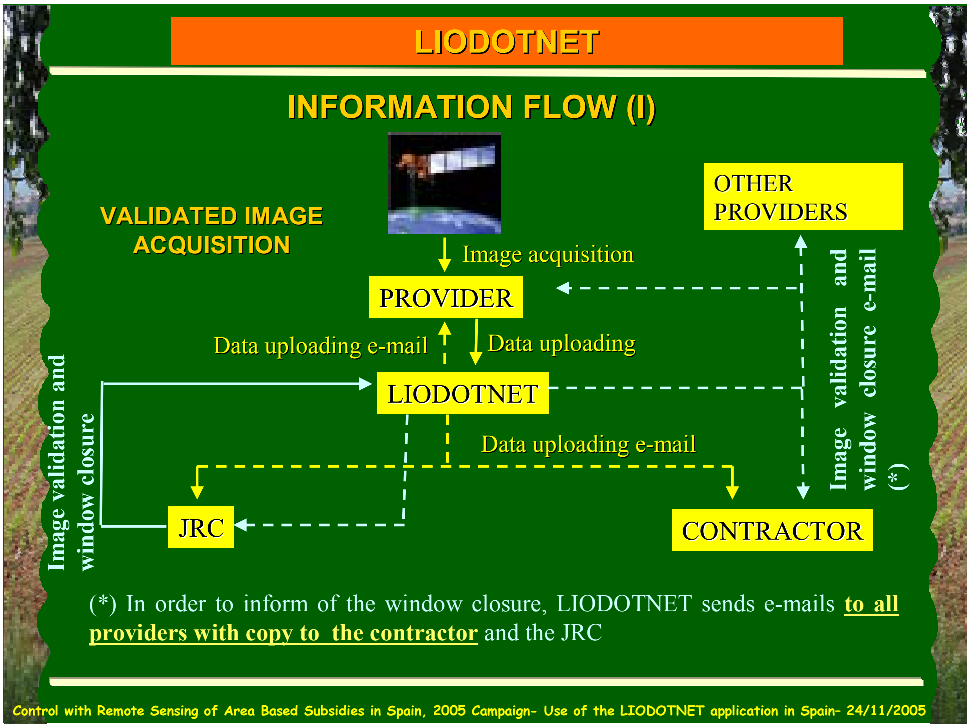
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

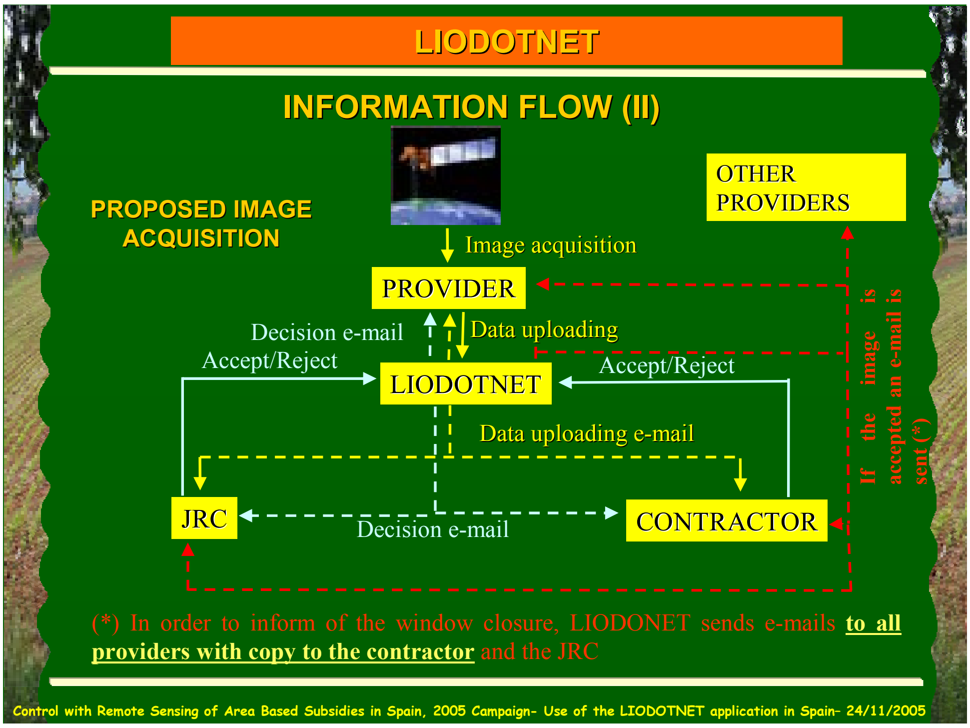


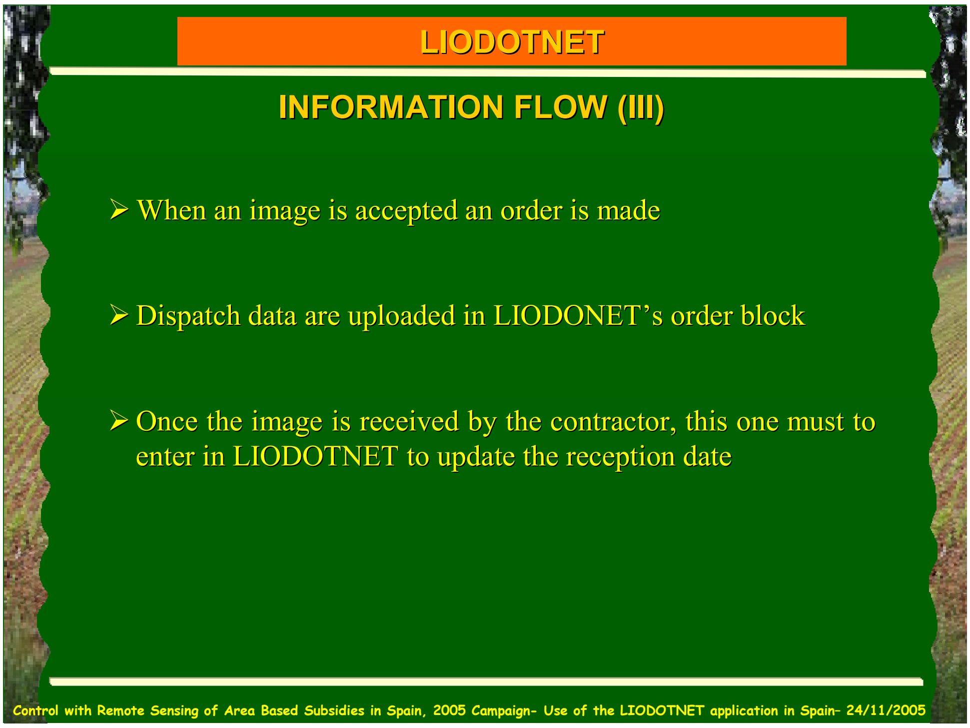

LIODOTNET
PAST HISTORY
Until 2004, the image management was carried out by means of messages (e-mail and fax)
➢In case of validated acquisition, the JRC, the contractor and the other providers were informed . The order of imagery was made by the JRC, and the delivery was sent to the contractor, by the provider.
➢In case of proposed acquisition, the JRC and the contractor were informed and a QL was enclosed in the message. The contractor was encouraged to give a reply to the JRC, accepted or rejected image.
▪ If the proposed acquisition was rejected, the window remained opened
▪ If the proposed acquisition was accepted, the order of image was made and the images were sent to the contractor
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005


LIODOTNET
CHARACTERISTICS (I)
For 2005 Campaign, the JRC has developed a new tool for image management , called LIODOTNET.
The LIODOTNET application is a web-based informatics application that manages:
➢Acquisition request
➢Validation of images/passes
➢Ordering and reception of images
Allows an automatic mail exchange to syncronize actions between different involved actors
Allows the knowledge of:
➢Image status (validated, proposed…)
➢Image characteristics (satellite, acquisition date…)
➢Dispatch and reception status
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

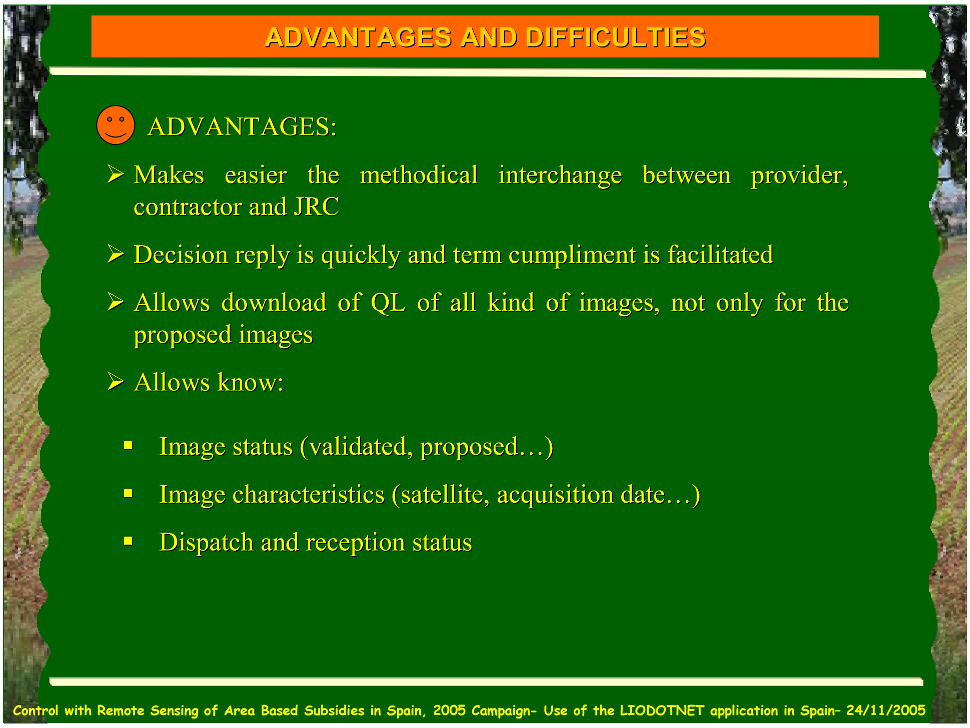

LIODOTNET
CHARACTERISTICS (II)
LIODOTNET BLOCKS
SITES
Contractor's sites characteristics:
-Nom
-Coordinates …
ACQUISITION REQUEST
Image characteristics:
-Site
-Satellite
-Acquisition date …
ORDER
Order characteristics:
-Dispatch number
-Included images
-Reception date …
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

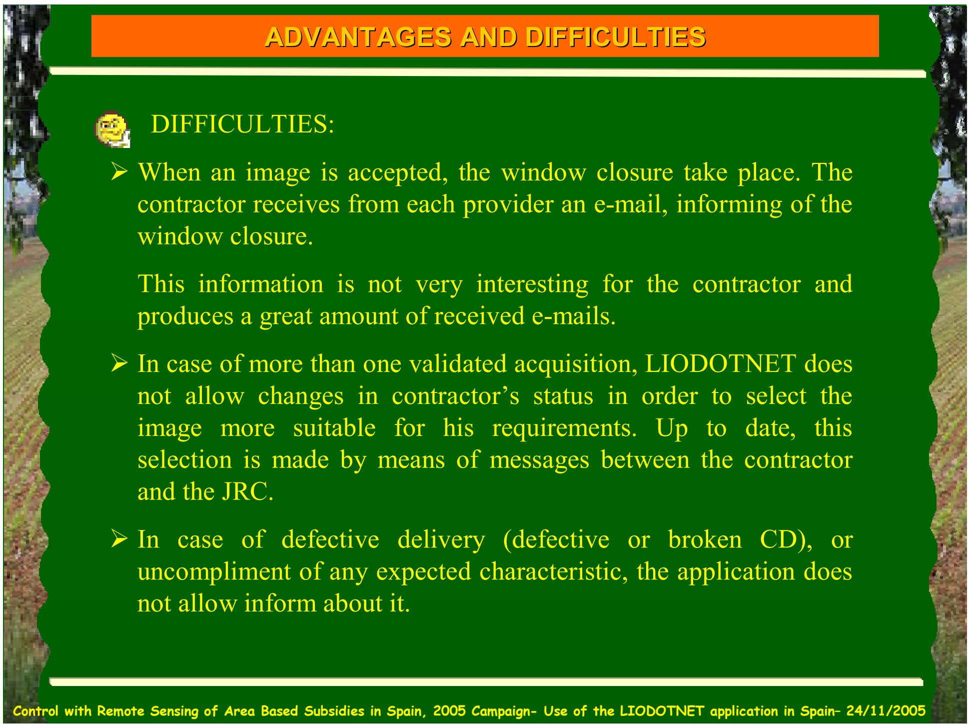

LIODOTNET
INFORMATION FLOW (I)
VALIDATED IMAGE ACQUISITION
OTHER PROVIDERS
Image acquisition
PROVIDER
Data uploading e-mail
Data uploading
LIODOTNET
Data uploading e-mail
Image validation and window closure e-mail (*)
Image validation and window closure
JRC
CONTRACTOR
(*) In order to inform of the window closure, LIODOTNET sends e-mails to all providers with copy to the contractor and the JRC
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005


LIODOTNET
INFORMATION FLOW (II)
PROPOSED IMAGE ACQUISITION
OTHER PROVIDERS
Image acquisition
PROVIDER
Decision e-mail
Accept/Reject
Data uploading
LIODOTNET
Accept/Reject
Data uploading e-mail
JRC
Decision e-mail
CONTRACTOR
If the image is accepted an e-mail is sent (*)
(*) In order to inform of the window closure, LIODONET sends e-mails to all providers with copy to the contractor and the JRC
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005


LIODOTNET
INFORMATION FLOW (III)
When an image is accepted an order is made
Dispatch data are uploaded in LIODONET's order block
Once the image is received by the contractor, this one must to enter in LIODOTNET to update the reception date
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

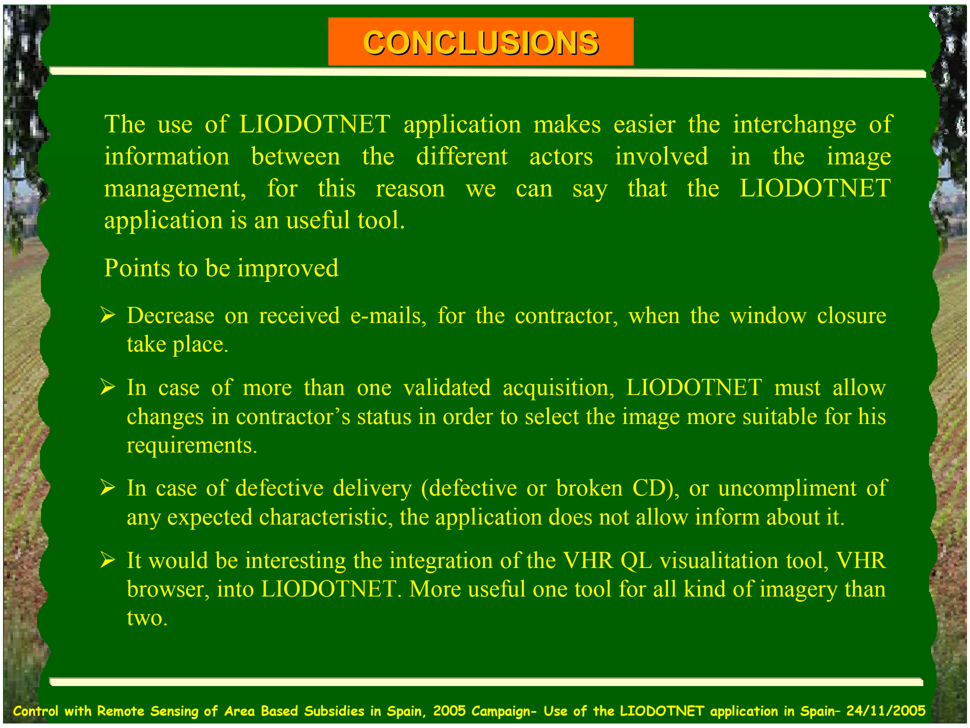

ADVANTAGES AND DIFFICULTIES
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005


ADVANTAGES AND DIFFICULTIES
ADVANTAGES:
➢ Makes easier the methodical interchange between provider, contractor and JRC
➢ Decision reply is quickly and term cumpliment is facilitated
➢ Allows download of QL of all kind of images, not only for the proposed images
➢ Allows know:
▪ Image status (validated, proposed…)
▪ Image characteristics (satellite, acquisition date…)
▪ Dispatch and reception status
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005



ADVANTAGES AND DIFFICULTIES
DIFFICULTIES:
➢ When an image is accepted, the window closure take place. The contractor receives from each provider an e-mail, informing of the window closure.
This information is not very interesting for the contractor and produces a great amount of received e-mails.
➢ In case of more than one validated acquisition, LIODOTNET does not allow changes in contractor's status in order to select the image more suitable for his requirements. Up to date, this selection is made by means of messages between the contractor and the JRC.
➢ In case of defective delivery (defective or broken CD), or uncompliment of any expected characteristic, the application does not allow inform about it.
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

CONCLUSIONS
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005


CONCLUSIONS
The use of LIODOTNET application makes easier the interchange of information between the different actors involved in the image management, for this reason we can say that the LIODOTNET application is an useful tool.
Points to be improved
➢ Decrease on received e-mails, for the contractor, when the window closure take place.
➢ In case of more than one validated acquisition, LIODOTNET must allow changes in contractor's status in order to select the image more suitable for his requirements.
➢ In case of defective delivery (defective or broken CD), or uncompliment of any expected characteristic, the application does not allow inform about it.
➢ It would be interesting the integration of the VHR QL visualitation tool, VHR browser, into LIODOTNET. More useful one tool for all kind of imagery than two.
Control with Remote Sensing of Area Based Subsidies in Spain, 2005 Campaign- Use of the LIODOTNET application in Spain- 24/11/2005

Presentation 4 – LIODOTNET and VHR BROWSER - Tools for images acquisition management

Eric Guzzonato – SCOT, FR

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

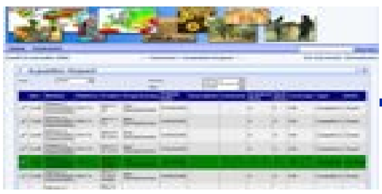
LIODOTNET and VHR BROWSER
Tools for images acquisition management

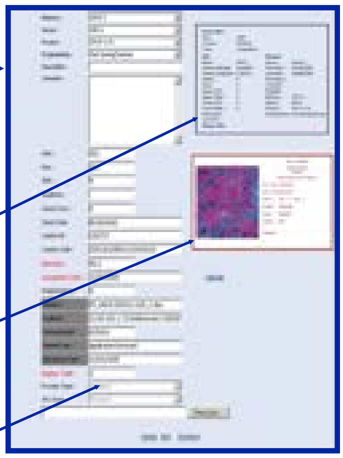
Regarding the SCOT experience for 2005 campaign
We have appreciated :

- an easier Acquisition following for 140 HR images and 17 VHR covering
- The consult of data, metadata and quicklook for all images during the campaign with downloading possibilities
- The direct on line images acceptation or reject
- The Order following

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

LIODOTNET and VHR BROWSER
SCOT amelioration proposition for 2006





We would prefer :

One window including

- image generality
- Quicklook visualisation
- Acceptation or reject possibility

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

LIODOTNET and VHR BROWSER
SCOT amelioration proposition for 2006

For VHR imagery management

We would prefer:

One tool including Liodotnet interface and VHR Browser

Presentation 5 - Cloud Coverage assessment – ImageSat

Rani Hellerman
ImageSat International N.V

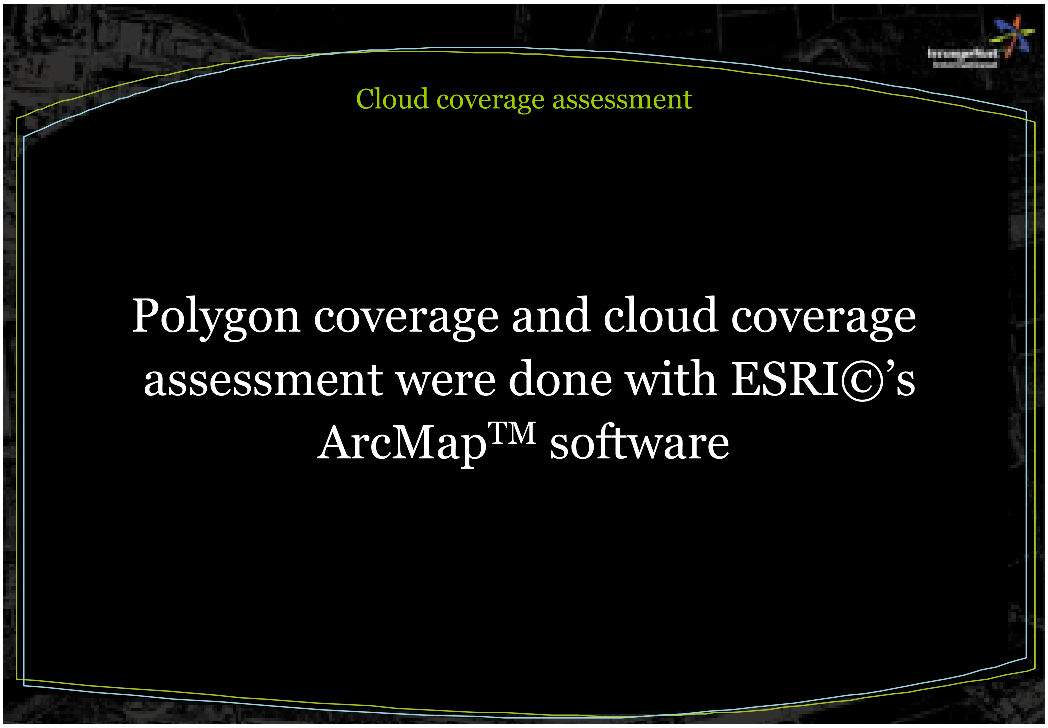
Abstract

The cloud coverage assessment is one of the major parts of the QA procedure to ensure that the production of a product meets a set of accepted standards.

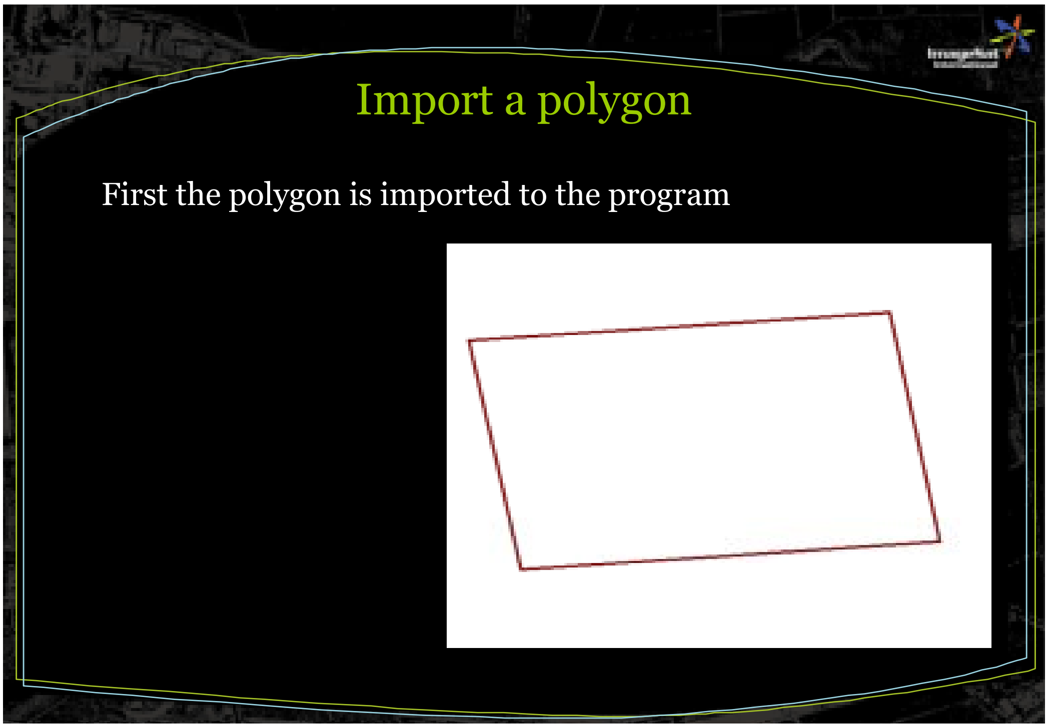
Cloud was defined as white opaque with little or no image information available of the ground features below. The Cloud Cover (CC) was assessed according to the number of pixels with whiteness above a threshold defined separately by the operator for every image. The customer service rep. Is importing the image to the ArcView SW and calculates the number of white pixels defined as “clouds” related to the total amount of pixels inside the polygon.

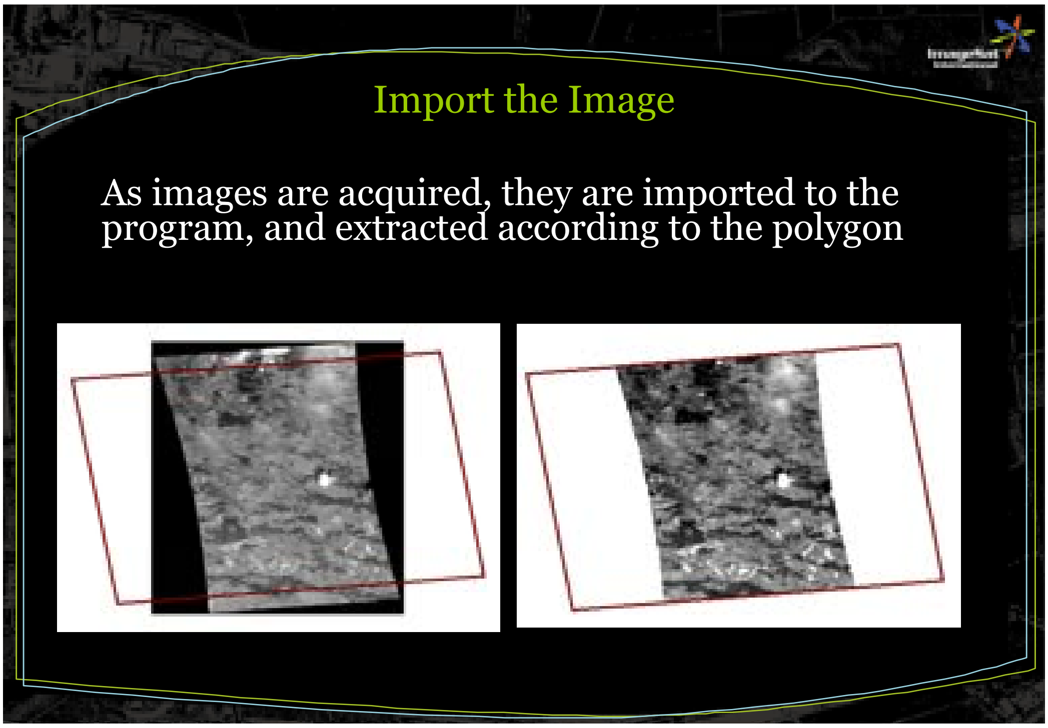
Keywords: Cloud coverage, ImageSat,

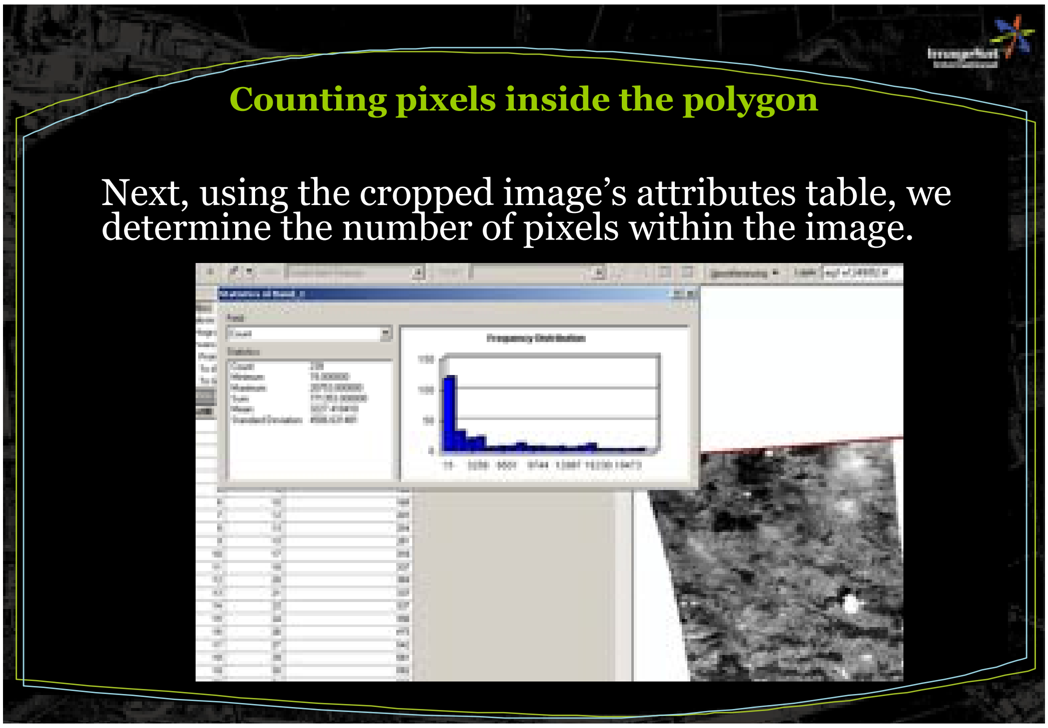
November 2005
EUROPEAN COMMISSION
Joint Research Centre
AGRIFISH Unit
Cloud Coverage Assessment
ImageSat International
Owners and Operators of the EROS Family of High-resolution Imaging Satellites

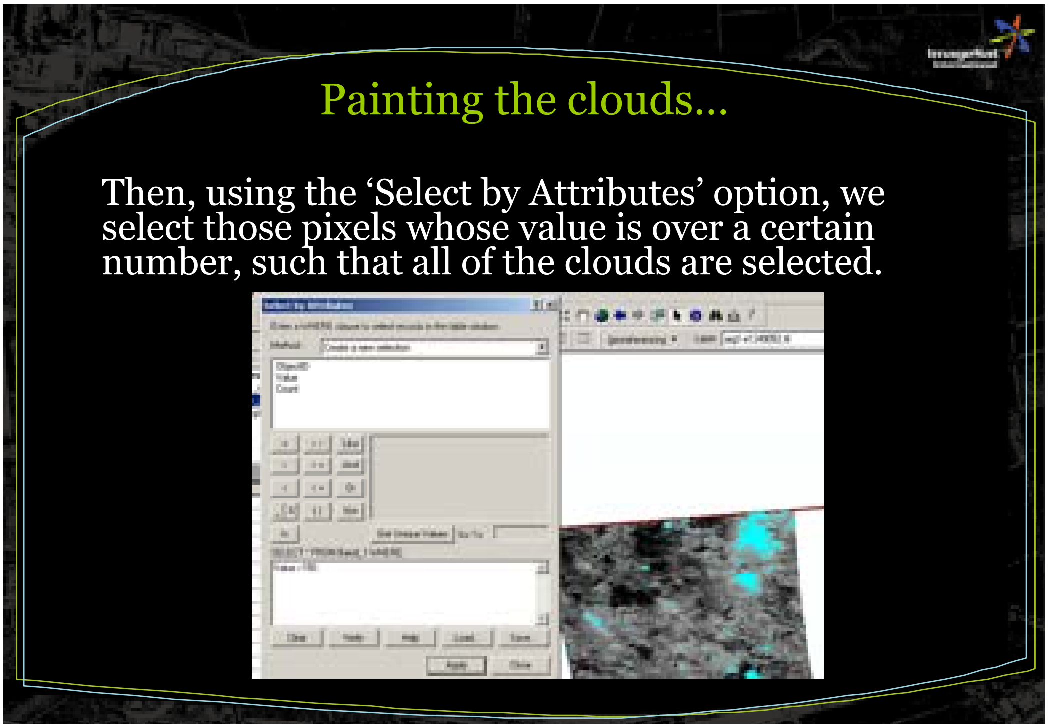


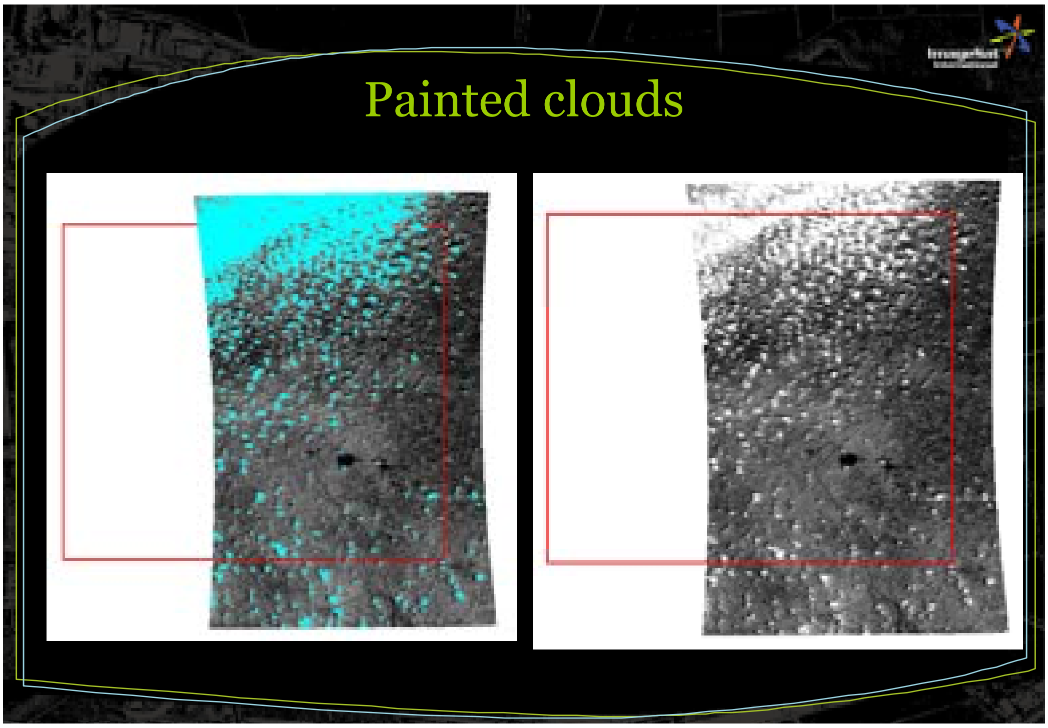
Cloud coverage assessment
Polygon coverage and cloud coverage assessment were done with ESRI©'s ArcMap™ software

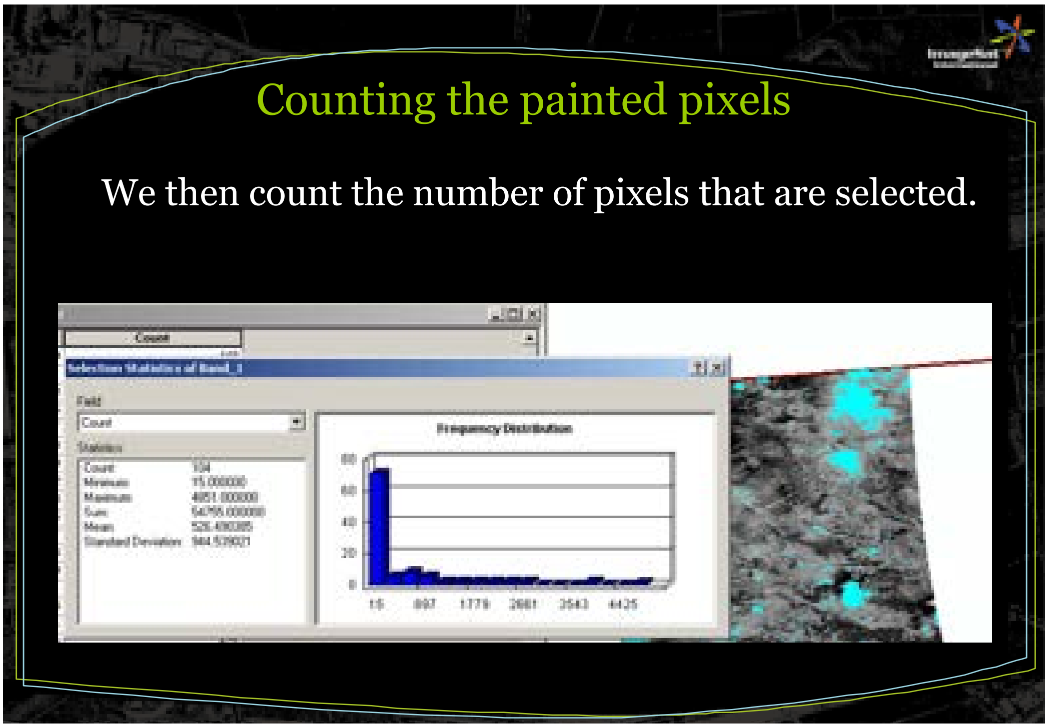

Import a polygon
First the polygon is imported to the program

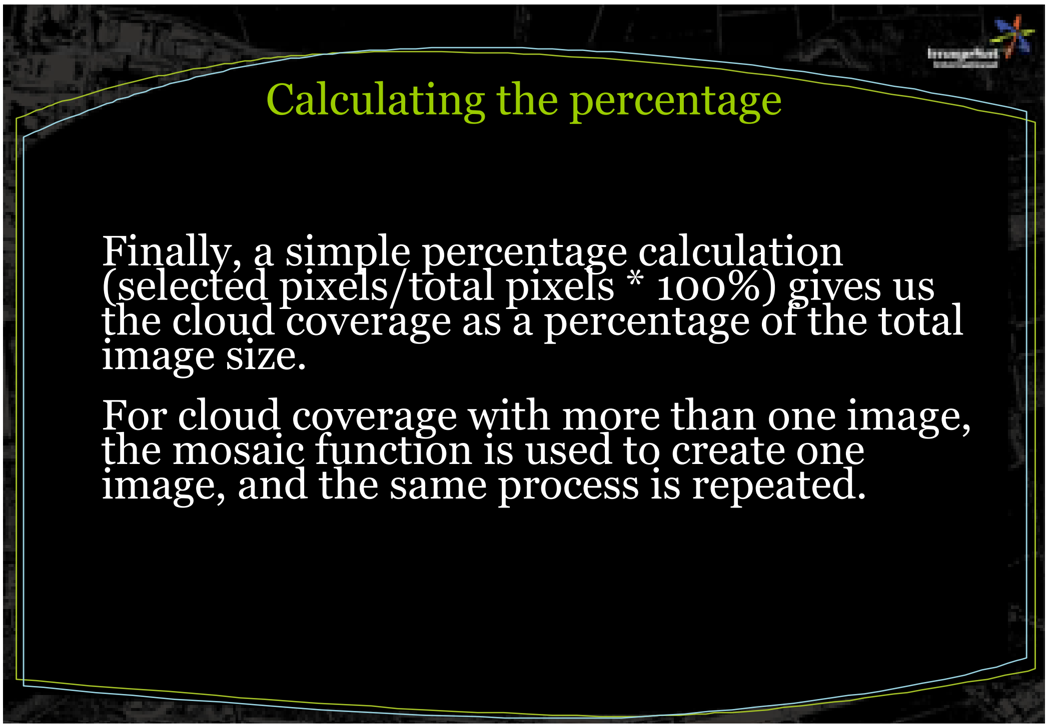

Import the Image
As images are acquired, they are imported to the program, and extracted according to the polygon

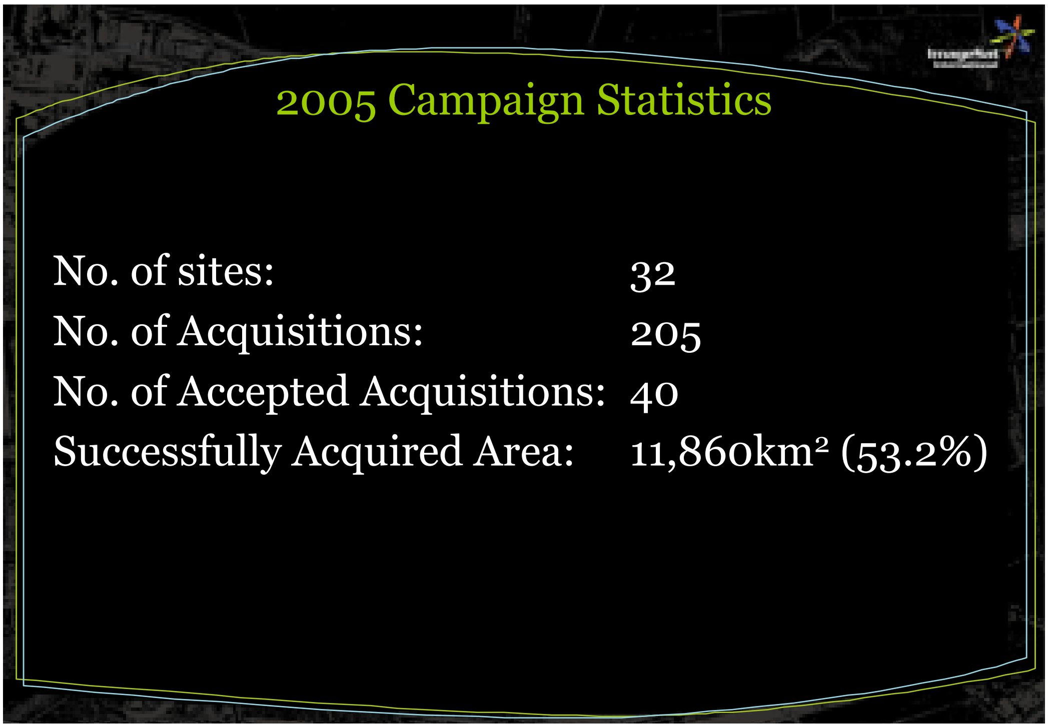

Counting pixels inside the polygon
Next, using the cropped image's attributes table, we determine the number of pixels within the image.

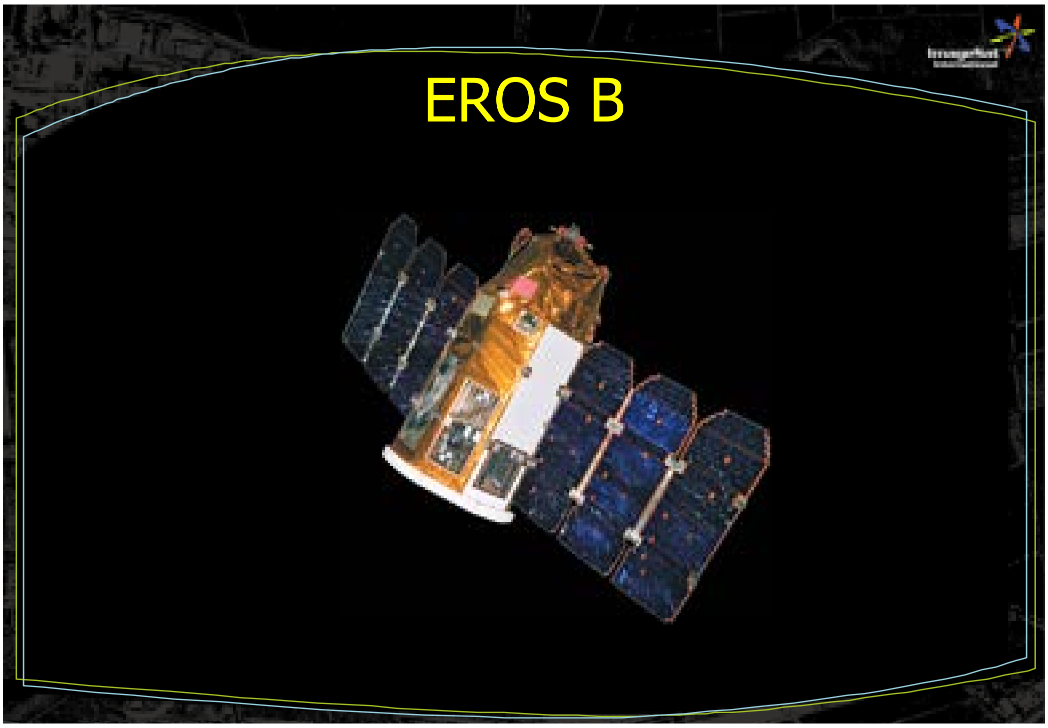

Painting the clouds…
Then, using the 'Select by Attributes' option, we select those pixels whose value is over a certain number, such that all of the clouds are selected.

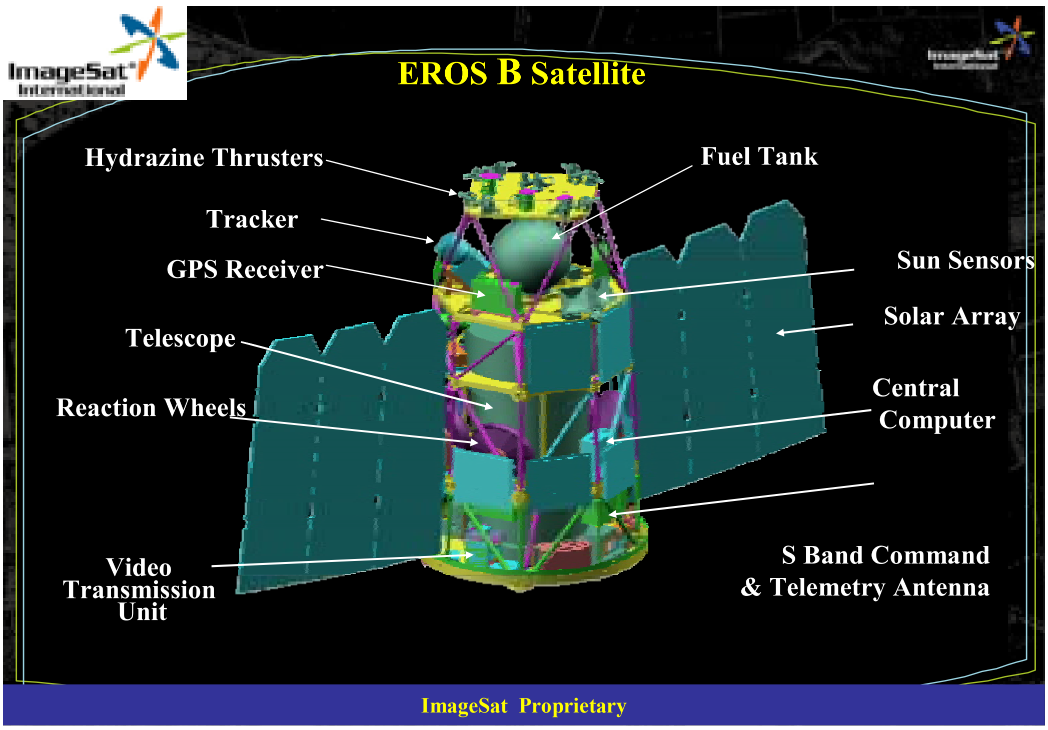

Painted clouds

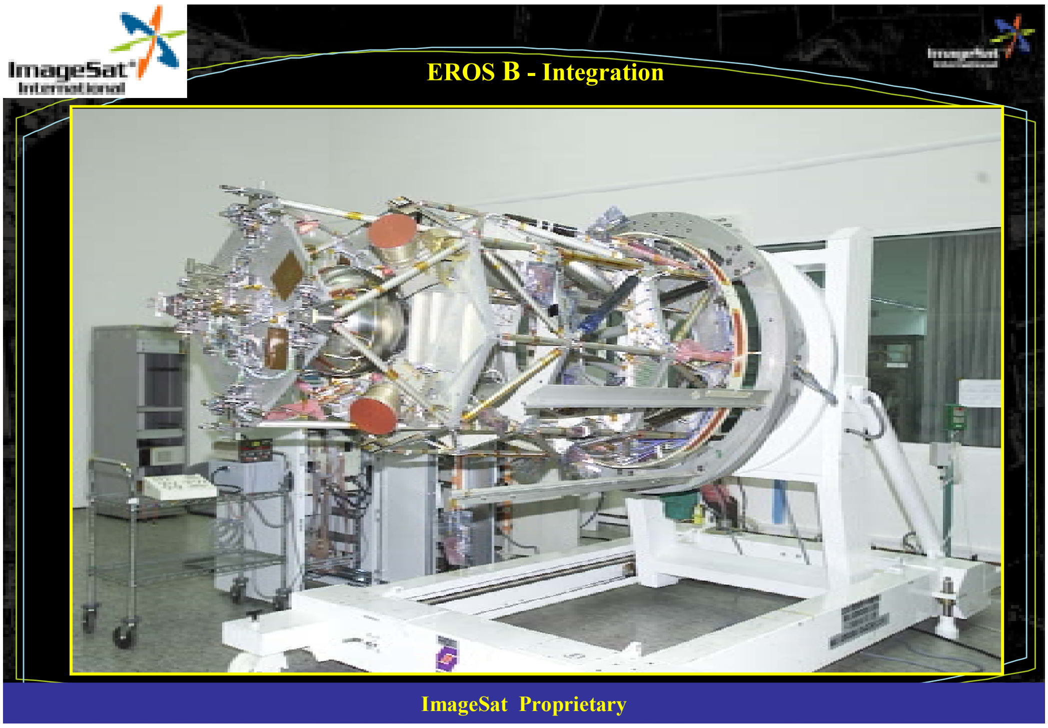

Counting the painted pixels
We then count the number of pixels that are selected.
Frequency Distribution

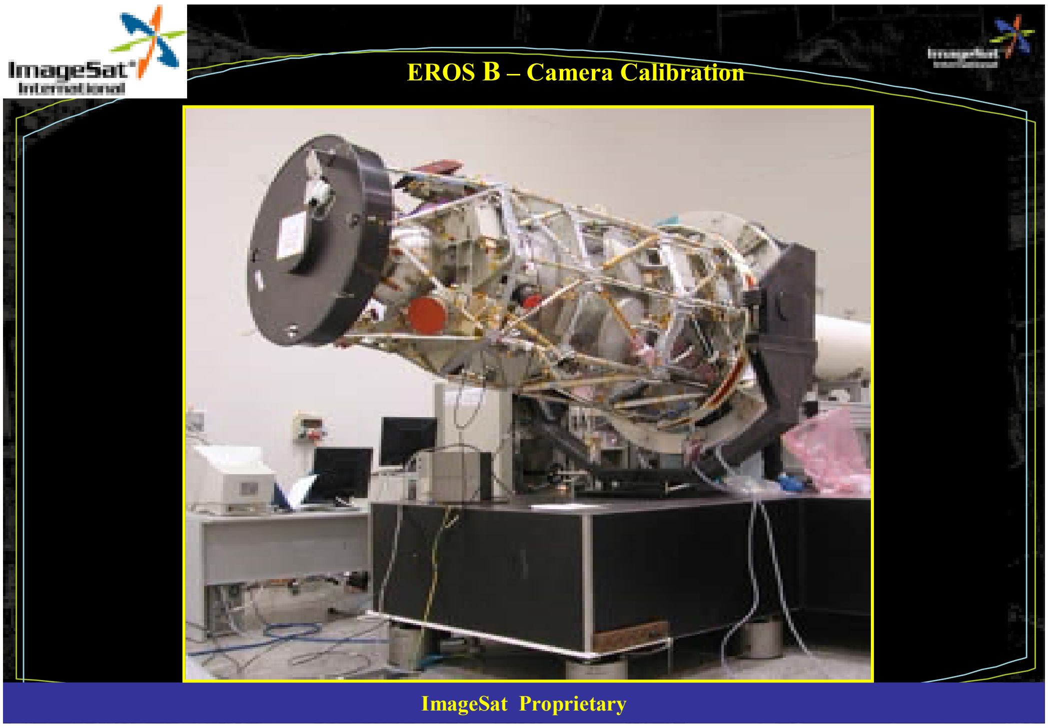

Calculating the percentage
Finally, a simple percentage calculation (selected pixels/total pixels * 100%) gives us the cloud coverage as a percentage of the total image size.
For cloud coverage with more than one image, the mosaic function is used to create one image, and the same process is repeated.


2005 Campaign Statistics
No. of sites: 32
No. of Acquisitions: 205
No. of Accepted Acquisitions: 40
Successfully Acquired Area: 11,860km² (53.2%)


EROS B


EROS B Satellite
Hydrazine Thrusters
Fuel Tank
Tracker
GPS Receiver
Sun Sensors
Solar Array
Telescope
Reaction Wheels
Central Computer
Video Transmission Unit
S Band Command & Telemetry Antenna
ImageSat Proprietary


ImageSat International
EROS B - Integration
ImageSat Proprietary


ImageSat International
EROS B – Camera Calibration
ImageSat Proprietary

EROS-B Mission & Performances

Orbit altitude and period	510 km & 95 min
Expected lifetime	2006 through 2016
Focal length	8,250 mm
Spectral band	Panchromatic only, 500 to 900 nanometer
TDI stages	1, 4, 8, 16, 32, 48, 96 selectable
Image collection rate	2,400 lines/sec
Sampling depth	10 bits
Radiometry	300 gray levels average
Array length & pixel size	10,151 & 11 micron
Field of view	0.775 deg
Footprint (nadir)	0.7 m
Nominal scene size	7 x 7 km
Mean response time (30 deg)	2.8 days
Stereo imaging	Along track & cross-track capable
Targeting accuracy CE90	Better than 500 m
Image geo-precision w/o GCPs	Better than 300 m

Presentation 6 - Evaluation of Cloud Cover and Future Evolutions

Laurent Garcia
Spot Image

Abstract

The presentation will explain the way we judge the cc over a given image.

We have the possibility to see the images acquired and everything that could obstruct the interpretation: clouds, snow and shadows…the quotations automatically made by the system for an octant are our reference for the analysis.

As a second step, we analyse the image in more details, by zooming on certain part and at the final estimate the percentage of CC within the AOI. We also analyse the presence of haze over the area, by making dynamic adaptation, and we isolate the hazy parts.

hen necessary, we have special tools that can estimate precisely the percentage of clouds + shadow+haze over an AOI. In fact, we make manually a vector mask.

It is mainly the visual analysis of the operator which estimate the percentage of clouds within the AOI in order to validate the acquisition or not, or propose it.

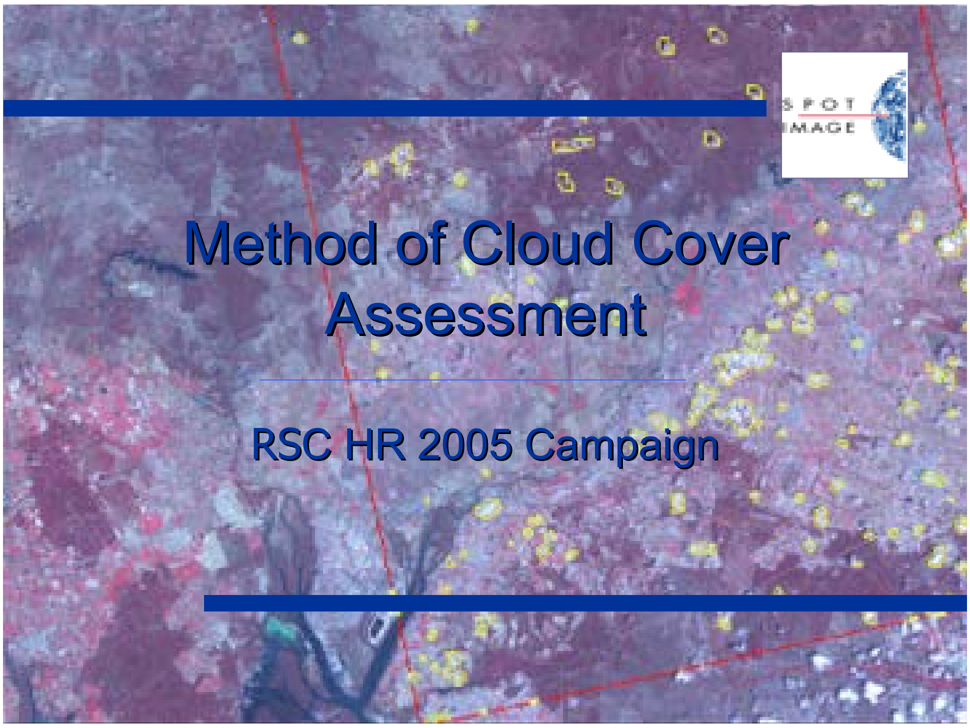
Validation with less than 1% CC is quite easy and can be made with a visual control only. Proposing and "retaining" images require more experience in image analysis.

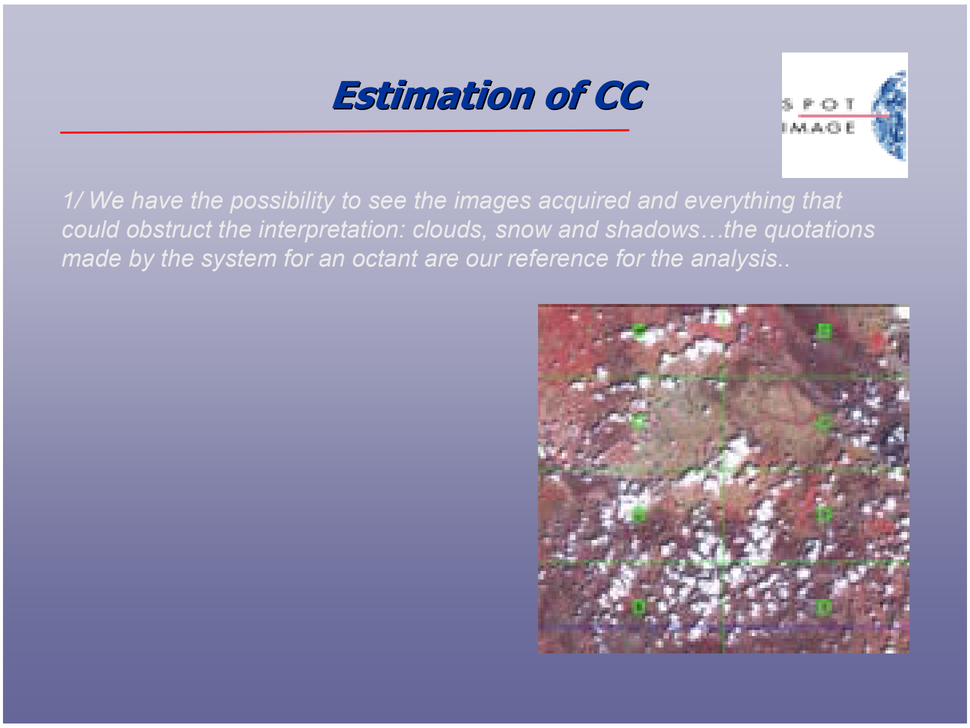
We take into account the radiometric values and also the dynamics of the image, we take into account the clouds +shadows and also the haze that can false the radiometric values. This qualitative estimation combined with our experience benefit to the client.

The future for Spot Image is a automatic system that could estimate automatically the clouds+shadows within the AOI for a given image, based on the SISA experience…

We will also briefly talk about the ordering and delivery, which is quite simple.

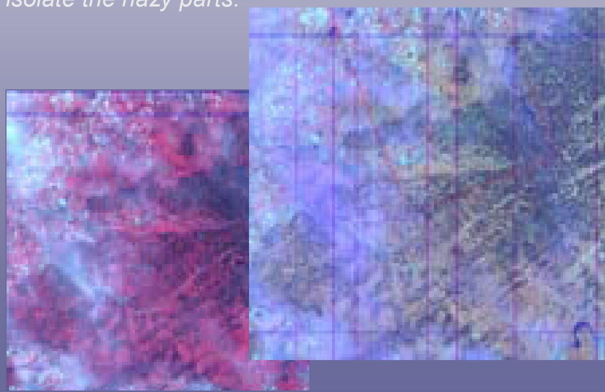
Keywords: CC (Cloud Cover), SISA, AOI (Area of Interest)


SPOT IMAGE
Method of Cloud Cover Assessment
RSC HR 2005 Campaign


Estimation of CC
SPOT IMAGE
1/ We have the possibility to see the images acquired and everything that could obstruct the interpretation: clouds, snow and shadows…the quotations made by the system for an octant are our reference for the analysis..

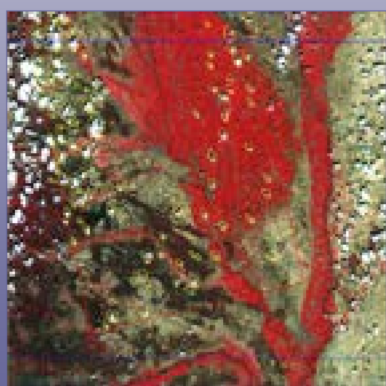
Estimation of CC

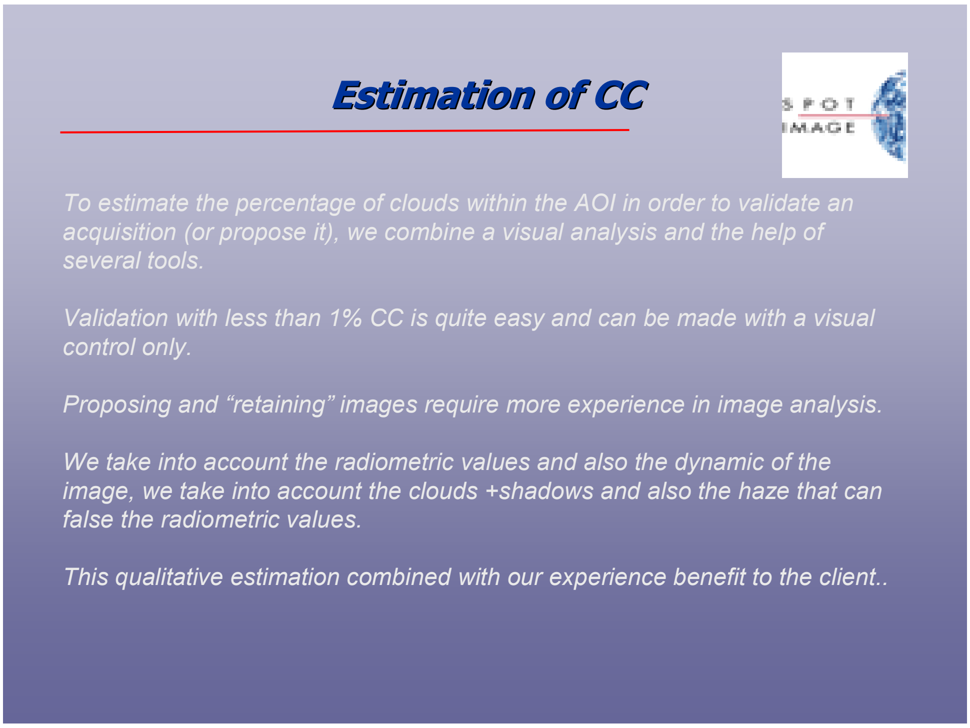
2/ As a second step, we analyse the image in more details, by zooming on certain part and at the final estimate the percentage of CC within the AOI. We also analyse the presence of haze over the area, by making dynamic adaptation, and we isolate the hazy parts.

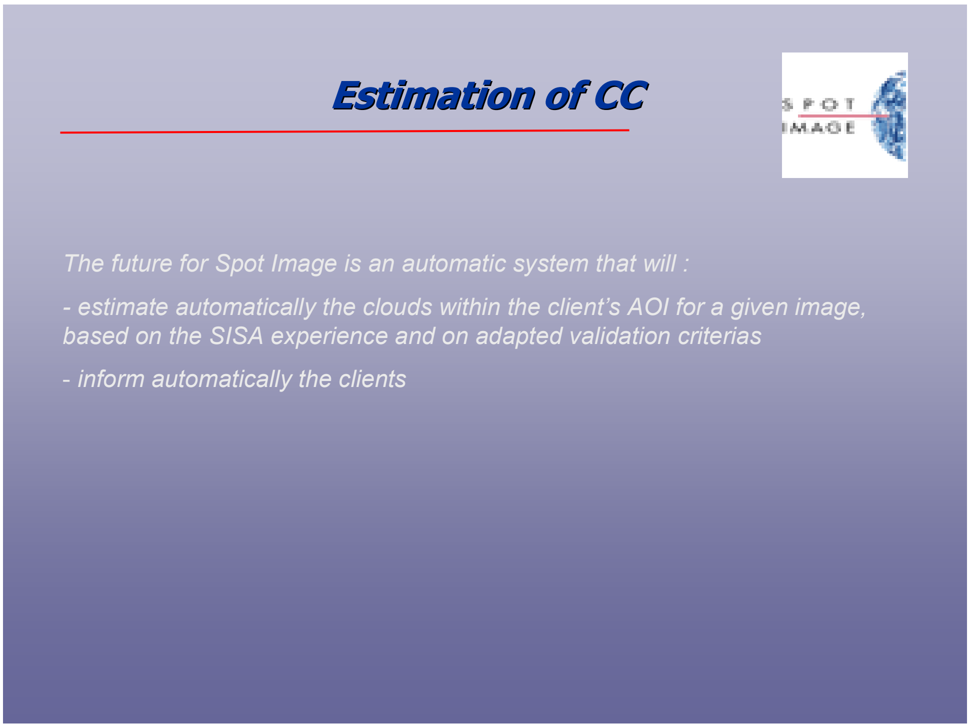


Estimation of CC

3/ When necessary, we have special tools that can estimate precisely the percentage of clouds + shadow + haze over an AOI. In fact, we create a vector mask. Here the percentage of cloud + shadow within the AOI is 11.04%




Estimation of CC
SPOT IMAGE
To estimate the percentage of clouds within the AOI in order to validate an acquisition (or propose it), we combine a visual analysis and the help of several tools.
Validation with less than 1% CC is quite easy and can be made with a visual control only.
Proposing and "retaining" images require more experience in image analysis.
We take into account the radiometric values and also the dynamic of the image, we take into account the clouds +shadows and also the haze that can false the radiometric values.
This qualitative estimation combined with our experience benefit to the client..


Estimation of CC
SPOT IMAGE
The future for Spot Image is an automatic system that will :
- estimate automatically the clouds within the client's AOI for a given image, based on the SISA experience and on adapted validation criterias
- inform automatically the clients

Presentation 7 - LIODOTNET; new requirements for 2006 – discussion; Image return and archiving

Pär Johan ÅSTRAND – JRC, IPSC, Agrifish Unit
Mihaela Fotin – JRC, IPSC, Agrifish Unit)

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LIODOTNET enhancements for the 2006 Campaign and in medium term

"discussion / questions"

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Outline of discussion

- LIODOTNET improvements
- VHR Browser improvements
- Cloud Cover (CC) analysis
- Image return and archiving

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Actors in LioDotNet

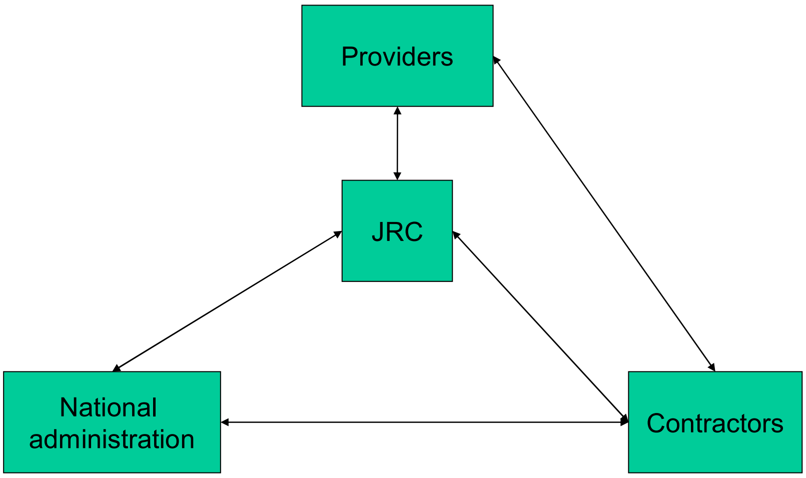

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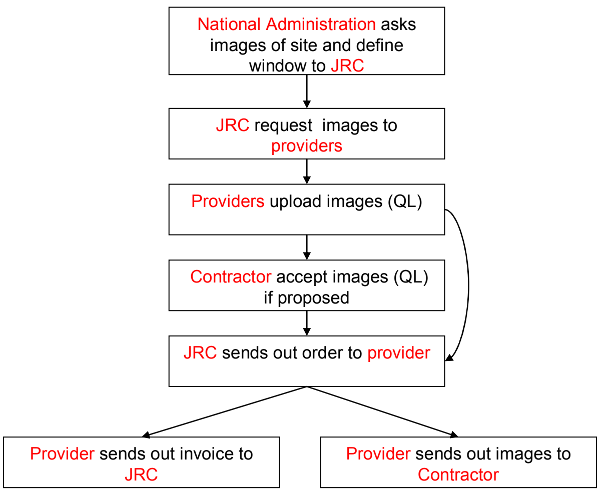
Image Request Workflow



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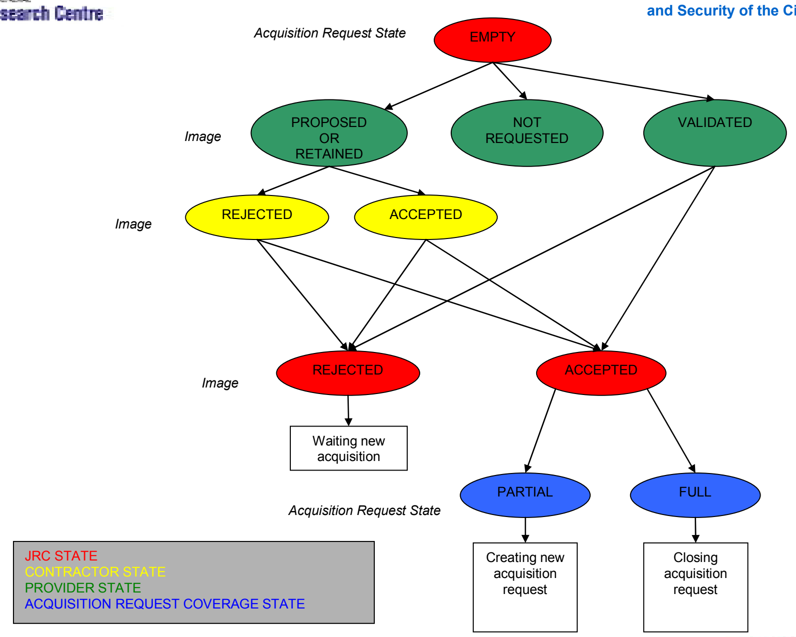

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LIODOTNET – 1; enhancements

- JRC – Providers – Contractors
  - differences in the LIODOTNET i/f and functions
    - restrictions to be discussed
  - new development
- JRC
  - ARs module
  - Orders module
  - Site module
  - Reports module
  - " a lot more…"
- Provider / Contractor
  - ARs module
  - Orders module
  - Site module

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LIODOTNET – 2

- how to best visualize an AR status / change of AR status
  - improve ARs module
  - what can Reports Module do ?

  - overview of all ARs – year, period, country, site etc.
  - need to easily see AR status
  - need of status change e-mail

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LIODOTNET – 3

- how to best visualize an order status / change of order status
  - improve Order module
  - what can Reports Module do ?

  - tracking of orders
  - dispatch e-mail
    - now; order #, Acq. ID ref #, site should include also sensor (or resolution) to differentiate VHR/HR
  - need of status change e-mail
  - change colour in order
  - order form
    - introduce sensor (or resolution) to differentiate VHR/HR

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LIODOTNET – 4

AR accepted and closed for SPOT
Order status : Sent to provider

AR accepted and closed for SPOT
Order status : Image Sent to tto contractor

Year | Period Selection

Country	Country	Country	Country	Country	Country	Country	Country	Country
Site	Site	Site	Site	Site	Site	Site	Site	Site
Site	Site	Site	Site	Site	Site	Site	Site	Site
Site	Site	Site	Site	Site	Site	Site	Site	Site
Site	Site	Site	Site	Site	Site	Site	Site	Site
Site	Site	Site	Site	Site	Site	Site	Site	Site
Site		Site	Site		Site	Site	Site	Site
Site		Site	Site		Site	Site	Site	
		Site	Site		Site	Site		
		Site			Site	Site		

1 Image SPOT Validated waiting JRC action

2 Images QB Proposed waiting (Contractor) action

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LIODOTNET – 5

- e-mail flow
  - make e-mail flow efficient
  - configuration form
    - every user (JRC, image provider, contractor) defines the email he wants to receive
  - filter
    - define eg. Outlook to archive appropriately

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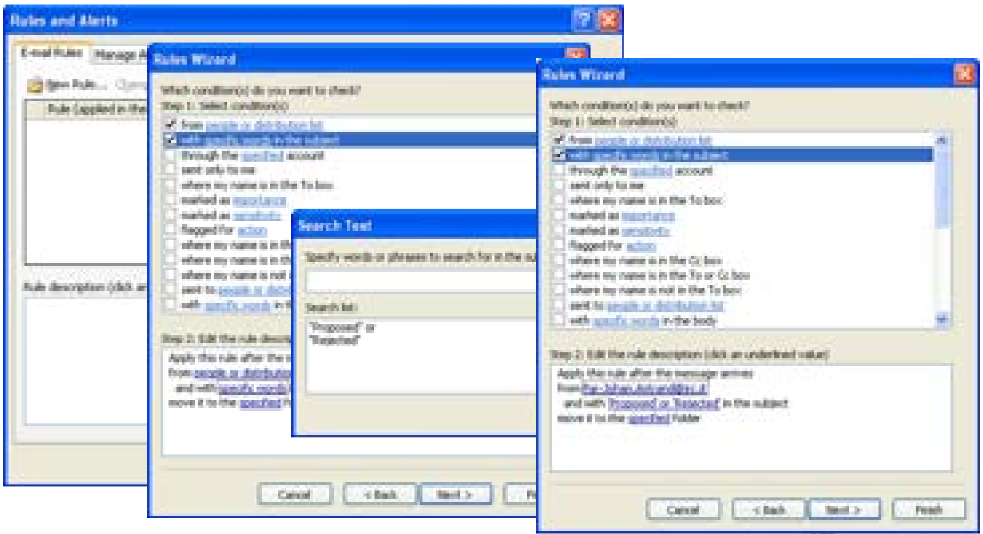
LIODOTNET – 6; filtering emails



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LIODOTNET – 7; THE AUTOMATIC E-MAIL FLOW GENERATED IN LIODOTNET

Purpose:

- **to ensure a good interaction for the acquisition management of the Campaign**

- **to synchronize the actions between all involved actors:**
  - **providers,**
  - **contractors,**
  - **JRC and**
  - **National Administrations**

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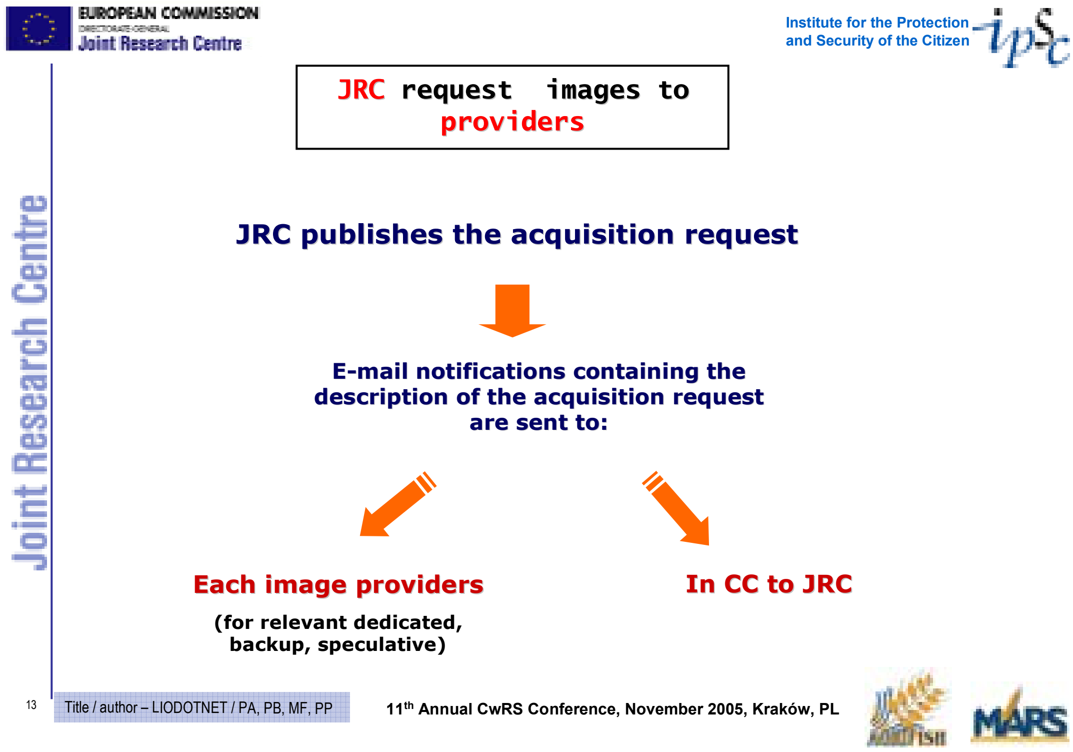
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JRC request images to providers
JRC publishes the acquisition request
E-mail notifications containing the description of the acquisition request are sent to:
Each image providers
(for relevant dedicated, backup, speculative)
In CC to JRC
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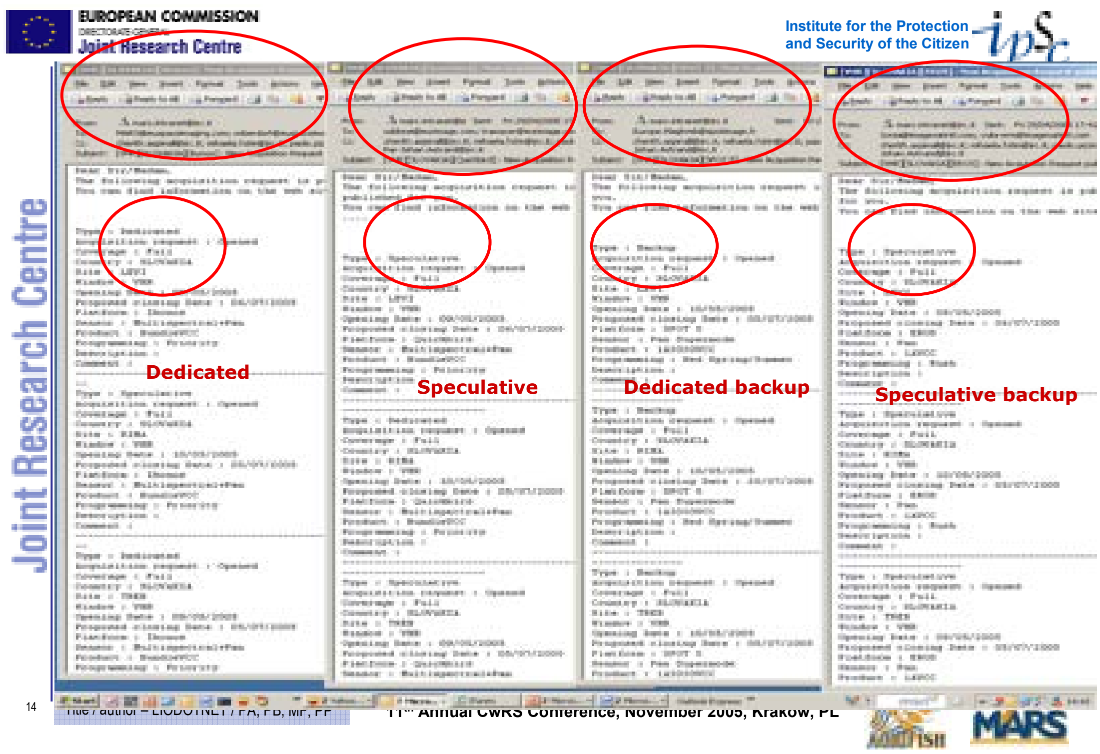
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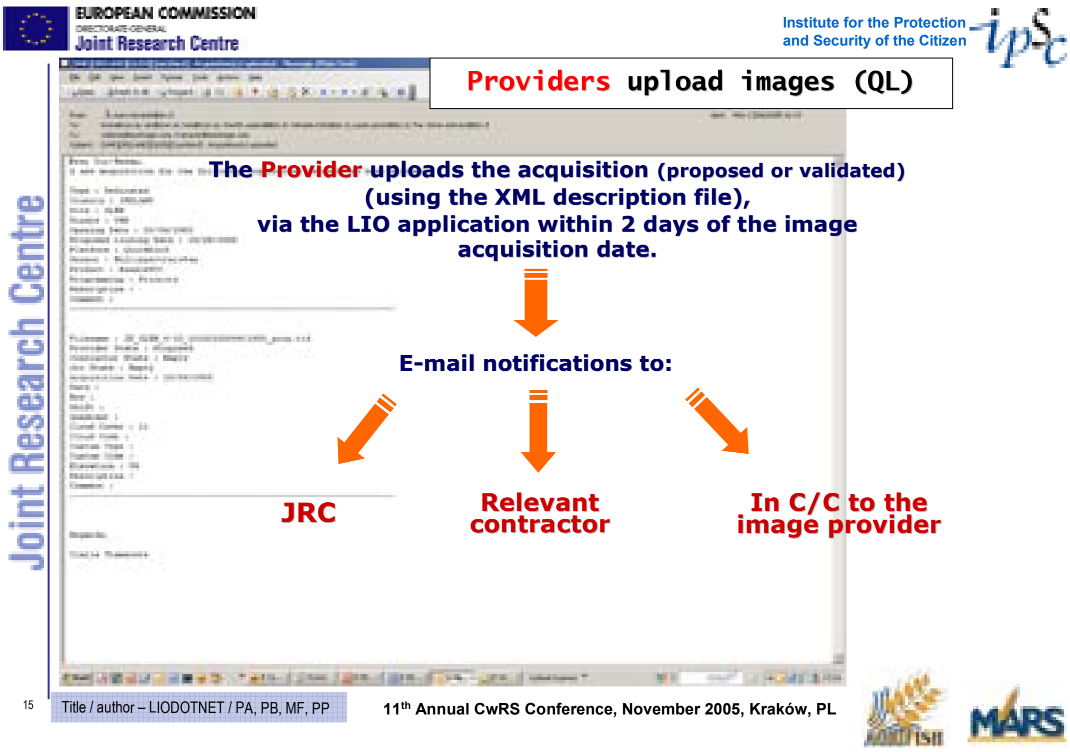
Dedicated
Speculative
Dedicated backup
Speculative backup
14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Providers upload images (QL)
The Provider uploads the acquisition (proposed or validated)
(using the XML description file),
via the LIO application within 2 days of the image acquisition date.
E-mail notifications to:
JRC
Relevant contractor
In C/C to the image provider
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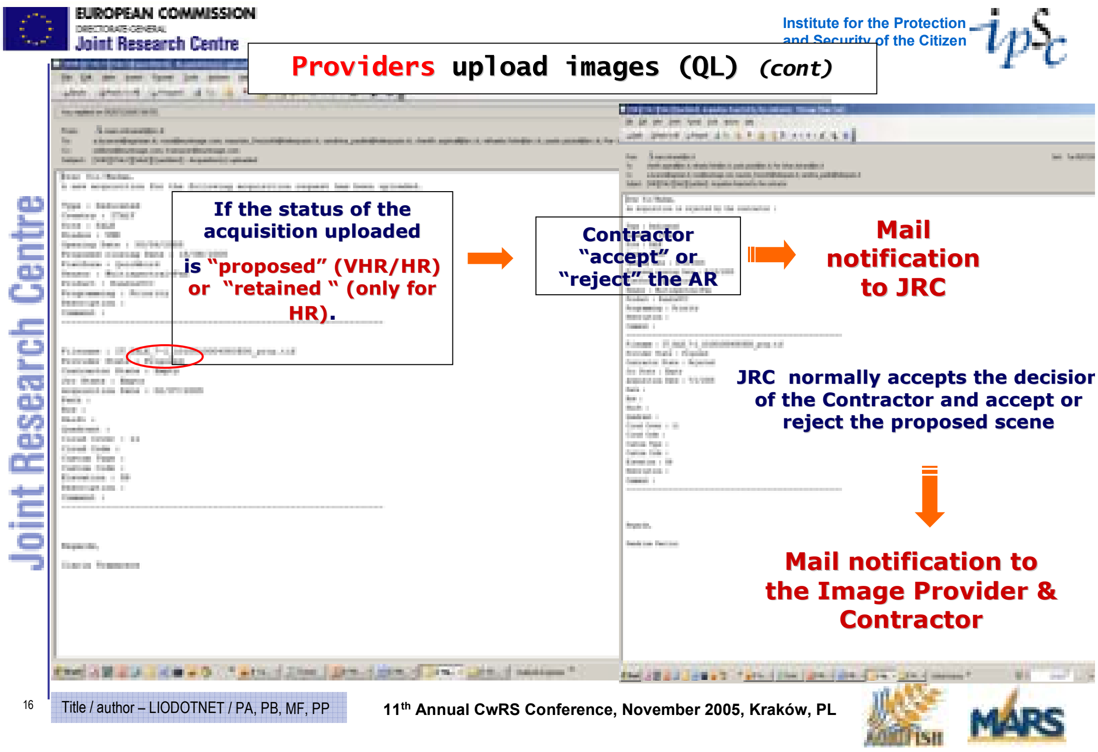
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Providers upload images (QL) (cont)
If the status of the acquisition uploaded is "proposed" (VHR/HR) or "retained " (only for HR).
Contractor "accept" or "reject" the AR
Mail notification to JRC
JRC normally accepts the decision of the Contractor and accept or reject the proposed scene
Mail notification to the Image Provider & Contractor
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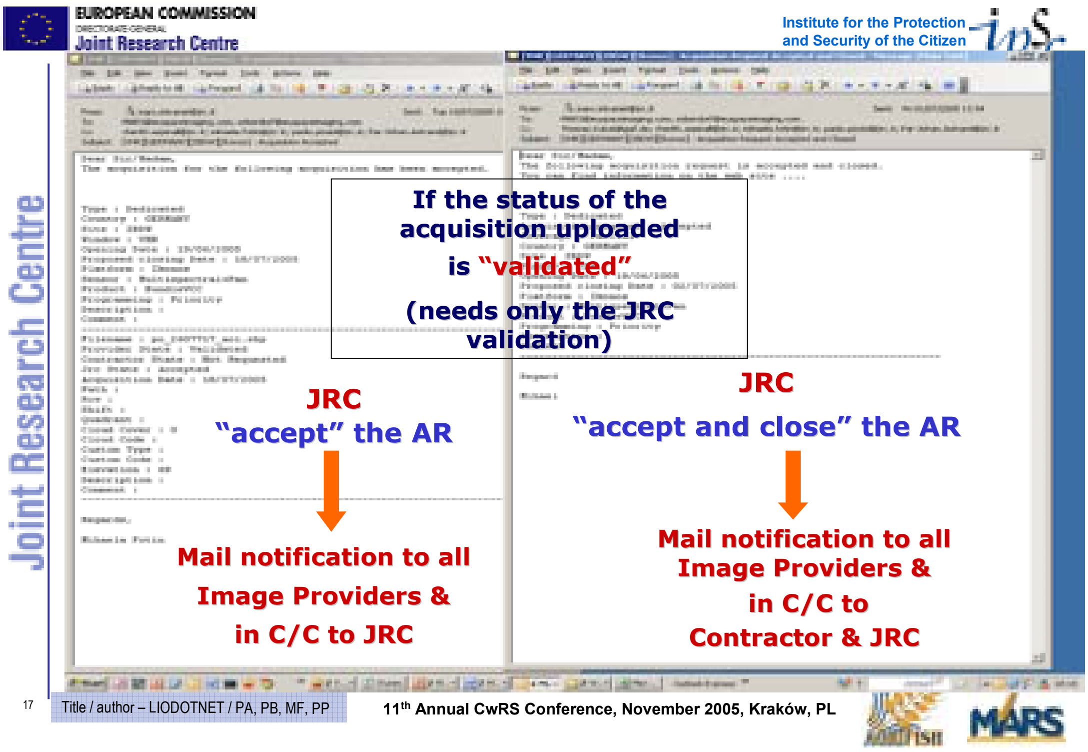

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Other automatic e-mail notifications

- **Extended AR (window extensions)** - **Image Providers, JRC**
- **Failed AR** - **Image Providers, JRC**
- **Disabled AR (wrong uploads)** - **Contractors, Image Providers, JRC**
- **Dispatch order** - **Contractors, Image Providers, JRC**

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LIODOTNET – 8

- Scheduler
  - end of window notification
  - email trigger time to be inserted in LIODOTNET

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VHR Browser – 1

- what is the VHR Browser
- the MARS VHR Browser is an online application for displaying and browsing VHR quick looks and shape files from the image acquisitions
- see MF on –live demo earlier in this session...

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VHR Browser - 2 ; enhancements

- visualize original and extended VHR windows in same viewer
- visualize dedicated and backup VHR acquisitions in same viewer
- visualize Georeferenced HR in same viewer as VHR
  - do we need to geo reference HR QL?
  - upload of georeferenced HR QL
    - XML, ZIP
- add a control to change layer display order [up/down]
- layer transparency

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Cloud Cover Assessment - 1

- no. of uploads in total
  - CC%, thresholds
- use of more imagery
  - mask out clouds
  - image provider takes 3-5 times required km2 to achieve acceptance – contractor may use multiple set
- handle control parcels vectors to image provider
  - helps image provider to propose right imagery

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Cloud Cover Assessment - 2

- CC analysis MF from VHR presentation S2

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Images uploaded by Provider - Cloud Cover

All Image Providers used LIODOTNET server to upload : validated, proposed, backup, and speculative backup imagery (in case of VHR image with their related shapefiles)

Images uploaded/ CC	< 5%	5 - 8%	8 - 10%	10 - 12%	> 12%	TOTAL
EURIMAGE	82 (73%)	8	1	10	12	113
EUSI	157 (79%)	12	10	5	16	200
IMAGESAT	25 (60%)	9	4	4	0	42
SPOTIMAGE	27 (100%)	0	0	0	0	27
TOTAL	291	29	15	19	28	382

CC < 5% = 76.0 % of total uploaded (291)

CC 5-10% = 11.6 % of total uploaded (44)

CC > 10% = 12.4 % of total uploaded (47)

	Proposed	Accepted	
EURIMAGE (CC>10%)	22	3	13.6%
EUSI (CC> 5%)	43	17	39.5%
IMAGESAT (CC>10%)	4	2	50.0%

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Image return and image archiving - 1

- **Data Return and Image Archiving**
  - At the end of the campaign, the HR/VHR source and ortho-corrected imagery used in the CwRS Campaign must be returned to the JRC, Ispra. This is explained in the CTS (§ 7.5.4) and in Recommendations 1 (§ 5.8.1) The delivery must be accompanied by the necessary documentation:
  - the IDQA_2005 (Image Data Quality Assessment) document giving parameters on the source image see IDQA_2005
  - the metadata for the ortho corrected imagery - see http://marsmap.jrc.it/public/tools/metadata/
  - the data itself on CDROM or DVD
- i.e. metadata
  - source, ortho
- source and ortho-corrected data

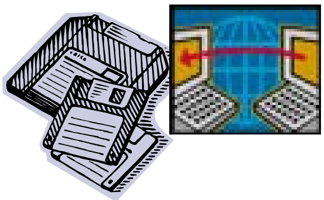

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Image return and image archiving - 2

- metadata for source data
  - image return form
    - IDQA
- source data
  - original DVD, CDROM => JRC
  - if FTP download place on DVD, CDROM => JRC

SITE name
JRC Order code (1) - see LIODOTNET order /delivery note
JRC Order code (2) - see LIODOTNET order /delivery note
Data Readability source image
Ancillary information to allow for ortho-correction (eg. view angle, orbit, RPC etc) present and readable
Imagery allows for GCP placement
Image visual quality (haze, contrast, saturation, histogram)
Cloud on parcel structure

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Image return and image archiving - 3

- metadata for ortho corrected data
- most important one is the projection system
  - without knowing the projection system the data are nearly useless because projection system has then to be estimated, which is not really easy or just impossible (eg. in countries like France where they use 10 different Lambert coordinate systems in various flavours).
  - the rest of the information could in principal be retrieve from the file if it's a true GeoTIFF (or a full valid IMG).
  - best is to identify the correct EPSG code using the search function available from the online metadata tool.
  - getting the “Well Known Text” description is OK in case the EPSG code really cannot be found
- also the acquisition date should be indicated in case we cannot trace back the ortho to the raw image.

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Image return and image archiving - 4

* completely fill in the form
* download the form as XML file
* store the XML file *together* (on the same media) with the image data (according to the instructions)
* instead of filling in all information by hand, the metadata could alternatively be written out to XML files by a small script, using the required XML structure.
* do *not* send the metadata files separated from the images
* provide only image formats that are mentioned in the Image Format drop-down list
* GeoTIFF is the strongly recommended format
* GeoTIFF format should be *real* GeoTIFF with correct headers, not just TIFF with world file (*.tfw)
* if a projection EPSG code cannot be found in the provided search functionality, provide the complete Well Known Text (WKT) description; an example of WKT structure is available via the link "Example for WKT definition"
* SCENE coordinates should be in *decimal* degrees, not in degree-minute-second notation

Instructions for Ortho Image return

Please fill in the mandatory fields. You can check complete entries using the 'Check Entries' button. If all required entries are done, save the metadata to an XML file clicking on 'Return Metadata XML File'. You will then be asked to download the file.
Please save this file and place it together with your orthoimage file, keeping the name 'imgmeta.xml'.
If there are more than one orthoimage in the same directory then rename the imgmeta.xml for every image corresponding to the image name in the way 'YOUR_IMAGE_FILENAME_meta.xml'; e.g.
image file: hetr_08876df9xs.tif
metadata file: hetr_08876df9xs_meta.xml
If necessary, you can still modify this XML file with a text editor.

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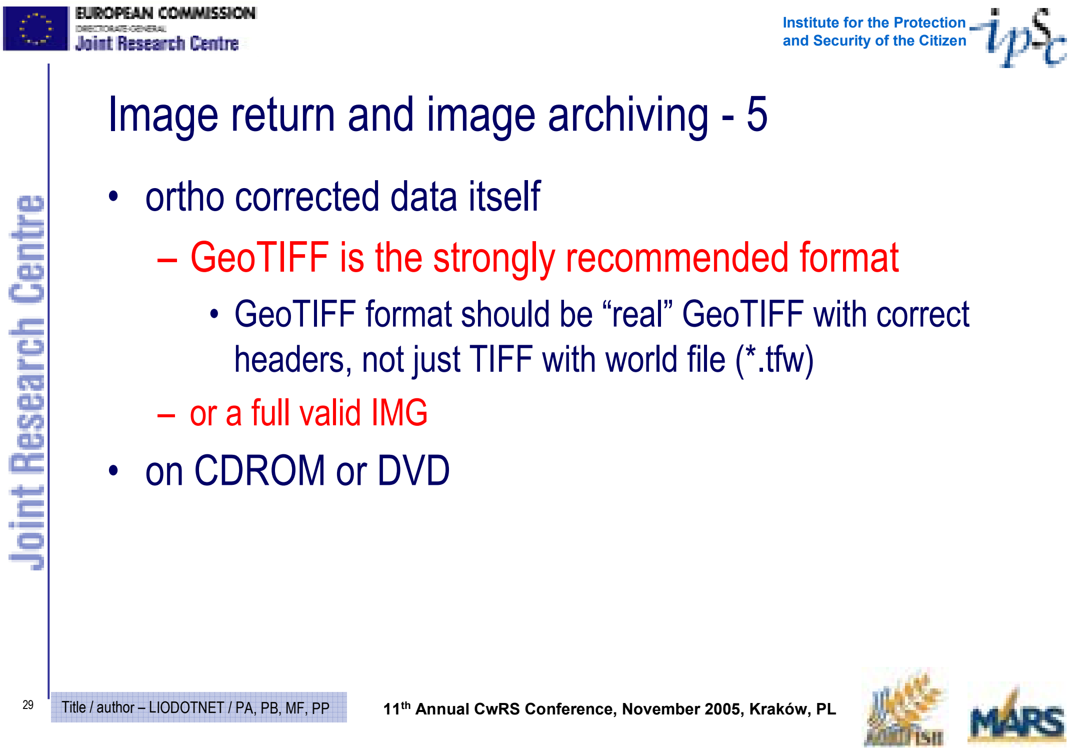
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Image return and image archiving - 5
• ortho corrected data itself
– GeoTIFF is the strongly recommended format
• GeoTIFF format should be "real" GeoTIFF with correct headers, not just TIFF with world file (*.tfw)
– or a full valid IMG
• on CDROM or DVD
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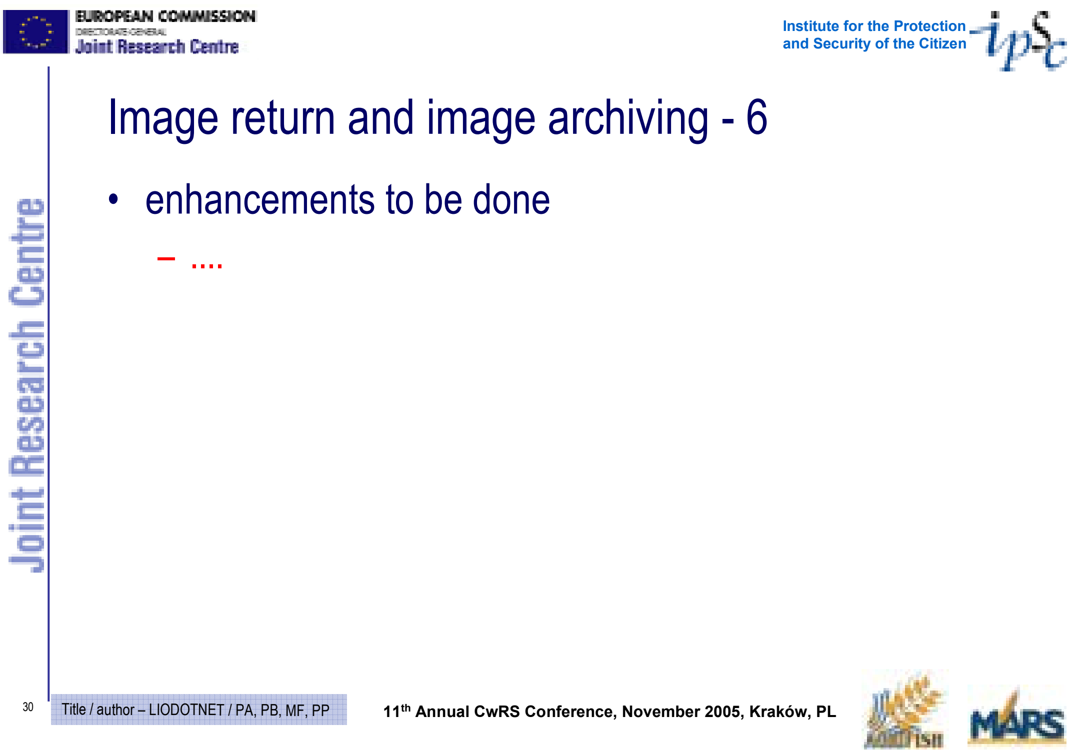
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Image return and image archiving - 6
• enhancements to be done
– ....
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thank you !

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- philippe.buchet@jrc.it
- mihaela.fotin@jrc.it
- paolo.pizziol@jrc.it

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Parallel Session T5 – Image Processing, CAPI and (IACS) GIS

Chairman:

Jolanta Orlinska, PL

Presentation 1 – LPIS/GIS data acquisition and quality management

Jolanta Orlińska, Jacek Jarząbek
ARMA, PL

Abstract

The most important element of IACS system within the process of payment's authorization is Land Parcel Identification System (LPIS). It operates in GIS technologies and constitutes the primary source of eligibility control pertaining to agricultural land declared for aid schemes within CAP. The principle factor of usefulness measurement of any spatial system, in particular such as LPIS, is completeness and quality of data which constitute the reference database for administrative checks. A proper establishment of technical standards for source materials adjusted to agrarian structure and specific technological conditions in connection with the principle objective, which is the delimitation of eligible areas and determination of its surface, guarantee the efficient operation of the system and its reliability. Also taking into account the fact that the data acquisition is the most cost- and time-consuming part of building up the Information System, effective management of data collection, quality assurance procedures, proper archiving and sharing is a crucial element in the process, especially when the huge amount of data have to be implemented in the system IACS.

The paper presents the concept of the LPIS/GIS as regards the type and source of data and their roles in the system are concerned. The organisation of data acquisition, verification, quality control and management to ensure the compliances with needs and requirements of the data in the system are also covered in the presentation.

LPIS/GIS data acquisition and quality management

DEPARTMENT OF FARM REGISTER

Plan of presentation

Part 1	**LPIS/GIS in Poland – general information**
Part 2	Data – types and their role in the system
Part 3	Data quality control
Part 4	Data management and distribution

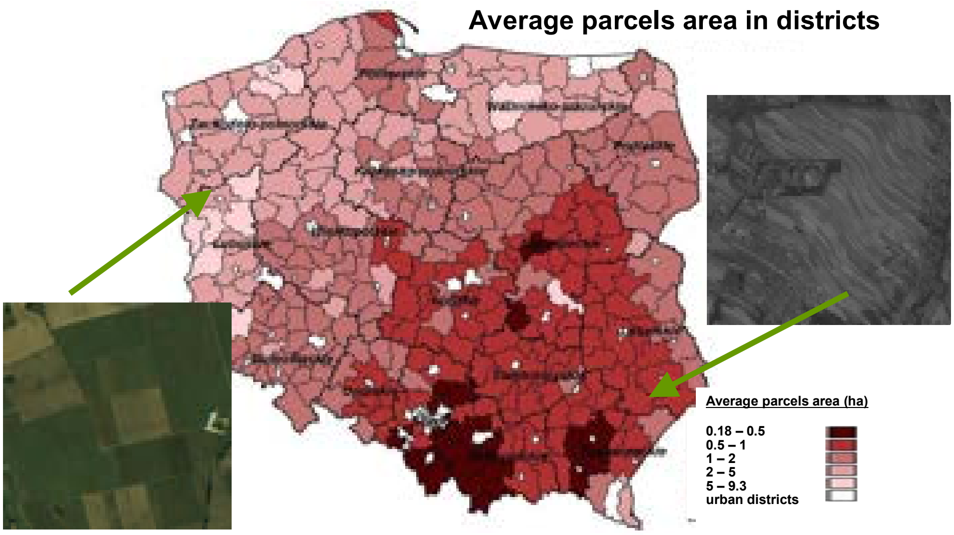
General information

- Poland covers an area of 312 685 km²
- agricultural areas 183 926 km²
- permanent pasture 40 780 km ²
- farms (> 1 ha) 1 840 000
- average farm area 8,4 ha
- potential beneficiaries 2,0 mln
- cad. parcels ~ 32,5 mln
- cad. parcels/agricultural area ~ 22,0 mln

- number of agriculture parcels ~13 mln
- number of cadastral parcels ~9.7 mln
- average number of agriculture parcel per farm 9

Agriculture structure

Average parcels area in districts



Main characteristic of reference data

Statistical data after 2004 campaign

- **70% of reference parcels consist of one land use**
- **Average area of reference parcel - 1.58 ha**

- **95% area of reference parcel is eligible**
- **Average size of eligible area on reference parcel - 1.46 ha**

- **98% of area eligible is declared**
- **Average area of agriculture parcel – 1.06ha**

Methodology – reference parcel

- **cadastral parcel –** boundaries and surface constitute the universal base for different payment schemes,
- **unique reference parcel localization -** (TERYT+ geodetic unit, number of geodetic unit, number of map sheet, number of cadastral parcel)
- **information concerning reference parcels** (object data, subject data – number/total area/eligible area)
- **unique attribute of payment eligibility**
  arable land, permanent pastures, orchards – EUROSTAT
  R+Ł+S+Ps+E-Ł+E-R +E-Ps

Plan of presentation

Part 1	LPIS/GIS in Poland – general information
Part 2	**Data types and their role in the system**
Part 3	Data quality control
Part 4	Data management and distribution

LPIS/GIS database

- **Descriptive part of land register** ***(processed)***
- **Raster of cadastral map**
- **Orthophotomap**
- **Vector data**
- **Register of agricultural producers**

Descriptive database from the land register

- Up-dated from December to March every year
- 33.1mln parcels imported and 46.8 mln of land uses on the reference parcels
- Aggregation of land uses and quality checks performed
- Clarification of discrepancies with geodetic service
- Land uses in the cadastre updated by farmers
  (110 000 applications recognized during 0.5 year in the cadastre)

Changes monitoring and intervention importing procedures applied

Descriptive database from the land register

The role of descriptive data in the system:

- Identification of reference parcel (number and total area of cadastral parcel)
- Localization of reference parcel
- Determination of eligible areas of reference parcel

Graphical database

ORTOPHOTOMAPS:

1. **Standard I**
   Pixel size 0.5 – 1.0 m
   RMSE 1.5 – 2.5 m
2. **Standard II**
   Pixel size 0.25 m
   RMSE 0.75 m

aerial photos (85%)
satellite imagery (15%)

Graphical databases

The role of orthophotomaps in the system:

- **Identification of reference parcel, its borders and land use areas**
- **check of eligibility of area declared entirely and definitely – (measurement)**
- **source for delimitation of reference parcel and eligible areas within the reference parcel – (vectorization)**

Graphical databases

CADASTRAL MAPS (raster with centroids):

- 79% of territory of Poland covered by scanned cadastral maps
- Centroids integrated with the descriptive database

The role of raster maps in the system:

- spatial identification of the parcel by centroid on the orthophotomap
- support in the identification of land uses eligible for the payment through the land uses marked on the cadastral map
- Raster borders of reference parcel (tool for interpretation)

Graphical databases

Vector data in the system

- Borders of reference parcel
- Borders of eligible areas
- Borders of non-eligible areas

  (nine categories of different kind of land uses)
- Administrative borders
- Selective topographic features

- Landscape features, borders of ranges of selective EU directives … etc. (nearest future)

Summary of LPIS/GIS concept

Identification

- Agriculture parcel identified through the unique number and localizations of cadastral parcel

Eligibility

- Eligible area calculated through automatic spatial intersection of vector layers
  - Non-eligible areas
  - Boundaries of cadastral parcels
- Identification of eligibility supported by land uses from cadastral map

Summary of LPIS/GIS concept

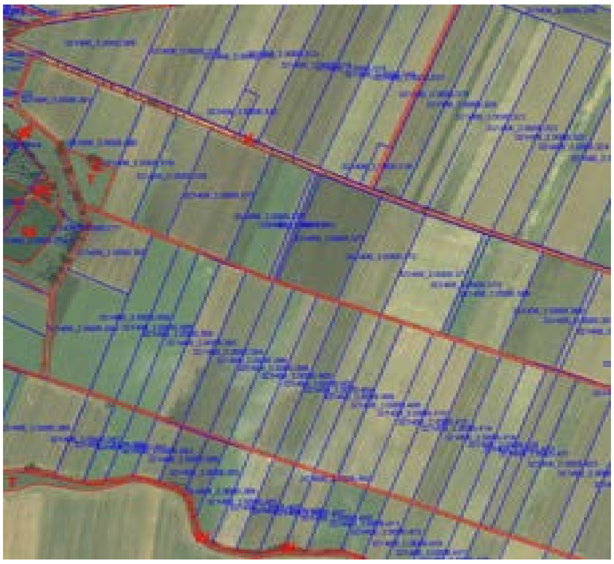
Verification

- Control procedure of quality of data
- Clarification with the farmer if the discrepancies are detected during the application and administrative control procedure on the bases of graphical materials
- On-the-spot-check

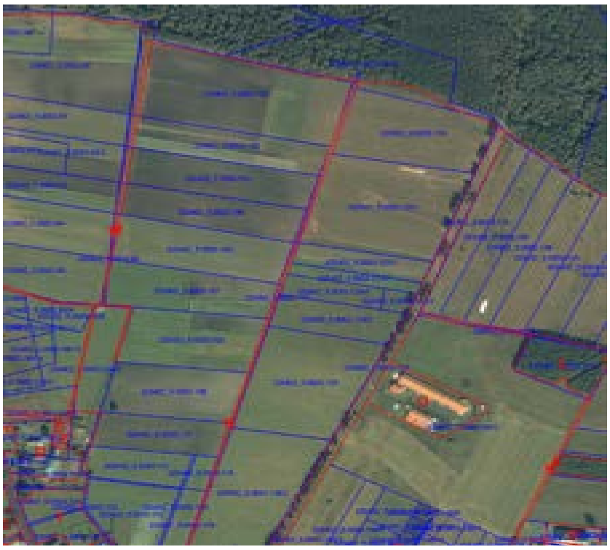
Up-dating

- Current updating as a result of the verification process of application
- Permanent updating within approximately 5 years period (1 year for descriptive part)

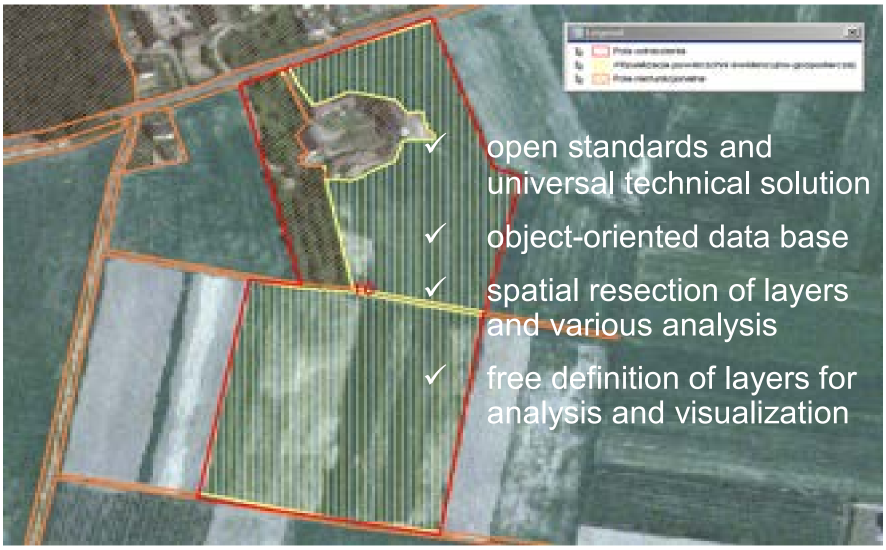
Graphical databases vector layers

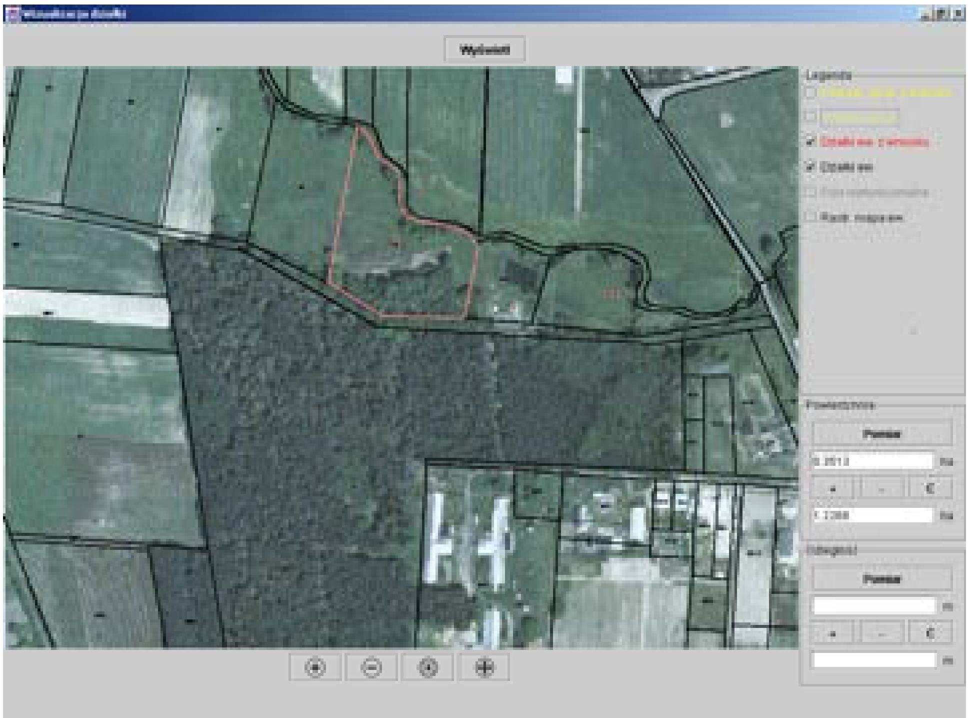


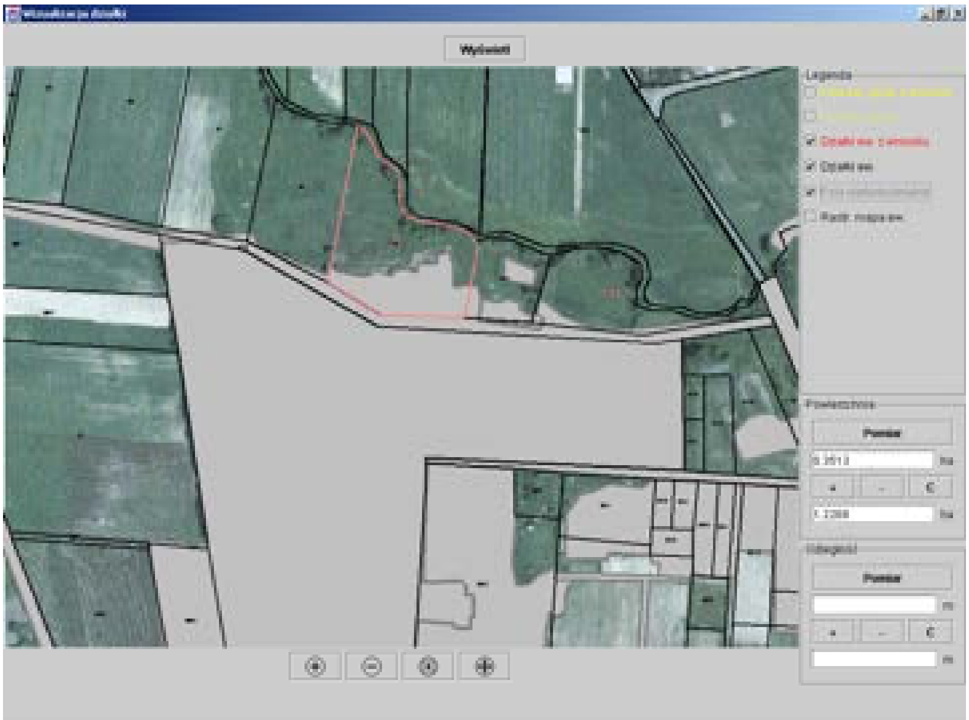
Graphical databases vector layers

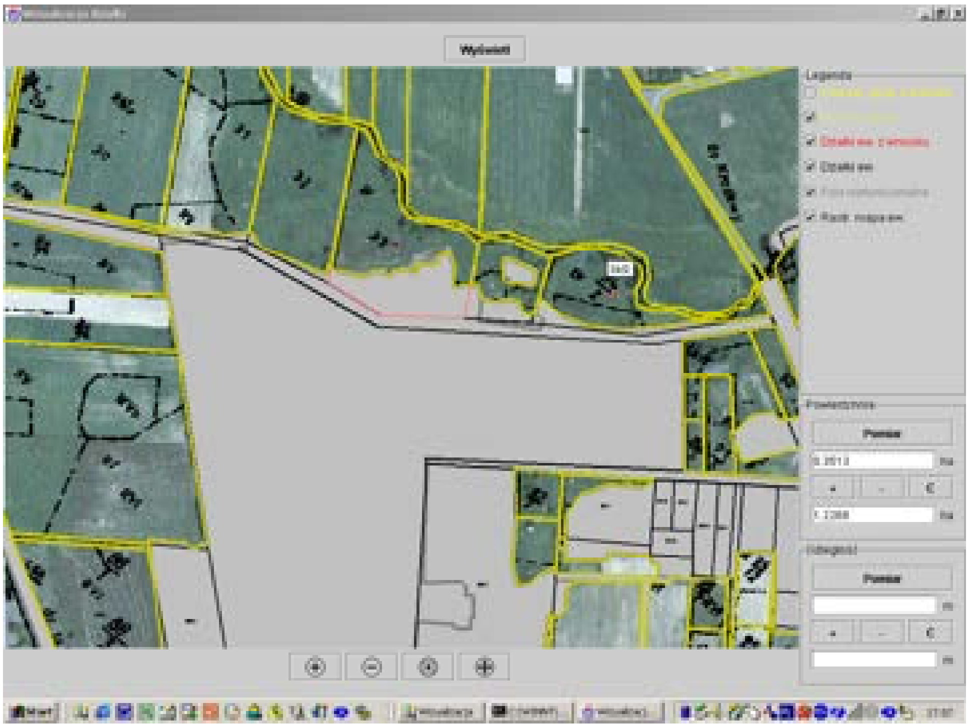


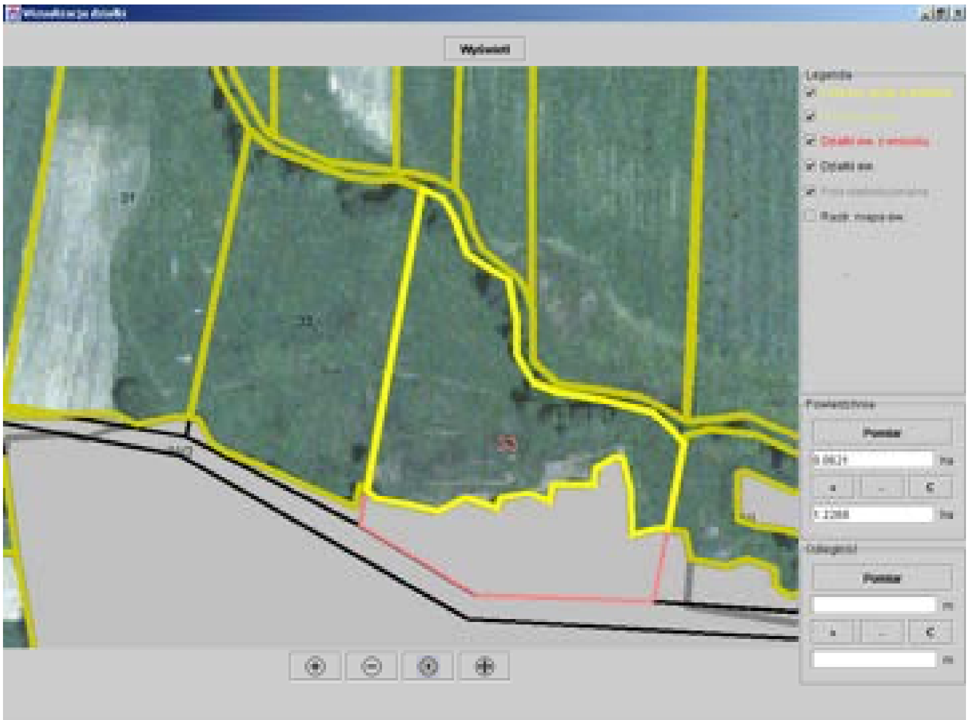
Layers in the LPIS











Plan of presentation

Part 1	LPIS/GIS in Poland – general information
Part 2	Data types and their role in the system
Part 3	**Data quality control**
Part 4	Data management and distribution

Data quality control

- **Controlled data:**
  1. **orthophotomaps**
  2. **vector boundaries of cadastral parcels**
  3. **vector boundaries of non-eligible areas**

- **Control authorities:**
  1. **contractors**
  2. **independent body – GINiK**
  3. **ARMA – Authority**

Aspects of quality control

- **Technical control**
  - **repeated actions,**
  - **technical knowledge and experience**

- **Management of quality control process,**
  - **managing and coordination,**
  - **monitoring,**
  - **increasing of effectiveness,**

Quality Control methodology

Scope of work – main tasks (ARMA needs)

In reference to products:

- standardizations of data handling
- quantity and quality control of data according to technical specification
- protocols, reports and conclusions

In reference to tasks of Management:

- coordination and supervision of the projects performed by Contractors
- monitoring of progress of work against the schedule of contracts
- arrangement of data delivery to the Authority

Quality Control methodology

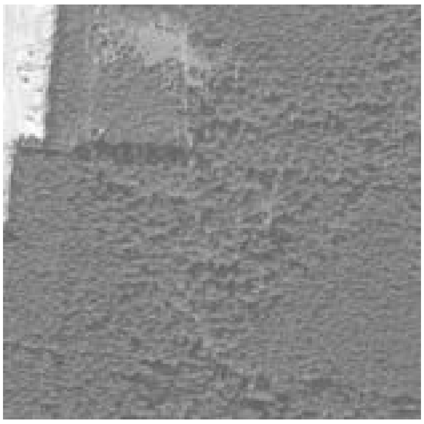
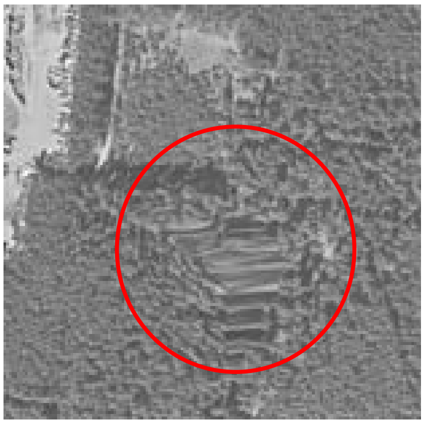
Aerial triangulation, DTM, orthophoto

- quantity and recording control
- documentation revision
- aerial triangulation results revision and block control
- visual and accuracy control (comparison of DTM and GCP's point)
- stereo model and DTM imposition control
- terrain profiles
- control of radiometry, mosaics and seam lines
- geometric accuracy control – check points

Orthophotomaps errors

Orthophotomaps errors

Orthophotomaps errors

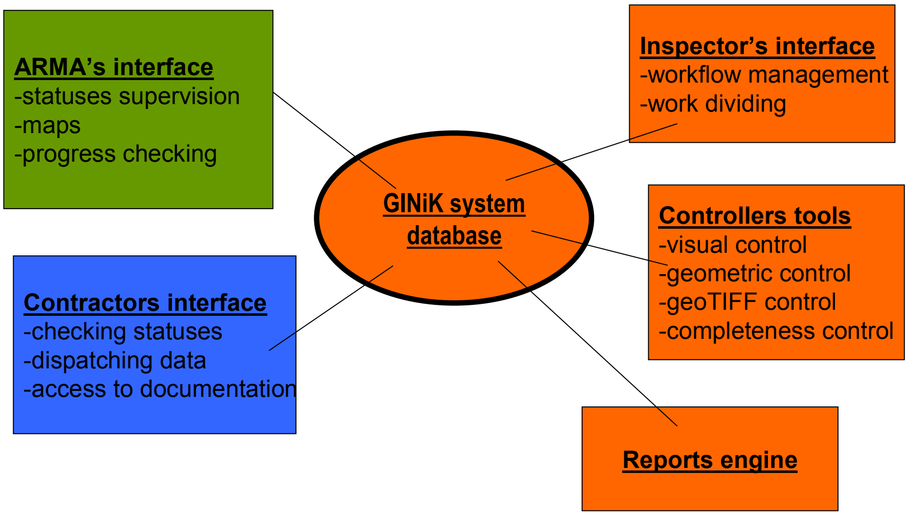



Quality Control methodology

Vector data control e.g.:

- quantity and recording control
- documentation revision
- control of source materials used
- quality of interpretation and accuracy of objects
- attributes, topology and contacts points between the units
- informatics standards and formats (GML)

GINiK – "process" architecture



GINiK – system functionality

Database of internet application:

- stores work units with statuses, control results
- works logic division – contractors, contracts, stages, products and users (access restriction).

Contractors interface:

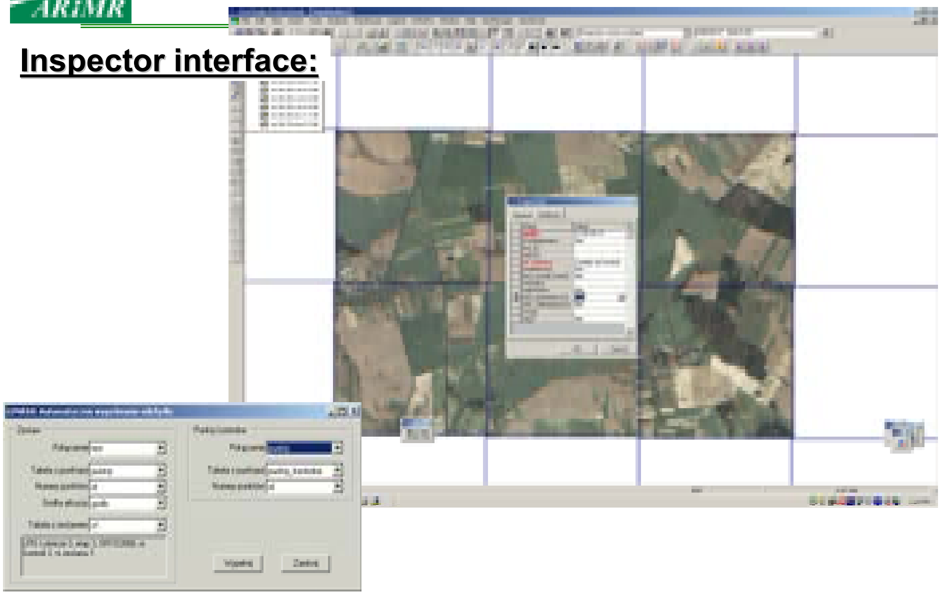
- Access to the projects, indexes, results of control and technical documentation,

Controllers interface:

- Selection of data to be controlled, recording the results of the control, and informatics tools to support the control

GINiK – system functionality

Inspector interface:

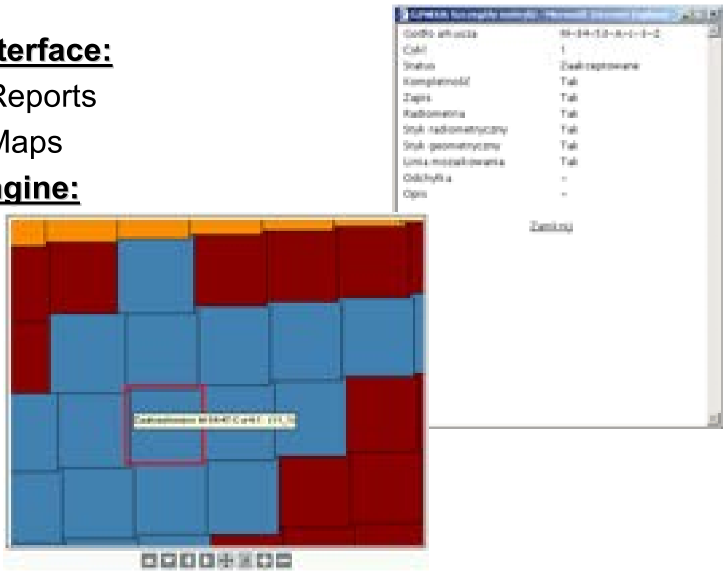


GINiK – system functionality

ARMA's interface:

- On-line Reports
- On-line Maps

Reports engine:



GINIK – on-line reports

Descriptive information concerning: object, stage, loop, sheets quantity, before production, under production, delivered to GINiK

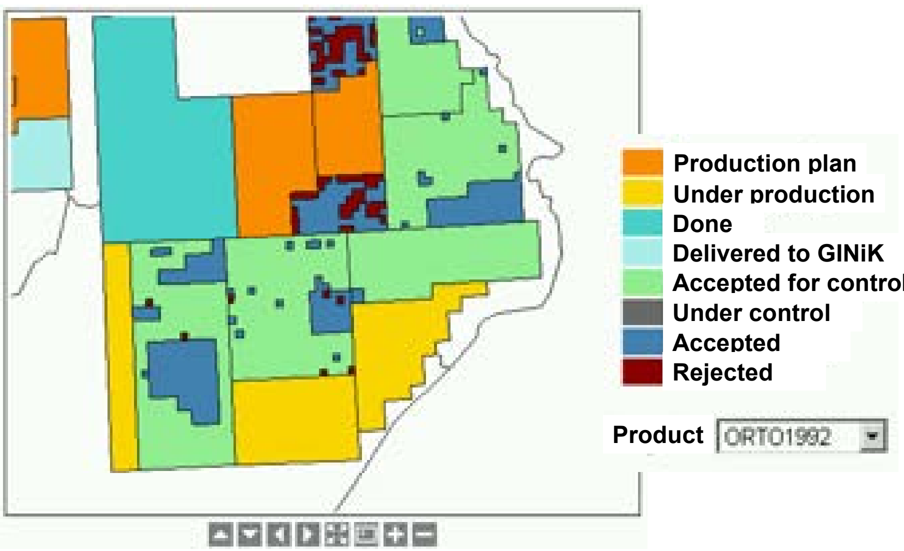
Opcje:
- [x] Kolumna 'Wszystkie'
- [x] Powierzchnia
- [ ] Wersja tekstowa - do druku

Raport na dzień 2004-09-20
- [ ] Uwzględnij tylko zmiany wprowadzone po 2004-09-21

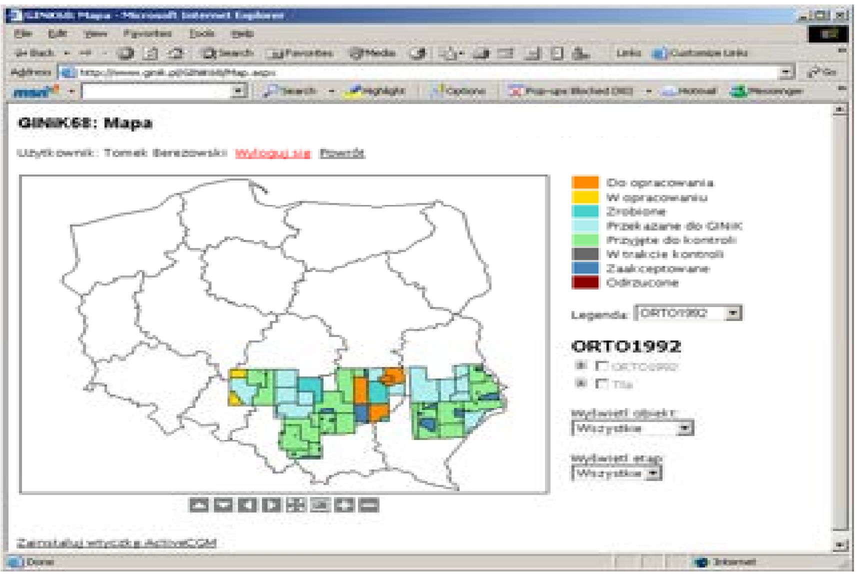
Generuj

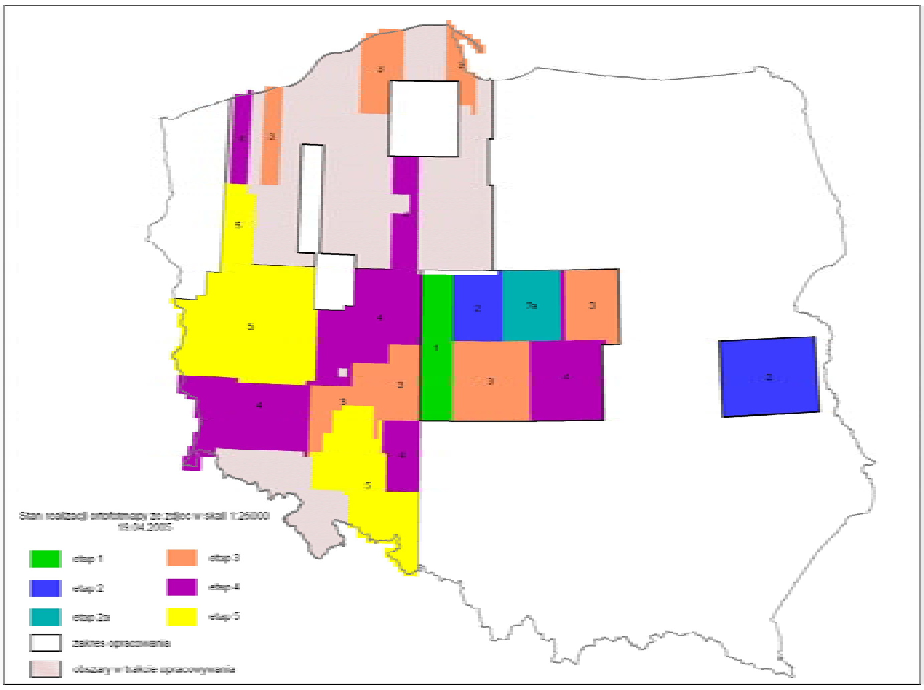
Obiekt	Etap	Numer cyklu	Wszystkie Liczba metryk	Do opracowania Liczba metryk		W opracowaniu Liczba metryk		Zrobione Liczba metryk		Przekazane do GINIK Liczba metryk	
LPIS Lotnicze 1 (OPGK Olsztyn)	Etap 1	-	0	0	-	0	-	0	-	0	-
	Etap 2	2	204	0	0,0%	0	0,0%	0	0,0%	0	0,0%
	Etap 3	2	324	0	0,0%	0	0,0%	0	0,0%	324	100,0%
	Etap 4	2	320	0	0,0%	0	0,0%	0	0,0%	0	0,0%
	Etap 5	1	176	0	0,0%	176	100,0%	0	0,0%	0	0,0%
		Suma	1024	0	0,0%	176	17,2%	0	0,0%	324	31,6%
LPIS Lotnicze 2 (OPGK Kraków)	Etap 1	-	0	0	-	0	-	0	-	0	-
	Etap 2	4	144	0	0,0%	0	0,0%	0	0,0%	144	100,0%
	Etap 3	2	296	0	0,0%	0	0,0%	0	0,0%	296	100,0%
	Etap 4	1	256	0	0,0%	0	0,0%	0	0,0%	256	100,0%
	Etap 5	1	280	0	0,0%	0	0,0%	0	0,0%	280	100,0%
		Suma	976	0	0,0%	0	0,0%	0	0,0%	976	100,0%

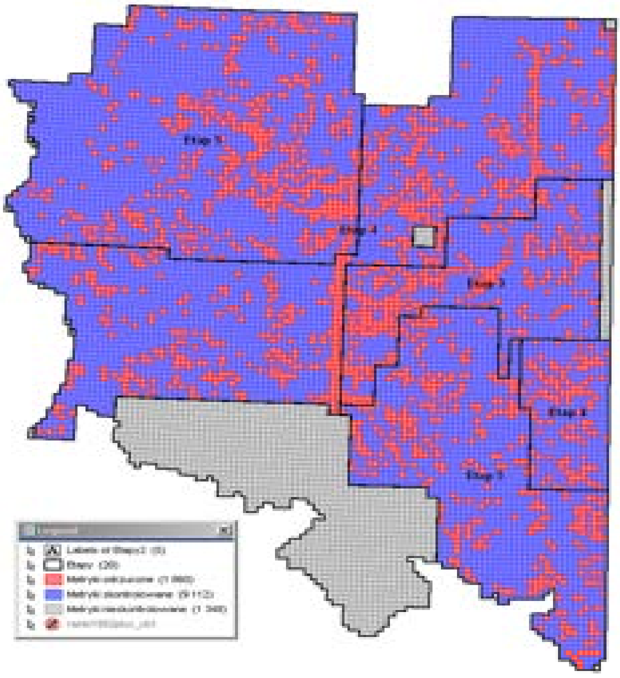
GINiK – on-line maps



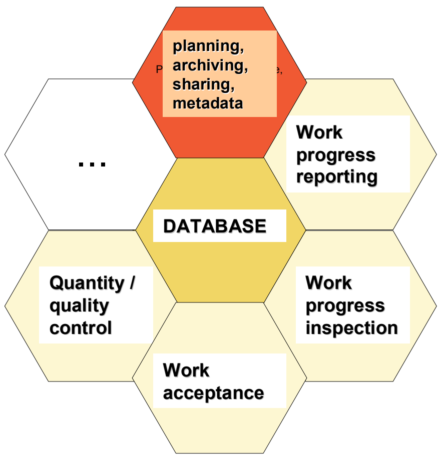
GINiK – on-line maps







GINiK – Summary



Plan of presentation

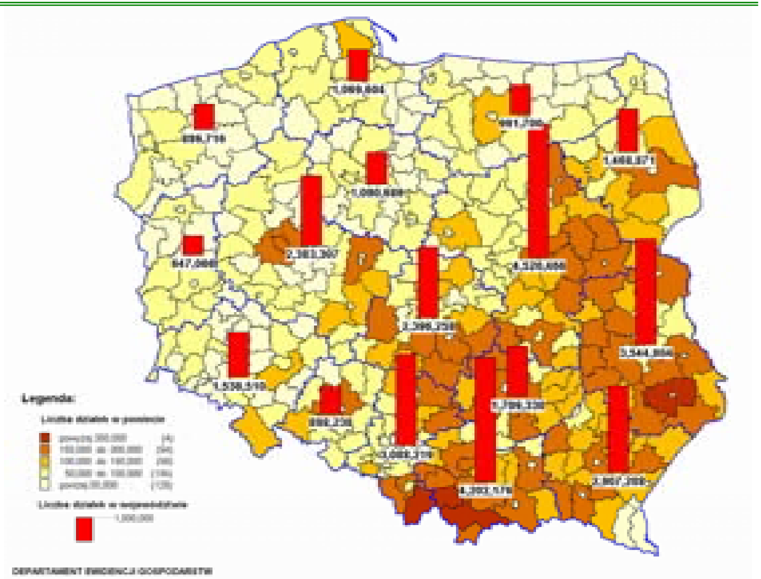
Part 1 LPIS in Poland – general information
Part 2 Data – types, acquisition and their role
Part 3 Data quality control
Part 4 Data management and distribution

Data management, verification and archiving system

- The overall objective of the "System" is to provide adequate protection of data, but also to ensure efficient management and use of data collected by ARMA
- To support tasks of ARMA Farm Register Department staff: manage the control, import and archiving of data.
- The goal of the system is to simplify and organize work in the Farm Register Department and in other Departments and administration organization using the GIS data information

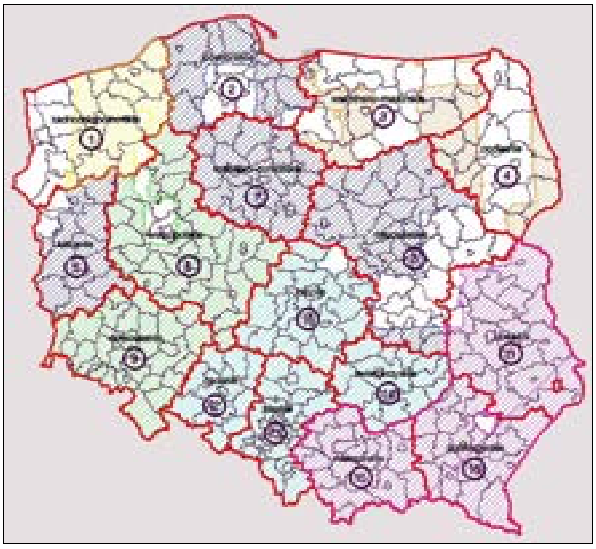
Goal of the system: to manage and handling large amount of LPIS/GIS data in efficient way

Amount of data - numbers of reference parcels



Amount of data – cadastral maps with centroids

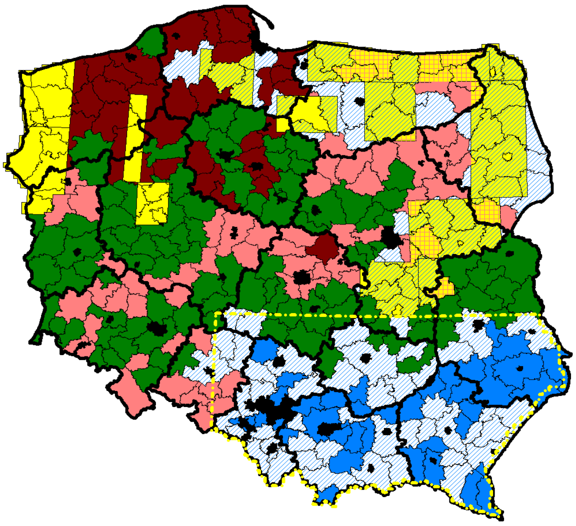
- 95 000 raster files
- 53 000 geodetic units
- ~30 mln centroids



Amount of data – orthophotomaps and vector data

- 65 000 – map sheets
- 53 000 – geodetic units
- thousands of CD/DVD
- Tb's of data

- About 90 contracts in period of (2002-2005)
- About 40 contractors in period of (2002-2005)
- Area of "project" – more than 300 000 km2



Data management, verification and archiving system

- technical documentation prepared last year in cooperation with French, Italian and German long term experts
- modular solution for LPIS data, devices and documentation management
- data verification is one of internal system processes
- consisting of functionalities enabling: tender planning, registering of new media, geographic metadata management, spatial analysis on the base of metadata and vector data
- metadata profile based on ISO 19115 standard
- implementation according to ISO19139 standard

Data management, verification and archiving system

Hardware part:

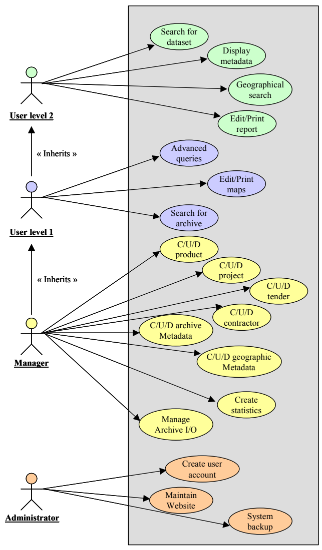
- **Main database Server, Web server,**
- **Data verification workstations,**
- **Devices for CD/DVD handling, disk array system**
- **Networking elements**

Software part:

- **Designed software combined with on the shelf GIS software**
- **Database of metadata concerning CD/DVD**
- **Database of geographic metadata about geographic dataset**
- **'thin' clients – access through a set of functionalities**
- **Intranet/Internet solution – Internet Explorer**

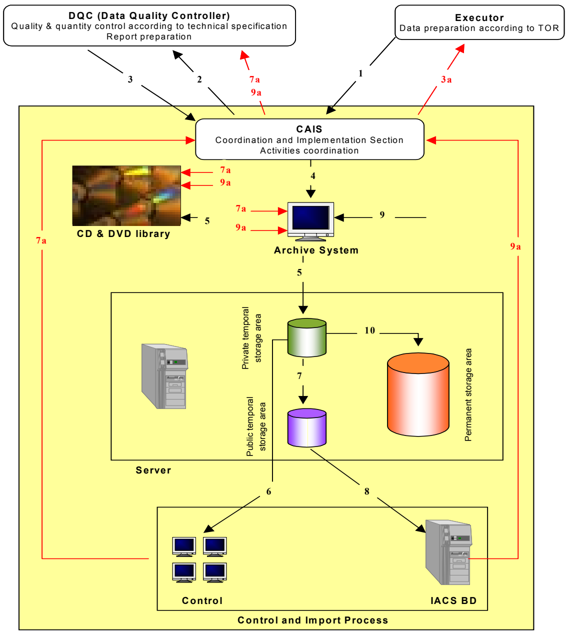
Data management, verification and archiving system

Administrator	Creates user accounts
	Creates system backup copy
Manager	Manages Archive Input/Output
	Manages GIS environment
	Generates statistics
	Manages orders
	Creates/Updates/deletes archive metadata
	Creates/Updates/deletes the contractor
	Creates/Updates/deletes the project
	Creates/Updates/deletes the tender
	Creates/Updates/deletes the product
Level 1 user	Uses pre-generated queries
	Edits/prints maps and reports
	Print-out/record of query results
	Advanced search and spatial-attributive queries
Level 2 user	Attributive-spatial data search
	Metadata display
	Order placement



Data flow

- Data initial record in the system when ensured by GINiK of their propriety
- Internal control procedures
- Import to IACS database
- Metadata final completeness



Benefits of the „System”

- Functionalities for planning and analysis give possibility for LPIS updating process control from the very beginning – easier needs identification
- Tools for CD/DVD handling enables resources efficient and systematic management
- Enables data in digital form delivery to various users – cooperating ARMA's departments, executors in process of LPIS updating, internal purposes, external organizations
- Advanced control tools enables final stage of control of the executors and GINiK
- Manage large amount of LPIS data in efficient way

Thank you

for your attention

Jolanta Orlińska - Director of Farm Register Department

Jacek Jarząbek - Deputy Director of Farm Register Department

Piotr Woźniak - Specialist in Farm Register Department

Presentation 2 – Land cover and crops identification using VHR satellite images and various image processing techniques

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Abstract

The metric properties of VHR satellite images and potential content of thematic information make them very useful in many mapping oriented application areas. These images are used also for IACS (Integrated Administration and Control System) purposes. For IACS control activities the different scenarios of using VHR satellite images are possible in practice. In case of simplified methodology (e.g.: *rapid field visits*) the geometric properties of one date VHR satellite image are mainly explored with usually less attention to the optimal extraction of its thematic content. The last task requires basically more than standard techniques of digital image processing. It is especially important in the complex and spatially fragmented rural landscape where the successful identification of land cover elements and agricultural crops depends on the well chosen and optimal techniques of VHR satellite image analysis.

The paper presents the selected outcomes of the VHR satellite images evaluation related to the image thematic information content (in the context of land cover and crops). The efficiency and usability of classic and more advanced digital processing and analysis techniques is also considered. The original multispectral as well as pan-sharpened VHR satellite imagery from defined various study areas are used in different approaches adaptable to the specific conditions and spatial structure complexity of Polish agriculture.

Keywords: IACS, CwRS, VHR image, data fusion, digital classification.

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Land cover and crops identification using VHR satellite images and various image processing techniques

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„Land cover and crops identification using VHR satellite images and various image processing techniques "

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Outline of the presentation

- The context of the research and presented results
- Short characteristics of the spatial agricultural structure in Poland
- The goals and applied selected methods.
- Review of the selected results.
- Conclusions

2

„Land cover and crops identification using VHR satellite images and various image processing techniques "

The context of the research

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- Very high resolution (VHR) satellite images are presently widely used in Control with Remote Sensing (CwRS) methodolody for Integrated Control and AdministrationSystem (IACS, in the frame of Common Agricultural Policy).
- In Poland, where spatial agricultural structure is quite complex for the majority of land, the VHR satellite images are also used in on the spot control.
- It is important to know how far the VHR satellite images acquired for the IACS control (one date) can be considered as good source of information about land cover / use and crops. What is the efficiency of the standard methods of their processing?
- The paper presents part of the results from the research Project ongoing in Inst. of Photogrammetry & Cartography (Warsaw University of Technology) with cooperation with the institutions involved in IACS activity. The main goal: to evaluate the *potential usability of VHR satellite images for land cover/use & crops discrimination*

- usefulness; e.g. IACS purposes, other application areas.

3

„Land cover and crops identification using VHR satellite images and various image processing techniques "

VHR satellite images in IACS controls

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- Classic method of CwRS, traditionally uses the multitemporal set of high resolution satellite multispectral images (Spot or IRS satellites) and one VHR image. The identification process can be done either entirely by CAPI (computer aided photointerpretation), or by a combination of automatic classification followed by CAPI. *The usefulness of high resolution satellite images in agricultural areas with complex spatial structures, presents a certain level of limitations due to image spatial resolution.*
- Rapid field visit method which assumes the land use (crop) recognition during the field visit (with the hard copy of the orthophotomap at hand) and after return back from the field the digital orthophotomap is used basically for area measurement.

4

„Land cover and crops identification using VHR satellite images and various image processing techniques "

VHR satellite images in IACS controls in Poland

•In first control campaign in Poland (in 2004) the ‘photo’ method (*rapid field visits* variant) was chosen (with orthophotomaps produced basically from VHR satellite images) to control the minor part of farmers applications and direct field inspection (and measurements) to control the significant majority of applications selected for control sa

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The applied methods

incl. in the presentation

- Testing of the usability and efficiency of different “pan-sharpening” alghorithms
- Comparison between 16 bits and 8 bits images
- Visual interpretation
- Supervised classification

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Thematic information extraction from VHR images – *general considerations (1)*

- How accurate (thematically) and valuable can be output from VHR image analysis; one date image? time series (but costs...)?
- the VHR image acquisition date versus the optimal date for thematic information extraction?
- Which approach and methods can be applied in wide operational mode (*not too complex & scientific; easy repeatable*)?
- Digital image processing for original 11 bits image (as 16 bits data format) or 8 bits?
- Not only spectral but also spatial, textured features (discriminators) like e.g. shape, size, texture, pattern, context, should be more explored.
- The increasing rule of existing databases (e.g.: LPIS) in future image analysis.

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„Land cover and crops identification using VHR satellite images and various image processing techniques"

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Thematic information extraction from VHR images – *general considerations (2)*

- Geometric quality evaluation tests confirmed high geometric accuracy of orthorectified VHR based on products.
- Small and narrow fields need to be analyzed with an adequate spatial resolution images and image processing methods.
- The usefulness of traditional satellite images (e.g. SPOT XS, IRS or Landsat ETM) for land cover, land use, or crop identification in agricultural areas with complex spatial structures, presents a certain level of limitations.
- higher spatial resolution – while reducing the problem of mixed pixels - exacerbates the internal variability of the classes and statistical noise, which in certain cases can be significant and perturb classification accuracy.

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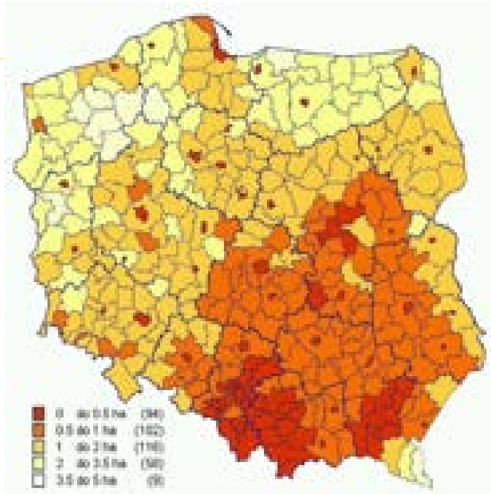
„Land cover and crops identification using VHR satellite images and various image processing techniques"

Characteristics of the spatial agricultural structure in Poland



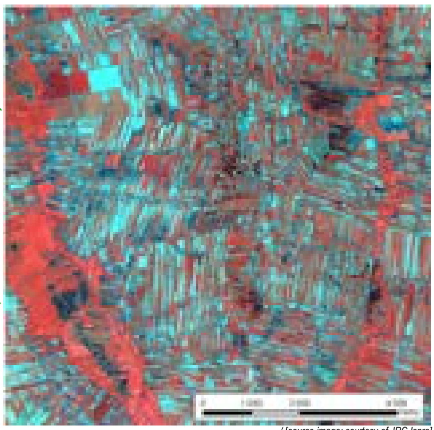
Mean area of cadastral parcels in Poland (in sub-districts)

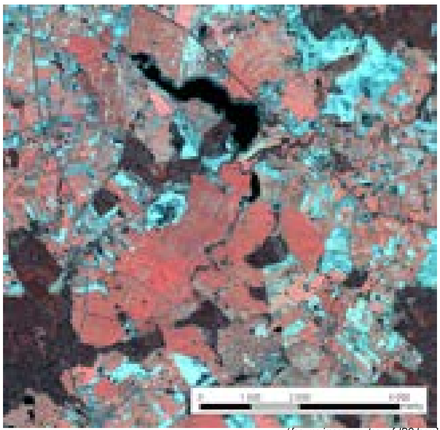
/ [courtesy of ARMA]

Average size of cadastral parcels, extreme cases

/ [courtesy of ARMA]

The main test sites and image data


/ [source image: courtesy of JRC Ispra]


/ [source image: courtesy of JRC Ispra]

- **•Łowicz** (central part of Poland)
  QuickBird image; MS and Pan 11/05/2004
- **•Nieborów** (central part of Poland)
  Ikonos, MS and Pan [06/08/2003]
- **•Bartoszyce** (north part of Poland)
  Ikonos Pan-sharpened [14/04/2004]
  QuickBird image; MS and Pan [20/04/2004]

/ The VHR image data were made available for the study owing the permission of EC JRC /

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Review of the selected results

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Testing of the fusion methods (pan-sharpening)

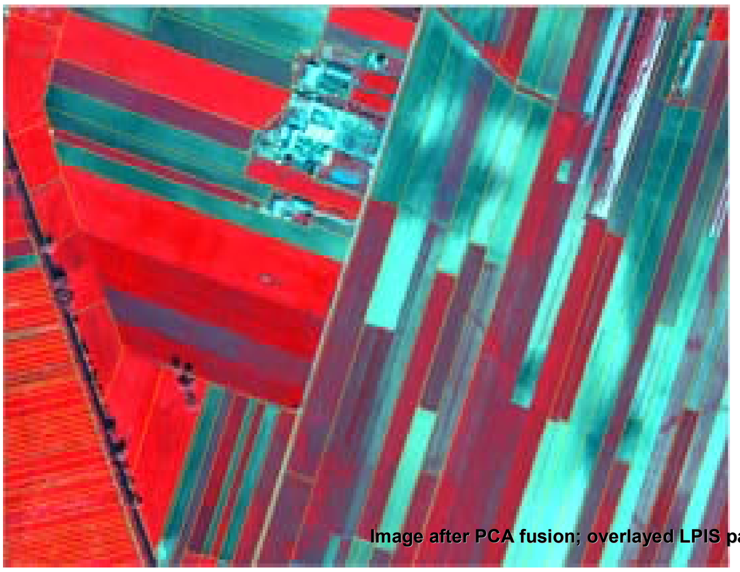

Image after PCA fusion; overlayed LPIS parcels

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„Land cover and crops identification using VHR satellite images and various image processing techniques "

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Applied fusion methods and comparison of the basic statistics

kanał		oryginał					
		min	max	średnia	moda	mediana	sd
pan	1	0	2440	370.12	364.54	368.43	64.32
ms	1	137	1698	220.09	205.85	211.95	22.71
	2	129	2148	301.80	281.88	289.98	42.55
	3	8	2153	171.21	127.92	148.88	54.20
	4	71	2306	585.85	453.69	565.25	178.79
Gram-Schmidt average	1	155	1613	220.090	200.56	211.95	21.558
	2	166	1939	301.796	283.74	290.66	39.547
	3	39	2068	171.209	126.18	149.96	52.375
	4	0	4579	585.880	339.85	572.38	198.286
Gram-Schmidt sensor	1	163	1528	220.090	210.99	210.99	19.684
	2	180	1770	301.796	291.80	291.80	35.673
	3	51	1910	171.210	130.88	152.66	48.195
	4	0	3948	585.877	323.86	570.61	209.077
CN	1	0	2325	252.87	245.21	245.21	26.47
	2	0	3001	346.62	339.96	339.96	47.46
	3	0	2554	195.28	159.63	169.60	56.24
	4	0	3387	685.44	515.99	648.29	244.32
PC	1	0	1430	220.09	206.68	212.27	17.16
	2	0	1736	301.80	284.81	291.59	33.13
	3	0	1813	171.21	134.56	155.80	39.79
	4	0	6322	585.87	567.99	567.99	181.97
Cheng	1	10	1823	220.09	207.00	214.00	22.87
	2	0	2665	301.80	282.00	292.00	42.86
	3	0	2437	171.21	134.00	153.00	54.51
	4	0	4992	585.84	458.00	566.00	179.92
Wavelet transform PC	1	0	1720	219.32	204.5	210.19	22.61
	2	0	2209	300.88	279.29	286.24	42.23
	3	0	2361	170.02	132.3	148.63	54.03
	4	62	2119	589.17	679.72	575.41	178.14
Wavelet transform single band	1	183	571	218.70	205.73	210.28	22.33
	2	209	897	299.61	286.94	286.94	41.90
	3	93	686	169.62	143.96	150.91	53.72
	4	119	1135	583.64	527.78	579.38	178.34

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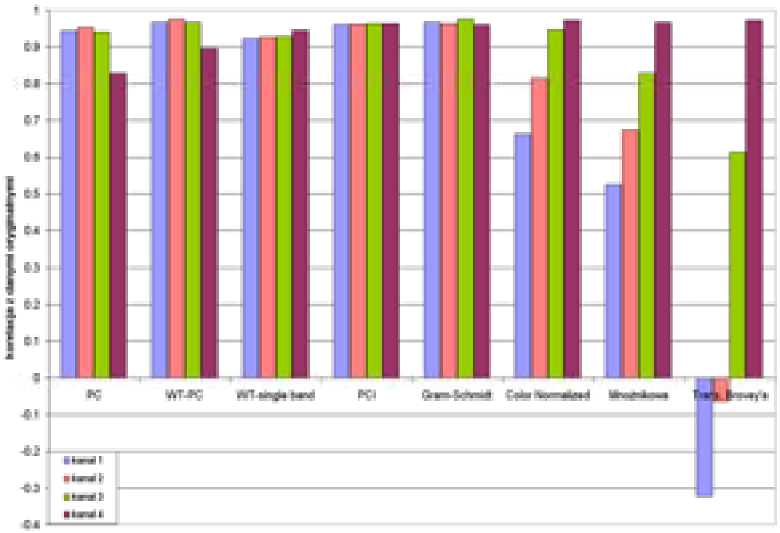
Inter-channels correlation: MS_{or} - Pansharp



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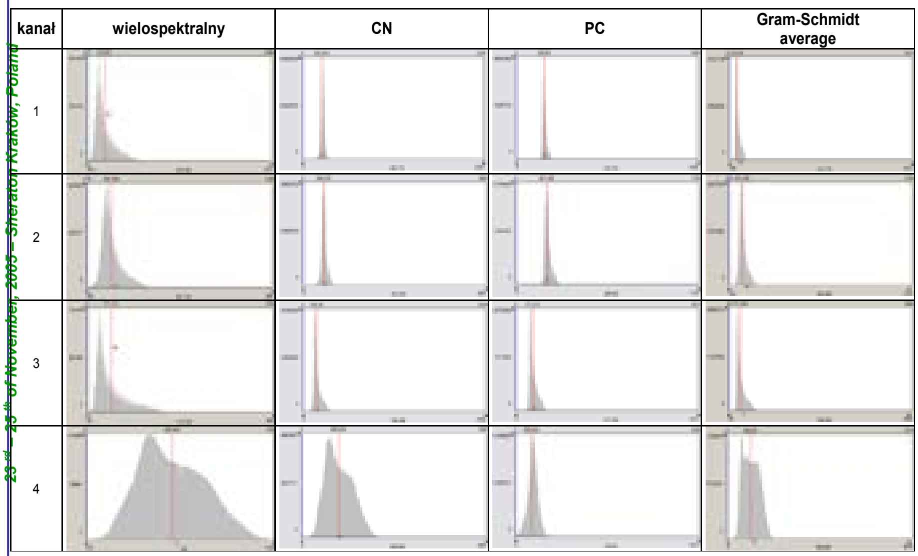
Comparison of the histograms



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Inter-channels correlations

WIELOSPEKTRALNY				
kanał	1	2	3	4
1	1	0.976	0.968	-0.456
2	0.976	1	0.959	-0.370
3	0.968	0.959	1	-0.524
4	-0.456	-0.370	-0.524	1
MNOZNIKOWA				
kanał	1	2	3	4
1	1	0.988	0.833	0.577
2	0.988	1	0.889	0.483
3	0.833	0.889	1	0.071
4	0.577	0.483	0.071	1
PC				
kanał	1	2	3	4
1	1	0.961	0.948	-0.112
2	0.961	1	0.924	0.038
3	0.948	0.924	1	-0.221
4	-0.112	0.0378	-0.221	1
Wavelet transform – PC				
kanał	1	2	3	4
1	1	0.979	0.969	-0.473
2	0.979	1	0.961	-0.389
3	0.969	0.961	1	-0.541
4	-0.473	-0.389	-0.541	1
Wavelet transform – single band				
kanał	1	2	3	4
1	1	0.970	0.965	-0.363
2	0.970	1	0.955	-0.277
3	0.965	0.955	1	-0.419
4	-0.363	-0.277	-0.419	1

PCI				
kanał	1	2	3	4
1	1	0.978	0.969	-0.373
2	0.978	1	0.961	-0.292
3	0.969	0.961	1	-0.439
4	-0.373	-0.292	-0.439	1
GRAM-SCHMIDT average				
kanał	1	2	3	4
1	1	0.972	0.965	-0.567
2	0.972	1	0.953	-0.475
3	0.965	0.953	1	-0.633
4	-0.567	-0.475	-0.633	1
GRAM-SCHMIDT sensor				
kanał	1	2	3	4
1	1	0.966	0.958	-0.570
2	0.966	1	0.941	-0.464
3	0.958	0.941	1	-0.646
4	-0.570	-0.464	-0.646	1
CN				
kanał	1	2	3	4
1	1	0.965	0.785	0.1082
2	0.965	1	0.861	0.032
3	0.785	0.861	1	-0.390
4	0.108	0.032	-0.390	1

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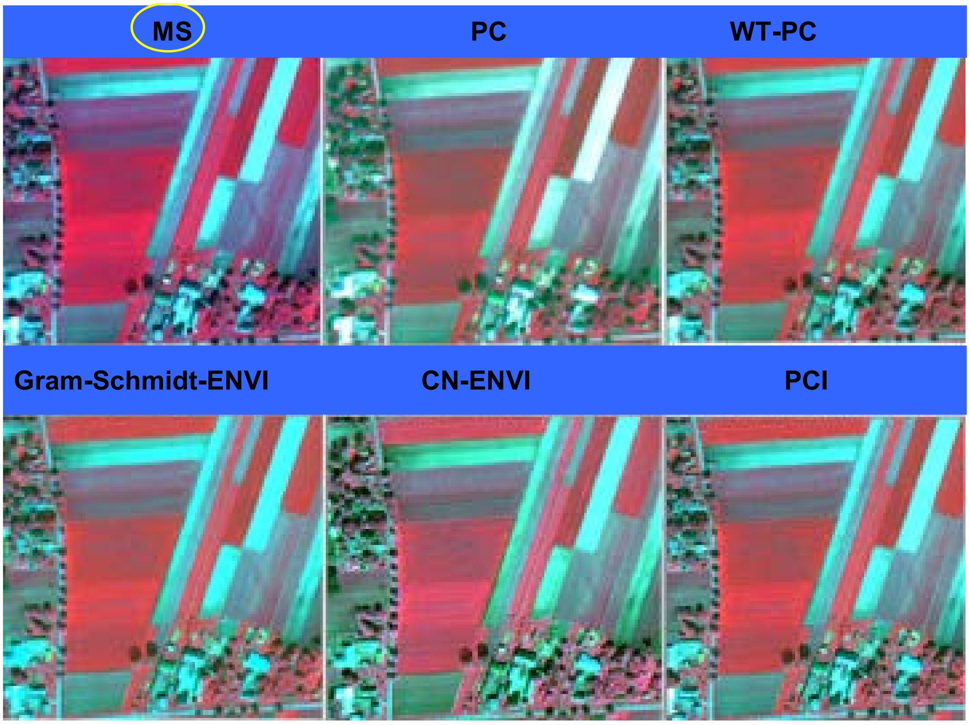
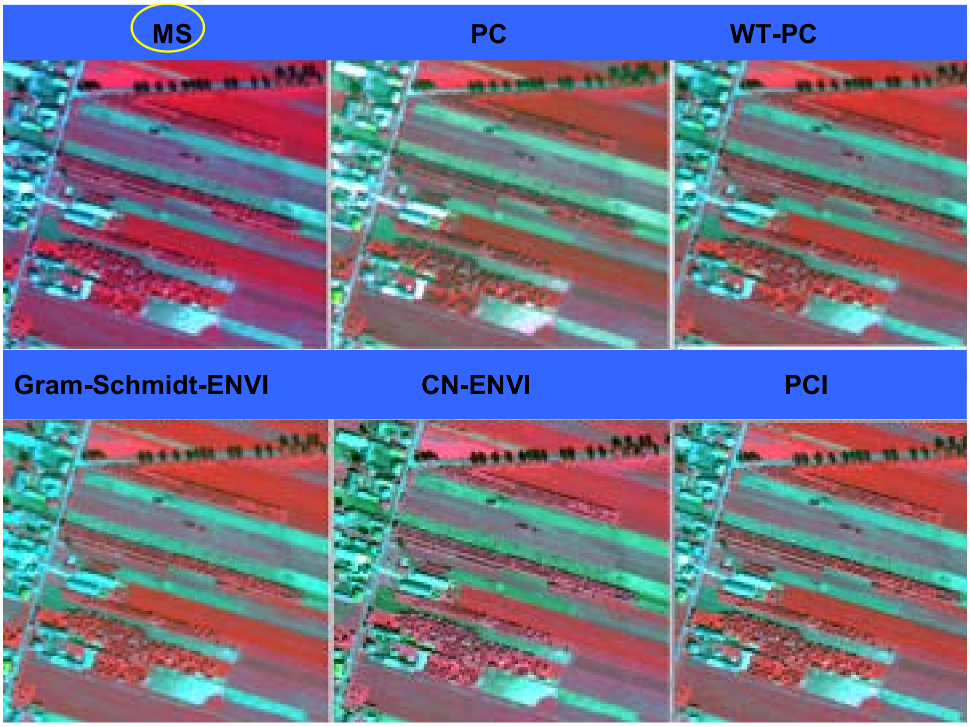
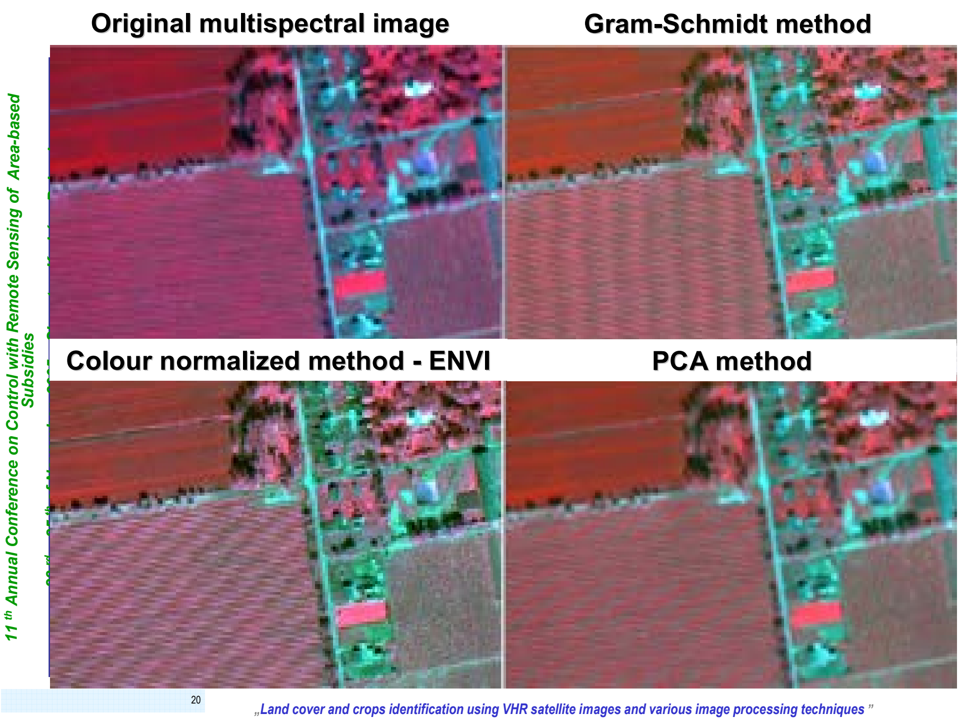



MS
PC
WT-PC
Gram-Schmidt-ENVI
CN-ENVI
PCI


Original multispectral image
Gram-Schmidt method
Colour normalized method - ENVI
PCA method
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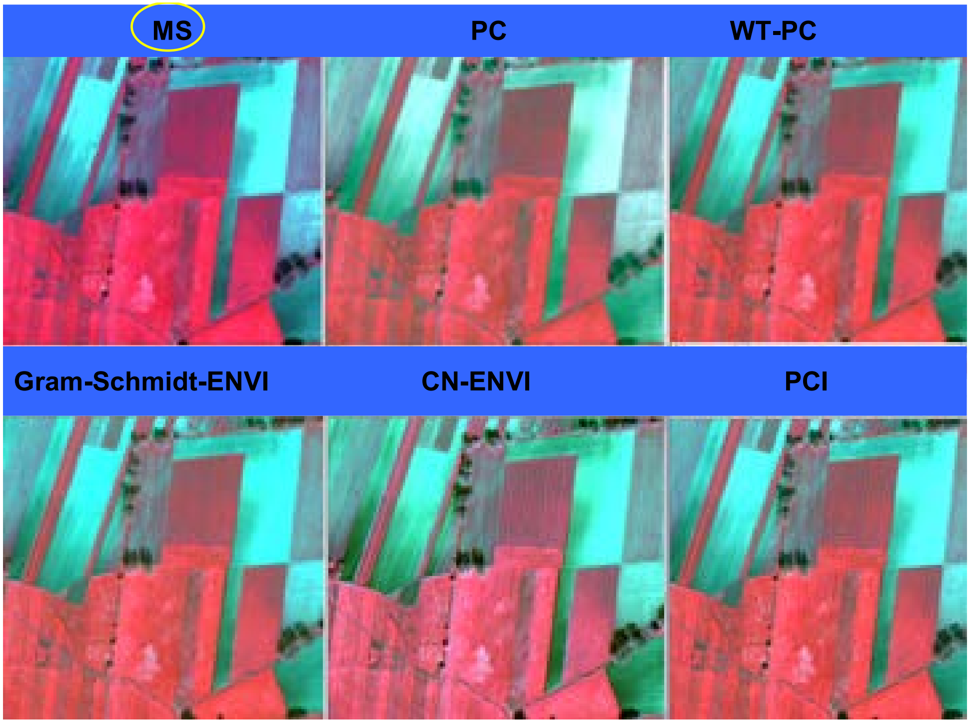
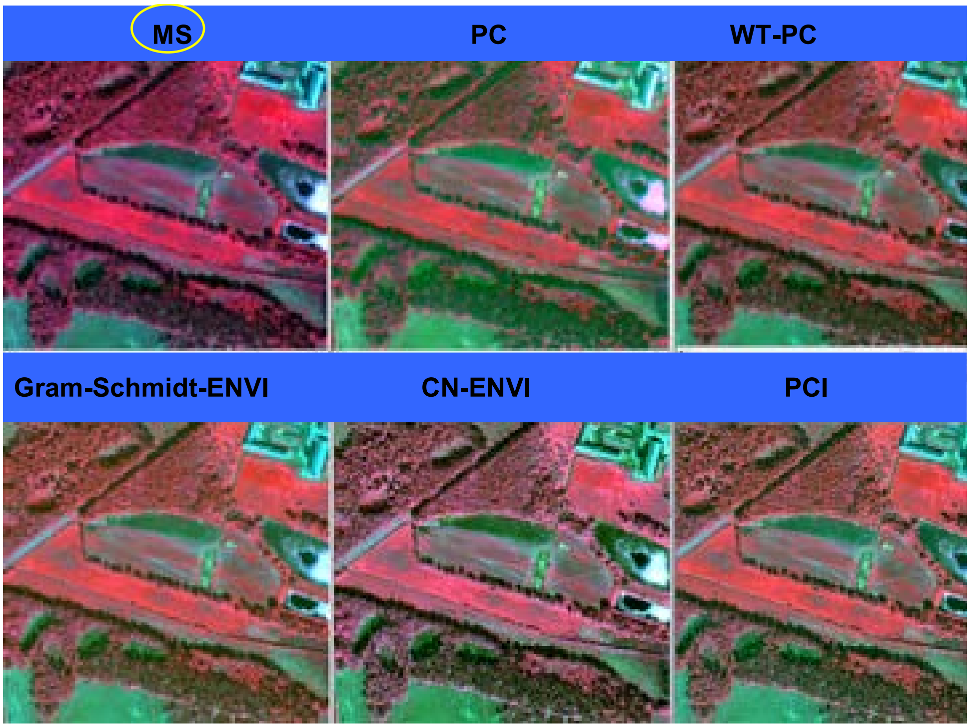
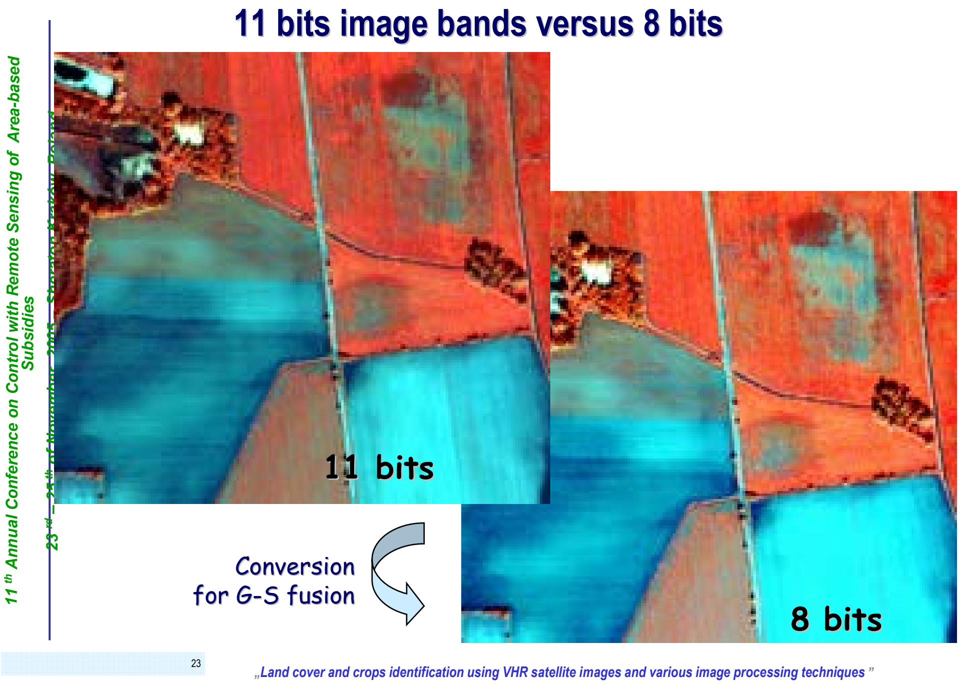

MS
PC
WT-PC
Gram-Schmidt-ENVI
CN-ENVI
PCI


MS
PC
WT-PC
Gram-Schmidt-ENVI
CN-ENVI
PCI


11 bits image bands versus 8 bits
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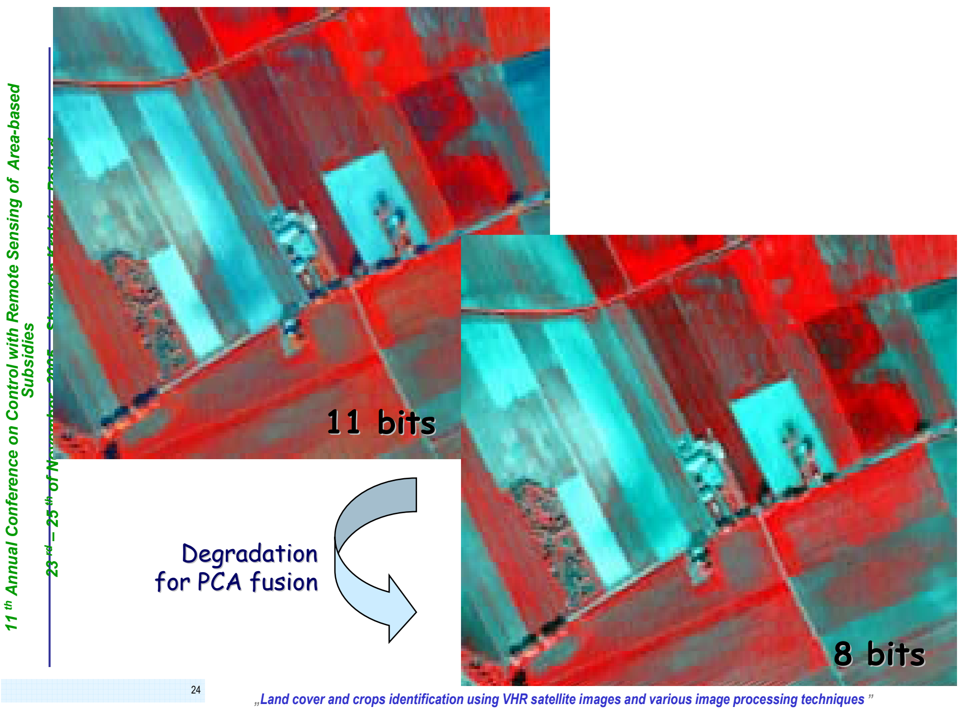
11 bits
Conversion
for G-S fusion
8 bits
23
„Land cover and crops identification using VHR satellite images and various image processing techniques”


11 th Annual Conference on Control with Remote Sensing of Area-based Subsidies
11 bits
Degradation
for PCA fusion
8 bits
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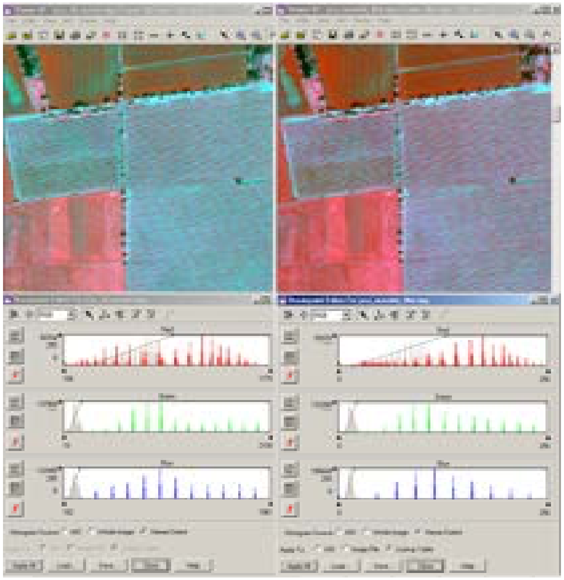
11 bits Wavelet merge – PC 8 bits



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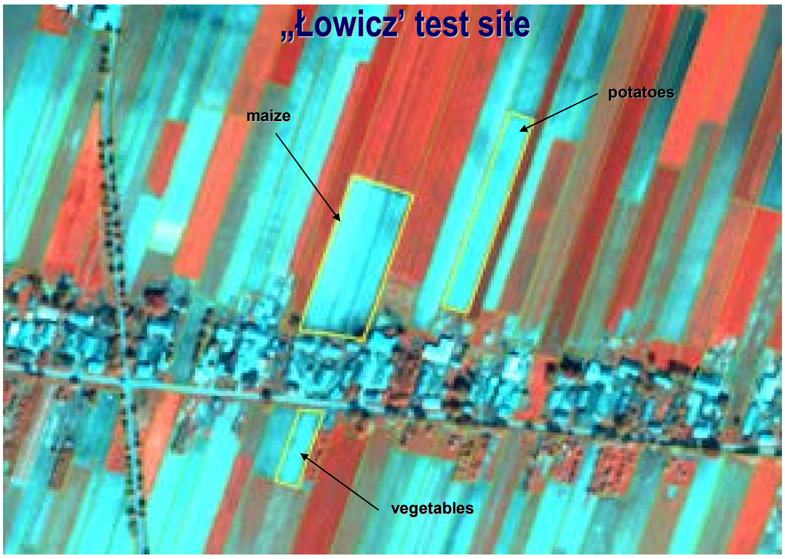
VISUAL INTERPRETATION TEST

results from „Łowicz" test site

{ ~2000 parcels in the test, 3 indep. interpretations }

Photo-interpretation results



Different crops which belong to different payment groups are impossible for identification

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„Łowicz' test site

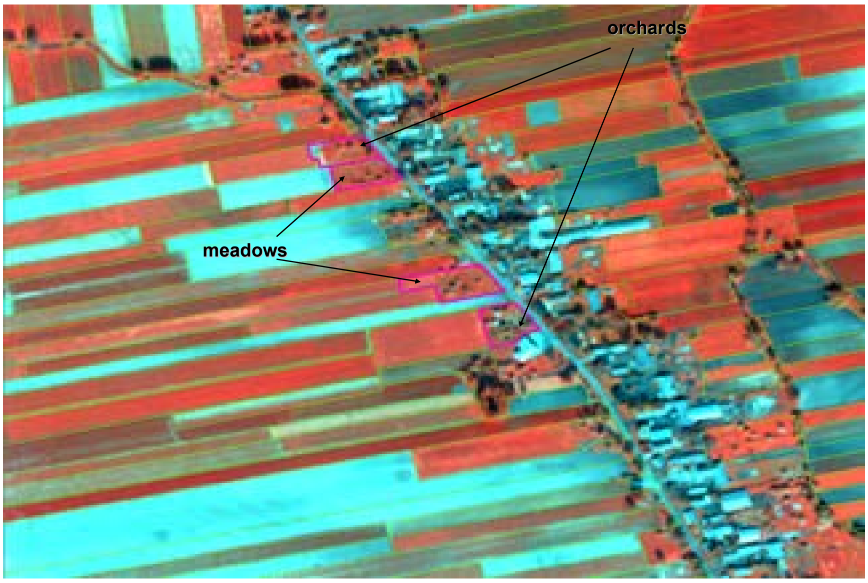

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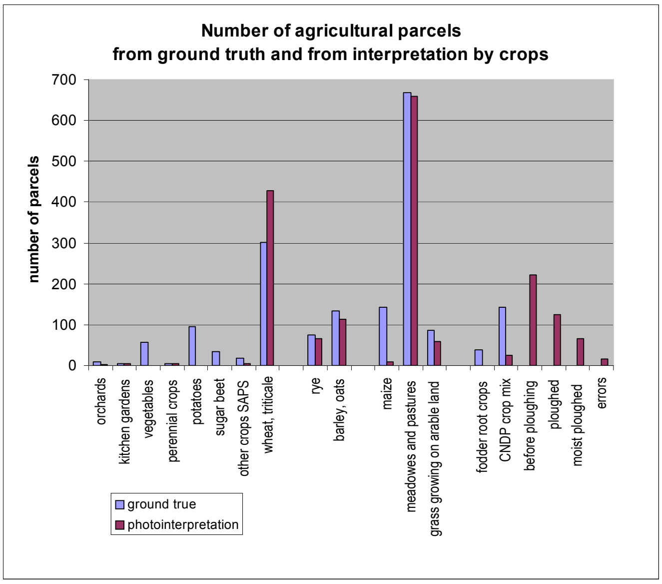
Photo-interpretation results for „Łowicz' test site



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Accuracy of the visual interpretation

	LOWICZ 11/05				BARTOSZYCE 14/04			
	user accuracy	omission error	proceder accuracy	commission error	user accuracy	omission error	proceder accuracy	commission error
orchards	0,467	0,533	0,822	0,178	0,511	0,504	0,398	0,471
kitchen gardens	0,417	0,583	0,667	0,333	0,528	0,509	-	-
vegetables	0,006	0,994	-	-	0,000	1,000	-	-
perennial crops	1,000	0,000	1,000	0,000	0,167	0,810	0,694	0,306
potatoes	0,000	1,000	-	-	0,000	1,000	-	-
sugar beet	0,000	1,000	-	-	-	-	-	-
other SAPS	0,059	0,941	0,500	0,500	0,039	0,961	0,833	0,167
wheat, triticale	0,797	0,203	0,699	0,301	0,778	0,222	0,817	0,183
rye	0,378	0,627	0,604	0,396				
oats, barley	0,429	0,571	0,499	0,501	0,000	1,000	-	-
colza	-	-	-	-	0,800	0,200	0,844	0,156
maize	0,054	0,946	0,578	0,422	0,000	1,000	-	-
meadows, pastures	0,946	0,054	0,923	0,077	0,852	0,148	0,810	0,190
grass on arable land, herbage legumes	0,463	0,537	0,706	0,294	-	-	-	-
fodder root crops	0,000	1,000	-	-	0,000	1,000	-	-

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Digital classification of the VHR images

The thematic accuracy depends on many different factors.
For the given type of image (and its GSD) and area it can be sensitive in particular to:

- number of classes and their definitions
- classification method (*incl.* algorithm)
- date of image acquisition, quality of image
- quality of data for verification

What is the efficiency of the standard claasification alghorithms?

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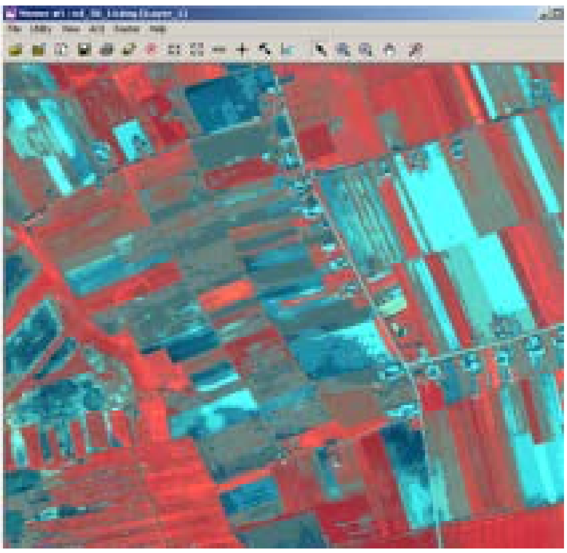
Maximum likelihood classification – part of „Łowicz" test site



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Classification results – part of „Łowicz" test site

	% of correctly classified pixels											
Type of classification	Suger beets	Barley	Maize	Perrenial crops	oats	wheat	triticale	grass	vegetables	potateous	Meadows, pastures	rye
ml_30_14	38,25	30,32	30,42	21,72	13,58	9,56	43,63	17,57	12,08	14,2	26,99	37,96
mnd_30_14	33,2	23,18	27,19	21,34	10,18	5,76	30,35	23,51	13,17	20,84	21,71	36,01
mhd_30_14	39,73	31,5	29,79	16,85	12,6	9,35	43,96	16,54	11,71	12,98	30,92	38,35

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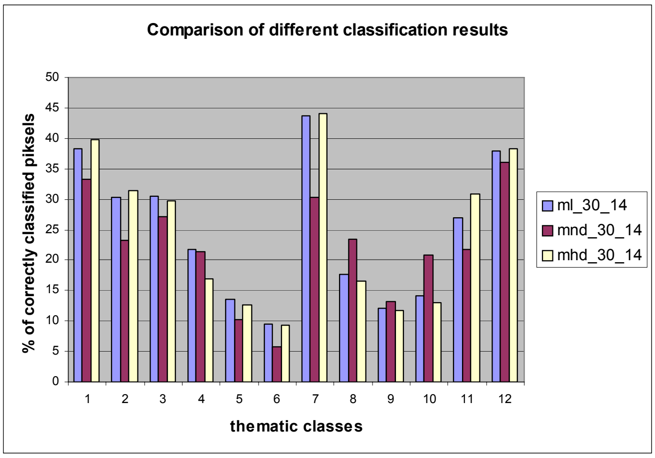
Classification results – part of „Łowicz" test site



1 sugar beets
2 barley
3 maize
4 perennial crops
5 oats
6 wheat
7 triticale
8 grass
9 vegetables
10 potatoes
11 meadows, pastures
12 rye

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Conclusions (1)

- High usability of some image fusion methods applied for multispectral and panchromatic data from QuickBird and IKONOS:
  - for visual effects: *multiplicative*, *Brovey transformation*, *Gram'a-Schmidt* (ENVI), *Zhang* method (PCI Geomatica 9),
  - For preserving the radiometric integrity: *wavelet transform - option PC* (ERDAS Imagine), *Gram'a-Schmidt* (ENVI), *Zhang* method (PCI Geomatica 9), and *transformation PC* (ENVI).
- Pansharpened image products are very useful for visual interpretation of agricultural areas dominated by small and elongated parcels. The efficiency of the approach is significant in more spectrally heterogeneous and textured areas.
- There is visible influence (in accordance with the known rules) of time relationship between the date of image acquisition and crop calendar on final land cover and crop identification.

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Conclusions (2)

- Pansharpened (MS+P) image products can be successfully used also for digital classification – the classification accuracy is at least as good as for oryginal multispectral (with original resolution) set of images, giving much better spatial quality of identified areas.
- In case of pansharpened option, the most important problem concerns the size of files and necessary time of processing – prompting testing on the classification performance of 8-bit converted (instead original 11-bit) images.
- The obtained results showed that thematic content for 8-bits images is not worse compared to results achieved for 11-bits images and such image is still preserving advantages of pansharpened product.

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THANK YOU
FOR YOUR ATTENTION

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„Land cover and crops identification using VHR satellite images and various image processing techniques"

Presentation 3 – Spectral characteristics preserving image fusion to facilitate computer-assisted photointerpretation (CAPI)

Manfred Ehlers,
Research Center for Geoinformatics and Remote Sensing FZG,
University of Osnabrueck, DE

Abstract

Almost all of the new generation of satellite and aircraft sensors provides the highest geometric resolution only in their panchromatic mode whereas their multispectral images are of lower spatial resolution. The ratios between high resolution panchromatic and low resolution multispectral images vary between 1:2 and 1:8 (or even higher if different sensors are involved). Consequently, appropriate techniques have been developed to merge the high resolution panchromatic information into the multispectral datasets. These techniques are usually referred to as pansharpening or data fusion.
Most popular among them are image transforms such as the Intensity-Hue-Saturation (IHS), Brovey, or Principal Component (PC) transforms. These techniques create multispectral images of higher spatial resolution but usually at the cost that these transforms do not preserve the original color or spectral characteristics of the input image data. As a consequence, these fused datasets cannot be processed by standard image analysis techniques such as clustering or classification because they no longer represent the original spectral reflectance values. The fusion process also produces severe impediments to photo-interpretation techniques, especially for multi-sensoral and multi-seasonal image fusion.
We have developed a new method for image fusion that is based on the standard IHS transform combined with precedent filtering in the Fourier domain This method preserves the spectral characteristics in the visible bands and also in the infrared bands of the lower resolution multispectral images. It is also possible with this technique to fuse multi-temporal and multi-sensoral data. Examples for the new image fusion technique are presented for the fusion of panchromatic Ikonos image data with multispectral SPOT, Landsat ETM, DMC and Ikonos multispectral data. It is shown that the fused datasets enhances the possibilities for computer assisted photo-interpretation (CAPI). The higher spatial resolution in the fused image coupled with the original multi spectral characteristics represents a significant improvement for the CAPI method.

Keywords: Data fusion, pansharpening, color preservation, multi-sensor fusion

Spectral Characteristics Preserving Image Fusion to Facilitate Computer-Assisted Photo-Interpretation (CAPI)

Manfred Ehlers

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and
Research Center for Geoinformatics
and Remote Sensing – FZG

University of Osnabrueck, Germany
www.gin-online.de & www.fzg.uni-osnabrueck.de

Spectral Characteristics Preserving Image Fusion

- Data Fusion: Reasons and Methods
- FFT Based Filtered Image Fusion
- Results
- Fusion for Automated Classification
- Conclusions

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Data Fusion: Why is it Necessary?

- Remote sensors have different spatial resolution for panchromatic and multispectral imagery
- The ratios vary between 1:2 and 1:5
- For multisensor fusion the ratios can exceed 1:30 (Ikonos/DMC)

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Data Fusion

- "Data fusion is a formal framework in which are expressed means and tools for the alliance of data originating from different sources. It aims at obtaining information of greater quality; the exact definition of 'greater quality' will depend upon the application."

Source: Wald, L., 1999, Definitions and terms of references in data fusion. *International Archives of Photogrammetry and Remote Sensing*, vol. 32, part 7-4-3 W6, Valladolid, Spain

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Fusion Principles

- Pixel Based Fusion (Ikonic)
- Feature Based Fusion (Symbolic)
- Knowledge or Decision Based Fusion

Source: Pohl, C. and Genderen, J.L. van, 1998, Multisensor image fusion in remote sensing: concepts, methods and applications. *Int. J. Remote Sensing*, Vol. 19, pp. 823-854.

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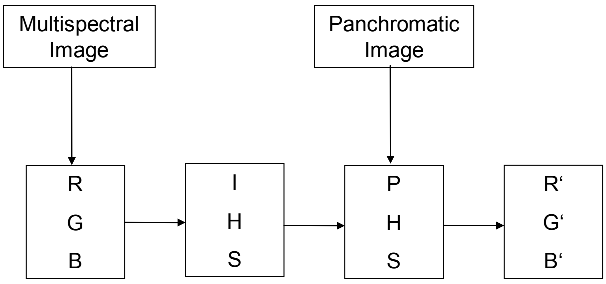
Data Fusion: How?

Example: Image Fusion via Intensity-Hue-Saturation (IHS) Transform



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olor Distortion

Landsat TM Original

Multiplicative Fusion

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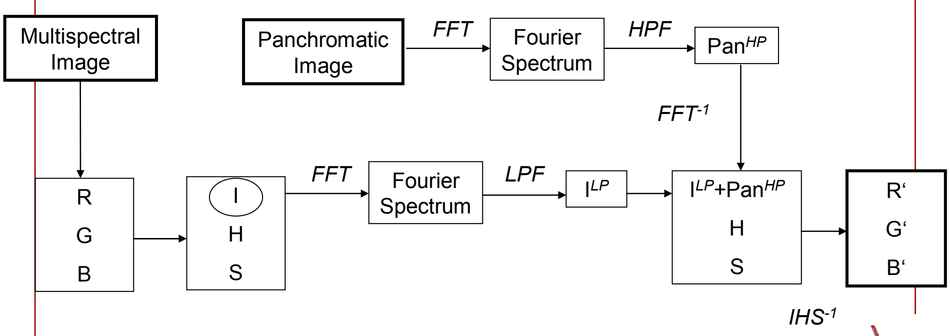
Fusion Problem: Color Distortion

- Panchromatic band has a different spectral sensitivity
- Multisensoral differences (e.g. SPOT and TM merge)
- Multitemporal (seasonal) changes between pan and ms image data

➢ Inconsistent panchromatic information is fused into the multispectral bands

FFT Filter Based Data Fusion

Basis: IHS Transform and Filtering in the Fourier Domain

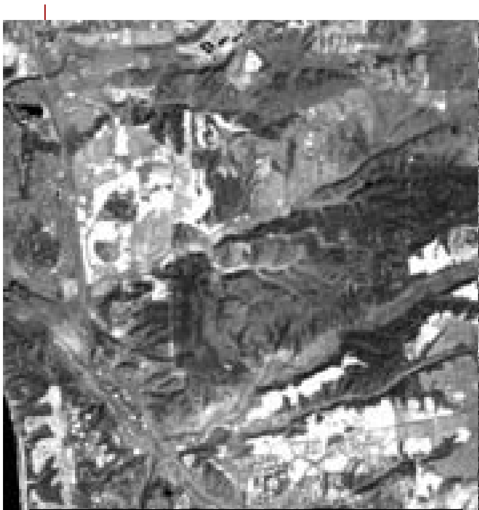


Example: Landsat TM/SPOT Data Fusion

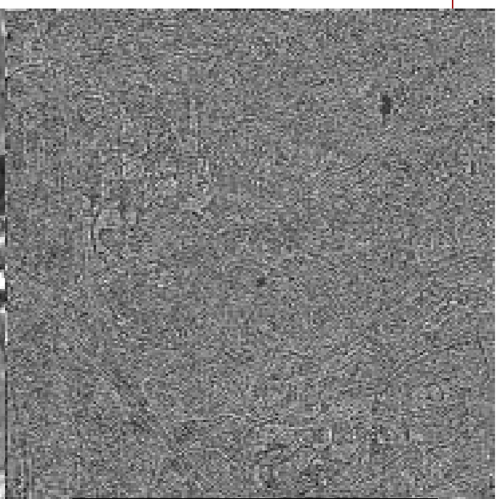
Landsat TM: Intensity Component

SPOT: Pan

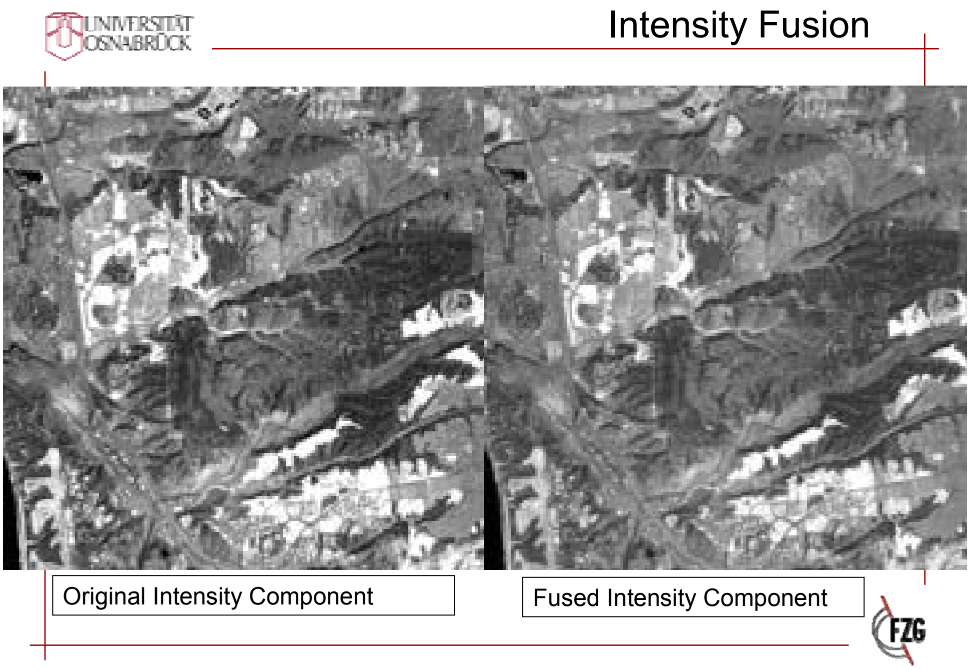
FFT Based Filtering



Filtered Landsat Intensity Component after Inverse FFT



Filtered SPOT Pan Image after Inverse FFT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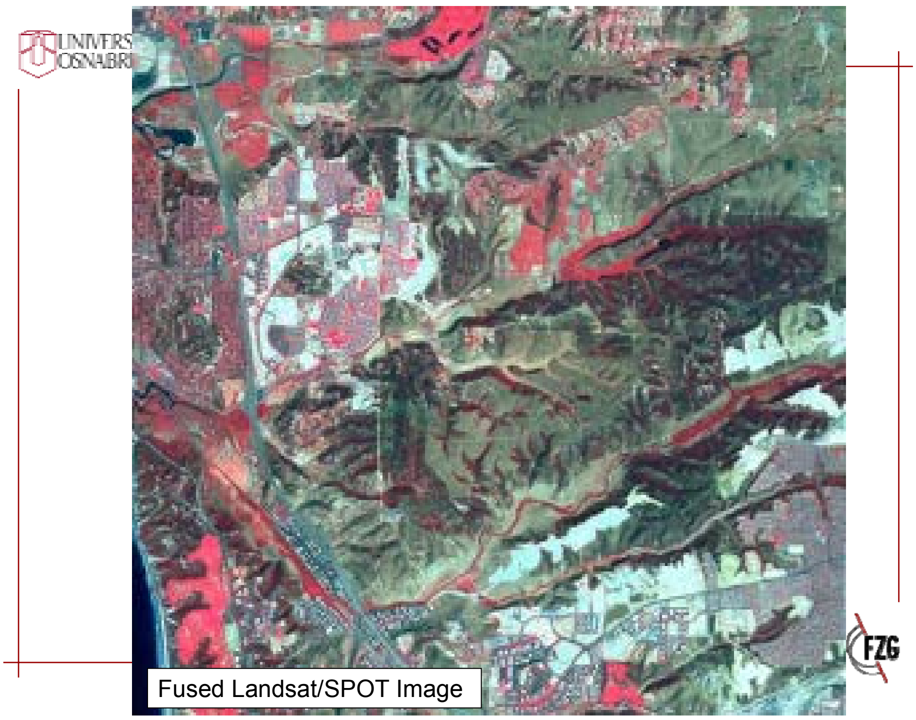
Intensity Fusion
Original Intensity Component
Fused Intensity Component
FZG


Fused Landsat/SPOT Image
FZG

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Fusion results: Blow-Up

Landsat/SPOT FFT Filtered Fusion

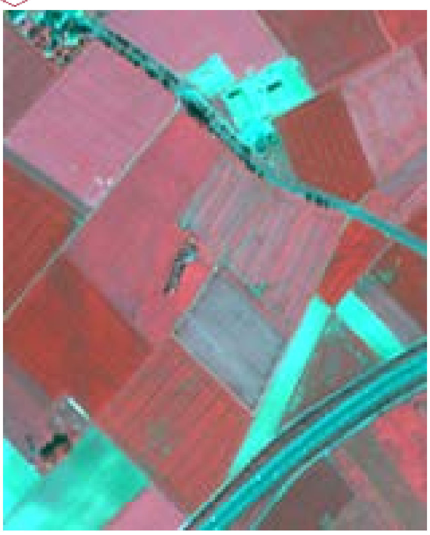
ring I

IKONOS Ehlers Fusion pan/multispectral

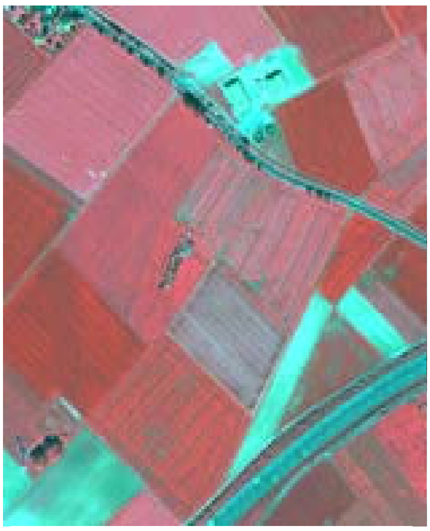
Fusion Results: Variable Filtering II

Ehlers Fusion: Compromise Between Color Preservation and Resolution Enhancement

Ikonos Multispectral and Panchromatic



Ikonos multispectral 4m
Bands 4,3,2



Ikonos multispectral 4m fused with
Ikonos panchromatic (Ehlers fusion)

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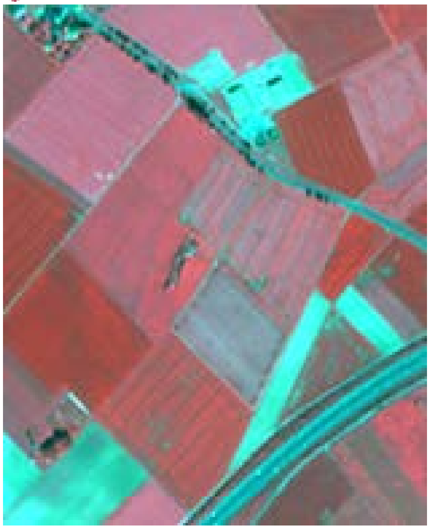
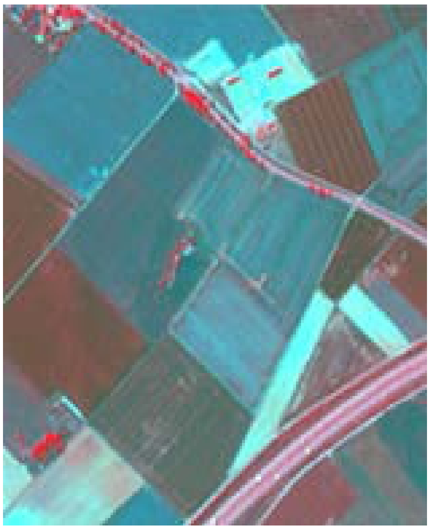
Fused Ikonos with PC



Ikonos multispectral 4m
Bands 4,3,2



Ikonos multispectral 4m fused with
Ikonos panchromatic

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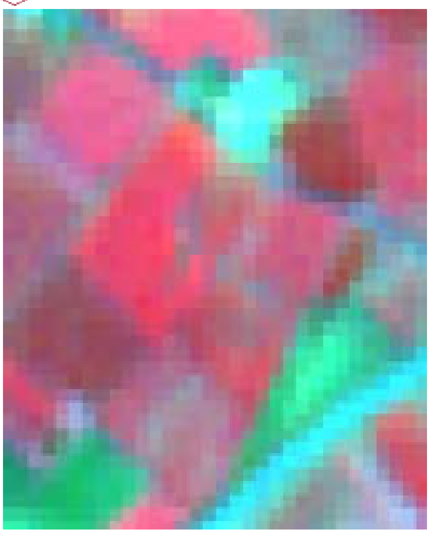
SPOT 2 / SPOT 5



SPOT 2 multispectral 20 m
Bands 1, 2, 3

SPOT 5 multispectral 10 m
Bands 4, 3, 2

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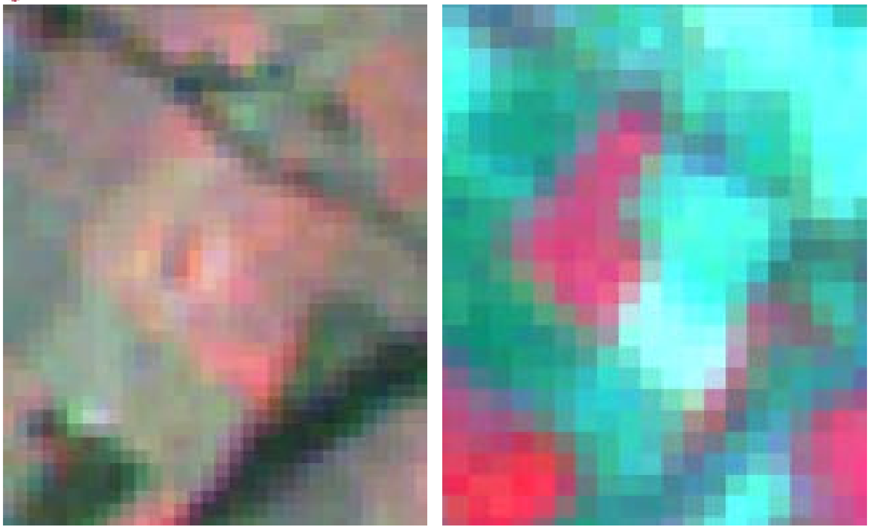
Landsat / DMC



Landsat multispectral 30 m
Bands 4, 3, 2

Disaster Monitoring Constellation (DMC) multispectral 32 m Bands 1, 2, 3

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Result: SPOT 5

SPOT 5 multispectral 10 m
Bands 4, 3, 2

SPOT 5 multispectral 10 m fused with Ikonos panchromatic

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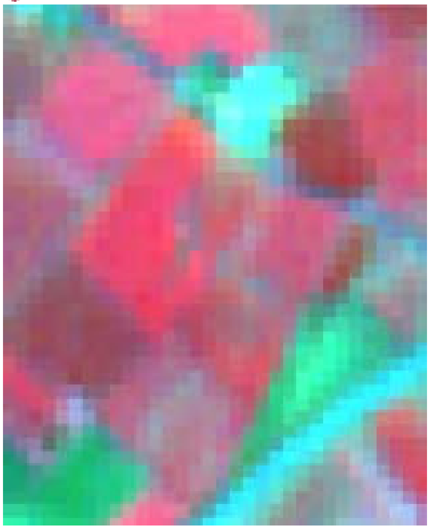
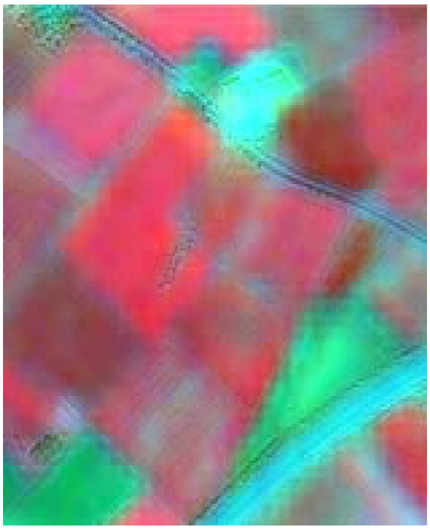
Result: SPOT 2



SPOT 2 multispectral 20 m
Bands 1,2,3



SPOT 2 multispectral 20 m fused with Ikonos panchromatic

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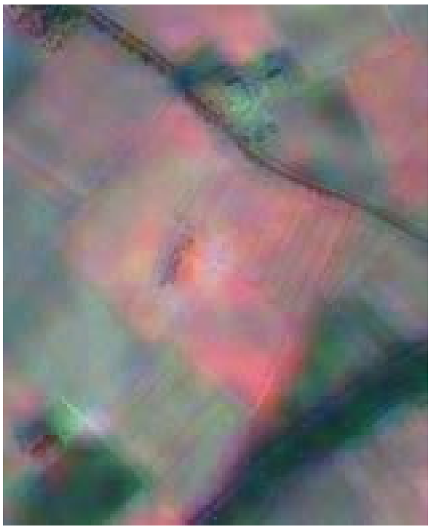
Result: Landsat ETM

Landsat ETM multispectral 30 m
Bands 4, 3, 2



Landsat ETM multispectral 30 m fused with Ikonos panchromatic

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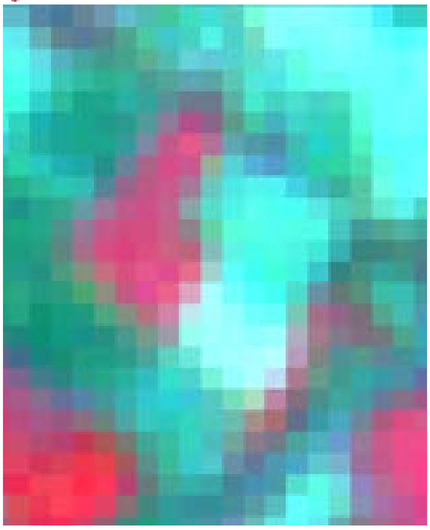
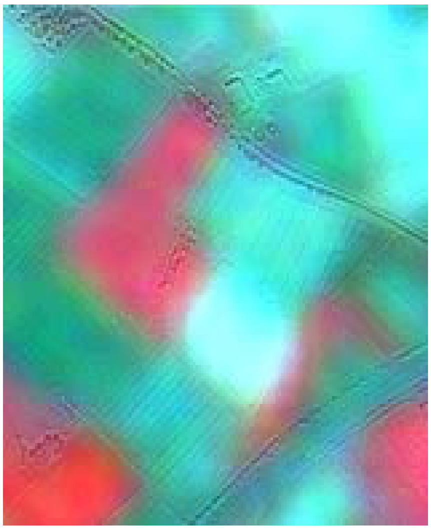
Result: DMC



DMC multispectral 32 m
Bands 1, 2, 3



DMC multispectral 32 m fused with
Ikonos panchromatic

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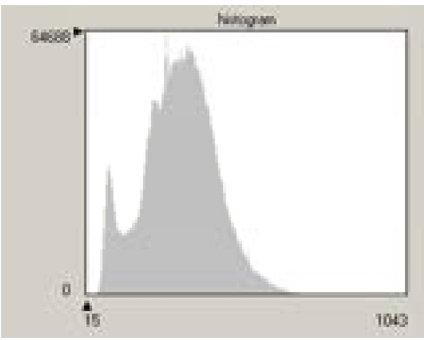
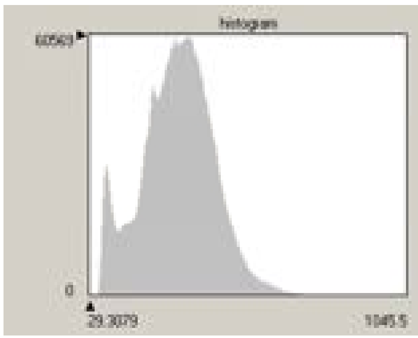
Results: Histogram Comparison



Histogram Band 4 Original
Ikonos Multispectral Image



Histogram Band 4 Fused
Ikonos Multispectral Image

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Results: Image Statistics

Statistical Values Original Ikonos Image

	Standard Deviation	Mean value	Minimum	Maximum	Median
Band 1	37,278	203,461	139	1022	194,19
Band 2	58,616	211,844	96	1066	198,3
Band 3	69,669	166,427	41	1026	152,58
Band 4	117,748	311,688	15	1043	312,16

Statistical Values after Ehlers Fusion

Band 1	41,211	206,56	99,735	1045,5	196,62
Band 2	59,428	210,879	101,78	1071	197,62
Band 3	69,98	167,603	13	1045,5	152,52
Band 4	116,374	309,521	28,373	1045,5	311,14

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Results: Band Statistics

Correlation Coefficients

Band No	Mult.	PC	Brovey	IHS	Ehlers
1	0.83	0.91	0.51	0.29	0.72
2	0.89	0.83	0.71	0.61	0.89
3	0.92	0.89	0.86	0.84	0.96
4	0.86	0.71	0.91	0.94	0.98
5	0.89	0.62	0.88	0.90	0.98
7	0.93	0.82	0.92	0.92	0.98
Average	**0.89**	**0.80**	**0.80**	**0.75**	**0.91**

Gray Value Differences

Multiplicative	4,305.50
Principal Component	13.32
Brovey	10.07
IHS	3.55
Ehlers	1.34

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Results: RMSE

$$RMSE = \sqrt{\left(\bar{x}_{mult} - \bar{x}_{pan}\right)^2 + \left(\sigma_{mult} - \sigma_{pan}\right)^2}$$

Band	Mult.	PC	Brovey	IHS	Ehlers
1	5,178.2	4.3	11.64	1.93	1.47
2	4,033.3	7.0	8.6	0.6	1.2
3	3,958.2	9.3	8.2	1.9	1.3
4	6,321.3	24.1	12.6	0.4	1.1
5	4,998.6	20.6	10.3	1.0	0.9
7	3,787.7	14.2	7.6	0.6	0.5

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Classification Accuracy

Image Data	Class Based Classification Accuracy (min-max)	Overall Classification Accuracy	Kappa Coefficient
Original Landsat Data	**40% - 100%**	**87%**	**0.86**
Landsat/SPOT IHS Fusion	20% - 95%	74%	0.71
Landsat/SPOT Brovey Fusion	40% - 100%	77%	0.74
Landsat/SPOT PC Fusion	25% - 100%	73%	0.70
Landsat/SPOT Multiplicative Fusion	25% - 100%	79%	0.76
Landsat/SPOT Ehlers Fusion	**70% -100%**	**90%**	**0.89**

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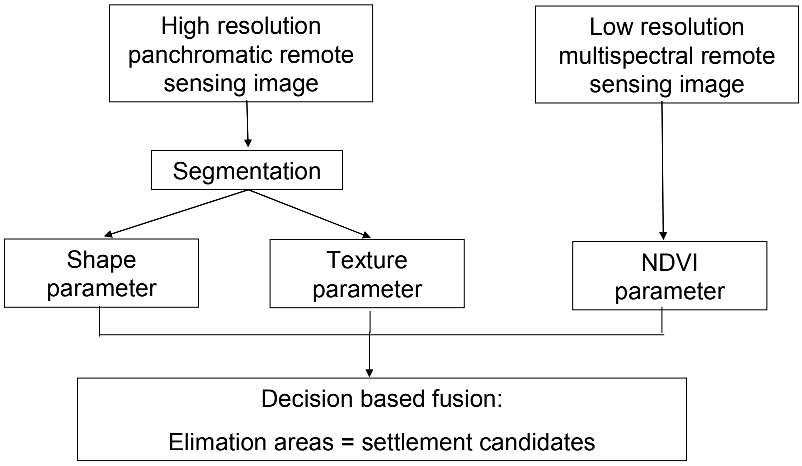
Decison Based Fusion for Automated Classification



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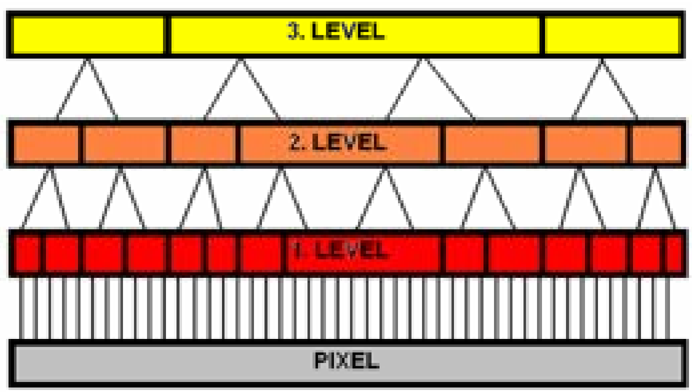
Basic Principle

- Hierarchical segmentation of the panchromatic image data (3 levels)



- Hierarchical network based classification

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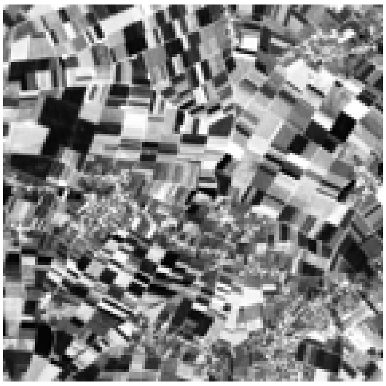
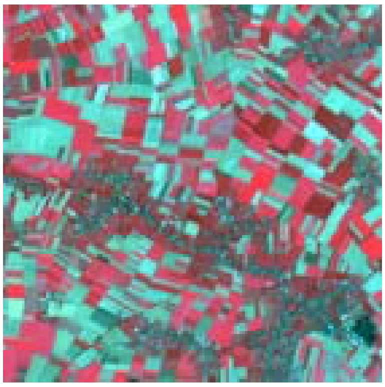
Example

- Test site near Aachen, Germany
- Appr. 25 km^2



KOMPSAT Image



ASTER Image

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Processing – Level 3

Classification 3rd level

- Basis: Large segments
- Low Restriction parameters for
  - Texture (heterogeneity/homogeneity)
  - Shape (compactness/length)
  - NDVI (elimination of vegetated areas)

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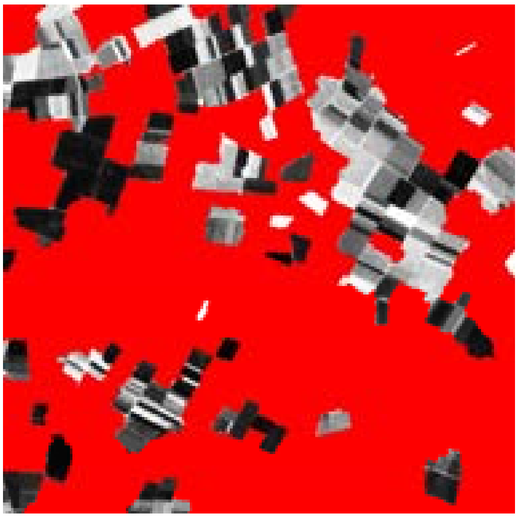
Results – Level 3

Level 3: Settlement candidates (red)

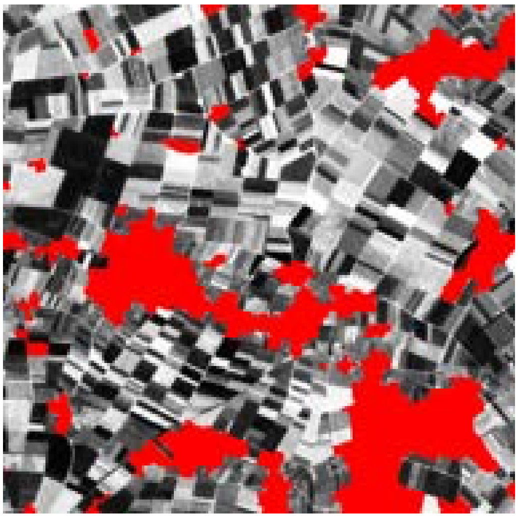


Processing – Level 2

- **Classification 2nd level:**
- Basis: **median sized** segments
- **Higher** restrictions for
  - Texture
  - Shape
  - NDVI
  - **Only applied to candidate areas from level 3**

Results – Level 2

Level 2: Settlement Candidates

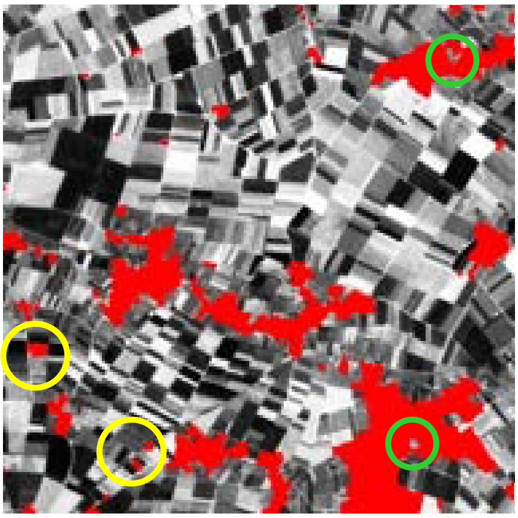


Processing – Level 1

- **Classification final level**
- Basis: small segments
- Highest restrictions
- Only applied to candidate areas from level 2

Results – Level 1

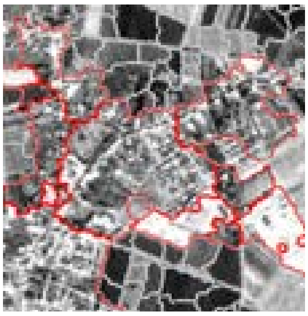
Level 1: Potential settlement areas



Results After Fine Tuning

Fine tuning of end results – step 1

- Merge of settlement areas



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Results After Fine Tuning

Fine tuning of end results – step 2

- Filtering of agricultural areas: calculation of grey value variances per segment)
- Allocation of not detected settlement areas inside of settlements (parks, lakes, cemeteries etc.): calculation of neighborhood relations

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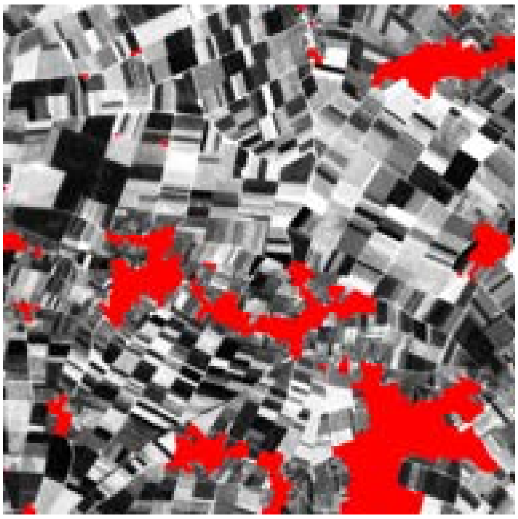
Final Result

End level: settlement areas



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Accuracy

- Accuracies for KOMPSAT and ASTER data
- Improvement with each processing step

	User's Accuracy
Level 3	18.60 %
Level 2	64.38 %
Level 1	86.72 %
End Level	90.38 %

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Accuracy

- Accuracies for SPOT and Landsat ETM data

	User's Accuracy
Level 3	13.57 %
Level 2	69.98 %
Level 1	86.90 %
End Level	90.34 %

→ Fusion method works for KOMPSAT/ASTER as well as for SPOT/LANDSAT data

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Conclusions

- Ehlers fusion method allows the preservation of spectral values for CAPI
- It can also be used for optimum spatial enhancement
- For automated classification use has to be made of other fusion techniques
- Multisensor fusion improves the potential for image analysis

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Presentation 4 – Development of eCognition protocols for automatic segmentation of VHR imagery and updating of the LPIS – the case studies on agricultural dynamics in South Poland

Piotr Wezyk, Roeland de Kok, Krystian Koziol,
Agricultural University of Cracow, PL

Abstract

The visual interpretation of increasing amount of VHR satellite imagery require a large numbers of experts as well as enough time for analysis. In this case the automatisation of the image classification process is extremely important.

From Data, to Information and from Information to Knowledge, expert systems are required to enable this process-flow. Although the flow of Data towards Information, IACS/LPIS is based for an important part on information from farmers, the direct link from satellite image data to GIS information can profit extremely from intelligent image understanding methods that are now available.

Presented paper, demonstrate the state of the art methods (eCognition ver. 5) and procedures of updating GIS layers (cadastre) with data gathered automatically from VHR satellite image.

Case study 1: shows automatic procedures for the quantitative analysis of the dynamic of natural succession (detect 69,28 ha of young forest; 16,2% of the test site) on abandoned agricultural parcels, a problem encountered in small scale farming in South Poland.

Case study 2: shows the experiments of borderline detection in agricultural parcels to arrive at ‘Field-block’ level. This study shows state of the art as well as the strategy how to solve the important missing links in automatic mapping of parcels and field-blocks.

Case study 3: shows patch analysis and indicator development for agricultural landscape

Keywords: automatic image analysis, classification protocols, GIS spatial analysis, forest succession, landscape indicators

Development of eCognition protocols for automatic segmentation of VHR imagery and updating of the LPIS – the case studies on agricultural dynamics in South Poland

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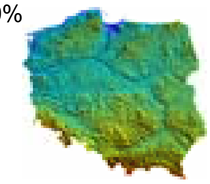
**** Lab. of GIS & RS, Faculty of Forestry, Agricultural University of Cracow, Poland***
***** landConsult.de***

Introduction (1)

General information regarding Polish agriculture
http://www.wirtschaft-polen.de/de/landwirtschaft.htm (Report 2004)

- Area of Poland: 312.700 km^2 (10% of the total area of the „old" EU members).
- Population: 38,3 Mio. people (Y. 2002);
- In the countryside lives 38,2% of the total population (14,6 mln)
- Average area-size of a single Polish farm is around 8,44 ha (3,31 ha South Poland; 24,1ha North-West Poland);
- Between 1996 and 2002, the total area of agricultural parcels diminished from 17,9 mln ha to 16,9 mln ha (1,0 mln ha, ca. 5,5%),
- Distribution of farm area:1-2 ha 26,5%; 2-5ha 32,2%; 5-10ha 21,9% 10-15ha 9,3ha, >15ha 10,1%,
- The amount of farms with an area > 1 ha is ca 1.956.000



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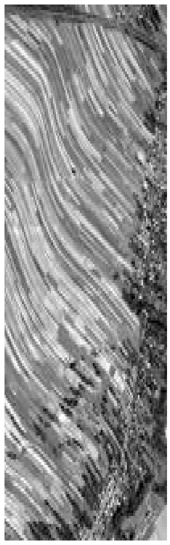
Introduction (2)

Some facts:

- Economical and demographic dynamics: between 1996-2002 the rural population was reduced with 1.084.700 people (9,4%)
- In the year 2002 the area of abandoned land was 2.3 mln ha (17.6% of arable land in Poland).
- In the year 2004 the total area of arable land in Poland equals 16.327 mln ha (52% of the country) and the abandoned land was reduced to 1.3 mln ha (9.9% of arable land in Poland).
- The total number of farms in Poland was 1.85 mln in year 2004 (7.5ha mean area).



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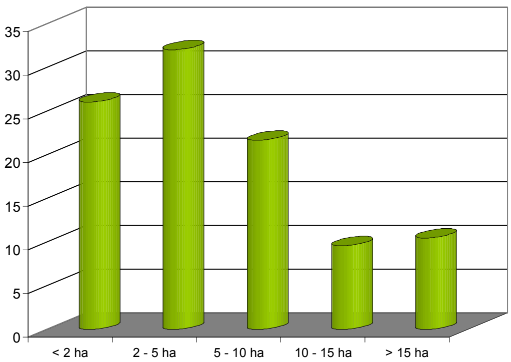
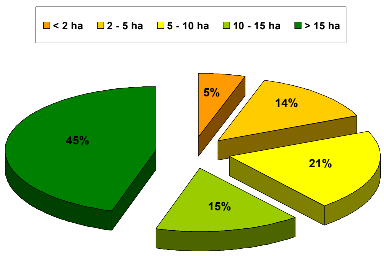
Introduction (3)



Structure of the farm size area [%]



Contribiution of the size-classes [%]

http://www.wirtschaft-polen.de/de/landwirtschaft.htm (Report 2005)

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