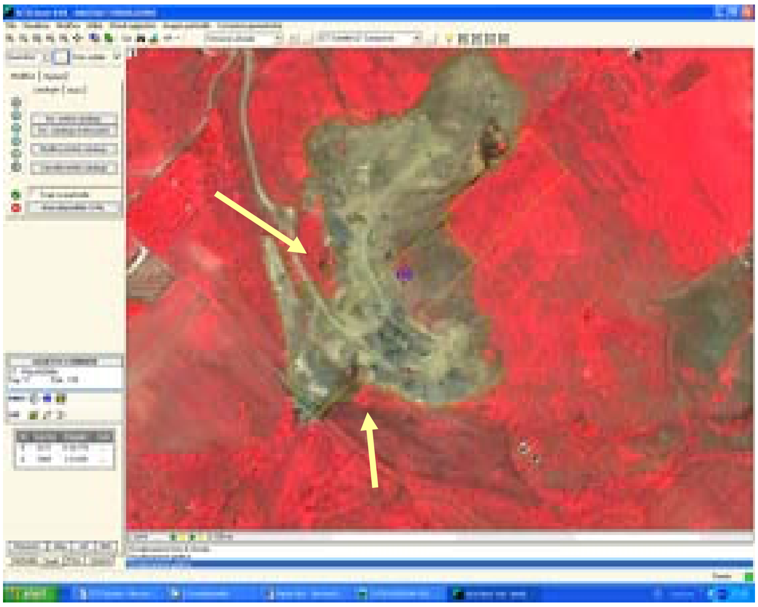
Standard 4:1
VHR examples

Standard 4.1: Catania – Palagonia – map n° 17 – parcel n° 176
declared pasture – detected new dump and pasture; ban on mowing grassland....



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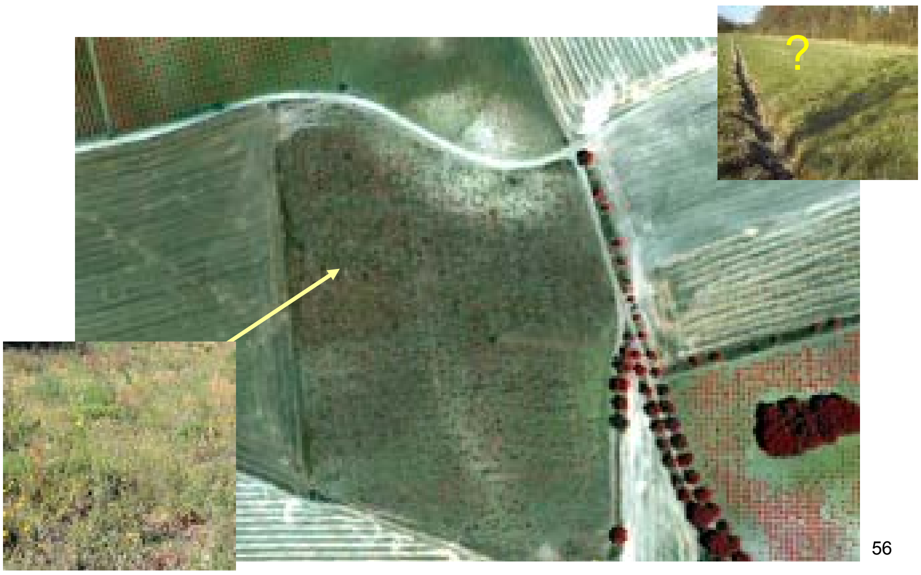
Standard 4:2
VHR examples

Standard 4.2: VHR for set-aside detection and monitoring of ploughing and mowing restrictions



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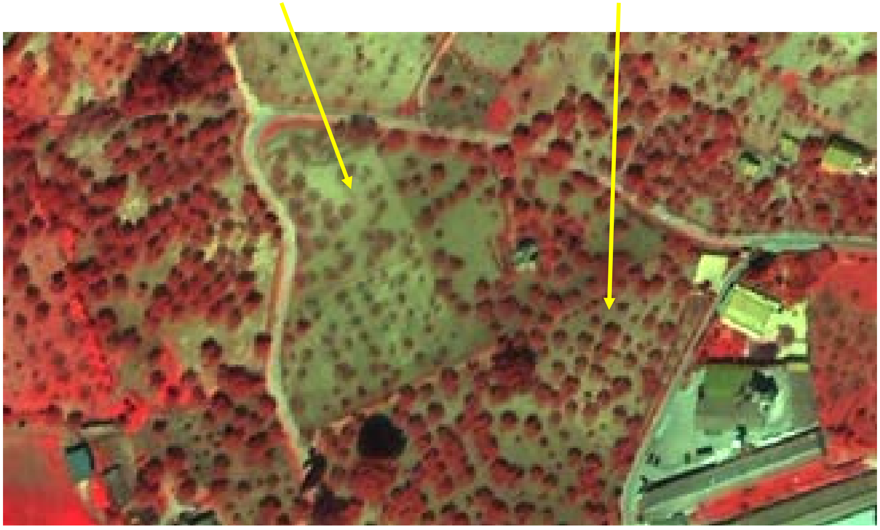
Standard 4.2: VHR - Different harvest/different crops/different operations on the same

57

Standard 4:3
VHR examples

Standard 4.3: Enna - olive grove analysis different pruning

recently pruned ***not recently pruned***



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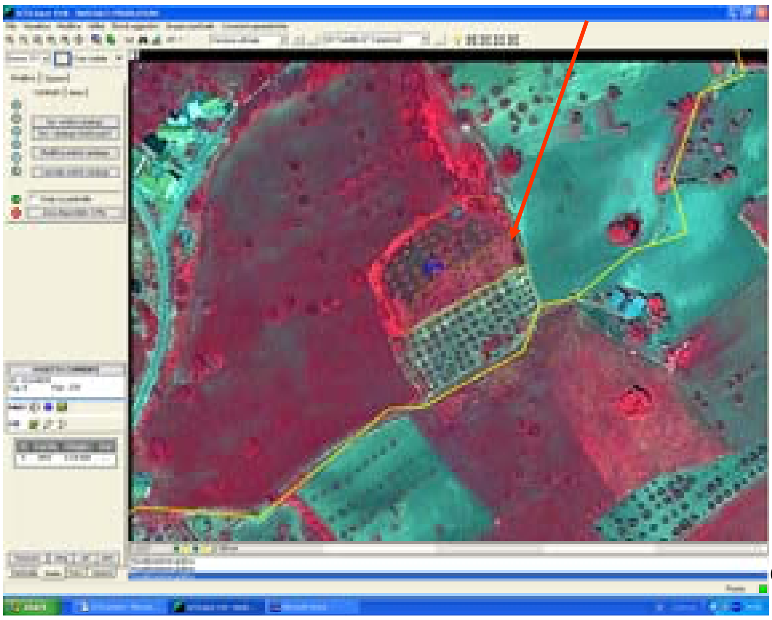
Standard 4.3: Avellino – Flumeri – map n° 8 – parcel 279
declared olive grove - accepted olive: scattered vegetation and difficulty in pruning detection



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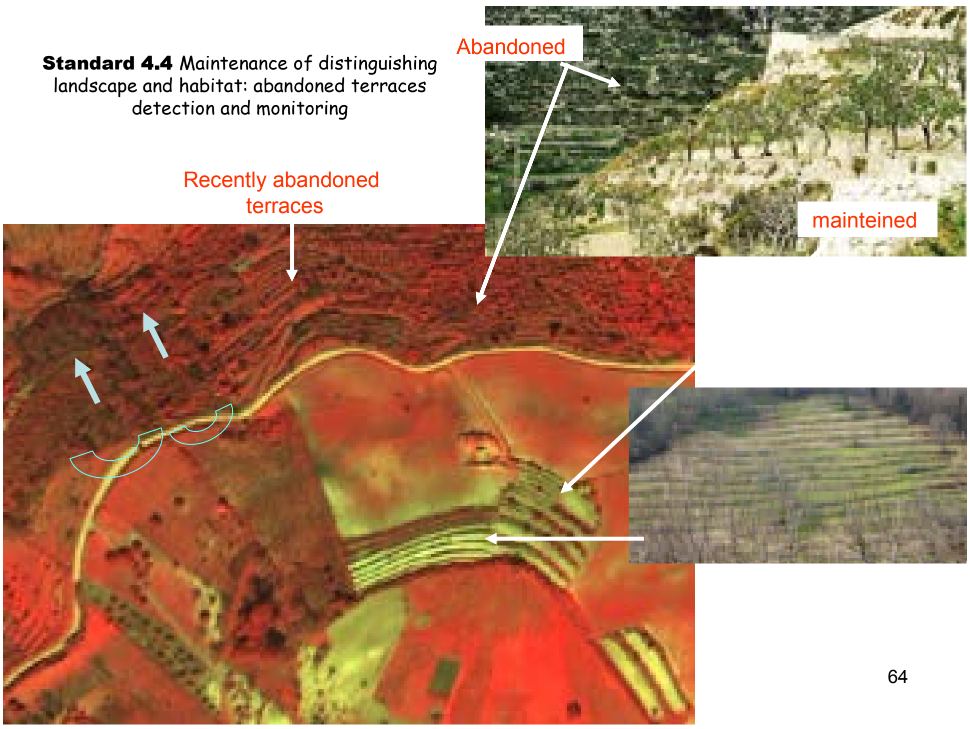
Standard 4.3: Tuscany: olive grove maintainance as ordinary orchards
transition woodland/permanent crops....

Standard 4.3: Tuscany: olive grove maintainance
olive trees / other trees detection

Standard 4:4
VHR examples

Standard 4.4 Maintenance of distinguishing landscape and habitat: abandoned terraces detection and monitoring



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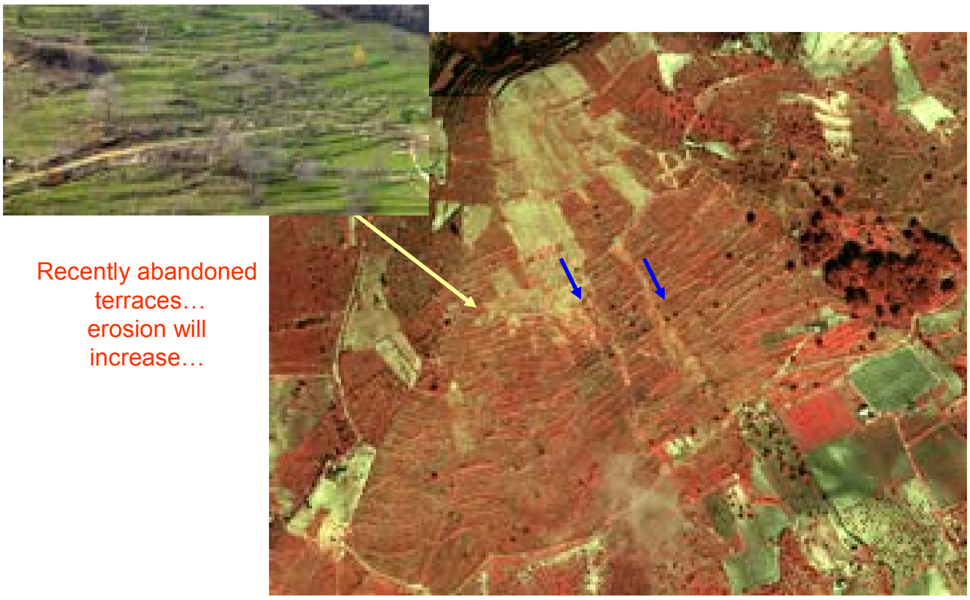
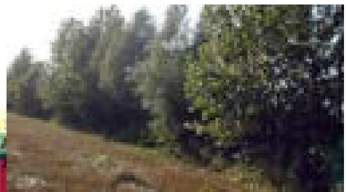
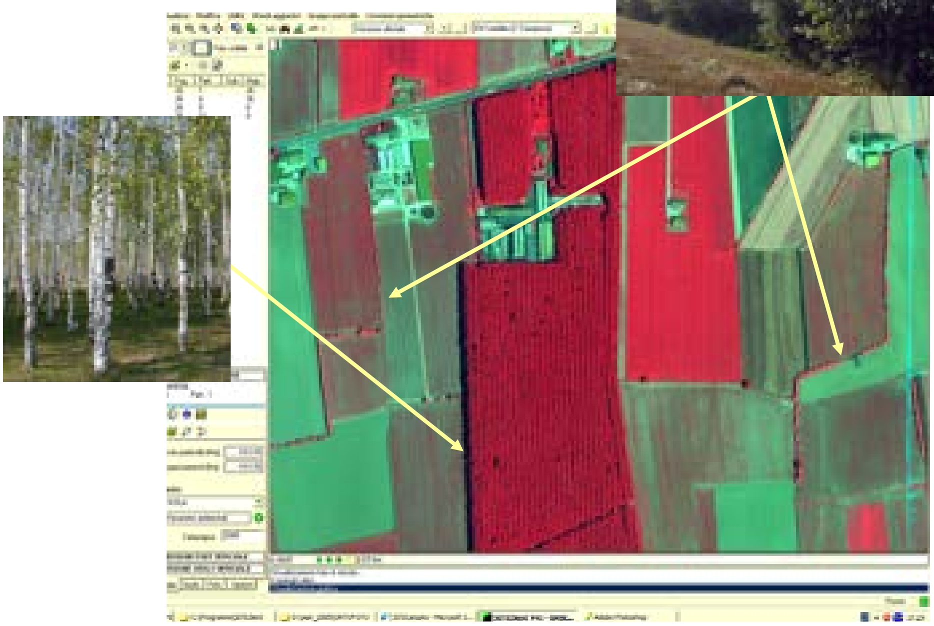
Standard 4.4: Catania, maintenance of distinguishing landscape and habitat: detection and monitoring of abandoned terraces



Standard 4.4: Cuneo, maintenance of distinguishing landscape and habitat: hedge conservation and monitoring





GAEC draft results by VHR for 6 provinces (without standard 2.1: burnt stubble by HR)

province	*involved municipalities*	*n° of maps*	*n° of parcels*	*GAEC standard*	*surface ha*
avellino	3	8	19	1.1; 4.2; 4.3	25,1
bari	1	5	17	1.1;	15,7
catania	3	8	12	1.1; 4.1;	40,8
enna	3	14	53	1.1; 4.1	125,8
perugia	3	6	17	4.2; 4.3;	14,3
viterbo	1	2	3	1.1; 4.3;	1,8
TOTAL	**14**	**43**	**121**		**223,5**

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GAEC first results in Italy: all methods (example)

	Violation standard 1.1			Violation standard 2.1			Violation standard 3.1		
PROVINCE	applications	Parcels	surface (ha)	applications	Parcels	surface (ha)	applications	Parcels	surface (ha)
VITERBO	0	0	0,00	0	0	0,00	0	0	0,00
CASERTA	0	0	0,00	0	0	0,00	0	0	0,00
SALERNO	0	0	0,00	0	0	0,00	1	1	0,18
CUNEO	1	1	0,35	1	1	0,19	0	0	0,00
AOSTA	0	0	0,00	0	0	0,00	0	0	0,00
MILANO	0	0	0,00	0	0	0,00	0	0	0,00
MACERATA	0	0	0,00	0	0	0,00	0	0	0,00
CHIETI	2	2	0,37	0	0	0,00	0	0	0,00
COSENZA	1	1	0,06	1	2	2,38	0	0	0,00
ISERNIA	1	2	0,43	0	0	0,00	0	0	0,00
BARI	2	3	0,57	1	1	0,12	0	0	0,00
BRINDISI	0	0	0,00	3	5	1,14	0	0	0,00
PERUGIA	0	0	0,00	0	0	0,00	0	0	0,00
ROMA	0	0	0,00	2	2	31,10	0	0	0,00
L'AQUILA	0	0	0,00	0	0	0,00	2	3	2,04
TARANTO	0	0	0,00	4	21	51,25	0	0	0,00
CATANIA	2	2	0,65	0	0	0,00	0	0	0,00
MESSINA	1	1	0,04	0	0	0,00	3	4	1,42
REGGIO DI CALAB	2	6	5,14	0	0	0,00	2	6	5,14
CAGLIARI	0	0	0,00	5	8	4,51	0	0	0,00
TORINO	0	0	0,00	2	2	0,16	1	1	0,15
BENEVENTO	8	16	4,22	1	1	0,41	0	0	0,00
AGRIGENTO	3	6	11,11	6	23	34,65	0	0	0,00
ENNA	6	23	3,98	1	1	4,30	0	0	0,00
MATERA	0	0	0,00	12	48	127,60	1	1	0,81
AVELLINO	8	14	1,46	3	5	0,54	0	0	0,00
CAMPOBASSO	13	68	16,91	2	6	6,38	2	2	1,92
PALERMO	15	44	100,22	11	35	67,82	0	0	0,00
TRAPANI	5	10	1,74	30	135	142,14	0	0	0,00
CALTANISSETTA	14	35	13,00	21	60	67,63	0	0	0,00
POTENZA	4	8	12,15	26	124	198,84	3	7	11,39
FOGGIA	13	25	24,85	242	1569	2593,36	0	0	0,00
TOTAL	**101**	**267**	**197,23**	**374**	**2049**	**3334,51**	**15**	**25**	**23,06**

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GAEC first results in Italy: all methods

GAEC campaign 2005	applications	parcels	surface (ha)
Violation standard 1.1	101	267	197,23
violation standard 2.1	374	2049	3334,51
Violation standard 3.1	15	25	23,10
Violation standard 4.1	14	31	14,51
Violation standard 4.2	25	89	169,69
Violation standard 4.3	19	40	18,12
Violation standard 4.4	2	6	0,51
Total including more than 1 violation	550	2507	3757,67
Total single applications	490		

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Standard 1.1 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =		
Timeliness capability vs. control activity =		
Risk analysis contribution =		

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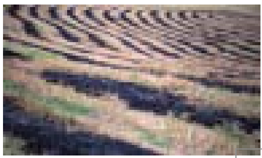


Standard 2.1 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =		
Timeliness capability vs. control activity =		
Risk analysis contribution =		


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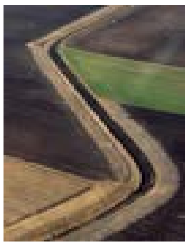
Standard 3.1 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =		
Timeliness capability vs. control activity =		
Risk analysis contribution =		


AGEA/Agrisian


Standard 4.1 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =	🙂	🙂
Timeliness capability vs. control activity =	🙁	😐
Risk analysis contribution =	😐	🙂

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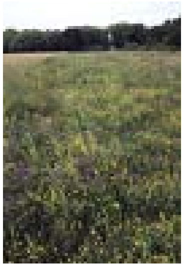

Standard 4.2 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =	🙂	😐
Timeliness capability vs. control activity =	🙁	😐
Risk analysis contribution =	😐	😐

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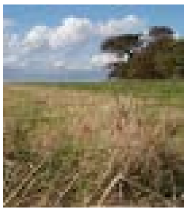

Standard 4.3 by SAT

SAT capability	By VHR	By HR
Detection and area calculation =		
Timeliness capability vs. control activity =		
Risk analysis contribution =		

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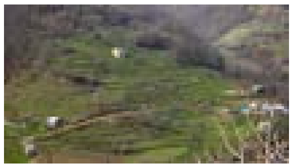
Standard 4.4 by SAT



SAT capability	By VHR	By HR
Detection and area calculation =		
Timeliness capability vs. control activity =		
Risk analysis contribution =		

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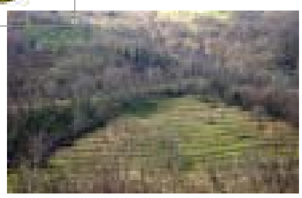

Recommendations and issues....

- **always use integrated multi-temporal data: VHR + HR and historical airborne imagery, if possible**
- **always use VHR pan-sharpened products, but with localized stretching**
- **prefer HR imagery with 2 infrared available bands**
- **Avoid, if possible, VHR high angles of acquisition for tree detection**

ISSUE

- **For multi-temporal GAEC analysis (olives, terraces, rotational crops, set-aside, etc.) must we change or maintain the sample sites for the next controls? What frequency must we foresee?**

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Presentation 4 – The use of GIS to support GAECs controls

Lucie Savelkova,
State Agricultural Intervention Fund, CZ

Abstract

The Czech Republic joined the European Union in 2004, and as most of the other new Member States applied the Single Area Payment Scheme (SAPS). Therefore, the Czech Republic had to implement the Good Agricultural and Environmental Conditions (GAECs) from the first year. The Czech Republic also expressed intention to use the Control with Remote Sensing to a large extent, and hence the idea of using the Remote Sensing for GAEC controls was taken on board.

During the process of GAEC controls in 2004, the Paying Agency (State Agricultural Intervention Fund) faced several obstacles regarding the control of individual GAEC requirements. When evaluating the campaign, it was agreed by the national administration, that the control of GAECs is more complex issue than it was previously expected. Consequently, the main factors influencing the outcome of GAEC controls were listed. What is now assumed by the Paying Agency, as one of the critical factors in respect of effective control is the definition of GAECs itself, followed by the risk assessment, the sample selection procedure, the possibility of re-use of control result, and of course, the quality of reference databases. Since the GAECs problematic is linked to agriculture area, the use of Geographic Information System (GIS) seems to be advantageous for all stakeholders involved. Even more, in respect of the Cross-compliance, the GIS based approach is becoming more important for the control purposes not only GAECs but also GFPs, SMRs.

Therefore, using the GIS to allocate precisely the risky target groups could heavily increase the effectiveness of the controls. And at the same point of time it could help the national administration to focus on specific groups, provide them training and education about environmental issues that are the most typical for that target group. In addition to that, the Czech Republic has decided to use the Control with Remote Sensing for four of the five defined GAECs in the 2005 campaign.

It could be stated that the Paying Agency is satisfied with the results achieved. Based on that, it has been assumed that the Remote Sensing can be effectively used for GAEC controls, but it requires analytical approach and sufficient integrated reference database.

Keywords: GAEC controls, Remote Sensing, GIS analysis, Risk analysis

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Czech Republic

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Use of GIS to support GAECs controls

Krakow, 23-25/11/2005

Lucie Savelkova, Jana Podhorska,
Rostislav Kolouch

State Agricultural Intervention Fund
Czech Republic
Department of System Support

Use of GIS to support GAECs controls

GAECs in the Czech Republic – 2005

GAECs controlled by CwRS

- Broad-row crops must not be grown on sloping land (more than 12° of steepness)
- Grassland must not be converted into arable land
- Maintaining of landscape features protecting soil against water, and wind erosion
- No burning of plant residues

VHR, HR data available for control of GAECs (Ikonos, QuickBird)

GAECs controlled by classical On-the-spot

- Liquid manure on farmer‘s block must be dunged into the land not later than 24 hours from application

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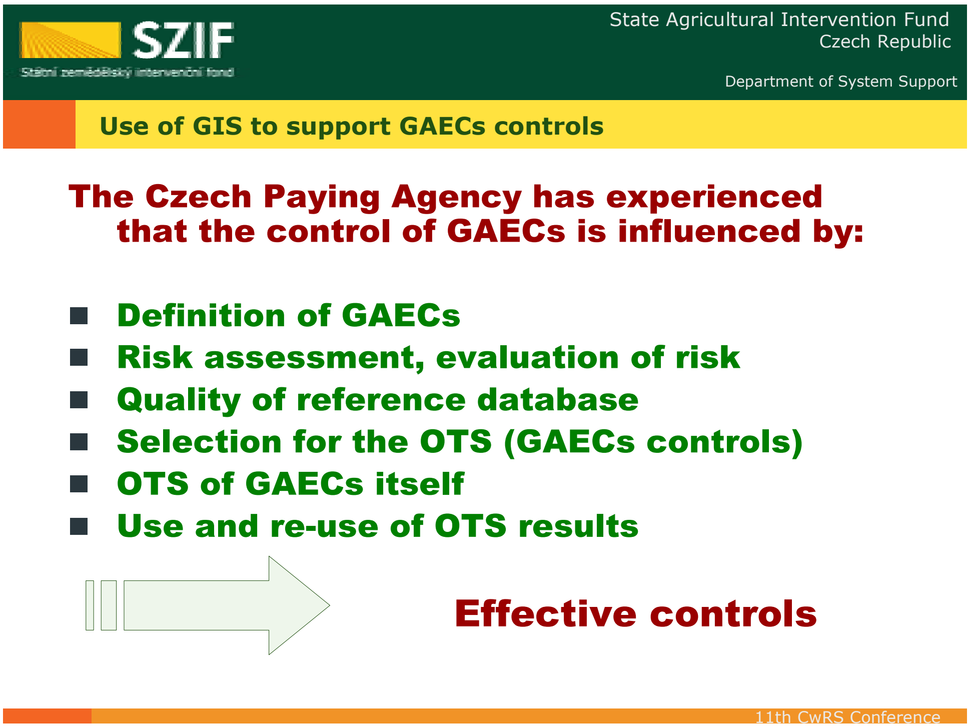
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Department of System Support
Use of GIS to support GAECs controls
The Czech Paying Agency has experienced that the control of GAECs is influenced by:
Definition of GAECs
Risk assessment, evaluation of risk
Quality of reference database
Selection for the OTS (GAECs controls)
OTS of GAECs itself
Use and re-use of OTS results
Effective controls
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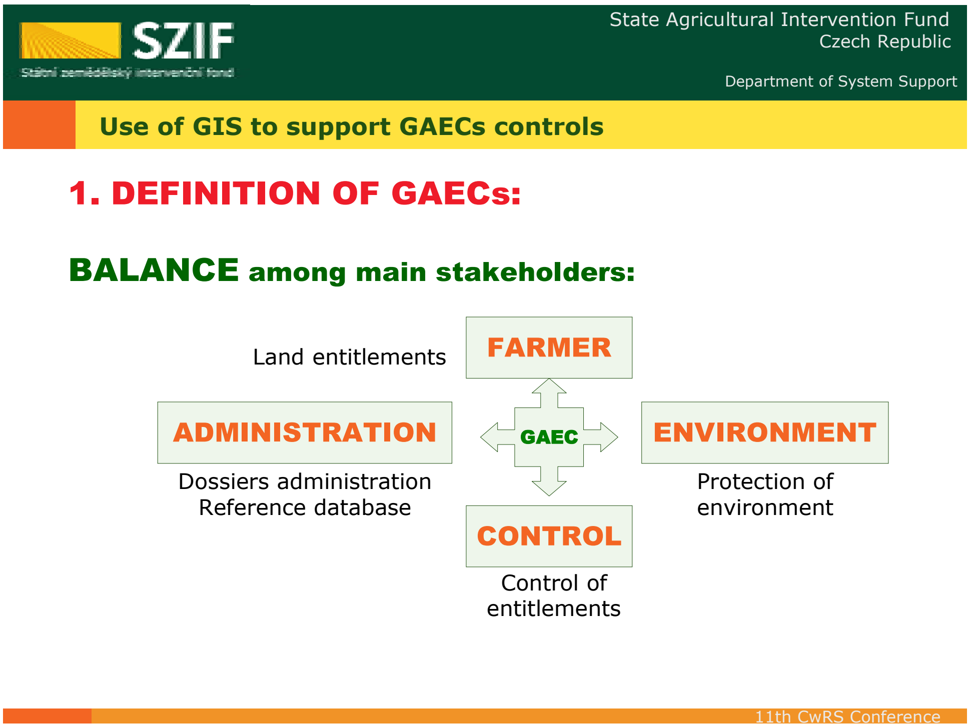
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Use of GIS to support GAECs controls
1. DEFINITION OF GAECs:
BALANCE among main stakeholders:
Land entitlements
FARMER
ADMINISTRATION
GAEC
ENVIRONMENT
Dossiers administration
Reference database
Protection of environment
CONTROL
Control of entitlements
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Use of GIS to support GAECs controls

1. GAECs DEFINITION

Definition of GAECs should be based on knowledge which target group is going to be potentially influenced by GAECs

- ***Regional basis/national basis***
- ***Crop type/payment group***
- ***Specific agricultural conditions***
- ***Specific farmers groups***

That way, the idea about the impact of GAECs on environment could be obtained, as well as the knowledge about the allocation of the potential target groups.

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Use of GIS to support GAECs controls

1. GAECs DEFINITION – assessment of target group

As far as the target groups/areas are known during the process of GAECs definition it is easier to focus on these groups/areas, and to provide them information, training, education regarding the GAECs requirements.

Since agriculture is linked to the area, the GIS analysis could heavily support these issues.

As far as the farmers know which fields are likely to fall under the GAECs requirements, it is easier to convince them to comply with GAECs. (The reason for that may be environmental, economic, other.)

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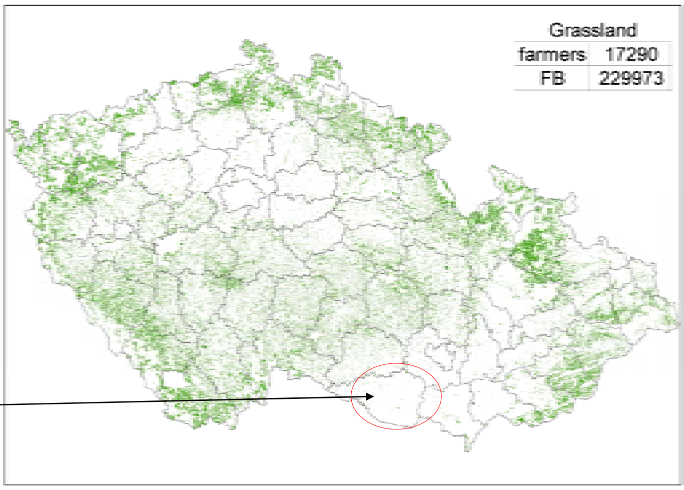
Use of GIS to support GAECs controls

Example of GIS analysis:

GAECs focused on Grassland

e.g. Not conversion of grassland to arable land

Not relevant for some areas



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Use of GIS to support GAECs controls

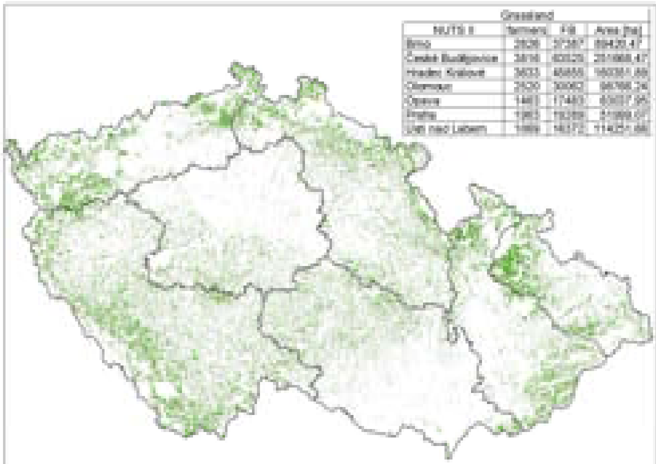
Example of GIS analysis:

GAECs focused on Grassland

Some regions would be more influenced by the GAEC than others

BUT generally,

ALL FARMERS SHOULD BE INVOLVED to entitlements



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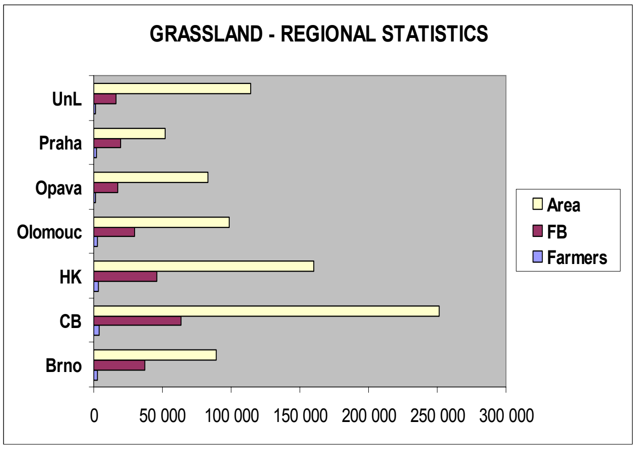

GRASSLAND - regional statistics		
REGION	AREA	FARMERS
CB	1	1
HK	2	2
UnL	3	7
Olomouc	4	4
Brno	5	3
Opava	6	6
Praha	7	5

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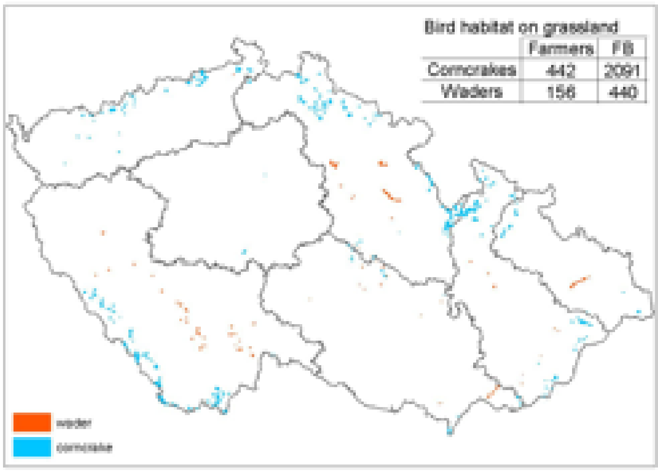
Example of GIS analysis:

GAEC, SMR focused on Bird habitats

Only in some specific areas BUT generally, not a broad issue

ONLY FEW FARMERS SHOULD BE INVOLVED to entitlements



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Use of GIS to support GAECs controls

The RISK ASSESMENT during the process of GAECs definition could be advantageous for all:

- **Farmers – *know what to focus on***
- **Environment – *focus where it is required***
- **Administration – *education, pre-printed forms***
- **Control bodies – *know what to focus on***

But it is not compulsory.

Nevertheless, the GIS based Risk Analysis may be one of the key risk assessment for control bodies.

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Use of GIS to support GAECs controls

2. GIS ANALYSIS for On-the-spot controls:

Evaluation of risk criteria and definition of risk groups/dossiers

Decision which type of control methods is suitable (classical OTS versus CwRS)

- **Is it possible to control the specific GAEC with CwRS, from the technical point of view?**
- **Is the risk group/area clustered – can CwRS be applied?**

The knowledge of allocation of subjects to be controlled may significantly increase the efficiency of controls.

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Use of GIS to support GAECs controls

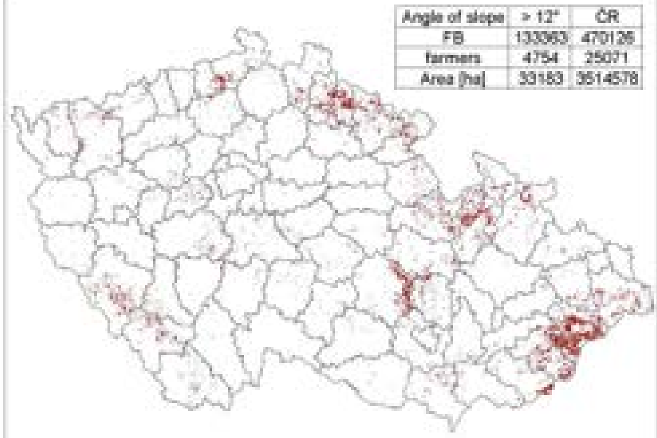
EXAMPLE of GIS risk assessment:

GAEC focused on sloping land

„Planting of broad-row crops on sloping land is forbidden."

THE TARGET GROUP IS DEFINED

= ALL FB/FARMERS on sloping land



Angle of slope	> 12°	ČR
FB	133363	470126
farmers	4754	25071
Area [ha]	33153	3514578

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Use of GIS to support GAECs controls

3. GIS ANALYSIS for On-the-spot controls and SAMPLE SELECTION:

GAEC example: „Planting of row-broad crops on sloping land is forbidden."

Can be the GAEC controlled with Remote Sensing from the technical point of view

- ***What type of RS data do I need for that ?***
- ***What type of reference data do I need for that ?***

Answer:

Yes, that GAEC could be controlled with Remote Sensing method from the technical point of view.

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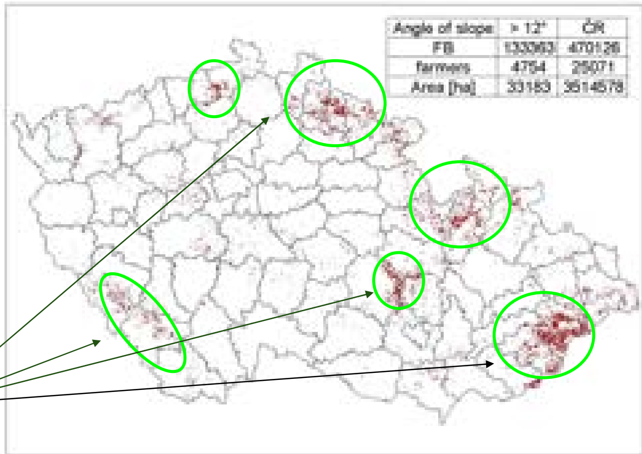
Use of GIS to support GAECs controls

EXAMPLE of GIS risk assessment:

GAEC focused on sloping land
„Planting of broad-row crops on sloping land is forbidden.“

Can I use the CwRS from the methodological or administration point of view?

YES, the risk groups are clustered, the CwRS could be applied.



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Use of GIS to support GAECs controls

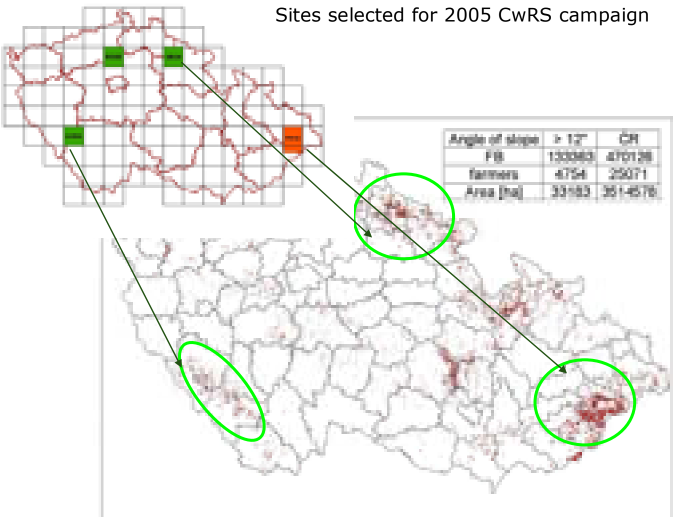
EXAMPLE of GIS risk assessment:

GAEC focused on sloping land
„Planting of broad-row crops on sloping land is forbidden.“

Can I apply the CwRS according to the Common Technical Specification?

YES, it has also targeted the CwRS selected sites.

Sites selected for 2005 CwRS campaign



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Use of GIS to support GAECs controls

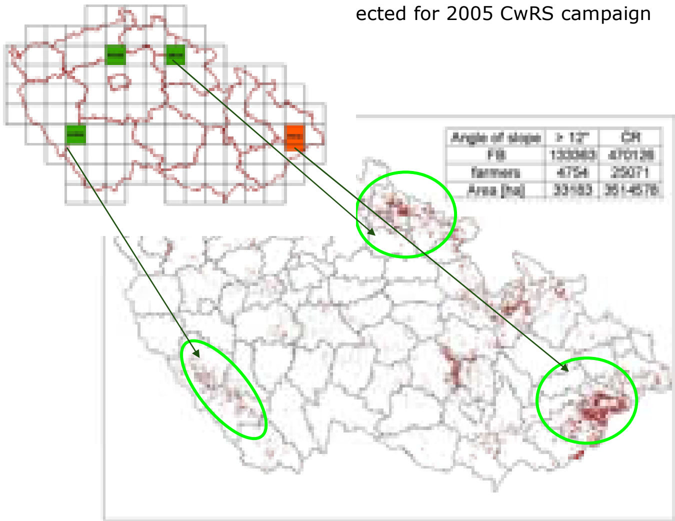
EXAMPLE of GIS risk assessment:

GAEC focused on sloping land

„Planting of row-broad crops on sloping land is forbidden.“

How do I select the GAEC 1% control sample?

I can select it under the 3 CwRS sites, and at the same point of time can assume, the sample was selected on the risk basis.



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Use of GIS to support GAECs controls

4. The On-the-spot control itself

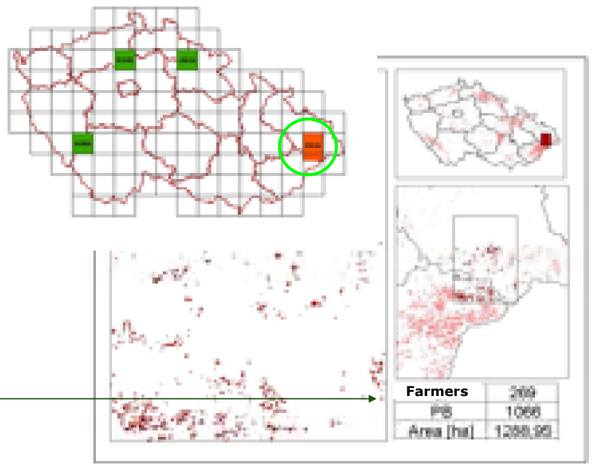
Control of GAEC:

GAEC focused on sloping land

„Planting of row-broad crops on sloping land is forbidden.“

One specific CwRS site.

The farmers to be controlled, as well as farmers blocks to be controlled for that site are known.



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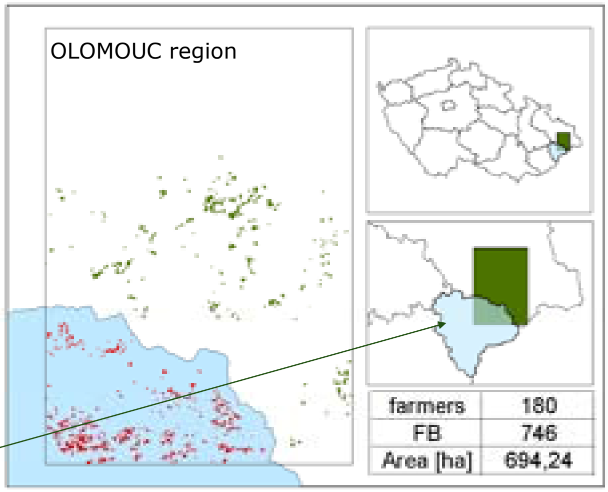
Use of GIS to support GAECs controls

EXAMPLE of GIS risk assessment:

GAEC focused on sloping land
„Planting of row-broad crops is forbidden.“

The CwRS site falls into two regions:

The analysis for individual region can be done, due to needs of planning the OTS by Paying Agency regional offices.



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Czech Republic

Department of System Support

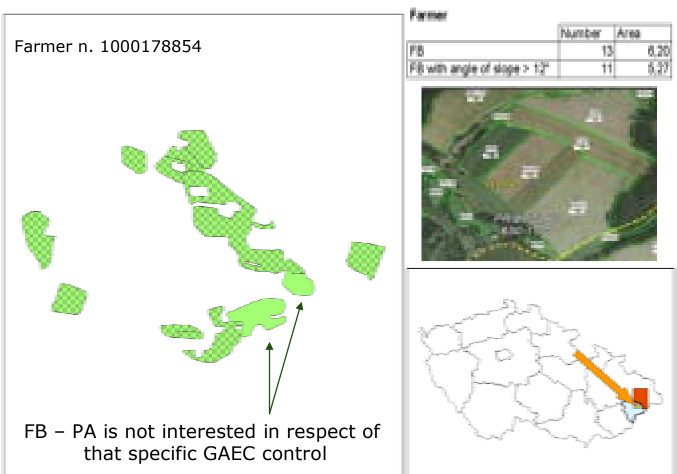
Use of GIS to support GAECs controls

EXAMPLE of GIS risk assessment:

GAEC focused on sloping land
„Planting of row-broad crops is forbidden.“

GIS assessment for individual:

- **FARMER**
- **FARMERS BLOCK**



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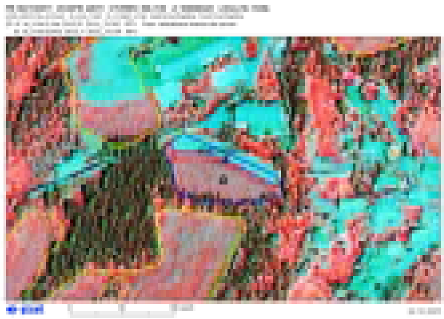
Use of GIS to support GAECs controls

GAEC control – focus on specific farmer/field



Result from CwRS

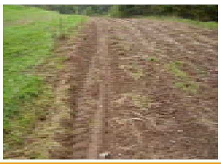
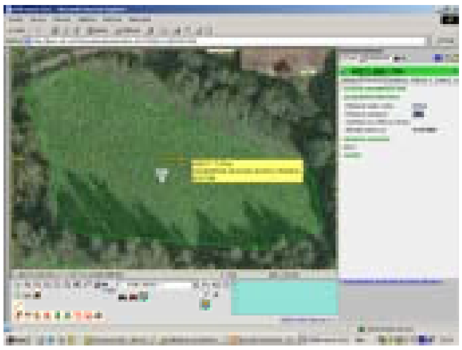


Photo from RFV (potatoes)



LPIS

The reference database is one of the key factors of effective controls

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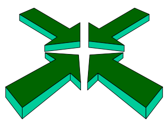
Use of GIS to support GAECs controls

RESULTS from the OTS controls:

Furthermore, the results from the OTS and from GIS analysis could be used for re-assessment of GAECs definition, and for re-assessment of balance among individual stakeholders:

FARMER **ENVIRONMENT**



ADMINISTRATION **CONTROL**

The general results of OTS controls could be also available to other institutions and FAS.

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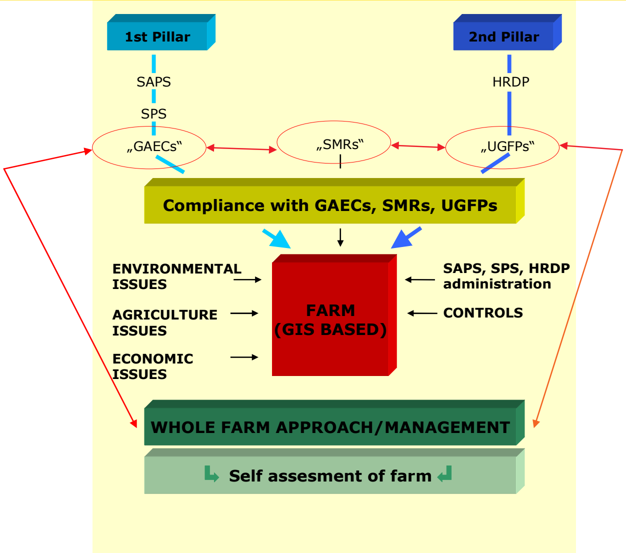
Use of GIS to support GAECs controls

The GIS BASED approach is important in terms of Cross-compliance, since more requirements are linked to the same field.



The data exchange among organizations is crucial.

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Use of GIS to support GAECs controls

CONCLUSIONS - GIS analysis for OTS controls:

- **The 1% sample selection for C-C controls is risk based, since accounts those who are really risky**
- **The control bodies know precisely their target group, and therefore could estimate the amount of work to be done, and could plan the controls more effectively.**
- **The control bodies know precisely to which farmers, and fields the GAECs conditions are entitled.**

MORE EFFICIENT CONTROLS and SAVING OF TIME DURING THE OTS

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Use of GIS to support GAECs controls

CONCLUSIONS

- **The CwRS can be effectively used for GAECs controls, but it requires analytical approach, and the data availability from reference database is necessary.**
- **The GAECs definition should be balanced among the stakeholders.**
- **The farmers should be aware of C-C requirements also on the GIS farm basis (pre-printed forms).**
- **The GIS risk analysis could be very effective tool in terms of Cross-compliance issues.**
- **The data exchange in terms of C-C controls is crucial issue.**

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Thank you for your attention.

Department of System Support

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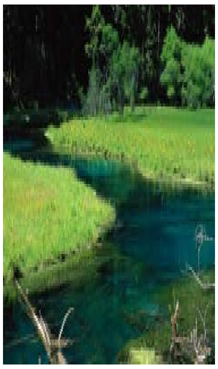
Presentation 5 – Good agricultural and environmental conditions. CAPI contribution by HORUS

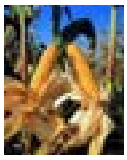
Alain PETITJEAN
ONIC, FR

Abstract

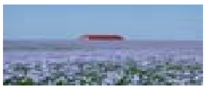
Five GAEC measures have been set up in France. The contribution of Horus, the French CAPI software, is a preparation for GAEC control of the spot check. Each preparation is systematically followed up by on the spot inspection. Horus has the capacity to localise and calculate the environmental areas covered, to verify crop rotation and to put warnings on incineration of residues and on bad crop maintenance. The presentation describes the CAPI controls over the 3% environmental cover obligation, the respect of priority to the rivers banks and the final check test. It also presents the use of bad maintenance warnings. A brief report of the first controls results ends the presentation.

GOOD AGRICULTURAL AND ENVIRONMENTAL CONDITIONS





CAPI CONTRIBUTION

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SUMMARY

- Memo: Content of GAEC measures in France
- Use of remote-sensing (two exemples)
  - GAEC Program: environmental cover
  - GAEC Program: maintenance of crops
- Some data concerning the 2005 GAEC control campaign

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Memo: CONTENT OF THE FRENCH GAEC MEASURES

- 3% environmental cover
- Prohibition of the incineration of residues
- Crop rotation minimum (3 crops minimum) or winter soil management
- Irrigation (pumping autorization and water meter)
- Minimum level of maintenance of crops, set aside and forage area

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PREPARATION OF ON THE SPOT GAEC CONTROL BY REMOTE-SENSING

- Two principles
  - Each CAPI preparation is systematically followed up by an on the field inspection
  - The preparation is a useful tool for the controller enabling him to target his investigations on the spot

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PREPARATION OF GAEC CONTROL BY REMOTE-SENSING

Four measures are concerned.

- Localisation and calculation concerning « Environmental cover »
- Calculation of « Crop diversity/Crop rotation »
- Warning concerning « Prohibition of the incineration of residues »
- Warning concerning « Minimum level of maintenance »

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CAPI TREATMENT : « ENVIRONMENTAL COVER »

A great difficulty

- The farmer does not declare and localise the environmental cover areas
- The environmental cover areas may correspond to different declared categories : set-aside, environmental set-aside, permanent and temporary grasslands

The checks

- The program checks the respect of :
  - rate of 3% of environmental cover
  - the priority located alongside river

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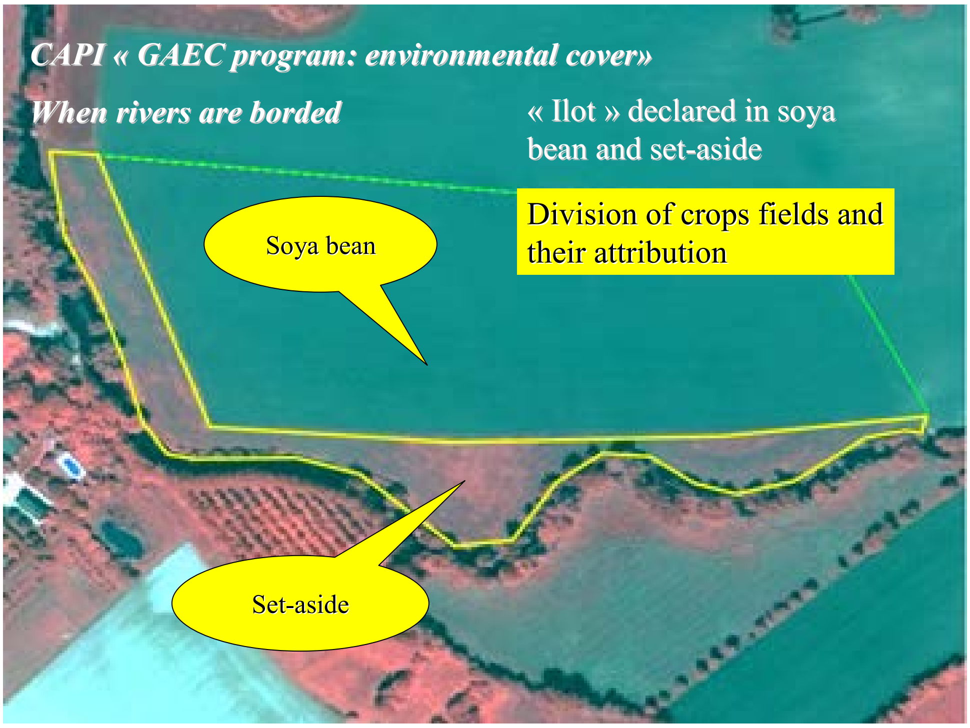
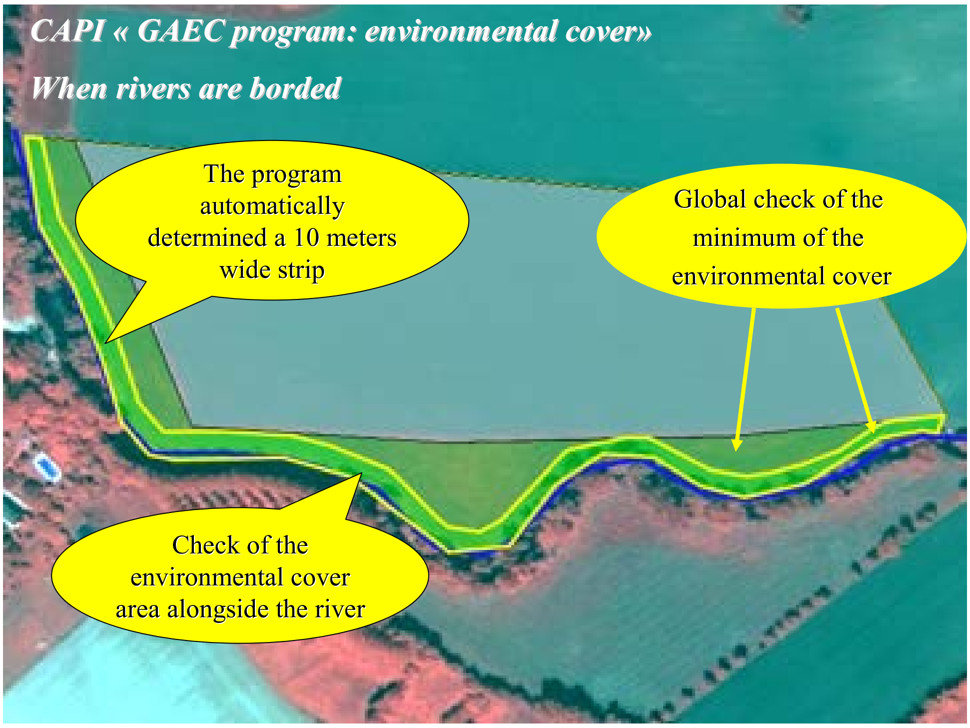
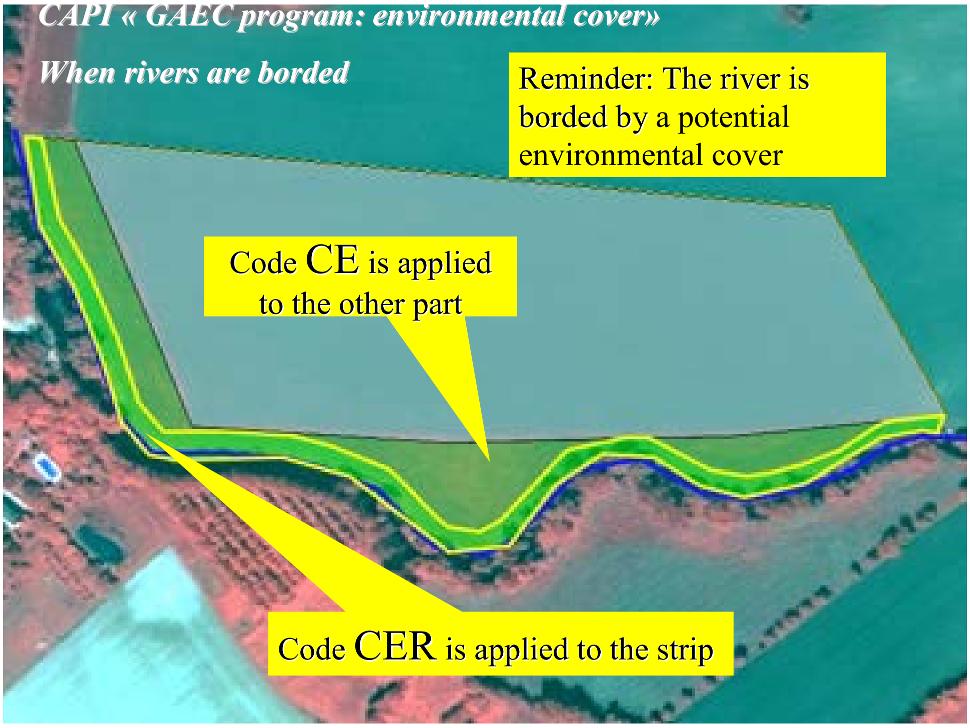
CAPI « GAEC program: environmental cover»
When rivers are borded
« Ilot » declared in soya bean and set-aside
Division of crops fields and their attribution

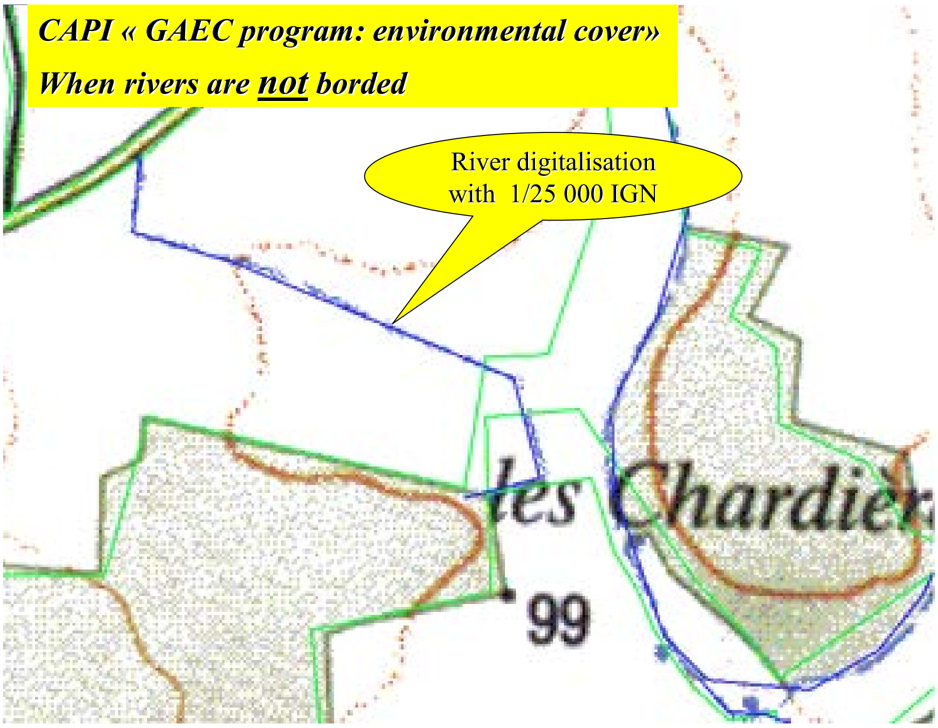

CAPI « GAEC program: environmental cover»
When rivers are borded
« Ilot » declared in soya bean and set-aside
Division of crops fields and their attribution
Soya bean
Set-aside

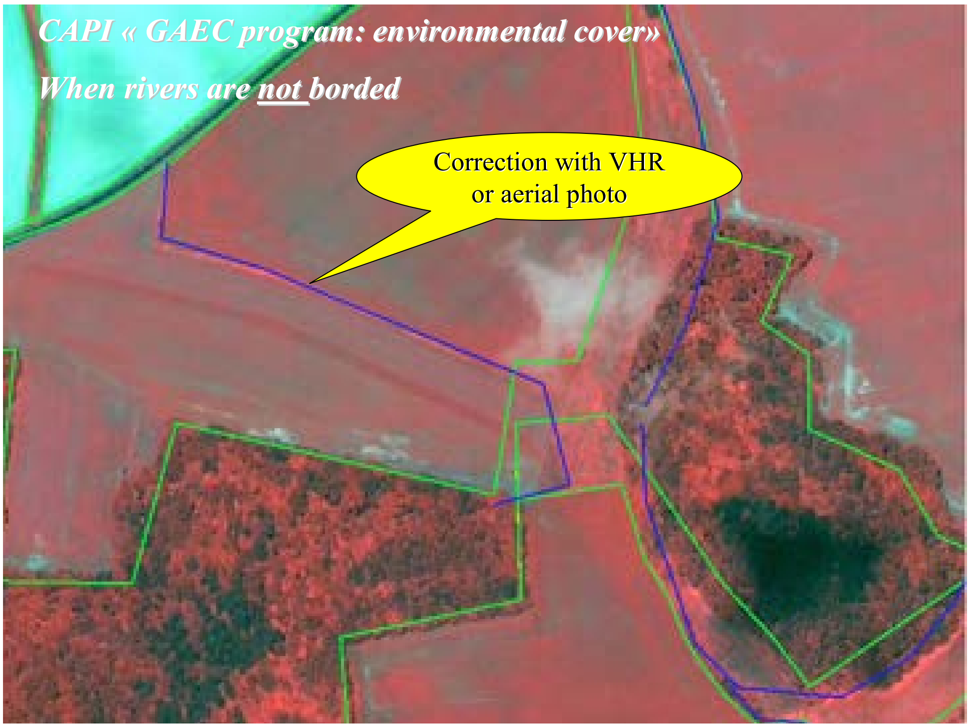

CAPI « GAEC program: environmental cover»
When rivers are borded
River digitalisation with 1/25 000 IGN and VHR or aerial photo

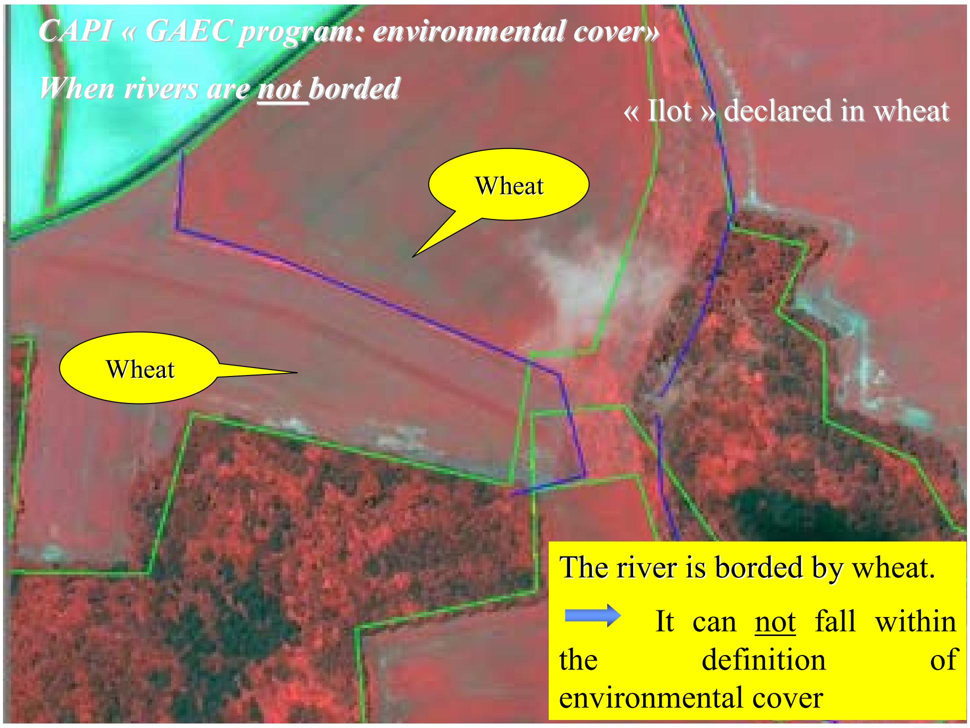

CAPI « GAEC program: environmental cover»
When rivers are borded
Superposing river to CAPI areas
Soya bean
Set-aside
The river is borded by set-aside.
It can fall within the definition of environmental cover

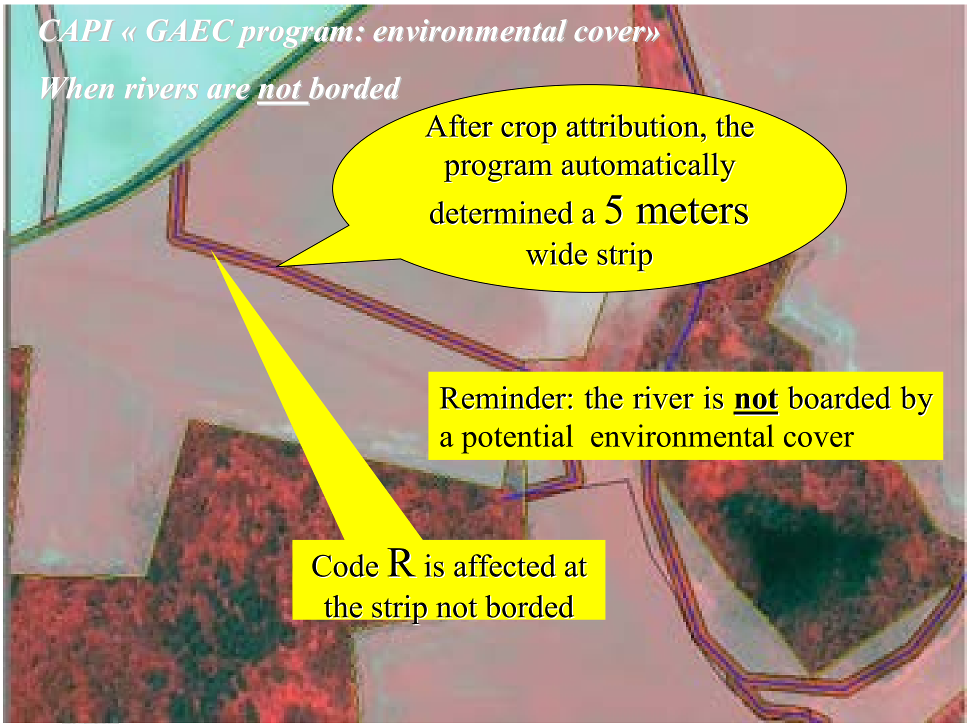

CAPI « GAEC program: environmental cover»
When rivers are borded
The program automatically determined a 10 meters wide strip
Global check of the minimum of the environmental cover
Check of the environmental cover area alongside the river


CAPI « GAEC program: environmental cover»
When rivers are borded
Reminder: The river is borded by a potential environmental cover
Code CE is applied to the other part
Code CER is applied to the strip


CAPI « GAEC program: environmental cover»
When rivers are not borded
River digitalisation with 1/25 000 IGN
les Chardier
99


CAPI « GAEC program: environmental cover»
When rivers are not borded
Correction with VHR or aerial photo


CAPI « GAEC program: environmental cover»
When rivers are not borded
« Ilot » declared in wheat
Wheat
Wheat
The river is borded by wheat.
It can not fall within the definition of environmental cover


CAPI « GAEC program: environmental cover»
When rivers are not borded
After crop attribution, the program automatically determined a 5 meters wide strip
Reminder: the river is not boarded by a potential environmental cover
Code R is affected at the strip not borded

CAPI « GAEC program: environmental cover»

After CAPI, three codes possibilities

- CE = environmental cover NOT adjacent to the river side
- CER = environmental cover adjacent to the river side
- R = river without environmental cover

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Respect test of 3% of environmental cover

CER >= 3% → OK

CER < 3% et R > 0 → KO

CER < 3% et R = 0

→ CER + CE >= 3% → OK

→ CER + CE < 3% → KO

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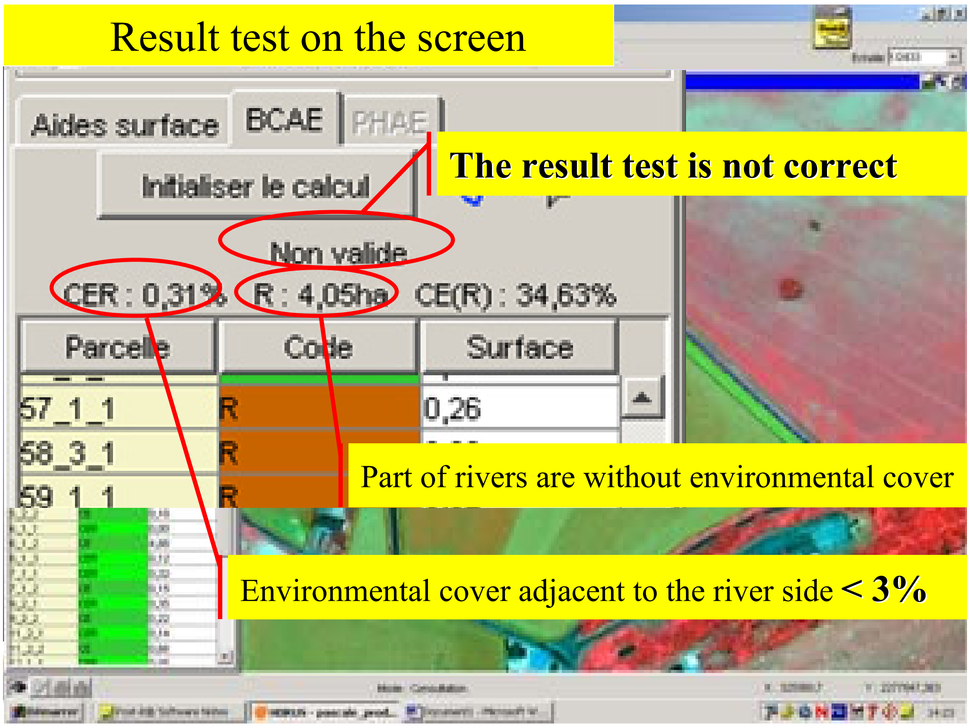
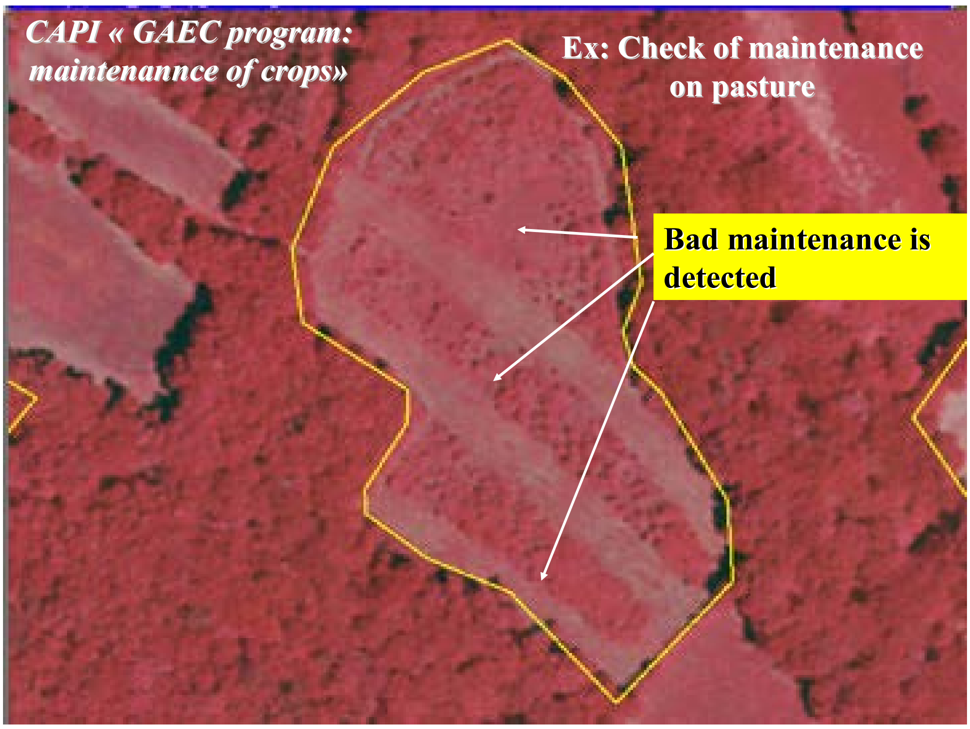
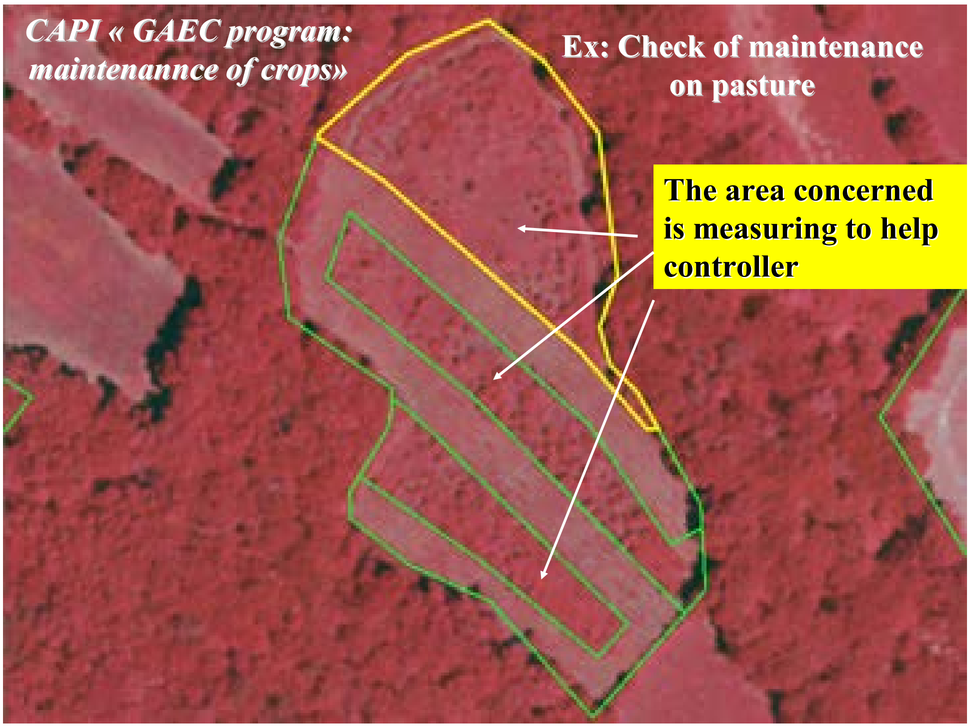
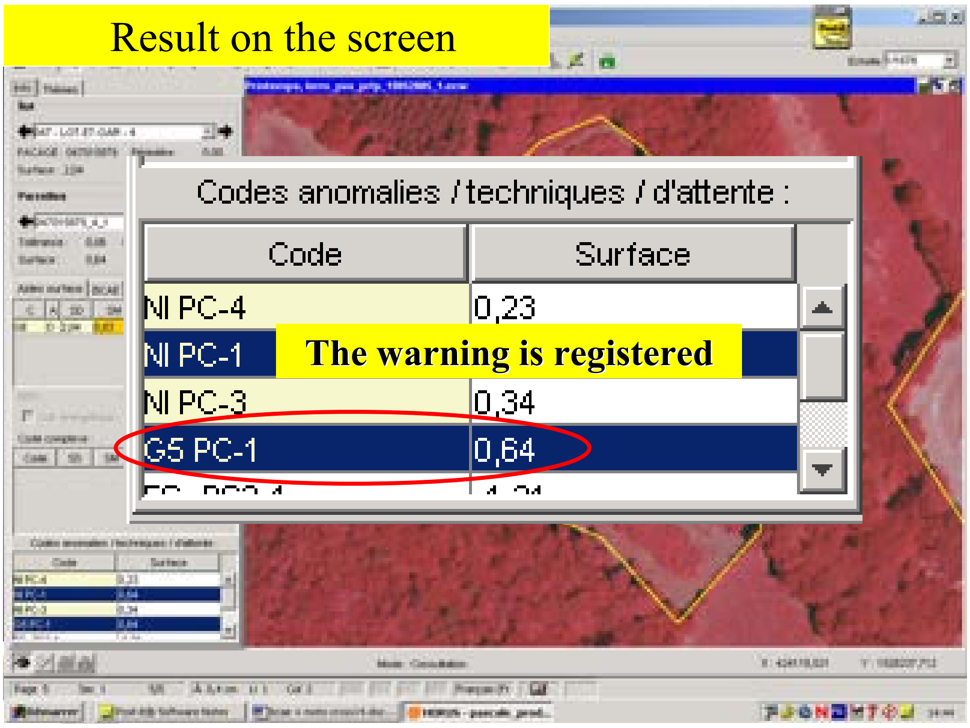

Result test on the screen
Aides surface
BCAE
PHAE
Initialiser le calcul
Non valide
CER : 0,31%
R : 4,05ha
CE(R) : 34,63%
Parcelle
Code
Surface
57_1_1
R
0,26
58_3_1
R
59_1_1
R
The result test is not correct
Part of rivers are without environmental cover
Environmental cover adjacent to the river side < 3%


CAPI « GAEC program: maintenannce of crops»
Ex: Check of maintenance on pasture
Bad maintenance is detected


CAPI « GAEC program: maintenannce of crops»
Ex: Check of maintenance on pasture
The area concerned is measuring to help controller


Result on the screen
Codes anomalies / techniques / d'attente :
Code
Surface
NI PC-4
0,23
NI PC-1
The warning is registered
NI PC-3
0,34
G5 PC-1
0,64

SOME DATA CONCERNING THE 2005 GAEC CONTROL CAMPAIGN

- 55% CAPI by Regional Agencies of ONIC
- 45% CAPI by contractors
- GAEC control carried out by the 17 Regional Agencies of ONIC
- Controllers are trained on legal aspects by ONIC and on agronomic aspects at the Institut National Agronomique Paris Grignon (INA-PG)

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SOME DATA CONCERNING THE 2005 GAEC CONTROL CAMPAIGN

- Of the GAEC files interpreted by CAPI, the following results were noted :
  - 305 warnings relating to « environmental cover » measure
  - 179 warnings concerning the « crop rotation » measure
  - 37 warnings concerning the «minimum level of maintenance» measure
  - 0 warnings about « prohibition of the incineration of residues » measure

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SOME DATA CONCERNING THE 2005 GAEC CONTROL CAMPAIGN

- 4000 GAEC on the spot controls linked to surface controls of which 40% were prepared by remote-sensing
- Out of a sample of 2 350 GAEC-control reports analysed, 5,1% were found to have GAEC anomalies

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SOME DATA CONCERNING THE 2005 GAEC CONTROL CAMPAIGN

- Improvements for 2006 campaign:
  - Identification of rivers by IGN 1/25 000 like in 2005, but also with an other kind of data base like « BD Carthage »
  - Improvements of on the spot GAEC's documents (fields documents) with more details on calculation of environmental cover areas

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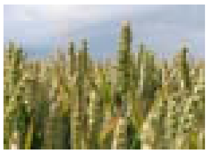

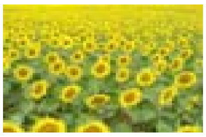

THANK YOU FOR YOUR ATTENTION !

Alain PETITJEAN

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Presentation 6 – DeCOVER – the German Joint Project to Develop a Tested Methodology for a Consistent National Land Cover Data Base

Klaus-Ulrich Komp & Oliver Buck
EFTAS Remote Sensing Transfer of Technology

Abstract

The need for consistent and up-to-date land cover information becomes more and more important with respect to recent international and European developments (e.g. Kyoto protocol, Water Framework Directive, Cross Compliance, IACS, GAECs). The existing German land cover data sets are insufficient to meet these requirements. Currently used data such as provided by the European CORINE Land Cover scheme as well as the German Automated Cartographic Information System (ATKIS) and the National Biotope and Land Use Type Mapping Scheme (BNTK) lack the required accuracy, national consistency and timeliness. Established competencies by ongoing European developments within the Global Monitoring for Environment and Security program (GMES) and the LUCAS and CORINE mapping schemes need to be bundled into a national initiative. The German DeCOVER Project aims therefore to develop a tested methodology for an improved German land cover database (DeCOVER) to:

- facilitate interoperability between existing data sets (ATKIS, BNTK, CORINE)
- employ a classification based on user requirements to meet the upcoming requirements from EC policies and directives (e.g. Thematic Soil Strategy)
- provide flexible updates of BNTK data and CORINE at the DeCOVER level
- identify target areas to update ATKIS data, GAECs and CC elements
- reduce mapping efforts for change detection
- link DeCOVER to international and national Geodata Infrastructure developments (INSPIRE, GDI-DE) and existing GMES Service Elements.

DeCOVER will be based upon a detailed user requirement analysis. Data interoperability will be developed employing ontologies and semantics. Sensor-independent change detection methodologies will use radar and optical satellite data. The developed services will be demonstrated using latest satellite technology (RapidEye and TerraSAR-X).

Keywords: German land cover data base, BNTK, CORINE, ATKIS, GAECs, CC, WFD, GMES, data interoperability, change detection, latest satellite technology, Radar-optical data integration.


DeCOVER
CwRS Conference Krakow 23. – 25. Nov. 2005
DeCOVER
The German Joint Project
to Develop a Tested Methodology
for a Consistent
National Land Cover Data Base
Klaus Ulrich Komp
Coordinator DeCOVER
Oliver Buck
EFTAS Germany
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DeCOVER
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Project Partners:
Coordination:
EFTAS
New Image Data:
infoterra
an EADS Astrium company
Service Provider:
GAFAG
RSS
Remote Sensing Solutions GmbH
Technology Development:
jenaoptronik
DEFINIENS
H. G. Geodata Solutions GmbH
Methodology and
Quality Development:
DLR
Data Support:
EUROPEAN COMMISSION
Joint Research Centre
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Situation

There is no consistent national LAND COVER Data Base meeting User Requirements in Germany
Actual available data sets (e.g. CORINE Land COVER, BNTK, ATKIS) Are not meeting requirements because of insufficient consistency and lack of actuality.

Upcoming needs for geo information serving European directives (e.g. WFD, FFH, CC) cannot be satisfied.

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Objectives of the Project:

Development of a proved concept for an consistent National land cover data base

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CORE ASPECTS:

- Facilitate interoperability between existing data sets (ATKIS, BNTK, CORINE, CC)
- Employ a DeCOVER classification based on user requirements to meet the upcoming requirements from EC policies and directives (e.g. Thematic Soil Strategy)
- Provide flexible updates of BNTK data and CORINE at the DeCOVER level
- Identify target areas to update ATKIS data, GAECs and CC elemets
- Reduce mapping efforts for change detection by innovative Remote Sensing approaches
- Link DeCOVER to international and national Geodata Infrastructure developments (INSPIRE, GDI-DE) and existing GMES service elements

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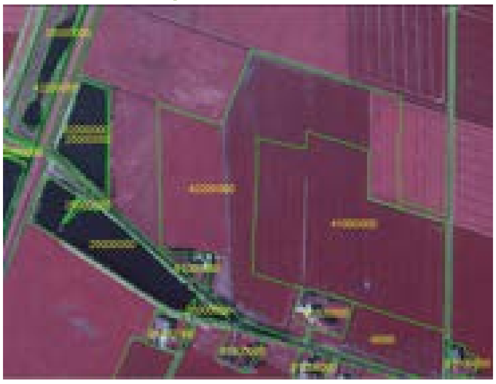
Existing German Data Bases:

Facilitate interoperability between existing data sets (**ATKIS, BNTK, CORINE, CC**)

ATKIS German Automated Cartographic Information System
16 Federal Survey Authorities are producing their specific variants



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Existing German Data Bases:
Facilitate interoperability between existing data sets (ATKIS, BNTK, CORINE, CC)
BNTK
National Biotope and Land Use Type Mapping Scheme
Basic inventories since 1985 established, update shows 16 different aspects
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DeCOVER
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Existing German Data Bases:
Facilitate interoperability between existing data sets (ATKIS, BNTK, CORINE, CC)
CLC
Update CLC2000 since2005 completed
funds for national 2005 update are missing, funding for CLC2010 not yet clear
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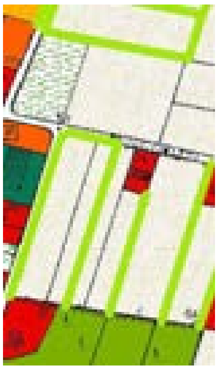
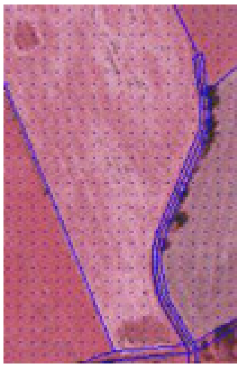
Existing German Data Bases:

Facilitate interoperability between existing data sets (ATKIS, BNTK, CORINE, CC)

CC — Cross Compliance in relation to IACS-LPIS
Mapping scheme established but up to 16 different states of progress





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INTEROPERABILITY ASPECTS:

Definitions of land use classes are not consistent

Example:
"Forest" — legal or actual forest cover
thresholds for "mixed" is different between ATKIS, BNTK and CORINE

Challenge:
Definition of common classes and rules for interoperability between several data bases

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MULTIPLE USER ASPECTS:
Public financial crisis will no longer allow budgets for fulfilling each mapping requirement separately,
If we try to realise each geo data base separately there will none of them be completed in due time:
Consequences will be
fines imposed by the EC
inconsistencies in regional policy
Targets:
Reduce mapping / reporting efforts by developing a consistent common data base for change detection
Reduce mapping / reporting efforts by innovative Remote Sensing approaches
Link DeCOVER to international and national Geodata Infrastructure developments (INSPIRE, GDI-DE) and existing GMES service elements
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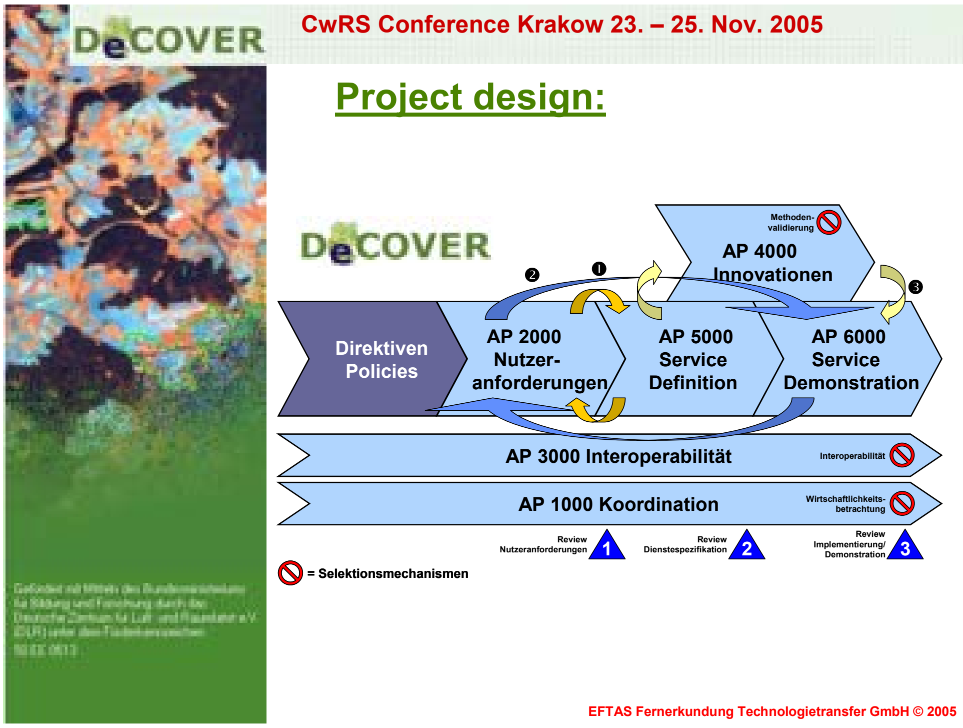
DeCOVER
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Project design:
DeCOVER
Methoden-validierung
AP 4000 Innovationen
Direktiven Policies
AP 2000 Nutzer-anforderungen
AP 5000 Service Definition
AP 6000 Service Demonstration
AP 3000 Interoperabilität
Interoperabilität
AP 1000 Koordination
Wirtschaftlichkeits-betrachtung
Review Nutzeranforderungen 1
Review Dienstespezifikation 2
Review Implementierung/ Demonstration 3
= Selektionsmechanismen
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Incorporation of User Institutions

Identification of key user organisations

User consultations

Establishment of a user federation
Workshops
Website area reserved for registered users

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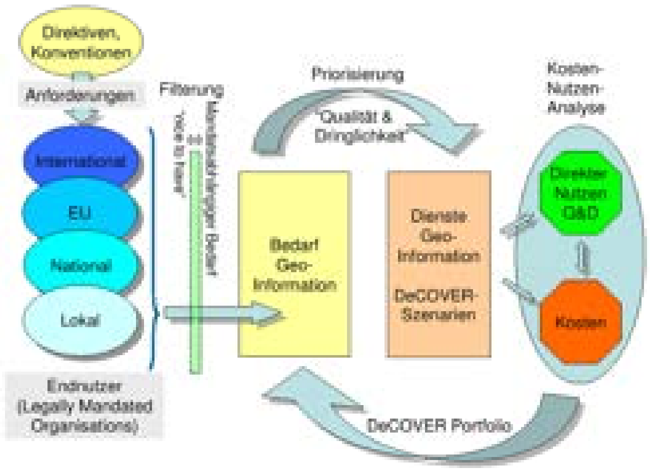
Incorporation of User Institutions

Identification of cost/benefit aspects of public markets



DeCOVER

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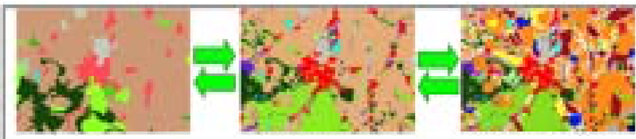
Purpose of a base product:

The base product shall allow aggregation to EC level or extension to special services



CLC 2000	Base Product	Service AGRI
MMU 25/5ha	MMU 1ha/5ha	MMU 1ha
44 classes	25 classes	44 cl.+ 8 crops

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DeCOVER

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Methodology

Development of innovative, sensor independent methods for change detection (e.g. for CC)

Demonstration of services for the use of actual satellite technology (RapidEye and TerraSAR-X)

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Data Sources of the Project:

2006/07
will be based on archive data with support from the JRC-Ispra (IACS data) and from the regional user organisations

2007/08
will be based new acquired data
a) RapidEye 5m Ortho Product 4 optical bands
b) TerraSAR-X Radar product 1-2m
c) Auxiliary data from User organisations

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Open Questions

IF SUCCESFUL .....
will DeCOVER be able to fit in the reporting schemes of the agricultural sector to serve info needs for GAECs, CC, agricultural statistics, LUCAS, water framework directive?

IF SUCCESFUL .....
may DeCOVER become a model for other member states of the EU?

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DeCOVER
CwRS Conference Krakow 23. – 25. Nov. 2005
DeCOVER
The German Joint Project
to Develop a Tested Methodology
for a Consistent
National Land Cover Data Base
actual informations on the
progress of the project under:
www.DeCOVER.info
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Parallel Session T3 – New Sensors and Image handling

Chairman:

Tamme van der Wal, Alterra, NL

Presentation 1 - MONITOR – an integrated EO monitoring service

Lars Edgardh, Torbjörn Westin,
Spacemetric AB

Abstract

Monitor is an ESA supported project for development and demonstration of a monitoring service based upon an integrated value chain. The basic idea of the service is to enable a highly automatic image production and value adding chain using multi sensor and multi resolution datasets.

The service integrates components for:

- logistics of satellite programming;
- data acquisition and assessment of quick look data during a data reception campaign;
- image browsing, product ordering; and
- automated high-accuracy orthoimage production and delivery solutions

The service includes an automated workflow with a notification system used by the satellite operator as well as the value adder. The value adder is notified when new images has arrived and can make assessments of the image quality and coverage to determine if more acquisitions are needed for the value added product. Images are ordered through an order system and processed as orthos and delivered automatically to the value adder.

The project has demonstrated and evaluated a pilot service for monitoring new forest clear cuts indicating risk areas for power line damage. The full service chain will be functional in January 2006. This service concept could also be applied to the area-based subsidy control. A possible scenario for this is presented.

Keywords: Integrated value chain, monitoring, logistics, workflow, orthorectification, satellite programming.

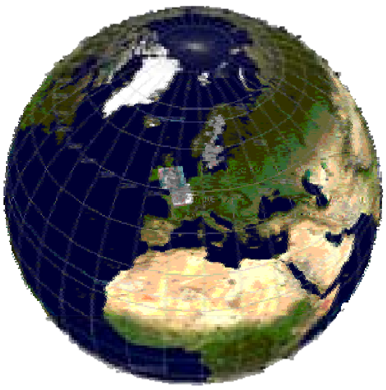
CwRS Conference Krakow
23rd - 25th of November, 2005 – Kraków

MONITOR – an integrated EO monitoring service

Lars Edgardh (lae@spacemetric.com)
Torbjörn Westin (tw@spacemetric.com)
www.spacemetric.com

MONITOR

- Background, idea and requirements
- The integrated EO monitoring service
- Similarities MONITOR and CwRS scenarios



Project

- ESA supported project
- Development and demonstration of a monitoring service based upon an integrated value chain
- Start May 2005, Finished January/February 2006
- Rollout of service in january/february 2006

Background

- Every year, power lines in the Swedish countryside are damaged due to storms, often in combination with heavy wet snowfalls
- Long costly interruptions in the power distribution
- Caused by trees falling on power lines often in combination with new forest clear cuts

Basic idea

- Find new forrest clear cut areas by RS change detection
- Combine with vector data (power lines) to find risk areas for filed control where trees are exposed to wind
- Enable a highly automatic image production and value adding chain using multi-sensor and multi-resolution datasets
- **Service**: Yearly recurrent clear cut mapping service to enable preventive removal of trees along the power lines in these high risk areas at a low cost

Consortium

- Spacemetric – development of underlying service technology for image production and delivery; overall service technical responsibility
- DMC II – operation of DMC spacecraft, acquisition planning and data reception; marketing of DMC service capabilities
- Metria – ongoing service value-added delivery and development; service marketing towards Swedish users and European institution

Integrated service components

- Logistics of satellite programming
- Data acquisition and assessment of quick look data during a data reception campaign
- Image browsing, product ordering
- Automated high-accuracy orthoimage production and delivery solutions
- Mapping of clear cuts in forests
- Identification of high risk areas for filed control

Critical parameters and bottlenecks

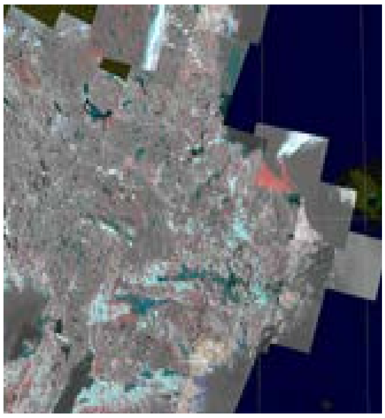
- Guaranteed and timely cloud free satellite data coverage
- Cost of satellite programming, data costs and costs of handling and analysing a large number of small scenes to cover large areas
- Geometric quality
- Radiometric and spectral quality

System requirements

- Quick programming response
- Timely delivery of quick looks
- Tools for geometric correction of quick looks.
- Quick assessment of cloud free coverage of the area of interest – continue / stop acquisition
- High precision geometric correction for multi-resolution change detection

Requirements on workflow

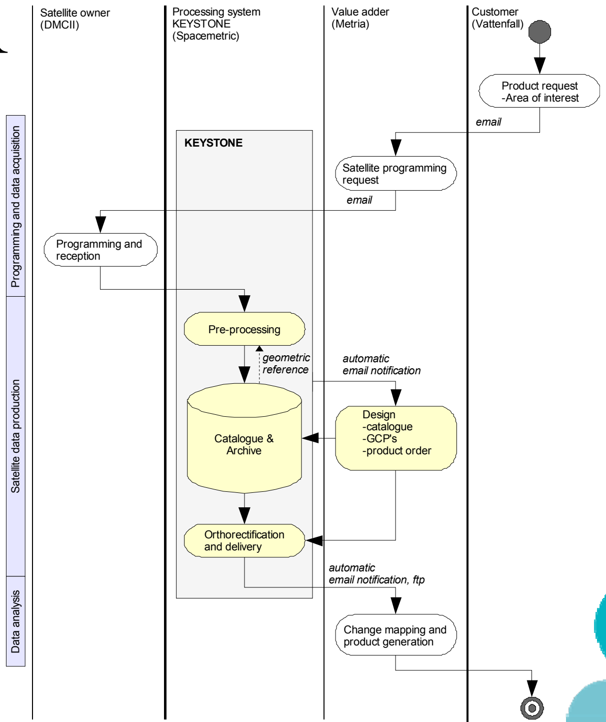
- Notification system (email) used by the satellite operator as well as the value adder
- Notification on AOI changes, new images, new product orders, product deliveries
- Automatic processing of products and delivery to value adder



Approach

- Existing SPOT5 for reference
- New DMC images for change detection against SPOT 5 images
- Cataloguing, archiving, quicklook mosaicing, geometric measurements and orthoproduction based on Keystone from Spacemetric
- Add workflow based on Keystone

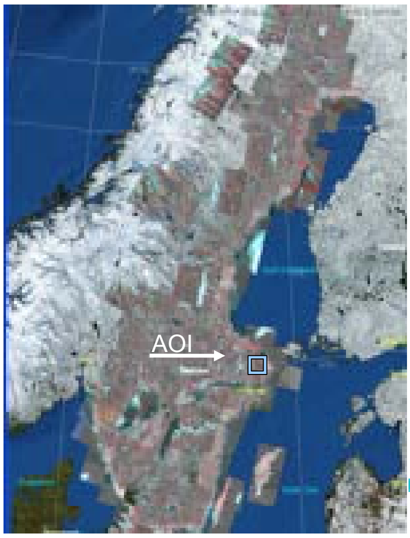
MONITOR workflow



Programming and data acquisition

Area of interest

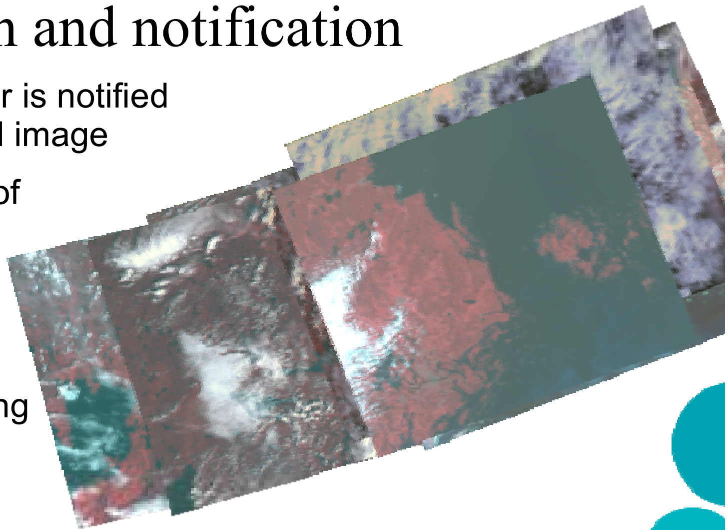
- Definition of AOI, timeframe and sensor
- Acceptance by satellite operator



Programming and data acquisition

Reception and notification

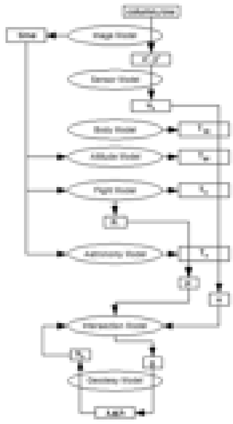
- Value adder is notified on received image
- Mosaicing of quicklooks
- Decision whether to keep programming or stop



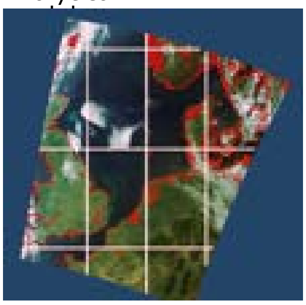
Satellite data production

Analytical models

- A mathematical model is required that describes the exact position of every image pixel.
- Based on the physical imaging process using a satellite orbital model



Analytical

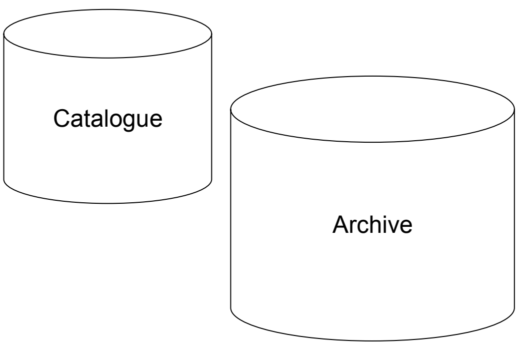


Polynomial model

Satellite data production

Archiving and cataloguing

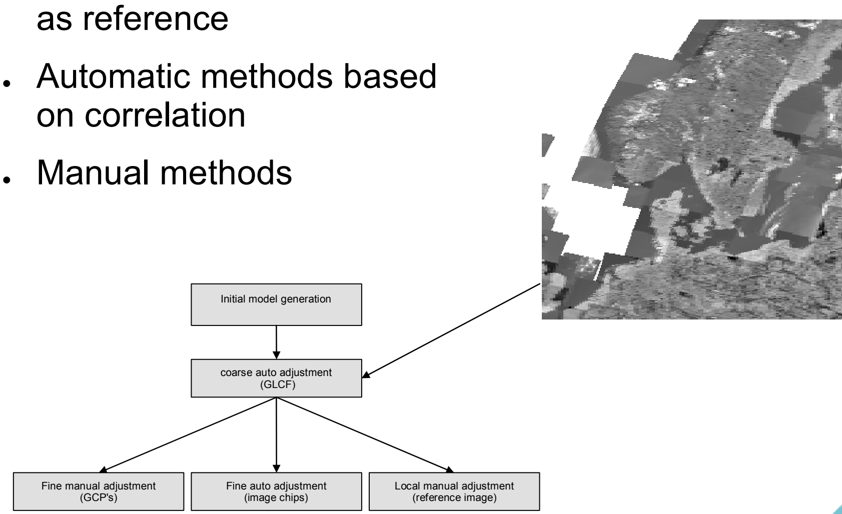
- Store all image data as raw as possible without preprocessing of pixels
- Update image geometry automatically or semiautomatically
during archiving



Satellite data production

Model refinement

- Landsat GLCF dataset used as reference
- Automatic methods based on correlation
- Manual methods



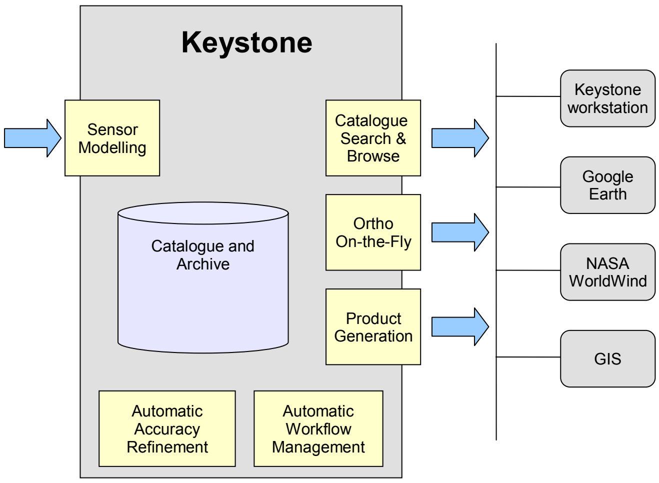
Satellite data production

On demand product processing

- Products are processed on request
- Coordinate system, file type and other parameters are set in the product order
- A preview gives possibilities to accept/reject before the processing starts
- Product automatically delivered using FTP

Satellite data production

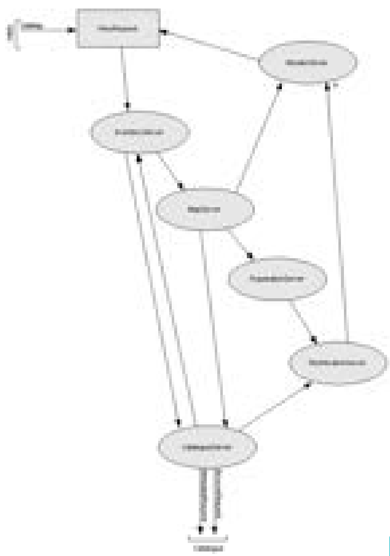
Keystone building blocks



Satellite data production

Server technology

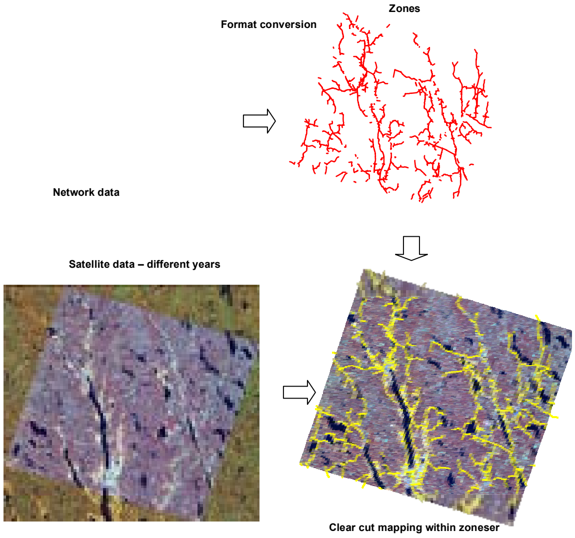
- Parallel processing
- Based on proven technology
- Scalable
- Load balancing
- Fault tolerant



PC cluster

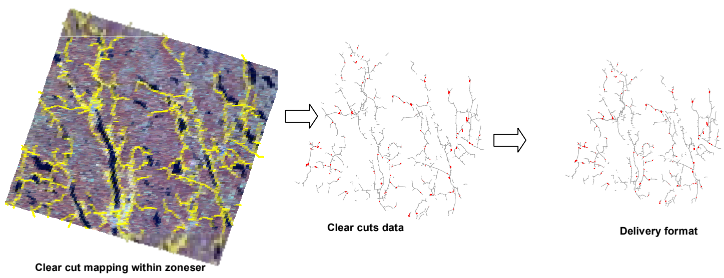
Data analysis

Mapping of forest clear cuts



Data analysis

Identification areas for field control



MONITOR vs CwRS scenarios

- Yearly mapping based on satellite data
- Dependent on newly acquired satellite images
- Dependent on geometric correction for accurate measurements
- Mapping of limited areas
- Extraction of areas for field control
- Different resolution (HR/VHR)

Presentation 2 - Digital Camera Airborne Data Acquisition

Fred Hagman
Aerodata International Surveys

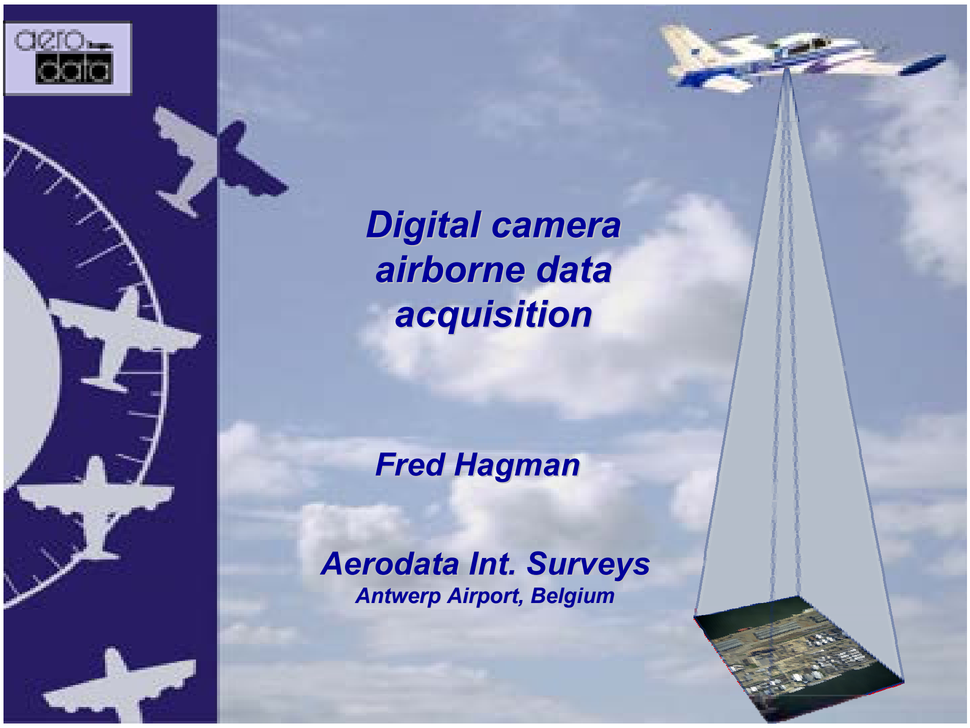
Abstract

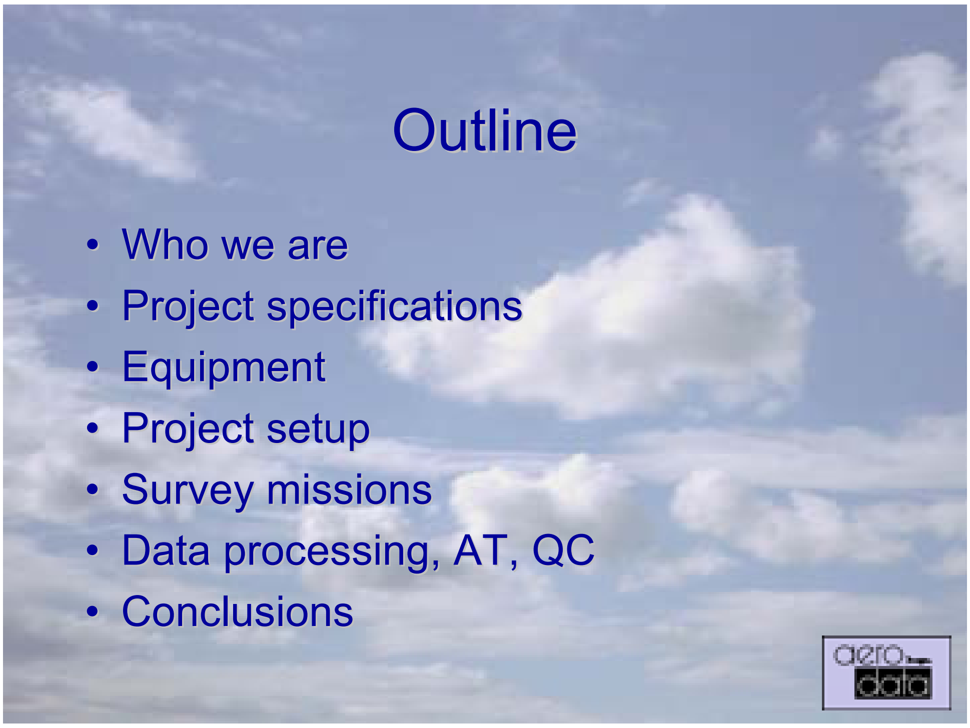
Early 2004 the new digital photogrammetric frame camera Vexcel UltraCam D was delivered to Aerodata International Surveys as one of the first in Europe. An extensive introduction programme was carried out including the setup of a new production environment and data management system.

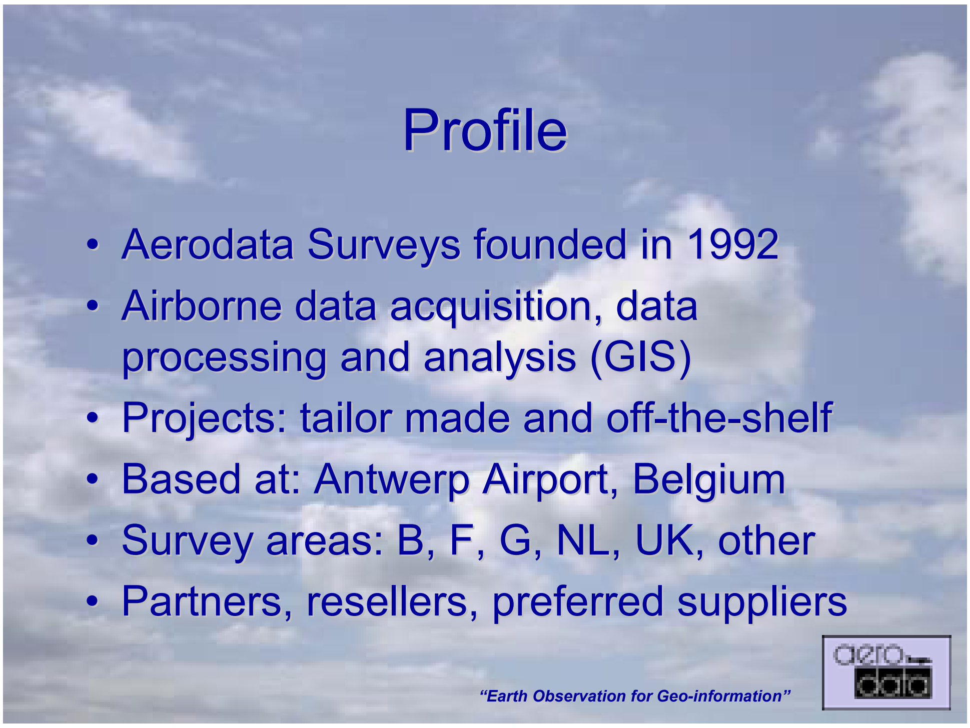
In 2005 Aerodata Surveys was selected as a subcontractor to carry out the airborne data acquisition with the UltraCam for control of area based subsidies of 5 areas in different parts of France. It also included pre-processing and aerial triangulation of the datasets. The project was planned in a very tight time schedule between data-acquisition and data-delivery.

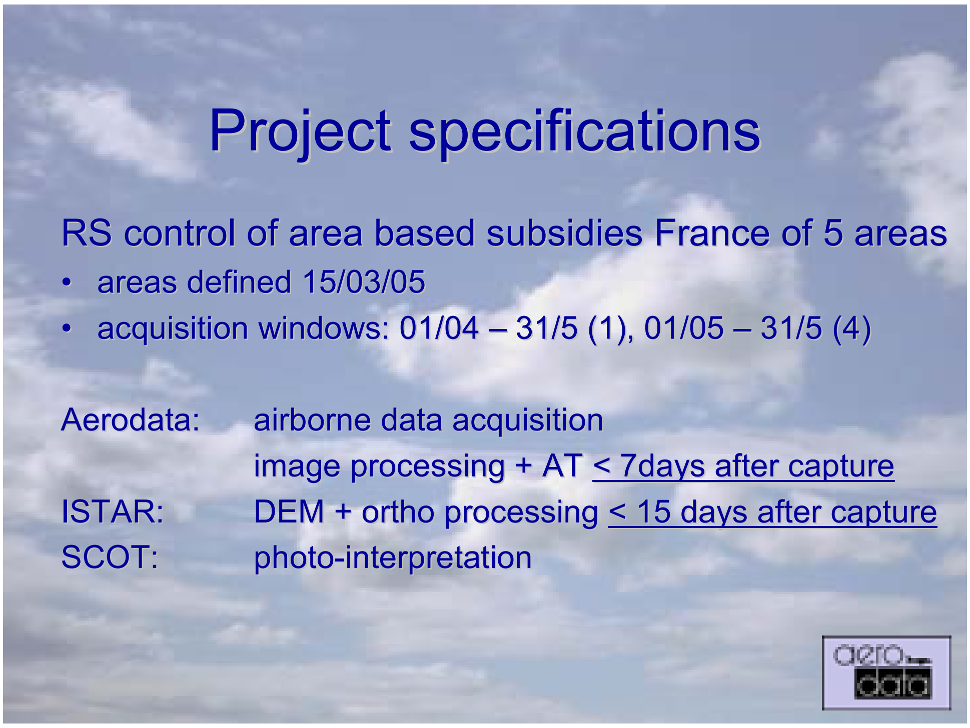
The presentation will focus mainly on the operational aspects of using this new digital camera in the surveys missions. It will include aspects like the project preparation, the equipment used with emphasis on the specific features of the UltraCam D, the workflow from data acquisition up to preprocessing of the digital data, quality control, storage and archiving.

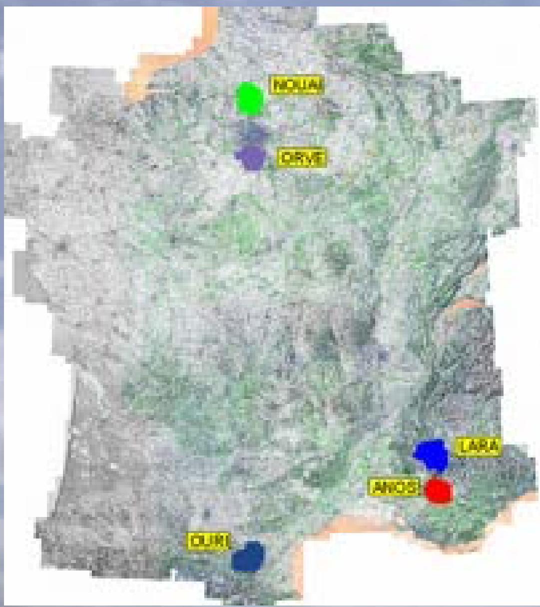
Keywords: Vexcel UltraCam D, aerial survey mission,


aero data
Digital camera airborne data acquisition
Fred Hagman
Aerodata Int. Surveys
Antwerp Airport, Belgium


Outline
• Who we are
• Project specifications
• Equipment
• Project setup
• Survey missions
• Data processing, AT, QC
• Conclusions
aero data


Profile
• Aerodata Surveys founded in 1992
• Airborne data acquisition, data processing and analysis (GIS)
• Projects: tailor made and off-the-shelf
• Based at: Antwerp Airport, Belgium
• Survey areas: B, F, G, NL, UK, other
• Partners, resellers, preferred suppliers
"Earth Observation for Geo-information"
aero data


Project specifications
RS control of area based subsidies France of 5 areas
• areas defined 15/03/05
• acquisition windows: 01/04 – 31/5 (1), 01/05 – 31/5 (4)
Aerodata: airborne data acquisition
image processing + AT < 7days after capture
ISTAR: DEM + ortho processing < 15 days after capture
SCOT: photo-interpretation
aero data



Areas

Aircraft

Speed: 500 km/hr

Endurance: 5 hrs

Airports

Antwerp

Montpellier

Marseille

Project specs

Project	Area (sqkm)	GSD (cm)	Strips	Images
Ouri	1.026	60	8 E-W	155
Anos	762	60	7 N-S	109
Lara	1.093	54	10 N-S	190
Nouai	832	66	6 N-S	107
Orve	644	66	6 E-W	92

all flights planned at 25.000 ft above sea level

acquisition times: 1 – 1,5 hrs/area

Equipment - Aircraft
Fairchild Merlin IIIA
(Cessna 310 R)
Navigation Tracker
dGPS Omnistar

Equipment - Digital camera
4 Color Cones
Panchromatic
Sensor Unit
Storage Computing
Vexcel UltracamD, GPS/INS Applanix POSAV 510 ,
Somag GSM3000 gyro-stabilized mount

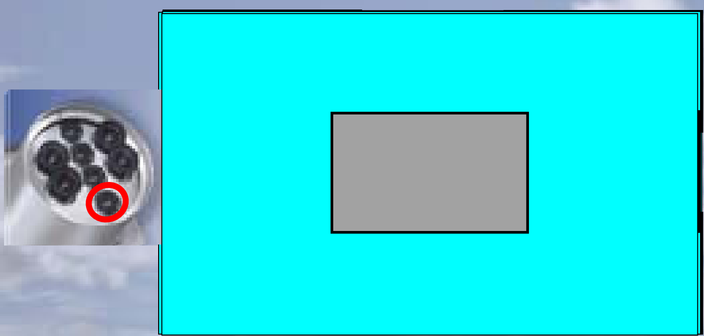
UltraCam D features

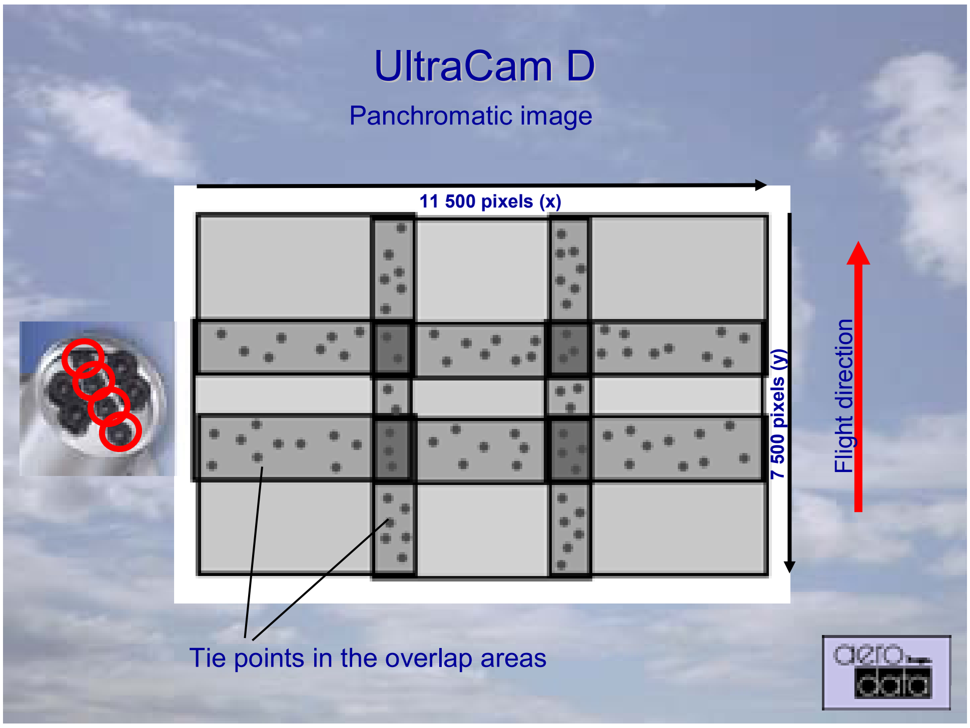
- digital photogrammetric camera (90 Mpix)
- PAN: 11500 x 7500; RGBIR: 4008 x 2672
- GSD: 1 cm per 100 m flying altitude
- in flight data storage > 2750 images
- Image interval time max. 0,75 sec
- better image quality (FMC, >12-bit, no grain)
- faster data processing (no film, no development, no scanning)
- use in low light conditions (broader time-window, more acquisition days)

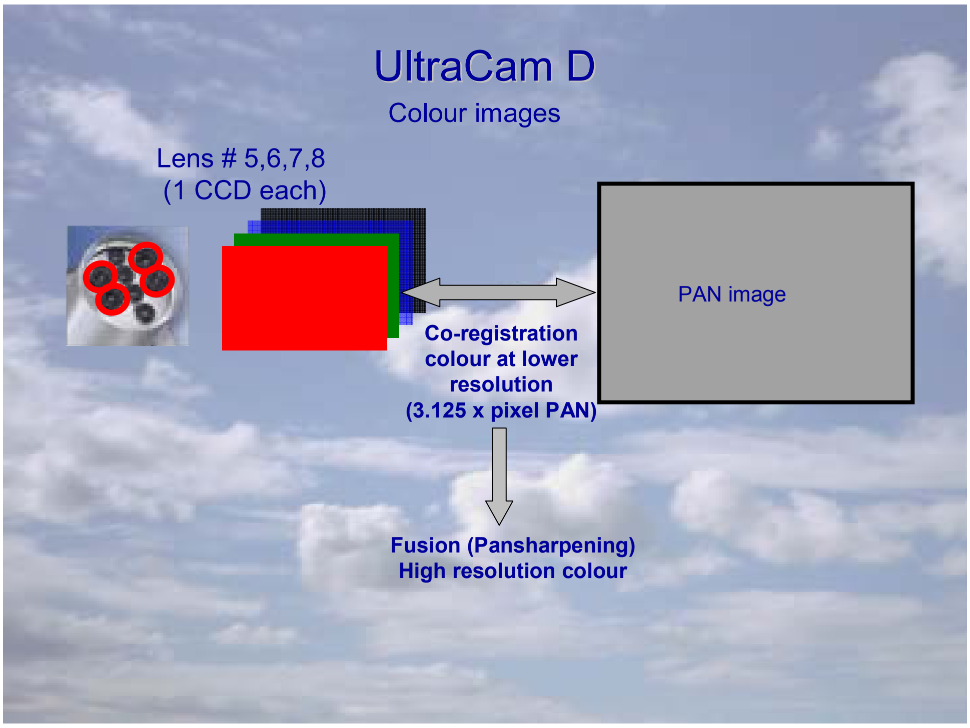
UltraCam D

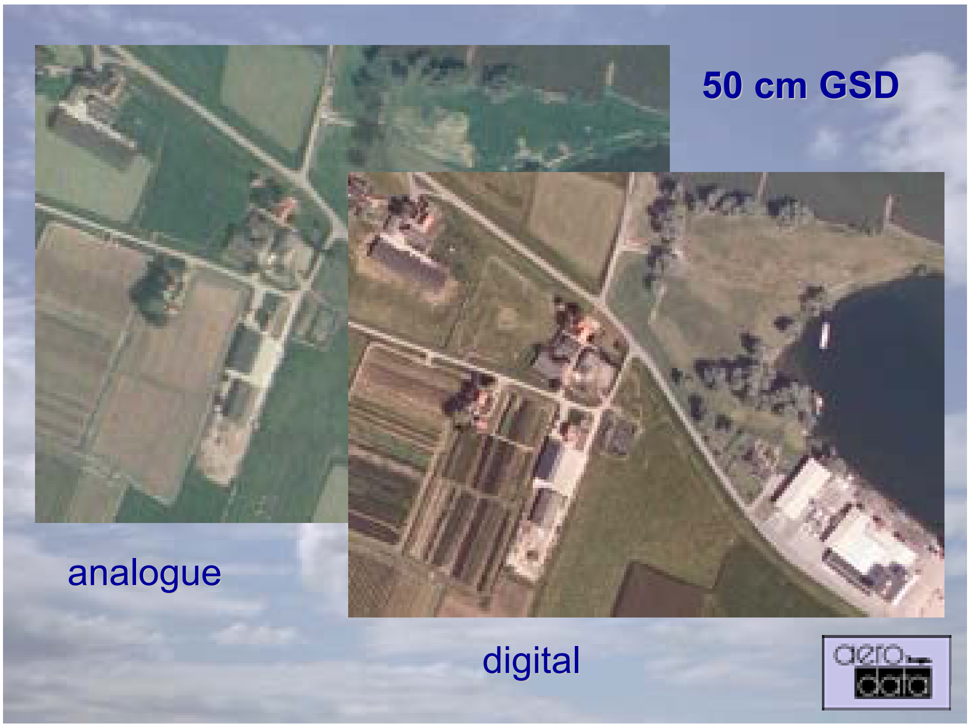
Panchromatic image

Lens #1: 4 CCD,



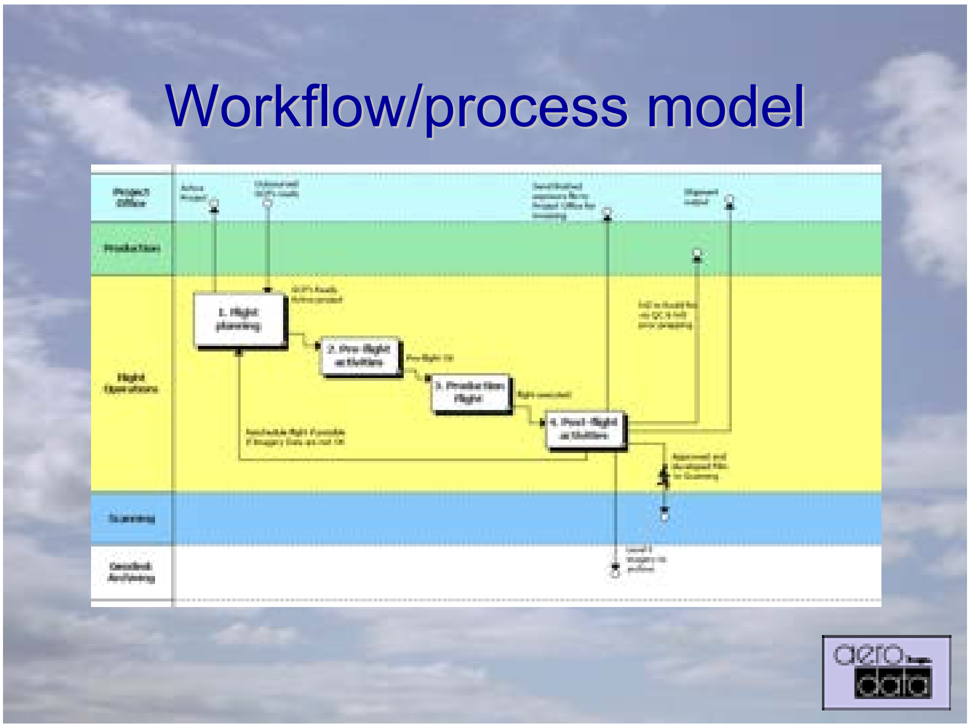

UltraCam D
Panchromatic image
11 500 pixels (x)
7 500 pixels (y)
Flight direction
Tie points in the overlap areas
aero data


UltraCam D
Colour images
Lens # 5,6,7,8
(1 CCD each)
PAN image
Co-registration
colour at lower
resolution
(3.125 x pixel PAN)
Fusion (Pansharpening)
High resolution colour

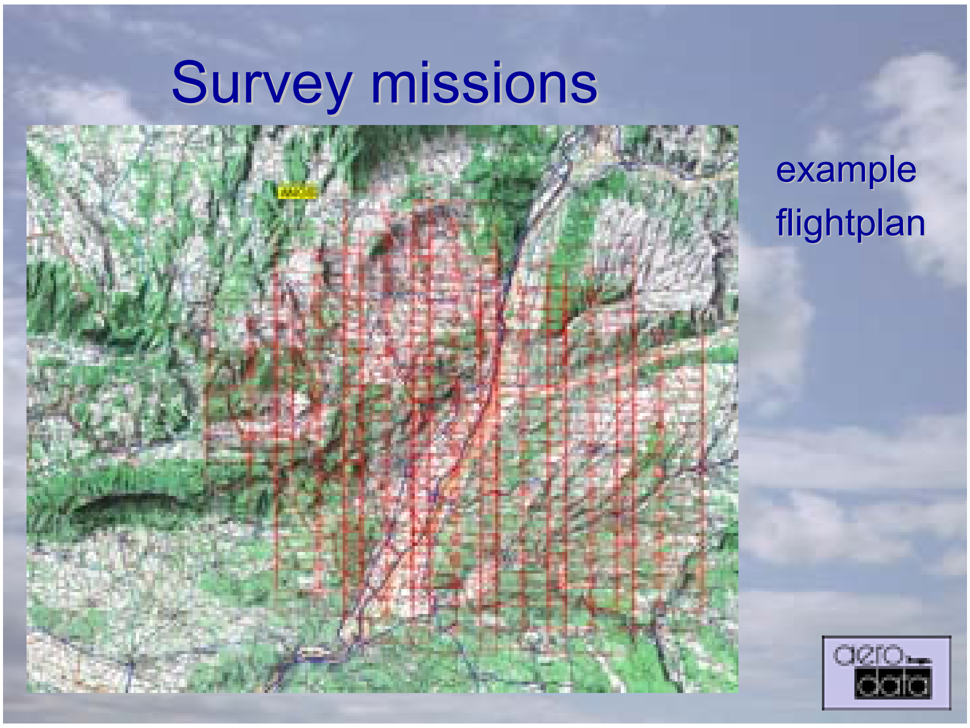


Project setup

- Flightplanning (Tracker)
- dGPS stations (select: IGN-France)
- GCP locations (prepare: 10/each area)
- Meteo checks (monitor: actuals, forecasts)
- ATC/Military (inform, coordinate, timeliness, slots)
- Data management preparations (processing, storage)
- Project team communication



Workflow/process model
Project Office
Production
Flight Operations
Scanning
1. Flight planning
2. Pre-flight activities
3. Production flight
4. Post-flight activities



Survey missions
example
flightplan

UltraCam processing

- Download camera -> MSU
  - ✓*Check integrity*
- Backup tape (Ultrium)
- Copy to production HD
- Processing level 0 -> level 2
  - ✓*HiPAN, Low RGBIR*
- Histogram analysis (colour balancing)
- Processing level 2 -> level 3
  - ✓*(HiPAN, HiRGB), HiCIR*

aero data

Vexcel UltraCam D

Image processing stages

	Level		
CCDs	00	Raw imagery (mirrored 2x)	[temp]
	0	Checked raw imagery	~250MB
	1	Radiometric corrected imagery (calibrated)	[temp]
Image	2	Images 16bits ‘stitched’ and RGBIR superimposed at original resolutions	~250MB
	3	Final product (‘pansharpening’) CIR (PAN, RGB) (8 or 16 bits)	~250MB(8b)

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UltraCam D

Image transfer and processing
Example: 500 images, 3-4 areas

Transfer (500 images) immediately after flight
- 10 min. to MSU (Mobile Storage Unit);
- 30 min. to cluster 7 workstations;

Processing (500 images)
- 5 hrs level 2 overnight
- 1 hr histograms next day
- 2.5 hrs level 2 to level 3 (RGB or CIR) next day

Archiving (500 images)
- 2 hrs archiving on tape next day

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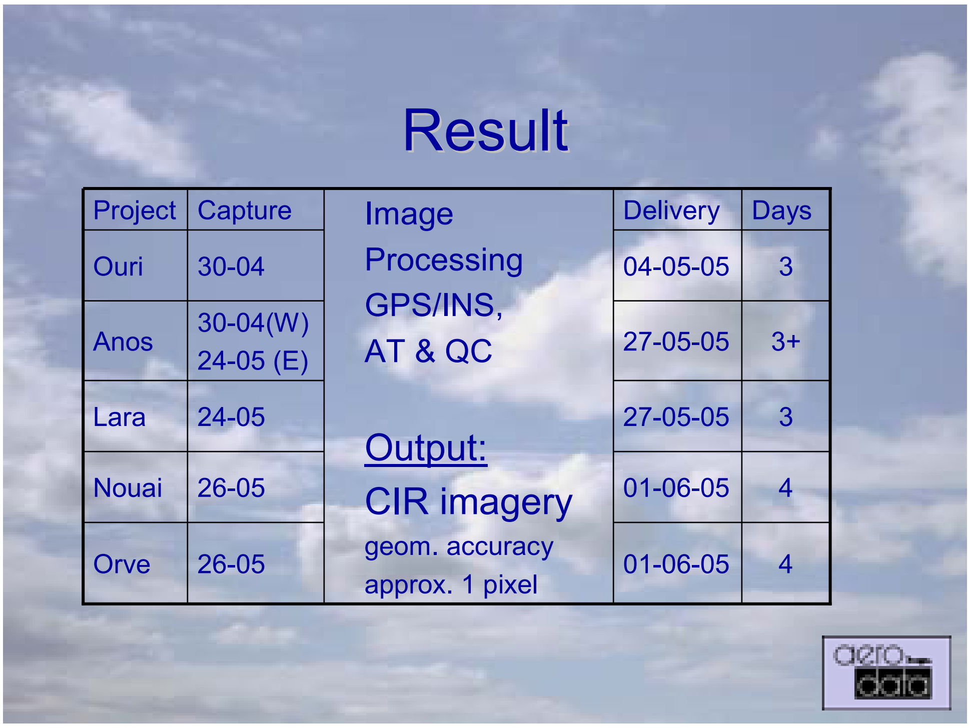
Processing GPS/INS & AT

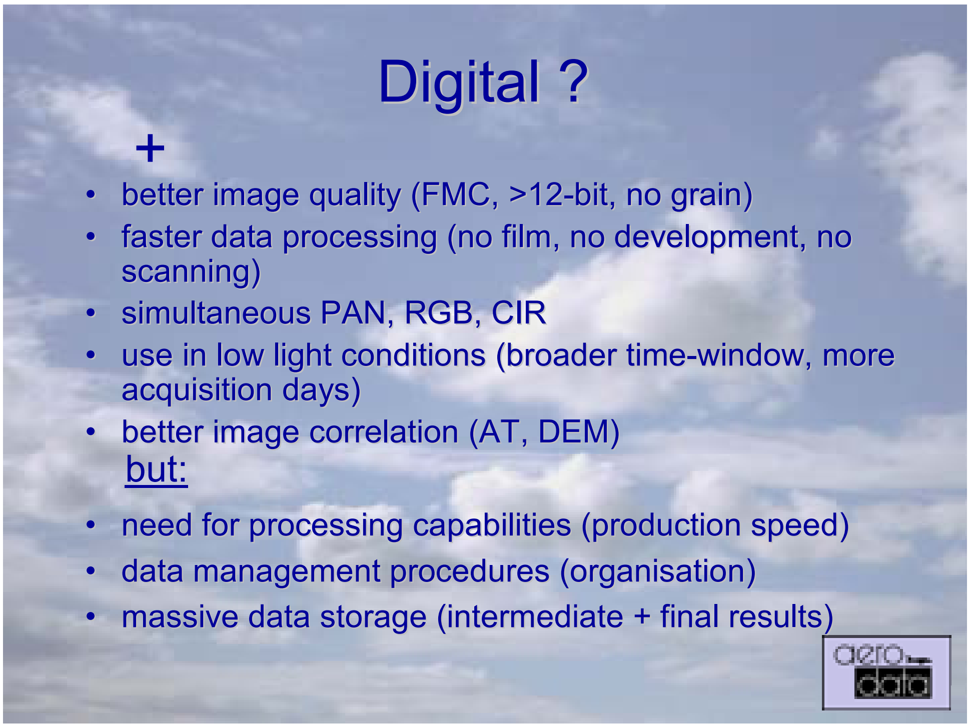
Applanix GPS/INS orientation parameters
- Download dGPS data (IGN permanent stations)
- Copy GPS/INS data
- POS Pac processing (X,Y,Z, ω, φ, κ)

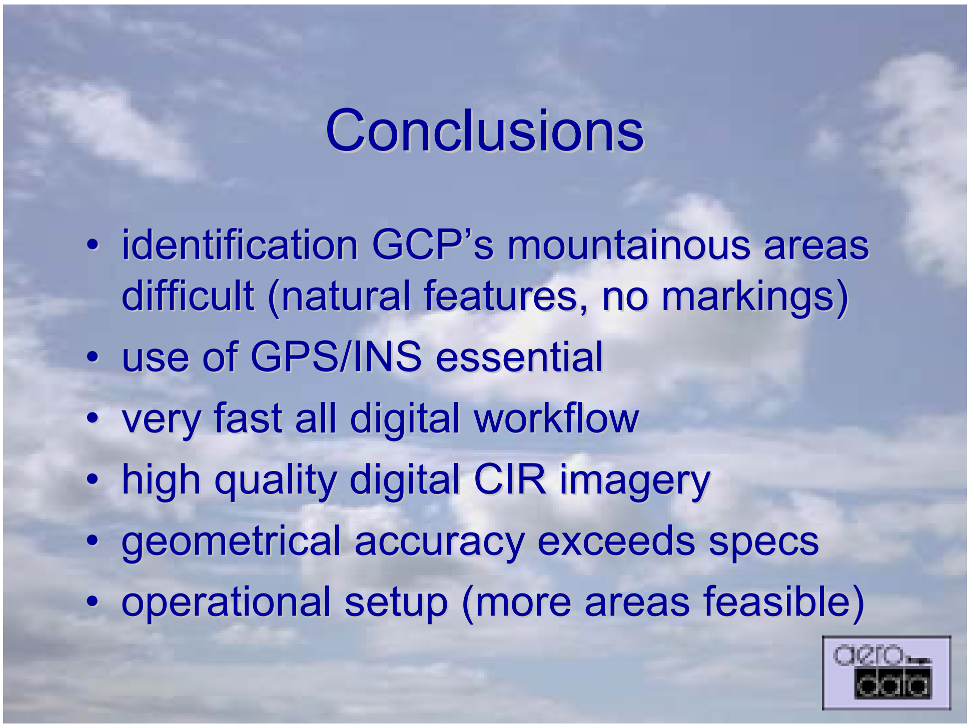
Aerial triangulation
- Tie point matching (use Applanix)
- GCP locations (use Applanix orientation param)
- Block adjustments (iterations)

aero data


Ground Control Points
TopoSat
Fiche d'identification de point (Photographies)
aero data


Result
Project
Capture
Image
Processing
GPS/INS,
AT & QC
Delivery
Days
Ouri
30-04
04-05-05
3
Anos
30-04(W)
24-05 (E)
27-05-05
3+
Lara
24-05
27-05-05
3
Nouai
26-05
01-06-05
4
Orve
26-05
01-06-05
4
Output:
CIR imagery
geom. accuracy
approx. 1 pixel
aero data


Digital ?
+
• better image quality (FMC, >12-bit, no grain)
• faster data processing (no film, no development, no scanning)
• simultaneous PAN, RGB, CIR
• use in low light conditions (broader time-window, more acquisition days)
• better image correlation (AT, DEM)
but:
• need for processing capabilities (production speed)
• data management procedures (organisation)
• massive data storage (intermediate + final results)
aero data


Conclusions
• identification GCP's mountainous areas difficult (natural features, no markings)
• use of GPS/INS essential
• very fast all digital workflow
• high quality digital CIR imagery
• geometrical accuracy exceeds specs
• operational setup (more areas feasible)
aero data


aero data
Thank you !

Presentation 3 - Digital airborne imagery for CwRS: methodology and return on experience from the 2005 campaign in France

Gilles Pichon, ISTAR
Eric Guzzonato, SCOT, FR

Abstract

The digital airborne cameras available on the market have gained enough maturity in the past years to be now involved in operational, time-constrained projects like aerial acquisition of CIR imagery for the purpose of CAPI. Geodata production systems have also proven their ability to integrate and take advantage of the features and quality of digital imagery.

ONIC, the French administration in charge of the CAP-subsidies control, has selected the SCOT-ISTAR-Aerodata consortium, for the delivery of 5 zones totalling 4,800 km² of 1m CIR orthophotos, acquired with a Vexcel UltraCamD digital camera in May 2005.

The workflow and organisation setup for this project are detailed, including the acquisition and pre-processing system from Aerodata, the "Pixel Factory" DEM and orthophoto production system from ISTAR, and the photo-interpretation system from SCOT. The results, issues and achievements are presented, as well as the potential enhancements allowed by this technology.

This first-time-ever digital airborne acquisition campaign for CwRS in Europe was a full success, with the on-time delivery of excellent quality orthophotos, beyond specifications both in radiometry and geometry, allowing in turn an easy and smooth CAPI work.

Keywords: digital airborne camera, aerial imagery, UltraCamD, Pixel Factory, CIR, orthophoto, CAPI

Gilles Pichon, ISTAR

EADS

Digital airborne imagery for CwRS : methodology and return on experience from the 2005 campaign in France

CwRS annual conference

Krakow – 25th of November, 2005

Project context

EADS

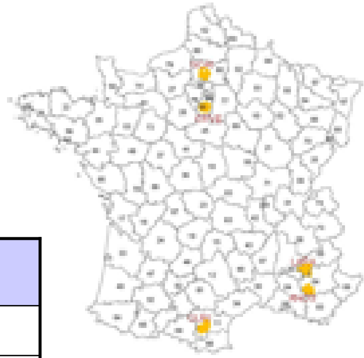
- **The challenge**

"for the first-time in Europe in the frame of operational CwRS, a digital airborne camera is used for acquisition and orthophoto production."

- **The team**
- **The tasks**
- **The results**
- **The issues**
- **The ways forward**

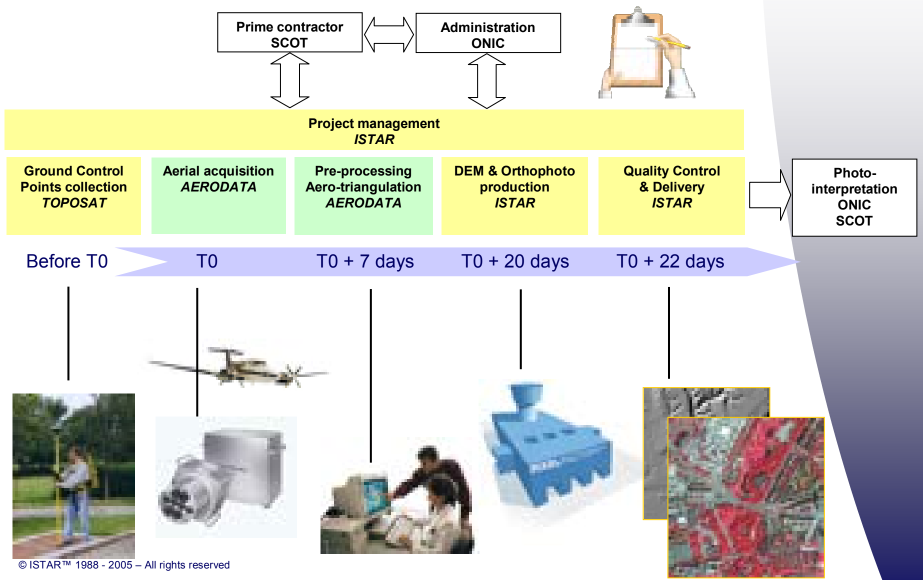
Aerial acquisition – the 2005 campaign

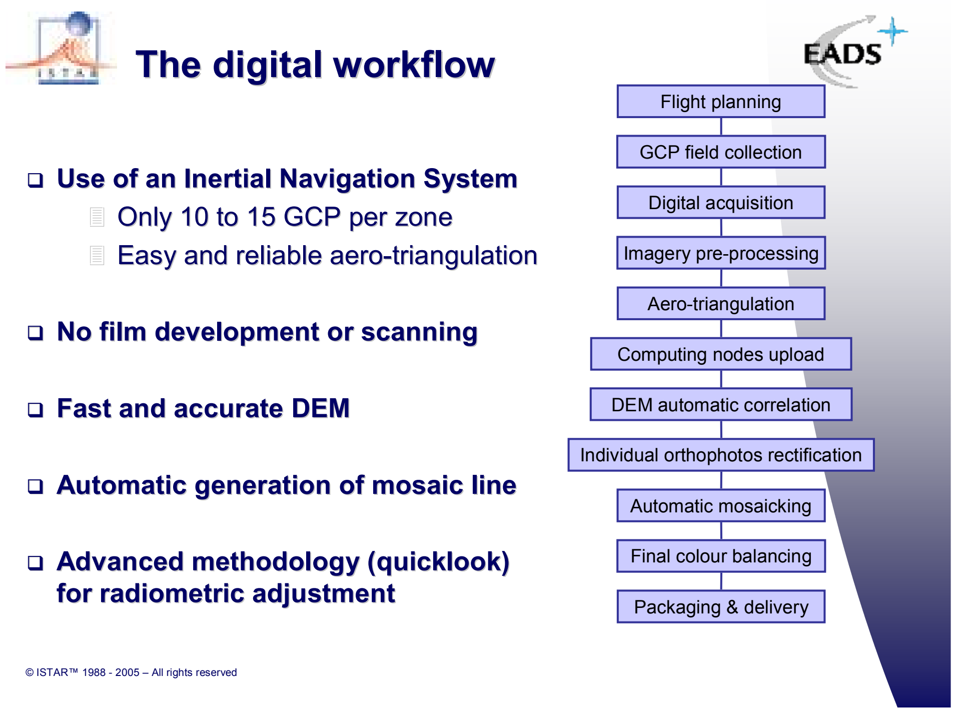
- **Expected output**
  - 1m CIR orthophoto mosaic
  - within 22 days after acquisition
- **5 zones attributed by ONIC**



Zone	Surface	Acquisition window	Type
OURI	1026 km²	Apr. 1st – May. 31st	Hilly
ANOS	762 km²	May. 1st – May. 31st	Hilly
LARA	1093 km²	May. 1st – May. 31st	Mountainous
NOAI	832 km²	May. 1st – May. 31st	Flat land
ORVE	644 km²	May. 1st – May. 31st	Flat land

Organisation




The digital workflow
Use of an Inertial Navigation System
Only 10 to 15 GCP per zone
Easy and reliable aero-triangulation
No film development or scanning
Fast and accurate DEM
Automatic generation of mosaic line
Advanced methodology (quicklook) for radiometric adjustment
© ISTAR™ 1988 - 2005 – All rights reserved
EADS
Flight planning
GCP field collection
Digital acquisition
Imagery pre-processing
Aero-triangulation
Computing nodes upload
DEM automatic correlation
Individual orthophotos rectification
Automatic mosaicking
Final colour balancing
Packaging & delivery

Results

- Timely delivery of all zones

Zone	Surface	Acquisition date	Delivery time
OURI	1026 km²	Apr. 30	24 days
ANOS	762 km²	Apr. 30 + May. 24	20 days
LARA	1093 km²	May. 24	17 days
NOAI	832 km²	May. 26	22 days
ORVE	644 km²	May. 26	25 days

- XY accuracy measured on zone ANOS
  - Reference = 1m « BD Ortho » from IGN (19 checkpoints)

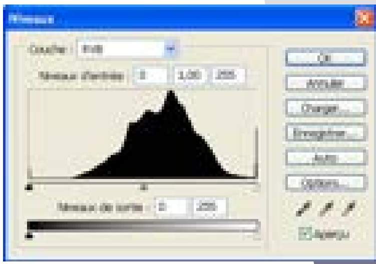
Residues on checkpoints	1D-x	1D-y	2D-xy
Min	-0.75m	-1.14m	0.09m
Max	+1.32m	+1.37m	1.50m
RMSE	**0.79m**	**0.76m**	**1.10m**

Achievements

- **Mastering the geometry**
  - Accuracy beyond specifications → about the pixel size (1m)
  - Benefit of Inertial Navigation System & large-frame camera
  - Correlation → dense and accurate DEM (RMSE z ~ 2m)
  - Allows automatic mosaicking
  - Even in mountainous areas…
- **Delivering better radiometry**
  - Better than traditional CIR film → no noise, spectral band separation
  - Native 12-bit digital capture → more flexibility during processing
  - Wider dynamic range available for the photo-interpreter
  - Homogeneous mosaic

Radiometric adjustment

- **More flexibility available**
  - Higher dynamic range captured (12-bit CCD)
  - Quicklook methodology
- **Possible adjustment**
  - On contrast
  - On luminosity
  - On relative channel weight
  - Gamma curves



- **…Giving control to the end-user**
  - Decision on colour balance driven by photo-interpretation considerations

Some ways forward...

- **The potential of these digital techniques has not been fully exploited in this project**
  - Delivery specifications defined by ONIC administration, on a common basis for VHR-satellite or film-CIR orthophotos
- **Possible enhancements**
  - Better resolution
    - flown at GSD=0.54m-0.66m, delivered at 1m
  - Simultaneous delivery of RGB or PAN orthophotos
  - 16-bit digital workflow
    - delivery of 3*16-bit colour information instead of the usual 3*8-bit
  - Optimisation of aerial acquisitions
    - Increasing the size of zones : cost per km², weather opportunities


Thank you for your attention !

Eric Guzzonato, SCOT

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

SCOT

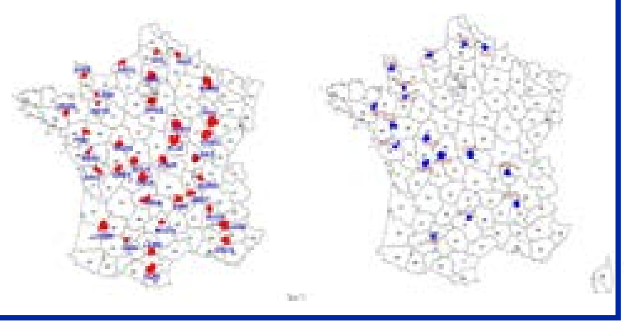
The CS group dedicated unit for EO based applications

INVOLVED IN DATA IMAGE PROCESSING FOR 2005 CAMPAIGN

SCOT –IGN espace

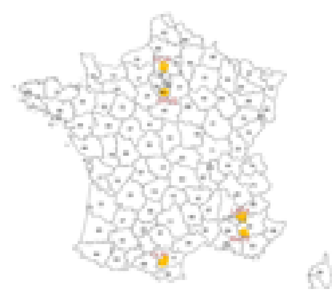
HR images Processing and preparation over 35 control zones

VHR images Processing and preparation over 17 control zones



AERODATA-ISTAR-SCOT

DIGITAL aerial photographs Processing and preparation over 5 control zones



CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

SCOT/CS

DATA IMAGE PROCESSING
2005 CAMPAIGN

136 HR images and 32 VHR images

	IMAGES HR				
	Automne	Printemps	Eté 1	Eté 2	TOTAL
LANDSAT 5 TM	1	2	6	6	15
IRS-1C LISS-3	0	4	3	1	8
SPOT 2 XS	4	5	8	13	30
SPOT 4 XI	18	14	10	7	49
SPOT 5 XI	11	7	8	8	34
TOTAL HR	35	32	35	35	136

	IMAGES VHR				
	Automne	Printemps	Eté 1	Eté 2	TOTAL
QUICKBIRD		2	4		6
IKONOS		8	18		26
TOTAL VHR		10	22		32

ONE METER RESOLUTION SENSOR FOR CAPI	NUMBER OF DOSSIER
IKONOS VHR	1228
QUICK BIRD VHR	407
PVA	2520
DIGITAL PVA	807
TOTAL	**4962**

CAPI REALISATION
2005 CAMPAIGN
12 Zones-4962 dossiers

ZONE	TOTAL	AC	AI	RC	RI	RDR	BCAE
ARIG	403	201	10	178	14	11	46
BOZO	358	210	7	131	10	1	
CHEV	439	206	7	220	6		25
FREI	404	188	5	202	8		42
LARA	397	106	50	182	59		11
LEMI	407	271	5	122	5	11	37
LERM	394	179	1	208	6		33
LOUR	466	317	7	131	11		5
NOAI	410	111	14	253	32		3
ONTA	416	252	0	164	0		30
PLIN	452	287	19	128	17		21
RARE	416	195	10	189	22	6	18
total	4962	2527	136	2189	190	29	271

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

Capi with digital aerial photographs

A very clear general view of land parcels with very good contrast between parcels

VHR

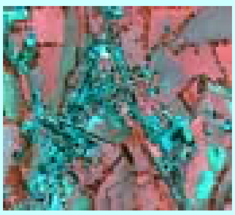
AP

Digital AP

CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

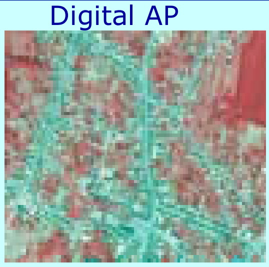
In urban and peri-urban areas: very good identification of built-up areas
At farm level: very good identification of buildings for agricultural activities

VHR



AP

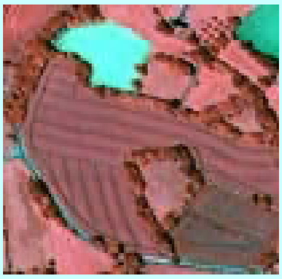
Digital AP



CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

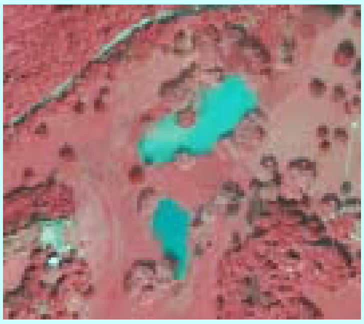
A very good view of the landscape features for permanent elements: water bodies, woodlands, hedges,…

VHR



AP

Digital AP



CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

Easy water area identification with natural colour

AP

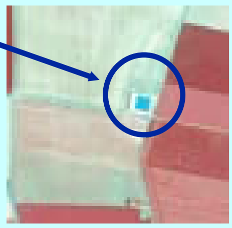
Water resources

At reservoir scale
(lake, pond, small dam, …)

Digital AP

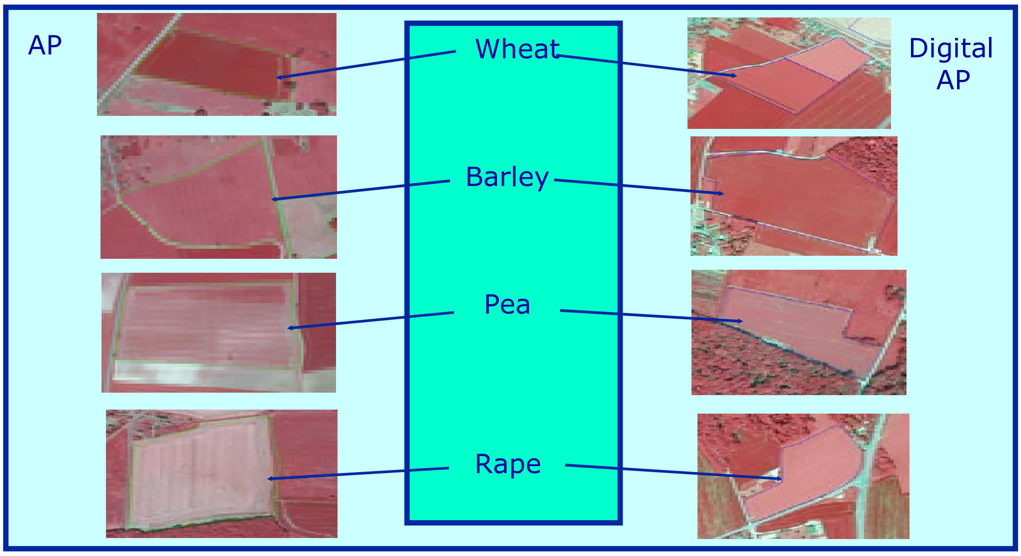
At watering places

Identification and location of ponds within or near parcels of interest



CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

Same methodology for crop identification by CAPI



CONCEPTEUR INTEGRATEUR OPERATEUR DE SYSTEMES CRITIQUES

Virtual 3D control zone visite, using Digital AP

-Quick, easy and friendly roaming over
the site for a better understanding

-An improved knowledge of the landscape features
-with the integration of the relief
Location of crops,natural and urban areas within the site,
area and erosion risk, water bodies….

- An incomparable overview of :
Interpreted areas
Field checked areas

- Multi layer display
-(various sources of information, models or simulation results…)
-Nuts trees, Olive trees, vineyards, crops of interest, pastures, forages,etc….
- Maps from environment directives.

Presentation 4 - The Disaster Monitoring Constellation (DMC)

David Hodgson
DMC International Imaging Ltd.

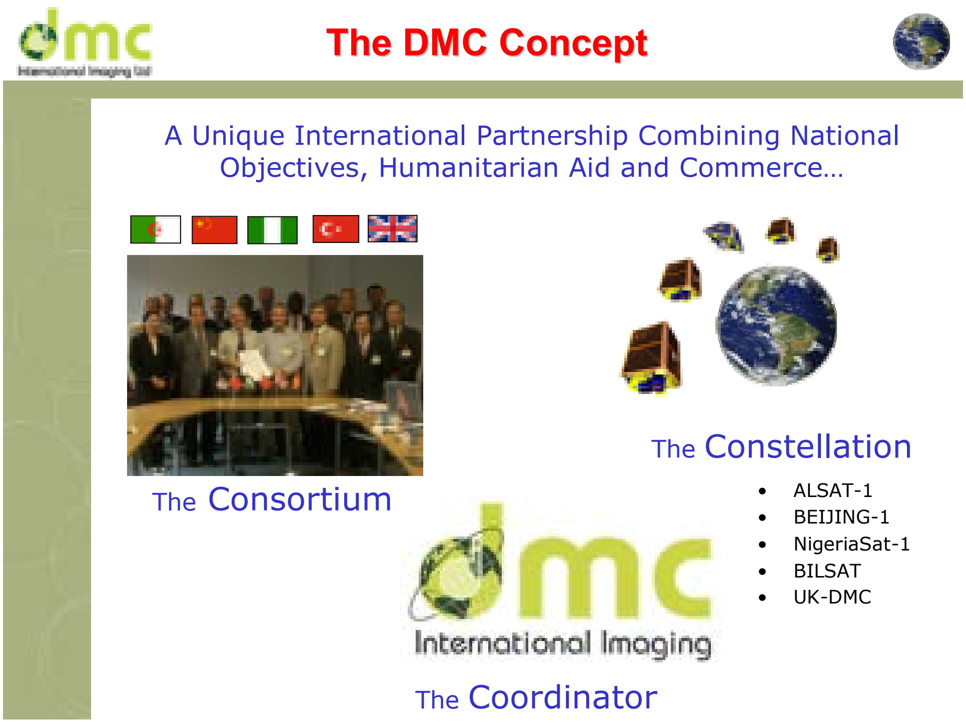
Abstract

The Disaster monitoring constellation (DMC) provides global high temporal frequency (daily) 32 metre optical remote sensing data with very board coverage (600km swath). The DMC sensors are designed to provide standard data products with three Landsat equivalent bands (Green, Red & NIR). The rapid revisit of a satellite constellation combined with familiar data products allows DMC data to serve an increasing number of existing and new applications for agriculture and environment.

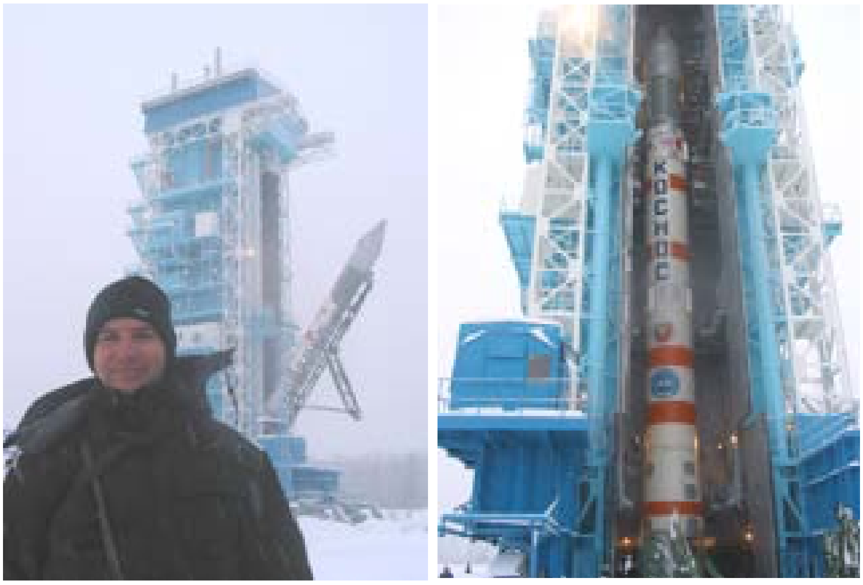
DMC data is acquired and supplied through UK based company DMC International Imaging Ltd (DMCii). DMCii are also responsible for DMC sensor calibration and image processing. This presentation seeks to provide, an overview of the DMC satellites, details of the characteristics & performance of the DMC sensor and information about the standard data products available.

Keywords: Disaster Monitoring Constellation, DMC, Sensor, DMCii


www.dmcii.com
dmc
International Imaging Ltd
The Disaster Monitoring Constellation
November 2005
Dave Hodgson
Managing Director


dmc
International Imaging Ltd
The DMC Concept
A Unique International Partnership Combining National Objectives, Humanitarian Aid and Commerce…
The Consortium
The Constellation
• ALSAT-1
• BEIJING-1
• NigeriaSat-1
• BILSAT
• UK-DMC
dmc
International Imaging
The Coordinator

DMC Launch 1: ALSAT-1, 28th November 2002



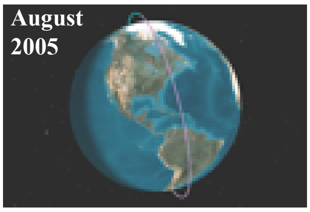
Cosmos-3M, Plesetsk Cosmodrome

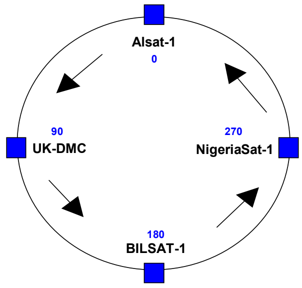
DMC Launch 2: BILSAT, NigeriaSat-1, UK-DMC 27 September 2003

Kosmos 11K65M, Plesetsk Cosmodrome

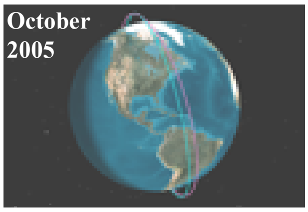
Coordinated Constellation

Plane 1 (ALSAT-1, BILSAT, NigeriaSat-1, UK-DMC)



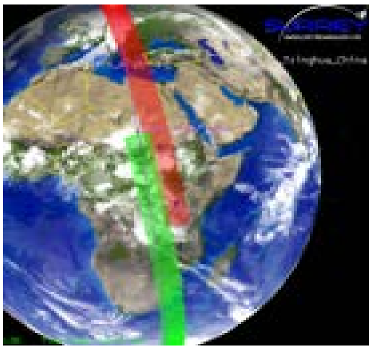


- 686 km Sun Synchronous Orbit (SSO)
- 98.2° Inclination
- 10:15 LTAN
- ALSAT-1 Reference Satellite
- Phased Ground Tracks
- Phased Equidistant around Orbit Plane at 90°
- On board Propulsion for Station Keeping
- Altitude Controlled to Maintain Station (Approx. +/- 3.5°)



Plane 2 (China DMC+4, Topsat) -10:30 LTAN

DMC Constellation Coverage



Global Daily Imaging

High Resolution (32m)
Broad Swath 600km
Landsat Compatible Bands

- Red
- Green
- NIR

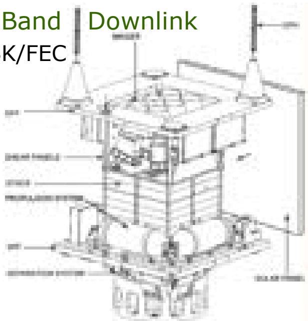
Coverage Overlap on Consecutive passes

Approx. 1.5m sq/km per day/satellite

2-4 Daily Downlinks per ground station

DMC Satellites – ALSAT-1, NigeriaSat-1, UK-DMC

- 5 year design life
- Weight - 90 kg
- Resistojet Electro-Thermal Propulsion
  - Butane CGT
- Data Handling
  - 386 On Board Computer (OBC)
  - CAN TT&C
  - 1GB Solid Sate Data Recorders
  - Onboard GPS Receiver
- 8Mb S-Band Downlink
  - QPSK/FEC



- ADCS
  - <0.01°/s, accuracy <1.0°
- DMC SLIM6 Imager Pushbroom
  - 32m multi-spectral (3-bands)
  - 600km swath width
  - 1.5Gbytes SSDR

DMC Standard SLIM6 Sensor

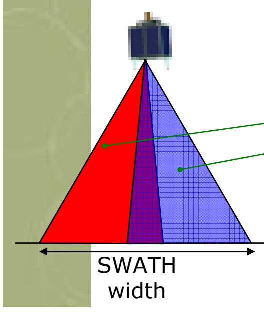
Sensor: Eastman Kodak KL10203 Linear CCD
10224 7.0 x 7.0um pixel array

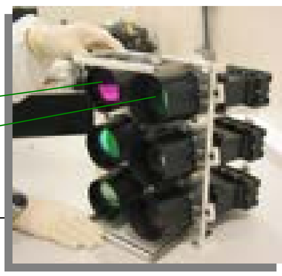
Lens: Schneider Apo-Componom HM
150mm, f/6.3

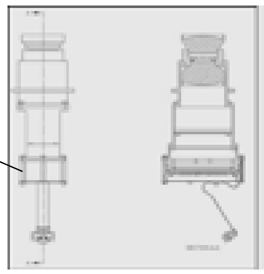
Per channel
FoV= 26.62 degrees
Swath = 324.58km

Filters: Barr Associates Inc., USA
Landsat equivalent

- NIR 0.77 - 0.90um ETM+4
- Red 0.63 - 0.69um ETM+3
- Green 0.52 - 0.60um ETM+2

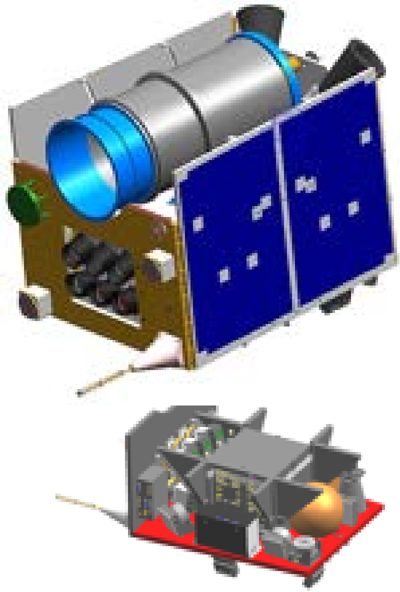


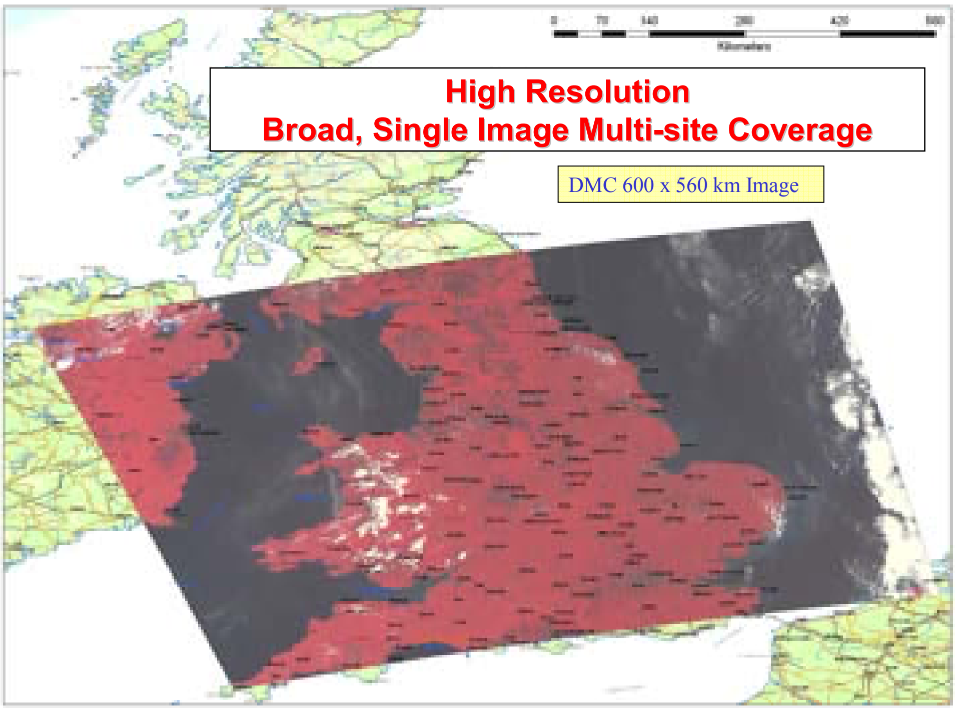




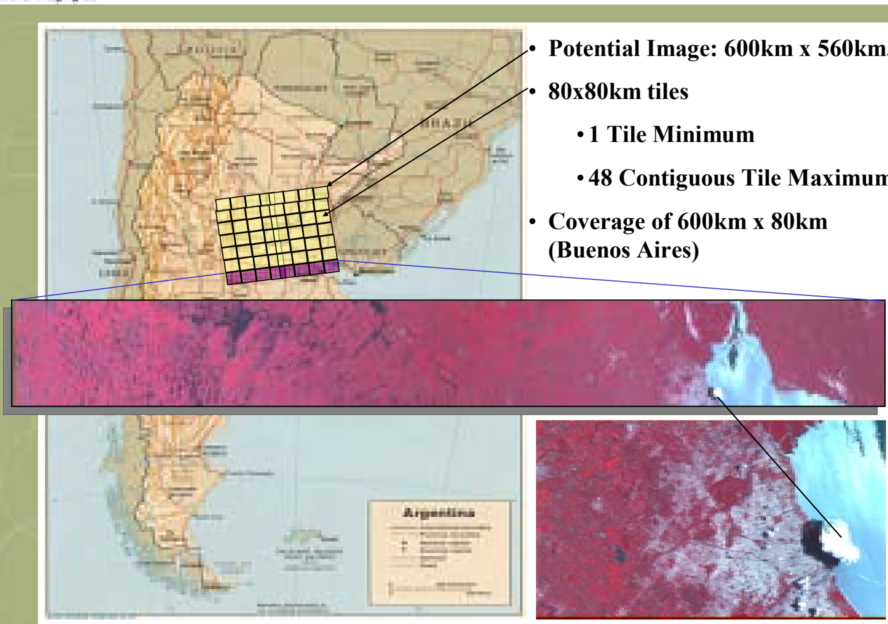
DMC Satellites – China DMC+4 (Launched Oct 2005)

- DMC SLIM6 Imager
  - 32m multi-spectral (3-bands)
  - 600km swath width
  - 8Mbps S-band downlink
  - 1.5Gbytes SSDR
- 4m Pan Imager
  - 4m pan
  - 24km swath width
  - 40Mbps X-band downlink
  - 3 Gbytes SSDR
  - 8 Gbytes harddisk
- ADCS
  - +/- 0.05° pointing knowledge
  - +/- 0.1° pointing control
  - +/- 30° off-pointing capability
- 5-year design life
  - With orbit station keeping





Programmable Coverage Example

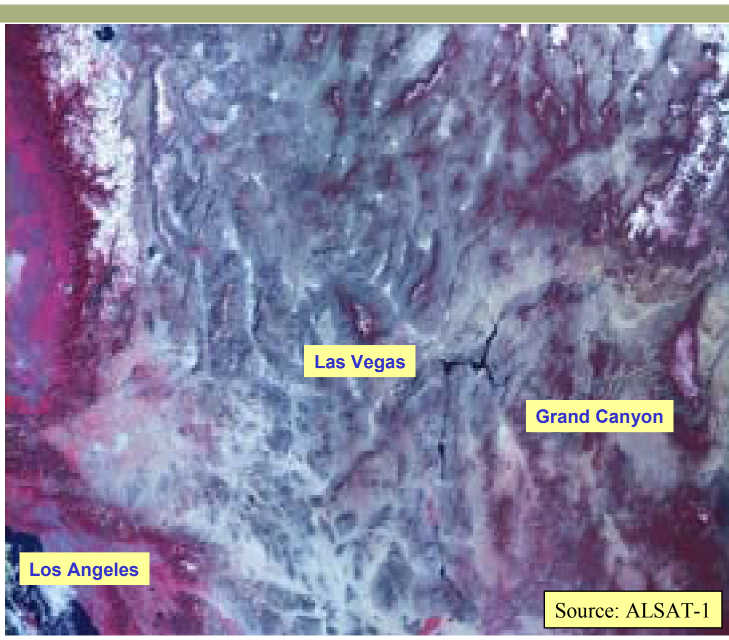


- Potential Image: 600km x 560km.
- 80x80km tiles
  - 1 Tile Minimum
  - 48 Contiguous Tile Maximum
- Coverage of 600km x 80km (Buenos Aires)

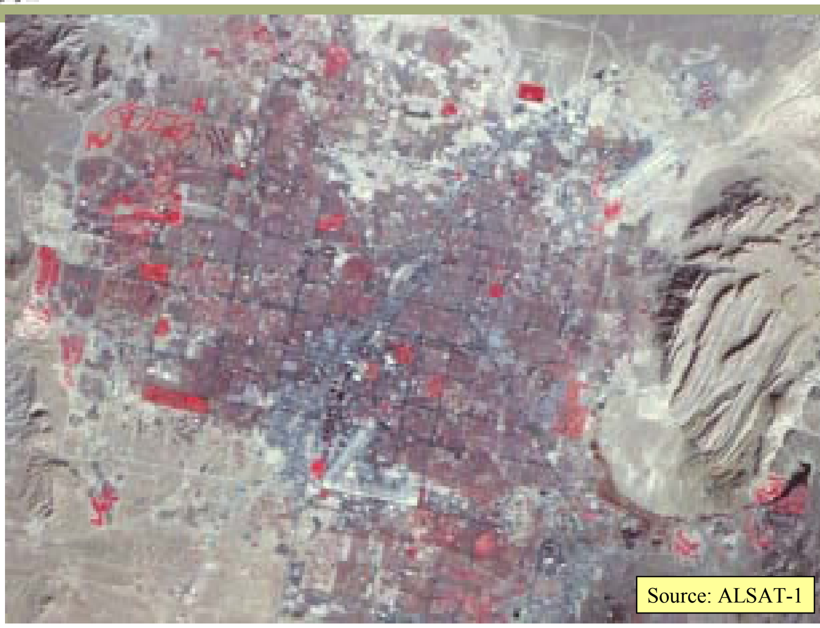
DMC in Operation

France (32m GSD 3-band m/s)

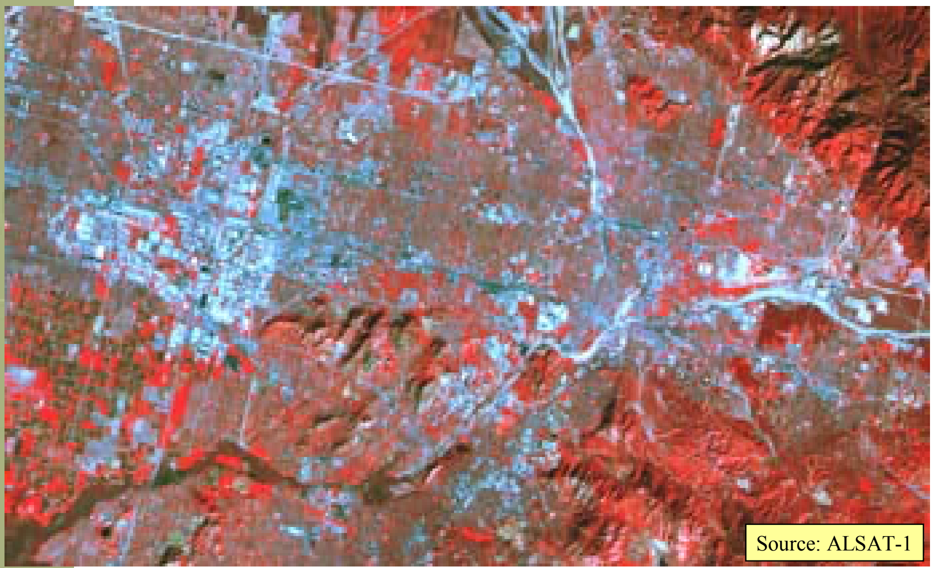
Coverage with Detail Example – Western USA



Coverage with Detail Example – Las Vegas



Coverage with Detail Example – Los Angeles



DMC International Imaging

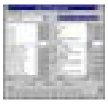
Commercial Supplier for DMC Imagery

Objectives

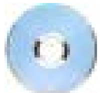
1. International Sales of DMC images
2. Manage DMC Image Quality
3. Coordinate Disaster Response

Standard Data Products

Level	Description	File Format
RAW	Raw imagery as acquired by sensor. Available upon request.	BIL
L0R	Individual band files Radiometrically corrected	TIFF
L1R	Registered bands Radiometrically corrected.	TIFF
L1G	As L1R plus: Geometric correction of systematic effects Standard cartographic projection (UTM WGS84 default)	GeoTIFF
L1T	As L1G plus: Orthorectified (1 km DEM) Higher resolution DEMs were available	GeoTIFF

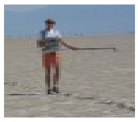


FTP or DVD/CD Delivery

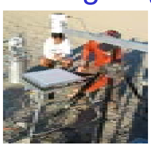


DMC Data Products: Regular Radiometric Calibration

Principal Scientist Dr Stephen Mackin (Surrey Space Centre, UK)



- Annual Absolute Calibration since July 2004
  – Railroad Valley, Nevada instrumented test site
  – Facilities & TOA radiance supplied by Arizona Uni., USA
- Ongoing Monthly Relative Calibration
  – 'Pacific at Night' & 'Antarctic & Greenland' images
- No significant performance change noted
- Full documentation available
  – Calibration report
- Finalising Aug 2005 Calibration Coefficients



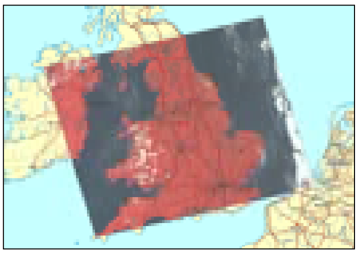
"In general this is good data. visible vertical striping…pushbroom sensor…even/odd detector bias… easily correctable in processing…no other radiometric problems in the data." **USGS**

Precision Orthorectification Service

- Automated Orthorectification (Spacemetric Keystone)
  - Automatic GCP Extraction from Landsat GLC Orthos
- Precision Manual Orthorectification Service
  - Sub pixel accuracy (Better than 25m RMS)
  - Standard Global reference: Landsat Geocover, GLOBE DEM
  - High precision local data sets utilised where available

Demanding customer routinely achieves 1/2 pixel registration with high precision DEM and local GCPs using simple 2nd order polynomial on L1R data.

Collins Bartholomew World Regular



ESRI 1:1,000,000 World

DMC Data Quality Compares Well with Landsat

	DMC SLIM6	Landsat ETM+
Noise	<1DN (1 SD)	<1DN (1 SD)
Signal-To-Noise	>100:1	>100:1
Absolute Radiometry	<10%	<10%
Gain	Fixed Gain (Aug-2005)	Earth Surface Dependant Gain
Integration Time	Variable	Fixed
Swath	640km (20000 Pixels)	182.61km (6087 pixels)
Quantisation	8bit (From 11)	8bit
Band: Near IR	0.77 - 0.90um	0.77 - 0.90um
Band: Red	0.63 - 0.69um	0.63 - 0.69um
Band: Green	0.52 - 0.60um	0.52 - 0.60um

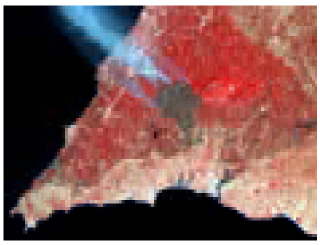
Archive Search Tools

Online Archive Search Coming Soon

International Earth Observation Markets

Agriculture

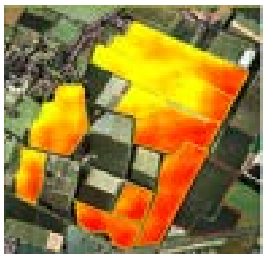
- *International Precision Farming*
- *Illicit Crop Monitoring*
- *EC AGRIFISH*
- *Food Security*

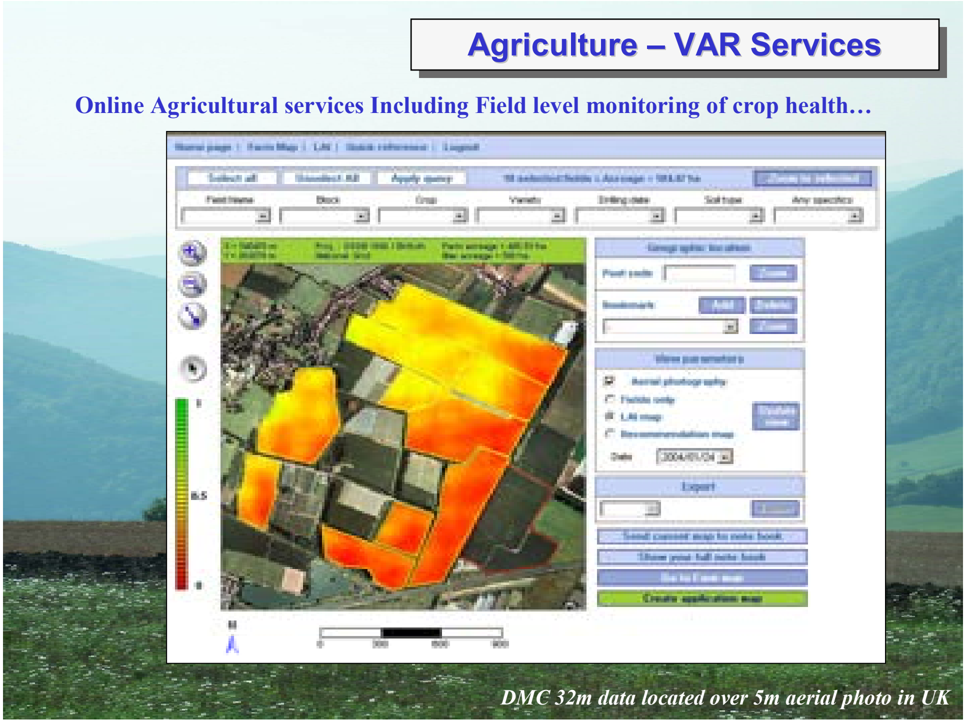


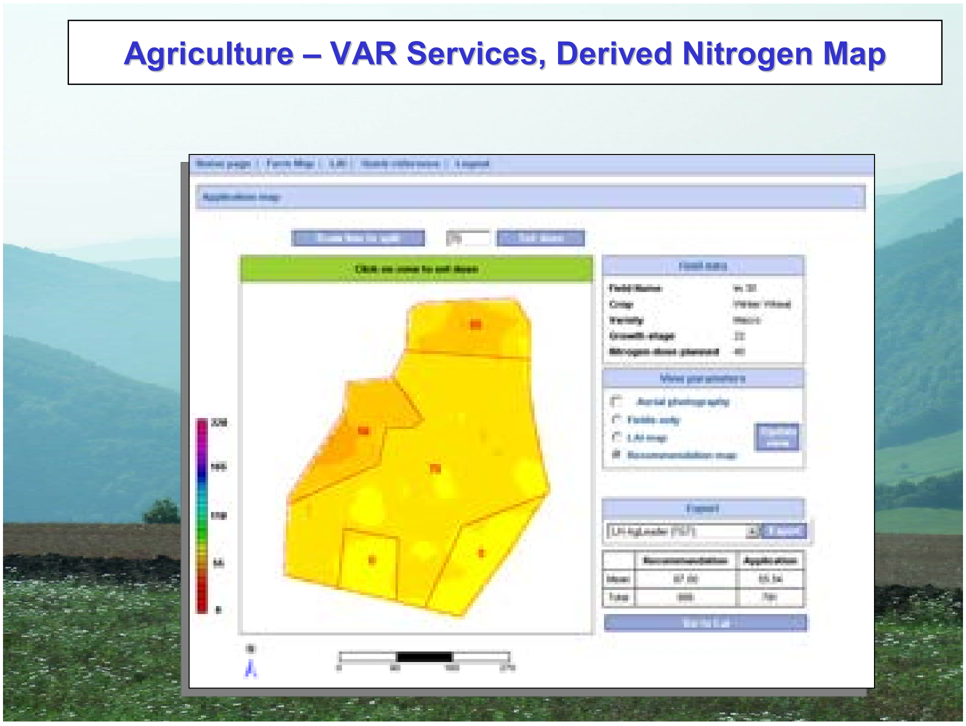
Source: ALSAT-1

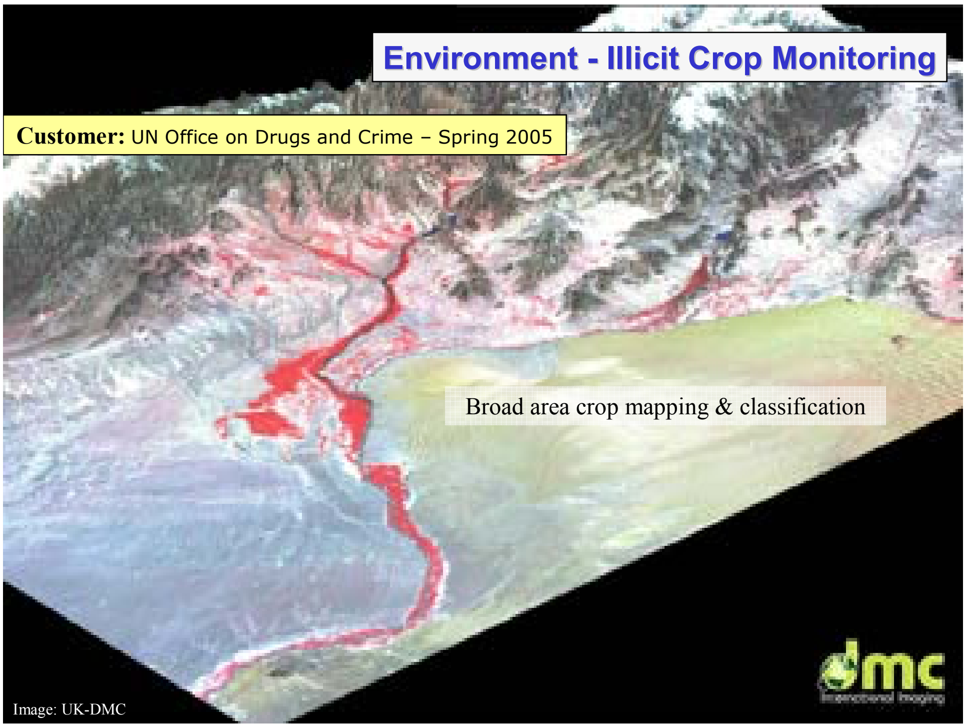
Environment & Forestry

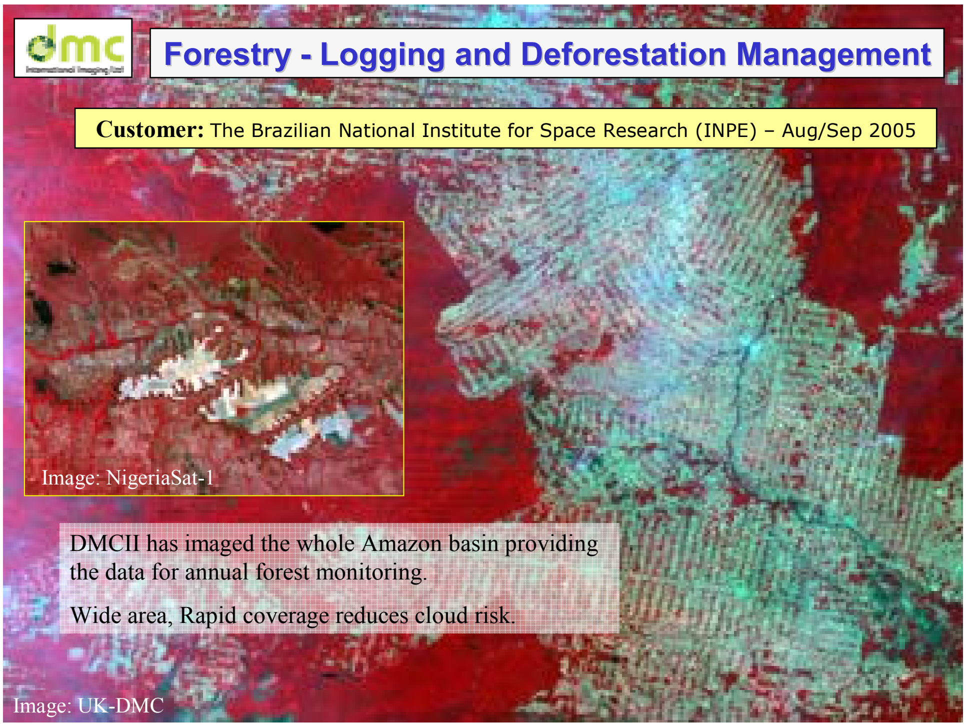
- *Coastal Erosion Monitoring*
- *Burn Scar Mapping*
- *Forest Powerline Risk Mapping*
- *Landcover & Habitat Mapping*
- *Hydrological Mapping*
- *Logging & Deforestation Management*

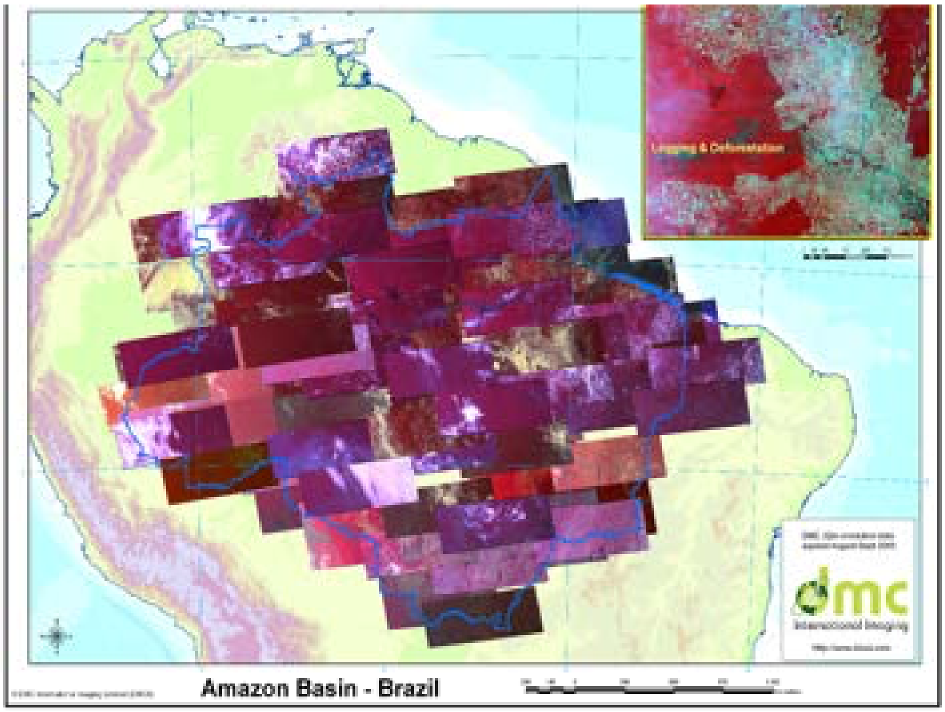


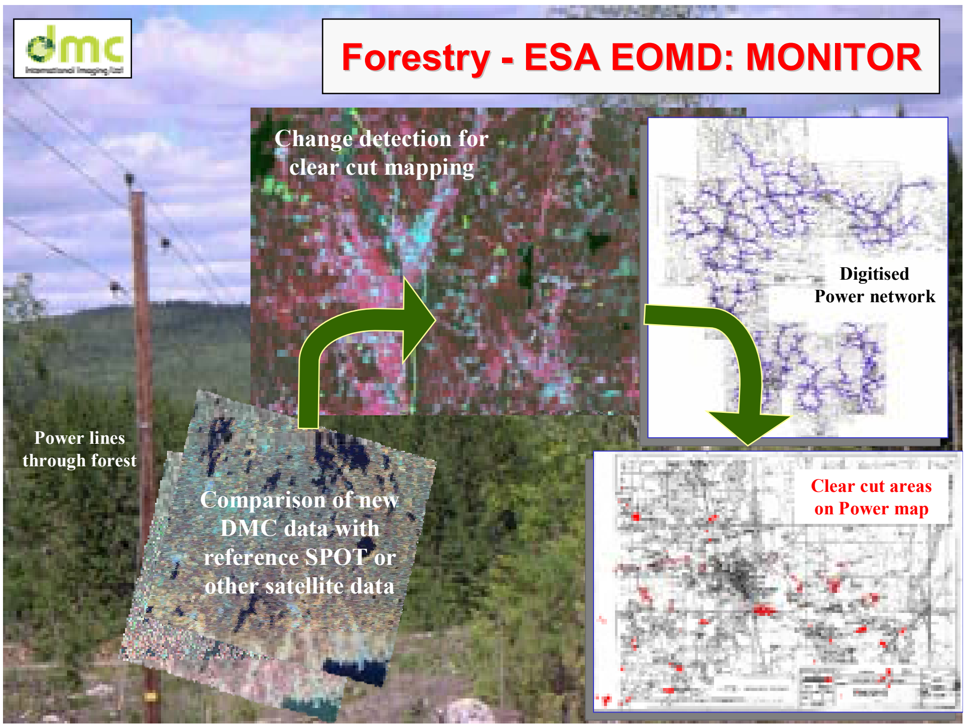

Agriculture – VAR Services
Online Agricultural services Including Field level monitoring of crop health…
DMC 32m data located over 5m aerial photo in UK

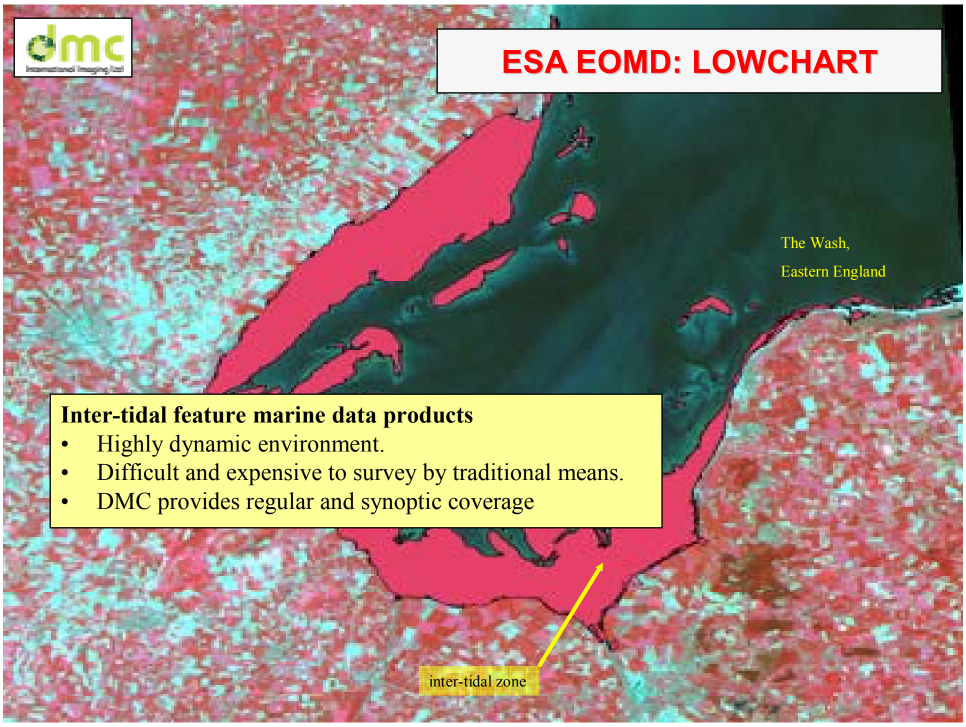

Agriculture – VAR Services, Derived Nitrogen Map

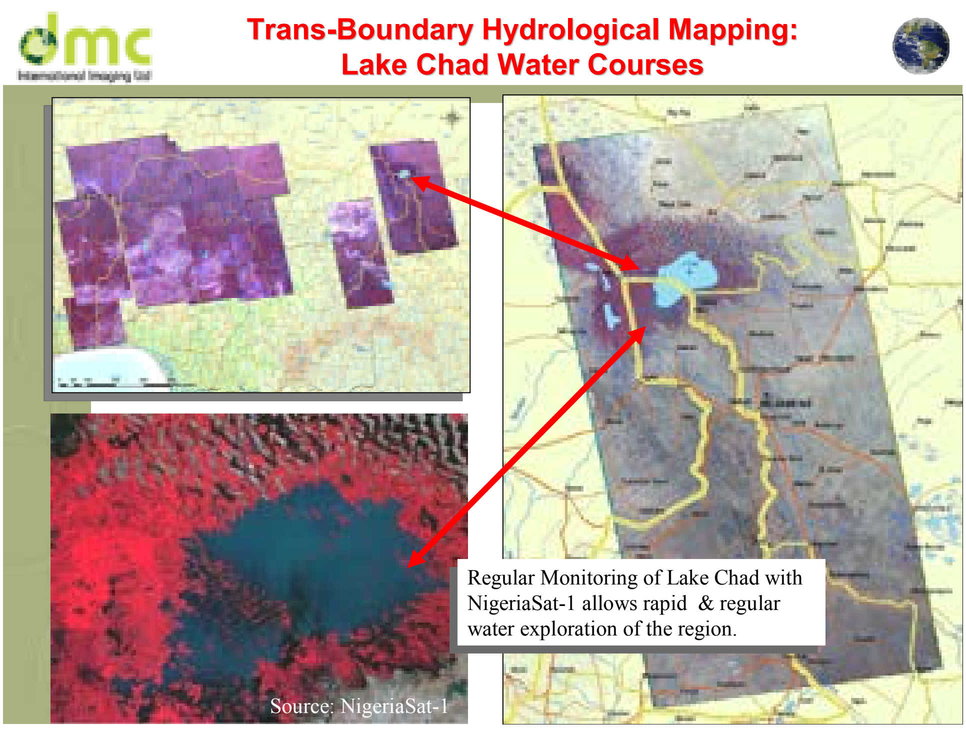

Environment - Illicit Crop Monitoring
Customer: UN Office on Drugs and Crime – Spring 2005
Broad area crop mapping & classification
dmc
Image: UK-DMC

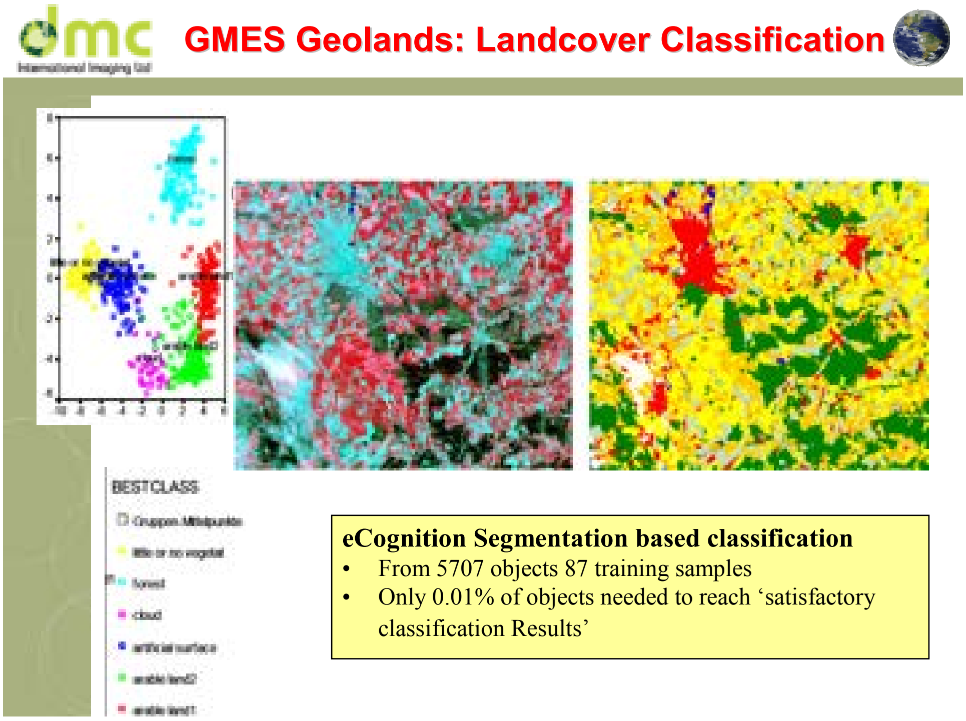

dmc
Forestry - Logging and Deforestation Management
Customer: The Brazilian National Institute for Space Research (INPE) – Aug/Sep 2005
Image: NigeriaSat-1
DMCII has imaged the whole Amazon basin providing the data for annual forest monitoring.
Wide area, Rapid coverage reduces cloud risk.
Image: UK-DMC


Amazon Basin - Brazil
dmc

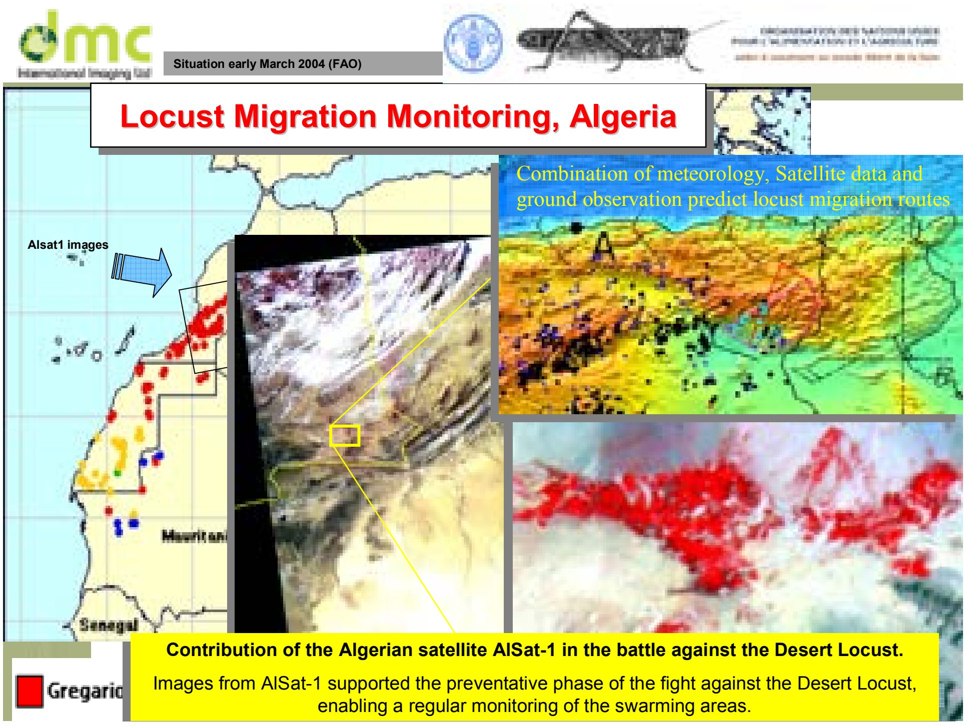

dmc
Forestry - ESA EOMD: MONITOR
Change detection for
clear cut mapping
Digitised
Power network
Power lines
through forest
Comparison of new
DMC data with
reference SPOT or
other satellite data
Clear cut areas
on Power map


ESA EOMD: LOWCHART
The Wash,
Eastern England
Inter-tidal feature marine data products
• Highly dynamic environment.
• Difficult and expensive to survey by traditional means.
• DMC provides regular and synoptic coverage
inter-tidal zone


Trans-Boundary Hydrological Mapping:
Lake Chad Water Courses
Regular Monitoring of Lake Chad with NigeriaSat-1 allows rapid & regular water exploration of the region.
Source: NigeriaSat-1

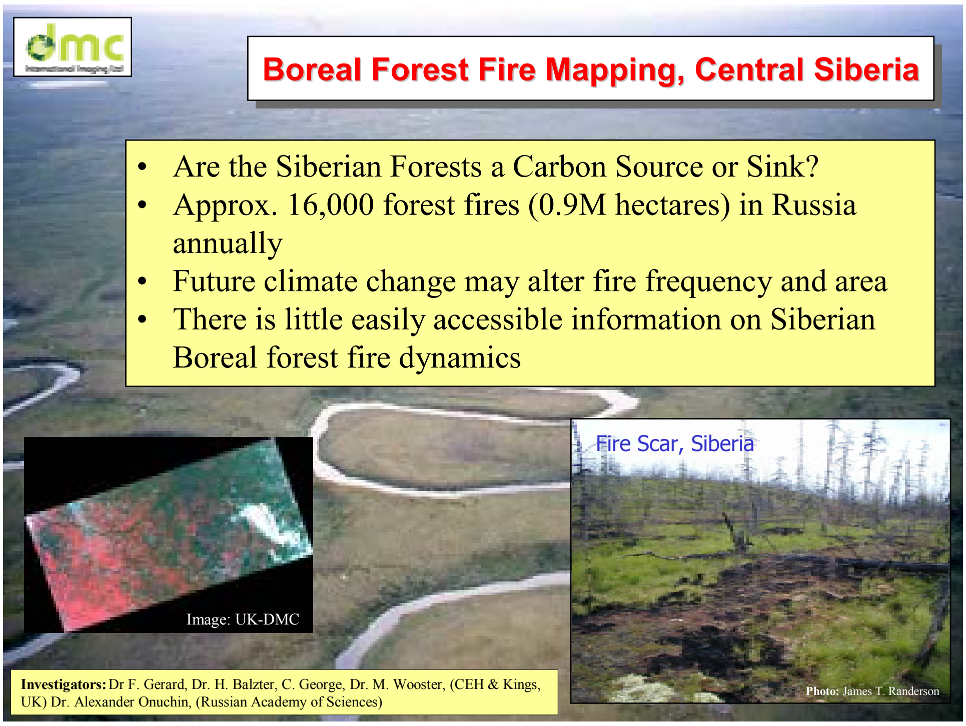


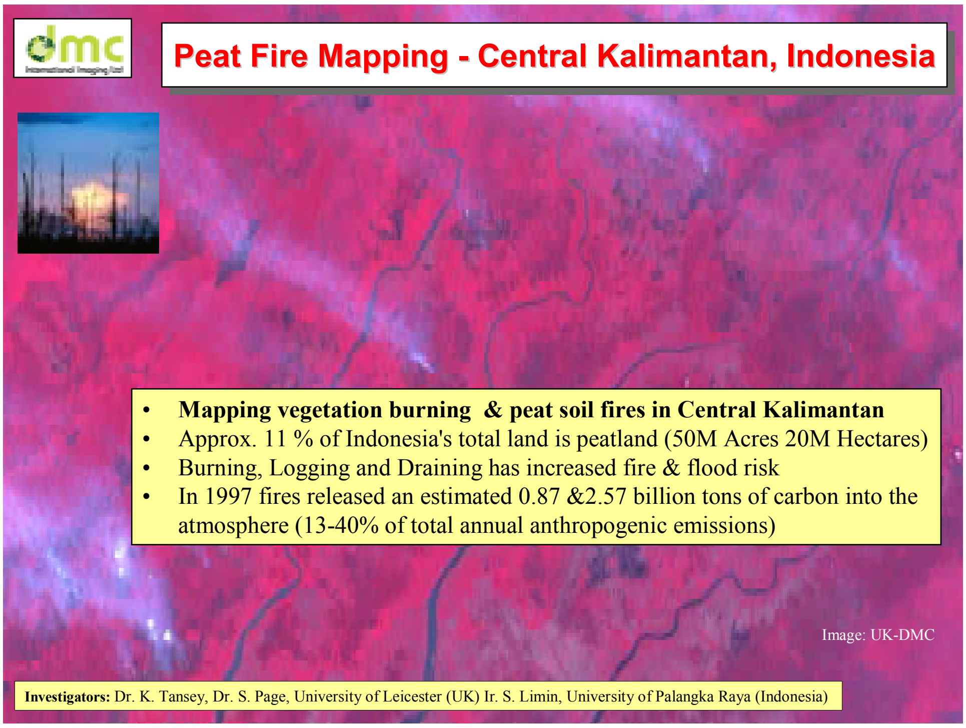
GMES Geolands: Landcover Classification
BESTCLASS
forest
cloud
artificial surface
arable land2
arable land1
eCognition Segmentation based classification
• From 5707 objects 87 training samples
• Only 0.01% of objects needed to reach 'satisfactory classification Results'

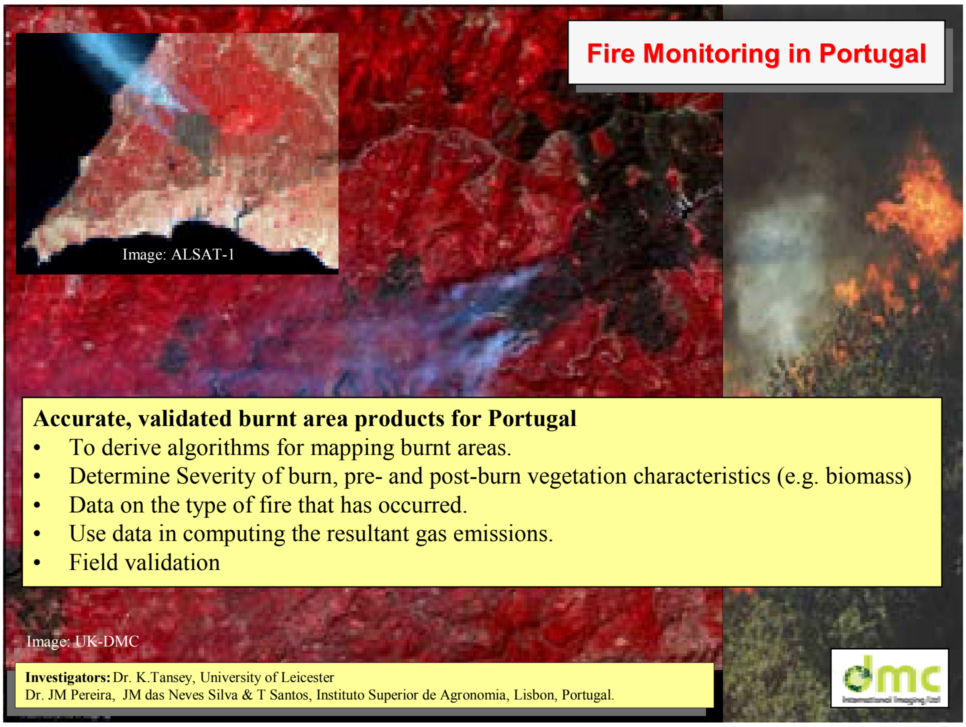


Situation early March 2004 (FAO)
Locust Migration Monitoring, Algeria
Alsat1 images
Combination of meteorology, Satellite data and ground observation predict locust migration routes
Senegal
Contribution of the Algerian satellite AlSat-1 in the battle against the Desert Locust.
Images from AlSat-1 supported the preventative phase of the fight against the Desert Locust, enabling a regular monitoring of the swarming areas.


Glacial Calving, Greenland Ice Sheet
• Monitoring Rates of glacial ice release (Calving flux)
• The Greenland Ice Sheet is melting at rates far quicker than previously realised.
• Predicted global impact: Rising sea levels, Ocean Current instability.
Image: UK-DMC
Investigators: Adrian Luckman and Tavi Murray, Swansea University


Boreal Forest Fire Mapping, Central Siberia
• Are the Siberian Forests a Carbon Source or Sink?
• Approx. 16,000 forest fires (0.9M hectares) in Russia annually
• Future climate change may alter fire frequency and area
• There is little easily accessible information on Siberian Boreal forest fire dynamics
Image: UK-DMC
Fire Scar, Siberia
Photo: James T. Randerson
Investigators: Dr F. Gerard, Dr. H. Balzter, C. George, Dr. M. Wooster, (CEH & Kings, UK) Dr. Alexander Onuchin, (Russian Academy of Sciences)


Peat Fire Mapping - Central Kalimantan, Indonesia
• Mapping vegetation burning & peat soil fires in Central Kalimantan
• Approx. 11 % of Indonesia's total land is peatland (50M Acres 20M Hectares)
• Burning, Logging and Draining has increased fire & flood risk
• In 1997 fires released an estimated 0.87 &2.57 billion tons of carbon into the atmosphere (13-40% of total annual anthropogenic emissions)
Image: UK-DMC
Investigators: Dr. K. Tansey, Dr. S. Page, University of Leicester (UK) Ir. S. Limin, University of Palangka Raya (Indonesia)


Fire Monitoring in Portugal
Image: ALSAT-1
Accurate, validated burnt area products for Portugal
• To derive algorithms for mapping burnt areas.
• Determine Severity of burn, pre- and post-burn vegetation characteristics (e.g. biomass)
• Data on the type of fire that has occurred.
• Use data in computing the resultant gas emissions.
• Field validation
Image: UK-DMC
Investigators: Dr. K.Tansey, University of Leicester
Dr. JM Pereira, JM das Neves Silva & T Santos, Instituto Superior de Agronomia, Lisbon, Portugal.

DMC Data Fusion

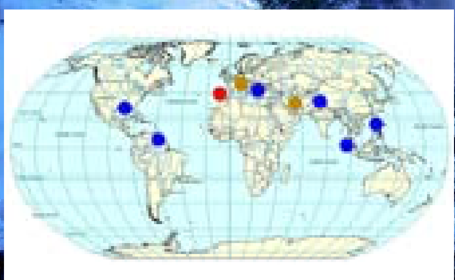
Bush Fire Mapping – NSW, Australia


Pre-Fire


Post-Fire DMC fusion product

DMC Disaster Response 2005

26/08	Flood	Hurricane Katrina, USA
25/08	Flood Landslide	Switzerland
23/08	Fires	Coimbra, Portugal
27/06	Floods	Sutley River, Himachal Pradesh, India
09/06	Floods	Bulgaria
24/02	Earthquake	Zarand, Kerman, Iran
08/02	Floods	Georgetown, Guyana
27/12	Floods	Indian Ocean,Tsunami
05/12	Floods	Manila, Luzon, Philippines



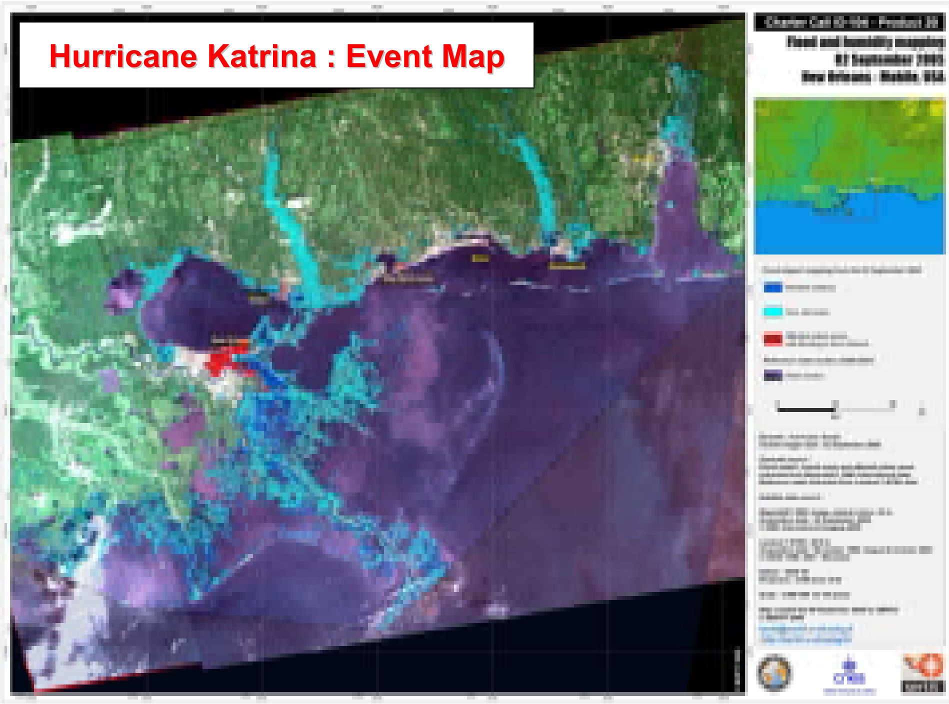
DMCii Provides:

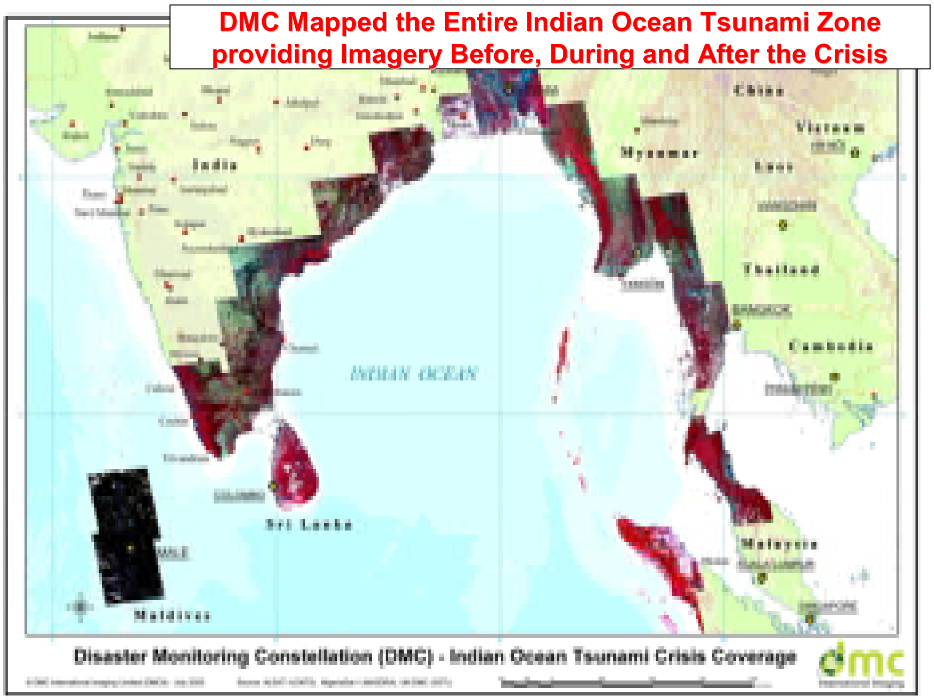
International Charter "Space & Major Disasters"

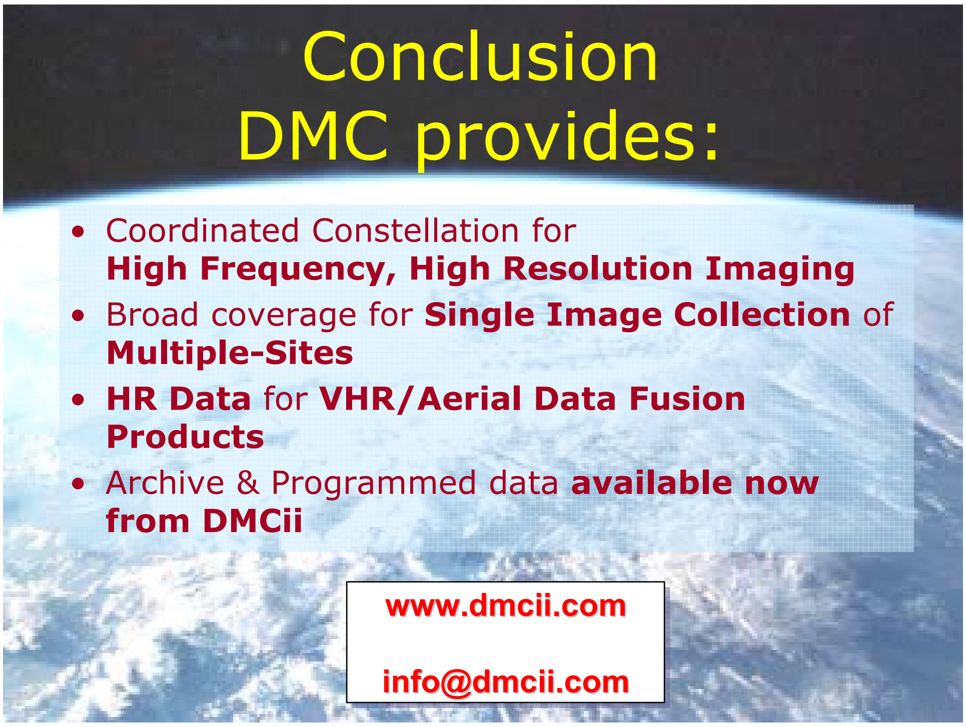
- Rapid response Imagery
- Emergency On Call Officers
- Executive Secretariat member

Hurricane Katrina : International Charter Call 104
Image: NigeriaSat-1

Hurricane Katrina : International Charter Call 104
Flooded areas
Superdome
Lake Ponchartrain
Smoke plume from wharf
Mississippi River
Image: NigeriaSat-1


Hurricane Katrina : Event Map


DMC Mapped the Entire Indian Ocean Tsunami Zone
providing Imagery Before, During and After the Crisis
China
Vietnam
Myanmar
Laos
India
Thailand
Cambodia
INDIAN OCEAN
Sri Lanka
Malaysia
Maldives
Disaster Monitoring Constellation (DMC) - Indian Ocean Tsunami Crisis Coverage
dmc



Conclusion
DMC provides:
• Coordinated Constellation for High Frequency, High Resolution Imaging
• Broad coverage for Single Image Collection of Multiple-Sites
• HR Data for VHR/Aerial Data Fusion Products
• Archive & Programmed data available now from DMCii
www.dmcii.com
info@dmcii.com

Presentation 5 - The use of DMC data as a substitute for missing common optical data. A comparison of accuracy and spectral capabilities

ROBERT STEIN
EFTAS Fernerkundung Technologietransfer, GmbH. De

Abstract

In 2005 EFTAS has been assigned to do the controls by remote sensing within the IACS in Germany for eighteen sites. Traditionally some of the administrations ordered a separated check of the summer crops using an optical image acquired in July. Due to the bad weather conditions it wasn't possible to collect regular optical data in three of those sites. Therefore JRC asked EFTAS to test DMC data instead to do both the checks of the summer crops and a feasibility test of the data for possible future use in RSC within the IACS.

The DMC data provides 32m resolution image data in 3 LANDSAT equivalent spectral bands covering NIR, visible Red and visible Green. What makes this dataset such a specific one is its very wide swath width allowing large areas to be imaged in one pass: The images acquired for EFTAS have got dimensions of about 404km x 460km covering almost 13 sites.

EFTAS got two datasets, an already ortho-corrected one using a rigorous model that corrected for the elements of the geometric distortion of images, such as earth shape, earth rotation, spacecraft orbit, spacecraft attitude etc. and one only corrected radiometrically.

EFTAS had been able to use a subset for one site only due to heavy cloud coverage on the rest of the two images. Therefore a subset from both datasets has been made. The ortho-corrected image of 28-07-2005 has been checked for its geometric accuracy and has been used successfully for CAPI of the summer crops. Additionally the "raw"-image has been geometrically corrected using ERDAS Imagine's *Projective Transform algorithm.* The accuracy of both images have been compared. Moreover DMC data has been compared with other optical datasets, commonly used for RSC in IACS like SPOT and LANDSAT TM, especially regarding geometric and radiometric resolution and capabilities. Results are, that DMC data in spite of its low geometric resolution is fully compatible to other comparable sensors, usually used for CAPI like LANDSAT TM. The geometric accuracy of the ortho-rectified product supplied by the provider has been approved by independent checkpoints to be within the tolerances given by the Common Tech. Specs.

Keywords: summer crops, optical datasets, DMC, swath width, geometric accuracy radiometric capabilities, IACS, CAPI

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Kraków 23th - 25th November 2005

The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

Session T3
New sensors and image handling

The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

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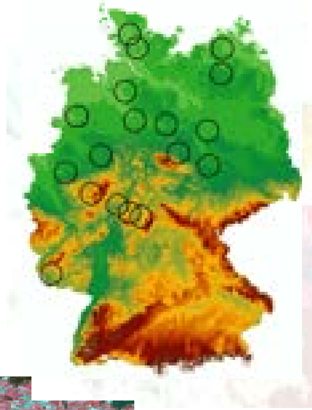
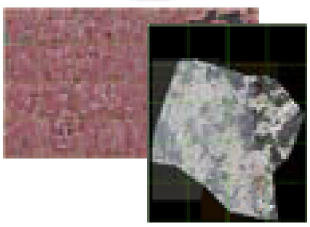
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

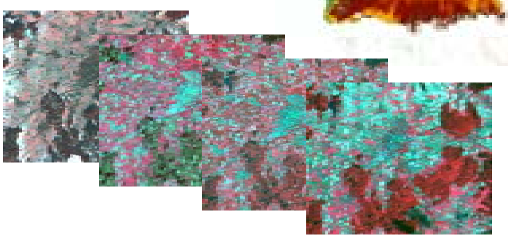
EFTAS Remote Sensing checked in 2005
- 7456 dossiers
- in seven Federal German states
- in 18 control sites

a combined method for CAPI is used:

- DOPs or VHR-data for controlling the area
- a time series of various optical HR data for checking the land use







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The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

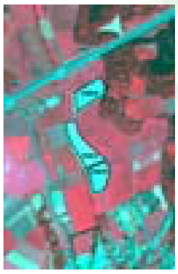
Some customers want the summer crops like oats, maize, sugar beets etc. to be checked with a separate CAPI on a late HR-image acquired in July to minimize errors due to bare soil

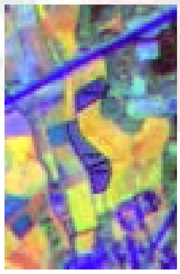
Example: maize can't be interpreted in any of the images within the „normal" time series


TM5 21.12.


XS2 21.04.


IK 18.06.


XS5 19.06.


MT 21.04 & 19.06.

slide 3

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The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

For three of the 18 EFTAS sites a summer image was programmed, but couldn't be acquired.

JRC asked EFTAS to test image data of the new sensor DMC (Disaster Monitoring Constellation) for IACS purposes

DMC data is used for CwRS first time.

DMC is designed to provide daily image capability all over the world. This is ensured by five satellites, owned and controlled by separate nations (Algeria, China, Nigeria, Turkey and United Kingdom.

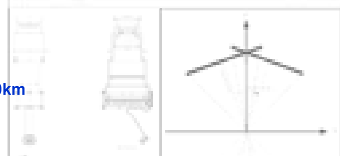
some Technical details:

Sensor: SLIM6 (six-channeled pushbroom CCD technology), two banks of three bands are combined

Orbit: near polar, sun-synchronous, altitude 686km, 98° inclination

Bands: 0.52µm - 0.60µm (visib. Green)
0.63µm - 0.69µm (visib. Red)
0.77µm - 0.90µm (near Infrared)

Image: 31.822m GSD at a swath width of 600km



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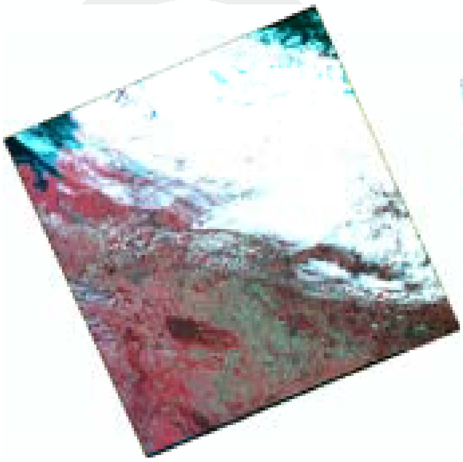
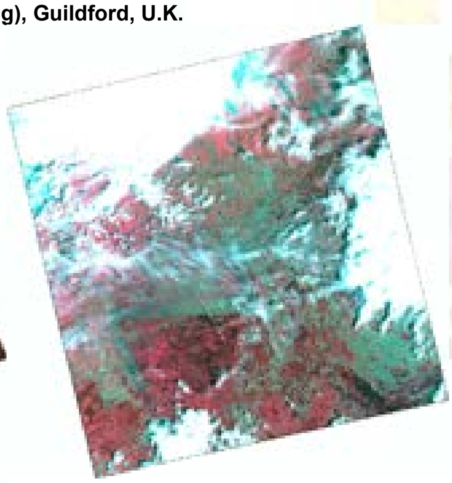
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

EFTAS got two images acquired by UK-DMC and processed by DMCII (DMC International Imaging), Guildford, U.K.



DMC 18-07-05



DMC 28-07-05

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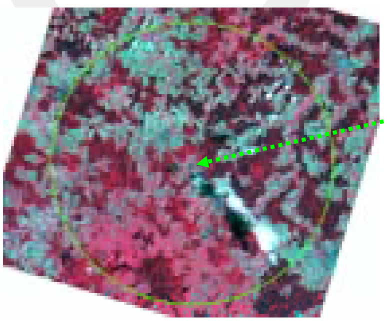
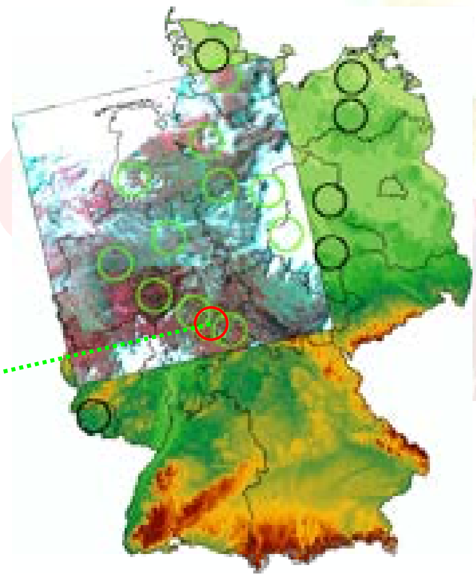
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

While one image was located too far in the east with too many clouds over the relevant sites the image of 28-07-05 was chosen with almost 13 out of 18 sites being covered by a single image.

There was one relevant site, where summer crops had to be checked: Site RAIN (Hesse)





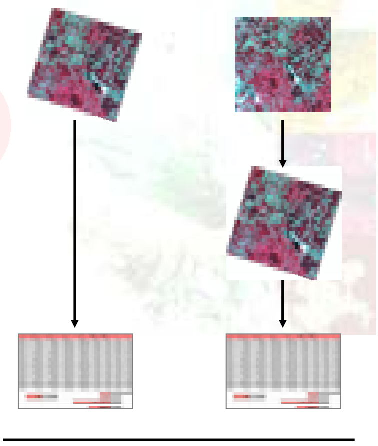
slide 6

DMC-Test, part 1: geometric accuracy

Images have been delivered by DMCII in two formats:
- **L1R (only corrected radiometrically)**
- **L2G (additionally ortho-rectified)**

Our approach was to

- **check the accuracy of the L2G-image,**
- **ortho-rectify the L1R-image by ourselves,**
- **check its accuracy, too**
- **and compare the results achieved.**



comparison of results

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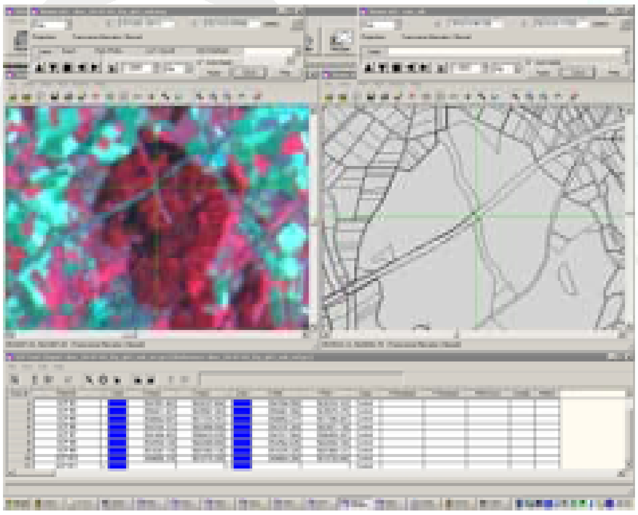
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy

An accuracy check of a rectified image is done by locating 25 independent check-points in the rectified image, which can be identified clearly in the reference.



The check itself is performed in ERDAS Imagine

The rectified image is loaded into one view,

the reference data, which consists of digital cadastral vector data (ALK), is loaded into another view.

25 Points of identical location have to be found.

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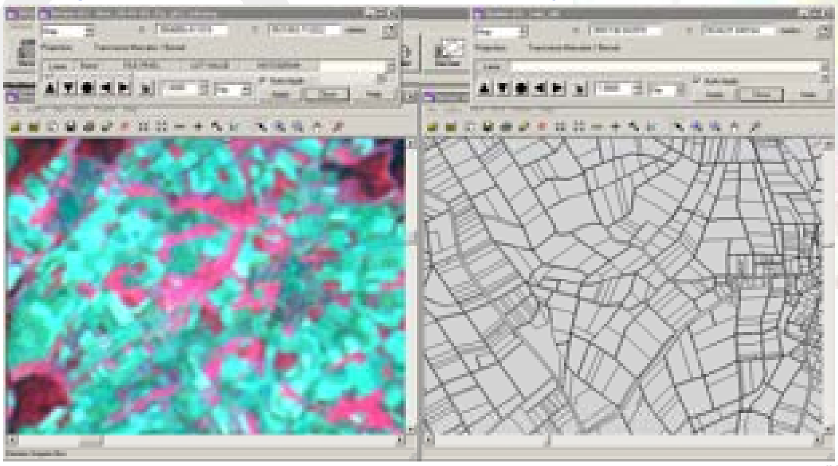
DMC-Test, part 1: geometric accuracy

Two major difficulties were encountered:

- **finding adequate checkpoints within the DMC data with 32m resolution (very rare)**
- **panning inside a vector data set of 1.724.655 arcs (very slow)**



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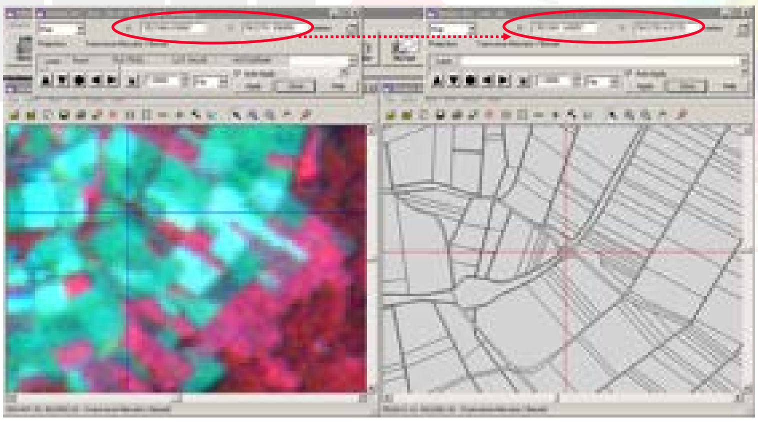
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy

Solutions:

- **Actually only large crossings or characteristic boundaries of different landuse, which can also be found in the vector data may be used as checkpoints**
- **Suitable points are located in the DMC data, their coordinates then copied and pasted into the reference view to check whether they can be found there, too or not.**



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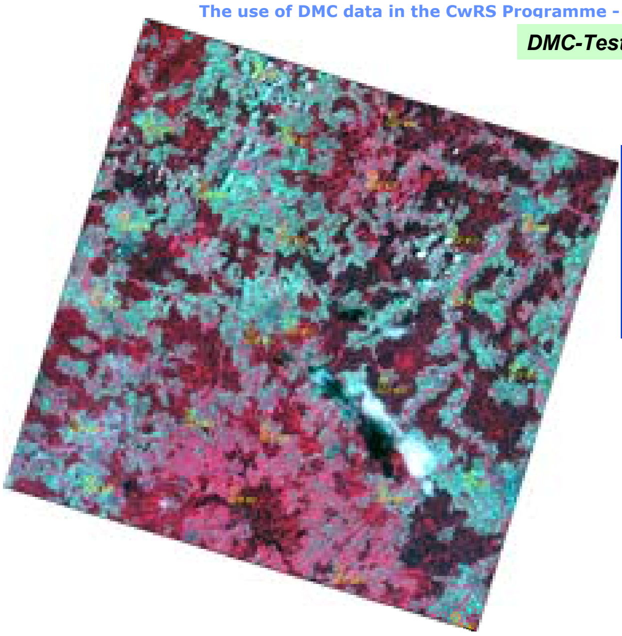
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy



There is no RMSE tolerance for DMC data in the CTS yet

well known tolerances for HR images so far:

SPOT 2, 4 multispectral	30 m
SPOT 5 multispectral	15 m
IRS multispectral	40 m
RADARSAT	20 m
LANDSAT TM	50 m

considering DMC‘s GSD of 32m one should expect a tole-rance of about 50m (like LANDSAT TM)

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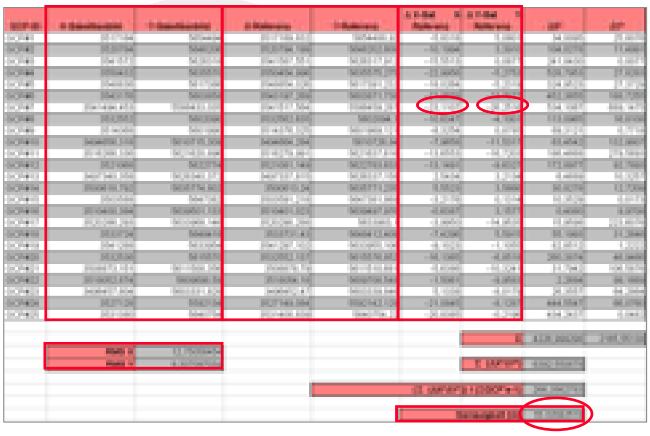
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy



The (x/y) locations of the checkpoints and the (x/y) locations of their reference were imported to a table.

The residuals and the absolute RMSE has been calculated.

For the L2G dataset (ortho-rectified by DMCII) an RMSE of 16.3204m could be validated.

Max. Res. (x): -23.1107m

Max. Res. (y): -26.2516m

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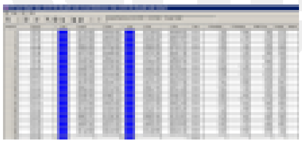
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy

Ortho-rectification of the L1R data has been done by using ERDAS Imagine's projective transformation algorithm

Due to the lack of a sensor model or additional infor-mation the use of a DTM seemed very useful

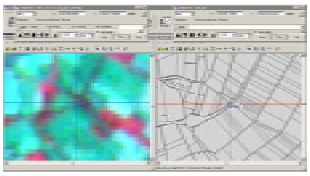


more GCPs are needed, but higher accuracy can be expected

The model offers different alternatives:

- **2D or 3D model**
- **same or different deno-minators for x and y**
- **1st, 2nd or 3rd order**

3rd order in combination with different denominators requires 39 GCPs, which were too difficult to locate in the 32m dataset



a 3D model with 2nd order and different denominators as well as 3rd order with same denominators has been chosen (use of 30 GCPs)

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The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 1: geometric accuracy

results of the different types of rectifications done by EFTAS

RPC order	same denominators	different denominators
1	6 GCPs requ. RMSE: 105.0976m	7 GCPs requ. RMSE: 40.5824m
2	15 GCPs requ. RMSE: 70.9888m	19 GCPs requ. RMSE: 31.3568m
3	30 GCPs requ. RMSE: 59.1904m	39 GCPs requ. RMSE: n.a.

Summary:

- **More than 30 GCPs were difficult to locate because of the image's characteristics**
- **It's possible to meet JRC's tolerances, but RMSE still is twice as high as DMCII's**
- **Better results could be achieved using a more accurate and specific satellite model**

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The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 2: spectral capabilities

comparison of commonly used HR-data (LANDSAT TM, SPOT, IRS) versus DMC

	LANDSAT	SPOT (XI5)	IRS	DMC
Spatial resolution	30 m	10 m	23 m	32 m
Spectral bands *)	Green, Red, NIR	Green, Red, NIR	Green, Red, NIR	Green, Red, NIR
Dimensions	185 km x 185 km	60 km x 60 km	140 km x 140 km	600 km x 520 km **)
Revisit (days)	18	26 (more often with different angles)	24	daily

*) only the bands are listed, which are used for CAPI by EFTAS
**) width can vary from 32 m up to 600km; length depends on width and storage constraints

- **Spatial resolution is at its upper limit for CAPI, esp. in areas with small parcels**
- **Spectral bands are fully compatible to commonly used sensors in CwRS**
- **DMC's large dimensions are a great advantage for covering several sites at once**
- **Daily revisits allow more acquisitions than other systems do**

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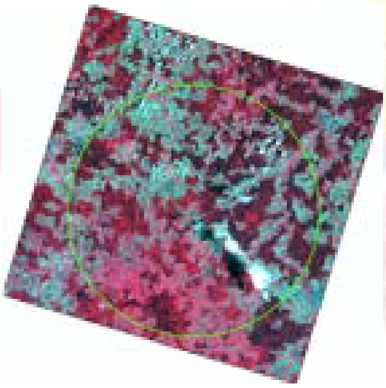
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 2: spectral capabilities

The DMC image of 28-07-05 has been used for CAPI of the summer crops in RAIN



- **Only a subset has been ortho-rectified to meet the dimension of the other HR scenes**

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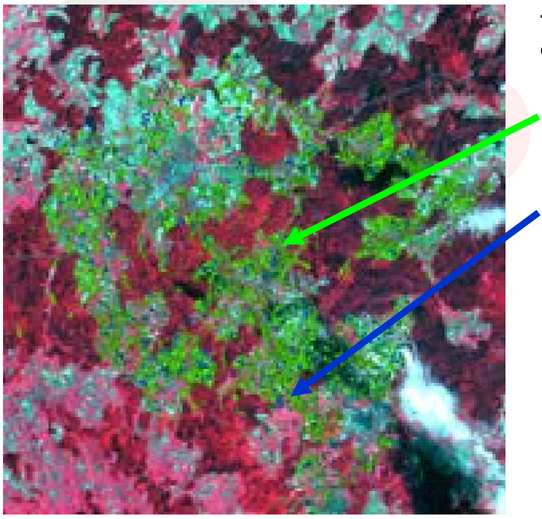
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

DMC-Test, part 2: spectral capabilities



The view shows the core of site RAIN

6192 parcels had to be checked in total (green)

668 of them have been applied for with summer crops (blue)

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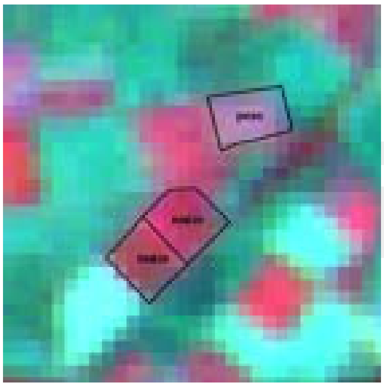
The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

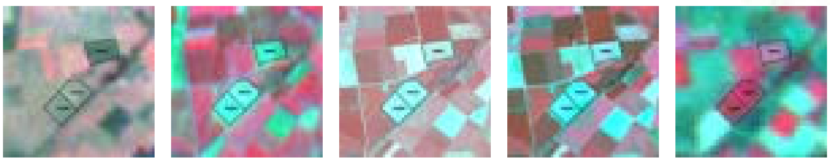
DMC-Test, part 2: spectral capabilities



TM5	21-12-04
XS2	21-04-05
IKONOS	18-06-05
XI5	19-06-05
DMC	28-07-05

The only problem with DMC encountered during CAPI was the pixel size

Landuse could be interpreted very well on average sized parcels



TM5 21-12-04 XS2 21-04-05 IKONOS 18-06-05 XI5 19-06-05 DMC 28-07-05

slide 18

DMC-Test, part 2: spectral capabilities

Results

Results of CAPI (summer crops using the DMC image)

[OK]	landuse as declared:	593 parcels (including C3+/C3-)
[C1]	landuse in another block:	2 parcels
[C41]	landuse not interpretable:	22 parcels
[A1]	smaller than 0.1ha:	51 parcels

This reflects a normal interpretation result

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Summary

- DMC data should be ortho-rectified by the provider or with a special model in order to achieve good results meeting JRC's TechSpecs
- DMC data is fully compatible to other sensors commonly used in CwRS regarding spectral capabilities
- DMC system offers certain advantages, such as wide swath width, daily revisits and fast processing services
- DMC data is at the upper limit for interpretation of smaller sized parcels regarding its pixel size of 32 m

slide 20

11th Conference on Control with Remote Sensing of area-based subsidies
Kraków 23th - 25th November 2005

The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

Session T3
New sensors and image handling

The use of DMC data in the CwRS Programme - accuracy and spectral capabilities

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Presentation 6 - OrbView-3 and FORMOSAT-2

Pierre Boubée
Spot Image, FR

Abstract

OrbView-3 was developed and built for ORBIMAGE by Orbital Sciences Corporation (NYSE: ORB) at its satellite manufacturing facility in Dulles, Virginia.

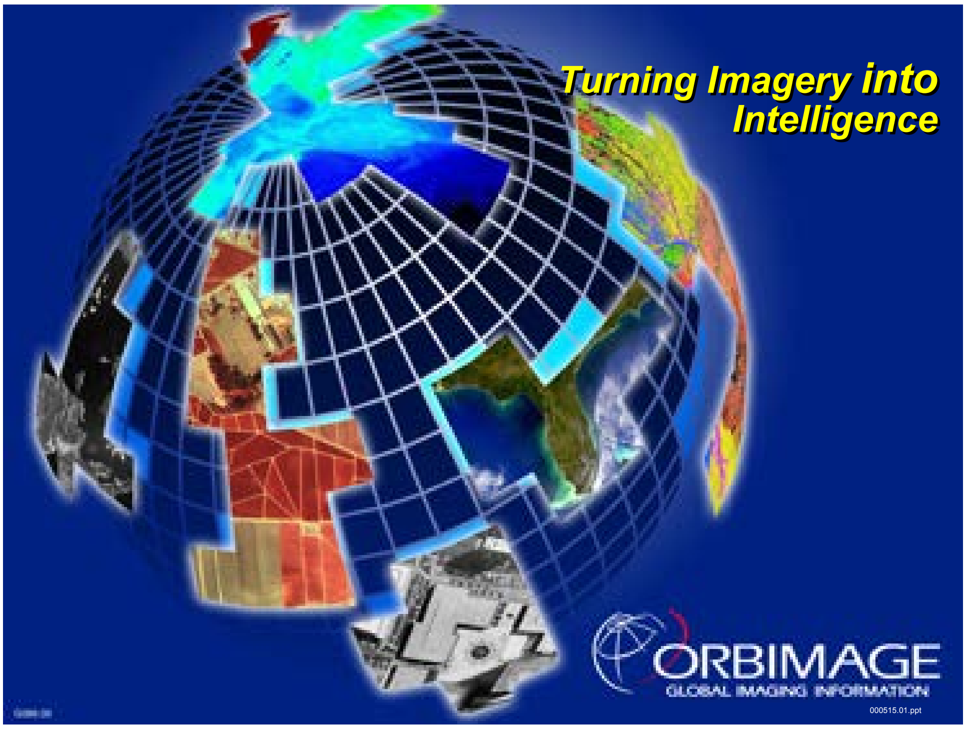
OrbView-3 has been successfully launched June, 2003.

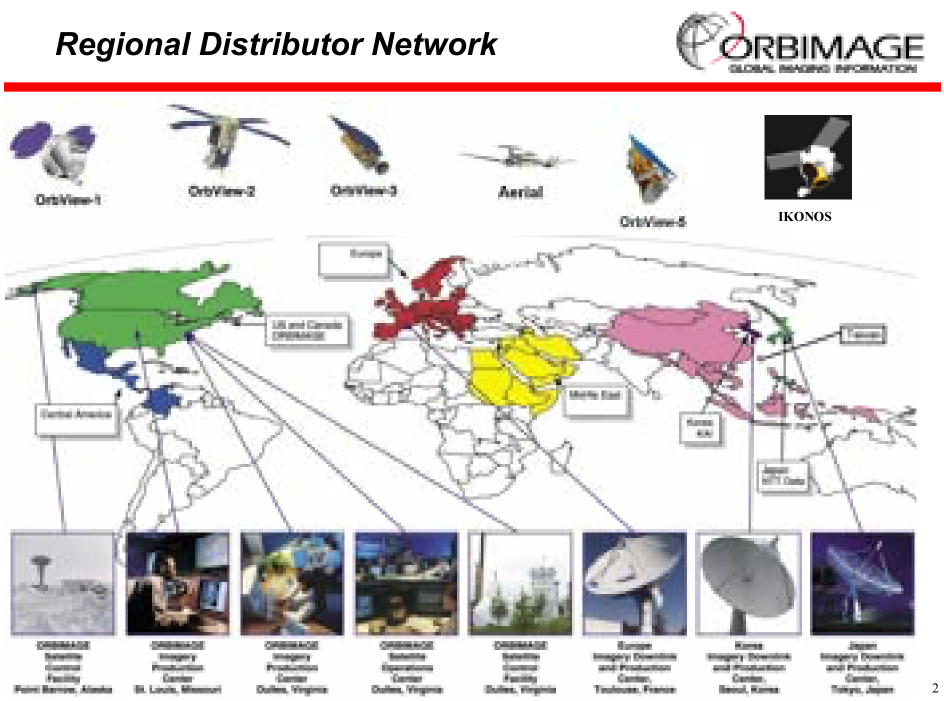
OrbView-3 is one of the world's first commercial satellites to provide high-resolution imagery from space. OrbView-3's high-resolution camera acquires one-meter resolution panchromatic (black and white) and four-meter resolution multispectral (colour) imagery.

This imagery is valuable to customers around the world for a wide-range of commercial, government and consumer applications. With the ability to image virtually anywhere in the world within three days, ORBIMAGE has established a global network of distributor partners to produce and deliver basic imagery as well as high-resolution value-added products.

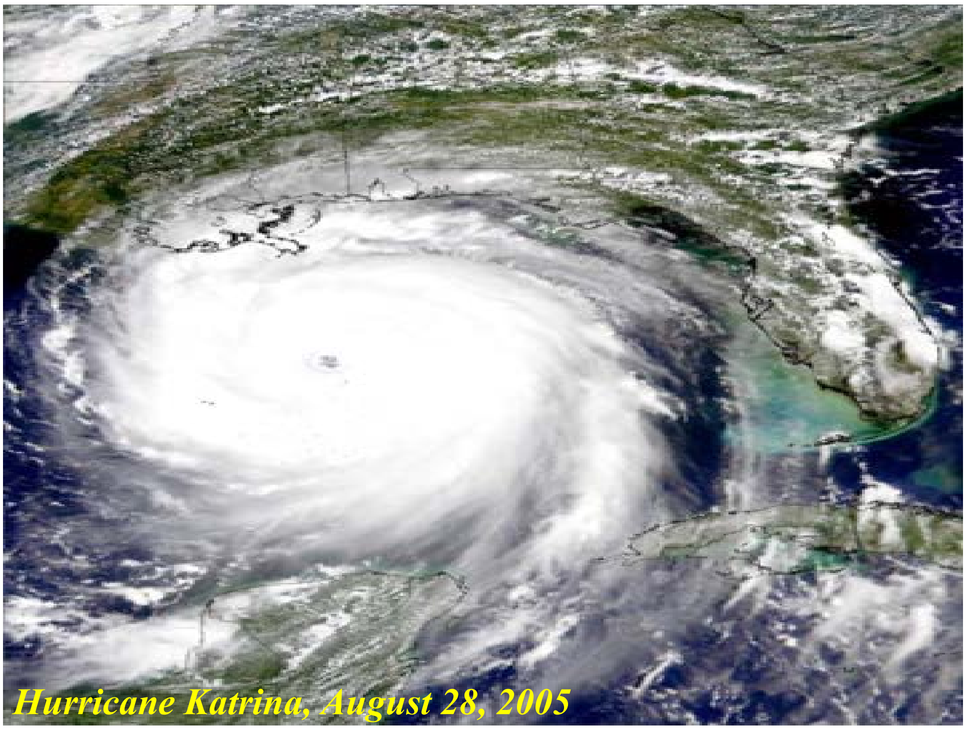
For more details: http://www.orbimage.com

Part 1 – OrbView 3



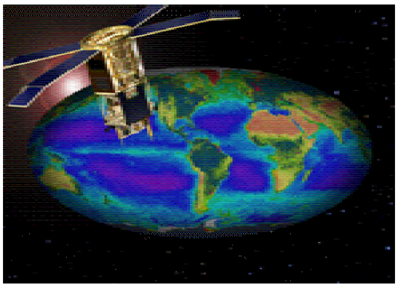



OrbView-2 Specifications


Hurricane Katrina, August 28, 2005

OrbView-2 Capability and Operations

ORBIMAGE
GLOBAL IMAGING INFORMATION



Capability

- Imaging Mode - Multispectral (Color)
- Color Bands - 8
- Spatial Resolution - 1 km
- Swath Width - 2,800 km
- Revisit Time - 1 day
- Orbital Altitude - 705 km (423 mi)
- Expected Life - 10 years

Operations

- Approaching 7-years on orbit
- In-service availability >99%
- Mission planning twice per week
- *Operated by equivalent staff of 2*

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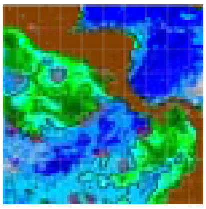
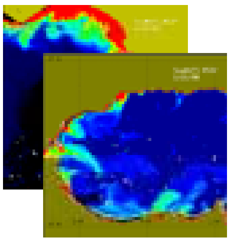
OrbView-2 Applications

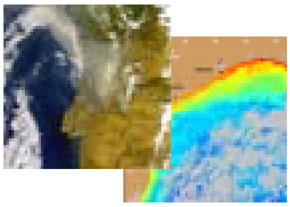
ORBIMAGE
GLOBAL IMAGING INFORMATION



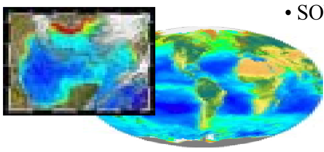
Fishing
• High Seas Fishing
• Coastal Fishing



Naval Operations
• LASER-Based Operations
• SONAR Operations



Environmental Monitoring
• Red-Tide Monitoring
• Fire Monitoring



Scientific Research
• Global Warming
• El Niño Monitoring

Agriculture
• Crop Estimates
• Land Health Assessment

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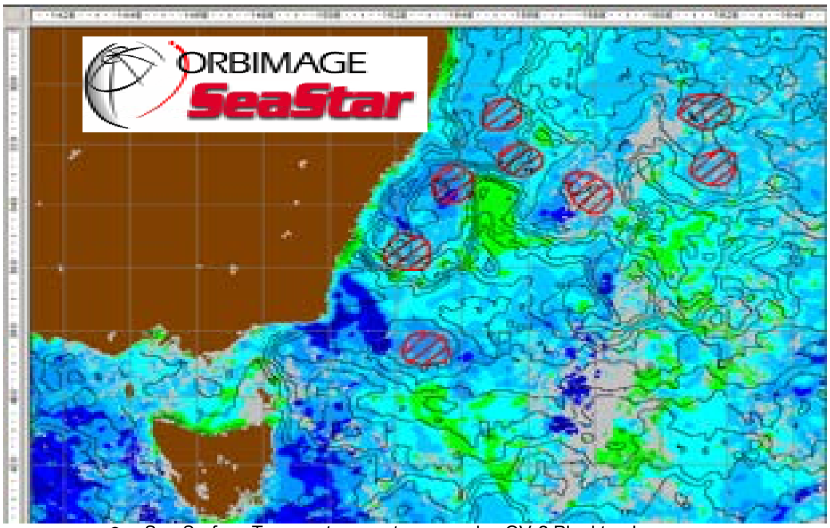
SeaStar Fish Finding Service



- Sea Surface Temperature contours overlay OV-2 Plankton Image map
- Recommended fishing grounds are shown in red (off coast of Australia)

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OrbView-3 Baseline

ORBIMAGE
GLOBAL IMAGING INFORMATION

- Resolution/Swath-Width
  - Pan: 1m at 8 km
  - MS: 4m at 8 km
- On-Board 32 Gb Solid State Recorder
  - 1m Pan: 226 Images
  - 4m MS: 904 Images
- 11 Bit Detector Dynamic Range
- Max Data Rate: 150 mbps
- Gimbaled X-Band Downlink Antenna
- Maximum Area Imaged per 10 min Pass
  - At scan rate of 5,000 lines/second
    - 1m GSD (Mono): 20,320 km2
    - 1m GSD (Stereo): 7,200 km2
- Revisit Time: <3 Days
- Orbit: 97° Sun Sync at 10:30 a.m., 470 km
- Launch Mass: ~300 kg
- Mission Life: 5 years (Fuel >7 Years)

Launched on June 26, 2003

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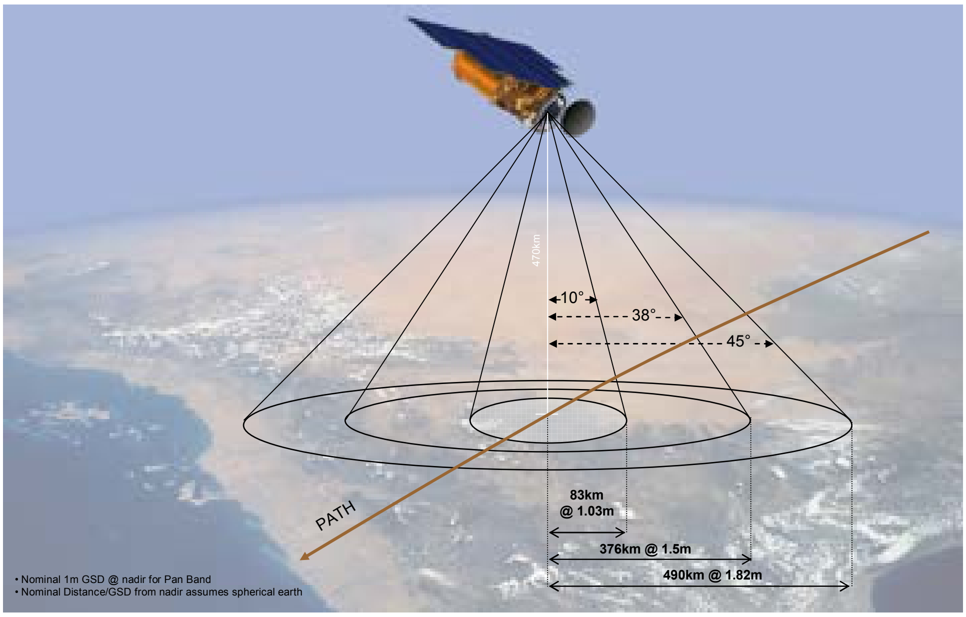
Satellite Field of Regard



OrbView-3 PAN 1m Image

Whiteman AFB - October 22, 2003

OrbView-3 MSI 4m Image

Baghdad Airport, September 27, 2004

ORBIMAGE GLOBAL IMAGING INFORMATION

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OV-3 Sensors and Collection Rates

ORBIMAGE GLOBAL IMAGING INFORMATION

- **Sensors**
  - PAN has 8,000 detectors, 1m resolution
    - Scan rates up to 5,000 lines/second (or 40km^2/second)
  - MultiSpectral has 8,000 detectors (2000 per band x 4 bands), 4m resolution
    - Scan rates up to 2,500 lines/second (or 80km^2/second)
- **Pan Collection Rates - Strips (scanning at 5000 lines/sec)**
  - Typical Single Pass Collection Rates vary and are *highly scenario dependent*

Scenario	GSD (m)	BW* Time (Minutes)	Area (Km2)	Collection Rates (Km2/min)
One 8x700 km strip	$\leq$ 1.4	4	5,600	1400
One 8x300 km strip	$\leq$ 1.03	3	2,400	800
Two contiguous 8x100 km strips	$\leq$ 1.3	3	1,600	533
Three contiguous 8x100 km strips	$\leq$ 1.8	5	2,400	480

* Boundary Window

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Point Target (8 x 8km) Collection Capability

Over a typical 10-minute pass in the 1m GSD Panchromatic mode, the satellite is capable of collecting the following quantities of point targets (at 8km x 8km):

Target Cross-Track Separation (Deg)	Target Cross-Track Separation (Km)	Number of Point Targets	Total in Km2
5º	40km	18	1,152 km2
10º	81km	16	1,024 km2
15º	123km	15	960 km2

Revisit Time to a Point Target				
	Max. GSD = 1.06 meters (Max. F.O.R. Angle = 15°)		Max. GSD = 1.5 meters (Max. F.O.R. Angle = 38°)	
Latitude (degrees)	Ave. # Visits Per Year	Ave. # Days to Revisit	Ave. # Visits Per Year	Ave. # Days to Revisit
10°	36	9.9	108	3.3
25°	39	9.1	119	3.0
40°	49	7.3	143	2.5

NOTE: F.O.R. = Field of Regard

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General Product Characteristics

- All imagery products are radiometrically corrected
- All imagery products are geometrically corrected to appear as if they were collected with an ideal linear array (detector alignment)
- Imagery products are annotated with ancillary info
  - Satellite time
  - Position
  - Attitude
- Available as either pan or multispectral imagery
- Monoscopic or Stereoscopic data sets
- Use various levels of geo-positioning models depending on desired product accuracy
- Product Format: GeoTIFF or NITF (8 or 11 bit quantization)
- Media: Electronic, CD-ROM, DVD, 8mm Tape

Note: Derived Product sizes may differ depending on the product

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Product Geometric Accuracy

ORBIMAGE
GLOBAL IMAGING INFORMATION

- Specifications for geometric accuracy ***without*** ground control points (depending upon look angle):
  - 20m/25m (CE and LE 90%) for single stereo pair
  - 12m/10m (CE and LE 90%) for 3 stereo pairs (in same pass)
- Specifications for geometric accuracy ***with*** four ground control points (depending upon GCP source) is 2-4m (CE and LE 90%)
- ORBIMAGE - St. Louis has extensive experience in:
  - Generating such products for variety of Commercial and Government organizations
  - Developing sophisticated image product generation systems
  - Providing related engineering services (to SI and EarthWatch)

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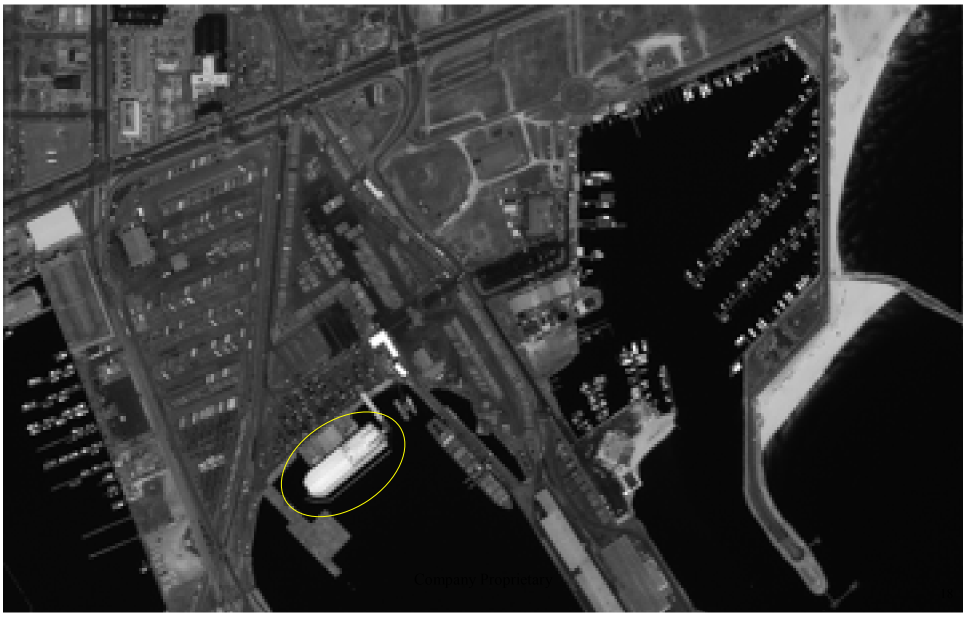
Gulfport city before Hurricane Katrina

ORBIMAGE
GLOBAL IMAGING INFORMATION

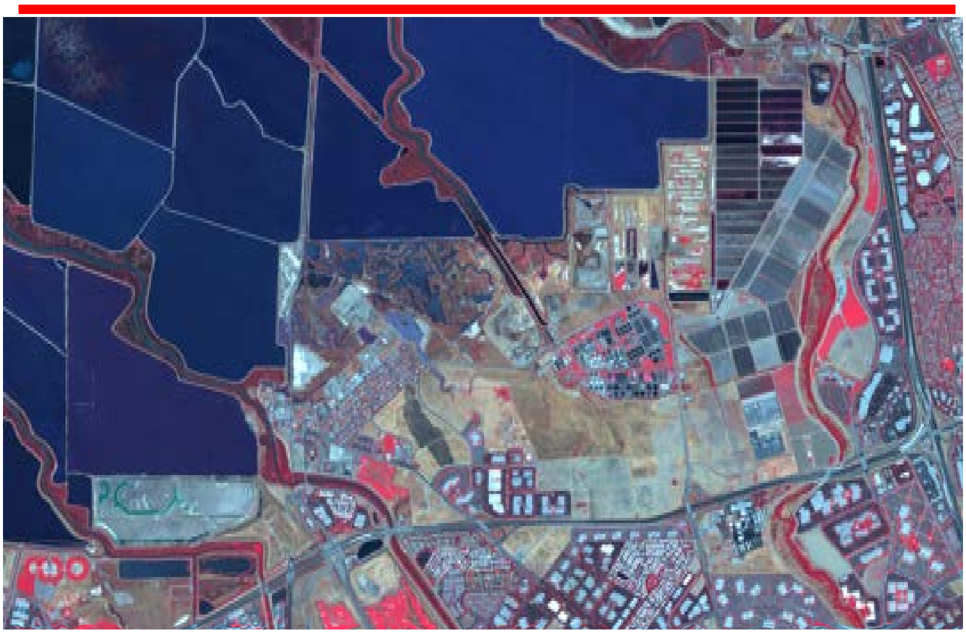


Gulfport city after Hurricane Katrina

ORBIMAGE
GLOBAL IMAGING INFORMATION

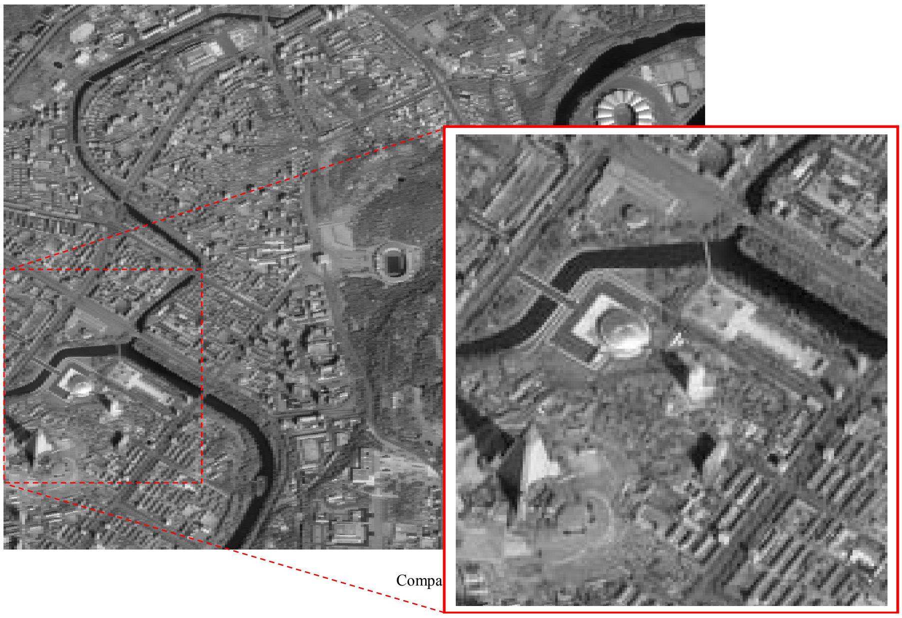
OrbView-3 MSI 4m Image
Sunnyvale, California – July 24, 2004

ORBIMAGE
GLOBAL IMAGING INFORMATION



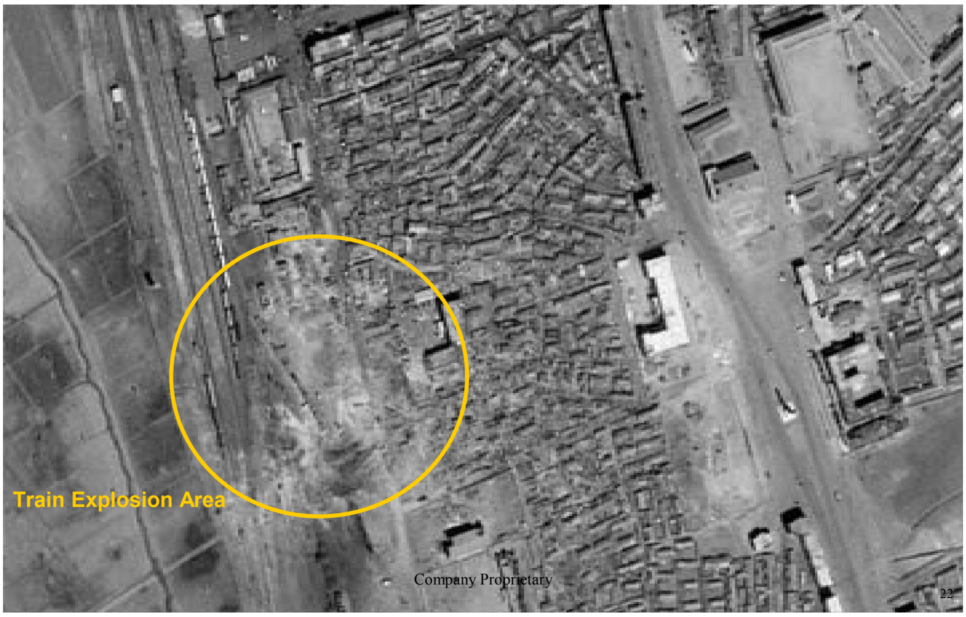
OrbView-3 PAN 1m Image

Pyongyang, North Korea - October 9, 2003



OrbView-3 PAN 1m Image

Ryongchong, N. Korea Train Explosion – April 24, 2004

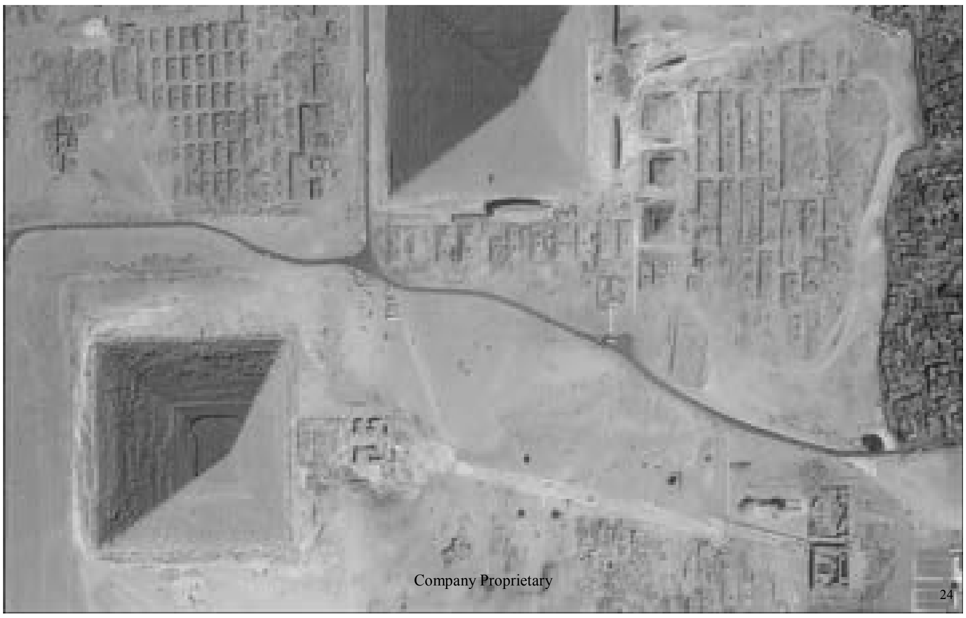


OrbView-3 MSI 4m Image

Fiji – May 13, 2004

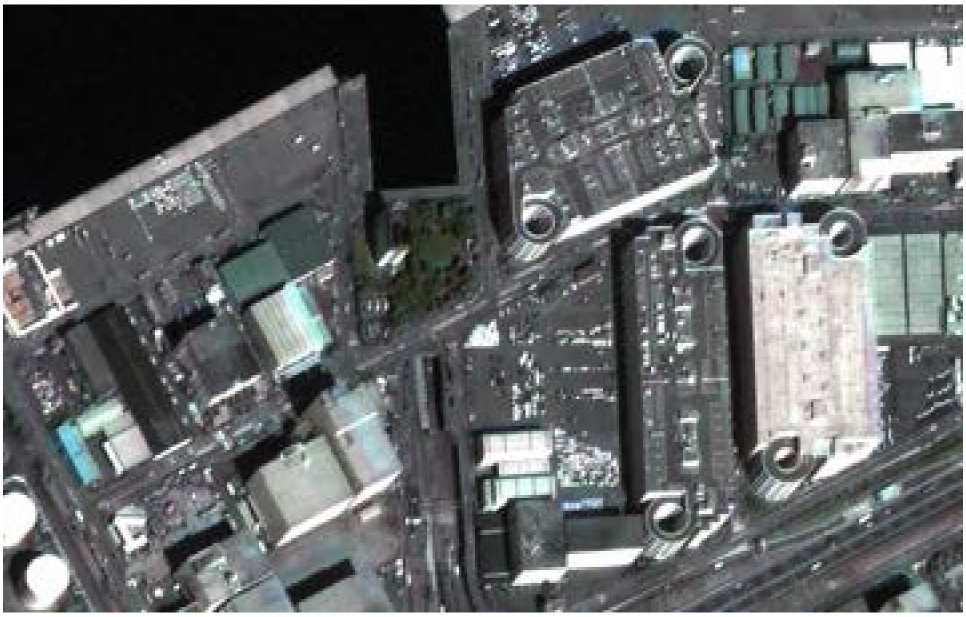
OrbView-3 PAN 1m Image

Great Pyramids of Giza, Egypt – April 16, 2004



OrbView-3 PAN Sharpened

1m Pan & 10m SPOT Image, Tokyo, Japan



OrbView-3 Products & Services

Description – OrbView BASIC *Products*

- ***BASIC EXPRESS*** **Products**
  - High volume product for customers who wish to generate their own value-added products (e.g., digital orthoimages, DEM, thematic maps and feature maps). Imagery is not resampled with geometry data and is available minutes after collection.
- ***BASIC ENHANCED*** **Products**
  - Products use post processed GPS based ephemeris with OV-3 rational functions. Serve as baseline product for higher level products (e.g., orthos can be made from DEM or Stereo Pairs).
- ***BASIC 1:50K*** **Products**
  - Accuracy equivalent to 1:50,000 scale map product (pan 25 m CE 90%). Geopositioning based on tie points from multiple images.
- ***BASIC 1:24K*** **Products**
  - Accuracy equivalent to 1:24,000 scale map product (pan 12 m CE 90%). Geopositioning based on tie points plus ground control points in rough terrain
- ***BASIC 1:12K*** **Products**
  - Accuracy equivalent to 1:12,000 scale map product (pan 10m CE 90%). Geopositioning based on ground control points and accurate DEM

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OrbView BASIC *Products (continued)*

Product Name	Model / Configuration	Spectral Bands	Ground Sample Distance	Geolocation Accuracy (CE/LE 90%)
Basic	Express	Panchromatic	1.0m	60m/60m
	(Mono or Stereo)	Multispectral	4.0m	65m/65m
	Enhanced	Panchromatic	1.0m	28m/44m
	(Mono or Stereo)	Multispectral	4.0m	37m/51m
	1:50K	Panchromatic	1.0m	25m/8m
	(Mono or Stereo)	Multispectral	4.0n	30m/12m
	1:24K	Panchromatic	1.0m	12m/5m
	(Mono or Stereo)	Multispectral	1.0m	15m/10m
	1:12K	Panchromatic	1.0m	10m/4m
	(Mono or Stereo)	Multispectral	4.0m	12m/5m

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OrbView ORTHO *Products*

- ***ORTHO 1:50K*** **Products**
  - Uses Medium Accuracy geopositioning model and DTED Level 1 or OrbView DEM 100m
- ***ORTHO 1:24K*** **Products**
  - Uses High Accuracy geopositioning model and DTED Level 2 or OrbView DEM 30m
- ***ORTHO 1:12K*** **Products**
  - Uses Very High Accuracy geopositioning model and OrbView DEM 10m

Product Name	Model / Configuration	Spectral Bands	Ground Sample Distance	Geolocation Accuracy (CE 90%)
Ortho	1:50K	Panchromatic	1.0m	25m
		Multispectral	4.0m	30m
	1:24K	Panchromatic	1.0m	12m
		Multispectral	4.0m	15m
	1:12K	Panchromatic	1.0m	6m
		Multispectral	4.0m	10m

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Description - OrbView GEO *Products*

- ***GEO EXPRESS*** **Products**
  - Image data is rectified and projected onto a horizontal reference plane
    - Corrects for earth rotation, earth curvature, panoramic effects, spacecraft position and attitude changes and sensor distortions
  - Data is Geo-corrected using a 900m post spacing elevation model
    - Terrain induced distortions are coarsely corrected
  - Coarse mosaic processing may be used for more than 1 source image. Uses tie points to minimize relative error

- ***GEO 1:50K*** **Products**
- ***GEO 1:24K*** **Products**
- ***GEO 1:12K*** **Products**

Products generated using geopositioning model. Limited applications - Available by special order only

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Part 2 – Formosat-2

Abstract

Successfully launched May 2004, FORMOSAT-2 is placed at an altitude of 890 km, on a circular, sun-synchronous and geo-synchronous orbit. FORMOSAT-2 proposes two resolutions, 2 meters in panchromatic mode and 8 meters in multi-spectral mode at Nadir. Swath is 24 kilometers.

FORMOSAT-2 is a new Earth Observation Satellite, owned by the NSPO (National Space Program Office) of Taiwan, built by Astrium (France) and launched May 20, 2004.

FORMOSAT-2 has a geosynchronous orbit: FORMOSAT-2 covers a whole number of revolutions per day (14 exactly), which means it passes over the same regions at least once a day. This characteristic of its orbit, coupled with the satellite's lateral off pointing capability, enables FORMOSAT-2 to acquire a daily image of any given site from the same viewing angle.

The FORMOSAT-2 orbit is also sun synchronous with each region of the globe being observed at the same local solar time. This means that images of a given region acquired on several, successive days have more or less the same illumination conditions which makes it easier to compare them.

The in-flight commissioning review for the satellite confirmed the excellent performance of the sensor, which thanks to its daily revisit capability, is able to meet the needs for surveillance and frequent monitoring of sites.

Since May 2005 a receiving station is installed at Kiruna, in Northern Europe thus reinforcing Taiwan's acquisition capability and enabling Spot Image to begin worldwide distribution of the data acquired.

The station is equipped with a terminal developed by EADS and guarantees homogeneous, high quality data according to standards defined by Spot Image.

This automatic terminal is handling all necessary operations needed for receiving, archiving and pre-processing images (levels 1A and 2A), thus achieving shortest possible lead and delivery times.

For more details: http://www.spotimage.fr

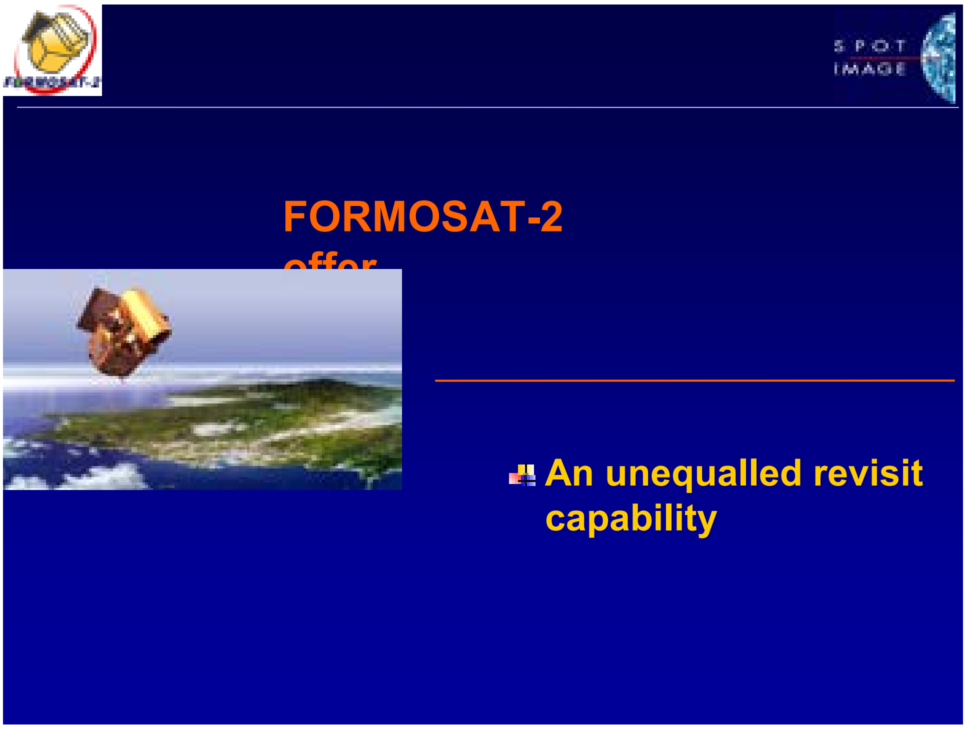

SPOT IMAGE
FORMOSAT-2
offer
An unequalled revisit capability


Table of contents
SPOT IMAGE
The Context
1. The FORMOSAT-2 system
a. The Satellite
b. Images
c. Imaging characteristics
d. Specific orbit
2. FORMOSAT-2 Offer
a. Competition overview
b. FORMOSAT-2 strengths
c. Offer benefits
d. Applications
e. The range
f. Standard offer
DC/MKG/Cco – Nov 2005
2

Context

- FORMOSAT-2 launched on May 20, 2004
- Instrument and bus designed and manufactured by Astrium
- NSPO has appointed Spot Image as exclusive worldwide* distributor

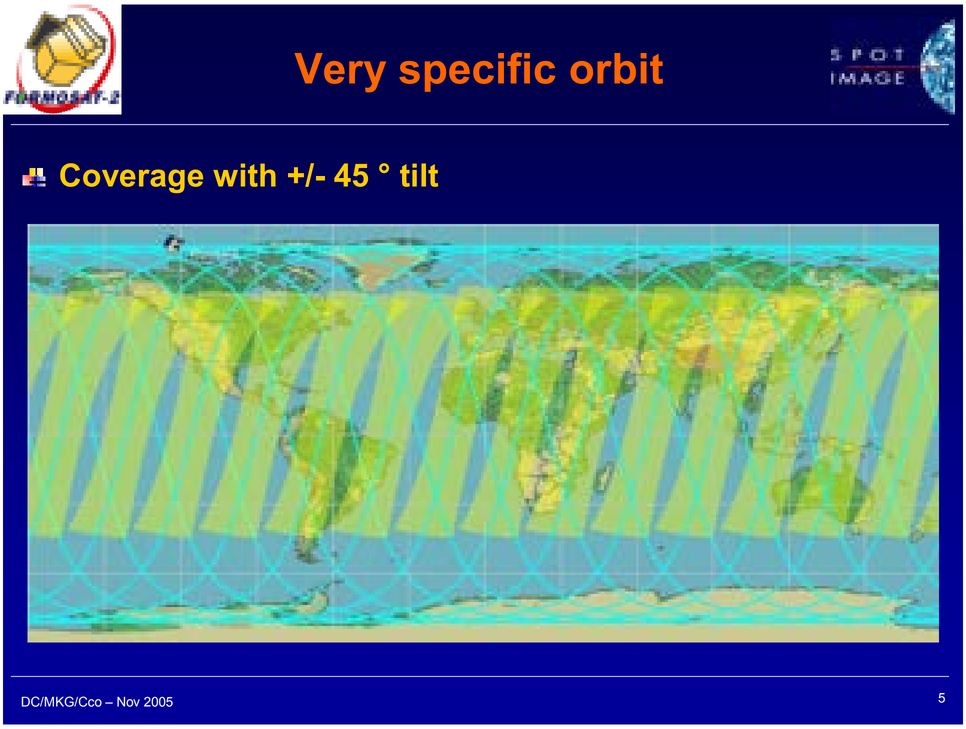
(*except for Taiwan & Mainland China)

DC/MKG/Cco – Nov 2005 3

The satellite

- FORMOSAT-2 imaging capabilities
  - 2-m pan / 8-m colour
  - Swath width @ NADIR: 24 km
  - 4 spectral bands (R.G.B., SWIR)
  - On board memory: 40 Gbit
  - High agility: stereo along the track and fast roll access
  - 8 minutes imaging per orbit
    - Only 2 mn for Taiwanese orbit and 4 mn for previous or next orbit
- FORMOSAT-2 special orbit
  - 891 km: sun-synchronous & geo-synchronous
  - Exactly 14 orbits/day
  - Daily revisit of accessible areas, always seen under the same roll angle
  - GSD & swath pre-determined
  - 9:30 am Local Time at descending node

DC/MKG/Cco – Nov 2005 4


FORMOSAT-2
Very specific orbit
SPOT IMAGE
Coverage with +/- 45 ° tilt
DC/MKG/Cco – Nov 2005
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FORMOSAT-2
Images
SPOT IMAGE
Kao Hsiung – Taiwan
2-m Pan
Mokpo Harbour – South Korea – 8-m MS
DC/MKG/Cco – Nov 2005
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