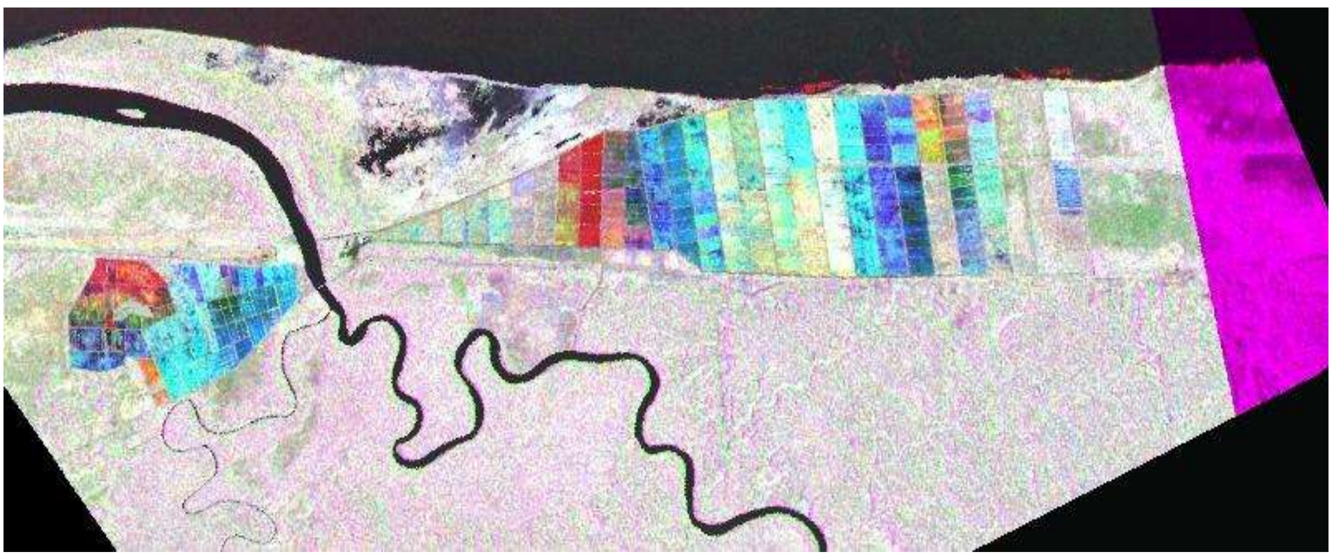
4th Conference on

Control with Remote Sensing of Area-based Subsidies

26-27 November 1998
Congress Centre LE ZITELLE
Venice, Italy

PROCEEDINGS



MARS Project - Monitoring Agriculture with Remote Sensing
ARIS UNIT - AGRICULTURE AND REGIONAL INFORMATION SYSTEMS

S.P.I.99.126

Space Applications Institute

Joint Research Centre
European Commission

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Foreword

For the 4th year in a row, the MARS project, supporting the DG VI and the National Administrations, organised this conference, which allowed us to make a technical review of the control campaign. This meeting was also an opportunity for all the users of this application to interact and exchange information: image providers, contractors from the various Member States, representatives from the National or Regional Administrations in charge of the IACS and controls, and representatives from different services of the Commission.

For the 4th time, we produce the present proceedings [1], which are the collection of the texts or overheads from the presentations. As in the past, this publication by the JRC does not entail any validation by the Commission. **Thus, information provided or the opinions expressed in the present documents are solely the responsibility of their authors.**

The conference in Venice, however, held particular significance due to an exceptional general context: the end of co-funding by the DG.VI of the Control with Remote Sensing, the transfer, from 1999 onwards, of technical support from the DG VI to JCR, and finally, the change of post of Michel Van de STEENE, who, since 1990- 91, has been the main architect behind the development of this activity and for its present success. In exceptional circumstances, an exceptional programme!

Thus, it had been decided to include a complete retrospective session on the development of the Control with Remote Sensing since 1990 (cf. Session 2). The corresponding presentations indeed allowed us to appreciate the long steps we have taken, but also testify to the historical conditions that made this development possible and fruitful.

The National Administrations had also been asked to provide for the conference, posters and examples of the various orthophotos or large scale maps they developed specifically for the identification of the parcel within their IACS. All have replied positively, but it is not possible to include this contribution into the present proceedings.

I would like however to thank them all here, and to highlightthe important participation and support of the Italian Administration which made this 4th conference successful.

Olivier Léo

[1] These proceedings can also be found on the Web: http://mars.aris.sai.jrc.it/Control/Meetings/Venezia98/

Avant-propos

Pour la 4eme année, le projet MARS a organisé, en support à la DG.VI et aux Administrations nationales, cette conférence, qui permet de faire un bilan technique de la campagne de contrôle passée. Cette réunion est aussi l'occasion d'échanges variés entre tous les acteurs de ce domaine: Fournisseurs d'images, contractants des différents Etats Membres, responsables des Administrations Nationales ou régionales en charge des SIGC et des contrôles, représentants de différents services de la Commission.

Pour la 4eme fois, nous publions[2] dans le présent document de « proceedings », l'ensemble des textes ou des transparents des différentes présentations. Comme par le passé, cette publication par le CCR ne signifie pas une quelconque validation par la Commission. **Aussi, les informations fournies comme les opinions exprimées dans le présent document n'engagent-ils que leur auteurs**.

La conférence de Venise a toutefois revêtu une importance toute particulière, du fait d'un contexte général exceptionnel: La fin des cofinancement par la DG.VI des contrôles par télédétection, le transfert à partir de 99, du support technique de la DG.VI au CCR, et, enfin, le changement d'affectation de Michel Van de STEENE, qui a été depuis 90- 91, l'artisan principal du développement de cette activité et de son succès actuel. A circonstances exceptionnelles, programme exceptionnel !

Il avait été ainsi décidé d'effectuer une rétrospective du développement des contrôles par télédétection depuis 1990 (cf. session 2). Les présentations correspondantes permettent en effet de mesurer l'ampleur du chemin parcouru, mais témoignent aussi des circonstances historiques qui ont permis ce développement fructueux.

Il avait également été demandé aux Administrations Nationales de fournir pour la conférence, des posters et des exemples des différentes orthophotos ou cartographies à grande échelle qu'ils ont développés spécifiquement pour les besoins de l'identification des parcelles au sein de leur SIGC. Toutes ont répondu présentes, mais il n'est pas possible d'inclure cette contribution dans le document présent.

Je tiens à les remercier toutes ici, avec une mention supplémentaire pour l'Administration Italienne, sa participation importante et son support qui ont permis le succès de cette 4eme conférence.

Olivier Léo

[2] Ces proccedings sont également disponibles sur le site Web: http://mars.aris.sai.jrc.it/Control/Meetings/Venezia98/

Programme

Thursday 26 November 1998

Session 1 — Summary of 1998 Campaign

09:30-10:45

Welcome and introduction • O. Léo, JRC

Statistics and results of Control with Remote Sensing in 1998 • M. Van de Steene, DG VI

Acquisition and delivery of satellite data in 1998 • G. Peroni, DG VI

Quality control in 1998 • J. Masson, JRC

10:45-11:15 Coffee break

Session 2 — Retrospective of IACS and Control with Remote Sensing

11:15-12:30

Historical review of IACS and Control with Remote Sensing • M. Jacquot

Review of present Land Parcel Identification Systems • J. Delincé, DG VI

Review of methodologies • O. Léo, JRC

12:30-14:00 Buffet lunch, “le Zitelle”

Session 3 — Optical Data: Acquisition and Use

14:00-15:45

Introduction • G. Peroni, DG VI

Programming of SPOT satellites • O. Virenque, SPOT Image (FR)

Advantages of incorporating middle-infrared data into image analysis • M. Hassani, GeoRas (NL)

Test of CASI scanner in the Verona Province • U. Minelli, CCIA (IT)

Earth observation satellites in the years 2000: the future in high resolution • V. Beruti, ESA-ESRIN (IT)

15:45-16:15 Coffee break

Session 4 — Use of SAR Data

16:15-18:00

Introduction: Summary of 1998 SAR results & new cases (rice in Guyana) • G. Lemoine, JRC

Fusion techniques for hybrid optical and SAR data • J. Jansa, TU Wien (OE)

Complementary use of RADARSAT and optical data: methodology • R. Kidd, JRC

Use of RADARSAT data: radiometric and geometric issues • A. Sowter, NRSC (UK)

18:00-19:00 Poster session and software demonstrations

Friday 27 November 1998

Session 5 — Geometric Accuracy

09:00-10:15

Introduction • P. Åstrand, JRC

Accuracy requirements and quality assurance of ortho-image production • S. Kay, JRC

Quality checking of geometrically corrected remote sensing imagery • M. Stuttard, RSAC (UK)

Quality control by FGI in the Finnish Land Parcel Identification System • H. Kaartinen, FGI (FI)

10:15-10:45 Coffee break

Session 6 — Optimisation of the Control

10:45-12:30

Introduction • T. Tollefsen, JRC

Optimum strategies for using cadastral data in Germany • H. Rüsseler, M. Agr. Hessen (DE)

IACS and remote sensing: the Belgian example • B. Van Pee, M. Agr. - CTS (BE)

Integration of CAPI and rapid field visits by Regional Administrations • A. Brugnera, ONIC Lyon (FR)

Remote-sensing control in Spain: evolution from 1993 to 1998 • M. A. Galiano, Tragsatec (ES)

Use of pen computer, GPS and digital camera during field visits • F. Steidl, CCIA (IT)

12:30-14:00 Buffet lunch, “le Zitelle”

Session 7 — Other Applications

14:00-15:00

Introduction • M. Van de Steene, DG VI

Use of remote sensing for control of ponds in Germany • J. Hies, M. Agr. Sachsen & R. Stein, EFTAS (DE)

Monitoring the British potato crop • Z. Stott, Logica (UK)

15:00-15:30 Coffee break

Session 8 — Views of National Administrations and Round Table

15:30-17:30

Introduction • O. Léo, JRC

Use and experience of Remote Sensing in Austria in 1998 • W. Fahrner, BMLF (OE)

Use of Control with Remote Sensing in Greece • A. Panayotopoulos, M. Agr. (EL)

Use of Control with Remote Sensing in Denmark • P. V. Andersen, M. Agr. (DK)

Review of six years of Control and future requests • C. Lo Conte, AIMA (IT)

Conclusions

Space Applications Institute

4eme Conférence

Contrôles par Télédétection

Venezia, 26- 27 novembre 1998

Introduction

- Contexte et objectif de la conférence
- Le Programme
- Les participants
- Informations Pratiques

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4eme Conférence • Contrôle par Télédétection
Venezia • 26- 27 Novembre 1998

Contexte et objectif de la conférence

- **En 1998: fin des cofinancements**
  - A partir de 99: la Commission ne financera que les achats d 'images satellite
    - 10-15% des coûts des sites TLD
    - 0% des sites avec photographies aériennes...
- **Transfert du support technique de la DG VI au CCR**
  - Regroupement des activités au sein du Projet MARS (ARIS-CCR)
    - d 'Achats/ fournitures d 'images,
    - support technique,
    - évaluation et contrôle de qualité.
  - mise en place d 'une équipe technique de 5 personnes.

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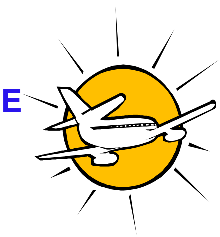
4eme conférence • Contrôle par Télédétection
Venezia • 26-27 Novembre 1998

Contexte et objectif de la conférence

- Responsabilité accrue et plus claire des Etats membres
  - Télédétection: Contrôles sur place à part entière
- Déjà trois conférences à BAVENO: 95,96, 97…
  - Intérêt de marquer un peu la rupture...
- Depuis 93-4, plus de 4-5 années de contrôles opérationnels
  - Occasion de faire un bilan général.
- Départ de Michel Van de STEENE
  - vers d 'autres cieux...



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4eme conférence • Contrôle par Télédétection
Venezia • 26-27 Novembre 1998

Contexte et objectif de la conférence

- en 98: VENEZIA
  - Marque un tournant important /rupture
  - tout en assurant la continuité
- Dans le futur:
  - Poursuite des activités techniques de la Commission:
    - Acquisition des données satellitales;
    - Méthodologies et A Offre communs;
    - Recherche et développement;
    - Evaluation et contrôle de qualité;
  - En <u>support aux Administrations nationales</u>
  - en relation avec la DG VI A1-3
    - aspects réglementaires.

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4ème conférence • Contrôle par Télédétection
Venezia • 26- 27 Novembre 1998

Le Transfert du support technique au CCR

Mise en place d 'une équipe de 5 personnes

Coordonnée par TORE TOLLEFSEN/supervision O.LEO
Josiane MASSON: Contrôle de Qualité...
Guido PERONI: Acquisition d 'images...
G LEMOINE: R & Développement, SAR...
Par AASTRAND: Correct. géométriques,T.H résolution ...

Autres et Post-doctorat: R&D ...

Secteur MARS / Unité ARIS

Institut des Applications Spatiales

D.G. C.C.R.

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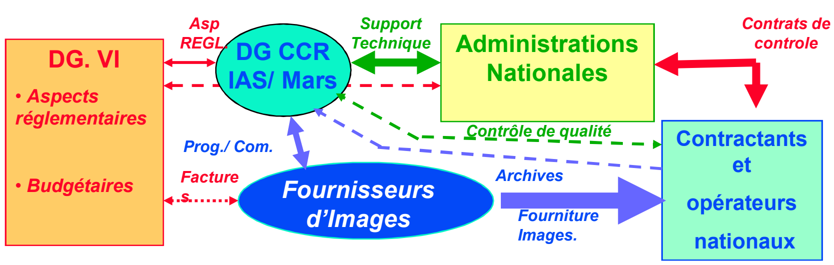
4ème conférence • Contrôle par Télédétection
Venezia • 26- 27 Novembre 1998

Le Transfert du support technique au CCR

Continuité pendant la phase de Transition

- Août 98-janvier 99: coordination avec la DG VI
  - Cahier des charges et accord DG VI- DG CCR
  - information des Etats membres
  - Courrier sélection des sites 99
  - Appel d 'Offre commun, Spécifications communes...
- Préparation des sites,acquisition des images.



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Venezia • 26- 27 Novembre 1998

Le Transfert du support technique au CCR

- **Orientations futures du support**
  - Renforcer échanges bilatéraux (Adm.nationales)
    - adapter les activités en fonction des demandes
    - Accueil au CCR des experts nationaux détachés?
  - Maintenir le niveau Européen:
    - Echanges, transparence, cohérence.
  - Réunions Administrations:
    - Coordonnées avec les Comités SIGC
    - coordonnées avec la DG VI A1-3.
  - Echanges techniques
    - séminaires, Eurocourses (Administrations seules)
- **Conférences finales? OUI**
    - ISPRA /BAVENO...
    - Ou hébergées par un EM différent? *Participation régionale*

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Venezia • 26- 27 Novembre 1998

Introduction: Le programme

- **Conférence: 8 sessions,** accent sur
    - les données optiques et SAR
    - intégration avec SIGC-contrôles classiques
    - point de vue des Administrations nationales
  - une session 2: Rétrospective, élargie
    - aux 6 années passées;
    - au Système d 'information Parcellaire et au SIGC.
  - Une session 6: Contrôles de mesures particulières
    - Pomme de Terre (UK), Lacs et étangs (D)
- **Critères de sélection**
  - Priorité aux nouveaux contractants,
  - aux sujets d 'intérêt européens.
  - Essayer de garder un équilibre entre présentations.

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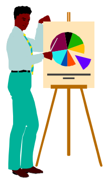
Venezia • 26- 27 Novembre 1998

Introduction: Le programme



- 28 présentations:
  - DG VI+CCR: 8
  - ITA, UK: 3 + 3
  - O, D:2
  - B, DK, ESP, FIN, FR, GR, NL, : 1
  - Autres: 3
- Session Poster & démonstration de logiciels
  - Peu de logiciels de Contrôles /PIAO
  - Une récapitulation des LPIS spécifiques (illustration de la session 2).
  - Présentation du SIGC Italien
  - Voir aussi, Stand Space-Imaging...

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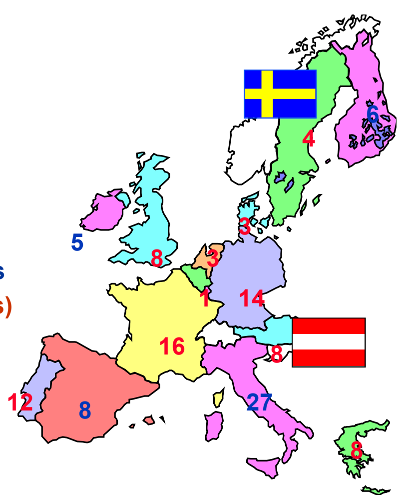
Venezia • 26- 27 Novembre 1998

Introduction: Les participants

- ±140 participants (98)
  - 148 (95), 115 (96), 126 (97)
- de 14 Etats membres
  - Autriche (98)
  - Suède (reprend en 99)
- 31 sociétés de service
  - + 10 fournisseurs d'images (satellitales ou aériennes)
- Statistiques:
  - cf carte.
  - COM: 14 dont
    - 2 Représentants DG XX
    - 1 Représentants DG VI A1-3



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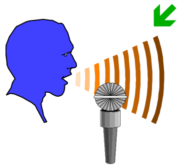
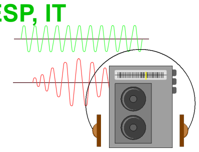
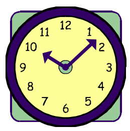
Venezia • 26-27 Novembre 1998

Introduction: Informations Pratiques



- **Interprétation**
  - **5 Langues parlées: ENG, FR, D, ESP, IT**
  - **3 Langues écoutées: ENG, FR, D.**





- **Respectons les Horaires...**
- **Présentations et pauses Café**

- ***SVP, pas de téléphones cellulaires!***

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4ème Conférence • Contrôle par Télédétection
Venezia • 26-27 Novembre 1998

Introduction: Informations Pratiques

- **Remboursements (Administrations nationales et certains conférenciers)**
  - **Voir Secrétariat MARS: Nadine SCHMIT**
    - **formulaires,**
    - **Photocopies des billets et carte accès à bord.**

- **Vérifier aussi vos coordonnées**
  (sur la liste des participants)
  - **Voir Relations Publiques du CCR:**
  Giuseppina CARABELLO
- **Problèmes de voyages ?**
  - **Voir hôtel ou agences voyage.**

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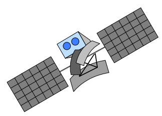
Venezia • 26-27 Novembre 1998

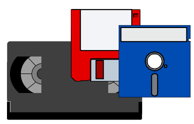
Introduction: Informations Pratiques

- **Retour des Données satellite**

Pour les archives du CCR:



- Emilie SCHEFFER n 'a pas pu participer à la conférence.
- Si vous avez apporté des données, remettez les à Nadine SCHMIT
  - qui signera un reçu
- Ou renvoyez les /post-express à E. SCHEFFER.



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DIRECTION GÉNÉRALE VI AGRICULTURE

Remote sensing controls, 1998
General overview, summary statistics and results

Venezia, 26-27.11.98

Michel VAN DE STEENE,
Commission Européenne,
Direction Générale de l'Agriculture
Bruxelles

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DIRECTION GÉNÉRALE VI AGRICULTURE

Contracts

- Technical Specifications available on the 17.11.97.
  ITT published on the 22.11.97, closed on 15.1.98.
  9 MS participating, including AT (BE eventually withdrew).
- IT, SP, UK and some DE Länder: long term contracts.
- DK + BE: in-house contracts.
- 19 contracts granted in 13 MS (i.e. 2 contracts in DE, EL, ES, FR, 3 in PO).
- 5 newcomers : Umweltdata (AT), Belgian and French Administrations, Elliniki Photogrammetriki (EL) and Estereofoto (PO).

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Special projects

- monitoring of rice in Guyana;
- agri-environmental checks (FR + UK);
- volume increases in IT, FIN and AT
- larger sites in Portugal.

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Methods

- Decision rules included in the Specs; 'Recommendations Part 3' discussed with the Administrations in November 97. Option still open to categorise at the parcel or group level.
- Final version of the 'Recommendations' circulated in March (1, 2 & 3) or April (4) 1998.
- RADARSAT offered to all "Northern" contractors (1 site), and SPOT 4 (launched in March) available to all, except BE and UK.

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Progress and timetable

- Preparatory meeting with all Administrations : Brussels, 24 March.
- EUROCOURSE (Administrations), Toulouse, April.
- Commission interim visits to 7 MS (June - September): AT, BE, DE, EL, FR, IT, PO.
- Full-scale Quality Control activity. Contract extended with Hunting TS, supervised by JRC.
- All summary tables and 18 final reports received to date (out of 19); missing: IT.
- Final meeting with Administrations Brussels 9-10 November.

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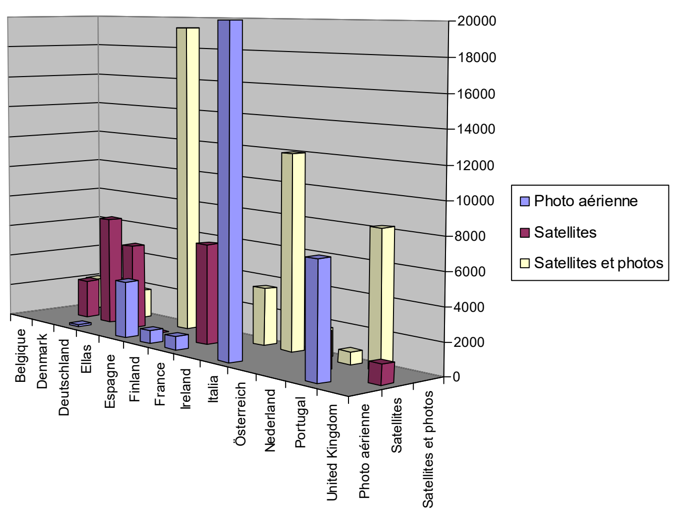
Répartition des contrôles par types



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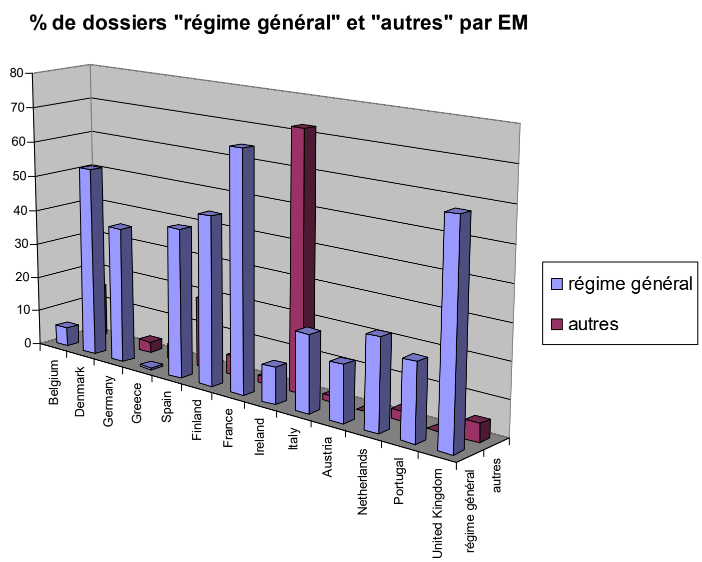

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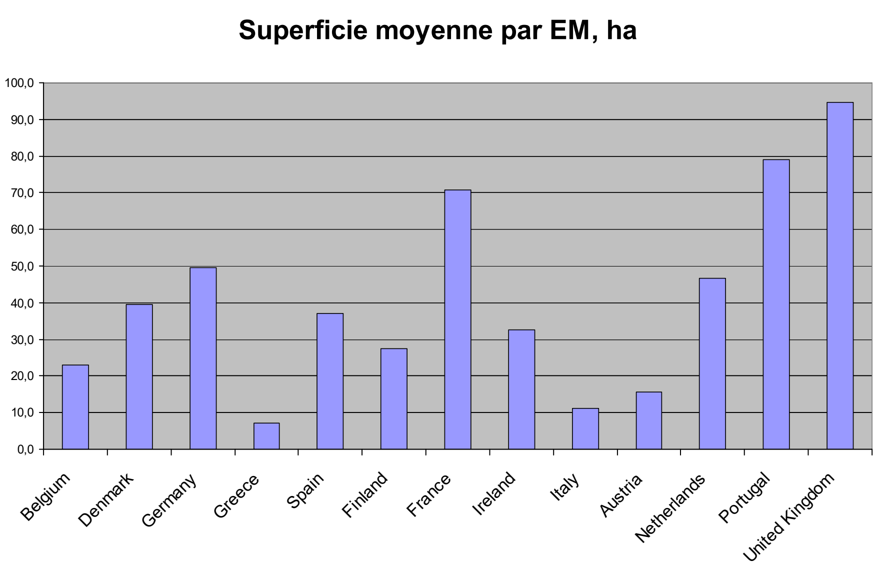

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Coût des contrôles par années

	Nombre dossiers	Nombre parcelles	Superficie, hectares	Prix contrats et images	ECU/ dossier	ECU/ parcelle	ECU/ hectare
Total UE parc. subsidiées	248.529	2.459.185	4.357.215	29.232.619	117,62	11,89	6,71
Rappel coût 1997 (subsid.)	223.529	2.040.043	3.631.525	24.341.842	108,90	11,93	6,70
Rappel coût 1996 (subsid.)	119.790	1.145.226	2.880.274	19.399.465	161,95	16,94	6,74
Rappel coût 1995 (subsid.)	100.198	994.032	2.660.417	14.641.474	146,13	14,73	5,50
Rappel coût 1994 (déclar.)	69.695	758.361	1.785.227	11.245.285	161,40	14,83	6,30
Rappel coût 1993 (déclar.)	34.674	331.567	937.055	8.866.351	255,70	26,74	9,46

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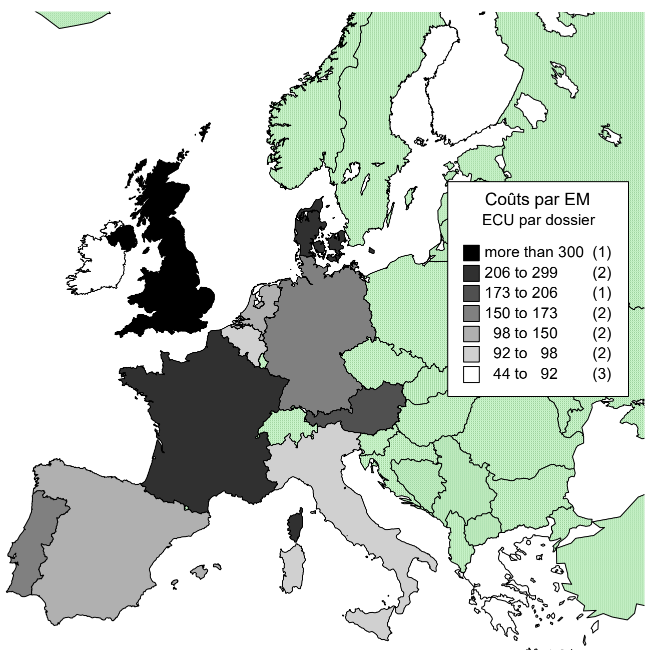

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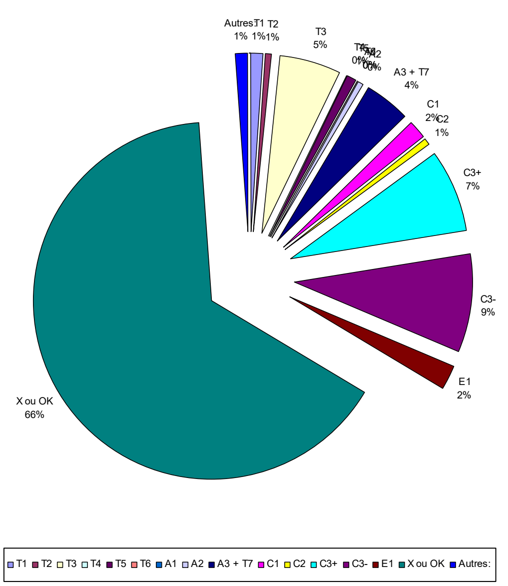
Superficies par codes, %



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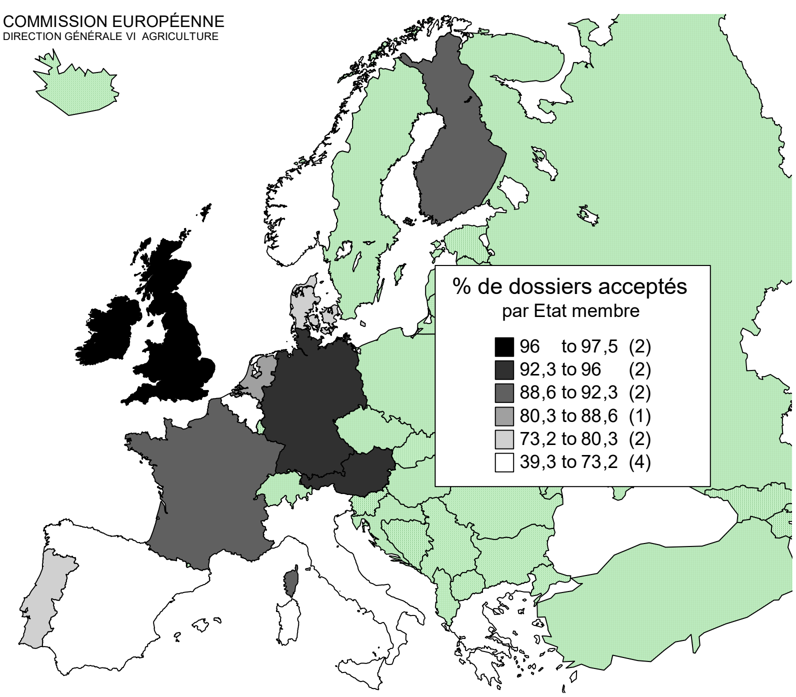

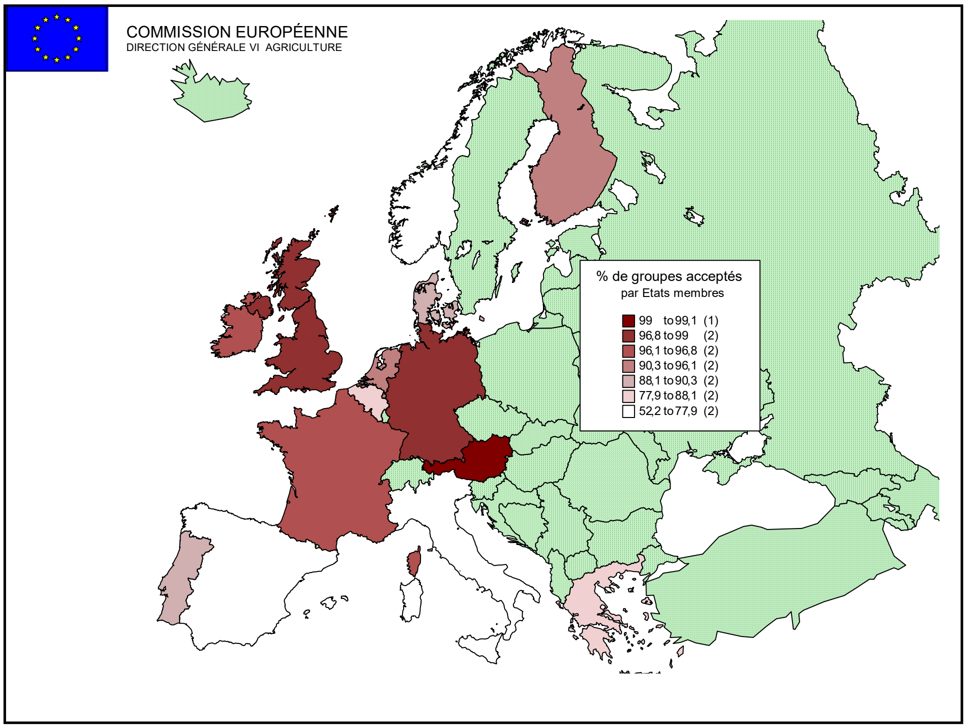
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% de groupes acceptés
par Etats membres
99 to 99,1 (1)
96,8 to 99 (2)
96,1 to 96,8 (2)
90,3 to 96,1 (2)
88,1 to 90,3 (2)
77,9 to 88,1 (2)
52,2 to 77,9 (2)

Acquisition and delivery of satellite data in 1998

by **Guido Peroni**

Venezia, 26-27 November 1998

Principal topics of the presentation:

- Some *statistical results*
- Major *problems* encountered during the campaign

Some statistics

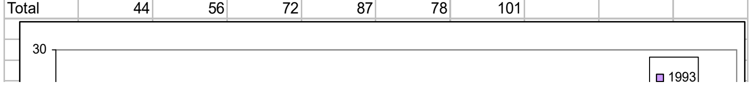
725 satellite images have been ordered and delivered

- **To: 17 contractors (in 13 MS)**
- **Period: 25 November 1997 - 14 September 1998**
- **Sites: 101**
- **Cost: 1,592,929 ECU**

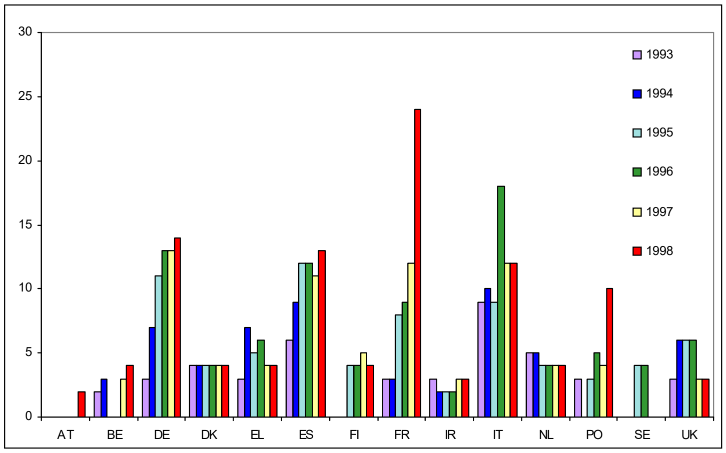
Total number of sites controlled with satellite imagery during the period 1993-98:

Number of FEOGA Sites Controlled by Satellite

EM	1993	1994	1995	1996	1997	1998
AT						2
BE	2	3	0	0	3	4
DE	3	7	11	13	13	14
DK	4	4	4	4	4	4
EL	3	7	5	6	4	4
ES	6	9	12	12	11	13
FI	0	0	4	4	5	4
FR	3	3	8	9	12	24
IR	3	2	2	2	3	3
IT	9	10	9	18	12	12
NL	5	5	4	4	4	4
PO	3	0	3	5	4	10
SE	0	0	4	4	0	0
UK	3	6	6	6	3	3
Total	44	56	72	87	78	101

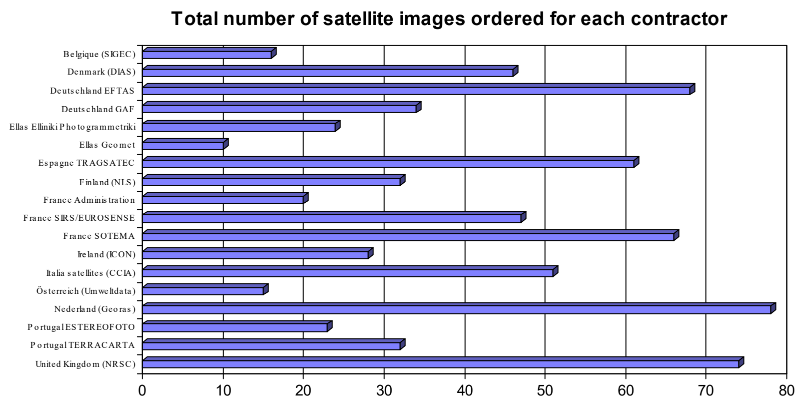


Number of sites controlled with satellite imagery in the MS during the period 1993-98:



Compared results of the 1998 and 1997 campaigns

	1998		*1997*		Δ
No. of sites	101		*78*		+30%
Tot. acquisitions	725		*594*		+22%
Optical images	578	80%	*479*	*81%*	+21%
Radar images	147	20%	*115*	*19%*	+28%



Optical images (tot: 578)

- **Acquired *during the campaign* (*) : 442 (76%)**
  - » **374 *multispectral* (over 100 sites in 13 MS), avg. 3.74/site**
  - » **68 *panchromatic* (over 66 sites in 10 MS), avg. 1.03/site**
- ***Archive* data (over 18 sites in 9 MS): 136 (24%)**

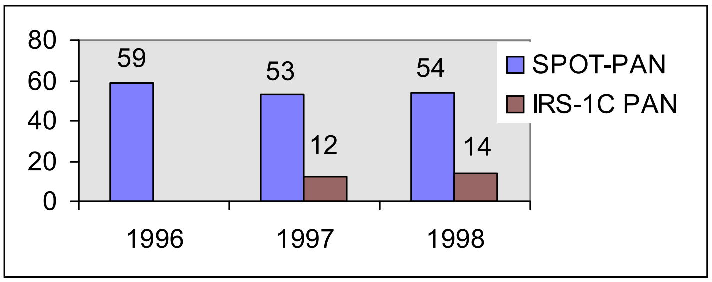
(*) Sept. 1997-Sept. 1998

68 *Panchromatic* images:

SPOT PAN: 54 (79%) 53 in 1997 (82%)

IRS-1C PAN: 14 (21%) 12 in 1997 (18%)

4 IRS PAN scenes were acquired during Autumn 1997.



Panchromatic imagery *acquired* over 66 sites
***Required* over 79 sites**

In 13 sites the PAN window closed without acquisition:

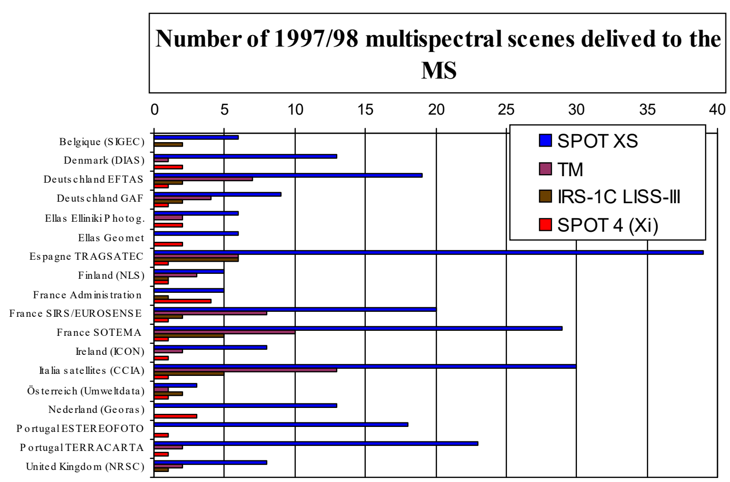
FI (4/4), IR (3/3), BE (2/3), FR (3/20), DE (1/12).

***Rate of success for PAN imagery required*: 84%**

Multispectral imagery acquired during the campaign: 374 images in total (293 in 1997): +28%

- **SPOT XS + XI: 284 (76 %), 231 in 1997 (73%) (+3%)**
- **Landsat TM: 61 (16 %), 47 in 1997 (16%) (+0%)**
- **IRS-1C LISS-III: 29 (8 %), 33 in 1997 (11%) (-3%)**

- **24 SPOT XI (SPOT 4) images have been acquired (since 13 May 1998).**



Multispectral scenes *not* acquired:

» **Period 1 (March-April): none**

» **Period 2 (May-June): 18**

MS affected: BE (3/3), FI (2/4), IR (1/3), UK (1/3), FR (6/20), DE (4/14), NL (1/4).

» **Period 3 (July-August): 10**

MS affected: FI (3/4), DE (5/9), BE (1/3), IR (1/3).

***Rate of success for multispectral imagery required*: 93%**

- **XI** not acq.: **4. Affected: BE, FI, IR, UK.** Late acquisition in **DE** (20/7 and 10/8)

Archive optical imagery

	1998 no.	1998 %	1997 no.	1997 %	Δ
Landsat TM	105	77	92	76	+1%
Spot XS	25	18	29	24	-6%
IRS-1C	6	5	0	0	+5%
Total	136	100	121	100	(+12%)

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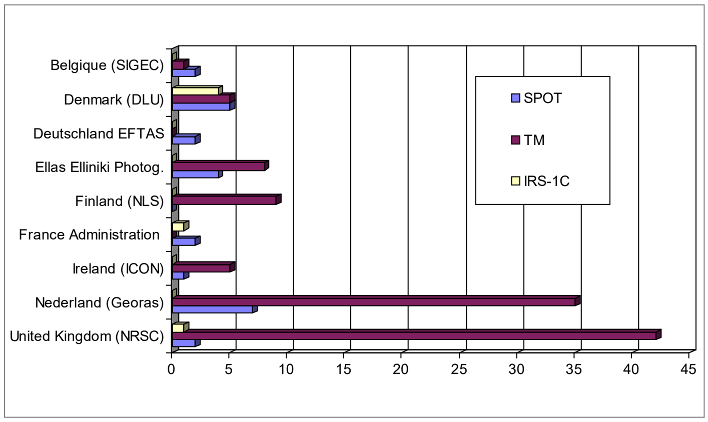
Archive imagery delivered to some MS for historical checks



4th. Conference on **Control with Remote Sensing of Area-based Subsidies** Venezia, 26-27 November 1998

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Radar images

Ordered and acquired only for 'risky' sites (latitude => 50°)

	1998 images	**1998 sites**	1997 images	1997 sites
ERS	**106**	**31**	111	32
Radarsat	**41**	**12**	4	1(test)
Total	**147**	**43**	115	33

Only 4 *preferred* dates (2 for each sensor) have *not* been acquired: replaced by alternative dates.

Rate of success for acquiring *first choice* SAR data is 97%

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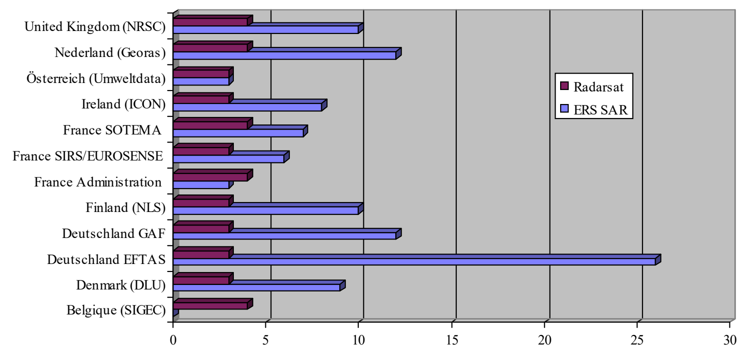
Number of radar images delivered to some MS



Delays in the delivery of *optical* data

(from ordering to delivery date, in *calendar* days):

SPOT: avg. **2.42** days

Out of a total of 338: 1 scene > 15 days

(after 1 June: 0 scenes > 7 days)

IRS-1C: avg. **2.89** days

Out of a total of 43: 0 scenes > 15 days

(after 1 June: 0 scenes > 7 days)

Landsat: avg. **5.12** days

Out of a total of 61: 1 scene > 15 days

(after 1 June: 0 scenes > 7 days)

Delays in the delivery of *radar* data

from acquisition (or ordering) to delivery, in *calendar* days:

ERS (total 106): avg. 6.64 days
11 scenes > 15 days

Radarsat (total 41) : avg. 9.63 days (*)
3 scene > 15 days

(*) When West Freugh (ground reception station in Scotland) will reach full calibration capability (1999?), it will no longer be necessary to ship the Radarsat raw data to Gatineau (Canada) for processing to path image (level 1) before delivering them to the contractor.

Problems encountered during the campaign

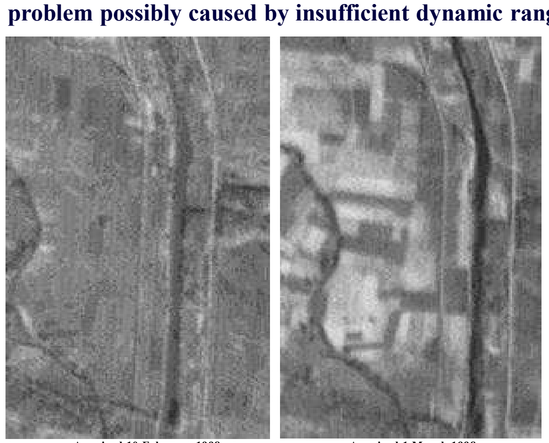
I) general problems

- **Scene (partly) misplaced in relation to site position:** 9 cases (UK, NL, EL, ES). 7 TM mini scenes were replaced by quad scenes (UK, NL, ES)
- **Product (CD-ROM) delivered not correctly readable:** 8 cases (DE, FI, DK, PO, UK). In two cases the problem was not confirmed by the image provider.
- **Product sent to wrong contractor:** 3 cases (ES, FR, PO).
- **General difficulty in the planning and co-ordination of acquisition windows' opening dates.**
- **Polygon sites in Portugal**

II) problems specifically related to the sensor/satellite

- **Ordered data regarded as not producible by the image provider after internal quality checks: 26 cases (mainly TM archive data). Affected: UK, NL, EL, BE. In 6 cases NL nevertheless accepted the scenes (artifacts caused by glass-houses response which saturated the detectors).**
- **SWIR faults: IRS-1C (serious in 5 cases: ES, FR, IT) and SPOT 4 (negligible)**
- **Super Structure format (IRS-1C data): one contractor (FR)**
- **Dynamic range of radiometric values (IRS-1C-PAN): one case (EL)**

Example of problem possibly caused by insufficient dynamic range (radiometric values)



Acquired 10 February 1998 Acquired 1 March 1998

Extracts from two IRS-1C PAN over Greece. The full scene acquired on 10 February shows the presence of snow in nearby montains.

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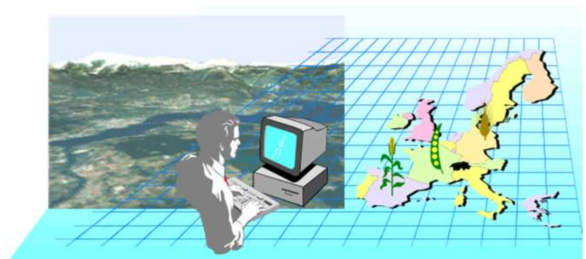
4th Conference on Control with Remote Sensing of Area-based Subsidies

Session 1 - Summary of the 1998 Campaign

1998 Quality Control

by Josiane Masson, JRC



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1. OBJECTIVES OF QC

- The main objective of the Quality Control is to assess the work of the contractor by applying specific, repeatable measurements.
- Specific objectives are:
  - ⇨ **Evaluation of work carried out and performance achieved by the contractor;**
  - ⇨ **Assessment of specific results attained;**
  - ⇨ **Appraisal of the observations made by the contractor.**
- Not included are checks of:
  - the declaration system and the Integrated Administrative Control System (IACS);
  - the ground checks performed by the National Administrations.

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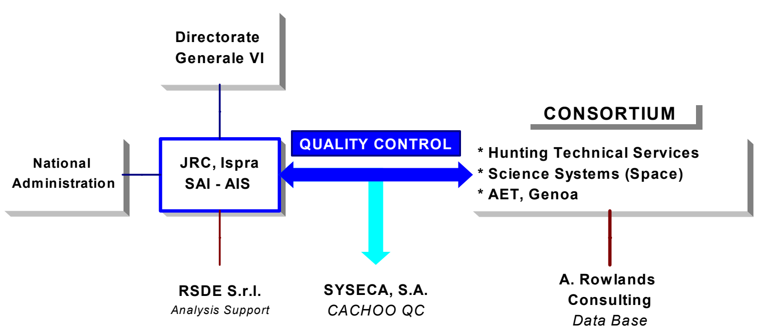
2. Organisation of the quality control

- As in previous years, the project is carried out by the Joint Research Centre, Ispra, in close co-operation with a consortium of companies lead by Hunting Technical Services, Ltd.



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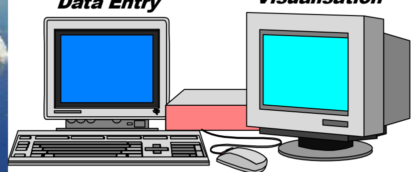
QC SYSTEM

INTERPRETATION

- Data Import (Exabyte)
- Vector Conversion
- Image Conversion
- Interpretation

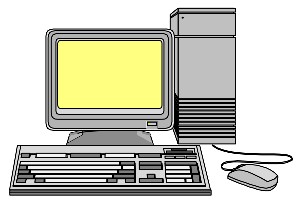
Data Entry *Visualisation*



SUN SPARC 10
CACHOO QC
ARC/Info
Oracle
Erdas Imagine

DATA BASE

- Data Import (CD)
- Alpha-Numeric Conversior
- Data Base Analysis
- Interpretation (NT)



PC Pentium
Windows NT 4.0
Word, Excel, Access
1st Stage System
CACHOO QC

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PHOTO-INTERPRETATION INTERFACE

ALPHA-NUM.
DATA BASE

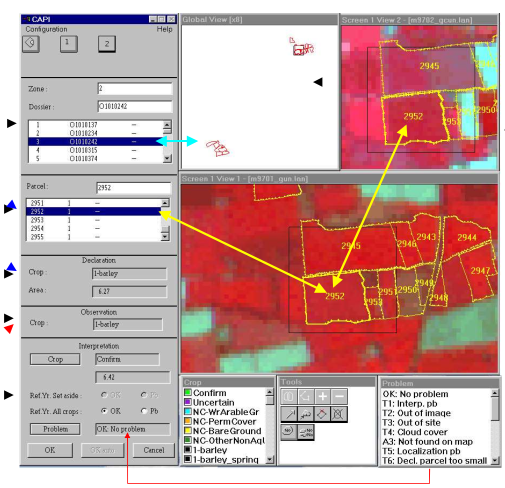
DOSSIER

PARCEL

DECLARATION

OBSERVATION

INTERPRET.
RESULT



LOCATION
OCCUPATIC

VECTOR
DATA

IMAGE
DATA

PROBLEM
CODES

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3. LIST OF 1998 QC SITES

	Member state / Contractor	1998 QC site
1	BE / Ministère Agriculture	HASS
2	D / EFTAS	LAXT
3	D / GAF	BLAU
4	DK / DLU	BORN
5	ESP / TRAGSATEC	CHIN
6	ESP / DAP	MALAGA
7	FIN / NLS	LOIM
8	FR / SIRS	ZONE 17 POIX
9	FR / SOTEMA	SITE 9 BUNO
10	GR / GEOMET	LAKT
11	GR / HELLINIKI	PYRG
12	IT / CCIA	PADO
13	IRL / ICON GROUP	LAOI
14	NL / GEORAS	ZONE 1 MAAS
15	O / UMWELTDATA	LINZ
16	P / TERRACARTA	ERVI – Mono, Evor Fera e Beja SITE 3
17	P / GEOMETRAL	TORR – Mono e Evor
18	P / ESTEREOPHOTO	LEIC
19	UK / NRSC	

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CRITERIA FOR SELECTING THE QC SITES

10 CONTRACTORS HAVE BEEN SELECTED FROM THE ABOVE LIST OF 19 → CONFIDENTIAL

PRIORITY ORDER 1:

- NEW CONTRACTORS
- NOT YET CONTROLLED IN 1996 AND 1997

PRIORITY ORDER 2:

- NOT CONTROLLED IN 1997 OR
- DIFFICULT CASES OR LARGE VOLUME OF DATA

PRIORITY ORDER 3:

- SUPPORT SPECIFICALLY REQUIRED BY THE ADMINISTRATION THE FOR IMPROVING THE QUALITY AND THE METHODOLOGY -> E.G. BELGIUM

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4. QUALITY CONTROL TASKS

- LOAD THE DATA
- CHECK THE FORMAT
- VERIFY CONTRACTUAL VOLUMES

All QC SITES

CONTROL OF ALPHANUMERIC DATABASE

- CHECK DUPLICATES
- CHECK CONSISTENCY AT PARCEL, GROUP, DOSSIER LEVELS
- CROSS-CHECK VECTOR AND ALPHA-NUMERIC DATA
- CHECK DIAGNOSTIC

10 QC SITES
FULL SITE

CONTROL BY CAPI

- CONTROL PARCEL BOUNDARIES
- CONTROL OBSERVED CROPS
- CONTROL TECHNICAL PROBLEMS AND ANOMALY CODES

10 QC SITES
SUBSAMPLE
1,000 PARCELS

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5. PROGRESS STATUS
5.1. QC DATA DELIVERY

- DEADLINE FOR DATA DELIVERY: 25TH SEPTEMBER

- A MAJORITY OF CONTRACTORS SENT THEIR DATA ON TIME (BEFORE 1ST OCTOBER)
  - GAF, DLU, TRAGSATEC, SIRS, SOTEMA, GEOMET, ELLINIKI, GEORAS, NRSC, *EFTAS (1ST PART)*

- 5 CONTRACTORS HAD SOME DELAY (1ST TO 16TH OCTOBER)
  - MIN. AGRI BELG, DAP, NLS, CCIA, ICON, UMWELTDATA

- 4 CONTRACTORS HAD A LOT OF DELAY (UP TO 20/11)
  - GEOMETRAL, TERRACARTA, ESTEREOFOTO, EFTAS (FOR ALPHANUMERIC DATA)

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5. PROGRESS STATUS
5.2. PLANNING FOR QC TASKS

- **PROGRESS STATUS FOR CONTRACTORS WITH FULL QC**

1998 QC - PROGRESS STATUS ON 26TH NOVEMBER

CONTRACTOR	LOADING THE DATA	DATABASE CHECKS	CAPI	QC REPORT
1	DONE	DONE	DONE	IN PROGRESS
2	IN PROGRESS (PROBLEMS WITH VECTOR DATABASE)	IN PROGRESS		
3	DONE	DONE	DONE (PROBLEMS WITH LARGE UNSUBDIVIDED PARCELS	VALIDATION STAGE
4	IN PROGRESS			
5	DONE	DONE	DONE	VALIDATION STAGE
6	DONE	DONE	DONE	DELIVERED 26/11/98
7	IN PROGRESS			
8	DONE	DONE	DONE	VALIDATION STAGE
9	IN PROGRESS (PROBLEMS WITH VECTOR DATABASE)	DONE	IN PROGRESS	
10	IN PROGRESS (PROBLEMS WITH FORMAT OF ALPHANUMERIC FILES AND VECTORS)			
11	*IN PROGRESS (PROBLEMS WITH FORMAT OF ALPHANUMERIC FILES AND IMAGES)*			

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PLANNING FOR DELIVERY OF QC REPORTS

1998 QC - REVISED PLANNING FOR QC REPORT DELIVERY

CONTRACTOR	STATUS OF QC REPORT	DELIVERY OF QC REPORT
1	IN PROGRESS	08-Jan-98
2		25-Jan-98
3	VALIDATION STAGE	17-Dec-98
4		05-Feb-98
5	VALIDATION STAGE	03-Dec-98
6	DELIVERED 26/11/98	26-Nov-98
7		30-Jan-98
8	VALIDATION STAGE	10-Dec-98
9		18-Jan-98
10		10-Feb-98
11		*TO BE CONFIRMED*

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5.2. PLANNING FOR QC TASKS (continue)

- FOR OTHER CONTRACTORS
  - LOADING AND CHECKING THE CONFORMITY OF QC DATA IN PROGRESS
  - REPORT ON CONFORMITY CHECKS WILL BE DELIVERED TO THE NATIONAL ADMINISTRATION FROM MID-DECEMBER TO END-JANUARY

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6. PROBLEMS ENCOUNTERED SO FAR

- MOST PROBLEMS WITH QC DATA FORMAT ARE DUE TO THE CONSTRAINTS OF CACHOO SOFTWARE: RESTRICTED NUMBER OF FORMATS SUPPORTED, PREPARATION REQUIRED FOR LOADING THE DATA …
- TO DATE THE PROCEDURES HAVE NOT BEEN ADAPTED FOR MULTI-LINKS BETWEEN ALPHANUMERIC AND VECTOR FILES (E.G. LARGE CADASTRAL PARCELS DECLARED BY SEVERAL FARMERS AND NOT SUBDIVIDED BY THE CONTRACTOR)
- SOME EXAMPLES OF PROBLEMS SO FAR:
  - GAF: PROBLEMS WITH UNSUBDIVIDED LARGE CADASTRAL PARCELS
  - EFTAS: SAME, BUT TREATED AS POINTS BY THE CONTRACTOR WITHOUT CADASTRAL LAYER SUPPLY
  - UMWELTDATA: CONFUSION IN VECTOR COVERAGE
  - ESTEREOFOTO, GEOMETRAL: PROBLEMS WITH DATA FORMAT

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7. Presentation of QC report contents

- **QC REPORTS BREAKDOWN IN THREE PARTS:**
  - **SUMMARY HIGHLIGHTING THE MAJOR ISSUES AND RECOMMENDATIONS**
  - **CORE OF REPORT, WITH RESULTS AND ANALYSIS FOR EACH TYPE OF CHECK**
  - **ANNEXES WITH DETAILS OF PROBLEMS ENCOUNTERED AT DOSSIER, GROUP OR PARCEL LEVEL**
- **ON THE BASIS OF THIS REPORT, THE JRC PROPOSE TO:**
  - ORGANISE A MEETING WITH THE CONTRACTOR, POSSIBLY WITH THE JRC IN ISPRA, TO DISCUSS THE PROBLEMS
  - ORGANISE A MEETING IN ISPRA WITH THE NATIONAL ADMINISTRATION TO EXPLAIN THE QC METHODOLOGY AND DISCUSS POSSIBLE IMPROVEMENTS FOR THE FUTURE

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EXAMPLE OF SUMMARY TABLE

SUMMARY OF CHECKS PERFORMED

	Description of QC criteria	Summary of problems encountered		Details found in the report (Section heading)
WORK AND PERFORMANCE ASSESSMENT	**Dates of delivery of QC data**	None	☺	§ 3.1
	Data format	None	☺	§ 3.2
	Verification of contractual volumes	Conformity between declared volumes and contractual volumes, cotton farms and ineligible parcels excluded from the QC data set	☺	§ 3.
VERIFICATION OF THE CONSISTENCY OF DELIVERED QC DATA	**Checking duplicates**	No significant problems (ineligible parcels)	☺	§ 4.1
	Consistency at parcel level	Problems with group codes at parcel level and invalid crop/group combinations	⚡	§ 4.2
	Consistency at group level	Confusion among group codes, correct group taken into account for the diagnostic per group	⚡	§ 4.3
	Consistency at dossier level	No significant problems	☺	§ 4.4
	Cross-checking α-numeric and vector data	No significant problems, cotton parcels exist in the vector coverage	☺	§ 4.5
	Correct application of diagnostic per group of crops	No significant problems	☺	§ 4.6.1
	Correct application of diagnostic per dossier	None	☺	§ 4.6.2
QC OF PHOTO-INTERPRETATION RESULTS	**Control of parcel boundaries**	24 parcels reshaped with reduction of area and 2 parcels moved	○	§ 5.3
	Control of observed land cover	25 parcels with land use discrepancy, 16 coded *Uncertain* by QC	○	
	Correct detection of technical problems and use of anomalies code	33 anomaly codes invalidated by QC, 15 new anomaly codes set by QC	○	§ 5.5

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8. PERSPECTIVES FOR 1999

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- ANALYSIS OF THE 3 QC CAMPAIGNS: 1996, 1997 AND 1998
  - PROBLEMS ENCOUNTERED: DATA FORMAT, LACK OF FLEXIBILITY OF THE QC SOFTWARE FOR HANDLING SPECIFIC CASES (MULTI-LINKS, CADASTRAL PARCELS, ILOTS), SOME CHECKS NOT RELEVANT, SOME CHECKS MISSING ...
  - POSSIBLE IMPROVEMENTS SUCH AS: DEFINE GROUPS OF SIMILAR CONTROL PROCEDURES (E.G. GROUP OF NON-CADASTRAL SYSTEMS, CADASTRAL SYSTEMS, RAPID FIELD VISITS) AND DEFINE ADAPTED QC PROCEDURES
- ON REQUEST OF MEMBER STATES THE JRC WILL CONTINUE QC FOR THE NEXT 3 YEARS.
  - A NEW ITT WILL BE ISSUED NEXT YEAR FOR TECHNICAL SUPPORT AS PREVIOUSLY
  - MORE FORMAL VISITS TO CONTRACTORS' SITES IF REQUIRED

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Historical review of control with remote sensing within the CAP

Michel Jacquot

The history, or the adventure, as I would rather say, of remote sensing in the Directorate-General of Agriculture is less than ten years old… But these are ten **"light years"**, ten years during which a handful of officials, Wolfgang KUMMER, then Prosper de WINNE who now follows another vocation, and especially their direct collaborators, Michel VAN de STEENE and Jacques DELINCE, have worked with competence, determination and intelligence to impose, within the management of the Common Agricultural Policy and particularly for its control, the technique of remote sensing, then still in its infancy.

If I may be allowed, I would like to testify for these exceptional officials. Without them, we would not have been here today to review this technique and would instead have satisfied ourselves then, as in many other scientific fields, to observe what the United States have been achieving in this matter.

Without depreciating in any way the work of these former collaborators, I cannot omit either the major role played by the JRC and, more specifically, by the Institute for Remote Sensing Applications[1] located in Ispra, for the development of the different projects that have germinated during these ten years. Right from the beginning, the JRC, with Jean MEYER-ROUX, was the enthusiastic and ideal partner whom everyone, in any project, can only wish to have. Of course, there was sometimes friction…. Generally only, for questions of personnel or money, the JRC, while not admitting that the EAGGF, "rich" with a few tens of billions ECU, could not draw from this Danaides's barrel a few millions for this activity, which required a highly qualified scientific assistance. Jean MEYER-ROUX also looked at me reprovingly when he learned that EAGGF

Survol historique des contrôles par Télédétection dans la PAC

Michel Jacquot

L'histoire, l'aventure dirais-je plutôt, de la télédétection à la Direction générale de l'Agriculture n'a pas dix ans… Mais ce sont dix **« années-lumière »**, dix années au cours desquelles une poignée de fonctionnaires, Wolfgang KUMMER, puis Prosper DE WINNE qui ont maintenant suivi une autre destination, et surtout leurs collaborateurs directs, Michel VAN de STEENE et Jacques DELINCE, a œuvré avec compétence, avec détermination et intelligence pour imposer, dans la gestion de la Politique Agricole Commune et particulièrement pour les contrôles de celle-ci, la technique, alors balbutiante de la télédétection.

Qu'il me soit donc permis de rendre témoignage à ces quelques fonctionnaires exceptionnels. Sans eux, nous ne serions pas ici, aujourd'hui, pour faire le bilan de cette technique et nous contenterions-nous alors, comme dans beaucoup d'autres domaines scientifiques, d'observer ce que font les Etats Unis en la matière.

Sans diminuer en quoi que ce soit le travail de ces anciens collaborateurs, je ne puis omettre non plus le rôle majeur joué par le CCR et plus particulièrement l'Institut des Applications de la Télédétection[2] situé à ISPRA, pour la mise au point des différents projets qui se sont échelonnés au cours de ces dix années. Le CCR, avec Jean MEYER-ROUX, fut au départ le partenaire enthousiaste et idéal que chacun, dans tout dossier, ne peut que souhaiter avoir. Bien sûr, il y eut parfois des frictions…. Le plus souvent seulement comme de bien entendu, pour des questions de personnel ou d'argent, le CCR n'admettant pas que le FEOGA, « riche » de quelques dizaines de milliards d'ECU, ne pouvait pas puiser dans ce tonneau des Danaïdes quelques millions pour

[1] Currently known as the Space Applications Institute..
[2] Actuellement devenu l'Institut des Applications Spatiales.

had lured away Jacques DELINCE, then at the JRC. It is clear that without Ispra, we would not have managed to turn remote sensing into the privileged knowledge and control instrument that it has presently become.

Neither will I forget that without the Member States and the few national officials who appealed to their superiors, in order to impose remote sensing as one of the methods of aid control, and who could also "sell" it to the farmers and to their professional organisations, the EAGGF project of control with remote sensing would have been doomed to failure. Among these Member States I will mention, in particular, Italy, which welcomes which and us today always, collaborated perfectly with the Commission in this field, and I will quote Ferdinando SMANIA's name.

Tribute therefore has to be paid to all of these officials of the Commission and of the National Administrations and to the personnel of the contracting private Companies.

* * *

As far as I remember, it was at the end of 1987 or the beginning of 1988 that the idea of using remote sensing for control arose within the EAGGF, following several visits to private companies, including SGS in particular. This was followed by the setting-up, within the Commission, of a Steering Committee instructed to study, under the supervision of the DGXII of Research and Development, the possibility of using data from space in the Community policies.

The reservations expressed by other Commission services about using satellite images for the control of area-based subsidies as desired by EAGGF, led us to abandon this common idea. We requested the Institute for Remote Sensing Applications of JRC of Ispra to draw up a **specific project for the control with remote sensing of durum wheat**, with an approach inspired by the "regional inventory" or

cette activité qui exigeait le concours de scientifiques hautement qualifiés. Jean MEYER-ROUX me fit également les gros yeux quand il apprit que le FEOGA avait débauché Jacques DELINCE, alors au CCR. Il est clair que sans ISPRA, nous ne serions pas arrivés à faire de la Télédétection, l'instrument privilégié de connaissance et de contrôle qu'elle est devenu à présent.

Je ne saurais oublier non plus, enfin, que sans les Etats-Membres et les quelques fonctionnaires qui, auprès de leur hiérarchie, ont milité pour imposer la télédétection comme un des moyen de contrôle des aides et qui ont su également le «vendre» aux agriculteurs et à leurs organisations professionnelles, les projets du contrôles par télédétection du FEOGA auraient été voués à l'échec. Je relèverai notamment parmi ces Etats-Membres, l'Italie qui nous accueille aujourd'hui et qui a toujours parfaitement collaboré sur ce terrain avec la Commission et citerai le nom de Ferdinando SMANIA.

Hommage donc soit rendu à tous ces fonctionnaires de la Commission et des Administrations Nationales et également au personnel des Sociétés privées contractantes.

***

Autant que je m'en souvienne, c'est la **fin 1987-début 1988** qu'est née au FEOGA l'idée d'utiliser la télédétection pour les contrôles, à la suite de plusieurs visites de firmes privées- dont notamment la SGS- et à la suite de la mise sur pied, au sein de la Commission, d'un Comité de Pilotage chargé d'étudier, sous la houlette de la DG.XII, Recherche et Développement, les possibilités d'application des données spatiales aux politiques communautaires.

Les réticences constatées dans les autres services de la Commission à propos de l'utilisation des images satellites pour les contrôles des surfaces aidées comme le souhaitait le FEOGA, nous conduisirent à nous dissocier de cette démarche commune de réflexions et à demander à l'Institut des Applications de la the "Action 1" of the MARS programme.

We were at the **beginning of summer 1989**. The EAGGF services indeed had noted, following long and difficult on-the-spot controls in Italy as well as in Greece, that an important discrepancy existed between the actual acreage and that registered in the requests for production aids for durum wheat. It was excluded, for lack of personnel, to carry out routinely repeated inspections on the ground. France had just tested, for its part, the use of remote sensing for assessing the 1989 drought and for control of the set-aside. One had therefore to innovate and to look ahead.

Convincing our "statistician" colleagues of the DGVI, who did not cease to wonder about the reliability and representativity of satellite images, and persuading our colleagues of the Financial Control, the UCLAF and the Legal Service of the validity of our choice was not an easy task. On the other hand, to overcome the Italian and Greek governments' reservations, was paradoxically easier, concerned as they both were, that if they did not undertake anything they would have the finger of shame pointed at them as accomplices to fraud.

The year 1990 was dedicated to theses pilot regional inventories, which covered 45% of the surfaces of durum wheat in Italy including the Sicily, Calabria and Basilicate Regions, and 73% in Greece with the use of SPOT and LANDSAT TM satellites.

The **assessment of this first campaign**, which had in fact only provided statistics by Nomos or Region, was made in Brussels on 16 November 1990, together with the Member States and the contractors; this meeting was among the most important ones, because:

- **On the regional scale**, statistics had been obtained with much better precision than that offered by on-the-spot controls, which were necessarily limited to a small sample of the population and not safe from observation

Télédétection du CCR d'ISPRA, d'élaborer un **projet spécifique de contrôles par télédétection pour le Blé dur**, avec une approche du type «inventaires régionaux», inspirée de «l'action 1» du programme MARS.

Nous étions au **tout début de l'été 1989**. Les services du FEOGA, avaient en effet, constaté, à la suite de contrôles sur place longs et difficiles, en Italie comme en Grèce concernant le blé dur, qu'un écart important existait entre les superficies cultivées et celles inscrites dans les demandes d'aides à la production. Il était exclu, par manque de personnel, qu'on répétât de tels contrôles systématiques sur le terrain. La France venait, de son coté, d'expérimenter la télédétection pour la sécheresse de 1989 et pour le contrôle de la jachère. L'on devait donc innover et l'on se devait d'aller de l'avant.

Convaincre nos collègues «statisticiens» de la DG.VI qui ne cessaient de s'interroger sur la fiabilité et la représentativité de la photo satellitaire et persuader du bien-fondé de notre démarche nos collègues du contrôle Financier, de l'UCLAF et du Service Juridique, ne fut pas la tâche la plus aisée. Paradoxalement plus commode en revanche, fut de vaincre les réticences des gouvernements Italien et Grec, soucieux qu'ils étaient l'un et l'autre, s'ils n'entreprenaient rien, de ne pas être montrés du doigt comme complices de la fraude.

L'année 1990, fut consacrée à cet inventaire régional qui porta expérimentalement sur 45% des superficies de blé dur en Italie avec les régions Sicile, Calabre et Basilicate, et 73% en Grèce, avec des prises d'images des satellites SPOT et LANDSAT TM.

Le **bilan de cette première campagne**, qui n'avait en fait que fourni des statistiques par Nomos ou Province fut tiré à Bruxelles le 16 Novembre 1990, avec les États-Membres et les contractants ; Cette réunion fut des plus importantes, car :

- A l'échelle régionale, une précision statistique avait pu être obtenue, bien meilleure que celle offerte par un errors and bias. That would make it possible, in the future, to focus the controls better.

- At the level of the cultivated plot, the remote control by itself - because of the images obtained - could not guarantee an exact cartography and therefore a link with the individual requests; individual control required a preliminary location stage on the image of the plots declared, from existing maps or from declaratory documents.
- Moreover, experimentation needed to be continued more methodically. Some basic principles were then advanced during this meeting... of which one could recognise the seeds of the principal elements of the Integrated System that was going to be set in place with the 1992 Reform of the CAP. According to F SMANIA, the expert invited then by the Italian Delegation, these principles were as follows: only one control service for all aid schemes; only one control by farm; digitisation of the formal administrative checks of all the area-aid applications; the choice of areas to be checked through satellite images; and control of farms by aerial photographs superimposed on the cartographic documents.
- To attract the Member States to this new control technique, it was appropriate to set up a **co-funding**.

If I stress this meeting of November 1990, it is because it remains in my memory as the meeting which **enabled the Commission to demonstrate the availability and the feasibility of techniques adapted to area-aid control and therefore to launch the 1992 Reform of the CAP**, in spite of the objections expressed by many against a generalisation of an aid per hectare, based on the fraud noticed in the agricultural sectors profiting from such subsidies.
Activities were continued in 1991 with a check**, at the plot level,** of applications for durum wheat, for set-aside, for cotton and for grubbing up of vines in **four regions** located in France, Spain, Greece, and in Italy.

In 1992, eleven Member States used remote sensing for the control of

contrôle sur le terrain nécessairement limité à un échantillon réduit de la population et nullement à l'abri d'erreurs d'observations. Cela devait permettre de mieux orienter dans le futur, les contrôles.

- Au niveau de la parcelle cultivée, la seule opération satellitaire - du fait des images obtenues- ne pouvait garantir une cartographie exacte et donc un lien sur avec les demandes individuelles ; le contrôle individuel exigeait un volet préalable de localisation sur l'image des parcelles déclarées à partir d'une cartographie existante ou de documents déclaratifs.
- L'expérimentation méritait de plus d'être poursuivie plus méthodiquement. Il fut alors avancé, à cette réunion, quelques principes de base... dont on reconnaît en germe les principaux éléments du Système Intégré qui allait être mis en place avec la Réforme de la PAC de 1992. Selon F. SMANIA, alors expert invité de la Délégation italienne, ces principes étaient les suivants : Un seul service contrôleur pour toutes les aides ; un seul contrôle par exploitation ; l'informatisation et le contrôle formel administratif de toutes les demandes d'aides ; le choix des zones à contrôler à partir d'images de satellites ; le contrôle des exploitations par photos aériennes superposées aux documents cartographiques.
- Pour attirer les Etats-Membres dans cette nouvelle technique de contrôle, il convenait qu'un co-financement fut mis en place.

Si j'insiste sur cette réunion de novembre 1990, c'est qu'elle reste pour moi dans ma mémoire, la réunion qui **permit à la Commission de pouvoir démontrer l'existence et la faisabilité de techniques de contrôles adaptés à l'aide à la surface et donc de lancer la Réforme de la PAC de 1992**, en dépit des objections formulées de toutes parts contre une généralisation des aides à l'hectare, au vu des fraudes constatées dans les secteurs agricoles bénéficiant d'une telle forme de soutien.

Les activités ont été poursuivies en 1991, applications for set-aside and/or for oilseeds. The services of EAGGF and the JRC of Ispra merely brought to the Member States an administrative and technical support; moreover, EAGGF was very careful not to draw financial conclusions at the level of the Clearance of Accounts.

The regulations concerning the IACS – Council Regulation no. 3508/92 and 3887/92 of the Commission – took into account all of the experience accumulated over these three years, and validate control with remote sensing, since they constitute an official method of control.

With the IACS, remote sensing became even richer through a new project aiming at the setting up of **complete agricultural Land Parcel Identification**, the first elements of which already are in place.

* * *

The technique of the remote sensing – whose foundation, I am delighted by this idea, is no longer questioned – is therefore promoted today by an additional project: the setting-up of these Land Parcel Identification Systems.

It is not a good management, from my point of view, that the DG VI does not give its political "support" to these systems and that the Commission does not offer its financial support to them.

Above all, it is not appropriate that control with remote sensing, within the DG VI, henceforth will be administered by the services of the Clearance of Accounts.

I will not add another word on this issue. But such is my point of view.

par une **vérification au niveau de la parcelle** des déclarations de blé dur, de retrait des terres, de coton et d'arrachage des vignes pour **4 régions** situées en France, en Espagne, en Grèce, en Italie.

En 1992, onze Etats-Membres utilisèrent la télédétection pour le contrôle des déclarations de retrait des terres et ou d'aides aux oléagineux, les services du FEOGA et le CCR d'ISPRA se contentant d'apporter aux Etats-Membres leur appui administratif et technique, le FEOGA se gardant bien de plus de tirer des conclusions financières au niveau de l'Apurement des Comptes.

La réglementation relative au SIGC – le règlement n° 3508/92 du conseil et celui 3887/92 de la Commission- tint compte de toute cette expérience accumulée au cours de ces trois années et valide les contrôles par télédétection, puisqu'ils constituent un mode de contrôle officiel.

Avec le SIGC, la télédétection s'est-elle même enrichie d'un nouveau projet visant à la mise en place d'un **parcellaire agricole complet**, dont les premiers éléments sont déjà en place.

***

La technique de la télédétection- dont les fondements, je m'en réjouis, ne sont plus du tout mis en doute- est donc aujourd'hui portée par un projet supplémentaire : la mise sur pied de ce parcellaire.

Il n'est pas de bonne administration, de mon point de vue, que la DG.VI n'apporte pas son soutien «politique» à ce dispositif et que la Commission n'y apporte pas son concours financier.
Il n'est surtout pas opportun que les contrôles par télédétection ressortent désormais, à la DG.VI, de la compétence des services de l'Apurement des comptes.

Je n'en dirais pas d'avantage sur cette question. Mais tel est mon point de vue.

COMMISSION EUROPÉENNE
DIRECTION GÉNÉRALE VI AGRICULTURE

Système Intégré : identification des parcelles agricoles

J. Delincé

Venezia, le 22.11.98

COMMISSION EUROPÉENNE
DIRECTION GÉNÉRALE VI AGRICULTURE

Objectifs

- Déclaration: Identification à la parcelle agricole
- Contrôle: Localisation des superficies

Différents systèmes

	Système de Référence		GIS	Carte Digitale	Utilisation d'îlots	Support othophotophoto		
	Spécifique	Extérieur				Util.	Emul.	Pixel
Belgique	Min Agri	-	Oui	Non	Non	Oui	N&B	1 m
Danemark	Min Agri	-	Oui	Oui	Oui	Oui	Coul	0.5m
Finlande	Min Agri	-	Oui	Non	Oui	Oui	N&B	1 m
Grèce	Min Agri	-	Oui	Non	Oui	Oui	N&B	1 m
Irlande	Min Agri	-	Oui	1/2	Oui	Oui	N&B	1 m
Portugal	INGA	-	Oui	Non	Oui	Oui	N&B	1 m
Pays-Bas	Min Agri	-	Oui	Oui	Oui	-	-	-
Suède	Min Agri	-	Oui	Oui	Oui	-	-	-
Italie	AIMA	Cadastre	Oui	Oui	Non	Oui	N&B	1 m
Allemagne	-	Cadastre	Non	-	Oui	-	-	-
Autriche	-	Cadastre	Non	-	Oui	-	-	-
Espagne	-	Cadastre	Non	-	Non	-	-	-
France	-	Cadastre	Non	-	Oui	Oise	N&B	1 m
Luxembourg	-	Cadastre	Non	-	Oui	-	-	-
Royaume Uni	Min Agri (Scot,N. Irl)	O. Survey (En, Wa)	Non Scot	- Oui	Non Oui	-	-	-

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Documents déclaratifs

	Documents graphiques	Types de documents		Caractéristiques			
		Carte +ortho	Carte seule	Echelle	Format	Indiv.	Surface réf. fournie
Allemagne	Non						
Autriche	Non						
Espagne	Non	(x)					
Italie	Non	(x)					
Luxembourg	Non						
France	1 départ						
Royaume Uni	1 départ		(x)	(10.000)	(A3)	(Oui)	(Oui)
Grèce	Oui	x		5.000	A1	Non	Non
Belgique	Oui	x		10.000	A3	Oui	Non
Danemark	Oui	X		10.000	A3	Oui	Oui
Finlande	Oui	x		5.000	A3	Oui	Oui
Irlande	Oui	x		10.000	A3	Oui	Oui
Pays-Bas	Oui		x	10.000	A4	Non	Non
Portugal	Oui	x		5.000	A4	Oui	Oui
Suède	Oui		x	10.000	A3	Oui	Non

Unicité du lien ID <=> parcelle

- 1 ID = 1 parcelle = 1 exploitant
  - Be, Po, El(?)
- 1 ID = # parcelles = 1 exploitant
  - îlot: Fr, De, Lu, Au, Uk, Ir, Su
- 1 ID = #parcelles = #exploitants
  - cadastre : It, **Es**
  - blocs topo : Nl, Sw, Dk

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Unicité du système dans l 'E.M.

- Oui : Be, Dk, Su, Sw, Au, Lu, It, Nl
- Non :
  - Uk: Maf, Dani, Sfoa
  - Fr: petits et grands producteurs
  - De: Feldstück, schlag ou parcelle cadastrale
  - Ir: arable et fourrage
  - Po, El: bloc et parcelle
  - Es: parcelle agricole si > 10ha

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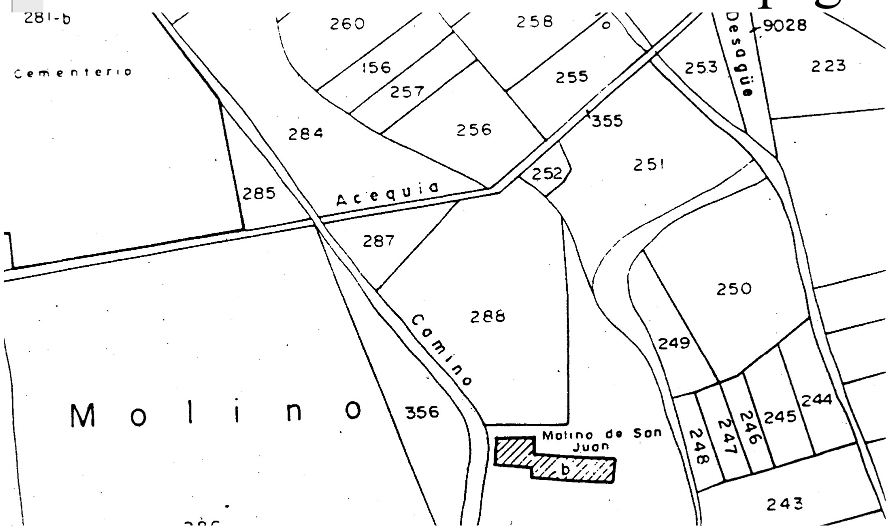
La référence cadastrale: Espagne



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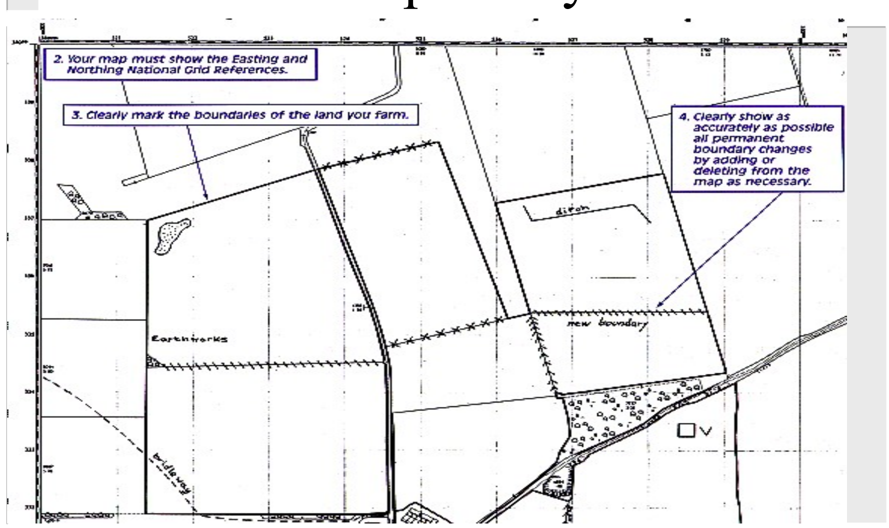
Carte topo: Royaume Uni



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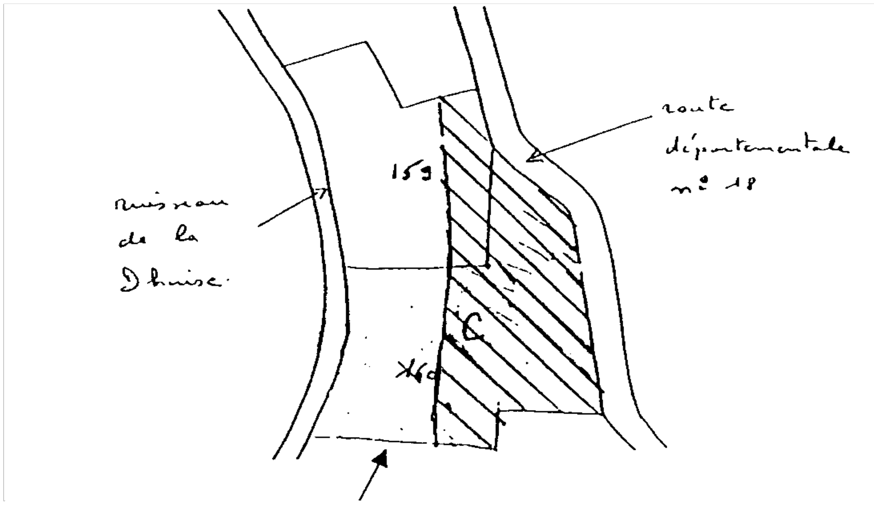
L 'îlot sur base du cadastre: France



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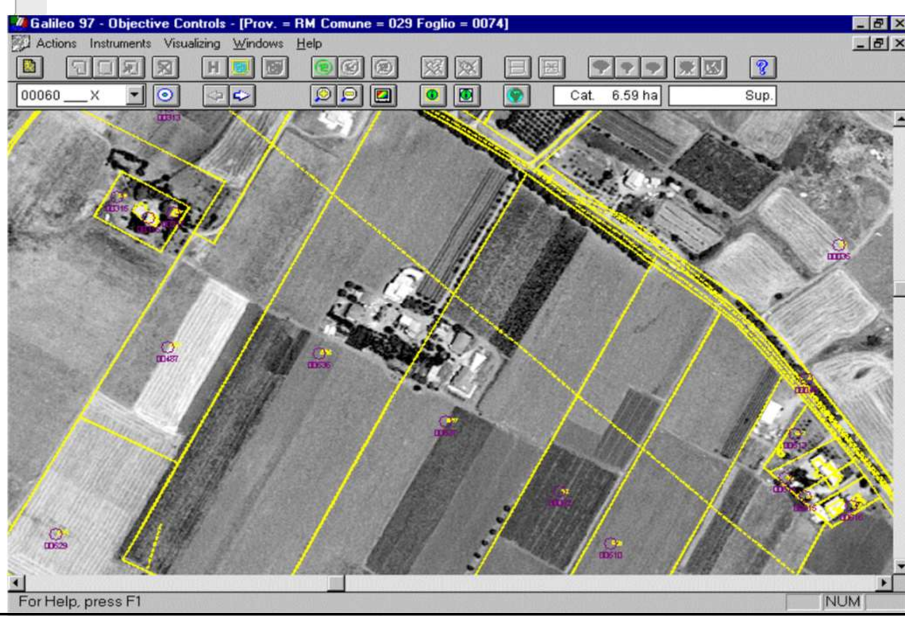
Italie: approche SIG



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Bloc topographique: Pays-bas

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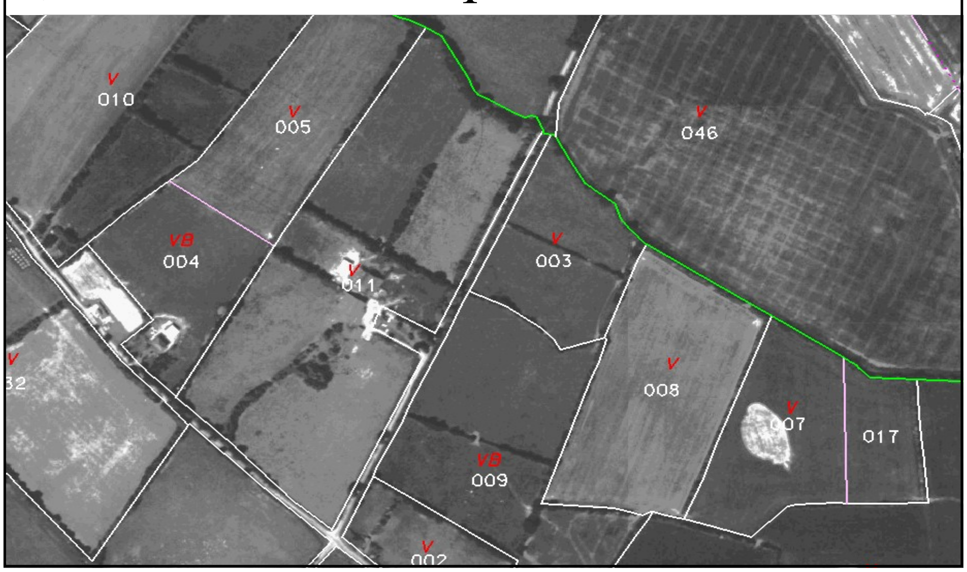
Bloc et orthophoto: Irlande



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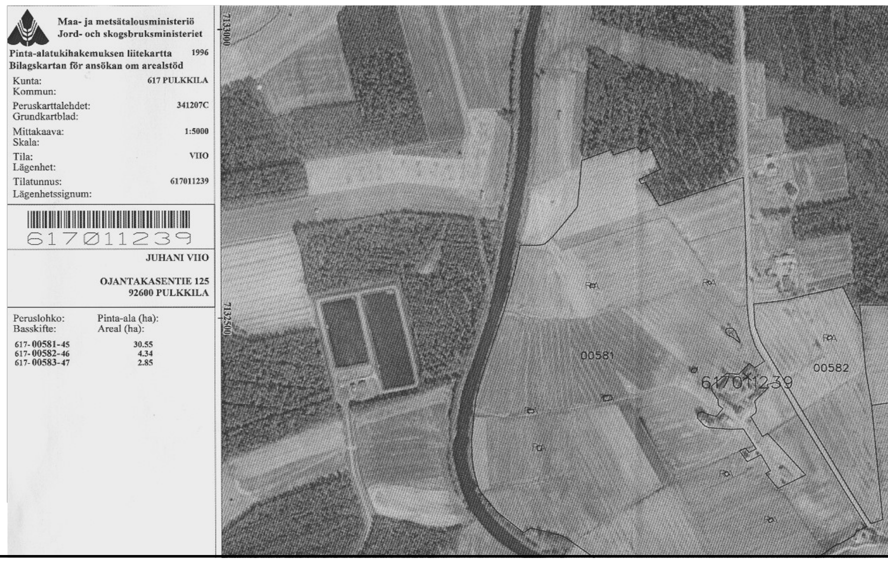
Ilot et ortho: Finlande



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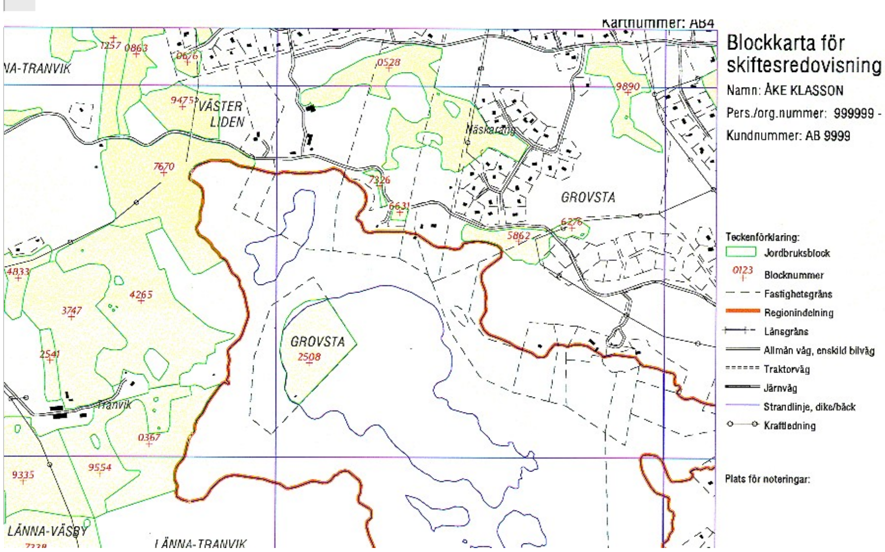
Carte topo: Suède



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Carte topo et ortho: Danemark

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Parcelle, bloc et ortho: Portugal

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SIG parcelle: Belgique

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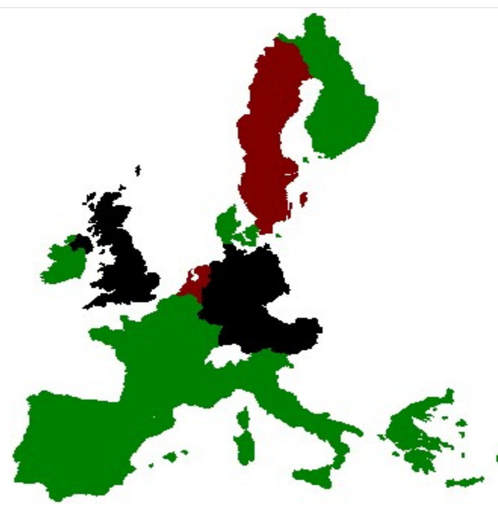
Eléments de coûts (MECU)

Be	4.
Dk	5.1
Su	4.5
Irl	9.2
El	10.
SW	10.2
Po	17.5
It	18.4



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SIG Oléicole et Viticole

Casier Oléicole:

Conseil: Reg 1638/98: SIG oléicole

Commission: en discussion (1.11.98)

Casier viticole:

Conseil: Reg 1549/95: Casier viticole simplifié

Réforme en discussion

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SIG Oléicoles & Viticoles: Situation

Italie : SIG réalisé de 96-98 (45 MECU)

Espagne: SIG Oléicole lancé en 1998

SIG Viticole: 8% des vignes

Portugal: OLI: A.O. en voie d 'attribution

VITI: Douro terminé (ortho)

Reste du pays: A.O. relancé

Grèce : Phase 1: A.O. en voie d 'attribution

Phase 2: cahier des charges rédigé

France : SIG oléicole - démarrage

Etudes OLISTAT-OLIAREA-OLIYIELD

Olistat: Estimation du nb total oliviers par E.M.

Sept 97- Juin 98: 3.5 MECU, cv de 2%

Nouvelles photos pour SP-FR-GR

Résultats: 300, 225, 71, 5.7 Mio (E,I,P,F)

Oliarea: Estimation des superficies oléicoles

Oct 98 - Mai 99, 1 MECU

Oliyield: Estimation des rendements

Déc 98 - Déc 01 ? 6.5 MECU.

Space Applications Institute

4ème conférence • Contrôle par Télédétection
Venezia • 26- 27 Novembre 1998

Session 2: Rétrospective

Bilan des **méthodologies** des contrôles par télédétection

- Les différentes méthodes utilisées et leur origines
- Les résultats 98
- Tendances et recommandations pour le futur

JOINT RESEARCH CENTRE EUROPEAN COMMISSION

Agriculture and Regional Information Systems Unit

Space Applications Institute

Les différentes méthodes utilisées

4ème conférence • Contrôle par Télédétection
Venezia • 26- 27 Novembre 1998

- Une méthodologie générale et des principes communs
- De nombreuses variantes et adaptations
- Une famille de méthodes, plus qu'une méthode unique
- Pourquoi et quelles conséquences?

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Les différentes méthodes utilisées

Quelques principes de base:

- Pré- contrôle effectué sans contact avec l 'Agriculteur
  - Avantage: Objectif et neutre
  - contrainte: Erreurs déclaratives et artefacts.
- la TLD ne remplace jamais totalement une inspection sur place
  - aucun dossier n 'est pénalisé ou « rejeté » sans contact avec l 'agriculteur.
  - Maintien de contrôles en dehors des sites « télédétection »
  - Le contractant ne se substitue pas à l 'Administration.
- Contrôle automatique?
  - La classification automatique ne remplace pas la PIAO.
  - *De même, La PIAO sera validée par Visite Rapide (en cas d 'OS différente).*

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Les différentes méthodes utilisées

Rétrospective:

les grandes étapes

le développement des principales familles de méthodes

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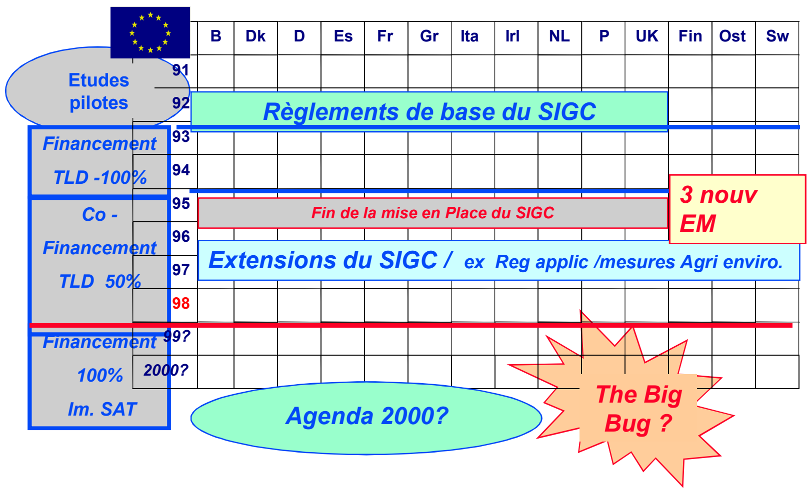
Agriculture and Regional Information Systems Unit

Les différentes méthodes utilisées

Les grandes étapes du développement



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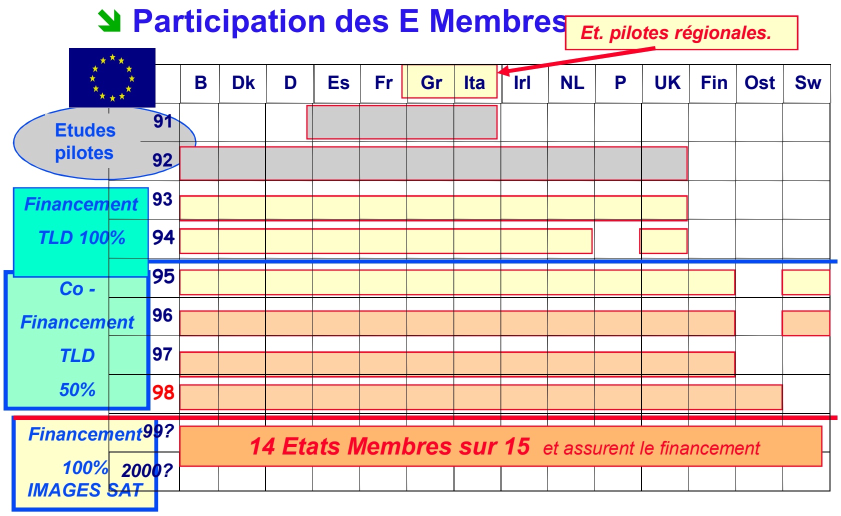
Les différentes méthodes utilisées

Participation des E Membres



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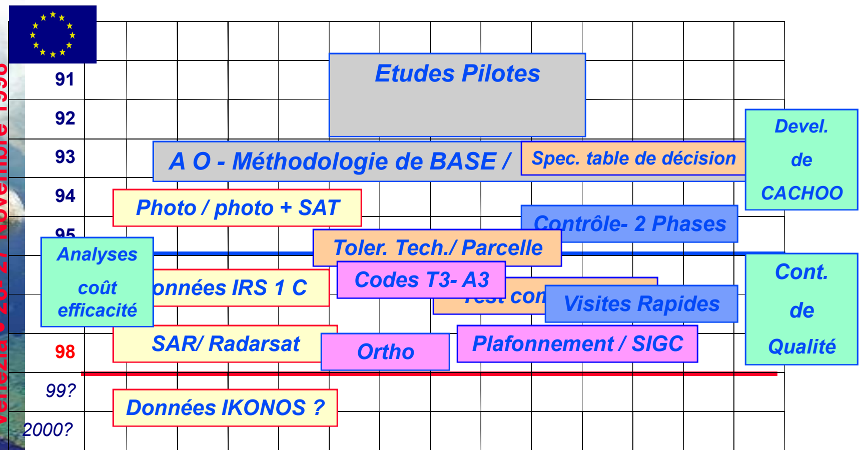
Les différentes méthodes utilisées

Les principales initiatives de la Commission



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Les différentes méthodes utilisées

- **La méthodologie initiale Commission:**

Satellite seul

- **4 images satellitales en cours de campagne**
- **1 Panchro, 10m**
  pour contrôle de la surface des parcelles….
- **3 XS, 20- 30m,**
  pour le contrôle de l 'occupation des sols..
- **P.I.A.O** ***photo-interprétation assistée par ordinateur,***
  en connaissant le déclaré (différents niveaux de plausibilité)
- **Gestion des doutes** **ou problèmes techniques**
- **Règles de diagnostic,** **Tri des dossiers à inspecter.**

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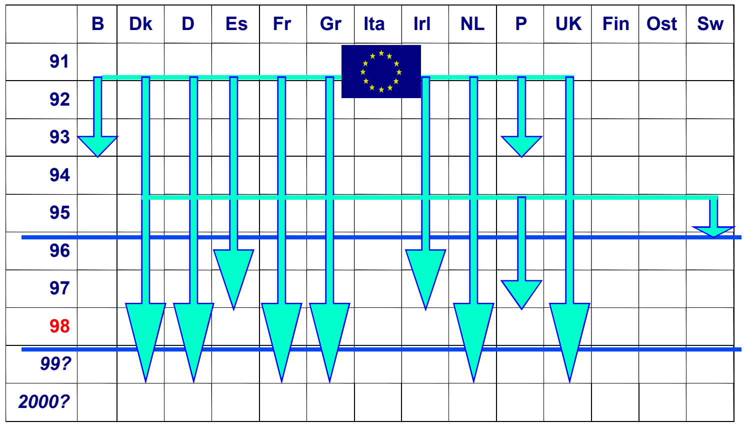
Les différentes méthodes utilisées

Données de Télédétection: Satellite seul



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Les différentes méthodes utilisées

- **Les variantes à cette méthode**

PHOTO(s) Aérienne(s) seule(s)

1 photo aérienne en début de campagne

initialement Panchro, 1/40 000

Superposition aux planches cadastrales,

pour contrôler la surface des parcelles….

(analogique, puis digitale)

Support d'enquête terrain Visite rapide

pour contrôler l 'Occupation des sols

sans contact avec l 'agriculteur

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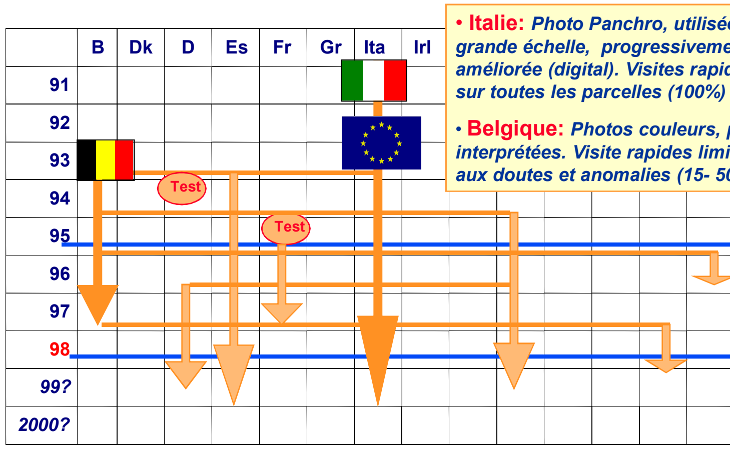
Les différentes méthodes utilisées

Données de Télédétection: Photo Seule



- **Italie:** *Photo Panchro, utilisée à grande échelle, progressivement améliorée (digital). Visites rapides sur toutes les parcelles (100%)*
- **Belgique:** *Photos couleurs, photo interprétées. Visite rapides limitées aux doutes et anomalies (15- 50%).*

Les différentes méthodes utilisées

- Les variantes à cette méthode

Satellite + Photo aérienne

- 1 photo aérienne, généralement PAN
  pour contrôle de la surface des parcelles….
- 3 images satellitales XS, en cours de campagne
  pour le contrôle de l 'occupation des sols..
- P.I.A.O *photo-interprétation assistée par ordinateur*,
  en connaissant le déclaré (différents niveaux de plausibilité)
- Gestion des doutes ou problèmes techniques
- Règles de diagnostic, Tri des dossiers à inspecter.

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Les différentes méthodes utilisées

- Les variantes à cette méthode

Satellite + Photo aérienne

- De très nombreuses variations possibles
- Différentes émulsions:
  - Couleur
  - Infra rouge couleur
- Différentes échelles
- Utilisation de photos d'archives
- Utilisation de photos numériques /SIGC.
- *Souvent testée ou utilisée localement*

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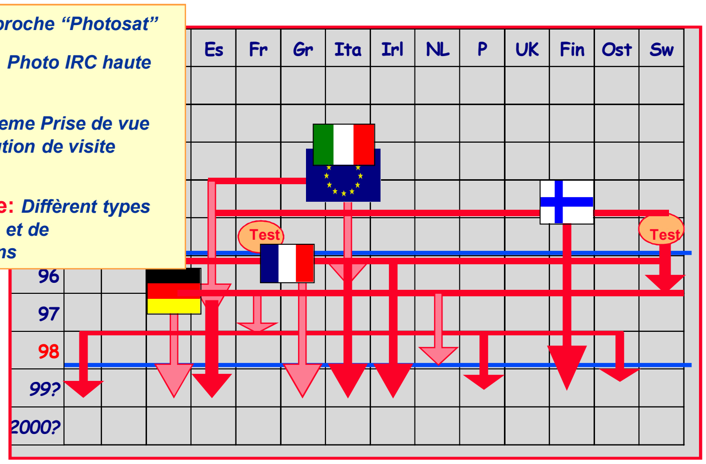
Les différentes méthodes utilisées

- Données de Télédétection: satellite+Photo

- **Italie:** *Approche "Photosat"*
- **Finlande:** *Photo IRC haute altitude*
- **France:** *2eme Prise de vue IRC substitution de visite rapide*
- **Allemagne:** *Diffèrent types d'émulsions et de combinaisons*



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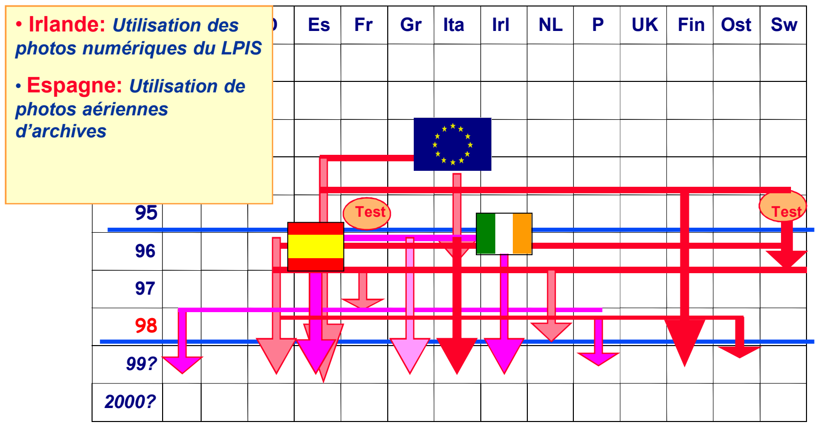
Les différentes méthodes utilisées

➘ Satellite+ Photo LPIS ou ARCHIVE



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Les différentes méthodes utilisées

- Les variantes à cette méthode

Les Visites Rapides

➘ Une visite rapide, effectuée sur le terrain
- sans contact avec l 'agriculteur

➘ Permet de vérifier l 'occupation des sols
- de toutes les parcelles
- de celles qui ne peuvent être vérifiées sur les données de télédétection
- de celles qui présentent une anomalie / déclaré...

➘ Initialement méthode Photo seule

➘Peut remplacer la (les) dernières images SAT.

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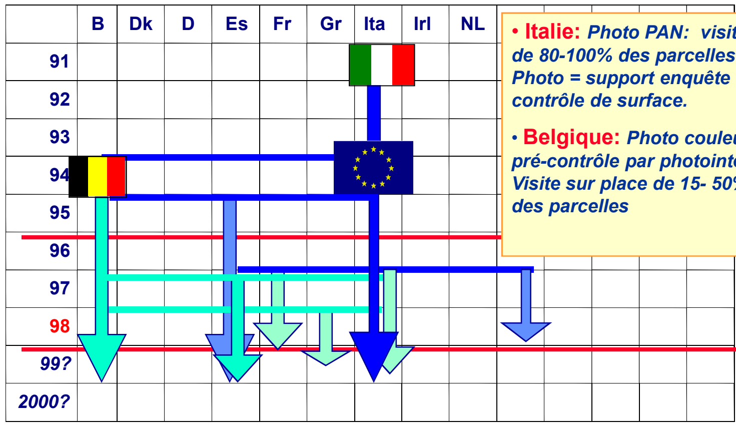
Les différentes méthodes utilisées

➘ Visites rapides: Deux approches



• **Italie:** *Photo PAN: visite de 80-100% des parcelles: Photo = support enquête et contrôle de surface.*

• **Belgique:** *Photo couleur pré-contrôle par photointer. Visite sur place de 15- 50% des parcelles*

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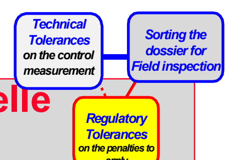
Les différentes méthodes utilisées

• **Les variantes à cette méthode**



Tolérances tech. à la parcelle

➘ à l 'initiative de la Commission

➘ clarification des 2 fonctions

- tolérance technique (concerne la mesure)
- Tri du dossier (stratégie de visite sur place/ réglementation)

➘ Précision de contrôle varie avec les données utilisées

➘ Mets en évidence les parcelles problématiques (retour SIGC)

➘ *Choix de l 'Etat membre sur la méthode et données de contrôles adaptées au contexte régional...*

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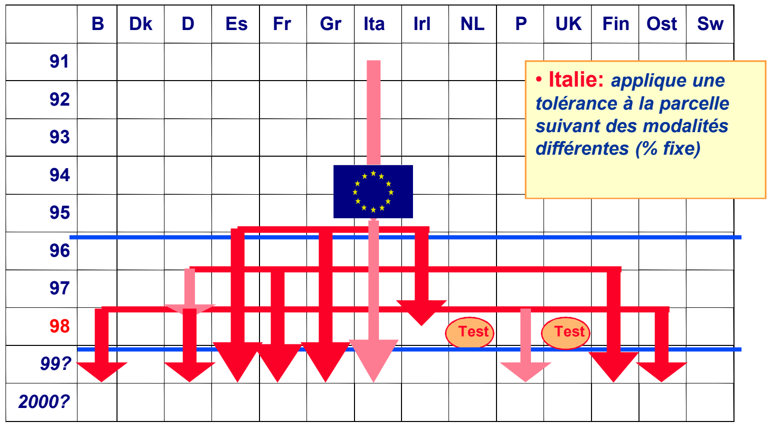
Les différentes méthodes utilisées

➘ tolérances technique à la parcelle



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Les différentes méthodes utilisées

- **Les autres variantes ….**
- **Doc. de terrains par zone géographique** (et non dossier)
- **Années de Référence….**
- **Utilisation de données SAR**
- **Contrôles en deux phases**
- **Mesures agri environnementales**
- **Autres régimes coton, etc**
- **Contrôles combinés/ casiers**

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Les différentes méthodes utilisées

- **Pourquoi ces variations?**
  - Historiquement, depuis 93,
    - diversification des méthodes
    - Amélioration générale
    - Menées en parallèle…
  - Les résultats
    - Données satellite//aériennes?
      - La concurrence du début a été transformée en synergie
    - Tolérances Techniques (parcelle ou Groupe)
      - la Commission a pris position..les E M se sont prononcés
    - Visite rapides
      - Principal souci: Délais et fiabilité des contrôles..

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Les différentes méthodes utilisées

- **Sont elles utiles ?**
  - En fait Variations positives:
    - Pour le développement des méthodes
    - pour leur bonne adaptation aux contextes régionaux:
      - Taille parcellaire
      - Système d 'identification parcellaire
      - Types d 'occupation des sols…
  - Laisse la place à la subsidiarité
    - et clarifie la responsabilité des Etats membres vis à vis des choix techniques ou stratégiques...
  - Initiatives:
    - A la fois Commission et Etats membres

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Les différentes méthodes utilisées

- **Rôles de la Commission (DG CCR):**
  - Suivi technologique (ex futurs satellites)
  - Identifier et diffuser innovations des E Membres.
  - Veiller au respect des obligations réglementaires
  - Spécifications, recommandations techniques
  - Clarifier les concepts
    - Exemple dossiers « douteux » ou « incomplets »
  - Améliorer la mise en oeuvre
    - Support technique, choix des techniques, Suivi,
    - Evaluation et contrôle de qualité...

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Venezia • 26- 27 Novembre 1998

Session 2: Rétrospective

Bilan des méthodologies des contrôles par télédétection

- Les différentes méthodes utilisées et leur origines
- **Quelques résultats 98**
- Tendances et recommandations pour le futur

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Quelques Résultats de 1998

- Cf présentation et tableaux résumés de M. Van de Steene

- **Deux points abordés ici:**
  - Les taux de « rejet »
    - Par télédétection (= taux de visite sur place)
  - Les délais de contrôle

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Quelques Résultats de 1998

- **Les taux de « rejets»** (moyennes app.)

	B	Dk	D	Es	Fr	Gr	Ita	Irl	NL	P	UK	Fin	Ost	Sw
95	18	21	3	48	22	26	-	7	11	20	4	19	-	13
96	26	26	9	33	18	20	-	16	8	30	10	12	-	29
97	40	21	6	39	22	16	20	9	9	25	5	17	-	-
98	33	20	8	40	11	25	60	3	12	25	4	9	5	-
99?														

- *Attention aux taux trop faibles (Risques d 'omissions)*
- *Problèmes logistiques des taux trop élevés ou irréguliers*
- *Hétérogénéité entre ETATS membres ?*

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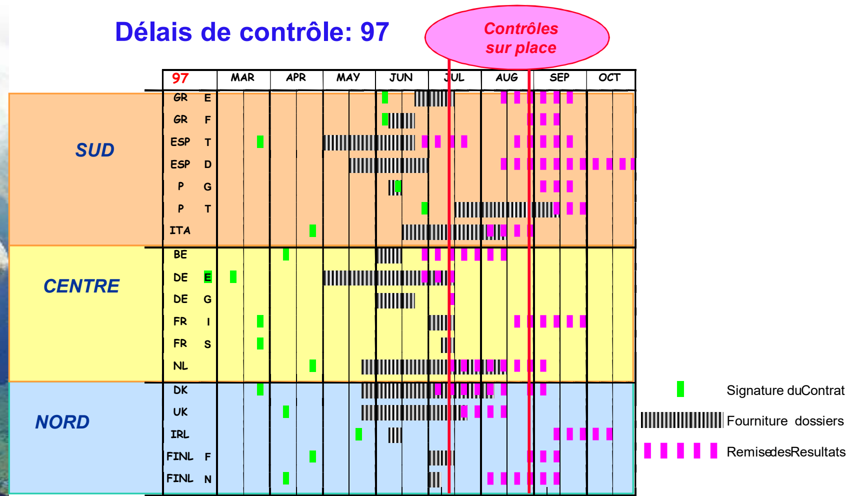
Les Résultats de 1998

Délais de contrôle: 97



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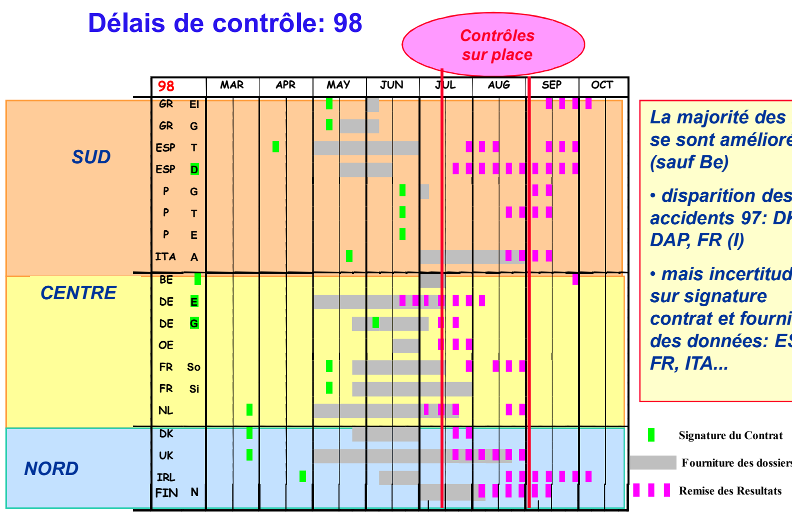
Tendances et recommandations pour le futur

Délais de contrôle: 98



La majorité des EM se sont améliorés- (sauf Be)

- *disparition des accidents 97: DK, DAP, FR (I)*
- *mais incertitudes sur signature contrat et fourniture des données: ESP FR, ITA...*

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- Tendances & recommandations

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Tendances & recommandations

- Les contrôle par télédétection se sont poursuivis…
  - A cause du co-financement?
  - A cause d 'une efficacité meilleure?
- 99 doit être une année décisive sur l évaluation
- Le contrôle par télédétection: un contrôle à part entière
  - Les contractants doivent maîtriser la technique
  - Les Administrations, piloter et « parametrer »

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Tendances & recommandations

- **Tendances générales**
  - Tolérances techniques à la parcelle
  - Renforcer les diagnostics
    - mesures des parcelles
      - données de très haute résolution
    - contrôle des O.Sols
      - Visite rapide ou moins de bénéfice du doute
  - Cohérence avec le SIGC :
      - Cf. & « Plafonnement des surfaces» des T.O.Ref.
  - améliorer les délais
      - Fourniture des données, visite rapide ou SAR
      - Contrats pluri-annuels (8 E M sur 14).

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Tendances & recommandations

- **Mieux Piloter les contrôles?**
  - Ajuster les paramètres des Tables de décisions
    - Tolérances techniques à la parcelle
    - Tri des groupes et dossiers
    - Test de complétude...
  - les paramètres indiqués dans les spécifications communes sont des conditions minima requises*
    - «Nivellement par le bas» pour consensus…
    - et soucis d 'éviter les problèmes majeurs lors du changement de système de tolérance techniques

**même si les chiffres correspondent généralement à des valeurs maximum requises.*

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Tendances & recommandations

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- **Exemple: TEST de COMPLETUDE**
  - 50% (25%) des surfaces contrôlées = dossier Contrôlé
    - …..Inquiétant!!!
    - En fait de 10 a 20% des surfaces en code T
  - Ces taux sont donnés à titre indicatif pour des cas extrêmes
    - très gros dossiers (1000- 2000 ha, cf ESP)
  - comment réajuster?
    - Analyse des histogramme des résultats 96- 98
      - Taux de surface en code T/ dossier
  - Idem pour les tolérances techniques
  - Facilité si contrat pluri-annuel

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Tendances & recommandations

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- **Tolérances techniques à la parcelle**
  - valeurs restent élevées pour les données aériennes
  - Analyser la sensibilité pour le tri des dossiers
    - Histogrammes des écarts par groupe
  - Veiller à appliquer des plafonnements aux surfaces SIGC (dans les deux cas de tolérances parcelle ou groupe)
  - Clarifier le suivi administratif
    - des parcelles hors tolérances
    - et dossiers à écart faibles (ne justifiant pas une inspection sur place)

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Session 3: *Optical data, acquisition and use*

European Commission - DG VI.AI.4

Introduction

Sensor	Spatial res. (m)	Swath (Km)	Spectr. bands	Revisit time (days)	ECU (min - max)
Land.TM	30	50 (1)	7	16	1400 - 1820 (2)
Spot XS/XI	20	60	3/4	2 (tilt.)	1600 - 4200 (3)
Spot Pan	10	60	1	26 (nadir)	1600 - 4200 (3)
IRS Liss-III	23/70	142	4	5 (tilt.)	2700
IRS Pan	5.8	70	1	24 (nadir)	2600
ERS Ami	25	100	1	35	750 – 800
Radarsat	10	50	1	3-24	1900

(1) mini scene
(2) cloud cover evaluation: 420 ECU
(3) programming fees: 450 ECU for Autumn acquisitions, and 2600 ECU for Spring/Summer acq.

A) SPOT SATELLITE CAPABILITIES

B) THE SPOT CONSTELLATION: SPOT 1 + 2 + 4

C) SPOT PROGRAMMING METHODS
- Satellites resource plan
- Daily programming optimisation

A) SPOT SATELLITE CAPABILITIES

- STRIP SELECTION MIRROR

➔ STEREOSCOPIC CROSS-TRACK AQUISITIONS

➔ HIGH REVISIT CAPABILITY: 11 attempts per 26 day cycle

➔ WIDE CORRIDOR OF ACCESSIBILITY: 950 km

A) SPOT SATELLITE CAPABILITIES

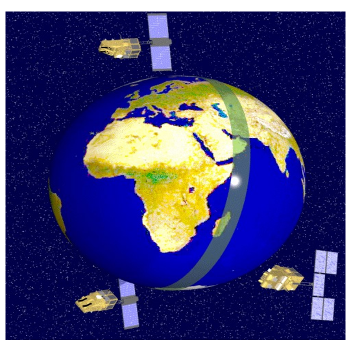
- IMPROVED SPOT 4 CAPABILITIES

➔ 2 RECORDERS OF 40 min + SOLID STATE MEMORY OF 3 min
= 50 min per day (compared to 20 min for SPOT 1 to 3)

➔ REDUCED TRANSITION TIME
➔ 2 HRVs TOTALLY INDEPENDENT
} + 15 to 20% efficiency

Control with Remote Sensing of Area-based Subsidies
Venezia, Italy, 26-27 November 1998

B) THE SPOT CONSTELLATION



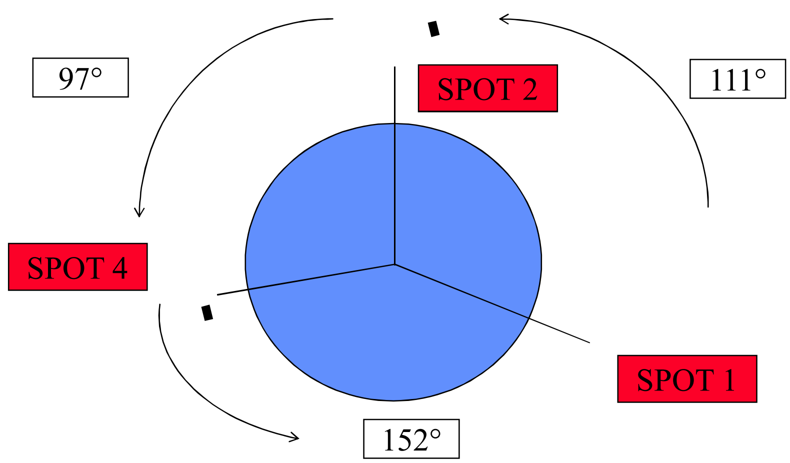
SPOT 4

+ SPOT 1 + SPOT 2

=

SIMULTANEOUS STEREO

Specific location in space of SPOT 4 in order to ease the tandem stereo with SPOT 2



SPOT 4

At 45° latitude:

- 5 days of tandem SPOT 2/4 STEREO in a cycle
- 4 days of tandem SPOT 1/2 STEREO in a cycle
- 1 day of tandem SPOT 1/4 STEREO in a cycle

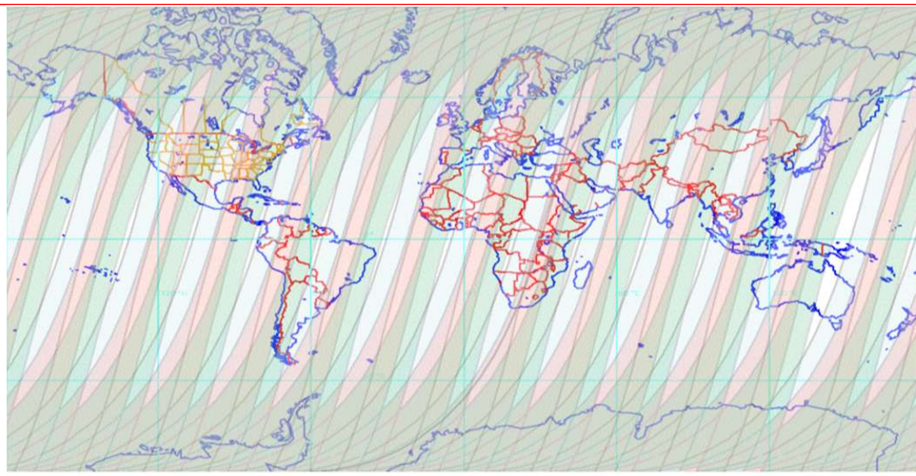
TOTAL: 10 days of tandem STEREO at the latitude of Toulouse

SPOT CONSTELLATION

SPOT 4 + SPOT 1 + SPOT 2

A 3 SATELLITE SYSTEM

ACCESS OF THE ENTIRE EARTH EVERY DAY



Control with Remote Sensing of Area-based Subsidies
Venezia, Italy, 26-27 November 1998

SPOT CONSTELLATION

SPOT 4 + SPOT 1 + SPOT 2

A 3 SATELLITES SYSTEM

MULTIPLE ACCESS OF A TARGET IN A VERY SHORT TIME FRAME

EXAMPLE

TOUBKAL (Morocco): 6 shots in 7 days

SPOT 1 - SPOT 2: tandem stereo PA on 23 April

SPOT 1: XS image on 24 April

SPOT 4: PA image on 26 April

SPOT 2: XS image on 27 April

SPOT 2: PA image on 28 April

SPOT 1: XS image on 29 April

C) SPOT PROGRAMMING METHODS

Thanks to the Centre for Programming (CPR) and the Programming team (8 persons):

- Satellite resource planning

a) ➔ programming requests memorised in the data base: a 3 year horizon

b) ➔ world-wide climatic statistics

SPOT PROGRAMMING METHODS (2)

Thanks to the Centre for Programming (CPR) and the Programming team (8 persons):

a+b ➔ c) feasibility studies:

- probability of success (angle, latitude, period……)
- location of the request (example of the FEOGA programming request)

d) permanent dialog with the client

- programming proposal
- confirmation
- satellite activation
- image following and validation

SPOT PROGRAMMING METHODS (3)

Thanks to the Centre for Programming (CPR) and the Programming team (8 persons):

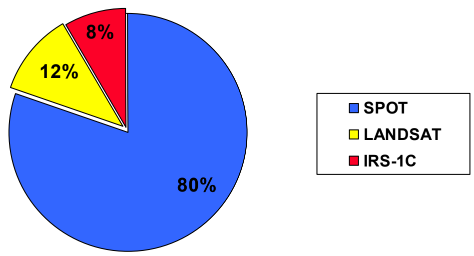
- daily programming optimisation :
  - 3 satellites = 6 HRVs = a lot of satellite resources
  - prepared by midday the day before the acquisition
  - several programming requests within a given swath
  - automatic stereoscopic optimization
  - world-wide weather forecasts

SPOT IMAGE

FEOGA CAMPAIGN 98

SCENES TO ACQUIRE:	**380**
VALIDATED SCENES:	**271**
SUCCESS RATE:	**71 %**

Break down of validated scenes in 1998



laser

Advantages of MIR Data in Image Analysis

By: Mahmoud Hassani

Venice
November 1998

GeoRas

Background

laser

- GeoRas: Dutch contractor since 1995
- FACTS: Farming Analysis and Control by Teledetection System
- Methodology closely tuned to Dutch IACS (PIPO)
  - ⇨ Digital vector and scanned PIPO maps for accuracy
  - ⇨ Digital alphanumeric data for efficiency
  - ⇨ Both maps and data for quality control

GeoRas

77 Images processed plus Aerial Mosaic

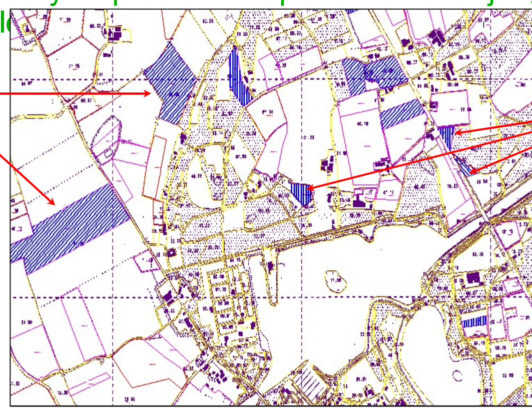
- 1 Site: Aerial Mosaic (19 photos, 292 MB) at 2 m resolution
- 4 SPOT panchromatic images
- 4 multispectral, autumn 1997 images
- 8 multispectral 1998 images for crop identification:
  - ⇨ of which 3 summer SPOT images with MIR band
- Reference year control in all four sites:
  - ⇨ 42 images: 35 Landsat, 7 SPOT multispectral
- Radar backup:
  - ⇨ 1 site Radarsat, 3 sites ERS (16 images)

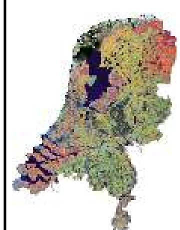
Remote Sensing Control in the Netherlands

- Good topographic data
- Usually wet and cloudy weather
  - ⇨ Early May (OK) and early August (late) usually cloud free
- Advanced reporting for field inspection
- Field work for classification and rapid field visits
- Poor images increase the need for rapid field visits
  - ⇨ Main crop is maize: requires summer image
  - ⇨ Usually maize recognizable during mid- to late June
  - ⇨ In 1998 parts of maize fields did not develop or were not yet recognizable on late July images

Image data influence on field work

- Doubtful fields and rare crops are plotted on maps to serve as guideline for the routing
- Advantages:
  - ⇨shortest route for field work
  - ⇨on virtually all problematic plots individual judgement is available



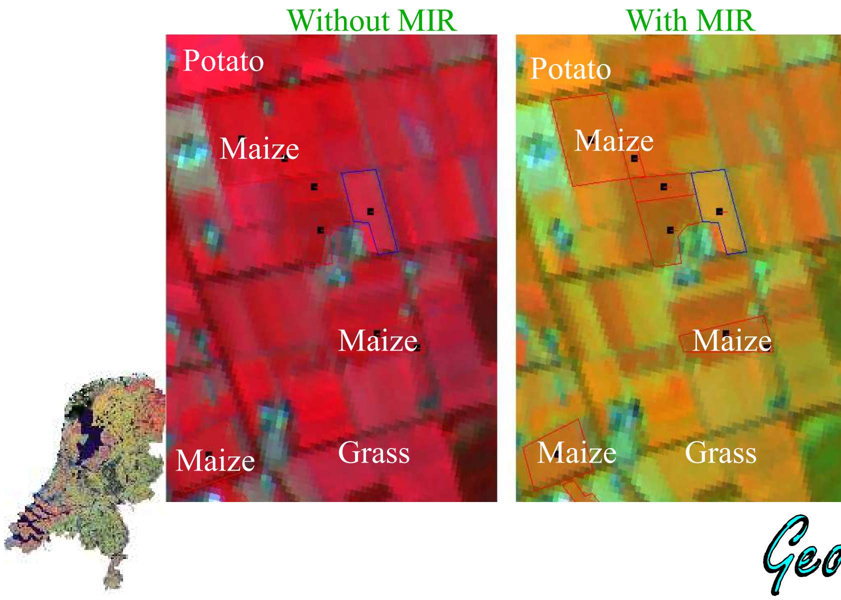


SPOT-4 evaluation

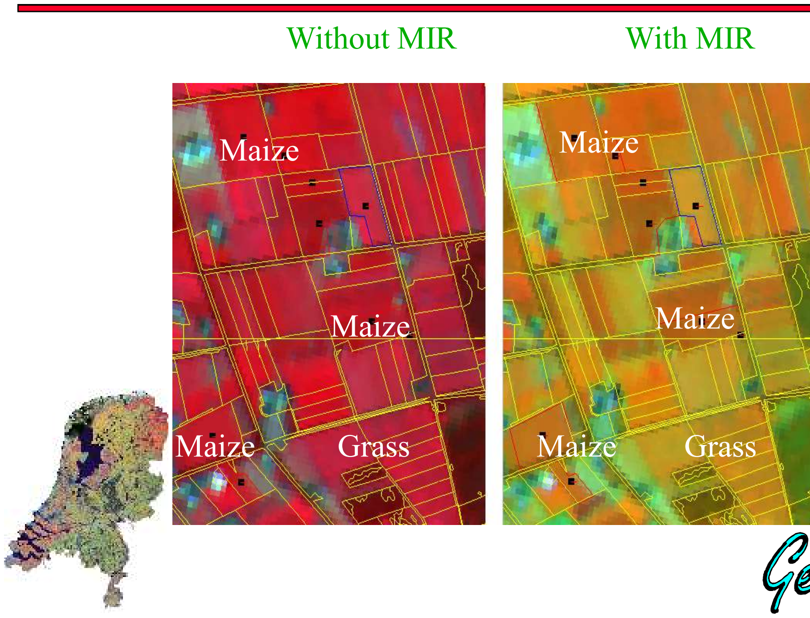
	SPOT-2	SPOT-4
Declared plots	3626	6110
Field work maize plots	86	40
All declared maize plots	330	366
FW maize/all maize plots	**26.06%**	**10.93%**
All FW / all declared plots	**19.06%**	**8.67%**

- Impact of SPOT-4 MIR band most obvious from comparison of two sites: both with a summer image (July 20) and large plots
- 2-2.5 x more maize and other crops were visited on the basis of SPOT-2 image

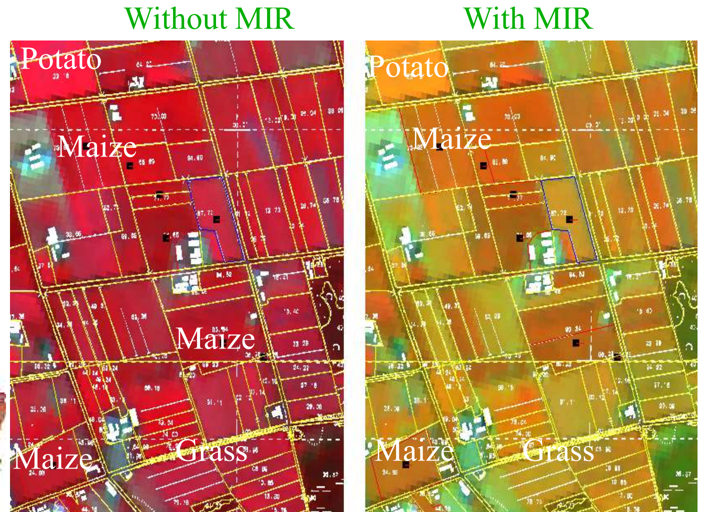
Influence of MIR band: Images only

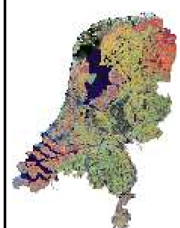


Influence of MIR band: Plus IACS vectors

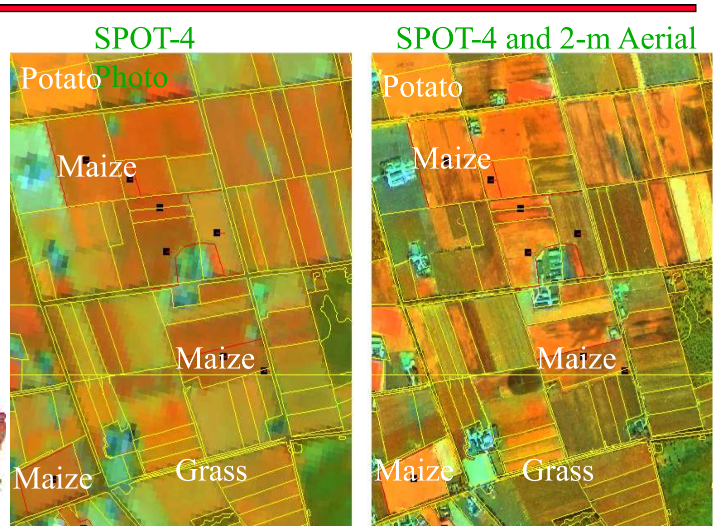


Influence of MIR band: Plus IACS maps





SPOT-4 merged with Aerial Photo



Conclusions

laser

- 1998 was an exceptionally wet and cold year with substantial crop damage
  - ⇨maize was damaged during the growing season
- Crop identification on SPOT-4 proved:
  - ⇨more reliable than SPOT-1, -2, -3 images
  - ⇨same spectral information and more spatial detail
  - ⇨auxiliary data have an important role in diagnosis

GeoRas

4th Conference on

Control with Remote Sensing of Area-Based Subsidies

26-27 November 1998

Test of ***casi*** instrument in the Verona Province

Consorzio CIA

Feasibility study targets

- Objectivity of the control
- Fast delivery of results
- Ground survey reduction
- Technical results analysis

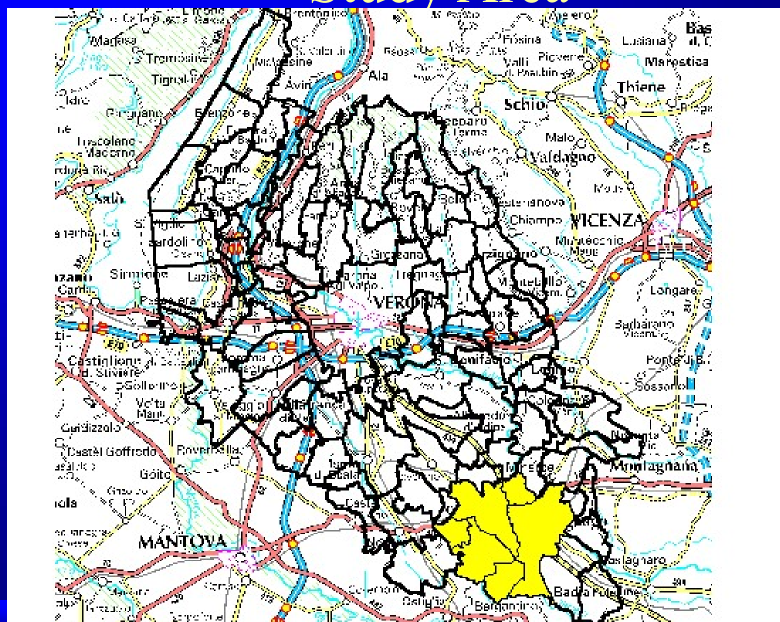
Methodology

- Study area definition
- Planning and implementation of aerial survey
- Orthoimages and “duple” production
- Computer-aided photointerpretation
- Rapid field visits
- Digitization of rapid field visit results
- Results at parcel level
- Analysis of results

Study Area

- Verona Province -- 5 Municipalities
  - Sanguinetto
  - Cerea
  - Casaleone
  - Legnago
  - Angiari

Study Area



Study Area

- 200 km^2
- 16 orthoimages - scale 1:10.000
- 7.016 cadastral parcels
- 600 dossiers

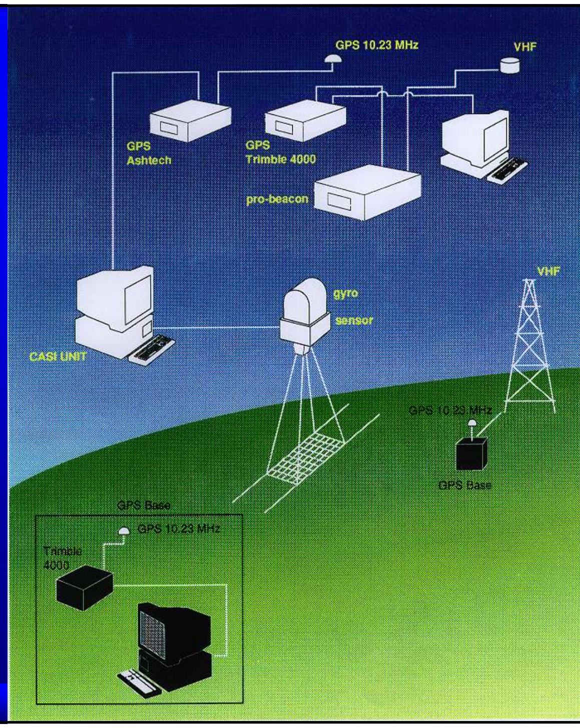
AREA	PROVIN_ID	COD_ISTAT	NOME_COM
13470850	561	5023003	ANGIARI
13506400	590	5023072	SANGUINETTO
38605540	587	5023019	CASALEONE
70297270	563	5023025	CEREA
79278740	566	5023044	LEGNAGO

Planning and implementation of aerial survey

- Flight is carried out using ***casi*** equipment
  *Compact **A**irborne **S**pectrographic **I**mager*
- ***casi*** is an airborne sensor, it acquires multispectral images in the 400 -970 nm electromagnetic range

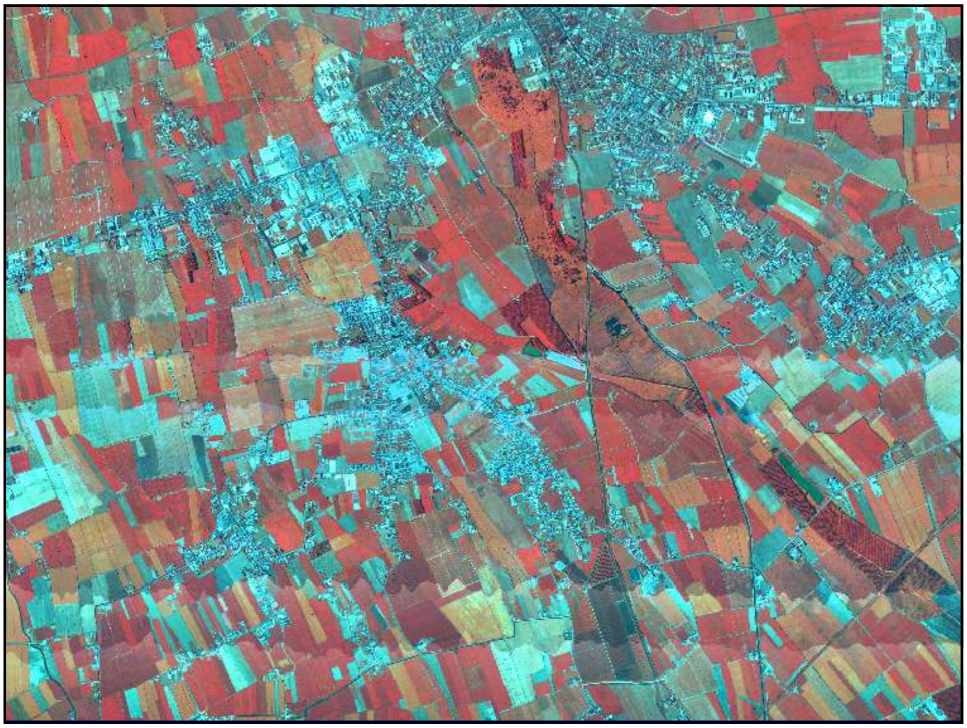
casi - System equipment

- Airborne equipment
  - Digital spectrometer
  - Incident radiance sensor
  - Position orientation system
  - Navigation system based on GPS instruments
- Ground station
  - GPS system
- Images Pre-processing Software
  - Radiometric and atmospheric correction
  - System correction and orthorectification



casi - Acquisition system

- Spatial and spectral programmability
- Spatial resolution varies from 0.7 to 4 metres, it is a function of flight altitude (e.g. 1.5 m at 1000m altitude)
- Geometric Accuracy: +/– 2 pixels
- Spectral Range: 400 - 970 nm
- 19 bands acquired simultaneously out of 288 available

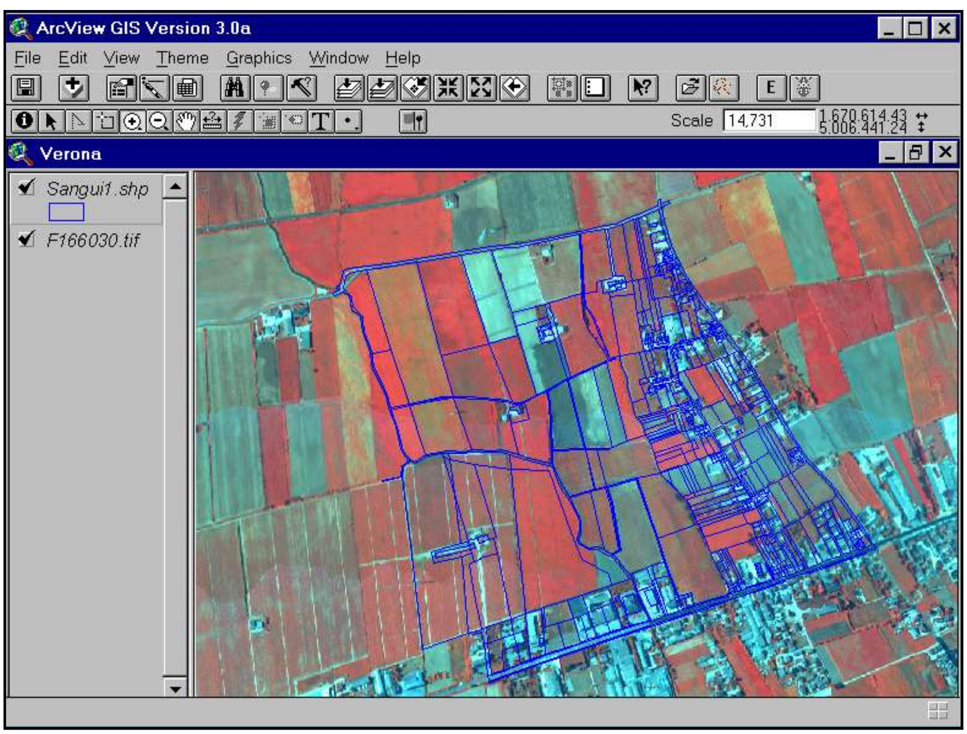


Orthoimage production

- Automatic orthorectification procedure
  - casi raw images
  - GPS data
  - POS data
- Data output
  - TIFF + TFW format
  - 4 bands (visible and infrared bands)
  - Frame as IGM maps - scale 1:10.000
  - Gauss Boaga projection system
  - 180 MB of storage space for each image

Computer-Aided Photointerpretation

- Data
  - Orthoimages
  - Parcel declarations (34bis)
  - Cadastral maps in raster format
- Software
  - ArcView
  - Avenue development software



Computer-Aided Photointerpretation

- Results at parcel level
  - List of positive parcels (5% tolerance compared to declared acreage with maximum 0.5 ha)
  - List of doubtful parcels
  - List of negative parcels
- List of parcels for ground survey (rapid field visit)

Municipality of Sanguinetto

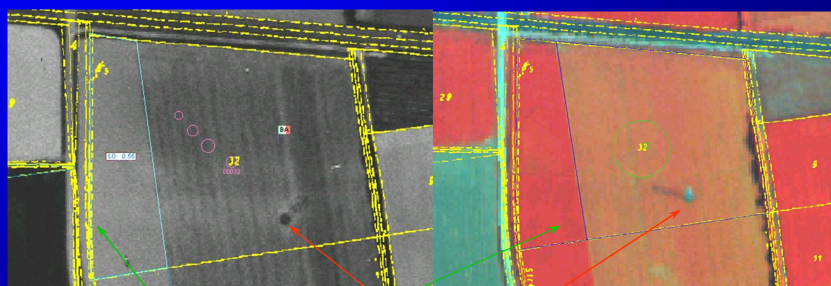
Map 13 parcel 15 - Declared soybean 1.05 ha; other uses 0.35ha

orthophoto

CASI image

Municipality of Sanguinetto

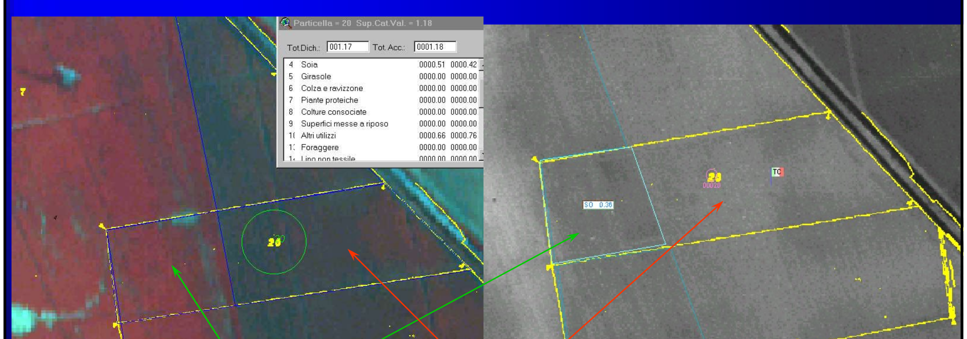
Map 21 parcel 32 - Declared soybean 0.55ha, Sunflower 1.35ha



Soybean 0.55 Sugar beet 1.35

Municipality of Cerea

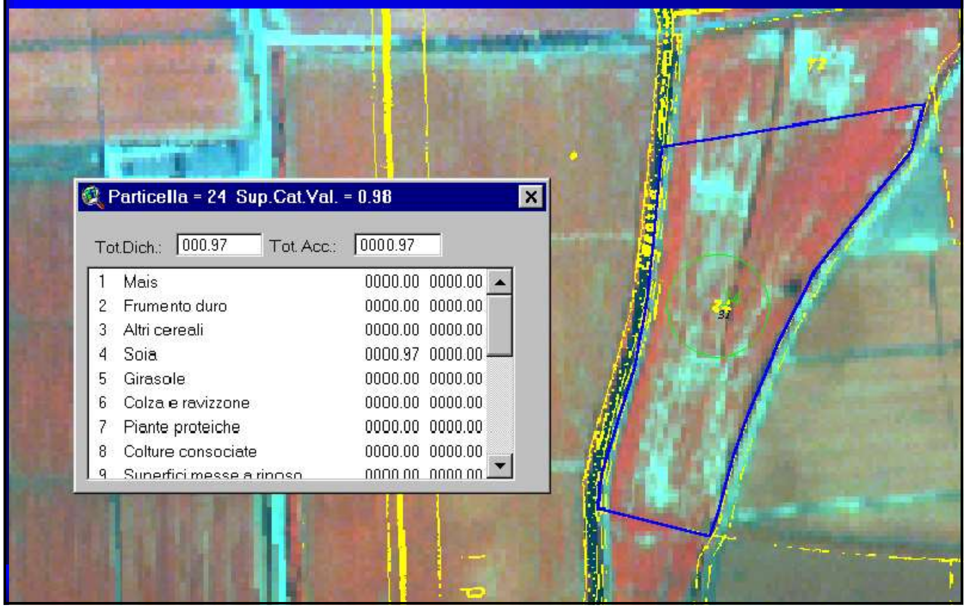
Map 14 parcel 20 - Declared soybean 0.51 ha; other uses 0.66 ha



Soybean 0.36 Other crops 0.81

Municipality of Cerea

Map 16 parcel 24 - Declared soybean 0.97 ha



Rapid field visit

- Doubtful and negative parcels
- “Dupla” plotting
  - Only one casi image band
  - Cadastral map
  - Selected parcels for rapid field visit
- “34bis” module

Digitization on screen

- The results acquired in the field
  - are entered into the system by digitizing the limits recorded in the field and superimposed on the images
  - are used to calculate crop acreage
  - are used to calculate the results at both parcel and farm levels

Analysis of results

Declarations

Crops	Total area (ha)	No. of parcels
Maize	2173.40	2196
Cereal	640.44	593
Soybean	3362.41	3292
Sunflower	84.15	81
Rape	4.52	1
Set aside	340.77	776
Other uses	16.48	23
Forage	44.77	54
Total	6666.94	7016

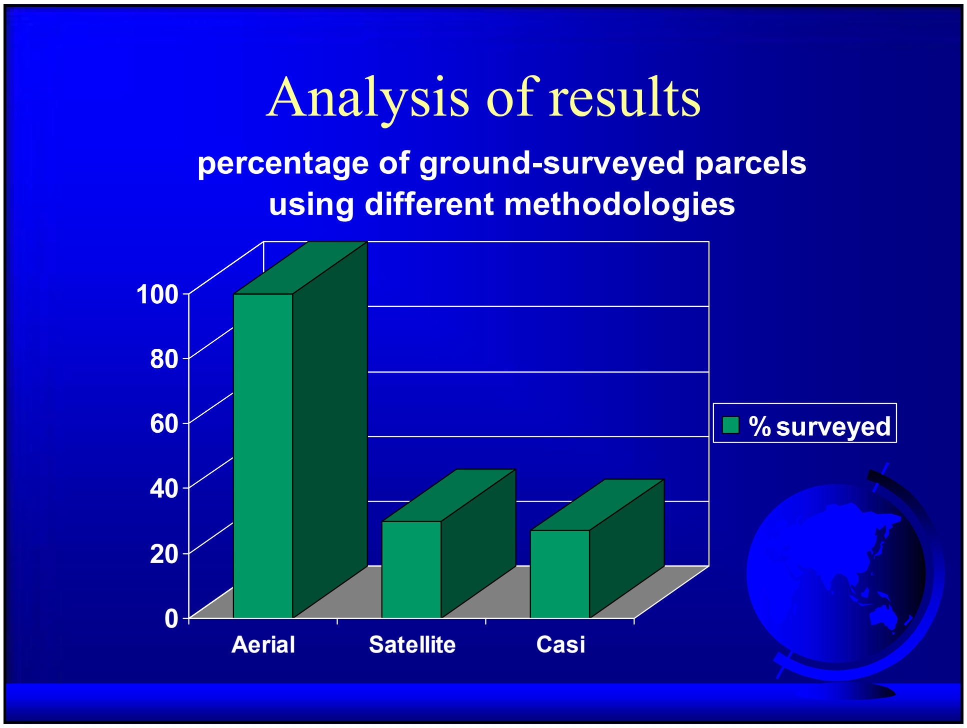
Analysis of results at parcel level

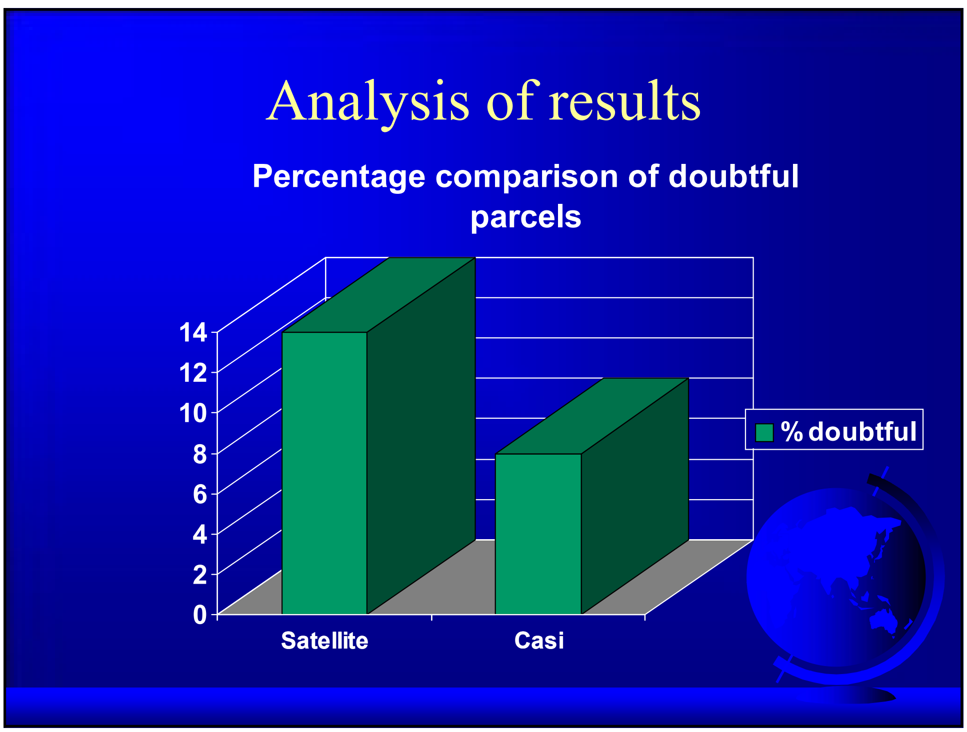
- Total no. of parcels: 7016
  - 5041 parcels confirmed
  - 765 negative for soil cover (10.9%)
  - 638 negative for acreage (9.0%)
  - 572 "doubtful" (8.1%)

- No. parcels to be surveyed on the ground: 1975 (28.1%)

Analysis of results

- Comparison with ground truth data
  - 6329 parcels present same results
  - 115 parcels present different results
  - 572 doubtful parcels


Analysis of results
percentage of ground-surveyed parcels using different methodologies
100
80
60
40
20
0
Aerial
Satellite
Casi
% surveyed


Analysis of results
Percentage comparison of doubtful parcels
14
12
10
8
6
4
2
0
Satellite
Casi
% doubtful

Analysis of results - timetable for spring crops

- flight prior to 15/5
- orthophotos available by 5/6
- selection of sample 15/6
- interpretation 15 June - 15 July
- production of survey material 10/7 - 20/7
- ground surveys starting 15/7

Analysis of results - timetable for summer crops

- flight prior to 15/7
- orthophotos available by 20/7
- selection of sample 15/6
- interpretation 22 July - 15 August
- production of survey material 10/8 - 17/8
- ground surveys starting 18/8

EUROPEAN SPACE AGENCY

Earth Observation Satellites in the year 2000 and beyond

The future in High Resolution

EC/JRC, Technical Conference on Control with Remote Sensing
Venice, 26-27 November 1998
Vincenzo Beruti, ESA-ESRIN, Frascati

Content

- MISSION CHARACTERISTICS EVOLUTION
  - Current mission limitations
  - Future E.O. mission trends
  - Impact on applications
- PLANNED MISSIONS:
  - *Canada*
  - *ESA*
  - *France*
  - *India*
  - *Japan*
  - *USA*
- THE TECHNOLOGICAL CHALLENGE
- THE SERVICE EVOLUTION
- AND IN SHORT TERM?

MISSION CHARACTERISTICS EVOLUTION

 TODAY'S MAJOR LIMITATIONS:

- *COMPLEX MISSIONS*
- *INSUFFICIENT RESOLUTION*
- *NOT ENOUGH BANDS*
- *LONG VISITING TIME*
- *SENSORS' RIGID OPERATING MODES*
- *LONG MISSION PLANNING DELAY*
- *SENSORS NOT APPLICATION ORIENTED*
- *MISSIONS DRIVEN BY TECHNOLOGY*
- *SPREAD DISTRIBUTION HUBS*
- *LONG DELIVERY DELAY*

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CURRENT MISSIONS

Mission	type	sensor	resolut.	bands	swath	visiting time	launch
LANDSAT 5	*single*	*opt.*	*30 m M*	*7*	*180 km*	*16 days*	*1984*
SPOT 1/2/4	*program*	*opt.*	*10 m P* *20 m M*	*1* *4*	*60 km*	*2 days* *26 days*	*86/98*
IRS C/D	*program*	*opt.*	*5.8 m P* *23 m M*	*1* *4*	*70 km* *142 km*	*5 days* *24 days*	*95/97*
ERS 1/2	*program*	*SAR*	*25 m*	*C*	*100 km*	*35 days*	*91/95*
RADARSAT	*program*	*SAR*	*8/25 m*	*C*	*37 km*	*24 days*	*95*

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MISSION CHARACTERISTICS EVOLUTION

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FUTURE SATELLITES TECHNOLOGY TREND:

- *MINI-SATELLITES*
- *SATELLITES CONSTELLATION*
- *VERY HIGH RESOLUTION (less than 1 metre)*
- *HYPERSPECTRAL BANDS*
- *~ ONE DAY VISITING TIME (constellation)*
- *FULLY STEERABLE SENSORS*
- *OPTICAL/SAR SENSOR COMPLEMENTARITY*
- *ON BOARD HYPER STORAGE CAPACITY*
- *ON BOARD PROCESSING*
- *USER-DRIVEN COMMANDS*
- *THEMATIC/APPLICATION-ORIENTED MISSIONS*

MISSION CHARACTERISTICS EVOLUTION

DIRECT BENEFITS:

- Terrain with better details
- Terrain seen with different perspectives
- Enhanced ground responses
- Increased cloud free chances
- More frequent or constant monitoring of phenomena

EXAMPLES OF APPLICATIONS AFFECTED:

- Defense (target identification, nuclear weapons, vehicles, etc.)
- Environment (pollution identification, measurements, classification, discharge plume, etc.)
- Infrastructure (identification, plan, inventory of urban and residential areas for city, regional and national governments)
- Mapping (features location at lower scale, no GCP's needed, accurate and inexpensive map generation and update)
- Elevation maps (more accurate digital elevation models from more precise stereo pairs imagery)

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MISSION CHARACTERISTICS EVOLUTION

 BENEFITS TO AGRICULTURE:

- Few metres multi-spectral imagery will allow precision farming, guiding all the phases (irrigation, fertilization, etc. up to harvest)
- Improved coverage will enhance the monitoring of growth stages and effects of treatments
- Both features will improve the disasters damages on the cultivation (storm, drought, etc.)
- Identification and classification of cultivated areas will increase in detail and effectiveness

PLANNED MISSIONS

- *Canada*
- *ESA*
- *France*
- *India*
- *Japan*
- *USA*

PLANNED MISSIONS

- The information contained in the following tables are based on today's knowledge. Operators are sometimes reluctant to distribute parameters not yet fixed or still confidential.
- Programs may always change for budget or policy reasons and other unpredictable events.
- The tables must be seen as a confirmation of trends in the years beyond 2000 toward higher performance and application-oriented missions.

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PLANNED MISSIONS

- New countries will enter the business, while satellites and launcher costs will decrease
- Satellite cycle from design to launch will be reduced to a few years
- Companies will offer spacecraft off the shelf for thematic applications and will exploit the services
- The marketing focus will shift from global to regional applications mainly

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PLANNED MISSIONS - CANADA

Mission	type	sensor	resol.	bands	swath	visiting time	launch
Radarsat 2	*program*	*SAR*	*5 m*	*C*	*30 km*	*16 days*	*2001*
Radarsat 3	*program*	*SAR*	*3 m*	*C/L*	*30 km*	*16 days*	*2004*

PLANNED MISSIONS - ESA

Mission	type	sensor	resolution	bands	swath	revisit time	launch
ENVISAT	*single*	*SAR*	*30 m*	*C*	*100 km*	*5 days*	*2000*

EARTH WATCH PROGRAM CANDIDATES

Mission	type	sensor	resolution	bands	swath	revisit time	launch
SKY MED	*const. 4*	*SAR*	*3 m*	*X*	*40 km*	*1 day*	*2003*
SKY MED	*const. 3*	*OPT*	*2.5 m P*	*1*	*15 km*	*1 day*	*2003*
			5 m M	*3*			
			7.5 m SWIR	*1*			
LUCIA	*single*	*OPT*	*5 m P*	*1*	*50 km*	*TBD*	
			20 m M	*17*			
FUEGO	*const. 3/9*	*OPT*	*36/72 m*	*4*		*30 min*	

PLANNED MISSIONS - ESA

EARTH WATCH PROGRAM CANDIDATES

Mission	type	sensor	resolution	bands	swath	revisit time	launch
Vegetation	const. 5	opt.	20-40 m M	TBD		1 day	
DIAMANT	single	opt.	5 m M	12		3 days	
Rapid EYE	const. 10	opt.	5 m M			< 1 day	
XSTAR	const. 2	opt.	20 m M	10		4.5 days	
TerraSAR	single	SAR	1-3 m 8 m	X L		2-3 days	
SIOUX	const. N	SAR	1 m 30 m Scansar	X	10 km 150 km		
Disaster mon.	const. 3	SAR	3 m 25 m Scansar	X	20 km 125 km	< 1 day	

PLANNED MISSIONS - FRANCE

Mission	type	sensor	resolution	bands	swath	visiting *time*	launch
SPOT 5	*program*	*opt.*	*5 m P* *2.5 m THR* *10 m M* *20 m SWIR*	*1* *1* *3* *1*	*60 km*	*8 days*	*2002*
3S	*const.*	*opt.*	*2 m P* *8 m M*	*1* *5*	*60 km*	*5 days*	*2003/4*

PLANNED MISSIONS - INDIA

Mission	type	sensor	resolution	bands	swath	visiting *time*	launch
IRS-P5 Cartosat 1	*program*	*opt.*	*2.5 m P*	*1*	*25 km*	*8 days*	*2000*
Cartosat 2	*program*	*opt.*	*< 1m P*	*1*	*pointable*		*2003*
IRS-P6 (2A) ResourceSat 1	*program*	*opt.*	*6 m M* *23 m M*	*3* *4*	*70 km* *142 km*	*8 days*	*2001*
IRS-2C ResourceSat 2	*program*	*opt.*	*6 m M* *23 m M*	*3* *4*	*70 km* *142 km*	*8 days*	*2003*
IRS 3	*single*	*SAR*		*multi-frequency*			*2004*

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PLANNED MISSIONS - JAPAN

Mission	type	sensor	resol.	bands	swath	visiting *time*	launch
ADEOS 2	*single*	*AMSR* *GLI* *ILAS II* *POLDER*			*6 km*	*global*	*1999*
ALOS	*single*	*opt.* *SAR* *Scansar*	*2.5 m P* *10 m M* *10 m*	*1* *4* *L*	*35/70 km* *70 km* *70 km* *100 km*	*2/46 days*	*2003*

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PLANNED MISSIONS - USA

Mission	type	sensor	resolut.	bands	swath	visiting time	launch
LANDSAT 7 (NASA)	*single*	*opt.*	*15 m P* *30 m M*	*1* *7*	*180 km*	*16 days*	*1999*
IKONOS 1/2 (Space Imaging)	*const. 2*	*opt.*	*0.8 m P* *3.3 m M*	*1* *4*	*11 km*	*1 day*	*1998/1999*
QUICK BIRD 1/2 (Earth Watch)	*const. 2*	*opt.*	*0.8 m P* *3.3 m M*	*1* *4*	*22 km*	*3 days*	*2000/2001*
ORBVIEW 3/4 (Orbimage)	*const. 2*	*opt.*	*1 m P* *4 m M* *8 m H*	*1* *4* *250 HSI*	*8 km*	*3 days*	*2000/2001*

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THE TECHNOLOGICAL CHALLENGE

 The very High Resolution satellites and, in most of the cases, the related constellation, will challenge the ground segment technology with a large spectrum of requirements:

- *Very frequent passes*
- *Complex mission planning*
- *Very high transmission rates*
- *Very large data volume*
- *Data compression (at all levels)*
- *Data transmission from main hub to users*
- *Fast and complex data processing*
- *Thematic products*
- *Information delivery*

 Synergies with other space application segments will be exploited for mutual benefit:

- *Telecom applications*
- *Precision navigation*
- *Meteorology*

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THE TECHNOLOGICAL CHALLENGE

The operational infrastructure will be characterized by three major elements:

- *cheap operation costs*
  - small/cheap/flexible acquisition chains
  - automation of operations
  - redundancy
- *fast response to user requirements*
  - open and standardized user interface tools
  - decentralized and distributed multi-mission hub network
- *integration with other information systems*
  - integration with positioning systems
  - parallel use of meteo parameters
  - merged use of non-space information

THE SERVICE EVOLUTION

The service scenario will evolve along four major axes:

- *delivery of information*
  - multi-source products
  - application oriented products
  - multi-temporal products
  - global data availability
- *near real-time/real-time delivery*
  - use of cheap channels
  - large bandwidth availability
  - on-line archives
- *interactive services*
  - user-driven ground segment
  - product scalability
  - remote processing selection tools
- *synergistic services*
  - combined space and in-situ products
  - integrated multi-discipline ventures
  - relationship with information service providers

AND IN SHORT TERM? For operations in the 1999-2000 period

- Landsat 5, Spot 2, IRS-C, ERS-1/2 and Radarsat will continue the current operations, enhancing their services to the users, via the established data distribution: *Eurimage (I), Spotimage (F), Euromap (D), Radarsat International (CND)*

- SPOT 4 (1998) and IRS-D (1997) entered in operation in 1998 and are ensuring continuity of services to their users, with increased performance in terms of resolution and visiting time (utilizing both satellites in the programme)

- New entries in 1999:

  - IKONOS 1 (USA, to be launched in December 1998):
    - Operated by Space Imaging
    - Covers most of Europe, from a station in Greece
    - Expected operation start: February 1999
    - IKONOS 2 to follow in 1999

  - Landsat 7 (USA, to be launched in April 1999):
    - Operated by NOAA/NASA
    - Acquired by ESA in Fucino (I), Neustrelitz (D) and Kiruna (S)
    - Expected operation start: June 1999

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AND IN SHORT TERM? For operations in the 1999-2000 period

- IKONOS 1 CHARACTERISTICS:

  - Orbit: 680 km altitude, sun synchronous
  - Resolution: 11x11 km at 0.82 m
    11x11 km at 3.28m
  - Bands (µm): 0.450-900 P
    0.450-530 V
    0.520-610 V
    0.640-720 V
    0.770-880 NIR
  - Dynamic range: 11 bits
  - Steerable sensors, several modes of operations
  - Data rate: 320 Mbits/sec
  - Revisiting time: < 3 days (only 1 day with IKONOS 2)
  - Accuracy: 1:24.000 without GCP's (on-board GPS and pointing devices)
  - 7 preprocessing levels (system corrected, geometrically corrected, ortho-corrected, stereo, pan-sharpened multispectral, multispectral and image mosaics)
  - Formats: TIFF, GeoTIFF, BSQ, LAN, etc.
  - On-board tape recording

  - Space Imaging Europe (based in Athens) is the distributor for Europe

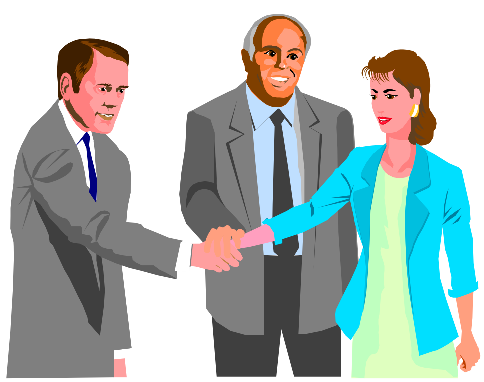
AND IN SHORT TERM? For operation in the 1999-2000 period

 LANDSAT 7 ETM+ CHARACTERISTICS:

- Orbit: 705 km altitude, sun synchronous
- Resolution: 185 km panchromatic strip at 15 m
  185 km multi-spectral strip at 30 m
- Bands (μm) 0.500-0.900 P
  0.450-0.520 V
  0.520-0.600 V
  0.630-0.690 V
  0.760-0.900 NIR
  1.550-1.750 NIR
  10.40-12.50 SWIR
  2.080-2.350 SWIR
- Selectable high and low gain
- Dynamic range: 8 bits
- Data rate: 85 Mbits/sec
- Revisiting time: 16 days
- Accuracy: 300 m
- Preprocessing levels: raw, system corrected, geometrically corrected, atmospherically corrected, strip products (7 or 3 bands selectable or PAN, 180 m resolution, variable sizes)
- Formats: Ceos, Fast, HDF
- On-board tape recording
- Eurimage (based in Rome) is the distributor for Europe

Conclusion

Earth Observation is moving soon and fast towards the fulfilment of the increased user needs



Thank you

esa

1

Control with Remote Sensing of Area-based Subsidies
Venezia, November 26, 1998

Summary of SAR results

Guido Lemoine
MARS New sensors and methods

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Overview

- **HISTORY: Why use SAR?**
- **STATUS: Scale and scope in the Control program**
- **USE: Assessing the current use in CAPI**
- **EXAMPLE: How does it work?**
- **CONCLUSIONS: Future use of SAR data**

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Why use SAR?

- SAR is an active sensor, independent of (sun) illumination
- SAR has day/night, all weather capability
- Therefore, SAR acquisitions are reliable and consistent
- RADARSAT introduces improved spatial resolution

- SAR data services improving (timely)
- SAR software now widely available
- SAR expertise growing
- ERS data is cheap, RADARSAT is not (multi-T use required)

Scale and scope in Control project

Scale

- 12 contractors received SAR products
- All member states > 45°N (not E, P, I, H)
- 106 ERS (111 in 1997) and 41 RADARSAT (4)
- Total expenditure 152.5 KECU (109) or 10% (9%)

Scope

- Backup for missing optical data (mainly ERS)
- Widening of RADARSAT evaluation
- Promoting integration in CAPI environments

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Use of SAR in 1998

- WWW questionnaire to 12 contractors
- Emphasis on assessing operational use of SAR in CAPI
- Evaluation of technical constraints
- ERS and RADARSAT specific questions
- Response good: 9 replies in 2 weeks. Total 10.

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Survey results

- 3* contractors have tried out SAR data use in CAPI
- Located in UK, Ireland and Finland
- 7 contractors have NOT used SAR data (2 unknown)

For SAR users:

- SAR data handling is not a problem, sometimes serviced by third parties
- SAR software solutions are not flagged as problem
- RADARSAT Fine Mode data preferred source
- Continuation of SAR data use requested

* During the Venice meeting we were informed that also one of the German contractors had used RADARSAT data more extensively than reported in the questionnaire. Therefore, the number of contractors should be 4.

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Survey results (2)

For most (other) users:

- SAR interpretation is difficult
- Leads to quick rejection if optical data is available, even when timing is not optimal
- Reported difficulties:
  - inconsistency of SAR signatures,
  - confusion between crop types
  - lack of SAR expertise in CAPI
  - small field size

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Example SAR data use

- Rice area and growth stage mapping in Guyana (F)
- At the request of ONIC, with support from SOTEMA
- Simple, because rice is optimal crop for SAR demo
- Simple, because site is rice only in a non-rice background
- Interesting, because classical case for SAR promotion
- Interesting, because confirming consistency with other SAR & rice studies across the globe

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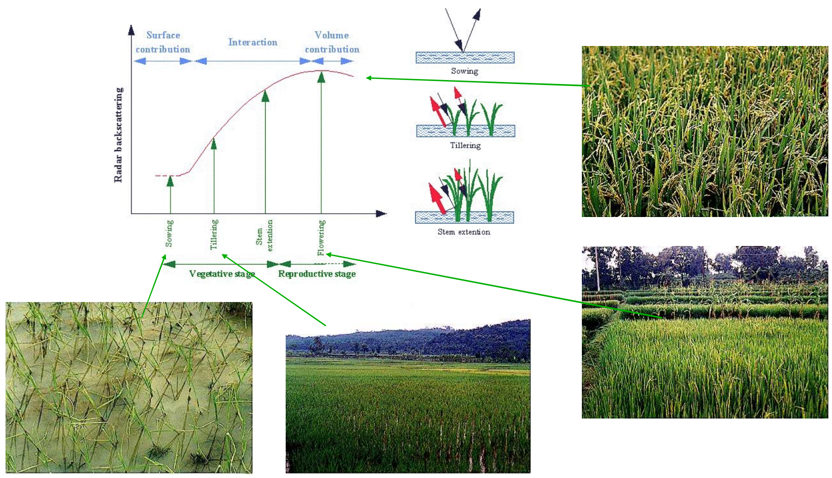
Rice growth stages and SAR backscattering



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Example SAR data use (2)

Data for MANA site:

- **RADARSAT fine mode: 20 June (F5N), July 14 (F1F), August 7 (F5N) and September 24 (F5N)**
- **RADARSAT data cover day 170 to 266, 80% of full rice cycle.**
- **ERS PRI: 7 July and 11 August**
- **SPOT 4: 5 and 11 August (cloud covered, no SWIR)**
- **Digitised field boundaries: processed by SOTEMA**

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Example SAR data use (3)

Data processing steps:

- SPOT data: ortho-rectification carried out by SOTEMA
- SAR data: geo-referencing to ortho-SPOT (~ 8 GCPs)
- SAR data: speckle filtering, calibration, generation of derived products
- Supervised classification of SAR products
- Generation of annotated polygon map
- Software used: standard image processing and radar tools (e.g. ERDAS, PCI, ENVI)

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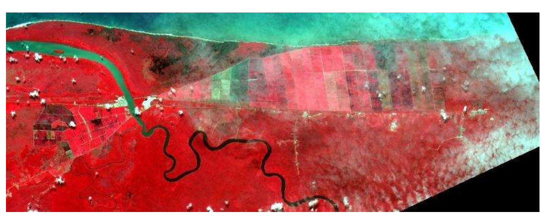
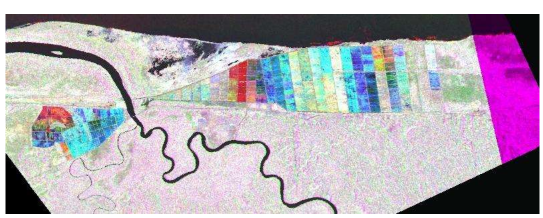


SPOT 4 of August 11, 1998



RSAT composite of June 20, July 14 and August 7, 1998

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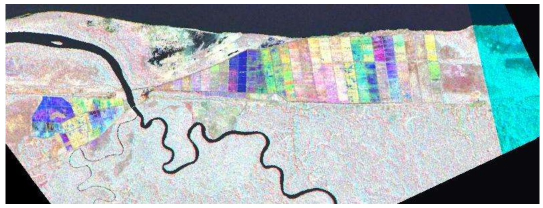
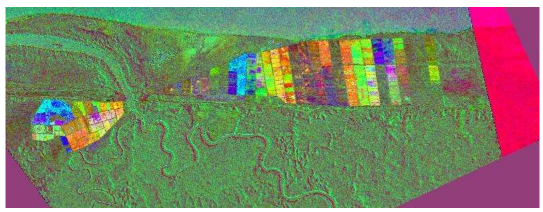
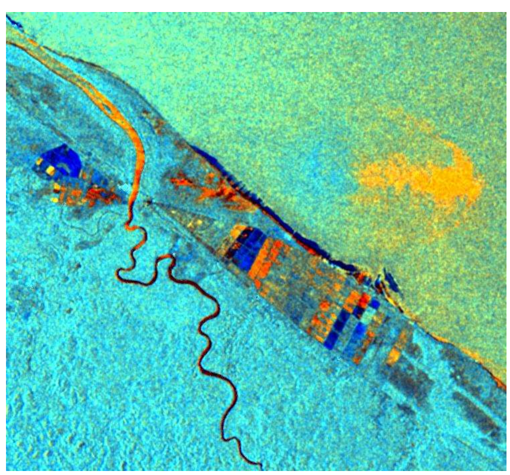


RSAT composite of July 14, August 7 and September 24, 1998



RSAT difference image composite



ERS composite of July 7, August 11 and difference image

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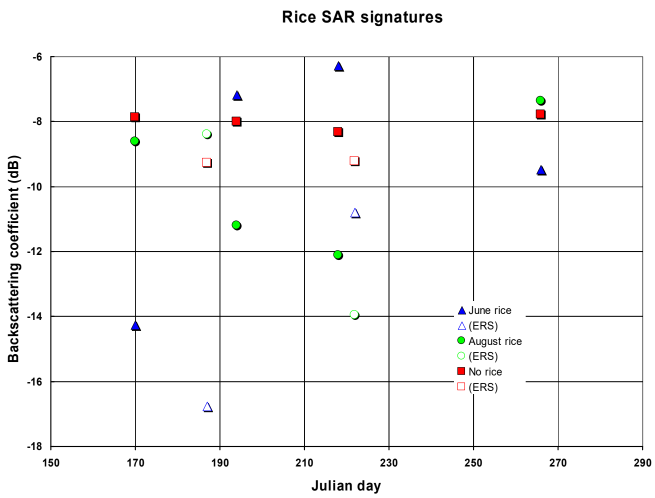

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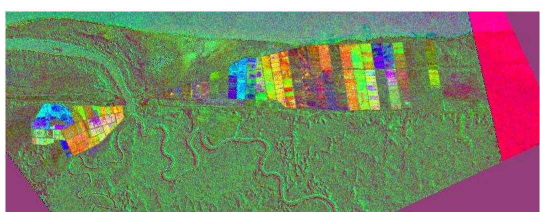
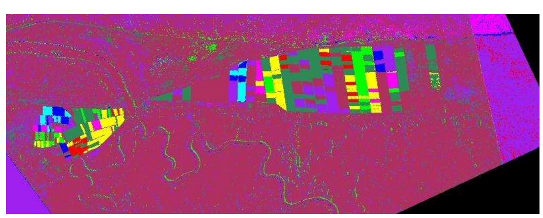


RSAT difference image composite



RSAT based annotated polygon map

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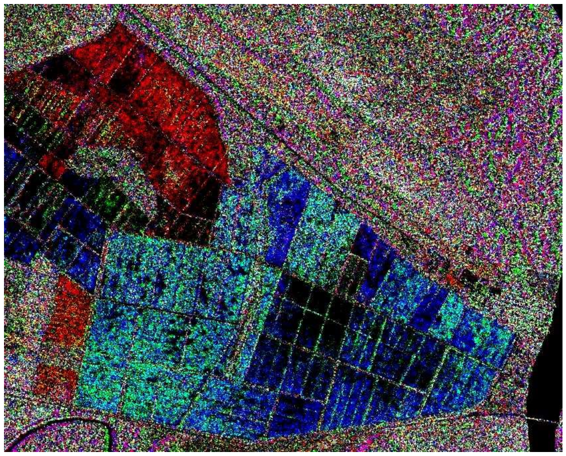

RSAT's spatial resolution is not bad either…

Conclusions

- SAR response shows expected behavior (robustness)
- Not too difficult to "translate" into required information
- Fine mode RADARSAT has excellent spatial resolution, ERS better radiometric resolution
- Example highlights all the key aspects of SAR
- Performance, in this case, cannot be matched by optical systems

Fusion Techniques for Hybrid Optical and SAR Data

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Wolfgang Fischer,
Klaus Steinnocher, Austrian Research Centers, Seibersdorf

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Introductory Remarks

- Both Austrian *control sites* (LINZ and MARC) were *completely covered by optical data* in 1998 (3 satellite images, 1 aerial orthophoto). Interpretation and *control* have *successfully* been *finished*.
- *SAR* (RADARSAT and ERS) data were delivered but *not used* for interpretation
- *Further investigations with SAR data* were *encouraged* during the intermediate meeting, although without additional optical image data . . .
- *Good quality* of landuse classification and reliable assignment to parcels of applicants *could not be expected*, due to
  - ☹ *Significant speckles and poor spatial resolution with respect to parcel size*
  - ☹ *Limited number of acquisiton dates (3)*
  - ☹ *Unfavourable distribution of acquisition dates* (18 Apr, 23 May, 8 Jun)
- Our decision: ➡ **Adaptive Fusion** of one high resolution optical image with multitemporal SAR images in order to
  - ☺ *Remove speckles* while
  - ☺ *Preserving and even enhancing edges*
  - ☺ *Without* severely *affecting intensity values of SAR*

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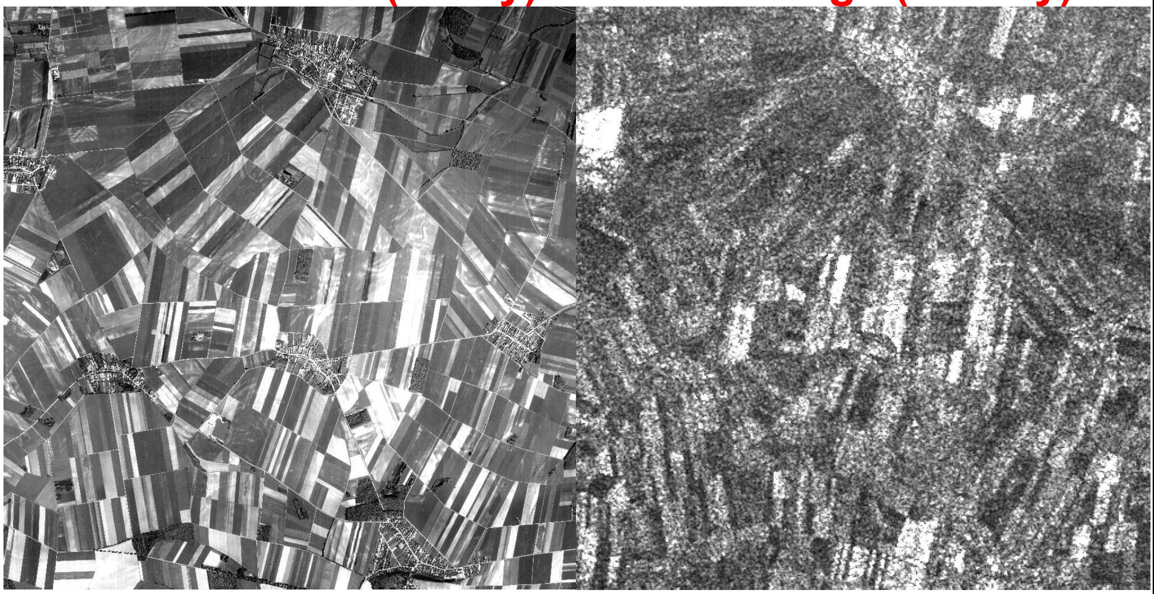
Panchromatic (9 May) and ERS Image (23 May)



Pixel size 6m
derived from 1m OP

- ❑ Part of control site MARC
- ❑ Small and narrow parcels a prevalent
- ❑ Left: simulated IRS1C pan

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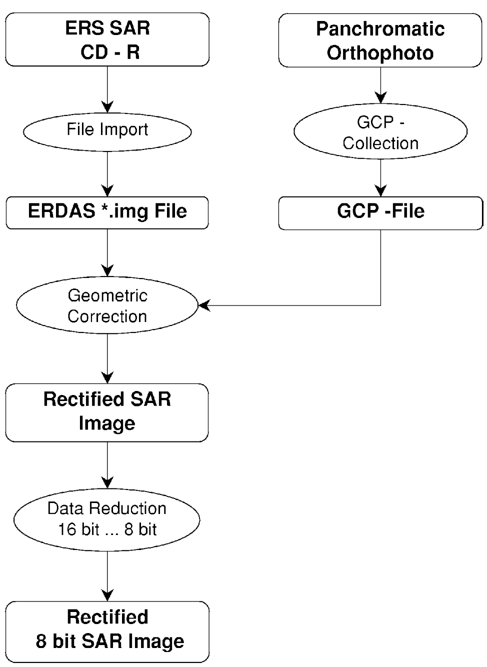

Adaptive Image Fusion Flow Chart

Left: Geometric Correction of SAR image ("Co-registration")

Below: Filter process

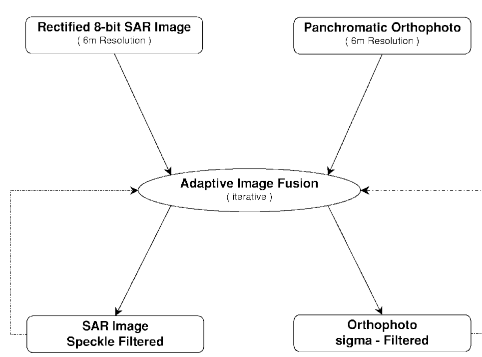

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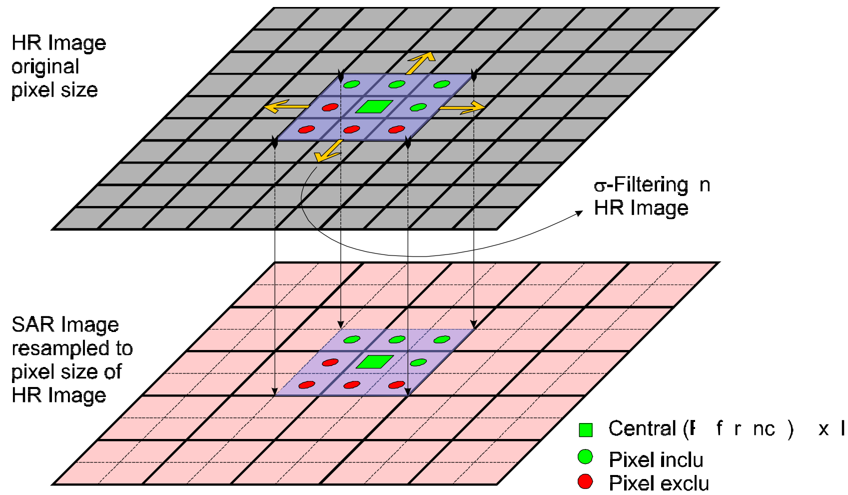
Image Fusion by σ-Filtering

(Edge preserving, noise removing filter)



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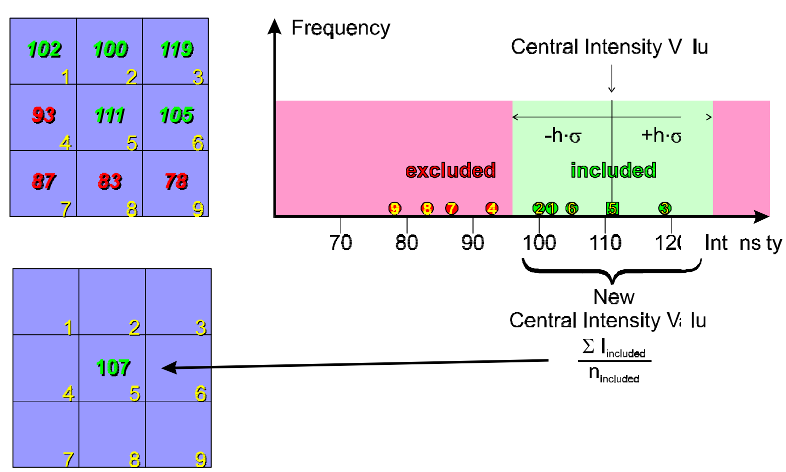
The Principle of σ-Filter



- Filter calculates the *mean value* of all pixels within ±h·σ-interval
- Frequency of noise determines size of filter window
- Amplitude of noise determines magnitude of σ and factor h
- Number of iterations determine steepness of edges

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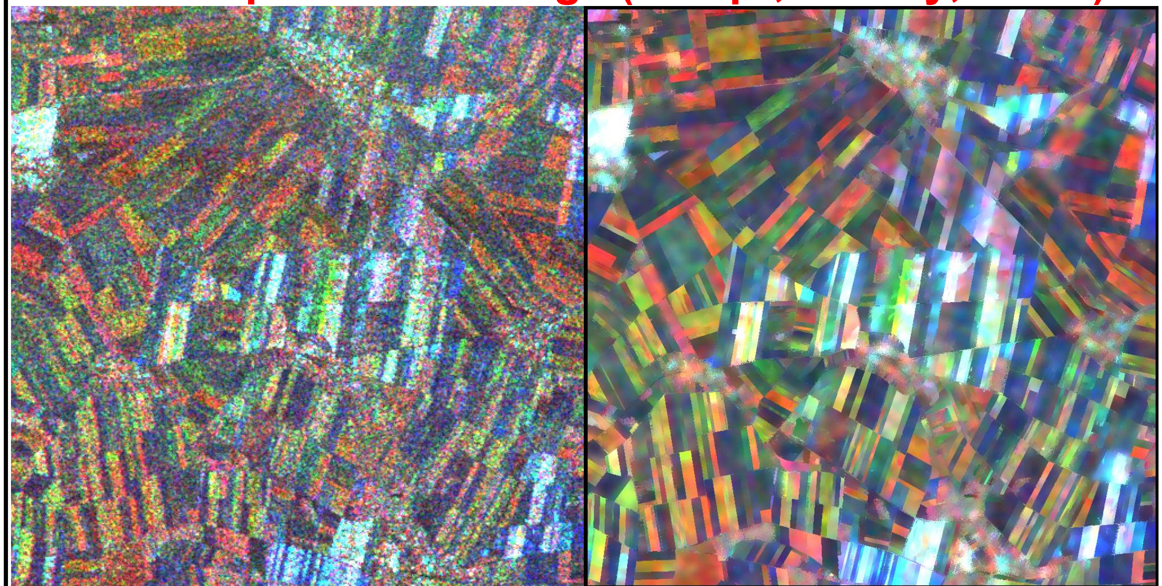
Multitemporal SAR Image (18 Apr, 23 May, 8 Jun)



Original Multitemporal Image

Image after Filtering and Fusion
(6 m pixels,13 x 13 → 1, 3 iterations)

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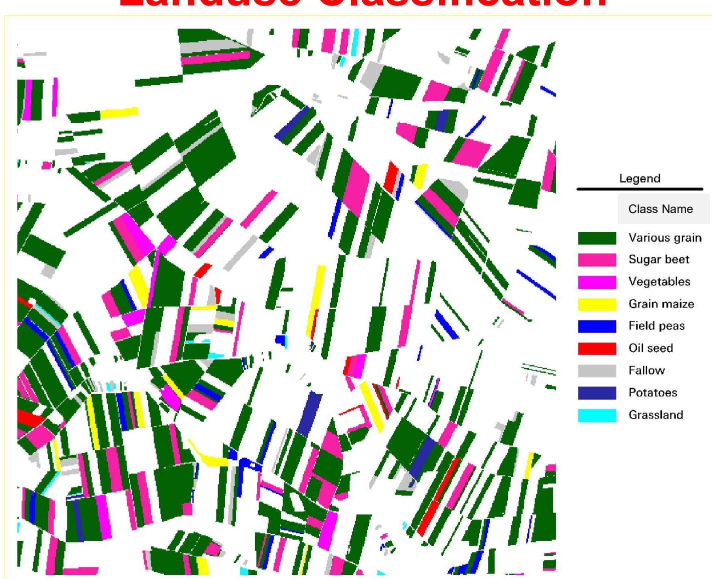
Landuse Classification



Ground truth data:
Result of the IACS control 1998 as anonymous data set

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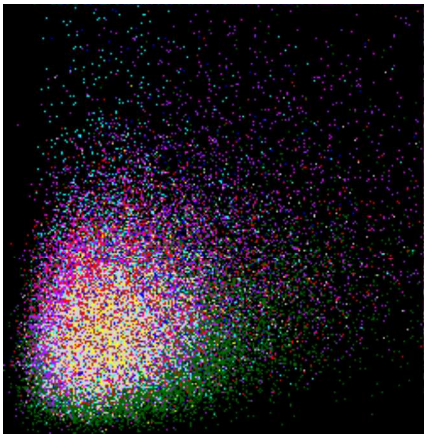
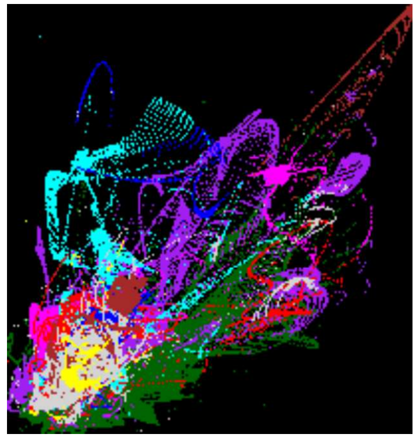
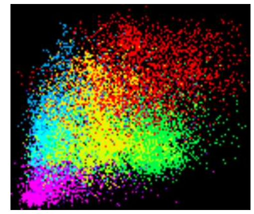
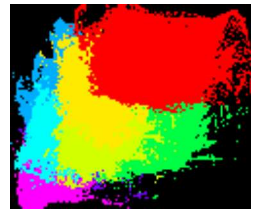
Feature Spaces (FS)









Left: FS of original
Centre: FS of filtered

SAR image (▹18 Apr against ▵23 May)

For comparison of filter influence:
Right upper: FS of original
Right lower: FS of filtered

NIR band of multitemp. optical image

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Result of Classification

(Confusion analysis)

▽ Multispectral Classification ▷ Reference Data

	1	2	3	4	5	6	7	8	9	%
1	224641	5245	828	1873	5113	1140	16237	814	1737	87.22
2	13678	43445	6726	8464	5714	3641	5618	4071	285	47.41
3	600	2577	2699	805	1873	72	91	195	25	30.21
4	353	831	317	940	73	470	167	69	5	29.15
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	463	3406	432	242	276	619	102	1419	16	20.34
9	0	0	0	0	0	0	0	0	0	0
	93,71	78,27	24,53	7,63	0	0	0	24,61	0	74.14

Classes: 1 various grain, 2 sugar beet, 3 vegetables, 4 grain maize, 5 field peas, 6 oil seed
7 fallow, 8 potatoes, 9 grassland

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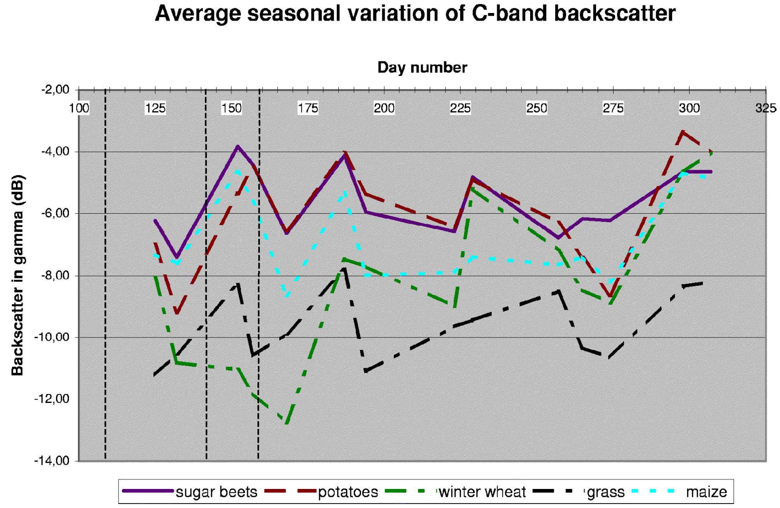
Acquisition Dates and Average Seasonal Backscatter

(Our acquisition dates: vertical dashed lines)



Reference: Schotten, van Rooy, Janssen (1995): Int. Journal of Remote Sensing pp.2619-2637

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Final Remarks

- Classification results were a bit disappointing because of
  - Insufficient information (as proved by other investigations) due to
    - ☹ *inadequate number* and
    - ☹ *non-optimal distribution* of acquistion dates
  - Automatic classification with conventional maximum likelihood rule
    - ☹ certainly *not optimal for multitemporal classification*
    - ☹ and *not appropriate if SAR data* are used
- Quality of preprocessing was *very encouraging* as the
  - **Adaptive Fusion** approach proved that
    - ☺ *Speckles* can be *removed*
    - ☺ *Edges* (i.e. field boundaries) can be *enhanced*

References:

Schotten C.G., van Rooy W.W.L., Janssen L.L.F. (1995): Assessment of the capabilities of multi-temporal ERS-1 SAR data to discriminate between agricultural crops. Int. Journal of Remote Sensing, Vol.16/14, pp.2619-2637.

Steinnocher K. (1997): Application of adaptive filters for multisensoral image fusion. Proceedings IGARSS'97, Singapure, pp.910-912.

Steinnocher K. (1998): Objects, edges and texture in feature based image fusion. Expert Meeting on Satelltie Data Fuson Techniques for Forest and Landuse Assessment. ISPRS Commission VI WG IV, Freiburg 1997, pp.77-81.

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Control with Remote Sensing of Area-based Subsidies
Venezia, November 26-27, 1998

Complementary use of RADARSAT and optical data

Richard Kidd, Guido Lemoine
MARS New sensors and methods

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Overview

- **OBJECTIVE: Prove complimentarity of SAR and optical data**
- **RATIONALE: Improve consistent image classification methodology for control**
- **DATA: Typical acquisition scenario for cloudy areas**
- **PROCESSING: What needs to be done?**
- **RESULTS: An example for EU conditions**

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Objective & rationale

- Timely optical data acquisitions sometimes difficult due to weather, with 1998 a typical example season
- This can lead to significant delays in the start of the control activities
- But also, may reduce the chance to reliably detect certain crop types
- SAR does not have the weather constraint
- SAR is sensitive to other vegetation characteristics
- The use of SAR in combination with optical may, thus, advance or optimise the CAPI workload

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Data

Optical

- March 9 TM image, poor quality
- SPOT XS May 2
- SPOT XS August 8

SAR

- RADARSAT Fine Mode (F3N): April 21, May 15, June 8, July 2, geocoded by NRSC

Polygon data

- “Anonymised” coverages (ArcInfo) from NRSC

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Processing requirements

Optical (Level 1B)	SAR (PRI)
Ortho-rectification	Geo-coding
Radiometric correction	Calibration
	Speckle filtering
Multi-spectral composite	Multi-temporal composite
Vegetation index (optional)	Difference image (optional)

All possible with standard software tools

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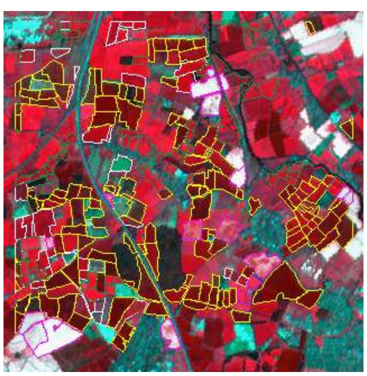
SPOT XS: May and August



02/05/98

05/08/98

White:Barley, Yellow: Wheat, Dark Green: Grassland, Magenta:OSR

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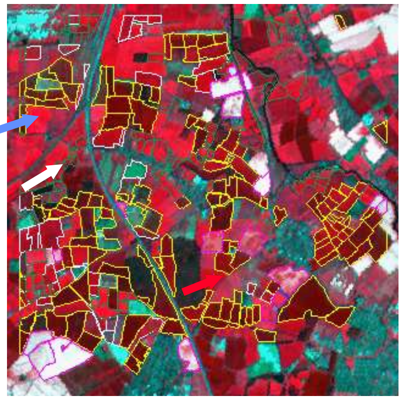
SPOT XS & multi-temporal RADARSAT (20m)

Example results



02/05/98

R:08/06 G:15/05 B:21/04

White:Barley, Yellow: Wheat, Dark Green: Grassland, Magenta:OSR

Conclusions

- **SAR data processing does not cause problems**
- **SAR response conforms to expectations**
- **Behavior is consistent over the site (and between sites, and years)**
- **Complementary use is obvious in particular cases (e.g. oil seed rape, grass land and cereals)**
- **RADARSAT spatial resolution is appropriate**
- **Potential for automated flagging of suspicious cases, especially due to availability of polygons (statistics)**
- **Potential to avoid delays due to image availability**

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Conclusions (2)

- Overall, SAR, and particularly RADARSAT data use, is recommended
- Scale of the activity may need to be reviewed, also pending image contract negotiations
- Amendment to ITT emphasizes the contractor’s ability to use SAR data (> 50ºN)
- JRC could play a more prominent role as a “SAR help desk” for contractors and administrations.

Radarsat Geometric and Radiometric Correction for Agricultural Monitoring in Europe

A Sowter, P Burgess Allen - NRSC
P Bird - DERA

Control with Remote Sensing of Area Based Subsidies
26-27 November 1998
Venice

Introduction

- **SAR is proving to be a useful tool in support of agricultural applications in Europe**
- **ERS SAR has already been used for many years within the Control of Subsidies contract**
- **Radarsat Fine Mode data was shown to be of great potential in 1997 and has now been used as part of the 1998 contract in the UK**

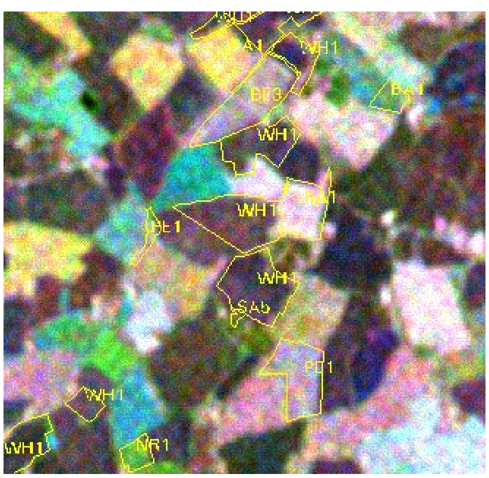
Benefits of Fine Mode

The Fine Mode product brings the highest possible resolution SAR available from a commercial satellite.

The Fine Mode product is:

- 8-10 m resolution
- 1 look
- Choice of 5 incidence angles
- 50 km x 50 km image size
- Fast turnaround between reception and delivery

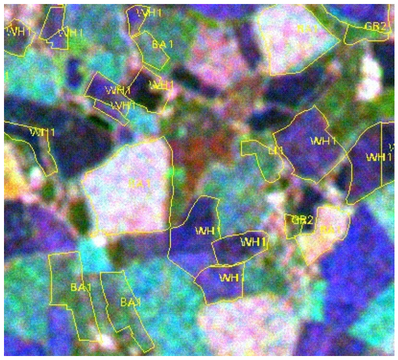
This potentially will give a much better degree of accuracy and reliability than ERS.



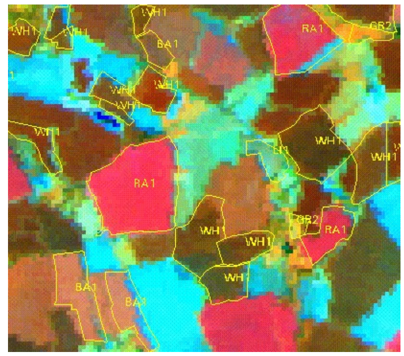
Filtered Radarsat Fine Mode Multi-Temporal Image

Red = 27/05/97 F4
Green = 27/06/97 F2
Blue = 14/07/97 F4

Comparison with Landsat TM

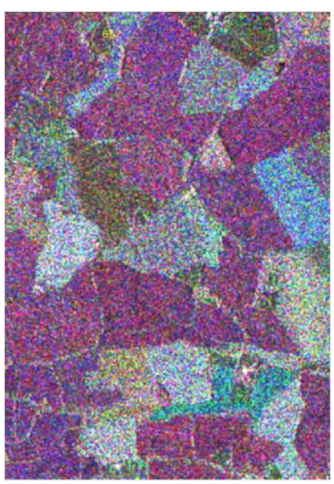


Filtered Radarsat Multi-temporal



Landsat TM

Comparison with SPOT PAN



Radarsat Multi-temporal

SPOT PAN

Radarsat Data Processing

Radar data, like all kinds of data, may require:

GEOMETRIC CORRECTION or RECTIFICATION

RADIOMETRIC CORRECTION

Geocoding

GEOCODING

What?

Rotation/rescale to map projection and correct for terrain variations

Why?

Needed to reference other geographic information (field boundaries etc.)

How?

Tie-pointing and warping

Simulation

Geometric Orientation

Direction of satellite motion

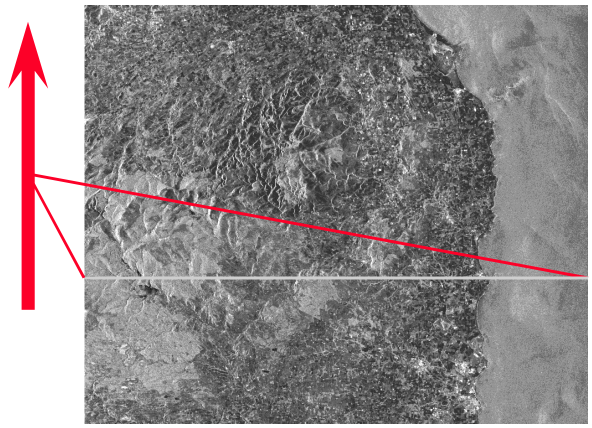
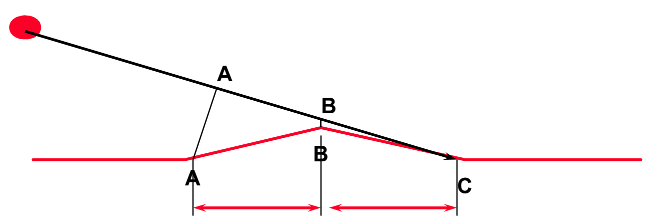


Image is ‘scanned-in’ line-by-line

Topographic Distortion

In a SAR image, positions on the ground are ‘lined-up’ according to their distance (range) from the sensor.

Sensor



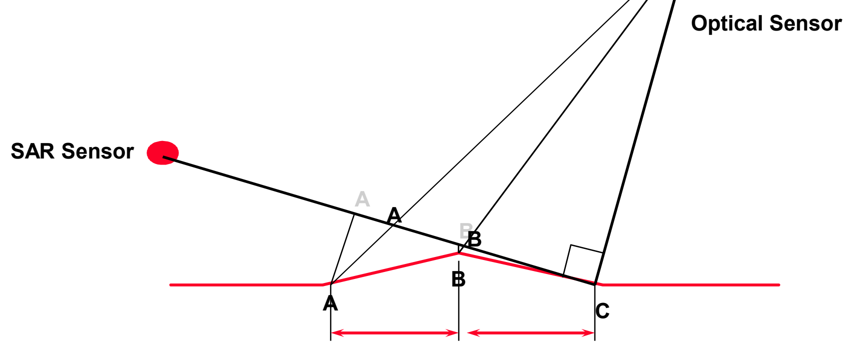
In the image AB < BC
On the ground AB = BC

- Foreshortening

Topographic Distortion - Relation to Optical

Locally, a SAR imaging at an incidence angle of θ gives a similar distortion to an optical image at an incidence angle of 90° - θ.

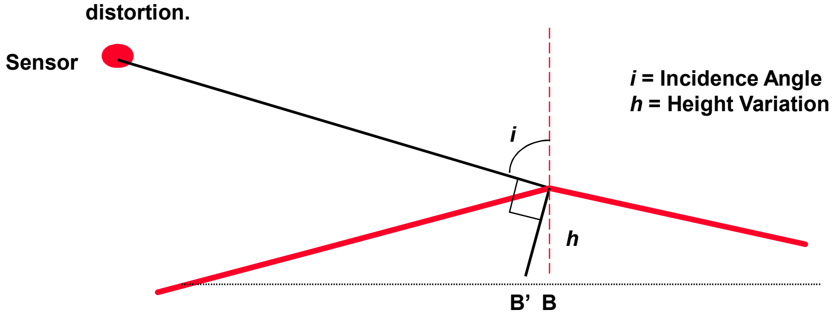
As optical sensor altitude increases, this is more the case.



Topographic Distortion - When Important?

For the Control of Subsidies case, we want to maintain an accuracy of < 1 resolution cell (1 pixel for optical data).

We can easily work out what variation in topography produces such a distortion.



If the distance B’B > 1 resolution cell, then terrain correction is needed.

Topographic Distortion - When Important? (2)

From a consideration of the geometry, the height variation *h* necessary to produce 1 resolution cell error is:

$$h = \rho \cot (90^{o} - i)$$

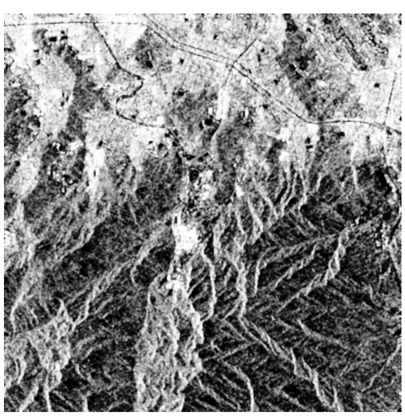
where ρ is the size of the spatial resolution cell.

The values of h for Radarsat Fine Mode (ρ = approx. 8 m) are as follows:

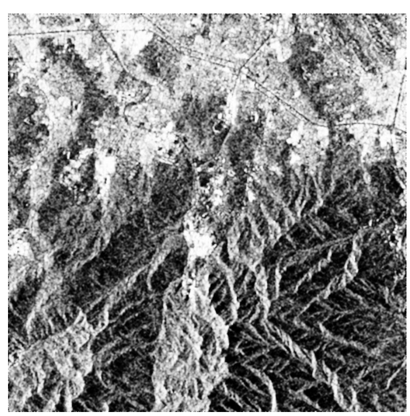
Mode	Incidence Angle (degs)	*h* (m)
F1	38	6.25
F2	40	6.71
F3	42	7.20
F4	44	7.73
F5	46	8.28

Therefore, if you can say your site contains less than *h* topographic variation then you don't need terrain correction (i.e. can use tie-points only)!!

Topographic Distortion (3)



F1



F5

Radiometric Correction

RADIOMETRIC CORRECTION

What?

Rescales pixel values to be closer to a fundamental parameter (sigma0)

Why?

Can quantify change between images much more precisely

How?

Application of standard Look Up Tables from the header

Simulation of imaging process to work out incidence angle effects

Radiometric Correction for SGF Radarsat Data

To obtain sigma0 for a pixel, we must first do the following:

beta0 =10*LOG10[(DN^2 +A3)/A2] dB

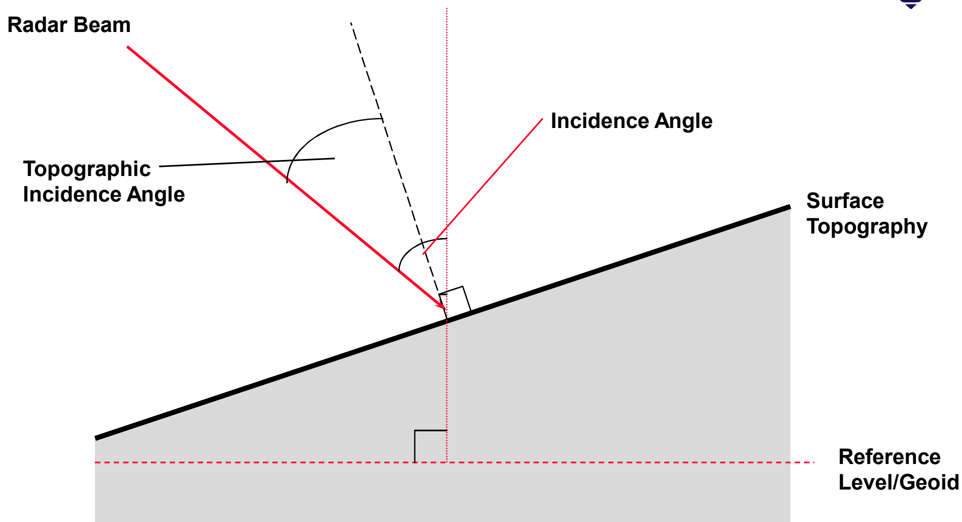
where A3 and A2 all come from the header and DN is the pixel value.

Then, we calculate sigma0 from:

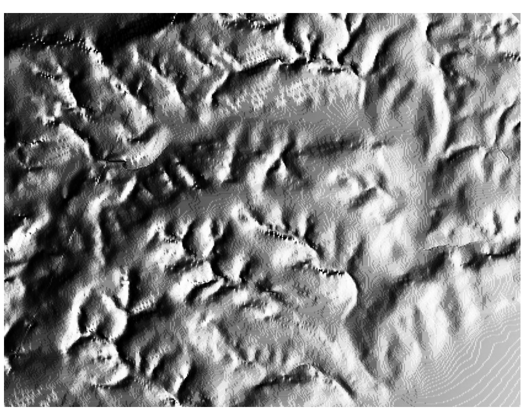
sigma0 = beta0 + 10*LOG10[sin θ] dB

where θ is the topographic incidence angle

Topographic Incidence Angle



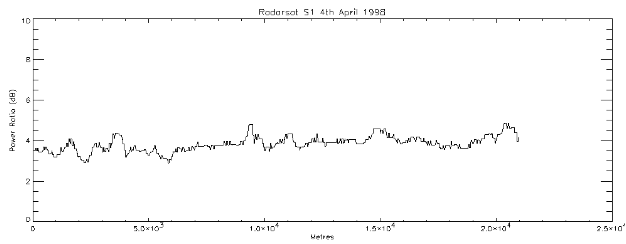
Radiometric Correction - Results



Power ratio of data before and after radiometric correction

Processed at West Freugh (DERA)

Radiometric Correction - Results (2)



Profile of Power Ratio

Incidence angle has greatest effect on radiometric correction (2-3 dB)

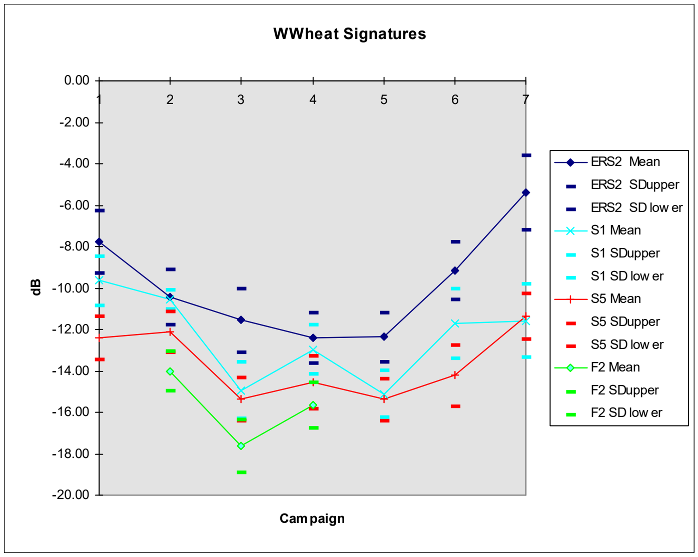
Topographic Incidence Angle gives further variations of +/- 1 dB

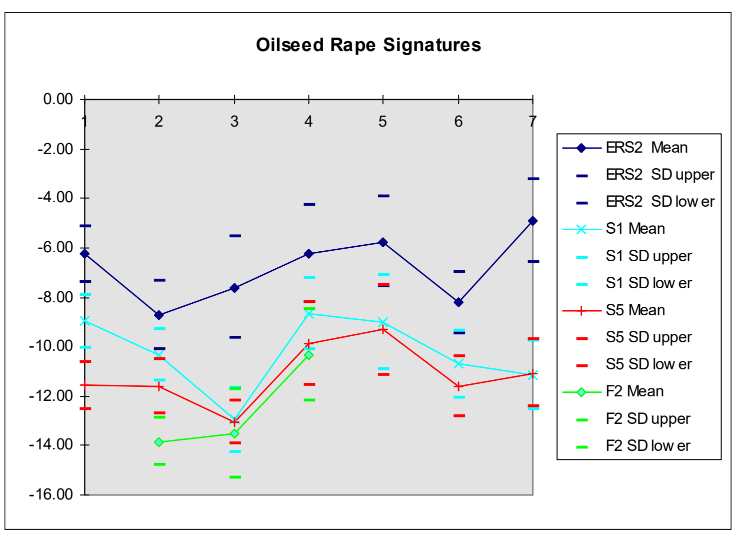
Incidence Angle Effects on Crop Radiometry

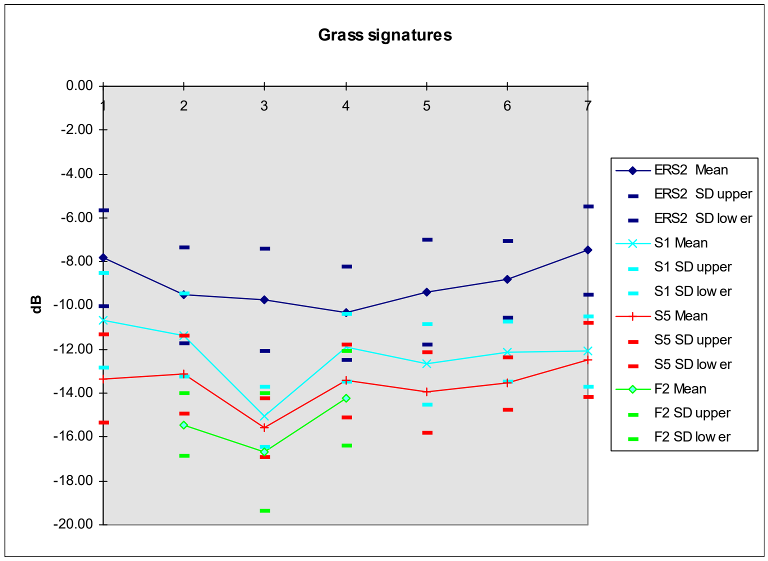
There are definite variations of sigma0 with incidence angle

However, nothing so far indicates that this is a useful parameter for differentiating the growing crop (research continues!)

The following plots show graphs of sigma0 from data gathered over the Great Driffield MARS Activity B site in the UK (reproduced courtesy of DERA).


WWheat Signatures
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
-18.00
-20.00
dB
1
2
3
4
5
6
7
Campaign
ERS2 Mean
ERS2 SDupper
ERS2 SD lower
S1 Mean
S1 SDupper
S1 SD lower
S5 Mean
S5 SDupper
S5 SD lower
F2 Mean
F2 SDupper
F2 SD lower


Oilseed Rape Signatures
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
-16.00
1
2
3
4
5
6
7
ERS2 Mean
ERS2 SD upper
ERS2 SD lower
S1 Mean
S1 SD upper
S1 SD lower
S5 Mean
S5 SD upper
S5 SD lower
F2 Mean
F2 SD upper
F2 SD lower



Conclusion

SAR geometry and radiometry is very well defined

Image rectification and conversion to sigma0 should be operationally available to all users of SAR data

Radarsat Fine Mode data is also a well-defined dataset in this context in that it has sufficient header information to allow:

- Geometric Correction
- Radiometric Correction

Furthermore, the data has been successfully used operationally in the UK in 1998 for the control of subsidies

Session 5
Friday 27/11, 09.00 - 10.15
Geometric Accuracy

Pär Åstrand

Session 5: Geometric Accuracy

3 presentations :

- Accuracy Requirements and Quality Assurance of Ortho-Image Production; S Kay, JRC
- Quality Checking of Geometrically Corrected Remote Sensing Imagery; M Stuttard, RSAC
- Quality Control by FGI in the Finnish LPIS: orthophoto production and land parcel digitization; H Kaartinen, FGI

3

Session 5 : Geometric Accuracy why ?

Absolute Geometric Accuracy is vital for our projects, e.g. IACS PIS, Registers, RS Controls…

- digitizing accurate parcel boundaries
- identification of crop, and a possible subsequent change of a parcel boundary
- revisiting parcel with other platform or sensor

In 1998 DGVI financed the geometric correction and interpretation of:

- 10-20.000 photogrammetric models
- 725 satellite images

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4

RS Controls - Specifications and Recommendations

Today's specs. & recs.:

- geometric correction methods
- DTM, GCP's, maps
- parcel digitizing and area measurement
- built on an accuracy specification
  - e.g. 2.5 m max. RMSE for 1:40.000 scale source air photos, based on ASPRS standards for 1:10.000 maps (ASPRS 1989)

Tomorrow :

- a more rigourous basis for such specification
- method for checking conformity with such specification, i.e. effective Quality Assurance
- prepare to include agri-environmental schemes and new sources of imagery

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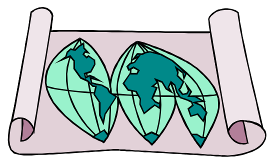
Session 5: Geometric Accuracy

Accuracy Requirements and Quality Assurance of Ortho-Image Production

…….S Kay !!!



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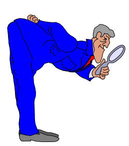
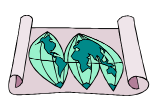
Session 5: Geometric Accuracy

Quality Checking of Geometrically Corrected Remote Sensing Imagery

- From a 6 month study by RSAC and UCL, 1998
  - "Development of Methods for the Quality Checking of Geometrically Corrected RS Imagery"
- i.e. define a QC framework and test it
  - Process scope - from acquisition to use of digital data; control and quantification of positional error throughout the geometric correction process
  - Image (data) scope - include all imagery that we use: aerial photography, SPOT, IRS-1C/D, Landsat, ERS1, …. open up for future Ikonos etc.





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Session 5 : Geometric Accuracy

Quality Control by FGI in the Finnish LPIS: orthophoto production and land parcel digitization

- project started summer 1996
- existing photography 1:60.000; existing DEM 25 m grid; existing GCP's
- orthophoto production over all of Finland finished end 1997; 340.000 km²; 4000 digital orthophoto maps 10x10 km; pixel size 1 m
- digitization of parcels; started spring 1997; final round finishing presently; approx. 1.000.000 parcels in total
- QC of orthos and digitizing
  - *internal by contractors*
  - *external by MAF and FGI*

Space Applications Institute

Accuracy requirements and quality assurance of orthoimage production

Simon Kay
MARS project

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This presentation:

- **Context**
  - ⇨ **Control with Remote Sensing programme (CWRS)**
  - ⇨ **CAP**
    - *IACS*
    - *SIG-OLI (I, F, G, P, E)*
  - ⇨ **Why?**
    - Importance to the Commission
- **Accuracy specification**
  - ⇨ **CWRS**
  - ⇨ **Other orthoimagery (parcel identification systems)**
- **Guidelines for accuracy checking**
  - ⇨ **Overview**
  - ⇨ **Collaboration: JRC role**

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Context

- Control with Remote Sensing:
  - ⇨ 725 satellite images in 1998
  - ⇨ 11 contractors using aerial photography
  - ⇨ Large areas covered with orthorectified imagery of one/both sorts
    - probable annual expenditure of +/-1M ECU on correction alone
- Synergy with CAP, Parcel Identification System (PIS)
  - ⇨ use of imagery within IACS (updating)
  - ⇨ use of imagery within SIG-OLI
  - ⇨ use of IACS/SIG-OLI imagery within CWRS
    - 100% panchromatic orthophotography
    - technical context somewhat more demanding

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Control with Remote Sensing accuracy requirements and specification

- Adapted to CWRS context and programme
  - ⇨ "Expeditious" specification; history:
    - use of less geometrically coherent imagery (SAR, TM)
    - use of non-corrected aerial photography (rapid field visit)
    - plane rectified (*affine*) specification for aerial photography
    - use of high data volume products (CIR, 50cm pixel)
  - ⇨ Evolution in line with:
    - sensor enhancement
      - *higher resolution*
      - *RADAR*
      - *Aerial photography*
    - software sophistication
      - *greater availability of orthorectification software as standard*
    - parcel identification system
      - *high accuracy geographic databases (cf. sketch maps)*

Control with Remote Sensing 1999

- **1999 specification, CWRS**
  - Airphoto - 2.5m *(synergy with PIS)*
    - or 10m (CRWS only)
  - SPOT + IRS1-Pan - 20m
  - SPOT XS - 30m
  - RADARSAT, IRS1-LISS - 40m
  - ERS, Landsat TM - 50m
- **All figures, absolute 1D-RMSE**
  - Specification applies to *all* images for each site
  - Concept of Relative RMSE dropped from specification
    - *maximum tolerance at product acceptance level not applicable to this product*

Guidelines: Overview

- **Introduction**
  - ⇨ Technical Definitions (4 pages…)
    - specific interpretations of technical terms
      - *Accuracy, Ellipsoid, Error, Absolute RMSE, etc.*
    - TLA's *(Three Letter Acronyms)*
  - ⇨ Justification, scope
    - Justification: brief, may be project specific
      - *negotiation and agreement precedes project execution*
    - Scope: aerial photo and satellite image (largely optical)

Guidelines: Requirements

- **Quality Assurance**
  - ⇨ **set of checks and measures to ensure consistent and reliable production processes**
- **Quality Control**
  - ⇨ **a clearly specified, quantifiable check within the QA programme**
- **Quality Audits**
  - ⇨ **a qualitative inspection which covers (possibly) a sub-unit of a production line (e.g. DEM creation)**
- **Quality Control Records**
  - ⇨ **usually stable documents (paper!) confirming actions, equipment**
    - **dated**
    - **signed**
    - **archived!**

Guidelines: Thresholds

- **Thresholds**
  - ⇨ **Confirmation: RMSE specification is X or Y (1D-RMSE)**
  - ⇨ **Tests applied to X and Y independently**

- ***Precedence of existing standards***
- ***Identification of systematic error***

- **DEM checks**
  - ⇨ **Why DEM checks?**
    - **Helps evaluate production process**
    - **In case of updating, key product for future use**
  - ⇨ **RMSE threshold checked with well defined points**
    - **Test threshold to be twice planimetric 1D-RMSE**
      - ***twice strictest planimetric specification for each CWRS site***

Guidelines: Production QA

- Not prescriptive
  - ⇨ Commission's concept of state of art
  - ⇨ "Best practice"
    - leaves open possibility of innovation
- Does not replace specification
  - ⇨ technical specification is remains (where possible) product based
    - Guidelines are action based
- Indicates typical/anticipated QC, QCR
  - ⇨ anticipates Commission/Administration quality audit
  - ⇨ indicates typical production thresholds
    - not pass-fail criteria: production "tuning"

Examples:
• interior orientation
• ground control distribution
• DEM/DTM grid spacing

Guidelines: External Quality Checks

- External
  - ⇨ executed by the Commission, the National Administration, or independent body
- Usually post-product delivery
  - ⇨ may occur during batch deliveries
- Based mainly on check point comparison
  - ⇨ applied to block/site level
    - failure rate above a predefined threshold may fail
      - *individual product (e.g., image file)*
      - *batch (e.g. photogrammetric block, CWRS site)*
      - *project (all such products under the same contract)*

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Check procedures

- Check will take place on *well defined* points in pre-defined structure
  - ⇨ check against a dataset of quality 3 to 5 times better (depends upon source)
  - ⇨ grid of evenly distributed points within the sample frame
    - photo: nine points per photogramme/image file
    - satellite: 25 points/scene
- RMSE to be checked separately, X, Y, (Z)
  - ⇨ individually compared to RMSE threshold
  - ⇨ no discrepancy to exceed 3x RMSE
    - product-level only
- Frequency of observed problems determines failure level:
  - ⇨ product - block/site - project

Image scan checks

- Mainly on scanned input data
  - ⇨ aerial photography
- Specification for Panchromatic available
  - ⇨ scan geometry QA
  - ⇨ saturation levels
  - ⇨ dropped DN values (histogram)
  - ⇨ interior orientation check
- Automated approach for testing
  - ⇨ quicklook production
  - ⇨ database results management

Quality Checking the Geometric Accuracy of Images

Development of a Method

Matthew Stuttard
Remote Sensing Applications Consultants Ltd
http://www.rsacl.co.uk

Study Objectives

- **Define a framework for quality checking geometrically corrected, remotely sensed imagery: for use in Agricultural Applications carried out by DGVI and compatible with existing QC activities at JRC**
  - Identify areas of the process susceptible to QC
  - Establish benchmarks and other criteria
  - Produce comprehensive, applied and clear guidelines
- **Devise and test operational approaches for QA**
  - Trials on two data sets
    - one for IACS
    - one for Vineyards or Olives

Scope

- **Include**
  - **aerial photography 1:40 000**
  - **SPOT/IRS PAN, SPOT XS/Landsat TM, ERS SAR**
- **Exclude**
  - **aerial photography > 1:40 000, digital airborne**
  - **satellite imagery < 5 m or > 50 m**

Quality Assurance

- **Specifications (see Simon Kay - this session)**
- **Quality Assurance Stages**
  - Internal Quality Checks (all products)
  - Production of Quality Control Records (QCRs)
    - open to external scrutiny
  - External Quality Checks (sample of products)
    - strict pass/fail criteria
      - based on the specifications
    - quantitative (quality metrics)
      - RMSE at check points < Tolerable accuracy
      - Maximum discrepancy < 3 x Tolerable accuracy
    - reliable methods to obtain the metrics

Data Preparation

Arles - Air Photos

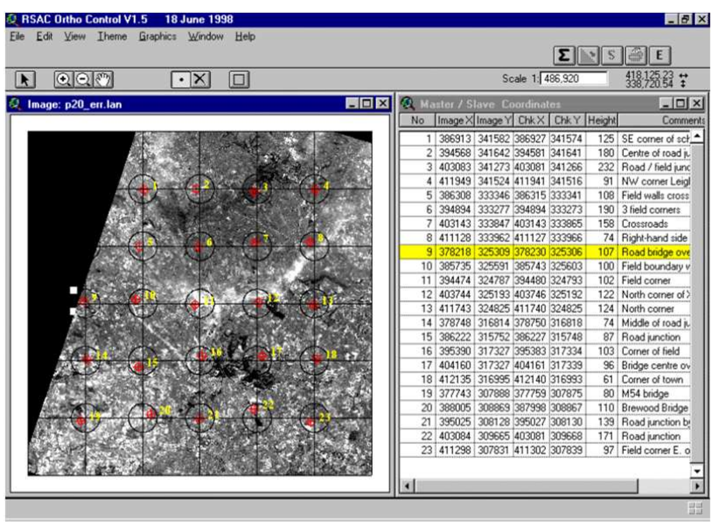
- **Elevation 0 - 130 m**
- **Input (from JRC)**
  - **5 photos: 1:40 000**
  - **DGPS Ground reference (<50cm)**
    - 8 GCPs
    - 35 Check Points
  - **Mosaic**
- **Phodis/Bingo (by UCL)**
- **Output**
  - **Ortho-images**
  - **Ortho-mosaics**
    - 12 m DEM
    - 25 m DEM
    - 50 m DEM

Staf - Satellite Images

- **Elevation 30 - 230 m**
- **Ground Reference**
  - 1:25 000 map for GCPs
  - 1:2500 map for checkpoints
- **ERDAS/RSG/PCI Radar**
- **Images Tested**
  - 1 SPOT PAN (8 variant products)
    - 6, 10, 20 GCPs
    - Polynomial/Orthocorrected
    - no DEM, 50m DEM, 200m DEM
  - 1 IRS-1C Pan (Orthocorrected, 8 GCPs)
  - 3 SPOT XS
    - 31° Image Poly & Ortho
  - 3 TM (Polynomial)
  - 3 ERS-1 SAR (Orthocorrected)

External QC Method

- **Tolerances**
  - **pass/fail**
- **Quantitative**
- **Quick**
- **Simple**
- **Replicable**
- **Reliable**
- **Standardised**
- **Consistent**
- **Controlled**
- **Future automation**



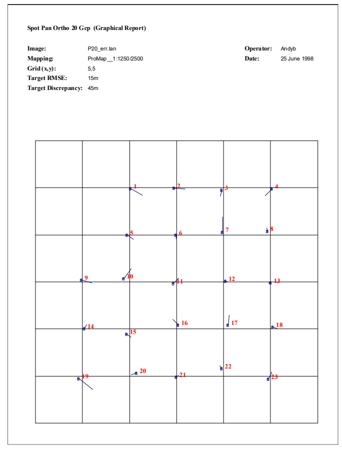
External QC Output

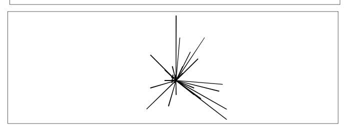
Spot Pan Ortho 20 Gcp (Text Report)

Image: P20_err.lan **Operator:** Andyb
Mapping: ProMap__1:1250/2500 **Date:** 25 June 1998
Grid (x,y): 5,5
Target RMSE: 15m
Target Discrepancy: 45m

No	Image X	Image Y	Check X	Check Y	Height	Check Point Description	Discrepancy (m)
1	386913	341582	386927	341574	125	SE corner of school block	16.1245
2	394568	341642	394581	341641	180	Centre of road junction	13.0384
3	403083	341273	403081	341266	232	Road / field junction	7.28011
4	411949	341524	411941	341516	91	NW corner Leigh's Plantat	11.3137
5	386308	333346	386315	333341	108	Field walls crossing riv	8.60233
6	394894	333277	394894	333273	190	3 field corners	4
7	403143	333847	403143	333865	158	Crossroads	18
8	411128	333962	411127	333966	74	Right-hand side of bridg	4.12311
9	378218	325309	378230	325306	107	Road bridge over canal	12.3693
10	385735	325591	385743	325603	100	Field boundary with road	14.4222
11	394474	324787	394480	324793	102	Field corner	8.48528
12	403744	325193	403746	325192	122	North corner of X roads	2.23607
13	411743	324825	411740	324825	124	North corner	3
14	378748	316814	378750	316818	74	Middle of road junction	4.47214
15	386222	315752	386227	315748	87	Road junction	6.40312
16	395390	317327	395383	317334	103	Corner of field	9.89949
17	404160	317327	404161	317339	96	Bridge centre over railwa	12.0416
18	412135	316995	412140	316993	61	Corner of town	5.38516
19	377743	307888	377759	307875	80	M54 bridge	20.6155
20	388005	308869	387998	308867	110	Brewood Bridge	7.28011
21	395025	308128	395027	308130	139	Road junction by M6	2.82843
22	403084	309665	403081	309668	171	Road junction	4.24264
23	411298	307831	411302	307839	97	Field corner E. of farm	8.94427

RMSE: 10.2278m
Max Discrepancy: 20.6155m
PASS



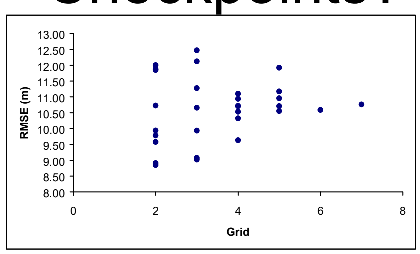


4th Conference on Control with Remote Sensing of Area-based Subsidies, 26-27 November 1998, Venezia, Italy

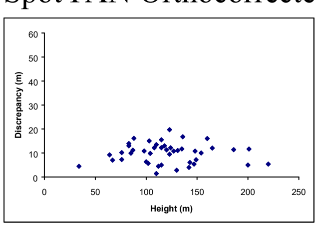
External QC - Checkpoints?

How many?

- 25 for satellite
- 9 per ortho-photo mosaic



Spot PAN Orthocorrected



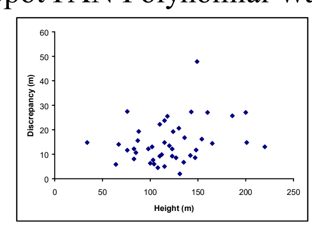
Where?

Grid

Sensitive?

Yes

Spot PAN Polynomial Warp



External QC - Reliable?

SPOT PAN

Operator	Calculated RMSE (m)	Highest Calculated Discrepancy (m)
Operator 1	10.6	18.9
Operator 2	8.0	17.0
Operator 3	10.7	16.3
Std. dev.	*1.5*	*1.3*

ERS SAR

Operator	RMSE (m)	Discrepancy (m)
Operator 1	39.1	82.2
Operator 2	26.9	55.9
Operator 3	37.0	62.5
Std. deviation	*6.5*	*13.7*

- **Good agreement on the discrepancy at each point**
- **30% of the *resolution* (cf. tolerance > 150%)**

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Test Results - Air Photos

	Ground Control Point	Quality Control Check Points				Quality Control Check Points	
Product	RMSE (m)	GCPs	Calculated RMSE (m)	Tolerable RMSE (m)	Tolerable Discrepancy (m)	Highest Calculated Discrepancy (m)	Result
A250249_12_Ortho	0.73	12	1.8	2.5	7.5	3.4	Pass
A249248_12_Ortho	0.73	9	1.5	2.5	7.5	3.1	Pass
A247246_12_Ortho	0.73	11	2.7	2.5	7.5	4.2	Fail
A12_Ortho_Mosaic	0.73	36	2.0	2.5	7.5	4.4	Pass
A25_Ortho_Mosaic	0.73	36	2.0	2.5	7.5	4.0	Pass
A50_Ortho_Mosaic	0.73	36	2.1	2.5	7.5	4.0	Pass
JRC_Ortho_Mosaic	N/A	36	2.2	2.5	7.5	5.6	Pass

- **GCP accuracy cf. checkpoint error**
- **Block checks recommended**
- **50 m DEM yields acceptable result**

Test Results - Satellite Images

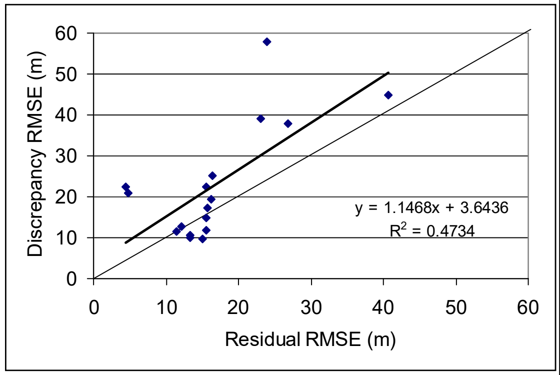
	Ground Control Point	Quality Control Check Points				
Product	RMSE (m)	Tolerable RMSE (m)	Calculated RMSE (m)	Tolerable Discrepancy (m)	Highest Calculated Discrepancy (m)	Result
SPan_Poly6_CC	*	20	31.1	60	61.4	Fail
SPan_Poly10_CC	12.1	20	12.6	60	26.2	Pass
SPan_Orth20_nodem	15.0	20	9.7	60	18.0	Pass
SPan_Orth6_50m	*	20	23.3	60	39.3	Fail
SPan_Orth10_50m	11.5	20	11.6	60	21.6	Pass
SPan_Orth20_200m	13.4	20	9.9	60	18.7	Pass
SXS_Poly20_CC	40.7	30	44.9	90	84.3	Fail
Ag_SXS_Orth35_14apr91	*	30	21.0	90	54.1	Pass
IRS_Pan_Orth8_RSG	17.4	20	20.4	60	30.4	Fail
Ag_TM_Poly25_28jun95	16.2	50	19.3	150	36.1	Pass
Ag_ERS1_Orth25_10apr96	26.9	50	37.9	150	82.3	Pass

Test Conclusions - Satellite Images

- **Blunder check on first-order polynomial fit to GCPs**
- **At least 15 GCPs recommended for ALL methods**
- **1:25 000 scale maps are adequate for GCPs**
- **Polynomial warp OK for:**
  - **view angle < 15° and terrain < 250 m**
- **DEM 50-100 m recommended**
  - **< 250 m acceptable**
- **Tolerances are achievable**
  - **SAR tolerances based on resolution (30 m) not pixel size (12.5 m)**

Residuals vs. Discrepancies

- **Residuals (GCPs - least squares fit)**
- **Discrepancy (image point - checkpoint)**
- **Residual RMSE is not reliable**
- **Internal QC**
  - **use checkpoints (>10)**
  - **or PRESS (jackknife)**
  - **or Residual RMSE x 2**



QUALITY CONTROL BY FGI
IN THE
<u>FINNISH LAND PARCEL IDENTIFICATION SYSTEM</u>
ORTHOPHOTO PRODUCTION
AND
LAND PARCEL DIGITIZATION

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INTRODUCTION

Ministry of Agriculture and Forestry of Finland (MAF) implements IACS in Finland.

Orthophotos
Parcel boundaries and attribute information

⇓ parts of

FLPIS
Finnish Land Parcel Identification System

connected via ⇓ attribute data to

IACS
Integrated Administration and Control System
(Control of agricultural subsidies)

⇓ belongs to

AAIS
Agriculture Administrative Information System

Implementation of FLPIS was started during summer 1996.

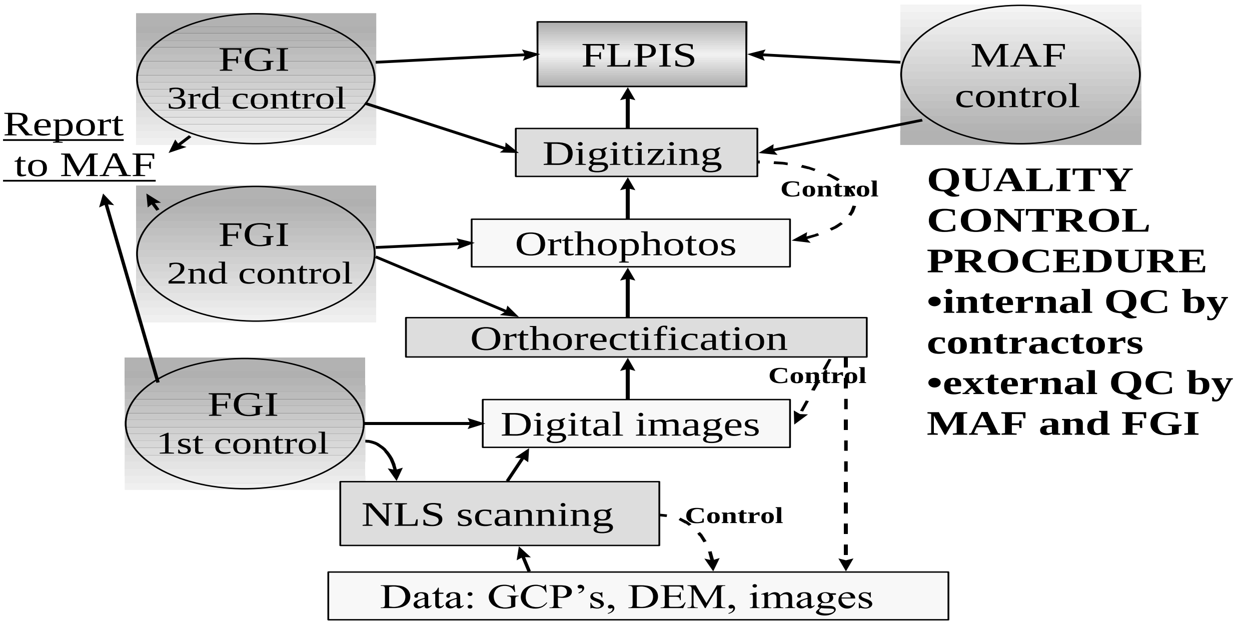
Special features of the process were

- tight schedule
- techniques used not yet standardized
- scope of the process
- existing materials, not especially designed and produced for the purpose, were used
- reliable quality estimates for the future uses were to be produced

Quality control

The following quality control actions were performed:

1) Process design
    - methods adjusted in co-operation with MAF, FGI and contractors to meet the requirements.
2) On-line quality control
    - performed by the contractors during production.
3) Acceptance sampling
    - performed by FGI.
    - in some cases results were used to adjust specifications.
    - if non-conforming units were found, usually the whole lot was rejected, and the contractor made a full inspection and performed sufficient corrections.



ORTHOPHOTO PRODUCTION

General remarks

Orthophoto generation process was divided into:

1) scanning of the photo negatives
2) orthorectification.

The process started during summer 1996 and finished by the end of 1997.

Quality components of orthophotos are generally the same as of images

- geometric quality and
- visual quality (spatial, radiometric and spectral resolution).

Orthophotos produced

For the most part, existing nationwide materials were used:

1) Photography.

- 1:60.000 analog, panchromatic aerial imagery produced by the Topographic Service of the Defence Forces of Finland (TSDFF).

2) Ground control points (GCP's)

- 1:16.000, 31.000 and 1:60.000 aerial triangulation by NLS, TSDFF or contractors.
- GPS points.
- In Northern Lapland, in areas with no cultivation, points were digitized from 1:20.000 topographic maps

3) DTM

- Korkeusmalli25 (DEM25), a grid with 25 m x 25 m grid spacing

TECHNICAL DETAILS:

Orthophotos:			
Coordinate system:	Finnish map grid KKJ		
Pixel size:	1 m x 1m		
Orthophoto size:	Appr. 10 km x 10 km		
Fraction of mosaicked orthos:	70 %		
Digital images:			
Scale:	1:60.000		
Age:	Mostly 1992-1995 (oldest 1985)		
Pixel size:	20 µm (1.2 m on ground)		
Gray values:	256		
Expected GCP accuracy:	Requirement	Inner precision	
	dX=dY=dZ	dX=dY	dZ
1:16.000 – 60.000 by NLS or contractors:	< 1 m	scale*10µm	2dX
GPS points:	< 1 m	< 0.2 m	<0.2m
1:31.000 by TSDFF	< 2 m	scale*15µm	2dX
Expected DTM accuracy in field areas:			
5 m contours:		m_{DTM} < 4 m	
10 m contours:		m_{DTM} < 8 m	

Estimating geometric accuracy of orthophotos

Significant factors:

- accuracy of the DTM
- orientation

Assuming these parameters to be independent, an estimate for the mean error of orthophotos is

$$m_{ortho} = \sqrt{m_{ortho\_ori}^2 + m_{ortho\_DTM}^2} \qquad (1)$$

where

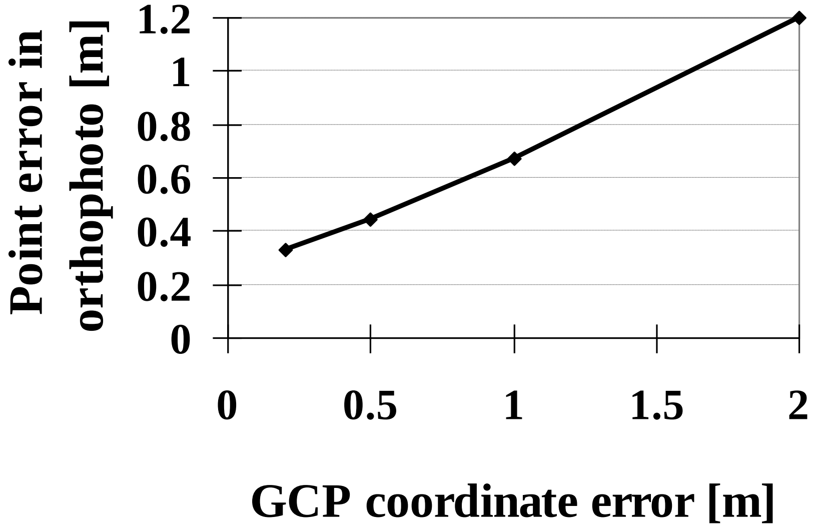
m_{ortho_ori} mean error resulting from orientation errors

m_{ortho_DTM} mean error resulting from DTM errors

Error resulting from orientation error

High accuracy photogrammetry: plane accuracy of 3-5 µm achieved.
Typical applications: 10-20 µm plane accuracy should be achieved.

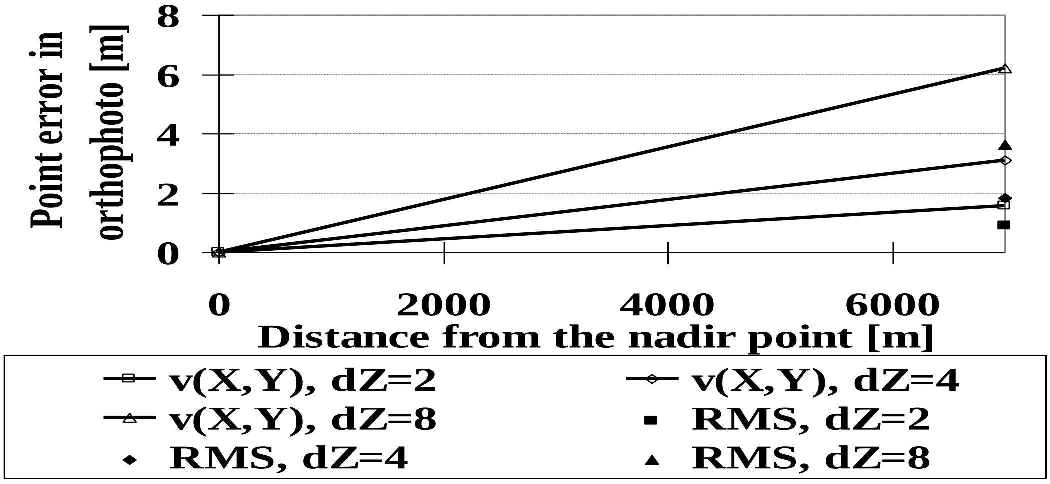
Simulated orthophoto point error (resection, 3x3 GCP) as a function of GCP quality:



Error caused by DTM error

The orthophoto error due to height error depends on imaging angle but not on image scale.

Orthophoto point error resulting from DTM error:



Expected geometric error

RMS point errors of orthophotos with varying GCP and DTM errors (metres):

GCP error/ DTM error	0.0	0.2	0.5	1.0	2.0
0.0	--	0.33	0.44	0.67	1.20
2.0	0.91	0.97	1.01	1.13	1.51
4.0	1.81	1.84	1.86	1.93	2.17
8.0	3.63	3.64	3.66	3.69	3.82

Quality control by FGI in orthophoto production

Material	Check type	Extent
Scanner	geometric + radiometric	sample
Scanned photographs	visual	4%
DEM	geometric	3%
Orthophotos	visual + geometric	3%

SCANNING

Geometric and radiometric quality of scanner was checked weekly or every second week.

Visual quality of scanned photographs was checked based on a sample (1-3 photos/flight, in total 181 photographs)

Geometric quality of scanner

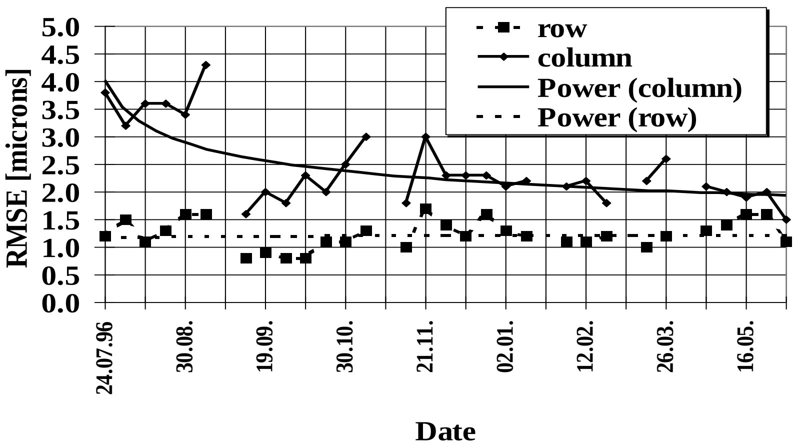
Requirements

Defined by using a calibrated photogrammetric grid.
After affine transformation

- RMS error ≤5µm
- abs. values of residuals ≤ 15µm in 95% of the points.
- residuals non-systematic.

Geometric quality of scanner

Results:



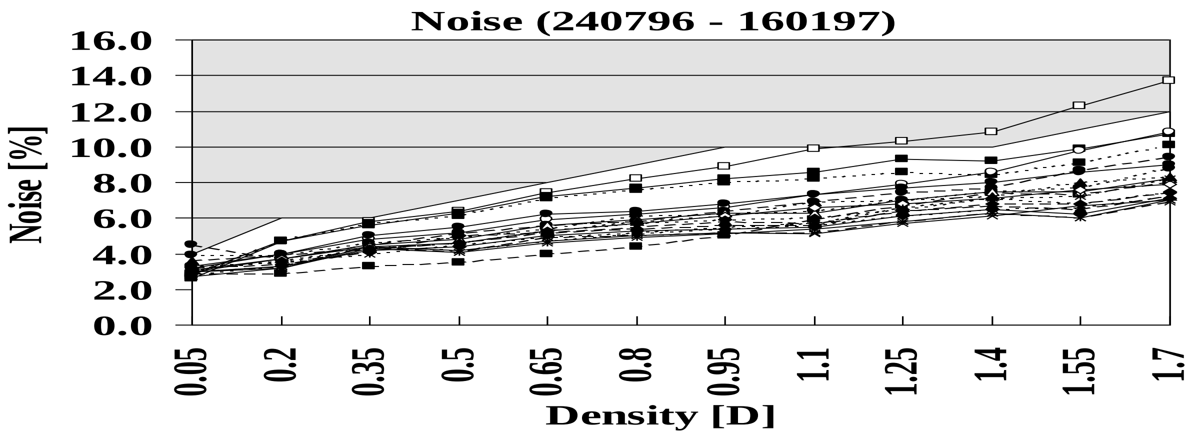
Radiometric quality of scanner

Requirements

Defined by using a Kodak Photographic Step Tablet

- Scanner density range at least 1.5D.
- Tolerances for radiometric noise based on test scanning.

Results:



Scanned photographs, requirements

- The extent of Finnish land covered.
- Radiometric quality requirements.
- Spatial resolution should be adequate for measurement of land parcels.
- Photographs must be complete. Clouds or other defects should not disturb measurements of parcels.

Technical properties and meta-data, requirements

- These should be perfect.

ORTHORECTIFICATION

Orthophoto production, visual quality

Requirements

- It is possible to recognize and measure the land parcels in every part of the image.

Results of visual quality control of orthophotos:

Factor	No. checked	No. rejected
Tone	164	6
Contrasts	164	1
Spatial resolution	164	0
Completeness	164	3
Mosaicking	111	2
Other	164	1

- All rejected orthophotos were corrected, and sometimes more extensive checks were performed.

Orthophoto production, geometric quality

Extent

- Geometric quality of 140 out of 3600 orthophotos (3.9%) was controlled.
- Checked areas were divided into:
    - areas with existing GCP's (about 2600)
    - areas with new GCP's (about 1000).

Requirements

- RMS point error should be < 2.5 m
- More than 95% of the point errors should be < 7.5 m
- If the DEM25 error is > 4 m, the requirements may have to be adjusted.

Orthophoto production, geometric quality

Results

<u>DEM25 quality</u>

Error of the DEM25 on the field areas

- computed in the areas of checked orthophotos.
- check points close to ground level.

RMSE and standard deviation (sdev) of the DEM25 in field areas in metres.

DEM id	No. points	RMSE (m)	sdev (m)
DEM1	1837	1.88	1.42
DEM2	2324	1.83	1.39

<u>Orthophoto geometric accuracy</u>

Point errors in metres.

GCP	Accuracy:			
	Exterior (RMSE)	Interior (sdev)	Map (RMSE)	Map (sdev)
1:16.000 AT	1.45	1.24	1.2	0.9
1:31.000 AT	1.57	1.41	1.2	1.0
1:60.000 AT	1.89	1.31	1.6	0.9

Map RMSE: point error of check points eliminated from Ext.

Map sdev: point error of check points eliminated from Int.

Comparison with theoretical expectations:

- If m_{DTM} =1.5 m and m_{GCP} = 0.2-1 m

  ⇒ expected point error of an orthophoto is 0.76-0.95 m.
- Reasonable estimate for point error in the non-field areas is 2.29-2.36 m (m_{DTM} = 5 m, m_{GCP} = 0.2-1 m).

LAND PARCEL DIGITIZATION

General

Digitization started in the spring of 1997.
The first round (96-digitization, 96-maps) was completed during spring of 1998.
Corrections to 96-maps and updates to 1997 situation were made during summer of 1998.
Further corrections and updates-98 should be performed until the end of November 1998.

As a result of the process, FLPIS was activated and every farmer in Finland got uniform, printed orthophoto maps of his/her parcels (at scale 1:5.000).

The following materials were used in the digitization (heads-up method)

- Orthophotos.
- Dossiers' maps. Paper copies of large scale maps or orthophotos on which farmers had outlined their parcels.
- Information from IACS.

Quality control by FGI

Visual check on the first round of digitization (96-digitization) using the same material as digitizers:

- 5500 parcels (0.6 % of all Finnish parcels)
  from 105 municipalities (23 % of all municipalities)
- over 1000 farm centres were checked.

A study on the accuracy of the 98-map is being carried out, and should be finished by the end of this year.

Tolerance for parcel area

$$E_A < ds *(p/A)$$

where

ds is mean error of border (FGI: 0.6 - 1.2 m)
p is parcel's perimeter
A is parcel's area

Quality requirements in digitization

Quality requirements were given for land parcels' borderline accuracy, area and attribute data.

Tolerances for parcel borders:

Class	Mean error of border (m)	Mean error of border point (m)	Maximum error of border point (m)
I	0.6	1.7	5.0
II	0.9	2.5	7.5
III	1.2	3.3	10.0

Classes:
I: Clear borders
II: Border interpretation difficult due to image quality
III: Border interpretation difficult due to object's properties (shadows, forest…)

Results of quality control of 96-digitization

Visually checked	**Number of checks**	**Amount of errors [%]**	**Distribution of errors [%]**
Borderline accuracy	5528	29.1	
coarse errors	4823		10.4
errors	4823		18.3
Border classification	5528	3.1	
Border ambiguity	5528	4.2	
Parcel-ID	5528	0.1	
Farm center	1083	2.2	
Error codes to parcels	5477	3.9	
Result of parcels	5528	34.1	

Comments on table of results:

- After the first 700 parcels had been checked, errors were classified as:
  1) errors: parcels digitized against the farmer map or orthophotomap, so that tolerances were exceeded.
  2) coarse errors: the effect of coarse error is large relative to parcel area (part of parcel left out or extra area included) or error is clearly due to carelessness.
- "Result of parcels" was marked with an error, if parcel had errors on any subject checked.
- If the amount of errors in a municipality was too large, corrections were made.

Study on accuracy of 98-map

Material

- orthophotos
- digitized 98-vectors
- 1:16.000 aerial images

Parcels digitized from aerial images with Kern DSR-1 stereoplotter compared with parcels digitized by contractor:

- area and border's mean error (absolute and adjusted using center of gravity) computed
- parcel boundaries on orthophotos classified visually into three classes ⇒ allowed mean error of parcel's border to be computed ⇒ tolerance for parcel's area obtained

Example:

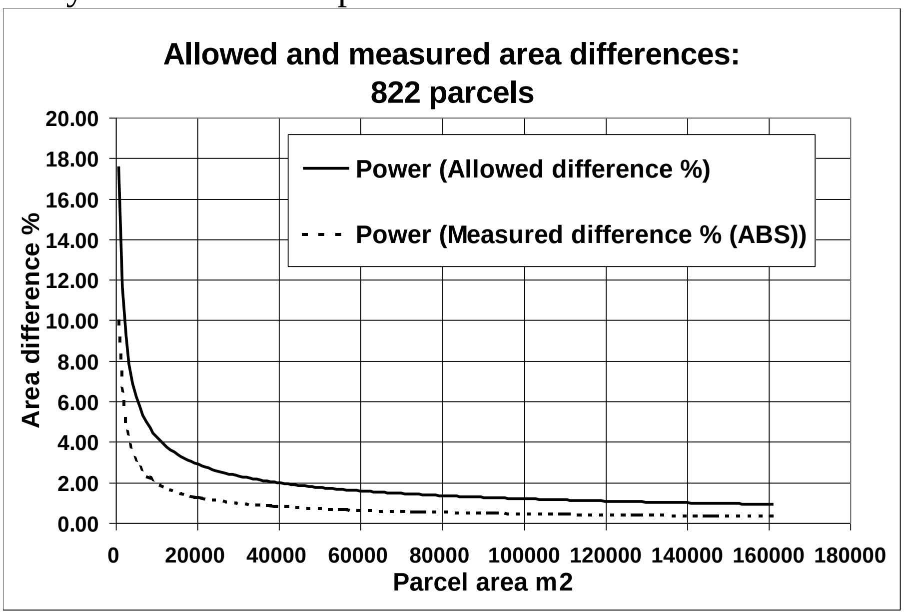
Contractor		DSR		Border's mean error		Class [%]			Allowed mean error	Area difference [%]	
area	perim.	area	perim.	abs.	adj.	I	II	III	of border	allowed	measured
58347	1005,7	58788	1009,8	1,3	0,6	50	50	0	0,75	±1,29	-0,75

Some preliminary results

Some very preliminary results on the accuracy of the 98-map:

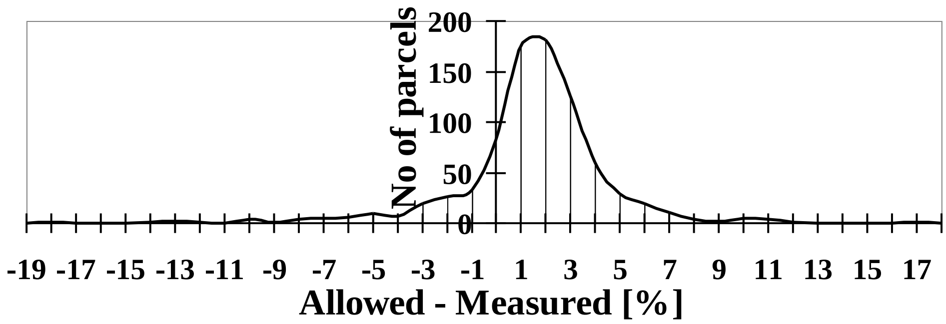
- 822 parcels from three different areas in Southern Finland.
- Allowed area difference has been computed using ds values 0.6 - 1.2 m, as previously described.

Preliminary results of 98-map:



Preliminary results of 98-map:

Allowed area difference - measured area difference
822 parcels



Mean	1.0
Standard Deviation	3.1
level of mean (95.0 %)	0.2
Parcels within FGI tolerance	75.3 %

CONCLUSION

Preliminary results of geometric accuracy analysis in field areas were given for 3200 orthophotos in southern Finland.

Geometric quality according to the results:

- RMS point error is less than 1.6 m in the areas based on 1:16.000 and 1:31.000 GCP material (about 60% of all orthophotos).
- In most areas the RMS point error is less than 2.5 m.
- Interior accuracy seems to be better than 1.6 m.
- Geometric accuracy is expected to be better than 2.5 m in a large portion of the country, also in outside field areas.
- Geometric quality analysis will be completed by the end of this year.

Visual quality of orthophotos produced at 1:60.000 scale photography is not very high, but it is good enough for land parcel digitizing.

At the time the process was going on, it seemed that the commercial orthophoto systems used did not have efficient tools for quality management and meta-data production.

Original **digitizing quality** is not very high, but it seems that satisfactory accuracy of area measurement is obtained. And future corrections and updates as well as those already made will improve the quality.