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1 1. Agricultural parcel

1.1 1.1. Definition of the agricultural parcel

As from 2010, Art 2(1) of Reg 1122/2009 defines the agricultural parcel in the following way:

- ?agricultural parcel? means a continuous area of land, declared by one farmer, which does not cover more than one single crop group[1]; however, where a separate declaration of the use of an area within a crop group is required in the context of this Regulation, that specific use shall if necessary further limit the agricultural parcel; Member States may lay down additional criteria for further delimitation of an agricultural parcel;

The uses needing a separate declaration within the SPS (or SAPS) crop group are permanent pastures (art 13(8) of Reg 1122/2009) and hemp (for the tetrahydrocannabinol content check, see art 39 of Reg 79/2003).

When a MS opts for further limitation of the agricultural parcel, the same definition should be applied systematically and in the whole of the procedure.

Art 2(1) of Reg 1122/2009 offers to Member States the possibility to choose the most appropriate definition of the agricultural parcel for their context: it could for instance be the **single crop parcel** or the **"crop group" parcel** as shown in the example below:
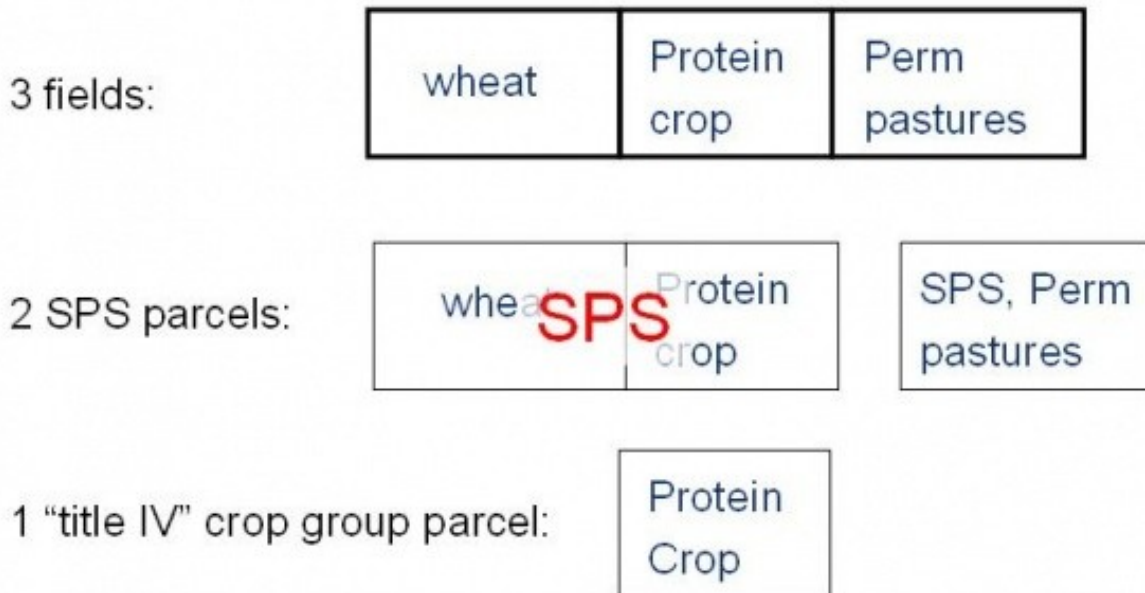
The example above illustrates the case where the Member States opts for the "crop group" parcel definition: the three fields make up two SPS parcels and one protein crop parcel.

In the figure below, the Member State defines the single crop parcel as the agricultural parcel. The three fields therefore correspond to three agricultural parcels (one of these, the protein crop field, being also claimed for Title IV).

Further limitation (single crop parcel)

SPS ~~Set-aside~~	SPS ~~Protein crop~~	SPS ~~Perm pastures~~
	Protein Crop	
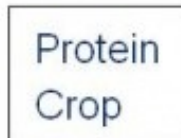
Where the crop or cover type is not explicitly required by the regulation, declaring "crop group" parcels instead of single crop parcels allows declaring parcels that otherwise might be below the minimum parcel size defined by the Member State. It may also simplify the farmer's declaration and the control, in particular when the "crop group" parcel matches a reference parcel.

Notes:

1. ? Cf. art. 56(1) of Commission Regulation (EC) No. 1122/2009 for the definition of crop groups

2 1.2. Definition of the area to be measured

The total area of the agricultural parcel, in accordance with Art.34(2) and 34(3) of R.1122/2009, should be measured. However, areas not taken up by agricultural activities such as buildings, woods, ponds and paths are to be excluded from this area (Art.34 of R.73/2009).

Art.34(4) of R.1122/2009 states that, without prejudice to Art.34(2) of R.73/2009 (parcels with permanent crop trees or parcels afforested under a 2nd pillar scheme), "an agricultural parcel that contains trees shall be considered as eligible area for the purposes of the area-related aid schemes provided that agricultural activities or, where applicable, the production envisaged can be carried out in a similar way as on parcels without trees in the same area".

In this **context**, the Commission services view is that **Woods** (in parcels not declared as short rotation coppice) should be interpreted as areas within an agricultural parcel with tree-cover (including bushes etc.) preventing growth of vegetative under-storey suitable for grazing.

- With regard to **parcels containing trees**, the commission services are of the view that, as a result, areas of trees inside an agricultural parcel with density **of more than 50 trees/ha** should, as a general rule, be considered as ineligible. Exceptions, justified beforehand by the Member States, may be envisaged for tree classes of mixed-cropping such as for orchards and for ecological/environmental reasons.

- With regards to **shrubs, rocks** etc, the conditions under which these elements can be considered as part of the agricultural parcel should be defined on the basis of the customary standards of the Member State or region concerned (e.g. land cover type, maximum area percentage).

To assess the eligibility of / eligible area within an agricultural parcel of (permanent) pasture, Member States can use a **reduction coefficient**, which can take the following forms:

- a *pro rata* system whereby the eligible area taken into account is determined according to different thresholds applied at the level of each parcel. For instance, if the crown cover determined on the ortho-imagery and recorded as such in the LPIS-GIS ranges between 25% and 75%, the parcel is considered as 50% eligible.

? a percentage reduction applied at agricultural parcel level based on an assessment of the parcel using scorecards differentiating the reduction to be applied according to the type of ineligible feature, its predominance within the parcel etc.

In the application of either option, the Member States should consider the exclusion of the ineligible area according to its proportion within the geographical area of the encompassing parcel.

- With regards to **ponds**, only permanent ponds are to be excluded (if not falling under Art.34(3)).
- **Paths**, other than those created by animal access, are to be excluded.

Member States shall define **beforehand** the criteria and procedure used to delimit the (in)eligible part of the parcel in order to ensure that these criteria are communicated to farmers, where necessary, correctly transposed in the LPIS and adequately included in the instructions for the on-the-spot checks; this all with the view to ensure that the land declared and accepted for payment complies with all legislative requirements (e.g. agricultural activity).

In accordance with the first subparagraph of **Art.34(2) of R.1122/2009**, the area to be measured can be the total area of the reference parcel provided that it is fully utilized according to the customary standards of the Member State or region concerned.

Where, in accordance with the second subparagraph of Art.34(2) of R.1122/2009 **features of up to 4m wide** (walls, ditches, hedges) serve as **boundaries** between agricultural parcels and are traditionally part of good agricultural practice in the region concerned (e.g. terrace walls, drainage ditches), such features may be considered as being included; half of their width up to a maximum of 2m being attributed to each adjacent agricultural parcel. **Internal features** are, under the same conditions, accepted as forming part of the agricultural parcel where their width is less than or equal to 2m. Where the feature is >4m wide (or >2m wide if internal to the parcel), the feature should be removed from the area to be measured (see figures below), unless the feature has been recognized under Article 34(3) of R.1122/2009.
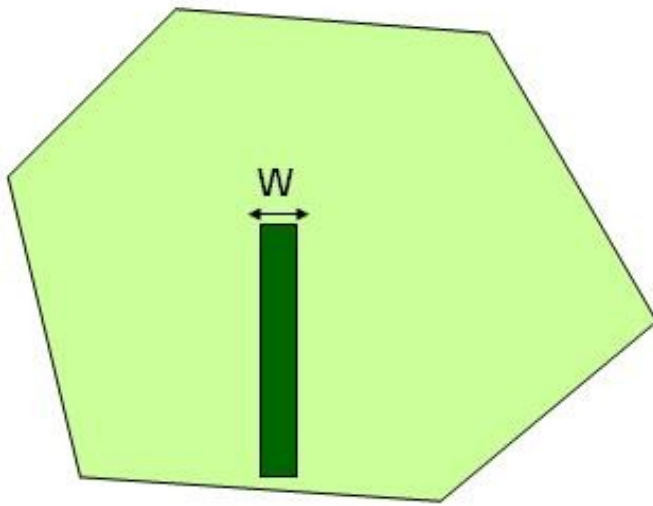
Internal feature of width W: if W?2m include the feature in the agricultural parcel; otherwise exclude the feature
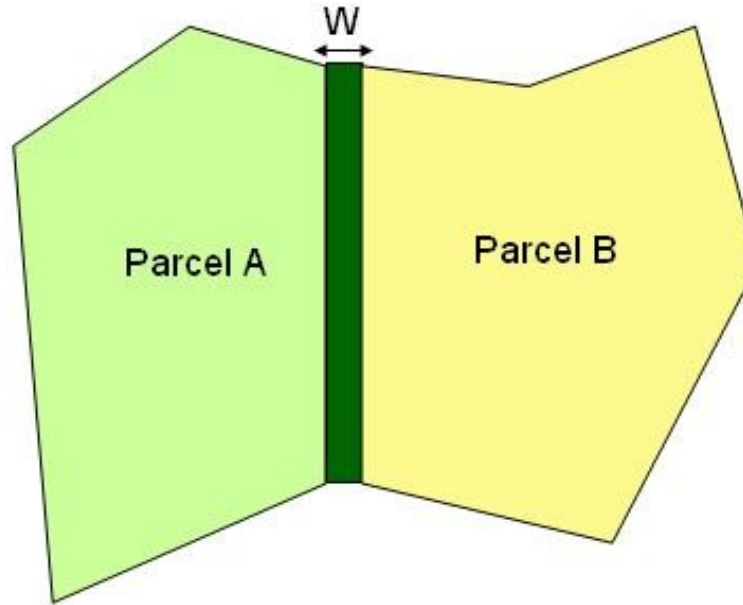
Boundary feature of width W: if W?4m include 50% of the feature area in parcel A 50% in parcel B; otherwise exclude the whole feature from both parcels

Where, under **Art.34(3) of R.1122/2009**, features that are part of the good agricultural and environmental condition obligations or the statutory management requirements (e.g. hedges, drainage ditches, small woods according to the local regulations) have been specifically recognised and defined as (landscape) features eligible for area payment, it is recommended that during the on-the-spot checks (i.e., remote sensing or otherwise) such features should be digitized as points, lines or polygons with their corresponding attributes in the LPIS, this way making possible the control of their maintenance (cf. the respect of the GAEC obligations).

NB: Such features are also eligible for coupled payments.

3 2. Area measurement

3.1 2.1. General considerations

The inspector should have received sufficient instructions and training, and be largely able to undertake the work autonomously. The inspector should have no conflicts of interest, and should be able to carry out the inspection independently.

Agricultural parcel areas shall be determined as laid down in Art.34 of R.1122/2009. In order to provide a result to the appropriate precision and to ensure effective verification, the inspector must have access to appropriate claim data (including map information) and measuring equipment.

On-the-spot checks of areas, as a general rule, consist of two parts:

1. A preliminary verification of eligibility and area of all declared agricultural parcels on the basis of map materials (LPIS, sketch maps, ortho-photos) and so forth (e.g. alphanumerical information such as results of administrative checks, LPIS maximum eligible area...).
2. The determination of the area of a sample of at least half of the parcels to verify the claim (eligibility, GAEC, and possibly declared crop), as well as the precise area of the agricultural parcels.

Every on-the-spot check shall be the subject of a control report in accordance with Art.32 of R.1122/2009 which makes it possible to review the details of the checks carried out independently.

3.2 2.2. Location of the agricultural parcel

The inspector should make sure he correctly located the reference parcel containing the claimed agricultural parcel.

3.3 2.3. Verification of the maximum eligible area of the reference parcel

Since the eligibility of the agricultural parcel area claimed will first be checked against the reference parcel maximum eligible area, it is important to **verify** that this **maximum eligible area is up to date** before starting measuring (temporary) ineligible features.

The Commission services take the view that the area of permanent ineligible features larger than 0.01 ha, or of features smaller than 0.01 ha but representing together an area larger than the LPIS parcel tolerance [1] (discovered during an OTS check or through any other source) should be deducted from the LPIS maximum eligible area without applying any tolerance; in addition, features above 0,1 ha should be mapped in the LPIS (see figure below). In the LPIS updating process, the historical maximum eligible area(s) and the deducted areas should be recorded to allow an adequate control trail (cf. log process in the LPIS data management flow).

However when permanent ineligible features smaller than 0.1 ha (and larger than 0.01 ha) are located at the border of the reference parcel, it could be more appropriate to map them out of the reference parcel (rather than including them and deducting their area from the maximum eligible area).

Real World

LPIS

Ineligible feature > 0.1 ha

100 m

0.2 ha

100 m

200m²

Ineligible feature > 100m² and <0.1 ha

100

0.2 ha

100 m
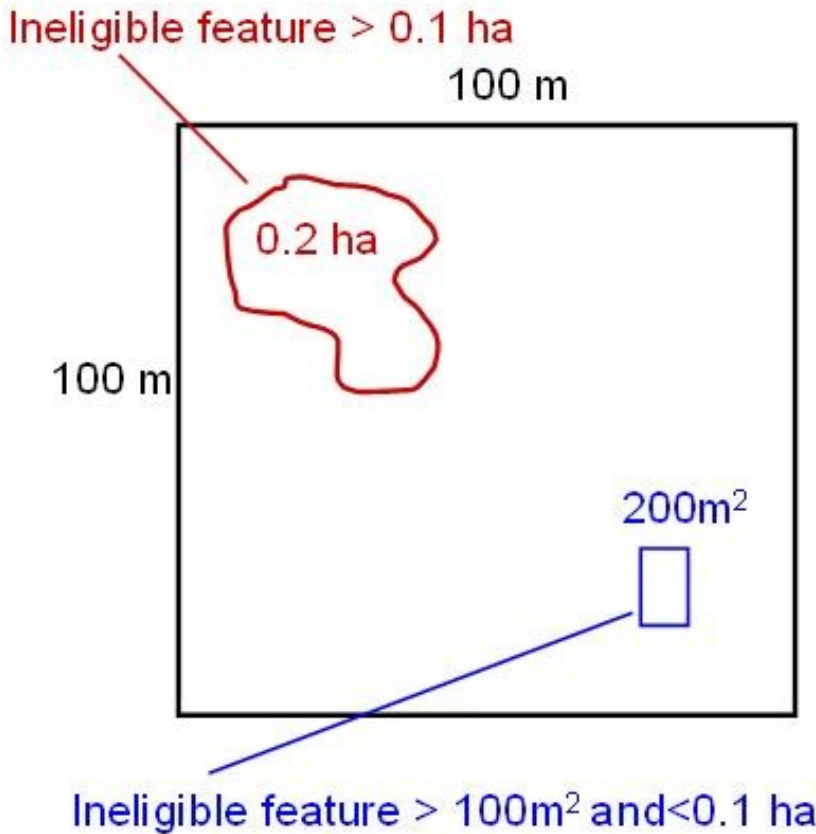
Maximum eligible area
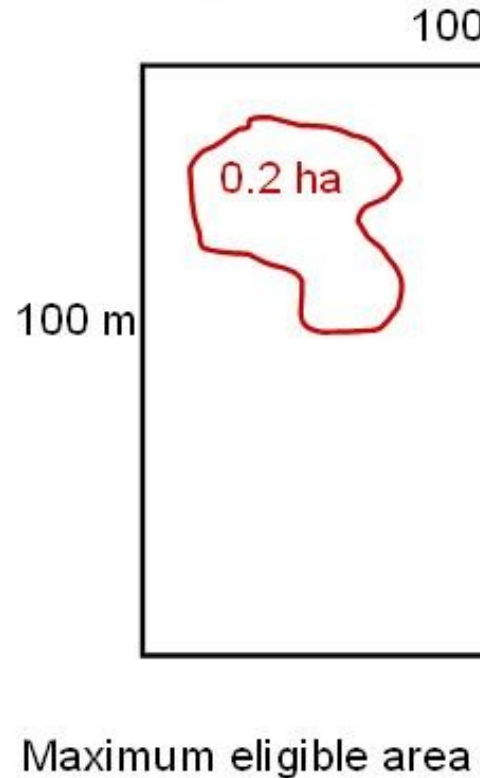
Figure: **Situation in the field (real world) and "transcription" into the LPIS** i.e. mapping of ineligible features > 0.1 ha and updating of the maximum eligible area.

3.4 2.4. Timing and advance warning

The entire check, especially *in situ* visits, has to be performed in a timely manner to ensure that unambiguous identification of the agricultural parcel limits and cropping (where necessary, e.g. for supplementary or recoupled payments) is possible.

In practice, inspections of crops, where necessary, have to be carried out in the appropriate period before, or (at latest) soon after the harvest to be effective. The Commission services consider on-the-spot checks to be completely ineffective from the moment the farmer starts to cultivate the land for the next crop season.

The use of advance warning should be kept to the minimum necessary, in order not to jeopardise OTS checks, and in any case no more than as laid down in Art.27(1) of R.1122/2009.

Notes:

1. ? as a general rule any **permanent ineligible** feature deducted during an OTS check is likely to trigger an update of the LPIS maximum eligible area (except for features below 0.01 ha (100 m2) which may together represent a significant area for an agricultural parcel, but not for the corresponding LPIS parcel).

4 2012 HR sensor menu

5 the 2012 HR sensor menu

The table below shows the types of HR satellite imagery available for the 2012 Control with Remote Sensing Campaign.

HR Sensor	Products	GSD [m]	Swath (at nadir)	Comments
SPOT4	MSP (4 bands, incl. SWIR)	20	60	
SPOT5	MSP (4 bands, incl. SWIR)	10	60	Acquisition of SPS PAN and SPOT5 MSP is possible in same pass
IRS P6	MSP (4 bands, incl. SWIR)	23,5	127-141	
RapidEye	5 MSP (5 bands, incl. SWIR)	6,5	77km	
DMC	MSP (3 bands Landsat 2,3,4 like)	32	325km	
THEOS	MSP (1 PAN 4 MSP)	2-15	22-90km	
Formosat-2	1 PAN 4 MSP)	1-4	24km	

6 the HR products

SPOT:

- Preprocessing: 1A
- Format SPOT4: CEOS (BIL) / DIMAP
- Format SPOT5: DIMAP
- Resampling: NN / CC
- Footprint: SPOT4 60x60km; SPOT5 20x20 30x30 40x40 60x60km

IRS-P6:

- The default recommended by the image provider for IRS-P6 data is SuperStructure format, UTM WGS84, CC & Ortho-kit with RPC-file.
- Orientation: North / Path
- Duplo ? two or more zones in one scene
- Footprint:140x140km, 70x70km

RapidEye:

- Preprocessing: 1B or 3A
- Format:NITF 2.0 with RPC
- Resampling: CC
- Footprint:77x50-300km

DMC:

- Preprocessing: L1T or L1R
- Format: DIMAP
- Resampling: CC
- Footprint:80x80km

Theos:

- Preprocessing: 1A (PSH 2A ? this product is used above 60deg latitude only)
- Format: DIMAP
- Resampling: CC
- Footprint:90 x90km MSP, 22x22km PAN

Formosat-2:

- Preprocessing: 1A
- Format: DIMAP
- Resampling:CC
- Footprint:24x24km

More information on the management of image acquisition and HR Imagery Specifications for the CwRS Programme can be found on the following website: http://cidportal.jrc.ec.europa.eu/home/image-acquisition/.

7 2012 VHR sensor menu

8 2012 VHR sensor menu

The table below shows the types of VHR satellite imagery available for the 2012 Control with Remote Sensing Campaign.

VHR Sensor	Products	Resolution [m]	Swath (at nadir)	Proposed role
IKONOS2	PAN, MSP (4 bands), PANMERGE	1 / 4	11.3	Prime
GEOEYE-1	PAN, MSP (4 bands), PANMERGE	0,5 / 2	15.2	Prime
QUICKBIRD	PAN, MSP (4 bands), PANMERGE	0,6 / 2,4	16.5	Prime
WV-2	PAN, MSP (8 bands, PANMERGE)	0.5/2	16.4	Prime
WV-1	PAN	0.5	17.6	Backup
EROS B	PAN	0.7	7	Backup/Prime
SPOT5	SPS/COL PAN supermode	2.5	60.0	Backup
F2	PAN, MSP (4 bands), PANMERGE	2 / 8	24	Backup
THEOS	PAN, mSP (4 bands)	2/15	22°-90°	Backup

9 The Ikonos2 (IK2) prime dedicated zone

The most efficient IK zone, for the purpose of a large set of CwRS zones, is a 30x30 km2 square acquired in one pass consisting of 3 strips of 10km width (technically the Ikonos sensor may acquire also larger areas in one acquisition; 20x40km, 20x60km, 40x60km). The minimum width of an AOI is 5km, and minimum size is 100km².

The necessary overlap (N-S or E-W) between subsequent acquisitions or strips should be a minimum of 0.5km in order to ensure the orthorectification process. The Ikonos system can acquire forwards and backwards giving a high collection rate, which means that there will be a tendency to acquire larger zones with this satellite sensor. The capacity will be forced.

For IKONOS the products ordered will be /km²:

- Geo Ortho-Kit
- Bundle (Panchromatic and 4 multispectral separate bands), or Pansharpened (4 multispectral bands at PAN resolution), resolution PAN 0.8-1.0m / MSP 3.28-4.0m
- Elevation angle 67-90º
- Cloud cover ?validated? 0 - ? 5 %, ?proposed? > 5 - ? 30 % CC
- Resampling CC
- Format GeoTIFF 1.0
- DRA (dynamic range adjustment) off
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery
- IK2 will be used only in constellation with GE1

10 The GeoEye-1 (GE1) prime dedicated zone

The GeoEye-1 system is built to acquire large areas in a single pass (up to 100x100 Km or 300x50 Km), anyway the best efficiency (meaning the capacity to acquire as many zones per pass as possible) is achieved with sites up to 40x40 Km

The minimum width of an AOI is 5km, and minimum size is 100km².

The GeoEye-1 system at launch could acquire forwards and backwards (bi-directional scan) giving a very high collection rate. Today it acquires only in one scan direction but is still capable of acquiring at a sufficient collection rate, and can still acquire large zones in one orbit path.

The satellite is designed to work in a preferred East-West scanning direction (but it works also North-South), therefore it is especially recommended for sites having such an orientation.

Due to its very high resolution (GSD of 50 cm) and high geolocation accuracy, this satellite is especially recommended for sites where CAPI of specific crops could benefit from the higher resolution of both the panchromatic and multispectral data, or where there is the need to get very high ortho accuracies and there are not many (or good) GCPs.

Even though the capacity for this sensor is set to 120.000 km2 in a dedicated scenario, it will not be programmed over 50.000 km2 in the 2009 campaign.

For GeoEye-1 the products ordered will be /km²:

- Geo products (which include RPCs)
- Bundle (Panchromatic and 4 multispectral bands as 4 separate files or as a single 4-layers file), or Pansharpened (4 multispectral bands at PAN resolution, provided as 4 separate files or as a single 4-layers file), resolution PAN 0.5 m / MSP 2.0 m
- Elevation angle 50-90º
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- Resampling CC
- Format GeoTIFF
- DRA (dynamic range adjustment) off
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery

11 The QuickBird (QB) prime dedicated zone

The best satellite tasking optimisation may be reached by ordering single areas of 12km width with variable length (approx 30km). A second strip may be defined but will be imaged at a later date. Even if the satellite is capable of acquiring diagonally, or horizontally, the most efficient scenario is N-S aligned strips. The minimum width of an AOI is 10km, and minimum size is 100 Km2.

The necessary overlap (N-S or E-W) between subsequent acquisitions or strips should be a minimum of 0.5km in order to ensure the orthorectification process.

Due to the very high resolution of the QB sensor (Ground Sampling Distance (GSD) of 0.6m) there will be a tendency to allocate this satellite sensor to zones with small parcel sizes, or where CAPI of specific crops could benefit from the higher resolution of both the panchromatic, and multispectral data.

For QUICKBIRD the products ordered will be /km²:

- Standard Ortho-Ready (or Standard 2A) , Basic format (1B)
- Bundle (Panchromatic and 4 multispectral separate bands; 2 files), or Pansharpened (4 multispectral bands at PAN resolution; 1 file), resolution PAN 0.6-0.7m / MSP 2.4-2.8m
- The tiling option will be used in order to avoid files larger than 2 GB; all QB orders will be produced with 16k tiling for the Bundle orders (if the zone is small there will be no tiling) and 14k tiling for all the Pansharpened orders. These options will permit having the smallest number of tiles, while maintaining the size of each piece below 2 GB. In the delivered QB products there is included the folder named GIS_FILES with detailed shape files of the different tiles provided, which gives an overview of the product structure.
- Off-nadir angle 0-37º (elevation angle 50-90º), (see Annex for conversion between the two angles)
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- Resampling Cubic Convolution CC, for Pansharpened product kernel ?pansharpened?
- Format GeoTIFF 1.0
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery
- QB will be used only in constellation with WV2

12 The WorldView-2 (WV2)prime dedicated zone

The WorldView-2 system is built to acquire both, large areas - typically more than 100x100 km in a single pass, as well as multiple single shot (point) targets. However, an efficient collection scheme is achieved with zones of approx. 40x40 km which will provide a moderate to high area yield per pass. Due to the extreme agility of the satellite another rather efficient collection scenario is multiple single shots of 15x15 km. A mix of both scenarios is also acceptable.

The necessary overlap (N-S or E-W) between subsequent acquisitions or strips should be a minimum of 0.5km in order to ensure the orthorectification process.

WorldView-2 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 16.4 km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between. Because of the extreme agility of the satellite the individual orientation of each AOI is of less importance. However, in the interest of the overall project a mostly consistent AOI orientation will be more favourable, either a combination of a) roughly square zones plus north-south oriented zones, or b) square zones plus east-west oriented zones. Option a) is slightly preferable.

WorldView-2 features a very high resolution of 50 cm GSD, high geolocation accuracy, 8 multispectral bands, and extreme agility. Therefore it is especially recommended for the following cases: a) zones where CAPI of specific crops benefits from the high spatial resolution of both the panchromatic and multispectral data, b) zones that need very high ortho accuracies, c) applications that may benefit from the increased spectral resolution, and d) areas with high density of control zones (AOIs) or exceptionally large control zones that benefit from the satellite?s collection capacity due to its agility.

For Worldview 2 the products ordered will be /km²:

- Standard Ortho-Ready
- Bundle (Panchromatic and 4 multispectral bands as 4 separate files or as a single 4-layers file), Pansharpened (4 multispectral bands at PAN resolution provided as 4 separate files or as a single 4-layers file),Bundle 8 bands (PAN,B,G,R, NIR1,NIR2,Coastal,yellow, Red Edge)
- resolution PAN 0.5m / MSP 2m
- The tiling option: Bundle: (4 or 8) 32k x 32k - GeoTIFF < 4 GB, PSH: 22k x 22k - GeoTIFF < 4 GB, (RPC file for a strip)
- Off-nadir angle 0-37º (elevation angle 50-90º), (see Annex for conversion between the two angles)
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- Resampling Cubic Convolution CC
- Format GeoTIFF 1.0
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery
- DRA (dynamic range adjustment) off

13 The WorldView-1 (WV1) backup (or prime)zone

WorldView-1 acquires in forward and backward (bi-directional) scan. Together with the very fast slewing and the wide image swath of 17.6 km at nadir this leads to a very high collection rate. The satellite can scan in north-south, east-west or any other arbitrary direction (scan azimuth) in between. Because of the extreme agility of the satellite the individual orientation of each AOI is of less importance. However, in the interest of the overall project a mostly consistent AOI orientation will be more favourable, either a combination of a) roughly square zones plus north-south oriented zones, or b) square zones plus east-west oriented zones. Option a) is slightly preferable.

WorldView-1 features a very high resolution of 50 cm GSD, high geolocation accuracy, and extreme agility. Therefore it is especially recommended for the following cases: a) zones where CAPI of specific crops benefits from the high spatial resolution of the panchromatic data, b) zones that need very high ortho accuracies, and c) areas with high density of control zones (AOIs) that benefit from the satellite?s collection capacity due to its agility.

The necessary overlap (N-S or E-W) between subsequent acquisitions or strips should be a minimum of 0.5km in order to ensure the orthorectification process.

WorldView-1 may be programmed as prime sensor where a MS Administrations? requests it, but usually it is programmed as a speculative backup solution for ?difficult? zones (zones which present difficulties in the feasibility assessment) or as a dedicated solution over zones declared as ?critical? towards end of window.

For Worldview 1 the products ordered will be /km²:

- Standard Ortho-Ready
- Panchromatic data (PAN)
- resolution PAN 0.5m
- The tiling option: 32x32k GeoTIFF < 2 GB, (RPC file for a strip)
- Off-nadir angle 0-37º (elevation angle 50-90º), (see Annex for conversion between the two angles)
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- Resampling Cubic Convolution CC
- Format GeoTIFF 1.0
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Commercial Priority Tasking
- DVD delivery or FTP delivery

14 The EROS B backup (or prime) zone

The swath width of the Eros B satellite is 7km, but a mosaic of multiples of this can be acquired in the same path. The most efficient Eros B zone is 26kmx28km.

The Eros B data only exists as PAN. Such data will normally be used as a speculative backup at the Administration?s request (over zones which present difficulties in the feasibility assessment), or as a dedicated solution over zones declared as ?critical? towards end of window. However Eros B may also be chosen as prime sensor if the MS Administration requests it.

Zones programmed with EROS B will be imaged starting half a second earlier and finishing half a second later in order to ensure correct telemetry at start/end of scene, this will allow usage of GCPs close to the boarder of the zones (a problem which was noted in 2008 campaign)

The quality and efficiency of the EROS B data has been assessed by the EC Services [1] ;

For Eros B the products ordered will be /km2:

- Eros B level 1A (plus pass file); BW, resolution 0.7 ? 0.8 m.
- Swath width at nadir is 7km
- Maximum off-nadir view angle 30° (i.e. 57-90° elevation angle), (see Annex for conversion between the two angles)
- Cloud cover ?validated? 0 - ?10 %, ?proposed? > 10 - ? 30 % CC
- Format tiff (1A)
- Bit depth 16 Bit (image 11 bit)
- UTM Datum WGS84
- Commercial Rush (high priority) Service
- DVD delivery or FTP delivery
- SW recommended ? Socet Set (EROS B model), ERDAS Imagine 9.2 and PCI Geomatica 10.1.1.

15 The Spot5 supermode (SPS/COL) backup zone

For Spot5 ?supermode?, the zone may be full scenes 60x60km or where possible ½ scene (40x40km), ¼ scene (30x30km), 1/8 scene (20x20km). The EC Services will provide the size of scene fitting the CwRS zone.

The Spot5 HRG sensor, with its ?supermode? 2.5m resolution imagery (resulting from interleaving, interpolation, restoration of 2 simultaneous HRG 5m PAN images) will be programmed as a backup at MS Administrations? request and most often in difficult climatic zones (e.g. above 45 º Lat.), or of zones which presents difficulties in the feasibility assessment. It will be used where the mean parcel size of the claimed area allows the use of such resolution, with relevant buffer tolerance [Ref 4]. The MS Administrations keep the responsibility of allowing usage of this type of data.

Acquisition of SPS (2.5m) and Spot 5 MSP (10m) is possible contemporarily in order to obtain the requested MSP component over the zone for the VHR window. This may be performed in order to produce Spot 2.5m colour (which however reduces Spot 5 HRG instruments? chances of looking elsewhere since one of the HRG instruments must acquire three images simultaneously), or 5 m colour (need of 2 images simultaneously). Another option is to programme SPS (2.5m) and SPOT 5 MSP (10m) separately but this does not guarantee acquisition the same day. The products SPOT 5 COL 5m or the product SPOT 5 COL 2.5m is offered as an option.

The necessary overlap (N-S or E-W) between subsequent acquisitions should be a minimum of 0.5km in order to ensure the orthorectification process.

The Spot5 Supermode (SPS/COL) will be programmed as a backup, if requested by MS Administrations?. Such backup will be either speculative; on zones declared as ?difficult? at feasibility; or dedicated on zones declared as ?critical? towards end of window.

For SPOT 5 supermode (SPS/COL) the products ordered will be :

- Product: 1A - Radiometric System Correction
- Product format: panchromatic data (PAN) or PSH (5 or 2,5PAN + 10m MSP)
- Scene: 60x60km, 40x40km, 30x30km,20x20km
- Resolution PAN 5m or 2.5m, PSH COL 5m or 2.5m
- Off-nadir view angle 0-30º (56-90º elevation angle), (see Annex for conversion between the two angles)
- Cloud cover ?validated? 0 - ?10 %, ?proposed? > 10 - ? 30 % CC
- Resampling CC
- Format GeoTIFF 1.0
- bit depth 16 Bit (image 11bit)
- UTM Datum WGS84
- Blue / Red Programming Service
- DVD delivery or FTP delivery

16 The Formosat2 (F2) backup zone

The most efficient Formosat2 zone will be a single scene 24x24 km or a longer N-S strip of 24 km width. The nature of the satellite being geo- and sun-synchronous permits a daily revisit time of locations on earth which can be reached from its orbit.

Formosat2 (F2) bundle data (PAN plus 4 MSP bands) or pansharpened (upon request) of 2m respectively 8m GSD at nadir will be used as a backup at MS Administrations? request and most often in difficult climatic zones (e.g. above 45 º Lat.), or of zones which present difficulties in the feasibility assessment.

The quality and efficiency of the F2 data has been evaluated by the EC Services [REF 6]. RMSE1D and have been set conservatively to 5m which may be revised downward after further assessment. Restrictions have also been set on the across/along angles to 20/25 deg. These restrictions on off-nadir view angles, not only ensure reaching required location accuracy, but are also consistent with GSD as a function of satellite viewing angles. GSD remains below 2.5m if mentioned restrictions on angles are maintained, and F2 may therefore be considered similar to SPOT supermode as far as the panchromatic image content is concerned.

FIGURE

The necessary overlap (N-S or E-W) between subsequent acquisitions should be a minimum of 0.5km in order to ensure the orthorectification process.

F2 will be programmed as a backup, if requested by MS Administrations?. Such backup will be either speculative; on zones declared as ?difficult? at feasibility; or dedicated on zones declared as ?critical? towards end of window.

For Formosat2 data the product order will be /scene:

- Processing level - Radiometrically corrected level 1A
- Product format: bundle (PAN,MSP),PSH upon request
- Scene 24x24km
- Resolution: PAN 2m,/MSP 8m
- DIMAP format (image in GeoTIFF, and metadata in XML file METADATA.DIM);
- Elevation angle: across 0-67º, along 0-61 °
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- 8 bits/pixel
- Blu/Red programming service
- Recommended minimum versions of sw suites are PCI Geomatica 10 with fix 10031, Erdas Imagine 9.1 with fix 33599, Erdas IMAGINE 9.2, Keystone SIPOrtho, Prodigeo of EADS SPOTImage and Socet Set.

17 The Theos backup zone

THEOS is an Earth observation mission of Thailand, developed at EADS Astrium SAS, Toulouse, France. GISTDA (Geo-Informatics and Space Technology Development Agency) of Bangkok is the owner of the satellite and is Thailand'?s leading national organization in the field of space activities and applications. The Thai Ministry of Science and Technology is funding the program. The EC Services have signed a FC with the Swedish Space Corporation for the procurement of imagery (FC 386.601)

The THEOS System allows 2 different missions: panchromatic, high resolution rather small FOV, and multispectral, medium resolution with large FOV ? Panchromatic o Class of Quickbird to Formosat 2 (10 to 20 km swath) o To be used in CwRS VHR backup scenario ? Multispectral o Class of Spot, Landsat, IRS (>60 km swath) o To be used in CAP CwRS HR 1st come 1st served scenario

Theos will be programmed as a backup, if requested by MS Administrations?. Such backup will be either speculative; on zones declared as ?difficult? at feasibility; or dedicated on zones declared as ?critical? towards end of window.

The necessary overlap (N-S or E-W) between subsequent acquisitions should be a minimum of 0.5km in order to ensure the orthorectification process.

For Theos data the product order will be /scene:

- Processing level - Radiometrically corrected level 1A, 2A geometrically corrected of systematic effects
- Product format: bundle (PAN,MSP(4bands)),PSH - only for zone above 60° latitude
- Scene 22x22km PAN,90x90km MSP
- Resolution: PAN 2m,/MSP 15m
- DIMAP format (image in GeoTIFF, and metadata in XML file METADATA.DIM);
- Elevation angle: 65-90°
- Cloud cover ?validated? 0 - ? 10 %, ?proposed? > 10 - ? 30 % CC
- 8 bits/pixel
- Priority tasking

More information on the management of image acquisition and HR Imagery Specifications for the CwRS Programme can be found on the following website: http://cidportal.jrc.ec.europa.eu/home/image-acquisition/.

Notes>

1. ? Benchmarking the WorldView-1 and EROS B sensors for use in the Common Agricultural Policy Control with Remote Sensing programme [PUBSY # JRC49378, Category 3.4 Oral presentation, Available at: http://mars.jrc.ec.europa.eu/mars/News-Events/MARS-Conference-2008/Agenda-and-Presentations/T2_Nowak_WV1_EROS2_JRC

18 4. Use of LPIS in on the spot checks

In the office, on-the-spot checks need to be prepared by selecting the areas to be measured, grouping and/or subdividing the parcels declared with reference to the LPIS, and arranging visit itineraries as efficiently as possible so as to cover one or more holdings.

- The LPIS data must be available for use during the on-the-spot checks campaign.
- The direct ? preferably in digital form ? consultation of the LPIS data (including where applicable orthophotos) shall be possible for the preparation of field controls.

When performing either conventional on-the-spot or remote-sensing checks, survey officers should have all the documentation needed to do the job properly from the outset.

- The output from the control exercise should be efficiently implemented in the management of any consequent on-the-spot checks that need to be made.

A clearly documented and/or non-proprietary interface to the LPIS should be implemented for the control exercise.

- The reference parcel vector layer and the associated alphanumeric application data must be directly exploited by the body (administration, contractor) responsible for executing these controls.
- The LPIS should include consistent transaction monitoring during the application and control process also for graphical objects. Conceptually, this requires time stamping and operator identification for all operations applied to graphical objects.

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19 Accuracy of the orthoimagery used in CwRS

DATA TYPE	MAX $RMSE_{1-d}$ in meters
aerial photographs	2.5
GeoEye1	2.5
Ikonos2	2.5
Quickbird	2.5
WorldView2	2.5
EROS B 1.8m satellite imagery vector scene (> 27 km)	3.5
SPOT 5 Pan Supermode	5
Formosat 2	5
SPOT 5 multispectral	15
SPOT 4 multispectral	30
RADARSAT	20
IRS P6 LISS III	40
DMC	50

20 Alphanumeric database

The alphanumerical database DB_ANUM_2008.mdb can be found here [1]. A full description of the tables can be found by following the links below.

The database comprises:

- 7 tables coded T1 to T7. Table T1 (DOSSIER) contains the declared data and results of diagnostics at dossier level. Table T2 (DIAGROUP) contains the declared data and results of diagnostic at group level. Tables T3 to T7 (CROSSREFPAR, PARCELD, PARCELM, CATEGPARC and RAPIDFIELDV, respectively) contain all data related to the parcel level (reference, declared, measured and retained areas, results of field visits).

- Digital ancillary data: nomenclature and a file with nomenclatures and parameters (files A1 to A6 and P1 to P7) should be supplied

In 2003, the structure of PARCELD and CATEGPARC was modified so as to account for the fact that a parcel may belong to a crop group and a (more general) payment group (e.g. a wheat parcel may belong to the cereal crop group and cereal-oilseed-protein payment group). As from 2006, the distinction between (agricultural) crop groups (e.g. cereals, oilseeds) and payment groups is no more needed and only the crop groups defined by art. 49 of Reg. 796/2004 plus the set-aside group[1] will be requested.

More and more, parcels are claimed in several groups, for instance SAPS and CNDP (e.g. arable crops) or SPS and energy crop, or even several schemes (SPS or SAPS and LFA, AEM). In order to avoid declaring the same parcel in several records[2] (one for each group or scheme) which results in an artificial increase of the number of checked parcels in the QC database, the contractors will be requested to adapt the PARCELD and CATEGPARC tables: i.e. to introduce as many crop groups / scheme fields as necessary. Examples are given with the detailed description of table PARCELD.

The relationship between declared parcels and observed parcels may not be straightforward. The database structure was designed so as to manage all systems of parcel identification in the same way:

- The Declared Parcels table contains the data declared by the farmer. The parcel identifier can be either the identifier of the **reference parcel** (i.e. directly the unique identification number as implemented in the land parcel information system (LPIS) of the Member State such as a cadastral parcel number, a block number, an ilot number or a land parcel number) or an internal number within the dossier.
- When the parcel identifier is an internal number created by the farmer himself (as is the case for the ilots), there should always be a link to the **reference parcels**. For that the contractor provides a cross-reference table between parcel ID used for declared and observed parcels and the Reference parcels (table CROSREFPAR).
- The observed parcels correspond to the results of interpretation by the contractor. The link between declared parcels and observed parcels is not necessarily unique but the parcel identifier allows to make the link between declared and observed parcels.
- Following the photointerpretation, the declared parcel area and crop are compared to the observed ones for the categorisation phase. Each declared parcel should be categorized.

Notes:

1. ? i.e. parcels declared for activating the set-aside entitlements in SPS, even if set-aside is part of the SPS group.
2. ? All linked to the same vector; if this is not the case, e.g. the CNDP parcel is a part of a larger SAPS parcel, then several vectors and records are needed.

page incomplete

21 Annexes for Quality Control data

21.1 Annexes for Quality Control data

Data media

File types

Alphanumeric database

Vector files

Image files

Satellite image metadata

Aerial photography metadata

Other ancillary data

22 Assessment of the risk analysis

22.1 Assessment criteria

According to Article 31(2) of Regulation 1122/2009, the effectiveness of risk analysis shall be assessed and updated on an annual basis:

- By establishing the relevance for each risk factor;
- By comparing the results of the risk based and randomly selected samples;

This analysis should be made taking into account the specific situation in the Member State. The purpose of the random sample is to permit an estimate of the ?background level? of anomalies. This background level, when compared with the rate of anomalies of the RA sample, allows assessing the quality of the RA. A higher rate of anomalies found in the random sample with respect to the RA sample might indicate inappropriate risk factors. There are several ways to express the rate of anomalies of a given sample. This rate can be:

- The % of applications of this sample with anomalies (i.e. for which the area determined is less than the declared area);
- The % of missing area in this sample (i.e. the total area not determined over the total claimed area). In MS applying SPS, the entitlements may be taken into account to reflect the fact that missing area does not necessarily lead to reductions or sanctions.
- The amount of aid not paid over the total claimed aid; this rate takes account of the possible sanctions and of the entitlements for MS applying SPS.

At the time risk factors have to be determined for the selection of control zones (i.e. in the autumn preceding the campaign), the percentage of missing area for each claim may be of easier access than the amount of aid (if sanctions have not yet been calculated).

Article 31(1) of regulation 1122/2009 fixes the random sample between 20% and 25% of the minimum sample rate for OTS checks, i.e. between 1 and 1.25%. This may create a problem in large sized countries, where for instance more than 10,000 random dossiers would be sampled. This is likely to be much higher than necessary to estimate the ?background level ?(probably <5,000 could be sufficient, depending on the frequency of dossiers with problems). While this may not present directly a problem with respect to the estimate, it may have two unintended effects:

- Fewer checks are focused on dossiers that do present a specific risk, thus missing opportunities to address risk
- Since it may be assumed that randomly sampled dossiers may be somewhat more expensive to organize, overall costs may increase.

The Commission has made no statement of what reliability this estimate should be. It was noted that, where the proportion of dossiers with problems approach low values (5% and below), the number of samples required to make this estimate at a given level of reliability/confidence increase geometrically. Thus, a member state which manages a) to keep levels of irregularities low, and b) keeps control levels constant, could find that the ?background level? estimate is not stable or reliable.

In brief, the above trend is that a MS that should be able to benefit from low levels of irregularity actually needs to undertake more controls to determine that low level reliably.

22.1.1 Identification of risk factors (CART method)

The identification of potential risk factors among all possible factors characterizing a claim should be made on a sample (1) representative of the whole population of claims and (2) for which the probability of selection is known.

The random sample is suitable for this analysis provided it is large enough to cover the main types of applications (with a minimum of 100 applications per class for major classes after the classification process; it is estimated that a minimum sample of several hundreds of applications should be used for this analysis). The RA sample (or part of this sample) could be suitable to complete the random sample provided it respects the two criteria defined previously (in particular, it should not be restricted to specific categories of claims). The use of this sample or part of it for the identification of risk factors still needs to be investigated.

Among the factors characterizing a claim, some are qualitative or categorical variables (e.g. existence of anomalies in the past controls, claim for crop X, closeness to minima or maxima, lodging of application after deadline, paper application without cross checks, claim for other schemes such as Less favoured Areas or Agri Environment Measures?) whereas others are continuous variables (e.g. amount of aid, number of parcels,?). The proposed method will identify criteria and thresholds for classifying the claims, therefore there is no need to convert continuous factors into categorical variables.

The analysis should assess the potential risk factors with respect to a given criterion. Since the ?risk for the fund? is understood in monetary terms, it seems logical to take the rate of anomalies in terms of amount of aid not paid, if available in time, or of area not determined as assessment criterion for this analysis. In other words, the analysis should identify the categories of claims for which the area not determined or the aid not paid is the highest rather than the categories of claims for which the number of anomalies is the highest.

CART (Classification And Regression Trees) algorithms are suggested for assessing the factors (or combinations or factors) associated with the highest rates of anomalies. These algorithms work as tree classifiers: at each node of the tree, they split the population present at this node into two (or more) groups though the identification of the factor that best divide the claims in this population with respect to the assessment criterion (e.g. % of missing area): starting from the whole sample, the 1st node will divide this sample into at least 2 classes of claims, which in turn will be split into at least 2 classes and so on. The split process stops on the basis of a statistical test. In the end, the initial population is divided into n classes, each one corresponding to a combination of factors (e.g. ?claims above x euros with request to access the national reserve and with claim for protein crops?; such a class would be identified after 3 nodes).

In practice it may be useful to rank the combinations of factors identified according to the selected criterion in descending order. The proportion of claims

in the whole population which would correspond to the 1st combination may then be estimated (hence the need for a representative sample) and so on with each successive combination of factors. Once the risk factors have been identified, two strategies may be used to select the RA sample from the whole population of claims (case possible for MS using classical inspections only or if a full VHR ortho coverage of the MS exists):

- Take all claims meeting combination 1, then combination 2 and so on till the targeted number of RA application is reached. The advantage of this strategy is that it should allow picking up the highest anomalies (assuming the sample used for the identification of the risk factors is representative and there is no change with respect to the previous year). However on the other hand this sample is not representative of the whole population of claims (since a number of combinations are left out of the sample) and will hence not be usable for next year?s RA assessment.
- Sample in each stratum or class with varying sample rates, for instance from 100% for combination 1 (highest risk, provided that a reasonable number of applications fall in this class) to 1% for combination n (lowest risk class containing the majority of the claims).

For MS using control zones, the previous strategy must be adapted e.g. through the mapping of risk factors.

23 Automatic classification

23.1 Overview

- Image classification can be used purely as a guide to help the interpreter at the CAPI stage (e.g. for the identification of specific crops such as the ones receiving supplementary payments or on the con-trary the ones not eligible for aid) or as a means of automatically identifying mismatches in the land use of a parcel. The use of automatic classification should be reserved for areas where the size and the shape of the parcels make it possible to obtain a sufficient number of pure pixels within the par-cel boundaries. Automatic classification should be used only for the predominant crop groups and for homogeneous land use (i.e. not for fallow land or set-aside, which may have different land cov-ers).

- Automatic classification should preferably be performed with multi-channel imagery. Multi-channel imagery can consist of single-date multi-spectral data sets, multi-date (selections of) multi-spectral data, or any other combination of spectral (SAR and multi-spectral) data sets. The use of very high resolution ortho-images for automatic classification should be considered with care, as the high level of detail in this kind of imagery tends to result in an increased heterogeneity inside field boundaries. New classification approaches may have to be considered to exploit or manage the additional texture information brought by such data.

- In the course of the Control programme, a number of methods for automatic classification have been proposed. These range from simple pixel based unsupervised classifications to supervised parcel-based classifications. Since the work carried out under the Control programme allows for the inclu-sion of detailed a priori information (e.g. parcel boundaries, results from field surveys, application data) the Commission recommends the use of supervised classification methods, since they generally allow both the parameterisation of the classification to selected crop classes and a consistent a poste-riori evaluation of the classification results.

- In a pixel based automatic classification, commission to (or omission from) a class is carried out per pixel. After that, a relative pixel count within the parcel boundary determines whether that parcel be-longs to the land use class or not. For instance, if 90% of pixels inside the boundary belong to class ?wheat?, the parcel may be accepted to have been classified as wheat (after which comparison to the declared crop class can be made). Since at this stage, parcel boundaries are supposed to have been adjusted to the right parcel outline (e.g. based on the VHR ortho-imagery), the other classes are usu-ally due to spectral confusion. This, on its turn, may be due to within-parcel variability of the multi-channel signature, spectral heterogeneity of the class, the quality of the original data, the selection of the channels, or the parameterisation of the classification method, etc. For example, a grassland par-cel that is partly cut may appear in two distinct classes due to differences in vegetation coverage. The commission percentage should not be set too low (e.g. below 80%) and classification results should be checked to determine whether the omitted pixels are not spatially correlated (i.e. possibly outlining systematically over-declared crop parcel areas).

- Parcel based classifications typically aggregate the multi-channel data for all pixels within the parcel boundary first (usually after exclusion of a pixel buffer around the parcel boundary) and then per-form the classification. Thus, only if the aggregated multi-channel signature fulfils the commission criterion of the classification will the parcel be labelled with the reference class. Also in this case, omission can be due to similar factors as in the pixel based classification. For instance, an oilseed rape parcel that is not already flowering, where most others are, may be omitted from the class ?oil-seed? if the classification has been parameterised to detect ?flowering oilseed? due to the availability of an optical image that is acquired at flowering stage.

- For either of the two supervised classification methods (pixel based or parcel based), training data are needed to ?seed? the classifier. Data from field surveys at the early stage of the contractor?s work (e.g. for training of CAPI staff) are usually best suited to this purpose, since they form an independ-ent data set from the application data. Field surveys should be aimed at providing a representative set of known locations for the main cultivations and land use classes, and preferably covering the char-acteristic terrain conditions in the site. Ideally, a subset of the survey data are used for training, while the remainder is used to evaluate the quality of the classification (Cf. §3).

- If only limited training data from field surveys are available, an alternative source of training data may be drawn from the application data. The use of this alternative should be considered with care. The Commission recommends restricting this method to the major crops, for which a large number of parcels have been declared. The selection of the application data sample is based on the plausibil-ity that the majority of the declared parcels are correct. A statistical outlier analysis may be used to reduce the risk of selecting into the sample parcels with signatures that deviate from the common signature (and are, therefore, likely candidates for further CAPI analysis).

- For any classification result, the classification accuracy should be analysed in at least two ways:
  - A classical evaluation of commission and omission errors in the form of an statistical confusion matrix analysis (or ??coefficient analysis). This is usually a good indicator for the quality of the classification, and can be used to quantify classification performance for different channel or class combinations. This analysis is equally applicable to pixel based and parcel based classifica-tions.
  - A sample of automatically classified parcels (of e.g. 5-10%) should be analysed using CAPI to determine possible anomalies in committed parcels and to highlight the reasons why certain par-cels may be omitted. Omitted parcels are usually committed to another class, which make a cross-analysis possible.

- The main purpose of automatic classification is to optimise the CAPI work. A reliable classification result permits the contractors to concentrate CAPI on parcels for which the classification result does not correspond to the declared class, land-uses that have not been included in the classification or parcels that may correspond to non eligible land uses (e.g. fruit and vegetables in SPS). In case auto-matic classification is used in the control programme, it is of the utmost importance that the contrac-tor fully details the methodology used and includes an analysis of the classification results obtained. It is, furthermore, required that the contractor flags automatically classified parcels, which have not also been subject to CAPI, with a special code.

- A parcel has to pass to the CAPI stage if it has not been classified or if the classification does not correspond to the declared land use. Examples of such cases are (but not limited to):
  - the corresponding radiometric classes have not been identified during the classification (e.g. rare type of crop or unusual response);
  - a potentially non eligible crop (e.g. potato in SPS) has been identified on all or part of the parcel, justifying further check by CAPI;

- for pixel based classifications: the relative pixel count of correctly classified within the parcel has not reached the pre-defined limit (e.g. 75% or other choice);
- for parcel based classification: the classification does not correspond to the declaration;
- the parcel is declared as set-aside.

• The check of GAECs is a new requirement and the use of automatic processes for this purpose is still to be assessed. Some of the proposed methods are still under development or assessment (e.g. the de-tection of burnt areas) and consequently, no specific recommendations are provided in the present document. Member States are however advised to use specific codes for the GAECs checked on the imagery and to report on the follow up of these checks as these results will allow the identifica-tion of areas where research is needed.

24 Buffer tolerance validation method - recommendation for orthoimagery

24.1 Recommendation for parcel area validation using orthoimagery

Recommendation for parcel area validation using orthoimagery basis on the general document concerning Area measurements validation scheme (see also the past studies)

- Selection of at least 30 parcels (see study 2011 below)
- Area measurements of these parcels performed by at least 6 operators (for proper statistical analysis)
- Each operator performing at least 4 measurements (repetitions) of each parcel (for proper statistical analysis)

For what concerns the parcels? selection:

- Parcels selected should be a representative sample of the control area zone (Fig. 1 strongly related to the parcel structure)
- Parcel sizes should cover the range observed in the control area (see next chapter concerning the choice of the parcel size and past study 2005)
    - ♦ S : small
    - ♦ M : medium
    - ♦ L : large
- Parcel shapes should vary (see next chapter concerning the choice of the parcel shape and past study 2005)
    - ♦ SF1 : compact
    - ♦ SF2 : elongated
    - ♦ SF3 : very elongated

- Some parcels should be selected with easily identifible borders and some with fuzzy borders (Fig. 2)
- However, parcels should be carefully selected so as to avoid interpretation problems and lead to some parcels rejections later on during the analysis (Fig. 3)

24.2 Remarks concering choice of the parcel size and shape ranges

Before parcel set definition (size and shape) statistical analysis of the parcel structure on the area to be controlled should be performed. In the first step parcel areas are sorted and 5% of outlying values are discarded (percentiles: 97.5% and 2,5%). In the next step the remaining range is divided by 3 equal parts (small, medium and large size). Parcel area and perimeter allow for Shape Factor calculation (SF=(perimeter/4)^2/area). The same procedure should be performed for SF (compact, elongated and very elongated parcels).

Example of parcel set (30 parcels):

- good border: 15 parcels
    - ♦ S and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels
    - ♦ M and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels
    - ♦ L and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels
- bad border: 15 parcels
    - ♦ S and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels
    - ♦ M and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels
    - ♦ L and SF1/SF2/SF3 - 2/2/1 i.e 5 parcels

24.3 Example of parcel border

Some examples are provided hereafter in order to illustrate the concepts of ?easy border?, ?fuzzy border? and ?borders leading to interpretation problems? (Fig.3).

Fig. 1 Parcel sizes should be representative of the zone
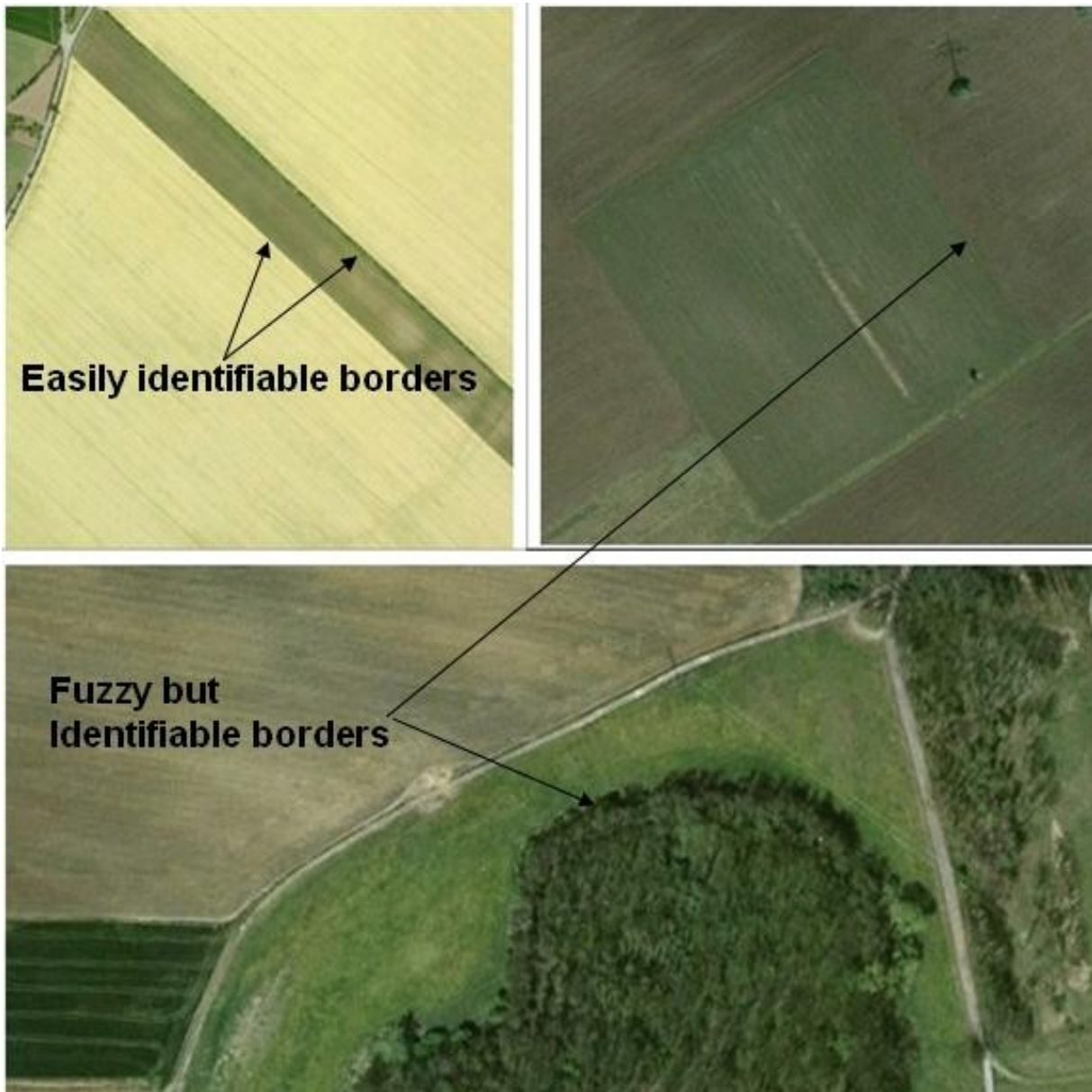
Fig. 2 Examples of ?easy? and ?fuzzy? borders that should be part of the parcels sample

Fig. 3 Examples of parcels with limits difficult to delineate (photo interpret) and that should not be part of the selected parcels sample

24.4 The past studies:

• ongoing tests made by the JRC concerning the configuration of parcels set recommended for validation

The following factors was analysed:

- influence of the number of parcels on the buffer tolerance
- relationship between buffer tolerance and area, border and size

Test was performed basing on the 128 parcels; 100 random samples of 5, 10, 20, 30 and 50 parcels were analysed(Bootstrapping); mean tolerance buffer and its standard deviations are calculated (please see figures below).

Evolution of the mean

Evolution of the standard deviation
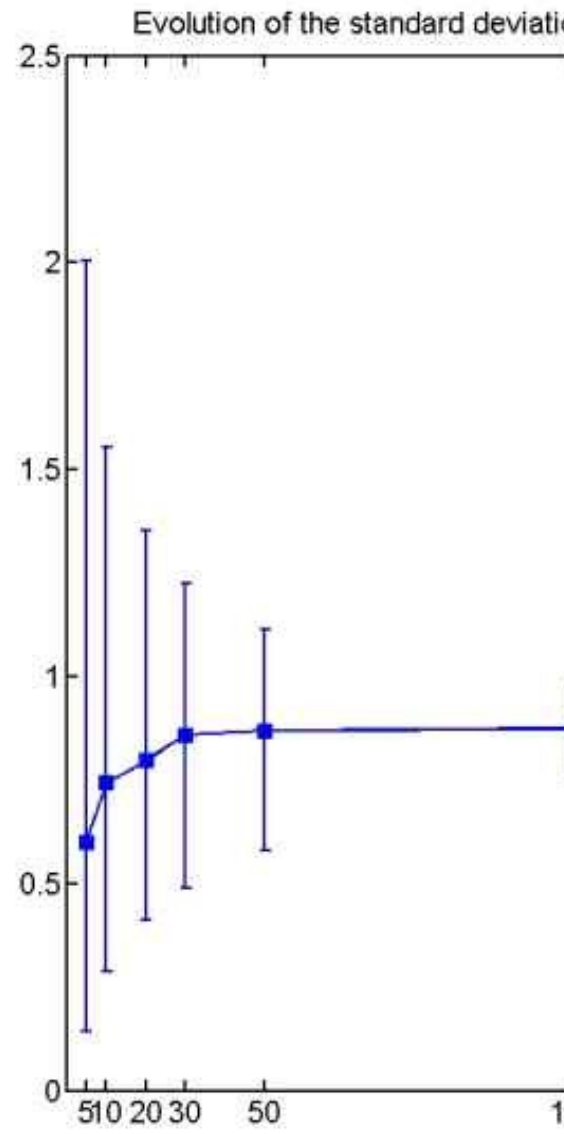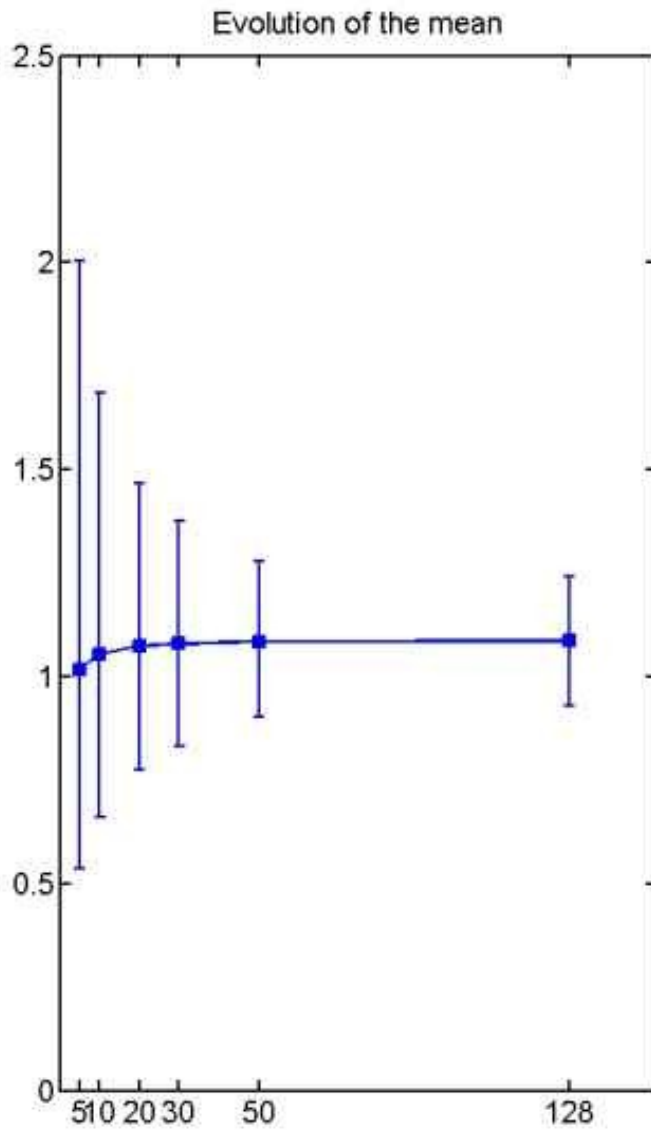
Relationship between mean buffer tolerance and its standard deviation and number of parcels
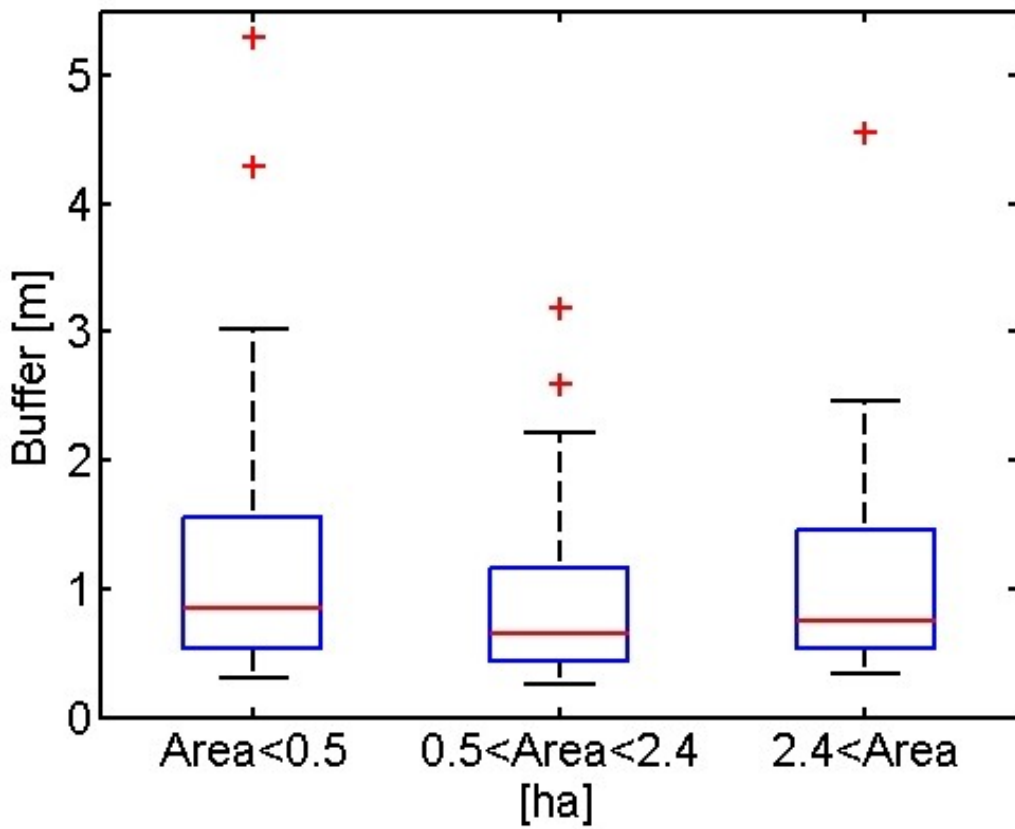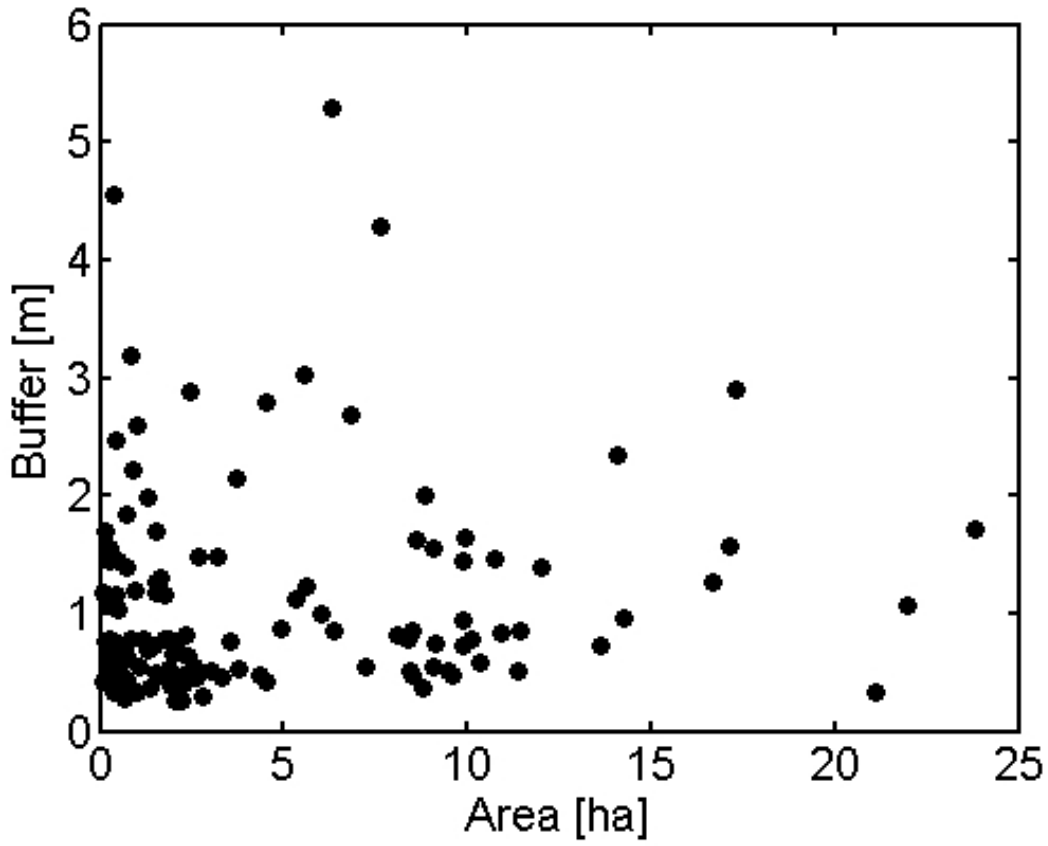
Relationship between mean buffer tolerance and parcels area, size factor
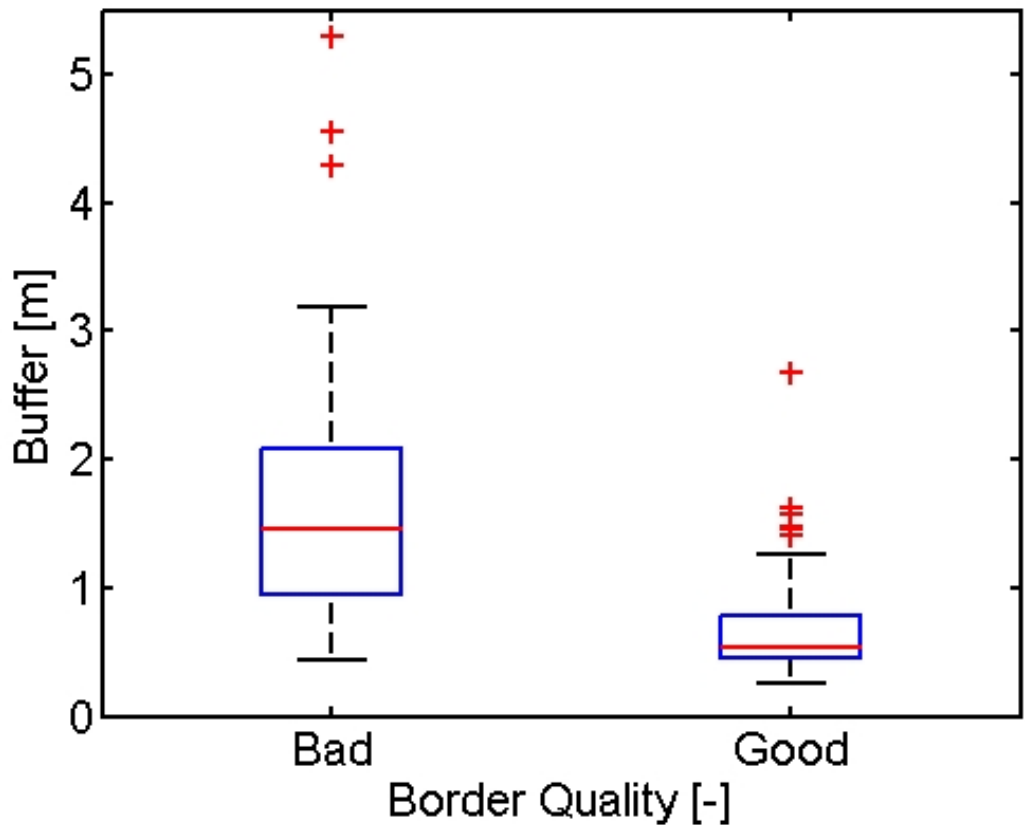
Relationship between mean buffer tolerance and parcels border

Relationship between mean buffer tolerance and parcels shape factor
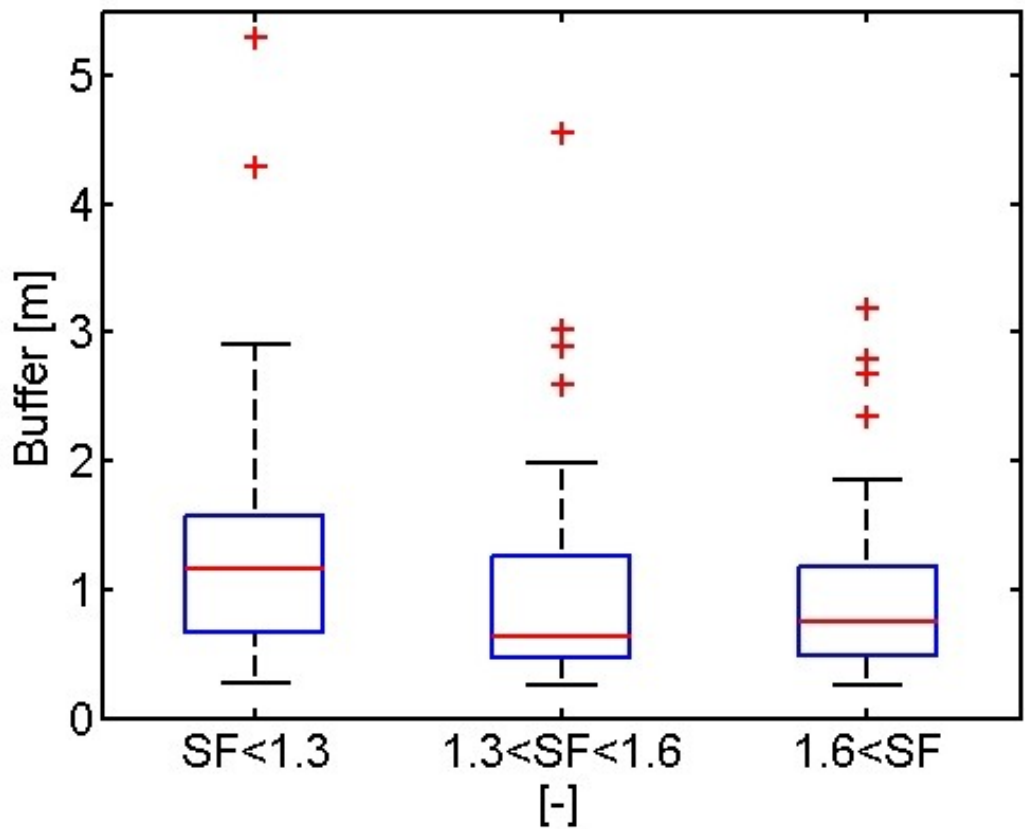
From 128 parcels we calculated mean buffer of 1,09 m with confidence level 95% (0,93-1,24 m) and its standard deviation of 0,88 with confidence level 95% (0,77-0,99 m). Comparison between the values and the results of Bootstrap analysis was the justification for recommendation of at least 30 parcels in validation process. The influence of the border factor is obvious, however the relationships between size and shape and area are not so clear, but these factors were also considered to cover all range of the measured parcels. Considering the statistical calculations and the analysis of figures above we recommended the parcel set in defined at the beginning of the page configuration: number of parcels, border, size and shape in validation process using orthoimagery.

- • analysis of the buffer tolerance validation tests (2005-2010) - the buffer couldn't be foreseen, extrapolate without validation, especially when we apply orthoimagery with decimeter pixel size form different sources

The following table shows the reproducibility limit of the buffer width (i.e. 2.8 x standard deviation of the buffer width under reproducibility conditions) observed on 12 orthoimages, the buffer width derived from the rule of thumb (i.e. by multiplying the GSD by 1.5) and from the linear regression model adjusted to the observed buffer widths.

Image	Pixel size (m)	Observed buffer width (m)	Rule of thumb buffer width (= 1,5 x GSD); predicted; (m)	Estimated buffer (through an O regression model
CZ colour orthophoto (0,20m)	0,20	0,60	0,30	0,48
Airborne PAN ortho (0,25 m, 1:13 000)	0,25	1,23	0,38	0,53
Airborne DMC (0,25 m)	0,25	0,40	0,38	0,53
Airborne Vexcel (0,50m)	0,50	0,80	0,75	0,81
Eros B (0,70m)	0,70	0,93	1,05	1,04
Airborne colour orthophoto (0,75m, scale 1/26 000)	0,75	1,23	1,13	1,10
Ikonos P+XS (1m)	1,00	1,20	1,50	1,38
Ikonos P+XS (1m)	1,00	0,93	1,50	1,38
Airborne ADS 40 (1 m)	1,00	0,99	1,50	1,38
Airborne Vexcel (1 m)	1,00	1,25	1,50	1,38
Eros A, P (2m)	2,00	2,80	3,00	2,50
Spot supermode P (2,5m)	2,50	3,20	3,75	3,06
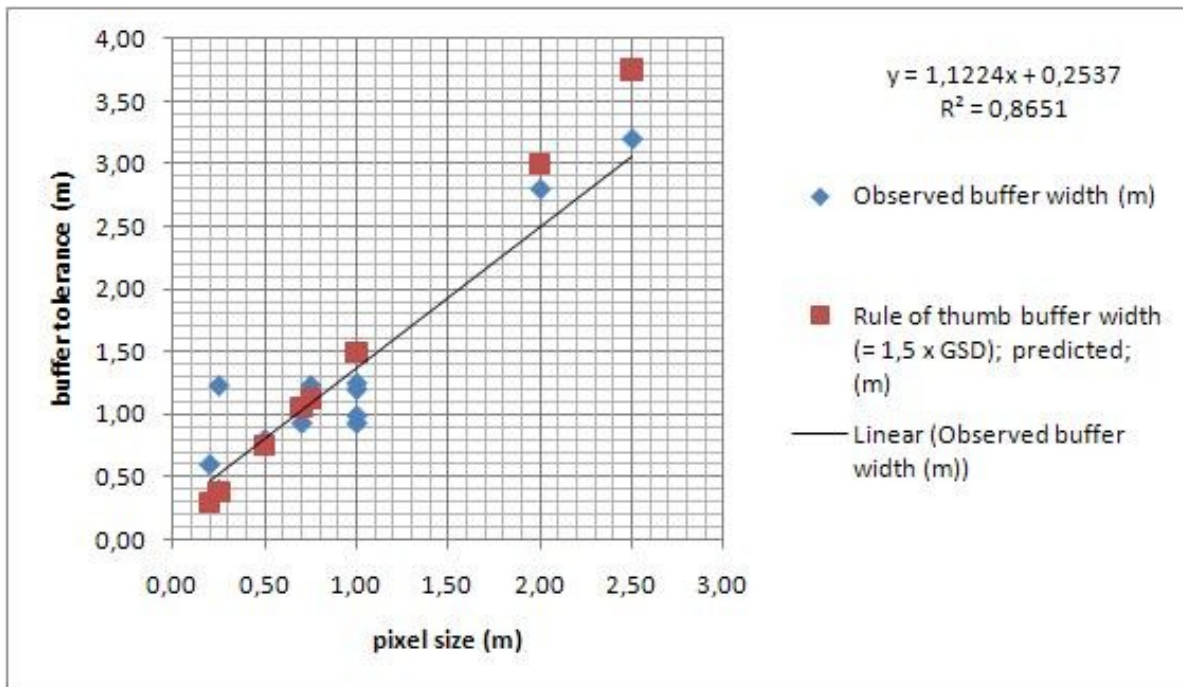
Relationship between buffer tolerance and pixel size; please notice underestimations for small pixel size and overestimation for bigger pixel size

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- **the 2010 tests made by the JRC on 1 m ADS, 1 m Vexcel, 25 cm DMC**
  - ♦ Orthoimagery validation ADS 40, Vexcel, France
  - ♦ Orthoimagery validation DMC, Catalunya

- **the 2009 tests made by the JRC on 0.7 m EROS B, 1 m IKONOS PAN+XS**
  - ♦ Use of VHR PAN image for the CwRS Results of validation test of EROS B and Ikonos imagery
  - ♦ Suitability of VHR PAN-only data for large scale rural mapping under CAP

- **the 2008 tests made by the JRC on 1 m and 3 m TerraSAR, 1 m Cosmo SkyMed**
  - ♦ Agricultural Parcels Measurement on VHR SAR Images, JRC Scientific and Technical Report

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- **the 2005 project: Validation of methods for measurement of land parcel areas**

made by AGH University of Science and Technology PL, Cracow UWM, University of Warmia and Mazury, Olsztyn, PL and Unité de Statistique et Informatique, Gembloux, BE

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  - ♦ main report: 20 cm PAN orthophotos, 75 cm colour orthophotos, 1m Ikonos
  - ♦ supplemetary study: 2m Eros A and 2.5m Spot supermode data

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25 Categorization at dossier level

There are three steps in the categorisation of the dossiers: A conformity test; a completeness test; and a final diagnosis per dossier combining the two previous ones.

25.1 Conformity test

A dossier is accepted if all crop groups are accepted (i.e. Dg-Mg ? 0 for any crop group). Table 5 below summarizes this test for Member States making a distinction between minor rejects (all crop groups are minor rejects) and major rejects (i.e. at least one crop group is a major reject) at dossier level. The pro-posed coding (DMi and DMa) remains valid whatever the test applied for sorting the rejected dossiers (e.g. fixed threshold in ha or monetary unit). If no sorting is applied (i.e. all rejected dossiers are pro-cessed in the same way), the categories DMi and DMa could be amalgamated into one category coded DR1.

For dossiers including the SPS crop group, the categorization (as Accept or Reject and for the Rejects, as minor or major Rejects) will be considered as provisory as long as the payment entitlements will not have been taken into account. This provisory categorization may be used as an indicator of the quality of the application.

25.2 Completeness test

The purpose of the completeness test is to avoid ?accepting? a dossier which has been checked on a too restricted extent due to technical problems, i.e. T codes. In such a case, the dossier is considered as not having been controlled by remote sensing. If the dossier was part of the control sample, it has to be completed it in the field, i.e. field inspected.

Once a farmer has been selected for a remote sensing control, at least 50% of the parcels for which he requests aid shall be checked, ?provided that the sample guarantees a reliable and representative level of control in respect of area checked and aid claimed? (Article 33 of Commission Regulation (EC) No 1122/2009).

A dossier will be categorized as "complete" if the percentage of parcels with T codes with respect to the claimed parcels is lower than 50% (Cf. Table 5). The assessment of the representativeness of the sample of parcels checked in terms of area and aid claimed is left at the discretion of MS. A possibility could be to request that at least 80% of the total claimed area and at least one parcel per crop group should be checked.

Input	Test	Dossier conformity test	Dossier codes	
			Yes	No
The whole dossier	D1	All crop groups accepted (Dg-Mg ? 0) ?	DA1	-
		If at least 1 crop group is rejected, dossier is rejected	DMi	DMa
		Are all rejected crop groups coded RMi ?	All rejected groups are RMi	at least 1 rejected group is RMa
Input	Test	Dossier conformity test	Dossier codes	
			Pass (complete)	Fail (incomplete)
Area retained for: the whole dossier	D2	(# of parcels with T codes) / (# of claimed parcels) <= 50% and (total retained area of T coded parcels) / (total retained area) < 20% and at least one parcel per crop group	DC	DI

In order to improve the efficiency of the control, applications sharing a reference parcel with any application from the control sample may be included (Cf. National Addendum). This recommendation is valid for any type of OTS check (physical inspection or CwRS), and particularly for checking joint cultivations, but is probably easier to apply in CwRS than in physical inspection. Such ?ancillary? applications are likely to be incomplete and should hence not be completed in the field, in contrast with the applications from the control sample. However, although very partially checked, these applications could be rejected on the basis of irregularities found on the parcels checked.

25.3 Final diagnosis at the dossier level

The final diagnosis summarizes the diagnoses of the conformity and completeness tests at dossier level. This table proposes a general diagnostic code per dossier and describes a possible follow-up action to be undertaken for rejected crop groups or incomplete dossiers. It is reminded that incomplete dossiers that were part of the initial control sample have to be completed in the field. In some Member States, the contractor may be in charge of the

RFV necessary to complete the dossier (Cf. National Addendum).

The general diagnostic code proposed takes account of the distinction between dossiers rejected for minor and major discrepancies. If such a sorting is not used, the diagnostic codes can be simplified (e.g. DR7 and DR8 for rejected complete and rejected incomplete respectively).

Whatever the diagnosis at dossier level, Member States may decide to manage parcels outside toleranc-es by appropriate administrative procedures, in particular if the anomaly originates from the LPIS.

A dossier categorized as incomplete will be counted and paid to the contractor if it has been processed and photo-interpreted normally. It neither will be counted nor paid if it appeared incomplete before the digitization and the photo-interpretation.

Notes:

26 Categorization at group level

26.1 Conformity test

For each crop group, the total declared area of the crop group (Dg) will be compared to the total retained area of the crop group (Mg). In practice, the areas declared and retained for all parcels claimed in a given crop group are summed, therefore allowing compensation between over-claimed and under-claimed parcels of the same crop group (if this compensation is allowed in the Member State concerned ? cf. National Addendum).

Since, for the SPS crop group, the calculation of reductions and exclusions depends not only on the declared and retained group areas (Dg and Mg) but also on the number of entitlements, the categorisation rules based on Dg and Mg may not be relevant for the SPS crop group. The contractor is referred to the National Addendum for the diagnosis of the SPS crop group (the National Addendum may require the contractor to indicate only the declared and retained group areas, separating between different types of areas eligible for SPS).

The conformity test based on the group declared and retained areas is however valid for the other crop groups i.e. title IV aids (e.g. protein crops, rice, nuts), Article 68 support, SAPS and CNDP.

26.2 Sorting of crop groups into Accepts and Rejects

For a given crop group, the following three cases may be encountered:

- A1: The declared area is equal to the measured area (**Dg - Mg = 0**).
- A2: The declared area is less than the measured area (**Dg - Mg < 0**). In this case, the Administration will accept and pay only the claimed group area.
- R: The declared area is greater than the measured area (**Dg - Mg > 0**).

The first two categories are considered as accepted. All crop groups with a declared area greater than the retained area (third category) shall be **rejected**.

26.3 Sorting of rejected crop groups into minor and major rejects

As any rejected crop group should be subjected to a follow-up action because it incurs reductions or sanctions, a second test may be performed in order to sort minor and major rejects. This test, which consists in comparing the discrepancy (Dg ? Mg) with some threshold to be fixed by the Member State (cf. National Addendum), is useful when the follow-up action varies according to the discrepancy. If the follow-up action is the same for all rejects (e.g. letter sent to the farmer and field inspection in case of no reply within a number of days), sorting the rejected crop groups appears as unnecessary.

The thresholds suggested (cf. in Table below) are those stipulated by the regulation[1] to determine whether a sanction should be applied to a crop group. The criteria for sorting rejected crop groups into minor or major rejects will be decided by the National Administration.

The follow up actions for minor and major rejects are of the responsibility of the Administration. In particular, if the contractor is requested to establish a diagnosis for the SPS crop group without accounting for the payment entitlements, this indicative diagnosis may have to be recomputed by the Administration before starting any follow-up action.

Table: Sorting of the rejected crop groups into minor or major rejects

Scheme	Test	Codes for the crop groups	
	declared ? measured crop group areas	No	Yes
All schemes i.e. SPS, SAPS, coupled payments, SAPS CNDP [2]	(Dg - Mg) > 3% Mg or 2 ha	RMi	RMa

*In this table: **Dg** - declared area of the crop group; **Mg** - total retained area for the crop group.*

Notes:

1. ? Article 58 of Commission Regulation (EC) No 1122/2009 for both SPS and SAPS
2. ? The National Addendum should indicate if this sorting applies to CNDP. According to Article 93 of Commission Regulation (EC) No 1121/2009, MS ?have to apply appropriate control measures in order to ensure that the conditions for granting of the CNDP are complied with?.

27 Categorization at parcel level

27.1 General considerations

At the end of the CwRS process (i.e. after the pre-CAPI check, the CAPI or RFV), each claimed parcel should be assigned <u>at least one technical code</u>, a measured area (wherever feasible) and an observed land use or crop group.

The roles of the technical codes are the following:

- Trace the work of the interpreter (e.g. for quality control purposes);
- Allow to <u>compute the retained area</u> for each claimed parcel;
- Describe the problem found to the administration (and the inspector for parcels to be visited in the field);
- Allow a posteriori analysis and identification of particular problems (e.g. high occurrence of a given code in a region).

The retained area should then be compared (capped) to the official area of the reference parcel (i.e. LPIS area).

Although parcels not claimed will have no impact on the diagnosis, checking these parcels allows to better check claimed parcels (in case parcels not claimed share a reference parcel with claimed parcels) and to train the interpreter on specific crops (e.g. crops that <u>may</u> **not be eligible for SPS).**

Several codes may be used simultaneously if necessary. When several codes are assigned to a parcel, the retained area and land use should correspond to the <u>least favourable condition</u>. In any case the rules should always be defined in accordance with the National Administration.

Some codes are likely to change after a rapid field visit (if this option is chosen). In the latter case, it will be preferable to keep track of the two successive situations: i.e. to keep the code(s) before and code(s) after the rapid field visit.

In the frame of the control of Cross-Compliance, specific codes should be applied to **flag parcels for which a breach to a specific GAEC or cross compliance issue** is observed or suspected during the CAPI process.

27.2 Codification rules and standard codes

A series of ?standard? codes have been defined and classified in three categories:

- The **T**x codes are assigned to parcels not checked for some technical reason independent from the interpreter (e.g. parcel outside the image). As assigning a T code implies giving the benefit of doubt to the applicant, these codes should not be assigned to parcels deemed doubtful during CAPI.
- The **A**x codes correspond to anomalies, in particular those related to eligibility, and lead to the rejection of part or a totality of the parcel.
- The **C**x codes are assigned to the interpreted parcels (i.e. checked parcels) but for which the declared area or crop group is not accepted by the interpreter. Different rules apply for computing the retained area.

If relevant, several codes could be assigned to the same parcel. If both the declared area and the declared crop group are accepted, the controlled parcel will be coded as ?OK?.

Additional codes may be defined by the National Administration to record specific cases not described by existing codes (e.g. LPIS boundary to be updated, or codes for other schemes). In order to avoid con-fusion it is preferable:

- not to reuse already existing codes (by changing their definition);
- to create new codes by subdividing existing codes: for example A31 (unknown cadastral reference), A32 (valid cadastral reference, but no vector).

Moreover, the new code(s) should be connected to an existing category (T, A, C) as much as possible.

28 Categorization of dossiers

28.1 Objective of the diagnostic rules

- In classical Control with Remote Sensing (CwRS), i.e. the control performed in the office mainly, diagnostic rules are applied at parcel, group and dossier levels. The objective of these rules is to separate the dossiers that will need a field visit from those which are considered as correct and therefore don?t need any follow-up action (for the points that could be checked by remote sensing). Three categories of dossiers are distinguished as a function of the follow up action: accepted, rejected and incomplete dossiers (see Crop Groups and CwRS diagnosis).
- In the case the CwRS ?photo? method is applied (i.e. systematic visits to all parcels followed by parcel area measurement in the office), the sorting of the dossiers is only requested for statistical purposes.
- The sorting of the dossiers for which a follow-up action is necessary is a characteristic of the classical CwRS method. One of the basic principles of this sorting is to concentrate field inspections on a reduced number of problematic parcels. Apart from the regulatory aspects, the criteria to decide on a field inspection also depend on organizational or strategic considerations. To some extent, the sorting of the dossiers to field inspect should remain consistent with the thresholds applied for the reductions or penalties defined in the regulation .
- As a general rule, reductions or exclusions should not be applied following remote-sensing controls without informing the applicant i.e. without offering him any possibility of recourse or re-inspection.

28.2 Categorisation at crop group and dossier level

- The categorisation rules are meant to classify each group into accept, minor or major reject on the basis of the difference between the declared and the retained group areas. Groups classified as reject may incur reductions or exclusions and are hence subjected to a follow up procedure.

- The rules for the application of sanctions or exclusions are defined at the crop group level (cf. article 51 of Commission Regulation No. 796/2004 for SPS and SAPS CNDP and article 138 of Commission Regulation No. 1973/2004 for SAPS). As a consequence, the most appropriate method for sorting the dossiers to follow up is a diagnosis at the crop group level.

- The Administrations should adapt the sorting of groups to their own strategies of irregularities management (rapid field visits, meetings with the farmer, notification to the farmer, etc.). MS may apply different criteria, for instance based only on the amount disputed, on a fixed area threshold or on the threshold(s) defined in the regulation for the calculation of reductions and exclusions (e.g. 3% or 2ha for SPS coupled aids or SAPS CNDP , 3% for the SAPS group). In practice, this categorisation will condition the dossiers or parcels for which the contractor will have to produce field inspection documents (if the follow up strategy consists in field inspections).
- Different ways of following up the positive discrepancies are acceptable provided that the farmer has the possibility of requesting a contradictory field inspection. More generally the rules applied to sort the dossiers for field inspections will depend, in a given MS or region, on the administrative procedures in force to notify and apply the readjustments.

29 Code A1

Code A1 is assigned to parcels declared or found, after the application of the tolerance rule , below the minimum size of agricultural parcel defined by the MS (this minimum cannot exceed 0.3 ha according to Article 13(9) of Commission Regulation 1122/2009). For such parcels, the retained area is set to 0.

30 Code A2

Parcels claimed more than once, i.e. with a partial or total overlap, should be coded **A2**. In case several farmers declare a part of a reference (LPIS) parcel, the code A2 may be applied when the sum of the declared areas exceeds the official reference area (overclaim). Multiple claims identified at an early stage (i.e. before CAPI) may be returned to the Administration for clarification with the farmers involved.

The retained area for A2 coded cases not solved before CAPI is calculated by subtracting the overlap-ping (or overclaimed) area to each of the parcels involved. Alternatively, disallowing the whole area of these parcels is also acceptable.

31 Code A3

In MS where the IACS has been running for several years, parcels ?not found? should be an exception and are no longer a ?technical? but an ?administrative? problem, i.e. a declaration anomaly coded A3, with a retained area set to zero. In the new MS the A3 code will be very important to assess the quality of the declaration and of the LPIS. In all MS, **specific codes** may be used to better characterize the different **types of LPIS anomaly** identified. Alternatively an A5 code may be defined for agricultural parcels declared in an existing LPIS parcel but found to be in another LPIS parcel.

32 Code A4

The Commission suggests that the check of reference year eligibility should be made separately i.e. after the normal crop / area checks. The parcels found ineligible, fully or partly, will be assigned an **A4** code and the ineligible part of the parcel will be set to zero.

33 Code C1d

Since a given parcel may be claimed for decoupled and coupled payments simultaneously, the C1 code has been divided into two new codes: **C1d** for cases where a parcel claimed for decoupled payment is not eligible and the C1c for parcels claimed for coupled payment and where the observed crop group differs from the declared crop group.

34 Code C2

Code C2 has been designed as a transitional code and mainly for coupled crop groups; another code should be added to explain the decision made on the subparcels resulting from the division (e.g. C3+, overdeclaration).

35 Code C4

The **C4** code regroups cases of ?land use interpretation impossible? and ?parcel limit problem not re-solved on the image?. In contrast with the T codes, the C4 code is the result of some interpretation and an indication of possible disagreements with the declared land use or area. It should hence require some follow-up action (e.g. RFV).

36 Code E1

This code only applies to the cases that comply with the definition of ?obvious error? given in the document DOC AGR 49533/2002: [[1]].

37 Code T2

Parcels falling outside all current year images and that cannot be checked by CAPI are given the benefit of doubt with the T2 code (the declared area and land use are retained). However this code should not be used if a potential problem appears on the archive VHR ortho imagery (e.g. LPIS ortho-photos). Example of such problems could be: the parcel appears to fall on an ineligible land (wood, urban area, water); the parcel seems to include ineligible features? In such a case, a reject code (e.g. C1a for C1 on archive imagery) should be used so as to trigger some follow up. These codes should be defined with the National Administration.

38 Code T3

This code should be given to parcels falling outside the control zone, i.e. the VHR current imagery, but only in cases where no other check can be made. For instance if the parcel area and land use can be checked using the available current year HR imagery and archive VHR ortho imagery, this code should not be used.

39 Codes to be applied for the GAEC check

Code	Meaning	Follow up rule
N/A	Requirement not applicable	-
NC	Requirement not checked	Compulsory RFV to check requirement
S	Suspected non compliance	Compulsory RFV to check requirement
Pb	Clear infringement	RFV to be decided by Administration
OK	Parcel compliant with requirement	RFV could be carried out on a sample of parcels for QC purpose

- By default, all the GAEC for the parcels of the GAEC sample are considered as not checked (NC).
- The N/A code will be assigned either manually or automatically by the system. This will be the case for parcels for which a given GAEC is not applicable, either because of their observed land use (e.g. GAEC specific to pasture or olive grove) or because of environmental characteristics (slope, presence of terrace?).
- Parcels where a possible infringement is suspected (e.g. lack of winter coverage, encroachment of unwanted vegetation) will be assigned an S code. These cases will have to be clarified in the field.
- The Pb code should be limited to parcels for which the infringement is clearly identifiable on the imagery and could constitute non-disputable evidence. The purpose of the Pb code is to identify cases for which a field visit could be avoided during the inspection if the farmer accepts the evi-dence of the imagery.
- The **OK** code will be assigned only if the interpretation of the parcel allows confirmation of full compliancy with the considered GAEC.
- The NC code will remain assigned for requirements that were not checked on the imagery (e.g. because of cloud, parcel outside image, unsuitable date of the images). A RFV will have to be carried out to check these requirements.

The following table shows an example of a GAEC check report for a given parcel located in a MS where the following 5 requirements would be checked with remote sensing:

- G1.1.1 corresponds to the obligation of minimum soil cover in winter;
- G1.2.1 corresponds to the prohibition of certain crops on parcels with a slope > 10%;
- G2.2.1 corresponds to the prohibition of burning stubbles;
- G3.0.1 corresponds to heavy poaching by animals;
- G4.4.1 corresponds to the obligation of maintenance of the parcel with respect to unwanted vegetation;

GAEC	G1.1.1	G1.2.1	G2.2.1	G3.0.1	G4.4.1
Code	S	N/A	NC	OK	Pb

It should be emphasised that when any anomaly is observed in a parcel, the **whole parcel is considered as non-compliant**. Therefore there is no need to digitize any exclusion area inside the parcel. However, in order to ease the work of the controller during the field visit, the location of the breach (e.g. mark of erosion) can be indicated with a point or a cross in the parcel.

For **parcels** subjected to CAPI checks which are **not part of the GAEC sample**, anomalies related to a possible GAEC breach may be detected on the imagery. Should this be the case, the operator should report on the observed anomalies. Ideally, a drop-down menu should present all possible anomalies that the Administration wishes the contractor to check by CAPI. Only the points where an anomaly is suspected (S code) or clearly identified (Pb code) will be reported by the operator (e.g. encroachment of unwanted vegetation, erosion trace). The GAEC check report for such parcels may therefore look as follows:

GAEC	G1.1.1	G1.2.1	G2.2.1	G3.0.1	G4.4.1
Code	-	-	-	S	Pb

For the GAEC that need to be checked at the whole farm level (e.g. ?the farm should have at least x% of such cover? or ?the farm should have at least x types of crops?), in contrast with the GAEC that are to be checked at parcel level, the diagnosis is derived automatically from observations at parcel level (e.g. land use). Generally only two diagnoses are possible: Pass (compliant) or Fail (not compliant). The Administration should decide whether the contractor will calculate this diagnosis at farm level.

The results of the GAEC checks (list of GAEC codes with their corresponding number of parcels as-signed N/A, NC, D, Pb, OK before and after field visits) will be supplied to the JRC in dedicated tables of the Summary Statistics.

40 Computer Assisted Photo-interpretation (CAPI)

40.1 Overview

The computer assisted photo-interpretation (CAPI) is the core task of the CwRS for both the crop and area checks. In case the crop check is supported by an automatic classification, all declared parcels that were not classified automatically are usually subjected to CAPI.

The photo-interpretation of agricultural parcels will normally be carried out using at least **one very high resolution (VHR) image** (aerial orthophoto or satellite ortho-image with a pixel size <1m) of the **current year**. The area of agricultural parcels, their land use wherever necessary, and if requested by the National Administration, cross compliance issues will be checked. In addition to the VHR image, multitemporal high resolution (HR) images may be provided upon detailed **justification** by the administration.

As a general rule, in SAPS and SPS, most crops are eligible for the SAPS or SPS group and some of these are at the same time eligible for some additional payment (coupled payments or top ups). As a result the need to identify individual crop types is less strong than in the past.

40.2 Methodology

The interpreter?s work could be summarized as follows:

- detect non eligible features (water, building, forest) and, in SPS, crops not eligible for aid (permanent crops, fruit vegetables and table potato according to the SPS system);
- pay special attention to tree parcels in SPS, in accordance with the regulation on dry nuts and olive trees.
    - ♦ Dry nuts parcels are not eligible in SPS but can be claimed for a title IV direct aid.
    - ♦ Olive tree parcels are eligible for the title IV (recoupled) aid provided that they were planted before 1 May 1998 (or included in an approved planting scheme). A systematic cross-check will be made with respect to the OLIGIS reference situation. New Olive tree parcels will be delineated as non eligible for the title IV aid only (but are eligible for SPS). For MS which do not allow the intensification of olive groves ? i.e. plantation of new trees in a parcel whose total parcel area remains unchanged - parcels with new trees should be identified by CAPI (with a counting of the new trees) and flagged for a possible field visit or administrative follow up.
- check the crops subjected to coupled payments (e.g. national ?Top-ups? in SAPS);
- check the minimum eligible area of the individual agricultural parcels taking into account the change in the definition of the agricultural parcel (see Agricultural parcel);

Where the Administration has decided to use remote sensing for the control of the GAECs, each parcel should be flagged with the appropriate code (see Standard codes applied at parcel level). We remind that interpreters should receive guidelines for the identification of non compliances on the imagery and should be specifically trained for checking the GAECs. Also, they should have the possibility to display on-screen the examples collected during the ground survey.

It should be possible during CAPI to edit each parcel individually so as to subdivide it or modify its boundary. It must also be possible to check that no other parcels totally or partially overlap with it.

During the photo-interpretation stage the interpreter must be able to simultaneously display at least 4 images (3 multi-spectral and the VHR ortho-imagery) and also the vector and alphanumeric data for each application.

In case image data with more than 3 bands are used, it is advisable to select the band combinations that contain the most significant information. This usually includes the near-infrared band, the mid (or short-wave) infrared and one of the visible bands, although the classical false colour composite (near-infrared, red, green) is in general sufficient for checking the crops/uses that need to be discriminated. The use of multi-temporal index images (e.g. NDVI image) is another option.

Where reference parcels (LPIS parcels) contain several (full or partial) agricultural parcels, the CAPI operator will have to locate and digitize the declared agricultural parcels inside the LPIS parcels using the sketch maps attached to the farmer?s application and taking account of the current definition of the agricultural parcel. Since farmers? sketch maps are only indicative, operators are advised to report cases where the retained area significantly exceeds the declared area so that complementary checks may be carried out by the Administration (particularly for dossiers where the possible excess retained area compensates for an over-declaration). Such cases may occur when the operator is not aware of all declared parcels in the reference parcel (e.g. as a result of the sample selection) or because some parcels may not be declared (e.g. because they belong to non farmers).

41 Coupled payments: crops claimed for Title IV aids or CNDP

The National Administration should give the list of crops receiving supplementary or recoupled payments, hereafter referred to as ?coupled payments?, applicable in the Member State (cf. title IV of Council Regulation No. 1782/2003 for SPS).

In case of use of CwRS, for parcels declared for coupled payments, the declared crop will be checked using the available imagery (VHR and HR). Doubtful cases will be visited in the field by the contractor if requested in the contract, or flagged for further verification by the National Administration.

In case few parcels are concerned by coupled payments, the National Administration will indicate whether these parcels should be checked by systematic RFV or by CAPI first. For instance checking summer crops directly by RFV should allow visiting the parcels at a time where the crop is till in place instead of waiting for the summer HR image and having to visit a sample of these parcels afterwards (e.g. because of possible confusion with potato).

42 Crop Groups and CwRS diagnosis

42.1 Definition

Article 56 of Commission regulation (EC) No 1122/2009 defines the crop groups for the purpose of calculation of aid, reductions and exclusions. This means that the diagnosis affecting the payment to the farmer is made at crop group level, where compensation between parcels (of the same crop group) is allowed. The National Addendum will give the list of crop groups applicable in a Member State. Contractors may expect to find:

- The SPS crop group in the 17 Member States applying SPS or the SAPS crop group in the 10 Member States applying SAPS. The SPS crop group includes any agricultural area of the holding, and any area planted with short rotation coppice (CN code ex 0602 90 41) that is used for an agricultural activity or, where the area is used as well for non-agricultural activities, predominantly used for agricultural activity (cf. Article 34(2)(a) of Regulation EC No 73/2009). Certain afforested areas or areas which no longer fulfill the definition of eligible hectare may still be eligible in accordance with Article 34(2)(b) of the same Regulation. The SAPS crop group remains unchanged i.e. includes any crop (arable land, permanent grassland, permanent crops and kitchen gardens).

- Crops receiving a different rate of aid, i.e. crops receiving supplementary or re-coupled payments (i.e. title IV or Article 68 aid) in SPS or Complementary National Direct Payments (CNDP) in SAPS. These aids are referred to as ?coupled payments? in this document as they depend on the crop. As a general rule, all parcels / crops receiving the same (additional) aid per ha belong to the same crop group.

As a result of the health check, the set-aside obligation in SPS is abolished as from 01/01/2009 and set-aside entitlements were converted to normal entitlements.

It is important to note that a given parcel/crop may belong to several crop groups (e.g. SPS and protein crop, or SAPS and CNDP). As a result, different measurements may be made for a given set of contiguous parcels (e.g. one measurement for the parcels claimed for SAPS/SPS and one for the parcels claimed for supplementary aid, if these differ).

42.2 Diagnosis

The CwRS contractor will establish a diagnosis (accept or reject) for each of the crop groups claimed and a summary diagnosis at dossier level. Each dossier should therefore fall in one of the following three categories:

- Dossiers (crop groups) accepted by RS that will not be subjected to a follow-up action regarding the points checked by RS (except for QC reasons for a sample of these dossiers). These dossiers may however be subjected to complementary controls according to the strategy of the National Administration (e.g. for checking seed certificates, specific crops such as durum wheat, the respect of agri-environmental measures, GAECs not verifiable with RS?).
- Dossiers (crop groups) rejected by RS that will be subjected to an appropriate follow-up action; the choice of the action (simple notification, meeting with the farmer, physical inspection?) remains of the responsibility of the Administration.
- Incomplete dossiers, i.e. dossiers for which less than 50% of the claimed parcels could be checked, that will be completed in the field (this rule applies to all the dossiers belonging to the ini-tial control sample).

The Contractor may not be able to calculate the final diagnosis at crop group level for the SPS crop group because such diagnosis requires access to the entitlements database. The National Addendum should describe whether the contractor should only provide results at parcel level for the SPS crop group or also at crop group level similarly as for the other crop groups.

As a general rule, reductions or exclusions should not be applied following remote-sensing controls without informing the applicant i.e. without offering him any possibility of recourse or re-inspection.

43 CwRS checks at parcel level

43.1 Location of the claimed parcel

Each declared parcel will be located on screen with the help of the **reference parcels** (LPIS) vectors and the farmer?s **sketch map** wherever necessary. The limits of the parcel will be determined by Computer-Assisted Photo-Interpretation (CAPI) using the available imagery, i.e. the current year VHR imagery. Only **in exceptional circumstances**, i.e. in case of failure of acquisition of the VHR imagery (prime and back up sensors), may archive VHR imagery be used in combination with current year HR imagery to determine the limits of the parcel. In this latter case, field visits may be needed to verify the parcel boundaries.

Ineligible areas such as buildings, wooded areas, or water bodies shall be **excluded** from the parcel, except if specified otherwise in the National Addendum.

It is important to locate and **delineate all declared parcels**, including those for which no aid is claimed, so as to detect possible multiple claims and to verify cross compliance issues required by the National Addendum.

43.2 Parcel area check

As a general rule, the area of each subsidized agricultural parcel will be verified on the current year VHR imagery. Unless requested otherwise by the Administration, the area of non-subsidized agricultural parcels will, in general, not be checked. The result of this digitization will be the photo-interpreted area, also called ?measured? area, which will be compared to the declared area for each agricultural parcel. The results will be expressed in hectares rounded to two decimal places.

The National Addendum shall provide the definition of the agricultural parcel selected by the MS (e.g. single crop group parcel or single crop parcel ? cf. Article 2 (1) of Commission Regulation (EC) No 1122/2009). The contractor shall follow this definition when measuring the claimed parcels.

The comparison between declared and measured area will be carried out during the categorisation phase. For declared parcels grouped at the time of measurement (i.e. when single crop group parcels are measured while single crop parcels are declared), the sum of declared areas will be compared to the measured area.

For the parcels whose observed crop group agrees with the claimed crop group, a **technical tolerance** per (measured) parcel will be calculated. Technical tolerances are intended to take into consideration the uncertainties specific to any measurement technique. The National Addendum will specify the technical tolerance to be used according to the measurement method (type of imagery). The principle of applying a **technical tolerance to the parcel measured area** is outlined here.

43.3 Determination of land use

Land use may be checked by automatic classification (supervised or unsupervised) or by Computer Aided Photo Interpretation (CAPI) of the available imagery. If the contractor uses classification, he will justify and illustrate his choice and the different stages of the checks. In particular he will give the criteria for assignment of land use and explain how the classification results are used in the parcel categorisation (e.g. as an ancillary image layer helping the interpreter or as automatic parcel label). Whatever the method chosen (CAPI or classification), the contractor will describe the training techniques and quality control for the proposed method. As a general rule, since the interpreter needs to determine the crop / land use extension by CAPI for checking the area, verifying the land use at the same time does not represent significant extra work. Performing an automatic classification might however be useful for detecting ineligible crops in SPS.

43.3.1 Decoupled Payment and land use check

As from 2009, any agricultural activity is eligible for SPS, as has been the case for SAPS since 2004.

In practice, land use check for decoupled payment will consist in checking that the parcel is cultivated (i.e. not abandoned) or, if not cultivated, maintained in GAEC and has no ineligible element (not yet referenced in the LPIS) for SPS.

43.3.2 Coupled payments: crops claimed for Title IV aids or CNDP

The National Addendum will give the list of crops receiving supplementary or re-coupled payments, hereafter referred to as ?coupled payments?, applicable in the Member State (cf. title IV of Council Regulation (EC) No 73/2009).

For parcels declared for coupled payments, the declared crop will be checked using the available imagery (VHR and HR). Doubtful cases will be visited in the field by the contractor if requested in the contract, or flagged for further verification by the National Administration.

In case only a few parcels are concerned by coupled payments, the National Addendum will indicate whether these parcels should be checked by systematic RFV or by CAPI first. For instance checking summer crops directly by RFV should allow visiting the parcels at a time where the crop is till in place in-stead of waiting for the summer HR image and having to visit a sample of these parcels afterwards (e.g. because of possible confusion with potato).

43.3.3 Particular case of nuts

The control of the nut tree areas aid scheme (cf. Section 4 of Chapter 1 of Title IV of Council Regulation (EC) No 73/2009) will be carried out on the basis of the rules set up in articles 5(2), 15 and 16 (in case of additional national aid) of Commission Regulation (EC) No 1121/2009. For the practical implementation of this control, Member States and contractors are referred to the 1.3._Specific_considerations_for_area_measurement guidelines (category Art34) providing guidance for on-the-spot checks of area and area measurement. In addition to the minimum plot size, the minimum tree density which may vary according to the type of nut (hazelnuts, almonds, walnuts, pistachios or locust beans) will be indicated in the National Addendum.

43.4 Reference year eligibility checks

For the **8 MS applying SAPS** that entered the European Union on 1st May 2004, the reference year check consists in checking that any claimed parcel was in **good agricultural condition at 30 June 2003** (cf. Article 124(1) of Council Regulation (EC) No 73/2009; for the definition of these conditions, see the National Addendum). The purpose of this reference year check is to avoid any undue increase of agricultural land following the implementation of SAPS.

For **Bulgaria and Romania**, there is **no reference year check**: a parcel is eligible for SAPS in a given campaign if it is in good agricultural condition, whether in production or not, in that campaign (Cf. Article 124(1) of Council Regulation (EC) No 73/2009).

If the national LPIS does not provide information on the eligibility of the reference parcels, an extra photo-interpretation of the most suitable ortho-imagery (e.g. LPIS ortho-images) could be requested to the contractor in order to identify ineligible parcels or doubtful cases where complementary evidence could be requested to farmers (Cf. National Addendum). No archive satellite data will be provided. Doubtful cases identified by CAPI will lead to administrative follow up.

43.5 Control of Cross Compliance

Use_of_CwRS_for_control_of_Cross-Compliance

43.6 Checking other schemes with CwRS

Parcels benefiting from other area subsidy schemes included in the accompanying measures of Council Regulation (EC) No 1698/2005 on rural development, or in national environment protection schemes, and included in the sample, may also be checked during the control, depending on the choice of the Member State (Cf. National Addendum). Examples of such schemes are the compensatory allowances paid for less favoured areas (LFA) and for areas with environmental restrictions, and support measures for agri-environment and afforestation measures. For these schemes, the role of CwRS is generally restricted to the measurement of the parcel area and the identification of the land use. The controls needed to verify the other commitments related to these schemes (e.g. farm inspections) should be clarified by the Administration. In practice, the parcels claimed in these schemes may be managed as special groups (Cf. National Addendum).

44 CwRS programme

The context of the CwRS programme is describe on the diagram given below:
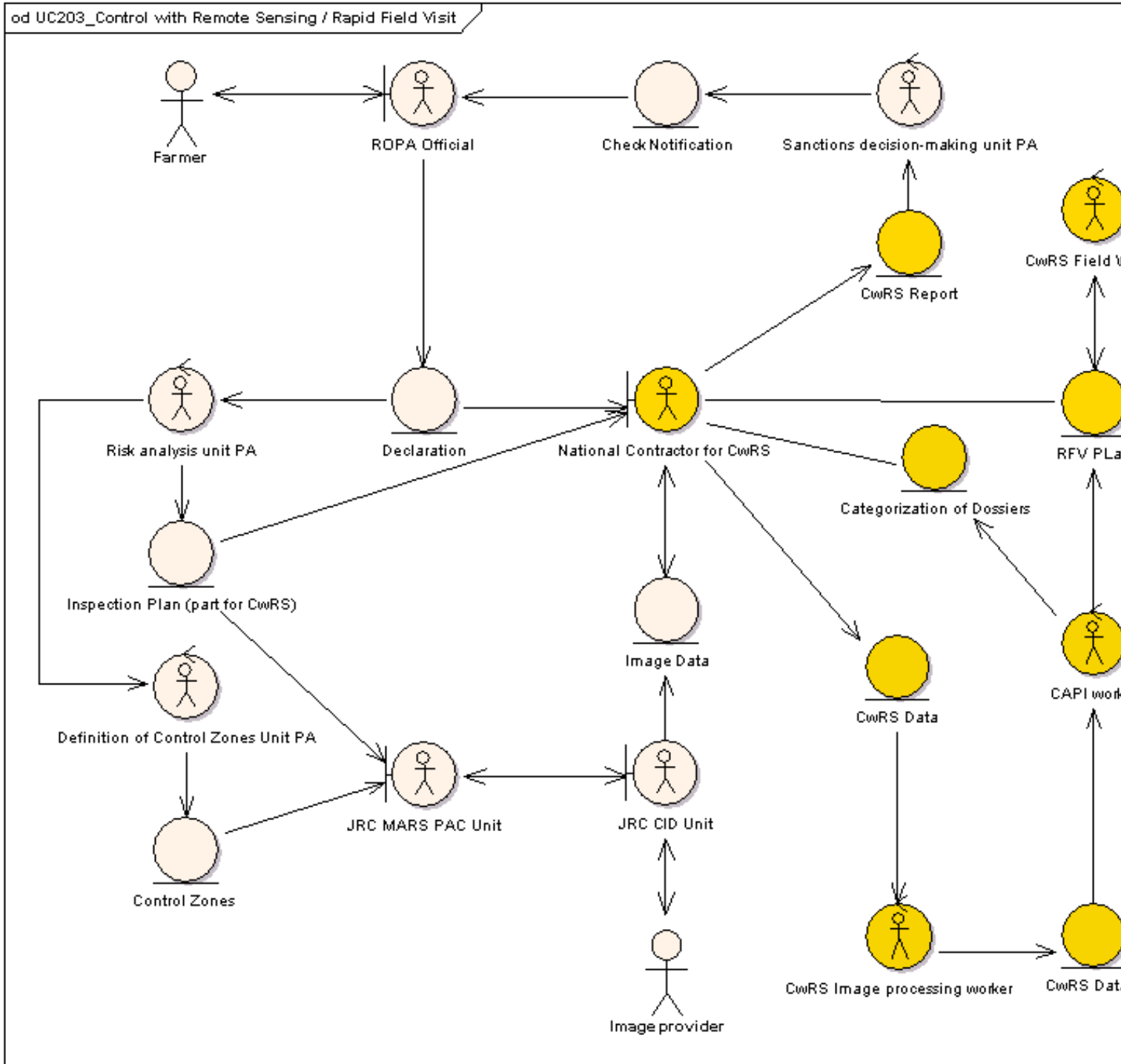
CwRS Programme - UML CLass Diagram

45 Decoupled Payment and land use check

In SPS, only few crops are not or may not be eligible for the decoupled payment (cf. art. 51 of Council Regulation No. 1782/2003). These are permanent crops (i.e. nuts and vineyard and possibly permanent fruit and nurseries since permanent pastures, olive groves and hops are eligible), and possibly vegetable crops till 2011 at the latest[1] (starch potato being eligible). The National Administration should provide the list of eligible crops.

In SAPS, all crops including kitchen gardens and permanent crops are eligible.

In practice, land use check for decoupled payment will consist in checking that the parcel is cultivated (i.e. not abandoned) and has no ineligible or potentially ineligible crop for SPS.

Since only few crops are (potentially) ineligible in SPS, inspectors/interpreters should be trained to detecting these crops. It may also be interesting to develop classification algorithms for the detection of these crops, in case of use of CwRS.

Notes:

1. ? In the regional model, table potatoes as well as fruit and vegetables may already be eligible under special conditions.

46 Definition of the zones

46.1 Control zones

Contrary to physical checks which can be geographically dispersed, zones where imagery is to be acquired need to be established, where the checks/controls with remote sensing are carried out. This clustering of checks is called a "control zone", and is a geographical area defined on the basis of GIS analysis, taking account of technical constraints (e.g. standard satellite 'scenes') and risk analysis.

Due to the timing of the image acquisition and planning, control zones need to be defined before aid applications are submitted, taking account of a number of constraints. The analysis leading to the definition of the zones is therefore usually based on the previous year's application data.

46.2 Number of control zones

The CwRS strategy which has to be defined in the summer / autumn preceding the campaign can be characterized by the following parameters or options:

- The rate of CwRS checks with respect to the total number of OTS checks to be carried out in a given MS or region;
- The number of control zones to achieve the targeted number of CwRS checks;
- The method of selection of these control zones (at random or on the basis of risk analysis);
- The method of selection of the applications inside the control zones; although not directly related to the definition of control zones, this criterion may affect indirectly their number or extent (e.g. in case applications are selected on the basis of risk analysis inside the control zones);
- The number and type of images (airborne/satellite, resolution) requested for the checks to be carried out as well as their timing (windows).

There is no simple rule to define the number of control zones for a given MS. This number is usually set as the result of experience as well as of budgetary, logistical, regulatory, landscape and other constraints. MS new to CwRS are advised to start with a low number of zones to assess the pros and cons of the technique. A large number of zones may allow a better distribution of the control pressure as well as a better representativeness (in case random zones are selected) while reducing the number of classical inspections in case of failure of image acquisition over some zones. However it also increases the fixed costs of image acquisition management, image processing, training (ground truth to train interpreters)...

The following criteria (which may be correlated) may be considered for deciding on the number of control zones:

- The effectiveness of Remote Sensing (RS) with respect to the alternative classical inspections: independently of the number of applications to be checked per zone, this effectiveness may depend on the landscape structure (e.g. presence of extensive agricultural areas to ensure a target controlled area of <u>at least 25% of the control zone</u>, large fields or large farms for which the classical field inspections are time consuming and costly) and of the control needs (e.g. type of crops or GAEC to be checked, proportion of applications for Agri-Environmental Measures for which a field visit is requested);
- The number of applications to be subjected to CwRS;
- The average size of the zone (compromise between the technical capacity of the satellites, logistical constraints?) and the average number of applications per zone (to be estimated based on historical claims using the LPIS).
- Logistical constraints: care should be taken not to overload a few regional offices by concentrating most CwRS checks on their respective territory. As much as possible, CwRS applications should be provided to the contractor in digital form and after administrative cross checks to avoid time consuming requests for clarification. When this processing is made by a regional office of the Paying Agency or the Ministry of Agriculture, it is worth considering the number of applications this office can prepare within a given time period (e.g. within 1 month of the lodging deadline). Also when the follow up of the CwRS checks is ensured by a regional office, it is worth considering the number of checks this office can carry out in due time (e.g. with respect to the crop calendar or other time constraints).
- Budgetary constraints (both at EU and MS levels)

46.3 Random zones versus zones selected by risk analysis

- The control sample for OTS checks needs to be selected a) on the basis of a risk analysis and b) representativeness of the aid applications. The representativeness is obtained by selecting *randomly* 20 to 25% of the minimum number of farmers to be subjected to OTS checks.

- For the selection of the random sample, two strategies may be applied:
  - Select applications randomly (using for instance simple random sampling) from the whole list of applications. Most likely this sample will be scattered over the MS territory and will have to be checked by classical inspection for most of the claims. However applications falling in a control zone may be checked with RS (and will be counted as part of the random sample even if the zone was selected on the basis of risk analysis).
  - Alternatively, a zone may be randomly, and inside these random zones select applications systematically (e.g. all applications falling in the zone) or randomly to constitute (part or a total) of the total random sample. However, care should be taken to ensure that the random sample is representative of the background level of anomalies in the MS; in effect the constraints affecting the definition of control zones (e.g. the targeted minimum % of controlled area in a zone) *may* bias the selection of random zones towards intensive agricultural areas, which may not be representative of the whole country. Also as a general rule, it is also not advised to have the random sample concentrated in one or 2 zones; a minimum number of 5 random zones should be defined for the representativeness of the random sample.

- A combination of the previous two strategies is also possible, for instance in countries where two distinct strata coexist: one stratum of intensive agriculture inside which random zones could be selected for RS checks and the other of more extensive agriculture (i.e. pastures mingled with non agricultural features) in which classical inspections would be used to check the scattered (random) applications.

- For the selection of the risk based sample, again two strategies are possible:
    - Select the control zones at random and perform RA inside the zones (provided there are enough applications in the zones to allow an efficient RA);
    - Select control zones using RA and then select applications inside these zones either in a systematic way (e.g. all applications with more than 50% of their parcels falling in the zone) or using RA among the applications falling inside the zones, in case the number of applications inside the zones is larger than the targeted number.

Selecting all applications inside a zone selected by RA is likely to result in a weaker RA than selecting applications individually out of the whole population of applicants. However because of budgetary and technical constraints, controlling zones selected by RA, i.e. geographical clusters of applications, is the best compromise between efficiency and cost. Moreover, controlling all applications in a given area may enable a more complete check of adjacent applications (for example, when sharing the same reference parcels).

- Very large applications (with high risk factor) with less than 50% of their parcels inside the control zones could be also included in the sample to be checked using RS as this will increase the effectiveness of RS. Even if the check of such applications may have to be completed with classical inspection, it may be worth using RS for the part falling inside the zone.

46.4 Mapping risk factors

The possible strategies for mapping risk factors are described here.

46.5 Selecting control zones by risk analysis

- Selecting control zones on the basis of RA does not necessarily mean selecting all zones in the high risk stratum only (which may be the same every year). Zones could also be selected in medium and low risk strata, for instance with lower sampling rates than in the high risk stratum. This strategy presents the advantage of distributing the control pressure in every stratum (therefore respecting the principle according to which ?no application should have a zero probability of being checked?), which may later be useful at the time of assessing the RA.

- Selecting the CwRS zones inside each stratum can be made ?manually? or at random. The latter strategy is called stratified random sampling and may allow estimating at the same time the background level of anomalies. In other words, the RA sample may help ?completing? the (simple) random sample of 1 to 1.25% of all applications (20% to 25% of checked applications). This could be particularly useful in MS where the (simple) random sample may be considered too small for deriving a reliable background level of anomalies (and later carrying out a reliable RA assessment).

- To illustrate how the RA sample could be used for estimating the background level of anomalies, here is a numerical example for the selection of a (stratified random) 3.8% RA sample that could be applied for CwRS or classical inspection. Each stratum is sampled: the highest sampling rate is set in the high risk stratum; the medium risk and to a lesser extent the low risk strata are also sampled to account for the possibility that the stratification (i.e. the risk factors selected) may not be perfect.

Stratum	% of applications in each stratum	Rate of OTS checks per stratum (% of applications checked in each stratum)	% of applications checked per stratum with respect to the total number of applications	Av anor ha
1 high risk	10%	20%	2%	
2 medium risk	30%	5%	1.5%	
3 low risk	60%	0.5%	0,3%	
total	100%		3.8%	

The overall rate of checks is 3.8% (20%x10% + 5%x30% + 0.5%x60% = 2% + 1.5% + 0.3% = 3.8%) The average rate of anomalies of this RA sample is 5.95% ((8% x 2% + 4% x 1.5% + 2% x 0.3%) / (2% + 1.5% + 0.3%) = 5.95%) whereas the background level of anomalies as derived from this random sample is 3.20% (8% x 10% + 4% x 30% + 2% x 60% = 3.20%)

- In practice, independently of the strategy of control (CwRS or field inspection) a possible strategy for selecting the OTSC samples could be:
    - Select a 1% (i.e. 20% of 5%) simple random sample from the whole population of claims; these will be likely checked by classical inspection (unless they fall in control zones);

♦ Divide the remaining 4% RA sample into 2 groups: one group selected manually and the other selected on the basis of stratified random sampling using varying sampling rates .

Such a strategy could be translated into random and risk zones for part or the total of the OTSC sample.

- In order to meet the targeted number of CwRS applications, it is advisable to select a slightly larger number of applications as the real number of applications is not known at the time of zones definition.

46.6 Satellite technical constraints

Whether the control zones are selected on the basis of a risk analysis or at random, the technical constraints of (satellite) remote sensing sensors should be taken into account to optimize the *probability of image acquisition*.

The Commission - in coordination with the Member State - will select a VHR sensor for each control zone also called **?dedicated sensor?,** taking account of the shape and size of the zone and the image provider?s feasibility study (see VHR Imagery Specifications for the CwRS Programme[[1]]).

The main constraint is the size and shape of the zone with respect to the coverage of the Very High Resolution (VHR) satellites: since these have narrow swaths (of the order of 10 ? 15 km ? see [[2]]), it is advisable to define a zone so it that can be acquired in one pass (or one day for satellites able to make several adjacent passes in a short time like Ikonos) so as to avoid, weather permitting, zones covered with scenes fragments acquired with several weeks difference.

- Accepting low elevation angles (higher off-nadir view angles) for VHR satellites also increases the number of acquisition attempts, therefore reducing the expected period needed to cover the zone. However MS should ensure that the ancillary data needed to orthorectify the VHR imagery (e.g. DEM, GCPs) is of adequate accuracy over the selected zone (see Guidelines for Best Practice and Quality Checking of Ortho Imagery). The elevation angle may also have to be limited in function of the use of the imagery (for example, LPIS QA).

- High Resolution satellites are usually not a constraint since scene extents are significantly larger than VHR scenes. The scenes of the main HR satellites are as follows: 60 x 60 km for SPOT (SPOT 5 may also be ordered in 40x40km, 30x30km, or 20x20km scenes); 170x183 km for Landsat TM (or 55x55 km for a mini-scene); and 140x140 km for IRS-P6 LISS (or 70x70 km for a quadrant).

- The geographic coordinates of the selected zones (e.g. in xml or alternatively .SHP file format) will be checked by the VHR image providers to assess the feasibility of acquiring the zones within the time windows set. The image providers may suggest a small adjustment to the zones in order to maximise the likely time needed for covering the zone (e.g. if a zone needs a second pass just because few km2 are not covered by the 1st pass, it may be worth considering shifting the zone so that it fits in 1 pass or increasing it significantly to take advantage of the satellite swath).

46.7 Technical aspects of zone definition

The technical aspects of zone definition are described here.

46.8 Synergy with LPIS orthoimagery

- Control zones may fall or be chosen in regions where there is a plan acquire VHR (satellite or aerial) imagery for the updating of the Land Parcel Identification System (LPIS). In such a case, the VHR imagery should be acquired and processed in priority over these control zones. This imagery could be used either as the main VHR image or as back up (depending on the timing of the flight and processing of the images).
- Use of by-products: The Digital Elevation Model (DEM) and the Ground Control Points used for the creation of the LPIS ortho-imagery may be used for the preprocessing of the new ortho imagery (satellite or aerial) so as to save time and resources.

47 Dossier selection

47.1 Selection of Dossiers for Inspection

The selection of the samples of applications to be checked on the spot (and in particular of the CwRS sample) will be made by the Administration in accordance with Articles 30 and 31 of Commission Regulation (EC) No 1122/2009

Art.31 of R.1122/2009 outlines the two main approaches for selection of the check sample: random selection and risk analysis.

48 External QC

The external quality control of the contractor?s work, which was formerly carried out by the Commis-sion on one control zone per contractor, has been the responsibility of the Member State as from the 2006 campaign. On request the Commission will support the National Administration for the setting up of a similar system.

As from 2009, the JRC stopped requesting quality control data over one control zone per contractor. A similar set of data (i.e. LPIS and interpreted vectors, orthorectified imagery, orthorectification Quality Control Records (QCRs), declaration data, measured and retained areas at parcel level) may however be requested for specific studies to prepare the technical visits to the Member States. During these visits, the whole CwRS methodology from dossier selection to follow up of CwRS results may be reviewed. CAPI of a sample of parcels may also be re-performed on the contractor?s system.

Notes:

49 FAQ CwRS

49.1 Frequently Asked Questions on IACS GIS and satellite imagery

Who pays for the images?

- DG Agriculture and Rural Development pays for the images. DG Joint Research Centre manages the image acquisition, since this is a fairly complex technical task.

Why aren?t aerial photographs paid for by the Commission?

- The current legislation does not permit the COmmission to finance aerial photography. It is each member state?s responsibility to arrange national acquisition of the aerial photography, since this doesn?t need to be coordinated at an EU level (by contrast such technical coordination is necessary to ensure efficient image acquisition).

How much detail can the images show?

- Some images can show a lot of detail ? tracks, paths, unused land. Other imagery used is less detailed, and is used for crop identification rather than the area measurements needed to justify farmers? claims.

How many satellite images are acquired each year?

- Around 1000 images. In total, more than 240,000 km2 are covered each year in the EU in the CwRS programme ? twice the area of England, or 8 times the area of Belgium.

What happens to the images once they have been used?

- The images are stored in an on-line archive managed by the JRC. They can be used by the Commission or the member states for updating maps for farmers, or checking controls from earlier years, or for research studies.

Does the Commission have information on each farmer?s field?

- No, the computerized maps of the farmer?s fields are managed by the member states. The Commission just provides the raw image to carry out the checks.

How many farms are checked with satellite imagery each year?

- About half the farms that must be checked by member states are checked using satellite imagery, roughly 450,000. The other farms are checked by an inspector actually visiting the farm.

Why aren?t these images visible to the general public?

- In the year that the images are acquired, the location of the checks is confidential information. Only after the images have been used for the checks can they become available to the public. Most of the imagery is also under licensing conditions that mean it cannot be placed immediately on the Internet.

Are satellite images used by the member states to make maps for farmers?

- Yes, mostly only in areas where it is difficult to acquire aerial photographs.

Which is cheaper, aerial photography or satellite imagery?

- It depends. When used for the spot checks of farms, satellite imagery is usually cheaper than aerial photography of the same quality. However, when a very large area needs to be covered, aerial photography is usually cheaper.

How much does satellite imagery cost?

- It depends on the detail: Between about 0.5eur/km2 for the coarse information to around 25eur/km2 for detailed images.

What is the difference? Satellite photos or satellite images?

- The word photo(graph) usually means that there is film used; however, all the satellite used have digital instruments on board and so we generally refer to satellite images, meaning digital. Most aerial imagery is now also acquired using digital cameras, too.

What is an orthoimage?

- An orthoimage is an image (satellite or aerial) that is geometrically corrected to fit to a map, so that it can be used (for example) to measure field areas accurately.

Which of the satellites are European?

- The main European satellites used SPOT (French) and RapidEye (German). The others are a mixture of American (IKONOS, GeoEye, WorldView, QuickBird, Landsat), Israeli (EROS), and Indian (IRS). About 40% of the budget is used on European satellite images

50 Follow-up of the results from the CwRS

The follow up procedure is at the discretion of the National Administration. The decision to inspect a rejected crop group or dossier in the field rather than summoning the farmer to a meeting or sending a letter informing him his claim will be reduced in conformity with the discrepancy found may depend on the importance of the discrepancy and/or the procedures in place in the Member State. For the SPS crop group, it will also depend on the number of payment entitlements, a data that the contractor may not have. Area thresholds expressed in absolute and/or relative values (ha or %) or monetary thresholds based on the payment in play may be used to decide on the follow-up action. The National Addendum will specify the results and documents to be provided by the contractor, as a function of the diagnosis at crop group and dossier level. A justification of the decision taken at parcel level may also be requested.

51 Ground control for aero-triangulation of airborne projects

51.1 General

There are 2 ways available:

- we pre-mark ground control points or
- we measure ground control points after the flight.

In case we do not have access of the imagery after the flight, pre-marking is essential. A refference could be made to the project that ISTAR has done for JRC in Maussanne. The flight was executed and an external company was asked to measure Ground Control to be used in the triangulations, without having the imagery at hand. This task is not easy, and can cause geometric shift. We have seen that one control point at the north of the block was rather vague, thus producing a shift of about 40 cm in the final result.

51.2 Airborne data 20cm

Well defined points have to be measured. Objects of about 3 times better then the pixelsize should be envisaged. Mainly manmade marks on the road.

Elongated narrow constructions

Different type of road-marks?.lot?s of possibilities

Road marks colour yellow. Very contrast-full.
Easy to position.

Rain-drains or manholes.

51.3 Airborne 50 cm

Still straithforward to find good GCP?s. Road marks however are becoming difficult to distinguish. Most of the points are sharp edges where 2 roads come together, tennis-fields (or other sport-fields) when contrast between lines and surface is important, or edge off wine plantations.

52 Ground Truth Collection

52.1 Ground Truth Collection

As training for the CAPI and/or classification of the satellite images, the contractor will carry out during the period most appropriate for the crops of interest, a field survey in a sample of control zones. The survey will cover at least 750 ha (or 300 parcels) and should ensure a good representation of the crops of interest. The survey sample size may be reduced or the field survey may be focused on crops of in-terest or rare crops, if the tenderer is able to demonstrate to the satisfaction of the Administration, that he is able to build a database of reference fields for the most common crops in another way. Parcels along public ways can be used, especially if private parcels are inaccessible.

In the case of SPS, the contractor should pay special attention to crops that may be ineligible (Cf. 6.4.1) as well as to crops subject to additional payments (Cf. title IV of Reg. 73/2009 and National Adden-dum). As a result, the ground data collection could focus on these crops so as to train the interpreters (or the classification) to detect them.

The tenderer will indicate the methodology that he intends to use for this fieldwork (transects, area frame survey, etc.), the origin and the characteristics of the documents drawn up for the investigators, the personnel envisaged and their qualifications, the proposed dates, the planned duration, the area sur-veyed, the method proposed to ensure a minimum number of parcels per crop of interest on a per-zone basis, etc.

Notes:

53 Guidelines for Best Practice and Quality Checking of Ortho Imagery

54 HR imagery for CwRS

By **High Resolution** (HR) imagery it is meant satellite imagery with a Ground Sampling Distance (GSD) of the order of 10m (usually between 10 and 30m in the optical domain).

This type of multispectral imagery may be provided, on request of the Member state, for specific checks related to land cover (e.g. check of crops receiving supplementary or recoupled payments) in complement to the VHR image.

As a general rule, the VHR and HR window(s) should be defined so as to avoid acquiring both types of images over the same period (e.g. with a less than 2-3 weeks difference). To avoid acquiring redundant images, Member State will define the ?dead period? between the date of acquisition of an image (VHR or HR) and the following window. This dead period corresponds to the minimum period that has to be left between two acquisitions.

In contrast with the VHR windows, the HR windows are open to all HR sensors (Spot4/5,IRS P6, RapidEye,DMC,THEOS,Formosat-2) simultaneously: **First come first served**. The first acceptable HR image covering the zone will be purchased. The Member State may justify a possible preference for a given sensor knowing that this strategy may lower the chances to obtain any HR imagery. The Commission will evaluate the justification for such a preference and try to satisfy it taking into account the acquisitions already made, availability of actual imagery, and programming feasibility.

The 2012 HR menu can be found here:

See HR Imagery Specifications for the CwRS Programme for more information on the image acquisition process: [[1]]

55 Identification GCPs on satellite data

55.1 Ground control for rectification of Satellite imagery

The best option is using the imagery acquired and go to the field for collecting GCP?s with the raw imagery as base. In our experience we have seen that using archieved GCP?s in the domain of satellite imagery (quickbird, ikonos) can be difficult.

It is therefore important to establish guidelines in order to maximize the success of stable and reliable points.

55.2 VHR Data

Best points for Very High Resolution Satellite points are road crossings, edges of agricultural parcels, ditches, swimming-pools. Traffic islands. Notice also the difference between IKONOS and QUICKBIRD. (QUICBIRD left, IKONOS right).

IMPORTANT NOT to use points on rooftops, electricity poles, pylons or any other object in altitude.

Road crossings
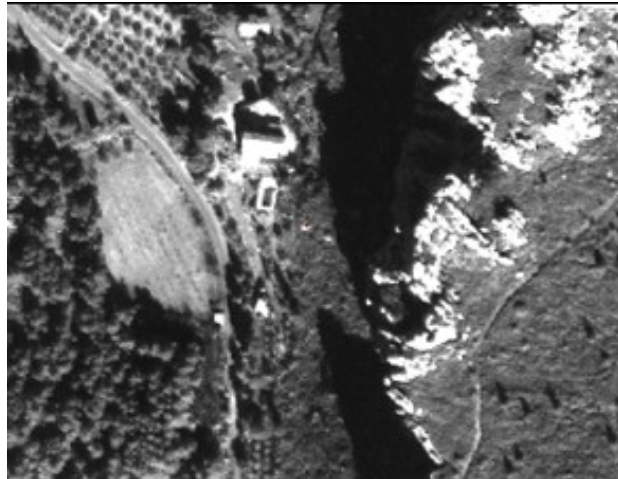
Rocks

Line structure, parcel boundaries

Man made constructions?.

55.3 HR Data

Some examples of GCPs taken on Spot5 images are shown bellow:
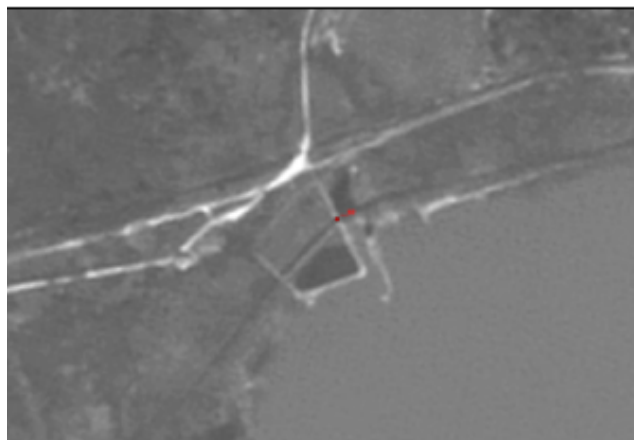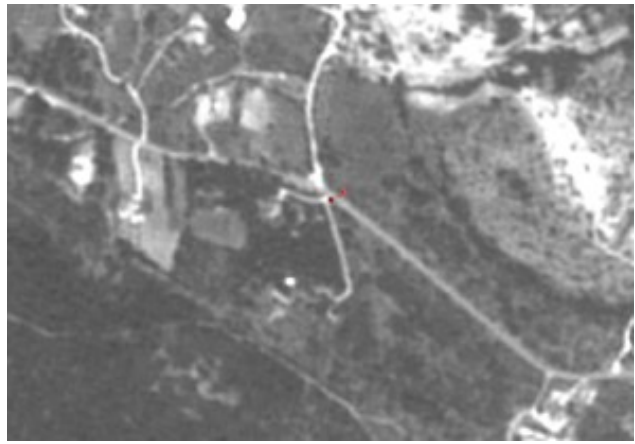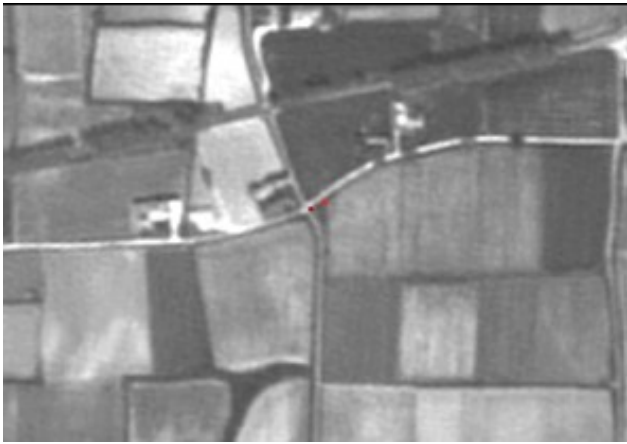
56 Image acquisition

56.1 Acquisition of satellite imagery

In order to check the conditions under which aid is granted (e.g. parcel area, crop and possibly GAECs), a control zone may be covered with the following possible configurations of data:

- VHR imagery (satellite or airborne) of the current year, panchromatic, colour and/or multispectral (or panmerged) provided by the Commission (or the Member State, in case of airborne)[1] ;
- a combination of VHR imagery (satellite or airborne) with HR satellite imagery provided by the Commission (or the Member State): optical (multispectral) or radar;

Information on the management of image acquisition and VHR and HR Imagery Specifications for the CwRS Programme could be found on the following website: http://cidportal.jrc.ec.europa.eu/home/image-acquisition/.

The IDQA (Image Data Quality Assessment) document giving parameters on the source image is also located there.

The LIODOTNET (Live Image Ordering) web based application is used for all CwRS image acquisition, validation and ordering. It allows viewing and downloading of georeferenced VHR/HR quicklooks through the CID Quicklook browser (http://lio2.jrc.it/LioDotNet/Default.aspx)

The User' Guide for **LIO DOTNET server and VHR browser** could be found here:
http://mars.jrc.ec.europa.eu/mars/content/download/816/5339/file/3908_LIODOTNET_2006.pdf

The **Technical aspects of zone definition** can be found here

The **VHR sensors** used in the 2012 Campaign can be found here

The **HR sensors** used in the 2012 Campaign can be found here

Instructions for **Image data return** can be found here

56.2 Acquisition of aerial photographs

- Acquisition of aerial photography for the controls is the responsibility of the MS Administration, i.e. is not coordinated by the Commission. The main advantage of aerial photography with respect to VHR satellite imagery is that it allows covering much larger areas (e.g. large administrative units such as full provinces) in a limited period of time. Alternatively a large number of small zones may also be covered in a given region.

- However, acquiring aerial photography has also some proper constraints such as restrictions over military zones and air traffic lanes. Cloud cover is not as restricting for aerial photography as for satellite imagery, but meteorological conditions are in any case affecting the radiometric quality of the photos.

- Moreover, the lead-time in the processing of analogue aerial photography (requiring development, printout, scanning) may be longer than that for satellite images. Aerial photography acquisition must therefore be organised sufficiently in advance, and the acquisition periods should be relatively early in the year. The use of (natural or infrared) colour imagery permits an easier identification of land covers, thus significantly reducing follow-up rapid field visits for crop identification.

- It is also compulsory that aerial flights be carried out within the present state of the art: the use of GPS and inertial navigation systems (i.e., ?pin-point flights?) linked to the camera makes it possible to optimise the flight coverage and considerably reduce the costs of further processing.

- If aerial photography is intended to be used, the flight plan proposed by the contractor must guarantee that the whole control area is covered. In practice, the MS Administration must approve this flight plan prior to the flight.

Notes>

1. ? Recent images (in particular orthophotos used for the national Land Parcel Identification System (LPIS)) may be used only in case of failure of the current year acquisition

57 Image data return

At the end of the campaign the image data needs to be returned to the EC services. This is necessary for audit purposes but also to make suitable re-use possible. From 2009 years campaign all source imagery supplied to the contractors via ftp is harvested automatically by the EC Services

Image Access conditions are accesible subject to terns & licencing conditions. More information can be found at
http://cidportal.jrc.ec.europa.eu/home/idp/cid-portal/

58 Image fusion (pan-sharpening)

58.1 General remarks and considerations

58.1.1 Requirements for fusion products

Aspects of relevance to standardization and to the quality assessment of fusion results irrespective of which algorithm is applied do not appear in many published papers. The following fields of requirements can be determined:

- Requirements for utilised sensors
- Requirements for methods and quality of co-registration
- Requirements for spatial image quality (e.g. from point spread function analyses) and
- Requirements for radiometric and colour quality (for true colour image data)

As for pan-sharpening methods the requirements correspond exemplarily to following aspects:

- The utilized sensors have to fulfil both remote sensing tasks and true colour demands
- The quality of co-registration refers to low-resolution multispectral data in comparison to the high-resolution band
- The spatial image quality (e.g. from point spread function analysis[1]) has to correspond with the image quality of the high-resolution band after the pan-sharpening process
- The radiometric and colour quality (for true colour image data) has to correspondent with the multispectral products

The quality aspects of pan-sharpened images are described in greater detail below.

- Enhancement of spatial resolution

A quality criterion for pan-sharpening methods is the preservation of the spatial resolution of the panchromatic image in the end product. This can be evaluated by analysis of the point spread function by means of distinctive image structures.

- Preservation of spectral features

Spectral features of the original low-resolution image need to be preserved in the generated high-resolution multispectral image in order to be in the position to adopt e.g. classification algorithms successfully. A modification of the colour distribution in the end product compared to the reference image can be roughly endorsed by comparison of the histograms of the red, green and blue proportions of the individual images. More differentiated assessment of the preservation of true colour features in the original and the pan-sharpened images can be carried out by applying colour-distance in Lab-space (Wyszecki and Stiles, 2000).

Another quality criterion for the pan-sharpening process performance is the number of visible artefacts. Especially problematic are object edges, if the red, green and blue bands are not accurately co-registered.

The information given bellow is more oriented to the problems of pan-sharpening of VHR (spaceborne) data, in particular:

- VHR (PAN)+VHR (MS) or
- VHR (PAN)+HR(MS)

In any case, the data fusion of any other kind of spaceborne data (HR+LR, HR+HR, etc.) follows in principle the same rules mentioned here.

Note: PAN - panchromatic; MS- multispectral; VHR - very high resolution; HR - high resolution; LR - low resolution

58.1.2 Geometric pre-processing

One of the key point to obtain spatially and spectrally enhanced image, through image fusion, is the proper co-registration of the different image datasets. With respect to the satellite data, the following main cases could be outlined:

- image fusion of data with different resolution, obtained by the same satellite at the same time
- fusion of images with different resolution, obtained by the same satellite at different time
- fusion of images with different resolution, obtained by different satellites

58.1.3 Radiometric pre-processing

The most common task performed prior to the image fusion is the resclaling of the image DN values. Usually, the radiometric depth of 8 bits, is considered enough to ensure efficient handling of the data without significant loss of information. The raw VHR (both PAN and MS) is usualy delivered by the provider as 16 bit (in reality, it is 11-bit for IK and QB), which is rescaled to 8 bits in order to save space and increase the performance of the processing.

The type of conversion to 8-bit format should be carefully considered. The use of the Standard Deviation stretch on the look table is the most common approach, with a setting between 2 and 3 standard deviations (up to the operator). An important points is to exclude the zero values, when calculating the statistics of the rescaled image.

58.2 Pan-sharpening Algorithms

There are many pan-sharpening algorithms available today in commercial packages.

Some of them are:

- HIS Sharpening

HIS stands for "Hue Intensity Saturation". The low resolution RGB image is upsampled and converted to HIS space. The panchromatic band is then matched and substituted for the Intensity band. The HIS image is converted back to RGB space.

- Brovey Transform

The Brovey Transformwas developed to visually increase contrast in the low and high ends of an image's histogram. It is a simple method to merge data from different sensors.

- Multiplicative

The multiplicative algorithm is derived by using the four possible arithmetic methods to incorporate an intensity image into a chromatic image (addition, substraction, division, and multiplication).

- PCA Sharpening

Principal Components Analysis is based on a rotation in which the covariance matrix becomes diagonal (all off diagonal elements are zero). The 1st principal component (PC) contains most of the information. The panchromatic band is substituted in for the 1st principal component. Image is rotated back to original space.

- Gramm Schmidt Sharpening

This is a Kodak / RSI proprietary sharpening algorithm. The algorithm is based on a rotation similar in nature to PCA. The results are quite similar to PCA ? robustness is an issue especially in heavily vegetated scenes

- Wavelet Sharpening

A relatively new sharpening algorithm involving wavelets has come into use lately. The low resolution RGB image is upsampled to match the panchromatic resolution, then converted to HIS space. High frequency information from the panchromatic band is extracted and added to the intensity band. The result is converted back to RGB space

- UNB Sharpening

UNB stands for University of New Brunswick. Algorithm is proprietary and was developed by Dr. Yun Zhang at UNB. This algorithm has been licensed by both DigitalGlobe and PCI (latest version of Geomatica). This is DigitalGlobe?s most popular pan sharpening algorithm to date.

58.3 Image fusion for VHR Pan and XS imagery, using particular software suites

- ERDAS Imagine
- PCI Geomatics

58.4 References

- ASPECTS OF THE STANDARDIZATION OF SENSOR AND DATA FUSION OF REMOTE SENSING DATA, R. Hoffmann, R. Reulke, Humboldt-University Berlin, Department of Computer Science, Commission I, WG I/1
- FUSION OF MULTISENSOR REMOTE SENSING DATA: ASSESSING THE QUALITY OF RESULTING IMAGES, E. Saroglu, F. Bektas, N. Musaoglu, C. Goksel, ITU, Civil Engineering Faculty, Turkey Istanbul, Commission IV, WG IV/7

Notes:

1. ? The point spread function (PSF) describes the response of an imaging system to a point source or point object. Another commonly used term for the PSF is a system's impulse response. The PSF in many contexts can be thought of as the extended blob in an image that represents an unresolved object.

59 Image Processing

59.1 Geometric correction

The Commission does not impose a methodology for geometric correction of imagery, but gives recommendations and guidelines in line with its Quality Assurance (QA) strategy. The philosophy is to have a set of suitable control procedures to ensure a satisfactory quality of the product. These guidelines are to be considered as the Commission?s current understanding of ?best-practice? and can be adopted as far as the MS administration/contractor considers they are sensible and plausible in a production environment. It must be clear, however, that in the end the administration/contractor alone is responsible for the accuracy of his product.

The allowed geometric error in the output images (and associated Digital Elevation Models, DEM) are expressed as a maximum permissible absolute (i.e. with respect to a specific geodetic reference frame) Root Mean Square Error (RMSE) with respect to check points, and are stated in the Technical Specifications. The geometrically corrected products and associated DEMs are assessed separately in up to three geometric dimensions RMSEx, RMSEy, and (where relevant) RMSEz .

The maximum 1-dimensional RMSE values, measured on independent checkpoints, allowed for the output images of each data type are given here.

59.1.1 Geometric Correction of Aerial Photography

For a detailed description of the procedures to be followed, the contractors are referred to the Guidelines for Best Practice and Quality Checking of Ortho Imagery. These Guidelines include best practice for Air-Photo and Airborne digital image orthocorrection.

59.1.2 Geometric Correction of Optical HR Satellite Imagery (eg. SPOT, IRS, Landsat)

- For a detailed description of the procedures to be followed, the contractors are referred to the Guidelines for Best Practice and Quality Checking of Ortho Imagery [Ref. 2]. These Guidelines include best practice for HR Satellite Image Correction.

59.1.3 Geometric Correction of VHR Optical Satellite Imagery (eg. Ikonos, Quickbird)

- For a detailed description of the procedures to be followed, the contractors are referred to the Guidelines for Best Practice and Quality Checking of Ortho Imagery [Ref. 2]. These Guidelines include best practice for VHR Satellite Image Correction. The approach for the Control with Remote Sensing implementation is to use as few GCPs as possible in order to render the use of VHR data more economic, and due to the relatively small image footprint.

- The three possibilities to orthorectify VHR satellite imagery are the following:
    - Use of RPC information provided by the image providers: this approach generally produces good results in agricultural terrain, requires the least ground control, and is strongly advised;
    - Use of rigorous sensor models: an alternative that may function better with some sensors, but requires more ground control;
    - Use of Rational Polynomial Coefficients (RPC) derived by the user (from ground control points): this approach is the least reliable of the three methods and requires the most ground control.

- Block bundle processing using an appropriate software suite may be applied to the whole control zone reducing the requirement of GCPs even further, but with use of tie points and at possible need of greater user competence [Ref. 2].

59.1.4 Geometric Correction of SAR Satellite Imagery

- Orthocorrection is required for SAR imagery in all cases where terrain height variation exceeds 50 m over the whole image.
- The DTM used for SAR orthocorrection should have an RMSEz equal to or lower than the resolution of the SAR data.

- Orthocorrecting SAR data requires the use of separate software modules (usually available as exten-sions to image processing software or as stand-alone solutions); i.e. it cannot be carried out with orthocorrection software for optical imagery, due to the radically different image formation process.

- It is recommended in SAR geocoding to resample the data using a sinc function, cubic convolution or bilinear interpolation in this order of preference.

- The Radarsat data will be provided in either the Single Look Complex (SLC) format or the Path Image format. The advantage of the SLC format with respect to the Path Image format is that the original SAR geometry (slant range) of the data is preserved, i.e. no resampling of the data (with the risk of introducing artefacts) has been performed. The drawback is that the speckle is higher and the pixels in general are not square (the resolution being higher in azimuth) and GCP collection may hence be more difficult (building a multilook image of the SLC data may help for GCP collection). On the other hand less GCPs are needed for the SLC product (1-2 GCPs/image) than for the Path Image data. Also from a radiometric point of view, Path Image data have undergone a partial calibration that does not account for the relief.

- As described in section 2.7.2 below it is advisable to proceed with co-registering of the image series (affine for SLC), then de-speckle filtering while still in SAR geometry, and finally perform the actual geocoding reaching pixel accuracy in ground range geometry.

59.2 Radiometric correction (optical)

- As a general rule, photointerpretation of the crop or land use and delineating the parcel boundaries do not require normalized top-of-canopy reflectance values. As a result atmospheric and bidirectional effect corrections are not necessary, but may be applied if they are part of the standard processing chain, or if automated image classification is used in conjunction with multi-date imagery for a single zone.

59.3 Radiometric correction (SAR)

- Calibration: SAR images can be easily calibrated. Calibration allows a quantitative evaluation of the backscattering signatures, which is especially important to assess the influence of environmental conditions (e.g. wetness of the soil). For each of the RADARSAT fine mode products, the data providers supply documentation on the radiometric calibration procedure. If calibration is not per-formed, SAR signatures can still be used to interpret crop types, for example using supervised classi-fication.

- Speckle filtering is beneficial to reduce the perceptibly noisy character of SAR data. SAR speckle filtering modules are available in most image processing software, in some cases as part of separate SAR modules. It is advisable to use a so-called GMAP filter, which best retains edge and line features. The settings of the GMAP speckle filter usually include ?window size? and ?number of (equivalent) looks? (NoL). The window size of the filter depends on the average size of the field in the scene. It is suggested to use small windows (3x3 or 5x5) for areas with small fields, and larger window (7x7 or 9x9) for areas with large fields. The NoL is determined by the resolution of the sensor and SAR processing settings.

- If several images (taken with the same incidence angle) are available, it is recommended to first co-register the images (with an affine transformation for SLC data) and then apply a multitemporal speckle filtering. This multitemporal filter is known to be more efficient than single date filters.

- Changing the value of the window size and NoL for the same SAR image yields different speckle filtering results. Since the scene properties (e.g. field size, shape of boundaries, etc.) are important, it is advisable to run a few tests with the speckle filtering, preferably on several selected sub-scenes, to determine the most appropriate filter settings. These setting should then be used for each additional SAR image for that scene.

- It can be beneficial to block average the original input data to improve performance of the speckle filtering operation. Block averaging usually results in a higher NoL. In the case of RADARSAT fine mode data, a 3x3 block averaging leads to an 18.75 m pixel spacing. Note that block averaging needs to be performed on intensity values, and not on the digital numbers stored in the input image, in order to retain radiometric conformity of the block averaged product. The combined use of multiple images in a time-series is yet another technique that can enhance the performance of speckle filters.

- Speckle filtering, if necessary preceded by block averaging, should be applied before geocoding is performed.

59.4 Resolution Merge

Although the spatial enhancement of remote sensing data through "resolution-merge" might be considered a straightforward process, incorporated in most of the "off-the-shelf" software, its proper handling is of vital importance for the final quality of the processed image, as well as for the result of the photointerpretation. This section on image fusion or pan-sharpening is dedicated to study this isssue more in detail and to provide more technical information.

60 Main stages of CwRS

Responsible	Description	Period
	Preliminary work	
Administration Commission	Selection of control zones, assessment of image requirements[1]	September-December
Administration	Call for tenders, selection of contractors, signature of contracts	December- March
Commission	Consultation Period for revision and update of the Art 34 and CwRS technical recommendations in WikiCAP	Sep-Mar
Administration	Selection and administrative processing of applications lodged in chosen zones; transfer to contractors of dossiers and data bases (declarations, digital LPIS and LPIS ortho-images)	April- June
Contractor	Collection of applications data, LPIS vectors and of farmers' sketch maps	March- June
	Preparation of data	
Commission/Contractor	Acquisition of satellite images (Commission) and/or aerial photographs (Administrations/Contractors), processing, geometrical correction etc.	October - September
	Photo-interpretation and categorisation of applications	
Contractor	*Photo-interpretation of parcels to be checked*	May- August
Contractor	Categorisation of applications and return of results	June- August
	Administrative follow up	
Administration	Follow up inspections in the field (if included in CwRS strategy)	July- October
Contractor	Contractor's report to Administration and discussions of results; summary statistics and images (raw and rectified) to the Commission;	October- December
Commission	JRC visits to contractor and Administration in support of MS	January ? September

Notes:

1. ? At the beginning of the campaign (e.g. autumn 2007 for the 2008 campaign) the Commission collects the Member States requests for VHR and HR imagery. These requests are decided upon in accordance with technical feasibility and budget available.

61 Mapping risk factors

- It is assumed that risk factors have been determined by the MS and any application can be given a ?score? per risk factor, most likely using previous year(s) data (e.g. application data from year n-1, control results from year year n-2, if the applications to be checked with RS are lodged on year n). As a result each application can be assigned a global risk score which is the weighted sum of the individual risk scores, where the weights are fixed according to the importance given to each risk factor. Alternatively, any application may be assigned a class of risk using a combination of risk factors (Cf. identification of risk factors). In such a case, it is advisable to convert these ?qualitative? classes into quantitative scores for the next step (e.g. if class B and D are considered to be high risk, they will be assigned a high score).

- There are several ways to map risk at MS level in order to define the control zones on the basis of RA:
  - Map the risk at LPIS parcel level.
  - Map the risk at administrative unit level (e.g. commune) by taking account of the applications falling inside each unit.
  - Map the risk at grid level: define a regular grid for instance with a spacing fitting the swath of VHR satellite (e.g. a 10 x 10 km grid) and compute the average risk per cell by taking account of the applications falling inside each cell.

- Mapping the risk at LPIS parcel level is straightforward when each LPIS parcel can be assigned to a single farm (case of agricultural parcel or farmer?s block LPIS) as the farm risk can be directly assigned to the LPIS parcel. When the LPIS parcel is shared by several farmers, a possibility could be to compute the LPIS parcel risk score as a weighted average of the risk scores of the parcels claimed inside the LPIS parcel, with weights proportional to each parcel area (i.e. equal to the parcel area divided by the LPIS parcel area). In this proposal, an LPIS parcel with only part of its area being claimed (e.g. 10%) is likely to have a low risk score, which is consistent with maximizing the use of the imagery (i.e. the area effectively checked) over a control zone .

- There may be a need to summarize the risk map derived at LPIS parcel level to a lower level of detail so as to ease the selection of zones. This could be made through a weighted average of the risk scores of each LPIS parcel falling inside an administrative unit or grid, using for instance weights proportional to the LPIS parcels area (i.e. LPIS parcel area divided by grid area).
- Alternatively, the risk at administrative unit or grid level may be mapped as follows:

1. identify the farms falling inside the administrative unit or grid;

2. compute the (weighted) average risk score of the administrative unit or grid for each risk factor (a weight may be introduced to account for the different sizes of farms);

3. For each risk factor, rank the administrative units or grids; it is possible to assign them a risk class (e.g. between 1 and 5) according to their quantile;

4. For each administrative unit or grid, compute the overall risk score using a weighted average of the risk scores of the different factors. Different weights may be assigned to give more emphasis on particularly high risk factors.

- The result of the risk map is a stratification of the MS showing for instance high, medium and low risk strata. There could also be a stratum ?not suitable for CwRS? if the density of applications is too low in some parts of the MS.

62 Minimum size and width of the agriculture parcel

62.1 Minimum size and width

The minimum parcel size applicable in a Member State (cf. art 13(9) of Commission Regulation N° 1122/2009) will be given in the National Addendum. Parcels found below this minimum parcel size are not eligible for aid and should be flagged with an appropriate code.

No specific minimum widths for agricultural parcels are identified in the current regulations.

63 Obvious error

Article 19 of Commission Regulation 796/2004 states that "an aid application may be adjusted at any time after its submission in case of obvious errors recognized by the competent authority".

Following requests from Member States, the concept of obvious error has been clarified by DG AGRI in the following guidance document: [[1]]

The main principles from this guidance document are the following:

- Obvious errors should be assessed on a case by case basis as the competent authority has to be convinced that the error is genuine i.e. that the farmer *acted in good faith*.
- As a general rule, an obvious error has to be *detected from information given in the aid application* form i.e. where an administrative check on the coherence of the documents and the information submitted to support the claim (especially the application form, supporting documents, declarations etc.) reveals such errors.
- Errors detected as a result of cross-checks of aid applications with independent databases (e.g. land registers) may not be considered automatically or systematically as obvious errors. An error *cannot* be judged as obvious on the grounds that a Member State has set up an effective system for detecting irregularities.

64 Orthoimage technical specifications for the purpose of LPIS

DQ Sub elements	Conformance Quality Level & Tolerance Limits	Notes	Expected rate of conforming items
Spatial resolution	<= 1m	Ratio of the final ortho resolution to the GSD is 1:1 for digital sensors, whereas for film cameras should be at least 1.2:1	100%
Radiometric resolution	=>8 bits/channel	11-12 bits per channel is highly recommended	100%
Spectral Resolution	Color (natural or color infrared)	Panchromatic only (satellite or aerial) data is allowed, only if there is no option for color imagery	100%
General Image Quality	Lack of defects and artifacts, which could prevent the visual interpretation of the image	Checking for existence of scratches, dust, threads, hot spots, haze, drop lines, shadows, color seams, spilling, artifacts, etc	N/A (no defects allowed)
Cloud cover	<5-10%	Per image and in total. The term "image" is used for the ?control unit? e.g. orthoimage, mosaic (map sheet)	100%
Overall clipping	<0.5% at each tail	Overall clipping of the luminosity histogram	100%
Histogram Peak	+/-15% of middle value	For 8 bit image, the middle value is 128	100%
Color balance	<2% between min and max value of triplet	Not applicable for panchromatic only	100%
Noise	Signal to Noise Ratio > 12 for each channel	SNR which is defined as the ratio of the mean DN value to the standard deviation of the DN values	100%
Contrast	The coefficient of variation of the image DN values should be in the range of 10-20%	Represented as the Standard Deviation of the DN values as a percentage of the available grey levels	100%
Geometric accuracy	RMSEx <= 2.5 m; RMSEy <= 2.5 m	RMSE is calculated on the base of at least 20 well distributed independent check points (ICP), per image	100%
Mosaicking	DN valies variation on similar area type not to exceed 10% in average (or 4% between each of the 3 channels)	.	100%
Mosaicking	Geometric mismatches along seam lines (d) <3 pixels	.	100%
Compression	Lossless (TIF, LZW-TIF) Visually lossless (JPEG2000, ECW, MrSID) at last stage (storage)	.	100%

For more information on the quality assurance and quality check, please refer to: [1]

See also: VHR spaceborne sensors, suitable for LPIS creation and update

65 OTSC Sample

According to Article 30 of Commission Regulation 1122/2009, the total number of on-the-spot checks carried out each year shall cover at least 5 % of all farmers submitting a single application.

66 Possible factors for the risk analysis

66.1 Context

According to article 31(2) of Regulation 1122/2009, MS are responsible for the definition of the risk criteria to be used for the Risk Analysis (RA).

The following risk factors which were included in the previous versions of the regulation are listed here only as suggestion:

- amount of aid involved;
- number of agricultural parcels and the area or number of animals for which aid is requested;
- changes from the previous year;
- findings of checks made in past years;
- farmers who are either just above or below ceilings or limits relevant for the granting of aids;
- other factors to be defined by the Member States.

The following paragraphs report on the experience of some MS with the use of these criteria. These factors may be applied directly (e.g. select all farms or x farms with an amount of aid above a threshold) or combined through weights (giving different weights to the different factors so as to get an overall score per farm) or combined in the selection criterion (e.g. select all farms with an amount of aid above a given threshold and claiming a particular crop and having been sanctioned in any scheme in the past 4 years).

66.1.1 Criterion ?amount of aid?

At first sight, the higher the amount of aid, the higher the risk. However, it was noted that this was not in general a positively correlated factor; (small) errors are more likely to be found on small farms. However, this may be compensated for by the increased risk of irregularities on larger farms.

Conversely, it was considered correlated to set-aside (indeed, even a ?leveraged? factor due to the effect of set-aside on payments; however this observation was valid before the introduction of SPS and in any case is not valid for SAPS).

66.1.2 Criterion ?number of parcels?

This criterion was generally positive when tested against previous years (more parcels to declare, more risk of error), and effective in identifying errors at the parcel level. In some MS, this factor was combined with the area (area / parcels), and only applied if >20 (for example) parcels were in the dossier. It was also noted that it is a costly criterion to control ? more parcels, more to control.

66.1.3 Criterion ?changes from the previous year?

This was often crop specific ? e.g. an increase in pasture land or alternatively to arable crops, was considered a useful change factor. In other MS, it was noted that the change focus is on particular (coupled) crops, where risk is positively correlated with the crop. Under the Single Payment Scheme, a move away from pasture land may indicate an eligibility problem.

66.1.4 Criterion ?findings of checks made in past years?

It is generally agreed that this could imply not only a ?black list? of applicants (ones that had anomalies) but also a ?white list? of applicants (applicants that had been checked and had presented no problems).

It is considered that ?past years? meant 3 to 4 years, and the findings can be used to give positive weightings as well as negative weightings.

For instance the sum of the reductions and sanctions (in euros) or the sum of ha not determined over the last 3 years divided by the number of OTS checks could be computed for each farm or each potential control zone (administrative unit or grid).

Since OTS checks are limited in area, it is likely that this factor will appear as ?not controlled? for many farms and potential zones or that the score of a zone may be computed over very few checks. In order to compensate for this, an additional ?historical? factor based on the number of checks made for a given farm (or administrative unit) in the past n years may be used (with a higher score i.e. risk for farms or zones with less checks).

66.1.5 Criterion ?applicants at/near "ceiling" thresholds or levels?

It is agreed that this is a potentially effective criterion, e.g. in GAECs checks, or in respect of the compulsory set-aside area, or where the parcel/holding area is just above minimum sizes.

66.1.6 Criterion ?other factors defined by MS?

A number of other ideas or practices could be listed:

- *Indications of irregularities resulting from cross-checks.*
- *Dispersion of farms: when outlying parcels are (for example) >50kms from the main farm.*

- *Set-aside: farms with set-aside entitlements not inspected in the last three years.*
- *VHR area: All farms selected (to ensure economic efficiency)*
- *Claimed parcel area close to GIS (agricultural parcel) area or:** Area claimed is less than 90% of gross LPIS reference
- *Areas where the LPIS needs to be updated (e.g. due to new infrastructure)** Inclusion of dairy farms (new to SPS)
- *New applicants, systematic check (but usually not found to be problematic); late applicants; applicants not using the main tool for lodging their application (e.g. paper claims in MS where the application process is digital which allows performing systematic cross checks and informing the farmer of possible mistakes); * New farmers requesting access to the reserve (SPS)*
- *No control for previous 4 years*
- *Focus on sensitive crops that pose a problem for dual use: sugar/fodder beet, beans, peas*
- *False declarations in other schemes*
- *Applicants having received forestry grant aid in the last 3 years*
- *Aid applications also containing areas for which production aid is claimed or areas cultivated with fruit and vegetables.*
- *Land under permanent pasture.*
- *Etc.*

67 Principles of Control with Remote Sensing and possible strategies

67.1 Purpose of Control with Remote Sensing

The purpose of on-the-spot checks and therefore of Control with Remote Sensing is to check the conditions under which aid is granted on a sample of applications. In practice, for each parcel claimed for SPS or SAPS aid, this means checking at least:

- the declared area of the agricultural parcel;
- the compliance with the minimum area of the agricultural parcel where necessary;
- the declared land use to the extent requested by the regulation (see National Addendum for a description of the crop groups);
- the number and/or position of trees and other features where necessary;
- the eligibility of the parcel with respect to the reference period where applicable (see National Addendum);
- the respect of the cross compliance requirements and particularly of the Good Agricultural and Environmental Conditions (GAECs).

As a by-product of these checks, feedbacks to the LPIS should be made (e.g. using specific codes) wherever appropriate. Contracts, seed certificates and other conditions (e.g. particular GAECs, or THC content in hemp) that need to be met but cannot be checked on the imagery (or in the field) will require specific provisions to be set up by the Administration.

The **list of the checks to be carried out** by the contractor **for each type of parcel, crop, zone, cross compliance issue** should be described explicitly in the **National Addendum**.

67.2 Principle of classical Control with Remote Sensing

The philosophy of **classical CwRS** is to check the claimed parcels ?in the office? as much as possible. Different images in resolution and time will be supplied, weather permitting, according to the checks to be carried out (Cf. National Addendum). The primary result of these checks is a **diagnosis at parcel level**. Parcel results will then be aggregated to derive a **diagnosis at crop group level** (i.e. the level where aid and penalties are calculated) and dossier level. The objective of these diagnoses is to separate the crop groups/dossiers that will need a follow-up action from those which are considered as correct and therefore do not require any subsequent action (for the points that could be checked by remote sensing).

Whenever the imagery does not allow the verification of some of the points listed in the National Addendum in a satisfactory manner, a **field visit** will have to be carried out. This field visit can be carried out **during the CwRS work** so as to integrate the results of these visits in the CwRS results **or after the CwRS** results have been delivered to the Administration. In this latter case, the field visits will likely be carried out by the Administration at a later time in the campaign.

The sorting of dossiers for which a follow-up action is necessary is a characteristic of CwRS. As a general rule, in classical CwRS anomalies detected on the imagery should be followed-up by any appropriate administrative action, and where necessary by a physical inspection in the field. The main objective of this sorting is to concentrate field inspections on a reduced number of problematic parcels. If the national law does not impose field inspection to certain categories of dossiers (e.g. penalised or rejected dossiers), the criteria to decide on a field inspection may also depend on organizational or strategic considerations.

68 QC data delivery

Contractors should deliver the data for the control zone in a single consignment, containing all elements specified in this document, in the format recommended, and, at the latest, by 15 December 2008.

A brief description of the data required for the Quality Control (one zone selected by the Member State) is given in the table below. More detailed information can be found here

Type of data	Contents	Format
Alphanumeric	Data resulting from the application input (dossiers, crop groups and parcels declared); Contractor?s results of photo-interpretation and categorisation, per parcel, crop group and dossier; Ancillary information	ACCESS database (pre-defined and supplied by JRC)
Vector	Vectorial database of the parcels as validated after the photo-interpretation; Original maps used for the location of declared parcels (in vector or raster format); Data from the ground survey (used for land use interpretation training)	SHAPE files or Export ARC/INFO or compatible with Ungenerate of ARC/INFO
Images	Satellite images and/or scanned aerial photographs (fully processed)	Digital, under the formats ERDAS ?IMG?, TIFF or compressed MrSID or ECW formats and related files (e.g. ?TFW?, etc.)
Ancillary data	Description of files and formats delivered. Metadata database inherent to each geometrically corrected image; Nomenclature of the land uses and crop groups declared and observed; Photo-interpretation rules and manual; Categorisation rules and tolerances; Quality Assurance procedures	ACCESS data base (pre-defined and supplied by JRC); Tables and digital files, and/or hard copies

If the contractor cannot supply the data in the formats described (SHAPE or ARC/Info Export uncompressed or GEN format, ERDAS IMG or TIFF etc.), then he should contact the JRC to arrange for alternative delivery formats. For large datasets (e.g. aerial photos) the JRC recommends to use MrSID, or ECW compression. The contractor should contact the JRC for any other format.

69 QC data requirements

The main types of digital data to be supplied for the quality checks are:

- alphanumeric data, containing the declared data and the contractor?s diagnosis per parcel, group and dossier; description of the codes and rules applied (when different from the Technical Specifications), of the crop codes, group codes and crop-group combinations allowed.
- vector data before and after interpretation, containing graphic data with their attributes;
- satellite images and/or aerial photography;
- specific ancillary alphanumeric data required for checking the geometric quality of images;
- any other ancillary data providing additional information relevant for the control.

Further information on file types can be found here.

A common format for data delivery has been specified in order that the data used and generated by the contractor could be read by Quality Control system.

For the alphanumeric data, the JRC has designed two separate MS ACCESS databases (downloadable from here [1]):

- DB_ANUM_2008.mdb contains tables to store the declared data and results of the contractor?s work per parcel, group and dossier;
- DB_QCRs_2008.mdb contains tables to store the required geometric data.

The contractor should complete the databases as much as possible.

Detailed format specifications of the data requirements for the Quality Control checks are given in the Annexes. The contractors are strongly advised to follow the data format specifications. Any deviations from the recommended formats should be justified and documented in detail.

70 QC Procedure

In each Member State involved, the Administration will select one Quality Control zone per contractor. This zone will not be revealed to the contractor until the contractor has delivered the diagnostic results for that zone to the Administration.

Once the contractor has delivered the diagnostic results for the zone to the Administration, and the Quality Control zone is known to him, the contractor will send all data needed for QC:

- either to the Administration, who will in turn forward the data to the JRC;
- or directly to the JRC, subject to prior agreement with the Administration.

For the purpose of QC, the contractor is not required to generate and deliver data for any other control zone[1].

For its own QC and in order to improve the CwRS methodology, the Administrations are advised to field inspect a sample of parcels or dossiers, in particular of accepted dossiers (since the rejected dossiers are systematically verified by field inspection or any other appropriate procedure).

Notes:

1. ? Summary statistics, however, are to be delivered for all control zones, but usually at the end of the campaign

71 Quality management

The contractor is required to carry out an **internal quality assurance** which will result in quality control records. These records should be maintained for inspection by the administration and/or the Commission services.

As a general rule, it is recommended for quality control reasons to verify in the field a **minimum number** of the accepted dossiers (for example 2% with a maximum of 100 dossiers). These supplementary checks may mostly involve the confirmation of the land use.

A similar quality control should be carried out to assess the suitability of CwRS for checking the GAECs (and possibly SMRs related to environment) that the MS have decided to check with RS. In particular, during the inspection of the farms belonging to the GAEC sample, it is recommended to perform rapid field visits on a sample of OK parcels in order to ensure that no anomaly was overlooked by CwRS.

In addition, the Member States have the responsibility to carry out an **external quality control** of the contractor's work.

72 Radar imagery for CwRS

The Commission does not currently use Radar imagery in the operational CwRS methodology.

73 Radar images

- Control of land cover during winter (GAEC) using multitemporal images of Envisat or Radarsat
- Assessment of VHR SAR image for agriculture parcel measurement on TerraSAR-X and on CosmoSkyMed

Other operated satellite radar systems: Seasat, ERS-1,2, JERS-1, Almaz-1, SAR Lupe

Here few basic elements of **slant-range distortion** (after http://www.radartutorial.eu) which effected features appearance on SAR image

Layover - Extreme form of elevation displacement or foreshortening in which the top of a reflecting object (such as buildings or trees) is closer to the radar (in slant range) than are the lower parts of the object. The image of such a feature appears to have fallen over towards the radar. Also defined as the displacement of the top of an elevated feature with respect to its base on the radar image. The effect is more pronounced for radars having smaller incidence angle. On agricultural area this occurs for high trees or bushes and houses.

Foreshortening - Occurs when the radar beam reaches the base of a tall feature tilted towards the radar (e.g. a mountain) before it reaches the top. Because the radar measures distance in slant-range, the slope will appear compressed and the length of the slope will be represented incorrectly at the image plane.

Shadowing effect - Increases with greater incident angle*, just as our shadows lengthen as the sun sets.

Incidence angle - is the angle defined by the incident radar beam and the vertical (normal) to the intercepting surface. In general, reflectivity from distributed scatterers decreases with increasing incidence angle.

SAR overview of agricultural applications can be found as short Use and interpretation of SAR data guideline

73.1 External links

http://envisat.esa.int/instruments/asar/

http://www.radarsat2.info/

74 Random selection

74.1 The ?representative sample? concept.

It was noted that the main use of the (randomly selected) representative sample would be to permit an estimate of the ?background level? of anomalies[1], and therefore support decisions enacting the mechanism for increasing the control rate (during the campaign). It also permits an assessment of the effectiveness of the criteria being applied for risk analysis.

Furthermore, the random sample often gives a higher rate than the risk analysis sample (this has been mentioned several times in meetings in Brussels by other MS). However, it was discussed that this might infer inappropriate use of criteria.

The legal text fixes the random sample (in Art 31 Commission Regulation 1122/2009) to between 20% and 25%: and that this may (according to the JRC) create a problem in different sized countries. For example, it would imply that in a large country with 100,000 on the spot checks planned, that some 20,000 dossiers would be sampled: this is likely to be much higher than necessary to estimate the ?background level ?(probably <5,000 could be sufficient, depending on the frequency of dossiers with problems). While this may not present directly a problem with respect to the estimate, it may have two unintended effects:

- Fewer checks are focussed on dossiers that do present a specific risk, thus missing opportunities to address risk
- Since it may be assumed that randomly sampled dossiers maybe somewhat more expensive to organise, overall costs may increase.

It was noted that all the larger countries may be in a similar situation: IT, DE, FR, ES, PL, HU.

By contrast, Luxembourg, with only ~100 checks carried out each year, would be unlikely to obtain a reliable estimate of background irregularities even if all the checks were random. It was confirmed that the ?background estimates? tended to fluctuate, which is an indication that the result is very dependent upon the sample structure.

74.2 Reliability of background estimate

The Commission has made no statement of what reliability this estimate should be. It was noted that, where the proportion of dossiers with problems approach low values (5% and below), the number of samples required to make this estimate at a given level of reliability/confidence increase geometrically. Thus, a member state which manages a) to keep levels of irregularities low, and b) keeps control levels constant, could find that the ?background level? estimate is not stable or reliable.

In brief, the above trend is that a MS that should be able to benefit from low levels of irregularity actually needs to undertake more controls to determine that low level reliably.

74.3 Types of random sampling

The main statistical criterion of random sampling is that all dossiers should ? so far as can be practicably implemented ? have equal probability of selection. In this regard, two approaches are considered most appropriate:

1. **simple random sampling**: selection from the full population of dossiers through the generation of a random key. This approach may require waiting until the full population is known, however, before the sample can be determined.
2. **systematic sampling**: for example each 100th dossier delivered at a collection centre or in the computer system. Whilst this approach has the advantage of producing immediately dossiers for checking (without waiting for the determination of the full population), care must be taken to avoid any creation of bias in the input order of dossiers.

74.4 Analysis of the random sampling methods

Since the regulation text states ?Member States shall select randomly? the 25% sample, a review of possible interpretations of ?random? to be compared with current practice was considered worhtwhile:

- **Simple random sampling:** all dossiers have equal probability of selection
    - ♦ Advantages
        - ◊ Cheap to compute, good/easy stats
    - ♦ Disadvantages
        - ◊ No prioritisation - Can miss certain types of problems
        - ◊ Can be expensive to get the data (no efficiency of sampling)
        - ◊ Could require a large sample
- **Systematic sampling:** E.g. Every 20th dossier registered, etc
    - ♦ Advantages
        - ◊ Easy to compute
    - ♦ Disadvantages
        - ◊ Not easy to set up a systematic sampling framework? (nation-wide?)
        - ◊ Again, not efficient
        - ◊ In fact, is a type of random sample
- **Stratified random sampling:** With certain strata (defined with criteria) a certain number of dossiers are randomly selected inside each strata
    - ♦ Advantages

◊ Can target certain types of problems (e.g. durum wheat farmers, or set-aside)
◊ Generally still considered ?random?
♦ Disadvantages
◊ Prior knowledge required
◊ Could be complex to compute
◊ This is very much like we work already?
◊ E.g., 5% inside each Departement, County, Land?
- **Cluster sampling:** Often geographically clustered (but could be clustered in another dimension), with (often) random selection within the cluster, e.g. a CwRS zone?
♦ Advantages
◊ Usually cheaper
♦ Disadvantages
◊ Big clusters are not good estimators
◊ Difficult to extrapolate to the full population

74.5 Remarks

Working document 7105/98 already gives some guidance on this.

It was noted that since dossiers were often delivered in ?clusters? from post offices, random sampling could be problematic.

Alternatively, a sampling frame could be structured according to a batch system, as defined in ISO 2859, and that each year is considered as a batch. Sampling rates are adjusted according to the number of ?failures? observed in the sampled units (application dossiers). However, this might have implications for the feedback mechanism supposed to increase sample rates when problems are identified.

Information on the RANDOM SAMPLING, according to earlier guidance of DG-AGRI, is given here: http://mars.jrc.it/Documents/lpis/60363rev1.pdf

Notes:

1. ? In DG AGRI document 60363, it is written "true level of irregularities."

75 Rapid field visits

Rapid Field Visits (RFV) are intended as a means to check the land use and possibly some cross com-pliance issues (GAECs) in the field without contacting the farmer.

As a general rule, area measurement is not carried out during rapid field visits. However, if permitted, for parcel boundaries not clearly identifiable on the VHR imagery, some distances or positions may be taken in the field so that the parcel area could be measured on screen at a later stage.

RFV may be systematic i.e. carried out on all parcels of the CwRS sample or directed to problem or doubtful parcels (Cf. National Addendum).

Systematic RFV are usually carried out for checking the land use and cross compliance when only one VHR image is available per control zone. In this method, the task of CAPI operators is mainly limited to measuring parcel areas on the screen. The advantages of this method are the following:

- field visits are made at the best possible timing for identifying the crop and assessing its extent;
- crops likely to be poorly recognized on the imagery (e.g. durum wheat versus soft wheat or barley) can be identified and a sample taken as a proof if requested by the National Addendum;
- cross compliance issues, whose the verification may no be feasible on the imagery, can be verified in the field, whenever possible;
- in principle no follow-up field inspection is needed; the follow-up action usually consists in sum-moning applicants to a meeting.

Classical CwRS may plan RFV for problem parcels when the available images do not permit a satis-factory verification of the land use (typically for doubtful parcels or crops of difficult identification such as durum wheat) or cross compliance issues.

Digital photographs of the parcels visited and (especially) parcels with problems may be taken during the visit, and stored in a database with their location, so as to be presented to the applicant in a follow-up meeting, thus reducing the number of follow up field inspections to a minimum.

RFV can be undertaken either by the CAPI operators or by other staff trained in crop identification and cross compliance checks. If relevant, the tenderer should indicate the following:

- The number of RFV planned, if any, and the type of parcels to be visited;
- The material and timing for these RFV;
- The personnel planned for this work and their qualifications.

The rapid field visits can also be undertaken by the local services of the Administration and their re-sults sent back to the contractor for completion of the diagnosis at parcel level (Cf. national Adden-dum).

Field visit documents such as maps for the overall location of the parcels and detailed location docu-ments (e.g. parcel boundaries overlaid on a VHR image) will have to be provided to the staff in charge of RFV. Alternatively, navigation systems based on GPS and systems allowing the display of images, vectors and data on a mobile computer in the field may be used. Predefined codes should be used to report on the actual land use and any anomaly found.

In classical CwRS, RFV may be used to assess the quality of the diagnosis derived from the imagery. In this case the diagnosis established before and after RFV should be recorded.

76 Schemes that may be checked with RS

Remote sensing may be used for the control of the area-related schemes defined by the following regulations:

- Council Regulation (EC) No 73/2009 and Commission Regulation (EC) No 1120/2009 laying down detailed rules for the implementation of the **Single Payment Scheme**.

- Commission Regulation (EC) No 1121/2009 laying down detailed rules for the application of Council Regulation (EC) No 73/2009 **as regards the support schemes provided for, as follows**:

TITLE I

- Chapter 2 - Crop-specific payment for rice;
- Chapter 3 ? Aid for starch potato growers;
- Chapter 4 - Protein crop premium;
- Chapter 5 - Area payment for nuts;
- Chapter 6 - Seed aid;
- Chapter 7 - Crop specific payment for cotton;
- Chapter 8 - Transitional payment for fruit and vegetables and soft fruits;

TITLE III

- Chapter 1 - Single Area Payment Scheme;
- Chapter 2 - Complementary National Direct Payments.

and

- Council Regulation (EC) No 1698/2005 establishing area-related payments for agricultural production methods to protect the environment and to maintain the countryside and for certain measures in relation to forestry. This regulation is the general basis for the rural development policies of the EC and is supported by the application Commission Reg. (EC) No 1974/2006.
- The Council Regulation (EC) No 73/2009 provides for the possibility to new Member States - subject to an authorisation by the Commission ? to grant Complementary National Direct Payments (CNDP) to farmers under relevant direct payments. The CNDP may take the form of a decoupled or coupled payment depending on the support schemes. As a general rule, CNDPs are fully nationally financed. However, during the first three-year period starting from the date of accession, new Member States were allowed to co-finance certain CNDP from their Rural Development Plan. In the case of co-financing, the Community rules of Commission Regulation (EC) No 1122/2009 shall apply to such payments.

77 Selection of the applications inside the control zone

77.1 Dossier Selection in the frame of the Control with Remote Sensing

Two levels of risk analysis may be carried out for CwRS: at zone level, and/or at dossier level.

A first point of note is that risk analysis for zone selection is clearly carried out on the previous year?s data. (For OTS checks, some criteria may be on the current year?s data.)

77.1.1 Zone selection

It was noted that in certain MS, a random zone selection would result in a predominance of forage dossiers being inspected (which are usually not the ones of interest). Indeed, this would also be the case in standard random selection for OTS, however, and is a good example of why SRS is not a good methodology in general. It was added that zone definition usually took place manually.

The Commission maintains however that the use of risk factors here is important, and that it would be interesting to prioritise placing zones where the LPIS was out of date. The 75%/90% rule could be used to identify such zones.

In any case it is clear that the GIS could be very effectively used in zone selection. The consensus was that the method appeared to be useful and powerful; certainly it appears objective. A clear procedure needs to be developed by the JRC that could then be trialed by MSs.

77.1.2 Dossier selection

Art 35 permits dossiers either to be selected:

- as all practically controllable dossiers (i.e., with >80% of area inside the zone), or
- by using the Art 31 risk criteria.

It was proposed that method a) could be considered ?random?. Thus a random zone selection, followed by selection of all dossiers (method a) would be considered a fully randomly selected dossier. It should be noted that ? while appearing a rather effective approach ? where only a limited number of zones exist (e.g. 4 or 5, where one is defined randomly to achieve the 20% random sample), this approach would involve an excessive level of clustering (see above) and in fact give a poor estimate of background level of anomalies. However, where the number of sites is (considerably) greater, (20?, 30?), this may be of much less significance.

Method b), fulfills the request by several member states to only select a sample of the dossiers inside a zone. At least one official request has been made (UK, 2004) to select only dossiers with 100% of their aid request area inside the zone in the control population. However, such an approach cannot be considered ?random? (large dossiers have reduced probability of selection), so it would seem appropriate that this would be considered a criterion under Art 31 para 2. c) (i.e. ?specific situation in MS?).

78 Specific codes at parcel level for Cross-Compliance

For the dossiers belonging to the GAEC sample, all requirements defined by the MS should be checked. The Administration will indicate to the CwRS contractor the list of requirements that will have to be checked with the support of imagery and/or GIS.

In addition, the Administration may ask the contractor to report any possible anomaly identified on a parcel of the ?5%? CwRS sample (e.g. heterogeneity that may be related to a lack of maintenance, en-croachment of unwanted vegetation, erosion).

In order to harmonize the GAEC codes across EU (e.g. for the compilation of summary statistics), it is proposed to code any requirement defined by a MS as follows: Gi.j.k where

- **i** is a number ranging from 1 to 5 and indicating the issue concerned by the requirement (1 for soil erosion, 2 for soil organic matter, 3 for soil structure, 4 for minimum level of maintenance; 5 for protection and water management; cf. *annex III of Regulation (EC) No 73/2009*);
- **j** is a number ranging from 1 to 7 and indicating the standard concerned by the requirement (annex III of Council Regulation (EC) No 73/2009 lists 8 compulsory and 7 optional standards in 5 issues, with a maximum of 7 for issue number 4);
- **k** is a sequential number indicating the national requirement.

NB: National requirements addressing more than one issue / standard should be identified by the code of the main issue / standard in order to avoid duplication.

In case the Administration decides to check some of the Statutory Management Requirements (SMR) related to the environment on the imagery during the CAPI phase, a similar coding is proposed: Si.j where i is the SMR number (from 1 to 5 according to Annex II of Regulation (EC) No 73/2009) and j is a sequential number indicating the element to be checked.

The parcels belonging to the **GAEC sample** will be screened by the operator in order to detect on the available imagery any anomaly that may indicate a possible GAEC breach.

For each of the requirements to be checked, one of the following codes should be used: Codes to be applied for the GAEC check

79 Standard codes applied at parcel level

Standard codes related to the conditions encountered at the parcel level, and proposed rules for the calculation of retained area, are given bellow:

Note related to the calculation of retained area: The last column of the table indicates which area should be retained at parcel level and therefore transferred at crop group level.

Observations at the parcel level	Code	Areas transferred to the crop group
Parcel outside all current year images	T2	Use the declared area and land use
Parcel outside control zone (i.e. VHR zone)	T3	
Parcel covered by clouds	T4	
Parcel declared or found as less than the minimum parcel size set by the Administration	A1	Give zero value to the area
Parcel (or part) claimed more than once	A2	Give zero value to (the disputed part of) the area
Parcel or reference not found in the LPIS	A3	Give zero value to area
Area ineligible (reference year 2003)	A4	
Parcel ineligible for decoupled group (SPS or SAPS)	C1d	Give zero value to the eligible area, except for "obvious errors". If possible, indicate the land use found
Parcel declared in one coupled crop group, but found in another	C1c	
Parcel declared in only one crop group, but found to be in more than one crop group	C2	Divide parcel, then apply previous rules
Land use correct, area outside tolerance (over-declaration i.e. declared > measured)	C3+	Use measured area and observed land use
Land use correct, area outside tolerance (under-declaration)	C3-	
Land use interpretation impossible or parcel limit problem not resolved on the image	C4	Give zero value to the area
Obvious error not covered by another code	E1	Use measured area and observed land use
Land use correct, area within tolerance	OK	Use declared area and declared land use

80 Systematic RFV

RFV may be systematic i.e. carried out on all parcels of the CwRS sample or directed to problem or doubtful parcels (Cf. National Addendum).

Systematic RFV are usually carried out for checking the land use and cross compliance when only one VHR image is available per control zone. In this method, the task of CAPI operators is mainly limited to measuring parcel areas on the screen. The advantages of this method are the following:

- field visits are made at the best possible timing for identifying the crop and assessing its extent;
- crops likely to be poorly recognized on the imagery (e.g. durum wheat versus soft wheat or barley) can be identified and a sample taken as a proof if requested by the National Addendum;
- cross compliance issues, whose the verification may no be feasible on the imagery, can be verified in the field, whenever possible;
- in principle no follow-up field inspection is needed; the follow-up action usually consists in summoning applicants to a meeting.

81 Technical tolerance

The purpose of the technical tolerance is to account for the uncertainty specific to any measurement technique. In the context of the control of area based subsidies, i.e. in the process of an on the spot check, tolerances are in general applied to the assessment of the difference between the declared and measured areas of the claimed agricultural parcel.

81.1 3.1. Regulatory basis

According to Art.34 of R.1122/2009, MS are required to use "**means proven to assure measurement of quality** at least equivalent to that required by applicable technical standard, as drawn up at Community level".

The quality of a measurement tool can be characterized by a number of parameters such as its bias, precision and accuracy (for the definition of these terms, see ISO 5725-1 or the "area measurement validation scheme"technical note); assuming there is no bias, it can also be characterized by its reproducibility limit, which is the parameter used to determine the technical tolerance.

As from 1 January 2008, only the perimeter **?buffer? tolerance** shall be applied to agricultural parcels. This buffer tolerance, which cannot exceed 1.0 ha, is calculated by multiplying the parcel perimeter by a (buffer) **width of maximum 1.5m**.

Therefore Member State should use only tools that allow measuring both the area and perimeter and should make sure that these tools meet the measurement accuracy (i.e. the maximum 1.5m buffer width) requested by the regulation.

81.2 3.2. Determination of the buffer width of a measurement tool

In order to determine the measurement accuracy of a given tool, whether it is a GNSS, an orthoimage or any other area measurement tool, **MS are requested** to systematically perform an **area measurement validation test** where needed, for instance through a validation test **before the start of the campaign** (see 'JRC Area measurement validation scheme'). The output of this test is a reproducibility limit at 95% confidence level, expressed as buffer width. The value of this reproducibility limit R determined experimentally will permit classifying the tool using, for instance, the following classes:

- (1) "better than 1.5m" for tools presenting an R falling inside]1.25m, 1.5m], i.e. buffer width = 1.5m;
- (2) "better than 1.25m" for R inside]1.0, 1.25m];
- (3) "better than 1.0m" for R inside]0.75m, 1.0m];
- (4) "better than 0.75m" for R inside]0.50m, 0.75m]; and
- (5) "better than 0.50m" for R below 0.50m.

The International Organization for Standardization (ISO) defines the reproducibility limit as "the value less than or equal to which the absolute difference between two test results (here area measurements) obtained under reproducibility conditions (with the same method but different operators and conditions, e.g. satellite configuration for GNSS measurements) is expected to be with a probability of 95%".

81.3 3.3. Application of the technical tolerance on parcel area measurement

The technical tolerances should be applied only to agricultural parcels and not to subdivisions of an agricultural parcel (e.g. internal cadastral parcels) as this would lead to the application of an excessive technical tolerance. For the definition of the agricultural parcel, please see Agricultural parcel.

For the creation or update of LPIS reference parcels, the buffer width to be used is indicated in paragraph 'Measurement on-screen on a digital orthoimage'.

The **outer perimeter** should be used for tolerance calculation as shown on Figure 1.
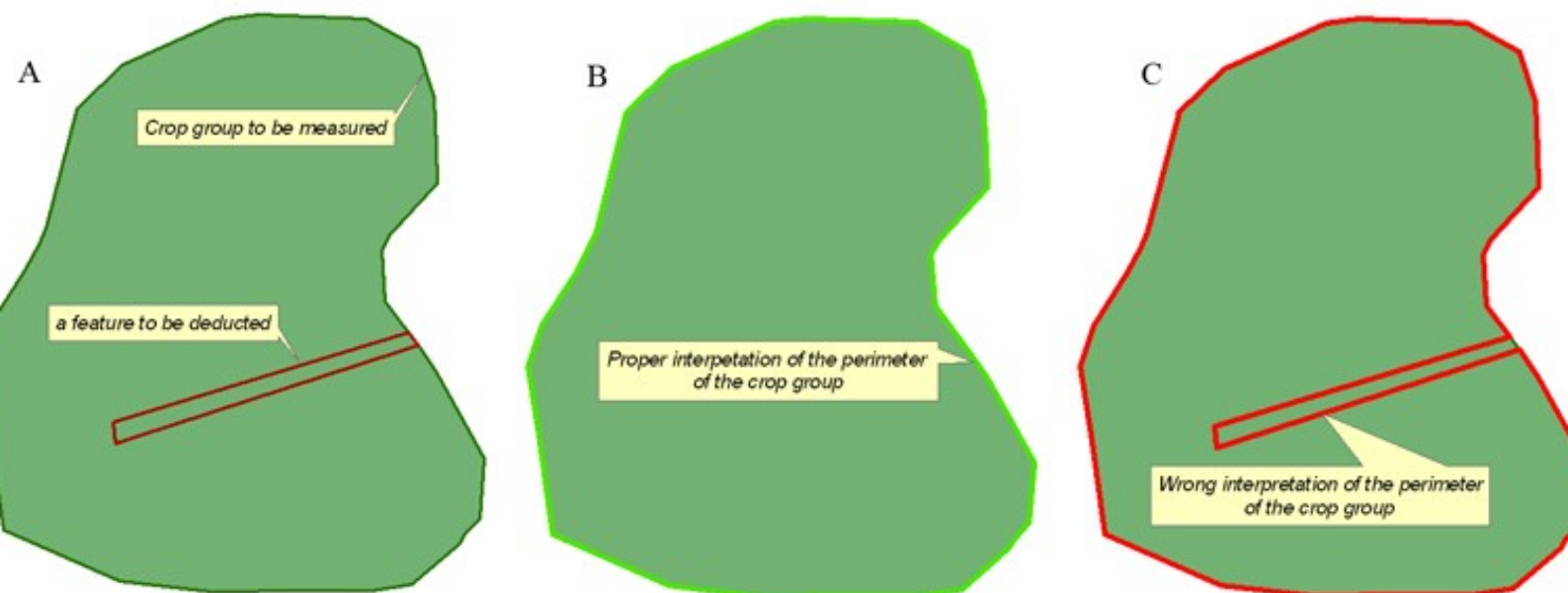
Figure 1. Example of correct and wrong perimeter interpretation.

Ineligible features included in the controlled area, like roads and maybe ditches or hedges, should not be taken into account when calculating the tolerance (see Figures 1B and 1C).

81.4 3.4. Tools used in conjunction with area measurement of cartographic materials (analogue or digital)

The buffer widths presented in this document should be understood as reproducibility limits at 95% confidence level (see 'JRC Area measurement validation scheme' and in particular § 7.1.3).

81.4.1 Planimeter

The change in the Regulation for 2008 and beyond means that, in principle, it is difficult to support the use of the planimeter, unless it is able to apply a perimeter tolerance and has been calibrated. In such a case, the Member State should make sure that the buffer width applicable to the planimeter has been proven, (e.g. certified) and in any case does not exceed 1.5m.

81.4.2 Measurement on-screen on a digital orthoimage

It is assumed for the purpose of these guidelines that the orthoimage quality meets at least 1:10,000 scale geometric specification (2.5m RMSE).

In absence of area measurement validation results for a given type of imagery, a buffer width set equal to **1.5 times the pixel size** will be used. For instance, in the case of images with a 1m pixel size, the tolerance will be 1.5m times parcel perimeter length, and in the case of a 50cm pixel image the tolerance will be 75cm times perimeter length (cf. Table 1).

However, before using this "rule of thumb", MS are advised to first check table 2 (cf. paragraph 3.6 below).

Table 1. Tolerance equated to map scale and pixel size

Map scale	Equivalent pixel size	Tolerance, on-screen
1:10,000	1m	1.5m
1:5,000	0.5m	0.75m
1:2,000	0.25m	0.4m

When linear features are to be measured on a digital orthoimage, it is recommended that the vector is digitised with a ground interval of around 50m (i.e., 5mm on a 1:10,000 scale image, or 10mm on a 1:5,000 scale image). A 2% tolerance may be applied to the length.

81.4.3 Measurement on screen on a digital map object (raster or vector)

It is assumed that the digital map quality meets at least 1:10,000 scale geometric specification (2.5m RMSE).

The tolerance, which should be applied as a buffer on the parcel perimeter, will be based upon the nominal scale of the digital map dataset which acts as source material. The values related to map scale are given in Table 1.

81.5 3.5. Tools used for physical field measurement

81.5.1 GNSS (standalone, EGNOS, or code differential)

GNSS area measurements made by single systems (stand alone) must work using a parcel-perimeter approach. As from campaign 2008, MS are requested to use means **proven** to assure measurement of a certain quality, i.e. certified or validated GNSS models. The list of GNSS models already validated by MS can be found here whereas the certified GNSS models are published here. In absence of any certification or other test results, the tolerance to be applied is **up to 1.25m** times the perimeter of the parcel. However, as from the 2010 campaign, such a default value is expected to be used in exceptional circumstances.

In case a validation test for a particular stand-alone GNSS has been performed, the class of measurement accuracy (e.g. "better than 1.0m") determined for this type of GNSS should be used.

As from 1st October 2009, the **EGNOS ?open service?** was officially announced as **available**. Technical performance parameters and terms and conditions of the use of the Open Service can be found in the Open Service Definition Document at this website.

If technically possible, MS are encouraged to use this service and to determine the buffer width to be applied with the EGNOS differential correction.

Due to the uncertainty of positioning at the start and end of measurements of linear features, it is recommended that standalone GNSS is only used for measuring linear features greater than 100m long; in exceptional circumstances shorter lengths may be measured but care should be made to check for irregularities in the recorded vector. The tolerance applied in such a case is recommended to be 2m, irrespective of the length.

81.5.2 Geodetic survey instruments (single of dual frequency phase GNSS, electronic total station)

These instruments are normally used for re-measurement in the case of disagreement by the applicant and therefore they will be operated by skilled, professional survey staff. A statement of their precision for area measurement expressed as buffer width around the parcel perimeter (e.g. a certificate provided by the manufacturer or a validation test result) should be a pre-condition of their use. Even if experience has shown that such instruments have a buffer width below 0.35m, a 0.5m buffer width is recommended to acount for the uncertainty in the parcel boundary itself (e.g. in case of hedge, ditch, bank). This value (0.5m) is also the default value to be applied in case of lack of such a statement.

81.5.3 Wheel, tape, topofil, etc.

These systems are considered as backup tools, primarily suitable for the measurement of lengths. The use, however, of a wheel on rough ground is strongly discouraged. Care should be taken when using the tape or topofil that the tool is not caught on branches, blown in the wind, etc.

For lengths of up to 100m, a linear tolerance of 2% can be accepted. This is to avoid problems when the feature is not perfectly straight, and/or the terrain is sloped or irregular. Care should be taken with all such ?analogue? tools to adjust the measured length to the projected (horizontal) length. Above 100m, other tools (e.g. GNSS) should normally be applied.

Laser range-finder tools are a preferred approach for distance measurements of absolutely straight features, and can be used for longer distances, provided that corrections for slope are possible and that the expected accuracy of the tools for such distance measurement is better than 2% linear length.

In general, the use of these tools should be restricted to linear measurements such as strip width, offset measurements from parcel boundaries, track lengths. It is not recommended that these tools are used for full parcel measurements (cf. borders, small deductions, etc.), primarily because the geometry (shape) and slope of typical agricultural fields is rarely regular. Nevertheless, in the exceptional case where such tools are used for area measurements, a tolerance based on the perimeter length multiplied by the linear tolerance shall be applied.

- width l = 6m, linear tolerance (tape) 2% = 0.12m
- length L = 500m, linear tolerance (GNSS length) = 2m
- perimeter tolerance on parcel length = 500m x 0.12m = 60m^2
- perimeter tolerance on parcel width = 6m x 2m = 12m^2
- total perimeter tolerance = 72m^2
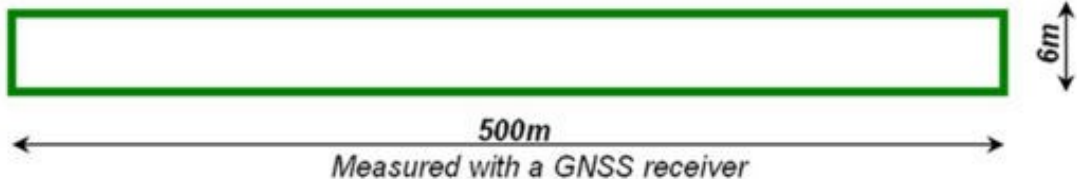
me tolerance is obtained calculating
ends of the interval, i.e.
per area: (L+2)*(l*1.02) = 3072 m$_2$
er area: (L-2)*(l*0.98) = 2928 m$_2$

This example regards a perfect rectangle, which in the field may be difficult to find.

81.6 3.6. Remote sensing control

In absence of validation test results, the guidance given in 'Measurement on-screen on a digital orthoimage' applies. In effect, the results of the validation tests, performed on seven types of VHR images of Ground Sampling Distance (GSD) ranging from 0.20m to 2.5m confirmed that the rule of thumb allows deriving a reasonable approximation of the buffer width, especially in the range 0.5m - 2m.

For the **VHR prime** sensors, the validation test results suggest using the following buffer widths:

Table 2. Tolerance to be used with VHR prime sensors

VHR sensor (GSD at nadir)	Recommended buffer width
Worldview 1 & 2, Geoeye-1 (0.5m)	0.8m
Quickbird (0.6m)	1.0m
Eros B (0.7m)	1.0m
Ikonos (1.0m)	1.25m

In case of failure of acquisition of the current year **dedicated**/**prime** VHR ortho-imagery, provisions should be taken to meet the requested area measurement accuracy. These may include the use of VHR back up imagery if available or of recent archive ortho imagery in case of stable boundaries; otherwise field inspections (e.g. with GNSS) should be carried out.

In case **VHR back up imagery** with a GSD above 1m will have to be used (in combination with the most recent LPIS orthophotos), a buffer **tolerance of 1.5m** will be allowed. The possible consequences of using such a tolerance with VHR back up imagery (of GSD above 1m) are presented at this page.

81.7 3.7. Tolerance in case of combined use of on-screen measurement and other tools (GNSS, field points)

In case **critical points** are taken in the field and reported on the (archive) ortho-imagery, the **tolerance** appropriate to the **ortho-imagery** should be used.

In case the boundary not visible on the (archive) ortho-imagery is measured by **GNSS** and reported on the ortho-imagery, the recommended tolerance is the **maximum** of the **GNSS** buffer width and the buffer width recommended for the (archive) **ortho-imagery**.

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82 Technical tolerance to be used with back up VHR imagery

In case of failure of acquisition of the VHR prime imagery, provisions should be taken to meet the requested area measurement accuracy. These may include the use of VHR "back up" imagery if available and of sufficient resolution or of recent archive ortho imagery in case of stable boundaries; otherwise field inspections (e.g. with GPS measurement) should be carried out as stated in Article 35(1)(b) of Commission Regulation (EC) No 1122/2009.

VHR sensors are classified as back up VHR for the CwRS program either because

- they do not meet the requested geometric accuracy (1D RMSE < 2.5m on check points) [1];
- their associated buffer width exceeds 1.5m (which is generally expected with a Ground Sampling Distance (GSD) greater than 1m[2]);

In practice it may be that a VHR "back up" image with a GSD above 1m is the only VHR image available to a MS. It can still, however, be used.

82.1 What tolerance should be used in such a case?

Considering that such back up imagery will have to be used only in exceptional circumstances, a buffer tolerance of maximum 1.5 m shall be used for any type of area measurement, including on back up imagery, thereby fulfilling the requirements of Reg 1122/2009 Art 34. Using a relatively "coarse" tool will result in measurements with a higher variability (higher range of values) than using a "precise" tool. From a control point of view, applying a strict tolerance with a "coarse" tool will have the following consequences:

- an increased risk to reject a correct declaration, which means more (redundant) inspections (but no corresponding risk for the fund).
- an increased risk to accept a wrong declaration. In case of underclaim, the wrong decision (to accept his claim) might penalise the farmer (therefore no corresponding risk for the fund). However, in the case of overclaim, the wrong decision might lead to excess payment. Nonetheless, this risk is mitigated by the cap to the LPIS area; this cap should prevent retaining an excessive (SPS or SAPS) area in LPIS based on reference parcels linked to a unique farmer (e.g. "agricultural" parcel or farmer's block LPIS).

Notes:

1. ? Although, it is up to the MS Administration and contractors to decide the technical and methodological approach to achieve the necessary geometric accuracy, the use of commercial off-the-shelf software is recommended.<
2. ? for example, tests made on Spot supermode (2.5m GSD) and Eros A (1.8m GSD resampled to 2m) showed buffer widths of 3.2 m and 2.8 m respectively

83 Use and interpretation of SAR data

- It is advisable to plan the use of radar data well in advance and in view of the specific requirements for processing the data and limitations for identifying crops. In order to substitute one optical image by radar imagery, several radar images may be necessary to obtain significant results. In general, land-use determination shall be done by photo-interpretation. A multi-temporal radar classification displayed in a separate window may support the photo-interpreter.

- For proper use in a CAPI environment three (3) SAR images should be combined in an image com-posite. In some cases, a single SAR image combined with co-registered optical image channels may provide a workable solution. If only 2 SAR images are available, a composite can be generated with a difference image as the third band. This, however, implies that the 2 images have been calibrated.

- In general, SAR backscattering of agricultural crops is dependent on the depth and status of the crop canopy and characteristics of the (underlying) soil. Since soil moisture conditions have a significant impact on backscattering, site conditions at the time of acquisition must be known, for example from meteorological records. Wet conditions are usually preferable for SAR image quality, especially when early season images are used (March to May). Also note that the local incidence angle, which is determined by the nominal incidence angle of the SAR sensor and the local slope, has a noticeable effect on the backscattering signature. Information on the local slope can be derived from the DTM.

- Image interpretation may benefit from accumulated knowledge on SAR signatures analysis for crops that is available in the literature. Experience with long term SAR data series has shown that SAR data use can be especially beneficial for separating cereals, oil seed rape, grassland and the several types of summer crops.

- In case of doubt in the interpretation of the SAR data that cannot be solved by the available optical imagery, rapid field visits should be carried out to check the land use. Alternatively, the parcel should be rejected so as to trigger a field inspection.

84 Some general rules to work with SAR image

84.1 Use of polarization types

To recognize the crop type

- VV: Sensitive to vertical structures on the Earth?s surface, provides good contrast among vegetation types that have different vertical canopy structures
- HH: Penetrates canopy more than vertically-polarized microwaves, provides more information about the underlying soil condition
- HV or VH: Sensitive to crop structure within the total canopy volume, information acquired is complementary to HH and VV images
- HH and HV or VV and VH: Studies show considerable improvement in crop discrimination using two polarizations (from 45% accuracy using 1 band to 78% accuracy using 2)

For crop condition

- Quad-Pol: Multi-polarized data are useful for deriving crop condition information, optimal polarization for mapping crop condition varies depending on crop growth stage and crop type
- Ultra-Fine beam mode: Useful for within field zonal mapping of crop condition

Land use classification

- HV - useful for differentiating vegetative surfaces from bare surfaces

84.2 Backscatter coefficients

- Very high (above -5dB): Man-made objects, terrain slopes towards radar, very rough surface
- High (-10 to 0dB): Rough surface, dense vegetation (forest)
- Moderate (-20 to -10dB): Medium level of veg, agricultural crops, moderately rough surface
- Low (below -20dB): Smooth surface, calm water, road, very dry terrain (sand)

return to Radar images

85 Use of CwRS for control of Cross-Compliance

Remote sensing data may be used in two ways for the control of cross compliance:

- Use of RS for a partial control of the GAEC.
- Use of RS as a support for the selection of the cross compliance sample (risk analysis).

CwRS as a <u>partial control of cross compliance</u>: This approach may be envisaged for the GAEC (or SMR) that may be checked on satellite or airborne imagery. This is the case for instance for the maintenance of a soil cover during winter, the prohibition of burning cereals stubble, the maintenance of grassland and set aside (absence of bushes), the ploughing on slopes above a certain threshold (DTM needed) etc? According to the minimum requirement defined for a given act or standard, MS may decide to use RS images to check specific conditions (e.g. requirements that need to be checked during autumn or winter).

In practice, during the photo-interpretation of the satellite imagery the CAPI operator will flag any case of possible non compliance (e.g. doubtful land use) with an appropriate code.

Also cases of non compliance in respect of some GAEC that would be observed during a RFV should be reported to the Administration.

CwRS as a <u>support for selecting the cross compliance sample</u>: On the CwRS OTSC sample or on the whole area covered by the HR image, an automatic classification (refined by CAPI) could provide a list of parcels potentially in breach with some GAEC that can be checked with RS. The corresponding dossiers may hence be part of the risk based sample for the controls of cross compliance of a given control body (the ?1% sample? per competent authority).

Member States should mention in their National Addendum the option(s) retained (no control of cross compliance with RS, use of RS for partial control or for risk analysis) for each of the control zones. If relevant, the GAECs to be checked and the criteria to be assessed should also be described as well as the specific imagery / processing requested (e.g. SAR imagery in winter for the detection of bare soil).

86 VHR imagery for CwRS

By **Very High Resolution** (VHR) imagery it is meant (satellite or airborne) imagery with a Ground Sampling Distance (GSD) of the order of 1m. In the panchromatic band, the GSD of VHR sensors usually ranges from 0.5m to 2.5m. VHR was defined by contrast with High Resolution (HR), which is the label given to satellite images with a GSD of the order of 10m (usually between 10 and 30m in the optical domain).

In CwRS, we distintiguish 2 categories of sensors: VHR prime and VHR back up. To qualify as **VHR prime** sensor, the following conditions must be met:

- **Geometric accuracy**: the **1D RMSE** measured on Check Points should be **below 2.5m**;

- **Tolerance**: the **buffer width** determined through a parcel area measurement validation test should be **less than or equal to 1.5m**.

Failing to meet any one of these conditions qualifies the VHR sensor as back up in the CwRS programme.

Although, it is up to the MS Administration and contractors to decide the technical and methodological approach to achieve the necessary geometric accuracy, the use of commercial off-the-shelf software is recommended.

The requirement to systematically offer **multispectral** bands in addition to the Panchromatic (Pan) band is dropped as from the 2009 campaign following the study on Pan only sensors (EROS B) showing that parcels could be measured on Pan imagery with an acceptable quality. It will be up to the MS to request an additional HR image to be acquired in the same window as the VHR Pan.

As a general rule, at least one VHR (satellite or aerial) image of the current year should be provided for each control zone (either by the Commission or the Administration). The choice of the imagery to be used shall be made according to local conditions[1] and in agreement with the regulatory requirements on the accuracy of area measurement as laid down in Article 34 of Reg. 1122/2009.

For each zone to be covered by a VHR satellite image provided by the Commission, an acquisition window is defined by the Member State[2]. Over this VHR window, acquisition attempts will be restricted to a **?dedicated? or "prime" VHR sensor** to be decided by the Commission in agreement with the Member State.

For the 2012 campaign, 3 classical VHR (PAN+MS) and 2 VHR (PAN only) sensors will be used as prime. The PAN only sensors will be programmed as prime only upon request by the Member State. They are as follows:

Sensor	Spatial Resolution (GSD in meters)	Spectral Resolution	Geometric accuracy (1D RMSE < 2.5m) ?	Area measurement (Buffer width < 1.5m) ?
Ikonos2	1.00	pan+ms	Yes (JRC & contractors)	Yes, 1.2m (PL test, 1.19m LT test)
Quickbird	0.60	pan+ms	Yes (JRC & contractors)	Not formally tested but assumed OK
Geoeye 1	0.50	pan+ms	Yes (JRC & Tragsatec, 1 scene)	assumed OK
Eros B	0.70	pan only	OK (but pending objective validation)	Yes, 1m
WorldView-2	0.50/2	pan+ms	OK (tested on 2 images)	Assumed OK (to be tested)

For selected zones agreed between the Member State and the Commission, a back up sensor will be defined in agreement with the Member State at the beginning of the campaign. For the 2012 campaign, the following **back up** sensors will be used:

Sensor	Spatial Resolution (GSD in meters)	Spectral Resolution	Geometric accuracy (1D RMSE < 2.5m) ?	Area measurement (Buffer width < 1.5m) ?
WorldView-1	0.5	pan	No (< 5 m)	No? (to be tested)
Spot Supermode	2.50	pan only	No (< 5 m)	No, 3.2 m (PL test)
Formosat-2	2.00	pan+ms	No (< 5 m)	No? (to be tested)
Theos	2/15	pan+ms	No (< 5 m)	No? (to be tested)

The 2012 VHR menu can be found here:

See VHR Imagery Specifications for the CwRS Programme for more information on the image acquisition process [1]])

Notes:

1. ? the information content (resolution, radiometry, etc.) of the VHR sensor (including the back up sensor) should be sufficient to ensure proper parcel identification
2. ? Usually a 6-8 week window is defined, but the window may be longer if this fits the MS control requirements

87 Workflow of CwRS

The basic process outline - or process flow - can be summarised as follows:

Perform Risk Analysis

Start 202

Selection of Risk-Based Sample

Selection of the GAEC sample

Random Selection

CwRS OR Classical Field Inspections

CwRS

No CwRS

FlowFinal

Definition of Contr Zones

Selection of OTS(sample inside the zone

Preparation of Inspection Plan

Delivery of Control zones by Risk analysis unit of PA to JRC

Request for imagery by JRC to image provider

Satellite acquisition

Delivery of Satellite Data and methodological support by JRC

Control with Remote Sensing (CwRS)

Data preparation and diagnostics

Image processing

GCP Collection

Orthorectification

Ancillary Data preparation (DEM; reference projection)

Quality Control

Image Enhancement

Ground Truth Collection

CAPI

Categorization

No

Parcels difficult to Interpret

Yes

Rapid Field Visits (RFV)

Location of the postition using GPS and Maps

Location of reference parcel

Identification of the parcel limits

Verification of the land use

Check for agry environmental measures (examples)

Check for specific landscape (and historical) protected areas

Check bird locations in grassland

Check for row crops on fields with slope higher than 12%

Check for encroachment of unwanted vegetation on agriculture land

Second categorization of declarations using the results of RFV
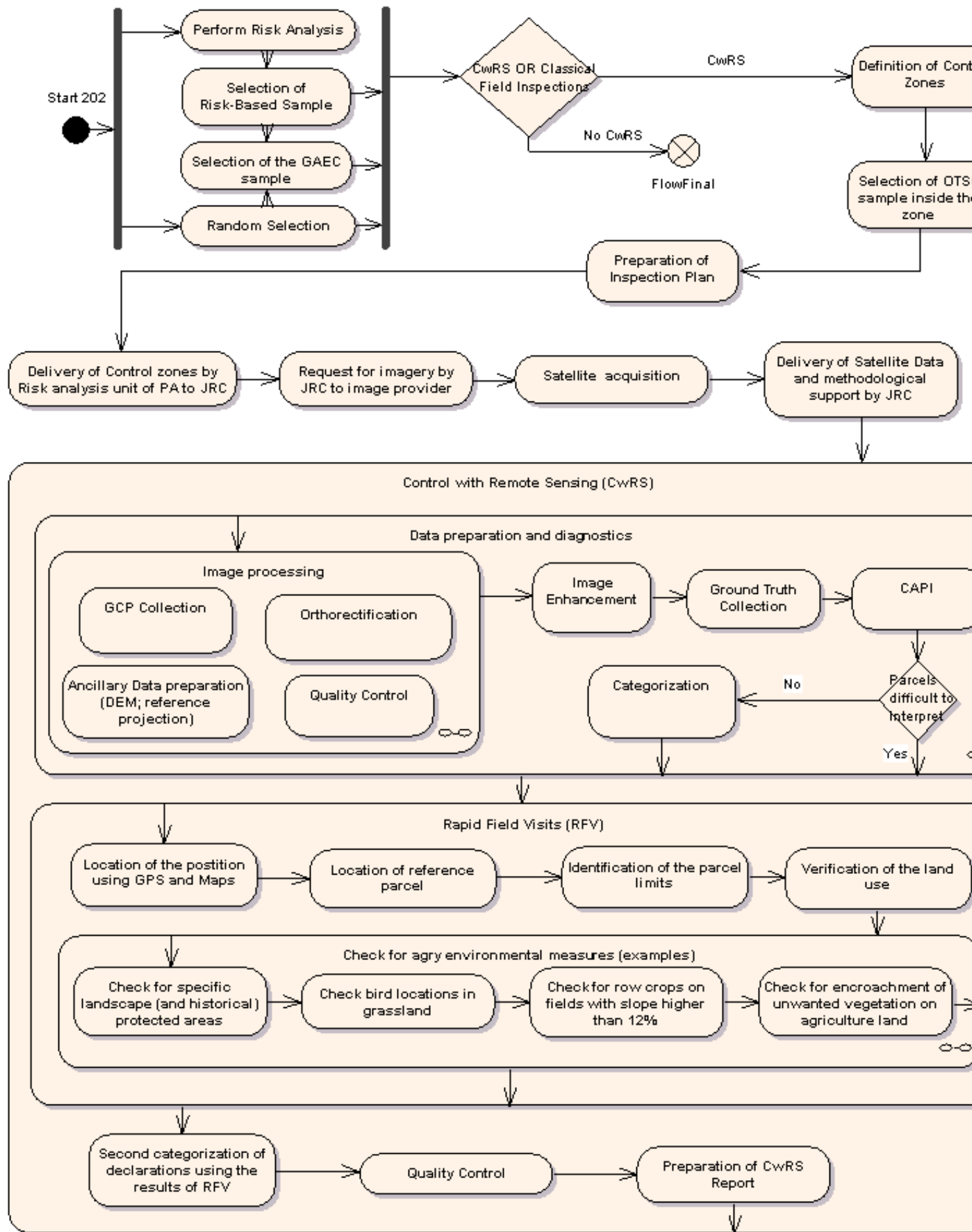
Quality Control

Preparation of CwRS Report

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Fig.1 CwRS Workflow: UML Activity Diagram