
JRC Scientific and Technical Reports

HR Image Specifications for the CwRS Programme Campaign 2009

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EUR 23993 EN - 2009

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JRC 53184

EUR 23993 EN
ISSN 1018-5593

Luxembourg: Office for Official Publications of the European Communities

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Printed in Italy



Specifications

HR Image Specifications for the CwRS Programme

Campaign 2009

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Co-author: Pär Åstrand	Circulation: Internal/Commission, Image providers, MS Administrations, CwRS Contractors, Public
Approved: Pär Åstrand	
Date: 03/04/2009, 20/06/2009	Int. ref: file://S:\FMPArchive\C\10621.doc

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Document History

Version	Date	Comment	Author	Modified Pages
1.0	01/03/2008 01/05/2008	1 st release; information taken from CTS FMP 8451 (chapters 4, 4.3, 4.4, 4.6), Recs 1 FMP 5608 (chapters 2.4, 2.5, 5, 6), Recs 2 FMP 7658 (chapters 2.3), Selection of Control sites and Risk Analysis FMP 8218 (chapter 2.4), Geom. Guidelines FMP 2402 and from Ref. 3: VHR Image Specifications for the CwRS Programme	ME, PA	
1.1	30/05/2008	Final version after draft revision deadline 30/05/2008	ME, SPOT	
1.2	02/04/2009	2009 Campaign update, introduction of Rapideye	ME, Rapideye	
1.3	20/06/2009	Final review; edits Fig. 2, Introduction of RE Fig. 4, and completion of text for RE.	PA	

1. Introduction

1.1. HR Image Acquisition for the CwRS Project

- 1.1.1. Since 1993, DG AGRI has promoted the use of “Controls with Remote Sensing” (CwRS) as an appropriate control system suitable to check if aids are granted correctly. On the basis of the Council Regulation (EC) 165/94 and of the Commission Regulation (EC) 601/94, the Commission Services are required to centralize the acquisition of satellite images. This task was transferred to DG JRC in 1999 (ref.17 September 1998/VI/34942). This is managed through a sub-delegation of signatures by DG AGRI to DG JRC.
- 1.1.2. HR imagery may be used in the CwRS Programme (in addition to VHR imagery) for crop, and/or land use identification. A series of images over the control zone suitably acquired during the crop cycle is supplied to the MS Administration or their contractors by the EC Services in order for them to fulfil their area-based subsidy control in accordance with EC Regulation [Ref 1]. The control methods are further described in the Common Technical Specifications for the 2009 Campaign of Remote-Sensing Control of area-based subsidies [Ref 2]

1.2. Objectives and structure of document

- 1.2.1. This document constitutes the specifications for HR imagery to be used within the CwRS Programme. Its objective is to give the stakeholders¹ in the image acquisition management chain clarity in the technical details of the process. This document is available on the EC, JRC, Institute for the Protection and Security of the Citizen (IPSC), Agriculture Unit, Community Image Data portal (CID) webzone at: <http://mars.jrc.it/> (or directly <http://cid.jrc.it/image-acquisition/>)
- 1.2.2. Reference is made to the Common Technical Specifications (CTS) for the Remote Sensing Controls of area-based subsidies [Ref 2]. Reference is also made to the WikiCAP [Ref 4] for further recommendations.
- 1.2.3. Reference is also made to the VHR Image Specifications for the CwRS Programme [Ref 3] which should be should be used in conjunction with present document.

¹ stakeholders, or actors = JRC, Image Provider, Administration/Contractor performing the CwRS

1.2.4. Reference is also made to the terms and conditions of the satellite remote sensing (SRS) data Framework Contracts (FCs) for image procurement to the EC Services signed with image providers². [Ref 5]

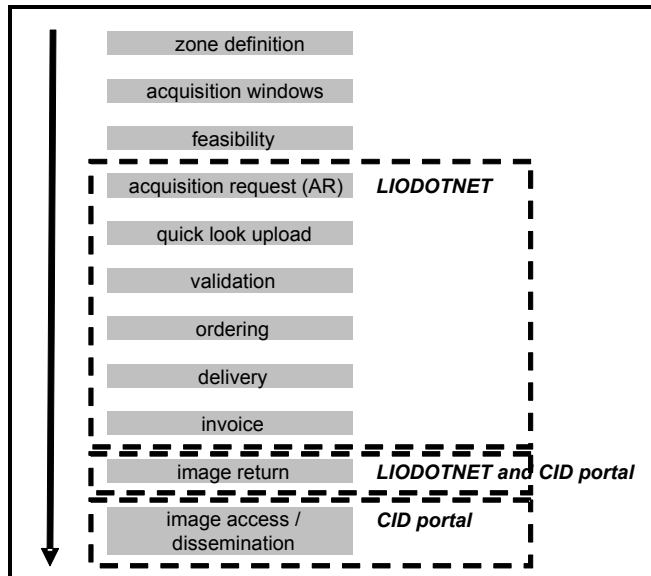


Figure 1 - Figure showing structure of document and image acquisition process flow

2. Zone Definition

2.1. General

2.1.1. General principles and Regulatory basis for selecting the zones to be checked by Remote Sensing are laid down in Commission Regulation (EC) No. 796/2004 [Ref.1]. These are further described in the Common Technical Specifications for the Remote Sensing Controls of area-based subsidies [Ref. 2]. The WikiCAP website [Ref. 4] on “selection of control zones” recommends that “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 acquisition”. These technical constraints, further detailed below, include: footprints, programming options, swath widths, elevation angles, AOI definition, window adjustments, feasibility assessment etc.

2.1.2. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3] regarding the definition of a CwRS zone (or Area of Interest; AOI).

² A new ITT covering the period 2010 to 2013 will be launched during spring 2009.

2.1.3. In general, all HR control zones are programmed for all sensors on a competitive “first come, first served” basis. MS can request to exclude sensors without the SWIR (SPOT2) (if needed for crop recognition) or sensors with a lower resolution (in case of small parcel sizes).

2.1.4. All zones’ definition parameters should be defined by MS administration in conjunction with the EC SERVICES and delivered to image providers before campaign start. Relevant zone definition parameters are:

- Member State
- Zone name
- Sensor restrictions (e.g. exclusion of SP2)
- HR window(s) (start date, length and dead period from acquisition to the next window opening)
- Delivery: DVD or FTP
- Shapefile; files with extensions .shp, .shx, .dbf, .sbx, .sbn, .prj (one shapefile / zone)

2.1.5. The table below summarises the main characteristics and capacity for the sensors used for HR image acquisition.

HR Sensor	Products	GSD [m]	Swath width (at nadir)	Approx capacity [scenes or km2] in a 1st come 1st served scenario; mean "winners" plus "losers"	Proposed role	Comments / Constraints
SPOT 2	MSP 3 bands (no SWIR)	20	60	160 ; plus approx 70 ; sum 230	autumn, winter, HR ₁ , HR ₊₁ , HR ₊₂	Old - launched on jan. 22, 1990;
SPOT 4	MSP 4 bands (incl. SWIR)	20	60	210 ; plus approx 80 ; sum 290	autumn, winter, HR ₁ , HR ₊₁ , HR ₊₂	
SPOT 5	MSP 4 bands (incl. SWIR)	10	60	200 ; plus approx. 50 ; sum 250	autumn, winter, HR ₁ , HR ₊₁ , HR _{VHR}	acquisition of SPS PAN and SPOT 5 MSP is possible in same pass
IRS P6	MSP 4 bands (incl SWIR)	23,5	127 - 141	40 ; plus approx. 50 ; sum 90	autumn, winter, HR ₁ , HR ₊₁ , HR ₊₂	
Landsat 5	MSP 7 bands	30	183	25	autumn, winter, HR ₁ , HR ₊₁ , HR ₊₂	
F2	MSP 4 bands (incl. BLUE)	8	24	10000 km2 ; approx 15 scenes / window gives approx. 45	HR _{VHR}	capacity depends on off-nadir angle ; fixed orbits means that some areas are never covered ; capacity should be seen
DMC	MSP 3 bands (Landsat 2,3,4 like)	32	325	5 ; plus approx. 5 ; sum 10	autumn, winter, HR ₁ , HR ₊₁ , HR ₊₂	upon request by MS
ALOS - AVNIR	MSP 4 bands (incl. BLUE)	10	70	unknown	HR - archive searches	presently not used
SUM				940		

Figure 2 - The High Resolution (HR) Sensors menu

2.1.6. From above table extrapolated from earlier Campaigns it can be deduced that the technical capacity of the available HR satellites is not a constraint for a normal Campaign of 500-600 images.

2.1.7. The swath of the HR satellite sensors is usually not a constraint either since scene extents are significantly larger than the control zones. In fact, each HR control zone is normally covered by one scene. In the rare case that the zone is too big to be covered by one scene, it will be divided into more sub-zones.

2.1.8. 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 sensor footprints depend on the respective satellite orbits. For most sensors, it is however possible to compose an image from two pieces of successive images frames along the orbit (“shift along track” or “SAT”). The footprint can therefore be moved along the track towards the North or the South (Figure 3).

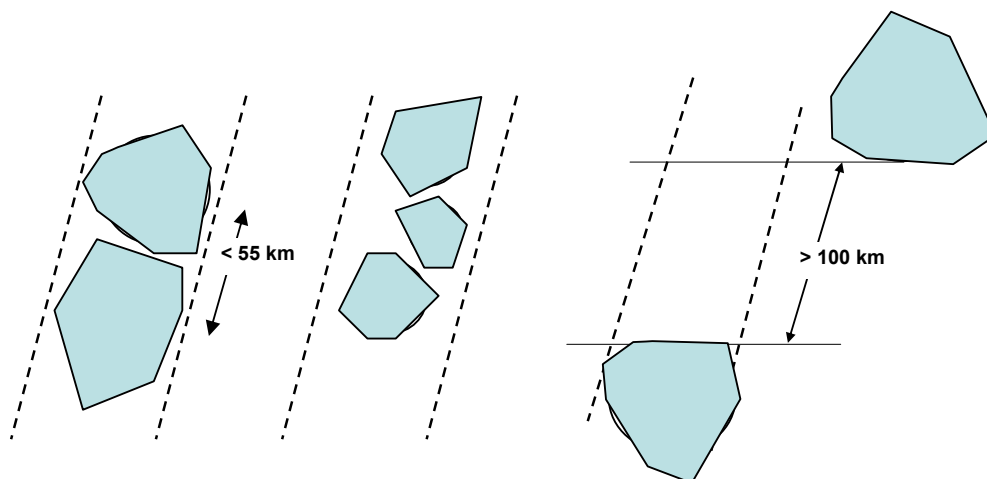


Figure 3 - Examples of control zone configuration and location constraints

Case a: Example of two control zones which are “contiguous”: a single programming fee is due in this case

Case b: Same case, for three contiguous control zones

Case c: Non-aligned zones: programming will be more difficult in the same satellite pass if the distance between the sites is less than 100 km (SPOT case).

2.2. The SPOT zone

2.2.1. In order to maximize the ability to provide images for a high number of zones, the Commission and SPOTIMAGE have agreed upon the concept of “contiguous” zones. If possible zone selection should adhere to this concept. Zones should therefore be less than 55 km apart and preferably aligned to the same SPOT path. The image acquisition windows for “contiguous” sites must be opened on the same date. Such programming allows the EC services to make a sound financial management since only one programming fee is due.

2.3. The IRS P6 control zone

2.3.1. The above logic to placing zones in a 60-70 km wide corridor also fits with the IRS-P6 nominal coverage; especially in areas above Lat. 43.5° where this could double the frequency of IRS since it would allow use of the overlap area of the passes. The nominal coverage for P6 are available at http://www.euromap.de/products/prod_029.html

2.4. The RapidEye control zone

2.4.1. RE consists of 5 small satellites built by SSTL (UK). They were launched on 29 August 2008. They have 6.5 m GSD @ nadir, 5 MS bands, and the swath is 77 Km.

2.4.2. With 5 satellites RE has daily revisit on the whole world, which fits very well to the CwRS scenario. However, being less agile, the off-nadir view angle is set only once per orbit which reduces collection capacity/orbit. The total capacity and the capacity to collect 1 complete zone / orbit, remains to be proven. The satellites will be introduced during campaign 2009.

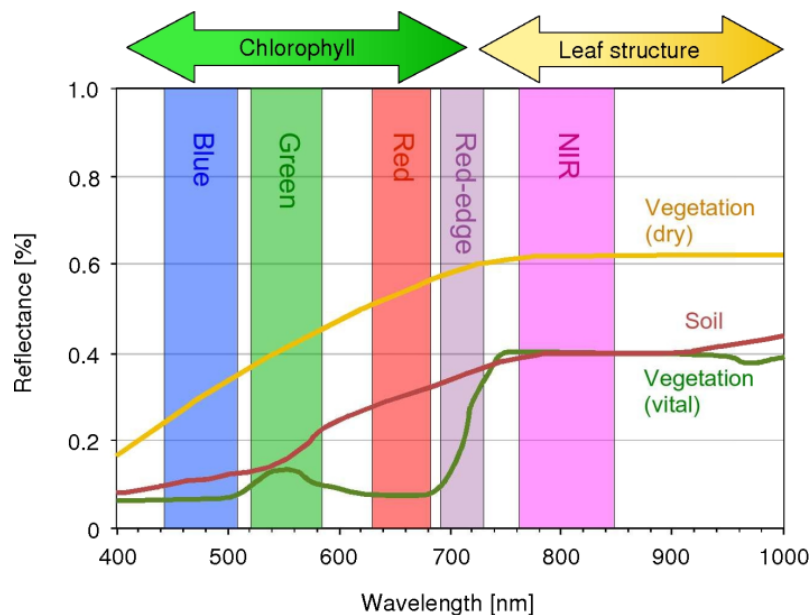


Figure 4 -The 5 MSP bands of RapidEye

3. Acquisition Windows

3.1.1. For HR optical imagery, “acquisition windows” and “dead periods” (separating acquisition windows) will be agreed between the Administration/Contractor and the Commission. The acquisition windows are calendar periods during which the HR satellites are programmed and are in competition to acquire data. There are, in the general case of multi-spectral HR images, two or three windows during crop season (more windows may be defined in accordance with the Commission if cross-compliance and GAEC issues are to be controlled by Remote Sensing).

3.1.2. For autumn or winter HR images or images in the beginning of the spring, the Commission suggests acquisition only if the sun angle is higher than 20 degrees, in order to ensure sufficient contrast and to minimize the effect of shadows cast.

- 3.1.3. When an optical HR image has been acquired for a given acquisition window, the window will be closed. The opening of the next window will be defined by taking the dead period into account. The dead period must be a minimum of 2 weeks.
- 3.1.4. The HR windows are named as follows: autumn/winter; HR-1; HR+1; and HR+2. The names of the HR windows are named as to indicate their relative position to the VHR window (satellite or aerial VHR). HR-1 opens before the VHR and is open at maximum until the opening date of the VHR window. HR+1 opens after the VHR window and its opening date is defined by adding the dead period defined by the MS to the acquisition date of the satellite or aerial VHR image. MS have the possibility to add an earliest possible starting date of the windows following the VHR window. Finally the HR+2 window opens after HR+1 and is defined by adding the dead period to the date of acquisition of the HR+1 image. In case of aerial VHR it is important that the MS inform the EC services of the acquisition date to be able to define the starting date of the HR+1 window.
- 3.1.5. The window lengths are a minimum of 2 weeks, but preferably 3-4 weeks.
- 3.1.6. For a window change due to climate conditions, please refer to the VHR Image Specifications for the CwRS Programme [Ref. 3].
- 3.1.7. If no image has been acquired at the end of the window, the HR-1 can be extended maximum until the opening of the VHR window (or if not applicable; the start date of the aerial photography flight). HR+1 and HR+2 will be extended until the image has been acquired or until the contractor indicates that the acquisition request should be failed.
- 3.1.8. If the VHR image is acquired late, the contractor may request an archive search for a suitable HR image acquired during the first part of the VHR window. To increase the chances of finding something in the archive, the Commission will inform the HR image providers of the VHR windows to enable them to target these zones if there is free satellite capacity.
- 3.1.9. If the control zone has VHR backup planned and this backup is only panchromatic, an extra HR image will be programmed over the VHR window. For further information refer to the VHR Image Specifications for the CwRS Programme [Ref. 3].

4. Feasibility

- 4.1.1. The Image providers will receive a list of zones, the windows planned and the corresponding shapefiles before campaign start.
- 4.1.2. Image providers will also receive the information on the dates of the VHR windows if they wish to acquire data for the archive.

- 4.1.3. Image providers (IP) are to indicate contiguous zones within 2 weeks of receiving the planning to the EC Services in order to arrange for best programming possibility. Also, Acquisition Requests (ARs) will be opened for both full and duplo scenes and IP³ are to upload all suitable images.

5. Acquisition Requests

- 5.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3] regarding LIODOTNET handling and relevant messaging triggered.
- 5.1.2. One Acquisition Request (AR) is published per sensor and is open until midnight on the same day as the 1st competing sensor uploads validated imagery.
- 5.1.3. In accordance with the IPs (SPOTImage) the ARs are published with priority (red) programming in northern Europe to obtain the best acquisition results. Southern Europe is programmed with standard (blue) programming.

6. QL (Browse Image) Upload

- 6.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3] regarding quicklook (QL) upload, and relevant messaging triggered. All georeferenced Quicklooks can be uploaded via LIODOTNET⁴ into the CID QL Browser. Non-georeferenced QLs (L5, IRS, DMC) are uploaded only as viewable QL in LIODOTNET.
- 6.1.2. Contrary to VHR image acquisition, the haze flag is not used for HR imagery.

7. Validation

- 7.1.1. The evaluation of the quality of an image (cloud cover, haze, snow etc.) always refers to the Area Of Interest (AOI) as defined by the shapefiles.
- 7.1.2. For each HR zone and each open window, the first optical image (SPOT, Landsat, IRS, or DMC) notified by a supplier with less than 1% cloud cover is “validated”, ordered by the Commission and delivered to the contractors, who are notified through LIODOTNET. The window is then closed.
- 7.1.3. If the HR area of interest contains more than 1% cloud cover, dense haze etc., then:
- If cloud cover is between 1 & 5%: the image is “proposed”, a quick-look is uploaded in LIODOTNET, and according to the case (depending on the satellite programming load) the programming is stopped or not. The contractor needs to accept or reject the image within a

³ Relevant in the case of IRS, and Landsat5

⁴ LIODOTNET = Live Image Ordering system developed within Microsoft .NET domain

maximum of 3 days, thus allowing the Commission to order the image and close the window, or to continue programming if the image is not suitable.

- If cloud cover is between 5 & 20% cloud cover: the image is “retained” for future assessment, Quick-looks of all images acquired are uploaded in order to allow the contractor to select a suitable image at any time if no “validated image” is available.
- More than 20% of cloud cover: in principle, it is not foreseen that image providers send Quick-looks in such cases. Only upon request of the EC services, such QL’s may be uploaded (e.g. when a window is coming to an end without a validated acquisition).

7.1.4. In the case of several validated images uploaded the same day, the contractor chooses the most suitable image. The EC Services have the final decision.

8. Ordering

8.1.1. Ordering of all imagery will be made using the EC Services’ LIODOTNET system; the order is scanned and sent to the Image Provider in digital form. The order contains all relevant acquisition details including:

- European Commission - Joint Research Centre (JRC), Institute for the Protection and Security of the Citizen, IPSC order #, Acquisition Request ID (ARid) for each image.
- HR: country, zone, period, state, acquisition date, elevation angle, product, cloud cover, where applicable (shift, custom id, path, row, etc.), delivery media
- delivery address
- any other order parameters according to Chapter 12 Products.

8.1.2. An order letter is prepared for imagery acquired over all zones with the same contractor and period of acquisition. In the peak season the order letter is prepared within 2 working days of the image being accepted. During the autumn/winter windows one order per IP/Contractor/window will be prepared to reduce administration.

8.1.3. When the contractor has not been named the order will be pending or the imagery will be delivered to the National Administration. It is of the utmost importance that the MS communicate the name and contact details of the contractors as soon as they are appointed.

9. Delivery

9.1.1. The contractual delivery period (production, internal QC, and ex-works availability) agreed with the EC services from the date of ordering are 6 working days for HR data.

9.1.2. Images (after validation according to procedure in § 7) are delivered directly to contractor after having passed through the internal Quality Control (QC) of the IP.

- 9.1.3. The contractor receives a delivery note through LIODOTNET as soon as the product is shipped by the image provider. Data delivered by ftp is available during 40 **(8)** working days and the contractors who have requested delivery via ftp must ensure that the data is downloaded during this time frame.
- 9.1.4. Reference is made to the VHR Image Specifications for the CwRS Programme chapter 9.1.7 [Ref. 3] regarding the receipt of imagery and completing the IDQA.

10. Invoicing

- 10.1.1. Pricing for products will be according to Framework Contracts (FC) stipulated with the 4 Image Providers; Eurimage for Landsat imagery, SPOTImage for SPOT imagery, Euomap for IRS imagery, and DMCii for DMC imagery.
- 10.1.2. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3] regarding details on invoicing.

11. Image Data Return

- 11.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3] regarding details on Image Data Return and Image Data Access
- 11.1.2. It should be mentioned that the EC Service purchases a right to the use of the images, but not the copyright, which remains the property of the image providers. If use of imagery is allowed {Ref 3} the following references must be quoted, according to the case:
- ✓ SPOT: "Distributed by SPOTImage, © CNES [year of the image]"
 - ✓ Landsat TM: "Distributed by EURIMAGE S.p.A. (© ESA), year of the image]"
 - ✓ IRS: "Original data provided by EUROMAP GmbH, © Antrix [year of the image]"
 - ✓ DMC – DMCii (to be confirmed)
 - ✓ **RapidEye: "Original data provided by RapidEye AG, © RapidEye [year of the image]"**.

12. Products

- 12.1.1. Landsat:
- Programming level: 0 / 1G
 - Format: FAST / CEOS
 - Resampling: NN / CC
- 12.1.2. SPOT:
- Preprocessing: 1A / 2A
 - Format SPOT2, 4: CEOS (BIL) / DIMAP

- Format SPOT5: DIMAP
- Resampling: NN / CC

12.1.3. IRS:

- Preprocessing: RC / SC
- Format: SS / FAST
- Resampling: NN / CC
- Orientation: Map / Path
- The default recommended by the image provider for IRS P6 data is SuperStructure format, UTM WGS84, CC & Ortho-kit with RPC-file.

12.1.4. DMC: The data is available in two processing formats; L1R band registered and L1T orthorectified. Since it has been shown that polynomial or projective transform does not give sufficient accuracy in geometric correction, and the DMC orbit model is only used in certain specific sw suites (e.g. Keystone SIP Ortho) it has been decided to deliver the DMC data to the contractor orthorectified. Such orthorectification is performed using existing ancillary data by image provider [DEM 1km, Landsat data as reference (and GCPs)] so no DEM and no GCPs are required. Therefore the EC Services will deliver the L1T orthorectified level data, in format GeoTIFF with DIMAP metadata.

12.1.5. RapidEye

- The standard image products come in three processing levels: 1B – Basic, 2A- geocorrected product and 3A – Orthorectified.
- **Level 1B must be orthorectified by contractor (few SW suites presently support the RE sensor model why this format will be used restrictively and upon request only for campaign 2009)**
- **Orthorectification will in most cases therefore be performed by RE making use of a semi-automatic orthorectification approach using the Landsat Global Mosaic as reference (2-7 GCPs per scene), and SRTM-3 90m (GTOPO30 for areas above 60 degrees North) as DEM. EC Services have concluded that delivery of the 3A product (approx. rmse 20m rmse) requires only a subsequent shift (0 order polynomial) to reach sub pixel accuracies.**
- File Format: 2A and 3A - GeoTIFF
- Size/Orientation: 2A and 3A – 25km x25km, North facing tile
- Resampling CC

12.1.6. For a complete description of image processing levels and data formats, please consult the technical documentation of the image providers.

12.1.7. All data delivered to the contractors goes into the CID portal. Semiautomatic orthorectified data is available for download upon request.

13. Quality Assurance / Quality Control

13.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3].

14. Risk of Satellite Failure

14.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3].

15. Responsibles and email addresses

15.1.1. Reference is made to the VHR Image Specifications for the CwRS Programme [Ref. 3].

16. References

- 1) Commission regulation (EC) No. 796/2004 of 21 April, 2004 laying down detailed rules for the implementation on cross-compliance, modulation and IACS provided for in the Council Regulation (EC) No. 1782/2003 establishing rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers.
- 2) European Commission (2008); Common Technical Specifications announced in ITT no. 2008/S 228-302473 (22 November 2008); JRC IPSC/G03/P/HKE/hke D(2008)(10021)
- 3) VHR Image Specifications for the CwRS Programme - 2008 Campaign [Ref JRC IPSC/G03/C/PAR/D(2009)(10617)]
- 4) WikiCAP: <http://marswiki.jrc.ec.europa.eu/wikicap/index.php> (requires user/password). This wiki allows access to information concerning former documents; Selection of Control Zones and Risk Analysis - Draft Guidance Document [JRC IPSC/G03/P/HKE/hke D(2007)(8218)], European Commission (2003), Guidelines for Best Practice and Quality Checking of Ortho Imagery. [Ref. JRC IPSC/G03/P/SKA/ska D(2003)(2402) Issue 2.6, which will not be revised after version dated 11/05/2007], and indeed also to [Ref 2] above.
- 5) The satellite remote sensing (SRS) data Framework Contracts (FCs) for image procurement to the EC Services signed with image providers EURIMAGE (# 251.537 for Landsat5), SPOTIMAGE (# 251.603 for SPOT2, SPOT4 and SPOT5), EUROMAP (# 251.502 for IRS P6), DMCii (# 251.490 for DMC) and any specific ad hoc agreements on top of these FCs valid for the CwRS programme.

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European Commission

EUR 23993 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: HR Image Specifications for the CwRS Programme Campaign 2009

Author(s): Maria Erlandsson, Pär Johan Åstrand

Luxembourg: Office for Official Publications of the European Communities

2009 – 18 pp. – 21 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1018-5593

Abstract

This document constitutes the specifications for VHR imagery to be used within the CwRS Programme. Its objective is to give the stakeholders¹ in the image acquisition management chain clarity in the technical details of the process and describes the process flow starting from zone definition, through the image use, reaching image return and possible re-use of imagery at end of Campaign

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