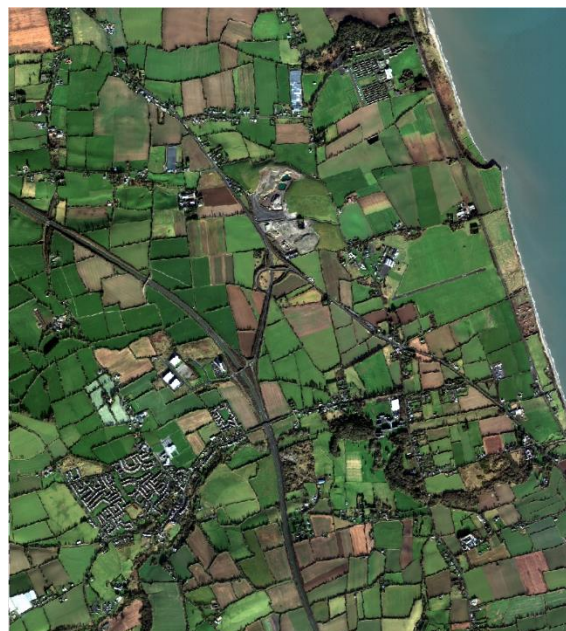JRC TECHNICAL REPORT

VHR Image Acquisition Campaign 2020

Technical guidance for CwRS and for the LPIS QA

ÅSTRAND P.J., VAJSOVA B., BREUNIG J.,
LEMAJIC S., WALCZYNSKA A., HAIN S.,
KORNHOFF A, RANKL M., FLINGELLI T.

2020

WorldView-4 data, © EUSI/Digital Globe™, 2017

Joint Research Centre

Author:	Pär Johan ÅSTRAND	*Status:*	**V.10.9**	
Co-authors:	Blanka VAJSOVA, , Jürgen BREUNIG, Slavko LEMAJIC	*Circulation:*	Internal/Commission, MS administrations and their contractors, FW contractors	
	Agnieszka WALCZYNSKA, Susanne HAIN, Ansgar KORNHOFF, Melanie RANKL, Tine FLINGELLI			
Approved:	Pär Johan ÅSTRAND			
Date:	17/03/2020	*Int. ref:*	\\139.191.148.210\D5_capland\Projects\CAPISA_WP1\2019\Image_Acquistion_FWC_Deliverables\VHR\D.3.1_VHR_Specifications	

Table of Contents:

List of Figures

List of Tables

Document history

1.0	01/05/2008	First release includes updates of 2007 specifications (FMP 7528) incorporating exclusion of OrbView3, changes to EROSB, changes to Formosat2, inclusion of WorldView1, backup procedure changes, image return, etc.	PA, ME, image providers
1.1	30/05/2008	Final version after draft revision deadline 30/05/08	PA
1.2	12/03/2009	Updates on GeoEye-1	Image providers
1.31	23/03/2009, 02/04/2009, 22/06/2009	Administrative routines, image return, change on EROS B and SPOT backup; Final check, minor corrections on image return, and GE1 sw suites	PA, ME, CA PA
2.0	01/05/2010	New edits 2010: WV1, WV2, copyrights	EUSI, PA
3.0-3.1	10/02/2011, 25/02/2011	Update of document for the 2011 Campaign: introduction of auto-backup; introduction of new backup approach; elevation angle restrictions; introduction of 2010 year's edits including WV2 (ref. doc. JRC IPSC/G03/C/PAR/par (2010)(11936)); introduction of the THEOS sensor; invoicing issues; other miscellaneous issues (e.g. sensor formats, zones: no 500/5 km rule on shapes); all edits in RED	PA
3.2	05/03/2011	Further updates according to EG, BW (minor clarifications, and edit to pricing issue), updates on LioDotNet by EG (e.g. upload with shapefile, plus minor other changes); introduction of checksum by image providers and contractors to be able to check correct image data delivery by FTP (AB)	EG, BV, SG, AB
3.3	13/03/2011	Clarifications on data return, introduction of functional e-mail LioDotNet, ref. THEOS FWC no., and THEOS products, elevation angle clarifications, clarifications upon EUSI input 10/3/2011 (e.g. inserted WV2 tiling options, deleted minimum width of an area of interest (AOI), clarification on feasibility iterations, and references on benchmarks inserted)	PA
3.31	17/03/2011	Grammatical edits and minor clarification on elevation angle and image data access	CA, PA
3.32	04/04/2011	Accept of image providers: EUSI (no further input); e-GEOS (minor corrections allowing panchromatic (PAN) to be prime upon Member State's (MS's) request with possible additional high resolution (HR)/very high resolution (VHR) if requested); renumbering of erroneously numbered chapters	MW, BB, RN, (image providers)
4.0	20/10/2011	New version for 2012 and future: constellation tasking, feasibility categories; elevation angle thresholds for LPIS QA and for hilly/mountainous control zones; no dedicated VHR backup; tiling; LioDotNet upgrades on zone definition parameters and on ordering. Moreover, some chapters have been rearranged to avoid repetitions (e.g. the sensor zone description chapter has been moved to be with the sensor product description)	PA
4.1	21/11/2011	Introduction of Constellation WV2 and WV1; update on chapter on feasibility; updates on F2, The3os products	PA, BB, MW
4.2	16/12/2011	Inputs after Tallinn Conference November 2011; e-GEOS (elevation angle typo, on copyright text, GE1 specs, IK2 specs); EUSI (recommendation is to keep shapes simple but no compulsory limit; QB may be chosen as prime; QB tiling)	PA, AO, ES
4.3	26/10/2012	Updates on unit name; introduction of the new VHR sensor – Pleiades (PL1); updates on zone parameters; updates on speculative backup; updates on licensing text	EG, BV, PA

5.0	10/02/2013	Rework of document to fit the framework contract for supply of satellite remote sensing (SRS) data and associated services in support to checks within the Common Agricultural Policy (CAP) – VHR sensor-independent profile	PA
5.1	26/03/2013	Edits after CID-IAT, and AB input on 5.0: roles of stakeholders; other edits on zone parameters, acquisition windows (AWs), feasibility, delivery image data return, and VHR profile sensors	PA, EG, BV, ISM, AB
5.2	26/06/2013	Corrections for LioDotNet, and final review before outsource tendering	CW, SG, PA, CD
6.0	03/02/2014	Corrections for changes due to the upgrade of LioDotNet to G-LIO.NET	GDM, PA
6.1	10/02/2014	Minor edits on delivery notes and finalisation of the document	GDM, PA, ISM
6.2	20/02/2014	Various edits and comments by FWC VHR profile EUSI	EUSI (ES, SO, AK, MW)
7.0	16/03/2014	Finalisation of Campaign 2014 specification	PA
7.1	29/09/2014	Draft for improved VHR specifications 2015	EUSI
7.2	15/11/2014	Check, acceptance and insertion of certain elements regarding iteration of specified area/shapefile/corrections; update of profiles, and complete check of document for the 2015 Campaign	Joint Research Centre (JRC) (PA, JB, GDM, BV, CW)
7.3	01/12/2014	Update of image return (provision to the JRC)	JRC (PA, JB)
7.5	17/12/2014	Update of feasibility assessment (EUSI); update of profiles (JRC)	EUSI/JRC (PA, JB, GDM, BV, CW)
7.6	30/09/2015	Updates by EUSI for Campaign 2015	EUSI
7.7	06/10/2015	Updates for the use of G^4CAP; smaller textual edits	JRC (GDM)
7.8	21/11/2015	Updates by the JRC after meeting with EUSI (12/10/2015) and AB(29/10/2015)	JRC (PA, JB, GDM, BV, CW)
8.0	29/02/2016	Final version after MS administrations and their contractors input and LPIS A5 issue update (section 12.1.3 and Table 1, p. 28)	JRC (PA, JB, GDM, BV, CW)
8.1	15/03/2016	Final version after EUSI input on above, and on percentage of A5/A2 (section 4.1.7–8); JRC edits in dense haze flag (becomes dense haze/snow/flood flag or MeteoFlag section 7.1.8)	JRC (PA, JB, GDM, BV, CW)/EUSI
9.0	14/11/2016	JRC draft after input from EUSI as of Del. D.3.1 (17/10/2016)	JRC (PA, JB, GDM, BV, CW)
9.1	13/03/2017	JRC final check, and edits on, for example, feasibility and profiles	JRC (PA, JB, GDM, BV, CW)
9.3	29/03/2017	Delete column root mean square error to be proven in benchmark (Table 1); and error in section 12.1.4: 75 cm. Finalisation of feasibility section after having concluded FEASIBILITY module development in G^4CAP	JRC (PA, JB, GDM, BV, CW)
9.4	17/10/2017	Added details on buffers around zones; AComp possibility; procedure with an exchange of letters; pre-image request chapter; LPIS QA separate chapter; image return (source) Update of profile characteristics, zone and AW parameters; link to Digital Globe's archive; copyrights (WV4 added, EROS B deleted); references (WV4 and S2B added); XML metadata file structure	JRC (PA, JB, GDM, BV, CW)/EUSI
9.5	13/11/2017	LPIS chapter updated; invoice chapter updated	JRC (SL, PA, GDM, CW, BV)
9.51	05/01/2018	Final update of section 4.1.13 on feasibility classes; removal of suggested additional input percentage and reduction of class 2	JRC (PA, GDM, BV, SL)

		(medium, yellow) to 70%; final update of LPIS chapter	
10.0	01/03/2018	Proof read final	JRC proof read service, checked by JRC staff (SL, PA, GDM, CW, BV)
10.1	through campaign	Updates regarding LPIS, IDQA, proposed/backup use, …	SL, JB, PA, BV, GDM
10.2	01/10/2018	EUSI updates after 2018 Campaign	AW, EUSI team
10.3	03/12/2018	JRC revision after Dubrovnik, 2018; sentence in feasibility chapter; Acquisition acceptance – validation mainly on backup; LPIS chapter clarification	BV, SL, PA
10.4	20/12/2019	LPIS chapter; cleanup of document after EUSI input	EUSI, JRC
10.5	18/01/2019	Edit on item 3.3.16 on 'automatic extension flag'; review LPIS chapter; note on WV4 chapter 15	EUSI, JRC
10.6	27/09/2019	EUSI input: Maxar, K3A, search tool, LPIS …	EUSI
10.7	20/10/2019	JRC: remove yellow, minor updates, K3A, LPIS	JRC
10.8	08/11/2019	Final corrections	JRC
10.9	17/03/2020	3.3.16 and 4.1.13 edited for 'automatic extensions'; and LPIS chapter 16.6.6	JRC

Authors' initials

ACRONYM	FULL NAME	ORGANISATION
AK	Ansgar Kornhoff	EUSI
AW	Agnieszka Walczynska	EUSI
BV	Blanka Vajsova	JRC
CW	Csaba Wirnhardt	JRC
GDM	Giovanni Di Matteo	JRC
JB	Juergen Breunig	JRC
PA	Pär Johan Åstrand	JRC
SL	Slavko Lemajic	JRC
SO	Susanne Hain	EUSI
TF	Tine Flingelli	EUSI

Abbreviations, acronyms and terms

AComp	Atmospheric Compensation algorithm
AOI	Area of interest (e.g. a control zone)
AR	Acquisition request; a *closed AR* is an AR that has one of the following statuses: Accepted/Full, Accepted/Partial or Failed
(AR) ID	Identifier of an acquisition request
AW	Acquisition window
CAP	Common Agricultural Policy
CAPI	Computer-assisted photo interpretation
CC	Cloud cover
Contractor	A contractor of the MS administration responsible for the CAP subsidy diagnosis of the MS using the SRS imagery; not to be confused with the successful tenderer (ST) of the framework contract (FWC) signed in [1]
CTS	Common technical specifications
CwRS	Control with Remote Sensing
DEM	Digital elevation model
DG AGRI	Directorate-General for Agriculture and Rural Development
DRA	Dynamic range adjustment
EC	European Commission
ECA	European Court of Auditors
EFA	Ecological Focus Area
EPSG	European Petroleum Survey Group
EU	European Union
EULA	End-user licence agreement
FW contractor	The successful tenderer(s) who has/have been awarded an FWC with the JRC as of [1] – the equivalent of IP (see below)
FWC	Framework contract
G^4CAP	Final evolution of *LIO systems, available from August 2015

GAEC	Good agricultural and environmental condition (CAP cross compliance)
GCP	Ground control point
GIS	Geographic Information System
GSD	Ground sampling distance, the nominal size of one sensor pixel projected onto the imaged surface
HHR	High High Resolution (SRS imagery)
HR	High resolution (SRS imagery) - used also as generic term for high-resolution imagery in this document
IACS	Integrated Administration and Control System (CAP)
IDQA	Input Data Quality Assessment
IES	Institute for Environment and Sustainability, Joint Research Centre
IP	Image Provider, in this document, the successful FW contractor or successful consortium of image providers who signed an FWC with the JRC [1]
JRC	Joint Research Centre of the European Commission
LF	Landscape Feature
LioDotNet, G-LIO.NET, NG-LIO.NET	JRC web-based systems for the management of image acquisitions from 2005 to 2015
LPIS	Land Parcel Identification System
LPIS QA	Land Parcel Identification System Quality Assurance
MARS	Monitoring Agricultural ResourceS
MD5 (md5sum)	MD5 is one in a series of message digest algorithms; md5sum is used to verify the integrity of files, as virtually any change to a file will cause its MD5 hash to change
MS	Member State
MS administrations (or contractors)	MS administrations or appointed contractors of the MS administration responsible for the CAP subsidy diagnosis using the SRS imagery delivered by the JRC
MSP	Multispectral
ONA	Off-Nadir Angle
ORAW	Originally Requested Acquisition Window

OTSC	On-The-Spot Check
PAN	Panchromatic
Pre-IR	Pre-Image Request
PSH	Pansharpened
QA	Quality Assurance
QC	Quality Control
QCR	Quality Control Record
QL	Quick-Look, reduced resolution browse image
RFV	Rapid Field Visit
RMSE	Root mean square error
RP	(Agricultural) Reference Parcel
SC	Specific Contract
SMR	Statutory Management Requirement (CAP Cross Compliance)
SPS	Single Payment Scheme
SMR	Statutory Management Requirement (CAP Cross Compliance)
SRS	Satellite Remote Sensing
SWIR	Short Wavelength InfraRed
UTM	Universal Trasverse Mercator
VHR	Very High Resolution (SRS imagery)
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984

1 Introduction

1.1 VHR image acquisition for the CAP checks programme

1.1.1 Since 1993, the Directorate-General for Agriculture and Rural Development (DG AGRI) has promoted the use of 'Control with Remote Sensing' (CwRS) as an appropriate control system suitable for checking whether or not aid is granted correctly. The legal basis of CwRS is Regulation (EC) 1306/2013 (Article 6(b), 21) and its implementing Regulations No 908/2014 (Article 26), No 809/2014 (Articles 24, 38, 39 and 40) and No 2333/2015 [2].

1.1.2 It should be mentioned that in May 2018, (EU) Regulation was further amended to allow for the introduction of the so called 'checks by monitoring'. In fact, several MS Regions are, according to the recently adopted Article 40a of the implementing regulation (EU) 746/2018 of 18 May 2018 amending the Implementing Regulation (EU) No. 809/2014, opting to introduce an agricultural aid check system based on monitoring. This change will be of importance for the future CAP. The purpose of these specifications is however to describe the rules for the presently used CwRS for the On-The-Spot-Checks (OTSC), and not yet the checks by monitoring [3].

1.1.3 Financing of the CwRS imagery is in accordance with above mentioned Council Regulation (EU) 1306/2013 and Commission Implementation Regulation (EU) 809/2014, 908/2014, where the Commission services are asked to centralize the acquisition of SRS imagery, and their free of charge supply to the MS. This responsibility was transferred to DG JRC in 1998. It is today managed through a co-delegation of signature by DG AGRI (via DG BUDG; internal ref. Ares (2015)1215220) to DG JRC's D.5 Food Security Unit.

1.1.4 Regarding the timing of the operations, Commission Implementing Regulation (EU) No 908/2014, specifies, in Article 26:

   (a) 1.) For the purposes of Article 21 of Regulation (EU) No 1306/2013, each Member State shall inform the Commission by 1 November of each year at the latest, as to: (a) whether it wishes the Commission to acquire the satellite images necessary for its programme of checks and/or for its Land Parcel Identification System Quality Assessment; (b) the area to be checked and the number of planned control zones.

   (b) 2.) Member States requesting the Commission to obtain the satellite images shall finalise, in cooperation with the latter and before 15 January, following the communication of information referred to paragraph 1, the zones to be covered and the timetable for obtaining those images.

1.1.5   Following the real-time evaluation in 2003 and the successful operational application since 2004, the JRC, in agreement with DG AGRI, continues to supply very high-resolution (VHR) SRS imagery to the Member State (MS) administrations for their CwRS for area-based subsidies.

1.1.6   Since 2010, DG AGRI has called for a yearly Land Parcel Identification System Quality Assurance (LPIS QA). Reference is made to the legal basis for the LPIS QA, given in Delegated Regulation (EU) No 640/2014 (Article 6). Specific VHR imagery satisfying the technical LPIS QA recommendations, for example including specific conditions of elevation angle and cloud cover (CC) (see section 13.2), is acquired for this purpose (see section 3.1.2 and [3]).

1.1.7   Since the 2014 Campaign, the detailed management of VHR image acquisition – to cover the correct areas at the correct times of the growing season required for the CAP checks – has passed to industry to carry out within quality specifications managed by the JRC. This choice has been made because there are several suppliers of SRS imagery that have proven competency in supplying the JRC efficiently with the SRS data needed for the CAP checks.

1.1.8   There may be one or more framework (FW) contractors appointed by the contracting authority, the JRC, to perform this task. In these specifications, the image provider (IP) therefore refers to the FW contractor, with which the JRC has signed a framework contract (FWC) [1].

1.2   Objectives, referencing and structure of this document

1.2.1   This document defines the VHR profile-based specifications to be used within the CAP checks programme (CwRS and LPIS QA). Its objective is to give the stakeholders[1] in the image acquisition process clarity in the technical detail, and it describes the process flow starting from zone definition, through image use, to image return and possible re-use of imagery at the end of the Campaign (see Figure 1).

1.2.2   The JRC has an overarching role as responsible for the functioning of the FWCs and for the quality control (QC) of the operations, while most of the interaction necessary within the image acquisition process takes place between the FW contractor and the MS administrations (or contractors) performing the CAP checks. These specifications are intended also to describe these interactions.

1.2.3   This document is available in the 'Documentation' section of the G⁴CAP Web application [4].

---

[1] The stakeholders, or actors, are the JRC, DG AGRI and the FW contractor acting as IPs and operators, and the MS administrations (or their contractor) performing the CAP checks.

1.2.4   Several references are made here to the common technical specifications for the remote sensing controls of area-based subsidies [5], and relevant guidance documents found at the Monitoring Agricultural ResourceS (MARS) WikiCAP [3], to the Guidelines for Best Practice and Quality Checking of Ortho Imagery [6] and to the high-resolution (HR) profile-based specifications [7], which should be used in conjunction with the present document. Reference is also made to the terms and conditions of the FWCs for image procurement with the JRC [1].

1.2.5   Figure 1, shows the overall process of the SRS image acquisition, split into macro-actions and coloured by the function of the type of user responsible for the single macro-action. This document tries to follow the same flow as that shown here.
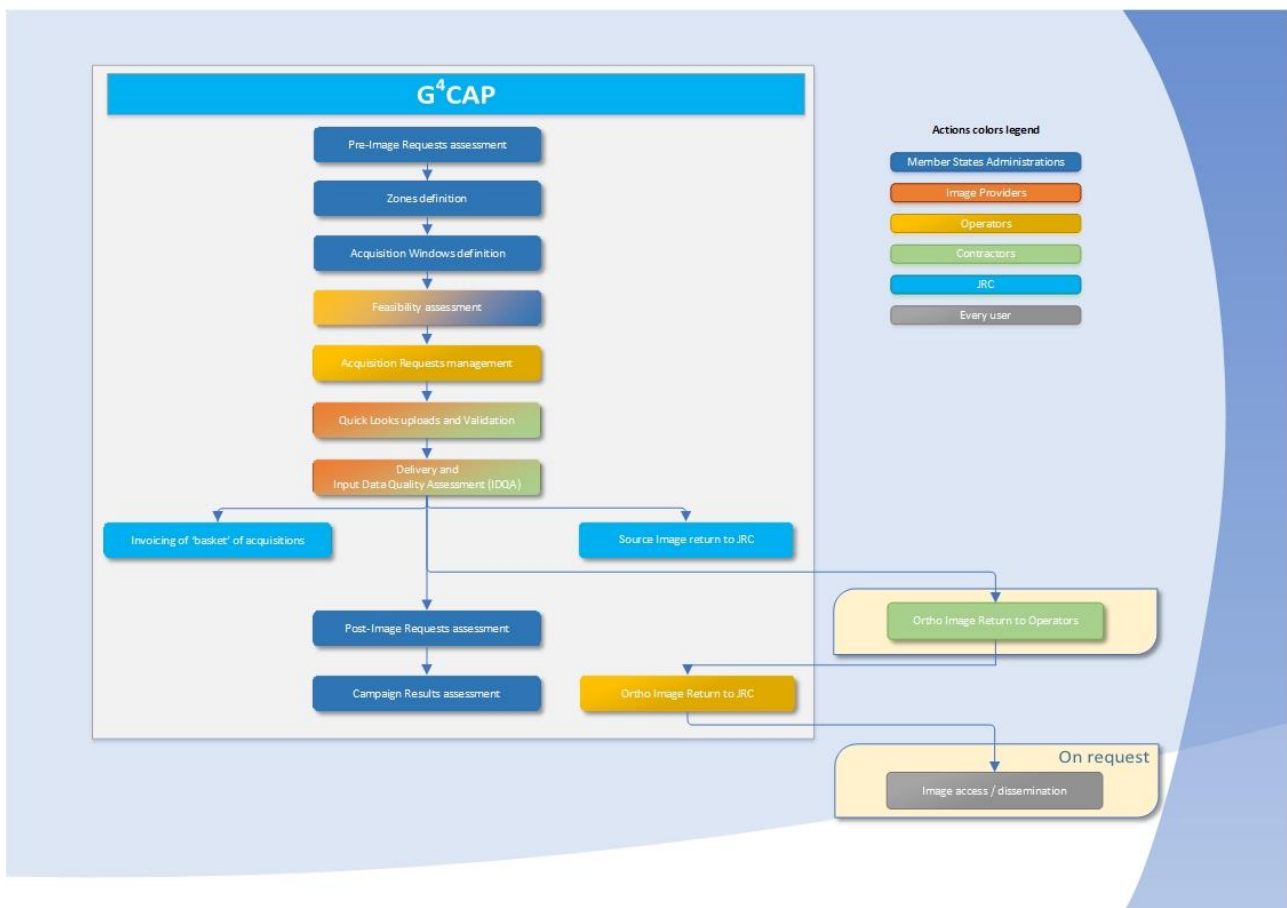
Figure 1 - The overall process of the SRS image acquisition.

1.3 G4CAP

1.3.1   *LIO systems, which were created in 2005, 2013 and 2014 to manage the CwRS campaigns online, were replaced in 2015 by the G4CAP system, a Web application that is kept updated and constantly improved by the JRC to enhance the daily work of the campaign stakeholders and in line with the CAP evolution.

1.3.2   G4CAP is the Web-based application used to manage the whole campaign workflow. Its functionalities are described in its manual, available online at the G4CAP Website under the 'Documentations' section [8]. G4CAP is also the main communication tool between the CAP check actors during the campaign: its automatic e-mail notifications are used to synchronise actions between different actors.

1.3.3   It is compulsory for all the stakeholders involved in the CAP checks to use G4CAP.

2   Pre-image request

2.1.1   All MS administrations participating in the CAP checks campaign must input their forecasted requests for imagery into the pre-image request (pre-IR) module of G4CAP for the campaign to start. This input provides the JRC with information on:

- basic on-the-spot check (OTSC) information;

- basic CwRS information;

- details of planned CwRS methods, with relevant justifications;

- VHR/HR profile requests2 (for each type of profile; see chapter 13, and [7]).

2.1.2   In accordance with Regulation (EU) No 908/2014; Article 26 (see section1.1.4), each MS shall finalise insertion of its pre-IR by 1st of November, before the campaign starts.

2.1.3   Imagery will be allocated only if MS administrations justify their image choice as needed for effective CAP checks. The JRC will use inserted information to efficiently model image allocation. This will be done to fit established budgetary envelopes (indices such as efficient image use and fair image cost/OTSC area are used).

2.1.4   It is strongly advised that the MS administrations refer to G4CAP online help (information and tip-over) when the pre-IR is inserted and also refer to the instructions given in Chapter 4: Feasibility assessment.

2.1.5   The JRC recommendation is to use one VHR AW and between one and a maximum of three HR AWs (plus any number of Copernicus Sentinel-1/2 (S1, S2)), but exceptions to this rule may occur: the methodology must be justifiable by the MS administrations in the pre-IR module.

2.1.6   The JRC also recommends substituting a second VHR AW with a VHR aerial AW, or with a fixed high high resolution (HHR) AW (setting the earliest and latest start dates to be the same) and defining a suitable AW length (e.g. 6 weeks).

---

2 Special profiles may be requested by the JRC; these will allow elevation angle uplift or certain ground sampling distance (GSD) requirements (e.g. VHR+ Topographic, or VHR_EFA_LF, etc. or 8/16 bands and pan bundle data), but MS administrations will have to justify these options in detail; see Chapter 13.

3   Data requests

3.1   General

3.1.1   The regulatory basis for the CwRS programme (see section 1.1.1) allows MSs to use remote sensing techniques as a mean of carrying out OTSCs on agricultural parcels. Guidance to this Regulation is given in the documents in ref. [3], including the 'Guidance for on-the-spot checks and area measurement' which describes a 'control zone' as a geographical area defined on the basis of GIS analysis, taking account of technical constraints (e.g. standard satellite 'scenes'). These technical constraints, which are further detailed below, include swath widths, elevation angles, area of interest (AOI) definition, AW adjustments, feasibility assessment, etc.

3.1.2   The Regulation (see section 1.1.6) also calls for a yearly LPIS QA [3]. Specific VHR imagery is acquired during the CwRS campaign for this QA exercise (see section 13.2). Also MS administrations not participating in the CwRS programme can obtain specific acquisitions for LPIS QA assessment through the JRC.

3.1.3   The MS administration (or contractor), the FW contractor and the JRC must name at least one contact person (or functional e-mail address) for communicating with each other regarding the issues listed above and for all other communication during the campaign. For any changes of contact person, the stakeholder shall contact the JRC.

3.1.4   In accordance with Regulation (EU) No 908/2014, Article 26, each MS shall finalise its image requests in G^4CAP before 15 January, providing all parameters (zone and AW parameters) necessary for image acquisition initialisation.

3.1.5   As the MS administrations finish inserting their image requests, the FW contractor will start the feasibility assessment. The FW contractors are responsible for checking the completeness of the MS's inserted parameters and reporting to the JRC if any error or discrepancy is discovered before the start. After JRC validation, the zones and AW parameters are used as the basis for the feasibility assessment and the image acquisition.

3.2   Zone definition

3.2.1   A CAP control zone (or AOI) consists of <u>a minimum of 4 and a maximum of 999 vertices</u> in latitude/longitude geographic coordinates (decimal degrees, World Geodetic System 1984 (WGS 84) ellipsoid), represented by a shapefile containing files with the extension(s) .shp, .shx, .dbf, .sbx, .sbn and/or .prj, and should be provided by the MS administration, using the safe and secure mechanism provided by G^4CAP, to the FW contractor. The MS administration should strive to make shapefiles that define simple, regular shapes and to avoid creating corridors that are too narrow (i.e. < 5 km width, since the FW contractor is not obliged to deliver a larger area which would allow a smooth, homogeneous orthorectification of such image). There is no regulatory minimum distance between the vertices of the shapefile. The MS administration should, however, strive to create the simplest suitable zone, which must have a minimum size of 100 km^2.

3.2.2   JRC will reject zones' shapefiles if they:

- overlap within the MS (this may be allowed only in exceptional cases, for example where the control schemes/measures over the overlapping area are different and require separate AWs, such as arable cf. and permanent crops);

- overlap with adjacent MSs borders (this includes MS regions handling CAP claims individually, for example Scotland/England/Wales);

- cover large amounts of mountainous or other non-agricultural areas;

- stretch into coastal waters;

- have ≥ 1 000 vertices;

- contain corridors narrower than 5 km.

3.2.3   MSs that have selected control zones in topographically 'difficult' terrain must consider a buffer around their zones of at least 0.2 km (in extremely hilly terrain, 0.5 km is recommended), depending on topography, to ensure complete coverage of the zone after orthorectification. This is because the FW contractor delivers Ortho Ready Standard products that are geo-referenced to the average base height of a given AOI and there could therefore be a horizontal offset for each individual pixel depending on the difference between the actual local height of the pixel and the average base height of the AOI, which therefore, in orthorectification, may cause a further 'shift' as a result of topography. It is therefore highly recommended that a sufficient buffer around an AOI should be considered to ensure that the AOI is still completely covered by satellite data after orthorectification. The required buffer (equal to the maximum horizontal offset) can be calculated as follows, taking into account the terrain differences inside the AOI, as well as the minimum allowable satellite elevation angle:

$$\frac{H_{\max} - H_{average}}{\tan(ELA_{\min})}$$

(maximum possible height difference of the local height to the average base height of the AOI/tangent of the minimum allowable SatElevation angle).

Care should be taken to calculate the average base height from the heights of all pixels inside the AOI (not just using the highest and lowest heights inside the AOI and making an average). See Annex 0 for detailed examples and a downloadable Excel spreadsheet from the G4CAP documentation section for individual calculations.

3.2.4   In summary, the relevant zone parameters in G[4]CAP are:

- control zone shapefile (specifications as described above);

- zone name (≤ 5 characters); this must be unique for the whole campaign and shall not include special country-specific characters such as 'é', 'Ç', etc. (i.e. only ISO basic Latin characters and numbers allowed);

- zone (AOI) area (rounded to a whole km², Universal Transverse Mercator (UTM)) in accordance with the shapefile area;

- European Petroleum Survey Group (EPSG) code (optional); this is the final output national projection used by the MS. Currently, this is relevant to HR image acquisitions only if the HHR ORTHO profile is requested (i.e. the HHR F2 profile).

3.3 Acquisition window definition

3.3.1 There can be either one or two VHR image AWs (VHR1 and/or VHR2 periods) defined for each CAP control zone. These AWs will be defined by the MS administrations and will be scheduled as suitable for the measurement and computer-assisted photo interpretation (CAPI) of the largest number of agricultural parcels possible. Exact dates will depend on crop cycles and will vary with latitude. The tasking of the second AW depends on the budget available and is determined by the JRC at the pre-IR stage or, at the latest, at the image requests definition stage (see section 2.1.2).

3.3.2 As imagery is acquired, depending on the sensor's technical characteristics, the AW's zone is gradually covered entirely or partially. The FW contractor, who is responsible for the implementation of an efficient image acquisition set-up, always aims to cover the zone in as few acquisitions as possible, but multi-temporal collection is considered valid if performed within the time limit of the AW. Such multi-temporal acquisitions should be as close as possible in time to favour crop interpretation (CAPI); that is, 'multi-temporality' should be as short as possible.

3.3.3 MS administrations will request a VHR prime profile to be used to cover the zone. The MS administration could have to accept a profile that is less strict after feasibility assessment and/or also agree to a backup profile for the best chance of acquisition success (see Chapter 4 - Feasibility assessment). The FW contractor will task within the agreed AW to cover the control zone efficiently.

3.3.4 The AW's zone may be covered by multiple sensors fitting the profile selected by the MS administration (i.e. <u>multi-sensor and multi-temporal acquisitions are allowed</u>). The FW contractor will task the sensors in an optimal manner to complete the zone as soon as possible with any of the sensors within the AW agreed. It has been shown in earlier campaigns that multiple sensor tasking has given an efficiency gain by completing zones more quickly, that is, a reduction of the acquisition time by adding satellite capacity. Moreover, it has also been shown that there will be a greater chance that a second acquisition is closer in time to the first acquisition, that is, less multi-temporality.

3.3.5 When completing any AW for a zone, the FW contractor shall guarantee an overlap (east–west or north–south) between subsequent acquisitions or strips of a minimum of 0.5 km. Moreover, there shall be an overlap of a minimum of 0.5 km between any partial acquisitions between different sensors. Such overlap is necessary for the orthorectification process.

3.3.6 The VHR zone in a relevant AW will be covered by a bundle product (panchromatic (PAN) and multispectral (MSP) as separate bands), the pansharpened (PSH) product[3] or the PAN-only product. If the profile A4 (VHR stereo) is requested, a stereo product will be delivered.

---

[3] Please note that a PSH four-band product always comes with the 4 first bands, that is, blue, green, red and near-IR1 (so-called MS1). It is not possible to produce a PSH four-band product using the remaining 4 bands (so-called MS2) or SWIR bands.

3.3.7 It is not recommended to define many zones with profiles with elevation angle restrictions close to each other, as this decreases satellite capacity and will risk that no acquisition being made within the AW.

3.3.8 The VHR1 and/or VHR2 periods should be preferably 8 weeks (56 calendar days) but never shorter than 6 weeks (42 calendar days).

3.3.9 If, on the day before a VHR AW is going to open, the previous HR AW is still open, the HR AW will be closed automatically. Communication on the closure is made via G^{4}CAP.

3.3.10 When defining the VHR1 and VHR2 AWs, the MS administrations shall keep in mind in their planning that the final AWs might have to be longer than that initially requested to make an acquisitions feasible. It shall also be taken into account that a potential shift of the VHR1 AW end date may occur and the subsequent AW start date may have to be postponed.

3.3.11 If extraordinary weather conditions prevail in any region, an AW may change (opening and closing dates will move). This will be dealt with on a case-by-case basis. Such AW dates changes should occur only in very rare cases. Notice shall be given by the MS administration (or contractor) to the FW contractor at least 1 week before the scheduled opening.

3.3.12 It is not useful to open an AW too early in the season, as the sun angle is generally low and the crops may not have developed sufficiently to provide a scene with adequate contrast for a good delineation of the parcels. It is suggested that no AWs be opened when sun angle is still below 20 degrees to ensure sufficient contrast and to minimise the effect of shadows.

3.3.13 Conversely, this is also true for late start dates of the VHR2 AW, when the sun elevation could drop below 20 degrees.

3.3.14 If a VHR profile sensor (see section 13.1.2) acquires imagery late in the AW, the MS administration may request an archive search for an earlier HR sensor acquisition within the AW. In this case, the FW contractor shall contact the JRC, which may (or may not) give clearance. This must be communicated to the FW contractor. It is, however, strongly advised that Copernicus-S1/S2 imagery be used.

3.3.15 The MS administrations (or contractors) may 'pre-extend' AWs. This 'pre-extension' can be used for any AW that has not opened yet, if it has to be shifted to an earlier start date than agreed during the feasibility process. No extra feasibility assessment (see Chapter 4) has to be performed by the FW contractor, since the end date of the AW remains as agreed, while the start date is set to an earlier date (according to the request from the MS administration or contractor), resulting in an overall longer AW. The option to 'pre-extend' an AW should be used carefully by the MS administrations (or contractors) whenever the weather conditions and CAP checks method allow such a change. The FW contractor shall be notified in due time (e.g. from 5 days to a minimum of 2 days in advance of the new AW start) to allow the FW contractor to change its satellite tasking. The 'pre-extend' request will trigger an automatic notification to the responsible FW contractor, who will have the right to accept or refuse the request, providing explanations. If the request is accepted by the IP, G^{4}CAP will manage all the edits required to the AW automatically, within a maximum of 24 hours.

3.3.16 An AW may be extended if none of the prime or backup profile tasking has been successfully completed over the zone with input data quality assessment (IDQA)-accepted acquisitions. With effect from the 2018 Campaign, G^{4}CAP automatically manages the extension of AWs that have been agreed by an MS administration, by a maximum 1 or 2 (default) weeks at a time. To come to such an agreement, the MS administration must set the extension flag in either the AW or the acquisition request (AR) module. G^{4}CAP will send an automatic notice of the extension to the FW contractor at least 3 working days before the AW closure. This will allow the FW contractor to continue tasking. Such extensions will be allowed if the crop cycle allows and shall be as long as possible. AW will not be extended if there are some proposed or backup acquisitions not yet managed by the MS administration (or contractor) that could potentially cover the whole zone area. Allowing such "automatic extension" facilitates the collection planning of the image provider and therefore can be seen as a good option already at the IR and AW definition to have set this flag to obtain best feasibility result from the image provider (see 4.1.13).

3.3.17 If the automatic management of AW extension described above is not used, the following procedure shall apply at the end of the AW:

- If there are still some acquisitions outside the AW's image profile specifications, they may be uploaded by the FW contractor, as proposed or backup profile (this depends on AW definition (see Chapter 7) and may be accepted by the MS administration (or contractor)).

- If the above option does not provide enough images to complete the area, the AW can still be extended for the prime and backup VHR profiles. The MS administration (or contractor) will evaluate the maximum acceptable AW extension based on the status of the crop phenology.

3.3.18 If the IP is able to acquire valid imagery within the original AW, even if this AW was already extended, the AW will be automatically de-extended by G⁴CAP.

3.3.19 The MS administration (or contractor) is notified about an AW that is coming to an end by selecting the dedicated notification option in G⁴CAP. If no request for the extension of an AW is set in G⁴CAP, the AW will close on the planned closure date (defined end date of the AW).

3.3.20 Upon request from the JRC, the FW contractor shall inform the JRC and the MS administrations (or contractors) of image acquisition status over the zone (e.g. number of attempts left before AW closure or possible attempts soon afterwards).

3.3.21 MS administrations should not allow an AW to extend beyond any MS contractor contract end date. If the MS administrations allow this, they will be responsible for the proper use of the imagery in their controls procedure.

3.3.22 The relevant AW parameters are summarised as follows (each AW is identified in G⁴CAP by a unique integer numerical value called ID):

- period: VHR1, VHR2;

- image profile (see Table 1);

- start and end dates;

- previous AW, where applicable;

- Image mode: Bundle/PSH[3]/Multispectral (MSP)/PAN (possible choices are dependent on chosen image profile);

- delivery method: DVD/file transfer protocol (FTP)

- possibility of automatic extension of AW.

4   Feasibility assessment

4.1.1   The basic zone and AWs parameters explained above are received by the FW contractor through the 'Reporting' or the 'Zones' and 'Image Requests' modules in G^{4}CAP. They shall be made available to the FW contractor 6 weeks before the first AW starts. These parameters also form the basis for the relevant specific contracts (SCs) set up between the JRC and the VHR FW contractor.

4.1.2   The FW contractors are then responsible (see section 3.1.5) for interacting with the MS administrations (or contractors) to check and finalise any remaining feasibility parameters, and perform the feasibility study in G^{4}CAP. For these tasks, a time frame of at least 4 weeks shall be given to the FW contractor.

4.1.3   Since feasibility assessment is no longer carried out in one single batch, but by period and zone, if any AW is requested with a start earlier than others its feasibility assessment can exceptionally be performed earlier. It is up to the IP to make the feasibility assessment as efficient as possible and start with the earliest AWs in the period undergoing feasibility assessment.

4.1.4   A technical and competitive feasibility assessment by the FW contractor includes, among other things, assessments of satellite characteristics, zone size, zone shape, zone latitude, elevation angle, AW, priority level, CC, statistical weather forecasting and other competitive tasking requests. All tasking shall be placed at priority level for the CwRS and LPIS zones.

4.1.5   One of the parameters of the feasibility assessment is the elevation angle. It is well known that a lower elevation angle places higher demands on ancillary data (digital elevation model (DEM), ground control points (GCPs), etc.) to reach orthorectification accuracy specification thresholds (see chapter 13, and [6]). The FW contractor should keep the elevation angle as high as possible to facilitate orthocorrection.

4.1.6   A higher elevation angle threshold may be requested for certain control zones, for example if the control zone is situated in hilly or mountainous areas or has complex topology (see chapter 13). The total area allowed for such elevation angle uplift will have been agreed between the MS administration and the JRC prior to the feasibility assessment at the pre-IR stage, and the basic AW parameters (see chapter 2) will include relevant profiles for each MS.

4.1.7   MS administrations should be aware that feasibility assessment suffers if control zones with an elevation angle restriction are too concentrated and close to each other; collection attempts will decrease substantially from an A.1 profile to an A.2, A5 or A.6 profile (see Chapter 13: VHR image profiles). Therefore, MS administrations are advised to consider the maximum possible AW length for control zones with an elevation angle restriction when defining their image requests.

4.1.8   MS administrations are reminded that they should keep their requests for the A.2 plus A.6 plus A.5 profile elevation angle restriction to ≤ 25% of their overall VHR campaign control area.

4.1.9 MS administrations are reminded that they should keep their requests for the A.5 profile to ≤ 10% of their overall VHR campaign control area (preferably well distributed for best acquisition success).

4.1.10 MS administrations should also have in mind that they should keep their requests for the A.4, A.11, A.51, A.61, A.62, A.71 and A.81 profiles to be ≤ 1 000 km^2 of their overall VHR campaign control area (see Chapter 13: VHR image profiles, and G^{4}CAP pre-IRs tip-over help under the VHR 'Profiles' tab).

4.1.11 Special profiles, such as A.11, A.12, A.51, A.52, A.61 and A.62, that is, 8/16 bands with relative elevation angles, will be provided depending on feasibility and budget availability. These should already have been requested by the MS administrations in the pre-IR stage, since they require bilateral agreement with the JRC.

4.1.12 If the FW contractor, when checking, notices any discrepancies between the areas/parameters, with respect to section 2.1.1 in the pre-IRs, and the areas/parameters inserted in the subsequent data requests (zones and AWs) in G^{4}CAP by the MS administrations, a final acceptance must be obtained from the JRC before feasibility assessment can start.

4.1.13 Whenever possible for the MS, it is recommended to set the "automatic extension" flag within the IR AW definition, at the beginning of the campaign, before the feasibility calculation starts. Even if the "automatic extension" flag is set for an AW, the image provider still tries to acquire the image within the original window (ORAW). The "automatic extension" will only be used in cases when no suitable full acquisition could be achieved in the original window. The setting of the extension flag shall be consistent for the whole campaign, i.e. the allowance of an "automatic extension" shall not be removed by the MS after the feasibility calculation has started or during the ongoing acquisition window. In case a removal is necessary, the MS shall keep a lead time of 1 week and G4CAP shall send an automatic notification to the image provider.

4.1.14 The feasibility assessment performed by the FW contractor shall divide the AWs into three categories:

1) GOOD (GREEN) - FEASIBLE WITHIN AW - approaching 100% probability (90–100%);

2) MEDIUM (YELLOW) - FEASIBLE WITHIN AW - 70% probability; may need EXTENSION - suggestions can be made to improve possibility of success (70 - 89%);

3) LOW (RED) - NOT FEASIBLE WITHIN AW – with suggestions to make it feasible (e.g. AW extension with the suggestion of a new start/end date, change of profile allowing e.g., a less strict elevation angle, change of a sensor or acceptance of backup) (< 70%).

The IP will in above success rate include additional factors (e.g. based on experience) in order to make best scenario possible for the feasibility. However, in G^{4}CAP, if

suggestions made by the IP are accepted to change the original AW with respect to its dates or image profile, or to accept backups, the AW will have an improved feasibility status compared with the original and the FW contractor will specify this status in the new suggestion.

If the original AW was not feasible and it was not possible to find a valid agreement between the FW contractor and the MS administration, the FW contractor has two options, exploiting a fourth category:

4)   BLACK - acquisition is not feasible within the requested AW and 'no agreement has been reached between FW contractor and MS administration to make it feasible'.

The FW contractor can:

- Task the AW anyway, even if the feasibility is still 'not feasible' or the AW length is not compliant with technical specifications. In this case, the FW contractor will make a new proposal with a BLACK feasibility status with the same or changed new dates agreed with the MS administration, even if such changes will not make the AW feasible. In the event of failure, such AWs will NOT be counted in the campaign statistics for the FW contractor, and the MS administrations MUST BE PREPARED TO USE AN ALTERNATIVE CONTROL METHOD, SINCE NO IMAGE IS GUARANTEED. This situation is called BLACK-BLACK feasibility.

- Choose NOT to task the AW. The FW contractor will upload a black status feasibility without proposing a new solution. The AW will be marked as 'Refused' and no AR will be opened. The MS administrations MUST USE AN ALTERNATIVE CONTROL METHOD, SINCE NO IMAGE WILL BE PROVIDED.

4.1.15   Following feasibility assessment, the results will require some iterations between the MS administrations and the FW contractor. These will normally be made during the first months of the calendar year before the campaign starts (however, see sections 4.1.1, and 4.1.3). All interactions between the MS administration and the FW contractor in this feasibility process are performed in the G^4CAP 'Feasibility' module.

4.1.16   Finally, an optimum acquisition scenario will be reached, with clearly defined profiles, zone constraints, final AWs and products to be delivered, etc. This result, completed in G^4CAP and accepted by the MS administrations, will form the basis for the campaign (accepted by all parties, including the JRC) for each zone AW.

4.1.17   The feasibility assessment should be ready not later than 2 weeks before the AW opens, on condition that the timelines under sections 4.1.1 and 4.1.2 are met. If a phased feasibility assessment is performed (see section 4.1.3), the FW contractor and the JRC shall agree on a shorter time frame to finalise the first feasibility assessment for the early zones (e.g. 1 week before the first VHR AW of the early zones opens).

5   Acquisition requests

5.1.1   An AR is defined as the implementation by the FW contractor of an AW of the MS administration to cover a zone, with its defined ancillary parameters.

5.1.2   After the feasibility assessment, G^{4}CAP will automatically open an AR 3 days before the AW start date is reached. Each AR has a unique identifier called ID.

5.1.3   If no request for the extension of an AW is received by the FW contractor, its AR will close on the planned closure date (defined end date of the AW) (see section 3.3.19).

6 Quick-look image upload

6.1.1 The FW contractor will notify an acquisition through its upload in the G^{4}CAP system (or by e-mail in the case of temporary system unavailability) within 2 working days[4] from the acquisition date (validated/proposed, or partial/full upload). In the exceptional case of multiple national holidays or after a weekend, this time limit will be extended so that those days do not count.

6.1.2 IPs can upload image acquisitions details into G^{4}CAP either via batch upload, available in the AR module, or by clicking on the proper AR. Required acquisition metadata must be defined in the metadata XML[5] file. This XML file must be compressed in a zip archive together with 'quick-look' images (QLs), shapefiles and other necessary metadata files and uploaded into G^{4}CAP (see Annex 19.1 for details).

6.1.3 Upon upload of an acquisition, the G^{4}CAP system will automatically send a dedicated notification to interested actors. Users' subscriptions to these notifications are managed through the G^{4}CAP system. By default, all users receive this message, unless they specifically deactivated the notification option for this item (see under G^{4}CAP Tab Acquisition acceptance).

6.1.4 Uploaded QLs can be previewed using the G^{4}CAP QL Browser, which is an online Web application for displaying and browsing QLs, metadata and shapefiles from the image acquisitions. It can be reached directly from within G^{4}CAP. Every user can also use this tool at any time during the campaign to check the overall status of the acquisitions over zones for which it is responsible for a specific campaign in the Zones module of G^{4}CAP.

6.1.5 The MS administrations (or contractors) may consult the FW contractor's archives [9]. Services are normally free of charge, but often require a subscription. The MS administrations (or contractors) may suggest to IP any imagery for upload that is suitable for their controls activity. The FW contractor will proceed to upload QLs of such imagery into G^{4}CAP for acceptance by the MS administrations (or their contractors).

6.1.6 From the 2018 Image Acquisition Campaign onwards, the VHR IP has the option of using the Atmospheric Compensation Algorithm (AComp)[6] to improve image clarity by mitigating the effects of haze and atmospheric scattering [10]. The AComp is currently available for imagery acquired by the GE1, WV2, and WV3 satellites. All QL images related to these satellites and uploaded in G^{4}CAP are enhanced by the AComp algorithm.

---

[4] Numbers of working days throughout this document are calculated as calendar days minus weekends (national holidays are not taken in account)

[5] XML metadata file specification - see Annex 19.1.

[6] For more information on the AComp algorithm, see https://g4cap.jrc.ec.europa.eu/g4cap/Default.aspx?tabid=172

7 Acquisition acceptance - validation

7.1.1 Acquisition acceptance or 'validation' is performed on the QLs uploaded by the FW contractors. They may cover a whole zone or just a part of a zone (partial upload, defining an area to be validated by a vector shapefile). The area to be validated has to be contiguous and should have a regular and simple shape. It can be composed of one strip or multiple strips. The validation of an acquisition is done on the basis of specifications set by an image profile defined for each AW (i.e. CC, ELA, GSD. etc.). Snow, flooding and haze, which is not considered cloud by the FW contractor, do not result in rejection, but are flagged and may trigger extra re-tasking (see 'MeteoFlag').

7.1.2 Uploaded acquisitions can have either validated or proposed status.

- A <u>validated</u> acquisition is compliant with all specifications defined by AW's image profile. Validation of this imagery does not require any interaction with the MS administration (or contractor). Validated images are delivered directly to the MS administration (or contractor) once they have passed through the FW contractor's QC (see Chapters 9 and 14).

- A <u>proposed</u> acquisition is not compliant with

  (a) CC parameter; an acquisition proposed due to an extensive CC is defined by a 10% < CC ≤ 30% over the AOI.

  (b) any other parameter of the AW's image profile if there is no backup profile defined. If AW has a backup profile defined see 7.1.4.

  Proposed images are delivered to the MS administration (or contractor) only once the MS administration (or contractor) has agreed in G^4CAP. Tasking continues for better acquisitions during the period for accepting/declining, which shall not exceed 3 working days. Once it has been accepted, the proposed image goes through QC with the FW contractor and is shipped to the MS administration (or its contractor).

7.1.3 An acquisition exceeding CC parameter of the AW's image profile is automatically uploaded with the status set to 'proposed' on the basis of information stated in xml metadata file used for the upload. If the acquisition is not compliant with any other parameter apart from CC its xml metadata file has to be complemented by IP with additional attributes regarding such parameter (e.g., image mode, or image profile. See further Annex 19.1 Tables 3, 4, 6)

7.1.4 If a backup profile is accepted during the feasibility analysis then:

- An acquisition which is not compliant to the requested profile specifications due to exceeding CC will be uploaded as proposed. MS Administration/Contractor has 3 working days to accept/reject the acquisition. CASE 1, Figure 2.

- An acquisition which is not compliant to the requested profile specifications due to exceeding parameters ELA or/and GSD, will be uploaded as a validated backup. MS Administration can accept this validated backup acquisition as soon as possible or can wait until the AW is over. CASE 2, Figure 2.

- If the AW ends only with backup acquisition, the backup acquisition has to be accepted.

- If the AW ends with validated acquisition (collected in the meantime), the validated acquisition will be delivered to MS Administration.

- An acquisition which is not compliant to the requested profile specifications due to exceeding parameters CC & ELA or/and GSD will be uploaded as a proposed backup. MS Administrations can accept this backup acquisition as soon as possible or can wait until the AW is over. CASE 3, Figure2.

7.1.5 If a backup profile is rejected during the feasibility analysis then: An acquisition which is not compliant to the requested profile specifications due to exceeding parameters (ELA, GSD, or CC) will be uploaded as proposed. MS Administration/Contractor has 3 working days to accept/reject the acquisition. CASE 4, Figure2.

BACKUP vs. PROPOSED

Backup accepted during feasibility study

Backup rejected during feasibility study

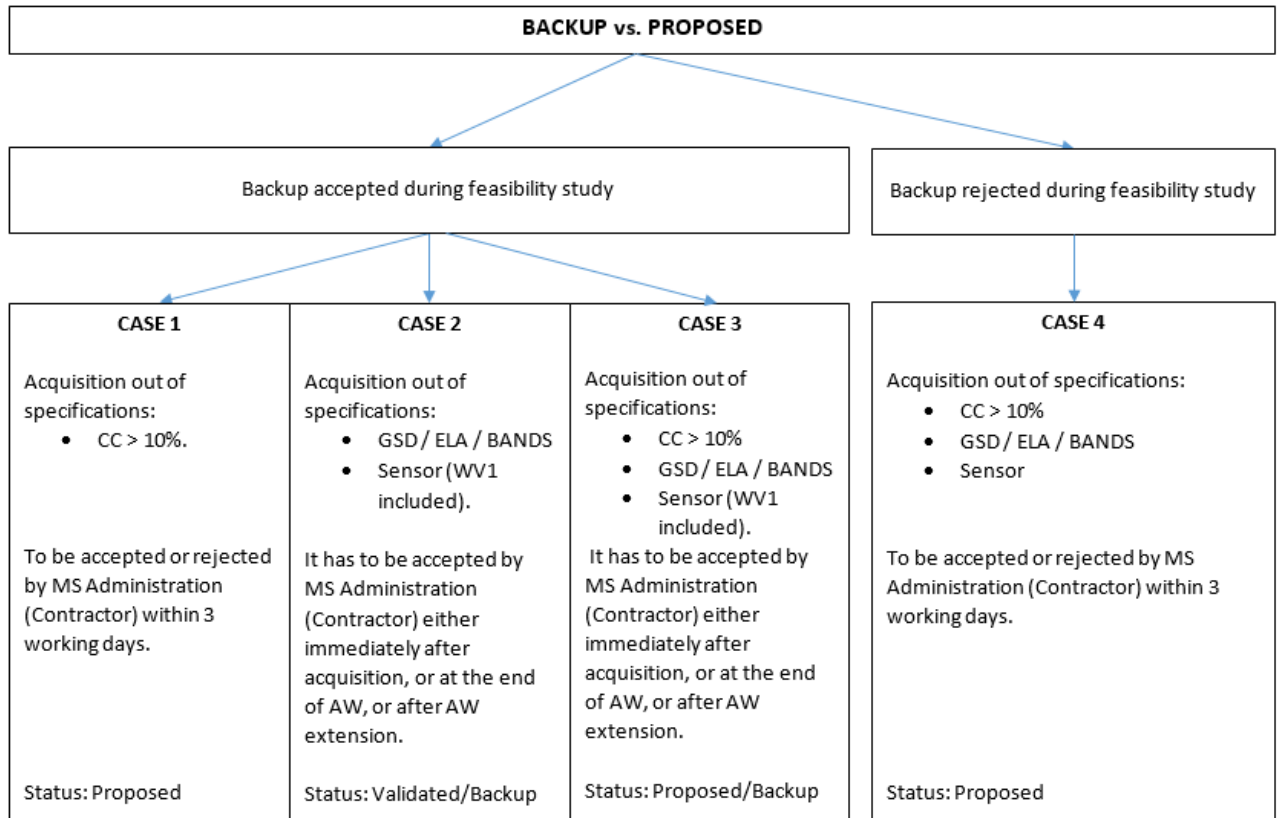| CASE 1	CASE 2	CASE 3	CASE 4
Acquisition out of specifications: • CC > 10%.	Acquisition out of specifications: • GSD / ELA / BANDS • Sensor (WV1 included).	Acquisition out of specifications: • CC > 10% • GSD / ELA / BANDS • Sensor (WV1 included).	Acquisition out of specifications: • CC > 10% • GSD / ELA / BANDS • Sensor
To be accepted or rejected by MS Administration (Contractor) within 3 working days.	It has to be accepted by MS Administration (Contractor) either immediately after acquisition, or at the end of AW, or after AW extension.	It has to be accepted by MS Administration (Contractor) either immediately after acquisition, or at the end of AW, or after AW extension.	To be accepted or rejected by MS Administration (Contractor) within 3 working days.
Status: Proposed	Status: Validated/Backup	Status: Proposed/Backup	Status: Proposed

Figure 2 - Explanation of difference between a proposed acquisition and a backup profile acquisition

7.1.6   For the validation of a series of proposed acquisitions, the FW contractor for the VHR FWCs has agreed to provide all proposed acquisitions to the MS administration (or contractor) if they accept one proposed acquisition over the control zone. The MS administration (or contractor) must keep in mind that, when further proposed acquisitions are made available over the same zone, they can be used together with previously rejected acquisitions.

7.1.7   The FW contractor will produce, on a best-effort basis, regular mosaics of proposed imagery to aid in decision making on the usability of a series of acquisitions. Such mosaics can be sent to MS administrations (or contractor) bilaterally, copying in the JRC. The MS administration should keep in mind that accepting a series of proposed acquisitions will allow the FW contractor to release satellite capacity for other zones.

7.1.8   The FW contractor may re-upload part of a rejected proposed acquisition if, in combination with a new validated acquisition, it will serve to complete a zone. The re-uploaded proposed acquisition has to be above the validated CC threshold, be acquired on one date, cover a contiguous area, and have a regular and simple shape.

7.1.9   In the case of a conglomeration of CC within part of a large acquisition, this part (minimum 100 km^2) may be re-tasked. Even if the whole acquisition is validated, the MS administration (or contractor) may ask the FW contractor to perform such a re-task. The FW contractor will contact the JRC, which will make a decision based on technical and financial justification. A new zone will be defined in G^{4}CAP for this area, keeping a link with the original zone, and a new AW and AR will be issued for this area. The MS administration (or contractor) will follow a procedure similar to that described in the section below on the use of 'MeteoFlag' to prove that re-tasking is required.

7.1.10   An acquisition with the 'MeteoFlag' set on is validated as follows:

- If the acquisition with the 'MeteoFlag' set on for dense haze/snow/flood/mixed is uploaded, this flag will add dedicated information in the upload notification to the MS administration (or contractor). The MS administration (or contractor) will, within 3 working days, assess if the dense haze/snow/flood/mixed situation prevents control of the parcels, by:

    o   firstly, assessing whether or not the haze image can be used if an atmospheric correction or local lookup table stretch is applied to the imagery; it should be kept in mind that the image viewed is a QL, which is always inferior in quality compared with the real source image;

    o   secondly, if the above does not solve the issue, provide the JRC with information regarding the following issues for a decision on possible re-tasking to be taken:

        •   preparing a shapefile of the control parcels structure (latitude/longitude DD WGS 84),

        •   assessing preliminary technical coding (e.g. T4[7]) due to haze (see the guidance for OTSC [5]),

---

[7] T4 is the technical code in parcel level observation diagnosis meaning "parcel covered by clouds, haze, snow, or flooding".

- checking if any proposed image is available.

- If the above steps cannot ensure a successful control procedure, the following actions should be undertaken:

  o if the whole zone is not to be re-collected, preparing a new shapefile to be re-collected for the AOI (minimum 100 km²),

  o deciding on a new AW and assessing the time delay that re-tasking implies for the success of the control procedure.

- Upon receiving the information indicated above from the MS administration (or contractor), the JRC will make a decision on whether or not to collect additional imagery (re-task) over a part of the control zone based on technical and financial justification.

7.1.11 From the 2018 Campaign, it has been decided to perform AComp processing automatically on all 'MeteoFlag'-tagged imagery to reduce haze, water vapour and particles (see section 6.1.6). In rare cases it could happen that the Acomp algorithm will not improve the visual quality of an image. A MS administration (or contractor) may, if not satisfied by result, ask for re-processing without after receiving the AComp:ed imagery with.

8   Ordering

8.1.1   Ordering follows the procedures set up in the FWC signed by the FW contractor and the JRC [1]. This is managed by the signature of SCs within the FWC.

8.1.2   Changes to image requests during the Image Acquisition Campaign that result in the addition of area (adding new zones, re-tasking) require an update in the form of a relevant SC. The update is managed via an 'exchange of letters' between the Commission and FW contractor. In this case, the new requests are inserted in G^{4}CAP only when the whole financial/contractual procedure is finished to allow the feasibility assessment to start.

9 Delivery

9.1.1 Validated partial acquisitions covering a minimum of a 100 km^2 contiguous area with a regular and simple shape, as defined in section 7.1.1, will be delivered in the format and on the media requested. If, however, a remaining area required to complete an AOI is less than 100 km^2, smaller validated acquisitions are acceptable. If demanded by the MS administration (or contractor), the delivery of validated proposed imagery will include all proposed uploads over the zone.

9.1.2 The contractual delivery period, which includes production, internal QC and ex-works availability, is 6 working days after acquisition for VHR data.

9.1.3 Images (after acquisition acceptance, according to the procedure laid out in Chapter 7) are delivered directly to the MS administration (or contractor) after they have passed through the internal QC of the FW contractor.

9.1.4 The MS administration (or contractor) receives a delivery notification through G^{4}CAP as soon as the product is confirmed as shipped by the FW contractor. This delivery notification includes the AR ID and the acquisition identifier. If the product is delivered via FTP, G^{4}CAP displays the FTP address, and the username and password required for access; if it is delivered on DVD, a delivery note is uploaded on G^{4}CAP containing information on the shipment. Even in the case of DVD delivery, an FTP account must be set up to deliver the acquisition to the JRC and its details must be entered into G^{4}CAP, as for FTP-delivered acquisitions.

9.1.5 The MS administration (or contractor) must download the product within 6 working days from the day it was placed on FTP server by the FW contractor.

9.1.6 The FW contractor will use checksum for correct delivery between the FW contractor and MS administration (or contractor), and for image data provision to the JRC (see Chapter 12).

9.1.7 At the request of the JRC, the FW contractor will inform the JRC about the image production/QC status (production pending, production finished and production date) at any time during the campaign.

9.1.8 If the IP captures an image "better" than one already uploaded and basketified, and wants to deliver such image to the MS Administration (or contractor), he may after bilateral contacts with MS Administration (or contractor) and JRC, upload such image by using the RESET FTP button in the Delivery Information part of the Acquisition Request module in G^{4}CAP.

10 Input data quality assessment

10.1.1 The MS administration (or contractor) will fill in the IDQA on the acquisition page of G^{4}CAP within 8 working days after the image has been delivered. This action will allow the JRC to obtain QC records (QCRs) on products and on the delivery performance of the FW contractor.

10.1.2 If an MS administration experiences a delay in nominating a contractor, the MS administration will have to perform all the necessary actions by itself. This means that the MS administration will act as a contractor in G^{4}CAP, to avoid delaying the process.

10.1.3 When an acquisition has passed its IDQA, the JRC will set the acquisition as 'ready to be invoiced' and move it to the 'basket' of invoiceable acquisitions.

10.1.4 If the required IDQA is not filled in by the MS administration (or contractor) in 8 working days (maximum 12 calendar days) from delivery of the imagery, the IDQA status will be assumed to be 'accepted', to allow its timely categorisation as invoiceable. Although the contractual relation is between the JRC and the FW contractor, in these cases an automatic notification will be sent via G^{4}CAP to the responsible MS administration and contractor stating that they will not be able to file any complaint on any image characteristics that could have been discovered in the IDQA. This means that all imagery that was delivered more than 12 calendar days previously will be classified as IDQA/Accepted and categorised as invoiceable at the beginning of each month. Exemption from the above workflow is granted to acquisitions on which the MS administration/contractor has already filed a complaint (see below).

10.1.5 If a MS administration (or contractor) experiences a proven technical malfunction in performing an IDQA within the required time, the JRC must be informed and, if this is confirmed, the IDQA will be put on hold and not automatically accepted.

10.1.6 If, in the IDQA procedure, the MS administration (or contractor) notes that the image area delivered[8] does not match the area specified by the FW contractor, it will note this discrepancy and upload a corrected shapefile in G^{4}CAP. The JRC will have a final validation role in cases of non-compliance.

10.1.7 If, in the IDQA procedure, the MS administration (or contractor) notes that the metadata on which sensor acquired the imagery are wrong, or that the received image mode is not the requested one, it will be able to correct it directly in G^{4}CAP when performing the IDQA. The system will trigger an automatic correction notification to IPs and FWCs. In the latter case, the acquisition will be re-delivered in the correct image mode.

10.1.8 An AR is closed only after the whole area has been imaged and the acquisitions have been accepted through the IDQA by the contractor (unless other circumstance cause closure; for example, the AW comes to an end).

---

[8] Calculated (rounded to whole km²) as the intersection between the validated acquisition (using final ephemeris data) and the zone in geographic projection UTM/WGS 84.

10.1.9 If the IDQA is not satisfactory for any other reason, the FW contractor and the MS administration (or contractor) shall solve the situation bilaterally by either an acceptance by the MS administration (or contractor), or a reproduction (e.g. different product type or product of specified quality) or a partial or complete re-task by the FW contractor. If no agreement is reached, the FW contractor will report to the JRC, which has a final decisive role in determining the action to be undertaken. The relevant provisions of the FWC [1] shall apply.

11 Pricing and invoicing

11.1 Pricing

11.1.1 Pricing for products will be in accordance with the FWC signed by the FW contractor and the JRC [1].

11.2 Invoicing - the VHR 'basket'

11.2.1 The FW contractor can invoice any single acquisition:

- that has been accepted (IDQA/Accepted) by the MS administration (or contractor);

- that the JRC has thereafter set to the status 'ready to be invoiced' (for all acquisitions for which the time delay from delivery is more than 12 calendar days, see section 10.1.4). G^4CAP will, at this point, move the acquisition to the 'VHR basket' of invoiceable acquisitions.

11.2.2 Such invoicing shall normally be made cumulatively once per month, according to the rules established in the FWC signed by the FW contractor and the JRC [1]. The identification value for an acquisition to be invoiced is the Acq. ID displayed in the basket.

11.2.3 If, when accepted and delivered, imagery turns out to be inadequate, the relevant provisions of the FWC shall apply [1], where FW contractor image warranty applies.

12 Image data provision to the JRC (image return) and image access

12.1 Image return to the JRC by FW contractor - introduction

12.1.1 Image return involves returning the imagery, purchased for the purpose of the CAP checks by DG AGRI for the MS administration, to the JRC. This follows Article 21 of Regulation (EU) No 1306/2013: "...The Commission shall supply ... satellite images free of charge to the control bodies or to suppliers of services authorised by those bodies to represent them. The Commission shall remain the owner of the satellite images and shall recover them on completion of the work ...".

12.1.2 Both source and orthorectified SRS data shall be returned to the JRC, as described in the following sections.

12.2 Source image return to the JRC by the FW contractor

12.2.1 All source data shall be made available to the JRC by the FW contractor directly after data acquisition, with minimum delay, contemporaneously with data provision to the MSs and their contractors. The FTP address and credentials will be the same for the contractor and the JRC. In case of DVD delivery see paragraph 9.1.4. G^{4}CAP will automatically harvest this account as soon as possible after the IDQA is completed with acceptance by the MS administration (or contractor) (see section -9.1.4 and chapter 10).

12.2.2 The source data shall be provided to the JRC via standard FTP[9] protocol. The FW contractor shall ensure that the minimum transfer speed of the FTP service is 150 Mbit/s, with a minimum of four possible connections at the same time, and guarantee that the service has an uptime of at least 99.0%. The minimum retention time for data on the FTP server of the FW contractor shall be 2 weeks from IDQA Acceptance.

12.2.3 Finally, to enable the JRC (and the MS administrations or their contractors) to run checks for complete data transfer, the FW contractor shall provide MD5 checksums for every file included in an acquisition. These MD5 checksums shall be added to checksum files that are named checksum.md5 and shall be placed in the same folder as the data, referencing to all files in that folder. The content and structure of the checksum files must follow the syntax of the md5sum tool,[10] using UNIX style line breaks (newline). The creation of the MD5 checksum files must be performed at the earliest possible stage of the data acquisition workflow. If the source imagery is returned as a ZIP file, the MD5 checksum of the archive shall be included in the root folder of the archive.

---

[9] http://en.wikipedia.org/wiki/Ftp

[10] http://en.wikipedia.org/wiki/Md5sum

12.3 Ortho image return to the JRC by the FW contractor

12.3.1 The FW contractor shall collect the orthorectified data at the end of every campaign from the MS administrations (and/or their contractors) on behalf of the JRC and provide them to the JRC. The deadline for this data collection is at the end of the control campaign year (i.e. 31st December of each year for CwRS and 31st January of the year after the campaign for LPIS QA).

12.3.2 From 2018 image acquisition campaign onwards ortho image data shall be made available to the JRC by the FW contractor through a dedicated G^{4}CAP OIRTN module. The module requires for each AR to manually select the acquisitions belonging to the same ortho-imagery and the FTP address where to download such ortho-imagery. Each ortho-image return needs its own dedicated FTP address folder.

12.3.3 The ortho data shall be provided to the JRC via standard FTP[11] protocol. The requirements on a minimum transfer speed and a number of connections are the same as for the source data provision, see 12.2.2.

12.3.4 The FW contractor shall provide MD5 checksums for every file included in an acquisition. The same rules are valid as for the source data provision, see 12.2.3

12.3.5 The FW contractor shall provide for each ortho image return a xml metadata file called "JRC metadata" containing following obligatory features:

● EPSG code used for the ortho-rectification of this images

● index of the bands used for the ortho-rectification

The structure of the XML schema and a sample XML can be found in the annex 19.2.

12.3.6 The FW contractor is allowed to delete returned ortho images from FTP as soon as the status in G^{4}CAP OIRTN monitor module change to "Downloaded/OK". However the FW contractor shall keep the ortho data until notice from the JRC.

12.3.7 Returned ortho imagery shall follow below mentioned rules:

• Format: uncompressed GeoTiff (.TIF) or standard Erdas IMAGINE HFA (.IMG) format. Compressed formats like ECW, MrSID will not be accepted.

• Be referenced to a validated Coordinate Reference System (CRS)12. It is strongly recommended to use the official national reference coordinate system.

• To contain all source bands, in original band order.

• To be in original radiometry (i.e. number of bytes/pixel), without histogram stretching.

• In case source imagery has been delivered as a BUNDLE product, return ortho imagery as a BUNDLE product. In case source imagery has been delivered as

---

[11] http://en.wikipedia.org/wiki/Ftp

[12] Validated CRS is an by national or regional institutions officially authorized CRS. It should be double checked to be same as LPIS QA ortho return CRS (see gml ETS reporting packages, and G4CAP_campaign results 'Other issues').

PANSHARPENED product, return ortho imagery as PANSHARPENED product. In case MS administration created own PANSHARPENED product, it will be accepted as valid OIR only if it preserves the original radiometry of the delivered source BUNDLE.

- Image mosaics are accepted only if they preserve original radiometry and all bands in original band order. In case of non-original radiometry and band order, then the orthocorrected image strips as received has to be returned back, with original radiometry and including all bands. The mosaic may be returned as additional product but does not constitute a full OIR.

- Rescaling from 16 bit (respective 11/12 bit) to 8 bit is NOT accepted.

12.4 VHR image access

12.4.1 MS administrations (and their contractors) may access imagery purchased through the FWCs [1]. This image access must follow the principles set up in the licensing agreement between the FW contractor and the JRC, as agreed in the FWC. An end-user licence agreement (EULA)[11] based on the same principles will bind the users from the moment of their registration to G^4CAP [4].

12.4.2 In accordance with the EULA [11], images used in the abovementioned operations may not be disseminated and the resulting products may not be sold. Image access should be arranged through the JRC.

12.4.3 The JRC purchase a limited right of use, but the images themselves remain the property of the FW contractor. In addition, according to the EULA [11], paragraph 6 on IPRs, imagery must have proper references. When using the imagery, the licensee must refer to the supplier with the exact display of the credits as specified in the product's metadata, which will take the form:

'*© owner or supplier name or mission name (year of acquisition, or validity of Framework Contract), all rights reserved)'.*

In addition, the end user should indicate the following information:

'*Data received via the Joint Research Centre of the European Commission under FWC xxx.yyy'*

where the FWC number is available from the JRC.

For the presently running FWCs [1] with European Space Imaging (EUSI), the first sentence above shall be substituted with one of the following:

- 'WorldView-1 data, © European Space Imaging/DigitalGlobe, A Maxar Company, year of acquisition, provided by European Space Imaging';

- 'WorldView-2 data, © European Space Imaging/DigitalGlobe, A Maxar Company, year of acquisition, provided by European Space Imaging';

- 'WorldView-3 data, © European Space Imaging/DigitalGlobe, A Maxar Company, year of acquisition, provided by European Space Imaging';

- 'WorldView-4 data, © European Space Imaging/DigitalGlobe, A Maxar Company, year of acquisition, provided by European Space Imaging';

- 'GeoEye-1 data © European Space Imaging/DigitalGlobe, A Maxar Company, year of acquisition, distributed by European Space Imaging';

- 'KOMPSAT-3 Image, © KARI, provided by SIIS & European Space Imaging';

- 'KOMPSAT-3A Image, © KARI, provided by SIIS & European Space Imaging';

13 VHR image profiles

13.1.1 Since the 2014 Campaign, the MS administrations are able to request a sensor-independent profile of interest for a control zone from an available menu of profiles (see Table 1). Each profile is defined by certain parameters and it is in the FW contractor's responsibility to coordinate the collection and assign the sensors in the most efficient and suitable way.

13.1.2 A summary of the profile characteristics is given in Table 1.

Image Profile ID	Description	Spatial resolution requirement (*)	Radiometric resolution (**) and spectral bands	Minumum Elevation Angle restriction (***)	Cloud Cover (CC) over AOI	Acquisition programming	Resampling	Remarks	Example of sensors
A1. VHR prime - CwRS [std]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	≤10%	Priority programming	sensor dependent	standard CwRS profile	WV3, WV2, GE1, K3, K3A possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)						
	Pan-sharpened	PAN GSD≤0.75m, MS GSD≤3m	at least 4 bands						
A11. VHR prime - CwRS [VHR+][8]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	≤10%	Priority programming	0.50m		WV3, WV2, possibly others not benchmarked yet
		GSD≤3m	MS (at least 8 bands)				2m		
A12. VHR prime - CwRS [VHR+][16]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 50	≤10%	Priority programming	0.50m		WV3, possibly others not benchmarked yet
		GSD≤3m	MS (16 bands; 8 SWIR bands may have coarser resolution)				2m		
A2. VHR prime - [Topographic] [less strict than A5]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	> 56	≤10%	Priority programming	sensor dependent		WV3,WV2, GE1, K3, K3A possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)						
	Pan-sharpened	PAN GSD≤0.75m, MS GSD≤3m	at least 4 bands						
A3. VHR prime - CwRS [Pan only]	Pan	GSD≤0.75m	PAN	> 50	≤10%	Priority programming	sensor dependent		WV3, WV2, GE1, WV1,K3, K3A possibly others not benchmarked yet
A4. VHR prime - CwRS [Stereo]	Pan+Multispectral (Bundle)	GSD≤0.75m	PAN	according to IP specifications	≤10%	Priority programming	sensor dependent		WV3, WV2, GE1, possibly others not benchmarked yet
		GSD≤3m	MS (at least 4 bands)						
	Pan-sharpened	PAN GSD≤0.75m, MS GSD≤3m	at least 4 bands						
A5. VHR prime - CwRS [VHR+ Topographic]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	≤10%	Priority programming	0.40m		WV3,WV2, GE1, possibly others not benchmarked yet
		GSD≤2m	MS (at least 4 bands)	> 67			1.60m		
	Pan-sharpened	PAN GSD≤0.50m, MS GSD≤2m	at least 4 bands	> 67			0.40m		
A51. VHR prime - CwRS [VHR+ Topographic][8]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	≤10%	Priority programming	0.40m		WV3, WV2, possibly others not benchmarked yet
		GSD≤2m	MS (at least 8 bands)	> 67			1.60m		
A52. VHR prime - CwRS [VHR+ Topographic][16]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 67	≤10%	Priority programming	0.40m		WV3, possibly others not benchmarked yet
		GSD≤2m	MS (16 bands; 8 SWIR bands may have coarser resolution)	> 67			1.60m		
A6. VHR prime - CwRS [VHR_EFA_LF]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 50	≤10%	Priority programming	0.50m		WV3,WV2, GE1, possibly others not benchmarked yet
		GSD≤2m	MS (at least 4 bands)				2m		
	Pan-sharpened	PAN GSD≤0.50m, MS GSD≤2m	at least 4 bands				0.50m		
A61. VHR prime - CwRS [VHR_EFA_LF][8]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 50	≤10%	Priority programming	0.50m		WV3, WV2, possibly others not benchmarked yet
		GSD≤2m	MS (at least 8 bands)				2m		
A62. VHR prime - CwRS [VHR_EFA_LF][16]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 50	≤10%	Priority programming	0.50m		WV3, possibly others not benchmarked yet
		GSD≤2m	MS (16 bands; 8 SWIR bands may have coarser resolution)				2m		

Image Profile ID	Description	Spatial resolution requirement (*)	Radiometric resolution (**) and spectral bands	Minumum Elevation Angle restriction (***)	Cloud Cover (CC) over AOI	Acquisition programming	Resampling	Remarks	Example of sensors
A7. VHR prime - near nadir profile [VHR_NN_50]; LPIS	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 80	close to cloud free, haze free, better than ≤10%	Image Provider (IP) best programming, when sensor available	0.50m	new profile; longer acquistion window: typically March-August; AOI chosen by IP within large areas given by JRC	WV2, GE1, possibly others not benchmarked yet
		GSD≤2m	MS (at least 4 bands)	> 80			2m		
	Pan-sharpened	PAN GSD≤0.50m, MS GSD≤2m	at least 4 bands	> 80			0.50m		
A71. VHR prime - near nadir profile [VHR_NN_50]	Pan+Multispectral (Bundle)	GSD≤0.50m	PAN	> 80	≤10%	Priority programming	0.50m	new profile	WV3, WV2, GE1, possibly others not benchmarked yet
		GSD≤2m	MS (at least 4 bands)	> 80			2m		
	Pan-sharpened	PAN GSD≤0.50m, MS GSD≤2m	at least 4 bands	> 80			0.50m		
A8. VHR prime - near nadir profile [VHR_NN_40]; LPIS	Pan+Multispectral (Bundle)	GSD≤0.40m	PAN	> 80	close to cloud free, haze free, better than ≤10%	Image Provider (IP) best programming, when sensor available	0.40m	new profile; longer acquistion window: typically March-August; AOI chosen by IP within large areas given by JRC	WV3, possibly others not benchmarked yet
		GSD≤1.60m	MS (at least 4 bands)	> 80			1.60m		
	Pan-sharpened	PAN GSD≤0.40m, MS GSD≤1.6m	at least 4 bands	> 80			0.40m		
A81 VHR prime - near nadir profile [VHR_NN_40]	Pan+Multispectral (Bundle)	GSD≤0.40m	PAN	> 80	≤10%	Priority programming	0.40m		WV3, possibly others not benchmarked yet
		GSD≤1.60m	MS (at least 4 bands)	> 80			1.60m		
	Pan-sharpened	PAN GSD≤0.40m, MS GSD≤1.6m	at least 4 bands	> 80			0.40m		
B. VHR archive	as any of above	as any of above	as any of above		as any of above	Archive	sensor dependent	used for archive search for any profile	WV4, WV3,WV2, GE1, K3, K3A, WV1
	as any of above	as any of above	as any of above		as any of above	Priority programming	sensor dependent	used for re-task for any profile	WV4, WV3,WV2, GE1, K3, K3A, WV1
	as any of above	as any of above	as any of above		10%>CC≤30%	Priority programming	sensor dependent	proposed for any profile	WV4, WV3,WV2, GE1, K3, K3A, WV1
E. VHR back up	Pan+Multispectral (Bundle)	GSD≤3m	PAN		≤10%	Priority programming	sensor dependent	back up for any profile	WV3,WV2, GE1, K3, K3A, WV1
		GSD≤12m	MS (at least 3 bands)						
	Panchromatic	GSD≤3m	PAN						
	Pan-sharpened	GSD≤3m	at least 3 bands						

(*) GSD in both directions (across track, along track) including the effect of earth curvature should satisfy this criterion

(**) Dynamic range, minumum ≥ 11 bits/pixel

(***) Elevation angle (ELA) of any uploaded strip of an acquisition should satisfy this criterion

Table 1 - VHR profiles adopted within the CAP OTSCs, and the LPIS QA

13.1.3   To fulfil the new CAP requirements, all VHR imagery should have a spatial resolution that is compliant with at least 1:5 000 or larger accuracies. This translates into a required positional accuracy of a maximum 1.25 m 1-D root mean square error (RMSE) and a ground sampling distance (GSD)/pixel size of 75 cm or smaller. The requirements for absolute accuracy for the VHR sensors are in the FWCs [1] and are set to 2 m/1.5 m, depending on the sensor. The RMSEs of the VHR sensors (WV1 [22], WV2 [14], WV3 [13], ~~WV4 [12],~~ GE1 [14]) were, however, shown to be below 1.25 m in the JRC's geometry benchmark studies. Regarding Kompsat-3, the RMSE for a maximum allowed elevation angle of 74.5° (14° ONA) was 1.5m; however, in other, more extensive, studies dealing with the geolocation accuracy of Kompsat-3 imagery, an RMSE below 1 m can be found [19], which is why Kompsat-3 is also allowed as a prime VHR sensor under those restrictions. In order to satisfy GSD requirements the VHR sensor KOMPSAT-3A is restricted to 57.2° (30°ONA).

13.1.4   For a better overview of the existing profiles, and to help the MS administrations in their choice of correct profiles for their controls, the profiles can be represented in a graph of GSD versus elevation angle. See Figure 3.
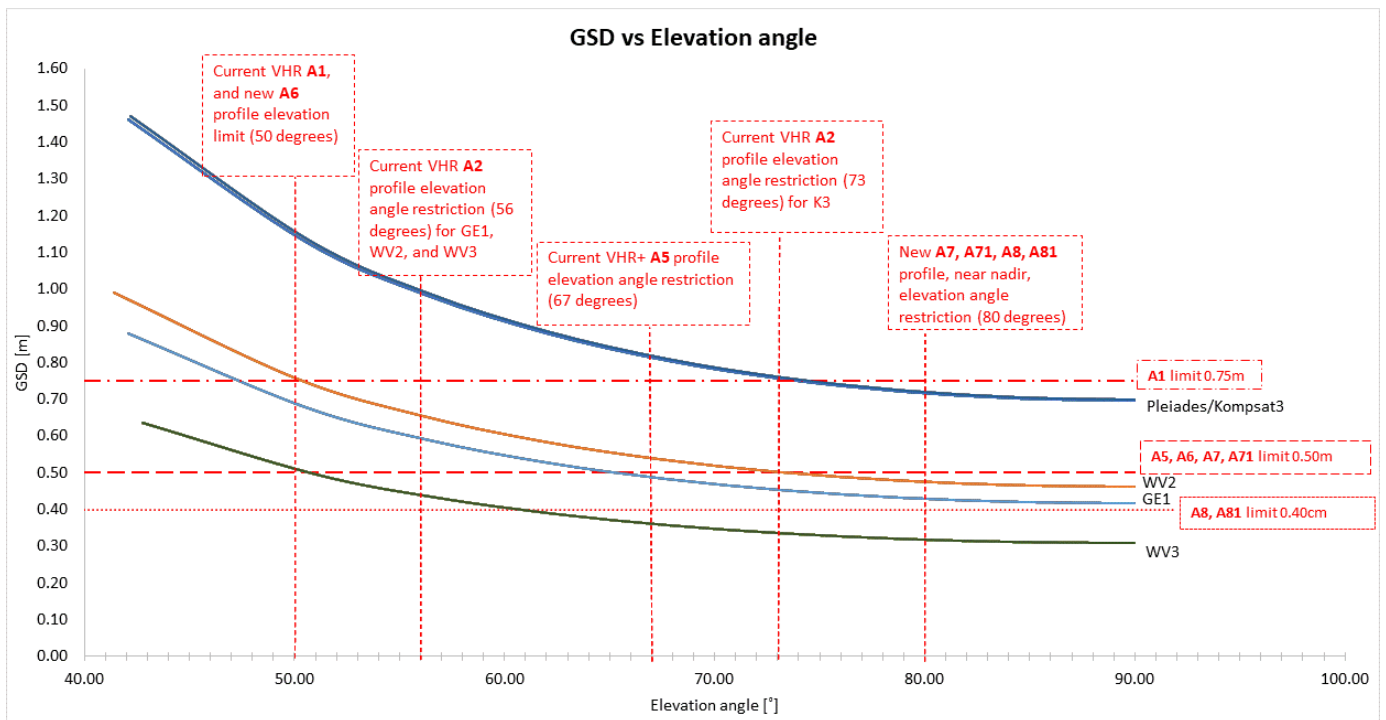
Figure 3 - GSD versus elevation angle for the VHR profiles

13.1.5 The VHR zone will be covered by a bundle product (PAN and 4 bands MSP as separate bands), the PSH product or the PAN-only product. If the profile A4 (VHR stereo) is requested, a stereo product will be delivered. PAN and 8 bands MSP products (A.11/A.51/A.61 profiles) or PAN and 16 bands MSP products (A.12/A.52/A.62 profiles) are also options, but the requirement for such profiles must be negotiated bilaterally with the JRC at the pre-IR stage.

13.1.6 The technical details of the sensors that fit the abovementioned profiles are explained in Annex 19.5.

13.2 LPIS-specific profiles

13.2.1 For the LPIS QA Campaign, the VHR image acquisition approach guarantees close to nadir (threshold > 80 degree elevation angle), haze-free and nearly cloud-free imagery. See Table 1 for the specific profiles used in the LPIS QA. See Chapter 16 for a more detailed description of LPIS QA image acquisition.

14 Quality assurance/quality control

14.1 Quality assurance/quality control

14.1.1 The principal objective of the CAP image acquisition is to reach the goal of a minimum 95% success rate of images supplied on time and according to specifications. To ensure this, an adequate QA/QC process must be put in place; the FW contractor shall therefore apply QA and internal QC to the imagery and to the process of performing image acquisition. The JRC will have an overarching role in applying external QC to the procedures that the FW contractor has set up. This is performed through specific deliverables, QCRs and QC visits throughout the contract between the FW contractor and the JRC [1].

14.1.2 QA may be defined as the steps performed to ensure that the production of a product meets a set of accepted standards. QC aims to detect non-conformities in a product.

14.1.3 QC includes assessment of issues such as data integrity, data completeness, CC, haze or thin clouds, cloud shadows, fog, smoke, smog, snow, flares, etc. It also includes assessing the product geometry, radiometry, image characteristics (dropouts, etc.), the production parameters (resampling algorithm, bit depth), etc.

14.1.4 The FW contractor will follow their internally defined QA/QC procedures on their products including at least the issues mentioned above. They will deliver a conforming product or propose a non-conforming product for evaluation, clearly stating reasons for QC failure – such an image will be treated as a 'proposed' image. A proposed image can also be, for example, an acquisition at an elevation angle below the requirement.

14.2 Specificities on cloud cover

14.2.1 Cloud will be defined as a white opaque area with little or no image information available of the ground features below. It does not include cloud shadow. Dense haze, which causes consistent muting of imagery, should be included.

14.2.2 There are different CC assessment routines, for example:

a) Automatic or semi-automatic thresholding, with subsequent quality factor including issues of dense haze, haze, smoke, pollution, snow, shadow, etc. A visual observation after classification is required to adjust CC, taking into account issues of dense haze, cloud conglomeration, etc.

b) Manual photo interpretation and subsequent vector digitising. If a definite boundary between affected pixels and unaffected pixels is visible, it is a cloud.

14.2.3 The JRC decided that imposing a common CC assessment approach on the FW contractor is not efficient. The CC assessment should result in an agreement between the FW contractor and the MS administrations (or contractors), otherwise the FW contractor must report to the JRC, which has the right to decide.

14.2.4 Both approaches in section 14.2.2 are accepted by the JRC. However, to arrive at an efficient CAP checks programme with a successful outcome, the MS administration (or contractor) and the FW contractor should aim for optimisation of the image use.

14.2.5 CC validation and MeteoFlagging should follow the procedure described in Chapter 7.

14.2.6 The accuracy to which CC assessment will be performed is better than 1% of CC definition.

15 Risk of satellite failure

15.1.1 The FW contractor is responsible for communicating any technical problem connected to a satellite sensor, the receiving station or the processing chain as soon as possible to the JRC. This is important to limit risks to the campaign by allowing switching to other satellite sensors or switching to traditional OTSC for the checks of the area-based subsidies.

15.1.2 The malfunction of the WV-4 control moment gyros is considered non repairable. Therefore the WorldView-4 satellite is unfortunately considered lost. However, all other satellites that are operated by Maxar (WorldView-1, WorldView-2, WorldView-3 and GeoEye-1) are reported to be in perfect working order.

16 LPIS QA image acquisition

16.1 LPIS QA introduction

16.1.1 The LPIS QA is a yearly exercise that has been jointly organised since 2010 by the EC (through the JRC) and the MS Administrations. It consists in an evaluation of the quality of the LPIS systems based on a sample of the reference parcels (RPs) and a recent photo-interpretation of the parcel boundaries and interiors. A set of quality elements have been defined by the EC and compared with limiting quality thresholds. The LPIS QA sample requirements are driven by ISO Standard 2859/2 [3].

16.1.2 In practice, the JRC orders the images directly from the IP. The images are stored and kept confidentially until the MS Administrations upload the full population, subject to the LPIS QA exercise of the campaign. After several quality checks on the population sent, the JRC crops the submitted population to the zone delimited by the images and proceeds with a random selection of the *sample pre-selection*, which consists of a 3 times the target sample size (i.e. 500/800/1 250 RPs), depending on the population size) [3].

16.1.3 The LPIS QA exercise is performed at LPIS system level. The 28 European MSs there are 44 LPIS systems running. Belgium, Germany and the United Kingdom split their national territories following their administrative regional boundaries: Belgium is split into two regions (Wallonia and Flanders), Germany into 13 *Bundesländer* and the United Kingdom into four countries (England, Scotland, Wales and Northern Ireland). During the LPIS QA exercise MSs (or LPIS system custodians) inspect what they consider a homogeneous population (lot) of their RPs. All MSs/LPIS custodians send one lot for each sub-population (usually MS's/LPIS custodians send one per LPIS system). The LPIS QA zones for the LPIS QA image acquisition campaign have been created by further subdivision of the 44 LPIS systems. It is very important to mention that for the MS's/LPIS systems that are subdivided into many LPIS QA zones different restrictions for the image acquisition are applied (see Chapter on Image Acquisition below 16.6).

16.1.4 Until 2014 inclusive, the samples were taken from a subset of the CwRS zones from the current campaign's OTS control period, to minimise the inspection burden for the MSs. The selection of the zones was, in this case, known in advance by the MS Administrations.

16.1.5 After an evaluation in 2014, the JRC set up an image acquisition procedure in which the LPIS QA zones are not known by the MS Administrations before the beginning of the LPIS QA measurements. The objectives of the procedure were to:

- rely on better quality images for the inspections;

- reduce the logistical burdens of control zone selection and RP sample generation;

- as a result of the point above, facilitate complementary field observations; and

- most importantly, rely on random zone selection.

16.2 Pre-image requests assessment

16.2.1 No input is required from the MS Administrations for this exercise except the preparatory work described in Chapter 2.

16.3 LPIS QA zones definition

16.3.1 The number of LPIS QA zones by LPIS system will be determined based on the proper characteristics of the corresponding LPIS system and according to the statistical analysis performed considering the RP population. Basically, the concept of determining the number of zones is as follows:

- One image will be assigned for small countries/LPIS systems, such as Malta and DE_SL (Saarland in Germany) requiring a sample of 500 RPs.

- Two or three images will automatically be assigned to LPIS systems requiring samples of 800 and 1 250 RPs, respectively.

- Extra image(s) will be allocated to larger LPIS systems:

- +1 when $0.05 \leq \sin(lat_{\max}) - \sin(lat_{\min}) \leq 0.07$;

- +2 when $\sin(lat_{\max}) - \sin(lat_{\min}) \geq 0.07$,

  where lat_{min} and lat_{max} are, respectively, the minimum and maximum latitudes of the corresponding LPIS system. This latitude parameter is chosen because it is closely linked the bio-geographical zoning.

In addition, additional images might be allocated based on the statistical analysis of the representativeness of the sample; that is, for LPIS systems with one or two images, an additional image will be proposed. Relying on a single image (where sample size is 500 RPs), according to the abovementioned concept, might not be appropriate when extending the result of the sample to the whole population. The reason is that it could be affected by where this unique zone is located. To avoid this possibility, according to the recommendations of the ECA, it was decided to guarantee two or three images per LPIS system (except for DE_SL and Malta, for which the representativeness of the samples is already satisfactory and for which the 15 ×15 km unique image already represents a significant percentage of their total territory: 9% for DE_SL and 70% for Malta).

16.3.2 This gives a total of 44 LPIS systems, to which between 1 and 6 zones each will be allocated. For the systems where extra zones will be allocated, a sub-division of the system will be created as a spatial aggregation of the NUTS2 regions, with the constraint that each aggregation should contain roughly the same number of RPs.

16.3.3 Finally, the zones with a density of RPs lower than two parcels per km² will be regrouped into two zones (PAN EU, includes the parts of Europe with a low density of agriculture parcels is split into two parts i.e. northern and southern part) for which two LPIS QA images will be requested to guarantee the chance of selection for RPs inside these low-density areas (one image per each (northern and southern) PANEU zone). The zones with no RPs are completely excluded for the acquisition of the images.

16.3.4 In practice, the European Union (EU) territory will be split into a number of different zones (90 in 2019) for which a number of images/acquisitions are expected to be acquired for the purpose of the LPIS QA. The resulting zones will be uploaded directly to G^{4}CAP.

16.4 Acquisition window definition

16.4.1 The AW for the LPIS QA VHR imagery to be acquired will normally be February/March to August. There are no common criteria for the definition of AW dates; however, the following principles form a basis:

- The decision was made that the starting date of LPIS QA acquisition of an LPIS (or a neighbouring system if an MS does not participate in the CwRS campaign) will be 1 month before starting its earliest CwRS AW.

- For the PAN EU zones, the most restrictive criteria will be used, that is, the latest starting date for the CwRS over the PAN EU masks.

- The end date for all zones will be 31 August 2020.

16.4.2 The proposed dates of AWs will be communicated bilaterally between the JRC and the MS's LPIS custodians. They can propose an alternative AW only with an appropriate reason. The final AW will be inserted for each LPIS QA zone directly in G^{4}CAP by JRC.

16.5 Feasibility assessment

16.5.1 No feasibility assessment is performed by the IP. Acquisition is performed without a feasibility assessment, since the IP will be responsible for acquiring the requested number of LPIS images per LPIS region/zone. It will select LPIS image(s) randomly, taking into account collection efficiency (within priority tasking), weather forecast and real time weather development and in accordance with the image profile requirement (see Chapter 13 for image profiles).

16.6 Image acquisition

16.6.1 The LPIS QA image acquisition (ARs, QLs, acquisition acceptance (validation) and ordering) is managed by the IP and the JRC, without interfacing with the MS Administration (or contractor).

16.6.2 For the LPIS QA Campaign, the VHR image acquisition approach guarantees images with the following basic characteristics: close to nadir (threshold > 80 degree elevation angle), snow-free, haze-free and nearly cloud-free imagery (see Chapter 13 for image profiles).

16.6.3 The IP is in exceptional cases allowed to upload a slightly hazy and snowy image. The acquisition is uploaded as 'validated', but with the meteo-flag ON, and with a comment like: "LPIS haze (snowy) image; to be checked at IDQA". JRC will at IDQA verify usability and if QC accepts image, the IP shall stop programming.

16.6.4 All CwRS and LPIS QA QLs images uploaded in G^{4}CAP are enhanced by the AComp algorithm (see 6.1.6). If the LPIS QA acquisition is uploaded with the meteo-flag ON also the final product will be enhanced by AComp algorithm. Non AComp'd QL and/or final product can be delivered on request.

16.6.5 The IP will collect the data as of the LPIS QA IRs inserted in G^{4}CAP. The resampling shall in any case be carried out to best accommodate a 1:1 ratio of acquired GSD : delivered output pixels.

16.6.6 General restrictions for the data collections per satellite overpass are as follows:

- It is possible to collect only one image per LPIS QA zone in one pass. In the exceptional cases, i.e. in the zones with very bad weather conditions and in the second half of the acquisition window, it will be possible to collect two images in one pass trying to maximize distance between two resulting zones (the rule about a minimum distance of 200 km does not apply then). IP should report which zones are affected with bad weather conditions before expiration of the first half of the AW in order to activate that possibility.

- It is not possible to collect two images in the same strip/pass between two neighbouring LPIS QA zones within a single MS/LPIS system if the distance between the resulting zones is less than 200 km (see Figure 4)

- Within a single MS or a single LPIS system divided into several LPIS QA zones, it is possible to collect more images per MS/LPIS system in one pass if the distance between the resulting zones is more than 200km (see Figure 5).

- Between two neighbouring MSs/LPIS systems it is possible to collect two images (one per country/system) from one single pass if the distance between the two selected zones (from one satellite pass) is more than 200km (see Figure 5).

- The PANEU zone is split into PANEU-1 (north) and PANEU-2 (south) zones. One image is planned per each PANEU zone, but they should be taken in two separate satellite passes.

- All other cases not mentioned in the text above, in terms of the image acquisition, should be communicated between IP and JRC.

Image strip	*Possible solutions*
Image strip MS1 or LPIS system1 (LPISQA zone x) Satellite ground track LPISQA zone border line (virtual border within the same MS/LPIS system) MS1 or LPIS system1 (LPISQA zone y)	Selected zone **1** Image strip MS1 or LPIS system1 (LPISQA zone x) Satellite ground track LPISQA zone border line (virtual border within the same MS/LPIS system) MS1 or LPIS system1 (LPISQA zone y) or

Figure 4 - Image selection from the single image strip within the same MS/LPIS system
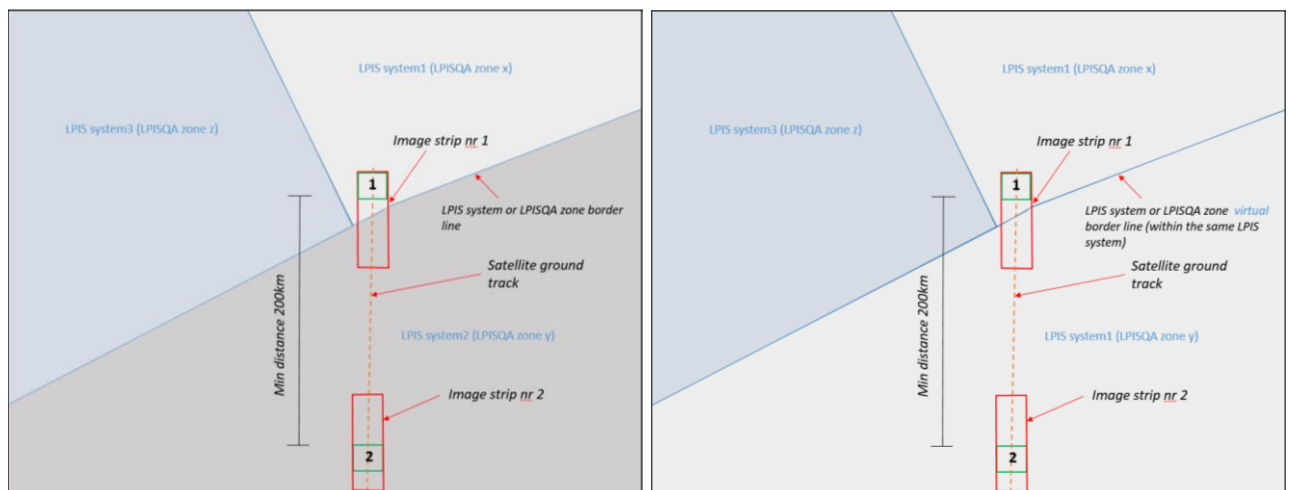
Figure 5 - Left: Image selection from the single satellite pass between two different LPIS systems (two LPIS QA zones; right : Image selection from the single satellite pass within the same LPIS system or LPIS QA zones (two LPIS QA zones)

16.7 Image delivery

16.7.1 The IP should strive to create the simplest suitable shape (a square). By default a shape of 15 km × 15 km (225 km^2) image in the UTM projection, shall be created. In the cases where the resulting shape might be affected by the coastal line, border line or in order to avoid the clouds, it is possible that a resulting zone of an image has an irregular/complex shape.

- General rules for the shapes with only four vertices:

  - square shape (a = b);

  - rectangular shape (a ≠ b),

  - regular, but not rectangular, shapes (parallelogram, rhombus, kite, trapezoid, etc., with minimum internal angle of 60 deg);

- irregular shapes (irregular quadrilateral, with minimum internal angle 60 deg);

- for the elongated shapes it is recommended that the ratio of the shape's short/long sides is below 1:5

- For the shapes with more than four vertices (where the shape depends on a borderline, coastline or area of inland water or was created to exclude cloud), these cases will be dealt bilaterally before delivery.

- Also, it is recommended to avoid spikes when creating the shapes. A spike is defined as an internal angle between two long segments of the shape. It is recommended that internal angle is bigger than 60deg. This rule is applicable also for the rhombus, kite and trapezoid types of the shapes (see Figure 6). For "L" types of the shapes, it is recommended that the short segments are not shorter than 5km.
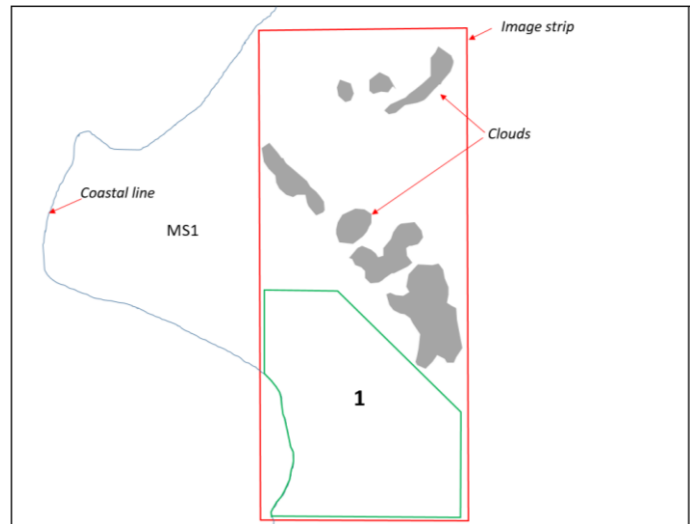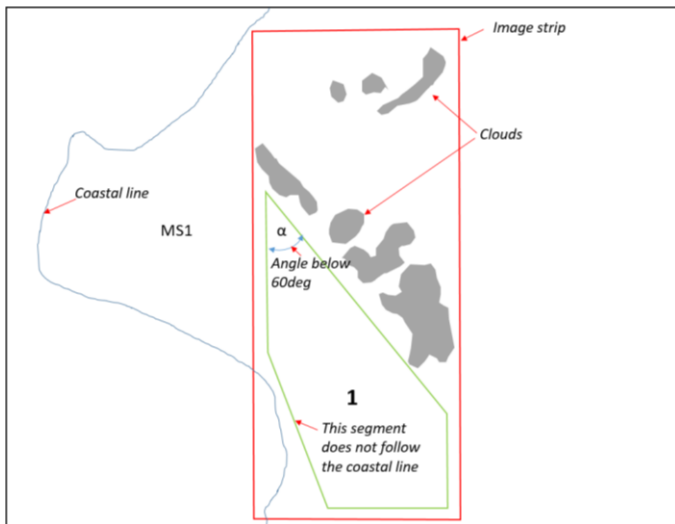
The resulting shape is affected by a spike and one segment of the shape does not follow the coastal line

The spike has been eliminated and the resulting shape follows the coastal line

Figure 6 - Image selection from the single satellite pass between two countries (left: bad choice; right: good choice)

- Additional manual creation of the shape can be applied in the cases when the clouds should be excluded (see figure 6) in order to respect the CC thresholds and when larger parts of the lakes/seas are at the border of the resulting shape/zone.

- An irregular shape defined by using a coastal line provided by the JRC. Also, under certain conditions, such as a group of small islands, it is necessary to create a shape in such a way that these islands are included (see Figure 7). Small islands

without agricultural parcels and reefs without agricultural parcels are already excluded from any LPISQA zone at the zones definition procedure.
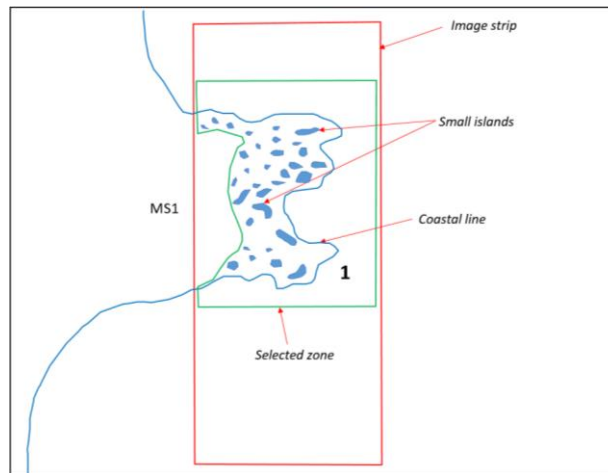
Figure 7 - Specific case with a group of small islands

- All other possible cases in terms of the shape creation not mentioned in the text above should be communicated between IP and JRC.

In general, in above ad hoc shape creation (complex cases belonging to this chapter 16.7.1) JRC will upon request assist the IP to create most efficient AOI.

16.7.2 Bonus images may be required as follows:

- After the MS finishes the upload of the LPIS QA population, the JRC performs an evaluation of whether or not the required number of the RPs can be selected within the acquired images. If the required number of RPs cannot be selected within the already acquired images, a bonus image will be requested from the IP.

- The AW for the requested bonus image should be at least 4 weeks. If it is not possible to guarantee this minimum length of AW, an eventual failure of the acquisition is not counted in the statistics for the LPIS success rate.

16.7.3 Contingency – in the case of an image acquisition failure and after expiration of the acquisition window, the contingency measures shall apply in the following order:

- extension of the AW (the length of the extension will be established after the evaluation and may last between two and four weeks maximum);

- use of a part of a CwRS image (depending on availability of CWRS imagery fulfilling the LPISQA image acquisition requirements);

- use of any other image appropriate for the LPISQA which will be purchased as archive image.

16.8 Workflow - simplified

16.8.1 The LPIS QA image acquisition workflow can be summarised as follows:

- The JRC manages the image acquisition for all LPIS systems together with the IP.

- Zones definition, creation and upload to the G4CAP.

- Starting with 28 MS's, there are a total of 44 LPIS systems (because in addition Germany is divided into 13 systems, Belgium into two and the United Kingdom into four system)

- Based on the RP population (from the previous year), the JRC calculates the density map.

- The JRC performs the analysis of the density and makes a decision regarding divisions at the country (or LPIS system) level (giving a total of LPIS zones for the campaign (90 LPIS QA zones in 2019)

- The JRC uploads the final polygons into G4CAP (LPIS systems, subdivided polygons plus two PAN EU zones) with the required number of images per each LPIS QA zone.

- The JRC defines the AWs for each single LPIS QA zone in G^4CAP

- The IP performs image acquisition.

- The JRC performs IDQA.

- The success rate of the acquisition of LPIS QA imagery, after all contingency measures, is kept separate from the calculated 95% contractual threshold on CwRS.

17 JRC responsible staff and e-mail addresses

17.1.1 Directorate D Sustainable Resources/Unit D.5/image acquisition: par-johan.astrand@ec.europa.eu.

17.1.2 Directorate D Sustainable resources/Unit D.5/contractual FWC: philippe.loudjani@ec.europa.eu.

18 References

1. FWCs for satellite image purchase held at the JRC:

   a. Framework contracts for supply of Satellite Remote Sensing (SRS) data and associated services in support to checks within the Common Agricultural Policy (CAP); (1) VHR profile II FWC 931.886, VHR+ profile FWC 199.309, with European Space Imaging GmbH; (2) HHR profile FWC 198.995 with Airbus Defence and Space.

   b. Framework contract for supply of any type of satellite remote sensing data, Broker FWC 391.782.

2. Access to European Union law. Available online: http://eur-lex.europa.eu/homepage.html

3. LPIS QA and OTSC guidance and discussion documents on the future checks by monitoring; (WikiCAP). Available online:

   https://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page

4. G^{4}CAP. Available online: https://g4cap.jrc.ec.europa.eu

5. Common technical specifications (CTS) and guidance documentation. Available online:

   https://marswiki.jrc.ec.europa.eu/wikicap/index.php/Main_Page

6. Kapnias, D., Milenov, P. and Kay, S., Guidelines for best practice and quality checking of ortho imagery, Issue 3.0. Available online:

   https://g4cap.jrc.ec.europa.eu/g4cap/Portals/0/Documents/10133.pdf

7. HR 'profile based' specifications. See "Documentation" section in G^{4}CAP Web site.

8. G4CAP manual. Available online:

   https://g4cap.jrc.ec.europa.eu/g4cap/Portals/0/Documents/G4CAP%20user%20manual%203.4.pdf?ver=2018-03-28-132028-250

9. Archives for the VHR FWC search tools. Available online:

   a. http://www.euspaceimaging.com/imagery-search; https://discover.digitalglobe.com/ for GE1 and WV1–4; http://arirang.kari.re.kr/ for KOMPSAT-3 and KOMPSAT-3A.

10. *Digital globe atmospheric compensation*, white paper. Available online:

    http://digitalglobe-marketing.s3.amazonaws.com/files/documents/AComp_WP_ACOMP.pdf

11. Satellite remote sensing data EULA. Available online:

    https://g4cap.jrc.ec.europa.eu/g4cap/EULA.htm

12. Vajsova, B., Walczynska, A., Åstrand, P., Bärisch, S. and Hain, S., New sensors benchmark report on WorldView-4. Geometric benchmarking over Maussane test site for CAP purposes, PUBSY JRC107673, EUR 28761 EN, ISBN 978-92-79-73187-7, ISSN

1831-9424, doi: 10.2760/872158, 2017. Available online:

http://publications.jrc.ec.europa.eu/repository/handle/JRC107673

13   Benchmarking Worldview-3 sensor for use in the CAP CwRS programme: Vajsova, B.,
        Walczynska, A., Åstrand, P., Bärisch, S. and Hain, S., New sensors benchmark report on
        WorldView-3. Geometric benchmarking over Maussane test site for CAP purposes,
        PUBSY JRC99433, EUR 27673 EN, ISBN 978-92-79-54236-7, ISSN 1831-9424,
        doi:10.2788/237561, 2015. Available online:

        http://publications.jrc.ec.europa.eu/repository/handle/JRC99433

14   Benchmarking Worldview-2, GE1, DMCII, THEOS, Kompsat-2 for use in the CAP CwRS
        programme:

15   Nowak Da Costa, J. and Walczynska, A., Evaluating the WorldView-2, GeoEye-1, DMCII,
        THEOS and KOMPSAT-2 imagery for use in the Common Agricultural Policy Control
        with Remote Sensing Programme, oral presentation (JRC61995), 16th Conference on
        'Geomatics in support of the CAP', GeoCAP Action of the MARS Unit, IPSC, JRC
        (organiser),   24   November   2010,   Bergamo,   Italy.   PUBSY:
        http://publications.jrc.ec.europa.eu/repository/

16   Nowak Da Costa, J. K., Geometric quality analysis of the WorldView2 Basic (level 1A)
        and OrthoReady (level 2A) images acquired over the JRC MARS Unit's Maussane
        terrestrial test site, JRC Scientific and Technical Report No 24525 EN, 2010, ISSN 1018-
        5593,   ISBN   978-92-79-15625,   JRC   PUBSY   Category   2.2,   No JRC60424
        http://publications.jrc.ec.europa.eu/repository/handle/JRC60424

17   Sensitivity analysis of the WorldView-2 satellite orthoimage horizontal accuracy... (ref.
        JRC   IES/H04/C/PAR/par   D(2011)(13754)   ),   PUBSY   JRC66797.
        http://publications.jrc.ec.europa.eu/repository/handle/JRC66797

18   WorldView-2 potentialities for orthoimage production within the Control with Remote
        Sensing   Programme   of   the   European   Commission   ,PUBSY   JRC67516,
        http://publications.jrc.ec.europa.eu/repository/handle/JRC67516

19   Benchmarking the Kompsat-3 for use in the CAP CwRS programme:

20   Vajsová, B., Walczynska, A., Bärisch, S., Aastrand, P. and Hain, S., New sensors
        benchmark report on Kompsat-3, PUBSY JRC93093, EUR 27064 EN, ISBN 978-92-79-
        45054-9,   ISSN   1831-9424,   doi:10.2788/240349,   2015.   Available   online:
        http://publications.jrc.ec.europa.eu/repository/handle/JRC93093

21   Jeong, J., Kim, J. and Kim, T., 'Analysis of geolocation accuracy of KOMPSAT-3
        imagery', Korean Journal of Remote Sensing, Vol. 30, pp. 37–45, DOI:

10.7780/kjrs.2014.30.1.4.   Available   online:

http://koreascience.or.kr/article/ArticleFullRecord.jsp?cn=OGCSBN_2014_v30n1_37

22   Benchmarking the WorldView-1 sensor for use in the CAP CwRS programme (PUBSY

JRC 49378), Category 3.4, oral presentation;

http://publications.jrc.ec.europa.eu/repository/

23   Vajsová, B., Walczynska, A., Bärisch, S., Aastrand, P. and Rankl, M., New sensors

benchmark report on KOMPSAT-3A: Geometric benchmarking over Maussane test site

for CAP purposes, JRC112656, EUR 29331 EN, ISBN 978-92-79-92955-7, ISSN 1831-

9424,   doi: 10.2760/321649,   2018.   Available   online:

http://publications.jrc.ec.europa.eu/repository/handle/JRC112656

19 Annexes

19.1 XML metadata file specification for image providers used for the QL upload

For more details, please see G⁴CAP user manual [8].

Zip archive

The IP must upload a zip archive containing the following files:

- one XML file with the metadata of the image file(s) or shape(s) to be uploaded;

- image file(s);

- shapefile(s);

- other file(s) for geo-referencing (if applicable).

This is an example of XML upload to upload two different acquisitions in the same AR. Green nodes and attributes are the ones differing from the previous *LIO XML upload file.

Code 1 - Example of xml metadata file for G⁴CAP QL upload

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>

<G4CAP xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="https://g4cap.jrc.ec.europa.eu/Portals/0/g4capAcquisitionU
pload.xsd">

<Acquisition>

<ARID>65843</ARID>

<AcquisitionDate>12.02.2016</AcquisitionDate>

<Sensor backup="true" imageMode="psh">WORLDVIEW02</Sensor>

      <Comment>This is a comment for you.</Comment>

      <CloudCover>1.98</CloudCover>

      <MeteoFlag>SNOW</MeteoFlag>

      <Shape>

            <Filename>test.shp</Filename>

      </Shape>

      <Strips>

            <Strip>

                  <Elevation>64.15</Elevation>

                  <Filename>WV20250071G101P_000040462_Browse_0.jpg</Filename>

            </Strip>

            <Strip>

                  <Elevation>68</Elevation>

                  <Filename>WV20250071G101P_000040462_Browse_1.jpg</Filename>

            </Strip>
```

```
        </Strips>
    </Acquisition>
    <Acquisition>
        <ARID>65843</ARID>
        <AcquisitionDate>15/02/2016</AcquisitionDate>
        <Sensor>WORLDVIEW04</Sensor>
        <Comment>This is a new comment for you.</Comment>
        <CloudCover>0.0</CloudCover>
        <MeteoFlag/>
        <Shape>
                <Filename>test2.shp</Filename>
        </Shape>
        <Strips>
                <Strip>
                        <Elevation>61.15</Elevation>
                        <Filename>WV20250071G123P_000040462_Browse_0.jpg</Filename>
                </Strip>
                <Strip>
                        <Elevation>60</Elevation>
                        <Filename>WV22350071G101P_000040462_Browse_1.jpg</Filename>
                </Strip>
        </Strips>
    </Acquisition>
</G4CAP>
```

XML Schema Definition (XSD)

This XSD is publicly available at
https://g4cap.jrc.ec.europa.eu/Portals/0/g4capAcquisitionUpload.xsd.

Code 2 - XML metadata file structure

```
<xs:schema attributeFormDefault="unqualified" elementFormDefault="qualified"
xmlns:xs="http://www.w3.org/2001/XMLSchema">
    <xs:element name="G4CAP">
        <xs:complexType>
        <xs:sequence>
                <xs:element name="Acquisition" maxOccurs="unbounded" minOccurs="1">
                <xs:complexType>
                        <xs:sequence>
        <xs:element type="xs:int" name="ARID"/>
        <xs:element type="xs:string" name="AcquisitionDate"/>
        <xs:element name="Sensor">
        <xs:complexType>
```

```xml
      <xs:simpleContent>
                                <xs:extension base="xs:string">
      <xs:attribute type="xs:boolean" name="backup"/>
      <xs:attribute type="xs:string" name="imageMode"/>
                                </xs:extension>
      </xs:simpleContent>
                        </xs:complexType>
      </xs:element>
      <xs:element type="xs:string" name="Comment" minOccurs="0"/>
      <xs:element type="xs:float" name="CloudCover"/>
      <xs:element type="xs:string" name="MeteoFlag" minOccurs="0"/>
      <xs:element name="Shape">
                        <xs:complexType>
      <xs:sequence>
                                <xs:element type="xs:string" name="Filename"/>
      </xs:sequence>
                        </xs:complexType>
      </xs:element>
      <xs:element name="Strips">
                        <xs:complexType>
      <xs:sequence>
                                <xs:element name="Strip" maxOccurs="unbounded"
minOccurs="1">
      <xs:complexType>
                                        <xs:sequence>
      <xs:element type="xs:float" name="Elevation"/>
      <xs:element type="xs:string" name="Filename"/>
                                        </xs:sequence>
      </xs:complexType>
                                </xs:element>
      </xs:sequence>
                        </xs:complexType>
      </xs:element>
                  </xs:sequence>
      </xs:complexType>
      </xs:element>
          </xs:sequence>
      </xs:complexType>
   </xs:element>
 </xs:schema>
```

Table 2 - Main structure nodes

TAG	DESCRIPTION	CARDINALITY
G⁴CAP	Main container	1
Acquisition	Main container for a single acquisition	1-n
Shape	Container for shapefile information	1
Strips	Container for strips information	1
Strip	Container for single strip information	1-n

Table 3 - XML metadata file, values

METADATUM	TYPE	DESCRIPTION	VALUES	REQ.
ARID	Integer	AR unique identifier	The ID of AR (where to upload this acquisition)	X
AcquisitionDate	Date	Date of acquisition	dd.MM.yyyy or dd/MM/yyyy – this must be inside the AW and not in the future	X
Sensor	Enum	Name or abbreviation of sensor used to acquire the imagery	See *Sensors* table	X
Comment	String (4096)	Acquisition comment, to be used for any kind of non-standard communication about the acquisition itself, for issues that could be useful at AUDIT level, or as a future reminder	Free text (4 096 characters)	
CloudCover	Double	Cloud coverage percentage over the whole acquisition area	$0.00 \le CC < 100.00$	X
MeteoFlag	Enum	Whether or not the imagery presents a meteorological issue	See *MeteoFlag* table	
Filename	String	Name of the file inside the .zip archive	Name of one of the files in the uploaded .zip archive	X
Elevation	Double	Elevation angle of the single strip	50.00 (for HHR 58.00) $\le$ elevation angle ≤ 90.00	X

Table 4 - Possible values for the sensor tag, their allowed abbreviations and their combination with profiles

VALUE	ABBREVIATION	POSSIBLE PROFILES
UK-DMC2	DMC2	n/a
GEOEYE-1	GE01	A1, A2, A3, A4, A5, A6, A7, A71, B, C, E
WORLDVIEW-1	WV01	A3, B, C, E
WORLDVIEW-2	WV02	A1, A11, A2, A3, A4, A5, A51, A6, A61, A7, A71, B, C, E
WORLDVIEW-3	WV03	A1, A11, A12, A2, A3, A4, A5, A51, A52, A6, A61, A62, A7, A71, A8, A81, B, C, E
~~WORLDVIEW-4~~	~~WV04~~	~~A1, A2, A3, A4, A5, A6, A7, A71, A8, A81, B, C, E~~
KOMPSAT-3	K03	A1, A2, B, C, E
KOMPSAT-3A	K03A	A1, A2, B, C, E
SPOT6	S6	F1, F2
SPOT7	S7	F1, F2
PlanetScope	PS2	F1, F14, F2, F24 (multispectral MSP mode only)
PLEIADES-1A	PL1A	Broker
PLEIADES-1B	PL1B	Broker
DEIMOS-1	D1	n/a
DEIMOS-2	D2	F1, F2
SENTINEL-2A	S2A	n/a

Table 5 - Possible values for MeteoFlag and their description

VALUE	DESCRIPTION
Haze	Haze in the imagery
Snow	Presence of snow in the imagery
Flood	Presence of floods in the imagery
Mixed	Presence of different issues in the imagery, or the issue cannot be determined

Table 6 - Possible values for ImageMode node and their description

VALUE	DESCRIPTION
PAN	Panchromatic
MSP	Multispectral
PSH	Pansharpened
BUN	Bundle

19.2 XML metadata file specification for operators used for the OIRTN upload

Code 3 - Example of xml metadata file for G⁴CAP QL upload

```xml
<G4CAP xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:noNamespaceSchemaLocation="https://g4cap.jrc.ec.europa.eu/g4cap/Portals/0/D
ocuments/G4CAPOrthoIRTN.xsd">
            <OIRTN>
                    <Acquisitions>
                            <AcqID>12313</AcqID>
                            <AcqID>41233</AcqID>
                            <AcqID>22318</AcqID>
                    </Acquisitions>
                    <EPSG>12893</EPSG>
                    <Comments>We used an auxiliary imagery not provided by EC</Comments>
            <Bands>
                    <Band>
                            <BandIndex>1</BandIndex>
                            <BandComment>BAND_B</BandComment>
                    </Band>
                    <Band>
                            <BandIndex>2</BandIndex>
                            <BandComment>BAND_G</BandComment>
                    </Band>
                    <Band>
                            <BandIndex>3</BandIndex>
                            <BandComment>BAND_R</BandComment>
                    </Band>
                    <Band>
                            <BandIndex>4</BandIndex>
                            <BandComment>BAND_N</BandComment>
                    </Band>
            </Bands>
        </OIRTN>
</G4CAP>
```

Code 4 - XML metadata file structure

```xml
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" attributeFormDefault="unqualified"
elementFormDefault="qualified">

<xs:element name="G4CAP">

    <xs:complexType>

            <xs:sequence>

                    <xs:element name="OIRTN" maxOccurs="1" minOccurs="1">

                        <xs:complexType>

                            <xs:sequence>

                                <xs:element name="Acquisitions">

                                    <xs:complexType>

                                        <xs:sequence>

                                            <xs:element
name="AcqID" type="xs:int" maxOccurs="unbounded" minOccurs="1"/>

                                        </xs:sequence>

                                    </xs:complexType>

                                </xs:element>

                                <xs:element type="xs:int" name="EPSG"/>

                                <xs:element type="xs:string"
name="Comments" minOccurs="0"/>

                                <xs:element name="Bands">

                                    <xs:complexType>

                                        <xs:sequence>

                                            <xs:element
name="Band" maxOccurs="unbounded" minOccurs="1">

  <xs:complexType>

  <xs:sequence>

  <xs:element name="BandIndex" type="xs:int" minOccurs="1"/>

  <xs:element name="BandComment" type="xs:string" minOccurs="0"/>

  </xs:sequence>

  </xs:complexType>

                                            </xs:element>

                                        </xs:sequence>

                                    </xs:complexType>

                                </xs:element>

                            </xs:sequence>

                        </xs:complexType>

                    </xs:element>

            </xs:sequence>
```

```
            </xs:complexType>
    </xs:element>
</xs:schema>
```

19.3 General recommendations for a buffer creation around CwRS zones

Minimum elevation angle 50° Relevant profiles: A1, A11, A12, A3, A6, A61, A62	
Max. height difference [m]	Recommended buffer [m]
100	84
200	168
300	252
400	336
500	420
600	503
700	587
800	671
900	755
1000	839
1500	1259
2000	1678

Minimum elevation angle 56° Relevant profiles: A2	
Max. height difference [m]	Recommended buffer [m]
100	67
200	135
300	202
400	270
500	337
600	405
700	472
800	540
900	607
1000	675
1500	1012
2000	1349

Minimum elevation angle 67° Relevant profiles: A5, A51, A52	
Max. height difference [m]	Recommended buffer [m]
100	42
200	85
300	127
400	170
500	212
600	255
700	297
800	340
900	382
1000	424
1500	637
2000	849

Minimum elevation angle 73°	
Max. height difference [m]	Recommended buffer [m]
100	31
200	61
300	92
400	122
500	153
600	183
700	214
800	245
900	275
1000	306
1500	459
2000	611

Minimum elevation angle 80°	
Max. height difference [m]	Recommended buffer [m]
100	18
200	35
300	53
400	71
500	88
600	106
700	123
800	141
900	159
1000	176
1500	264
2000	353

Maximal height difference = Maximal height of the AOI - Average base height of the AOI

Figure 8 - General recommendations for a buffer creation around CwRS zones

19.4 Relation elevation angle versus off-nadir angle and some satellite angles of importance
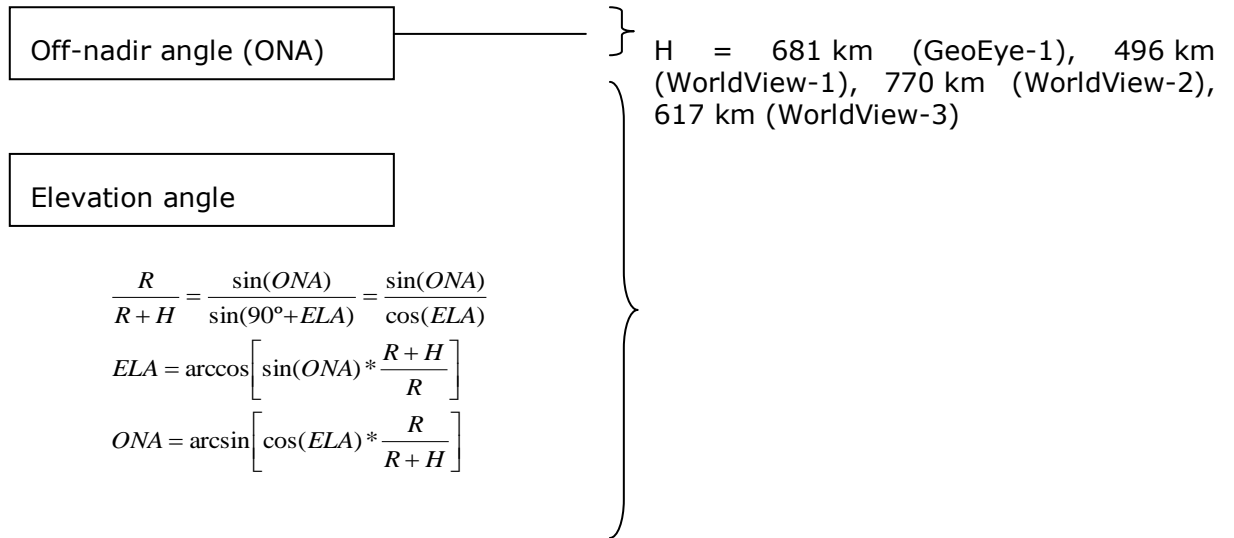
Off-nadir angle (ONA)

Elevation angle

H = 681 km (GeoEye-1), 496 km (WorldView-1), 770 km (WorldView-2), 617 km (WorldView-3)

$$\frac{R}{R+H} = \frac{\sin(ONA)}{\sin(90°+ELA)} = \frac{\sin(ONA)}{\cos(ELA)}$$

$$ELA = \arccos\left[\sin(ONA)*\frac{R+H}{R}\right]$$

$$ONA = \arcsin\left[\cos(ELA)*\frac{R}{R+H}\right]$$

Figure 9 - Relation elevation angle versus off-nadir angle and some satellite angles of importance

19.5 VHR sensors

WorldView-2	
Satellite specification	
Launch information	Date: 8 October 2009 Launch Vehicle: Delta 7920 (9 strap-ons) Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 770 km Type: Sun-synchronous, 10:30 a.m. descending node Period: 100 minutes
Sensor bands	PAN: 450–800 nm 8 MSP: Four standard colours: blue/green/red/NIR1 + 4 new colours: coastal/yellow/red edge/NIR2 coastal blue: 400–450 nm; blue: 450–510 nm yellow: 585–625 nm; green: 510–580 nm red: 630–690 nm, red edge: 705–745 nm NIR1: 760–900 nm, NIR2: 860–1040 nm
Sensor resolution GSD	PAN: 0.46 m at nadir MSP: 1.85 m at nadir
Dynamic range	11 bits per pixel
Swath width	16.4 km at nadir
Retargeting agility	Time to slew 200 km: 10 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	138 × 112 km mono (8 strips) 63 × 112 km stereo (4 pairs)
Revisit frequency	1.1 days at 1 m GSD or less 3.7 days at 20° off nadir or less (0.52 metre GSD)
Geolocation accuracy (CE 90)	Demonstrated < 3.5 m CE90 without ground control
Product specification	
Tasking level	Special Priority Tasking (Select Plus Level)
Product options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1)) Ortho Ready Standard PSH 4 bands (BGRNIR) Ortho Ready Standard PAN only Ortho Ready Standard Bundle 8 bands (PAN plus 4 bands MSP (BGRNIR1) plus 4 bands MSP2 (Coastal, Yellow, RedEdge, NIR2)) Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1)) Ortho Ready Standard Stereo PSH 4 bands (BGRNIR) Ortho Ready Standard Stereo PAN only Ortho Ready Standard Stereo Bundle 8 bands (PAN plus 4 bands MSP (BGRNIR1) plus 4 bands MSP2 (Coastal, Yellow, RedEdge, NIR2))

WorldView-2	
Satellite specification	
Resolution	PAN: 0.5 m for VHR+ profiles; 0.4 m for A5, A51, A52, A8, A81 MSP: 2.0 m for VHR+ profile; 1.6 m for A5, A51, A52, A8, A81
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off
Bit depth	16 bit
Projection/datum	UTM/WGS 84
Tiling	4 band bundle (32 k × 32 k tiling): MUL files have a maximum of 537 MB/tile, PAN files have a maximum of 2 140 GB/tile 8 band bundle (32 k × 32 k tiling): MUL files have a maximum of 1 073 GB/tile, PAN files have a maximum of 2 140 GB/tile 4 bands PSH (22 k × 22 k tiling): files have a maximum of 3 872 GB/tile
Delivery medium	DVD or FTP

WorldView-3	
Satellite specification	
Launch information	Date: 13 August 2014 Launch Vehicle: Atlas V – 401 Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 617 km Type: Sun-synchronous, 10:30 a.m. descending node Period: 97 minutes

Sensor bands	PAN: 450–800 nm
	8 VNIR bands: 4 standard colours: blue/green/red/NIR1 (MSP) + 4 new colours: coastal/yellow/red edge/NIR2 coastal blue: 400–450 nm; blue: 450–510 nm yellow: 585–625 nm; green: 510–580 nm red: 630–690 nm, red edge: 705–745 nm NIR1: 770–895 nm, NIR2: 860–1 040 nm
	8 SWIR bands: SWIR-1: 1 195–1 225 nm; SWIR-2: 1 550–1 590 nm
	(MSP) SWIR-3: 1 640–1 680 nm; SWIR-4: 1 710–1 750 nm
	SWIR-5: 2 145–2 185 nm; SWIR-6: 2 185–2 225 nm
	SWIR-7: 2 235– 2 285 nm; SWIR-8: 2 295–2 365 nm
	12 CAVIS bands: Desert Clouds: 405–420 nm; Aerosol-1;
	Aerosol-1: 459–509 nm; Green: 525–585 nm;
	Aerolos-2: 635–685 nm; Water-1: 845–885 nm;
	Water-2: 897–927 nm; Water-3: 930–965 nm;
	NDVI-SWIR: 1 220–1 252 nm; Cirrus: 1 365–1 405 nm;
	Snow: 1 620–1 680 nm; Aerosol-1: 2 105–2 245 nm;
	Aerosol-2: 2 105–2 245 nm
Sensor resolution GSD	PAN: 0.31 m at nadir
	VNIR: 1.24 m at nadir
	SWIR: 3.70 m at nadir
	CAVIS: 30 m at nadir
Dynamic range	11 bits per pixel (Pan, MSP), 14 bits per pixel (SWIR)
Swath width	13.1 km at nadir
Retargeting agility	Time to slew 200 km: 12 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	65.5 × 112 km mono (5 strips) 26.2 × 112 km stereo (2 pairs)
Revisit frequency	1.0 days at 1 metre GSD or less 4.5 days at 20° off nadir or less
Geolocation accuracy (CE 90)	Predicted < 3.5 m CE90 without ground control
Product specification	
Tasking level	Special Priority Tasking (Select Plus Level)

Product options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Ortho Ready Standard PSH 4 bands (BGRNIR)
	Ortho Ready Standard PAN only
	Ortho Ready Standard Bundle 8 bands (PAN plus 4 bands MSP (BGRNIR1) plus 4 bands MSP2 (Coastal, Yellow, RedEdge, NIR2))
	Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Ortho Ready Standard Stereo PSH 4 bands (BGRNIR)
	Ortho Ready Standard Stereo PAN only
	Ortho Ready Standard Stereo Bundle 8 bands (PAN plus 4 bands MSP (BGRNIR1) plus 4 bands MSP2 (Coastal, Yellow, RedEdge, NIR2))
	SWIR band Product 1
Resolution	PAN: 0.5 m for VHR+ profiles; 0.4 m for A5, A51, A52, A8, A81
	MSP: 2.0 m for VHR+ profile; 1.6 m for A5, A51, A52, A8, A81
	SWIR: 7.5 m
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off
Bit depth	16 bit
Projection/datum	UTM/WGS 84
Tiling	4 band bundle (32 k × 32 k tiling): MUL files have a maximum of 537 MB/tile, PAN files have a maximum of 2 140 GB/tile
	8 band bundle (32 k × 32 k tiling): MUL files have a maximum of 1 073 GB/tile, PAN files have a maximum of 2 140 GB/tile
	4 bands PSH (22 k × 22 k tiling): files have a maximum of 3 872 GB/tile
	SWIR Product 1 default tiling
Delivery medium	DVD or FTP

GeoEye-1	
Satellite specification	
Launch information	Date: 6 September 2008
	Launch Vehicle: Delta II
	Launch Site: Vandenberg Air Force Base, California

Orbit	Altitude: 681 km
	Type: Sun-synchronous, 10:30 a.m. descending node
	Period: 98 minutes
Sensor bands	PAN: 450–800 nm
	4 MSP: Blue: 450–510 nm
	Green: 510–580 nm
	Red: 655–690 nm
	NIR: 780–920 nm
Sensor resolution GSD	PAN: 0.46 m at nadir
	MSP: 1.65 m at nadir
Dynamic range	11 bits per pixel
Swath width	15.3 km at nadir
Retargeting agility	Time to slew 200 km: 20 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	44 × 112 km mono (3 strips)
	28 × 224 km stereo (2 pairs)
Revisit frequency	2.6 days at 30° off nadir
Geolocation accuracy (CE 90)	5 m CE90 without ground control
Product specification	
Tasking level	Special Priority Tasking (Select Plus Level)
Product options	Ortho Ready Standard Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Ortho Ready Standard PSH 4 bands (BGRNIR)
	Ortho Ready Standard PAN only
	Ortho Ready Standard Stereo Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Ortho Ready Standard Stereo PSH 4 bands (BGRNIR)
	Ortho Ready Standard Stereo PAN only
Resolution	PAN: 0.5 m for VHR+ profiles; 0.4 m for A5, A51, A52, A8, A81
	MSP: 2.0 m for VHR+ profile; 1.6 m for A5, A51, A52, A8, A81
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off
Bit depth	16 bit
Projection/datum	UTM/WGS 84

Tiling	4 band bundle (32 k × 32 k tiling): MUL files have a maximum of 537 MB/tile, PAN files have a maximum of 2 140 GB/tile
	4 bands PSH (22 k × 22 k tiling): files have a maximum of 3 872 GB/tile
Delivery medium	DVD or FTP

WorldView-1	
Satellite specification	
Launch information	Date: 18 September 2007
	Launch Vehicle: Delta 7920 (9 strap-ons)
	Launch Site: Vandenberg Air Force Base, California
Orbit	Altitude: 496 km
	Type: Sun-synchronous, 10:30 a.m. descending node
	Period: 95 minutes
Sensor bands	PAN: 400–900 nm
Sensor resolution GSD	PAN: 0.5 m at nadir
Dynamic range	11 bits per pixel
Swath width	17.7 km at nadir
Retargeting agility	Time to slew 200 km: 10 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	111 × 112 km mono (6 strips) 51 × 112 km stereo (3 pairs)
Revisit frequency	1.7 days at 1 metre GSD or less 5.4 days at 25° off nadir or less (0.55 metre GSD)
Geolocation accuracy (CE 90)	Demonstrated < 4.0 m CE90 without ground control
Product specification	
Tasking level	Special Priority Tasking (Select Plus Level)
Product options	Ortho Ready Standard PAN only Ortho Ready Standard Stereo PAN only
Resolution	PAN: 0.5 m
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off
Bit depth	16 bit
Projection/datum	UTM/WGS 84
Tiling	32 k × 32 k, PAN files have a maximum of 2 140 GB/tile
Delivery medium	DVD or FTP

Kompsat-3	
Satellite specification	
Launch information	Date: 18 May 2012
	Launch Vehicle: H-IIA launch system
	Launch Site: Tanegashima Space Centre, Japan
Orbit	Altitude: 685 km
	Type: Sun-synchronous, 13:30 p.m. ascending node
	Period: 98 minutes
Sensor bands	PAN: 450–900 nm
	4 MSP: Blue: 450–520 nm
	Green: 520–600 nm
	Red: 630–690 nm
	NIR: 760–900 nm
Sensor Resolution GSD	PAN: 0.7 m at nadir
	MSP: 2.8 m at nadir
Dynamic range	14 bits per pixel
Swath width	16 km at nadir
Retargeting agility	Time to slew 200 km: 10 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	48 × 110 km mono (3 strips)
	16 × 200 km stereo (2 pairs)
Revisit frequency	3.5 days at 30° off nadir
Geolocation accuracy (CE 90)	70 m (50 cm expectation) CE90 without ground control
Product specification	
Tasking level	Priority Plus Tasking
Product options	Level 1R Option Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Level 1R Option PSH 4 bands (BGRNIR)
Resolution	PAN: 0.7 m
	MSP: 2.8 m
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off
Bit depth	14 bit

Projection/datum	UTM/WGS 84
Tiling	Default
Delivery medium	DVD or FTP

Kompsat-3A	
Satellite specification	
Launch information	Date: 26 March 2015
	Launch Vehicle: RS20 rocket (Dnepr Launch Vehicle)
	Launch Site: Yasny Launch Base, Orenburg region, Russia
Orbit	Altitude: 528 km
	Type: Sun-synchronous, 13:30 p.m. ascending node
	Period: 98.5 minutes
Sensor bands	PAN: 450–900 nm
	4 MSP: Blue: 450–520 nm
	Green: 520–600 nm
	Red: 630–690 nm
	NIR: 760–900 nm
Sensor resolution GSD	PAN: 0.55 m at nadir
	MSP: 2.2 m at nadir
	Infrared: 5.5 m at nadir
Dynamic range	14 bits per pixel
Swath width	> 12 km at nadir
Retargeting agility	Time to slew 200 km: 10 seconds
Maximum contiguous area collected in a single pass (at 30° ONA)	48 × 110 km mono (3 strips)
	16 × 200 km stereo (2 pairs)
Revisit frequency	3.5 days at 30° off nadir
Geolocation accuracy (CE 90)	70 m (50 cm expectation) CE90 without ground control
Product specification	
Tasking level	Priority Plus Tasking
Product options	Level 1R Option Bundle 4 bands (PAN plus 4 bands MSP (BGRNIR1))
	Level 1R Option PSH 4 bands (BGRNIR)
Resolution	PAN: 0.55 m
	MSP: 2.2 m
	Infrared: 5.5 m
CC	CC 'validated': 0 to ≤ 10%; 'proposed': 10% to ≤ 30%
Resampling kernel	Cubic convolution
Format	GeoTIFF
DRA	Off

Bit depth	14 bit
Projection/datum	UTM/WGS 84
Tiling	Default
Delivery medium	DVD or FTP

(end document)

JRC Mission

As the science and knowledge service
of the European Commission, the Joint
Research Centre's mission is to support
EU policies with independent evidence
throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub – Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office
of the European Union