Horizon 2020

Space Call - Earth Observation: EO-3-2016: Evolution of Copernicus services

Grant Agreement No. 730008

ECoLaSS

Evolution of Copernicus Land Services based on Sentinel data

D1.4

"D11.3a – Interim Progress Report (Issue 1)"

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submitted by:

GAFAG

in collaboration with the consortium partners:

SIRS JOANNEUM RESEARCH DIGITAL UCL Université catholique de Louvain DLR

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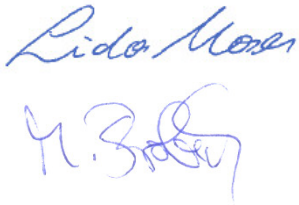
Author(s):	Linda Moser (GAF) Markus Probeck (GAF) Inés Ruiz Gomez (GAF) David Herrmann (GAF) Gernot Ramminger (GAF) Christophe Sannier (SIRS) Sophie Villerot (SIRS) Heinz Gallaun (JR) Xavier Blaes (UCL) Pierre Defourny (UCL) Annekatrin Metz (DLR) Andreas Hirner (DLR)	29.09.2017	
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DISSEMINATION LEVEL		
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APPLICABLE DOCUMENTS

ID	DOCUMENT NAME / ISSUE DATE
AD01	Horizon 2020 Work Programme 2016 – 2017, 5 iii. Leadership in Enabling and Industrial Technologies – Space. Call: EO-3-2016: Evolution of Copernicus services. Issued: 13.10.2015
AD02	Guidance Document: Research Needs Of Copernicus Operational Services. Final Version issued: 30.10.2015
AD03	Proposal: Evolution of Copernicus Land Services based on Sentinel data. Proposal acronym: ECoLaSS, Proposal number: 730008. Submitted: 03.03.2016
AD04	Grant Agreement – ECoLaSS. Grant Agreement number: 730008 – ECoLaSS – H2020-EO-2016/H2020-EO-2016, Issued: 18.10.2016
AD05	D11.2 - Project Management Plan
AD06	D11.1 - Agendas and Minutes of Meetings
AD07	D12.1 – DWH use for 2017
AD08	D12.2 – DWH request for 2018
AD09	D21.1 - Service Evolution Requirements Report
AD10	D22.1 - EO and other Data Requirements Report
AD11	D23.1 - Service Infrastructure/Architecture Requirements Report
AD12	D51.1 - Stakeholder Consultation Report
AD13	D61.1 - Project Website
AD14	D61.2 - Communication, Dissemination and Exploitation Plan

EXECUTIVE SUMMARY

The Horizon 2020 (H2020) project "Evolution of Copernicus Land Services based on Sentinel data" (ECoLaSS) addresses the H2020 Work Programme 5 iii. Leadership in Enabling and Industrial technologies - Space, specifically the Topic EO-3-2016: Evolution of Copernicus services. ECoLaSS will be conducted from 2017–2019 and aims at developing and prototypically demonstrating selected innovative products and methods for future next-generation operational Copernicus Land Monitoring Service (CLMS) products of the pan-European and Global Components. This will contribute to demonstrating operational readiness of finally selected products, and shall allow the key CLMS stakeholders (i.e. mainly the Entrusted European Entities (EEE): EEA and JRC) to take informed decisions on potential procurement of the next generation of Copernicus Land services from 2020 onwards.

ECoLaSS makes full use of dense time series of Sentinel-2 and partially Sentinel-3 optical data, as well as Sentinel-1 Synthetic Aperture Radar (SAR) data. Rapidly evolving scientific as well as user requirements are analysed in support of a future pan-European roll-out of new/improved CLMS products, and the transfer to global applications.

This Deliverable *"D11.3a: Interim Progress Report (Issue 1)"* is provided upon the Interim Progress Meeting 1 (M9), as a precursor of the Periodic Report at M18, and is split in two parts: The main report part provides information on the status of the work carried out in different WPs (chapter 2). This contains an overview of achieved deliverables and milestones (section 2.1), a summary of the administrative and project management efforts including risk management (section 2.2), a summery of scientific and technical coordination (section 2.3), and explanations of the work carried out by all Work Packages (WPs) during the first half (until Month 9, M9) of the first reporting period (M18) (section 2.4). An update of the project impact assessment is provided in chapter 3. Annex 1 of this Deliverable, which is provided as separate, confidential Annex to this Deliverable provides a review and update of the work plan as well as an explanation of the use of resources for each WP and beneficiary.

Key achievements of the ECoLaSS project in the first 9 months comprise: Delivery of all eleven due reports by M9 (with only one significant delay); consultation of various stakeholders and finalisation of related CLMS service evolution requirements analysis; finalisation of Sentinel data pre-processing for all phase 1 test sites; fine-planning of methodological WP implementations in test and demo sites and ongoing methodological developments and testing of high data volume processing lines in WPs 31–35 since Month 4; placement of VHR data orders and quota with ESA DWH; several dissemination activities executed; Homepage published and Twitter account active.

An assessment of the level of work plan completion as well as of the further update needs, together with an in-depth assessment of the use of the project's resources have been conducted and are presented in Annex 1. Summarising, the project appears to be largely on track without major deviations from the plan.

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Abbreviations

AI	Action Item
AWiFS	Advanced Wide Field Sensor
CL	Cropland
CLC	CORINE Land Cover
CLC+	CORINE Land Cover plus (with improved specifications)
CLMS	Copernicus Land Monitoring Service
CNES	Centre National d'Études Spatiales (French Space Agency)
CO	Confidential
Cross-Pol	Cross-polarized
CT	Crop type
D	Deliverable
DAP	Data Access Portfolio
DEM	Demonstrator
DLR	German Aerospace Center
DLT	Dominant Leaf Type
DRC	Democratic Republic of Congo
DTM	Digital Terrain Model
DWH	Data Warehouse
EC	European Commission
ECoLaSS	Evolution of Copernicus Land Services based on Sentinel data
EEA	European Environment Agency (EEA)
EEEs	European Entrusted Entities
EIONET	European Environment Information and Observation Network
EO	Earth Observation
ESA	European Space Agency
ETRS	European Terrestrial Reference System
EU	European Union
FOR	High Resolution Layer Forest
FTP	File Transfer Protocol
GAF	GAF AG (a service provider)
GRA	High Resolution Layer Grassland
GRD	Ground Range Detected
H2020	Horizon 2020
HR	High Resolution
HRL	High Resolution Layer
HRL2015	High Resolution Layer 2015
IMP	High Resolution Layer Imperviousness
INSPIRE	Infrastructure for Spatial Information in Europe
IPM1	Interim Progress Meeting 1
ISO	International Organization for Standardization

IW	Interferometric Wide swath
JECAM	Joint Experiment of Crop Assessment and Monitoring
JR	Joanneum Research
JRC	Joint Research Center
KO	Kick-OffLC/LU Land Cover/Land Use
LAI	Leaf Area Index
LPIS	Land Parcel Identification System
M	Month
MS	Microsoft
NDBI	Normalized Difference Built-up Index
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
PCA	Principal Component Analysis
PM	Person Month
PU	Public
QM	Quality Management
RSG	Remote Sensing Software Package Graz
S-1	Sentinel-1
S-2	Sentinel-2
S-3	Sentinel-3
SAR	Synthetic Aperture Radar
SIRS	Systèmes d'Information à Référence Spatiale SAS
SWIR	Short-wave Infrared
SyGMa	System for Grant Management
TCD	Tree Cover Density
UCL	Université catholique de Louvain
VHR	Very High Resolution
WP	Work Package

1. Introduction and Objectives

INTRODUCTION

The Horizon 2020 (H2020) project, "Evolution of Copernicus Land Services based on Sentinel data" (ECoLaSS) addresses the H2020 Work Programme 5 iii. Leadership in Enabling and Industrial technologies - Space, specifically the Topic EO-3-2016: Evolution of Copernicus services. ECoLaSS will be conducted from 2017–2019 and aims at developing and prototypically demonstrating selected innovative products and methods for future next-generation operational Copernicus Land Monitoring Service (CLMS) products of the pan-European and Global Land Components. This will contribute to demonstrating operational readiness of the finally selected products, and shall allow the key CLMS stakeholders (i.e. mainly the Entrusted European Entities (EEEs) EEA and JRC) to take informed decisions on potential procurement of the next generation of Copernicus Land services from 2020 onwards.

ECoLaSS makes full use of dense time series of Sentinel-2 and partially Sentinel-3 optical data as well as Sentinel-1 Synthetic Aperture Radar (SAR) data. Rapidly evolving scientific as well as user requirements are analysed in support of a future pan-European roll-out of new/improved Copernicus Land Monitoring Service products, and the transfer to global applications.

Figure 1 shows the timeline of operational Copernicus Land implementations and where ECoLaSS is embedded in order to suggest prototypes for potential implementation into a future Copernicus Land Service 2020+. The overall duration of the project is 36 months (Jan 2017 - Dec 2019), with two development cycles of 18 months each.

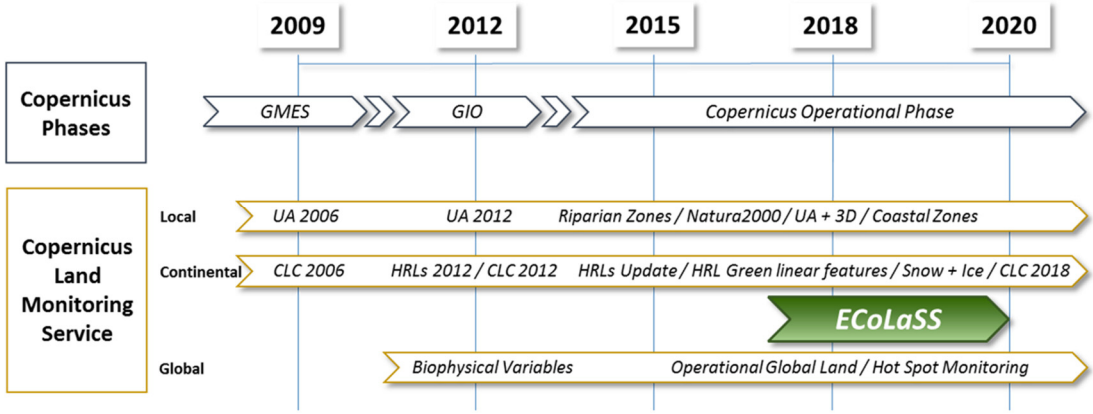


Figure 1: ECoLaSS Project implemented in the operational Copernicus timelines

The Deliverable D1.4: "**D11.3a: Interim Progress Report (Issue 1)**" is provided upon the Interim Progress Meeting 1 (M9), as a precursor of the Periodic Report at M18, and is split in two parts: The main report part provides information on the status of the work carried out in different WPs (chapter 2). This contains an overview of achieved deliverables and milestones (section 2.1), a summary of the administrative and project management efforts including risk management (section 2.2), a summery of scientific and technical coordination (section 2.3), and explanations of the work carried out by all Work Packages (WPs) during the first half (until Month 9, M9) of the first reporting period (M18) (section 2.4). An update of the project impact assessment is provided in chapter 3. The final chapter of the ECoLaSS Interim Progress Report (Issue 1) is provided as separate, confidential Annex 1 to this Deliverable. It provides a review and update of the work plan as well as an explanation of the use of resources for each WP and beneficiary.

PROJECT OBJECTIVES

The overall objective of the ECoLaSS project is to **improve existing & develop novel products/services for the pan-European & Global Copernicus Land components**. In more detail, the key objectives of the ECoLaSS project are:

- to conduct a dedicated stakeholder consultation process, assessing relevant **user requirements**;
- to make full use of **high data volume processing of dense time series** of SAR and optical Sentinel (and other) EO data;
- to develop **several prototypes** of new or enhanced Copernicus Land services of the Continental and the Global Component;
- to **assess/benchmark** all operational product candidates in view of their innovation potential and technical excellence, automation level, potential for roll-out to pan-European level and/or global scale, timeliness for operational implementation, costs versus benefits, etc.;
- to **suggest** to EC and the relevant decision-makers **candidates for operational integration** into the future Copernicus Land Monitoring Service from 2020 onwards.

PROJECT CONCEPT

In early phases of the project, **requirements** for future Copernicus Land services evolution are gathered in terms of (i) needs from Copernicus Land user and stakeholder groups, (ii) Earth Observation (EO) and other data to be used for deriving products and services, and (iii) infrastructure and architecture to process high volume data, as shown in the project overview scheme (Figure 2).

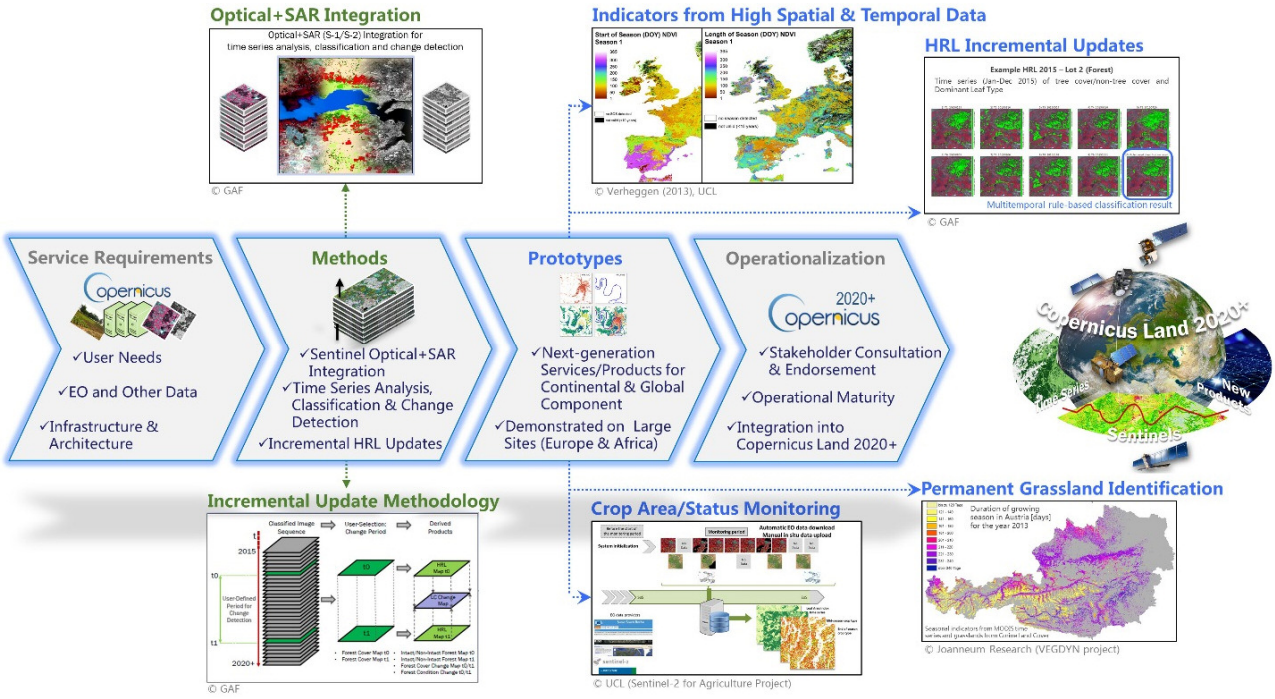


Figure 2: ECoLaSS project concept

With these requirements as basis, **innovative methods** for automated high volume data processing of Sentinel (optical and SAR) time series are developed to improve existing and test novel products and services for the pan-European and Global Copernicus Land Components. The most important methods are in the fields of i) Sentinel-1/-2/-3 time series integration, (ii) time series pre-processing methods, (iii) thematic classification from time series analysis, (iv) change detection from time series analysis and (v) incremental update methodologies for the Copernicus Land High Resolution Layers (HRLs). All methods are applied on test sites, located both in Europe and Africa, and are undergoing a benchmarking process.

By applying these methods in large prototype sites of bio-geographical diversity, **prototypes** for improved and novel next-generation operational Copernicus Land services are demonstrated. Prototypic implementations is envisaged for: (i) indicators and variables from high spatial and temporal resolution data, for both the Continental and Global component products; (ii) incremental update strategies for the main pan-European products (i.e. the HRLs Forest, Grassland and Imperviousness) (iii) crop area and crop status/parameters monitoring; and (iv) further novel LC/LU products.

In order to get to final service candidates for operational implementation, the project applies an **operationalization framework**, comprising (i) a continuous stakeholder consultation process throughout the project, (ii) a benchmarking framework of candidate services in view of their technical excellence and operational implementation potential (roll-out), as detailed by (iii) dedicated integration plans into the Copernicus Land service environment from 2020 onwards.

2. Work Carried Out

This chapter provides detailed explanations of the work carried out in the project's WPs in the first 9 months of Reporting Period 1:

- Section 2.1 reports on achieved milestones and deliverables, WP progress and Deliverable status;
- Section 2.2 documents the work performed in terms of administrative management (as part of WP 11), including project management, meetings, reporting, coordination and risk management;
- Section 2.3 reports on technical and scientific coordination work and activities, and on the quota and acquired additional VHR data sources via ESA's Data Warehouse (DWH) and their use;
- The final section 2.4 contains detailed explanations of the work carried out by the project, with respect to all ongoing and completed WPs in the project phase 1.

The **key achievements** of the ECoLaSS project in the first 9 months runtime are:

- 11 Deliverables due at M9 were submitted; among them, all phase 1 Deliverables of Task 2
- Various stakeholder consultations conducted
- Copernicus Land service evolution requirements analysis concluded
- Data sharing & document management methods established
- Split of work, test & demo sites, and collaborations for methodological WPs implemented
- Sentinel data pre-processing for all phase 1 test sites finalised
- DWH VHR data orders and quota placed
- Methodological developments and testing in WPs 31–35 ongoing since Month 4
- Implementation of high data volume processing lines ongoing
- Homepage published, Twitter account active
- Numerous dissemination activities executed and further ones planned

2.1 Achieved Milestones and Deliverables

This section describes the achieved Milestones (Table 1) and the consecutive status of WPs (Table 2) and Deliverables (Table 3) until M9. The status of WPs and Deliverables is described, and the Gantt chart is adapted to the current status.

Table 1: List of Milestones

MILE-STONE NO.	MILE-STONE NAME	RELATED WPS[1] (PARTICIPANT PORTAL)	RELATED WPS[2] (PROJECT STRUCTURE)	DUE DATE (IN PROJECT MONTH)	MEANS OF VERIFICATION
1	Kick-Off Meeting	1-2	11-12	1	• Agenda of Kick-Off Meeting provided • Project contract signed • Consortium Agreement in place • Project management procedures established • Test and demonstration site concept provided • Project concept presented by consortium
2	Interim Progress Meeting 1	3-5, 19	21-23, 61	9	• Project Management Plan implemented • Copernicus Land Evolution Requirements (product specification: EO, infrastructure) consolidated • Final test and demonstration sites established • 1st draft of high data volume processing lines • 1st round of Stakeholder Consultations concluded • 1st issue of Communication, Dissemination and Exploitation Plan provided • 1st Interim Progress Report delivered

[1] Sequential WP name, as specified in the EC Participant Portal
[2] WP names corresponding to project structure (Tasks) as have been kept in the WP title;

The two first clearly defined Milestones (Table 1) – which are also coupled with precisely identified times and Deliverables (see also Table 3) – (i) have been successfully completed with the **Kick-Off Meeting** on 20 January 2017 in Munich (M1), or (ii) is scheduled to be completed approx. 1.5 weeks after delivery of this Interim Progress Report (M2), at the **Interim Progress Meeting 1** on 19 October 2017 in Brussels.

Table 2 lists all Work Packages, with information on the lead partner and planned start and end dates of each project phase. Information on the initiation time and ongoing status until M9 is provided for every WP. The WPs which have started on-time, or even earlier than planned, and which are still on track are marked in green in the status column. Some WPs had a later initiation due to external reasons (e.g. developments in the community, such as in case of WP 23 with the procurement of DIAS), which does, however, not significantly influence the overall work plan, Deliverable deadlines or quality of work. WP 21 is the only WP that had to be extended as compared to the initial plan, and the associated Deliverable was submitted at a later stage (see chapter 4).

*Remark on WP and Deliverable Nomenclature: (i) WP names with **sequential numbering** are specified in the EC Participant Portal, whereas (ii) WP/Deliverable names corresponding to the **project structure (Tasks)** have been kept in the WP/Deliverable title (as defined in the proposal and Grant Agreement phase). As in the Project Management Plan (AD05), WP and Deliverable names in the present report refer to (ii).*

Table 2: Status of Tasks and Work Packages

Task	WP No[1]	Work Package Title[2]	Lead (Name)	Start Month phase 1	End Month Phase 1	Start Month phase 2	End Month Phase 2	Status	
								Initiation	Current Status
1	1	WP 11 - Administrative Management	GAF	1	18	19	36	on-time (M1)	ongoing
	2	WP 12 - Scientific Coordination	GAF	1	18	19	36	on-time (M1)	ongoing
2	3	WP 21 - Assessment of Service Evolution Requirements	GAF	1	4	19	21	on-time (M1)	phase 1 completed delayed (M8)
	4	WP 22 - Assessment of EO and other Data Requirements	SIRS	1	9	19	24	later than planned (M3)	phase 1 completed on-time (M9)
	5	WP 23 - Assessment of Service Infrastructure/Architecture Requirements	DLR	1	9	19	24	later than planned (M4)	phase 1 completed on-time (M9)
3	6	WP 31 - Sentinel-1/2/3 Integration Strategies	DLR	2	14	19	26	on-time (M2)	ongoing
	7	WP 32 - Time Series Preparation	JR	3	14	19	26	on-time (M3)	ongoing
	8	WP 33 - Time Series Analyses for Thematic Classification	UCL	4	14	19	27	on-time (M3)	ongoing
	9	WP 34 - Time Series Analyses for Change Detection	JR	4	14	19	27	on-time (M4)	ongoing
	10	WP 35 - Time Series Consistency for HRL Product (incremental) Updates	SIRS	4	14	19	29	later than planned (M5)	ongoing
4	11	WP 41 - Time Series-derived Indicators & Variables	UCL	9	17	22	31	not started	
	12	WP 42 - Incremental Updates of HR Layers	GAF	11	17	22	33	not started	
	13	WP 43 - Improved Permanent Grassland Identification	JR	11	17	22	33	not started	
	14	WP 44 - Crop Area and Crop Status/Parameters Monitoring	UCL	11	17	22	33	not started	
	15	WP 45 - New LC/LU Products	SIRS	11	17	22	33	not started	
5	16	WP 51 - Stakeholder Consultation	GAF	7	18	22	34	earlier than planned (M3)	ongoing
	17	WP 52 - Candidates for Operational Roll-out	GAF	13	18	25	35	not started	
	18	WP 53 - Integration Plan into Copernicus Service Architecture	SIRS	13	18	25	36	not started	
6	19	WP 61 - Communication, Dissemination & Exploitation	DLR	4	18	19	36	earlier than planned (M1)	ongoing
	20	WP 62 - Market Opportunities & IPR Strategy	GAF	10	18	31	34	not started	

[1] Sequential WP name, as specified in the EC Participant Portal
[2] WP names corresponding to project structure (Tasks) have been kept in the WP title;
Green = according to plan
Yellow = slightly postponed
Orange = delayed
(Red = missing delivery)

In the first nine months of the project, the **11 Deliverables** due at M9 were successfully submitted at, or shortly after, the estimated delivery date (Table 3). With the exception of one Deliverable, almost all were submitted on-time or with minor delays. "D21.1 - Service Evolution Requirements Report" was planned to be delivered at M4 but had to be delayed until M8. This was due to adjusting the user and stakeholder interviews and respective documentation to the timetable of the involved stakeholders. Moreover, "D11.2 – Project Management Plan" was submitted 2 weeks after the deadline, due to the delay also of the Kick-Off Meeting on 20 January 2017.

Table 3: List of Deliverables

Deliv. No1	Deliverable Name[2]	WP No[1]	WP No[2]	Lead	Type[3]	Diss. Level[4]	Deliv. Date		Status
							Planned	Done	
D1.1	D11.1 - Agendas and Minutes of Meetings	1	11	GAF	R	CO	cont.	17.02.2017	✓
D1.2	D11.2 - Project Management Plan	1	11	GAF	R	CO	31.01.2017	17.02.2017	✓
D1.4	D11.3 - Interim Progress Report	1	11	GAF	R	PU	30.09.2017	12.10.2017	✓
D2.1	D12.1 – DWH use for 2017 / 2018 / 2019	2	12	GAF	R	PU	30.09.2017	29.09.2017	✓
D2.4	D12.2 – DWH request for 2018 / 2019	2	12	GAF	R	PU	30.09.2017	15.09.2017	✓
D3.1	D21.1 - Service Evolution Requirements Report	3	21	GAF	R	PU	30.04.2017	28.08.2017	✓
D4.1	D22.1 - EO and other Data Requirements Report	4	22	SIRS	R	PU	30.09.2017	30.09.2017	✓
D5.1	D23.1 - Service Infrastructure/ Architecture Requirements Report	5	23	DLR	R	PU	30.09.2017	10.10.2017	✓
D16.1	D51.1 - Stakeholder Consultation Report	16	51	GAF	R	PU	30.09.2017	30.09.2017	✓
D19.1	D61.1 - Project Website	19	61	DLR	DEC	PU	30.06.2017	03.07.2017 (*Mar 2017)	✓
D19.2	D61.2 - Communication, Dissemination and Exploitation Plan	19	61	DLR	R	PU	30.09.2017	29.09.2017	✓

[1] Sequential Deliverable name (WP.issue), and WP name, as specified in the EC Participant Portal

[2] Deliverable/WP names corresponding to project structure (Tasks and WPs) have been kept in the Deliverable title; D: Document, P: Product;

[3] R: Document/Report, DEM: Demonstrator/Prototype, DEC: Website

[4] Dissemination Level: PU = Public, CO = Confidential

*Deliverable "D61.1 - Project Website" (Type: DEC) was online since mid-March 2017

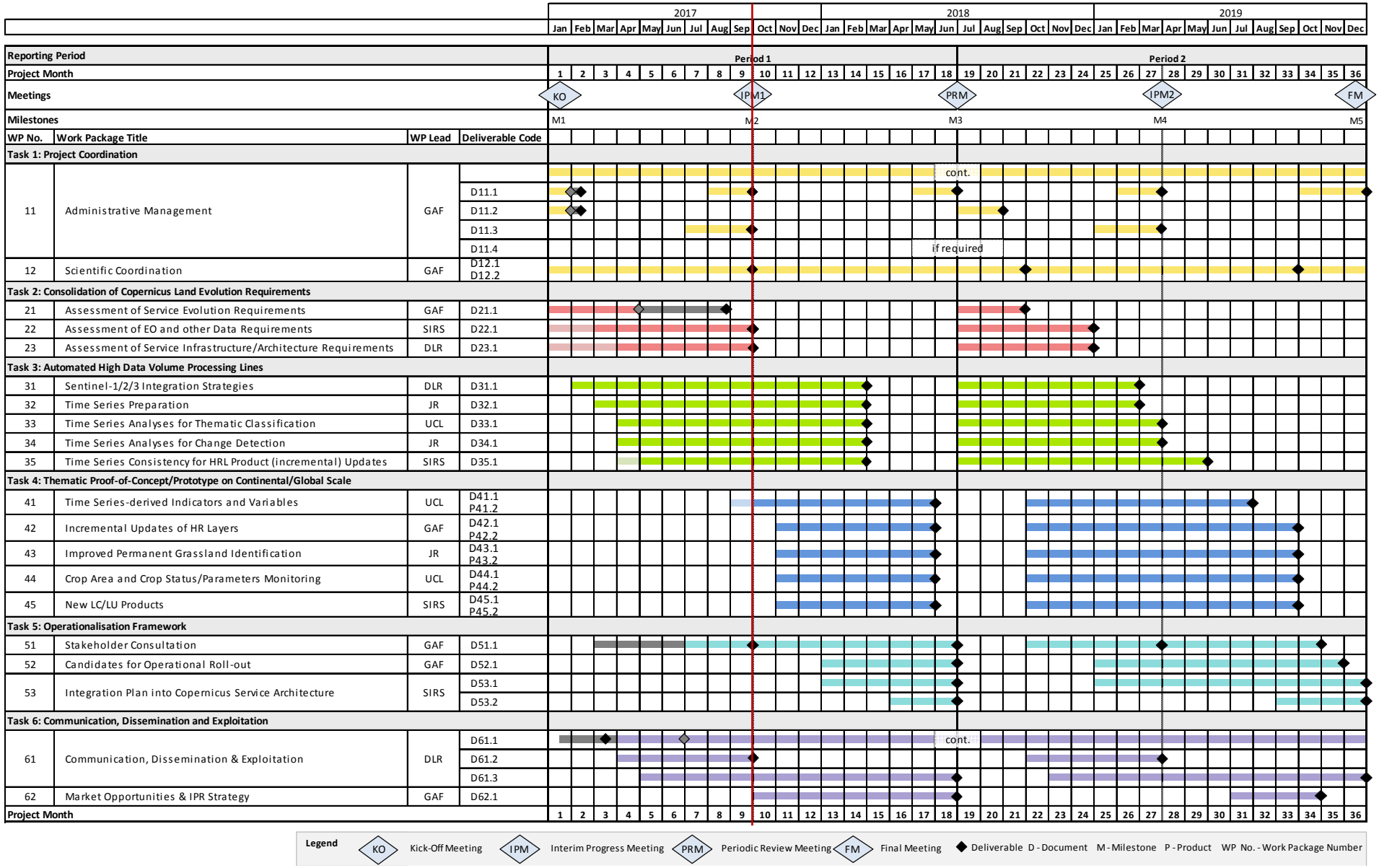
✓ submitted on-time/in advance

✓ submitted with minor delay (up to ~ 2 weeks)

✓ submitted with major delay

Figure 3 provides the updated Gantt chart with necessary adjustments, visualised as grey markings, which signalise WPs that started earlier or lasted longer than planned, and brighter colours which symbolise delayed starts of WPs as compared to the initial plan. A grey rhombus signalises a planned but shifted Deliverable date, and all actual delivery dates are marked with a black rhombus.

Figure 3: Gantt Chart - Time Plan



2.2 Administrative Management (WP 11)

The applicable ECoLaSS project management procedures are described in detail in the Project Management Plan: "*D11.2 – Project Management Plan (Issue 1)*" (AD05). They are implemented as part of WP 11 - Administrative Management, which is carried out by the Coordinator GAF. This section describes all measures taken in terms of proper information exchange inside the consortium and with the European Commission, project schedule control, as well as meetings and teleconferences that have been conducted and reporting that has been carried out until M9. Legal and Ethics aspects are discussed, and an update of the Risk Management and Mitigation Plan is provided.

INFORMATION EXCHANGE WITHIN THE CONSORTIUM AND WITH THE EC:

The consortium is led and managed by Mr. Markus Probeck, the *Project Coordinator* on behalf of GAF, being responsible for overall management and reporting to the EC on all activities. This is performed in close coordination with Ms. Linda Moser, who is the *Scientific Coordinator*, and is responsible for coordinating all scientific issues between the WPs, as well as between the project and the scientific community.

The information exchange between the EC, the Coordinator and the project partners is carried out the following way: The Project Coordinator is the general contact point to the EC's Project Officer (PO) for communication with the project team, both for technical and management aspects. The WP Managers report directly to the Project Coordinator. The official communication and reporting is carried out via the EC's Research Participant Portal, where continuous reporting is performed and Deliverables are uploaded. All formal Deliverables are transmitted to the EC by the Project Coordinator. A project website and a Twitter account have been established (see section 2.4.10), via which the most important information and news about the project are published and shared with EC, stakeholders, scientists, the commercial sector and the general public.

PROJECT SCHEDULE CONTROL

The review and monitoring of project progress against the defined schedule and Milestones (see section 2.1) is performed on a regular basis primarily by the Project Coordinator, with support of the WP Managers, via meetings, telephone/video conferences and progress reports. The ECoLaSS project schedule (see Gantt chart – Figure 4) serves as reference for schedule control and reporting.

The Project Coordinator implemented an Action Control System, in which all Action Items (AIs) from official Milestone/Review meetings (starting from the Kick-Off) are recorded and their status is continuously tracked. Such recording of AIs is performed as well for all meetings and teleconferences, and the status of AIs is regularly followed-up by the Coordinator and communicated to the consortium. No "Project Anomaly Reports and Recovery Action - Plans" were necessary so far.

MEETINGS & TELECONFERENCES

Official project/review meetings as well as consortium-internal administrative and technical meetings are normally organised by the Project Coordinator GAF. For all meetings, minutes are drafted by the Coordinator and distributed to the participants. For the official Review meetings there is a dedicated Deliverable with confidential status which contains: "*D11.1 - Agendas and Minutes of Meetings*" (AD06).

In terms of official meetings, the **Kick-Off (KO) Meeting** was held on 20 January 2017 in Munich, with participation of the EC Project Officer, key stakeholders and all consortium partners. The **Interim Progress Meeting 1 (IPM1)** will be carried out short after submission of the present Deliverable, on 19 October at REA premises in Brussels. The aim will be to present progress on Milestones, Deliverables and key achievements versus the project plan. The IPM1 is located in the middle of the first Reporting Period, i.e. close to M9.

Regular **consortium-internal progress meetings** are mostly carried out as **teleconferences** every 4 – 8

weeks as required, where administrative issues are clarified, the project progress of all partners and relevant WPs is communicated, and further work is planned and coordinated. **Two technical meetings** have been held as physical meeting: from 2-3 May 2017 at DLR in Oberpfaffenhofen (day 1) and GAF in Munich, Germany (day 2), and from 4-5 October 2017 at Joanneum Research premises in Graz, Austria. A summary of all meetings and teleconferences until the IPM1 is displayed in Table 4:

Table 4: List of Meetings and Teleconferences

NAME OF MEETING	TYPE OF MEETING	DATE	PLACE	PARTICIPANTS
Kick-off preparation	Teleconference	16 Dec 2016	NA	All consortium partners
Internal Kick-Off	Meeting	19 Jan 2017	Munich, GAF	All consortium partners
Official Kick-Off	Official Kick-Off Meeting	20 Jan 2017	Munich, GAF	All consortium partners, EC REA, stakeholders
Progress Teleconference 1	Teleconference	8 Feb 2017	NA	All consortium partners
Progress Teleconference 2	Teleconference	7 Apr 2017	NA	All consortium partners
Technical Meeting 1	Meeting	3 – 4 May 2017	Oberpfaffenhofen, DLR (day 1); Munich, GAF (day 2)	All consortium partners
Progress Teleconference 3	Teleconference	22 Jun 2017	NA	All consortium partners
Progress Teleconference 4	Teleconference	25 Jul 2017	NA	All consortium partners
Progress Teleconference 5	Teleconference	15 Sep 2017	NA	All consortium partners
Technical Meeting 2	Meeting	4 – 5 Oct 2017	Graz, Joanneum Research	All consortium partners
Interim Progress Meeting 1	Review Meeting	19 Oct 2017	Brussels, EC REA	All consortium partners, EC REA, reviewer

Additionally, numerous **stakeholder and user meetings** took place in the framework of WP 21 and WP 51, either as physical meeting back-to-back with other events, or as dedicated physical meeting or teleconference, addressing previously defined topics, e.g. for the user requirements analysis (WP 21) – cf. "*21.1 - Service Evolution Requirements Report*" (AD09), or for stakeholder interaction (WP 51) – cf. "*D51.1 - Stakeholder Consultation Report*" (AD12).

German and French **National Copernicus Meetings/Fora** were attended by GAF and SIRS, respectively, and ECoLaSS was presented there. Further **Copernicus Meetings** and Copernicus conferences/fora organised by the EC or EEA, e.g. upon invitation or suggestion of the EC, will be attended in the future.

REPORTING

The Project Coordinator is responsible for the reporting duties in ECoLaSS, following GAF's ISO 9001:2008 certified QM procedures. Reporting activities and uploads of Deliverables are carried out via the System for Grant Management (SyGMa) of the EC's Research Participant Portal. Specific types of reporting are highlighted in the following:

- **Deliverables:** 11 deliverables due at M9 have been uploaded (see Table 3). For a complete list of all project deliverables refer to AD05.
- **Interim Progress Reports:** This Deliverables is the first of two Interim Progress Reports which are to be provided upon the two Interim Progress Meetings (M9 and M27). These reports follow the same structure and similar contents as the Periodic Reports at M18 and M36.

- **Agendas & Minutes:** During all meetings, minutes are drafted by the Project Coordinator or the Scientific Coordinator and shared with all participants a few days after the meeting for their review and comments. The minutes provide a record of discussions, decisions, and AIs on the topics discussed. Typically, relevant Annexes and the meetings' presentation slides form part of the minutes.
- **Project Anomaly Reports:** There were no unexpected or unforeseen events that required filing a Project Anomaly Report.

LEGAL ASPECTS

The Coordinator GAF is also providing assistance on legal issues, such as website disclaimer, legal notice and privacy policy for the ECoLaSS website and the project's Twitter account. Furthermore, tools for website access statistics, e.g. Google Analytics, PIWIK and Wix tools were analysed for their legal implications.

ETHICS ASPECTS

Ethics requirements are being observed throughout the project by the ECoLaSS Project Coordinator and the Scientific Coordinator. Currently, there are no changes in the situation as compared to the ethics requirements as stated in the Grant Agreement, and there is currently no need for action.

RISK ASSESSMENT & MITIGATION PLAN

Relevant risks for successful implementation of the ECoLaSS project are continuously monitored, and mitigation measures are put in place, if required. At the moment, no critical risks are observed.

However, some of the risks already identified and analysed in the Grant Agreement and Project Management Plan, have been re-assessed. Table 5 provides an according update of the current project risks, with the updates specifically marked).

Table 5: Updated relevant risks for successful Implementation of the ECoLaSS Project

DESCRIPTION OF RISK (+ LEVEL OF LIKELIHOOD)	RELATED WPs[1] (PART. PORTAL)	RELATED WPs[2] (PROJECT STRUCT.)	PROPOSED RISK-IMPACT & MITIGATION MEASURES
Availability of VHR1 data for future time steps from DWH may prove insufficient, particularly in case of new acquisitions 2017 (medium risk)	4, 6-10, 11-15	22, 31-35, 41-45	UPDATE: Reduced VHR1 data availability in first 9 months due to delayed access to the DWH. New image acquisition options were therefore restricted towards the end of the growing season 2017. The granted quota for new image acquisitions could not be fully utilised in 2017 (see section 2.3.2). Mitigation Measures: In turn, more archive VHR1 data were ordered, largely compensating for the fewer new data acquisition orders (which also would bear higher risk of clouds etc.). New orders are planned to be extended with next data order 2018. No major impact on successful implement-ation of all project tasks in the first Reporting Period expected.
Shortage of suitable HR EO data availability (S1-3, L8) due to satellite failure (e.g. Sentinel B-units), delayed launch, long commissioning phase, high cloud cover, data hub issues (low risk)	All WPs	All WPs	Impact: Limited time series availability/density; restrictions in realistic scenario assessment of future operational service implementation. Mitigation Measures: Exploitation of other constellation scenarios (Sent.1-3, with/ without B-units, S-1 for closing optical acquisition gaps, Landsat-8) to reduce data shortage risk, applying flexible data processing methods. Alternative other satellite data to be envisaged (DMC, AWiFS, PROBA, etc.)
Restricted/delayed access to appropriate national in-situ/ ancillary reference data (low risk)	4, 6-10, 11-15	22, 31-35, 41-45	Impact: Reduced quantity and quality of training areas and validation datasets. Mitigation Measures: The consortium's extensive Copernicus Land heritage and established contacts with national in-situ hosting entities facilitate access to appropriate reference data. Data access via CORDA is well established and being used. Test/demo sites have been selected based on established contacts, so that no major restrictions are expected.
Temporal and/or thematic misalignment of the project with EEEs' (EEA & JRC) planning for operational Copernicus Land services (low risk)	6-10, 17-18	31-35, 52-53	Impact: Project results would not fully meet stakeholder requirements. Mitigation Measures: Regular coordination with key stakeholders and systematic identifica-tion of their requirements, including anticipation of evolving product needs and portfolios, are core activities during the project life cycle. Upcoming product/tender specifications (i.e. HRL 2018) and update requests by stakeholders are taken into account as far as coincident with project objectives. Unexpected misalignments are thus unlikely.
Lack of active stakeholder and user engagement in support of the project (low risk)	3-5, 16-15,	21-23, 51-53	UPDATE: The involvement of JRC, being the key stakeholder of the Global CLMS Component, in the stakeholder consultation process (WP 51) and the project in general, has been positive and responsive, but in different mode than anticipated, i.e. mostly through side-meetings at other occasions, rather than dedicated consultations. Mitigation Measures: Not needed. There was a specifically good exchange with JRC on a future agricultural service; the engagement of JRC's Global CLMS group is planned to be further extended from October 2017 onwards.

[1] Sequential WP name, as specified in the EC Participant Portal

[2] WP names corresponding to project structure (Tasks) have been kept in the WP title;

Highlight = Update of the Risk and Mitigation Plan with respect to the Grant Agreement and Project Management Plan

2.3 Technical/Scientific Coordination (WP 12)

This documents conducted scientific coordination activities as part of WP 12 Scientific Coordination. Section 2.3.1 deals with overall scientific coordination measures, whereas section 2.3.2 addresses specifically the management of quota and use of VHR data accessible via ESA's DWH mechanism.

2.3.1 Scientific Coordination Measures and Activities

In this section, measures of overall scientific coordination of the methodological developments are explained, the benchmarking procedures – to be applied for all method and prototype developments – are described in detail, the selection of test sites and prototype sites is illustrated, data management and data sharing procedures are described, the Scientific Coordinator's support to dissemination measures is explained as well as the approach to overall quality management.

ADAPTATIONS TO THE SCIENTIFIC CONCEPT

In the Horizon 2020 Call for Tenders EO-3-2016: Evolution of Copernicus services, which led to the present ECoLaSS project, the requirement for "Improved permanent grassland identification methods" had been identified as relevant topic, separately from existing HRLs, probably due to a previous HRL 2012 product called "**NATURAL GRASSLAND (NGR)**" that had shown issues in quality control and accuracy assessment, and had therefore not been continued by EEA, leading to the need of a new definition of the grassland theme. Shortly after the abovementioned H2020 tender, however, the EEA Call for Tender for "Copernicus Land High Resolution Layer Updates 2015" was published, comprising also a new HRL Grassland 2015. A consortium, including amongst others the ECoLaSS partners GAF and SIRS, was awarded the new production of the HRL Grassland (GRA) 2015, under the lead of GAF.

As this development re-confirmed the belonging of the HRL Grassland to the set of thematic LC/LU Layers of the Continental CLMS component, from an ECoLaSS point of view, developments towards an improved HRL GRA (previously described in WP 43 "Improved Permanent Grassland") are being addressed synergistically with the HRLs Forest (FOR) and Imperviousness (IMP) as part of WP 42 "Incremental Updates of HR Layers". In turn, WP 43 will address new methods for additional, further-reaching thematic characterisation of different types of grassland as well as use categories and intensities.

SCIENTIFIC COORDINATION OF METHODOLOGICAL DEVELOPMENTS

The coordination of the development and prototyping Tasks 3 and 4 is particularly complex. Besides the fact that partners are involved in many Work Packages, which requires good coordination by the Task 3 WP Leads, the activities in Task 3 are highly related to Task 4 and therefore, had to be well defined and adjusted in advance. This definition was carried out with particular thematic and coordination support of WP 12.

For this coordination of inter-related technical activities, product developments, tests and method setups, detailed tables are used which were conceptualized at an early stage of the project and refined during the technical coordination meeting from 2-3 May 2017 in Oberpfaffenhofen (DLR) and Munich (GAF). This process was performed in five steps:

1. Task 4 (prototype development) WP Leads defined their requirements towards activities that have to be carried out in Task 3 in terms of method developments and benchmarking.
2. These requirements were then grouped and generalised to efficiently deduct where synergies can be used for different prototype developments, and in order to avoid duplications.
3. Task 3 activities were defined related to the Task 4 requirements.
4. Test sites (i.e. the "where"), as well as partner split ("who/what"), relation to prototypic implementation requirements ("why") and timing and deadlines ("when") were defined in a fourth step and assigned to the activities of Task 3 WPs (see example in Table 6).

5. The resulting information was extracted and further split into sites per partner per prototyping development, and single information sheets were created for every Task 3 Work Package.

These tables are living documents and were updated and adjusted during joint meetings and teleconferences. The scientific coordinator is providing centralised coordination in this respect, the coordination of each WP however, stays with the respective WP Leads. Table 6 exemplifies such table for WP 31 and 32 after the first four steps:

Table 6: Task 3 / 4 Table for WPs 31 and 32 – Work in Progress

Task 3 WP Activities		Test Sites	Task 3 WP Contributors (for respective activity)					Task 3 WP Planned Timing		Task 4 requirements towards Task 3					
Activity Name	Detailed Description		GAF	SIRS	JR	UCL	DLR	Phase 1	Phase 2	ALL Topics	WP 41 (UCL)	WP 42 (GAF)	WP 43 (JR)	WP 44 (UCL)	WP 45 (SIRS)
WP 31 - Sentinel-1/2/3 Integration Strategies (DLR)				SIRS		UCL	DLR	2 - 14	19 - 26	WP 31 - Sentinel-1/2/3 Integration Strategies					
Activity 1	**Literature review** and iterative decision on investigation focus with T4 WPs, incl. Consideration of Landsat/MODIS (analogy to S-2/S-3) from Literature			X		X	L	M9: first results		**Literature review** and iterative decision on investigation focus with T4 WPs, **incl. Consideration of Landsat/MODIS (analogy to S-2/S-3) from Literature**					
Activity 2	investigate/test **spectral, spatial, temporal interpolation and/or fusion approaches** (S-1/S-2), (S-2/S-3 fusion)	presumably 1 (TBD) according to outcome of literature study		X (S2/S3)		L (S2/S3)	X (S1/S2)	M10: first results		investigate/test **spectral, spatial, temporal interpolation** and/or **fusion approaches (S-1/S-2), (S-2/S-3 fusion)**		x			x
Activity 3	investigate/test optical based **(i) spectral and (ii) textural time series metrics/variables** (DETAILS IN WPD) (S-1/S-2) & (S-2/S-3 fusion) relevant for classification of all HRLs	presumably 1 (TBD) according to outcome of literature study		L		C		M10: first results		investigate/test optical based **(i) spectral** and **(ii) textural time series metrics/variables** (DETAILS IN WPD) **(S-1/S-2) & (S-2/S-3 fusion)** relevant for classification of XXXXX		x	x	x	
WP 32 - Time Series Preparation (JR)					JR		DLR	3 - 14	19 - 26	WP 32 - Time Series Preparation					
Activity 1	**Pre-processing** of S1/S2/S3 time series in test sites with the **chosen methods (see Activity 2 - 11):** Central (jointly: DLR & JR), West (JR), North (DLR), Belgium (JR), South Africa (JR), Mali (tbd.)	4 European, 1-2 African test sites within Central						M6: mid June (next telecon) Central & West & North. M7: Belgium, South Africa, Mali (tbd)	East (DLR), DRC (tbd.)						
Activity 2	~~(a) S-1/S-2 desk study + test of geometric validation correction approach, if needed propose new methods ; (b) S-2/S-3 only desk study (for now)~~	~~testsite approx. 2 sites (min. south-north)~~			X(S1/2)		X(S2/3)	M7: first results		investigate/test approach to derive **geometric consistency** (S-1/S-2/S-3 fusion)	x	x	x	x	x
Activity 3a	~~(a) Investigate/test approach to derive radiometric consistency of time series (S-2/S-3 fusion). Use ESA level 2a product (in future maybe L2A) as the reliable radiometric adjustment reference ; (b)~~	~~testsite approx. 2 sites (min. south-north)~~					x	M7: first results		investigate/test approach to derive **radiometric consistency** (S-2/S-3 fusion) --> **ESA / L2; MAYA**				x	
Activity 3b	~~Test: Compare atmospheric correction & relative radiometric normalization~~	~~within Central testsite approx. 2 sites (min. south-north)~~			x			M7: first results							
Activity 4	**desk study** on cloud-(shadow) masking of S-2 (if needed alternative solutions form literature - benchmark with MAYA)						x	M7: first results		investigate/test automated **multi-temporal** approach for **cloud-/cloud-shadow** detection for S-2 (S-3) data **--> included in MAYA**	x	x	x	x	x
Activity 5	**desk study** topo normalization of S-2 (if needed alternative solutions form literature - benchmark with MAYA)				x			M7: first results		investigate/test reliable **topographic normalisation** method (minor priority) **--> included in MAYA (tbd.)**					x
Activity 6	**desk study/test** S2/S3 gap filling, ~~with focus on northern test-site~~	~~min. northern test site~~					x	M9: first results		investigate/test S2 time series **gap filling** by **interpolation** or **alternative observation (S3)**	x	x	x	x	
Activity 7	**desk study of spatio-temporal noise reduction for** S-2						x	M9: first results		investigate/test spatio-temporal methods for **noise reduction S-2** dense time series		x	x		
Activity 8	investigate which quality layers are available for S-2/S-3, e.g. uncertainty/quality layer (flag, identifier) on pixel (scene?) basis [Remark: not sure if we agreed on that in the meeting? It's not in the proposal in WP32]									investigate/test S-2/S-3 **uncertainty/quality layer** (flag, identifier) on pixel (scene?) basis --> for S-2 already included.	x	x		x	
Activity 9	Investigate available methods (~~SNAP, ORFEO etc.~~) for **SLC pre-processing** to retrieve **short-term coherence**; investigate how to incorporate into Sentinel-1 pre-processing chains; ~~check on suitable polarization for coherence (VV,...)?~~ [Remark: this check is in WP31 acc. proposal]	selected scenes			x		x	M9: first results		investigate/test temporal series of S-1 **coherence** data at 6 days		x		x	
Activity 10	Investigate/test spatio-temporal methods for **noise reduction**: 10m full resolution versus multi-looking in test sites				x			M9: first results		investigate/test spatio-temporal methods for **noise reduction**: 10m full resolution versus multi-looking in test sites					
Activity 11	~~develope method to exclude "corrupted" imagery (procedure to automatically sort out problematic S1 scenes by e.g. flags on pixel, scene, granule basis?, indicence angle;~~ [Remark: this is in WP33 acc. proposal]									investigate/test S-1 **uncertainty/quality layer** (flag, identifier) on scene basis	x	x		x	

BENCHMARKING PROCEDURE

Benchmarking is applied for methods developed in Task 3 as well as prototypes developed in Task 4, in cases where there is more than one potential candidate method, input data, algorithm, software, hardware configuration, etc. In order to harmonise the benchmarking work in the project, a generic benchmarking procedure has been defined, following the structure described below, which shall be applied separately for each benchmarking case. Suitable criteria shall be defined to (qualitatively or quantitatively) perform the benchmarking and subsequent selection process.

This general procedure shall be considered for each Task 3 and Task 4 Deliverable report where applicable – i.e., for Task 3 Deliverables due at M14 (Feb 2018), and for Task 4 Deliverables due at M17 (May 2018).

1. **Introduction**: Description of the need and the procedure for benchmarking in the subject matter
   - *What is the background in the project (e.g. wider context of Task / WP / processing chain in relation to the subject matter*
   - *Why is there a need to benchmark and (potentially) decide for only one method?*
   - *Brief generic overview of all following steps of Benchmarking and the expected outcome*

2. (Generic) description of the **candidate methods*** to be benchmarked
    - *highlighting the origin / purpose / history / current use of the candidate methods**
    - *generically describing basic characteristics / specifics of the candidate methods* – without going into detailed numbers*
3. Selection and description of **benchmark criteria** to be applied
    - *Briefly describing the selection process (who decides on the criteria, based on which experience (project, literature…)?)*
    - *List of the selected benchmark criteria & individual justification of their selection (why is it relevant?)*
    - *Description of each benchmark criterion (how will it be applied, what is the expected range?)*
4. **Implementation** of the Benchmarking
    - *Explanation of the applied system of (relative or absolute) "marks" to be given to the candidate methods* in relation to the benchmarking criteria (e.g. from +++ to - - -)*
    - *Filled matrix of "marks" for candidate methods* vs. all benchmarking criteria*
    - *If appropriate, additional matrix line with overall mark, as a summary/average of the individual marks, per candidate method**
5. Summary and **Conclusion**
    - *Discussion / interpretation of the outcome of the Benchmarking (e.g. is there a clear result, or two equally suited methods, etc.?)*
    - *In case the result should be inconclusive (e.g. two methods* resulting equally good):*
        i. *Discussion whether the benchmarking method / criteria were appropriate / complete*
        ii. *Discussion whether the Benchmarking needs to be repeated at a later stage (e.g. because further developments / information / experience will become available)*
        iii. *Or: Discussion whether both methods* can/should be used*
    - *Discussion of implications & Recommendations for the project*

* or data, algorithms, software, hardware configurations, …

TEST- AND DEMONSTRATION SITES:

The EO-based processing activities of Tasks 3 and 4 are carried out in selected Test- and Demonstration (Prototype) Sites in Europe (related primarily to the pan-European CLMS component), see Figure 4, and partly Africa (global CLMS component), see Figure 5.

The methodological developments (Task 3) are investigated in small **Test Sites** with good access to specific in-situ data, and representing the spread of biogeographic regions in Europe (Source EEA: *http://www.eea.europa.eu/data-and-maps/data/biogeographical-regions-europe-3#tab-gis-data*).

Test Sites are located in France, Belgium, Sweden, Germany, Austria, Bulgaria and Greece and are being used to test the methodological developments (see sections 2.4.4 – 2.4.8):

- The test-site in **Sweden** is dominated by forests. In some central parts and in the South, larger agricultural areas are included. The forest land is interspersed with lakes and smaller water bodies, peat bogs and grassland.
- The test-site in **Germany/Austria** is dominated in the North by cropland areas, mixed with grassland (pastures). The Southern part, covering the Bavarian Alpine Foreland, is dominated by forest cover and

grassland, including extensively used grassland and wetland areas. The test-site covers the "Wetterstein mountain range" as part of the Alps with mountain-specific vegetation zones and stretches South down to the Inn valley.

- The test site in **Belgium** comprises areas of dense agriculture and intensively used grassland, as well as a fragmented mixture of grassland and broadleaved forests, which poses a challenge to grassland classification. Two major cities and a full gradient of imperviousness degrees is represented in the site.
- The test site in **France** comprises large urban agglomerations (such as Toulouse) as well as natural grassland and intensively used grassland areas which are mixed with cropland. Towards the South, the site comprises highly mountainous landscapes.
- The **Bulgarian/Greek** test-site covers parts of the Continental, the Alpine and the Mediterranean biogeographical regions. The Alpine part is constituted by the Rhodopian Mountains which reach up to about 2000m in the centre, and which are forest-covered to a high degree. The test-site includes various semi-natural grassland areas and pastures, with cropland mainly in the North and South.

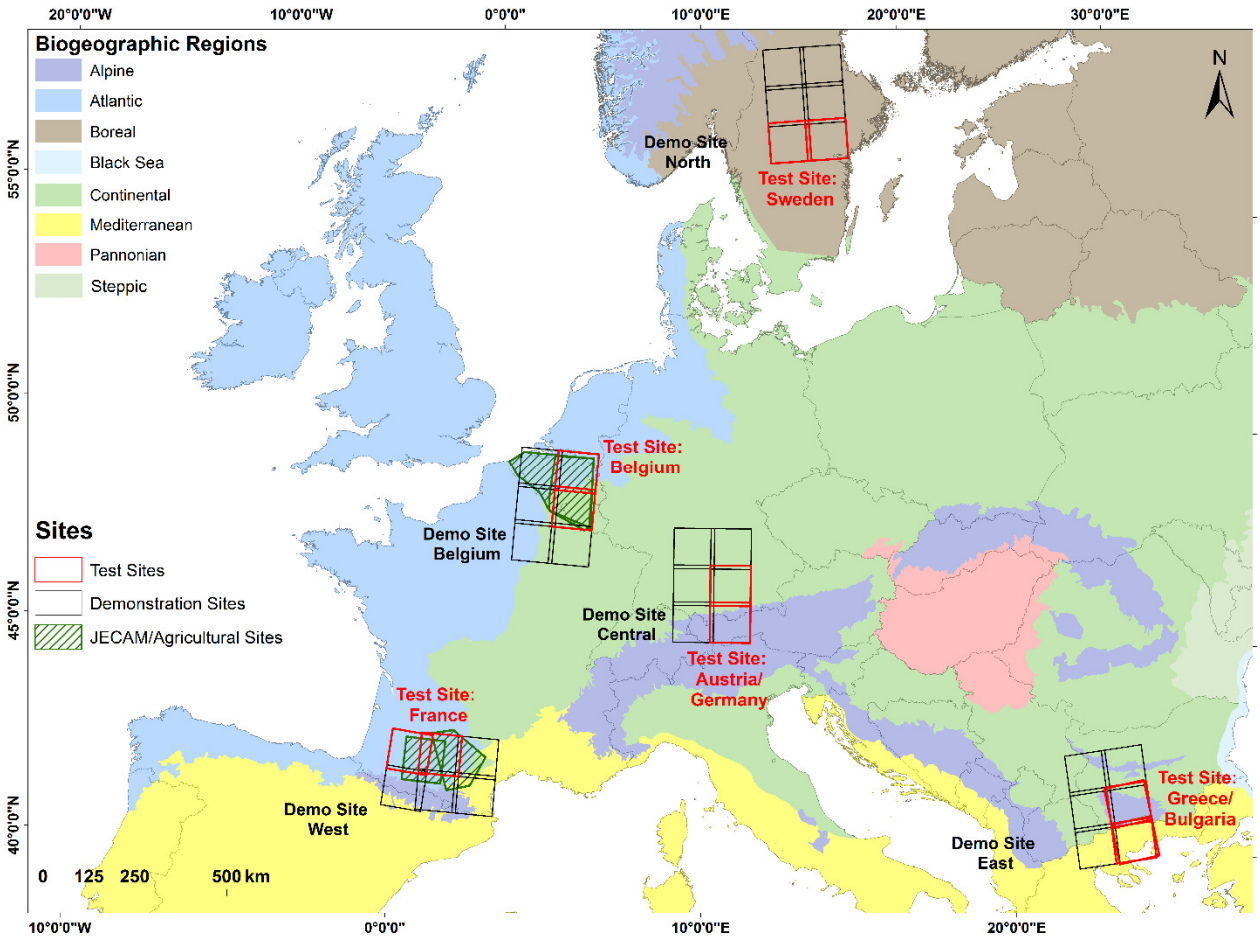


Figure 4: ECoLaSS Test- and Demonstration- Sites in Europe

Five larger **Demonstration Sites** (approx. 60.000 km² each), which incorporate the areas of the test sites, serve for demonstrating the proposed candidates for Copernicus Land Service evolution in terms of roll-out to a larger scale (Task 4). These selected Prototype Sites cover the most important environmental zones (Source: EEA) of Europe and the member states of the EEA-39:

- The Demonstration Site "**North**" is located in the Boreal zone in the North of Europe;
- The "**Central**" site is in the Continental and Alpine Central region (Germany, Austria, Switzerland, Italy);
- The "**West**" site is in the Atlantic and Steppic region (Belgium, France);

- The"**South-West**" site represents a landscape gradient from the Atlantic biogeographic region in the North over the Alpine region of the Pyrenees, to the Mediterranean region in the South and East (France, Spain, Andorra);
- The "**South-East**" site is in the Mediterranean, Continental and Alpine South-East (Serbia, Macedonia, Greece, Bulgaria and Kosovo).

It should be mentioned that, compared to the Grant Agreement, it is suggested to increase the number of European Demonstration Sites to five, in order to better reflect the regional diversity and the individual specificities of individual CLMS products under investigation, across Europe. In turn, the consortium considers it necessary to reduce the sizes of the demonstration sites to 60,000 km² (six Sentinel-2 granules) each (instead of previously 100,000 km²). A cost-benefit assessments in the first project phase has clearly shown that the incurred effort and costs for data handling, pre-processing, methods testing and, not the least, storage of intermediate products, would appear disproportionate for demonstration sites of 100,000 km² size in, taking into account that:

(i) Currently, adequate operational infrastructure systems are still not in place which would allow full-capacity data access, cloud processing, intermediate product retrieval and handling, and, not the least, storage (such as will be enabled through DIAS); and

(ii) the project needs to ensure being able to keep the focus of the effort on thematic developments rather than massive Sentinel (pre-)processing and data handling in a not-yet operational environment.

With respect to the global perspective, three **African Sites** (see Figure 5) distributed across the continent have been selected to cover a wide range of land cover/use diversity:

- The **Mali** site is representative of many semi-arid regions;
- The **Democratic Republic of Congo (DRC)** site Kisangani corresponds to the dense moist tropical forest, which is subject to various degradation levels of the forest canopy and conversions to cropland or urban areas and
- The **South Africa** site covers various natural landscapes combined with subsistence agriculture.

A key driver for the selection of the ECoLaSS Test and Demonstration Sites was the need for availability of ground truth data for the development of a crop area and crop status layer based on Sentinel data time series with pan-European and global perspective. Therefore, the sites comprise four **JECAM** (Joint Experiment for Crop Assessment and Monitoring) test sites located in Belgium, France, Mali and South Africa. The selection of these sites in different biogeographic regions ensures a large crop and field size diversity, and covering also grassland and natural vegetation.

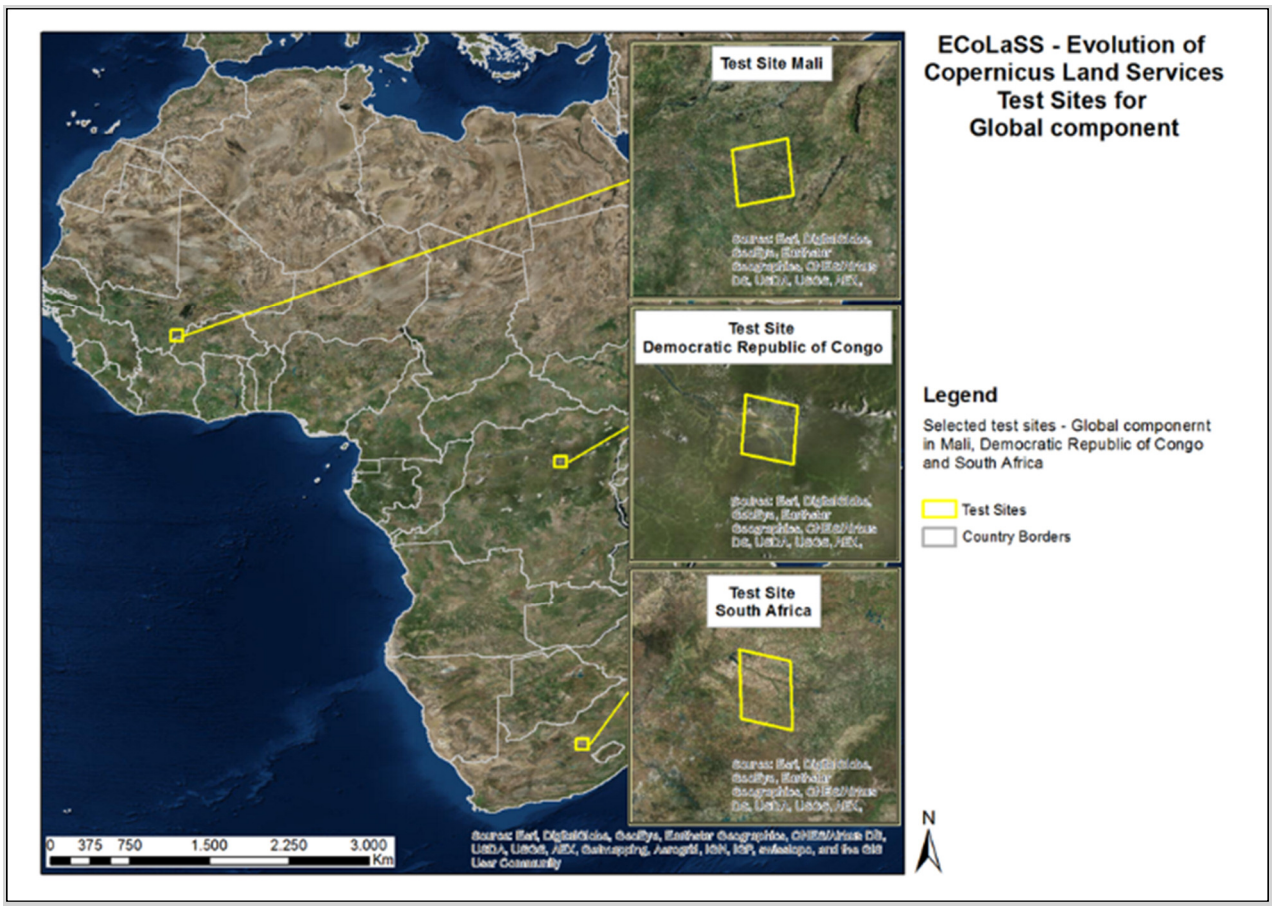


Figure 5: ECoLaSS test sites in Africa

DATA MANAGEMENT AND DATA SHARING

Two tools for document management and data sharing were set up:

- A MS Sharepoint-based **Teamsite** was set up by DLR for facilitating the exchange of project documents. This central storage and collaboration space also allows to jointly work and edit documents (e.g. MS Word, MS Excel), and versioning is supported as well. This reduces exchange of documents per email between the consortium partners.
- An **FTP** was set up by SIRS for the storage & exchange of pre-processed satellite data and derived products. This FTP allows the exchange of high volume data for all test sites and demonstration sites.

SUPPORT TO DISSEMINATION ACTIVITIES

A part of WP 12 Scientific Coordination is also the support to dissemination activities. This was provided by the Scientific Coordinator for jointly creating the first ECoLaSS conference contribution and poster, and further project presentations in the following. Moreover, the Scientific Coordinator has supported the website layout and contents, and is participating in activities on Twitter, for which both the Dissemination WP 61 Lead DLR and the Coordinator GAF have access. Dissemination activities, e.g. participations in workshops and conferences, are jointly coordinated and updated via the Teamsite.

QUALITY MANAGEMENT

The ECoLaSS Project Management Procedures are based on GAF's certified ISO 9001:2008 Quality Management (QM) System. This stringent framework covers all aspects of the project implementation and management cycle. Amongst others, the following procedures are regularly carried out by GAF in order to assure an overall high quality and consistency of the project outcomes:

- Quality Assurance of all deliverables and reports in terms of completeness, scientific/technical content, layout and formatting
- Ensure the use of corporate colours on webpage, poster, flyers, proper logos and references, etc.
- Make sure that social media communication is carried out in a conform way
- Quality control of prototype datasets (towards the end of project phase 1)
- Common document naming for all Deliverables, structured in the following way: "Number(system)_Number(title)-Name_IssueX_MX", e.g., for this Deliverable this is: "*D1.4_D11.3a-Interim_Progress_Report_Issue 1_M9*".

2.3.2 Quota Management and Data Acquisition within the ESA DWH Mechanism

The ECoLaSS consortium has requested a quota of 13,200 km² of additional VHR Earth Observation data from Copernicus Contributing Missions in 2017. These additional VHR1 data are essential for methodological testing in the framework of improving the existing High Resolution Layers on Imperviousness, Forest and Grassland, and the new layer on Agriculture. In terms of VHR1 data use 2017, the focus is on four test sites: Sweden (North), France, Belgium and Mali.

The abovementioned quota had been accepted by ESA and was subsequently granted to the project. The quota for optical VHR1 archive data orders was slightly exceeded whereas the quota for new acquisitions was not fully exploited for the acquisition year 2017. The main reason for that is that the DWH access for ECoLaSS could be established only at the end of August 2017 where the growing seasons relevant for forest, grassland and agriculture had almost reached their final stages.

Ordering and provision of satellite data is performed through the ESA DWH mechanism, providing eligible users with free and open access to space-based Earth Observation data.

Detailed information on the use of this data in relation to the project objectives as well as deviations from the assigned quota are documented in the Deliverable "***D12.1a-DWHuseFor2017_Issue_1_M9***" (AD07).

For the next project year (2018), the project has requested again an overall quota of 13,200 km², as documented in the Deliverables "***D12.2a_DWH-RequestFor2018_M9-M21***" (AD08). It is planned that a higher proportion of new acquisitions can be made use of in 2018.

2.4 Work Package Progress

Whereas WP 11 and WP 12 were already described in section 2.2 and 2.3, respectively, the following sections present the Work Package progress of the ongoing WPs 21–23, 31–35, 51 and 61. Objectives, ongoing work in progress, first results and plans for the coming months are explained.

2.4.1 Assessment of Service Evolution Requirements (WP 21)

The WP 21 "Assessment of Service Evolution Requirements" analyses the requirements evolution of Copernicus Land Services for mid-term (2018) and long-term (2020+).

Table 7: WP 21 – Assessment of Service Evolution Requirements

Work Package Number	3	**Lead Beneficiary**		GAF		
Work Package Title	WP 21 – Assessment of Service Evolution Requirements					
Short Name of Participant (Participant Number)		**GAF (1)**	SIRS (2)			
Person/Months per Participant		**2.90**	2.30			
Phase 1	**Start Month**	1	**End Month**	8		
Phase 2	**Start Month**	19	**End Month**	21		
Objectives: To collect and describe the evolution requirements of Copernicus Land Monitoring Services in view of a potential post-2020 implementation, by analysing the state of the art, product specifications, identifying challenges, shortcomings and lessons learned from current and upcoming operational land monitoring services.						

The first round of user requirements analysis – documented in Deliverables: "***D21.1 - Service Evolution Requirements Report***" (AD09) – was one of the first activities at the beginning of the project, at an early stage of the first 18-month project cycle. It has primarily been a qualitative analysis, featuring questions with possibilities for open responses. The second round of analysis (planned in the second project phase between M19 and M22) will provide an update to the first deliverable, and will focus on specific topics of interest.

These first requirements were collected by conducting a number of phone and face-to-face interviews with key representatives of European institutions as well as key national users and stakeholders that are in charge of implementing or coordinating CLMS activities. The synthesis report from this WP contains a compilation of all responses from user and stakeholder interviews, extended by information from additional sources such as relevant concept notes, reports or relevant stakeholders' workshop presentations on the topic. During the interviews, the following questionnaire has been followed (Figure 6):

Description of your Organisation
Organisation:
Department/Unit:
Contact person:

Please describe the overall mission/mandate and policy objectives of your organisation and state which department/unit is responsible for following up on Copernicus Land Services.

Policy Framework

Role in Copernicus Land

Please describe the role of your organisation in relation to the CURRENT implementation/use of Copernicus Land Monitoring Services.

Please describe the involvement of your organization for FUTURE (2020+) Copernicus Land Service implementation/use.

Policy-related Events/Milestones

What are the policy related events/milestones/reports for the work of your organisation within the next 5 years, with relevance to Copernicus Land Services?

Policy Drivers

(a) Highlight the main environmental regional/national and international environmental policies that your organisation implements or provides implementation support for (either directly or indirectly);
(b) Explain how these policies drive your geographical information needs in relation to Copernicus Land Monitoring Services.

Use of Copernicus Land Products

(a) Which Copernicus Land Service products are used in your organisation, and in which context?
(b) Where do you see the strengths and most valuable information in these products, and why?
(c) Which current shortcomings do you experience?

End Users & Applications:

Product Users

(a) Which kind of users are the users of the CURRENT Copernicus Land products (as far as you are aware of)?
(b) Can you predict possible new kinds of users in 2020+?

End-use Applications

(a) What are the main end-use APPLICATIONS of the CURRENT Copernicus Land products (as far as you are aware of)?
(b) What are your thoughts on the situation in 2020+?

Technical Specifications for Copernicus Land Service Evolution:

Evolution of Existing Products

Products for Service Evolution

(a) Based on the current Copernicus Land product specifications, for which existing products do you consider an improvement/evolution as necessary? (b) Please state the reasons why?

Evolution of Key Specifications

Please provide desired specifications for the products under evolution

New Services/Products

Definition of New Services

Which new Copernicus Land products do you envisage?
(a) Mid-term (until ~2018 Update) (b) Long-term (2020+)

Key Specifications for New Services

Please provide your idea of specifications for these new products

Cross-cutting Services

(a) Do you see the need for new cross-cutting Copernicus Services? (b) If yes, which?

Implementation of Improved and New Services & Products

Implementation Schedule

What is your required schedule and plan for implementation of improved or new services/products into the operational Copernicus Land Monitoring Service portfolio?

Infrastructure

Do you have any specific requirements in terms of service provision via online platforms, data and information access services?

Figure 6: User & Stakeholder Questionnaire

WP21 considers recent developments regarding Copernicus Land services as well as future plans. The results of this first user requirements analysis show that the methodological and prototypical developments planned for ECoLaSS largely concur with the perception and future plans of the key users and stakeholders in terms of Copernicus Land Service Evolution.

Regarding the obtained results, the ECoLaSS project focuses on the pan-European and Global Component aspects, as these are partially closely related, and take into account the respective needs of the key user and stakeholder community. There is generally substantial interest in use of the High Resolution Layers, particularly when equivalent information is not available at national level, but it should be stressed that some users indicated that there is still a lack of awareness about the HRLs, which is hampering their take-up and use.

Furthermore, national users showed particularly high interest in products of the Local CLMS Component, which is clearly related to the higher spatial resolution of the products, better fulfilling the information needs on a regional level and also perhaps because these products are thematically closer to those already available locally. There is a general trend towards increasing interest in Copernicus (Sentinel) satellite data, which was repeatedly mentioned by several users.

In terms of specifications, the requirement for shorter update frequencies and change products (incremental updates) was mentioned several times. Concerning new services, a pan-European Agricultural Service as well as a Phenology Layer were the most frequently recorded responses. A further outcome is a trend towards the desire for more generic or cross-cutting services and products.

The assessment brought also further-reaching feedback on Copernicus or the CLMS as a whole, which cannot be directly addressed by ECoLaSS, but has been recorded in the respective Deliverable, and may be further used by the relevant decision makers. While it was observed that technical issues and limitations of the CLMS products' (satellite and other) input data, as well as the actual methods for generation of the products are not of major concern to the users, it was also found that (depending on the individual user) the knowledge of specifications of the existing products and metadata is in general rather limited. Requests for obtaining more information on the products and metadata were voiced several times. Additionally, a general requirement for an easier and standardised access to data, products and documentation, via a unified access portal, was repeatedly stated, including the desire for a multi-layer online visualisation and/or evaluation tool for the products.

In Phase two of the ECoLaSS project, this Service Evolution Requirements Assessment, including the User Requirements Analysis, will be updated and refined, considering all relevant ongoing developments and future evolution plans. The second analysis cycle will be targeted to more specific aspects as needed, and will provide an update of the respective Deliverable.

2.4.2 Assessment of EO and Other Data Requirements (WP 22)

WP 22 is on the "Assessment of EO and other Data Requirements" and is as such considering the outcomes of WP 21 and is of relevance for WP 23:

Table 8: WP 22 – Assessment of EO and other Data Requirements

Work Package Number	4	**Lead Beneficiary**	SIRS			
Work Package Title	WP 22 – Assessment of EO and other Data Requirements					
Short Name of Participant (Participant Number)		GAF (1)	**SIRS (2)**			
Person/Months per Participant		3.60	**2.90**			
Phase 1	**Start Month**	1	**End Month**	9		
Phase 2	**Start Month**	19	**End Month**	24		
Objectives: To assess, monitor and document the requirements for EO and other data availability as input for future Copernicus Land operational services (2020 and beyond) by monitoring the effective implementation of the Sentinel satellites deployment, the third parties missions as well as the in-situ activities.						

The consolidation of Copernicus Land Service evolution requirements needs to consider EO and other data requirements to make sure that the general requirements expressed as part of WP 21 "Assessment of Service Evolution Requirements" are realistic and can be supported by a sustainable provision of relevant input data to ensure the service operational conditions in the near and more distant future. Therefore, the objectives of this WP are to:

- Assess current available EO, reference and in situ data and their usability for the evolution of Copernicus Land Services
- Follow and analyse the evolution of new and upcoming satellite/sensors
- Define data requirements relevant for future Copernicus land services 2020+

A first deliverable of WP22 was produced: "***D22.1 - EO and other Data Requirements Report***" (AD10) that represents the first iteration of WP22 deliverable at the end on month 9 of the project only considering the outcome of WP21 in terms of user requirements. A second iteration is due at month 24 that will consider a first implementation of the services envisaged over the demonstrations sites (Task 4) and should enable the consolidation of EO and other data requirements to be made.

A detailed review of the status of Copernicus EO and other data was made outlining the shortcomings of the current provision and the consequence this might have for future services. An assessment of the current and future offering in terms of EO data was made including the Sentinel constellation based on available documentation and the assessment of future mission evolution was also done primarily based on the participation to relevant meetings. This was confronted to the needs identified as part of WP21 to assess any critical gaps and potential mitigation measures as outlined below:

- There is a lack of a reliable geometric reference dataset hampering the use of the Copernicus VHR dataset for calibration and validation of the thematic classification associated with the production of HRL at pan-European level. This could be resolved by improving the quality of the pan-European DTM and by developing a reliable VHR reference based on one of the VHR coverages and making use of available orthophoto coverages from MS.
- Supporting in situ data for training and validation of thematic data are not homogeneous. One of the more obvious example is that of LPIS which could provide reliable training and validation data for the production of HRL grassland and a future crop layer, but its availability at pan-European level is far from complete despite the INSPIRE Directive. This would require further support and

Strengthening of the Copernicus In-situ Component to improve the access to high quality reference and in-situ data for the Copernicus Services

- The level of pre-processing for Sentinel 2 imagery is currently inadequate thus hampering the development of automated processing chains based on dense time series. At the very least, cloud masks need to be urgently improved

The analysis of critical gaps and the provision of mitigation measures will be reviewed in the next version of the deliverable following the first demonstration of future CLMS service candidates."

2.4.3 Assessment of Service Infrastructure/Architecture Requirements (WP 23)

WP 23 on the "Assessment of Service Infrastructure/Architecture Requirements" builds on WP 21 and 22:

Table 9: WP 23 – Assessment of Service Infrastructure/Architecture Requirements

Work Package Number	5	**Lead Beneficiary**	DLR			
Work Package Title	WP 23 – Assessment of Service Infrastructure/Architecture Requirements					
Short Name of Participant (Participant Number)		GAF (1)	SIRS (2)	JR (3)	UCL (4)	**DLR (5)**
Person/Months per Participant		1.70	1.20	0.66	1.00	**3.60**
Phase 1	**Start Month**	1	**End Month**	10		
Phase 2	**Start Month**	19	**End Month**	24		
Objectives: To assess currently available and upcoming IT architectures in terms of their capabilities for processing large volumes of EO data in order to minimise Input-Output operations within and across systems, recommend strategies for easy integration of prototype products into the future Copernicus Land service infrastructure.						

The launch and operation of the Sentinel 1, 2 and 3 Earth observation satellites have resulted in a sharp increase of remote sensing data for global land and ocean monitoring services. Together with already existing data sets (e.g. Landsat) users face the problem of dealing with massive data sets. Approaches taken by different users and organizations are highly diverse and rapidly evolving, especially since the appearance of readily available commercial processing platforms (e.g. Google Earth Engine, Amazon Web Services), which solve the problem of data organization.

Each member of the ECoLaSS consortium has unique experience in working with EO data sets. This was evident during the initial project phase, when planning of work packages and organizing the resulting tasks revealed the different approaches towards data handling and processing. Pre-processing and data exchange activities during this phase further increased this awareness and led to collaborations that required the synchronisation of different actors.

A subsequent survey and study successfully highlighted common strategies as well as fundamental differences. This is documented in the report "***D23.1 - Service Infrastructure/Architecture Requirements Report***" (AD11, the first deliverable of this work package), which provides the description of state of the art paradigms and developments in EO data processing, analyses the service architecture, infrastructure and requirements of each member of the consortium and addresses assessments for future developments regarding hardware, software and platform infrastructure and the overarching orchestration.

Also described are areas of cooperation and interaction that were identified during the practical work and the study.

Future work in WP 23 will (i) identify points of interaction; (ii) make recommendations for streamlined collaboration; (iii) set up tests were some of the ideas will be tested in practice; (iv) document solutions; and (v) provide lessons learned.

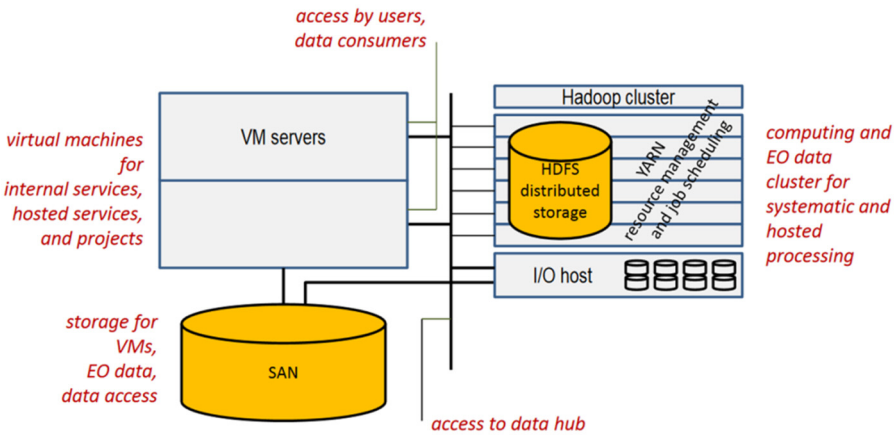


Figure 7: Generalized view of the DLR Code-DE processing infrastructure

2.4.4 Sentinel-1/2/3 Integration Strategies (WP 31)

WP 31 is on "Sentinel-1/2/3 Integration Strategies":

Table 10: WP 31 - Sentinel-1/2/3 Integration Strategies

Work Package Number	6	**Lead Beneficiary**	DLR			
Work Package Title	WP 31 - Sentinel-1/2/3 Integration Strategies					
Short Name of Participant (Participant Number)		GAF (1)	SIRS (2)	JR (3)	UCL (4)	**DLR (5)**
Person/Months per Participant		1.70	1.20	0.66	1.00	**3.60**
Phase 1	**Start Month**	2	**End Month**	14		
Phase 2	**Start Month**	19	**End Month**	26		
Objectives: To investigate S-1/2 complementary information integration techniques for improved LC/LU updates, crop area and improved grassland services; to identify alternative strategies for using S-1/2 time series indicators in classification / post-classification approaches; to explore the potential of and define S-2/3 fusion approaches.						

Monitoring of land use / land cover (LULC) change and seasonal dynamics of vegetation and crops requires temporally and spatially high resolution Earth observation (EO) data. Currently, this requirement cannot be satisfied by one EO sensor alone (Gao et al., 2015). On the one hand, frequent cloud cover in optical imagery can limit the availability of a complete time series for the classification; while on the other hand, speckle noise as well as geometric and radiometric effects due to topography in SAR imagery can increase the uncertainty und result in poor classifications (Joshi et al., 2015). Therefore, data fusion approaches have been developed over the past decades to use the advantages of different sensors in LULC classifications. In general, fusion approaches are developed for the integration of different spectral and spatial resolutions from two or more sensors to the effect of including data into high spatial resolution as well as preserving the high spectral and temporal resolution properties of the sensors.

According to the desk study within WP31, the following integration strategies are possible and reasonable in relation to the objectives of ECoLaSS:

- Multi-sensor-temporal approach for classification and change detection analysis (fusion of Sentinel-1 and Sentinel-2)
- Multi-sensor-spatial-temporal approach to enhance temporal high resolution time series data (fusion of Sentinel-2 and Sentinel-3)

Depending on the type of land cover (e.g., urban, grassland, etc.), specific fusion approaches need to be evaluated. First, adequate pre-processing steps to retrieve spectral and spatial consistency as well as enabling complementary information integration and fusion have to be defined. Then, suitable indices and spectral bands from optical and SAR data need to be identified and explored for the different targeted land cover classes (e.g., LAI, Cover, indicators including Red Edge and SWIR bands, wetness sensitive indicators, Sigma Nought backscatter coefficient in Co-Pol, Cross-Pol bands, polarisation ratios, textural parameters, indicators representing changes in water content, etc.). Finally, the results have to be assessed and evaluated with respect to the effectiveness and accuracy of the tested fusion approach.

Based on the desk study, the following test cases will be set up to meet thematic requirements of the ECoLaSS project:

- Explore SAR & optical based indicator approaches as parallel inputs in classification / post-classification schemes;
- Assess potential of improving S-2 time series by fusion with S-3 information for mapping LC (cloud compensation);
- Define interpolation and fusion tools of S-2 and S-3 data.

Generally, the fusion of data from sensors with different spatial or spectral resolution is not straightforward. Furthermore, fusing different temporal resolutions can be challenging as the radiometric properties of single images can change in terms of atmospheric and phenological variations, differences in illumination and observation angles, cloud and shadow contamination, and sensor calibration changes (Roy et al., 2008; Coppin et al., 2004; Song and Woodcock, 2003). Therefore, radiometric normalization as a part of pre-processing has to be considered when data fusion approaches are applied. Furthermore, the data of each sensor have to be precisely co-registered, calibrated, spectrally normalized to common wavebands, and atmospherically corrected using appropriate atmospheric characterization in order to retrieve reliable results (Roy et al., 2008). However, the EO data from the different Sentinel sensors have high spatial consistency. Thus, it can be relied on these data and no further calibration is required.

NEXT STEPS

Class specific requirements for input data are being requested from the service providers of the HR layers and define the design of the integration test cases, which is being finalized in coordination with the WP4* leads at the moment. Furthermore, strategies to analyse the performance and added-value of data fusion and synthetic high temporal-high spatial time series are being assessed. A benchmarking of the fusion output products will be conducted on post-classification level. This requires all WP4* leads to test their classification approaches for the thematic layers with differently fused EO time series input data. Finally, these have to be validated in order to derive the best input data set and integration strategy.

2.4.5 Time Series Preparation (WP 32)

WP 32 is on "Time Series Preparation":

Table 11: WP 32 – Time Series Preparation

Work Package Number	7	**Lead Beneficiary**	JR			
Work Package Title	WP 32 – Time Series Preparation					
Short Name of Participant (Participant Number)		**JR (3)**	DLR (5)			
Person/Months per Participant		**4.33**	3.92			
Phase 1	**Start Month**	3	**End Month**	14		
Phase 2	**Start Month**	19	**End Month**	26		
Objectives: Provide methods for precisely and considerately pre-processing of S1, S2, S3 and LS8 time series.						

The aim of WP32 is to identify robust methods for fully automated pre-processing of Sentinel 1 and 2 data streams, which are a prerequisite for all further processing tasks. The quality of the pre-processing procedure determines the thematic quality, content and accuracy that can be achieved in any subsequent information extraction processes.

SENTINEL-2 (S2)

The resulting data streams of Sentinel-2 optical time-series are spatio-temporal consistent optical time series of bottom of atmosphere reflectance. The processing is implemented in automated processing lines which include the extraction of metadata, atmospheric correction, an optional topographic normalization, and cloud, cloud shadow and snow masking.

For S2 the following granules were processed for the corresponding test sites (in brackets the responsible partner for pre-processing is listed):

- Central: 32TPT, 32UPU (JR)
- Belgium1: 31UFR, 31UFS (JR)
- Belgium2: 31UES, 31UER (JR)
- France: 30TYP, 31TCJ (JR)
- North: 33VVF, 33VWF (DLR)
- South-Africa: 35JMJ, 35JNJ (JR)
- Mali 29PRP, 29PTU (JR)

The pre-processing has been performed with the IMPACT module "Sentinel-2 Reflectance Data Processing" by JR and sen2cor with additional post-processing by DLR.

In the processing line of JR, the Sen2Cor software package provided by ESA has been implemented into the IMPACT environment. For cloud masking, improvements have been implemented, applying morphological filtering. The output products are:

- GeoTIFF of Scene (.tif)
- output from Sen2Cor (.zip)
- cloud probability (_cld)
- mask from derived clouds (_cloudmask)
- scene, no-scene mask (_mask)
- scene without clouds mask (_ncl)
- solar azimuth and solar zenith angles in degree (_sol)
- scene classification (_scl)

The bands with 20m spatial resolution are resampled to 10m resolution. All data is projected to ETRS LAEA projection.

Also the pre-processing of S2 data by DLR used the sen2cor software provided by ESA. After the sen2cor processing (including atmospheric correction, scene classification and derivation of additional layers), the data were post processed applying the following steps:

- 20m bands resampled to 10m
- Reprojection to ETRS LAEA

The output products where named according to the new file naming convention of ESA for Sentinel-2 Level-1C products after the 6th of December, 2016:

- Zip: L2A_T33VVF_20150809T103018.zip
  - *L2A – processing level*
  - *T33VVF – Granule*
  - *20150809T103018 – Date of acquisition*
- Filename: L2A_T33VVF_20150809T103018_B02_10m.tif
  - *B02 .. B12 - Band*
  - *10m - resolution*
  - *AOT – Aerosol Optical Thickness*
  - *SCL – scene classification*
  - *VIS – QL im Visible*
  - *WVP - Water Vapour*

For the SENTINEL2 optical data an overall data amount of 955 scenes, encompassing a download volume of 893GB and a processed data volume of 4.1 TB, has been processed.

SENTINEL-1 (S1)

In general for JR and DLR, the pre-processing of S1 time series data is based on Level-1 products in Interferometric Wide swath (IW) mode and Level-1 Ground Range Detected (GRD), because the IW is to be considered the main acquisition mode over land and satisfies the majority of service requirements.

In addition to backscatter products, first results of the coherence products are processed by JR in order to give useful additional information for the differentiation of land cover classes.

All radar data required substantial pre-processing including a) automated SAR image download, b) automated preparation of digital elevation data, c) automated update of orbit files, d) GRD border noise removal, e) radiometric calibration, f) multi-looking and image filtering (speckle, adaptive), g) spatio-temporal speckle filtering, h) radiometric terrain corrections and i) geo-referencing.

Considering the data size and number of scenes to be processed, an automated and rapid processing chain is essential, especially for near real-time scenarios. In order to fulfil these requirements an automated processing chain for SENTINEL 1 data pre-processing has been implemented into the RSG module “Space Suite” at JR. It comprises the following processing steps:

- Image ingestion: bulk import of original images to RSG .rsx files, orbit update (precise orbits), automated combination of adjacent scenes
- Image pre-processing: definition of image frame extent (based on selected granules), full image resolution, no speckle filtering, no multitemporal filtering, radiometric terrain correction to gamma naught based on SRTM 4.1 model (CENTRAL: also tests with sigma naught), combine polarizations in one image stack (band1: VH; band2: VV)

- Orthorectification: based on interpolated DEM (SRTM 4.1), output image resolution is 10m, output image resampling method (nearest neighbour), coordinate system: UTM WGS84
- Calculation of incidence angle map
- Generation and testing of coherence product

Resulting ortho images have been organised according to SENTINEL2 granule ID. In each test site relevant granules (with granule ID) can be found.

At DLR, the S1 data were pre-processed using the S1 Toolbox. The pre-processing was also automated due to the high data amount already mentioned above. The pre-processing included the following steps:

- Thermal noise removal
- Radiometric calibration
- Terrain correction with SRTM 30
- full image resolution, no speckle filtering, no multi-temporal filtering at the moment

The output has been delivered in Sigma naught in DN with a spatial resolution of 10m in ETRS LAEA projection. Data was cropped to the outline of the corresponding S2 granules. VV & VH polarization band were delivered in separate Tiffs.

For the SENTINEL1 radar data an overall number of 1086 scenes, encompassing a download volume of 2.7 TB and a processed data volume of 1.3 TB, has been processed. Altogether, optical and radar, the pre-processing data volume encompass more than 9 TB.

BENCHMARKING

In addition to the preprocessing of the S1 and S2 time series for the test sites, a benchmarking process has been initiated in order to find the best methods and workflows. Here, a detailed literature analysis has been started dealing with:

- Geometric validation correction approaches,
- Approaches to derive radiometric consistency of time series,
- Atmospheric correction & relative radiometric normalization,
- Cloud (-shadow) masking of S2,
- Topographic normalization of S-2, and
- Spatio-temporal noise reduction for S-2.

In the following months, pre-processing product comparisons will be initiated in close cooperation of the WP33, WP34, WP45 and WP4* leads, as the different pre-processing products have to be compared also on post-classification level for the specific thematic layers to identify the best methods for an operational workflow.

2.4.6 Time Series Analyses for Thematic Classification (WP 33)

WP 33 is on "Time Series Analyses for Thematic Classification" and builds up on pre-processed data from WP 32 and methods for integrating Sentinel-1, -2, and -3 data from WP 31:

Table 12: WP 33 – Time Series Analyses for Thematic Classification

Work Package Number	8	**Lead Beneficiary**		UCL		
Work Package Title	WP 33 – Time Series Analyses for Thematic Classification					
Short Name of Participant (Participant Number)		GAF (1)	SIRS (2)	JR (3)	**UCL (4)**	DLR (5)
Person/Months per Participant		4.70	2.90	4.83	**5.00**	4.95
Phase 1	**Start Month**	4	**End Month**	14		
Phase 2	**Start Month**	19	**End Month**	27		
Objectives: To develop a framework for times series analysis for thematic classification based on Sentinel multi-sensor constellation.						

This WP aims to develop a framework for times series analysis for thematic classification based on Sentinel multi-sensor constellation. Build on the availability of calibrated and atmospherically corrected surface reflectance or backscattering coefficient time series (provided by WP32) it aims to support the development of various prototypes products: HRLs (Imperviousness, Forest layers), Grassland, Crop type, and new LC/LU products.

A general common workflow has been adopted by all the partners for each thematic application. The main activities consist in (1) identifying the best strategy for time series production based on optical S2 imagery; (2) identifying indicator based on backscattering and coherence S1 images; (3) testing different automated reference sampling approaches; (4) developing temporal metrics; (5) analysing the best curve fitting and filtering method from multi-annual optical and SAR series for land surface phenology; (6) studying the methods for phenological metrics estimation; (7) studying the S1/S2 fusion possibility at biophysical variable level, (8) investigating different algorithm for time series classification; and then (9) validating the classification.

This WP has started in M3 and will continue till M27 with two reporting phases at M14 and M27. The following paragraphs relate the work carried out so far and the future plan till M14 for the different thematic applications.

Concerning **forest**, work is in progress for the two primary status layers: Dominant Leaf Type (DLT) and Tree Cover Density (TCD). The HRL 2015 forest products in 20 m spatial resolution, which were produced based on an automated classification approach using multi-temporal time-series data together with manual enhancements, serve as reference data for benchmarking new approaches with respect to Time Series Analyses for thematic classification. First focus was put on testing different automated reference sampling approaches (activity 3) to enhance initial thematic classification results for Tree Cover and HRL Forest Status Layers. Different automated approaches were tested (e.g. outlier detection, random vs. systematic sampling scheme). First results of the automated outlier detection (OneClass SVM) are provided in Figure 8.

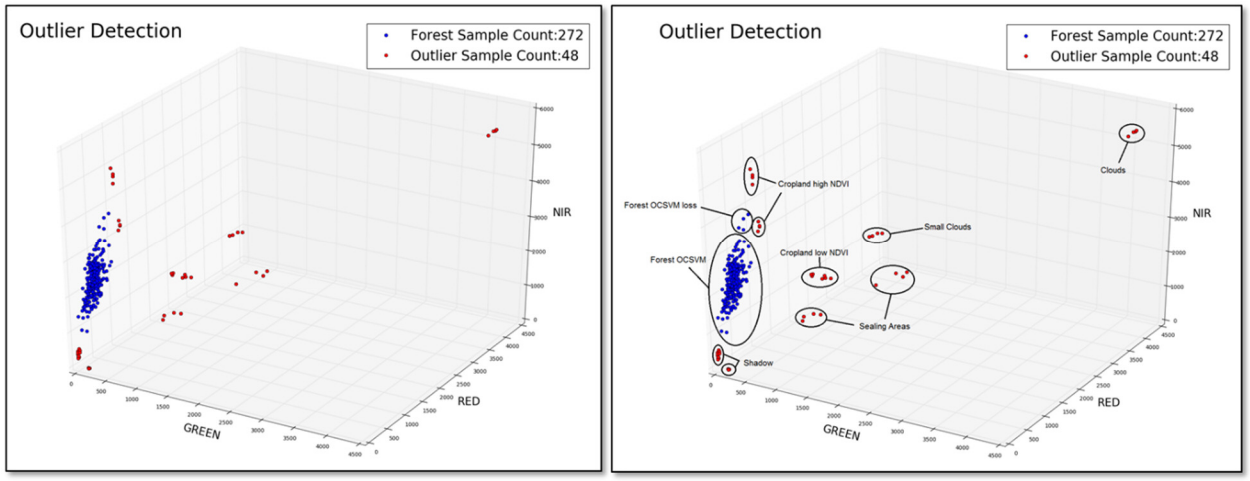


Figure 8: Reference Sampling – Automated Outlier Detection

The outlier detection using OneClass SVM already led to improved classification results (compare Figure 9 with reduced false classification in agricultural fields). Comparative studies on other algorithms will be performed.

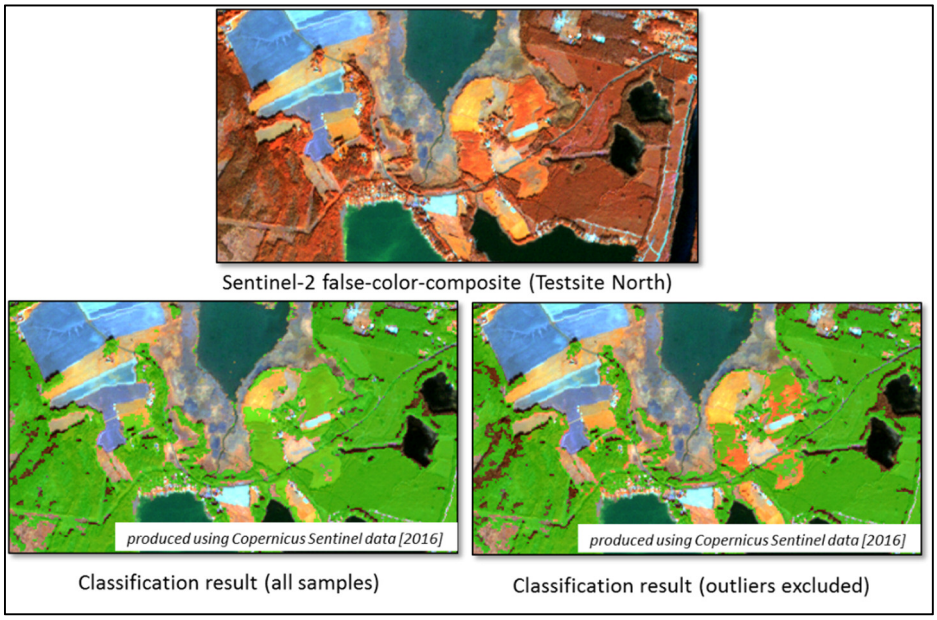


Figure 9: Improved classification result as outcome of the outlier detection

In addition, research is initiated on the development of temporal metrics (activity 4) and the phenological metrics estimation (activity 6) based on Sentinel-2. The latter one will a) enhance and automate the scene selection, b) improve the identification of best suitable timespans for feature differentiation (e.g. cropland vs. forest), and c) indicate start and end-point of potential satellite image acquisition dates to support incremental updates within seasons. Until M14 it is planned to a) prepare different layers as input for the classification process (e.g. PCA on spectral bands of Sentinel-2, NDVI time series/metrics, Brightness time series/metrics), b) compare single scene based classification and application of specific rule sets (majority decision,…) with classification of multi-temporal data stacks. In addition, different classification methods such as Random Forest and Support Vector Machine will be benchmarked against each other. The plan until M14 is also to extend analysis to the central test site.

Concerning **imperviousness**, it is proposed to use the HRL 2015 as an absolute reference data. For the French test sites, new layer is being generated using change detection and a following reclassification on the changed area. Improvement of the reclassification algorithm is under investigation (relying on dense time series to derive a series of variables (NDVI, NDBI, NDWI…) to produce statistical indicators as basis

for classification), as well as new methods to automatically calibrate newly incoming images, relatively to this reference layer. The approach developed as part of the CLMS Pan-European validation exercise will be adapted to validate the imperviousness layer. This work is expected to be extended to Belgium test sites after M9.

Concerning the **CLC+ products**, the potential use of the IOTA processing chain is being investigated, among other literature reviews. This land cover and land use classification automated chain has been created using the ORFEO toolbox designed by the CNES. However, not all classes of the CLC convention can be generated by its algorithms. The CLC classes more related to land use are difficult to characterize purely from EO data and there needs to assess to which extent thematic classes can be extracted from the CLC nomenclature and what needs to be characterized from ancillary and/or other means.

Initial activities related to **agriculture** products are reported in this paragraph. A desk study on the compositing techniques has been initiated (activity 1). An initial set of criteria to evaluate the best compositing method for crop recognition (cropland-CL, crop type-CT) and crop growth monitoring (CG) have been selected. After a preliminary evaluation of the S2 input data (L2A) the performance of several compositing techniques is under evaluation on a small scale area over the Belgian test site. A desk study has been done in order to identify existing methods to estimate phenology (initially focusing on the start of the growing season) based on optical (S2) time series (activity 6). Comparison of six different algorithms has been initiated over a test area covering three S2 granules in South Africa. Moreover, agreements have been done between UCL and external partners to get access to in-situ information (crop type map, phenological metrics, meteorological data). Additional VHR data have been ordered over the Belgium and Mali site for validation purpose.

The work plan for agriculture products till M14 is to continue the initiated analysis related to the activity 1 (compositing strategy for different products) and activity 6 (enlarging the set of phenological metrics to be tested such as end-of-season detection, duration, and some specific development stages, relying on both S2 but also S1 time series). Indicator based on S1 time series will be first identify through the activity 2. Automated reference sampling approach (activity 3) will also be initiated. As a first focus, Belgium and Malian sites will be used (as well as South Africa). A desk study concerning the fitting and filtering techniques (5) will be initiated. Classification (8) and validation (9) of two first products (CL and CT) will be initiated over two sites (Belgium and Mali) in order to compare input data type (single day versus time series, composite, temporal features or interpolated time series).

A state of the art review on monitoring **grassland** is currently ongoing which focuses on feature identification and classification methods based on optical (activity 1) and SAR (activity 2) time series imagery. Feature analysis is currently performed based on the time-series which are already pre-processed by WP32, with an initial focus on the Belgian test site, for which also reference data is already available (see below). As basis for the various analysis and classifications, LPIS (Land Parcel Identification System) data is prepared for the Belgian test site. Further VHR data has been selected which is later used for validation purposes. For optical time-series, features such as NDVI, Red-Edge-Position and temporal metrics were derived and are currently analysed. For SAR time-series, the focus is on back-scatter parameters and for parts of the Belgium test site, short term coherences are derived from Sentinel1 time series.

Work on above steps is currently ongoing, and results will be provided until M14. Further detailed planning for the period M14 to M27 will be based on these results as well as on the results of the other work packages.

2.4.7 Time Series Analyses for Change Detection (WP 34)

WP 34 is on "Time Series Analyses for Change Detection" and as such closely connected to WP 33 and WP 35:

Table 13: WP 34 – Time Series Analyses for Change Detection

Work Package Number		9	**Lead Beneficiary**	JR		
Work Package Title	WP 34 – Time Series Analyses for Change Detection					
Short Name of Participant (Participant Number)		GAF (1)	SIRS (2)	**JR (3)**	UCL (4)	DLR (5)
Person/Months per Participant		3.90	2.90	**5.60**	3.00	4.95
Phase 1	**Start Month**	4	**End Month**	14		
Phase 2	**Start Month**	19	**End Month**	27		
Objectives: To explore and set up a methodological approach for automated change detection based on optical and SAR Sentinel time series to be used as input for the local, pan-European and Global Components of the Land Monitoring Service.						

This work package aims to explore and set up a methodological approach for automated change detection based on optical and SAR Sentinel time series to be used as input for the local, pan-European and global components of the Land Monitoring Service. Special emphasis will be drawn on the development of the prototypes products Imperviousness, Forest layers, Grassland, Cropland, and new LC/LU (CLC+) products. The work package started in M4 and reporting milestones are planned at M14 and M27. As this work package builds on the results of the previous work packages, especially WP31, WP32 and WP33, work will be concentrated in the first project phase between M9 and M14.

Currently, a state of the art review is performed for (i) signal anomaly detection in time series based on optical & SAR data, and (ii) change detection by fusing signal anomaly detection results. Together with results from other work packages, specifically WP33, this will provide a sound basis for the analysis and developments in the coming months.

First testing's were applied within the Belgian test site, where JR produced in addition to the optical and SAR time-series imagery also short term coherences from Sentinel1, and for which already LPIS (Land Parcel Identification System) reference data is available. The analysis focused on derivation of temporal metrics from time series imagery. In addition to scene-by-scene pre-processed imagery, also multi-temporal filtered time-series features were used as basis for deriving temporal metrics. In the next months this work will be complemented by investigating curve fitting methods.

Further, derivation of phenological parameters has been performed from long-term, dense MODIS time-series in low resolution. Analysis with special focus on forests and grasslands is ongoing, and results are expected until M14, as first multi-annual NDVI time series based on Sentinel-2 (see Figure 10) will become available, supporting the generation of phenological metrics and timely parameters for optimal data selection and feature differentiation also with respect to anomaly detection (compare following Figure 11).

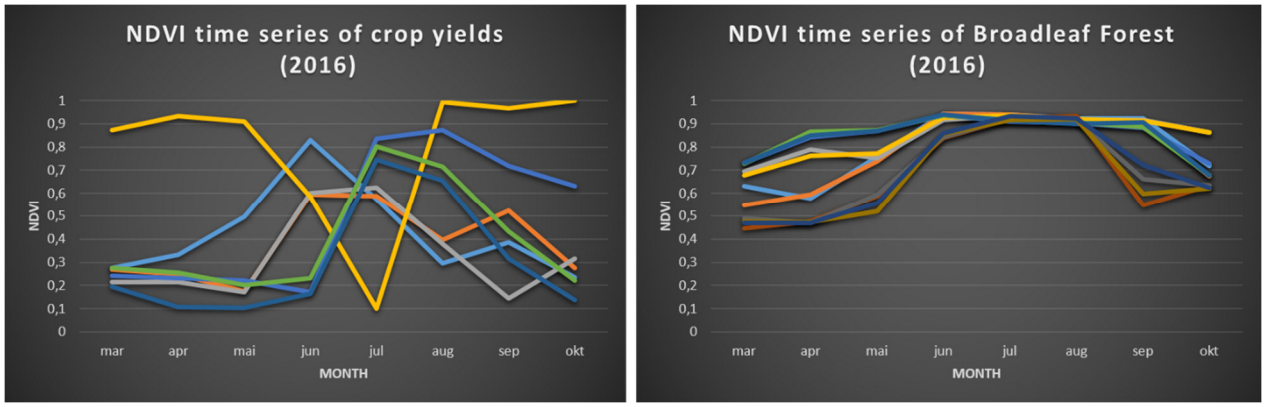


Figure 10: Sentinel-2 Level 2A-based NDVI time series of crop yields and broadleaf forest within test site North

The following Figure 11 shows NDVI Time Series (Sentinel-2 2016) and changes of NDVI values over time to a specific reference (here March 2016).

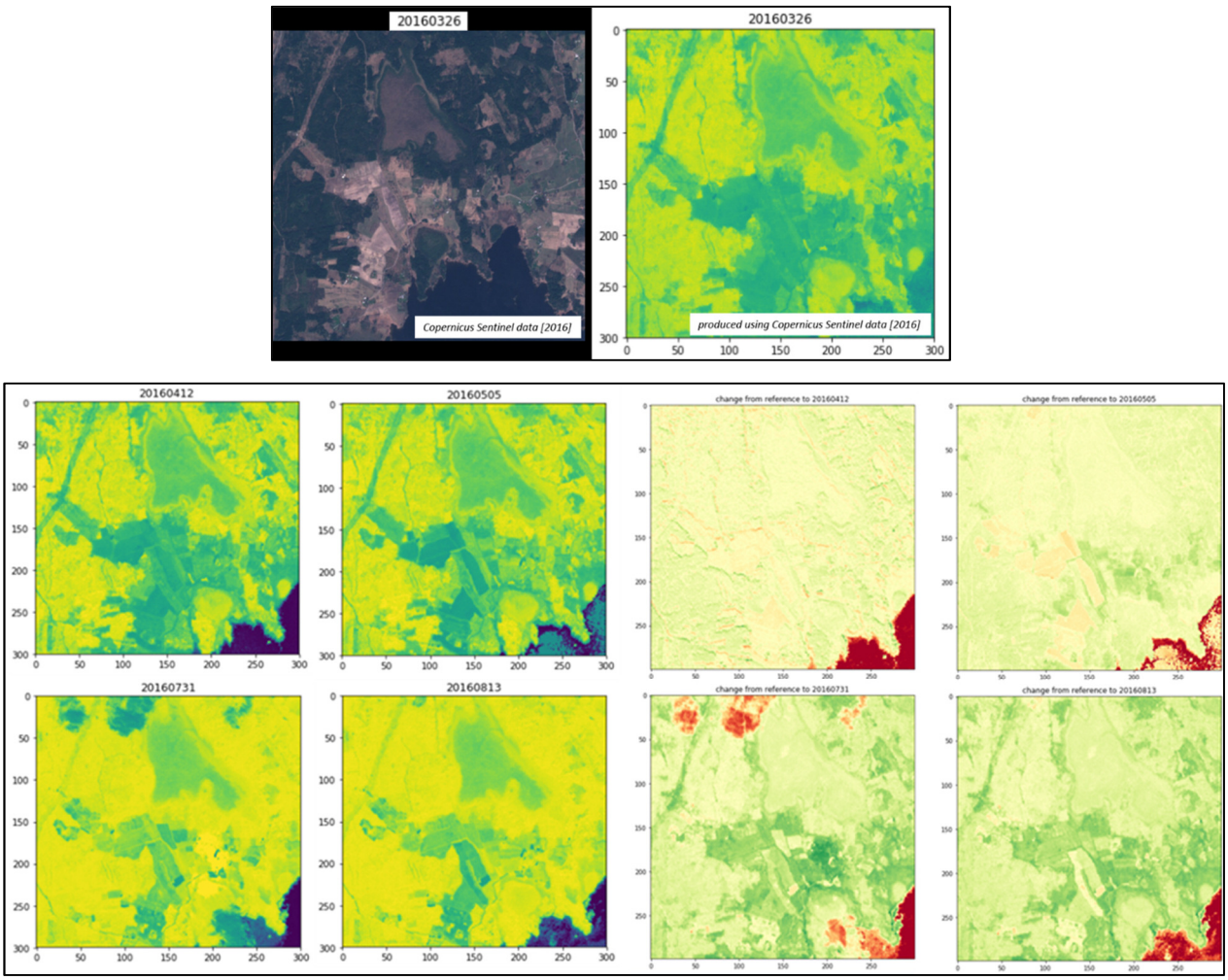


Figure 11: Sentinel-2 Level 2A- NDVI time series (left) and changes of NDVI values (right) over time to a specific reference (cloudy areas not excluded!)

Further focus until M14 and beyond will be on developing and testing of a time series based change detection approach by rating independent classification results in their temporal and qualitative context (atmospheric condition, phenology) as both factors do influence the accuracy of the forest cover classification and therefore can provide a priori reliability values. Additionally, the continuity of classification results of a specific object is used to calculate context driven reliability. A moving window,

that respects a number of successive classification results, is used to compare each class assignment with the adjacent ones in the timeline. The level of agreement is calculated for each segment. The value, denoted as class reliability, considers the consistency of classification results along the time axes. Additionally, a plausibility rating is introduced to consider natural behaviour of forest ecosystems such as time needed until canopy cover is again detectable in satellite imagery and the phenology of trees.

Based on these indicators, the algorithm iteratively optimises the individual classification results by maximising the plausibility of the entire code sequence. The procedure results in logically consistent code sequences that correspond to an expected behaviour of – or transition between - the forest cover under consideration (Overview of the concept see Figure 12).

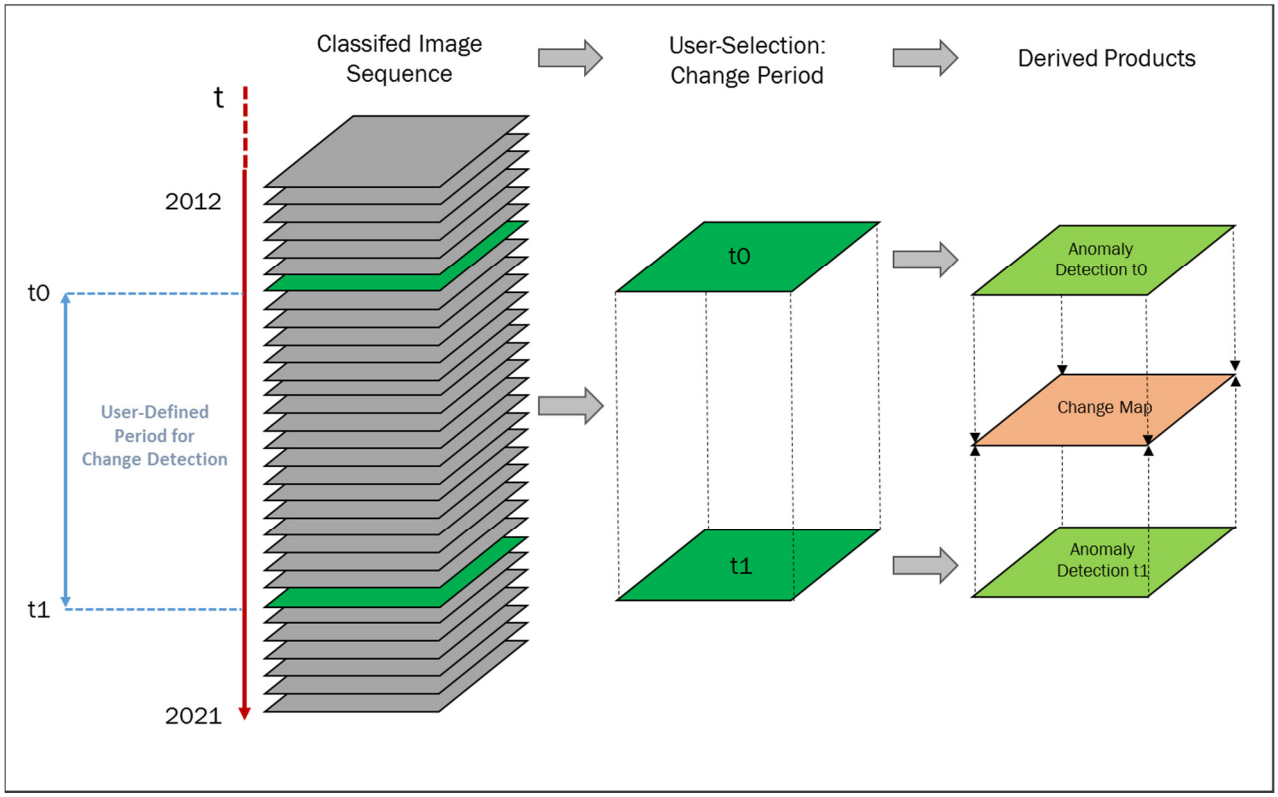


Figure 12: Time Series based change detection approach

For different other layers, a special focus until M14 will be in testing of anomaly detection methods for monitoring land cover changes. Various methods will be tested ranging from object-based methods based on features of the previous years, change identification by multi-temporal classification and change from annual mapping. Special emphasis will be drawn on change detection methods which use the HRL2015 status classification for forest, imperviousness and grassland as input. Testing for agriculture and grassland will start in the Belgian site, for forest in the Northern sites and for imperviousness in the Frances site. Towards M14 and the second project phase these tests will expanded into further sites. For quantitative assessment of the achieved monitoring accuracies, a sampling based approach will be implemented in the next project phase, which is also applied for area estimation, such as for example for estimation of the area which changed from grassland to other land uses.

2.4.8 Time Series Consistency for HRL Product (incremental) Updates (WP 35)

WP35 is on "Time Series Consistency for HRL Product Incremental Updates" and is highly connected to the WPs 33 and 34. The results will then be directly useful for WP 42 "Incremental Update of HR Layers".

Table 14: WP 35 – Time Series Consistency for HRL Product (incremental) Updates

Work Package Number	10	**Lead Beneficiary**		SIRS		
Work Package Title	WP 35 – Time Series Consistency for HRL Product (incremental) Updates					
Short Name of Participant (Participant Number)		GAF (1)	**SIRS (2)**	JR (3)		
Person/Months per Participant		4.70	**4.70**	3.00		
Phase 1	**Start Month**	4	**End Month**	14		
Phase 2	**Start Month**	19	**End Month**	29		
Objectives: To develop suitable methods for ensuring spatially and temporally consistent incremental updates of HRL products at an appropriate time frequency by defining an appropriate combination between time series-derived classification and change detection algorithms.						

This WP aims to determine the temporal frequency that will be appropriate for HRL products, mainly the Imperviousness layer and the Forest layer, while harnessing the breakthrough revisit time offers by the Sentinel constellation. Automatically detected changes (as set by the WP34) between two successive layers, should then be classified into eventually new relevant themes.

Spatial and temporal accuracy and consistency of such changes need to be assessed by a suitable method, that will minimize all types of errors: commission errors as well as omission errors.

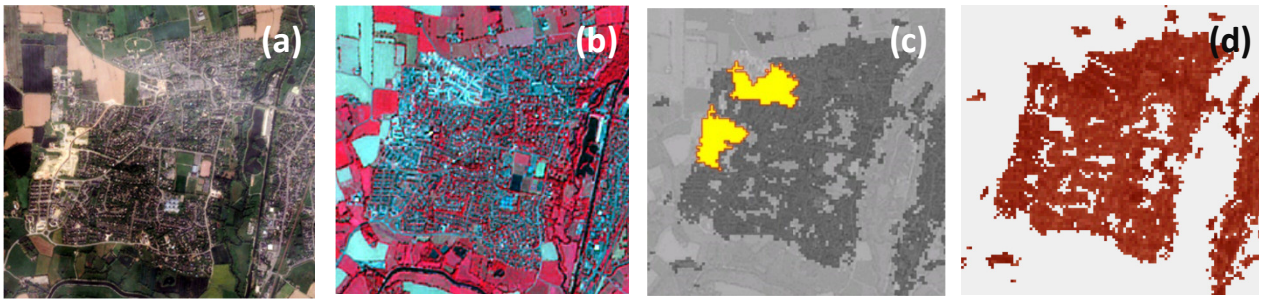
The main activities consist in:

1- Testing and defining the most appropriate input data for incremental updates of HRLs
2- Testing and defining the most appropriate composing approaches for each specific land cover classifications
3- Considering the dynamics (or stability) of each kind of land cover, defining the most useful frequencies for status layers, as well as the most appropriate frequencies for incremental updates, i.e. for change in-between the status layers
4- Testing and defining methodology for patchworking on-demand updates
5- Selecting and defining an algorithm to reduce errors in change detection, to ensure spatial and temporal consistency

With respect to the **Forest** layer, investigations have been started to identify suitable parameters and conditions for an improvement of layer consistency over time. Besides the definition of an optimal set of acceptance criteria (e.g. degree of agreement, min/max deviation from reference), further analysis is required to determine the best suitable time span for implementation of incremental updates.

Concerning **Imperviousness** layer, the work in progress is based on the re-analysis of HRL on imperviousness, from 2006 to 2015, localized in the south of France. This long time series has undergone several tests to optimize the spatial and temporal repartition of omission and commission errors. A particular sampling strategy has been conceived to assess the improvement made during this re-analysis. Further analysis is required to determine the proper incremental time step.

Figure 13 shows the difference between an (a) optical image (natural color composite) in Google Earth and (b) a Sentinel-2 image (false color composite) from 2015. (c) In the top right corner of the town new built-up areas can be detected, marked in yellow in the 2012 – 2015 HRL Imperviousness (IMP) change map – which provides an incremental change of the HRL Imperviousness – and (d) the 2015 HRL IMP.



2010 © Google Earth | 2015 Sentinel-2 | 2012 – 2015 HRL IMP change map | 2015 HRL IMP

Figure 13: Detection of new built-up area between two dates and resulting imperviousness layer (HRL Imperviousness incremental update)

2.4.9 Stakeholder Consultation (WP 51)

WP 51 is on Stakeholder Consultation and is in close connection to WP 21 and WP 61. The outcomes of WP 51 have high influence on the prototype developments in Task 4, and serve as input to the WPs 52 and 53 as part of the Operationalisation Framework.

Table 15: WP 51 – Stakeholder Consultation

Work Package Number	16	**Lead Beneficiary**	GAF			
Work Package Title	WP 51 – Stakeholder Consultation					
Short Name of Participant (Participant Number)		**GAF (1)**	UCL (4)			
Person/Months per Participant		**2.90**	3.00			
Phase 1	**Start Month**	7	**End Month**	18		
Phase 2	**Start Month**	22	**End Month**	34		
Objectives: To conduct a stakeholder consultation process with EC, EEA, JRC and others in order to gather their feedback on the project's technical developments and adaptation needs, to assess current and evolving priorities and to allow an informed discussion on their side.						

WP 51 Stakeholder Consultation is the first part of Task 5 "Operationalisation Framework", in which the future conditions, under which new/improved Copernicus Land products will (or will not) qualify as operational Copernicus Land service candidates, will be assessed. It specifically has to ensure the proper involvement of main stakeholders and decision-makers in this assessment process, through regular consultations with the main stakeholders such as EEA, JRC, EC DGs and key national stakeholders. In these consultations, the developed proofs-of-concepts/prototypes of Task 4 shall be discussed, in order to determine priorities for continuation of work in the next project phase(s) and seek the stakeholders' view/approval of suggested operational candidates.

The Deliverable D2.1: "D51.1a - Stakeholder Consultation Report" is the first report of WP 51 and has been delivered in due time at M9 (end-September 2017). Because of the paramount importance of the stakeholder process for ECoLaSS, it has been agreed that four Issues of this Deliverable shall be provided in the course of the project, each providing the latest status update on stakeholder involvement and related achievements of the project. The current first 9-month phase has focussed on establishing a close relation and information exchange between the ECoLaSS project and the relevant stakeholders, to be ready for assessing service and product prototypes once available from Task 3 and Task 4.

The Deliverable D51.1 has a close link to WP 21 "Assessment of Service Evolution Requirements" with its main Deliverable "D21.1a – Service Evolution Requirements Report", where the results of user and stakeholder interviews are documented, and where the functional and technical evolution requirements of existing and upcoming services of the Continental and Global CLMS Components are collected and consolidated. In practise, gathering the stakeholder requirements in the frame of WP 21 and consulting with stakeholders on the planned service developments in WP 51 often went hand in hand at this early stage of the project. Whereas the first Issue of the WP 51 Stakeholder Consultation Report comprehensively documents the entire stakeholder consultation process as such, the related thematic recognitions are currently mostly documented in the Deliverable D21.1a – Service Evolution Requirements Report, and are therefore not repeated in the present report.

For a Horizon2020 project like ECoLaSS, with clearly defined tasks and resources, it is generally unfeasible to interact with a multitude of potential stakeholders on an individual basis. Therefore, the ECoLaSS team has taken on the approach of consulting in as many cases as possible with federating entities of relevant stakeholder segments, or proxies of relevant bigger groups of stakeholders. These allow to comprehensively address, or interact with, a large group of stakeholders in an efficient manner.

In view of the collected information, the project team gained many valuable insights into future CLMS product needs and about the perception, use and further needs with respect to the CLMS products by the various stakeholders.

Summarising the project's achievements in stakeholder consultation in the first half of the first Reporting Phase (M1-9), substantial and fruitful interactions have been taking place with all major relevant European (EEA, JRC, DGs GROW, ENV, CLIMA) and many national stakeholders in key Member States (e.g. DLR, BKG, UBA, EAA, IGN, CGDD), as well as with a multitude of further stakeholder groups (EARSC, parallel H2020 projects, operational CLMS services). Several further opportunities for consultation of relevant stakeholders have been used in the frame of international scientific, earth observation and Copernicus conferences and workshops (such as WorldCover, ISRSE, MultiTemp, IUFRO, etc.). This was facilitated by the consortium partner's collective unique positioning in the Copernicus and land monitoring community, as well as by a sophisticated stakeholder consultation concept, building on a dual strategy of targeted stakeholder meetings and using basically every opportunity for back-to-back meetings. Therefore, the consortium considers the WP 51 to be fully on track as planned.

Some improvement potential is recognised particularly in view of the mode and intensity of the exchange with JRC, although this has been a key focus throughout the first nine months of the project, and has taken place at various occasions. A further intensification of efforts will be put in this in the next project phase. The close and fruitful contacts with EEA will be continued. Some further potentially relevant entities are planned to be addressed as well (such as further EC DGs).

Particularly for the second project phase, upfront the consultations in the frame of WP 51, the relevant most recent results and outputs of both Task 3 (i.e. developed methods and related documentation, methods compendia, etc.) and of Task 4 (i.e. proof-of-concept/prototype data sets of new and improved products, including derived/estimated accuracy figures) and/or related dissemination material (organised and provided by WP 61) will be compiled and provided by the consortium to the addressed stakeholders, in order to realistically reflect the actual status of development, with all relevant advantages and limitations discovered by then.

2.4.10 Communication, Dissemination & Exploitation (WP 61)

WP 61 is on "Communication, Dissemination & Exploitation" and is as such connected to all activities and developments carried out in the project throughout the full project runtime and beyond.

Table 16: WP 61 – Communication, Dissemination & Exploitation

Work Package Number	19	**Lead Beneficiary**		DLR		
Work Package Title	WP 61 – Communication, Dissemination & Exploitation					
Short Name of Participant (Participant Number)		GAF (1)	SIRS (2)	JR (3)	UCL (4)	**DLR (5)**
Person/Months per Participant		1.70	1.90	1.06	1.50	**1.15**
Phase 1	**Start Month**	4	**End Month**	18		
Phase 2	**Start Month**	19	**End Month**	36		
Objectives: To define and perform communication, dissemination and exploitation activities during the project in order to promote the new/enhanced Copernicus Land information product developments and findings of the project.						

Objective of the "WP 61: Communication, Dissemination and Exploitation" is to define and perform communication, dissemination and exploitation activities during the project in order to promote the new/enhanced Copernicus Land information product developments and findings of the project. This is being done through i) communicating within the project team and with stakeholders (e.g., EEA, EIONET group, JRC) by means of technical meetings, workshops etc.; ii) defining specific dissemination actions tailored for the different defined target groups; iii) preparing communication and dissemination media for providing information on the project status and ongoing activities, e.g., through the website, social media, project flyer, etc.; and iv) coordinating dissemination activities on dedicated conferences and workshops as well as in scientific publications.

Several activities are envisaged for dissemination and exploitation of the project results via different channels in the future, which aim at providing the project results to the stakeholders and users as soon as possible, during the projects lifetime as well as in the follow-up of the project. All these activities are defined in the second deliverable: the Communication, Dissemination and Exploitation Plan (PEDR) of the ECoLaSS project. The PEDR comprises a roadmap for implementing various dissemination and promotional activities in the project, tailored towards diverse target audiences, in order to promote the new/enhanced Copernicus Land information product developments and findings of the project. It will be also used by the consortium to measure the dissemination progress over time. Communication activities of the project team with the relevant stakeholders (e.g. EEA, EIONET group, JRC) by means of technical meetings, workshops etc. are highlighted. Dissemination and exploitations measures such as project flyers, publications in scientific journals and conference proceedings, presentations and posters as well as on the project website are described in detail. The first issue of the PEDR has been finalized for delivery by M9: *D19.2_D61.2_Communication Dissemination and Exploitation Plan_Issue 1_M9* (AD14).

One of the dissemination measures, which are described in the PEDR, is the project website. It has been set up at www.ecolass.eu (see Figure 14) and will be maintained and regularly updated throughout the projects lifetime. To quantify the success of the webpage, the view statistics will be measured. It has been delivered by M6 with the corresponding deliverable: "*D19.1_D61.1ProjectWebsite_Issue 1_M6"* (AD13). The website represents the core for information about the project and is among others one of the dissemination and exploitation measures which gives more into detail information about the background, the members of the consortium, the test and prototype sites of the project, as well as up-to-date information about ongoing activities, e.g., the participation in relevant events, of the ECoLaSS project.

Figure 14: ECoLaSS website: Main Page

Furthermore, it provides contact details and links to other outreach instruments, such as social media channels or the blog. In the future, new information about prototype developments will be provided as soon as their progress is mature enough to be presented. As mentioned above, additional dissemination media have been set up and are available via the website. The first is the blog (https://www.ecolass.eu/news-events, see Figure 15), which informs users more in detail about new developments or important events of the ECoLaSS project. In general, it includes articles with additional detail compared to social media which are supplemented with graphics or videos.

Figure 15: Website - Blog.

The second is the social media channel Twitter, where the account @ECoLaSS2020 (https://twitter.com/ecolass2020 (see Figure 16) has been created 6 months after project start and will be maintained and regularly updated throughout the projects lifetime.

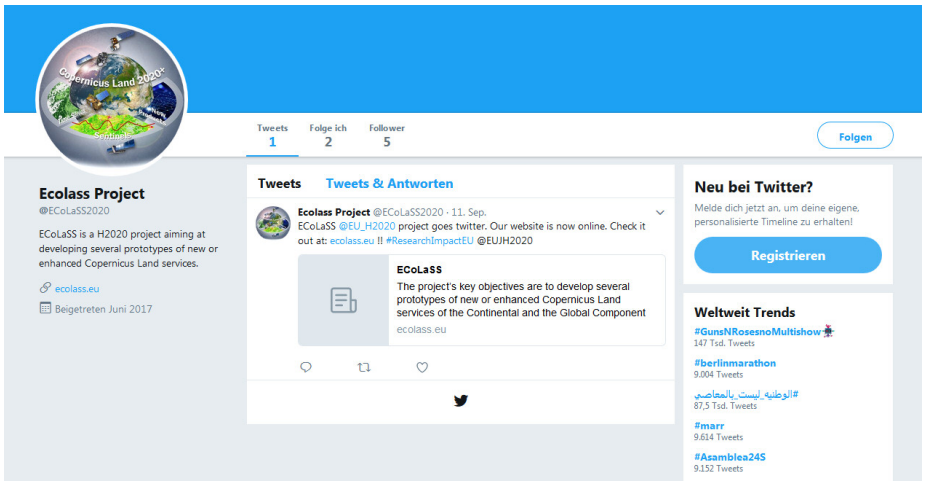


Figure 16: ECoLaSS Twitter account

For the immediate future, a project specific site will be created on ResearchGate, which lists the scientific work and publications of the project and links to the website as well as twitter. Here it is envisaged to reach especially the scientific community. Furthermore, the project flyer will be created providing the essential information about the ECoLaSS project including contact information (project coordination, website, blog, etc.) to potential new users and thus making them aware of the ECoLaSS project, which can be send via Email or disseminated during conferences, workshops, etc. The flyer includes a short description of the project's background, objectives, envisaged achievements/innovations, and partner as well as contact details (project coordination, website, blog, etc.) and graphics of as well as meaningful and impressive examples of outputs of the ECoLaSS project. It will be created before the end of the first project year, to be available to be distributed within the 2nd year of the project and conference/workshop season 2018.

Finally, the contribution of the consortiums partners to scientific conferences, project relevant events and workshops will be planned and updated according to the availability of new dates and information on additional events.

3. Impact

The main expected impacts from the Work Programme 5. Leadership in Enabling and Industrial technologies iii. Space, and the specific Topic EO-3-2016: Evolution of Copernicus Services include the need to:

- "enhance the European industry's potential to take advantage of emerging market opportunities and capacity to establish leadership in the field";
- "boost competitiveness of the industrial actors in EU and national procurements"; and
- "establish a proof-of-concept or a prototype, which can act as reference for the independent assessment of Copernicus service evolution, in light of product extensions and service improvements".

In that sense, several activities are being carried out aiming to fulfil the abovementioned goals.

EMERGING MARKET OPPORTUNITIES:

The ECoLaSS project is primarily aiming to suggest and demonstrate innovative services and products, extending or improving the future Copernicus Land Monitoring Service. In that sense, it is a project not oriented to building up specific service provider know-how that could be commercialised independently from the CLMS, but to evolve the CLMS's portfolio and thus its potential impact and outreach. Such evolution of the portfolio will not only open opportunities to potential new value-added/downstream service activities, but also to new users groups.

However, the targeted highly automated EO data pre-processing chains that are being developed, as well as related analysis methods and semi-automated thematic post-processing workflows, will be relevant for further commercial and scientific long-term market development, in a variety of other markets beyond the Copernicus Land Monitoring Service.

Taking all this into account, instead of a business plan to address market opportunities, the project will, after thorough assessment of all project findings, provide an "Integration Plan into the Copernicus Service Architecture (Deliverable D53.1 in WP 53)". The first version of this deliverable will be provided by the end of Reporting Period 1, with some first conclusions. A final version with more specific and consolidated conclusions and recommendations will be delivered towards the end of the project.

At the same time, through open access scientific publications, the competitiveness of the service provider community as well as the various user communities outside the consortium are strengthened, improving the scientific State of the Art. Additionally, the ECoLaSS Deliverables are provided as publically accessible documents, potentially increasing their outreach and impact.

Additionally the feedback from the stakeholders that the project receives, is a major asset to ensure product designs, which are user driven, taking into account the real needs. This improvement capacity and user commitment can strengthen the CLMS and ensure broad service use and uptake.

IMPROVING COMPETITIVENESS OF THE EO SERVICE INDUSTRY

Through a successful development and (prototypic) implementation of new/enhanced Copernicus Land services, which utilise Big Data processing and analysis techniques for various Land applications, the competitiveness and leading market position of the European EO value-adding industry will be strengthened. This will also support creating company and job growth and new export opportunities. The ECoLaSS research partners will further undertake to pursue own exploitation opportunities, targeting a return of their investments via an enhancement of their capabilities to act as technology transfer hubs.

The consortium will address the exploration of all kinds of market opportunities in WP 62 and document all outcomes in the Deliverable *D62.1* - Market Opportunities and IPR Strategy", being delivered in its first

version by the end of Reporting Period 1 of the ECoLaSS project. It will also incorporate the feedback from the already ongoing activities in various WPs such as WP 21, WP 51 and WP 61.

ESTABLISHING PROTOTYPES FOR COPERNICUS LAND SERVICE EVOLUTION

Through the development of dedicated Sentinel-based processing methods (Task 3) and thematic prototypes (Task 4) of future Copernicus Land Monitoring services and products, ECoLaSS will contribute to the CLMS evolution, closing gaps in the current portfolio in terms of technical, methodological as well as operational capabilities.

The prototypes are structured in two phases or iterations, allowing several improvements before resulting in a final prototype. The presentation of first prototype results to the key stakeholders will provide the project with the opportunity to get valuable feedback regarding not only the performance but also the real needs and potential uses, based on the concrete prototype cases.

The feedback cycle is expected to result in a second iteration of the prototypes, in which recommendations will be implemented as far as feasible. The project will strive to stay in contact with the stakeholders to possibly obtain also intermediate feedback on interim results before the end of the prototyping phase, in order to ensure as far as possible that results will be aligned with the expectations.

The first cycle of the prototypes (mainly addressed by WPs 41-45) will begin starting at M10 under the activities of Task 4 and is currently expected to end some weeks before Reporting Period 1 ends. The second cycle will take place during Reporting Period 2.

DISSEMINATION OF PROJECT RESULTS

An important mechanism to ensure a wide impact of the project is a broad dissemination of its results. Therefore, ECoLaSS has defined a range of suitable dissemination paths, increasing the possibility to reach more users, to get closer to the currently existing ones and to keep both updated on the project progress.

Since not all users and stakeholders have the same degree of knowledge and/or impact, the project has established various targeted means and levels of dissemination, aiming at spreading and nurturing the knowledge about the project.

Various stakeholder groups are addressed, such as public sector entities, the private sector, the scientific community etc. The different dissemination activities and media are focused on one or several of these groups, allowing either one-way or two-way interaction with ECoLaSS, the intention being to always allow and encourage ways of feedback to the project.

Main dissemination activities comprise meetings with stakeholders, conferences and workshops. Main distribution media will be project flyers and posters, publications in scientific journals, conference proceedings and other suitable printed or online sources, as well as information dissemination via social media and the project's webpage.

All these activities are currently ongoing. Further detailed information and a discussion of the impact is provided in the D61.2 Deliverable "Communication, Dissemination and Exploitation Plan", which has already been delivered as a first version.