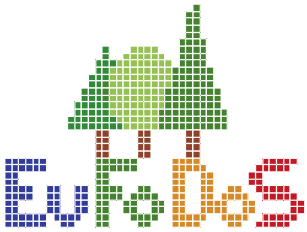

D510.1 User Utility Synthesis Report

Issue 1

EUFODOS – Improved Information of Forest Structure and Damages

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Executive Summary:

The User Utility Assessments (UUAs) of the FDS from the various users are compiled and collated in order to make an overall assessment on the sustainability of these products. Thus, this WP will undertake to summarise all the main results of the UUAs and provide a Service Utility Report document which is an independent, comprehensive assessments of the value of the services delivered by the FDS services.

The Service Utility Report will document the complete use and life-cycle and impact of products and services delivered to a single end-user-organisation over a fixed period of time, analyse the overall results and recommendations such that a more comprehensive report is made on the overall sustainability of the FDS.

In the course of the project the title of this Deliverable has been changed to "Overall Synthesis of User Utilities" as it came out from the first discussions in the consortium that the validation of the Core Service products is beyond the scope of the user's expertise.

In this synthesis report Chapter 1 starts with an introduction on the topic. In Chapter 2 the results from the UUAs in WP440 are reported in a brief overview. Chapter 3 focuses on the synthesis of UUAs for Phase1, and Chapter 4 analyses the life cycle and sustainability of the DSS. In Chapter 5 conclusions are drawn from the first 18 months.

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1. Introduction

The User Utility Assessments (UUAs) of the FDS from the various users are compiled and collated in order to make an overall assessment on the sustainability of these products. Thus, WP 510 will undertake to summarise all the main results of the UUAs and provide a Service Utility Report document which is an independent, comprehensive assessments of the value of the services delivered by the FDS. The Service Utility Report will document the complete use and life-cycle and impact of products and services delivered to a single end-user-organisation over a fixed period of time, analyse the overall results and recommendations such that a more comprehensive report is made on the overall sustainability of the FDS. In the course of the project the title of this Deliverable has been changed to "Overall Synthesis of User Utilities" as it came out from the first discussions in the consortium that the validation of the Core Service products is beyond the scope of the user's expertise.

In WP440 EURAC has elaborated an UUA and distributed this document to all SPs and users. In May 2012 the completed documents were collected and compiled by EURAC and D440.1 serves as input for the compilation of the synthesis report.

In Phase1 some deviations from the scheduled product generation has to be reported, which mainly is caused by the lack of storm events, and, thus, no windfall areas could be derived with prepared tools. Nevertheless, the methodological and software developments have been performed in time and could even be tested in simulated events for some testcases, e.g. Upper Styria. On the other hand some SPs showed high flexibility, in close cooperation with the users, as they investigated sudden phenomena which took place in the testcases, such as tree top damage from heavy snowfall. In another case a reported storm in northern Poland was the reason that this region has been selected to investigate the caused damage using new sensor data. Therefore, a new user had to be contacted for this purpose. However, due to the lack of real storms the users could not evaluate these scenarios in Phase 1. Only the performance of the developed SW environment has been demonstrated by the SPs.

Since the starting of EUFODOS the users were strongly involved in the service development, such as they had to elaborate the detailed definitions for the forest parameters and following had to track the progress in the developments. Several meetings and training sessions were organised by the SPs, especially in the phase of the generation of Demo-products. Finally, the users have evaluated and validated the processed results from Phase 1 and documented in the UUAs.

However, it can be stated, that after Phase 1 the service prototypes are prepared and ready for the role out in Phase 2 of the project, even in case of storm related tools. In order to continue with the service development in Phase 2 small adaptations and modifications will be applied to the prototypes according to the feedback from the user's side. The main task in Phase 2 will be the transfer – that means proof of operationality – from the small testsites in a roll-out implementation onto the entire testcases. The second issue of this report, after month 36, has to prove if this task could be fulfilled and consequently the services have been successfully implemented according to the user's requirements.

2. Results from WP440 - UUA

The completed report from WP440 was delivered by EURAC in May 2012 and is shortly reviewed in this chapter. Each SP has discussed the preliminary results and Demo-products with its user and together they have elaborated the UUA questionnaire. This cooperation was necessary in order to avoid that the users misinterpret some of the technical terms, but the rating and evaluation was carried out by the users themselves. The following users have responded to the UUA questionnaire.

- Styrian Forestry Board, Austria
- Nadleśnictwo Świeradów, Poland
- Stora Enso Oyj, Finland
- ThüringenForst – Anstalt öffentlichen Rechts, Germany
- Executive Forest Agency, Department Security and Forest Protection ,Bulgaria
- Department of Forest Planning, Autonomous Province of Bolzano/Bozen, Italy

The complete results of the questionnaires can be read in D440.1 and are listed in the following in a brief version:

- Concerning the *state of work* for Phase 1 the main statements are:
  - The state of work is in accordance with the work plan of the project.
  - For several case studies, damage maps could not yet provided since there has not been a significant event, i.e. windfall, which could be used for a demonstrator.
  - Instead, the SP has provided forest parameter maps as agreed in the SLA. Even some additional products have been produced. (e.g. Core Service products for case studies without coverage from GEOLAND demonstrators).
- Remarks on *functionality and utility* of the DS-Services:
  - All users rated the demonstration products very positively.
  - The DS-Services are not replacing existing services, but offer to complement them or deliver a kind of new information.
  - The level of integration was mostly rated as high and the integration of the products into their forest GIS as easy.
  - Most important benefits were: time saving, rapid availability and easy comprehensibility of the products.
  - Potential constraints include: the dependency of the users towards the SP and the potentially higher cost if additional data is needed.
- *Sustainability* of the service. Even if in this demonstrator phase no final answer can be given some interesting aspects become obvious:
  - Users are very interested in sustaining the services and would be willing to pay for selected services.
  - Important for all services based on high resolution data would be the availability of SENTINEL 2 data, which would reduce costs and allow for a higher update cycle and a more rapid availability of the service.
  - For more than 2/3 of the products updates are planned within the project duration. For 1/3 updates are also planned after the end of the product.
- *Assessment of Procedures* and recommended *Improvements:*
  - The negotiation phase at the beginning of the project and the production phase for the demonstrator in Phase 1 were rated as very good by the users.
- *Assessment of Impacts* and *Value Statement*:
  - In this early stage of EUFODOS the impact of the services cannot yet be fully assessed by the users, as this will finally be possible not until the end of Phase 2.
- *Overall Evaluation* and *Outlook*:
  - All users evaluated the demonstrator products as good to very good.
- *Suggestions* for further improvements included:
  - a regular update of changes
  - consideration of other damage types (e.g. snow load)
  - more near-real time assessment
  - information on regeneration of areas
  - monitoring the effects of climate change (upper forest border, development of natural forest associations)
  - Users stated that they would like to use the second phase of EUFOFOS to better streamline ideas on new potential services.

These are the main results from the analysis of the UUAs, which were delivered with a delay due to some unexpected events, mainly caused by dense schedules. It has to be stated that the users in general have a tight working program with much field work to fulfil and, therefore, it is not always possible to find meeting days. Nevertheless, it is recognized that the users are highly interested and engaged in the discussions, evaluations and usability of the EUFODOS products.

3. Synthesis of Phase 1 WP 440 Results

The products in Phase1 have been produced in small testsites in order to be able to assess and, if needed, to modify the outcomes for the roll-out over the entire testcase. Therefore, the understanding of the term "completeness of products" in the UUA is solely related to the finalisation of the small testsite products, which are used as Demo-products. In Phase2 the findings from the testing and implementation phase has to be utilized for the realization of the roll-out production for the entire testcases, which were defined in the SLAs. Evidently,

these final results will then decide if the completeness of the EUFODOS products, reflected in the final UUA, is achieved or not. It can be stated that up to now the users responded that they are satisfied with the Phase1 production. In the following a synthesis and interpretation out of the UUAs responses is presented and compiled.

The **State of Work** is currently in line with the objectives although some small tasks have still to be completed. . However, this can be explained if the following project inherent aspects are to be included into the considerations. Firstly, users see the completeness strongly connected with the finalisation of the production for the entire testcase. Thus, they hesitate to rank this point with 100% as they are expecting to obtain the full coverage after Phase2. Secondly, there is still the product "storm damage" missing due to the lack of storm events. Although, they highly appreciate that the installation of the SW environment, which are a prerequisite for the full implementation, are already fully operational. As a matter of fact the users are satisfied with the achieved status during Phase1 and are confident that they will receive the full product portfolio after the end of EUFODOS. This fact was confirmed by the users during the workshop in Vienna on 21st June 2012.

The items **Functionality and Utility of the FDS** are related to the integration of the EUFODOS products into the forest GIS, their improvements, benefits and sustainability. These topics are strongly related to the users working practise and gives valuable feedback for the Phase2 working program.

As Earth Observation is delivering geographic information it has first to be asked in the UUA if the DSS are *geographically explicit*. From this question very clear answering with 100% agreement was provided by the user organisations, thus, it can also be concluded that the preparation of the SLAs has been performed effectively. Otherwise a geographically non-conformance would have been the resulting outcome.

The term *"quantitative information"* (chapter 3.1.1. of the UUA questionnaire) proved, that there is a different understanding of what means "quantitative". As already mentioned it is important to reflect the technical terms together with the users in order to avoid confusion for the outcome answers. For instance, "forest type" has been interpreted as quantitative in terms, that it is derived for an area of some hundreds, even thousands, square kilometres, which is therefore considered as "quantitative". On the opposite some meant "forest type" is "non-quantitative" as there are only 2D information delivered and not 3D information. For the latter term "crown/canopy volume" or "stem volume" are examples. This point has to be made clear before the final UUA is sent out. This issue was also discussed during the user workshop in Vienna in order to increase the awareness for the final evaluation.

The users stated that the currently derived DSS do not replace existing information. This statement is strongly connected with the terminus *"complementarity of information"*. It is clear from the DSS type of information that many products were not available for the users until recently and hence complements their standard portfolio of information. It also gives a clear message that forest users do need a rather large portfolio of data in order to increase the potential of their forest management tasks. It also can be stated, that the products are apart from only "nice-to-have"; on contrary they reflect a data need within the forest GIS and, even some of them, can be considered as for long time on the wish list of the planning authorities. For instance, products derived from LIDAR data are rather unique and very valuable or as another example the opportunity to get data layers which cover entire regions as in the past this coverage could not be achieved using conventional technical tools or the financial resources were not sufficient for such a task.

Another aspect dealing with the generation of products from remote sensing technology is often reflected by forest users that they are concerned that their positions can be replaced by the use of these modern technologies. In this context it is very important that the SPs should clearly highlight that any products derived from satellite imagery does not replace any post in the forestry sector, because the produced layers are only complementing or increasing the existing information. Two more aspects in this context are demonstrating this statement nicely. The first is that there is still field work necessary, because it is a must for the generation of expert reports or for the verification which takes place in field, and, the second example is related to the difficult and cumbersome survey in a mountainous environment, where it is hardly possible for the foresters to gather data in inaccessible and exposed areas. Therefore, EUFODOS services can be considered as a supporter of valuable information which also fills-up "white patches" in the forest GIS.

This fact is to be confirmed by the users in the rating of the term *"new type of information"*. The answers proved that the SPs have carefully selected the applications according to their experience or to their market knowledge. As a conclusion of these findings it is advisable to stay in line with the wider user community in order to plan and produce custom-tailored products. This approach has been confirmed in the course of the project by further installing the additional WP640 which is assigned to strengthen the contacts to potential users. With the help of EAA the SPs have the opportunity in Phase2 to browse through the user community and to acquire new customers with new ideas.

What did the outcome of this high rated term *"new type of information"* else mean? Another aspect taken into consideration is the fact that the forest user community often acquire data on a spot-like base, but not over entire regions. For instance the parameter "tree height" is a cost-intensive measurement which is only available for specific occasions or very small locations. With the availability of LIDAR in connection with satellite remote sensing data data it is now available over entire regions. Even more, a DTM beneath forest areas has not been existing before the LIDAR survey campaigns were initialised, consequently, the foresters have now got a new and unique product. In this context this information could be rated with the term *"new type of information"*.

Another nice example is illustrated with the operational use of EO data for storm damage assessment. Until recently the derivation of storm damaged areas was hampered by some factors such as weather conditions, processing efforts and in case of big events by the restrictions on coverage. The forest authorities used more or less patch-like information such as information gathered from helicopter flights or information from local forest owners or aerial photo surveys. This information was not collected on a regular or complete base and often not geo-referenced. Now with the new and forthcoming satellite systems and the developed EUFODOS toolboxes it is feasible that the damaged areas from storm events can be delivered to the forest users in short time and with complete coverage. From this point of view it can be considered as a new type of product.

Furthermore, for 2013 the SENTINEL2 satellite systems will dramatically increase the usability of this service - to be completed in 2014 with a second satellite. The users have already commented that the opportunity to receive cost-free data from SENTINEL2 with high temporal, high spectral and adequate spatial resolutions is increasing their financial scope for further forest applications. This fact is indeed a significant facilitation for future applications in the forestry related domain.

Another important issue in the UUA is the *"ease of integration into the existing operational setup"*. This aspect is to be considered as decisive from the user's point of view, because DSS are assigned to support the user's performance and not to cause more or even complicated work on the users working premises. In the preparation of the SLA careful attention was put on the product outcome in order to satisfy the user's needs. Therefore the products are standard formats which allow an easy integration into the respective forest GIS. The level of integration is rated as high to medium due to sometimes higher amount of data be delivered with the new products. This fact makes it a bit more difficult on one hand, but is outbalanced by the advantage of getting a number of new information layers, which have been missing in the past, e.g. ecological or economical parameters.

What are the *"improvements and benefits or are there constraints"* in the new products is questioned and answered for several items. Generally, the response to this issue is rated very well, which mirrors the overall professional performance in the negotiation and definition phase. In the case of thematic and spatial accuracy very slight improvements are envisaged. Some of the products are not delivered yet due to their early processing stage or the event still not occurred, as it is in the case of storm damage. The latter does not mean that the SPs are not prepared to deal with this issue if it becomes urgent. The EUFODOS toolbox Change Detection and other comparable SW packages have been tested and are at hand for any emergency case.

The item *"type of information"* has shown some kind of uncertainty to the users as this belongs to the derivation of damage maps which can nicely delineate the extent of damaged areas and also geo-reference these damages, but cannot give any statements on the cause of these damaged areas. In this context clear-cut areas can easily be intermingled with areas from windfall. This issue, hence, can be discussed and elaborated in Phase2. A proper solution would be if the pre-event and the post-event images are only a few days apart, implying that the number of areas with removed by other causes could be neglected.
Concluding it can be stated, that requirements are compliant with the SLA on a very high percentage and the rating of the needed improvements are rather low.

Time saving is rated highest and can thus be considered as the most important aspect for the DSS products. Other important benefits include an easy comprehensibility of the data, the rapid availability of information, cost saving and improved monitoring capabilities. New functionalities are the least benefit, but this can be seen from the point of view that new products always need some time to get acquainted with and that the production of these new products just started. As from other experience well-known this item should be rated higher after the full approval of the new products. Important constraints and disadvantages include the high dependency on the service provider. This point has to be discussed in detail within Phase2, because there are also some varying

opinions. One user states that it is beyond its scope to deal with all the technical or personal capacities in order to generate such products. He willingly is given the order to the service provider for the generation of the DSS products. A detailed analysis of the user's equipment and personal resources could clarify this point.

Another important aspect besides the cost saving topic is related to the potential high costs of such a service, especially if data costs and service costs have to be considered in the calculation. Sometimes the high costs of Earth Observation data hampered the realization of an ordering process. In this context the current development with respect to the launch of the new SENTINEL2 data is to be brought to the notice of the users. As the launch is planned for 2013 this is a foreseeable time span and thus will increase the opportunities of financing DSSs based on satellite data, because SENTINEL2 data are going to be delivered cost-free. Additionally, the users showed cautious optimism when they also realized the high time revisit cycle and the huge orbit swath width.

Also for the aspect benefits and advantages, many products need a more in-depth assessment by the users, since they were just recently provided. An interesting next step would be an evaluation of the data by local foresters through field work. This is already scheduled for summer in some of the testcases.

An important aspect deals with the *"sustainability of the services"*. For more than 2/3 or the products updates are planned within the project duration and for 1/3 updates are also planned after the end of the project. For almost half of the DSS products a budget for future updates is foreseen, which seems to be a good indicator for a potential sustainability of the services. On the other hand, users stated that it is difficult to plan a budget for any activities beyond 2013 due to the difficult financial situation in all economic sectors. Therefore, this information has only be considered as an indicative information, but a rather strong one.

Probably cases for the ordering of update rates, where a budget could be available, are the cases of sudden events like damages from storm or fire. Some of the forest parameter layers are already planned to be derived over larger areas on a regular base. As already mentioned above the availability of SENTINEL2 data could become a consolidating factor in terms of sustainability.

The *"assessment of procedures"* was rated as very good to good, which means that from the negotiation process, over the customer care to the personal engagement all processes have been evaluated in very positive way. The "assessment of impact" has been asked, but it is evident that in Phase1 not a full evaluation on this point could be made by the users, although the users recommended the DSSs as 100% valuable. The DSSs are in this phase not completed over the entire testcases, therefore a final conclusions could not be drawn. The evaluations on the small testsite are nevertheless predominantly positive. This tendency is confirmed in the "overall evaluation" which is rated as very good to good.

In the outlook for Phase2 and beyond the users emphasized some improvements which comprise the following statements:

- regular updates of changes
- consideration of other damage types (e.g. snow load)
- more near-real time assessment
- information on regeneration of areas
- monitoring effects of climate change (e.g. upper forest border, development of natural forest associations)

Finally it can be stated, that the UUAs give an important and necessary feedback to the SPs and even to the users themselves. They are aware on the Pros and Cons in the development of a DSS and can therefore react on the main issues in Phase2. The SPs are going to discuss the proposed changes and modify their processing line in order to successfully complete the DSS after Phase2. The overall rating of the DSSs was high for Phase1, although a very important service – i.e. storm damage – could not be demonstrated in a real world scenario. Nevertheless, all SPs are very well prepared for Phase2 and have established a strong and fruitful connection to their users.

4. Analysis on Life Cycle and Sustainability

It has to be stated that the EUFODOS project encompasses a number of six testcases with more than 20 products, therefrom currently 17 are produced by the SPs. This fact makes it difficult to standardize or harmonize processing steps or to draw common conclusions. The variety of these services is already documented in D320.1 "service portfolio specifications". Table 1 shows the different services (see D320.1, p. 9) and the related SPs and users.

Table 1: Overview of EUFODOS Forest Downstream Services (see D320.1).

Forest Damage Assessment – Rush Services		
Service/Product Name	**SP**	**User Organisation**
Fast/Rapid Storm Damage Assessment	GAF	Thuringian State Institute for Forest, Game and Fishery
Forest Change Map for Windfall Areas	RapidEye	Local Forest Authority of the state forests in the Western Sudety mountains, Regional Directorate of State Forests Wroclaw
Rapid Mapping for Disaster Management	RESAC	The Executive Forest Agency (SFA), Sofia. SFA, Council of Ministers, Bulgaria
Forest Damage Assessment – Non-Rush Services		
Service/Product Name	**SP**	**User Organisation**
Event Maps	EURAC	Autonomous Province of Bolzano, Department of Forest Planning
After Event Monitoring Product	EURAC	Autonomous Province of Bolzano, Department of Forest Planning
Spatially explicit Forest Damage Information System	EURAC	Autonomous Province of Bolzano, Department of Forest Planning
Detailed Storm Damage Assessment	GAF	Thuringian State Institute for Forest, Game and Fishery
Insect Infested Damage Assessment	GAF	Thuringian State Institute for Forest, Game and Fishery
Forest Degradation Mapping	JR	Styrian Forestry Board
Ecological and Economical Functions / Forest Parameters		
Service/Product Name	**SP**	**User Organisation**
Base data on forest and potential risk on forest	EURAC	Department of Forest Planning - Autonomous Province of Bolzano
Impact of Forest Degradation on Forest Functional Indicators	JR	Styrian Forestry Board
Forest Vitality Map	RapidEye	Local Forest Authority of the state forests in the Western Sudety mountains, Regional Directorate of State Forests Wroclaw
Stem Volume Map with Tree Species	VTT	Stora Enso
Map and GIS database for the forest areas and forest area changes	ReSAC	The Executive Forest Agency (SFA), Sofia. SFA, Council of Ministers, Bulgaria
Map and GIS database for forest fire infrastructure	ReSAC	The Executive Forest Agency (SFA), Sofia. SFA, Council of Ministers, Bulgaria

The products generated for Phase1 are demo-products which have been sent to the users in spring 2012 and have been critically reviewed and validated by them. The feedback to these products has been reported and analyzed in the UUAs. Table 2 gives an overview on the current status after phase1. More explanations can be found in D430.2 "Technical report on products for all services, issue 1" (see D430.2, pp. 11-12).

Table 2: Overview of generated demonstration products, project Phase 1 (see D430.2).

SP	PNR	Testcase	Product	Comment
GAF	C-01	several	HR Forest Core Layer (based on Image 2009): **Tree Cover Density** (0 – 100%)	had to be processed in addition, (necessary base product)
GAF	C-02	several	HR Forest Core Layer (based on Image 2009): **Forest Types** (20m resolution 10% minimum Tree Cover Density)	had to be processed in addition, (necessary base product)
GAF	P-02	Thuringia	Storm Damage Assessment	Modified products since no storm but other damage types occurred. GAF: Detection of snow damage
GAF	P-03	Thuringia	Insect Infested Damage Assessment (class: trees infected by bark beetle)	GAF: A map with dominant spruce stands in Thuringia is produced based on Image 2009 as base input to the assessment of insect infested damage.
JR	P-01	Styria	Ortho image Map	accomplished
JR	P-02	Styria	Functional Forest Parameters	accomplished
VTT	P-01	Finland	Stem Volume Map by Tree Species groups (pine, spruce, broadleaved trees) using Spot equivalent data	IRS P6 26 July 2010, Cloudy, Haziness, Striping
VTT	P-02	Russia	Stem Volume Map by Tree Species groups (pine, spruce, broadleaved trees) using Spot equivalent data	
EURAC	P-02	Bolzano	Damage Maps	Windfall event map (Line 2, High resolution data – Landsat); Windfall event map (Line 3, Very high resolution data – RapidEye)
EURAC	P-03	Bolzano	After Event Monitoring	Larch pest infestations maps (Line 1, Low resolution data – MODIS)
ReSAC	P-01	Sofia	Forest Area Map	accomplished
ReSAC	P-03	Sofia	Forest Density Map	accomplished
ReSAC	P-05	Sofia	Forest Damage Maps	accomplished
RapidEye	P-01	Swieradow	Time Series of Custom RapidEye Ortho image Maps	To be contained in the SLA
RapidEye	P-02	Swieradow	Forest Area Map	To be contained in the SLA
RapidEye	P-03	Swieradow	Forest Damage Map of Windfall Areas	Alternative test area for demonstration: Storm Saxony
RapidEye	P-04	Swieradow	Forest Vitality Maps	Partly accomplished

In the following chapters an overview will be given on the different service components, the impact of the generated products and also an analysis on the sustainability of the services.

4.1 Main components

Some of the services are rather unique, and thus cannot be put into the same category as others, which makes it impossible to give a common structure. However, for the reporting some main components of all services have been identified and will be described for the life cycle using following structure:

- Service / product definition
- Service / product quality
- Input data procurement
- Processing line
- Product delivery and accuracy assessment

4.1.1 *Service / product definition*

For each service and respective product the SPs have intensively discussed and elaborated the definitions and specifications with users. They are reflected in the Service Level Agreements and were signed by the users. In Table 3 an overview on their status is shown.

Table 3: Overview on status of services and products.

Testcase	SP	Service/Product Name	Status (SLA)	Comments
Styria	JR	Impact of Forest Degradation on Forest Functional Indicators	completed	
Styria	JR	Forest Degradation Mapping	completed	
Finland	VTT	Stem Volume Map with Tree Species	completed	
Thuringia	GAF	Fast/Rapid Storm Damage Assessment	completed	
Thuringia	GAF	Detailed Storm Damage Assessment	completed	
Thuringia	GAF	Insect Infested Damage Assessment	completed	
Bolzano	EURAC	Event Maps	completed	
Bolzano	EURAC	After Event Monitoring Product	completed	
Bolzano	EURAC	Spatially explicit Forest Damage Information System	completed	
Bolzano	EURAC	Base data on forest and potential risk on forest	completed	
Swieradow	RapidEye	Forest Change Map for Windfall Areas	completed	
Swieradow	RapidEye	Forest Vitality Map	completed	
Sofia	ReSAC	Map and GIS database for the forest areas and forest area changes	completed	
Sofia	RESAC	Rapid Mapping for Disaster Management	completed	
Sofia	ReSAC	Map and GIS database for forest fire infrastructure	completed	

A final update of these definitions will be delivered with the second issue of D410.2 which is currently prepared and will be issued in November 2012.

4.1.2 *Service / product quality*

The service quality is another important component which has intensively been elaborated between SPs and users because the outcome can also influence the data processing efforts in a significant way. More information and an overview for each testcase can be found in D320.2 "service portfolio specifications". The main components encompass thematic accuracy, positional accuracy and quality assurance. The latter comprises items such as completeness, reliability, flexibility, delivery of products, and accuracy measures.

In Phase1 of EUFODOS each SP was keen to fulfill these quality requirements to the full satisfaction of the user. In D440.1 the reaction of the users on these topics is compiled for the Phase1 products. Concluding, it can be stated that the SPs have carefully followed the quality procedures in order to be compliant with the SLA which can be followed according to the user's answering and validation report.

4.1.3 *Input data procurement*

One of the major requirements to start and develop a DSS is the availability of data. In this context each SP was busy to collect and prepare the input data in their testcases. Within the various testcases a wealth of input data has been collected and processed. An overview of these data sets is continuously reported in the "quality management plan", but has also been incorporated into D320.1, D330.1 and D430.2.

Therefore, it can be stated, that from the outcome of all these documents and also from the reporting duties during the meetings and TELECONs that the SPs have collected all needed input data, from in-situ to Earth Observation. The current situation in the project confirms that a sufficient collection of input data sets in all testcases has been achieved.

4.1.4 *Processing line*

The processing is a key component in the life cycle of the DSS. Specifically for each DSS in the respective testcases the processing line is differing because the products are very specific and thus a coarse overview is given. More detailed information on the processing lines can be read in D330.1 and D340.2. The processing structure can be described with consideration of the main steps such as pre-processing, thematic issues, post-processing and accuracy assessment. These main categories guide a workflow, which is then transferred into a DSS processing line.

All SPs have generated a processing line for their services, either from existing modules in their labs or by modifying or incorporating external modules, and have now, after Phase1 a prototype at hand. The processing have been reported not only in the reports (see D330.1 and D430.2), but were also presented at the interim progress meeting in Vienna/A.

4.1.5 *Product delivery and accuracy assessment*

In spring 2012 the first demo-products have been produced and completed until June 2012 latest. That means the product delivery to the users took place in May in order to start with the validation. The validation was a two-step procedure which encompasses an accuracy assessment and its documentation via the UUAs. The exchange of the final products was mutually accomplished between SPs and users under consideration of the - in the SLA - defined data formats.

The accuracy assessment of the demo-products is strongly dependent on the type of data, the thematic classes or the intended use. Therefore, it could be observed and reported that in the testcases different approaches were applied, which range from visual inspection, stratified random sampling to ground truth campaigns in field. It can also be stated that after Phase1 the consortium as a whole has declared a further elaboration of the accuracy assessment approaches. In this context the beneficiaries have agreed: first, to elaborate a draft version of common accuracy assessment procedures to be included into D320.2 "service portfolio specifications", and second to hold a progress meeting in October at RapidEye/Potsdam in order to clarify this issue.

4.2 Impact – Results

To assess the impacts from the resulting DSS demo-products which were generated during Phase1 it is advised to read also the UUAs which are described in chapters 2 and 3.

The exchange of knowledge and expertise between the SPs has not only increased the technical capacities within the consortium, but also yielded a better understanding on the different topics. This can be considered as a strong impact, because it also increases the expertise of each beneficiary and with their enhanced knowledge strengthens the competence in the cooperation with the users.

A strong impact is the improved communication with users and SPs in order to increase their understanding for products derived from remote sensing. Henceforth, it has been a focus to discuss the Pros and Cons of these products in order to avoid wrong expectations by them. This has been achieved so far as could be observed during the progress meeting, mainly through organizing meetings and training sessions.

A major impact from the first 18 months can be reported, from a technical point of view, as the generation of the Toolboxes. JR and VTT have finalized some prototypes, e.g. "EUFODOS Change Detection", "EUFODOS LIDAR", "Estimating Forest parameters" or "AutoChange", which can be used by any beneficiary, and hence is essential for the production process. In this context the SPs were able to deliver the products in time to the users.

4.3 Sustainability and Recommendations

Sustainability as such can be defined e.g. as the continuation of the developed services after project life time. From this point of view a closer look has been made in the outcome of the UUAs and the discussion process during the Workshop hold in Vienna.

In the following some user statements will be cited because these statements give a better picture on sustainability than abundant descriptions:

- "if the service is convincing money should be no problem" (Lick (LFD-STMK); Vienna Workshop June 2012)
- "in case of storm damage satellite imagery will be requested" (UUA)
- "the received information is highly important as for the first time all damaged areas could be found" (S. Tumbev (SFA); Vienna Workshop June 2012)
- "Stora Enso states, that it is using the VTT software to calculate stem volume estimates every year" (Susila; Vienna Workshop June 2012)
- "the products will save time and costs within the process of mapping the devastated areas, and it is also expected to be received sooner and with more detailed information than in neighbouring countries, so that the timber can be offered on the market earlier with a higher price" (Sagischewski (ThüringenForst); Vienna Workshop June 2012)
- "the costs of the service will not be such a barrier when Sentinel2 data will be available" (Unterthiner (Bolzano); Vienna Workshop June 2012)

As the majority of the received answers are positive it can be stated that the outcome of Phase1 is an excellent base in order to achieve a sustainability of the DSS. There was only one reluctant message on the continuity of the DSS, but this statement can be regarded as a work order and challenge for Phase2. From the latter message it can be concluded that the users are looking forward to the roll-out phase and the completion of the final products. Then it will be clarified if the services will achieve sustainability or not. With this work order the SPs are looking forward in an optimistic mood for the forthcoming 18 months, as could be recognized in the interim progress meeting.

From the users feedback also some recommendations for the DSS development and the dissemination of these services has been recognized. A strong point, often emphasized, is the completion of the product generation over the entire testcases. As the small testsites in Phase1 covers only a few hundred square kilometers the users are curious to see the final results which cover up to a few thousand square kilometers in some testcases. However, this is in the line with the EUFODOS schedule, but has to be emphasized in this report because the users often mentioned it.

Additionally, one recommendation from the users is to extend the geographical coverage of the service. As the financial resources in EUFODOS are limited this recommendation has to be negotiated between SP and user mutually for each testcase. The same may be valid for the proposed improvement of thematic accuracy. However, in the latter case it could be feasible to achieve an agreement between SP and user within EUFODOS.

As one of the products is the generation of damage maps one user recommends to use this product also to identify timber harvest, either unknown or unplanned ones. Evidently the use of DSS products can be used for

other purpose too and as soon as the users have integrated the products into their Forest GIS more useful impact could arise.

Finally the users are asked to which organizations or institutions they can recommend the products. Currently, and these proposals are based on the demo-products, they identified following institutions such as:

- Forest industry
- Forest authorities
- Nature protection
- AFL Germany
- GIS cooperation
- Other departments in bigger organizations
- Other ministries

More recommendations and feedback from the users will be expected during Phase2, but for the Phase1 results it can be concluded that the users show a strong engagement within EUFODOS.

5. Conclusions

Phase 1 of EUFODOS has been closed with end of June 2012. Within these first 18 months the fundament for the development of the DSS was laid by the SPs and the users. After the Kick-Off in January 2011 they elaborated the requirements and needs for the services and products. A framework has been worked out in terms of service architecture, INSPIRE implementation, Core Service integration and the procurement of data. Scheduled working procedures guided the SPs to create the first demo-products which were sent to the users in spring for their evaluation. Intensively discussed and validated were these demo-products and a report was generated for the UUAs by end of May 2012.

In this document the results of the UUAs are briefly reviewed and a synthesis is elaborated focussing on the UUAs results. This synthesis reflects the state of the work and the functionality and utility of the FDS. Valuable feedback is given by the users, which in turn has to be incorporated into the Phase2 DSS finalisation process. These issues encompass information gains from the DSS, technical issues such as the integration of products into the Forest GIS environment or the benefits from the DSS. On the other hand critics and constraints are always accompanied as important items in each of the production steps. The overall performance or cooperation of SPs with users is a major topic in the realization of the DSS. For the first phase the feedback to these questions showed a very good ‘climate’ between SPs and users.

The analysis of the life cycle and sustainability comprise the fields of service definition and service quality, data management, processing lines, product delivery and its validation. The impact of the services is discussed as well as sustainability and recommendations. In this context the SPs are busy to reach high standards in order to fulfil their obligations from the SLA. The outcome of Phase1 proofed that this goal has been achieved for almost all derived products in the testcases. The only aspect to be mentioned in this context is, that the service for assessing storm damage has been implemented from the technical point of view, but not realized in a real scenario owing to missing storm events.

During the user workshop the users have reported on their experience within EUFODOS from working procedure to the evaluation of the products. The EUFODOS users are regarded to represent a large user community and if they envisage to make use of the services it can be expected that an uptake by many other users will follow. From the elaborated UUAs and the discussions during the workshop in Vienna it can be concluded that the DSS already reached a quite mature level. This is an important aspect as it supports the sustainability of the DSS and thus makes the full implementation in Phase2 easier and faster.

Finally, it can be stated that EUFODOS is on the way to develop powerful and practical DS services, which are not only highly accepted by the users but also demanded by them and envisaged to be of use in the near future.

6. Abbreviations & Acronyms

ALU-FR	Albert-Ludwigs-Universität Freiburg
BMLFUW	Austrian Federal Ministry for Agriculture, Forestry, Environment and Water Management
CS	Core Service
DEM	Digital Elevation Model
DN	Digital Number
DS	Downstream
DSM	Digital Surface Model
DSS	Downstream Services
EAA	Federal Environment Agency Austria
EU	European Union
EUFODOS	European Forest Downstream Services
EURAC	European Academy Bozen/Bolzano
FD	Forest Downstream
FDS	Forest Downstream Service
FELIS	Department of Remote Sensing and Landscape Information Systems, University Freiburg, Germany
Fodis	Forest Damage Information System
GAF	GAF AG, Consultant and main contractor
GIS	Geographic Information System
GUI	Graphical User Interface
HR	High Resolution
HW	Hardware
INSPIRE	Infrastructure for Spatial Information in Europe
IPR	Intellectual Property Rights
JR	Joanneum Research
kNN	k-nearest neighbor algorithm
LFD-STMK	Landes Forstdirektion Steiermark
LIDAR	Light Detection and Ranging
LMSC	Land Montoring
LULC	Land Use / Land Cover
MMU	Minimum Mapping Unit
NDSM	Normalised Digital Surface Model
RE	RapidEye
ReSAC	Remote Sensing Application Center, Bulgaria
SAR	Synthetic Aperture Radar
SP	Service Provider
SW	Software
UUA	User Utility Assessment
VTT	Technical Research Centre of Finland