D7.4 – Evaluation of SCENT toolbox

Smart Toolbox for Engaging Citizens into a People-Centric Observation Web

Abstract

Whilst citizen participation in environmental policy making is still in its infancy, there are signs of a growing level of interest. The majority of citizens, though, both as individuals and as groups often feel disengaged from influencing environmental policies. They also remain unaware of publicly available information, such as the GEOSS or Copernicus initiatives. The SCENT project will alleviate this barrier. It will enable citizens to become the 'eyes' of the policy makers by monitoring land-cover/use changes in their everyday activities. This is done through a constellation of smart collaborative technologies delivered by the SCENT toolbox in TRLs 6-8.

The report aims to provide an evaluation of the implementation of the entire SCENT toolbox and to strengthen its utilisation and applicability in the field of advanced policy making for flood and land cover/ land use management. Completion of this task helps to improve recommendations and methodology to support the efficiency of the SCENT system. At the same time, it provides the opportunity to review the current methodology and the benefits of SCENT.

Keywords: SCENT toolbox, evaluation, policy making

D7.4	**Dissemination Level:** PU	Deliverable Type: R

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Document/Revision history

Version	Date	Partner	Description
V0.1	22/07/2019	DDNI	ToC, first draft
V0.2	23/08/2019	DDNI	Updated version based on partners contributions
V0.5	26/08/2019	ICCS	Document with comments and changes from ICCS
V0.6	31/08/2019	IHE	Document with updates from IHE
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V1.0	06/09/2019	ICCS/CARR	Approved, final version submitted

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Acronyms and abbreviations

Abbreviation	Description
CBA	Cost-Benefit Analysis
KPIs	Key Performance Indicator
APM	Advanced Policy Making
CO	Citizen Observatories
KSI	Key Success Indicators

Table 1: List of Abbreviations

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Executive Summary

The report constitutes an evaluation of the SCENT toolbox following the real-life field validation of the latter in the large-scale demonstrations organised in Kifisos and Danube Delta pilot areas. This evaluation is conducted taking into consideration a set of Key Performance Indicators (KPIs) that were identified in the beginning of the project and aim to assess the success of the demonstration campaigns, the project impact and the acceptance of the SCENT Toolbox from the user perspective. A qualitative and quantitative analysis is performed, aiming to depict the measurable impact of the toolbox. In particularly, the methodological framework considers the assessment of flood risks and flood patterns, the contribution of citizen-generated environmental information as well as the end-user evaluation of the system in terms of performance and ease of use.

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1 Introduction

1.1 Purpose of the Document

The objectives of this report fall into Task 7.5 "Evaluation and Advanced Policy Making". This task aims to contribute to a sustainable improvement of the capacity of the public administration to model and manage the flood risk, by making some structural and process improvements of the management of the public policy cycle. T7.5 is within the major area of developing the capacity for formulating public policies, harnessing the concept of Citizen Observatories (CO), and achieving better regulation and strategic planning of the SCENT Toolbox, as well as developing inter-institutional partnerships. The central problem aimed to be addressed refers to the deficiencies registered in the administration structures in the process of substantiating the decisions. Deficiency in substantiating decisions is directly caused by the lack of up-to-date information and the fragmented approach to public policy issues.

This report aims to demonstrate the measurable impact of SCENT toolbox in the assessment of flood risks and flood patterns, the contribution of citizen-generated environmental information as well as the end-user evaluation of the system in terms of performance and ease of use.

1.2 Intended readership

This deliverable is primarily intended as an internal document for Consortium partners including the Commission services.

1.3 Relationship with other SCENT deliverables

D1.1 and D1.2 consist the starting point for this deliverable, presenting the user requirements and the KPIs that are utilised in the context of this evaluation. The deliverable is also aligned with the high-level toolbox architecture (D1.4) as well as with the technical reports addressing implementation aspects of the SCENT toolbox components (WP2-WP6), and their validation in the project's large scale demonstrations (WP7), and namely D2.5, D3.1, D3.2, D4.4, D4.5, D5.2, D6.3, D7.1, D7.2 and D7.3. The deliverable complies also with the D9.3 Ethical Issues Clearance Plan.

1.3 Structure of the document

The report is structured in 8 sections. After this introduction, an overview of the methodology adopted, the KPIs used for the toolbox evaluation as well as the output of the end-user assessment is presented in section 2. Sections 3-5 aim to analyse the impact of the SCENT toolbox components, the newly sourced environmental data as well as of the technologies used for improved land cover / land use mapping, whilst section 6 focuses on the impact of the project's flood modelling activities in the decision-making process. Section 7 presents the quantification of the impact in the form of a Cost Benefit Analysis and section 8 concludes the report providing a summary of the main results.

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2. Description of SCENT Toolbox Evaluation and Advanced Policy Making (APM) process

For a long time, APM was considered an intuitive process improved through trial and error. A variety of individual styles based on human creativity, reasoning, intuition and experience have been used to solve problems and identify quantitative methods and scientific approaches for the flood management. Understanding the relevant environmental changes and how they should affect the policies for flood management is a complicated problem. The lack of a consistent strategy invariable in time makes it difficult to identify errors in the decision-making process and predict long-term consequences especially due to the complexity of operations and the chain reaction that an error can cause. One of the characteristics of any information delivery system for modelling the socio-economic systems, such as SCENT, should support the tendency to evolve in order to achieve the objectives of the APM.

The decision making is the central point of the management activity which highly depends on the quality of the information. Managerial decisions imply much greater responsibility because any decision influences the activity of flood risk management and a wrong / incorrect decision can cause a number of problems or even a chain reaction that can bring significant damages.

The benefits of implementing the SCENT Toolbox in the APM process are:

– Providing a larger volume of information, with better spatial and temporal distribution.
– Generating an alternative way to monitor an area of interest without relying on expensive infrastructure
– Relieve part of the decision-making stress due to the access to a plethora of information
– Involving the community in the decision-making process.

The importance of SCENT assessment is given by the need to improve the APM process for flood risk management.

The approach complements the actions made so far at the SCENT project for the introduction of this approach that aims to make decisions based on evidence - interpreted visual information, photographs, photoplanes, etc. (evidence based policy) and impact analysis using the hydraulic model, approaches which will be completed by developing guides, manuals, methodologies with guiding role in this approach.

Choosing the best solution to solve the problem to which the public policy is addressed, quantifying the financial and social costs and benefits, on the management of risk and the environment, are elements that lead to the elaboration of policies that are easier to implement and monitor, whose impact on the budgets of the institutions compared to the targets / performance indicators that they are expected to meet are easier to plan and track.

2.1 Methodology

There are several methods for quantitative assessment of the components with potential impact on the production of environmental information and LU / LC. The distinction between monetary methods and non-monetary methods can be distinguished. Non-monetary approaches are less controversial and may be more appropriate in a cost-effectiveness analysis of aspects related to the volume of the

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newly sourced environmental information and the accuracy of the produced maps. Such methods include a multicriteria analysis that provide an evaluation methodology that takes into account several objectives by assigning a weight for each measurable objective. In terms of the monetary methods cost and benefit analysis (CBA) can be applied. Often, the risks cannot be completely eliminated without exaggerated costs and in these cases the cost benefit analysis is useful to determine if it is, for example, more efficient to spend money on the CO system to improve the monitoring than on increasing the quality of the administrative system for obtaining information. According to the European Union methodologies, cost-benefit analysis plays a major role in evaluating investment projects.

Last but not least qualitative methods involving structure interviews and/or questionnaires can be employed for the evaluation of the system from relevant users and stakeholders.

2.1.1 Research Methodology Briefing

Verifiable, good quality data is an essential component of both quantitative and qualitative assessments. The quality of the information provided during them ensures the solid foundation of the identified solutions and their proper implementation. The following is how the data collection activity intervenes during the course of the evaluation process of T7.5, which comprises 2 steps:

Step 1. The first step involves the identification of the economic, social and ecological impacts of the SCENT implementation option in public policies. The effects that appear in the administrative framework, but also outside it, must be taken into account. Even though many of these impacts are indeed public policy goals, the focus should be on the potential unintended impacts and effects of the interaction between the various options. This analysis is complemented by the conduction of qualitative methods (i.e. online questionnaire) aiming to establish a better understanding of the applicability of the toolbox in the wider decision-making process.

Step 2. It involved a detailed quantitative analysis of important impacts. After conducting an extensive qualitative assessment in step 1, the expected benefits and costs are analysed in a quantitative and / or monetary estimation. Such an analysis can take several forms, depending on the methodology chosen such as CBA and/or multicriteria analysis.

The premises of the CBA applied involve:

1. Initial investments estimated to be made are expressed at constant prices, without being adjusted for inflation;

2. The calculated benefits refer only to the initial investments, considering that they add value to the company. The incomes obtained by the economic operators after the implementation of SCENT were not taken into account. To the extent that some of this income is transferred to employees' salaries, it can be considered that this benefit is rendered as a social benefit by creating jobs;

3. The depreciation and residual value of buildings and equipment were not taken into account;

4. KPIs have been transformed into success indicators

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5. The number of units estimated to be set up as a result of public policy has not been evaluated.

6. No transaction costs were calculated, such as the cost of developing feasibility studies and other necessary documents;

7. No externalities were added to the costs

8. The discount rate used was 5%, recommended by the European Commission for major investment projects

2.1.2 Key Performance Indicators for evaluation of the SCENT Toolbox

A list of Key Performance Indicators (KPIs) that are considered important to evaluate the success of the demonstration campaigns, the project impact and the acceptance of the SCENT Toolbox from the user perspective is provided in the following table. These are not strictly technological KPIs, they are indicators from the SCENT stakeholders' perspective as to the acceptance of the SCENT solution during the pilots and to the impact of the project in general.

Table 2: Key Performance Indicators evaluated and/or proposed by SCENT stakeholders

No	Description of KPI	Importance[1]	WPs
1	Number of participants in the pilot campaigns	1	WP7
2	Area covered by the pilot campaigns	1	WP7
3	Clarity of guidelines before and during the pilot campaigns	2	WP7
4	Number of Twitter, Facebook or other social media followers	3	WP8
5	Unique SCENT website visits	2	WP8
6	Number of players of SCENT serious games	2	WP7
7	Number of returning players of SCENT serious games	1	WP2, WP7
8	Overall satisfaction in SCENT serious games	2	WP2
9	Number of images sourced during the pilot campaigns annotated through the SIE	2	WP7
10	Number of images sourced during the pilot campaigns annotated manually (by gamers)	2	WP7
11	Number of open platforms/repositories images annotated through the SIE	2	WP5
12	Number of open platform/repositories images annotated manually (by gamers)	3	WP5, WP7
13	Update rate of improved LC/LU maps (with crowd-sourced data) for the pilot regions	2	WP5, WP7
14	Average time from crowd-sourced data submission (eg image, text) to updated flood risk / flood pattern maps generation	1	WP2-WP7

[1] (Scale 1: very important, 2: somewhat important, 3: not really important, 4: not important/not relevant)

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In the following sections, details about the KPIs are presented in the context of the SCENT toolbox implementation and its demonstration in the pilot campaigns of the project, while a more comprehensive analysis/calculation is given in Appendix A1.

2.2 Questionnaires/structured interviews for SCENT Toolbox Evaluation & APM

During July-August 2019, a questionnaire was developed to elicit from SCENT end-users, pilot participants and stakeholders involved in T1.1 as well as from other organisations their feedback with particular focus given on aspects of the SCENT toolbox. It used 20 questions with quantitative and qualitative indicators and was applied online on the Google platform. The questionnaire is provided in Appendix A2.

48 stakeholders answered the questionnaire, from whom most of the respondents were female (64,6%), and the predominant age group was between 20 and 60 years.

From the perspective of the level of education of the respondents, 52,1 % were university graduates, whilst in terms of the field of activity of the respondents, it varied, consisting mainly of stakeholders from public authorities (50%) as well as representatives from the private sector, NGOs, volunteers and students (Figure 1).

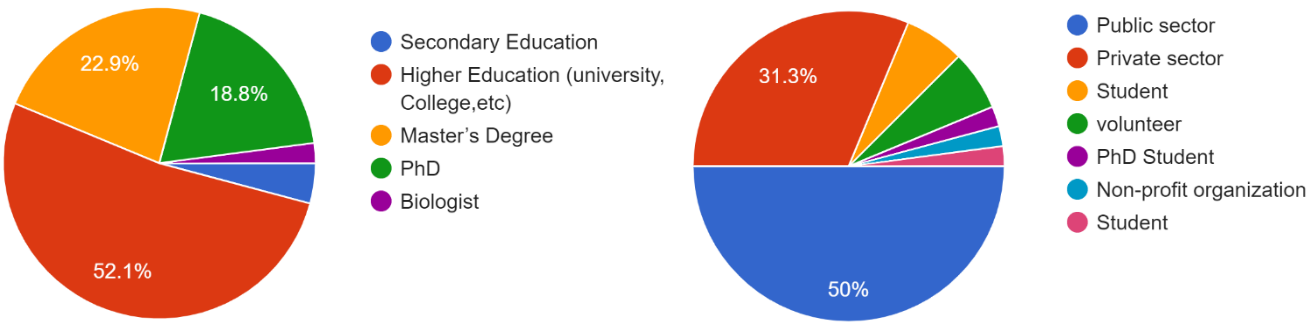

Figure 1: Level of education (left) and profession details (right) of the responders

The 77.1% of the responders were aware of the SCENT Toolbox and they had used some its public facing applications before the dissemination of this questionnaire, while 83,3 % have participated in SCENT field campaigns either in Kifisos or Danube Delta pilot sites. Through the different activities of the project, participants declared that they have gained good knowledge (54,2%) of the different aspects of the toolbox (Figure 2). Only a small portion (6.3%) think they have acquired less knowledge.

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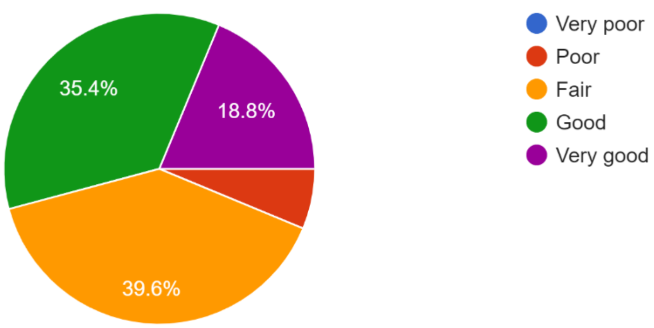

Figure 2: Evaluation of the interviewees' knowledge about SCENT Toolbox

Figure 3 presents (left pie-chart) the different applications that have been used by the responders. As it can be seen, SCENT Explore and SCENT Measure were used mostly by the participants in the context of their interaction with the project. In addition, 50% of the responders stated that they were very satisfied with the benefits that can be obtained through SCENT toolbox for their institution / company / organization, whilst 4 % of the responders declared that they were slightly and/or not at all satisfied.

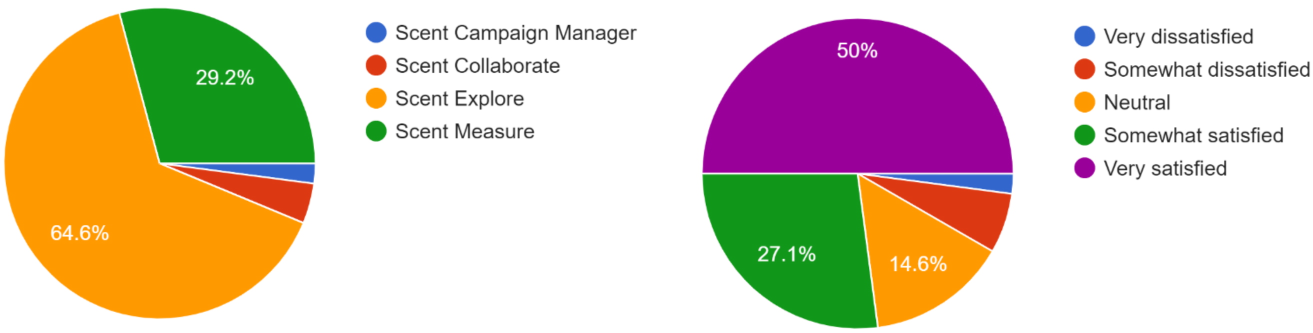

Figure 3: SCENT Toolbox applications that have been used by the responders (left) and their overall level of satisfaction from this experience (right)

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Most of the interviewees (75%) have a good understanding and level of awareness regarding floods and/or related phenomena (Figure 4), while more than 85% rated that the impact of SCENT activities in the areas of flood risk management and monitoring is high (Figure 5).

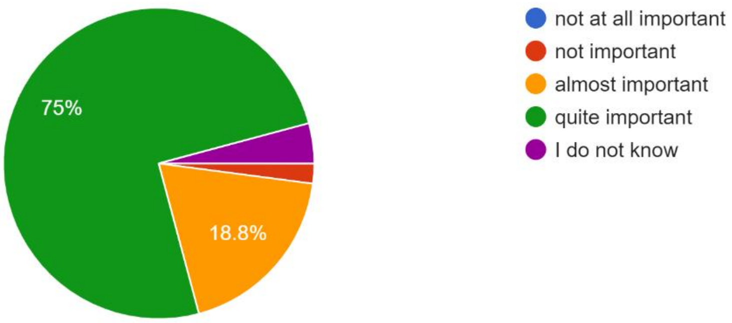

Figure 4: Interviewees' awareness about floods and/or related phenomena

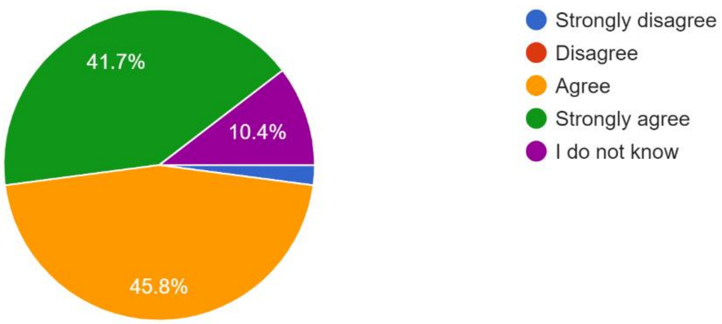

Figure 5: Evaluation of the applicability of SCENT Toolbox as an appropriate solution for flood monitoring and management

Further to the above-mentioned insights and based on the awareness that was raised through the project activities, as well as the results showcased, 91,7% of the responders expressed their belief that Citizen Observatories and methods and technologies of collaborative nature constitute an appropriate solution for flood risk management.

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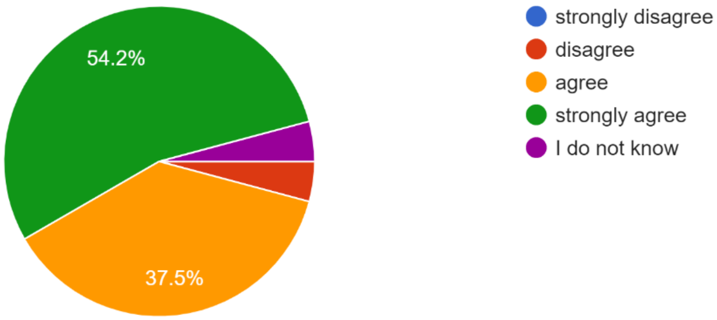

Figure 6: Evaluation of the applicability of citizen observatories and relevant collaborative solutions in the context of flood risk management

Aiming to establish a better perception of the system, a set of questions regarding its performance and its characteristics were included in the questionnaire in order to acquire the perspective from a wide range of stakeholders that constitute the main future users of the toolbox. In particular, 56.3% of the responders stated that they consider that the system doesn't conflict or threaten the current data management principles and privacy policies in place by their organisation.

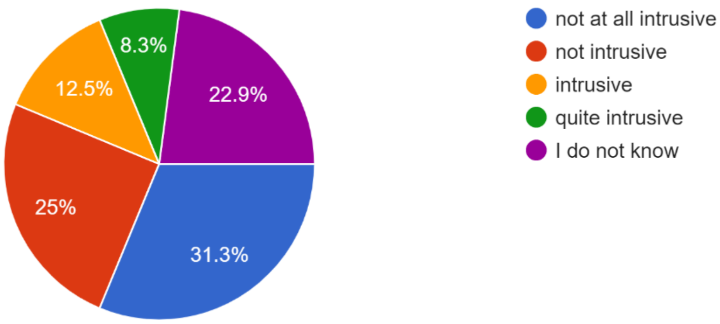

Figure 7: Data management and privacy considerations of the SCENT Toolbox

Moreover, the majority of the stakeholders (79.2%) mentioned that they wanted to keep working with the SCENT Toolbox following their first interaction with the system. In particular, Figure 8 presents some the features of SCENT toolbox that were appreciated by the participants. The answers were quite diverse, including applications of the toolbox such as SCENT Measure and Explore, serious gaming approach, and the data gathered (i.e. soil moisture, etc).

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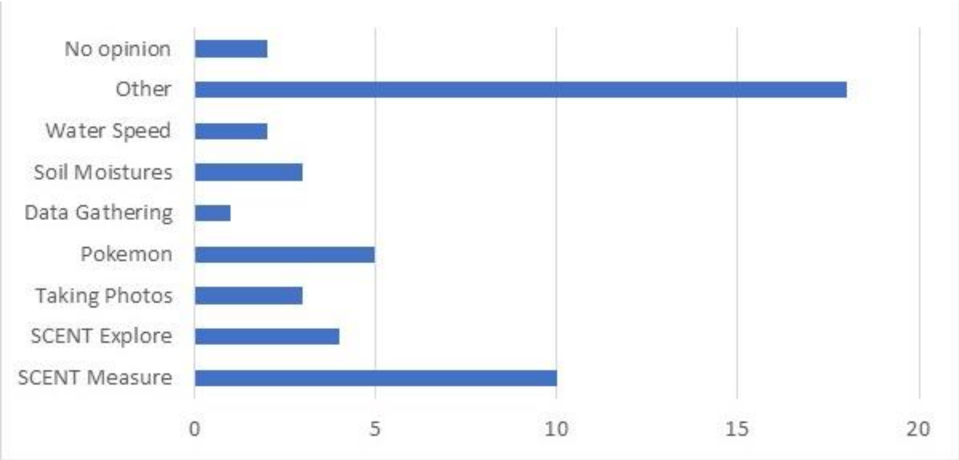

Figure 8: Features of the SCENT toolbox that were liked the most by the responders

In terms of user acceptance, more than 80% of the users were not disturbed while using the SCENT toolbox (Figure 9), while approximately 90% consider the system intuitive, easy to use and fast (Figure 10).

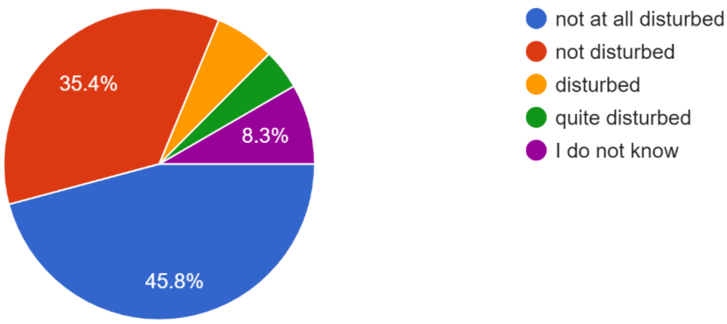

Figure 9: Evaluation of the SCENT toolbox in terms of disturbance

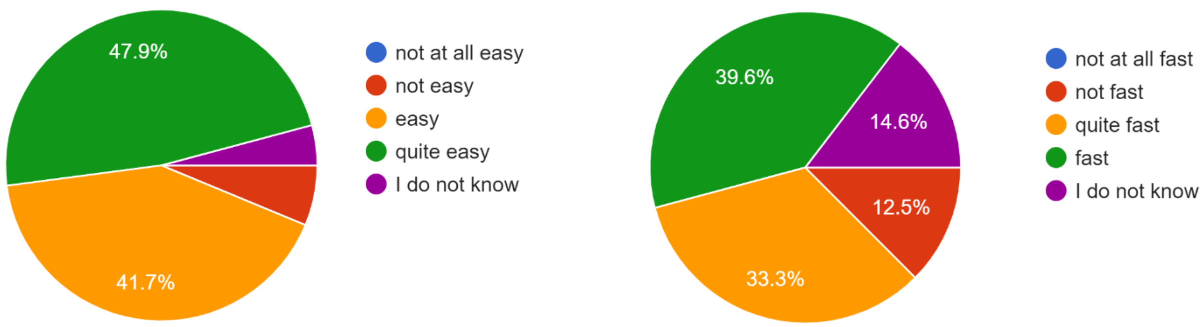

Figure 10: Evaluation of ease to use (left pie-chart) and of the system response time for providing flood risk awareness input (right pie-chart)

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In terms of data quality, most participants show great confidence in the SCENT approach for data collection (77,1%) while 64.6%, consider stated that they would consider reliable the outputs of the toolbox components in the context of their activities (Figure 11).

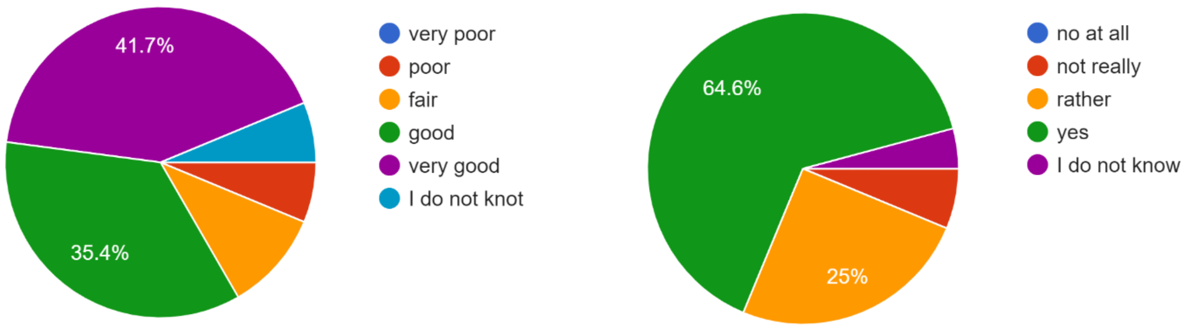

Figure 11: Evaluation of the quality of the data collected via the system (left pie-chart) and of the reliability to the outputs of the toolbox components

Finally, feedback was elicited from the participants regarding the adoption of the toolbox in the future. In particular, as presented in Figure 12, approximately 90% of the users consider that the system is scalable and that can be generalised and adopted in different contexts of environmental monitoring (Figure 12). In addition, 72% of the responders expressed high interest in using SCENT toolbox components in the future.

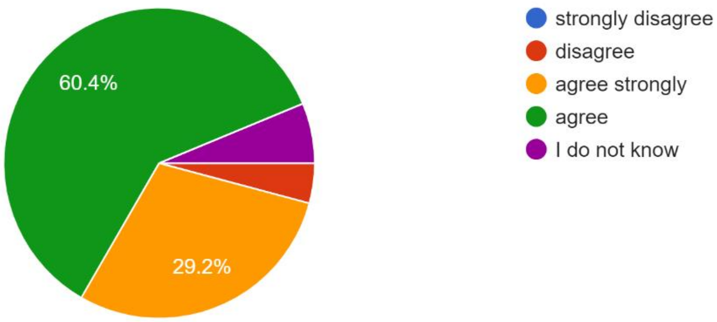

Figure 12: Evaluation of system's potential in terms of generalisation and adoption in different environmental contexts

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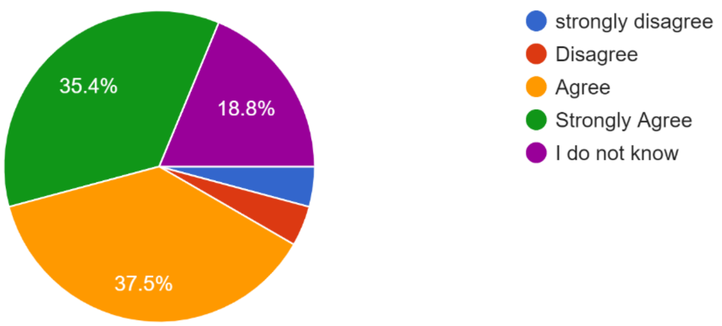

Figure 13: Evaluation of the possibility of using SCENT toolbox components in the future

Last but not least, more than 85% of the participants expressed their overall satisfaction regarding the SCENT toolbox.

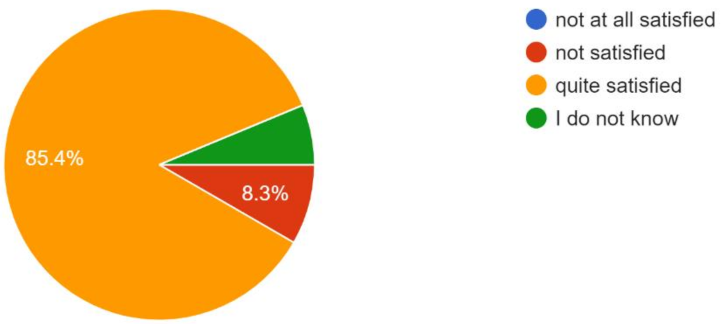

Figure 14: Overall appreciation of the SCENT toolbox

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3 Crowdsourced data collection and analysis

SCENT toolbox constitutes of a constellation of smart and innovative technologies that aim to enable citizens to monitor Land Cover/ Use (LC/LU) changes and how these affect flood phenomena in their urban or rural areas. Apart from enabling the collection of important environmental information, the toolbox supports the proper analysis and management of the latter so as to facilitate their utilisation in the context of actual applications while demonstrating such cases in the fields of land cover / land use mapping and flood modelling. The following sections provide an overview of the impact of the technologies in the decision-making process.

3.1 SCENT Toolbox end user applications

SCENT Explore, SCENT Measure and SCENT Collaborate constitute the crowdsourcing and gaming applications that were used from citizens and volunteers in the context of the project's pilot campaigns in Kifisos and Danube Delta. A total number of 704 participants (counting 510 unique participants) joined the citizen science campaigns of the project organised in both pilot areas (KPI #1) and used SCENT Explore and Measure applications collecting images of LC/LU elements, sensor measurements of soil parameters (soil moisture, air temperature) as well as images containing a water level indicator that is half-submerged into water and videos capturing a pre-defined floating object moving on the surface of a water body that are used subsequently analysed to extract water level and water surface velocity respectively.

Analysis of the completed feedback forms from the participants (Deliverables D7.2 & D7.3), shows that the participants liked mostly about the SCENT apps (SCENT explore, SCENT Measure) the characters, the concept of the application and the project, the interactive aspect of the apps, which were easy to use and the offline-mode functionality of the app which was a very important element used during the field campaigns. In addition, based on feedback from the campaigns participants, the applications were continuously being improved and thus resulting in a high overall satisfaction level, particularly in the last campaigns in each pilot area (KPI #8). For instance, in Danube Delta, 71.42% of the participants of all campaigns stated that they couldn't find a least likeable characteristic in the applications while in Kifisos 47% of the volunteers didn't specify such a characteristic as well.

The total number of 1746 users have contributed to the project goals via the use of both SCENT Explore, Measure and Collaborate applications (KPI #6). SCENT Explore users have contributed with a total of 18988 images that were collected in the pilot campaigns (KPI #10) whilst more than 16000 annotations have been provided though the SCENT Collaborate platform. Moreover, approximately 10083 unique users have visited the SCENT Collaborate site, whilst an appreciable percentage of the validation was conducted from guest users (2600+). It should be noted, that SCENT has established an active online community involving, as of August 2019, 1130+ active registered users of Scent Collaborate platform, while SCENT Explore and Measure downloads have reached 2000+, with 612 active users. During the pilot campaigns, the number of returning players amounts to 481 for SCENT Explore (users participating in different campaigns or campaign days) and 673 for SCENT Collaborate (users participating in different time sessions) (KPI #7).

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Apart from the abovementioned, SCENT Campaign Manager, a web application that enables policy makers, public administrators and other relevant stakeholders to streamline the design and creation of citizen has been implemented and utilised in the context of the abovementioned pilot campaigns.

From a societal perspective, these technological innovations facilitate the engagement of citizens and volunteer associations in environmental decision making, whilst strengthening the democratic processes applied in public administration as well as the effectiveness of governance and application of EU and global policy objectives (environmental dimension). In addition, coupled with the back-end components mentioned in the following section, provide a cost-effective solution that extent in-situ networks and provide environmental information in an enhanced spatial and temporal resolution.

3.2 SCENT Toolbox backend components

All applications and services of the SCENT Toolbox are connected and orchestrated through the SCENT Crowdsourcing platform. The platform acts as a central data broker that links the Scent frontend applications used by citizens to provide images, annotations, sensory data, event reports and videos, to all the other toolbox components.

It also manages the complete lifecycle of citizen-generated images. Once a citizen takes a relevant image using SCENT Explore, the image is sent to the crowdsourcing platform. It stores a copy of the image on the cloud and makes it available to the SCENT artificial intelligence 'heart', also known as the SCENT Intelligence Engine (SIE), which uses advanced machine learning techniques to automatically detects land cover types and objects in image according to SCENT taxonomy. The annotations are fed back to the crowdsourcing platform, which is in charge of deciding whether the quality of the annotations is sufficient. If not, the image is made available for being further annotated, this time by people, through the SCENT Collaborate. In addition, the crowdsourcing platform provides crawling functionality by querying a predefined set of open image platforms. This is achieved through the Open Image Tool (OIT) that allows to collect publicly available data that is of interest to the active campaigns directly from the web. In the context of the spring pilot campaigns 10 images were harvested from the Flickr open platform and they were annotated through the SIE and SCENT Collaborate (KPI #11 & #12). The rather small number of images was anticipated as of the lack of available data in the points of interests where the citizen science campaigns took place.

Furthermore, apart from the analysis of the LC/LU information, SIE provides dedicated tools enabling the extraction of relevant river measurements from multimedia. More specifically, state of the art image recognition techniques is employed from the Water Level Measurement Tool allowing the extraction of the water level from images containing a water level indicator that is half-submerged into water. The goal of the tools is to 'read' the indicator and extract the number that is closer to the water level. On the other hand, the Water Velocity Calculation Tool uses innovative video processing algorithms in order to extract the water surface velocity from a video containing a pre-defined floating object moving on the surface of a water body.

As of its functionalities, SIE enables large-scale continuous environmental monitoring, thus helping the decision makers to take steps towards the management of the environment and the preservation and monitoring of natural disasters (i.e. flood related events). It should be noticed that all the images collected in the SCENT field campaigns (18988) have been annotated from SIE (KPI #9) while providing

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up to 5 annotations per image and thus facilitating the production of semantically enriched datasets. In addition, SIE, acts as an enabler for the SCENT Crowdsourcing platform that unites people in the shared goal of preserving their living environment, and increases awareness of the dangers to this environment. Finally, information provided by SIE translates to financial value via reduction of damage from natural disasters (by preventive steps) and better urban and infrastructure planning.

In the post-funding period of the project, interested stakeholders will be able to interact with the SCENT toolbox and its components through the project's website that will act as gateway, providing details about accessing and utilizing the system as well as the overall SCENT journey.

4 Volume of newly sourced environmental data

The vast amount of citizen-generated and added-value products that have been produced in the context of the project are offered to GEOSS portal. These include descriptive information about LC/LU elements, river parameters (water level and water velocity) and sensor measurements (soil moisture and air temperature) that have been collected from citizens and properly processed and validated through the toolbox components.

Such data constitute a unique environmental resource for the pilot sites, enabling the scientific community and relevant stakeholders to further utilise them in the context of their activities.

Additionally, from an economic perspective, the overall approach implemented in SCENT Citizen Observatory demonstrated that high quality datasets can be produced from citizen science activities, being able to be integrated in flood modelling and thus extending costly traditional in-situ infrastructure. For instance, it should be mentioned that the cost for the acquisition and installation of a radar sensor for the measurement of surface flow velocity may range from 6000 to 8000 Euros, without considering the costs associated with the maintenance and infrastructure to manage such resources that may reach high levels as well. Moreover, standardisation constitutes a key process of the SCENT Harmonisation Platform, enabling the maximization of the value of the data provided by the project through the utilisation of common systems for transmitting and/or exchanging environmental information. In particular, during the last years there has been a rapid increase of citizen-generated knowledge that has been facilitated by the wider use of mobile devices and low-cost portable sensors. To enable their easy integration to existing models and systems as well as their utilization in the context of new applications, citizen-science data should be easily discoverable, re-usable, accessible and available for future use. Thus, SCENT Citizen Observatory, apart from ensuring the interoperability of resources generated in the context of the project, has also established a connection with Global Earth Observation System of Systems[2] (GEOSS), that can elevate the value of citizen science communities and data of SCENT from local to global scales, facilitating their utilisation from a wide variety of users.

[2] https://www.earthobservations.org/geoss.php

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5 Land cover / land use mapping

In the context of SCENT, a map segmentation delineation, annotation and characterisation tool has been implemented that introduces novel machine learning approaches that automatically detect and annotate segments on satellite and aerial imagery, with land cover / land use (LC/LU) elements that affect flood risk and flood pattern determination (i.e. river banks, forests, buildings, etc). Citizen-generated data are utilized for the training of the map segmentation tool, that aims to produce LC/LU maps of improved accuracy which are essential for the construction of hydrodynamic and hydrological models. These added value products are also offered to GEOSS in a standardised format.

More specifically, the state-of-the-art Deep Neural Network technologies that have been employed and properly adjusted to the satellite imaging peculiarities, resulted to the implementation of a tool, appropriate for SCENT land cover/land use taxonomy items of the project, that is capable of (i) assigning a semantic class (SCENT taxonomy) to each pixel, (i.e. converting the raw data to a semantically meaningful raster map), (ii) converting SCENT taxonomy annotated points into annotated areas on the satellite/aerial maps and, (iii) characterizing whole areas for which a land-cover/use description is not available.

In the context of the project, such maps have been produced for Kifisos and Danube Delta pilot sites. Considering also the volume of data available for each pilot area (approximately 5000 and 2000 data of LC/LU textual descriptions for Kifisos and Danube Delta pilot sites respectively), pre-processing and training of the DNN requires up to 2 hours. Further to this, and based on the process adopted the segmentation time of the Danube Delta and Kifisos satellite maps amounts approximately to 80 and 20 hours respectively (KPI #13). The maps produced have a pixel resolution of 50cm × 50cm and contain LC/LU elements of importance for flood modelling.

Monitoring land cover and land use change is important for land resource mapping, understanding ecosystem services including resilience to climate change, natural disasters, biodiversity conservation and other issues. However, updates are infrequent and classification systems do not always serve key user groups, whilst maps at the regional level lack some of the typological resolution needed for many regional applications and decision-making contexts. Thus, the map segmentation tool aims to extend current repositories (i.e. GEOSS) by allowing for more frequent updates of local monitoring of land cover/use changes and with higher spatial resolution, using inexpensive crowd-sourcing tools.

6 Improved flood modelling for decision-making

The SCENT Toolbox is being evaluated qualitative and quantitatively in terms of its impact and possible adoption to the decision-making process. One of the aspects tested through the SCENT Toolbox in the field demonstrations is its overall ability to improve flood models to be used for decision-making with the crowdsourced data collected. In Section 6.1 it is better developed the view on how to assess model results form a policy-making perspective, while sections 6.2 and 6.3 go into the results obtained and what do they mean in terms of the contributions of the project.

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6.1 Impact of flood modelling in decision-making

Flood modelling is a tool used to simulate the extent, depth and velocity of floods. This simulation can be performed as hindcast, i.e. simulation of past events; it can consider incoming data, in a nowcasting framework; and lastly, but less commonly, flood models can be used to forecast the above-mentioned properties. Moreover, it is possible to simulate situations that did not happen, as scenario analyses. Flood models can be considered cheap in comparison with the extensive data collection costs related to physically surveying the above properties and compared to physical models (i.e. miniature versions of the system). In this context, it can be understood that flood models are versatile tools that can be used for varied purposes, one of each is to aid policy-makers to reach decisions. Flood models can help decision-makers in:

1. Managing flood risk management, used in different elements according to the Commission of European Communities (COM, 2014):
   1.1. To derive flood hazard maps, based on design floods, to be used for prevention
   1.2. To derive some vulnerability information for the creation of flood risk maps, such as the vulnerability to high speeding waters, to be used for prevention
   1.3. To simulate the impact of flood risk reduction measures (e.g. inclusion of dykes), to be used for protection
   1.4. To emit flood warnings, to be used for preparedness
   1.5. To simulate occurred disasters, to be used for recovery and lessons learned
2. Managing natural areas prone to flooding, such as wetlands
   2.1. To simulate the impact of changes to the river system (e.g. dredging of canals for fishery or blockages in the river channel)
   2.2. To provide input for water quality or ecological models
3. Managing large hydraulic interventions that cause flooding
   3.1. To simulate the impact of inclusion of river structures, such as dams
4. Managing the impact of climate change, by evaluating different climatic scenarios

By using flood modelling in such widespread management decisions, flood modelling can have impacts in many aspects of society. Societal impacts include decisions related to land regulation, as flood hazard maps generated by flood models can be used to define zoning policies. It also impacts society in the impact of floods on loss of life in case that flood models are used for warnings. Economic impacts are also related to flood risk, as the same flood hazard maps can be used by insurance companies to tax more or less certain regions. Lastly, concerning the use of models for understanding the environment, flood models can be coupled to water quality and ecological models for quantitatively assessing the health of ecosystems, as well as designing and testing measures and policies for its preservation. On a higher level, the implementation of flood modelling as a tool for improving water resources management also contributes indirectly to the Sustainable Development Goals, in specific:

- Goal 11 on Sustainable cities and communities: by using results of flood models to design river interference measures that respect sustainable river basin development;
- Goal 13 Climate action: by using climate change scenarios to simulate its impacts on local flooding; and

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- Goal 14 on Life below water: by using results of flood models to help manage the health of aquatic ecosystems.

In SCENT, given the needs identified in D1.1 by local stakeholders and the design of the citizen campaigns chosen, flood models were designed to help decision-makers in terms of flood risk management (use 1 from list above), for Kifisos catchment, and to manage natural areas (use 2), in the case of Danube Delta. More specifically, the flood models developed within the project aid decision-makers in use 1.1, 1.2 and 1.3, when it comes to prevention and protection. With this view in mind, it is presented the results from the models and the improvement gained with crowdsourced data.

6.2 Results for Danube Delta

As mentioned in the previous section, local policy-makers need to understand the effect of flows within natural areas in order to make decisions to conserve the environment. Specifically, in wetland areas, as it is the case for the Danube Delta, biodiversity is influenced by spatial and seasonal patterns of floods, which are simulated by flood models.

The complex pilot area chosen, the Sontea-Fortuna area, was modelled in different ways using varied model schemes, in order to capture such changes, as described in Deliverable 6.1. The final model was calibrated and validated for low flow conditions and only partially calibrated for smaller canals, due to limited data in those areas. The hydrodynamic models of Danube Delta were improved by using SCENT updated land cover map, which was used to characterize the resistance to water flow (Deliverable 6.3).

It is possible to assess the effects of the update by looking at the inundation extent in these two configurations (dry and outdated and updated land cover), displayed in Figure 15. For the dry period the inundation extent increased, probably due to the reduced roughness values employed for certain land cover types.

Improvements to the model were also made in terms of validating the model for both dry and wet conditions. As described in Deliverable 6.3, validating the model with crowdsourced data yielded similar results to performing the calibration with traditional datasets.

In conclusion, the updated land cover information influenced the flooding patterns crowdsourced water depths can validate the models. By this validation, mainly for the wet period, an improved model is obtained in comparison with the initial one for low-flows. Thus these model cover a wider range of conditions that affect biodiversity as, for example, different birds nest in different times of the year.

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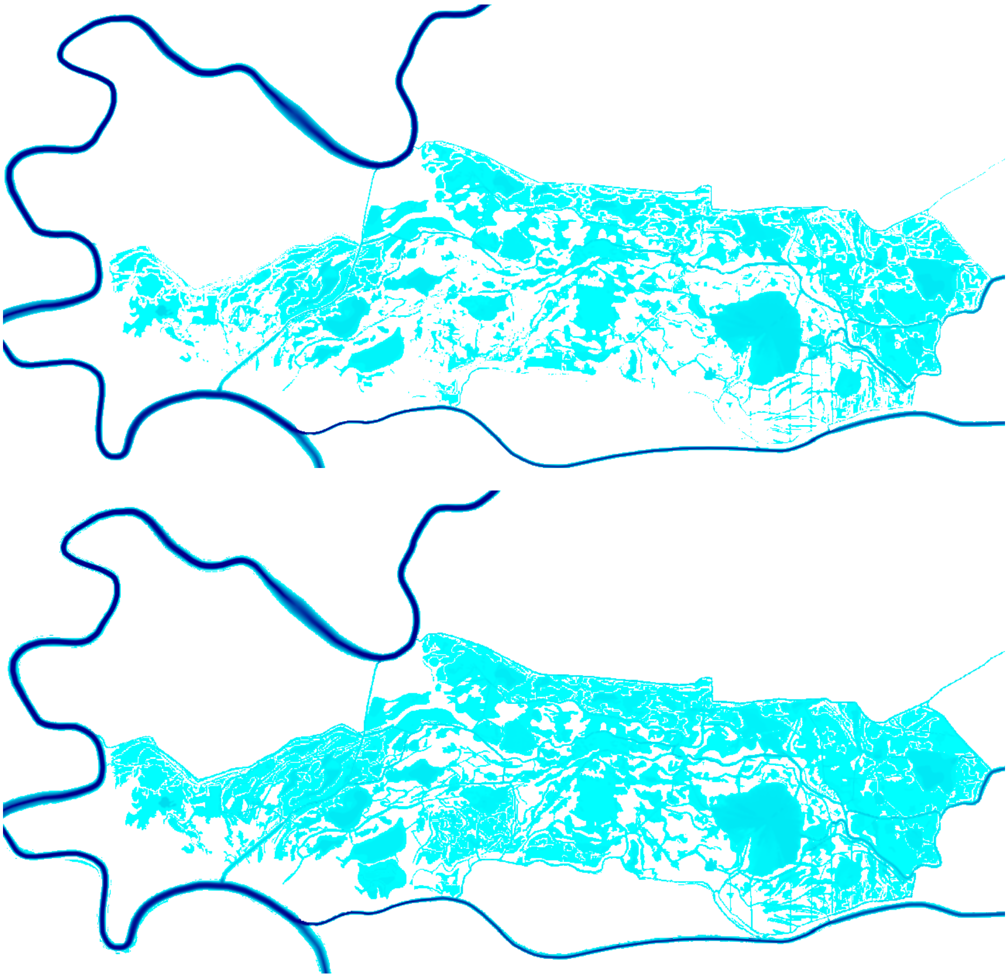

Figure 15: Difference in inundation patterns for the dry campaign. Top panel represents the outdated model and the bottom one represents the improved model with SCENT land cover map

6.3 Results for Kifisos catchment

In Kifisos catchment, flood modelling is used as a tool to aid in the understanding of flood hazard. Coupled hydrological and hydrodynamic models were used. The constructed models using existing data was calibrated using discharge data from 2000 and 2001, due to the extremely scarcity of this type of data in the region (Deliverable 6.1).

Deliverable 6.3 describes how the initially developed model was updated. This was done by employing the crowdsourced land cover map for the hydrological model and the drone data in the elevation characterization of the hydrodynamic model. Additionally, a flood event was simulated and validated with traditional and crowdsourced data.

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The improvement of the hydrological model did not result in considerable changes in the discharge at the sub-basin used as input for the hydrodynamic model, for the February event simulated (Figure 16). Peaks are higher in the improved model, which could reflect an increase in imperviousness due to an increase in urbanization. However, as it presents higher values, it performs worse than the outdated model, when validated with crowdsourced data and traditional data, as discussed in Deliverable 6.3.

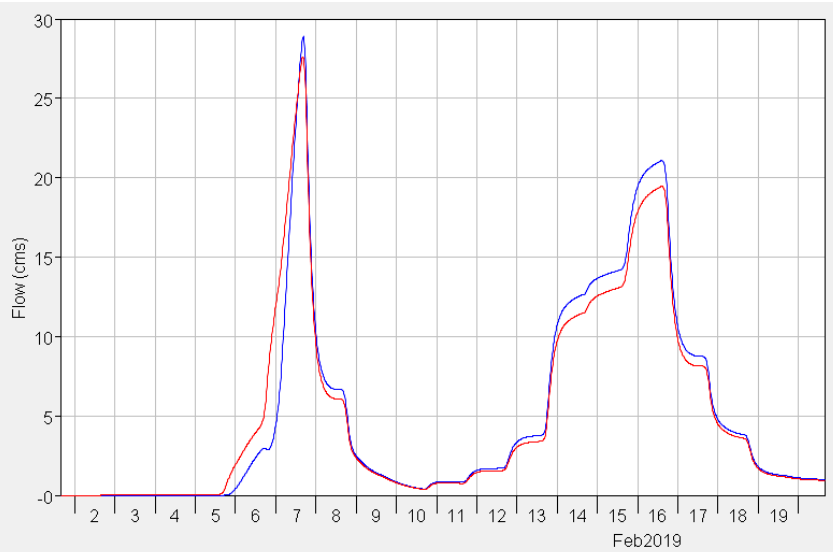

Figure 16: Discharge hydrographs for Kifisos hydrological model. Red line represents the discharge with the outdated CORINE land cover, while the blue line represents the model with the updated land cover.

In terms of the use of drone data, considerable changes in the flood extent were observed (Figure 17). As it can be seen, the drone result dataset allowed for the building features to be detained and consequently a very detailed result is obtained, which is what is desired from flood hazard maps.

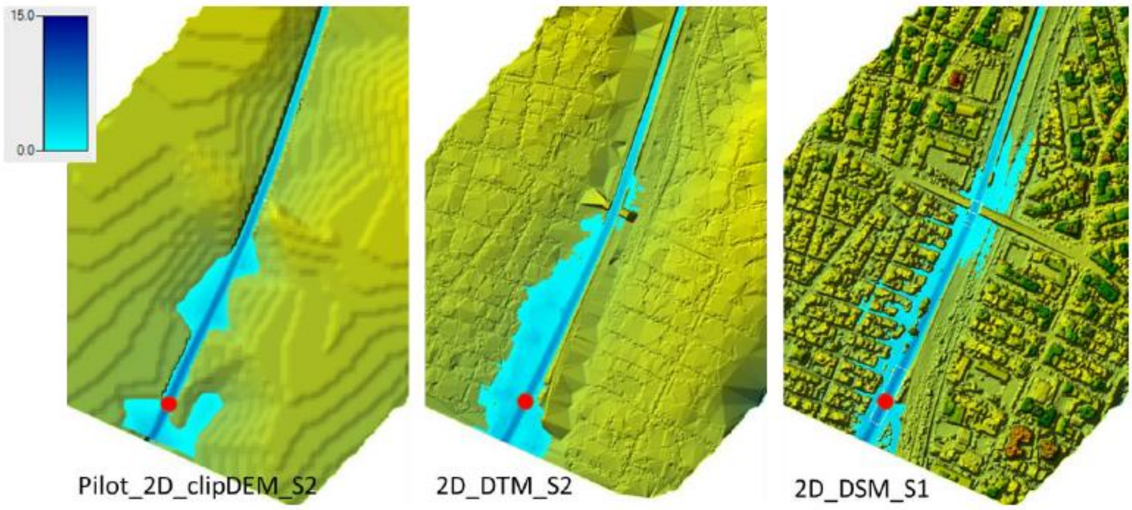

Figure 17: Inundation at the downstream part of three models: original Digital Elevation Model, drone Digital Terrain Model and drone Digital Surface Model. Source: Phuoc (2019).

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Lastly, considering the added value of crowdsourced water depths and velocities, for the limited comparisons made and discussed in Deliverable 6.3, mainly crowdsourced water levels measured with portable gauges showed satisfactory for hydrological model validation. It was not possible to obtain paired traditional and crowdsourced data for the hydrodynamic model stretch and therefore, validation for this model was not performed.

Overall, the hydrological and hydrodynamic models were improved through the use of the SCENT Toolbox, greatly through the elevation model using the drone data and by the acquisition of crowdsourced river data (water depths and velocities) that is comparable to traditional data. The overall model validation was limited, due to the event-based nature of the hydrological model and the limited paired traditional and crowdsourced datasets acquired. For that, the valuable dataset of telemetric water level data obtained through SCENT, together with the updated detailed land cover map, should be leveraged to build an improved model, a continuous and distributed hydrological model. The only limitation of SCENT for this case study is in the provision of crowdsourced data beyond low-flow conditions, when it is dangerous for citizens to collect data. Thus, if telemetric data is also available, the improved model can configure an improved local tool for flood hazard mapping. Otherwise, the model can be used for water management purposes.

6.4 Runtime performance

In terms of the average time needed from crowd-sourced data submission (eg image, text) to updated flood risk / flood pattern maps generation (KPI #14) the following calculation is presented according to the involved steps:

– Images collected by volunteers are processed by SIE and/or the Water Level Measurement Tool as needed. Next each image goes through the Data Quality module at the CROWD BE. This process lasts approximately 5-6 seconds per image. Videos collected by volunteers are processed by the Water Velocity Calculation Tool, requiring approximately 3 minutes per video. As these processes are done gradually within the duration of the campaign it does not affect the overall time for the update of the flood models.

– After the end of a Campaign there are on average 2.000 new images. The majority of these images are queued at SCENT Collaborate waiting manual annotation from users. On average an image goes through the Collaborate 5 times, each time takes the user 5 to 10 seconds to validate the existing annotations and/or add new ones based on his level of expertise.

– A user spends an average of 2 minutes 33 secs in the Collaborate website, annotating around 13 images. There are 834 average monthly visits. For the 2000 images at most 4 days are needed.

– After that the process of the Map Segmentation is initiated. For the map segmentation tool, 2 hours for training and 12hours/100km^2 for segmentation are needed (see KPI #13).

– Then the update of the flood models is initiated. For this, an average time of 28 hours needed. In particular, considering the amount of data and process implemented in the project, 15 hours are needed for the Kifisos model and 40 hours for the Danube Delta model. Further details regarding the calculation are presented in Appendix A1.

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– Overall, from the end of a campaign till the new maps are available 5,5 – 9 days are needed.

7 Cost Benefit Analysis

Cost-benefit Analysis is an analytical tool used to evaluate an investment decision in order to decide the effects it will eradicate and, thus, the contribution to the objectives of EU cohesion policy. The purpose of the CBA is to facilitate a more efficient allocation of resources, demonstrating the effect on the company for a certain intervention, compared to other alternatives (Guide to Cost-Benefit Analysis of Investment Projects Economic appraisal tool for Cohesion Policy 2014-2020 - December 2014).

In practice, CBA is used to obtain clear answers to a series of questions such as:

- is the project timely (through its realization more benefits will be obtained than the costs)?

- which of the possibilities of realization is the most financially efficient?

- is the project beneficial to society?

- does the project require public money support?

Therefore, Cost-Benefit Analysis is a complex tool for evaluating all available project information and providing answers to the above and other questions, being useful to decision makers in substantiating the execution or waiver of an investment project.

7.1 KPIs analysis

A cost-benefit analysis made for a public project, involves taking into account all the costs and benefits that result from its implementation. In order to achieve this, it is necessary that the values of costs and benefits generated by the respective project must be expressed in monetary units. The expression in monetary terms can be simplified by determining the changes generated by the project in the surplus of the consumer or the producer, as well as its effect on the budgetary revenues. Knowing the changes in these values provides appropriate sizes for measuring the benefits and costs of a project. Since these values are expressed in monetary terms, they can be summed.

Cost-benefit analysis of the SCENT toolbox, with KPIs demonstrating SCENT measurable impact in the environmental monitoring and assessment of flood risks can be done by transforming the defined KPIs into Key Success Indicators (KSI). The most applicable KPIs selected for this process are described as follows:

1. ***Number of participants in the pilot campaigns (KPI #1)***: It can be economical interpreted by calculating the difference between using volunteers instead of Institutional Personnel (IP), taking in account the accommodation and food expenses, transportation, and salary paid for each kind of participant.

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Participant type/ Expenses	Volunteer	IP
Accommodation	25	25
Food expenses	10	10
Transportation	15	15
Training	10	0
Salary	0	35X 8 HOURS
Total cost in Euro	60	330

As seen in the table above, the difference is of 270 euro/participant, resulting in a benefit in the context of data collection campaigns. Furthermore, calculated for each Pilot area and each case number of participants, the amount saved by using volunteers is provided below.

Pilot Name	Number of participants	Amount saved per participant	Total amount saved (€)
Danube Delta	193	270	52.110
Kifisos	511	270	137.970
Total amount saved (€)			190.080

2. ***Area covered by the pilot campaigns (KPI #2):*** In the initial Voronoi Diagram of monitoring Geographical Points in Danube Delta pilot area the distance between Points of Interest (PoI) was 15 km, whilst the average distance between PoI in SCENT is 1.25km, and thus resulting in 12 times more volume of data, generating more accurate information that is also considered a benefit.

   If it is calculated the difference of using Institutional Personnel versus volunteers for assessing 90 PoIs, taking in account the price per day and considering the average number of 30 participants per campaign the following amount is saved as presented below.

Participant type	IP	Volunteers
Cost/day	330	60
Number of participants	30	30
Number of PoIs Danube Delta	90	90
Total cost (€)	891.000	162.000
Amount saved (€)		729.000

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3. ***Number of Twitter, Facebook or other social media followers (KPI #4):*** Of course, the number of followers on Facebook, Twitter and other social media can be counted, but another great benefit is that these dissemination methods are free resulting in minimal cost of using this tool while facilitating the participation of volunteers.
   The cost of organising a Dissemination Conference is around 3000€ and the cost of posting on social networks is zero resulting in total profit by using the second dissemination method.

4. ***Number of players of SCENT serious games (KPI #6):*** Cost of educating through the classic way will be much higher than the learning by ''Playing'', and also another benefit is that by enabling information collection through a game, the final user is more engaged and more attracted to the issues raised.

Learning method	Classic method	Learning by playing
Cost per hour (€)	20	0
Number of hours	20	0
Total cost (€)	400	0
Amount saved/user (€)		400

5. ***Number of images sourced during the pilot campaigns annotated through the SIE (KPI #9):*** Total number of images is 18988, resulted from both the Kifisos pilot (3844) and Danube pilot (15144) campaigns. This KPI can be financially analysed by taking in account the fact that the classic (manual) method for photointerpretation costs approximately 35 euro/hour, while the Scent Intelligent Engine (SIE) does the photointerpretation online automatically, resulting in a direct benefit.

   If we take in consideration only the number of images annotated during the pilot campaigns, we get the following direct cost saving.

Type of photointerpreter	SIE	Manual Method
Price /hour (€)	35[3]	35
Number of images interpreted /hour	720	30
Total number of images	18.988	18.988
Total cost (€)	923	22.153
Difference (€)		21.230

6. ***Update rate of improved LC/LU maps (with crowd-sourced data) for the pilot regions (KPI #13):*** The demands of the companies have evolved, from the need for LU / LC information to the spatial analysis of data, respectively image segmentation - which is a computer vision task in which we label specific regions of an image according to what's being shown and has the

[3] As part of this analysis, and in the context of this scenario, the same cost applied for institutional personnel is assumed for SIE too.

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goal to predict class labels for each pixel in the image - a process of optimization of the classic photointerpretation process.

The benefits of these solutions are directly related to the need to increase the cost-effectiveness of the expensive and demanding photointerpretation process, such:

- Reflecting in price all the costs of photointerpretation
- Optimization of the load of computers / processors and their use to the maximum load capacity
- Establishing an optimal algorithm for automatic interpretation through computer-learning process,
- -Monitoring of the determined segments in order to check if they comply with the proposed photointerpretation.

If we take into account photointerpretation, the average cost per km^2 was of 3 euros in other projects (i.e. Corine LC/LU Project that had as main activity the assessment and photointerpretation of the Land Cover). The update rate also of such project is scarce, conducted on a 6-years basis. Thus, being able to produce such maps at a higher spatial and temporal resolution, would result to a crucial benefit. The analysis between the map segmentation performed in SCENT and the classic method is provided in the following table.

Type of photointerpretation	Map segmentation	Classic Method
Price /hour (€)	35[4]	35
Number of hectares / hour	835	38,5
Total number of hectares	292.400	292.400
Total cost	12.256	265.818
Difference (€)		253.562

7.1.1 Overview of results

KPIs are usually quantitative and are measurable, they are, by definition, dependent on certain data with which they are compared for performance analysis.

The defined KPI's from Table 1 can be transformed and measured according to Cost Benefit Analysis as follow:

[4] As part of this analysis, and in the context of this scenario, the same cost applied for the classic method is assumed for map segmentation too.

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Defined KSI	Importance	Measurement	Result
Cost of using volunteer's vs Cost of using IP (Institutional Personnel)	1	Difference of cost **x** Number of participants	190.080 € saved
Voronoi Diagram of monitoring points	1	Cost of using volunteers vs Cost of using IP (Institutional Personnel)	729.000 € saved
The cost of presenting information, dissemination	3	Cost of presenting the information on Social Media VS presenting the information on a Dissemination Conference	3000 €
Cost of learning by playing	2	Cost of learning by playing vs cost of educating trough the classic way	400 € saved/user
IP cost VS SIE cost	2	Direct saved amount by using SIE	23.123 €
Update rate of improved LC/LU maps (with crowd-sourced data) for the pilot regions	2	Difference generated between the map segmentation and classical method the production of LC/LU map	253.562€

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8 Conclusions

The results presented above emphasize the important role of SCENT toolbox in the context of flood risk management.

The Cost-Benefit Analysis highlighted through the analyses of KPIs and by transforming them into KSI a series of advantages from which the most money saving was the use of volunteers in the field campaigns instead of institutional personnel.

The hydrological and hydrodynamic models were improved through the use of the SCENT toolbox, greatly through the elevation model using the drone data and by the acquisition of crowdsourced river data (water depths and velocities) that is comparable to traditional data. The overall model validation was limited, due to the event-based nature of the hydrological model and the limited paired traditional and crowdsourced datasets acquired. For that, the valuable dataset of telemetric water level data obtained through SCENT, together with the updated detailed land cover map, should be leveraged to build an improved model, a continuous and distributed hydrological model.

The end user evaluation trough the online questionnaire showed that almost 90% of the responders consider SCENT toolbox to be an appropriate solution for flood management and monitoring, a system easy to use and intuitive that can be adapted to monitor the environment in other contexts, showing a high degree of adaptability.

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Appendices

A 1: KPIs calculation sheet

No	Description / Calculation of KPI
1	Number of participants in the pilot campaigns
	• A total number of 704 participants (counting 510 unique participants) joined the citizen science campaigns of the project organised in both pilot areas
2	Area covered by the pilot campaigns
	• For the Kifisos pilot area, the points of interest where the field campaigns took place were spread in a total area of 62.8 km^2. • For the Danube Delta pilot area, the points of interest where the field campaigns took place were spread in a total area of 292.4 km^2. It should be noted that the campaigns took place in a quite remote area and the field activities were conducted through the use of boats.
3	Clarity of guidelines before and during the pilot campaigns
	• In Kifisos, a training workshop was conducted in the beginning of each campaign day, while in Danube Delta, it was conducted once in the beginning of each campaign. This training session was organised aiming to introduce the SCENT project to the participants as well as to explain the scope of the campaign, aspects regarding the utilisation of the data to be collected and guide the volunteers in using the SCENT applications • The clarity of the guidelines can be indirectly elicited from the feedback gathered by the participants regarding the campaign and application experience (deliverables D7.2 & D7.3). In particular, in Kifisos 25% of the volunteers stated that they appreciated the most the ease of use in the data collection process while 76% considered it as an interesting experience. In Danube Delta 52% acknowledged the ease in the data collection activity among other aspects of the process. • In addition, the end user evaluation through the online questionnaire that was conducted in the context of this analysis, showed that almost 90% of the responders consider SCENT toolbox to be an appropriate solution for flood management and monitoring, a system easy to use and intuitive that can be adapted to monitor the environment in other contexts, showing a high degree of adaptability.
4	Number of Twitter, Facebook or other social media followers
	• Twitter followers: 1832 • Facebook followers: 250 • Instagram followers: 260 • LinkedIn connections: 98
5	Unique SCENT website visits
	• Unique website users: 7,900 • Website sessions: 13,000+
6	Number of players of SCENT serious games
	• The total number of 1746 users have contributed to the project goals via the use of both SCENT Explore, Measure and Collaborate applications
7	Number of returning players of SCENT serious games
	• During the pilot campaigns, the number of returning players amounts to 481 for SCENT Explore (users participating in different campaigns or campaign days) and 673 for SCENT Collaborate (users participating in different time sessions)
8	Overall satisfaction in SCENT serious games

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	• Based on feedback from the campaigns participants, the applications were continuously being improved and thus resulting in a high overall satisfaction level, particularly in the last campaigns in each pilot area. For instance, in Danube Delta, 71.42% of the participants of all campaigns stated that they couldn't find a least likeable characteristic in the applications while in Kifisos 47% of the volunteers didn't specify such a characteristic as well. • Last but not least, as part of the online survey that was conducted in this analysis more than 85% of the participants expressed their overall satisfaction regarding the SCENT toolbox.
9	Number of images sourced during the pilot campaigns annotated through the SIE
	• 18988 images of LC/LU elements and water level information, collected during the pilot campaigns, have been annotated by SIE.
10	Number of images sourced during the pilot campaigns annotated manually (by gamers)
	• 18988 images of LC/LU elements and water level information have been collected and annotated by the volunteers in the campaigns of both pilot areas.
11	Number of open platforms/repositories images annotated through the SIE
	• 10 images collected from Flickr platform (https://www.flickr.com/) at points of interest of the field campaigns
12	Number of open platform/repositories images annotated manually (by gamers)
	• 10 images collected from Flickr platform (https://www.flickr.com/) at points of interest of the field campaigns
13	Update rate of improved LC/LU maps (with crowd-sourced data) for the pilot regions
	• The pre-processing and training of the DNN requires up to 2 hours. Further to this, based on the process adopted the segmentation time of the Danube Delta and Kifisos satellite maps amounts approximately to 80 and 20 hours respectively. Since the segmentation time is related to the map size, it can be estimated that approximately 12hours/100km2 are required. Thus, a total update rate amount to 2 hours for training + 12hours/100km2 for segmentation. • For the abovementioned calculation the following infrastructure characteristics are considered: ○ GPU: GeForce-RTX-2080-Ti-DUKE-11G-OC (with CUDA 9.5) ○ 32 GB RAM
14	Average time from crowd-sourced data submission (eg image, text) to updated flood risk / flood pattern maps generation
	In terms of the average time needed from crowd-sourced data submission (eg image, text) to updated flood risk / flood pattern maps generation (KPI #14) the following calculation is presented according to the involved steps: – Images collected by volunteers are processed by SIE and/or the Water Level Measurement Tool as needed. Next each image goes through the Data Quality module at the CROWD BE. This process lasts approximately 5-6 seconds per image. As this process is done gradually within the duration of the campaign it does not affect the overall time for the update of the flood models. – After the end of a Campaign there are on average 2.000 new images. The majority of these images are queued at SCENT Collaborate waiting manual annotation from users.

On average an image goes through the Collaborate 5 times, each time takes the user 5 to 10 seconds to validate the existing annotations and/or add new ones based on his level of expertise.

– A user spends an average of 2 minutes 33 secs in the Collaborate website, annotating around 13 images. There are 834 average monthly visits. For the 2000 images at most 4 days are needed.

– After that the process of the Map Segmentation is initiated. For the map segmentation tool, 2 hours for training and 12hours/100km^2 for segmentation are needed (KPI #13).

– For the flood modelling, the following steps are involved according to the needed data:

- For Land cover
  - Retrieval – Download Scent map from Harmonisation platform
- For all crowdsourced data
  - Model preparation – setting boundary conditions (rainfall and flow) and preparing land cover map
  - Model run
- For water depth/velocity
  - Retrieval - Download image/video metadata and images/videos using API
  - Data quality - Evaluate the quality of images/videos, remove invalid ones and extract water depths
  - Fine-tunning – remove inaccuracies, cluster the data and calculate average values
  - Model validation – comparisons and indicator calculation

The time needed is described in Table 3. This is based on processing made on a HP Zbook 15 G3.

Table 3: Time estimations to use crowdsourced data for flood modelling

	Land Cover	Water depth	Water velocity
Retrieval	Danube Delta: ~4 min Kifisos: ~40 s	1 min preparation + ~0.13s per image	1 min preparation + ~1.9s per video
Data quality	NA*	40s/image**	2 min/video***
Fine-tunning	NA	1-5 min/PoI (#DD3: 52 PoIs, ~ 4 hours) (All Kifisos campaigns: ~ 2 hours)	
Model validation	NA	5 min/PoI + ~8 hours pre-processing/post-processing	
Model preparation	Per campaign in Danube Delta: ~2 hours Per campaign in Kifisos: ~2 hours		
Model run	Per campaign in Danube Delta: ~6 hours (restart + simulation) Per campaign in Kifisos: ~ 15 min		

*NA: Not applicable

**approximately 400 and 150 water depth images are considered for Danube Delta & Kifisos pilot respectively

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	***approximately 600 and 180 videos are considered for Danube Delta and Kifisos pilot respectively – Overall, from the end of a campaign till the new maps are available 5,5 – 9 days are needed.

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A 2: USER EXPERIENCE AND USABILITY - SURVEY QUESTIONNAIRE

Part A. Socio-demographic characteristics	
Date of birthday	…..
Gender	□male □female
In which country do you live?	□ Romania □ Greece □ Other
Highest education level	□ Secondary Education □ Higher Education (University, College etc) □ Master's Degree □ PhD
Profession	□ Public sector □ Private sector □ Other ___________________________

Part B. General perception of SCENT TOOLBOX	
Q1. Have you ever heard before about SCENT TOOLBOX system (**before this questionnaire**)?	□ yes □ no
Q2. Have you ever tried a SCENT TOOLBOX system (**before this questionnaire**)?	□ yes □ no
Q3. Have you ever been part of a SCENT field pilot activities either in Danube Delta or Kifisos?	□ yes □ no
Q4. How would you rate your knowledge about SCENT TOOLBOX?	□ very poor □ poor □ fair □ good □ very good
Q5. Which SCENT Toolbox component(s) have you utilised and/or engaged with?	□ Scent Campaign Manager □ Scent Collaborate □ Scent Explore □ Scent Measure
Q6. How much satisfied were you from using the SCENT TOOLBOX components?	□ very dissatisfied □ somewhat dissatisfied □ neutral □ somewhat satisfied □ very satisfied
Q7. How would you rate your awareness about floods?	□ not at all important □ not important □ almost important □ quite important □ I do not know
Q8. In your opinion, can the SCENT TOOLBOX be an appropriate solution for flood management and monitoring?	□ strongly disagree □ disagree □ agree □ strongly agree □ I do not know
Q9. In your opinion, could citizen observatories and relevant collaborative solutions constitute an appropriate solution against flood risk?	□ strongly disagree □ disagree □ agree □ strongly agree □ I do not know

Part C. Perception of the tested system	
Q10. Does this technology threats your privacy wishes regarding data management?	□ not at all intrusive □ not intrusive □ intrusive □ quite intrusive

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	□ I do not know
Q11. When you started interacting with the SCENT TOOLBOX, did you want to continue working with it?	□ yes □ no
Q12. Which features of the SCENT TOOLBOX applications did you like the most?	Please specify: ……………………………………………. …………………………………………………………………….
Q13. Were you disturbed while using this system?	□ not at all disturbed □ not disturbed □ disturbed □ quite disturbed □ I do not know If yes, why? ___________________________
Q14. Is it easy to use this system?	□ not at all easy □ not easy □ easy □ quite easy □ I do not know
Q15. Do you find the risk awareness input fast?	□ not at all fast □ not fast □ quite fast □ fast □ I do not know
Q16. How would you evaluate the quality of the data collected via the system?	□ very poor □ poor □ fair □ good □ very good □ I do not know
Q17. In your opinion, can the system be generalised and adopted in different contexts of environmental monitoring?	□ strongly disagree □ disagree □ agree strongly □ agree □ I do not know
Q18. How likely it is to use SCENT toolbox components in the future?	□ strongly disagree □ disagree □ agree strongly □ agree □ I do not know
Q19. If you are likely to use this system in the future, what would be the intended scope/use?	□ flood monitoring □ testing □ environmental data collection □ other, please specify: …………………………………
Q19. Would trust the outputs of the toolbox components in the context of your operations?	□ no at all □ not really □ rather □ yes □ I do not know
Q20. What is your general appreciation of this SCENT system?	□ not at all satisfied □ not satisfied □ satisfied □ quite satisfied □ I do not know

Part D. Comments	
Your opinion is very important to us and therefore any comment is welcome.	____________________ ____________________ ____________________ ____________________

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