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CAPTOR

# Collective Awareness Platform for Tropospheric Ozone Pollution

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**Authors:**
Teresa Schäfer, Barbara Kieslinger (ZSI)

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# List of Abbreviations

| | |
|---|---|
| API | Application Programming Interface |
| CAPs | Collective Awareness Platforms |
| HTML | HyperText Markup Language |
| HTTP | HyperText Transport Protocol |
| ICT | Information and Communicaiton Technology |
| IPR | Intellectual Property Rights |
| URL | Uniform Resource Locator |
| DoA | Description of Action |
| WP | Workpackage |

# Executive Summary


## *Description of the work*

This deliverable describes CAPTOR's approach towards evaluation and impact assessment. It departs from the project objectives and presents a methodology of how the project is evaluating its process and outcomes contributing to the achievement of these objectives. An integrated matrix aligns the project objectives with specific evaluation questions, instruments for data gathering and impact indicators.

The presented approach towards evaluation and impact assessment is based on a literature review and theoretical assessment of how citizen science projects are currently evaluated. Given the heterogeneity of citizen science projects and the divers objectives from the more science-driven projects to the community-driven projects, there is no single recipe for evaluation. For CAPTOR we put a special emphasis on assessing its socio-ecological impact and its contribution to raising collective awareness on air pollution.

Next to the overall evaluation and impact assessment strategy this deliverable includes a detailed description of the individual evaluation instruments together with a timeline to indicate the data collection phases in the three test beds, running in Spain, Austria and Italy. Potential risks and how these can be mitigated are likewise addressed.

Finally, with this work we want to make a contribution to advancing evaluation approaches in citizen science. The authors have developed an initial evaluation framework that claims to be applicable in different settings to different types of citizen science projects. By applying this framework in the context of CAPTOR we will feed back important findings from a practical perspective to the fine tuning of this very timely evaluation framework.

## *Objectives*

The main objectives of this deliverable are:

- To develop an overall evaluation and impact assessment strategy and corresponding indicators based on project objectives
- To demonstrate how to indicate possible gaps between expected and achieved outcomes
- To present evaluation instruments and how to apply these in the context of the three CAPTOR test beds

# 1. Introduction

The main objectives of WP5 are to monitor the performance of the project, evaluate the expected outcomes and assess its potential impact. With this aim, data needs to be gathered that can bring evidence to verify or falsify a set of monitoring criteria and impact metrics that have been developed in the initial stage of CAPTOR. For the appropriate data collection a set of quantitative and qualitative data collection instruments have been elaborated which will help to evaluate the project's performance at different time-points of the project.

For the purpose of this deliverable and generally the work in WP5 we clearly distinguish between evaluation and impact assessment. Our evaluation activities look at the actual development and implementation of the project. They include formative and summative aspects and are useful in determining whether certain activities should be continued, refined or determined and replaced with other activities. Impact assessment looks at the longer-term, deeper changes that have resulted from the project, including e.g. change in behaviour of the participants or political agenda changes. While these aspects can often be measured only after the project end, we try to find evidence that indicates such changes to take place. In other words, evaluation data will help us to identify the strengths and weaknesses of the CAPTOR approach according to the initial goal set up by the project and to assess the potential impact of the project.

First, WP5 will evaluate the CAPTOR approach, assessing the developed tools and dissemination activities, which target the divers stakeholders of the project. The aim of these activities is to continually improve the CAPTOR approach and to collect lessons learned on how to successfully reach and motivate the broader public as well as scientific institutions to get involved in environmental awareness raising projects.

Second, WP5 will investigate the impact that comes from the involvement of the broader public in tropospheric ozone measurement, awareness raising and solution finding. The main questions to be answered are: How did this contribute to the creation of valuable scientific results? And which socio-ecologic impact did it have?

With these objectives in mind, it was necessary to develop a set of quantitative and qualitative monitoring criteria and impact metrics, which will help to monitor and understand in how far the aims of the project are reached. The work on these metrics is grounded on existing work related to impact measurement of Collective Awareness Platforms and citizen science projects.

# 2. State-of-the Art

Currently there are no commonly established indicators to evaluate Citizen science and individual projects struggle to define the most appropriate road towards collecting evidence of their impact. Articles concentrating on the methodology of Citizen Science and the validation of it's outcomes are still few in number (Follett & Strezov, 2015). While some experts tend to focus on the learning gains at the level of individual participants (e.g. Phillips et al., 2014) others concentrate evaluation on their scientific gains and socio-ecological relevance (Bonney et al., 2014; Jordan Ballard und Phillips, 2012).

There are initiatives to provide recommendations on how to evaluate Citizen Science, such as the guidelines offered by the Cornell Lab of Ornithology. In their users' guide the authors give very detailed assistance on how to evaluate learning outcomes from Citizen Science projects, focusing on individual learning outcomes, from personal knowledge gain, to personal development and changes in behaviour (Phillips et al. 2014). Learning occurs across the various project types (z.B. Holocher

& Kieslinger 2014, Wiggins & Crowston 2015, Ziegler & Pettibone 2015) and can be seen as a common denominator for Citizen Science, justifying the focus of evaluation on learning outcomes.

The evaluation criteria suggested by Phillips et al. (2014) to assess individual learning outcomes include any gains in scientific knowledge or skills as well as wider personal impact on a person's behavioural change, their interests in science, motivation and self-efficacy to participate in science. Aspects addressed under the heading of behavioural change, such as taking stewardship and civic action, which all point towards social implications, are also covered by other authors (Crall, 2011). Experts recommend not applying all criteria equally in a single project, but rather defining learning goals and expecting learning outcomes at the beginning and defining an appropriate evaluation strategy, aligning measurable indicators. (Jordan et al. 2012; Phillips et al. 2014). Learning outcomes should be aligned to the different target groups and their pre-existing knowledge and skills or else project evaluation runs the risk of not being able to properly assess the learning gains of individuals and document genuine impact (Skrip 2015).

Evaluation methods centred around demonstrating potential impact on the individual participating citizens are common (e.g. Brossard et al. 2005, Randi Korn 2010). Data tends to be collected via surveys, interviews and the analysis of personal communication with the participants (Gommerman and Monroe, 2012). Phillips et al. (2014) give very practical advice and templates for assessing individual learning outcomes.

Although personal development of the amateur scientists is an important aspect of any Citizen Science projects, evaluation approaches concentrating exclusively on personal learning outcomes can be regarded too narrow and miss out other important aspects of Citizen Science, such as the wider societal or scientific impact. Shirk et al. (2012) recommend a more holistic approach to project evaluation, considering the impact on the scientific knowledge gain, the individual development as well as broader socio-ecological impact and thus consider societal, ecological, economical and political influence factors during the evaluation process.

In a similar vein, Jordan et al. (2012) promote evaluation that goes beyond learning outcomes and suggest looking also into programmatic and community level outcomes. Their suggestions for a more comprehensive approach to evaluation stress the potential impact of Citizen Science on social capital, community capacity, economic impact and trust between scientists, managers and the public. According to the authors an evaluation on the three levels – individual, program and community - may ultimately contribute to socio-ecological system resilience. Wright (2011) emphasises the role of evaluation in adaptive project management. Continuously sharing experiences and lessons learned across the various stakeholders supports the social learning process and contributes to an iterative improvement of Citizen Science projects and programmes.

Evaluation approaches applied in science communication activities (e.g. Skrip 2015) also reveal relevant aspects for evaluating participatory processes. Special attention should be paid to the clear definition of the selected target groups, bi-directional communication and the transfer of responsibility and ownership. Skrip also suggest an iterative evaluation during the course of the project complementing adaptive project management in order to allow for flexibility and the possibility to counteract an undesirable project development.

Despite these individual efforts, experts seem to agree that Citizen Science projects are lacking in evaluation and sharing experiences. Comprehensive evaluation frameworks that would allow for comparability across projects and programme are missing (Bonney et al. 2009, Bonney et al. 2014). Jordan et al. (2015) critically mention a lack of criteria and methods to assess the democratisation of science and its benefits for society, making it difficult to show the direct and indirect impact of Citizen Science on society and the environment.

Danielsen at al. (2014) even suggest to link citizen science to the collection and monitoring of indicators of International Environmental Agreements. This would not only increase understanding and awareness amongst citizens for the indicators, but also link the indicators to the concrete knowledge of citizens on how to improve the situation and take realistic measures.

While this state-of-the-art analysis reveals that there is no single road to take when evaluating citizen science, we find useful elements in various of the approaches that can be adopted to the needs of CAPTOR. The project focuses on social and political change in relation to an environmental problem. The evaluation matrix elaborated in the next chapter is thus considering specifically aspects related to socio-ecological impact and the individual outcomes related to learning and behavioural change. As changes of lifestyle are also part of an individual learning process and we will thus combine elements of evaluation looking at different outcomes and impacts as the following section will show.

# 3. Evaluation Matrix

## *3.1. CAPTOR objectives guiding evaluation*

As described in the introduction, CAPTOR evaluation is foremost driven by the defined objectives that we aim to reach and also wish to better understand why we reach them or where are the problems on our way to reaching them.

To gain an integrated view on the complexity of the evaluation and impact assessment approach, we elaborated a table overview (Table 1) of the objectives as defined in the Description of Action (DoA), main questions to be answered by evaluation, involved target groups for evaluation, evaluation instruments and exemplary metrics or indicators in the following table.

## *3.2. Bringing evidence for impact*

Table 1 & 2 also integrate impact indicators and from which evaluation metrics such indications can be derived. CAPTOR's impact indicators on different levels have been originally fed by indicators developed by the iA4Si project[1].

To bring evidence for the project's impact and to understand the why and how behind it, we will use a mix of quantitative and qualitative evaluation instruments as indicated in the Table 1 & 2 (e.g. usage data from the system, questionnaires, interviews, workshops, polls, etc.). These will be implemented from the very beginning of any activity, starting with citizen engagement activities and awareness measures.

It should also be mentioned that evidence collection will be adjusted to the activities in the 3 countries and varies according to the specific test-bed activities.

[1] Impact Assessment for Social Innovation, http://ia4si.eu

**Table 1: Overview of objectives, research questions, stakeholders, evaluation instruments, outputs and impact (Objective 1-4)**

| Questions | Involved stakeholders | Evaluation instrument | Exemplary evaluation metrics | Impact indicators |
|---|---|---|---|---|
| **Objective 1:** Demonstrate the effectiveness of the CAPTOR approach of participatory innovation to raise awareness for the air pollution problem. | | | | |
| • What are the perceived benefits from the CAPTOR approach in terms of awareness raising for air pollution problems?<br>• What are barriers to the CAPTOR approach towards awareness raising?<br>• What are means to overcome these barriers?<br>• Did CAPTOR leverage collective intelligence of local communities? | • Individual citizens involved in CAPTOR<br>• Civil society organizations and local communities involved in CAPTOR<br>• Print and social media<br>• Involved scientists | • Questionnaires for participants<br>• Interviews with participants, representatives from civil society organisations and the local community<br>• Street event evaluation instrument<br>• Internal statistics and documentation regarding dissemination activities | • Individual learning, higher sensitivity and behavioural change<br>• Local empowerment and increasing of capacity<br>• New solutions found, ideas discussed<br>• Number of stakeholders actively involved in learning and innovating<br>• Presence in mass and social media.<br>• *Publications about the influence on awareness, knowledge and behavioural changes,* best practice from the CAPTOR approach.<br>• Numbers from social and print media | • Increased knowledge on how to involve citizens on different engagement levels in environmental issues and its influence on awareness, knowledge and behavioural changes (scientific impact)<br>• Participants' increased sensitivity towards ozone pollution and origins of pollution (environmental impact)<br>• Wider public awareness on tropospheric ozone pollution (environmental impact)<br>• Changed life styles to prevent air pollution (environmental impact, social impact)<br>• Citizens' awareness, sense of ownership and responsibility for the air quality in their communities (social impact) |
| **Objective 2:** Involve various sectors of society in collaborative networks to address air pollution from a socio-economic, technical and political perspective and create a sustainable community that collaboratively elaborates sustainable solutions. | | | | |
| • How can we successfully create a sustainable community of all stakeholders relevant to the air pollution problem? Which communication means are successful and what not?<br>• How can the network | • Citizens<br>• Civil society organizations<br>• Farmers and agriculture unions<br>• Health associations<br>• Producers of air pollution | • Workshop evaluation questionnaires<br>• Internal reports<br>• Internal statistics and documentation regarding sustainability activities | • Nr. of local communities and NGOs deploying sensors and platforms;<br>• Number of bottom-up actions driven by local communities and citizens to fight air pollution<br>• Number of new stakeholder groups sustainably involved<br>• Number and quality of CAPTOR instantiations taken over by local communities | • Creation of local community networks related to air quality (economic impact)<br>• Implementation of a sustainable business model (economic impact)<br>• Crowd-funding activities and money attracted by these activities, willingness to pay or donate (economic impact)<br>• Reputation of the project (economic impact)<br>• Demonstrable cost savings thanks to user |

| | | | | |
|---|---|---|---|---|
| sustain after the end of the project?<br>• Did the project support the creation of sustainable solutions to the pollution problem? | • Political decision makers | | • *Increased knowledge and best practice on how to involve citizens on different engagement levels in environmental issues*<br>• Sustainability model developed, and validated; | engagement (economic impact)<br>• Number of collaborations and new business opportunities for partners (economic impact)<br>• Changes in attitudes of citizens with regards to air pollution (social impact) |
| **Objective 3:** To demonstrate that the bottom-up approach of CAPTOR could also be applied for other environmental problems such as water pollution, soiling of grounds, waste management etc. | | | | |
| • Prove that the practical local knowledge of people can be harnessed for change in other environmental areas | • Environmental grass roots and civil society organisations interested in CAPTOR<br>• CAPs innovators | • Workshop<br>• Internal statistics and documentation | • Number of projects on other environmental issues following CAPTOR approach<br>• Documentation of best practice and lessons learned on drivers and barriers for other application areas. | • Wider uptake of the approach to other environmental issues (environmental & social impact) |
| **Objective 4:** Demonstrate that the exploitation of the capabilities of open-hardware and software helps to effectively involve citizens in solving an environmental problem. | | | | |
| • Do citizens get involved with open soft- and hardware to address environmental problems?<br>• Which challenges does this approach face and how can they be overcome?<br>• In which roles do citizens engage with open soft- and hardware (consumer, producer, producer) | • Citizens involved in CAPTOR<br>• Civil society organizations<br>• Hackers and makers<br>• Technical and scientific institutions | • Interviews with selected stakeholders<br>• Internal monitoring statistics<br>• Survey | • New ICT tools developed and applied by local communities<br>• Number of people accessing and engaging with the ICT tools<br>• *Tool kit for the construction of low cost, high quality monitoring stations*<br>• *Implementation of Open Standards and Open Source*<br>• *Existence of API and access to API*<br>• Number of downloads of CAPTOR Open Source products<br>• Documentation about different activity levels of stakeholders and the design and usage of the tools by different stakeholders;<br>• Number of publications in technical and scientific forums | • Increased participation in environmental-related actions (environmental impact)<br>• Social acceptance of open hardware and software for solving environmental issues (social impact) |

**Table 2: Overview of objectives, research questions, stakeholders, evaluation instruments, outputs and impact (Objective 5-8)**

| Questions | Involved stakeholders | Evaluation instrument | Exemplary evaluation metrics | Impact indicators |
|---|---|---|---|---|
| **Objective 5:** Collect high-quality ozone data with low-cost sensors maintained by citizens | | | | |
| • Can low cost sensors collect high quality data on ozone pollution?<br>• What are the encountered problems and what are best practices that can be shared with related projects and initiatives? | • Related projects<br>• Technical and scientific institutions<br>• Citizens participating in CAPTOR<br>• Scientists and technical staff involved in CAPTOR | • Internal statistics and project documentation | • Documentation of high quality data collected from CAPTORS<br>• Public provision and usage of Open Data repositories<br>• Number of papers and communications to scientific (social, environment, and medical) forums.<br>• Number new studies about this pollutant based on CAPTOR data and work | • Availability and accessibility of open, high quality data on ozone pollution in the test bed areas (Scientific impact)<br>• Implementation of Open standards and open source (scientific impact) |
| **Objective 6:** To prove the effectiveness of the CAPOTR ICT tools. | | | | |
| • Did CAPTOR ICT tools support awareness raising, collective action, and the continuous collection of user-generated content from stakeholders in behaviour changes?<br>• What were the drivers and barriers ? | • CAPTOR tool users | • Usage statistics and data from the tools<br>• Interviews with CAPTOR tool users<br>• Internal monitoring statistics | • Number of downloads of CAPTOR open source products<br>• Numbers of solution found and actively discussed online<br>• Documentation of lessons learned on drivers and barriers for ICT supported community wide collaborative learning. | • Toolkit for the construction of low cost, high quality monitoring stations (scientific impact)<br>• Existence of API and access to API (Scientific impact)<br>• Usage of the collective knowledge platform and the mobile app (scientific impact)<br>• |
| **Objective 7:** Demonstrate that the CAPTOR approach also supports greater awareness amongst young citizens and their future civic engagement | | | | |
| • Can we support new approaches in science teaching and participatory democracy, where students actively | • Schools incl. students, teachers, parents<br>• Wider education community (e.g. educational research | • Focus group with involved teachers<br>• Questionnaires from students<br>• Internal monitoring statistics | • Number of activities in schools, universities and other educative centres,<br>• Numbers of students and teachers engaged in CAPTOR activities<br>• Measurable knowledge gain on air | • Increased knowledge on the origins of tropospheric ozone pollution and how to address them amongst the target groups (social impact)<br>• Increased number of (young) citizens being engaged with the involved civic- |

| | | | | |
|---|---|---|---|---|
| collaborate in science to understand scientific processes and take responsibility for their environment?<br>• What are the drivers and barriers from involving schools in CAPTOR activities? | community, educational policy makers, etc)<br>• society in general | | pollution and on scientific processes, increased interest, engagement behavioural change amongst target group (students, teachers)<br>• Documentation of best practice and lessons learned from the collaboration with schools | society organisations or other environmental organisations fighting tropospheric ozone pollution (social impact)<br>• Changes in the time spent by students/teachers in persuading friends, relatives and colleagues about the fighting against tropospheric ozone (social impact) |
| **Objective 8:** Empower citizens to trigger political actions for better air quality based on scientifically validated data. | | | | |
| • Can open data collections and citizen engagement exert political influence on air quality measures? | • Individual citizens involved in CAPTOR<br>• Civil society organizations and local communities involved in CAPTOR<br>• Local/national policy makers | • Interviews with selected stakeholders<br>• Collected evidence of policy briefs, petitions, etc.<br>• Internal statistics and documentation | • Number of people involved in actions related to air pollution, uptake in discussions and regulations of political decision makers<br>• Number of petitions brought forwards by local communities<br>• Number of policies/regulations/laws changed or updated by the project | • Development of the CAPTOR platform offering new channels for civic and political participation to collaborate with regards to ozone pollution (political impact)<br>• International, national and local meeting/conferences organised/attended for influencing policy makers (political impact)<br>• Increased capability of the involved participants to influence policies related to tropospheric ozone pollution (political impact) |

## 4. EVALUATION INSTRUMENTS

As described above a set of quantitative and qualitative evaluation instruments will help to answer the questions defined in chapter 3 and collect the defined impact metrics. These instruments aim to collect evidence from the manifold information sources we have in the project.

### *4.1. Pre-/post questionnaires distributed to CAPTOR volunteers*

These questionnaires deepen our understanding about motivators and drivers for participation in CAPTOR as well as the achieved impacts on individual participant's level, like knowledge increase, changed attitudes, increased ownership, motivation to further participate in actions related to air pollution etc. The pre/post-evaluation setting allows to track changes in individuals, between the beginning of a CAPTOR campaign and it's end. The main questions of this survey are:

***CAPTOR Hosts Pre-Questionnaires (distributed e.g. during the first training event)***

***Why are you interested to participate in CAPTOR?***

- *I want to help raising awareness for the Ozone Pollution in my region (0=not at all, 10=very much)*
- *I want to actively fight Ozone Pollution in my region.*
- *I want to learn more about Ozone Pollution and what to do against it*
- *I am attracted by the idea to be involved in a research project*
- *I want to help my local community*
- *Others are expecting from me to get involved*
- *I want to try it out of curiosity*
- *If you are driven by curiosity, what are you curious of? (open question)*
- Other (open question)

***Ozone Pollution and you …***

- *In general, how would you estimate your knowledge on Ozone Pollution and its origins? (0=very low, 10=very high)*
- *How would you estimate your knowledge on Ozone Pollution and ways to reduce it?*
- *Do you have the feeling that you can positively influence the air quality in your region?*
- *Do you think that you can influence policies and measures taken by public authorities that address Ozone Pollution? (0=not at all, 10=very much)*
- *Do you exchange with family and/or friends about the topic of polluted air?*
- *Are you personally taking measures to reduce Ozone Pollution? (No/Yes)*
- *If yes, could you tell us the most important one(s)? (open question)*

***About you (this will be treated in a completely anonymous way):***

- *What is your year of birth?*
- *Are you…(Female /Male)*

***Participant code (a unique code per parcitipant to compare pre/post questionnaires)***

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## *4.2. Workshop evaluation questionnaires*

This questionnaire collects formative feedback from participants, concerning for instance the provided information, and investigates the drivers and expectations of participants joining the workshop as well as individual outcomes from the participation. The main questions of this survey are:

***CAPTOR Workshop Evaluation questionnaire (distributed at the end of the workshop)***

***Information about CAPTOR***

- *I believe to understand the objectives of the CAPTOR project (0=not at all, 10= very much)*
- *The provided information was difficult to comprehend (0=not at all, 10= very much)*
- *I have a clear picture of how I could contribute to the CAPTOR project now? (0=not at all, 10= very much)*

***Ozone Pollution and you:***

- *In general, how would you estimate your knowledge on Ozone Pollution, its origins and ways to reduce it? (0=very low, 10= very high)*
- *Do you have the feeling that you can positively influence the air quality in your region? (0=not at all, 10=very much)*
- *Do you think that you can influence policies and measures taken by public authorities that address air quality in your region?*
- *Do you exchange with family and/or friends about the topic of polluted air?*
- *Are you personally taking measures to reduce Ozone Pollution? (No, Yes)*
- *If yes, could you tell us the most important one(s)? (open question)*

***Future engagement***

- *How much are you interested to participate in CAPTOR?*
- *Could you please explain your choice (open question)*
- *Would you recommend the participation in CAPTOR to family and friends? (yes, no)*
- *Please explain your choice (open question)*
- *Do you have any recommendations for future CAPTOR events? (open question)*

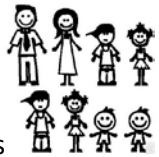
***About you:***

- *What is your year of birth?*
- *Are you… Female /Male*
- *Which of these descriptions best describes your situation? Are you currently...? (in education, in paid work (employee, self-employed, working for your family business), unemployed, permanently sick or disabled, retired, in community or military service, doing housework, looking after children or other persons, other )*

## *4.3. Street event evaluation*

This evaluation instrument aims to collect by-passers opinion on ozone pollution, make them visible and thus attract new by-passers to stop and provide their opinion.

**a. „Ozone concerns me“ - wall**

Passers can choose from a set of stickers  and put stickers on a wall to express their attitude, awareness, concern .

**B. Street event report**

**Ozone Pollution concerns me…?**

\+ + +  +/-  - - -

**Ozone Pollution in my region**

worries me not at all  worries me a lot

**Local levels of Ozone**

are well communicated  not transparent at all

**Origins and effects of Ozone Pollution**

are clear to me  are not clear at all

**I am aware of what I can do to reduce ozone pollution**

is very high  is very low

## *4.4. Street event report*

The street event report is a form that supports the organisers of street events to summarize the main outcomes and observations. It investigates aspects like “what attracted by-passers attention”, “which questions and opinions did they share with others around the topic of ozone pollution?”.

**Live event reporting/Observation template**

Event:

City, Country:
Date:
Organiser:

1. **Basic information**

| **Item** | ***2. Description*** *(to be filled in)* |
|---|---|
| Timeframe<br>(At what time of the day did the event take place? What were the attendance peak times) | |
| Location (e.g. room, public space) | |
| Participants, audience (number, gender, age, etc.) | |
| Basic format<br>(picnic, fair, theatre play…) | |
| Did you collaborate with any supporting institutions? Were your activities part of a bigger event? | |
| External invited special guests, experts etc. | |
| How did you promote the event? | |

2. **Activities**

| | |
|---|---|
| Which materials were used (including information) | |
| Core elements (e.g. information, evaluation wall, etc) | |

| | |
|---|---|
| experiences, obstacles on willingness of passers-by to be engaged (arguments why they would not) | |
| Main reactions of by-passers | |
| What worked best to invite people to stop? | |

2. **Reactions, Results**

| | |
|---|---|
| Involvement and areas/activities of interest of participants and audience | |
| Requests and questions Which topics are brought up by participants? | |
| Was change in opinion/attitude/knowledge observed or self-estimated by participants? | |
| Feedback gathered in terms of understandability, suggestions for improvement | |
| Observed barriers of dialogue (what prevented from participation or active involvement) | |

**2. Reflection and Documentation**

Self-assessment by organisers

| | *explanations* |
|---|---|
| Pros: what went well? | |
| Cons: what didn't work? What could be changed? | |

## *4.5. Guided interviews*

The interviews gain deeper insights into good and bad practice from the stakeholder communication

and involvement in CAPTOR. They involve a variety of CAPTOR target groups and aim to collect insights on drivers and barriers of our approach, the outcomes on individual, organisational and community levels regarding aspects like awareness raising, learning, solution finding, activation or ownership.

Guided interviews will be organised 1) on the one hand with representatives from the affected communities: citizens (hosts, observers or innovators), representatives from civil society organisations, official representatives (e.g. mayor, representatives from local public health authorities), representatives from pollutant industries. 2) On the other hand interviews will collect the lessons learned from those people involved in the implementation of the CAPTOR approach, like involved technicians, data analysts, organisers of hackathons, testbed hosts etc.

For the guided interviews the evaluation team will prepare interview guidelines, which help to answer the questions defined in chapter 3. Guided interviews permit the interviewer to keep the interview within in the parameters traced out by the evaluation objectives. Nevertheless this approach gives a certain flexibility and allows the interviewer to explore, probe and ask questions which might not be part of the question guidelines but deemed interesting for the project.

The interviews will be organised either via telephone or face-to-face by the project partners who are situated in the countries of the interviewees. After each interview protocols will be elaborated for the further analysis.

### *4.6. Focus group discussions with teachers*

A focus group will be organised with teachers who are involved in the CAPTOR project with their students to understand in how far the project activities and underlying theories about ozone pollution fit with existing school curricula, in how far the proposed project activities motivated students to engage with the topic and with science in general and which impact this engagement had on learning and attitudes. The focus group discussion will also examine in how far the CAPTOR approach is also valuable for other environmental issues discussed in the school text.

### *4.7. Usage statistics from website, local community sites and AirAct App*

In the website, the local community sites and the AirAct App logging is done and allows detecting the usage patterns of people interacting with our awareness raising platforms. It helps us to understand what are most relevant contents and functionalities to raise awareness for air pollution and support mutual learning of the stakeholders involved.
It will support our understanding about the efficiency of selected campaigning activities – e.g. in how far does a workshop result in higher interest in ozone pollution (e.g. information pages on formation, consequences, pollution), stimulate discussions in our online forum, or increase access to sensor data?
These data not only deliver input for the to understand which functions and topics were most relevant for participants but also how much participants got engaged in terms of time spent in the systems and active contributions made. They let us understand the importance of specific functions but also the different behaviours of participants: How much time do participants spend in our tools? Are they actively contributing with knowledge? Are they regularly reading contributions from their colleagues?

# 5. Data analysis

## *5.1. Analysis of quantitative data from questionnaires*

Analysis of Pre- and Post data from CAPTOR hosts: to compare pre- and post scores for the group of CAPTOR hosts group, we will use t-tests for dependent means or Wilcoxon tests to determine if there is a significant change in aspects like knowledge, motivation or ownership. For categorical dependent variables we will use McNemar's chi-square and Mantel-Haenszel-Methods. Correlations will be computed to determine whether there is a significant positive or negative relationship between the different indicators.

## *5.2. Analysis of focus groups and guided interviews*

For the analysis of the focus group discussions and interviews, the CAPTOR evaluation team will conduct qualitative content analysis of the protocols as proposed by Mayring (2000). The applied method is a technique of summarisation, whereby categories are created in an inductive procedure by reducing, paraphrasing and generalisation relevant text passages with a content analysing tool.

The analysis will be conducted in three steps (Mayring 2000): 1) Summarisation, 2) Explanation and 3) Structuring. At least two researchers will be involved in the analysis of every protocol. Only those codes and respective sub codes which all agreed upon will be introduced or retained. This method of co-analysis guarantees improvements of objectivity. The results do not depend on one specific person and are reproducible independently of the individual researcher. As anonymity is guaranteed to the participants, each person is given a unique code instead of revealing their names. The findings consist of a systematisation of the relevance of codes a generalisation and an interpretative framework.

## 6. Timeline

The timeline presented in Figure 1 shows the main activities and evaluation instruments during the upcoming campaign 2017, generalised for all three test beds in Austria, Italy and Spain. As it is a generalised view it does not mean that all awareness raising activities will be implemented in all three testbeds, but each testbed will specifically chose and adapt the most appropriate instruments for their campaigns. The objective of this overview is to show how the main campaigning activities link and are reflected in quantitative and qualitative evaluation activities involving different stakeholders.
A detailed plan of campaigning activities can be found in *D4.2 Engagement and empowerment report for citizen science* for each testbed. If and how evaluation instruments are adapted to these specific activities will be reflected in the upcoming D5.2. together with the presentation of the results from this evaluation.

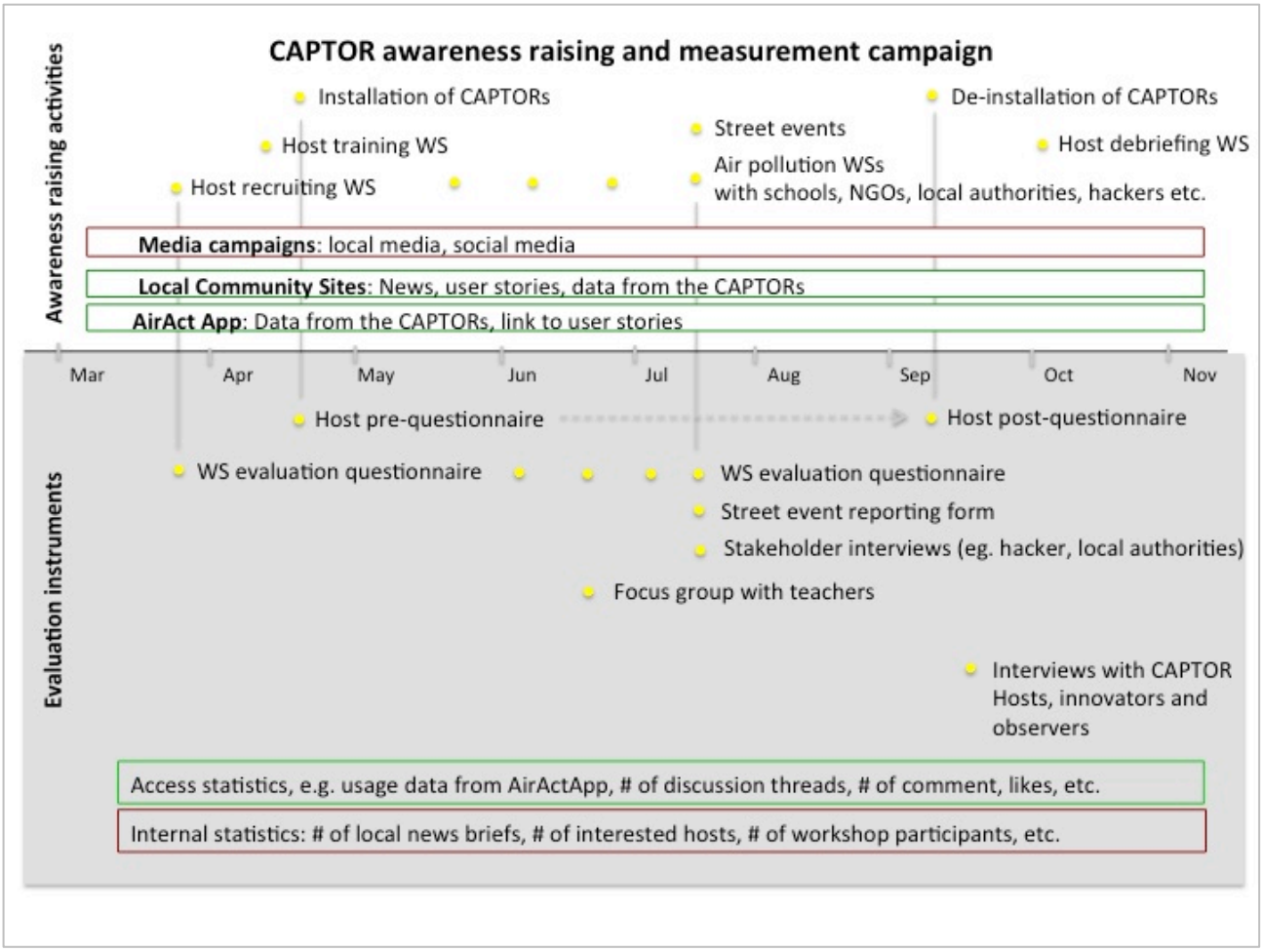



**Figure 1 Evaluation timeline along a CAPTOR Campaign**

## 7. Possible Risks

While risk monitoring is part of the continuous monitoring process performed by the project management there are also a few risks that should be mentioned in the context of evaluation and impact assessment. In the following we will discuss the main potential risks for evaluation identified so far and propose actions to be taken to cope with each specific risk.

**Number of participants**

**Risk:**

- We do not achieve the required number of volunteers to host our CAPTORs and miss to reach a critical numbers of participants who get involved in observing the data, discussing ozone pollution and suggesting ideas for measures to act against air pollution. Thus, the impact measurement would be limited to a small number of people and the impact as such would be smaller than expected.

**Action:**

- To address the risk of having lower number of participants we will carefully monitor the number of citizens who show interest in our project, let them sign in to a list of interested parties, and share good and bad experiences from the acquisition and communication process in the affected region amongst consortium partners. If we observe low interest in our project in some of the selected areas, we will elaborate additional incentives for participation, think about new target groups that might be attracted by our ideas and share all lessons learned within the consortium as well as in our reports.

**Technical problems**

**Risk:**

- The technological infrastructure does not work as expected: We develop technically complex systems and the usage of low cost sensor for the collection of high quality data is still a challenge. But the success of the volunteers' involvement depends on the proper quality of data and the proper set of functionalities, which need to be easily accessible and easy to use for people of all age groups who also show low affinity for technology.

**Action:**

- The CAPTOR consortium has foreseen a step-wise implementation and testing of its technical infrastructure. CAPTORs are only deployed amongst users in Spain in the first year, to collect experience with the calibration and functioning of the sensors in the field. From this experience lessons learned are derived and the consortium works as a whole to improve the infrastructure for a roll out in summer 2017. Volunteers will stay in close contact with project representatives from their countries in case there are problems that need to be solved together. A local service structure for the volunteers is established.

**Difficult fight against ozone after awareness raising**

**Risk:**

- CAPTORs aim is to increase the awareness for tropospheric ozone pollution and support the mutual learning and solution finding between the involved stakeholders. But the tropospheric

ozone is often formed from gaseous precursors in urban areas that are transported towards urban and suburban areas. CAPTOR wants to raise awareness of this fact and transfer this fact into a topic of political discussion, which needs strong political commitment and discussion across larger regions. If we cannot support this process the impact from the project might be smaller as expected.

**Action:**

- In CAPTOR we have three environmental organisations that provide of extensive experiences in leading discussions with political decision makers on local, regional and national level. These organisations will support and facilitate the local CAPTOR communities in their fight against ozone pollution, via official requests, complaints, meetings etc.

## 8. Ethical issues

In order to achieve the goals defined within the research task in WP5, the project partners of CAPTOR have to collect personal data from the participants, like interaction data on the platform, basic demographic data and responses to questionnaires as well as group discussions. This data is essential for validating the project's success criteria, so during the data collection the data protection issues involved with handling of personal data will be addressed by the following strategies:

Volunteers to be enrolled will be exhaustively informed, so that they are able to autonomously decide whether they consent to participate or not. In an informed consent (see Annex 1), the purposes of the research, the procedures, potential discomforts or benefits as well as the handling of their data (protection, save storage) will be explained. In order to make the CAPTOR research transparent, participants will have to sign the informed consent in Annex 1.

The data exploitation will be in line with the respective national data protection acts. Since data privacy is under threat when data are traced back to individuals – they may become identifiable and the data may be abused – we will anonymise all data.

The data gathered through logging, questionnaires, interviews and focus group discussions during this work package will be anonymised and therefore the data cannot be traced back to the individual. Data will be stored only in anonymous form so the identities of the participants will only be known by the partners involved and will not even be communicated to the whole consortium. Reports based on the interviews and focus groups discussions will be based on aggregated information and comprise anonymous quotations respectively. In this form data will also be provided for download in the data repositories of the CAPTOR website (for more details please see D1.2. Data management plan).

# 9. Outlook

The collection of data already started in 2016 in Spain and will be launched in the other two pilot sites in 2017, when all evaluation instruments will be applied in appropriate settings and formats. As the environmental organisations are the interface to the stakeholders in the local regions they will all assign a responsible person for the data collection process who closely works with the core evaluation team of WP5. The analysis of data will be organised centrally by the leader of WP 5 and results from all testbeds will be presented in aggregated and detailed view in the next deliverable D5.2. at the end of 2017.

Evaluation of citizen science projects is still not standardised and there are various approaches currently under experimentation that tend to focus on selected perspectives, such as the educational goals or the scientific dimensions of a project. Kieslinger, Schäfer, Fabian (2015) have developed a more holistic approach to evaluating citizen science projects that cover the scientific dimension as well as the citizen perspective and the wider socio-ecological implications (Table 3). The authors, who are WP5 leaders in CAPTOR, provide a detailed list of questions that can be applied as a self-assessment tool for projects to assess process and feasibility as well as outcome and impact.

| | **Process & Feasibility** | **Outcome & Impact** |
|---|---|---|
| **Scientific dimension** | Scientific objectives<br>Data & systems<br>Evaluation & adaptation<br>Cooperation & synergies | Scientific knowledge & publications<br>New research fields & structures<br>New knowledge resources |
| **Citizen scientist dimension** | Target group alignment<br>Degree of involvement<br>Facilitation & communication<br>Cooperation & synergies | Knowledge & attitudes<br>Behavior & ownership<br>Motivation & engagement |
| **Socio-ecological dimension** | Dissemination & communication<br>Target group alignment<br>Active involvement<br>Cooperation & synergies | Societal impact<br>Ecological impact<br>Wider innovation potential |

**Table 3: Dimensions and main categories of the citizen science evaluation framework**

For the analysis of the CAPTOR data the evaluation framework will serve as a starting point. In the following table (Table 4) the whole framework is presented in detail. The indicators are translated into questions to help operationlise the framework.

As argued in Kieslinger, Schäfer, Fabian (2015) projects should not strive to achieve all criteria equally. Some of the criteria in the framework may not necessarily foster each other and projects cannot easily fulfil all to the same degree. While a project might aspire social goals and succeed in creating societal impact it might not open new research fields or have little economic potential. Certain projects and initiatives will likely occupy different spaces across the range of criteria proposed and the framework can help projects to identify their strengths.

Thus, in Table 4 we are highlighting the areas that are most relevant for CAPTOR in green. These are the areas where we hope to fulfil the proposed criteria to a high degree These are for instance all criteria that we label on the citizen-scientist dimension, the impact on society and economy as well

as scientific issues related to openness and adaptive management.

**Table 4: Evaluation Criteria for Citizen Science projects**

| | Categories | Driving Questions |
|---|---|---|
| **Scientific dimension** | ***Process and Feasibility*** | |
| | **Scientific objectives** | |
| | Relevance of scientific problem | • Does the project adhere to the definition of citizen science? E.g. does it include citizens in the scientific process?<br>• Is the scientific objective generally apt for citizen science and why?<br>• Does the scientific objective show relevance for society and does it address a socially relevant problem?<br>• Are the scientific goals sufficiently clear and authentic?<br>• What are the scientific gains of the project and how are these defined? |
| | **Data and Systems** | |
| | Ethics, data protection, IPR | • Does the project have a data management plan, IPR strategy and ethical guidelines?<br>• Is the data handling process transparent? E.g. do citizens know what the data is used for, where the data is stored and shared?<br>• Are data ownership and access rights clear and transparent? How is the publication of data handled? |
| | Openness, standards, interfaces | • Does the project have open interfaces to connect to other systems and platforms?<br>• Is the generated data shared publicly and under which conditions, e.g. anonymized, metadata, ownership, consent, etc.? |
| | **Evaluation and adaptation** | |
| | Evaluation and validation of data | • Does the project have a sound evaluation concept, considering scientific as well as societal outcomes?<br>• Is evaluation planned at strategic points of the project?<br>• Does the validation of citizen science data match with the scientific question and the expertise in the project?<br>• Are indicators and evaluation methods defined? Are all stakeholders considered?<br>• What processes are defined to guarantee high data quality? |
| | Adaptation of process | • Does the project include a scoping phase?<br>• Does the project have an appropriate risk management plan?<br>• Are project structures adaptive and reactive?<br>• Does the project include feedback loops for adaptation? |
| | Cooperation and synergies | • Does the project cooperate with other initiatives at national or international level?<br>• Does the project link to experts from other disciplines?<br>• What are the plans for sustaining the collaboration between citizens and scientists?<br>• Does the project build on existing citizen science expertise in the specific field of research? |
| | ***Outcome and impact*** | |
| | **Scientific results** | |
| | Scientific knowledge and publications | • Does the project demonstrate an appropriate dissemination strategy?<br>• Are citizen scientists participating in publications or is their engagement recognized?<br>• Did the project contribute to adult education and life-long-learning? |
| | New fields of research and research structures | • Did the project generate new research questions, new projects or proposals?<br>• Did any cross-fertilization of projects take place?<br>• Did the project contribute to any institutional or structural changes? |

| | | |
|---|---|---|
| | New knowledge resources | • Does the project ease the access to traditional and local knowledge resources?<br>• Does the project foster new collaborations amongst societal actors and groups?<br>• Does the project contribute to a mutual understanding of science and society? |
| **Citizen scientist dimension** | ***Process and Feasibility*** | |
| | **Involvement and support** | |
| | Target group alignment | • Does the project have specific communication plans for target groups?<br>• What engagement strategies does the project have (e.g. gamification)?<br>• Are the options for participation and the degree of involvement diversified? |
| | Degree of intensity | • In which project phases are citizens involved?<br>• Are citizens and scientists equal partners in the knowledge generation process? |
| | Support, training, communication | • What kind of support and training measures are offered for different participant groups?<br>• How is the communication and collaboration between scientists and citizens organized? |
| | Access and interfaces | • Does the project involve civic society organizations?<br>• Are communication structures towards the target groups clear? |
| | ***Outcome and impact*** | |
| | **Individual development** | |
| | Knowledge, skills, competences | • What are the specific goals to be achieved by the participants?<br>• What are the learning outcomes for the individuals?<br>• Do individuals gain new knowledge, skills and competences?<br>• Does the project contribute to a better understanding of science? |
| | Attitudes and values | • Does the project influence the values and attitudes of participants regarding science? |
| | Behavior and ownership | • How much involvement and responsibility is offered to the participants?<br>• Does the project foster ownership amongst participants?<br>• Does the project contribute to personal change in behavior? |
| | Motivation and engagement | • Does the project raise motivation and self-esteem amongst participants?<br>• Are participants motivated to continue the project or involve in similar activities?<br>• In case of younger students, do they consider a scientific career? |
| **Socio-ecological dimension** | ***Process and Feasibility*** | |
| | **Dissemination** | |
| | Target group and context alignment | • Does the project have a targeted outreach and dissemination strategy?<br>• Does the project include appropriate means of science communication and popular media? |
| | Active involvement, bi-directional communication | • Does the dissemination strategy include hands-on experiences and bi-directional communication?<br>• Is the engagement strategy clearly communicated and transparent?<br>• Are the project objectives and results clearly and transparently communicated? |
| | Cooperation and synergies | • Does the project seek cooperation with science communication professionals?<br>• Does the project include innovative means of dissemination, including e.g. art?<br>• Does the project leverage civic society organizations for communication and synergies? |
| | ***Outcome and impact*** | |
| | **Societal impact** | |

| | | |
|---|---|---|
| | Collective capacity, social capital | • What are the societal goals of the project and how are they communicated?<br>• Does the project foster resilience and collective capacity for learning and adaptation?<br>• Does the project foster social capital? |
| | Political participation | • Does the project stimulate political participation?<br>• Does the project have any impact on political decisions? |
| | **Ecological impact** | |
| | Targeted interventions, control function | • Does the project include objectives that protect natural resources?<br>• Does the project contribute to higher awareness and responsibility for the natural environment? |
| | **Wider innovation potential** | |
| | New technologies | • Does the project foster the use of new technologies?<br>• Does the project contribute to the development of new technologies? |
| | Sustainability, social innovation practice | • Does the project have a sustainability plan?<br>• How far are project results transferable?<br>• Does the project contribute to social innovation? |
| | Economic potential, market opportunities | • Does the project have any economic potential to be exploited in the future?<br>• Does the project include any competitive advantage?<br>• Does the project have any cooperation for exploitation, e.g. with social entrepreneurs?<br>• Does the project generate any economic impact, e.g. cost reduction, new job creation, new business model, etc.? |

The authors of the evaluation framework are currently working on a self-assessment tool to be offered to Citizen Science projects generally. While this is still work in progress at the time of writing this deliverable, we can already say that we will apply a mix of qualitative and quantitative methods for the intended self-assessment. In CAPTOR we plan to perform such as self-assessment with the whole consortium at 2 points in time.

There will be e.g. the possibility to indicate in how far the project adheres to the questions in quantitative terms, using an 7-point likert scale. This scale will allow for a fine-grained self-evaluation, where already small changes can be tracked back over time. E.g a self-assessment question in CAPTOR could be:

| |
|---|
| There are diversified options for citizens to get engagement with the project at different degree, according to interests, knowledge and availability.<br>*(0=does not apply at all, 7=applies very much)* |

In open questions respondents are then asked to provide explanations for their rating and details about how certain things are done within the project. E.g.

| |
|---|
| Please describe engagement opportunities briefly. |

The questionnaire will be provided online for the self-assessment. It will be possible for respondents to print out their answers to the questions.
And we aim for a visualisation that shows in which areas the project reaches high scores in the rating and where are areas less covered.

Some of the indicators can only come into play with a longer run-time of the project, beyond the current funding period. Especially impact indicators like influence on political decisions, impact on

the capacity of the community involved, on the protection of natural systems etc. will only be visible long-term. Thus, the rating will also allow choosing a category, which indicates that the effects are “not known yet”. With the advancement of the project these indicators are expected to become evident.

In terms of concrete objectives for CAPTOR, we aim to reach high scales between 5 and 7 (where 0=”does not apply” at all and 7= “applies very much”) in the categories indicated in green in the table above.

The self-assessment will be conducted as a critical reflection exercise of the whole consortium in a face-to-face meeting The discussion and agreement about the ratings as well as the answering of the open questions will help us to make our strengths evident and to see our shortcomings. It will be an important instrument for the project self-assessment and contribute to the sustainability planning towards the end of the project.

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# Annex I

## Informed Consent for CAPTOR hosts (in Catalan)

ACORD VOLUNTARI DE COL·LABORACIÓ ENTRE EL PROJECTE EUROPEU CAPTOR I EL VOLUNTARI PER LA REALITZACIÓ DE LA CAMPANYA CIUTADANA DE MESURA DE L'OZÓ TROPOSFÈRIC

_____, __ de ____ de 2016

El/la Sr./Sra _____, amb DNI _____, VOLUNTARI/A per la realització de la campanya ciutadana d'ozó troposfèric.

I per part del projecte CAPTOR la Sra. Anna Ripoll, amb DNI 46966702N, que actua com a responsable de la campanya ciutadana d'ozó troposfèric.

**ACORDEN**

I. Que el/la VOLUNTARI/A accepta la instal·lació del node _____ a la ubicació _____ _____ per la realització de mesures d'ozó durant la campanya ciutadana d'ozó troposfèric que es realitzarà l'estiu del 2016, 2017 i 2018. Reservant-se el dret de retirar-se de l'estudi en qualsevol moment.

II. Que el projecte CAPTOR es fa responsable de la instal·lació i dels danys materials que aquesta instal·lació pugui causar, així com dels danys que el node pugui patir.

III. I que per tot això, ambdues parts acorden de subscriure aquest acord amb els següents

**PACTES**

Primer. El projecte CAPTOR es compromet a donar accés al voluntari/a a les dades d'ozó mesurades a la ubicació anteriorment esmentada.

Segon. El projecte CAPTOR es compromet a emmagatzemar les dades personals del/la VOLUNTARI/A segons les mesures de seguretat i confidencialitat establertes legalment per l'art. 5 de la llei 15/1999, de 13 de desembre, de protecció de dades de caràcter personal.

Tercer. El/la VOLUNTARI/A pot accedir, rectificar o cancel·lar les seves dades personals enviant un escrit a l'adreça electrònica anna.ripoll@idaea.csic.es

Quart. El/la VOLUNTARI/A no té cap responsabilitat sobre el funcionament i manteniment del

node instal·lat.

Cinquè. El/la VOLUNTARI/A autoritza la publicació de les coordenades de la ubicació anteriorment esmentada a la web del projecte CAPTOR i a la memòria escrita d'aquest, sense cap referència a noms ni cognoms del/la VOLUNTARI/A.

Sisè. El/la VOLUNTARI/A autoritza (SI/NO) a les entitats que impulsen el projecte CAPTOR a utilitzar les imatges de les diferents activitats que realitzi com a voluntari/a de la campanya ciutadana d'ozó troposfèric perquè puguin ser utilitzades com a material de promoció i difusió del projecte CAPTOR. Reservant-se el dret d'anul·lar aquesta autorització o d'impedir que es faci ús de qualsevol fotografia, imatge o dada que consideri que no ha de ser publicada.

Setè. La vigència d'aquest acord de col·laboració s'inicia en la data de la signatura i finalitzarà quan s'hagi dut a terme l'última campanya ciutadana d'ozó troposfèric l'estiu del 2018.

I com a prova de conformitat, signen aquest conveni amb duplicat exemplar i a un sol efecte, a la ciutat i en la data de l'encapçalament.

Pel projecte CAPTOR: Pel/la VOLUNTARI/A: