

Supplementary Material

1 Activity protocols

Protocol S1. Air pollution monitoring with Smart Citizen Kits

Objectives

To collect data from the maximum number of Living Labs for a common period in order to compare qualitatively the degree of pollution in the different regions.

To raise awareness about the project and sensitize the public about air pollution in order to promote their change of behaviors for the most sustainable ones.

Methodology

This section describes the different phases for the implementation of the activity which are summarized on Protocol S1 - Protocol S1 - **Table 1**.

Phases	Summary	DURATION
Before starting (T – 4 weeks)		
Block A	Rol assignation and activity setup Stakeholder engagement (LL volunteers)	2 - 5 h
Block B	Sensor Installation	1 h / sensor
Block C	Sensor's checkup Sensor characterization forms Stakeholder workshop 1 - Introduction	30 min 30 min /sensor 1.5 h
Data Campaign (T)		
Block D	Measurement period	4 weeks
After the data campaign (T + 1 to 12 weeks)		
Block E	Data download	4 - 8 h

	Data processing Campaign promotion through social media	
Block F	Data analysis	1 - 2 months
Block G	Stakeholders' workshop 2 – data discussion	1.5 h
Block H	Internal project results discussion	2 h
	Results dissemination	1 h

Protocol S1 - Table 1. Summary of the implementation steps.

Protocol and timeline:

Before starting

- Block A (T – 4 weeks):
 - a) Designate a global activity coordinator for the inter LL campaign. It has to have scientific background and experience working with air pollution data.
 - b) Each LL designates a team (LL staff) to locally lead the activity in the LL.
 - c) Designate a social media dissemination team to increase outreach and help disseminate the campaign results. It can be formed by members from different LLs or an external team.
 - d) Engage volunteers from every LL or recruit new participants in every LL, with interest on air pollution and capacity to host and install a sensor (with the support of the LL).
 - e) Decide what type of sensors (the same for all the sensors participating in the campaign) and how many are going to be used in each LL.
 - f) LL staff have to indicate the sensor IDs (to identify them on the online platform) to the activity coordinator and where the sensors are or are going to be installed (type of building and approximate city or population).
 - Block B (T - 3 weeks):
 - a) Installation of the SCK in case it is not yet installed (see recommendations in point 4) with the supervision by the LL staff.
 - Block C (T -2 weeks):
 - a) LL staff have to ensure that all sensors are installed and working properly with data collection (online or offline).
 - b) The volunteers in every LL have to fill out the SENSOR AND ENVIRONMENT CHARACTERIZATION FORM (see point 4). LL staff will supervise the information provided and contact the volunteers if it is needed to correct the characterization details.
 - c) Stakeholders' workshop 1 - Introduction: the LL staff has to contact the campaign volunteers as well as other LL stakeholders and participants interested in the topic (e.g.: a group of students from each school, a group of citizens):
 - d) Explain the project, the data measuring campaign and the objectives

- e) Ask the attendees to answer a survey specifically designed to evaluate the social and economic impact of the CS activities (I-CHANGE survey uses the Com-B model, Michie et al., 2011)
- f) LL staff and the volunteers jointly decide on the level volunteer involvement in the Air Pollution Monitoring campaign, as well as their interest in participating in additional activities.
- g) Agree on a date after the campaign to discuss the data and results obtained.
- h) Comment the SENSOR AND ENVIRONMENT CHARACTERIZATION FORM (see section 5) and correct if necessary. The LL staff send it to the activity coordinator and the social media dissemination team.

Data Measuring Campaign

- Block D (T):
 - a) Measurement Period - 1 month. It can be extended afterwards, there is no need to uninstall the sensors. LL staff check every few days that data is being properly collected, if needed.
 - b) 5 of June, the I-CHANGE DAY: Data download by the activity coordinator using the API and the sensors' IDs. Processing of sensors measurements, representation of hourly and daily averages for the period.
 - c) Social media dissemination team uses the generated images and preliminary information for social media content publicizing the campaign during the I-CHANGE Day.

After the data measuring campaign

- Block E (T + 1 week):
 - a) After the Measurement Period (T: 4 weeks+1 day):
 - b) The activity coordinator updates the download data for the entire period, using the API and the sensors' IDs.
 - c) If the sensor was installed offline, the respective LL staff should download the data from the SD card and send it to the activity coordinator.
 - d) The activity coordinator updates the images for the hourly and daily averages.
 - e) The social media dissemination team promotes the campaign through social media I-CHANGE channels. The LL staff can translate the promotional material into the local language of the LL and share it on their social media and with their stakeholders.
- Block F (T +5 to +10 weeks):
 - a) The activity coordinator leads the in-depth data analysis (with the support of all the air quality experts involved in the initiative) looking for similarities/differences between sensor locations (different cities, environments and meteorology), comparison of daily cycles, or maximum concentrations along the entire period.
 - b) Inter LL meeting to expose the results obtained (activity coordinator and air quality experts to the rest of the LL staff)
- Block G (T +10 weeks):
 - a) Stakeholders' workshop 2 – Data discussion (optional) – Organize an activity to discuss the data collected during the campaign and the obtained results.
 - b) It can be both locally and with an inter-city comparison. This activity focuses on reflecting on how individual habits can have an influence over air pollution and whether citizens, as individuals, can take action to improve it.
 - c) Remember to save some time to answer the same assessment survey AFTER the activity

- Block H (T +12 weeks):
 - a) Outcome: internal project presentation and discussion (all the project participants and LL staff).
 - b) Final dissemination of data and findings (social media dissemination team and LL staff). Use the results and insights of the campaign in upcoming stakeholder events on each LL or in multi-LLs events (ex: I-CHANGE dialogue events or Climate action training schools).

Sensor installation recommendations:

If it is possible, 2 SCK/SCS should be installed.

In the event that two or more sensors are installed, they should be placed in two different areas, with different and representative environmental conditions for the city/village. For instance, one in an area with active traffic (potentially highly polluted) and the other one in a green area (better air quality). If it is possible, it should be installed in a place where it could also play the role of raising awareness among citizens (schools, civic centers, libraries, markets, etc.)

Avoid installing the sensor too close to a structure that does not allow normal air circulation.

Install the sensor at least 1.5 m above ground.

Put the location of the sensor on the web smartcitizen.me even if it is in offline mode.

You can find more information about the sensor at: <https://docs.smartcitizen.me/>

Additional Materials

SENSOR AND ENVIRONMENT CHARACTERIZATION FORM

		SENSOR AND ENVIRONMENT CHARACTERIZATION FORM			
Living Lab		Sensor Name		Date of installation	
Picture(s) of the sensor and surroundings					
Type of sensor		ID Sensor			
Coordinates (Latitude) degrees		Coordinate (Longitude) degrees			
Postal address					
Height above street level		Altitude (m.a.s.l.)			
Location		Specific location			
School		Rooftop			
House		Terrace			
Public building		Window			
Market		Wall			
Other, which?		Other, which?			
Are there any obstructions from another nearby building?					
In which direction? (N/S/E/W)					
Soil characteristics below the sensor					
Gravel		Asphalt			
Sand		Other, which?			
Google Earth image					
Considering all the facilities located within a radius of 500 meters the sensor installed, please answer the following questions:					
Characterization of urban area					
Commercial area		Industrial zone			
Gas stations		Residential area			
Educational facilities		Sports/recreational areas			
Other, which?					
Type of road					

Highway		Avenue (more lanes than a single street)	
Street		Pedestrian road	
Other, which?	-		
Type of traffic			
<u>Variable with traffic</u> jams at peak hours		Scarce	
Frequent		No traffic	
Other?	-		
Characterization of natural area (mark with an X if located up to 500 m)			
Farmland		Natural Park	
Forest		River	
Other, which?			
Other nearby emission sources identified			
Additional details of the location or other aspects to be highlighted			

Protocol S1 - Figure 1: Sensors characterization form used to characterize the place of installation of the low-cost air pollution sensor

Protocol S2. Temperature Perception in Urban Environments

Objective

Promote behavioral changes (mitigation and adaptation through participation in a citizen science campaign).

Subobjectives

- Evaluate the perception of temperature by the population and the role played by humidity.
- Identify the most relevant places for neighbors and their social uses.
- Collect temperature data in different areas: identification of risk areas and safe routes.
- Promote sustainable behaviors.
- Compare experiences between the different LLs
- Disseminate the I-CHANGE project Living Labs.

*Note: this citizen science proposal is based on the experiment protocol developed by I-CHANGE and OPUSH European projects in Barcelona.

Methodology

This section describes the different phases for the implementation of the activity which are summarized on Protocol S2 - **Table 2**.

Phases	Summary	DURATION
Before starting (T - 1 week)		
Block 0	Selection of stakeholders and the meeting place. Design/Preparation of the Communication protocol Preparation meeting of LL staff Training meetings of LL staff (30 min) Materials preparation	4 – 6 h
WORKSHOP (T, about 4 hours)		
Block A	Introduction by LL staff. Citizen Science, extreme temperatures and rainfall, and importance of water resources. Objectives of the project and the activity.	35 min
Block B	Collect participants' perceptions of their neighborhood in terms of temperatures and social uses of the public spaces and their perception on the influence of climate change. Survey.	1 h
Block C	MT setup and roles distribution (in groups)	20 min
Block D	Walking journey through the selected spots. Temperatures and humidity measurements. Pictures.	1 h 30 min

Block E (or other day)	Discussion about the results, reflection about behavioral changes	25 min
After the workshop (T + 1 week to 1 month)		
Block F	Participants complete the I-CHANGE survey or another assessment tool and provide activity feedback Deeper analysis of the results and report summary Key insights are disseminated Internal activity evaluation	1 month

Protocol S2 - Table 2. Summary of the different implementation blocks

Protocol and timeline:

Before starting

- Block 0. Engagement and Communication
 - a) Select the place where the experiment will be conducted. Select the stakeholders to involve in this area and in the activity. It is a good idea that they are from the territory, their engagement is a way to facilitate the participation of citizens in the activity.
 - b) Contact the stakeholders with the proposal of activity (online).
 - c) Select one person to be facilitator
 - d) Meet with the interested stakeholders to explain and plan the activity (online or face-to-face meeting). Main points to be discussed:
 - e) Specific location / venue where the activity will take place.
 - f) The type of public we want to engage (students, seniors, families, etc.).
 - g) Other practical aspects (registration process, ethics, inclusivity, and privacy issues).
 - h) Define the registration calendar (deadline).
 - i) Contingency plan (low participation, adverse weather conditions, etc.).
 - j) Role distribution:
 - a. 1 person as facilitator (Ideally not from the research group but a person already trusted by the community, for example people from the entity/library/museum/civic association). Mission: generate a trustful and friendly atmosphere. Make sure that all participants can have their say. Keep track of the speaking time and make sure that the planned activities are done.
 - b. 2/3 researchers, in this case, LL staff. Role: People responsible for explaining the different objectives of the project and the reasons for doing the planned activities. Expertise needed: ethics and personal data protection, meteorology, citizen science, collective measurements, collective mapping.

- k) Disseminate the activity in close collaboration with the stakeholder/s (online, mailing lists and posters in strategic places/businesses in the neighborhood). Common templates of communication materials can be prepared by the project (according to European Green Week guidelines).
- l) Close follow-up on the registration process.

Activity Workshop

Documents and material needed for the activity:

- Informed Consent forms
- Presentation (ppt)
- Panels with spaces classification
- Individual survey forms (temperatures perception...)
- MeteoTrackers and setup guides
- Printed maps (small) A3 or A4 (1/ group) of the concrete neighborhoods: squares of approximately 1,4 km with the activity venue at the center.
- 2 Printed maps (large, for example, 91,4 cmx 91,4 cm). Main source: OpenStreetMaps (OSM).
- I-CHANGE video
- Laptop
- Smartphone and/or camera
- Post-its, name tags and rounded stickers
- Pens and A4 white papers
- Water/juices and snacks, glasses

- Block A. INTRODUCTION- 35 min

Who	What	Time
Researchers and/or facilitator (staff)	<p>Welcome and why we are here.</p> <p>*Time should be reserved within the first block or, preferably, before the day of the activity, to fill in the I-CHANGE Survey.</p> <p>In the same way, when the feedback will be sent, also add the link to the survey so that it can be filled in after the activity. This will be very useful for the project but even more to evaluate the impact of the activity.</p>	5'
Researchers and/or facilitator	<p>Presentation of participants:</p> <p>1. Ice breaking: what do you know best, in your neighborhood?</p>	5'

	2. Why did you decide to participate?	
Researchers	Presentation of the research team and I-CHANGE project. I-CHANGE video.	10'
Researchers and/or facilitator	<ol style="list-style-type: none"> 1. Situation in the neighborhood (parameters that characterize the surroundings of the museum, library or center where the meeting takes place). 2. Presentation of the categorization of spaces, in relation to their uses. 3. Which information is missing? microscale and perceptions of inhabitants. Importance of public spaces. 4. Presentation of the activity: what we will do. 5. Explanation of the terms of collaboration and planning. Personal data protection, privacy, data ownership and open data. 6. Time for questions 7. Consent signing document and contact details collection. 	15'

- Block B. Selection of the places and routes – 1h

Who	What	Time
Everybody in groups, staff can assist the participants	<ol style="list-style-type: none"> 1. Creation of groups (recommended: 4 – 8 members/group) 2. Group work: think about all places you frequently use in the neighborhood and those related with water and extremes (fountains, dry vegetation, irrigation, flood prone areas, etc.). Between 5 and 8 places. The participants can get inspiration from the printed map, which is available on a table or wall. 3. Mark all the selected places on the map with stickers. 	10'

<p>Researchers with the help of facilitator</p>	<ol style="list-style-type: none"> 1. For each place, we check for duplicates from other participants. 2. Discussion about the different spots to visit. Are they representative of the activity in the neighborhood? Are we missing any important place/ activity? 3. Discuss if the stickers are concentrated in the same places, if people use them for the same activities, etc. If necessary, search for new places. 4. Collectively decide on the places/spaces to be investigated. 5. Number and distribution of the places between the different groups (maximum 8 per group). 	<p>30'</p>
<p>Everybody in groups, staff can assist the participants</p>	<ol style="list-style-type: none"> 1. Collective decision about the journey to visit all the assigned places 2. Individual work: fill the Individual survey (table sheet) with information from the different places you are going to visit, including: Assigned number to the place (written in the map), Name of the space, Category (according to the provided table), Expected temperature feeling (Scale 1-5: 1.Cold, 2.Refreashing, 3.Tolerable, 4.Hot, 5.Too hot), Expected humidity (Scale 1-5: 1.Very low, 2.Low, 3.Normal, 4.High, 5.Very high) 	<p>20'</p>

- Block C. Prepare for the data collection in groups – 20 min

Who	What	Time
<p>Everybody in groups, LL staff assist the participants</p>	<p>For each group:</p> <ol style="list-style-type: none"> 1. Mark on the printed map of the group the journey to follow including the selected spots to visit. It doesn't matter if the group passes over the same street several times. 2. Assign the following roles between the members of the group (in case there are less than 5 people per group, the tasks should be distributed among them): 	<p>20'</p>

	<ul style="list-style-type: none"> - Guide (1 o 2). A person that knows the neighborhood well, responsible of guiding the group through the journey. - Group coordinator: person in charge of checking that all people in the group stay together (it can be the same as the guide). - Sensor "holder". (1 person or 2 walking close by). One is going to hold the sensor and the other has to write the temperature registered by the sensor in a sheet at each stop. The MT needs to be held parallel to the grown, always in front of the carrier and trying to maintain a constant altitude. - Notetaker person. The person in charge of taking notes about the discussion at each spot. Ethnographic work. - Photographer. Responsible of taking pictures with Floodup APP or MT App, to contextualize the environment. <p>Recap and leave the room.</p> <p>Foresee hats and sun cream. Bottles of water.</p> <p>Participation in the collective measurement is totally voluntary. If people with disabilities or reduced mobility wish to participate, a shorter/adapted journey can be organized. These measures are especially relevant, they aim reflect the realistic path they could perform.</p> <p>If anyone is not feeling well, they should notify the group and they need to be accompanied to a safe space (bar, area with shadow). The priority is, above all, the wellbeing of the participants.</p> <p>If the meteorological conditions are not adequate (over clouded, rainy, cold, too hot...), postpone the walk for another day. If the heat is extreme, warn the most vulnerable people of the danger. And consider organizing a shorter walk for them with scheduled stops in cooler places (cafe, library). It is important everyone does the same</p>	
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- Block D. Walking Journey - 1h 30 min

Who	What	Time
LL Staff	<p>Sensors are activated and connected to the mobile phones. Take a short walk in front of the venue to check everything works.</p> <p>Remain to the people about the need of taking notes about the temperature feelings and humidity.</p>	10'
Everybody in groups, staff can assist the participants	<p>Rehearsal: A "fake stopping point" at the entrance of the venue.</p> <p>Actions to be done:</p> <p>Photographer: takes the picture</p> <p>Note-taker: writes down the name and address of the place.</p> <p>All: write the individual heat sensation on the survey.</p> <p>Sensor holder: shows the temperature and humidity measured.</p> <p>Note-taker: take notes on the discussion about the place: what do we see? How do we feel? Do you have nice / bad memories of this place? What is their social use?</p> <p>Group coordinator: gathers the group</p> <p>Guide: takes the group to the next point</p> <p>The group starts the journey and at each point repeat the process.</p>	1h 20'

- Block E. Discussion about the results, information about behavioral changes – 25 min

Who	What	Time
Everybody	1. Meeting at the venue (library/museum/center), with water/juice and snacks	25'

	<p>2. Store material.</p> <p>3. Debriefing and wrap up</p> <p>4. To conclude the session, each group proposes (can be written on post-it notes, one of each color):</p> <p>An EVIDENCE,</p> <p>A CONCERN</p> <p>A PROPOSAL FOR IMPROVEMENT (in the neighborhood)</p> <p>INDIVIDUAL BEHAVIOUR THAT I CAN CHANGE TO DEAL WITH THESE SITUATIONS</p>	
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After the activity

- Block F. Outcomes and participants feedback
 - a) Distribution of the I-CHANGE survey (or the selected assessment survey)
 - b) Analysis in-deep by LL staff or another scientific expert in the project
 - c) Feedback to the participants with a summary report of results.
 - d) Dissemination of key insights obtained from the activity through social media, LL channels and involved stakeholders.
 - e) An internal evaluation of the activity should also be conducted to reflect on its outcomes and implementation process.

Materials

S	HEALTH: CAPs, Hospital, pharmacy,...	V	GREEN AREAS: parks,...
E	EDUCATION: kindergarten, schools, institutes,..	R	MEETING SPACES: parks, squares, playgrounds, pedestrian promenade,...
M	MARKETS: municipal markets and supermarkets	P	SPORTS EQUIPMENT: sports centers, swimming pools,...

B	SHOPS: bakery, butcher,...	C	CULTURAL FACILITIES: libraries, civic centers, museums...
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Protocol S2 - Table 3: Colors and proposed spaces classification categories to characterize the locations participants want to visit.



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1. Date of the experiment:
 2. Nickname: 3. Age: 4. Group name:
 5. What gender do you identify with the most
 Female Male Nonbinary I prefer not to answer Other: _____

(: questions to be answered before the journey)*

Number*	SPACE NAME*	CATEGORY*	EXPECTED TEMPERATURE FEELING*	ACTUAL TEMPERATURE FEELING	TEMPERATURE ACORDING TO THE MT	EXPECTED HUMIDITY*	RELATIVE HUMIDITY ACORDING TO THE MT
Indicate the location of the place on the map with a number, write it down here	Feel free to include a brief description or just a single word that identifies it, for example, 'Clot Market'.	According to the space classification table	What is the temperature sensation you expect to have? 1. Cold 2. Refreshing 3. Tolerable 4. Hot 5. Too hot	What is your temperature feeling at this point? 1. Cold 2. Refreshing 3. Tolerable 4. Hot 5. Too hot	Write down the temperature registered by the MT	What is the humidity sensation you expect to have? 1. Very low 2. Low 3. Normal 4. High 5. Very high	Write down the relative humidity registered by the MT

Protocol S2 - Figure 2: Individual forms to fill with the characterization of the selected places, expectations and observations and in-situ measurements.