Project no. 265432

EveryAware

Enhance Environmental Awareness through Social Information Technologies

http://www.everyaware.eu

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Final publishable summary report

1.1 An executive summary

The issue of sustainability is now on top of the political and societal agenda and is considered to be of extreme importance and urgency. There is overwhelming evidence that the current organisation of our economies and societies is seriously damaging biological ecosystems and human living conditions in the very short term, with potentially catastrophic effects in the long term. A lot can and must be done from the technological and policy-making perspective, for example to build passive houses, develop renewable energy, and so on, but it is only when people become fully aware of their actual environmental conditions and their future consequences that the much needed change of behaviour will truly happen.

Public participation in environmental decision making was pushed to the fore as a result of the 1992 Rio Declaration on Environment and Development. However, the provision and production of environmental information, particularly on issues such as noise pollution and air quality, rely heavily on a 'top-down' approach in which public authorities collect the data and release it to the public. There is still room to develop better mechanisms that support citizens to not only consume but to generate their own environmental information. If successful, such processes could lead to an increased awareness and learning about current environmental issues. Furthermore, this may serve to encourage more citizens to participate in environmental decision making, and ultimately stimulate them to take steps to improve their own environment based on new observation techniques.

The EveryAware project responded to this societal need by pushing the evolution of ICT with the aim of supporting informed action at the hyperlocal scale, providing capabilities for environmental monitoring, data aggregation, and information presentation. The goal was that of enhancing knowledge, understanding and social awareness about environmental issues emerging in urban habitats through the use of ICT tools deployed to gather user-generated and user-mediated information from mobile sensing devices. The leading idea of the EveryAware Consortium has been that gathering both personal and community data, collected by citizens, processed with suitable analysis tools, and re-presented in an appropriate format by usable communication interfaces, has the potential of triggering a bottom-up improvement of collective social strategies.

With this aim in mind EveryAware deployed the infrastructures to support participatory sensing in an environmental framework, high-performance data gathering and storage. The resulting EveryAware platform is highly effective and represented the main backbone for all the EveryAware activities. The very same realization of the EveryAware infrastructure represents a major achievement of the project since for the first time we demonstrated a complete end-to-end infrastructure able to integrate participatory sensing, accuracy of measurements from low-cost sensors, people engagement, mobile and web technologies. This infrastructure has been successfully deployed in several case studies (cs.everyaware.eu) devoted to Noise pollution and Air-quality. In addition EveryAware launched the Experimental Tribe platform (www.xtribe.eu), a general-purpose platform designed for scientific gaming and social computation whose aim is that of providing the scientific community with a tool to realize web-based experiments by skipping all the unnecessary technical coding overhead. Finally a great deal of attention has been devoted to the theoretical investigation of the social dynamics underlying the processes through which opinions are formed and individuals enhance their awareness.

The whole EveryAware experience is being gathered in a Book the Consortium is editing about *Participatory sensing, opinions and collective awareness* and published by Springer. The book will present in a comprehensive and non-technical the experience learned through the EveryAware project as a lens to gather the potential of the emerging frameworks of participatory sensing, citizen science, social computation, coupled with the theoretical and modelling tools recently developed by physicists, mathematicians, computer and social scientists to analyse, interpret and visualize complex data sets. What is emerging is a a very clear proof of concept about the potential ICT-mediated social sensing can have in monitoring and possibly affecting individual perceptions, the emergence of awareness and the dynamics of opinions.

1.2 Summary description of project context and objectives

The EveryAware project expected to contribute significantly to the social goals of achieving greater awareness of localised, personalised environmental information through the implementation of novel infrastructures for bi-directional communication.

Specifically, it aimed to develop the tools and the knowledge needed to make environmental information transparent, available and easily integrated with the perceptions of people, regarded as a first-order observable. *Bridging the gap between opinions and sensor data is the single factor that can make environmental knowledge actionable at the grassroots level.* Current approaches to the onset of sustainable practices in citizens' environmental behaviour have been based on top-down strategies for understanding behaviour [Jackson, 2005] and have met with mixed success [J. Collins and Wilsdon, 2003]. The participation of citizens has traditionally been limited to opinion polls and public discussions where people have been asked to convey their needs and their opinions to panels of designated experts responsible for tackling emerging issues. The environmental monitoring activity, the public dissemination and discussion, and the policy making are performed in separate places and at different times, with little transparency about how environmental issues are treated by each actor throughout the whole process.

EveryAware project, conversely, has been based on the idea that citizens should be involved not only as passive receivers of pre-packaged environmental information, but also as active producers of it, by means of the networking possibilities allowed by mobile devices, pervasive Internet access, Web 2.0 and the mobile Web tools that support sharing and annotation of geo-localised content. The framework envisioned in the project allows the user to participate in all stages of environment management: by contributing to enrich its monitoring, expressing opinions, joining a motivated community, and eventually implementing best practices with the potential to improve environmental conditions.

The notion of geo-localised user-generated content is of course not novel. A number of par-

ticipatory websites and Internet-based scientific projects have been successfully deployed (see [Flanagin and Metzger, 2008; Goodchild, 2007a; Hudson-Smith et al., 2009] or http://tah.openstreetmap.org for examples and a review of the field of Volunteered Geographic Information). However, most collaborative web-based systems have bound themselves to merely visualise the data collected by users, without a scientific analysis of it. In contrast, EveryAware proposed that users participate in the scientific endeavour itself by making use of current and emerging hand-held electronic devices incorporating significant computing power. Such devices should be easily connected to sensing equipment and to the Internet without requiring specific expertise from the user. In the field of environmental monitoring and research it was, and still is, a great novelty to deal with data from a large number of mobile, randomly distributed, "uncontrolled", low-cost and therefore potentially less reliable sensors carried by non-skilled individuals, as compared to the practice of a limited number of mostly stationary and highly controlled data collection systems based on expensive high-quality measurement instruments. It was additionally novel to involve non-expert users in an end-to-end process from data capture to final output. The integration of participatory sensing with the monitoring of subjective opinions has been the key and crucial novelty of EveryAware, as it has the potential to expose the mechanisms by which the local perception of an environmental issue, corroborated by quantitative data, evolves into socially-shared opinions, and how the latter, eventually, drive behavioural changes. In our opinion, this approach represents a scientific and technological advance from several points of view as explained below, and EveryAware carefully addressed all the different research and technological challenges it implies. In the following we briefly describe them.

The EveryAware platform A key technological novelty of the EveryAware project has been the design and the implementation of the so-called EveryAware platform that handles both sensor and subjective data acquisition. The platform is a modular system composed by several components: a SensorBox to gather objective data about the environment, a smartphone controlling the data acquisition and the user-experience, a system of data gathering, storage, analysis and visualisation and several web-services. This approach guarantees high scalability of the overall system and allows for further developments aimed at having pluggable sensors, eventually miniaturised and integrated (e.g., wearable sensors). At the same time the associated software platforms allow users to easily upload their sensor readings, and equally easily tag these with subjective information. The ICT challenge here was that of making this upload process as automatic and natural for the user as possible.

Community Engagement Work dating as far back as 1969 [Arnstein, 1969] lists the possible levels of citizens' participation, ranging from non-participation to citizen control (where budgets are assigned to the citizens themselves) and more recent projects ([Aoki et al., 2009; M Haklay and Whitaker, 2008; Maisonneuve and Stevens, 2008; Paulos et al., 2007; Quarterly, 2009]) stress the importance of the participation process and the impact that informed community members have on local decisions. Such participation can improve both the science literacy of a population [Paulos et al., 2009] and offer different views of communities [Srivastava et al., 2006] to scientists: the real-time monitoring of opinions related to empirical observations will provide environmental sociologists with a corpus of detailed knowledge about how environmental conditions are perceived by a community: what issues are regarded as most relevant? How are novel behaviours propagated? What motivates participation, engagement and behaviour change?

Motivation for users' engagement and continuing participation in online project such as Wikipedia http://www.wikipedia.org/ or OpenStreetMap http://www.openstreetmap.org/ has already been extensively examined [HAK, 2007; Benkler, 2002; Nov, 2007]. However, similar motivations cannot necessarily be attributed to the citizen sensing participants in the EveryAware project, which presumably requires a higher level of commitment to that of a Wikipedian (who contributes 8.27 hours per week on average [Nov, 2007]). Obtaining information related to encouraging initial and continued participation was therefore fundamental to the developers of systems such as

EveryAware as it can be utilised to ensure that participants are highly motivated to engage with the project, and more importantly remain engaged over the longer term. Novel research has been focused on two aspects of the problem. Firstly, a number of participant recruitment techniques (such as social networking sites, flyers, posters, e-mail campaigns) has been trialled systematically to identify those that achieve greatest success and validate whether similar techniques can be applied both in cross-border situations and with groups having different interests. Secondly, still ongoing research is identifying a list of motivations for ongoing participation once recruited, with a particular focus on those users who remain engaged with the project over a longer term. The results from both elements of research not only informed all the stages of the project, but will also be of great relevance to similar participatory projects elsewhere.

Processing sensor data Specific issues emerged concerning sensor data. To illustrate this point let us focus on air-quality sensors. Although in most epidemiological studies air quality is commonly defined at the level of a city, recent air quality studies have highlighted that significant differences in pollutant concentrations, and in related health effects, can occur over the day and between different locations [Beckx et al., 2009; Kaur et al., 2007b; Milton and Steed, 2007; Wilson et al., 2005]. The measurement of air quality at a high spatial and temporal resolution can yield a tremendous advance in the characterization of the pollutants' urban concentration variability. Measuring mobility and activity patterns allows researchers to gauge the real-world exposure of citizens, and in turn the overall effect on the health of urban communities.

The use of networks of available low-cost sensors will enlarge the data coverage. In the past, the adoption of low-cost sensors for ambient air quality monitoring has always been constrained by lack of accuracy, selectivity and reliability [Carotta et al., 2007]. However, new sensing technologies (arising from additional developments in the fields of semiconductors, nanotechnologies and fibre optics amongst others), will bring the detection limits of commercial sensors to the part-per-billion range needed for air quality monitoring. At the same time selectivity increases [Brunet et al., 2008; Elmi et al., 2008; Li et al., 2003; Viricellea et al., 2006]. Thanks to the integration of cheap sensors in sensor networks, increased data availability, network intelligence and advanced data mining techniques, limited accuracy and reliability can further be countered [Kularatna and Sudantha, 2008; Ma et al., 2008; Tsujitaa et al., 2005] (see also IDEA project `http://www.idea-project.be`).

Several research projects have developed or are developing low-cost portable air quality sensing tools based on commercially available sensors [Aoki et al., 2008; Eisenman et al., 2007; Honicky et al., 2008; Hull et al., 2006; Maisonneuve et al., 2009; Milton and Steed, 2007; Völgyesi et al., 2008] (see also `http://www.lamontreverte.org/`, the Cambridge Mobile Urban Sensing (CamMobSens) `http://www.escience.cam.ac.uk/mobiledata/` or `http://urban.cens.ucla.edu/projects/cyclesense/`). However, when EveryAware started none of those efforts had reported extensive field trials or reported full-scale validation exercises. Specific technical challenges have also to be tackled such as the precision of GPS in densely built urban environments [Milton and Steed, 2007].

Combining sensor and subjective data One of the main novelties of EveryAware has been the strong effort towards an integration of sensor and subjective data in order to provide insights about the social perception of the state of the environment (see also below). A quantitative analysis of the gap between perceived and measured environment had never been attempted in a systematic way. Both kinds of data are affected by the procedures to gather them as well by intrinsic biases, both in space and in time. This raised new issues of data validation, calibration, interpretation and representativeness, that had to be tackled in a creative way and embedded in digital data processing procedures in an, as much as possible, autonomous, learning way.

Citizen science An important challenge concerns the development of and examination of the use of web-based tools through which (groups of) interested lay people and scientific experts can interact directly, discuss provisional results of data collection and mutually enrich both the data

itself and the interpretation of the data. Here the actual challenge was the presentation of complex scientific analysis in a user-friendly manner to non-specialists. From this point of view the project paid a special attention to ICT challenges that include: (i) the usability of the interface design so that users can easily find the desired information (at the individual level or aggregated); (ii) the appropriateness of the actual displaying methods: how to present results so that non-specialist users understand both the analysis undertaken and the outcomes? Will access to this information help users feel rewarded and part of a community, encouraging further participation? Thus the overall novelty of this component of the project has the development of a user-friendly manner to present complex scientific analysis (both the methods and the results) to non-specialists.

Opinion and Behaviour Change The direct involvement of the users in the research as described above leads to the potential discovery of emerging behavioural patterns, as well as to an assessment of the impact of new technological solutions at the socio-economic level. Despite these benefits, none of the existing studies [Aoki et al., 2009, 2008; Eisenman et al., 2007; Honicky et al., 2008; Hull et al., 2006; Ma et al., 2008; Maisonneuve et al., 2009; Milton and Steed, 2007; Paulos et al., 2007] (see also `http://www.escience.cam.ac.uk/mobiledata/` or `http://urban.cens.ucla.edu/projects/cyclesense/`) using citizen sensors specifically evaluate individual behaviour change in any way, although Honicky *et al.* and Milton and Steed [Honicky et al., 2008; Milton and Steed, 2007] raise this as an issue to be investigated.

This issue is closely linked with the concept of participant motivation described above - will a participant sufficiently engaged with the project also modify his or her behaviour as a result of the personalised information presented? Lawrence [Lawrence, 2009] notes that the link between engagement and behaviour change is not yet fully established in the context of environmental change and climate change discourse. Although other studies using diverse sources of data have identified the usefulness of such individualised information ([Darby, 2008; Paulos et al., 2007]), many of the citizen sensor studies are still at pilot stage [Honicky et al., 2008; Milton and Steed, 2007] and do not state behavioural investigation as one of their direct aims.

In general, the dynamic processes underlying the formation and the evolution of opinions, uses and behaviours have rarely been investigated in experimental settings and almost never coupled to the exposure of users to suitably detected and processed relevant information. Influencing behaviour change is notoriously difficult due to the complexity and variety of factors that affect behaviour [Jackson, 2005], and a number of alternative models have been proposed. ”Expectancy-value” theories group together models where choice is motivated by the expectations we have about the consequences of our behaviour and the values we attach to those decisions [Jackson, 2005] (for example the rational choice model). Staged models (Prochaska and DiClemente (1986) and Lee and Owen (1985) in [State Government of Victoria, 2006]) include the fact that understanding and assimilation of the consequences of an action may be incomplete, that information may relate to events in the future (e.g. the possibility of developing lung cancer) and that a distinct cognitive effort is required to modify behaviour [Jackson, 2005]. The basis of all behaviour models, however, is the assumption that knowledge and awareness of an issue or a problem are key requirements for a behavioural change. However, very few studies have been undertaken on changes in individual behaviour due to the provision of individual-specific information.

A theoretical contribution to the understanding of opinion and behaviour change came from recent studies performed in the opinion dynamics field [Castellano et al., 2009]. Such interdisciplinary area focuses on the modelisation of opinion spreading in large social networks, with a heavy use of mathematical tools and methods borrowed from statistical physics. Many models have been developed in the literature to explain how social systems develop a consensus on a given issue (e.g., on political votes), or which social interaction favours the co-existence of multiple opinions in a community [Lambiotte and Ausloos, 2007; Sznajd-Weron and Sznajd, 2000]. However, empirical bases behind such models are still scarce, in particular for what concerns the opinion dynamics, which requires the monitoring of a social system during time. Although some of the partners had

already explored these problems in recent works, focussing on the emergence of semantic agreement in social networks [TAGora, 2007], crucial issues such as the study and the modelisation of the resistance to opinion shift are still a largely unexplored field. The EveryAware project contributed to provide the empirical, computational and theoretical base for an advance in such line of research.

Overall, the EveryAware project adopted a number of novel mechanisms, methods and techniques to meet the challenges listed above, ranging from the involvement and motivation of users to the monitoring of relevant environmental parameters, the processing and dissemination of this information in a significant way, the monitoring and modelling of all the processes underlying large scale opinion shifts. More schematically the objectives of EveryAware, each corresponding to a specific research challenge, were:

- to develop a **hardware platform** enabling citizens to effortlessly capture personal environmental information. The platform had to incorporate an interoperable set of sensors for environmental parameters connectable to a smartphone, a central server unit for data storage and processing. The platform was thought to be intrinsically scalable allowing the integration of progressively miniaturised, embedded or wearable sensors with increasingly powerful smartphones and interfaces.

- in conjunction with the above, to develop a **software platform** enabling citizens to effortlessly capture information related to their behaviour and choices. This platform had to be seamlessly integrated with the **hardware platform** and also pass data to the central server unit for data storage and processing. A suite of personal computer and smartphone applications had to allow users to exchange sensor data and opinions to and from the central unit and the social network composed of other participants.

- to develop **protocols** for community engagement in urban sensing experiments, enabling communities to perform the monitoring activity at grass-roots level, in a decentralised fashion. Here the core research challenge was the development of validated engagement schemes to encourage initial and ongoing community participation. Additionally, research has been required to validate whether such techniques can be generally applied across borders and with community groups having differing interests and focus.

- to develop **methods** for real-time analysis of subjective and objective data from users. Here the core research challenge was the development of validated schemes for geo-spatial data fusion, efficient enough to provide appropriate feedback to users in a timely manner. The methods had to aggregate distributed, geo-localised, noisy information sources ranging from multi-channel sensor data with subjective opinions of individuals, building a real-time picture of environmentally-relevant factors. Here crucial issues concerned spatial and temporal scale, as well as community size. Targeted researches been carried out to interpolate and model the acquired data, to enhance the understanding and the predictability of the monitored environments, and to feed back context-relevant information to individual contributors.

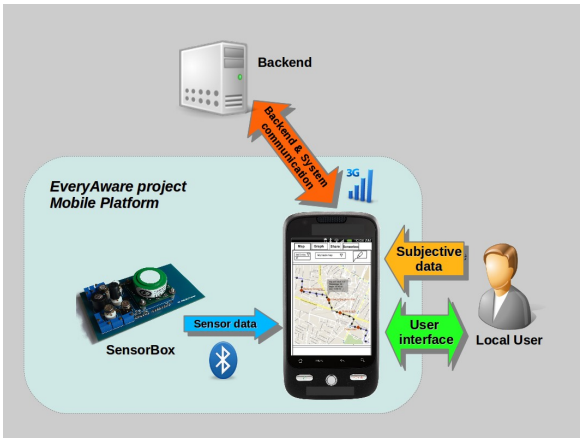
- to develop **interfaces** and software to feed back the results of the analysis to users in a manner that was both related to their interests and immediately understandable by users with little or no specialist knowledge about environmental issues or geospatial datasets. The information has been fed back by mashing it up with other bodies of user-generated content. The challenge here was to design an appropriate feedback mechanisms using an interface that is suitable for the mobile devices in use and provides sufficient information, in a timely manner, to have potential impact on behaviour. Additionally, this interface had to be seamlessly integrated with that developed for the subjective and sensor data capture.

- to develop a deep quantitative **understanding**, at the theoretical and empirical level of the opinion formation processes as well as of how the aggregated opinions of individuals shift over time, driven by localised environmental communication, and how this triggers subsequent changes in individual and group behaviour.

1.3 Description of the main S&T results/foregrounds

Here we give a brief account of the main achievements of the EveryAware project. We refer of course to the more technical deliverables for a detailed account of all the infrastructures the Consortium constructed as well as of all the research activities performed.

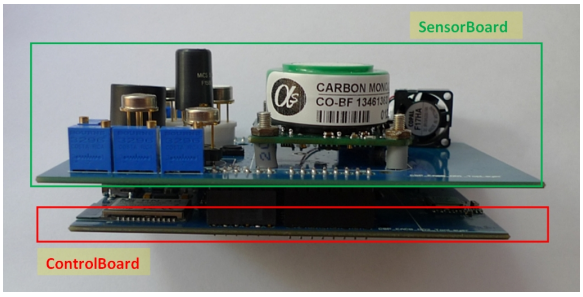
1.3.1 EveryAware platform



The EveryAware Consortium devised and realised a complex infrastructure for participatory sensing and a lot of work has been devoted to the design and the development of ICT components for the different case-studies organized in the framework of the project. Throughout the project, the overall architecture of the platform has been continuously discussed among the partners, and some key point have been fixed for the sake of an optimal result in terms of the usability and scalability of the results. The main components of the EA platform are depicted in Figure where one can identify the following elements:

- **SensorBox**: this is the system made of custom hardware and firmware that allows the integration of the air quality sensors and communicates with the smartphone through a Bluetooth connection;
- **Smartphone and dedicated apps**: throughout a software application, it acts both as data gateway (using standard mobile data connection) and as a local system and user interface;
- **Local User**: it is the user equipped with the mobile platform acting as a mobile sensing probe; other users can just interact with the system through the back-end, and see the output of the data collection;
- **Back-end**: this part of the system collects, elaborates and publishes the collected data; this part is described in the deliverable D2.1.

The SensorBox



The SensorBox adopted in the large-scale case-studies is already the second version produced after a strong effort in integrating most of the components in order to reduce weight and dimension. The *SensorBoard* design implements the sensor positioning that brings a smaller board with an optimal air flow over the sensors. A small fan is used to push the air inside the sensor chamber. Output signals can always be regulated by the trimmers and an LC filter has been inserted for each sensor in order to reduce high frequency noise. The *ControlBoard* has been integrated in a single PCB including the Arduino Mega 2560 design with the other devices, such as Bluetooth, GPS and

micro SD card. These components are different from the ones used in Version 1 because they have been found as smaller, requiring less power and with improved signal strength. A 5 V voltage regulator has been added to avoid voltage drop from the battery and stabilize supply voltage. This implies also a better gas sensor output signal. The firmware on the microcontroller is an improvement of the previous version, doing an oversampling and filtering of the sensor output (10 times per second). This way it is possible to reduce the high frequency noise further. The SensorBox is powered by an external USB battery because it allows to be more flexible on the choice if a larger battery (capacity, weight and dimension) is preferred over a smaller one or vice-versa, according to the specific use case.

The geo-localization of the collected data is done with a *GPS receiver*. After some initial discussions, the partners of the project decided to place a GPS chipset inside the SensorBox, even if modern smartphones are usually equipped with a GPS chipset too. This approach mainly has two positive points: the former is that the SensorBox becomes a mobile data logger that is independent from the smartphone except for the communication with the back-end. The latter is that it is well known that the GPS causes lot of energy consumption, and in the chosen configuration this part of the energy is sinked from the battery of the SensorBox, leaving almost unchanged the battery life of the user's smartphone.

One of key point about the SensorBox is that it integrates *low cost gas sensors* in order to keep the final production price of the hardware low, and have a larger production capability. The optimal trade-off between sensor price and quality has been an important part of the study of the project, and the results obtained are presented in the Deliverables of WP1 (D1.1 and D1.2).

It is important to briefly comment on the calibration procedure of the SensorBox.

SensorBox calibration

Following the analysis of sensor abilities and conclusions from Deliverable 1.1, we have proceeded with calibration of the SensorBox. Issues identified by our initial analysis included sensor sensitivity to temperature and humidity, hence the decision to include a temperature an humidity sensor in our sensor array, sensor drift in time and sensitivity to other gasses. Hence one needs to calibrate devices against a reference in order to control for this issues and obtain a measurement meaningful for the user.

Calibration means performing simultaneous measurements with the SensorBox and a reference device, and then train a model that is able to map the values measured by our sensor array with the values recorded by the reference. We have used artificial neural networks (ANNs) for this regression task. For reference, we used micro-aethalometers (see Figure), which provide high quality measurements of black carbon (BC), however at a much higher cost (about 30 times more expensive than our SensorBox).

Calibration started in Turin, where the sensor boxes were built. There were several stages in data collection and model training, due to lessons learned on the way. The analysis and experience from Turin was then applied to the other cities for the calibration of the sensor boxes used during the AirProbe International Challenge (APIC).

The calibration work allowed to come up with one single calibration model valid for different boxes used in the same location, taking into account the possibility of measurements performed indoor and outdoor, stationary (SensorBox fixed) or dynamics (SensorBox in motion) and in different whether conditions and seasons. The results we obtained are really encouraging (see Fig. 1.1 for an example) and represents a proof of concept for the possibility to successfully adopt low-cost

gas sensors for air-quality monitoring in a participatory sensing setting.

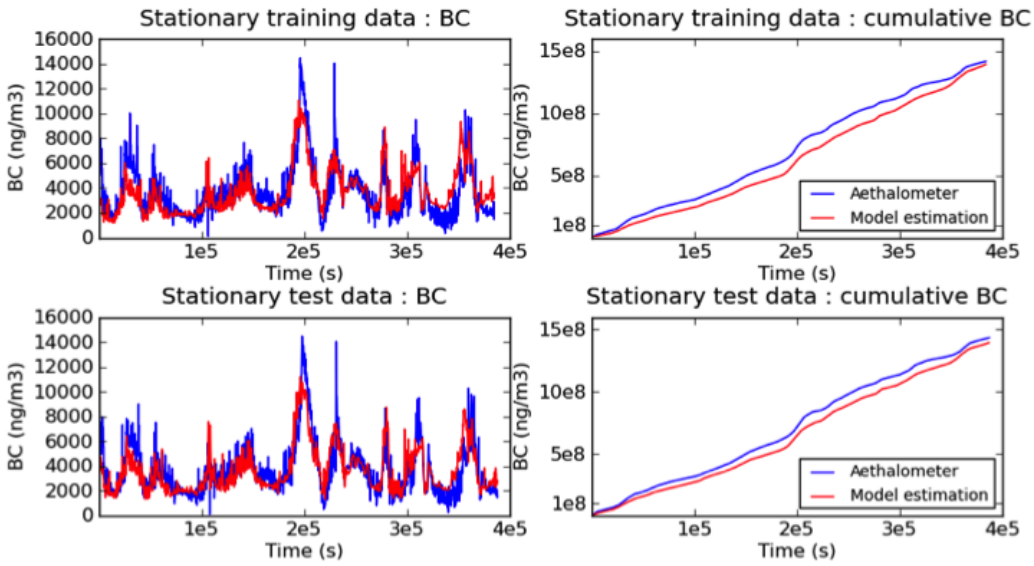


Figure 1.1: Comparison of the Air-Quality Index as obtained from the SensorBox and the Black Carbon (BC) values as measured through a reference microethalometer in a stationary situation. We display both instantaneous values and cumulative value of BC.

Widenoise app

EveryAware freely delivered WideNoise, an app (for iPhone and Android devices) that helps monitoring the noise pollution in our environment and understand the soundscape around us.

WideNoise has a long history, from being a pioneering iPhone “spime” to being the showcase product of WideTag’s OpenSpime protocol and WideSpime infrastructure. After being awarded the inclusion in the ADI Design Index 2011 and being cited as the Top 10 Internet of Things object of 2009 by the New York Times and Read Write Web, version 3.0 has been updated as a social research tool within the EveryAware project. In the framework of the EveryAware project WideNoise was completely redesigned in order to make it more like a professional tool. With the cooperation of the EveryAware project WideTag added some additional features like the slider to try and guess how much noise is there and the panel to add more details about the sampled noise itself (i.e., add perceptions as depicted in Figure, and tags). All the raw data detections are being sent to the EveryAware server for collection. The application is free, its source is released with an open license. EveryAware exploited Widenoise in many different case studies in London, Rome and Antwerp and worldwide through the Web. Through these case studies the Consortium gathered important data to address the issue of data coverage as well as

the interplay between subjective and objective data.

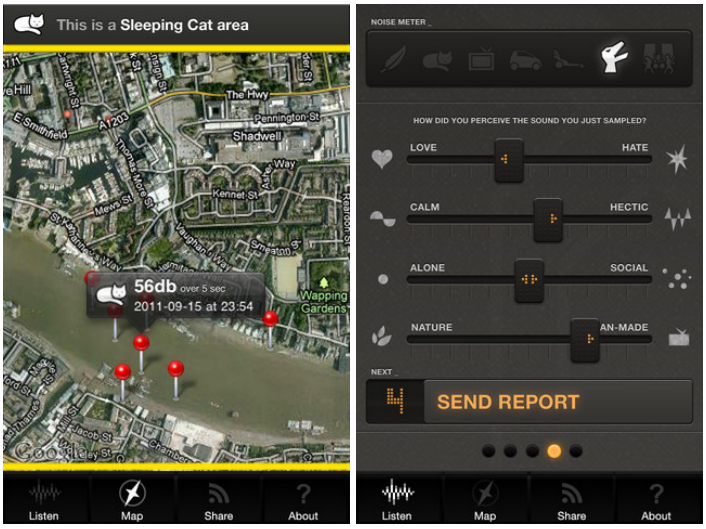


Figure 1.2: WideNoise map view (left) and WideNoise perceptions slider view (right).

Airprobe app

AirProbe is an Android application designed to connect to the SensorBox via Bluetooth, acquire sensors readings and transit them to the EveryAware servers as soon as a working connection to the Internet becomes available. Without this application, the sensor box data cannot be accessed nor uploaded to the servers. In addition, the application allows users to visualise the data they collect. Specifically, they can see their tracks on a map, calculate an estimated black carbon exposure and follow sensor output in real time plots. While collecting data, users can make free annotations (tags) that will be attached to the recordings and sent to the servers. AirProbe is freely available for the Android platform and can be installed from Google PlayStore. Please refer to deliverable D1.1 for more details about the design principles of AirProbe application.

In the final implementation, AirProbe can operate in different modes: Live Track, Synchronisation and Browsing. In the Live Track mode (depicted in Figure) the application will search for Bluetooth devices nearby and present the user with a list of found devices. EveryAware sensor boxes can be easily identified by their MAC suffix. Once the user has selected the sensor box, AirProbe starts displaying real time data collected by the sensor box, using the Bluetooth connection.

In the Synchronisation mode AirProbe downloads data from the sensor box and uploads them to the EveryAware server. The sensor box in this case is used as a pure data logger, allowing the user to send data only in suitable conditions (e.g. where battery lifetime and/or connection billing are not a problem). Finally in the Browsing mode the app does not require an active Bluetooth connection to a SensorBox and can browse the list of available tracks on the mobile device.

Each user has the possibility to associate the data gathered to a personal account existing on the EveryAware server in order to access anytime his/her own data, inspect and display them for further analysis.

1.3.2 Gaming platform

EveryAware was committed to gather information about how people perceive their environment, what they think and how they behave. Gathering this kind of data can be a treacherous task because, by definition, they can be obtained only from humans. There are several strategies to

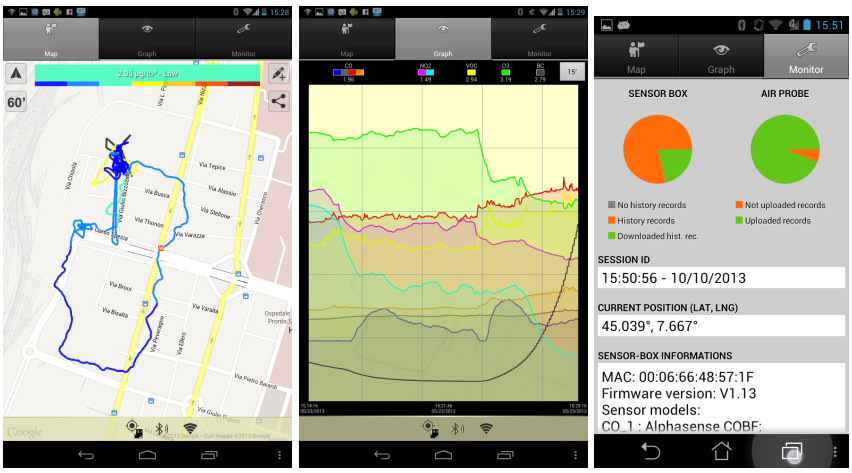


Figure 1.3: AirProbe: Live mode

get these information. The most common approach is data mining, for example by performing a web-crawling of a social network. In this way, people opinions are gathered together with a lot of less useful information, and it is difficult to isolate the interesting part. Beside this, the approach is implicitly "passive", let us say just observational, so it may be subject to a lot of uncontrolled, and often unknown, biases. EveryAware opted for a more direct approach, exploiting the potential of the Web to realize web-based experiments.

The use of web-based games [von Ahn et al., 2006] for research purposes is a fast spreading phenomenon, changing the way research activities are conducted and how data are generated in many scientific fields. Here the word "game" is intended as an interaction protocol among a few players implementing a specific task as well as a synonym of experiment on interactive behavior. Two paradigmatic examples are *Foldit*[1] [Cooper et al., 2010], a game in which players are challenged to guess the 3D structure of a protein, and *Planet Hunters*[2] [Fischer and et al., 2011], by which participants can help in identifying new extra-solar planets using NASA data of star brightness. The above mentioned projects have in common the involvement of individual volunteers or networks of volunteers, many of whom may have non specific scientific training, to perform or manage research related tasks in scientific projects. In this sense there are two examples of *citizen science* [Arnstein, 1969; Goodchild, 2007b; Paulos et al., 2009], i.e., a long-standing series of programs traditionally employing volunteer monitoring for natural resource management.

Though an increasing number of tools starts to be available, still the coding overhead for researchers to set-up web-based experiments is very high, especially in areas related to the social sciences. Individual solutions to such problems often remain insulated with little or no cumulative growth of tools and solutions. This is the reason why it is important to develop a versatile platform to implement social *games*, to take advantage of the game motivation. This has been that aim of Experimental Tribe, or XTribe,

Xtribe is a platform for web-based experiments and social computation, currently available in beta version at `www.xtribe.eu` as showed in Fig. 1.4. Xtribe aimed at both gathering otherwise separate efforts to use web resources for scientific purposes and at providing the community with a tool to design experiments on the web, bypassing much of the "hard work". The benefit is twofold: on the one hand, it allows virtually any researcher to realize his own experiment with minimal effort, paving the way of the use of the web as a standard "laboratory" to perform experiments. On the other hand, it can be a strong "basin of attraction" for people willing to participate to experiments,

[1] `http://fold.it`
[2] `http://www.planethunters.org`

making in this way recruitment much more easier than for single-experiment platforms.

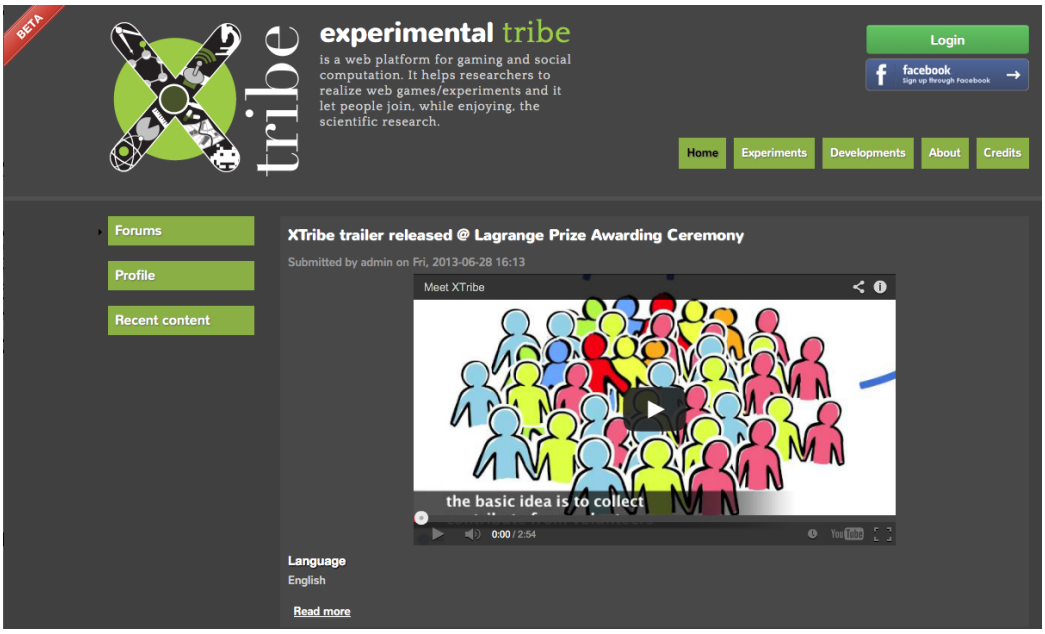


Figure 1.4: Screenshot of the Xtribe platform

The idea behind Xtribe is quite simple. When implementing a web experiment there are a lot of parts which have almost nothing to deal with the experiment itself and are common to almost all the kinds of web experiment, such users handling, interface hosting, security and privacy issues, etc. Xtribe can take care of all these aspect allowing researchers to focus only on the interface and the logic part of the experiment. Thanks to Xtribe it is possible to implement a simple multi-player web-game, with a users registry, a rank system and a tutorial page in a few hours.

The EveryAware Consortium largely exploited the Xtribe platform for several games/experiments. The most interesting ones, in the context of the EveryAware project, are *Blindate* and *Joe's City Race*. *Blindate* is a collaborative game, very close to the well known *Schelling's Games*, first introduced in the early '60s [Schelling, 1960]. In Schelling's original version (one of many similar problems), two players, unable to communicate with each other, were asked to find a point on a map where to meet, i.e., they had to find a strategically salient "focal point" among a potential infinity of solutions to the coordination problem. In the Xtribe version of Blindate, two players, again unable to communicate to each other, are shown a portion of the map of a real city and are asked to point to a location in a given area where they think it is more likely to meet each other. The reward is a score depending inversely on the distance between the guesses. They can guess for a maximum of 5 times if their guesses do not match. In addition, after the choice, participants may optionally explain with suitable tag words the reason of their choice. These tag words or, alternatively, the direction or the distance between the previous guesses can be given to the other player as hint. *Joe's City Race* is a web game designed to facilitate the analysis of the response of individuals to environmental information. To this end, players are asked to draw a route between two points in a city, having local information available. At the moment, the game is implemented with traffic data, but variants are already foreseen exploiting different kinds of geo-localised data, e.g. data about urban pollution.

Finally Xtribe has been exploited in the AirProbe International Challenge (APIC) that will be discussed in details below. In this framework a brand new game, AirProbe, has been released.

The AirProbe web game is a simplified kind of map management game. We reported in Fig. 1.5 the interface of the game. Players are called to fulfil their role of *Air Guardians* by annotating the

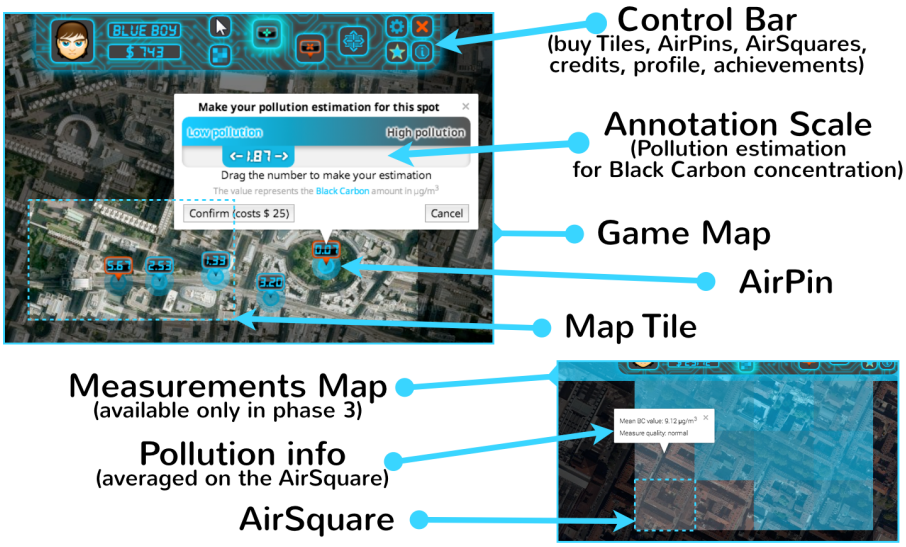


Figure 1.5: Screenshots of the game interface, with indication of the main entity and tools.

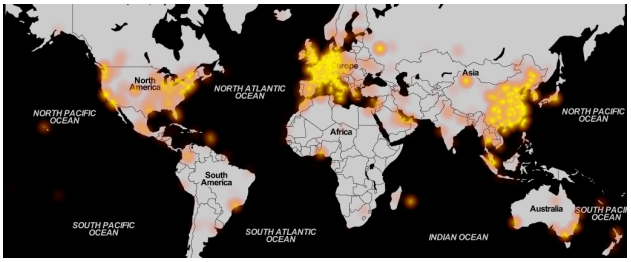
map with AirPins, geolocated flags with an estimation of the pollution level identified as the level of Black Carbon in $\mu g/m^3$ within a scale from 0 to 10. A system of revenues is implemented based on the accuracy of the estimates as compared with actual field measurements realized with the SensorBox (see section below about the Air Quality case-study).

1.3.3 Noise pollution case study

The EverAware Consortium organized a large-scale case study focused on noise pollution. Noise pollution is a problem in cities across the world and is one that is likely to affect an increasing number of people with the majority of the global population now living in urban areas. In Europe, this has been recognised and abatement measures have been introduced in many countries. However, noise pollution, in particular, is an environmental problem that relies heavily on 'top down' approaches, both in terms of communicating the issue, through instruments such as strategic noise maps, but also in the methods used to gather data. For example, strategic noise mapping became a requirement of all Member States under the EU's European Noise Directive (ENDS). The maps are used to estimate population exposure to noise in certain areas, to communicate to the public and as a basis for action plans [Commission et al., 2002].

Exposure to noise is not merely a case of annoyance. Researchers have provided a growing body of evidence that suggests that long-term exposure to noise constitutes a health risk hazard and can modify social behaviour, cause annoyance [Passchier-Vermeer and Passchier, 2000], increase the risk of cardiovascular diseases [Babisch et al., 2005] and adversely affect levels of attentiveness and the ability to read in children [Haines et al., 2001]. The World Health Organisation (WHO) estimated that at least one million healthy life years are lost every year from traffic-related noise in the western part of Europe [Fritschi et al., 2011].

New participatory sensing applications that exploit information and communication technologies (ICT) are providing novel approaches to environmental monitoring. Simultaneously, they present an opportunity to widen citizen engagement and participation in local, regional and global environmental issues. This has been enabled, in part, by the relative affordability and growth in the number of smartphones in use, now estimated to have breached the 1 billion mark [Alexander, 2012].



With this aim in mind EveryAware freely delivered WideNoise (recently renamed as *WideNoisePlus*), an app for iPhone and Android devices that helps monitoring the noise pollution in our environment and understand the soundscape around us. Widenoise is a smartphone application developed within the EveryAware project, which was designed not merely as a measurement tool for its users, but also as a means to monitor opinions on the environment and noise, in a way as transparent to the user as possible. Hence the application has several features that allow for subjective/personal data to be acquired.

Throughout the project the Consortium organized many different test-cases (e.g., Rome, Turin, London, Heathrow, Kassel, Antwerp, etc.) on noise pollution and expanded its user basis, as witnessed by the Worldwide sample density illustrated in Figure. In addition, thanks to the open character of the app data have been gathered worldwide also independently of the specific actions taken by the Consortium.

Through all these case studies the Consortium gathered important data to address the issue of data coverage as well as the interplay between subjective and objective data. Figure 1.6 shows the number of measurements collected each day since December 2011. The higher spikes correspond to case studies or public advertising of our application.

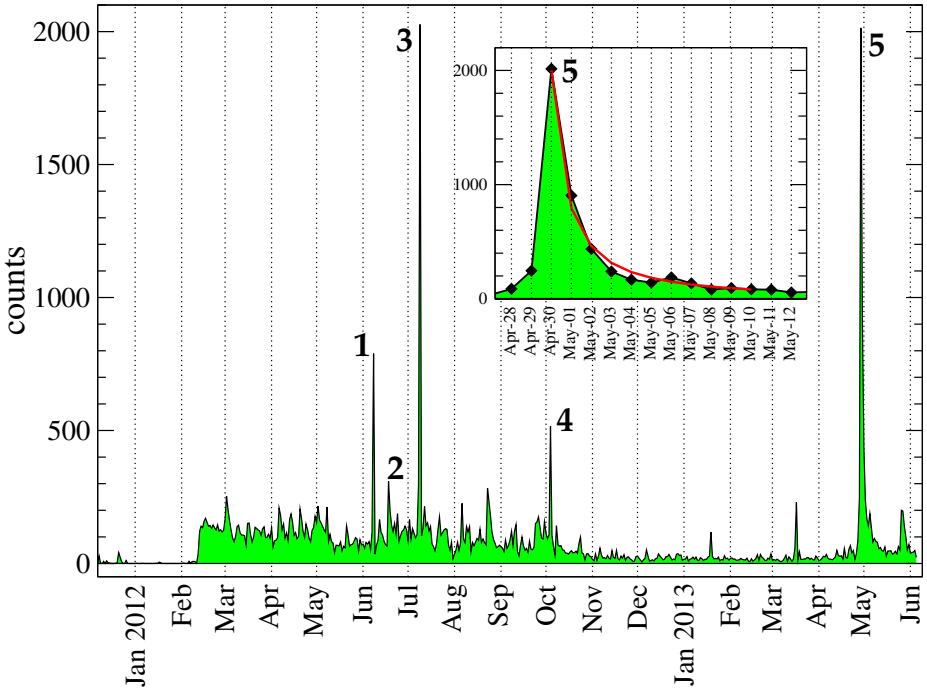


Figure 1.6: **Measurements per day.** Number of measurements collected each day from Dec. 8th 2011 till Jun. 6th 2013. The labels correspond to: (1) case study in Rome (9th June 2012); (2) launch of the Heathrow activities (19th June 2012); (3) Antwerp test case (10th July 2012); (4) Birmingham workshop (5th October 2012); (5) article in German regional newspaper (published 29th April 2013, activity peak on the 30th of April 2013). In the inset an enlarged view of event 5 is showed. The decay of user participation is consistent with a power-law of exponent $-\frac{4}{3}$ (red curve).

By means of the subjective data collected during measurements, we performed an analysis of user awareness. The interest is in assessing whether usage of the application leads to any change in behaviour, and whether this change indicates an increase in awareness of environmental noise and its effects. For this study, only data collected by users not belonging to the EveryAware consortium is considered (38267 measurements).

A first analysis of awareness/learning involves studying the decibel values estimated by users, in comparison with the measured values. Figure 1.7 displays the estimated vs real noise level, with light-coloured small points corresponding to early measurements by a single user, while dark large points corresponding to later measurements. Hence, the size and darkness of points displays user expertise. The figure shows larger darker points closer to the diagonal compared to lighter ones, which means that the estimation is closer to the measured value for later measurements. This indicates that during repeated usage of the application the ability of users to guess the noise level around them increases, hence the user learns in time.

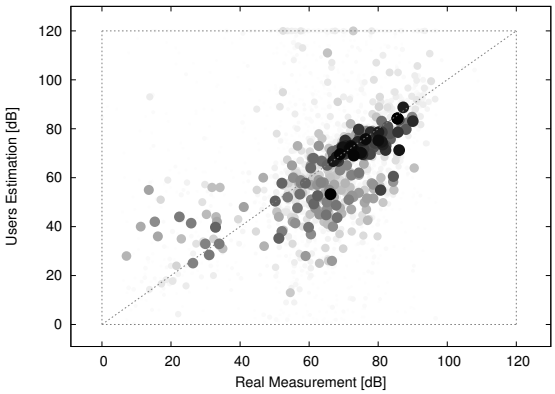


Figure 1.7: **Estimated versus measured noise.** Each point corresponds to one measurement, while both the colour scale light to dark grey and the point size represent the user expertise (small to large amount of previous measurements).

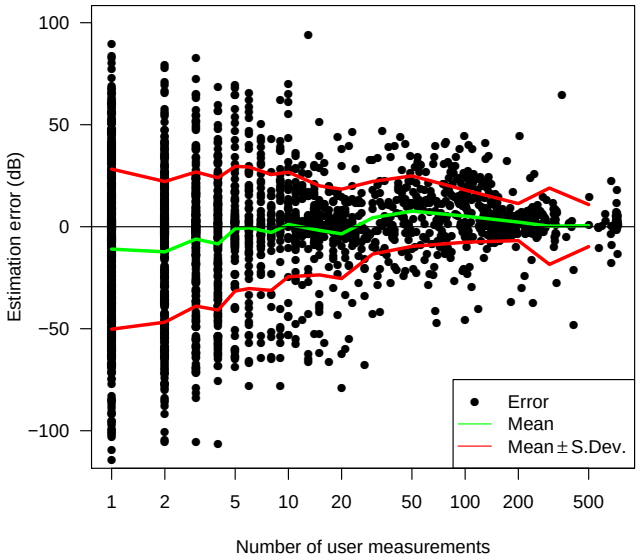


Figure 1.8: **Estimation error.** Difference between estimated and real dB value vs the number of measurements a user has performed.

To emphasise this point, Figure 1.8 shows the difference between the estimated and the real noise level as the users repeatedly perform measurements. Averages and standard deviations are also displayed. This shows that as the expertise increases (number of measurements by the same user

- horizontal axis), the errors become closer to zero and deviations from the mean decrease.

Using these data, an analysis of user behaviour/opinions that may emerge after usage of WideNoise has been performed. Figure 1.9 includes two curves. One shows average perception levels for the first 5 measurements of every user, as a function of noise, while the other shows perceptions for measurements performed after some expertise has been gathered, i.e. more than 50 measurements.

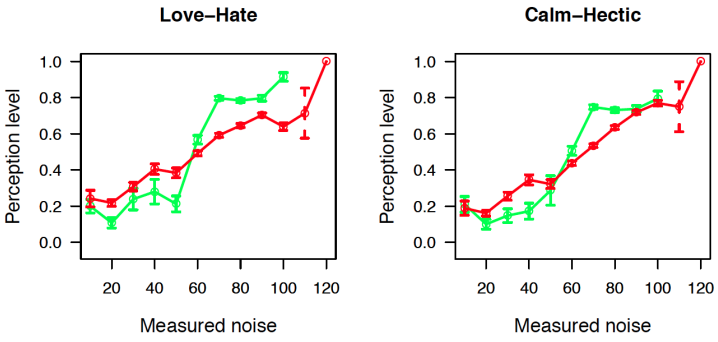


Figure 1.9: Perception evaluation versus the measured noise level. The red lines display the average evaluation over the first five measurements of all users; the green lines correspond to the average evaluation over the set of all measures taken by users starting from the 50th one.

The two curves show a different behaviour for novice and expert users Changes in behavior are indeed visible after a user performs several measurements, which is a strong indication of increased awareness and learning. Specifically, noisy environments are perceived as less pleasant and more artificial as the users become more experienced, while quiet environments as more natural and lovable. A switch between the two possibilities is observed around 55-60 dB, for all three types of perceptions, indicating this as a threshold where noise becomes bothersome. This shows that indeed, exposure to information from the noise application does influence the way in which users perceive the environment. Experienced users have a more stringent evaluation of their environment, and stronger opinions about how much they love or hate the noise levels around. A categorisation of the noise levels appears to emerge, with plateaus visible for high and low levels of noise, when considering data from experienced users.

Although initial signs of learning and increased awareness have been found already at this level, the usage of the application and evaluation of indicators such as those presented here will be continued in the future. Additionally, an in depth study of several data components is envisioned for future work, such as a semantic analysis of tags, which could give further important insight into both the motivation and opinion of users about their environment.

1.3.4 Air-quality case study

Air pollution has an important effect on our health, with an increasing number of studies showing higher risk of respiratory and cardiovascular diseases for people exposed to higher pollution levels [Lave and Seskin, 2013]. In this context, keeping air pollution at bay has been a major priority for policy makers in the past decades. A lot of efforts have been done in monitoring and controlling air pollution. Large scale monitoring networks routinely monitor pollutants. They allow to follow up temporal trends in air pollution. Significant efforts have also been made to make information accessible to the broad public. However, several papers indicate that official monitoring networks do not have sufficient spatial coverage to provide detailed information on personal exposure of people, as for some pollutants, this may vary substantially among micro-environments [Dons et al., 2012; Kaur et al., 2007a], i.e. in urban, traffic-prone areas spatial variability is very high [Peters et al., 2013; Setton et al., 2011]. Several pollution sources have been addressed with success. However, persistent problems remain in urban areas, where traffic and domestic heating are important sources [European Environment Agency, 2013]. Next to the technical solutions (e.g. electrical

mobility), people's personal perceptions, behaviour and choices play a major role in addressing these issues and facilitating change in a bottom-up manner.

Figure 1.10: Poster of the EveryAware AirProbe International Challenge.

Participatory sensing, involving citizens in environmental monitoring, can have multiple potential benefits. Firstly, it can increase coverage of monitored areas, both in time and space, due to the possibility to distribute the monitoring activities to multiple individuals [Hasenfratz et al., 2012]. Secondly, the act of monitoring pollution by citizens could facilitate learning and increase their awareness of environmental issues (see for instance the Rio declaration on environment and development, UN General Assembly, 1992)

The EveryAware Consortium set up a large scale international test case, the AirProbe International Challenge (APIC), organised simultaneously in four cities: Antwerp (Belgium), Kassel (Germany), London (UK) and Turin (Italy). In this experiment a web-based game, air quality sensing devices and a competition-based incentive scheme were combined to collect both objective air quality data and data on perceived air quality, to analyse participation patterns and (changes in) perception and behaviour of the participants. The test case was organised as a competition between the cities, to enhance participation. To that extent, for the first time to our knowledge, an end-to-end scientific platform for participatory air pollution sensing, developed as part of the EveryAware project, was used. This platform has been described above.

During this test case, volunteer participants were asked to get involved in two types of activities. The first one consisted in using a sensing device (the SensorBox described above), to measure air pollution (black carbon (BC) concentrations) in their daily life, generating what we call *objective* data. The second activity was playing a web game (AirProbe), where volunteers were asked to estimate the pollution level in their cities, by placing flags (so called *AirPins*) on a map and tagging them with estimated black carbon (BC) concentrations on a scale from 0 to $10\ \mu g/m^3$, resulting in *subjective* data on air pollution (perception). Volunteers involved in the measuring activities were also encouraged to play the game and bring other players as well.

The two data types allow for an analysis of user behaviour and perception throughout the challenge. To enable this, the test case was composed of three phases. In phase I, only the online game was available, so we could obtain an initial map of the perceived air pollution. In phase II the measurements started in a predefined area in each of the cities (corresponding also to the game area), with the web game running in parallel. Phase III introduced a change in the game, so that players could purchase (with virtual money self-consistent within the game) information about the real pollution in their cities. At the same time, measurements were continued, this time without a restriction of the area to be mapped.

A very important aspect when monitoring air-quality in a participatory way is coverage, both in space and time. Measurements have been performed at all hours of the day and days of the week. However, usually, not all areas are covered equally. Figure 1.11 shows general information about coverage achieved. In order to compute the coverage, the area of each of the four participating cities was divided into 10 by 10 meter squares (tiles). One square was considered covered if at least one measurement was performed within its area. However, since pollution levels vary both

in time and space, it is important to have more measurements in the same location. So, for each tile, we also look at how many measurements it contains, with larger numbers indicating better temporal coverage. The left panel of Figure 1.11 shows the distribution of the number of data points per covered square, and this appears to follow a power-law. This means that many areas were covered sparsely in time, however there are some locations where many measurements were performed (up to 100,000 points). These correspond, most likely, to hubs in the cities.

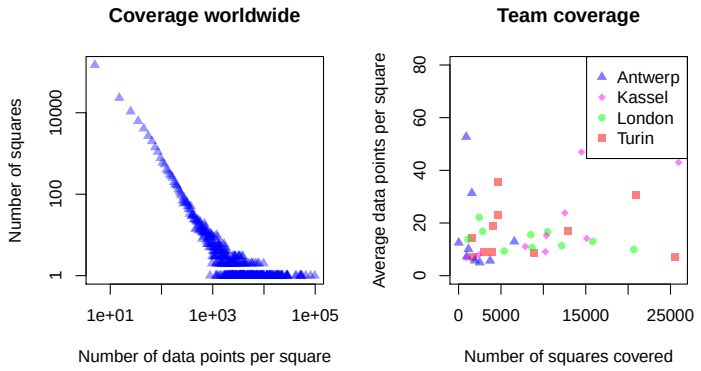


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Figure 1.11: **General coverage data.** Left panel: distribution of number of data points per 10X10 meter square covered. Right panel: Number of squares covered and average number of data points per square for individual teams. The team location is represented by the different plotting symbol and colour.

During the challenge both objective and subjective data on air pollution were collected. Objective data consisted in air quality measurements performed in the four European cities. We obtained in total over 6 million geolocalised data points, with an additional 3 million without geolocation. This shows the large involvement of the volunteers. Subjective data were mainly collected through the APIC web game. These were used to analyse participatory patterns and possible changes in behaviour or perception.

Objective measurements and associated GPS data allowed for analysis of user interests during the challenge, as well as learning. Both coverage and pollution levels measured indicated a tendency to monitor familiar areas, with a search for highly polluted spots. However, as users become more familiar with an area, the levels of pollution decrease in the data, a first indication of learning how to avoid high pollution levels, but also a decreased interest in locating highly polluted spots.

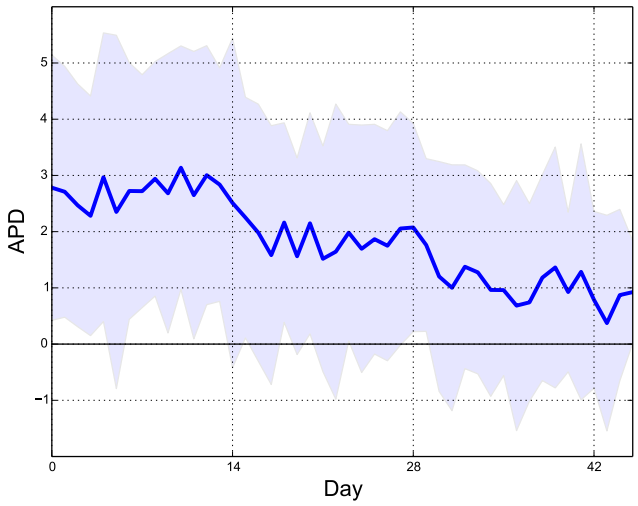

Figure 1.12: Daily APD average (and standard deviation) in the APIC web game. The APD is the difference between volunteers pollution estimations and the measured values they were able to consult in phase III.

Subjective data, on the other hand, allowed for analysis of perceived pollution levels. Volunteers started with a sharp categorisation in polluted and non-polluted areas, with pollution levels largely overestimated. Thanks to the feedback obtained from data gathered through the SensorBoxes, these predictions were progressively adjusted. This shows that involving volunteers in monitoring campaigns can help learning to build a more accurate perception of air quality issues.

As we outlined earlier, volunteers playing the AirProbe web-game received hints about real pollution levels in phase II by the Air Ambassadors and in phase III from the web-game itself. In fact, in the last two weeks they could purchase in-game mean information about pollution. Both information sources affected the annotations of the players, as is clearly visible in Fig. 1.12, which shows the daily average deviation between users' predictions and measured values (named APD). This deviation can be thought of as the error in the estimation of the players. Two main facts can be observed. First, the overestimation of the pollution levels, which can be interpreted as a blank slate effect. At the beginning of the case study users did not have any hints about a reasonable scale for the pollution levels and presumably tended to use as a reference the middle point of the scale (~ 5 $\mu g/m^3$), while the real average values were around ~ 2 $\mu g/m^3$. Another important observation about Figure 1.12 concerns the progressive reduction over time of the deviation between predictions and actual values (APD). On average we observe a drop of about 1 $\mu g/m^3$ at each phase change. This reduction is a clear signature of a learning process: players are presumably progressively learning the right pollution levels though one cannot completely rule out the possibility that they are simply *copying* the available information. This point deserved a further investigation.

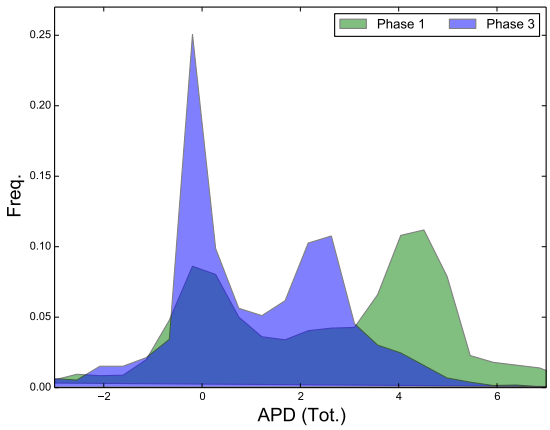

Figure 1.13: Phase I and Phase III distribution of APD (APIC web-players estimation errors) calculated from data for all cities.

From Fig. 1.12 it is also visible that, in each phase, the accuracy of the predictions seems to be steady enough, while changes occur mainly at the phase changes. For this reason we aggregated data per phases, and measured the distribution of the APD, separately in each phase and in each city. For the sake of brevity, we only report in Fig. 1.13 the APD distributions (cumulative for all the cities) in the first and last phases. From this graph we can read how and how much people tend to be wrong in each phase. We found again the initial pollution overestimation already observed in Fig. 1.12 in the first phase. If people were just copying available information (from inside the game) we would expect, in the third phase, a very narrowly peaked and symmetric distribution around 0 $\mu g/m^3$. We observe instead something quite different, namely the expected peak around zero, though with non-symmetric tails and more importantly a secondary peak around 2 $\mu g/m^3$, presumably a the outcome of a sort of inertia of users in changing their predictions with respect to the original peak at around 4 $\mu g/m^3$. Similar observations can be made separately in each city. A simple statistical model allows to account for the change from phase I to phase III, based on simple assumptions on users' behaviour.

In summary, our data seems to suggest that people involved in our case study coherently, even though not completely, displayed a tendency to change their predictions (and presumably their mind) about the pollution levels around them. It is fair to say that they learned something about air-quality levels and they consequently modified, at least partially, their vision of their urban envi-

ronment, even though this shift has been demonstrated only in the virtual framework of the APIC web-game.

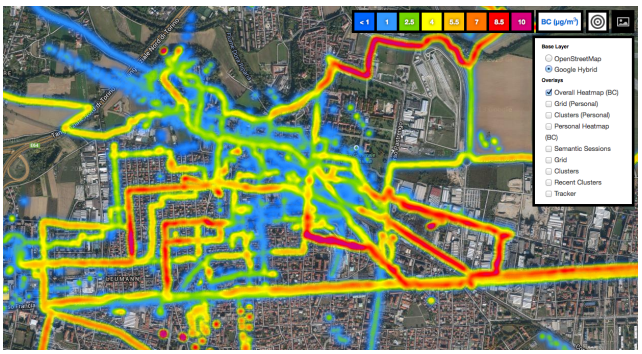

Figure 1.14: Air-quality map collected during the Collegno case-study.

Another interesting initiative involved an high-school in Collegno (Turin). A small-scale case study has been organized to involve a whole class of the local Liceo Scientifico, twenty eight 15-years old students along with their professors. For three weeks the students monitored their home-school paths and also competed to find the most and the least polluted paths in their city. The case-study has been the opportunity for the class to pursue a very peculiar learning path, involving all the teachers: Physics and Mathematics for analyzing and making sense of the data gathered, Science and Biology for the impact of pollutants, English and Italian for writing about their experience. All in all the event has been a proof of concept for an innovative learning scheme, more problem-oriented and curiosity driven. A final event celebrated this case-study hosted by Collegno's major.

1.4 Potential impact, dissemination activities and exploitation of results

1.4.1 Technological impact

The project meant to be a driver of several emergent ICT technologies, and given that there is a clear vision of the application, we are confident that that these technological developments will be relevant to the society and deployable in practice. The state of the art in several areas of future and emerging ICT had to be pushed forward: the calibration of low-cost sensors not intended for air-quality monitoring; the linking of sensors to mobile phones; storage and data management on mobile phones in interaction with aggregating web resources, including existing social networks; improved localisation by integrating GPS; Internet access points and phone tracking; extraction and integration of geometric models and maps from various data sources.

Hardware and software technology (specifically the SensorBox, the WideNoise App, the Air Probe App and the noise and air-quality website) formed a fundamental part of the EveryAware project. The effort required to develop, calibrate and maintain the tools used for this and other citizen sciences projects is considerable, and as with many research projects the importance of a flexible development process, with developers willing to respond to feedback from other team members (initially) and from participants (during pilot and full scale Case Studies) has been fundamental to the success of the project.

An important impact of the project in this context is the EveryAware platform. To date, projects that use mobile phones as a platform for urban sensing and data collection are built as a closed system and not in a modular, plug-and-play fashion. Because of the requirement in this project to use a range of sensor, the EveryAware platform will provide the foundation for future applications that can use the generic framework of mobile sensing and integrate different sensors easily. Furthermore, the EveryAware platform is unique in integrating perceptions and indication of behaviour change into the framework of the monitoring and sensing. These elements will make it widely adaptable to many other application areas.

Moreover, this approach defines a new way to design and engineer sensor devices, embedding

them inside clothes as jackets or bicycle helmets, maximising sensor exposure to the air. This solution permits to introduce in every days activities sensors and environmental measurement, without any requirement to the users. Furthermore, the mobile phone application permits to associate GPS, time and user comments to the environmental data, enriching the overall information.

As Consortium we already received many requests from Institutional bodies, local associations and individual citizens to adopt the SensorBox for monitoring air-quality in many different contexts. Though the SensorBox and the whole platform supporting it are still at the prototypical level we shortly expect to enter a pre-competitive phase to explore the possibility of a low-cost mass production of SensorBoxes for a dissemination well beyond that planned in the EveryAware project timeframe.

Contribution to standards The project tried to use as much as possible emerging standards, particularly when they are developed within the context of Open Source projects. This is a guarantee that the technology can spread easily and fast, including to citizen groups that do not have the means to heavily invest in the monitoring of their own environment. For some aspects of the overall system (e.g., participatory sensing) no standards existed yet, and they had to be proposed and published by project partners in order to open up the market to all companies that can provide components (e.g. specific sensors that can be plugged in).

1.4.2 Industrial impact

From an industrial ICT point of view, the project provided a strong input in several interesting application areas. The project may stimulate additional markets for novel products, particularly for hand held sensors connectable to mobile phones, and for the development of derived software systems that add intelligence to community memories, for example suggesting the best way to navigate through the city minimising pollution exposure. We can expect that there is a further penetration of mobile phones, personal computers, Internet usage, etc. and that their power will steadily increase, so the infrastructure created in this project will surely be largely available. Furthermore, the study about the usability of cheap sensors for the environment quality monitoring will open perspectives about the integration of new functionalities into next-generation mobile handhelds.

1.4.3 Environmental impact

This project aimed at contributing to one of the most important and pressing problems of our time: how to keep human environments and ecologies sustainable. It is suggested that it is time to have a scientific basis of adequate sensing and predictive modelling and this project made an attempt to contribute significantly to this highly important societal need. One way to sensitise and involve citizens is to personalise data gathering and model prediction and to allow mediated modelling through appealing graphical interfaces. These issues have been directly addressed in the project and we expect that they will impact significantly to raising environmental awareness. The project partners strongly think that, if personal ecological conditions and views are made measurable and visible, consensus about concerted actions will follow naturally.

A clear example of how the idea that environmental awareness can be raised when people are informed and involved in the problem is illustrated by a recent evolution in the Flanders region of Belgium. Since the end of 2006, the Flemish government has imposed a speed limitation of 90 km/h on the important motorways around the large cities during smog (particulate matter, PM) episodes. These speed limitations have had an important impact on all citizens but also have given a clear visibility to the actual environmental problem of dangerous exposure to increased PM levels. It is questionable and still under debate whether this collective restrictive action has had an effective impact onto the actual air quality. However, the speed limitations that have been

imposed now during four periods since the winter of 2006-2007, have resulted in high levels of popular awareness about the air quality problem in Flanders. This recent evolution in Flanders strengthens our conviction that the setup of the EveryAware project is going to have a huge social impact on the test local communities that will participate in the project. The methodologies and outcomes can be in a second moment successfully extended to cover larger scale communities of cities and regions of Europe.

It is well established that simple user coordinated actions can improve the efficiency of energy consumption. As an example, household appliances with relatively high power consumption should be used during night hours, rather than during the day, in order to avoid line overloads. Another pressing problem from the global energetic point of view concerns how to encourage the installation of ecological power generators in private houses, which could feed back a great amount of clean energy into the main stream lines. These problem is hard to solve because it needs people awareness as well as a sensible political side (there are regions of Europe where self-energy production is still kept forbidden).

Excessive water consumption is also another pressing problem in modern society so that local institutions throughout Europe pursued a massive campaign in the past to sensitise people and change bad eradicated behaviour. Crucial again is driving people to be aware of such problems.

Air quality assessment at the urban scale is currently performed by making use of typically a few fixed monitoring stations at some strategic locations in the city. However it is well known that due to the complexity of the city's morphology, the spatial representativeness of these point measurements can be limited, especially at places that are heavily influenced by traffic or industrial emissions. By setting up a participatory sensor network for environmental parameters such as air quality or radiations, a dramatic change is introduced in this assessment procedure. A massive set of data will become available, probably with a reduced accuracy but in contrast with unprecedented information about the spatial distribution of the pollutant. Similar impacts as described above can thus be expected in the domain of urban air quality as people get more aware of both the impact of environmental quality on their well-being, and the impact of their own activities on the exposure to pollution.

1.4.4 Scientific impact

The project is expected to make strong contributions to the various Sciences that are brought together in this multi-disciplinary setting. The research areas of computer science and complex systems, i.e. systems composed of a multitude of interconnected parts that as a whole exhibit one or more specific properties not simply discernible from the properties of the individual parts, will benefit because new sources of data will become available for analysis, namely massive quantitative data about the state of natural complex systems over time (temperature, air pollutant concentrations, etc.) and massive qualitative data about opinions and subjective experiences of citizens related to the state of the environment. It must be expected that new complex systems tools will be needed to make sense of these data and that opportunities will be created to develop better models of the opinion dynamics and social dynamics that we will be able to observe. A large number of models exists in the field of opinion dynamics, but – to date – the inherent difficulty of finding first-hand, unbiased data on social dynamics and opinion data has hampered quantitative research in the field. The direct access afforded by the platforms developed in EveryAware will fill this gap and boost analytics and modeling of opinion dynamics.

In the last years a lot of effort has been devoted, at the national and international level, to understand how environmental quality influences the perception and usage of the urban environment. Knowing the relations between urban environmental design, microclimate and climate perception is one of the key knowledge in order to design sustainable cities, especially in the context of global climate change and the expected increase of extreme heat waves. The methodology of EveryAware

demonstrated the way ahead to collect reliable databases that are large and complete enough to extract general knowledge about these feedback mechanisms.

The physical sciences, particularly fluid dynamics, specifically atmospheric sciences, will benefit because for the first time it will be possible to have a tight loop integrating large-scale fine-grained measurement and prediction. This raises very difficult issues in model assessment and data assimilation, which will advance the state of the art in the application of physical models in general and environmental models in particular.

The social sciences, specifically sociology and anthropology, will benefit because it will be possible to track the origins and development of a community and to record and monitor the changing opinion dynamics. For example, the potential to use tagging for fine-grained social geography has so far been hardly explored. Moreover we expect important new insights from testing our methods for community formation and how they evolve over time. Multi-agent modelling has already been explored in the social sciences. This project not only built further on these developments but also pushed the connections with real-world applications.

The impact on assessment methods for urban air quality, and potentially other aspects such as noise or traffic congestion, has been mentioned already in the previous paragraph. Classical air quality measurements aiming for high accuracy, are framed by the high costs for instrumentation and operation, resulting in datasets with high quality but rather poor spatial representativeness. Air quality modeling at high spatial resolution is also framed by the need for detailed input data, very high calculation times and lack of data for validation. The use of low cost sensors carried by non-skilled individuals constitutes a paradigm shift in environmental monitoring, and can become a strong alternative to fill in the need for detailed environmental data.

As a result it will be possible to have better exposure estimates so that causal relations between exposure and health will be understood more easily. Exposure science and eventually environmental epidemiology will thus greatly benefit from the results of EveryAware. Although health impacts of air pollution have been clearly and consistently demonstrated in the past, this has always required the use of large and hence expensive cohorts to be established. Because the exposure of the people in the cohorts is poorly known, exposure misclassification is a cause of major scientific concern in epidemiological studies. The experiments carried out in EveryAware take into account that people engage in different activities during the day which affects their environment and exposure to air pollution. Taking such an activity based approach will lead to a much better picture of actual urban exposure to air pollution. The most challenging scientific achievement would be to create a true “exposome”: a description of aggregate exposure that is made up of hundreds of exposure events over the day/weeks for each individual in the population.

EveryAware also provided new data analysis tools that are necessary to clean up and interpret this new type of environmental data. These tools will be of use also in other domains in which pervasive data collection techniques can be applied, e.g. in the field of traffic monitoring.

Finally, the EveryAware experience has the potential to create new means of interaction between scientists and the public, sometimes called “citizen science”. The combination of expert knowledge and the public will lead to more check-ups of the hypotheses put forward by scientists, and will be more driven by public demand as communities can start their own investigations and focus on their priorities. Groups of interested people will have complementary knowledge on their environment that classical scientists can only get hold of or understand properly at the expense of huge efforts.

1.4.5 Societal and economic impact

This project aimed at understanding the key mechanisms involved in the process of social awareness creation. Individuals tend to behave in a self-centred way, preferring immediate small gains achieved with no effort rather than more consequential long term benefits that require much greater effort. In a certain sense, individuals act in an uncoordinated way, while in most urgent situations

involving environment, economy or security, a common agreement is desirable. To overcome a person's inertia and resistance towards a new, unfamiliar action is a tough task.

Certainly, mass media help local institutions to achieve social awareness, but due to the high costs of using mass media their application is limited in practice. The most effective way to increase public awareness is through the intervention of the social network of friendship and contacts, rather than using expensive mass communication systems.

With the help of an ICT infrastructure, one can imagine that key communities could be initially composed of a small number of individuals who act as aggregators attracting more and more members. The benefits attained by the community will feed back into the community itself, favouring its growth and fuelling additional participation.

As a side effect, but nevertheless of great importance, EveryAware experience has the potential to change the way information spreads through society, empowering social communities as a vehicle of information flow, with the aim of leading people to awareness of common societal issues in the most efficient way.

Human society has always found itself confronted with a number of grand challenges. The explosive population growth over the last couple of decades has dramatically increased their scale and potential impact. In particular the environmental challenges call for a strong collaborative effort of that public at large. Understanding how to motivate such collaboration, how to ensure that participants remain motivated and engaged and how to best understand behaviour change at collective and individual levels has potential impact beyond citizen science and participatory sensing, and into the wider agenda of community participation in decision making at all levels.

The success of the Free Software and Open Source movements shows that it is possible for a community with a largely altruist agenda to exploit collaborative ICT to perform a collective task in an effective manner. What is seemingly required is the right mixture of appropriate socio-technical tools and the right incentives to motivate the collaborators.

Once these requirements are in place, the collaborative movement has the capacity to transform society. Indeed the Free Software and Open Source movements had an undeniable effect on the software industry and civilisation at large. For example, the operating system and software tools provided in the laptop by the *One Laptop Per Child* `http://laptop.org/` initiative are Open Source. This constitutes a "public" contribution created through the collaborative efforts of the Open Source community.

Policy shaping This project is expected to increase the effectiveness of distributed technologies capable of fostering awareness and measuring the degree of consensus in the population on specific policy issues. This can both be seen as a tool for policy makers to monitor the public, and as a tool for the public to influence policy making. The idea is that the availability of locally-relevant digital data, together with their analysis, processing and visualisation should trigger a bottom-up improvement of social strategies. Indeed, the use of collaborative socio-technical systems can improve the efficiency of grass-root initiatives to complement the well organised industrial lobbies. Increasing the basic data and the knowledge underlying environmental policies can lead to better, more targeted policy actions, taking underlying variability and people's concerns and priorities more into account.

1.4.6 Dissemination and/or use of project results

Given EveryAware's overall objectives, the dissemination of the project's results has been essential and it has been coordinated in a targeted workpackage, i.e., WP6. The goal of this work package was to ensure that the results of this project were adequately disseminated towards the different groups that can benefit from the project: the public at large, the scientific and engineering community, and policy makers and governmental organisations.

A partial dissemination of results has been a natural consequence of the deployment of public socio-technical systems. The various case-studies and experimental initiatives themselves promoted and stimulated the use of such systems. In addition, besides deploying concrete experiments and platforms, the Consortium is making available the resulting software tools for others to use and deploy. These tools are accompanied with appropriate documentation and tutorial texts and the tools that specifically cater for concrete communities will be additionally accompanied with clear documentation that shows interested communities how to deploy and use them.

In addition, to assure the dissemination of the results of the project to a wider scientific and non-scientific audience, the following actions have been taken:

- foster publications through standard scientific and engineering communication channels. Publish results in the best scientific journals and communicate the results of the project at top conferences. Use all the possible existing communication media to reach the largest possible audience;
- foster the exhibition of demonstrators in industrial exhibitions or in other contexts where the public at large and a broad scientific/engineering audience can get exposure to the ideas of the project.
- disseminate results to the press at large in order to diffuse them as widely as possible;
- identify all the possible actions that can be taken, beside those already described in this document, to disseminate the results to other projects and to favour synergies and possible joint activities;
- establishing and maintaining the web-based dissemination platform associated to all the scientific initiative of the projects as well as to the case studies.
- maximise the availability of tools and experimental platforms developed by the partners during the project to other related projects and to the scientific community as large;
- exploit the fact that many partners are involved in dissemination and educational activities to train students (including Ph.D. students) and to develop course material that can be used to spread further the results of this project;
- encourage the partners to organise tutorials at major conferences in the different fields that are relevant to the present project. Encourage the partners to contribute to summer schools or other educational activities which touch in particular younger students. Tutorials on subjects related to the project activities have been given by the senior scientists of the network in occasion of international workshops.
- all members of the project have been encouraged to publish their results with a special emphasis on early-stage researchers to present their work at international conferences.

A detailed list of all the dissemination activities is described in Deliverable 6.3 as well as in the following section.

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Chapter 2

Use and dissemination of foreground

A plan for use and dissemination of foreground (including socio-economic impact and target groups for the results of the research) shall be established at the end of the project. It should, where appropriate, be an update of the initial plan in Annex I for use and dissemination of foreground and be consistent with the report on societal implications on the use and dissemination of foreground (section 4.3 âĂŞ H). The plan should consist of:

2.0.7 Section A

This section describes the dissemination measures, including any scientific publications relating to foreground. Its content will be made available in the public domain thus demonstrating the added-value and positive impact of the project on the European Union. This section includes two templates:

Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES

No.	Title	Main author	Title of the periodical or the series	Source volume	Source issue	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers (if available). A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).	Is/Will open access provided to this publication? Yes/No N. B. Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.
1	Awareness and Learning in Participatory Noise Sensing	The EveryAware Project Consortium	PLoS ONE	12	8	Public Library of Science	USA	2013	e81638	http://dx.doi.org/10.1371/journal.pone.0081638	Yes
2	Naming a structured world: a cultural route to duality of patterning	F. Tria	PLoS ONE	7	6	Public Library of Science	USA	2012	e37744	10.1371/journal.pone.0037744.g001	Yes
3	Cohesion, consensus and extreme information in opinion dynamics	Alina Sirbu	Advances in complex systems	16	6	Worldscientific	International	2013	1350035	10.1142/S0219525913500355	Yes
4	Complex structures and semantics in free word association	P. Gravino	Advances in Complex Systems, 2012.	15	3 & 4	World Scientific	International	2012	1250054	10.1142/S0219525912500543	Yes
5	Why are Basic Color Names "Basic"?	A. Mukherjee	Advances in Complex Systems, 2012.	15	3 & 4	World Scientific	International	2012	1150016-1-1150016-13	10.1142/S0219525911003426	Yes
6	Language Dynamics	A. Baronchelli	Advances in Complex Systems, 2012.	15	3 & 4	World Scientific	International	2012	1203002	10.1142/S0219525912030026	Yes
7	Cyclist exposure to UFP and BC on urban routes in Antwerp, Belgium	Jan Peters	Atmospheric Environment	92	-	Worldscientific	International	2014	31-43	http://dx.doi.org/10.1016/j.atmosenv.2014.03.039	No
8	Manifesto of Computational Social Science	R. Conte	European Physical Journal Special Topics (2012)	214	1	Springer-Verlag	EU	2012	325-346	10.1140/epjst/e2012-01697-8	Yes
9	Challenges in Complex Systems Science	M. San Miguel	European Physical Journal Special Topics (2012)	214	1	Springer-Verlag	EU	2012	245-271	10.1140/epjst/e2012-01694-y	Yes
10	Emergence in fast agreement in an overhearing population: The case of naming game	S. K. Maity	Europhysics Letters	101	6	EDP Sciences, IOP Publishing, Italian Physical Society	EU	2013	68004	doi:10.1209/0295-5075/101/68004	Yes
11	A fast no-rejection algorithm for the Category Game	F. Tria	Journal of Computational Science	2	4	Elsevier	International	2011	316-323	http://dx.doi.org/10.1016/j.jocs.2011.10.002	Yes
12	Opinion dynamics with disagreement and modulated information	A. Sirbu	Journal of Statistical Mechanics, 2013.	151	1/2/2014	Springer	International	2013	218-237	DOI 10.1007/s10955-013-0724-x	Yes
13	Ubicon and its Applications for Ubiquitous Social Computing	M. Atzmueller	New Review of Hypermedia and Multimedia	20	1	Taylor & Francis	International	2014	53-77	http://dx.doi.org/10.1080/13614568.2013.873488	No
14	On the origin of the hiearchy of color names	V. Loreto	Proceedings of the National Academy of Sciences (PNAS)	109	18	United States National Academy of Sciences	USA	2012	6819–6824	10.1073/pnas.1111347109	Yes
15	EveryAware: Enhancing environmental awareness through social information technologies. White Paper.	The EveryAware Project Consortium: ISI, UCL, LUH, VITO, PHYS-SAPIENZA.	-	-	-	-	-	2012	-	http://www.everyaware.eu/wp-content/uploads/2011/04/E	Yes
16	A Flexible Database-Centric Platform for Citizen Science Data Capture, Computing for Citizen Science Workshop	C. Ellul	Proceedings on the 2011 Seventh IEEE International Conference on eScience Workshops (eScienceW 2011).	-	-	Institute of Electrical and Electronics Engineers	Stockholm, Sweden	2011	39 - 44	10.1109/eScienceW.2011.15	Yes
17	Tag Recommendations for SensorFolkSonomies	J. Mueller	Recommender Systems and the Social Web Workshop at 7th ACM Conference on Recommender Systems, RecSys 2013, Hong Kong, China - October 12-16, 2013. Proceedings	-	-	CUER-WS	Aachen, Germany	2013	1066	http://ceur-ws.org/Vol-1066/Paper9.pdf	Yes
18	The EveryAware SensorBox: a tool for community-based air quality moonitoring	B. Elen	SCW Conference: Sensing a Changing World	-	-	-	Wageningen University, The Netherlands	2012	-	http://www.wageningenur.nl/upload_mm/b/6/a/f2f818	Yes
19	Engaging with local communities: A review of three years of community mapping. Urban and Regional Data Management	C. Ellul	UDMS Annual 2011 - Proceedings of the Urban Data Management Society Symposium 2011, edited by Massimo Rumor CRC Press 2011, pp. 165-177.	-	-	CRC Press	Delft, Netherland	2011	165 - 177	10.1201/b11647-16	Yes
20	Modeling Location-Based Profiles of Social Image Media using Explorative Pattern Mining.	F. Lemmerich	Proc. IEEE SocialCom 2011, Workshop on Modeling Social Media MSM 2011, IEEE Computer Society, 2011.	-	-	Institute of Electrical and Electronics Engineers	Boston, USA.	2011	1356 - 1363	10.1109/PASSAT/SocialCom.2011.186	Yes
21	3rd workshop on recommender systems & the social web (2011)	J. Freyne	Proceedings of the fifth ACM conference on Recommender systems, ACM	-	-	Association for Computing Machinery	New York, NY, USA.	2011	383 - 384	10.1145/2043932.2044014	Yes
22	Consensus in Language Dynamics: naming, categorizing and blending	V. Loreto	Book chapter in the festschrift in honor of Prof. William S-Y. Wang's 80th birthday, Feng Shi and Gang Peng, 2012.	-	-	City University of Hong Kong Press	International	2012	451-482	http://www.everyaware.eu/resources/publications/	Yes
23	The Blending Game: emergence of duality of patterning in an interacting population	F. Tria	Chapter in book, Luc Steels ed., Springer, 2012	-	-	Springer	International	2012	-	http://www.everyaware.eu/resources/publications/	Yes
24	Geography and HCI	Haklay, M	CHI 2013 Workshop on GeoHCI	-	-	-	Paris, France	2013	16-18	http://www-users.cs.umn.edu/~bhecht/geohci2013p	Yes
25	Development of a low-cost mobile sensor-system for participatory measurements of urban air quality	Peters, J.	COST Action TD1105 EuNetAir 1st International Workshop, Open Satellite Workshop inside Transducers 2013	-	-	-	Barcellona, Spain	2013	15-16	http://www.eunetair.it/cost/workshops/Barcelor	Yes
26	Participatory Air Quality Sensing	Peters, J., Theunis, J., Elen, B.	COST Action TD1105 EuNetAir 2nd International Workshop 2014	-	-	-	Brindisi, Italy	2014	-	not yet available	Yes
27	A Generic Platform for Ubiquitous and Subjective Data	M. Becker	1st International Workshop on Pervasive Urban Crowdsensing Architecture and Applications, PUCAA 2013. Proceedings	-	-	ACM	Zurich, Switzerland	2013	1175-1182	http://dx.doi.org/10.1145/2494091.2499776	No
28	Subgroup Analytics and Interactive Assessment on Ubiquitous Data	M. Atzmueller	Mining Ubiquitous and Social Environments Workshop at European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases, (proceedings)	-	-	University of Kassel	Prague, Czech Republic	2013	19-27	http://www.kde.cs.uni-kassel.de/ws/muse2013/proceedi	Yes
29	Experimental tribe: a general platform for web-gaming and social computation	C. Cicali	Proceedings of the NIPS Workshop on Computational Social Science and the Wisdom of Crowds - NIPS 2011 (2011).	-	-	-	Sierra Nevada, Spain	2011	-	http://www.everyaware.eu/resources/publications/	Yes
30	Ubicon: Observing Social and Physical Activities	M. Atzmueller	IEEE International Conference on Cyber, Physical and Social Computing, CPSCom 2012, Besançon, France, 20-23 November, 2012. Proceedings	-	-	IEEE	Besançon, France	2012	317-324	http://doi.ieeecomputersociety.org/10.1109/GreenCom.2012.75	No
31	XTribe: a web-based social computation platform	Saverio Caminiti, Pietro Gravino	IEEE Proceedings of the Third International Conference on Cloud and Green Computing	-	-	IEEE	Karlsruhe, Germany	2013	397 - 403	10.1109/CGC.2013.69	Yes
32	Towards Mining Semantic Maturity in Social Bookmarking Systems.	M. Atzmueller	In Alexandre Passant, Sergio Fernández, John Breslin, and Uldis Bojārs (Eds.), Proceedings of the 4th international workshop on Social Data on the WebSDoW2011, 2011.	-	-	-	Bonn, Germany	2011	-	http://www.kde.cs.uni-kassel.de/pub/pdf/atzmueller2011	Yes
33	Citizen Science and Volunteered Geographic Information – overview and typology of participation	M. Haklay	in Sui, D.Z., Elwood, S. and M.F. Goodchild (eds.), 2012. Volunteered Geographic Information, Public Participation, and Crowdsourced Production of Geographic Knowledge. Berlin: Springer.	-	-	Springer-Verlag	EU	2012	105-122	10.1007/978-94-007-4587-2_7	Yes
34	Proceedings of the 2011 International Workshop on Mining Ubiquitous and Socila Envirinments (MUSE 2011).	M. Atzmueller (editor)	International Workshop on Mining Ubiquitous and Socila Envirinments (MUSE 2011)	-	-	ECML/PKDD	Athens, Greece	2011	-	http://www.kde.cs.uni-kassel.de/ws/muse2011/proceedi	Yes
35	Bottom-up air quality monitoring - the case of AirProbe	Alina Sirbu	PLoS ONE	submitted	-	-	-	-	-	-	Yes

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES											
No.	Title	Main author	Title of the periodical or the series	Source volume	Source issue	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers (if available). A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).	Is/Will open access provided to this publication? Yes/No N. B. Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.
36	A new platform for Human Computation and its application to the analysis of driving behaviour in response to traffic information	Alina Sirbu	Human Computation Journal	submitted	-	-	-	-	-	-	Yes
37	Mapping air quality with mobile monitoring in the highly variable urban environment	Joris Van den Bossche	Atmpspheric Environment	submitted	-	-	-	-	-	-	Yes

Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters). These tables are cumulative, which means that they should show all publications and activities from the beginning until after the end of the project.

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

No.	Type of activities (choose among: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.	Main leader	Title	Date of publication	Place	Type of audience (Scientific Community, higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).	Size of audience	Countries addressed
1	Invited Seminar	V. Loreto	New developments in language dynamics.	2012	Modelli Matematici per le Applicazioni (MOMA) Seminars. Mathematics Dept. Sapienza University of Rome, 03-02-2012.	Scientific Community	20	Italy
2	Invited Talk	V. Loreto	Citizen Science in the EU project EveryAware.	2012	The 2nd Citizen Cyberscience Summit, London Feb 16th-18th, 2012.	Scientific Community	100	Italy
3	Invited Talk	V. Loreto	New platforms for web-gaming and social computation	2012	Workshop on Web Epistemics ZIF Bielefeld, February 15th-17th, 2012.	Higher education	20	Italy
4	Invited Short Talk	V. Loreto	EveryAware: Enhancing environmental awareness through social information technologies	2011	1st Dialogue on Platforms for collective awareness and action, Brussels September the 9th 2011.	Scientific Community, Policy Makers	20	Italy
5	Invited Seminar	V. Loreto	New avenues for social dynamics	2011	LUISS University, 27th June Rome, 2011.	Higher education	100	Italy
6	Invited Talk	V. Loreto	New perspectives for the investigation of collective behaviour and opinion shifts	2011	ESF PESC/SCSS Exploratory Workshop: The Internet of Things for a Sustainable Future, Vielsalm (Belgium), May 9th-13th 2011.	Higher education	50	Italy
7	Invited Colloquium	V. Loreto	Statistical physics of language dynamics	2011	ETH Zurich, May the 3rd 2011.	Research	20	Italy
8	Keynote Talk	V.D.P. Servedio	Participatory Sensing and Social Dynamics	2012	Summer School for Master and PhD Students on "Modeling andAnalysis of Novel Mechanisms in Future Internet Applications", April 4th 2012, Würzburg, Germany.	Higher education	50	Italy
9	Poster	M. Atzmueller	Towards Mining Semantic Maturity in Social Bookmarking Systems.	2011	4th international workshop on Social Data on the Web SDoW2011, ISWC 2011.	Scientific Community	50	Germany
10	Poster	F. Lemmerich	Modeling Location-Based Profiles of Social Image Media using Explorative Pattern Mining.	2011	Workshop on Modeling Social Media MSM 2011, IEEE SocialCom 2011.	Higher education	50	Germany
11	Poster	R. Jäschke	Social Bookmarking: Analysis and Applications. Tutorial at the "Modeling and Analysis of Novel Mechanisms	2012	Future Internet Applications Summerschool", Würzburg, 2012.	Higher education	50	Germany
12	Talk	V. Loreto	New perspectives for the behaviour and opinion shiftsinvestigation of collective	2011	ESF Exploratory Workshop on The Internet of Things for a Sustainable Future, Vielsalm (Belgium), 9–13 May 2011.	Higher education	10	Belgium
13	Talk	M. Haklay	Extreme Citizen Science and the Internet of Things - participatory sensing and sense making	2011	ESF Exploratory Workshop on The Internet of Things for a Sustainable Future, Vielsalm (Belgium), 9–13 May 2011.	Scientific	30	EU
14	Talk	J. Theunis	The potential of community sensing for outdoor air quality monitoring	2011	ESF Exploratory Workshop on The Internet of Things for a Sustainable Future, Vielsalm (Belgium), 9–13 May 2011.	Higher education	30	Belgium
15	Talk	M. Haklay	Participatory GIS, Volunteered Geographic Information and Citizen Science	2011	GISRUK 2011, Portsmouth, April 2011.	Scientific Community, Higher Education and Research	120	United Kingdom
16	Talk	G. Stumme	Data Mining in online and offline social networks	2011	Dagstuhl Seminar on Data Mining, Networks and Dynamics, Dagstuhl, Germany, 7.11.2011.	Scientific Community, Higher Education and Research	30	Germany
17	Talk	G. Stumme	Das ubiquitäre Web - Analyse und Gestaltung.	2012	Web Science Workshop, L3S Hannover, Germany, 1.3.2012.	Scientific Community, Higher Education and Research	50	Germany
18	Talk	G. Stumme	Towards the Ubiquitous Web.	2011	L3S Advisory Board Meeting, L3S Hannover, 31.5.2011.	Scientific Community, Higher Education and Research	20	Germany
19	Talk	A. Hotho	Auf dem Weg zum ubiquitären Web	2011	Web Science Workshop,L3S Hannover,Germany, 16.3.2011.	Scientific Community, Higher Education and Research	30	Germany
20	Talk	J. Müller	Infrastructure for Noise Montoring application in EveryAware	2012	Citizen Cyberscience Summit, London, 18.2.2012.	Scientific Community, Higher Education and Research	100	Germany
21	Talk	J. Theunis	Presentation of EveryAware Project	2012	CS Workshop in Brussels to showcase the results of the running FET complex systems projects, Brussels 29 March 2012.	Scientific, Higher Education, Research, Policy makers	30	Belgium
22	Press	K. Austen	One per Cent: Interactive maps helps pygmy tribes fight back	2012	New Scientist, One Per Cent, 21 February 2012.	Medias	-	United Kingdom
23	Press	G. Stumme	Sensoren messen dicke Luft - Kasseler Professor Gerd Stumme will Verschmutzung erfahrbar machen	2011	In Hessisch-Niedersäschsische Allgemeine. Kassel, 28.2.2011	Medias	-	Germany
24	Press	G. Stumme	Project presentation	2012	In L3S@work magazin, edition of April 2012.	Medias	-	Germany
25	Press	G. Stumme	Eine bessere Umwelt durch soziale Informationstechnologien: Wie Sensorboxen die ökologischen Lebensbedingungen verbessern sollen.	2012	In Unimagazin, Leibniz Universität Hannover. 01-02-2012.	Medias	-	Germany
26	Press	L. Francis	Mapping Highbury's Air Pollution	2012	Jenny Jones for London, (2012).	Medias	-	United Kingdom

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

No.	Type of activities (choose among: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.	Main leader	Title	Date of publication	Place	Type of audience (Scientific Community, higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).	Size of audience	Countries addressed
27	Press	L. Francis	Air Pollution in Putney	2011	Posted on Jun 08, 2011. http: //www.putneysociety.org. uk/issues/air-pollution-in-putney. html	Medias	-	United Kingdom
28	Talk	J. Theunis	Presentation of EveryAware Project	2012	CS Workshop in Brussels to showcase the results of the running FET complex systems projects, Brussels 29 March 2012.	Scientific Community, Higher Education and Research	50	Belgium
29	Press	S. Geall	Scientists and citizens	2012	Review in the China Dialogue (February 24, 2012)	Medias	-	United Kingdom
30	White paper	The EveryAware Project Consortium	EveryAware: Enhancing environmental awareness through social information technologies. White Paper.	2012	The EveryAware Project Consortium: ISI, UCL, LUH, VITO, PHYS-SAPIENZA.	Scientific Community, Higher Education and Research	30	International
31	Proceeding	M. Atzmueller	Proccedings of the 2011 International Workshop on Mining Ubiquitous and Socila Envirinments (MUSE 2011).	2011	International Workshop on Mining Ubiquitous and Socila Envirinments (MUSE 2011). ECML/PKDD 2011, Athens, Greece, 2011.	Scientific Community, Higher Education and Research	50	Germany
32	Poster	J. Theunis	Community-based urban air quality monitoring with the EveryAware SensorBox	2012	Poster presented at the iSUP-2012 Innovation for Sustainable Production, Bruges 6-9 May 2012.	Scientific Community and Research	50	Belgium
33	Poster	J. Theunis	The Potential of Connunity-based Monitoring for Urban Air Quality	2012	Poster presented at Urban Environmental Pollution 2012, Amsterdam, 17-20 June 2012.	Scientific Community and Research	50	Belgium
34	Invited Talk	V. Loreto	Collective behaviour and opinion shifts	2011	The Internet Of Things For A Sustainable Future, ESF Exploratory Workshop, Vielsalm 9-13 May 2011.	Scientific Community, Higher Education and Research	100	Italy
35	Invited Colloquium	V. Loreto	Statistical physics of language dynamics	2011	Torino University, 20/05/2011.	Scientific Community, Higher Education and Research	20	Italy
36	Invited Talk	V. Loreto	Statistical physics of language dynamics	2011	Workshop on, Complexity in Language: Developmental and Evolutionary Perspectives, Collegium de Lyon, ENS, May 23-25 2011.	Scientific Community, Higher Education and Research	50	Italy
37	Contributed Talk	V. Loreto	On the origin of the hiearchy of color names	2012	Evolang IX Kyoto, The 9th International Conference on the Evolution of language, Kyoto, Japan, 13-16 March 2012.	Scientific Community, Higher Education and Research	50	Italy
38	Invited Talk	V. Loreto	Consensus in Language Dynamics	2012	Meeting at the ESF-funded Drust project, Bologna (Italy), 10-11 April 2012.	Scientific Community, Higher Education and Research	30	Italy
39	Invited Talk	V. Loreto	A Cultural Route to the Emergence of Duality of Patterning	2012	28th Altenberg Workshop in Theoretical Biology, Origins of Complex Communication and Language: Epigenetic Modeling and Ethological Observation, Altenberg, Austria, July 5-8 2012.	Scientific Community, Higher Education and Research	50	Italy
40	Invited Talk	V. Loreto	Misura il tuo ambiente e diventa scienziato	2012	Revolution Festival, 22-23 Settembre 2012, Parco Villa Morosini Cappello, Cartigliano (VI).	Scientific Community, Higher Education, Research, Civil Society, Policy Makers	100	Italy
41	Talk	M. Atzumueller	Analysis of Patterns in Social Media	2012	University of Koblenz, Koblenz, Germany, August 16, 2012.	Scientific Community, Higher Education and Research	40	Germany
42	Talk	M. Atzumueller	Onto Collective Intelligence in Social Media - Exemplary Applications and Perspectives	2012	Workshop on Modeling Social Media, ACM Hypertext 2012, Milwaukee, WI, USA, June 25, 2012.	Scientific Community, Higher Education and Research	30	Germany
43	Talk	M. Atzumueller	Mining Ubiquitous and Social Environments: Communities and Collective Challenges	2012	Spring Meetings on Mining and Learning (SMiLe), Bad Neuenahr, Germany, April 18, 2012.	Scientific Community, Higher Education and Research	40	Germany
44	Talk	B. Elen	The EveryAware SensorBox	2012	Citizen Cyberscience Summit, London, 18.2.2012.	Scientific Community, Higher Education and Research	50	Belgium
45	Talk	G. Stumme	Data Mining in online and offline social networks	2011	Dagstuhl Seminar on the Data Mining, Networks and Dynamics, Dagstuhl, Germany, 7.11.2011.	Scientific Community, Higher Education and Research	40	Germany
46	Talk	G. Stumme	Data Mining in online and offline social networks	2011	Dagstuhl Seminar on the Analysis of Dynamic Social and Technological Networks, Dagstuhl, Germany, 8.11.2011.	Scientific Community, Higher Education and Research	40	Germany
47	Talk	G. Stumme	Towards the Ubiquitous Web	2011	DFG-Rundgesprach "Wissenserschliessung im Web", Darmstadt, Germany, 19 May 2011.	Scientific Community, Higher Education and Research	50	Germany
48	Talk	G. Stumme	Technisch-soziale Vernetzung	2011	Stifterbeirat der Informatik der Universitaet Kassel, Germany, 26 May 2011.	Scientific Community, Higher Education and Research	40	Germany
49	Talk	G. Stumme	Datenanalyse von sozialen Netzen - Online und Offline	2012	Forschungskolloquium des Center of Environmental Systems Research, Universitaet Kassel, 7 May 2012	Scientific Community, Higher Education and Research	50	Germany

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50	Talk	L. Francis	The Use of Citizen Science and Participatory Mapping in Gathering Local Environmental Knowledge of Air Quality	2012	Royal Geographical Society/Institute of British Geographers, July 2012.	Scientific Community, Policy Makers	40	United Kingdom
51	Talk	A. Sirbu	Opinion dynamics with disagreement and modulated information	2012	European Conference on Complex Systems (ECCS12), Workshop ``Cultural and opinion dynamics: modelling, experiments and challenges for the future'', Brussels, Belgium, 3-7 September 2012.	Scientific Community, Policy Makers	50	Italy
52	Talk	A. Sirbu	Joe's City Race presentation	2012	`Hack he City'', ``Idea Lab'' Workshop, Dublin, Ireland, 14-24 June 2012.	Scientific Community, Civil Society, Policy Makers	50	Italy
53	Talk	A. Sirbu	City Race: effect of trafic information on driving behaviour	2012	European Conference on Complex Systems (ECCS12), Workshop "Complexity paradigms for Smart, Green and Integrated Transport", Brussels, Belgium, 3-7 September 2012.	Scientific Community, Policy Makers	50	Italy
54	Press	V. Loreto	Così imparammo a dire rosso, Gabriele Beccaria.	2012	La Stampa,Tuttoscienze, February 2012.	Medias	-	Italy
55	Press	J. Lewis	Interactive maps help pygmy tribes fight back.	2012	New Scientist, One Per Cent, 21st February 2012.	Medias	-	United Kingdom
56	Press	V. Loreto	How colors get their names: it's in our vision, Charles Choi.	2012	LiveScience, 16th April 2012.	Medias	-	United Kingdom
57	Press	V. Loreto	Hierarchy of Color Naming Matches the Limits of Our Vision System.	2012	Scientific American, 16th April 2012.	Medias	-	United States
58	Press	J. Theunis	Na wit en zwart komt altijd rood. Hilde Van den Eynde.	2012	De Standaard, 17th April 2012.	Medias	-	Belgium
59	Press	V. Loreto	Come nascono i nomi dei colori. Martina Saporiti.	2012	Galileonet, 20th April 2012.	Medias	-	Italy
60	Press	V. Loreto	Colours: Differing points of hue. Philip Ball.	2012	BBC - Future, Under the radar, 27th April 2012.	Medias	-	United Kingdom
61	Radio	V. Loreto	Moebius, Radio 24, June the 2nd 2012, EveryAware project.	2012	-	Medias	-	Italy
62	Press	V. Loreto	Colourful language.	2012	Doctordisruption, 6th June 2012.	Medias	-	International
63	Radio	V. Loreto	Radio 3 Scienza, June the 13th 2012, Intervista con Rossella Panarese.	2012	-	Medias	-	Italy
64	Press	M. Haklay	Riddled with irregularities: Why are languages so different and disorderly? Philip Ball.	2012	Prospect Magazine, 22 August 2012.	Medias	-	United Kingdom
65	Radio	V. Loreto	Radio Capital, September 1st 2012, Intervista con Fabiana	2012	-	Medias	-	Italy
66	Radio	V. Loreto	ECO Radio, September 4th 2012, Intervista sul progetto EveryAware con Francesco Pompilio.	2012	-	Medias	-	Italy
67	Press	V. Loreto	Eco-tecnologia per un'Europa più sensibile, Intervista sul progetto EveryAware con Federica Ionta.	2012	Energie sensibili, September 12th 2012.	Medias	-	Italy
68	Press	V. Loreto	Lo zainetto misura smog, Maria Rosa Pavia.	2012	Corriere.it, August 31st 2012.	Medias	-	Italy
69	Press	V. Loreto	Veleni, arriva lo zainetto antismog, Livia Ermini.	2012	Il Venerdi di Repubblica , August 31st 2012.	Medias	-	Italy
70	Press	G. Stumme	Eine bessere Umwelt durch soziale Informationstechnologien: Wie Sensorboxen die ökologischen Lebensbedingungen verbessern sollen.	2012	Unimagazin 01/02/2012, 42-45.	Medias	-	International
71	Press	P. Gravino	Cittadini scienziati, Marco Motta, Interview to Dr. P. Gravino.	2012	Funkhaus Europa, June 27th, 2012.	Medias	-	Italy
72	Poster	A. Sirbu	External information effects in opinion dynamics	2013	25th International Conference on Statistical Physics, Seoul, South Korea, July 2013	Scientific	600	International
73	Presentation	A. Sirbu	Modelling opinion dynamics	2013	Mathematics Department, University of Ferrara	Scientific	20	Italy
74	Presentation	A. Sirbu	External effects in multiple choice opinion dynamics	2014	Citizen Cyberscience Summit, London, UK, February 2014	Scientific Community, Higher Education and Research	30	International
75	Presentation	J. Theunis	Community-based urban air quality monitoring with the EveryAware SensorBox	2012	Poster presented at the iSUP-2012 Innovation for Sustainable Production, Bruges 6-9 May 2012.	Scientific Community, Industry, Policy Makers	40	International
76	Presentation	J. Theunis	The Potential of Connunity-based Monitoring for Urban Air Quality	2012	Poster presented at Urban Environmental Pollution 2012, Amsterdam, 17-20 June 2012.	Scientific Community, Policy Makers	30	International
77	Presentation	J. Theunis	Poster presentation and demo of EveryAware SensorBox	2013	Launch of the European Citizen Science Association (ASCA), Interactive displays of best examples of Citizen Science Programmes in the EU, Green Week - Cleaner Air for All, Brussels, 6th June 2013.	Scientific Community, Policy Makers	50	International
78	Talk	J. Theunis / J.Peters	EveryAware Symposium: Participatory Air Quality Sensing	2014	Citizen Cyberscience Summit 2014	Scientific Community, Policy Makers, Civil Society	50	International

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79	Newsletter	J. Theunis	Monitoring close to the individual. How healthy are you today ?	January 2014	VITO Newsletter VITO Vision, https://www.vito.be/SiteCollectionDocuments/VITO/D	Medias	-	International
80	Lecture	C. Ellul	Citizen Science and the Science of Cities	March 2014	University College London	Higher education students	15	United Kingdom
81	B Eng. Dissertation and Final Presentation	Keyan Guo/Sai Wong, supervised by C Ellul	Integrating Building Information Modelling and Geographical Information Science	June 2014	University College London	Higher education students, scientific community	100	United Kingdom
82	MSc Dissertation	Eleonora Cognetti (supervised by M Haklay)	Are smartphone apps a viable solution for crowd-sourced environmental noise monitoring?	October 2012	University College London	Higher education students	40	United Kingdom
83	PhD Thesis	C Nold (supervised by M Haklay)	How does Participatory Sensing construct Sensation and the Environment?	Ongoing	University College London	Scientific Community	40	United Kingdom
84	Talk	M Haklay	United Nations Environmental Programme – World Conservation Monitoring Centre seminar – Invited speaker (with Jerome Lewis) 'Extreme Citizen Science' by Chris Sandbrook.	Nov 2012	Cambridge	Scientific Community, Research	30	International
85	Talk	M Haklay	UCL Centre for Spatial Analysis seminar – Invited speaker on 'Participatory GIS, Volunteered Geographic Information and Citizen Science', by James Cheshire [CASA]	Jan 2012	London	Scientific Community, Higher Education, Research	60	United Kingdom
86	Talk	M Haklay	Over the Air 2012 – Invited speaker on Extreme Citizen Science by Margaret Gold [OTA prganiser]	Jun 2012	London	Scientific Community, Research, Industry	40	United Kingdom
87	Talk	M Haklay	University of Salzburg, GI Forum - Invited keynote 'Making Geographical Information Usable: Computers, Interfaces and People', by the conference organiser Adrijana Car [Salzburg]	Jul 2012	Salzburg	Scientific Community, Research	200	Inernational
88	Talk	M Haklay	Centre de Recherches Interdisciplinaires (CRI), Université Paris Descartes Night Science - Learning through Research – Invited speaker on 'Extreme Citizen Science', by the conference organiser Kathleen Zylbersztejn [CRI]	Jul 2012	Paris	Scientific Community, Research, Professional	200	International
89	Talk	M Haklay	Ecological Society of America, Public Participation in Scientific Research conference – Invited speaker 'Taking Public Participation in Scientific Research to its logical conclusion: Extreme Citizen Science', by the conference organisers Jake Weltzin [USGS] and Meg Domroese [Cornel Lab of Ornithology]	Aug 2012	Portland, OR	Scientific Community, Research	600	United States of America
90	Talk	M Haklay	University of Oxford, Biodiversity Technologies – the Oxford Biodiversity Institute symposium – Invited speaker on 'The role of technology in extending Citizen Science to new groups and places', by the conference organiser, Gillian Petrokofsky [Oxford]	Sep 2012	Oxford	Scientific Community, Research	200	United Kingdom
91	Talk	M Haklay	Newcastle University, Geomatics Research Seminar – Invited speaker on 'Crowdsourced geographic information and citizen science - can we trust the data?', by the seminar coordinator Pauline Miller [Geomatics, Newcastle University]	Oct 2012	Newcastle	Scientific Community, Research	50	United Kingdom
92	Talk	M Haklay	FIG Commission 3 meeting, Athens - Invited keynote speaker on 'Crowdsourced geographic information: understanding and trusting it', by the Chair of the commission, Yerach Doytsher [Geoinformation, Technion, Israel]	Dec 2012	Athens	Scientific Community, Research	70	International
93	Talk	M Haklay	UCL Lunch Hour Lecture – Invited speaker on 'Science for everyone by everyone – the re-emergence of citizen science' by the public engagement team of UCL.	Jan 2013	London	Scientific Community, Higher Education, Research, Public	250	United Kingdom

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

No.	Type of activities (choose among: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.	Main leader	Title	Date of publication	Place	Type of audience (Scientific Community, higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).	Size of audience	Countries addressed
94	Talk	M Haklay	Virtual Biodiversity Research and Access Network for Taxonomy (ViBRANT) citizen science workshop – Invited speaker on 'Extreme Citizen Science' by the workshop organiser, Ed Baker [Natural History Museum]	Jan 2013	London	Scientific Community, Research	30	United Kingdom
95	Talk	M Haklay	UNESCO WSIS+10 multi-stakeholders review - Invited speaker and chair of Technical Working Group 'Emerging Trends in E-Science: Citizen Science, Mobile technologies and ICTs' by Lidia Brito, Division of Science Policy and Capacity-building [UNESCO]	Feb 2013	Paris	Scientific Community, Research, Policy Makers	150	International
96	Talk	M Haklay	Eye on Earth user conference – Invited speaker on 'From public access to environmental information to citizen science' by the conference organiser, Malene Bruun [EEA]	Mar 2013	Dublin	Scientific Community, Research, Policy Makers	50	International
97	Talk	M Haklay	Thinking and Doing Digital Mapping - Invited speaker on 'Digital Mapping, Technological Information, The Device Paradigm and Focal Practices' by the workshop organiser Sybille Lammes [University of Warwick]	Jun 2013	Warwick	Scientific Community, Research	20	United Kingdom
98	Talk	M Haklay	Participatory GIS: learning from practice? - Invited speaker on 'Keeping the spirit alive' – preservations of Participatory GIS values in the Geoweb', by the conference organisers Jeroen Verplanke [ITC – University of Twente] and Michael McCall [UNAM – Mexico]	Jun 2013	Enschede, the Neatherland	Higher Education, Scientific Community, Research	200	International
99	Talk	M Haklay	The Future of Ecological Possibilities in Citizen Science (INTECOL 2013) – Invited speaker on 'Towards an inclusive citizen science: fulfilling the promise of everyone and everywhere' by the symposium organisers Jennifer Shirk [Cornell] , Jonathan Silvertown [Open University]	Aug 2013	London	Scientific Community, Research	100	International
100	Talk	M Haklay	SXSW Eco – Invited speaker on 'Citizen Science for real-time and local models' by Cynthia Conner [British Consulate-General, Houston]	Oct 2013	Austin, TX	Scientific Community, Research, Policy Makers, Public	100	United States of America
101	Talk	M Haklay	Bloomsbury Festival - Speaker at UCL Ideas Salon. Invited by UCL Public Engagement Unit	Oct 2013	London	Public	20	United Kingdom
102	Talk	M Haklay	EU ICT 2013 – Invited speaker on 'Can we open up the scientific process to everyone' by John Magan [Digital Science Unit, EC]	Oct 2013	Vilnius, Litheunia	Scientific Community, Research, Policy Makers	80	International
103	Talk	M Haklay	Bezalel, Urban Design Seminars – Invited speaker 'Can we build better cities, together? Participatory Mapping and Citizen Science in the era of Smart Cities & Big Data' by the programme coordinator, Haim Yacobi [Bezalel]	Dec 2013	Jerusalem, Israel	Scientific Community, Research, Public	40	Israel
104	Talk	M Haklay	UCL Diversity Week - Invited speaker on 'Inclusion, participation and mapping – why diversity matters?' by the session organiser, Dr Charlene Jennet [UCL]	Feb 2014	London	Scientific Community, Research, Public	50	United Kingdom
105	Talk	M Haklay	Olomouc University, Cartocon 2014 conference - Invited keynote speaker on 'User centred and participatory cartography' by the conference organisers.	Feb 2014	Olomouc, Czech Republic	Higher Education, Scientific Community, Research	150	International
106	Talk	M Haklay	University of Leicester, Department of Geography - Invited speaker on 'From crowdsourced geographic information to participatory citizen science - exploitation or empowerment?' by the seminar organiser, Dr Clare Smith [Leicster]	Mar 2014	Leicester, UK	Higher Education, Scientific Community, Research	40	United Kingdom

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

No.	Type of activities (choose among: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.	Main leader	Title	Date of publication	Place	Type of audience (Scientific Community, higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).	Size of audience	Countries addressed
107	Talk	M Haklay	The Conservation Volunteers, Volunteering Impact Conference - Invited speaker on 'How can we map the positive impact of volunteering' by the conference organisers at The Conservation Volunteers.	Mar 2014	London	Civic Society, Policy Makers	80	United Kingdom
108	Talk	M Haklay	Université Paris Descartes, Jurnée Numérique – La Vie Connectée – Invited speaker 'Science for all : the possibilities of extreme citizen science' by the programme coordinator, Eric Cherel [UPD]	Apr 2014	Paris, France	Higher Education, Scientific Community, Research	200	France
109	Lecture	M Haklay	Mapping Science - Volunteered Geographical Information	November 2012, November 2013	London	Higher Education	45	United Kingdom
110	Lecture	M Haklay	Human Computer Interaction	February 2014	London	Higher Education	15	United Kingdom
111	Other	C Nold / L Francis	How to use the WideNoise App - Training Manual for Heathrow Communities	January 2012	London	General Public/Citizen Scientists	200	United Kingdom
112	Other	EveryAware Team	How to use the AirProbe App and Sensor Box	October 2013	London, Kassel, Antwerp, Turin	Higher Education, General Public, Citizen Scientists	200	International
113	Talk	V. D. P. Servedio	Participatory Sensing and Social Dynamics	2012	Summer School for Master and PhD Students on Modeling and Analysis of Novel Mechanisms in Future Internet Applications , March 28th - April 4th 2012, Würzburg, Germany	Scientific Community, Research	40	Germany
114	Short Talk	V. D. P. Servedio	Raising citizens awareness on urban sound pollution and air quality: A citizen-science approach.	2014	Citizen science and smart cities summit, February 5th - 7th 2014, JRC Ispra, EU	Scientific Community, Research	30	Italy
115	Talk	V. D. P. Servedio	Learning and Awareness in Participatory Sensing	2014	Citizen Cyberscience Summit 2014, February 20th - 22th 2014, London, UK	Scientific Community, Research	50	United Kingdom
116	Talk	V. D. P. Servedio	Awareness and Learning in Participatory Noise Sensing	2014	EveryAware Symposium in the Citizen Cyberscience Summit 2014, February 20th - 22th 2014, London, UK	Scientific Community, Research	30	United Kingdom
117	Talk	V. D. P. Servedio	Serious Games for Research Purposes	2014	ELSA Workshop, March 20th, 2014 Rome, IT	Scientific Community, Research	30	Italy
118	Talk	P. Gravino	XTribe: A general purpose web-based platform for social computation	2013	Social Computing and its Applications, Karlsruhe, October 2nd, 2013	Scientific Community, Research	20	Germany
119	Invited Talk	P. Gravino	THE GRAPH OF A LANGUAGE: structure and semantics in a network of word association	2013	Language and Network Science 3rd June 2013 – Copenhagen, Denmark	Scientific Community, Research	30	Denmark
120	Talk	P. Gravino	XTribe: A general purpose web-based platform for social computation	2012	The 2nd Citizen Cyberscience Summit, London Feb 16th-18th, 2012.	Scientific Community, Research	40	United Kingdom
121	Press	V. Loreto	Laboratorio in spalla	November 8th 2012.	TG Leonardo (Italian Television)	Medias	-	Italy
122	Press	V. Loreto	L'umore degli elettori social in un gioco online	January 30th 2013	La Stampa (Italian Journal)	Medias	-	Italy
123	Press	V. Loreto	laPENSOcosì esperimento scientico per misurare l'umore degli elettori"	January 30th 2013	Linkiesta (Italian web-journal)	Medias	-	Italy
124	Press	V. Loreto	Scopri la tua anima di elettore con gli algoritmi sul Web"	February 2nd 2013	La Stampa,Tuttoscienze	Medias	-	Italy
125	Press	V. Loreto	Interview about Widenoise	February the 5th 2013	Ecoradio (Italian Radio)	Medias	-	Italy
126	Press	V. Loreto	Interview about laPENSOcosì	February the 26th 2013	Ecoradio (Italian Radio)	Medias	-	Italy
127	Press	V. Loreto	Torino: in giro con Everyaware a controllare la qualità dell'aria	September 2013	La Stampa (Italian Journal)	Medias	-	Italy
128	Press	V. Loreto	Io e i miei studenti in giro a misurare lo smog" (My students and me monitoring smog around)	February the 24th 2014	La Repubblica	Medias	-	Italy
129	Invited Contribution	V. Loreto	Participation, awareness and learning	February 13-14th 2013	Workshop on Urban Development and Global Systems Science, European Commission, Brussels	Higher Education, Scientific Community, Research	40	EU
130	Invited Talk	V. Loreto	On the emergence of linguistic conventions	March 6-8 2013	Modelling Emerging Norms workshop, Interacting Minds Centre, Aarhus University	Higher Education, Scientific Community, Research	70	EU
131	Invited Talk	V. Loreto	Environmental awareness and learning: a race against time	April 16th 2013	14th Swiss Global Change Day, Bern	Higher Education, Scientific Community, Research	50	EU
132	Invited Seminar	V. Loreto	Consensus dynamics in social systems	April 23rd 2013	University of Liverpool	Higher Education, Scientific Community, Research	30	United Kingdom
133	Invited Seminar	V. Loreto	The dynamics of correlated novelties	September 4th 2013	Northeastern University, Boston, USA	Higher Education, Scientific Community, Research	40	United States of America
134	Invited Plenary Talk	V. Loreto	The dynamics of correlated novelties	5-6th September 2013	Wolfram Data Summit, Washington DC, USA	Higher Education, Scientific Community, Research	20	United States of America

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities (choose among: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.	Main leader	Title	Date of publication	Place	Type of audience (Scientific Community, higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).	Size of audience	Countries addressed
135	Invited Talk	V. Loreto	Participatory sensing and social computation	October 10-11 2013	INSITE Workshop: Games, Science & Society, International Institute Applied Systems Analysis, Laxenburg, Austria	Higher Education, Scientific Community, Research	30	Austria
136	Invited Talk	V. Loreto	Games, prediction and Learning	December 14-15th 2013	International Game Competition for Education and Research, Paris, France	Higher Education, Scientific Community, Research	100	France

2.0.8 Section B

This section specifies the exploitable foreground and provide the plans for exploitation.

Part B1 The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The outcomes of the project did not require any patent application, since everything has been implemented following an open source and open hardware paradigm.

Part B2:

Type of Exploitable Foreground (General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.)	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application (see here http://ec.europa.eu/competition/merg	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
General advancement of knowledge commercial exploitation of R&D results	low cost gas sensor box design	NO		Air quality monitoring devices based on low-cost gas sensors	Environmental monitoring Instrumentation and testing	2016		VITO / CSP
General advancement of knowledge commercial exploitation of R&D results	calibration models for low-cost sensor arrays	NO		Air quality monitoring devices based on low-cost gas sensors	Environmental monitoring Instrumentation and testing	2016		VITO / ISI
General advancement of knowledge Exploitation of results through EU policies commercial exploitation of R&D results	Know-how on mobile air quality monitoring, data quality, data processing, guidelines	NO		BlackCarbonMappe: Urban air pollution exposure maps based on mobile monitoring ; Maps of healthy cycling routes	Environmental monitoring Urban planning Health Community services Policy support	2014		VITO
General advancement of knowledge Exploitation of results through EU policies commercial exploitation of R&D results	Know-how on spatio-temporal variability of black carbon in urban environments	NO		Measurement campaigns and consultancy on urban air quality, i. e. consultancy and follow-up on measures to reduce traffic-related pollution (i. e. black carbon)	Environmental monitoring Urban planning Health Community services Policy support	2012		VITO
General advancement of knowledge Exploitation of results through EU policies	Conclusions and framework on potential of citizen particpation in air quality monitoring	NO		Consultancy on measurement methods and tools for participation of citizens / stakeholders in design and follow-up of urban mobility and air quality policies	Environmental monitoring Urban planning Health Community services Policy support	2014		VITO

4.1 Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	265432
Title of Project:	Enhance Environmental Awareness through social information technologies
Name and Title of Coordinator:	Prof. Vittorio Loreto

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***Yes***
2. Please indicate whether your project involved any of the following issues (tick box):	***YES***
RESEARCH ON HUMANS	
• Did the project involve children?	NO
• Did the project involve patients?	NO
• Did the project involve persons not able to give consent?	NO
• Did the project involve adult healthy volunteers?	YES
• Did the project involve Human genetic material?	NO
• Did the project involve Human biological samples?	NO
• Did the project involve Human data collection?	NO
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	NO
• Did the project involve Human Foetal Tissue / Cells?	NO
• Did the project involve Human Embryonic Stem Cells (hESCs)?	NO
• Did the project on human Embryonic Stem Cells involve cells in culture?	NO
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	NO
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	YES
• Did the project involve tracking the location or observation of people?	YES
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	NO
• Were those animals transgenic small laboratory animals?	NO
• Were those animals transgenic farm animals?	NO

• Were those animals cloned farm animals?	NO
• Were those animals non-human primates?	NO
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	NO
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	NO
DUAL USE	
• Research having direct military use	NO
• Research having the potential for terrorist abuse	NO

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		5
Work package leaders		5
Experienced researchers (i.e. PhD holders)	4	4
PhD Students		3
Other	2	1

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	10
Of which, indicate the number of men:	8

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

X	Yes
○	No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
X	Design and implement an equal opportunity policy	○	○	○	○	X
❑	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
X	Actions to improve work-life balance	○	○	○	○	X

○ Other:

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

X No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

X Yes- please specify: We organized many case-studies involving students and open competitions (See reports)

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

X Yes- please specify: Websites, tutorials, videos.

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

X Main discipline[1]: 1 (1.1 and 1.2)

X Associated discipline[1]: 2 (2.2)

X Associated discipline[1]: 5 (5.4)

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

X	Yes
○	No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No

○ Yes- in determining what research should be performed

X Yes - in implementing the research

[1] Insert number from list below (Frascati Manual).

X	Yes, in communicating /disseminating / using the results of the project	
11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	X ○	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

○	No
○	Yes- in framing the research agenda
○	Yes - in implementing the research agenda
X	Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

X Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
○ Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
○ No

13b If Yes, in which fields?

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		**Information Society**	
Budget		Enterprise		Institutional affairs	
Competition		**Environment**		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		**Research and Innovation**	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

- ○ Local / regional levels
- X National level
- X European level
- X International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	34
To how many of these is open access[2] provided?	30
How many of these are published in open access journals?	30
How many of these are published in open repositories?	5
To how many of these is open access not provided?	4
Please check all applicable reasons for not providing open access:	
X publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available X no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[3]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		None
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	None
	Registered design	None
	Other	None
17. How many spin-off companies were created / are planned as a direct result of the project?		None
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	X	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:* *31*

[2] Open Access is defined as free of charge access for anyone via Internet.
[3] For instance: classification for security project.

Difficult to estimate / not possible to quantify	❑

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

X Yes ○ No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes X No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
❑	Media briefing	X	Coverage in general (non-specialist) press
X	TV coverage / report	X	Coverage in national press
X	Radio coverage / report	X	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
X	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

X	Language of the coordinator	X	English
X	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES
1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
1.3 Chemical sciences (chemistry, other allied subjects)
1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY
2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as

geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

Chapter 4

Final report on the distribution of the European Union financial contribution

This report shall be submitted to the Commission within 30 days after receipt of the final payment of the European Union financial contribution.