ICARUS NEWSLETTER | Issue 3 – Jan 2018

ICARUS Newsletters – 3rd issue

Integrated Climate forcing and Air pollution Reduction in Urban Systems

Welcome to the third newsletter of the ICARUS project. This issue covers the period from July 2017 to December 2017 and gives you an overview of the progress we made in our project.

The ICARUS Newsletter shares information about results and events of the EU research project ICARUS aiming at keeping all relevant stakeholders, interested in air quality and climate change in urban areas.

Your engagement is very important to us. Therefore, we would like to encourage all interested parties and stakeholders to support us in our endeavor and to constructively collaborate in achieving the study results for the benefit of the society as a whole. We hope that you find this information useful and we were looking forward to hearing your effective and constructive feedback.

We are looking forward to making your voice matter in revamping our cities and combatting climate change!!

If you would like to see previous issues of the newsletter, you can find them all at the ICARUS website https://icarus2020.eu/category/news/

Content

Project Coordinator, Prof. D. Sarigiannis.

Project Manager, Dr. A. Gotti

www.icarus2020.eu

Follow at: @ICARUS2020

The ICARUS project run from 2016-2020 and has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No.690105. This newsletter is produced by the ICARUS Communications team. Articles can be republished with the editors' permission.

Introduction

In these last six months there have been many advancements in the scientific production of the ICARUS project, dealing with the execution of the filed campaigns for source apportionment, the development of the ICARUS DSS and mobile app, the analysis of literature about current methodologies for integrated urban impact assessment in support of air quality and climate change governance in EU Member States as well the development of the methodologies for estimating individual exposure and for data fusion.

Most of the deliverables will become fully available on the ICARUS website over the next months. See below for further information.

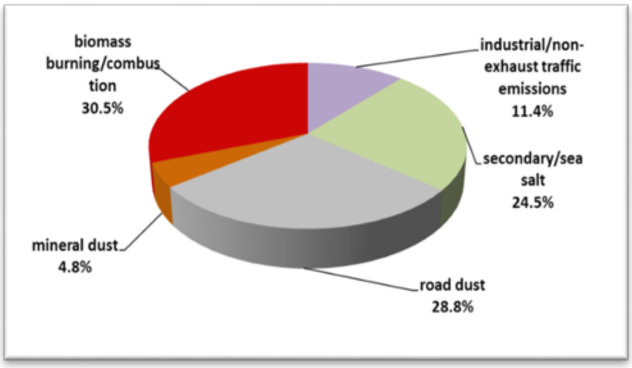
Source apportionment campaigns

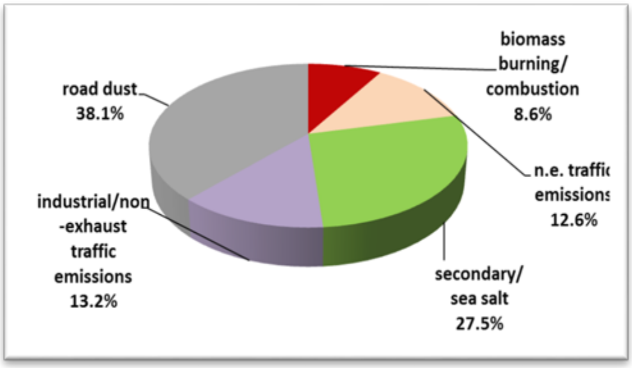
An extensive monitoring field campaign took place in six European cities (Athens, Thessaloniki, Madrid, Stuttgart, Ljubljana, Brno) at three sites (urban background, traffic and regional) for one month during both the winter and summer seasons.

$PM_{2.5}$ samples collected during the ICARUS measurement campaigns were analyzed for 27 PAHs, 24 trace elements, anions (Cl^-, NO_3^-, SO_4^{2-}) and elemental and organic carbon (EC, OC).

After chemical analysis in the lab PMF (Positive Matrix Factor) receptor model was run to derive quantitative information about pollution sources and the amount they contribute to ambient air pollution levels based on the composition or fingerprints of the sources. Outliers were excluded from the analysis. Concentration data below the detection limit was substituted with one-half of the detection limit

Figures 1 shows the preliminary results in term of contribution of the emission sources to the measured $PM_{2.5}$ concentration respectively for Athens, Ljubljana and Thessaloniki traffic sites





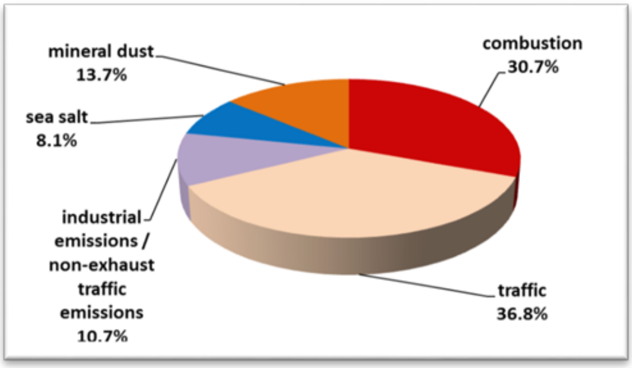


Figure 1: Source Apportionment modeling results for Athens, Ljubljana and Thessaloniki traffic sites

Preliminary results show that depending on the case, PMF model runs resulted in a number of three, four or five identified PM2.5 sources/group of sources for each site/city.

The prevailing source at traffic sampling sites was traffic-related source, which appears in three forms (either separately or combined): exhaust, non-exhaust and road dust sources. The contribution of traffic in total is 40.2% for Athens traffic site, 46.7% for Brno traffic site, 40.7% for Ljubljana traffic site and 48,5% for Thessaloniki traffic site. Traffic source contribution at urban background sites was significantly lower (indicatively: 25% at Brno, 27% at Athens urban background sites). At rural sites, it was road dust that prevailed (indicatively: 34% at Athens, 41.9% at Ljubljana).

Biomass combustion contribution ranged between 8% (traffic and urban background at Ljubljana) and 31% (traffic sites at Athens and Thessaloniki).

Soil dust (natural source) contribution ranged between 5% (traffic site Athens) and 19% (rural site Athens). All other cities ranged between these values.

Secondary particles contributed in higher percentages at urban background sites (34% Ljubljana, 37% Thessaloniki, 40% for Athens and

Brno. Secondary aerosol source percentages may include the natural source of aged sea salt.

Data fusion methodology

Under this activity, we have developed a methodology aiming at providing a comprehensive estimate of tropospheric pollution at different spatial and temporal resolutions at the urban to regional scales fusing different information sources. Earth Observation (EO) data used in conjunction with atmospheric chemical transport models and ground-based measured data through the application of data and model fusion techniques, gives a comprehensive and accurate estimate of tropospheric pollution over the investigated domain.

The data fusion methodology in ICARUS is organised in two consecutive layers: the first layer of data fusion consists in the fusion between ground-based data concentration of PM and gaseous chemicals as measured by the regulatory monitoring network and/or by ad hoc measurements campaigns and the scattering coefficient reckoned from EO-derived aerosol optical thickness and mixing layer height

The first layer of data fusion produces PM and gaseous chemicals concentration maps over the whole domain with a very high spatial resolution. This concentration field is needed to calculate the second layer of data fusion (second step), which involves the fusion between air quality concentration data calculated from EO (through the first layer of data fusion) and the concentration values resulting from chemical transport modelling applications The aim of this second step of fusion process is to merge on cell-by-cell basis these two classes of information in order to obtain an improvement of the final concentration field.

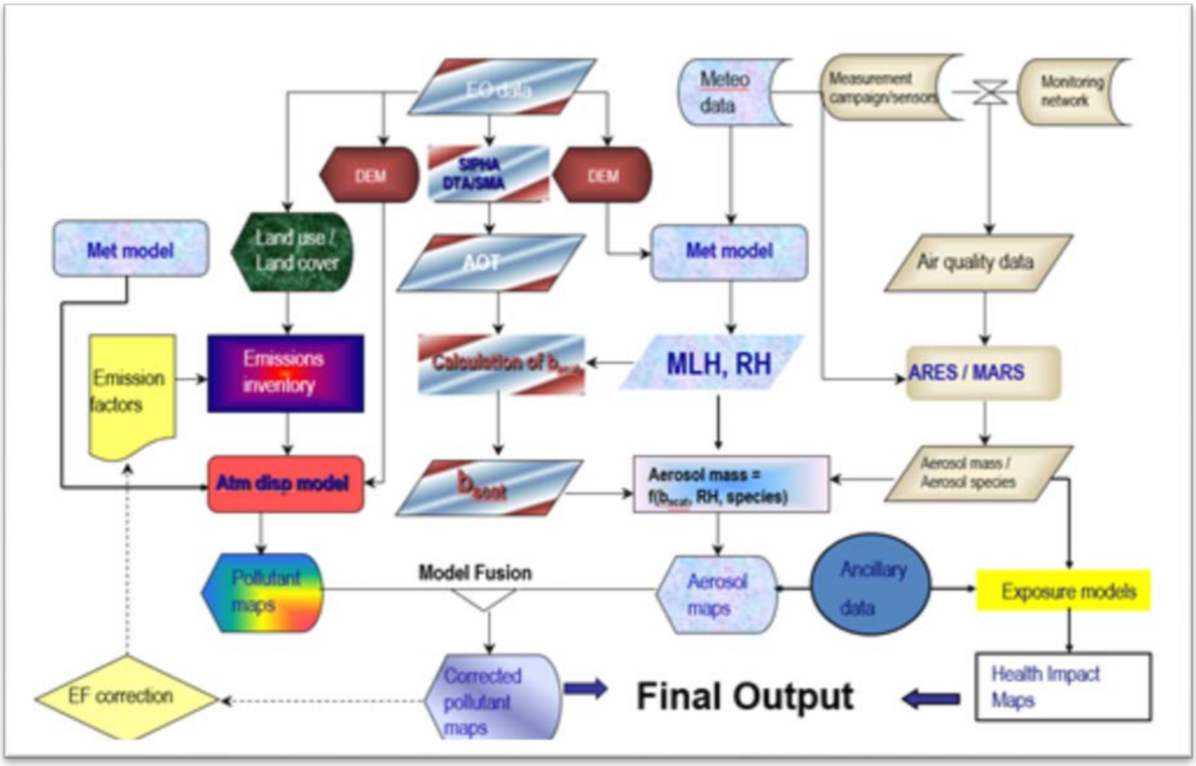


Figure 2: The ICARUS Information Fusion Algorithm

Other commonly used data fusion techniques such as Artificial Neuronal Networks (ANN), Optimal Interpolation (OI) and 3 and 4 dimensional variational methods (3 and 4DVAR) are also described in this report. The data fusion scheme more appropriate for each ICARUS participating city will be devised and applied.

Methodology for estimating individual exposure

The ICARUS methodology for estimating exposure at individual level was developed. It makes use of Air Quality, personal activity and GPS sensors. These technologies can facilitate longer-term and wider-scale monitoring of exposure for population surveys. Data from these sensors are indeed advantageous in deriving to conclusions regarding population exposure to pollutants. However, measuring, though, personal exposure directly, especially when capturing exposure profiles of the entire sociodemographic spectrum of a region, requires individual measurements from a large sample of population which, practically, is often not feasible due to financial restrictions. Considering the significant technical and ethical hurdles related to collecting individual time-use and exposure related data for whole populations, a decision has been made to simulate human movement and interaction behaviour using Agent Based Modelling (ABM), validated against sensor data captured from local campaigns.

Agent Based Modeling

An agent-based model (ABM) is a class of computational models for simulating the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole. The ICARUS ABM approach permits the cost-effective construction of refined time-activity diaries and diurnal exposure profiles, by modelling the heterogeneous routine of human agents.

Pollutants concentrations are being recorded for every microenvironment a virtual individual has stayed/passed through during the day. This then leads to the assessment of individual level of exposure, where exposure can be viewed as the summation of an individual's travel through "hazard fields" in space over time. The dynamic nature of intake dose assessment at the individual level allows for the derivation of guidance regarding behavioural options that limit exposure to high levels of pollution.

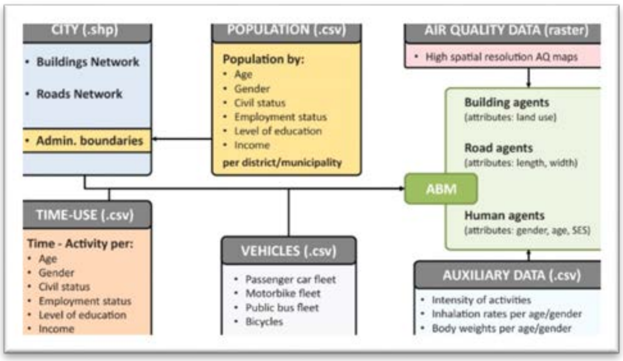


Figure 3: ABM input data

The capacity for aggregation and analysis at various levels of population size and the model's ability for integration of SES indicators are features that enable a refined exposures assessment. Such a model can be useful especially for vulnerable groups of population, like children, the elderly and people with low SES. This study represents the first step towards improving the calculation process of population exposure to environmental substances so that we would be able to draw better conclusions on the association between environment and health.

It should be mentioned that this approach can be established for different cities, without changing the basic programming architecture. The realistic representation of the surrounding geography makes the ICARUS ABM a valuable tool for forecasting the impacts of new policies on a local and regional area. The computational platform developed can be further used as a means for estimating and comparing the probable effects of different public health strategies prior to implementation, therefore reducing the time and expense required to identify effective policies in all ICARUS cities.

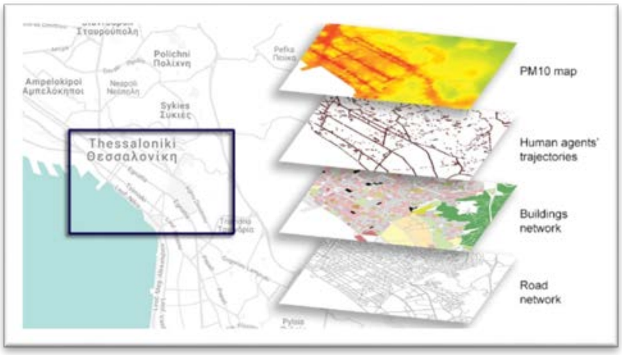


Figure 4 GIS layers - Exposure assessment at personal/community level, using ABM

Process Evaluation Plan

Process evaluation in ICARUS is primarily aimed at:

- ensuring good quality (completeness, clarity, consistency) of expected project outcomes;
- avoiding/mitigating obstacles during project work;
- ensuring clear insight into reasons for not performing the project work as expected, if such situations occur.

The process evaluation exercise therefore serves to identify typical barriers (and drivers) that affect the implementation of the ICARUS project at both project and city level, especially in terms of formulating, developing and implementing the measures/policies

Through process evaluation a better insight is given into three working steps: planning, implementation, delivering and interpretation of output/results.

Process Evaluation Plan also provides substance for the formulation of technical/scientific recommendations regarding future similar research and related policy interventions for public good.

In terms of process evaluation two components are vital for the overall process evaluation.

The first is performance assessment designed as a continuous/regular evaluation of the conduct of the work plans of each WP (e.g., whether data collection has been performed and completely, whether progress of the modelling is visible and fit for purpose, how historic data are interpreted, etc.). This will be done during regular project partners meetings.

The second is integral work progress evaluation designed as continuous/regular monitoring of factors of success and unexpected barriers in the four WPs 2 to 5; in parallel inputs for policy/measure recommendations for the cities will be followed up. In turn, the cities are expected to provide information about their willingness, capability, and determination to implement certain measures/policies recommended by ICARUS.

In terms of project outputs, process evaluation will also help in supporting the assessment of the feasibility of the proposed measures/policies in the partner cities, as indicated in Figure 5.

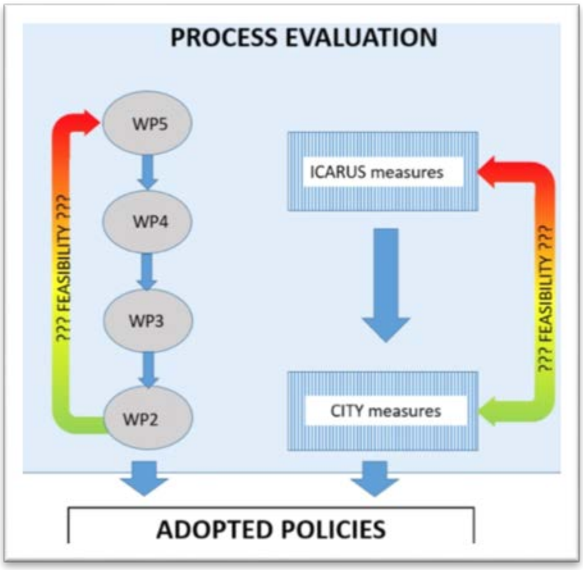


Figure 5: Schematic view of the PEP's role in the measures/policies feasibility evaluation

The primary aim is to assess the defined framework of the overall synthesis of results and to ensure that clear messages can be extracted from the project work. Mid-term assessment of the work of WP2, WP3, WP4, and WP5 based on the specifications in the process evaluation plan in the form of workshops (for each WP or jointly) was carried out. This gave insights into the overall work progress and enabled partners to make revision, re- direction, synchronization, adaptation, or collection of additional information, if needed.

Motivating citizens towards the vision

ICARUS Decision Support System (DSS)

ICARUS DSS aims to serve as a tool for decision makers in taking efficient measures regarding air quality issues. To this end, it will enable them use predefined policies or create their own ones and receive a quantitative estimation of the expected impact, adapted to the unique characteristics of their jurisdiction. It will also provide result evaluation tools, offering functionality to compare actual and estimated impact in the course of time. Destined to be a commercial product, it will provide for usage tracking, billing and decentralized user management.

Based on the needs of its target users, as collected through a series of interviews, the DSS user requirements and functional specifications have been elaborated during the first year of the Project, together with its modular and scalable architecture.

According to its design, ICARUS DSS is putting together many different technologies (WebGIS, IoT devices, measurement stations, wearables and smartphone applications) in order to collect, process and present data. Its modular architecture simplifies integration of new features and optimizes scalability when deployed on cloud infrastructure. The WebGIS technology used in its user interface is a key factor to ensure usability and is under constant improvement, along with new feature integration.

Region-specific data, such as population density, emissions, landcover and pollutant concentration has been inserted to the system. Moreover, a geospatial database has been set up to store data of different sources, together with the necessary adaptors to ensure uniformity.

The next steps of the DSS Partners will be to integrate the modelling techniques that have been developed and the data that will be acquired by the other Work Packages of the Project.

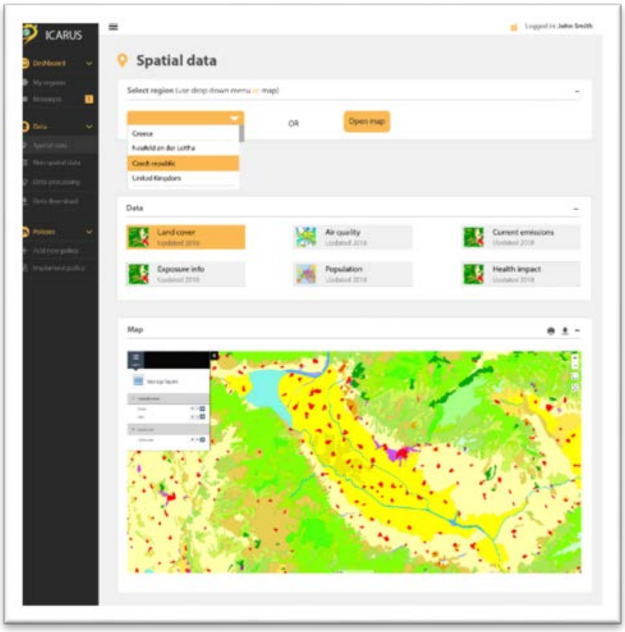


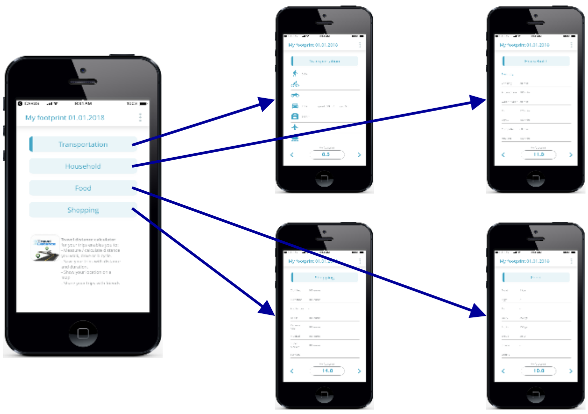
Figure 6: User Interface of the ICARUS DSS

ICARUS User-Centric Tools (UTC)

The User-Centric Tools are the principal means of motivating citizens towards a more environment-friendly way of life. They aim to achieve so by providing tangible and personalized information on the environmental and health impact of the user's lifestyle. They will track the user's habits and provide advice for improving them, offering progress tracking mechanisms at the same time, to promote engagement.

Together with informing the user on the impact of their behaviour, gamification and rewarding techniques will be used to increase motivation. Corporations and regional authorities will be able to organize campaigns through the UCT and offer rewards to users that achieve certain goals.

More information on how the requirements have been designed can be sought in the next article.



Design Thinking for ICARUS User-Centric Tools

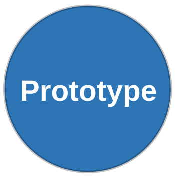
What is Design Thinking?

Design Thinking is a methodology aiming to create practical and innovative solutions for products, services, processes and strategies based on an anthropocentric approach in the understanding of the users' needs. The approach proposed by Design Thinking methodology consists of 5 non-linear stages, i.e. they could (and should) overlap with each other:

Understand the user's thoughts, habits, feelings, how they interact with their environment.

Understand what the problem is, identify the market gap (opportunity).

As many ideas as possible must be considered; the most innovative will be combined into solutions. Brainstorming is the most popular technique.



Produce a first tangible outcome that allows for concrete feedback and early identification of strengths and weaknesses.

Test the solution on a wider scale and closely monitor users' reactions. Testing serves as input to iterations of previous phases.

Design thinking employed in ICARUS User-Centric Tools

1. Empathize

Fourth four individuals of 6 different age groups were interviewed across Europe by the participating cities, based on a mutually agreed questionnaire. Emphasis was put in conducting live, recorded interviews, in order to facilitate direct communication and free expression, which could be limited by filling in printed forms.

The answers were analyzed by age group, enabling the team to obtain a revealing insight on the needs and concerns of each group.

2. Define

Three *personas* were elaborated by grouping the aforementioned characteristics, that are viewed as representative example of:

- A pupil/student (15 to 25 years old)
- An adult of (25 to 60 years old)
- A pensioner (over 60 years old)

Both their shared and opposing characteristics, including their attitude towards environment and modern technology, helped the team clearly define the problem (*needs*) that the UCT must address. A thorough joint market analysis put in evidence what existing or emerging solutions cover and what not.

3. Ideate

Among the ideas that were proposed to address user needs, the most promising ones were used to define the user requirements of the UCT.

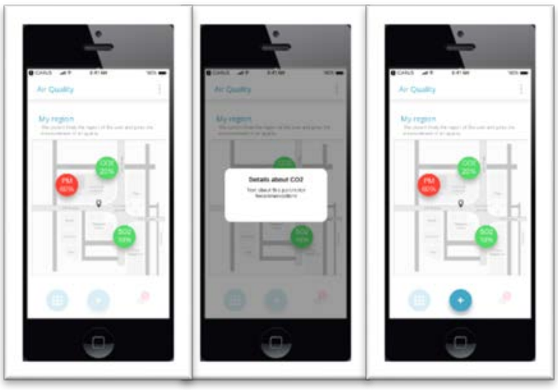


Figure 7: UCT wireframes example

4. Next steps

During the 3rd year of the project, the involved partners will focus on the creation of a prototype for the User-Centric Tools that will be first tested internally and, after improvements, at a larger scale amongst citizens. The final goal of this procedure is the production of a commercial and in the long term, sustainable solution to motivate and engage citizens.

User training program

Internal training helps to permeate skills in and knowledge of the ICARUS concept and tools and to harmonize techniques and methodologies.

The external training program, is aimed not only at capacity building of ICARUS young scientists, but also open to other end-users and other interested parties consists of annual workshops/courses on methodological advances and new findings organized by ICARUS participants each covering a specific area of expertise.

Training needs were identified via direct exchange with all other WP leaders, and via an evaluation of progress reports, as almost all aspects of the project do require training.

The training plan includes a first workshop of the project focused on inter-disciplinary communication and on the promotion of participatory development of the project's methodological advances exploring and advancing community-based research and citizen science. The international programme includes:

1. a workshop for stakeholders organized in Thessaloniki during the first 6 months of the project to enhance the interdisciplinary communication,
2. a workshop presenting the ICARUS concepts and methodologies to the city managers, SMEs but also students and academic staff organized in Brno. ICARUS summer school in the end of the second year.
3. a workshop focused on ICARUS results in pilot applications in participating cities organized back to back to the 2summer school in Pavia in the end of the third year,
4. a workshop organized in the end of the fourth year in Thessaloniki together with the 3 ICARUS summer school will provide an opportunity of the final training on the use of the ICARUS paradigm and computational tools.

On the national level, there will be at least two training events in each case city:

1. a workshop presenting the ICARUS concepts, methodologies and pilot studies to the local stakeholders as well as general public. These workshops have to be organized during the second year of the project,
2. a workshop providing a platform to discuss the project results and outcomes and their potential application in development of the smart city strategies of the participating cities. These workshops should be organized in the final year of the project.

Dissemination Activities

A number of dissemination and networking activities happened during these 6 months. This includes the participation at international conferences, congress and scientific workshops. The most important are hereinafter summarized:

Special session at the 18th MESAEP International Symposium, Rome, October 2017.

A special session entitled "Climate change mitigation and air pollution abatement – towards win-win solutions" was organized by ICARUS in the frame of the 18th MESAEP International Symposium held at Rome, Italy. The session was introduced by a keynote lecture given by Dr. Simone Cresti project officer at the University of Siena who provided an overview of the Partnership on Research and Innovation in the Mediterranean Area (PRIMA) foundation initiative.

ICARUS team participated with several presentations as reported hereinafter.

- Prof. Denis Sarigiannis gave the oral presentation entitled *"An integrated approach to combat atmospheric pollution in smart cities through policy interventions and behavioural change – The ICARUS paradigm"*.

Figure 8 ICARUS session during the MESAEP 2017 Symposium

- Prof. R. Friedrich gave a presentation entitled: *"Conflicts between climate change mitigation and air pollution abatement"*.
- Dr. E. Scoccimarro gave a presentation entitled: *"Extreme events of perceived temperature over Europe: a projected northward extension of dangerous area"*.
- Dr. Rosemary Hiscock gave oral presentation entitled: *"A systematic review of socioeconomic determinants of exposure"*.
- Dr. Dimitris Chapizanis gave oral presentation entitled *"Emerging methodologies for personal exposure assessment: coupling portable sensor data and agent based modelling (ABM)"*.
- Dr. Evangelos Handakas participated to the MESAEP Symposium by giving oral presentation entitled: *"Nanoparticles concentration, number and size distributions in outdoor and indoor locations"*.

Figure 9: ICARUS special session at the MESAEP 2017 Symposium (October 1017)

Figure 9: discussion among delegates during break

This event contributed to greatly enhance the ICARUS visibility and to lay the groundwork for a closer cooperation in air quality and climate change management and to institute a dialogue in the scientific community and gave us the opportunity to establish strategic connections with other European initiative such as PRIMA foundation and to learn from other research groups what is the state of the art in this research field in the Mediterranean area.

Clean Air Forum, Paris, November 2017

The ICARUS Coordinator Prof. D. Sarigiannis represented the project consortium at the **Clean Air Forum.** The forum served as the platform for experts and politicians to put forth innovative ideas, solutions, to share, learn and implement the results to reduce the health risk posed by the air pollution.
Over 300 participants from government, industry, and NGOs as well as citizens shared their views at the Forum.

Figure 10: the Clean Air Forum in Paris

- Discussions focused on three themes: air quality in cities; air pollution from the agricultural sector; and clean air business opportunities.
- More than 30 high-level speakers reflected on the clean air challenge, on areas for action, the actors involved and on how policies can be crafted to deliver benefits on multiple fronts.

Collective Awareness Platform for Data Needs, Citizens' Participation and Regulatory Society Challenges: A Worldwide Exploitation of Emerging Technologies – Brussels, November 2017

On behalf of the ICARUS consortium Dr. Alberto Gotti attended this joint exploitation workshop organized by the European Executive Agency for Small and Medium-sized Enterprises (EASME) in Brussels. The event was be a key opportunity to discuss goals and aims of other EU-funded projects dealing with climate change and air quality, and the solutions emerging from the new technologies to tackle those issues.

Beside ICARUS other projects which joined the event were iSCAPE hackAIR, ClairCity CITI-SENSE, and nanoMONITOR.

Earth's Climate Change Science and Impacts Symposium, Belgrade, October 2017

Dr. E. Scoccimarro gave an oral presentation entitled "*Extreme events of perceived temperature over Europe in the future: the humidity role*"

Figure 11: web page of the Earth's Climate Change Science and Impacts Symposium

Social media

Twitter @ICARUS2020 is used regularly to link to content on the website and build networks outside of the project. By addressing the broader community and the general public, the project will contribute to bridging the gap between science and society.

ICARUS reports

For all, detailed information about deliverables, milestones please visit tye ICARUS web site at
www.icarus2020.eu
All materials are downloadable.

Participate in Project

For every updates about ICARUS project you can follows us at @ICARUS2020, where you can participate in the project by giving constructive suggestions, comments, etc.

Next Issue

The next issue will feature other news and documents developed by the ICARUS Consortium covering the period of next 6 months from January 2018 to June 2018.

Contact us

We want to hear from you! Please do not hesitate to send us your feedback, comments or questions here

H2020 - SC5-04-2015
GA No.690105

www. icarus2020.eu

Follow at: @ICARUS2020

CONTACT:
Project Coordinator : Aristotle University of Thessaloniki

Tel.: (+30) 2310 994562
sarigiannis@auth.gr