FIRST VERSION OF THE USER REQUIREMENTS DOCUMENT

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About this document

Work package in charge: WP1: Identification of User's Needs and Service Design

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1. Abstract /publishable summary

This document describes the meetings that have taken place between AQ-WATCH partners and prime users in the USA, China and Chile. It also compiles the requirements from those prime users for the products that will be developed.

The development of these products by AQ-WATCH partners is based on the "Spiral process". With this process, dynamic interactions between the developers of the prototype products/services and the prime users in 3 regions of the world will be developed. The process by which value is added to space and in situ data will be modulated by the input of these users and will involve successive iterations during which feedback reactions will be collected, analysed and included in the new development.

2. Conclusion & Results

Not relevant

3. Project objectives

This deliverable contributes directly and indirectly to the achievement of specific objectives indicated in section 1.1 of the Description of the Action:

Specific objectives of the project	**Contribution of this deliverable?**
[1] To design and produce new global and regional air pollution atlases that include the climatological distribution of chemical pollutants complemented by quantities such as the diurnal and seasonal variations, air quality and related health indices, premature mortality exceedance frequency, long-term trends, etc.	Yes
[2] To develop software packages with the capability to provide more accurate daily forecasts of air quality at the regional scale including tailored high-resolution fire smoke and wind-blown dust forecasts; downscaling of air quality forecasts to 2 km resolution in urban areas.	Yes
[3] To develop a source apportionment service to mitigate air pollution and hence increase the life expectancy of the population in different regions of the world, with special focus on the role of agricultural sources of air pollution and the potentially important effects of fracking operations.	Yes
[4] To develop a new tool-box that will be user-friendly and accessible to decision-makers to evaluate the efficiency of proposed mitigation measures in different industrial sectors on the resulting level of air pollutants in three different regions of the world. This will establish the basis for their wider adoption and generalization.	Yes
[5] To co-design, co-produce and co-evaluate for the first time prototype products and services with prime users in three regions of the world chosen for their specific level of economic, social and environmental development.	Yes

This deliverable directly contributes to the achievement of specific objectives indicated in the description of the Work Package.

Objectives of WP1	**Relevance in this deliverable?**
1.1 Identification of the User's Needs and elaboration of the User Requirement Document	Yes
1.2 Identification of Improved Products based on Users' feedbacks	Yes
1.3 Identification of the final products for commercialisation consistently with the business model	Yes

Objectives of WP2	**Relevance in this deliverable?**
2.1 Preparation of an air-quality dataset using satellite data downloaded from the WEkEO DIAS (Copernicus Data and Information Access Services). WEkEO is still under development: before it is fully operational, the data will be accessed through the Copernicus Atmosphere Data Store (available in July 2019) and through the Sentinel Hub EO browser (sentinel-hub.com/explore.eobrowser). The Copernicus Atmosphere Service retrospective reanalysis will also be accessed through WEkEO. As soon as all the observations are available in WEkEO, all data used in the project will be accessed through this system, complemented by third-party data for parameters not covered by Copernicus.	No
2.2 Develop an atlas including visualization of satellite and in-situ data as well as air pollution maps to assist monitoring and analyses of air pollution.	Yes
2.3 Use of satellite, surface observations and the CAMS reanalysis to provide global and regional climatologies of air pollution including statistical information (means, diurnal and seasonal variability, long-term trends, exceedances)	No
2.4 Develop an innovative method to calculate health indices and mortality from outdoor pollution using satellite observations	No

Objectives of WP3	**Relevance in this deliverable?**
3.1 To develop a harmonized set of detailed AQ forecast and alert systems for the focus regions: US Colorado State, Chile, Beijing Urban Area and BTH (Beijing-Tianjin-Hebei) area with possibility of expansion to other regions	Yes
3.2 To develop the tailored fire and fire smoke forecasting services targeting the focus regions	Yes
3.3 To develop the tailored wind-blown dust services targeting the focus regions	Yes
3.4 To establish the near-real-time evaluation of the developed services using the operationally available satellite and in-situ data	No

Objectives of WP4	Relevance in this deliverable?
4.1 To establish a user driven service for (NRT) source apportionment information	Yes
4.2 To establish a user driven service for mitigation information on most effective emission reduction measures	Yes
4.3 To establish a fracking service for the assessment of the impact of fracking activities on air pollution	Yes
4.4 To improve the quality of the above mentioned three services, through validation, customization and targeted developments	Yes

Objectives of WP5	Relevance in this deliverable?
5.1 Release the developed applications for web and mobile air quality toolkit, targeted to air quality managers and to the public.	Yes
5.2 Enable an easy access to warning systems to allow individuals exposed to air pollution to take preventive measures, which could reduce health impacts and healthcare costs from adverse effects of air pollution.	Yes
5.3 Give an access to personalized information or variability forecast to help individuals manage their life. Users will be able to use tools to search locations, view personal exposures, or exposure reduction over time. The AQ-WATCH tools will allow individuals to navigate and choose outdoor places to live, work, go to school, shop, travel, exercise, plan activities ahead and better manage treatments. The system will allow patients' physicians access to air quality information, which should enhance disease management and medical decisions.	Yes
5.4 Introduce behavioral changes through air quality alerts (push notifications) with thresholds to be defined in accordance with national or local regulation, in coordination with local authorities.	Yes
5.5 Allow a better location of air quality issues, which represents a key value for healthcare professionals and policy-makers to better locate and enhance prevention for communities at risk.	Yes

Objectives of WP6	Relevance in this deliverable?
6.1 To work with prime users in Colorado, Chile and China on the implementation and development of the proposed prototype products and services. The pilot implementations will include Denver/Colorado, Santiago/Chile and BTH (Beijing-Tianjin-Hebei) /China, each region experiencing different AQ issues and different air quality policies and management structure so as to develop a tool that is applicable to a wide range of users.	Yes

6.2 To release the developed web and mobile AQ toolkit to air quality managers and the public. The AQ toolkit will collect user feedback via closed end questions (ease of use, practicality, perceived impact on health, and willingness to pay, etc.) which will feed back into tool development/improvement.	Yes

Objectives of WP7	**Relevance in this deliverable?**
7.1 Clustering with major EU and international projects and initiatives relevant for the project to guarantee the use of available knowledge (state-of-the-art);	No
7.2 Establishing contact with potential international end-users by building a community interested and capable to make the best use of the project results;	No
7.3 Providing information and technological briefings to the competent authorities to make them aware of project results;	No
7.4 Providing support for standardization activities;	No
7.5 Preparing the AQ-WATCH Plan for Use and Dissemination of Foreground Knowledge;	No
7.6 Develop business cases in the regions of the world of the pilot-cases.	No

Objectives of WP8	**Relevance in this deliverable?**
8.1 Project management: Facilitating governance and strategic decision-making through project committees, boards, management procedures, and project management tools, performing technical, financial and contract management of the consortium, establishing and maintaining an effective working relationship between AQ-WATCH and the European Commission (EC).	No
8.2 Day-to-day scientific and innovation coordination: Carrying out the overall coordination necessary for reaching the scientific and innovation objectives, and elaborating research risk management.	No
8.3 Data management: Establishing data management linked to the Copernicus system (DIAS) at project level, fostering transparency and the promotion of data and meta-data standards, implementing open access data policies.	No
8.4 Implementing the innovation management, support dissemination and communication activities: Coordinating innovation management and monitoring the IPR relevant issues. Supporting WP6 and WP7 to deliver dedicated communication tools and materials, tailored dissemination and communication activities, and promotion of AQ-WATCH Toolkit and marketable products towards stakeholders and customers in several regions of the world outside Europe.	No

4. Detailed report on the deliverable

In this initial phase of the development of the 7 products to be delivered by AQ-WATCH in about 2-3 years, three meetings with prime users took place with the purpose of presenting the potential products and to collect first reactions. These meetings took place in Colorado, USA, in Beijing, China and in Santiago, Chile. At this stage of the project development, no detailed mock-up could be presented and this initial conversation focused on the needs of the prime users and their general views on the benefit they expect from the project. It also helped in identifying additional potential prime users.

The outcome of these meetings and the information provided by the prime users is essential in the process of the product development. The information gathered during these meetings will be circulated within the project and will be the basis for further developments of the products and services. Similar consultations will happen in about a year with the display of the first prototype products and services. This second round of consultations will provide an opportunity to improve the original products and services.

4.1. Meeting with prime users

4.1.1. Meeting with prime users in the USA

A meeting with prime users in the USA took place on 27th April 2020, between AQ-WATCH partners from NCAR and members of the Department of Environment and Public Health (CDPHE). CDPHE's main tasks as they relate to AQ-WATCH are to (1) issue air quality warnings, daily during ozone season (June-September) and as needed other times; (2) issue permits for prescribed and agricultural fires; (3) provide air quality assessments for Colorado; (4) develop emission control strategies to ensure attainment of the national health standards for ozone (the Colorado Front Range is classified as a serious violation); and (5) provide documentation for exceptional events (e.g. wildfires, stratospheric intrusions, dust storms) that lead to the exceedance of a criteria pollutant and influence the attainment/non-attainment status.

AQ-WATCH partners presented slides with an overview of the project, the available mockup for the global atlas and ideas for the other products. Given that mockups for other products have not yet been available, discussions centred around air quality forecast products for metropolitan areas.

CDPHE is consulting NCAR's products on a regular basis and states that they are of great value to them. They use the products for daily forecasting as well as analysis of exceptional events (stratospheric intrusion events (STE), wildfire influence, dust storms). Most used information includes hourly maps of fine particulate matter ($PM_{2.5}$) and ozone, CO tracers for Fire and Asian emissions, and ventilation index (overlaying winds on all these maps is important). For their work, they need information at the surface but also at upper levels. The current display of maps at 3 km, 5 km and 8 km altitude works well for them. Adding a higher resolution (4 km) domain over Colorado to a 12 km CONUS forecast is welcome.

Evaluation and Suggestions by the User:
CDPHE is interested in seeing how the forecasts performed on recent events and the current evaluation (time series comparisons for each forecast cycle of surface O_3 and $PM_{2.5}$ concentrations for different regions and hourly maps of observations and model) fits these needs.

Additional products wished by the user:

- Additional desired model products: Visibility, Dust concentrations, MDA8 O_3, 24-hr average PM, AQI
- Additional desired products: GOES-16 Band 7 (for fires) and Band 9 (for rel. hum.) in near-real time
- Additional desired visualization: Display time series of surface concentrations by clicking on map.
- Additional desired evaluation: Long-term comparison of surface observations to forecasts for EPA regions, but also at selected surface sites could be of interest.
- Additional needs: Most up-to-date information on fires. The NCAR forecasts, to be included among the AQ-WATCH products use at the moment fire emissions from the previous day; we will try to change this to using same day fire emissions.

Feedback on Global and Regional Atlases:
There appears to be less interest in a global atlas, but display of satellite products on a regional level would be of interest. Additional information to display: $HCHO/NO_2$ ratio (monthly to seasonal).

Needs for Source Attribution and Mitigation Service:
Colorado is in non-compliance for surface ozone and of most interest to them would be a box model-based tool, which can be used to test different emission scenarios. This would enable them to also test new and less well-known emission sources (e.g. cannabis industry in Colorado). Hence such a tool should also include fairly detailed chemistry.

4.1.2. Meeting with prime users in China

A meeting with prime users in the China took place on 26th May 2020, between AQ-WATCH partners from the Beijing Municipal Institute of Labor Protection (BMILP) and the Beijing Computing Centre (BCC), and members of the Taoranting Subdistrict Office (TRT) and Appraisal Center for Environment and Engineering (ACEE).

TRTs main tasks as they relate to AQ-WATCH are to (1) monitor air quality and provide related assessments for the Taoranting sub-district in Beijing; (2) develop and carry out emission control strategies to ensure attainment of the air quality standard of Xicheng District. ACEE's main tasks related to AQ-WATCH is to provide technical support for air quality management of Cangzhou city, Hebei province.

AQ-WATCH presented slides with an overview of the project, the available mockup for the global atlas and ideas for the other products. Given that mockups for other products are not yet available, discussions centred around the mockup of the global atlas and current BMILP/BCC local air quality atlas as an example of its use by a district of Hebei province. The discussion also focused on hourly air quality forecasts in the BTH (Beijing-Tianjin-Hebei) region.

Evaluation and Suggestions by the Users:

Feedback on Global and Regional Atlases

- There appears to be less interest in a global atlas, but good interest in higher resolution monitoring atlas at street level.
- The users wonder how AQ-WATCH products could be combined with current city and local observation data to provide helpful supporting information to improve their air quality management at the district and street levels.
- Products in English is hard for Chinese users, in particular for local government officers. So, the user hopes that there will be a Chinese version for all the products for pilot use.

Feedback on local atlas and regional forecast products:
The users are interested in seeing how the high-resolution local air quality atlas (using observation data from monitoring stations and mobile air quality micro-sensors) will display the spatial distribution of pollutants (specifically $PM_{2.5}$), the hot spot areas for air pollution and the forecasts performed on recent events. These are information that which fits their needs.

Additional needs: higher resolution (e.g. at street level) and longer time-scale atlas based on both real-time observations and forecasting data with the purpose of detecting fine spatial distributions and temporal evolutions of regulated pollutants. If possible, it is preferred to overlay meteorological variables (wind speed and direction, atmospheric pressure, temperature, radiation, mixing height, etc…) on the concentration atlas so as to display the impact of those variables on the evolution of pollutants.

Needs for Source Attribution and Mitigation Service
Source attribution and the corresponding mitigation strategies are of highest concern for TRT and ACEE. TRT is particularly interested by the distribution of pollution sources at the street level, and the reasons for the high concentrations of TSP, $PM_{2.5}$. This information will help them to take effective measures to improve the air quality in their governance area.

Urgent need for both users: Quantify the relative contribution of external sources of transported species in neighbourhood areas and the contribution of local sources for each emission sector. The closest to real-time is the identification of the sources, the better. The most concerned pollutants are $PM_{2.5}$, TSP and O_3 (in summer).

4.1.3. Meeting with prime users in Chile

A meeting with prime users in the Chile took place on 15th June 2020, between AQ-WATCH partners from the University of Chile, officers from Ministry of Environment from the Metropolitan Region of Santiago and the Institute of Public Health. The Chilean partners decided to include in the discussion different organisations and institutions (public and private) that are related to air quality, either through managing it or because of their area of operations.

The main aim of the discussion with these partners was to identify the needs, opportunities and benefits of an interactive air quality platform with 48-72 hour forecasting, the ability to attribute the air quality to different emissions sectors, and pollution concentration maps, among other characteristics, designed to contribute to decision-making processes regarding air quality management and the operation of systems in healthcare and industry.

This section presents the organized and classified summary of the discussion that took place during the workshop. An open consultation was carried out with the participants regarding the interactive platform and the products presented. They were specifically consulted about the following: the uses of air quality information, their needs and expectations (product display formats, temporal and spatial scales, etc.), and possible improvements to the platform. The results are presented below:

THE USES OF AIR QUALITY INFORMATION

- Predict the cases of sick patients at 7 and 14 days.
- Environmental exposure to which each person is subjected.
- Complement presentations of graphs showing the evolution of air quality to assess effectiveness.
- Project how the application of a measure will function and assess its effectiveness.
- Comparative Analysis of the cost-effectiveness of measures.
- Assess an implemented measure over a shorter timeframe.
- Predict disease events for specific pathogens.
- Have access to a forecast for healthcare decision-making (the services offered during winter campaigns, for example), through air quality information by sector.

NEEDS AND EXPECTATIONS	**IMPROVEMENTS TO THE PLATFORM**
- Expectation of assessing a measure in a shorter timeframe rather than every 5 years (updating of decontamination plans). - Expectation of the emission source being updated so one can view air quality results to compare projections with the actual situation. - Need to understand the scientific validity of the model used. - Need to understand the coverage area in order to obtain background information about the long-term exposure and type of contaminants pertaining to a patient. - Need to determine individual exposure to pollutants and their subsequent association with a health problem.	- Usefulness of the annual scale, but daily results are needed to predict diseases on a smaller scale. - Usefulness of the platform at the grid level. - Have access to information on both the annual and monthly scale (evolution of air quality). - Have a spatial distribution for forecasting air quality by sector.

THE QUESTIONS ASKED BY PARTICIPANTS DURING THE WORKSHOP

- What is the level of uncertainty with respect to the air quality forecast? What is the forecast period that it provides? 48 hours? 72 hours?
- How is this information used in the countries where you are working in order to make decisions about air quality management?
- Considering the usefulness of determining individual exposure to pollutants and their subsequent association with a health problem, will these contamination records be downloadable?
- How often are the pollution sources updated?

- What source of information are you using for the emissions being input into the air quality model? How does this methodology (and its calculation uncertainty) vary between different locations?
- In the mitigation analysis is it assumed that the per-sector contribution is constant for any day and any time? Or are the per-sector contributions considered to vary during the week?
- Do you create specific forecast models for each country?
- For the module where the sources of contamination appear on the left-hand side, are these variables found in a forecast model?
- Are you planning to publish a scientific paper regarding validation of the proposed model for the platform?
- How do I download that database?

A questionnaire was sent to the different participants about the need for the development of an interactive platform for forecasting and attributing air quality. The information provided by the responses to the questionnaire is presented in the following three tables. The responses have been classified into the uses, advantages and benefits (in terms of forecasting and attributing air quality) of both the platform and the specific products presented in the workshop.

a. USES, ADVANTAGES AND BENEFITS OF THE INTERACTIVE PLATFORM

<table>
<tr><th colspan="2">THE USES OF AIR QUALITY INFORMATION</th></tr>
<tr><td colspan="2">- Assess standards.
- Forecast air quality.
- Assess measures.
- Environmental management.
- Implementation of the plans for the prevention and/or decontamination of atmospheric pollution.
- Specific projects related to health.
- Models for predicting diseases.
- Management of critical episodes in air quality forecasting.
- Local monitoring of own emissions based on environmental qualification resolutions.</td></tr>
<tr><th colspan="2">THE ADVANTAGES OF ACCESSING INFORMATION RELATED TO AIR QUALITY</th></tr>
<tr><th>IN TERMS OF FORECASTING</th><th>IN TERMS OF ATTRIBUTION</th></tr>
<tr><td>- Analysis of scenarios.
- Improved forecasting.
- Forecasting specific diseases.
- Predictive models for resource planning and management during health alerts.
- Inputs for declaring critical episodes.
- Preventive actions with more specific measures for projecting emissions.</td><td>- Identification of key sectors for mitigation measures.
- Projects and/or agreements for studying the relationship between pollutants and health.
- Better information for Ministry of Health decision-making.
- Being able to observe the effectiveness of pollutant reduction measures.</td></tr>
<tr><th colspan="2">THE BENEFITS FOR PUBLIC HEALTH AND OPTIMISING RENEWABLE ENERGY</th></tr>
<tr><th>IN TERMS OF FORECASTING</th><th>IN TERMS OF ATTRIBUTION</th></tr>
<tr><td>PUBLIC HEALTH:</td><td>PUBLIC HEALTH:</td></tr>
</table>

- Low level of improvement, as it depends on the timely implementation of the decontamination plans and not on the forecast. - Improvements in public policy planning regarding attention to the public with respect to the health care impacts of air quality. - Better management of resources, prevention of deaths and anticipation of critical periods. **RENEWABLE ENERGIES:** - Generation of changes in the industrial energy matrix.	- Identification of critical zones for assessing impact. - Low level of improvement, as it depends on the timely implementation of the decontamination plans and not on the forecast. - Estimate the harm to health caused by pollution in order to improve regulations. - Better focus on air quality measures in specific zones. **RENEWABLE ENERGY:** - No comments.

b. PRODUCT 1: "GLOBAL AND REGIONAL ATLAS OF AIR QUALITY INDICES AND REPORTS"

THE USEFULNESS OF UNDERSTANDING AIR QUALITY	
AT DIFFERENT SPATIAL SCALES (GLOBAL, REGIONAL AND LOCAL) - It would allow focussed management. - Improved forecasting. - It would make it possible to identify a higher prevalence of pathogens by zone. - Establish future studies on the interaction between air quality and health by zone. - Estimate the different impacts and polluting sources for future regulations. - Planning of public attention measures. - It would make it possible to focus emission reduction measures on a spatial scale. - It would be useful in operations in different regions of Latin America.	**IN THE PAST (DAYS, MONTHS, YEARS)** - Knowledge of the evolution and impact of air quality measures. - Link the evolution and quality of air in the city. - This already exists through the air quality information system, but only in the Metropolitan Region. - Complement studies for seasonal pathogens. - Daily provision of data would permit the development of predictive health models. - Gather background information of exposure to pollutants in people and associate this with diseases. - Ascertain how the measures applied have contributed to reducing emissions. - Useful for traceability, setting goals and correlating these with the energy matrix.
IMPROVEMENTS TO THE PRODUCT	
WITH RESPECT TO THE INFORMATION PROVIDED - Improve the spatial identification of emission sources. - Improve the most relevant indices by zone in Chile.	**IN RELATION TO THE NEEDS OF THE COMPANY/INSTITUTION** - Modification of emissions inventory in order to generate scenarios. - Have access to hourly projections of the behaviour of pollutants (pollution peaks). - Include health factors.

- Facilitate the complete data download from the atlas in grid form and R packages. - Provision of forecasting and real data at hourly and daily intervals in terms of: rainfall, wind, mixing layer height, temperatures, and concentrations of pollutants.	- Greater ease of downloading information for analysing environmental exposure. - Provision of forecasting and real data at hourly and daily intervals in terms of: rainfall, wind, mixing layer height, temperatures, concentrations of pollutants.

c. PRODUCT 2: ATTRIBUTION SERVICE

USEFULNESS OF UNDERSTANDING THE PER-SECTOR CONTRIBUTION TO EMISSION CONCENTRATIONS BY DAY AND HOUR	
- Better focus management and measures. - Identify possible impacts. - Prepare health studies for the oversight of polluting companies. - Understand the contribution of each sector to different diseases. - Improve emissions reduction measures	
IMPROVEMENTS TO THE PRODUCT	
WITH RESPECT TO THE INFORMATION PROVIDED	**IN RELATION TO THE NEEDS OF THE COMPANY/INSTITUTION**
- Improve its geographic precision so that the emission sources proportional to each sector can be identified. - Consider confidence intervals in the predictions. - Make it easier to fully download.	- Have access to a real-time monitoring of the mixing height parameter. - Prepare PM time profiles (24, 48, 72 hours) taking into account the uncertainty. - Incorporate monthly predictions - Include meteorological parameters associated with the appearance of specific diseases

5. References (Bibliography)

Not relevant

6. Dissemination and uptake

6.1. Uptake by the targeted audience

As indicated in the Description of the Action, the audience for this deliverable is

X	The general public (PU)
	The project partners, including the Commission services (PP)
	A group specified by the consortium, including the Commission services (RE)
	This report is confidential, only for members of the consortium, including the Commission services (CO)

7. Deliverable timeliness

Is the deliverable delayed?

☐ Yes ☒ No

8. Difficulties encountered, if any

The meetings with the prime users have been a challenge to arrange, particularly due to the Covid-19 pandemic. Organisations in different parts of the world responded to the situation in different ways, and AQ-WATCH partners and prime users had to establish contact remotely, which led to some significant delays in setting up the meetings.

9. Sustainability

Not relevant

10. Full track of dissemination activities

Not relevant

11. Full track of publications and IP

Not relevant