Ref. Ares(2021)2842144 - 28/04/2021

First report on the review meetings with the 3 prime-users

Deliverable title	**First report on the review meetings with the 3 prime-users**
Deliverable number	**D6.1**
Revision	**1**
Status	**Final**
Planned delivery date	**30/12/2020**
Actual date of issue	**28/04/2021**
Nature of deliverable	**Report**
Lead partner	**UCAR**
Dissemination level	**PU (Public)**

The research leading to these results has received funding from the European Union's Horizon 2020 Research and Innovation programmes under grant agreement No 870301

About this document

Work package in charge: WP6 : Regional co-production and pilot implementation

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1. Abstract /publishable summary

This document describes the first review meetings with the prime users in Chile, China and the USA. These meetings follow the initial meetings that have taken place between AQ-WATCH partners and prime users, where the first versions of the prototypes were presented, as reported in Deliverable 1.1. The development of the AQ-WATCH toolkit is based on the "Spiral process", where several dynamic iterations take place between developers and the prime users. 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 will be collected, analysed and included in the new development.

2. Conclusion & Results

Prime users have provided a general feedback on value and functionality of the products, and also specific feedback on each of the module. Overall, products were well received and showed a clear value in support of prime users' needs. However, as they represent different interests (private business, local and regional government), prime users expressed distinct feedback based on their needs, highlighting the most appropriate modules that can provide useful information to them. The current version of the toolkit, as described in Deliverable 1.2, has addressed and implemented feedback and particular needs from prime users, after the first review meetings. As part of AQ-WATCH's "Spiral process", further meetings with prime users will take place within the next 12 months, particularly as the toolkit becomes operational.

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 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.	No

4. Detailed report on the deliverable

In this phase of the production of the toolkit to be delivered by AQ-WATCH, three meetings with prime users took place with the purpose of presenting the further development of the products, and gathering feedback and other potential needs. These meetings took place in Colorado, USA (online), in Beijing, China and in Santiago, Chile (online). At this stage of the project development, a detailed version of the mock-ups were presented and the conversation focused on the feedback of the prime users and how the products would attend their specific needs. 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 has been discussed among developers 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 a "live" version of the prototype products and services.

4.1. Meeting with prime users

4.1.1. Meeting with prime users in the USA

A review meeting with prime users in Colorado, USA (Figure 1) took place online on 1st February 2021, between AQ-WATCH partners from NCAR and Breezometer, and members of the Colorado Department of Public Health and Environment (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 non-attainment area for ozone); 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.

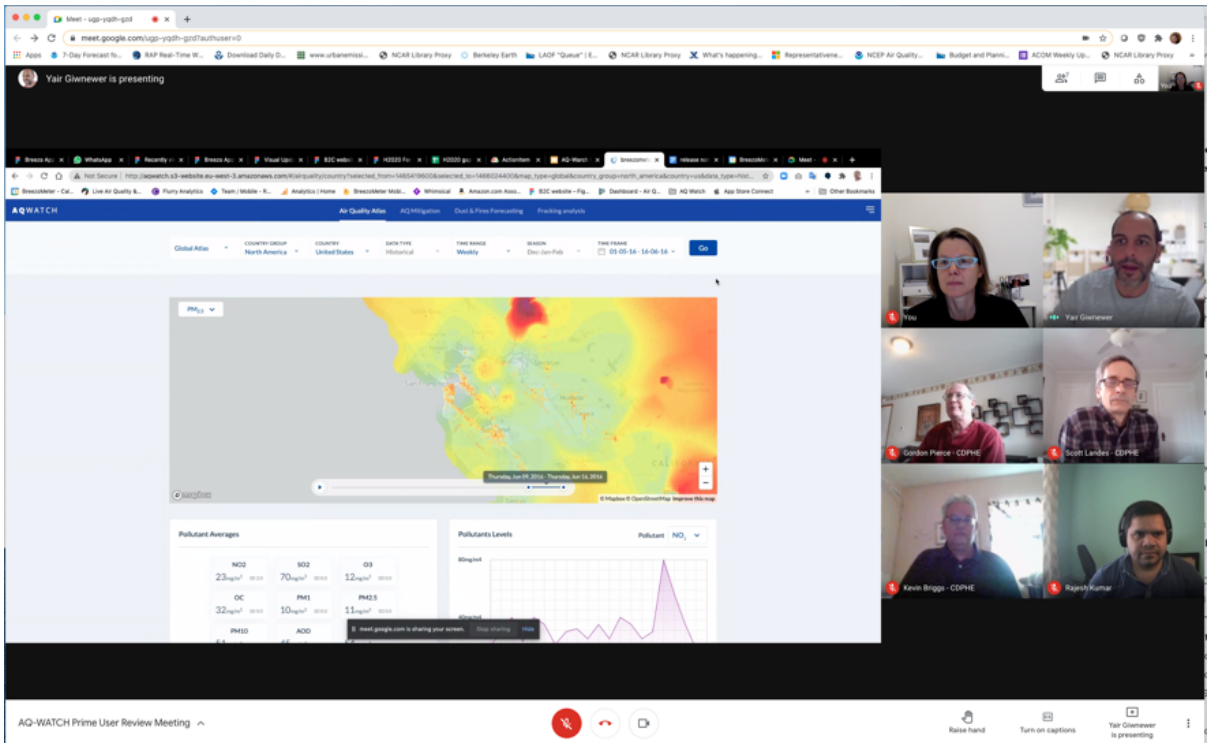


Figure 1 – Participants of meeting between AQ-WATCH and Colorado (USA) prime users

AQ-WATCH partners presented the system and explained that we are using mock data as of now. After a brief overview of the products we showed the essential functionality of each module, which was then discussed.

General feedback on value: CDPHE likes the design and layout and sees a definite value for the different tools, which would also be of great support for public outreach (e.g., air quality alerts are issued via email, Twitter, Facebook and also broadcast on media) and for media requests ("one-stop shop"). Public may be interested in historical products as well as the fracking tool but the public must be cautioned that this information, specifically the latter, is based on models and subject to uncertainties.

General feedback on Functionality: CDPHE would like to see legends added to the maps and provide the user with an option to download all the images at the same time (e.g. as one PDF) as well as to download individual images (e.g. as png). Also, the end users should be able to change the colour scales on the map and possibly for the line plots and the concentration range. This is to allow for seasonal changes in pollutant concentrations or adjusting for extreme events such as fires.

Global and Regional Atlas: CDPHE stated that the tool is useful to tell which parts of the Colorado Front Range have the worst air quality (a frequent public and media question). Showing satellite data as well surface observations and model re-analysis are of interest. CDPHE will benefit by displaying the *in situ* observations on top of the maps that show the model output. CDPHE would like to see the historical data for as long back as possible. "People are interested in understanding how AQ changed over long periods of time, even 10 years". Decadal time scales are useful for the historical perspective.

CDPHE would benefit from air quality information for the recent 4-5 days (consider as a default setting). Having a (static) emissions layer (e.g., the anthropogenic emissions in the model) could be useful for decision-making but adding emissions is not a top priority for them.

Attribution/Mitigation tools: CDPHE suggested that the source attribution tool should display the contributions of all different sources (e.g., also dust and wildfires) to PM2.5 (and other compounds). This means all sources should add up to the total concentrations (with non-tagged contributions defined as "Others"). To help understand the importance of transboundary pollution, it is desirable to display which countries/states/provinces are contributing the most to air pollution in Colorado. Interstate transport of CO from selected states (to be determined in collaboration with the CDPHE, ideally to be changed interactively by the user) would be useful for the CDPHE.

Fire/Dust/Visibility/Air quality forecast tools: It was discussed that it is useful to show the location of fires on the map but the best way to do so still needs to be decided. If fires are shown by icons, there should be an option to turn the fire icon off so that they don't obscure the model forecasts. It would be useful if something similar to InciWeb[1] can be implemented (InciWeb provides the fire perimeter but this might not be identical to the fire information used in the models). Solar radiation/cloud display is useful to assist in understanding of ozone chemistry and displaying wind vectors would assist with characterizing transport of pollutants. Dust and fire forecasts should be overlaid with masks showing where the visibility is less than 5 miles, which is the threshold for issuing advisory in Colorado ("If visibility is less than 5 miles in smoke in your neighbourhood, smoke has reached levels that are unhealthy")[2]. Visibility forecast also of value for Class 1 (e.g., National Parks) areas (U.S. EPA Regional Haze Program)[3]. For the dust and wildfires product, the domain should cover western US and western Canada.

Fracking Service: Not something that would be used on a daily basis but CDPHE sees a definite interest by the public. Should include a warning that the estimates, while to the best of knowledge and constrained by observations, are based on a model and therefore subject to uncertainties. The tool needs to also include additional information in layman's terms. The list of proposed VOC species looked sufficient to them.

Additional products for consideration: Regarding satellite imagery, CDPHE frequently uses GOES-16/17 imagery[4] to examine fire hotspots and dust outbreaks. These should be added to the atlas. They most frequently use GeoColor (CIRA) and 7, 3.9µm, and the recently added Shortwave WindowDust - DEBRA (CIRA) product.

4.1.2. Meeting with prime users in China

A review meeting with prime users in China (Figure 2) took place on 12th March 2021, between AQ-WATCH partners from the Beijing Municipal Institute of Labor Protection (BMILP) and members of the Taoranting Subdistrict Office (TRT). TRT's 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.

1 https://inciweb.nwcg.gov/

2 https://www.colorado.gov/airquality/advisory.aspx#GenYearRound

3 https://www.epa.gov/visibility

4 https://rammb-slider.cira.colostate.edu/

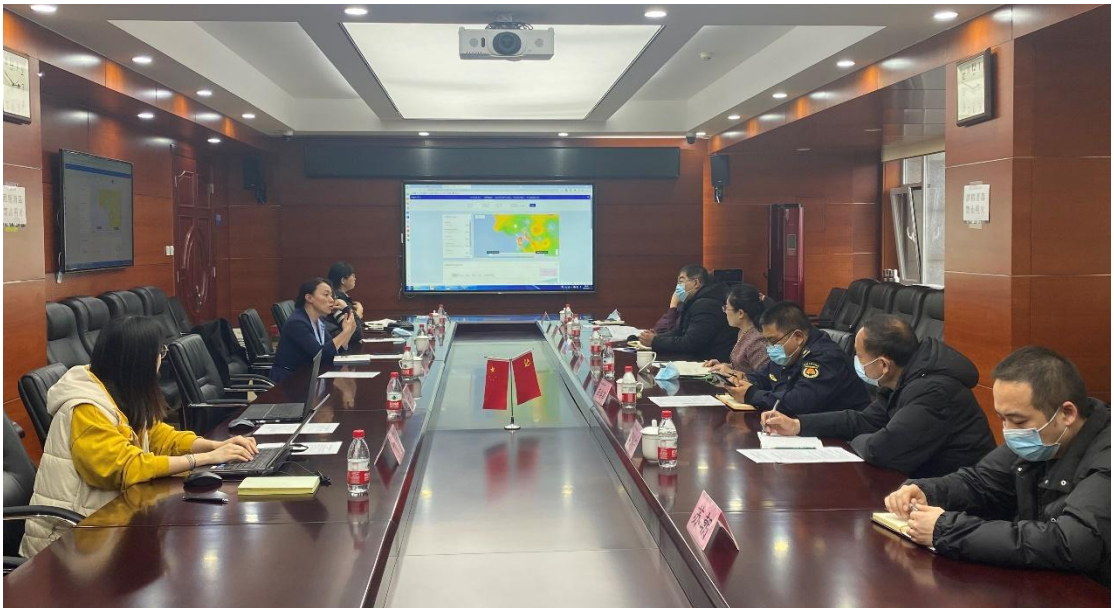


Figure 2 – Participants of meeting between AQ-WATCH and China prime users

AQ-WATCH partners presented the AQ-WATCH service prototypes through the website provided and with the help of an introductory video made and recorded by Breezometer. After a brief overview of the products and a demonstration of the mockups, Xiaohui Ji (BMILP) showed the essential functionality of three modules including "Global and Regional Atlas", "AQ Attribution/Mitigation" and "Air Quality Forecast", which were then discussed. The "Dust and Fire Forecasting" and "Fracking Analysis" modules were just mentioned briefly in regard to their essential functionality without discussing them in detail in that meeting because these two modules are of less interest to TRT users.

General feedback on value: TRT like the design and layout and find the system informative in regard to the distribution of air pollutants at various scales, source apportionment and prediction results. They do appreciate the user-controllable component of the system. As government users with a focus on the street level, they are most concerned about the current situation and the impacts of governance measures of air quality on local scales. The high resolution gridded local data and related source apportionment/mitigation module is of their most interest.

General feedback on Functionality: TRT suggested adding legends to the maps to tell the user the specific concentration value range represented by different colours. They also like to see the colour of the legend to better correspond to the air quality standard grade of the country. They would like to have users choose the units of the species, such as ppb, ppm, or $\mu g/m^3$. For Chinese users, the default unit is best set as $\mu g/m^3$ (mg/m^3 for CO) to conform with Chinese National Air quality Standards.

Global and Regional Atlas: TRT suggested adding meteorological parameters to the maps, as well as a (static) emission layer to the air quality atlas layer, which will make it easier for users to intuitively understand the source direction of pollutants. This also would be useful for decision-making. It will be more helpful for air quality management if an automated warning alerts the user of high concentration events and informs on recommended mitigation measures. For example, a warning message could be sent automatically to the user's phone if the concentration of one or more pollutants exceeds the standards to remind him/her that one or more certain measures should be taken. Users also want to see the system to provide a set of high-resolution satellite observation data/maps.

Attribution/Mitigation tools: TRT is most interested in this module and believe it is very useful for their AQ management work. Apart from the species ($PM_{2.5}$, PM_{10}, NO_2, SO_2, CO) which have been included in the AQ mitigation module of the current prototypes, they also are interested in ozone (O_3). Specifically, they would like to know the contribution of air pollutants (especially $PM_{2.5}$ and O_3) that is due to traffic into the city versus local sources in the city. For the local sources, they would like to know which sectors are contributing the most in Taorangting as this information is needed to support their decision-making. They suggest keeping the species consistent between different types of figures (e.g., mitigated pollutant levels, country contribution and sector contribution). They also like to see the country contribution replaced by a spatial contribution representing states, cities and districts in addition to countries. The figures and species also need to be consistent between historical and forecast data.

AQ Forecast: Similar feedback as given above also applies to the Global/Regional Atlas. They want to see also the evolution of the meteorological situation overlaid on the forecasting air quality map.

Dust and Fires Forecasting and Fracking analysis: As mentioned above, these modules are not directly applicable for TRT users and were not discussed in detail.

Additional products for consideration: Observed concentrations and emission data of carbon dioxide and other greenhouse gases such as, e.g. available from satellite, would be a valuable addition to the maps in order to support China's carbon peak and carbon-neutral target.

4.1.3. Meeting with prime users in Chile

A review meeting with prime users in Chile took place on 15th December 2020, between AQ-WATCH partners from the University of Chile, Barcelona Supercomputer Center and Breezometer, and members of the Chilean Association of Renewable Energy and Storage (ACERA, in Spanish).

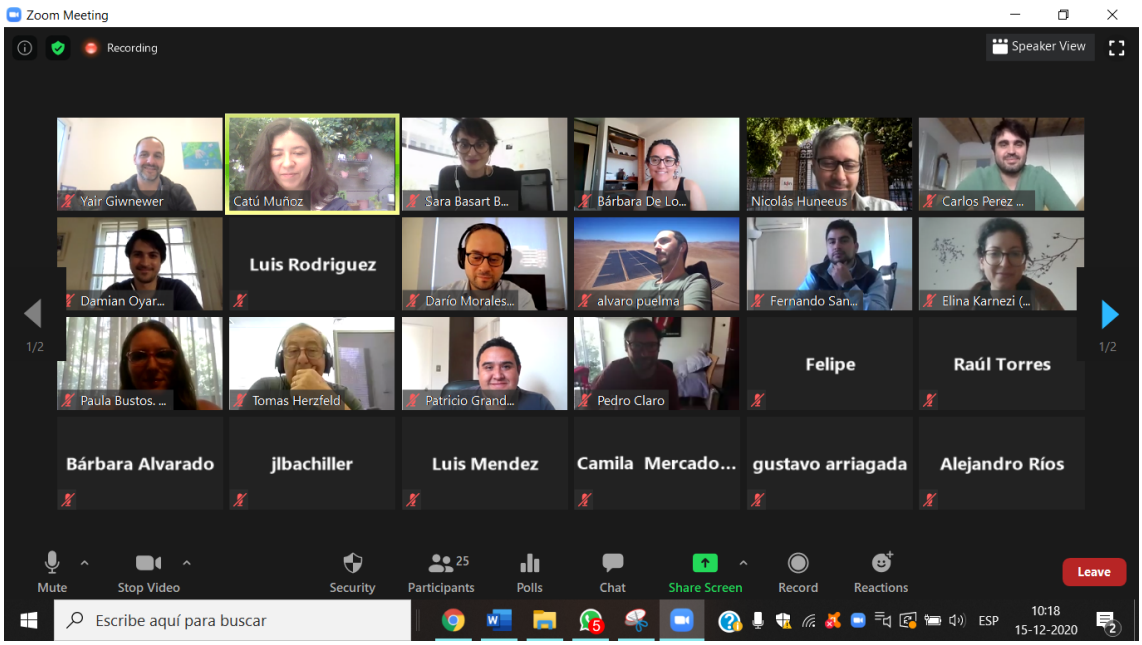


Figure 2 – Participants of meeting between AQ-WATCH and Chile prime users

Given the characteristics of the prime users and the meeting participants, the workshop was centred on the Dust and solar energy forecasting product. Three presentations were given:

- General aspects: Nicolás Huneeus, Responsible researcher of AQ-WATCH in Chile, Universidad de Chile (UChile).
- Modelling of mineral dust at BSC: Sara Basart, Responsible researcher of AQ-WATCH in Spain, Barcelona Supercomputing Center (BSC).
- Mock-up of the product "Dust and solar energy forecasts": Yair Giwnewer, Product Manager, Consumer Products, Breezometer.

In general terms, three important take-aways emerge from the workshop. First, dust forecasting tools are still little known on the Chilean market and specifically as it relates to the production of solar energy. Second, although solar power plants are working on monitoring and cleaning alternatives (e.g., soiling models or use of internal sensors) and dust forecasting instruments are generating more and more interest and demand, having access to dust forecasts would be more useful on a medium- and long-term scale than on a daily basis. This is explained mainly by two reasons that also illustrate the needs of the Chilean Solar Power market; one is that information related to the dust forecast can be linked with other relevant production data and used for planning purposes in e.g., costs associated to the energy losses due to dirt, the cleansing of solar panels, etc. The other is related to the particularities of the dust activity in the Chilean desert. In Chile it is not common to have intense dust events as can be observed in other parts of the world (e.g., Saudi Arabia), so cleaning is not needed on a daily basis but rather something that can be planned.

The major outcome of the meeting was that the information related to dust forecasting, such as the one proposed to be delivered through AQ-WATCH, would be most useful for the market (or pricing) department of the solar plants (where production is planned on a yearly basis), and not so much for the maintenance and operation departments. In other words, the needs of the Chilean market are not in regard to operations, but rather planning. Based on these results, we plan in the next meetings to invite participants that are related to the market and pricing areas and put less focus on the maintenance and operation sectors.

<u>Usefulness of dust forecasts</u>

- The information provided would complement and allow working with the sensors already installed in the solar plants, which identify inefficiencies in temperature and availability.
- The data could allow to know how much energy is being lost or, in other words, allow to balance between the loss in production due to energy loss (due to dirt) and cleaning costs.
- The information provided could allow optimizing costs in different aspects such as maximize production, cleaning costs and water consumption.
- Data could allow conducting site studies and characterize the cycles and times when cleaning of solar panels is most efficient and develop maintenance plans and costs accordingly.
- Having a monthly or annual product would serve for the plants planning and construction stage, insofar as it would allow to know the approximate production in a year according to parameters such as the P80 probability of irradiation and P80 of dirt.
- A 7-day forecast could be useful for planification and distribution by the supply regulator of the electricity market

<u>Needs and expectations</u>

- Dust forecasting is still rather unfamiliar to the solar energy industry, but there is a growing interest, mainly for its potential to support planning activities in different areas.
- Developing an operation and maintenance system in which data and optimization calculations regarding energy loss can be integrated. In this way, a complementary analysis of the data could be done at the plant.
- In the area of operation, it is more important to have a model that is corrected according to the variations of 'a typical year', and that also allows the identification of external factors that may modify the dirt rate and the P80 model.

Suggested improvement to the platform

- For operation and maintenance, the platform format (colour maps) does not say much about the energy lost. In addition to the information regarding the energy losses, it would be useful if the information provided allowed a cross-over with the plant data.

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

Justification: The second interaction with the prime users was dependent on the full development of the prototype of the toolkit, which was finished in December 2020 (D5.2). Therefore, full feedback from prime users (China, USA and Chile) only took place at the end of 2020 and in the first quarter of 2021.

8. Sustainability

Not relevant

9. Full track of dissemination activities

Not relevant

10. Full track of publications and IP

Not relevant