European Clean Air Day - citizen science for clean air

Executive summary

According to health research and the World Health Organization (WHO), air pollution in urban areas leads to 3 million premature deaths annually. Concerns about the human health impact of air pollution has prompted the development of many community-led air quality monitoring initiatives, which has helped to bring the topic to a wider audience and mobilise policy change. However, as yet there is no large scale coordinated effort for community-led air quality monitoring. This policy brief presents a framework for organizing a yearly European Clean Air Day, starting from 20th June 2019, with the objective of scaling up European awareness of air quality issues, and ways in which air quality can be improved. The brief presents a range of financing options and tools for air quality monitoring within grassroots organisations.

Air quality and public health issues

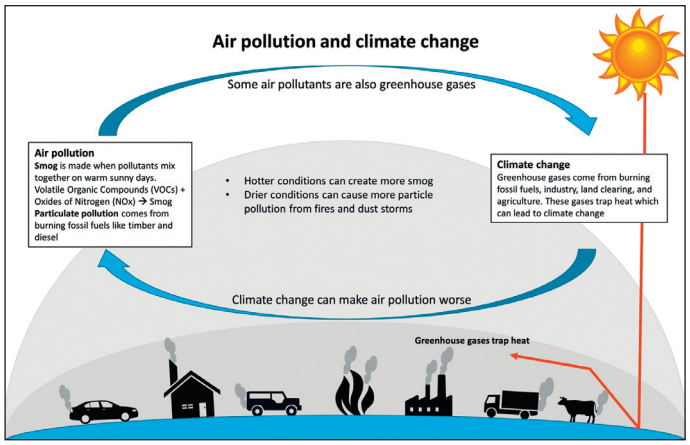
Poor air quality has been attributed to a range of health issues, resulting in the premature death of three-million people annually. Of these three-million premature deaths, 34% are attributed to heart disease, 21% are due to pneumonia (lung inflammation), 20% are due to a stroke, 19% are caused by chronic obstructive pulmonary disease (COPD) and 7% are attributed to lung cancer. Fine dust air pollution has been estimated to reduce life expectancy by as much as a year in the Netherlands, and is the cause of 5.7% of all illnesses in Denmark (Volksgezondheid Toekomst Verkenning, RIVM 2014; Carton et al., 2018).

Air pollution and climate change

Urban air pollution is influencing cities at different stages of development. The Global North is mainly impacted by transport pollution while the Global East and South is influenced by low quality fuel (coal dust or slurry) and road traffic. Levels of air pollutants are intensified by particular weather conditions e.g. hot, dry and windy conditions, and weather phenomena such as thermal inversions - deviation from the normal change of an atmospheric property with altitude, warmer air is held above cooler air and it traps air pollution, such as smog, close to the ground.

"Anthropogenic activities are responsible for the emission of gaseous and particulate pollutants that modify atmospheric composition. Such changes are, in turn, responsible for the degradation of air quality at the regional/local scale as well as for changes of climate. Air pollution and climate change are two intimately connected environmental issues. However, these two environmental challenges are still viewed as separate issues, which are dealt with by different science communities and within different policy frameworks. [...] Policy measures to mitigate air quality and climate change must necessarily be integrated." (Maione et al 2016)

Air pollution and climate change show a number of important feedback loops. Warm, dry weather can increase smog (a mixture of pollutants) levels, and particulate pollution. Some of these pollutants are also greenhouse gases (primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone) which exacerbate 'The Greenhouse Effect' i.e. global warming. Most air pollutants are produced by individual actors (e.g. cars, heating).



Source: Bader et al (2018)

Citizen science and air quality monitoring

Since Citizen science (scientific research conducted, in whole or in part, by nonprofessional scientists) helps to build large, global communities focused on air quality monitoring who also influence local or national policies. Since 2015 there has been a rapid growth in the number of citizen science projects focused on improving air quality. Due to a new generation of low-cost air quality sensors, it is now possible to measure selected pollutants with relatively high accuracy in standard weather conditions.

Below are examples of citizen science air quality monitoring projects, ranging from low-cost and low-tech to high-tech sensor systems using internet technologies for transmitting data in near real-time.

1. **Diffusion tube method for measuring Nitrogen Dioxide and Sulfur Dioxide**

   This is a simple and cheap (~8 euros / per tube) method for measuring levels of Nitrogen Dioxide (NO2) or Sulfur Dioxide (SO2), gases that are considered key indicators of transport-related pollution. Citizens place the tubes in a preferred location which are collected after one month and processed in a laboratory. This method is popular for its high accuracy and acceptance by official institutions. The diffusion tubes have to be processed in a professional laboratory.

   Examples (Carton et al, 2018):

   - London, Mapping for Change project (UCL, Extreme Citizen Science Lab) - works with groups and organisations in UK and Uganda, where collected more than 2300 samples of diffusion tubes to improve and produce information about air quality;
   - Flanders and Antwerp, CurieuzeNeuzen project (University Antwerp and De Standaard - 2000 citizens measure the air quality outside their windows;
   - Barcelona, xAire Project (Open Systems Lab) - students, teachers and parents at 20 primary schools chose the sites for 800 air-quality sensors to measure NO2 levels.

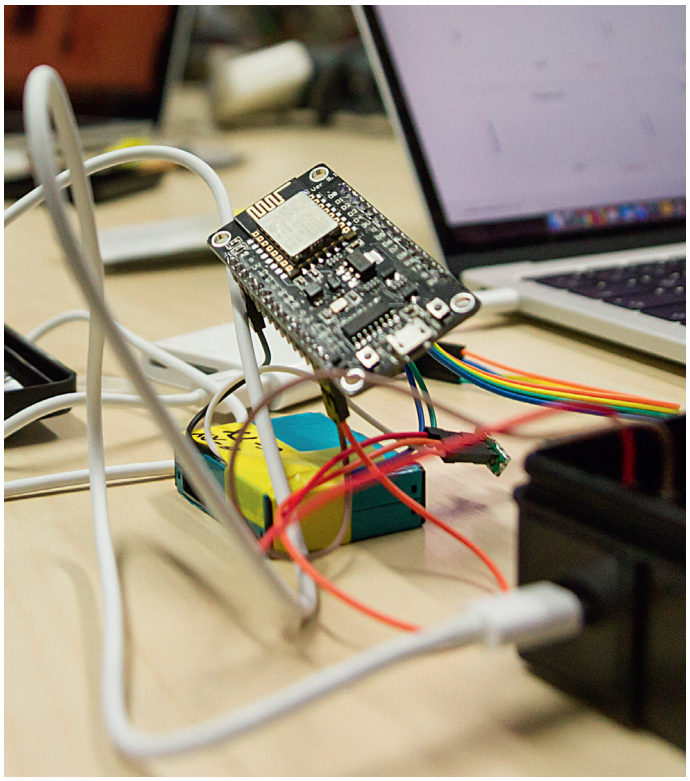
2. **Low-cost sensors and sensor systems**

   This method uses advances in wireless data transmission (Lora, Wifi, 4G) and internet technologies such as low-cost electronics (Arduino) and Cloud Platforms for data storage. The sensors can be assembled from a number of elements in Do-It-Yourself (DIY) community projects, or bought online. A popular sensing device for measuring fine dust, PM2,5 and PM10 (PM - particulate matter of size 10 and 2.5 micrometers leads to an increased risk of premature death and can penetrate the deepest part of the lungs or gas exchange regions of the lung), is the SDS011 Air Quality sensor (https://aqicn.org/sensor/sds011/). Other low-cost sensors measure gases like Ozone (O3) and Nitrogen Dioxide (NO2), with dedicated sensors (eg Alphasense, among many other brands) (Piedrahita, 2014).

   The advantage of these methods is their instantaneous data visualisation in real-time on data collecting platforms. Meanwhile, ongoing research on calibration issues research is advancing the knowledge base on the accuracy of this method. However, these methods haven't yet been incorporated into official monitoring schemes due to issues around the accuracy of the data.

   Examples:

   - Luftdaten (https://luftdaten.info/) with DIY sensor station and data platform operated by Open Knowledge Lab Stuttgart;
   - AirsensEUR (https://airsenseur.org/website/) with sensor package and data platform operated by Liberaintentio s.r.l. Societa' a Socio Unico;
   - Sensebox (https://sensebox.de/) who produce an education pack for schools;
   - Smart Emission (https://data.smartemission.nl/) pilot research on citizen-sensor-networks and sensor Spatial Data Infrastructure development.



3. **Low-tech do-it-yourself at home methods**

   Methods for 'do it yourself at home measurements' have been developed by citizen science NGO's such as the Waag Society, Amsterdam in cooperation with Environmental protection gencies. An example of a DIY method is the White-paper-with-vaseline method (Carton et al, 2018).

   Example: The white-paper-with-vaseline method is used by the Norwegian Environmental Protection Agency (NILU), in a citizen campaign that ran from March to May, 2019 as part of the Oslo Green Capital 2019. Citizens place a white card in an area where they want to monitor the level of particulate matter in the air, then compare the dust results with sample pictures, and upload the results to an app. This way, measurement is made visible as measurement point on a collaborative online map to compare results from different places).

4. **Community Platforms with citizen-created online air quality maps**

   There are a number of web platforms that serve the purpose of bringing communities in a specific city, region or country together to monitor air quality and share data. Some focus on one method or project, others gather recent projects and activities.

Examples:

- **Prepair:** Italian and Slovenian regions engaged to policies of air: http://www.lifeprepair.eu/?lang=en
- **Samen Meten:** Dutch initiatives collected under one umbrella: https://www.samenmetenaanluchtkwaliteit.nl/ (communities) and https://samenmeten.rivm.nl/dataportaal/ (data map)
- **HackAIR:** European Open Technology Platform http://www.hackair.eu/
- **CitizenScience.gov:** Official government website designed to accelerate the use of crowdsourcing and citizen science across the U.S. government. Platform for air sensing: https://www.citizenscience.gov/air-sensor-toolbox/#

European Clean Air Day Initiative

To further European awareness of air pollution, members of Doing-It-Together Science project and European Citizen Science Association Working Group call for a Europe-wide Clean Air Day to be organized annually starting from 20th June 2019. The primary focus of the event is to engage citizens across Europe in doing science on air pollution. This idea was inspired by the Clean Air Day organized in June 2018 by Global Action Plan in the UK. Two thousand organisations participated in the organization of 550 events across the UK. The event engaged with 10.5 million people in the UK and increased the number of people using bicycles and walking thereby avoiding 27,000 tonnes CO2, 13 tonnes of NOx and 2 tonnes of PM10 each year. It shows huge potential for citizen engagement and behavior change around Europe.

A European Clean Air Day would have the following objectives:

1. Engage thousands of citizens air quality citizen science activities.
2. Generate high resolution data on air quality levels across Europe.
3. Gain a better understanding of citizen science in air quality.
4. Turn quantitative data into local, national and European action.
5. Understand how large-scale citizen science can become successful in building awareness.

Novelty of approach

The European Clean Air Day will bring together citizen science efforts and offer a European platform (CleanAirDay.eu) for promoting the existing, citizen science initiatives on air quality, and open access to the sensor technology.

Based on best examples of campaign in United Kingdom, European Clean Air Day is focused on building communities of stakeholders on different level and publish special toolkits with information, posters, leaflets, resources and recommendations for actions, eg. work, school, influencer, local council/community, company (CSR).

Funding and resources

European Clean Air Day is a grassroot initiative so there is no one, central source of financing. Local crowdsourcing and crowdfunding campaigns should help build a community and find ideas to actions and means to finance them.

Participants of EU Clean Air Day can use several platforms to develop their project ideas or find source of funding, eg. experiment.com (USA), crowd.science (UK), fundrazr.com (Canada). It is possible also to join already developed projects and scale them up locally during EU Clean Air Day, eg. Luftdaten.info - electronic, particulate matters sensor, Hackair.eu - e-sensor but also subjective feelings on air quality or vaseline and carton sensor. Dozen of other ideas are presented on such web-sites like siceurope.eu or publiclab.org/tag/air-quality.

How to join European Clean Air Day

We envisage that citizens could engage with European Clean Air Day at very different levels. Here are some examples:

- Researcher level - citizen science research project involving the measurement of air pollution with diffusion tubes.
- Municipality level - organisation of school activities around air pollution scenarios; press-briefing on actions to improve air quality.
- Company level - promotion of carsharing day for workers.
- Community level - distribution of leaflets and posters, group discussions.
- Social media level - distribution of media materials with hashtag #cleanairday.eu

Timeframe for actions

European Clean Air Day will take place on 20th June 2019, the same day as UK Clean Air Day being run by Global Action Plan. On December 2018 the idea of a European Clean Air Day was presented during the United Nations Framework Convention on Climate Change, 24st Conference of the Parties in Katowice, Poland (COP24). From January till April 2019 municipalities and other stakeholders around Europe can declare on the website cleanairday.eu that they are prepared to take action against air pollution and join European Clean Air Day.

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How to Cite

DITOs consortium, (2018). European Clean Air Day - citizen science for clean air. DITOs policy brief 8.

Colophon

This policy brief was facilitated by the lead authors ECSA & Meritum through open interaction and discussion with the ECSA Air Quality working group. While this was carried out as part of H2020 'Doing It Together Science' (DITOs) Coordination and Support Action project, the views expressed in it do not reflect the consensus opinion of DITOs partners.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 709443.