

Results of the AIRLAB Microsensors Challenge 2021: new technologies to measure air quality

Airparif and AIRLAB unveiled the winners of the AIRLAB Microsensors Challenge 2021 on 13 October 2021 during an international workshop on air quality microsensors. The results of the Challenge show an overall improvement in the performance of these measurement tools, especially in indoor air. Outdoor air is also increasingly being measured with these microsensor solutions, resulting in the first prize-giving since the launch of the Challenge in 2018.

The AIRLAB International Microsensors Challenge aims to regularly assess the progress in efficiency and reliability of these new air quality measurement technologies. These microsensors have been growing rapidly over the past five years due to technological advances and the increasing awareness of the health impacts of outdoor and indoor air quality. Draft standards for these devices are currently being formalised at European level. Airparif is also participates in the French Association for Standardisation's group of experts for the implementation of these future European standards. In parallel to these new standards, Airparif and AIRLAB give, through this competition, the possibility to manufacturers who wish to have their solutions evaluated by a jury of independent international experts on both metrological and ergonomic aspects. It is also an opportunity to enlighten potential users on the adequacy between the performance of the sensors, the uses and the advantages put forward: ease of use by everyone, simplified information and affordable cost, for most of them. With sufficient accuracy, even if none of them meet the European requirements imposed on analysers, in terms of reliability and accuracy used by approved air quality monitoring organisations.

Microsensors still more efficient in indoor air with progress in outdoor air

The results of this new Challenge show a clear improvement in the quality of the microsensors participating in the competition and in their ability to share their measurement data. As in the previous Challenge, the microsensors examined stood out in particular for measuring indoor air quality. Progress is noted in outdoor air and mobility: one of the solutions proposed for the citizen air category, namely portable personal microsensors for awareness raising, received an award (winner "Citizen Air": *Magnasci uRADMonitor AIR – Romania*). For the first time, the Challenge awarded prizes to microsensors for measuring outdoor air, whose performance has improved significantly (winners "Outdoor Air": *Ethera NEMO Extérieur – France* and *Magnasci SMOGGIE – Romania*).

On the other hand, the microsensors used to carry out mobile measurements on vehicles or individuals in order to finely characterise individual exposure still do not provide sufficiently accurate measurement, due in particular to excessive sensitivity to changes in the environment, humidity and temperature, so the jury was unable to choose a winner. The do-it-yourself devices were among the new solutions tested in this 3rd edition of the Challenge. However, they did not receive a prize mainly because of problems with the formatting and acquisition of data and variable assembly quality, making it difficult to evaluate them.

Each microsensor examined measured on or more different pollutants. In general, the measurement of nitrogen dioxide (NO₂) showed a high level of performance. The measurement of the particulate matters (PM₁₀ and PM_{2.5}) is highly dependent on the environment. The measurement of fine particulate matter PM_{2.5} was always more accurate than PM₁₀. The measurement of volatile organic compounds (VOCs), pollutants specific to indoor air, was disappointing overall. The measurement of carbon dioxide (CO₂), in indoor air allowing the evaluation of room ventilation (and thus facilitating the implementation of ventilation measures and the fight against the spread of the coronavirus) has shown a high level of accuracy. The measurement of ozone (O₃), air pollutant responsible for pollution peaks in summer, is also progressing.

54 microsensors from around the world evaluated by an international and independent jury

This new edition of the Microsensors Challenge continued its internationalisation, with more than half of the devices proposed by companies outside France: Switzerland, United States, China, Spain... In total, 54 microsensors from 35 companies were submitted for evaluation by an independent and international jury. After several months of evaluation work, this jury unveiled this Wednesday 91 complete evaluations (one per microsensor and per situation: indoor air, outdoor air, citizen air) based on an average of 42 evaluations per pollutant in terms of measurement accuracy, microsensor utility and usability among others. The measurement of 16 air pollutants was evaluated.

Each sensor competed for one or more uses (outdoor or indoor air measurement, fixed or mobile measurement, public awareness, etc.) and was evaluated according to five criteria: accuracy, utility, usability, portability and cost. A new feature in 2021: the evaluation protocol included a more detailed analysis of the relevance and ease of use of the solutions that applied, as well as the processing of the raw data from the sensors.

It should be noted that the World Meteorological Organisation, the World Health Organisation and the United Nations Environment Programme indicate that low-cost sensors are not a direct substitute for reference measurements, particularly for regulatory purposes, although they do represent a complementary source of information, provided that appropriate equipment is used ([read here](#)). Furthermore, the results of these evaluations allow lessons to be learned about the intrinsic qualities of each sensor but cannot be extrapolated to the performance of an operational measurement network composed of these microsensors. For the users of such a network, further studies should be carried out to assess their cost/efficiency according to the local context, both for deployment and for "full-scale" management and maintenance.

The results demonstrated the need to have reference tools for the acceptance of the devices, their calibration, the improvement of the algorithms and the permanent validation of the data produced.

The list of winners of the Challenge 2021

- Multi-pollutant sensor with the best accuracy - Outdoor: KUNAK Air Pro (Spain)
- Multi-pollutant sensor with the best accuracy - Indoor: Rubix POD (France)
- Citizen Air (all categories): Magnasci uRADMonitor AIR (Romania)
- Outdoor Air - Monitoring : Ethera NEMO Outdoor (France)
- Outdoor Air - Awareness: Magnasci SMOGGIE (Romania)
- Indoor Air (all categories): Ethera Mini XT basic+ (France)
- Best accuracy for PM2.5 - Outdoor: Airlabs AirNode (U.K.)
- Best accuracy for PM2.5 - Indoor: Rubix POD (France)
- Best accuracy for NO2: Envea Cairnet (France)
- Best accuracy for O3: Bettair Static Node MK2 (Spain)
- Best accuracy for CO2: Zaack IAQ (France)
- Best accuracy for VOC: SGS AirSense Omni (France)

All the results per sensor are freely available on the AIRLAB website www.airlab.solutions or airparif.shinyapps.io/ChallengeResultsEN/ via a newly created interactive platform. It offers a navigation among the results of the Challenge, allowing searches by criteria and comparisons between the different solutions. These evaluations are available in French and in English.

A new edition of the Challenge is planned for 2023.

This Challenge is part of AIRLAB's activities: launched by Airparif and its partners, AIRLAB brings together a community that is committed to improving air quality. Large companies, SMEs and start-ups, research institutes, local authorities, citizens: everyone brings ideas, skills, resources and means. AIRLAB contributes to protect the health of citizens, to support innovative companies and to develop employment by promoting the development and implementation of solutions to air pollution in Paris and Ile-de-France. It also encourages their promotion at national and international level. AIRLAB is supported by its founding members: Airparif; Région Île-de-France; Marie de Paris; Métropole du Grand Paris; Préfecture de la Région Île-de-France; Île-de-France Mobilités; SNCF; Véolia; Icade; EDF; Engie; and all of its partners, a list of which is available on its website www.airlab.solutions.

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