



DELIVERABLE

D5.1 Guide to Air Quality Monitoring

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Revision History

| Version | Date | Author | Organization | Description |
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| 0.1 | 20/09/22 | Evelyne Elst | VMM | Initial structure |
| 0.2 | 11/10/22 | Evelyne Elst | VMM | Introduction/summary/conclusion |
| 0.3 | 12/10/22 | Upasna Rai | IMEC | Input added on IMEC chapters |
| 0.4 | 25/10/22 | Christophe Stroobants | VMM | Review |
| 1.0 | 27/10/22 | Evelyne Elst | VMM | Final version |

Table of Contents

| | |
|--|----|
| Executive Summary | 5 |
| 1. Introduction | 6 |
| 2. Guide to Air Quality Monitoring | 7 |
| 2.1 - PowerPoint chapter 1: Air Quality training | 8 |
| 2.2 - PowerPoint chapter 2: Low cost sensor training | 9 |
| 2.3 - PowerPoint chapter 3: Sensor maintenance training | 10 |
| 2.4 - PowerPoint chapter 4: Data collection training | 11 |
| 2.5 - PowerPoint chapter 5: Making sense of sensor data and its implications for research, policy and practice | 12 |
| 3. Conclusion | 13 |

List of Abbreviations

| Abbreviation | Definition |
|-----------------|---|
| PM | Particulate Matter |
| NO ₂ | Nitrogen Dioxide |
| BC | Black Carbon |
| LCS | Low Cost Sensor |
| ppm | Parts per million |
| ppb | Parts per billion |
| VOC | Volatile organic compounds |
| CO ₂ | Carbon dioxide |
| PAH | Polycyclic aromatic hydrocarbon |
| EEA | European Environmental Agency |
| WHO | World Health Organisation |
| IARC | International Agency for Research on Cancer |
| N ₂ | Nitrogen |
| O ₂ | Oxygen |
| Ar | Argon |
| O ₃ | Ozon |
| CO | Carbon monoxide |
| SO ₂ | Sulfur dioxide |
| UFP | Ultra Fine Particles |

Executive Summary

The Guide to Air Quality Monitoring was created to support the COMPAIR pilots and provide them with some basic information on air quality and low cost air quality sensors. This deliverable consists of a compendium of training content provided in the form of a PowerPoint presentation. The presentation is a living document, available on the COMPAIR website, which might be changed according to the needs of the pilots as the project continues. The compendium consists of five chapters:

In the first chapter '**Air Quality training**' we explain what air quality is and why it is important. Thereafter an overview of the three most important pollutants for human health (PM, NO₂, BC) is given. This overview gives insight on what the pollutant is, where it comes from, its health impact and the situation in Europe. Finally this chapter also talks about the environmental impact on air quality.

In the second chapter '**Low Cost Sensor training**' we compare the different types of equipment that is currently available to measure the three pollutants of concern ranging from low cost sensors (LCS) that are to be used in COMPAIR, to research-grade reference station analysers found at monitoring stations. To understand how specific sensors are suited for specific pollutants, each sensor's working principle is explained. In citizen science projects such as COMPAIR as well as other use cases of LCS, it is valuable to learn about the feasibility and performance of LCS. This chapter provides some guidelines for this as well to further the use cases of LCS in various fields.

The third chapter '**Sensor Maintenance training**' consists of some basic housekeeping steps such as inspection, cleaning and finally replacement, should the need arise, to effectively maintain a low cost sensor. Maintenance is key for the proper working of an LCS given that its lifespan is limited. That said, all measurement instruments including sensors need to be calibrated alongside being maintained. Sensor calibration ensures that the signal produced by the sensor is representative of the measurements being aimed at in the study. This chapter therefore provides a brief introduction into sensor calibration and its importance as a step-up to the next chapter.

In the fourth chapter about '**Sensor Data Collection training**' we talk about the various methods available to perform sensor calibration. These methods are influenced by the data quality, level of accuracy being targeted in the study as well as how well the sensor is responding during the study time interval. These various aspects that make the data useful to interpretation are also addressed in this chapter.

Lastly the fifth chapter is about '**Making sense of sensor data and its implications for research, policy and practice**'. This chapter first gives an overview of some examples of experiments that can be done when measuring air quality. Thereafter, a stepwise plan is introduced that can help local authorities and citizens to start their own air quality measurements. It guides you through knowledge gaining, composing a research question and starting up your own experiment. Finally four cases of policy implications are presented: schoolstreet, low emission zone, traffic circulation plan and the influence of the covid lockdown on air quality.

1. Introduction

This deliverable provides a compendium of training content to support the COMPAIR pilots and provide them with some basic information on air quality and low cost air quality sensors. In order to answer the pilot's needs a questionnaire was sent to COMPAIR partners asking them what they wanted to learn from this deliverable and in what format they wanted to get this information. Based on the responses of the different partners Telraam, imec and VMM defined that a PowerPoint presentation (available on the COMPAIR website) was most suitable for this training. The compendium is a living document which might be adapted to the needs of the pilots as the project continues. Concerning the training content, five chapters were drafted:

- (1) Air quality training
- (2) Low cost sensor training
- (3) Sensor maintenance training
- (4) Data collection training
- (5) Making sense of sensor data and its implications for research, policy and practice

As much of the required information was already present at VMM, this information was first drafted in a master document per chapter. These master documents, together with some additional information by other organisations (e.g. EEA, WHO, ...) and the input from VMM and imec experts, served as input for the training chapters.

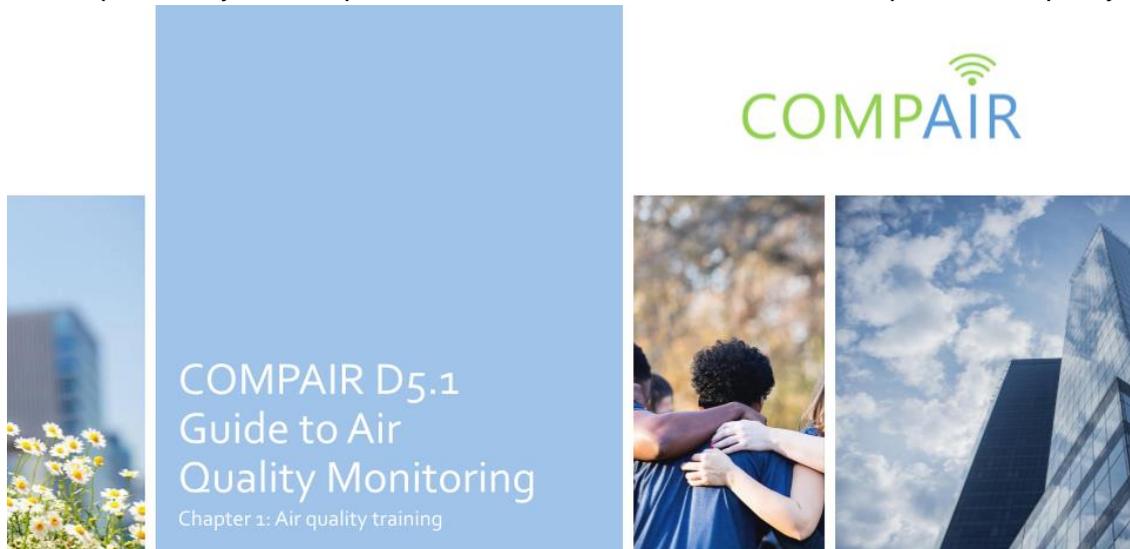
Note that this training is meant only for educational purposes related to air quality experiments with citizens. The COMPAIR pilots can use these slides to educate the people who will participate in their pilot. A subset of slides may be selected as not all content might be useful for every pilot. Pilots are also encouraged to adapt the slides to their specific needs (e.g. a map with air quality in Europe is presented in the slides, but a regional map will provide much more specific information for the pilots).

2. Guide to Air Quality Monitoring

The compendium 'Guide to Air Quality Monitoring' can be found in the form of a PowerPoint presentation on the [COMPAIR website](#). The training consists of the following chapters.

2.1 – PowerPoint chapter 1: Air Quality training

In this chapter we explain what air quality is and why it is important. Thereafter an overview of the three most important pollutants for human health (PM, NO₂, BC) is given. This overview gives insight on what the pollutant is, where it comes from, its health impact and the situation in Europe. Finally this chapter also talks about the environmental impact on air quality.



Content

Introduction

- What is air?
- How is air quality changing over time?
 - High pollution episodes with high concentrations (smog, ...) but in general improving quality
- More evidence on health effects -> limit values are reduced
- NO₂, PM, BC relevant pollutants + measured in CompAIR

Per pollutant

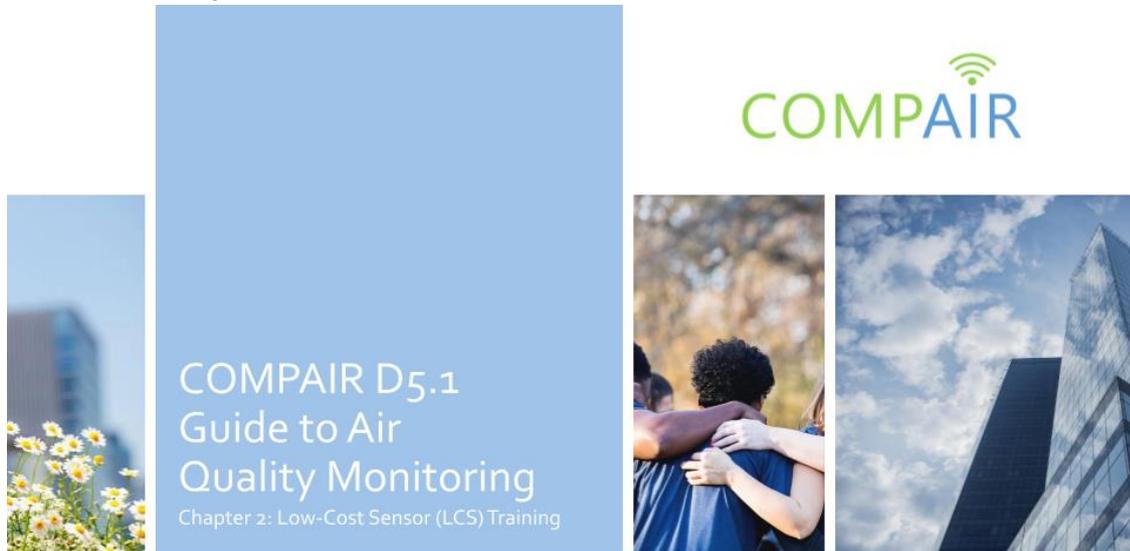
- What is it?
- Sources
- Health impact
- Situation in EU

Environmental impact

- Meteo
- Transportation
- Street canyons

2.2 – PowerPoint chapter 2: Low cost sensor training

In this chapter we compare the different types of equipment that is currently available to measure the three pollutants of concern ranging from low cost sensors (LCS) that are to be used in COMPAIR, to research-grade reference station analysers found at monitoring stations. To understand how specific sensors are suited for specific pollutants, each sensor's working principle is explained. In citizen science projects such as COMPAIR as well as other use cases of LCS, it is valuable to learn about the feasibility and performance of LCS. This chapter provides some guidelines for this as well to further the use cases of LCS in various fields.

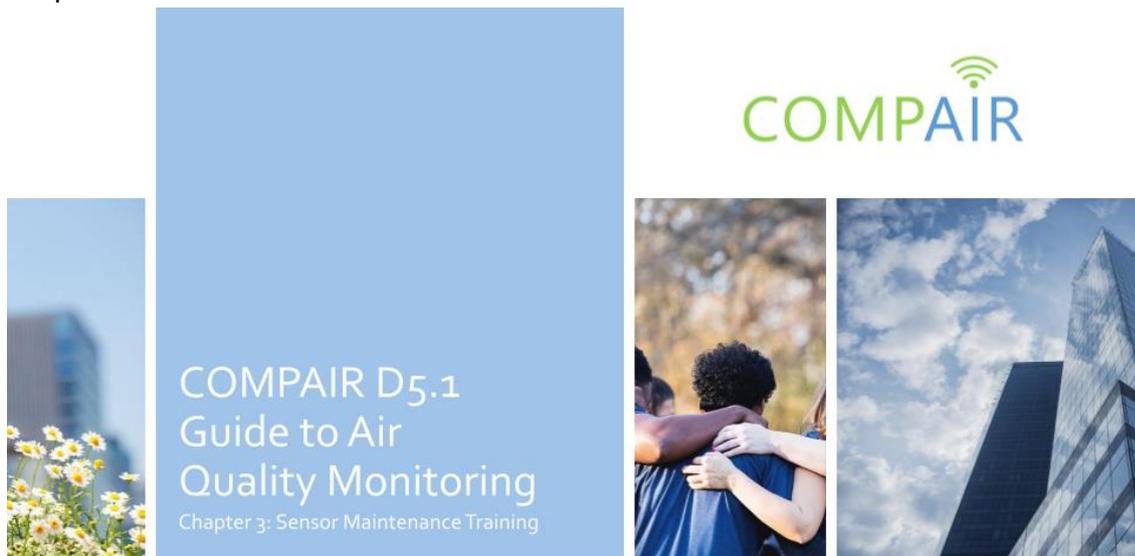


Chapter 2: Low-Cost Sensor (LCS) Training

- Types of PM Measurement Equipment
- Types of NO₂ Measurement Equipment
- Types of Black Carbon (BC) Measurement Equipment
- Measurement Approaches of Low-Cost Sensors (LCS)
- LCS Applications
- LCS response time and overall performance

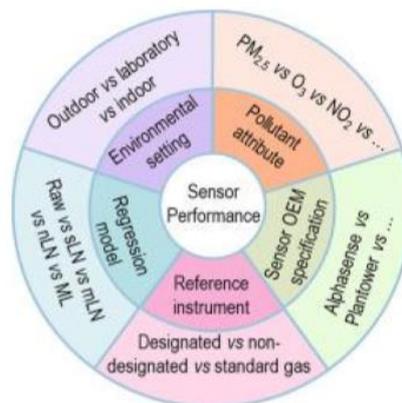
2.3 - PowerPoint chapter 3: Sensor maintenance training

This chapter consists of some basic housekeeping steps such as inspection, cleaning and finally replacement, should the need arise, to effectively maintain a low cost sensor. Maintenance is key for the proper working of an LCS given that its lifespan is limited. That said, all measurement instruments including sensors need to be calibrated alongside being maintained. Sensor calibration ensures that the signal produced by the sensor is representative of the measurements being aimed at in the study. This chapter therefore provides a brief introduction into sensor calibration and its importance as a step-up to the next chapter.



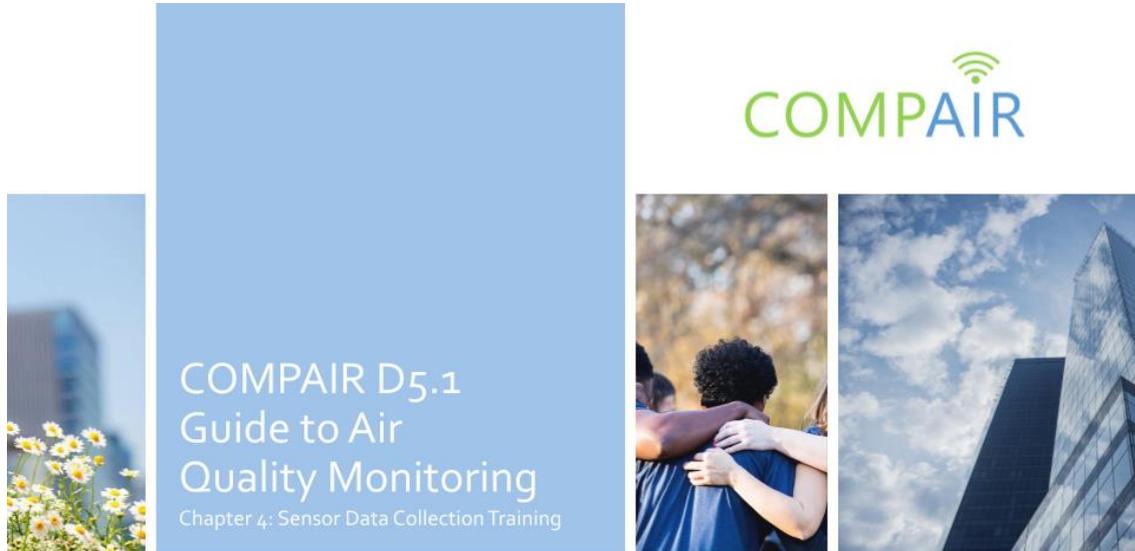
Chapter 3: Sensor Maintenance Training

- Sensor Calibration
- Sensor Cleaning
- Sensor Inspection
- Sensor Replacement



2.4 – PowerPoint chapter 4: Data collection training

In this chapter we talk about the various methods available to perform sensor calibration. These methods are influenced by the data quality, level of accuracy being targeted in the study as well as how well the sensor is responding during the study time interval. These various aspects that make the data useful to interpretation are also addressed in this chapter.

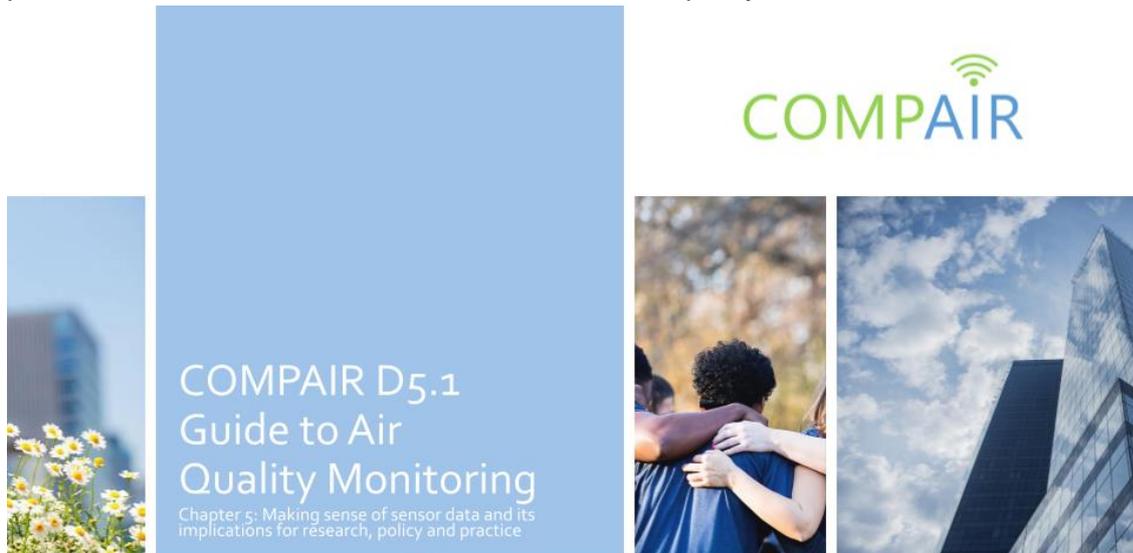


Chapter 4: Sensor Data Collection Training

- Data Collection and Calibration
- Assess data quality, patterns, anomalies
- Assess interfering chemical compounds, drift

2.5 – PowerPoint chapter 5: Making sense of sensor data and its implications for research, policy and practice

This chapter first gives an overview of some examples of experiments that can be done when measuring air quality. Thereafter, a stepwise plan is introduced that can help local authorities and citizens to start their own air quality measurements. It guides you through knowledge gaining, composing a research question and starting up your own experiment. Finally four cases of policy implications are presented: schoolstreet, low emission zone, traffic circulation plan and the influence of the covid lockdown on air quality.



Contents

- Practice
 - Examples of experiments
- Research:
 - Steps to take when starting an experiment
- Policy: 4 cases
 - Schoolstreet
 - Low Emission zone
 - Traffic Circulation plan
 - Influence Covid lockdown on air quality

3. Conclusion

This Guide to Air Quality Monitoring aims to be a training document for the COMPAIR pilots. General information on the different topics can be found in the different chapters:

- (1) Air quality training
- (2) Low cost sensor training
- (3) Sensor maintenance training
- (4) Data collection training
- (5) Making sense of sensor data and its implications for research, policy and practice

Before the onset of the pilot studies, VMM and imec will go through the training with the COMPAIR partners that are interested in using this training in support of their pilot study. Content related unclarities will be resolved during this session.

Note that this training is meant only for educational purposes related to air quality experiments with citizens. The COMPAIR pilot's can use these slides to educate the people who will participate in their pilot. A subset of slides may be selected as not all content might be of use for every pilot. Pilots are also encouraged to adapt the slides to their specific needs (e.g. a map with air quality in Europe is presented in the slides, but a regional map will provide much more specific information for the pilots).