

Enhancing urban CO₂ monitoring for climate action

Case Study



The client:

Technical University of Munich (TUM),
Professorship of Environmental Sensing and Modeling (ESM)

Vaisala solution:

Vaisala CARBOCAP® Carbon Dioxide Probe GMP343

Image source: ICOS_RI

THE CHALLENGE:

Piloting CO₂ measurement systems for ICOS Cities

The Technical University of Munich (TUM) is a leading institution known for its excellence in both education and research. The university is renowned for its research in areas such as sustainable living environments, life sciences, medicine, digitalization, AI, and quantum technologies.

The Environmental Sensing and Modeling (ESM) group at TUM led by Prof. Jia Chen participates in the Integrated Carbon Observation System (ICOS) Cities project, which aims to understand and measure greenhouse gas (GHG) emissions in urban areas. The scope of [ICOS Cities](#) includes pilot projects across Paris, Zurich and Munich, with the support of 12 additional European cities.

ICOS Cities develops systematic GHG observations in densely populated urban areas for cities to support their local climate action plans. As one of the three pilot cities, top scientists at TUM ESM have designed and built an innovative and highly accurate GHG monitoring system in Munich.

Accurate and reliable CO₂ measurements are crucial for this project, but urban environments present unique challenges, including variable weather conditions such as temperature and humidity fluctuations. As TUM was designing monitoring systems, they sought a reliable, accurate and affordable CO₂ sensor that provides stable measurements in outdoor conditions. It also must achieve an accuracy of 1 ppm RMSE for CO₂ which is critical for understanding spatial patterns in urban environments.

"The GMP343 delivers consistently precise CO₂ measurements, which are essential for analyzing spatial patterns in urban environments. Its robust design, including the ability to correct for water-induced effects and maintain stable performance under controlled temperature conditions, makes it a solid choice."

*Patrick Aigner
Researcher, Technical University of Munich*

THE APPROACH:

Excellent accuracy and stability for demanding applications

TUM ESM selected the Vaisala CARBOCAP® Carbon Dioxide Probe GMP343 for its robust performance and high accuracy.

The CO₂ measurement system TUM ESM created for the ICOS Cities project consists of 20 autonomous roof-top systems designed to measure GHGs in urban environments. Each system is scalable and cost-effective, with an outdoor enclosure to protect against precipitation. In addition to GMP343, key components include a wind sensor to monitor wind conditions and environmental sensors for tracking temperature, pressure, and humidity.

The system supports remote operation, while a heated enclosure maintains a stable temperature for sensor accuracy. The system auto-calibrates GMP343 every two days using gases with known CO₂ concentrations to ensure 1 ppm RMSE accuracy. The system also performs wet to dry conversion for CO₂ data for consistently reliable information.

THE RESULTS:

Actionable data to support urban climate initiatives

TUM ESM has created an accurate, stable and reliable CO₂ monitoring system that will continue to provide actionable data to support urban climate initiatives. Twenty systems are being used to create a dense sensor network, evenly distributed across the city of Munich to monitor the change of CO₂ concentrations in the city and with seasonal variations. Local emission sources can also be identified with wind data.

GMP343 has proven to be a valuable tool for the ICOS Cities project at TUM ESM. Its high accuracy, robust performance, and remote operation capabilities make it an excellent choice for environmental protection agencies and climate scientists looking to measure greenhouse gases in cities for climate action purposes.

Why Vaisala?

As the global leader in weather and environmental measurements, Vaisala provides trusted weather observations for a sustainable future. With over 85 years of experience and customers in 170+ countries, from the North and South Poles to Mars, we help provide the most reliable and accurate weather and climate information for better and safer daily lives.

Our instruments and intelligence are known as the gold standard for precision and reliability. As a sustainability leader we enable meteorology professionals to better understand, forecast and explain climate change. We continue to channel our curiosity into climate action and new ways of enabling a better planet for all.

