European Metrology
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Accurately monitoring trace pollutants

Man-made and naturally occurring volatile organic compounds, such as methanol or acetone, affect air quality and the climate by the formation of ozone and aerosols. The World Meteorological Organization's Global Atmosphere Watch monitoring network tracks these trace compounds and aerosols to increase our understanding of climate trends and the success of mitigation strategies. Improving the accuracy of networks monitoring data requires improved links between lab-based calibrations and networked instruments.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Traces of man-made and naturally occurring volatile organic compounds (VOC) and oxygenated VOCs such as methanol or acetone react with other atmospheric trace gases to create ozone and aerosols, which impact on air quality and climate. Sources of these include fossil fuel and biomass burning, and the use of solvents in paints and coatings. The World Meteorological Organization's monitoring network Global Atmosphere Watch observes these trace gases and monitors atmospheric chemical changes to enable an improved understanding of how human activities create climate change and the success of mitigation strategies. Detecting climate trends relies on accurate monitoring of trace gas pollutants. To obtain accurate measurement data, air sampling procedures and reliable calibrations of field-based analytical instruments are essential.

Monitoring stations collect air samples to pre-concentrate trace gases prior to analysis. However, oxygenated VOCs are very reactive and are prone to sticking to any metal surfaces they come in contact with, such as sampling lines and storage containers. This introduces measurement errors as gas traces are reduced from the levels present in the atmosphere. Shipping from remote locations to measurement centres for precise analysis may introduce additional gas adsorption losses. A similar effect occurs in the gas standards used to calibrate analysis instruments at monitoring network measurement centres. Ensuring that highly accurate measurement results are achieved requires the use of inert materials in gas transfer lines and vessels and the development of stable calibration standards and methods to reliably compare performance across all the networks calibration laboratories.

Solution

The EMRP project *Metrology for VOC Indicators in Air Pollution and Climate Change* developed methods to quantify oxygenated VOC absorption by metal surfaces and found that a proprietary coating manufactured by SilcoTek™ significantly improved their long-term stability. Zero gases, such as nitrogen, free of volatile carbon containing compounds were also developed to ensure the accuracy of calibration standards and the zeroing of gas analysis instrumentation free from spurious VOC traces.

Impact

The German meteorological service (DWD) operates the Global Atmosphere Watch trace gas monitoring station Hohenpeissenberg. DWD was also a partner in the EU 2020 Horizon Aerosol, Cloud, and Trace Gases Research Infrastructure (ACTRIS) project in which they organised an assessment exercise to confirm oxygenated VOC (OVOC) analytical laboratory performance using the EMRP projects new developed OVOC gas standards. This exercise was the first joint side by side comparison of prospective European ACTRIS calibration facilities and included the GAW World Calibration Centre. It demonstrated facility proficiency in measuring atmospheric OVOCs and provided the first opportunity to calibrate all participating measurement systems with the new OVOC calibration gas.

In the future DWD plans to regularly perform similar exercises to assess VOC lab capabilities, to test new VOC analytical instruments, and to circulate calibration gas mixtures to help ensure that ACTRIS and GAW networks labs are producing high quality and comparable VOC data.

This interaction has increased links and improved the understanding of the importance of SI traceable measurements between European NMIs and the atmospheric monitoring community. As a result, the Dutch NMI VSL expects to be appointed as a lead Global Atmosphere Watch Central Calibration Laboratory for OVOC measurements, paving the way for increased future collaborations between these two communities that will increase measurement accuracy in atmospheric trace gas monitoring.

Monitoring volatile organic compounds in air

The EMRP project *Metrology for VOC Indicators in air Pollution and Climate Change* developed new point-of-use reference materials and gas standards at the low concentrations required for monitoring volatile organic compounds (VOCs) in the environment. The project investigated the use of coatings and materials to reduce interactions between VOCs and metal surfaces which is important in both maintaining gas standard stability in storage as well as the transfer of sampled air to analytical instrumentation. The projects gas standards were used to evaluate the performance of low-cost gas sensors for environmental monitoring of VOCs and generated increased knowledge in the use of this type of sensors. This work builds on outcomes from the EMRP project *Metrology for Chemical Pollutants in Air* and supports increased measurement accuracy for detecting trace pollutants in the atmosphere.

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European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

www.euramet.org/project-ENV56

Annarita Baldan

VSL, Netherlands
+31 15 2691500 | ABaldan@vsl.nl

11326/0519 - ENV56 19004