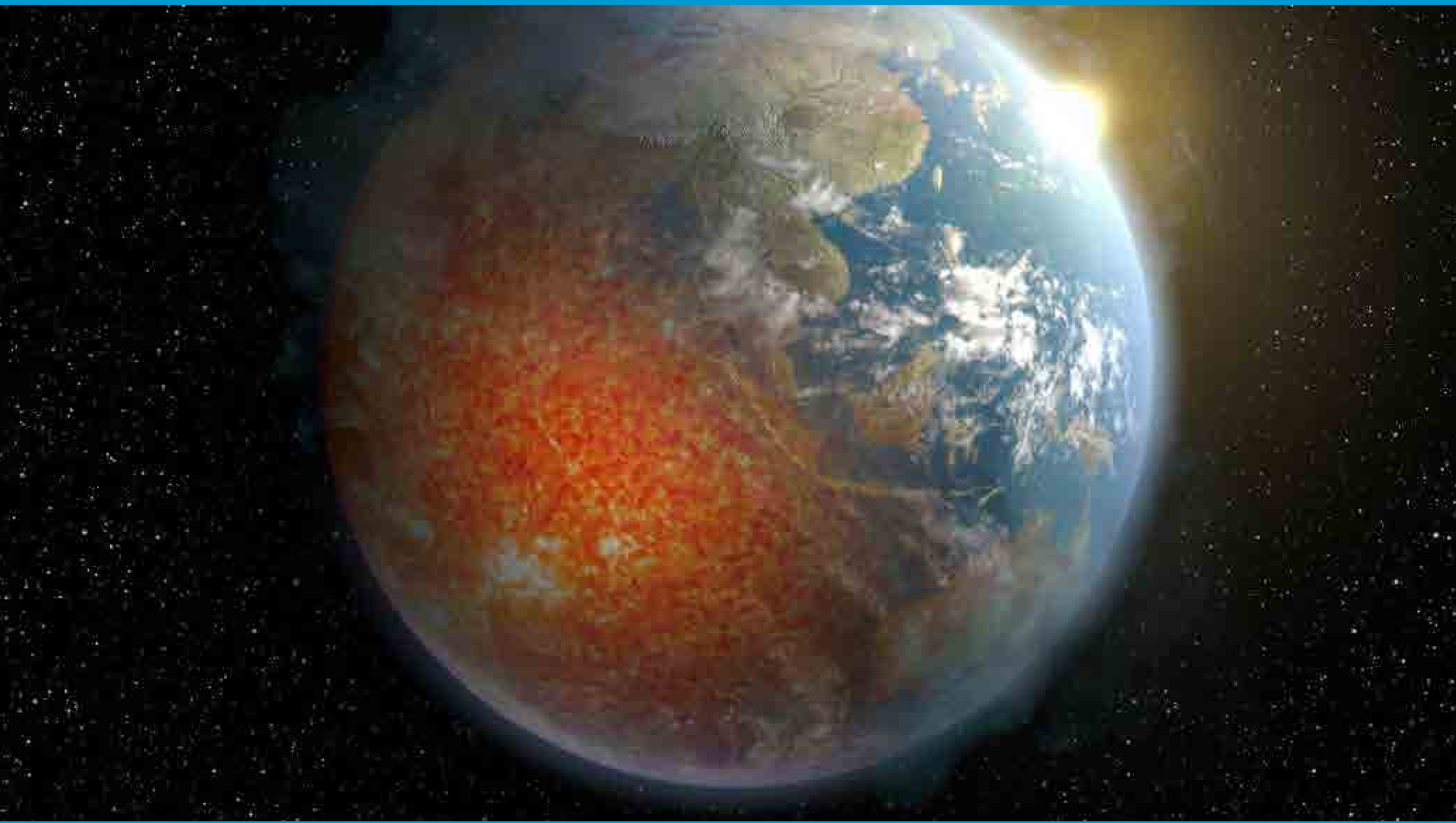
European Metrology
Research Programme
Delivering Impact



Detecting new pollutants in the air

Atmospheric greenhouse gases are driving global warming. Amongst the most damaging are those containing fluorine and other halogens, frequently used as refrigerants. Per molecule, these are many times more potent than carbon dioxide. Whilst international treaties regulate many of these gases, new variants are continually entering use. To determine their source and atmospheric trends, networks of monitoring instruments need robust calibration standards for measurement accuracy.

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

Halogenated gases such as hydrofluorocarbons and chlorine containing compounds, have Global Warming Potentials thousands of times greater than that of carbon dioxide, and can remain in the air for decades to centuries, so even trace amounts can damage the environment. European regulations aim to considerably cut halogenated gas emissions by 2030 but newer compounds are continually being introduced for use as refrigerants in fridges and in car air-conditioning systems.

Establishing the source of these pollutants and determining atmospheric trends relies on monitoring stations often at geographically remote locations. Detecting gas traces at the part per trillion level present in the atmosphere requires highly accurate gas standards for instrument calibrations. Currently, these gas standards are produced at only a limited number of specialist atmospheric monitoring institutes, and these are trying to keep up with the rapid introduction of new gas compounds. Gas standards with robust links to SI units would increase the number of suppliers from the NMI community, but first the accuracy of these standards must increase to match user community expectations.

Solution

The EMRP project *Metrology for High-Impact Greenhouse Gases* developed a method for making fluorinated gas mixture calibration standards suitable for use by halogenated gas monitoring networks. These standards are extremely accurate and involve several precise dilution stages using highly accurate weighing and mass flow control to achieve the required halogenated mixture in a single gas cylinder. The creation of a mixed gas standard enables users at monitoring stations to perform calibrations for several gas compounds in a single operation so reducing the complexity and time required to establish ongoing instrument performance.

Impact

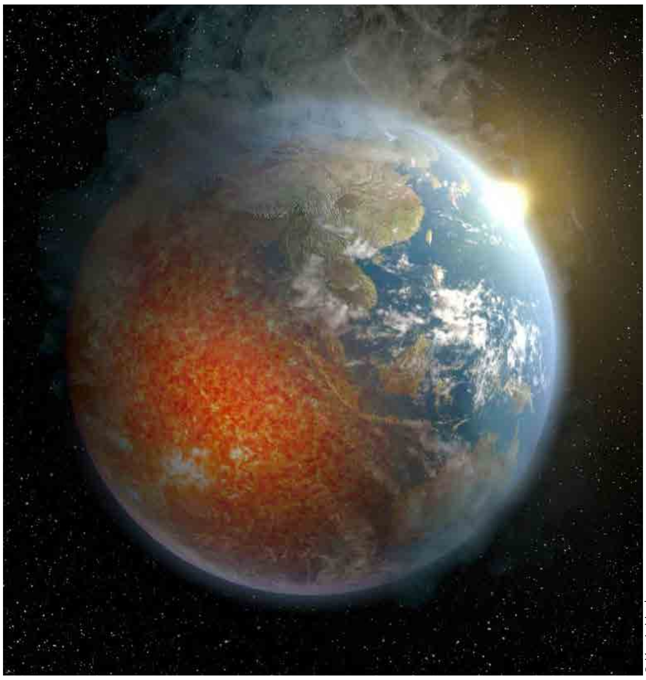
The Swiss Federal Laboratories for Materials Science and Technology, Empa is a material testing and air quality research institute, which runs the Swiss air monitoring network, including the high-altitude station at Jungfraujoch. This is part of the AGAGE network that tracks and records hydrofluorocarbons and chlorine containing compounds in the atmosphere.

Empa has used the project's new halogenated standard with their own dilution system to produce a reference gas mixture with a composition similar to the one part per trillion level in the atmosphere. Satisfied with its suitability for use at a monitoring station, a canister containing this mixture was tested and included into the international monitoring networks' measurement scale. A careful comparison between it and the existing standards must first be conducted to ensure measurement continuity and the early identification of any issues that a change in preparation methods might introduce. Once the new SI traceable standards suitability for use has been confirmed, a greater number of institutes around the world will be able to share the responsibility for producing these complex halogenated standards essential for detecting atmospheric halogenated gas trends and pollution sources.

Accurate monitoring of greenhouse gases

The EMRP project *Metrology for High-Impact Greenhouse Gases* developed CO_2 standards isotopically matched to the ratio of $^{13}CO_2$ to $^{12}CO_2$ in the atmosphere along with improved point-of-use standards for CO_2, CO, CH_4, N_2O, and halogenated gases - all with traceability to the SI. A synthetic "zero" air gas was also generated containing quantified trace amounts of contaminants for use in reference gas production and setting instrument background responses. In addition, an SI-traceable optical transfer standard for spectroscopic measurements of CO and CO_2 was developed and the use of Optical Isotopic Ratio Spectroscopy for measuring different isotope abundance in analysis samples was investigated. Isotope analysis is important for increasing the accuracy of calibration standards and determining greenhouse gas sources.

This new suite of reference standards will improve the measurement accuracy for gases that drive global warming, help in locating the source of the producers and aid the enforcement of International treaties.



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EMRP
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-ENV52

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