



First fully-synthetic standard gas mixtures with atmospheric isotopic composition for global CO₂ and CH₄ monitoring

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As the requirement for data that is comparable to the World Meteorological Organisation (WMO) scale increases, there is a corresponding increase in the demand for comparable reference standards. An infrastructure to disseminate gravimetric reference standards that are traceable to the International System of Units (SI) offers a means of broadening availability. These could overcome the cost and complexity of sampling air under global background conditions which can only be carried out at remote locations. It promises the possibility for the provision of standards from more than one source and would be enabled and supported by the global agreement under the International Committee for Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA) to which the WMO became a signatory in 2010.

We report the first fully-synthetic gaseous reference standards of CO₂ and CH₄ in a whole air matrix with an isotopic distribution matching that in the ambient atmosphere. The mixtures are accurately representative of the ambient atmosphere and were prepared gravimetrically. The isotopic distribution of the CO₂ was matched to the abundance in the ambient atmosphere by blending ¹²C enriched CO₂ with ¹³C enriched CO₂ in order to avoid measurement biases, introduced by measurement instrumentation detecting only certain isotopologues. The reference standards demonstrate excellent comparability to the WMO scale. This work is a valuable step towards enabling the wider dissemination of traceability for these atmospheric components. Since these standards are prepared synthetically, they can be replicated and avoid the complexity of sampling whole air in global background locations. They are a significant step towards making suitable reference standards for global atmospheric monitoring available more widely.