O-9: TOWARDS THE DEVELOPMENT OF ATMOSPHERIC CARBON DIOXIDE CERTIFIED REFERENCE MATERIALS AT KNOWN ISOTOPIC COMPOSITION

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From provisional data, global mean temperature in 2022 was estimated to be 1.15 ± 0.13 °C above the pre-industrial average level, thus making this year one of the warmest years on record. The increased levels of greenhouse gases (GHGs) in the atmosphere represent the main cause for such an increasing and carbon dioxide (CO_2) is the single most important anthropogenic GHG. Immediate action on GHG emissions mitigation is required to limit dangerous changes to Earth's climate. To support governments verifying emissions and demonstrating national reduction targets, it is necessary to discriminate between the natural and various man-made sources of GHGs. Discriminating man-made emissions in the measured CO_2 amount fraction is challenging and requires information on the isotopic composition, especially if reduced man-made emissions start to play a role.

INRiM, in the framework of the EMPIR Joint Research Project 19ENV05 "Stable isotope metrology to enable climate action and regulation (STELLAR)", uses its expertise in the preparation of gas standards by gravimetry for the realisation of Certified Reference Materials (CRMs) of CO_2 at known amount fraction and isotopic composition. The verification of the mixtures is carried out with different spectroscopic techniques, non-dispersive infrared photometry for amount fraction determination and Fourier-transform infrared spectroscopy for the assignment of the isotopic composition.

Starting from the development of new RMs of pure CO_2 in high pressure cylinders with different isotopic compositions carried out in the previous EMPIR Joint Research Project 16ENV06 "Metrology for Stable Isotope Reference Standards (SIRS)", diluted RMs at 410 μmol·mol^{-1} in synthetic air were prepared, in the range from +1.2 ‰VPDB to -42 ‰VPDB for δ13C, with a target uncertainty of 0.05 ‰ for δ13C-CO_2.

The prepared mixtures were then sampled in glass flasks by using an ad hoc system based on calibrated MFCs, and sent to the Max Planck Institute for Biogeochemistry (MPI-BGC), partner of both SIRS and STELLAR projects, for the validation of their isotopic composition.

An appropriate uncertainty budget was prepared for the developed RMs, taking into account the relevant uncertainty sources, such as the contributions pertaining to parent materials, to sampling and to possible contaminations from the matrix gas.

The final goal of this activity is the production of CRMs of atmospheric CO_2, and will be carried out after completing the ongoing stability study of the gaseous mixtures. The participation in an international comparison organised by CCQM will also support the production of these CRMs.