Calibration strategies for FTIR and other IRIS instruments for accurate $\delta^{13}C$ and $\delta^{18}O$ measurements of CO_2 in air

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This talk will describe calibration strategies in laboratory conditions that can be applied to ensure accurate measurements of the isotopic composition of the CO_2 in air, expressed as $\delta^{13}C$ and $\delta^{18}O$ on the VPDB scale, with either FTIR (in this case a Vertex 70V (Bruker)) or an Isotope Ratio Infrared Spectrometer (IRIS) (in this case a Delta Ray (Thermo Fisher Scientific)). In the case of FTIR, two standards with known CO_2 mole fraction, and isotopic composition, in air are sufficient to make accurate measurements with standard uncertainties of 0.05 ‰ and 0.77 ‰ for $\delta^{13}C$ and $\delta^{18}O$ respectively at a nominal CO_2 mole fraction of 400 µmol/mol in air. In the case of the IRIS system, two pure CO_2 gas isotope standards, diluent air and two standard of CO_2 certified for mole fraction and isotopic composition ($\delta^{13}C$ and $\delta^{18}O$) are sufficient to make accurate measurements of $\delta^{13}C$ and $\delta^{18}O$ with standard uncertainties of 0.29 ‰ and 0.60 ‰ respectively. The calibration strategy was validated using a set of five traceable Primary Reference Standards. The standards, produced with whole air or synthetic air as the matrix over the mole fraction range of 378- 420 µmol mol-1, were prepared and/or certified either by the National Institute of Standards and Technology (NIST) and the National Physical Laboratory (NPL). The standards were prepared in three subsets of different $\delta^{13}C$ values between -35‰ and -1‰ using pure CO_2 obtained from specific sources, namely: combustion; Northern Continental and Southern Oceanic Air and a gas well source. The isotopic composition of all standards was value assigned at the Max Planck Institute for Biogeochemistry Jena (MPI-Jena).