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First measurements of continuous δ^{18}O-CO_2 with a Fourier Transform InfraRed spectrometer in Heidelberg, Germany

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Continuous in-situ measurements of δ^{13}C and δ^{18}O in atmospheric CO_2 open the door to differentiating between different CO_2 source and sink components with high temporal resolution. Until now only few instruments have been able to provide a continuous measurement of the oxygen isotope ratio in CO_2. The Fourier Transform InfraRed (FTIR) spectrometer measures both the ^{13}C/^{12}C and ^{18}O/^{16}O ratios of CO_2, but the precision and accuracy of the δ^{18}O-CO_2 measurements have not yet been evaluated. Here we present a first analysis of δ^{18}O-CO_2 measurements with an FTIR trace gas and isotope analyser in Heidelberg. We find that the spectrometer resolves ^{18}O in CO_2 with a reproducibility of better than δ^{18}O= $\pm$ 0.3 ‰ as determined from target gas measurements over a period of ten months. An Allan variance test shows that the δ^{18}O repeatability reaches 0.1 ‰ for hourly means. The compatibility of the spectroscopic measurements was determined by comparing FTIR measurements of δ^{18}O of ambient air to the mass-spectrometric measurements on flask samples episodically collected over two diurnal cycles (events). A compatibility of better than $\pm$ 0.1 ‰ for δ^{18}O was found during these comparisons. Even though the FTIR precision does not reach that of isotope ratio mass spectrometry, a number of interesting scientific applications seem possible. In particular, investigation of processes that govern the δ^{18}O variability of atmospheric CO_2 on the regional scale seem very promising. Two episodes of recent ambient air measurements in Heidelberg, one in winter and one in summer, illustrate how high resolution regional δ^{18}O and δ^{13}C records may provide a better understanding of the regional scale processes leading atmospheric CO_2 variability. However, quantitative analysis requires comprehensive knowledge on the isotopic signature of different CO_2 sources and sinks as well as the influencing water reservoirs, which may largely govern the δ^{18}O-CO_2 variability during summer.