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A portable FTIR spectrometer for real time field measurements of δD in water vapour and δ^{13}C in CO_2

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We describe a portable Fourier Transform InfraRed (FTIR) spectrometer for laboratory and field measurements of δ^{13}C in CO_2 and δD in water vapour at ambient atmospheric levels. The instrument is based on a commercial 1 cm^{-1} resolution FTIR spectrometer fitted with a mid-IR globar source, 26 m multipass White cell and thermoelectrically-cooled MCT detector operating between 2000 and 7500 cm^{-1}. δD in water vapour is measured in whole air passed at 1-2 L min^{-1}through the cell in real time without any pre-treatment. For δ^{13}C measurements the sample airstream is dried to < 20 μmol mol^{-1} to avoid interference from water vapour. An inlet selection manifold allows automated sequential analysis of samples from up to 12 inlet lines, with typical measurement times of 4-5 minutes per line. The spectrometer, inlet sampling sequence, real-time spectrum analysis, data logging and real-time display are all under the control of a single program running on a laptop PC, and can be left unattended for continuous measurements over periods of days to weeks.

Selected spectral regions of typically 100-200 cm^{-1} width are analysed by a least squares fitting technique to retrieve concentrations of trace gases and isotopologues. Typical precision is 1-2‰ for δD and 0.1 – 0.2‰ for δ^{13}C. Calibration and performance are described in more detail in an associated poster (Tadros et al.) The collected spectra also provide simultaneous analysis of concentrations of CO_2, CH_4, CO and N_2O in the analysed air samples with high precision, typically 0.1%.

Performance of the FTIR analyser will be illustrated with results from a recent field

campaign in which we measured vertical profiles of δD in water vapour and δ^{13}C in CO_2 on a 70 m tower in a eucalypt forest in SE Australia. Hourly 7-point profiles were obtained continuously for 3 weeks interspersed with measurements from soil and leaf chambers. The results, combined with a multilayer ecosystem model of water and carbon exchange, are described in detail in the paper by Haverd et al. (this conference).