Improvements of the Spectronus FTIR instrument for application in static mode at tall towers

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The Spectronus instrument uses FTIR spectroscopy to measure simultaneously and at high reproducibility the most important greenhouse gases CO_2, CH_4, N_2O and also CO and $\delta^{13}CO_2$ in dry air at ambient concentrations (Esler et al, 2000, Hammer et al, 2013). Several improvements have been applied to adapt the system for use at (remote) tall tower sites in order to reduce gas consumption and improve stability at static mode in order to measure gradients along the tall towers. Compared to the standard 3.5 L glass cell this instrument is equipped with a metal cell with a volume of 2.5 L and temperature control up to 10 mK accuracy. After laboratory testing (reproducibility results in Table 1) the instrument has now been tested for six months at Cabauw tall tower (Netherlands), measuring vertical gradients at four heights along the tower, with all inlets connected to a buffer volume system. Data coverage in the period was 98% (see figure 1 for CO_2 timeseries).

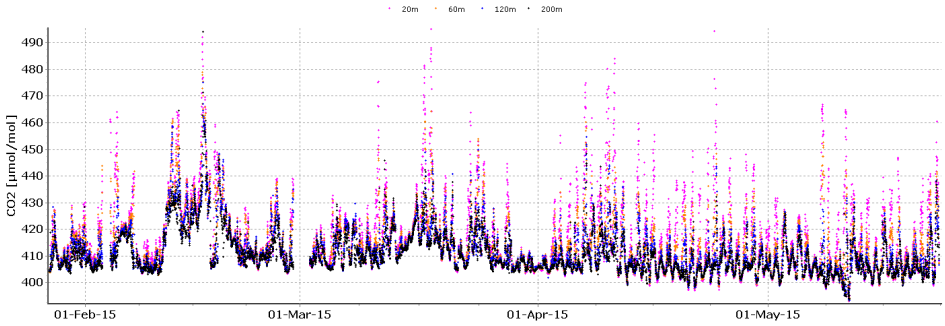

Figure 1 Hourly CO_2 mole fractions in µmol/mol for all four heights along Cabauw (NL) tall tower.

Table 1 Target gas reproducibilities of the optimized Spectronus in flow and static mode

Spectronus metal cell, increased temp control

Species	Allan Var				Precision	Drift	Unit
	flow 1 min	flow 5 min	static 1 min	static 5 min	stdev 3 days	per day	
CO2	0.018	0.007	0.018	0.014	0.031	0.021	ppm
13CO2	0.08	0.04	0.03	0.02	0.07	0.03	permille
CH4	0.18	0.10	0.20	0.10	0.18	0.11	ppb
N2O	0.15	0.07	0.12	0.05	0.08	0.009	ppb
CO	0.25	0.12	0.20	0.07	0.14	0.04	ppb

Esler M.B., Griffith D.W.T., Wolson S.R. & L.P. Steele: Precision trace gas analysis by FT-IR spectroscopy. 1. Simultaneous analysis of CO2, CH4, N2O, and CO in air. Anal. Chem., 72:1, 2000

Hammer S., Griffith D.W.T., Konrad G., Vardag S., Caldow C., and I. Levin: Assessment of a multi-species in situ FTIR for precise atmospheric greenhouse gas observations, Atmos. Meas. Tech., 6, 1153-1170, doi:10.5194/amt-6-1153-2013, 2013