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*Supplement of*

## **Sources of error in open-path FTIR measurements of N<sub>2</sub>O and CO<sub>2</sub> emitted from agricultural fields**

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**Table S1:** Reference spectra of N<sub>2</sub>O, water vapour, and CO<sub>2</sub> used in CLS models were generated from the HITRAN database at 30 °C.

Spectra #	N <sub>2</sub> O	Water vapour	CO <sub>2</sub>
		(ppm*m)	
1	35	2631500	2000
2	50	3289400	5000
3	75	3947300	10000
4	70	4605200	20000
5	100	5263000	30000
6	150	6578800	40000
7	105	7894600	50000
8	150	9210400	100000
9	225	7894500	150000
10	140	9868200	200000
11	200	11841900	250000
12	300	13815600	300000
13		10526000	350000
14		13157600	400000
15		15789200	450000
16		18420800	500000
17			550000

**Table S2:** Sixty mixed-gases calibration spectra were collected from the lab FTIR joined with the multi-pass gas cell (optical path length = 33 m) to build partial least squares (PLS) models for N<sub>2</sub>O quantification: The information of spectra and PLS models was shown in (a) concentrations of N<sub>2</sub>O and water vapor, and (b) the number of factors used in models.

(a) N<sub>2</sub>O/water vapor concentrations

Spectra#	N <sub>2</sub> O (ppm)	N <sub>2</sub> O (ppm*m)	Water vapor (ppm)	Water vapor (ppm*m)	Spectra#	N <sub>2</sub> O (ppm)	N <sub>2</sub> O (ppm*m)	Water vapor (ppm)	Water vapor (ppm*m)
1	0.31	10.23	7330.60	241909.89	31	0.31	10.23	20720.00	683760.00
2	0.31	10.23	7334.38	242034.64	32	0.31	10.23	20720.00	683760.00
3	0.31	10.23	7344.42	242365.75	33	0.31	10.23	20720.00	683760.00
4	0.40	13.20	7345.97	242417.03	34	0.40	13.20	21166.00	698478.00
5	0.40	13.20	7335.69	242077.81	35	0.40	13.20	21166.00	698478.00
6	0.40	13.20	7384.26	243680.45	36	0.40	13.20	21166.00	698478.00
7	0.50	16.50	7425.25	245033.38	37	0.50	16.50	21352.00	704616.00
8	0.50	16.50	7435.31	245365.38	38	0.50	16.50	21352.00	704616.00
9	0.50	16.50	7428.77	245149.42	39	0.50	16.50	21352.00	704616.00
10	0.60	19.80	7472.43	246590.20	40	0.60	19.80	22409.00	739497.00
11	0.60	19.80	7561.33	249524.05	41	0.60	19.80	22409.00	739497.00
12	0.60	19.80	7561.16	249518.13	42	0.60	19.80	22409.00	739497.00
13	0.70	23.10	7428.18	245129.78	43	0.70	23.10	25814.00	851862.00
14	0.70	23.10	7387.42	243784.78	44	0.70	23.10	25814.00	851862.00
15	0.70	23.10	7359.32	242857.45	45	0.70	23.10	25814.00	851862.00
16	0.31	10.23	15367.62	507131.41	46	0.31	10.23	26786.16	883943.19
17	0.31	10.23	15372.82	507303.06	47	0.31	10.23	26584.12	877275.94
18	0.31	10.23	15360.80	506906.44	48	0.31	10.23	26597.24	877708.81
19	0.40	13.20	15595.24	514643.03	49	0.40	13.20	30446.93	1004748.69
20	0.40	13.20	15704.48	518247.72	50	0.40	13.20	30738.75	1014378.88
21	0.40	13.20	15708.70	518387.22	51	0.40	13.20	30386.46	1002753.19
22	0.50	16.50	15521.94	512224.06	52	0.50	16.50	29310.16	967235.44
23	0.50	16.50	15678.90	517403.75	53	0.50	16.50	28955.07	955517.25
24	0.50	16.50	15771.27	520452.06	54	0.50	16.50	28851.81	952109.88
25	0.60	19.80	15766.92	520308.47	55	0.60	19.80	28499.03	940467.94
26	0.60	19.80	15707.03	518332.09	56	0.60	19.80	28247.49	932167.31
27	0.60	19.80	15859.43	523361.28	57	0.60	19.80	27876.50	919924.50
28	0.70	23.10	16033.97	529121.00	58	0.70	23.10	28584.89	943301.38
29	0.70	23.10	15967.60	526930.88	59	0.70	23.10	29724.95	980923.31
30	0.70	23.10	15887.32	524281.53	60	0.70	23.10	29897.34	986612.19

(b) The number of factors in PLS models

Analytical window (cm <sup>-1</sup> )	No. of factors in PLS	
	N <sub>2</sub> O	water vapor
W <sub>N</sub> 1: 2170.0 - 2223.7	3	5
W <sub>N</sub> 2: 2188.5 - 2223.7	4	4
W <sub>N</sub> 3: 2188.5 - 2204.1 + 2215.8 - 2223.7	4	4
W <sub>N</sub> 4: 2188.5 - 2204.1	5	4

**Table S3:** Quantification biases (%) of N<sub>2</sub>O and CO<sub>2</sub> were categorized by the wind speed (1 m s<sup>-1</sup> interval), and statistics of biases were calculated from seven groups. Levene's test was used to compare variances of biases among the groups to test the low wind speed threshold. Levene's hypothesis test is defined as:  $H_0: \sigma_1^2 = \sigma_2^2 \dots \sigma_n^2 (n \geq 1)$  and  $H_a$ : *at least one variance is different*.

<b>Statistics of quantification bias (%) and Levene's variance test</b>							
Groups	1	2	3	4	5	6	7
Wind speed (m s <sup>-1</sup> )	0.0-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-6.0	6.0-7.0
<b>N<sub>2</sub>O Bias (%)</b>							
Mean	-0.93	0.33	1.58	1.16	1.31	1.32	0.93
SD	4.92	3.39	2.90	2.63	1.81	1.79	1.87
N	22	82	73	108	53	32	18
Test Groups	(1-7)	(2-7)	(3-7)	(4-7)	(5-7)	(6-7)	
F-value	7.45	6.81	4.67	4.46	0.19	0.35	
P-value	0.000	0.000	0.001	0.005	0.830	0.555	
<b>CO<sub>2</sub> Bias (%)</b>							
Mean	1.14	-0.26	-0.78	-1.10	-1.50	-1.56	-1.20
SD	10.24	10.84	3.74	2.06	2.29	2.42	2.33
N	21	75	69	98	46	28	17
Test Groups	(1-7)	(2-7)	(3-7)	(4-7)	(5-7)	(6-7)	
F-value	11.10	9.77	2.05	0.36	0.23	0.09	
P-value	0.000	0.000	0.088	0.779	0.796	0.767	