Field Testing the New Open-Path and Enclosed-Path CO_2/H_2O Flux Measurement Systems

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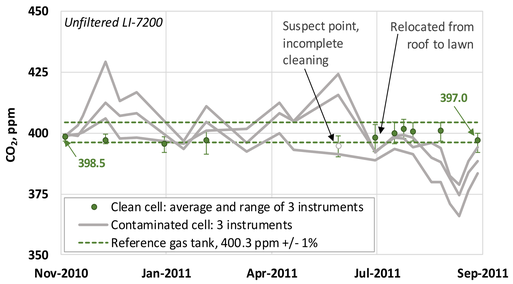
INTRODUCTION

- New models, LI-7500RS and LI-7200RS, are based on the original LI-7500/A and LI-7200 gas analyzers
- Development focused on improving stability in the presence of contamination and on refining temperature controls
- New systems also include automated fully corrected flux calculations by remotely-accessible microcomputer, SmartFlux 2

ORIGINAL MODELS



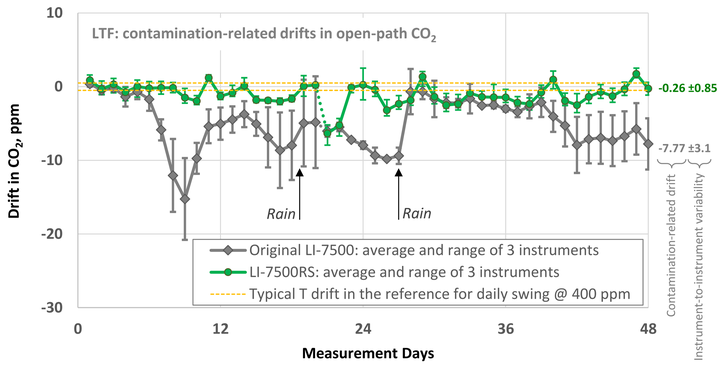
- When original models experienced contamination, drifts ranged from -35 to +30 ppm vs reference gas tank
- When instruments were clean, average total drift (span+zero) over 11-month period was 1.5 ppm, well within specifications of gas tanks
- Clean original models can be used as reliable field references for new instrumentation

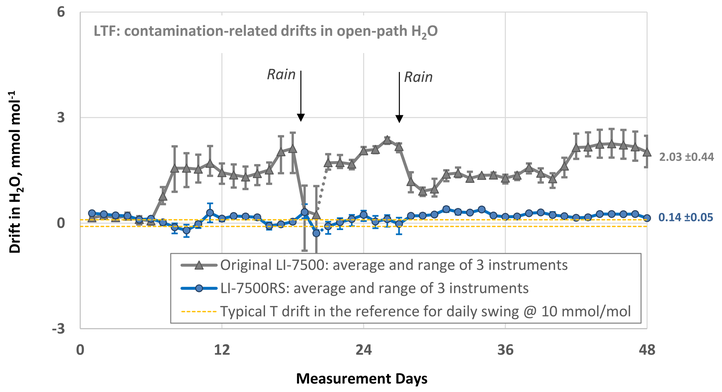
TEST SITES

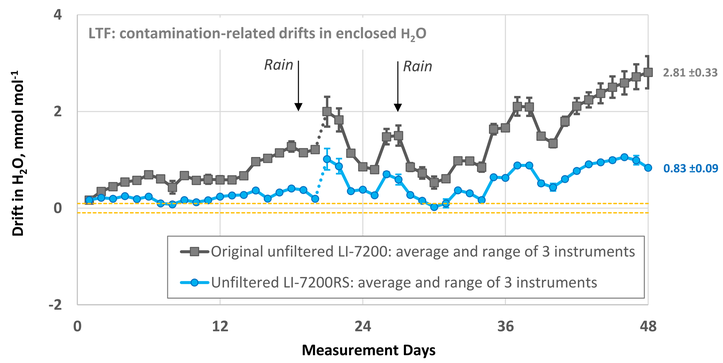
- Field tests were conducted over six periods 5-14 months long, at 6 diverse sites, using 26 gas analyzers: details are in Begashaw et al (2016)

FIELD RESULTS

Drifts at Highly Contaminated Sites





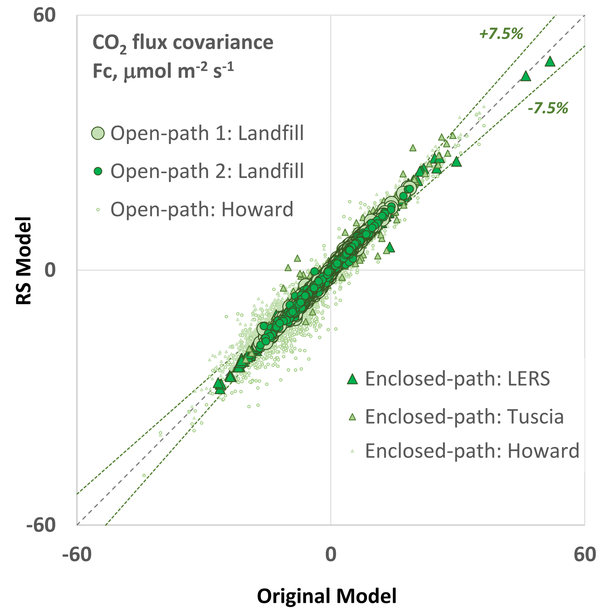


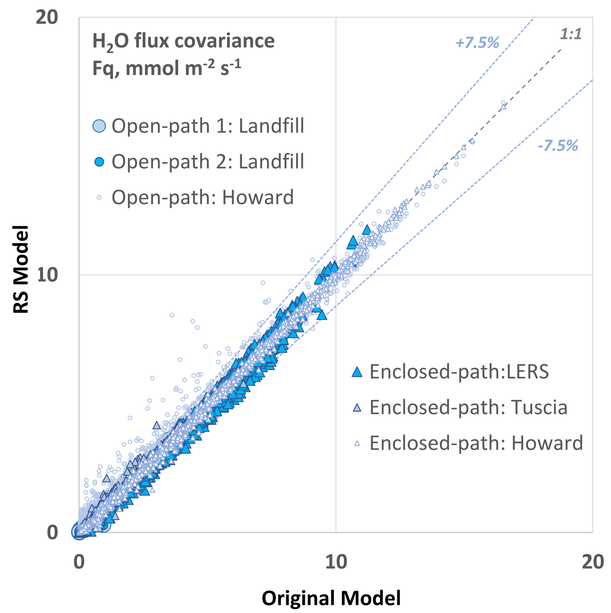
Specie	Design	Site	Original	RS model	Drift reduction x times
CO_2 ppm	open-path	Landfill	-6.8 to -4.0	-1.4 to 0.2	2.9 to 16.7
		LTF	-7.8	-0.3	29.9
		Tuscia	0 to 20[1]	0	1 to >>>[1]
	enclosed	Tuscia	25 to 60	0 to 40[2]	1.3 to >>>
		Howard	27.8	59.2[3]	0.47[3]
H_2O mmol mol^{-1}	open-path	Landfill	1.2 to 1.6	-0.01 to 0.1	8.4 to 188
		LTF	2.0	0.1	14.5
		Tuscia	0	-4.0[2] to 0	<<<[2] to 1
	enclosed	Tuscia	1.5 to 3.0	0[2]	>>>
		Howard	4.5	1.9[3]	2.4

[1]Possible human error when calibrating original model; [2]RS model was never cleaned in prior 4 months while original model was cleaned 3 times; [3]RS model was never cleaned in prior 7 months while original model was cleaned 3 months earlier

Reduction of contamination-related drift in RS models determined by the change in readings before and after cleaning. Zarnekow site did not see significant before-after cleaning differences, likely as a result of low-contamination season. LERS site had filtered reference, so no before-after cleaning data were available.

Fluxes at All Sites





- When both original and new RS models were in similar conditions in terms of mean concentrations, setup and field regimens, the 1:1 hourly flux comparisons were good
- Slopes ranged 0.93-1.07, R^2 ranged 0.93-1.00, with *n* ranging from 796 to 2129
- Most differences in fluxes came from the contamination drifts in the original models

SUMMARY

- Instrument-to-instrument variability was reduced 3-9 fold in new RS systems vs originals
- In terms of contamination-related drifts, the new open-path RS system performed significantly better than the original for both CO_2 and H_2O
- CO_2 drifts in open-path RS system were few-to-tens of times less than in the original models
- H_2O drifts in open-path RS system were many tens of times less than in the original models
- The unfiltered enclosed RS system performed substantially better than the original for H_2O drifts, at times drifting few-to-tens of times less
- Improvements in enclosed-path CO_2 drifts were modest, being similar or just a bit better than the original

CONCLUSIONS

- Field results suggest that new RS systems can significantly reduce site maintenance requirements and improve flux data coverage vs originals models
- Improvements are especially strong in open-path CO_2 and H_2O measurements, but also significant for the enclosed-path H_2O measurements
- Improvements may be particularly effective at sites or during periods experiencing medium and high levels of contamination

DETAILS: Begashaw I., G. Fratini, F. Griessbaum, J. Kathilankal, L. Xu, D. Franz, E. Joseph, E. Larmanou, S. Miller, D. Papale, S. Sabbatini, T. Sachs, R. Sakai, D. McDermitt, and G. Burba, 2016. Results of first field tests of the improved open-path and enclosed models of CO2 and H2O flux measurements systems. European Geosciences Union General Assembly, Vienna, Austria, April 17-22

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