



ICOS

integrated
carbon
observation
system

MSA

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Paris

CO Instruments Update

Benoit Wastine, Ali Guemri, Olivier LAURENT



LABORATOIRE DES SCIENCES DU CLIMAT & DE L'ENVIRONNEMENT



UNIVERSITÉ DE
VERSAILLES
ST-QUENTIN-EN-YVELINES



LGR CO/N2O EP

2 LGR 23r EP (Enhanced Performance) instruments purchased by Andra have been evaluated at LSCE between May/August 2013.



23r EP Guaranteed performance specifications:

	N2O	CO
Precision 1- σ (3min avr)	0.05 ppb	0.05 ppb
24h Max Drift (15min avr)	0.1 ppb	0.1 ppb

LGR CO/N2O EP

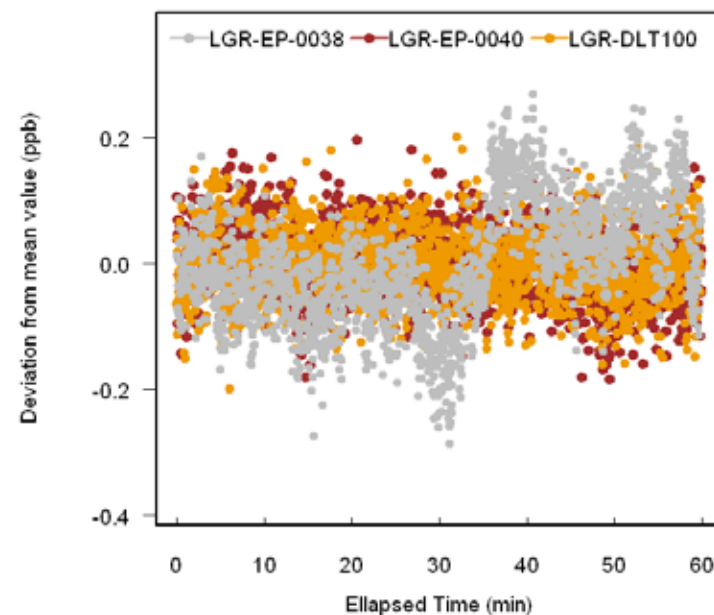
Precision :

CO (ppb)	LGR-EP-38	LGR-EP-40	LGR-DLT100
1 σ (raw data)	0.09	0.06	0.06
1 σ (3 min data)	0.08	0.02	0.01

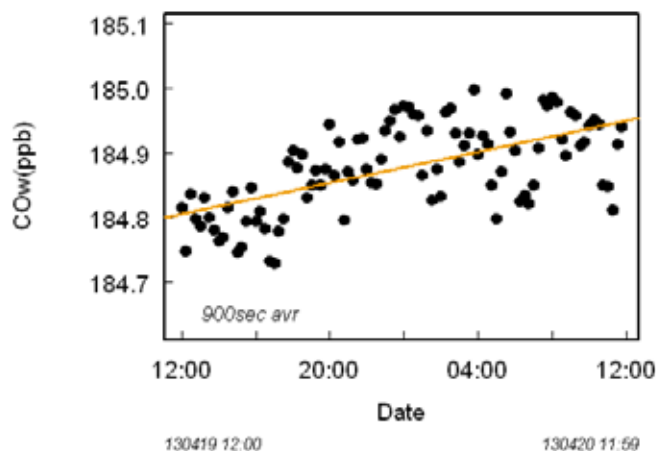
24h Drift:

CO (ppb)	LGR-EP-38	LGR-EP-40	LGR-DLT100
MaxDrift (p. to peak)	0.27	0.15	0.35

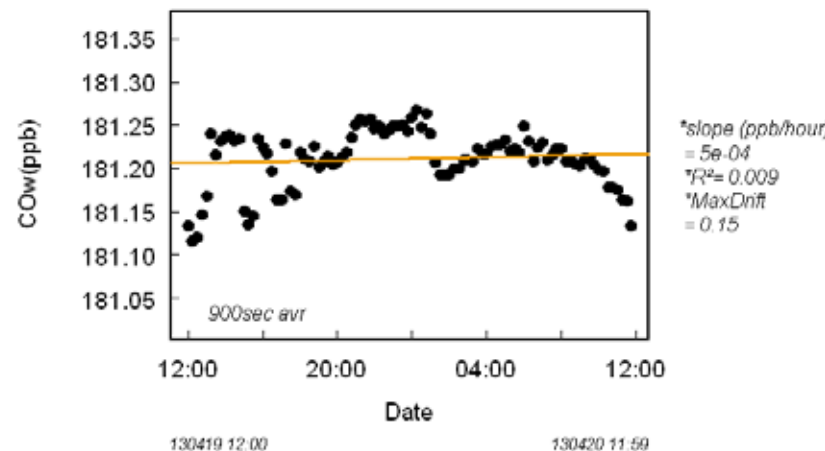
LGR N2O/CO instruments: CO precision



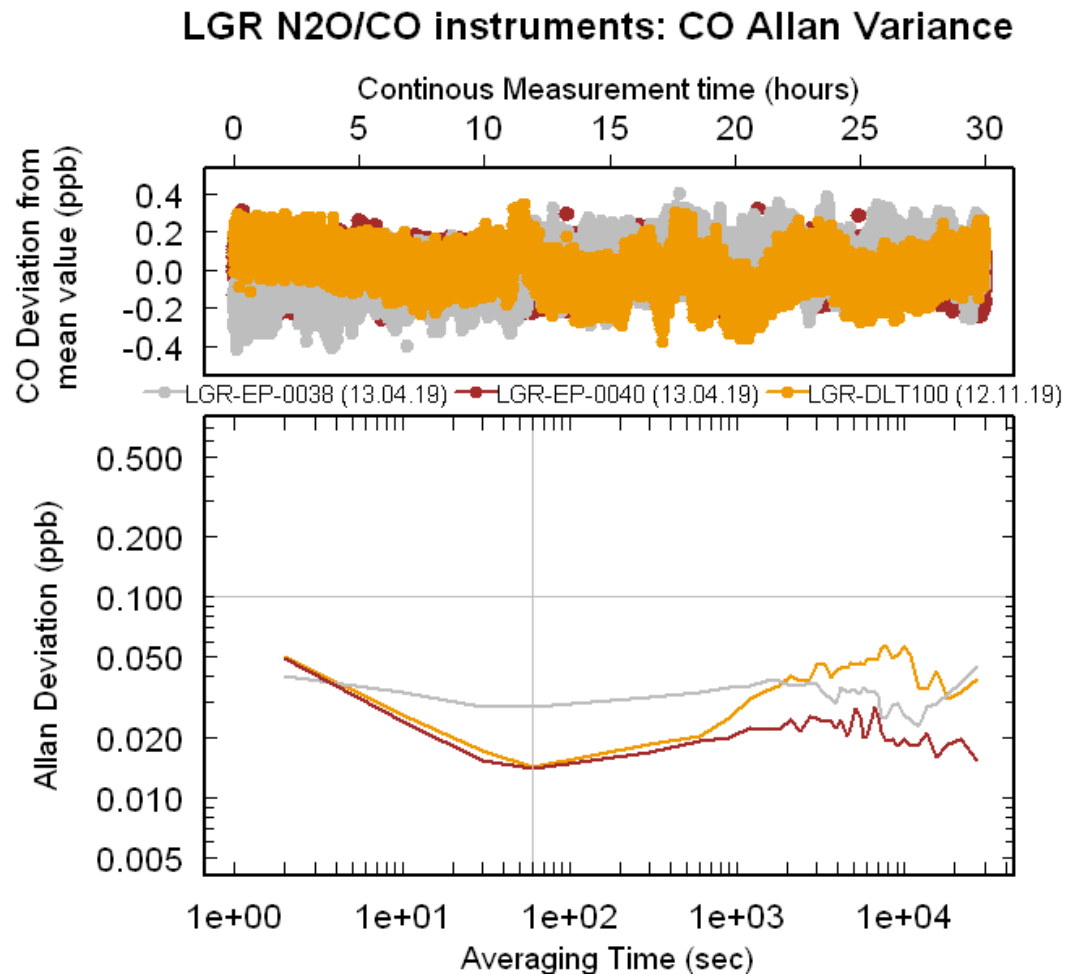
LGR-13-0038: TGT_D655681



LGR-13-0040: TGT_D655681

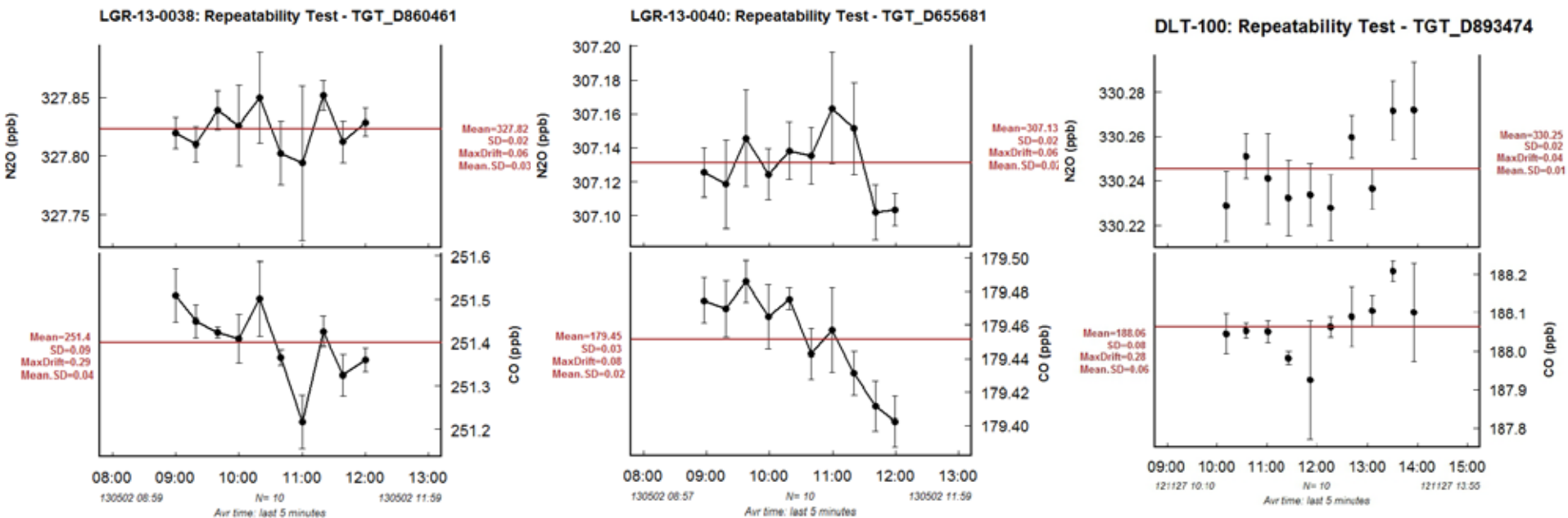


Allan Variance:



LGR CO/N2O EP

Repeatability:

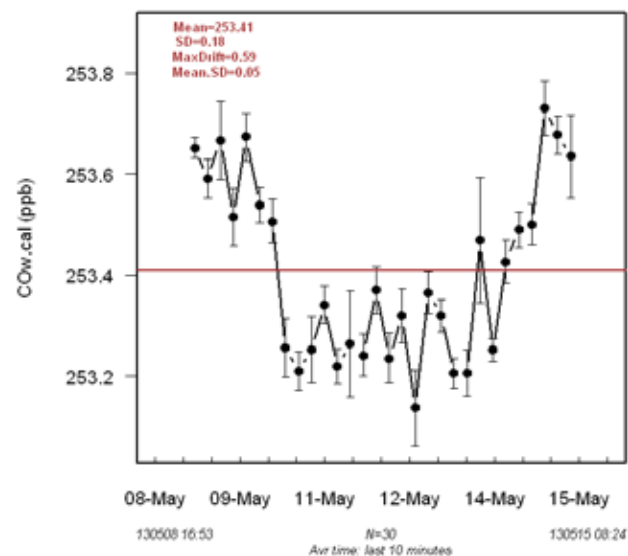


	LGR-EP-38	LGR-EP-40	LGR-DLT100
CO (ppb)			
Repeatability	0.09	0.03	0.08
MaxDrift (p.to peak)	0.29	0.08	0.28
5min mean stdev.	0.04	0.02	0.06

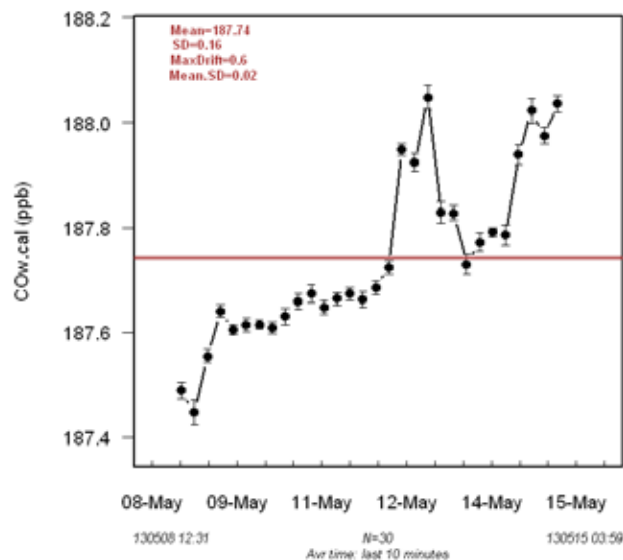
LGR CO/N2O EP

Reproducibility:

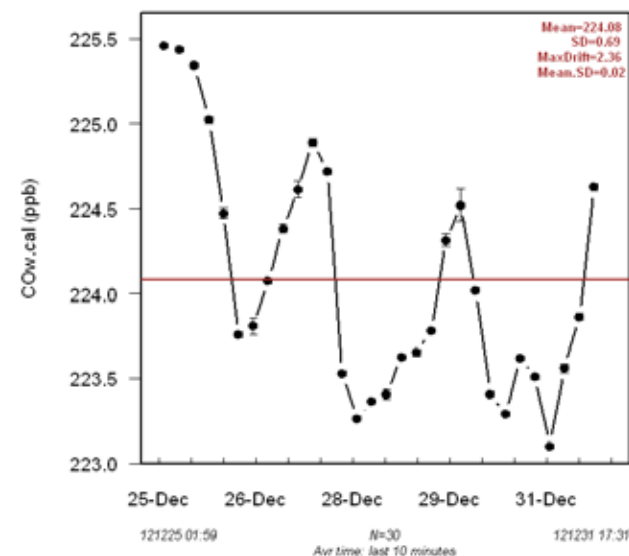
LGR-13-0038: TGT_D860461



LGR-13-0040: TGT_D655681



DLT-100: TGT_D609139



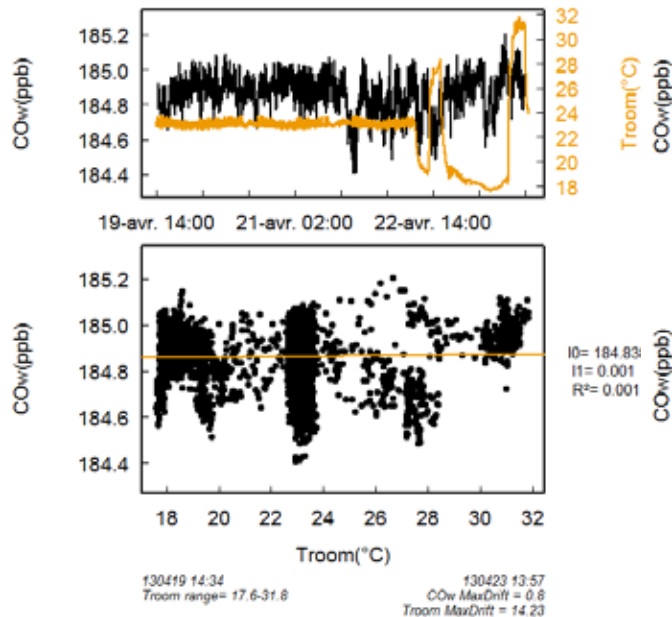
CO (ppb)	LGR-EP-38	LGR-EP-40	LGR-DLT100
N	30	30	30
Reproducibility	0.2	0.2	0.7
MaxDrift (p.to peak)	0.6	0.6	2.4



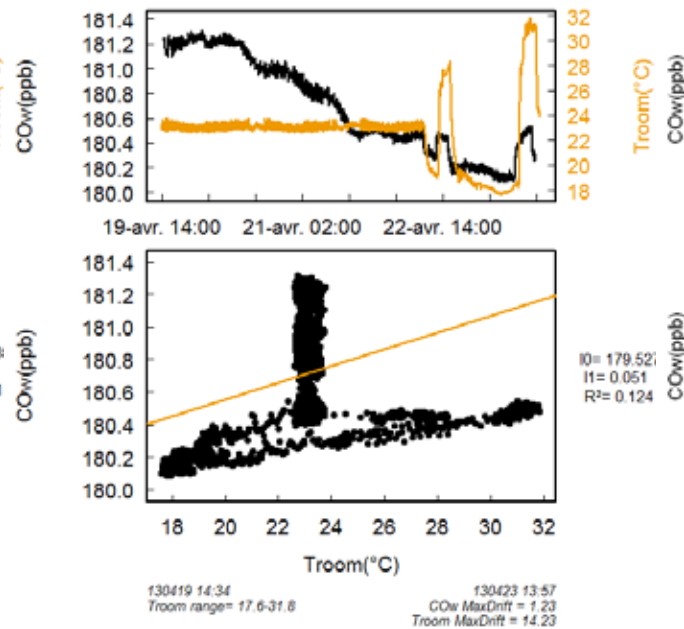
LGR CO/N2O EP

Temperature influence:

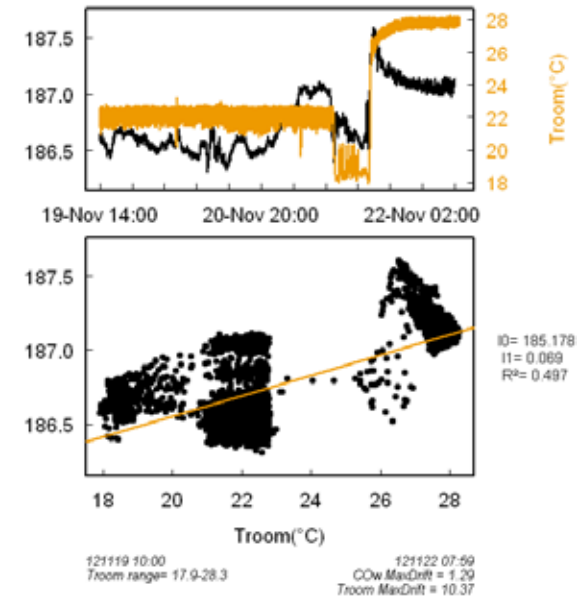
LGR-13-0038: TGT_D655681



LGR-13-0040: TGT_D655681



DLT-100: TGT_D893474

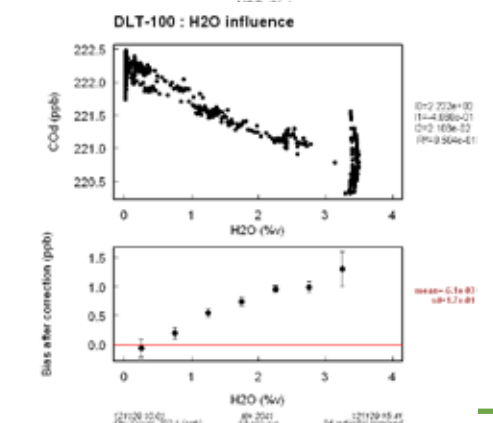
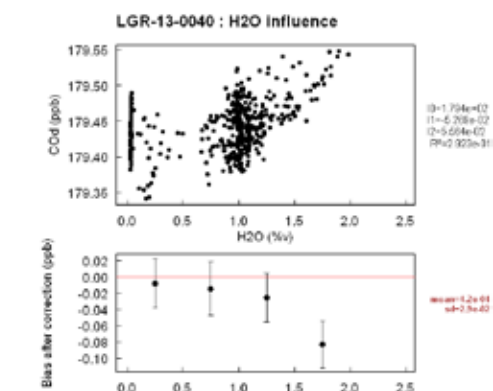
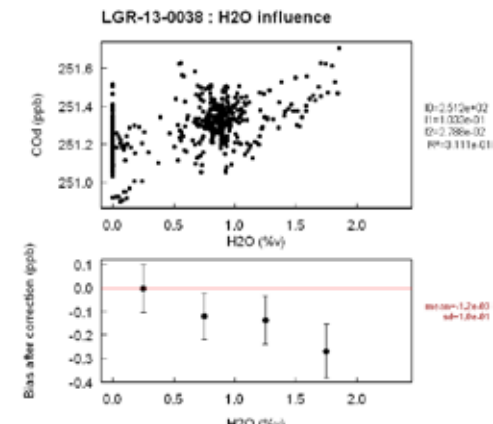
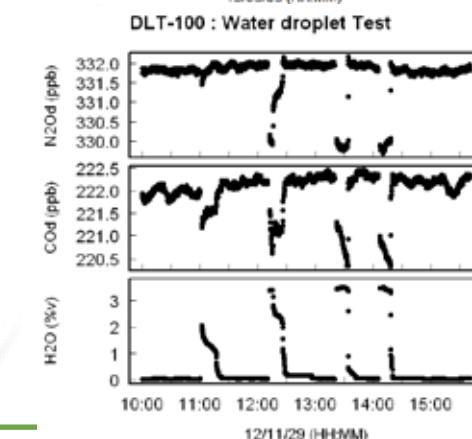
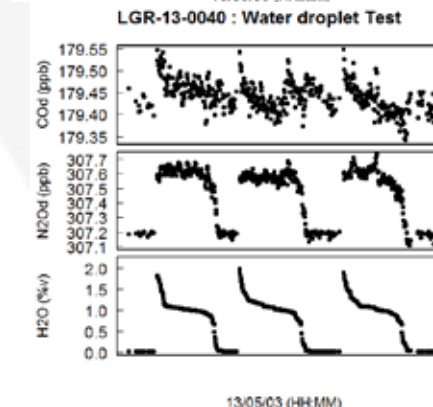
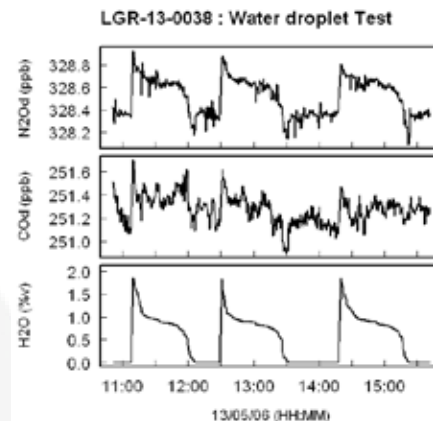


Water correction check:

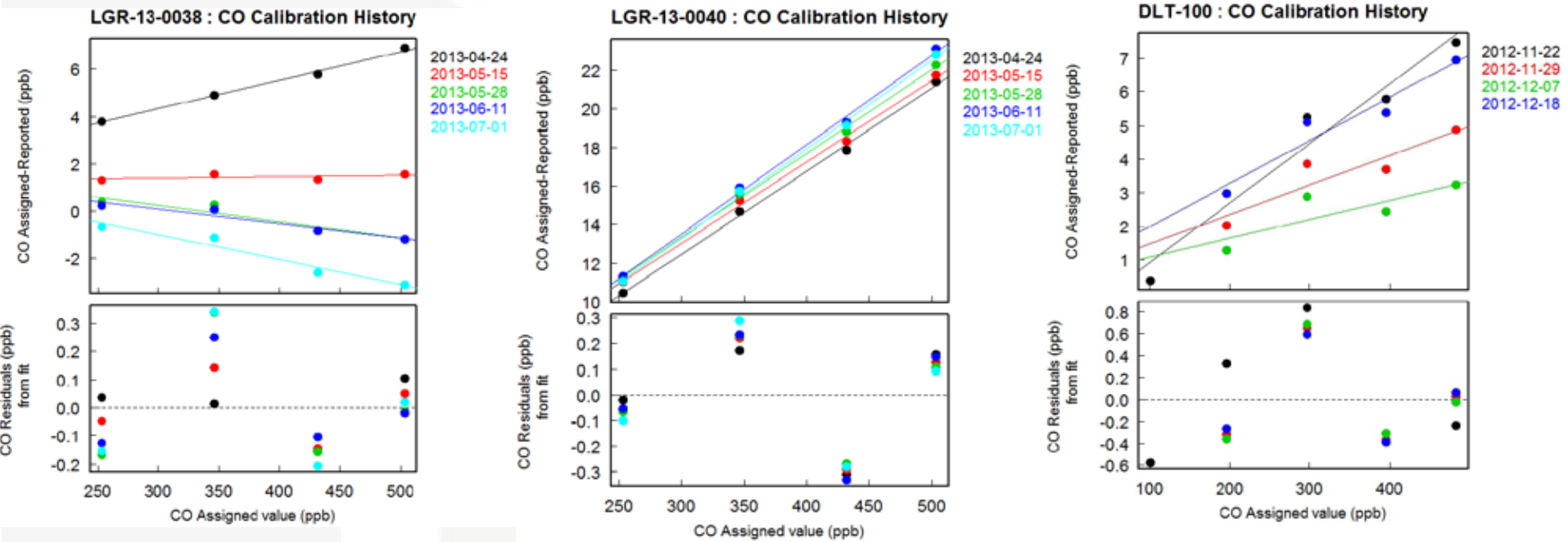
§ Methodology: Measure a tank filled with dry natural air through an hygroscopic filter (M&C LB1SS). Add a water droplet (0.2 ml) in the sample line to humidify the stream and wait for total evaporation of the droplet. Repeat the experiment 3 times. Check the validity of the water corrections implemented by LGR.

Water correction bias:

$$C_{dry} - C_{corrected}$$



Calibration:



LGR CO/N2O EP

Summary:

CO (ppb)	LGR-EP-38	LGR-EP-40	LGR-DLT100
Precision (1 σ , 3 min Avg)	0.08	0.02	0.01
24h Drift (peak to peak)	0.27	0.15	0.35
Repeatability (5 min Avg) 1 σ / MaxDrift	0.09 / 0.29	0.03 / 0.08	0.08 / 0.28
Reproducibility (5 min Avg) 1 σ / MaxDrift	0.2 / 0.6	0.2 / 0.6	0.7 / 2.4
Temperature Influence (/°C)	0	0.03	0.07
Water vapor correction Bias (up to 2%v H2O)	<0.3	<0.1	<1
Calibration drift (/month)	<5	<1	<4
Linearity (residuals from calibration linear fit)	<0.4	<0.3	<0.9



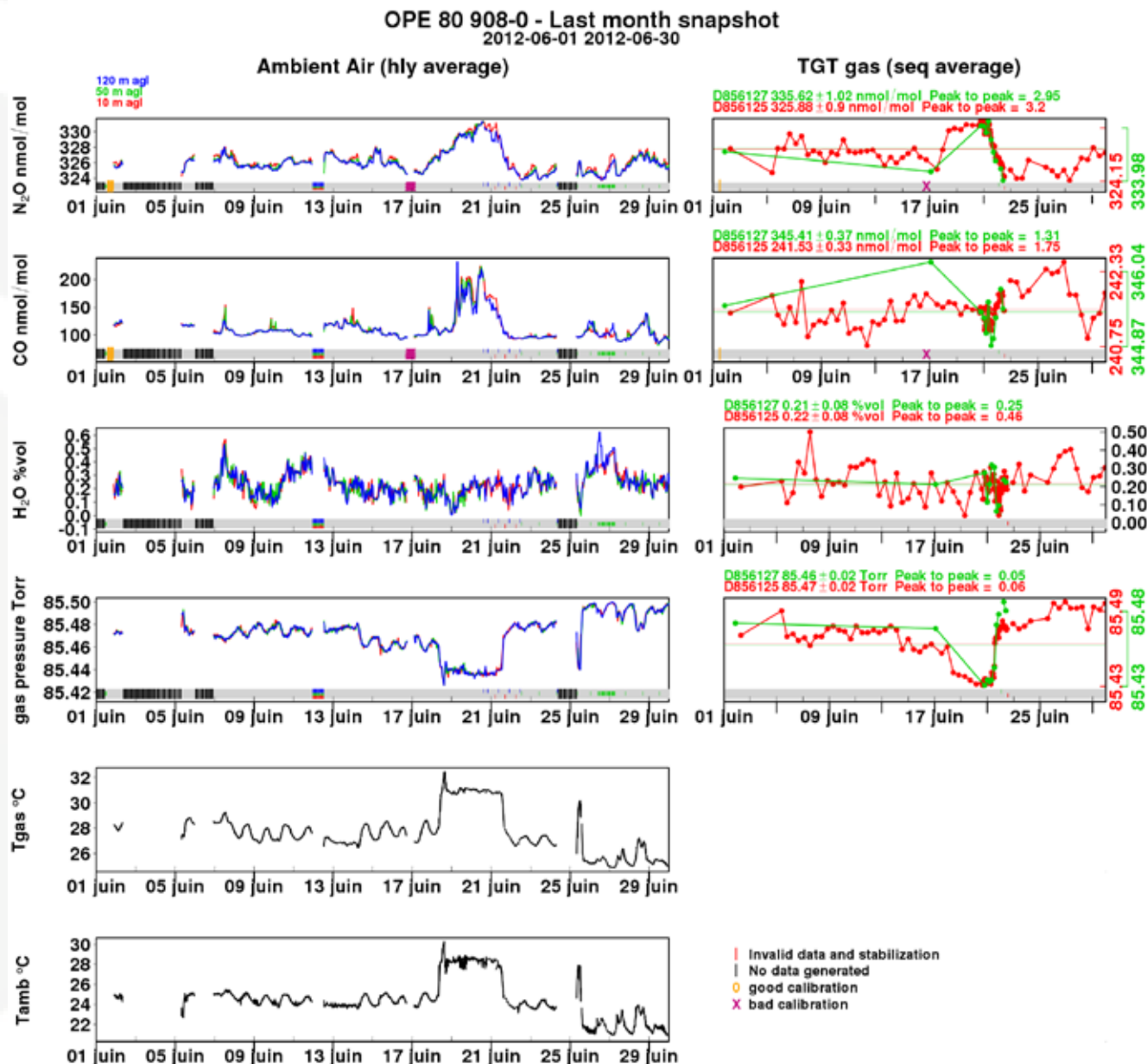
LGR CO/N2O EP

Field Performance:

LGR DLT100 installed at
OPE station (ANDRA)

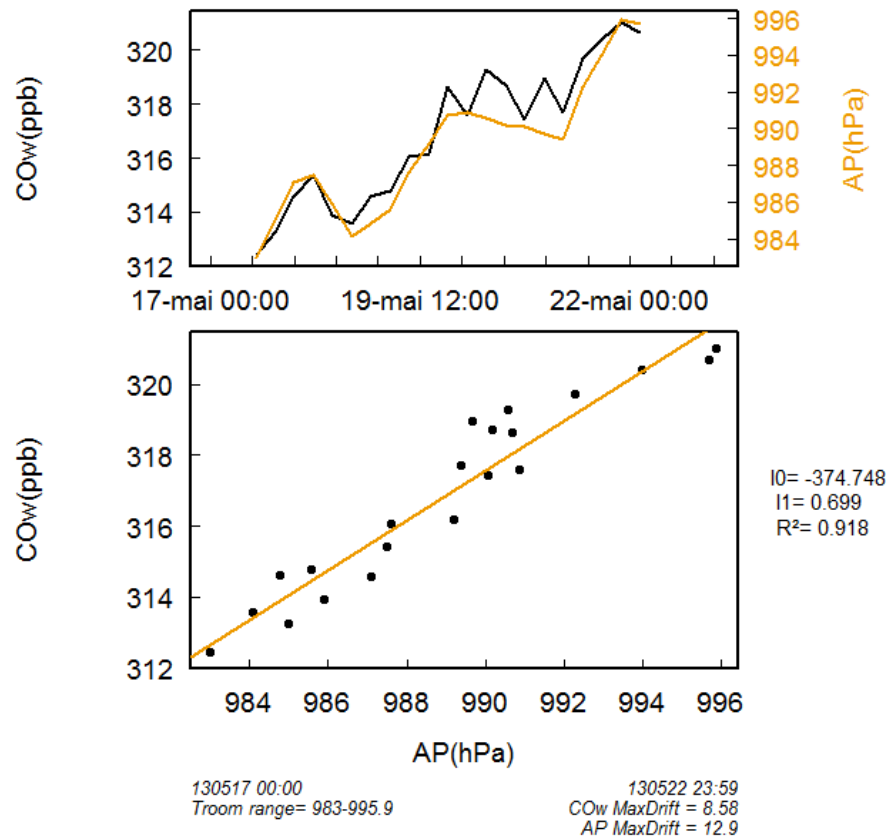
CO Reproducibility (1σ):

0.33 ppb over a month



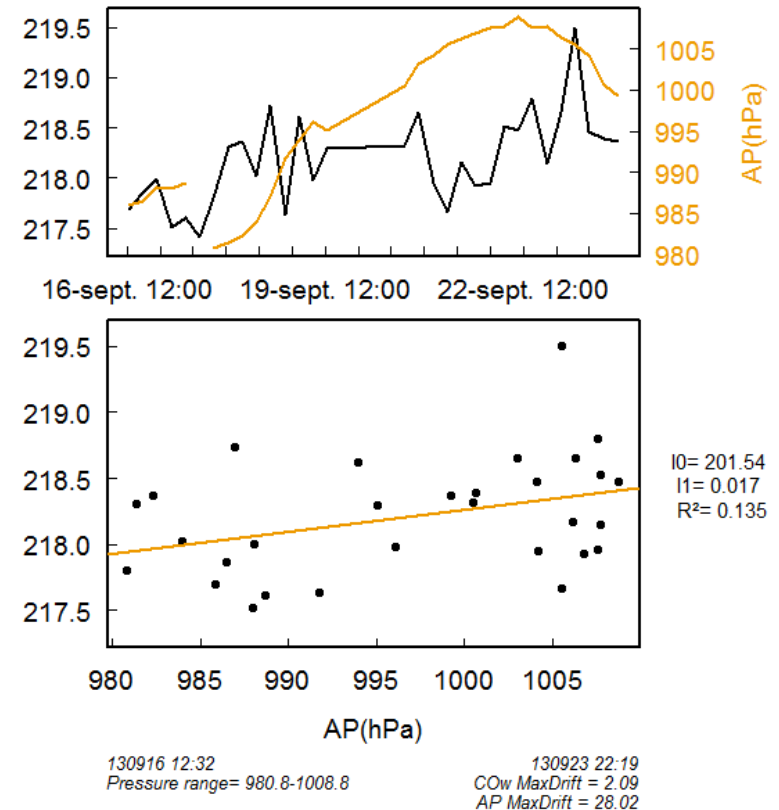
Atmospheric Pressure Influence:

CFKADS-2084: Atmospheric pressure influence



+0.7 ppbv/hPa

CFKADS-2105: Atmospheric pressure influence



+0.02 ppbv/hPa

Picarro found a solution: the Picarro CFKADS-2084 return back to Picarro for Upgrade.

Performance:

Test	ICOS Specifications (August 2013)	ATC TestLab results						
		CFKADS -2041	CFKADS -2022	CFKADS -2037	CFKADS -2071	CFKADS -2072	CFKADS -2073	CFKADS -2084
Precision (1-sigma) on minute averaged data over 24 hours	< 2 ppb	1.55	1.37	1.57	1.2	2.12	1.1	2.56
Precision (1-sigma) on hour averaged raw data over 24 hours	< 1 ppb	0.65	0.55	0.18	0.38	1.84	0.24	2.19
Peak-to-peak on minute averaged raw data over 24 hours	< 15 ppb	10.76	10.11	9.74	7.47	12.38	7.41	15.81
Peak-to-peak on hour averaged raw data over 24 hours	< 2 ppb	2.48	1.74	0.76	1.58	7.09	0.81	7.65
Std dev (1-sigma) on 10 minute averaged raw data 72 hours	< 1 ppb	1.23	1.67	0.35	0.93	2.8	0.74	1.12
Peak-to-peak on 10 minute averaged data drift corrected data over 72 hours	< 3 ppb	4.77	5.02	1	3.03	8.41	2.83	4.4
Response Time 10%-90% on minute averaged raw data	≤ 2 minutes	OK	OK	OK	OK	OK	OK	OK
Response Time 90%-10% on minute averaged raw data	≤ 2 minutes	OK	OK	OK	OK	OK	OK	OK

The atmospheric pressure sensitivity do not explain always the variability.
Few instruments seem to have intrinsic unsuitable performance (independently to the atmospheric pressure).

Picarro G2401

Field Performance:

A G2401 has been installed at ERS (Corsica) station.

CO Reproducibility (1σ):

0.55 ppb over a month



ERS 150 G2401 - Last month snapshot
2013-08-04 2013-09-04

update 06:54
2013-09-04

