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Assessing greenhouse gas measurement consistency and traceability in the UK and Ireland atmospheric monitoring network using whole and synthetic air reference materials

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Supplementary

Below shows the measurement results of each reference material (D664636, D664637, D664638, NPL-2892, NPL-3097, NPL3064 and NPL-2997) from each site and instrument that took part in the intercomparison exercise (Bilsdale (BSD), Ridgehill (RGL), Tacolneston (TAC), Weybourne (WAO), Heathfield (HFD) and Mace Head (MHD)). There is a separate table for each cylinder and each species. The MHD site had two CRDS instruments of the same make and model (Picarro Inc. G2401) for CO_2 and CH_4 measurements owned by the University of Galway and Laboratory for Climate and Environmental Sciences (LSCE) in France. They were given identification numbers (695 and 955 respectively) to distinguish between them. The results are the mean of the measurements collected from each instrument at each site. They are obtained using optical instrumentation (CRDS, LGR and FTIR) and GC-ECDs (denoted "ECD" in the tables below). The standard deviation is that taken of the measurements over the period they were measured and is considered the variability in the measured value.

Table S1. Measurement results and uncertainty for CO_2 from D664636.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRDS	398.06	0.01
RGL CRDS	398.17	0.01
TAC LGR	398.17	0.01
WAO FTIR	398.02	0.05
HFD CRDS	399.00	0.01
MHD CRDS 695	398.14	0.01
MHD CRDS 955	398.17	0.01

Table S2. Measurement results and uncertainty for CH_4 from D664636.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	1837.97	0.14
RGL CRDS	1838.00	0.13
TAC LGR	1837.95	0.14
WAO FTIR	1837.73	0.11
HFD CRDS	1837.40	0.19
MHD CRDS 695	1838.08	0.04
MHD CRDS 955	1838.03	0.08

Table S3. Measurement results and uncertainty for N_2O from D664636.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	323.94	0.17
BSD CRDS	324.19	0.02
RGL ECD	324.06	0.16
TAC LGR	324.19	0.05
WAO FTIR	324.31	0.13
HFD ECD	323.96	0.25
HFD CRDS	324.19	0.04
MHD ECD	323.65	0.30

Table S4. Measurement results and uncertainty for CO_2 from D664637.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRDS	439.58	0.01
RGL CRDS	439.67	0.01
TAC LGR	439.76	0.02
WAO FTIR	439.59	0.04
HFD CRDS	439.67	0.01
MHD CRDS 695	439.66	0.02
MHD CRDS 955	439.70	0.01

Table S5. Measurement results and uncertainty for CH_4 from D664637.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	2209.86	0.16
RGL CRDS	2210.16	0.13
TAC LGR	2210.74	0.23
WAO FTIR	2209.62	0.15
HFD CRDS	2210.81	0.18
MHD CRDS 695	2210.01	0.07
MHD CRDS 955	2209.93	0.12

Table S6. Measurement results and uncertainty for N_2O from D664637.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	335.46	0.18
BSD CRDS	335.96	0.02
RGL ECD	335.78	0.14
TAC LGR	335.69	0.04
WAO FTIR	336.14	0.13
HFD ECD	335.88	0.32
HFD CRDS	336.08	0.06
MHD ECD	335.89	0.29

Table S7. Measurement results and uncertainty for CO_2 from D664638.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRDS	502.77	0.01
RGL CRDS	502.84	0.01
TAC LGR	502.92	0.01
WAO FTIR	502.70	0.10
HFD CRDS	502.88	0.02
MHD CRDS 695	502.78	0.01
MHD CRDS 955	502.83	0.01

Table S8. Measurement results and uncertainty for CH_4 from D664638.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	2425.56	0.18
RGL CRDS	2424.86	0.17
TAC LGR	2425.77	0.18
WAO FTIR	2424.25	0.14
HFD CRDS	2426.00	0.30
MHD CRDS 695	2425.07	0.07
MHD CRDS 955	2424.93	0.10

Table S9. Measurement results and uncertainty for N_2O from D664638.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	344.78	0.12
BSD CRDS	34492	0.03
RGL ECD	345.12	0.24
TAC LGR	344.77	0.04
WAO FTIR	345.11	0.08
HFD ECD	345.30	0.36
HFD CRDS	345.00	0.03
MHD ECD	345.29	0.27

Table S10. Measurement results and uncertainty for CO_2 from NPL-2892.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRDS	384.07	0.01
RGL CRDS	384.13	0.01
TAC LGR	384.05	0.01
WAO FTIR	383.78	0.07
HFD CRDS	384.05	0.02
MHD CRDS 695	384.12	0.01
MHD CRDS 955	384.13	0.01

Table S11. Measurement results and uncertainty for CH_4 from NPL-2892.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	1849.34	0.14
RGL CRDS	1849.72	0.10
TAC LGR	1849.04	0.14
WAO FTIR	1849.37	0.03
HFD CRDS	1849.05	0.23
MHD CRDS 695	1849.77	0.07
MHD CRDS 955	1849.78	0.11

Table S12. Measurement results and uncertainty for N_2O from NPL-2892.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	322.27	0.14
BSD CRDS	322.52	0.03
RGL ECD	322.29	0.31
TAC LGR	322.88	0.03
WAO FTIR	322.35	0.11
HFD ECD	321.92	0.15
HFD CRDS	322.55	0.02
MHD ECD	322.23	0.23

Table S13. Measurement results and uncertainty for CO_2 from NPL-3097.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRDS	409.67	0.01
RGL CRDS	409.73	0.02
TAC LGR	409.70	0.01
WAO FTIR	409.42	0.06
HFD CRDS	409.65	0.02
MHD CRDS 695	409.70	0.01
MHD CRDS 955	409.71	0.01

Table S14. Measurement results and uncertainty for CH_4 from NPL-3097.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	1986.09	0.17
RGL CRDS	1986.52	0.14
TAC LGR	1986.19	0.18
WAO FTIR	1985.97	0.22
HFD CRDS	1986.49	0.22
MHD CRDS 695	1986.41	0.08
MHD CRDS 955	1986.43	0.07

Table S15. Measurement results and uncertainty for N_2O from NPL-3097.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	336.00	0.29
BSD CRDS	336.43	0.03
RGL ECD	336.42	0.20
TAC LGR	336.67	0.03
WAO FTIR	336.41	0.10
HFD ECD	336.16	0.15
HFD CRDS	336.51	0.03
MHD ECD	336.53	0.17

Table S16. Measurement results and uncertainty for CO_2 from NPL-3064.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRD	445.32	0.01
RGL CRDS	445.35	0.01
TAC LGR	445.33	0.01
WAO FTIR	444.99	0.03
HFD CRDS	445.28	0.01
MHD CRDS 695	N/A	N/A
MHD CRDS 955	N/A	N/A

Table S17. Measurement results and uncertainty for CH_4 from NPL-3064.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	2254.54	0.17
RGL CRDS	2254.57	0.15
TAC LGR	2254.50	0.17
WAO FTIR	2254.03	0.09
HFD CRDS	2255.16	0.20
MHD CRDS 695	N/A	N/A
MHD CRDS 955	N/A	N/A

Table S18. Measurement results and uncertainty for N_2O from NPL-3064.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	340.89	0.24
BSD CRDS	340.98	0.05
RGL ECD	341.21	0.15
TAC LGR	340.85	0.04
WAO FTIR	340.89	0.04
HFD ECD	340.87	0.12
HFD CRDS	341.08	0.03
MHD ECD	N/A	N/A

Table S19. Measurement results and uncertainty for CO_2 from NPL-2997.

Site	CO_2 (µmol mol^{-1})	Standard deviation (µmol mol^{-1})
BSD CRD	480.64	0.02
RGL CRDS	480.64	0.01
TAC LGR	480.62	0.01
WAO FTIR	480.36	0.03
HFD CRDS	480.64	0.02
MHD CRDS 695	480.60	0.01
MHD CRDS 955	480.62	0.01

Table S20. Measurement results and uncertainty for CH_4 from NPL-2997.

Site	CH_4 (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD CRDS	2506.04	0.24
RGL CRDS	2505.60	0.15
TAC LGR	2505.74	0.20
WAO FTIR	2504.98	0.10
HFD CRDS	2506.60	0.24
MHD CRDS 695	2505.62	0.07
MHD CRDS 955	2505.57	0.09

Table S21. Measurement results and uncertainty for N_2O from NPL-2997.

Site	N_2O (nmol mol^{-1})	Standard deviation (nmol mol^{-1})
BSD ECD	347.18	0.38
BSD CRDS	347.19	0.06
RGL ECD	347.53	0.22
TAC LGR	347.48	0.04
WAO FTIR	347.27	0.06
HFD ECD	347.07	0.24
HFD CRDS	347.35	0.03
MHD ECD	347.86	0.28