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Supplement of

Continuous atmospheric CO₂, CH₄ and CO measurements at the Observatoire Pérenne de l'Environnement (OPE) station in France from 2011 to 2018

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| | |
|---|---|
| Definition of the calibration sequence | |
| Valve port connections of calibration tanks | 4 tanks on ports 1, 2, 3 and 4 |
| Tank measurement duration | 30 minutes |
| Number of calibration cycles | 4: 8 hours |
| Definition of the ambient/target sequence | |
| Valve port connections of sampling line(s) and target tanks | Port 16: in situ; 5: Long Term Target; 6: Short Term Target; 7: Reference |
| Duration of ambient air measurement | 5 hours |
| Duration of short-term target measurement | 20 minutes |
| Duration of long-term target measurement | 30 minutes |
| Duration of reference measurement | 20 minutes |
| Long-term target measured before the ambient/tgt sequence | yes |
| Long-term target measured after the ambient/tgt sequence | no |
| Short-term target measured before the ambient/tgt sequence | yes |
| Short-term target measured after the ambient/tgt sequence | no |
| Number of ambient/target cycles | 49 : 21 days |
| Definition of the overall sequence | 1 calibration seq. 1 ambient/target seq. |

Table S1 : Definition of the measurement sequence for instruments # 91 and 80 at OPE.

| Parameter | Analyser | ICOS Id | Levels | Frequency | Period 1 - start | Period 1 - end | Period 2 - start | Period 2 - end | Period 3 - start | Period 3 - end | Period 4 - start | Period 4 - end |
|---|--|---------|-----------------|------------|------------------|----------------|------------------|----------------|------------------|----------------|------------------|----------------|
| CO ₂ /CH ₄ /H ₂ O | Picarro G1301 | 91 | 10m / 50m /120m | 5s/1min/1h | 20/07/2011 | 06/11/2012 | 18/03/2013 | 18/05/2017 | | | | |
| CO ₂ /CH ₄ /H ₂ O | Picarro G2301 | 75 | 10m / 50m /120m | 5s/1min/1h | 20/04/2011 | 07/11/2013 | | | | | | |
| CO ₂ /CH ₄ /CO/H ₂ O | Picarro G2401 | 187 | 10m / 50m /120m | 5s/1min/1h | 12/02/2014 | 24/03/2014 | 12/05/2014 | 03/08/2014 | 04/09/2014 | 18/12/2015 | 11/12/2017 | 24/09/2018 |
| CO ₂ /CH ₄ /H ₂ O | Picarro G2301 | 379 | 10m / 50m /120m | 5s/1min/1h | 27/01/2016 | 24/11/2017 | 03/04/2018 | - | | | | |
| CO ₂ /CH ₄ /CO/H ₂ O | Picarro G4301 | 728 | 10m / 50m /120m | 5s/1min/1h | 24/09/2018 | - | | | | | | |
| CO/N ₂ O/H ₂ O | Los Gatos Research N ₂ O and CO | 80 | 10m / 50m /120m | 1s/1min/1h | 13/05/2011 | 24/11/2017 | | | | | | |
| CO/N ₂ O/H ₂ O | Los Gatos Research N ₂ O and CO | 478 | 10m / 50m /120m | 1s/1min/1h | 05/04/2018 | - | | | | | | |
| Wind | Gill Wind Observer | | 10m / 50m /120m | 5s/1min/1h | 05/05/2011 | | | | | | | |
| Temperature - Relative Humidity | Vaisala HMP155A | | 10m / 50m /120m | 5s/1min/1h | 05/05/2011 | | | | | | | |
| Pressure | RM Young 61302 | | 10m / 50m /120m | 5s/1min/1h | 05/05/2011 | | | | | | | |
| Radon monitor | U Heidelberg | 117 | 10m | 30 min | 25/03/2011 | 22/08/2011 | | | | | | |
| Radon monitor | U Heidelberg | 118 | 10m | 30 min | 16/09/2011 | 05/01/2012 | | | | | | |
| Radon monitor | ANSTO | 546 | 120m | 30 min | 10/07/2017 | | | | | | | |
| Integrated NaOH 14CO ₂ sampler | U Heidelberg | | 120m | 2 weeks | 25/03/2011 | - | | | | | | |
| Flask sampler | LSCE | | 120m | 1 week | 12/05/2011 | 15/07/2014 | 27/05/2015 | | | | | |

Table S2 : Analysers, sensors and samplers, atmospheric parameters, associated ICOS reference number as well as the period of operation at the OPE station.

| Compound | level | Min | 1st Quartile | Median | 3rd Quartile | Max | Mean | Std-dev | N |
|-----------------------|-------|--------|--------------|--------|--------------|-------|---------|---------|--------|
| CO ₂ (ppm) | 10m | -7.292 | -0.289 | -0.083 | 0.041 | 9.973 | -0.132 | 0.49 | 25622 |
| | 50m | -7.737 | -0.171 | -0.045 | 0.051 | 12.33 | -0.0713 | 0.49 | 25826 |
| | 120m | -8.01 | -0.144 | -0.04 | 0.099 | 17.57 | -0.002 | 0.7 | 100458 |
| CH ₄ (ppb) | 10m | -62.46 | -0.56 | -0.07 | 0.42 | 65.32 | -0.035 | 2.92 | 25634 |
| | 50m | -121.8 | -0.86 | -0.17 | 0.37 | 57.04 | -0.23 | 3.04 | 25828 |
| | 120m | -83.45 | -1.18 | -0.32 | 0.45 | 100.3 | -0.27 | 2.92 | 24864 |

Table S3 : Summary statistics (minimum, 1st quartile, median, 3rd quartile, maximum, mean, standard deviations and number of points) of the difference between the afternoon (12:00-17:00 UTC) hourly measurements of

CO₂ and CH₄ for the different GHG analyzers operated at the same time at the OPE station at the 10m, 50m and 120m levels.

| Station | Reference | Period | CO ₂ (ppm) | CH ₄ (ppb) | CO(ppb) |
|-------------|----------------------|-----------|-----------------------|-----------------------|---------|
| Trainou | Schmidt et al., 2014 | 2006-2013 | 0.14 | 3.2 | 1.9 |
| Puy de Dôme | Lopez et al., 2015 | 2010-2013 | 0.1 | 1.2 | - |
| Beromunster | Beranu et al., 2016 | 2013-2014 | 0.05 | 0.29 | 2.79 |

Table S4 : Field equivalent metric of Continuous Measurement Repeatability (CMR) for CO₂ and CH₄ at the Trainou, Beromunster and Puy de Dome stations.

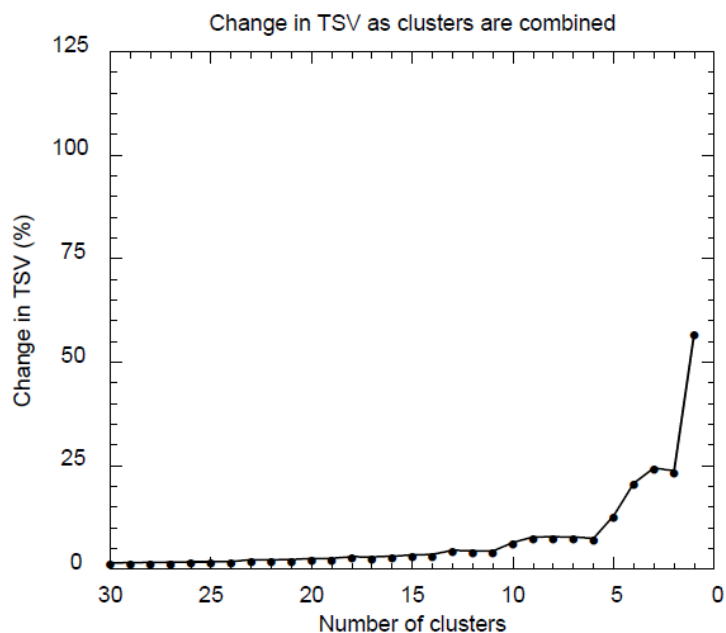


Figure S1 : Change in the Total Spatial Variance (TSV) versus number of clusters for the 96hour back-trajectory frequencies reaching the OPE station 120m above ground level at 12h UTC using the NCEP reanalysis for the period 2011-2018

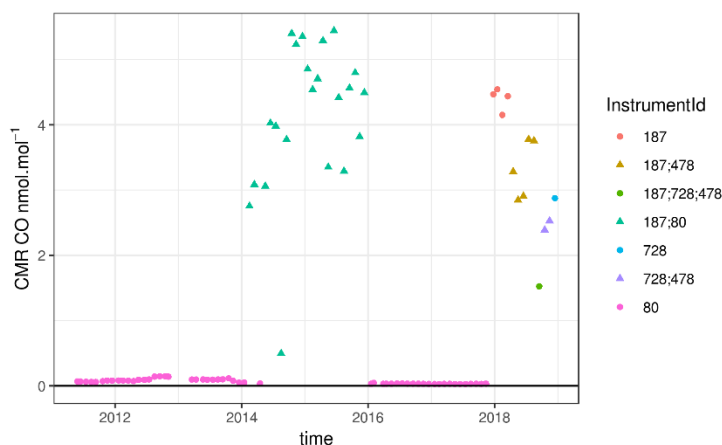


Figure S2 : Monthly mean field Continuous Measurement Repeatability (CMR) for CO estimated over time for the different instruments in operation at the OPE station over the 2011-2018 period. The different instruments are shown in colour and their identifiers are labelled in the key on the right side. Some months have several instruments running at the station and are identified with several labels