PyCAMA report generated by tropl2-proc

tropl2-proc

2023-10-02 (05:30)

1 Short Introduction

1.1 The list of parameters

You may want to keep the list given in table 1 at hand when viewing the results.

2 Definitions

The averages shown here are unweighed averages:

$$\overline{x} = \frac{1}{N} \sum_{i=1}^{N} x_i \tag{1}$$

with N the number of observations in the dataset.

The spread of the measurements is indicated with the variance V(x), or rather the standard deviation $\sigma(x) = \sqrt{V(x)}$.

$$V(x) = \frac{1}{N-1} \sum_{i=1}^{N} (x_i - \bar{x})^2$$
(2)

We also report the more robust statistics median, minimum, maximum, various percentiles and inter quartile range.

The median m is the value of parameter x for which half of the observations of x is smaller than m:

$$P(x \le m) = P(x \ge m) = \int_{-\infty}^{m} f(x) \, \mathrm{d}x = \frac{1}{2}$$
(3)

with f(x) the probability density function.

The median is a special case of a percentile. Instead of $\frac{1}{2}$ in equation 3, other threshold values can be used. We report results for 1%, 5%, 10%, 15.9%, 25%, 75%, 84.1%, 90%, 95% and 99%. The inter quartile range is the difference between the 75% and 25% percentiles. Similarly the minimum and maximum values correspond to the 0% and 100% percentiles respectively.

For normally distributed parameters the mean and median are the same, while the $\mu \pm \sigma$ values and the 15.9% and 84.1% percentiles coincide.

To get a measure for the relation of one variable $x_{(k)}$ with another $x_{(l)}$, we calculate the covariance matrix C_{kl} .

$$C_{kl} = C(x_{(k)}, x_{(l)}) = \frac{1}{N-1} \sum_{i=1}^{N} (x_{(k),i} - \overline{x_{(k)}}) (x_{(l),i} - \overline{x_{(l)}})$$
(4)

Rather than a dimensionally dependent covariance, it is often easier to interpret a correlation matrix R_{kl} , a matrix of Pearson's *r* coefficients:

$$R_{kl} = R(x_{(k)}, x_{(l)}) = \frac{C_{kl}}{\sqrt{C_{kk}C_{ll}}} = \frac{C_{kl}}{\sqrt{V(x_k)V(x_l)}}$$
(5)

The diagonal elements of the covariance matrix are the variances of the elements, $V(x_{(k)}) = C_{kk}$ and obviously $R_{kk} = 1$.

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Variable	mean $\pm \sigma$	Count	Mode	IQR	Median	Minimum	Maximum
qa value [1]	0.735 ± 0.298	676576	0.995	0.600	1.000	0.160	1.000
methane mixing ratio [parts per 10 ⁹]	$(0.189 \pm 0.004) imes 10^4$	676576	1.873×10^{3}	53.4	1.884×10^{3}	1.102×10^3	2.203×10^3
methane mixing ratio precision [parts per 10 ⁹]	2.38 ± 1.92	676576	1.50	1.64	1.58	0.641	43.4
methane mixing ratio bias corrected [parts per 10 ⁹]	$(0.189 \pm 0.004) imes 10^4$	676576	1.893×10^{3}	42.3	1.889×10^{3}	$1.087 imes 10^3$	$2.263 imes 10^3$
number of spectral points in retrieval [1]	798 ± 3	676576	798	4.00	798	751	805
wavelength calibration offset SWIR [nm]	$(-9.902 \pm 3.529) \times 10^{-3}$	676576	$-9.000 imes10^{-3}$	$2.594 imes10^{-3}$	$-9.696 imes 10^{-3}$	-7.113×10^{-2}	$5.454 imes10^{-2}$
chi square SWIR [1]	$(0.227 \pm 0.261) \times 10^5$	676576	3.550×10^{3}	$2.421 imes 10^4$	$1.535 imes 10^4$	1.572×10^{3}	$7.707 imes10^{6}$
chi square NIR [1]	$(0.692 \pm 488.679) \times 10^7$	676576	6.050×10^{3}	$7.565 imes 10^3$	6.604×10^{3}	96.5	4.006×10^{12}
degrees of freedom [1]	18.3 ± 0.4	676576	18.4	0.575	18.4	17.0	20.8
number of iterations [1]	10.1 ± 1.1	676576	10.2	0.0	10.00	10.00	30.0
fluorescence [mol $s^{-1} m^{-2} nm^{-1} sr^{-1}$]	$(-5.775 \pm 104.014) \times 10^{-9}$	676576	-7.100×10^{-9}	$2.739 imes10^{-8}$	$-5.963 imes10^{-9}$	$-4.373 imes10^{-5}$	$1.296 imes 10^{-6}$
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			Table	2: Percentile	ranges					
Variable	1 %	5 %	10 %	15.9 %	25 %	75 %	84.1 %	90 %	95 %	99 %
qa value [1]	0.400	0.400	0.400	0.400	0.400	1.000	1.000	1.000	1.000	1.000
methane mixing ratio [parts per 10 ⁹]	1.760×10^{3}	1.823×10^{3}	1.841×10^{3}	1.852×10^{3}	1.862×10^{3}	1.915×10^{3}	1.928×10^3	1.938×10^{3}	1.951×10^{3}	1.980×10^{3}
methane mixing ratio precision [parts per 109]	0.971	1.05	1.13	1.22	1.33	2.97	3.76	4.44	5.53	10.00
methane mixing ratio bias corrected [parts per 10 ⁹]	1.783×10^{3}	1.837×10^{3}	1.850×10^{3}	1.857×10^3	1.867×10^{3}	1.909×10^{3}	$1.918 imes 10^3$	1.927×10^3	1.940×10^{3}	1.970×10^{3}
number of spectral points in retrieval [1]	791	793	794	795	796	800	801	802	803	804
wavelength calibration offset SWIR [nm]	$-1.940 imes 10^{-2}$	$-1.415 imes 10^{-2}$	$-1.284 imes 10^{-2}$	-1.206×10^{-2}	$-1.119 imes 10^{-2}$	$-8.597 imes 10^{-3}$	$-8.033 imes10^{-3}$	$-7.386 imes 10^{-3}$	$-6.114 imes 10^{-3}$	$-4.915 imes 10^{-4}$
chi square SWIR [1]	2.203×10^{3}	3.098×10^{3}	3.710×10^{3}	4.375×10^{3}	5.715×10^{3}	$2.993 imes 10^4$	$4.518 imes 10^4$	$5.476 imes 10^4$	$6.589 imes 10^4$	$1.016 imes 10^5$
chi square NIR [1]	928	1.616×10^{3}	2.296×10^{3}	3.058×10^3	$4.074 imes 10^3$	$1.164 imes 10^4$	$1.496 imes 10^4$	$1.724 imes10^4$	$1.949 imes 10^4$	$2.364 imes 10^4$
degrees of freedom [1]	17.3	17.7	17.8	18.0	18.1	18.6	18.8	18.9	19.0	19.1
number of iterations [1]	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	12.0
fluorescence [mol s ⁻¹ m ⁻² nm ⁻¹ sr ⁻¹]	-1.129×10^{-7}	$-6.090 imes10^{-8}$	$-4.118 imes10^{-8}$	$-2.892 imes10^{-8}$	$-1.878 imes10^{-8}$	8.609×10^{-9}	$1.875 imes10^{-8}$	$2.949 imes10^{-8}$	$4.747 imes10^{-8}$	$9.392 imes10^{-8}$

Table 3: Parameterlist and basic statistics for the analysis for observations in the northern hemisphere											
Variable	mean $\pm \sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile			
qa value [1]	0.691 ± 0.300	476247	0.600	0.400	0.160	1.000	0.400	1.000			
methane mixing ratio [parts per 10 ⁹]	$(0.190 \pm 0.004) \times 10^4$	476247	53.1	1.900×10^{3}	1.302×10^{3}	2.203×10^{3}	1.873×10^{3}	1.926×10^{3}			
methane mixing ratio precision [parts per 109]	2.57 ± 2.06	476247	2.12	1.71	0.840	43.4	1.27	3.38			
methane mixing ratio bias corrected [parts per 10 ⁹]	$(0.190 \pm 0.003) \times 10^4$	476247	34.0	1.899×10^{3}	1.317×10^{3}	2.263×10^{3}	1.882×10^{3}	1.916×10^{3}			
number of spectral points in retrieval [1]	798 ± 3	476247	4.00	798	785	805	796	800			
wavelength calibration offset SWIR [nm]	$(-9.879 \pm 3.588) \times 10^{-3}$	476247	2.530×10^{-3}	-9.701×10^{-3}	-6.824×10^{-2}	$4.684 imes10^{-2}$	$-1.116 imes 10^{-2}$	-8.633×10^{-3}			
chi square SWIR [1]	$(0.256 \pm 0.302) \times 10^5$	476247	$3.695 imes 10^4$	1.350×10^4	1.572×10^{3}	$7.707 imes 10^6$	4.936×10^{3}	$4.188 imes 10^4$			
chi square NIR [1]	$(0.981 \pm 582.459) \times 10^7$	476247	$1.035 imes 10^4$	7.593×10^{3}	96.5	4.006×10^{12}	3.736×10^{3}	$1.408 imes 10^4$			
degrees of freedom [1]	18.3 ± 0.5	476247	0.729	18.3	17.0	20.8	18.0	18.7			
number of iterations [1]	10.1 ± 1.2	476247	0.0	10.00	10.00	30.0	10.00	10.00			
fluorescence [mol s ⁻¹ m ⁻² nm ⁻¹ sr ⁻¹]	$(-9.391 \pm 122.572) \times 10^{-9}$	476247	2.823×10^{-8}	-7.946×10^{-9}	-4.373×10^{-5}	$1.182 imes 10^{-6}$	-2.281×10^{-8}	5.422×10^{-9}			

Table 4: Parameterlist and basic statistics for the analysis for observations in the southern hemisphere											
mean $\pm \sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile				
0.838 ± 0.266	200329	0.600	1.000	0.160	1.000	0.400	1.000				
$(0.186 \pm 0.003) \times 10^4$	200329	23.4	1.866×10^{3}	1.102×10^{3}	2.143×10^3	1.853×10^{3}	$1.877 imes 10^3$				
1.95 ± 1.46	200329	0.413	1.51	0.641	40.5	1.39	1.80				
$(0.186 \pm 0.003) \times 10^4$	200329	23.8	1.865×10^{3}	1.087×10^{3}	2.199×10^{3}	1.853×10^{3}	$1.877 imes 10^3$				
798 ± 3	200329	4.00	798	751	805	796	800				
$(-9.957 \pm 3.383) \times 10^{-3}$	200329	2.741×10^{-3}	-9.683×10^{-3}	$-7.113 imes 10^{-2}$	$5.454 imes 10^{-2}$	$-1.126 imes 10^{-2}$	-8.514×10^{-3}				
$(0.160 \pm 0.078) \times 10^5$	200329	8.882×10^3	$1.616 imes 10^4$	1.617×10^{3}	$9.023 imes 10^5$	1.156×10^4	$2.044 imes 10^4$				
$(0.401 \pm 82.455) \times 10^5$	200329	2.904×10^{3}	5.891×10^{3}	103	3.596×10^9	4.556×10^{3}	$7.460 imes 10^3$				
18.4 ± 0.2	200329	0.287	18.4	17.0	20.5	18.2	18.5				
10.1 ± 1.0	200329	0.0	10.00	10.00	30.0	10.00	10.00				
$(2.822 \pm 26.793) \times 10^{-9}$	200329	$2.668 imes 10^{-8}$	$-7.654 imes 10^{-10}$	$-3.639 imes 10^{-7}$	1.296×10^{-6}	-1.224×10^{-8}	$1.444 imes 10^{-8}$				
	Parameterlist and basic sta mean $\pm \sigma$ 0.838 \pm 0.266 (0.186 \pm 0.003) × 10 ⁴ 1.95 \pm 1.46 (0.186 \pm 0.003) × 10 ⁴ 798 \pm 3 (-9.957 \pm 3.383) × 10 ⁻³ (0.160 \pm 0.078) × 10 ⁵ (0.401 \pm 82.455) × 10 ⁵ 18.4 \pm 0.2 10.1 \pm 1.0 (2.822 \pm 26.793) × 10 ⁻⁹	Parameterlist and basic statistics for mean $\pm \sigma$ Count 0.838 \pm 0.266 200329 (0.186 \pm 0.003) × 10 ⁴ 200329 1.95 \pm 1.46 200329 (0.186 \pm 0.003) × 10 ⁴ 200329 (0.186 \pm 0.003) × 10 ⁴ 200329 (-9.957 \pm 3.383) × 10 ⁻³ 200329 (0.160 \pm 0.078) × 10 ⁵ 200329 (0.401 \pm 82.455) × 10 ⁵ 200329 18.4 \pm 0.2 200329 10.1 \pm 1.0 200329 (2.822 \pm 26.793) × 10 ⁻⁹ 200329	Parameterlist and basic statistics for the analysis fomean $\pm \sigma$ CountIQR 0.838 ± 0.266 2003290.600 $(0.186 \pm 0.003) \times 10^4$ 20032923.4 1.95 ± 1.46 2003290.413 $(0.186 \pm 0.003) \times 10^4$ 20032923.8 798 ± 3 2003294.00 $(-9.957 \pm 3.383) \times 10^{-3}$ 2003292.741 $\times 10^{-3}$ $(0.160 \pm 0.078) \times 10^5$ 2003298.882 $\times 10^3$ $(0.401 \pm 82.455) \times 10^5$ 2003292.904 $\times 10^3$ 18.4 ± 0.2 2003290.287 10.1 ± 1.0 2003290.0 $(2.822 \pm 26.793) \times 10^{-9}$ 2003292.668 $\times 10^{-8}$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Parameterlist and basic statistics for the analysis for observations in the southern hemmean $\pm \sigma$ CountIQRMedianMinimum0.838 ± 0.266 2003290.6001.0000.160(0.186 ± 0.003) $\times 10^4$ 20032923.41.866 $\times 10^3$ 1.102 $\times 10^3$ 1.95 ± 1.46 2003290.4131.510.641(0.186 ± 0.003) $\times 10^4$ 20032923.81.865 $\times 10^3$ 1.087 $\times 10^3$ 798 ± 3 2003294.00798751(-9.957 ± 3.383) $\times 10^{-3}$ 2003292.741 $\times 10^{-3}$ -9.683 $\times 10^{-3}$ -7.113 $\times 10^{-2}$ (0.160 ± 0.078) $\times 10^5$ 2003292.904 $\times 10^3$ 1.616 $\times 10^4$ 1.617 $\times 10^3$ (0.401 ± 82.455) $\times 10^5$ 2003292.904 $\times 10^3$ 5.891 $\times 10^3$ 10318.4 ± 0.2 2003290.28718.417.010.1 ± 1.0 2003290.010.0010.00(2.822 ± 26.793) $\times 10^{-9}$ 2003292.668 $\times 10^{-8}$ -7.654 $\times 10^{-10}$ -3.639 $\times 10^{-7}$	Parameterlist and basic statistics for the analysis for observations in the southern hemispheremean $\pm \sigma$ CountIQRMedianMinimumMaximum 0.838 ± 0.266 2003290.6001.0000.1601.000 $(0.186 \pm 0.003) \times 10^4$ 20032923.4 1.866×10^3 1.102×10^3 2.143×10^3 1.95 ± 1.46 2003290.413 1.51 0.64140.5 $(0.186 \pm 0.003) \times 10^4$ 20032923.8 1.865×10^3 1.087×10^3 2.199×10^3 798 ± 3 2003294.00798751805 $(-9.957 \pm 3.383) \times 10^{-3}$ 200329 2.741×10^{-3} -9.683×10^{-3} -7.113×10^{-2} 5.454×10^{-2} $(0.160 \pm 0.078) \times 10^5$ 200329 8.882×10^3 1.616×10^4 1.617×10^3 9.023×10^5 $(0.401 \pm 82.455) \times 10^5$ 200329 2.904×10^3 5.891×10^3 103 3.596×10^9 18.4 ± 0.2 200329 0.287 18.4 17.0 20.5 10.1 ± 1.0 200329 0.68×10^{-8} -7.654×10^{-10} -3.639×10^{-7} 1.296×10^{-6}	Parameterlist and basic statistics for the analysis for observations in the southern hemisphereMaximum25 % percentile $mean \pm \sigma$ CountIQRMedianMinimumMaximum25 % percentile 0.838 ± 0.266 2003290.6001.0000.1601.0000.400 $(0.186 \pm 0.003) \times 10^4$ 20032923.4 1.866×10^3 1.102×10^3 2.143×10^3 1.853×10^3 1.95 ± 1.46 2003290.413 1.51 0.64140.5 1.39 $(0.186 \pm 0.003) \times 10^4$ 20032923.8 1.865×10^3 1.087×10^3 2.199×10^3 1.853×10^3 798 ± 3 2003294.00798751805796 $(-9.957 \pm 3.383) \times 10^{-3}$ 200329 2.741×10^{-3} -9.683×10^{-3} -7.113×10^{-2} 5.454×10^{-2} -1.126×10^{-2} $(0.160 \pm 0.078) \times 10^5$ 200329 2.904×10^3 1.616×10^4 1.617×10^3 9.023×10^5 1.156×10^4 $(0.401 \pm 82.455) \times 10^5$ 200329 2.904×10^3 5.891×10^3 103 3.596×10^9 4.556×10^3 18.4 ± 0.2 200329 0.287 18.4 17.0 20.5 18.2 10.1 ± 1.0 200329 0.0 10.00 10.00 30.0 10.00 $(2.822 \pm 26.793) \times 10^{-9}$ 200329 2.668×10^{-8} -7.654×10^{-10} -3.639×10^{-7} 1.296×10^{-6}				

Table 4: Decemptorlist and basic statistics for the analysis for observations in the southern homisphere

Table 5:	Parameterlist	t and basic	statistics	for the a	nalysis for	: observations	over water

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Variable	$ $ mean $\pm \sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile
qa value [1]	0.579 ± 0.277	31650	0.600	0.400	0.160	1.000	0.400	1.000
methane mixing ratio [parts per 10 ⁹]	$(0.188 \pm 0.003) \times 10^4$	31650	36.9	$1.885 imes 10^3$	1.586×10^3	2.040×10^3	1.866×10^{3}	$1.903 imes 10^3$
methane mixing ratio precision [parts per 10 ⁹]	3.28 ± 1.02	31650	1.01	3.30	1.08	26.9	2.73	3.74
methane mixing ratio bias corrected [parts per 10 ⁹]	$(0.189 \pm 0.003) \times 10^4$	31650	37.0	1.892×10^{3}	1.592×10^{3}	2.048×10^3	1.873×10^{3}	$1.910 imes 10^3$
number of spectral points in retrieval [1]	798±3	31650	4.00	798	790	803	796	800
wavelength calibration offset SWIR [nm]	$(-8.991\pm1.198)\times10^{-3}$	31650	1.361×10^{-3}	$-8.887 imes10^{-3}$	-2.447×10^{-2}	7.201×10^{-3}	-9.661×10^{-3}	-8.300×10^{-3}
chi square SWIR [1]	$(0.625 \pm 1.721) \times 10^4$	31650	2.821×10^3	4.748×10^3	1.776×10^3	$2.097 imes10^6$	3.855×10^{3}	$6.676 imes 10^3$
chi square NIR [1]	$(0.290 \pm 1.287) \times 10^4$	31650	1.591×10^3	2.002×10^3	143	$8.903 imes 10^5$	1.462×10^{3}	3.053×10^3
degrees of freedom [1]	18.1 ± 0.2	31650	0.132	18.1	17.0	19.0	18.0	18.1
number of iterations [1]	10.0 ± 0.6	31650	0.0	10.00	10.00	30.0	10.00	10.00
fluorescence [mol s ⁻¹ m ⁻² nm ⁻¹ sr ⁻¹]	$(1.121 \pm 19.379) \times 10^{-9}$	31650	$1.798 imes10^{-8}$	-2.351×10^{-9}	-6.905×10^{-8}	1.520×10^{-7}	-1.012×10^{-8}	7.857×10^{-9}

Table 6: Parameterlist and basic statistics for the analysis for observations over land												
Variable	mean $\pm \sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile				
qa value [1]	0.765 ± 0.293	511591	0.600	1.000	0.160	1.000	0.400	1.000				
methane mixing ratio [parts per 10 ⁹]	$(0.189 \pm 0.004) \times 10^4$	511591	56.5	1.889×10^{3}	1.102×10^{3}	2.173×10^{3}	1.865×10^{3}	1.922×10^3				
methane mixing ratio precision [parts per 10 ⁹]	1.93 ± 1.34	511591	0.629	1.45	0.641	36.8	1.26	1.89				
methane mixing ratio bias corrected [parts per 10 ⁹]	$(0.189 \pm 0.003) imes 10^4$	511591	43.4	1.889×10^{3}	1.087×10^3	2.205×10^3	1.867×10^{3}	$1.910 imes 10^3$				
number of spectral points in retrieval [1]	798 ± 3	511591	4.00	798	751	805	796	800				
wavelength calibration offset SWIR [nm]	$(-9.974 \pm 2.185) \times 10^{-3}$	511591	2.419×10^{-3}	-9.762×10^{-3}	$-4.088 imes10^{-2}$	3.607×10^{-2}	$-1.116 imes 10^{-2}$	-8.739×10^{-3}				
chi square SWIR [1]	$(0.276 \pm 0.277) \times 10^5$	511591	2.862×10^4	$1.973 imes 10^4$	1.595×10^{3}	$7.707 imes 10^6$	1.061×10^{4}	$3.924 imes 10^4$				
chi square NIR [1]	$(0.914 \pm 561.979) \times 10^7$	511591	8.229×10^3	7.722×10^{3}	356	$4.006 imes 10^{12}$	$5.216 imes 10^3$	$1.345 imes 10^4$				
degrees of freedom [1]	18.4 ± 0.4	511591	0.525	18.5	17.0	20.8	18.2	18.7				
number of iterations [1]	10.1 ± 1.1	511591	0.0	10.00	10.00	30.0	10.00	10.00				
fluorescence [mol s ⁻¹ m ⁻² nm ⁻¹ sr ⁻¹]	$(-6.829 \pm 117.768) \times 10^{-9}$	511591	3.132×10^{-8}	-6.246×10^{-9}	-4.373×10^{-5}	1.129×10^{-6}	-2.096×10^{-8}	1.036×10^{-8}				

Viewing zenith angle	Solar zenith angle	Latitude	Mole fraction of CH4	Precision of mole fraction of CH_4	Bias corrected mole fraction of CH_4	Number of points in the spectrum	Spectral offset SWIR (λ (true) – λ (nominal	χ^2 (SWIR)	χ^2 (NIR)	Degrees of freedom	Number of iterations	Fluorescence
1.000	$4.856 imes 10^{-2}$	$-7.075 imes 10^{-2}$	-9.326×10^{-3}	-7.211×10^{-2}	-1.243×10^{-2}	$4.610 imes10^{-2}$	-0.329	5.868×10^{-3}	$-9.237 imes10^{-4}$	$7.100 imes 10^{-2}$	$2.800 imes 10^{-2}$	0.105
4.856×10^{-2}	1.000	0.503	-0.385	0.457	-0.223	-5.503×10^{-3}	-3.226×10^{-2}	-0.424	-1.100×10^{-3}	-0.621	-2.477×10^{-2}	-1.402×10^{-2}
-7.075×10^{-2}	0.503	1.000	0.149	0.321	0.304	2.432×10^{-2}	4.026×10^{-3}	-8.548×10^{-2}	$2.486 imes10^{-4}$	-0.323	-1.179×10^{-3}	-3.414×10^{-2}
-9.326×10^{-3}	-0.385	0.149	1.000	-0.500	0.925	-7.301×10^{-3}	-1.567×10^{-2}	0.457	2.147×10^{-3}	0.521	-9.783×10^{-3}	-8.925×10^{-2}
-7.211×10^{-2}	0.457	0.321	-0.500	1.000	-0.254	$-3.968 imes10^{-3}$	$4.251 imes10^{-2}$	-0.399	$-7.141 imes10^{-4}$	-0.583	$-3.634 imes10^{-3}$	$1.698 imes10^{-3}$
$-1.243 imes 10^{-2}$	-0.223	0.304	0.925	-0.254	1.000	$-8.279 imes10^{-3}$	$-1.232 imes 10^{-2}$	0.222	$2.032 imes 10^{-3}$	0.233	$-1.227 imes 10^{-2}$	$-9.740 imes 10^{-2}$
$4.610 imes10^{-2}$	-5.503×10^{-3}	$2.432 imes 10^{-2}$	-7.301×10^{-3}	$-3.968 imes 10^{-3}$	-8.279×10^{-3}	1.000	$-1.859 imes 10^{-2}$	$8.803 imes 10^{-3}$	$3.435 imes 10^{-4}$	$-4.875 imes10^{-3}$	$4.913 imes10^{-3}$	$1.110 imes10^{-2}$
-0.329	-3.226×10^{-2}	4.026×10^{-3}	$-1.567 imes 10^{-2}$	4.251×10^{-2}	-1.232×10^{-2}	-1.859×10^{-2}	1.000	-4.335×10^{-3}	$8.903 imes 10^{-4}$	$-3.055 imes 10^{-2}$	$-7.074 imes 10^{-3}$	-6.132×10^{-2}
$5.868 imes10^{-3}$	-0.424	$-8.548 imes10^{-2}$	0.457	-0.399	0.222	$8.803 imes10^{-3}$	$-4.335 imes 10^{-3}$	1.000	$1.691 imes 10^{-3}$	0.665	$4.439 imes10^{-2}$	$-4.908 imes10^{-3}$
$-9.237 imes10^{-4}$	$-1.100 imes10^{-3}$	$2.486 imes10^{-4}$	$2.147 imes10^{-3}$	$-7.141 imes10^{-4}$	$2.032 imes 10^{-3}$	$3.435 imes10^{-4}$	$8.903 imes10^{-4}$	$1.691 imes 10^{-3}$	1.000	$1.181 imes10^{-3}$	$1.137 imes10^{-3}$	$2.522 imes 10^{-3}$
7.100×10^{-2}	-0.621	-0.323	0.521	-0.583	0.233	-4.875×10^{-3}	-3.055×10^{-2}	0.665	1.181×10^{-3}	1.000	-5.880×10^{-2}	-7.338×10^{-3}
$2.800 imes 10^{-2}$	$-2.477 imes 10^{-2}$	-1.179×10^{-3}	-9.783×10^{-3}	-3.634×10^{-3}	-1.227×10^{-2}	$4.913 imes 10^{-3}$	-7.074×10^{-3}	4.439×10^{-2}	$1.137 imes 10^{-3}$	$-5.880 imes 10^{-2}$	1.000	-1.524×10^{-2}
0.105	$-1.402 imes 10^{-2}$	$-3.414 imes 10^{-2}$	$-8.925 imes 10^{-2}$	$1.698 imes 10^{-3}$	$-9.740 imes 10^{-2}$	$1.110 imes10^{-2}$	$-6.132 imes 10^{-2}$	$-4.908 imes 10^{-3}$	2.522×10^{-3}	$-7.338 imes 10^{-3}$	$-1.524 imes 10^{-2}$	1.000

Table 7: Correlation matrix

Viewing zenith angle	Solar zenith angle	Latitude	Mole fraction of CH4	Precision of mole fraction of CH_4	Bias corrected mole fraction of CH_4	Number of points in the spectrum	Spectral offset SWIR (λ (true) – λ (nominal)	χ^2 (SWIR)	χ^2 (NIR)	Degrees of freedom	Number of iterations	Fluorescence
286	10.7	-38.8	-6.68	-2.34	-7.42	2.21	-1.965×10^{-2}	$2.586 imes 10^3$	$-7.629 imes 10^7$	0.479	0.531	$1.853 imes 10^{-7}$
10.7	169	213	-212	11.4	-102	-0.203	-1.481×10^{-3}	-1.438×10^{5}	$-6.992 imes 10^7$	-3.22	-0.361	-1.898×10^{-8}
-38.8	213	1.054×10^3	205	20.0	348	2.24	$4.613 imes10^{-4}$	$-7.235 imes10^4$	$3.945 imes 10^7$	-4.18	$-4.291 imes10^{-2}$	$-1.153 imes10^{-7}$
-6.68	-212	205	1.795×10^{3}	-40.6	$1.385 imes 10^3$	-0.879	$-2.344 imes10^{-3}$	$5.043 imes 10^5$	$4.446 imes 10^8$	8.80	-0.465	$-3.933 imes 10^{-7}$
-2.34	11.4	20.0	-40.6	3.68	-17.2	-2.165×10^{-2}	$2.880 imes10^{-4}$	$-1.997 imes10^4$	$-6.698 imes 10^6$	-0.446	-7.823×10^{-3}	$3.390 imes 10^{-10}$
-7.42	-102	348	$1.385 imes 10^3$	-17.2	$1.248 imes 10^3$	-0.831	-1.536×10^{-3}	$2.041 imes 10^5$	$3.509 imes10^8$	3.28	-0.486	-3.579×10^{-7}
2.21	-0.203	2.24	-0.879	-2.165×10^{-2}	-0.831	8.07	$-1.864 imes10^{-4}$	652	$4.770 imes10^{6}$	-5.524×10^{-3}	$1.565 imes10^{-2}$	$3.280 imes10^{-9}$
-1.965×10^{-2}	$-1.481 imes 10^{-3}$	$4.613 imes10^{-4}$	-2.344×10^{-3}	$2.880 imes10^{-4}$	$-1.536 imes 10^{-3}$	$-1.864 imes 10^{-4}$	$1.245 imes 10^{-5}$	-0.399	$1.535 imes 10^4$	$-4.299 imes10^{-5}$	-2.799×10^{-5}	-2.251×10^{-11}
$2.586 imes 10^3$	$-1.438 imes10^5$	$-7.235 imes10^4$	$5.043 imes 10^5$	$-1.997 imes10^4$	2.041×10^5	652	-0.399	$6.797 imes10^8$	$2.155 imes 10^{11}$	6.914×10^3	1.298×10^3	$-1.331 imes10^{-5}$
$-7.629 imes10^7$	$-6.992 imes10^7$	$3.945 imes 10^7$	$4.446 imes10^8$	$-6.698 imes10^6$	$3.509 imes 10^8$	$4.770 imes10^6$	$1.535 imes 10^4$	$2.155 imes 10^{11}$	$2.388 imes10^{19}$	$2.301 imes 10^6$	$6.234 imes10^{6}$	1.28
0.479	-3.22	-4.18	8.80	-0.446	3.28	-5.524×10^{-3}	-4.299×10^{-5}	6.914×10^3	2.301×10^6	0.159	-2.629×10^{-2}	$-3.043 imes 10^{-10}$
0.531	-0.361	-4.291×10^{-2}	-0.465	$-7.823 imes10^{-3}$	-0.486	1.565×10^{-2}	-2.799×10^{-5}	$1.298 imes 10^3$	$6.234 imes10^{6}$	-2.629×10^{-2}	1.26	-1.778×10^{-9}
$1.853 imes 10^{-7}$	$-1.898 imes 10^{-8}$	$-1.153 imes 10^{-7}$	$-3.933 imes 10^{-7}$	$3.390 imes 10^{-10}$	$-3.579 imes 10^{-7}$	$3.280 imes 10^{-9}$	-2.251×10^{-11}	$-1.331 imes 10^{-5}$	1.28	$-3.043 imes 10^{-10}$	$-1.778 imes 10^{-9}$	$1.082 imes 10^{-14}$

Table 8: Covariance matrix



Figure 1: Map of correlation graph for 2023-09-16 to 2023-09-18.



Figure 2: Map of correlation matrix for 2023-09-16 to 2023-09-18.

Granule outlines



Figure 3: Outline of the granules.

4 Input data monitoring



Figure 4: Input data per granule

5 Warnings and errors



Figure 5: Fraction of pixels with specific warnings and errors during processing

6 World maps



Figure 6: Map of "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18



0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 Precision of mole fraction of CH₄ [parts per 10⁹]



Figure 7: Map of "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 8: Map of "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18

2023-09-17



-1.00-0.75-0.50-0.25 0.00 0.25 0.50 0.75 1.00 Fluorescence [mol s⁻¹ m⁻² nm⁻¹ sr⁻¹/×10⁻⁸



Figure 9: Map of "Fluorescence" for 2023-09-16 to 2023-09-18



Figure 10: Map of the number of observations for 2023-09-16 to 2023-09-18

7 Zonal average



Figure 11: Zonal average of "QA value" for 2023-09-16 to 2023-09-18.



Figure 12: Zonal average of "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 13: Zonal average of "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 14: Zonal average of "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 15: Zonal average of "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 16: Zonal average of "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 17: Zonal average of " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 18: Zonal average of " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 19: Zonal average of "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 20: Zonal average of "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 21: Zonal average of "Fluorescence" for 2023-09-16 to 2023-09-18.

8 Histograms

The definitions of the parameters given in this section can be found in section 2.



Figure 22: Histogram of "QA value" for 2023-09-16 to 2023-09-18



Figure 23: Histogram of "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 24: Histogram of "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 25: Histogram of "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 26: Histogram of "Number of points in the spectrum" for 2023-09-16 to 2023-09-18



Figure 27: Histogram of "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18


Figure 28: Histogram of " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18



Figure 29: Histogram of " χ^2 (NIR)" for 2023-09-16 to 2023-09-18



Figure 30: Histogram of "Degrees of freedom" for 2023-09-16 to 2023-09-18



Figure 31: Histogram of "Number of iterations" for 2023-09-16 to 2023-09-18



Figure 32: Histogram of "Fluorescence" for 2023-09-16 to 2023-09-18

9 Along track statistics

The TROPOMI instrument uses different binned detector rows for different viewing directions. In this section statistics are presented for each of the binned rows in the instrument.



Figure 33: Along track statistics of "QA value" for 2023-09-16 to 2023-09-18



Figure 34: Along track statistics of "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 35: Along track statistics of "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 36: Along track statistics of "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18



Figure 37: Along track statistics of "Number of points in the spectrum" for 2023-09-16 to 2023-09-18



Figure 38: Along track statistics of "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18



Figure 39: Along track statistics of " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18



Figure 40: Along track statistics of " χ^2 (NIR)" for 2023-09-16 to 2023-09-18



Figure 41: Along track statistics of "Degrees of freedom" for 2023-09-16 to 2023-09-18



Figure 42: Along track statistics of "Number of iterations" for 2023-09-16 to 2023-09-18



Figure 43: Along track statistics of "Fluorescence" for 2023-09-16 to 2023-09-18

10 Coincidence density

To investigate the relation between parameters scatter density plots are produced. These include some 'hidden' parameters, latitude and the solar- and viewing geometries, in addition to all configured parameters. All combinations of pairs of parameters are included *once*, in one direction alone.



Figure 44: Scatter density plot of " χ^2 (NIR)" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 45: Scatter density plot of " χ^2 (NIR)" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 46: Scatter density plot of " χ^2 (NIR)" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 47: Scatter density plot of " χ^2 (SWIR)" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 48: Scatter density plot of " χ^2 (SWIR)" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 49: Scatter density plot of " χ^2 (SWIR)" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 50: Scatter density plot of " χ^2 (SWIR)" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 51: Scatter density plot of "Degrees of freedom" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 52: Scatter density plot of "Degrees of freedom" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 53: Scatter density plot of "Latitude" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 54: Scatter density plot of "Latitude" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 55: Scatter density plot of "Latitude" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 56: Scatter density plot of "Latitude" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 57: Scatter density plot of "Latitude" against "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 58: Scatter density plot of "Latitude" against "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 59: Scatter density plot of "Latitude" against "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 60: Scatter density plot of "Latitude" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 61: Scatter density plot of "Latitude" against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 62: Scatter density plot of "Latitude" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 63: Scatter density plot of "Bias corrected mole fraction of CH₄" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.


Figure 64: Scatter density plot of "Bias corrected mole fraction of CH₄" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 65: Scatter density plot of "Bias corrected mole fraction of CH_4 " against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 66: Scatter density plot of "Bias corrected mole fraction of CH_4 " against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 67: Scatter density plot of "Bias corrected mole fraction of CH_4 " against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 68: Scatter density plot of "Bias corrected mole fraction of CH_4 " against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 69: Scatter density plot of "Bias corrected mole fraction of CH₄" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 70: Scatter density plot of "Mole fraction of CH₄" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 71: Scatter density plot of "Mole fraction of CH₄" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 72: Scatter density plot of "Mole fraction of CH₄" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 73: Scatter density plot of "Mole fraction of CH₄" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 74: Scatter density plot of "Mole fraction of CH_4 " against "Bias corrected mole fraction of CH_4 " for 2023-09-16 to 2023-09-18.



Figure 75: Scatter density plot of "Mole fraction of CH₄" against "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 76: Scatter density plot of "Mole fraction of CH₄" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 77: Scatter density plot of "Mole fraction of CH₄" against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 78: Scatter density plot of "Precision of mole fraction of CH₄" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 79: Scatter density plot of "Precision of mole fraction of CH₄" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 80: Scatter density plot of "Precision of mole fraction of CH₄" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 81: Scatter density plot of "Precision of mole fraction of CH₄" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 82: Scatter density plot of "Precision of mole fraction of CH_4 " against "Bias corrected mole fraction of CH_4 " for 2023-09-16 to 2023-09-18.



Figure 83: Scatter density plot of "Precision of mole fraction of CH_4 " against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 84: Scatter density plot of "Precision of mole fraction of CH₄" against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 85: Scatter density plot of "Precision of mole fraction of CH₄" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 86: Scatter density plot of "Mole fraction of CH₄" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 87: Scatter density plot of "Number of iterations" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 88: Scatter density plot of "Number of points in the spectrum" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 89: Scatter density plot of "Number of points in the spectrum" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 90: Scatter density plot of "Number of points in the spectrum" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 91: Scatter density plot of "Number of points in the spectrum" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 92: Scatter density plot of "Number of points in the spectrum" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 93: Scatter density plot of "Number of points in the spectrum" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 94: Scatter density plot of "Solar zenith angle" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 95: Scatter density plot of "Solar zenith angle" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 96: Scatter density plot of "Solar zenith angle" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 97: Scatter density plot of "Solar zenith angle" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 98: Scatter density plot of "Solar zenith angle" against "Latitude" for 2023-09-16 to 2023-09-18.



Figure 99: Scatter density plot of "Solar zenith angle" against "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18.


Figure 100: Scatter density plot of "Solar zenith angle" against "Bias corrected mole fraction of CH_4 " for 2023-09-16 to 2023-09-18.



Figure 101: Scatter density plot of "Solar zenith angle" against "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 102: Scatter density plot of "Solar zenith angle" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 103: Scatter density plot of "Solar zenith angle" against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 104: Scatter density plot of "Solar zenith angle" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 105: Scatter density plot of "Viewing zenith angle" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 106: Scatter density plot of "Viewing zenith angle" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 107: Scatter density plot of "Viewing zenith angle" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 108: Scatter density plot of "Viewing zenith angle" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 109: Scatter density plot of "Viewing zenith angle" against "Latitude" for 2023-09-16 to 2023-09-18.



Figure 110: Scatter density plot of "Viewing zenith angle" against "Mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 111: Scatter density plot of "Viewing zenith angle" against "Bias corrected mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 112: Scatter density plot of "Viewing zenith angle" against "Precision of mole fraction of CH₄" for 2023-09-16 to 2023-09-18.



Figure 113: Scatter density plot of "Viewing zenith angle" against "Number of iterations" for 2023-09-16 to 2023-09-18.



Figure 114: Scatter density plot of "Viewing zenith angle" against "Number of points in the spectrum" for 2023-09-16 to 2023-09-18.



Figure 115: Scatter density plot of "Viewing zenith angle" against "Solar zenith angle" for 2023-09-16 to 2023-09-18.



Figure 116: Scatter density plot of "Viewing zenith angle" against "Spectral offset SWIR (λ (true) – λ (nominal))" for 2023-09-16 to 2023-09-18.



Figure 117: Scatter density plot of "Spectral offset SWIR (λ (true) – λ (nominal))" against " χ^2 (NIR)" for 2023-09-16 to 2023-09-18.



Figure 118: Scatter density plot of "Spectral offset SWIR (λ (true) – λ (nominal))" against " χ^2 (SWIR)" for 2023-09-16 to 2023-09-18.



Figure 119: Scatter density plot of "Spectral offset SWIR (λ (true) – λ (nominal))" against "Degrees of freedom" for 2023-09-16 to 2023-09-18.



Figure 120: Scatter density plot of "Spectral offset SWIR (λ (true) – λ (nominal))" against "Fluorescence" for 2023-09-16 to 2023-09-18.



Figure 121: Scatter density plot of "Spectral offset SWIR (λ (true) – λ (nominal))" against "Number of iterations" for 2023-09-16 to 2023-09-18.

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