PyCAMA report generated by tropl2-proc

tropl2-proc

2025-06-12 (03:30)

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:

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

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 $\sigma(x) = \sqrt{V(x)}$.

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

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:

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

with $f(x)$ the probability density function.

The median is a special case of a percentile. Instead of ½ 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}.

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

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

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

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

Table 1: Parameterlist and basic statistics for the analysis

Variable	mean $\pm\sigma$	Count	Mode	IQR	Median	Minimum	Maximum
qa value [1]	0.591 ± 0.255	7536456	0.705	0.300	0.700	0.0	1.000
carbonmonoxide total column [mol m^{-2}]	$(2.853 \pm 0.842) \times 10^{-2}$	7536456	3.070×10^{-2}	1.088×10^{-2}	2.857×10^{-2}	0.0	0.453
carbonmonoxide total column precision [mol m^{-2}]	$(1.147 \pm 0.615) \times 10^{-3}$	7536456	7.350×10^{-4}	6.713×10^{-4}	9.638×10^{-4}	0.0	0.101
number of spectral points in retrieval [1]	154 ± 1	7536456	155	2.00	154	33.0	156
chi square [1]	$(0.190 \pm 1.288) \times 10^{4}$	7536456	518	1.364×10^{3}	1.231×10^{3}	215	6.140×10^{6}
degrees of freedom [1]	7.52 ± 0.47	7536456	7.95	0.878	7.68	3.00	8.00
number of iterations [1]	8.42 ± 1.25	7536456	8.17	1.000	8.00	5.00	15.0

Table 2: Percentile ranges

Variable	1 %	5 %	10 %	15.9 %	25 %	75 %	84.1 %	90 %	95 %	99 %
qa value [1]	0.0	0.0	0.0	0.400	0.400	0.700	0.700	0.700	1.000	1.000
carbonmonoxide total column [mol m^{-2}]	1.338×10^{-2}	1.646×10^{-2}	1.817×10^{-2}	1.975×10^{-2}	2.227×10^{-2}	3.316×10^{-2}	3.540×10^{-2}	3.780×10^{-2}	4.266×10^{-2}	5.509×10^{-2}
carbonmonoxide total column precision [mol m^{-2}]	3.856×10^{-4}	5.013×10^{-4}	5.767×10^{-4}	6.395×10^{-4}	7.235×10^{-4}	1.395×10^{-3}	1.698×10^{-3}	2.013×10^{-3}	2.425×10^{-3}	3.153×10^{-3}
number of spectral points in retrieval [1]	151	152	153	153	153	155	155	156	156	156
chi square [1]	352	434	508	593	731	2.095×10^{3}	2.672×10^{3}	3.307×10^{3}	4.543×10^{3}	9.142×10^{3}
degrees of freedom [1]	6.00	7.00	7.00	7.00	7.06	7.94	7.97	7.99	7.99	8.00
number of iterations [1]	6.00	7.00	7.00	8.00	8.00	9.00	9.00	9.00	11.0	14.0

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]	0.595 ± 0.251	5374606	0.300	0.700	0.0	1.000	0.400	0.700
carbonmonoxide total column [mol m^{-2}]	$(3.174 \pm 0.723) \times 10^{-2}$	5374606	7.201×10^{-3}	3.099×10^{-2}	0.0	0.198	2.748×10^{-2}	3.469×10^{-2}
carbonmonoxide total column precision [mol m^{-2}]	$(1.093 \pm 0.598) \times 10^{-3}$	5374606	6.347×10^{-4}	9.094×10^{-4}	0.0	1.143×10^{-2}	6.889×10^{-4}	1.324×10^{-3}
number of spectral points in retrieval [1]	154 ± 1	5374606	2.00	154	33.0	156	153	155
chi square [1]	$(0.216 \pm 1.479) \times 10^{4}$	5374606	1.560×10^{3}	1.403×10^{3}	215	6.140×10^{6}	811	2.371×10^{3}
degrees of freedom [1]	7.51 ± 0.48	5374606	0.893	7.67	4.00	8.00	7.04	7.93
number of iterations [1]	8.41 ± 1.33	5374606	1.000	8.00	5.00	15.0	8.00	9.00

Table 4: Parameterlist and basic statistics for the analysis for observations in the southern hemisphere

Variable	mean $\pm\sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile
qa value [1]	0.579 ± 0.267	2161850	0.300	0.700	0.0	1.000	0.400	0.700
carbonmonoxide total column [mol m^{-2}]	$(2.053 \pm 0.523) \times 10^{-2}$	2161850	4.928×10^{-3}	1.978×10^{-2}	0.0	0.453	1.754×10^{-2}	2.247×10^{-2}
carbonmonoxide total column precision [mol m^{-2}]	$(1.282 \pm 0.636) \times 10^{-3}$	2161850	7.437×10^{-4}	1.093×10^{-3}	0.0	0.101	8.277×10^{-4}	1.571×10^{-3}
number of spectral points in retrieval [1]	154 ± 1	2161850	2.00	154	147	156	153	155
chi square [1]	$(0.126 \pm 0.580) \times 10^{4}$	2161850	865	936	216	3.385×10^{6}	613	1.478×10^{3}
degrees of freedom [1]	7.55 ± 0.43	2161850	0.830	7.70	3.00	8.00	7.11	7.94
number of iterations [1]	8.46 ± 1.05	2161850	1.000	8.00	5.00	15.0	8.00	9.00

Table 5: Parameterlist and basic statistics for the analysis for observations over water

Variable	mean $\pm\sigma$	Count	IQR	Median	Minimum	Maximum	25 % percentile	75 % percentile
qa value [1]	0.582 ± 0.239	4537475	0.300	0.700	0.0	1.000	0.400	0.700
carbonmonoxide total column [mol m^{-2}]	$(2.715 \pm 0.817) \times 10^{-2}$	4537475	1.179×10^{-2}	2.731×10^{-2}	0.0	0.453	2.051×10^{-2}	3.231×10^{-2}
carbonmonoxide total column precision [mol m^{-2}]	$(1.222 \pm 0.643) \times 10^{-3}$	4537475	7.739×10^{-4}	1.010×10^{-3}	0.0	0.101	7.540×10^{-4}	1.528×10^{-3}
number of spectral points in retrieval [1]	154 ± 1	4537475	2.00	154	33.0	156	153	155
chi square [1]	$(0.167 \pm 1.281) \times 10^{4}$	4537475	1.122×10^{3}	1.094×10^{3}	215	5.091×10^{6}	683	1.805×10^{3}
degrees of freedom [1]	7.56 ± 0.44	4537475	0.777	7.72	3.00	8.00	7.16	7.94
number of iterations [1]	8.49 ± 1.29	4537475	1.000	8.00	5.00	15.0	8.00	9.00

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]	0.606 ± 0.288	1994217	0.300	0.700	0.0	1.000	0.400	0.700
carbonmonoxide total column [mol m^{-2}]	$(2.938 \pm 0.723) \times 10^{-2}$	1994217	8.261×10^{-3}	2.910×10^{-2}	0.0	0.183	2.493×10^{-2}	3.319×10^{-2}
carbonmonoxide total column precision [mol m^{-2}]	$(1.009 \pm 0.561) \times 10^{-3}$	1994217	5.930×10^{-4}	8.735×10^{-4}	0.0	1.070×10^{-2}	6.357×10^{-4}	1.229×10^{-3}
number of spectral points in retrieval [1]	154 ± 1	1994217	2.00	154	145	156	153	155
chi square [1]	$(0.239 \pm 1.338) \times 10^{4}$	1994217	1.924×10^{3}	1.529×10^{3}	219	6.140×10^{6}	816	2.740×10^{3}
degrees of freedom [1]	7.41 ± 0.52	1994217	0.908	7.47	4.00	8.00	7.00	7.91
number of iterations [1]	8.32 ± 1.19	1994217	1.000	8.00	5.00	15.0	8.00	9.00

3 Granule outlines

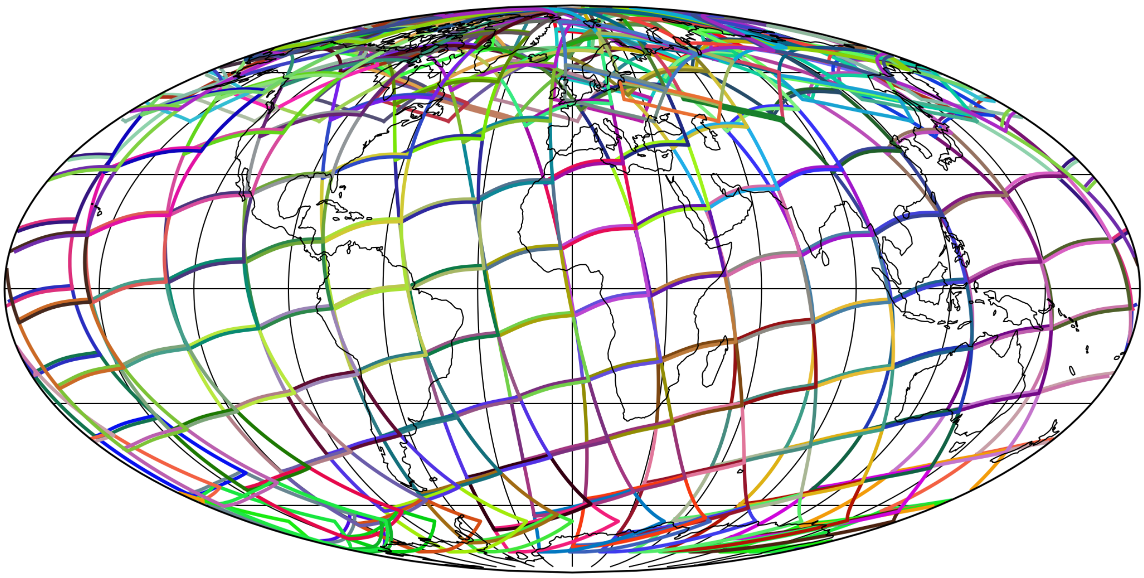

Figure 1: Outline of the granules.

4 Input data monitoring

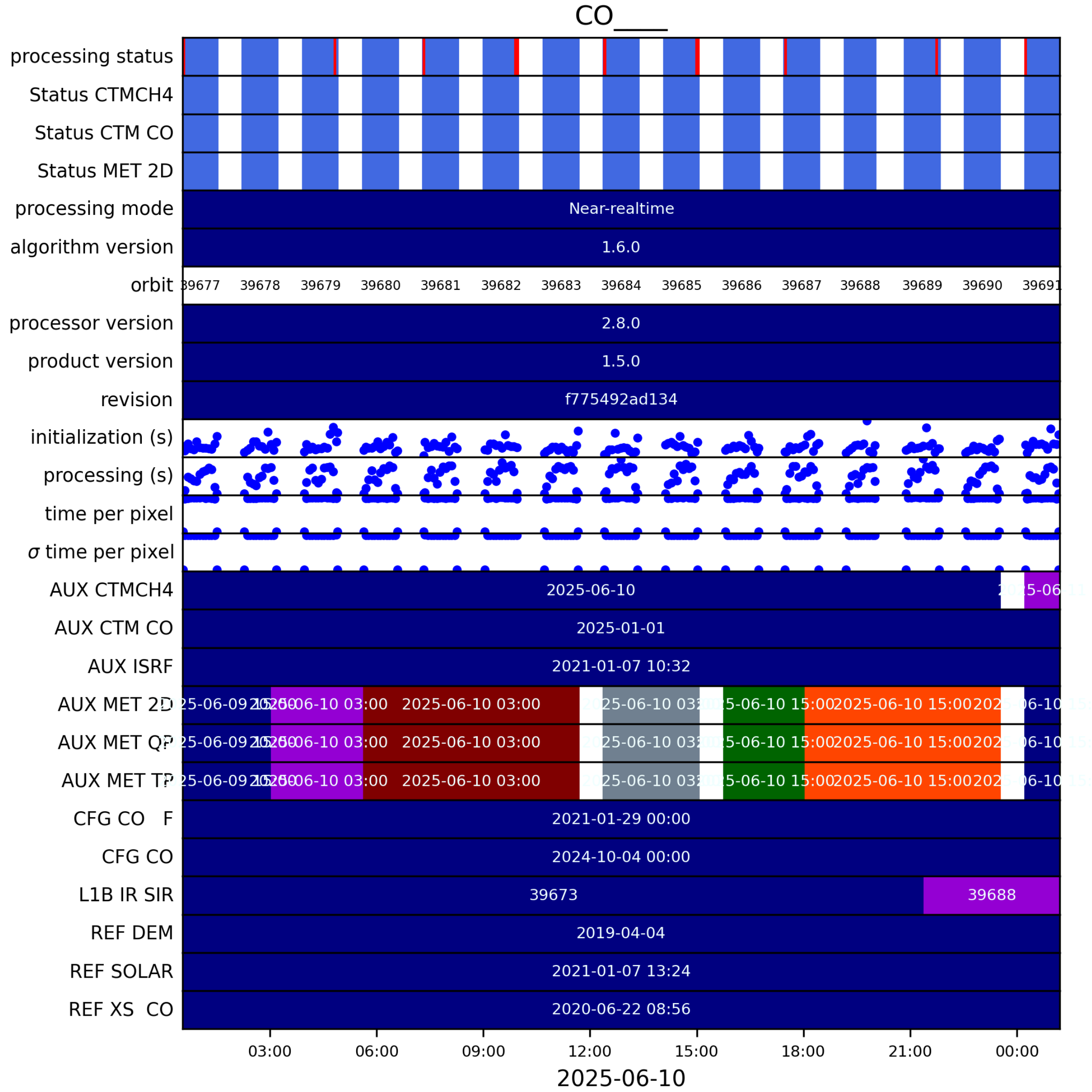

Figure 2: Input data per granule

5 Warnings and errors

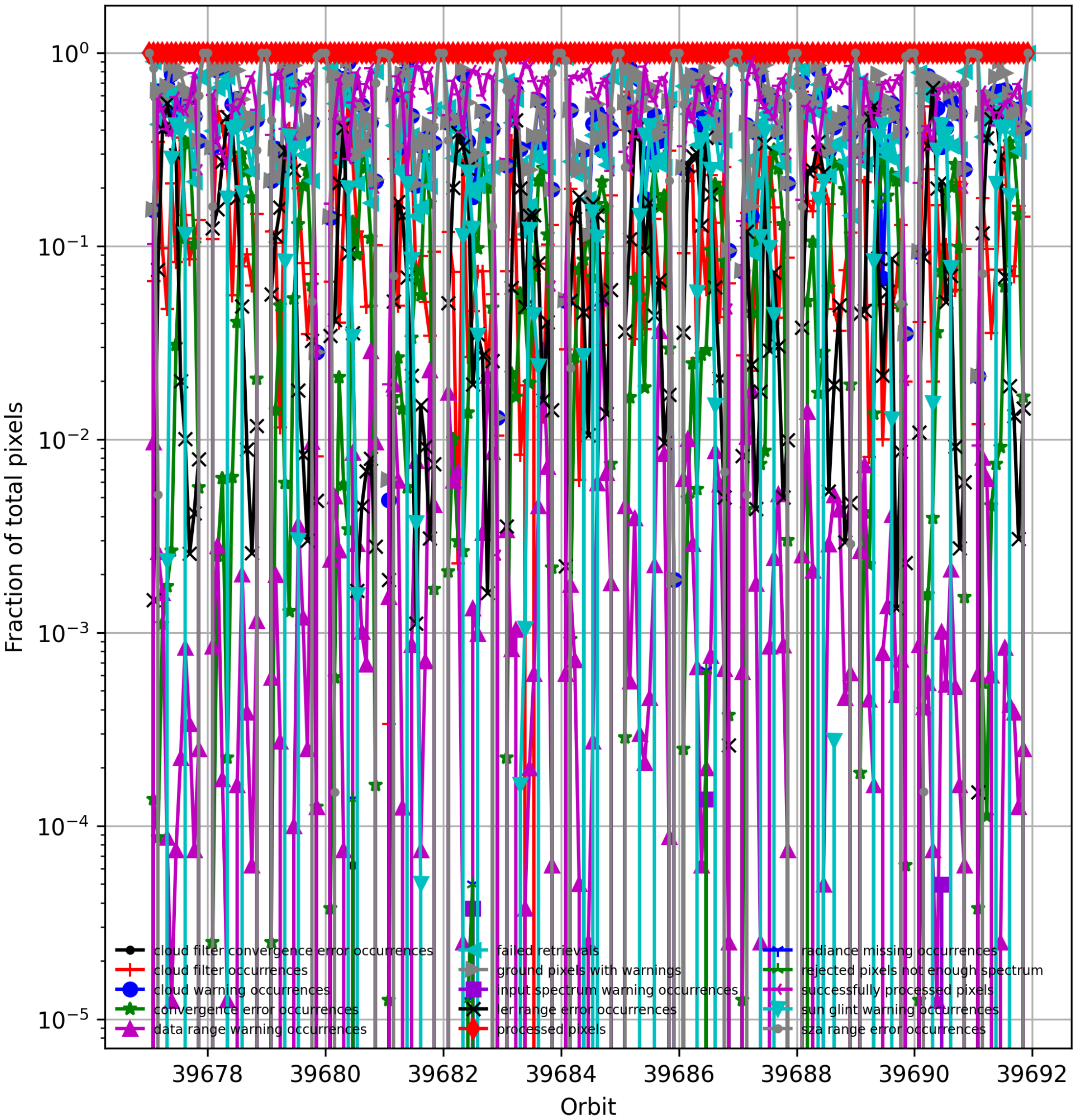

Figure 3: Fraction of pixels with specific warnings and errors during processing

6 World maps

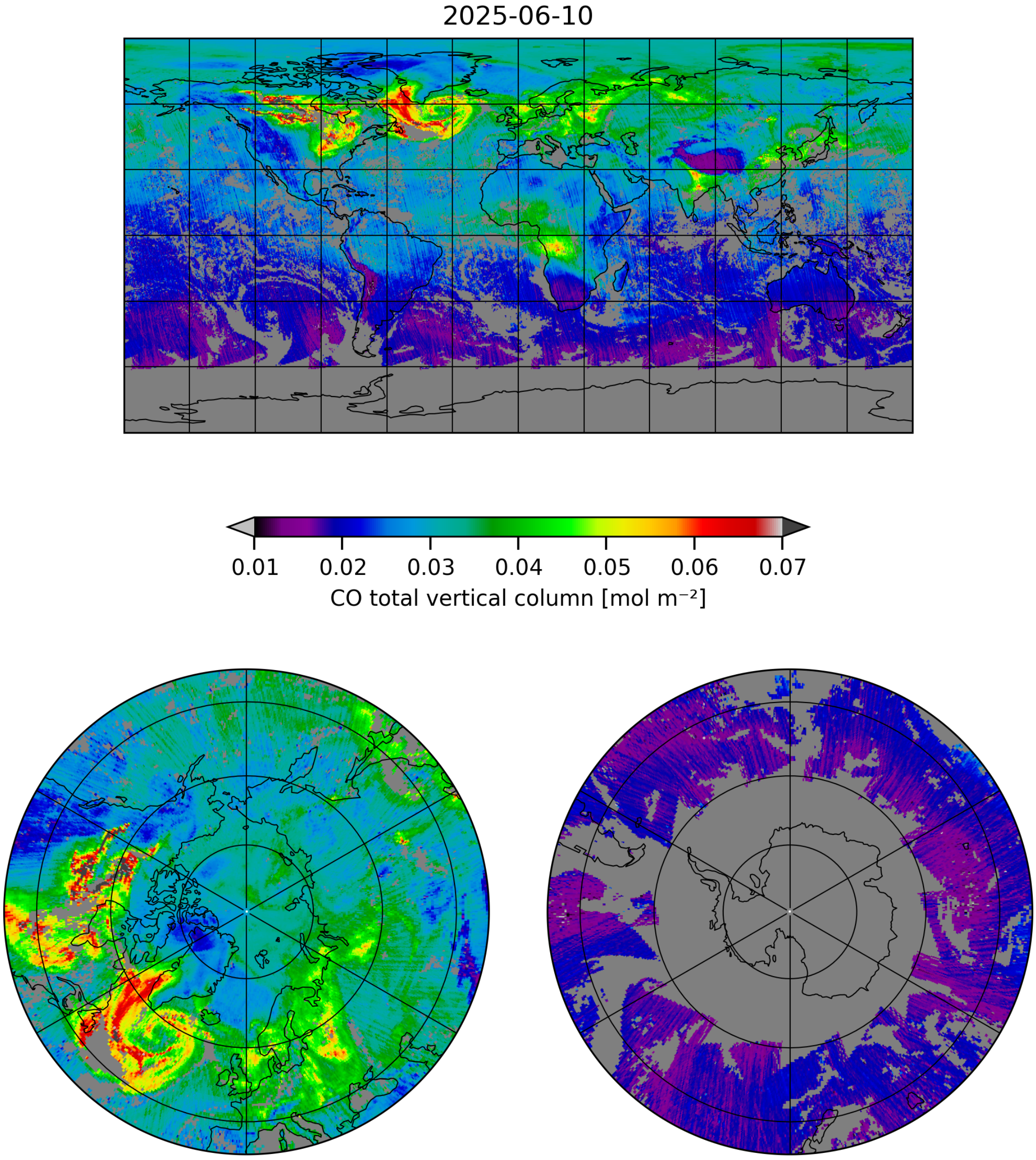

Figure 4: Map of “CO total vertical column” for 2025-06-10 to 2025-06-11

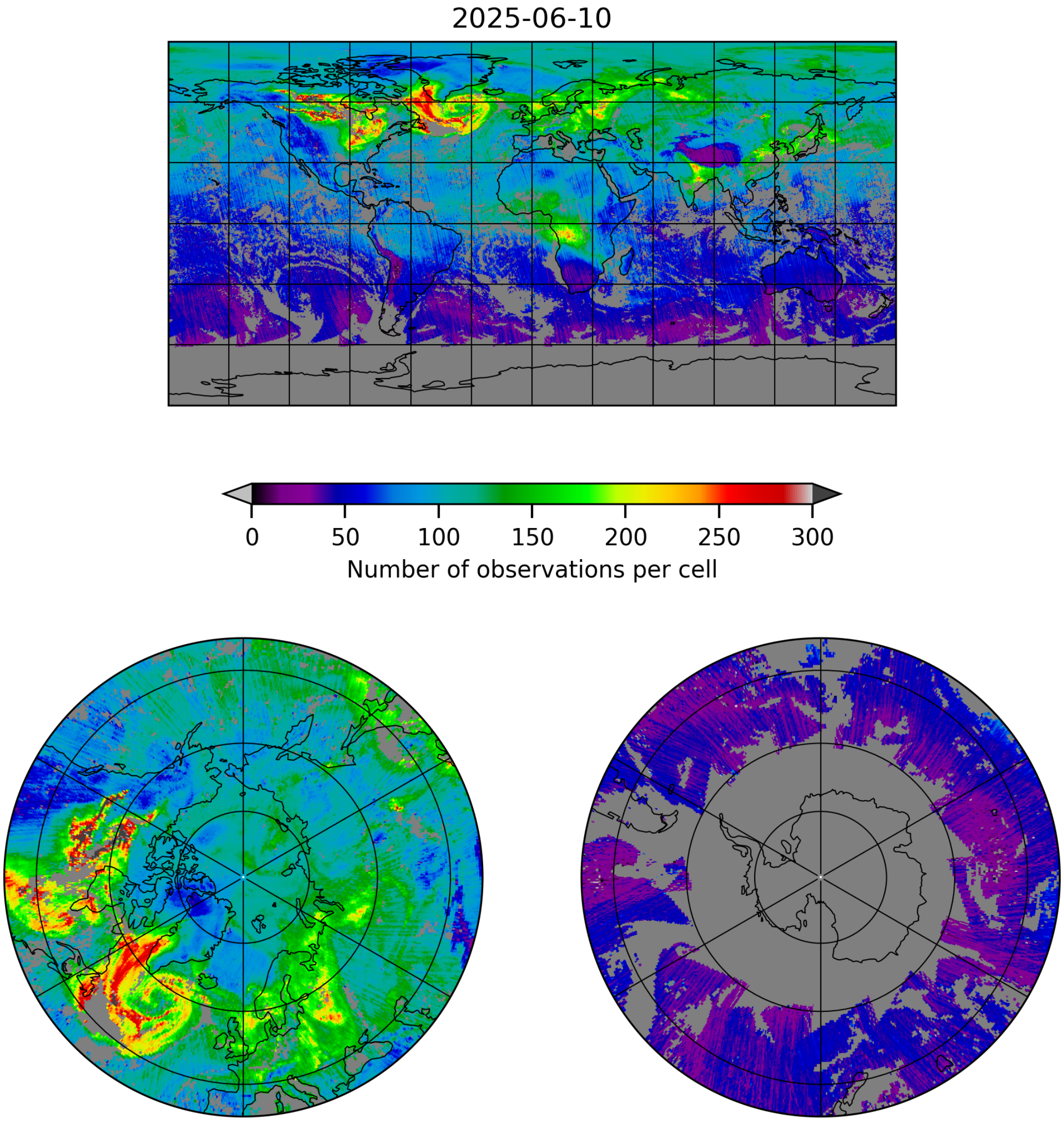

Figure 5: Map of the number of observations for 2025-06-10 to 2025-06-11

7 Zonal average

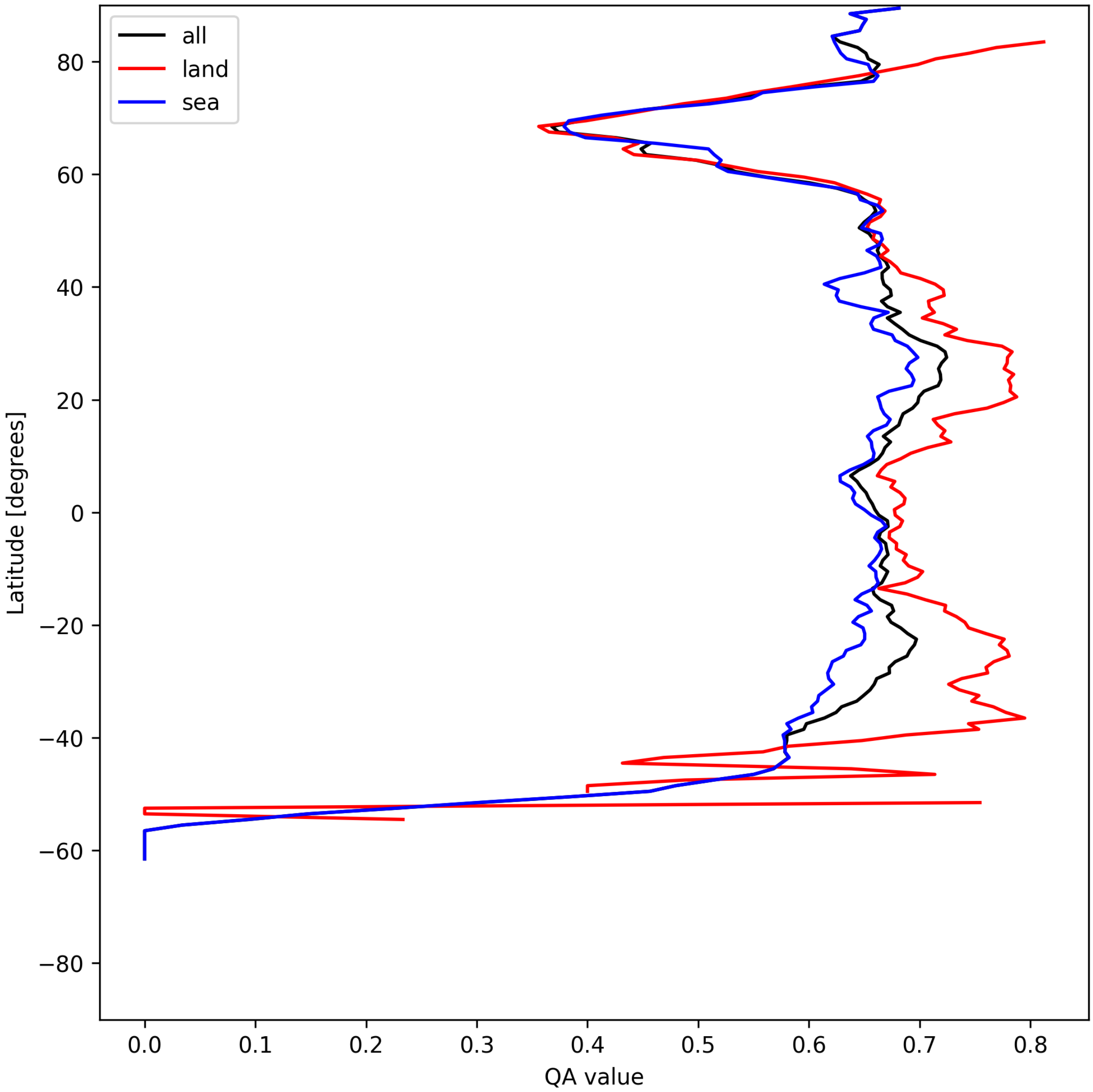

Figure 6: Zonal average of “QA value” for 2025-06-10 to 2025-06-11.

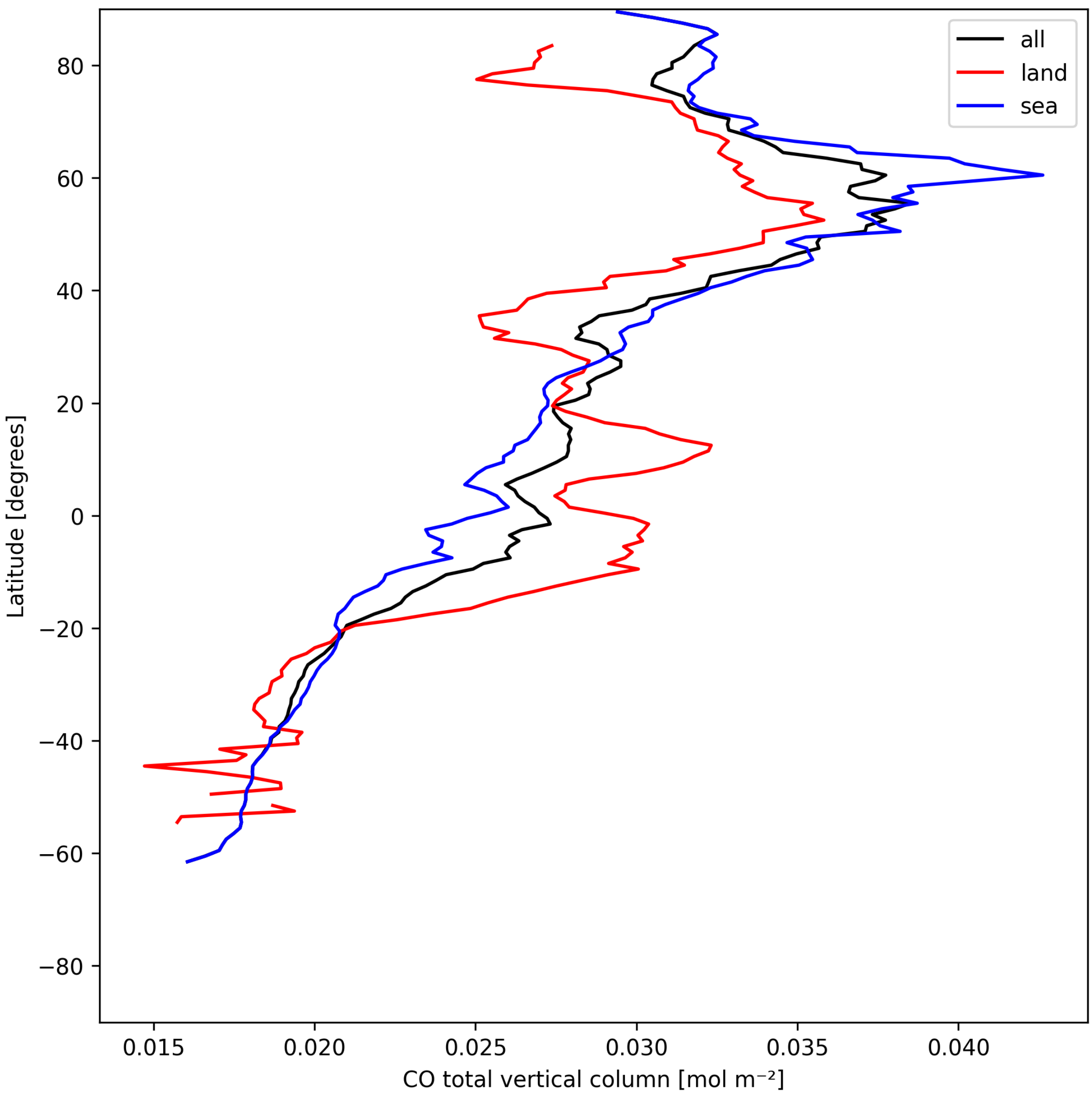

Figure 7: Zonal average of “CO total vertical column” for 2025-06-10 to 2025-06-11.

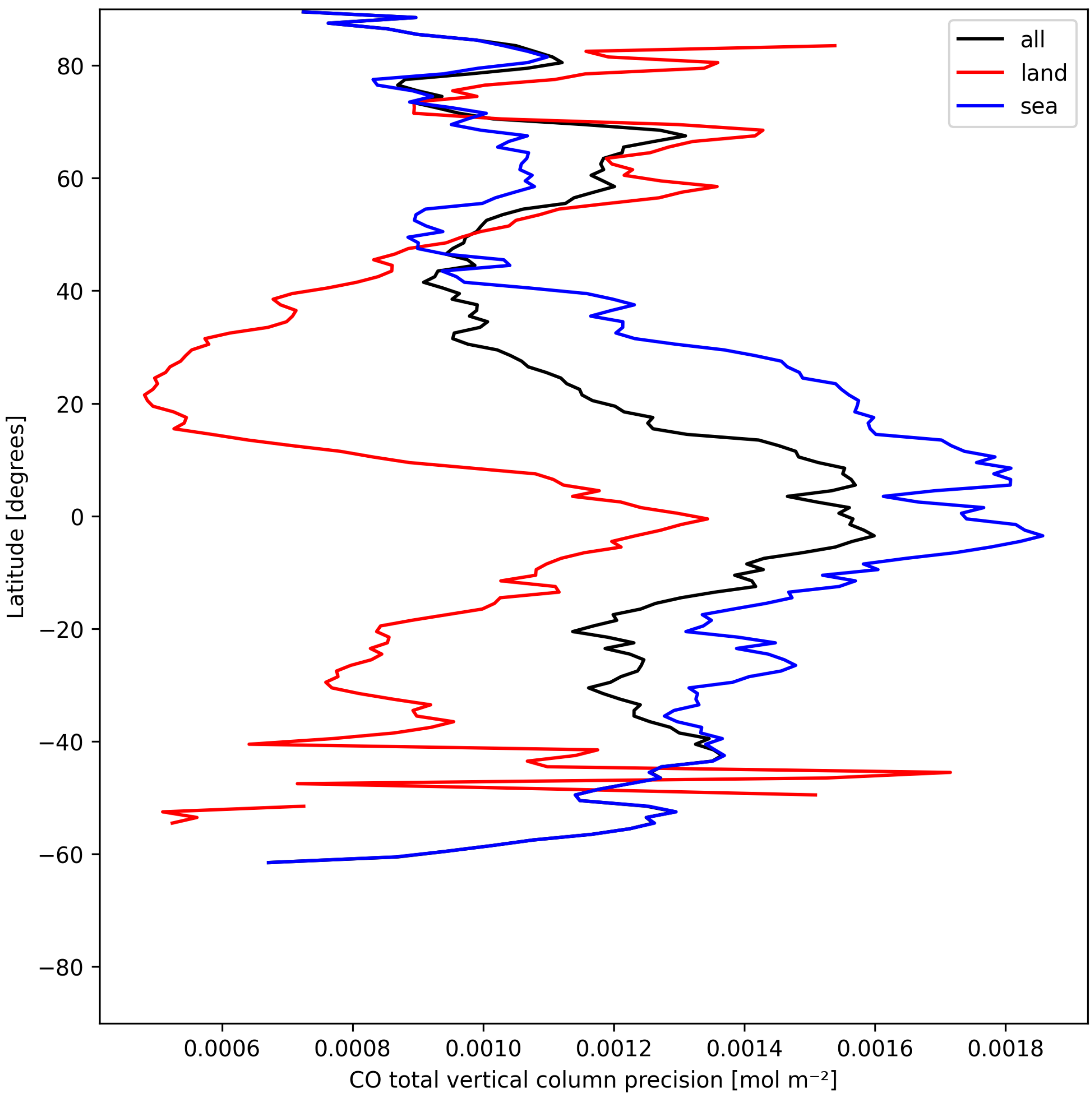

Figure 8: Zonal average of "CO total vertical column precision" for 2025-06-10 to 2025-06-11.

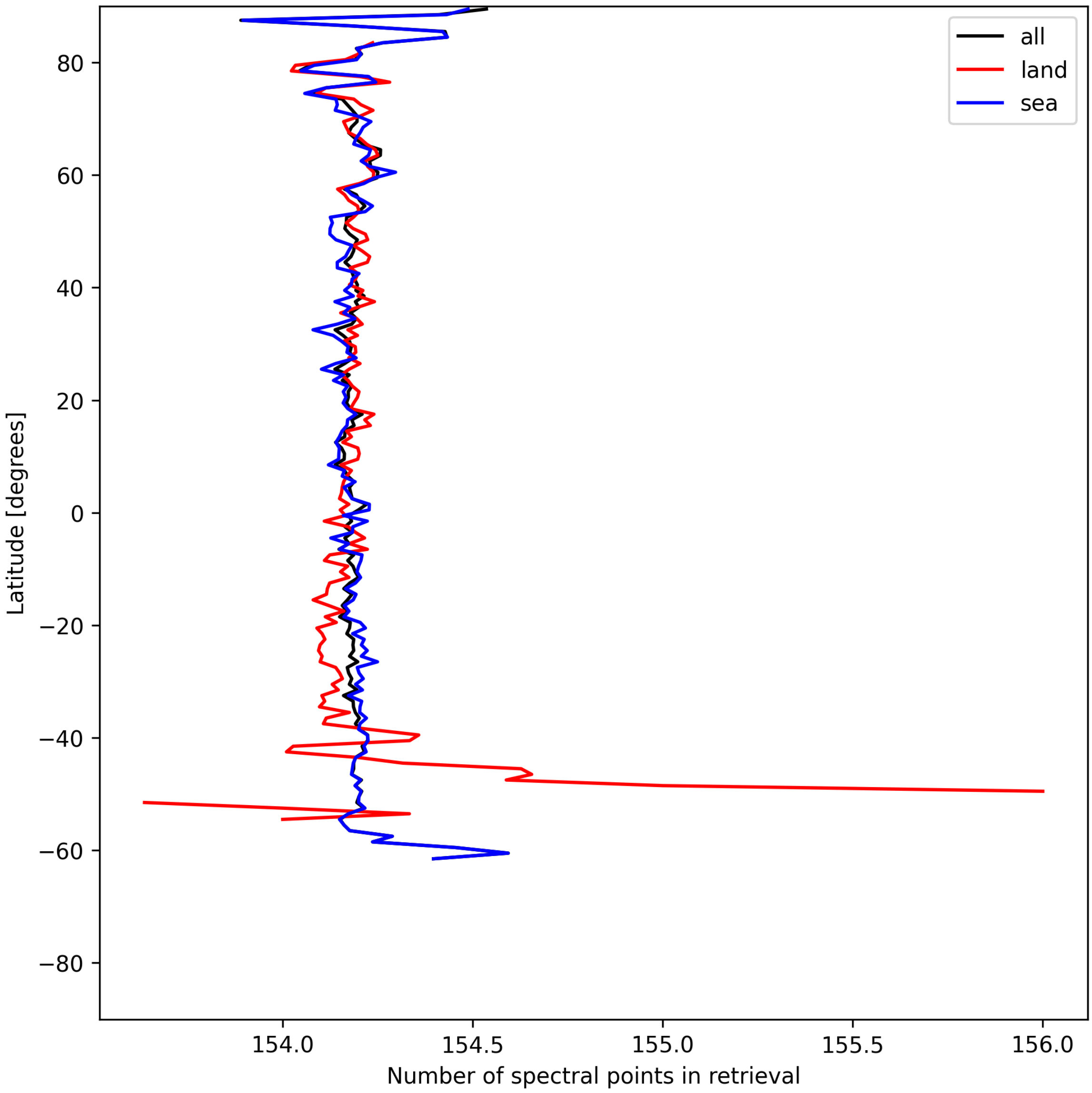

Figure 9: Zonal average of “Number of spectral points in retrieval” for 2025-06-10 to 2025-06-11.

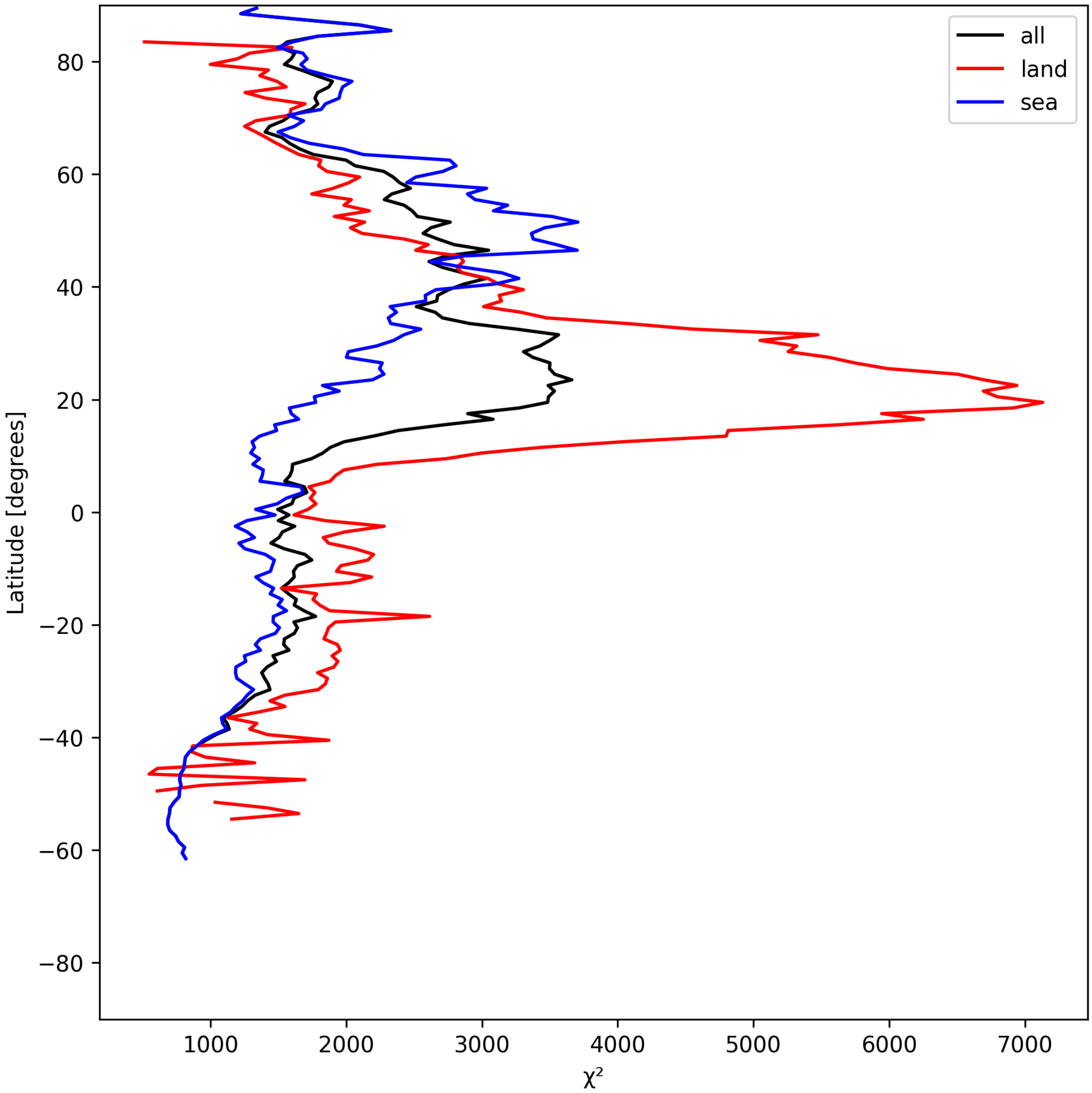

Figure 10: Zonal average of "χ^2" for 2025-06-10 to 2025-06-11.

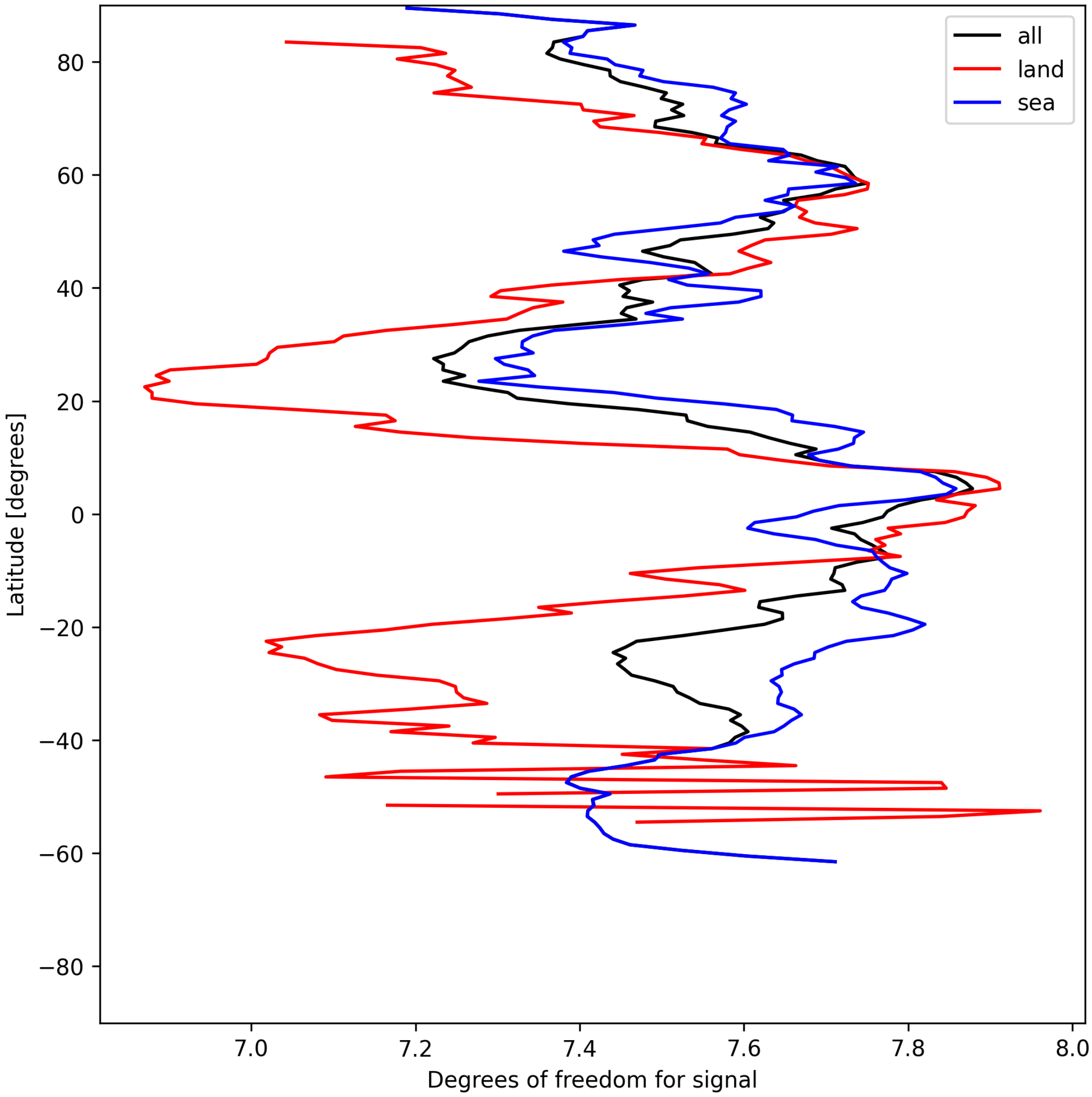

Figure 11: Zonal average of “Degrees of freedom for signal” for 2025-06-10 to 2025-06-11.

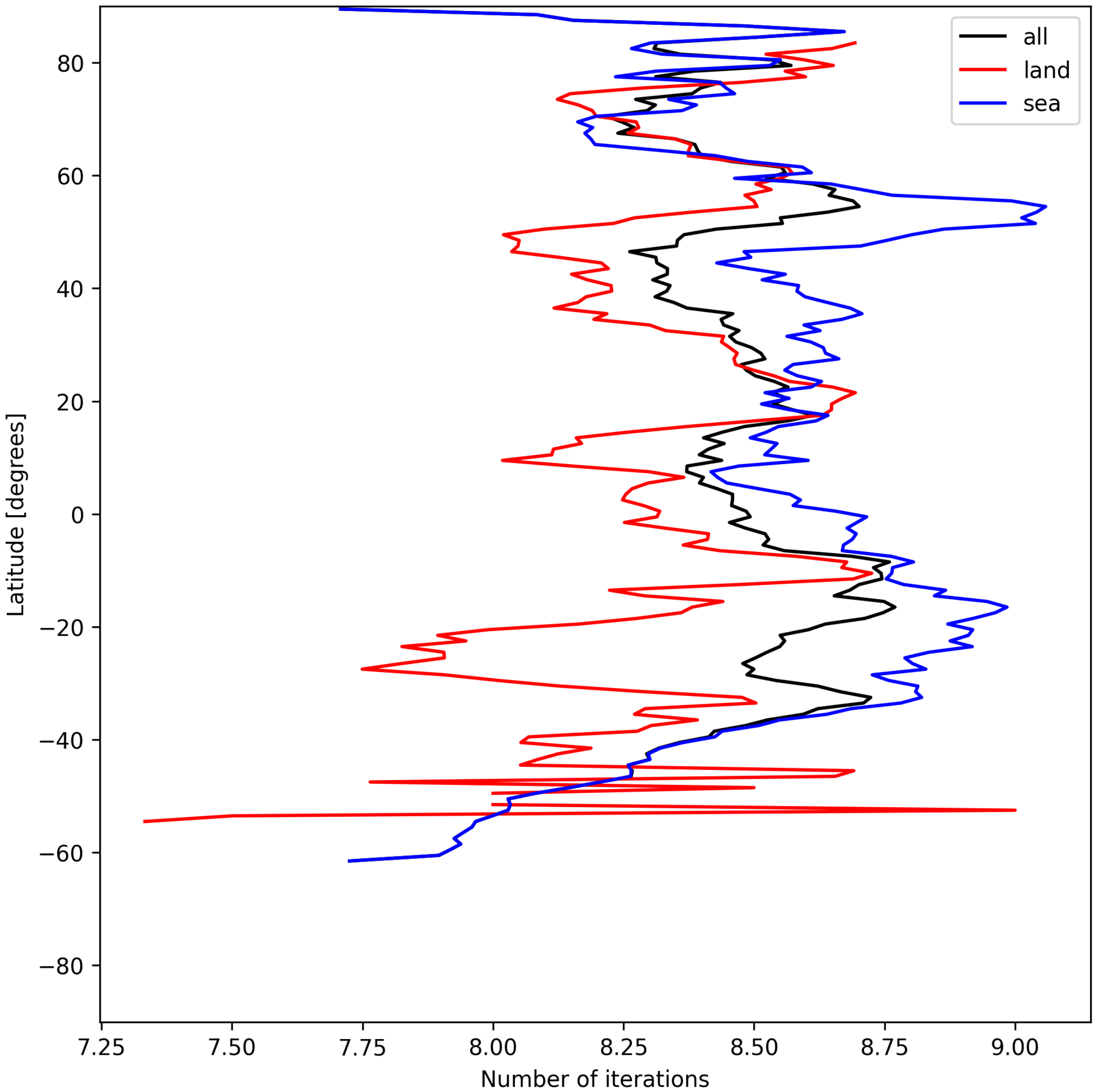

Figure 12: Zonal average of “Number of iterations” for 2025-06-10 to 2025-06-11.

8 Histograms

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

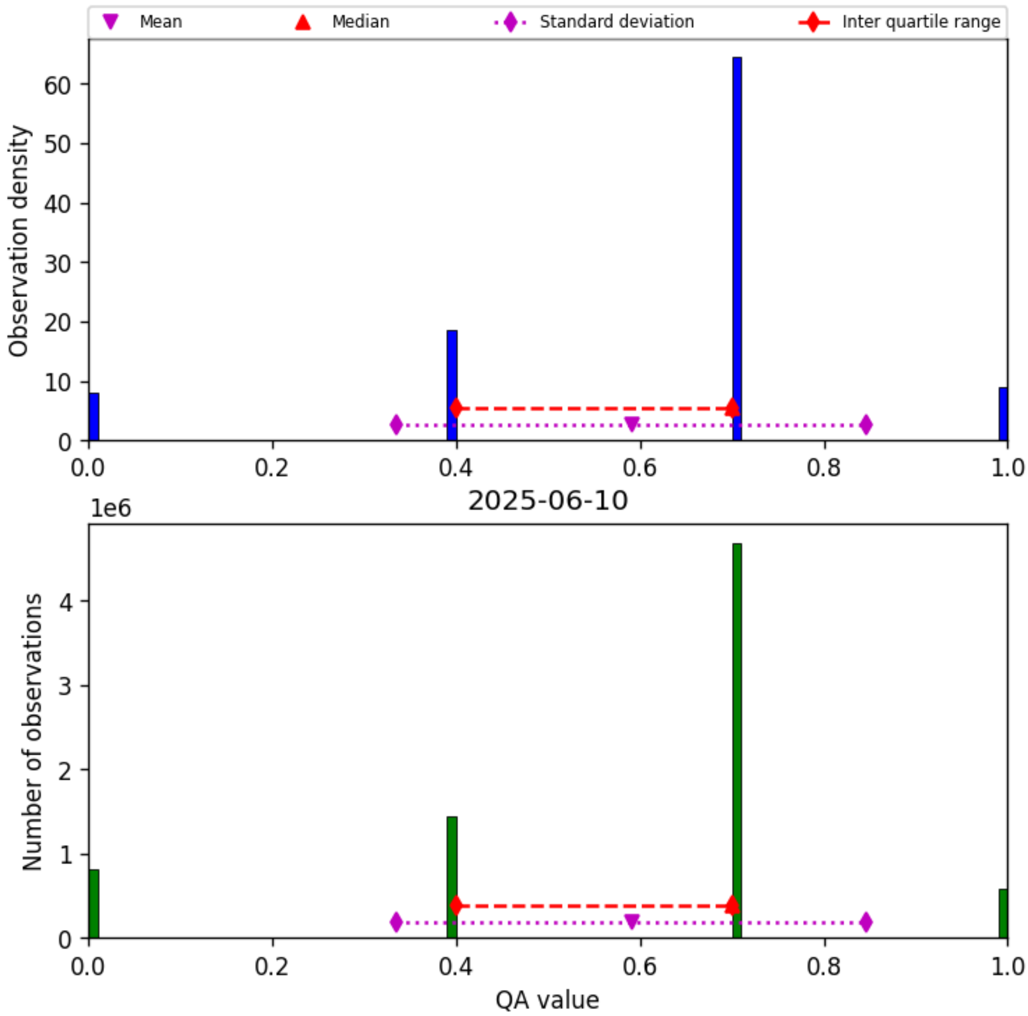

Figure 13: Histogram of “QA value” for 2025-06-10 to 2025-06-11

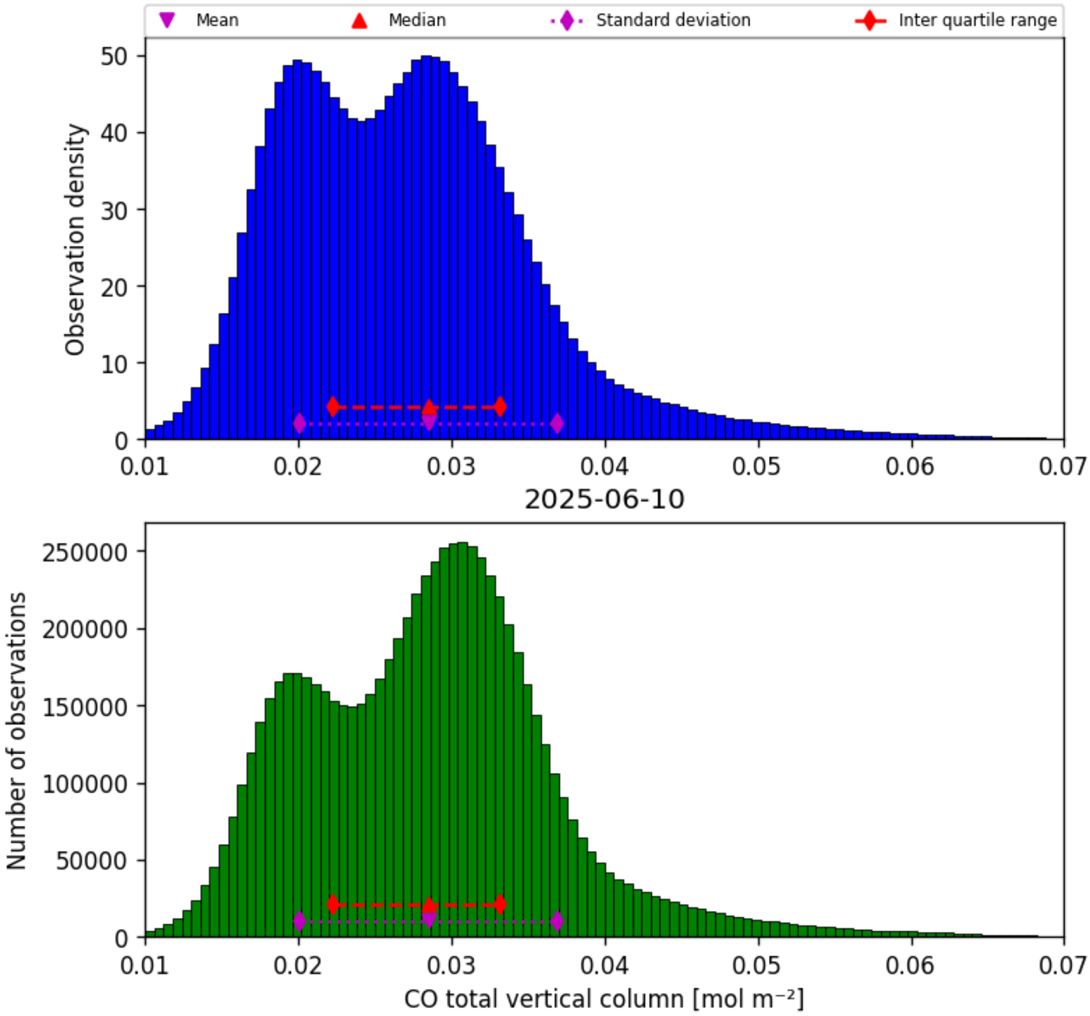

Figure 14: Histogram of “CO total vertical column” for 2025-06-10 to 2025-06-11

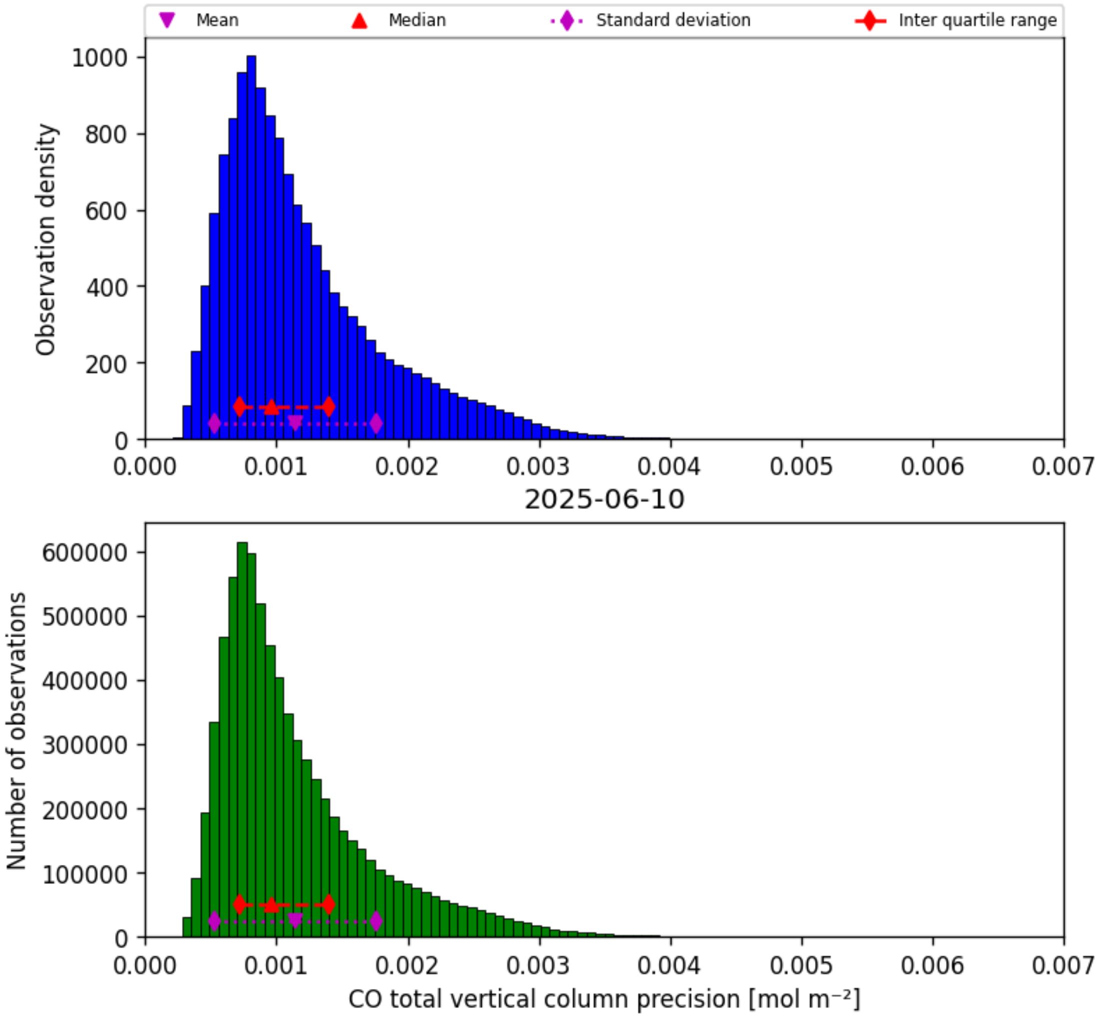

Figure 15: Histogram of “CO total vertical column precision” for 2025-06-10 to 2025-06-11

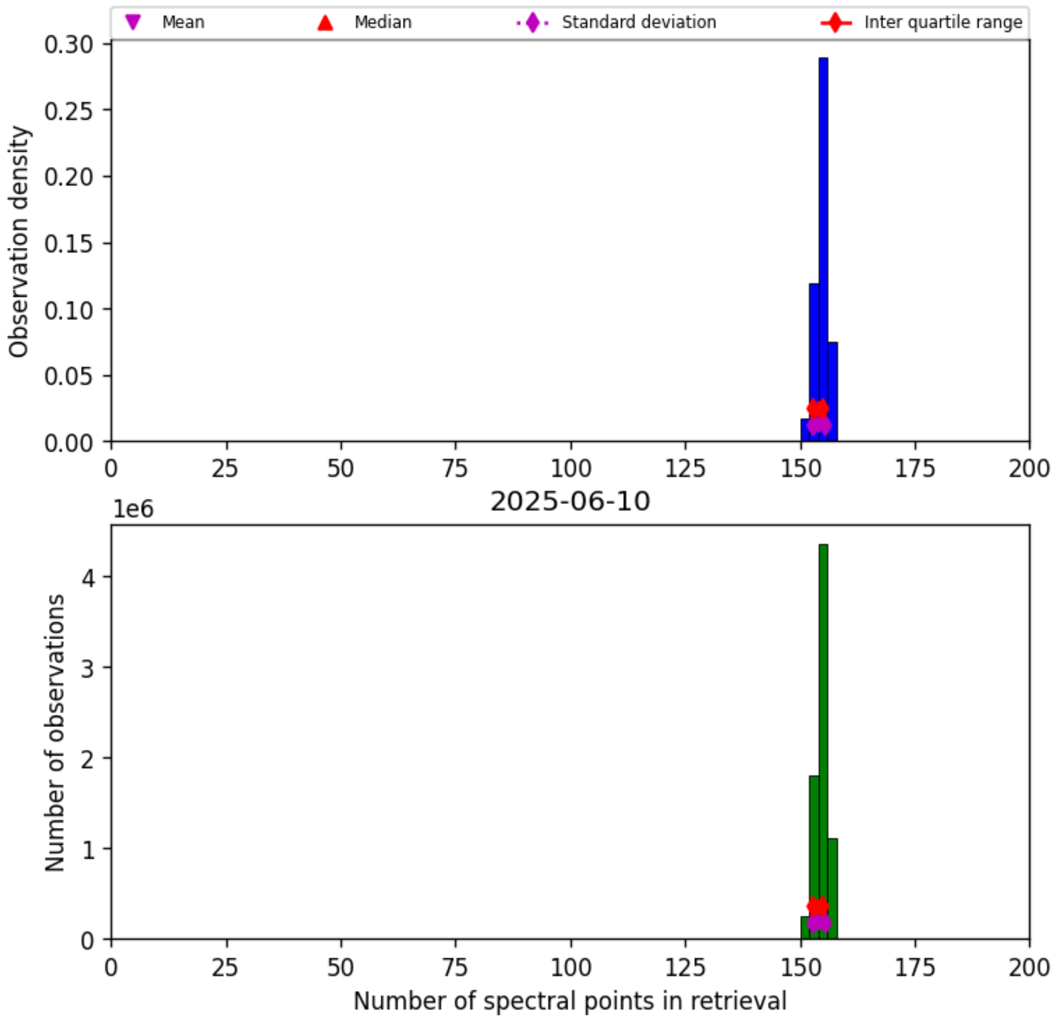

Figure 16: Histogram of “Number of spectral points in retrieval” for 2025-06-10 to 2025-06-11

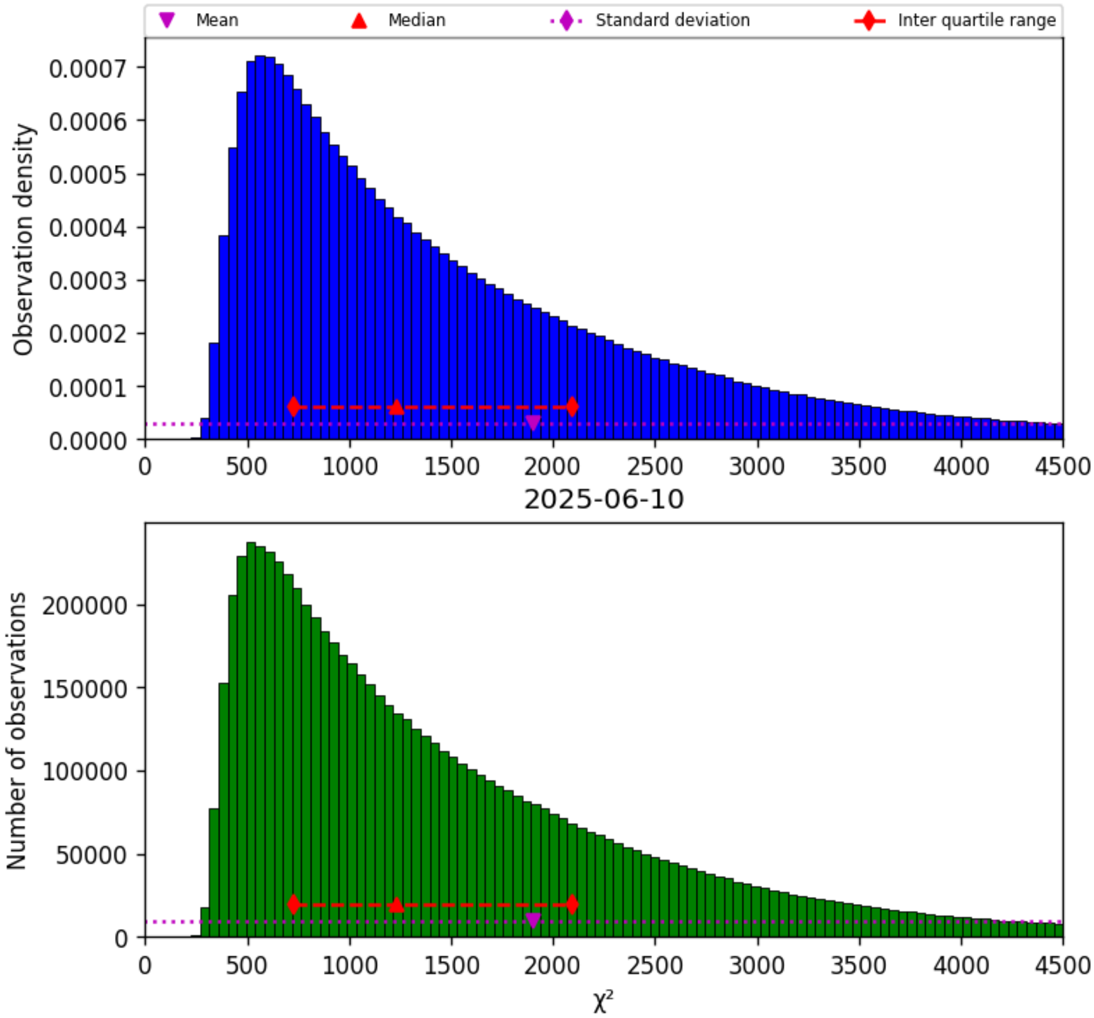

Figure 17: Histogram of “χ^2” for 2025-06-10 to 2025-06-11

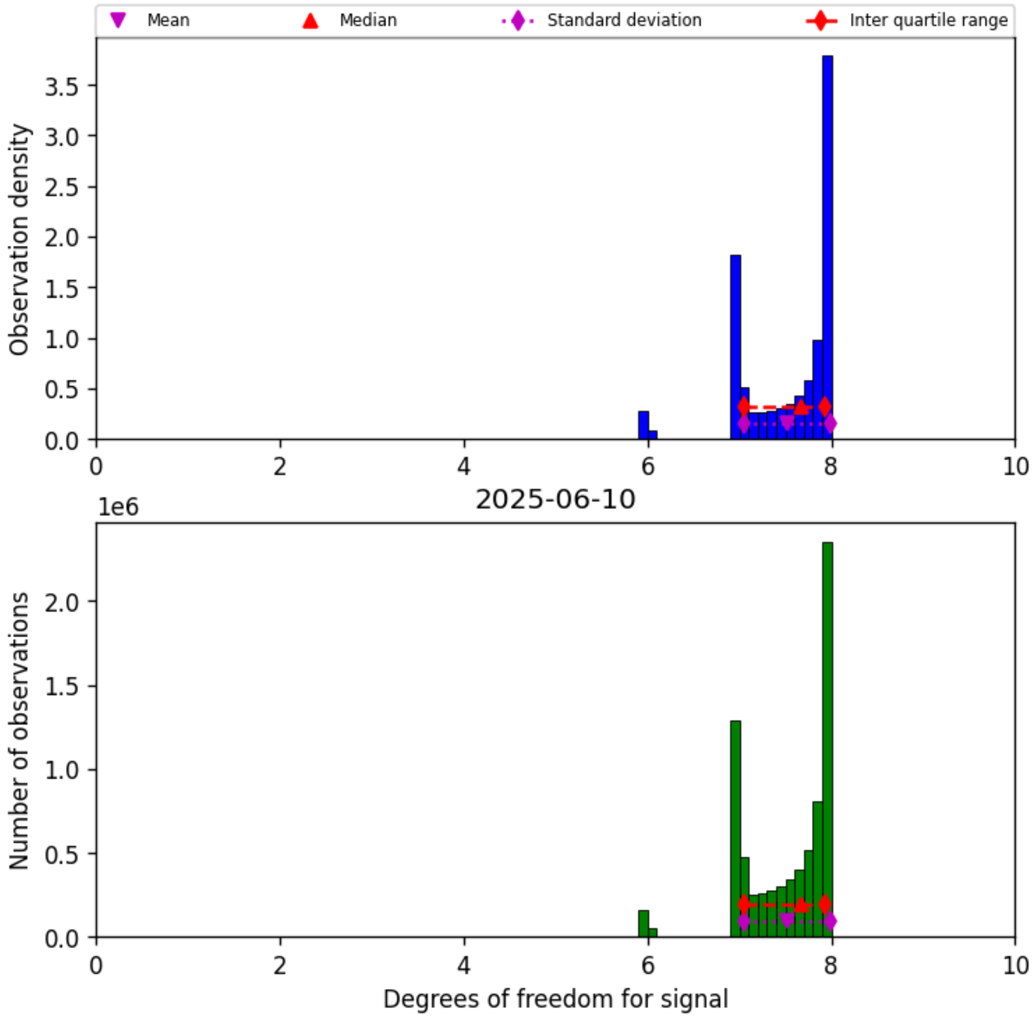

Figure 18: Histogram of “Degrees of freedom for signal” for 2025-06-10 to 2025-06-11

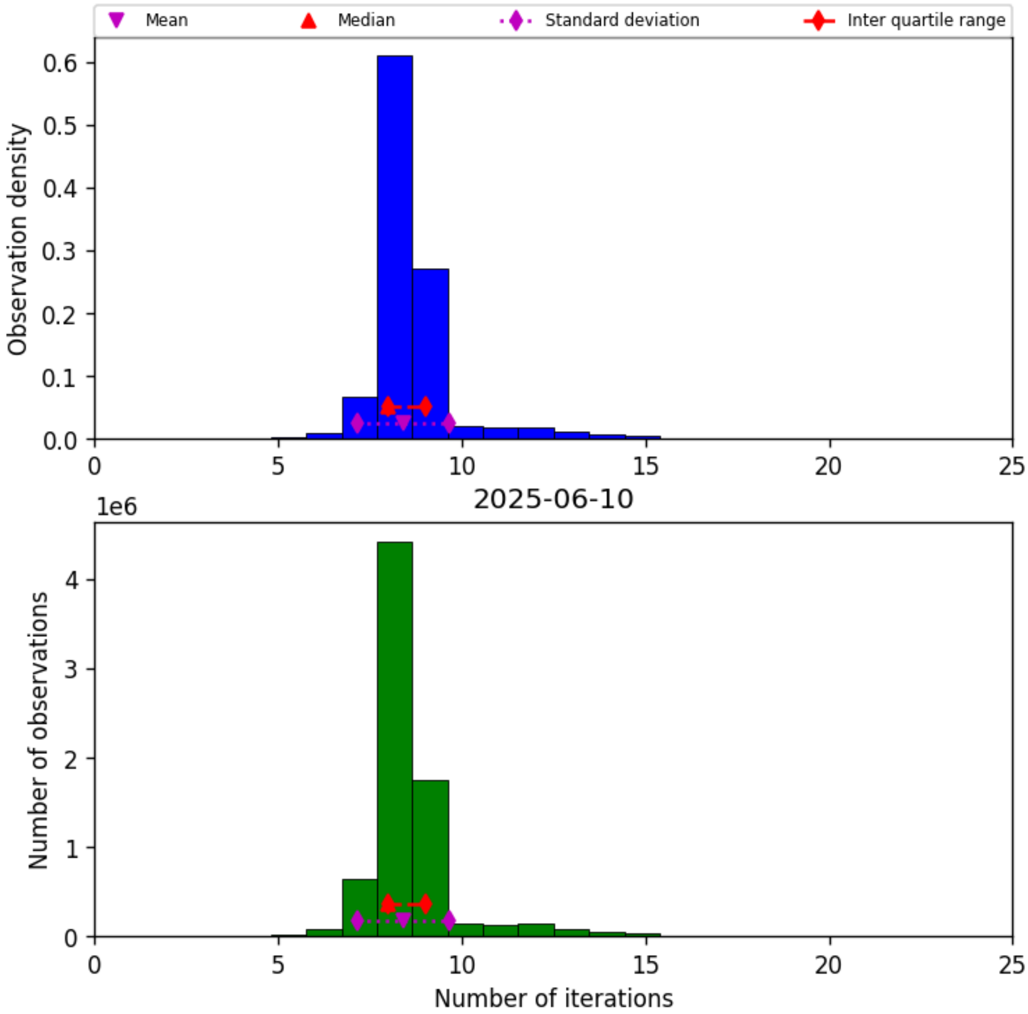

Figure 19: Histogram of "Number of iterations" for 2025-06-10 to 2025-06-11

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.

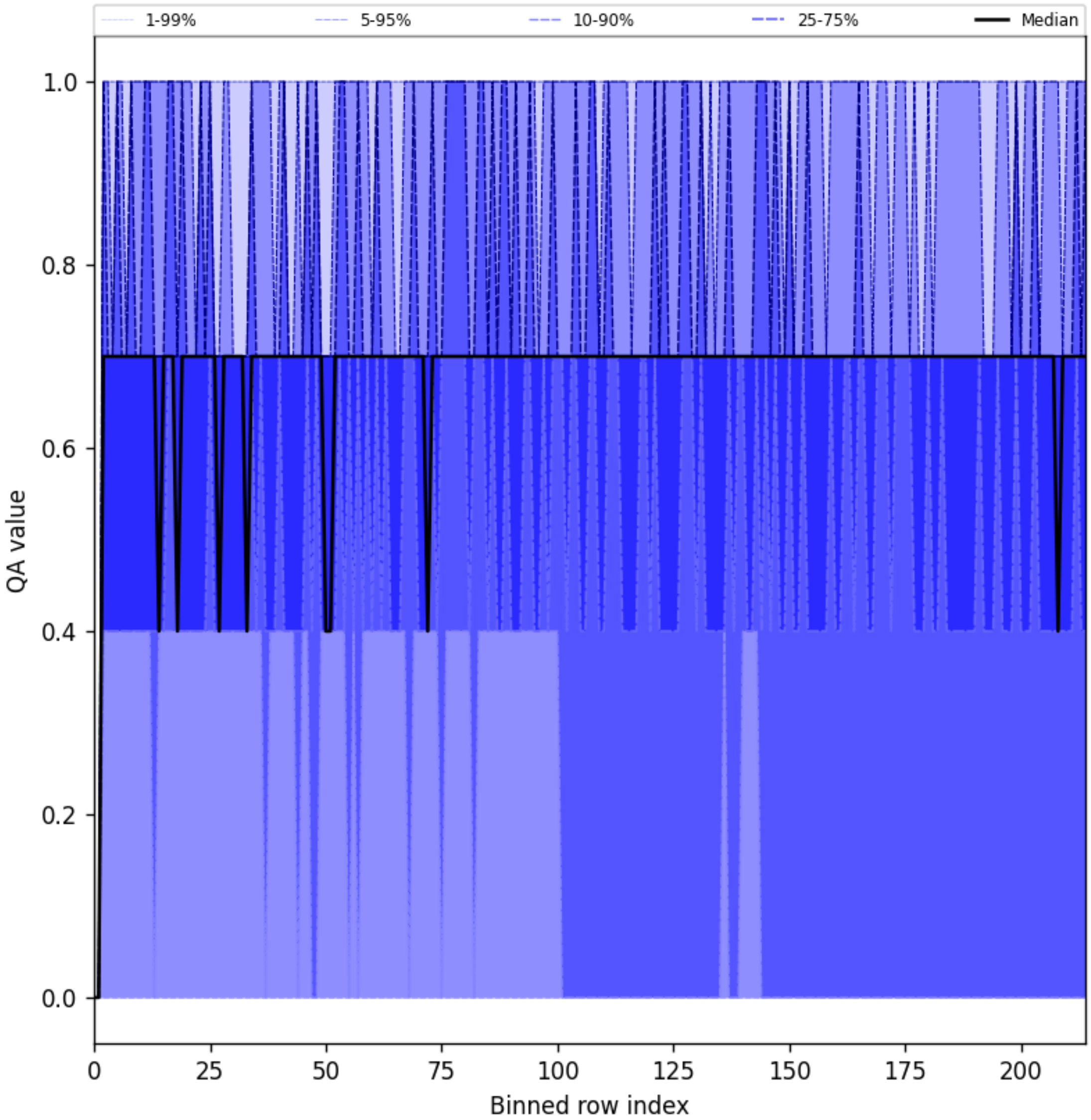

Figure 20: Along track statistics of "QA value" for 2025-06-10 to 2025-06-11

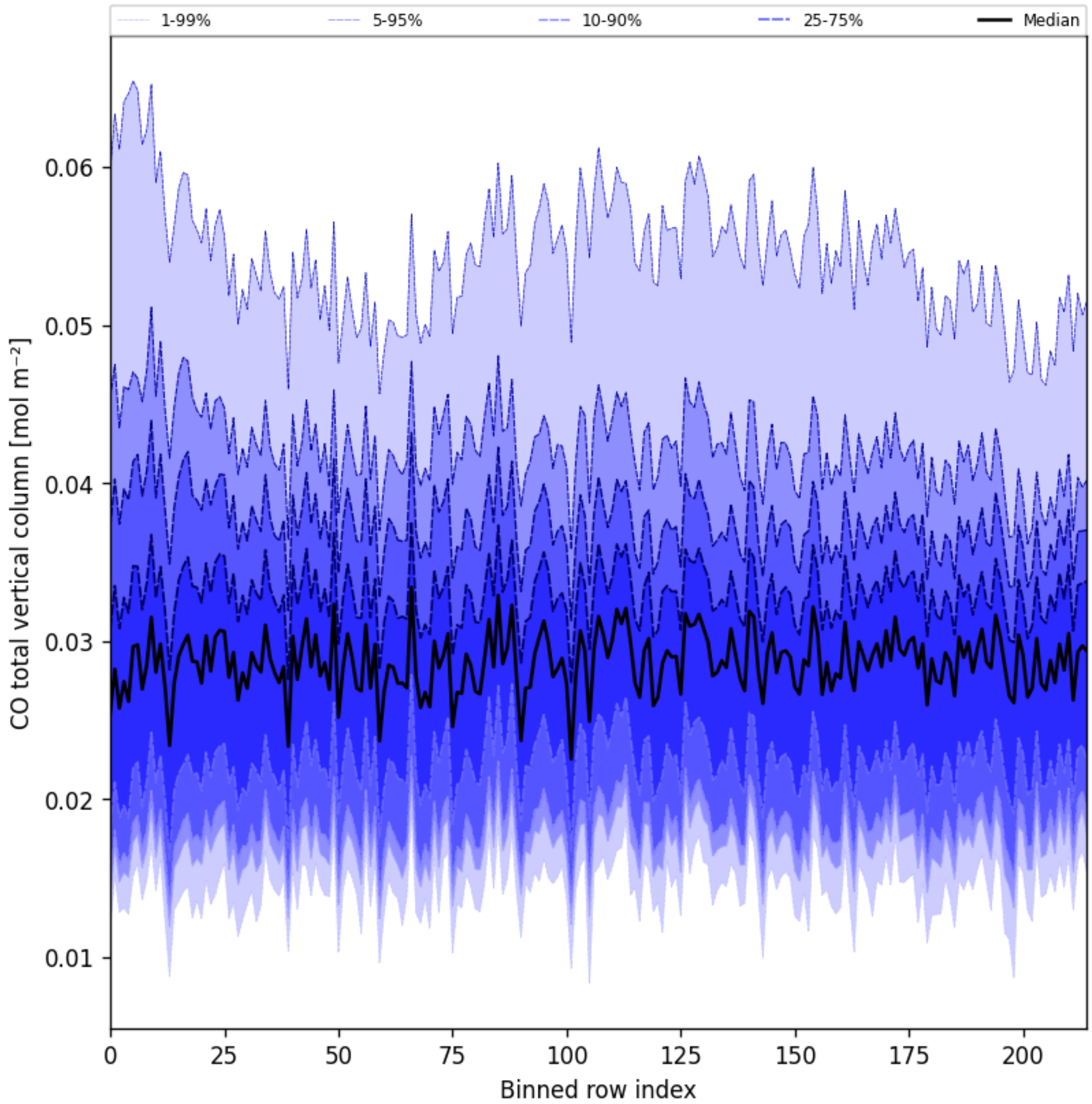

Figure 21: Along track statistics of “CO total vertical column” for 2025-06-10 to 2025-06-11

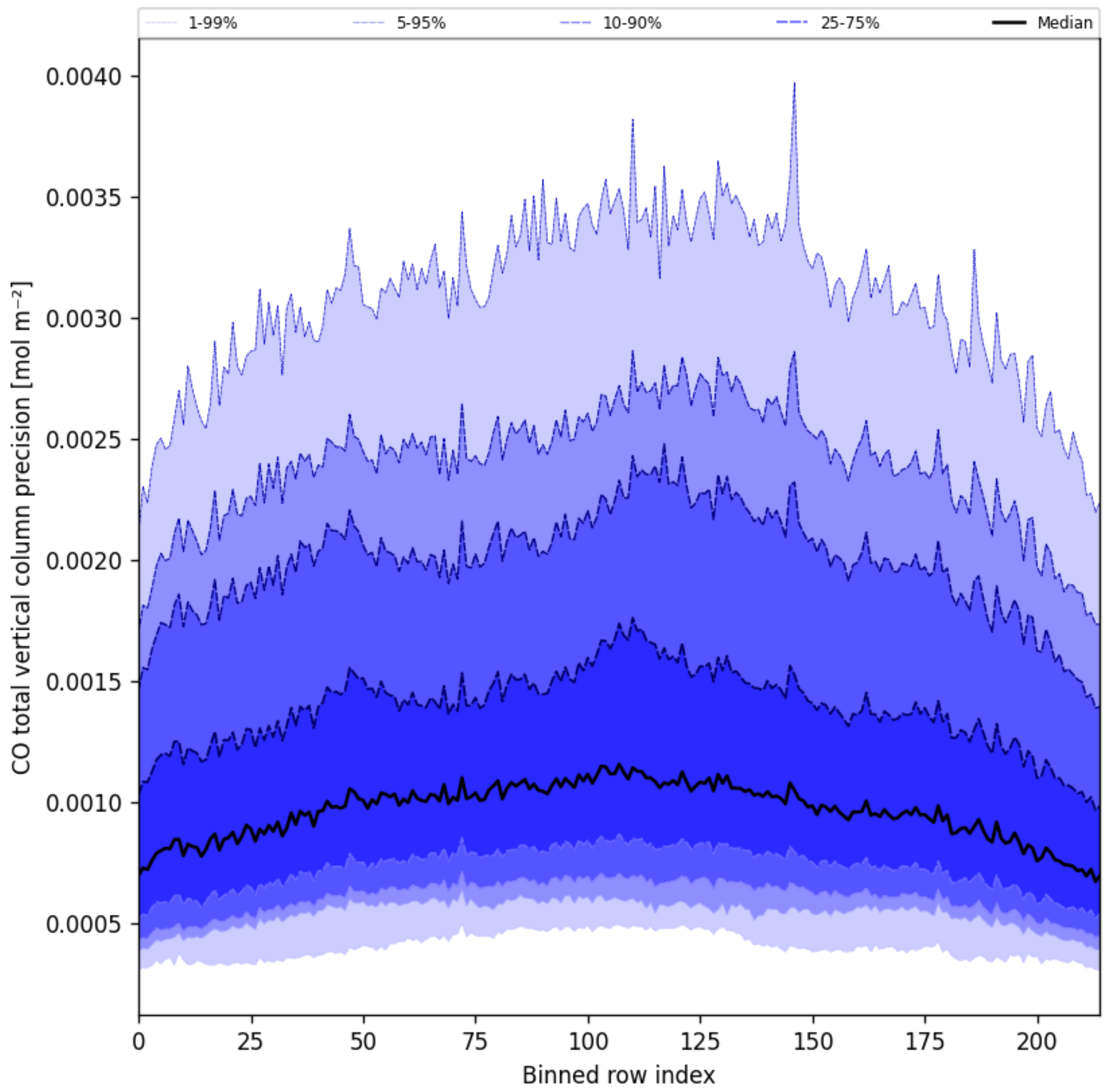

Figure 22: Along track statistics of “CO total vertical column precision” for 2025-06-10 to 2025-06-11

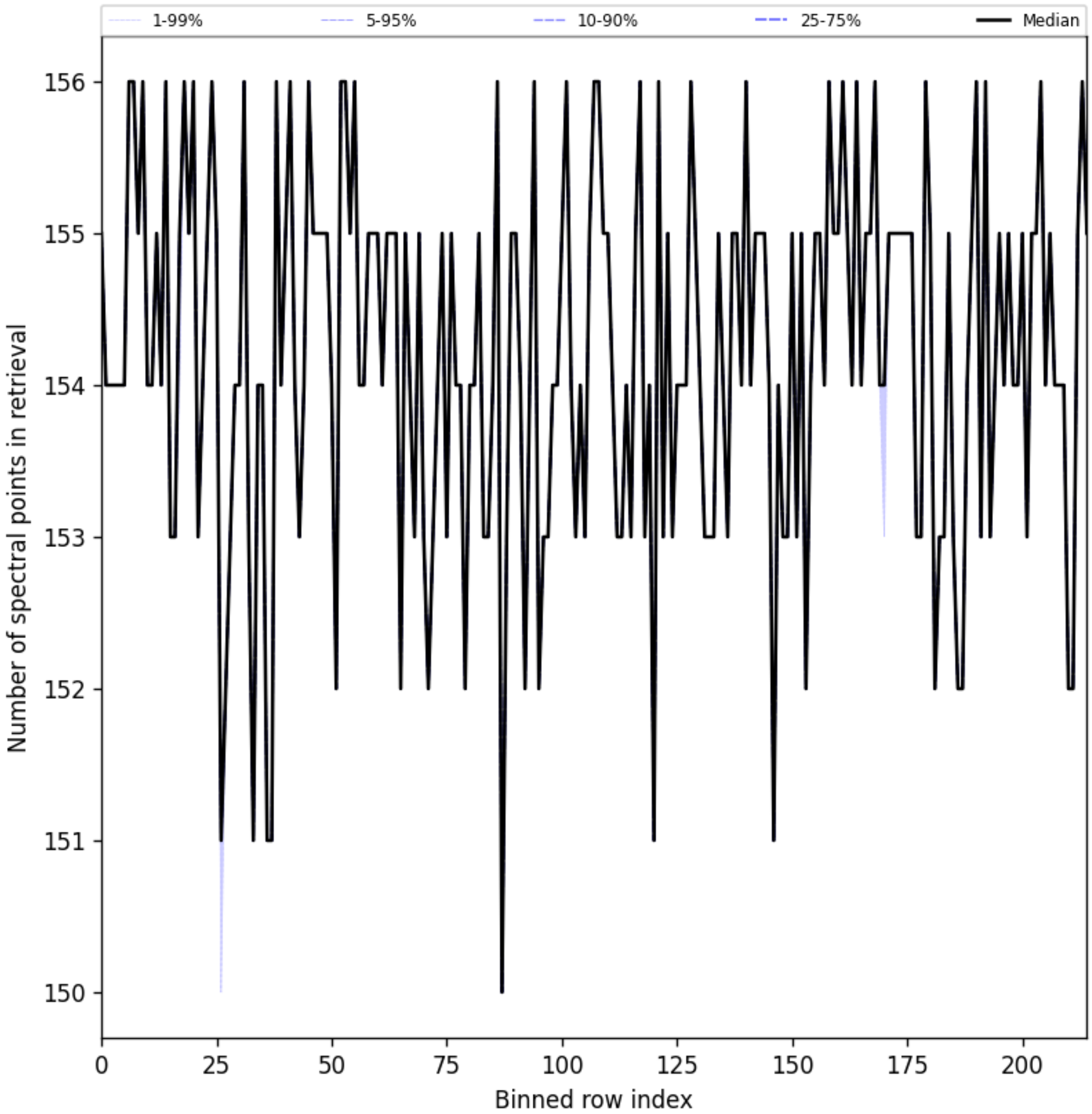

Figure 23: Along track statistics of “Number of spectral points in retrieval” for 2025-06-10 to 2025-06-11

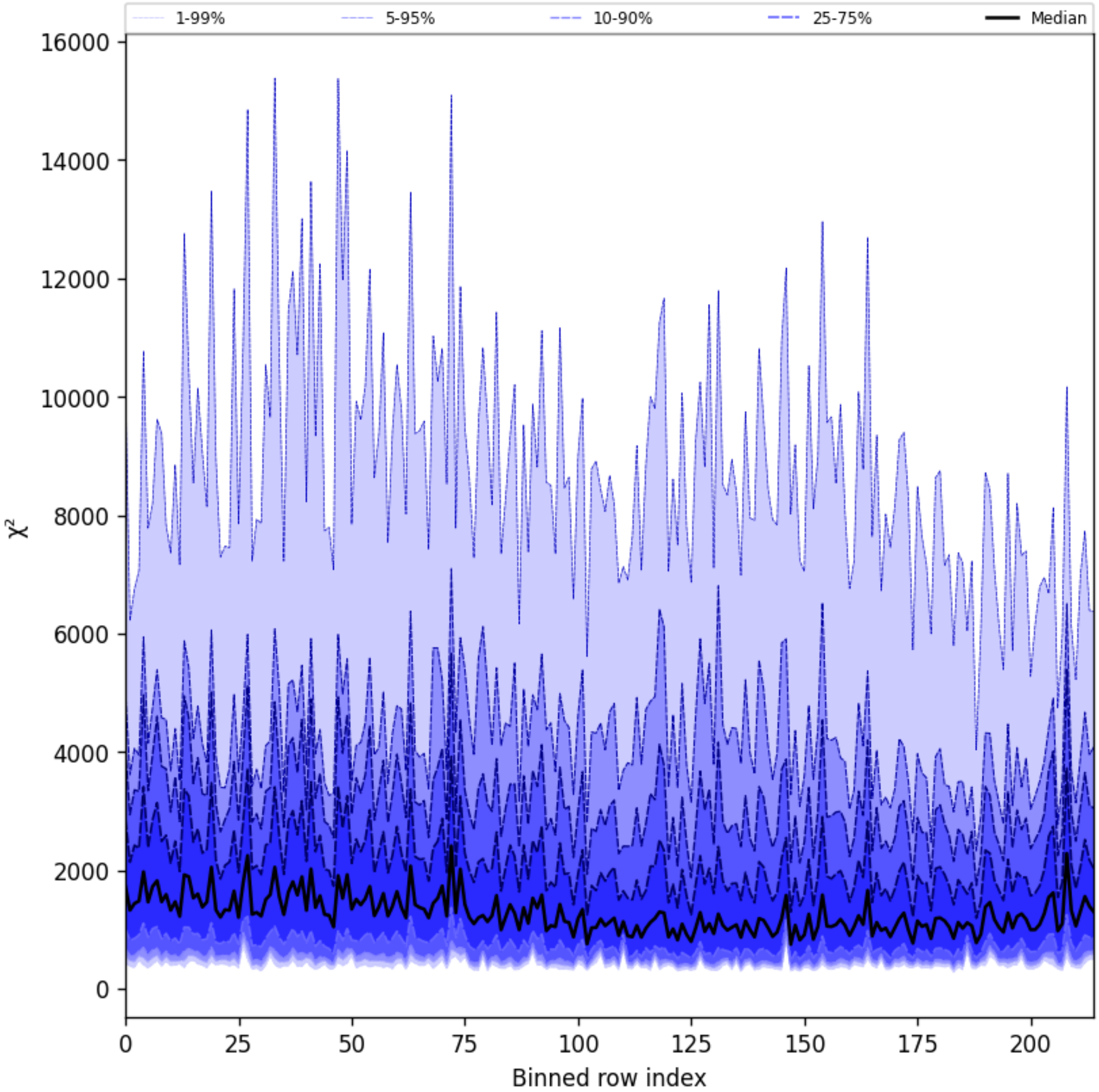

Figure 24: Along track statistics of "χ^2" for 2025-06-10 to 2025-06-11

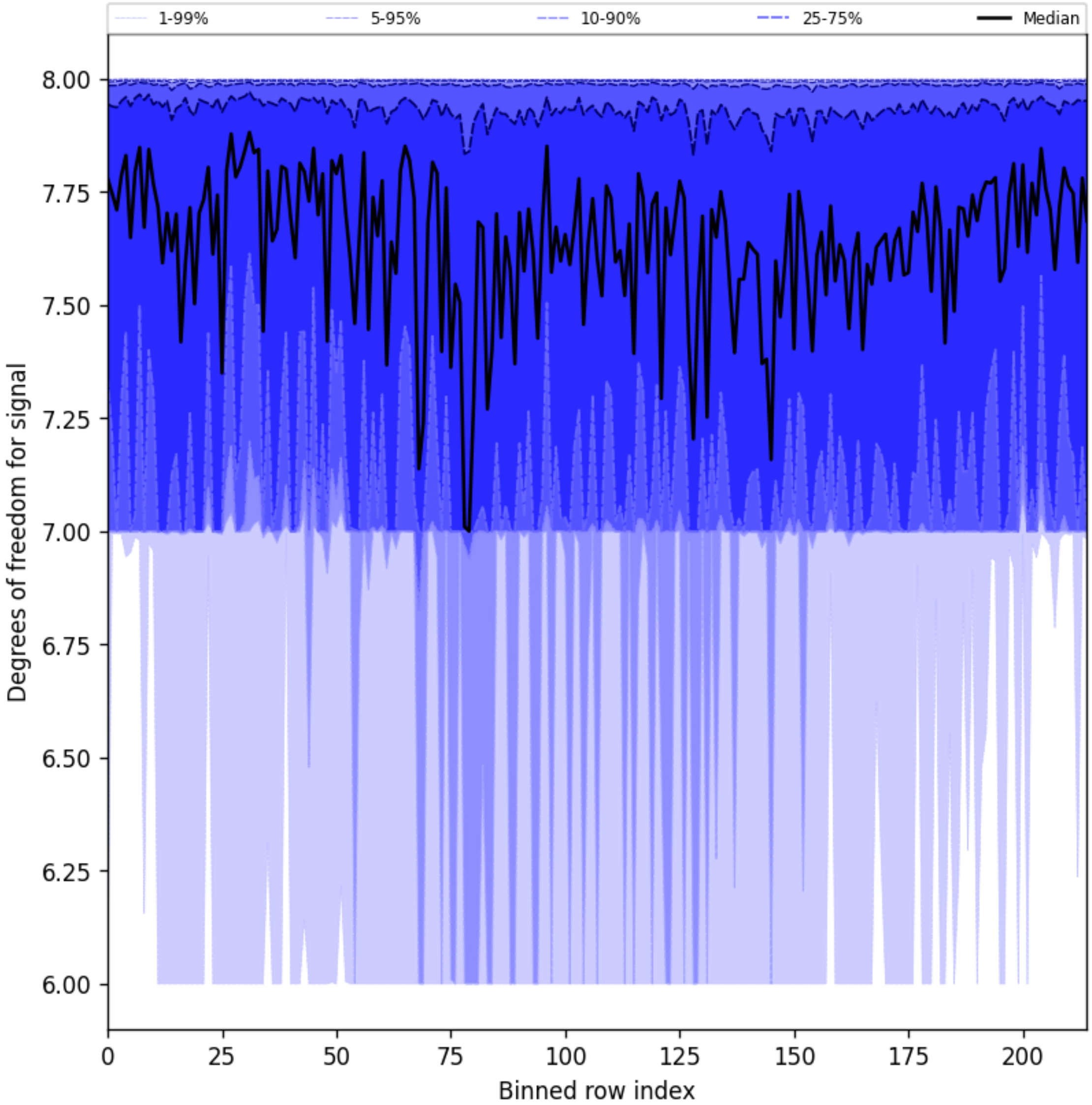

Figure 25: Along track statistics of “Degrees of freedom for signal” for 2025-06-10 to 2025-06-11

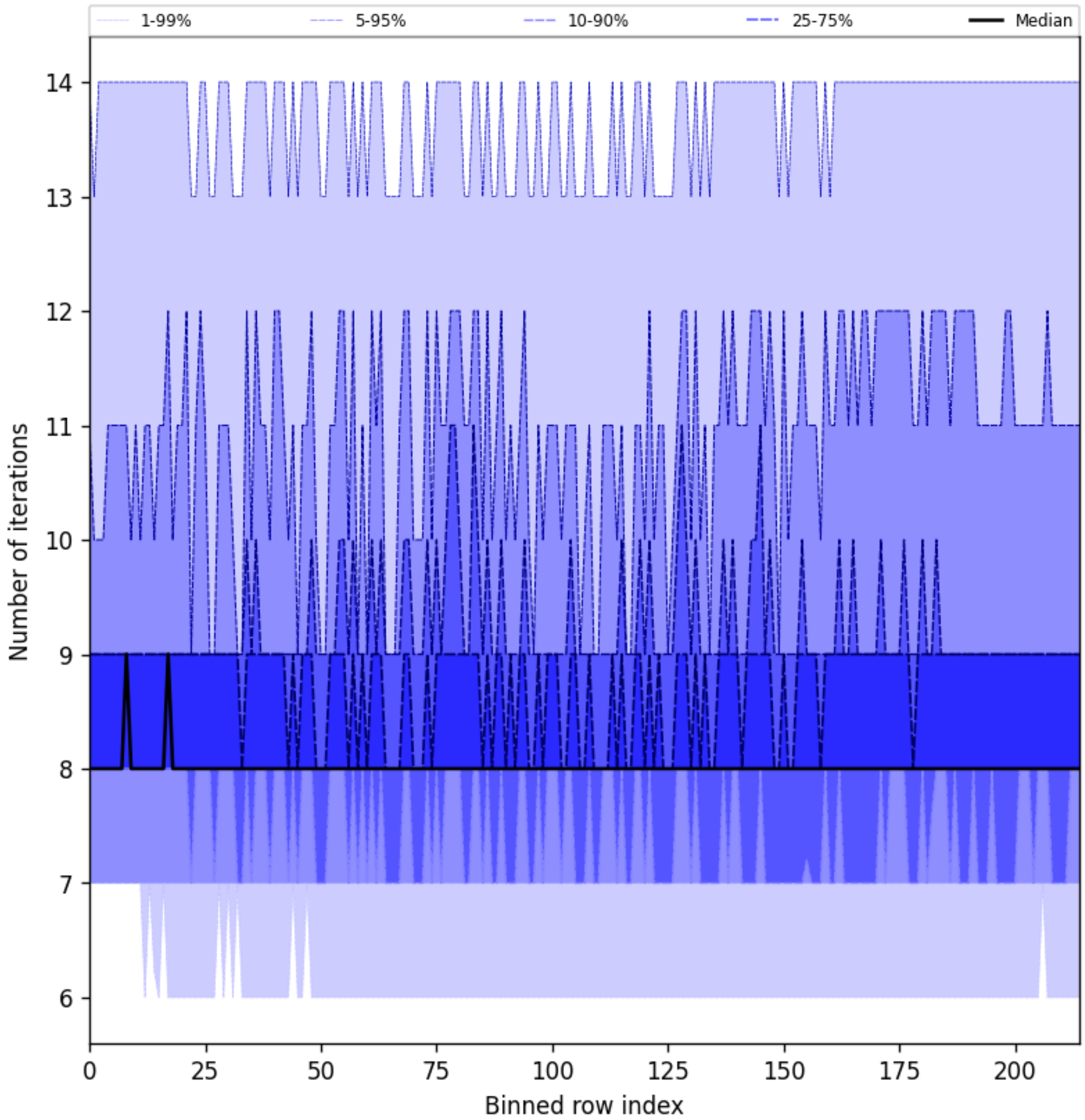

Figure 26: Along track statistics of “Number of iterations” for 2025-06-10 to 2025-06-11

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.

Contents

List of Figures

List of Tables

11 Copyright information of 'PyCAMA'

Maarten Sneep (maarten.sneep@knmi.nl).