

PyCAMA report generated by tropl2-proc

tropl2-proc

2024-12-24 (01:45)

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:

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

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

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

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 :

$$P(x \leq m) = P(x \geq m) = \int_{-\infty}^m f(x) dx = \frac{1}{2} \quad (3)$$

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} .

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

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

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

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]	0.743 ± 0.262	23967694	0.735	0.270	0.740	0.0	1.000
nitrogendioxide tropospheric column [mol m^{-2}]	$(1.118 \pm 6.341) \times 10^{-5}$	23967694	8.636×10^{-6}	1.152×10^{-5}	3.061×10^{-6}	-5.633×10^{-3}	9.147×10^{-3}
nitrogendioxide tropospheric column precision [mol m^{-2}]	$(1.445 \pm 9.242) \times 10^{-5}$	23967694	6.168×10^{-6}	5.484×10^{-6}	6.485×10^{-6}	3.005×10^{-6}	8.121×10^{-2}
air mass factor troposphere [1]	2.42 ± 1.32	23967694	1.98	1.46	2.10	1.002×10^{-2}	8.66
air mass factor total [1]	3.39 ± 1.87	23967694	2.10	1.34	2.73	0.247	14.1
number of spectral points in retrieval [1]	304 ± 2	23967694	304	1.000	304	235	305
number of iterations [1]	3.91 ± 1.19	23967694	4.22	1.000	4.00	3.00	10.00
wavelength calibration offset [nm]	$(-2.078 \pm 5.652) \times 10^{-3}$	23967694	-8.000×10^{-4}	4.711×10^{-3}	-1.839×10^{-3}	-7.581×10^{-2}	6.652×10^{-2}
nitrogendioxide stratospheric column [mol/m^2]	$(5.184 \pm 2.485) \times 10^{-5}$	23967694	3.350×10^{-5}	4.202×10^{-5}	4.484×10^{-5}	8.668×10^{-6}	1.349×10^{-4}
nitrogendioxide stratospheric column precision [mol/m^2]	$(3.321 \pm 0.000) \times 10^{-6}$	23967694	3.350×10^{-6}	0.0	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m^2]	$(6.016 \pm 2.594) \times 10^{-5}$	23967694	8.493×10^{-5}	3.698×10^{-5}	5.821×10^{-5}	1.867×10^{-6}	3.776×10^{-3}
nitrogendioxide total column precision [mol/m^2]	$(1.266 \pm 0.659) \times 10^{-5}$	23967694	1.699×10^{-5}	7.055×10^{-6}	1.220×10^{-5}	1.115×10^{-6}	6.378×10^{-3}
nitrogendioxide summed total column [mol/m^2]	$(6.302 \pm 6.276) \times 10^{-5}$	23967694	8.493×10^{-5}	3.845×10^{-5}	5.883×10^{-5}	-5.518×10^{-3}	9.188×10^{-3}
nitrogendioxide summed total column precision [mol/m^2]	$(1.524 \pm 9.235) \times 10^{-5}$	23967694	4.899×10^{-6}	4.936×10^{-6}	7.286×10^{-6}	4.479×10^{-6}	8.121×10^{-2}
chi square [1]	529 ± 601	23967694	312	201	402	153	9.643×10^4
root mean square error of fit [1]	$(4.147 \pm 2.707) \times 10^{-4}$	23967694	5.130×10^{-4}	3.234×10^{-4}	3.505×10^{-4}	8.506×10^{-5}	7.820×10^{-3}
air mass factor stratosphere [1]	3.89 ± 2.33	23967694	2.22	1.77	3.01	2.06	16.0

Table 2: Percentile ranges

Variable	1 %	5 %	10 %	15.9 %	25 %	75 %	84.1 %	90 %	95 %	99 %
qa value [1]	3.000×10^{-2}	7.000×10^{-2}	0.220	0.670	0.730	1.000	1.000	1.000	1.000	1.000
nitrogendioxide tropospheric column [mol m^{-2}]	-3.460×10^{-5}	-1.289×10^{-5}	-7.195×10^{-6}	-4.157×10^{-6}	-1.695×10^{-6}	9.825×10^{-6}	1.483×10^{-5}	2.222×10^{-5}	4.435×10^{-5}	1.991×10^{-4}
nitrogendioxide tropospheric column precision [mol m^{-2}]	3.212×10^{-6}	3.398×10^{-6}	3.651×10^{-6}	3.971×10^{-6}	4.548×10^{-6}	1.003×10^{-5}	1.428×10^{-5}	2.089×10^{-5}	3.830×10^{-5}	1.307×10^{-4}
air mass factor troposphere [1]	0.251	0.667	0.999	1.27	1.58	3.04	3.78	4.38	5.10	6.32
air mass factor total [1]	1.43	2.00	2.09	2.16	2.28	3.62	4.54	5.84	7.60	11.0
number of spectral points in retrieval [1]	303	303	304	304	304	305	305	305	305	305
number of iterations [1]	3.00	3.00	3.00	3.00	3.00	4.00	4.00	4.00	8.00	8.00
wavelength calibration offset [nm]	-1.941×10^{-2}	-1.049×10^{-2}	-7.642×10^{-3}	-6.150×10^{-3}	-4.530×10^{-3}	1.816×10^{-4}	1.478×10^{-3}	3.208×10^{-3}	6.343×10^{-3}	1.521×10^{-2}
nitrogendioxide stratospheric column [mol/m^2]	1.186×10^{-5}	1.756×10^{-5}	2.547×10^{-5}	2.899×10^{-5}	3.192×10^{-5}	7.394×10^{-5}	8.302×10^{-5}	8.793×10^{-5}	9.330×10^{-5}	1.078×10^{-4}
nitrogendioxide stratospheric column precision [mol/m^2]	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m^2]	1.523×10^{-5}	2.818×10^{-5}	3.272×10^{-5}	3.642×10^{-5}	4.114×10^{-5}	7.812×10^{-5}	8.444×10^{-5}	8.825×10^{-5}	9.301×10^{-5}	1.269×10^{-4}
nitrogendioxide total column precision [mol/m^2]	3.434×10^{-6}	6.230×10^{-6}	7.214×10^{-6}	7.951×10^{-6}	8.876×10^{-6}	1.593×10^{-5}	1.710×10^{-5}	1.784×10^{-5}	1.894×10^{-5}	2.994×10^{-5}
nitrogendioxide summed total column [mol/m^2]	-1.004×10^{-6}	2.039×10^{-5}	2.959×10^{-5}	3.457×10^{-5}	4.032×10^{-5}	7.878×10^{-5}	8.459×10^{-5}	8.819×10^{-5}	9.365×10^{-5}	2.227×10^{-4}
nitrogendioxide summed total column precision [mol/m^2]	4.620×10^{-6}	4.752×10^{-6}	4.936×10^{-6}	5.176×10^{-6}	5.632×10^{-6}	1.057×10^{-5}	1.466×10^{-5}	2.115×10^{-5}	3.845×10^{-5}	1.307×10^{-4}
chi square [1]	227	256	276	295	322	523	614	760	1.155×10^3	2.954×10^3
root mean square error of fit [1]	1.185×10^{-4}	1.377×10^{-4}	1.552×10^{-4}	1.740×10^{-4}	2.092×10^{-4}	5.326×10^{-4}	6.215×10^{-4}	7.333×10^{-4}	9.386×10^{-4}	1.388×10^{-3}
air mass factor stratosphere [1]	2.08	2.13	2.19	2.27	2.42	4.19	5.56	7.25	9.48	12.6

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]	0.717 ± 0.315	9478275	0.270	0.740	0.0	1.000	0.730	1.000
nitrogendioxide tropospheric column [mol m ⁻²]	$(2.647 \pm 9.822) \times 10^{-5}$	9478275	1.985×10^{-5}	8.921×10^{-6}	-4.622×10^{-3}	9.147×10^{-3}	1.077×10^{-6}	2.093×10^{-5}
nitrogendioxide tropospheric column precision [mol m ⁻²]	$(2.738 \pm 14.409) \times 10^{-5}$	9478275	1.282×10^{-5}	1.036×10^{-5}	3.340×10^{-6}	8.121×10^{-2}	7.268×10^{-6}	2.009×10^{-5}
air mass factor troposphere [1]	1.70 ± 0.85	9478275	0.992	1.70	1.176×10^{-2}	7.34	1.13	2.12
air mass factor total [1]	3.38 ± 1.79	9478275	1.44	2.75	0.247	14.1	2.29	3.73
number of spectral points in retrieval [1]	304 ± 1	9478275	1.000	304	235	305	304	305
number of iterations [1]	3.71 ± 1.06	9478275	1.000	4.00	3.00	8.00	3.00	4.00
wavelength calibration offset [nm]	$(-1.791 \pm 5.980) \times 10^{-3}$	9478275	4.987×10^{-3}	-1.531×10^{-3}	-6.767×10^{-2}	6.652×10^{-2}	-4.335×10^{-3}	6.521×10^{-4}
nitrogendioxide stratospheric column [mol/m ²]	$(2.968 \pm 0.831) \times 10^{-5}$	9478275	1.005×10^{-5}	3.122×10^{-5}	8.668×10^{-6}	5.192×10^{-5}	2.538×10^{-5}	3.543×10^{-5}
nitrogendioxide stratospheric column precision [mol/m ²]	$(3.321 \pm 0.000) \times 10^{-6}$	9478275	0.0	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m ²]	$(4.820 \pm 3.107) \times 10^{-5}$	9478275	1.732×10^{-5}	4.195×10^{-5}	1.867×10^{-6}	3.776×10^{-3}	3.431×10^{-5}	5.163×10^{-5}
nitrogendioxide total column precision [mol/m ²]	$(1.072 \pm 0.927) \times 10^{-5}$	9478275	3.613×10^{-6}	9.018×10^{-6}	1.115×10^{-6}	6.378×10^{-3}	7.516×10^{-6}	1.113×10^{-5}
nitrogendioxide summed total column [mol/m ²]	$(5.615 \pm 9.681) \times 10^{-5}$	9478275	2.166×10^{-5}	4.105×10^{-5}	-4.601×10^{-3}	9.188×10^{-3}	3.123×10^{-5}	5.288×10^{-5}
nitrogendioxide summed total column precision [mol/m ²]	$(2.789 \pm 14.404) \times 10^{-5}$	9478275	1.237×10^{-5}	1.088×10^{-5}	4.710×10^{-6}	8.121×10^{-2}	7.991×10^{-6}	2.037×10^{-5}
chi square [1]	464 ± 528	9478275	150	337	153	8.439×10^4	287	437
root mean square error of fit [1]	$(4.309 \pm 2.983) \times 10^{-4}$	9478275	3.452×10^{-4}	3.508×10^{-4}	9.410×10^{-5}	7.820×10^{-3}	2.035×10^{-4}	5.487×10^{-4}
air mass factor stratosphere [1]	4.58 ± 2.70	9478275	2.77	3.48	2.13	16.0	2.70	5.47

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]	0.760 ± 0.220	14489419	0.150	0.740	0.0	1.000	0.730	0.880
nitrogendioxide tropospheric column [mol m^{-2}]	$(1.183 \pm 9.308) \times 10^{-6}$	14489419	7.753×10^{-6}	1.065×10^{-6}	-5.633×10^{-3}	8.550×10^{-4}	-2.294×10^{-6}	5.460×10^{-6}
nitrogendioxide tropospheric column precision [mol m^{-2}]	$(5.991 \pm 19.086) \times 10^{-6}$	14489419	2.743×10^{-6}	5.078×10^{-6}	3.005×10^{-6}	6.167×10^{-2}	3.930×10^{-6}	6.673×10^{-6}
air mass factor troposphere [1]	2.88 ± 1.36	14489419	1.85	2.51	1.002×10^{-2}	8.66	1.90	3.75
air mass factor total [1]	3.40 ± 1.92	14489419	1.28	2.72	0.765	14.1	2.26	3.55
number of spectral points in retrieval [1]	304 ± 2	14489419	1.000	304	235	305	304	305
number of iterations [1]	4.03 ± 1.25	14489419	1.000	4.00	3.00	10.00	3.00	4.00
wavelength calibration offset [nm]	$(-2.266 \pm 5.418) \times 10^{-3}$	14489419	4.522×10^{-3}	-2.024×10^{-3}	-7.581×10^{-2}	5.915×10^{-2}	-4.645×10^{-3}	-1.227×10^{-4}
nitrogendioxide stratospheric column [mol/m^2]	$(6.633 \pm 2.110) \times 10^{-5}$	14489419	3.324×10^{-5}	6.685×10^{-5}	2.289×10^{-5}	1.349×10^{-4}	5.038×10^{-5}	8.361×10^{-5}
nitrogendioxide stratospheric column precision [mol/m^2]	$(3.321 \pm 0.000) \times 10^{-6}$	14489419	0.0	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m^2]	$(6.798 \pm 1.808) \times 10^{-5}$	14489419	2.714×10^{-5}	6.889×10^{-5}	9.701×10^{-6}	2.590×10^{-4}	5.607×10^{-5}	8.320×10^{-5}
nitrogendioxide total column precision [mol/m^2]	$(1.393 \pm 0.340) \times 10^{-5}$	14489419	5.060×10^{-6}	1.410×10^{-5}	4.188×10^{-6}	5.197×10^{-5}	1.170×10^{-5}	1.675×10^{-5}
nitrogendioxide summed total column [mol/m^2]	$(6.751 \pm 1.825) \times 10^{-5}$	14489419	2.666×10^{-5}	6.938×10^{-5}	-5.518×10^{-3}	8.845×10^{-4}	5.597×10^{-5}	8.263×10^{-5}
nitrogendioxide summed total column precision [mol/m^2]	$(6.967 \pm 19.044) \times 10^{-6}$	14489419	2.309×10^{-6}	6.068×10^{-6}	4.479×10^{-6}	6.167×10^{-2}	5.145×10^{-6}	7.454×10^{-6}
chi square [1]	571 ± 640	14489419	194	443	166	9.643×10^4	361	556
root mean square error of fit [1]	$(4.041 \pm 2.504) \times 10^{-4}$	14489419	3.123×10^{-4}	3.503×10^{-4}	8.506×10^{-5}	6.862×10^{-3}	2.138×10^{-4}	5.261×10^{-4}
air mass factor stratosphere [1]	3.43 ± 1.92	14489419	1.26	2.75	2.06	14.3	2.30	3.55

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]	0.776 ± 0.221	14710493	0.260	0.740	0.0	1.000	0.740	1.000
nitrogendioxide tropospheric column [mol m^{-2}]	$(4.164 \pm 19.976) \times 10^{-6}$	14710493	9.687×10^{-6}	3.642×10^{-6}	-5.633×10^{-3}	3.174×10^{-3}	-1.196×10^{-6}	8.492×10^{-6}
nitrogendioxide tropospheric column precision [mol m^{-2}]	$(8.787 \pm 31.724) \times 10^{-6}$	14710493	3.688×10^{-6}	6.341×10^{-6}	3.123×10^{-6}	6.167×10^{-2}	4.924×10^{-6}	8.612×10^{-6}
air mass factor troposphere [1]	2.20 ± 0.96	14710493	0.881	2.06	1.225×10^{-2}	8.36	1.67	2.55
air mass factor total [1]	3.09 ± 1.70	14710493	0.885	2.54	0.524	14.1	2.25	3.13
number of spectral points in retrieval [1]	304 ± 1	14710493	1.000	304	235	305	304	305
number of iterations [1]	4.06 ± 1.27	14710493	1.000	4.00	3.00	9.00	3.00	4.00
wavelength calibration offset [nm]	$(-1.965 \pm 6.072) \times 10^{-3}$	14710493	5.103×10^{-3}	-1.759×10^{-3}	-6.258×10^{-2}	6.652×10^{-2}	-4.587×10^{-3}	5.157×10^{-4}
nitrogendioxide stratospheric column [mol/m^2]	$(4.967 \pm 2.126) \times 10^{-5}$	14710493	3.260×10^{-5}	4.564×10^{-5}	8.668×10^{-6}	1.349×10^{-4}	3.252×10^{-5}	6.512×10^{-5}
nitrogendioxide stratospheric column precision [mol/m^2]	$(3.321 \pm 0.000) \times 10^{-6}$	14710493	0.0	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m^2]	$(5.495 \pm 1.960) \times 10^{-5}$	14710493	2.867×10^{-5}	5.398×10^{-5}	1.867×10^{-6}	4.691×10^{-4}	3.938×10^{-5}	6.805×10^{-5}
nitrogendioxide total column precision [mol/m^2]	$(1.150 \pm 0.383) \times 10^{-5}$	14710493	5.436×10^{-6}	1.138×10^{-5}	1.115×10^{-6}	1.103×10^{-4}	8.546×10^{-6}	1.398×10^{-5}
nitrogendioxide summed total column [mol/m^2]	$(5.384 \pm 2.543) \times 10^{-5}$	14710493	2.982×10^{-5}	5.401×10^{-5}	-5.518×10^{-3}	3.183×10^{-3}	3.849×10^{-5}	6.831×10^{-5}
nitrogendioxide summed total column precision [mol/m^2]	$(9.588 \pm 31.666) \times 10^{-6}$	14710493	3.291×10^{-6}	7.158×10^{-6}	4.559×10^{-6}	6.167×10^{-2}	5.939×10^{-6}	9.230×10^{-6}
chi square [1]	566 ± 619	14710493	221	420	153	9.643×10^4	336	556
root mean square error of fit [1]	$(3.512 \pm 2.400) \times 10^{-4}$	14710493	2.277×10^{-4}	2.901×10^{-4}	9.235×10^{-5}	7.820×10^{-3}	1.903×10^{-4}	4.180×10^{-4}
air mass factor stratosphere [1]	3.37 ± 2.00	14710493	1.05	2.66	2.06	16.0	2.31	3.36

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]	0.703 ± 0.301	7492849	0.210	0.810	0.0	1.000	0.670	0.880
nitrogendioxide tropospheric column [mol m ⁻²]	$(1.386 \pm 6.477) \times 10^{-5}$	7492849	1.303×10^{-5}	5.925×10^{-7}	-3.034×10^{-3}	9.147×10^{-3}	-2.336×10^{-6}	1.069×10^{-5}
nitrogendioxide tropospheric column precision [mol m ⁻²]	$(1.616 \pm 11.435) \times 10^{-5}$	7492849	7.388×10^{-6}	5.842×10^{-6}	3.005×10^{-6}	6.604×10^{-2}	3.587×10^{-6}	1.097×10^{-5}
air mass factor troposphere [1]	3.06 ± 1.66	7492849	2.73	3.28	1.002×10^{-2}	8.66	1.59	4.31
air mass factor total [1]	4.02 ± 2.01	7492849	2.11	3.44	0.272	14.0	2.66	4.77
number of spectral points in retrieval [1]	304 ± 2	7492849	1.000	304	235	305	304	305
number of iterations [1]	3.66 ± 1.01	7492849	1.000	3.00	3.00	10.00	3.00	4.00
wavelength calibration offset [nm]	$(-2.285 \pm 4.642) \times 10^{-3}$	7492849	4.038×10^{-3}	-1.943×10^{-3}	-7.581×10^{-2}	6.118×10^{-2}	-4.381×10^{-3}	-3.436×10^{-4}
nitrogendioxide stratospheric column [mol/m ²]	$(6.092 \pm 2.904) \times 10^{-5}$	7492849	5.345×10^{-5}	7.182×10^{-5}	9.101×10^{-6}	1.339×10^{-4}	3.342×10^{-5}	8.687×10^{-5}
nitrogendioxide stratospheric column precision [mol/m ²]	$(3.321 \pm 0.000) \times 10^{-6}$	7492849	0.0	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}	3.321×10^{-6}
nitrogendioxide total column [mol/m ²]	$(6.930 \pm 2.594) \times 10^{-5}$	7492849	3.921×10^{-5}	7.733×10^{-5}	2.341×10^{-6}	3.776×10^{-3}	4.740×10^{-5}	8.661×10^{-5}
nitrogendioxide total column precision [mol/m ²]	$(1.446 \pm 0.796) \times 10^{-5}$	7492849	7.294×10^{-6}	1.573×10^{-5}	1.292×10^{-6}	6.378×10^{-3}	1.016×10^{-5}	1.745×10^{-5}
nitrogendioxide summed total column [mol/m ²]	$(7.479 \pm 6.174) \times 10^{-5}$	7492849	3.866×10^{-5}	7.909×10^{-5}	-3.019×10^{-3}	9.188×10^{-3}	4.840×10^{-5}	8.706×10^{-5}
nitrogendioxide summed total column precision [mol/m ²]	$(1.702 \pm 11.428) \times 10^{-5}$	7492849	6.578×10^{-6}	6.720×10^{-6}	4.479×10^{-6}	6.604×10^{-2}	4.888×10^{-6}	1.147×10^{-5}
chi square [1]	469 ± 533	7492849	175	389	162	8.983×10^4	309	484
root mean square error of fit [1]	$(5.211 \pm 2.754) \times 10^{-4}$	7492849	2.824×10^{-4}	5.133×10^{-4}	8.506×10^{-5}	6.611×10^{-3}	3.425×10^{-4}	6.249×10^{-4}
air mass factor stratosphere [1]	4.61 ± 2.47	7492849	2.41	3.73	2.06	15.5	2.95	5.37

3 Granule outlines

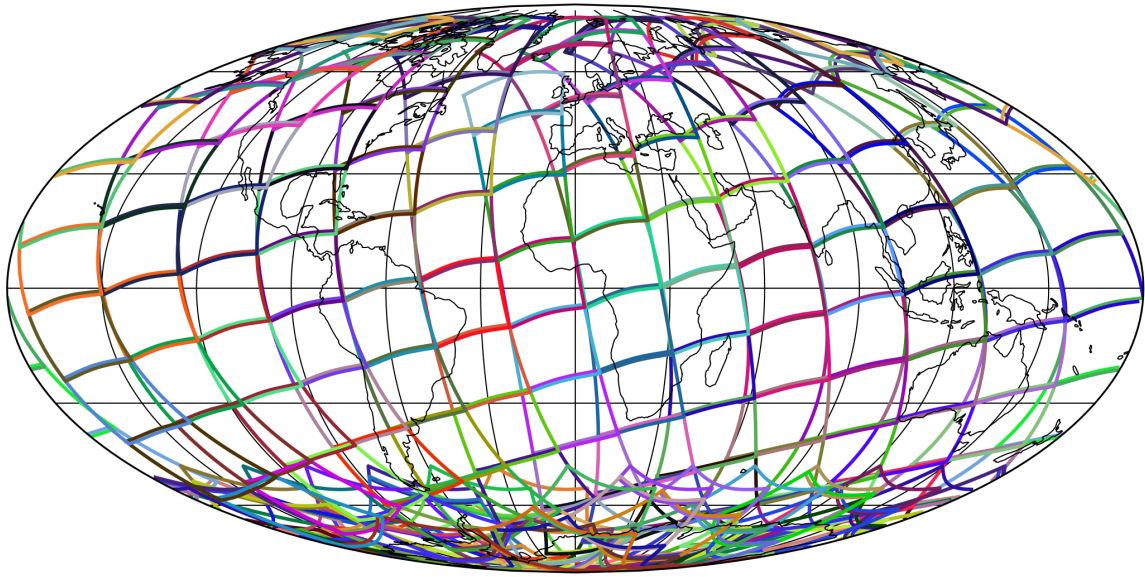


Figure 1: Outline of the granules.

4 Input data monitoring

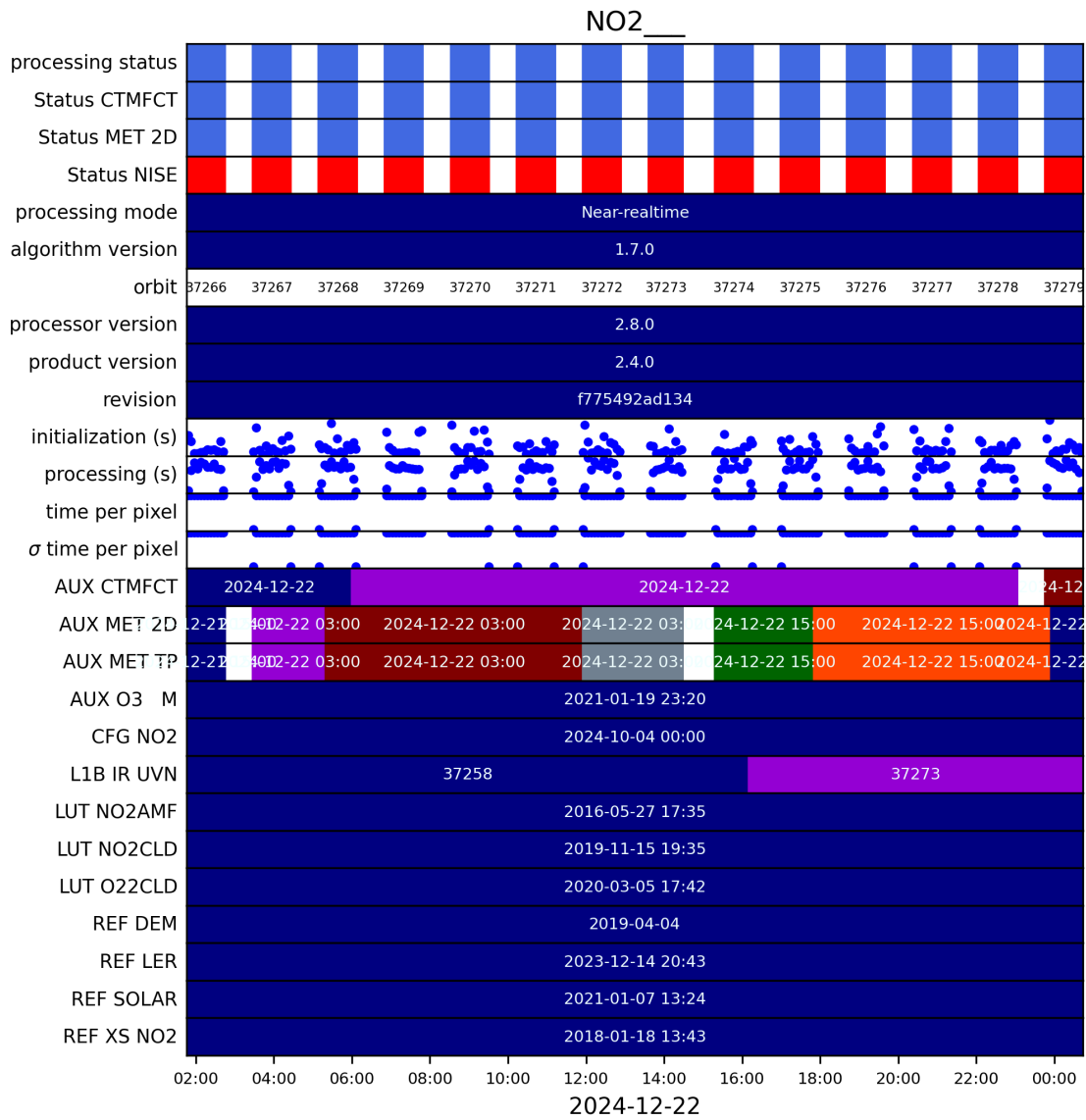


Figure 2: Input data per granule

5 Warnings and errors

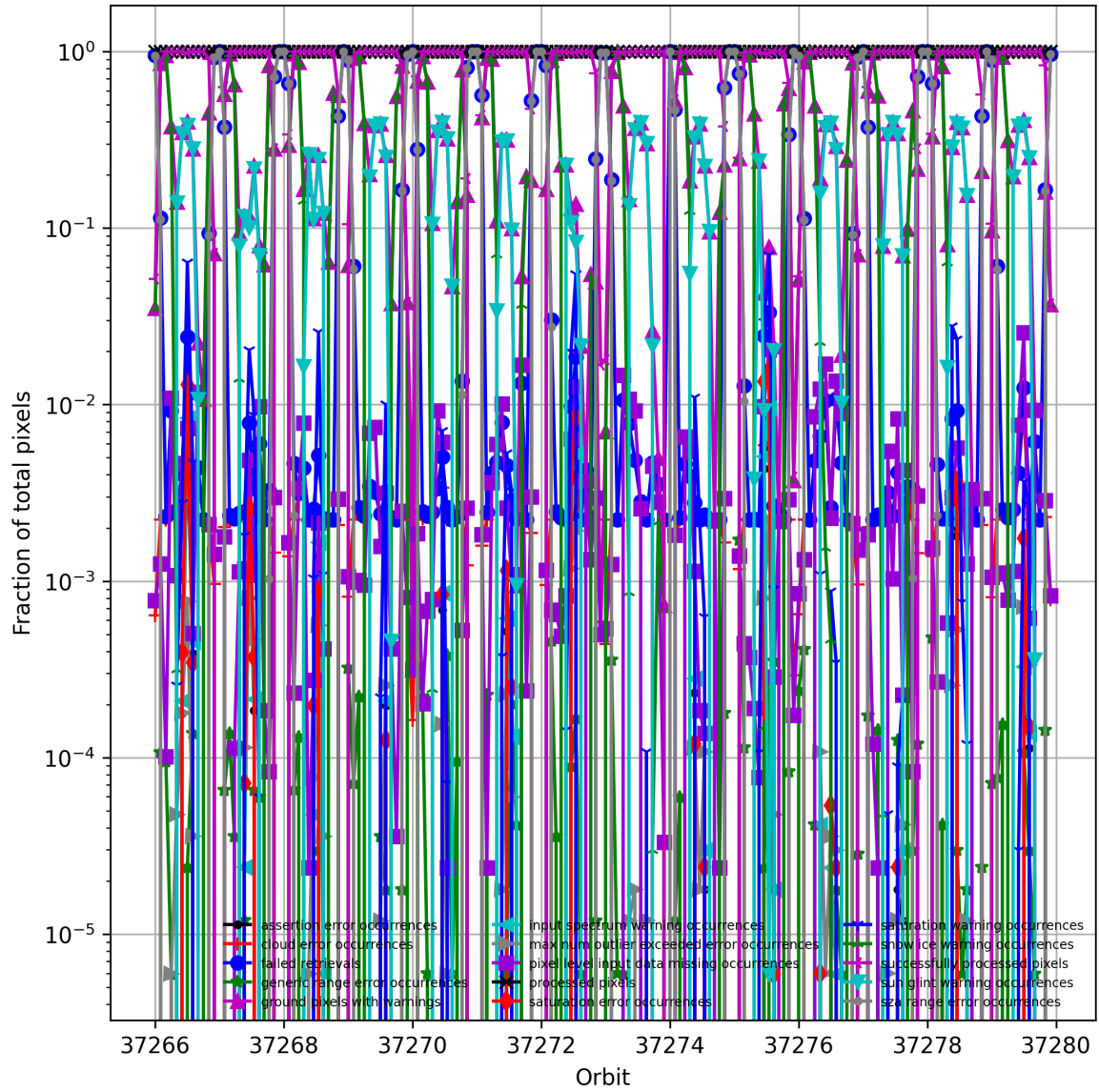


Figure 3: Fraction of pixels with specific warnings and errors during processing

6 World maps

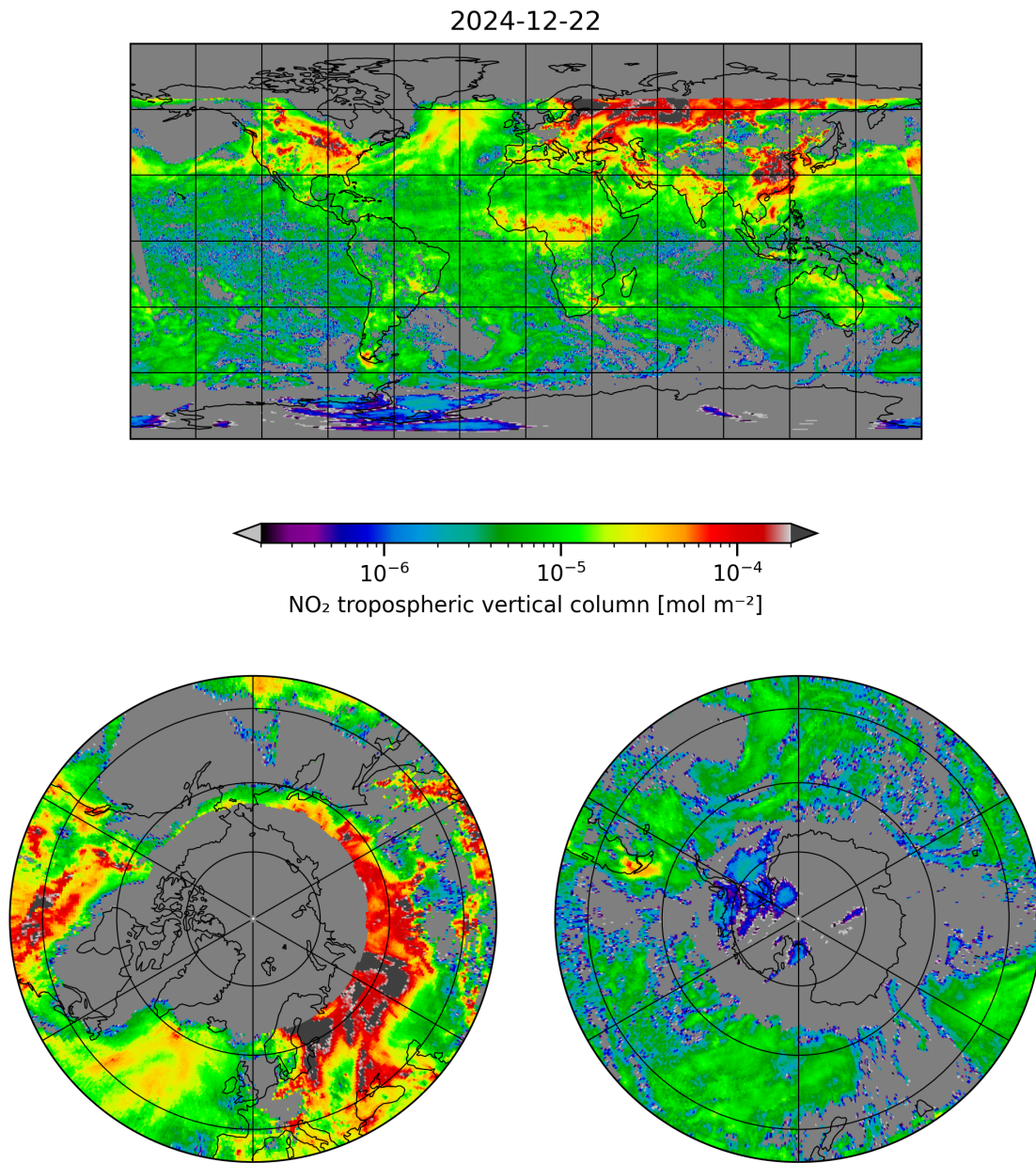


Figure 4: Map of “NO₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23

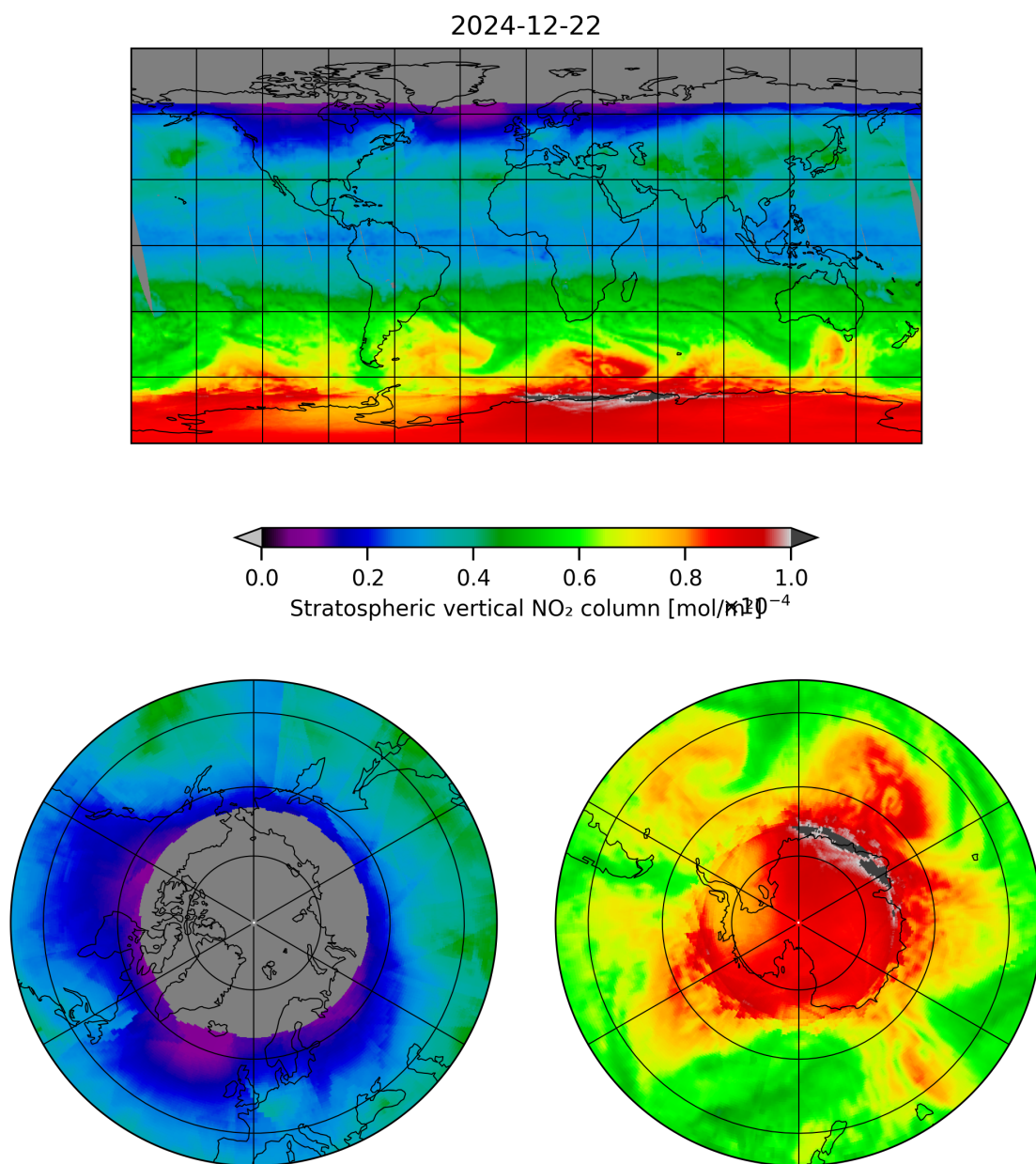


Figure 5: Map of “Stratospheric vertical NO₂ column” for 2024-12-22 to 2024-12-23

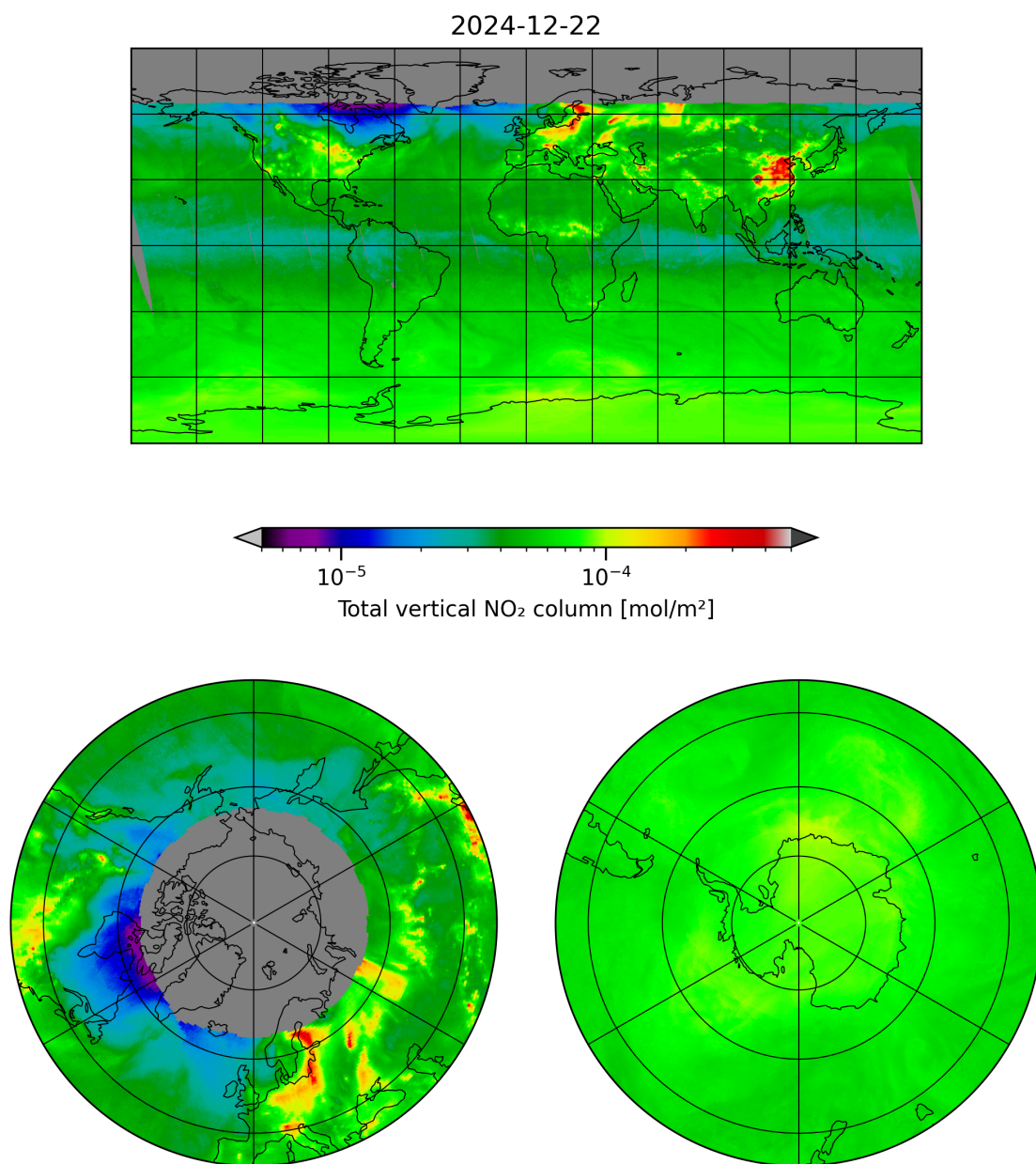


Figure 6: Map of “Total vertical NO₂ column” for 2024-12-22 to 2024-12-23

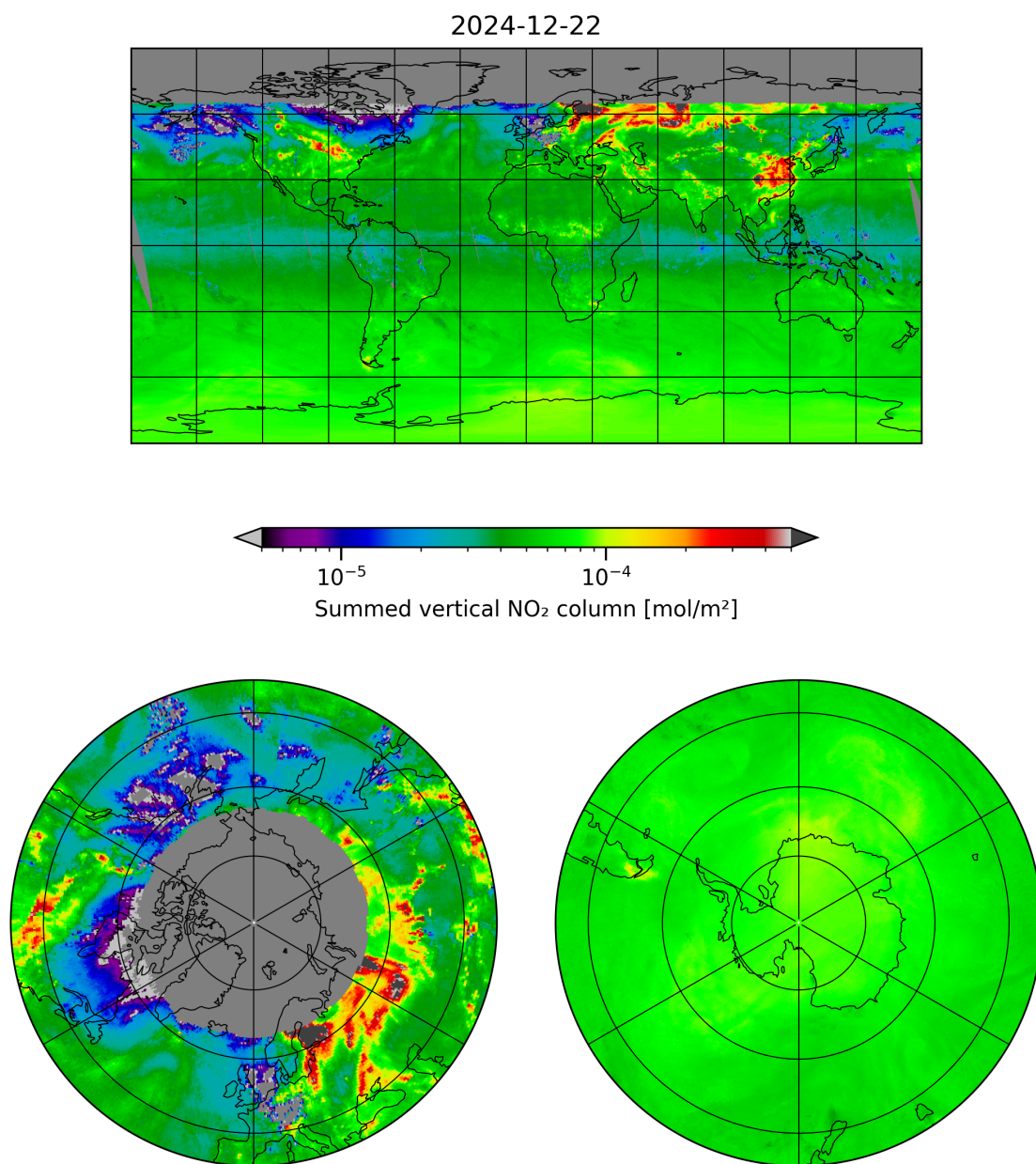


Figure 7: Map of “Summed vertical NO₂ column” for 2024-12-22 to 2024-12-23

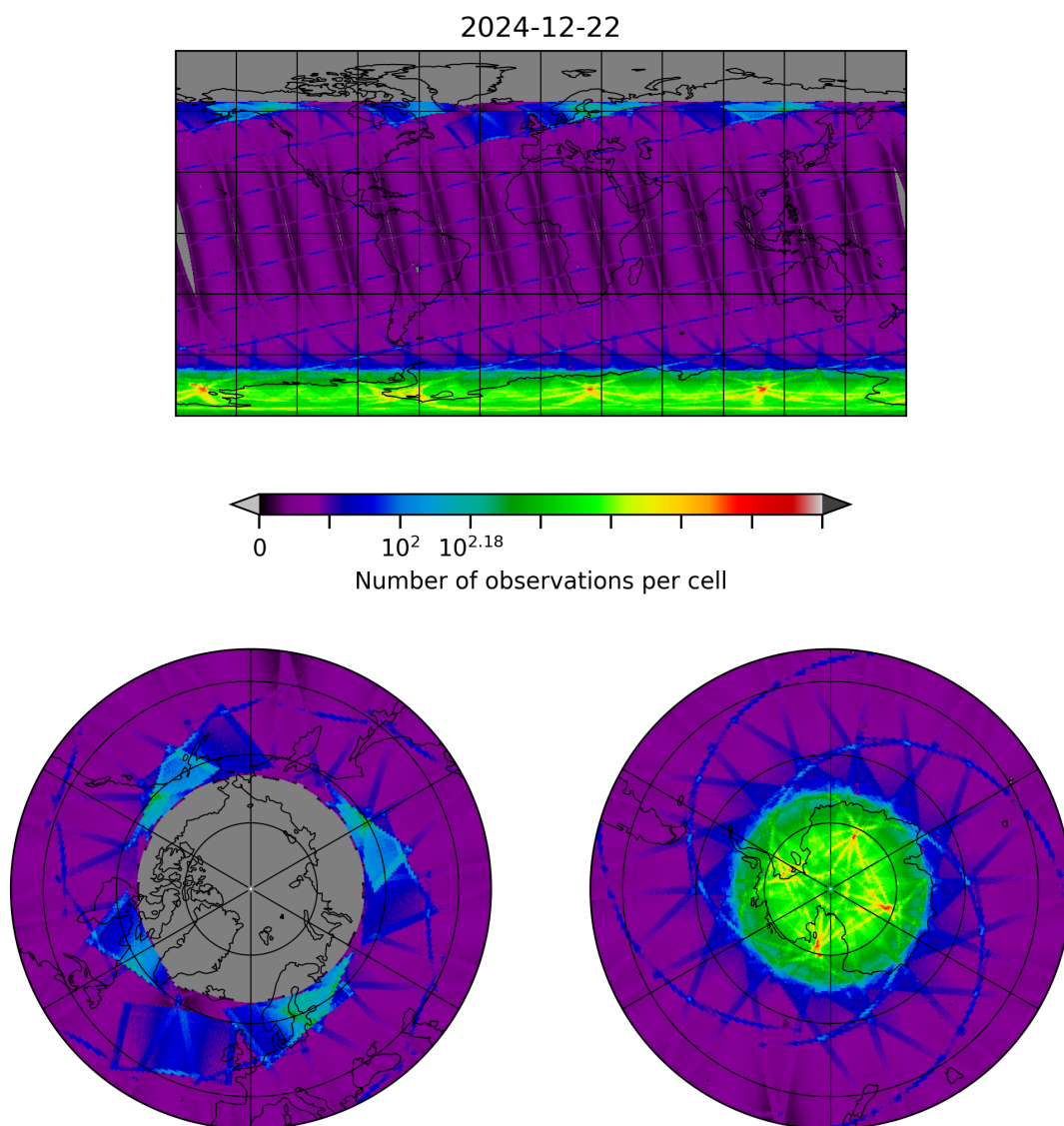


Figure 8: Map of the number of observations for 2024-12-22 to 2024-12-23

7 Zonal average

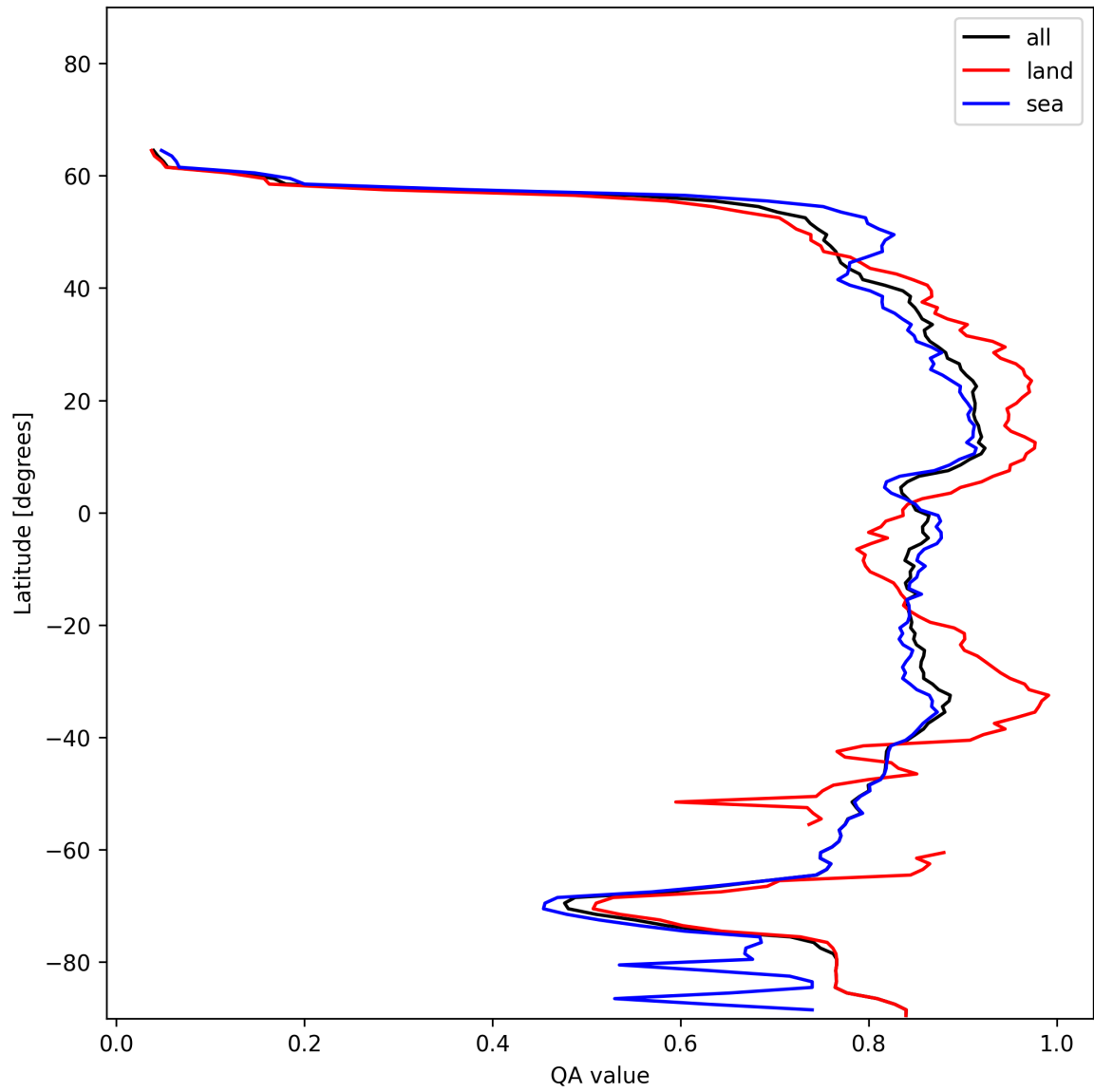


Figure 9: Zonal average of “QA value” for 2024-12-22 to 2024-12-23.

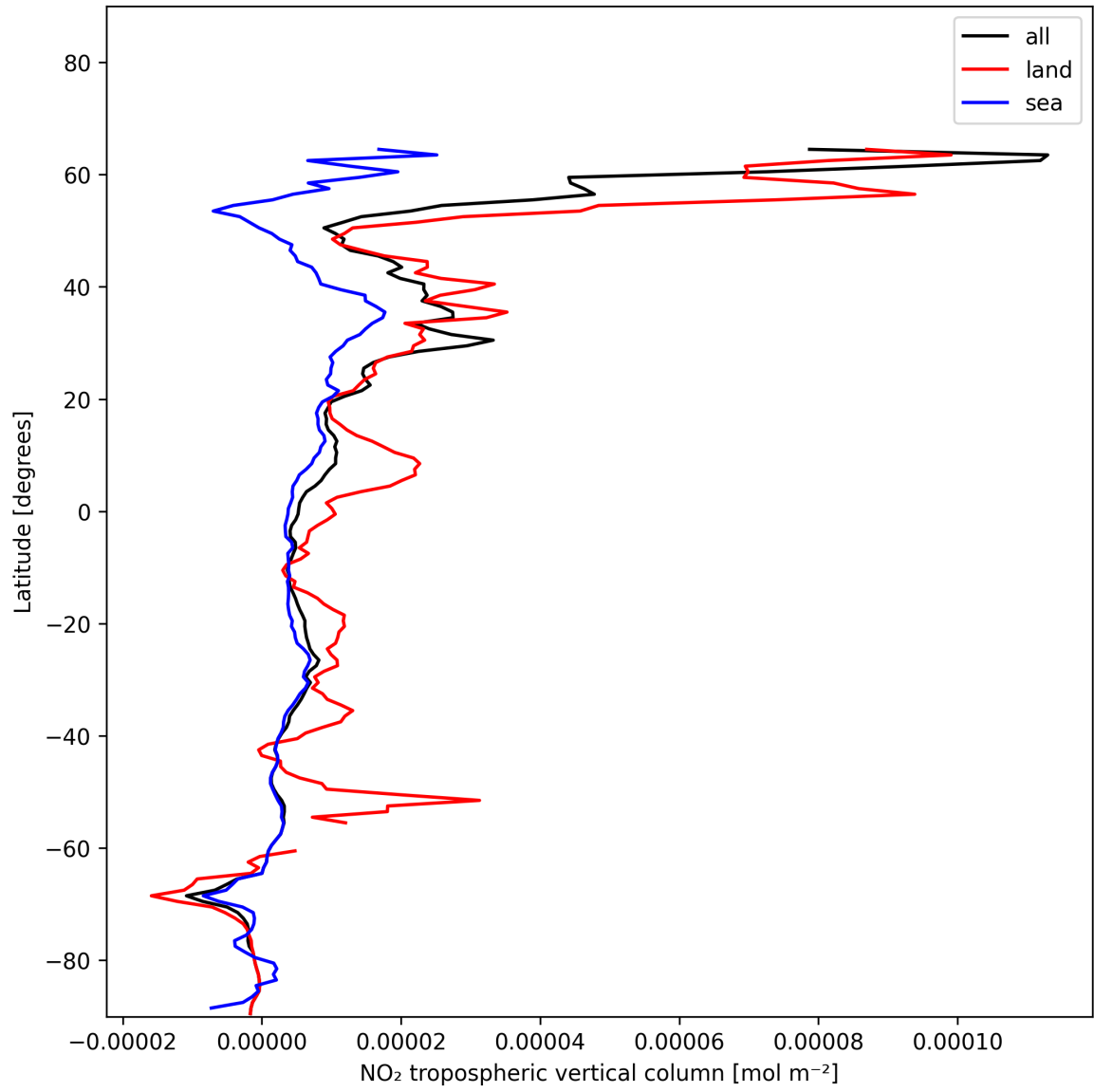


Figure 10: Zonal average of “NO₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23.

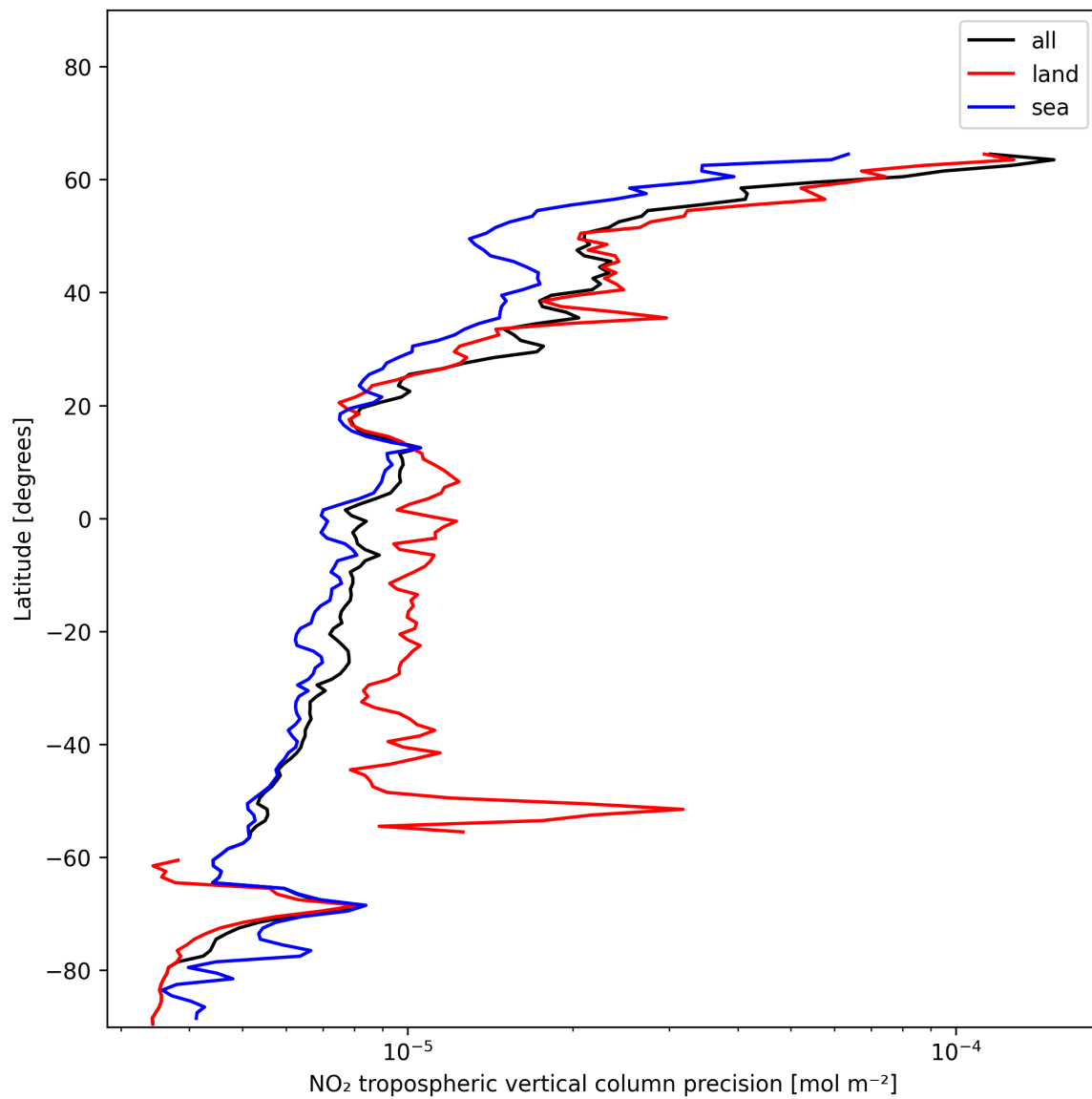


Figure 11: Zonal average of “NO₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23.

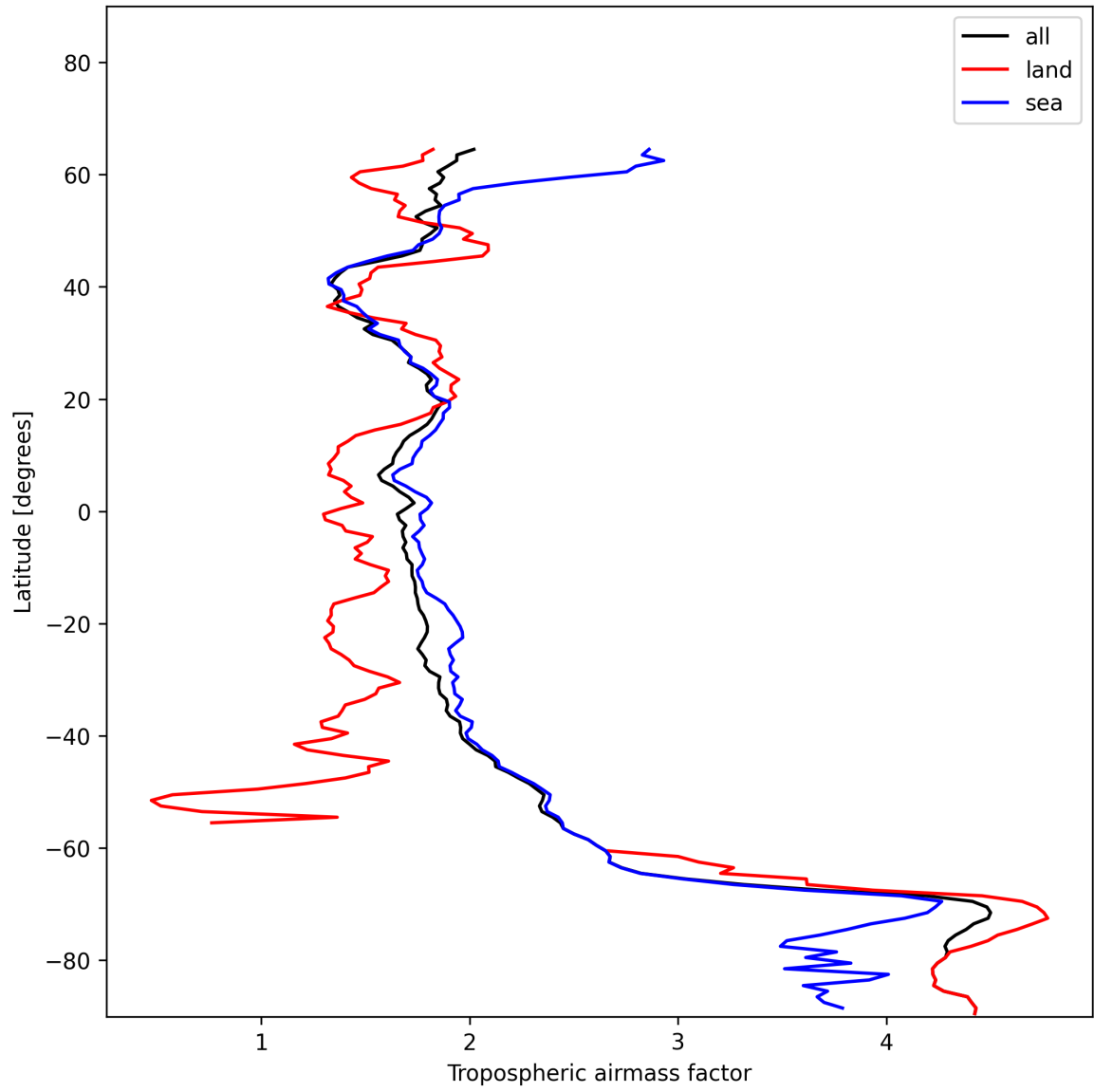


Figure 12: Zonal average of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23.

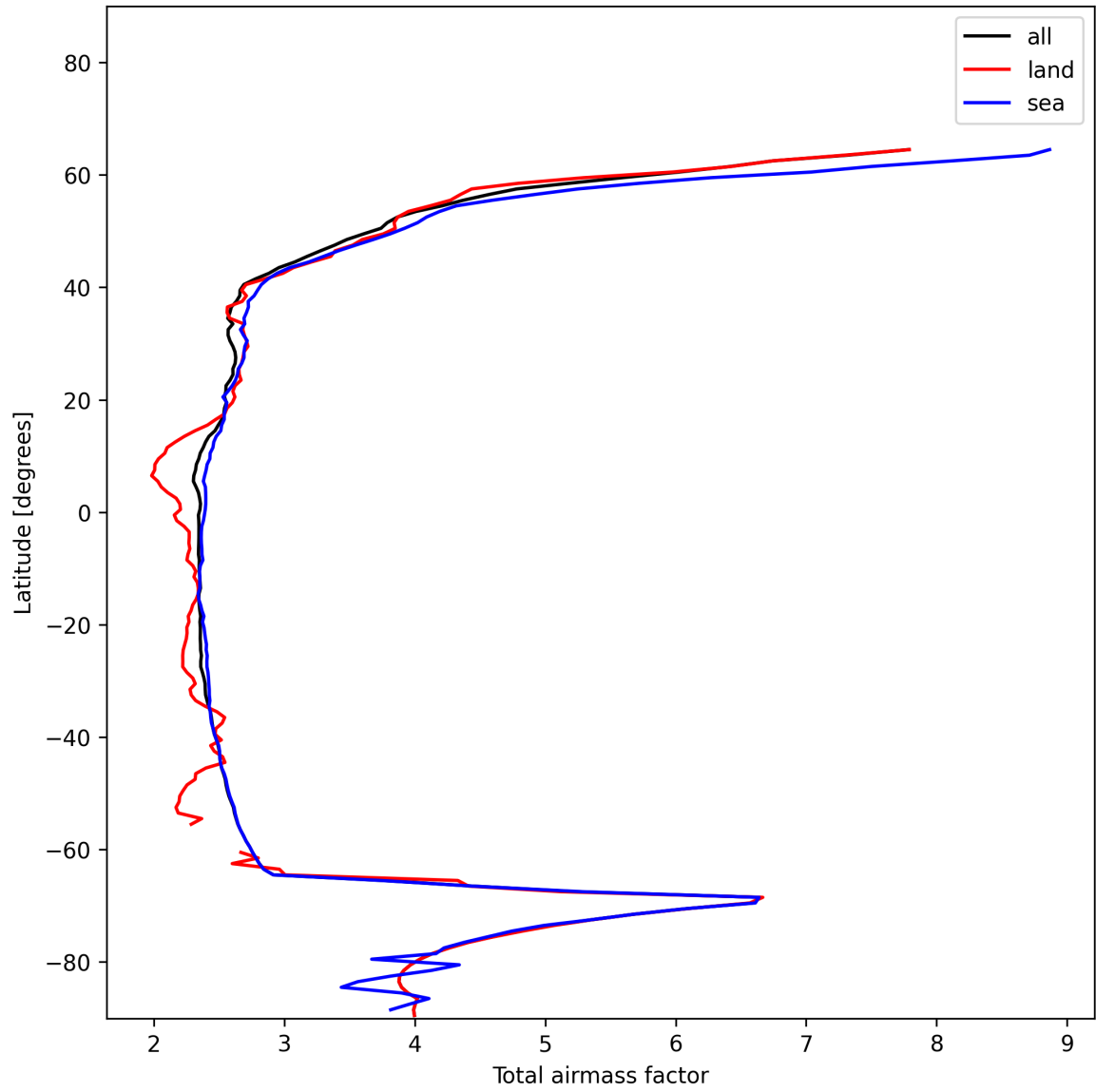


Figure 13: Zonal average of “Total airmass factor” for 2024-12-22 to 2024-12-23.

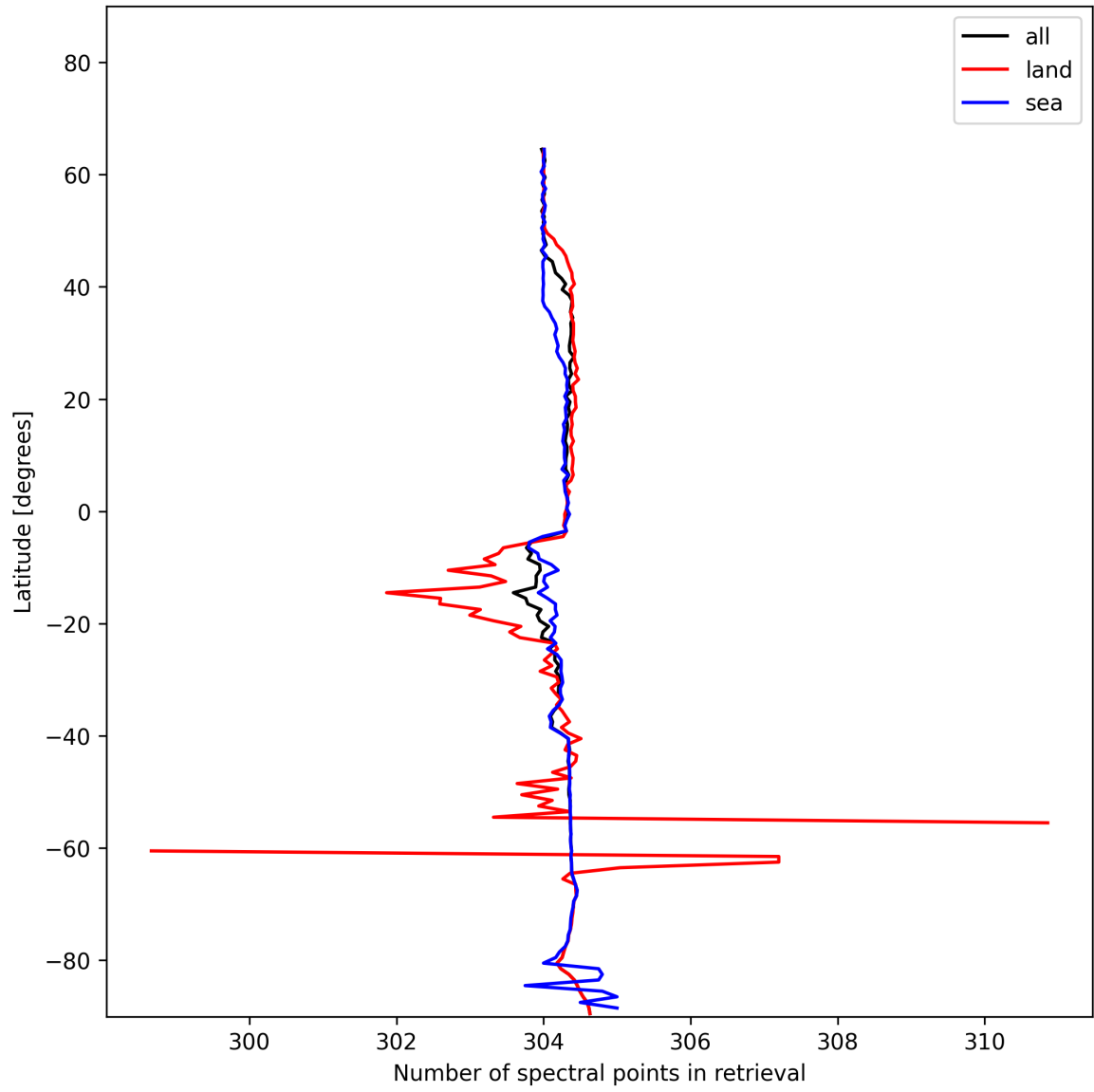


Figure 14: Zonal average of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23.

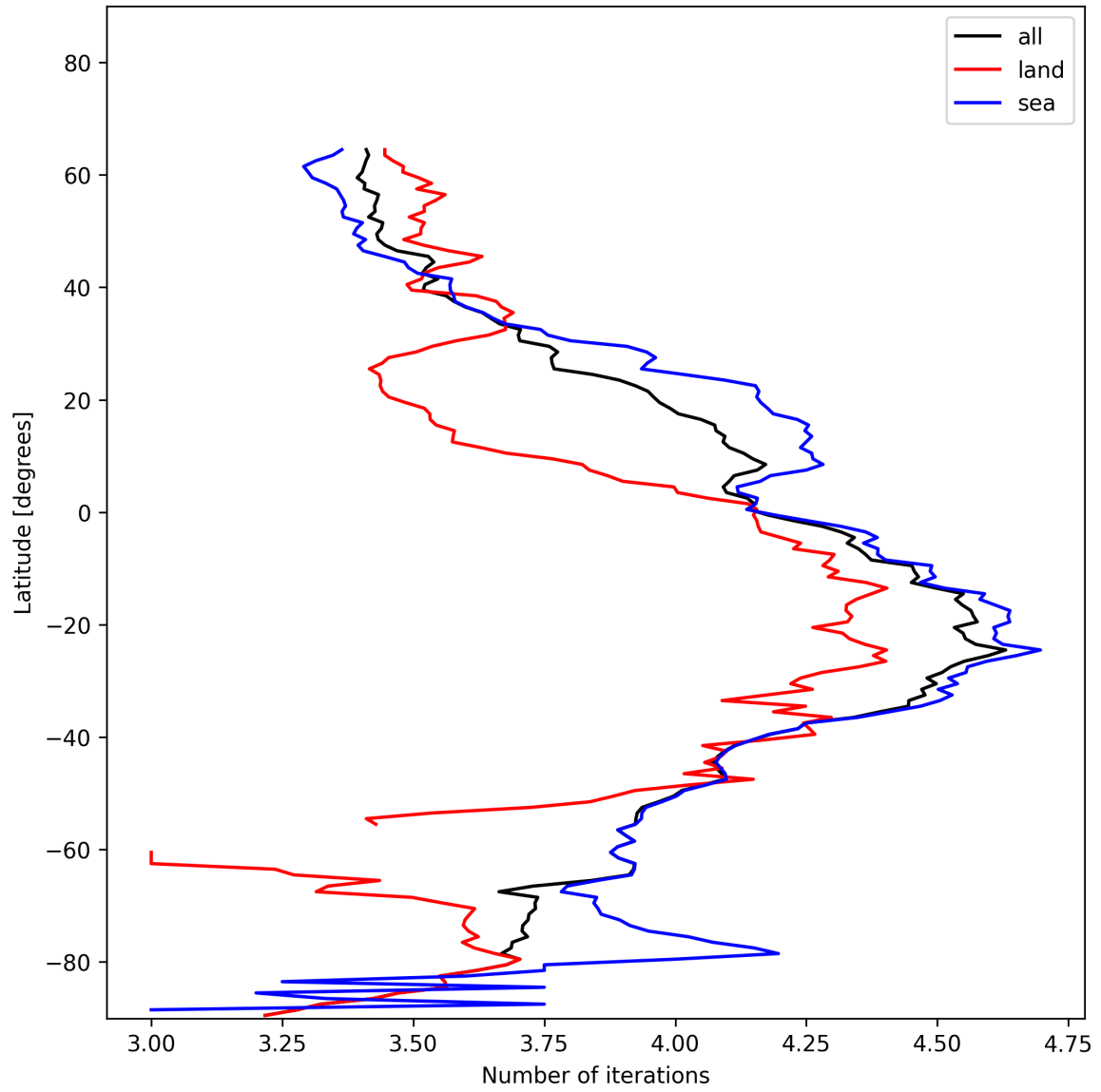


Figure 15: Zonal average of “Number of iterations” for 2024-12-22 to 2024-12-23.

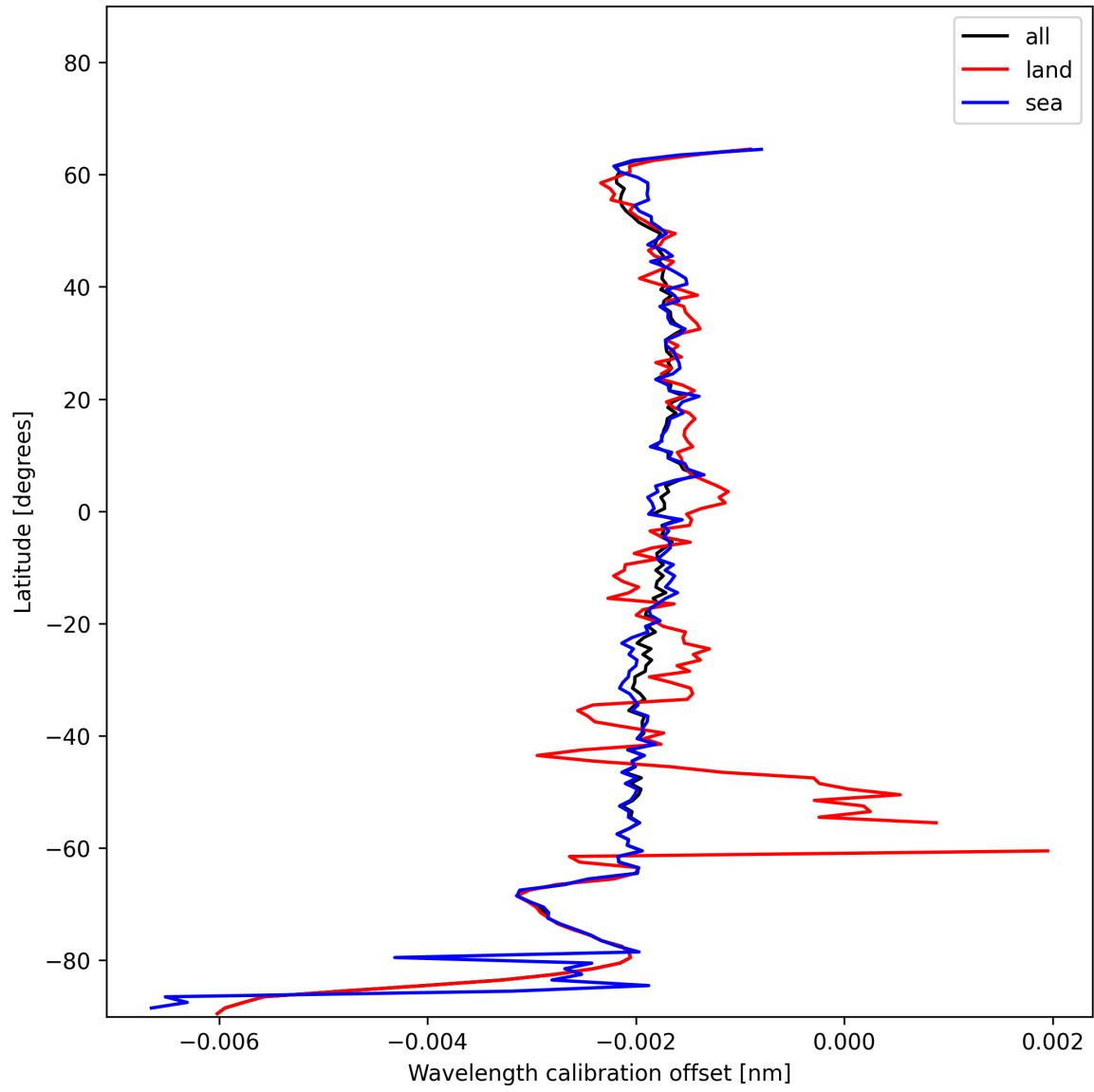


Figure 16: Zonal average of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23.

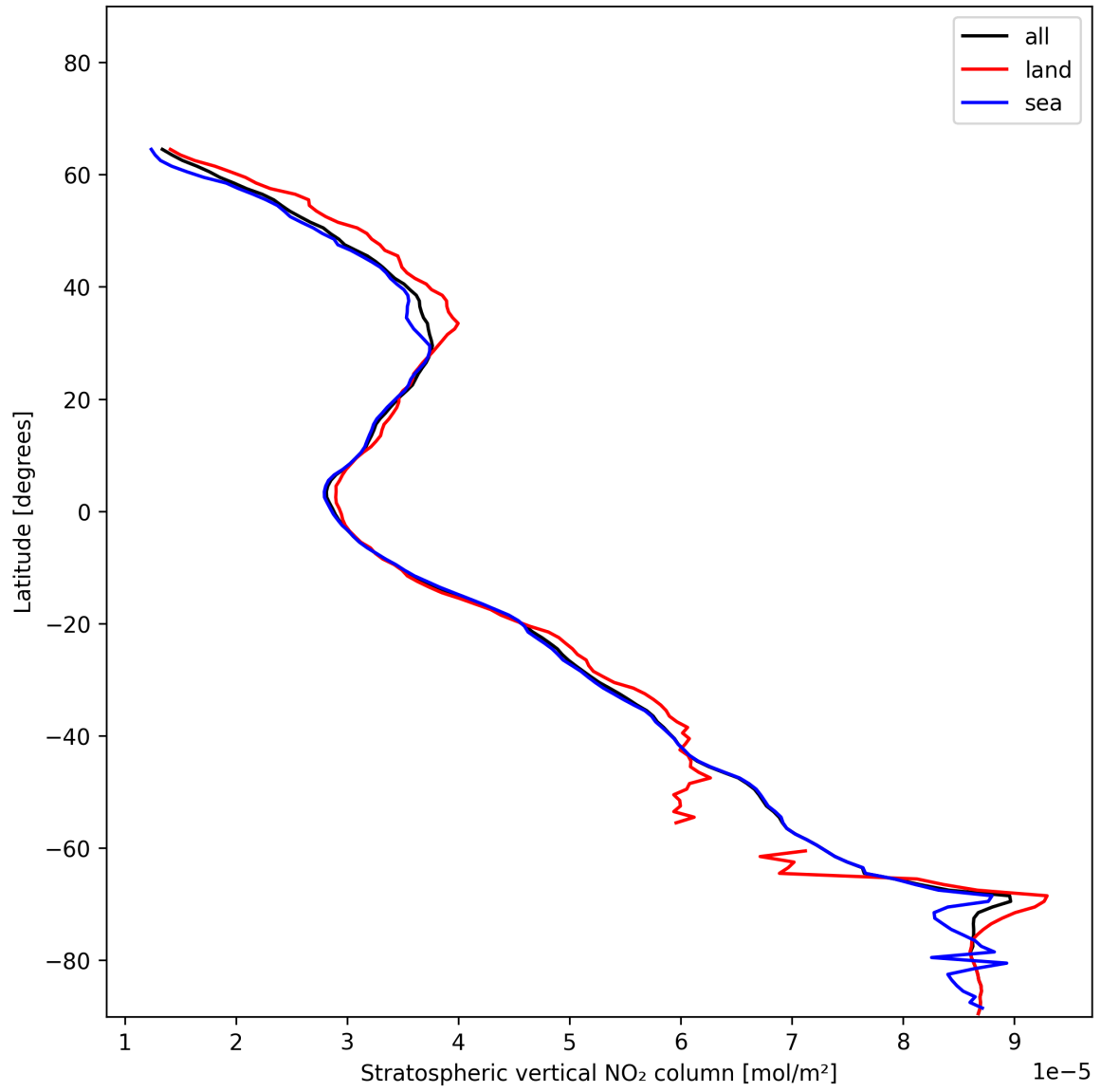


Figure 17: Zonal average of “Stratospheric vertical NO₂ column” for 2024-12-22 to 2024-12-23.

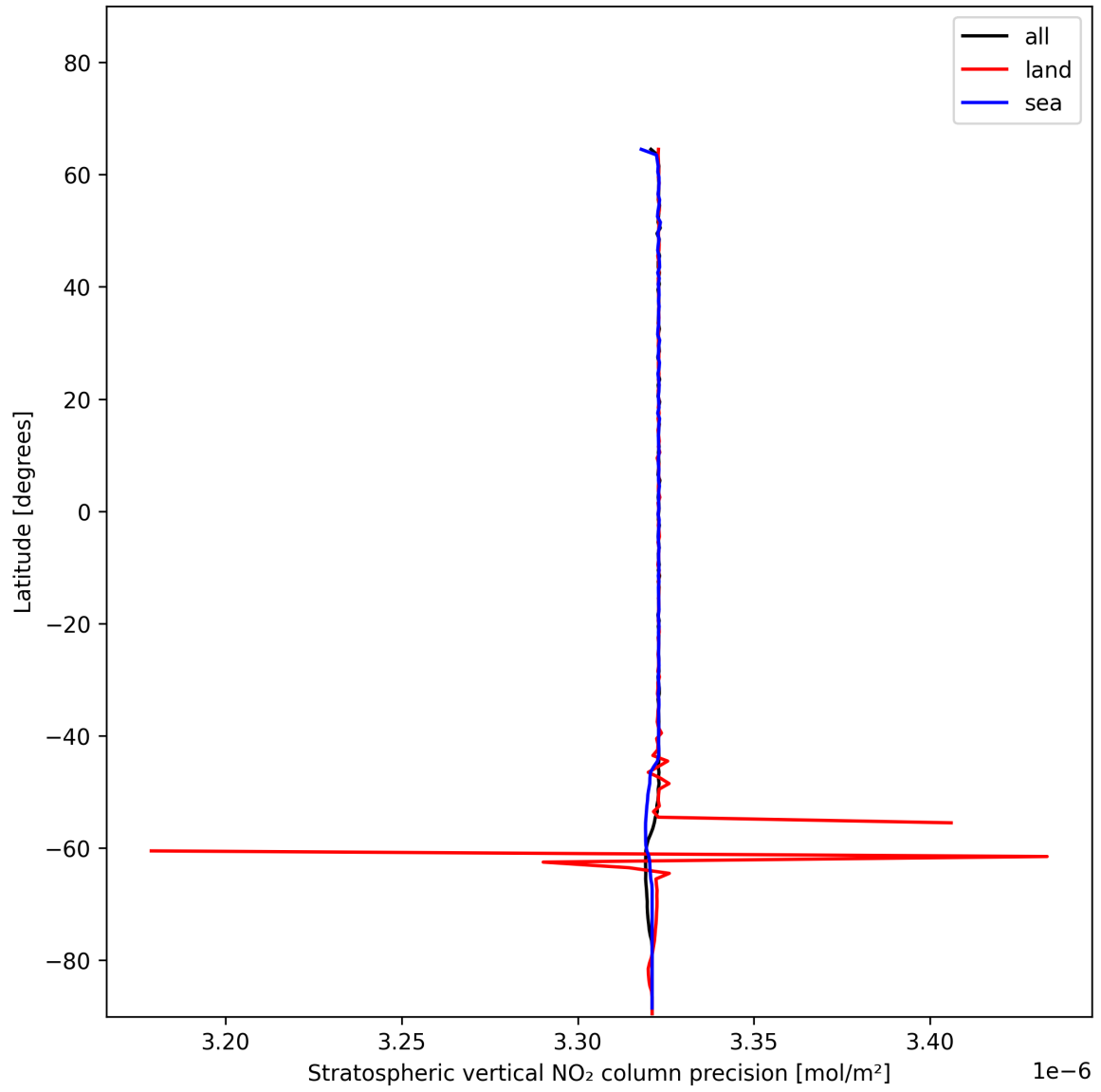


Figure 18: Zonal average of “Stratospheric vertical NO₂ column precision” for 2024-12-22 to 2024-12-23.

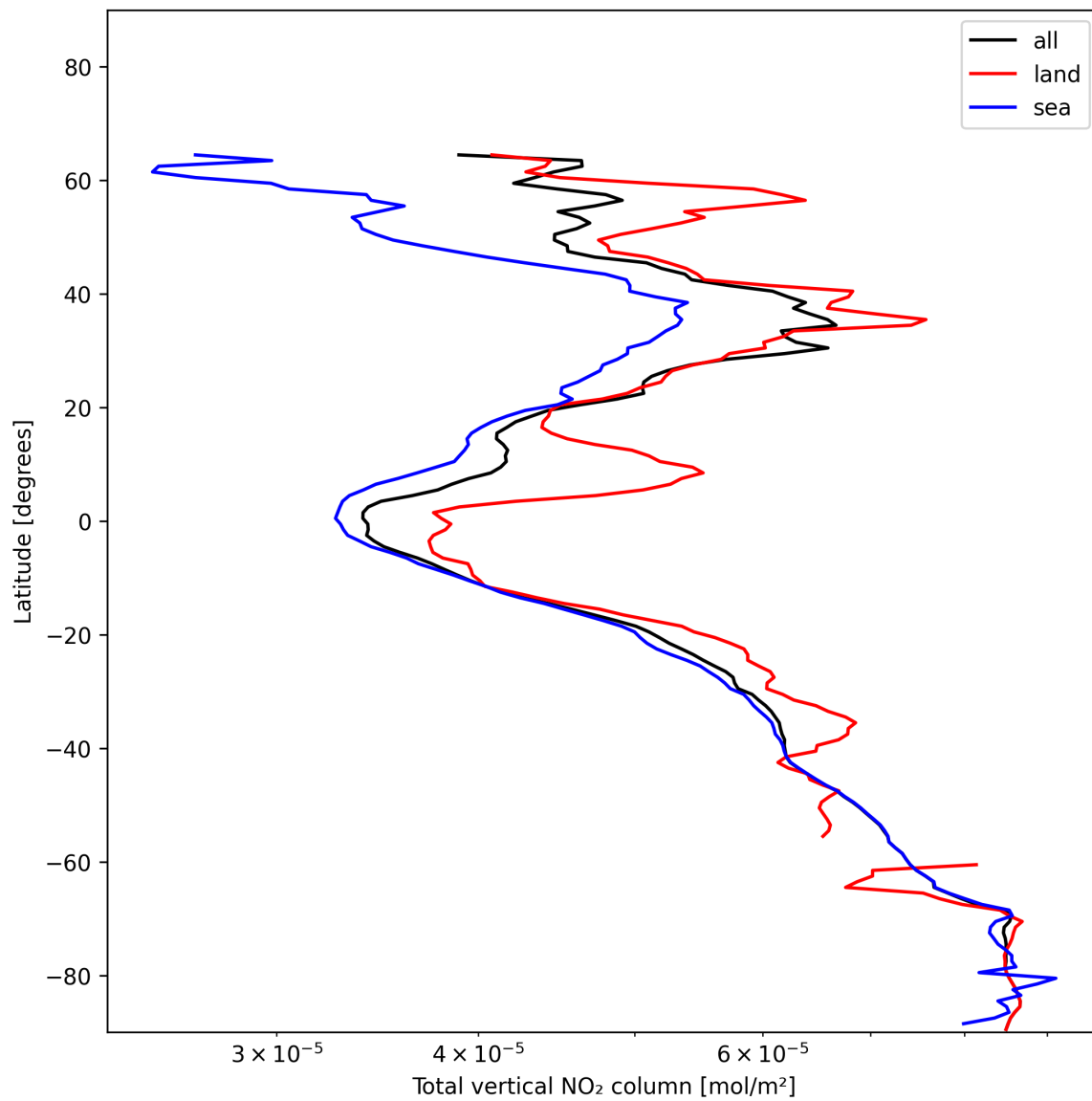


Figure 19: Zonal average of “Total vertical NO₂ column” for 2024-12-22 to 2024-12-23.

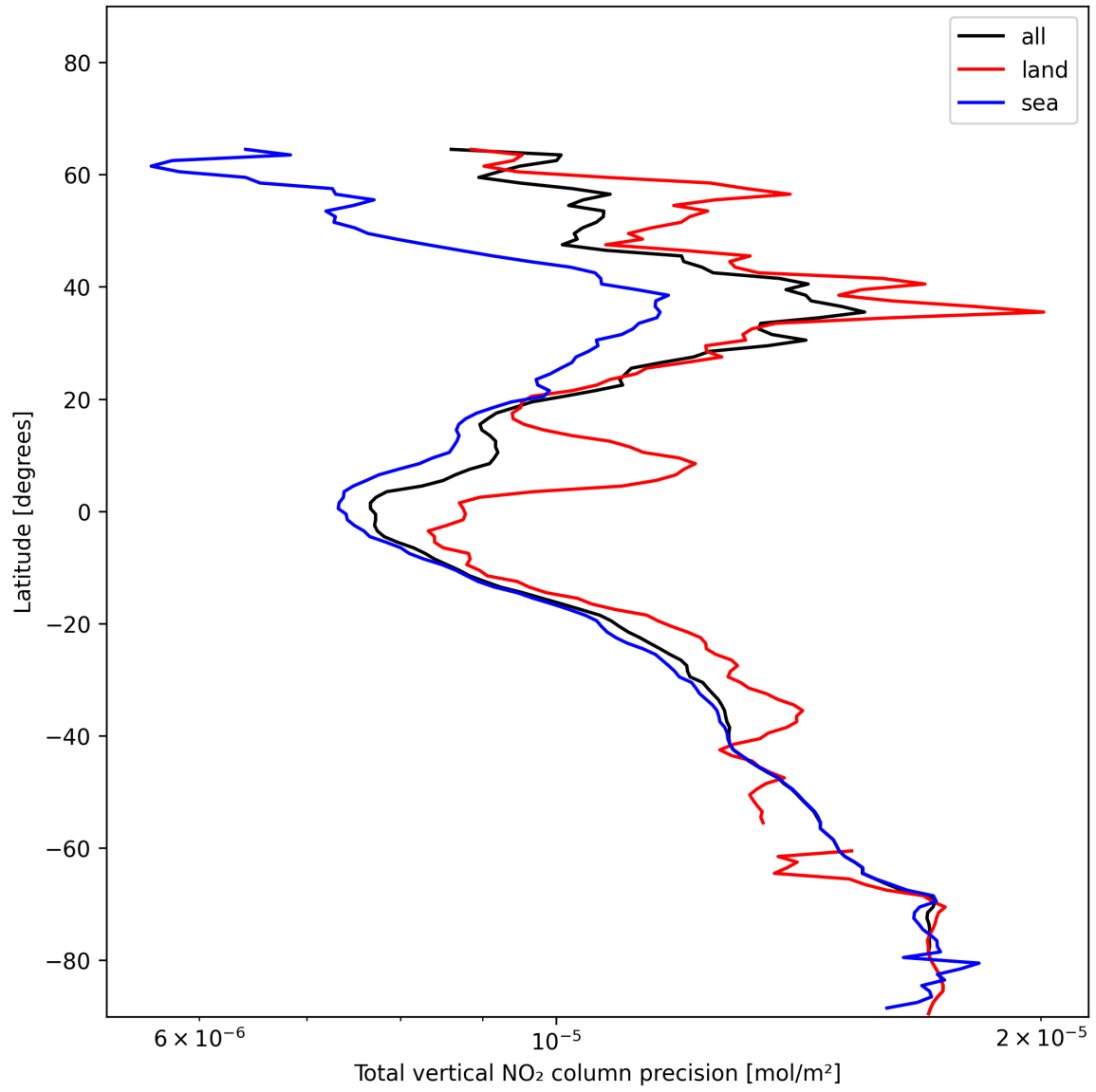


Figure 20: Zonal average of “Total vertical NO₂ column precision” for 2024-12-22 to 2024-12-23.

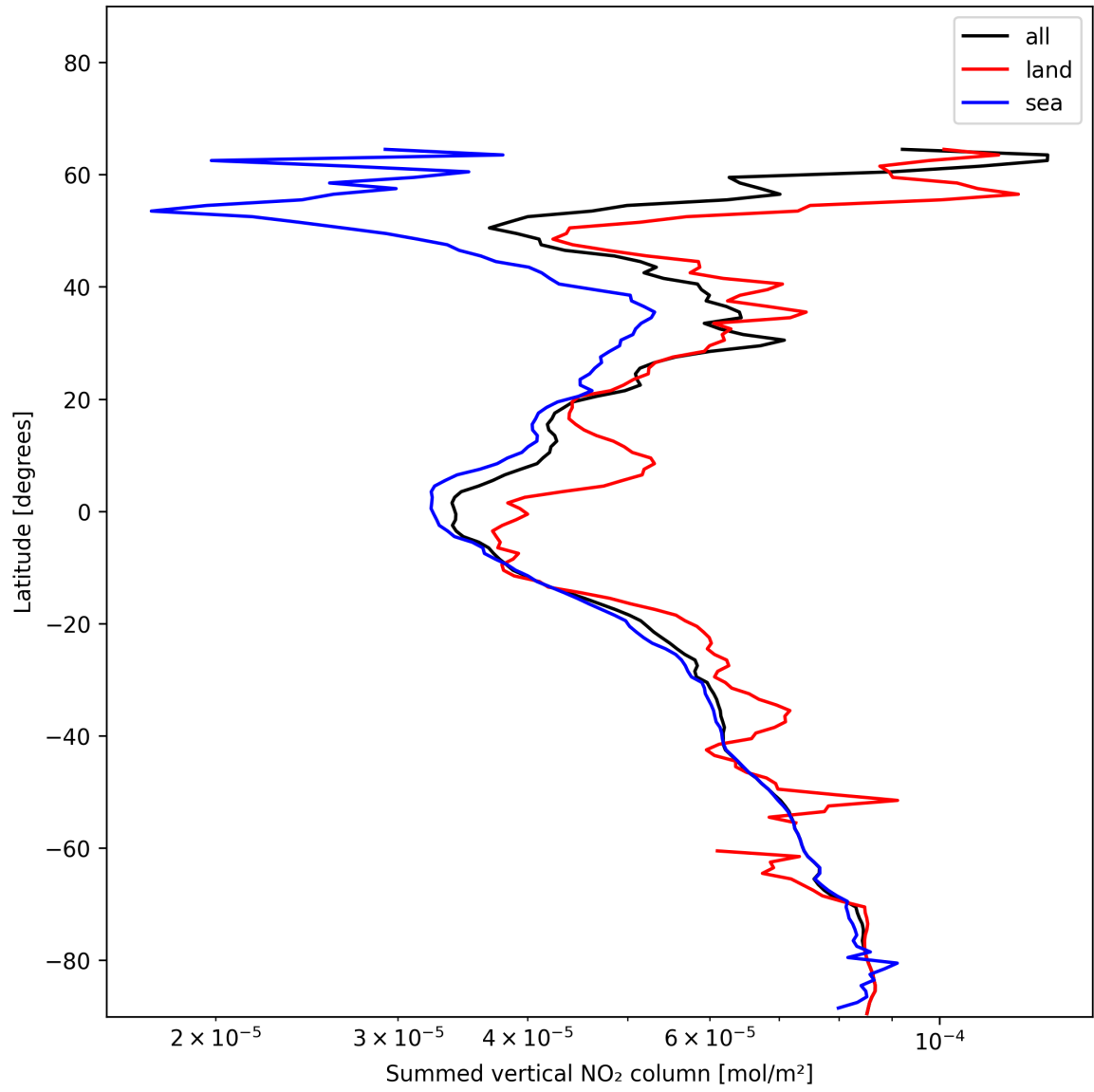


Figure 21: Zonal average of “Summed vertical NO₂ column” for 2024-12-22 to 2024-12-23.

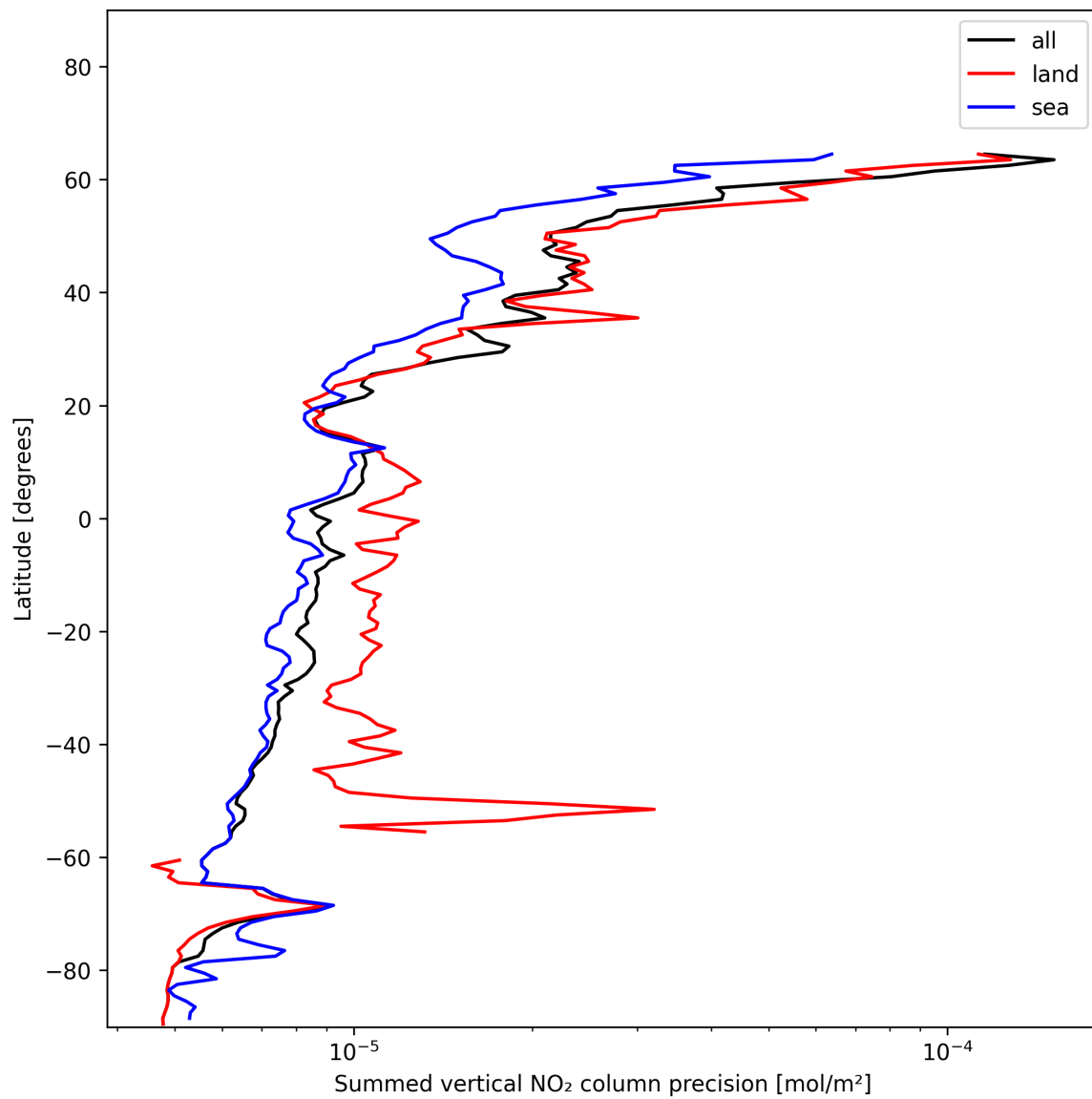


Figure 22: Zonal average of “Summed vertical NO₂ column precision” for 2024-12-22 to 2024-12-23.

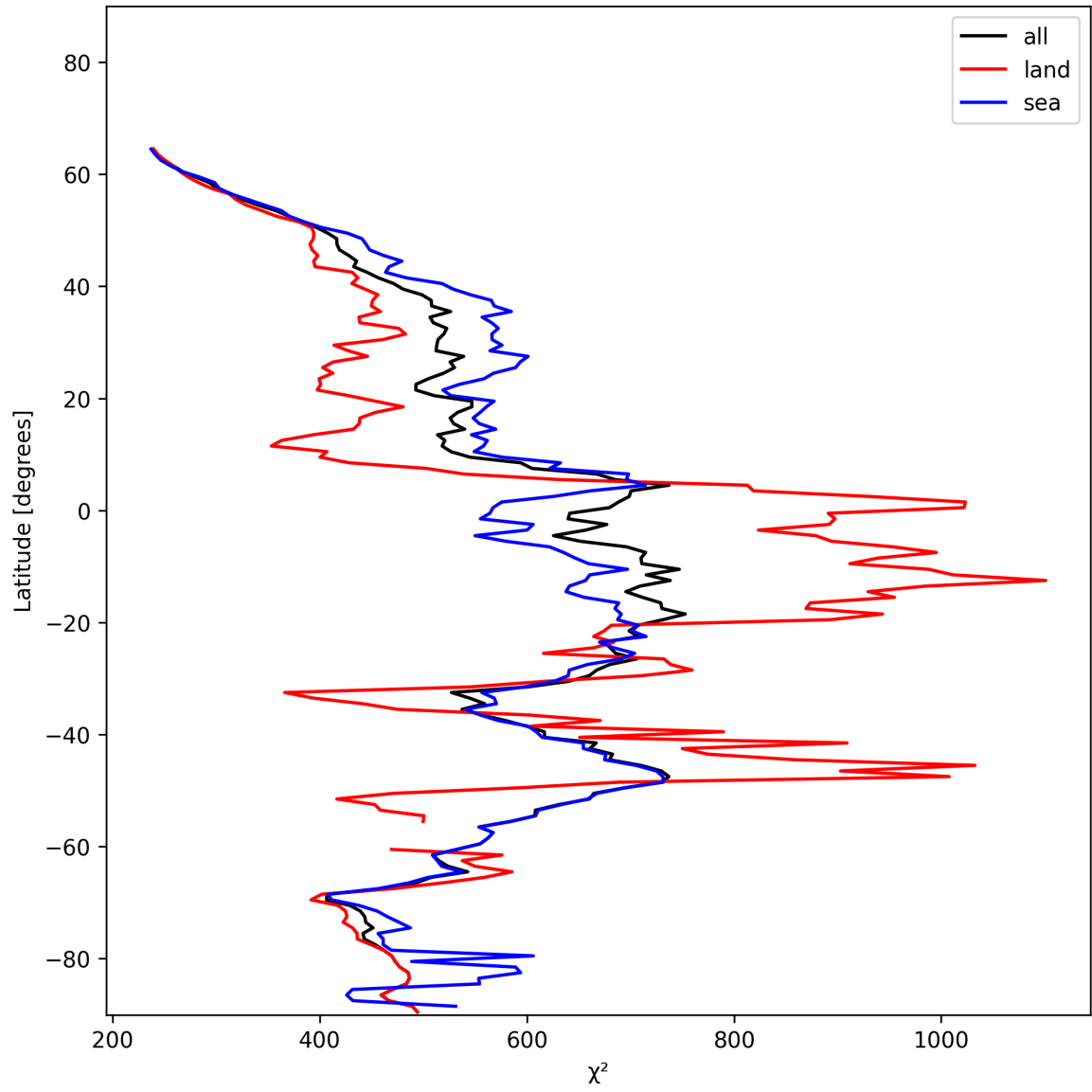


Figure 23: Zonal average of “ χ^2 ” for 2024-12-22 to 2024-12-23.

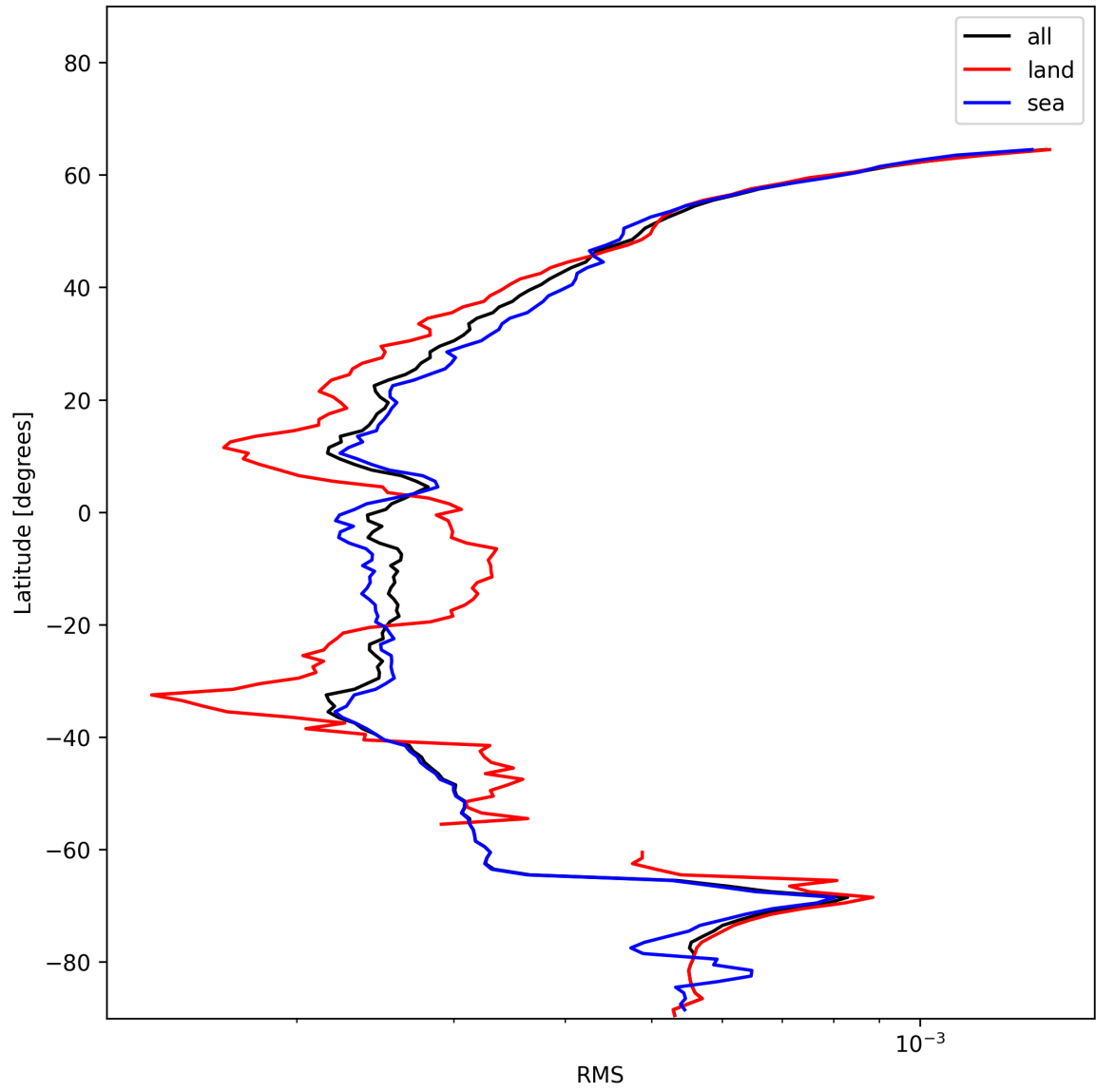


Figure 24: Zonal average of “RMS” for 2024-12-22 to 2024-12-23.

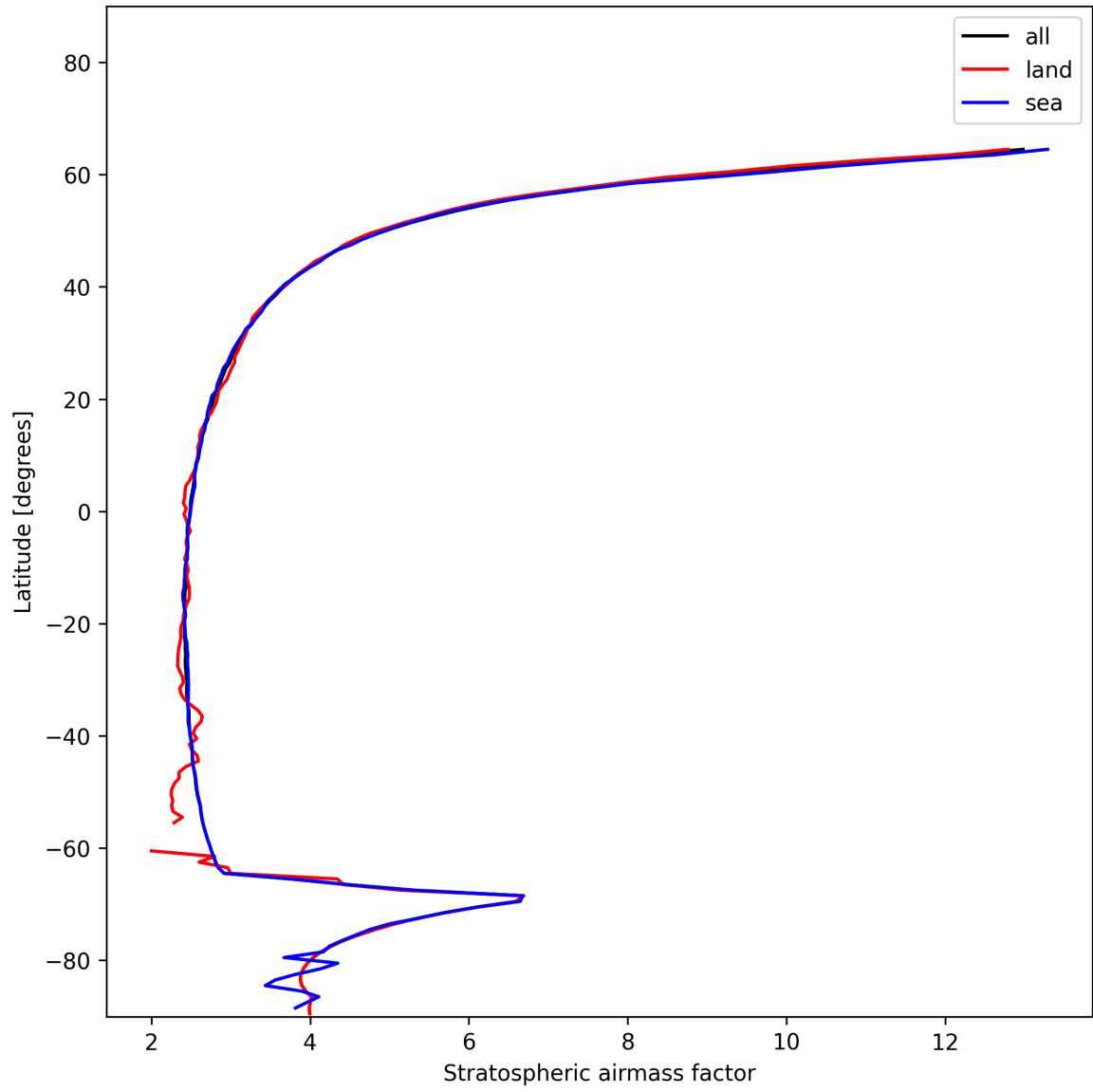


Figure 25: Zonal average of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23.

8 Histograms

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

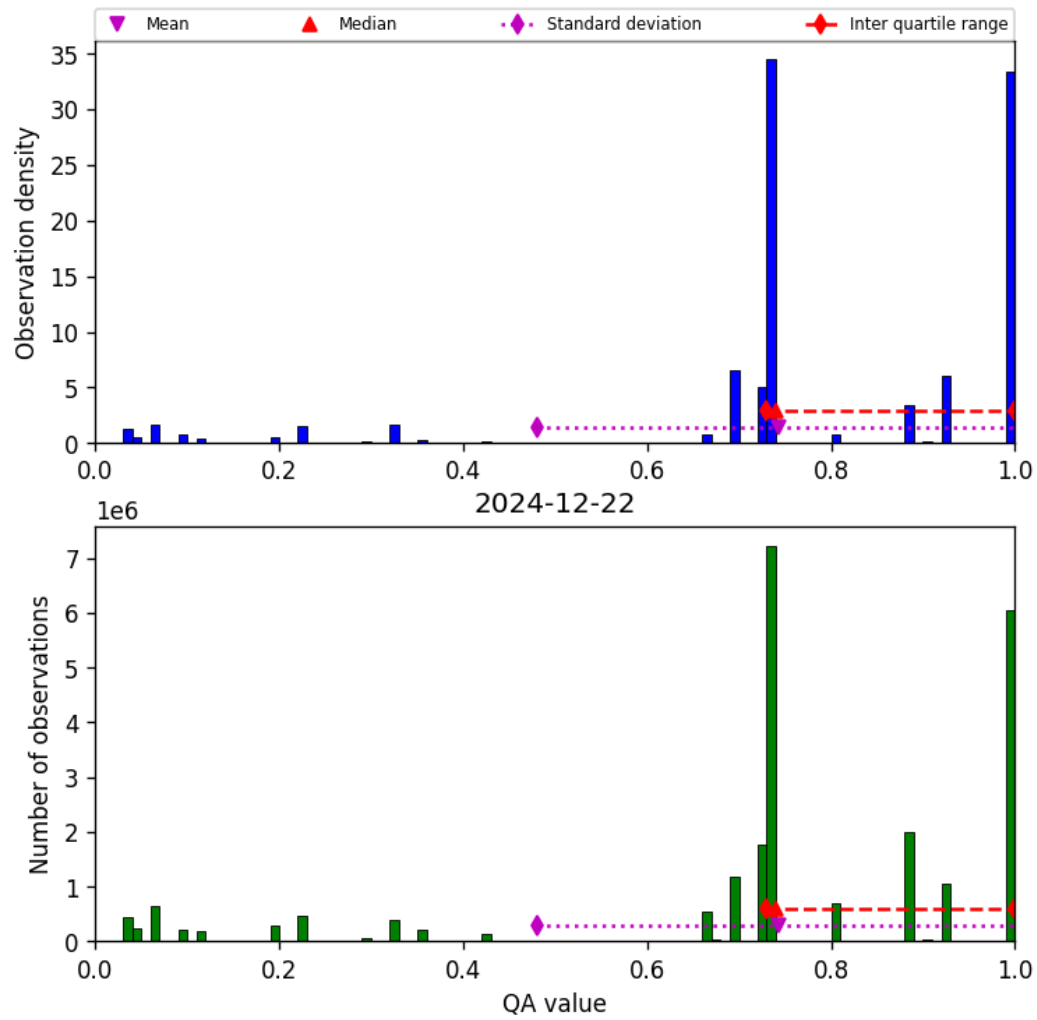


Figure 26: Histogram of “QA value” for 2024-12-22 to 2024-12-23

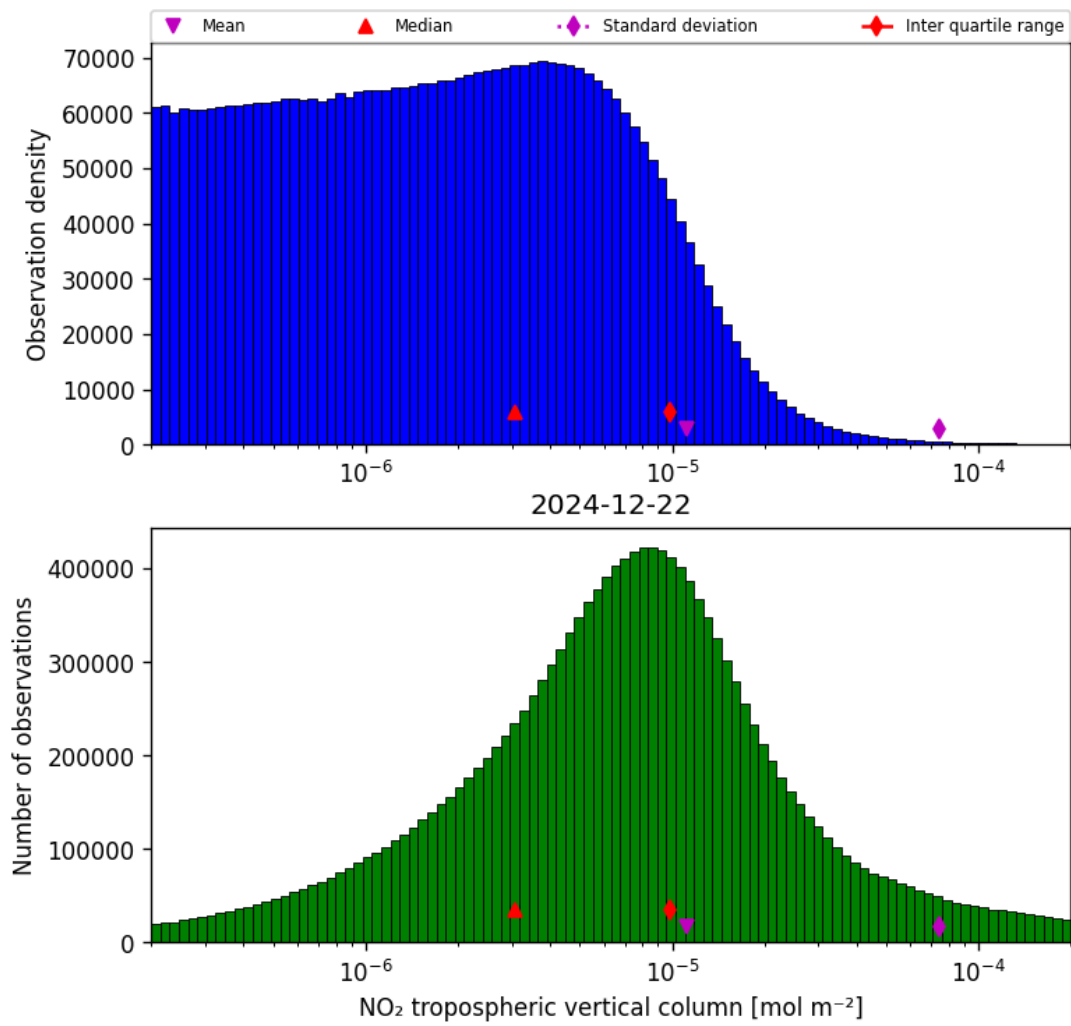


Figure 27: Histogram of “NO₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23

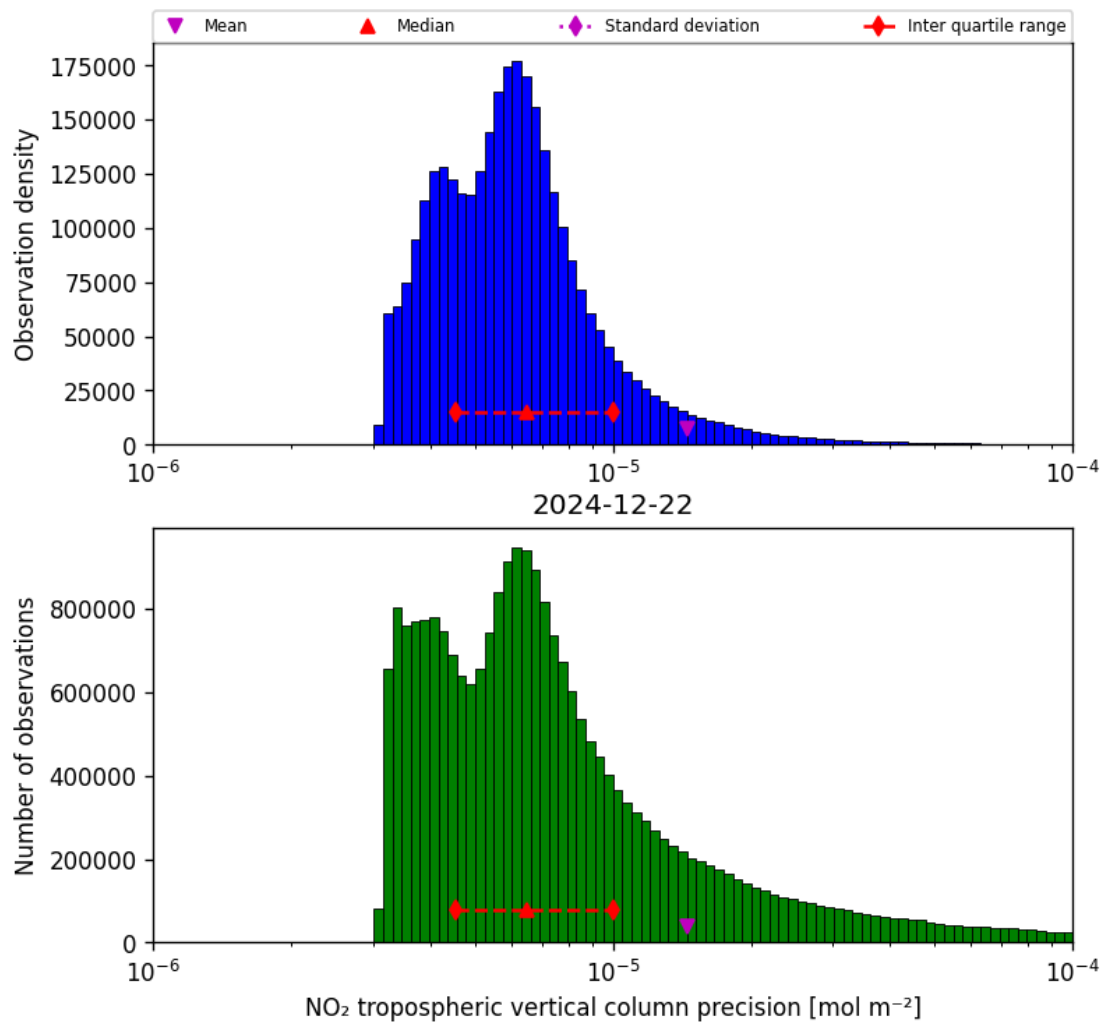


Figure 28: Histogram of “NO₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23

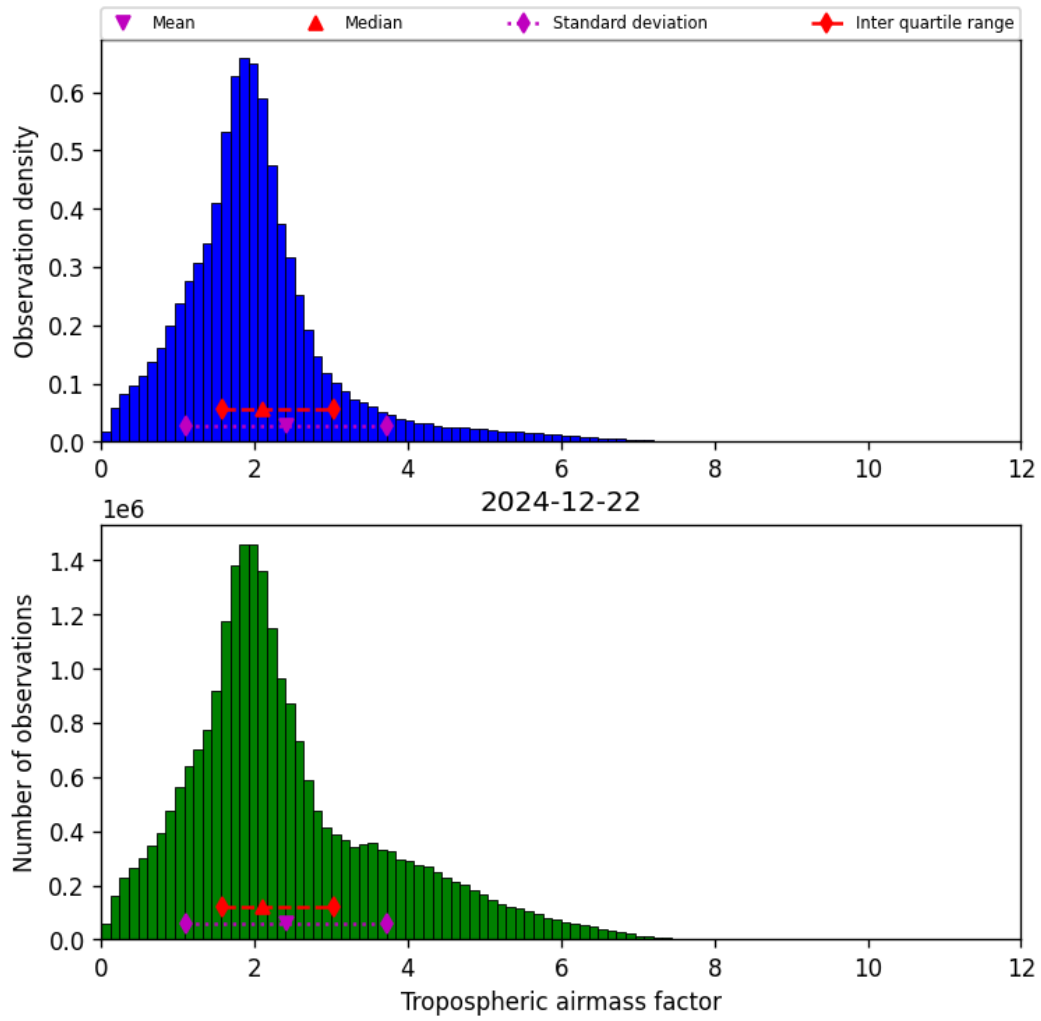


Figure 29: Histogram of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23

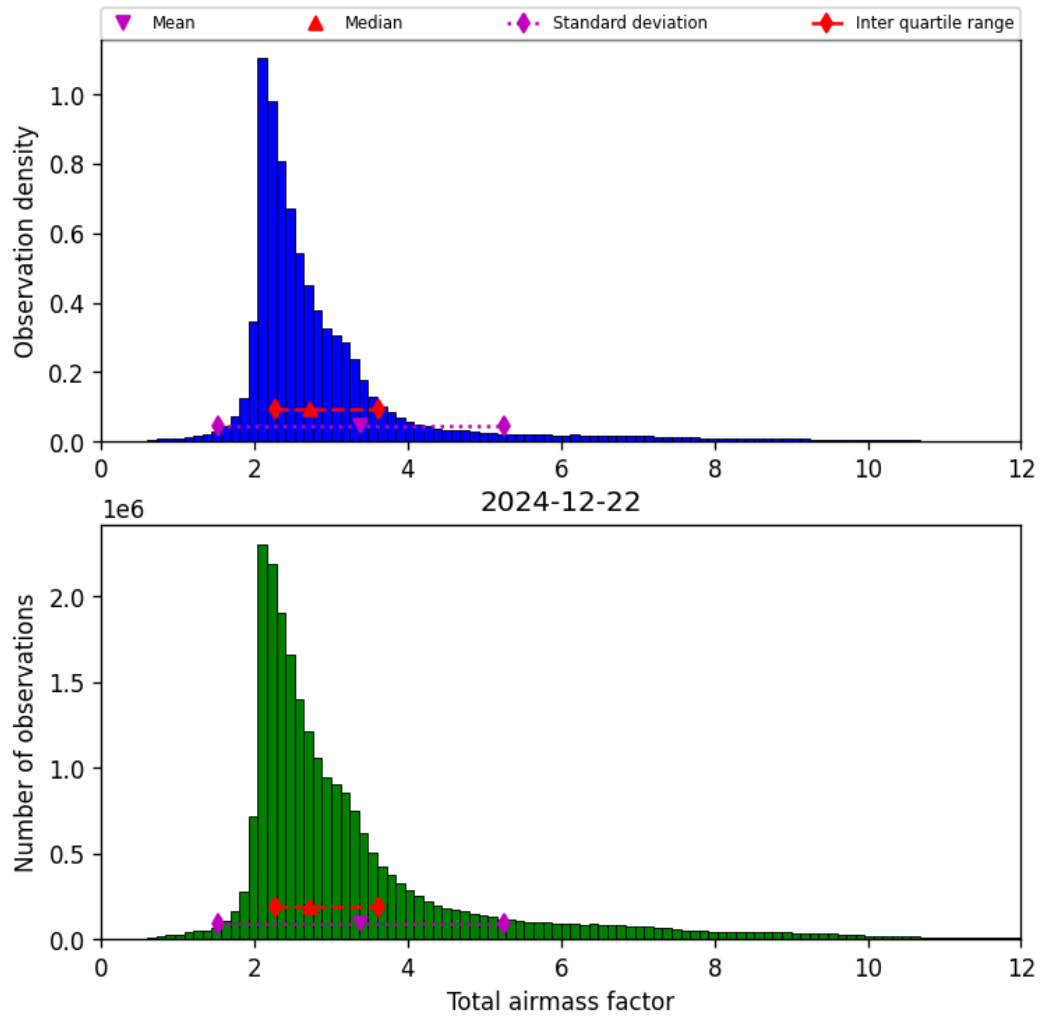


Figure 30: Histogram of “Total airmass factor” for 2024-12-22 to 2024-12-23

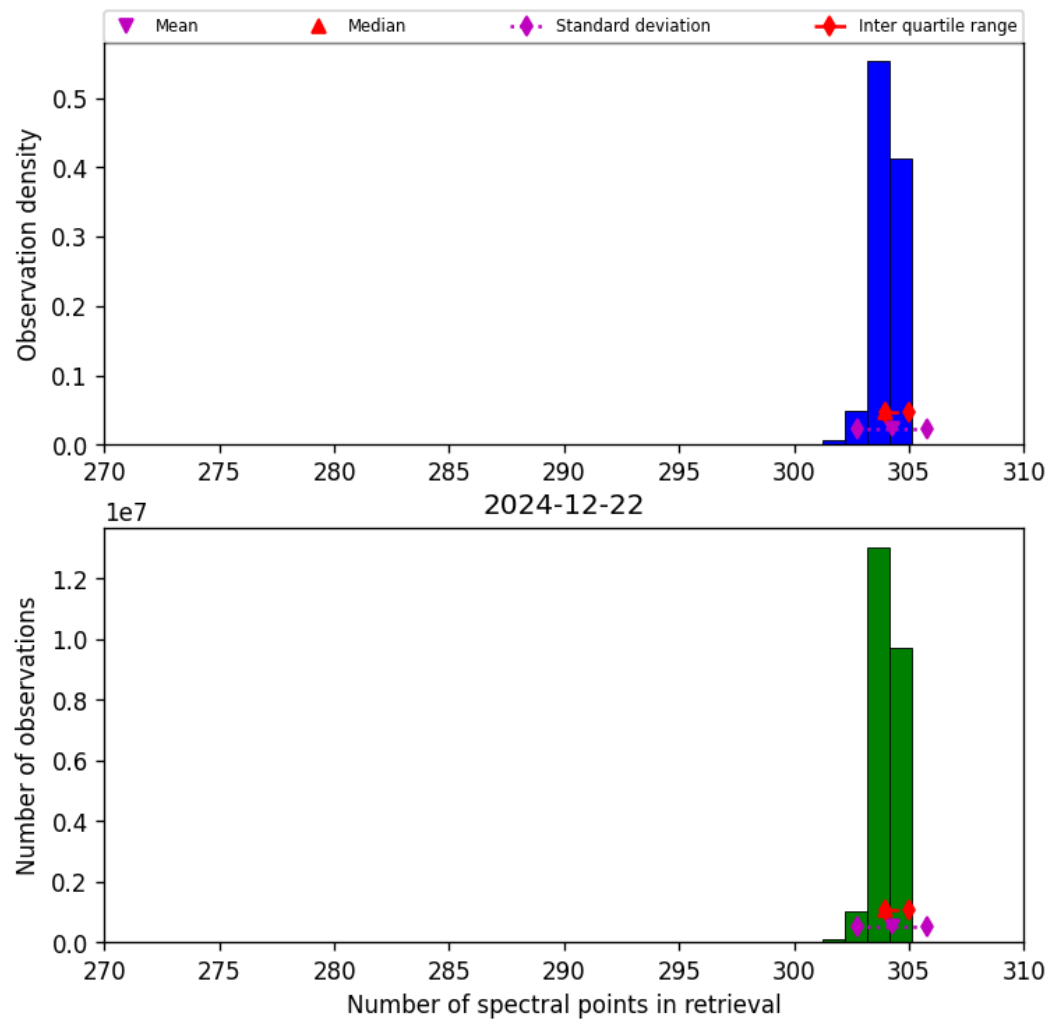


Figure 31: Histogram of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23

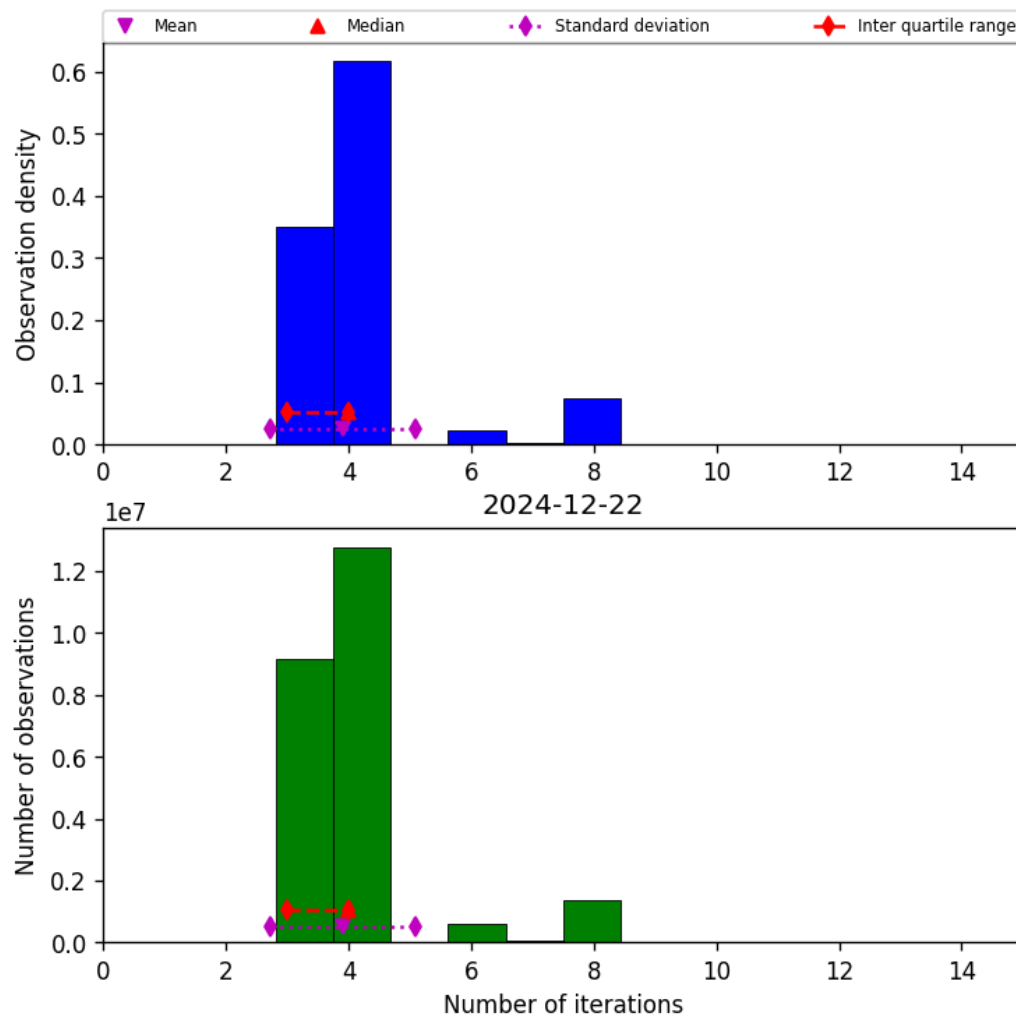


Figure 32: Histogram of “Number of iterations” for 2024-12-22 to 2024-12-23

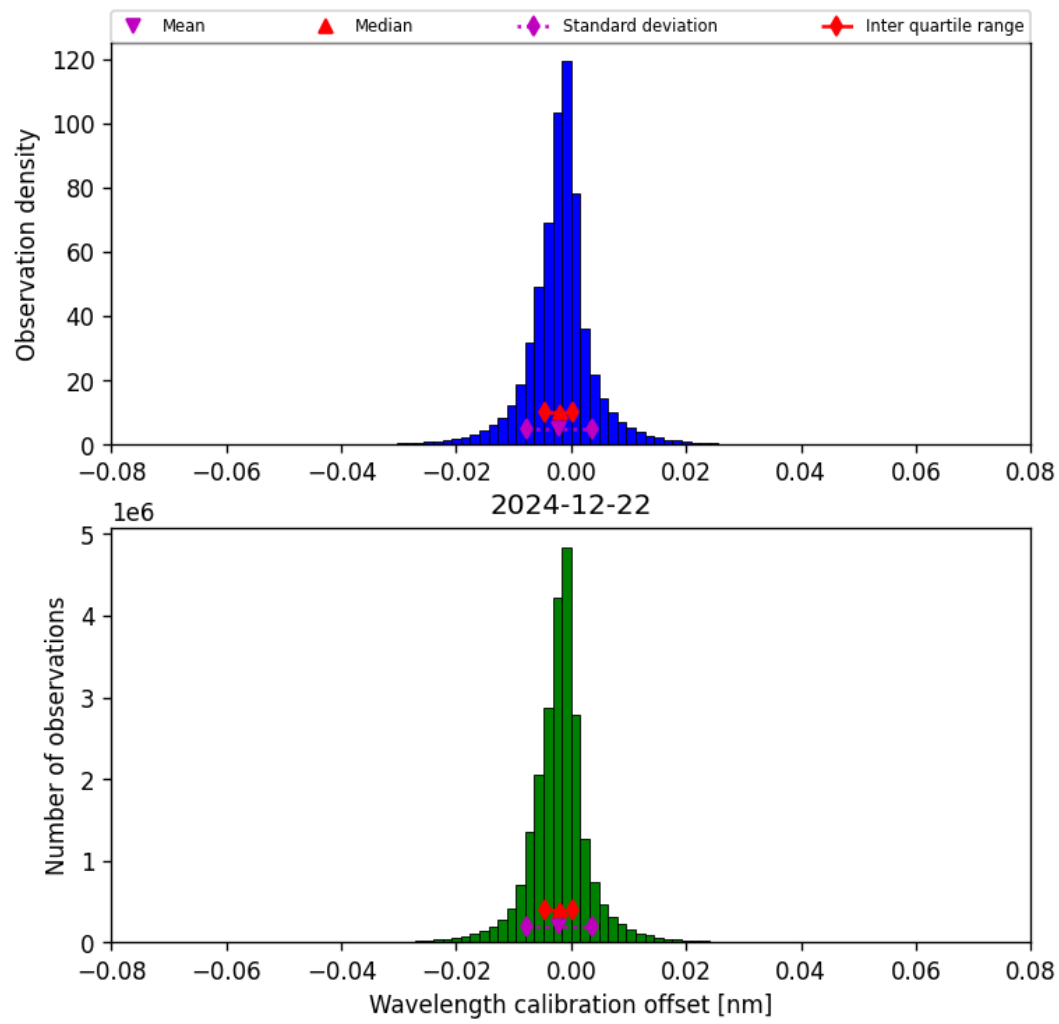


Figure 33: Histogram of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23

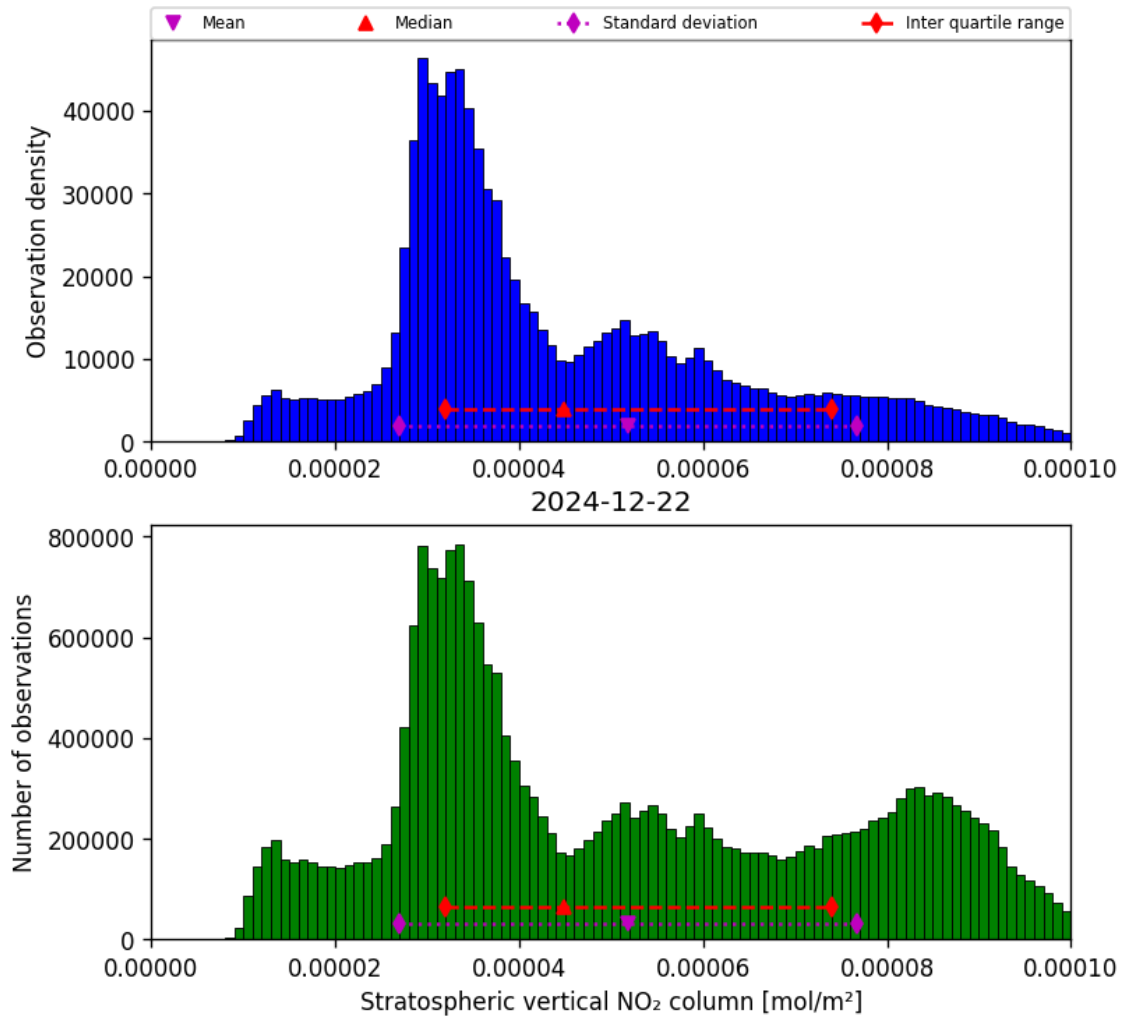


Figure 34: Histogram of “Stratospheric vertical NO₂ column” for 2024-12-22 to 2024-12-23

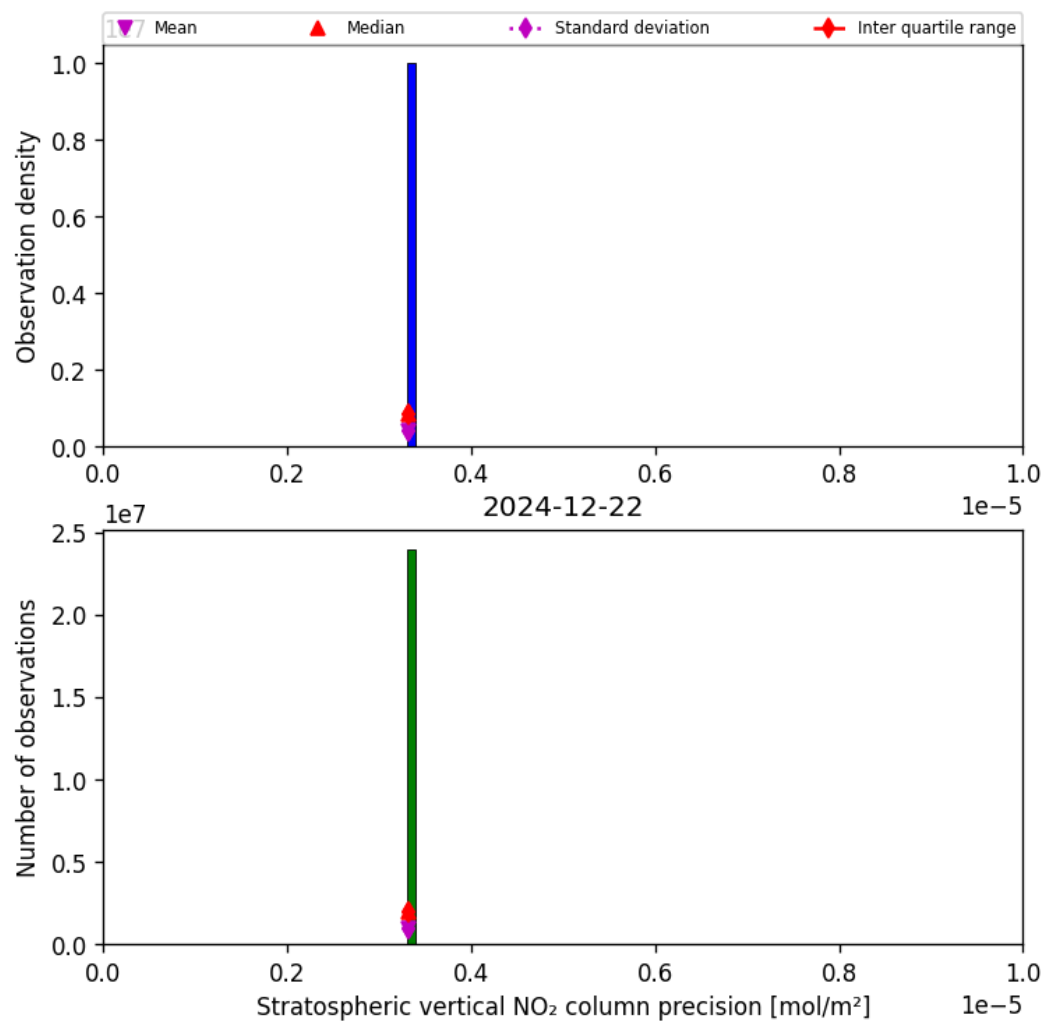


Figure 35: Histogram of “Stratospheric vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

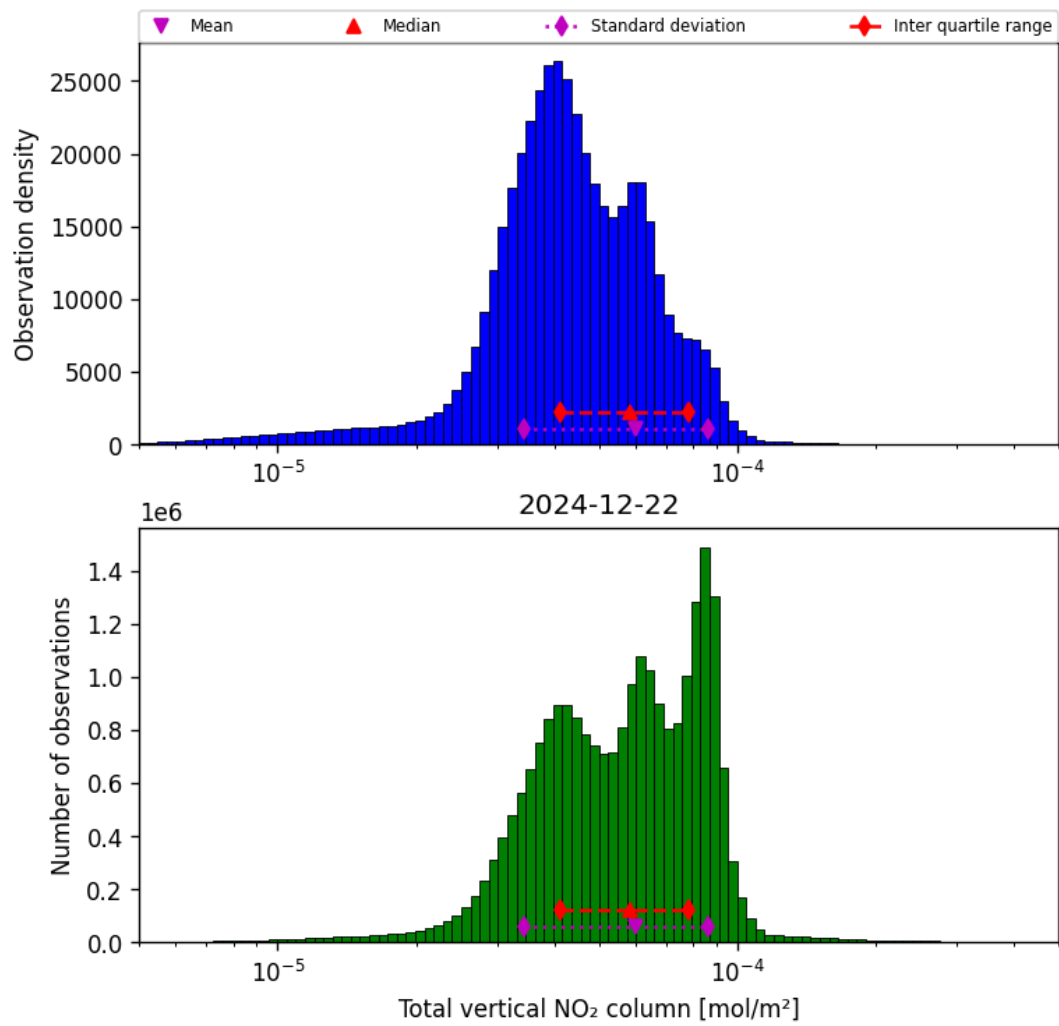


Figure 36: Histogram of “Total vertical NO₂ column” for 2024-12-22 to 2024-12-23

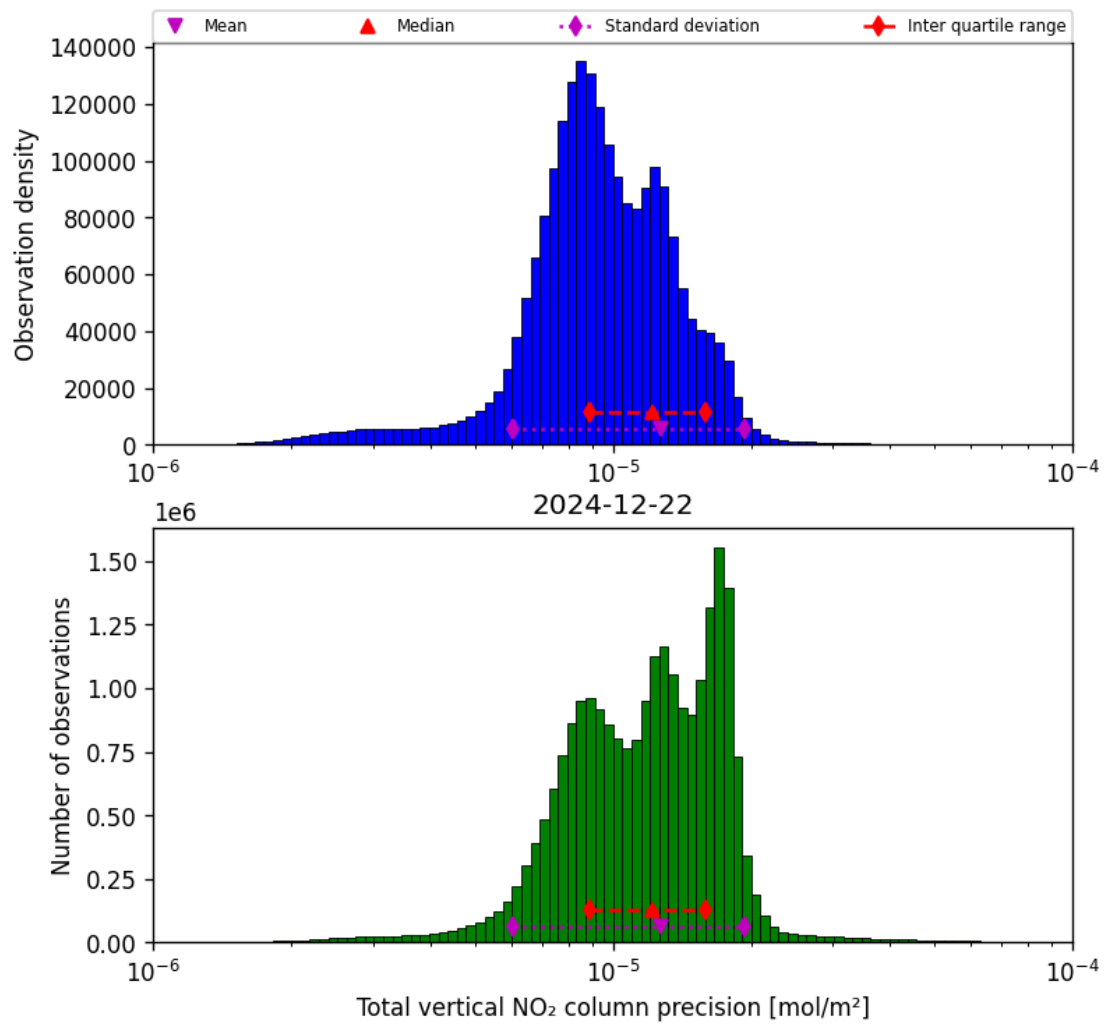


Figure 37: Histogram of “Total vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

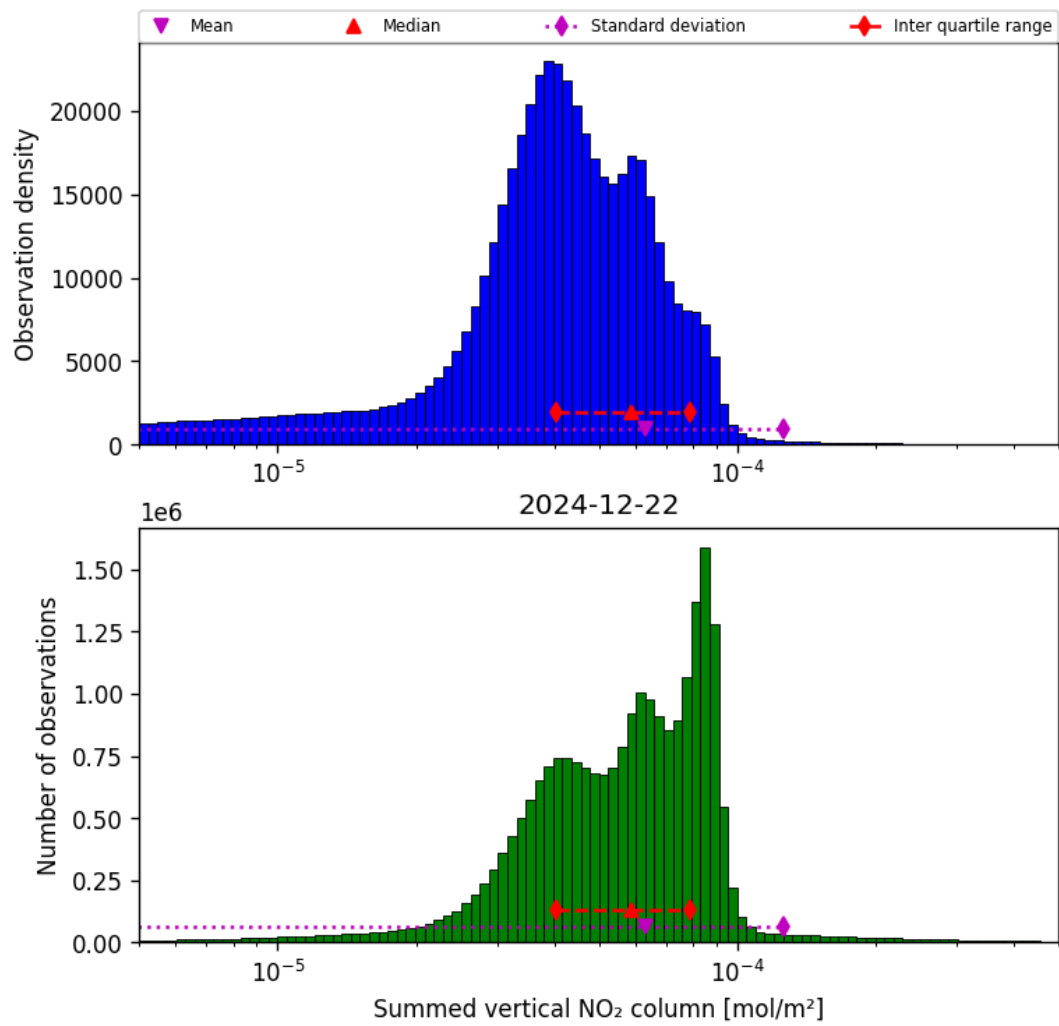


Figure 38: Histogram of “Summed vertical NO₂ column” for 2024-12-22 to 2024-12-23

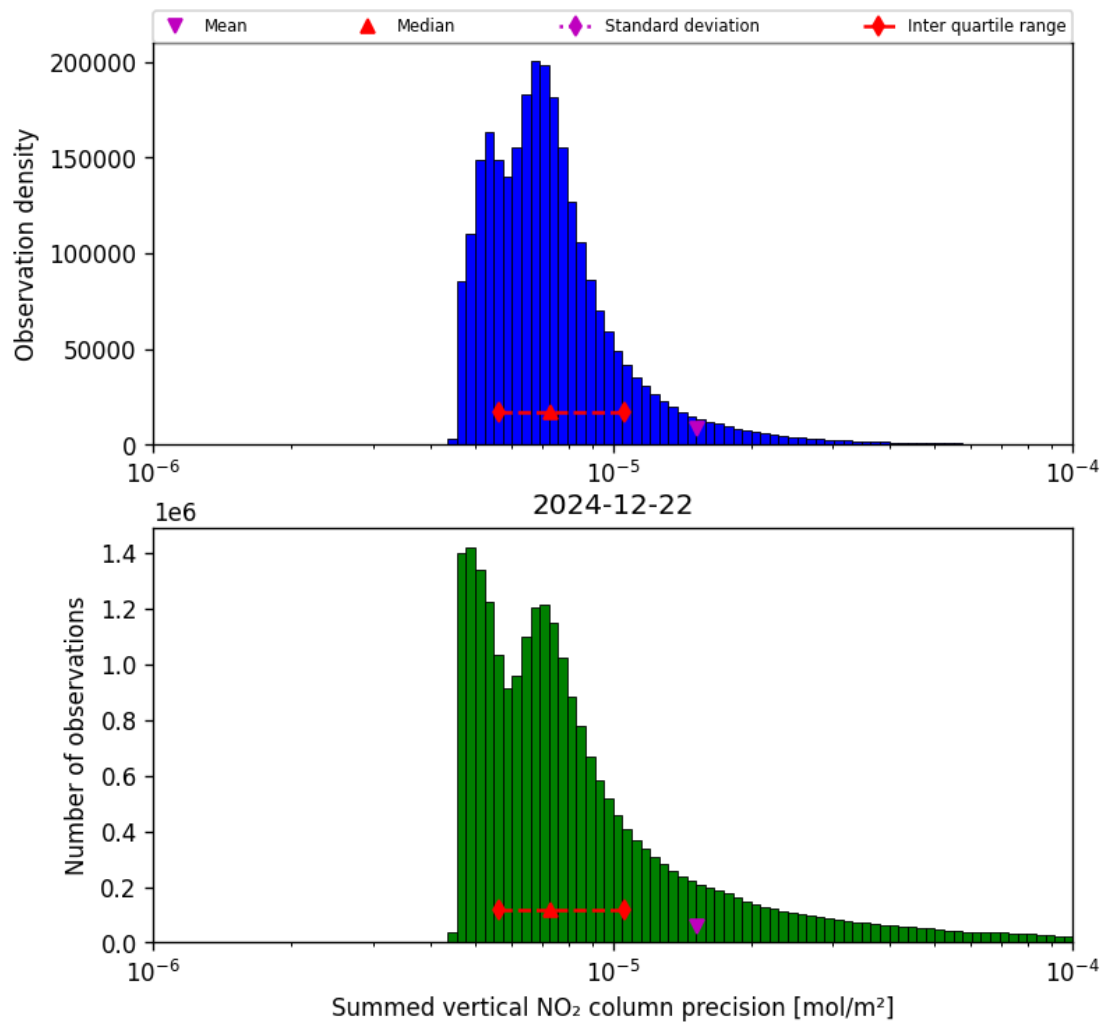


Figure 39: Histogram of “Summed vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

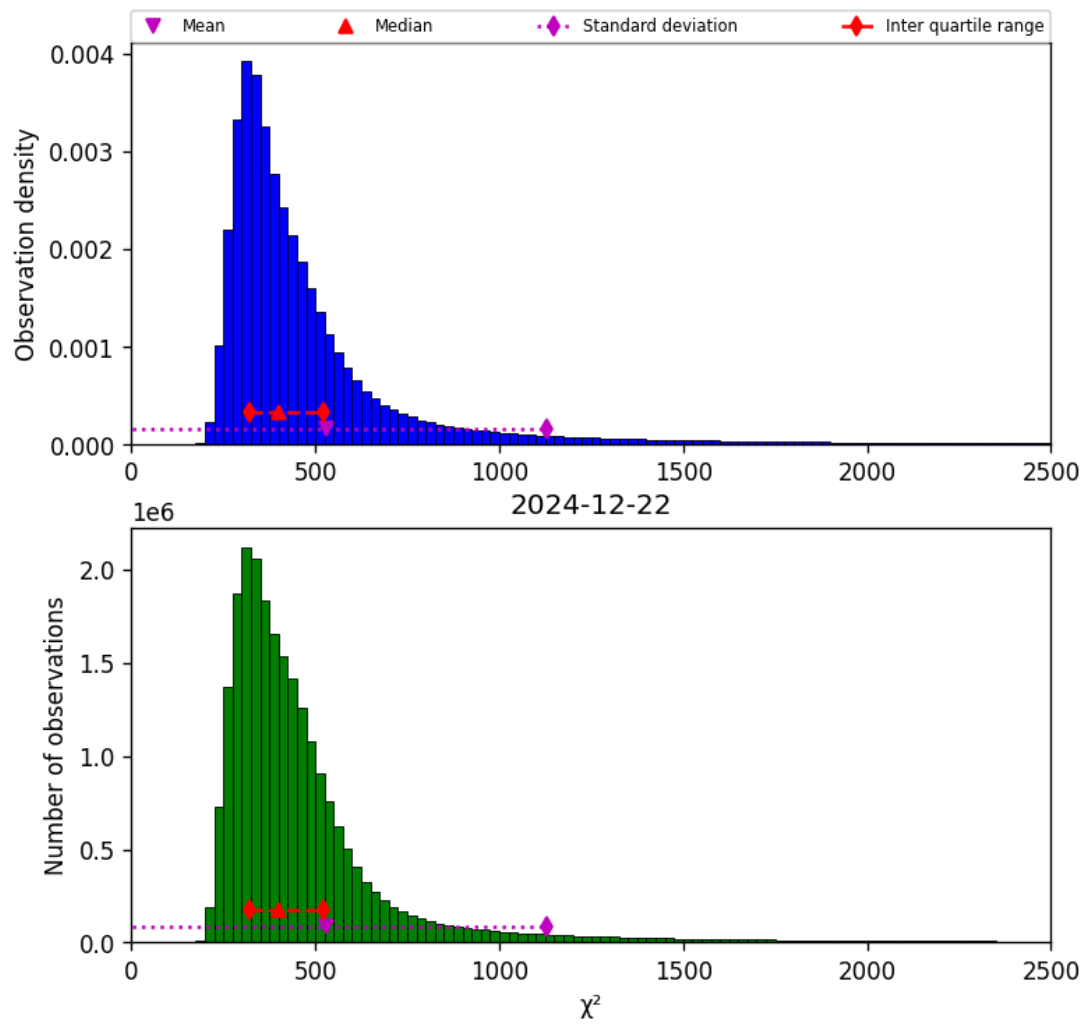


Figure 40: Histogram of “ χ^2 ” for 2024-12-22 to 2024-12-23

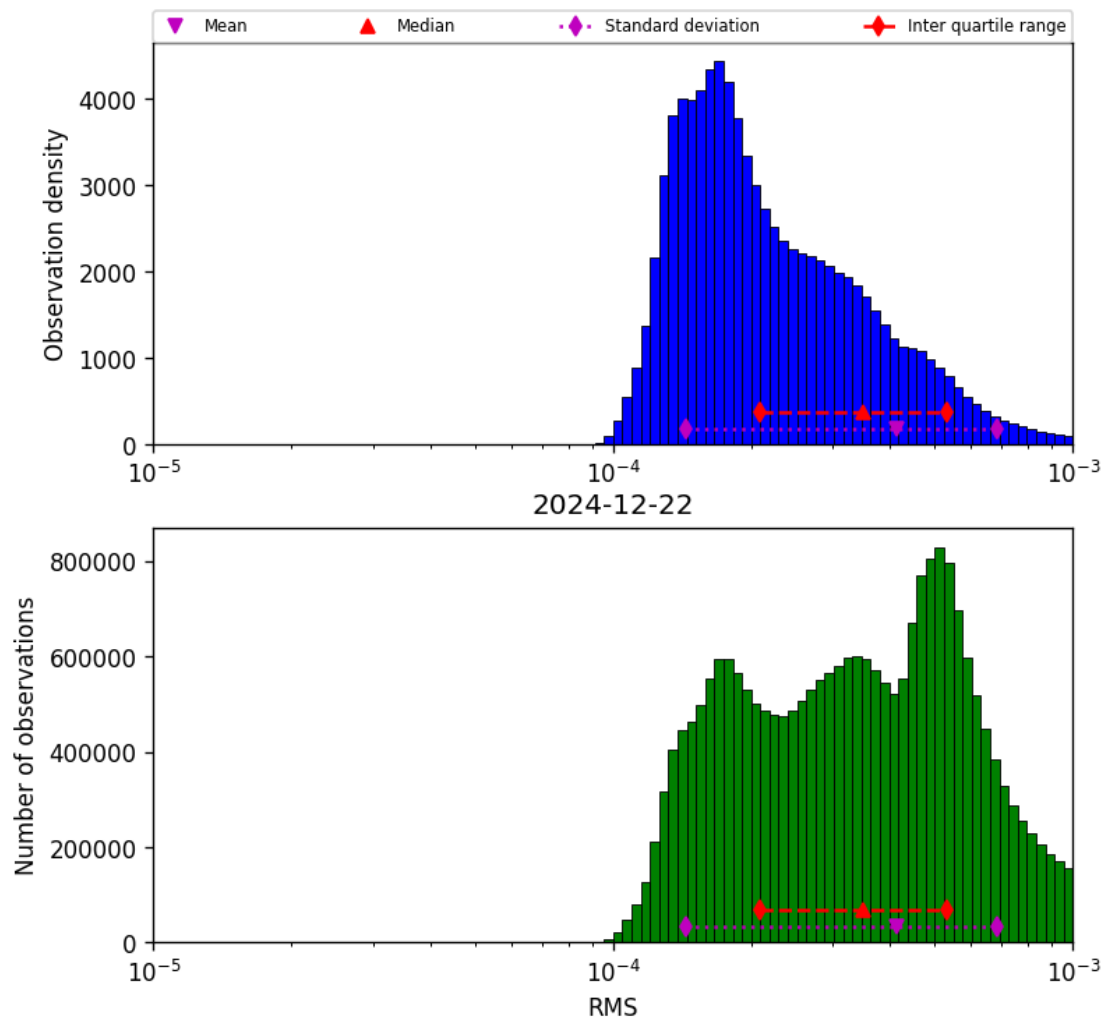


Figure 41: Histogram of “RMS” for 2024-12-22 to 2024-12-23

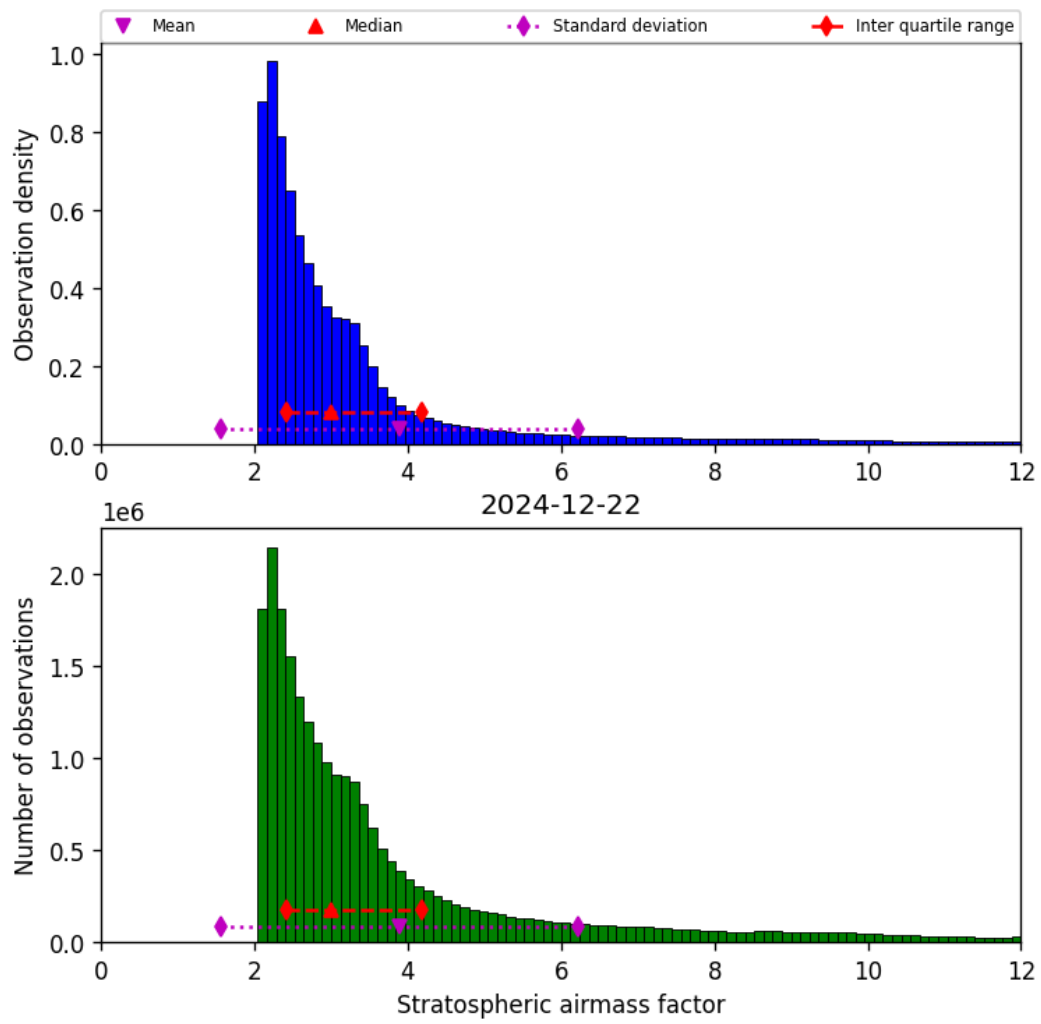


Figure 42: Histogram of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23

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.

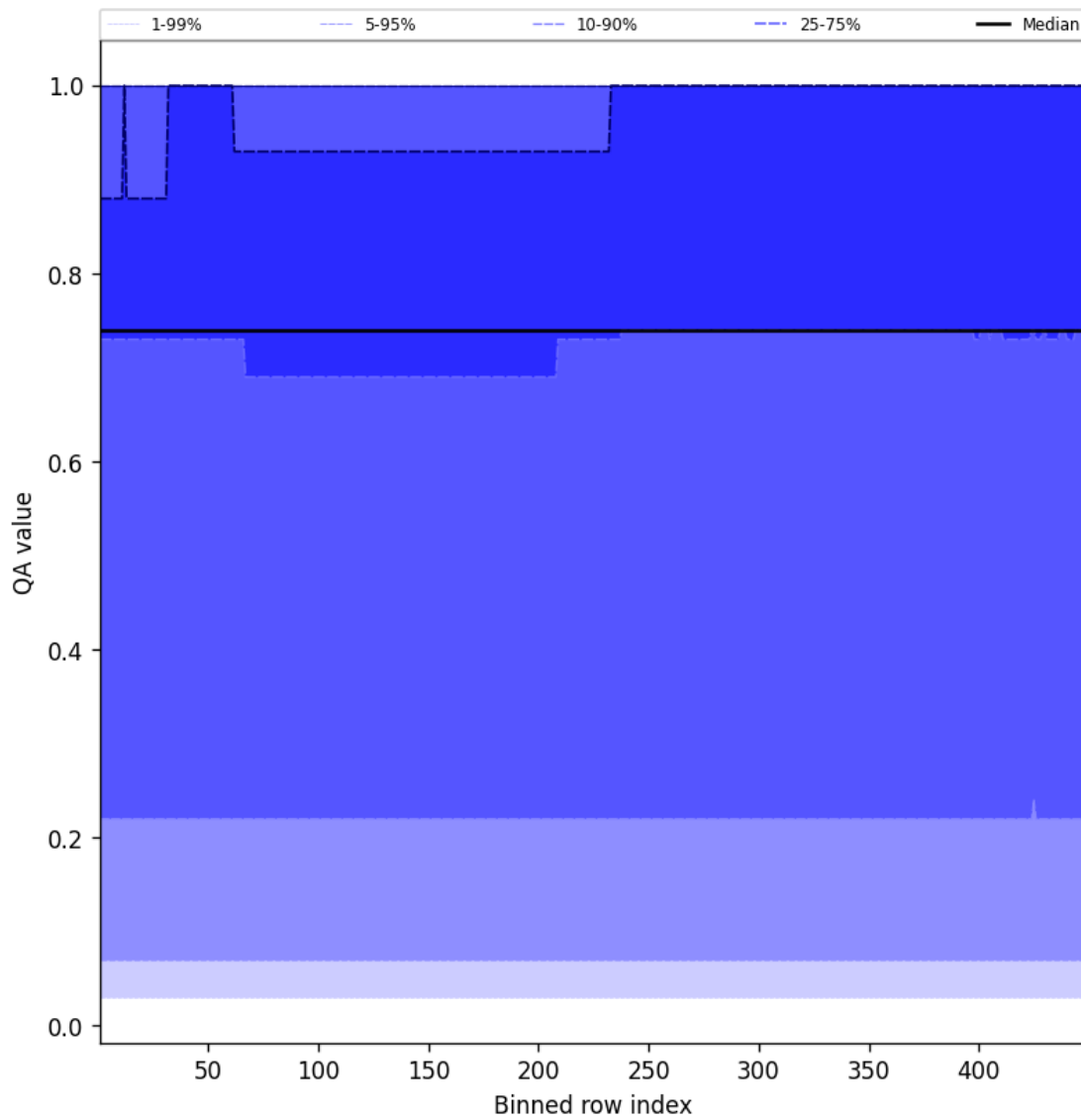


Figure 43: Along track statistics of “QA value” for 2024-12-22 to 2024-12-23

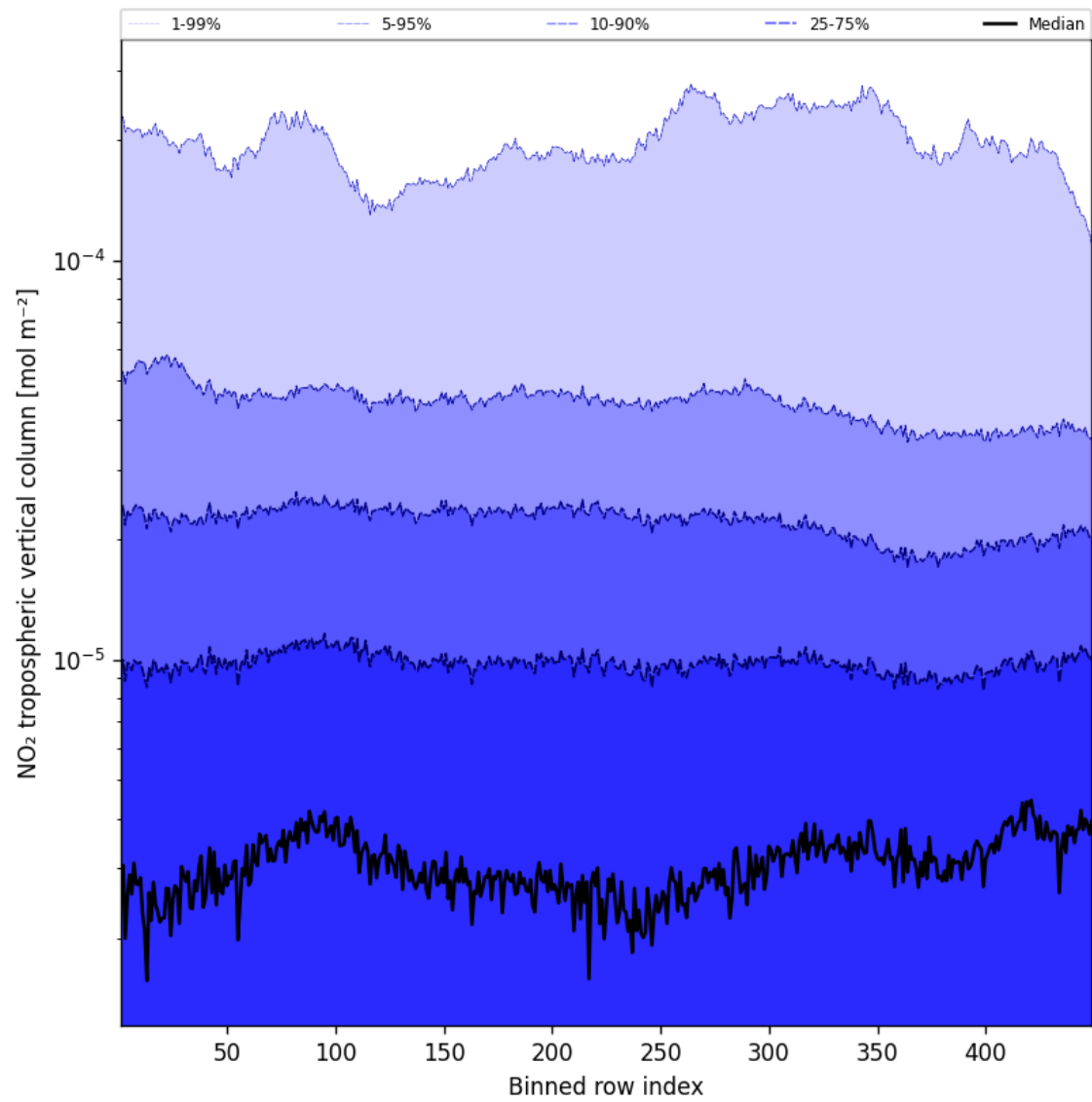


Figure 44: Along track statistics of “NO₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23

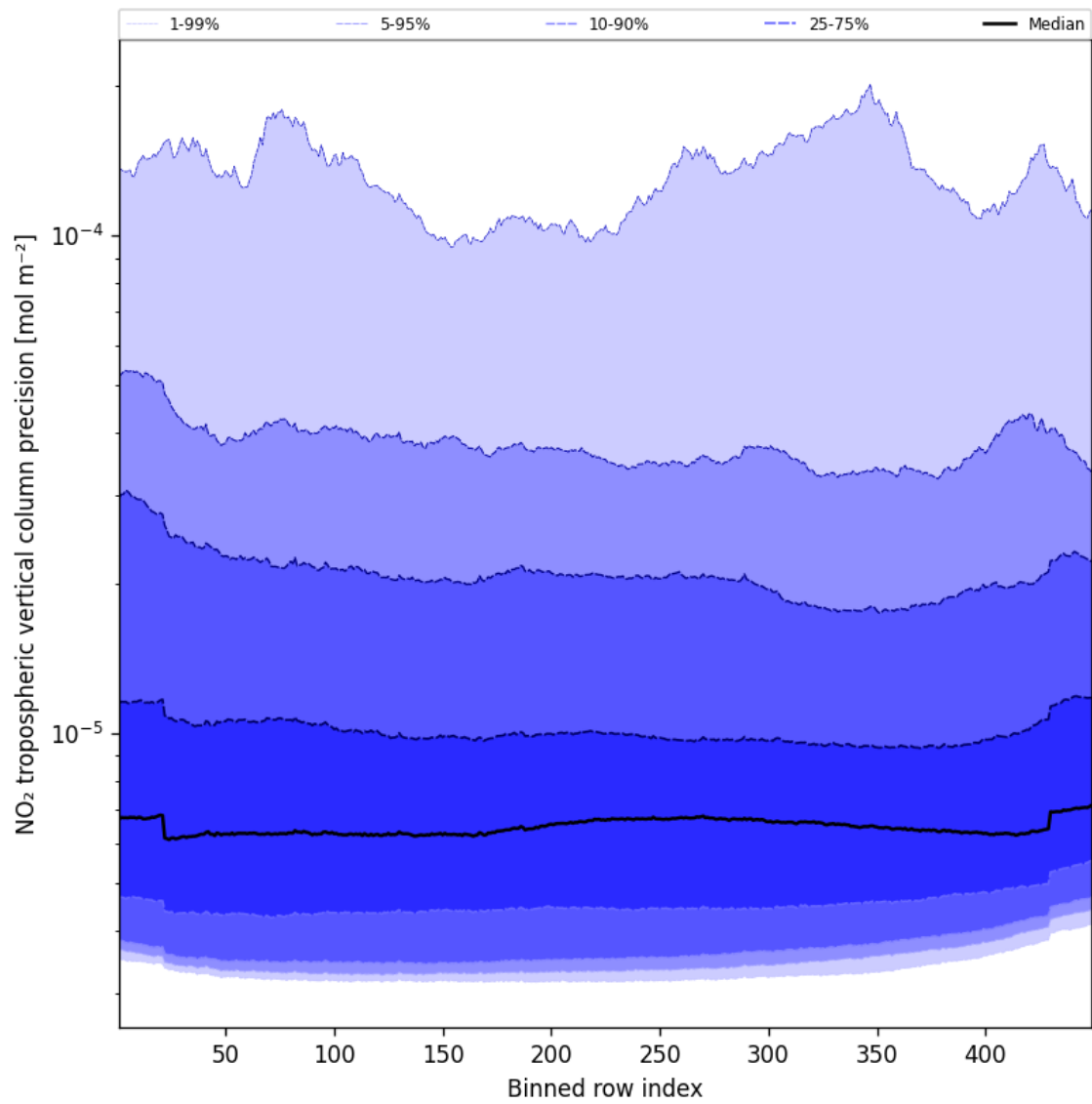


Figure 45: Along track statistics of “NO₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23

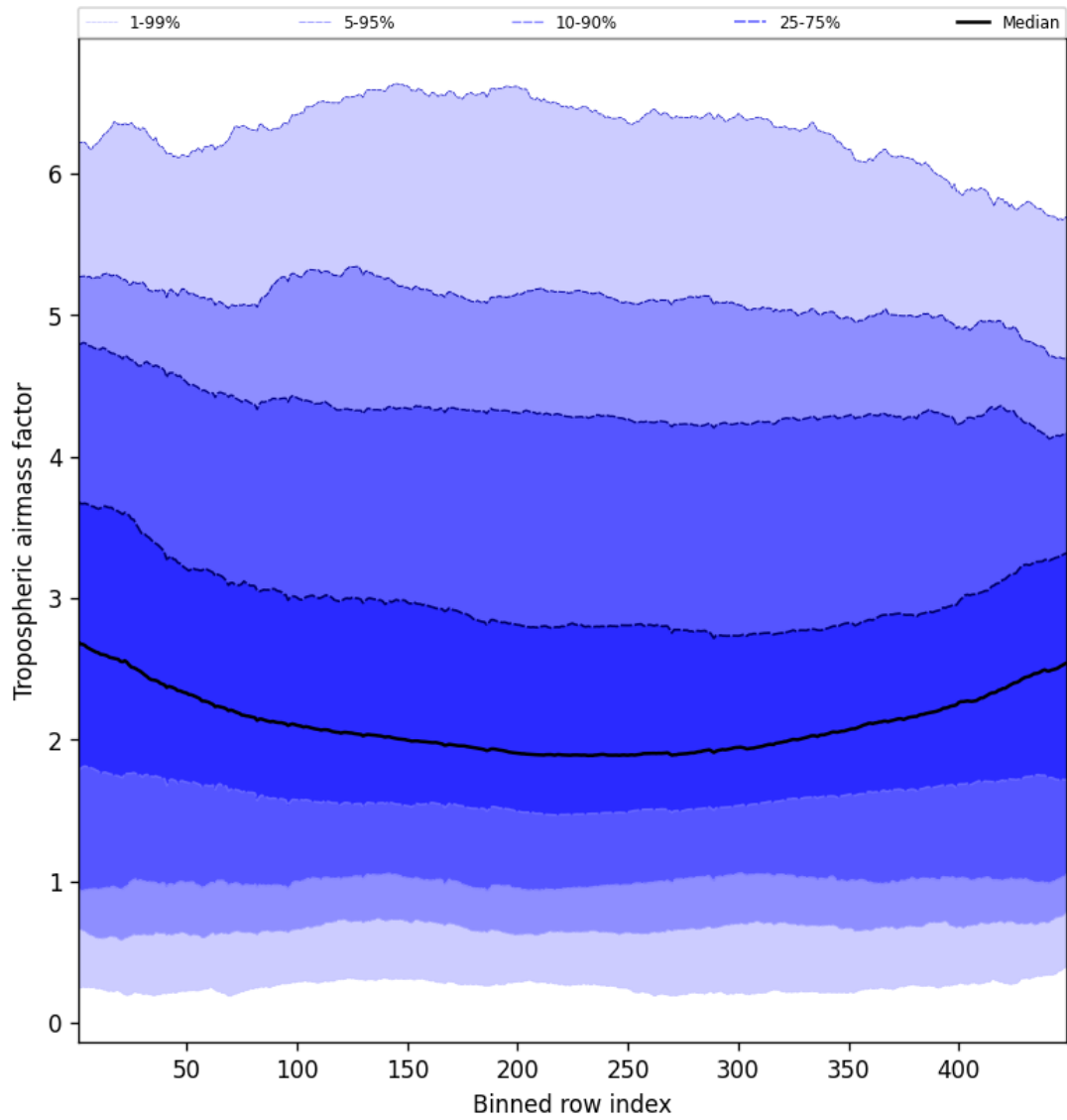


Figure 46: Along track statistics of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23

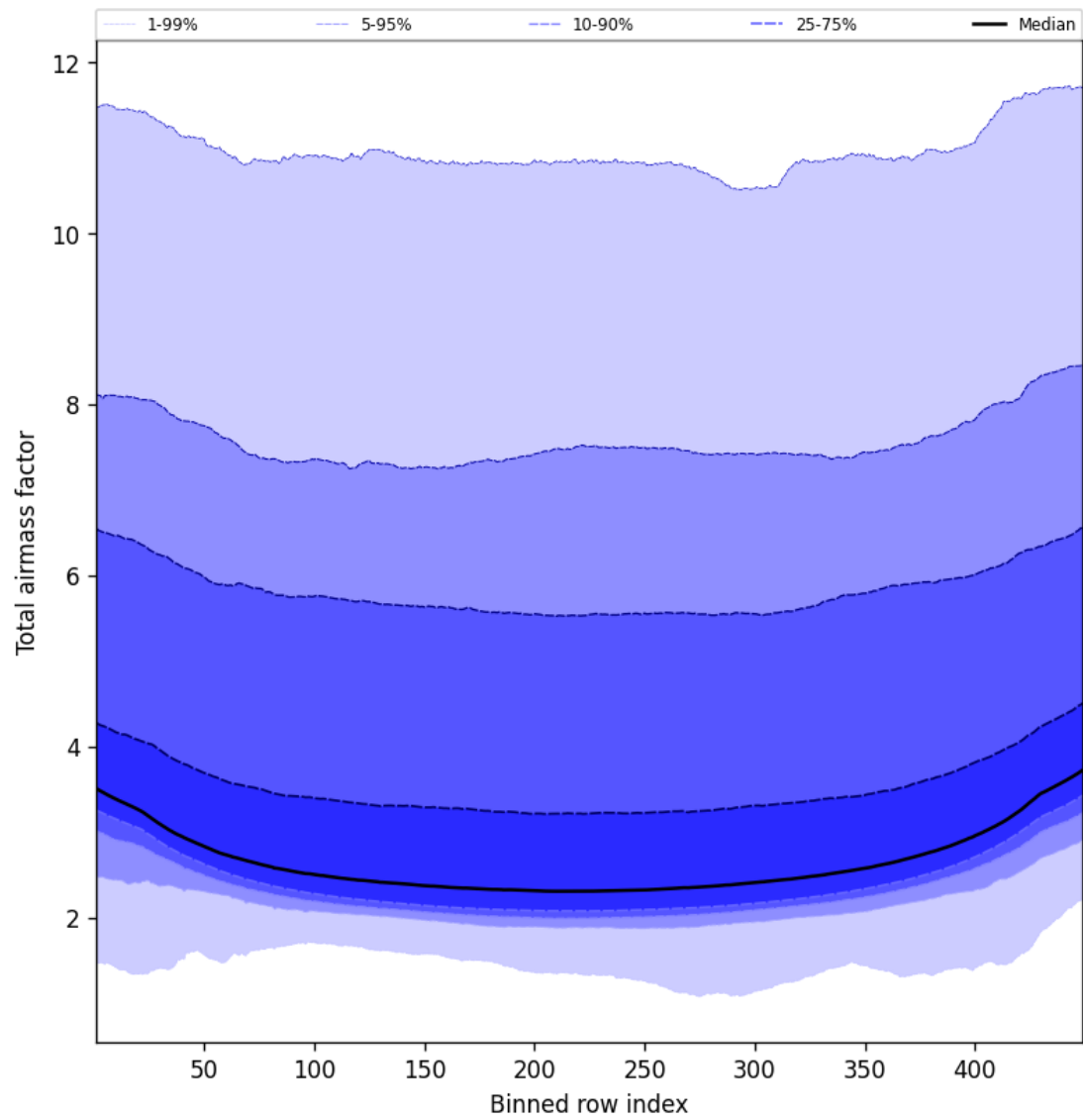


Figure 47: Along track statistics of “Total airmass factor” for 2024-12-22 to 2024-12-23

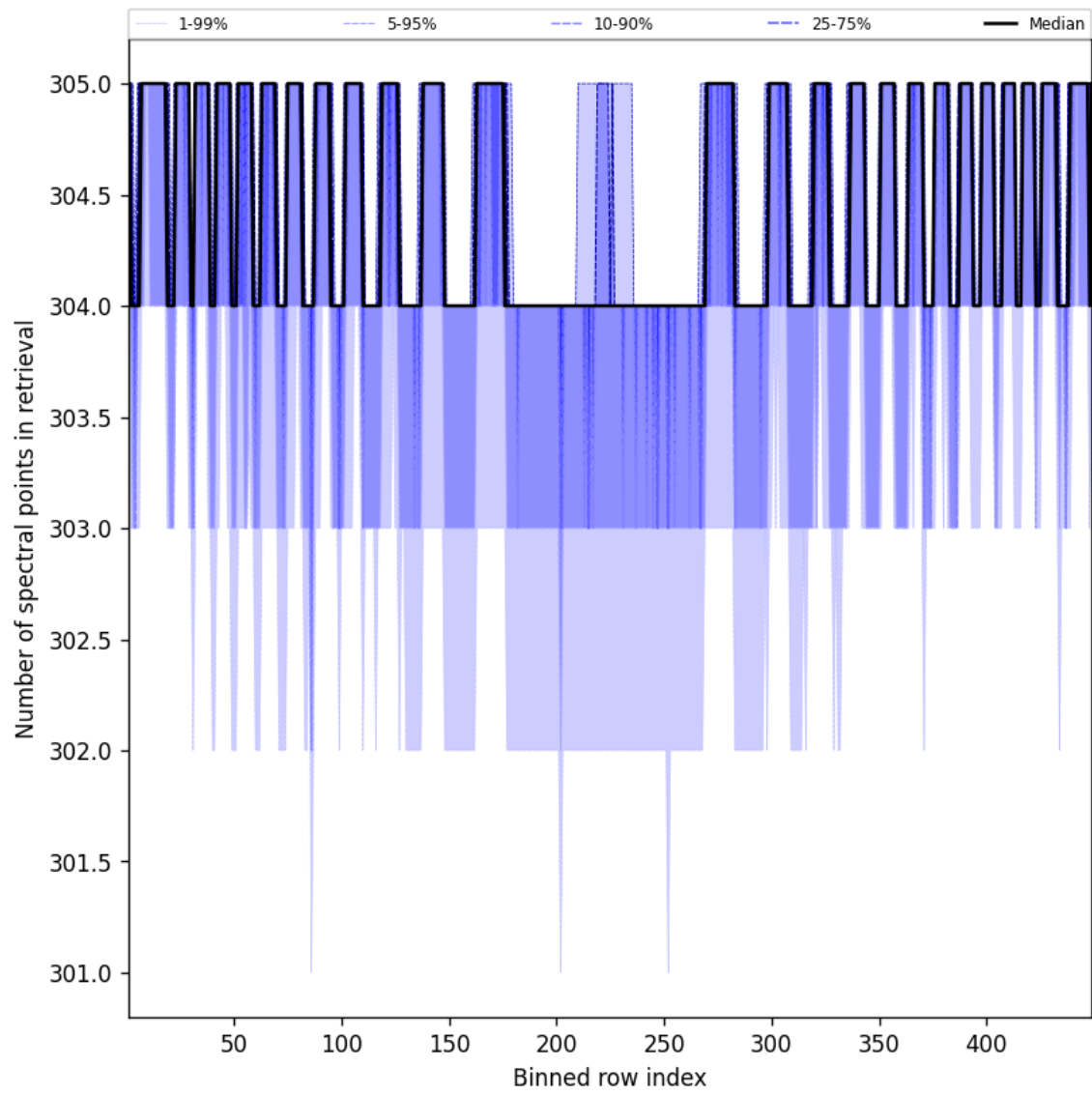


Figure 48: Along track statistics of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23

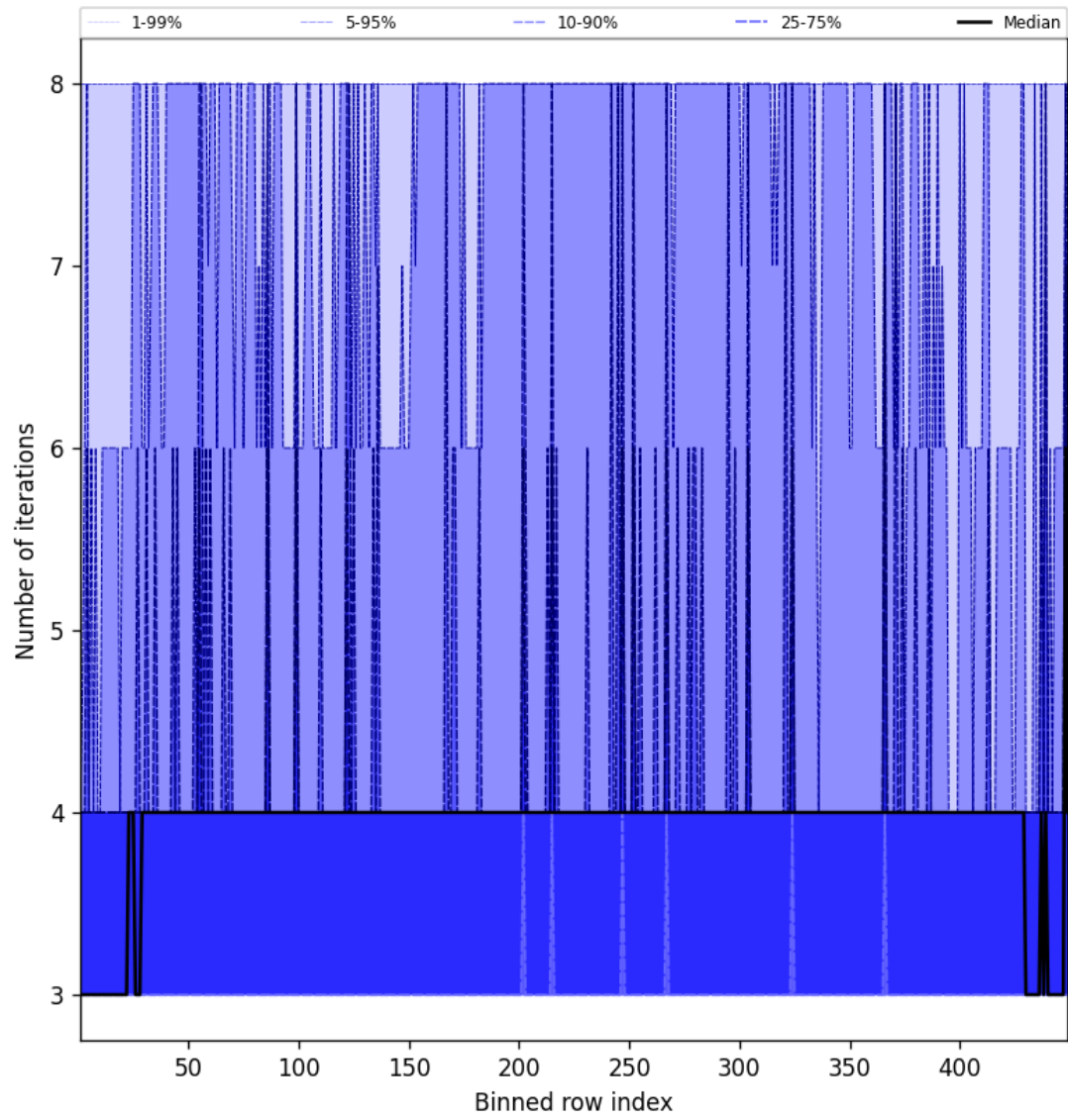


Figure 49: Along track statistics of “Number of iterations” for 2024-12-22 to 2024-12-23

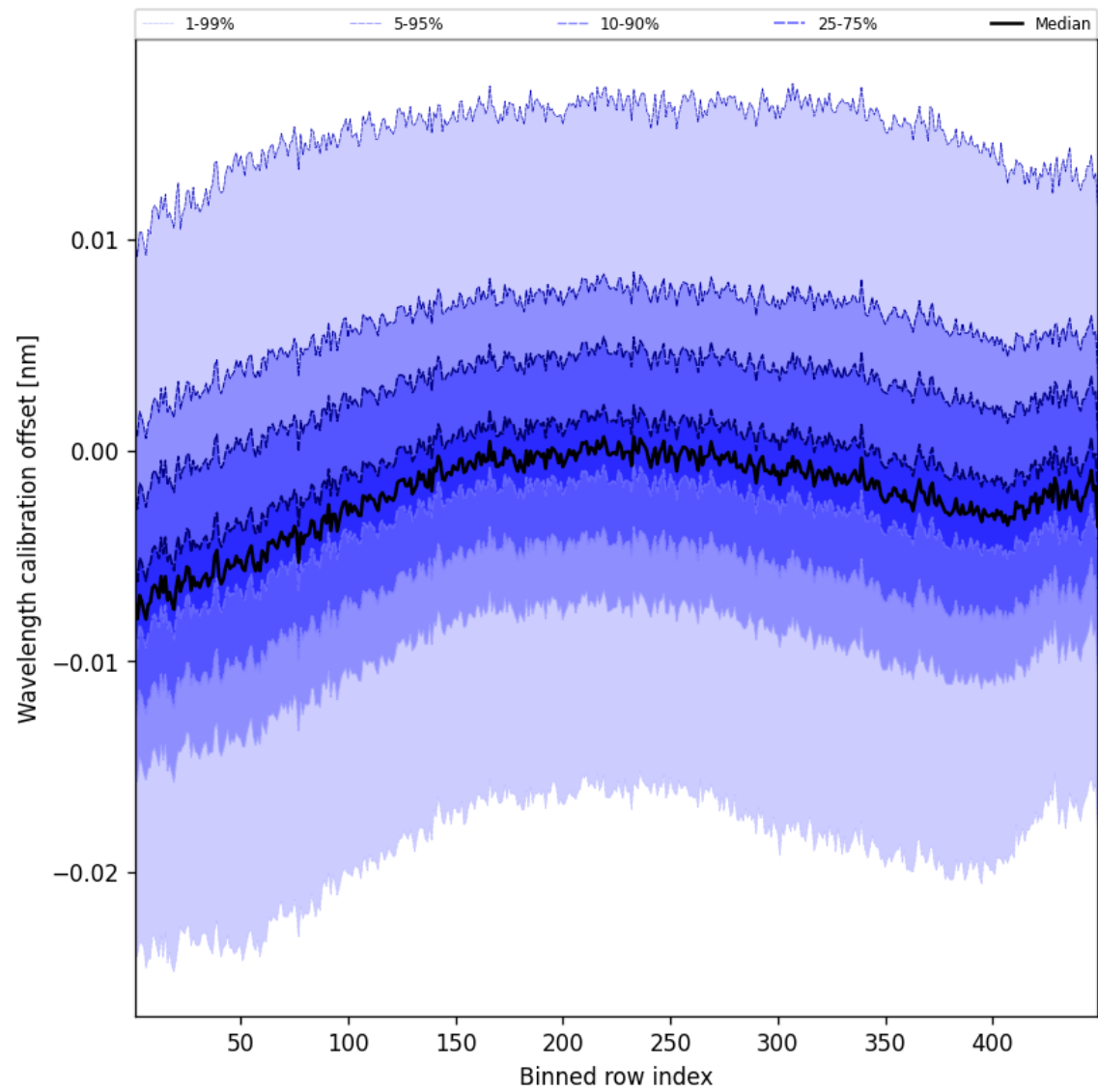


Figure 50: Along track statistics of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23

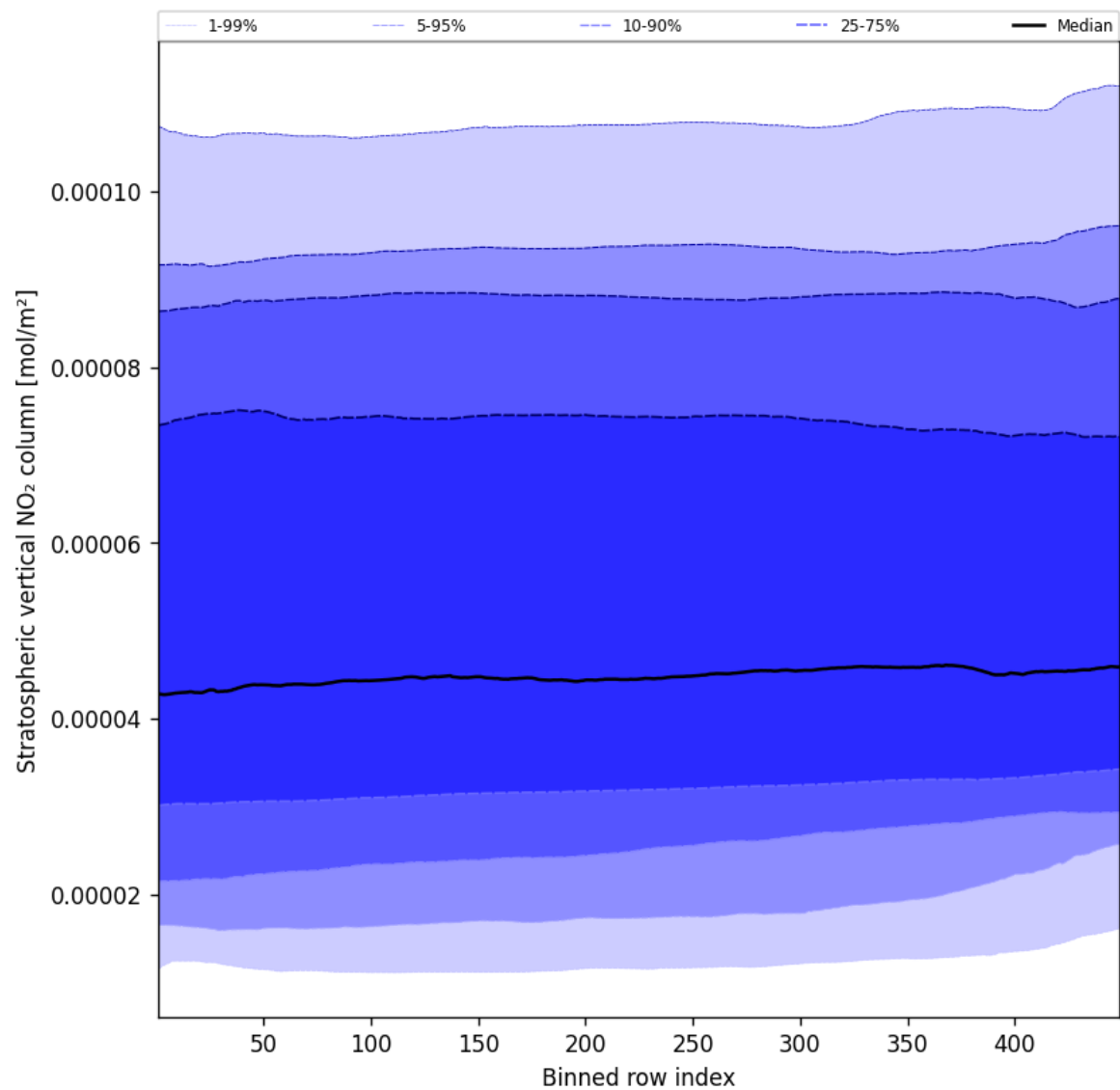


Figure 51: Along track statistics of “Stratospheric vertical NO₂ column” for 2024-12-22 to 2024-12-23



Figure 52: Along track statistics of “Stratospheric vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

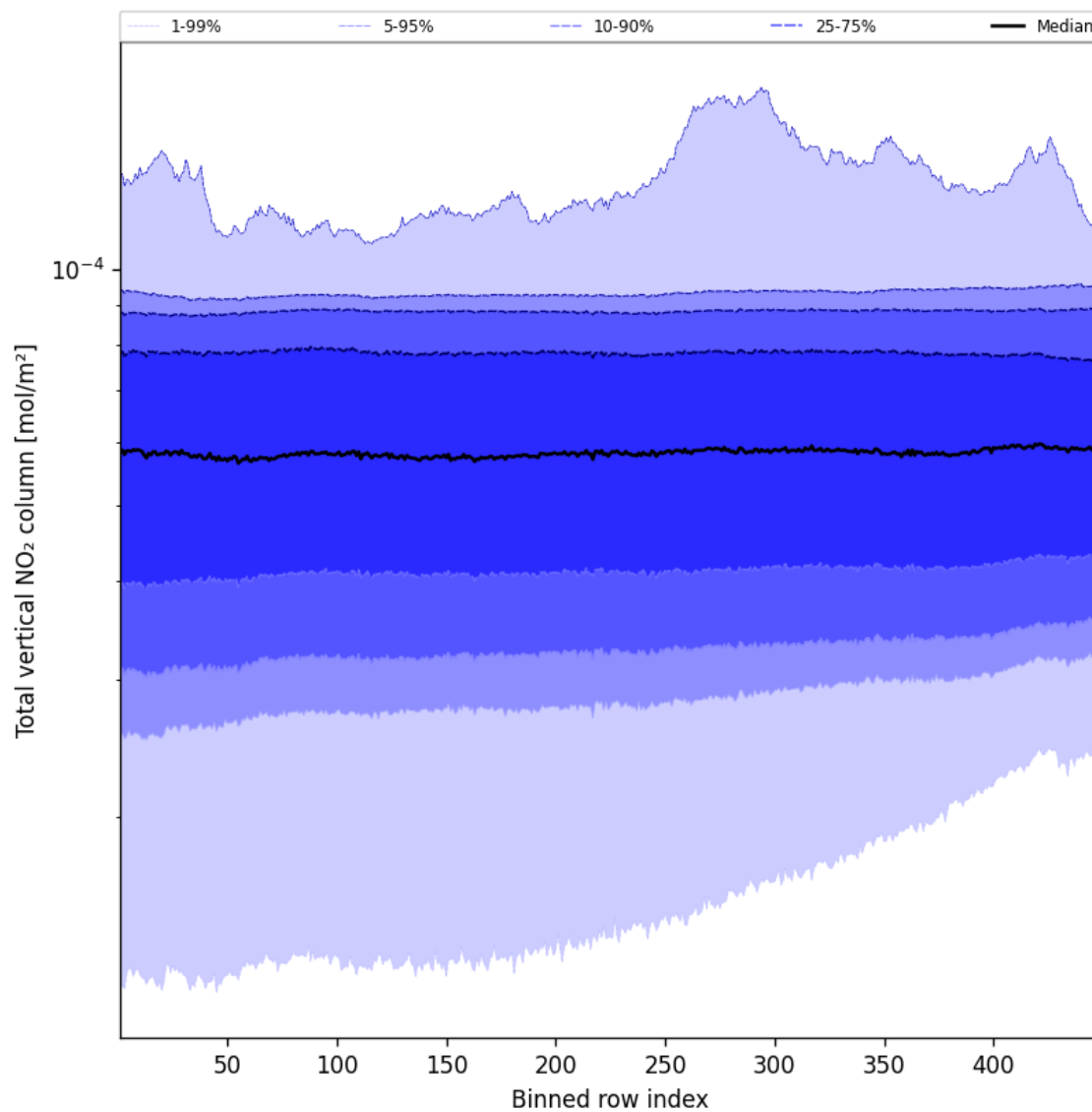


Figure 53: Along track statistics of “Total vertical NO₂ column” for 2024-12-22 to 2024-12-23

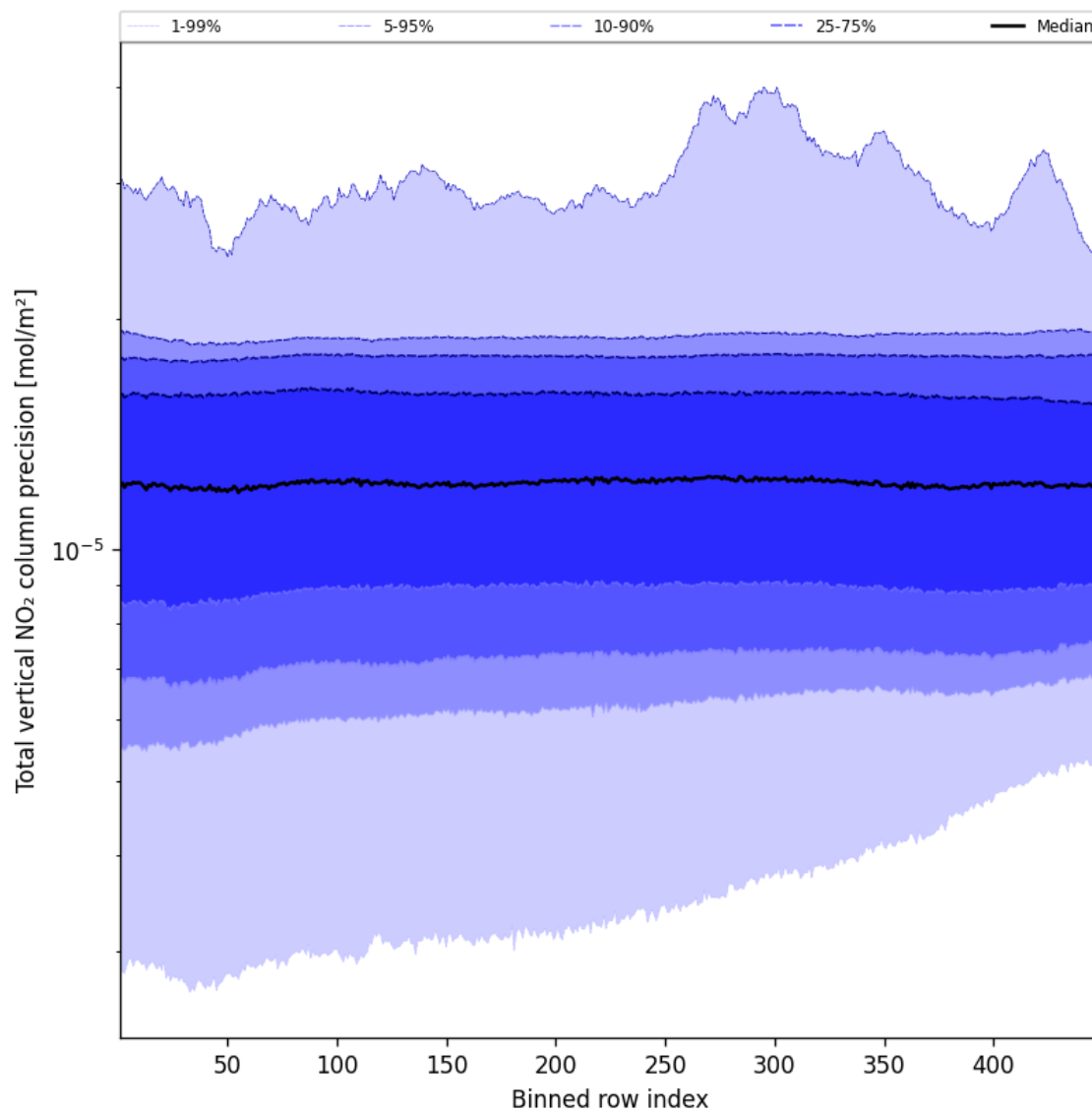


Figure 54: Along track statistics of “Total vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

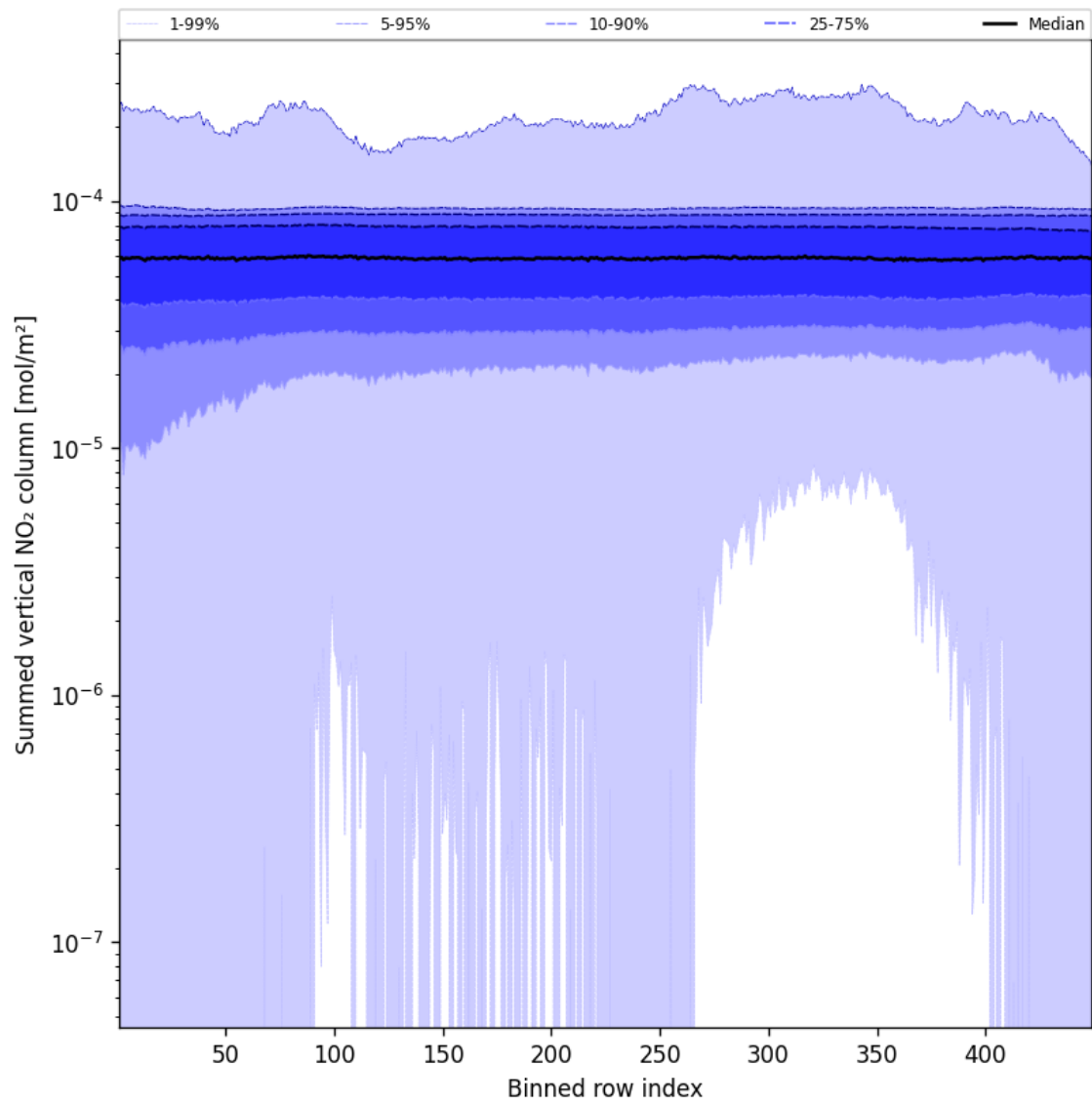


Figure 55: Along track statistics of “Summed vertical NO₂ column” for 2024-12-22 to 2024-12-23

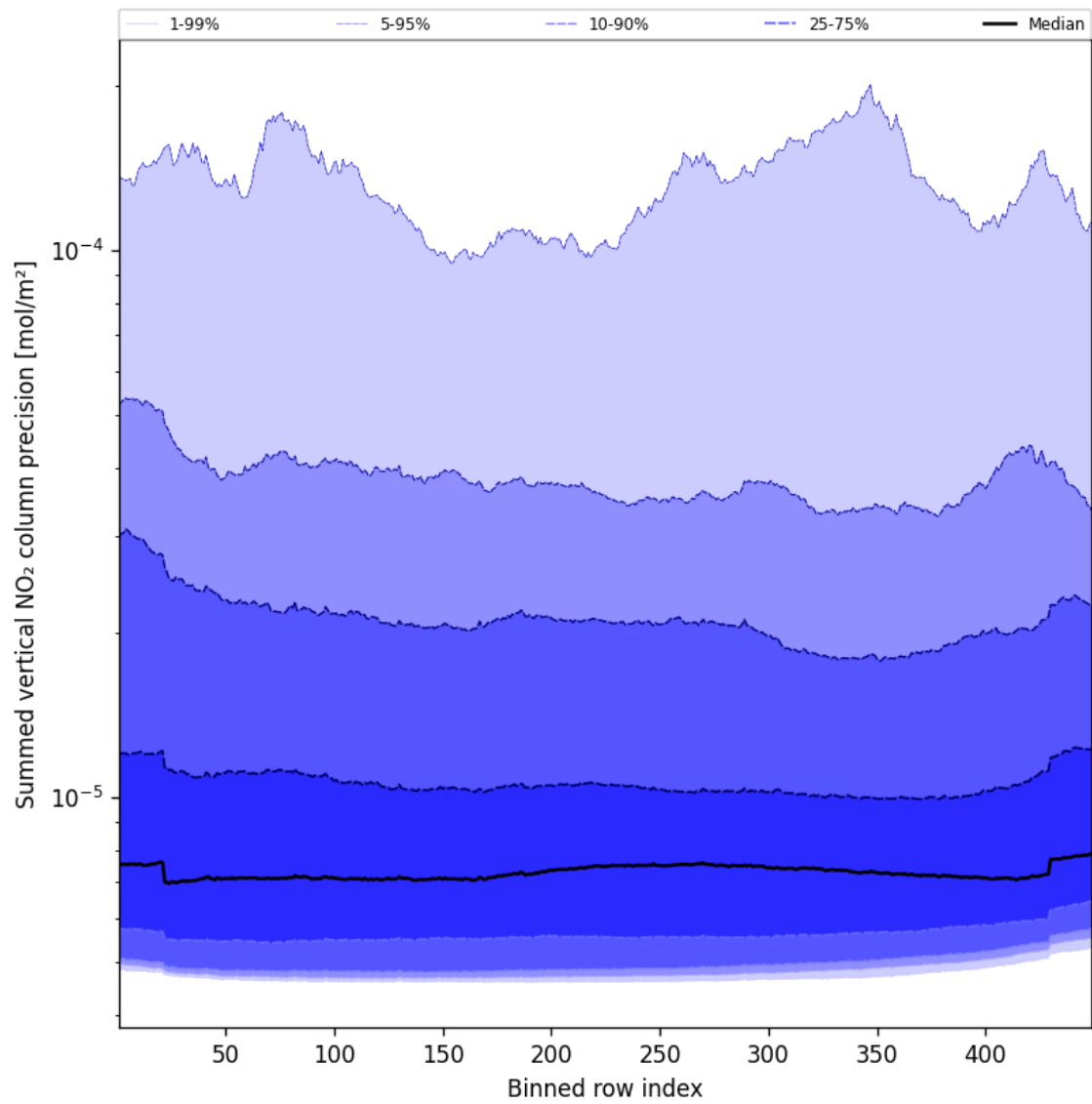


Figure 56: Along track statistics of “Summed vertical NO₂ column precision” for 2024-12-22 to 2024-12-23

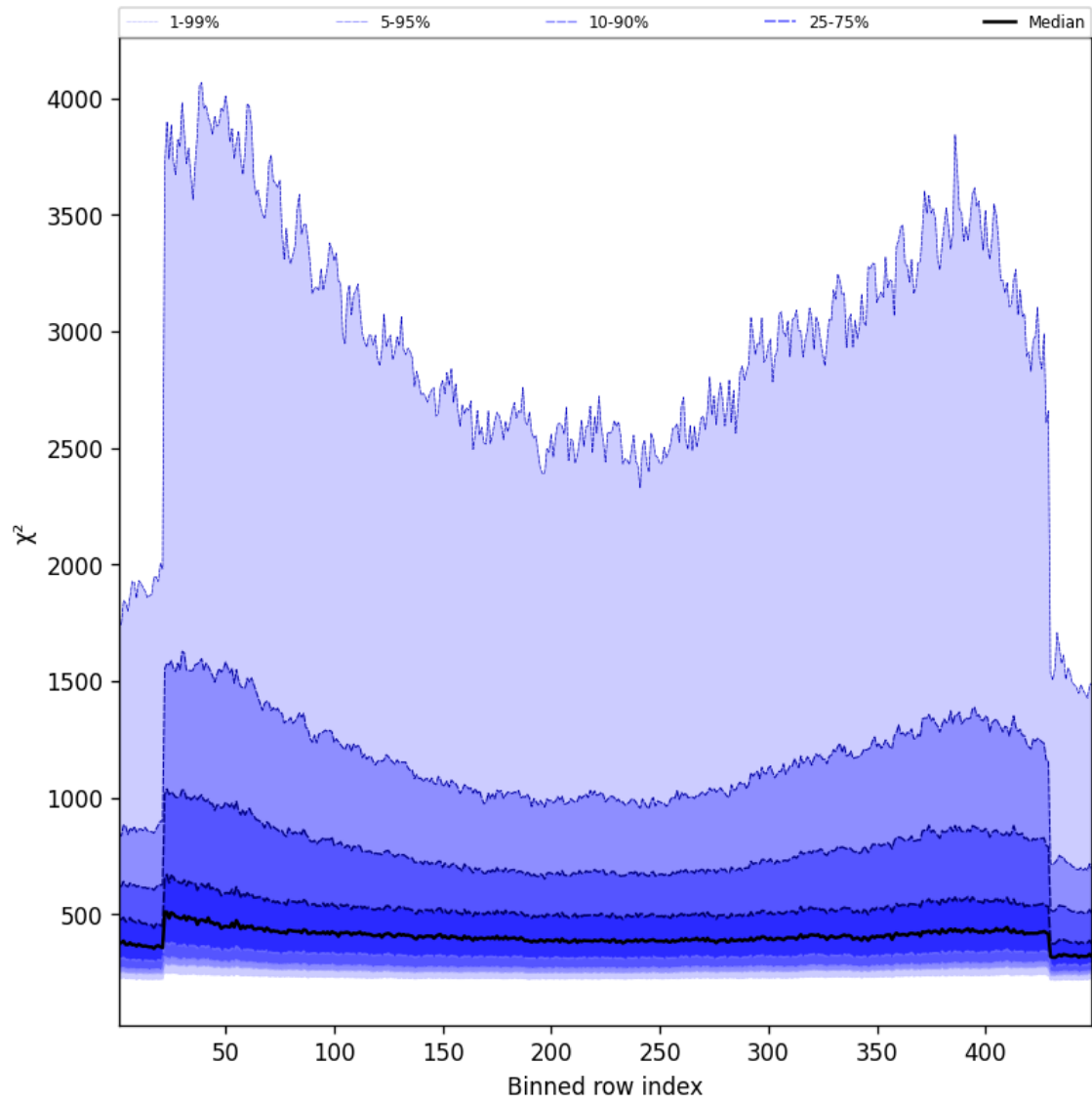


Figure 57: Along track statistics of “ χ^2 ” for 2024-12-22 to 2024-12-23

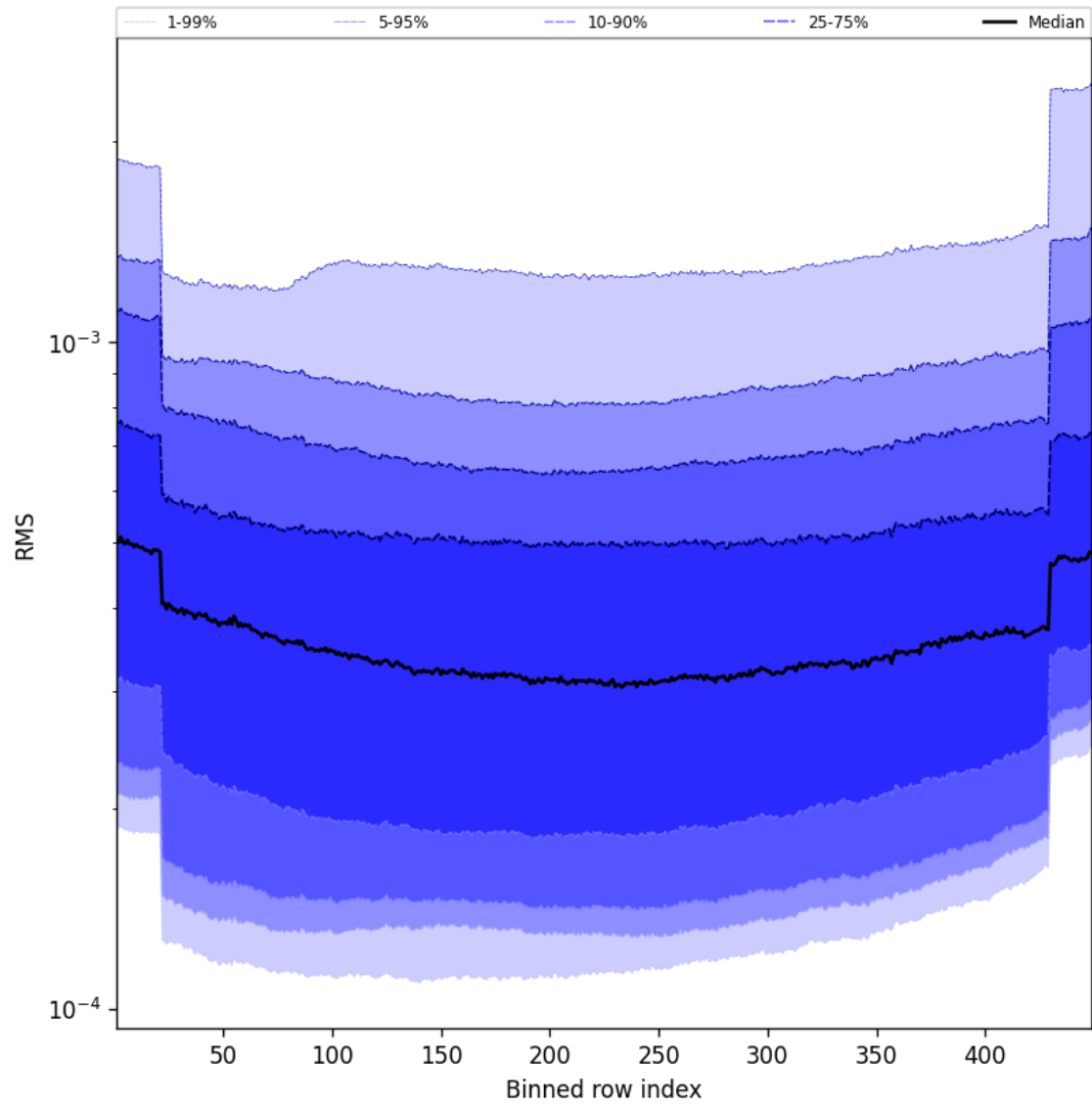


Figure 58: Along track statistics of “RMS” for 2024-12-22 to 2024-12-23

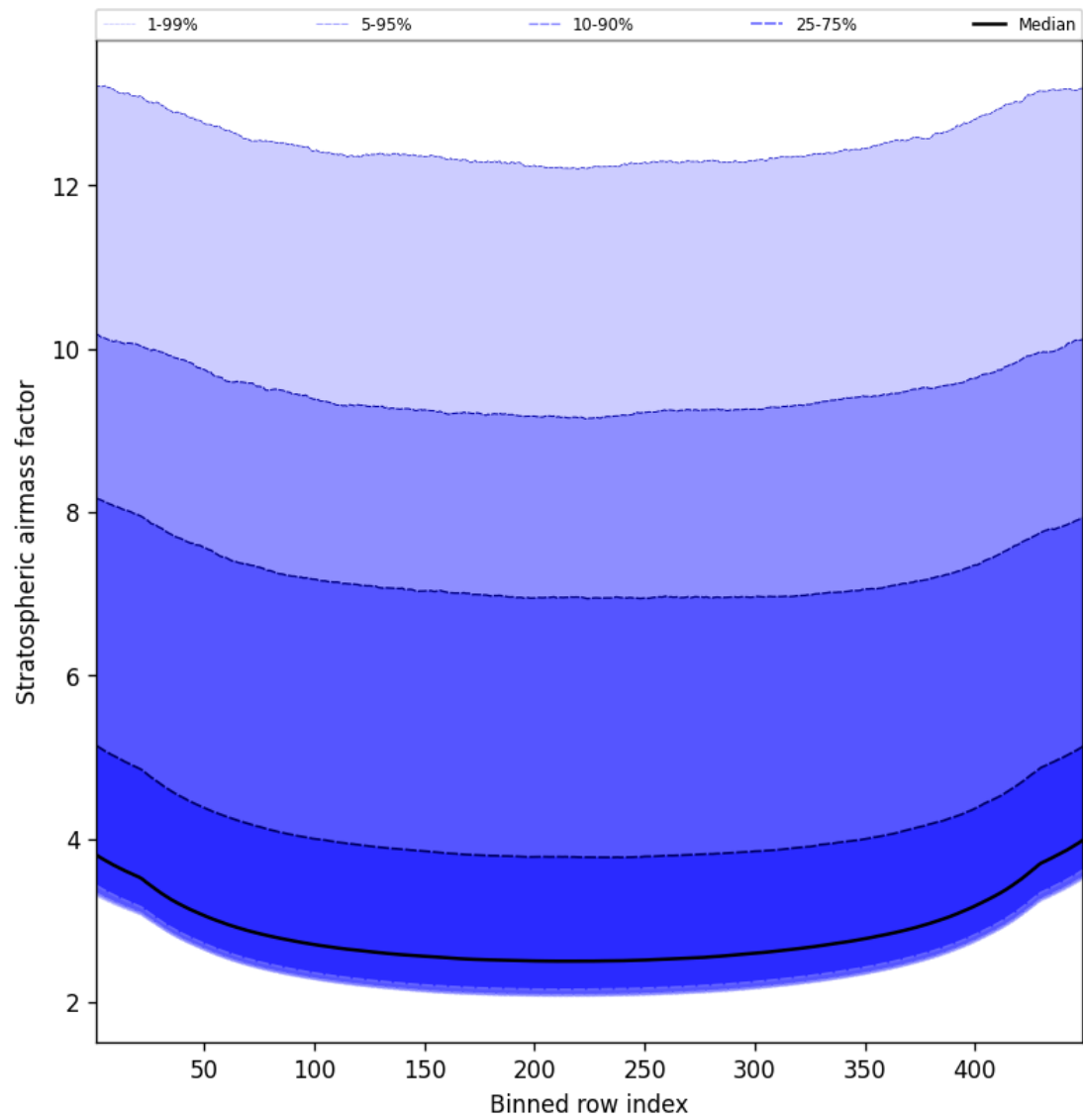


Figure 59: Along track statistics of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23

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

1	Short Introduction	1
1.1	The list of parameters	1
2	Definitions	1
3	Granule outlines	8
4	Input data monitoring	9
5	Warnings and errors	10
6	World maps	11
7	Zonal average	16
8	Histograms	33
9	Along track statistics	50
10	Coincidence density	67
11	Copyright information of ‘PyCAMA’	67

List of Figures

1	Outline of the granules.	8
2	Input data per granule	9
3	Fraction of pixels with specific warnings and errors during processing	10
4	Map of “NO ₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23	11
5	Map of “Stratospheric vertical NO ₂ column” for 2024-12-22 to 2024-12-23	12
6	Map of “Total vertical NO ₂ column” for 2024-12-22 to 2024-12-23	13
7	Map of “Summed vertical NO ₂ column” for 2024-12-22 to 2024-12-23	14
8	Map of the number of observations for 2024-12-22 to 2024-12-23	15
9	Zonal average of “QA value” for 2024-12-22 to 2024-12-23.	16
10	Zonal average of “NO ₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23.	17
11	Zonal average of “NO ₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23.	18
12	Zonal average of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23.	19
13	Zonal average of “Total airmass factor” for 2024-12-22 to 2024-12-23.	20
14	Zonal average of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23.	21
15	Zonal average of “Number of iterations” for 2024-12-22 to 2024-12-23.	22
16	Zonal average of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23.	23
17	Zonal average of “Stratospheric vertical NO ₂ column” for 2024-12-22 to 2024-12-23.	24
18	Zonal average of “Stratospheric vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23.	25
19	Zonal average of “Total vertical NO ₂ column” for 2024-12-22 to 2024-12-23.	26
20	Zonal average of “Total vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23.	27
21	Zonal average of “Summed vertical NO ₂ column” for 2024-12-22 to 2024-12-23.	28
22	Zonal average of “Summed vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23.	29
23	Zonal average of “ χ^2 ” for 2024-12-22 to 2024-12-23.	30
24	Zonal average of “RMS” for 2024-12-22 to 2024-12-23.	31
25	Zonal average of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23.	32
26	Histogram of “QA value” for 2024-12-22 to 2024-12-23	33
27	Histogram of “NO ₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23	34
28	Histogram of “NO ₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23	35
29	Histogram of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23	36

30	Histogram of “Total airmass factor” for 2024-12-22 to 2024-12-23	37
31	Histogram of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23	38
32	Histogram of “Number of iterations” for 2024-12-22 to 2024-12-23	39
33	Histogram of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23	40
34	Histogram of “Stratospheric vertical NO ₂ column” for 2024-12-22 to 2024-12-23	41
35	Histogram of “Stratospheric vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	42
36	Histogram of “Total vertical NO ₂ column” for 2024-12-22 to 2024-12-23	43
37	Histogram of “Total vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	44
38	Histogram of “Summed vertical NO ₂ column” for 2024-12-22 to 2024-12-23	45
39	Histogram of “Summed vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	46
40	Histogram of “ χ^2 ” for 2024-12-22 to 2024-12-23	47
41	Histogram of “RMS” for 2024-12-22 to 2024-12-23	48
42	Histogram of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23	49
43	Along track statistics of “QA value” for 2024-12-22 to 2024-12-23	50
44	Along track statistics of “NO ₂ tropospheric vertical column” for 2024-12-22 to 2024-12-23	51
45	Along track statistics of “NO ₂ tropospheric vertical column precision” for 2024-12-22 to 2024-12-23	52
46	Along track statistics of “Tropospheric airmass factor” for 2024-12-22 to 2024-12-23	53
47	Along track statistics of “Total airmass factor” for 2024-12-22 to 2024-12-23	54
48	Along track statistics of “Number of spectral points in retrieval” for 2024-12-22 to 2024-12-23	55
49	Along track statistics of “Number of iterations” for 2024-12-22 to 2024-12-23	56
50	Along track statistics of “Wavelength calibration offset” for 2024-12-22 to 2024-12-23	57
51	Along track statistics of “Stratospheric vertical NO ₂ column” for 2024-12-22 to 2024-12-23	58
52	Along track statistics of “Stratospheric vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	59
53	Along track statistics of “Total vertical NO ₂ column” for 2024-12-22 to 2024-12-23	60
54	Along track statistics of “Total vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	61
55	Along track statistics of “Summed vertical NO ₂ column” for 2024-12-22 to 2024-12-23	62
56	Along track statistics of “Summed vertical NO ₂ column precision” for 2024-12-22 to 2024-12-23	63
57	Along track statistics of “ χ^2 ” for 2024-12-22 to 2024-12-23	64
58	Along track statistics of “RMS” for 2024-12-22 to 2024-12-23	65
59	Along track statistics of “Stratospheric airmass factor” for 2024-12-22 to 2024-12-23	66

List of Tables

1	Parameterlist and basic statistics for the analysis	2
2	Percentile ranges	3
3	Parameterlist and basic statistics for the analysis for observations in the northern hemisphere	4
4	Parameterlist and basic statistics for the analysis for observations in the southern hemisphere	5
5	Parameterlist and basic statistics for the analysis for observations over water	6
6	Parameterlist and basic statistics for the analysis for observations over land	7

11 Copyright information of ‘PyCAMA’

Copyright © 2005 – 2023, Maarten Snee (KNMI).

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

This software is provided by the copyright holders and contributors “as is” and any express or implied warranties, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose are disclaimed. In no event shall the copyright holder or contributors be liable for any direct, indirect, incidental, special, exemplary, or consequential damages (including, but not limited to, procurement of substitute goods or services; loss of use, data, or

profits; or business interruption) however caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way out of the use of this software, even if advised of the possibility of such damage.

Maarten Sneepe (maarten.sneepe@knmi.nl).