PyCAMA report generated by tropl2-proc

tropl2-proc

2023-12-19 (03:33)

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]	0.844 ± 0.203	25624958	0.995	0.200	0.900	0.0	1.000
ozone total vertical column [mol m^{-2}]	0.126 ± 0.025	25624958	0.116	2.900×10^{-2}	0.125	6.424×10^{-2}	0.316
ozone total vertical column precision [mol m^{-2}]	$(7.070 \pm 3.269) \times 10^{-4}$	25624958	5.500×10^{-4}	2.828×10^{-4}	6.503×10^{-4}	2.763×10^{-4}	8.974×10^{-3}
root mean square slant column fit [1]	$(1.211 \pm 0.670) \times 10^{-3}$	25624958	8.700×10^{-4}	4.000×10^{-4}	1.010×10^{-3}	3.950×10^{-4}	0.119
ozone effective temperature [K]	232 ± 6	25624958	231	6.32	232	53.2	377
ozone ghost column [mol m^{-2}]	$(1.360 \pm 1.911) \times 10^{-3}$	25624958	5.000×10^{-5}	1.864×10^{-3}	5.325×10^{-4}	0.0	7.913×10^{-2}
number of iterations vertical column [1]	3.67 ± 0.69	25624958	4.05	1.000	4.00	1.000	6.00

Table 2: Percentile ranges

Variable	1 %	5 %	10 %	15.9 %	25 %	75 %	84.1 %	90 %	95 %	99 %
qa value [1]	0.130	0.430	0.600	0.620	0.800	1.000	1.000	1.000	1.000	1.000
ozone total vertical column [mol m^{-2}]	7.800×10^{-2}	8.289×10^{-2}	8.837×10^{-2}	0.103	0.112	0.141	0.148	0.157	0.168	0.198
ozone total vertical column precision [mol m^{-2}]	3.755×10^{-4}	4.237×10^{-4}	4.524×10^{-4}	4.778×10^{-4}	5.156×10^{-4}	7.984×10^{-4}	8.505×10^{-4}	9.237×10^{-4}	1.167×10^{-3}	2.141×10^{-3}
root mean square slant column fit [1]	6.428×10^{-4}	7.268×10^{-4}	7.749×10^{-4}	8.149×10^{-4}	8.666×10^{-4}	1.266×10^{-3}	1.494×10^{-3}	1.831×10^{-3}	2.499×10^{-3}	4.184×10^{-3}
ozone effective temperature [K]	209	219	225	227	229	235	238	239	241	243
ozone ghost column [mol m^{-2}]	0.0	0.0	0.0	0.0	2.141×10^{-6}	1.866×10^{-3}	3.052×10^{-3}	4.181×10^{-3}	5.682×10^{-3}	8.008×10^{-3}
number of iterations vertical column [1]	2.00	3.00	3.00	3.00	3.00	4.00	4.00	5.00	5.00	5.00

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]	0.855 ± 0.215	9715289	0.110	0.900	0.0	1.000	0.890	1.000
ozone total vertical column [mol m^{-2}]	0.134 ± 0.025	9715289	2.749×10^{-2}	0.125	8.980×10^{-2}	0.316	0.116	0.143
ozone total vertical column precision [mol m^{-2}]	$(8.431 \pm 4.267) \times 10^{-4}$	9715289	2.565×10^{-4}	7.567×10^{-4}	2.877×10^{-4}	7.351×10^{-3}	6.273×10^{-4}	8.838×10^{-4}
root mean square slant column fit [1]	$(1.344 \pm 0.806) \times 10^{-3}$	9715289	5.513×10^{-4}	1.080×10^{-3}	4.077×10^{-4}	0.119	8.936×10^{-4}	1.445×10^{-3}
ozone effective temperature [K]	227 ± 6	9715289	6.44	229	57.2	346	225	231
ozone ghost column [mol m^{-2}]	$(1.889 \pm 2.319) \times 10^{-3}$	9715289	2.803×10^{-3}	8.868×10^{-4}	0.0	1.765×10^{-2}	1.151×10^{-4}	2.918×10^{-3}
number of iterations vertical column [1]	3.69 ± 0.71	9715289	1.000	4.00	1.000	6.00	3.00	4.00

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]	0.837 ± 0.196	15909669	0.270	0.900	0.0	1.000	0.730	1.000
ozone total vertical column [mol m^{-2}]	0.122 ± 0.024	15909669	3.830×10^{-2}	0.126	6.424×10^{-2}	0.214	0.102	0.140
ozone total vertical column precision [mol m^{-2}]	$(6.238 \pm 2.066) \times 10^{-4}$	15909669	2.405×10^{-4}	5.837×10^{-4}	2.763×10^{-4}	8.974×10^{-3}	4.839×10^{-4}	7.244×10^{-4}
root mean square slant column fit [1]	$(1.130 \pm 0.555) \times 10^{-3}$	15909669	3.243×10^{-4}	9.807×10^{-4}	3.950×10^{-4}	7.183×10^{-2}	8.537×10^{-4}	1.178×10^{-3}
ozone effective temperature [K]	234 ± 4	15909669	6.80	234	53.2	377	231	238
ozone ghost column [mol m^{-2}]	$(1.037 \pm 1.523) \times 10^{-3}$	15909669	1.367×10^{-3}	4.053×10^{-4}	0.0	7.913×10^{-2}	5.653×10^{-7}	1.367×10^{-3}
number of iterations vertical column [1]	3.66 ± 0.67	15909669	1.000	4.00	1.000	6.00	3.00	4.00

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]	0.887 ± 0.174	16486697	0.1000	0.900	0.0	1.000	0.900	1.000
ozone total vertical column [mol m^{-2}]	0.130 ± 0.022	16486697	2.829×10^{-2}	0.129	6.424×10^{-2}	0.316	0.115	0.143
ozone total vertical column precision [mol m^{-2}]	$(6.968 \pm 2.652) \times 10^{-4}$	16486697	2.440×10^{-4}	6.607×10^{-4}	2.791×10^{-4}	8.974×10^{-3}	5.440×10^{-4}	7.880×10^{-4}
root mean square slant column fit [1]	$(1.104 \pm 0.588) \times 10^{-3}$	16486697	2.824×10^{-4}	9.432×10^{-4}	3.950×10^{-4}	0.119	8.346×10^{-4}	1.117×10^{-3}
ozone effective temperature [K]	231 ± 5	16486697	4.39	231	53.2	354	229	234
ozone ghost column [mol m^{-2}]	$(1.519 \pm 1.923) \times 10^{-3}$	16486697	1.963×10^{-3}	7.147×10^{-4}	0.0	7.913×10^{-2}	1.938×10^{-4}	2.156×10^{-3}
number of iterations vertical column [1]	3.55 ± 0.66	16486697	1.000	3.00	1.000	6.00	3.00	4.00

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]	0.770 ± 0.215	7824087	0.300	0.870	0.0	1.000	0.600	0.900
ozone total vertical column [mol m^{-2}]	0.115 ± 0.027	7824087	4.314×10^{-2}	0.117	6.665×10^{-2}	0.222	8.829×10^{-2}	0.131
ozone total vertical column precision [mol m^{-2}]	$(6.826 \pm 3.601) \times 10^{-4}$	7824087	3.301×10^{-4}	5.763×10^{-4}	2.763×10^{-4}	7.329×10^{-3}	4.690×10^{-4}	7.992×10^{-4}
root mean square slant column fit [1]	$(1.348 \pm 0.674) \times 10^{-3}$	7824087	4.492×10^{-4}	1.160×10^{-3}	4.245×10^{-4}	4.992×10^{-2}	9.853×10^{-4}	1.435×10^{-3}
ozone effective temperature [K]	233 ± 8	7824087	10.4	235	65.7	377	229	239
ozone ghost column [mol m^{-2}]	$(8.760 \pm 16.620) \times 10^{-4}$	7824087	9.485×10^{-4}	5.632×10^{-5}	0.0	1.683×10^{-2}	0.0	9.485×10^{-4}
number of iterations vertical column [1]	3.87 ± 0.66	7824087	1.000	4.00	1.000	6.00	3.00	4.00

Table 7: Correlation matrix

Viewing zenith angle	Solar zenith angle	Latitude	O_3 vertical column	O_3 vertical column precision	Effective temperature	O_3 ghost column
1.000	9.435×10^{-4}	-1.070×10^{-3}	2.085×10^{-2}	-0.120	-2.210×10^{-2}	0.101
9.435×10^{-4}	1.000	6.975×10^{-2}	-2.630×10^{-2}	0.318	-5.097×10^{-2}	0.110
-1.070×10^{-3}	6.975×10^{-2}	1.000	0.445	0.433	-0.754	0.282
2.085×10^{-2}	-2.630×10^{-2}	0.445	1.000	0.423	-0.320	0.197
-0.120	0.318	0.433	0.423	1.000	-0.394	7.733×10^{-2}
-2.210×10^{-2}	-5.097×10^{-2}	-0.754	-0.320	-0.394	1.000	-0.255
0.101	0.110	0.282	0.197	7.733×10^{-2}	-0.255	1.000

Table 8: Covariance matrix

Viewing zenith angle	Solar zenith angle	Latitude	O_3 vertical column	O_3 vertical column precision	Effective temperature	O_3 ghost column
384	0.363	-0.968	1.025×10^{-2}	-7.676×10^{-4}	-2.75	3.797×10^{-3}
0.363	385	63.2	-1.295×10^{-2}	2.039×10^{-3}	-6.37	4.127×10^{-3}
-0.968	63.2	2.133×10^{3}	0.515	6.536×10^{-3}	-222	2.488×10^{-2}
1.025×10^{-2}	-1.295×10^{-2}	0.515	6.291×10^{-4}	3.465×10^{-6}	-5.112×10^{-2}	9.433×10^{-6}
-7.676×10^{-4}	2.039×10^{-3}	6.536×10^{-3}	3.465×10^{-6}	1.068×10^{-7}	-8.203×10^{-4}	4.829×10^{-8}
-2.75	-6.37	-222	-5.112×10^{-2}	-8.203×10^{-4}	40.5	-3.104×10^{-3}
3.797×10^{-3}	4.127×10^{-3}	2.488×10^{-2}	9.433×10^{-6}	4.829×10^{-8}	-3.104×10^{-3}	3.650×10^{-6}

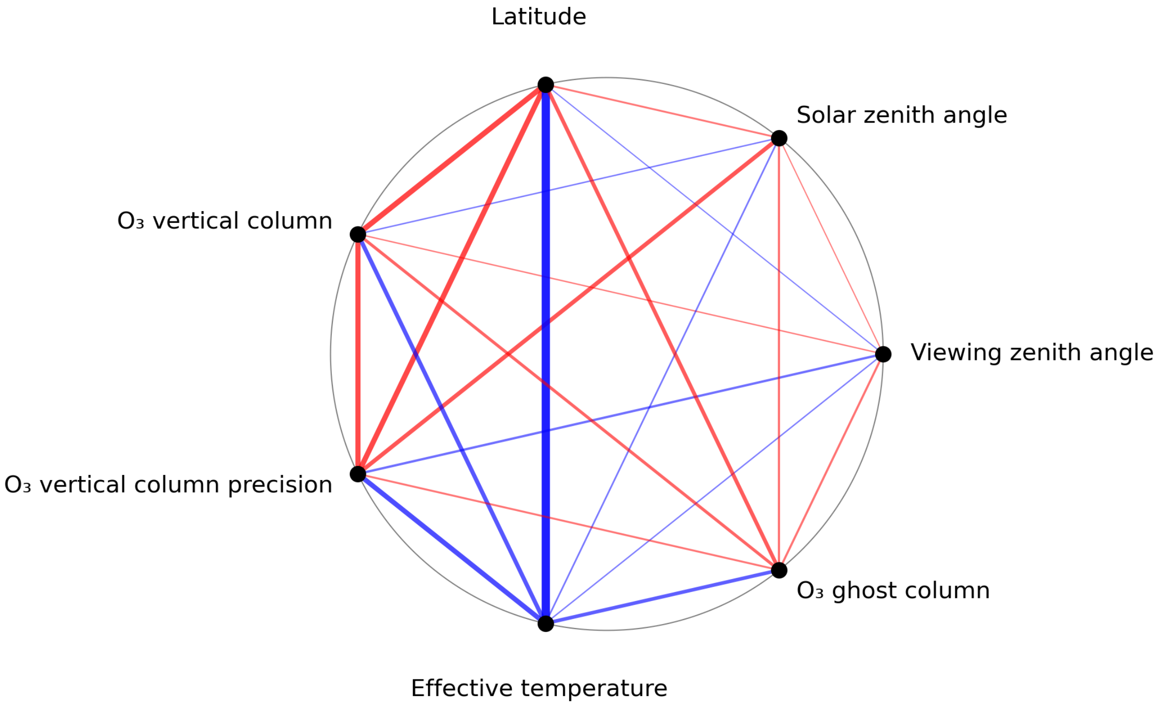


Figure 1: Map of correlation graph for 2023-12-04 to 2023-12-05.

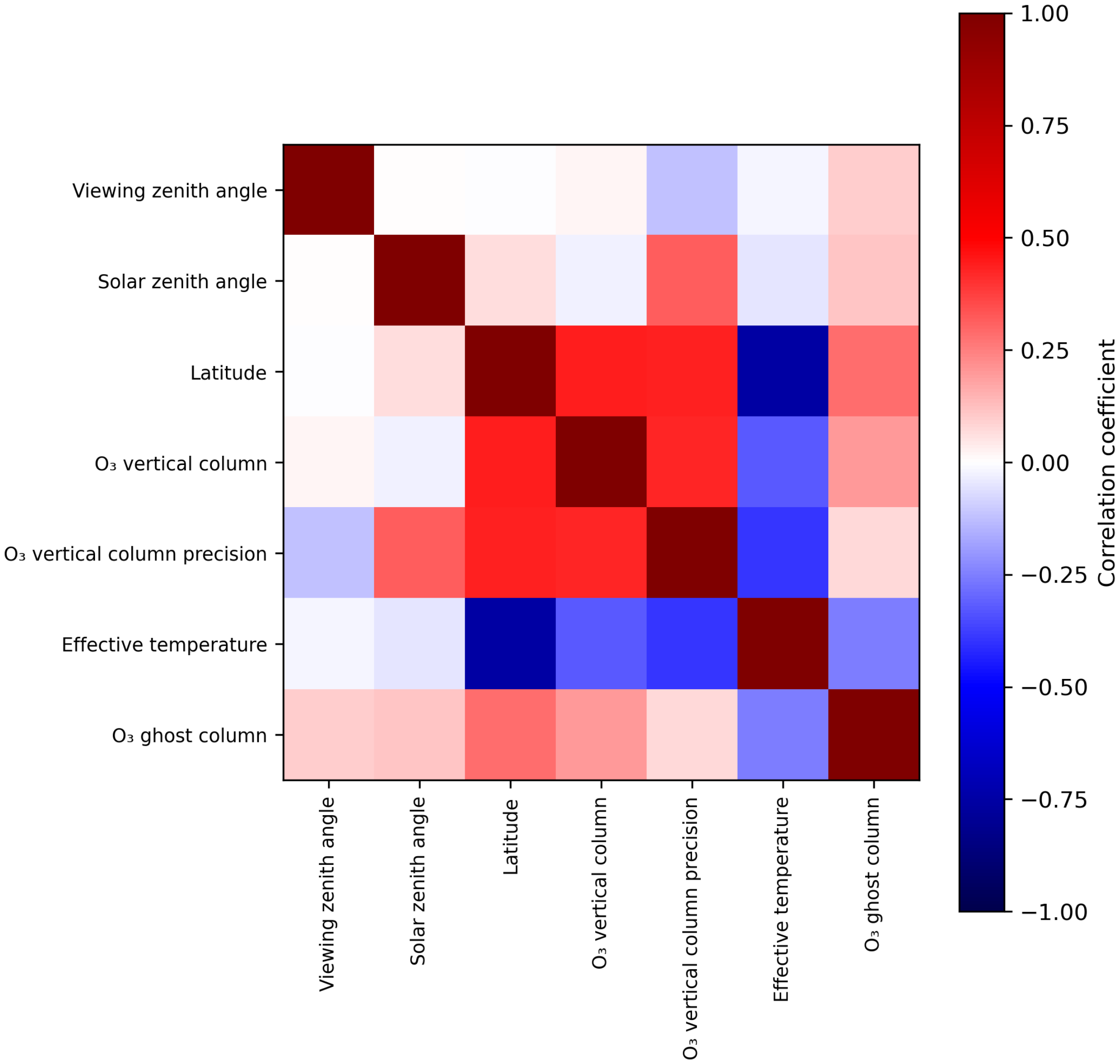


Figure 2: Map of correlation matrix for 2023-12-04 to 2023-12-05.

3 Granule outlines

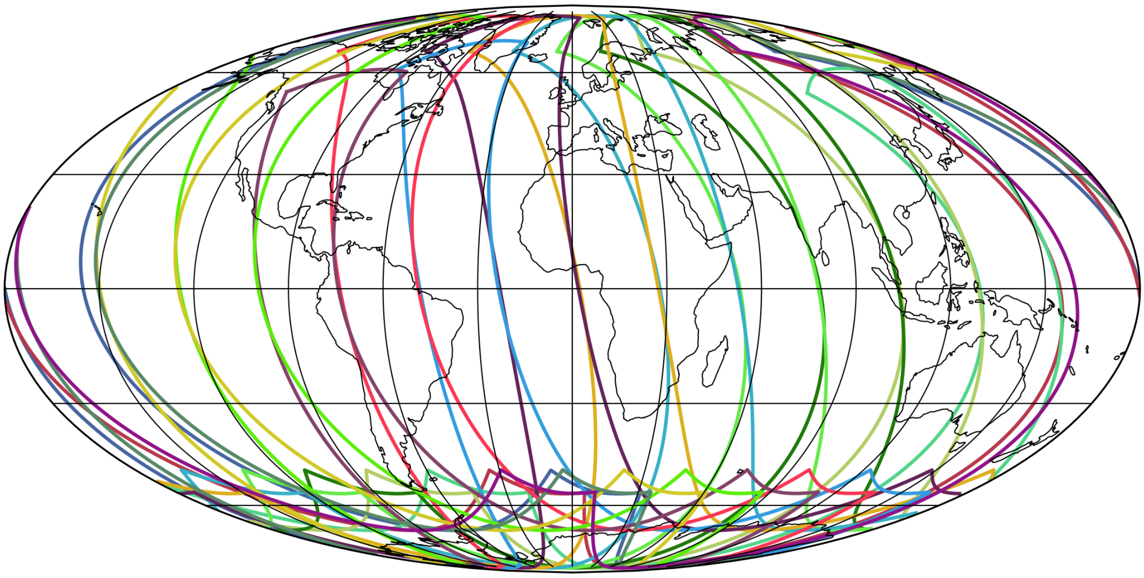


Figure 3: Outline of the granules.

4 Input data monitoring

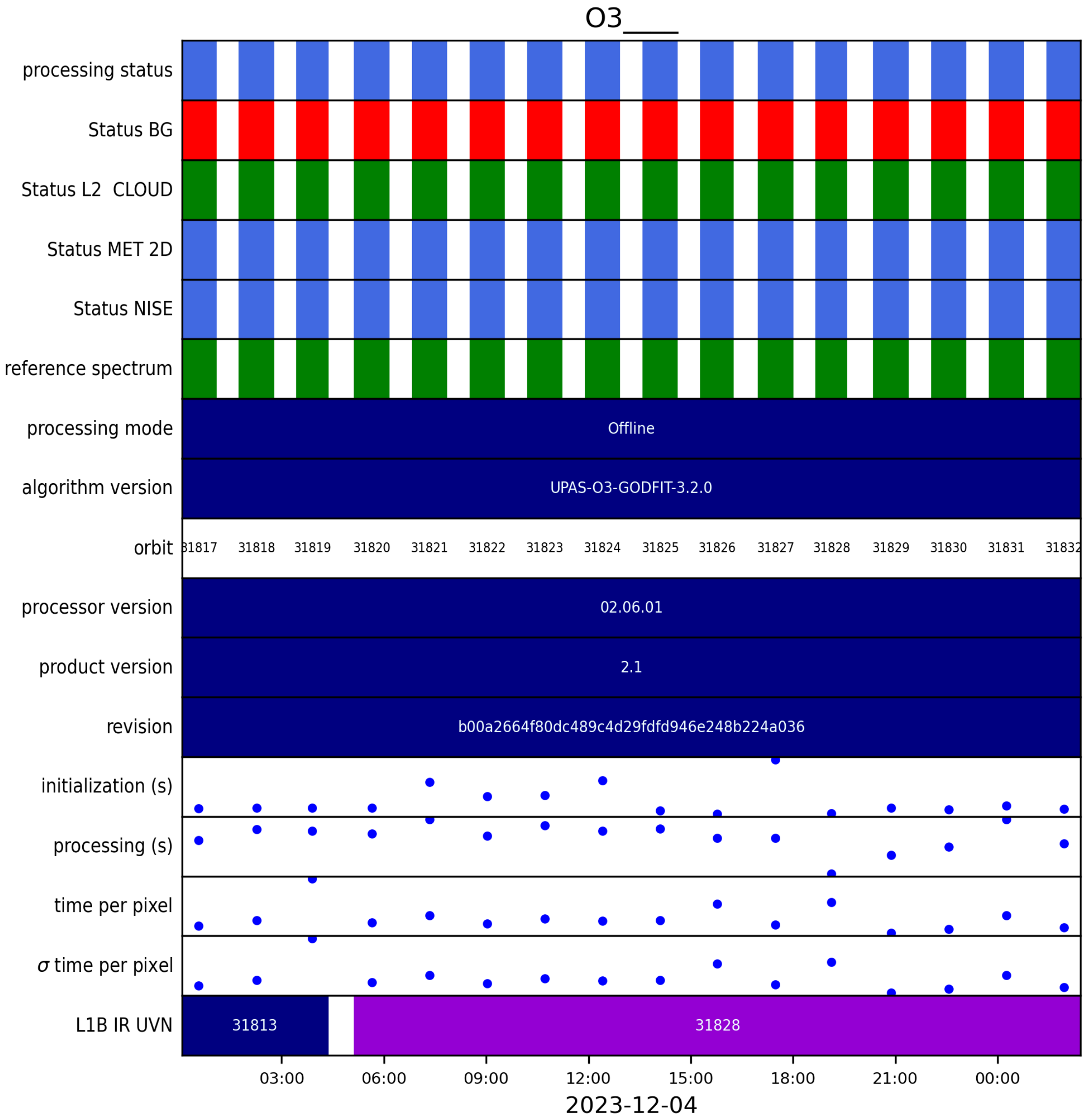


Figure 4: Input data per granule

5 Warnings and errors

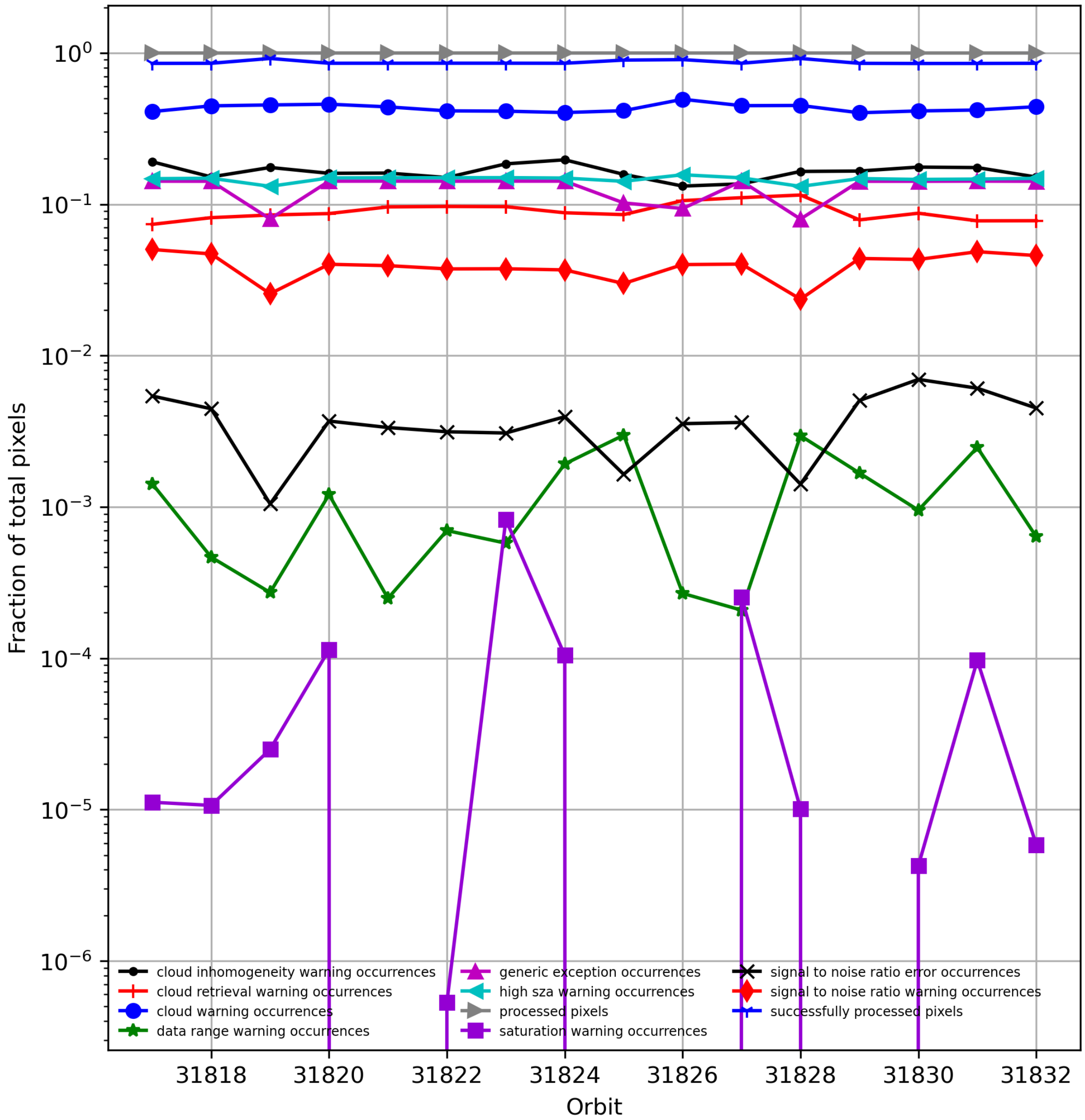


Figure 5: Fraction of pixels with specific warnings and errors during processing

6 World maps

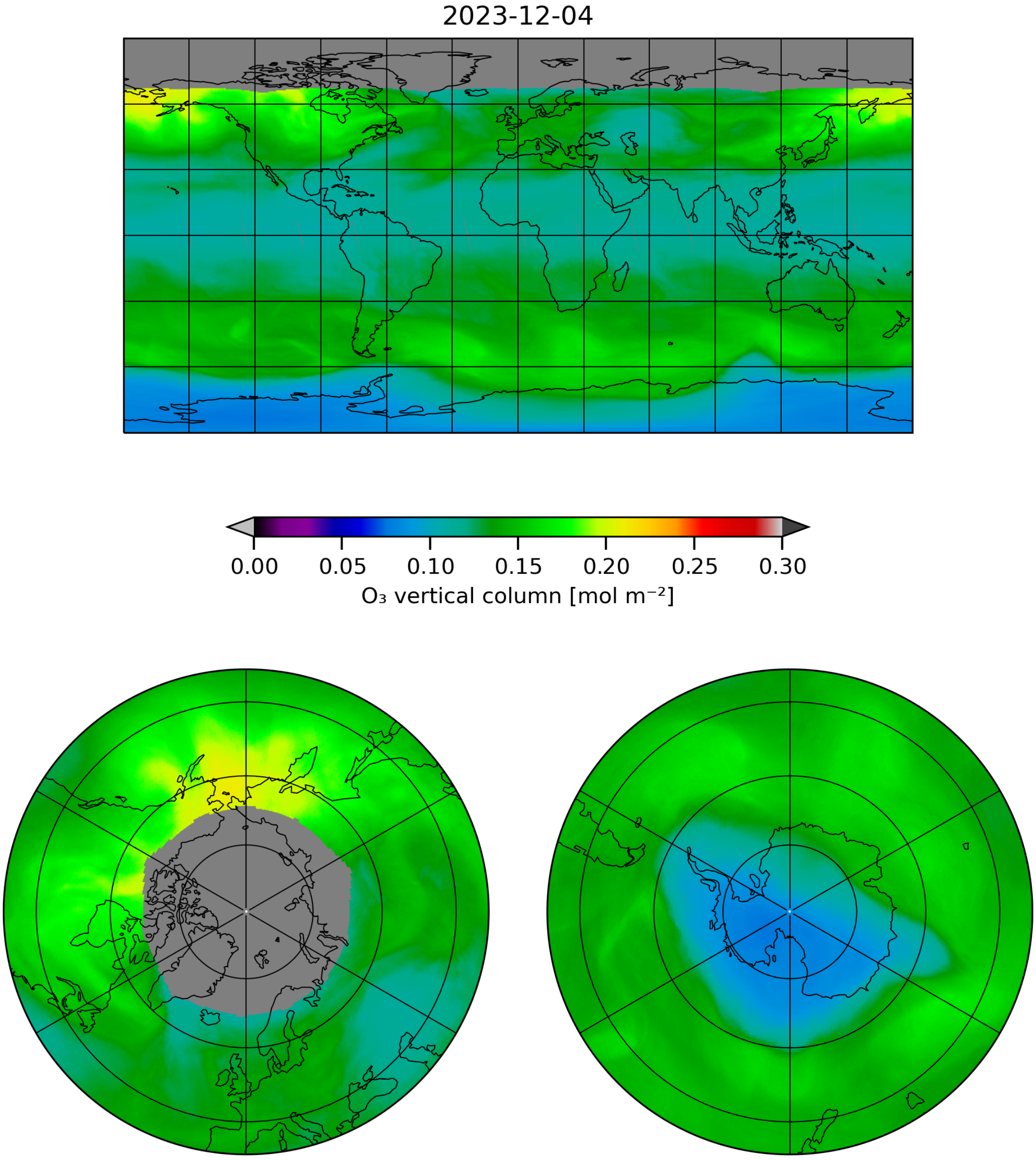


Figure 6: Map of "O_3 vertical column" for 2023-12-04 to 2023-12-05

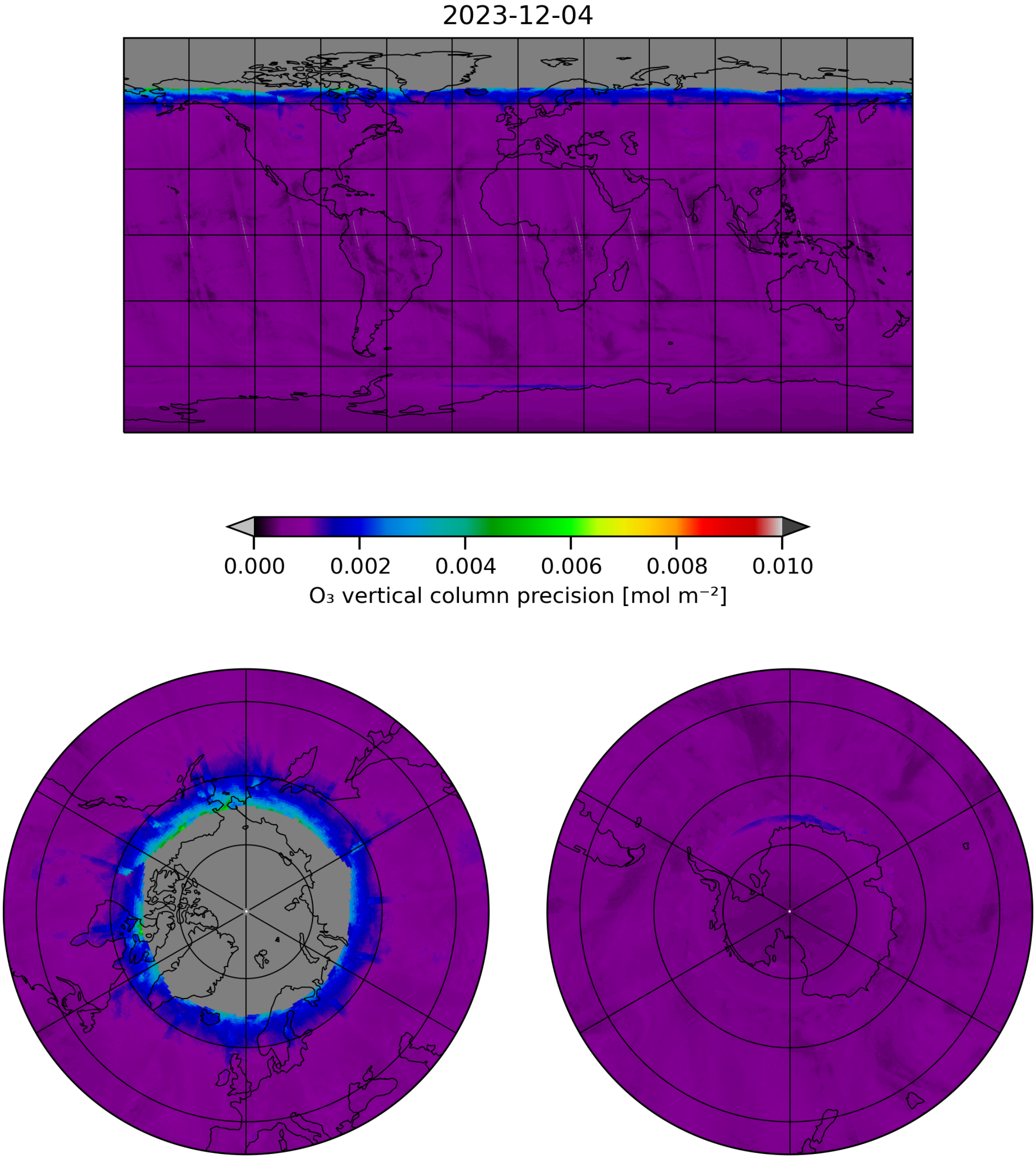


Figure 7: Map of “O_3 vertical column precision” for 2023-12-04 to 2023-12-05

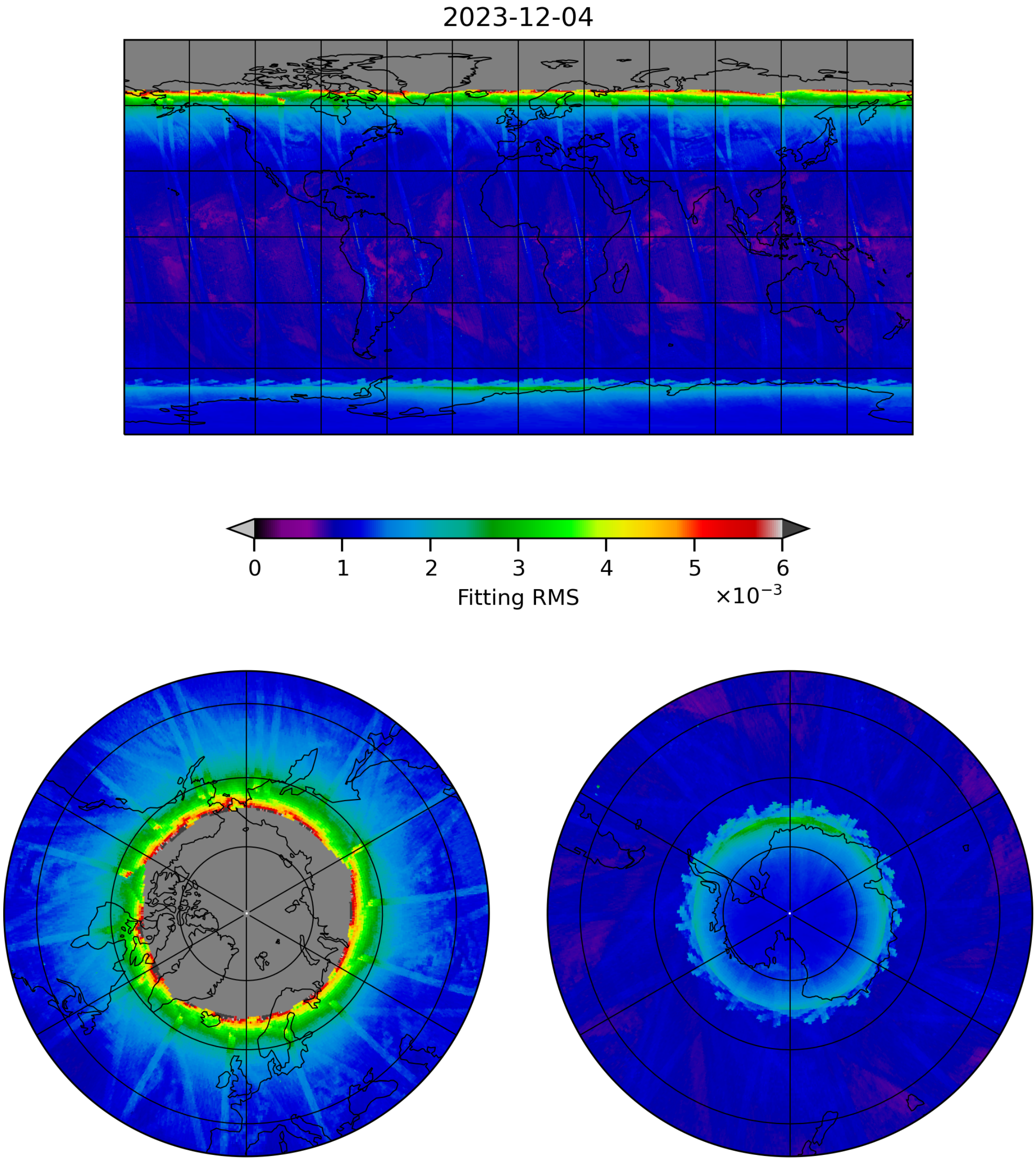


Figure 8: Map of "Fitting RMS" for 2023-12-04 to 2023-12-05

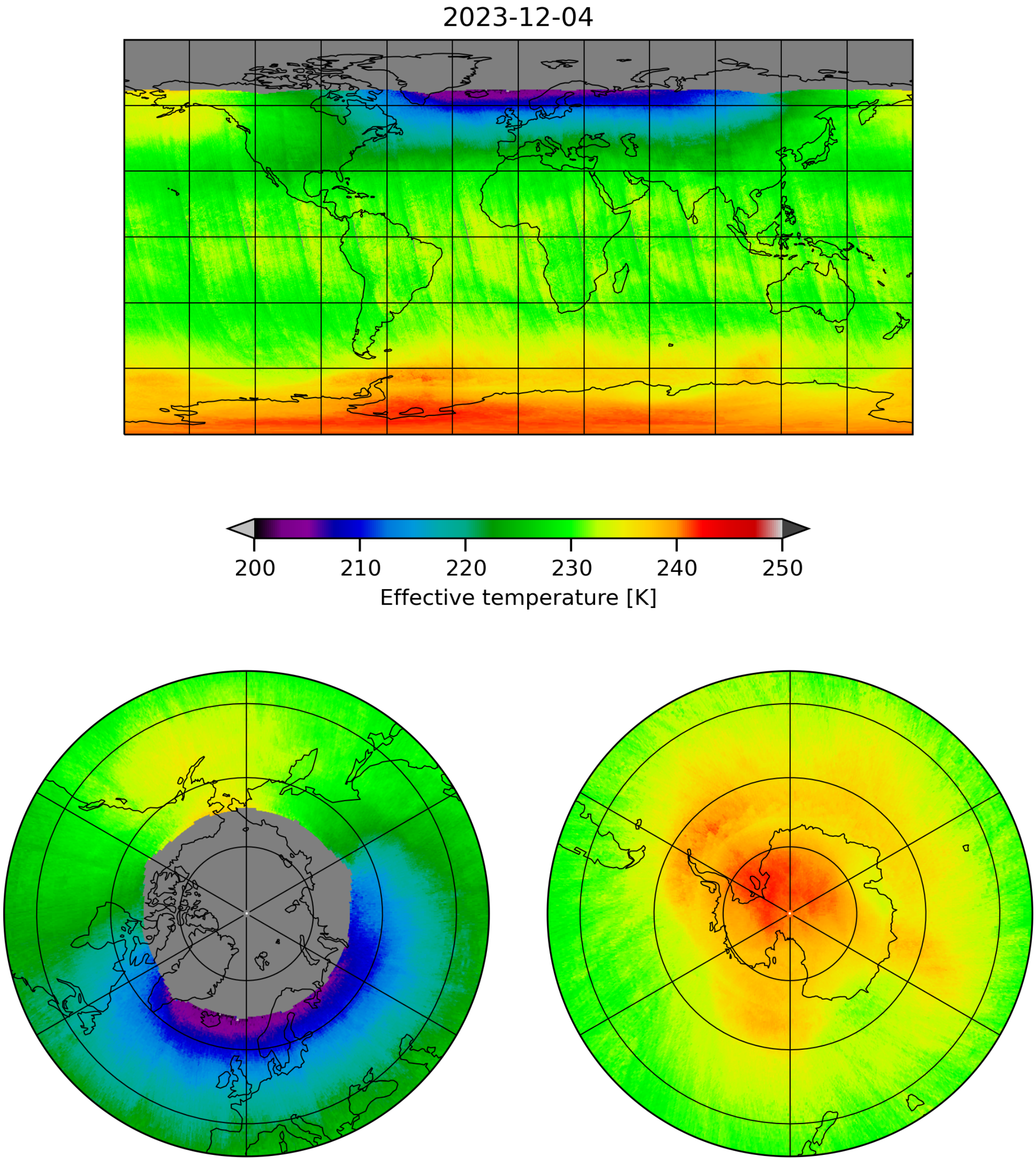


Figure 9: Map of "Effective temperature" for 2023-12-04 to 2023-12-05

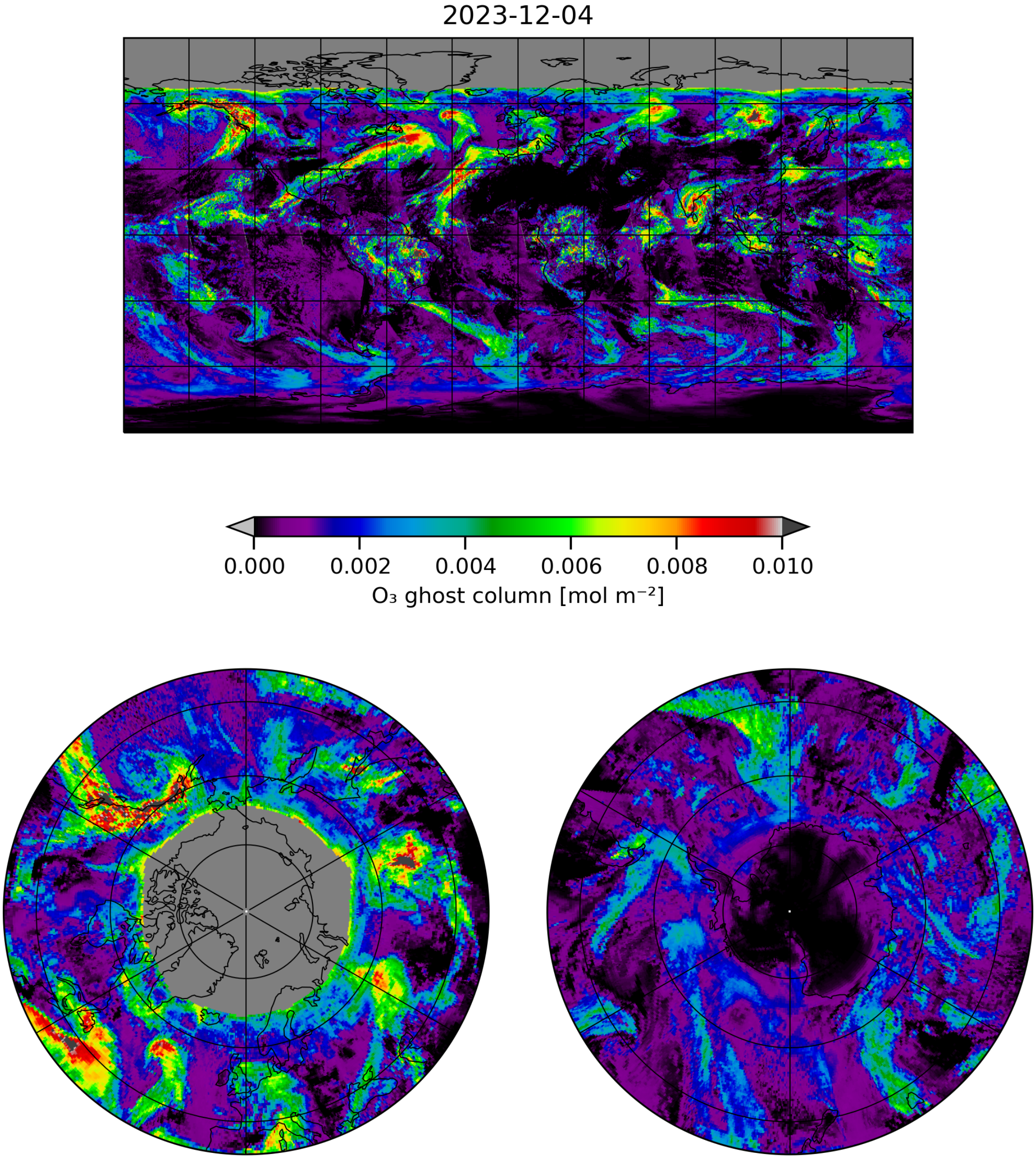


Figure 10: Map of "O_3 ghost column" for 2023-12-04 to 2023-12-05

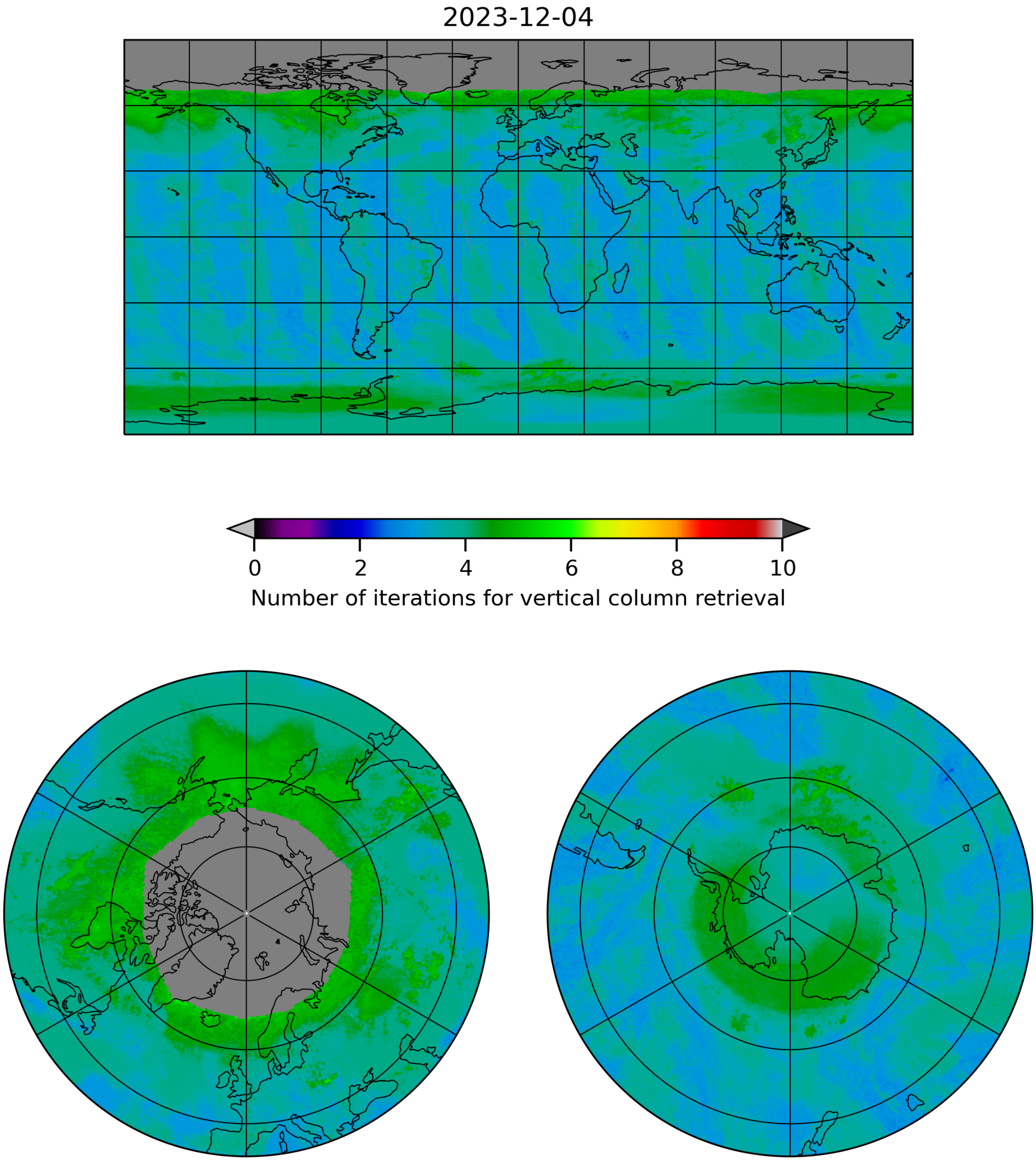


Figure 11: Map of “Number of iterations for vertical column retrieval” for 2023-12-04 to 2023-12-05

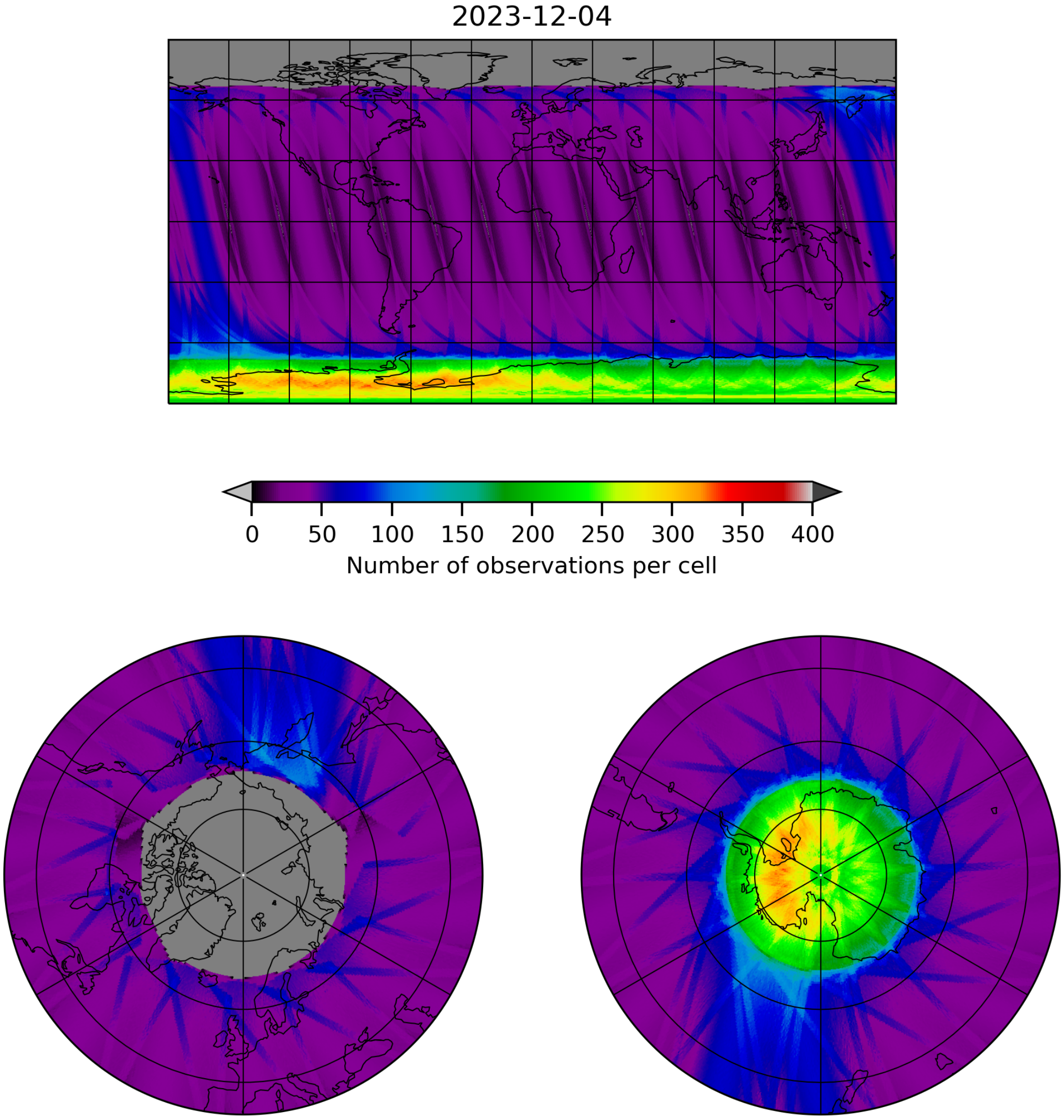


Figure 12: Map of the number of observations for 2023-12-04 to 2023-12-05

7 Zonal average

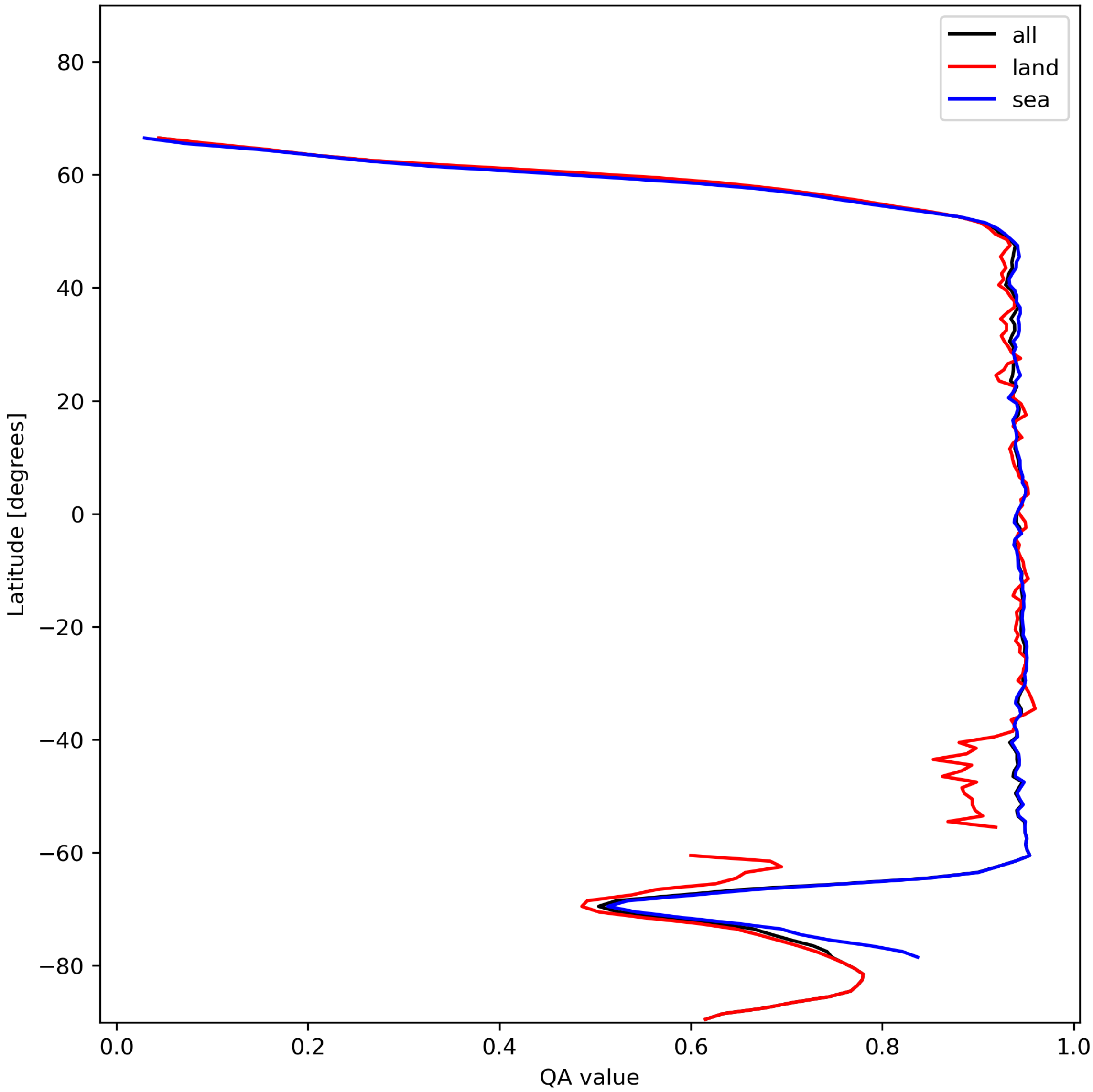


Figure 13: Zonal average of “QA value” for 2023-12-04 to 2023-12-05.

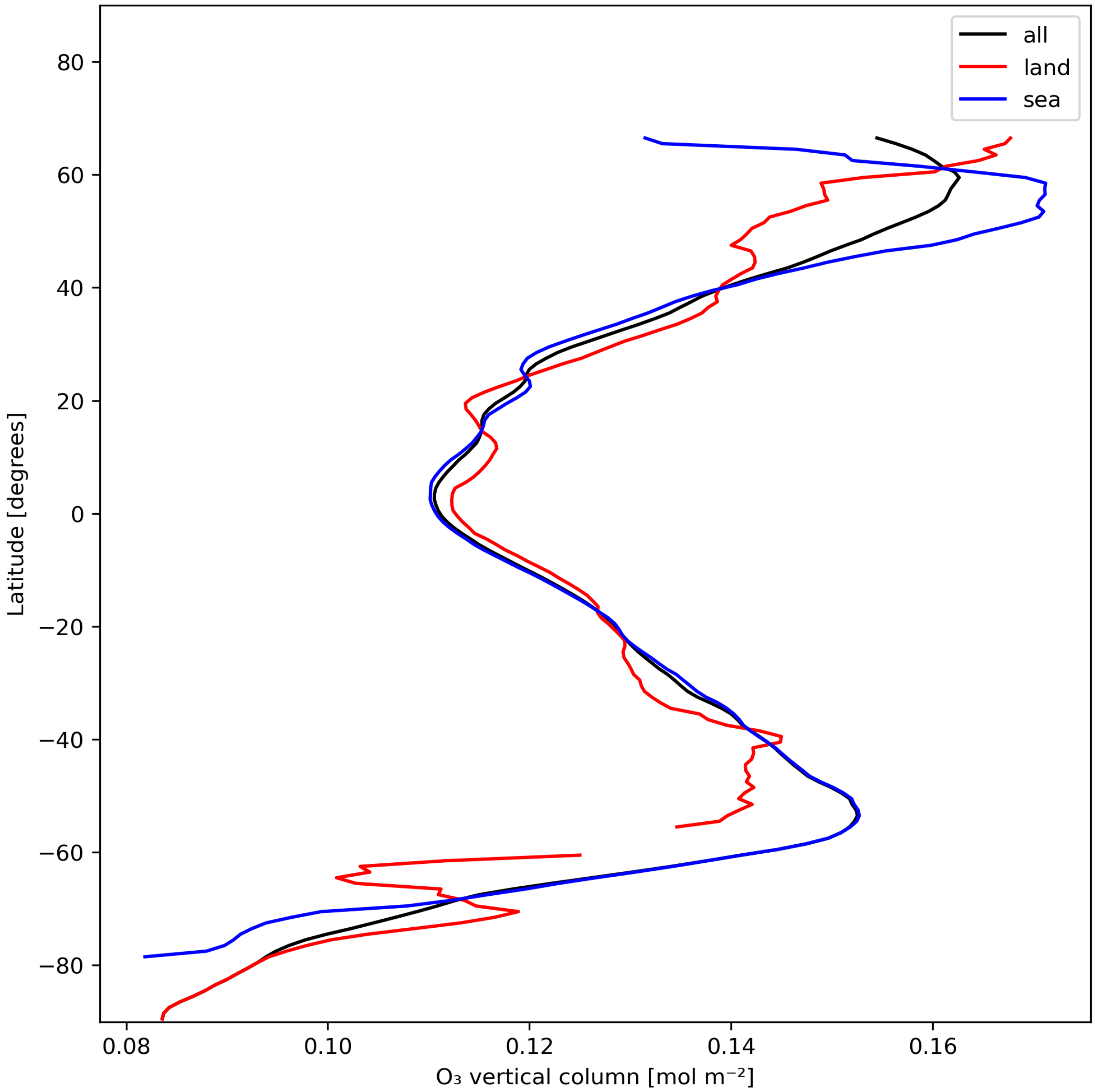


Figure 14: Zonal average of “O_3 vertical column” for 2023-12-04 to 2023-12-05.

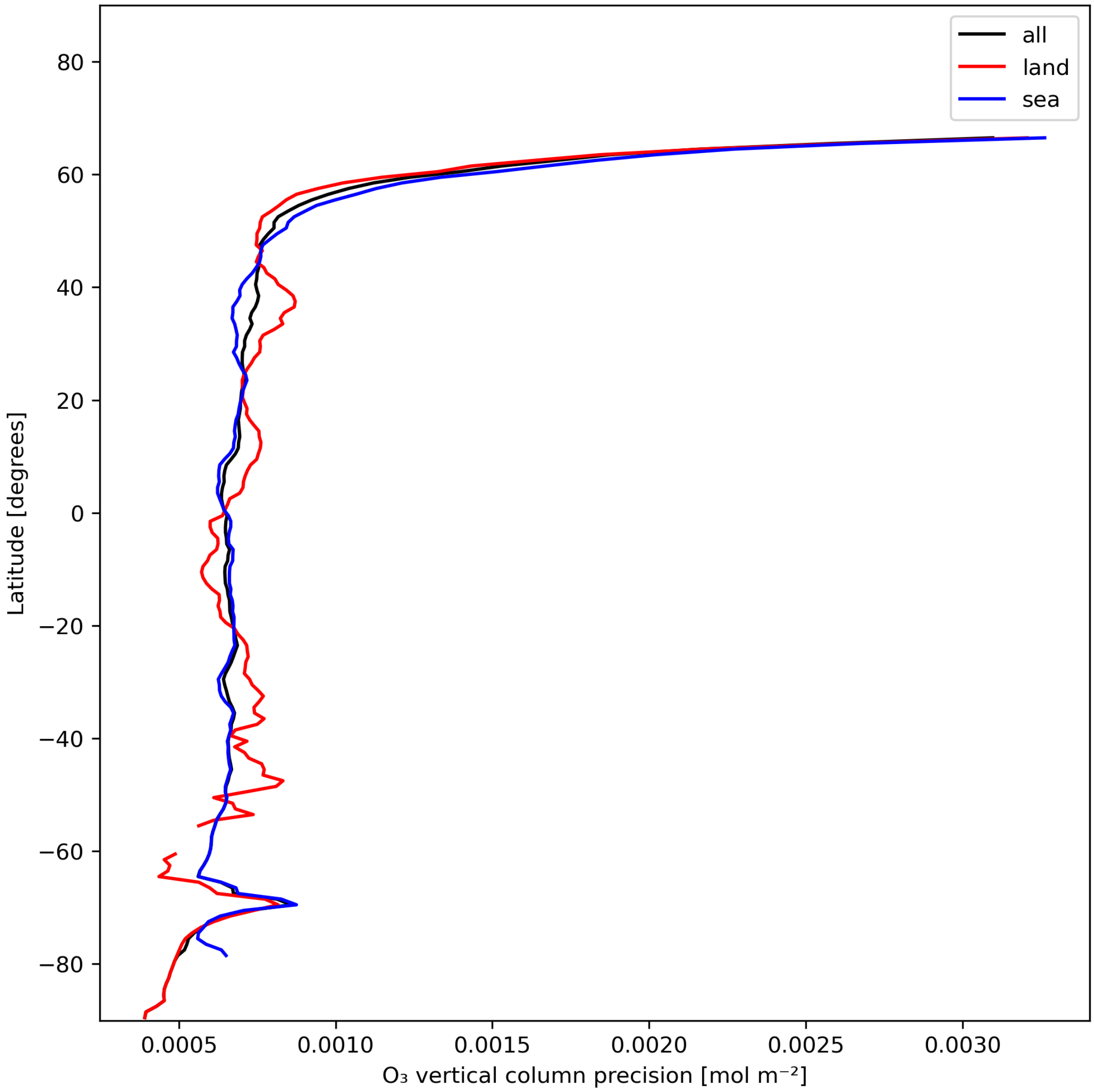


Figure 15: Zonal average of “O_3 vertical column precision” for 2023-12-04 to 2023-12-05.

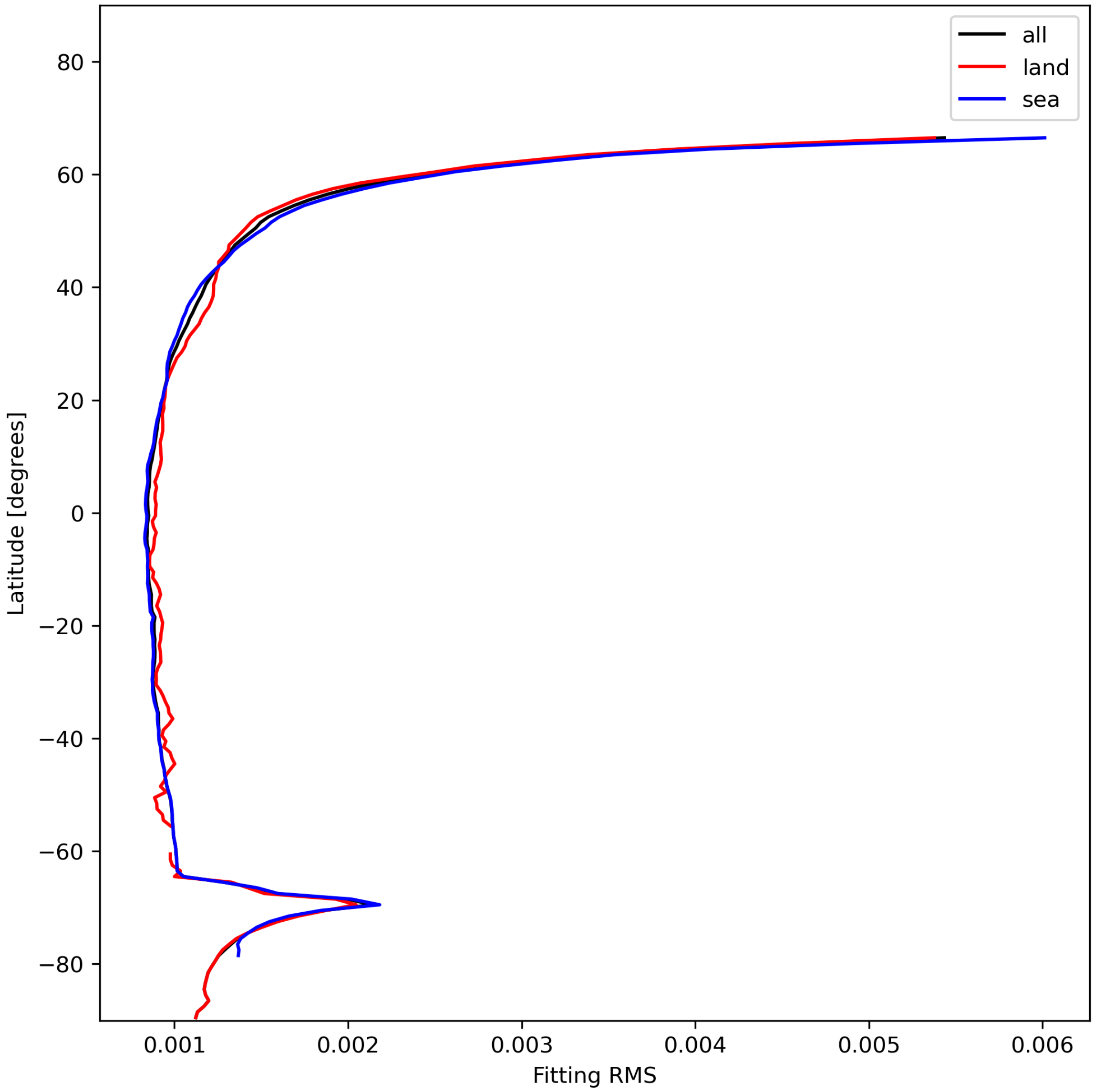


Figure 16: Zonal average of “Fitting RMS” for 2023-12-04 to 2023-12-05.

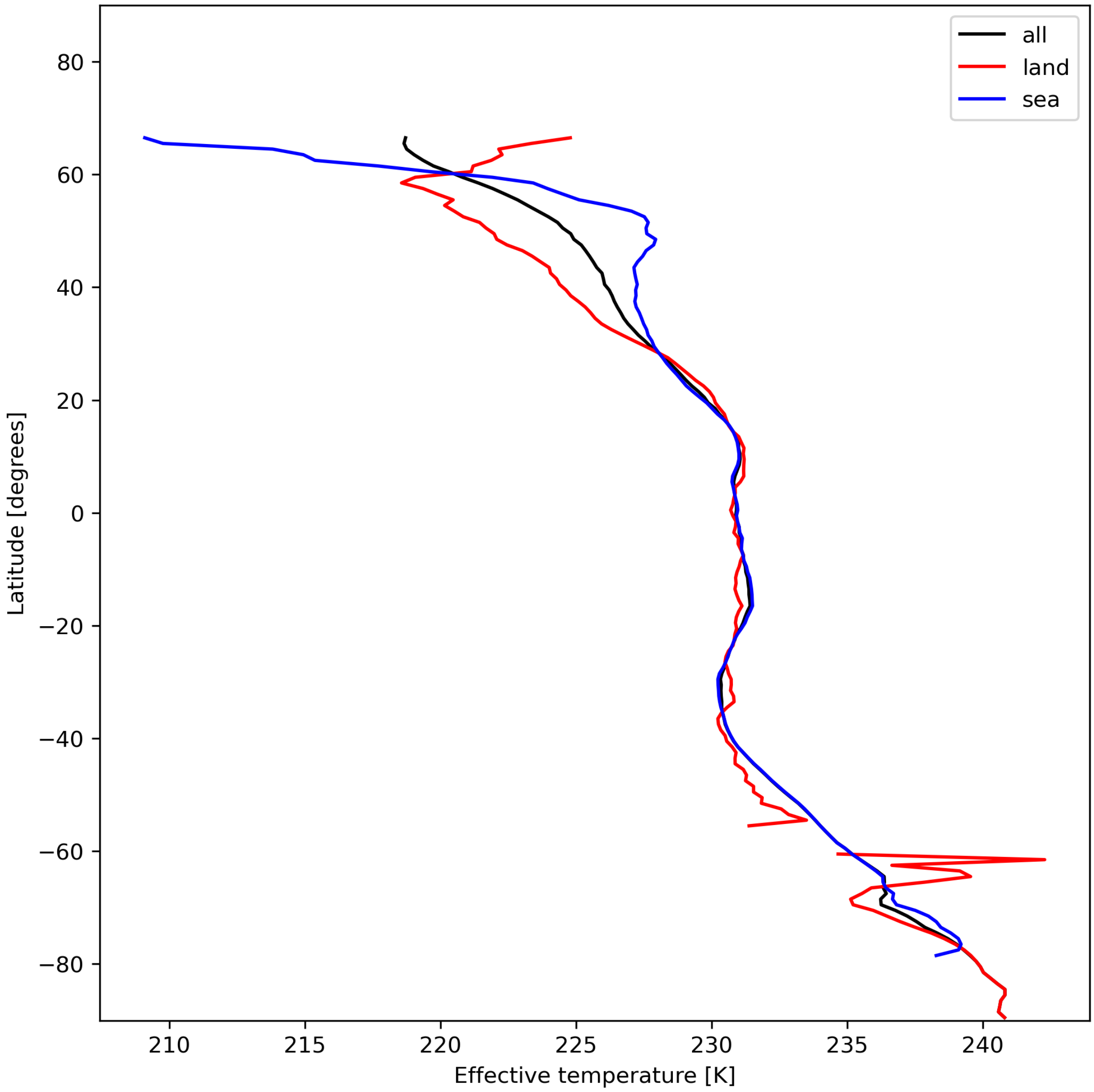


Figure 17: Zonal average of “Effective temperature” for 2023-12-04 to 2023-12-05.

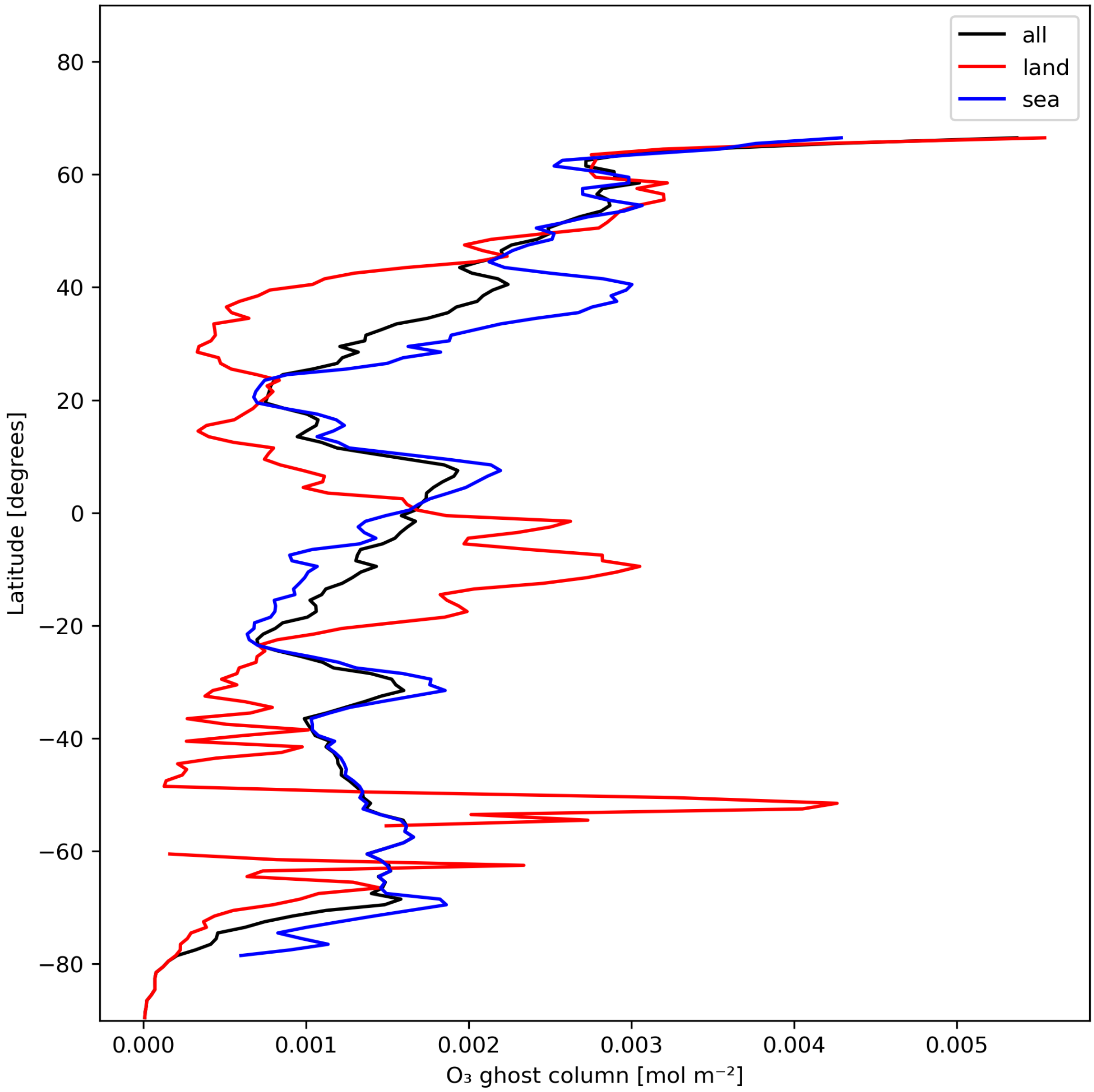


Figure 18: Zonal average of "O_3 ghost column" for 2023-12-04 to 2023-12-05.

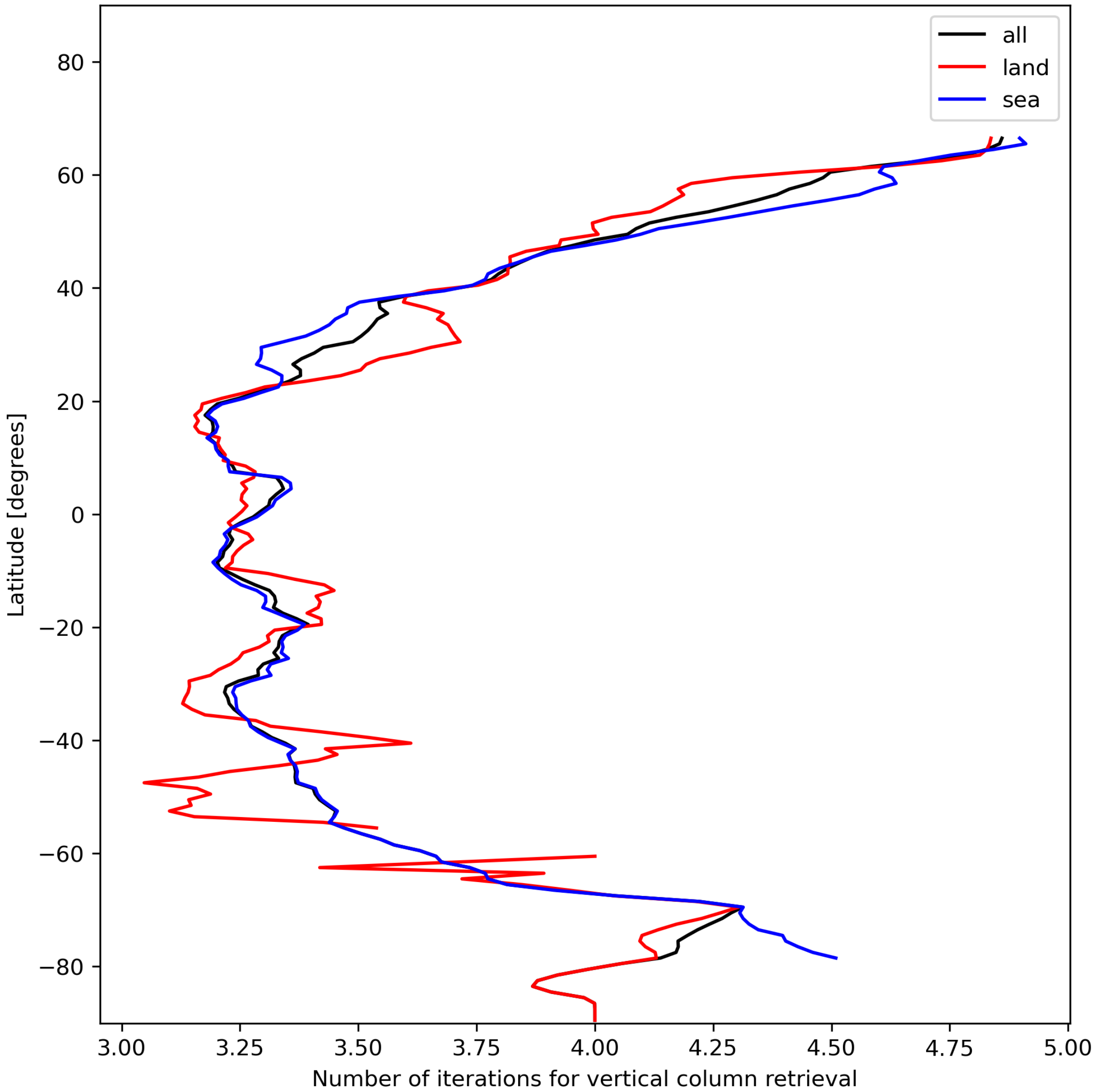


Figure 19: Zonal average of “Number of iterations for vertical column retrieval” for 2023-12-04 to 2023-12-05.

8 Histograms

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

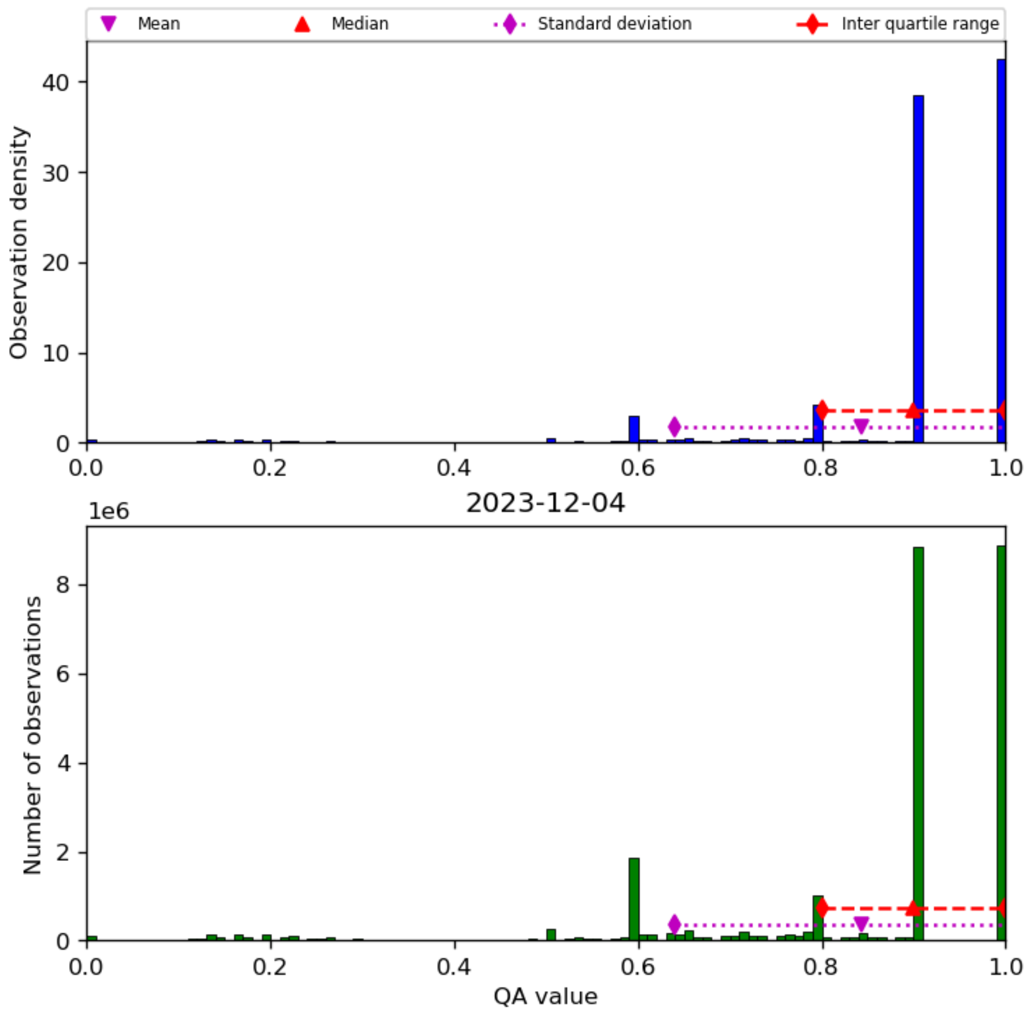


Figure 20: Histogram of “QA value” for 2023-12-04 to 2023-12-05

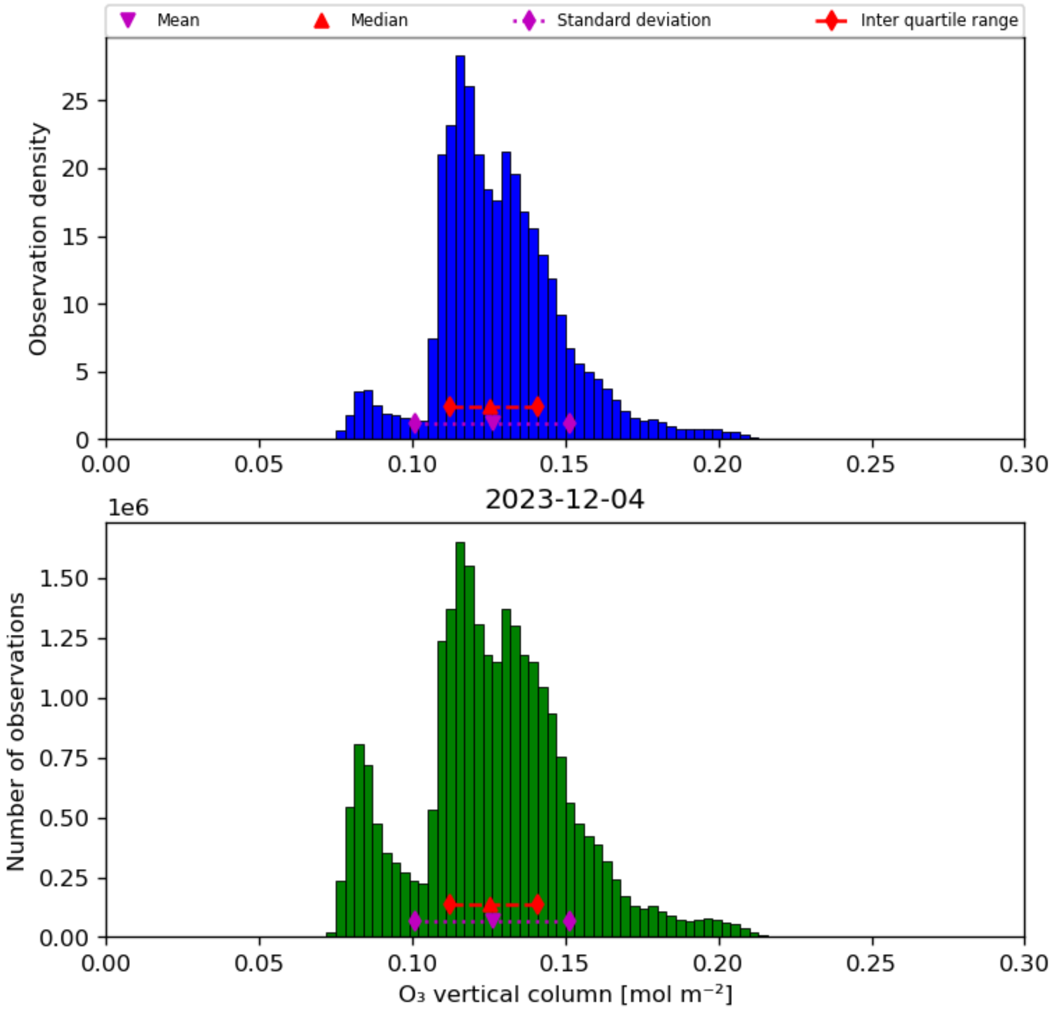


Figure 21: Histogram of "O_3 vertical column" for 2023-12-04 to 2023-12-05

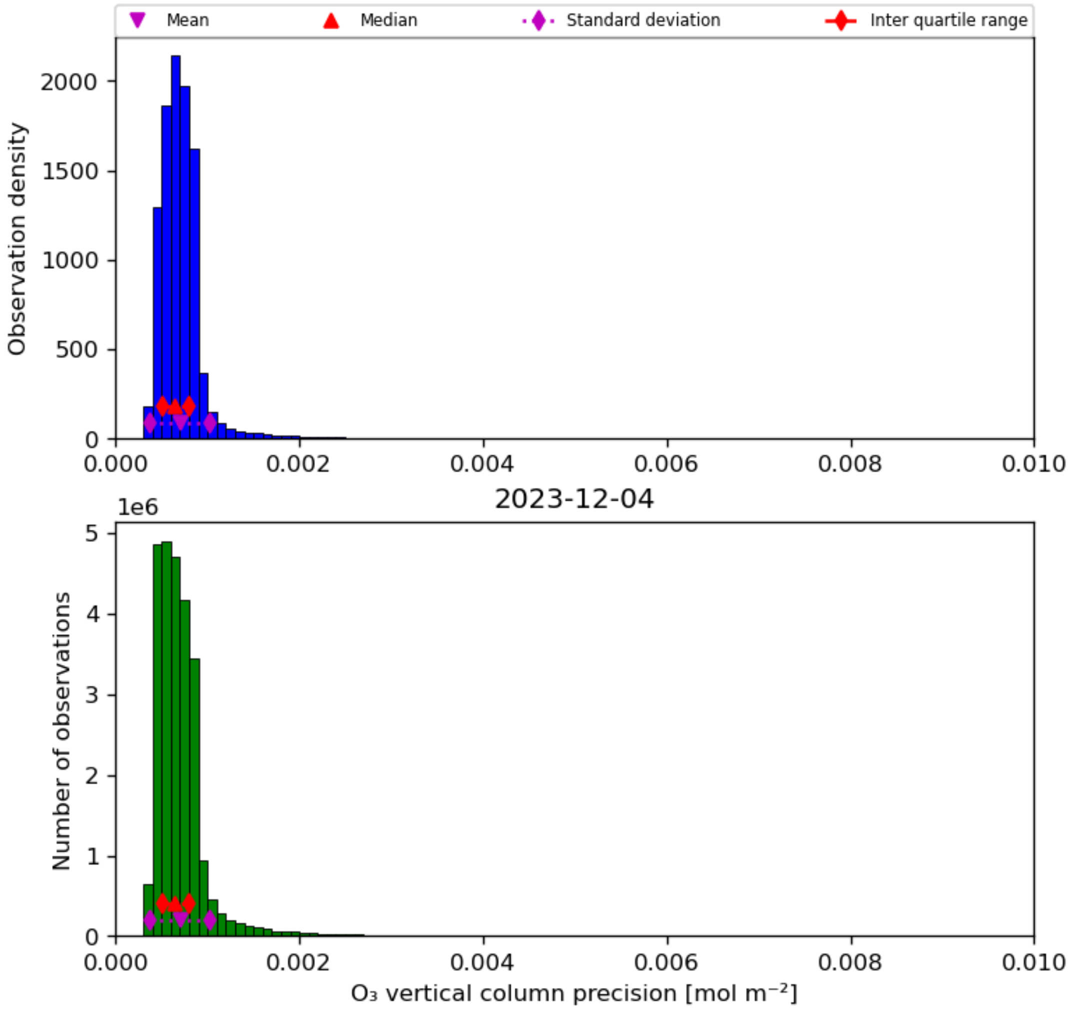


Figure 22: Histogram of "O_3 vertical column precision" for 2023-12-04 to 2023-12-05

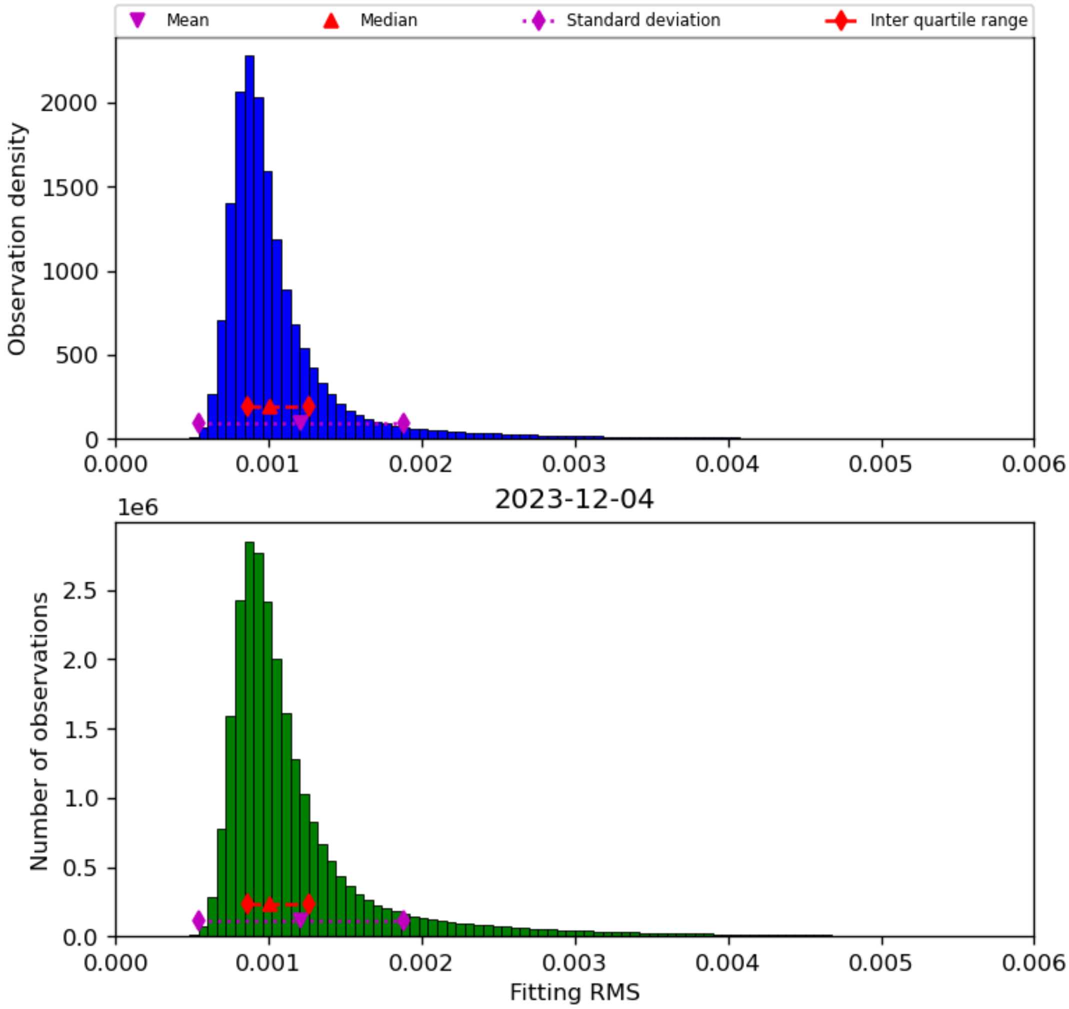


Figure 23: Histogram of “Fitting RMS” for 2023-12-04 to 2023-12-05

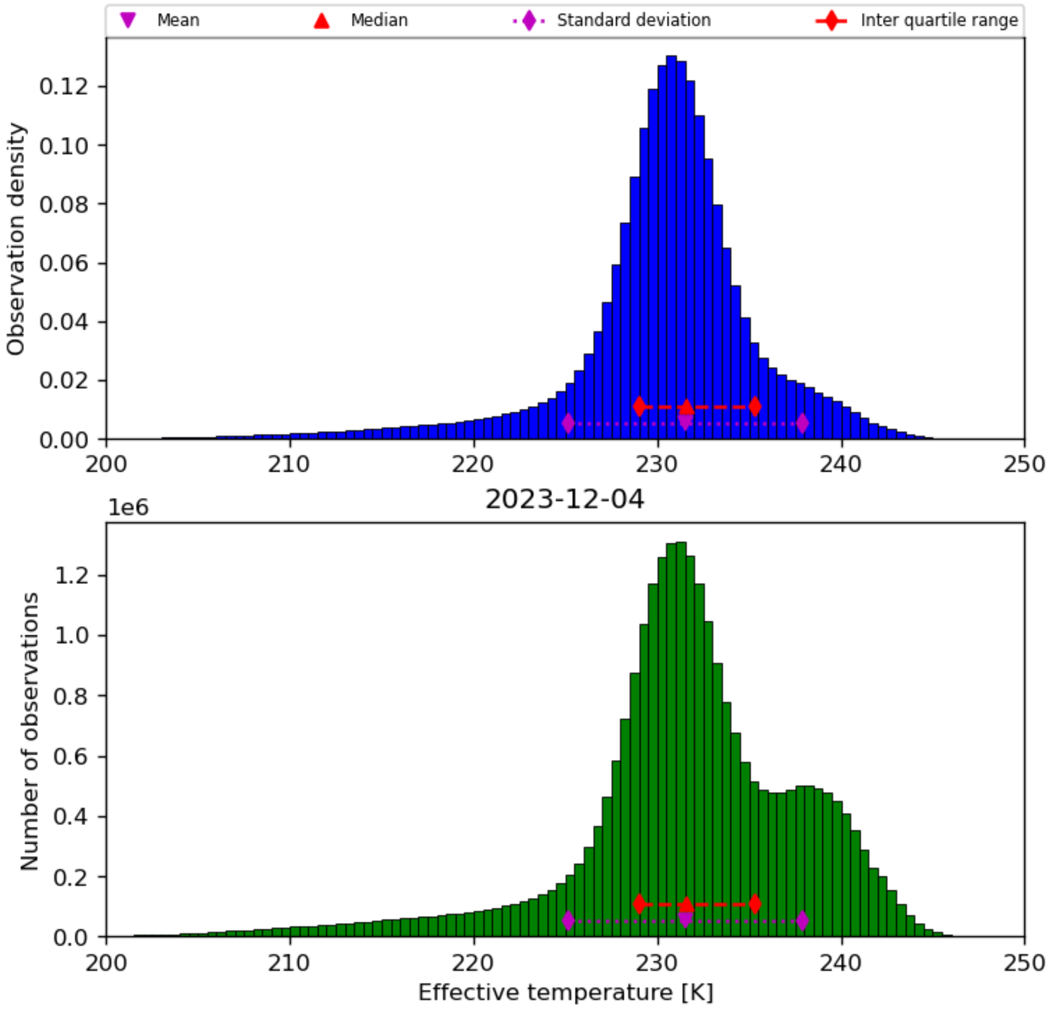


Figure 24: Histogram of “Effective temperature” for 2023-12-04 to 2023-12-05

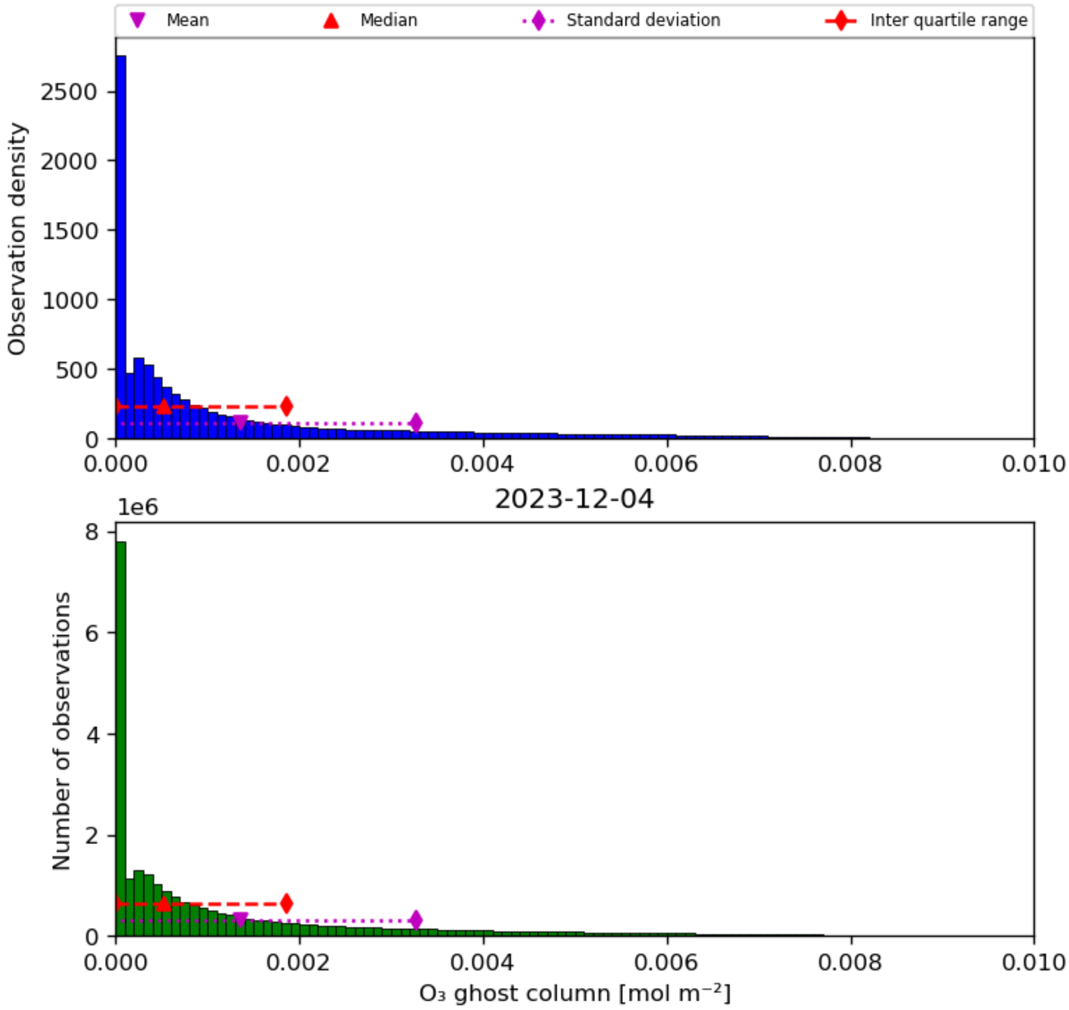


Figure 25: Histogram of “O_3 ghost column” for 2023-12-04 to 2023-12-05

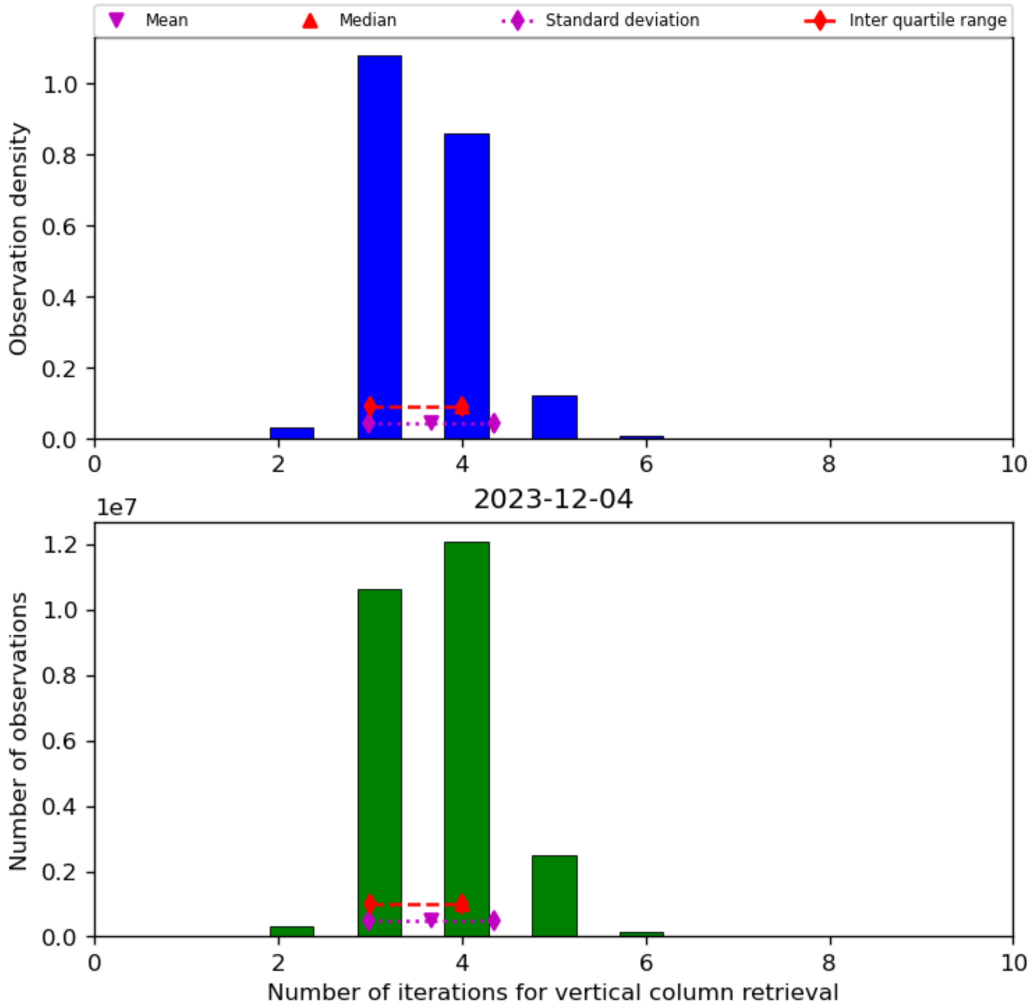


Figure 26: Histogram of “Number of iterations for vertical column retrieval” for 2023-12-04 to 2023-12-05

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.

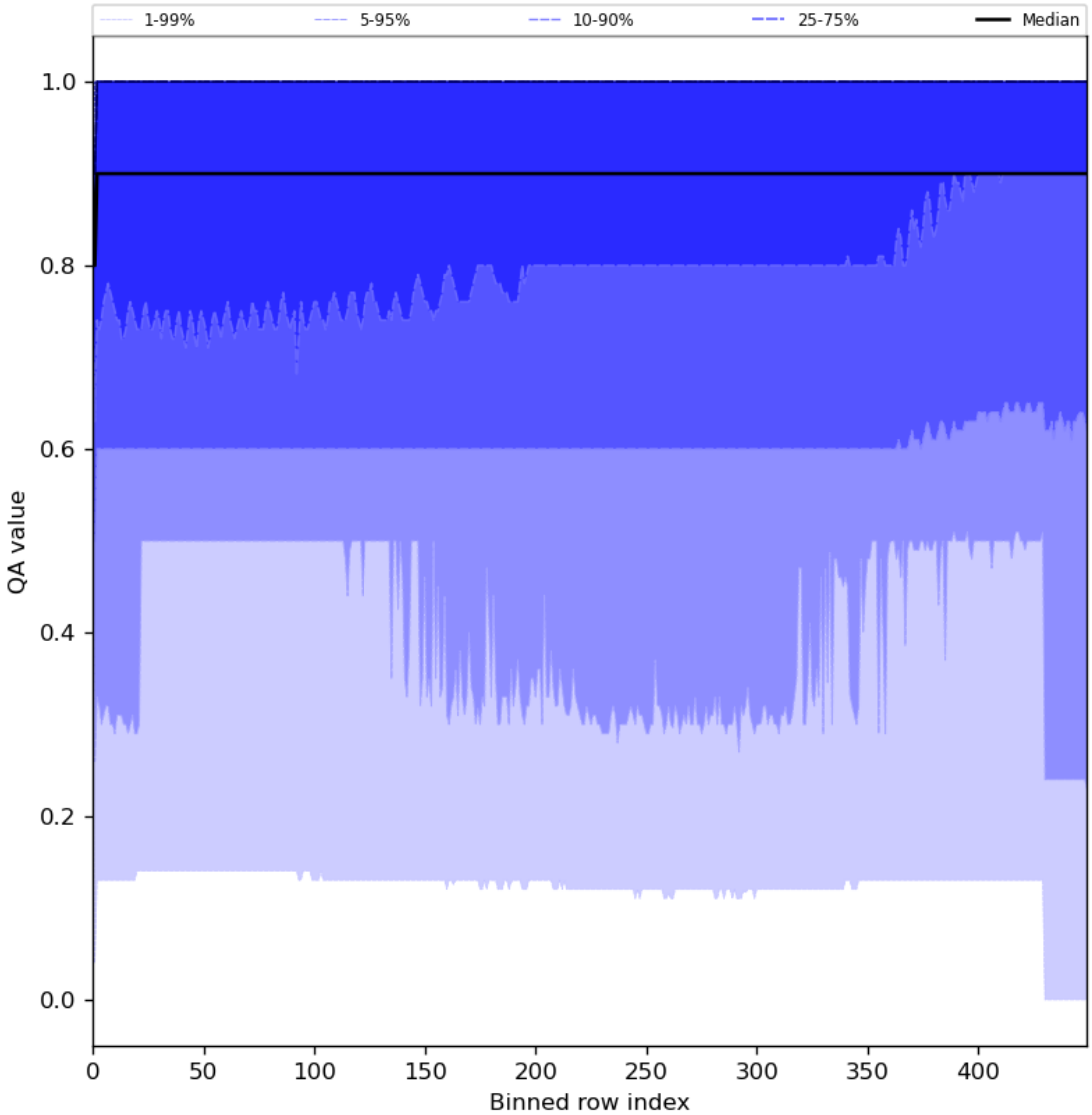


Figure 27: Along track statistics of “QA value” for 2023-12-04 to 2023-12-05

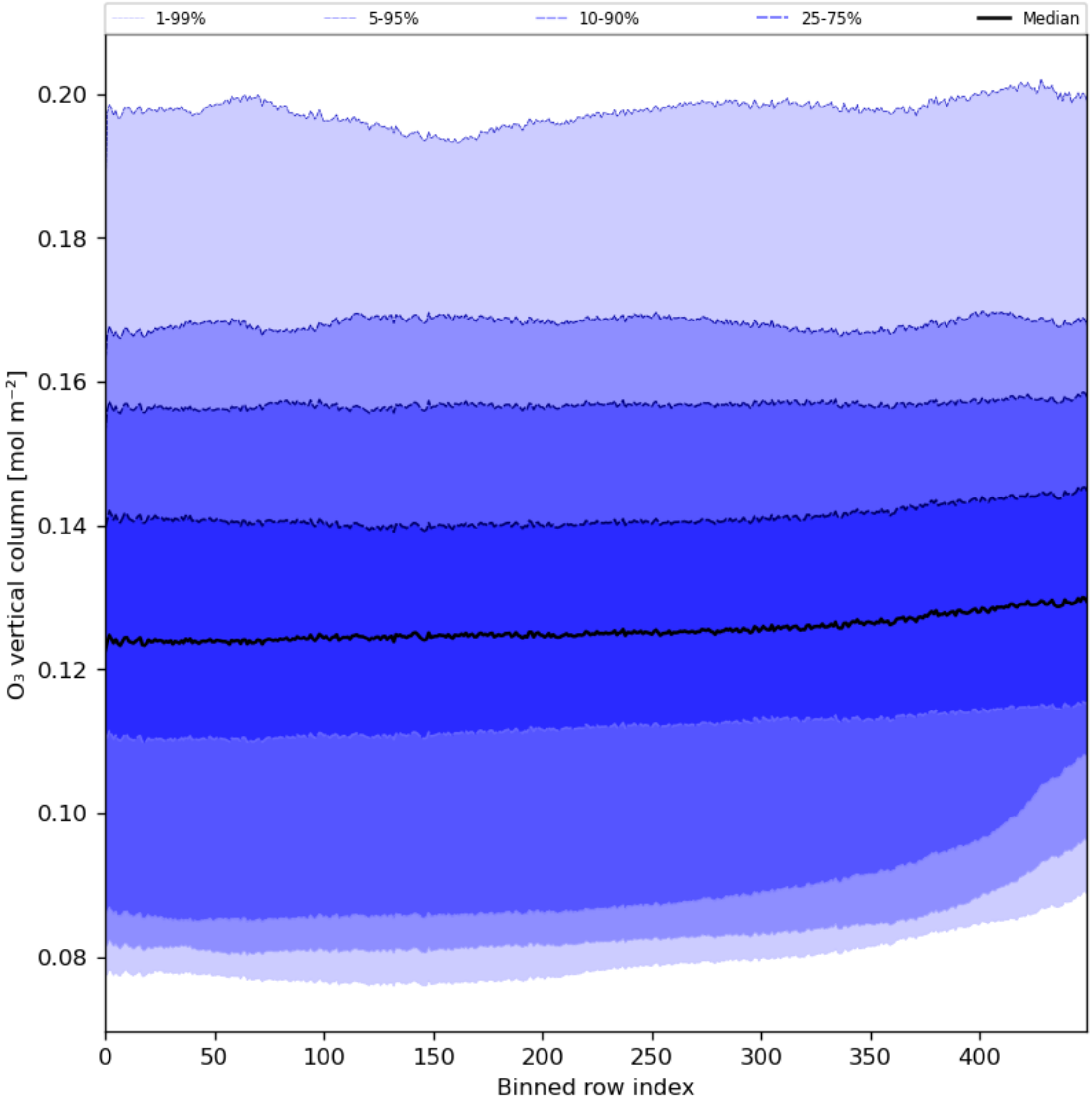


Figure 28: Along track statistics of “O_3 vertical column” for 2023-12-04 to 2023-12-05

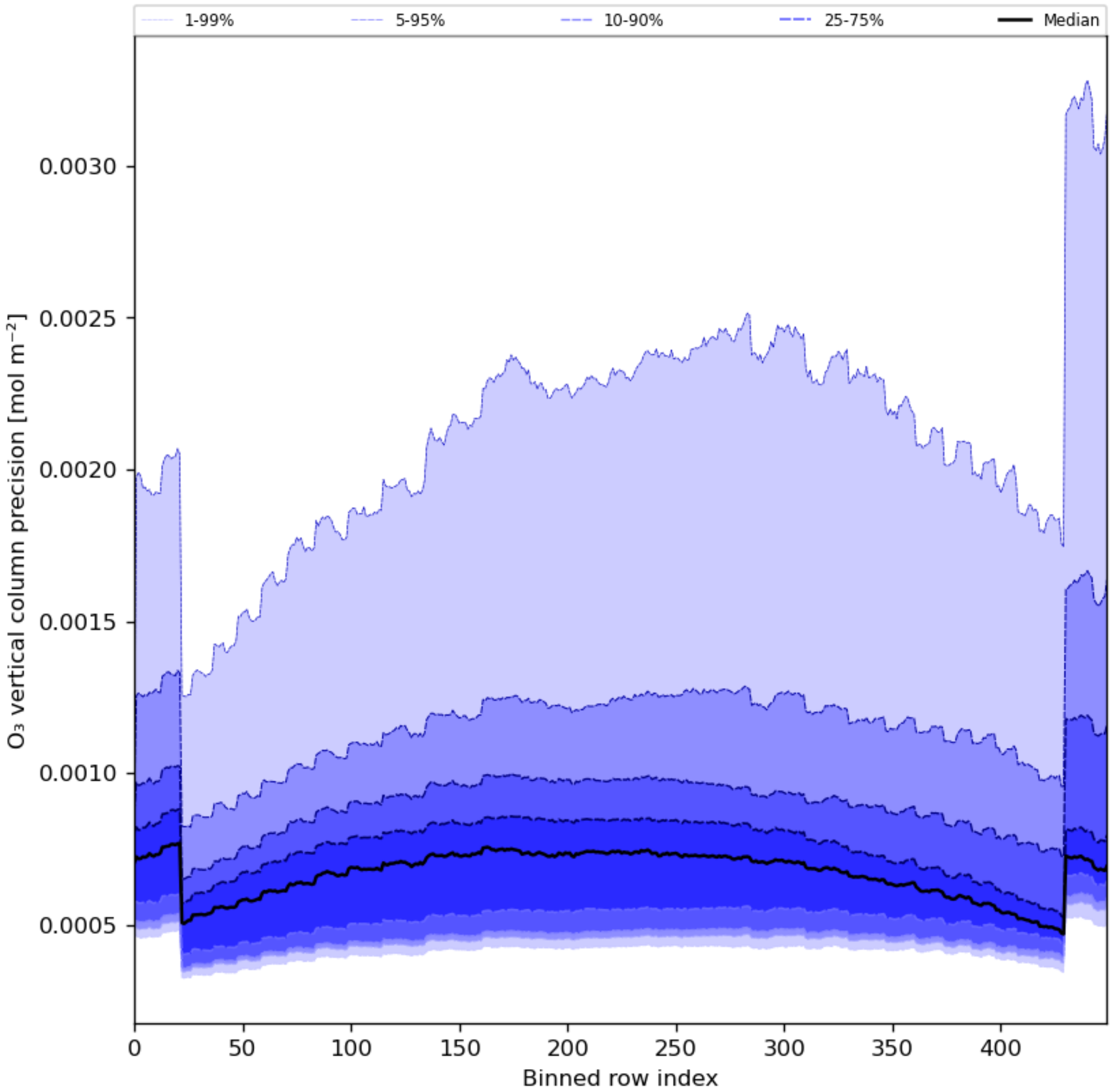


Figure 29: Along track statistics of “O_3 vertical column precision” for 2023-12-04 to 2023-12-05

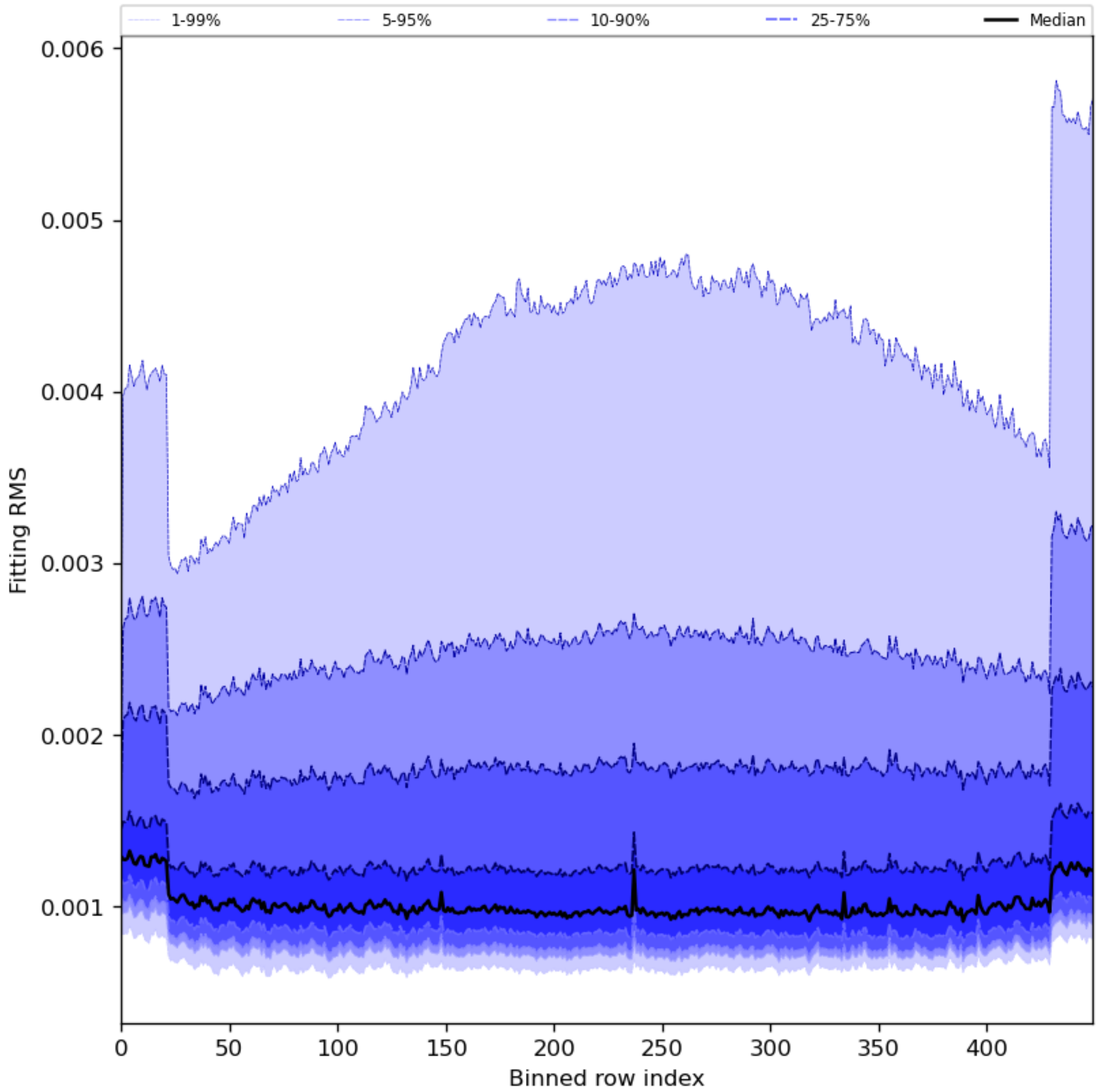


Figure 30: Along track statistics of “Fitting RMS” for 2023-12-04 to 2023-12-05

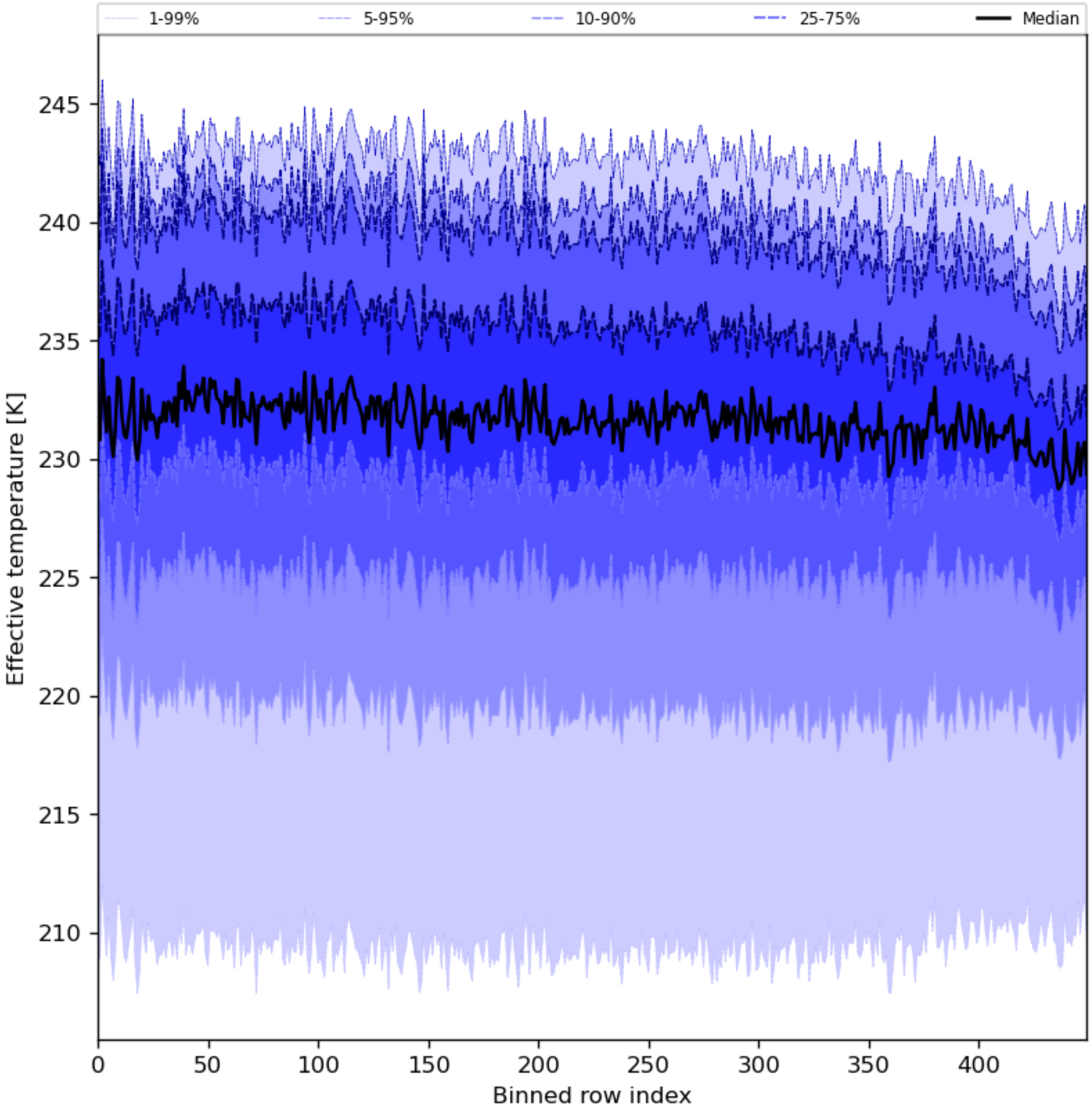


Figure 31: Along track statistics of “Effective temperature” for 2023-12-04 to 2023-12-05

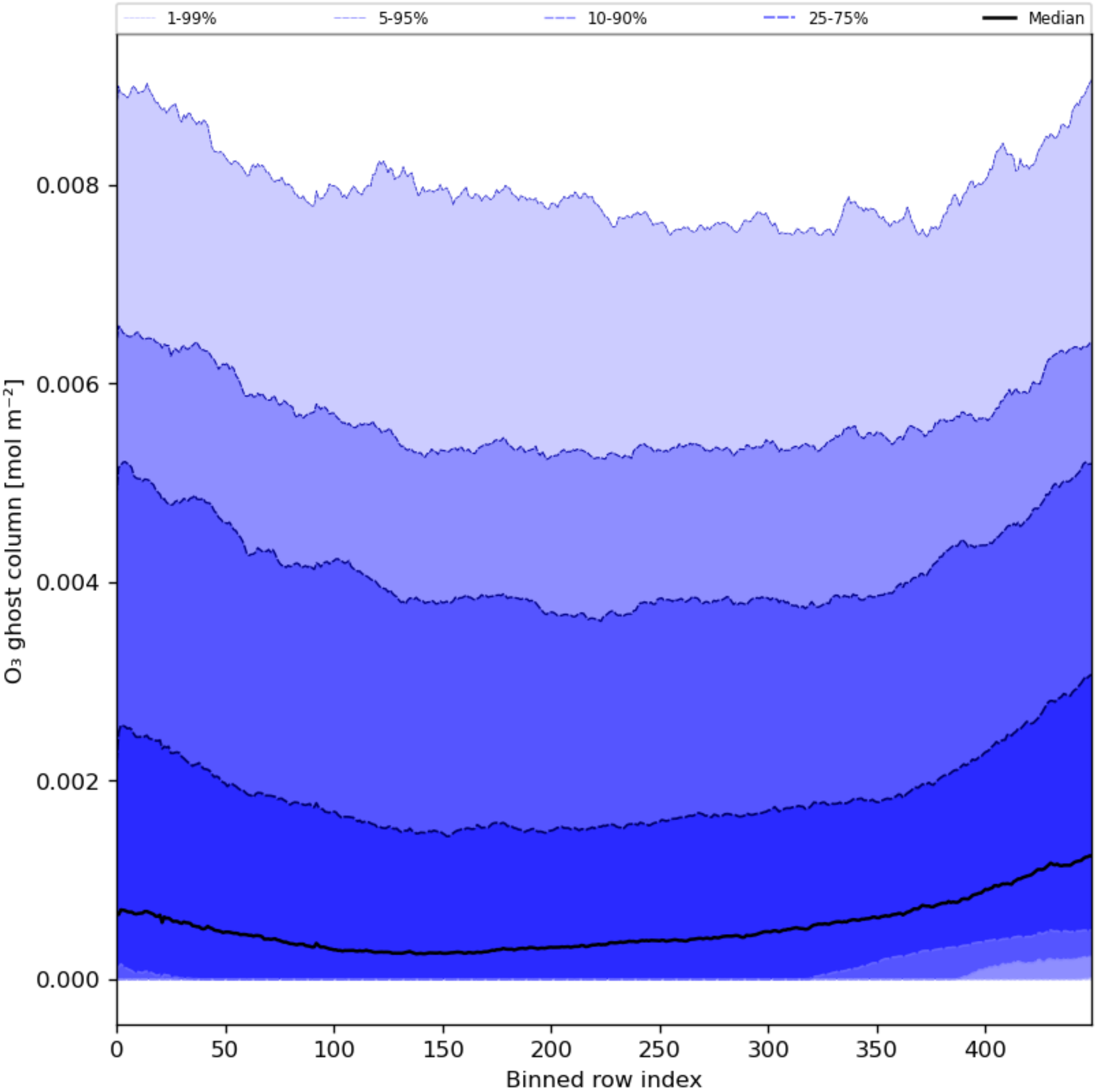


Figure 32: Along track statistics of “O_3 ghost column” for 2023-12-04 to 2023-12-05

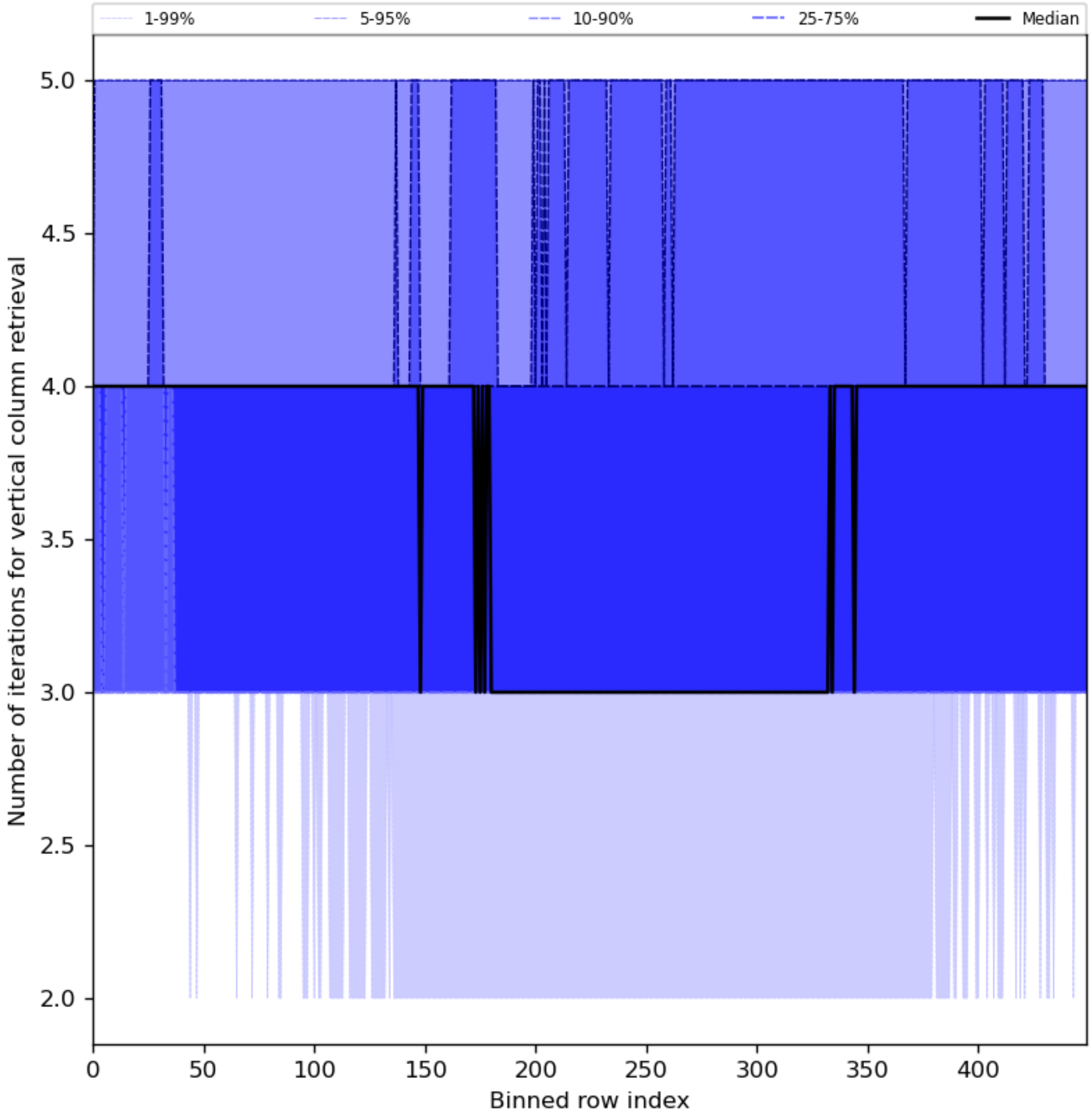


Figure 33: Along track statistics of “Number of iterations for vertical column retrieval” for 2023-12-04 to 2023-12-05

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.

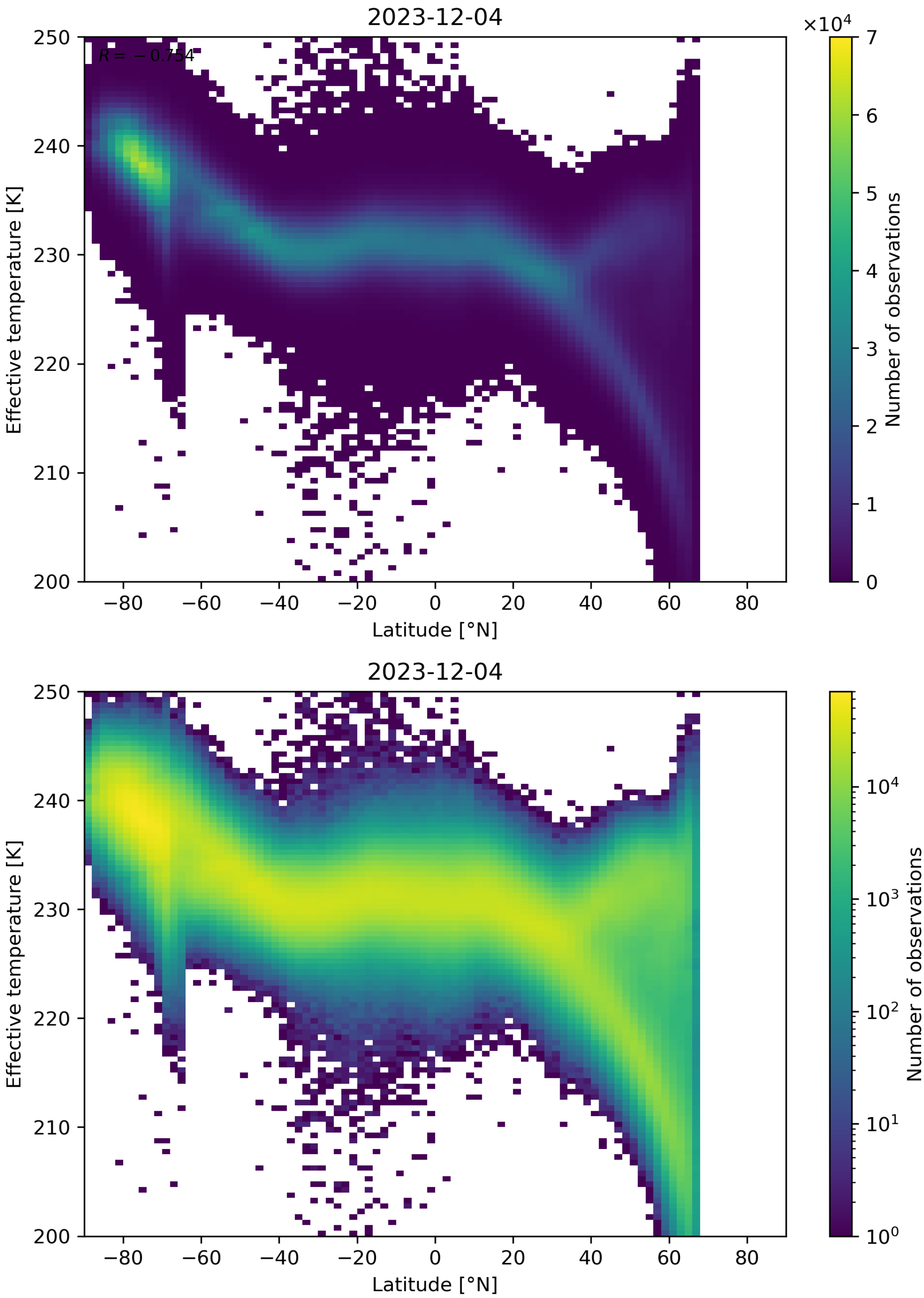


Figure 34: Scatter density plot of "Latitude" against "Effective temperature" for 2023-12-04 to 2023-12-05.

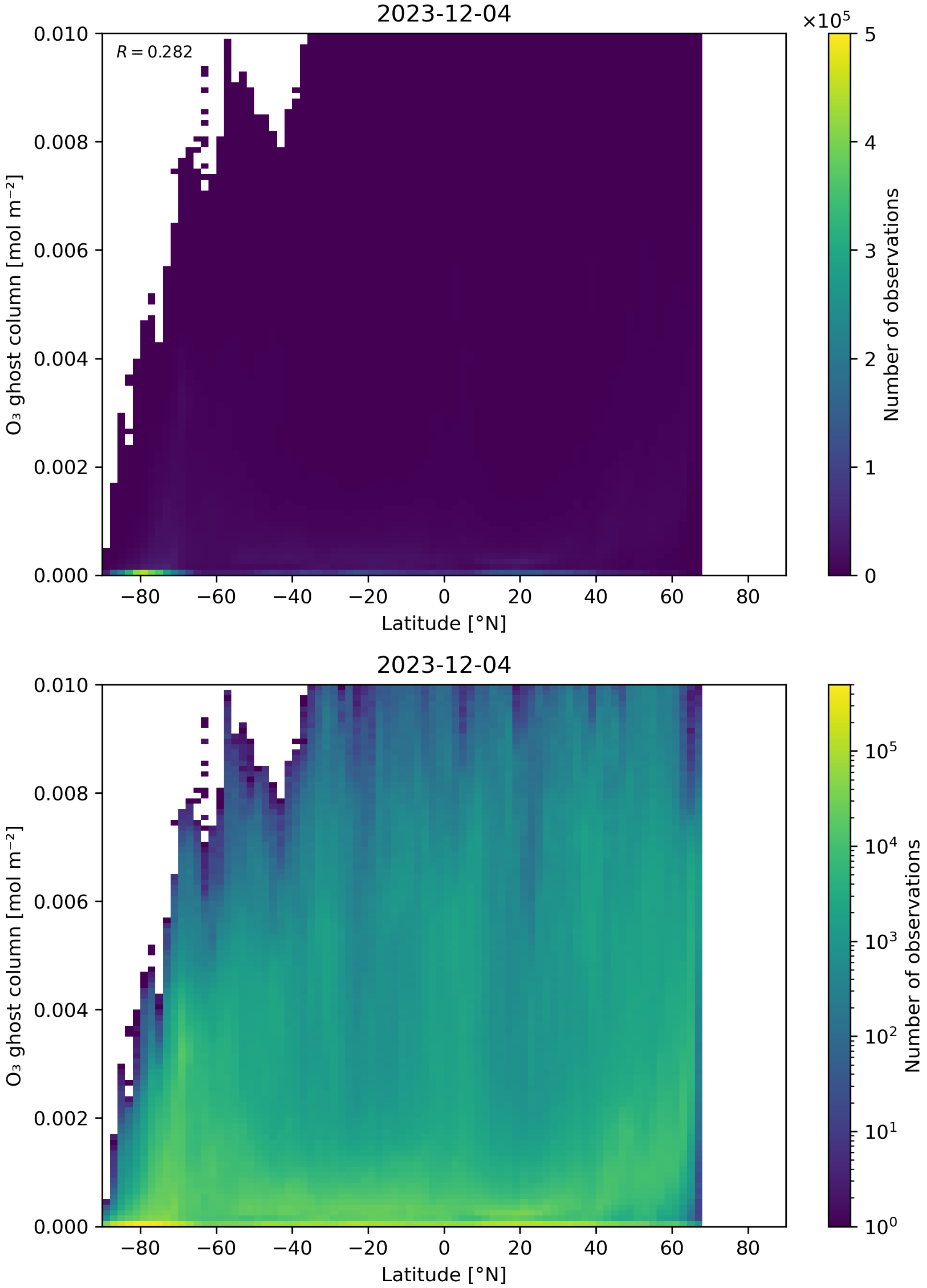


Figure 35: Scatter density plot of “Latitude” against “O_3 ghost column” for 2023-12-04 to 2023-12-05.

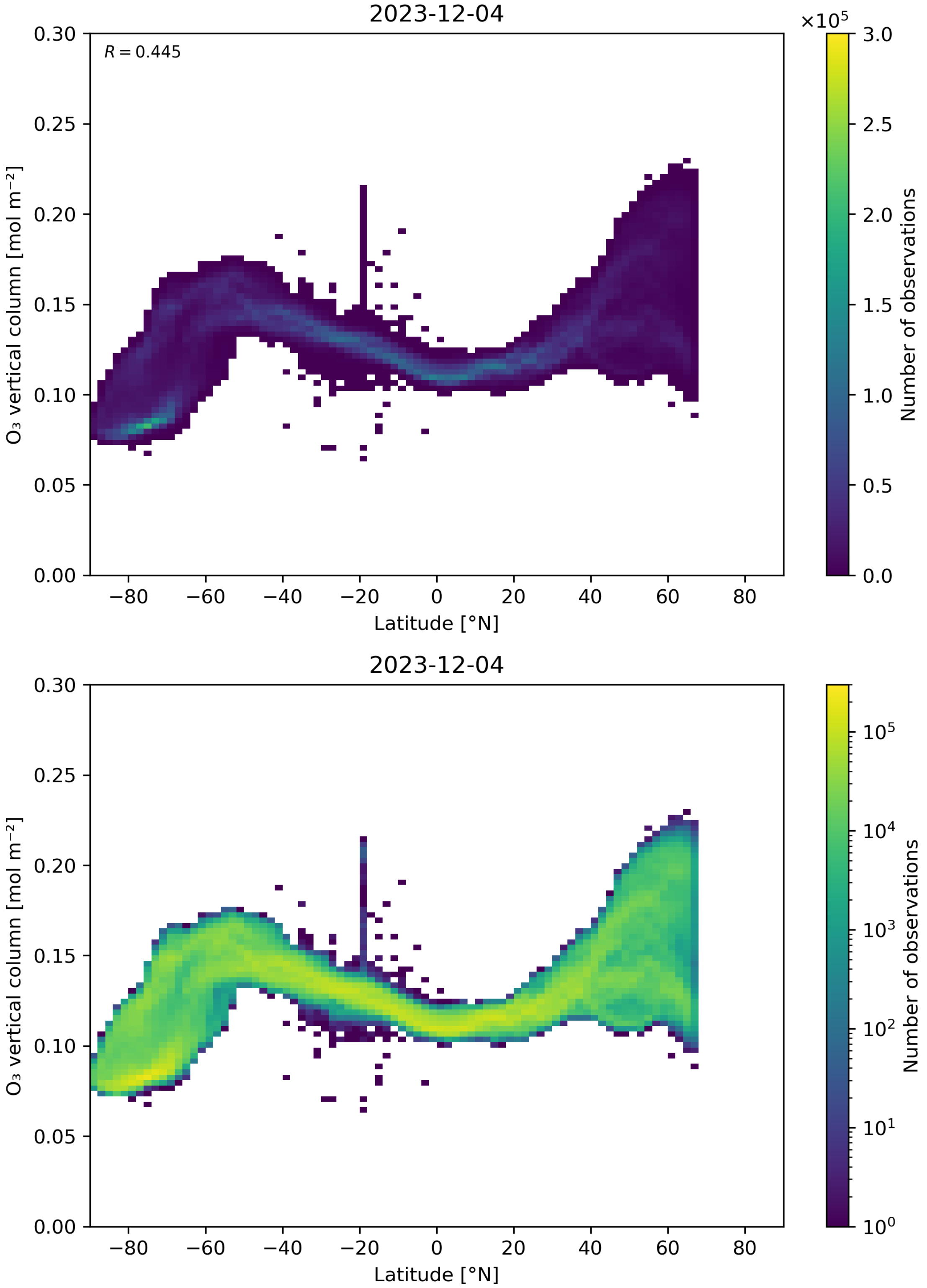
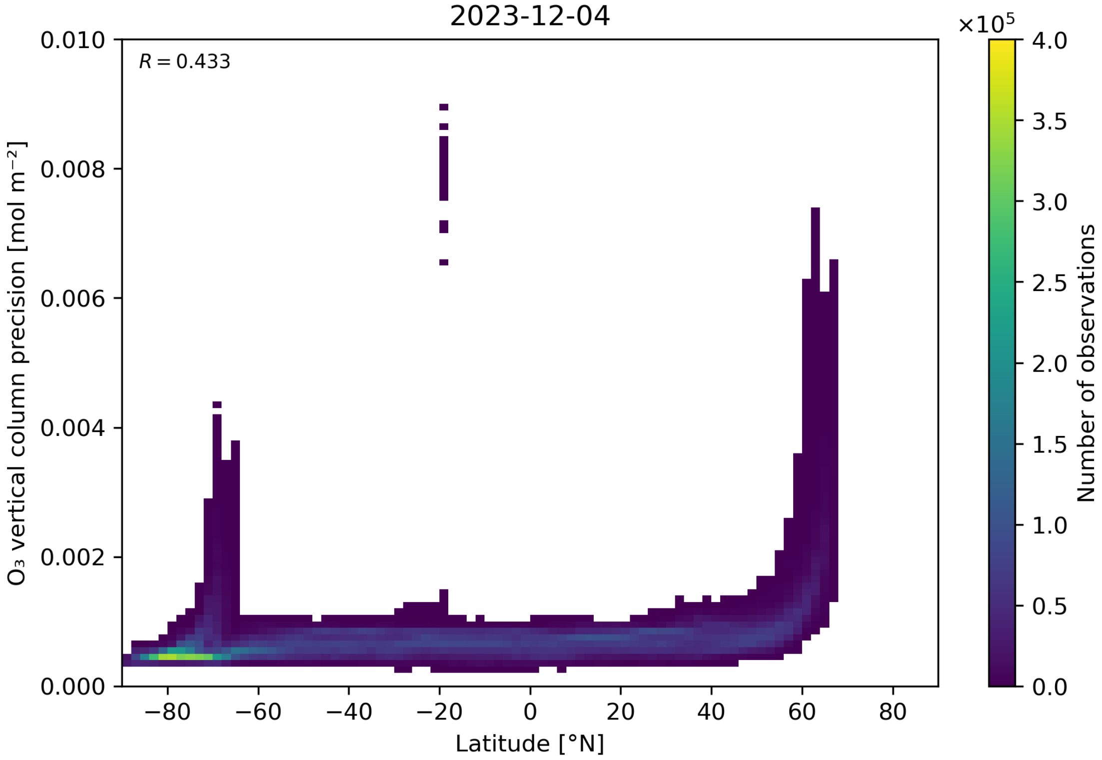


Figure 36: Scatter density plot of “Latitude” against “O_3 vertical column” for 2023-12-04 to 2023-12-05.



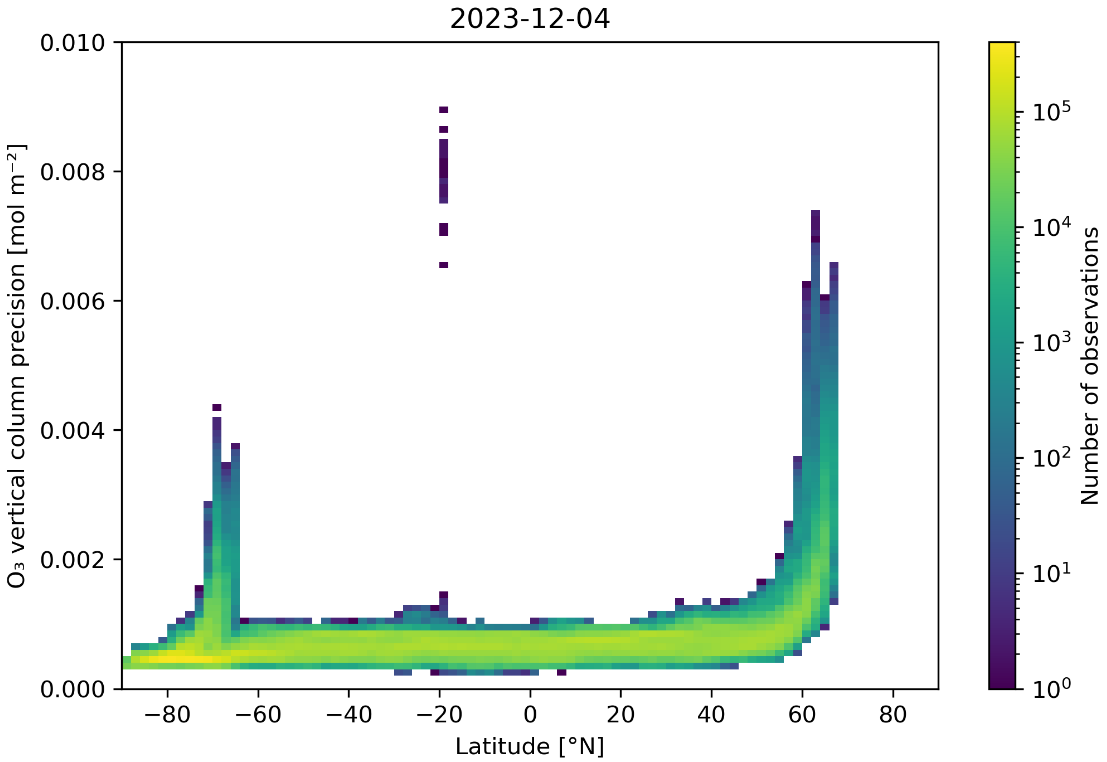
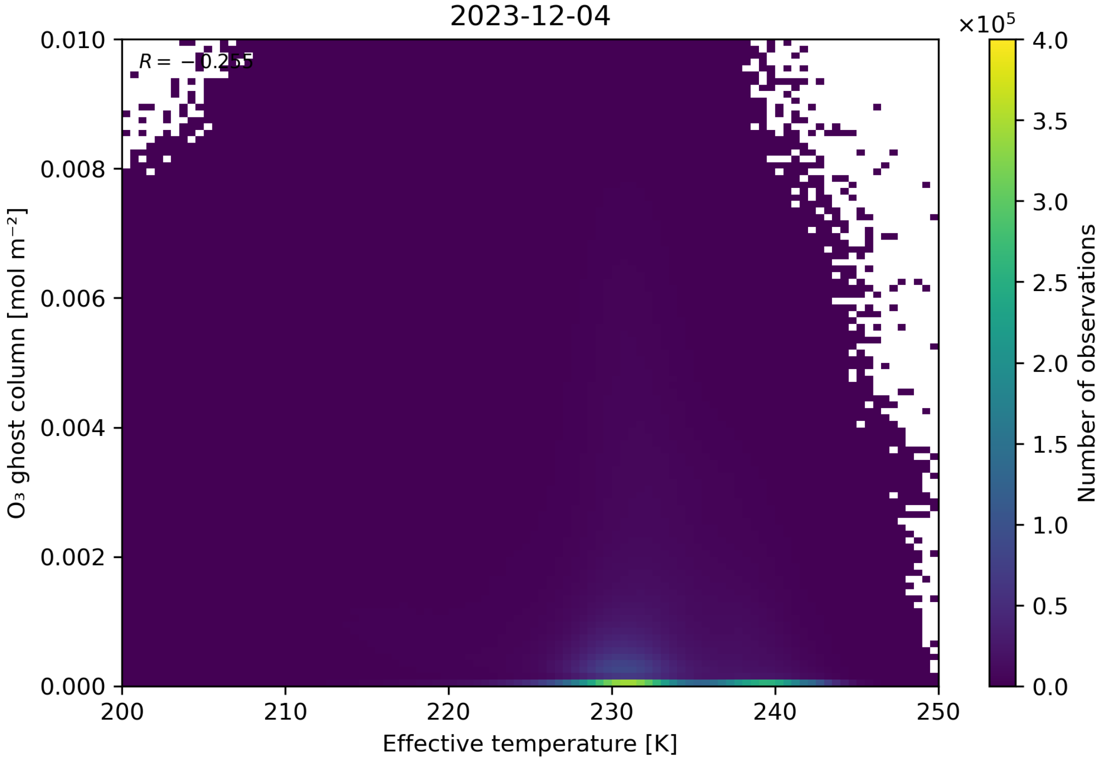


Figure 37: Scatter density plot of “Latitude” against “O_3 vertical column precision” for 2023-12-04 to 2023-12-05.



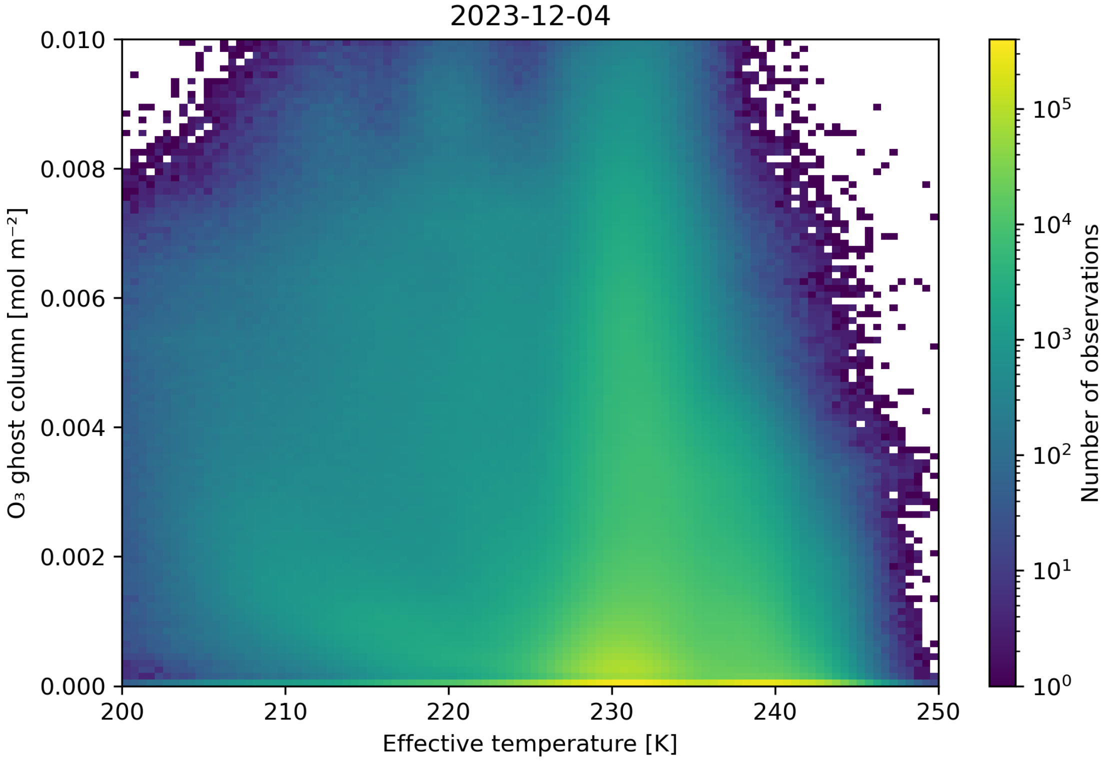


Figure 38: Scatter density plot of "Effective temperature" against "O_3 ghost column" for 2023-12-04 to 2023-12-05.

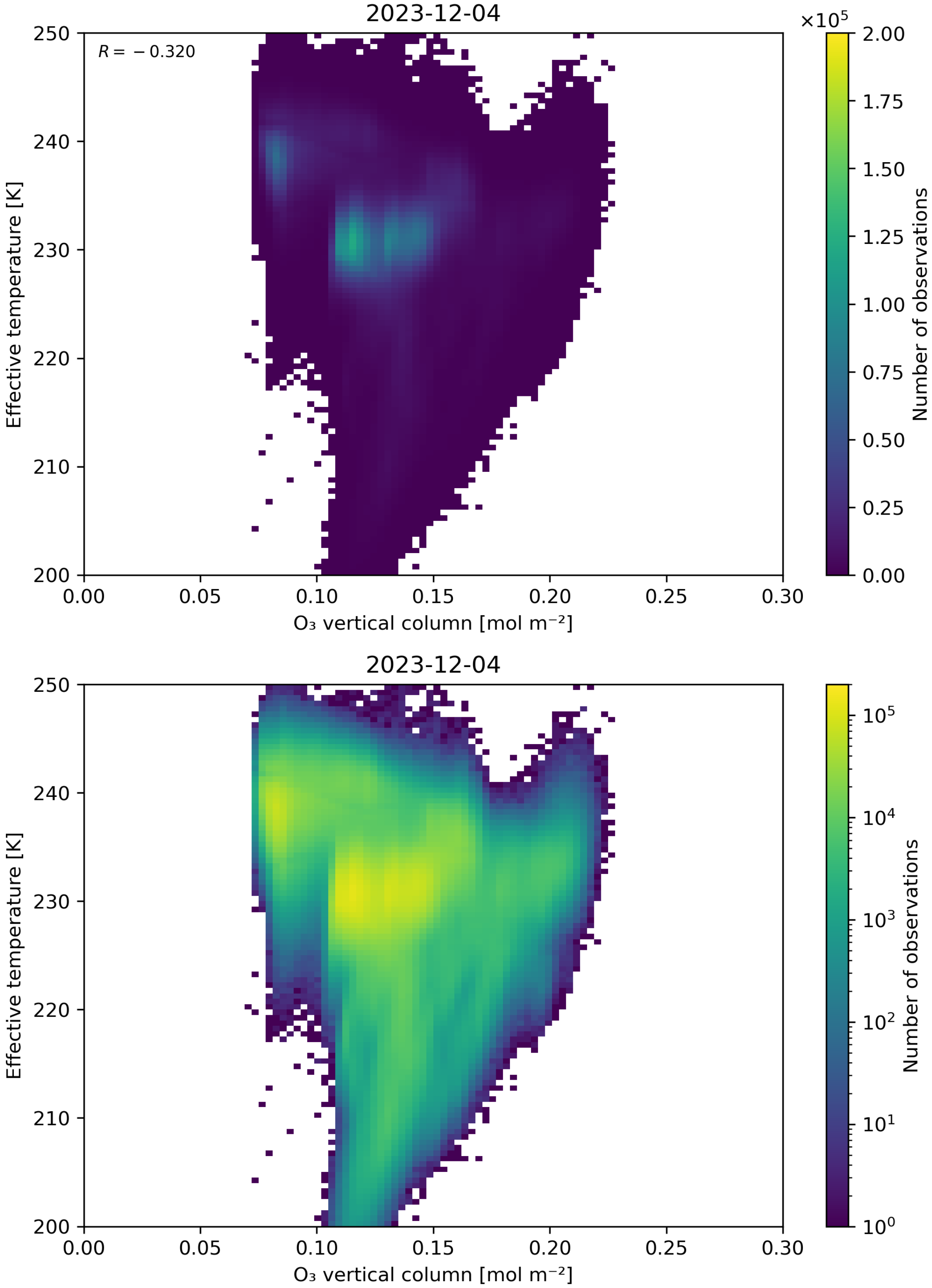


Figure 39: Scatter density plot of “O_3 vertical column” against “Effective temperature” for 2023-12-04 to 2023-12-05.

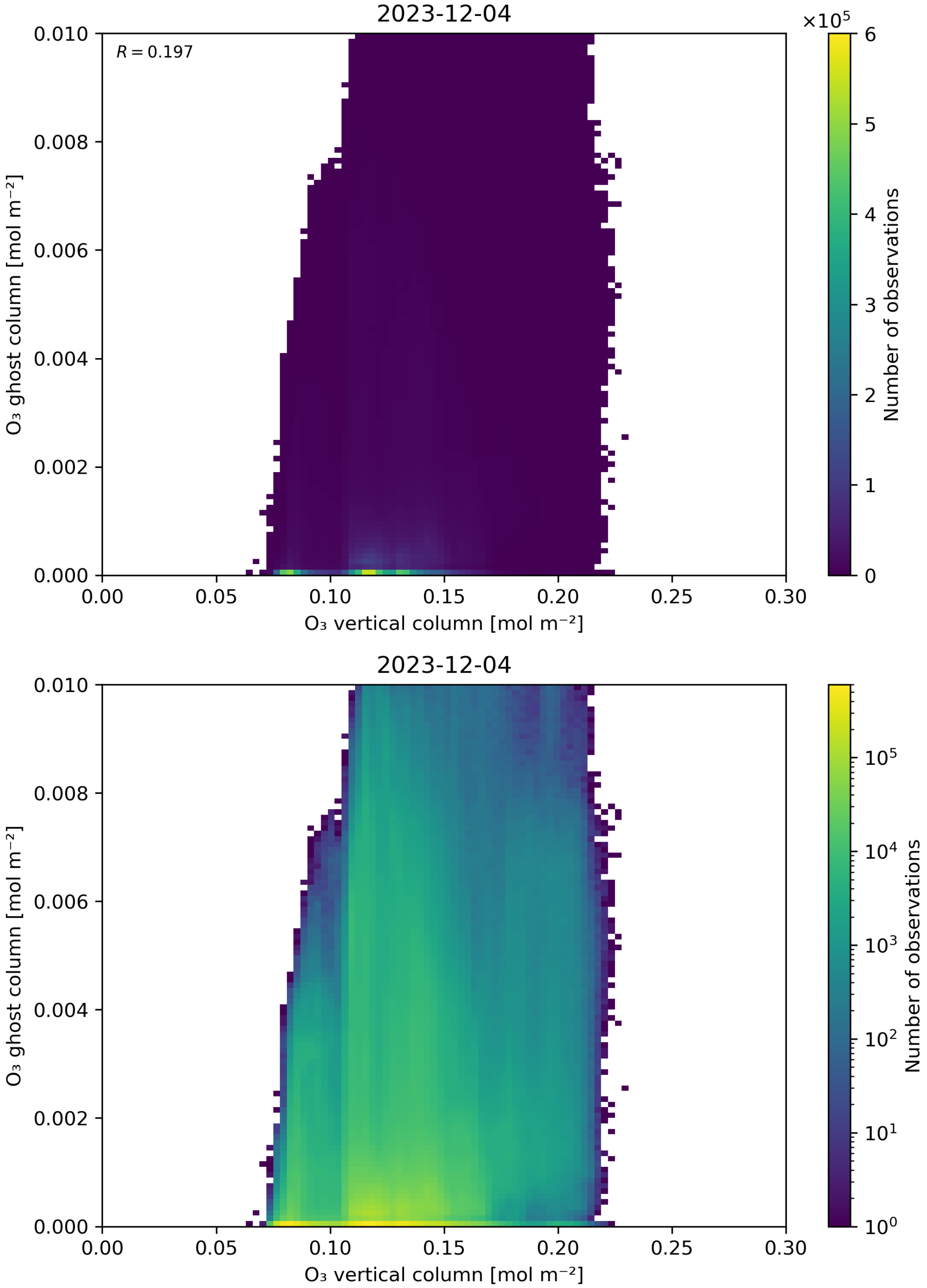


Figure 40: Scatter density plot of "O_3 vertical column" against "O_3 ghost column" for 2023-12-04 to 2023-12-05.

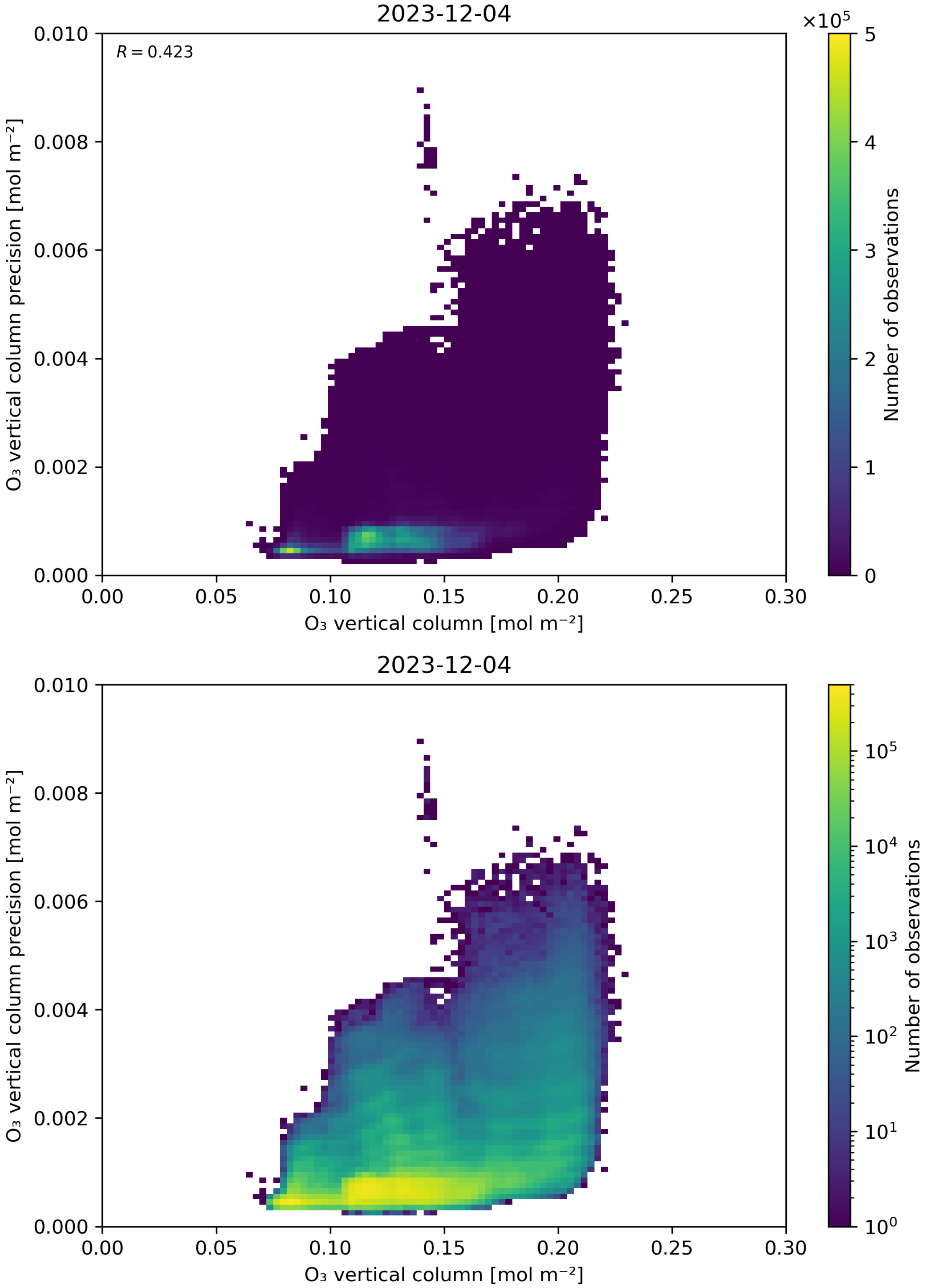


Figure 41: Scatter density plot of "O_3 vertical column" against "O_3 vertical column precision" for 2023-12-04 to 2023-12-05.

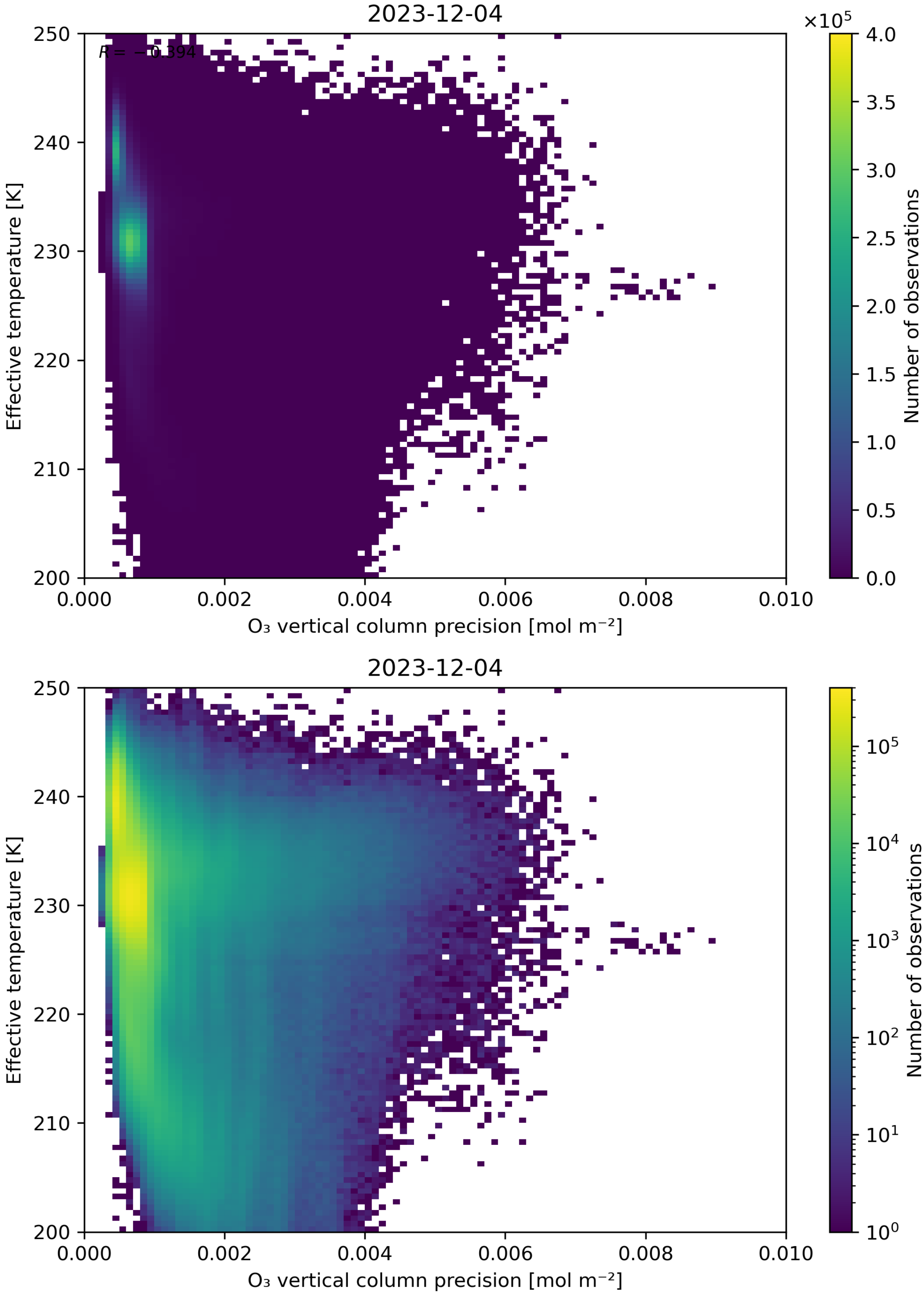


Figure 42: Scatter density plot of "O_3 vertical column precision" against "Effective temperature" for 2023-12-04 to 2023-12-05.

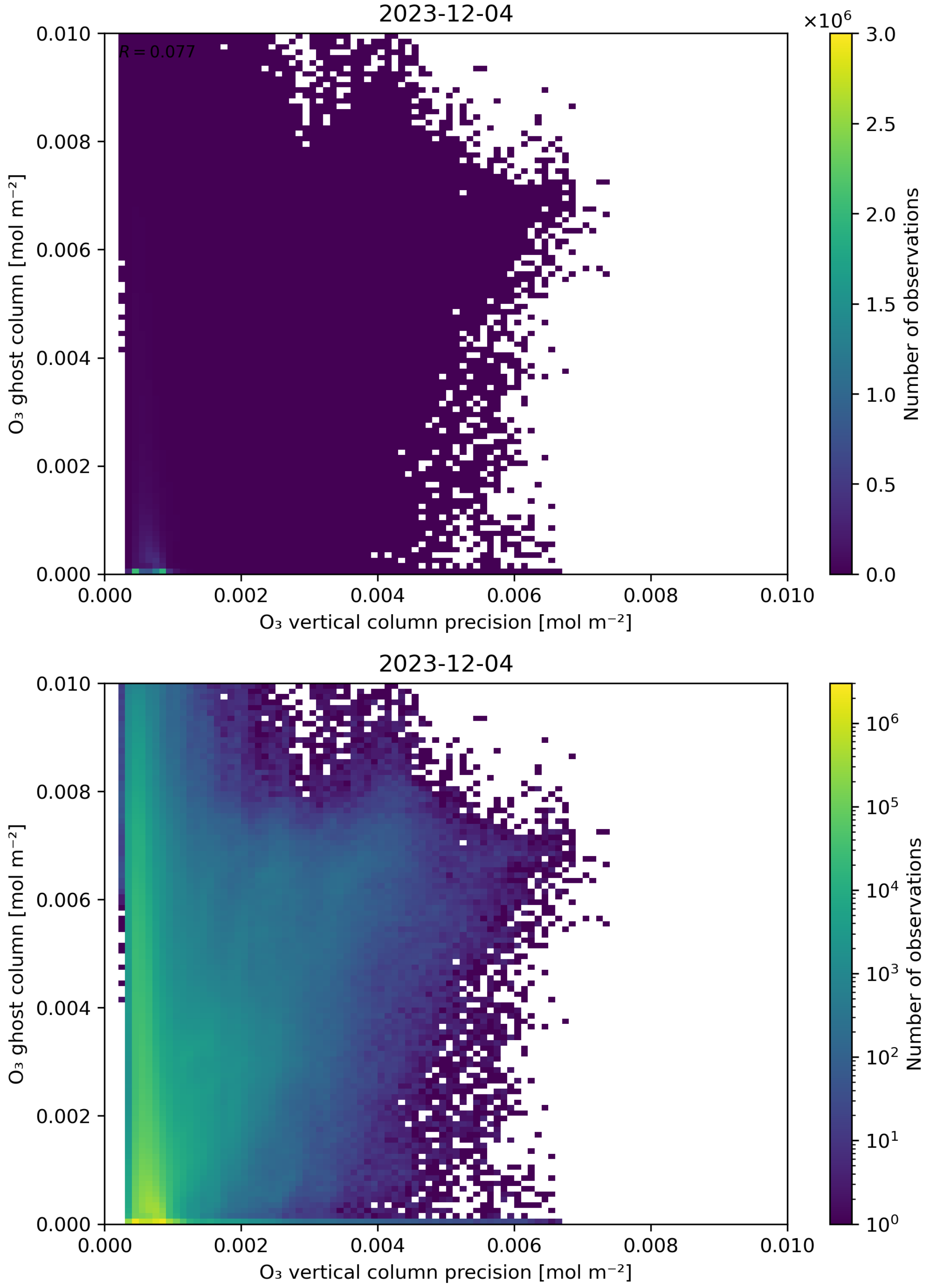


Figure 43: Scatter density plot of “O_3 vertical column precision” against “O_3 ghost column” for 2023-12-04 to 2023-12-05.

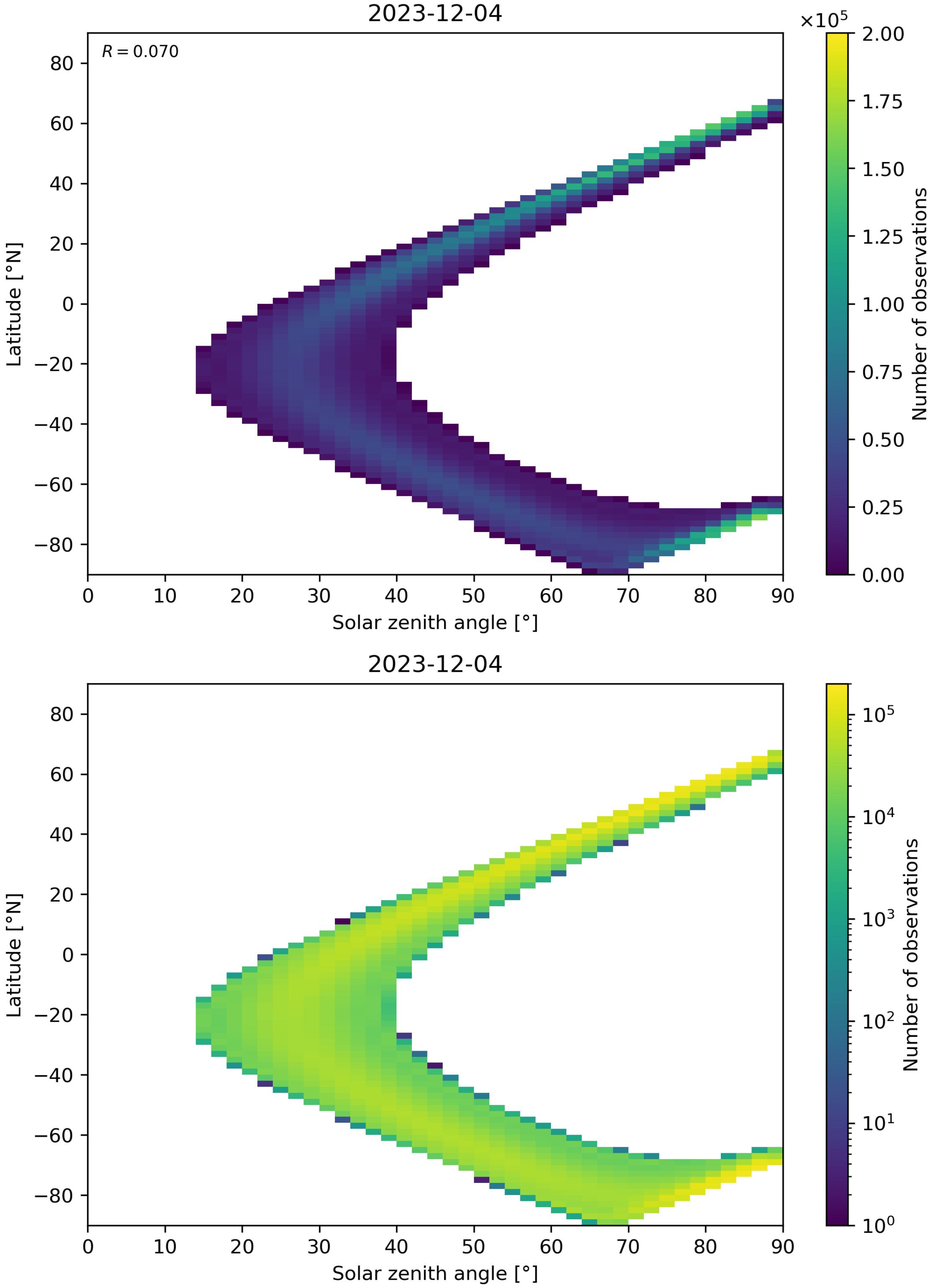


Figure 44: Scatter density plot of “Solar zenith angle” against “Latitude” for 2023-12-04 to 2023-12-05.

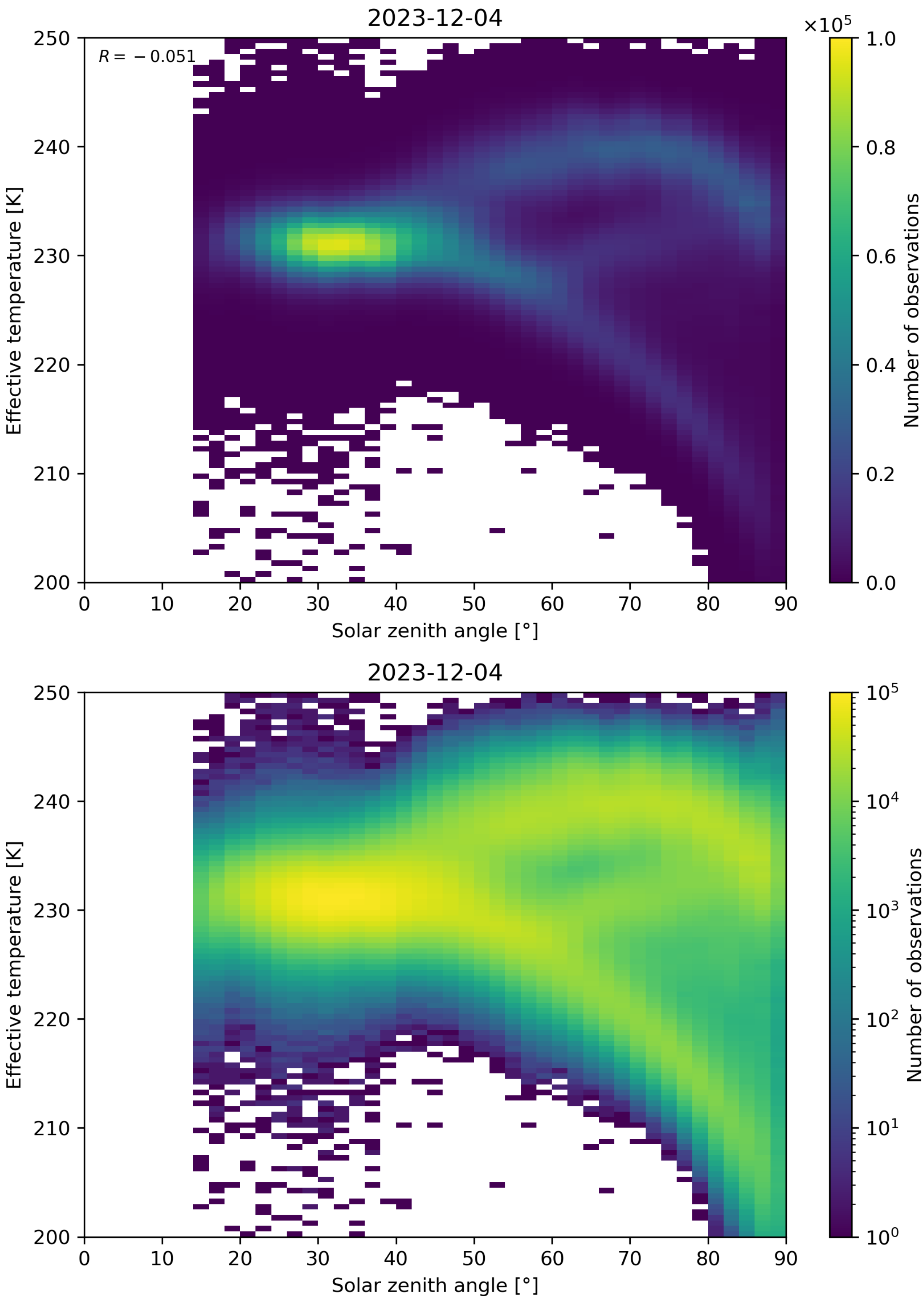


Figure 45: Scatter density plot of “Solar zenith angle” against “Effective temperature” for 2023-12-04 to 2023-12-05.

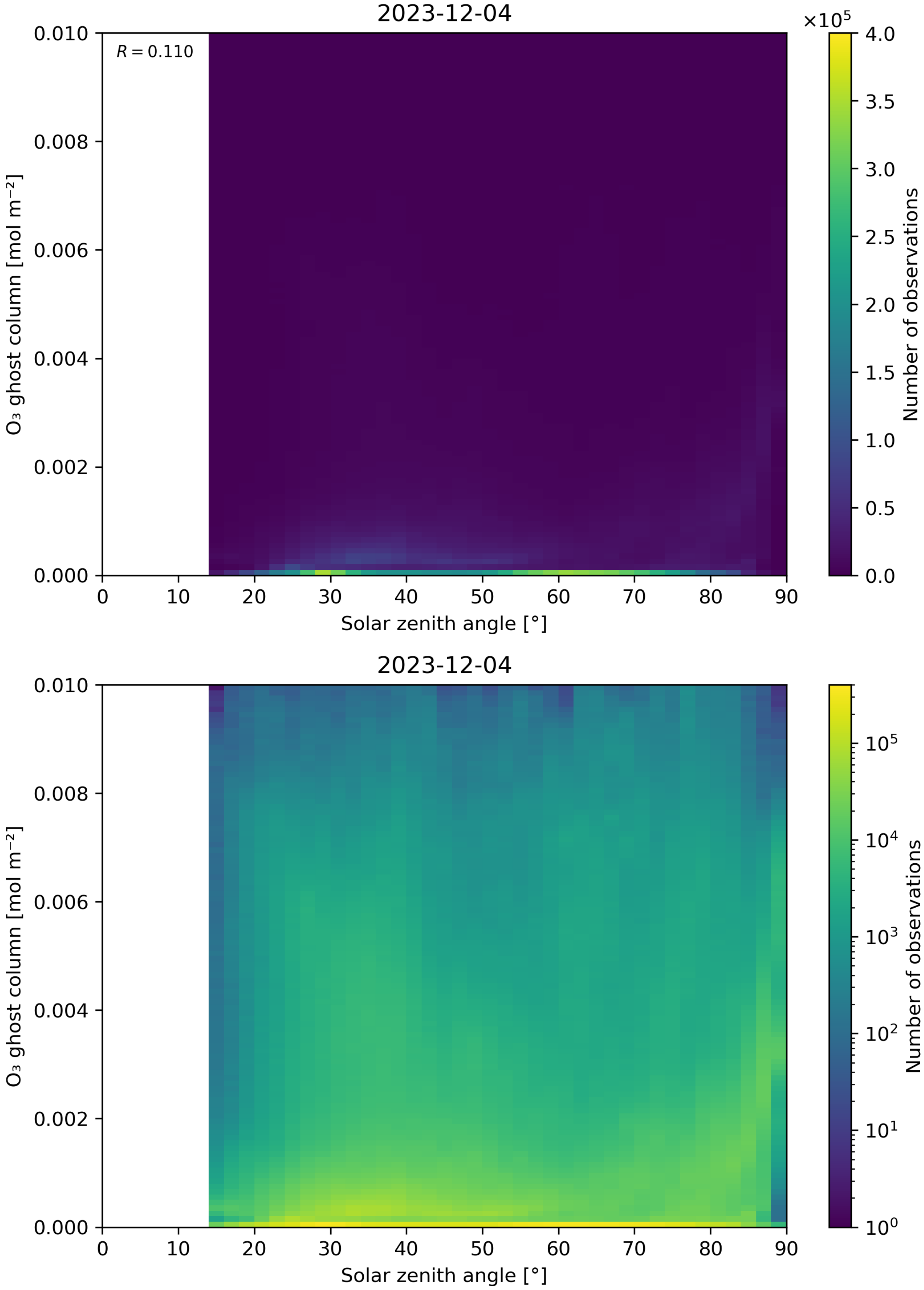
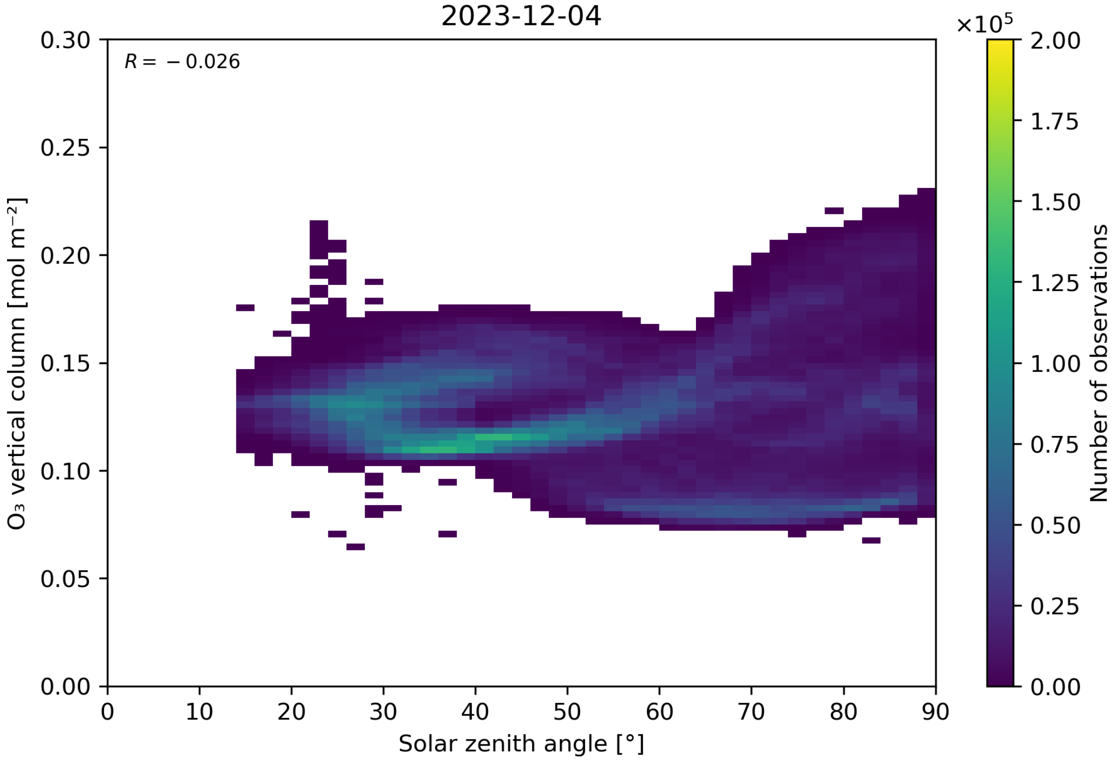


Figure 46: Scatter density plot of “Solar zenith angle” against “O_3 ghost column” for 2023-12-04 to 2023-12-05.



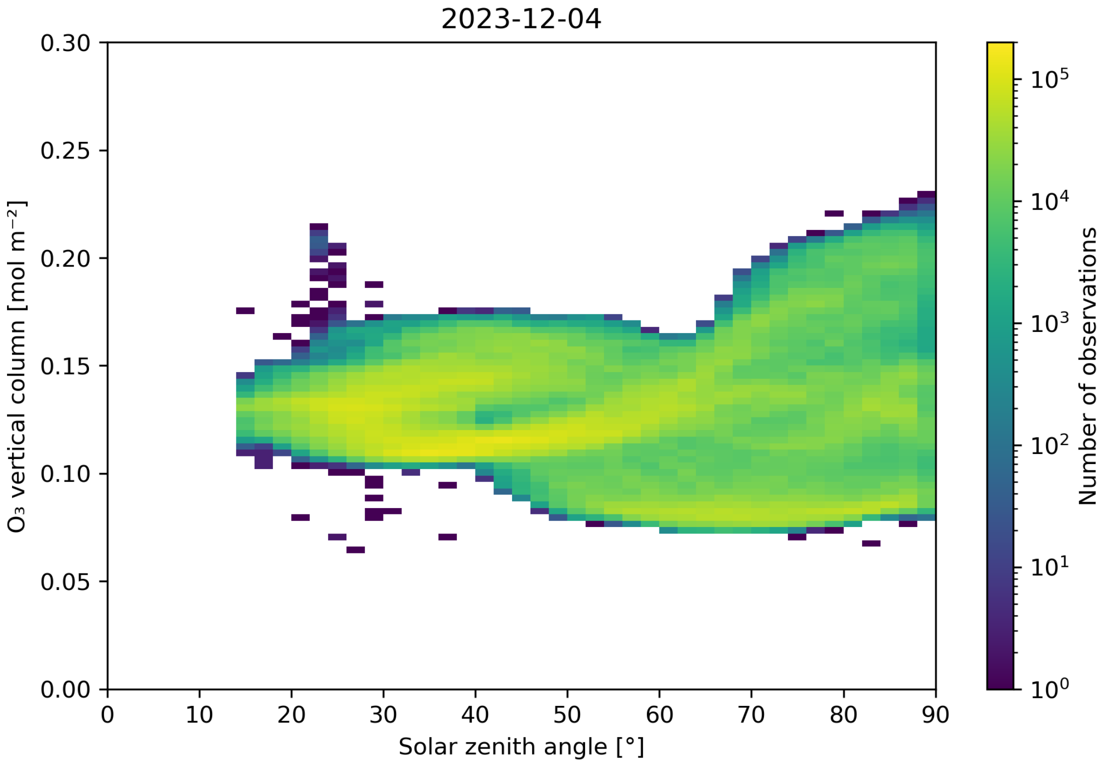
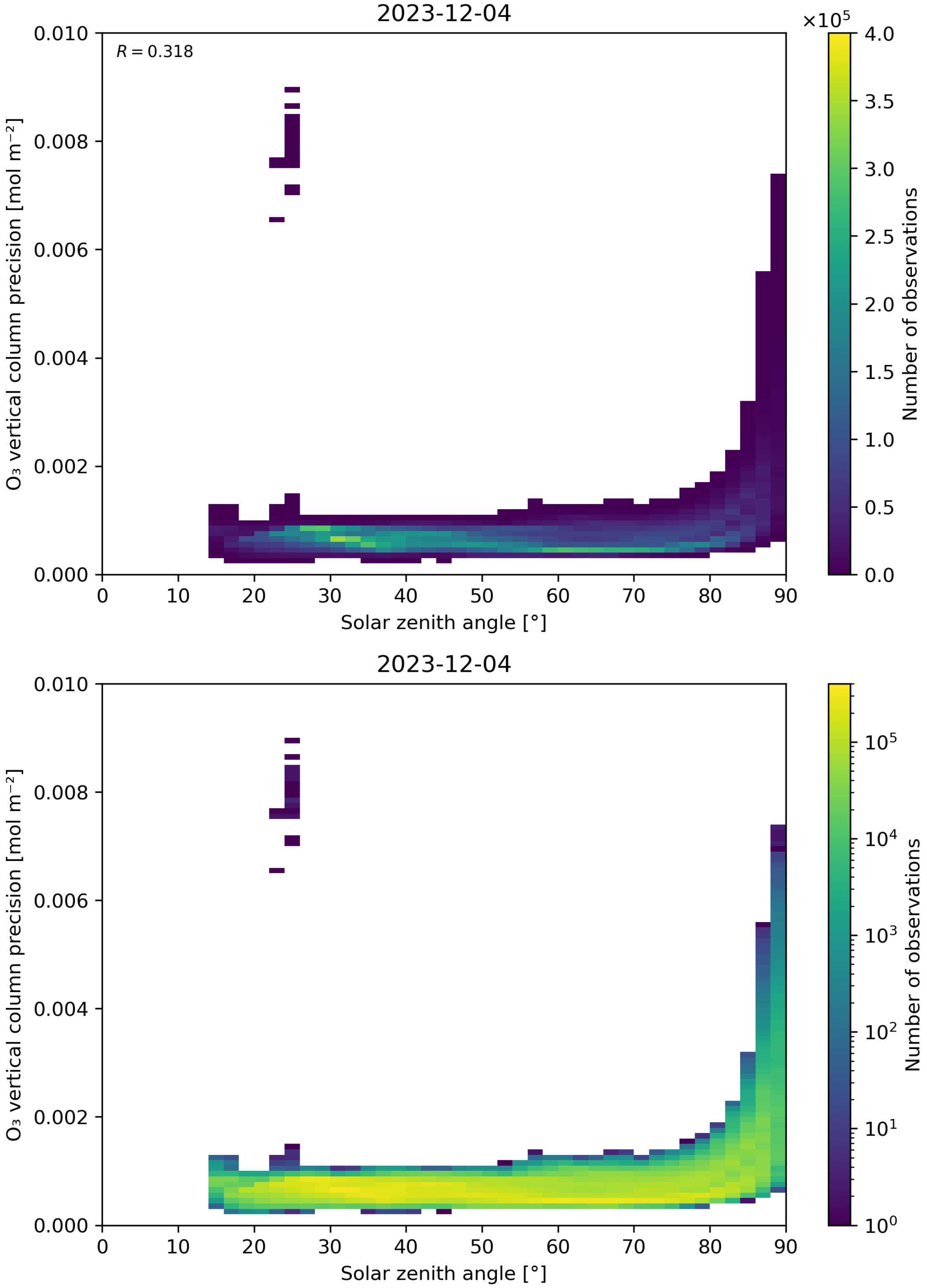


Figure 47: Scatter density plot of “Solar zenith angle” against “O_3 vertical column” for 2023-12-04 to 2023-12-05.



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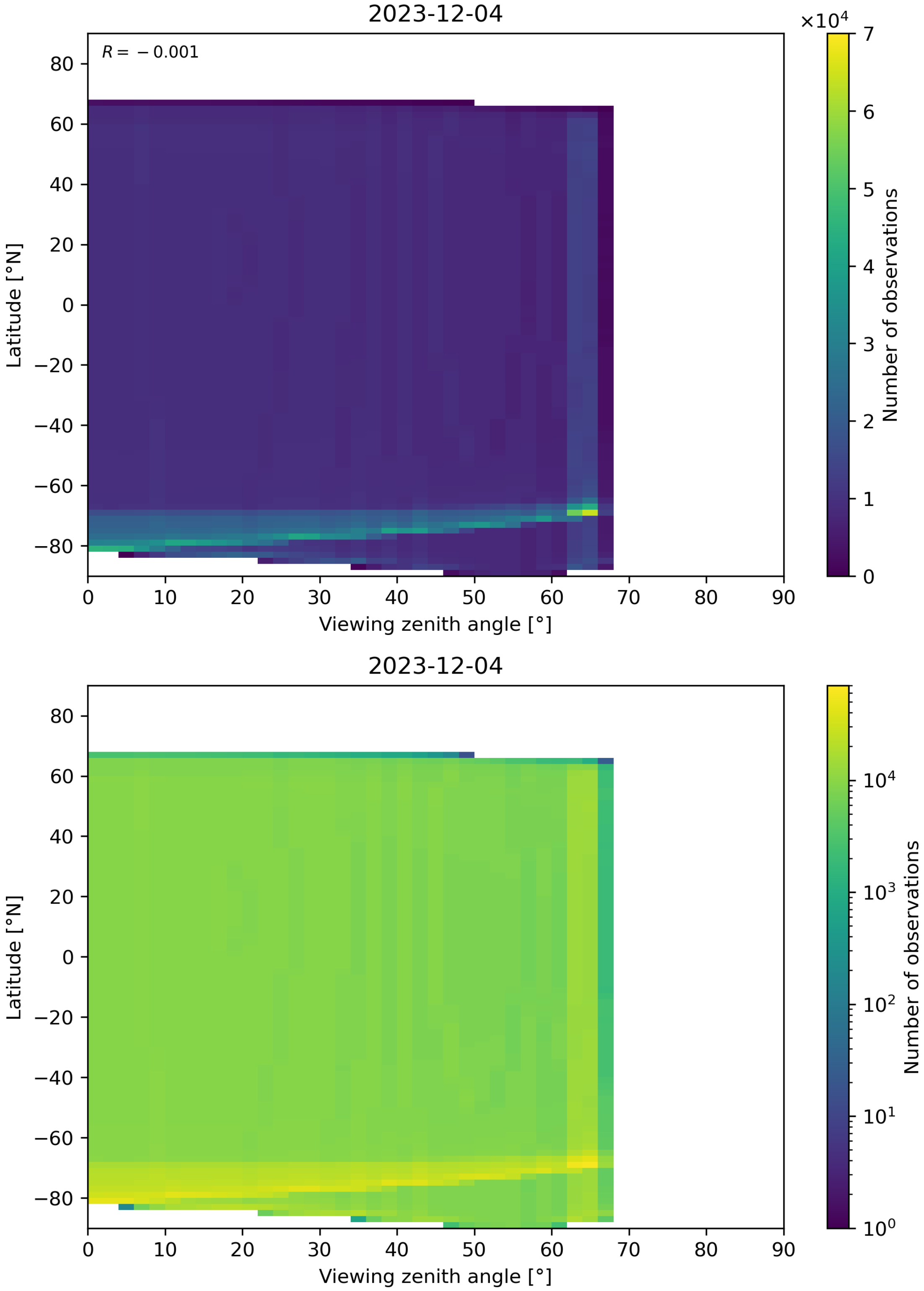
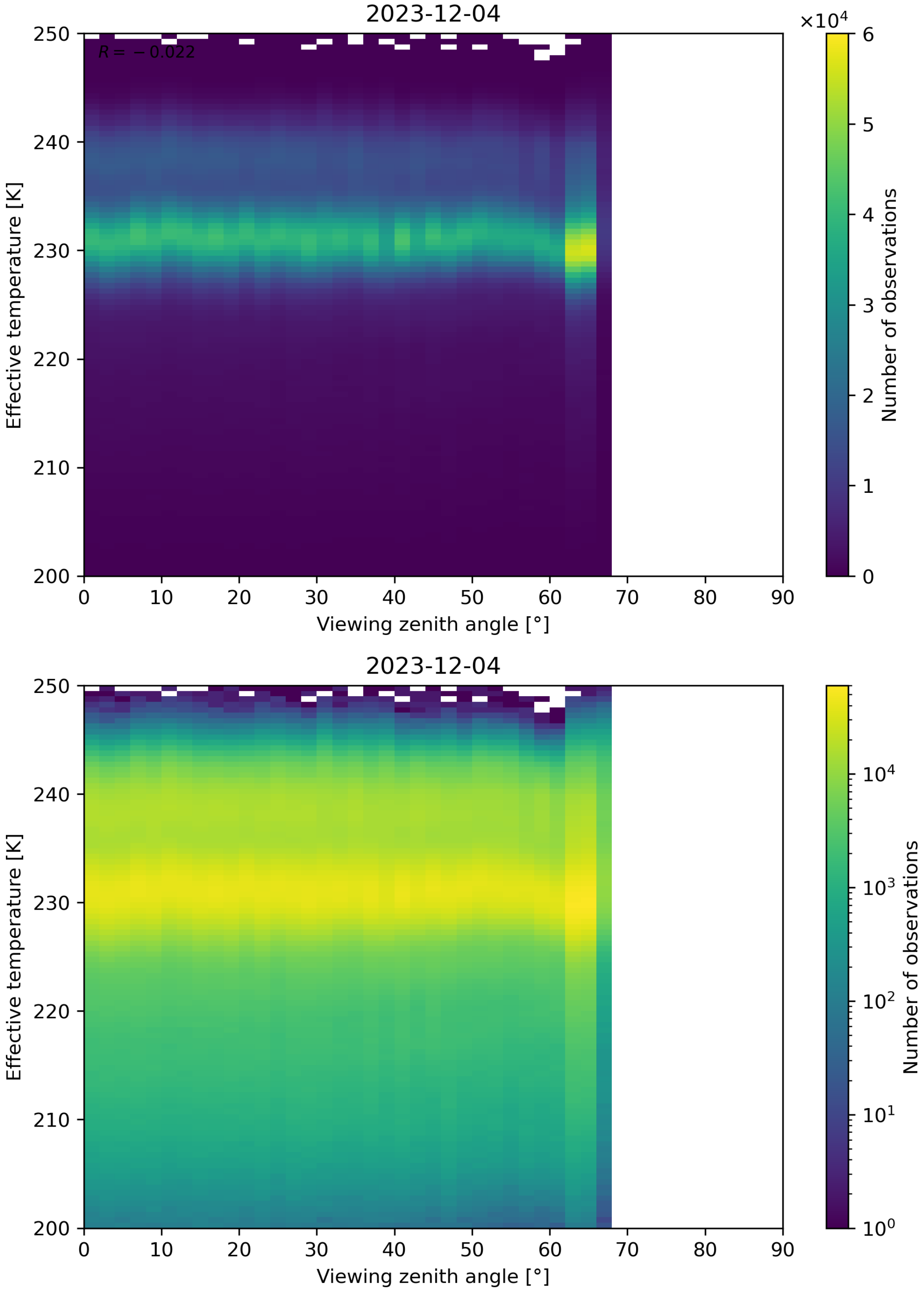


Figure 49: Scatter density plot of “Viewing zenith angle” against “Latitude” for 2023-12-04 to 2023-12-05.



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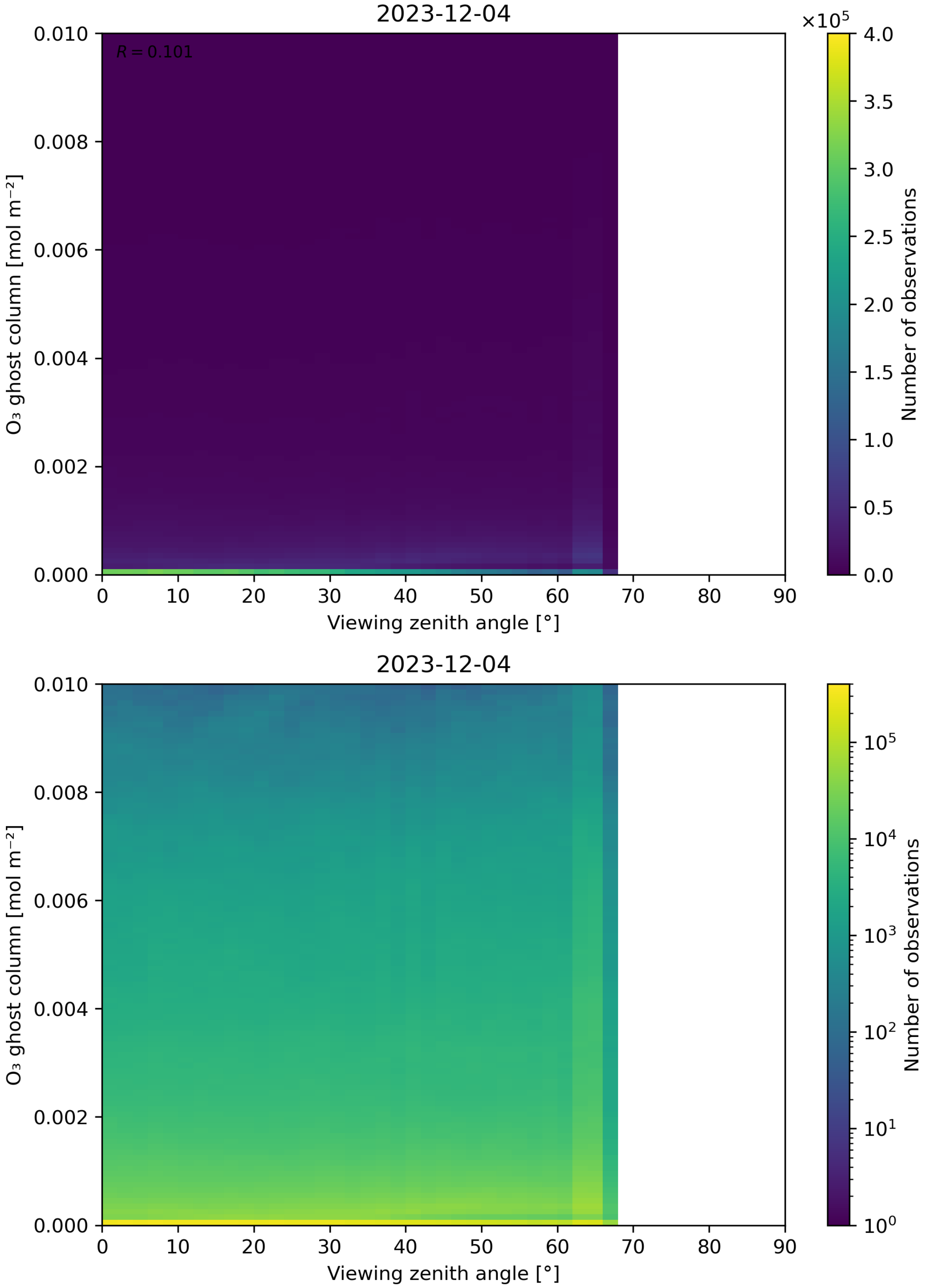
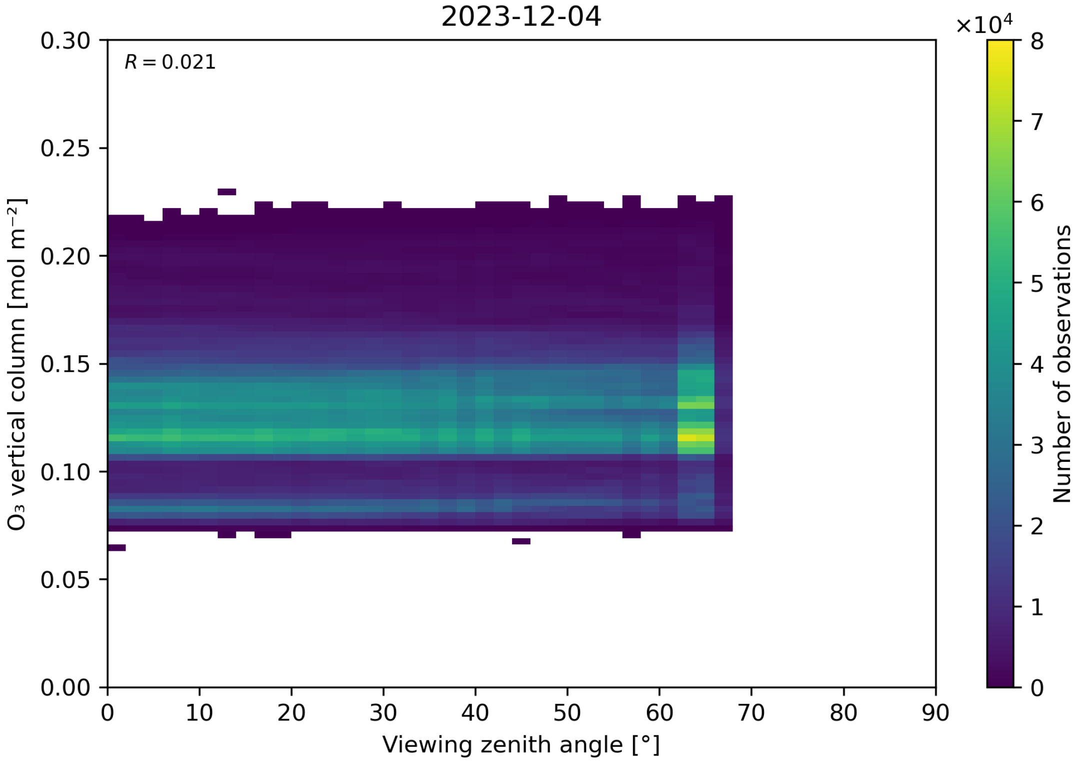
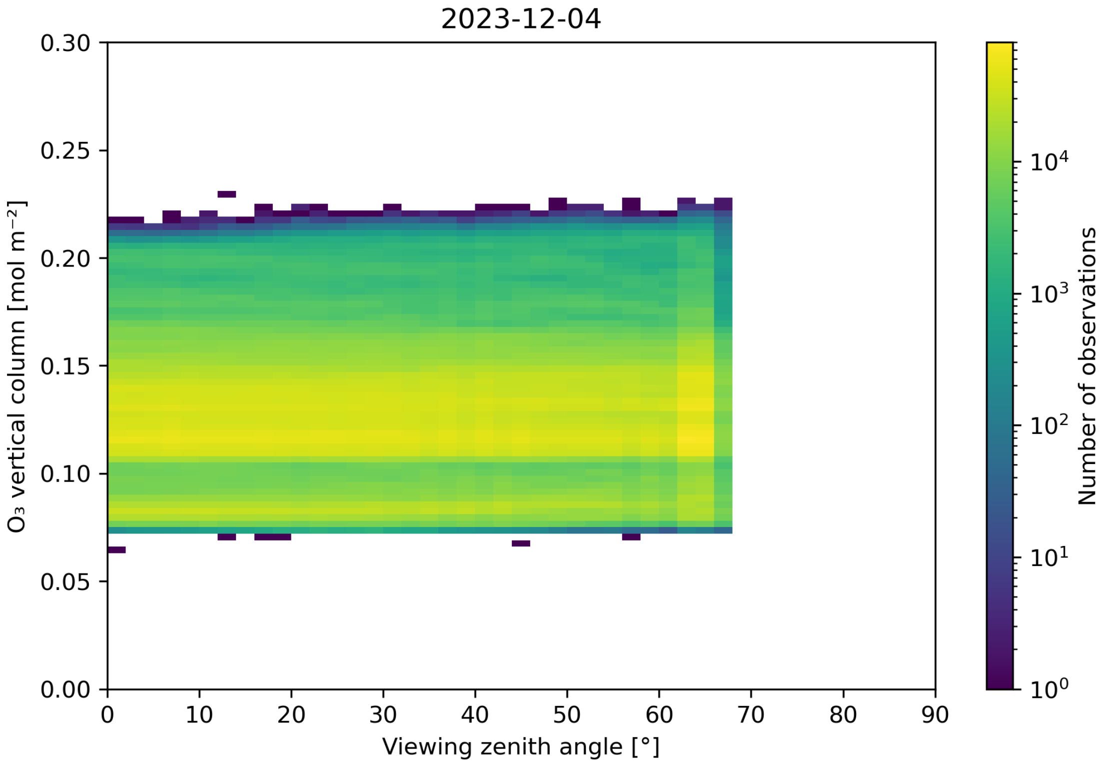


Figure 51: Scatter density plot of "Viewing zenith angle" against "O_3 ghost column" for 2023-12-04 to 2023-12-05.





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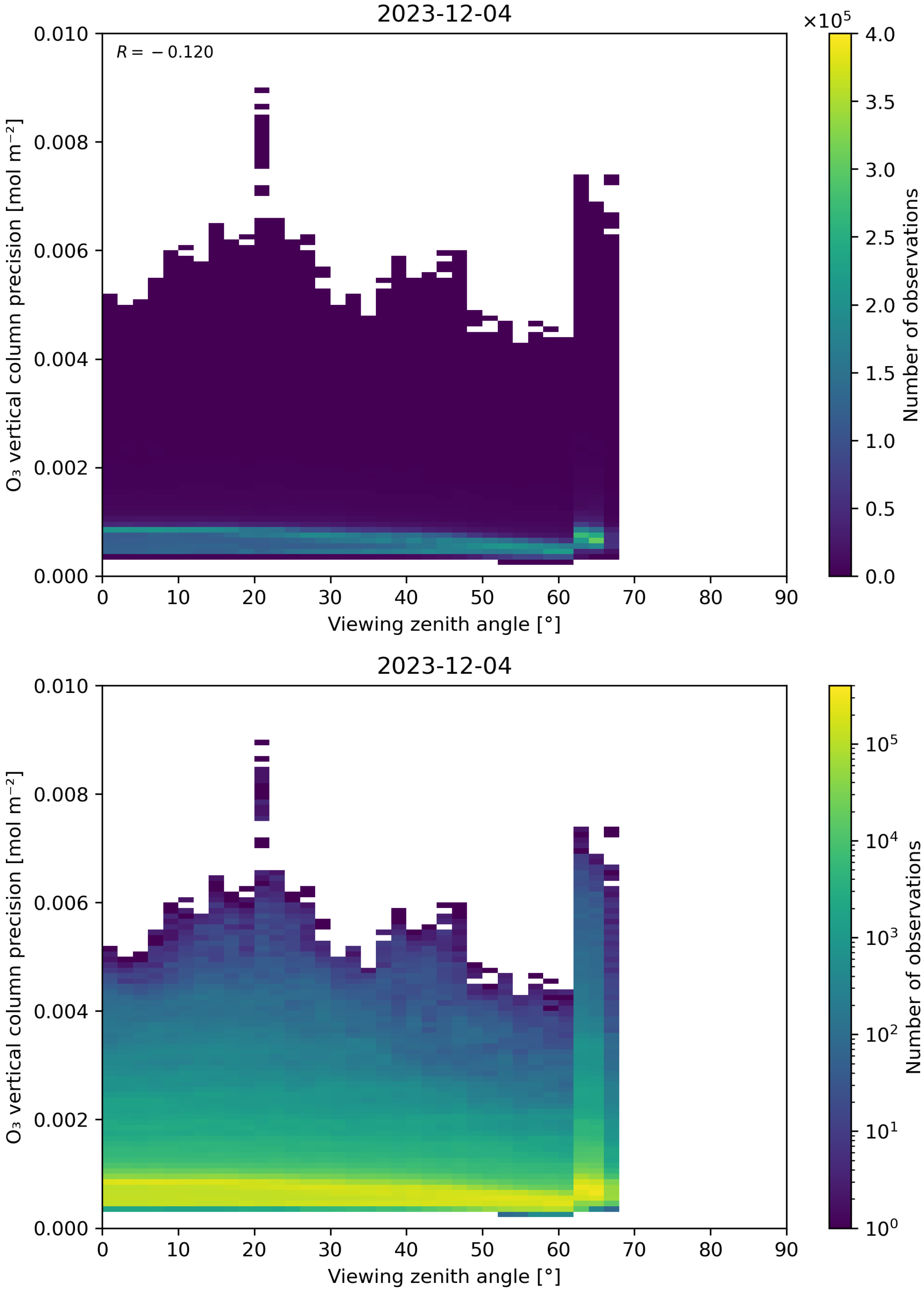

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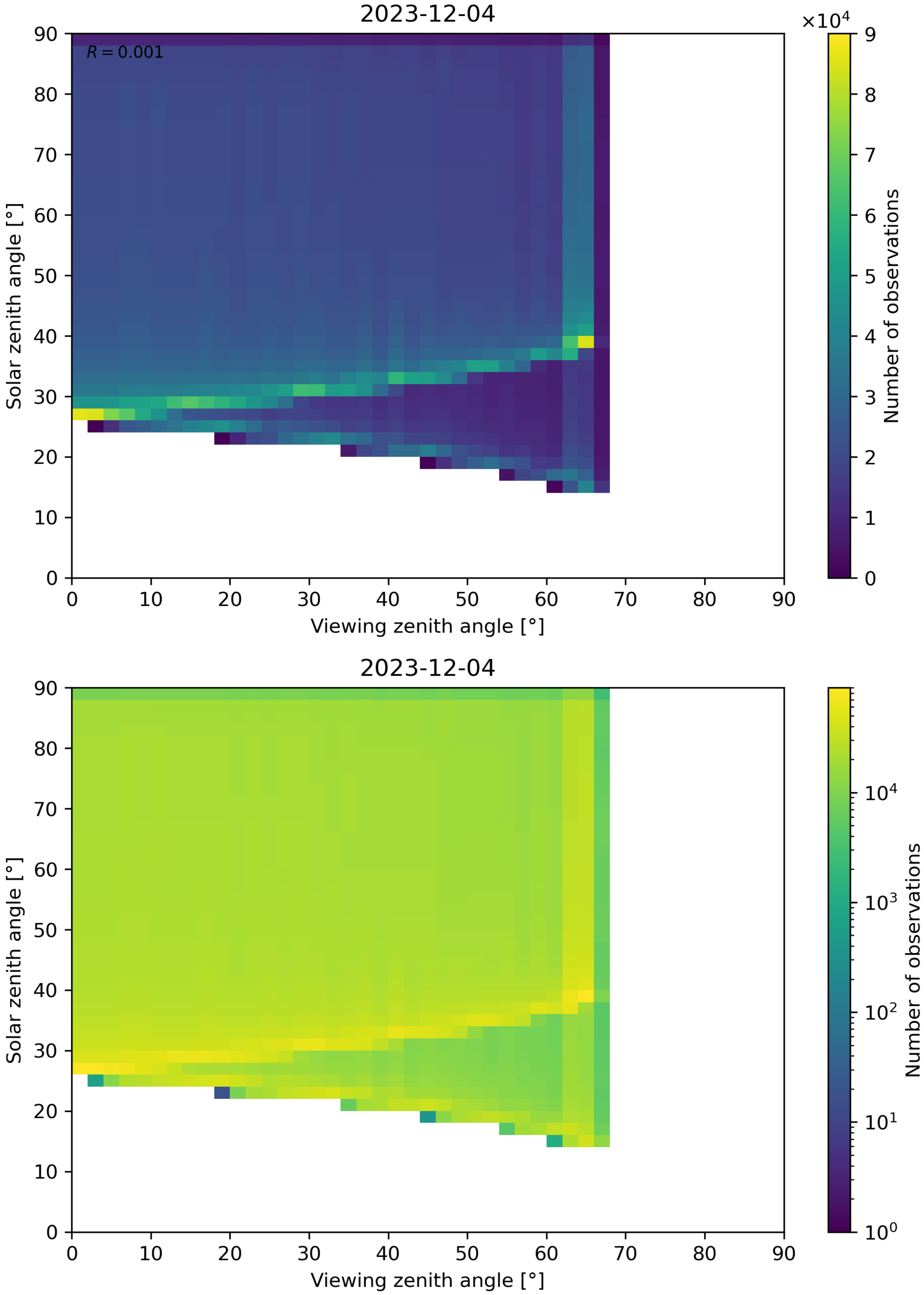

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