

# PyCAMA report generated by tropl2-proc

tropl2-proc

2024-01-04 (01:17)

## 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 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]                                                 | $0.601 \pm 0.300$                  | 6840071 | 0.705                  | 0.300                  | 0.700                  | 0.0                     | 1.000                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $(2.256 \pm 1.008) \times 10^{-2}$ | 6840071 | $1.450 \times 10^{-2}$ | $1.704 \times 10^{-2}$ | $2.175 \times 10^{-2}$ | 0.0                     | 0.221                  |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $(0.997 \pm 0.997) \times 10^{37}$ | 6840071 | $1.510 \times 10^{-2}$ | $1.705 \times 10^{-2}$ | $2.177 \times 10^{-2}$ | $-9.969 \times 10^{36}$ | 0.219                  |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $(1.101 \pm 0.576) \times 10^{-3}$ | 6840071 | $5.950 \times 10^{-4}$ | $6.824 \times 10^{-4}$ | $9.603 \times 10^{-4}$ | 0.0                     | $3.255 \times 10^{-2}$ |
| number of spectral points in retrieval [1]                   | $154 \pm 1$                        | 6840071 | 155                    | 2.00                   | 154                    | 90.0                    | 156                    |
| chi square [1]                                               | $(0.150 \pm 1.209) \times 10^4$    | 6840071 | 472                    | $1.117 \times 10^3$    | 971                    | 171                     | $4.508 \times 10^6$    |
| degrees of freedom [1]                                       | $7.36 \pm 0.56$                    | 6840071 | 7.95                   | 0.898                  | 7.39                   | 4.00                    | 8.00                   |
| number of iterations [1]                                     | $8.57 \pm 1.25$                    | 6840071 | 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                  | 1.000                  | 1.000                  | 1.000                  | 1.000                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $6.458 \times 10^{-3}$ | $8.402 \times 10^{-3}$ | $9.873 \times 10^{-3}$ | $1.156 \times 10^{-2}$ | $1.397 \times 10^{-2}$ | $3.102 \times 10^{-2}$ | $3.370 \times 10^{-2}$ | $3.556 \times 10^{-2}$ | $3.822 \times 10^{-2}$ | $4.695 \times 10^{-2}$ |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $6.964 \times 10^{-3}$ | $8.540 \times 10^{-3}$ | $9.912 \times 10^{-3}$ | $1.165 \times 10^{-2}$ | $1.404 \times 10^{-2}$ | $3.109 \times 10^{-2}$ | $3.361 \times 10^{-2}$ | $3.529 \times 10^{-2}$ | $3.787 \times 10^{-2}$ | $4.670 \times 10^{-2}$ |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $3.638 \times 10^{-4}$ | $4.612 \times 10^{-4}$ | $5.286 \times 10^{-4}$ | $5.864 \times 10^{-4}$ | $6.748 \times 10^{-4}$ | $1.357 \times 10^{-3}$ | $1.618 \times 10^{-3}$ | $1.905 \times 10^{-3}$ | $2.297 \times 10^{-3}$ | $2.949 \times 10^{-3}$ |
| number of spectral points in retrieval [1]                   | 151                    | 152                    | 153                    | 153                    | 153                    | 155                    | 155                    | 156                    | 156                    | 156                    |
| chi square [1]                                               | 322                    | 382                    | 432                    | 487                    | 582                    | $1.699 \times 10^3$    | $2.161 \times 10^3$    | $2.616 \times 10^3$    | $3.326 \times 10^3$    | $5.508 \times 10^3$    |
| degrees of freedom [1]                                       | 6.00                   | 6.00                   | 7.00                   | 7.00                   | 7.00                   | 7.90                   | 7.96                   | 7.98                   | 7.99                   | 8.00                   |
| number of iterations [1]                                     | 6.00                   | 7.00                   | 8.00                   | 8.00                   | 8.00                   | 9.00                   | 9.00                   | 9.00                   | 11.0                   | 14.0                   |

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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]                                                 | $0.591 \pm 0.286$                  | 2383726 | 0.300                  | 0.700                  | 0.0                     | 1.000                  | 0.400                  | 0.700                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $(3.267 \pm 0.624) \times 10^{-2}$ | 2383726 | $6.215 \times 10^{-3}$ | $3.275 \times 10^{-2}$ | 0.0                     | 0.136                  | $2.943 \times 10^{-2}$ | $3.565 \times 10^{-2}$ |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $(0.997 \pm 0.997) \times 10^{37}$ | 2383726 | $5.696 \times 10^{-3}$ | $3.277 \times 10^{-2}$ | $-9.969 \times 10^{36}$ | 0.136                  | $2.967 \times 10^{-2}$ | $3.537 \times 10^{-2}$ |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $(1.208 \pm 0.665) \times 10^{-3}$ | 2383726 | $7.905 \times 10^{-4}$ | $1.031 \times 10^{-3}$ | 0.0                     | $9.354 \times 10^{-3}$ | $7.266 \times 10^{-4}$ | $1.517 \times 10^{-3}$ |
| number of spectral points in retrieval [1]                   | $154 \pm 1$                        | 2383726 | 2.00                   | 154                    | 147                     | 156                    | 153                    | 155                    |
| chi square [1]                                               | $(0.134 \pm 0.725) \times 10^4$    | 2383726 | 933                    | 923                    | 205                     | $4.087 \times 10^6$    | 592                    | $1.524 \times 10^3$    |
| degrees of freedom [1]                                       | $7.44 \pm 0.50$                    | 2383726 | 0.910                  | 7.52                   | 5.00                    | 8.00                   | 7.00                   | 7.91                   |
| number of iterations [1]                                     | $8.42 \pm 1.08$                    | 2383726 | 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]                                                 | $0.606 \pm 0.307$                  | 4456345 | 0.300                  | 0.700                  | 0.0                     | 1.000                  | 0.400                  | 0.700                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $(1.715 \pm 0.716) \times 10^{-2}$ | 4456345 | $1.013 \times 10^{-2}$ | $1.581 \times 10^{-2}$ | 0.0                     | 0.221                  | $1.170 \times 10^{-2}$ | $2.183 \times 10^{-2}$ |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $(1.714 \pm 0.702) \times 10^{-2}$ | 4456345 | $1.001 \times 10^{-2}$ | $1.569 \times 10^{-2}$ | $-2.144 \times 10^{-3}$ | 0.219                  | $1.179 \times 10^{-2}$ | $2.180 \times 10^{-2}$ |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $(1.043 \pm 0.513) \times 10^{-3}$ | 4456345 | $6.407 \times 10^{-4}$ | $9.255 \times 10^{-4}$ | 0.0                     | $3.255 \times 10^{-2}$ | $6.508 \times 10^{-4}$ | $1.292 \times 10^{-3}$ |
| number of spectral points in retrieval [1]                   | $154 \pm 1$                        | 4456345 | 2.00                   | 154                    | 90.0                    | 156                    | 153                    | 155                    |
| chi square [1]                                               | $(0.158 \pm 1.401) \times 10^4$    | 4456345 | $1.215 \times 10^3$    | $1.006 \times 10^3$    | 171                     | $4.508 \times 10^6$    | 576                    | $1.791 \times 10^3$    |
| degrees of freedom [1]                                       | $7.32 \pm 0.59$                    | 4456345 | 0.887                  | 7.29                   | 4.00                    | 8.00                   | 7.00                   | 7.89                   |
| number of iterations [1]                                     | $8.65 \pm 1.32$                    | 4456345 | 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]                                                 | $0.606 \pm 0.223$                  | 3798726 | 0.300                  | 0.700                  | 0.0                     | 1.000                  | 0.400                  | 0.700                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $(2.412 \pm 0.828) \times 10^{-2}$ | 3798726 | $1.375 \times 10^{-2}$ | $2.291 \times 10^{-2}$ | 0.0                     | 0.217                  | $1.710 \times 10^{-2}$ | $3.085 \times 10^{-2}$ |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $(2.411 \pm 0.813) \times 10^{-2}$ | 3798726 | $1.387 \times 10^{-2}$ | $2.283 \times 10^{-2}$ | $-2.144 \times 10^{-3}$ | 0.217                  | $1.707 \times 10^{-2}$ | $3.094 \times 10^{-2}$ |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $(1.221 \pm 0.641) \times 10^{-3}$ | 3798726 | $8.506 \times 10^{-4}$ | $1.048 \times 10^{-3}$ | 0.0                     | $3.255 \times 10^{-2}$ | $7.194 \times 10^{-4}$ | $1.570 \times 10^{-3}$ |
| number of spectral points in retrieval [1]                   | $154 \pm 1$                        | 3798726 | 2.00                   | 154                    | 90.0                    | 156                    | 153                    | 155                    |
| chi square [1]                                               | $(0.162 \pm 1.368) \times 10^4$    | 3798726 | $1.120 \times 10^3$    | $1.111 \times 10^3$    | 207                     | $4.508 \times 10^6$    | 685                    | $1.805 \times 10^3$    |
| degrees of freedom [1]                                       | $7.57 \pm 0.44$                    | 3798726 | 0.803                  | 7.75                   | 5.00                    | 8.00                   | 7.15                   | 7.95                   |
| number of iterations [1]                                     | $8.70 \pm 1.37$                    | 3798726 | 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]                                                 | $0.600 \pm 0.377$                       | 2747728 | 0.600                  | 0.700                  | 0.0                     | 1.000                  | 0.400                  | 1.000                  |
| carbonmonoxide total column [mol m <sup>-2</sup> ]           | $(1.942 \pm 1.134) \times 10^{-2}$      | 2747728 | $1.990 \times 10^{-2}$ | $1.406 \times 10^{-2}$ | 0.0                     | 0.136                  | $1.001 \times 10^{-2}$ | $2.991 \times 10^{-2}$ |
| carbonmonoxide total column corrected [mol m <sup>-2</sup> ] | $(-0.762 \pm 99692.100) \times 10^{32}$ | 2747728 | $2.000 \times 10^{-2}$ | $1.390 \times 10^{-2}$ | $-9.969 \times 10^{36}$ | 0.136                  | $9.992 \times 10^{-3}$ | $2.999 \times 10^{-2}$ |
| carbonmonoxide total column precision [mol m <sup>-2</sup> ] | $(9.362 \pm 4.223) \times 10^{-4}$      | 2747728 | $5.589 \times 10^{-4}$ | $8.707 \times 10^{-4}$ | 0.0                     | $9.097 \times 10^{-3}$ | $6.141 \times 10^{-4}$ | $1.173 \times 10^{-3}$ |
| number of spectral points in retrieval [1]                   | $154 \pm 1$                             | 2747728 | 2.00                   | 154                    | 145                     | 156                    | 153                    | 155                    |
| chi square [1]                                               | $(0.134 \pm 0.944) \times 10^4$         | 2747728 | $1.025 \times 10^3$    | 777                    | 171                     | $3.302 \times 10^6$    | 488                    | $1.513 \times 10^3$    |
| degrees of freedom [1]                                       | $7.08 \pm 0.60$                         | 2747728 | 0.463                  | 7.01                   | 4.00                    | 8.00                   | 7.00                   | 7.46                   |
| number of iterations [1]                                     | $8.43 \pm 1.04$                         | 2747728 | 1.000                  | 8.00                   | 5.00                    | 15.0                   | 8.00                   | 9.00                   |

Table 7: Correlation matrix

| Viewing zenith angle    | Solar zenith angle      | Latitude                | CO total vertical column | CO total vertical column (stripe-corrected) | CO total vertical column precision | Number of spectral points in retrieval | $\chi^2$                | Degrees of freedom for signal | Number of iterations    |
|-------------------------|-------------------------|-------------------------|--------------------------|---------------------------------------------|------------------------------------|----------------------------------------|-------------------------|-------------------------------|-------------------------|
| 1.000                   | $5.537 \times 10^{-3}$  | $2.826 \times 10^{-2}$  | $3.570 \times 10^{-2}$   | $-1.315 \times 10^{-3}$                     | -0.237                             | $9.159 \times 10^{-2}$                 | $1.401 \times 10^{-2}$  | $6.145 \times 10^{-2}$        | $4.724 \times 10^{-2}$  |
| $5.537 \times 10^{-3}$  | 1.000                   | $-1.833 \times 10^{-2}$ | -0.164                   | $-7.345 \times 10^{-3}$                     | -0.157                             | $8.345 \times 10^{-3}$                 | $-3.128 \times 10^{-2}$ | -0.342                        | -0.119                  |
| $2.826 \times 10^{-2}$  | $-1.833 \times 10^{-2}$ | 1.000                   | 0.857                    | $-8.834 \times 10^{-3}$                     | 0.180                              | $1.624 \times 10^{-3}$                 | $-4.058 \times 10^{-3}$ | 0.233                         | $-8.796 \times 10^{-2}$ |
| $3.570 \times 10^{-2}$  | -0.164                  | 0.857                   | 1.000                    | $-6.711 \times 10^{-3}$                     | 0.203                              | $1.929 \times 10^{-3}$                 | $4.090 \times 10^{-3}$  | 0.291                         | $-5.843 \times 10^{-2}$ |
| $-1.315 \times 10^{-3}$ | $-7.345 \times 10^{-3}$ | $-8.834 \times 10^{-3}$ | $-6.711 \times 10^{-3}$  | 1.000                                       | $-6.519 \times 10^{-3}$            | $-2.527 \times 10^{-3}$                | $4.390 \times 10^{-4}$  | $-2.205 \times 10^{-3}$       | $2.176 \times 10^{-3}$  |
| -0.237                  | -0.157                  | 0.180                   | 0.203                    | $-6.519 \times 10^{-3}$                     | 1.000                              | $-2.964 \times 10^{-2}$                | $-5.458 \times 10^{-2}$ | $5.010 \times 10^{-2}$        | $-2.550 \times 10^{-2}$ |
| $9.159 \times 10^{-2}$  | $8.345 \times 10^{-3}$  | $1.624 \times 10^{-3}$  | $1.929 \times 10^{-3}$   | $-2.527 \times 10^{-3}$                     | $-2.964 \times 10^{-2}$            | 1.000                                  | $2.128 \times 10^{-3}$  | $-8.596 \times 10^{-3}$       | $1.369 \times 10^{-2}$  |
| $1.401 \times 10^{-2}$  | $-3.128 \times 10^{-2}$ | $-4.058 \times 10^{-3}$ | $4.090 \times 10^{-3}$   | $4.390 \times 10^{-4}$                      | $-5.458 \times 10^{-2}$            | $2.128 \times 10^{-3}$                 | 1.000                   | $1.968 \times 10^{-2}$        | $-8.797 \times 10^{-3}$ |
| $6.145 \times 10^{-2}$  | -0.342                  | 0.233                   | 0.291                    | $-2.205 \times 10^{-3}$                     | $5.010 \times 10^{-2}$             | $-8.596 \times 10^{-3}$                | $1.968 \times 10^{-2}$  | 1.000                         | $-8.436 \times 10^{-2}$ |
| $4.724 \times 10^{-2}$  | -0.119                  | $-8.796 \times 10^{-2}$ | $-5.843 \times 10^{-2}$  | $2.176 \times 10^{-3}$                      | $-2.550 \times 10^{-2}$            | $1.369 \times 10^{-2}$                 | $-8.797 \times 10^{-3}$ | $-8.436 \times 10^{-2}$       | 1.000                   |

Table 8: Covariance matrix

| Viewing zenith angle    | Solar zenith angle      | Latitude                | CO total vertical column | CO total vertical column (stripe-corrected) | CO total vertical column precision | Number of spectral points in retrieval | $\chi^2$               | Degrees of freedom for signal | Number of iterations    |
|-------------------------|-------------------------|-------------------------|--------------------------|---------------------------------------------|------------------------------------|----------------------------------------|------------------------|-------------------------------|-------------------------|
| 347                     | 2.01                    | 24.5                    | $6.702 \times 10^{-3}$   | $-1.297 \times 10^{33}$                     | $-2.541 \times 10^{-3}$            | 2.18                                   | $3.155 \times 10^3$    | 0.644                         | 1.10                    |
| 2.01                    | 381                     | -16.6                   | $-3.221 \times 10^{-2}$  | $-7.588 \times 10^{33}$                     | $-1.763 \times 10^{-3}$            | 0.208                                  | $-7.380 \times 10^3$   | -3.75                         | -2.89                   |
| 24.5                    | -16.6                   | $2.164 \times 10^3$     | 0.402                    | $-2.176 \times 10^{34}$                     | $4.823 \times 10^{-3}$             | $9.659 \times 10^{-2}$                 | $-2.283 \times 10^3$   | 6.09                          | -5.11                   |
| $6.702 \times 10^{-3}$  | $-3.221 \times 10^{-2}$ | 0.402                   | $1.017 \times 10^{-4}$   | $-3.584 \times 10^{30}$                     | $1.178 \times 10^{-6}$             | $2.487 \times 10^{-5}$                 | 0.499                  | $1.651 \times 10^{-3}$        | $-7.354 \times 10^{-4}$ |
| $-1.297 \times 10^{33}$ | $-7.588 \times 10^{33}$ | $-2.176 \times 10^{34}$ | $-3.584 \times 10^{30}$  | —                                           | $-1.988 \times 10^{29}$            | $-1.710 \times 10^{32}$                | $2.811 \times 10^{35}$ | $-6.570 \times 10^{31}$       | $1.438 \times 10^{32}$  |
| $-2.541 \times 10^{-3}$ | $-1.763 \times 10^{-3}$ | $4.823 \times 10^{-3}$  | $1.178 \times 10^{-6}$   | $-1.988 \times 10^{29}$                     | $3.316 \times 10^{-7}$             | $-2.181 \times 10^{-5}$                | -0.380                 | $1.623 \times 10^{-5}$        | $-1.833 \times 10^{-5}$ |
| 2.18                    | 0.208                   | $9.659 \times 10^{-2}$  | $2.487 \times 10^{-5}$   | $-1.710 \times 10^{32}$                     | $-2.181 \times 10^{-5}$            | 1.63                                   | 32.9                   | $-6.183 \times 10^{-3}$       | $2.185 \times 10^{-2}$  |
| $3.155 \times 10^3$     | $-7.380 \times 10^3$    | $-2.283 \times 10^3$    | 0.499                    | $2.811 \times 10^{35}$                      | -0.380                             | 32.9                                   | $1.462 \times 10^8$    | 134                           | -133                    |
| 0.644                   | -3.75                   | 6.09                    | $1.651 \times 10^{-3}$   | $-6.570 \times 10^{31}$                     | $1.623 \times 10^{-5}$             | $-6.183 \times 10^{-3}$                | 134                    | 0.317                         | $-5.925 \times 10^{-2}$ |
| 1.10                    | -2.89                   | -5.11                   | $-7.354 \times 10^{-4}$  | $1.438 \times 10^{32}$                      | $-1.833 \times 10^{-5}$            | $2.185 \times 10^{-2}$                 | -133                   | $-5.925 \times 10^{-2}$       | 1.56                    |

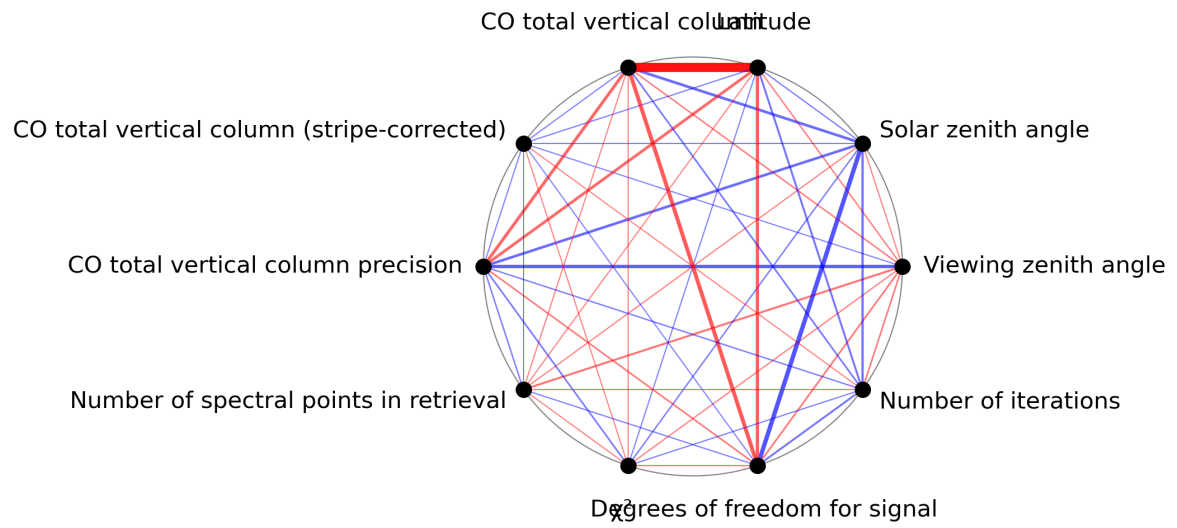


Figure 1: Map of correlation graph for 2023-12-20 to 2023-12-21.

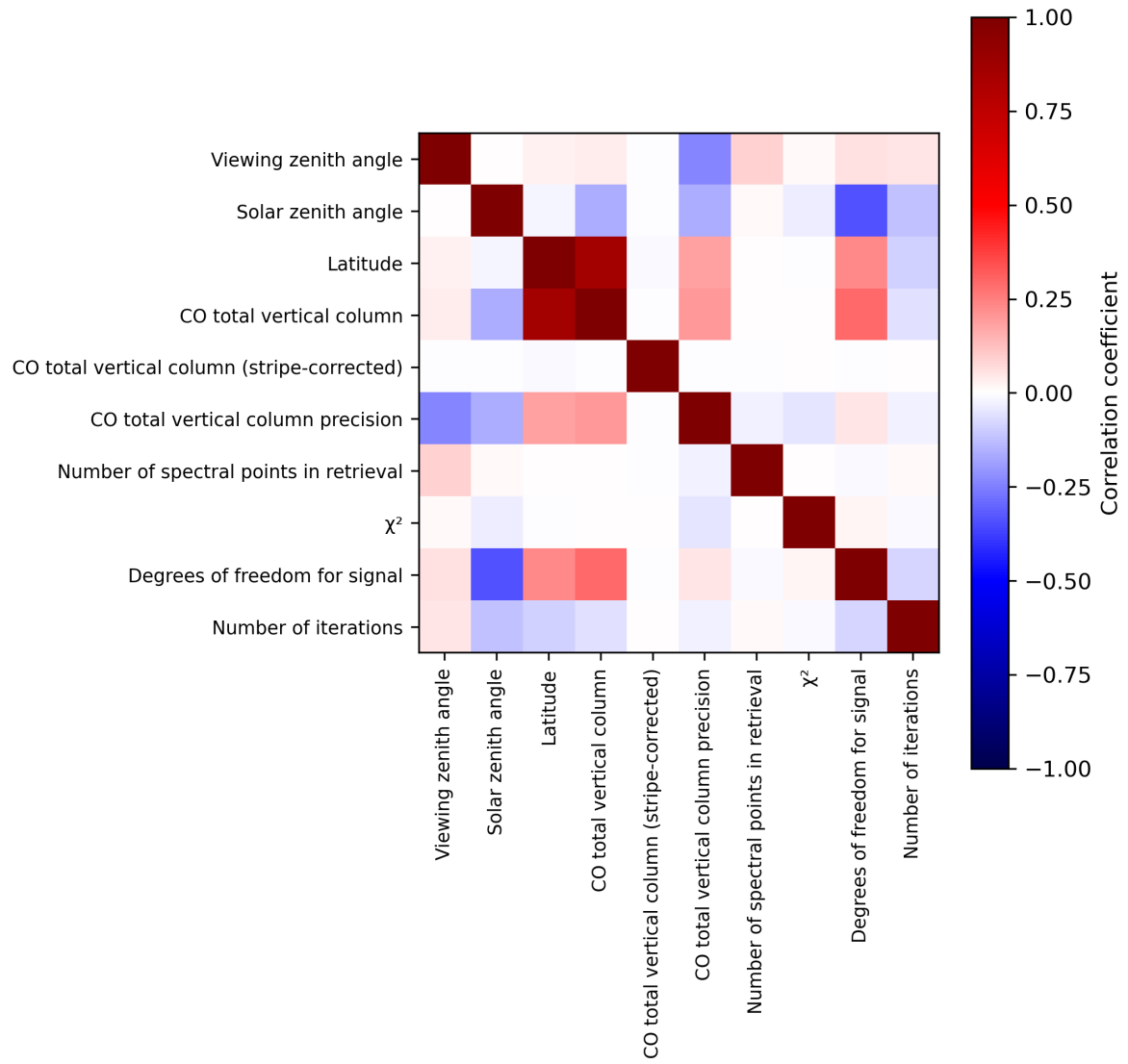


Figure 2: Map of correlation matrix for 2023-12-20 to 2023-12-21.

### 3 Granule outlines

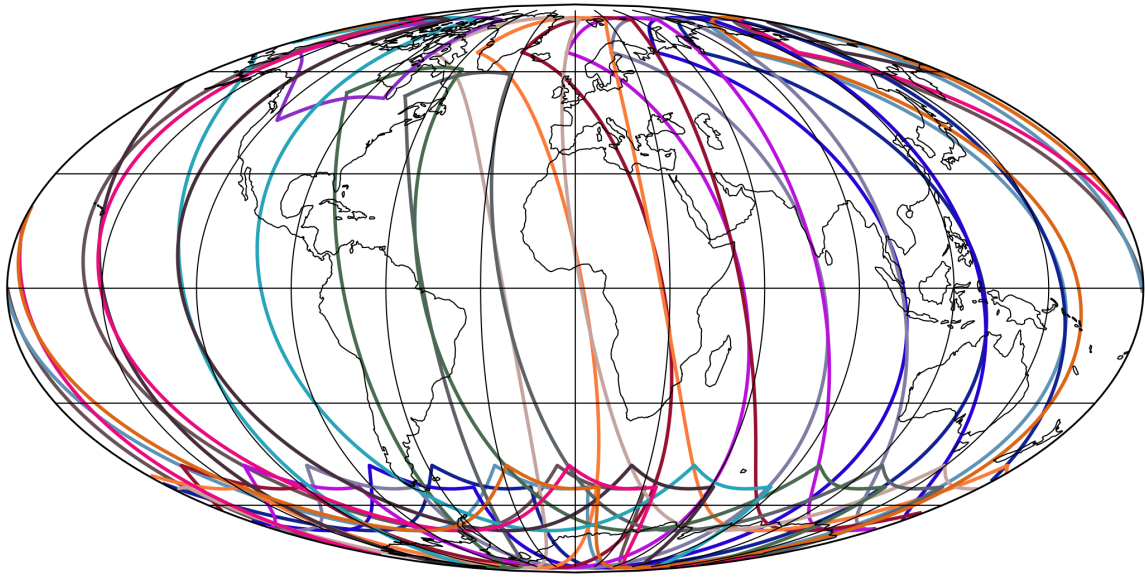


Figure 3: Outline of the granules.



## 4 Input data monitoring

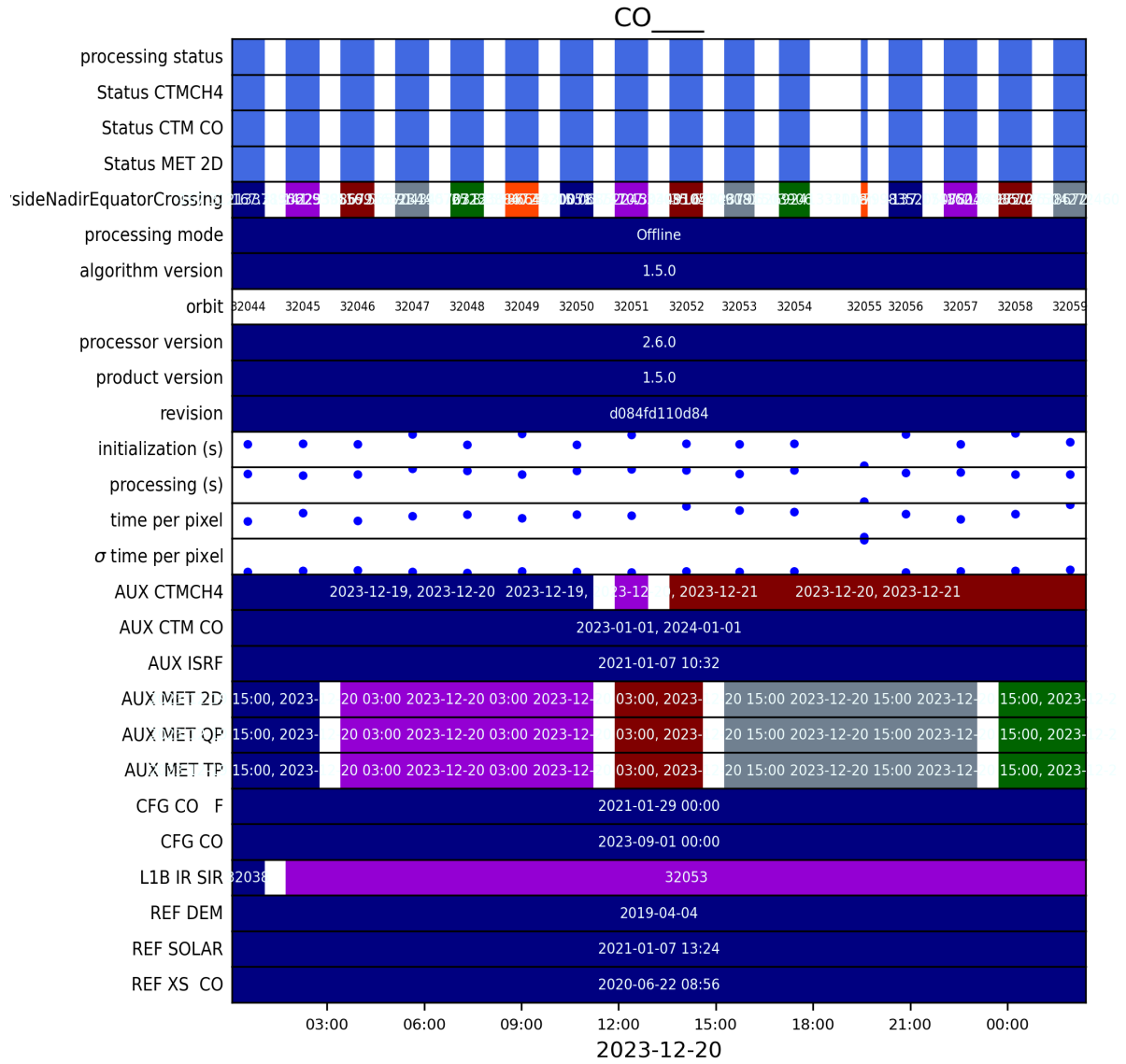


Figure 4: Input data per granule

## 5 Warnings and errors

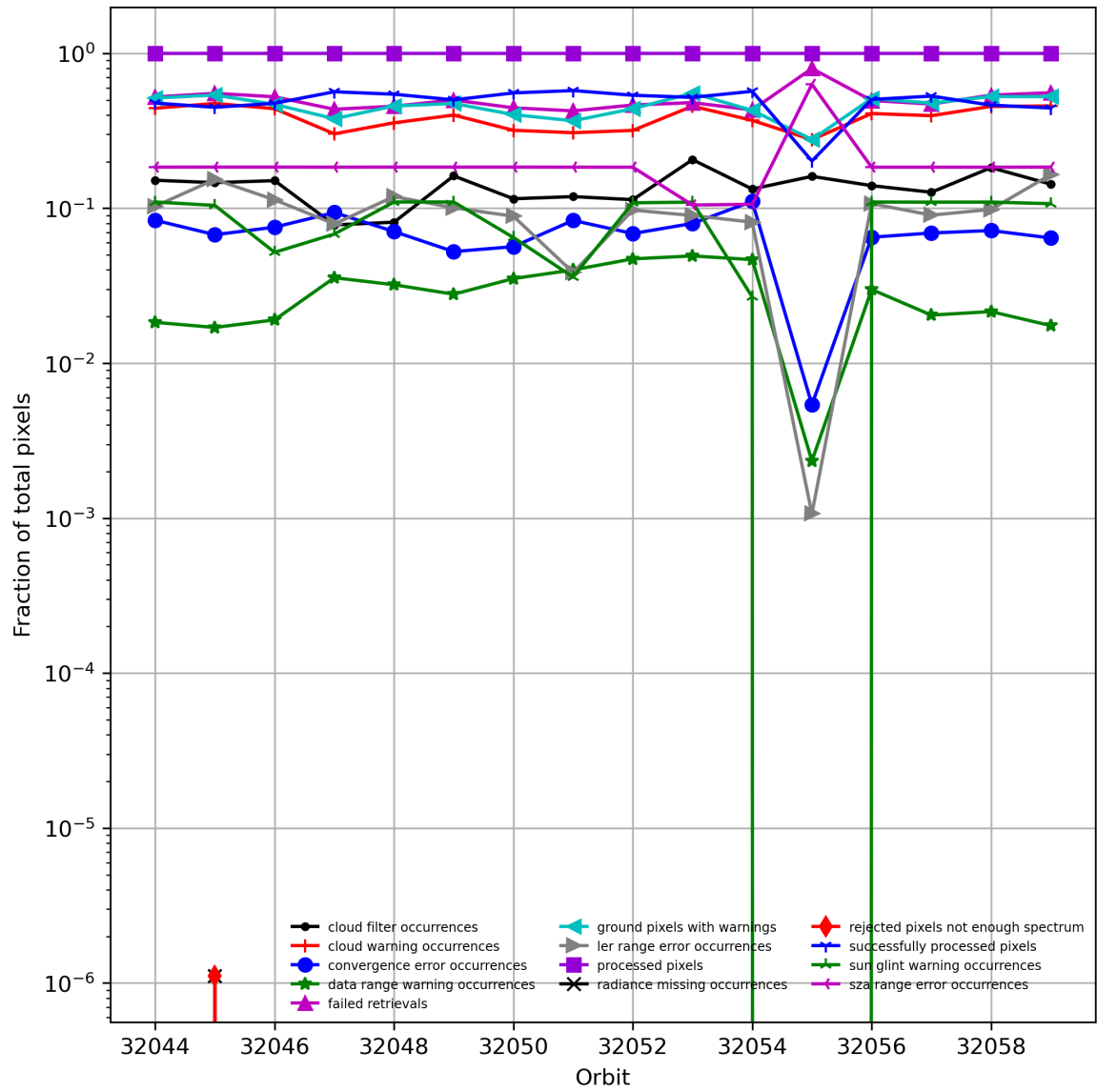


Figure 5: Fraction of pixels with specific warnings and errors during processing

## 6 World maps

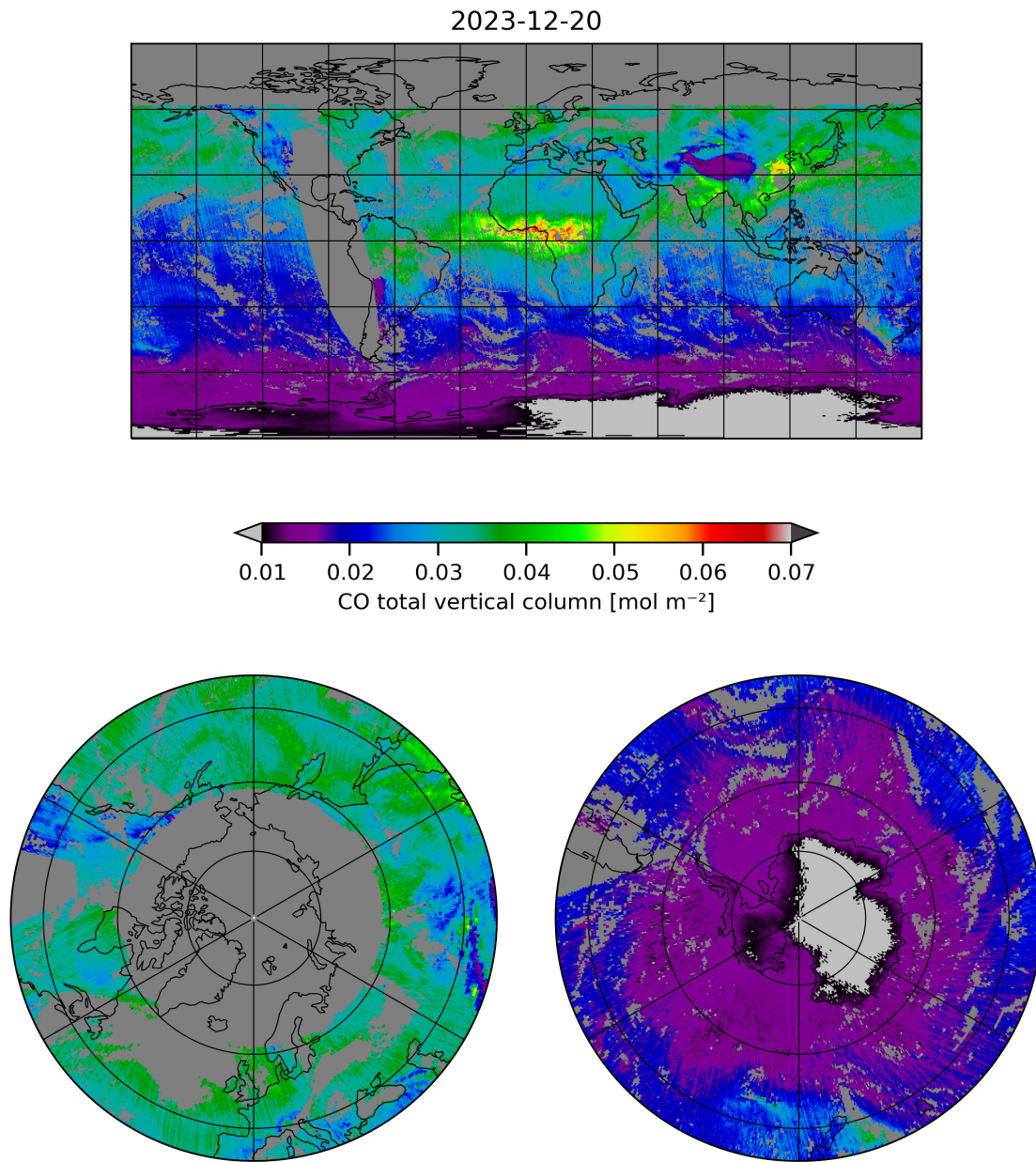


Figure 6: Map of “CO total vertical column” for 2023-12-20 to 2023-12-21

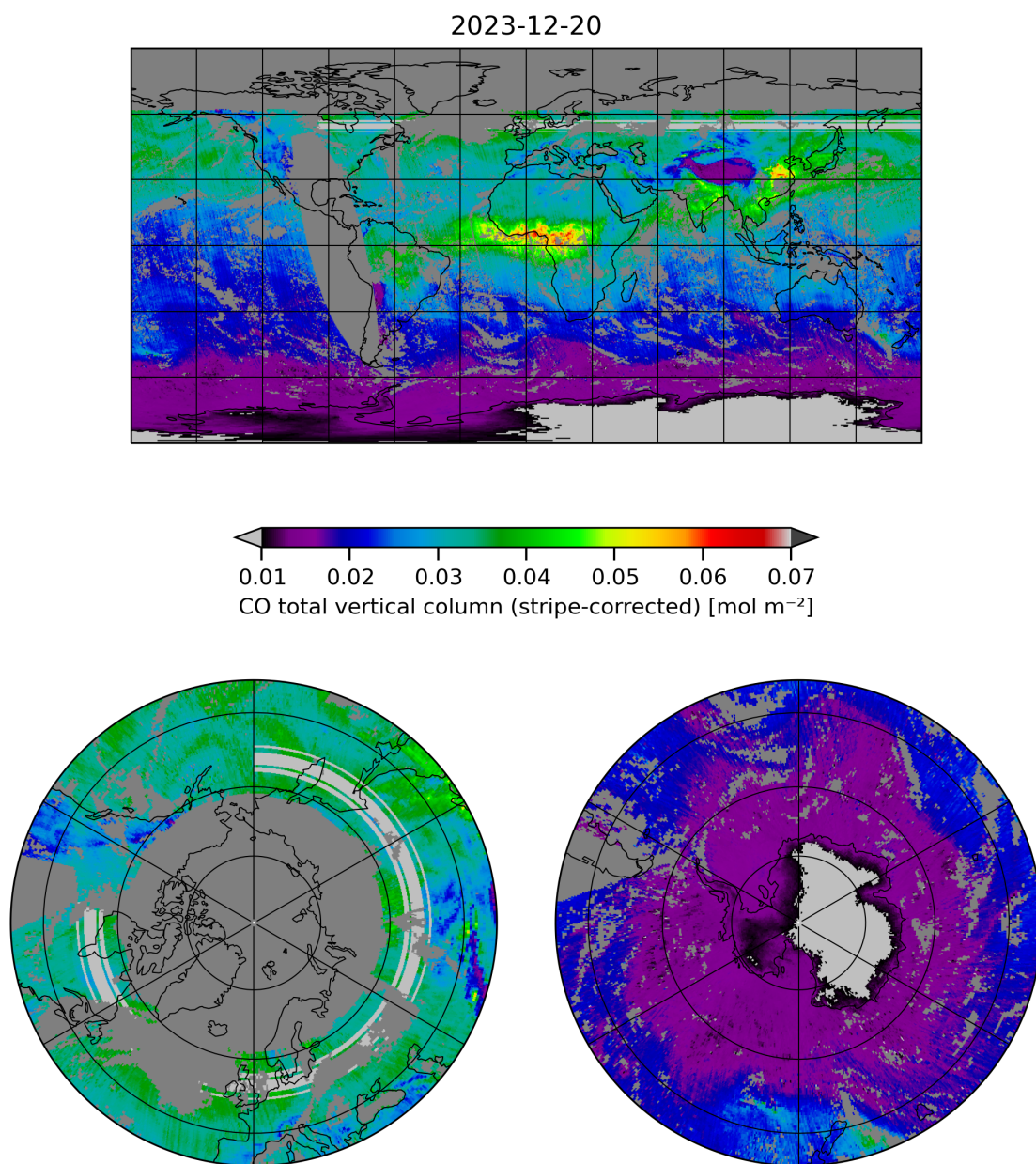


Figure 7: Map of “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21



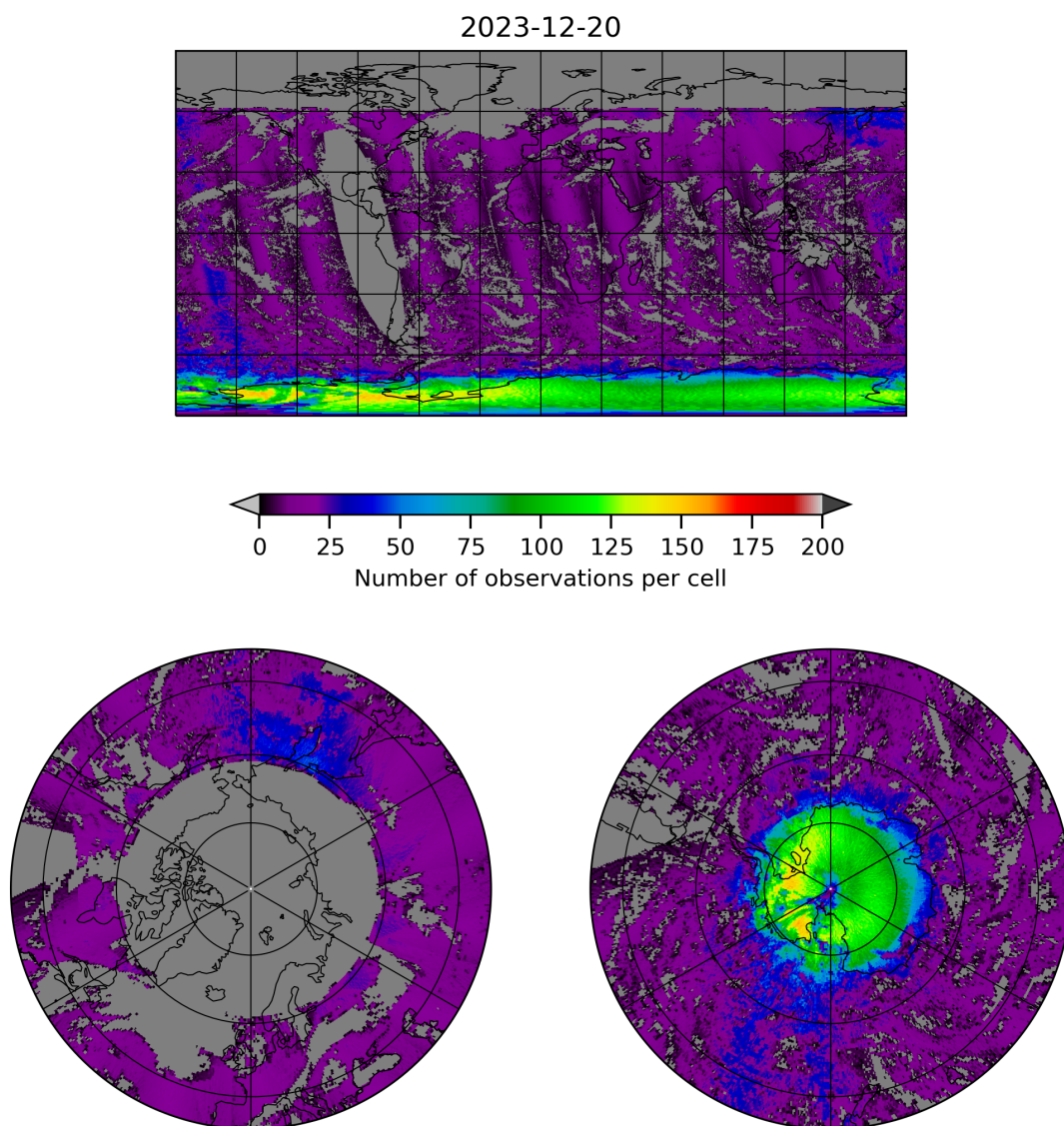


Figure 8: Map of the number of observations for 2023-12-20 to 2023-12-21

## 7 Zonal average

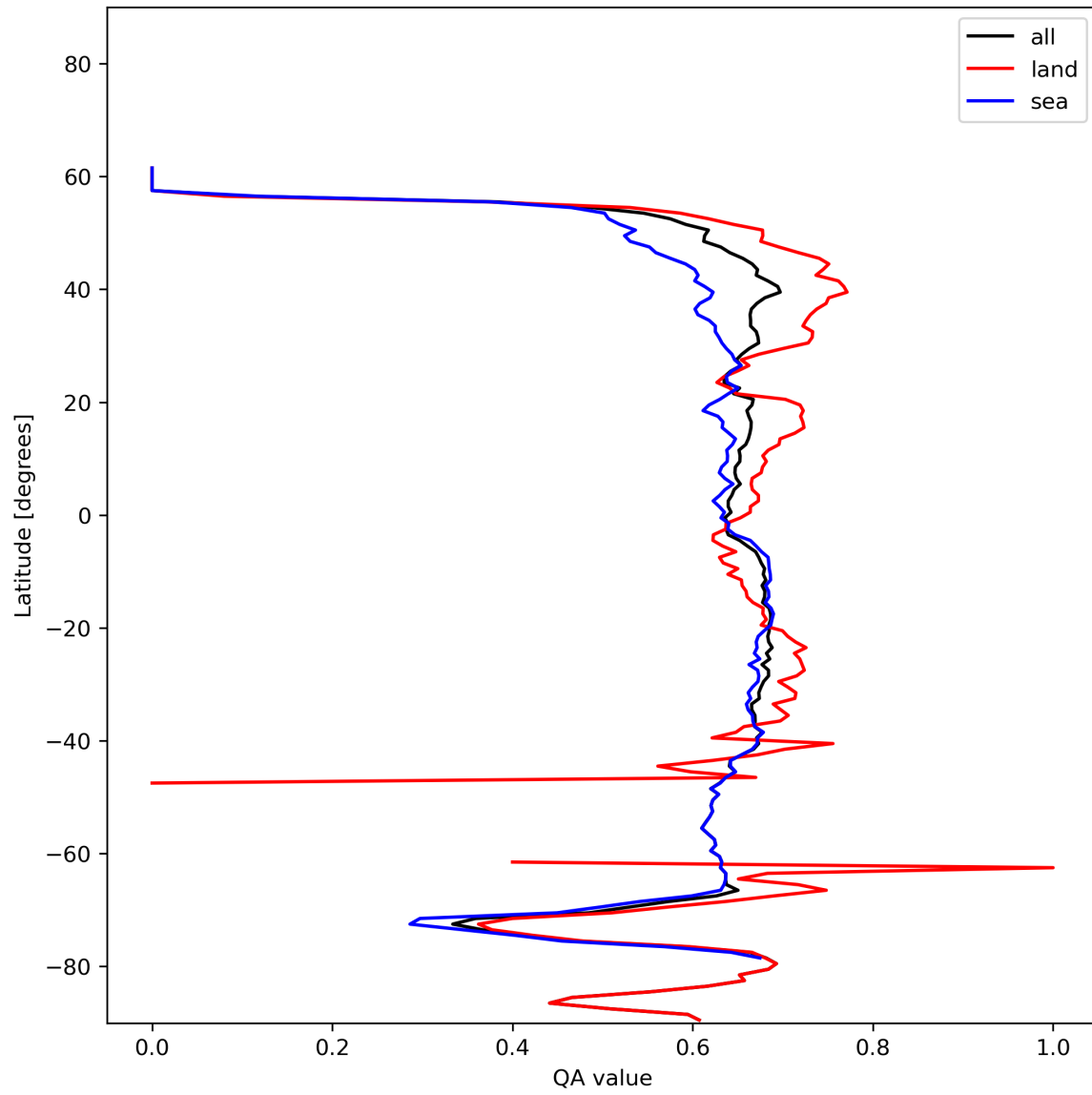


Figure 9: Zonal average of “QA value” for 2023-12-20 to 2023-12-21.

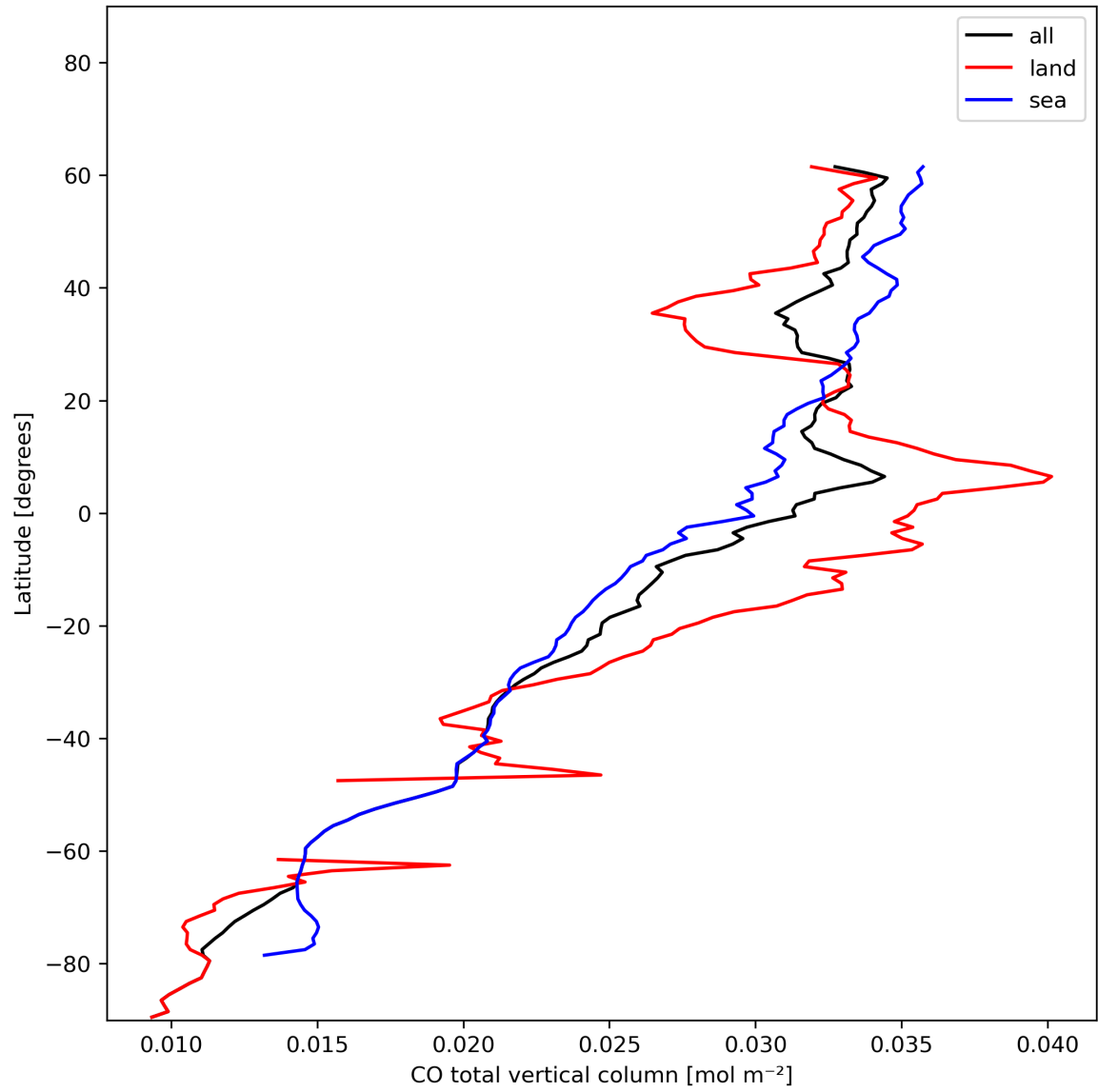


Figure 10: Zonal average of “CO total vertical column” for 2023-12-20 to 2023-12-21.

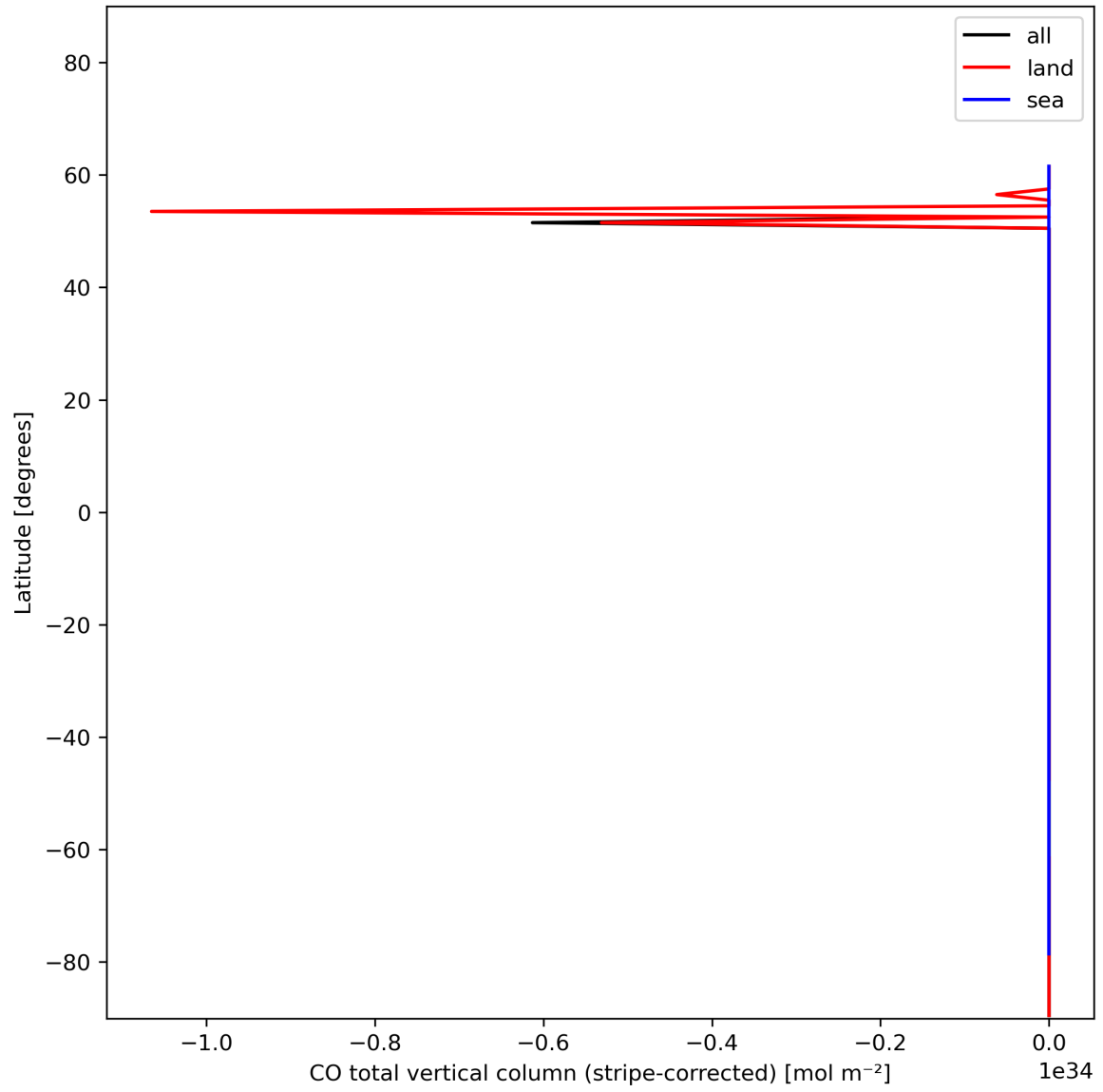


Figure 11: Zonal average of “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21.



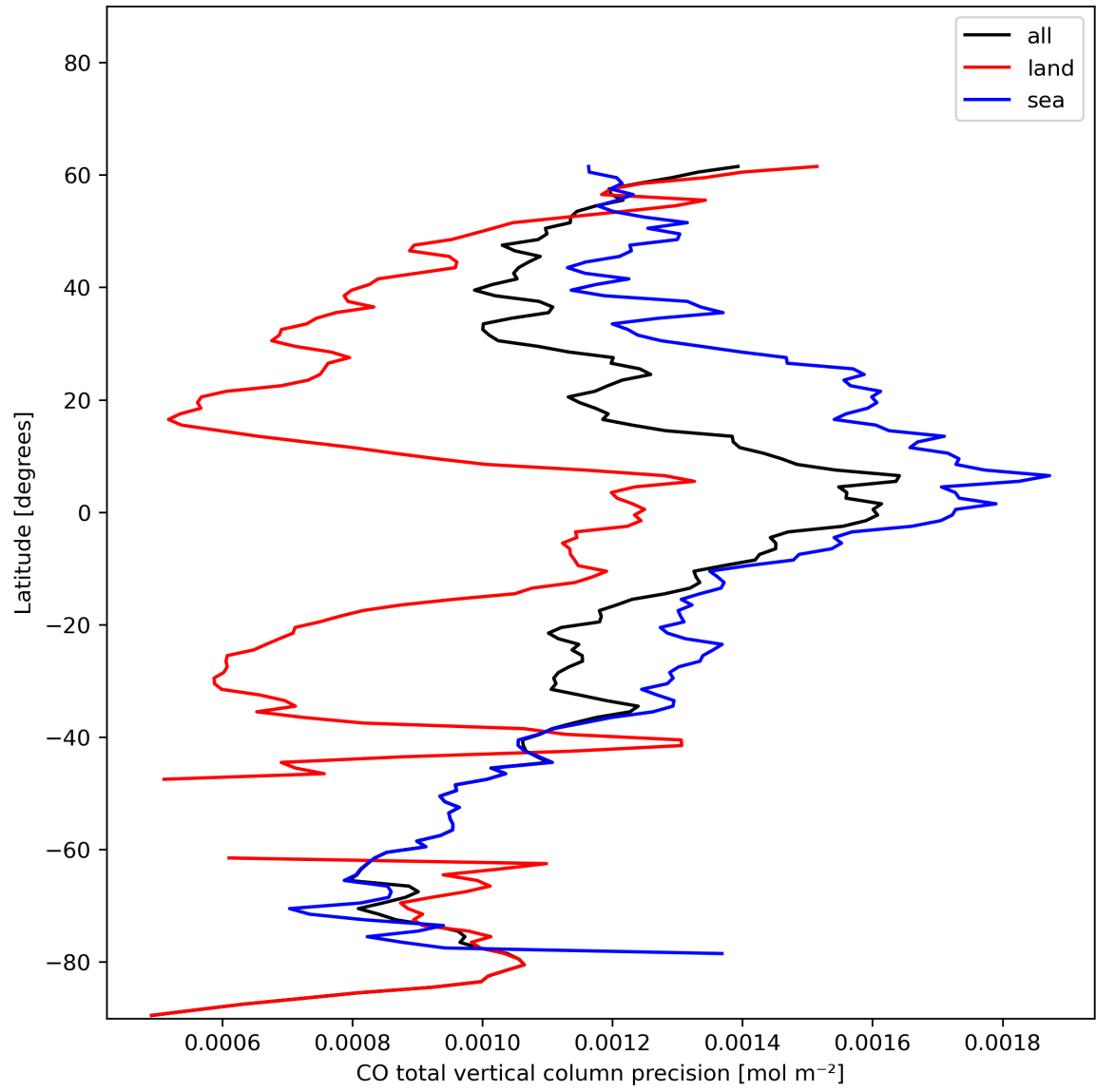


Figure 12: Zonal average of “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

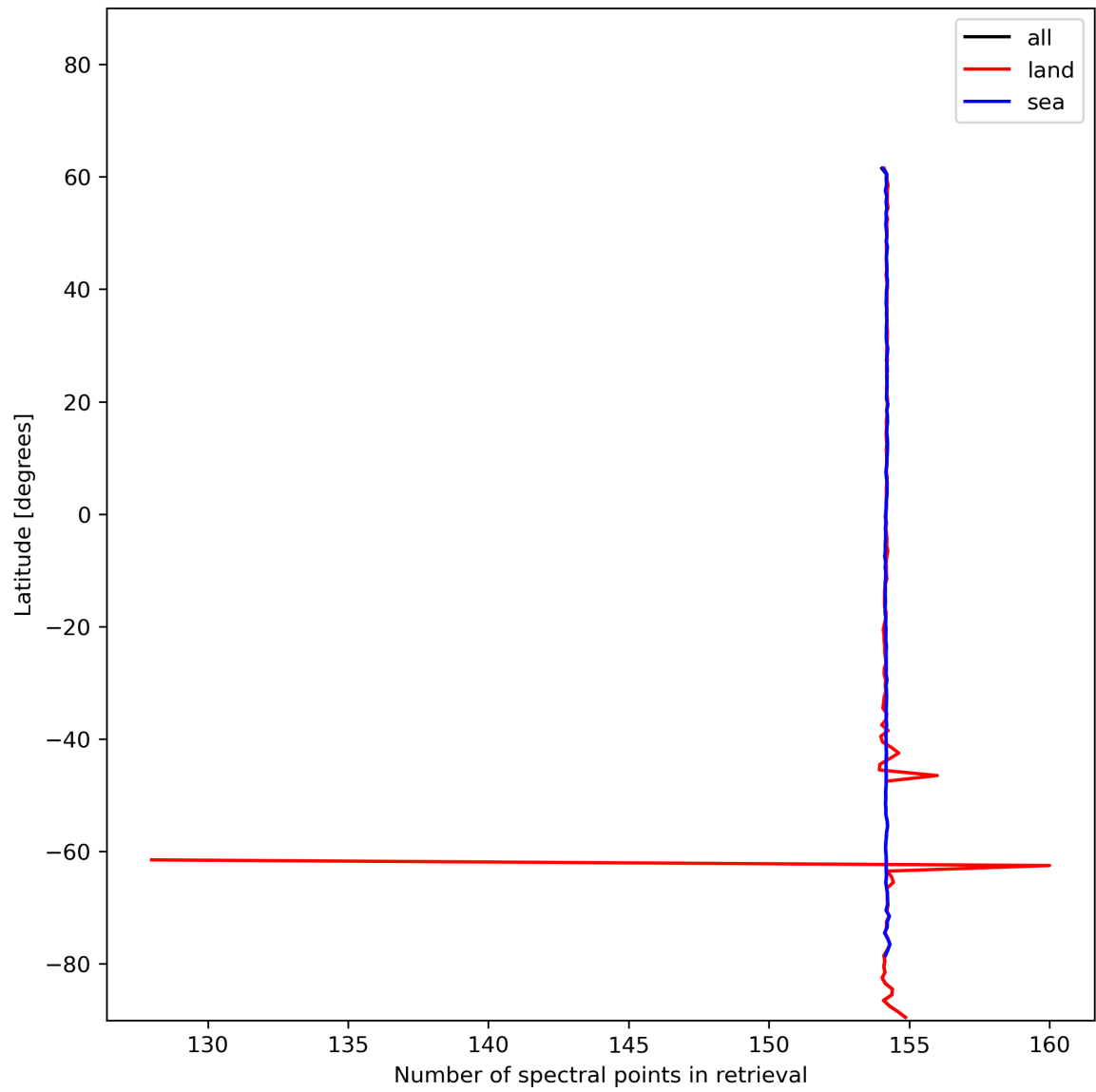


Figure 13: Zonal average of “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

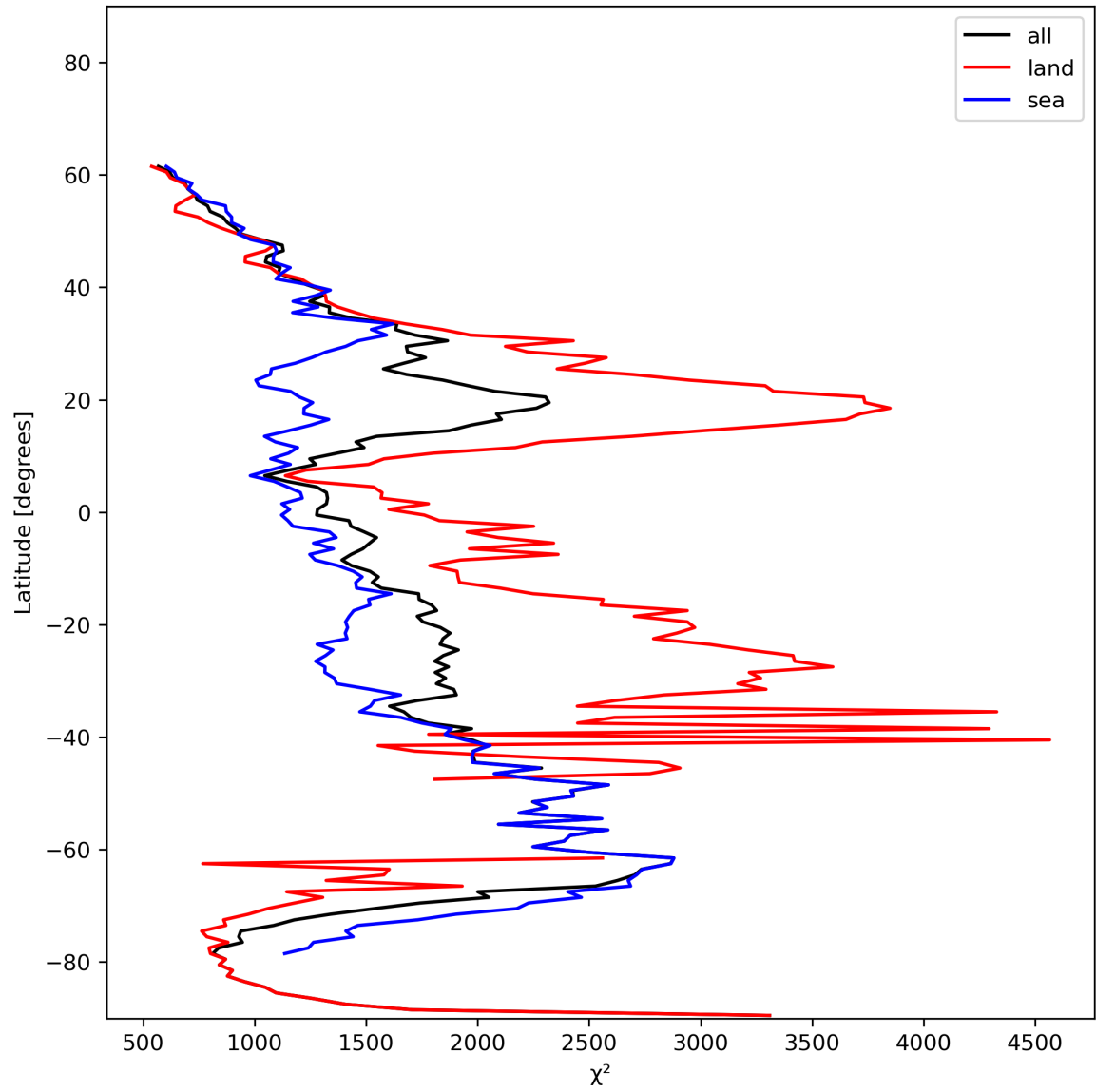


Figure 14: Zonal average of “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

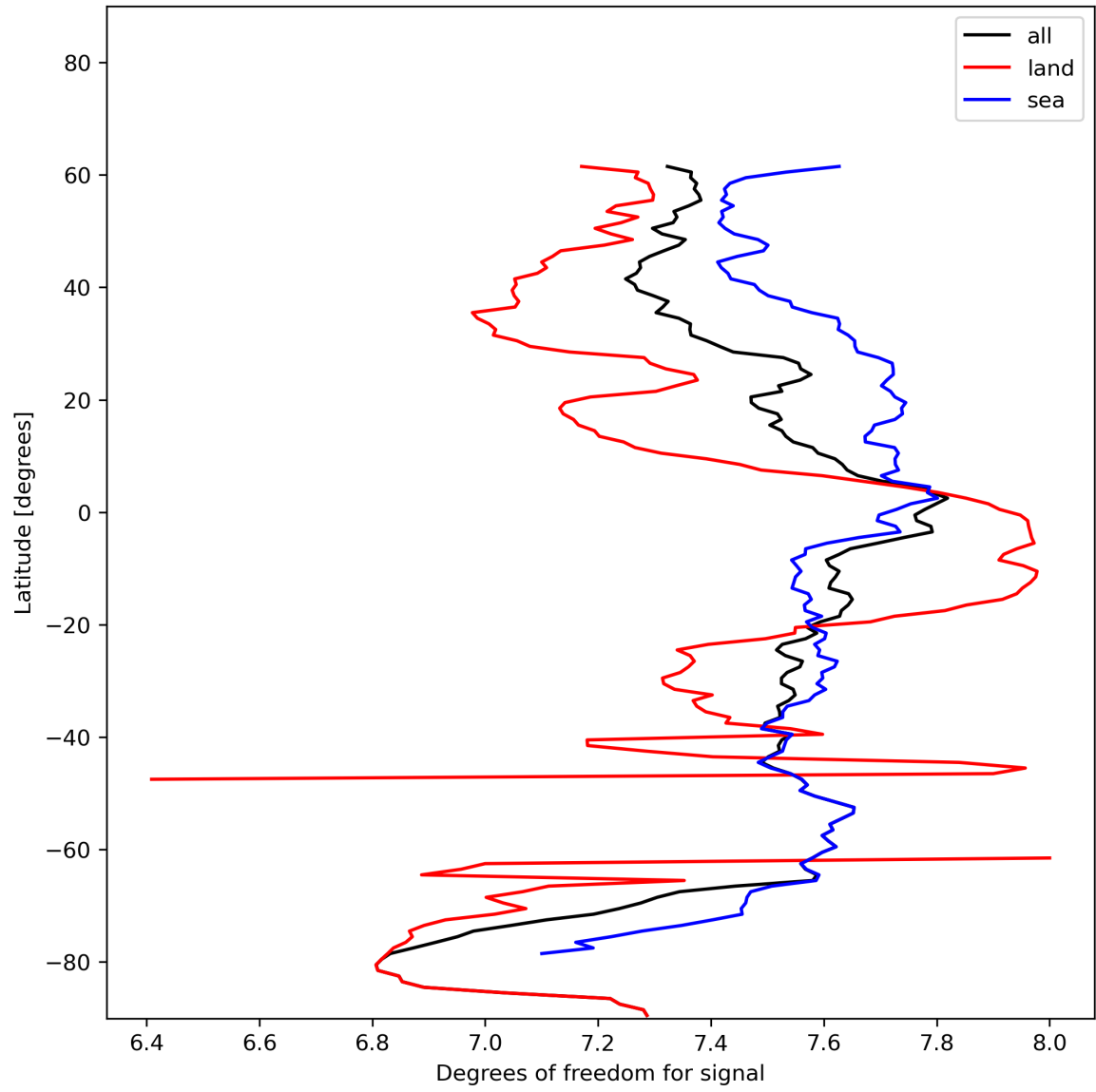


Figure 15: Zonal average of “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

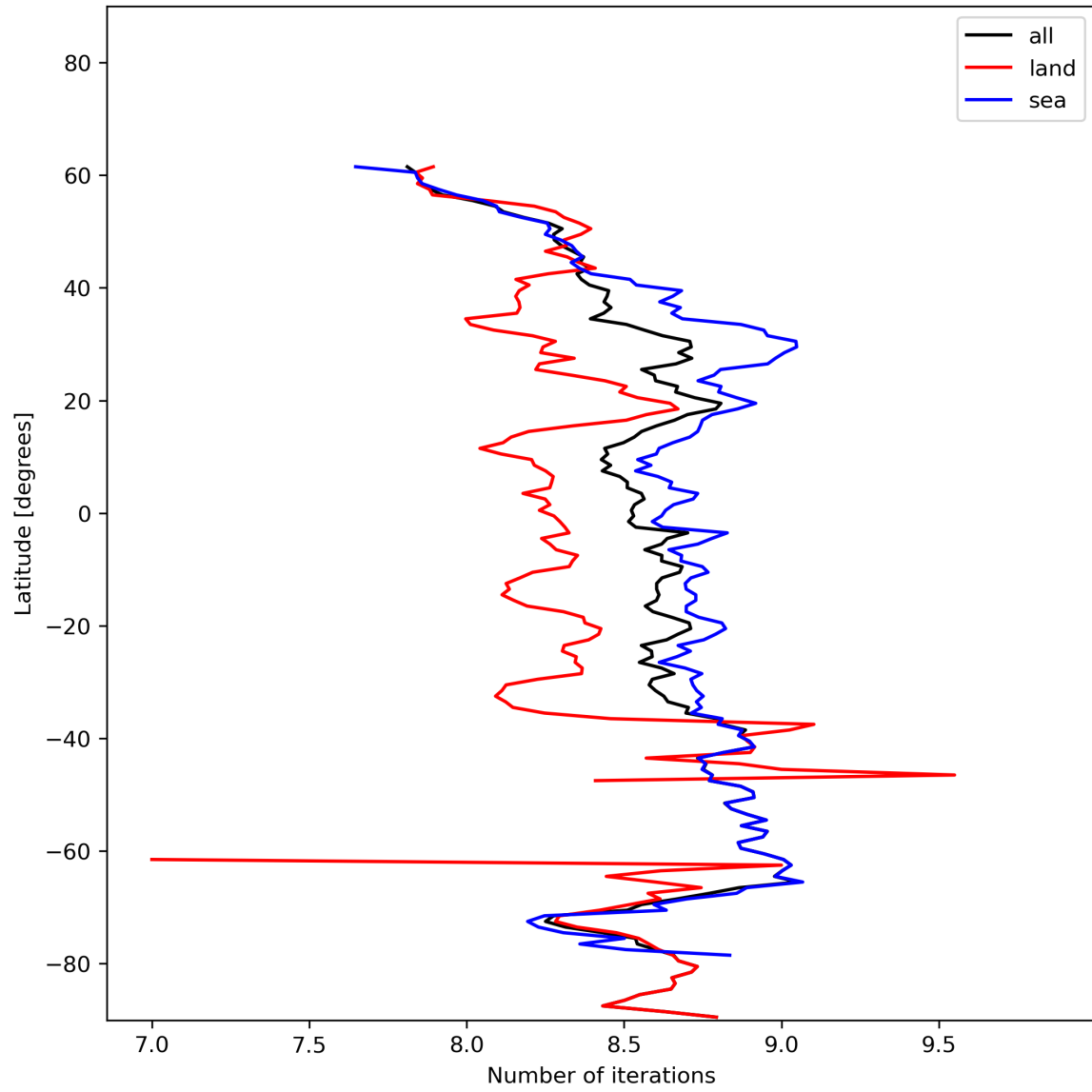


Figure 16: Zonal average of “Number of iterations” for 2023-12-20 to 2023-12-21.

## 8 Histograms

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

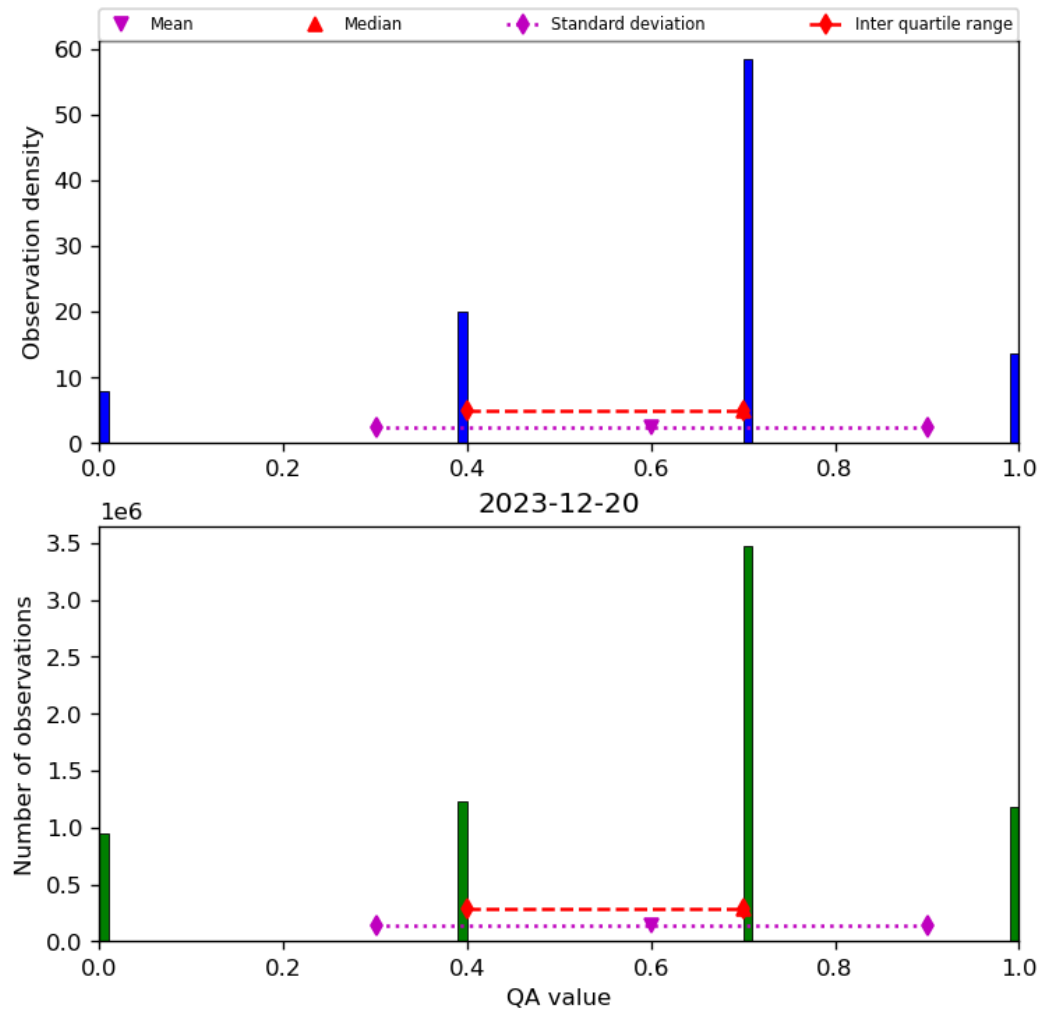


Figure 17: Histogram of “QA value” for 2023-12-20 to 2023-12-21

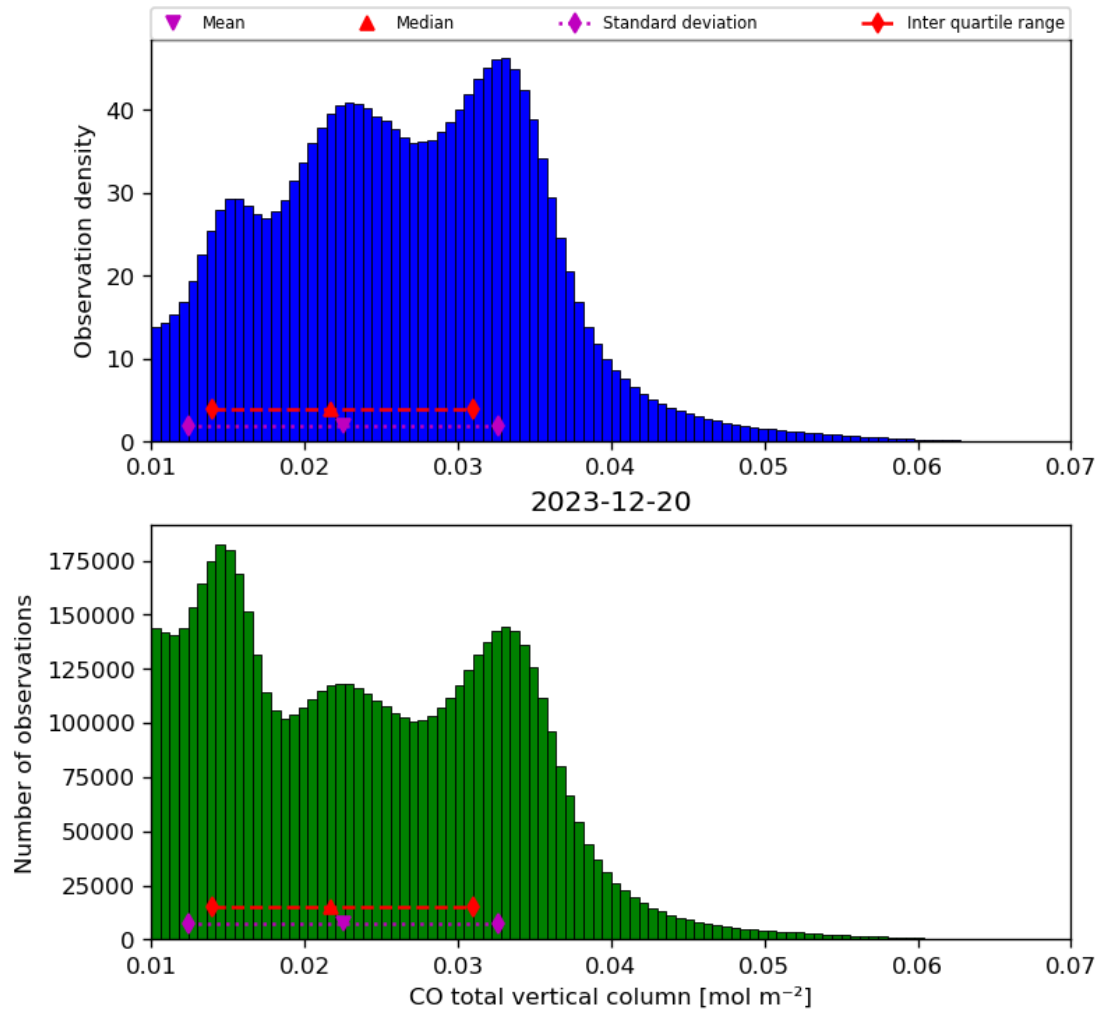


Figure 18: Histogram of “CO total vertical column” for 2023-12-20 to 2023-12-21

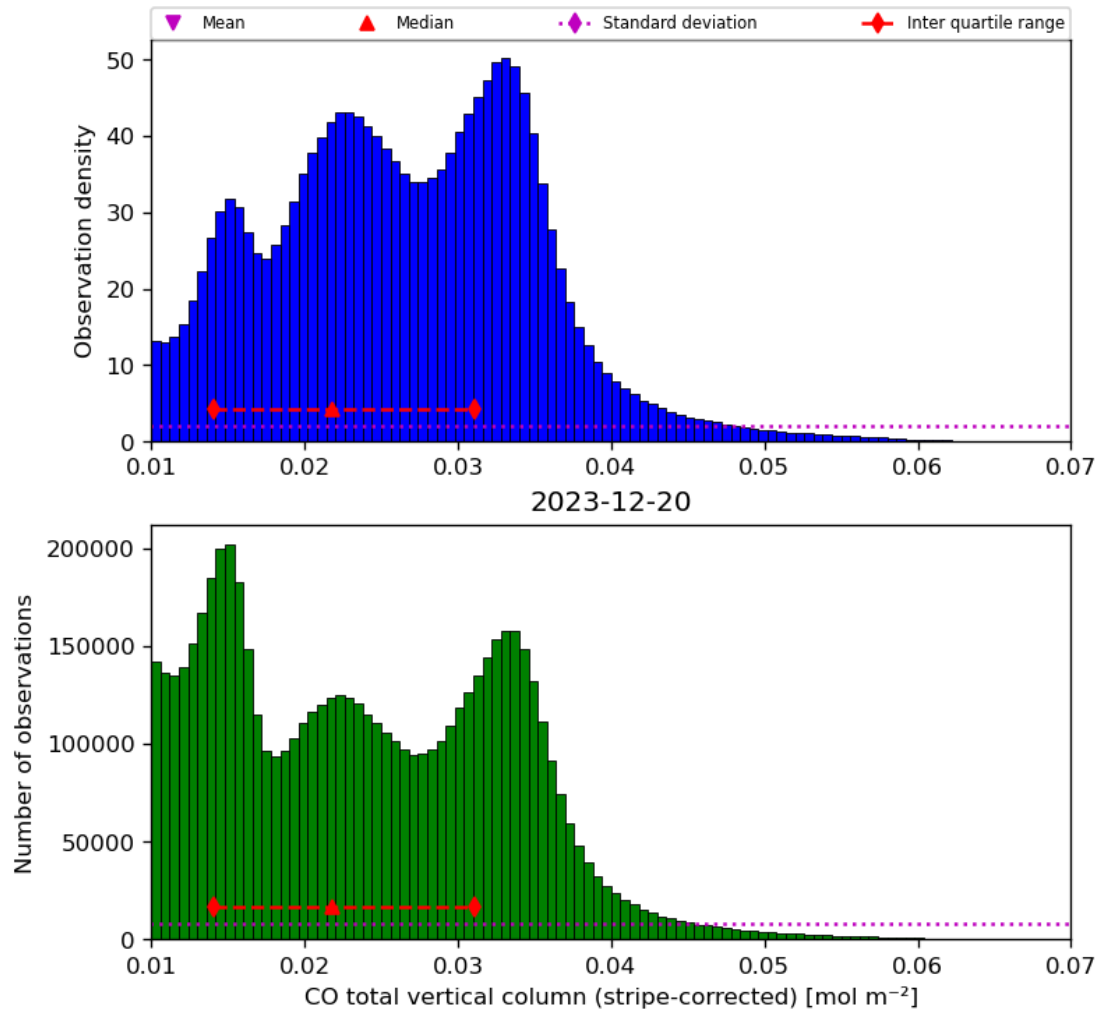


Figure 19: Histogram of “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21



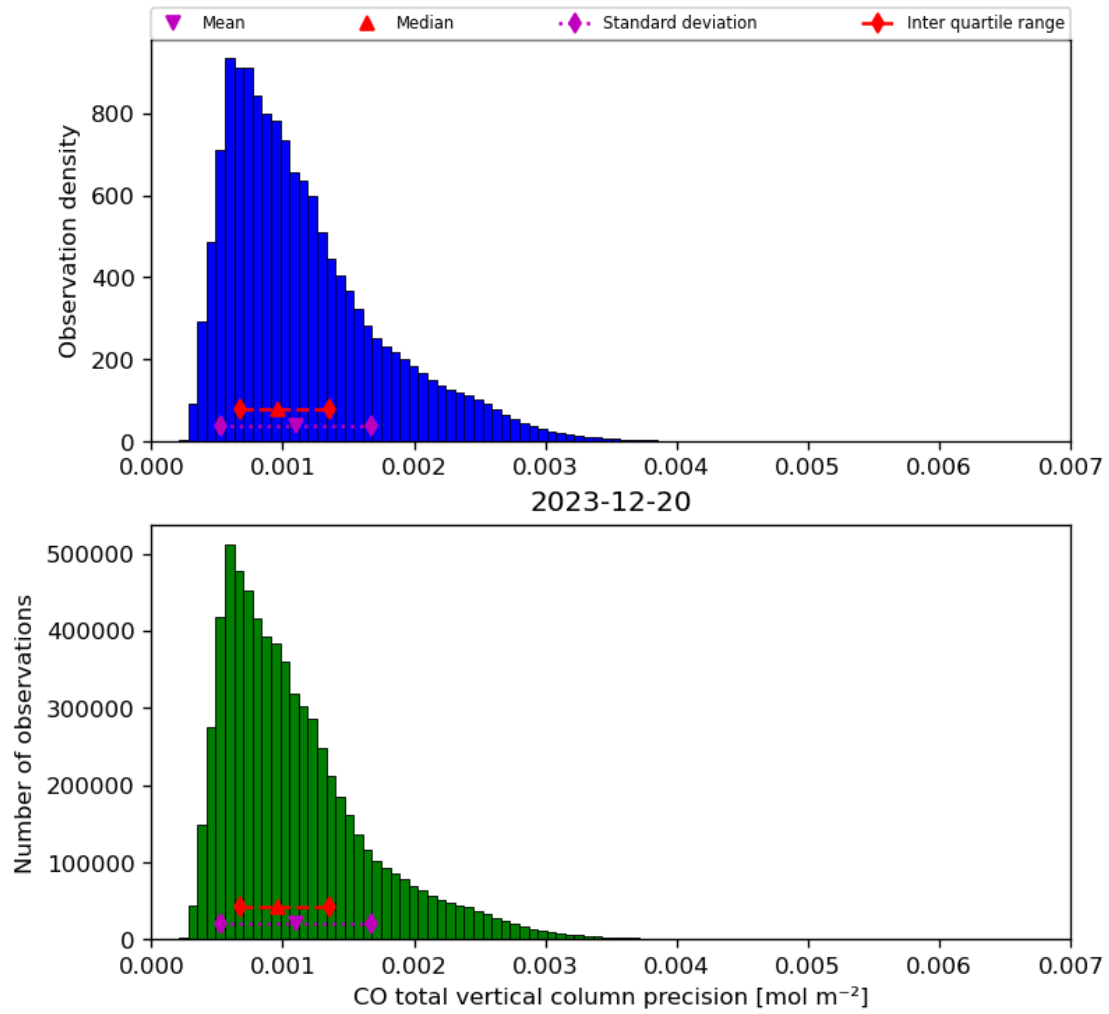


Figure 20: Histogram of “CO total vertical column precision” for 2023-12-20 to 2023-12-21

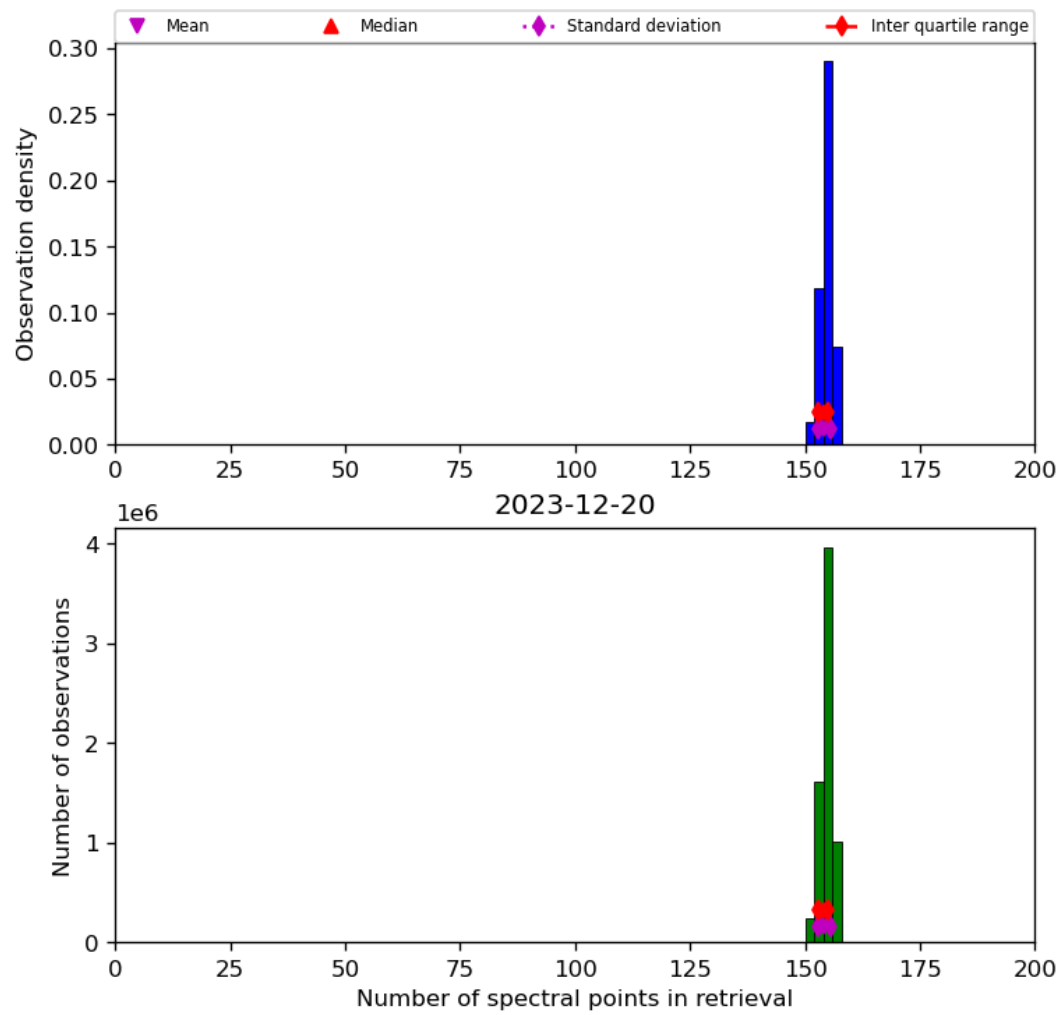


Figure 21: Histogram of “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21

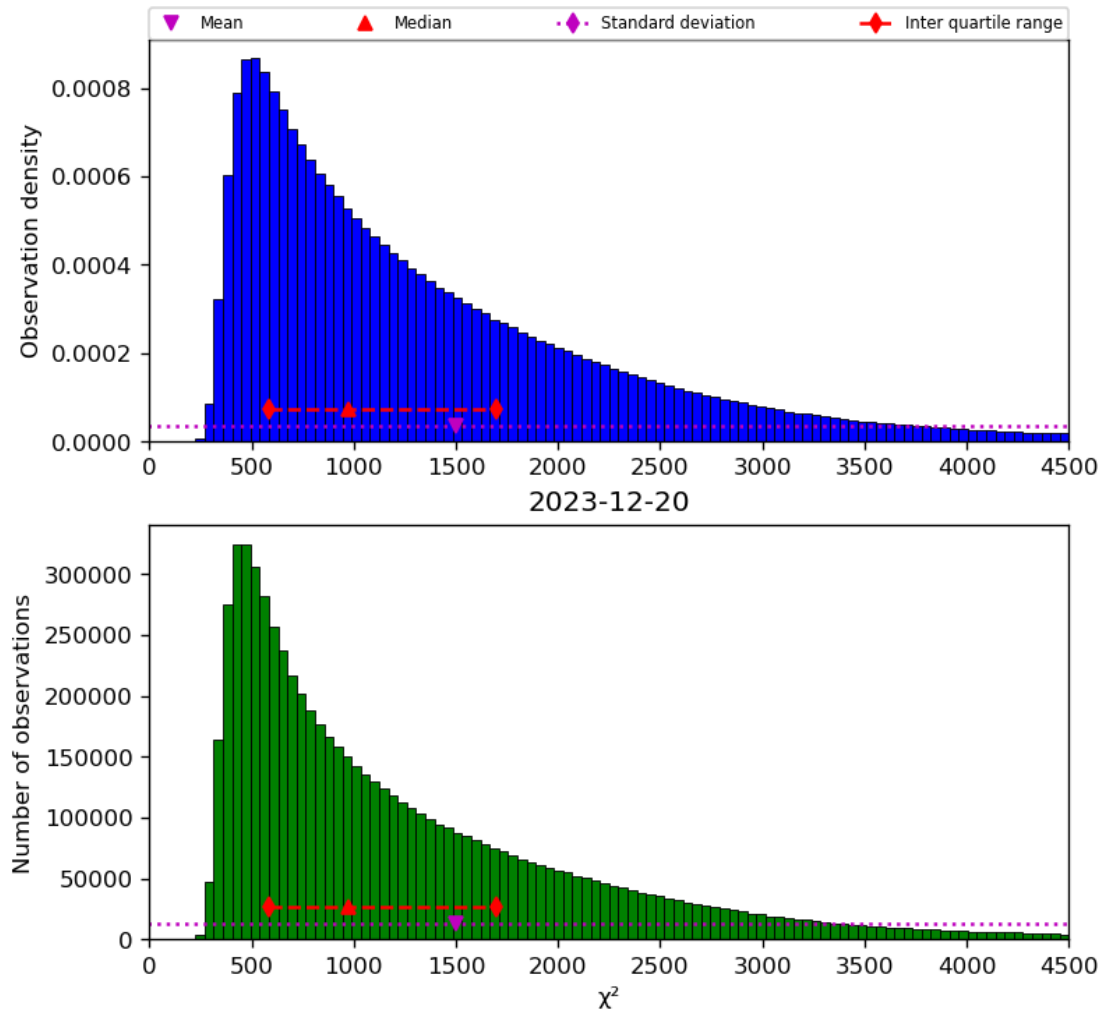


Figure 22: Histogram of “ $\chi^2$ ” for 2023-12-20 to 2023-12-21

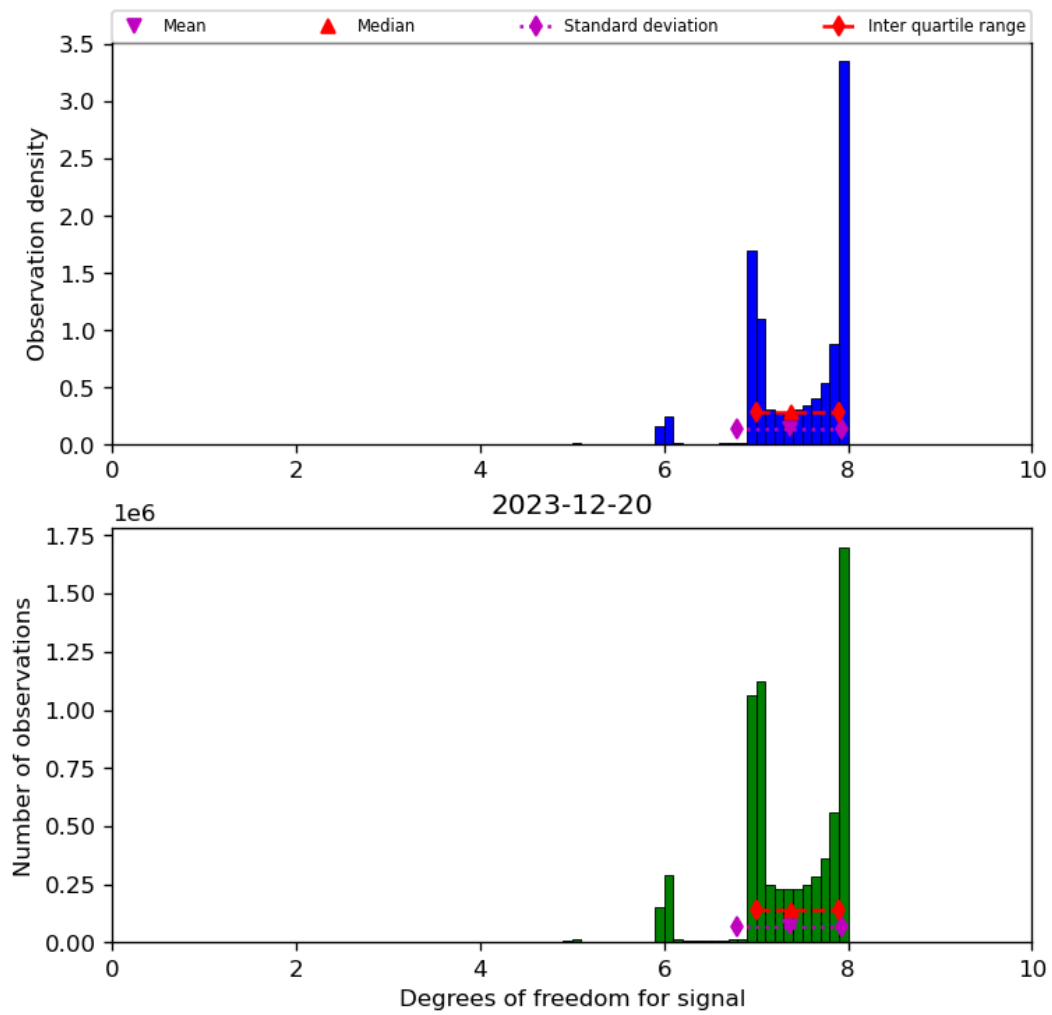


Figure 23: Histogram of “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21

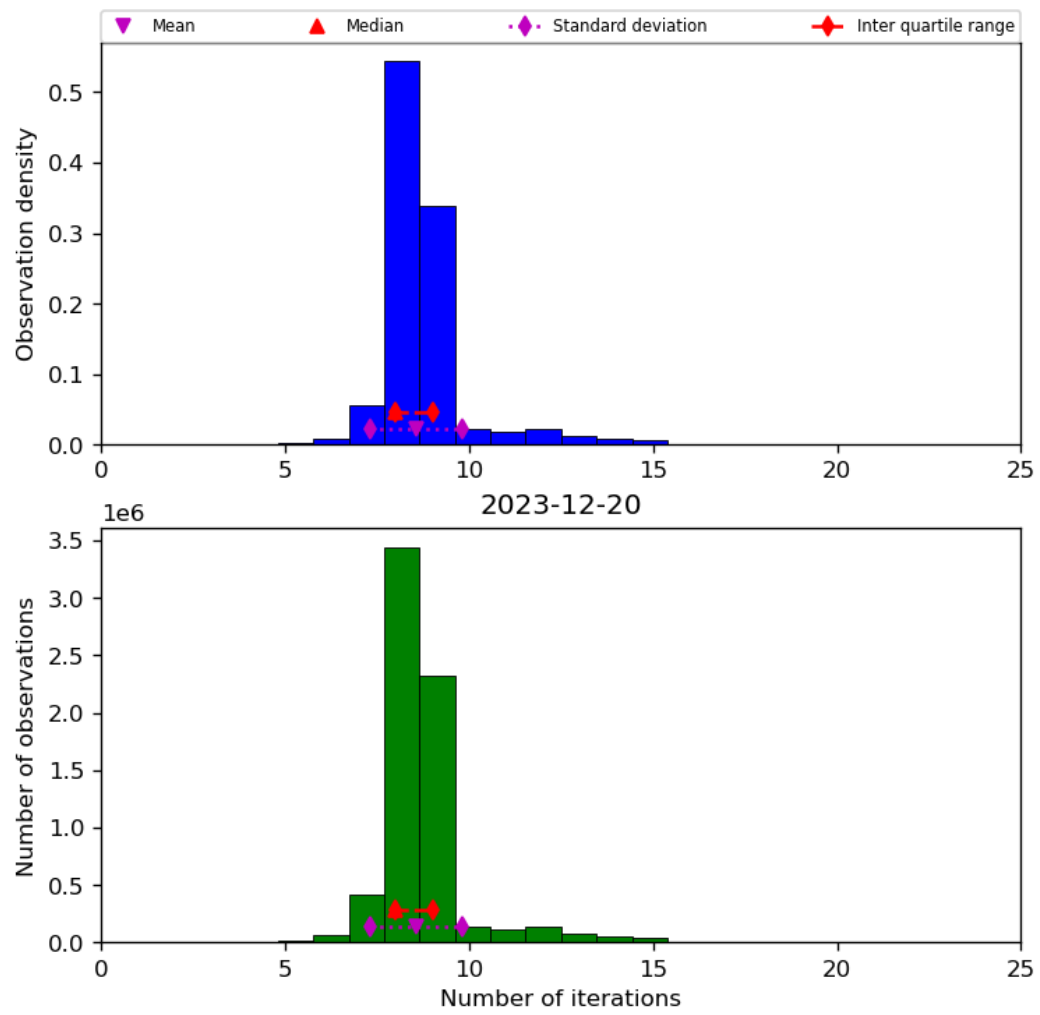


Figure 24: Histogram of “Number of iterations” for 2023-12-20 to 2023-12-21

## 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.

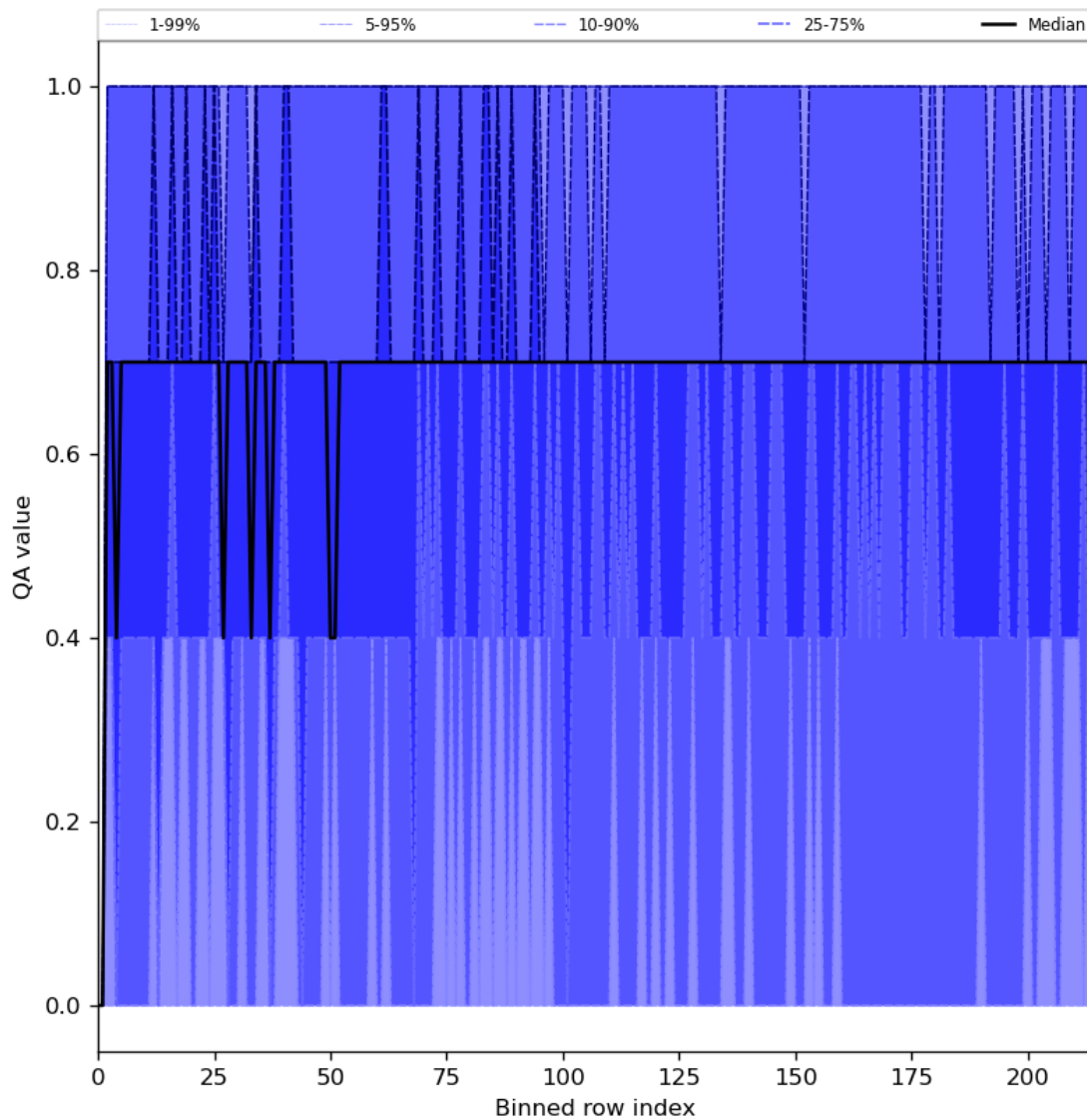


Figure 25: Along track statistics of “QA value” for 2023-12-20 to 2023-12-21

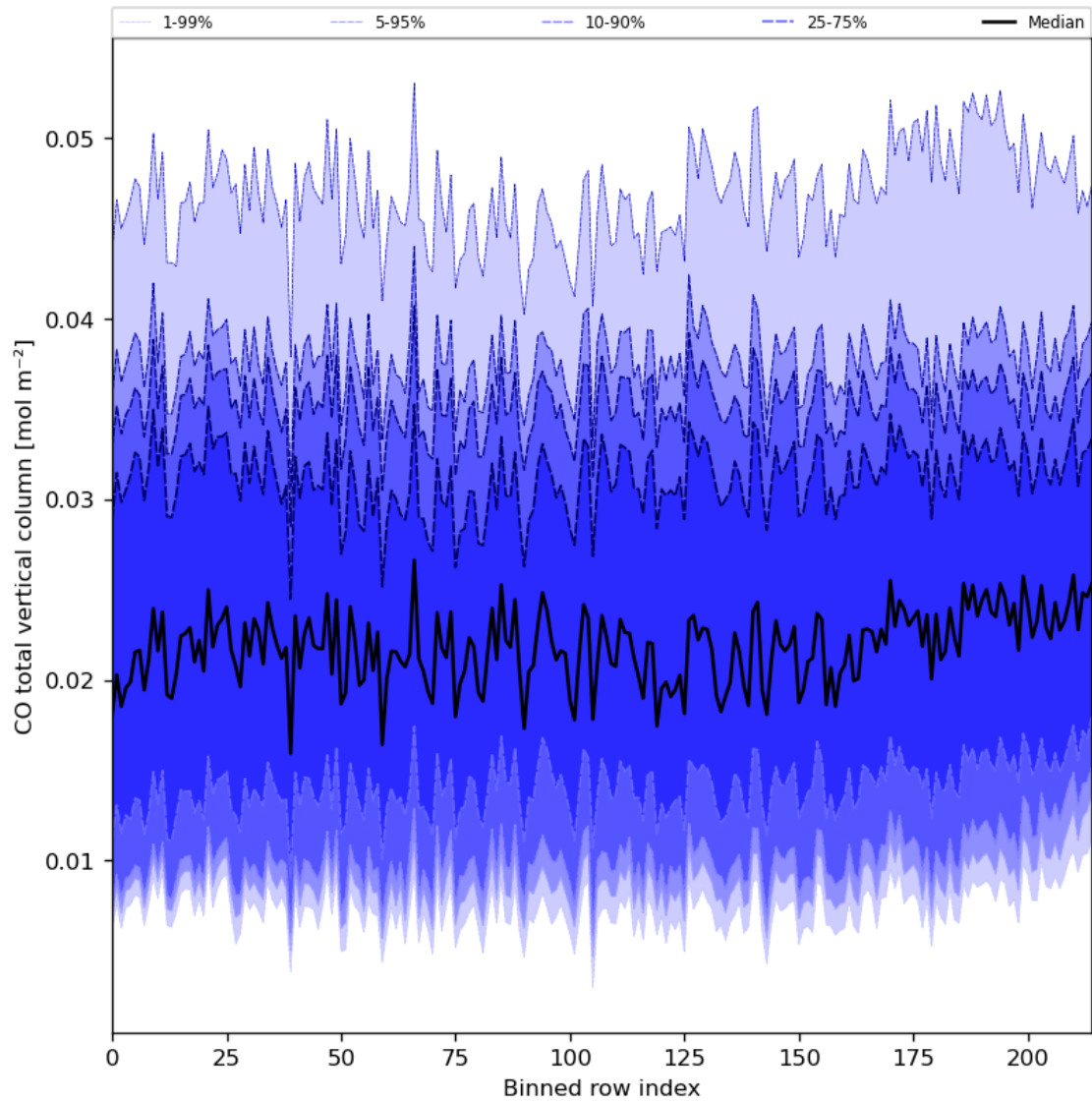


Figure 26: Along track statistics of “CO total vertical column” for 2023-12-20 to 2023-12-21

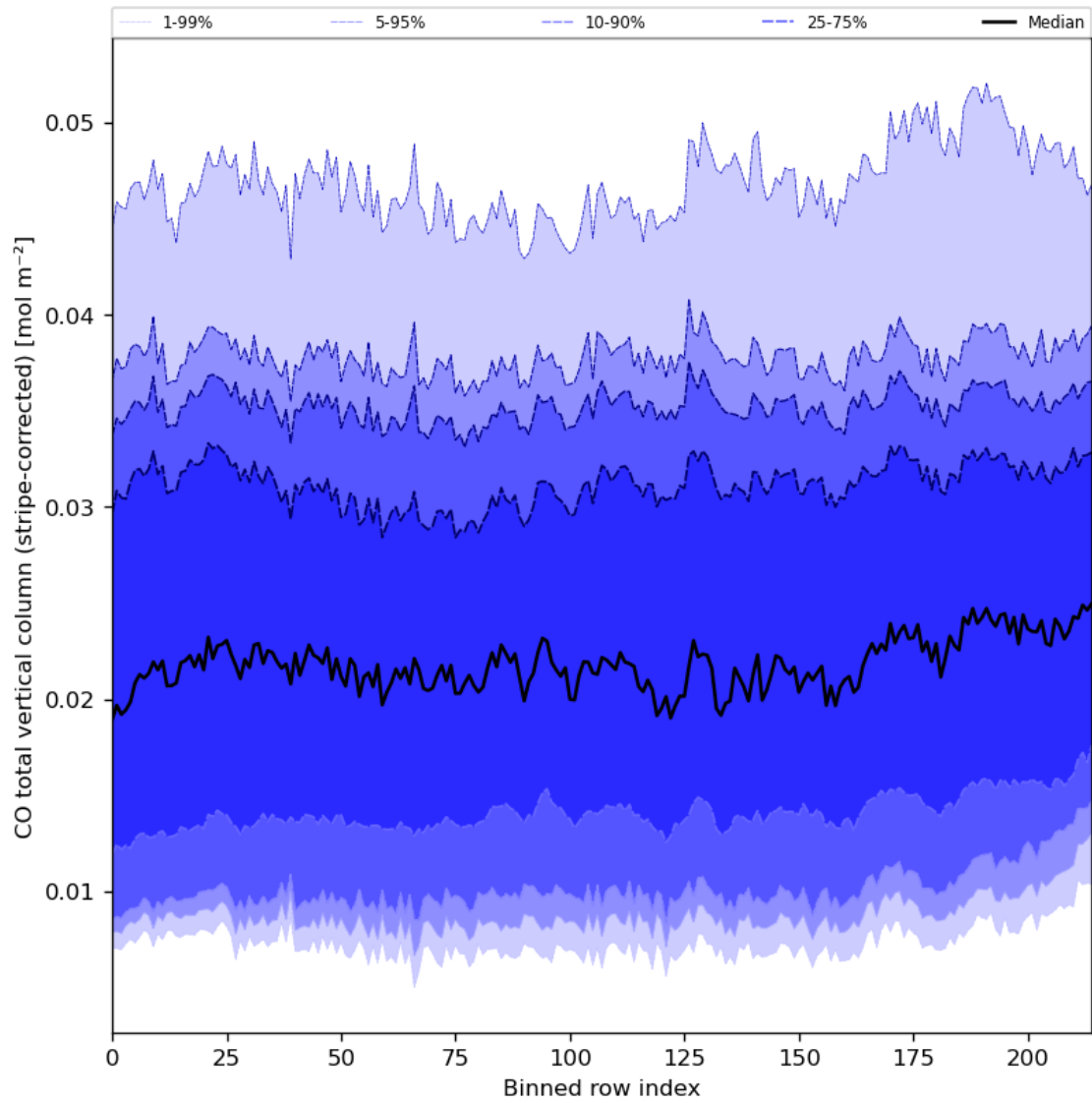


Figure 27: Along track statistics of “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21



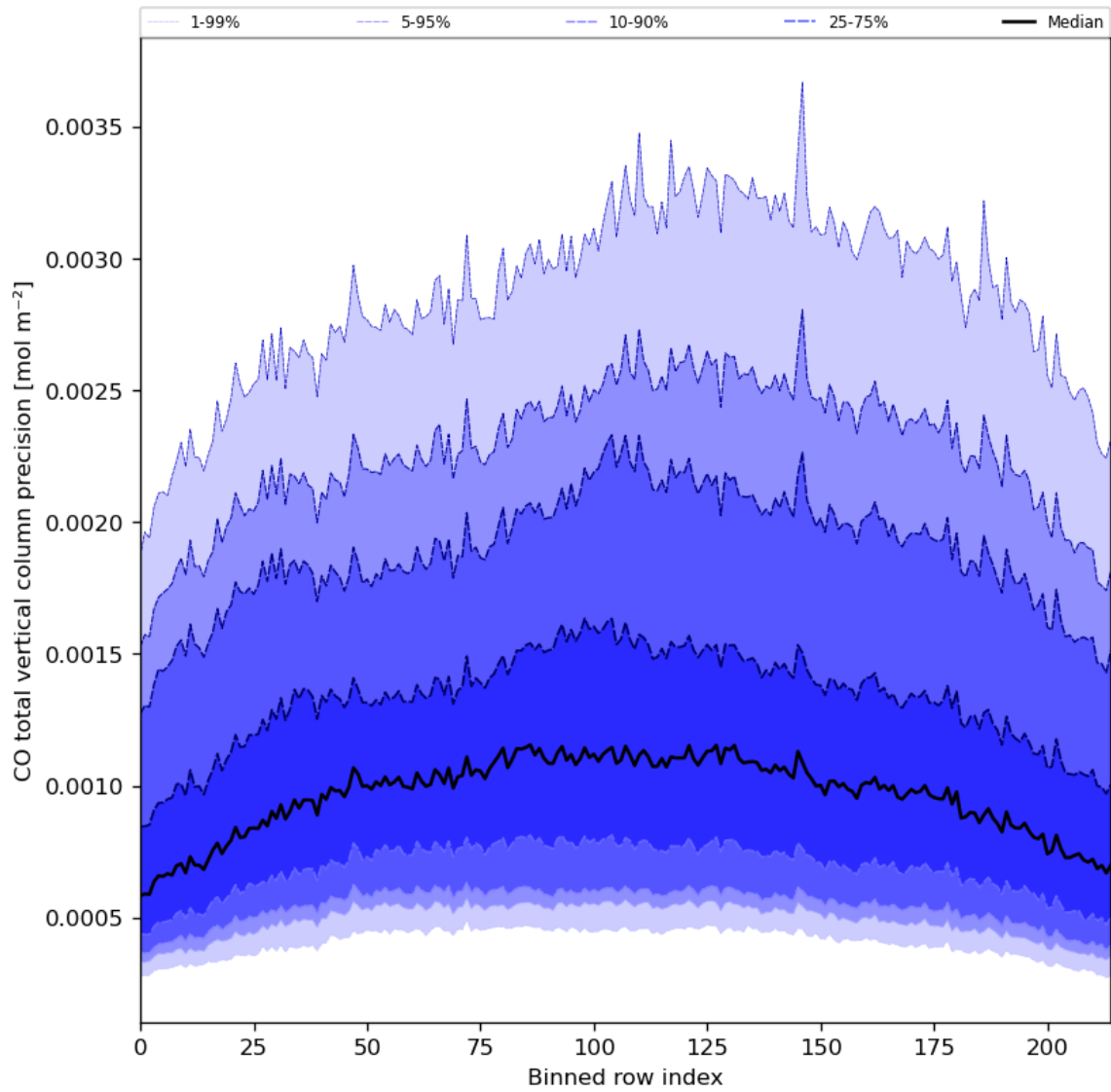


Figure 28: Along track statistics of “CO total vertical column precision” for 2023-12-20 to 2023-12-21

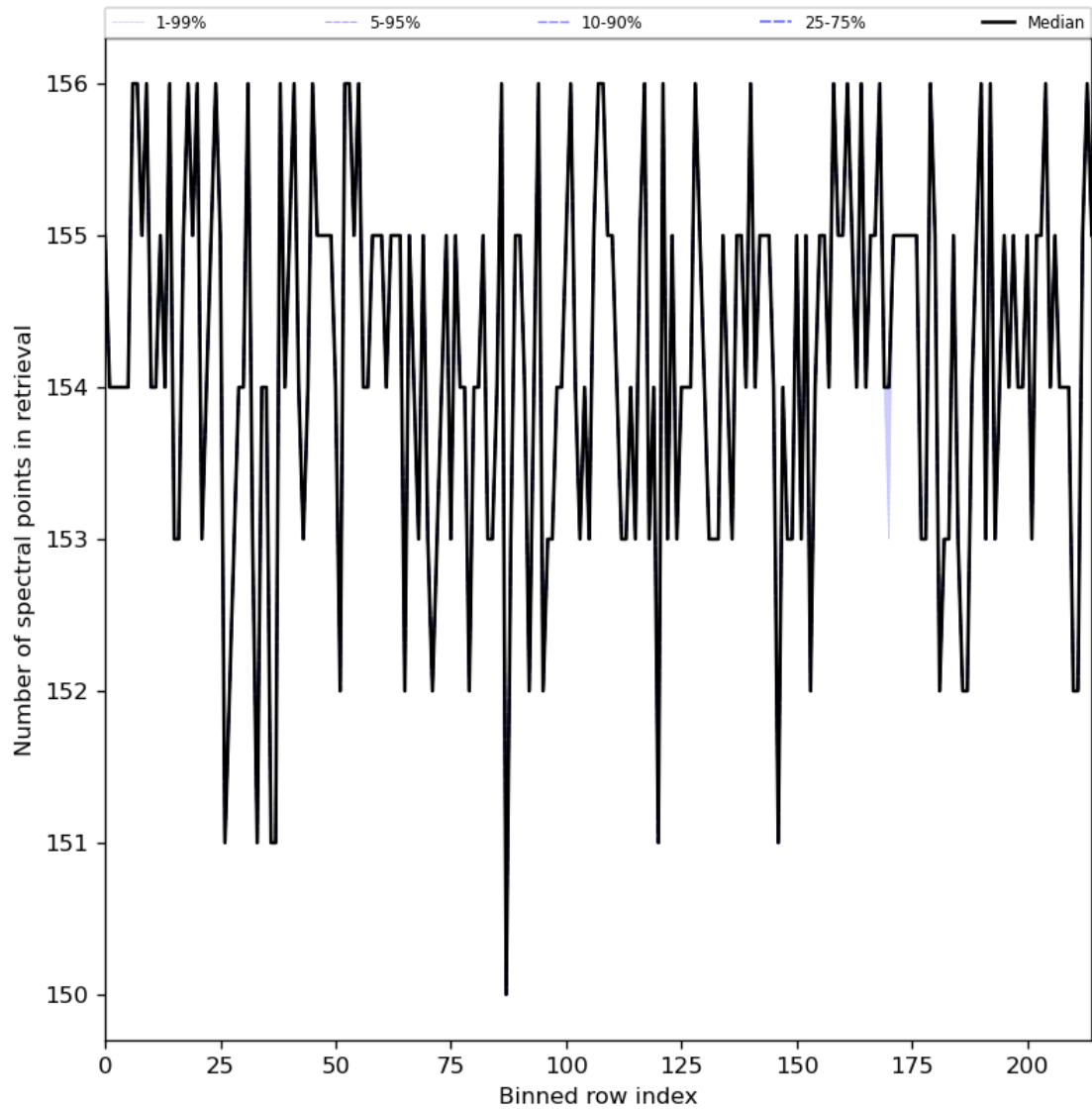


Figure 29: Along track statistics of “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21

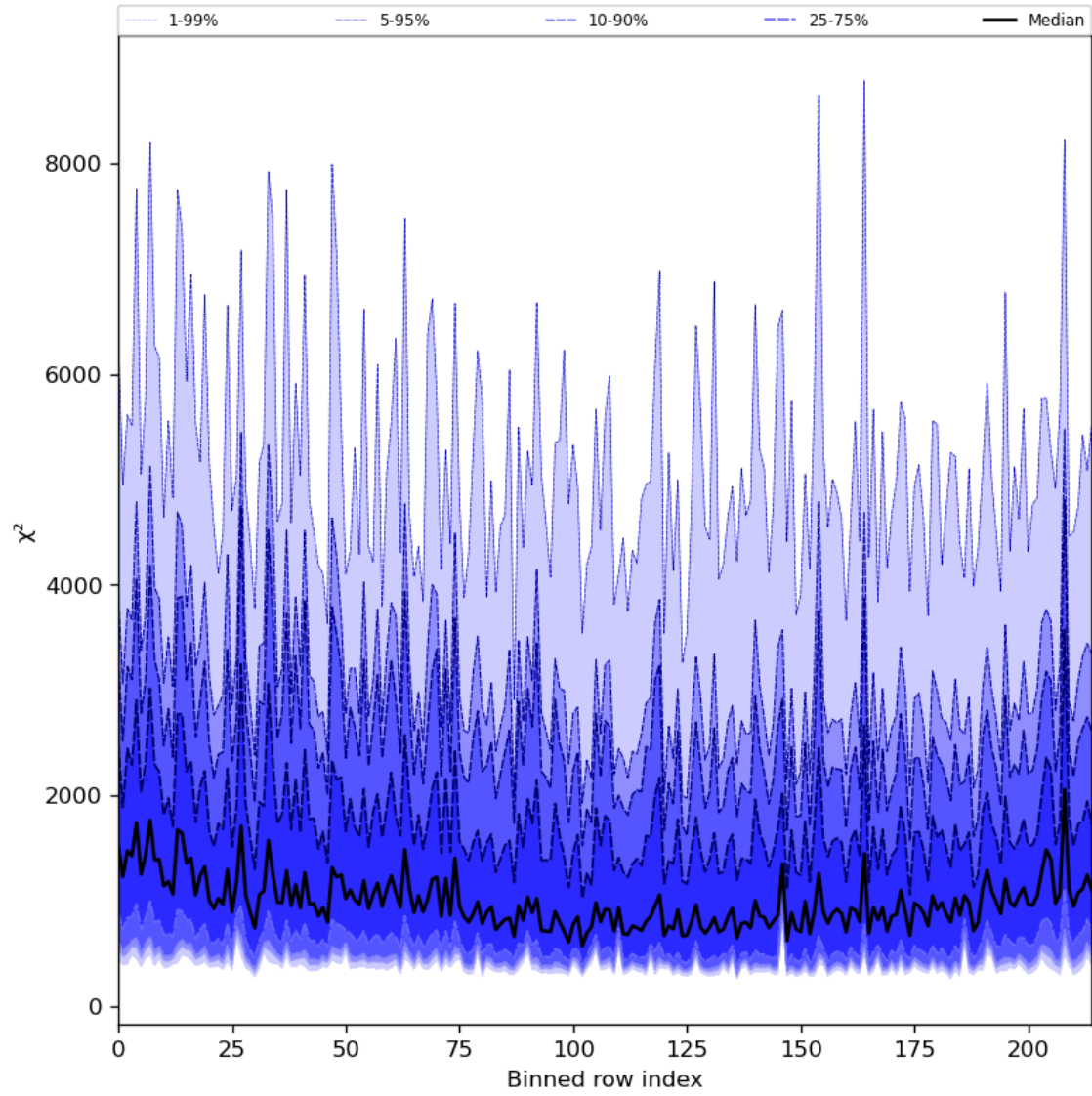


Figure 30: Along track statistics of “ $\chi^2$ ” for 2023-12-20 to 2023-12-21

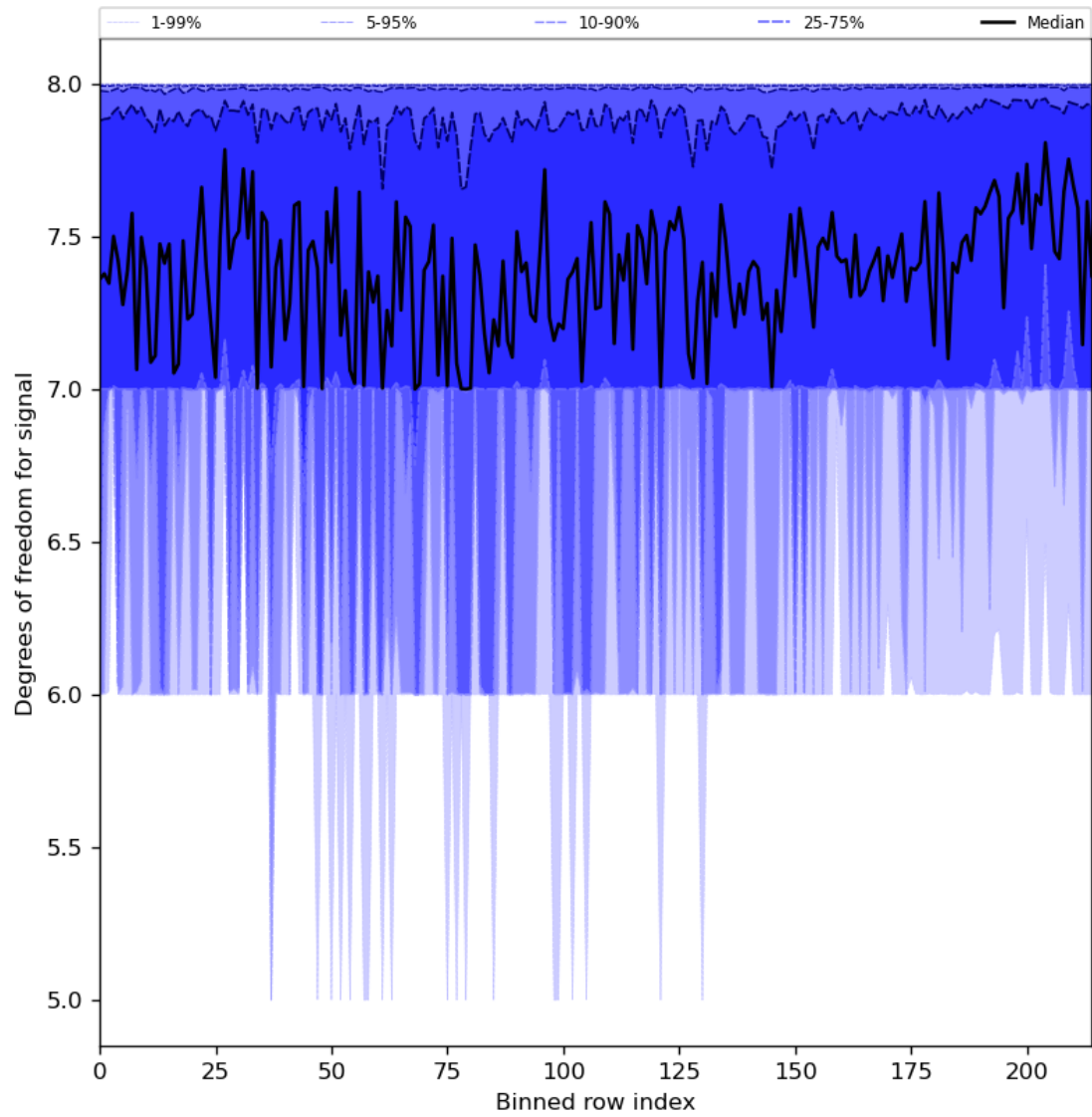


Figure 31: Along track statistics of “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21

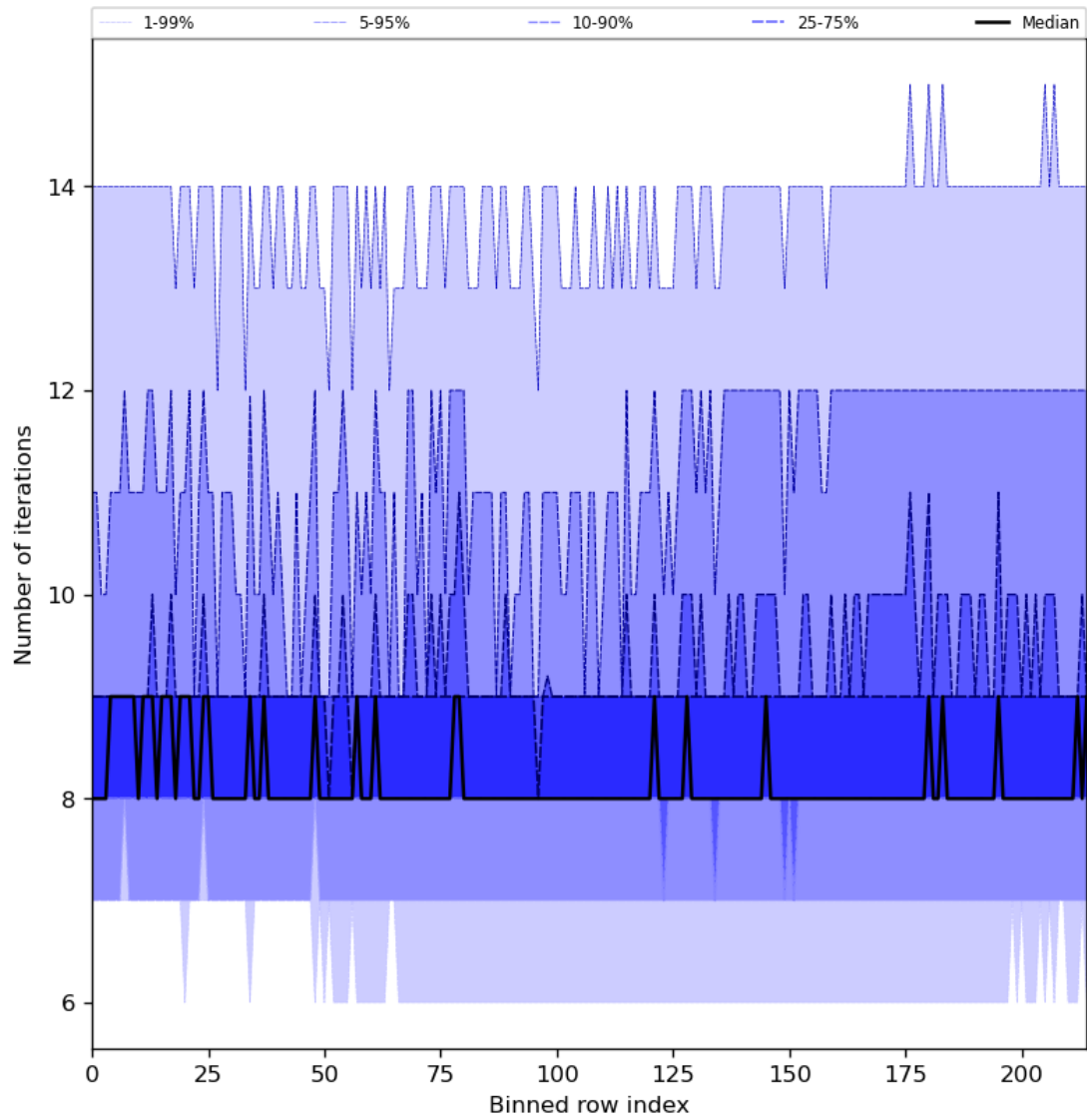


Figure 32: Along track statistics of “Number of iterations” for 2023-12-20 to 2023-12-21

## 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.

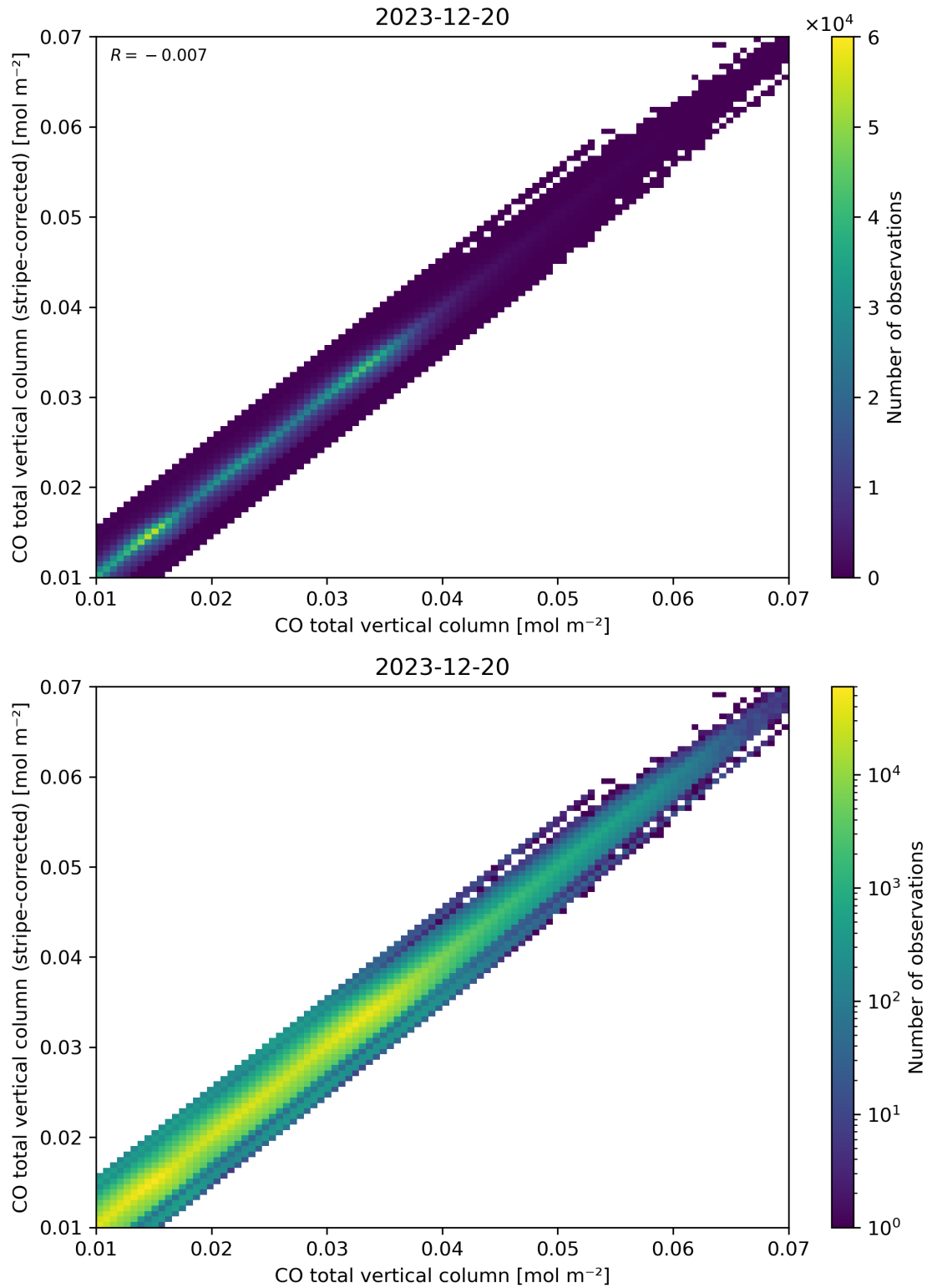


Figure 33: Scatter density plot of “CO total vertical column” against “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21.

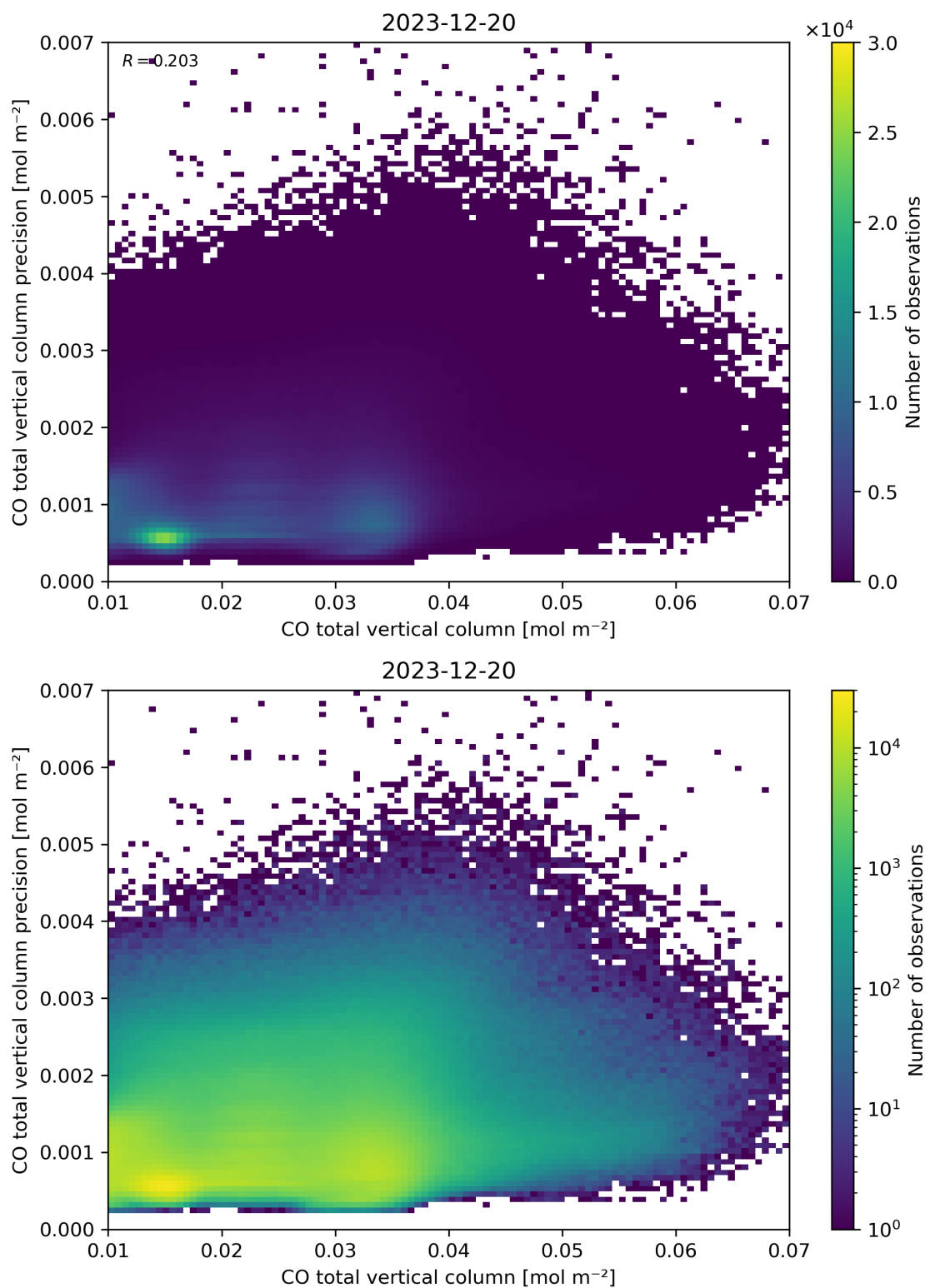


Figure 34: Scatter density plot of “CO total vertical column” against “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

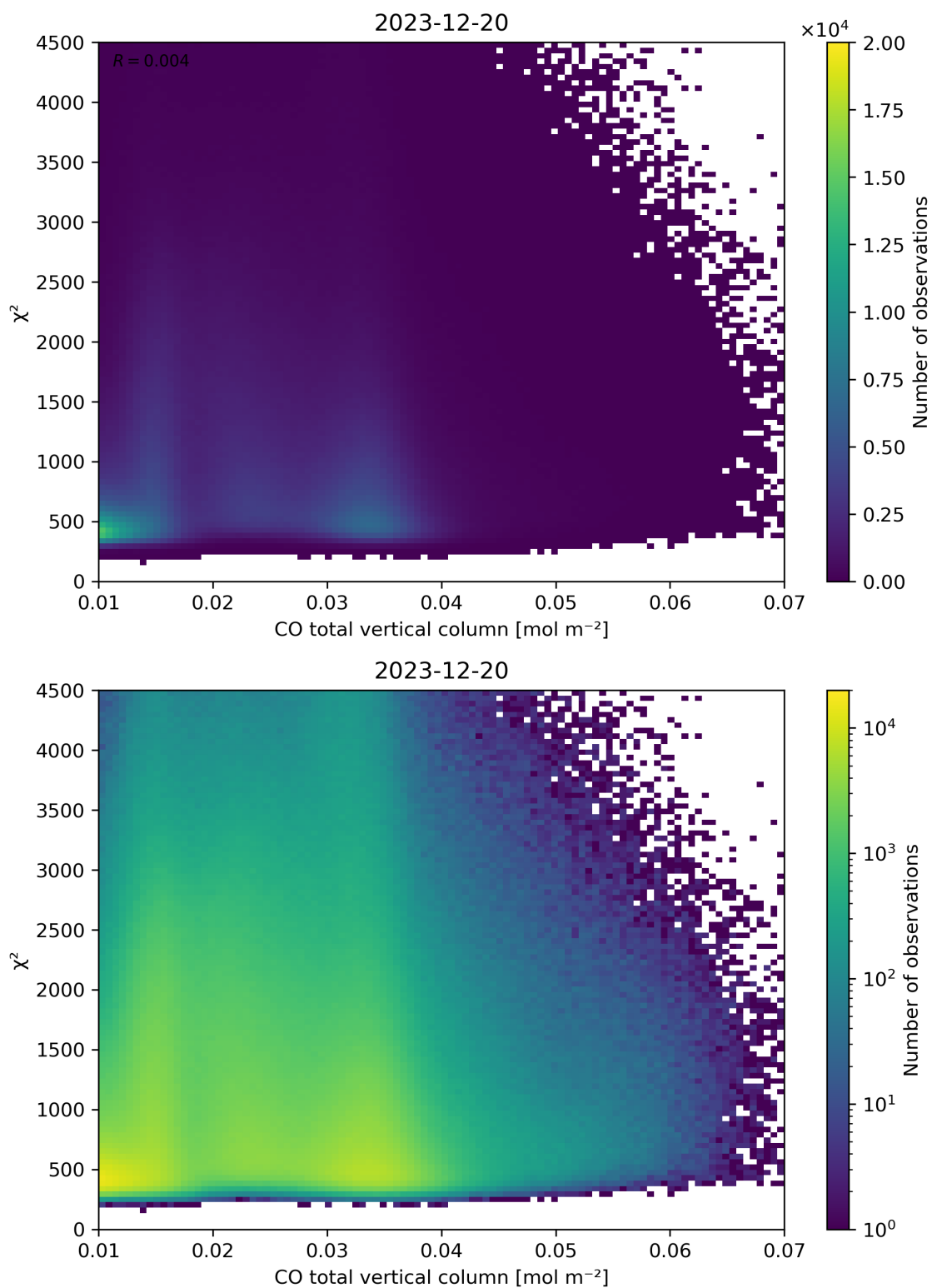


Figure 35: Scatter density plot of “CO total vertical column” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.



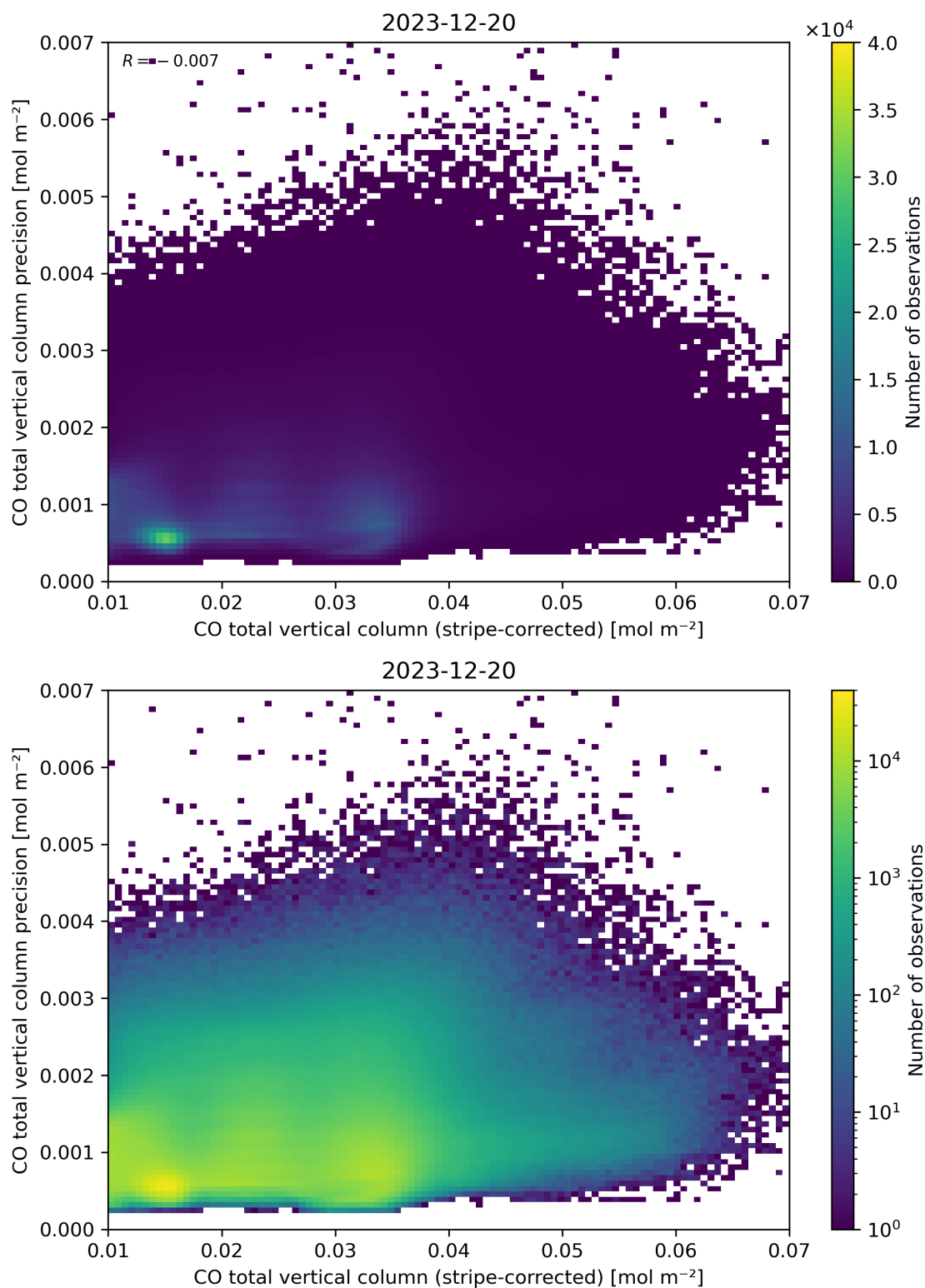


Figure 36: Scatter density plot of “CO total vertical column (stripe-corrected)” against “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

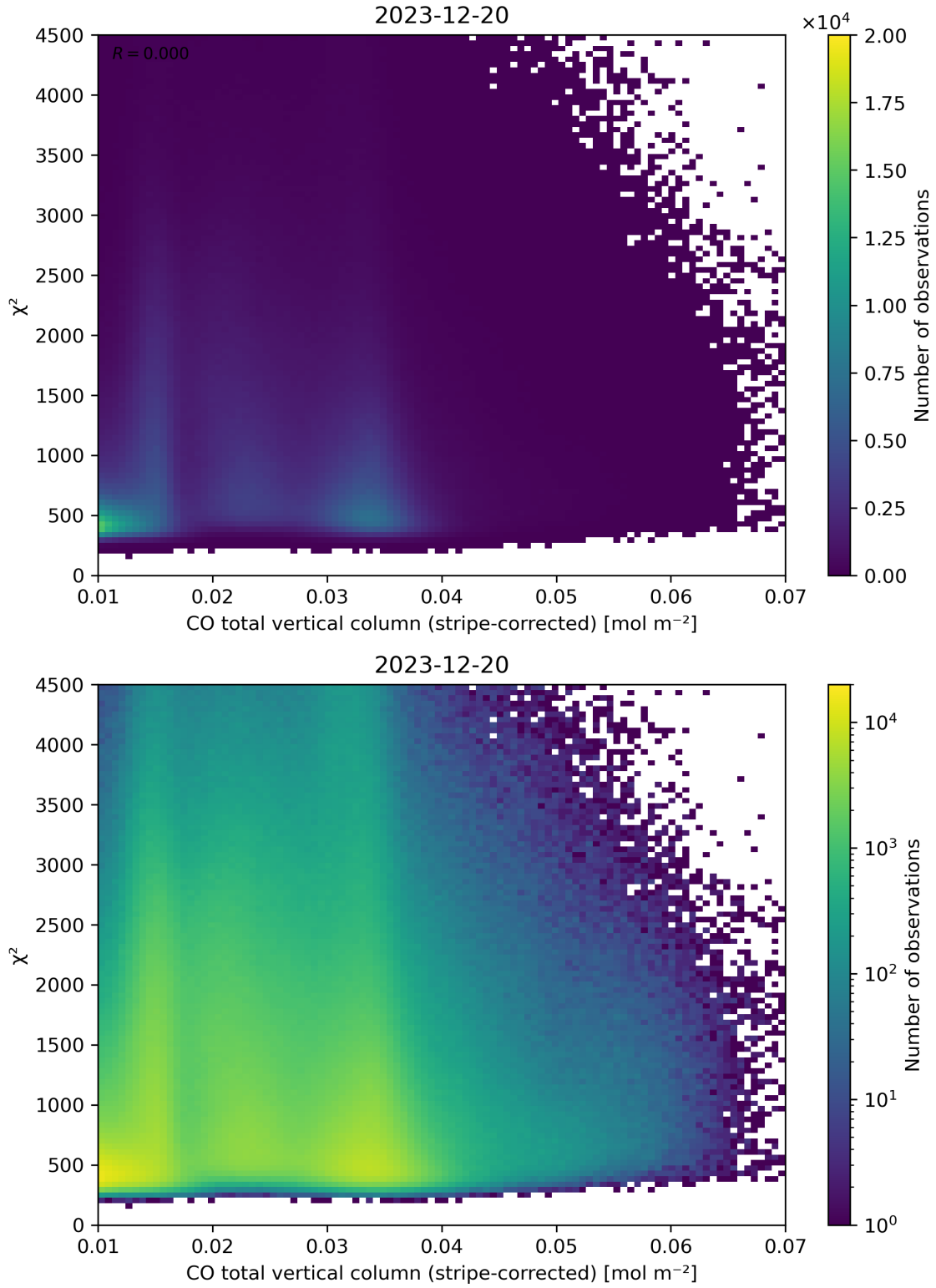


Figure 37: Scatter density plot of “CO total vertical column (stripe-corrected)” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

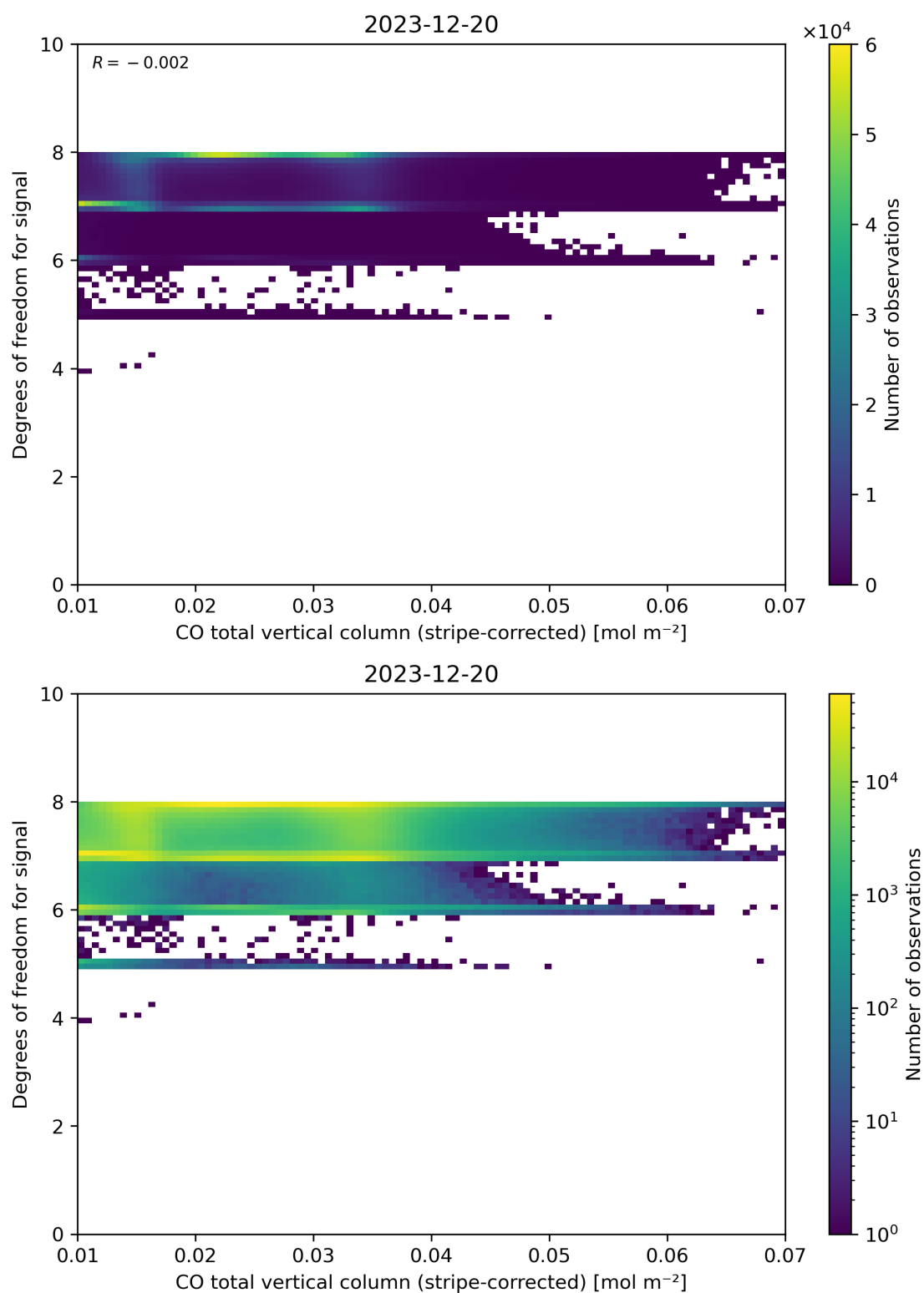


Figure 38: Scatter density plot of “CO total vertical column (stripe-corrected)” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

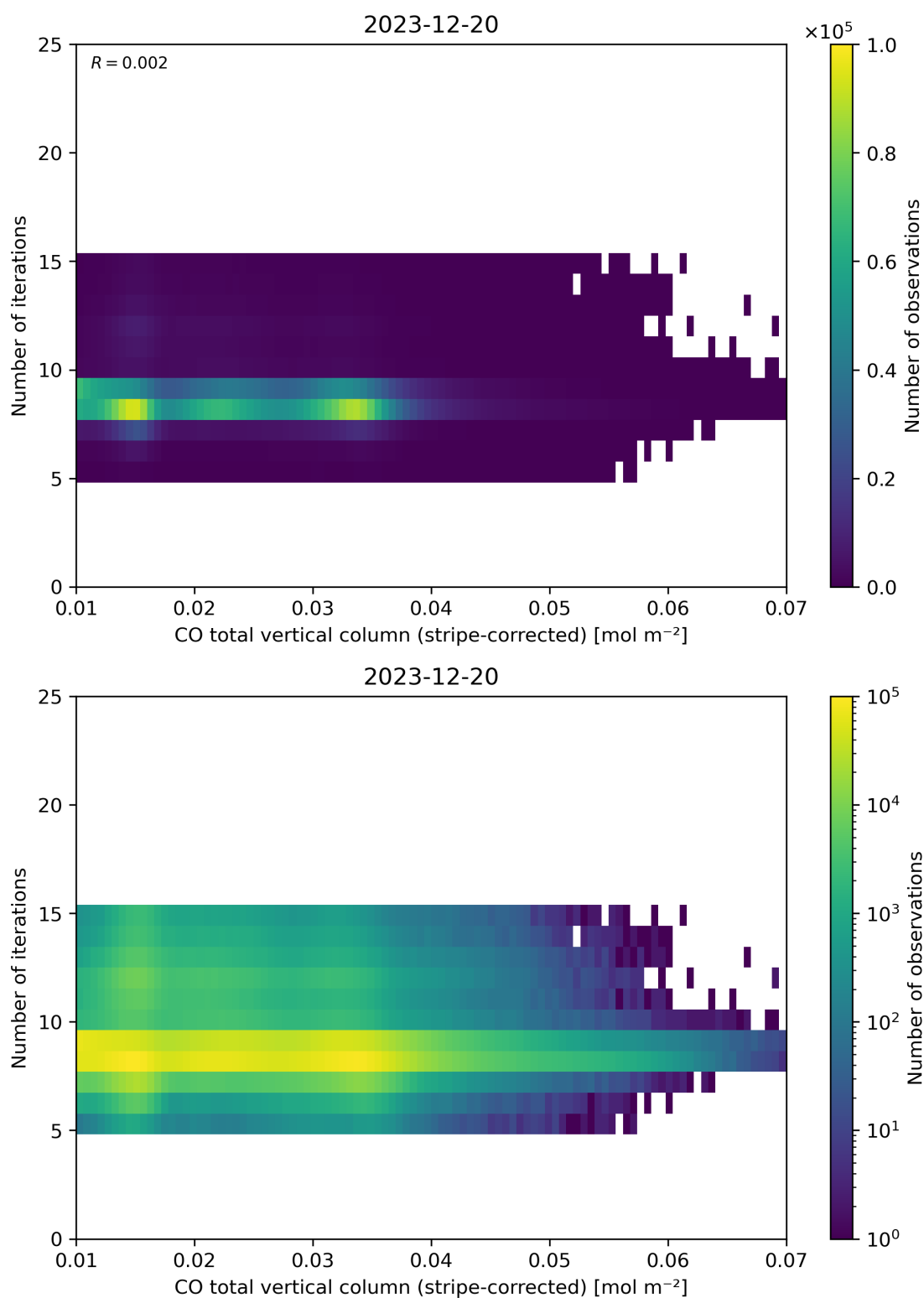


Figure 39: Scatter density plot of “CO total vertical column (stripe-corrected)” against “Number of iterations” for 2023-12-20 to 2023-12-21.

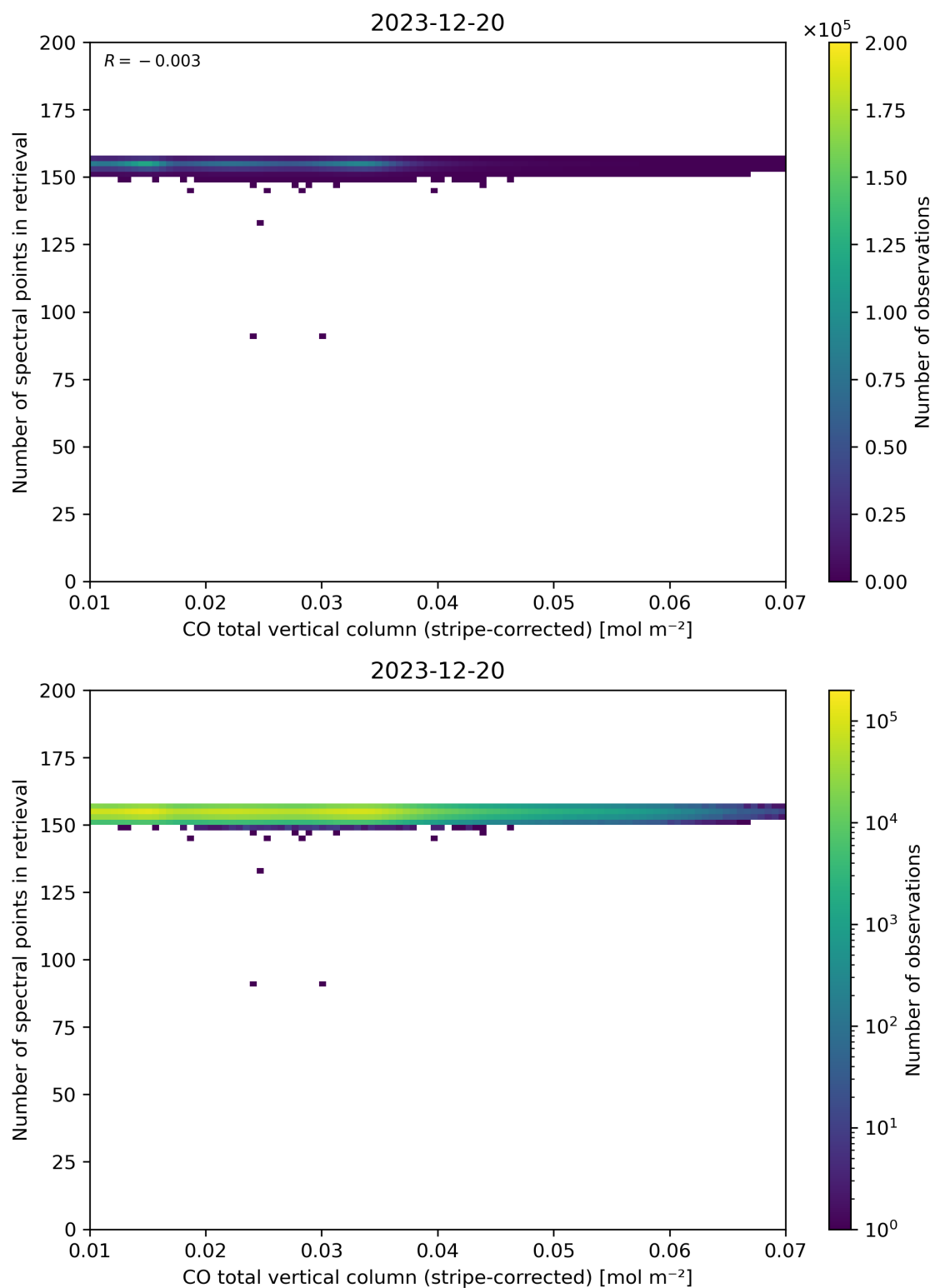


Figure 40: Scatter density plot of “CO total vertical column (stripe-corrected)” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

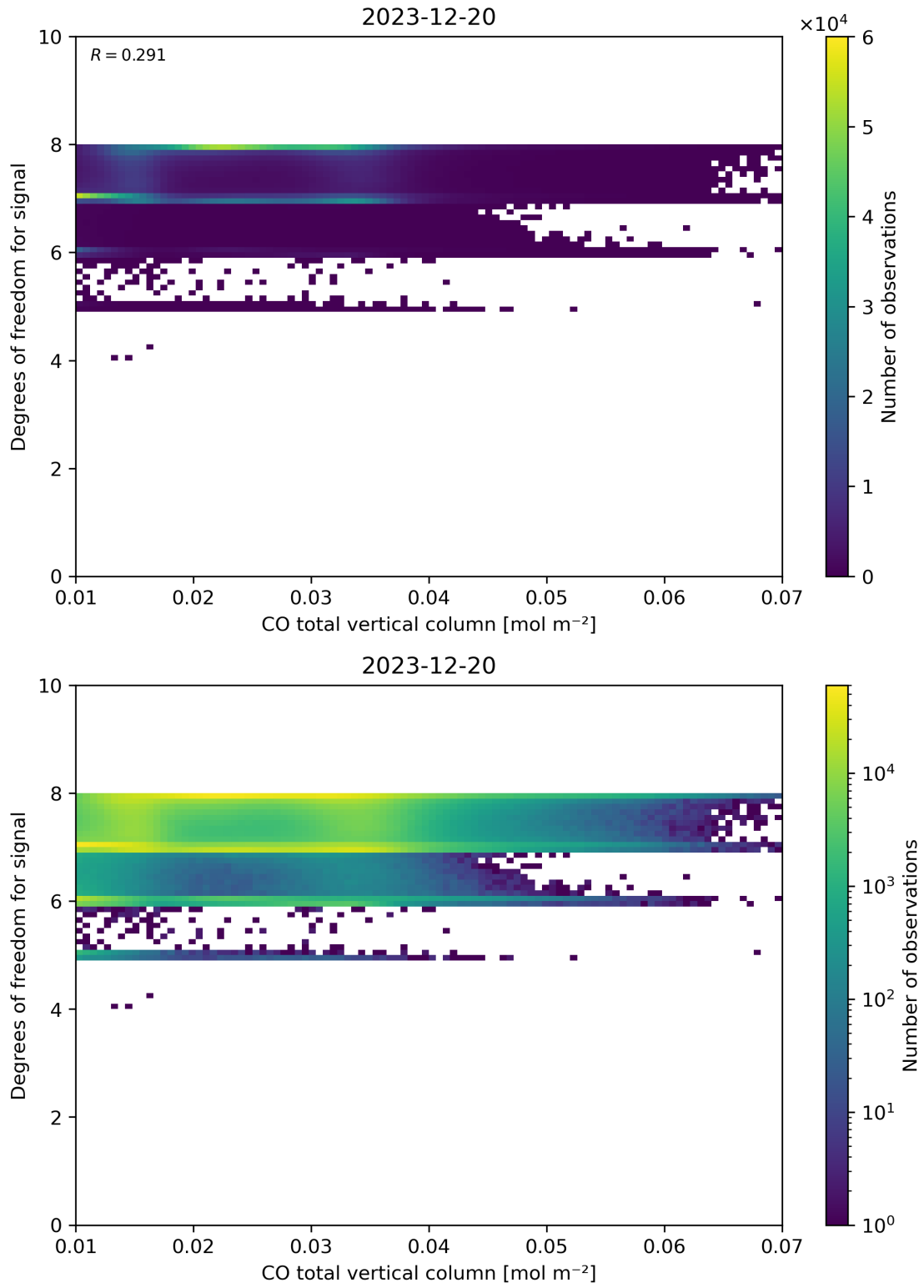


Figure 41: Scatter density plot of “CO total vertical column” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

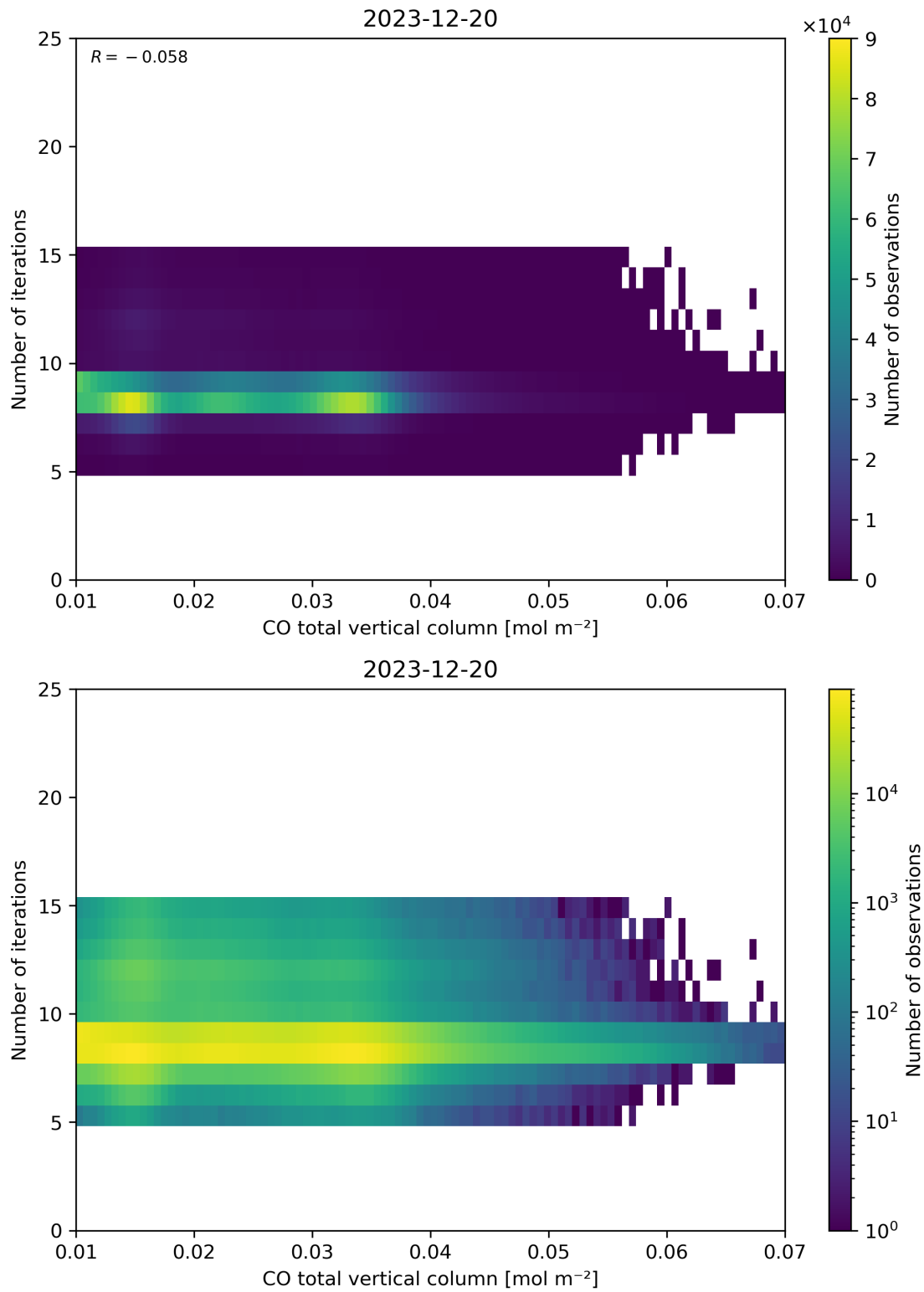


Figure 42: Scatter density plot of “CO total vertical column” against “Number of iterations” for 2023-12-20 to 2023-12-21.

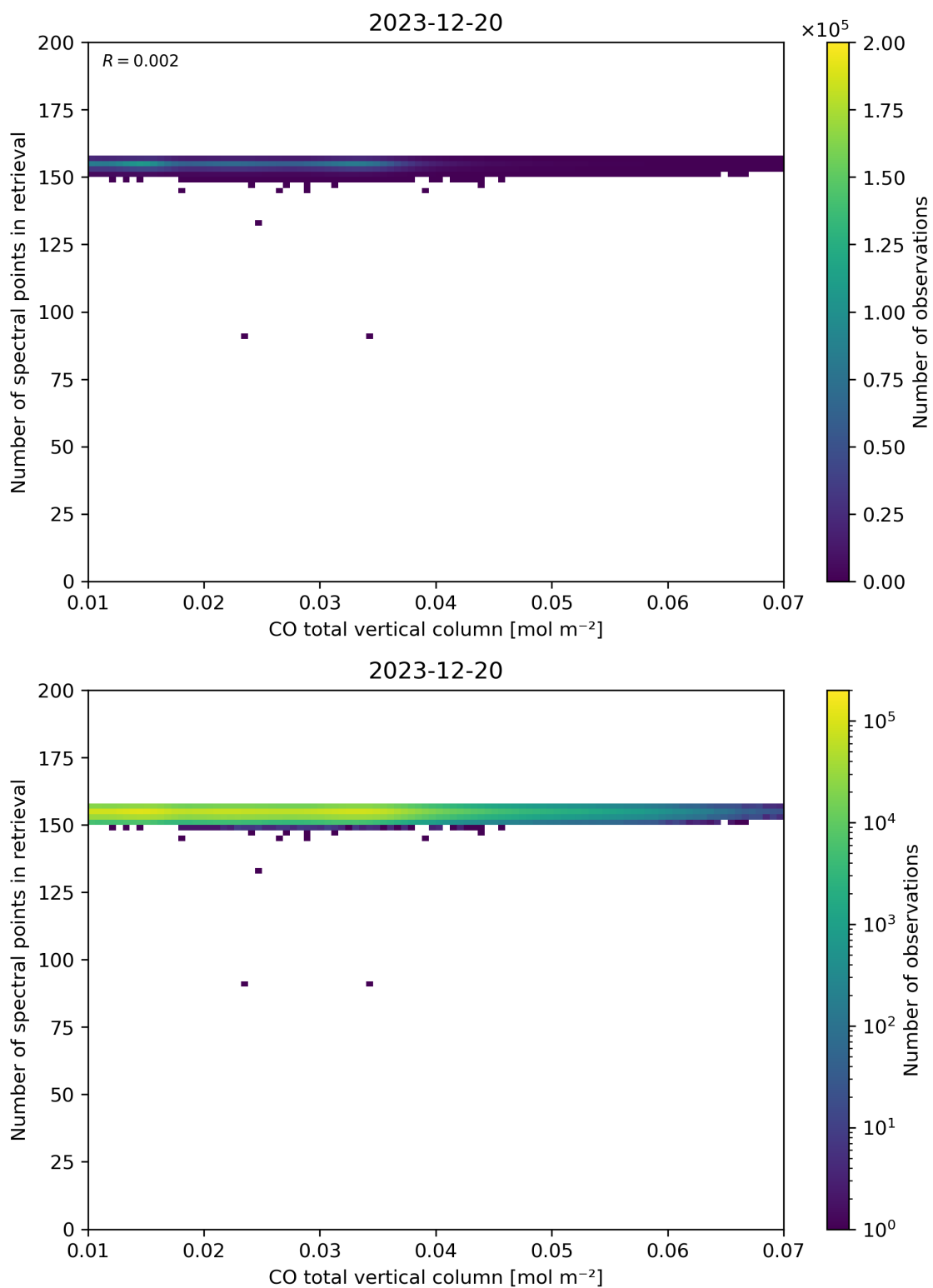


Figure 43: Scatter density plot of “CO total vertical column” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.



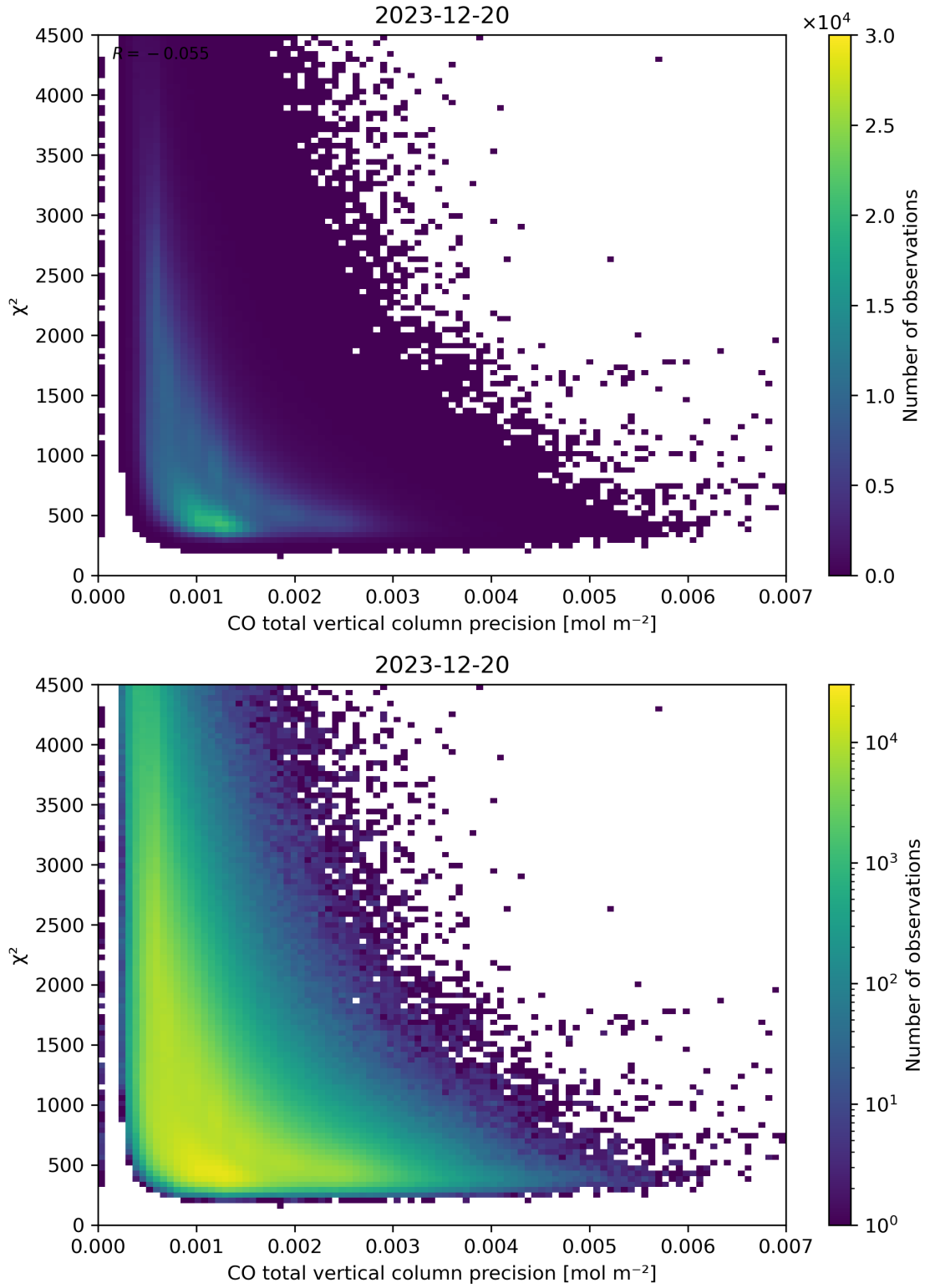


Figure 44: Scatter density plot of “CO total vertical column precision” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

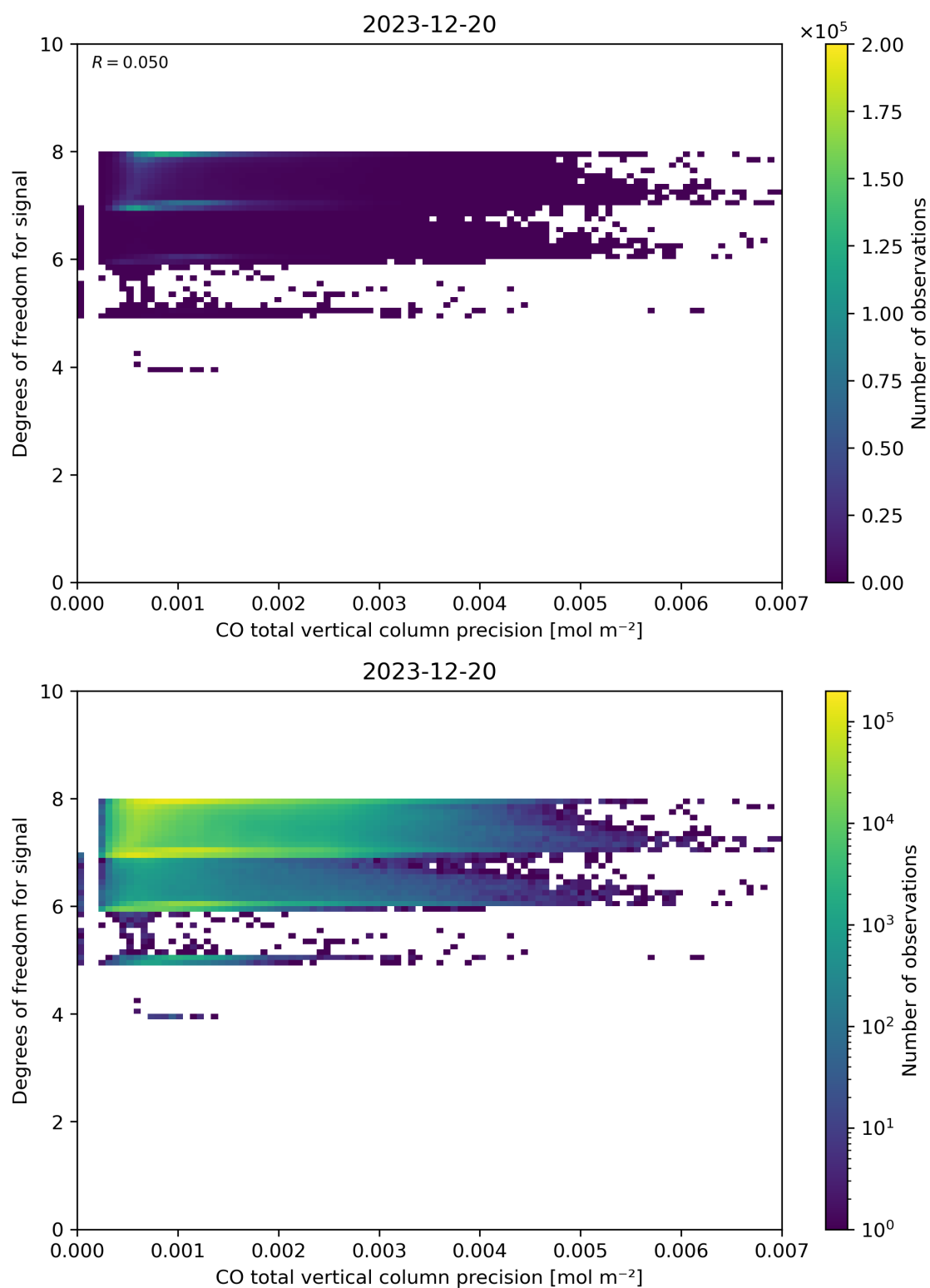


Figure 45: Scatter density plot of “CO total vertical column precision” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

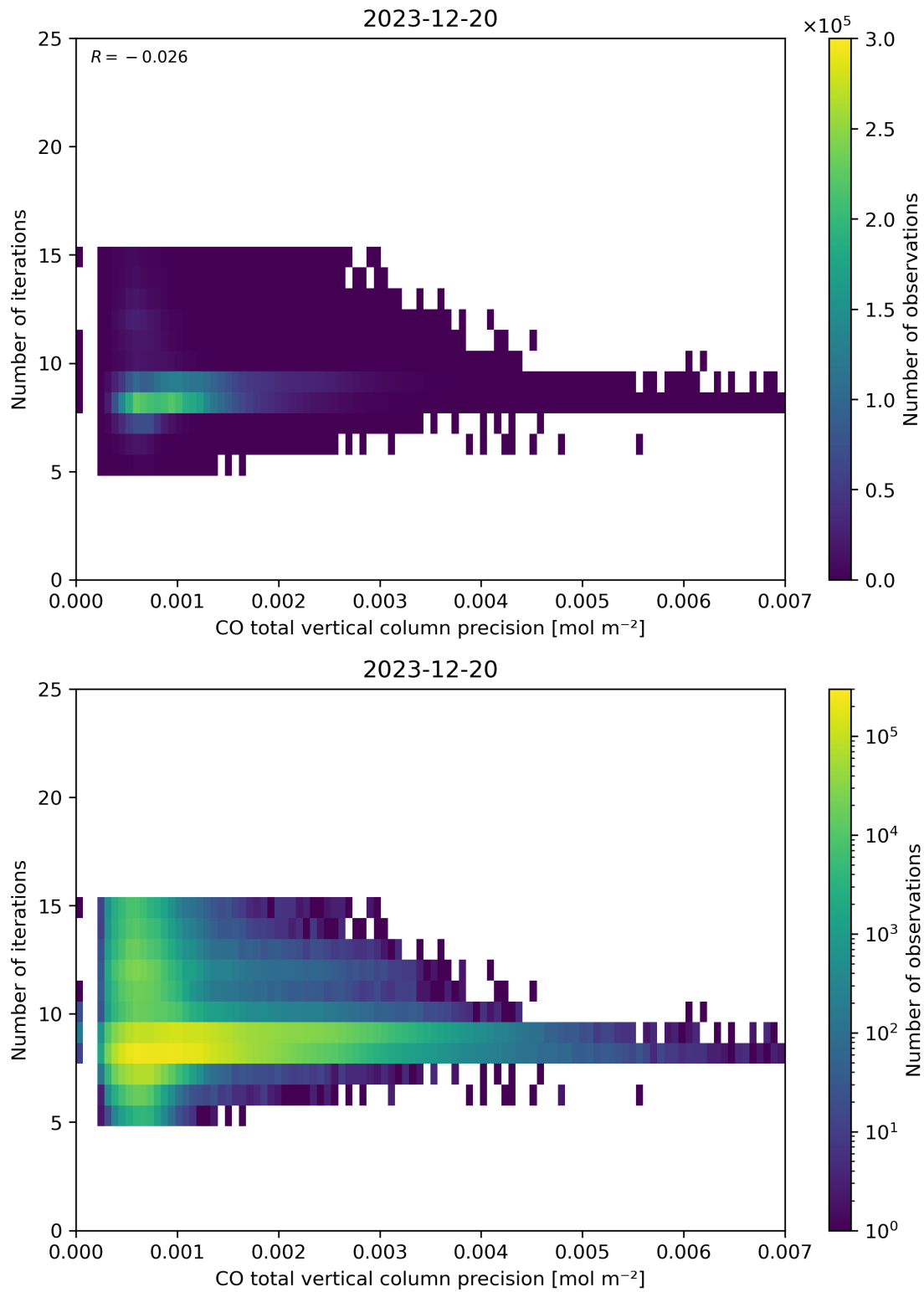


Figure 46: Scatter density plot of “CO total vertical column precision” against “Number of iterations” for 2023-12-20 to 2023-12-21.

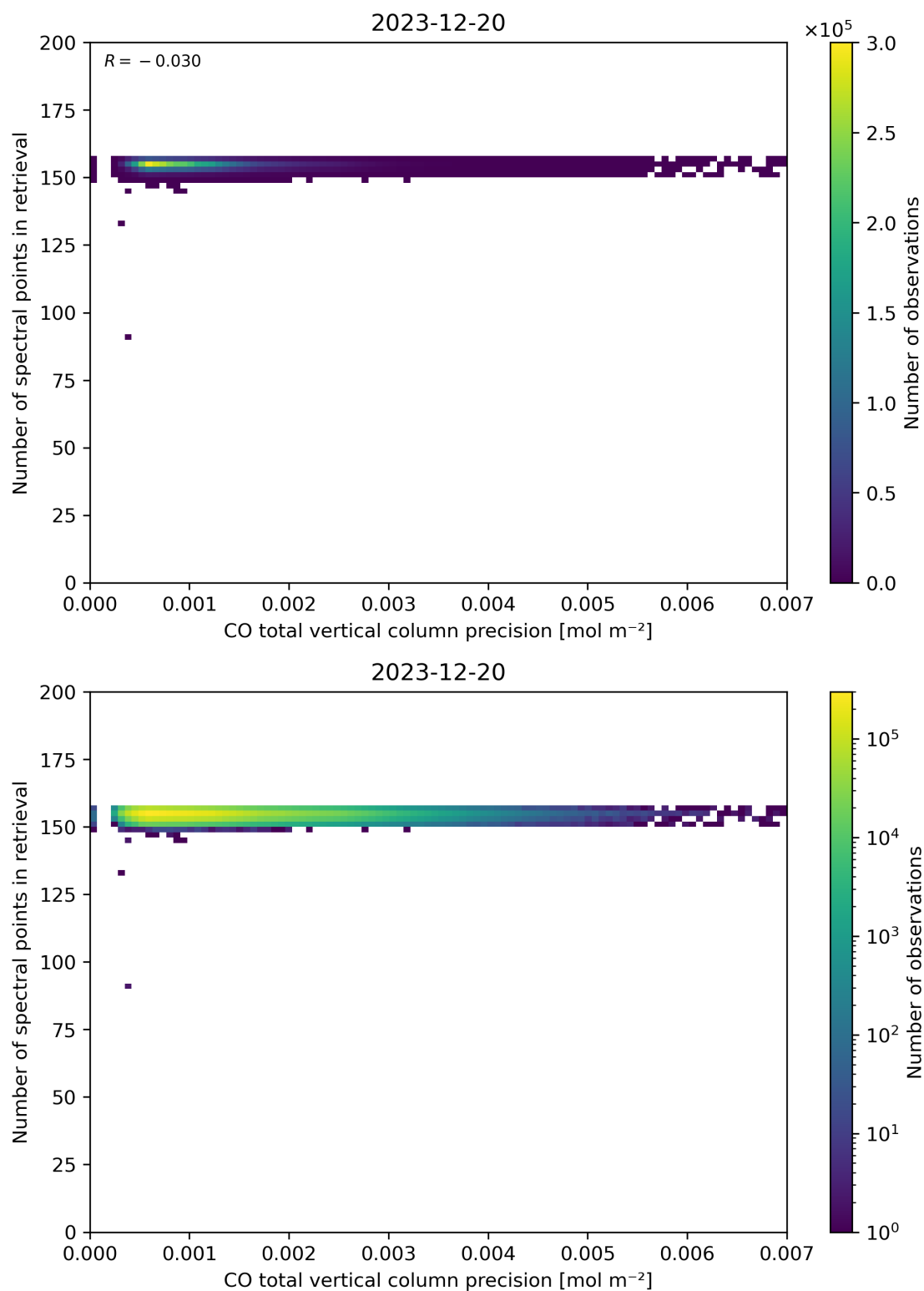


Figure 47: Scatter density plot of “CO total vertical column precision” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

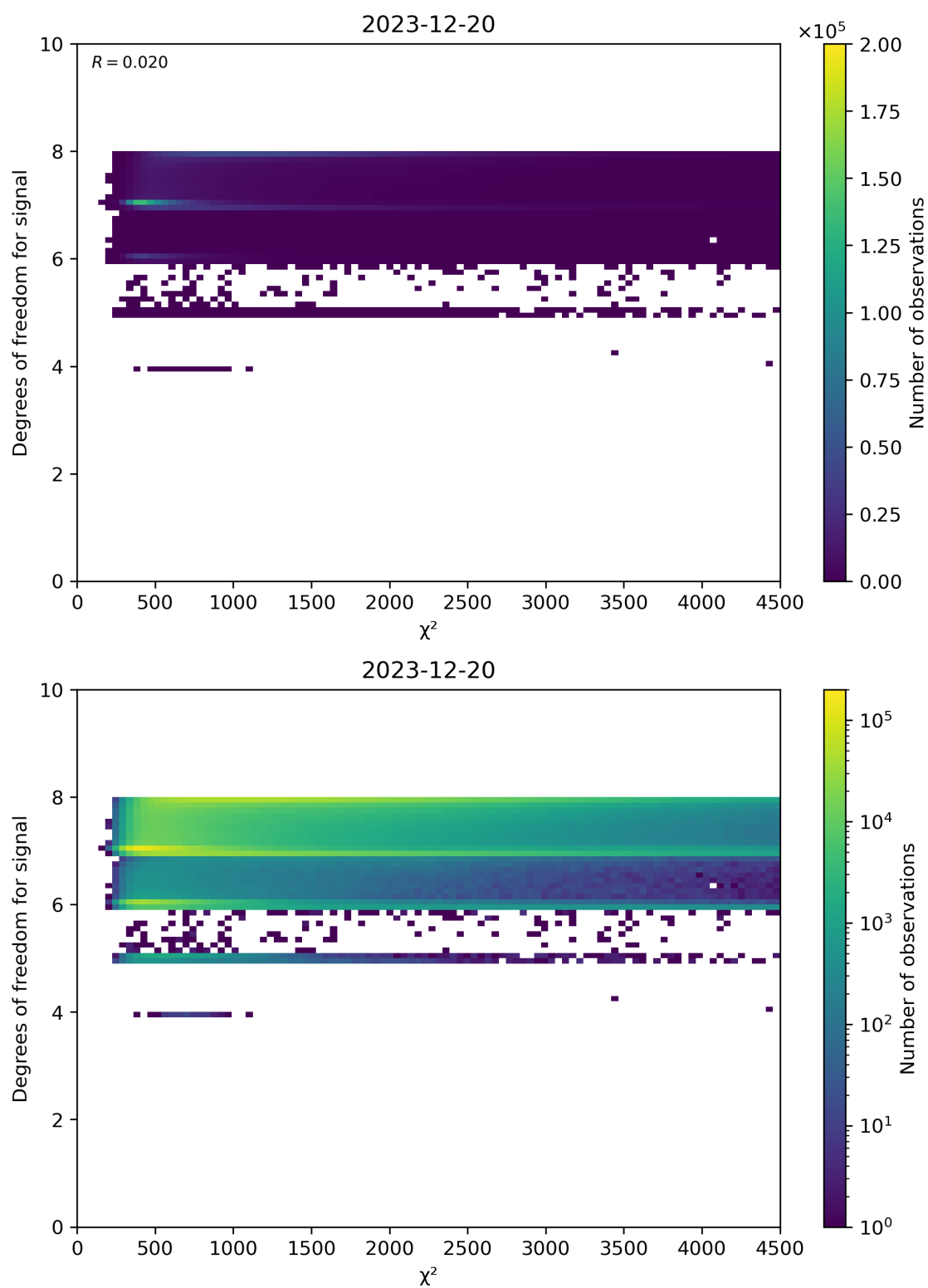


Figure 48: Scatter density plot of “ $\chi^2$ ” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

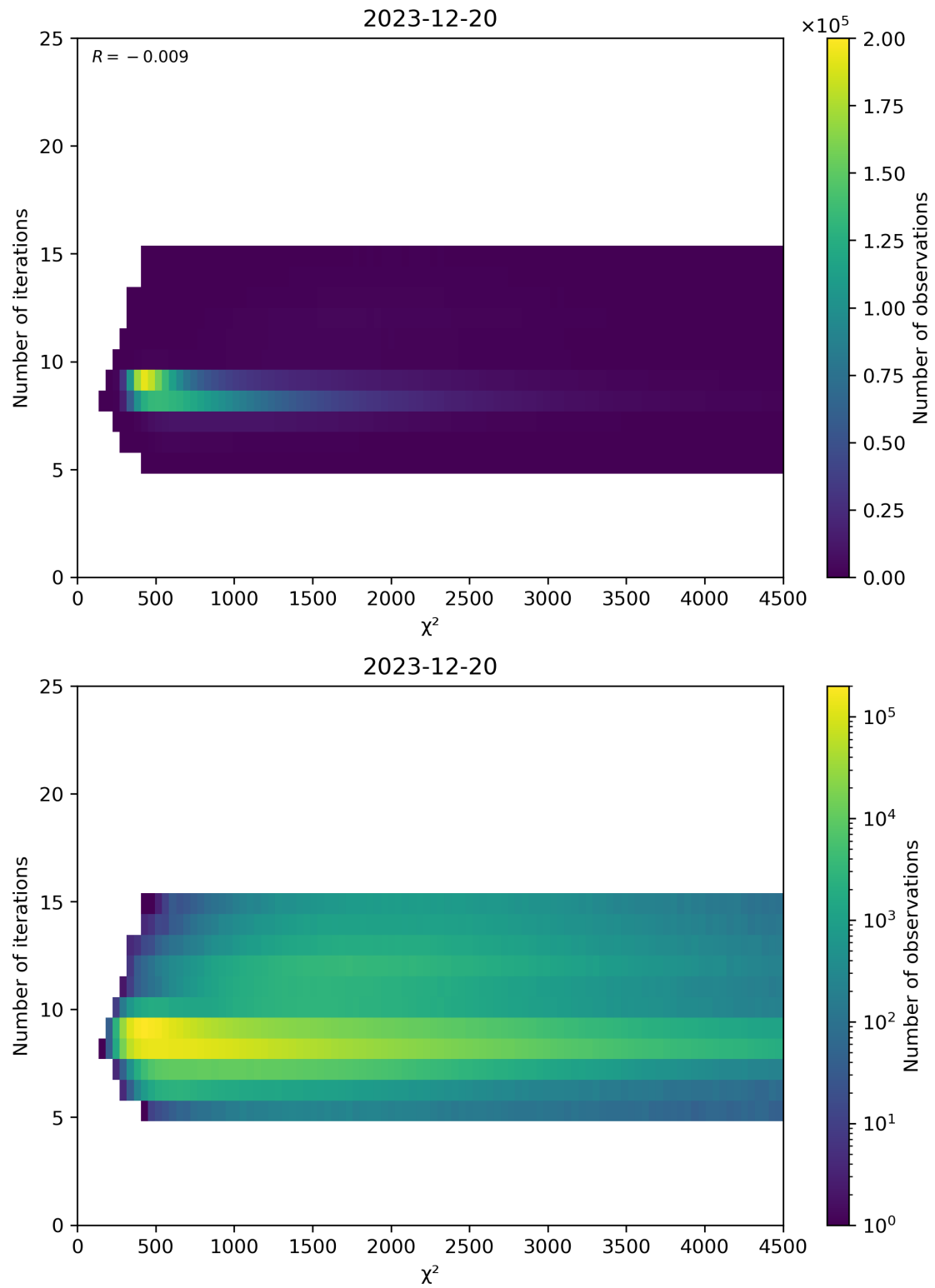


Figure 49: Scatter density plot of “ $\chi^2$ ” against “Number of iterations” for 2023-12-20 to 2023-12-21.

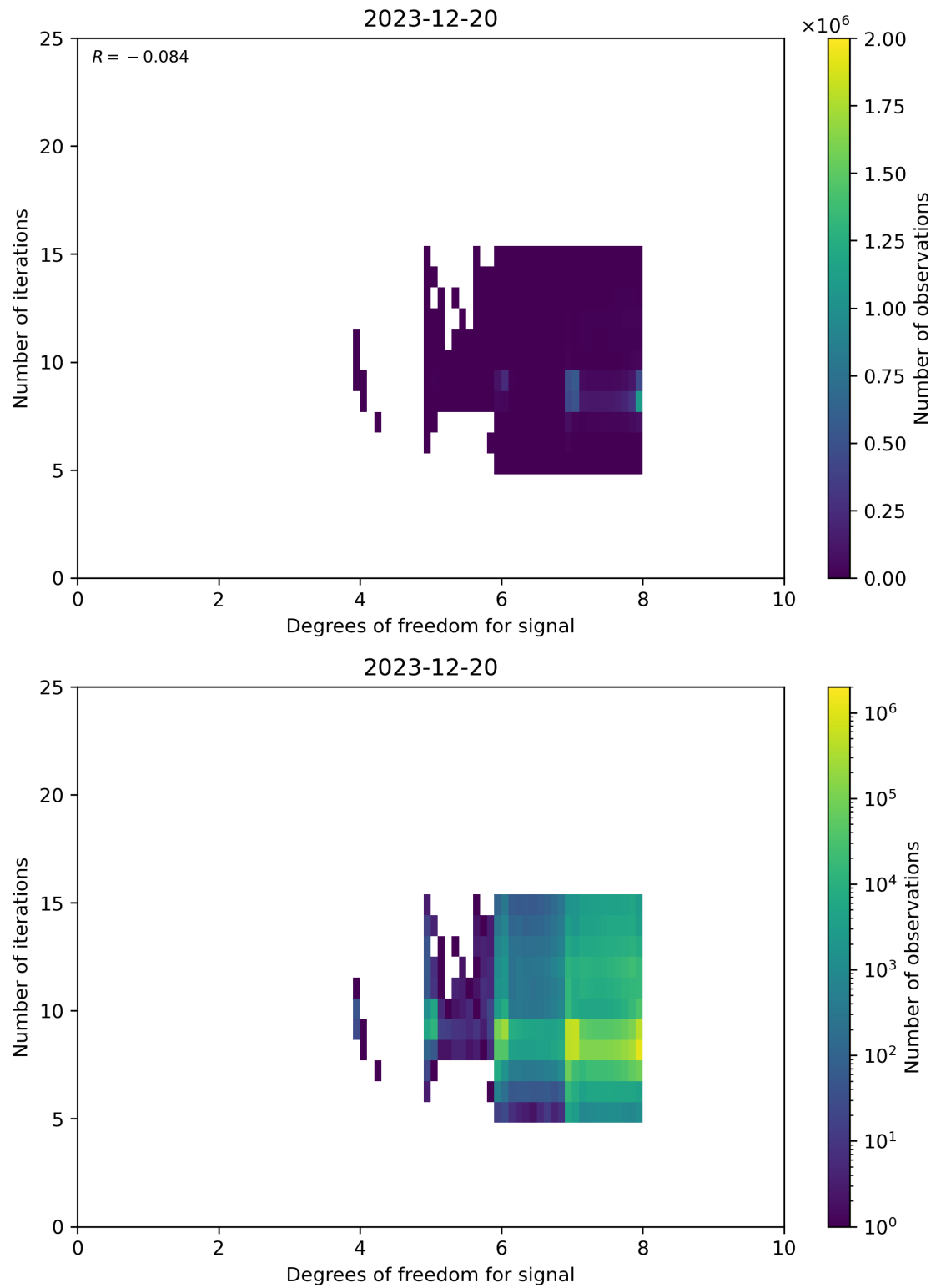


Figure 50: Scatter density plot of “Degrees of freedom for signal” against “Number of iterations” for 2023-12-20 to 2023-12-21.

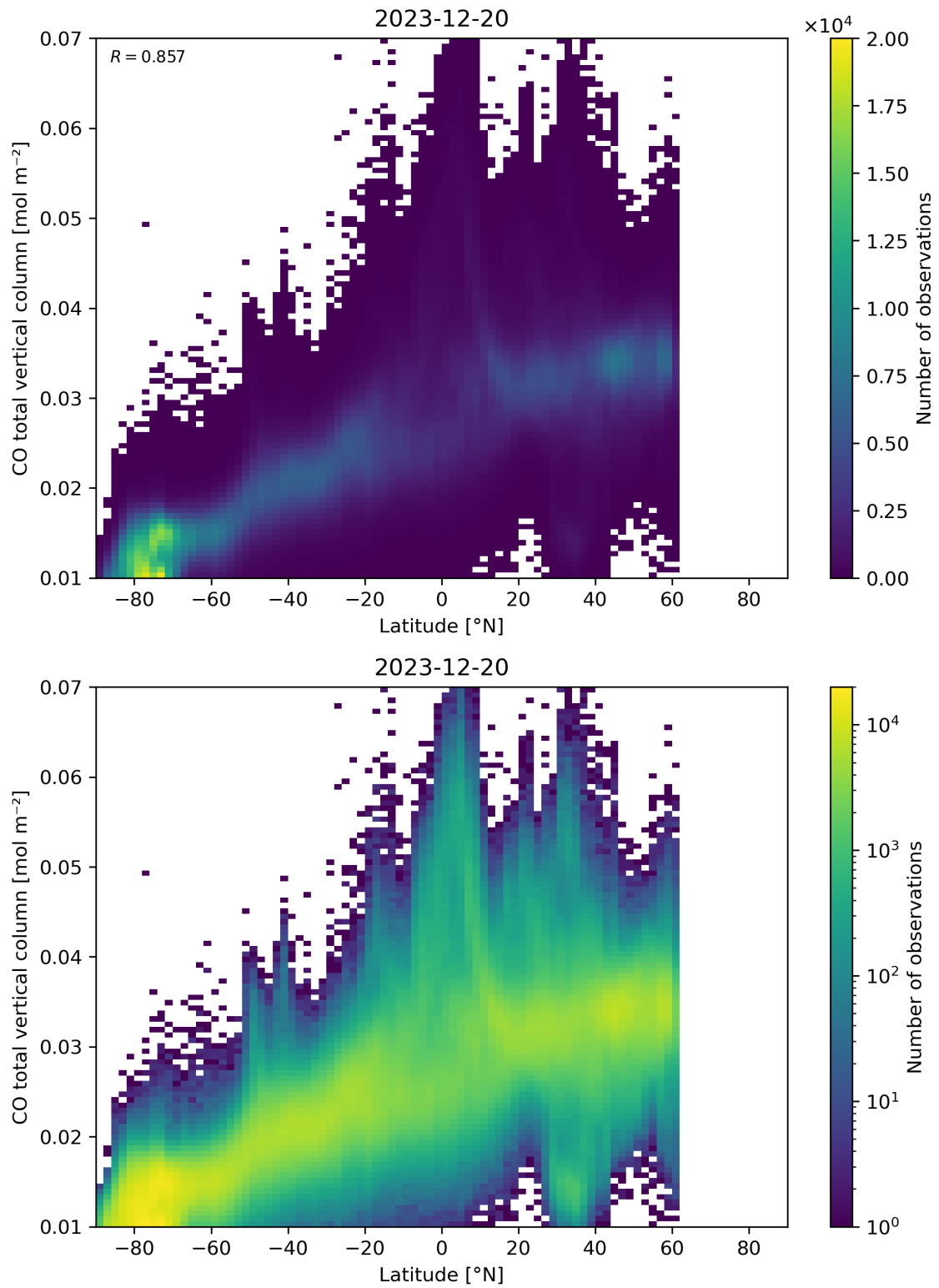


Figure 51: Scatter density plot of “Latitude” against “CO total vertical column” for 2023-12-20 to 2023-12-21.



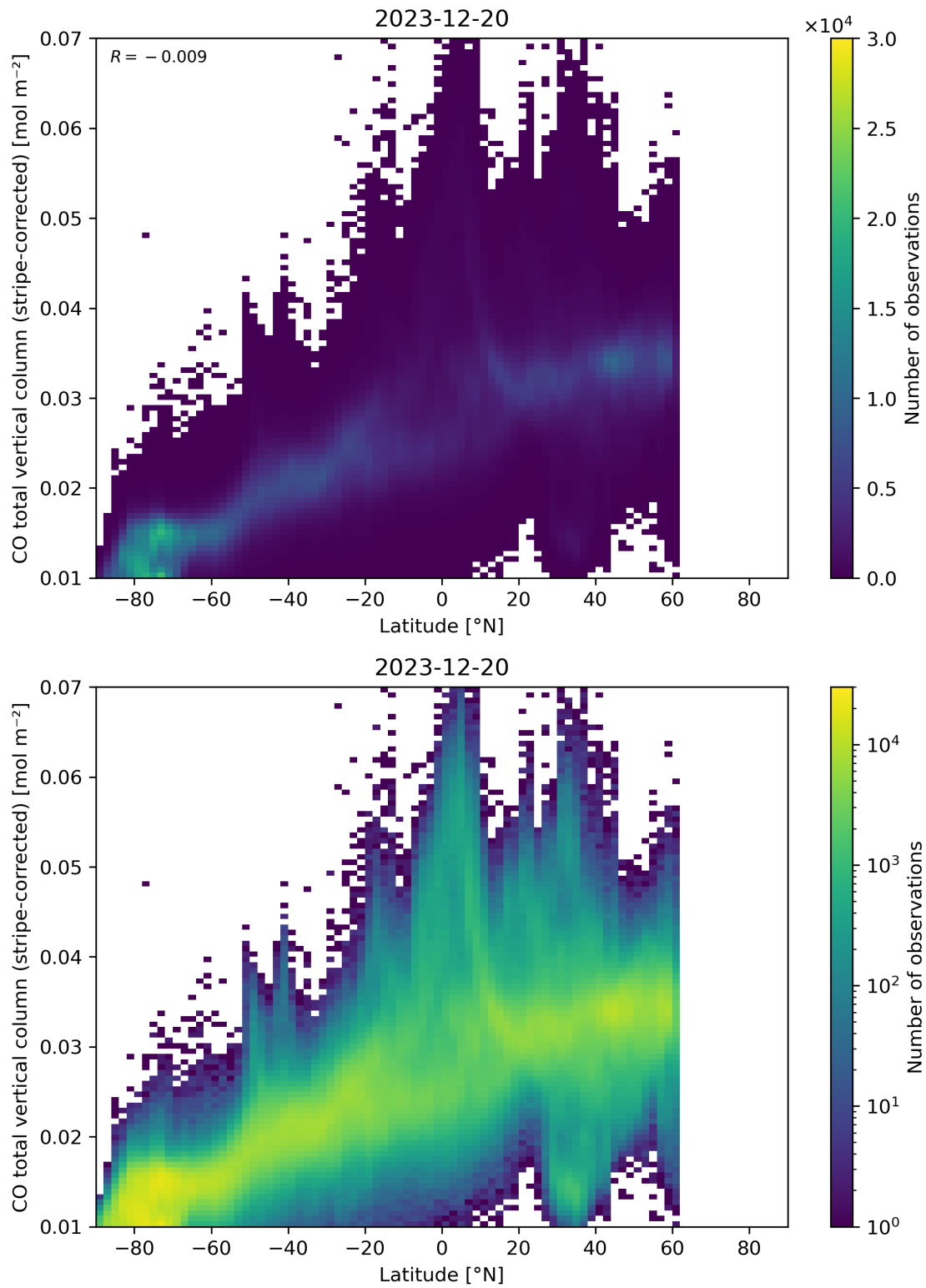


Figure 52: Scatter density plot of “Latitude” against “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21.

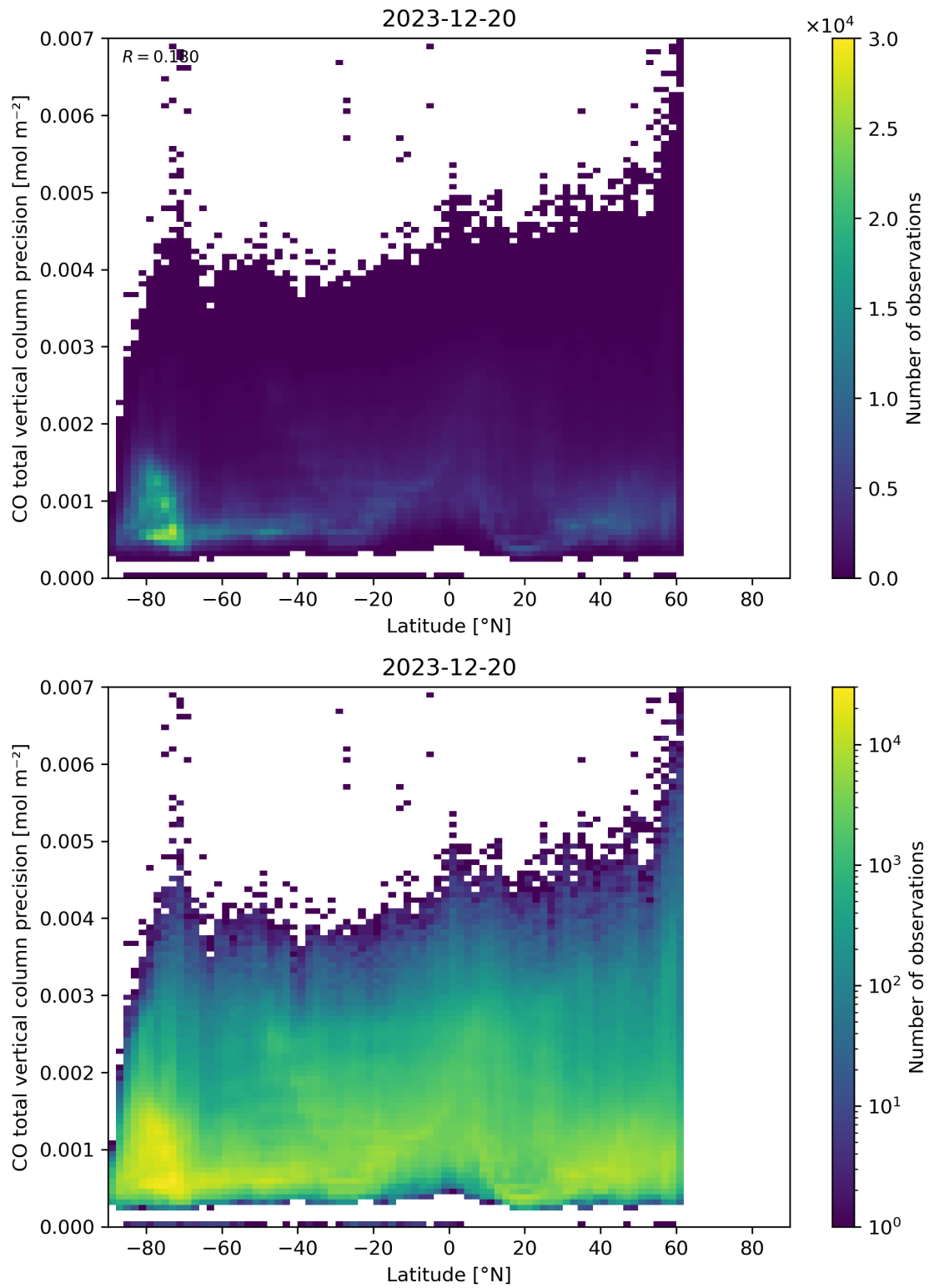


Figure 53: Scatter density plot of “Latitude” against “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

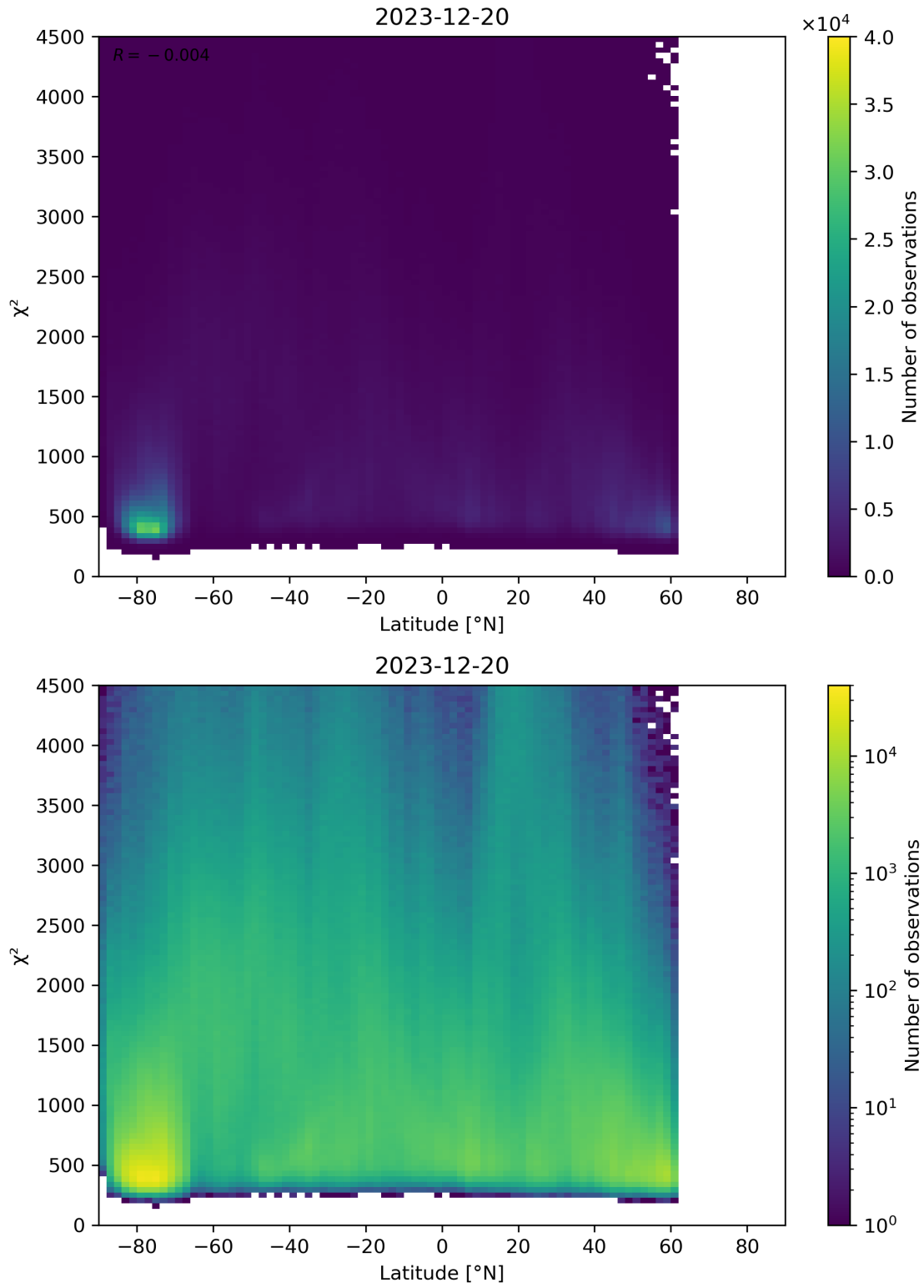


Figure 54: Scatter density plot of “Latitude” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

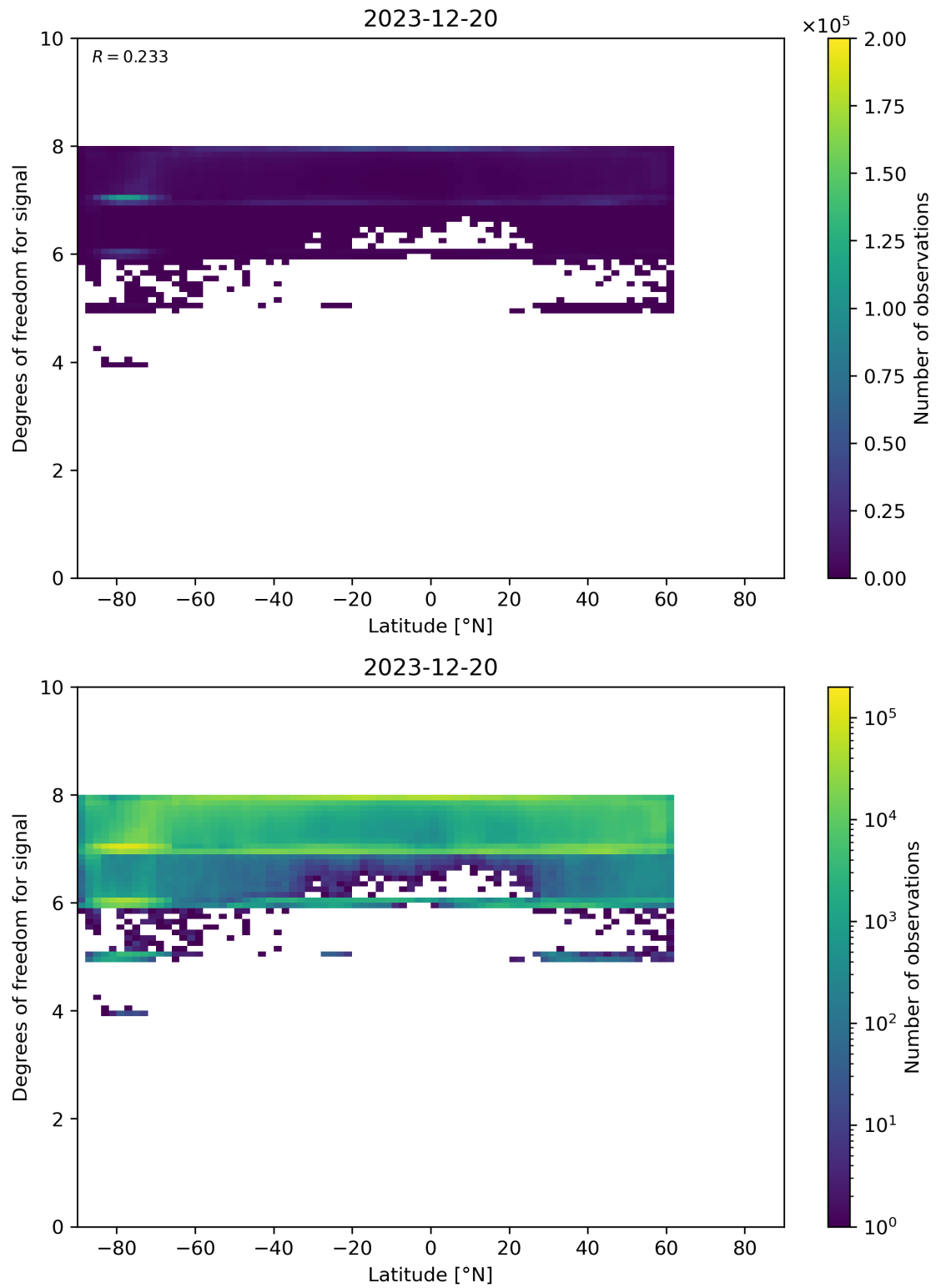


Figure 55: Scatter density plot of “Latitude” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

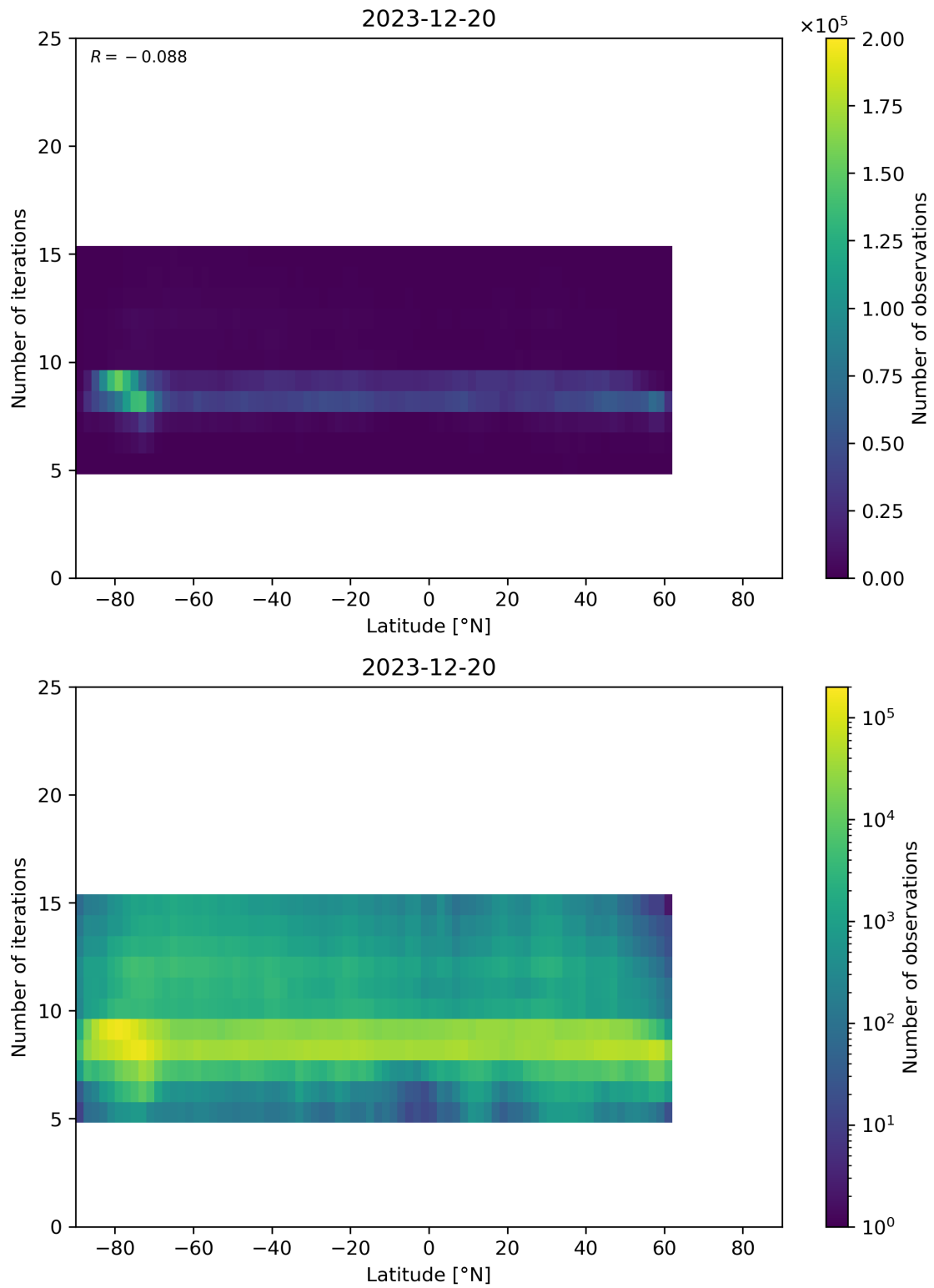


Figure 56: Scatter density plot of “Latitude” against “Number of iterations” for 2023-12-20 to 2023-12-21.

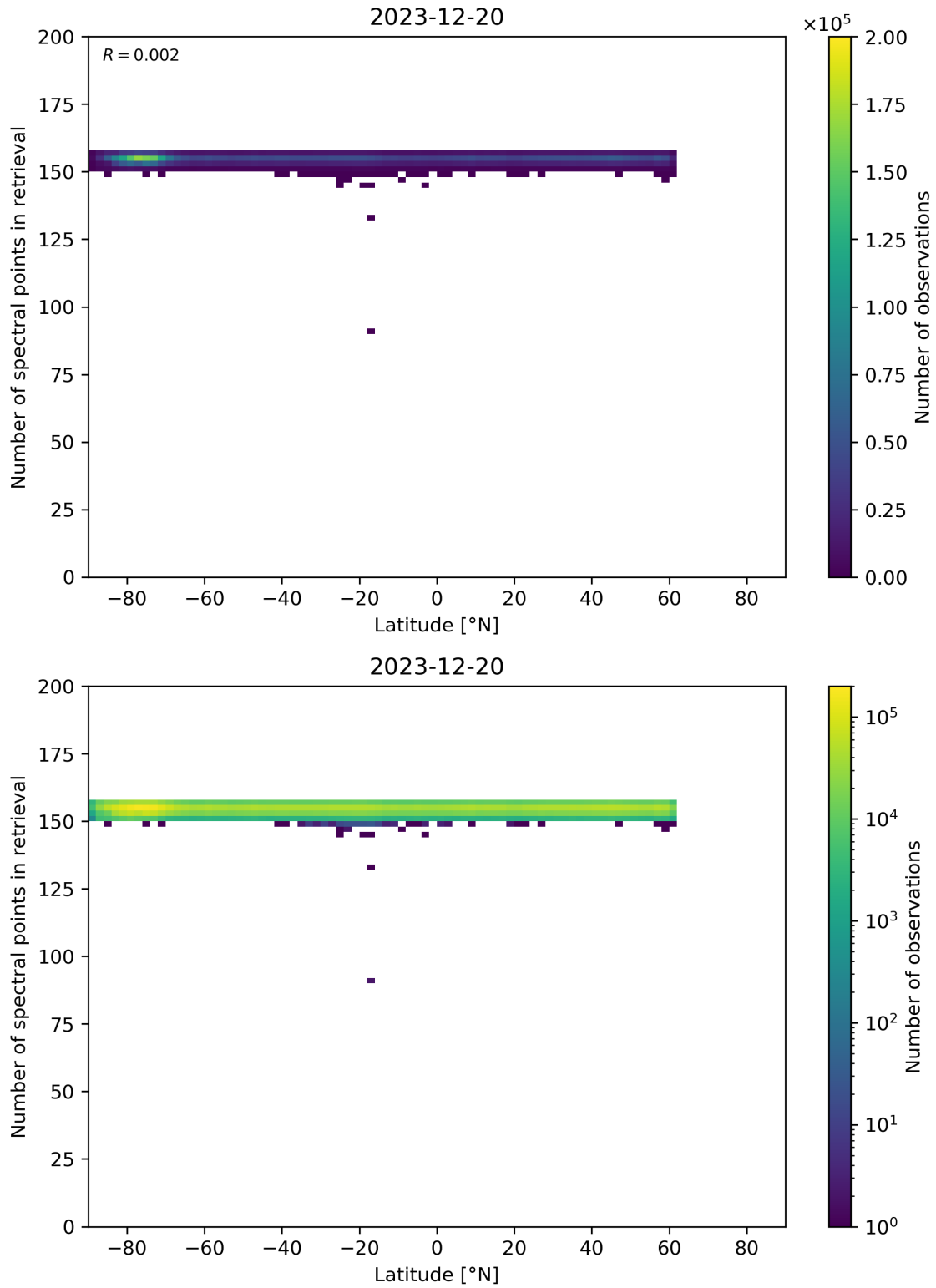


Figure 57: Scatter density plot of “Latitude” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

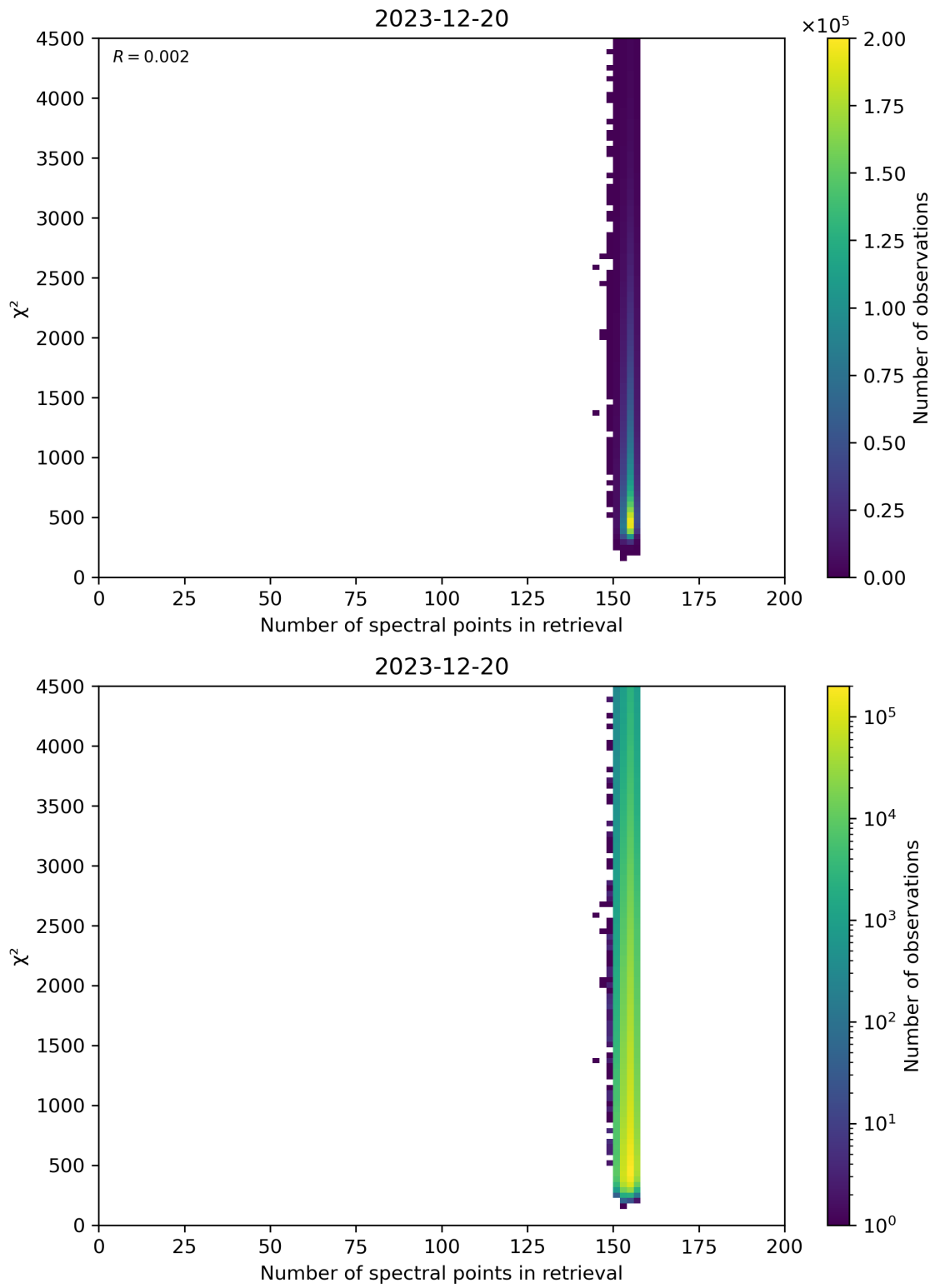


Figure 58: Scatter density plot of “Number of spectral points in retrieval” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

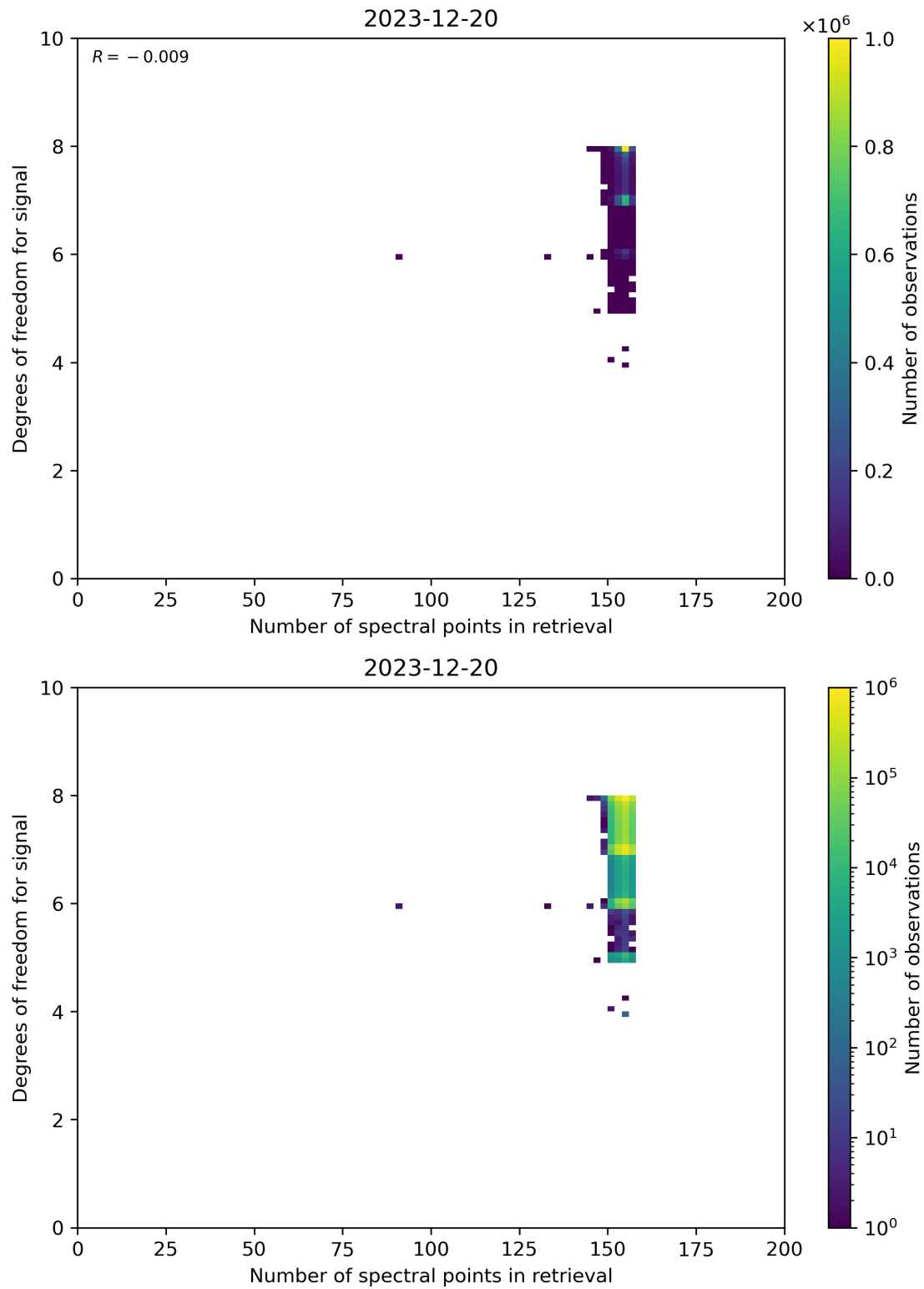


Figure 59: Scatter density plot of “Number of spectral points in retrieval” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.



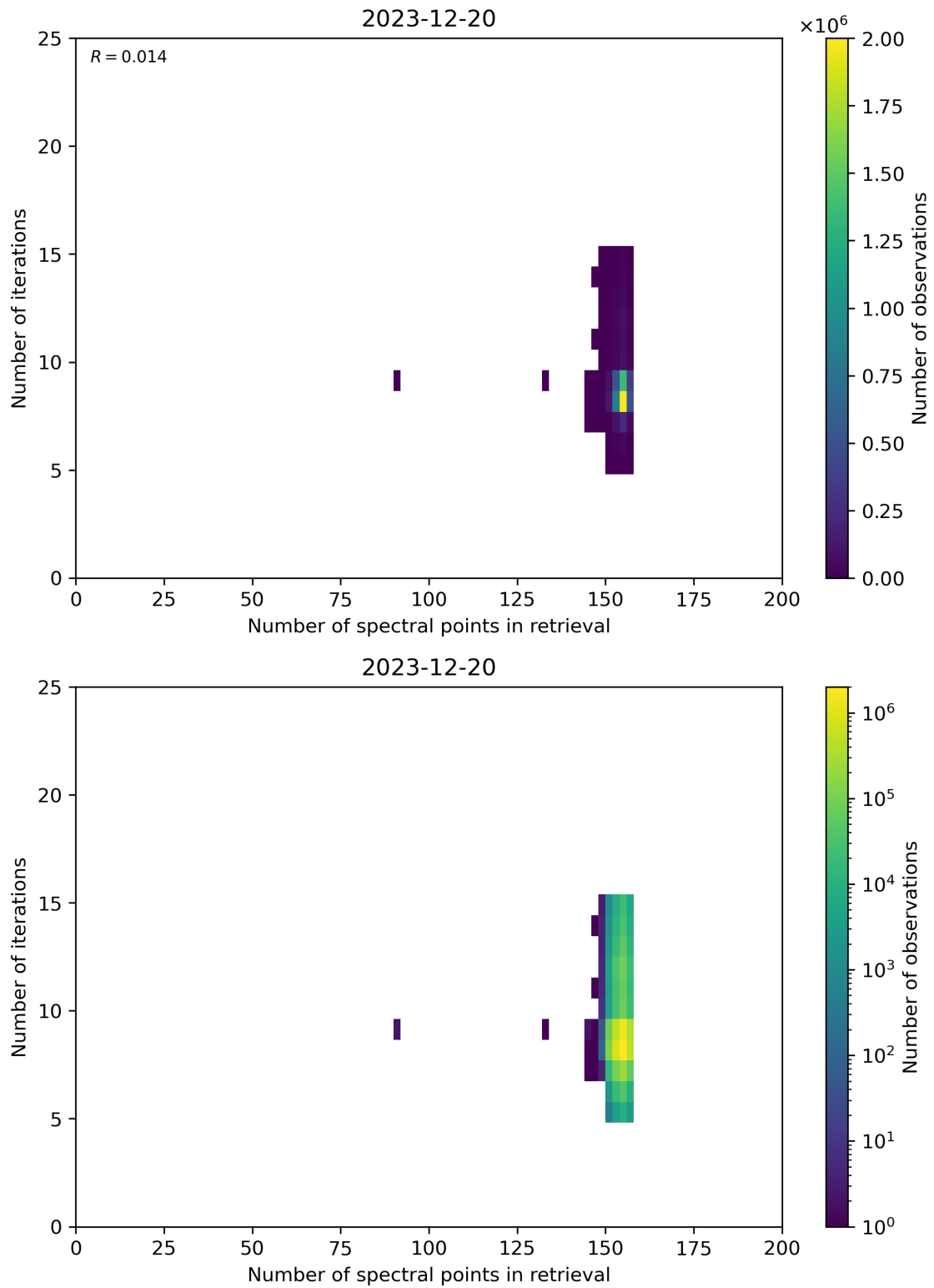


Figure 60: Scatter density plot of “Number of spectral points in retrieval” against “Number of iterations” for 2023-12-20 to 2023-12-21.

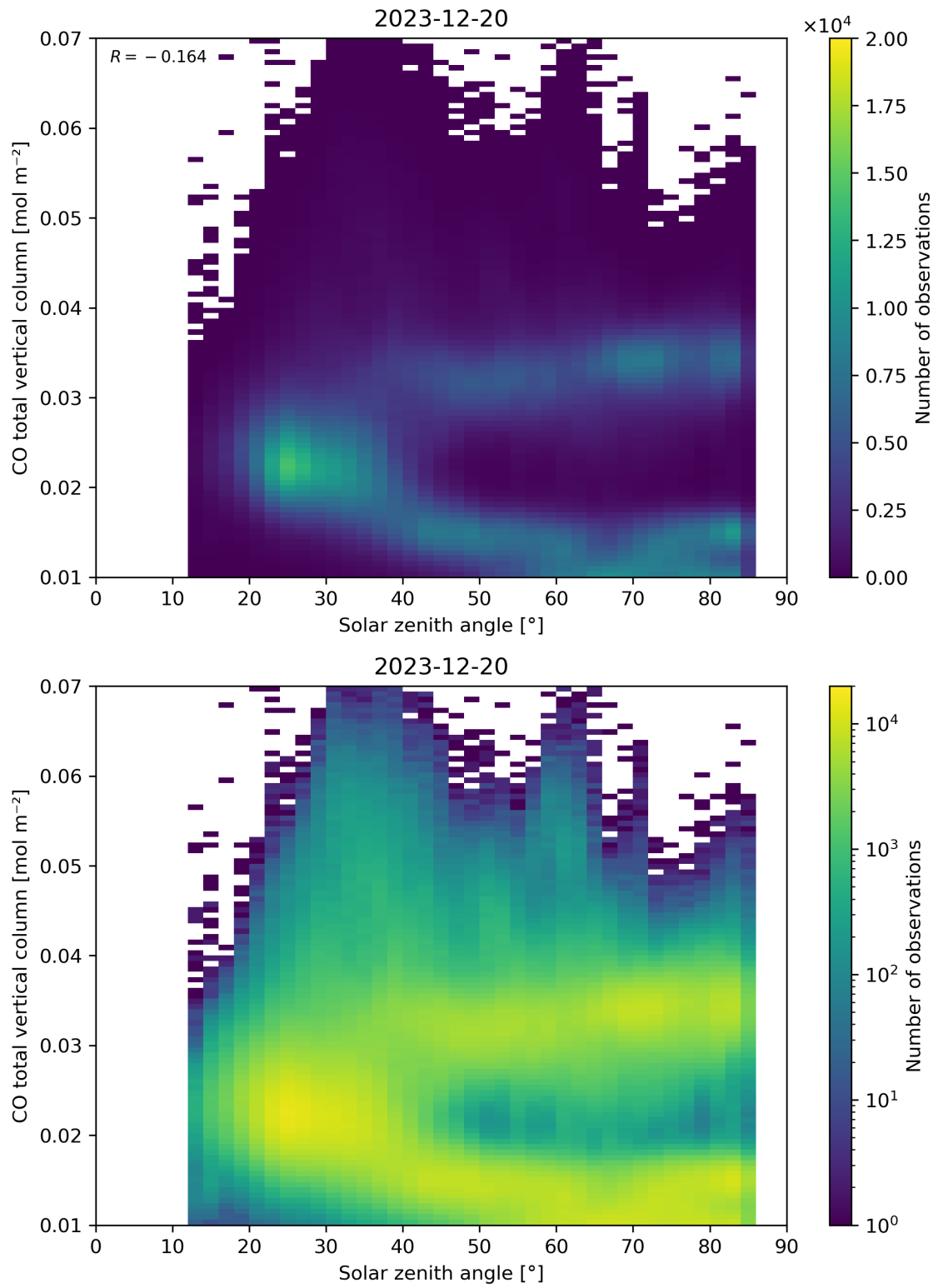


Figure 61: Scatter density plot of “Solar zenith angle” against “CO total vertical column” for 2023-12-20 to 2023-12-21.

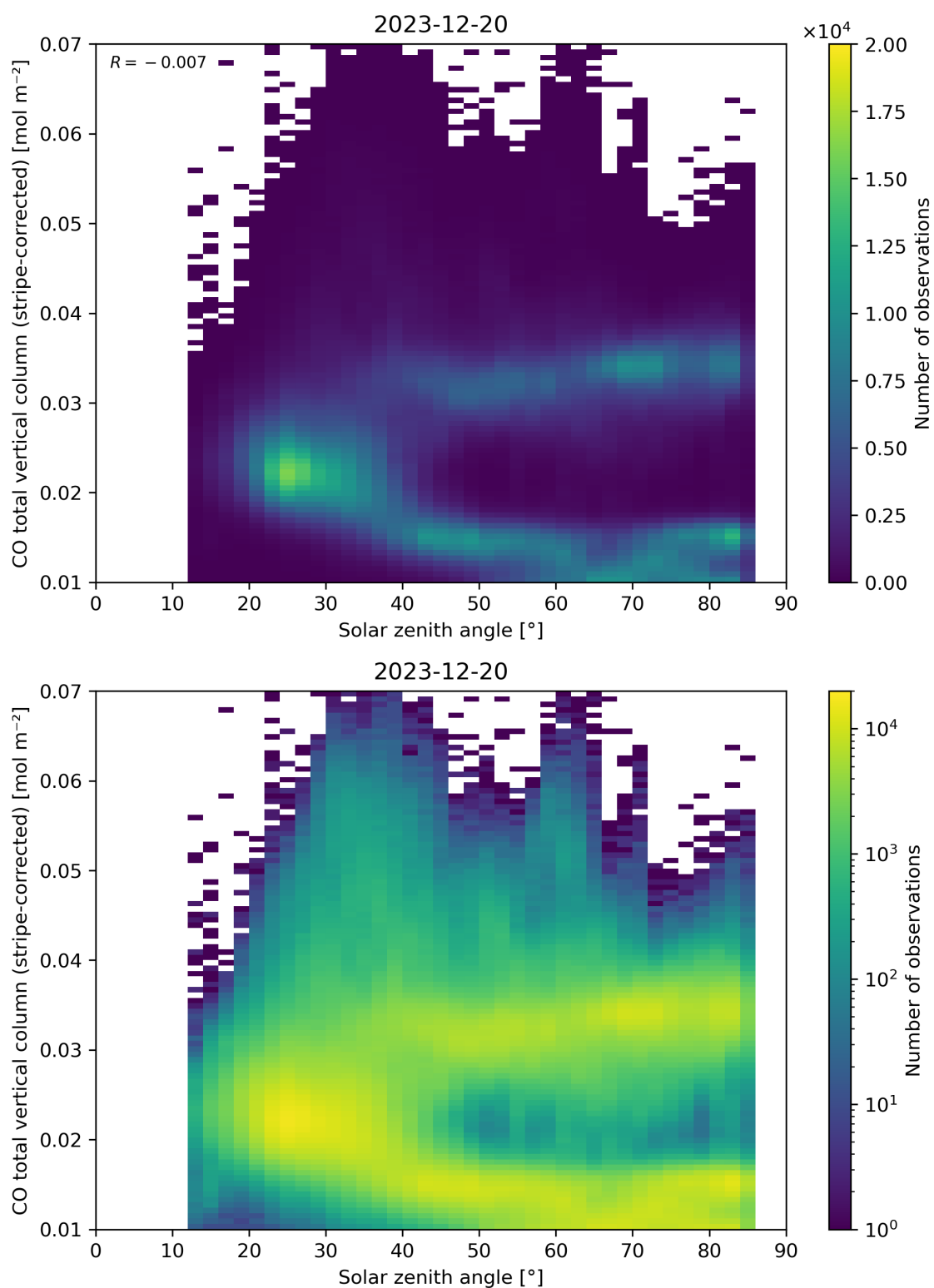


Figure 62: Scatter density plot of “Solar zenith angle” against “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21.

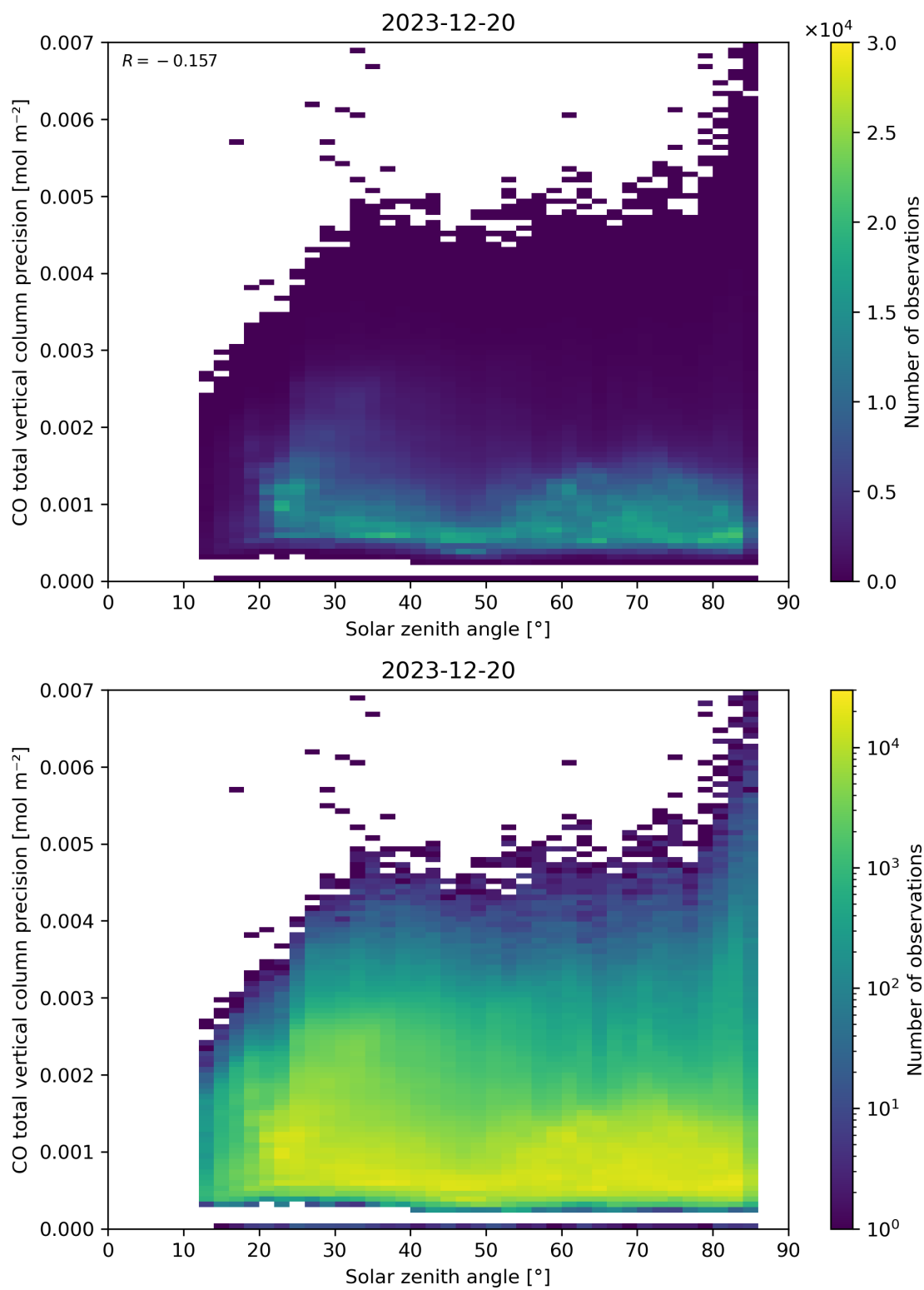


Figure 63: Scatter density plot of “Solar zenith angle” against “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

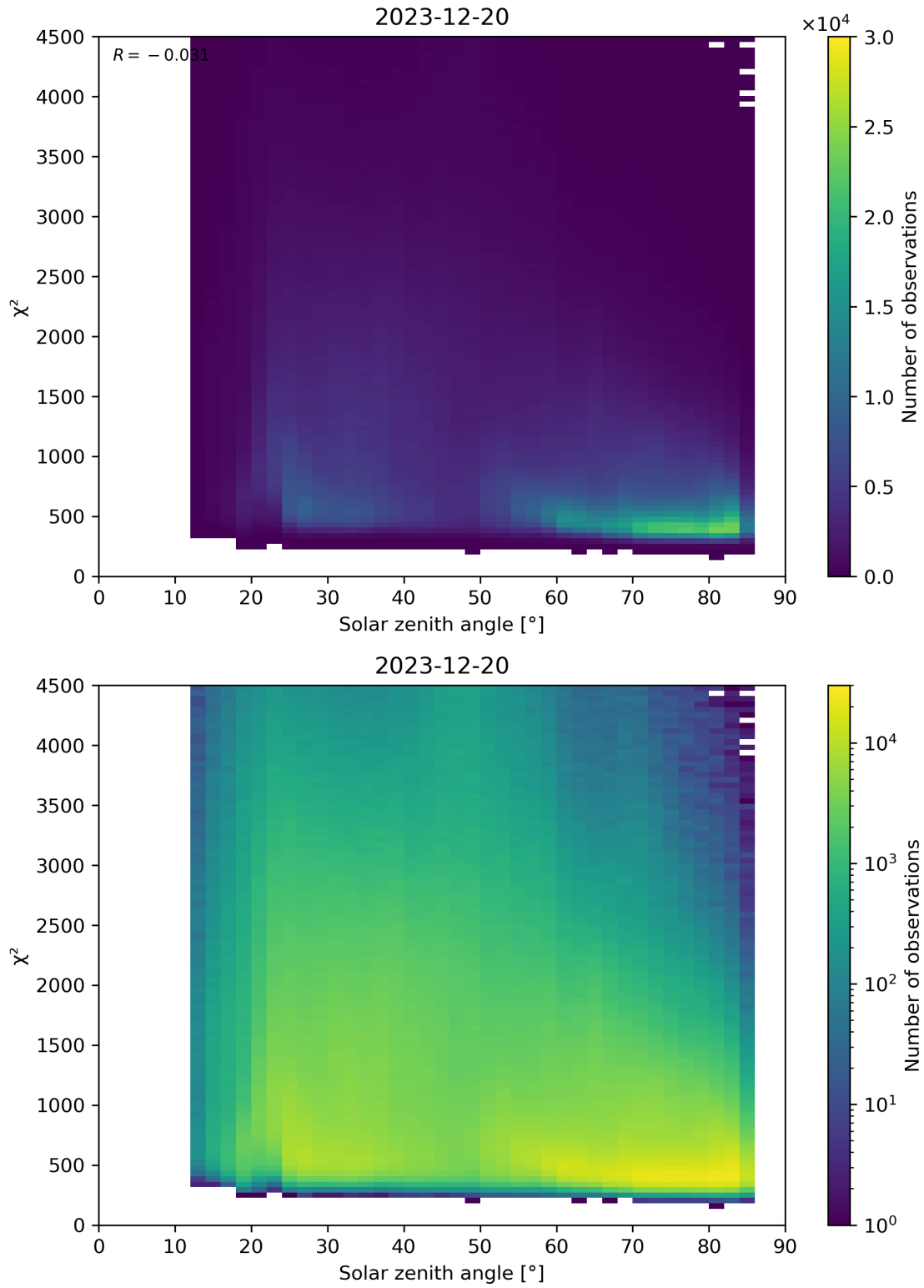


Figure 64: Scatter density plot of “Solar zenith angle” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

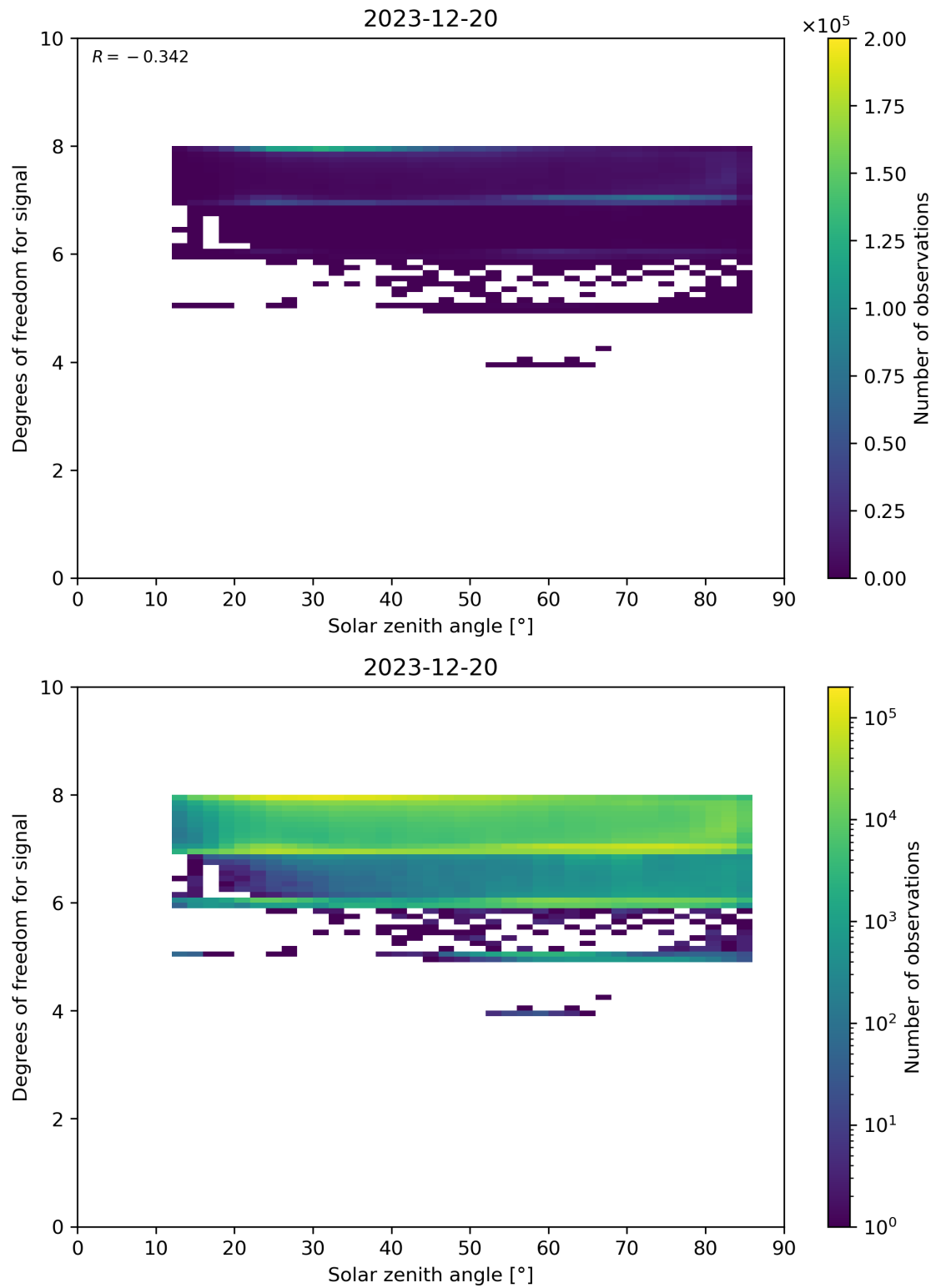


Figure 65: Scatter density plot of “Solar zenith angle” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

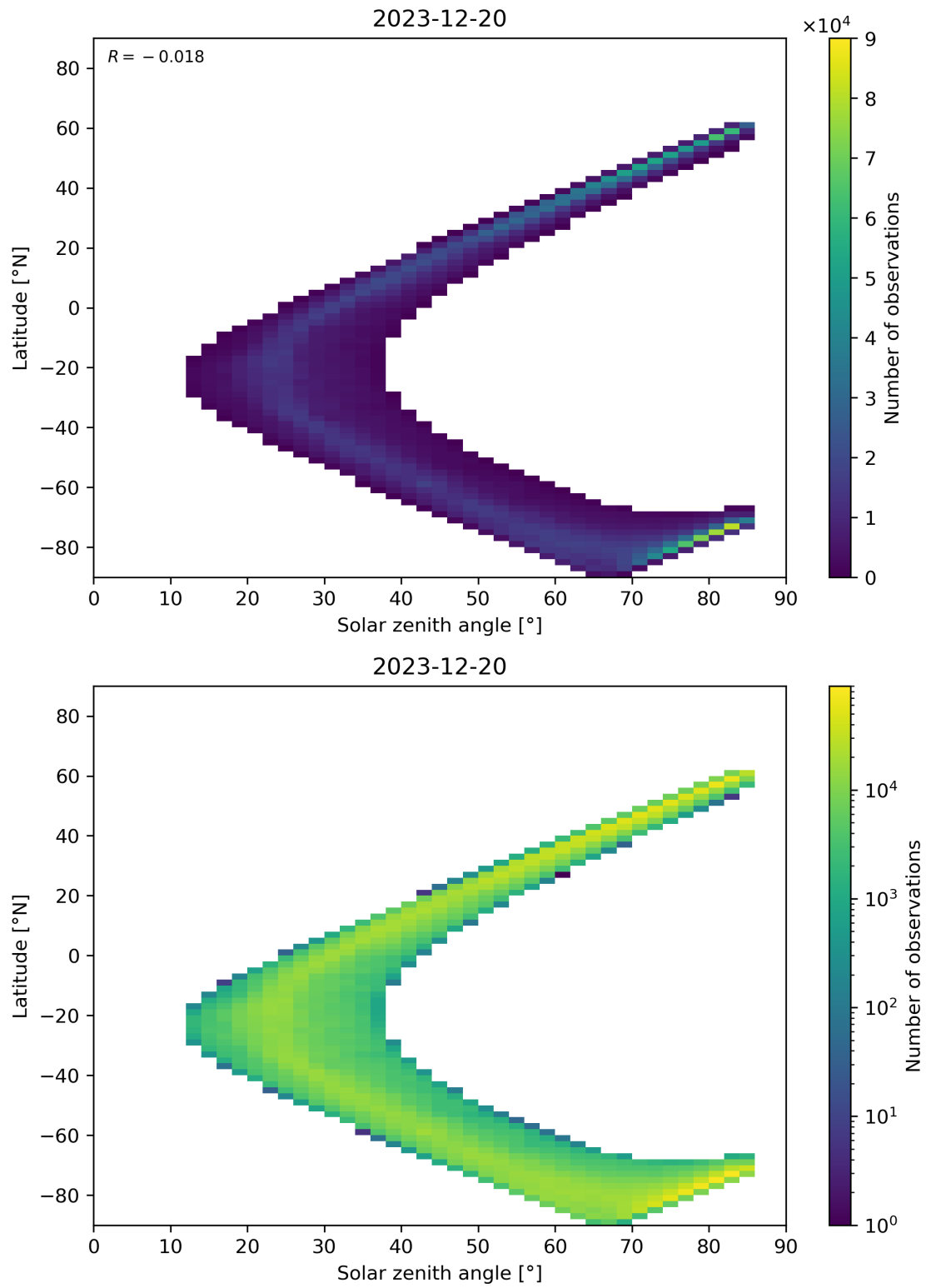


Figure 66: Scatter density plot of “Solar zenith angle” against “Latitude” for 2023-12-20 to 2023-12-21.

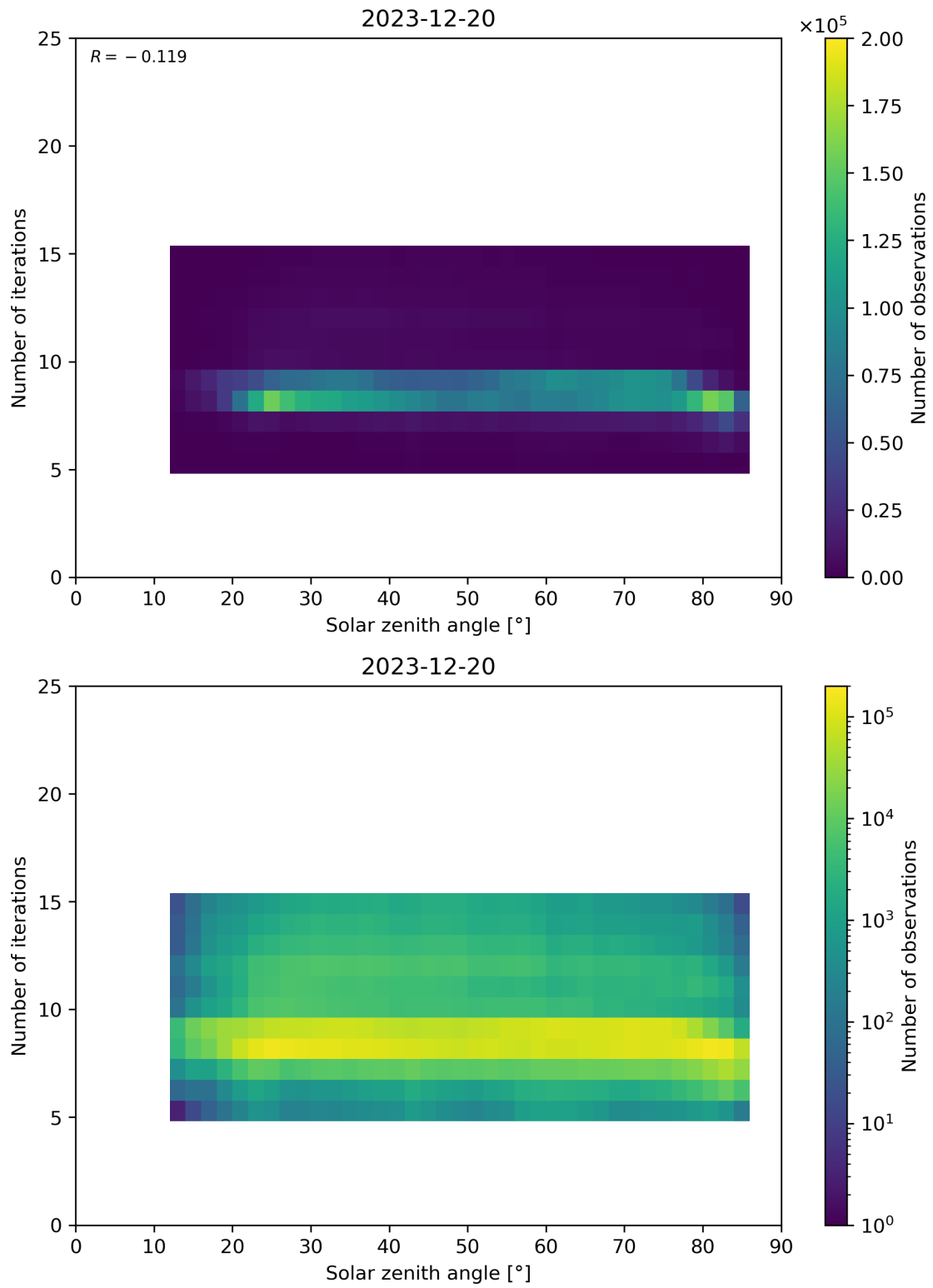


Figure 67: Scatter density plot of “Solar zenith angle” against “Number of iterations” for 2023-12-20 to 2023-12-21.



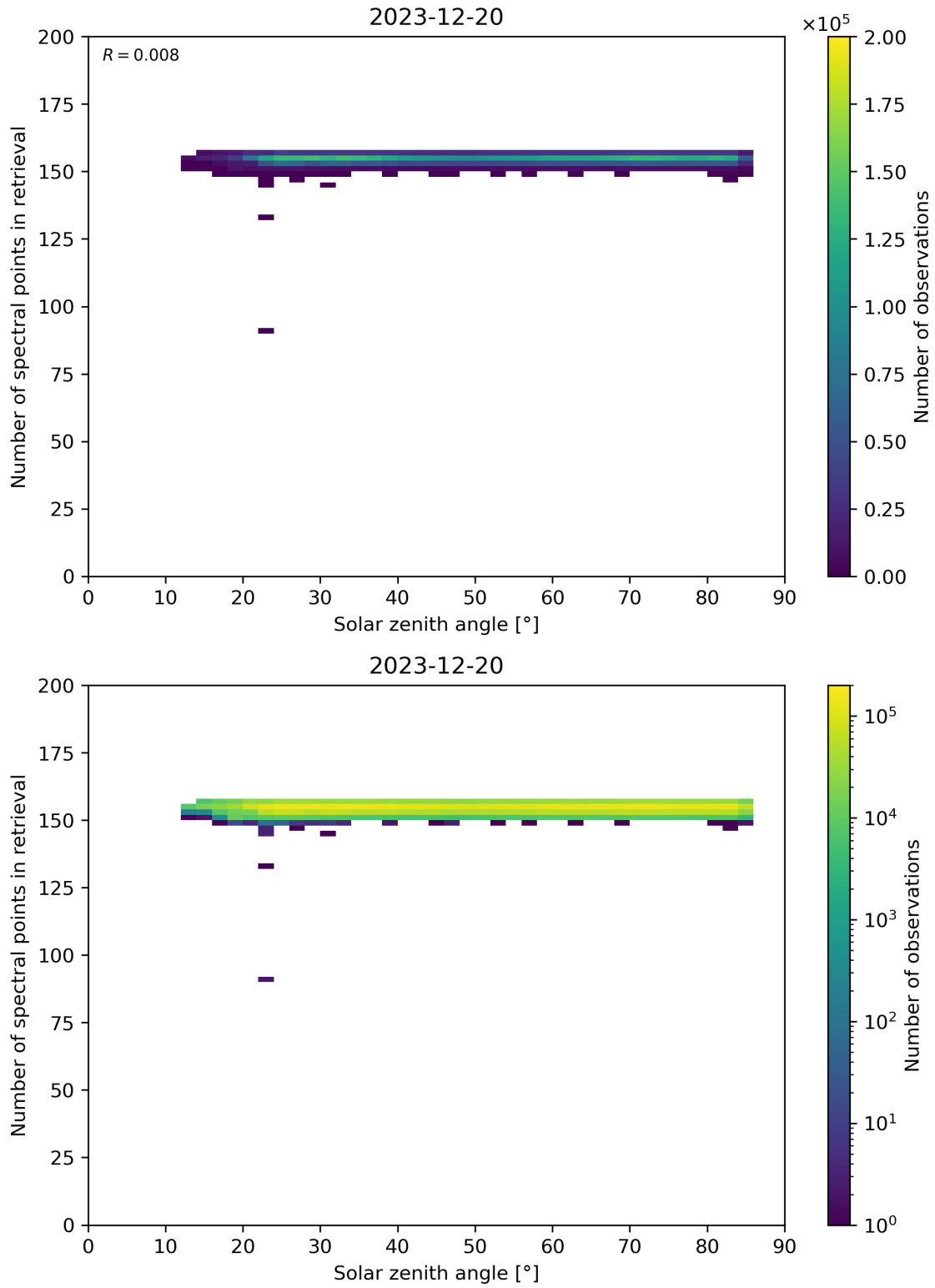


Figure 68: Scatter density plot of “Solar zenith angle” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

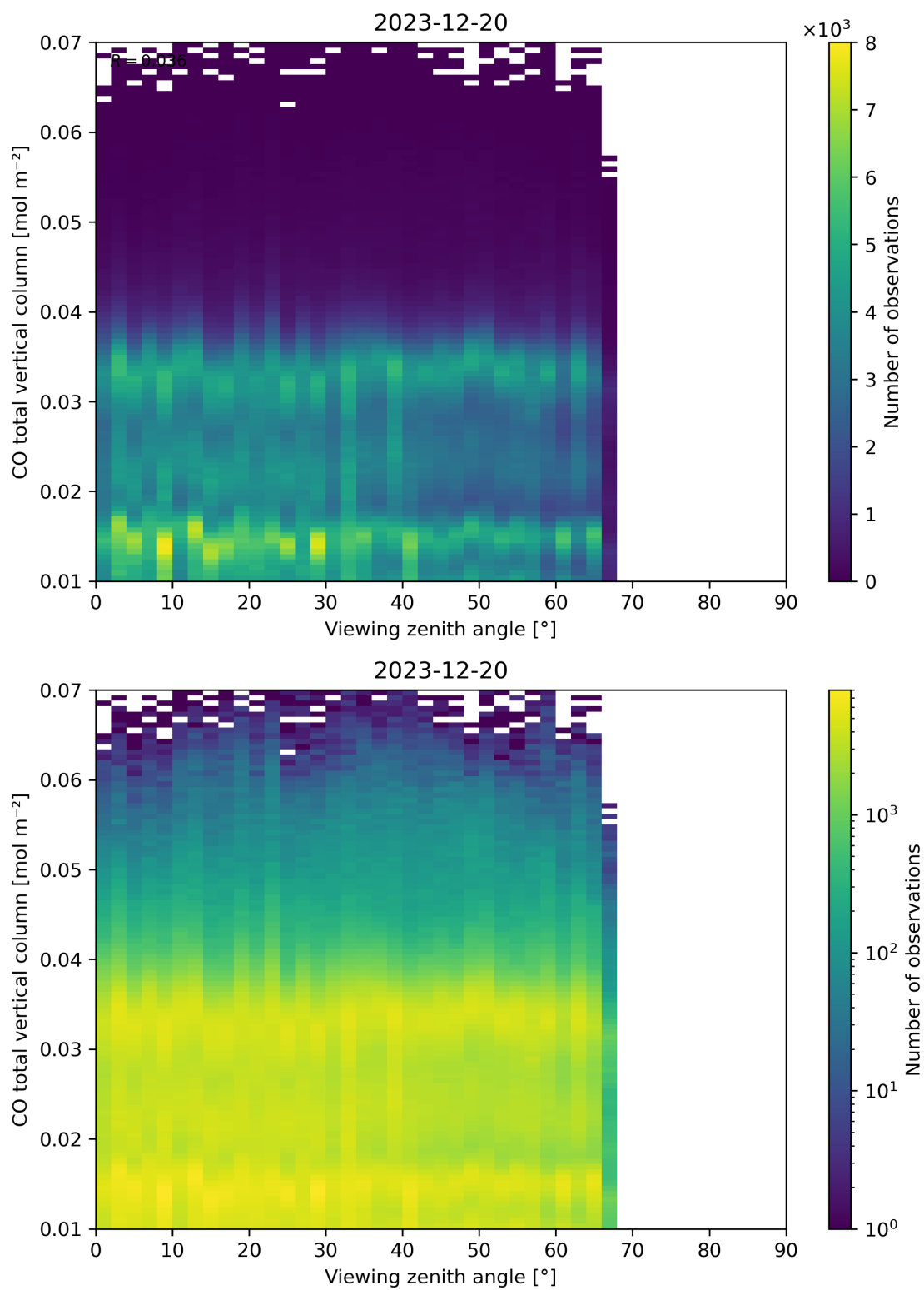


Figure 69: Scatter density plot of “Viewing zenith angle” against “CO total vertical column” for 2023-12-20 to 2023-12-21.

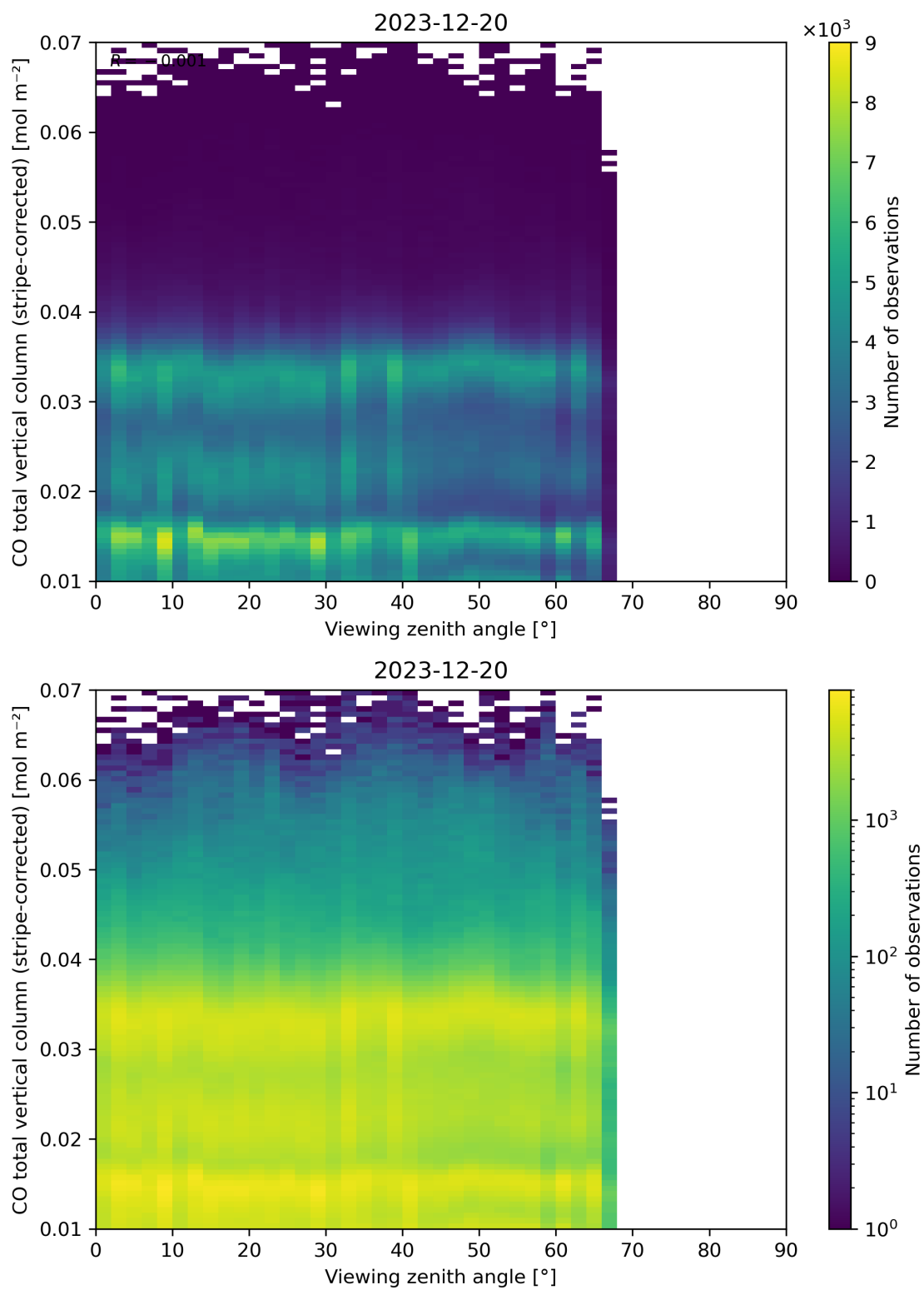


Figure 70: Scatter density plot of “Viewing zenith angle” against “CO total vertical column (stripe-corrected)” for 2023-12-20 to 2023-12-21.

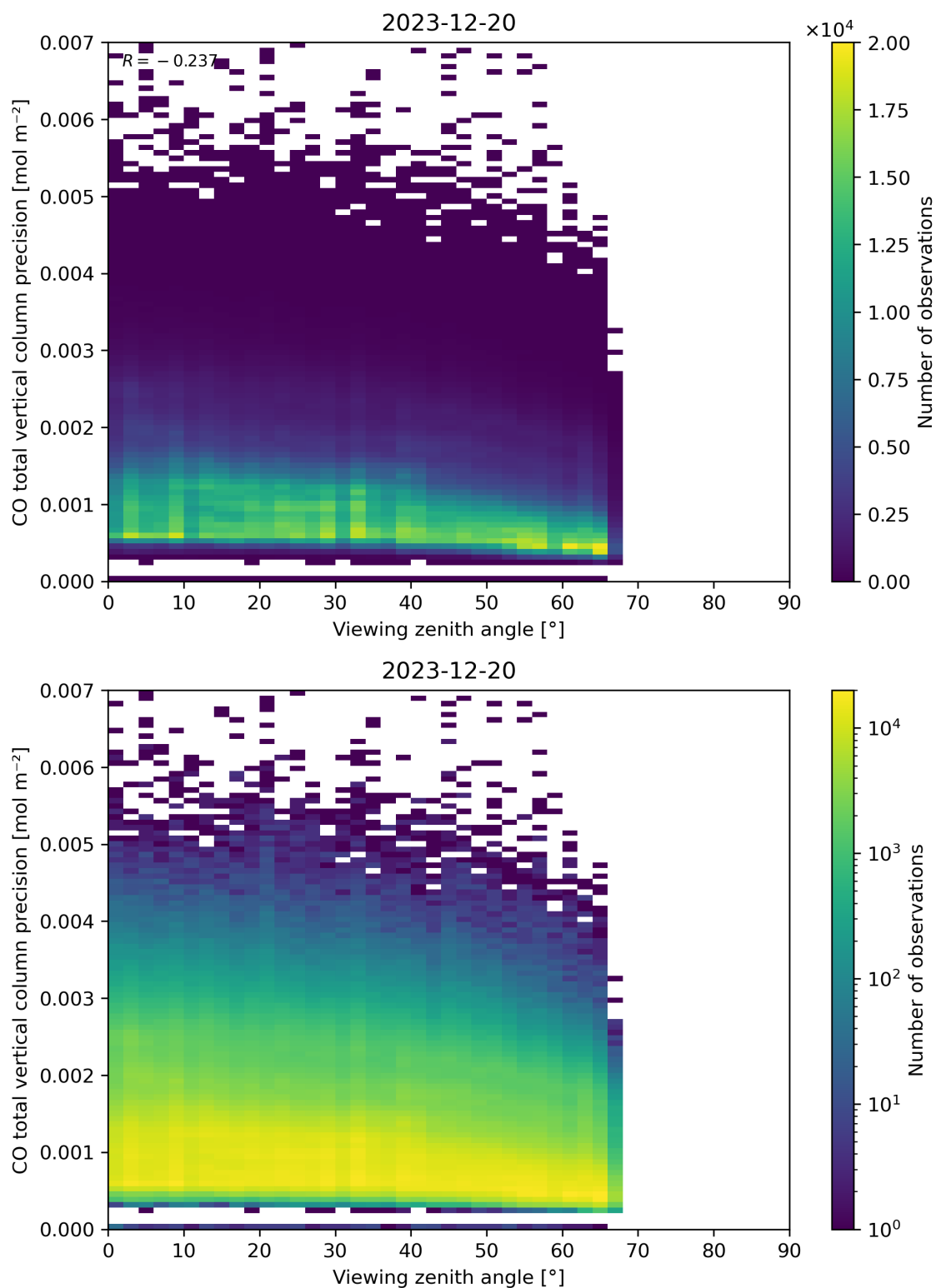


Figure 71: Scatter density plot of “Viewing zenith angle” against “CO total vertical column precision” for 2023-12-20 to 2023-12-21.

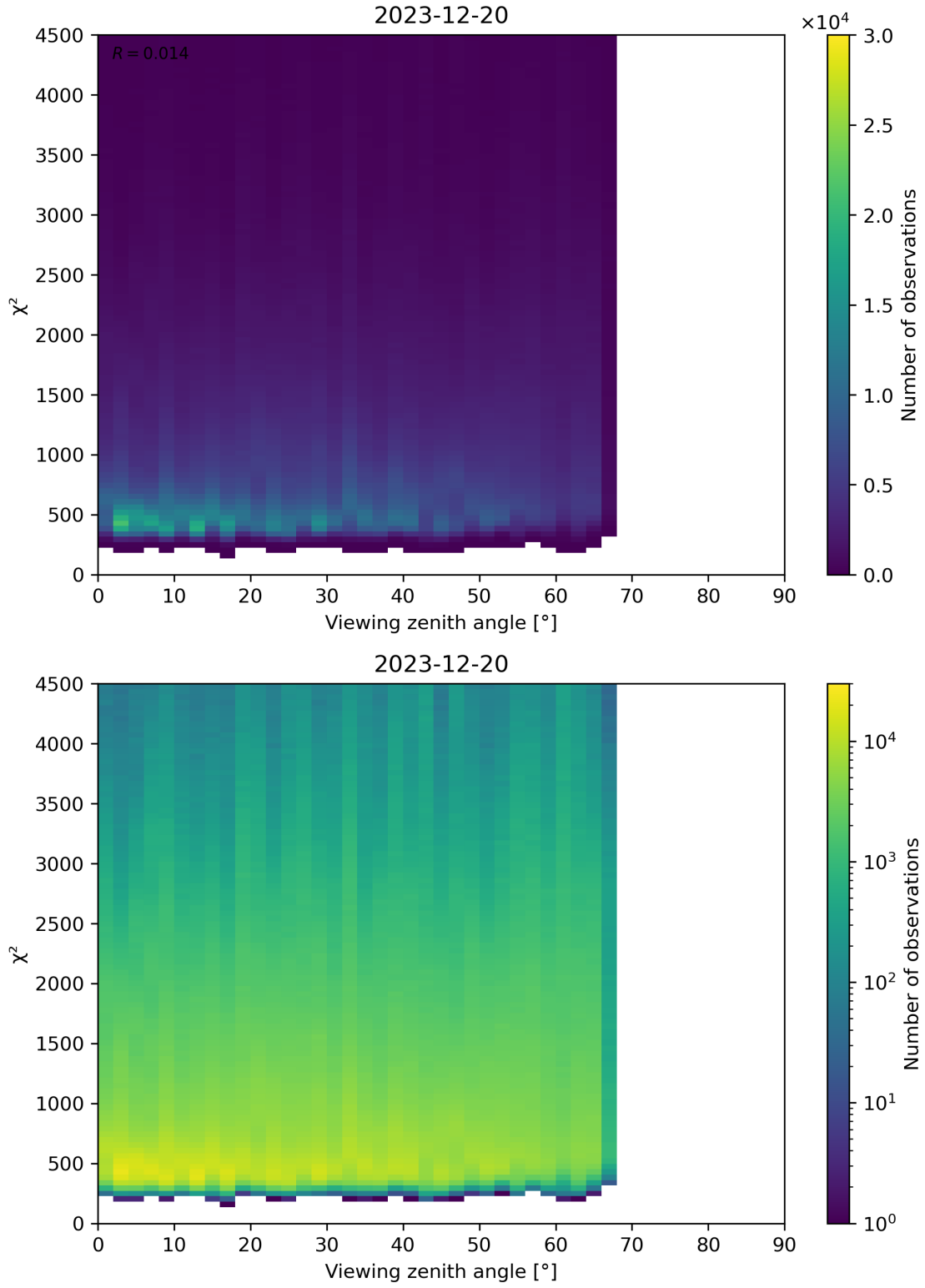


Figure 72: Scatter density plot of “Viewing zenith angle” against “ $\chi^2$ ” for 2023-12-20 to 2023-12-21.

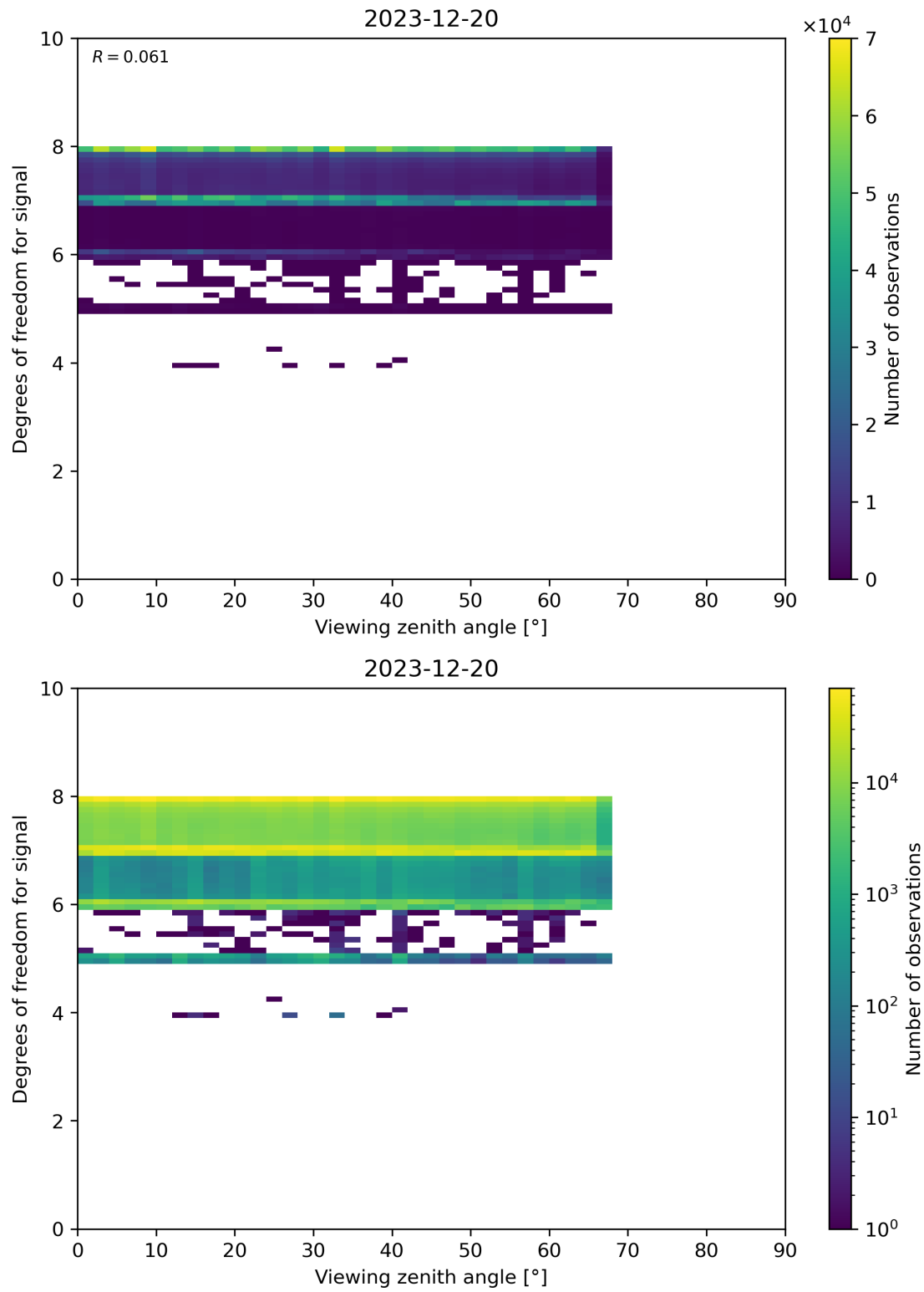


Figure 73: Scatter density plot of “Viewing zenith angle” against “Degrees of freedom for signal” for 2023-12-20 to 2023-12-21.

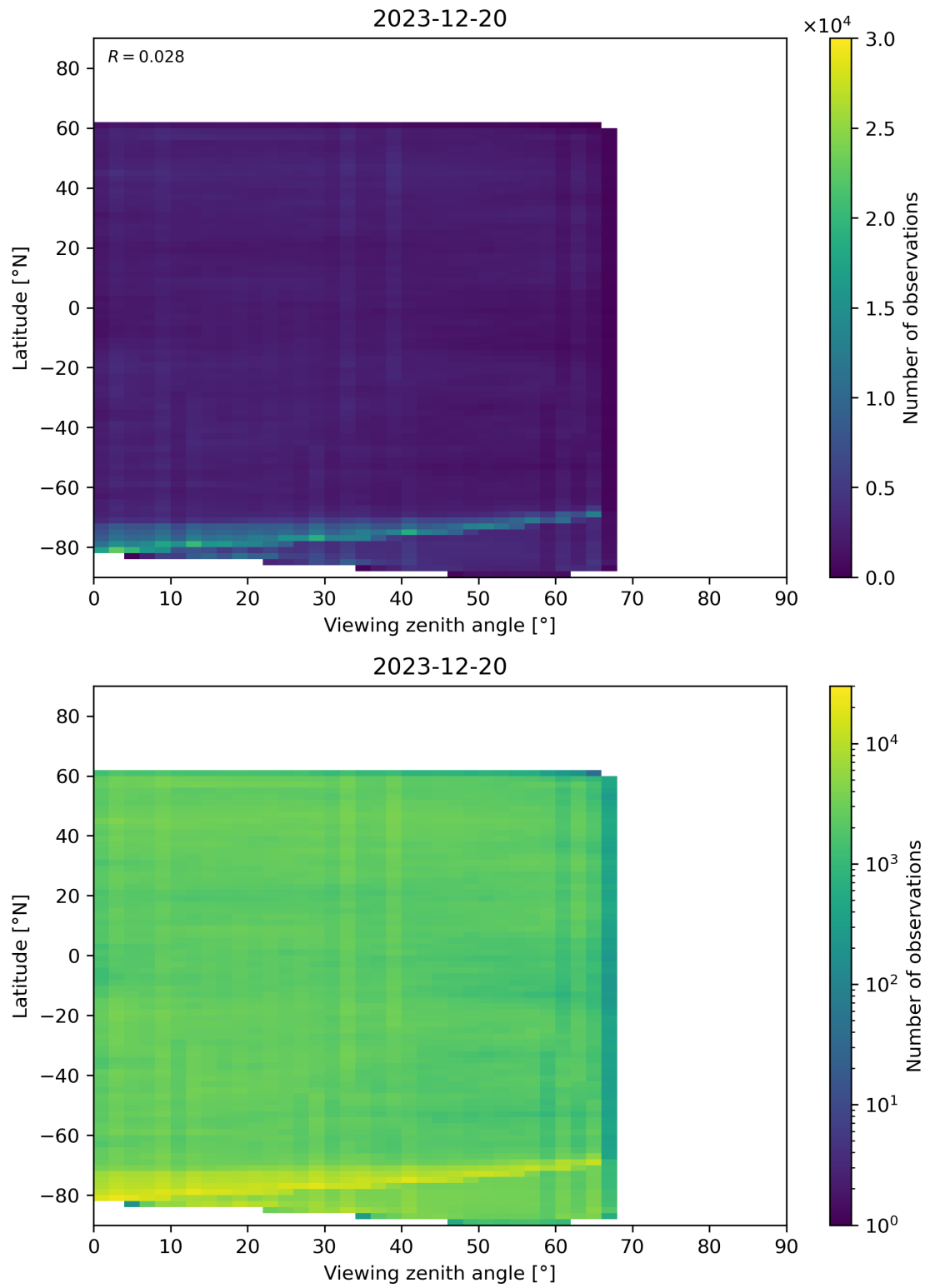


Figure 74: Scatter density plot of “Viewing zenith angle” against “Latitude” for 2023-12-20 to 2023-12-21.

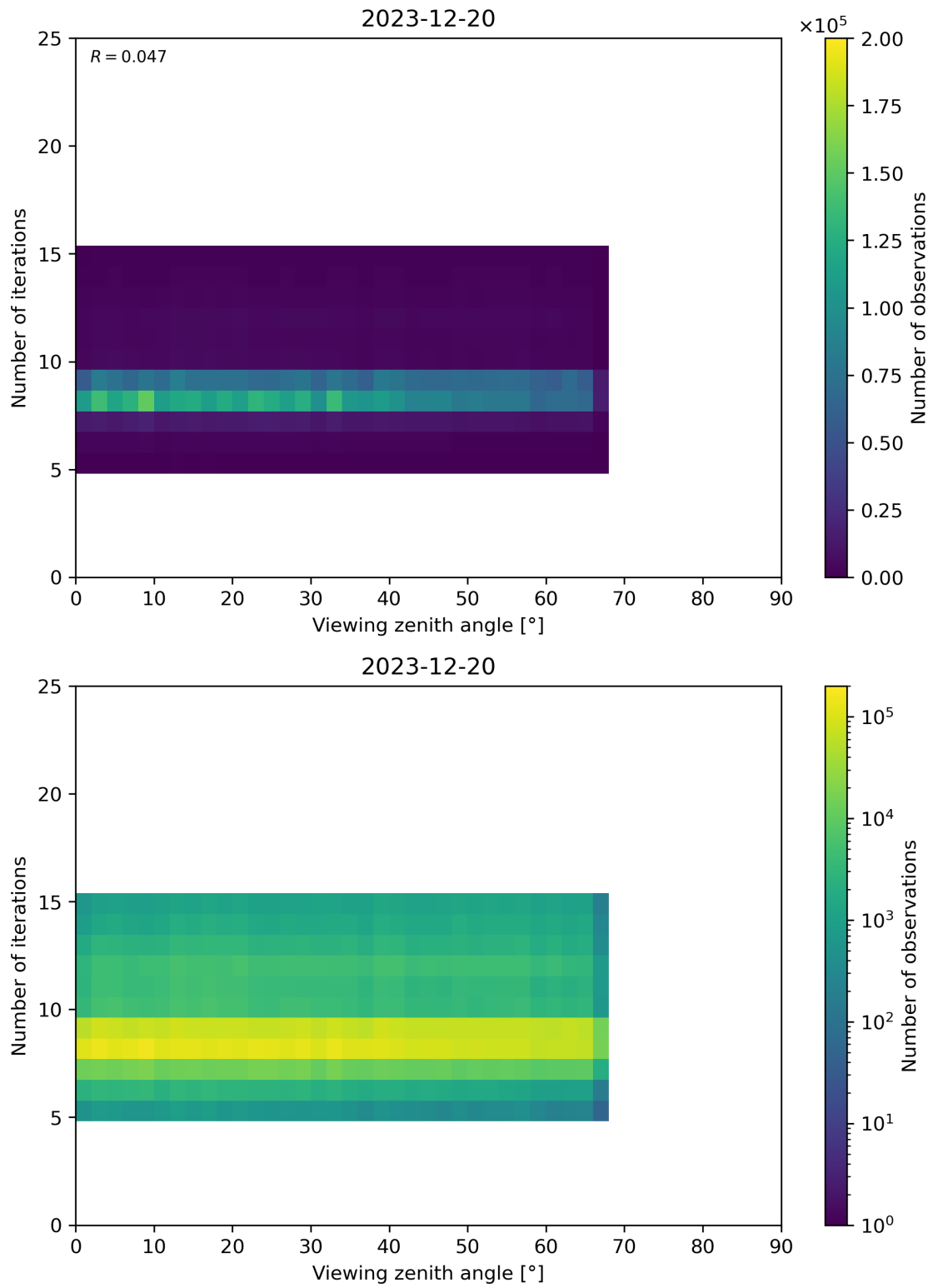


Figure 75: Scatter density plot of “Viewing zenith angle” against “Number of iterations” for 2023-12-20 to 2023-12-21.



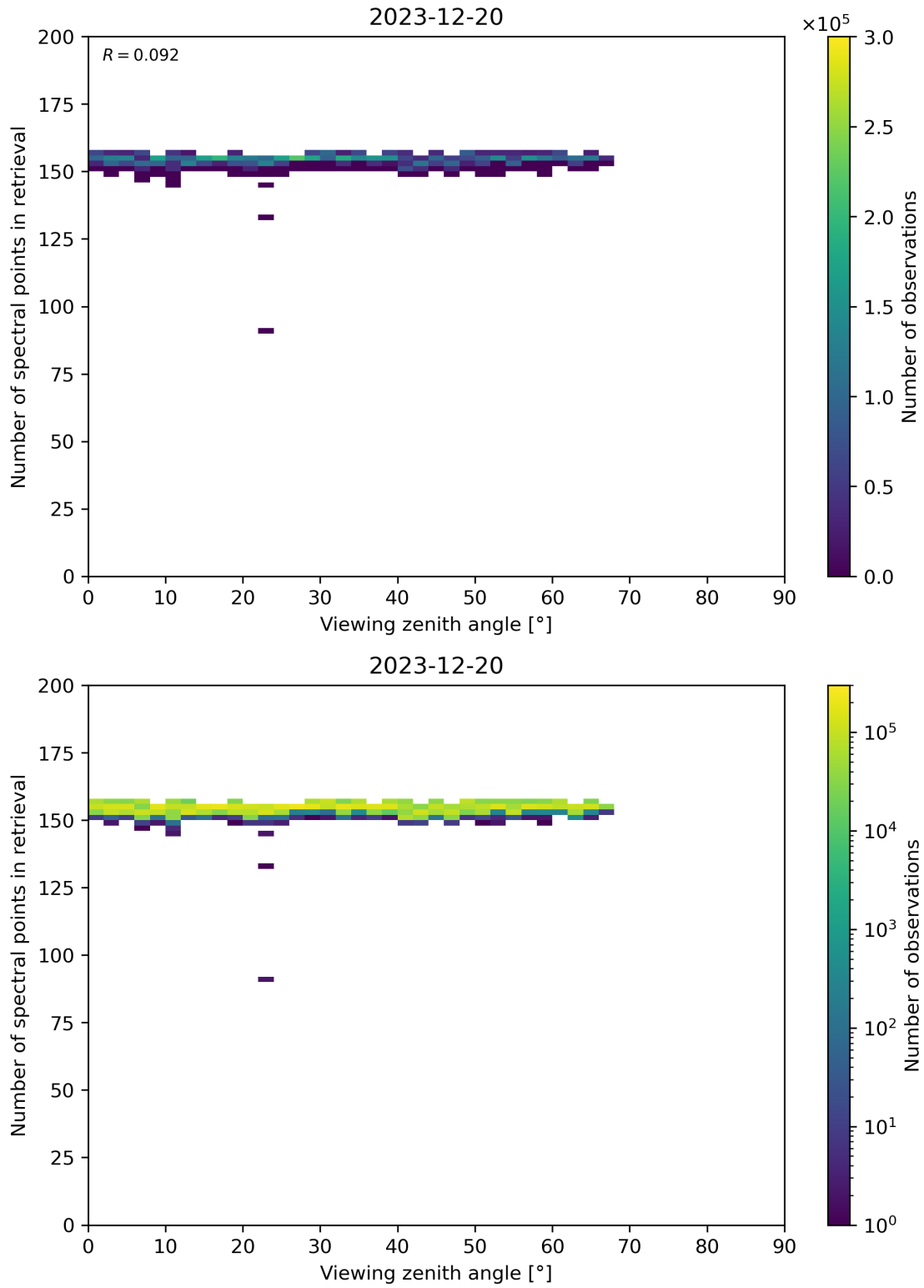


Figure 76: Scatter density plot of “Viewing zenith angle” against “Number of spectral points in retrieval” for 2023-12-20 to 2023-12-21.

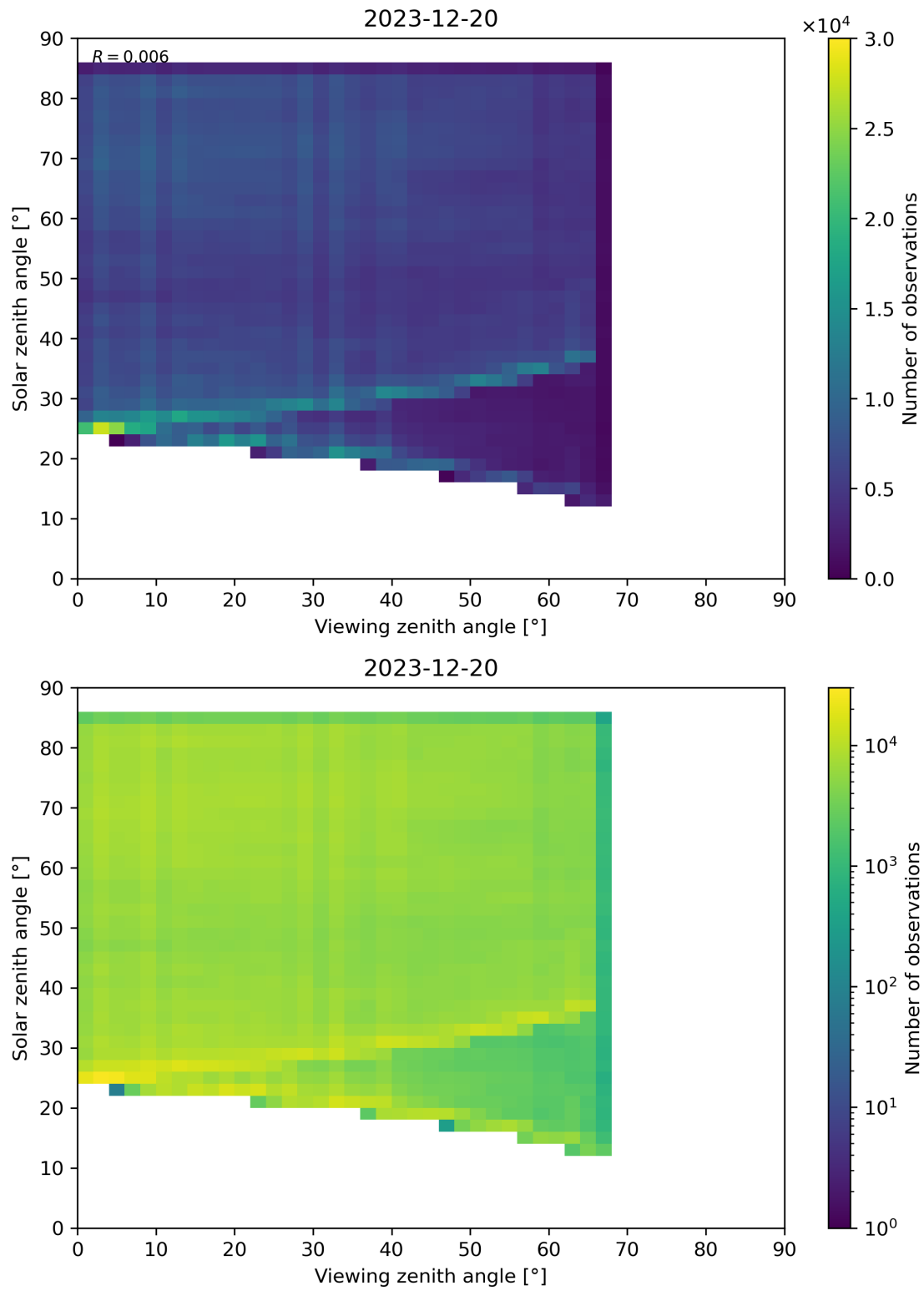


Figure 77: Scatter density plot of “Viewing zenith angle” against “Solar zenith angle” for 2023-12-20 to 2023-12-21.

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