

# PyCAMA report generated by tropl2-proc

tropl2-proc

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## 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]                                                                     | $0.756 \pm 0.295$                    | 627065 | 0.995                   | 0.600                  | 1.000                   | 0.160                   | 1.000                  |
| methane mixing ratio [parts per $10^9$ ]                                         | $(0.186 \pm 0.009) \times 10^4$      | 627065 | $1.933 \times 10^3$     | 140                    | $1.895 \times 10^3$     | 802                     | $2.312 \times 10^3$    |
| methane mixing ratio precision [parts per $10^9$ ]                               | $2.57 \pm 2.01$                      | 627065 | 1.30                    | 1.54                   | 1.91                    | 0.902                   | 43.5                   |
| methane mixing ratio bias corrected [parts per $10^9$ ]                          | $(0.186 \pm 0.008) \times 10^4$      | 627065 | $1.907 \times 10^3$     | 114                    | $1.893 \times 10^3$     | 824                     | $2.368 \times 10^3$    |
| number of spectral points in retrieval [1]                                       | $798 \pm 3$                          | 627065 | 798                     | 4.00                   | 798                     | 723                     | 805                    |
| wavelength calibration offset SWIR [nm]                                          | $(-1.036 \pm 0.312) \times 10^{-2}$  | 627065 | $-9.000 \times 10^{-3}$ | $2.195 \times 10^{-3}$ | $-1.016 \times 10^{-2}$ | $-7.032 \times 10^{-2}$ | $4.903 \times 10^{-2}$ |
| chi square SWIR [1]                                                              | $(0.181 \pm 0.466) \times 10^5$      | 627065 | $2.250 \times 10^3$     | $2.230 \times 10^4$    | $9.833 \times 10^3$     | $1.464 \times 10^3$     | $3.228 \times 10^7$    |
| chi square NIR [1]                                                               | $(0.238 \pm 52.612) \times 10^6$     | 627065 | $2.250 \times 10^3$     | $1.052 \times 10^4$    | $8.872 \times 10^3$     | 105                     | $3.377 \times 10^{10}$ |
| degrees of freedom [1]                                                           | $18.2 \pm 0.5$                       | 627065 | 18.3                    | 0.741                  | 18.2                    | 17.0                    | 20.9                   |
| number of iterations [1]                                                         | $10.1 \pm 1.3$                       | 627065 | 10.2                    | 0.0                    | 10.00                   | 10.00                   | 30.0                   |
| fluorescence [ $\text{mol s}^{-1} \text{m}^{-2} \text{nm}^{-1} \text{sr}^{-1}$ ] | $(-1.578 \pm 15.091) \times 10^{-8}$ | 627065 | $-7.700 \times 10^{-9}$ | $3.483 \times 10^{-8}$ | $-1.290 \times 10^{-8}$ | $-1.012 \times 10^{-4}$ | $2.735 \times 10^{-6}$ |

Table 2: Percentile ranges

| Variable                                                                              | 1 %                     | 5 %                     | 10 %                    | 15.9 %                  | 25 %                    | 75 %                    | 84.1 %                  | 90 %                    | 95 %                    | 99 %                    |
|---------------------------------------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| qa value [1]                                                                          | 0.400                   | 0.400                   | 0.400                   | 0.400                   | 0.400                   | 1.000                   | 1.000                   | 1.000                   | 1.000                   | 1.000                   |
| methane mixing ratio [parts per 10 <sup>9</sup> ]                                     | $1.660 \times 10^3$     | $1.694 \times 10^3$     | $1.714 \times 10^3$     | $1.736 \times 10^3$     | $1.788 \times 10^3$     | $1.928 \times 10^3$     | $1.938 \times 10^3$     | $1.945 \times 10^3$     | $1.954 \times 10^3$     | $1.972 \times 10^3$     |
| methane mixing ratio precision [parts per 10 <sup>9</sup> ]                           | 1.08                    | 1.17                    | 1.24                    | 1.30                    | 1.42                    | 2.96                    | 3.63                    | 4.43                    | 5.95                    | 11.2                    |
| methane mixing ratio bias corrected [parts per 10 <sup>9</sup> ]                      | $1.678 \times 10^3$     | $1.710 \times 10^3$     | $1.732 \times 10^3$     | $1.756 \times 10^3$     | $1.807 \times 10^3$     | $1.920 \times 10^3$     | $1.932 \times 10^3$     | $1.941 \times 10^3$     | $1.953 \times 10^3$     | $1.975 \times 10^3$     |
| number of spectral points in retrieval [1]                                            | 791                     | 793                     | 794                     | 795                     | 796                     | 800                     | 801                     | 802                     | 803                     | 804                     |
| wavelength calibration offset SWIR [nm]                                               | $-1.820 \times 10^{-2}$ | $-1.397 \times 10^{-2}$ | $-1.293 \times 10^{-2}$ | $-1.222 \times 10^{-2}$ | $-1.144 \times 10^{-2}$ | $-9.242 \times 10^{-3}$ | $-8.783 \times 10^{-3}$ | $-8.257 \times 10^{-3}$ | $-7.235 \times 10^{-3}$ | $-2.696 \times 10^{-3}$ |
| chi square SWIR [1]                                                                   | $1.894 \times 10^3$     | $2.151 \times 10^3$     | $2.400 \times 10^3$     | $2.771 \times 10^3$     | $3.710 \times 10^3$     | $2.601 \times 10^4$     | $3.752 \times 10^4$     | $4.526 \times 10^4$     | $5.388 \times 10^4$     | $9.321 \times 10^4$     |
| chi square NIR [1]                                                                    | $1.035 \times 10^3$     | $1.781 \times 10^3$     | $2.427 \times 10^3$     | $3.225 \times 10^3$     | $4.447 \times 10^3$     | $1.497 \times 10^4$     | $1.899 \times 10^4$     | $2.210 \times 10^4$     | $2.547 \times 10^4$     | $3.282 \times 10^4$     |
| degrees of freedom [1]                                                                | 17.2                    | 17.3                    | 17.5                    | 17.6                    | 17.8                    | 18.6                    | 18.7                    | 18.8                    | 18.9                    | 19.0                    |
| number of iterations [1]                                                              | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 10.00                   | 13.0                    |
| fluorescence [mol s <sup>-1</sup> m <sup>-2</sup> nm <sup>-1</sup> sr <sup>-1</sup> ] | $-1.011 \times 10^{-7}$ | $-6.991 \times 10^{-8}$ | $-5.637 \times 10^{-8}$ | $-4.647 \times 10^{-8}$ | $-3.450 \times 10^{-8}$ | $3.368 \times 10^{-10}$ | $9.952 \times 10^{-9}$  | $2.072 \times 10^{-8}$  | $3.815 \times 10^{-8}$  | $8.517 \times 10^{-8}$  |

Table 3: Parameterlist and basic statistics for the analysis for observations in the northern hemisphere

| Variable                                                                         | mean $\pm \sigma$                    | Count  | IQR                    | Median                  | Minimum                 | Maximum                | 25 % percentile         | 75 % percentile         |
|----------------------------------------------------------------------------------|--------------------------------------|--------|------------------------|-------------------------|-------------------------|------------------------|-------------------------|-------------------------|
| qa value [1]                                                                     | $0.790 \pm 0.286$                    | 375223 | 0.600                  | 1.000                   | 0.160                   | 1.000                  | 0.400                   | 1.000                   |
| methane mixing ratio [parts per $10^9$ ]                                         | $(0.192 \pm 0.003) \times 10^4$      | 375223 | 35.3                   | $1.923 \times 10^3$     | $1.324 \times 10^3$     | $2.312 \times 10^3$    | $1.903 \times 10^3$     | $1.939 \times 10^3$     |
| methane mixing ratio precision [parts per $10^9$ ]                               | $2.13 \pm 1.63$                      | 375223 | 0.819                  | 1.66                    | 0.917                   | 36.7                   | 1.35                    | 2.17                    |
| methane mixing ratio bias corrected [parts per $10^9$ ]                          | $(0.191 \pm 0.003) \times 10^4$      | 375223 | 33.9                   | $1.915 \times 10^3$     | $1.345 \times 10^3$     | $2.368 \times 10^3$    | $1.899 \times 10^3$     | $1.933 \times 10^3$     |
| number of spectral points in retrieval [1]                                       | $798 \pm 3$                          | 375223 | 4.00                   | 798                     | 723                     | 805                    | 796                     | 800                     |
| wavelength calibration offset SWIR [nm]                                          | $(-1.045 \pm 0.323) \times 10^{-2}$  | 375223 | $2.418 \times 10^{-3}$ | $-1.028 \times 10^{-2}$ | $-6.992 \times 10^{-2}$ | $4.903 \times 10^{-2}$ | $-1.169 \times 10^{-2}$ | $-9.271 \times 10^{-3}$ |
| chi square SWIR [1]                                                              | $(0.243 \pm 0.237) \times 10^5$      | 375223 | $2.950 \times 10^4$    | $1.478 \times 10^4$     | $1.512 \times 10^3$     | $9.565 \times 10^5$    | $7.865 \times 10^3$     | $3.736 \times 10^4$     |
| chi square NIR [1]                                                               | $(0.342 \pm 67.905) \times 10^6$     | 375223 | $7.315 \times 10^3$    | $6.172 \times 10^3$     | 105                     | $3.377 \times 10^{10}$ | $3.666 \times 10^3$     | $1.098 \times 10^4$     |
| degrees of freedom [1]                                                           | $18.4 \pm 0.4$                       | 375223 | 0.592                  | 18.4                    | 17.0                    | 20.9                   | 18.1                    | 18.7                    |
| number of iterations [1]                                                         | $10.2 \pm 1.5$                       | 375223 | 0.0                    | 10.00                   | 10.00                   | 30.0                   | 10.00                   | 10.00                   |
| fluorescence [ $\text{mol s}^{-1} \text{m}^{-2} \text{nm}^{-1} \text{sr}^{-1}$ ] | $(-8.308 \pm 95.693) \times 10^{-9}$ | 375223 | $2.313 \times 10^{-8}$ | $-9.120 \times 10^{-9}$ | $-2.620 \times 10^{-5}$ | $1.072 \times 10^{-6}$ | $-2.123 \times 10^{-8}$ | $1.893 \times 10^{-9}$  |



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]                                                                     | $0.705 \pm 0.300$                    | 251842 | 0.600                  | 1.000                   | 0.160                   | 1.000                  | 0.400                   | 1.000                   |
| methane mixing ratio [parts per $10^9$ ]                                         | $(0.177 \pm 0.007) \times 10^4$      | 251842 | 128                    | $1.754 \times 10^3$     | 802                     | $1.938 \times 10^3$    | $1.714 \times 10^3$     | $1.843 \times 10^3$     |
| methane mixing ratio precision [parts per $10^9$ ]                               | $3.22 \pm 2.32$                      | 251842 | 1.83                   | 2.71                    | 0.902                   | 43.5                   | 1.87                    | 3.70                    |
| methane mixing ratio bias corrected [parts per $10^9$ ]                          | $(0.178 \pm 0.006) \times 10^4$      | 251842 | 112                    | $1.776 \times 10^3$     | 824                     | $1.958 \times 10^3$    | $1.732 \times 10^3$     | $1.844 \times 10^3$     |
| number of spectral points in retrieval [1]                                       | $798 \pm 3$                          | 251842 | 4.00                   | 798                     | 774                     | 805                    | 796                     | 800                     |
| wavelength calibration offset SWIR [nm]                                          | $(-1.023 \pm 0.293) \times 10^{-2}$  | 251842 | $1.872 \times 10^{-3}$ | $-1.001 \times 10^{-2}$ | $-7.032 \times 10^{-2}$ | $4.607 \times 10^{-2}$ | $-1.109 \times 10^{-2}$ | $-9.213 \times 10^{-3}$ |
| chi square SWIR [1]                                                              | $(0.881 \pm 6.659) \times 10^4$      | 251842 | $8.416 \times 10^3$    | $3.366 \times 10^3$     | $1.464 \times 10^3$     | $3.228 \times 10^7$    | $2.445 \times 10^3$     | $1.086 \times 10^4$     |
| chi square NIR [1]                                                               | $(0.849 \pm 46.816) \times 10^5$     | 251842 | $1.409 \times 10^4$    | $1.520 \times 10^4$     | 140                     | $6.570 \times 10^8$    | $7.822 \times 10^3$     | $2.191 \times 10^4$     |
| degrees of freedom [1]                                                           | $17.9 \pm 0.4$                       | 251842 | 0.715                  | 17.8                    | 17.0                    | 20.8                   | 17.5                    | 18.2                    |
| number of iterations [1]                                                         | $10.1 \pm 1.0$                       | 251842 | 0.0                    | 10.00                   | 10.00                   | 30.0                   | 10.00                   | 10.00                   |
| fluorescence [ $\text{mol s}^{-1} \text{m}^{-2} \text{nm}^{-1} \text{sr}^{-1}$ ] | $(-2.692 \pm 20.701) \times 10^{-8}$ | 251842 | $4.959 \times 10^{-8}$ | $-3.072 \times 10^{-8}$ | $-1.012 \times 10^{-4}$ | $2.735 \times 10^{-6}$ | $-5.269 \times 10^{-8}$ | $-3.095 \times 10^{-9}$ |

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]                                                                     | $0.673 \pm 0.300$                    | 32183 | 0.600                  | 0.400                   | 0.160                   | 1.000                  | 0.400                   | 1.000                   |
| methane mixing ratio [parts per $10^9$ ]                                         | $(0.186 \pm 0.003) \times 10^4$      | 32183 | 32.3                   | $1.864 \times 10^3$     | $1.608 \times 10^3$     | $1.985 \times 10^3$    | $1.848 \times 10^3$     | $1.880 \times 10^3$     |
| methane mixing ratio precision [parts per $10^9$ ]                               | $2.83 \pm 1.01$                      | 32183 | 1.06                   | 2.72                    | 1.09                    | 21.6                   | 2.21                    | 3.27                    |
| methane mixing ratio bias corrected [parts per $10^9$ ]                          | $(0.187 \pm 0.003) \times 10^4$      | 32183 | 32.5                   | $1.871 \times 10^3$     | $1.614 \times 10^3$     | $1.992 \times 10^3$    | $1.855 \times 10^3$     | $1.888 \times 10^3$     |
| number of spectral points in retrieval [1]                                       | $798 \pm 3$                          | 32183 | 4.00                   | 798                     | 789                     | 803                    | 796                     | 800                     |
| wavelength calibration offset SWIR [nm]                                          | $(-9.577 \pm 1.098) \times 10^{-3}$  | 32183 | $1.050 \times 10^{-3}$ | $-9.417 \times 10^{-3}$ | $-3.601 \times 10^{-2}$ | $1.709 \times 10^{-2}$ | $-1.006 \times 10^{-2}$ | $-9.011 \times 10^{-3}$ |
| chi square SWIR [1]                                                              | $(0.773 \pm 18.006) \times 10^4$     | 32183 | $3.794 \times 10^3$    | $5.487 \times 10^3$     | $1.739 \times 10^3$     | $3.228 \times 10^7$    | $4.222 \times 10^3$     | $8.016 \times 10^3$     |
| chi square NIR [1]                                                               | $(0.681 \pm 72.383) \times 10^4$     | 32183 | $1.646 \times 10^3$    | $2.212 \times 10^3$     | 212                     | $1.298 \times 10^8$    | $1.661 \times 10^3$     | $3.307 \times 10^3$     |
| degrees of freedom [1]                                                           | $18.0 \pm 0.2$                       | 32183 | 0.275                  | 18.0                    | 17.1                    | 18.6                   | 17.9                    | 18.1                    |
| number of iterations [1]                                                         | $10.0 \pm 0.5$                       | 32183 | 0.0                    | 10.00                   | 10.00                   | 29.0                   | 10.00                   | 10.00                   |
| fluorescence [ $\text{mol s}^{-1} \text{m}^{-2} \text{nm}^{-1} \text{sr}^{-1}$ ] | $(-1.322 \pm 14.576) \times 10^{-9}$ | 32183 | $1.293 \times 10^{-8}$ | $-3.449 \times 10^{-9}$ | $-6.624 \times 10^{-8}$ | $3.474 \times 10^{-7}$ | $-9.614 \times 10^{-9}$ | $3.318 \times 10^{-9}$  |

Table 6: Parameterlist and basic statistics for the analysis for observations over land

| Variable                                                                         | mean $\pm \sigma$                    | Count  | IQR                    | Median                  | Minimum                 | Maximum                | 25 % percentile         | 75 % percentile         |
|----------------------------------------------------------------------------------|--------------------------------------|--------|------------------------|-------------------------|-------------------------|------------------------|-------------------------|-------------------------|
| qa value [1]                                                                     | $0.771 \pm 0.292$                    | 528240 | 0.600                  | 1.000                   | 0.160                   | 1.000                  | 0.400                   | 1.000                   |
| methane mixing ratio [parts per $10^9$ ]                                         | $(0.186 \pm 0.009) \times 10^4$      | 528240 | 167                    | $1.899 \times 10^3$     | $1.284 \times 10^3$     | $2.309 \times 10^3$    | $1.762 \times 10^3$     | $1.930 \times 10^3$     |
| methane mixing ratio precision [parts per $10^9$ ]                               | $2.42 \pm 1.80$                      | 528240 | 1.45                   | 1.79                    | 0.902                   | 39.6                   | 1.37                    | 2.82                    |
| methane mixing ratio bias corrected [parts per $10^9$ ]                          | $(0.186 \pm 0.008) \times 10^4$      | 528240 | 136                    | $1.894 \times 10^3$     | $1.319 \times 10^3$     | $2.368 \times 10^3$    | $1.784 \times 10^3$     | $1.919 \times 10^3$     |
| number of spectral points in retrieval [1]                                       | $798 \pm 3$                          | 528240 | 4.00                   | 798                     | 723                     | 805                    | 796                     | 800                     |
| wavelength calibration offset SWIR [nm]                                          | $(-1.042 \pm 0.201) \times 10^{-2}$  | 528240 | $2.099 \times 10^{-3}$ | $-1.022 \times 10^{-2}$ | $-6.440 \times 10^{-2}$ | $2.829 \times 10^{-2}$ | $-1.144 \times 10^{-2}$ | $-9.339 \times 10^{-3}$ |
| chi square SWIR [1]                                                              | $(0.198 \pm 0.240) \times 10^5$      | 528240 | $2.691 \times 10^4$    | $1.168 \times 10^4$     | $1.464 \times 10^3$     | $4.898 \times 10^6$    | $3.516 \times 10^3$     | $3.042 \times 10^4$     |
| chi square NIR [1]                                                               | $(0.279 \pm 57.315) \times 10^6$     | 528240 | $1.071 \times 10^4$    | $1.028 \times 10^4$     | 320                     | $3.377 \times 10^{10}$ | $5.331 \times 10^3$     | $1.604 \times 10^4$     |
| degrees of freedom [1]                                                           | $18.2 \pm 0.5$                       | 528240 | 0.828                  | 18.3                    | 17.0                    | 20.9                   | 17.8                    | 18.6                    |
| number of iterations [1]                                                         | $10.1 \pm 1.3$                       | 528240 | 0.0                    | 10.00                   | 10.00                   | 30.0                   | 10.00                   | 10.00                   |
| fluorescence [ $\text{mol s}^{-1} \text{m}^{-2} \text{nm}^{-1} \text{sr}^{-1}$ ] | $(-1.712 \pm 16.366) \times 10^{-8}$ | 528240 | $3.779 \times 10^{-8}$ | $-1.463 \times 10^{-8}$ | $-1.012 \times 10^{-4}$ | $9.756 \times 10^{-7}$ | $-3.767 \times 10^{-8}$ | $1.131 \times 10^{-10}$ |

Table 7: Correlation matrix

| Fluorescence            | Number of iterations    | Degrees of freedom      | $\chi^2$ (NIR)          | $\chi^2$ (SWIR)         | Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ ) | Number of points in the spectrum | Bias corrected mole fraction of CH <sub>4</sub> | Precision of mole fraction of CH <sub>4</sub> | Mole fraction of CH <sub>4</sub> | Latitude                | Solar zenith angle      | Viewing zenith angle    |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|---------------------------------------------------------------------------|----------------------------------|-------------------------------------------------|-----------------------------------------------|----------------------------------|-------------------------|-------------------------|-------------------------|
| 5.263 $\times 10^{-2}$  | 2.488 $\times 10^{-2}$  | 0.143                   | 6.280 $\times 10^{-5}$  | 2.016 $\times 10^{-2}$  | -0.328                                                                    | 2.937 $\times 10^{-2}$           | 0.114                                           | -6.718 $\times 10^{-2}$                       | 0.117                            | 0.119                   | 5.371 $\times 10^{-3}$  | 1.000                   |
| -6.728 $\times 10^{-2}$ | 6.638 $\times 10^{-3}$  | -0.454                  | -2.631 $\times 10^{-3}$ | -0.130                  | -6.886 $\times 10^{-2}$                                                   | 1.023 $\times 10^{-2}$           | -0.303                                          | 0.353                                         | -0.321                           | -0.122                  | 1.000                   | 5.371 $\times 10^{-3}$  |
| 8.224 $\times 10^{-2}$  | 4.549 $\times 10^{-2}$  | 0.569                   | 1.580 $\times 10^{-3}$  | 0.160                   | -3.015 $\times 10^{-2}$                                                   | 1.966 $\times 10^{-2}$           | 0.877                                           | -0.317                                        | 0.886                            | 1.000                   | -0.122                  | 0.119                   |
| 5.840 $\times 10^{-2}$  | 2.732 $\times 10^{-3}$  | 0.702                   | 2.024 $\times 10^{-4}$  | 0.202                   | -1.672 $\times 10^{-2}$                                                   | 4.084 $\times 10^{-3}$           | 0.987                                           | -0.425                                        | 1.000                            | 0.886                   | -0.321                  | 0.117                   |
| -4.198 $\times 10^{-2}$ | -1.321 $\times 10^{-2}$ | -0.438                  | -2.606 $\times 10^{-3}$ | -0.183                  | 4.769 $\times 10^{-3}$                                                    | -5.819 $\times 10^{-3}$          | -0.334                                          | 1.000                                         | -0.425                           | -0.317                  | 0.353                   | -6.718 $\times 10^{-2}$ |
| 5.157 $\times 10^{-2}$  | -5.484 $\times 10^{-3}$ | 0.622                   | -7.694 $\times 10^{-4}$ | 0.154                   | -1.235 $\times 10^{-2}$                                                   | 3.748 $\times 10^{-3}$           | 1.000                                           | -0.334                                        | 0.987                            | 0.877                   | -0.303                  | 0.114                   |
| 9.927 $\times 10^{-4}$  | -2.583 $\times 10^{-4}$ | 1.345 $\times 10^{-3}$  | 2.946 $\times 10^{-6}$  | 3.816 $\times 10^{-3}$  | -1.152 $\times 10^{-2}$                                                   | 1.000                            | 3.748 $\times 10^{-3}$                          | -5.819 $\times 10^{-3}$                       | 4.084 $\times 10^{-3}$           | 1.966 $\times 10^{-2}$  | 1.023 $\times 10^{-2}$  | 2.937 $\times 10^{-2}$  |
| -3.172 $\times 10^{-2}$ | -5.968 $\times 10^{-3}$ | -3.488 $\times 10^{-2}$ | 4.255 $\times 10^{-4}$  | -1.668 $\times 10^{-3}$ | 1.000                                                                     | -1.152 $\times 10^{-2}$          | -1.235 $\times 10^{-2}$                         | 4.769 $\times 10^{-3}$                        | -1.672 $\times 10^{-2}$          | -3.015 $\times 10^{-2}$ | -6.886 $\times 10^{-2}$ | -0.328                  |
| 2.563 $\times 10^{-2}$  | 3.134 $\times 10^{-2}$  | 0.305                   | 8.493 $\times 10^{-3}$  | 1.000                   | -1.668 $\times 10^{-3}$                                                   | 3.816 $\times 10^{-3}$           | 0.154                                           | -0.183                                        | 0.202                            | 0.160                   | -0.130                  | 2.016 $\times 10^{-2}$  |
| -3.112 $\times 10^{-3}$ | 9.196 $\times 10^{-3}$  | 1.173 $\times 10^{-2}$  | 1.000                   | 8.493 $\times 10^{-3}$  | 4.255 $\times 10^{-4}$                                                    | 2.946 $\times 10^{-6}$           | -7.694 $\times 10^{-4}$                         | -2.606 $\times 10^{-3}$                       | 2.024 $\times 10^{-4}$           | 1.580 $\times 10^{-3}$  | -2.631 $\times 10^{-3}$ | 6.280 $\times 10^{-5}$  |
| 8.325 $\times 10^{-2}$  | -2.635 $\times 10^{-2}$ | 1.000                   | 1.173 $\times 10^{-2}$  | 0.305                   | -3.488 $\times 10^{-2}$                                                   | 1.345 $\times 10^{-3}$           | 0.622                                           | -0.438                                        | 0.702                            | 0.569                   | -0.454                  | 0.143                   |
| -4.395 $\times 10^{-3}$ | 1.000                   | -2.635 $\times 10^{-2}$ | 9.196 $\times 10^{-3}$  | 3.134 $\times 10^{-2}$  | -5.968 $\times 10^{-3}$                                                   | -2.583 $\times 10^{-4}$          | -5.484 $\times 10^{-3}$                         | -1.321 $\times 10^{-2}$                       | 2.732 $\times 10^{-3}$           | 4.549 $\times 10^{-2}$  | 6.638 $\times 10^{-3}$  | 2.488 $\times 10^{-2}$  |
| 1.000                   | -4.395 $\times 10^{-3}$ | 8.325 $\times 10^{-2}$  | -3.112 $\times 10^{-3}$ | 2.563 $\times 10^{-2}$  | -3.172 $\times 10^{-2}$                                                   | 9.927 $\times 10^{-4}$           | 5.157 $\times 10^{-2}$                          | -4.198 $\times 10^{-2}$                       | 5.840 $\times 10^{-2}$           | 8.224 $\times 10^{-2}$  | -6.728 $\times 10^{-2}$ | 5.263 $\times 10^{-2}$  |

Table 8: Covariance matrix

| Fluorescence             | Number of iterations     | Degrees of freedom      | $\chi^2$ (NIR)          | $\chi^2$ (SWIR)        | Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ ) | Number of points in the spectrum | Bias corrected mole fraction of CH <sub>4</sub> | Precision of mole fraction of CH <sub>4</sub> | Mole fraction of CH <sub>4</sub> | Latitude                | Solar zenith angle      | Viewing zenith angle    |
|--------------------------|--------------------------|-------------------------|-------------------------|------------------------|---------------------------------------------------------------------------|----------------------------------|-------------------------------------------------|-----------------------------------------------|----------------------------------|-------------------------|-------------------------|-------------------------|
| 1.286 $\times 10^{-7}$   | 0.522                    | 1.11                    | 5.349 $\times 10^4$     | 1.521 $\times 10^4$    | -1.654 $\times 10^{-2}$                                                   | 1.35                             | 147                                             | -2.19                                         | 168                              | 86.6                    | 1.19                    | 262                     |
| -1.394 $\times 10^{-7}$  | 0.118                    | -3.00                   | -1.901 $\times 10^6$    | -8.291 $\times 10^4$   | -2.947 $\times 10^{-3}$                                                   | 0.398                            | -331                                            | 9.76                                          | -391                             | -75.0                   | 189                     | 1.19                    |
| 5.578 $\times 10^{-7}$   | 2.65                     | 12.3                    | 3.735 $\times 10^6$     | 3.345 $\times 10^5$    | -4.224 $\times 10^{-3}$                                                   | 2.51                             | 3.137 $\times 10^3$                             | -28.6                                         | 3.528 $\times 10^3$              | 2.020 $\times 10^3$     | -75.0                   | 86.6                    |
| 7.809 $\times 10^{-7}$   | 0.314                    | 29.9                    | 9.436 $\times 10^5$     | 8.329 $\times 10^5$    | -4.617 $\times 10^{-3}$                                                   | 1.03                             | 6.956 $\times 10^3$                             | -75.7                                         | 7.849 $\times 10^3$              | 3.528 $\times 10^3$     | -391                    | 168                     |
| -1.273 $\times 10^{-8}$  | -3.443 $\times 10^{-2}$  | -0.423                  | -2.756 $\times 10^5$    | -1.710 $\times 10^4$   | 2.988 $\times 10^{-5}$                                                    | -3.316 $\times 10^{-2}$          | -53.5                                           | 4.04                                          | -75.7                            | -28.6                   | 9.76                    | -2.19                   |
| 6.192 $\times 10^{-7}$   | -0.566                   | 23.8                    | -3.221 $\times 10^6$    | 5.723 $\times 10^5$    | -3.062 $\times 10^{-3}$                                                   | 0.845                            | 6.330 $\times 10^3$                             | -53.5                                         | 6.956 $\times 10^3$              | 3.137 $\times 10^3$     | -331                    | 147                     |
| 4.247 $\times 10^{-10}$  | -9.495 $\times 10^{-4}$  | 1.832 $\times 10^{-3}$  | 439                     | 504                    | -1.018 $\times 10^{-4}$                                                   | 8.04                             | 0.845                                           | -3.316 $\times 10^{-2}$                       | 1.03                             | 2.51                    | 0.398                   | 1.35                    |
| -1.492 $\times 10^{-11}$ | -2.412 $\times 10^{-5}$  | -5.222 $\times 10^{-5}$ | 69.8                    | -0.242                 | 9.715 $\times 10^{-6}$                                                    | -1.018 $\times 10^{-4}$          | -3.062 $\times 10^{-3}$                         | 2.988 $\times 10^{-5}$                        | -4.617 $\times 10^{-3}$          | -4.224 $\times 10^{-3}$ | -2.947 $\times 10^{-3}$ | -1.654 $\times 10^{-2}$ |
| 1.803 $\times 10^{-4}$   | 1.895 $\times 10^3$      | 6.824 $\times 10^3$     | 2.083 $\times 10^{10}$  | 2.173 $\times 10^9$    | -0.242                                                                    | 504                              | 5.723 $\times 10^5$                             | -1.710 $\times 10^4$                          | 8.329 $\times 10^5$              | 3.345 $\times 10^5$     | -8.291 $\times 10^4$    | 1.521 $\times 10^4$     |
| -2.471 $\times 10^{-2}$  | 6.274 $\times 10^5$      | 2.965 $\times 10^5$     | 2.768 $\times 10^{15}$  | 2.083 $\times 10^{10}$ | 69.8                                                                      | 439                              | -3.221 $\times 10^6$                            | -2.756 $\times 10^5$                          | 9.436 $\times 10^5$              | 3.735 $\times 10^6$     | -1.901 $\times 10^6$    | 5.349 $\times 10^4$     |
| 6.035 $\times 10^{-9}$   | -1.641 $\times 10^{-2}$  | 0.231                   | 2.965 $\times 10^5$     | 6.824 $\times 10^3$    | -5.222 $\times 10^{-5}$                                                   | 1.832 $\times 10^{-3}$           | 23.8                                            | -0.423                                        | 29.9                             | 12.3                    | -3.00                   | 1.11                    |
| -8.602 $\times 10^{-10}$ | 1.68                     | -1.641 $\times 10^{-2}$ | 6.274 $\times 10^5$     | 1.895 $\times 10^3$    | -2.412 $\times 10^{-5}$                                                   | -9.495 $\times 10^{-4}$          | -0.566                                          | -3.443 $\times 10^{-2}$                       | 0.314                            | 2.65                    | 0.118                   | 0.522                   |
| 2.277 $\times 10^{-14}$  | -8.602 $\times 10^{-10}$ | 6.035 $\times 10^{-9}$  | -2.471 $\times 10^{-2}$ | 1.803 $\times 10^{-4}$ | -1.492 $\times 10^{-11}$                                                  | 4.247 $\times 10^{-10}$          | 6.192 $\times 10^{-7}$                          | -1.273 $\times 10^{-8}$                       | 7.809 $\times 10^{-7}$           | 5.578 $\times 10^{-7}$  | -1.394 $\times 10^{-7}$ | 1.286 $\times 10^{-7}$  |

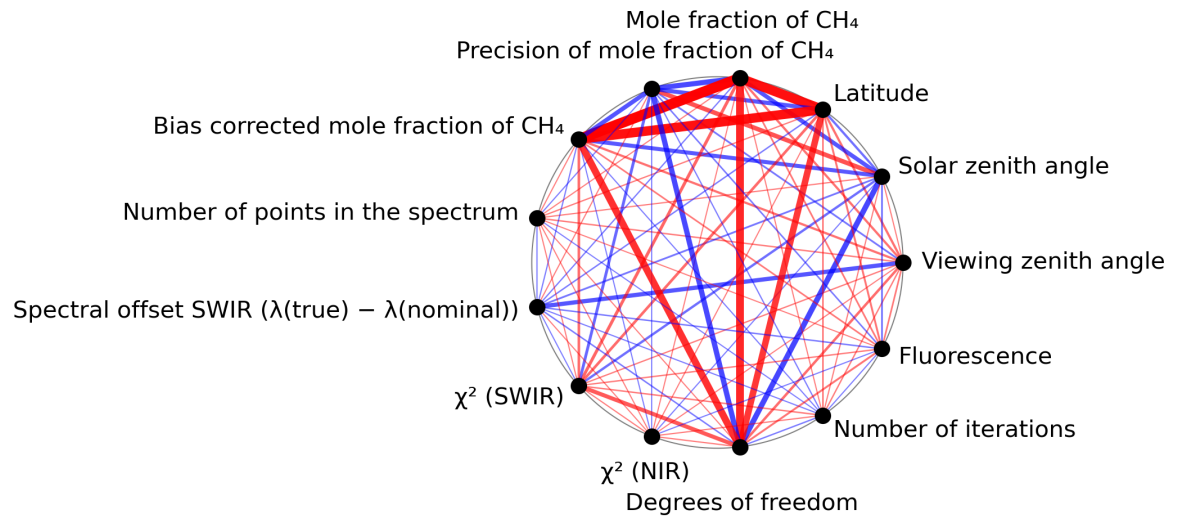


Figure 1: Map of correlation graph for 2023-11-20 to 2023-11-22.

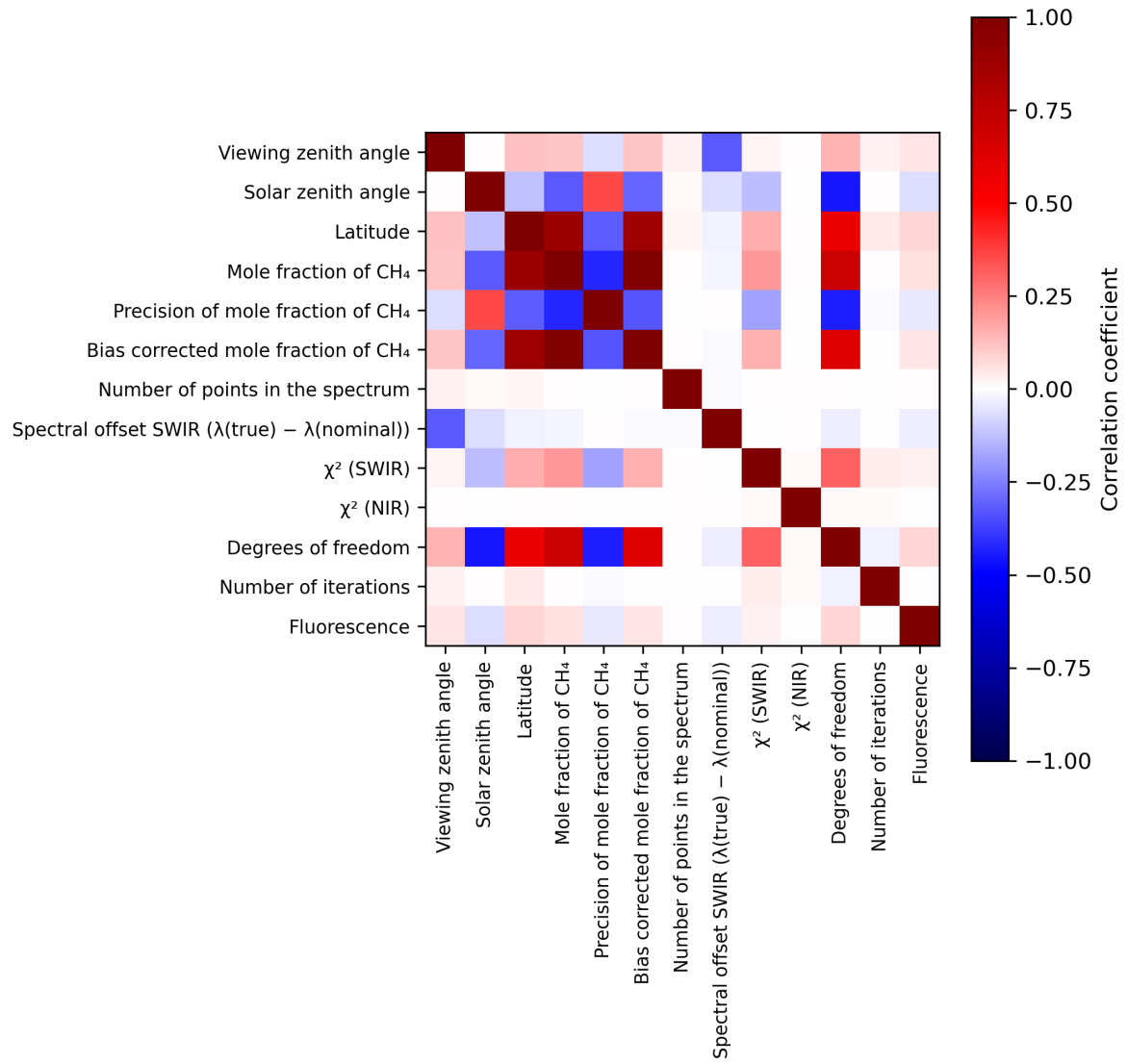


Figure 2: Map of correlation matrix for 2023-11-20 to 2023-11-22.

### 3 Granule outlines

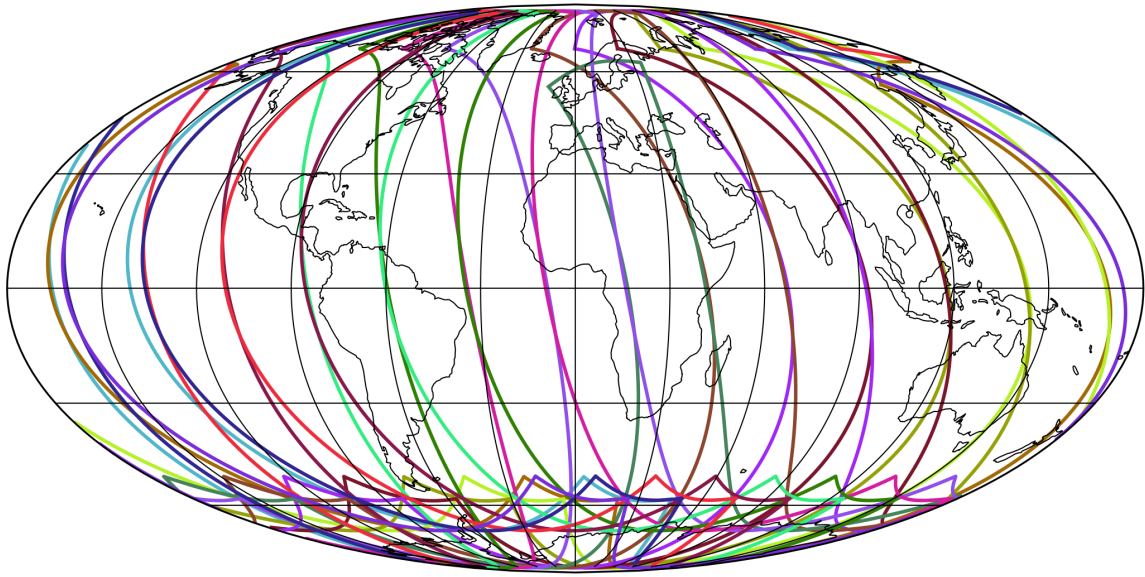


Figure 3: Outline of the granules.



## 4 Input data monitoring

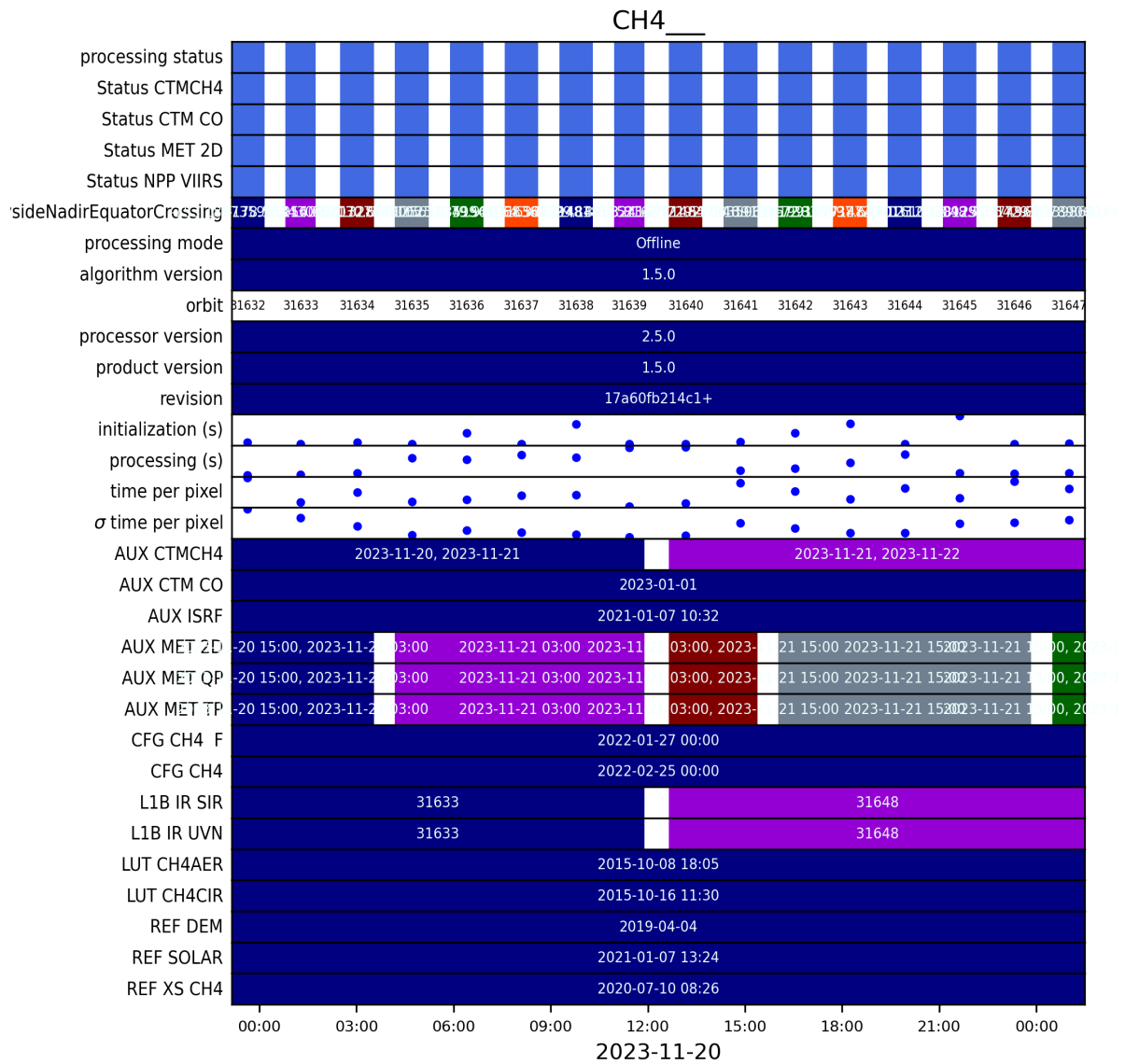


Figure 4: Input data per granule

## 5 Warnings and errors

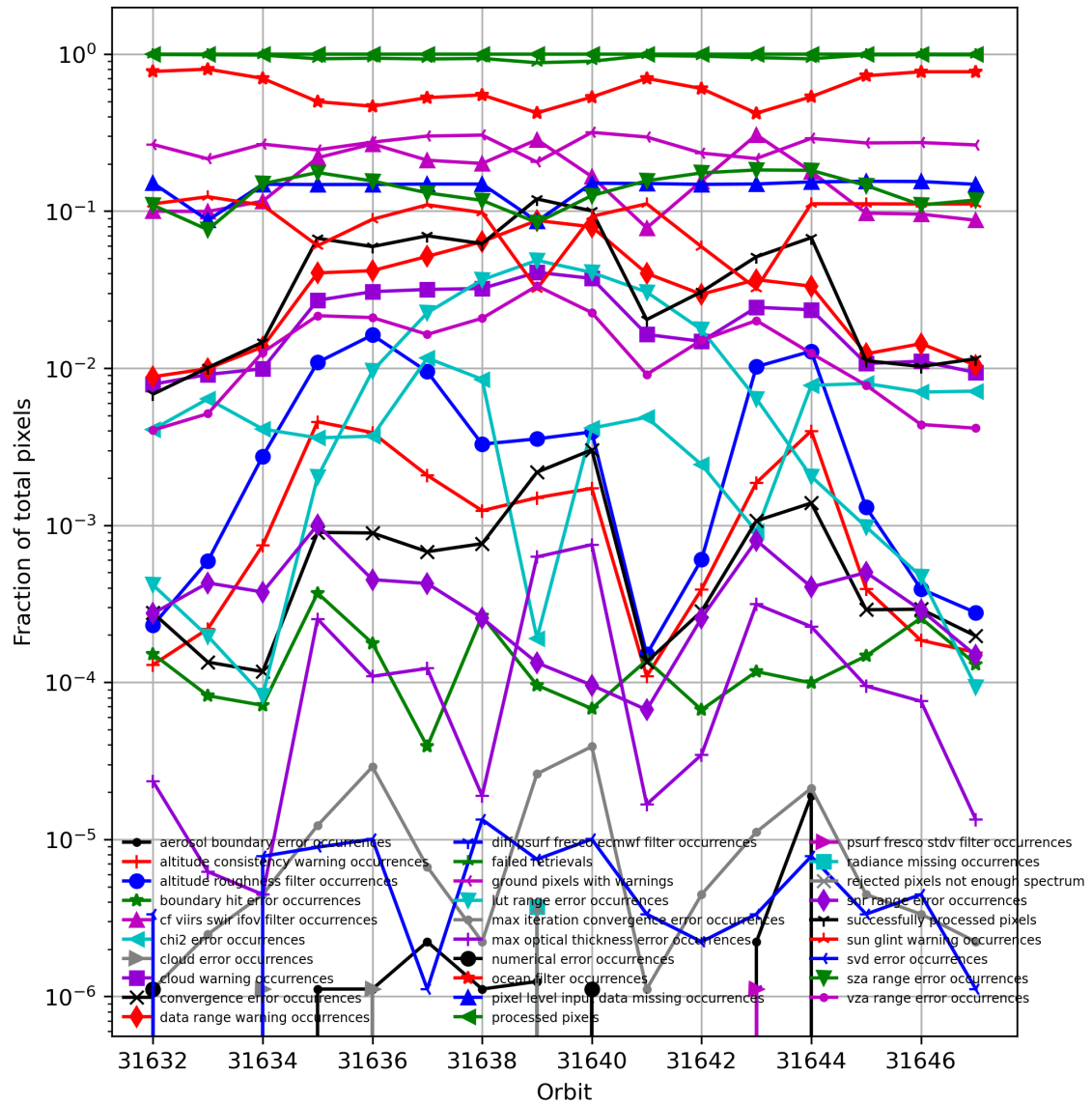


Figure 5: Fraction of pixels with specific warnings and errors during processing

## 6 World maps

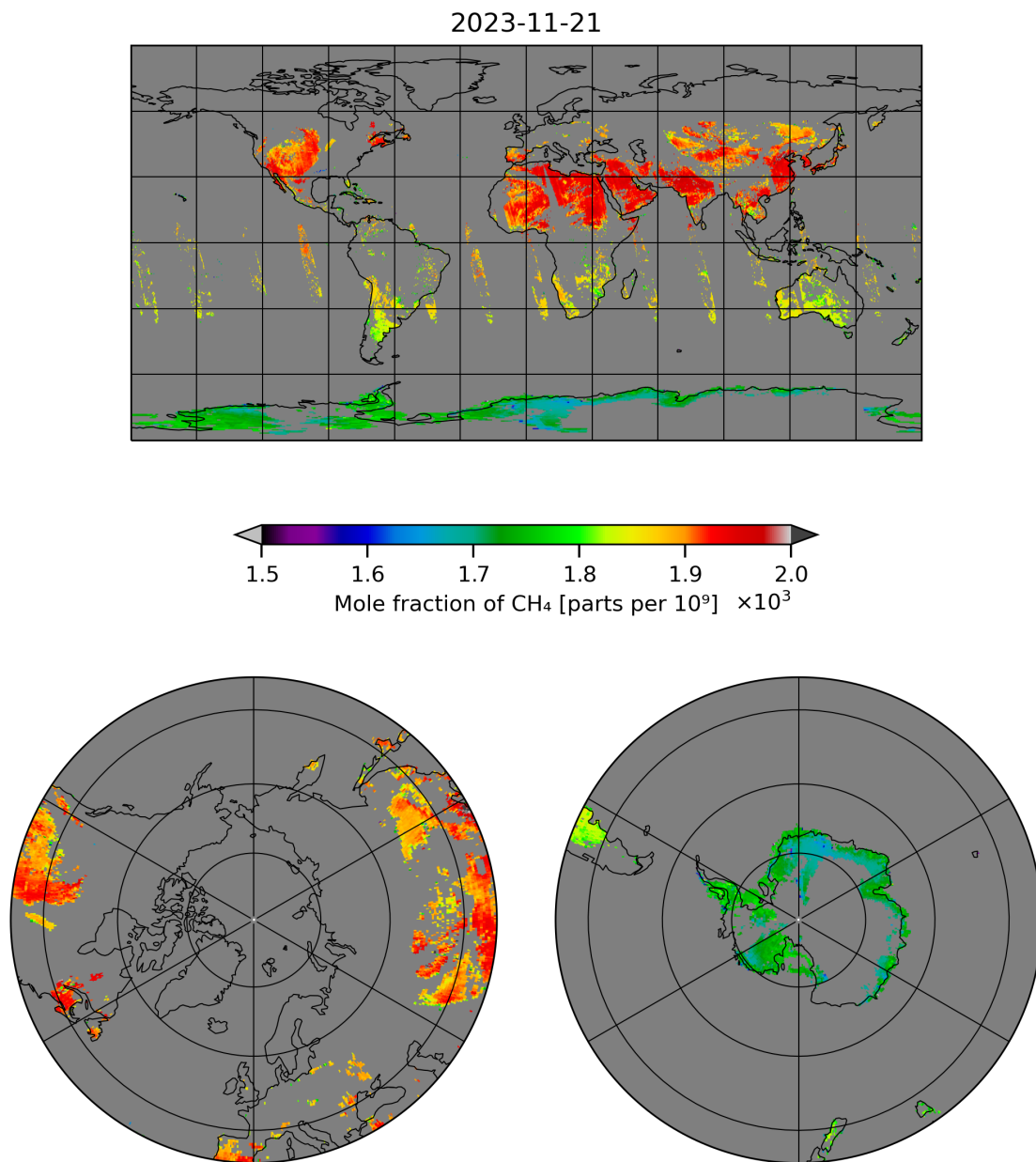


Figure 6: Map of “Mole fraction of  $\text{CH}_4$ ” for 2023-11-20 to 2023-11-22

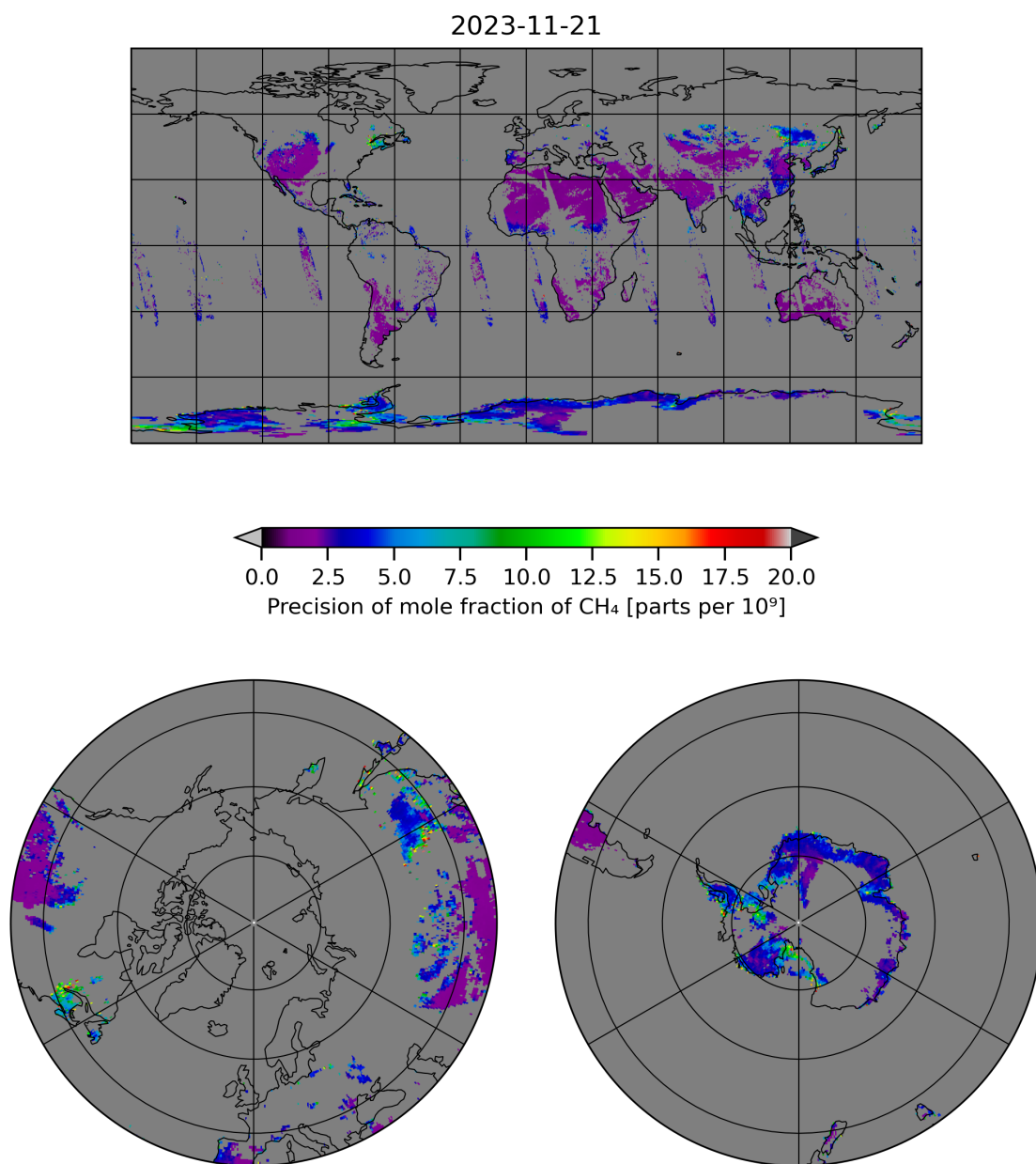


Figure 7: Map of “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

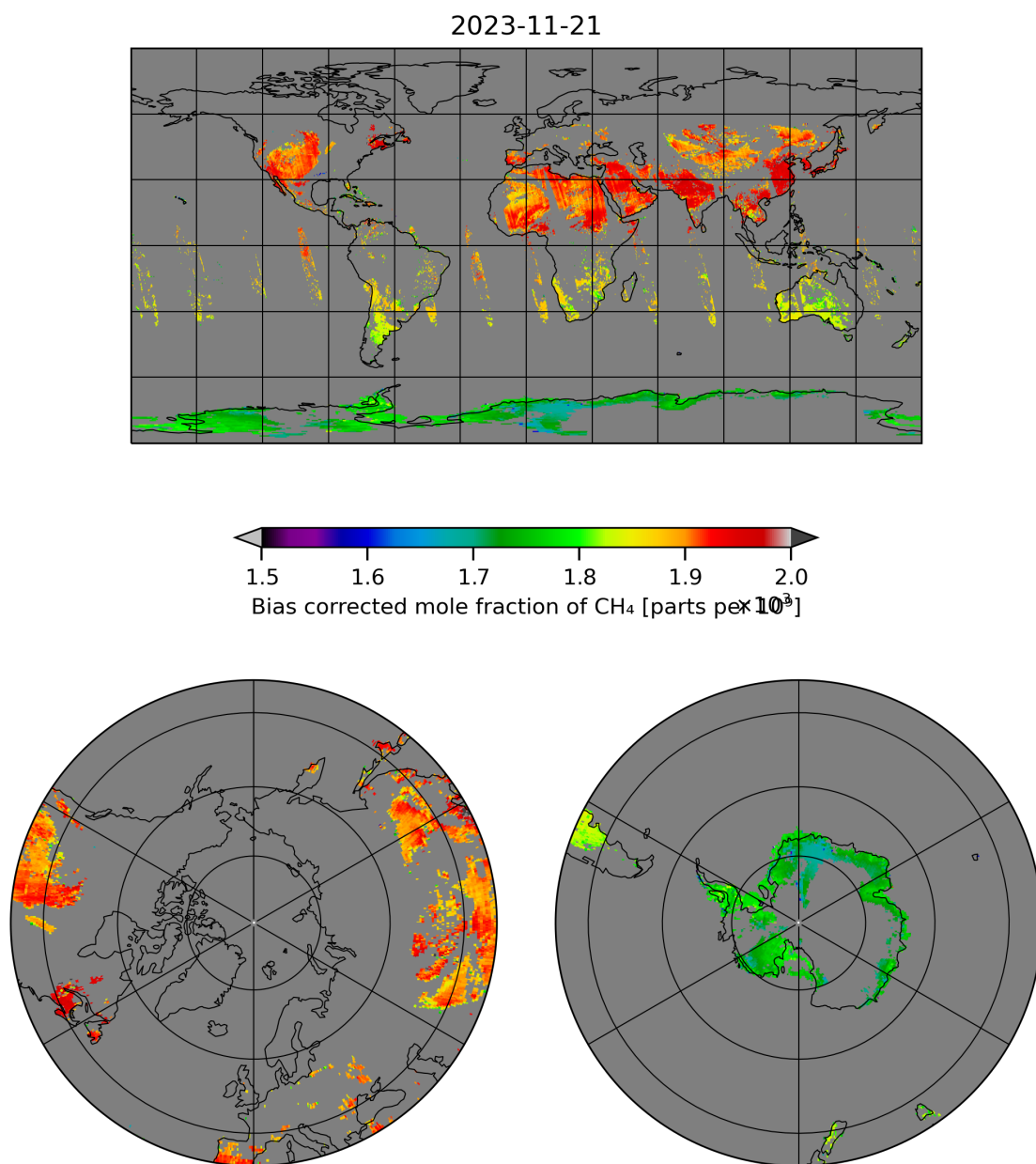


Figure 8: Map of “Bias corrected mole fraction of  $\text{CH}_4$ ” for 2023-11-20 to 2023-11-22

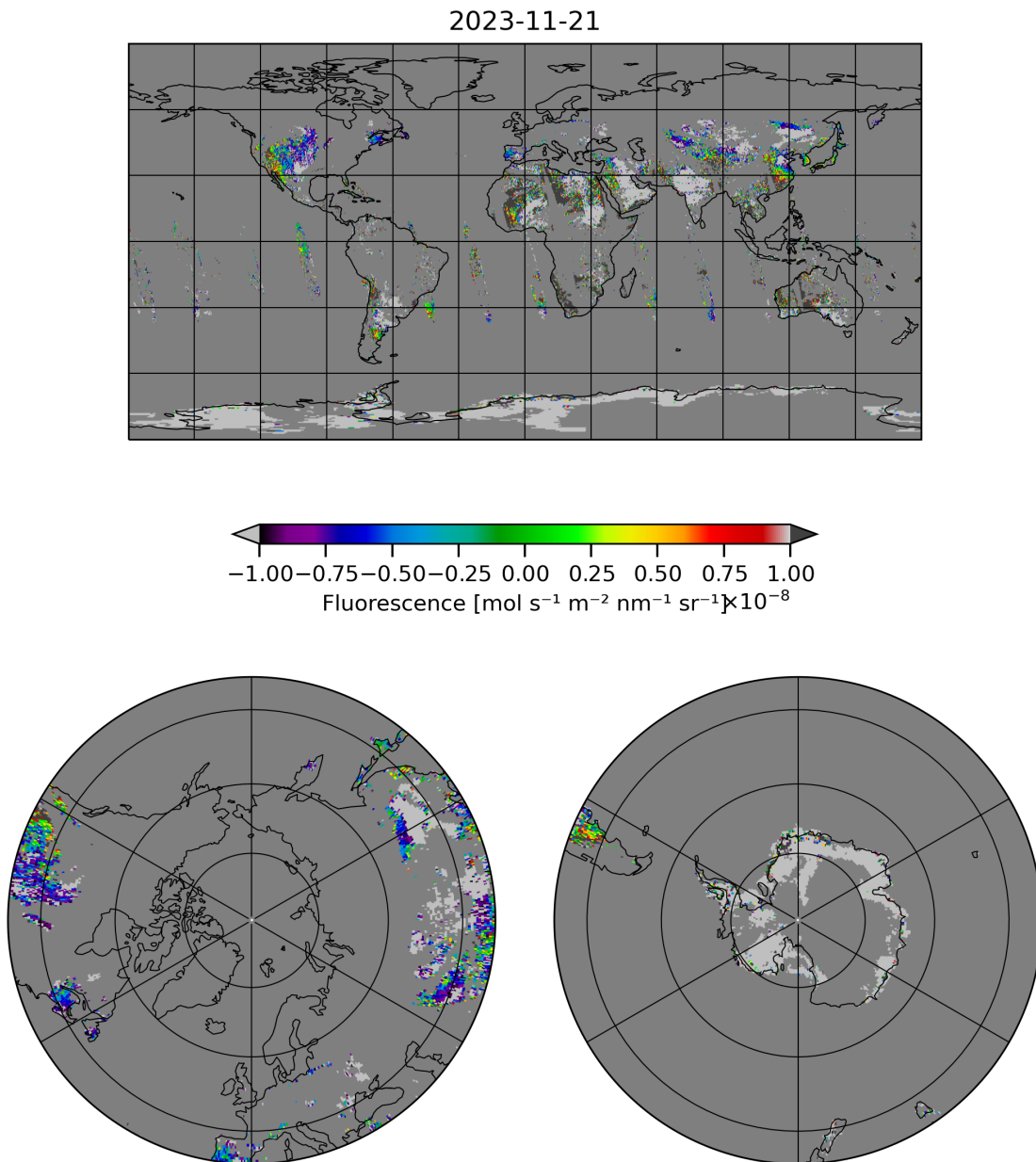


Figure 9: Map of “Fluorescence” for 2023-11-20 to 2023-11-22

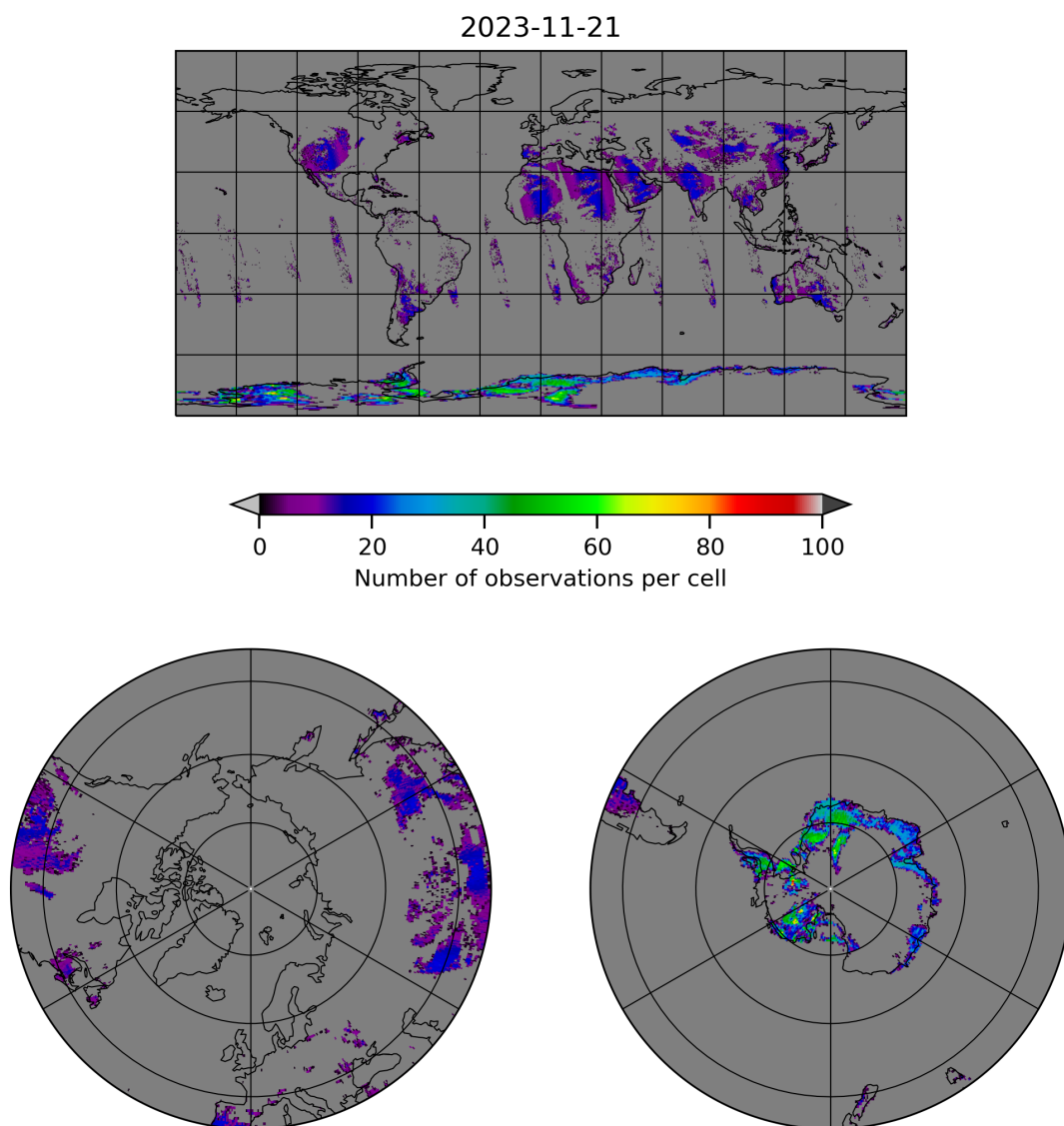


Figure 10: Map of the number of observations for 2023-11-20 to 2023-11-22

## 7 Zonal average

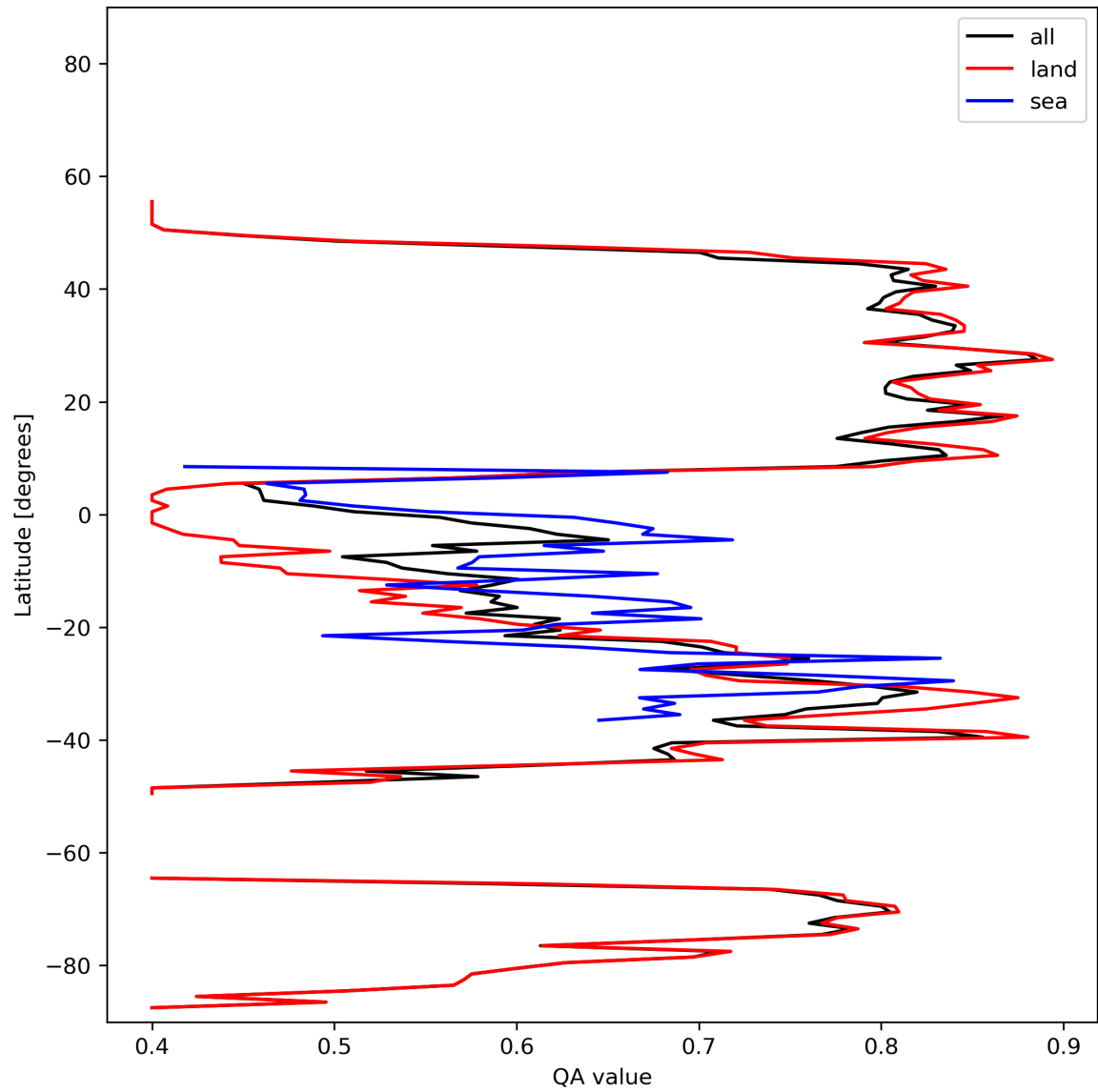


Figure 11: Zonal average of “QA value” for 2023-11-20 to 2023-11-22.



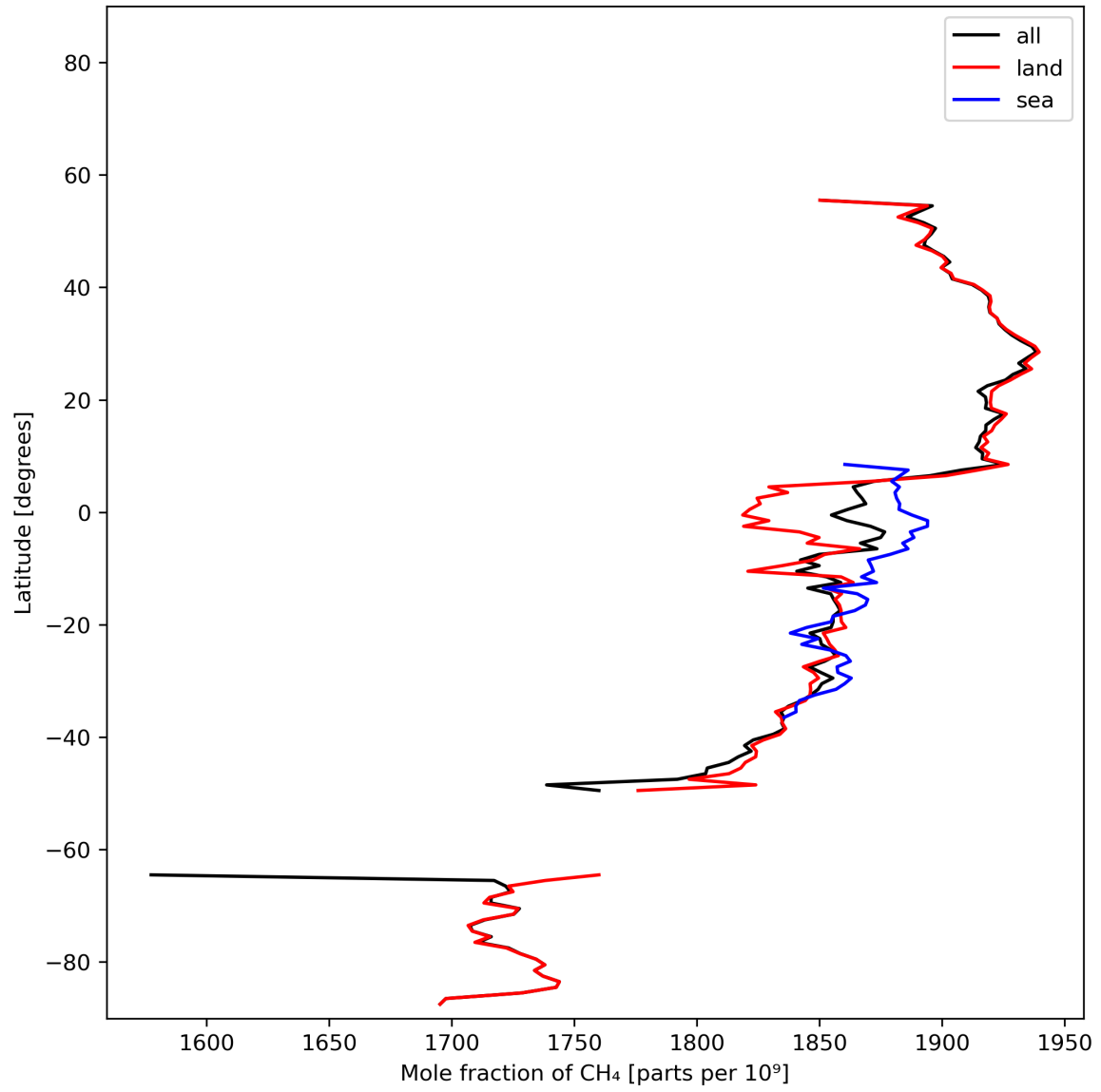


Figure 12: Zonal average of “Mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

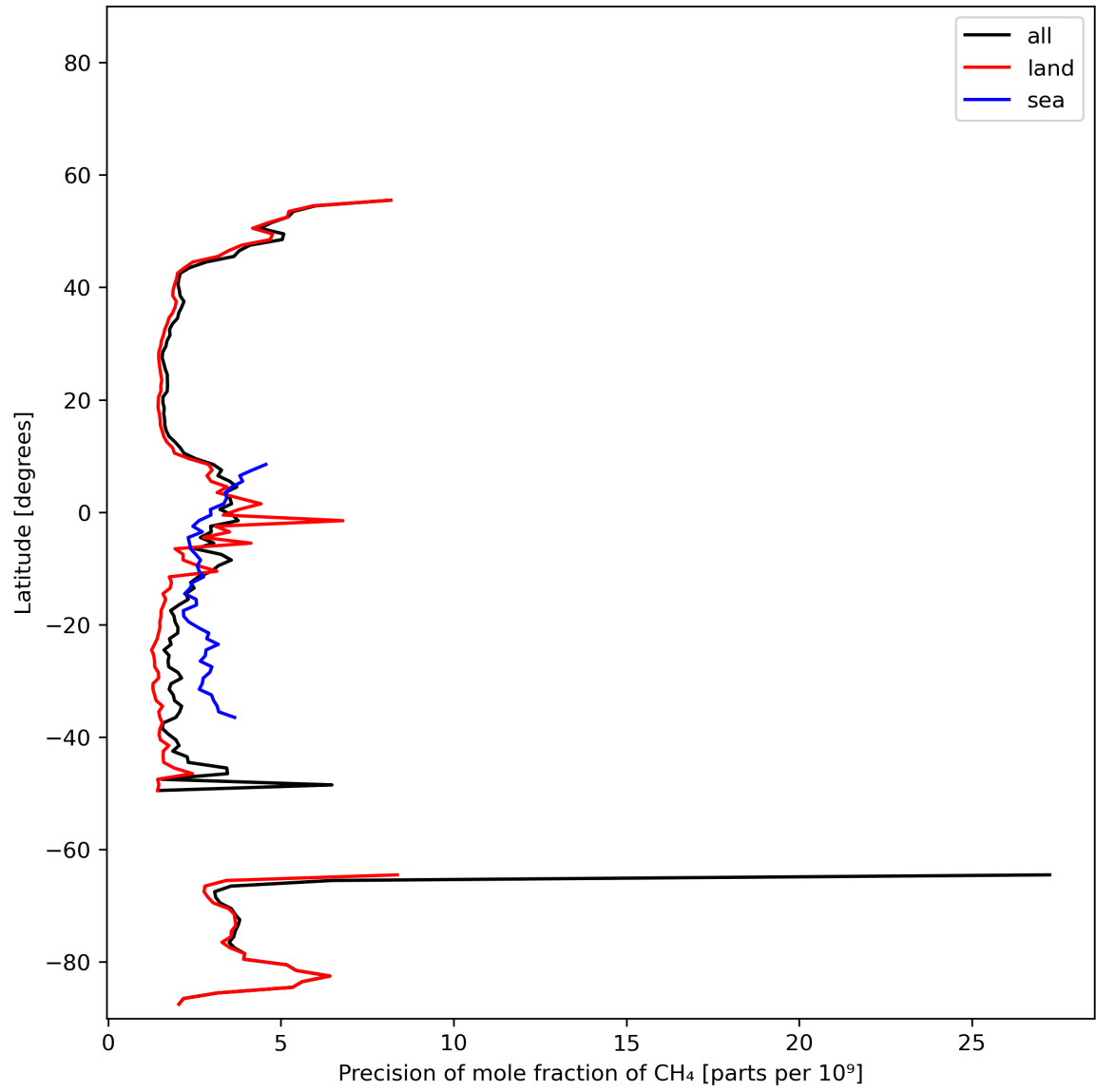


Figure 13: Zonal average of “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

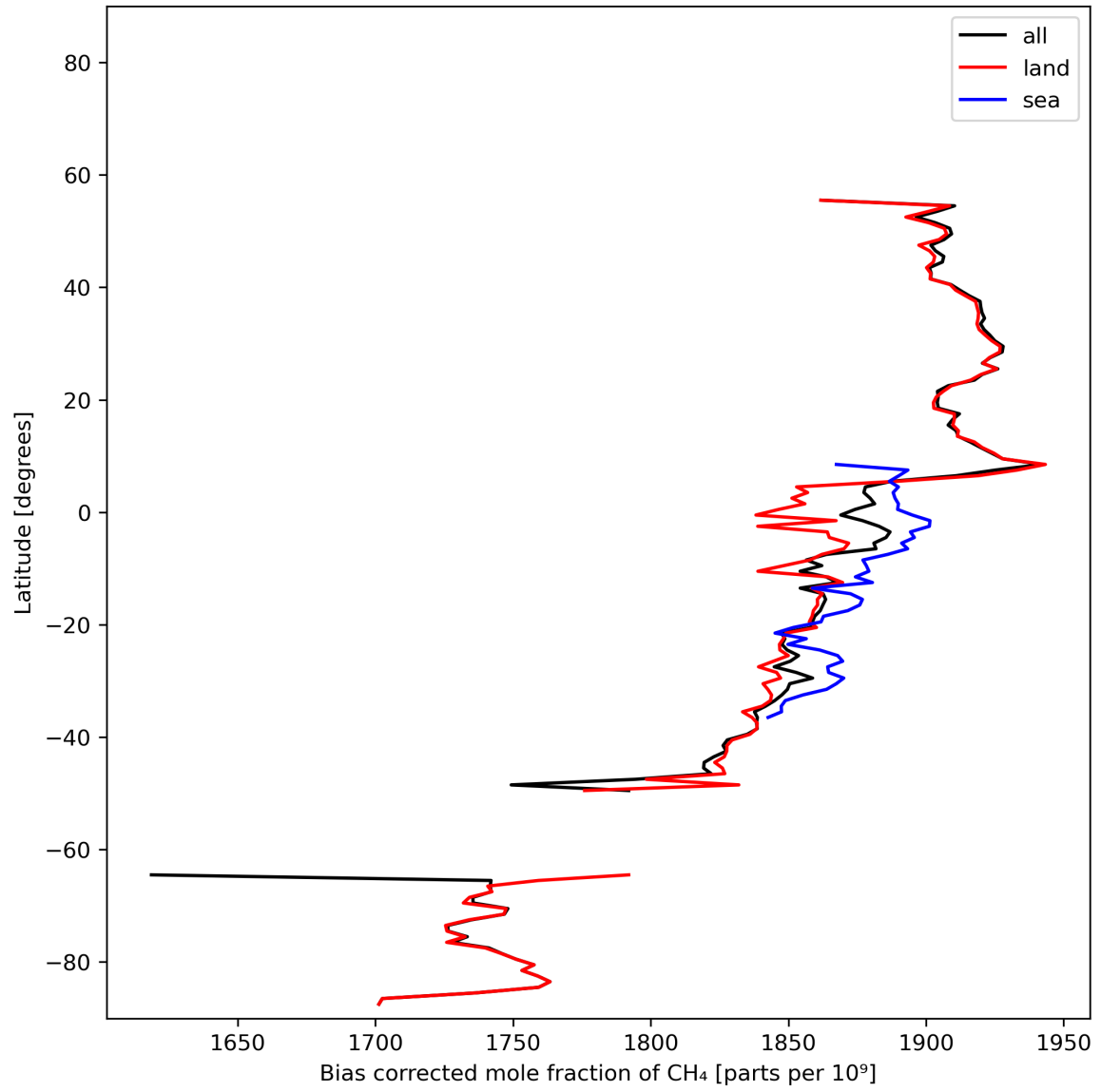


Figure 14: Zonal average of “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

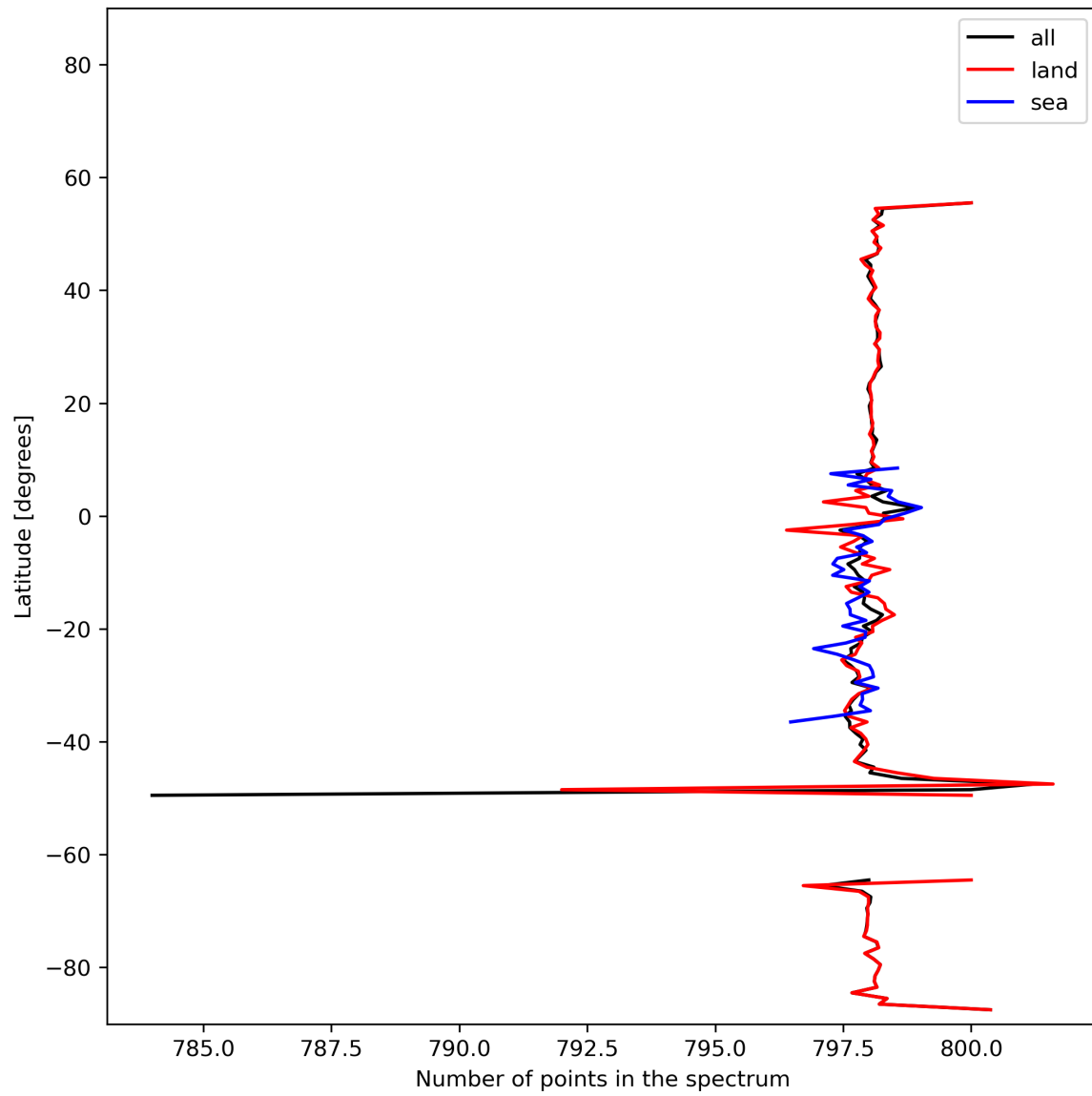


Figure 15: Zonal average of “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

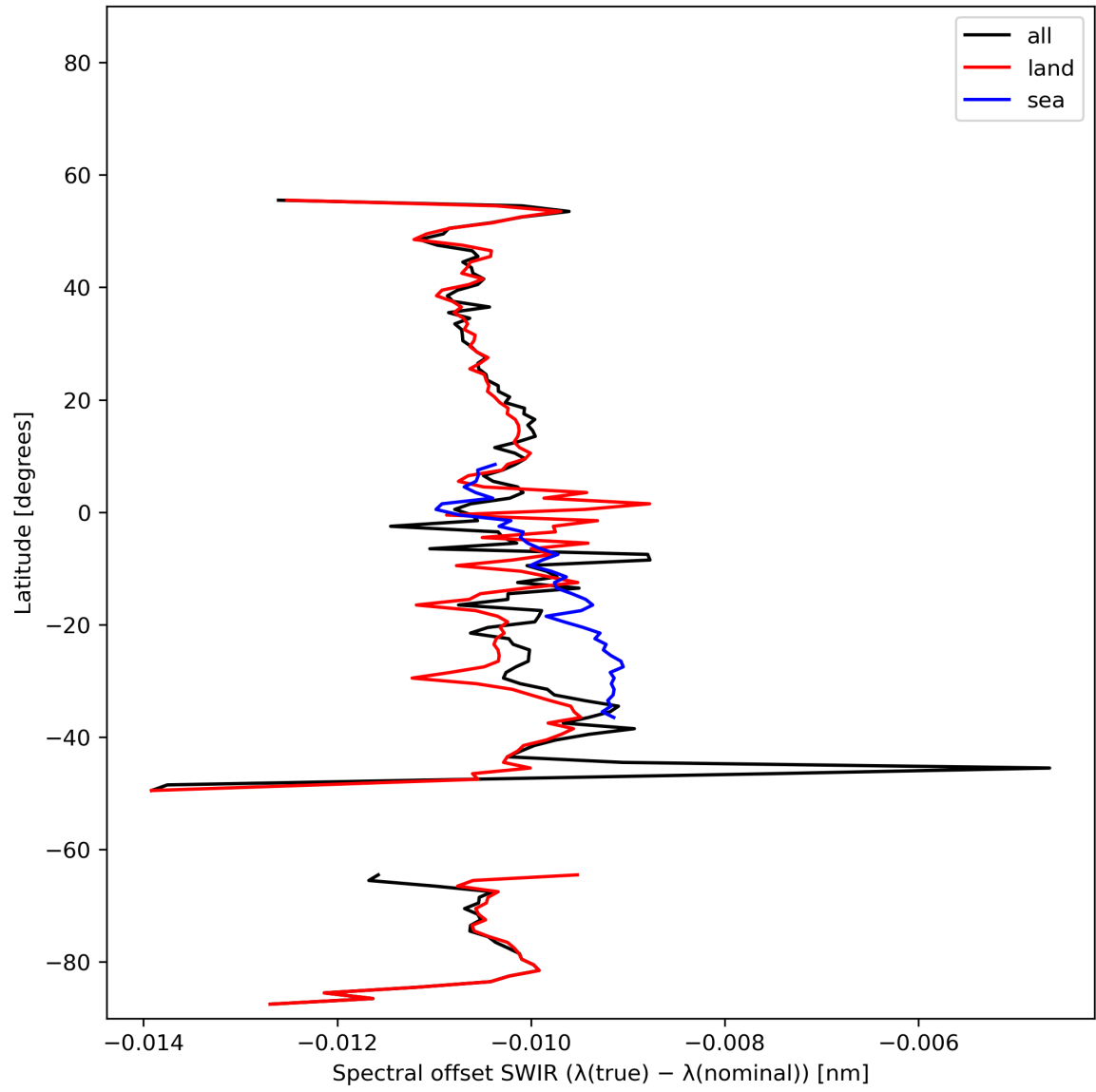


Figure 16: Zonal average of “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

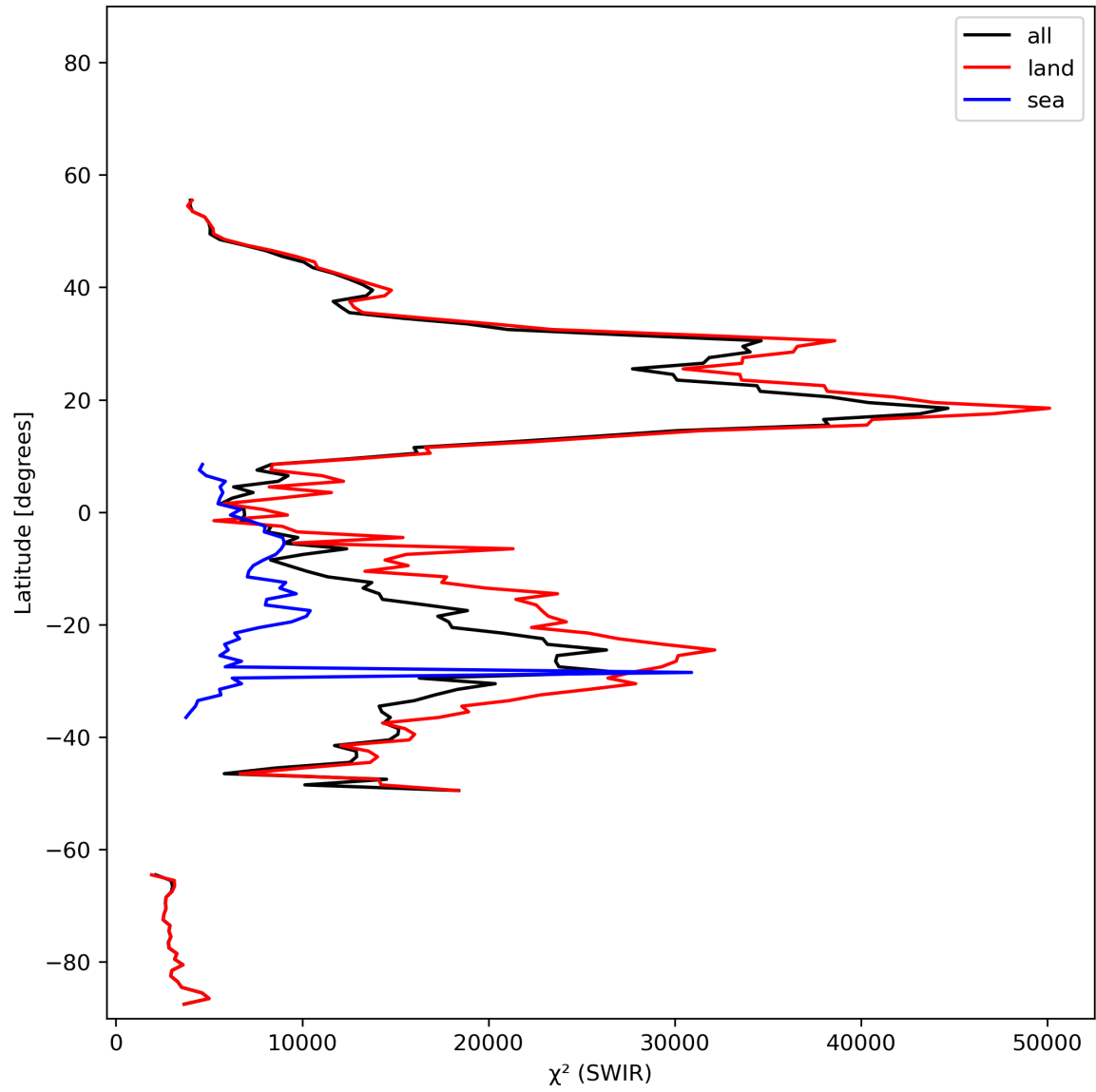


Figure 17: Zonal average of “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

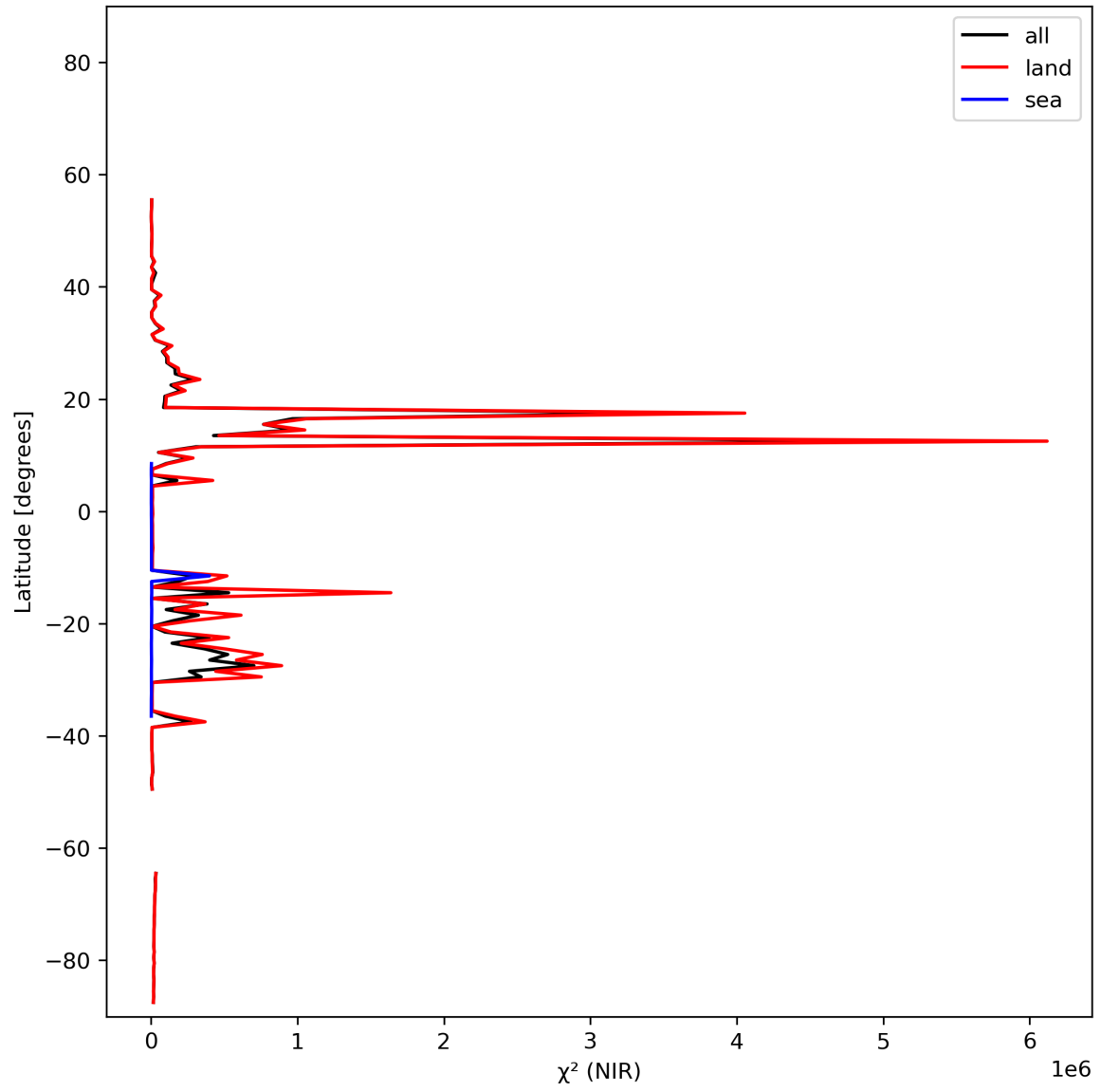


Figure 18: Zonal average of “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

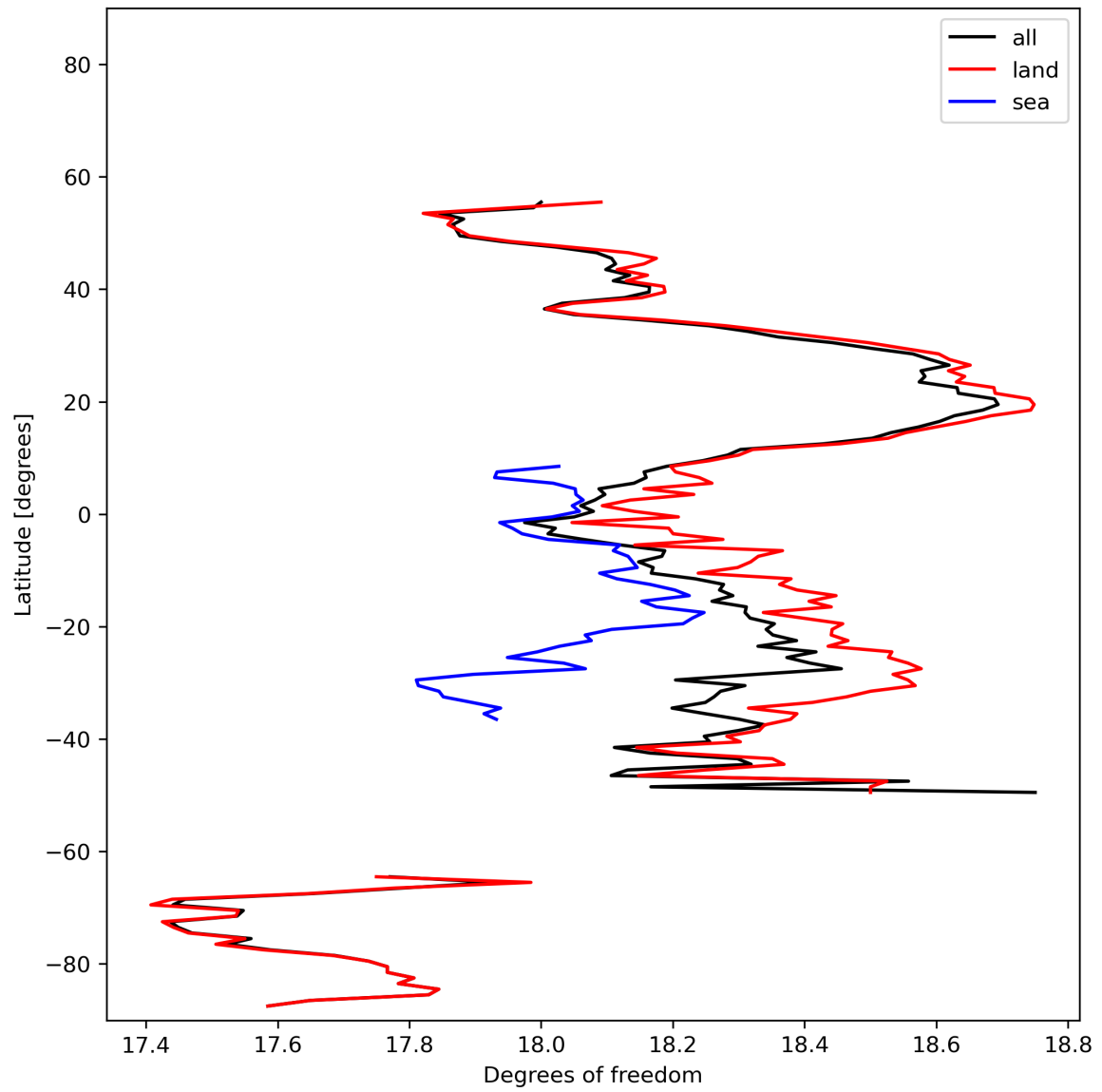


Figure 19: Zonal average of “Degrees of freedom” for 2023-11-20 to 2023-11-22.



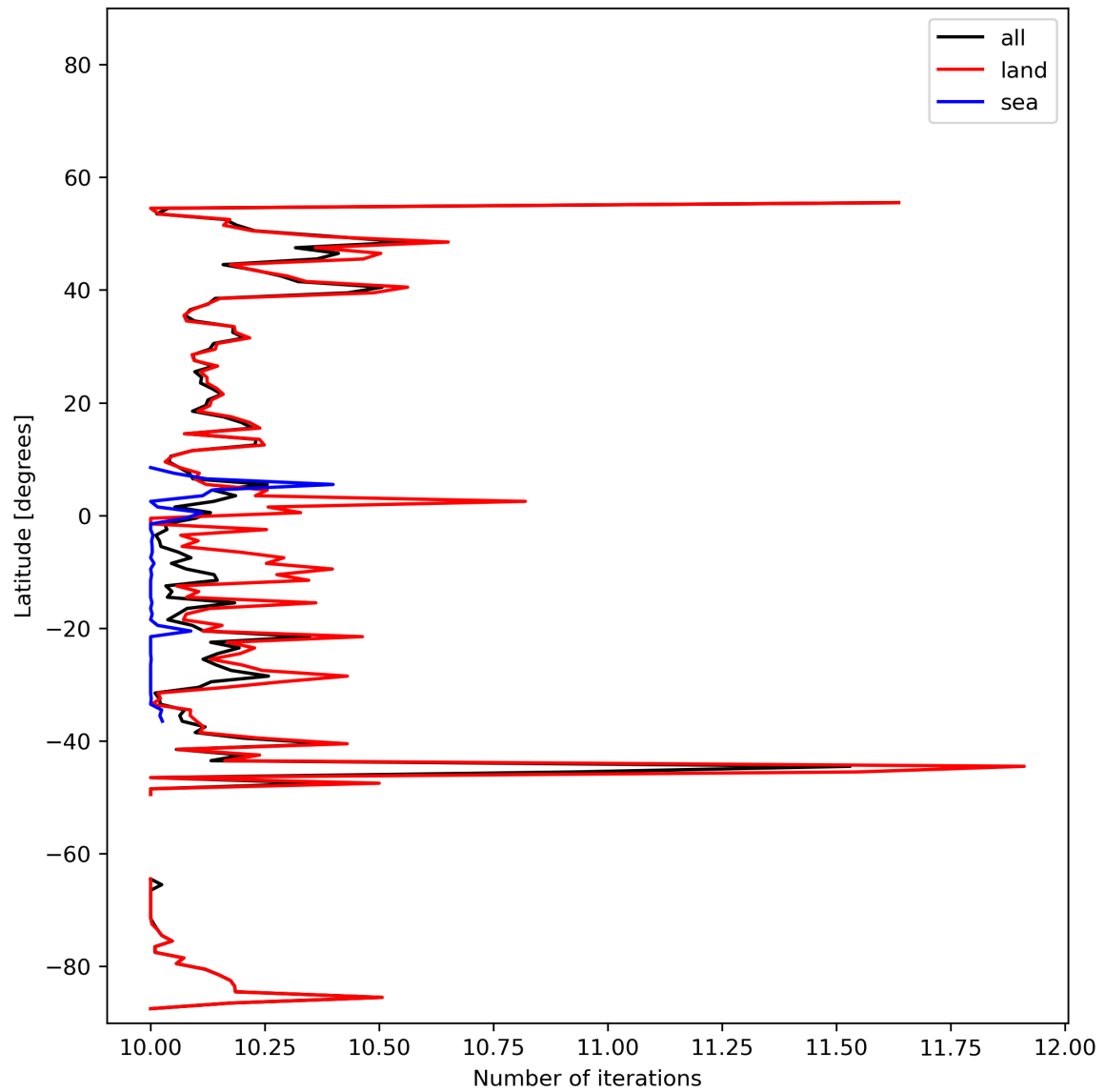


Figure 20: Zonal average of “Number of iterations” for 2023-11-20 to 2023-11-22.

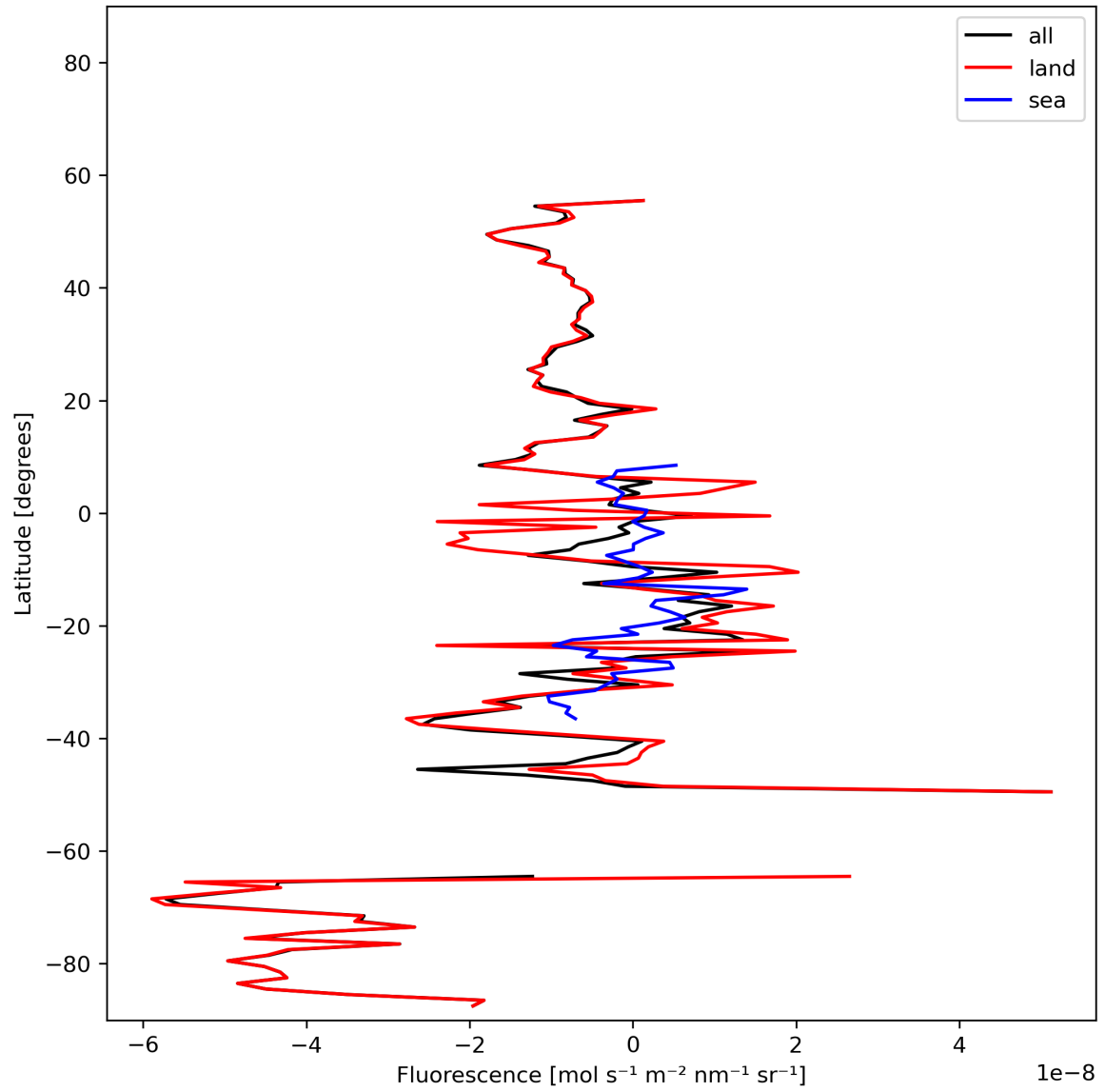


Figure 21: Zonal average of “Fluorescence” for 2023-11-20 to 2023-11-22.

## 8 Histograms

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

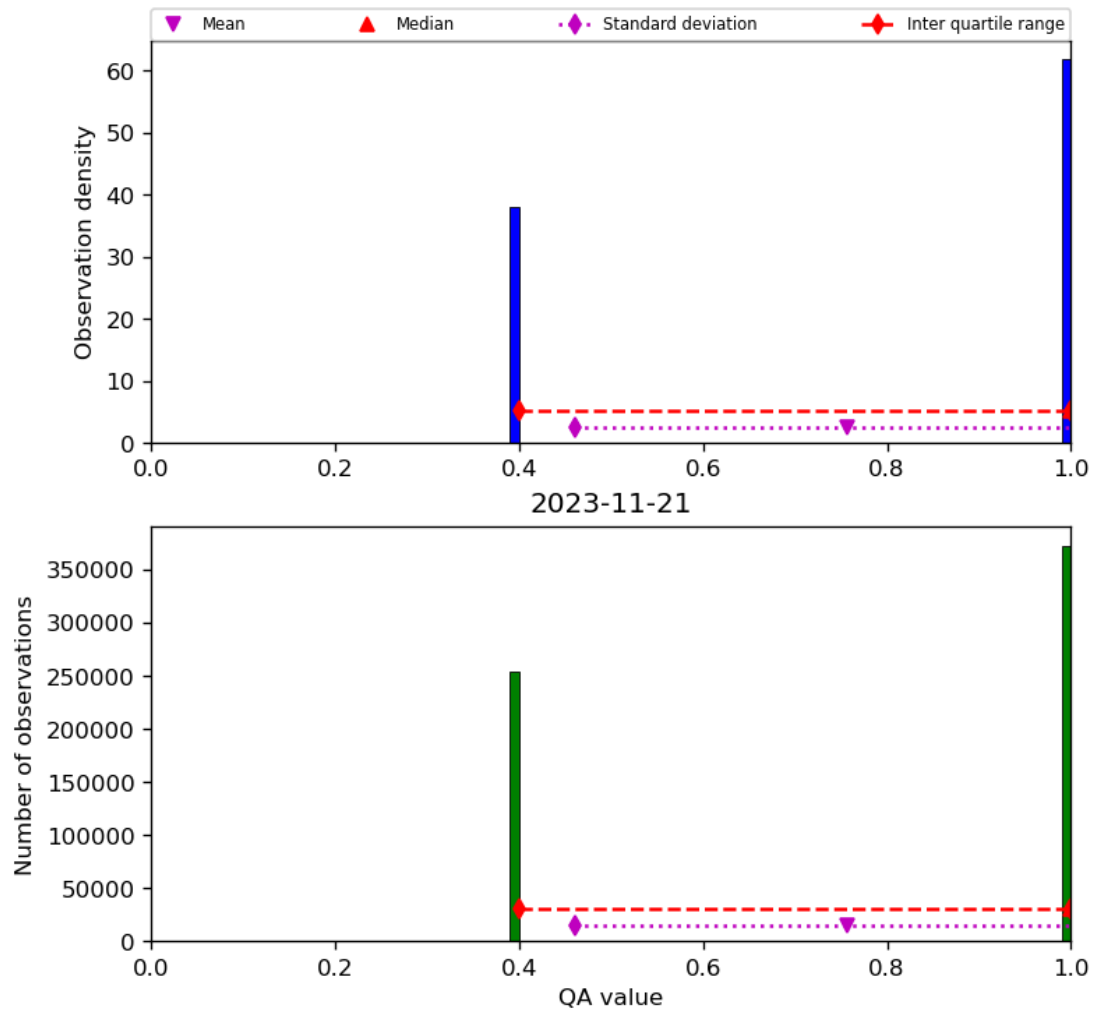


Figure 22: Histogram of “QA value” for 2023-11-20 to 2023-11-22

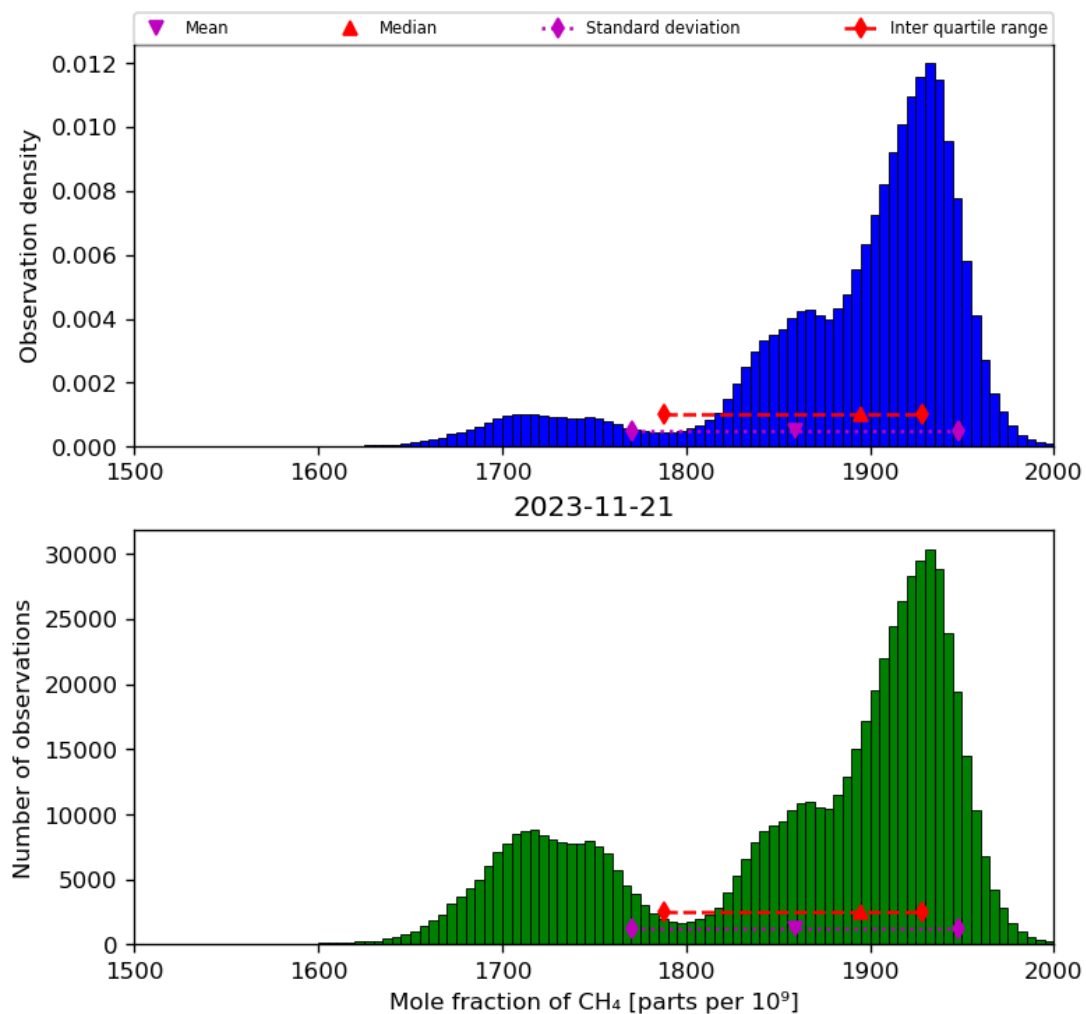


Figure 23: Histogram of “Mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

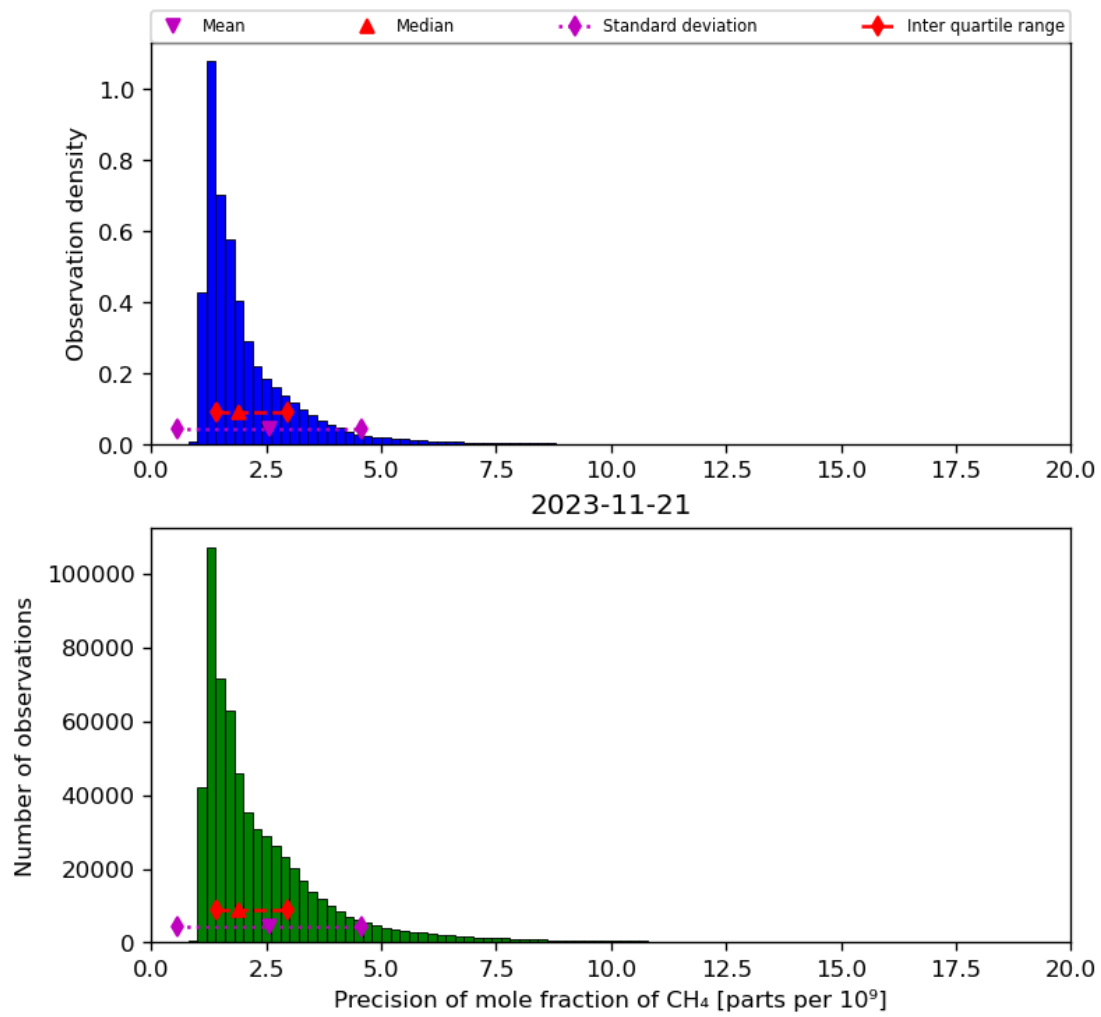


Figure 24: Histogram of “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

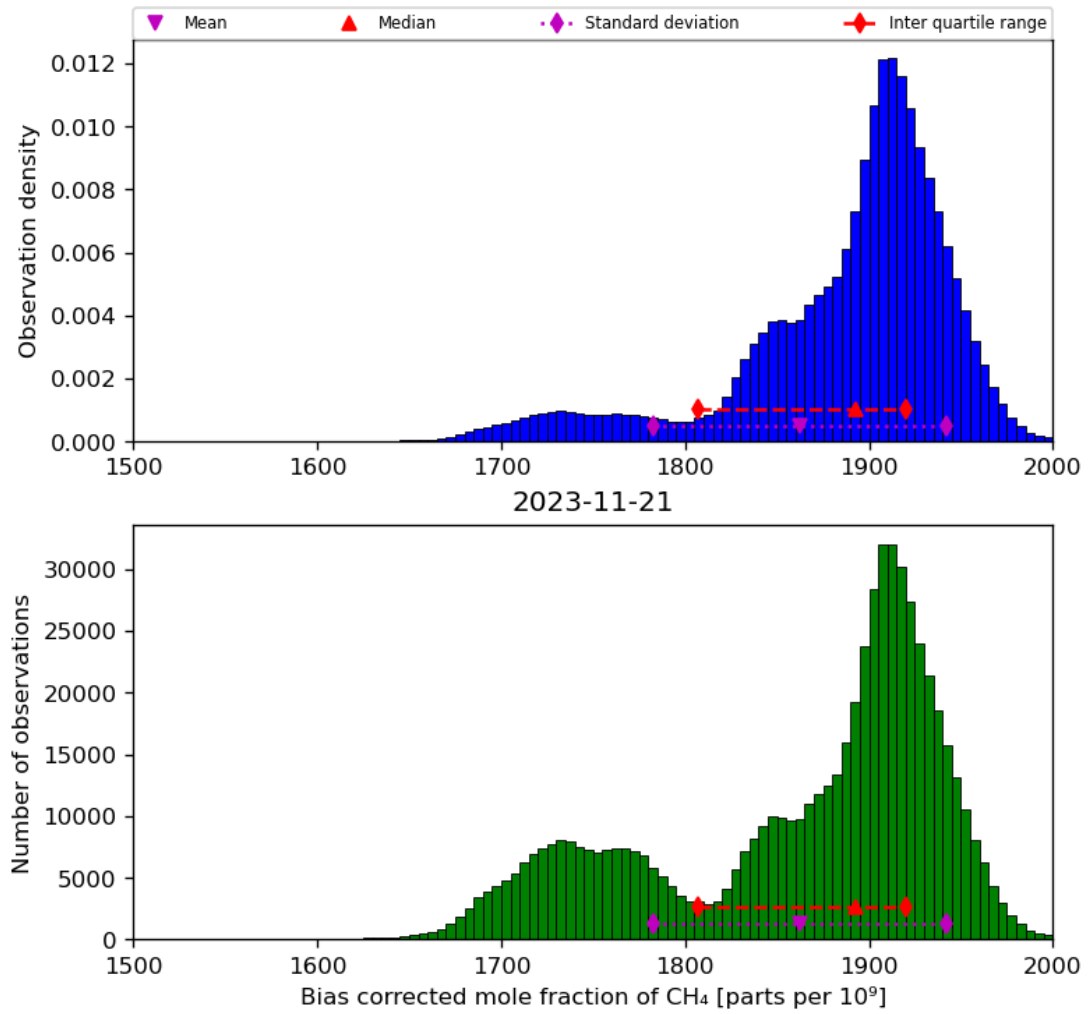


Figure 25: Histogram of “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

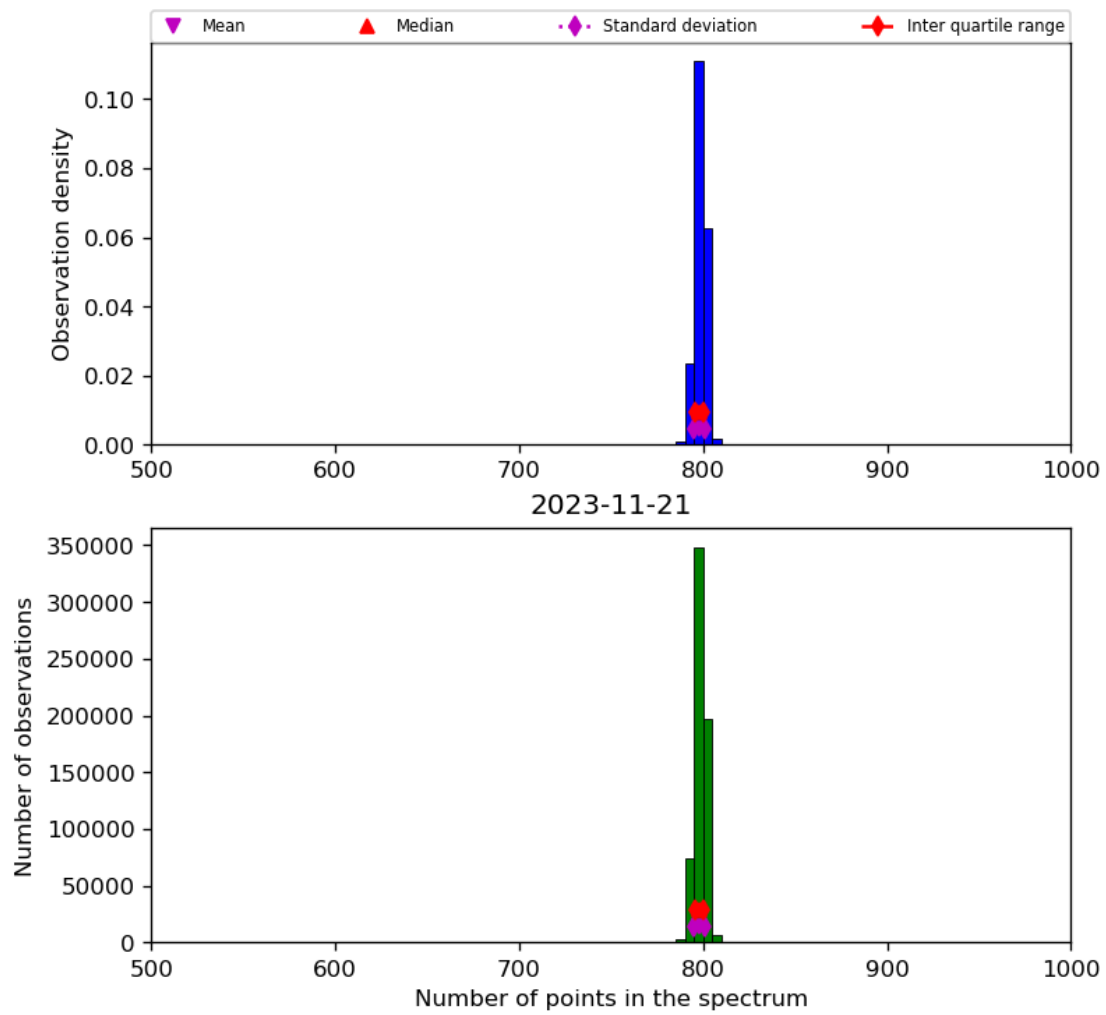


Figure 26: Histogram of “Number of points in the spectrum” for 2023-11-20 to 2023-11-22

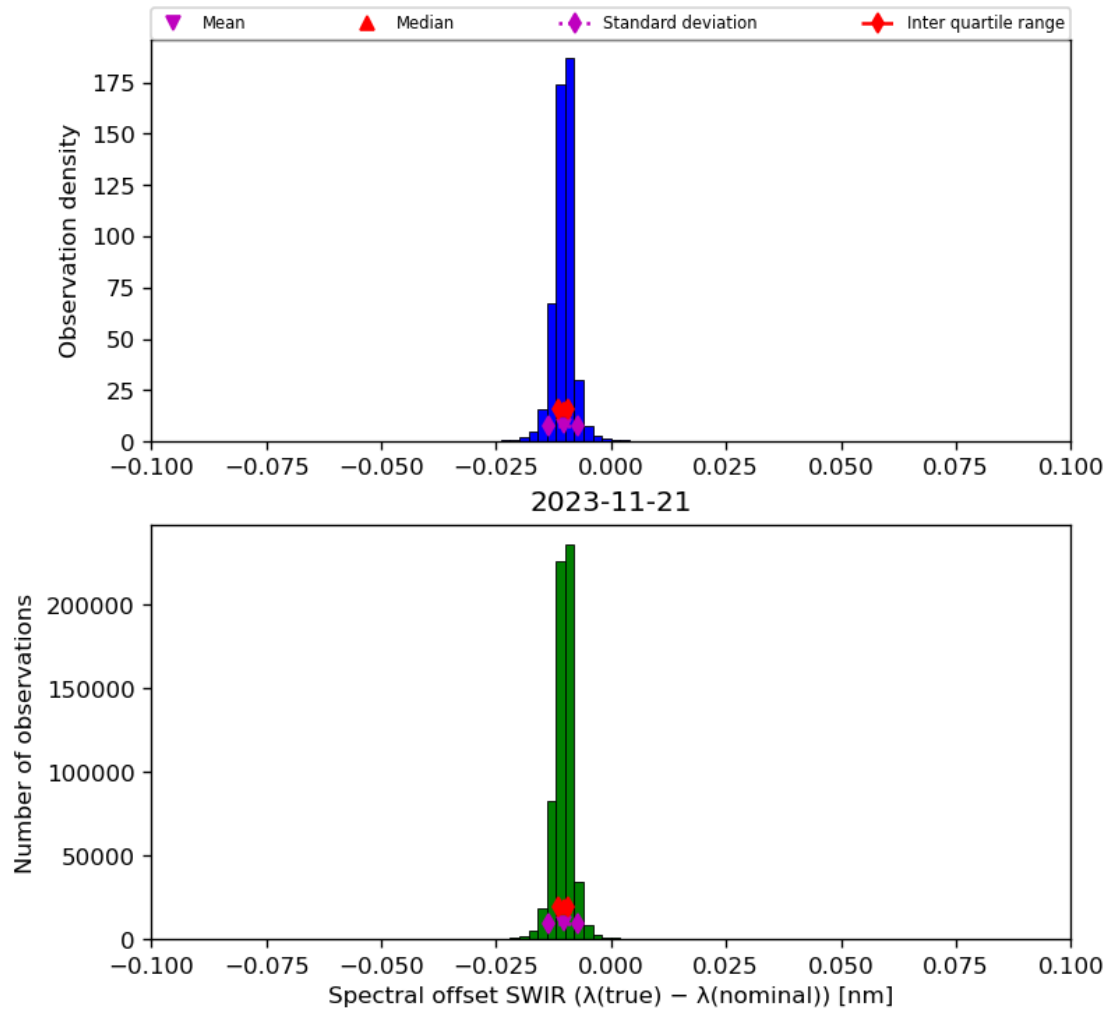


Figure 27: Histogram of “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22



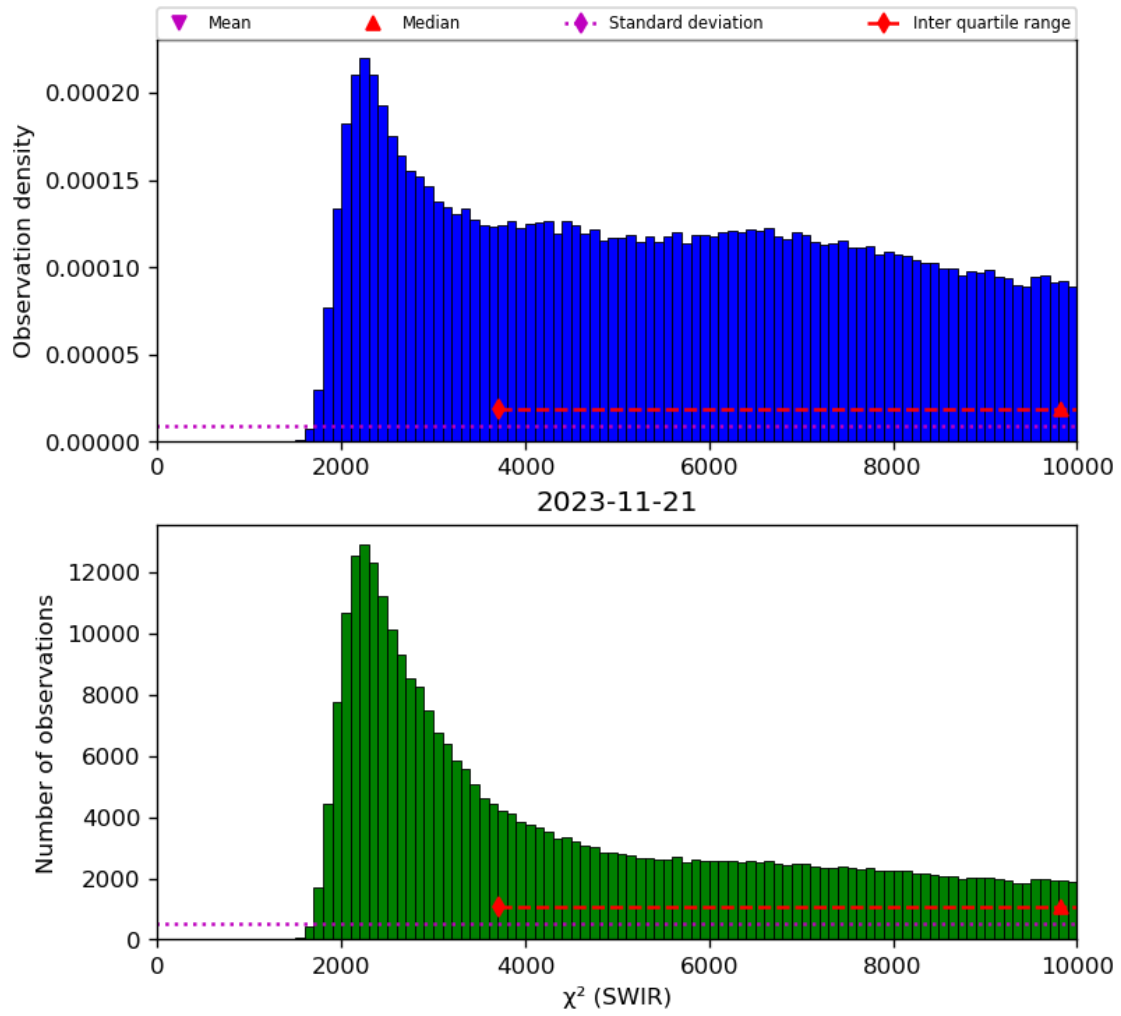


Figure 28: Histogram of “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22

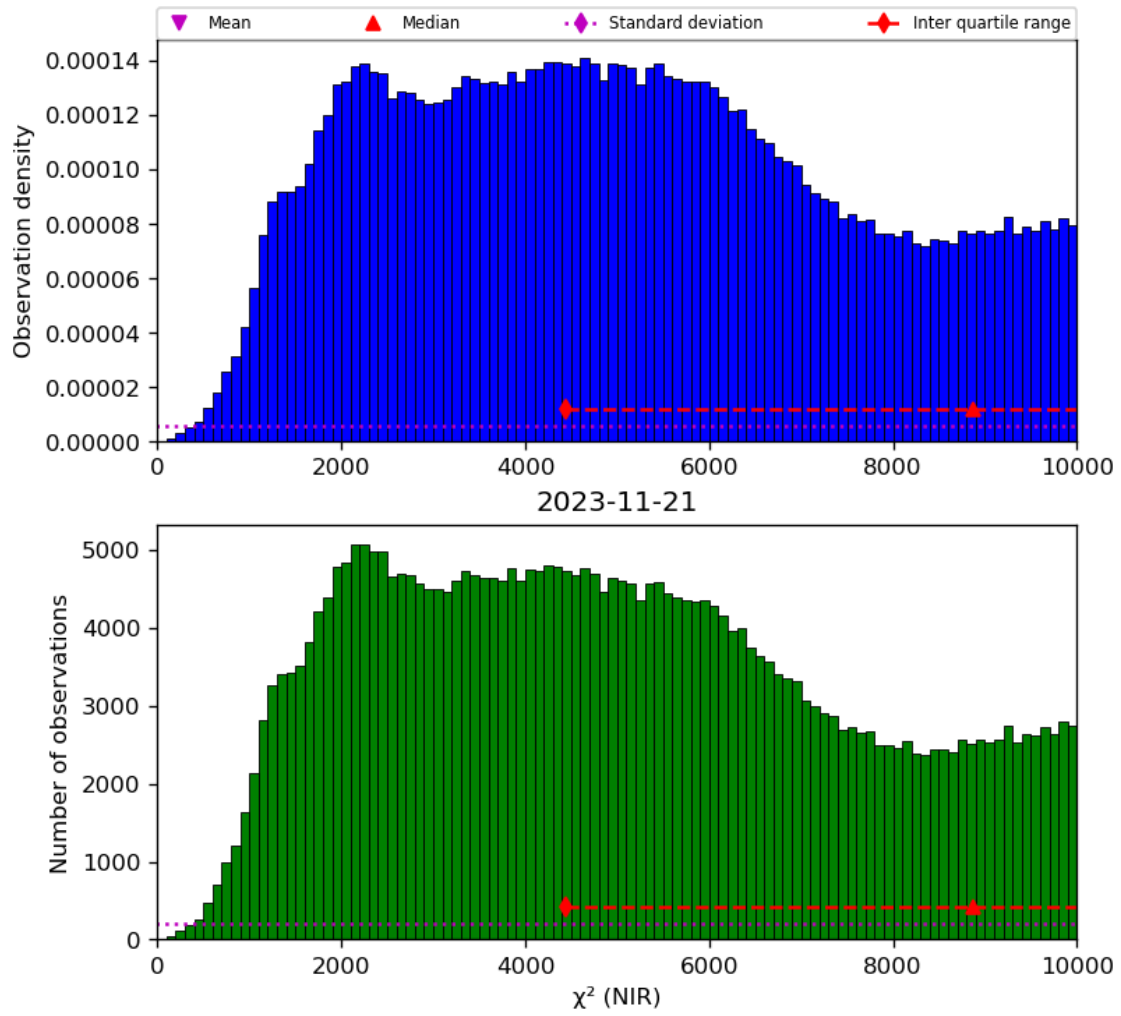


Figure 29: Histogram of “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22

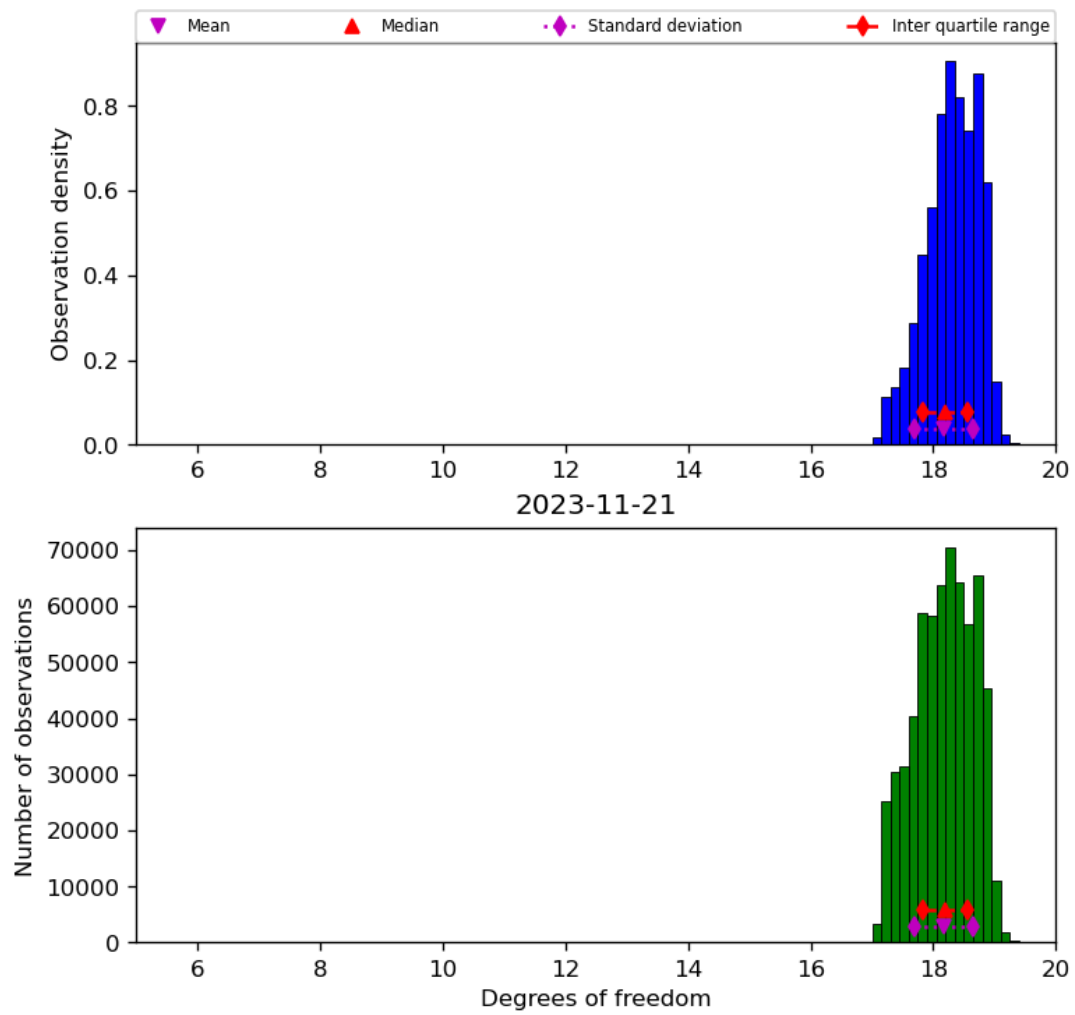


Figure 30: Histogram of “Degrees of freedom” for 2023-11-20 to 2023-11-22

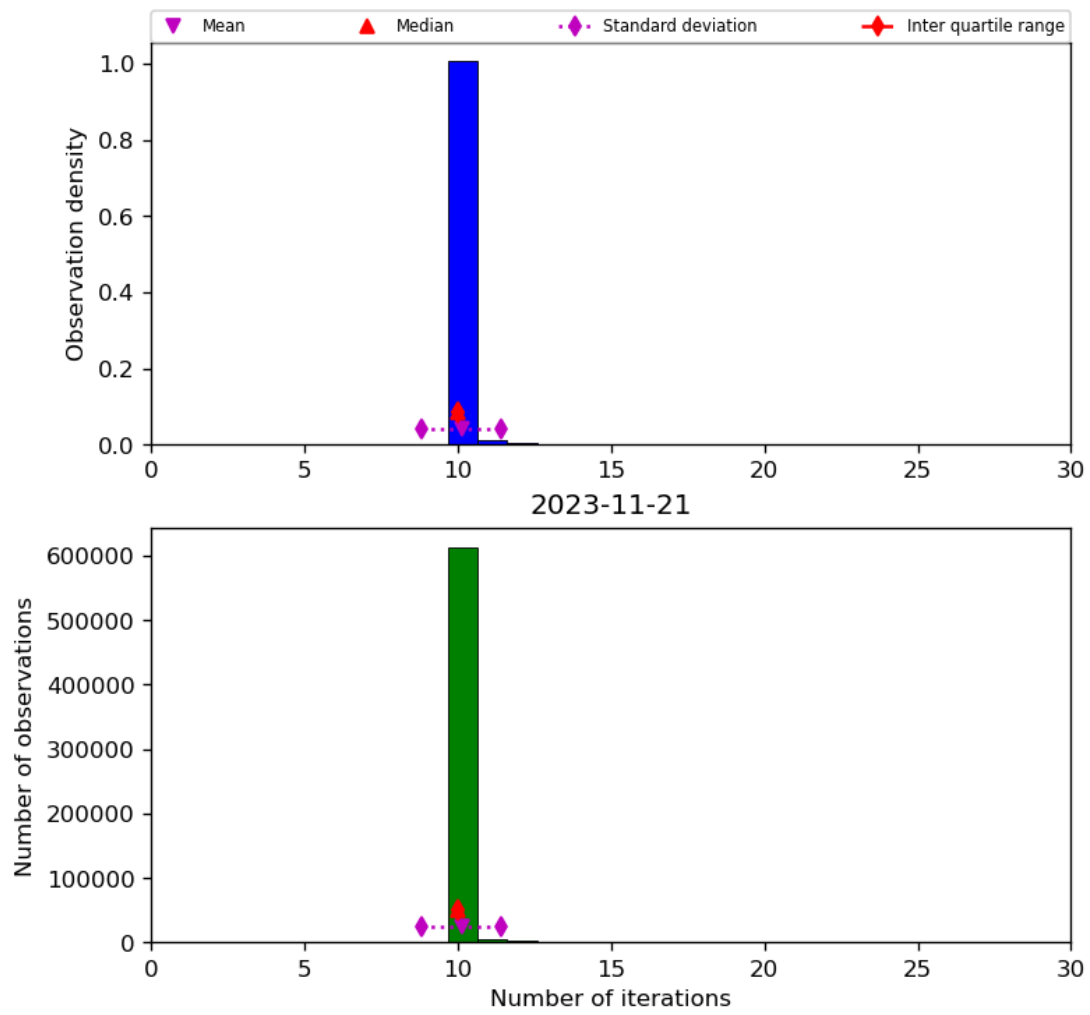


Figure 31: Histogram of “Number of iterations” for 2023-11-20 to 2023-11-22

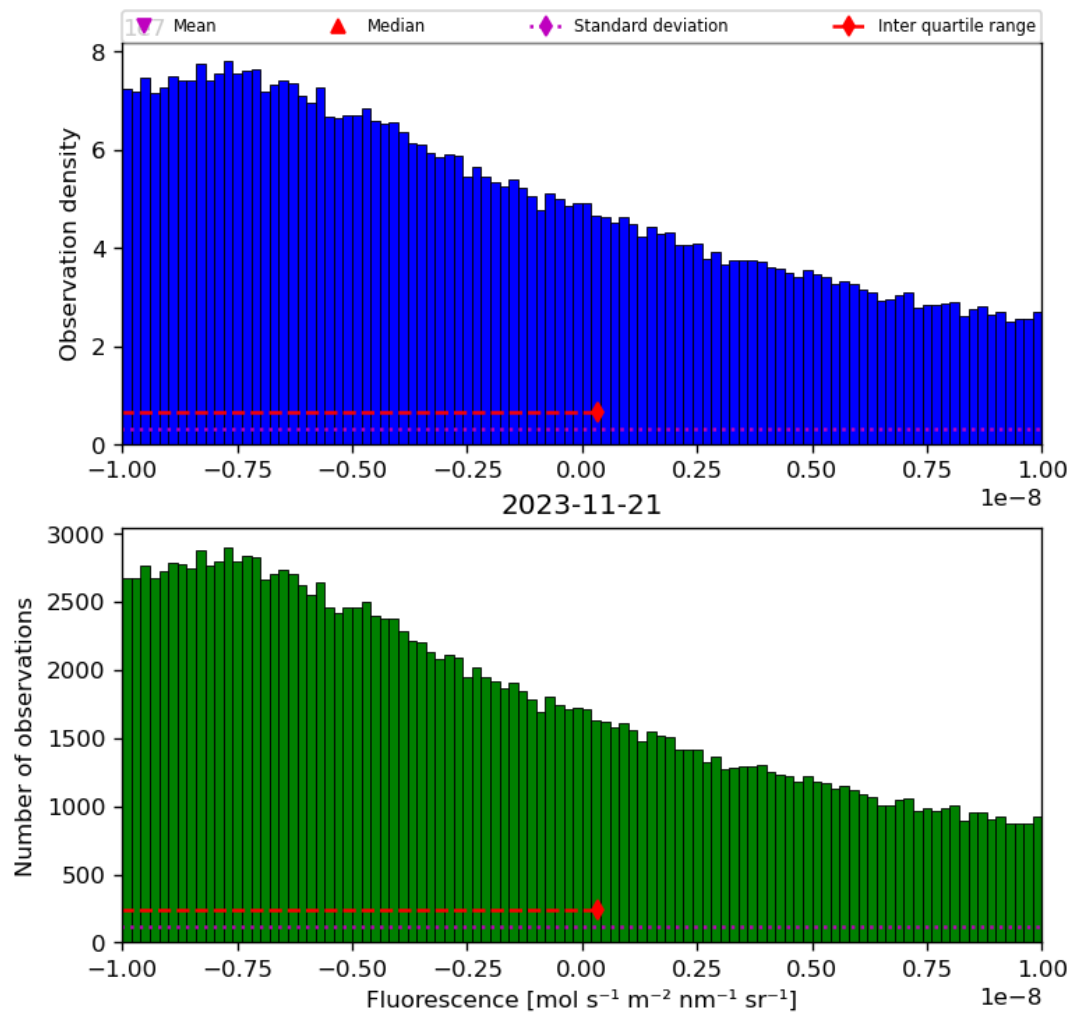


Figure 32: Histogram of “Fluorescence” for 2023-11-20 to 2023-11-22

## 9 Along track statistics

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

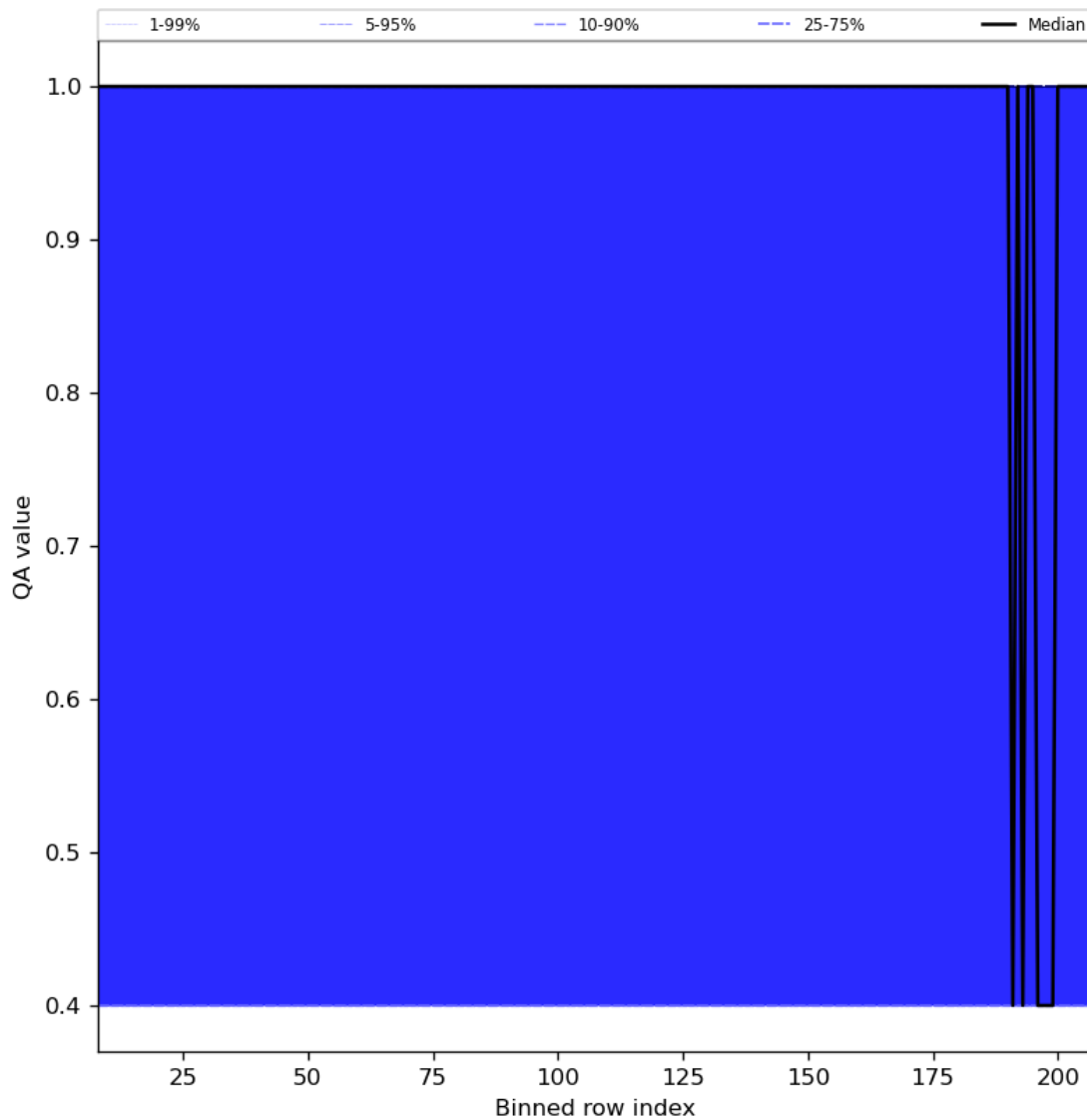


Figure 33: Along track statistics of “QA value” for 2023-11-20 to 2023-11-22

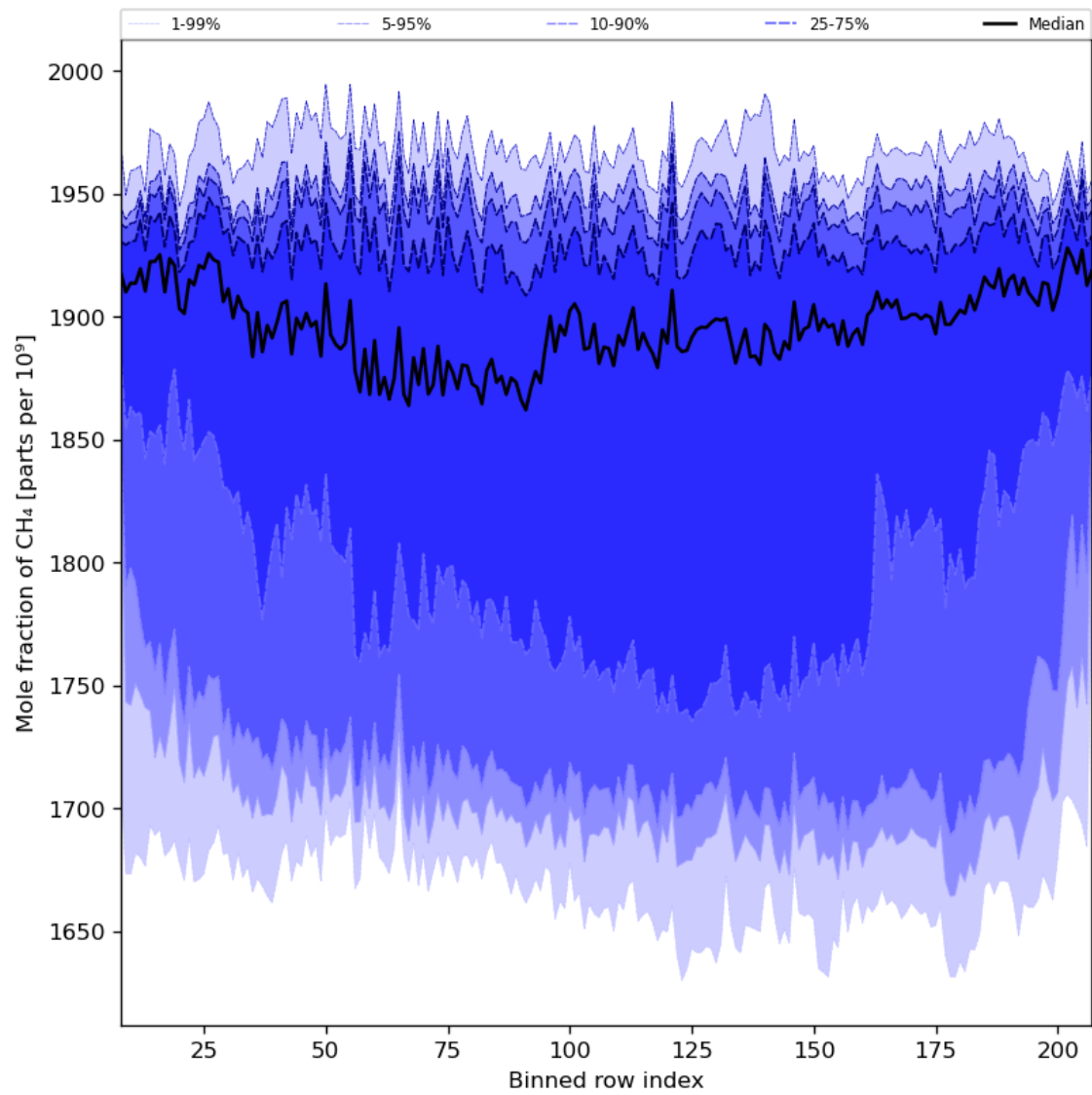


Figure 34: Along track statistics of “Mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

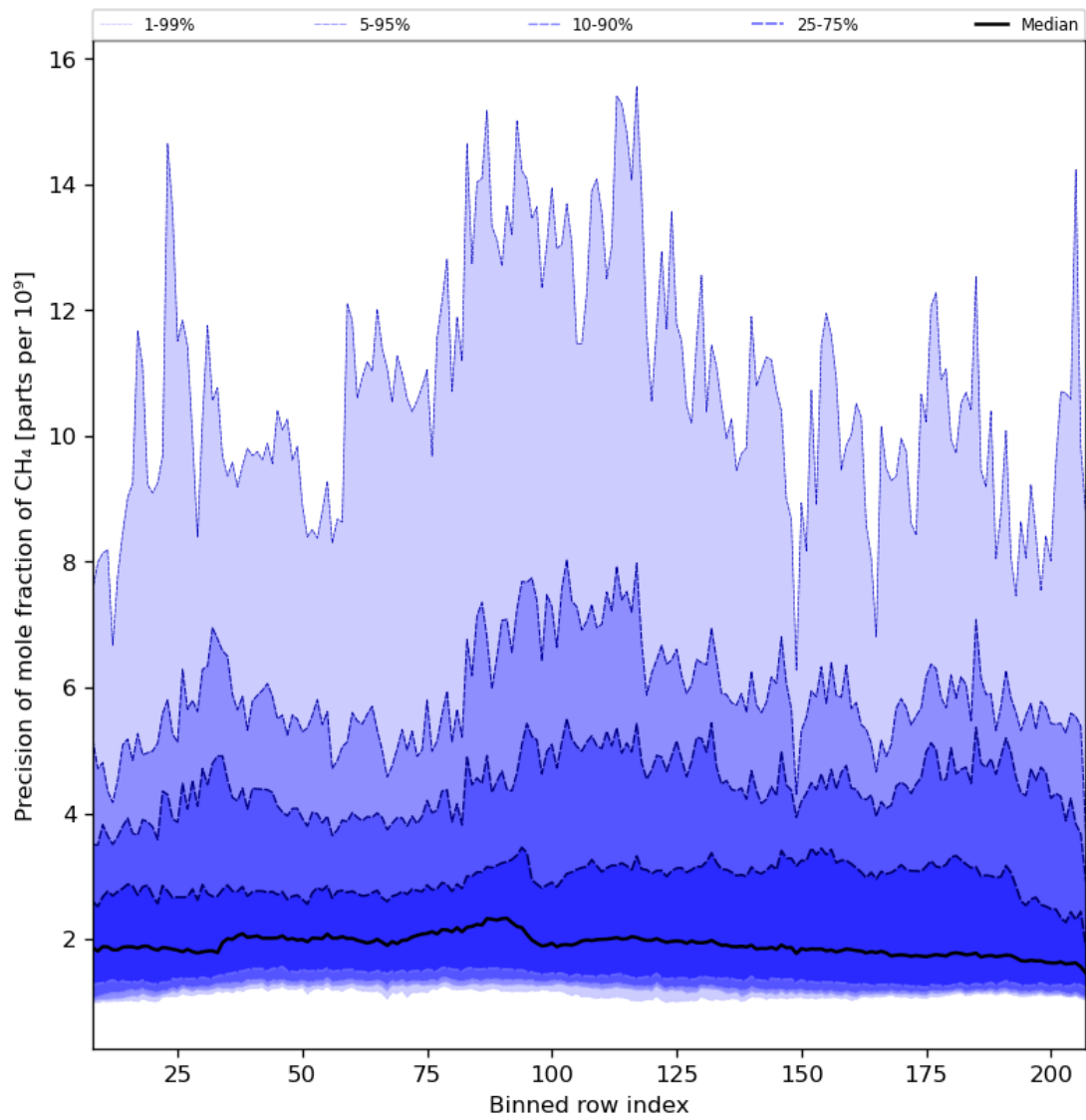


Figure 35: Along track statistics of “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22



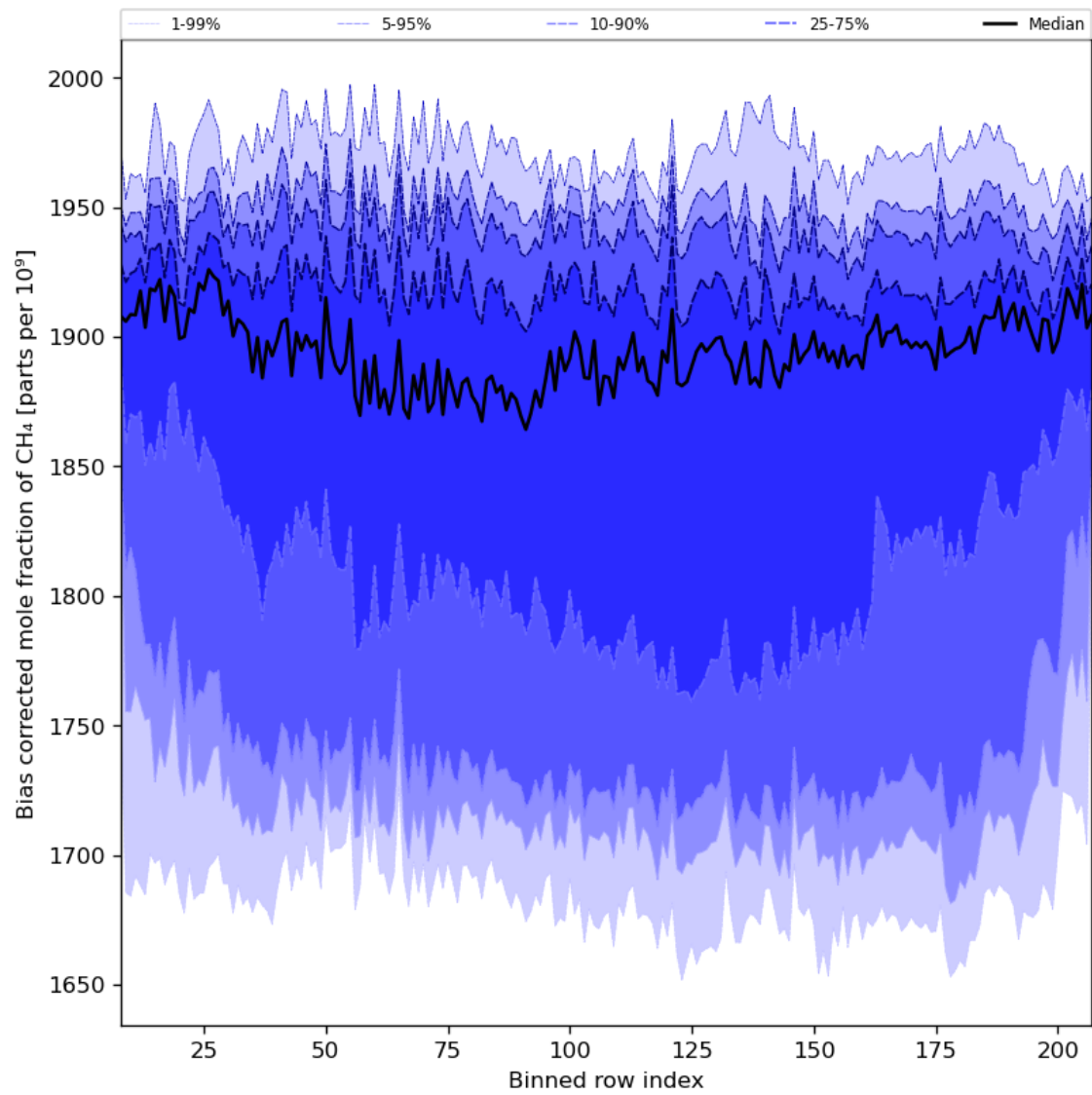


Figure 36: Along track statistics of “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22

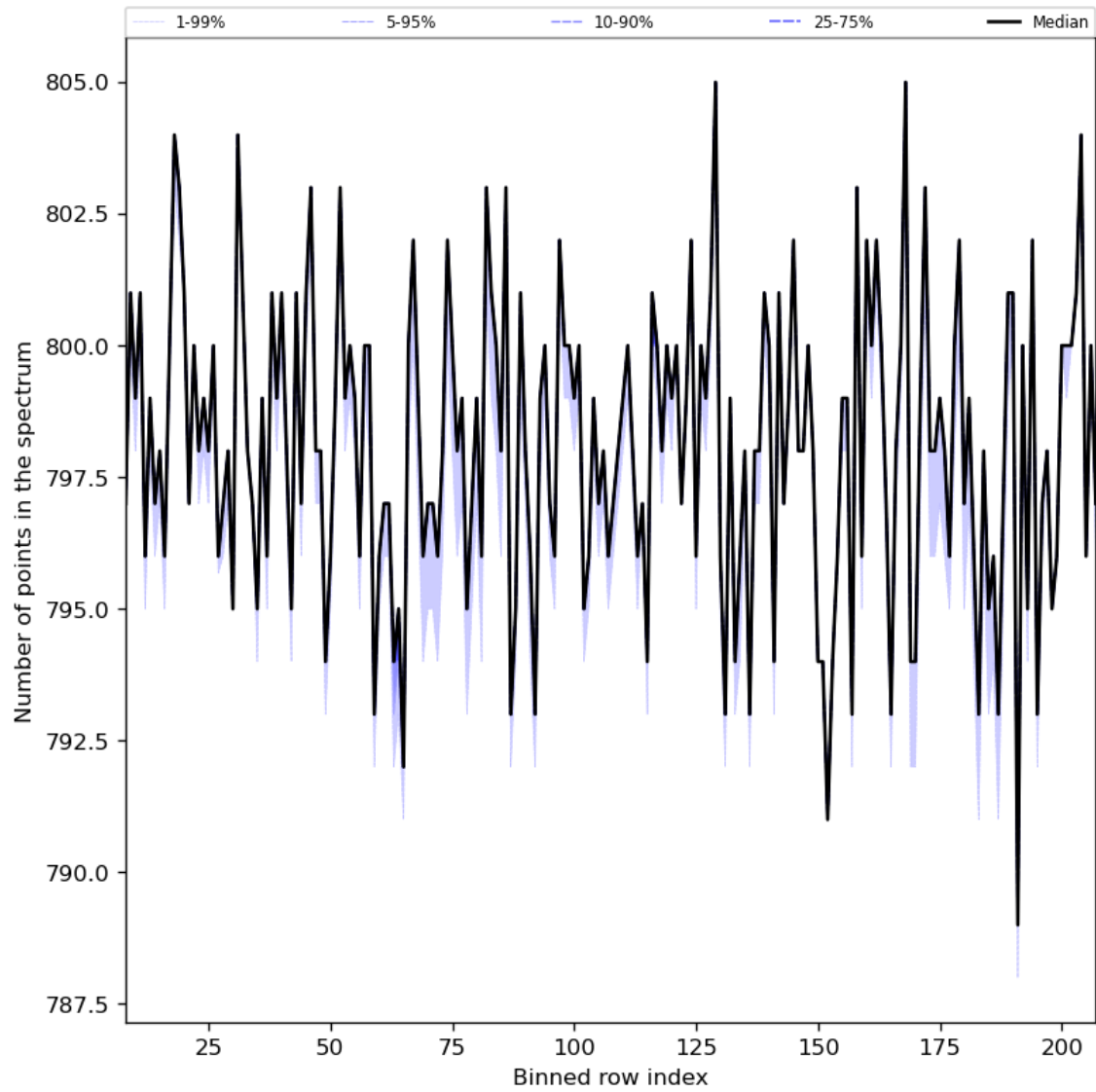


Figure 37: Along track statistics of “Number of points in the spectrum” for 2023-11-20 to 2023-11-22

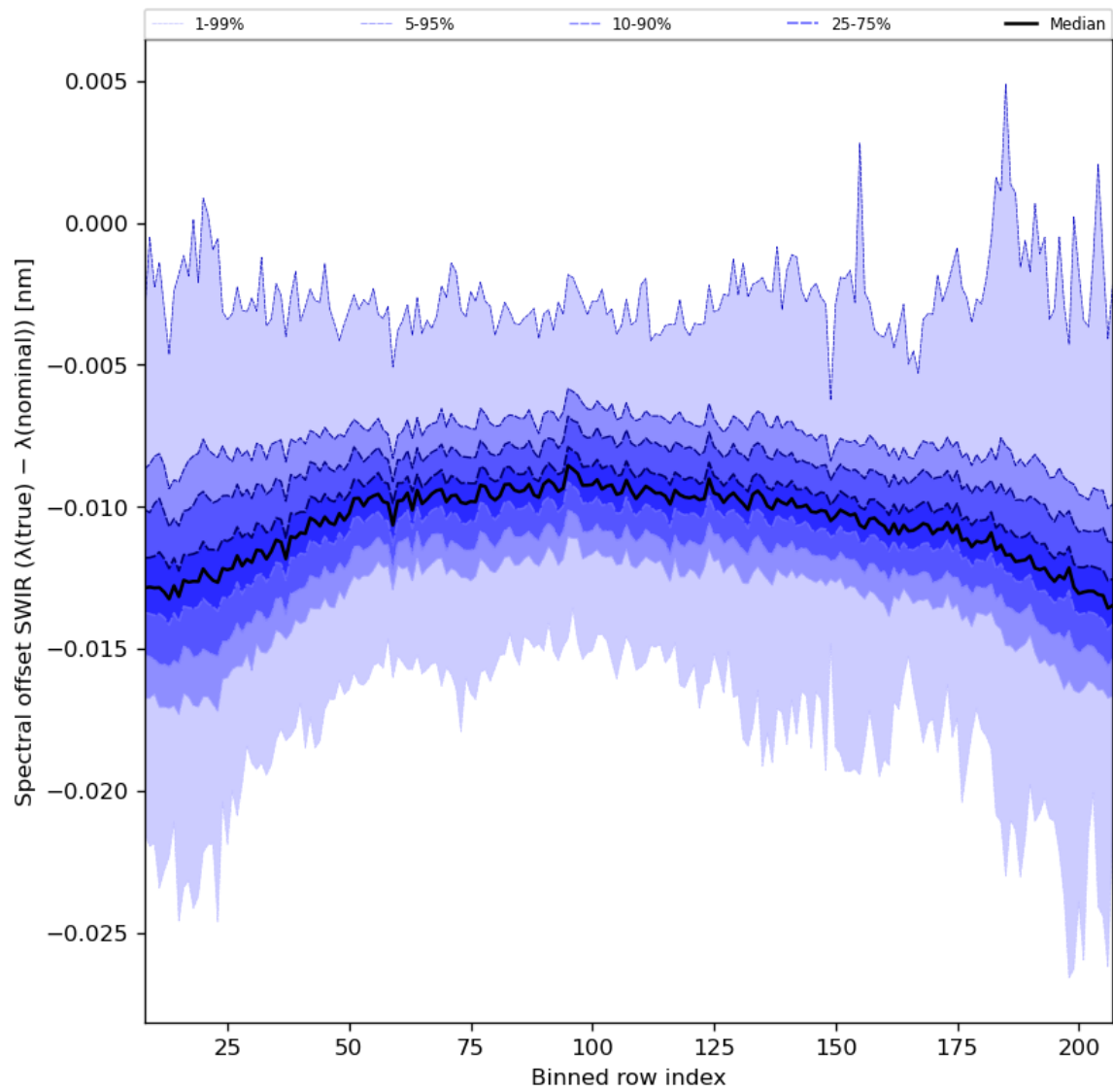


Figure 38: Along track statistics of “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22

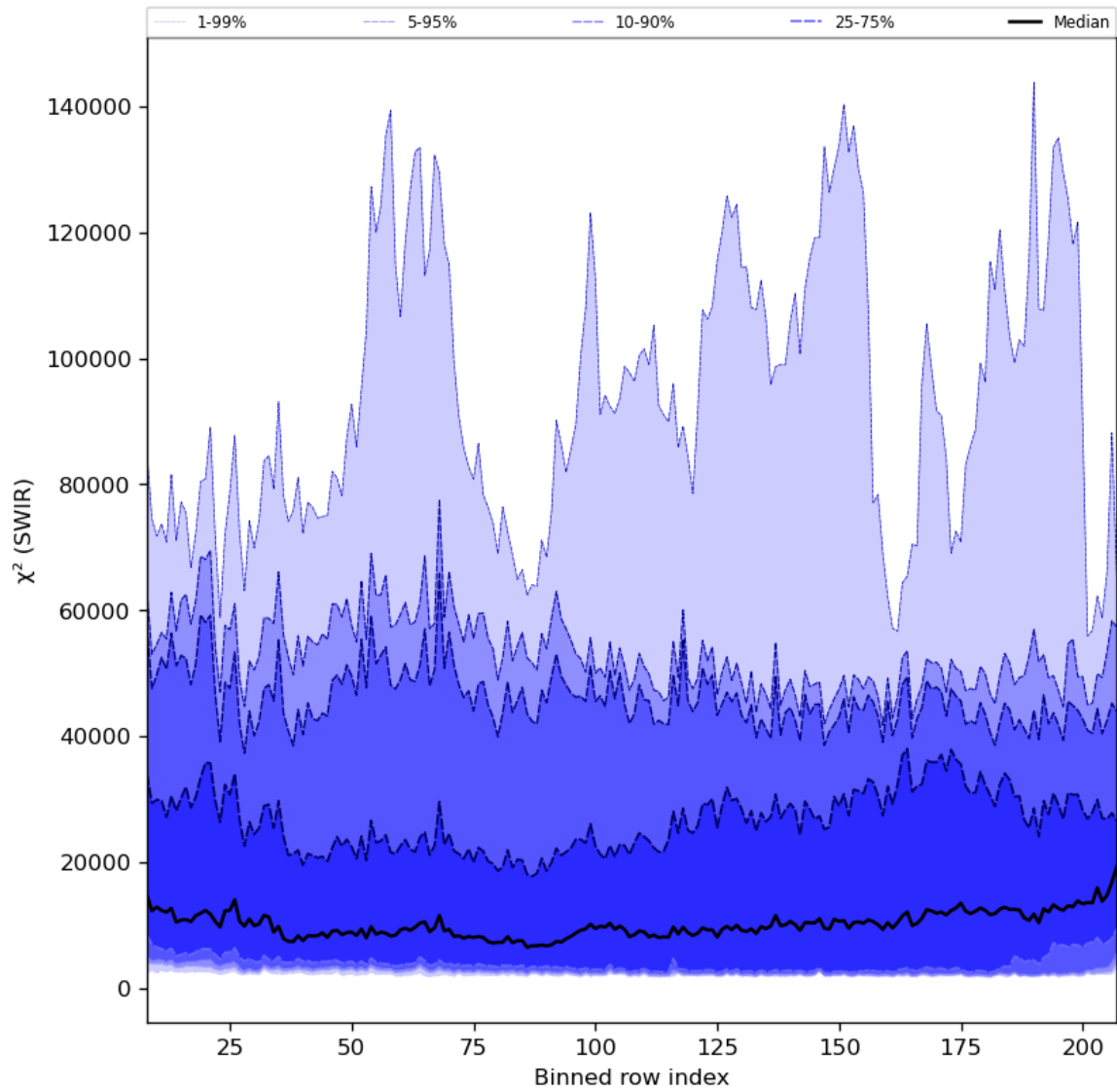


Figure 39: Along track statistics of “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22

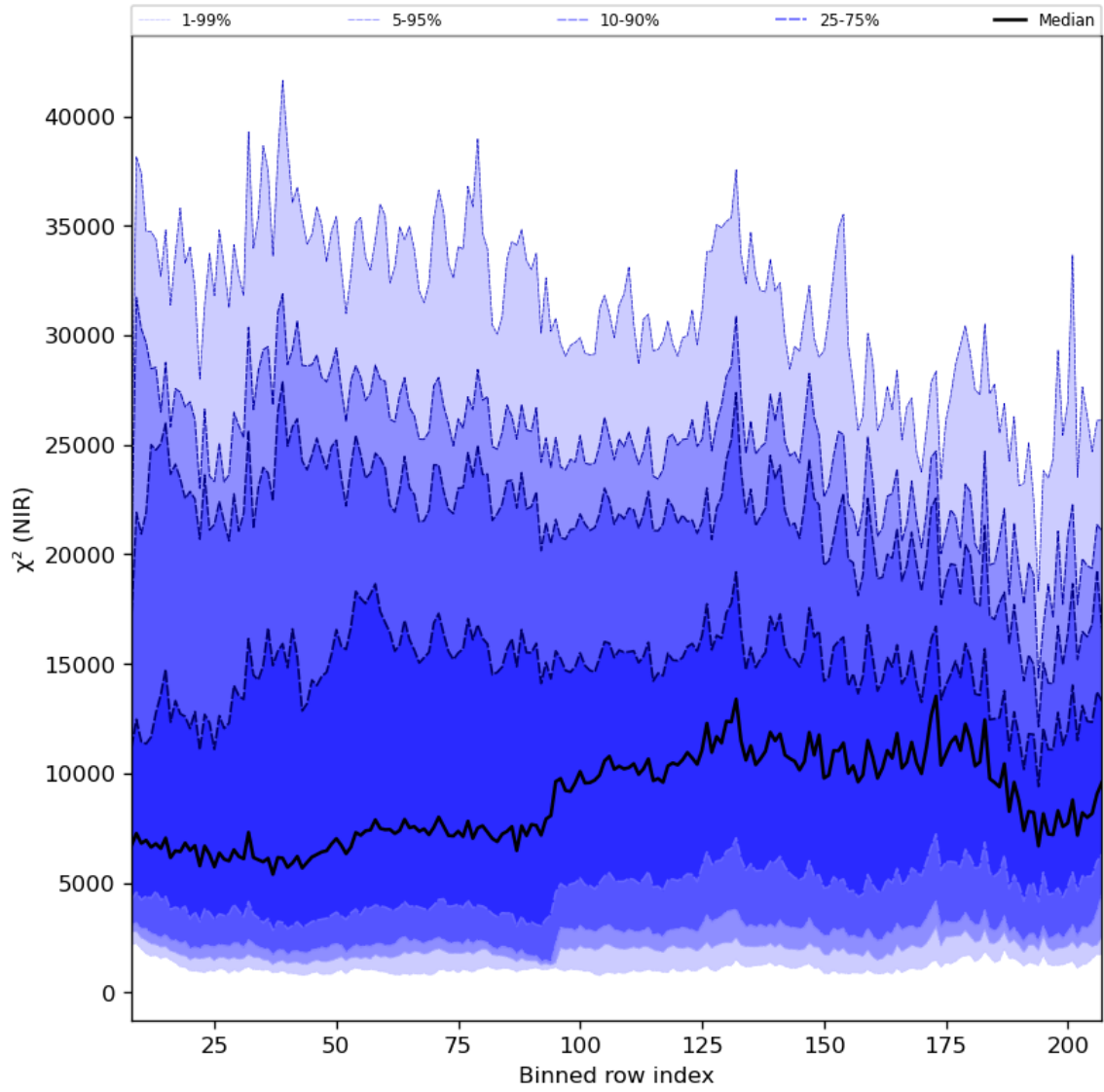


Figure 40: Along track statistics of “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22

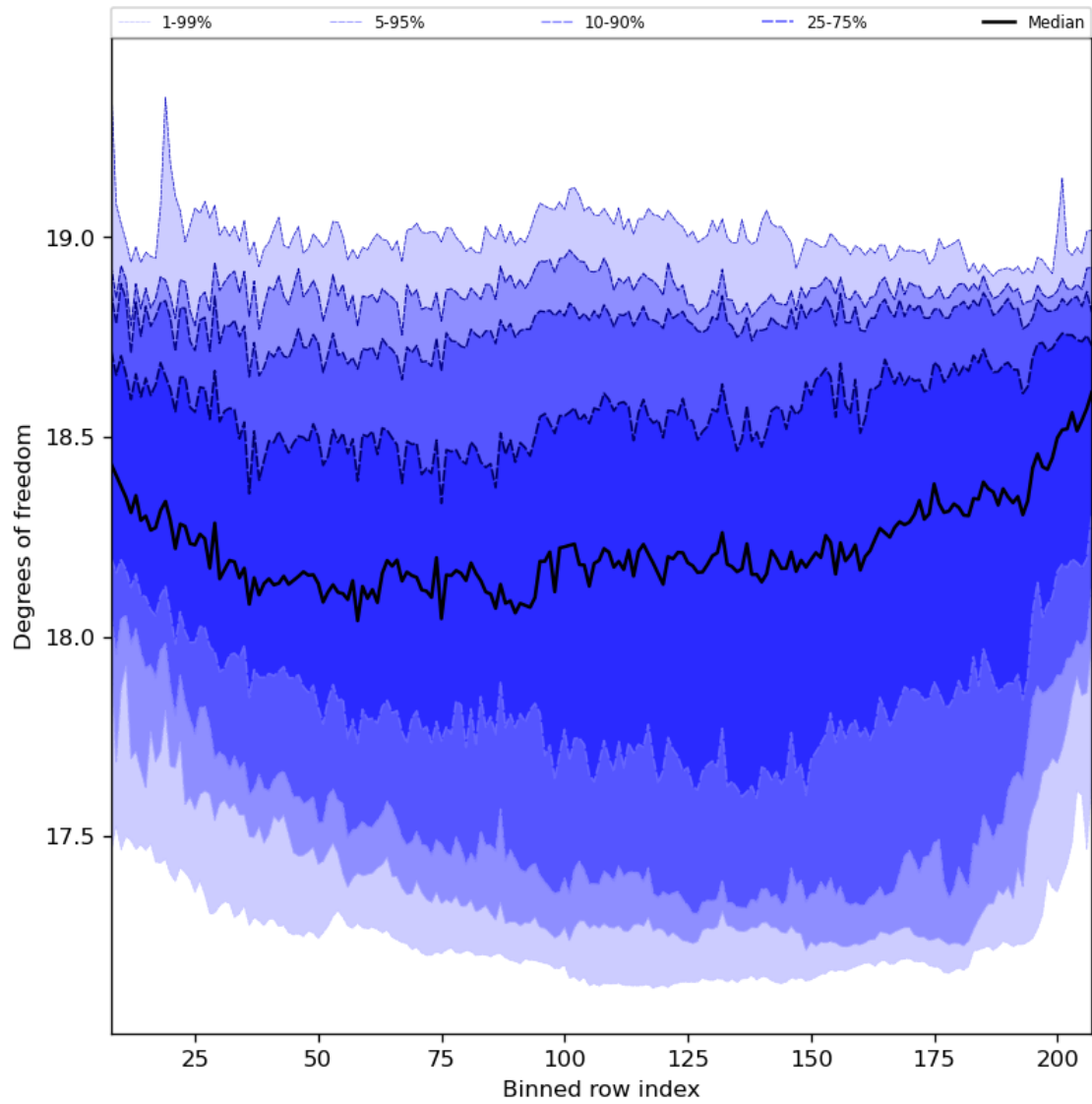


Figure 41: Along track statistics of “Degrees of freedom” for 2023-11-20 to 2023-11-22

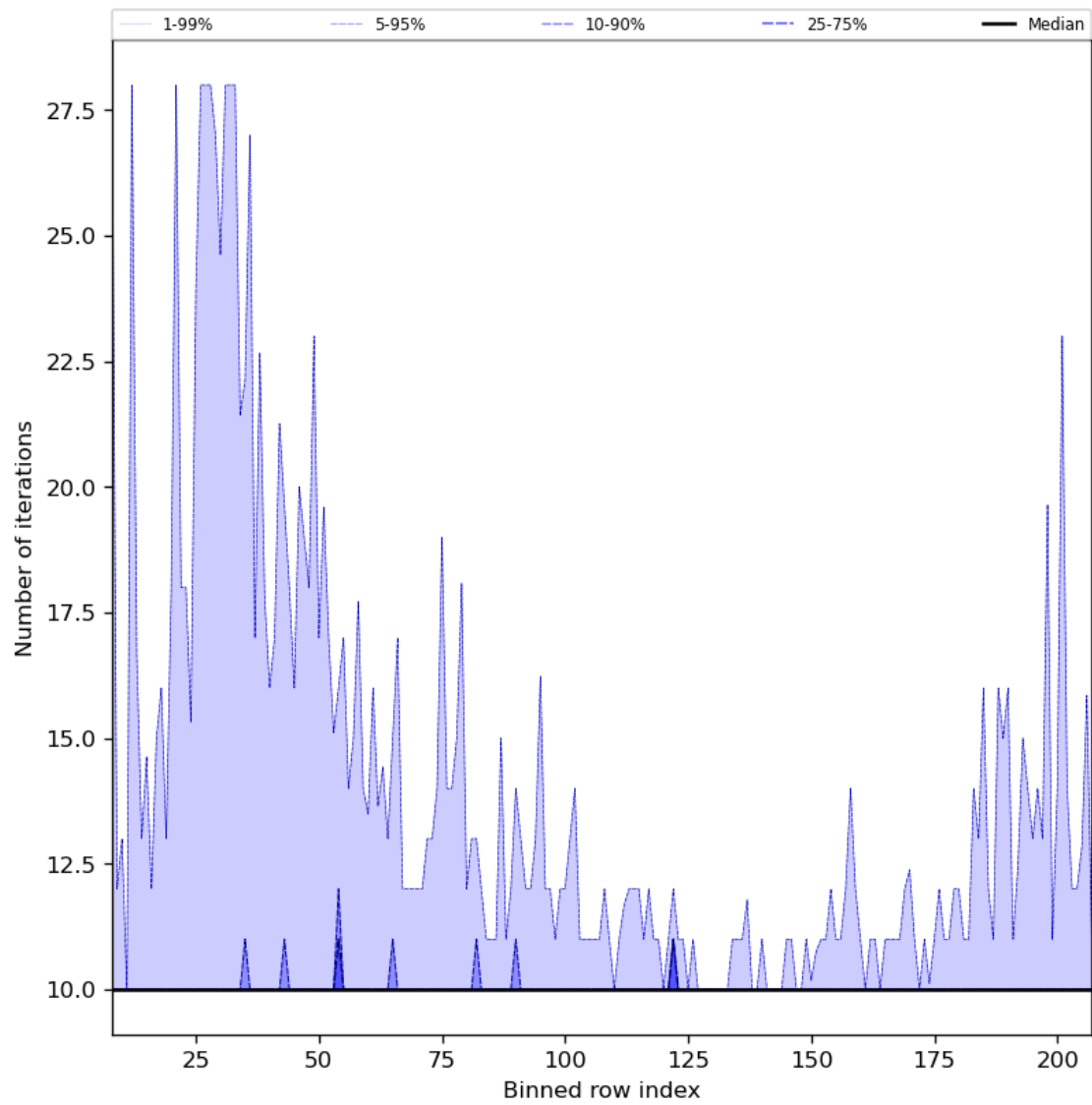


Figure 42: Along track statistics of “Number of iterations” for 2023-11-20 to 2023-11-22

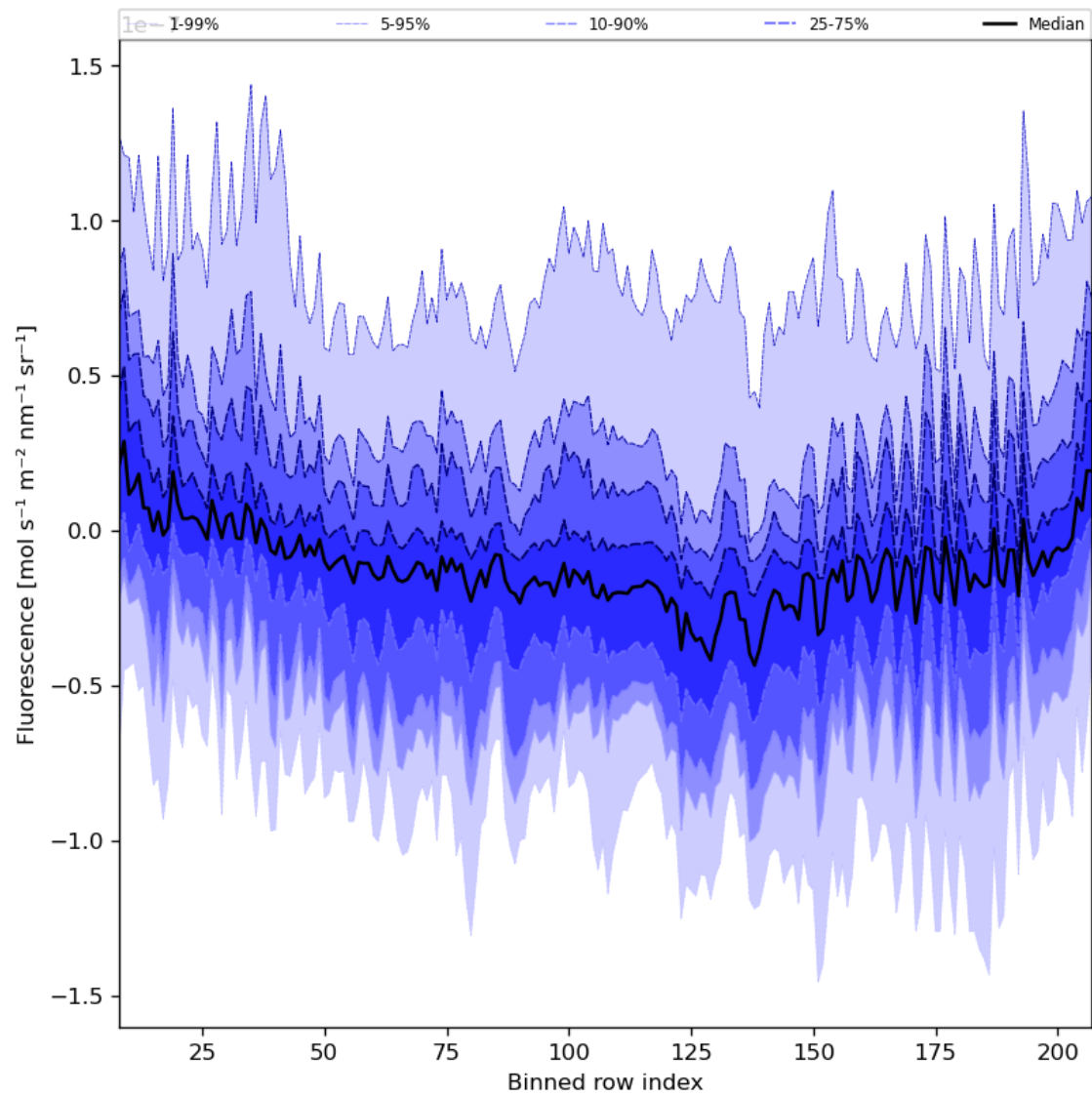


Figure 43: Along track statistics of “Fluorescence” for 2023-11-20 to 2023-11-22



## 10 Coincidence density

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

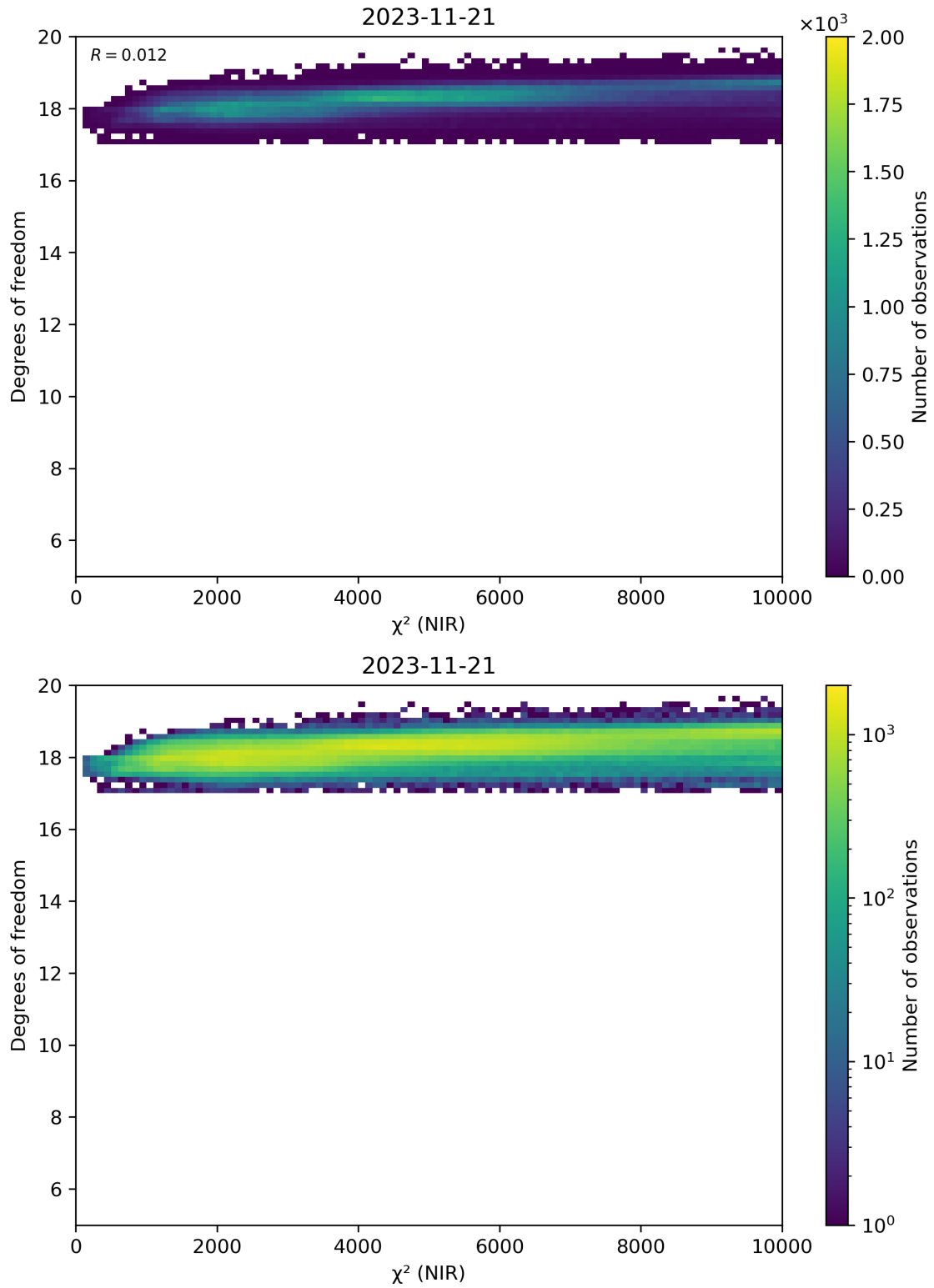


Figure 44: Scatter density plot of “ $\chi^2$  (NIR)” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

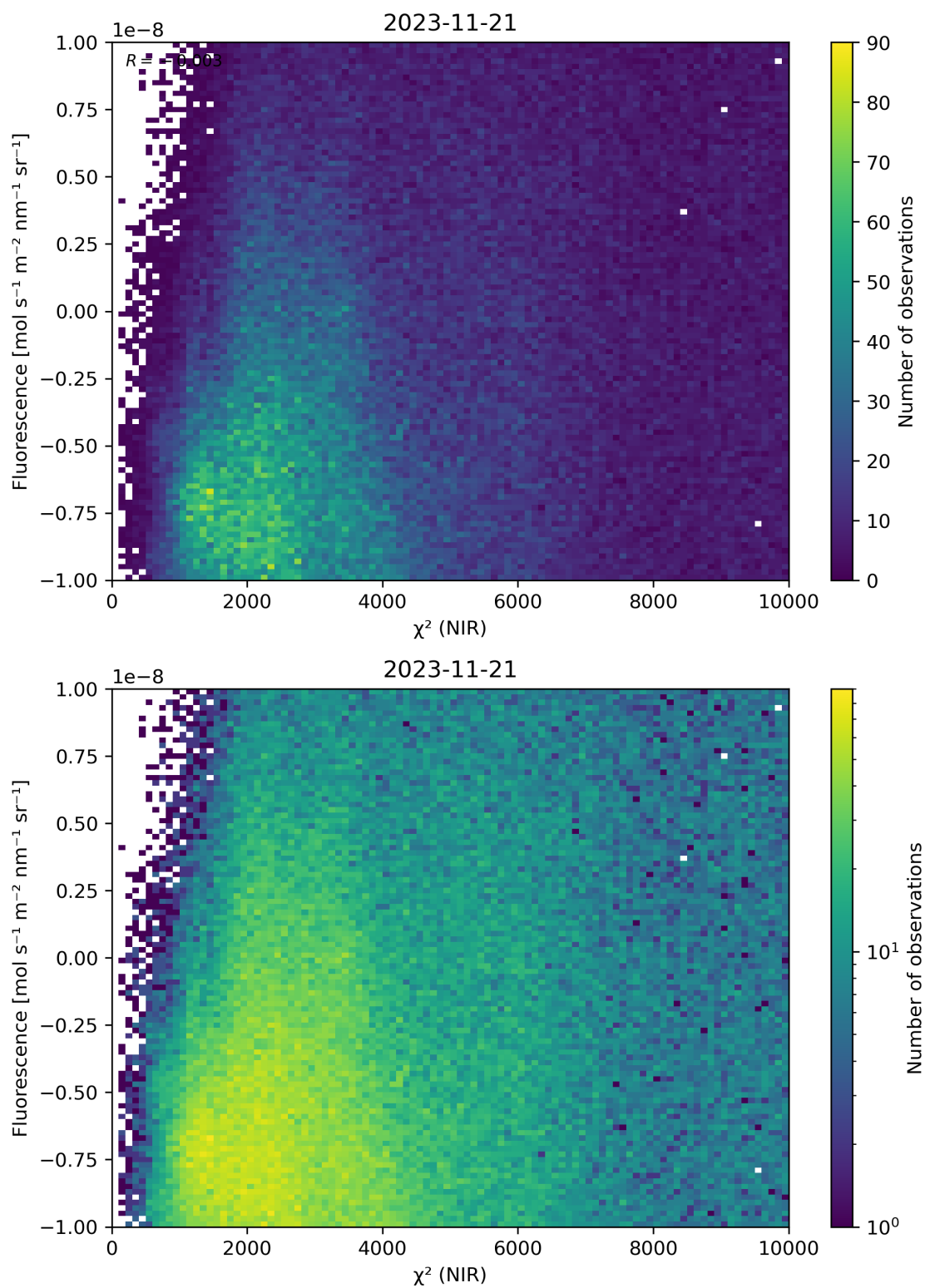


Figure 45: Scatter density plot of “ $\chi^2$  (NIR)” against “Fluorescence” for 2023-11-20 to 2023-11-22.

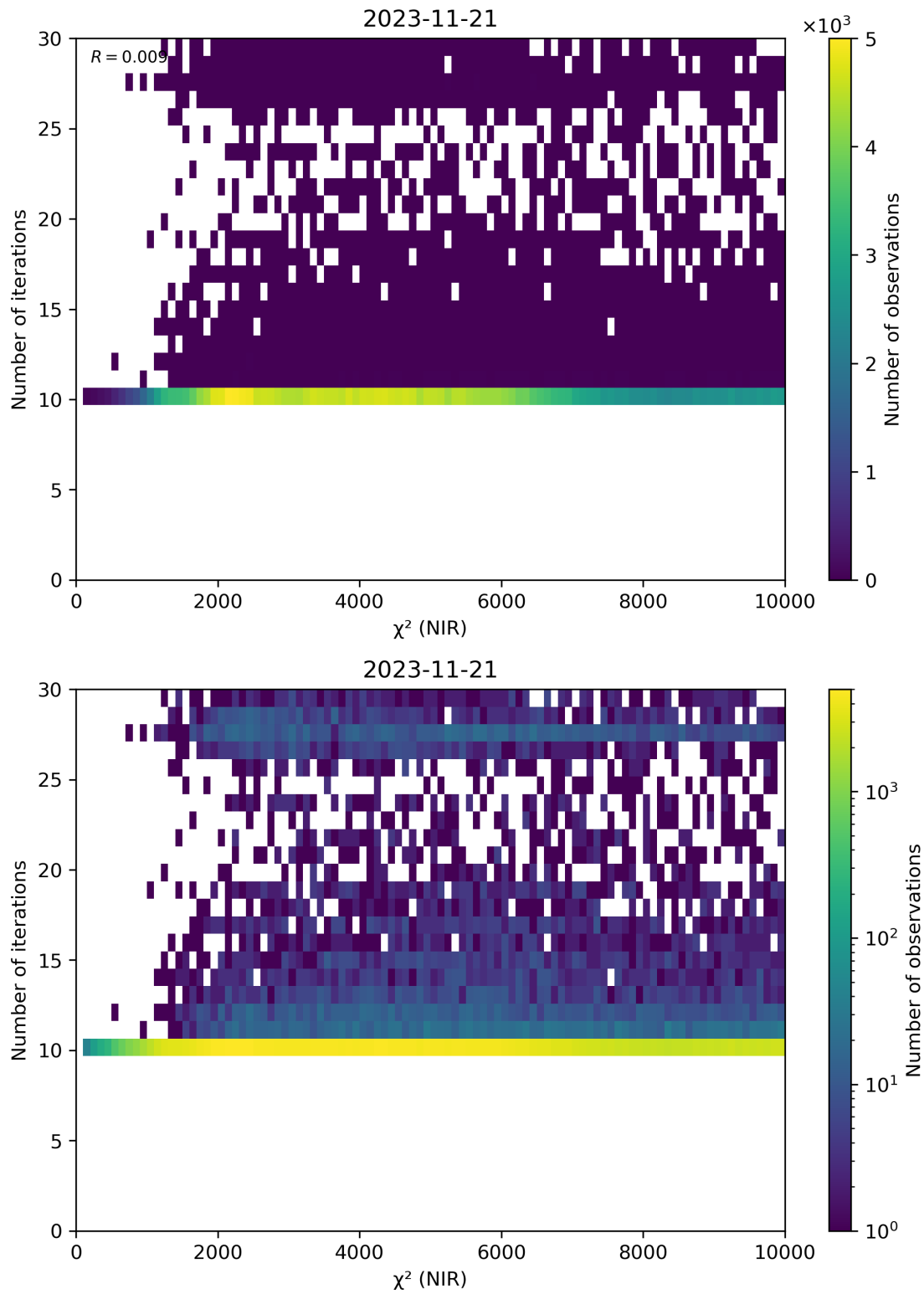


Figure 46: Scatter density plot of “ $\chi^2$  (NIR)” against “Number of iterations” for 2023-11-20 to 2023-11-22.

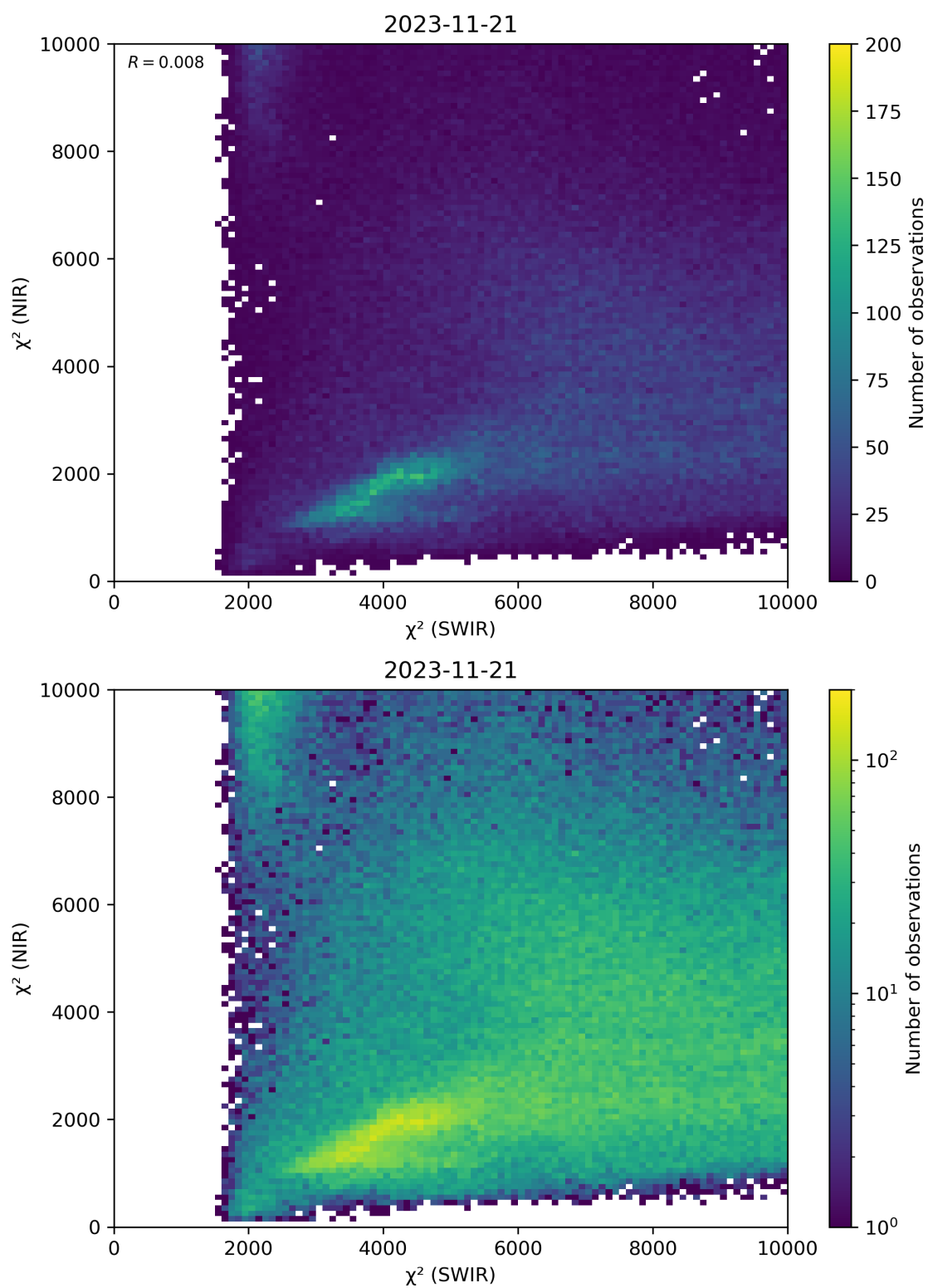


Figure 47: Scatter density plot of “ $\chi^2$  (SWIR)” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

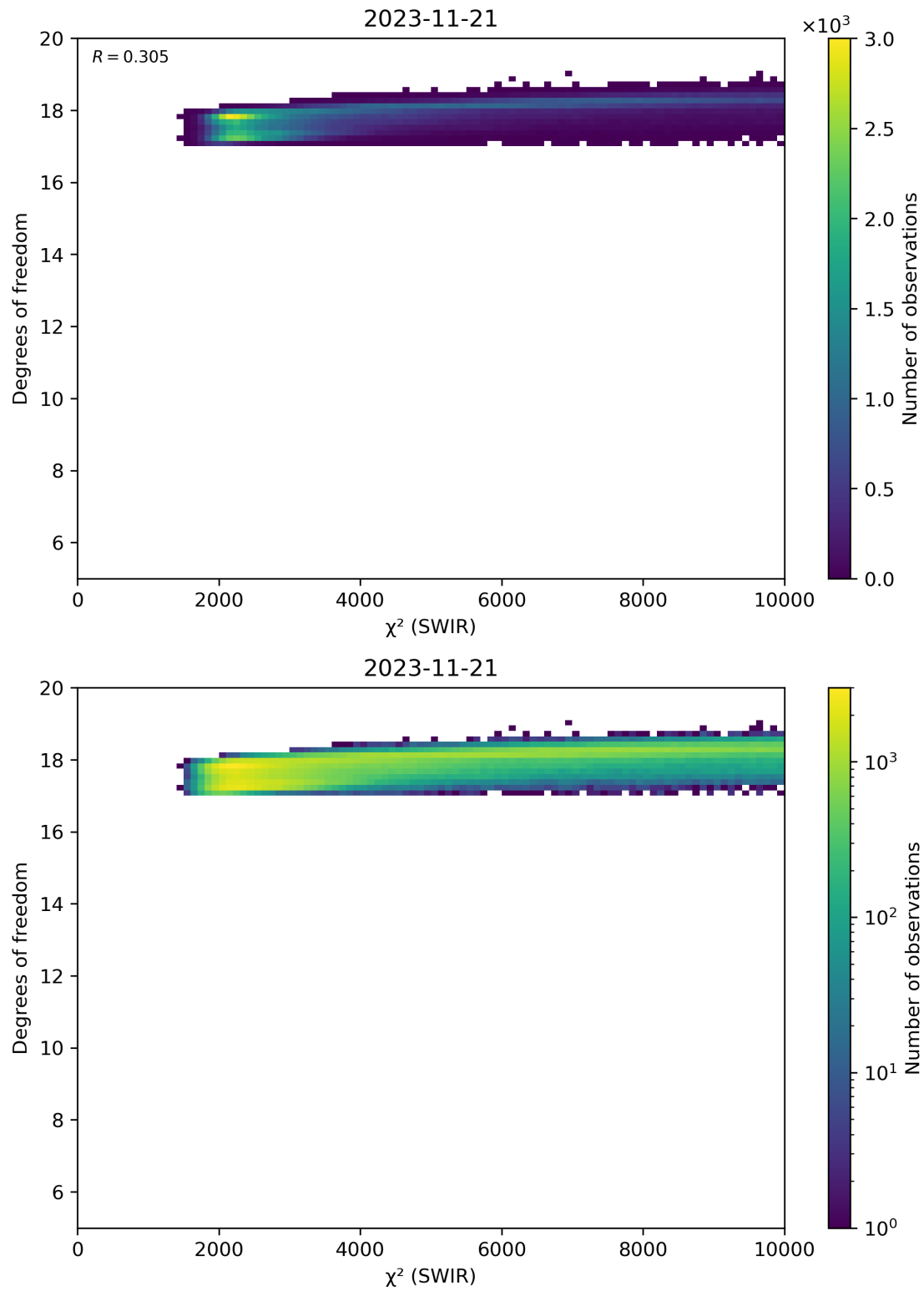


Figure 48: Scatter density plot of “ $\chi^2$  (SWIR)” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

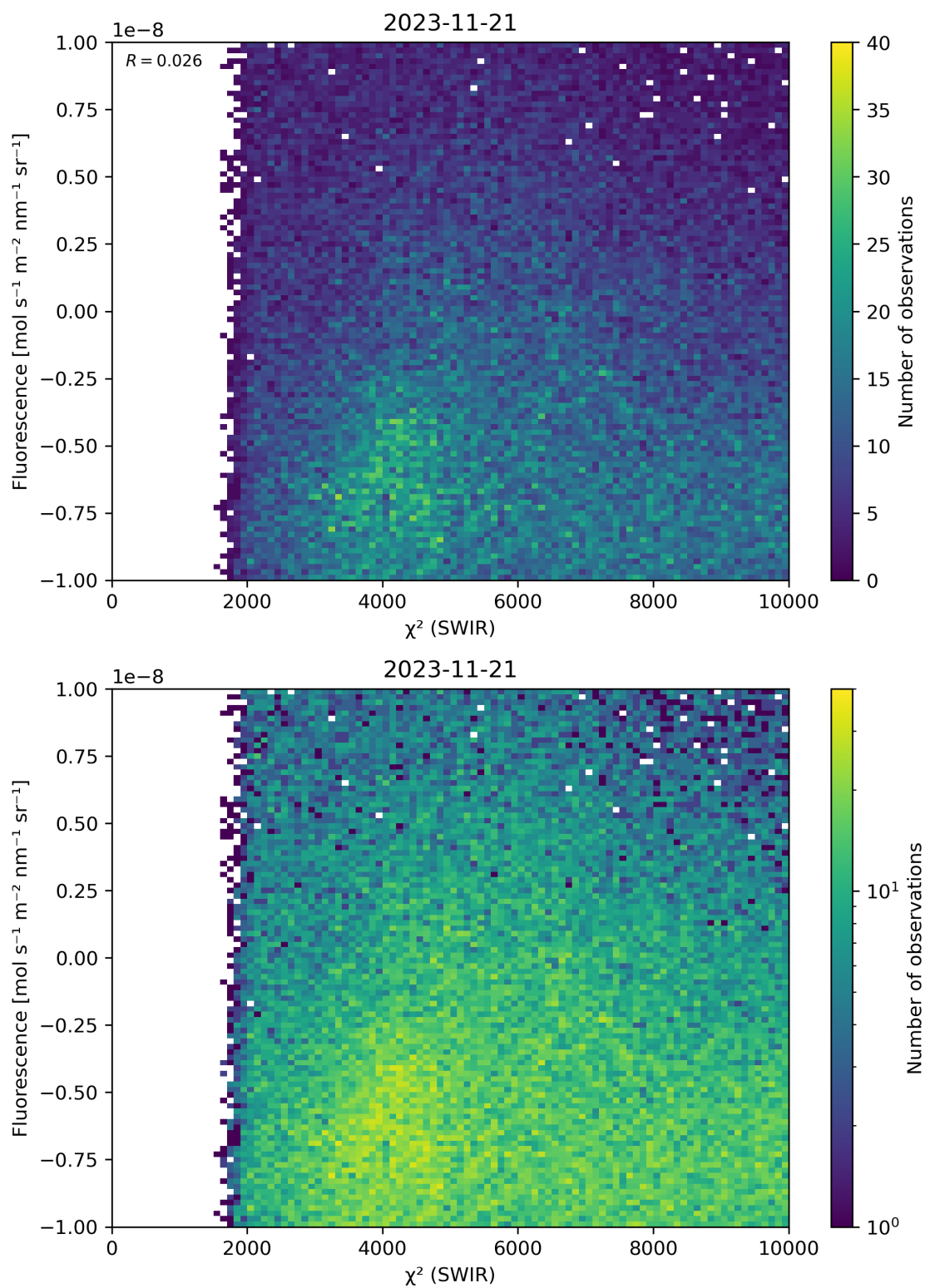


Figure 49: Scatter density plot of “ $\chi^2$  (SWIR)” against “Fluorescence” for 2023-11-20 to 2023-11-22.

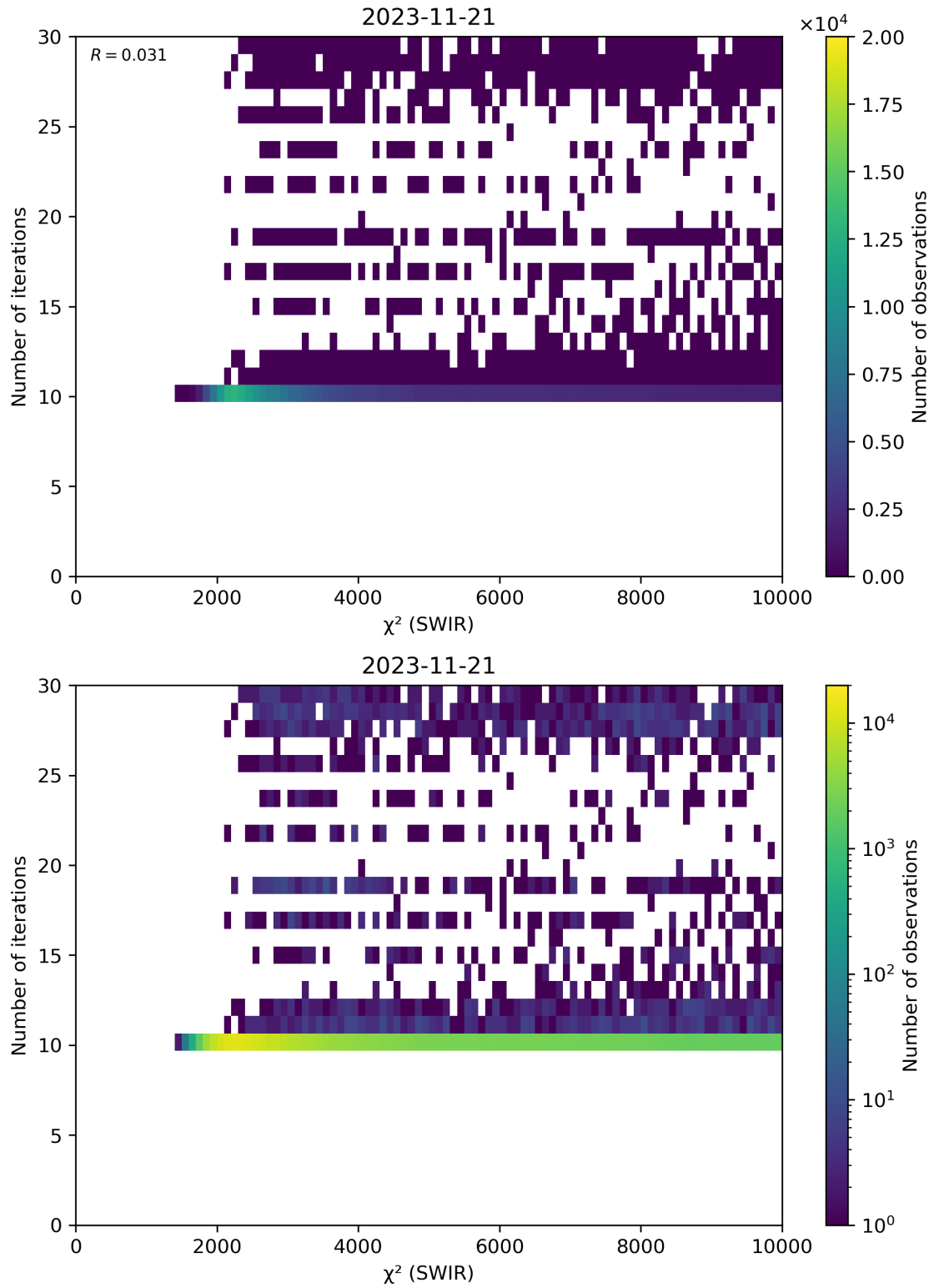


Figure 50: Scatter density plot of “ $\chi^2$  (SWIR)” against “Number of iterations” for 2023-11-20 to 2023-11-22.

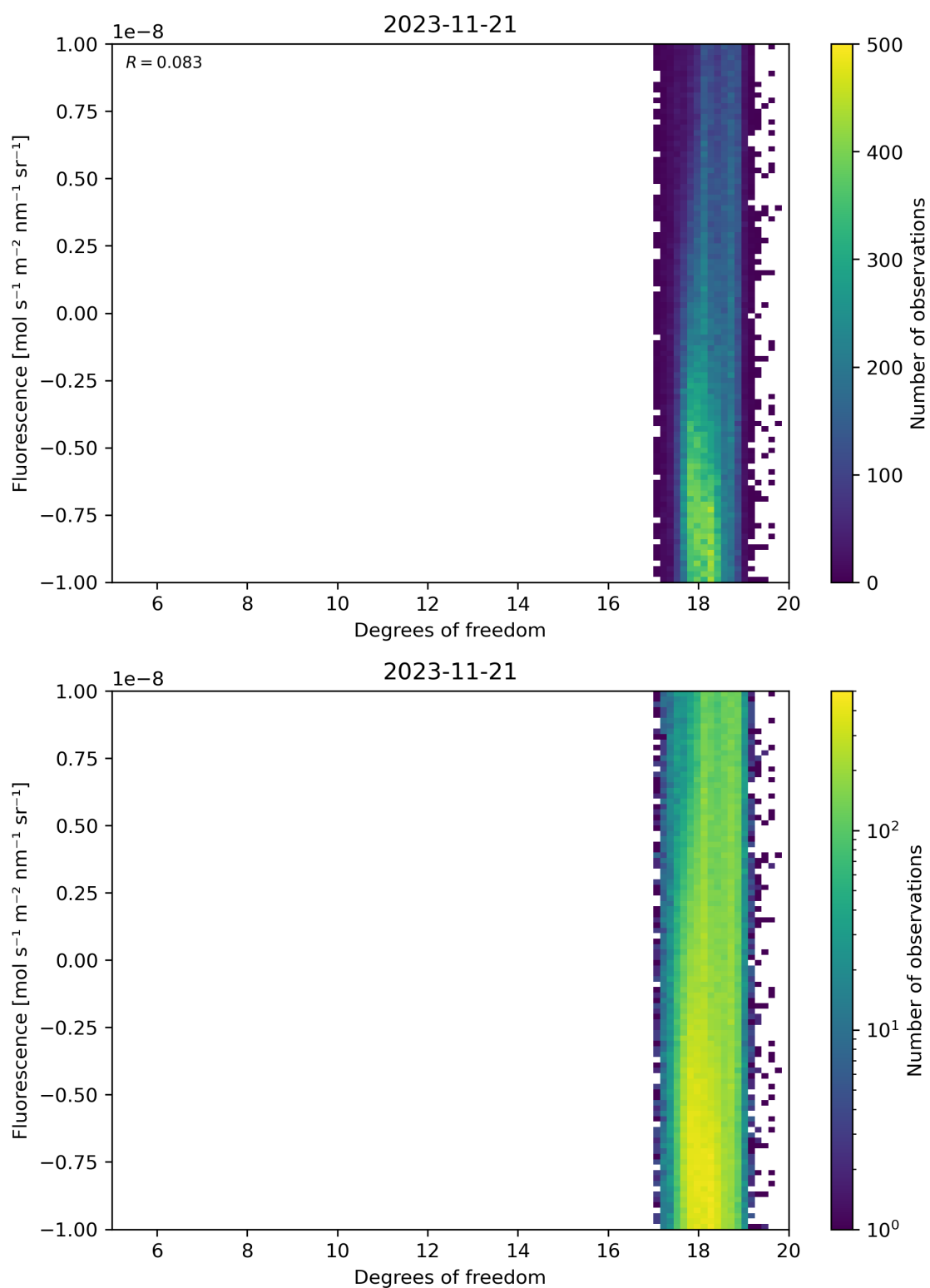


Figure 51: Scatter density plot of “Degrees of freedom” against “Fluorescence” for 2023-11-20 to 2023-11-22.



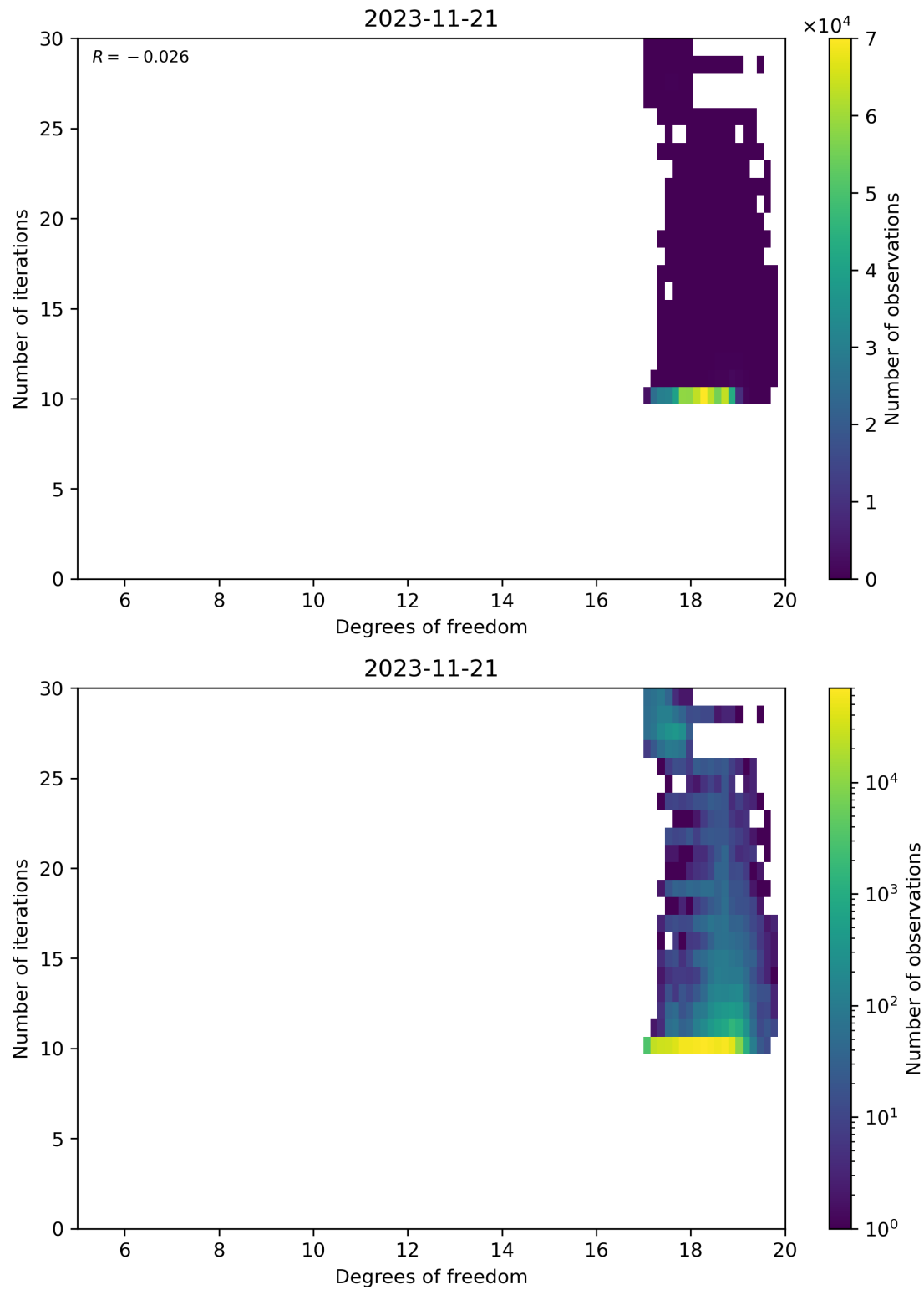


Figure 52: Scatter density plot of “Degrees of freedom” against “Number of iterations” for 2023-11-20 to 2023-11-22.

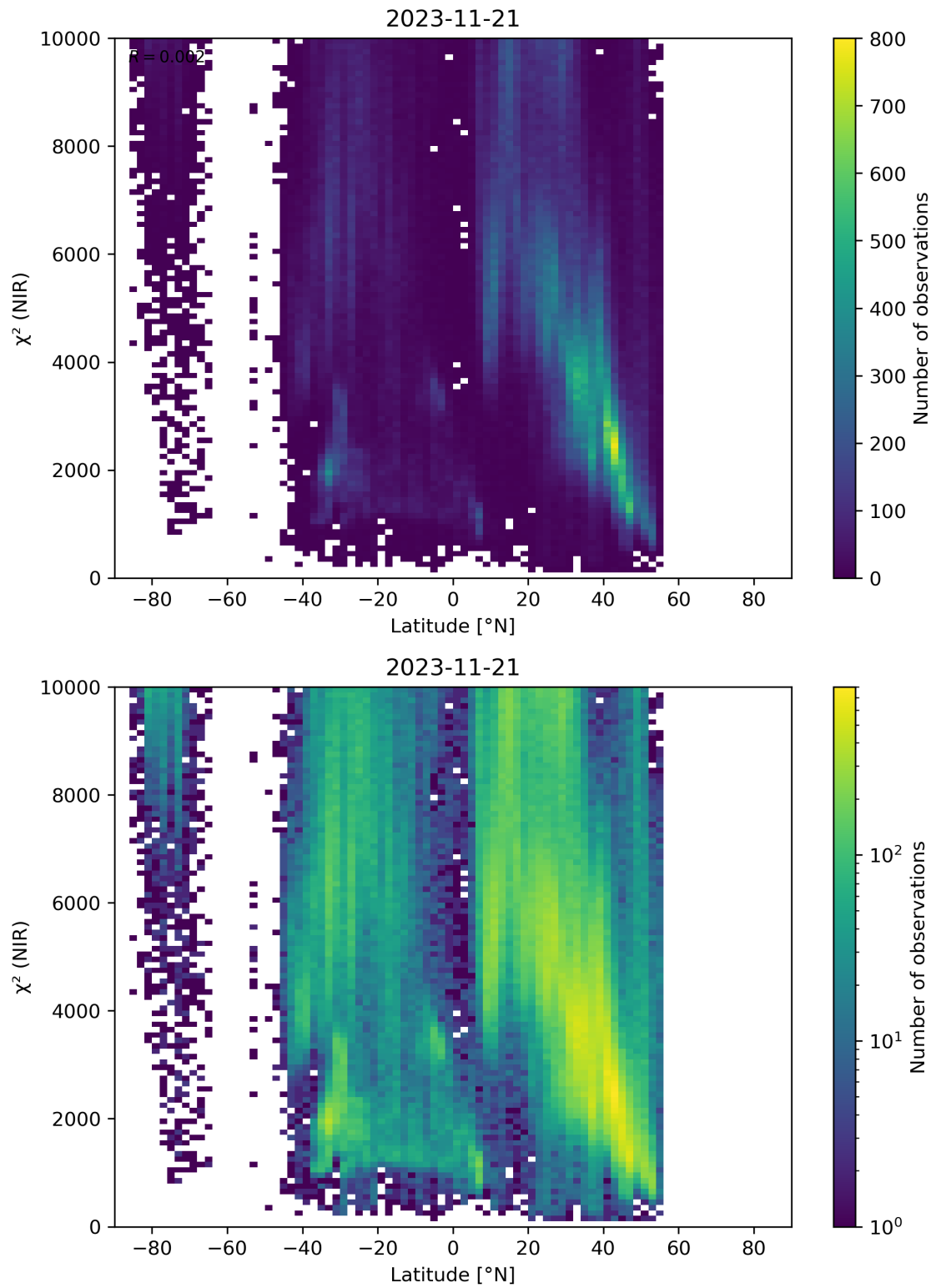


Figure 53: Scatter density plot of “Latitude” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

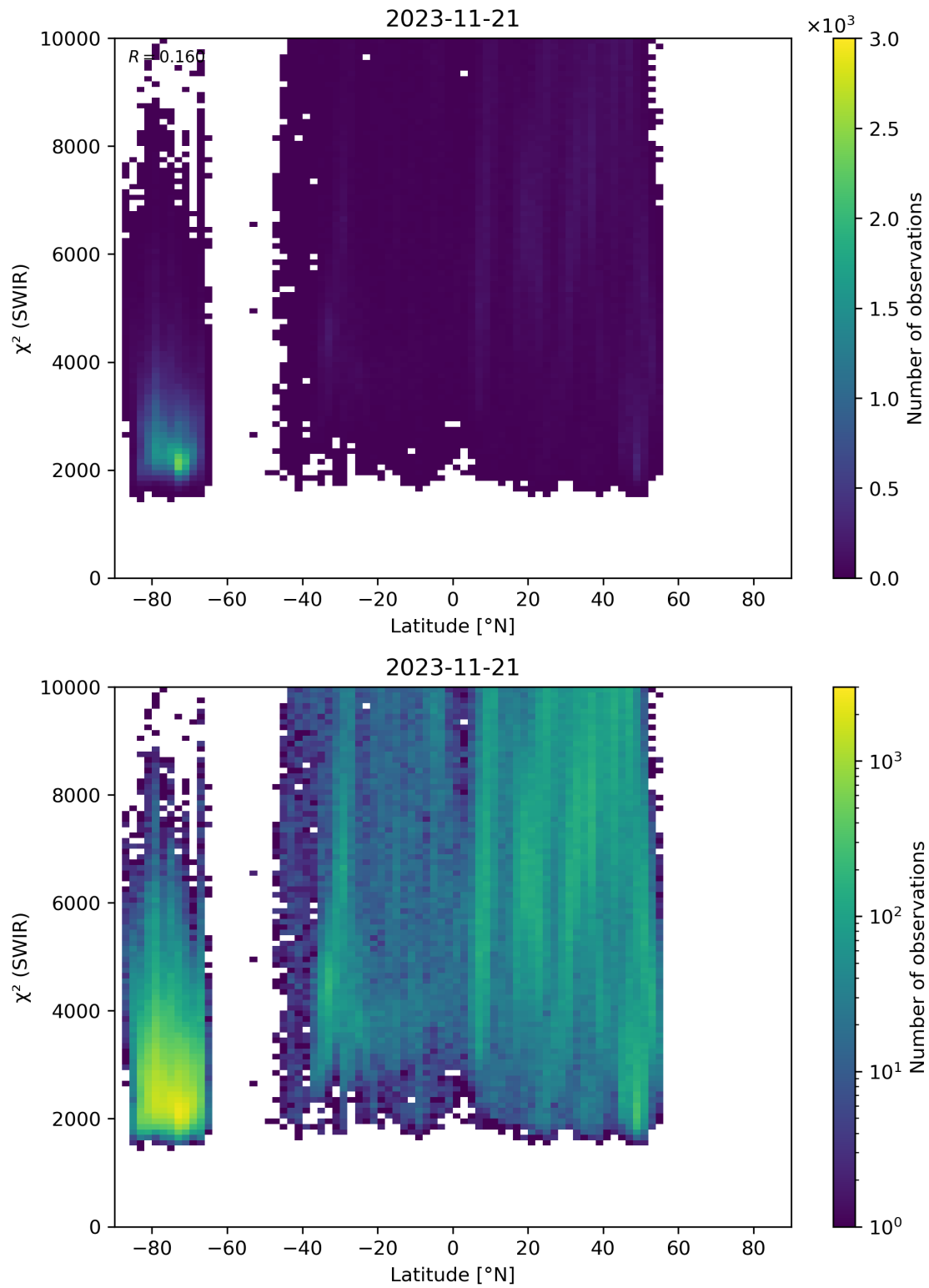


Figure 54: Scatter density plot of “Latitude” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

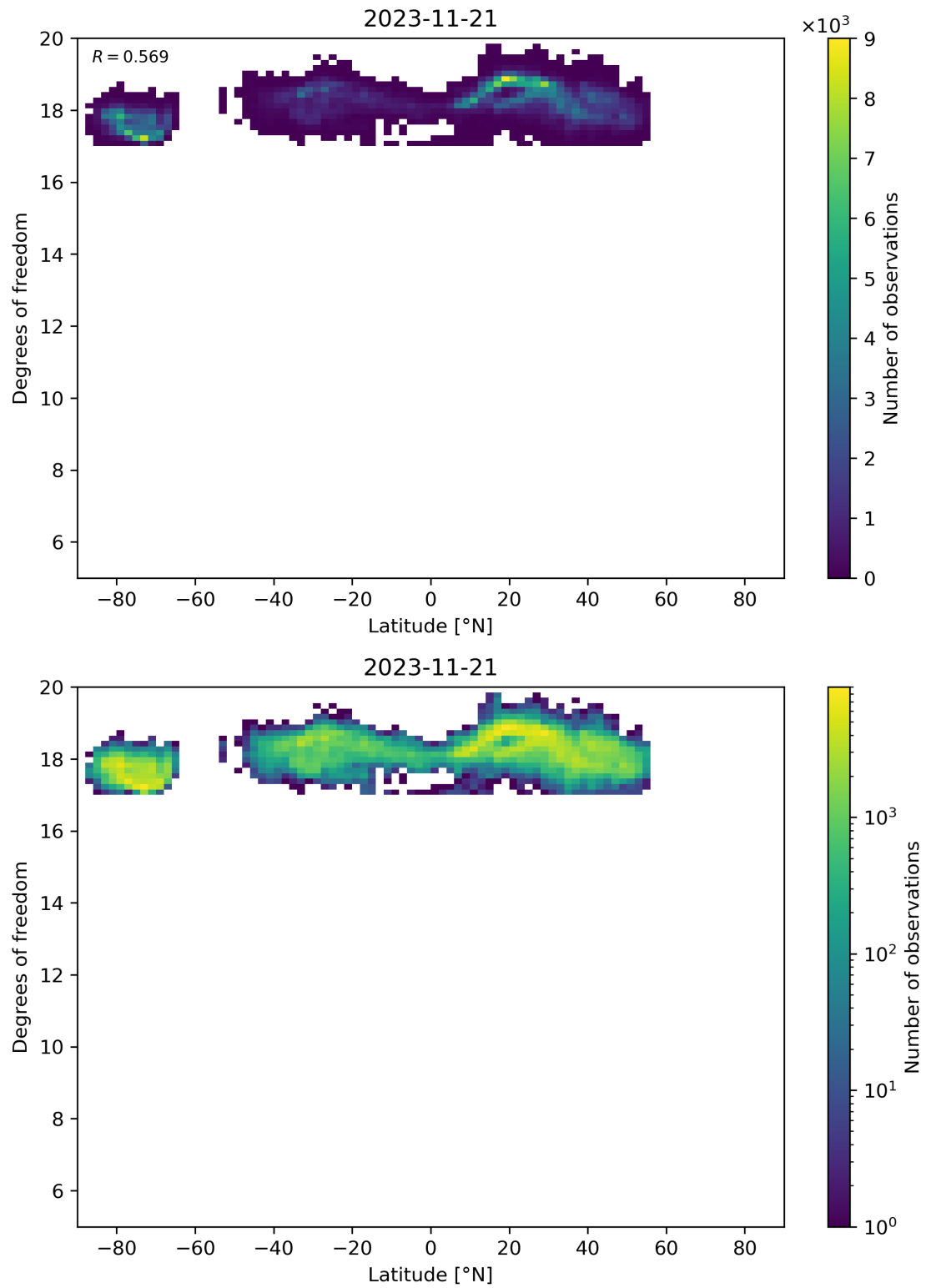


Figure 55: Scatter density plot of “Latitude” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

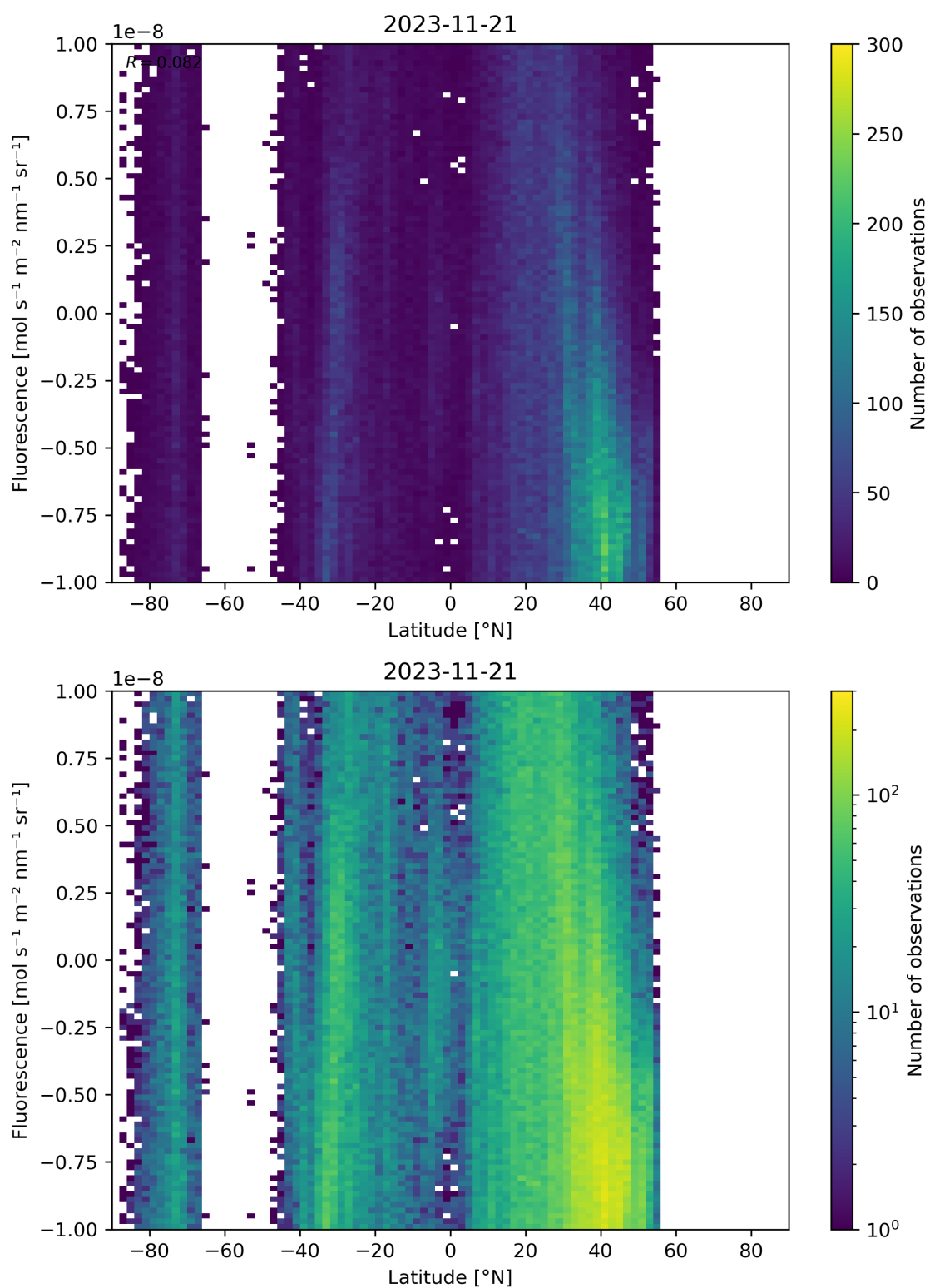


Figure 56: Scatter density plot of “Latitude” against “Fluorescence” for 2023-11-20 to 2023-11-22.

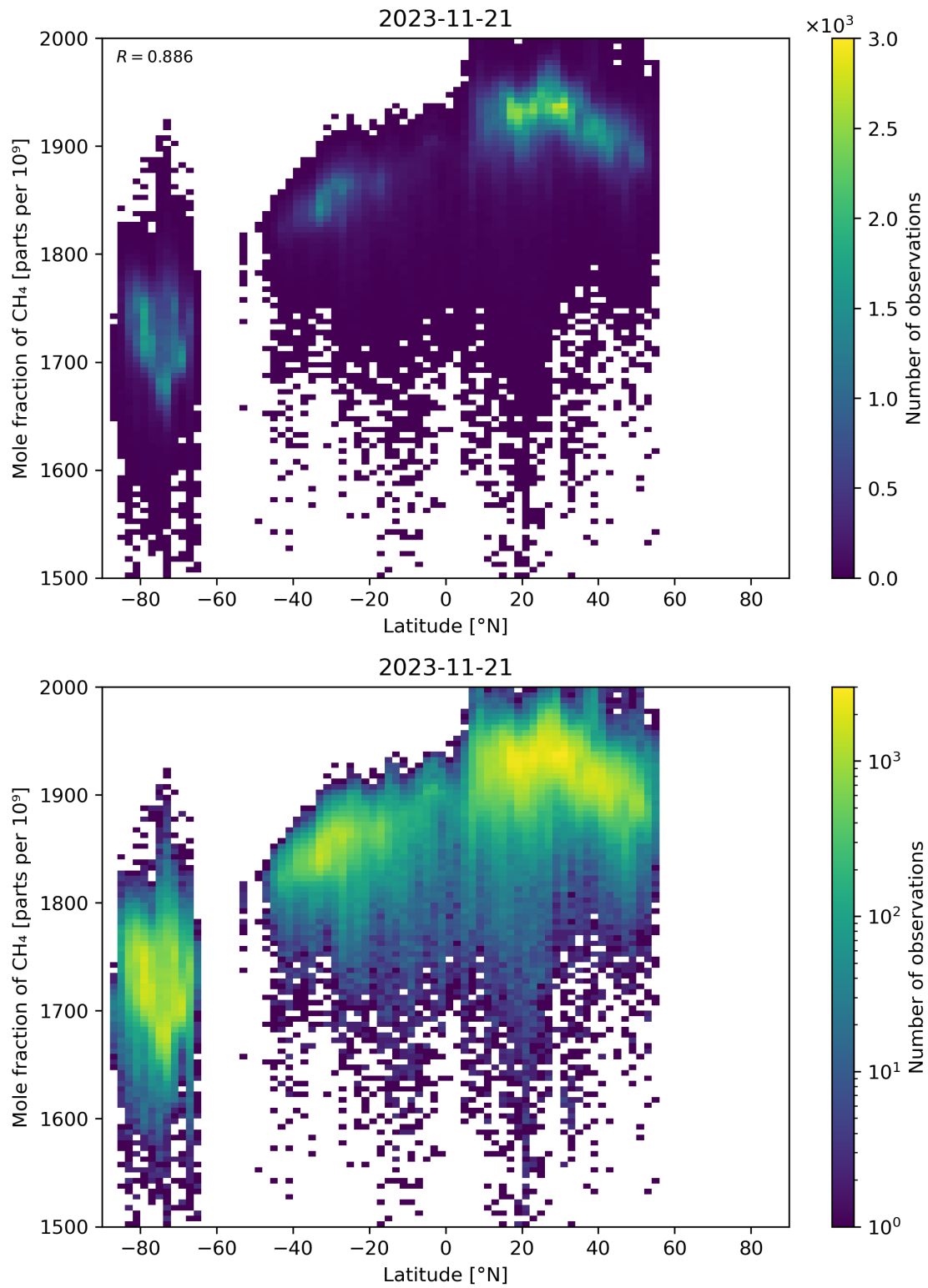


Figure 57: Scatter density plot of “Latitude” against “Mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

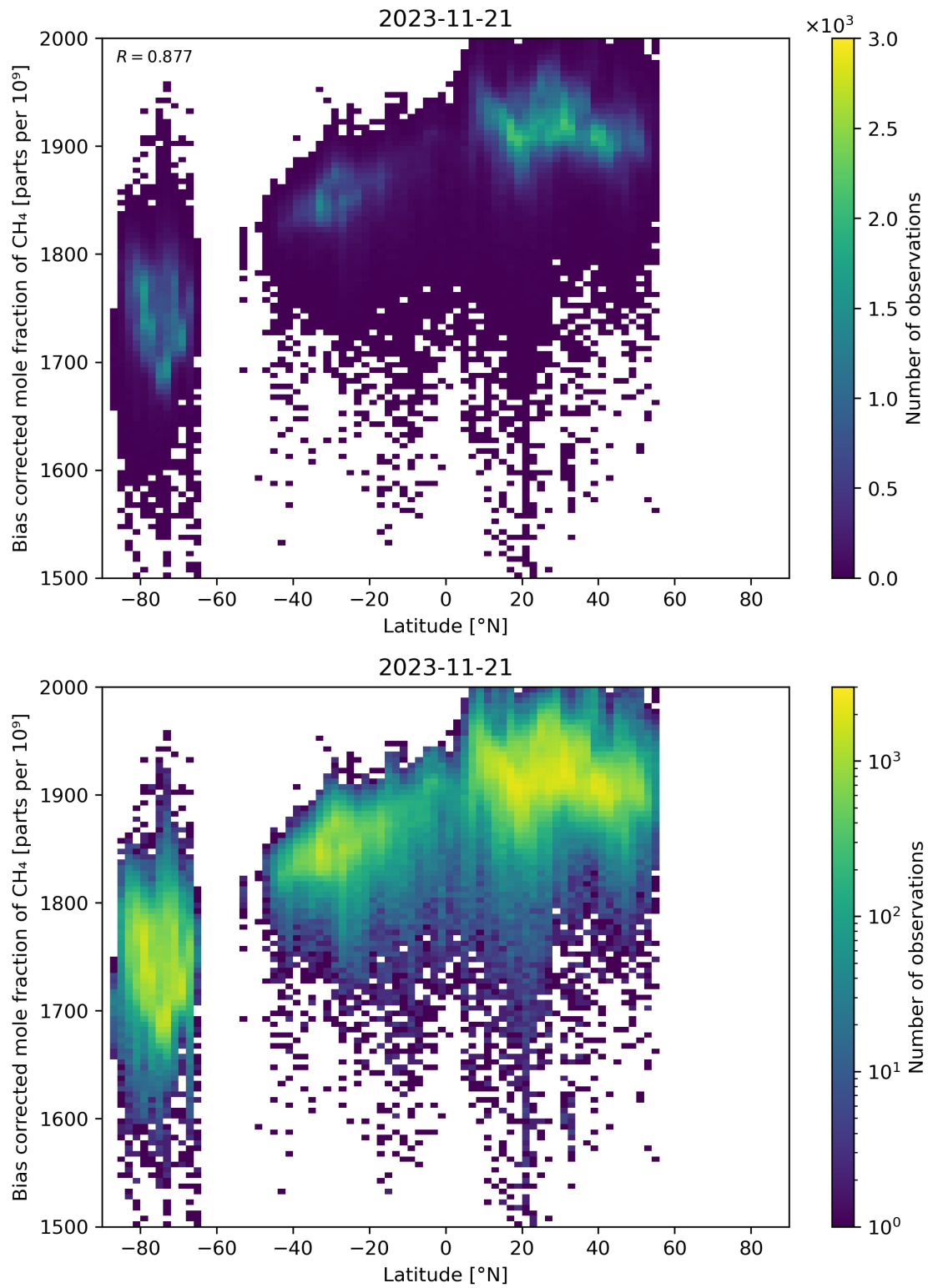


Figure 58: Scatter density plot of “Latitude” against “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

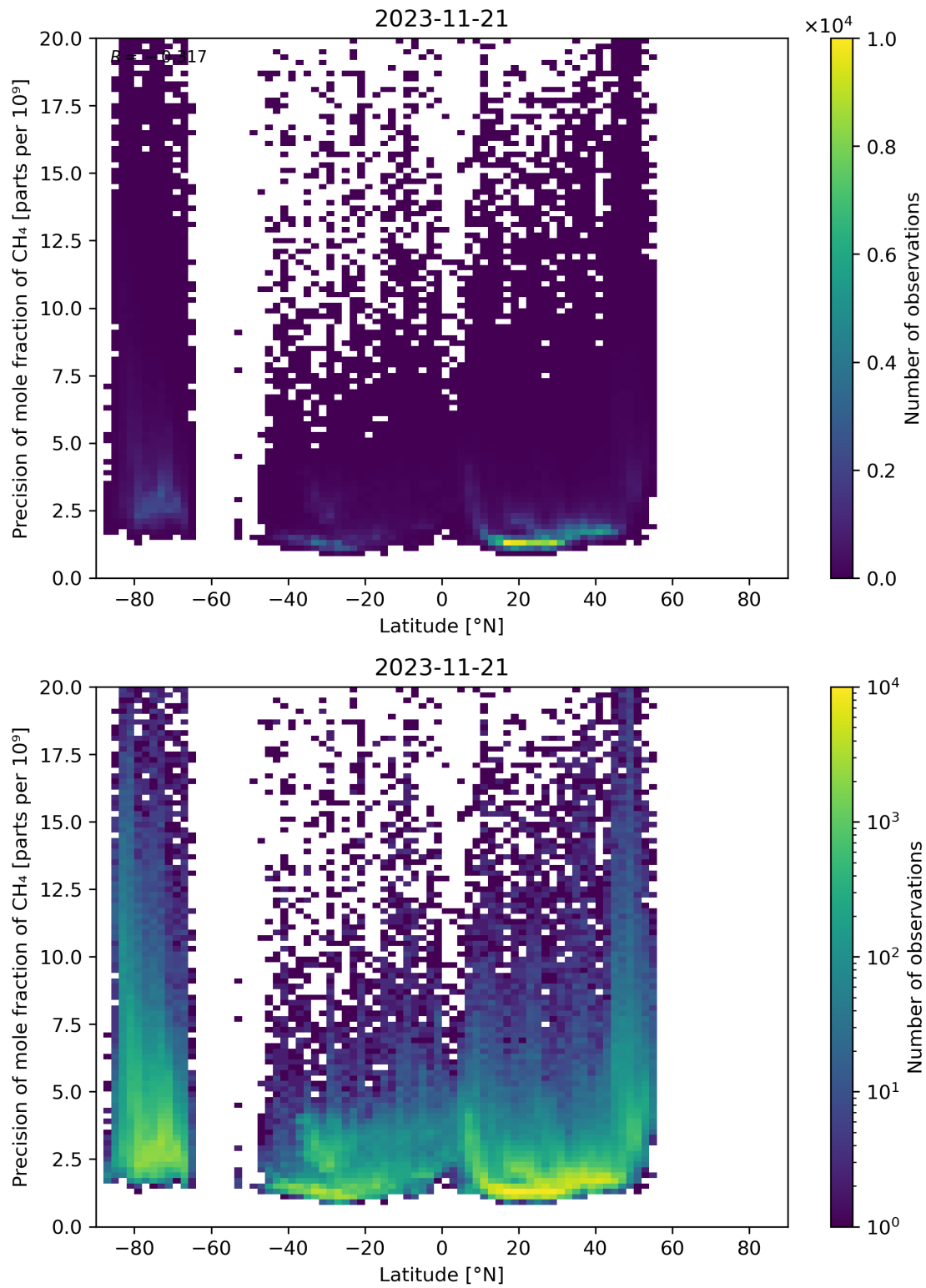


Figure 59: Scatter density plot of “Latitude” against “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.



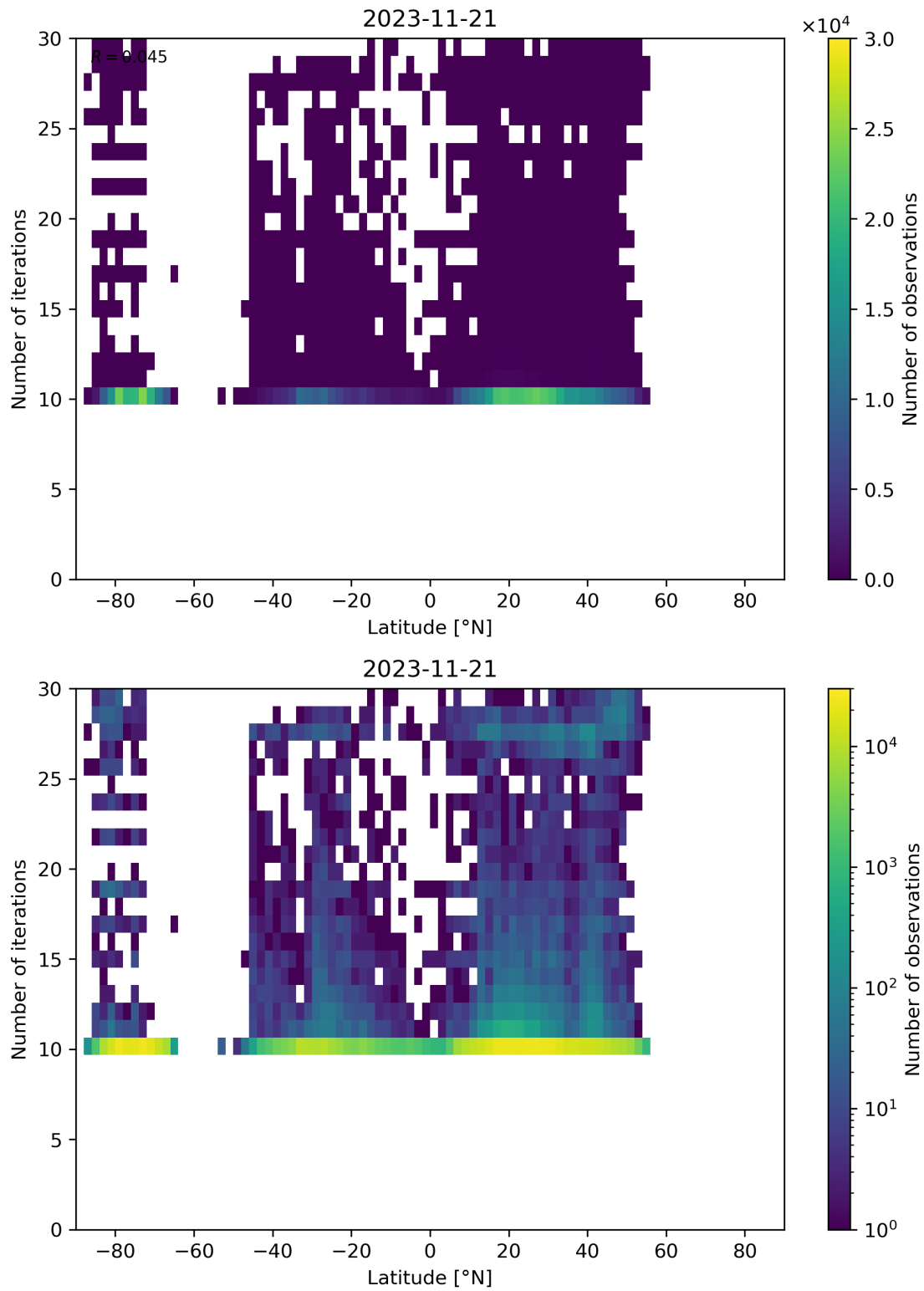


Figure 60: Scatter density plot of “Latitude” against “Number of iterations” for 2023-11-20 to 2023-11-22.

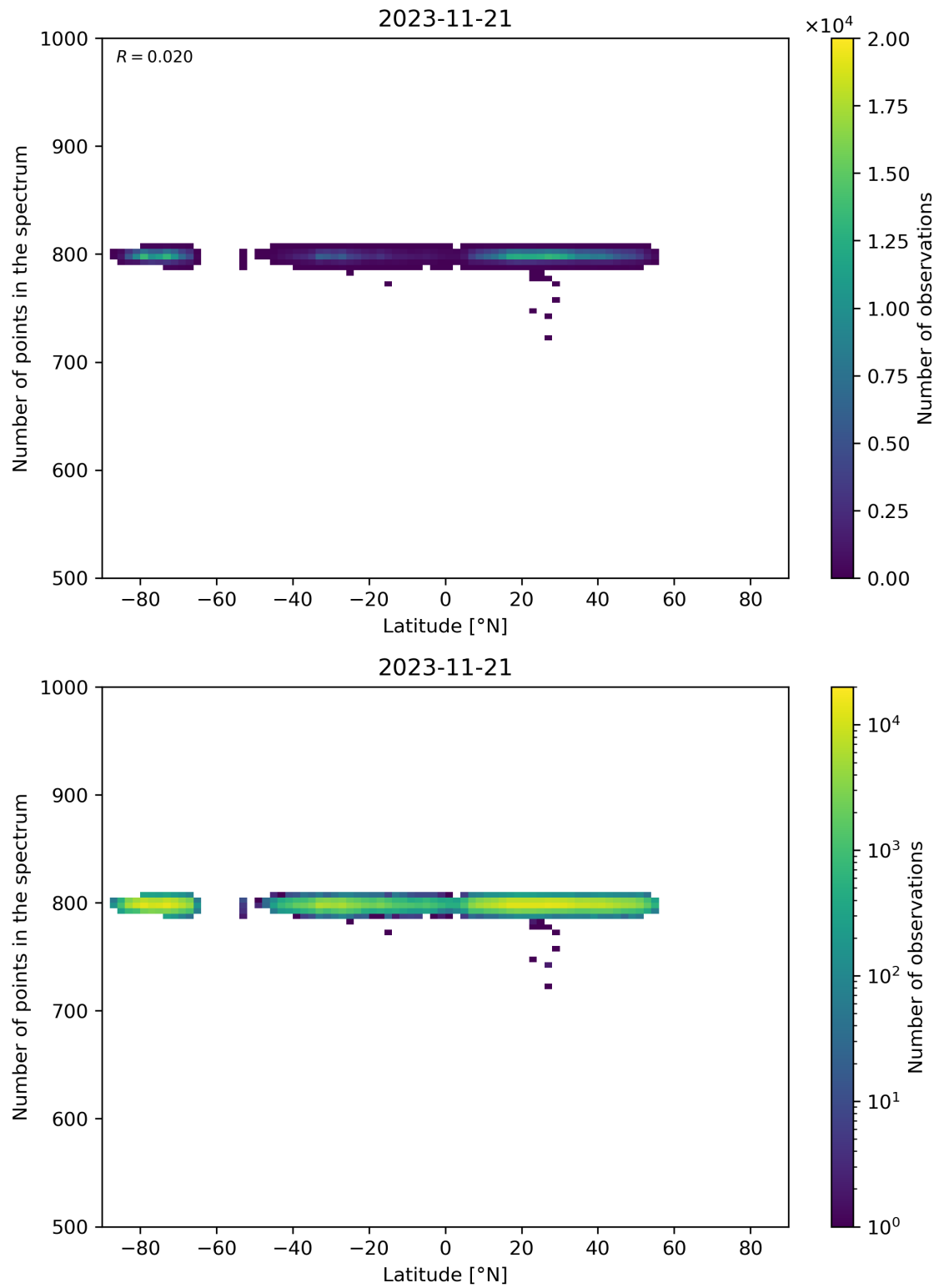


Figure 61: Scatter density plot of “Latitude” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

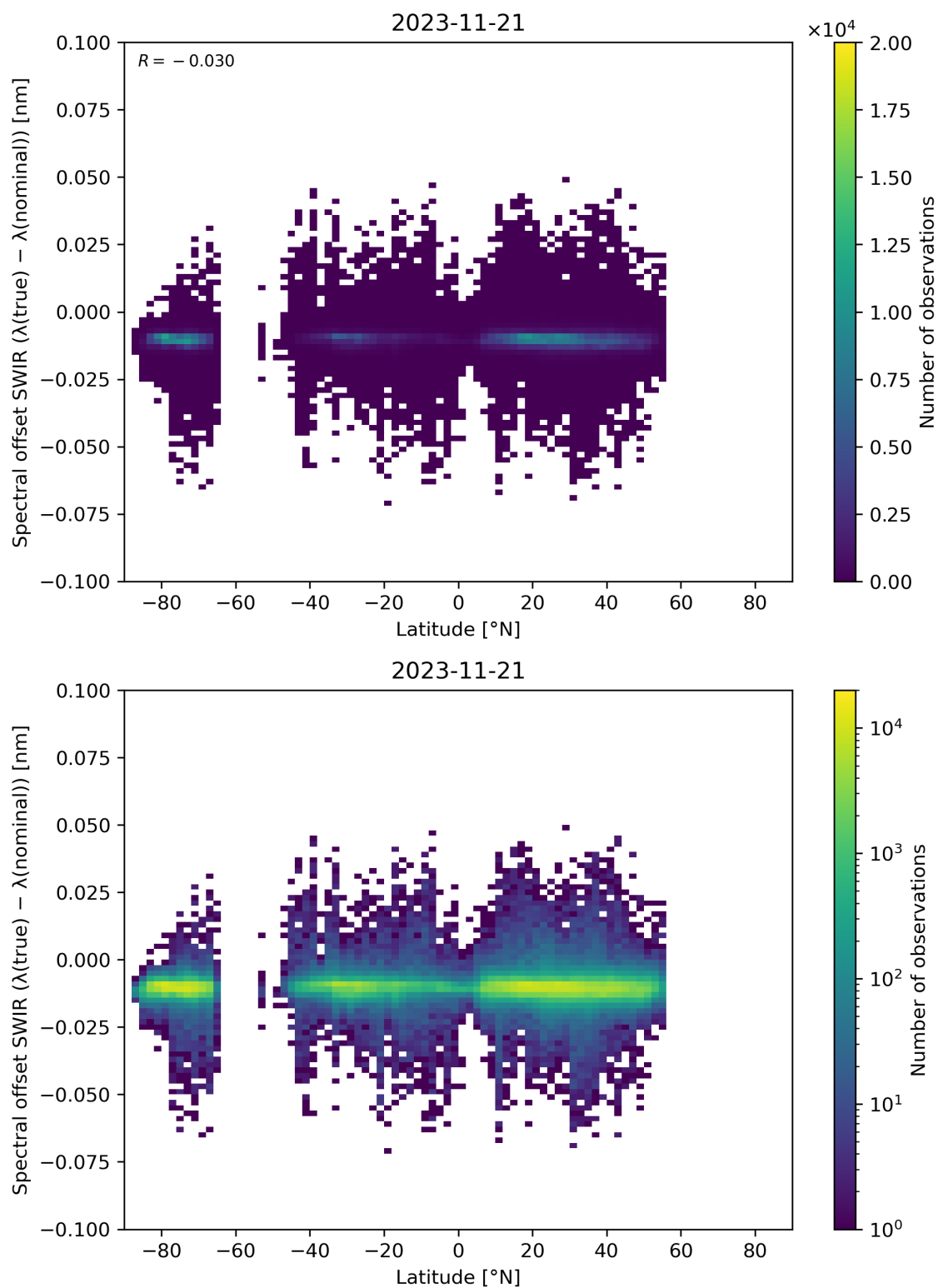


Figure 62: Scatter density plot of “Latitude” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

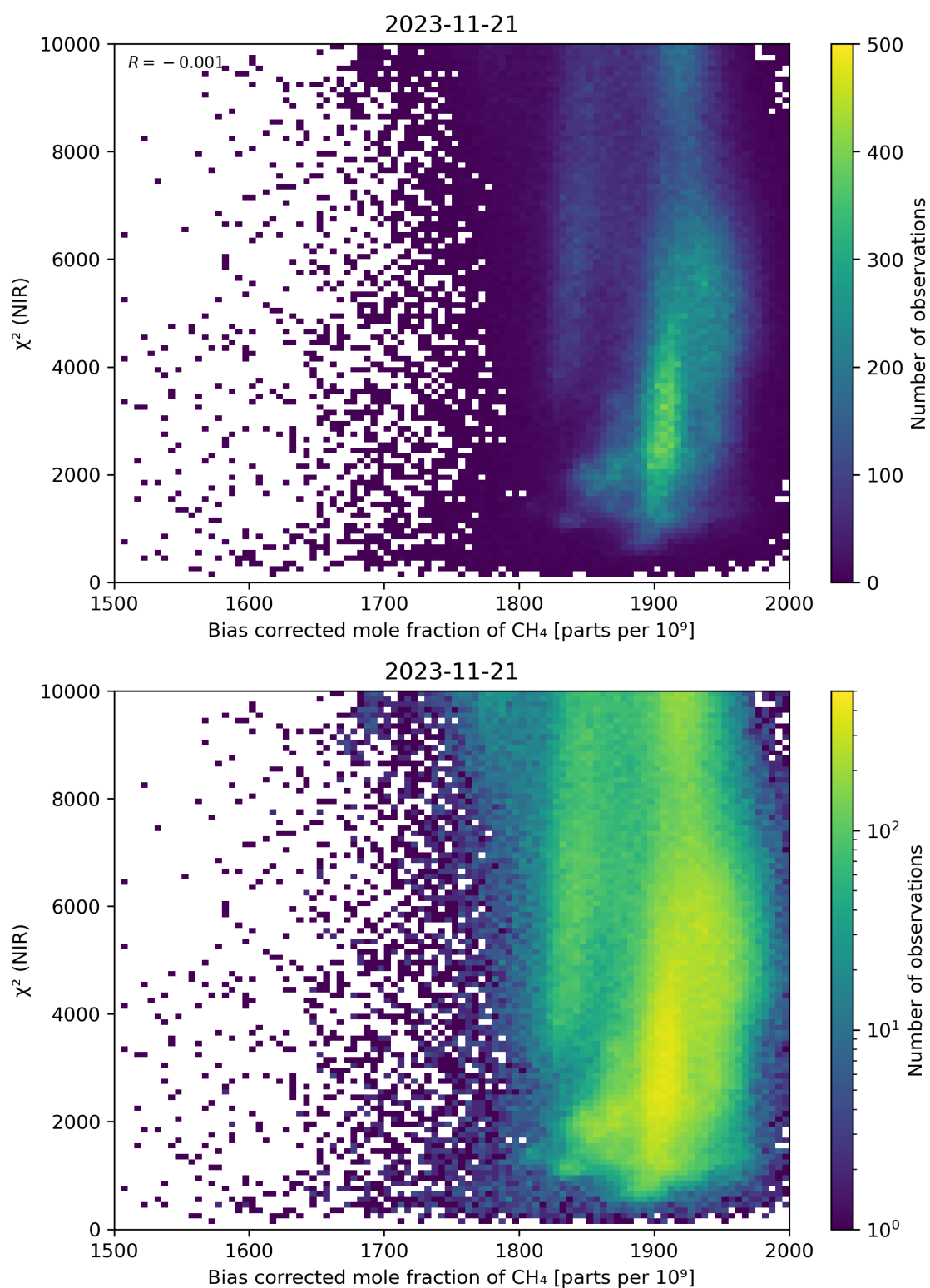


Figure 63: Scatter density plot of “Bias corrected mole fraction of CH<sub>4</sub>” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

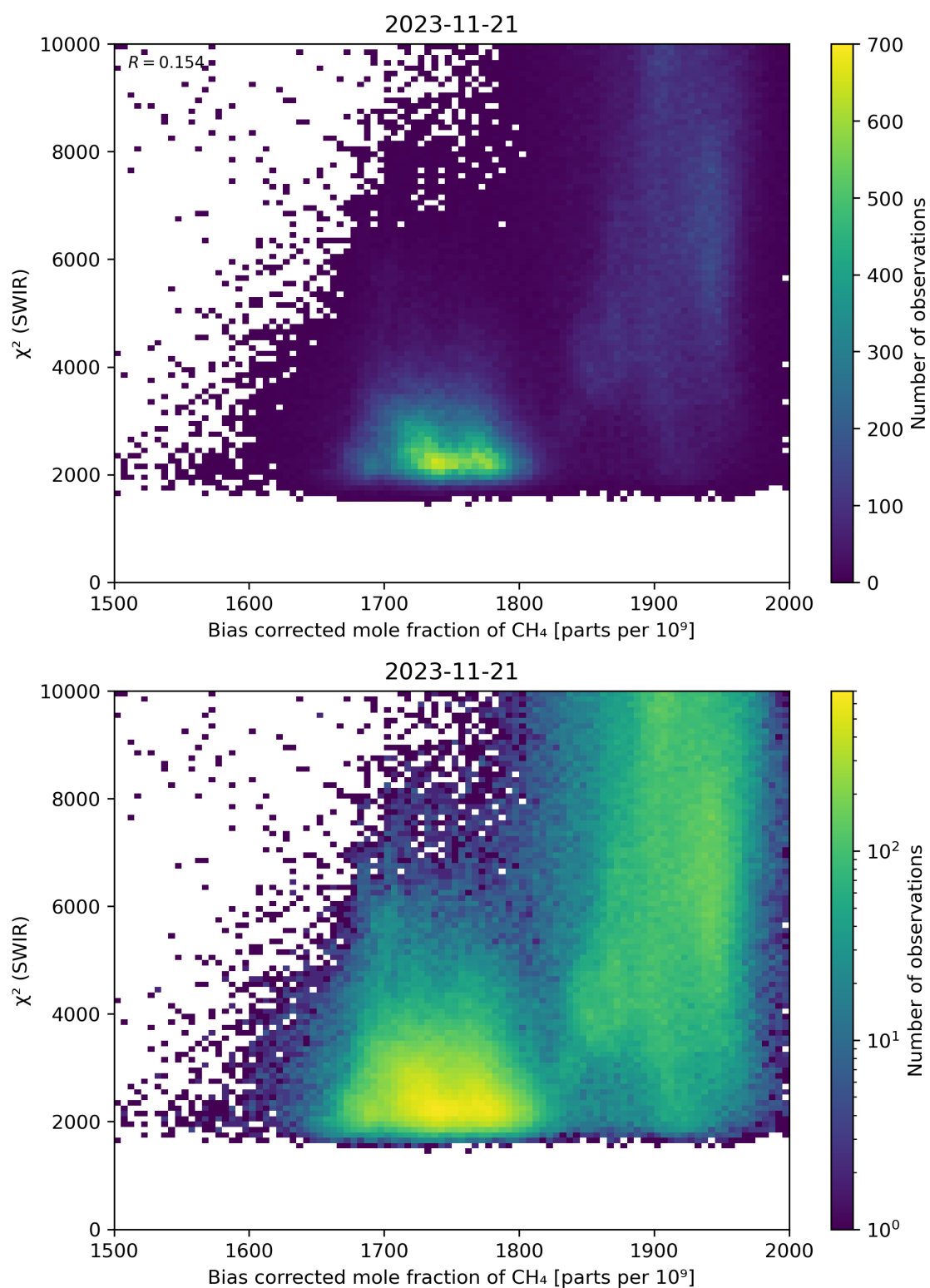


Figure 64: Scatter density plot of “Bias corrected mole fraction of  $\text{CH}_4$ ” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

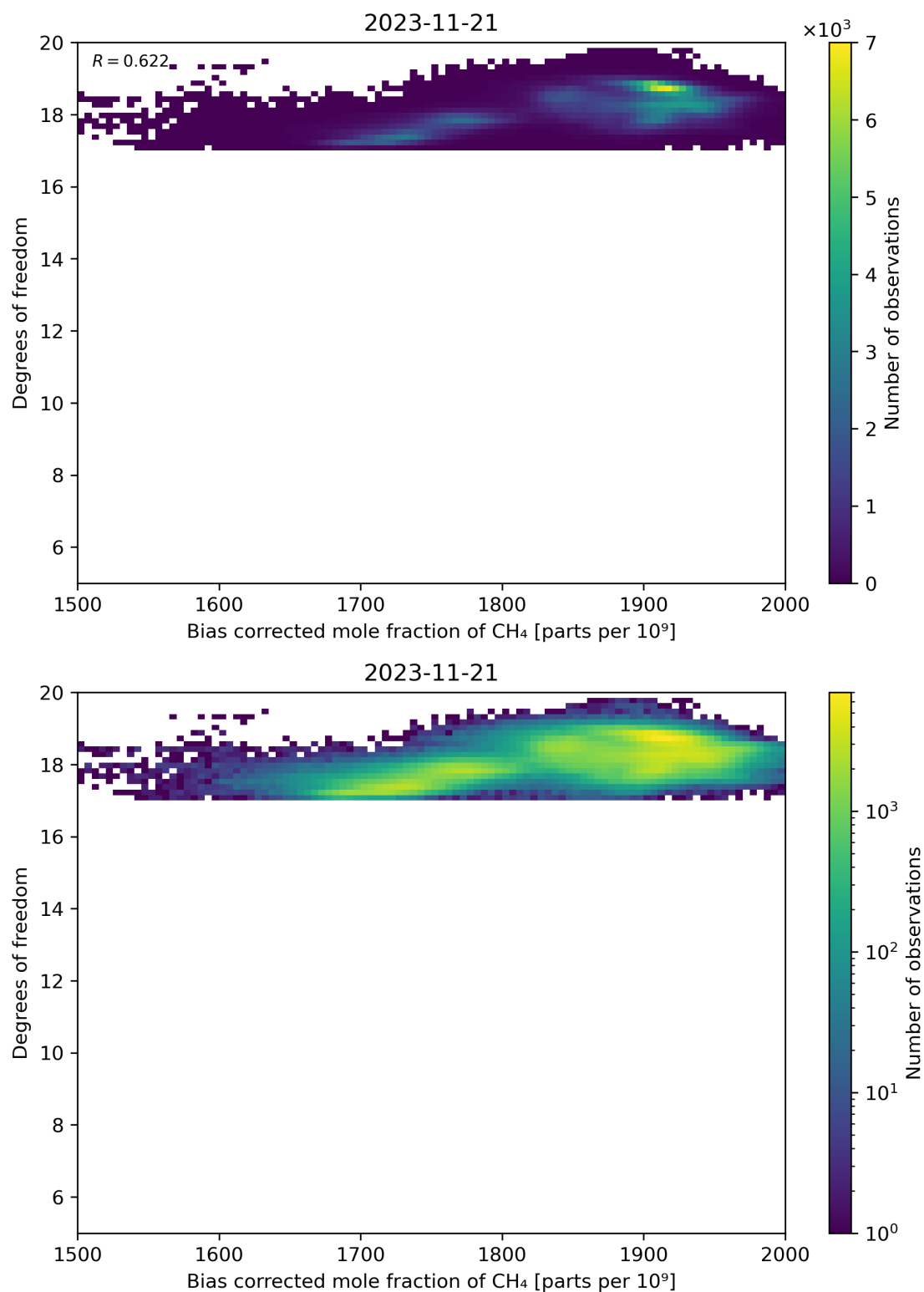


Figure 65: Scatter density plot of “Bias corrected mole fraction of CH<sub>4</sub>” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

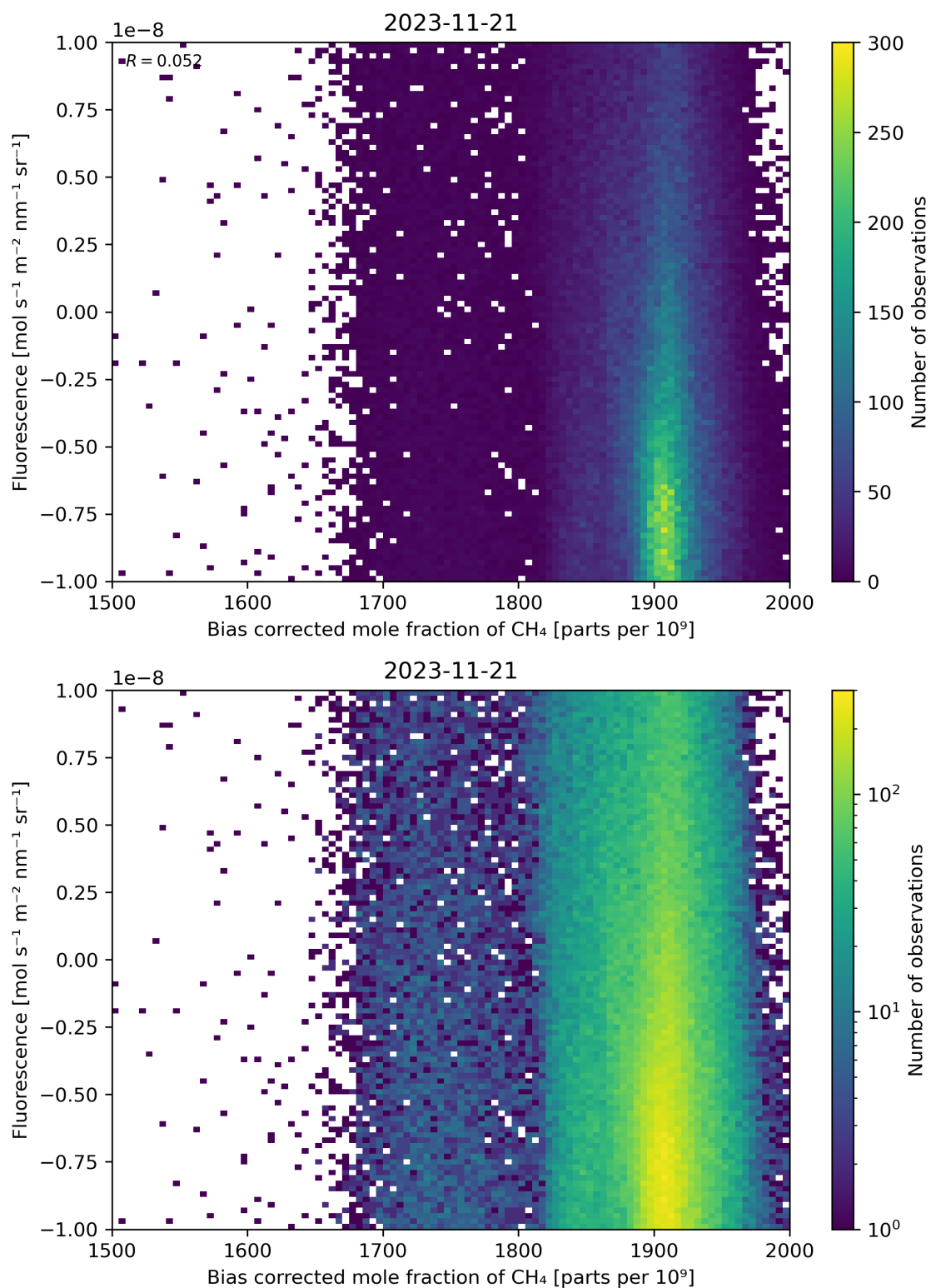


Figure 66: Scatter density plot of “Bias corrected mole fraction of  $\text{CH}_4$ ” against “Fluorescence” for 2023-11-20 to 2023-11-22.

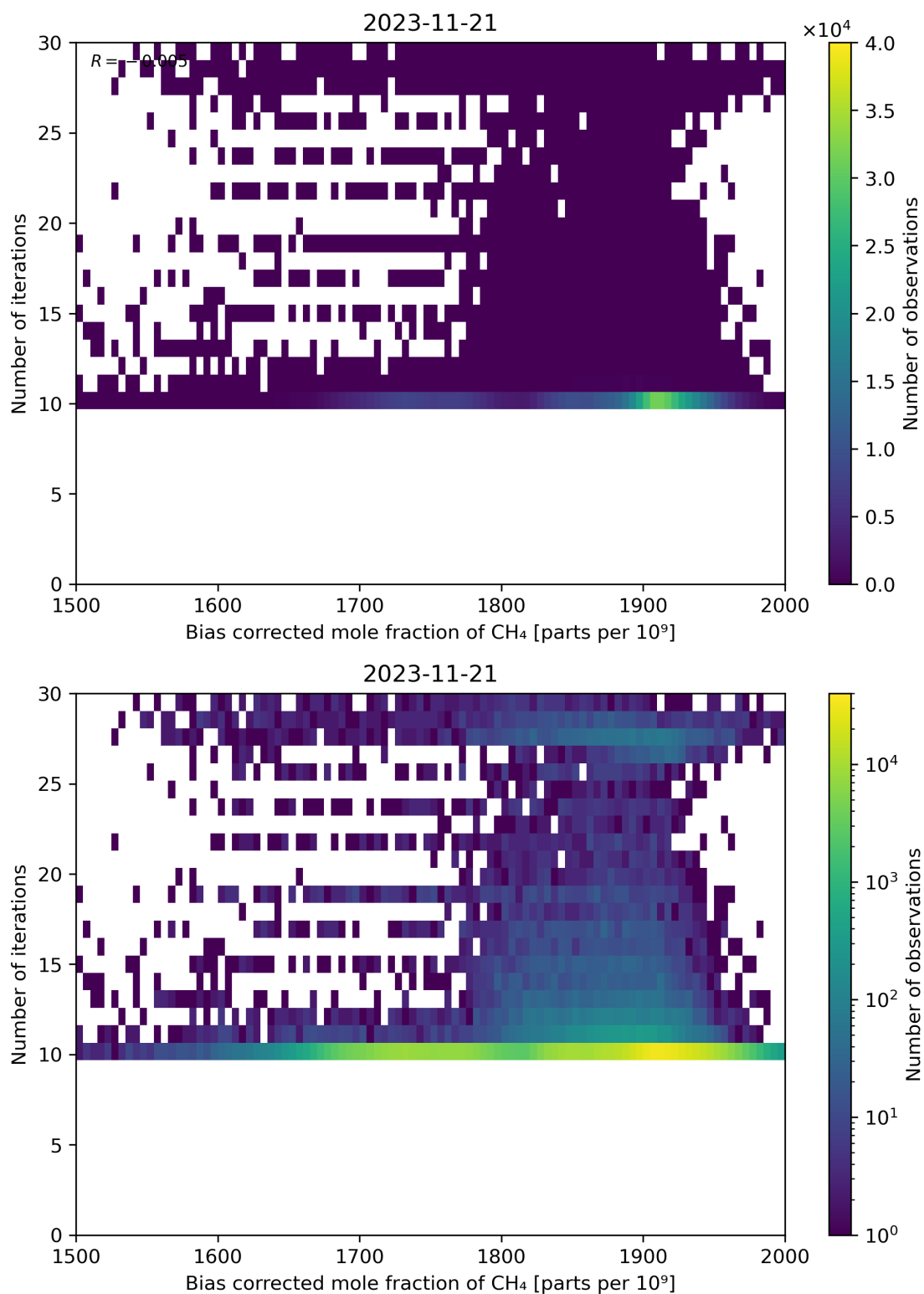


Figure 67: Scatter density plot of “Bias corrected mole fraction of  $\text{CH}_4$ ” against “Number of iterations” for 2023-11-20 to 2023-11-22.



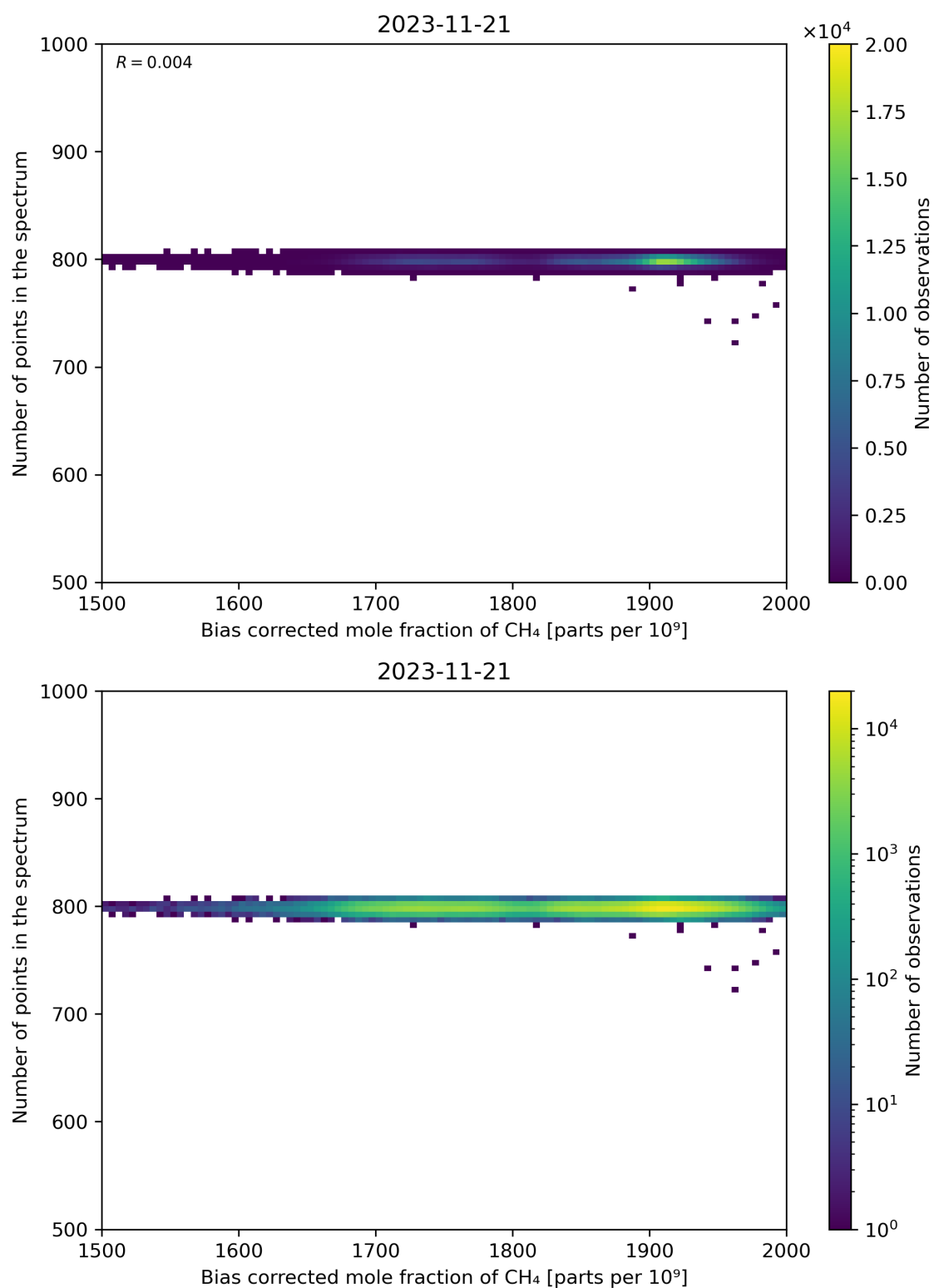


Figure 68: Scatter density plot of “Bias corrected mole fraction of CH<sub>4</sub>” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

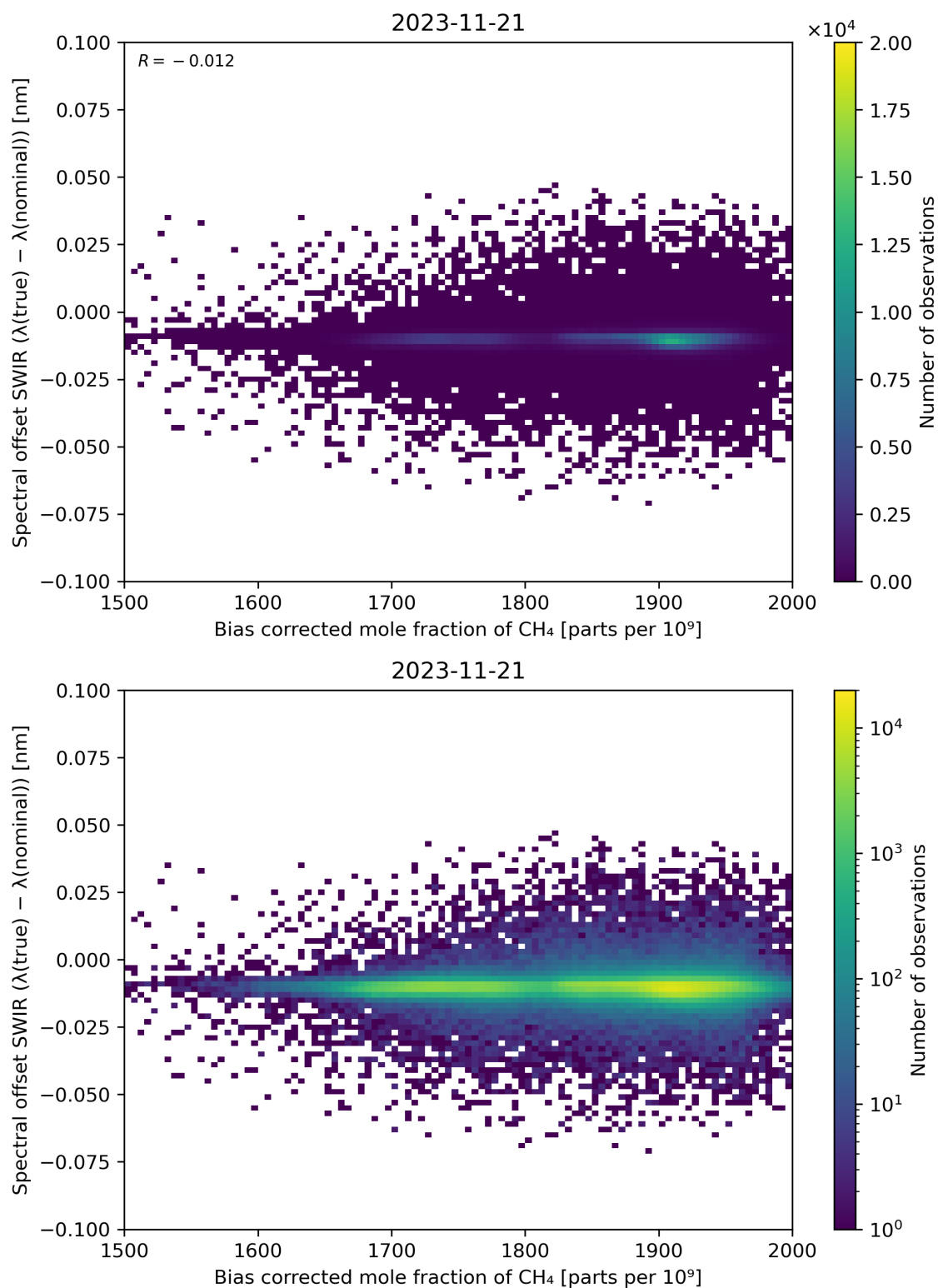


Figure 69: Scatter density plot of “Bias corrected mole fraction of  $\text{CH}_4$ ” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

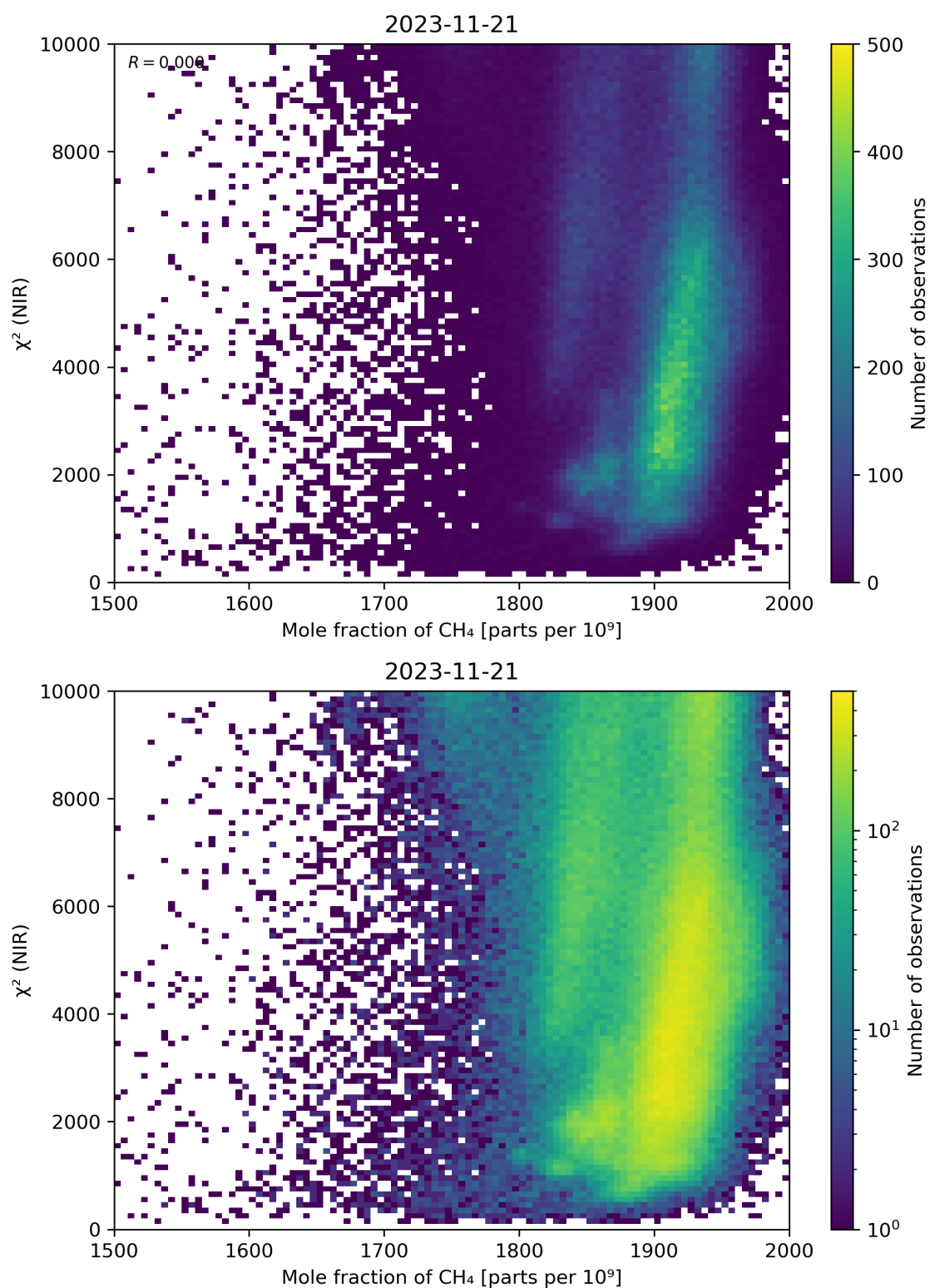


Figure 70: Scatter density plot of “Mole fraction of  $\text{CH}_4$ ” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

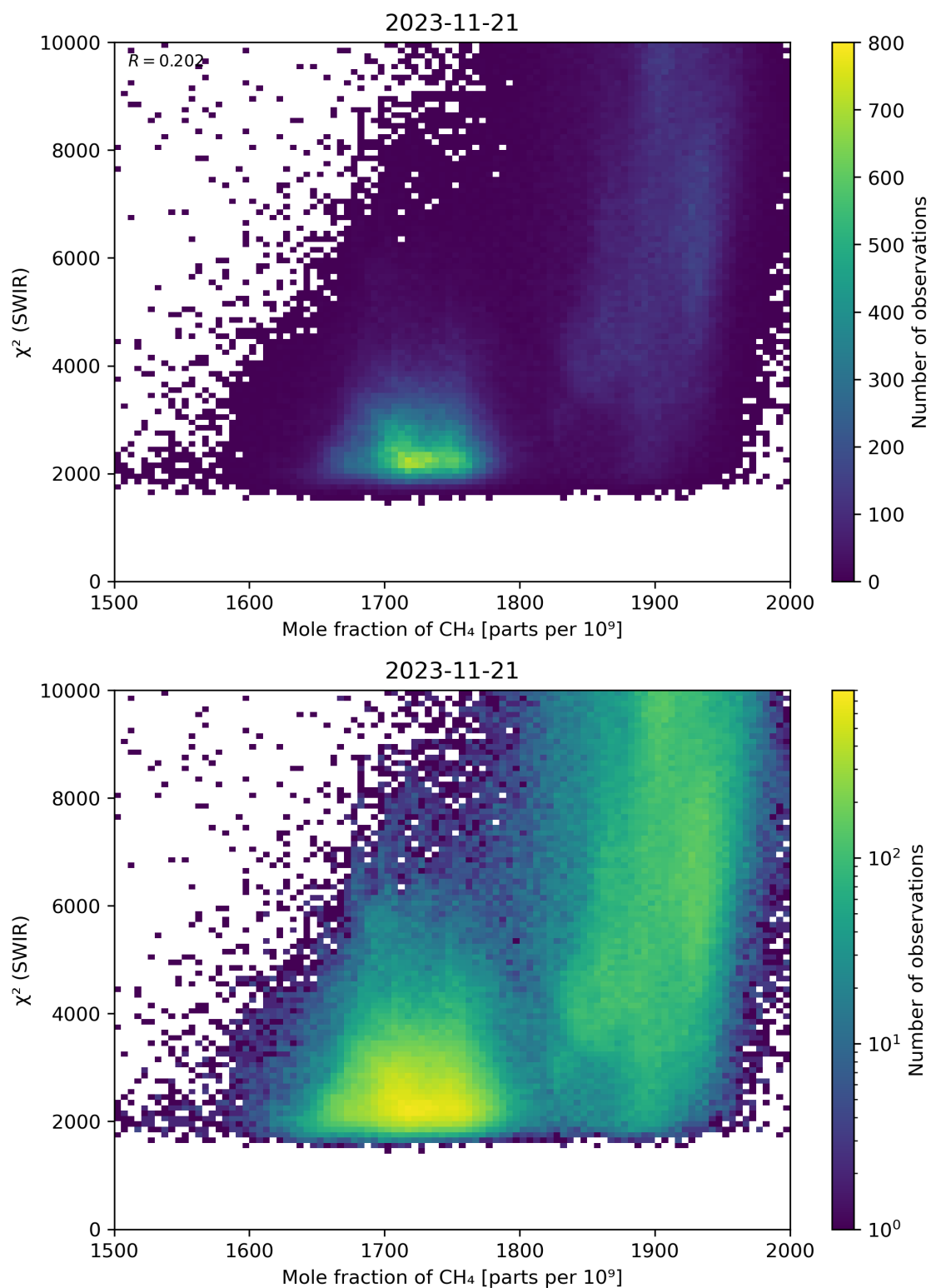


Figure 71: Scatter density plot of “Mole fraction of  $\text{CH}_4$ ” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

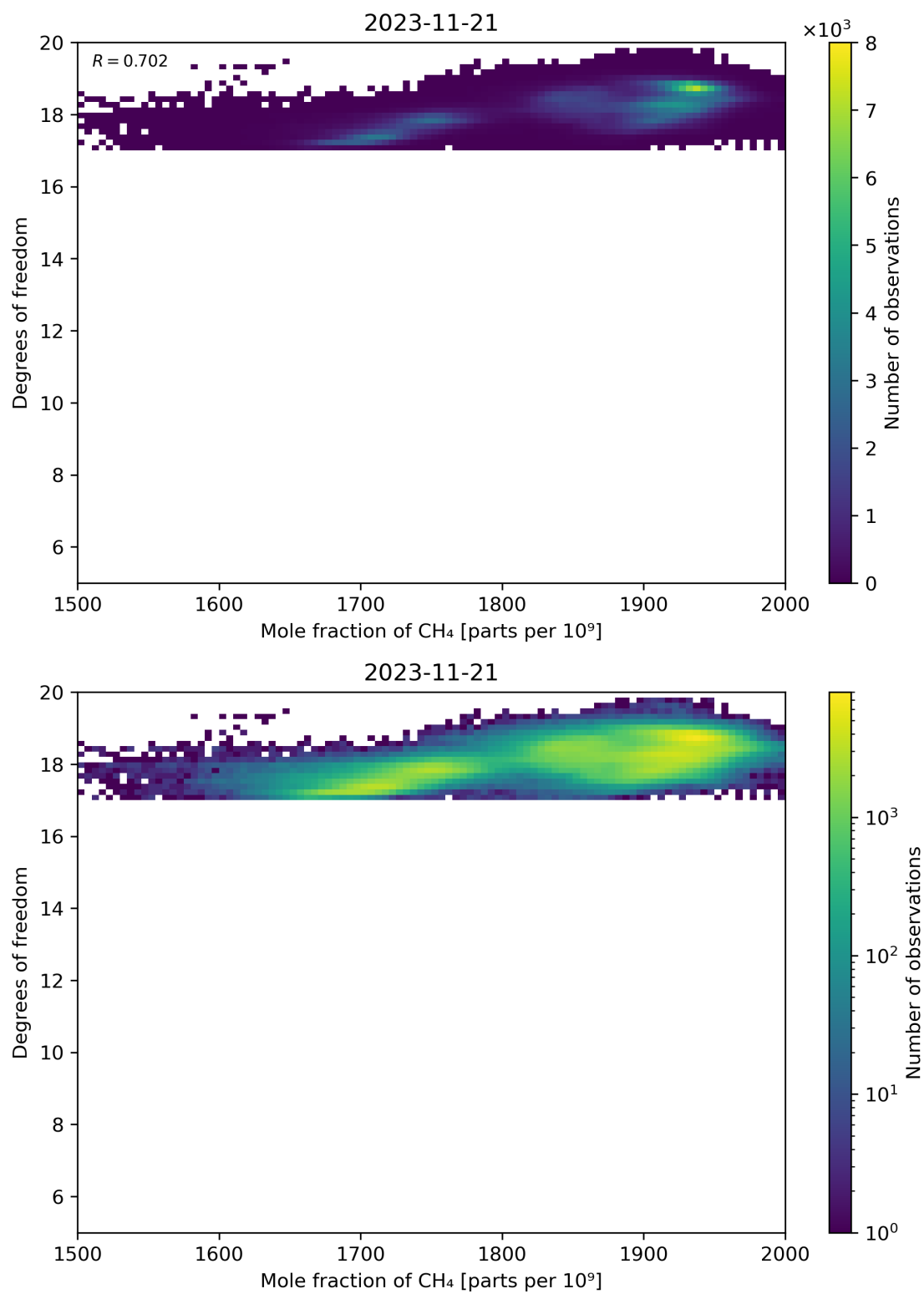


Figure 72: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

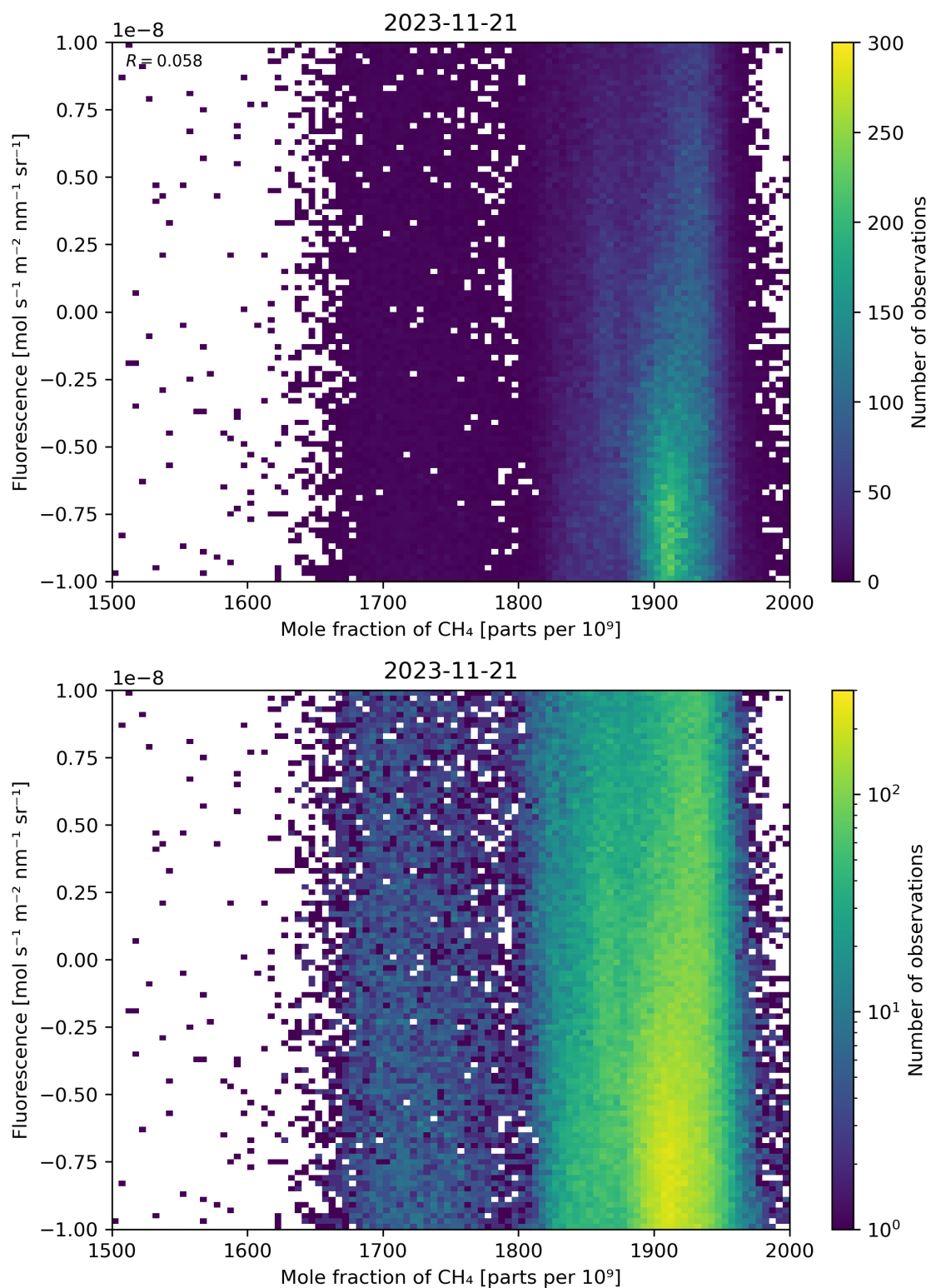


Figure 73: Scatter density plot of “Mole fraction of  $\text{CH}_4$ ” against “Fluorescence” for 2023-11-20 to 2023-11-22.

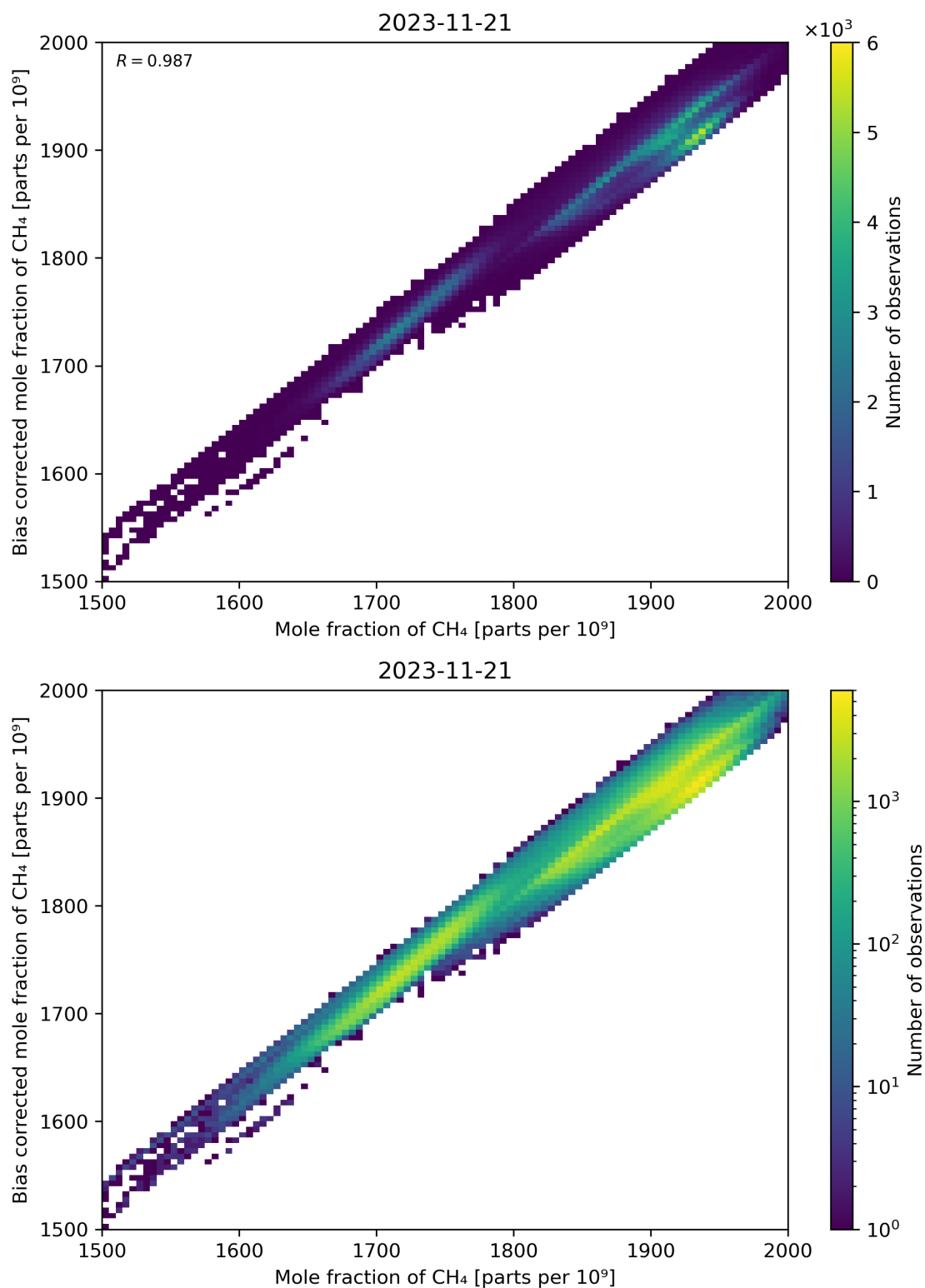


Figure 74: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

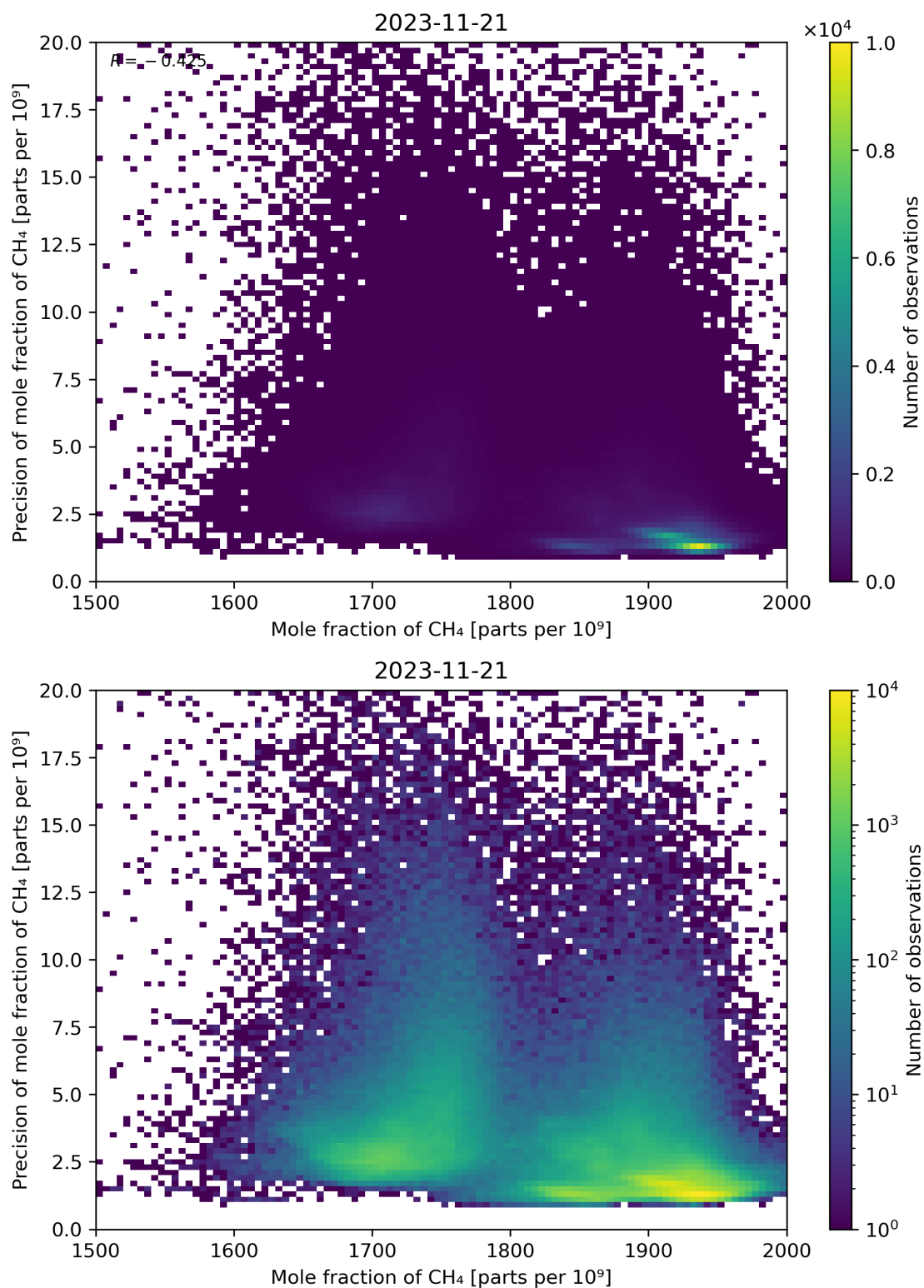


Figure 75: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.



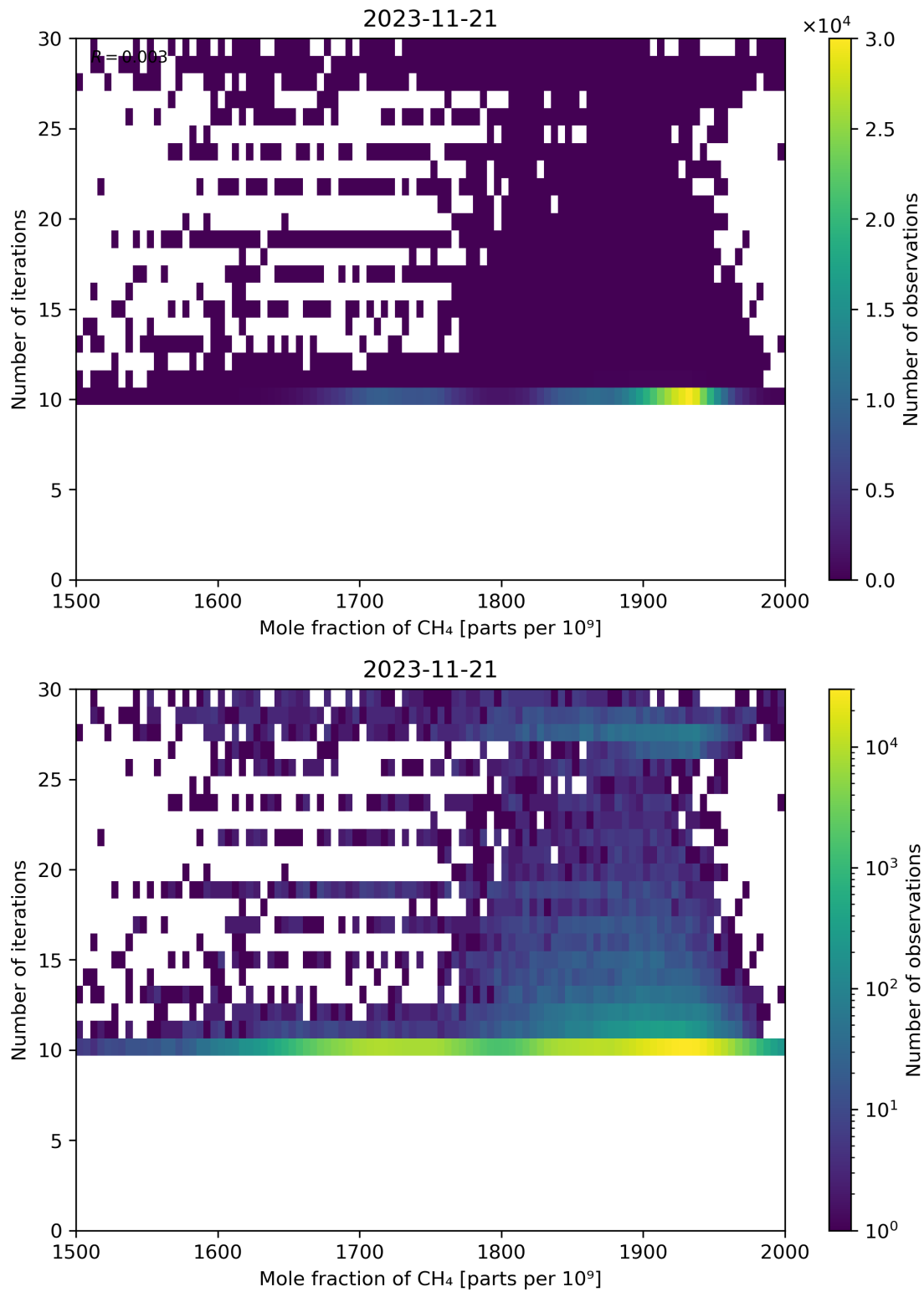


Figure 76: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Number of iterations” for 2023-11-20 to 2023-11-22.

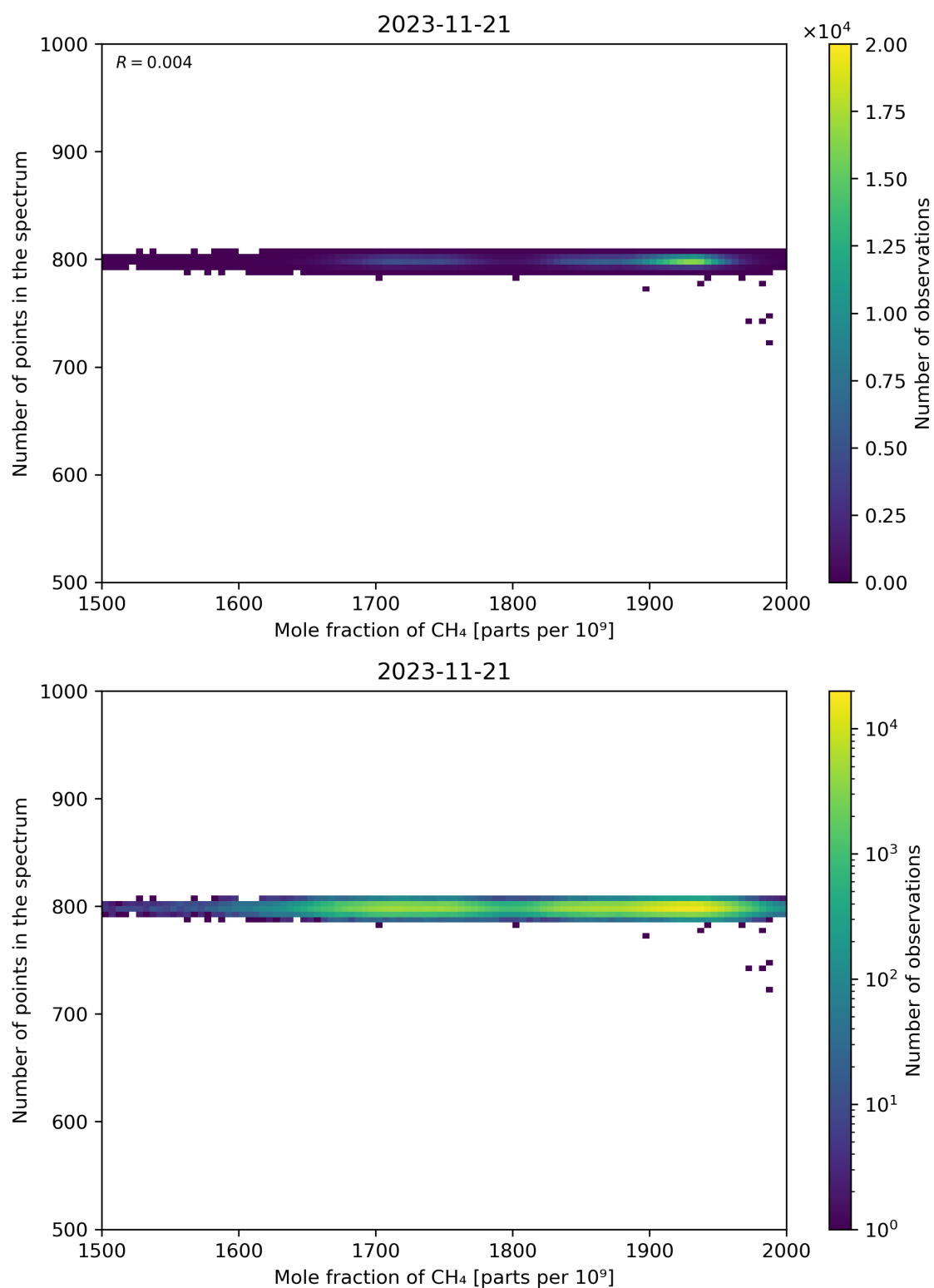


Figure 77: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

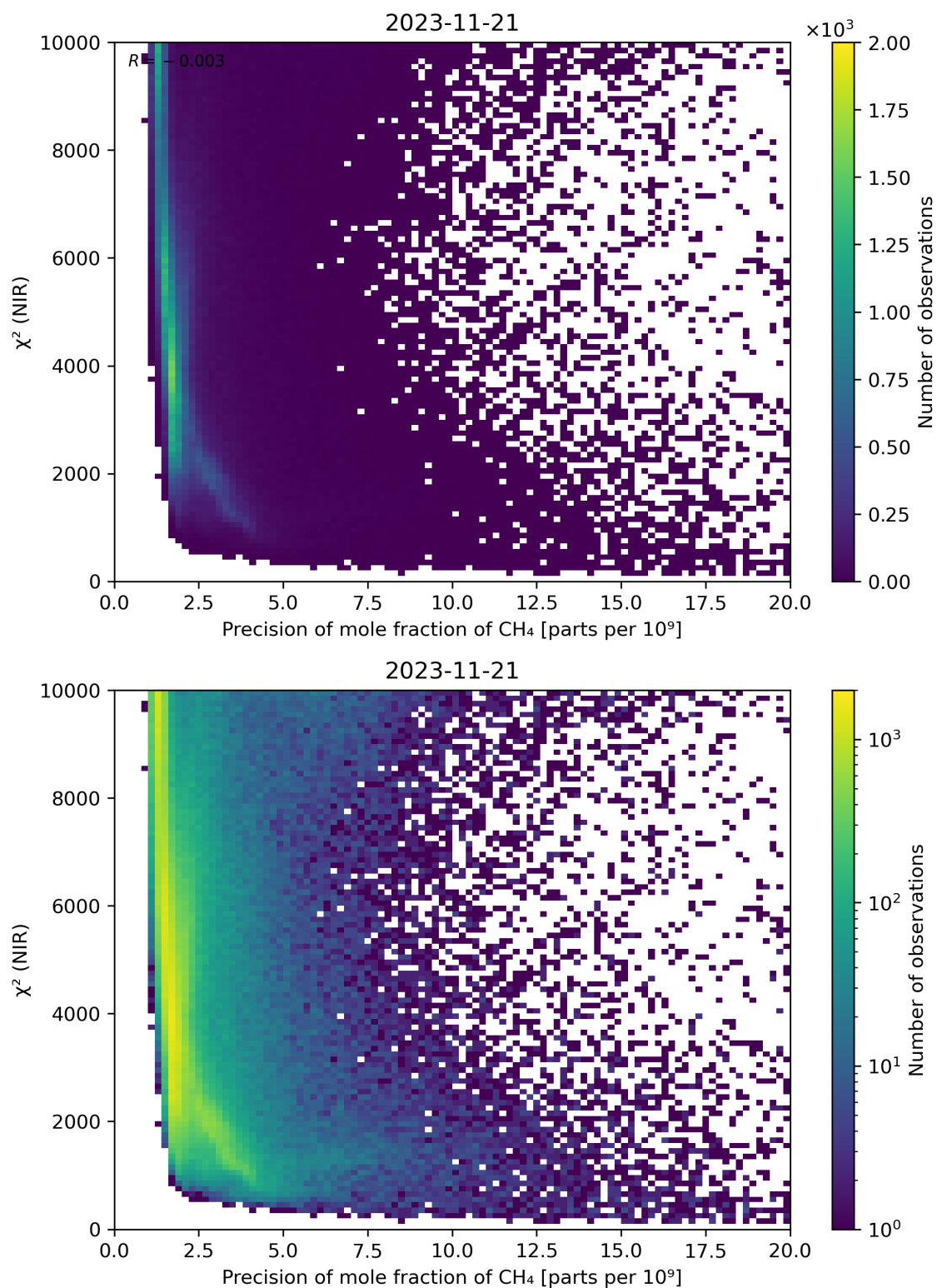


Figure 78: Scatter density plot of “Precision of mole fraction of  $\text{CH}_4$ ” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

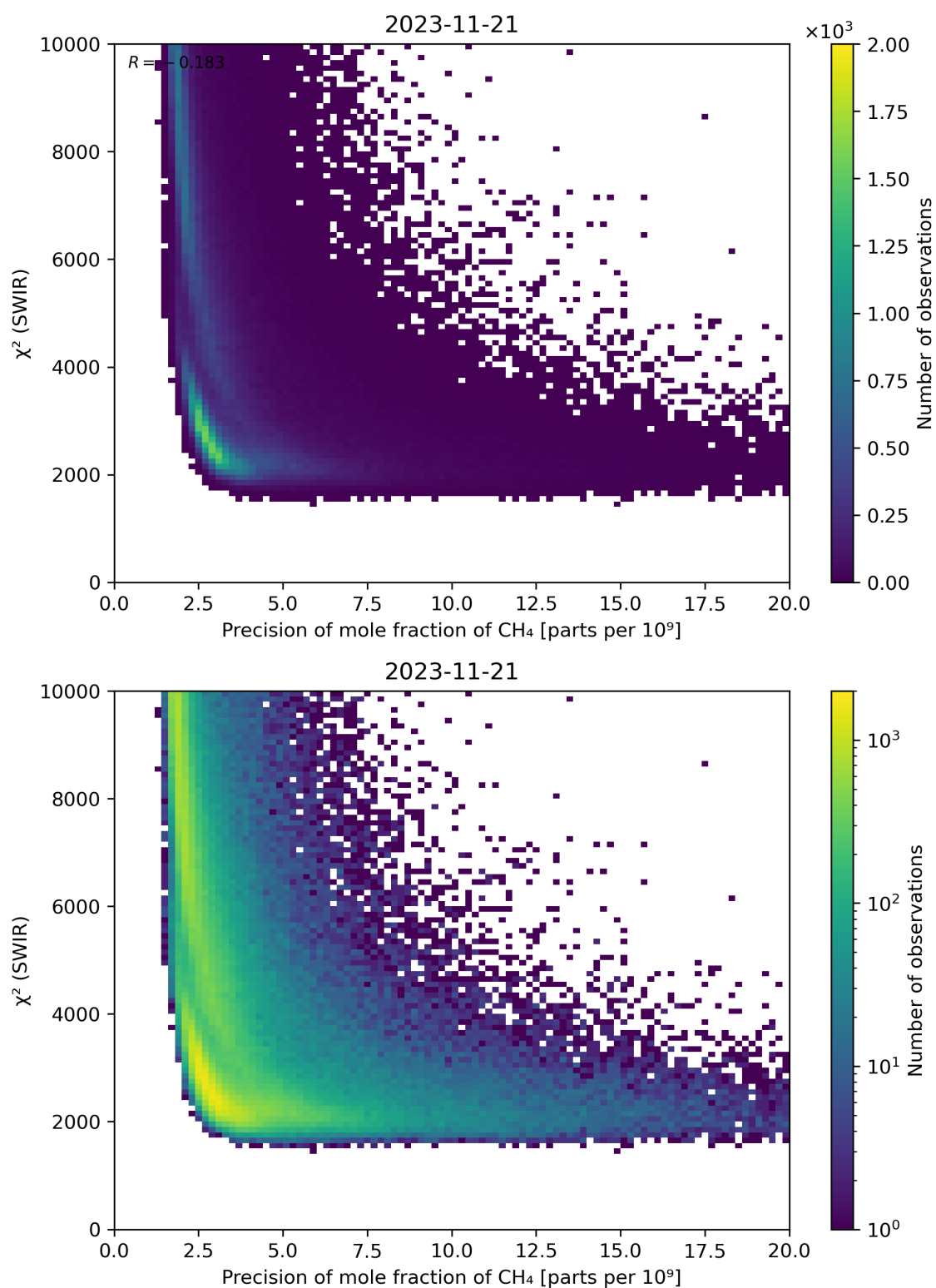


Figure 79: Scatter density plot of “Precision of mole fraction of  $\text{CH}_4$ ” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

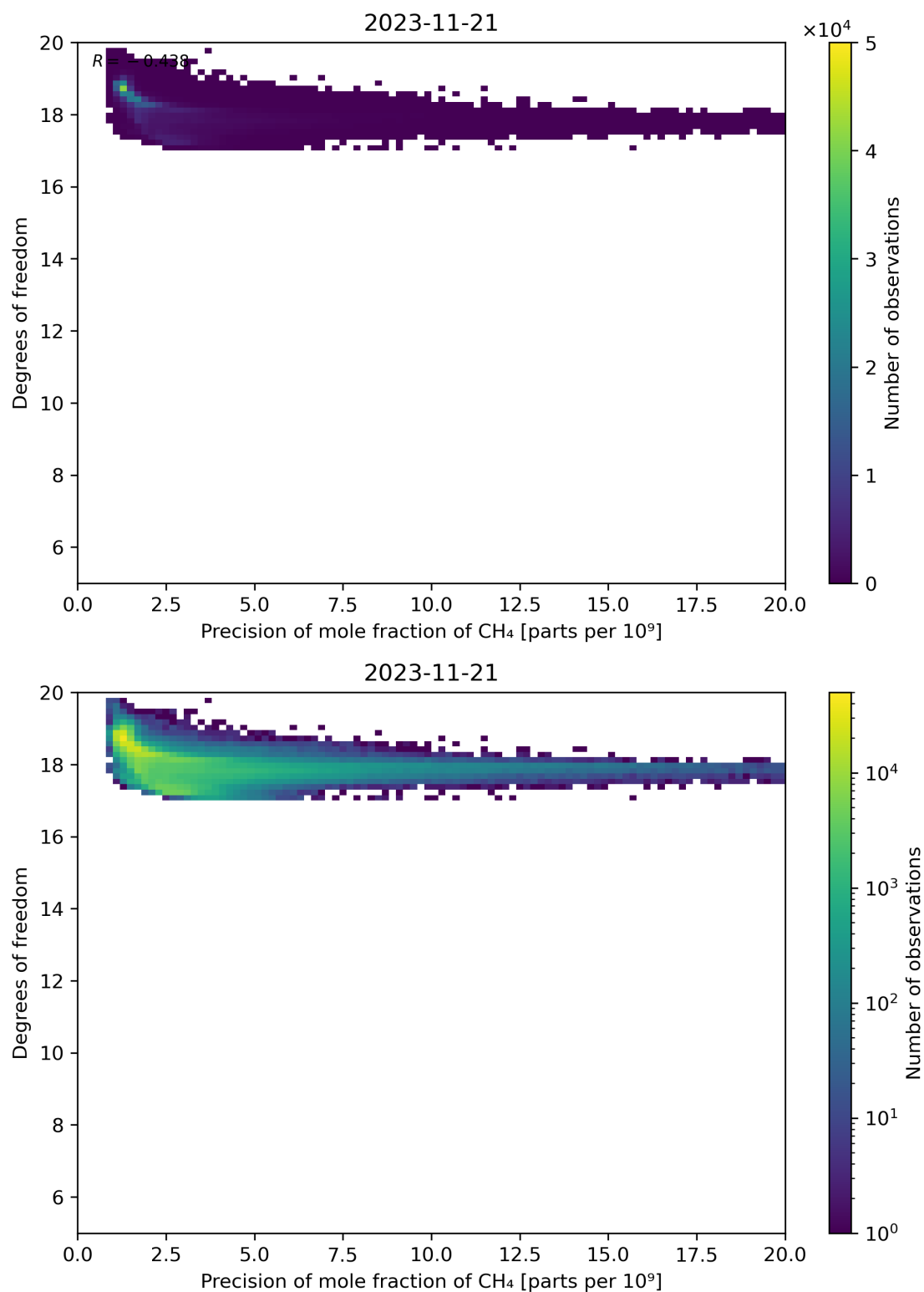


Figure 80: Scatter density plot of “Precision of mole fraction of  $\text{CH}_4$ ” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

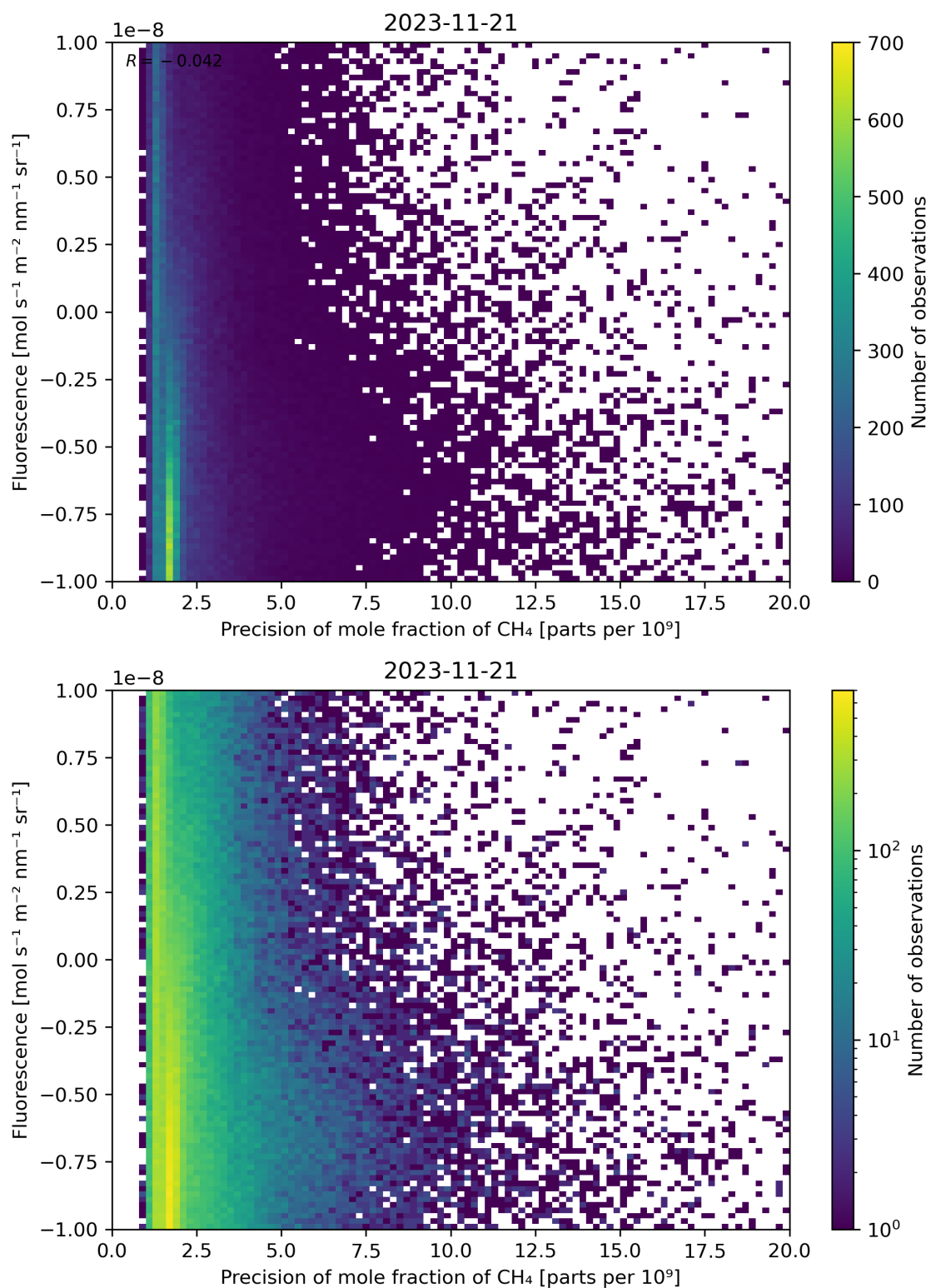


Figure 81: Scatter density plot of “Precision of mole fraction of  $\text{CH}_4$ ” against “Fluorescence” for 2023-11-20 to 2023-11-22.

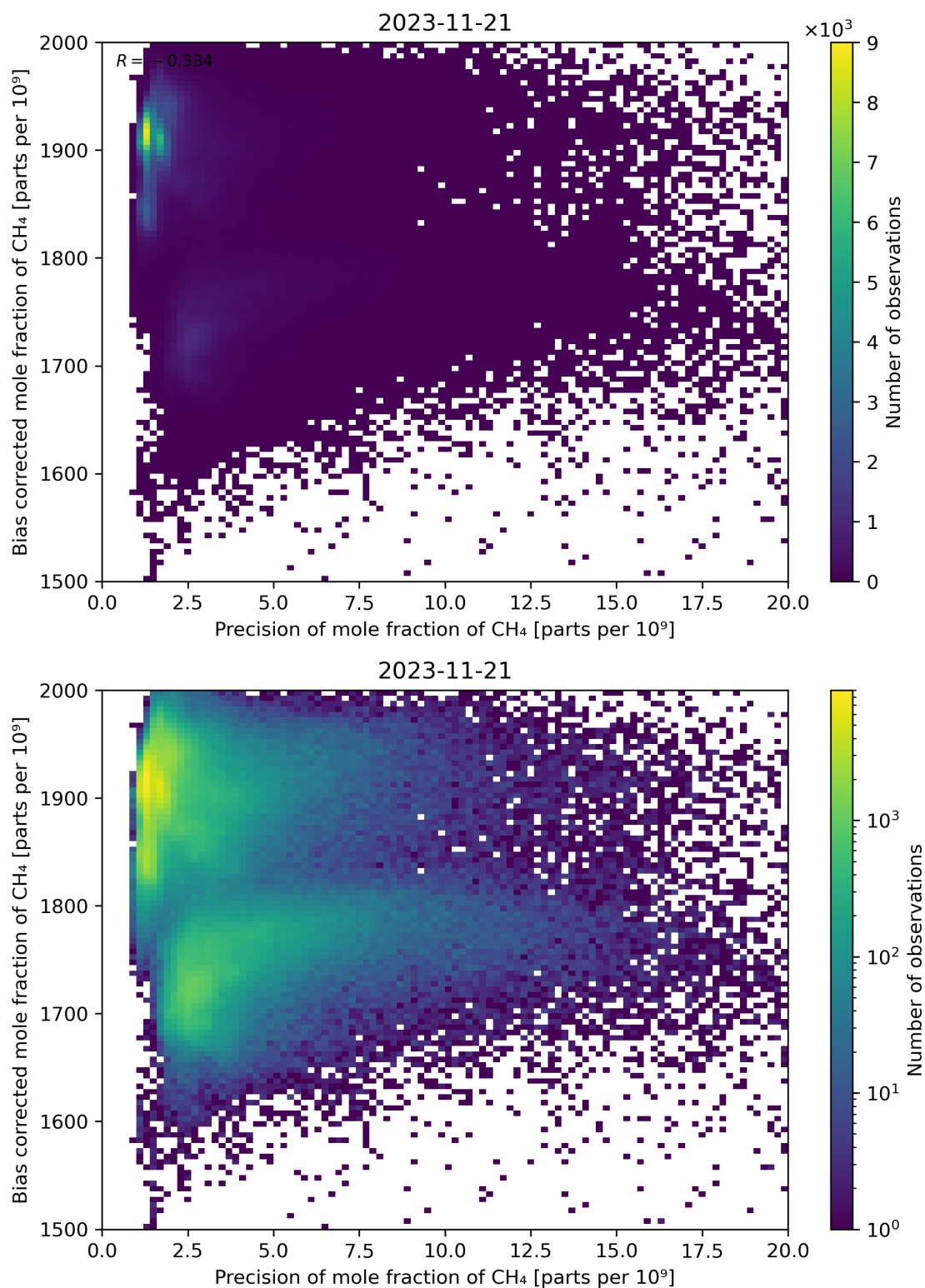


Figure 82: Scatter density plot of “Precision of mole fraction of CH<sub>4</sub>” against “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

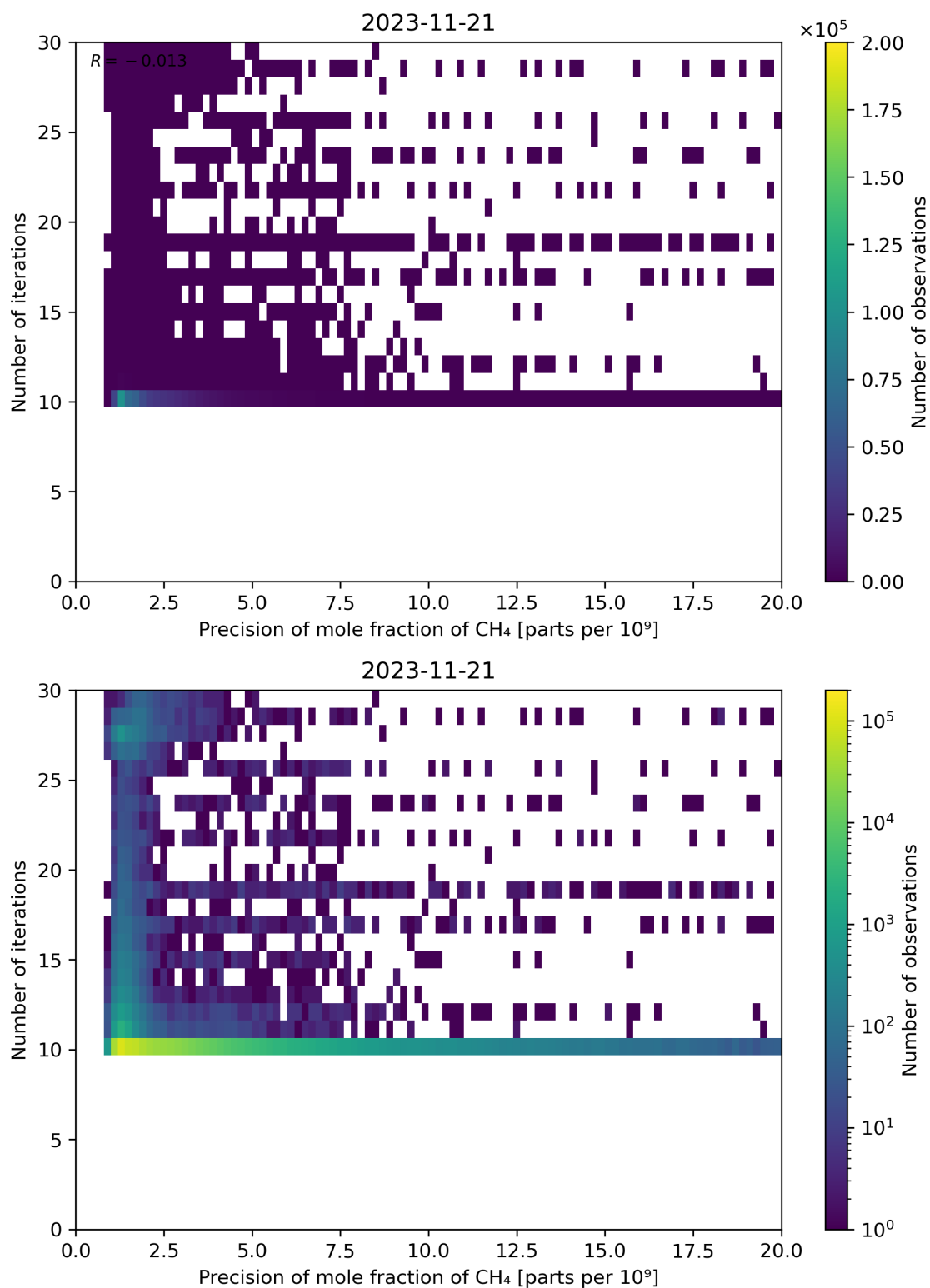


Figure 83: Scatter density plot of “Precision of mole fraction of CH<sub>4</sub>” against “Number of iterations” for 2023-11-20 to 2023-11-22.



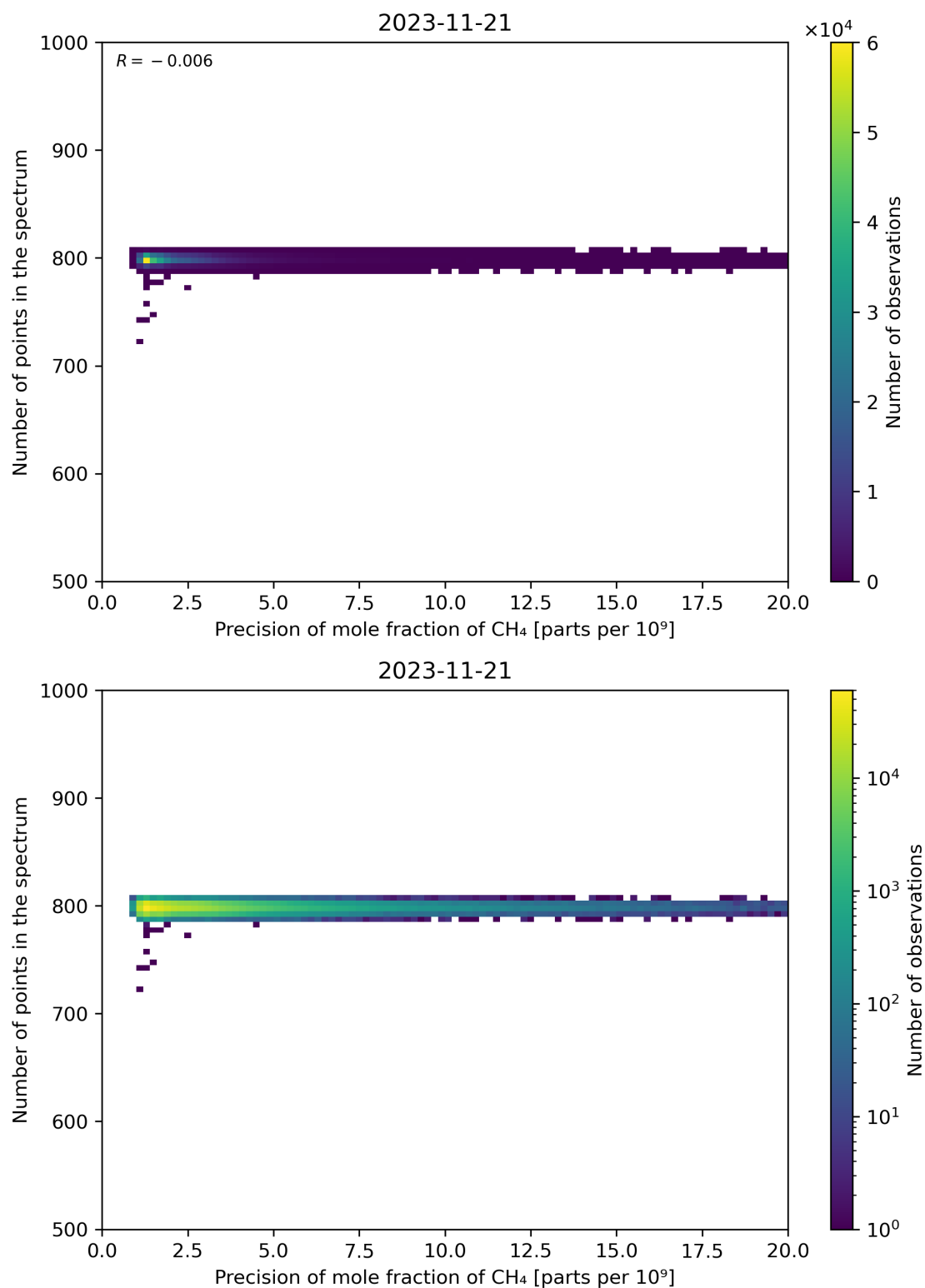


Figure 84: Scatter density plot of “Precision of mole fraction of CH<sub>4</sub>” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

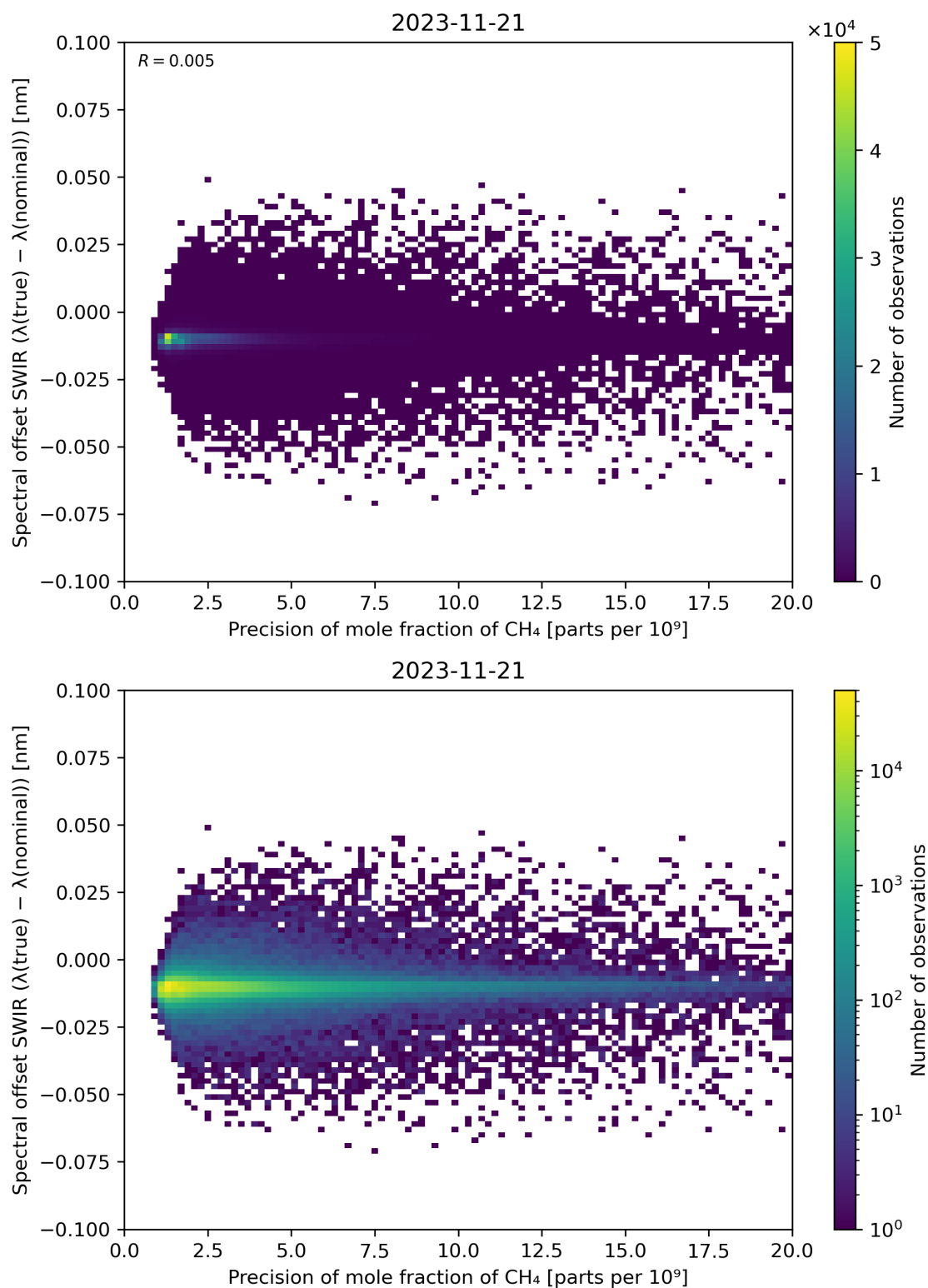


Figure 85: Scatter density plot of “Precision of mole fraction of  $\text{CH}_4$ ” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

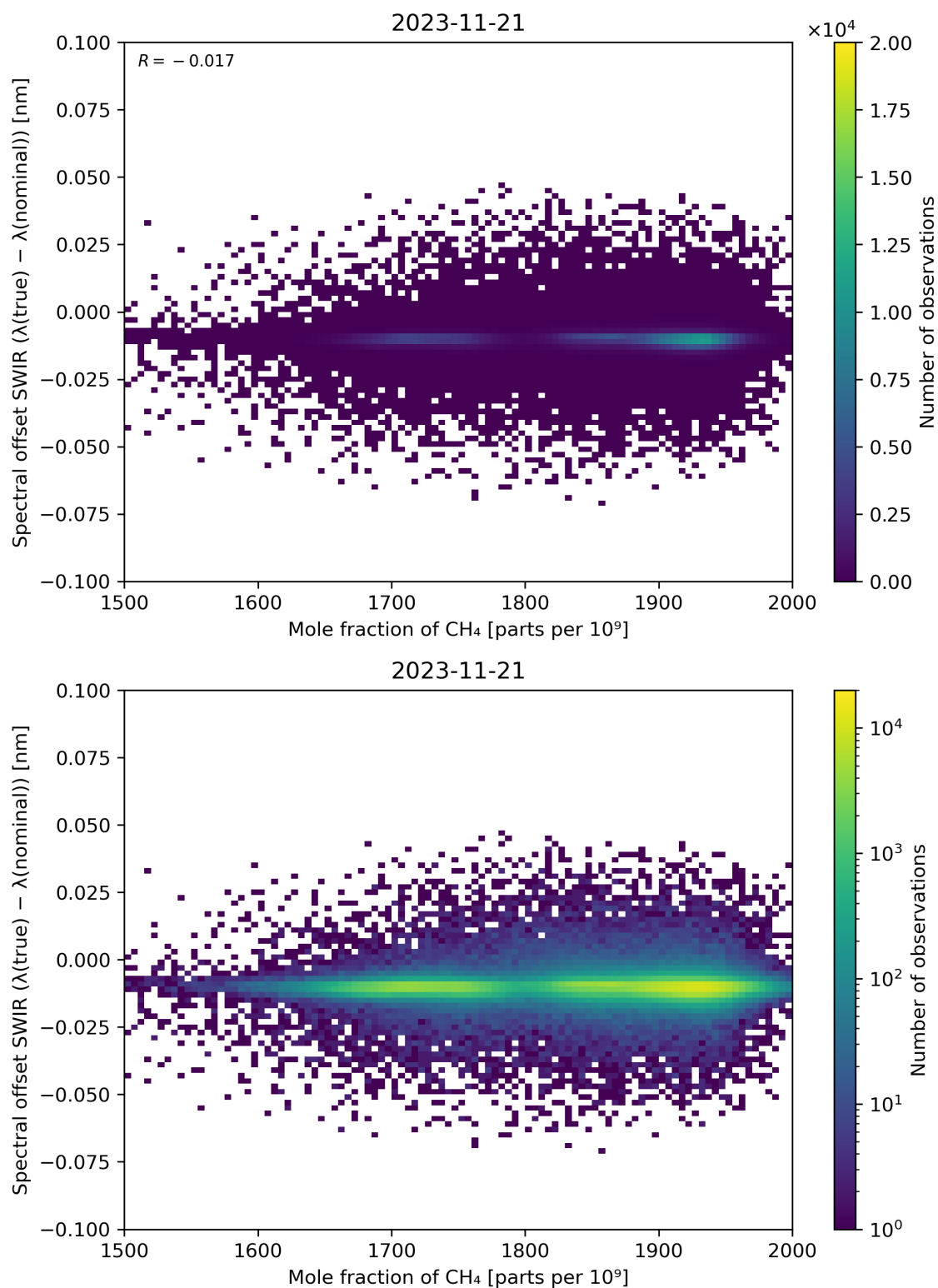


Figure 86: Scatter density plot of “Mole fraction of CH<sub>4</sub>” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

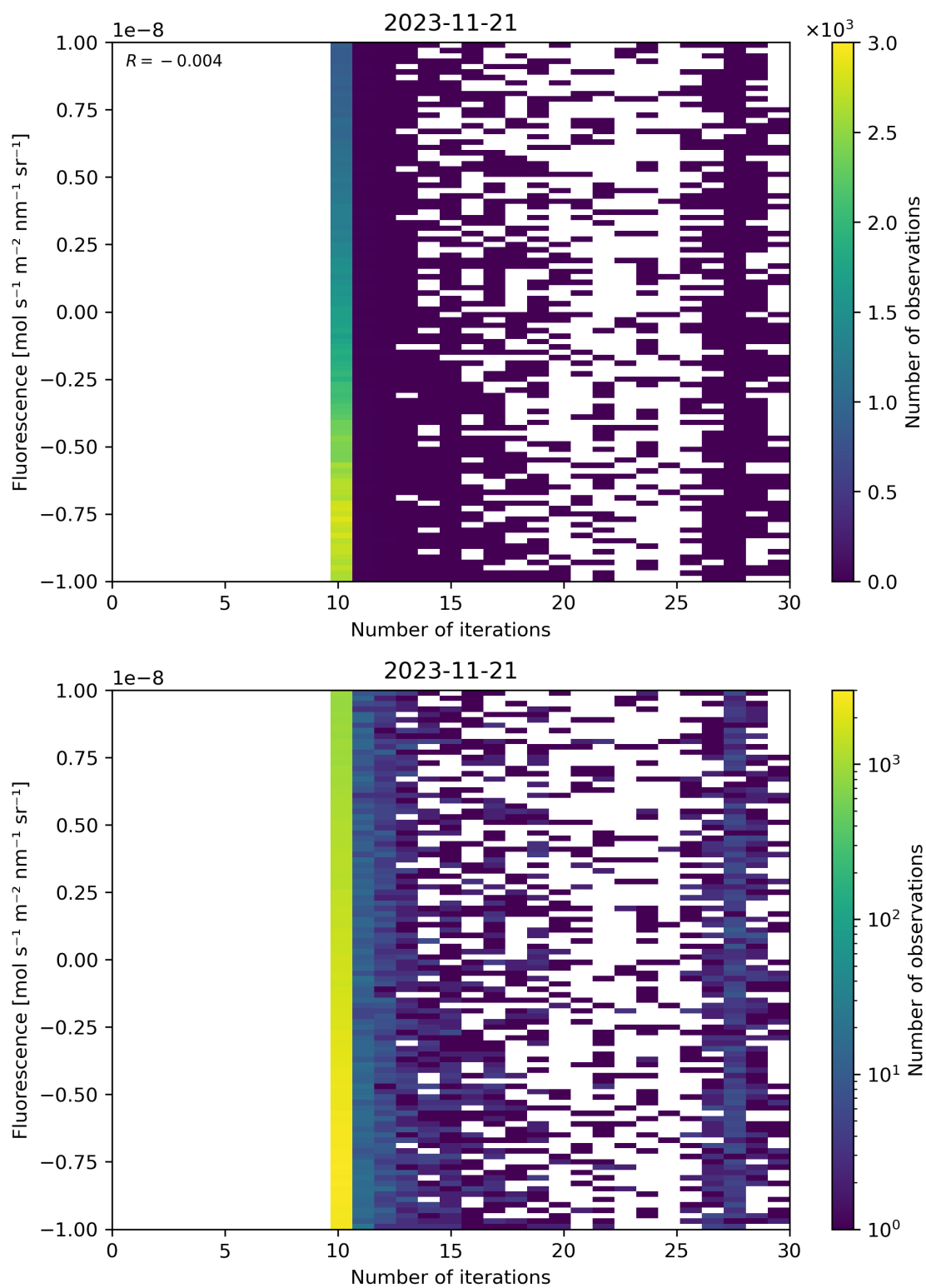


Figure 87: Scatter density plot of “Number of iterations” against “Fluorescence” for 2023-11-20 to 2023-11-22.

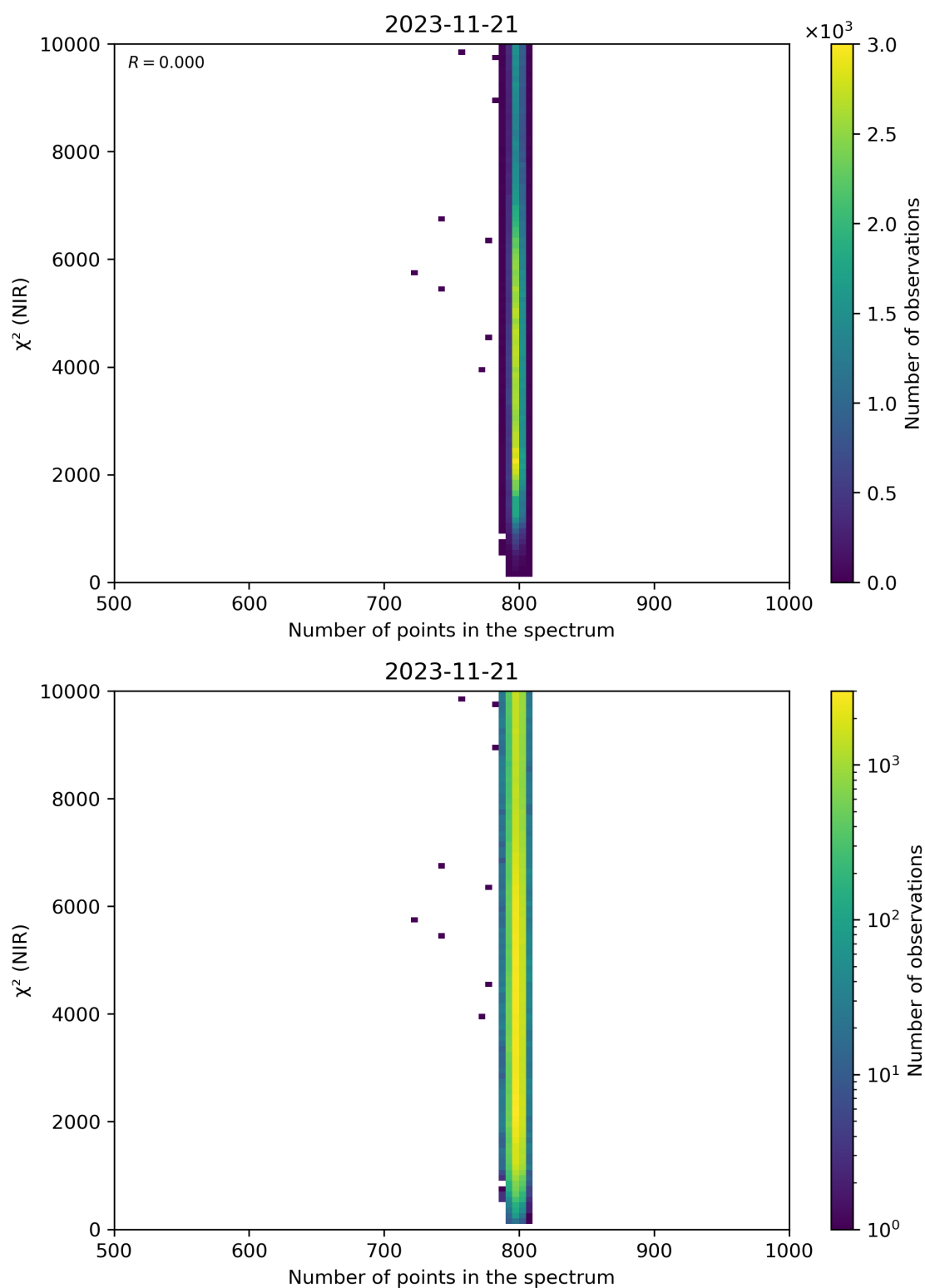


Figure 88: Scatter density plot of “Number of points in the spectrum” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

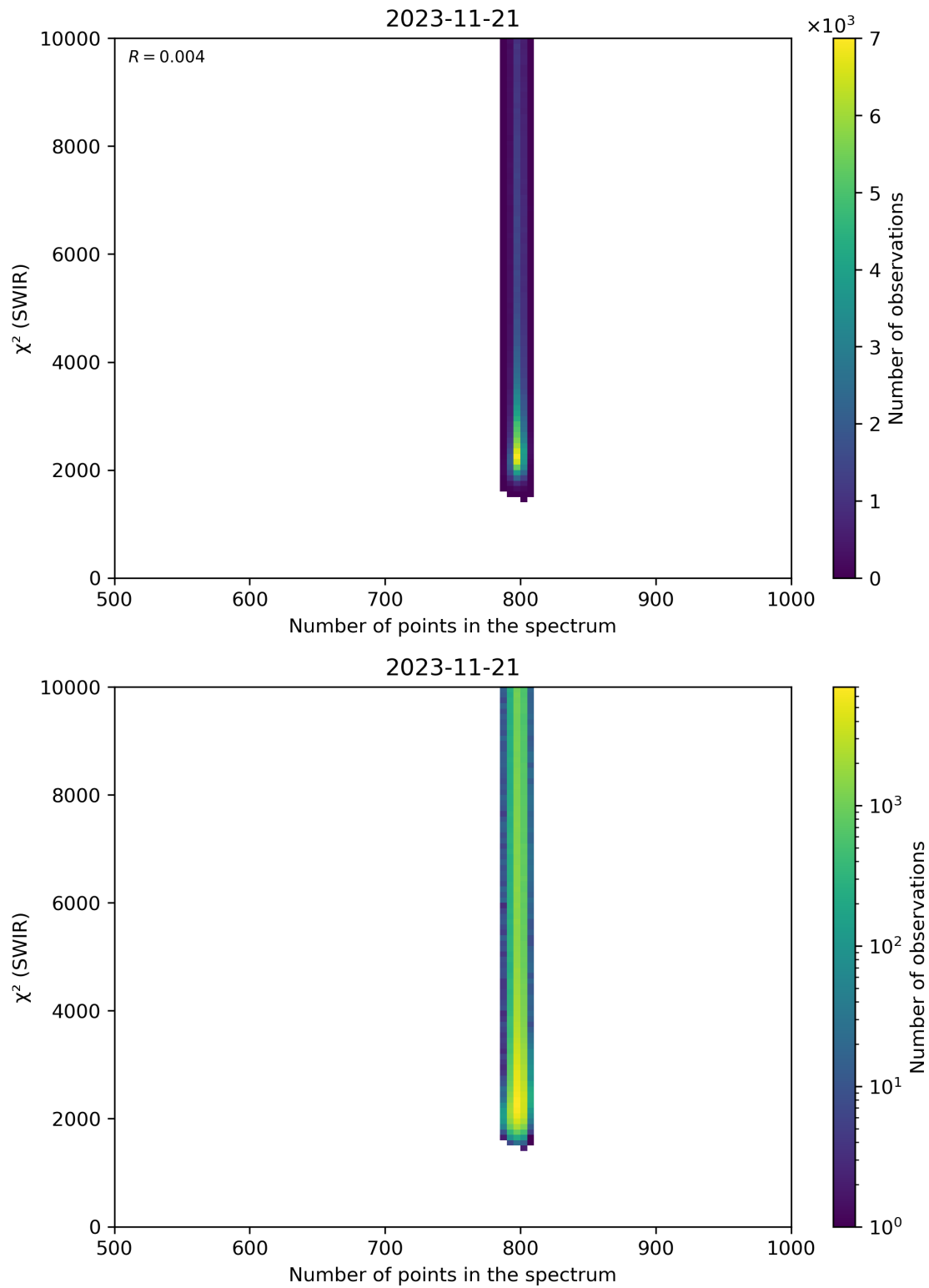


Figure 89: Scatter density plot of “Number of points in the spectrum” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

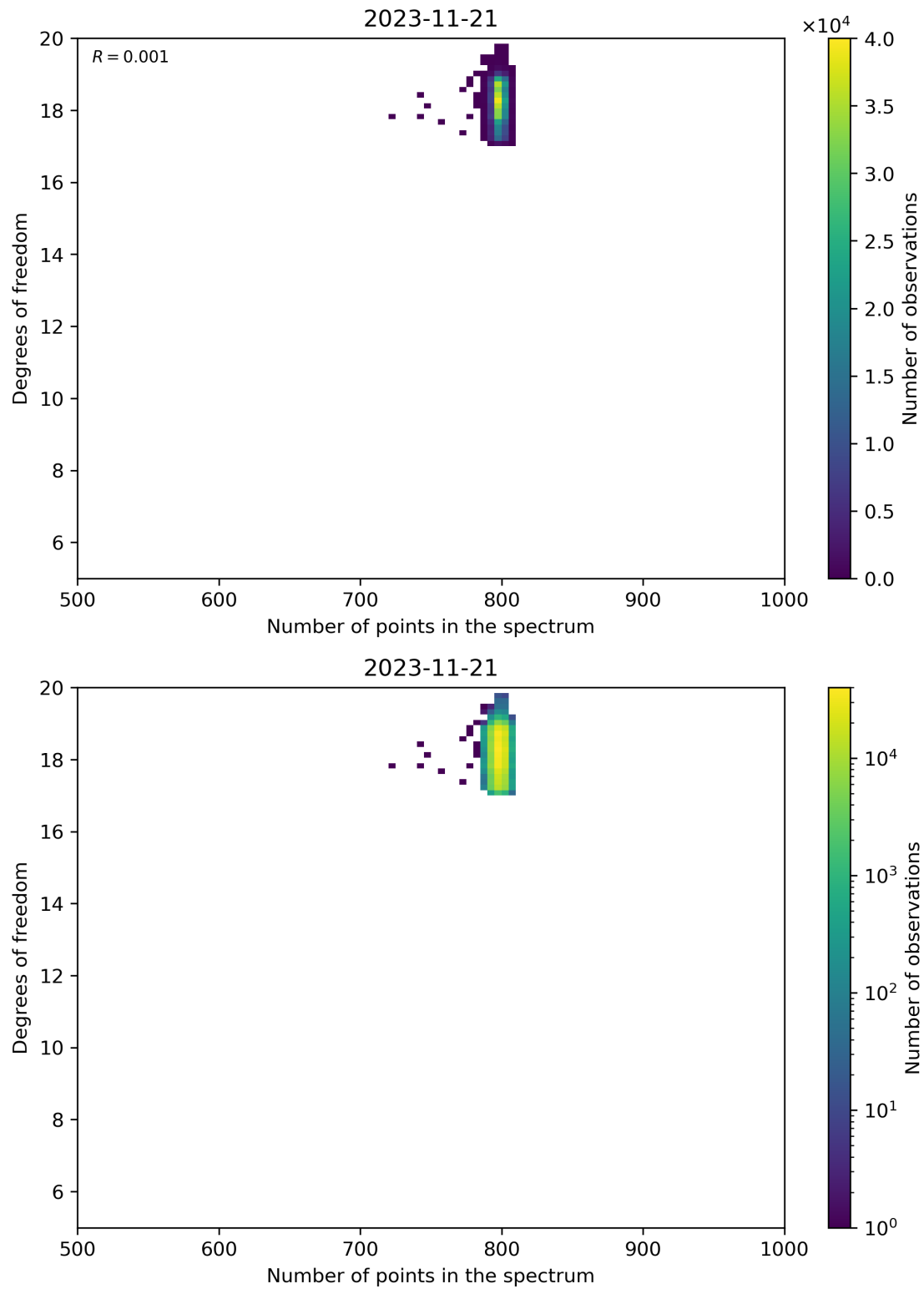


Figure 90: Scatter density plot of “Number of points in the spectrum” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

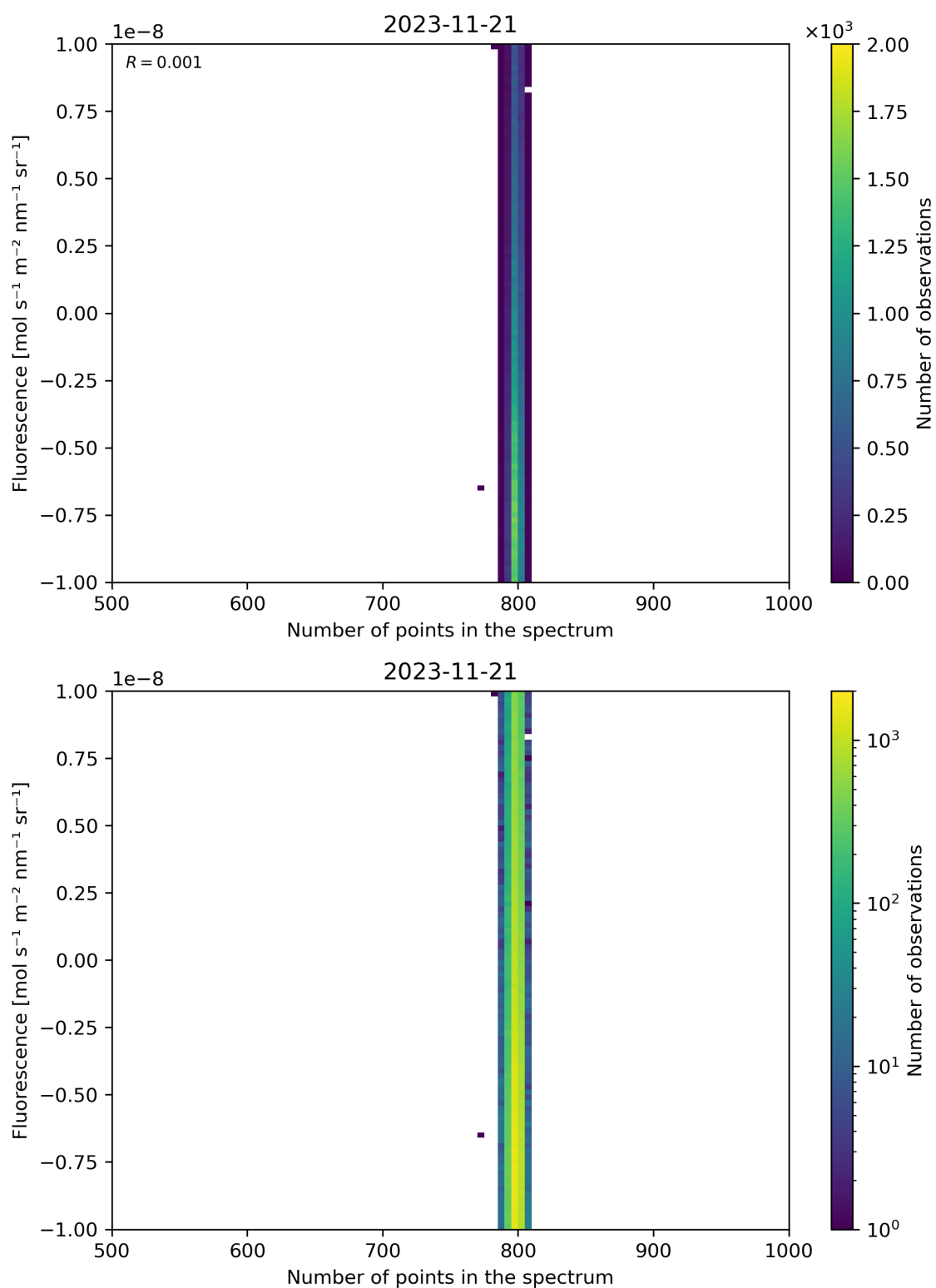


Figure 91: Scatter density plot of “Number of points in the spectrum” against “Fluorescence” for 2023-11-20 to 2023-11-22.



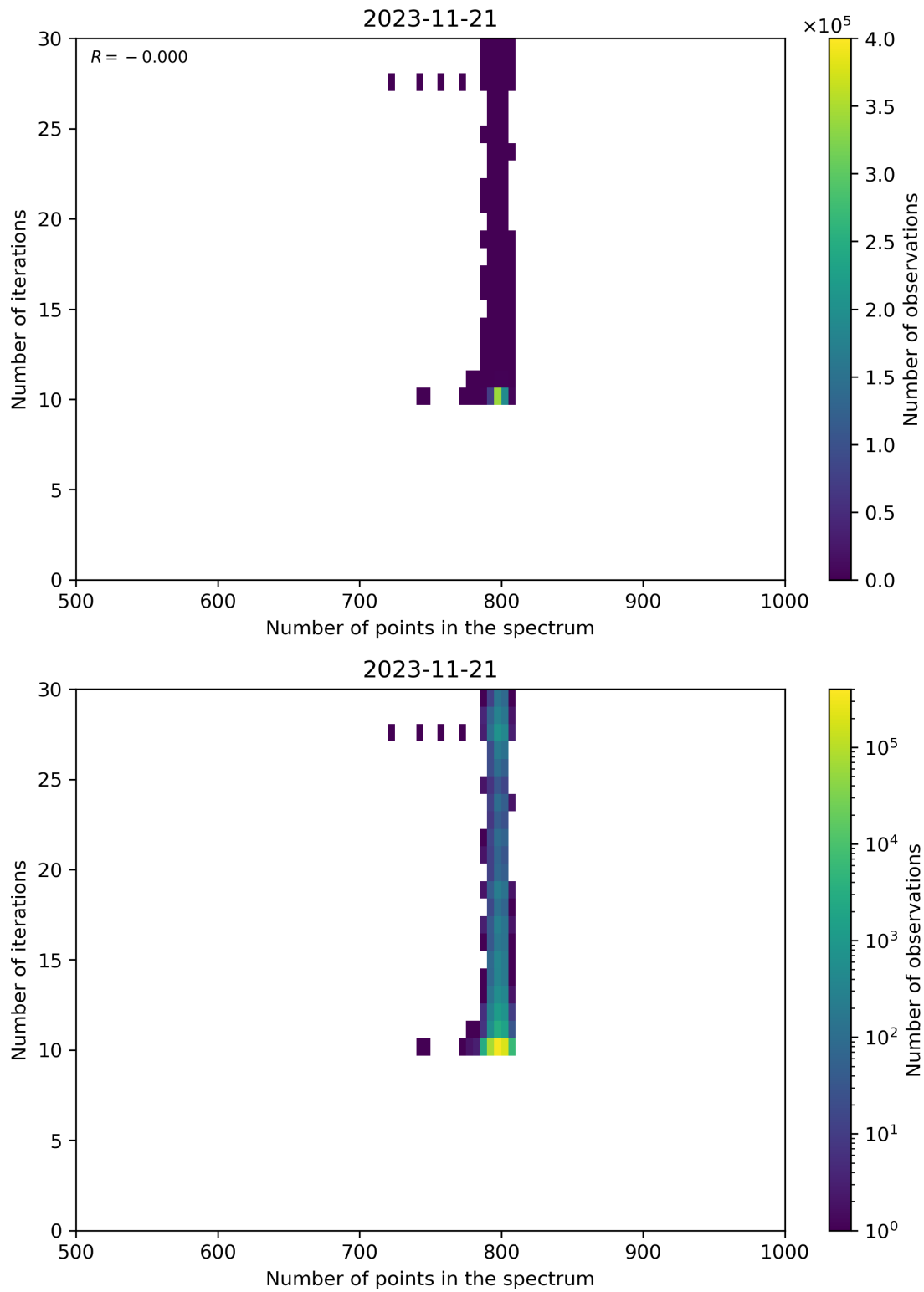


Figure 92: Scatter density plot of “Number of points in the spectrum” against “Number of iterations” for 2023-11-20 to 2023-11-22.

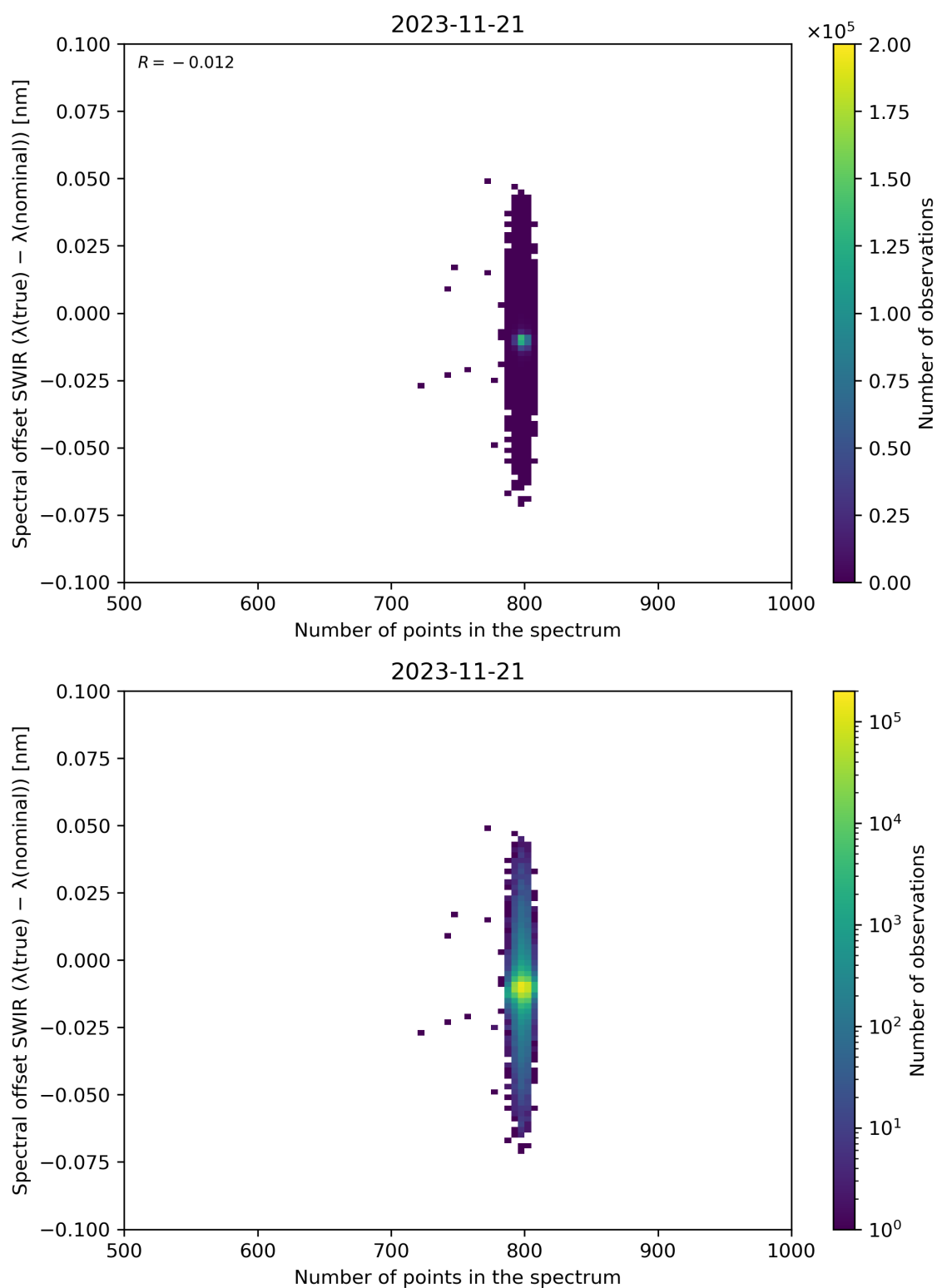


Figure 93: Scatter density plot of “Number of points in the spectrum” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

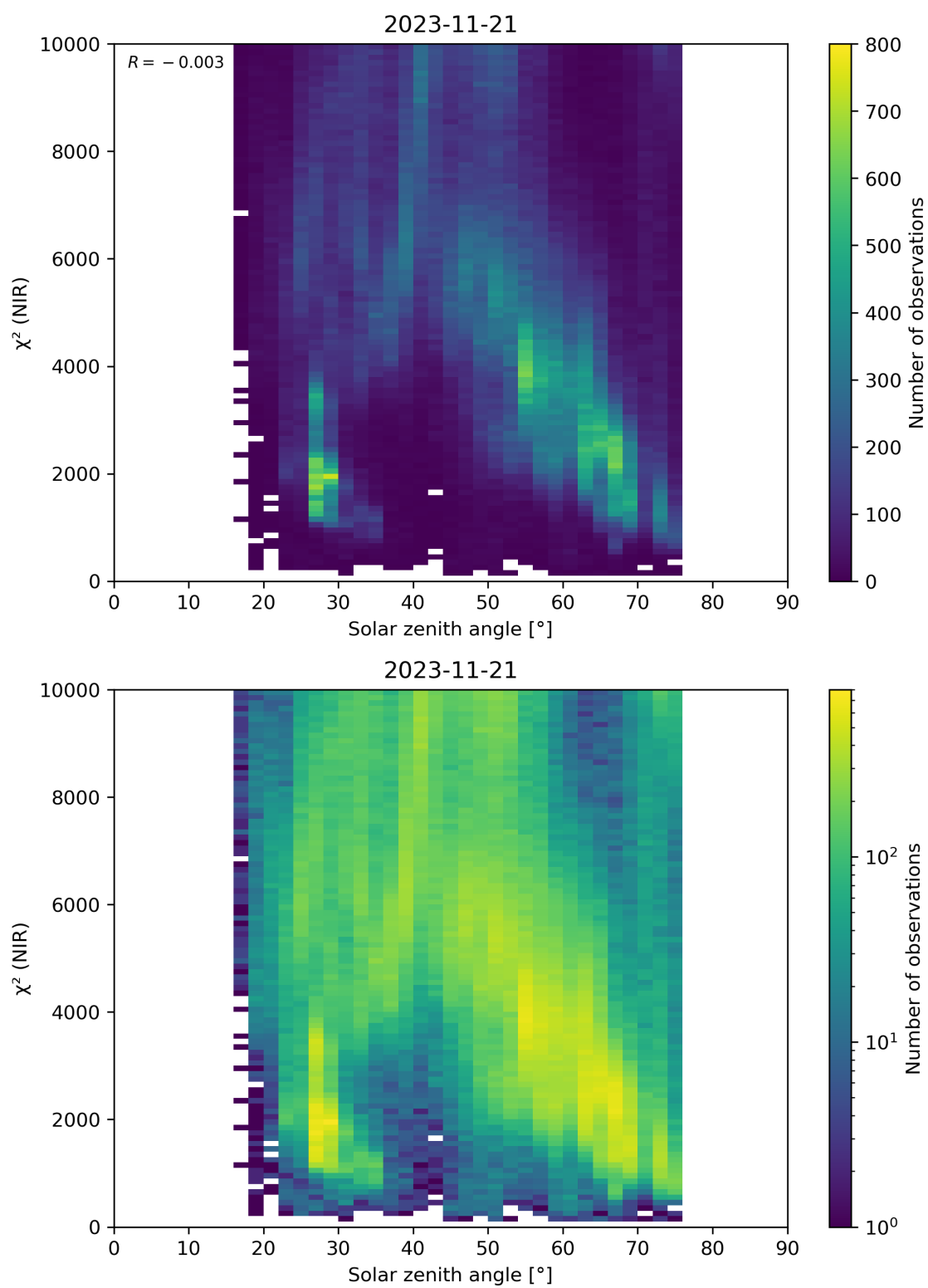


Figure 94: Scatter density plot of “Solar zenith angle” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

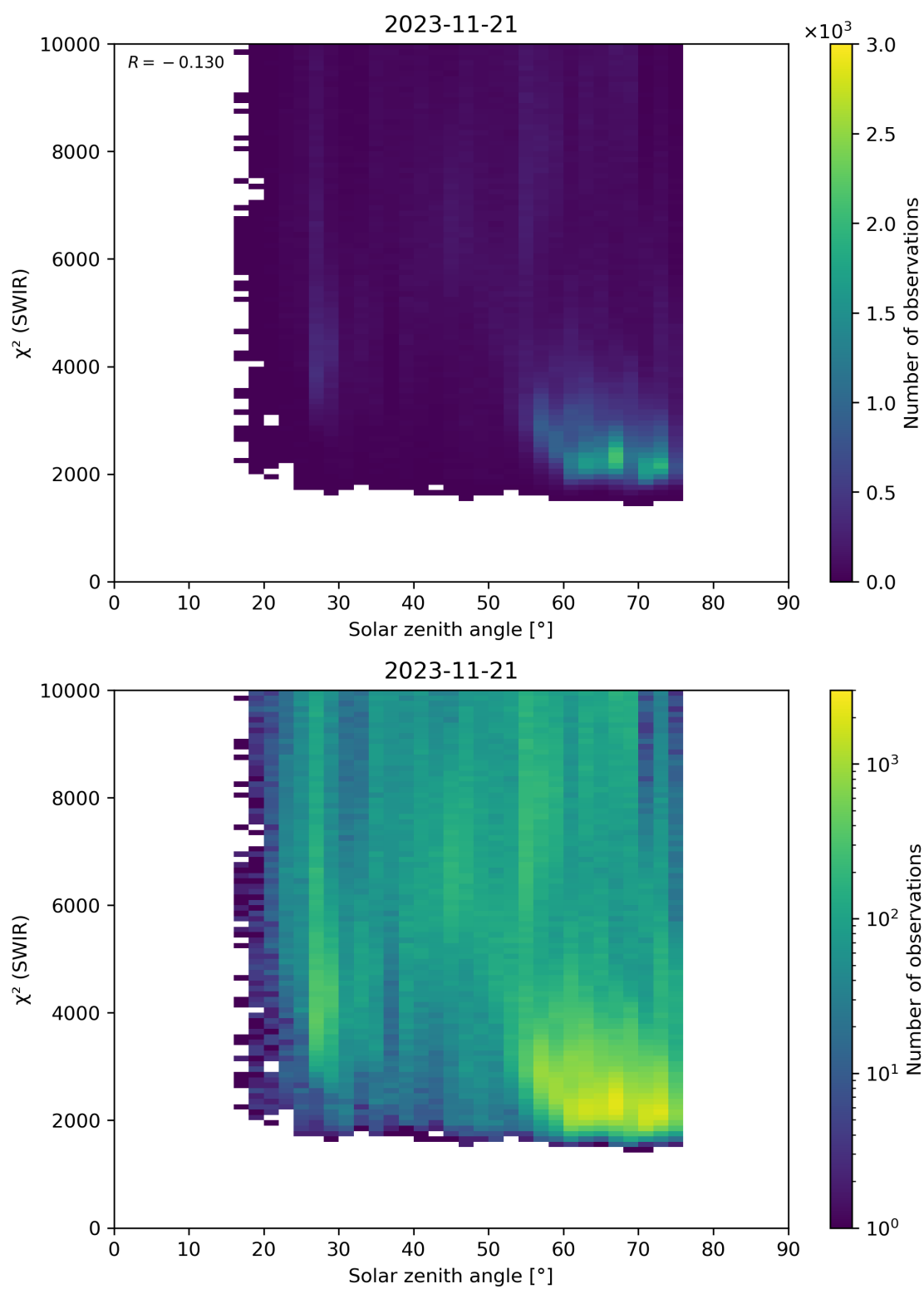


Figure 95: Scatter density plot of “Solar zenith angle” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

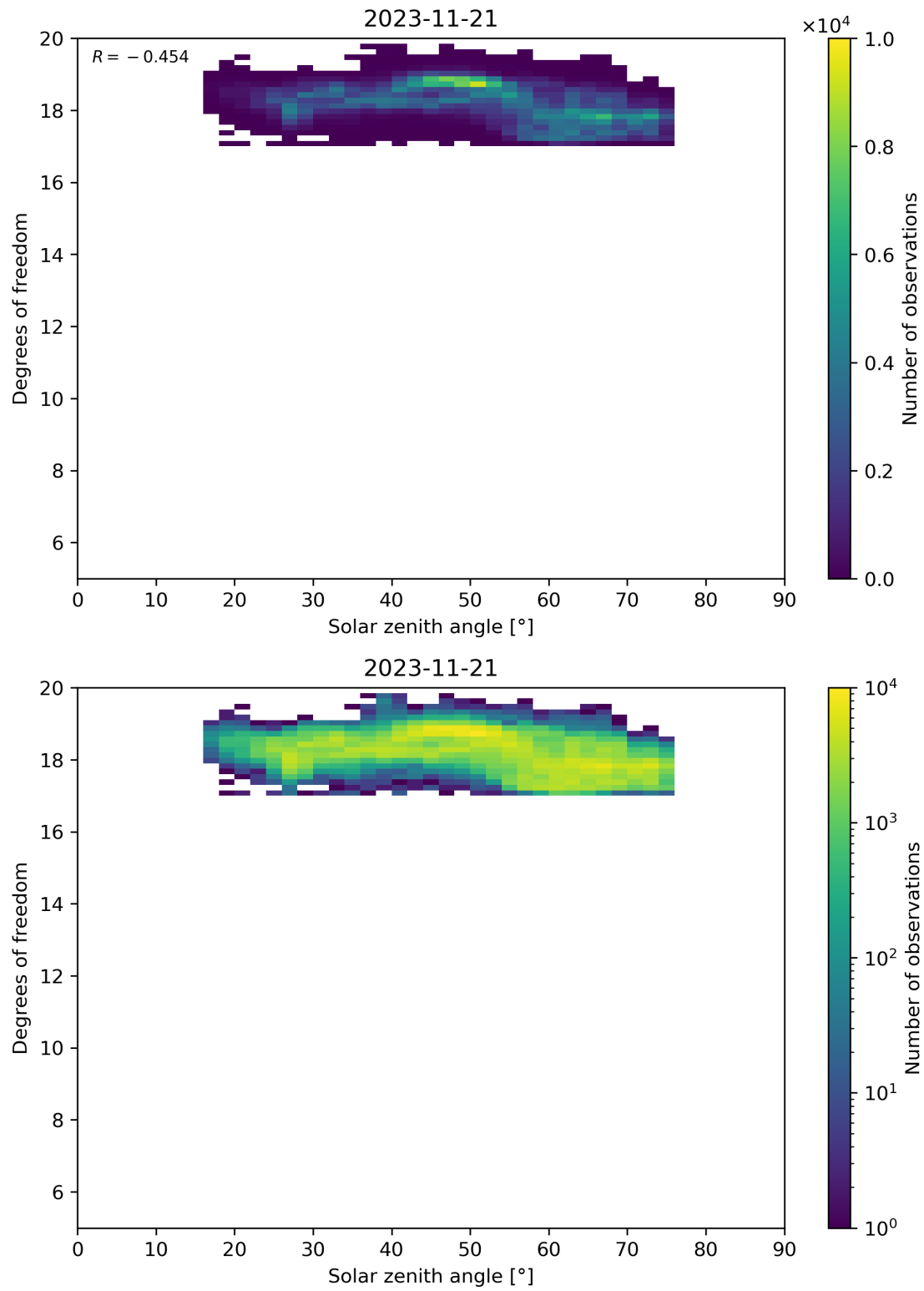


Figure 96: Scatter density plot of “Solar zenith angle” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.

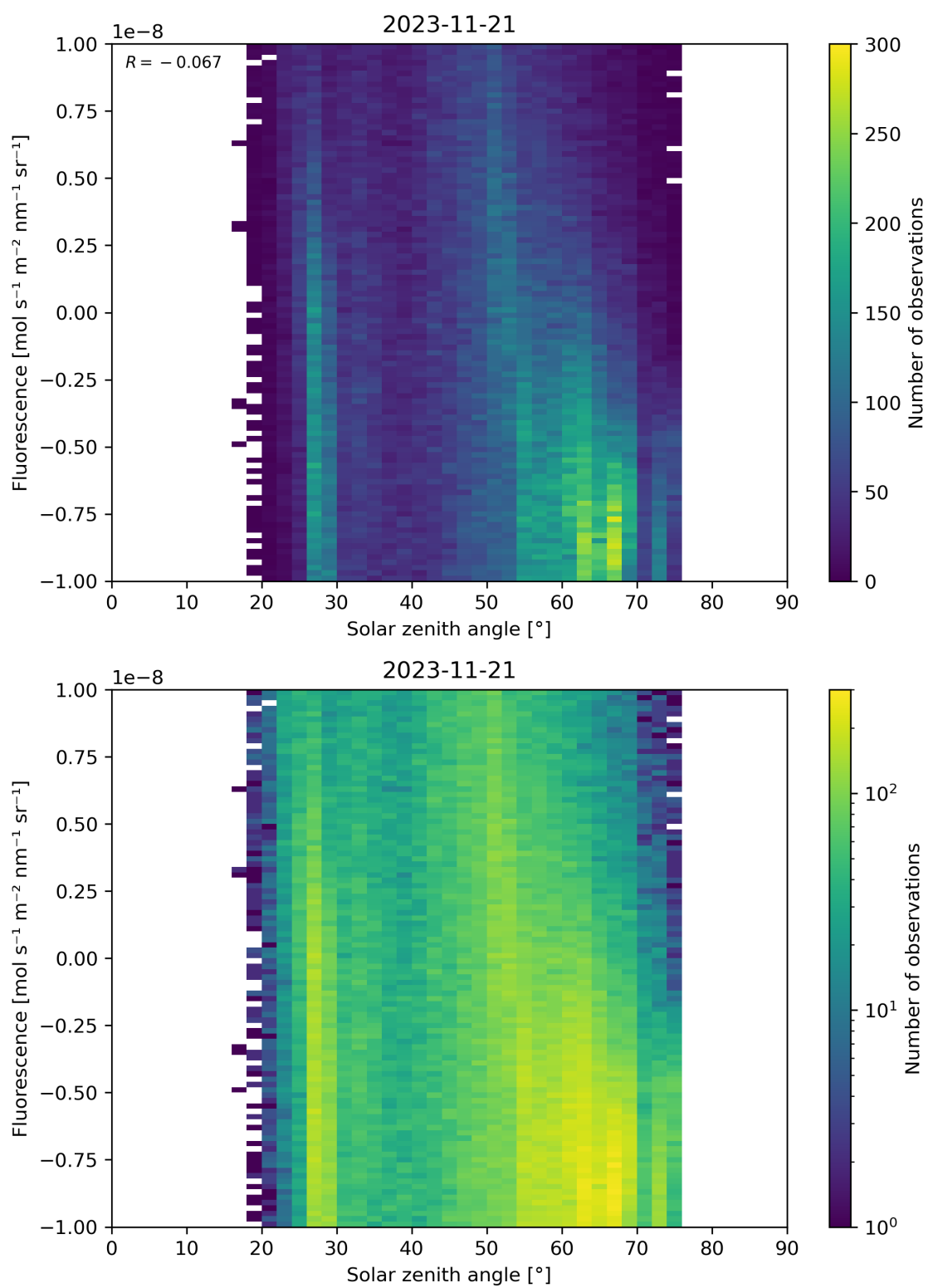


Figure 97: Scatter density plot of “Solar zenith angle” against “Fluorescence” for 2023-11-20 to 2023-11-22.

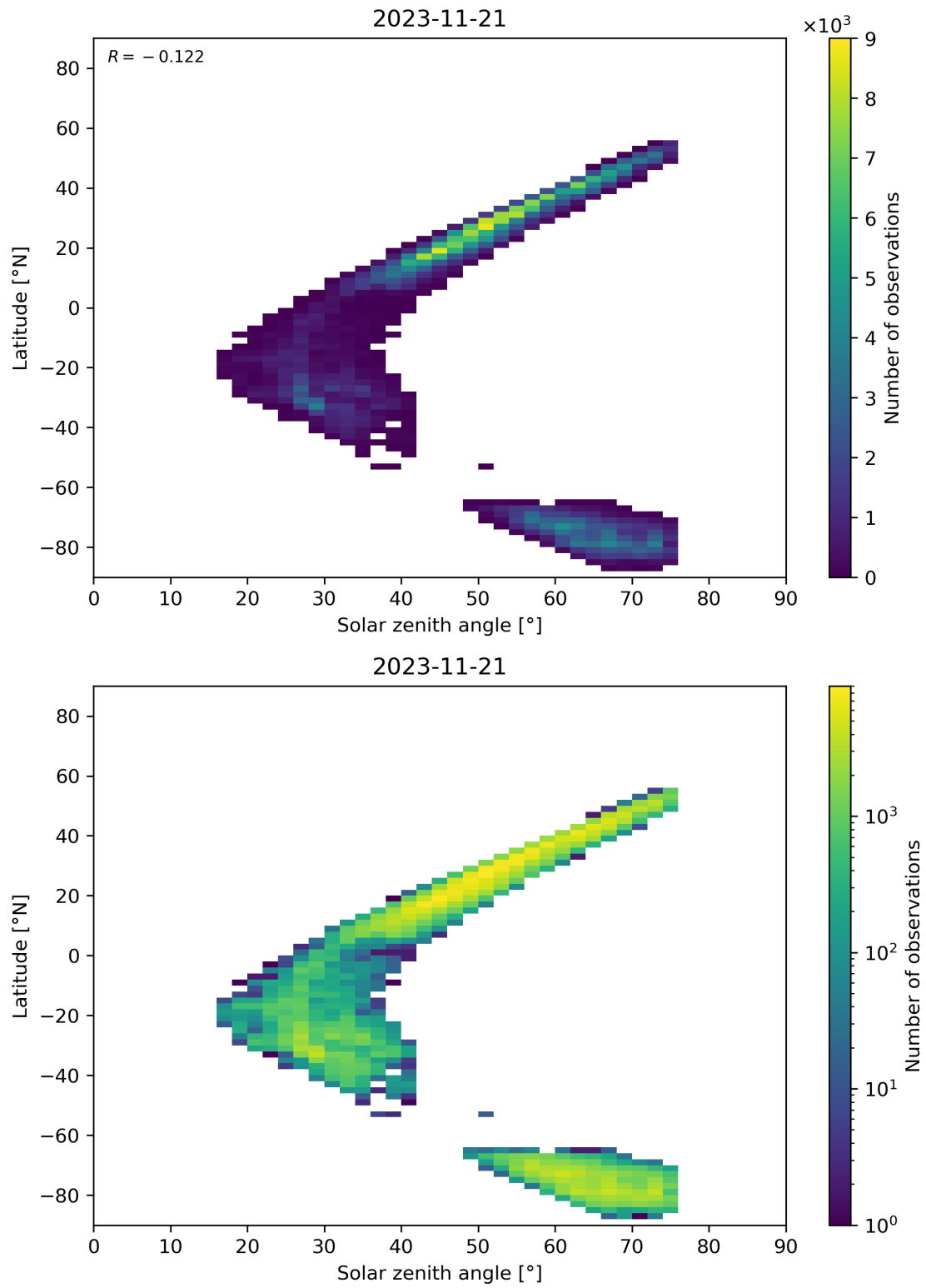


Figure 98: Scatter density plot of “Solar zenith angle” against “Latitude” for 2023-11-20 to 2023-11-22.

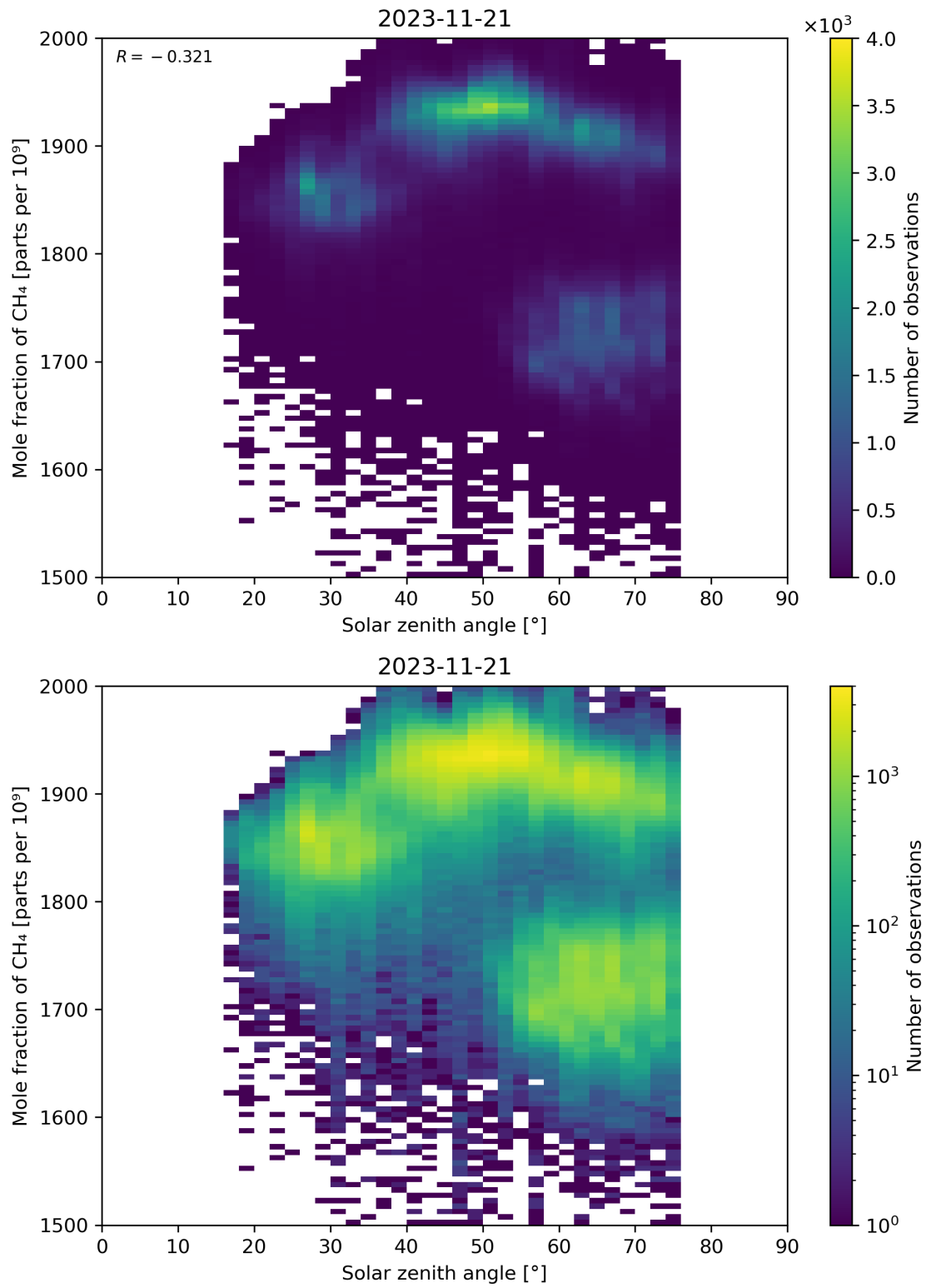


Figure 99: Scatter density plot of “Solar zenith angle” against “Mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.



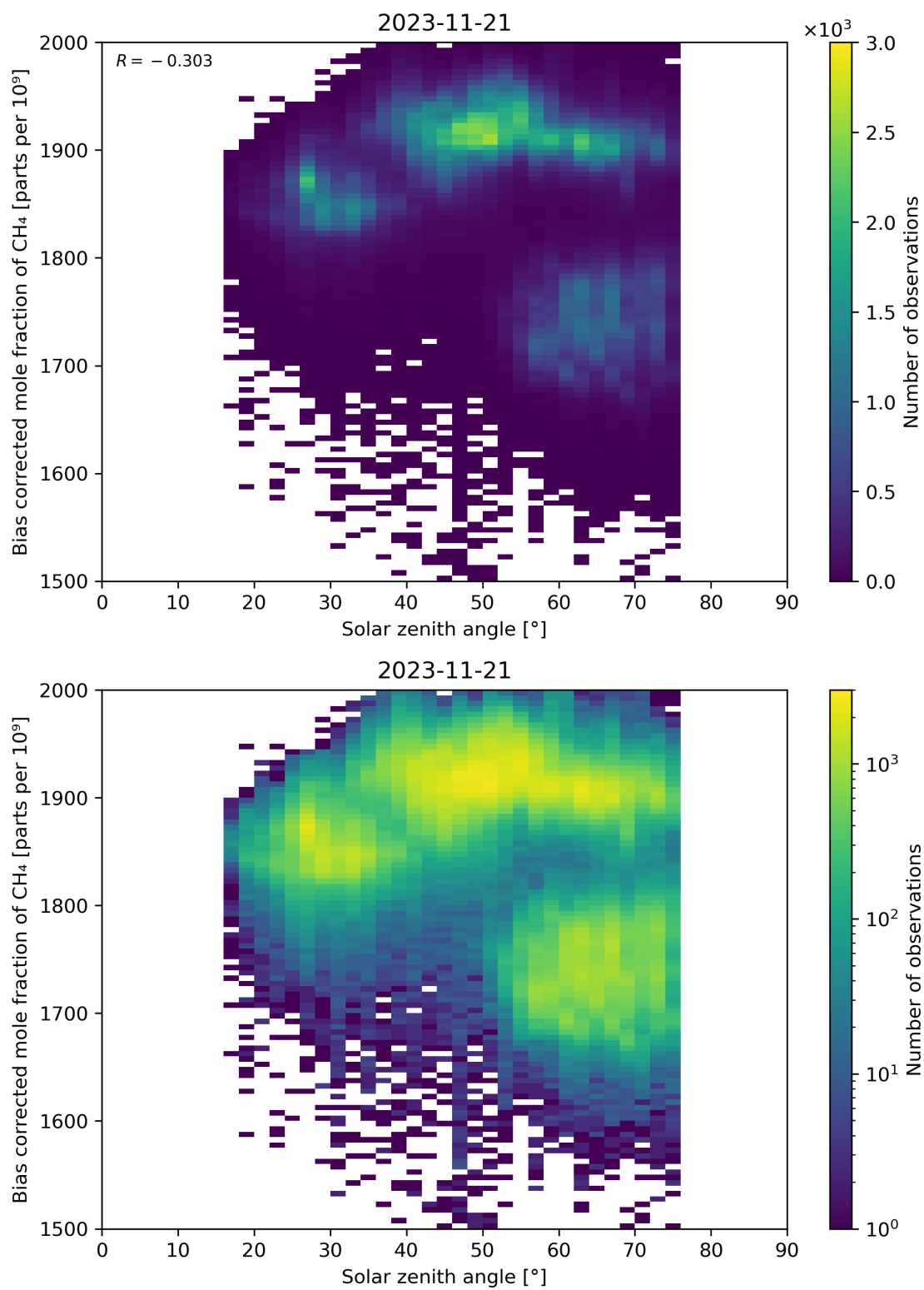


Figure 100: Scatter density plot of “Solar zenith angle” against “Bias corrected mole fraction of  $\text{CH}_4$ ” for 2023-11-20 to 2023-11-22.

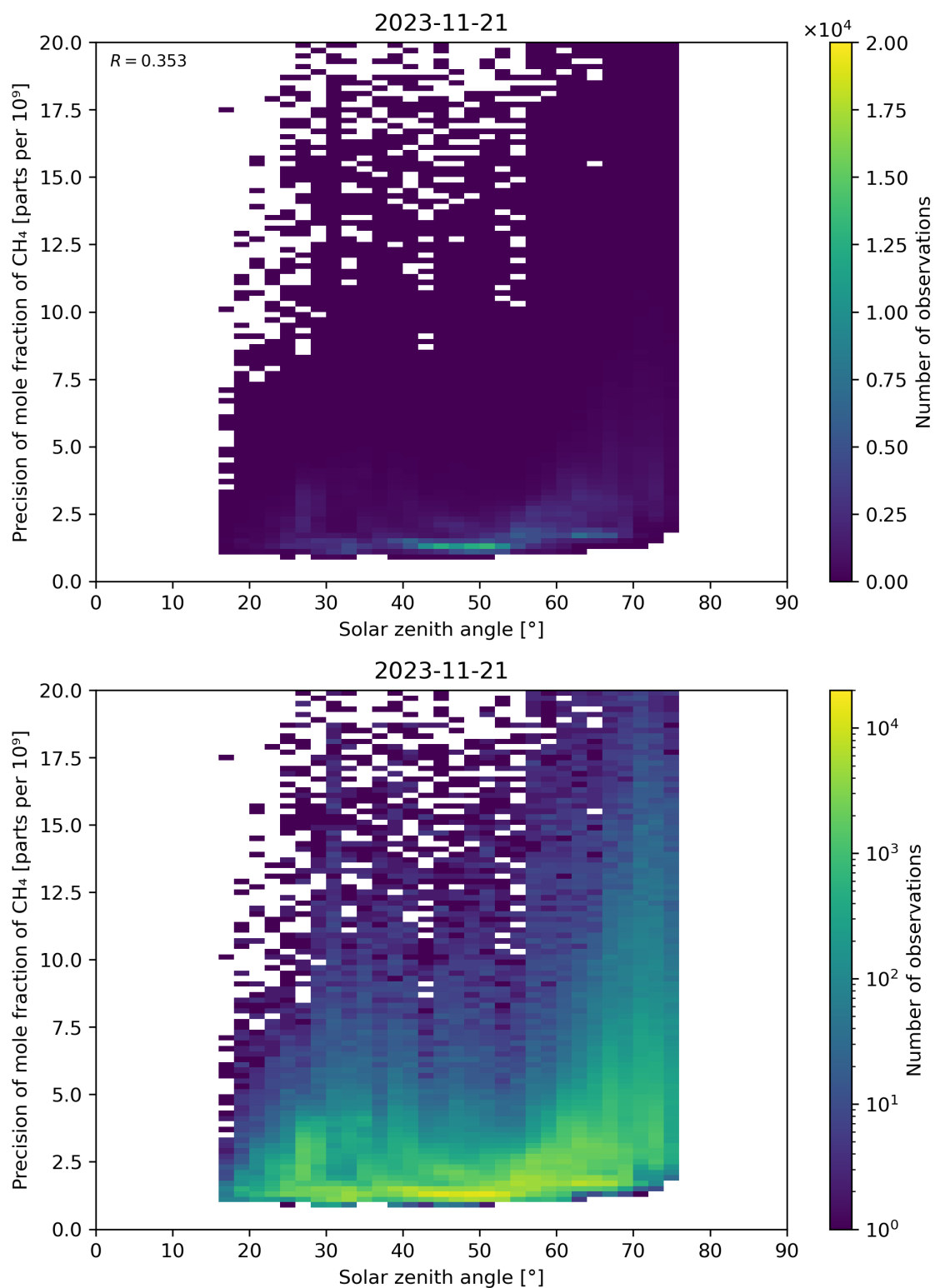


Figure 101: Scatter density plot of “Solar zenith angle” against “Precision of mole fraction of  $\text{CH}_4$ ” for 2023-11-20 to 2023-11-22.

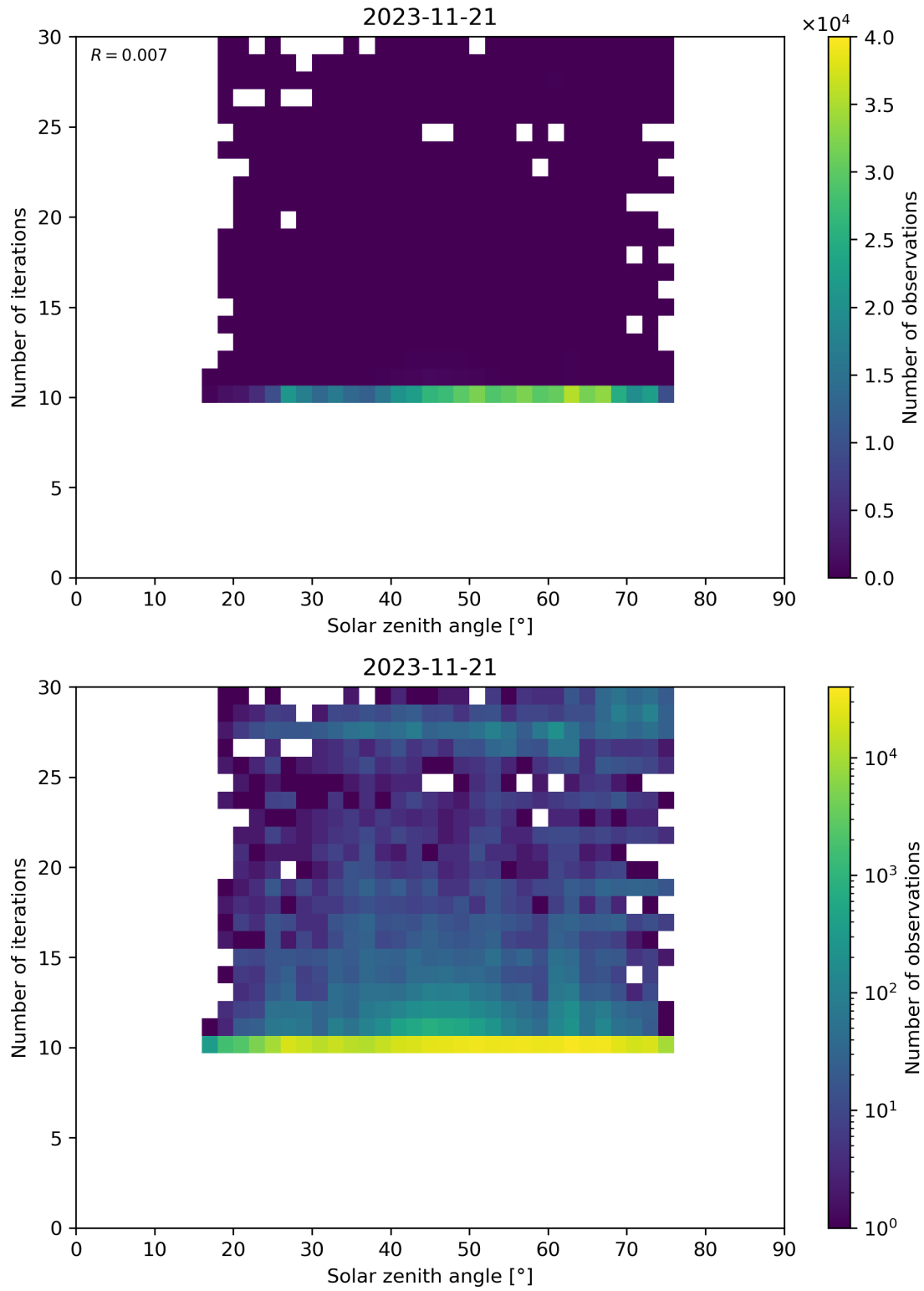


Figure 102: Scatter density plot of “Solar zenith angle” against “Number of iterations” for 2023-11-20 to 2023-11-22.

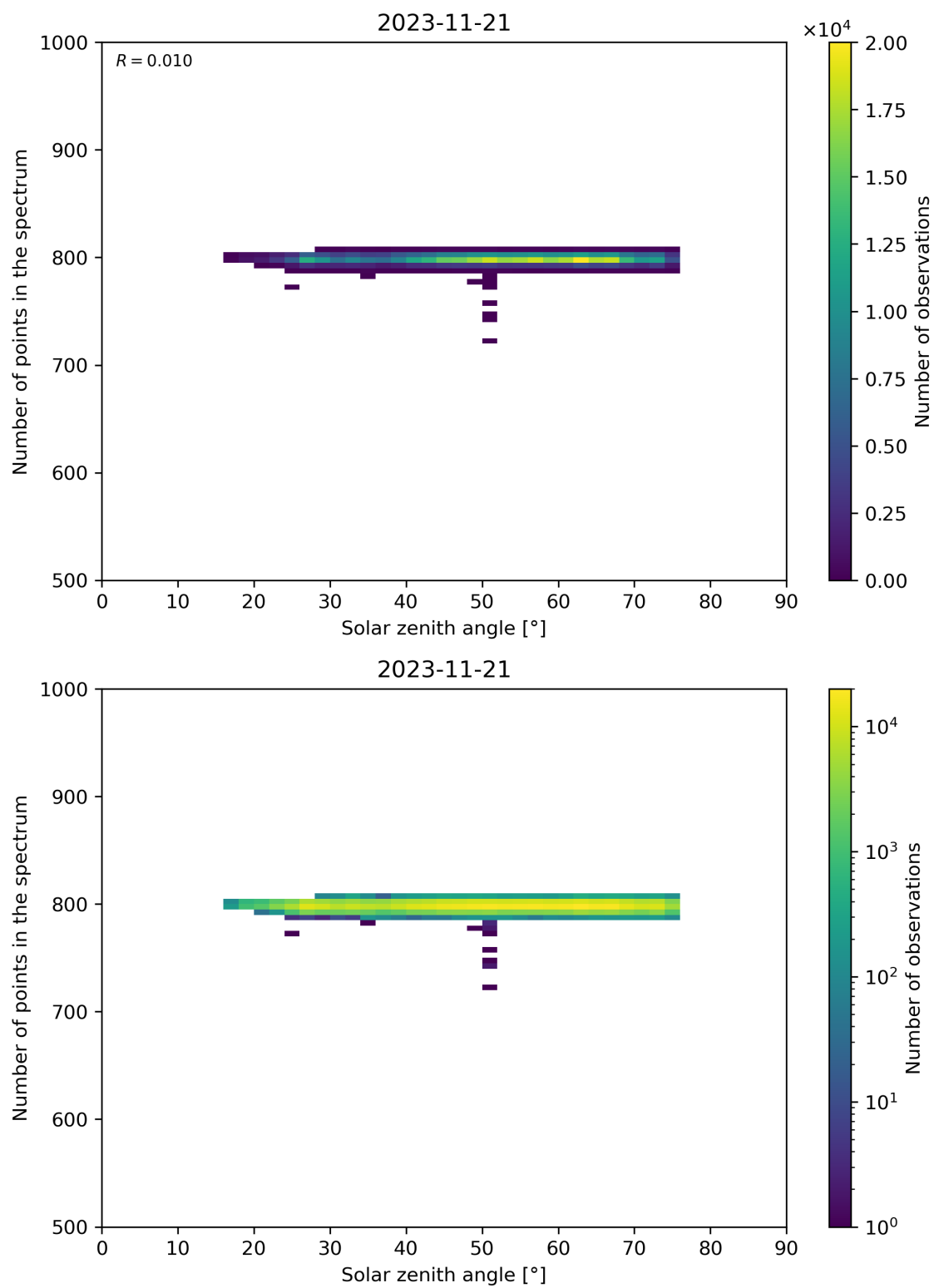


Figure 103: Scatter density plot of “Solar zenith angle” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

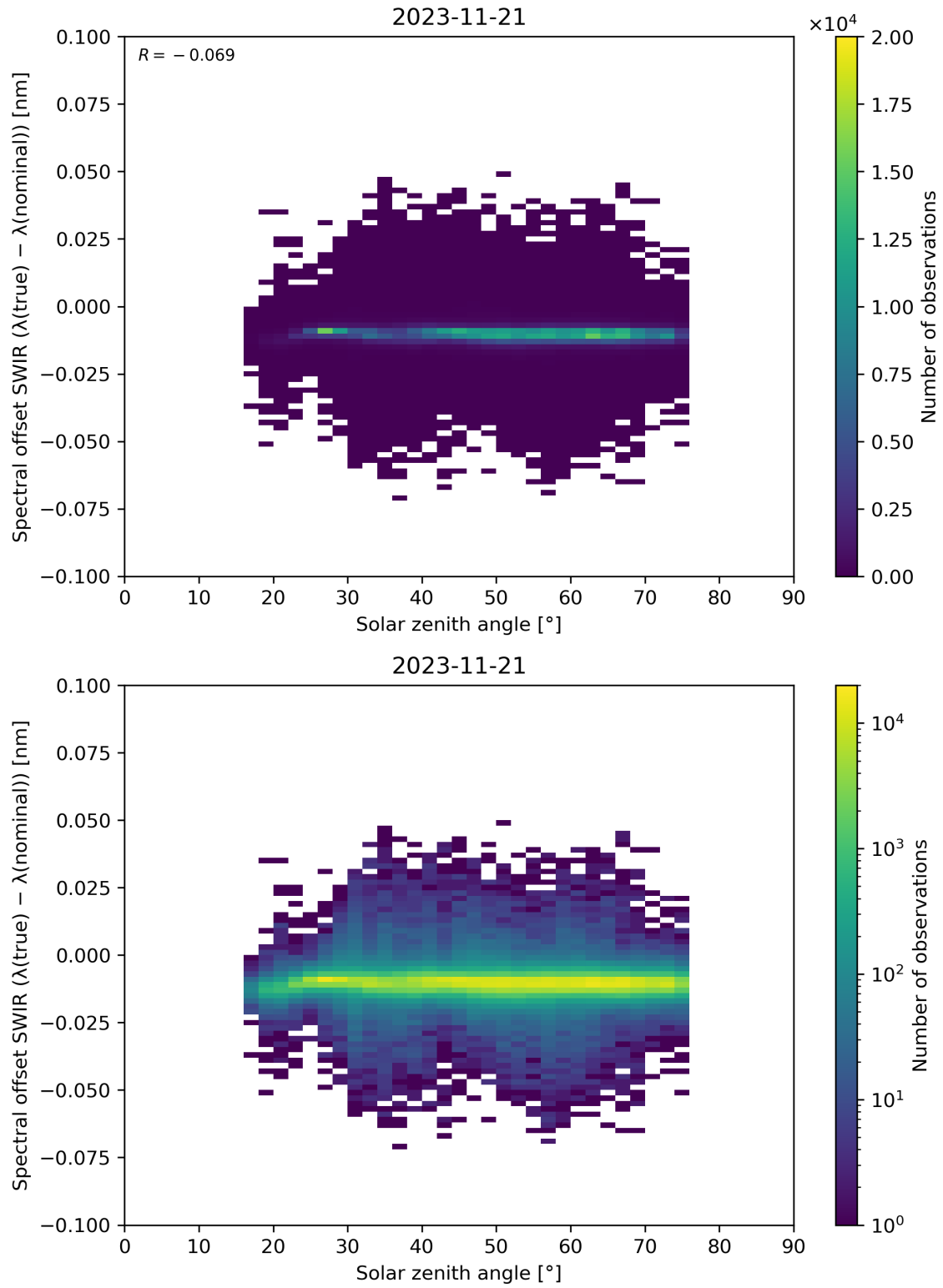


Figure 104: Scatter density plot of “Solar zenith angle” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

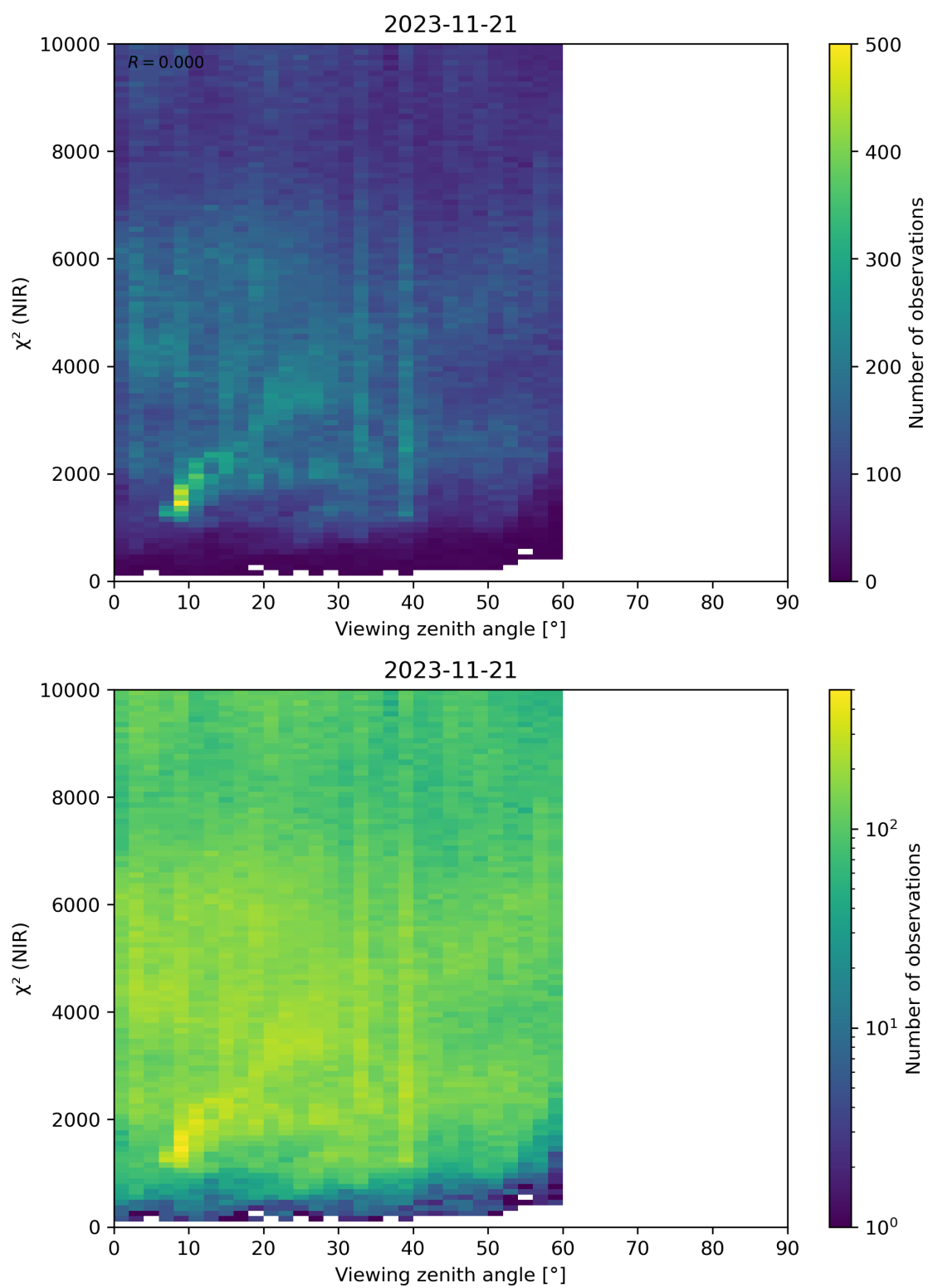


Figure 105: Scatter density plot of “Viewing zenith angle” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

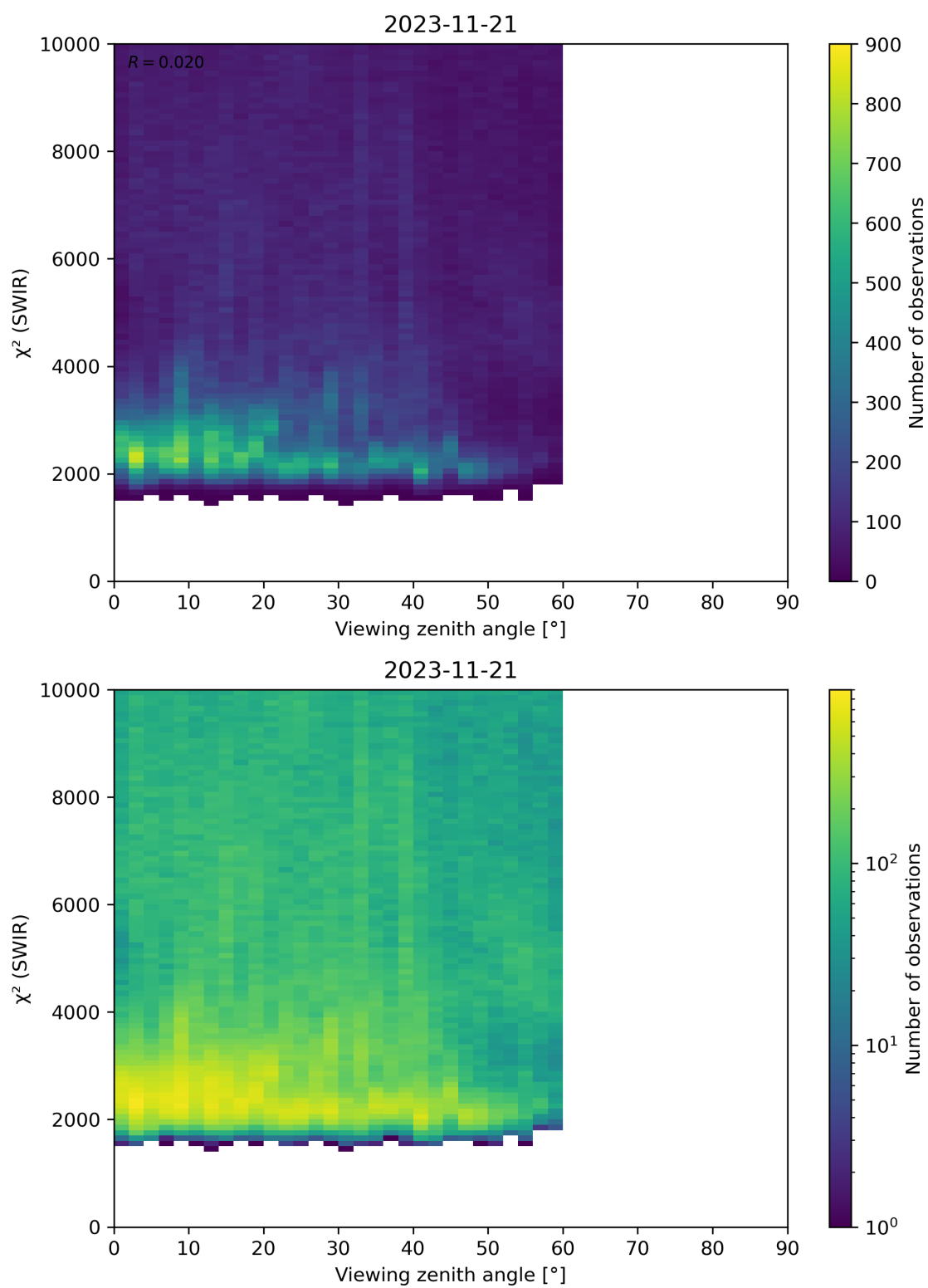


Figure 106: Scatter density plot of “Viewing zenith angle” against “ $\chi^2$  (SWIR)” for 2023-11-20 to 2023-11-22.

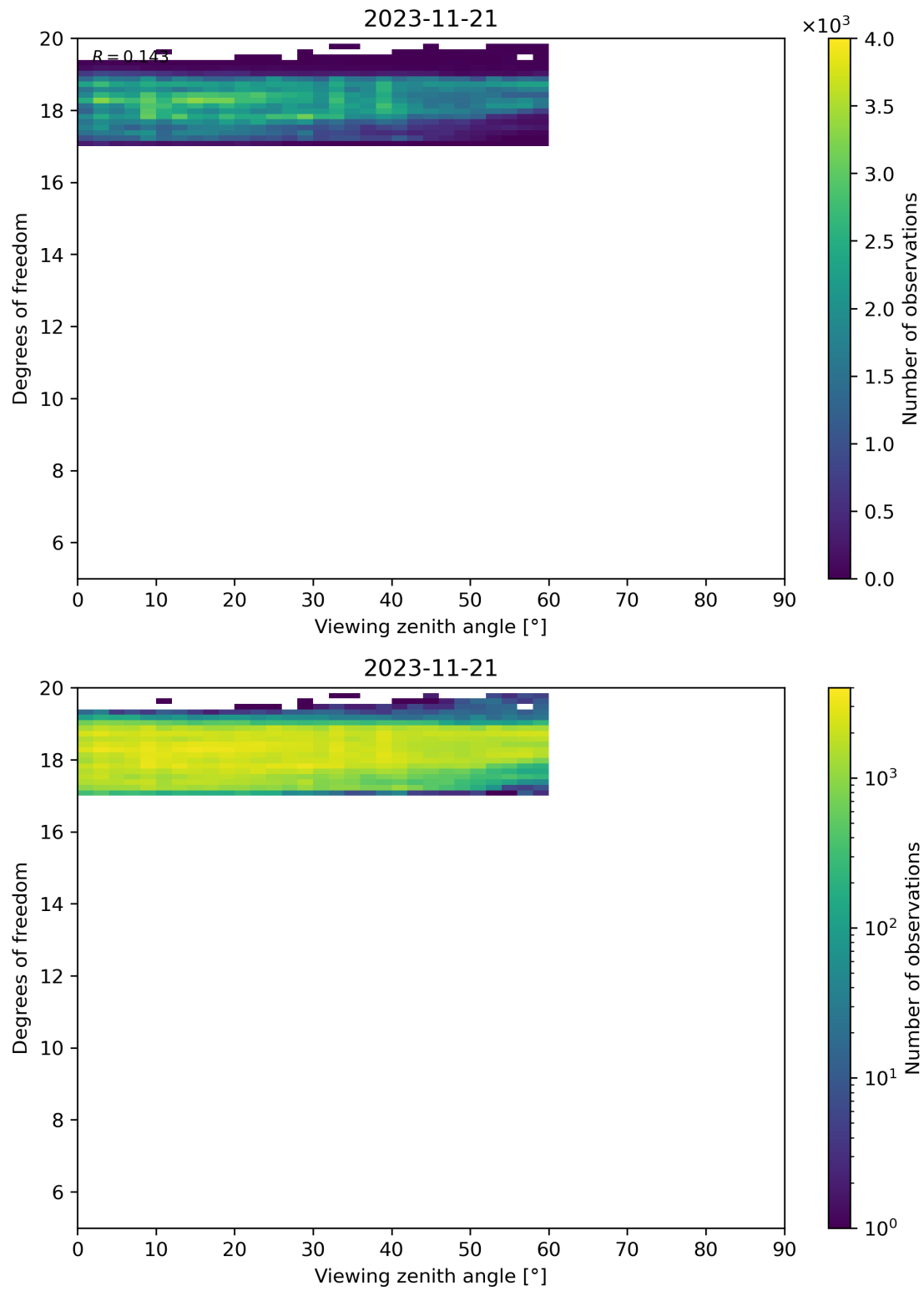


Figure 107: Scatter density plot of “Viewing zenith angle” against “Degrees of freedom” for 2023-11-20 to 2023-11-22.



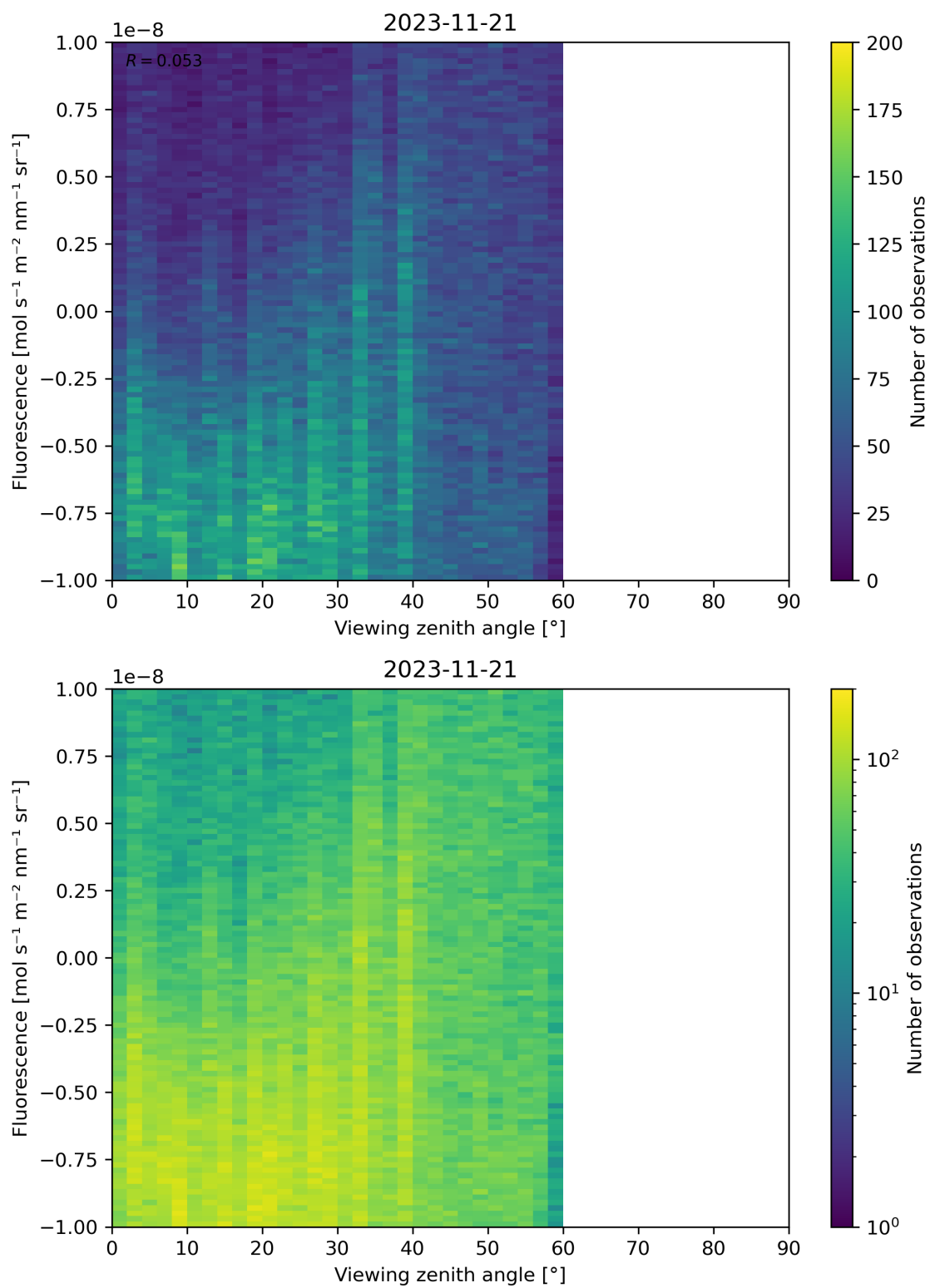


Figure 108: Scatter density plot of “Viewing zenith angle” against “Fluorescence” for 2023-11-20 to 2023-11-22.

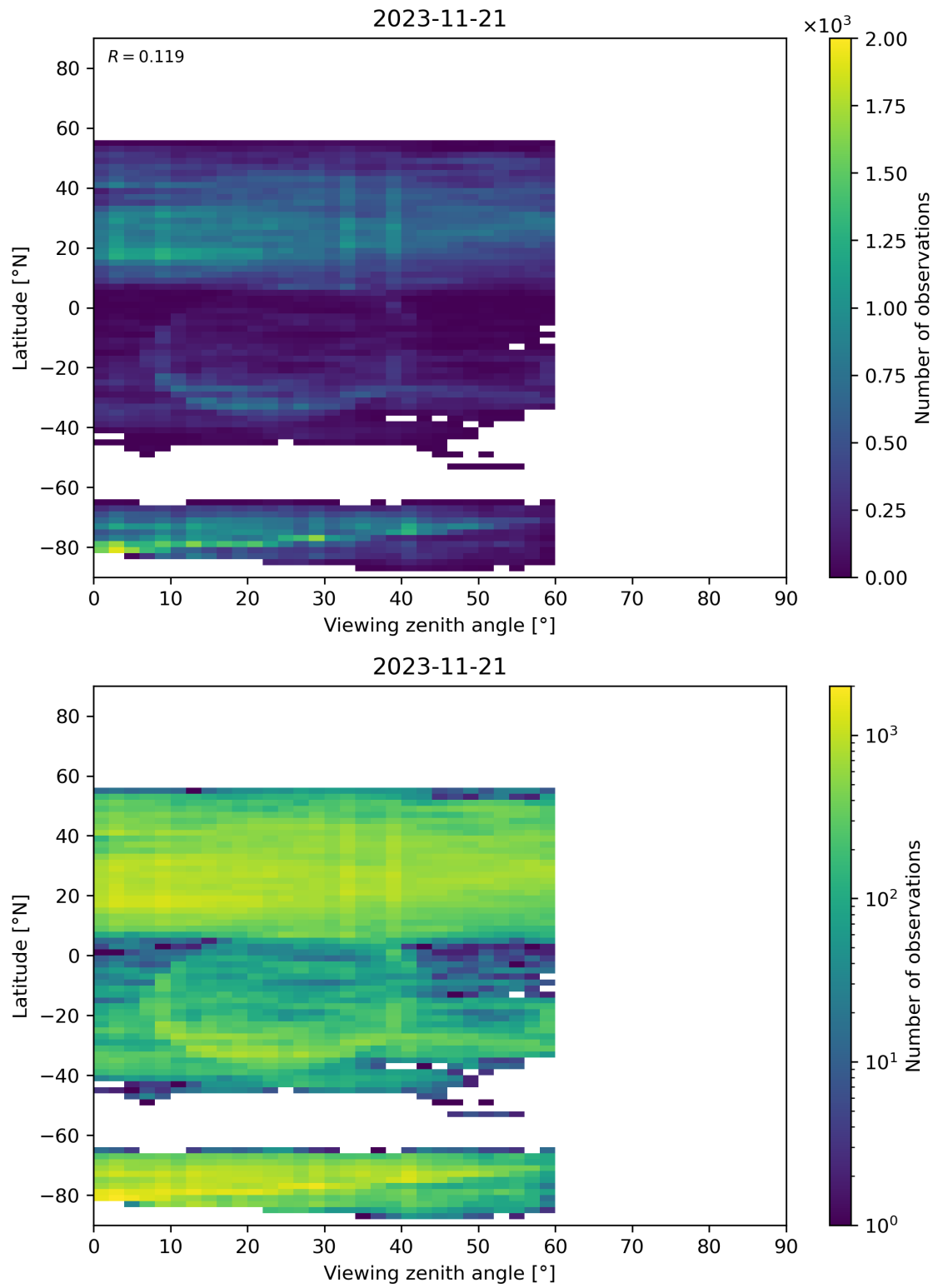


Figure 109: Scatter density plot of “Viewing zenith angle” against “Latitude” for 2023-11-20 to 2023-11-22.

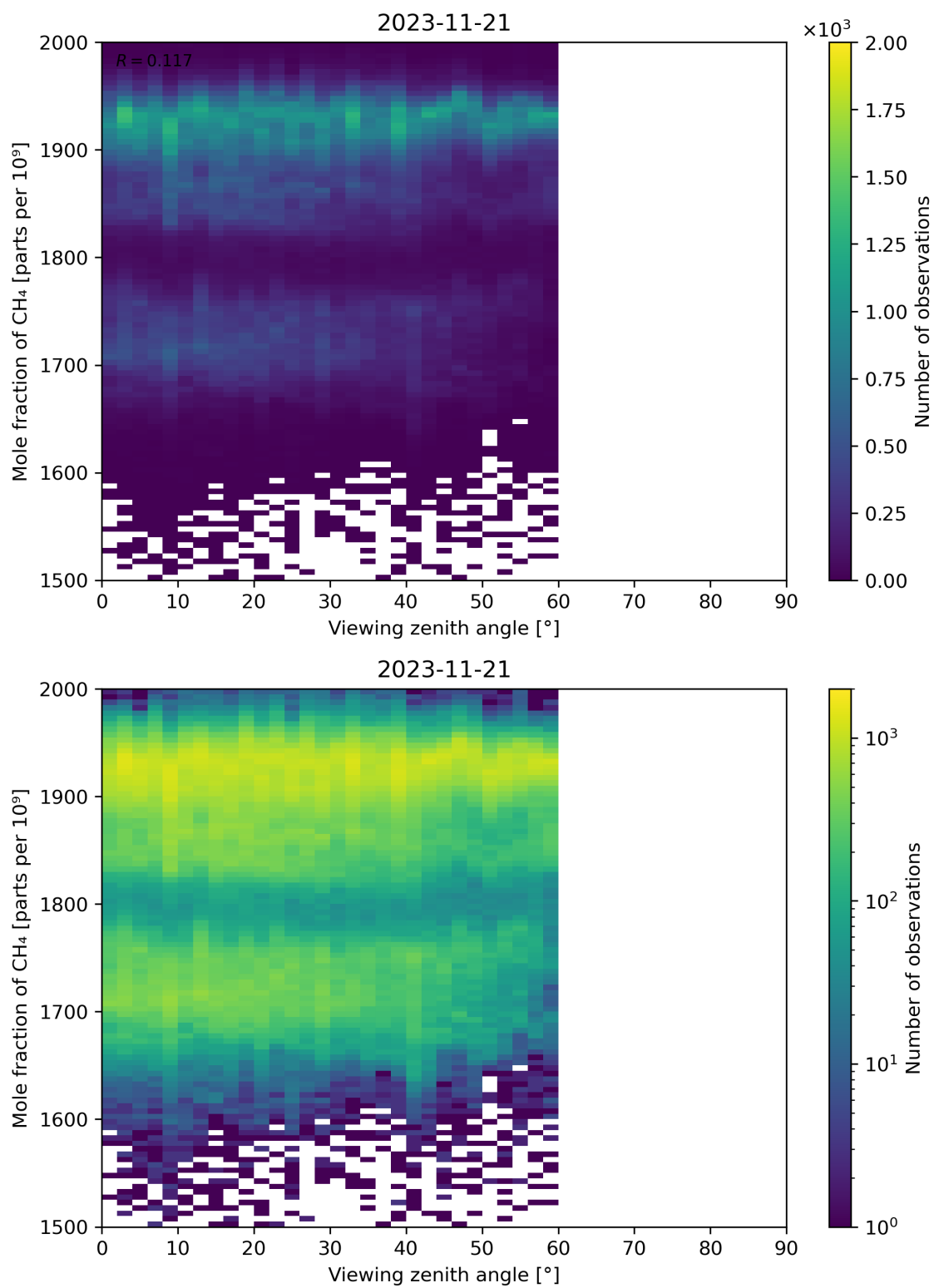


Figure 110: Scatter density plot of “Viewing zenith angle” against “Mole fraction of  $\text{CH}_4$ ” for 2023-11-20 to 2023-11-22.

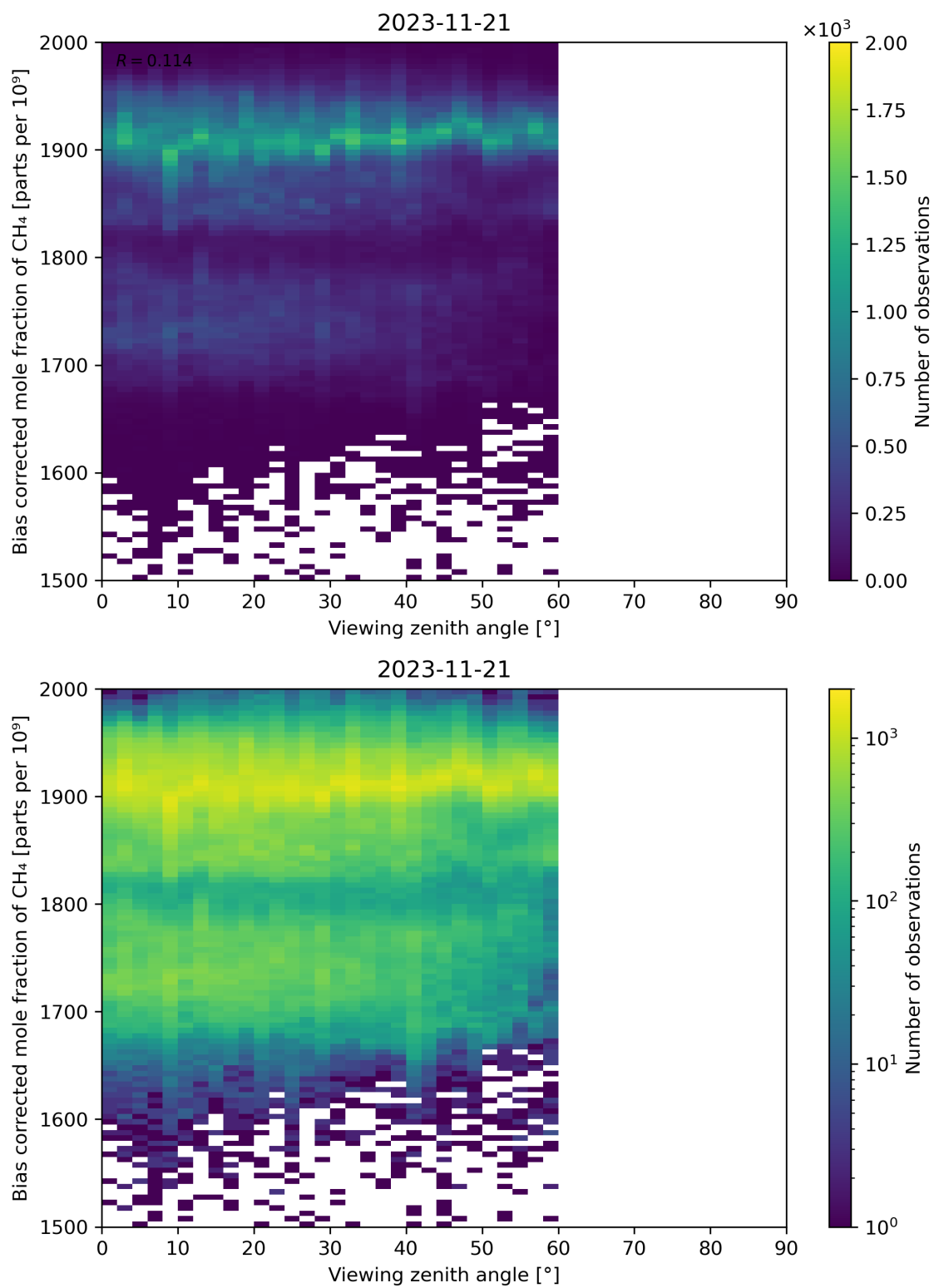


Figure 111: Scatter density plot of “Viewing zenith angle” against “Bias corrected mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

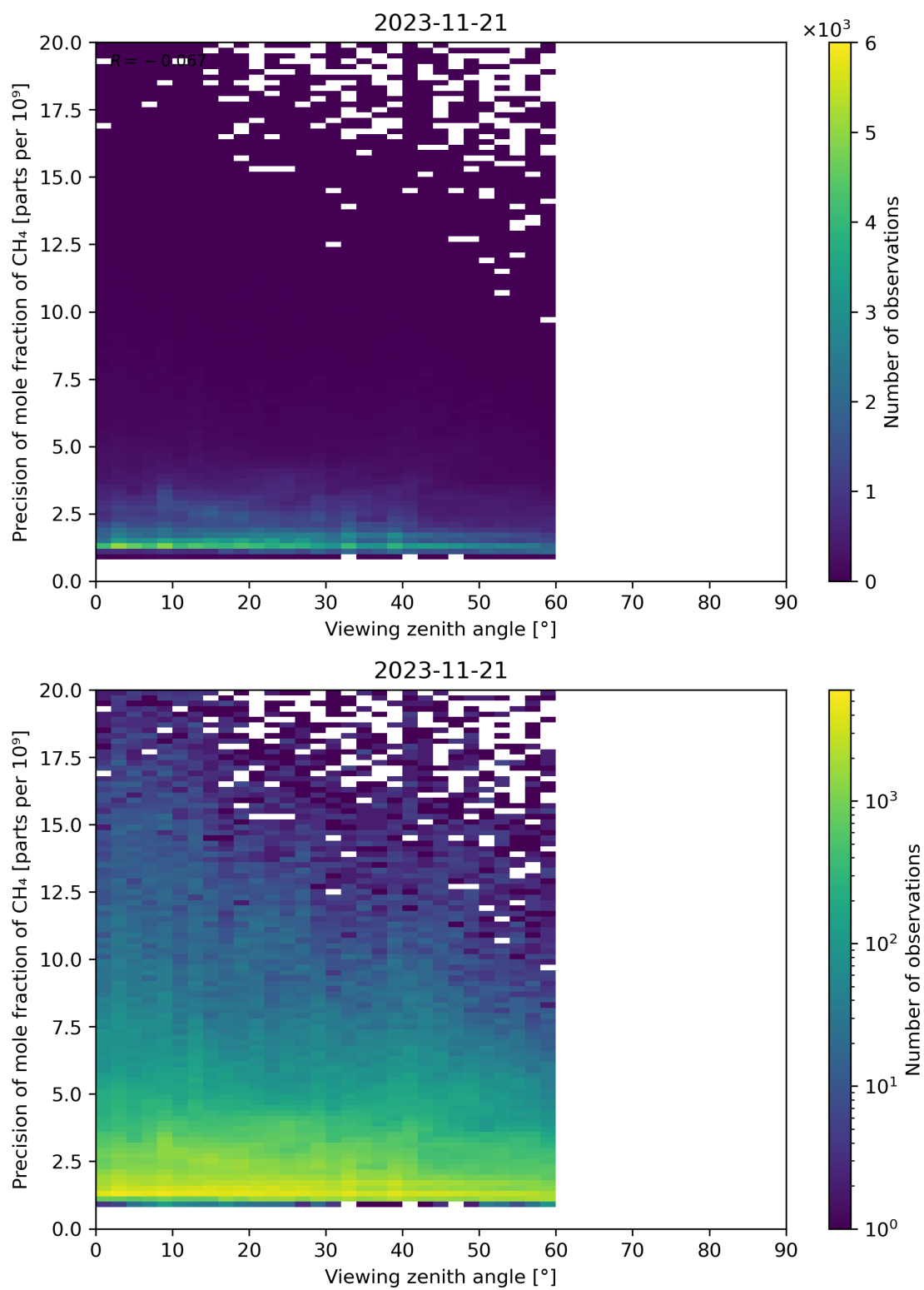


Figure 112: Scatter density plot of “Viewing zenith angle” against “Precision of mole fraction of CH<sub>4</sub>” for 2023-11-20 to 2023-11-22.

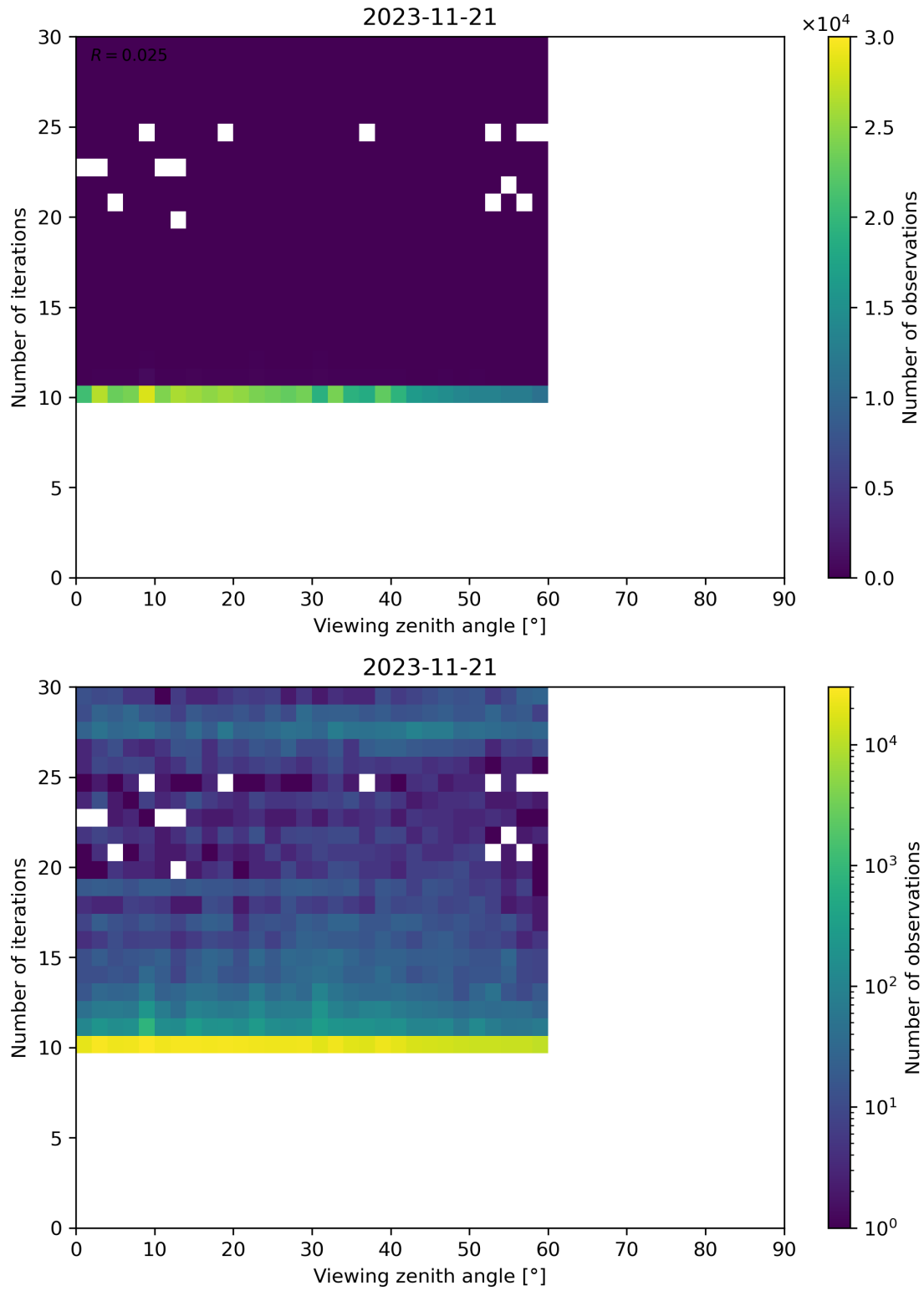


Figure 113: Scatter density plot of “Viewing zenith angle” against “Number of iterations” for 2023-11-20 to 2023-11-22.

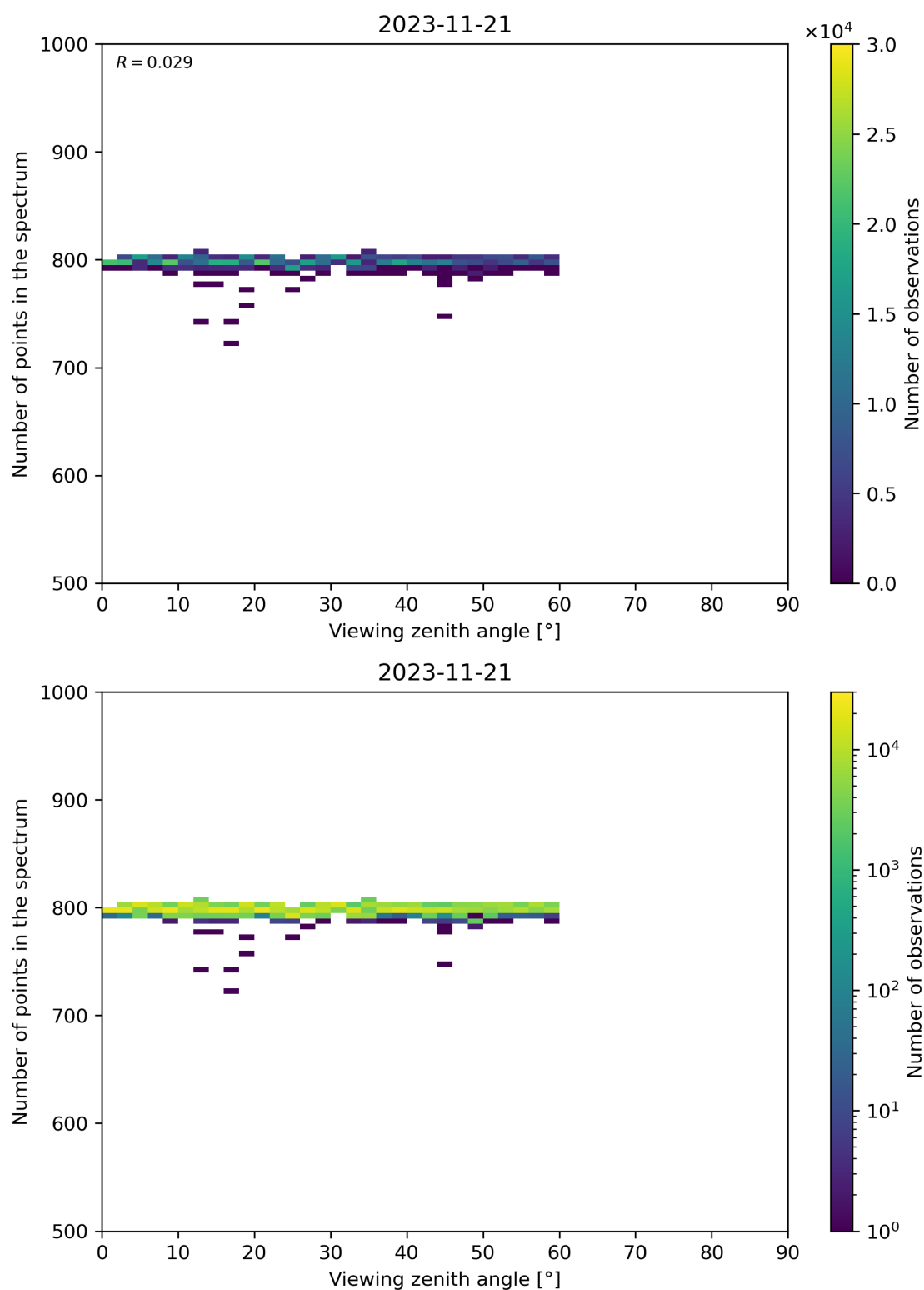


Figure 114: Scatter density plot of “Viewing zenith angle” against “Number of points in the spectrum” for 2023-11-20 to 2023-11-22.

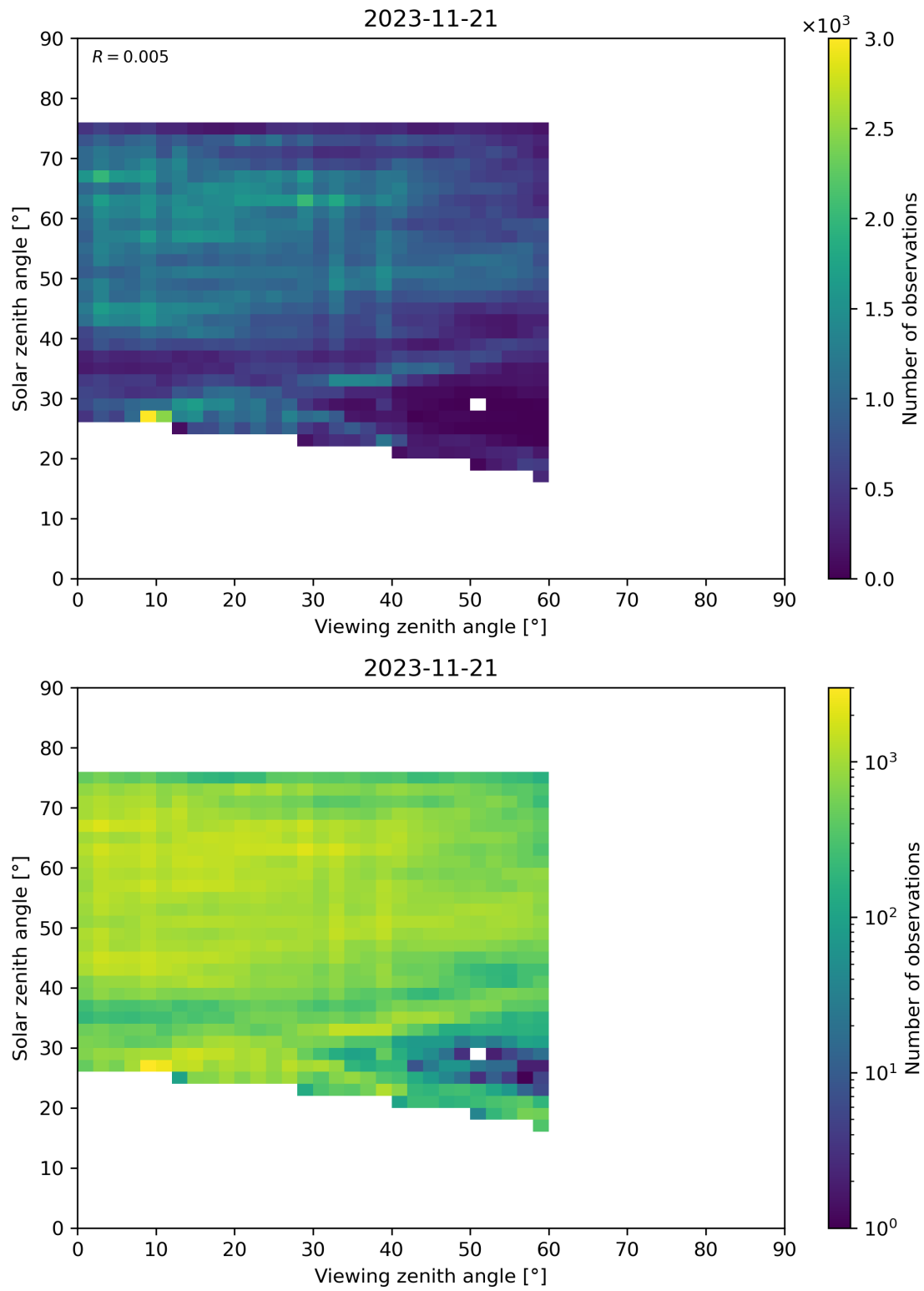


Figure 115: Scatter density plot of “Viewing zenith angle” against “Solar zenith angle” for 2023-11-20 to 2023-11-22.



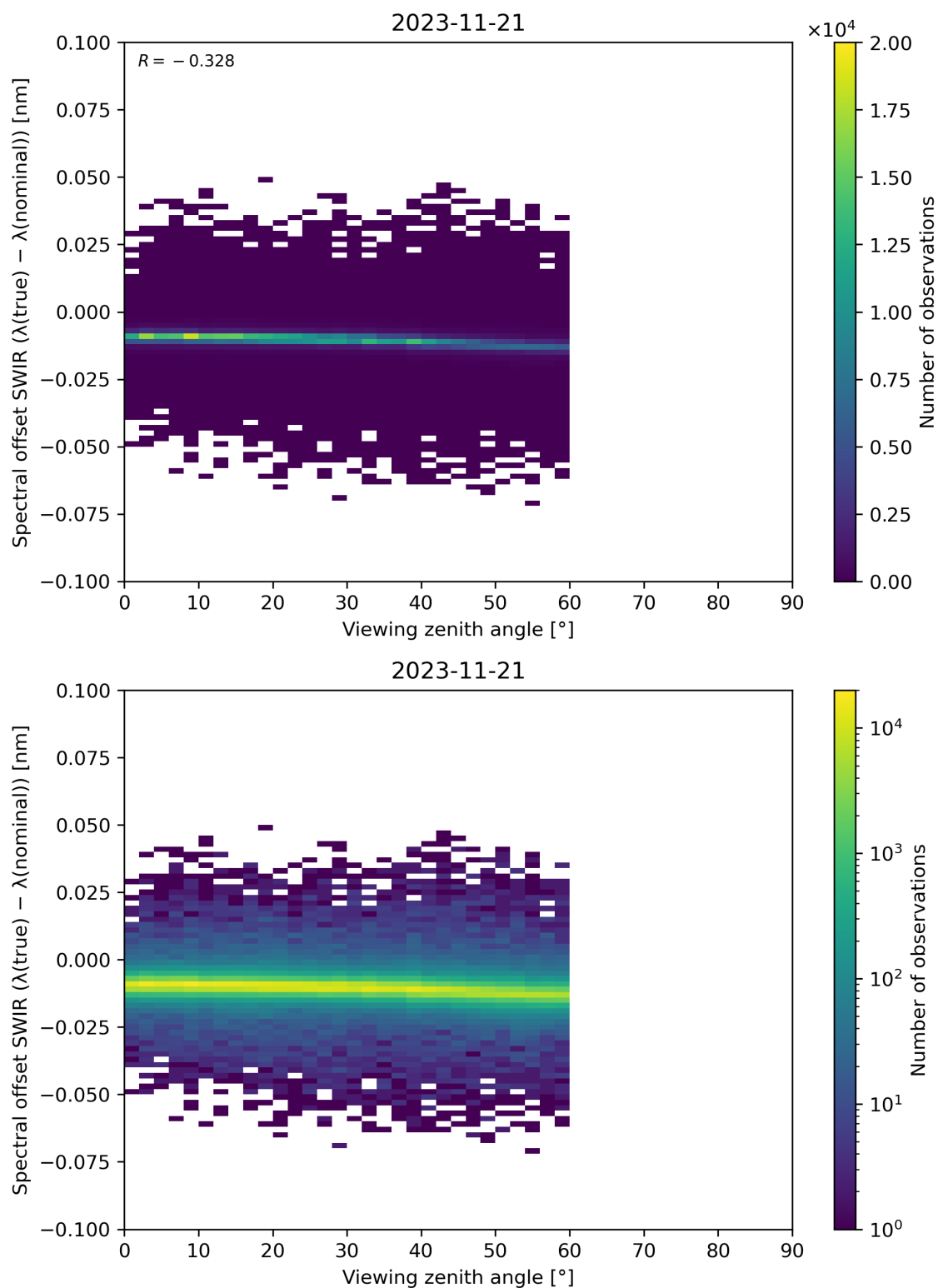


Figure 116: Scatter density plot of “Viewing zenith angle” against “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” for 2023-11-20 to 2023-11-22.

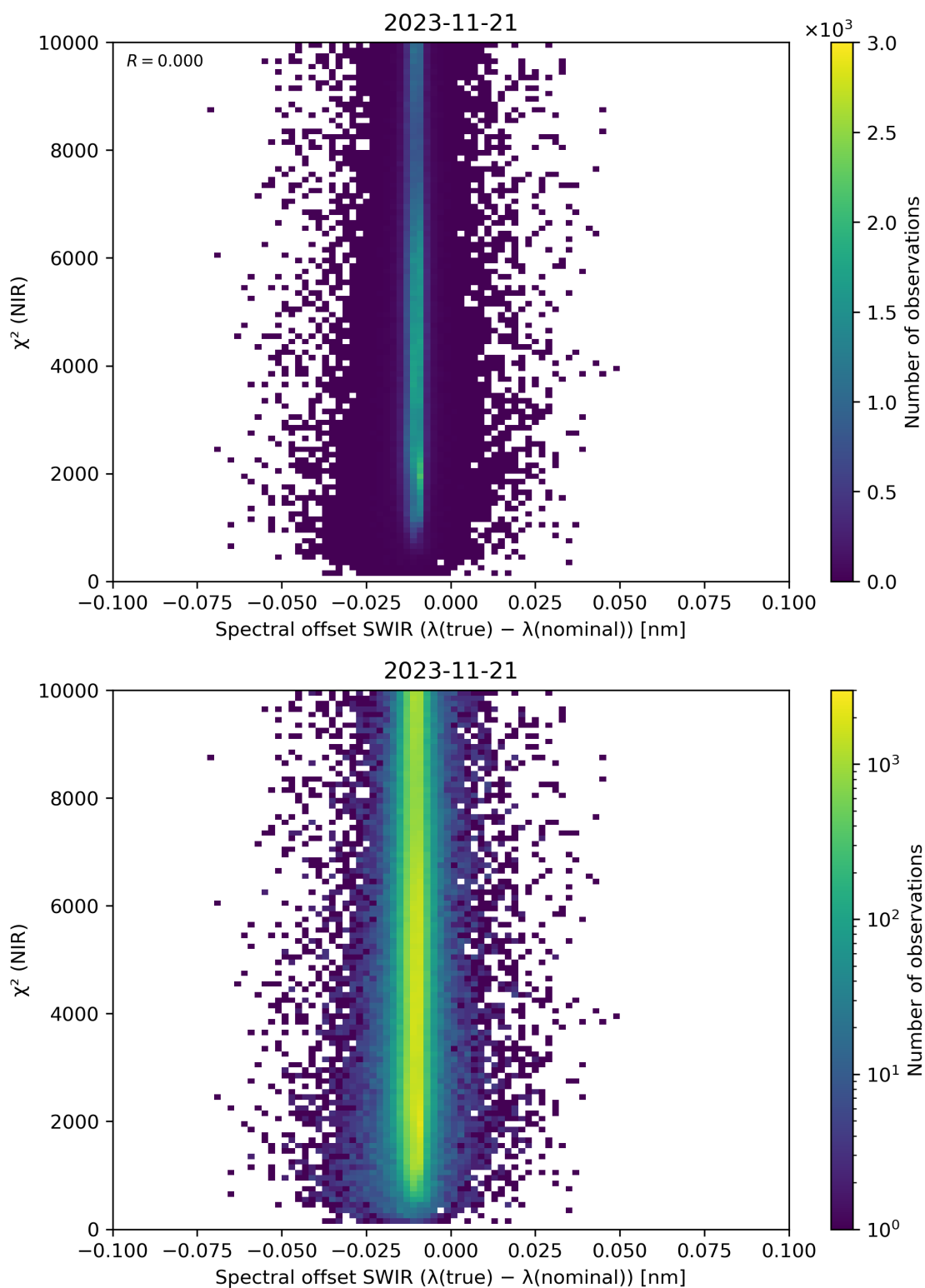


Figure 117: Scatter density plot of “Spectral offset SWIR ( $\lambda(\text{true}) - \lambda(\text{nominal})$ )” against “ $\chi^2$  (NIR)” for 2023-11-20 to 2023-11-22.

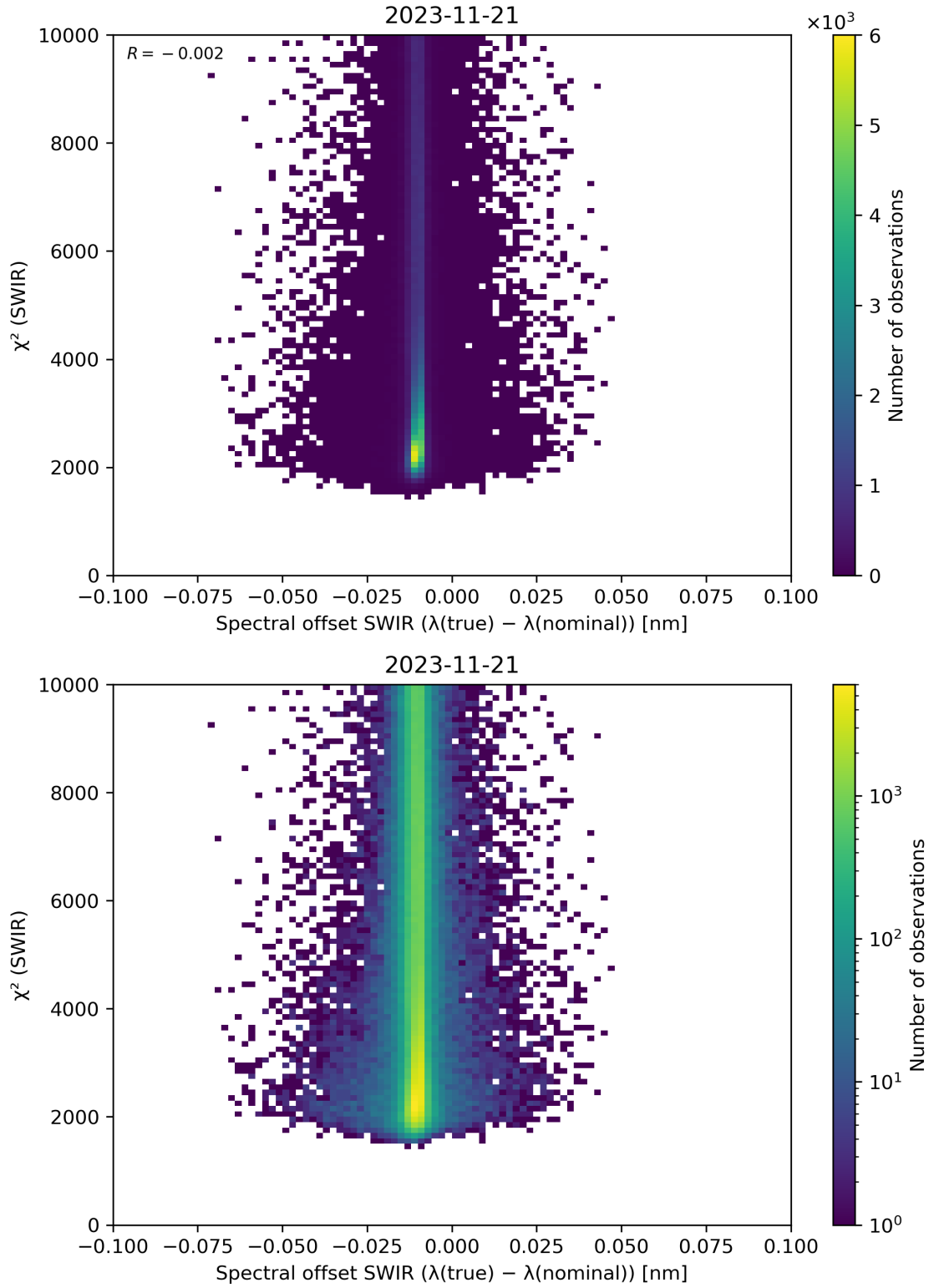


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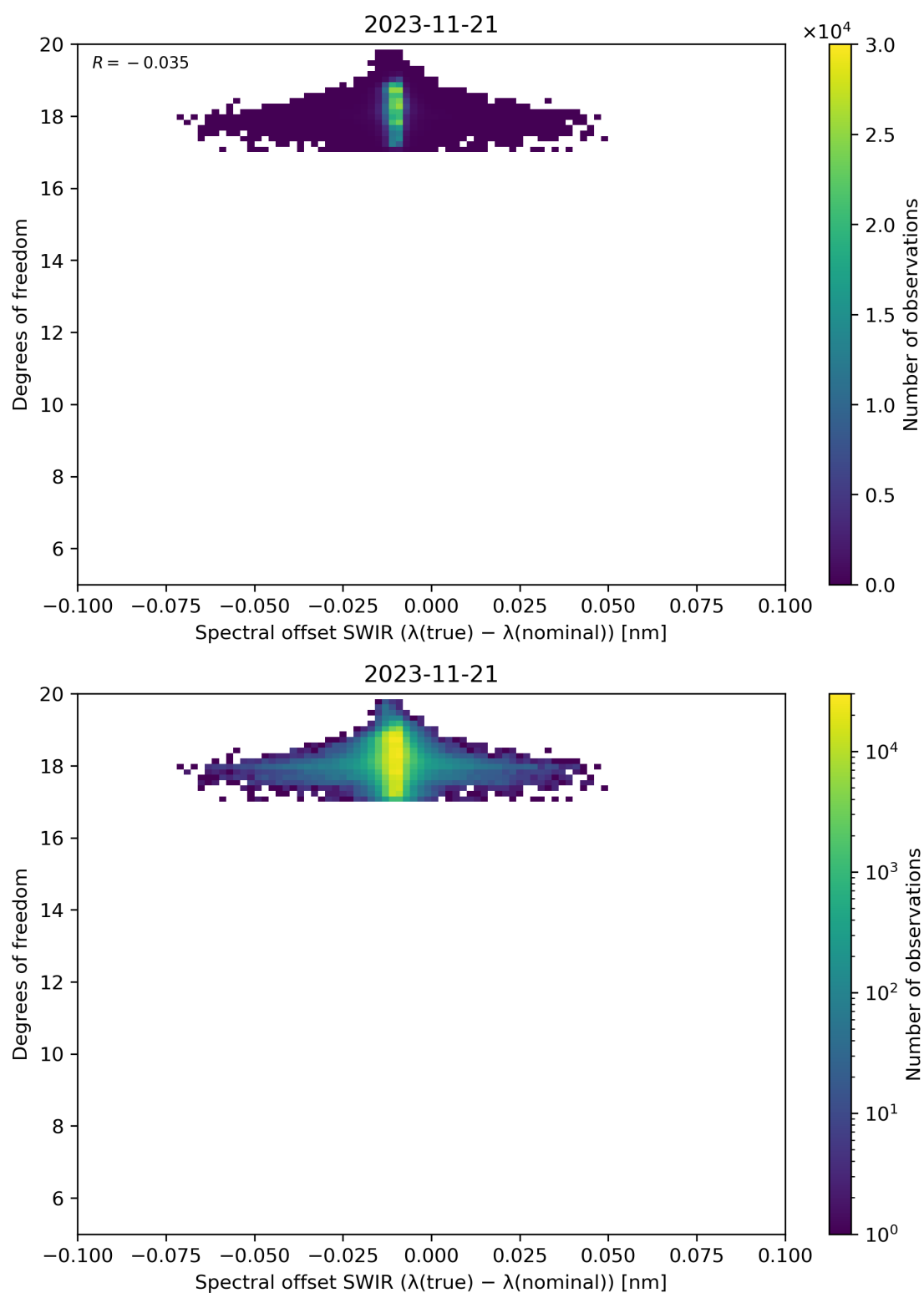


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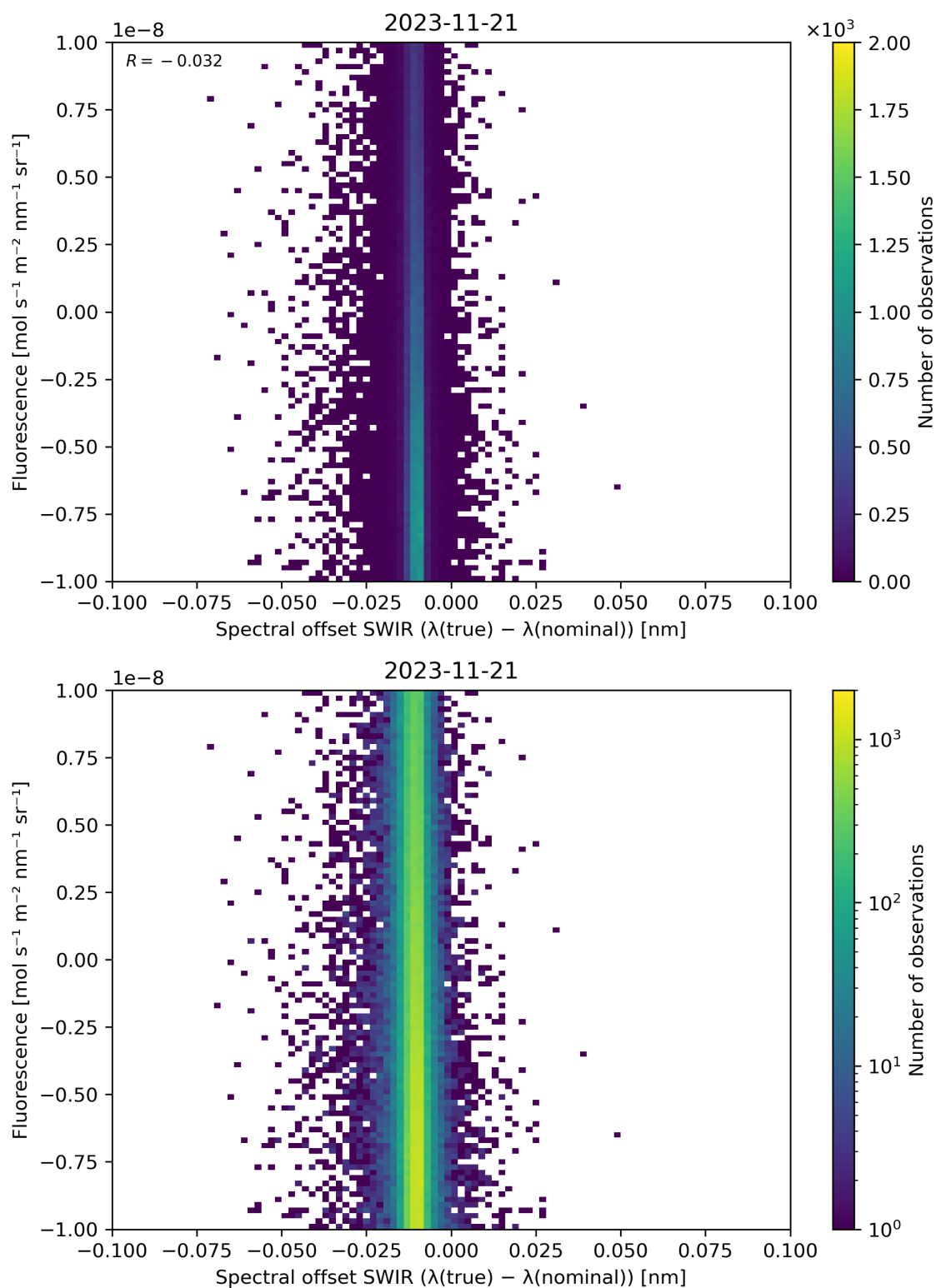


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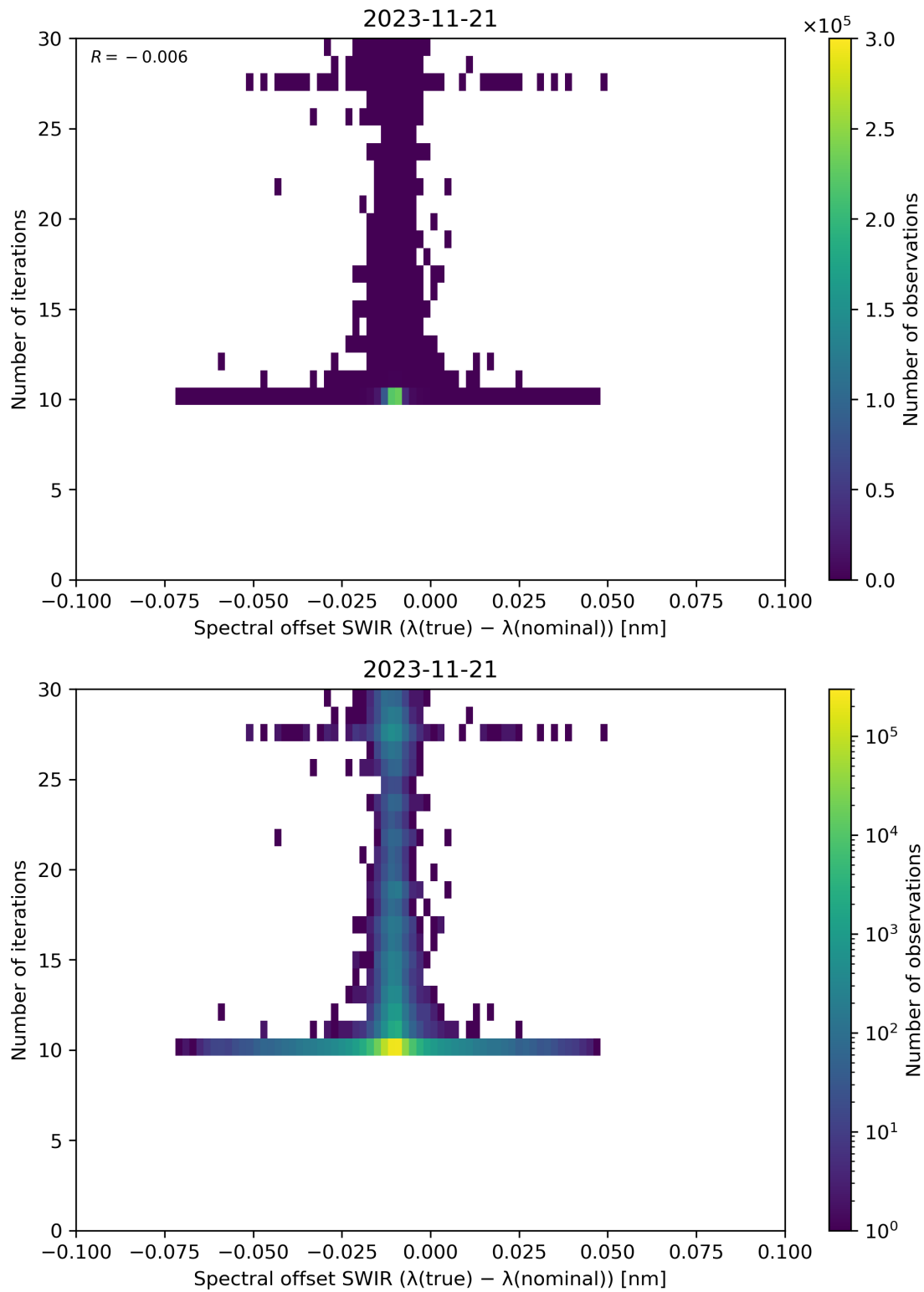


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