

Geosci. Instrum. Method. Data Syst. Discuss., author comment AC1 https://doi.org/10.5194/gi-2021-9-AC1, 2021 © Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.

# **Reply on RC1**

Maxim Philippov et al.

Author comment on "Accounting for meteorological effects in the detector of the charged component of cosmic rays" by Maxim Philippov et al., Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2021-9-AC1, 2021

Thank you very much for your comments and suggestions! We are sure that these comments will improve the quality of the paper and allow us to optimize our work.

# **Response to Anonymous Referee #1**

## **Reviewer #1:**

 One general comment is that the authors perform consequent corrections (first for pressure, then for temperature/height) but this does not guarantee the optimal solution, because they may correlate with each other. A more robust method can be a multi-regression analysis when both meteorological variables (barometric pressure and temperature/height) are considered simultaneously. The authors may want to comment on that.

# Response

Thank you very much for your comment and suggestion. We didn't try multi-regression analysis yet. It will be the subject for the next publications. For the current purposes independent correlation coefficients  $R^2 0,81$  (pressure) and 0,89 (temperature) are enough.

2.

- Line 14: check coordinates: Moscow is in the northern and eastern hemispheres.
- Line 16: "temperature coefficients" -> "temperature correction coefficients".
- Line 18: please define what is the "upper air". Normally, the stratosphere is not considered as the upper atmosphere.
- Line 33-34: should "any of" be replaced by "both", since it is about coincidence?
- Lines 46 and 48: please check the coordinates, the hemispheres are wrong.

# Response

Thank you very much for your comment and suggestion. We took into account your comments in the text

Line 56: what is meant by the "nuclear-active" particles?

#### Response

Thank you very much for your comment and suggestion. We checked. This term is correct in English-speaking literature. For example:

https://iopscience.iop.org/article/10.1088/0305-4470/7/6/010/pdf

We added comments in the text: «(protons, neutrons and also charged pions и kaons)»

 Line 57-58: the second part of the sentence "therefore, it is necessary" is not logically connected to the first part. Please revise.

#### Response

Thank you very much for your comment and suggestion. We've corrected this sentence:

"Muons are not nuclear-active particles (protons, neutrons and also  $\pi$ -  $\mu$  *K*-mesons) and lose energy for the excitation and ionization of air atoms; therefore, it is necessary to consider the atmospheric influence and take into account meteorological effects: pressure and temperature variations (Dorman, 1972, 2004, 2006)."

 (1). A standard way of barometric correction is via an exponential formula, not linear. The latter is an approximation working only in a narrow range of pressure changes. Please explain that the linear relationship is sufficient.

#### Response

Thank you very much for your comment and suggestion. You are absolutely right. This linear fit is a standard technique for determining the barometric coefficient of ground installations. Its correctness (linear) is shown in Fig. 2. Coefficient of determination 0.89

Line 70: is CARPET-MOSCOW the same as Dolgoprudny?

#### Response

Thank you very much for your comment and suggestion. Yes. We added in the text additional comment: «(which is installed at the Dolgoprudny Scientific Station of the

Lebedev Physical Institute RAS, Moscow region)»

Line 74: why was only one month chosen for the analysis? Was the temperature stable?

# Response

Thank you very much for your comment and suggestion. This month was chosen as the most stable in terms of variations in primary cosmic rays and temperature.

• Line 79: How exactly were the NM data used?

#### Response

Thank you very much for your comment and suggestion. We've corrected this phrase:

«To estimate that secondary CRs variations, associated with barometric effect are more significant than variations of primary CRs variations, we use pressure corrected data of the Moscow neutron monitor.»

• Line 83: Fig.3 contains no "upper horizontal time series" whatever it could be.

#### Response

Thank you very much for your comment and suggestion. We've corrected this phrase: «Fig. 3 shows neutron monitor count rate variations on the data of 2019. Black horizontal line is average count rate [pulses/min] according to the annual data. Black vertical dashed lines are the boundaries of the months. The names of the month are signed at the bottom. The standard deviation for the data of each month.»

Line 88: what is \beta\_{\sigma p}? Is it the same as \beta in line75?

#### Response

Thank you very much for your comment and suggestion. No, it's multiplication. We've correct it in the test:  $\ll = 0.018 (1.8\%)$ ,».

• Line 95-98: the positive and negative effects need to be explained in more detail as a reader may not be familiar with that.

#### Response

Thank you very much for your comment and suggestion. We've corrected this phrase: «The temperature effect has two components: negative and positive. The negative temperature effect is associated with a decrease in muon fluxes during heating and expansion of the atmosphere. The positive temperature effect is associated with the appearance of additional muons, due to a decrease in the density of the atmosphere and, in connection with this, a decrease in the probability of interaction of charged pions and kaons with air nuclei. As a consequence, the probability of decays of charged pions and kaons and the appearance of additional muons increases. These two effects (positive and negative) are competitive» • 3: the \Delta H-effect is also usually modeled by an exponential relationship.

# Response

Thank you very much for your comment and suggestion. You are absolutely right. This linear fit is a standard technique for determining the temperature coefficient of ground installations. Its correctness (linear) is shown in Fig. 6. Coefficient of determination 0.81

Line 156: what is the "temperature coefficient density"? The density of what?

# Response

Thank you very much for your comment and suggestion. Corrected. «density of the temperature coefficient»

• 4: panels d and e, representing different correction methods, are significantly different from each other, suggesting that the correction methods do not agree. The authors should comment on that and propose a preferred method.

# Response

Thank you very much for your comment and suggestion. We added additional conclusions: «This paper describes the CARPET installation, designed for detecting the charged component of secondary CRs. The barometric coefficient was determined using the built-in pressure sensor. The temperature coefficient was determined by two methods using the data of the upper-air sounding. The integral method for determining the temperature effect is the most accurate, however, due to the lack of regular measurements at high altitudes (since not all sounds reach high altitudes), it can be seen that the data processed by this method are less accurate. In this connection, it is more optimal to use the method of the effective generation level, since it does not require a complete temperature profile. Also, for the CARPET-MOSCOW installation, it is possible to use only the negative component of the temperature effect, since variations of the count rate have good ( $R^2 =$ 0.8191) correlation with .»

Table 1: what is the last column (n)?

# Response

Thank you very much for your comment and suggestion. We've corrected it in the text: «The results are shown in Table 1: the first column is the atmospheric pressure on the given surface, the second column is the average temperature according to the data for 2019 - 2020, the third column is the standard deviation of the temperature, the fourth column is the temperature coefficient for the given isobaric surface, the fifth column is number of measurements (number of launches at which the sound reached the required altitude).»