# Comment on gi-2021-35

Seigo Miyamoto et al.

Author comment on "A muographic study of a scoria cone from 11 directions using nuclear emulsion cloud chambers" by Seigo Miyamoto et al., Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2021-35-AC1, 2022

First of all, thank you for both of referees, for your careful reading of our manuscript and giving us some good comments.

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To the referee 1,

> Lines 93-94: "An ECC detector can measure the momentum of the charged particle by detecting deflection angles caused by multiple Coulomb scattering."â¨

> In my opinion a ECC doesn't measure the momentum. It can provide a statistical information of the momentum of the muons, as correctly described in the section 4.2

Maybe I've wrote some unclear text.

Although we used the statistical momentum filtering in this study, an ECC detector can measure the momentum of a high-energy charged particle, one by one, as shown in the previous studies (e.g., Agafonova et al., 2012).

I've changed the texts (Line 93-95).

"An ECC detector can measure the momentum of the charged particles, one by one, by detecting deflection angles caused by multiple Coulomb scattering (Agafonova et al., 2012)."

> Line 97: Please describe better and/or give a reference about the formula (1)

I've added the following reference "Review of Particle Physics", M. Tanabashi et al. (Particle Data Group)

Phys. Rev. D 98, 030001, 2018.

And I also gave the detailed description about some related equations of the reference (Line 95-97).


> Line 117 "at 4 ka"


I've changed  from "at 4 ka" to "about 4,000 years ago".


> Lines 169-170 "we needed to add time information to the ECC"


I've changed the sentenses:


Before:

Given that there is no temporal resolution in emulsion films, we needed to add time information to the ECC. In previous muographic studies using emulsion films, researchers have used emulsion films with a different alignment during the muon observations and standby (e.g., Tanaka et al., 2007).


After :

Given that there is no temporal resolution in emulsion films, the ordinary ECC detectors can't distinguish whether the cosmic-ray tracks pass the ECC during muographic observation or transportation and standby. Thus we also add a similar gimmick as previous muographic studies using emulsion films. The researchers have used emulsion films with a different alignment during the muon observations and standby (e.g., Tanaka et al., 2007).


> Line 232: please provide the units of the errors the angles.

> Is  the absolute azimuth  coordinates provided directly by the instrument ?

> Which are the angles measured with the FOG and which with the digital leveler ?

I added some additional information to the corresponding texts.

"Measure the attitude of the outer box (i.e., the yaw [azimuth], roll, and pitch). The yaw was measured with a fiber optic gyro (Japan Aviation Electronics Industry Ltd.; model FOG JM7711; Watanabe et al., 2000), and roll and pitch were measured by the digital leveler. The typical errors on the yaw, roll, and pitch are $8.7 \times 10^{-3}$, $1.0 \times 10^{-3}$, and $1.0 \times 10^{-3}$ radians, respectively."

> Lines 310-311: How do you evaluate the filtering efficiency ? It is not described and no reference is given.

I added the following sentence:

This figure was derived from a simple simulation in which the interaction of charged particles inside the ECC was assumed to be multiple Coulomb scattering only, and the scattering angle was approximated by a Gaussian distribution.

> Lines 315-316: how many are the candidate tracks ?

In the end of section 4.1, "... and $1.7 \times 10^{7}$ tracks in an entire ECC were reconstructed."

> Lines 444-445: "There were also 4%–7% in each detector  site except the forward directions at the SE and NNE site (Fig. 14)."

> This sentence is not clear to me.

I've modified.

Before:

There were also 4%–7% in each detector  site except the forward directions at the SE and NNE site (Fig. 14).

After:

An example of observed/expected muon flux ratio angular distribution of the site N is shown in Fig. 14. As can be seen in this figure, in each detector site, the inhomogeneous distribution of the observed/expected muon flux ratio exists. The deviations were 4%–7% except the forward directions at the site SE and NNE.

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To the referee 2,

> There is only one aspect that needs a clarification. ...........

> ..... the text does not clarify enough the treatment of position-dependent performance variations of the emulsion films.

I've added a new appendix and you can see the figure (Fig. 15) of position distribution of fill factor there.

Please also note the supplement to this comment:
https://gi.copernicus.org/preprints/gi-2021-35/gi-2021-35-AC1-supplement.pdf