

Interactive comment on “Evaluation of Monte Carlo tools for high energy atmospheric physics” by Casper Rutjes et al.

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Reply to the referee report of Dr. A. Chilingarian (reference: gmd-2016-147-RC1)

We would like to thank the referee for his extensive report that concerns three subjects: 1. code verification and validation in the first paragraph of his report, 2. the phenomenon of Thunderstorm Ground Enhancements (TGEs) and their relation to the underlying physical mechanisms in the 2nd to 5th paragraph, and 3. available validation data from TGEs observed in Armenia and additional literature in the remaining comment.

Ad 1. We agree with the definitions of code verification and validation, but we would like to clarify, that we do not intend to validate any code in this paper, as the general purpose codes Geant4, EGS5 and FLUKA have already undergone multiple verification

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and validation studies in different physical contexts, but they cannot readily be applied to all HEAP phenomena. Therefore, we rather provide here a set of tests – as simple and as informative as possible – to benchmark custom made codes that are built within the HEAP community.

Ad 2. The referee (Dr. A. Chilingarian) draws attention to Thunderstorm Ground Enhancements (TGEs), that have been measured by his group in Armenia. We agree that in our discussion of HEAP phenomena in section 1.1 we have used the terminology introduced by American and European researchers and did not mention the Armenian observations. The Armenian TGEs are similar (or the same?) as X-ray glows (high-energy photon emissions from a thundercloud with a time scale longer than 1 second) observed from planes (e.g. in the ADELE experiment), from balloons at thunderstorm altitude, or from ground at Mount Monju in Japan in winter time. TGEs can be short (<50 ms) or long events (> 1 second), but x-ray glows (as presented by Dwyer) are long events. Furthermore, long TGE events are supposed to be associated with cosmic ray induced extensive air showers (EAS), but for x-ray glows such an association has not been stated. In general, this issue touches on present discussions in the HEAP community, but is very far from the subject of our paper. The list of HEAP phenomena as a motivation for our study appears in section 1.1, and we now have extended this discussion in line 15: “Signals lasting longer than TGFs such as x- and gamma-ray glows or thunderstorm ground enhancements (TGEs) have also been observed near thunderclouds, from balloons, planes, or high mountains (McCarthy and Parks, 1985; Eack et al., 1996; Tsuchiya et al, 2007; Tsuchiya et al, 2008; Chilingarian et al, 2010; Chilingarian et al, 2011).”

Ad 3. We thank the referee for his review of available validation data from his TGE observations. But we repeat that code validation is not the purpose of our paper. Fortunately, his report will stay available for future use on the GMD-webpage together with our paper.

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