

## ***Interactive comment on “Ionization effect of solar particle GLE events in low and middle atmosphere” by I. G. Usoskin et al.***

**I. G. Usoskin et al.**

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We thank Reviewer#3 for his/her useful comments. We have revised the manuscript with all the changes being highlighted by bold face. Our answers are given below.

*Please compare or comment shrotly the results presented in Alexander Mishev, Peter Velinov, Lachezar Mateev Atmospheric ionization due to solar cosmic rays from 20 January 2005 calculated with Monte Carlo simulations, Comptes rendus de l'Académie bulgare des Sciences 63(11), 2010, 1635-1642*

**Reply:** We thank the Reviewer for letting us know about this interesting piece of research. We cite this work now. However, it is not directly comparable with our tabulated

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results because of the following important distinctions: (1) Mishev et al. focused on the upper polar atmosphere, while we discuss lower and middle atmosphere; (2) Mishev et al. did not consider the GCR variability (Forbush decrease) which is shown here to be a very important factor for the ionization; (3) Mishev et al. studied a few time snapshot, around the peak of the event and in the late decay phase, while we present the event-integrated (daily) effect.

*Replace everywhere in the text little with small (as example page 30383 line 3).*

**Reply:** We have corrected the text in page 30383 but keep it at page 30384 as we believe it is correctly used.

*Page 30382 line 2: new reconstruction what ?(method, data) please precise*

**Reply:** The new reconstruction uses both a new method and data (neutron monitors, which are often neglected when considering SEPs). This is described in sufficient detail in the text. We prefer not to encumber the abstract by details.

*Page 30384 line 23 Frobush is a missprint please correct*

**Reply:** Done.

*Page 30387 line 6 : Fluence is usually expressed for neutrons. In this case I think that flux is precise; Page 30388 line 20. The same as previous*

**Reply:** We believe the use of event-integrated fluence is correct as we indeed discuss not the flux (i.e. per unit of time - sec) but fluence (i.e., integrated flux over a time interval). The term “fluence” is often used in relation to SEP events (see, e.g., Feynmann et al., Interplanetary proton fluence model: JPL 1991, JGR, 98, 13281, 1993; Lario, D.et

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al., Radial and Longitudinal Dependence of Solar 4-13 MeV and 27-37 MeV Proton Peak Intensities and Fluences: Helios and IMP 8 Observations, ApJ, 653, 1531, 2006; Smart et al., Two groups of extremely large >30 MeV solar proton fluence events, ASR, 37, 1374, 2006; etc.).

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 30381, 2010.

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10, C13763–C13765,  
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