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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling of the Very Low Frequency (VLF) radio wave signal profile due to solar flares using the GEANT4 Monte Carlo simulation coupled with ionospheric chemistry" *by* S. Palit et al.

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We earnestly thank reviewers for their minute scrutiny of the manuscript. We believe that their noble and scholarly suggestions will be helpful for further improvements of it's quality and credibility. We have tried our best to follow their suggestions and make necessary modifications in the manuscript.

Journal Name: Atmospheric Chemistry and Physics

Title: "Modeling of the Very Low Frequency (VLF) radio wave signal profile due to solar flares using the GEANT4 Monte Carlo simulation coupled with ionospheric chemistry" by S. Palit, T. Basak, S. K. Mondal, S. Pal, and S. K. Chakrabarti, submitted for publication in ACP.

(B) Comments Reviewer 2:

In their manuscript "Modeling of the Very Low Frequency (VLF) radio wave signal profile due to solar flares using the GEANT4 Monte Carlo simulation coupled with ionospheric chemistry", Palit and co-workers show a modeling for the effect of the M- and X-class solar flares on the VLF propagation. The model results are compared to the VLF propagation measurements and the agreement is found to be very good, at least for the peak times of the flares (Fig. 9).

The strongest novel aspect of the paper is the calculation of the ionization rate by using the most throughout model for the purpose, the GRANT4. This approach is very interesting and clearly worth publishing. Related to that, however, I miss some further discussion on the significance of this approach, i.e., authors should discuss somehow what is the significance of GRANT4 modeling compared to more simplified models and how this is likely to be seen in the results. There are several other "moving parts" in both the modeling and the data-analysis (selecting a simplified ion chemistry model, "quiet-day-curving" in the VLF data etc.) âĂŤ so, how sensitive the analysis is for these compared to the GEANT vs. simplified ionization calculation. I'm not expecting a throughout investigation of this, but a few lines of discussion educated by the experience gained during the work.

Otherwise, this is a solid piece of work and, as said, worth publishing.

Ans. Thank you for your valuable suggestions.

We have changed and added paragraph on the significance of GEANT4 in the ionospheric simulations. The added text is

"GEANT4 is a well known object-oriented detector simulation program (Agostinelli et al., 2003), which includes all the required physics for the production of electron ion pair in the atmosphere by energetic photon interactions. Most of the ionization occur due to the collision of molecules with secondary electrons produced by initial photo ionization. The earth's ionosphere is a giant detector and as such, the software used to analyse detectors in high energy physics could be used here as well. Furthermore GEANT4 (GEANT is the abbreviation of Geometry and Tracking) is a openly available and widely tested toolkit and can be downloaded from the website http://geant4.cern.ch/. The Monte Carlo processes deal with the transport and interaction of particle with matter in a defined geometry and store all the information of track, nature and number of secondaries efficiently. With this application we can find accurately the ionization processes and tracks without any prior knowledge and assumption of chemical or physical model of the region. The included electromagnetic processes related with X-ray incidence are well developed, vast and suitable for application in the context of Ionosphere. For simulation with UV the application at this stage is not quite desirable, but with some development in the toolkit area it is possible to use it for Monte Carlo simulation with UV and EUV incidence in the ionosphere. We simulated only the rate of ionization at different altitudes due to solar X-ray photons during flares using this GEANT4. For the chemistry part related to the interaction of the produced electron and ions in the D-region ionosphere we adopt a different chemical model."

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 6007, 2013.