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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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The paper deals with modelling the observed amplitude perturbations of VLF (very low frequency) transmissions propagating in the earth-ionosphere waveguide, which are caused by solar flare X ray ionization effects in the daytime D region ionosphere. The authors combine computational codes and models, which are openly available, to produce quantitative estimates of VLF amplitude perturbations which are then compared with the observations.

The methods and models they use include: 1) A high energy physics Monte Carlo simulation code to derive the electron density production rates as a function of altitude caused by X-ray solar flare energy fluxes as measured by satellites (GOES, RHESSI). 2) The estimates of (1) are inputted in a simplified, D region ion-chemistry model, used before to model lightning induced radiation belt electron precipitation (LEP) events and early fast VLF events in the D region; it consists of 4 types of ion species and the main production and loss processes (there are 4 coupled continuity equations) and is used here to obtain elevated electron density profiles in the D region during the solar X-ray event. 3) The electron density profiles from (2) are inputted in (the publicly available) long wave propagation capability (LWPC) code which can estimate the amplitude and phase of a given VLF transmission that is received at a given location (here only amplitudes are computed). Finally, the amplitude estimates are compared with the measured VLF amplitude changes during the solar flares by simple superposition in time.

The methodology is applied in two cases of an M and an X type flares and the agreement between the model results and the measurements is indeed very good. This implies that the applied methodology, which, to my knowledge was never used before, is working well. The paper is well written and deserves to be published after some minor corrections and improvements; particularly the authors need to clarify/detail their methodology procedures better. Minor comments and suggestions are provided in the attached pdf file. Overall, this is a nice piece of work.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/13/C2468/2013/acpd-13-C2468-2013-supplement.pdf

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