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Interactive comment on "Auroral ionospheric E region parameters obtained from satellite-based far ultraviolet and ground-based ionosonde observations: Effects of proton precipitation" *by* Harold K. Knight

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Reviewer comment:

In this paper, the E-region electron density estimated from auroral fa ultraviolet (FUV) is compared with that observed with ionosondes. The obtained results could contribute to studies of aurora and ionosphere. Therefore, this paper is worth publishing in this journal. However, the following comments need to be addressed before its publication.

–ll. 141-142: Does "local equilibrium" means the equilibrium between the ionization

and recombination rates of plasma in the E region? If so, it is better to describe so.

HK reply:

Yes. I will add that to the text. I was leaving out details that were already given in Knight et al. (2018), and line 142 of the manuscript already refers to section 2.3 of Knight et al. 2018, in which more details about the nature of the equilibrium are given. Regardless, it is no problem for me to add a description of the equilibrium to the current paper under review.

Reviewer comment:

–ll. 143-144, "electron density is approximately proportional to the square root of the sum of squares of electron densities that would result from two different sources of ionization (i.e., electron and proton aurora, in this case)":

This explanation seems strange. If production rates of the ion by electron and proton aurora (q_e and q_pi, respectively) is balanced with the recombination rate (a * nˆ2, where a is a coefficient and n is the electron density), we can describe as q_e + q_p = a * nˆ2 Then, n = 1/a * sqrt(q_e + q_p) Does the author consider that q_e and q_p are proportional to square of electron density?

HK reply:

First, there is a minor notational issue, which is that I would not use "q" to denote an ion production rate, since the letter/variable q is reserved for precipitating particle energy flux (for example, see Knight et al., 2018). Aside from that, an equivalent equation to the ones you have written is given by Zhang et al. (2010), eqs. (2). The more complete citation, which is given in Knight et al. (2018), is:

Zhang, Y., Paxton, L. J., Bilitza, D., & Doe, R. (2010). Near real-time assimilation in IRI of auroral peak E-region density and equatorward boundary. Advances in Space Research, 46, 1055–1063. https://doi.org/10.1016/j.asr.2010.06.029

The only difference is that Zhang et al. are talking about the combination of ion production rates resulting from electron precipitation and solar EUV flux, while I am talking about the combination of electron and proton precipitation. The same principles apply in either case.

The statement at lines 143-144 you mentioned is equivalent to Zhang et al. (2010) eq. (5). I will add a reference to Zhang et al. eq. (5) to the manuscript in order to support the statement about electron density being approximately proportional to the square root of the sum of squares, etc.

As far as whether I think that individual production rates are proportional to the square of electron density, I would say yes, assuming that I am not misunderstanding your meaning. This is exactly what is stated in Zhang et al. eqs. (3) and (4).

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