Reply to Referee #2

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We thank Referee #2 for constructive comments and agree with all of them. Please, see below for our point-by-point replies. The original review is written in *black* and our replies in blue.

The paper introduced a new empirical model which can predict conductance based on divergence-free part of the horizontal current density. They built the model using EISCAT observations. They further introduced a method to further solve the field-aligned currents and potential. They validated the model against other empirical models and SWARM observations. Even though the validation result is not perfect, the method itself is novel. If more details about the methodology can be added, I will suggest publishing it.

Minor suggestions:

Section 3.2: More introduction to AMPS and SWIPE in the first paragraph would be helpful. For example, what is the input and output of these models. For example, is E_DF assumed to be zero in AMPS?

We suggest to add: "Both AMPS and SWIPE are parametrized with magnetic latitude, MLT, dipole tilt angle, solar wind speed, $F_{10.7}$, and Interplanetary Magnetic Field (IMF) $B_{GSM,y}$ and $B_{GSM,z}$. AMPS provides the DF and CF part of the horizontal ionospheric current density and the field-aligned current density. SWIPE provides the ionospheric Hall and Pedersen conductances and horizontal potential electric field and corresponding potential. $\boldsymbol{E}_{DF}$ is assumed to be zero."

Introduce the name of the model at the beginning. Usage of AMPS-EISCAT is a bit confusing.

Thank you for the suggestion, we will change this accordingly.

Font size in Figure 11 and 12 is too small. How are the internal and external E_DF separated?

We will increase the font size.

We suggest to add the following explanations in section 2.3 to clarify how the internal and external $\boldsymbol{E}_{DF}$ separated:

Line 173: "Using two DF SECS layers, one at $1\ \mathrm{m}$ depth and the other at 90 km altitude, will separate the external and internal contributions to the magnetic field variations."

Line 180: "The DF SECS amplitudes of the telluric equivalent current sheet at $1\ \mathrm{m}$ depth can be used to calculate the internal contribution to $\boldsymbol{E}_{DF}$ and the DF SECS amplitudes of the ionospheric equivalent current sheet at 90 km altitude can be used to calculate the external contribution to $\boldsymbol{E}_{DF}$. The total $\boldsymbol{E}_{DF}$ is then obtained as a sum of the internal and external contributions."