

Summary of Changes

The authors would like to thank the reviewer for the constructive comments. We provide below a detailed account on the changes that we have made in response to the comments that the editor and the reviewer have raised. We have marked the corresponding changes in the revised version in *Purple* color.

Response to Reviewer:

In this manuscript, authors have proposed a new automatic auroral oval boundary prediction model, based on deep learning method, using space physical parameters, and the location of auroral oval boundary at the previous moment. The proposed model is well explained with flow chart, and the procedure of training/testing of sufficient data sets supported by interpretation of results.

1. A significant aspect of this model is, several probable parameters that can influence the variation of auroral oval have been fed as the inputs, which is a prerequisite to model complex system. More specifically, 18 space physical parameters and the 48 coordinates value of aurora oval boundary points at the previous moment were utilised for training/ testing, leading to the reasonable prediction of the position of poleward and equatorward boundaries at 24 MLTs. Identification of optimum choice of input parameters is a crucial aspect. In this work, it is shown that, different space physical parameters have different effects on auroral oval boundary, especially interplanetary magnetic field (IMF), geomagnetic indexes and solar wind parameters. Out of the input parameters used for training and testing the present model, authors can check how does the prediction capability of the model vary when inputs with least significance were removed. Or they can add some more probable parameters as inputs and observe the performance of the model. Finally, a combination of input parameters can be selected, based on which model performance is highest. This kind of a procedure will help to identify an optimum choice of input parameters, thereby establishing an input-output relation, and refine the existing model further. The authenticity of the proposed model can be improved further, by this way.

Author's reply:

Thanks for the kind suggestion. We have conducted the experiments to find how will the prediction capability of the proposed model change when the inputs are different combinations of physical variables. And we considered all the possible combinations of physical variables which we mentioned in Table 5 to find an optimum choice of input parameters. However, we cannot give all the experiment results in this manuscript because of the huge numbers of all supplement experiments. The number of experiments which can be calculated by the following equation:

$$C_{11}^2 + C_{11}^3 + C_{11}^4 + C_{11}^5 + C_{11}^6 + C_{11}^7 + C_{11}^8 + C_{11}^9 + C_{11}^{10} + C_{11}^{11} = 2036$$

Therefore, we give the best experiment results (MAE value) obtained from different combinations of physical variables in Table 6. And other results are given in the supplementary materials.

Revision:

Table 6: The MAE influenced by different combinations of space physical parameters.

Parameters name	MAE (poleward/equatorward)
Bx, By	1.6145/1.5003
Bx, Vp, SYM/H	1.6359/1.5129
Bx, By, Vp, SYM/H	1.6118/1.5056
Bx, By, Vp, Pdyn, PC	1.6242/1.5084
Bx, By, Np, AU, SYM/H	1.6154/1.5181
Bx, By, Vp, Np, SYM/H, PC	1.6324/1.5017
Bz, Vp, Pdyn, AE, AU, AL, SYM/H	1.6282/1.5125
Bx, By, Bz, Vp, Np, Pdyn, AE, AU	1.6149/1.5044
Bx, By, Bz, Vp, Np, Pdyn, AE, AU, PC	1.6994/1.5028
Bx, By, Bz, Vp, Np, Pdyn, AL, AU, SYM/H, PC	1.6771/1.5716
Bx, By, Bz, Vp, Np, Pdyn, AE, AL, AU, SYM/H, PC	1.6669/1.5743

2. According to the revision above described, we revised the manuscript further as followings

(1) In section 3.3.5:

Page 15, Line 9, Secondly, from Table 5, when Np, Vp, Pdyn and SYM/H are sent to our model, the MAE of auroral oval boundary reaches the minimum. They are 1.6611 and 1.4919 respectively, which shows that the combinations of these four parameters have great influence on the location of aurora oval boundary.

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“Secondly, when Np, Vp, Pdyn and SYM/H are as input to our model, the MAE of auroral oval boundaries are 1.6611 and 1.4919 in poleward and equatorward respectively in Table 5, which is bigger than the MAE of auroral oval boundaries when the inputs are Np, Vp and Pdyn. So, we can conclude that the combinations of these four parameters strengthen mutual influence on the location of aurora oval boundary. According to the statistics from Table 6, the physical variables that appears most frequently are Bx, By, Vp and SYM/H. When the inputs of our model are the combination of these four variables or the combination of Bx and By, the MAE of auroral oval boundary reaches the minimum, which proves that these four parameters have great influence on the location of aurora oval boundary.”

Page 15, Line 9, As a summary, it can be seen that these space physical parameters shown in Table 5 play a crucial role in determining the location of auroral oval boundary based on the above conclusions.

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“As a summary, it can be seen that these space physical parameters, which include Bx, By, Vp and SYM/H, play a crucial role in determining the location of auroral oval boundary based on the above conclusions.”

(2) In Conclusion:

Page 16, Line 3, Some space physical parameters have a great influence on the position of auroral oval boundary, especially the space physical parameters which are shown in Table 5.

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“Some space physical parameters, Bx, By, Vp and SYM/H, have a great influence on the position of auroral oval boundary.”