

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 reviewers have raised. We have marked the corresponding changes in the revised version in *green* color.

1. This manuscript designed a new model based on deep learning to construct the relationship between the physical variables and auroral oval boundaries. Did the authors consider some specific aurora forms (such as, substorms, transpolar arcs) when you did the experiments? Is it possible to construct the connection among other forms of data? Such as: the relationship between physical variables and auroral oval intensity in the process of a specific aurora event (for example: substorms, polar cap arc). Please give an expatiation.

Author's reply:

In this paper, the main purpose is only to explore the possible and unknown relationship between physical parameters and auroral oval boundary over a period of time. But it is possible to occur any auroral events during December 1996 to March 1997. We analyzed all phenomenon that we observed in our experiments(Section 3.3.1-3.3.5),more than the relationship between specific aurora event (for example: substorms) and the variations of some specific physical parameters (such as, AE).The advantage of our model is that it can construct the connection among different forms of data. So, we think the proposed model in this manuscript can predict the auroral oval intensity by adjusting the model parameters according to the occurrence conditions and the data forms of substorm or polar cap arc. We can give some researches on this problem the reviewer mentioned in the future work.

2. As we known that the aurora dynamics are influenced by many factors, not only the variation of physical variables. Why the authors chose these 18 space physical parameters? Could you give an explanation? Whether this model can establish a connection between a specific aurora event and multiple forms of data, not only one parameter of data?

Author's reply:

In this paper, we chose 18 space physical parameters from OMNI dataset to train our model. Firstly, the common physical variables include IMF, solar wind parameters and geomagnetic indexes, which were discussed in previous work (Niu et al., 2015; Milan, 2010; Hu et al., 2017; Yang et al., 2016). The remaining physical variables are related to those common physical variables. So, we select these 18 space physical parameters as the research targets in this manuscript.

There are two ways to use multiple forms of data as the input of our model. Firstly, we can unify the different forms of data into a same data space. The other way is that we can extend our model as a new model which can input multi-source data. These two methods both can address the problems of establishing a relationship between multiple forms of data and a specific aurora event.

3. In the Introduction section, the authors described many previous studies. It seems to lack intrinsic and progressive connections among these previous studies. Could you rewrite them and make them more logically?

Author's reply:

In the Introduction section, we revised the part of previous studies according your suggestion. Details are as follow.

Revision:

- (1) Page 1, Line 25, In early research, Feldstein proposed that the position of auroral oval boundary is correlated with the Q-index of magnetic activity on the nightside of earth (Feldstein and Starkov, 1967). Starkov and Holzworth expressed that inner and outer boundaries of auroral oval can change with geomagnetic indexes and IMF (Holzworth and Meng, 1975; Holzworth and Meng, 1984; Starkov, 1994(a)).
- (2) Page 1, Line 28, Starkov designed some simple formulas on the location of auroral oval and diffuse aurora. Variations of the size of polar cap, → “The conclusions in this paper are based on mathematical statistics. Therefore, Starkov designed some simple formulas to describe the relationships between the specific physical parameter and different type of aurora. Variations of the size of polar cap,”
- (3) Page 2, Line 2, Since then, many scholars had been explored the connections between different physical parameters and auroral oval boundary or other auroral events.
- (4) Page 2, Line 11, After 2010, there are more and more new methods to construct connection between the position of auroral oval boundary and auroral oval boundary with the development of machine learning.

4. In section 3.3, please explain why the authors use the boundary data which calculated by ‘Quadratic Equation’ instead of the original boundary data to discuss the influence of space physical parameters on auroral oval boundary.

Author’s reply:

The original boundary data are chaotic because of the uncertain aurora events and complex space environment. It is hard to explore clearly variations of auroral oval boundary associated with space physical parameters. To obtain the variable patterns of auroral oval boundary clearly, we use the boundary data which calculated by ‘Quadratic Equation’ instead of the original boundary data in this paper.

5. Some figures in this manuscript are not clear enough, and the readers may need high quality figures.

Author’s reply:

We use high quality figures instead of original figures in this manuscript according your suggestion. Details are as follow.

Revision:

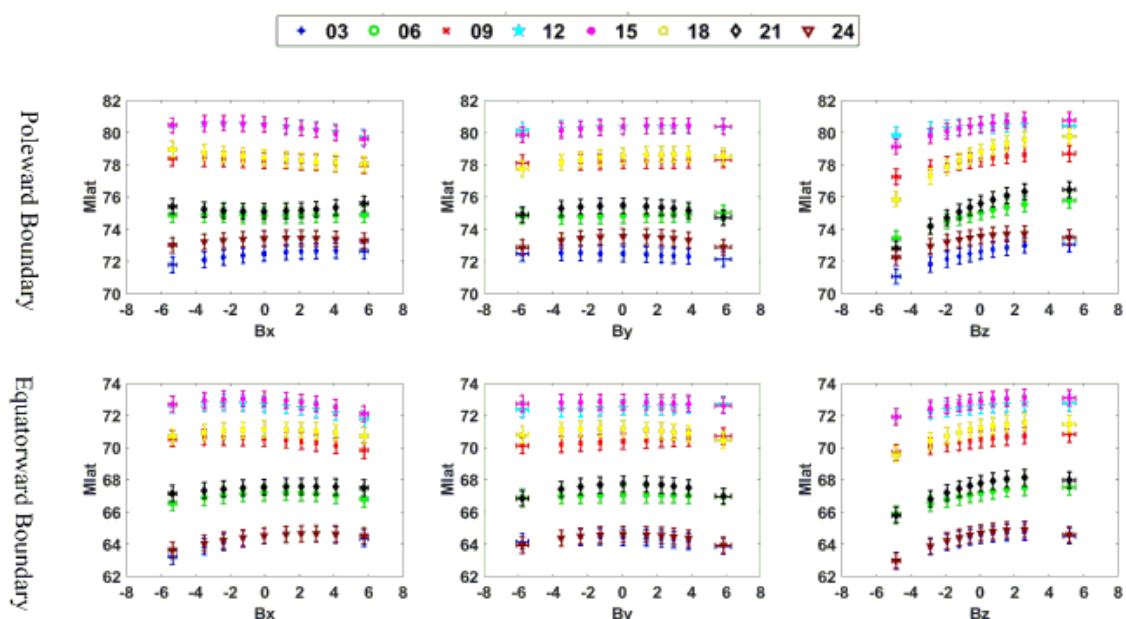


Figure 5: Response of magnetic latitude of poleward (left column) and equatorward (right column) boundaries to Bx, By and Bz respectively at 0030,0060,0090,1200,1500,1800,2100 and 2400 MLT.

→

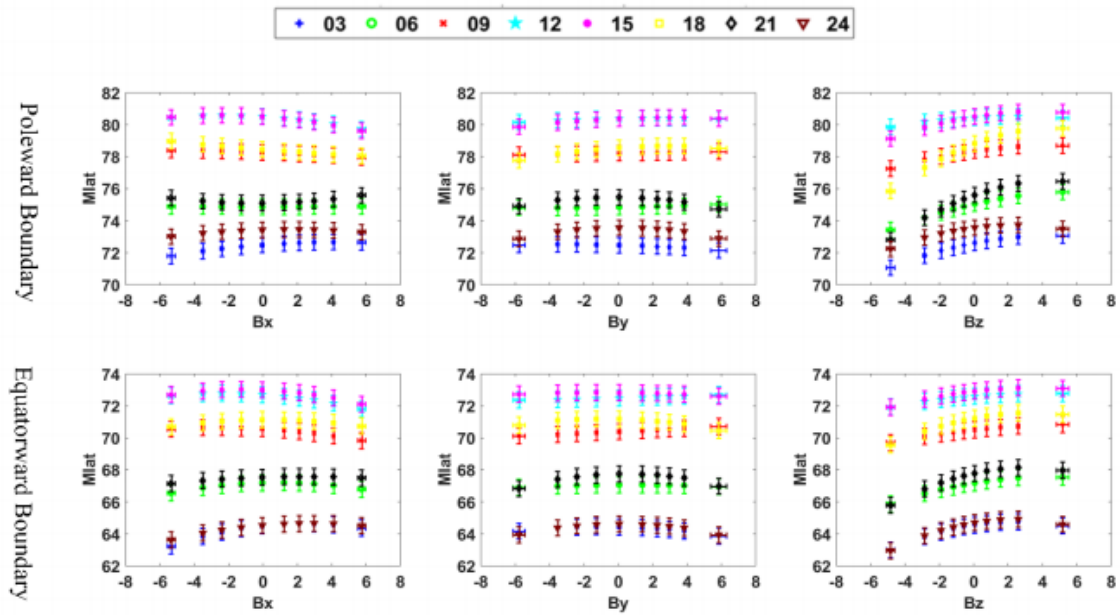


Figure 5: Response of magnetic latitude of poleward (top row) and equatorward (bottom row) boundaries to Bx, By and Bz respectively at 0030,0060,0090,1200,1500,1800,2100 and 2400 MLT.

6. When an abbreviation of term first appears in the manuscript, the term should have a full name first. Such as MRSM, MLT-MLAT et al. Please check them.

Author's reply:

We added the abbreviation of term first appears in the manuscript according your suggestion. Details are as follow.

Revision:

- (1) In Abstract section, Line 5, "UVI image" → "Ultraviolet Imager (UVI) image";
- (2) In Section 2, Line 4, "MRSM" → "Maximal Similarity Based Region Merging (MRSM)";
- (3) In Section 2, Line 6, "magnetic local time-magnetic latitude coordinate" → "magnetic local time-magnetic latitude coordinate (MLT-MLAT)".

7. The paper is easy to follow, but there are some writing mistakes or misleading descriptions which make the readers confused. Such as, Page 1, Line 24 "ex-tensive"; Page 2, Line 14 "be-tween"; Line 22, 26. Figure caption of Figure 5-7, should not be "left column", "right column". Please check and revise them. Please proofread this manuscript carefully.

Author's reply:

We revised these writing mistakes and misleading descriptions according your suggestion. Details are as follow.

Revision:

- (1) Page 1, Line 24, "In the past few decades, scholars have constructed ex-tensive researches on the relationship between location of auroral 25 oval boundary and space physical parameters (Niu et al., 2015)"; → "In the past few decades, scholars have constructed extensive researches on the relationship between location of auroral 25 oval boundary and space physical parameters (Niu et al., 2015)";
- (2) Page 2, Line 19, "those methods mentioned above just only used one or several space physical

parameters to explore the relationship between space physical parameters and auroral oval boundary.”

→ “those methods mentioned above just only used one or several space physical parameters to explore the relationship between space physical parameters and auroral oval boundary.”

(3) Page 2, Line 30, “The experiment results show that the model proposed in this paper can predict aurora oval boundary accurately by using space physical parameters and the location of auroral oval boundary at the previous moment.” → “The experiment results show that the model proposed in this paper can predict aurora oval boundary accurately by using space physical parameters and the location of auroral oval boundary at the previous moment.”

(4) Figure caption of Figure 5-7, “left column” → “top row”, “right column” → “bottom row”.