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Interactive comment on "Extending the Coverage Area of Regional Ionosphere Maps Using a Support Vector Machine Algorithm" *by* Mingyu Kim and Jeongrae Kim

Anonymous Referee #2

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The paper presents an extrapolative prediction capacity assessment of the Suport Vector Machine (SVM) and correlates it with predictions from Neural Networks (NN) and the Klobuchar Model. Results from the study suggest that the SVM gave better performance when compared to NN performance. The title is appropriate, and the abstract summarizes the intent and results of the research adequately.

I however make the following observations: 1. The performance of a NN model largely depends on the number of hidden layer neurons used. The authors indicate that they have used 80 hidden layer neurons based on previous studies. The previous study referenced does not give a convincing method to check overtraining of the networks.

Also the dataset is entirely different, and the NN architecture is also different. Using a different number of hidden layer neurons may give better results, perhaps better than the SVM method. I therefore suggest that the authors device a system to check performance of the networks (especially on extrapolation datasets), if not, the networks may even over-fit the training data and so perform poorly on extrapolation data. The authors may also choose to indicate/explain in the manuscript that the observation they report is not generalized (but limited to the case of their NN training) because a carefully done NN may give better results, even than the SVM does.

2. There is also information which appears missing in the manuscript. Inputs for the models do not include station locations? How do the models predict different values for different locations? The spatial structure (with station locations) is pre-fixed in the models? How do you query the models for data of, let's say, 10 degrees from the center of your circle? I wonder what applications there are for this method if the spatial structure for the models is pre-fixed.

3. Although the authors have used data for South Korea, they do not indicate the implication of this limitation anywhere on the manuscript. Given the spatial variability of the ionosphere, extrapolation schemes for a given region will perform differently for different regional models. For instance, whether the ionospheric ionization should be greater or otherwise in the outer regions is something too arbitrary to decide based on the inner data. And if the outer data will always be required to train the relationship, then the application I see of this work is defeated.

4. Page 2, lines 32-33: It is not clear why two solar activity indicators (F10.7 and SSN) are repeated. Also, how does the method in this work take care of the time lag (up to several hours/days) for geomagnetic storm effects to be observed in the ionosphere?

5. Page 1, lines 37-38: "Kim and Kim (2016) additionally used ionospheric delays in the inner ionospheric coverage area." It is not clear what this sentence means, and why it is necessary to include it here.

6. Page 3, line 16: "In the above equation..." should read " In equation 7...".

7. Consider using “ionospheric map/model” in places of “ionosphere map/model” throughout the manuscript.

8. Page 7, line 1: Authors should clarify what previous one-epoch values are referred. What is the interval between successive epochs? Is the interval between successive epochs sufficiently small for previous one-epochs to be safely used? And what happens if there may be no data for previous one, two, three. . .. epochs?

9. The authors cite SVM applications to other fields but not a citation on previous ionospheric applications. There have been previous studies on the use of SVM for Ionospheric research. E.g.:
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010RS004393
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010RS004633
https://www.ann-geophys.net/31/173/2013/angeo-31-173-2013.pdf

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