

## ***Interactive comment on “Predicting the maximum aa/Ap index through its relationship with the preceding minimum” by Zhanle Du***

**Zhanle Du**

zldu@nao.cas.cn

Received and published: 19 July 2020

Reply to Referee # 1 Overall modifications The manuscript has been thoroughly revised based on two referees. We discuss mainly the result using the 3-hourly aa index since 1868 in Sect. 2. For each 3 days' interval, we find out the highest/lowest aa index (aaH/aaL) from 24 values of the 3-hourly aa indices. In order to reduce accidental events in the data, both aaH and aaL are smoothed by 363 days (121 points) to mimic the 13-month smoothing, as suggested by Referee 1. The maximum of aaH (aaHmax) is found to be well correlated to the preceding minimum of either aaH (aaHmin,  $r=0.85$ ) or aaL (aaLmin,  $r=0.89$ ) for the 11-year solar cycle. Based on these correlations, the strength of geomagnetic activity for cycle 25 is estimated to be aaHmax (25) =  $85.5 \pm 6.9$  (nT), similar to the average over the past cycles, but about 32% higher than that of

C1

cycle 24. The rise time (THr) from aaHmin to aaHmax is found to be only weakly anti-correlated to the following aaHmax,  $r=-0.42$ . Such a weak correlation is no longer used to estimate THr as suggested by Referee 2. Similar result can also be obtained if using the 363-day-smoothing highest/lowest 3-hourly Ap index in 3-day-interval (ApH/ApL), shown in Sect. 3. The maximum of ApH (ApHmax) is well correlated to the preceding minimum of ApH (ApHmin,  $r=0.96$ ) or ApL (ApLmin,  $r=0.79$ ) for the 11-year solar cycle. The rise time (THa) from ApHmin to ApHmax is reversely correlated to the preceding minimum of ApL (ApLmin,  $r=-0.72$ ). For the 13-month smoothed monthly mean aa (Ap) index, the result is moved down to Sect. 4, retained as a comparison, as suggested by Referee 2, but using only the aa index since 1868. The maximum aa(Ap) index, aamax (Apmax), of the solar cycle is also well correlated to the preceding minimum, aamin (Apmin), with a correlation coefficient of  $r=0.95(0.86)$ . 'Predict' is changed to 'estimate' as suggested by Referee 2. ————— The author uses smoothed monthly aa/Ap index to study the relation between the minimum and maximum aa/Ap values in order to predict the maximum value of the aa/Ap index. Usually long-term smoothing is used to study the solar cycle; to show the correlation between the solar cycle and the index variations. Due to the small number of high amplitude values, smoothing removes all the high amplitude maxima and move the data towards the minimum. The author states that “the maximum aa index for the ensuing cycle 25 is predicted to be aamax(25) =  $26.9 \pm 2.6$ .” This is very small value and it could be mistakenly understood that this solar cycle will be very quiet. The values listed in Table 1 under the aamax are much smaller than those observed in any disturbed day. These values can't represent the maximum aa index or the strength of the geomagnetic activities. As it could be seen from Fig. 1 the aa index has arrive to a peak value of about 67 nT in 19 March 2020 and the Kp value for this time is 4+. Also the paper is based on the data listed in Table 1. Which have been retrieved from smoothed aa index data. The smoothing could be done in many different ways each will produce different data sets. However, when considering the geomagnetic activities, we are usually interested to know how sever it will be and for how long it will last.

C2

1) Therefore, I suggest the following. It should be stated clearly that these max values are for smoothed aa index and it should be given a special note. The paper title should also indicate this. R: Yes. Thank you. To clearly describe the data used, the title is changed to 'Estimating the maximum of 363-day-smoothing highest 3-hourly aa index in 3-day-interval by the preceding minimum of highest/lowest aa value for the 11-year solar cycle'.

2) The author could try to compare the expect strength of the 25 cycle with the previous cycles. So, we could understand is it will be more active or less active. R: Yes. We do. The strength of aaHmax for cycle 25 is estimated to be  $aaHmax(25)=85.5\pm6.9$  (nT), about 32% stronger than that of cycle 24.

3) The author could try to predict a more reliable maximum of the aa index for the 25th cycle. To do so I could suggest to construct two data sets of the observed aa index minimum and maximum values for each 3 days or more. These two sets could be smoothed for 13 months. The correlation between these two data sets (for 3 days min and max values) are about 0.79. From these two data sets the author could peak the maximum and minimum aa index for each solar cycle and replace these values with those in Table 1. R: Yes. Thank you. In the revised manuscript, we used the 3-hourly aa index of ISGI since 1868. For each 3-day-interval, we find out the highest aa index (aaH) and the lowest aa index (aaL) from 24 values of the 3-hourly aa indices. Then, both aaH and aaL are smoothed by 363 days (121 points) to mimic the 13-month smoothing. The results are similar to those using 13-month smoothed monthly mean values, apart from that the maximum is estimated to be around 85 for the highest value. The results using 13-month smoothed monthly mean values are now retained and changed to Section 4, as suggested by Referee # 2.

4) Finally, the units of the indices (nT) should be written in text and on the Figures. R: Yes. We do.

---

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2020-15>,

C3

2020.