

The authors' response to the Referee

Comments on Re-reply to RC2', of Fridrich Valach, 19 July 2023

I am much satisfied with the authors' responses to my main concerns.

However, in this new version there appear a number of weak points and flaws that need to be corrected before publication.

Line 205: The diurnal Bz variations at your station in summer are probably caused by the Sq currents. However, the amplitudes of those variations depend strongly on the solar flux. Are the solar activity conditions the same in 1910 and 1921?.

Owolabi et al. (2022) <https://doi.org/10.1029/2021JA029903>, showed in their Figs. 2 and 3 the strong dependence of Sq intensity on F10.7. For your period no F10.7 is available, but the sun spot number can also do a good job in this respect. This kind of dependence should be taken into account for the Bz scale factor or at least be discussed.

Response:

We investigated the relationship between daily sunspot numbers and the increase in the vertical intensity in millimetres. In agreement with Table 6, we performed this analysis for two separate periods: (1) for the data of 1909 and 1910 and (2) for the data of 1921. The data and the calculated correlation coefficients are listed below.

<i>Day</i>	<i>Sunspot number</i>	<i>Increase in Z (mm)</i>
16/07/1909	43	3.05
25/07/1909	153	2.90
23/05/1910	38	2.90
04/06/1910	45	3.45
06/06/1910	12	2.20
07/06/1910	28	2.70
14/06/1910	10	2.85
30/06/1910	30	3.20
01/07/1910	17	2.80

Correlation coefficient: 0.216 (i.e., very weak or no relationship)

<i>Day</i>	<i>Sunspot number</i>	<i>Increase in Z (mm)</i>
23/05/1921	18	5.70
25/05/1921	22	5.00
01/06/1921	42	5.50
05/06/1921	33	5.55
18/07/1921	22	5.85

Correlation coefficient: -0,062 (i.e., no relationship)

The two periods fell into the declining phase of the two consequent solar activity cycles. The sunspot number did not differ substantially between the selected days in 1909-1910 and 1921. Based on this short analysis, we assume that our determination of the scale factor was not influenced substantially by different conditions in solar activity in those two periods.

This analysis is summarized in Lines 210–219. References were added in Lines 499 and 504–506. (Line numbering is according to the manuscript with indicated changes.)

Fig. 1: I am confused by your lines marked, SCs. In the Introduction you mention three SCs: 13 May, 13:06 and 19:24 UT, 14 May, 14:05 UT. The first line may well mark the 13:06 UT event, but for the second, on 14 May, I find no correspondence in your list.

Your dealing with SCs, in general, is quite confusing for me. When comparing the listed times with the recordings at Sedin I can confirm the times listed for 13 May but not for the following day. Rather, a clear SC signature appeared at 16:0x UT, not at 14:05 UT, and there is definitely no SC at 22:10 UT, where the mark appears. The time of an SC should not be confused with the start of magnetic activity, which typically comes a few hours later. Please check again and correct the SC occurrences. I would love to see correct lines for all three SCs in both figures.

Response:

In the previous version of the manuscript, we had awkwardly combined information from three sources (namely; Lundstedt et al., 2015; Hapgood, 2019; and Mayaud, 1973). In addition, we made a typo that made everything even worse. We apologize for the confusion.

In the new version of the manuscript, we have corrected all information about the times of occurrence of the SCs according to the primary source, which is Mayaud (1973). The SCs mentioned in the manuscript are all those identified by Mayaud. Figs. 1, 3, and 4 now display three SCs. The corrections regarding SCs are in Lines 58–61, 65–67, 229–231, 287–289. The captions of Figs. 1, 3 and 4 have been updated as well.

Line 267: In the present version no hourly means of the Sedin observatory appear. It would be highly desirable to add that former Fig. 3 to the final version as Fig. 4 because it well outlines the gross features of that storm. Without such an overview plot the global variations shown in the figure below are difficult to understand.

Response: Done. (Fig. 4 as well as Lines 270–273, 276, 283–284, and 287)

After removing these weaknesses, the manuscript is regarded as suitable for publication in *Ann. Geophys.*

The authors thank the anonymous Referee for his or her help in improving the manuscript.