A statistical study of the magnetic signatures of the unique Tonga volcanic explosion of 15 January 2022

Leonid F. Chernogor

Dear Professor Chernogor

Thank you for your responses to the points raised in my earlier review.

Unfortunately, I am still unable to recognise the significance of the bay and higher-frequency disturbances in the magnetic-field record at each observatory that you identify as being caused by the volcanic eruption. They appear to be features common to an active geomagnetic field.

The manuscript attributes the disturbed magnetic field on 15 January 2022 to the volcanic eruption. (For example, lines 578 to 580:

During the day of the Tonga volcanic explosion, the variations in the magnitude of all components of the geomagnetic field varied less monotonically than during the days used as a quiet time reference. The strength of fluctuations also enhanced. All these factors indicated that the volcanic explosion led to the registered magnetic effect.)

However, data from Canberra geomagnetic observatory (CNB) show that active magnetic conditions began on 14 January, before the volcano erupted, and continued until around 17 January, well after the main eruption, suggesting a solar rather than volcanic origin of the activity evident during 15 January (see Figure 1 over page).

These disturbed activity levels are also reflected in the Kp index data (Table 1), which show that the higher activity began in the 18-21 3-hour period on 14 January and is correlated with Sunspot Numbers that increased to 98 on 14 January and remained elevated throughout the volcanic eruption period before returning to pre-eruption levels around 17 January.

Table 1. Kp index and Sunspot Number (SN) data from GFZ Potsdam for 13 to 20 January 2022.

Date	00-03	03-06	06-09	09-12	12-15	15-18	18-21	21-24	SN
13/01/2022	1	0	0	0.333	0.333	0.333	1	1	85
14/01/2022	0	0	0.333	1	2	2.667	4	5.667	98
15/01/2022	4.333	3.667	2.333	1.667	2.667	3	4	4.667	95
16/01/2022	3.667	3.333	2.333	2.667	2.333	2.667	4.333	3	102
17/01/2022	3	0.667	1	2	2.333	2.667	2.667	2.333	80
18/01/2022	5	3.333	3	2	2.333	3	2.667	3	66
19/01/2022	5.333	5	3.333	3	3	2	2	3	58
20/01/2022	3.333	0.333	0.667	0.333	0.333	0.667	0.333	0.333	57

This evidence suggests that solar activity was a key contributor to the geomagnetic-field disturbance levels observed during the period the manuscript analyses. This would make it more challenging, and all the more important, to clearly identify those features in the magnetic record that are caused by the eruption, distinguishing them from features of solar origin. I apologise if I am missing something obvious but I do not see that distinction in the manuscript.

Kind regards

Adrian Hitchman

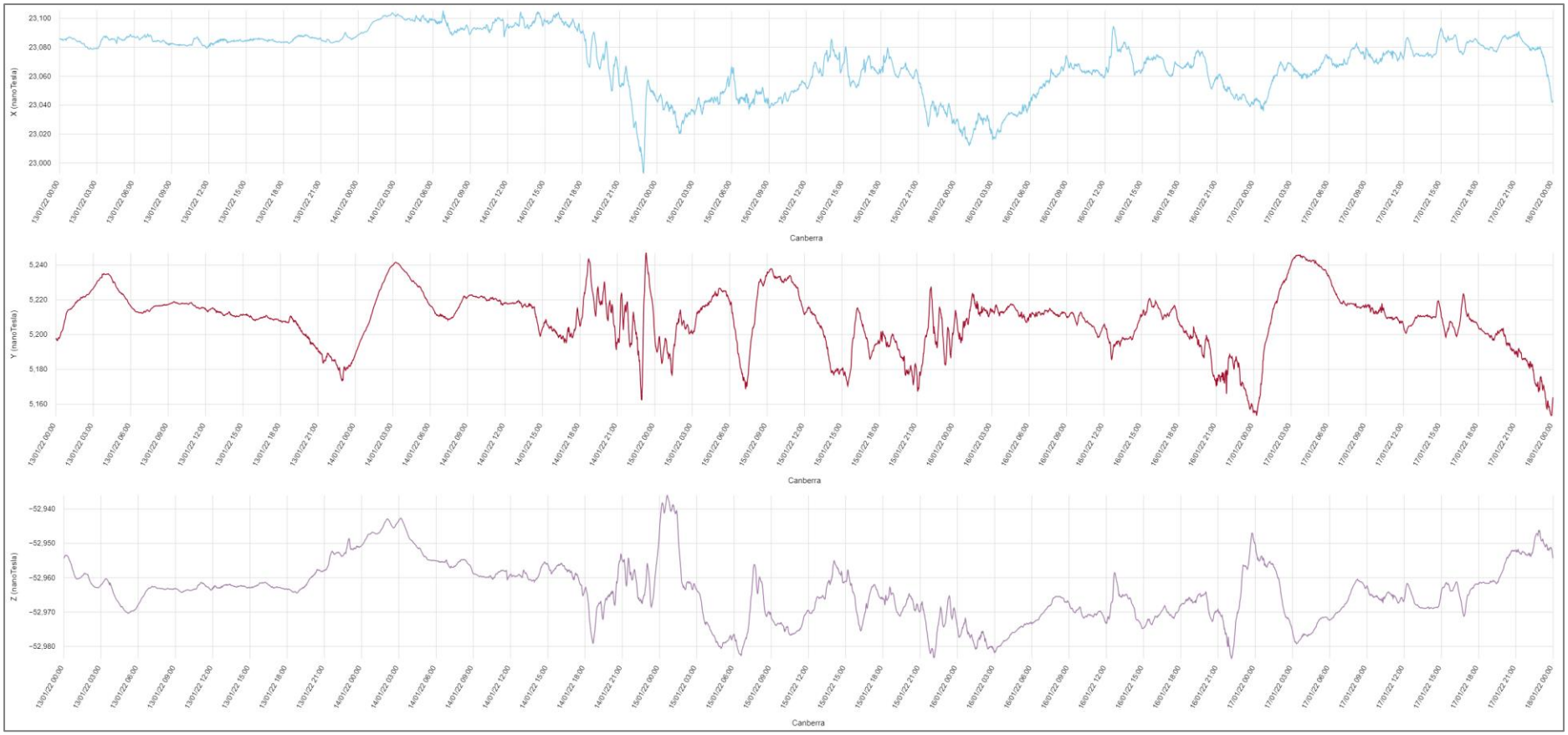

Figure 1. Geomagnetic-field X, Y and Z components recorded at Canberra geomagnetic observatory (CNB) between 13 and 17 January 2022.