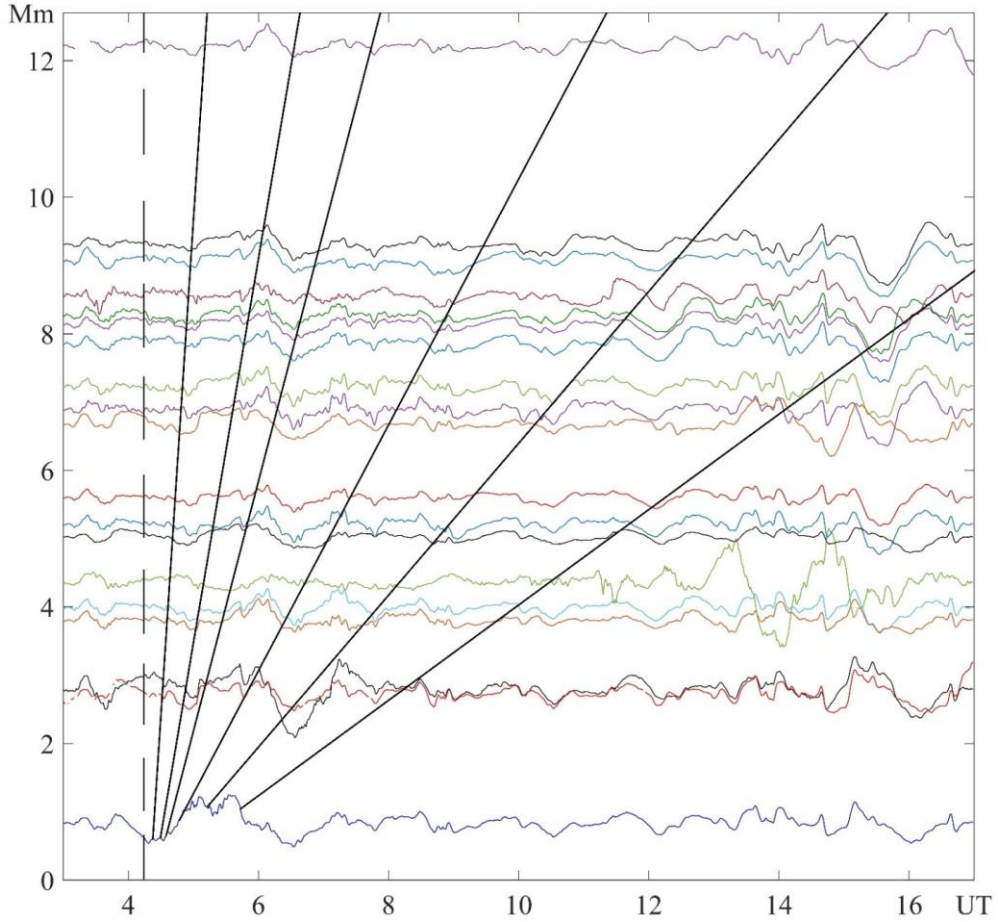
RC3: 'Comment on angeo-2023-27', Anonymous Referee #2, 16 Oct 2023
Dear Anonymous Referee #2,

Thank you very much for your comments.
Your comments and changes in the manuscript are marked in Bright Green.

The presentation of the state of the art and the bibliographic research are both quite good. The English form is almost perfect, even if, probably, the paper would benefit from a reading by a mother tongue English speaker. The topic discussed in the paper is well presented and everything goes smoothly until Section 4. Section 4, Instrumentations and tecnhiques, is, in my opinion the weakest section in the paper. Here the algorithm used for the study is presented, but the level of details is not sufficient. The author should go in much more details, explain how the algorithm was implemented, and provide quantitative statements.

Regarding the technique, it is presented in a mathematical rigorous manner providing a general framework for detecting perturbations from any high-power source of energy. Nevertheless, the technique is based on a clear and simple physical ground: any changes (spikes, most frequently) in the magnetic field strength that arrive necessarily at every point of the observational grid with the same speed, associated with a well-known type of wave, are considered to be caused by the source of energy, if these changes are not observed in the records made under quiet time conditions. The errors are indicated throughout the text. To illustrate the workings of this algorithm, I have already prepared a figure especially for the first referee, Dr. Adrian Hitchman.

This figure, copied here below, shows UT variations in all 19 *X*-components of the geomagnetic field together, in the distance from the volcano vs UT plane. The vertical dashed line indicates the moment of the volcanic explosion, while the six oblique straight regression lines virtually connect the possible moments of the onset of the magnetic field response indicated by the arrows in Figures 2–20. These variations have already been presented separately in Figures 2–20. Thus, these data clearly show that the disturbance time delay exhibits a tendency to increase with distance from the volcano, which testifies to the disturbance being propagated from the volcano.



Section 5 is, sorry to say, a bit boring. The signals acquired by each of the many stations are presented in Figures, and each of them is commented in the text. This is not the way to proceed. A competent reader can watch the Figure and deduce the most important issues from them. The comment should be collective, and intended to put in evidence the general message, like the ones put in the subsequent sections. I would have expected a different way of treating the data (maybe with figures summarizing the relevant aspects). It is also weird that the author, at some point, start using the word "trend" with a symbol that was never used up to that point (and X with a bar on it, line 197). Anyhow, almost 30 pages are used for this list which are way too much.

Regarding Section 5 being a bit boring, unfortunately, one cannot do without “a bit boring” Section 5. The results of the analysis are described in Section 5. Without this examination, the results of this work would be groundless and unvalidated.

Regarding the comment should be collective, the collective comment is presented in Section 6, Statistical data analysis of the bay excursions in geomagnetic field strengths, and in Section 7, Statistical data analysis of the quasi-periodic variations in geomagnetic field magnitudes.

Regarding the word “trend”, Dear Anonymous Referee #2, I thank you for indicating this blunder. The word trend now appear for the first time on page 8 (Line 149) with a symbol with a bar on it.

Last two Sections, where discussion of the results and drawing of the conclusions are done, are much more interesting, and I think that there good results and considerations there. In general, I think that the paper needs a deep revision, getting rid of the central part (to be strongly reduced, and maybe to be moved in an Appendix), but there is something good in it, so my advice is to reconsider it after the revision will be done.

It is hardly advisable to move Section 5 to Appendix. This disrupts the structure of the entire work. Section 5 is the main one, the entire work will not be complete or validated without Section 5. In addition, this idea has not been supported by both Reviewer #1 and a number of community comments.

In the following more specific modifications to be done:

Dear Anonymous Referee #2, I thank you for indicating these modifications, which are marked in Bright Green in the manuscript.

line 42 (Line 46, now): the current density J should not be expressed in ma/m^2 instead of mA/m?

The expression has been corrected.

line 73: "these variations is to advance understanding of this scientific issue"--> "these variations is in order to advance understanding this scientific issue"

line 84: "Table 1. Basic information on volcanos" -->"Table 1. Basic information on largest volcanos eruption recorded"

line 85: the line should not be indented.

line 136: "Figure 1: Map showing the sites of the recording stations."--> "Figure 1: Map showing the sites of the recording stations used for the present study"

line 150: "The more rapid fluctuations"--> "faster fluctuations"

line 443: I guess that R2 is the regression coefficient. Why not calling it like this?

The coefficient R^2 is termed the adjusted coefficient of determination. The regression lines are given in Equations (1)–(6).

line 449: "The formation of disturbance is close to root mean square deviations in time delays" what is the meaning of this sentence?

This sentence means that the error in time delay estimates is approximately equal to or greater than the time the disturbance takes to reach ionospheric heights, and consequently, the latter cannot be estimated.

line 463: Here the author discusses results presented in Table 3, shown several pages earlier. I would put this section close to the Table.

Transfer of Section 7 to Table. 3 does not seem appropriate. This is an independent section that is based on digital data from Table 3.

line 522: Please explain where this equation comes from.

With the use of Maxwell's equation

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j},$$

the perturbation in the magnetic induction, $\Delta\mathbf{B}$, caused by the perturbation in the current density, $\Delta\mathbf{j}$, is given by

$$\nabla \times \Delta\mathbf{B} = \mu_0 \Delta\mathbf{j}.$$

Since the derivatives with respect to the horizontal coordinates are much smaller than with respect to the height, we can write

$$\nabla \times \Delta\mathbf{B} \approx \frac{d}{dz}\Delta B,$$

where ΔB is the vector components in the horizontal plane. Using scaling arguments, the above equation can be written as

$$\left|\frac{d\Delta B}{dz}\right| \approx \frac{\Delta B}{\Delta z},$$

where Δz is the *E*-region dynamo thickness over which the contribution to the magnetic effect is produced.

line 529: "take" --> "takes"

line 530: "occur" --> "occurs"

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The author is grateful to Anonymous Referee #2 for the valuable comments that have helped the Author greatly improve the draft of his paper.

Sincerely,
Leonid Chernogor.