

Dear Editor,

We would like to thank the two reviewers for their helpful comments regarding the manuscript. The reviewers pointed to few minor issues that we have all addressed. They lead to some changes in the manuscript that are highlighted in red in the associated file. Below you will find further few comments regarding each of these points. The original reviewer comments are in bold fonts.

We point that as suggested by the reviewer 1, we have modified the title of the manuscript.

Reviewer-I

Line 88-90 – Please make very clear why you needed to make this compromise. Explain that the fluxgate instrument is very sensitive to possible pillar movement; having the pillar move by the tiniest amount would result in measuring a different magnetic field, especially in an environment with large gradients. Therefore, you want the pillar to be stable – at least long term, once the ground around the pillar has settled down and the position has stabilized. A short pillar means higher stability but also being closer to the magnets (the volcanic rocks). In my view it is a valuable point for the reader to understand.

In this part where we describe the data types, it is better not to discuss in details this compromise between pillar stability and strong magnetic rocks contribution. We therefore move this part of the text further down in the next paragraph and pointed to the risk linked to hurricane and the necessity of robust installation.

Line 94 – What is the horizontal distance between the scalar and the fluxgate instrument?

Around 6 meters. The distances are now reported on the observatory plan that has been added to the paper.

Line 69 – You mention that your first step was “surveys of potential sites”. I think explaining more here would be of value and interest. Did you survey the vertical gradients in the area? Did you run a grid survey or performed spot measurements at potentially suitable locations? Using the survey results to establish a gradient map of the area (e.g. a map displaying vertical gradients (nT/m) in contours) or a map of total field measurements taken would show how non- homogeneous the magnetic field is in the volcanic setting. It would visualize the challenges you are facing by establishing an observatory on a volcanic island.

We have modified the text while trying not to put too much emphasis on this point that remains a minor point for this paper that is more focused on the data processing and presenting the observatory.

Line 99 – Some observatories do use an additional scalar magnetometer for the handmade absolute measurements. As you did not allocate a section to it I assume you are using the variation scalar magnetometer data for your absolute measurements of the magnetic field strength. However, adding a sentence to clarify this would be good.

No. Scalar absolute measurements are made on the observatory main pillar, before and after, hand-made declination and inclination measurements. The type of instrument used has been added to the text.

**Line 180 - please explain the right side (with:..) of the equation. Is that your assumption?
Not clear to me.**

This righthand side equation simply gives the definition of the \tilde quantities. We replaced “with” with “where” in the new version.

These first reviewer comments are followed by a series of minor remarks that we almost all implement in the document.

Reviewer-II:

Line 9 -- “values vary during a day” How much?

More than $\sim 2\text{nT}$. This is now indicated in the text.

Line 13 -- “although the baseline values present strong variations” How much is the variations observed in the baseline?

70 nT, this is now given in the abstract

Line 17-18 – “There are currently around 120 magnetic observatories around the world collecting data, most of them being part of INTERMAGNET (Love and Chulliat, 2013);” Please update the statement with the latest information you can refer latest paper.

We are not aware of recent published paper giving a review of the INTERMAGNET network. We will be happy to include the reference if such a paper exists.

Line 37 -- What do you mean of calibration vector data? It is different from definitive data?

We have not been precise enough regarding what is described as “calibration”, “absolute” and “definitive”. We modified the text to systematically use “absolute” data (or measurements) in place of “calibration”. We prefer using “calibrated data” to “definitive data” because calibrating data does not imply that they should not change in the future. Deciding if calibrated data are “definitive” is under the responsibility of the scientists or technicians in charge of the observatories. The text has been modified.

Line 67-68 -- Please provide the details of the magnetic gradient values at selected area for observatory.

This point has been raised by the reviewer-1. Our answer is the same as for reviewer-1.

Line 80 -- The figure 2 does contain much information. Please include a layout map of observatory site with details of locations, instruments and their distances between them and details of the construction.

A schematic map of the observatory has been added.

Line 95 -- Please remove “These types of data are called the variation scalar data.” I don’t feel that it is necessary.

There is often a confusion between the different types of data that are produced in observatories, in particular from scientists that are not used to observatory operations. We here define and name each kind of data, and use these “definitions” throughout the manuscript. We would prefer keeping these “definitions” for the manuscript clarity. The sentence has not been erased.

Line 99-100 -- Please remove “The data angles are completed with absolute measurements of the magnetic field strength.” I felt it does not contain necessary information.

Often in observatories, the magnetic field strength is not measured before and after declination and inclination measurements. These measurements are made in La Réunion observatory and we think it is worth pointing to this fact. We have indicated the instrument type at the request of the reviewer 1.

Line 102 -- Rewrite it “As partly described above, to set the instruments two pillars in fibered concrete were build”

The sentence has been reorganized

Line 102-103 -- “at chest height,” write measurements standard way.

This is roughly 1.4m. The text has been modified.

Line 103-104 -- “a small one to rest the variation vector magnetometer in a box on the ground,” rewrite please. Here it is not clearly written about the sensor hut/vault/room. Please write it clearly.

There is no hut or vault to set the vector magnetometer but a simple box, with a proper thermic insulation. The text has been modified to clarify this point.

Line 125 – “strong magnetic gradient” what are probable gradients observed in this site during quiet and disturbed days.

We don’t think we need to indicate probable gradient values at this point in the paper. These gradients are estimated during the processing. As far as we can observe, there is no major differences between quiet or disturbed days. The values of the gradients are directly linked to the observed site differences that are, as indicated in the paper, of the order of 2500nT between the main pillar and vector variometer pillar and 718 nT between the main pillar and the scalar variometer pillar.

Line 129 – “ magnetometer reference frame” explain.

This is the frame defined by the three components of the vector (fluxgate) magnetometer. The text has been modified to clearly define this reference frame.

Line 157 – “what is rotation matrix for an angle and how do you define it here” Explain clearly.

Of course, we could add -- e.g. in appendix, the definition of a rotation matrix, but this is expected to be known by scientist reading this kind of paper. The definition of a rotation matrix is given in most academic books of introduction to mathematics. It can also be easily accessed through internet. We will follow here the decision of the editor regarding this point.

Line 173–175 – what is the periodicity of offset measurements “ This approximation can be however tested using an additional scalar magnetometer by recording the magnetic field strength simultaneously on the observatory main pillar and with the variation scalar magnetometer.” And explain the equation used clearly.

These measurements were done only once at 0.2 Hz on the 23rd of June. We modified the text and also slightly the equations as required by reviewer-1. We hope that it is now clearer.

Line 197 – Figure 3, It is not clear what is x-axis means. Please do figure description and explain in detail. I suggest to include for all figures.

The time unit is “modified Julian Day”, commonly used in satellite magnetic data. The time is counted in decimal days starting from the 01/01/2000 at 00h00. We modified the Figure 3,5,7 and 7 captions to include this information.

Line 202 – Figure 4, please explain the about figure, what is the right side axis? How did you calculated the values mentioned at the line 207. Please provide a clear description of the formula at line 203.

There is no quantity described by the figure-4 right side axis. The left side axis are the misfit values calculated using equations (8) as explained in the caption. We modified the text to point to the algorithm described in section 3.1, for the estimation of the baseline values.

Line 233 – Please correct them “02h00 in the morning and 22h00” Line 235 – Please correct “... 50 nT₂ for ... 3 nT₂

We do not understand what the reviewer wants us to modify. We have not changed the text.

Line 243 – May I know the how the pillar had constructed and can you explain the probability of the pillar movement. How do you check the same and do you have any example?

The constructed pillar is made of a large concrete block underground, and it is not rare that for the first few years, the pillar moves slightly before it stabilize. We already observed this effect on newly built pillars, in 2016, in Chambon-la-forêt observatory. We did not modify the text.