Revision of the manuscript "In-situ vectorial calibration of magnetic observatory" (gi-2017-21)

The manuscript deals with the calibration of variometers by use of previously calibrated observatory variometers or, especially, by use of automatic absolute instruments which are capable of providing the full magnetic vector in a geographic reference frame with a sufficiently high sampling rate. This is especially relevant for the authors, who manufacture the mentioned absolute magnetometers.

Even if new science is not specifically dealt with in the manuscript, the authors expound procedures beyond baseline determination that are often disregarded in the daily observatory practice, e.g., checking the scale factors or the orthogonality errors of triaxial magnetometers. In my opinion, this makes the manuscript suitable for publication in this special issue.

However, there are minor points that should be treated before publication. In particular, the manuscript is very concise, and some aspects need a somewhat more extended explanation to be useful for the potential reader.

The English is not bad, though it can be improved. The authors can find some hints at the end of this document, though they should note that I'm not a native English speaker.

Minor points:

- In equation (2) (and indeed throughout the manuscript) the authors assume that a geographic reference frame is used for the variometer. However, a number of observatories legitimately use a local geomagnetic reference frame instead. In order not to exclude those observatories, please, include a comment on how the subsequent equations would be modified in that case.
- Paragraph above equation (3). I think most observers (including myself) assume the scale factors are those given by the variometer manufacturers, thus disregarding future changes. Do authors suggest that the given scale factors might change in the long term or even be incorrect? If so, and in order for the article to alert the potential reader, could the authors give an order of magnitude of the error that those observers are making with this assumption? Extend this discussion to the orthogonality errors given by the manufacturers.
- Equation (4) – (5). Please, clarify this notation: define clearly what are the different k's and δX's, and what are their units.
- Equations (8) – (10) use δU, δV, δW while equations (3), (11) and (12) use U, V, W, whereas I think they refer to the same variables. If so, please unify the notation.
- Eq. (10): The plus sign in the right hand side should be a minus.
- Eq. (12): Please, give some more details on how to solve this system. For example, is it solved using least-squares? If so, this method assumes that the baselines (X_0, Y_0, Z_0) are constant, so one cannot extend for too many days (otherwise, the baseline conditions may have changed). The use of automatic absolute measurements for the variometer calibration probably gives better results if one catches disturbed rather than quiet (e.g., Sq) conditions, so that the range of variation is greater and somewhat

unpredictable. Please, discuss about these points and give some useful hints to the reader.

- Figure 2 is not referred in the main body of the manuscript.
- Others:
    - In the title, I've not been able to find the word "vectorial" in the English dictionary. I think the correct adjective is "vector".
    - P. 1, l. 8: I suggest replacing "they are primordial" with "it is essential".
    - P. 1, l. 13: Most magnetic observatories are built according **to** a standardized …
    - P. 1, l. 13-14: Please, just mention the three instruments at the end of this sentence.
    - P. 1, l. 16: … at **a** regular interval.
    - P. 1, l. 16: Space between 1 and Hz.
    - P. 1, l. 16: However**,** ...
    - P. 1, l. 17: … near zero sensors**,** ….
    - P. 1, l. 21: … e.g.**,**
    - P. 1, l. 21: What kind of motion do authors refer to?
    - P. 1, l. 23: Replace "realized" with "carried out".
    - P. 1, l. 24: Instrument**s**
    - P. 1, l. 25: First, a scalar magnetometer record**ing** the intensity of the field $\|\vec{B}\|$.
    - P. 1, l. 26: Replace "precess" with "perform precession".
    - P. 2, l.1: Therefore**,** …
    - P. 2, l. 7: according **to**
    - P. 2, l. 18-19: **w**here X, Y and Z are the three conventional Cartesian components of the field, **pointing to the geographic North, eastward and downward, respectively**.
    - P. 2, l. 27: guarantee**d**
    - P. 2, l. 28: follow**s**
    - P. 2, l. 31: Replace the last "in" with "into".
    - P. 3, l. 2: Is this what you really mean? Or: is not available **by** instruments orbiting around the **E**arth.
    - P. 3, l. 5: Replace "this last" with "the latter".
    - P. 3, l. 11: Sufficient**ly**.
    - P. 3, l. 12-13: Let us consider an observatory working **w i t h a variometer such as a LEMI-025**, in **a** Cartesian coordinate system.
    - P. 3, l. 14: nano**t**esla.
    - P. 4, l. 8: as **a** full …
    - P. 4, l. 10: Rasson (2005) treated …
    - P. 4, l. 23: e**i**ther
    - P. 4, l. 23: value**s**
    - P. 4, l. 23: sufficient**ly**
    - P. 4, l. 27: Therefore**,** a **vector** calibration
    - P. 4, l. 28: **The** general case, including orthogonality errors**,** can be expressed by rewriting Eq. (3) as follow**s**

- P. 5, l. 2: system**,** where
- P. 5, l. 7: according to **the** …
- P. 5, l. 7: replace “voluntary” with “deliberately”.
- P. 5, l. 12: observatories**,** …
- P. 5, l. 12: 30 min **has** been made during four days**.**
- P. 5, l. 18: Please, be more specific in what particular standards are not met.
- P. 5, l. 20: Finally, **the** magnetic field …
- P. 5, l. 23: setup**,** …
- P. 5, l. 24: from **the** “case study” variometer and **the** reference variometer.
- P. 5, l. 25: 10 **m**
- P. 5, l. 25: Is this what you mean?: “Notice that, even if both are separated by as much as 10 m, the observatory environment ensures a minimal difference.”
- P. 6, l. 4: … **the** international standards.
- P. 6, l. 5: future observator**y** deployments will be more and more complex**,** with …
- Figure 1 caption: **d**ark, and comma after occurred.
- Figure 4 caption: LEMi-025 baselines**.** Blue: before processing**; r**ed: after processing.
- Figure 5: Variometer difference between **a** reference variometer and **the** “case study” variometer. The value**s** are clearly within 1 nT. (Leave a space between 1 and nT).