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Geoscientific Instrumentation Methods and Data Systems Discussions

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Interactive comment

Interactive comment on "Time-stamp correction of magnetic observatory data acquired during unavailability of time-synchronization services" *by* Pierdavide Coïsson et al.

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Thank you for the positive comments to our work, all questions contributed to greatly improve the article. We provide here the answers to the points raised.

Comment: *1) In Fig. 1 and 2, (06.07.2014) we have negative values of the time lags, i.e. LZH time-series precede the others by nearly three minutes. This means the time lag has negative sign and this is correctly labelled on legends in Fig 2. On the other hand in Figs. 3 and 4 in the same period, July 2014, the time lag has positive sign. You should check sings on these figures. According to Fig. 1 and 2 I would expect reverse*

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Discussion paper

signs on y-axis in Figs. 3 and 4. If you change signs on Figs. 3 and 4 pay attention to do this also in Discussion and Conclusion section.

Answer: Indeed in the original manuscript there was an ambiguity on the definition of lag. Figure 2 was showing the lag obtained from cross correlation, while Figures 3 and 4 showed lags as estimated time-correction for LZH time-stamp. Both had been labelled "lag", but they have opposite sign.
In the revised version of the article the lag has been defined explicitly lag=$t_{\mathrm{LZH}} - t_{\mathrm{r}}$ and to avoid confusion, all figures have been redrawn to show lags following this definition. The whole text have been checked for consistency.

Comment: *2) To clearly show dependence between the clock drift and the temperature difference (between the ambient and data logger temperature) I recommend changes on Fig. 5. Instead the sensor temperature (which is irrelevant for discussion) to plot the difference between the battery temperature and data logger temperature. The y scaling for this curve can be placed on the right side of the plot.*

Answer: Thank you for this suggestion, the figure has been redrawn keeping only the most relevant quantity (energy card temperature). We do not have a record of the ambient temperature around the data logger, therefore we can only analyse the energy card temperature (that was indicated as battery temperature in the original submission). What was indicated as data logger temperature is the temperature of the electronic components a few meters away from the sensor, but in another building.
In the new figure we plotted only the energy card temperature, highliting its value at the time of loss GPS failure with an horizontal line. The caption and the text of the article were all changed accordingly to explain more clearly which temperature is shown..

Comment: *3) Did you note any problems in absolute measurements, i.e. with base*

values during the drift period? At least for the period Apr-Aug 2014 when time lags were higher I would expect more scattered observations, especially in the H component. I presume if you use variometer data with a few minutes time lag, to derive base values, this could introduce a few nT errors. Of course this also depends on the local geomagnetic activity during observational times, but in general I would expect systematic increase in scattering of the base values parallel with an increase of a time lag in recordings. If this was the case, maybe this fact should be mentioned in the text.

Answer: During the first period, from March 2013 to February 2014, the time lag on the data time-stamp did not produce a significant scattering of the baseline. In LZH, for baseline measurements each measure is taken at second 0 of each minute, using a clock available in the absolute measurements room. At every measurement session 10 measurements of the magnetic field intensity F are also recorded in the absolute measurements room, to compute ΔF with the sensors room. During the whole period under analysis, the ΔF remained quite stable around 1.5 nT, even during the period when the clock was drifting faster.

For the period between April and July 2014, since the acquisition system clock drift was too fast to provide a good correction of the time-stamp, we decided not to produce definitive data. Nevertheless absolute measurements were done routinely and the baseline was computed. It appears that there is a larger spreading of the measurements during this period (about 3.5 nT peak to peak on H component and 2 nT on Z component). This larger spreading starts in March 2014, before the reboot of the data logger and does not disappear at the time when the GPS PPS was re-established, lasting till September 2014. Thus it is not clear if it is correlated with the time-stamp or with the seasonal variation of the temperature in the absolute measurements room.

We do not think that this specific point should be discussed in the article, since there is not a well-defined correlation between the time-stamp evolution and the spreading of absolute measurements.

Comment: *Page 1, line 18: ensure → ensures, is part → is a part, line 20: (IAGA) → (IAGA)*

Answer: These mistakes were corrected according to the reviewer suggestions.

Comment: *Page 4, line 6: Tukey windows → Tukey window*

Answer: This typo has been corrected.

Comment: *Page 5, Line 5: ". . .the precision is not sufficient precision for the purpose. . ." → ". . .the precision is not sufficient for the purpose . . .", line 19: few → a few*

Answer: These errors have been corrected.

Comment: *Page 7, Figure 4: subplot left-top: "Y 2013. . ." → "X 2013. . ."*
Answer: The figure has been corrected.

Comment: *Lines 12-13: "Only when the temperature was exceeding more than 5°C the one at the time when F counter was last estimated, the clock drifted at a higher pace." → "Only when the temperature difference was exceeding more than 5°C at the time when F counter was last estimated, the clock drifted at a higher pace."*

Answer: The long and difficult sentence was broken into two separate shorter sentences: "It appears that the difference between this temperature and its value at the time when $F_{counter}$ was last estimated played an important role in the clock drift. Only when this temperature difference was exceeding more than $5°$C, the clock drifted at a higher pace."

Comment: *Page 9, line 9: the most affected → most affected*

Answer: The sentence was modified into "is the one most affected".

Comment: *Mostly you use "data logger", for consistency you should correct: Abstract, line 5 "data-logger", page 2, line15 "datalogger", also page 3, line 20, line 24, page 5, line 14, page 7, line 5.*

Answer: The text was revised using "data logger" everywhere.

Comment: *Also use "cross correlation" or "cross-correlation" everywhere in the text.*

Answer: The text was revised using "cross-correlation" everywhere.

Comment: *Page 7, line 7: -27 → -28 (everywhere else in the paper you are talking about lagging of 28 s)*

Answer: Actually in December the delay was 27 s. It remained stable all through the early months of 2014 and it is only during March 2014 that the last second of delay was accumulated. This value was not changed, but the text was modified to explain this point:

- Abstract: the value was changed into 27.
- Discussion: the sentence "and was kept at this level up to the beginning of April 2014" was changed into "It remained at this level up to March 2014, when a slowly increase started again. 28 s lag was reached before the data logger reboot on 2 April 2014."

Comment: *In my opinion the term "acquisition chain" could be replaced with "acquisition system".*

Answer: Following the reviewer suggestion, "acquisition chain" was replaced with "acquisition system" throughout the text.

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