About some small effects in magnetic field at observatories Paratunka (Kamchatka, Russia) and Choutuppal (India)

Alexey Y. Gvozdarev[1*], Sergey Y. Khomutov[1†], Kusumita Arora[2†], Phani Chandrasekhar[2†]

[1*]Geophysical Observatory Paratunka, IKIR FEB RAS, Mirnaya, 7, Paratunka, 684034, Kamchatka, Russia.
[2]Magnetic Observatory, National Geophysical Research Institute, street-???, Hyderabad, postcode-???, state-???, India.

*Corresponding author(s). E-mail(s): gvozdarev@ikir.ru;
Contributing authors: khomutov@ikir.ru; karora_ngri@yahoo.co.uk;
phaninelapatla@gmail.com;
[†]These authors contributed equally to this work.

Abstract

For many years, small variations have been observed in the magnetic data obtained at the Paratunka Observatory (PET, IKIR FEB RAS, Kamchatka, Russia) and at the Observatory Choutuppal (CPL, CSIR-NGRI, India). These variations are within the limits defined by the INTERMAGNET standards, but they are quite obvious and require explanation. Such variations at PET include, for example, seasonal fluctuations in the gradient of the total field F inside the absolute pavilion with amplitude up to 0.5 nT and its long-term trend up to 0.1 nT per year, measured by the POS-1 Overhauser magnetometer. Other example is daily fluctuations of F obtained by dIdD GSM-19FD magnetometer with amplitude up to 0.8 nT. At the CPL, diurnal variations of the differences of the Fvar calculated from the total field components H,D,Z of the variometers, and Fscal directly measured by a scalar magnetometer, dF=Fvar-Fscal, are noted. These diurnal variations of dF with amplitude up to 1 nT do not correlate with the temperature of magnetic sensors and electronics. Temperature fluctuations inside and outside the pavilions can be considered as the main cause, and the influence of magnetic susceptibility and its temperature changes can be considered as the mechanism of influence. A set of magnetic micro-surveys were made inside and outside the pavilions at PET in different seasons and the distribution

of the magnetic field and its dynamics were studied. The magnetic susceptibility of near-surface rocks in the area of the pavilions was studied under various temperatures (from room temperature to deep freezing), the expected effects in the magnetic field were calculated on models. At the CPL, possible induction effects occurring in the underlying rocks are considered as the cause. Estimation of the possibility to use obtained results in the real practice of the magnetic observatories are made.

Keywords: keyword1, Keyword2, Keyword3, Keyword4

1 Introduction

The Introduction section, of referenced text [1] expands on the background of the work (some overlap with the Abstract is acceptable). The introduction should not include subheadings.

Springer Nature does not impose a strict layout as standard however authors are advised to check the individual requirements for the journal they are planning to submit to as there may be journal-level preferences. When preparing your text please also be aware that some stylistic choices are not supported in full text XML (publication version), including coloured font. These will not be replicated in the typeset article if it is accepted.

2 Results

Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text.

3 This is an example for first level head—section head

3.1 This is an example for second level head—subsection head

3.1.1 This is an example for third level head—subsubsection head

Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text. Sample body text.

4 Equations

Equations in LaTeX can either be inline or on-a-line by itself ("display equations"). For inline equations use the `$...$` commands. E.g.: The equation $H\psi = E\psi$ is written via the command `$H \psi = E \psi$`.

For display equations (with auto generated equation numbers) one can use the equation or align environments:

$$\|\tilde{X}(k)\|^2 \leq \frac{\sum\limits_{i=1}^{p} \left\|\tilde{Y}_i(k)\right\|^2 + \sum\limits_{j=1}^{q} \left\|\tilde{Z}_j(k)\right\|^2}{p+q}. \tag{1}$$

where,

$$\begin{aligned} D_\mu &= \partial_\mu - ig\frac{\lambda^a}{2}A_\mu^a \\ F_{\mu\nu}^a &= \partial_\mu A_\nu^a - \partial_\nu A_\mu^a + gf^{abc}A_\mu^b A_\nu^a \end{aligned} \tag{2}$$

Notice the use of `\nonumber` in the align environment at the end of each line, except the last, so as not to produce equation numbers on lines where no equation numbers are required. The `\label{}` command should only be used at the last line of an align environment where `\nonumber` is not used.

$$Y_\infty = \left(\frac{m}{\text{GeV}}\right)^{-3}\left[1 + \frac{3\ln(m/\text{GeV})}{15} + \frac{\ln(c_2/5)}{15}\right] \tag{3}$$

The class file also supports the use of `\mathbb{}`, `\mathscr{}` and `\mathcal{}` commands. As such `\mathbb{R}`, `\mathscr{R}` and `\mathcal{R}` produces $\mathbb{R}$, $\mathscr{R}$ and $\mathcal{R}$ respectively (refer Subsubsection 3.1.1).

5 Tables

Tables can be inserted via the normal table and tabular environment. To put footnotes inside tables you should use `\footnotetext[]{...}` tag. The footnote appears just below the table itself (refer Tables 1 and 2). For the corresponding footnotemark use `\footnotemark[...]`

Table 1 Caption text

Column 1	Column 2	Column 3	Column 4
row 1	data 1	data 2	data 3
row 2	data 4	data 5[1]	data 6
row 3	data 7	data 8	data 9[2]

Source: This is an example of table footnote. This is an example of table footnote.

[1]Example for a first table footnote. This is an example of table footnote.

[2]Example for a second table footnote. This is an example of table footnote.

The input format for the above table is as follows:

3

```
\begin{table}[<placement-specifier>]
\caption{<table-caption>}\label{<table-label>}%
\begin{tabular}{@{}llll@{}}
\toprule
Column 1 & Column 2 & Column 3 & Column 4\\
\midrule
row 1 & data 1 & data 2  & data 3 \\
row 2 & data 4 & data 5\footnotemark[1] & data 6 \\
row 3 & data 7 & data 8  & data 9\footnotemark[2]\\
\botrule
\end{tabular}
\footnotetext{Source: This is an example of table footnote.
This is an example of table footnote.}
\footnotetext[1]{Example for a first table footnote.
This is an example of table footnote.}
\footnotetext[2]{Example for a second table footnote.
This is an example of table footnote.}
\end{table}
```

Table 2 Example of a lengthy table which is set to full textwidth

Project	Element 1[1]			Element 2[2]		
	Energy	σ_{calc}	σ_{expt}	Energy	σ_{calc}	σ_{expt}
Element 3	990 A	1168	1547 ± 12	780 A	1166	1239 ± 100
Element 4	500 A	961	922 ± 10	900 A	1268	1092 ± 40

Note: This is an example of table footnote. This is an example of table footnote this is an example of table footnote this is an example of table footnote this is an example of table footnote.

[1]Example for a first table footnote.

[2]Example for a second table footnote.

In case of double column layout, tables which do not fit in single column width should be set to full text width. For this, you need to use \begin{table*} ... \end{table*} instead of \begin{table} ... \end{table} environment. Lengthy tables which do not fit in textwidth should be set as rotated table. For this, you need to use \begin{sidewaystable} ... \end{sidewaystable} instead of \begin{table*} ... \end{table*} environment. This environment puts tables rotated to single column width. For tables rotated to double column width, use \begin{sidewaystable*} ... \end{sidewaystable*}.

6 Figures

As per the LaTeX standards you need to use eps images for LaTeX compilation and `pdf/jpg/png` images for `PDFLaTeX` compilation. This is one of the major difference between LaTeX and `PDFLaTeX`. Each image should be from a single input .eps/vector image file. Avoid using subfigures. The command for inserting images for LaTeX and `PDFLaTeX` can be generalized. The package used to insert images in `LaTeX/PDFLaTeX` is the graphicx package. Figures can be inserted via the normal figure environment as shown in the below example:

```
\begin{figure}[<placement-specifier>]
\centering
\includegraphics{<eps-file>}
\caption{<figure-caption>}\label{<figure-label>}
\end{figure}
```
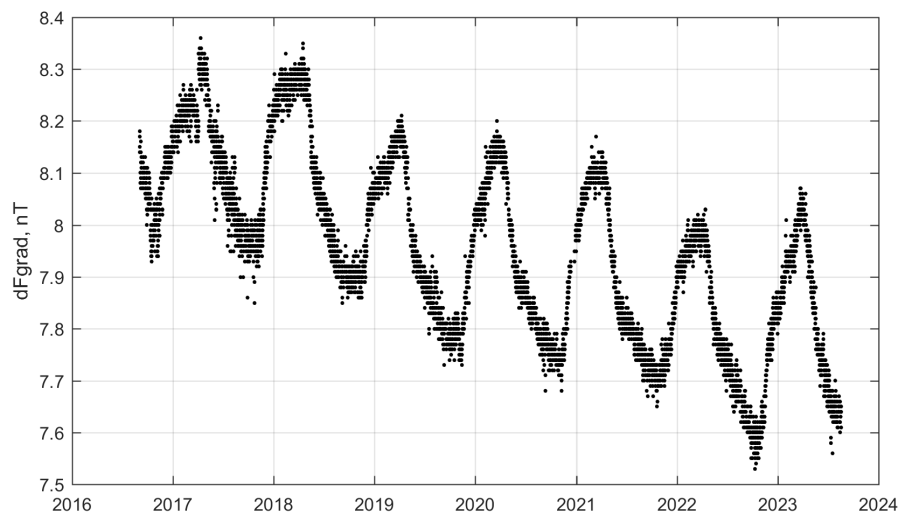

Fig. 1 This is a widefig. This is an example of long caption this is an example of long caption this is an example of long caption this is an example of long caption

Table 3 Tables which are too long to fit, should be written using the "sidewaystable" environment as shown here

| Projectile | Element 1[1] | | | Energy | Element[2] | |
	Energy	σ_{calc}	σ_{expt}		σ_{calc}	σ_{expt}
Element 3	990 A	1168	1547 ± 12	780 A	1166	1239 ± 100
Element 4	500 A	961	922 ± 10	900 A	1268	1092 ± 40
Element 5	990 A	1168	1547 ± 12	780 A	1166	1239 ± 100
Element 6	500 A	961	922 ± 10	900 A	1268	1092 ± 40

Note: This is an example of table footnote this is an example of table footnote this is an example of table footnote this is an example of table footnote.
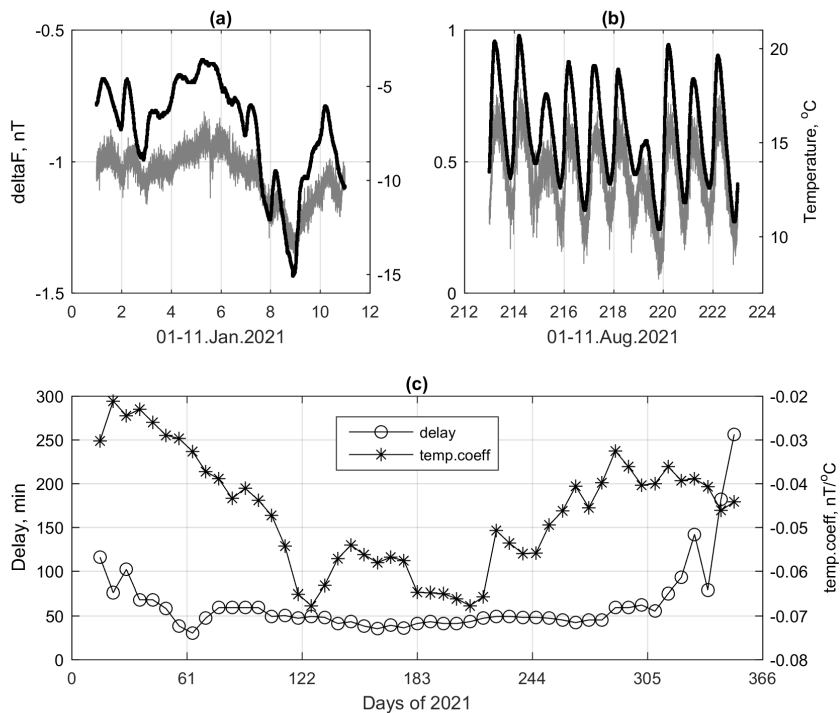
[1]This is an example of table footnote.

Fig. 2 This is a widefig. This is an example of long caption this is an example of long caption this is an example of long caption this is an example of long caption

In case of double column layout, the above format puts figure captions/images to single column width. To get spanned images, we need to provide `\begin{figure*}` `... \end{figure*}`.

For sample purpose, we have included the width of images in the optional argument of `\includegraphics` tag. Please ignore this.

7 Algorithms, Program codes and Listings

Packages `algorithm`, `algorithmicx` and `algpseudocode` are used for setting algorithms in LaTeX using the format:

```
\begin{algorithm}
\caption{<alg-caption>}\label{<alg-label>}
\begin{algorithmic}[1]
. . .
\end{algorithmic}
\end{algorithm}
```

You may refer above listed package documentations for more details before setting `algorithm` environment. For program codes, the "verbatim" package is required and the command to be used is \begin{verbatim} ... \end{verbatim}.

Similarly, for `listings`, use the `listings` package. \begin{lstlisting} ... \end{lstlisting} is used to set environments similar to `verbatim` environment. Refer to the `lstlisting` package documentation for more details.

A fast exponentiation procedure:

```
begin
  for i := 1 to 10 step 1 do
      expt(2,i);
      newline() od                    Comments will be set flush to the right margin
where
proc expt(x,n) ≡
  z := 1;
  do if n = 0 then exit fi;
     do if odd(n) then exit fi;
        comment: This is a comment statement;
        n := n/2;  x := x * x od;
     { n > 0 };
     n := n - 1;  z := z * x od;
  print(z).
end
```

Algorithm 1 Calculate $y = x^n$

Require: $n \geq 0 \vee x \neq 0$
Ensure: $y = x^n$
 1: $y \Leftarrow 1$
 2: **if** $n < 0$ **then**
 3:     $X \Leftarrow 1/x$
 4:     $N \Leftarrow -n$
 5: **else**
 6:     $X \Leftarrow x$
 7:     $N \Leftarrow n$
 8: **end if**
 9: **while** $N \neq 0$ **do**
10:     **if** N is even **then**
11:         $X \Leftarrow X \times X$
12:         $N \Leftarrow N/2$
13:     **else**$[N$ is odd$]$
14:         $y \Leftarrow y \times X$
15:         $N \Leftarrow N - 1$
16:     **end if**
17: **end while**

```
for i:=maxint to 0 do
begin
{ do nothing }
end;
Write('Case insensitive ');
Write('Pascal keywords.');
```

8 Cross referencing

Environments such as figure, table, equation and align can have a label declared via the `\label{#label}` command. For figures and table environments use the `\label{}` command inside or just below the `\caption{}` command. You can then use the `\ref{#label}` command to cross-reference them. As an example, consider the label declared for Figure 1 which is `\label{fig1}`. To cross-reference it, use the command `Figure \ref{fig1}`, for which it comes up as "Figure 1".

To reference line numbers in an algorithm, consider the label declared for the line number 2 of Algorithm 1 is `\label{algln2}`. To cross-reference it, use the command `\ref{algln2}` for which it comes up as line 2 of Algorithm 1.

8.1 Details on reference citations

Standard LATEX permits only numerical citations. To support both numerical and author-year citations this template uses `natbib` LATEX package. For style guidance please refer to the template user manual.

Here is an example for `\cite{...}`: [1]. Another example for `\citep{...}`: [2]. For author-year citation mode, `\cite{...}` prints Jones et al. (1990) and `\citep{...}` prints (Jones et al., 1990).

All cited bib entries are printed at the end of this article: [3], [4], [5], [6], [7], [8], [9], [10], [11], [12] and [13].

9 Methods

Topical subheadings are allowed. Authors must ensure that their Methods section includes adequate experimental and characterization data necessary for others in the field to reproduce their work. Authors are encouraged to include RIIDs where appropriate.

Ethical approval declarations (only required where applicable) Any article reporting experiment/s carried out on (i) live vertebrate (or higher invertebrates), (ii) humans or (iii) human samples must include an unambiguous statement within the methods section that meets the following requirements:

1. Approval: a statement which confirms that all experimental protocols were approved by a named institutional and/or licensing committee. Please identify the approving body in the methods section

2. Accordance: a statement explicitly saying that the methods were carried out in accordance with the relevant guidelines and regulations
3. Informed consent (for experiments involving humans or human tissue samples): include a statement confirming that informed consent was obtained from all participants and/or their legal guardian/s

If your manuscript includes potentially identifying patient/participant information, or if it describes human transplantation research, or if it reports results of a clinical trial then additional information will be required. Please visit (https://www.nature.com/nature-research/editorial-policies) for Nature Portfolio journals, (https://www.springer.com/gp/authors-editors/journal-author/journal-author-helpdesk/publishing-ethics/14214) for Springer Nature journals, or (https://www.biomedcentral.com/getpublished/editorial-policies#ethics+and+consent) for BMC.

10 Discussion

Discussions should be brief and focused. In some disciplines use of Discussion or 'Conclusion' is interchangeable. It is not mandatory to use both. Some journals prefer a section 'Results and Discussion' followed by a section 'Conclusion'. Please refer to Journal-level guidance for any specific requirements.

11 Conclusion

Conclusions may be used to restate your hypothesis or research question, restate your major findings, explain the relevance and the added value of your work, highlight any limitations of your study, describe future directions for research and recommendations.

In some disciplines use of Discussion or 'Conclusion' is interchangeable. It is not mandatory to use both. Please refer to Journal-level guidance for any specific requirements.

Supplementary information. If your article has accompanying supplementary file/s please state so here.

Authors reporting data from electrophoretic gels and blots should supply the full unprocessed scans for key as part of their Supplementary information. This may be requested by the editorial team/s if it is missing.

Please refer to Journal-level guidance for any specific requirements.

Declarations

Some journals require declarations to be submitted in a standardised format. Please check the Instructions for Authors of the journal to which you are submitting to see if

you need to complete this section. If yes, your manuscript must contain the following sections under the heading 'Declarations':

- Funding
- Conflict of interest/Competing interests (check journal-specific guidelines for which heading to use)
- Ethics approval
- Consent to participate
- Consent for publication
- Availability of data and materials
- Code availability
- Authors' contributions

If any of the sections are not relevant to your manuscript, please include the heading and write 'Not applicable' for that section.

Editorial Policies for:

Springer journals and proceedings: https://www.springer.com/gp/editorial-policies

Nature Portfolio journals: https://www.nature.com/nature-research/editorial-policies

Scientific Reports: https://www.nature.com/srep/journal-policies/editorial-policies

BMC journals: https://www.biomedcentral.com/getpublished/editorial-policies

Appendix A   Section title of first appendix

An appendix contains supplementary information that is not an essential part of the text itself but which may be helpful in providing a more comprehensive understanding of the research problem or it is information that is too cumbersome to be included in the body of the paper.

References

[1] Campbell, S.L., Gear, C.W.: The index of general nonlinear DAES. Numer. Math. **72**(2), 173–196 (1995)

[2] Slifka, M.K., Whitton, J.L.: Clinical implications of dysregulated cytokine production. J. Mol. Med. **78**, 74–80 (2000) https://doi.org/10.1007/s001090000086

[3] Hamburger, C.: Quasimonotonicity, regularity and duality for nonlinear systems of partial differential equations. Ann. Mat. Pura. Appl. **169**(2), 321–354 (1995)

[4] Geddes, K.O., Czapor, S.R., Labahn, G.: Algorithms for Computer Algebra. Kluwer, Boston (1992)

[5] Broy, M.: Software engineering—from auxiliary to key technologies. In: Broy, M., Denert, E. (eds.) Software Pioneers, pp. 10–13. Springer, New York (1992)

[6] Seymour, R.S. (ed.): Conductive Polymers. Plenum, New York (1981)

[7] Smith, S.E.: Neuromuscular blocking drugs in man. In: Zaimis, E. (ed.) Neuromuscular Junction. Handbook of Experimental Pharmacology, vol. 42, pp. 593–660. Springer, Heidelberg (1976)

[8] Chung, S.T., Morris, R.L.: Isolation and characterization of plasmid deoxyribonucleic acid from Streptomyces fradiae. Paper presented at the 3rd international symposium on the genetics of industrial microorganisms, University of Wisconsin, Madison, 4–9 June 1978 (1978)

[9] Hao, Z., AghaKouchak, A., Nakhjiri, N., Farahmand, A.: Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare https://doi.org/10.6084/m9.figshare.853801 (2014)

[10] Babichev, S.A., Ries, J., Lvovsky, A.I.: Quantum scissors: teleportation of single-mode optical states by means of a nonlocal single photon. Preprint at https://arxiv.org/abs/quant-ph/0208066v1 (2002)

[11] Beneke, M., Buchalla, G., Dunietz, I.: Mixing induced CP asymmetries in inclusive B decays. Phys. Lett. **B393**, 132–142 (1997) arXiv:0707.3168 [gr-gc]

[12] Stahl, B.: DeepSIP: Deep Learning of Supernova Ia Parameters, 0.42, Astrophysics Source Code Library (2020), ascl:2006.023

[13] Abbott, T.M.C., *et al.*: Dark Energy Survey Year 1 Results: Constraints on Extended Cosmological Models from Galaxy Clustering and Weak Lensing. Phys. Rev. D **99**(12), 123505 (2019) https://doi.org/10.1103/PhysRevD.99.123505 arXiv:1810.02499 [astro-ph.CO]