地磁気観測所テクニカルレポート　第 10 巻第 2 号　1 － 2 頁　平成 25 年 3 月
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『地磁気絶対観測頻度軽減』特集号に寄せて

平成 23 年 4 月, 地磁気観測所女満別出張所（北海道大空町）および鹿屋出張所（鹿児島県鹿屋市）は半世紀強に亘る出張所としての幕を閉じ, 無人化した観測施設となった．この組織変更に伴い，出張所の人員を地磁気観測所本所に集約するとともに，両施設近隣の網走地方気象台，鹿児島地方気象台内に地磁気観測連絡事務所をそれぞれ開設し，職員各 2 名（うち 1 名は地方気象台との併任職員）を配置して地磁気絶対観測や定常的な機器保守を行うようになった．翌年度には毎週実施していた地磁気絶対観測を隔週実施へと低減し，連絡事務所職員は地方気象台との併任職員 1 名に減員となった．

この組織変更は，平成 18 年度に気象庁内に設置された「地磁気観測所のあり方に関する検討委員会」における，地磁気観測業務の実施体制についての検討結果の報告を受けたものであり，業務の省力化を図るとともに，磁気嵐情報などの情報提供業務の改善，広報活動の充実や研究開発・国際協力等の推進の実効性を高めることを目的としたものであった．

地磁気観測所ではこの報告を受け，「出張所の遠隔観測化にむけての技術検討部会」において検討するとともに地磁気観測所調査研究重要課題により，関連する諸問題の解決のための調査研究を実施した．「技術検討部会」では，観測データの品質維持に関する事項，観測環境の監視及び測器等の保守・維持管理に関する事項，出張所の絶対観測及び定期保守体制，及び本所の体制に関する事項について技術的課題の抽出・検討を行い，平成 20 年 1 月にその検討結果が取りまとめられた．この検討の中では，遠隔化後の観測データの品質の確保のために必要な絶対観測の間隔や人工擾乱の検出と補正，障害対応に関する問題が指摘された．

地磁気観測所では，これら諸課題を解決し観測体制の変更を実行に移すため，遠隔観測化のための機器や人工擾乱の影響を監視するための観測施設の整備を行うとともに，観測精度維持に必要な調査研究に取り組み, 平成 20 年度には「地磁気絶対観測の効率化のための調査」および「地磁気人工擾乱監視手法の高度化」が，平成 21 ～ 22 年度には「地磁気観測の信頼性向上のための調査」が実施された．これらの成果は，西村　他（2010），三島　他（2011），Minamoto *et al.*（2011），藤井　他（2012）で報告されている．

平成 23 年度には「絶対観測頻度軽減に係る調査」により，人工擾乱の影響を排して，女満別，鹿屋において毎週行っていた地磁気絶対観測の精度を落とすことなく隔週実施に変更するための方策について調査された．本特集号では，本調査の成果のうち，地磁気絶対観測における基線値の決定に係る問題（地中温度の影響を補正した基線値の活用，絶対観測中に人工擾乱の影響を受けた場合の補正法），及び女満別，鹿屋における人工擾乱の検知能力について報告されている．

本報告が地磁気観測を実施している各機関の地磁気観測業務の改善に活用されることを願っている．

平成 25 年 3 月

地磁気観測所長
吉川　澄夫

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「地磁気絶対観測頻度軽減に係る調査」概要

本特集号では，平成 23 年度地磁気観測所調査研究重要課題「絶対観測頻度軽減に係る調査」の研究成果を報告する．

本研究において地磁気絶対観測における基線値の決定方法を改善するとともに，絶対観測の間隔が基線値の精度や再観測の頻度に与える影響について調査した．本研究で得られた新しい基線値の決定法を用いることで，絶対観測の間隔を毎週から隔週に延長することが可能となった．また，絶対観測に人工擾乱の影響を受けた場合にその影響を補正する方法を確立した．さらに，絶対観測の間隔や観測者の違いが基線値の決定に及ぼす影響を検証するため，7 日，10 日および 14 日間隔で地磁気絶対観測の試行観測を実施した．

本研究の成果を受けて，2012 年には，女満別および鹿屋での絶対観測の頻度が毎週から２週間に一度に軽減された．

本特集号では以下の４つの課題について報告を行う．試行観測の結果と個人差の問題については次号以降で報告される予定である．

１．福井敬一・大和田毅・森永健司「地温の影響を加味した地磁気絶対観測基線値の推定と再観測頻度」

地中温度の影響を取り入れた基線値推定手法を提案した．本手法を適用すると，絶対観測の間隔を広げても，毎週観測の場合に比べ再観測の頻度は増大せず，良い結果を得ることができる．

２．大和田毅・森山多加志・森永健司「基線値における環境要素の影響補正とその効果－複数磁力計基線値の比較－」

地中温度，傾斜およびセンサー温度の影響を考慮して，主磁力計および副磁力計の基線値を推定した．これらの補正を施した基線値は時間的に安定しており，各磁力計の基線値は良く一致していた．

３．徳本哲男・室松冨二男・生駒良友「女満別・鹿屋における人工擾乱の検出能力」

女満別，鹿屋において人工擾乱検出システム（5 台の 3 成分フラックスゲート磁力計と 3 台のプロトンあるいはオーバーハウザー磁力計で構成）による人工擾乱検知能力を評価するためシミュレーションを行った．人工擾乱源が観測施設の付近にあれば擾乱源のソースパラメータを推定することができるが，鹿屋では南側，女満別では北側に擾乱源がある場合は，検出能力は低くなる．

４．森永健司・長町信吾・生駒良友・大和田毅「鹿屋観測施設における絶対観測時の人工擾乱について－絶対観測時の人工擾乱の発生状況と擾乱補正方法－」

鹿屋における 2011 年 4 月から 2012 年 3 月までの絶対観測中に発生した人工擾乱事例と，人工擾乱の影響を補正して基線値を決定する方法について報告した．

Preface to Special Issue: Reduction in Frequency of Absolute Geomagnetic Measurements

The curtain fell on the field offices of the Memambetsu Magnetic Observatory (Ozoracho, Hokkaido) and Kanoya Magnetic Observatory (Kanoya, Kagoshima Prefecture) as field offices, and they became unmanned observation facilities in April 2011 after slightly more than a half-century of operations. With this organizational change, the personnel of the field offices were collected at the main office at the Kakioka Magnetic Observatory, and liaison offices for geomagnetic observations were also established at both the Abashiri Local Meteorological Observatory and the Kagoshima Local Meteorological Observatory, which were near the two facilities. Two staff members (one of them having shared duties with the local meteorological observatory) were dispatched to each, and they began to carry out absolute magnetic observations and perform routine maintenance on the equipment. In the year that followed, the absolute magnetic observations that had been carried out weekly were reduced to biweekly, and the liaison offices were reduced to one employee each jointly employed with the local meteorological observatory.

This organizational change was based on a report of the results of investigations into the system for carrying out geomagnetic observation work by the Committee to Study the State of Magnetic Observatories, established within the Japan Meteorological Agency in 2006. The purpose was to reduce work and also increase the effectiveness of promoting the following improvements: work on supplying information such as that on magnetic storms, fuller PR activities, research and development, and international cooperation.

After receiving this report at the Kakioka Magnetic Observatory, an investigation was carried out by the Technical Investigative Subcommittee for Developing Remote Observations at Field Stations, and investigative studies were conducted to solve various related problems according to themes of importance for survey studies at magnetic observatories. The Technical Investigative Subcommittee extracted and examined technical problems related to items involved with maintaining the quality of observational data; items involved with monitoring the observation environment as well as maintenance and control of equipment; and items involved with absolute observations and routine maintenance policies for the field offices as well as the policies of the main office. The results of the investigation were brought together in January 2008. During this investigation, problems involving the absolute observation intervals required for maintaining the quality of observational data after conversion to remote observations, and those related to detecting and making corrections for artificial disturbances as well as the handling of failures, were brought forward.

To solve these problems and implement the changes in observation policies at the Kakioka Magnetic Observatory, arrangements were made for the equipment for remote observations and facilities for observing the effects of artificial disturbances. Additionally, work was done on investigative research necessary for maintaining the precision of observations. In FY 2008, the "Investigation for Making Absolute Magnetic Observations More Efficient" and "Advancement of Observational Techniques for Artificial Disturbances in Geomagnetism" were carried out. Furthermore, in FY 2009–2010, the "Investigation for Improving Reliability of Geomagnetic Observations" was conducted. These results were reported in Nishimura *et al.* (2010), Mishima *et al.* (2011), Minamoto *et al.* (2011), and Fujii *et al.* (2012).

In FY2011 investigations were carried out on methods for changing to biweekly observations without the effects of artificial disturbances and reducing the precision of the absolute magnetic observations, which had been carried out weekly at Memambetsu and Kanoya, according to the "Research on Reducing the Frequency of Absolute Magnetic Observations". In this Special Issue, reports from the results of this investigation are given on problems related to determining baseline values in absolute magnetic observations (use of baseline values corrected for the effects of earth temperature, and methods for correction when effects of artificial disturbances occur during absolute observations) and the capabilities for detecting artificial disturbances at Memambetsu and Kanoya.

We hope that these reports will be used for improving work on geomagnetic observations at various institutions carrying out such observations.

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Summary of "Research on reducing the frequency of absolute magnetic observations"

This special issue reports the research results for the Kakioka Magnetic Observatory primary research project carried out during FY2011 entitled "Research on reducing the frequency of absolute magnetic observations."

In this research, we improved the technique for baseline determination with absolute magnetic observations and investigated the impact of expanding the interval between absolute observations on baseline accuracy and on the frequency of re-observations. Baseline determination performance of the advanced method was sufficiently improved that the frequency of absolute observations could be reduced from weekly to bi-weekly. We also established a method to correct for the influence of artificial disturbances on absolute measurements. Furthermore, we carried out test absolute observations at intervals of 7, 10, and 14 days to confirm the validity of baselines determined from absolute observations made at different intervals and observers.

In 2012, after the completion of this research, the frequency of absolute magnetic observations at Memambetsu and Kanoya was reduced from weekly to bi-weekly.

The following four papers, describing the development of the new technique, are reported in this issue. The results of the test observations will be reported after the next issue.

1. Fukui, K., T. Owada and K. Morinaga, **Advanced method to predict variations of baseline values of absolute magnetic observations and frequency of re-observations**

This study proposes an advanced method of baseline estimation that takes into account soil temperature. This method produces good results even if the interval between absolute measurements is extended while the frequency of re-observations is not increased compared with their frequency when absolute measurements are performed weekly.

2. Owada, T., T. Moriyama and K. Morinaga, **Effect of environmental data on baseline values - comparison between main and sub-magnetometers**

The baseline values of the main and sub-magnetometers were calculated by considering the effects of soil temperature, tilt, and sensor temperature. The results show that the time variations of the corrected baselines were stable and consistent among the baselines of the main and sub-magnetometers.

3. Tokumoto, T., F. Muromatsu and Y. Ikoma, **Detecting artificial magnetic disturbances at Memambetsu and Kanoya magnetic observatories**

We used a model to evaluate the capability of the monitoring system for geomagnetic disturbances used at Memambetsu and Kanoya to detect human-caused disturbances. The monitoring system consists of five 3-component fluxgate magnetometers and three proton (Overhauser) magnetometers. If the source of the artificial disturbance is located nearby the measurement site, we can estimate the source parameters. The detectability is low for the source situated in the south of Kanoya and in the north of Memambetsu.

4. Morinaga, K., S. Nagamachi, Y. Ikoma and T. Owada, **Absolute magnetic observation influenced by artificial disturbances at Kanoya - occurrence status and correction method**

Human-caused disturbances occurring during the performance of absolute measurements are reported for the period from April 2011 to March 2012 at Kanoya, and a method to reduce the influence of such disturbances on the observed baseline values is introduced.