Geomagnetic Observation in Lapan

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ABSTRACT
LAPAN conducts geomagnetic observation in seven observatories around Indonesia. The observation includes daily magnetic variations which support the research on geomagnetic activity and magnetic pulsation in the field of the space weather programs. We calculate the K indices, daily correction in geomagnetic mapping, and find the magnetic pulsation characteristics. The observation data is also applicable in research on earthquake precursor as well as Geomagnetically Induced Current (GIC). The data from each observatory is transferred to LAPAN Bandung every 5 and/or10 minutes by using GPRS modem. Division of Geo- and Space Magnetism publish the information about the geomagnetic activity in website. It includes daily variation and magnetic pulsation which can be used as the indicator of space weather effect on geomagnetic field.

Keywords: Geomagnetic observation – Geomagnetic activity

1 INTRODUCTION

The Division of Geo- and Space Magnetism is a division of the National Institute of Aeronautics and Space (LAPAN) that is located in Bandung which organizes the geomagnetic observation. The observation is dedicated for monitoring the space weather; since the condition of geomagnetic is influenced by the condition in interplanetary space which depends on the solar activity. Therefore, geomagnetic field is observed in fixed stations

The observation is conducted in seven observatories which are located around Indonesia region. The observation of geomagnetic field is conducted by LAPAN and also in collaboration with SpaceEnvironmentCenter (under MAGnetic Data Acquisition System/MAGDAS project) Kyushu UniversityJapan [5], Indonesia Meterology, Climatology, and Geophysics Agency (BMKG), and Nagoya University of Japan. The geomagnetic field is measured to clarify the dynamics of geospace plasma changes during magnetic storms, the electro-magnetic response of iono-magnetosphere to various solar wind changes, and the penetration and propagation mechanisms of Ultra Low Frequency (ULF) range disturbances from the solar wind region into the equatorial ionosphere. The data can be used for studies of long-term variations, e.g. magnetic storm, quiet day variation (Sq), etc., while the induction-type will be useful for studies of ULF waves, transient and impulsive phenomena [4,5].

The observation data is also applicable in detecting the existence of geomagnetically induced current (GIC) which can affect the electricity/power system [3]. The research on earthquake's precursor is also conducted by identifying magnetic pulsation which can be derived from daily variation magnetic field [1, 2].

In this paper we introduce the geomagnetic observation in LAPAN and the observation data as well as the researches and services which are deployed in LAPAN. We also explain the data transfersystem which is developed for transferring data from all the observatories to the server in LAPAN Bandung near real time.

2 OBSERVATION SITES

We measure the geomagnetic field in seven observatories located over Indonesia region, i.e. Kototabang, Tanjungsari, Pontianak, Manado, Parepare, Kupang and Biak. Three of them (Tanjungsari, Pontianak, Biak) are operated by LAPAN itself, one is under collaboration with

Nagoya University (Kototabang), and three (Kupang, Parepare, Manado) are under collaboration with MAGDAS. The location of the observatories is presented in figures 1 and 2

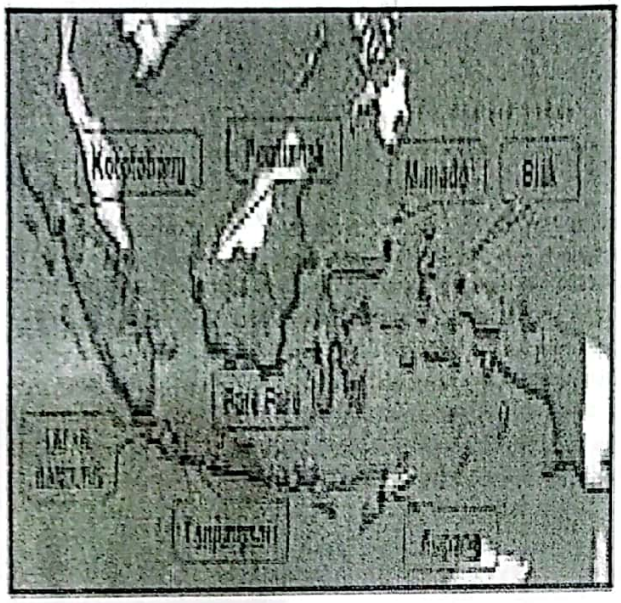

Figure 1. The location of magnetometers which measure the geomagnetic field over Indonesia region.

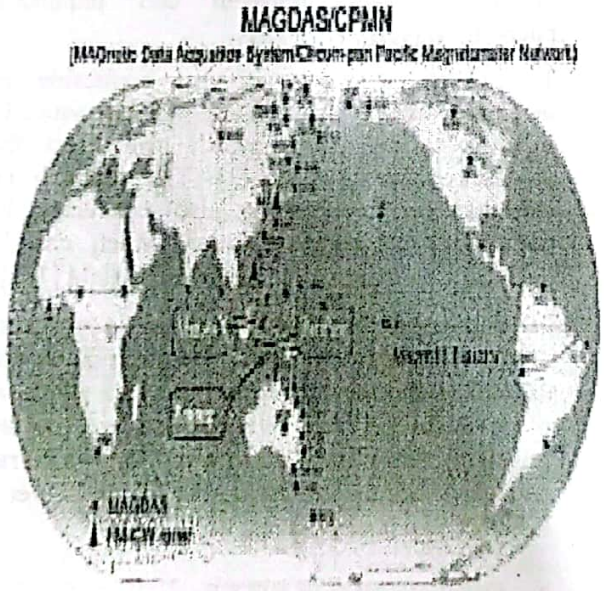

Figure 2. Three of the observatories (in Kupang, Parepare, and Manado) are parts of MAGDAS/CPMN.

The observation sites are as follows (see figures 1 and 2):

a. Biak(geographic 1.18°S, 136.10°E). We have been observing the geomagnetic field in this location by using Fluxgate Magnetometer since May1992.
b. Tanjungsari (geographic 6.91°S, 107.83°E). The fluxgate magnetometer in this observatory was installed in 2004
c. Kototabang (geographic 0.22°S, 100.32°E). The magnetometer was installed in 2005, and placed in BMKG station.
d. Pontianak (geographic 0.05°S, 109.34°E), since 2005.
e. Parepare (geographic 3.93°S, 119.65°E). The MAGDAS magnetometer was installed in 2005, and placed in Installation of Remote Sensing and Natural Resources of LAPAN.
f. Manado (geographic1.30°N, 124.93° E). MAGDAS magnetometer is placed in BMKG's geophysical observatory since 2005.
g. Kupang (geographic10.21°S, 123.65°E), has been operating the MAGDAS magnetometer since 2006. We placed the instrument in BMKG's geophysical observatory.

3 DATA

3.1 Observation Data

There are two types of measured data. They are:

a. Daily Variation

The Fluxgate Magnetometers in Biak, Pontianak, Tanjungsari and Kototabang measure the variation of H (north-south), D (east-west) and Z (vertical) components, with time resolution 1 second. Figure 3 shows the sample of daily variation data observed in Biak on October 10th, 2003, while Figure 4 shows the disturbed variation of magnetic field due to geomagnetic storm on October 29th, 2003.

b. Absolut Component

The magnetometers which measure the absolut components of geomagnetic field (H, D, Z) are those which located in Parepare, Manado and Kupang. These instruments are parts of MAGnetic Data Acquisition System/Circum-pan Pacific Magnetometer Network (MAGDAS/CPMN). Figure 5 shows the result of the observation in Manado observatory for H, D, Z components on August 3rd, 2010 and calculated total magnetic field (F).

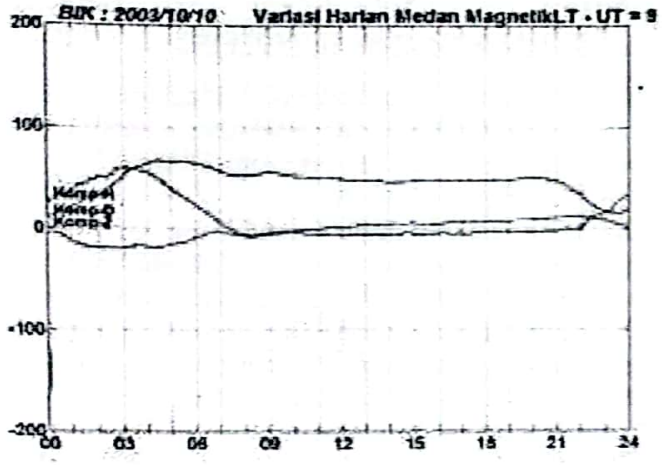

Figure 3. Daily variation of geomagntic field (H, D and Z components) observed from Biak observatory on October 10th, 2003.

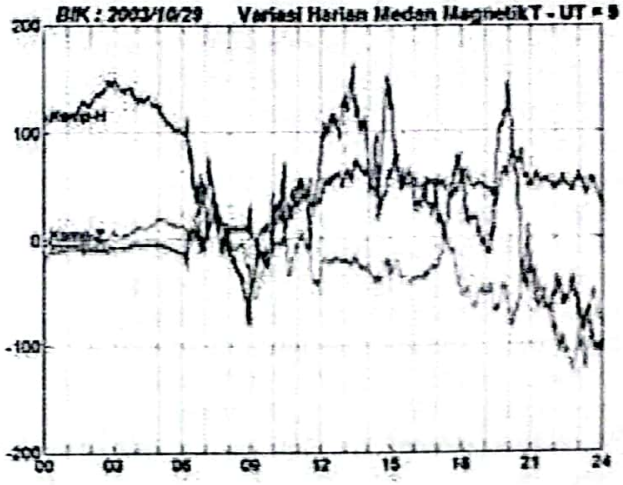

Figure 4. Plot of geomagnetic daily variation observed in Biak Observatory on October 29th, 2003. The H component depressed significantly according to the solar storm on October 28th 2003

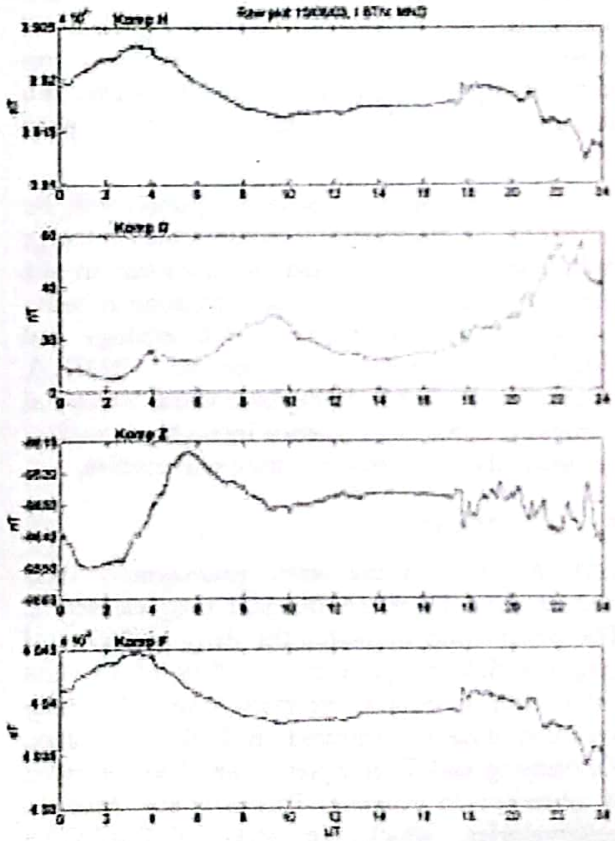

Figure 5. Geomagnetic field (H, D, Z) measured by MAGDAS instrument in Manado observatory on August 3rd, 2010 and the calculated total magnetic field (F). It shows the disturbance of magnetic field from 18 UT due to coronal mass ejection (CME) on August 1st.

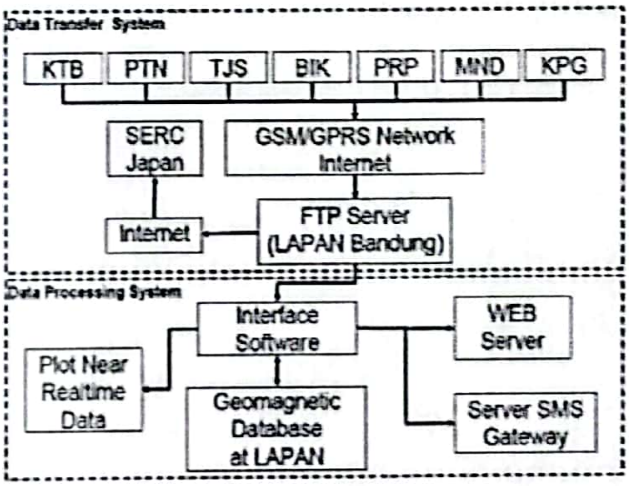

Figure 6. Illustration of data transfer system from observatories and data processing system in LAPAN Bandung

3.2 Data Transfer

In supporting the space weather program in LAPAN, we have to get the observation data soon and then give information concerning the geomagnetic disturbance. Therefore, we developed a near real time data transfer where the data is transferred from the observation sites to LAPAN Bandung. The data is transferred every 5 or 10 minutes by using GPRS (General Packet Radio Services); depend on the setting of the equipment. The system allows us to monitor the magnetic field from all observatories immediately. We also developed the data processing system to monitor the activity of magnetic field. When the data arrived, the system will save the data in the database and then simultaneously processes the data to display the magnetic variation and extract the magnetic pulsation. Figure 6 shows the data transfer and the data processing systems. Figure 7 shows the monitor which display the near real time data from the observatory. It shows the daily variation of magnetic field, magnetic pulsations Pc3 and Pc5. Information of geomagnetic activity will be published in LAPAN Bandung website.

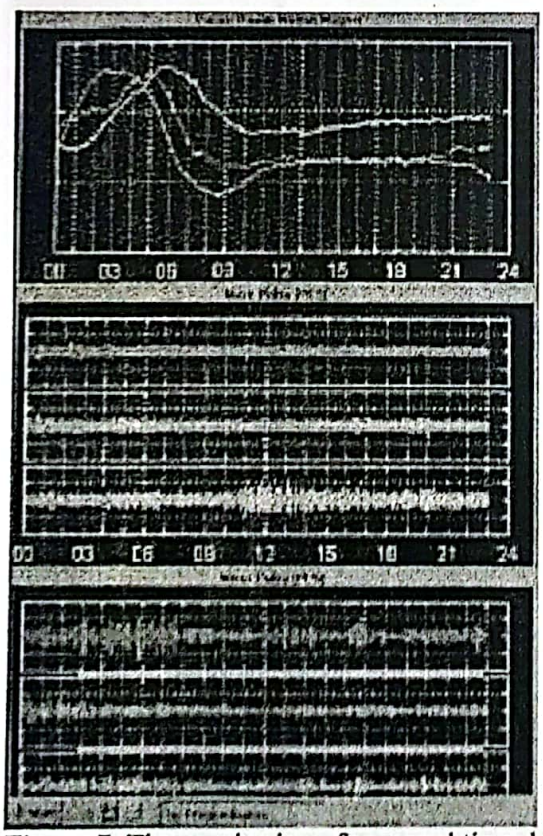

Figure 7. The monitoring of near real time data of daily variation of geomagnetic field (top), magnetic pulsations Pc3 (middle) and Pc5 (bottom)

4. RESEARCH AND ACTIVITIES

The Division of Geo- and Space Magnetism has research programs on space weather related geo and space magnetism. The research includes:

a. Geomagnetic activity

In the research on geomagnetic activity, the geomagnetic daily variation is investigated as well as the determination of K indices. The daily correction of geomagnetic field is very useful in geomagnetic mapping to remove the space weather influence in geomagnetic field.

b. Magnetospheric activity

The magnetic pulsations, pc3, pc5, and pi2 and their characteristics are determined and investigated. The ULF (Ultra Low Frequency) wave and its characteristics are also studied as well.

The Division of Geo and Space Magnetism also conducts the research on the application of the geomagnetic data, such as research on GIC (Geomagnetically Induced Current) which is related with the electrical power and on earthquake precursor by using the ULF wave. We also plan to publish the information about space weather in our web.

The collaboration with other institution will be valuable. The collaboration includes the exchange data, and the research and development in the field of geomagnetism. The collaboration is being established with Meteorology, Climatology and Geophysics Agency of Indonesia (BMKG), Marine Geological Institute, Indonesian Electrical Company, Indonesian Science Institute, as well as the researchers and students from universities.

5. SUMMARY

LAPAN conducts the static geomagnetic field measurement by using fluxgate magnetometers. The observation measures the daily variation of magnetic field components as well as the absolute value with 1 second resolution time. The daily variation data is measured in Biak, Pontianak, Kototabang and Tanjungsari. The absolute value is observed in Kupang, Parepare and Manado observatories, which are parts of MAGDAS network.

The measurement of geomagnetic field from seven observatories can be transferred near real time to the server in Bandung by using GPRS modem, and then processed. This data transfer system and data processing system allow us to manage the data into the database and then

display the magnetic variation and magnetic pulsation to monitor the geomagnetic activity.

The research program in LAPAN includes the research on geomagnetic activity and its disturbances, including the calculation of K indices, daily correction of geomagnetic mapping, ULF wave and its characteristics including magnetic pulsation pc3, pc5, and pi2 and their characteristics. The data is also applicable in investigating the earthquake precursor and geomagnetically induced current (GIC). Collaboration between researchers from other institutions will be valuable in research on space weather.

6. REFERENCES

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