Capacity Building of MAGDAS

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Abstract Under the framework of the MAGDAS Project of SERC (at Kyushu University), this report will cover the three phases of "Capacity Building": (1) Development of instrument capacity, (2) Development of data analysis capacity, and (3) Development of science capacity. Capacity Building is one of the major goals of IHY and ISWI, as specified by the organizers of IHY and ISWI.

Introduction

MAGDAS (Magnetic Data Acquisition System) is a real time magnetometer network deployed all over of the world (Yumoto et al., 2007). The first overseas unit was installed in Taiwan in 2005 and initially the installations were concentrated along the *210 deg. magnetic meridian*, which is essentially a vertical line running north/south and cuts through Japan. In the next stage of deployment, MAGDAS units were deployed around the globe along the *dip equator* – there are MAGDAS stations operating in India, Africa, and South America. After this stage, MAGDAS units were installed along a new meridian, which we call the *96 deg. magnetic meridian*. This runs north and south through Africa, cutting through Egypt (Yumoto et al., 2010).

By geography, one can see that most MAGDAS stations are located in developing countries. Therefore, it is essential to engage the local people (scientists, engineers, teachers, students, etc., or collectively known as "**the host**") in the operation of each magnetometer in order to make the operation *long-term and self-sustaining*.

To engage the host in a long-term manner, it is the strong belief of the MAGDAS Project (whose PI is the author of this report) that *Capacity Building* be conducted by the instrument provider for the benefit of the host. There are three main components to Capacity Building as follows:

1. Build **Instrument Capacity** of the host.
2. Build **Data Analysis** Capacity of the host
3. Build **Science Capacity** of the host.

In the following sessions, each component listed above will be elaborated on.

Instrument Capacity

There can be no science without data because data represents the real world. Moreover, to have data one must have instruments. Therefore, teaching the host on how to maintain instruments is the first and leading component of Capacity Building.

But, usually, in the case of MAGDAS, we begin with a new installation: A MAGDAS unit is installed at the host's site by a team from SERC (consisting of scientists, engineers, and/or students of Kyushu University) as shown in Fig. 1. During installation, the SERC team instructs the host on basic matters of maintenance: (1) How to re-boot the data-logging computer, (2) how to change its data card, (3) how to maintain the car battery (used for power fail backup), (4) how to operate the computer; and so on. In this way, the host begins to understand the instrument so that the host can maintain it for years and years of operation.

In the case of MAGDAS, another major challenge is getting the data from the instrument to SERC on a real time basis. The instrument is always capable of this. However, the instrument is always connected to the Internet provided locally by the host. In some cases, this Internet connection is readily available. But in many cases, it must be developed using the know-how of SERC staff and of the host. For example, in Indonesia, the host (LAPAN, the national space agency of Indonesia) developed a data transfer system using the local cell phone network. At three remote locations (Manado, Pare Pare, and Kupang), the data is sent via cell phone technology from each instrument to a central location (LAPAN HQ at Bandung).

Data Analysis Capacity

Data analysis can include examination of MAGDAS data (each host uses his or her own MAGDAS data, or the data of other MAGDAS stations) as well as data from satellites. All raw data transferred from MAGDAS stations are stored in the acquisition server, and have to be checked and corrected. Processed (corrected) data is then made available to users by putting the MAGDAS database on the public access servers at SERC as shown in Fig. 2. Data users can analyze those data with development of software to get a new finding from MAGDAS data.

MAGDAS data is available in two forms: (1) 1-minute sampling, and (2) 1-second sampling. The later has higher value as it is data that is collected once per second. High priority is given to the MAGDAS hosts. For example during three years, the 1-s data is made available only to SERC researchers and the host who generated that data. Also, each host has free access to all 1-minute data from any MAGDAS station.

It is an important MAGDAS policy that the hosts be given every opportunity to make use of MAGDAS data (for education, for research, for whatever). In this way, the host understands the importance of maintaining data collection instruments on a long-term basis.

Fig. 1. MAGDAS Installation in the Philippines.

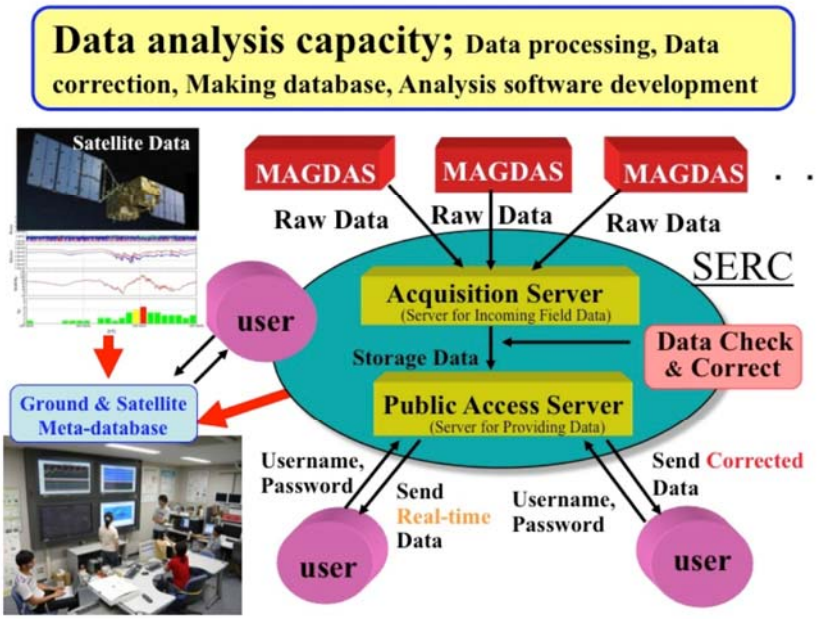

Fig. 2. Data analysis capacity; data processing (check and correction) of raw data from MAGDAS stations, database making, and development of software for data analysis.

Fig. 3. Science capacity; (1) data analysis, (2) discussion, (3) presentation, and (4) publication.

Science Capacity

The goal here is to enable hosts to get involved in the entire research process: (1) data analysis, (2) discussion, (3) presentation, and (4) publication as shown in Fig. 3. Building science capacity is the most difficult task of Space Weather Capacity Building because it takes the most time. It involves teaching space science to persons who normally would never come into contact with space-related science. Ultimately, MAGDAS data can only be effectively used by persons, having an adequate understanding of the Earth's magnetic field and associated subject areas.

The MAGDAS Project is teaching this science to young people on several fronts. At home, under the supervision of K. Yumoto, Kyushu University is educating four Phd candidates from developing countries. They are: (1) Emad, from Egypt, (2) Grace, from the Philippines, (3) Zemi, from Malaysia, and (4) Magdi, from Sudan. Each comes from a country where the MAGDAS Project has magnetometers on the ground. By educating each candidate, it is hoped that they will return to their respective countries and do the following: (1) Establish, or maintain, the tradition of magnetic measurement using a ground-based array of magnetometers, (2) perform research with the acquired data, and (3) educate the next generation of researchers for this field.

In addition to educating Phd candidates on a formal basis, the MAGDAS Project has the agenda to conduct "MAGDAS Schools". The first one occurred during the ISWI Workshop in Helwan, Cairo, Egypt, in which 31 talks were presented by various MAGDAS hosts. The next MAGDAS School is planned to take place at Redeemer's University, Mowe, Lagos, Nigeria, in August of 2011. This one-week intensive workshop is aimed at training personnel on how to handle MAGDAS data and systems. But the workshop will also have a strong science component as instruction will also be given on special topics such as principles of geomagnetism, space weather, equatorial ionosphere, etc.

Conclusion

In this report, the Capacity Building aspects of the MAGDAS Project were described. They are:

(1) Instrument Capacity,
(2) Data Analysis Capacity, and
(3) Science Capacity.

Note that each one is development of *human resources*. Therefore, this is not capacity in terms of additional hardware, software, equipment, or facilities. It takes people to maintain instruments, to analyze data, and to write scientific papers. These people must first be trained, and this is one of the major goals of ISWI.

Acknowledgement

I wish to express my gratitude to all the hosts of MAGDAS stations. (There are now 54 MAGDAS stations around the world.) Without their strong support, the MAGDAS Project cannot succeed.

References

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