

NEW MAGNETIC OBSERVATORIES IN BRAZIL

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Abstract

Observatórios magnéticos são fundamentais para a elaboração de modelos globais da variação do campo magnético terrestre, como o IGRF (Internacional Geomagnetic Reference Field) e para aferição de sistemas, de navegação de satélites, aviões e navios. Somente observatórios podem garantir registros contínuos do campo magnético, essenciais para o estudo dos seus processos geradores no núcleo terrestre, na magnetosfera e ionosfera. O Observatório Magnético de Vassouras (VSS), no Rio de Janeiro, é o único observatório participante do INTERMAGNET. Atualmente, o Observatório Nacional em colaboração com o GFZ (Alemanha) e SESC-Pantanal estão no processo de instalação de um novo Observatório no Pantanal, previsto para início do seu funcionamento em Dezembro de 2011. Entretanto, para monitoramento do campo geomagnético no Brasil são necessários cerca de sete observatórios, cobrindo a extensa área do Brasil. A instalação destes novos observatórios magnéticos é uma meta do Observatório Nacional para os próximos cinco anos.

Introduction

The observed geomagnetic field is a result of contributions from the core, ionosphere, magnetosphere, crust and induced field. The core magnetic field is caused by a dynamo process with an approximated dipolar geometry and magnitude of the order of 70000 nT near the poles and about half near the equator. The Earth magnetic field can be approximated by a dipole located at the Earth's center and tilted about 11° with respect to the axis of rotation, which accounts for roughly 80% of the field observed at the surface (Merril *et al.*, 1996).

The magnetic field is important to protect the Earth from the radiation coming from space. Solar storms may cause problems on satellites, navigation systems and radio-communication. These problems happen more frequently where the magnetic field is weaker. The weakest intensity of the magnetic field is located on the South Atlantic Anomaly (SAA) region (Figure 1) that may be delimited by the total field strength isoline for 30000 nT. Gubbins *et al.* (2006) suggest that the SAA is caused by reverse flux patches at the core-mantle boundary, which have developed over the last 200 years.

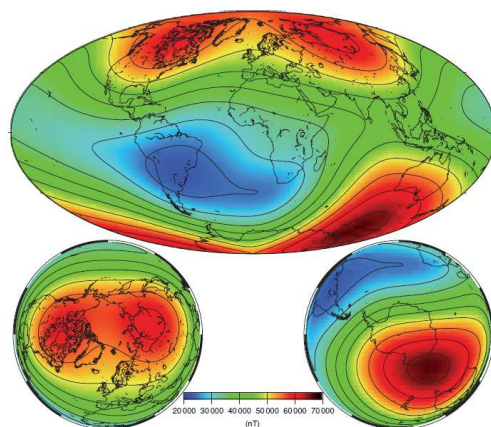


Figure 1: Scalar magnetic field intensity at the Earth's surface in 2005 as given by the CHAOS model. Taken from Olsen *et al.*, 2007.

However, the distribution of magnetic observatories is uneven, especially in the South America, where only few observatories are part of the INTERMAGNET (International Real-time Magnetic Observatory Network) as showed in Figure 2.

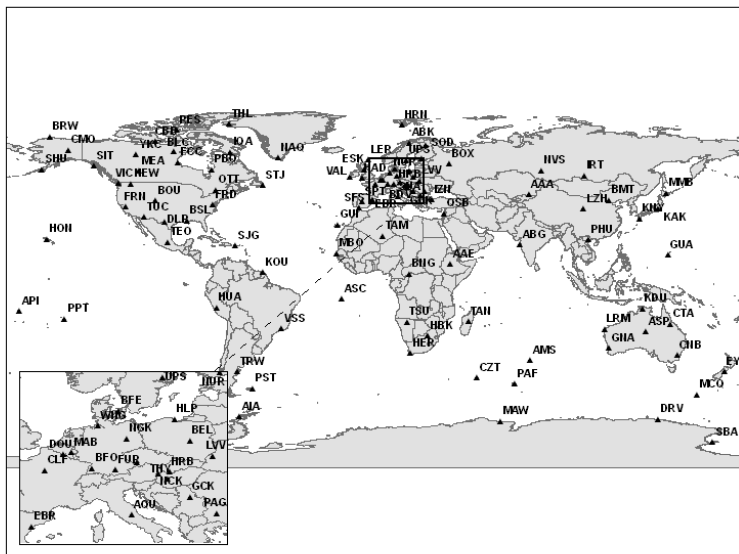


Figure 2: Global network of magnetic observatories (INTERMAGNET). Taken from <http://www.intermagnet.org>.

Methodology

The National Observatory plans to install seven new observatories in Brazil well distributed geographically, as shown in Figure 3. The new observatories will follow the patterns of quality established by INTERMAGNET (Newitt *et al.*, 1996).



Figure 3: Planned Brazilian network of magnetic observatories. The yellow symbols show the future observatories and blue symbols the existent observatories.

The first magnetic observatory will be in Pantanal (Mato Grosso), in collaboration with GFZ-Potsdam and SESC-Pantanal. In order to build this new observatory, we have to follow some requirements to choose the satisfactory location:

- i. Magnetically quiet that means no cars, trains or power lines close to the measurements. The area chosen in Pantanal is an ecological reserve far from any possible noise. The landing track is about 300 meters from the houses and only sporadic and small airplanes land there.
- ii. Variometer and absolute houses without any magnetic materials: we are constructing the houses with an ecological material (plastic wooden);
- iii. Temperature controlled inside the variometer house: in Pantanal the daily temperature oscillates considerably, consequently we will add styrofoam between the walls (Figure 4);

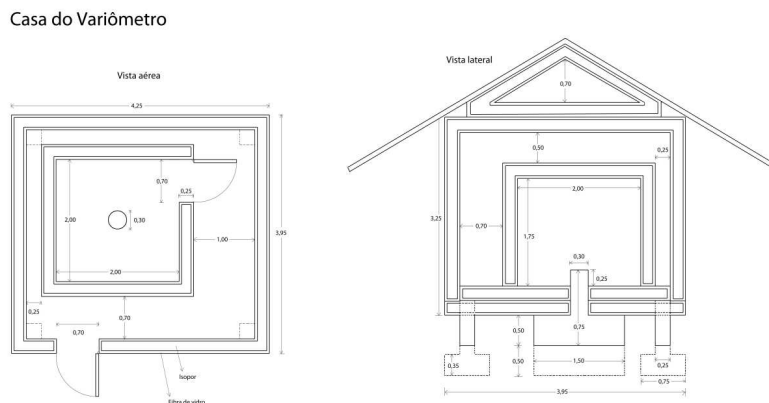


Figure 4: Scheme for the construction of the variometer house in Pantanal Magnetic Observatory.

- iv. Infra-structure: in the location we have houses to do the data processing and power supply for the magnetometers and computers. Internet is also required to transmit the data;
- v. Magnetic survey in the area to avoid strong magnetic gradients: this result is showed in the results section.

Results

A magnetic survey was done in the available area for installing Pantanal observatory. The measurements were done with two magnetometers overhauser at different heights, what allowed obtaining directly the gradient between the two magnetometers. The area has 35x20 meters and the interval between measurements was of 1 meter. The results are showed in Figure 5, where no strong spatial gradients were found.

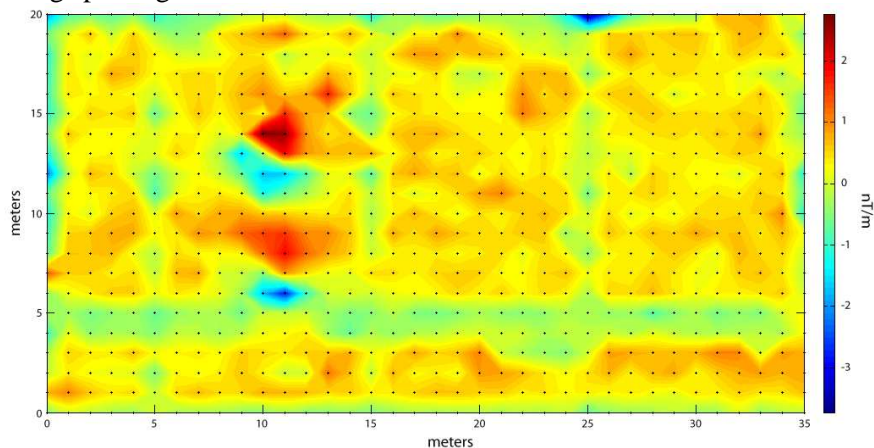


Figure 5: Gradiometer survey in the area chosen to install the Pantanal observatory.

Conclusions

Seven new magnetic observatories are planned to be installed in Brazil. The first is in Pantanal region that is planned to start working in December, 2011. The location was chosen and the first magnetic survey was done, showing an adequate location for a Pantanal observatory. The next steps will be to install the equipments with collaboration of GFZ- Potsdam and training of local staff to perform the absolute measurements.

Acknowledgments

We would like to thank Monika Korte and Joachim Linthe, from GFZ- Potsdam, for the constant support, training and installation of the Pantanal Observatory in Brazil. We also thank Waldir Wolfgang and Leopoldo Brandão, from SESC-Pantantal, for the support on the installation of Pantanal Observatory.

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