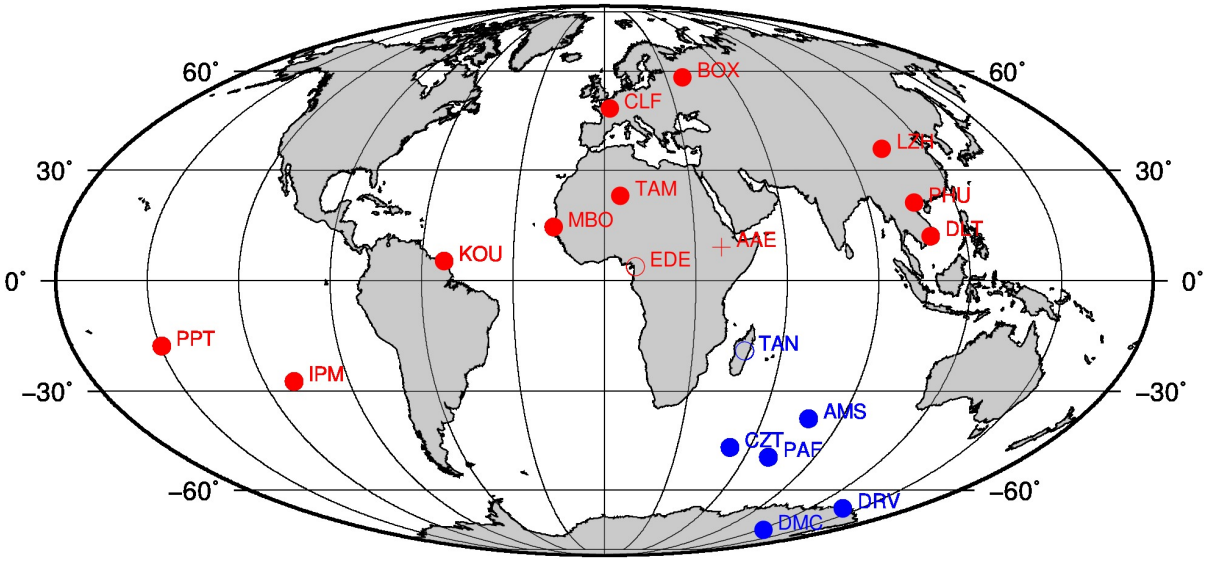
BUREAU CENTRAL DE MAGNÉTISME TERRESTRE
France

# Bureau Central de Magnétisme Terrestre

Activity Report

2013-2016

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## Foreword

This document describes the activities undertaken by the French service of magnetic observatories to maintain its network of stations around the world. It has been prepared in view of the BCMT Scientific Council meeting that will be held on May 2016, the $3^{rd}$.

## Reference documents

Chulliat, A., and Chambodut, A. (2013), Strategic Plan 2014-2018, *Bureau Central de Magnétisme Terrestre*, (`http://www.bcmt.fr/pdf/BCMT_strategic_plan_2014-2018.pdf`).

Kerridge et al. (2013), BCMT Scientific Council meeting, 30 October 2013: observations and recommendations, *Bureau Central de Magnétisme Terrestre*, (`http://www.bcmt.fr/pdf/bcmt_sc_20131030_recs.pdf`).

## List of Acronyms

**SNO :** Service Nationale d'Observation

**BCMT :** Bureau Central de Magnétisme Terrestre

**CNES :** Centre National des Etudes Spatiales (French space agency)

**CNRS :** Centre National de la Recherche Scientifique

**EOST :** Ecole et Observatoire des Sciences de la Terre

**FTE :** Full Time Equivalent

**INSU :** Institut National des Sciences de l'Univers

**IPEV :** Institut Paul Emile Victor (French Polar Institute)

**IPGP :** Institut de Physique du Globe de Paris

**ISGI :** International Service of Geomagnetic Indices

**NOAA :** National Oceanic and Atmospheric Administration (U.S.)

**SC :** Scientific Council

# Contents

# 1 Introduction

The "Bureau Central de Magnétisme Terrestre" (BCMT) is a French organisation founded in 1921, and attached to the "Institut de Physique du Globe de Paris" (IPGP). The primary mission of the BCMT is to provide ground geomagnetic observations of the highest quality to the scientific community, in France and abroad. It also serves industrial, military and other societal users. The BCMT operations are mainly run by two institutions: the IPGP and the "Ecole et Observatoire des Sciences de la Terre" (EOST). On national level, the BCMT is officially recognised as a "Service National d'Observation" (SNO) in magnetism by the "Centre National de la Recherche Scientifique - Institut National des Sciences de l'Univers" (CNRS-INSU). Together with the International Service of Geomagnetic Indices (ISGI), that is in charge of the elaboration and dissemination of geomagnetic indices, they constitute the French reference body for the ground observations in geomagnetism. BCMT and ISGI are now seen by the CNRS-INSU as two independent services.

In this document we first describe the resources available at IPGP and EOST for running the services, and then shortly present the status and evolution of each observatory associated to the BCMT. We then turn to our activities over the last two years. These follow the recommendations made by Scientific Council (SC) during the last meeting the 03-10-2013 (Kerridge et al., 2013). The recommendations are closely linked to the strategic plan 2014-2018 (Chulliat & Chambodut, 2013), that has been presented and accepted during the last SC meeting.

# 2 Resources

There are currently 17 observatories run under the BCMT umbrella. The IPGP is maintaining 11 observatories, and EOST 6, that are listed below in Table 1. The installation of a new observatory is planned for year 2016 in Edéa (Cameroon), in replacement of the Bangui observatory (BNG) that has been closed for security reasons in June 2011. Detailed information on each observatory is provided in section 3. The list of personnel working in the French magnetic observation service is given in Table 2.

In IPGP, there are two scientists, four engineers and two technicians looking after the observatories. Arnaud Chulliat was head of the IPGP magnetic observatory service until January 2014, and has been replaced by Vincent Lesur, in September 2015. In between, Xavier Lalanne overtook the responsibility of the service. Pierdavide Coïsson, has been appointed as a "Physicien Adjoint" in February 2014 and affected to CLF observatory. He is in charge of developing inside the observatory, ionospheric physics and space weather applications. Usual observatory operations include absolute magnetic field measurements in CLF, processing all data (de-spiking and baseline estimation), maintenance of the acquisition chains for all observatories, maintaining contacts and giving advice to technical staff in remote observatories. Furthermore regular visits are made to remote observatories that sometimes include considerable infrastructure maintenance work. Involvement in INTERMAGNET operations implies data cross-checking of 14 USGS and 1 Spanish observatories.

In EOST, there is currently one scientist, and also 1.55 FTE engineers looking after the observatories. Jean-Jacques Schott, who was head of the EOST magnetic observatories department, retired in January 2010 and was never replaced. In June 2015 Sylvain Morvan, left the observation service. He was an engineer taking care of the instruments and global logistics. From October 2015, Jihane Sayad has been appointed in EOST to overtake part of his tasks. Usual observatory operations include training of 6 to 12 new observers each year, processing magnetic

observatory data (de-spiking, baseline estimation, quasi-definitive and definitive data calculation), and managing technically the magnetic observatories remotely by emails. Furthermore regular visits are made to remote observatories. Typically there is a 1-month visit around March-April to Austral Territories, a 1 to 2 months visit around the end of the year in Antarctica, and few weeks in May in Madagascar. As for IPGP observatories, these visits sometimes include considerable infrastructure maintenance work.

The funding agency for the BCMT is the CNRS-INSU that has maintained its funding to $106k€$ over the last two years. Other agencies are contributing to the observatory network operations:

| | | | |
|---|---|---|---|
| CNES | Funding for the operation of Kourou observatory | $34k€$ in 2014 | $42k€$ in 2015. |
| IPGP | Funding for the observatory operations | $80k€$ in 2014 | $90k€$ in 2015. |
| EOST | Funding for the observatory operations | $12k€$ in 2014 | $10k€$ in 2015. |
| IPEV | Funding for EOST observatory operations | $16.5k€$ in 2014 | $20k€$ in 2015. |

IPGP has also been providing independent funding for the renovation of Chambon-la-Forêt observatory infrastructure and buildings ($180k€$ over 2014-2016). EOST is providing independent funding for the operational costs of the training and testing EOST site, Welschbruch geophysical station at 100km from Strasbourg (10 $k€$ /year). L'Institut Paul Emile Victor (IPEV) is providing annual funding for logistical support and manpower (in 2015, $623k€$ direct and indirect costs).

Table 1: List of magnetic observatories under BCMT umbrella.

| Code | Observatory | Lat.(N)/Long.(E) | Institutions | Country |
|---|---|---|---|---|
| AAE | Addis Ababa | $9.03^o/38.77^o$ | GO AAU / IPGP | Ethiopia |
| AMS | Martin de Viviés | $-37.80^o/77.57^o$ | EOST | France |
| BNG | Bangui | $4.33^o/18.57^o$ | IPGP | Central African Rep. |
| BOX | Borok | $58.07^o/38.23^o$ | BGO IPE RAS / IPGP | Russia |
| CLF | Chambon la Forêt | $48.02^o/2.26^o$ | IPGP | France |
| CZT | Port Alfred | $-46.43^o/51.86^o$ | EOST | France |
| DLT | Da Lat | $11.95^o/108.48^o$ | IG VAST / IPGP | Vietnam |
| DMC | Dome C | $-75.10^o/123.32^o$ | EOST/INVG | Antarctica |
| DRV | Dumont d'Urville | $-66.66^o/140.00^o$ | EOST | Antarctica |
| IPM | Ile de Pâques | $-27.17^o/-109.41^o$ | DMC / IPGP | Chilie |
| KOU | Kourou | $5.21^o/-52.73^o$ | IPGP | France |
| LZH | Lanzhou | $36.09^o/103.84^o$ | LIS CEA / IPGP | China |
| MBO | Mbour | $14.39^o/-16.96^o$ | IRD / IPGP | Senegal |
| PAF | Port-aux-Français | $-49.35^o/70.26^o$ | EOST | France |
| PHU | Phu Thuy | $21.03^o/105.96^o$ | IG VAST / IPGP | Vietnam |
| PPT | Pamatai | $-17.57^o/-149.57^o$ | CEA / IPGP | France |
| TAM | Tamanrasset | $22.79^o/5.53^o$ | CRAAG / IPGP | Algeria |
| TAN | Antananarivo | $-18.57^o/47.19^o$ | IOGA / EOST | Madagascar |

Table 2: Personnel List

| **Name** | **Grade & Activity** | **FTE** |
|---|---|---|
| Lesur V. | Physicist (IPGP). Director of IPGP magnetic observatories. Operation management of the observatories and, in particular, responsible of the data quality. | 30% |
| Chambodut A. | Associate Physicist (EOST). Director of EOST magnetic observatories. Director of ISGI. Operation management of the observatories and, in particular, responsible of the data quality. | 30% |
| Coïsson P. | Associate Physicist (IPGP), Responsible of Ionosphere and Space weather developments for the IPGP magnetic network. | 30% |
| Lalanne X. | Senior engineer, CNRS (IPGP). Technical director of the IPGP observatories, Instrumentation R&D | 100% |
| Bernard A. | Senior engineer, CNRS (EOST). System administrator Computing infrastructure & Data management Training of Observers. | 30% |
| Maury V. | Senior engineer, CNRS (IPGP). System administrator, Computing infrastructure & Data management | 100% |
| Fotze M. | Engineer, CNRS (EOST). Technical Director of the EOST Observatories. Acquisition R&D. | 100% |
| Heumez B. | Engineer, CNRS (IPGP). Geomagnetic network management, Data processing. | 100% |
| Luc T. | Engineer, CNRS (IPGP). Scientific instrumentation R&D and maintenance (electronics design and development). | 100% |
| Sayadi J. | Engineer, CNRS (EOST). Scientific instrumentation & Training of observers. | 25% |
| Telali A. | Technician, (IPGP). Scientific instrumentation R&D and maintenance (data acquisition systems software, signal processing and calibrations). | 100% |
| Parmentier E. | Technician CNRS (IPGP). Maintenance of the national observatory infrastructure. | 100% |
| Kouadio A. | Office assistant, (IPGP). Administration. | 40% |

# 3 Observatory status

We shortly present in this section the current status and recent activities in all observatories under the responsibility of IPGP and EOST.

**AAE:**

The Addis Ababa, has been running without major difficulties for years. The last major upgrade of the acquisition system was on the 15-05-2013. XL visited the observatory in July 2015 to fix transmissions problems between the sensor shelter and the main building. As a slow degradation of the data quality had been linked to the ageing of the sensor shelters and absolute measurement hut, a complete refurbishing had been planned for the end of 2015 or beginning 2016. However, from the 18-09-2015 a large amount of noise has been propagating into the data flow. Soon after, the origin of the noise was identified: a new electric urban train service had started in Addis Ababa. It became obvious that the observatory had to be shut down. The flow of data toward INTERMAGNET has been stopped on the 11-11-2015 and toward the BCMT on the 01-01-2016. Data are still collected, but cannot be used for scientific investigations. The geophysical observatory service of Addis Ababa University is currently looking for a new place to rebuild an observatory.

**AMS:**

The Amsterdam magnetic observatory has been running without non-tractable difficulties. Some major improvements have been achieved before 2014, including the installation of a new theodolite with a Bartington MAG01H probe. In 02-2014, during a couple of weeks, a group of Amateur Radio performed communications on Amsterdam Island with the help of high-power antennas. The data have been consequently polluted and corrupted by the produced electromagnetic signals.

Regular visits at the magnetic observatory (last one in 04-2016), in close cooperation with the seismological observatory, allow to maintain the data quality and to check the observatory routine operations achieved by a IT technician on site for a year.

**BNG:**

BNG has been closed after all equipments were stolen in June 2011. The civil war has been affecting Central African Republic since 2012 preventing any project of reinstallation in this country.

**BOX:**

The Borok observatory has been running without major difficulties over the last two years. The building infrastructure has been renovated during October and November 2013. The data acquisition system is relatively old and has not been upgraded for years. Therefore only 1 minutes data are available. Furthermore, by restriction of the Russian authorities, data are only delivered with a 24 hours delay. In January 2014 a new data logger for 1-second sampling has been sent for replacement. However, it took more than a year for this equipment to go through the local custom services. A visit to the observatory has been scheduled for April 2015, but the visa has been cancelled by Russian authorities. All permissions have now been obtained and the installation has be re-scheduled for after the snow season. XL is expected to go to Borok observatory in Summer 2016. Analysis of the observatory data shows an apparent discontinuity of the observatory baseline in July 2013. This is possibly related to a thunder strike in the vicinity ($<$ 10m) of the absolute pillar. XL will try to investigate this, through a local survey of the site, during his next visit.

**CLF:**

Although data have been continuously distributed at 1Hz during the last two years, massive amount of work has been achieved in Chambon-la-Forêt observatory. Three new shelters have been built so that the instruments continuously monitoring the field can be moved out from the sensor vault that is often flooded. This operation required first the removal of an old borehole metallic casing (17 m long) from the site. This was finished by 26-02-2015, and generates a small discontinuity in the 2015 baseline, but no discontinuity was noticeable at the absolute pillar position. The first shelter was delivered in July 2015 and an instrument put in test inside. Performances of the shelter being in line with specifications, two other shelters were built and ready to be used by end of December 2015. Migration of the instruments from the vault towards the new shelters took most of February 2016. The final tests were achieved in March, so that the observatory is now settled in its new configuration. A series of baseline discontinuities are to be expected for these two months. Daily absolute measurements were made over this period to help maintaining CLF data to the highest achievable accuracy.

**CZT:**

The Crozet magnetic observatory has been running without major difficulties over the last two years. It was recently visited on 04-2016 in close cooperation with the EOST seismological observatory, in order to maintain the data quality and to check the observatory operation achieved by a IT technician on site for a year.

**DLT:**

Open in 1978, Da Lat observatory joined the BCMT and was digitalised in 2010. The amount of missing data is slowly decreasing over the years. It has been 12% in 2015. The main reason for this relatively high rate is that DaLat observatory has been damaged several time by storm activities over the last two years. XL visited the observatory on the 05-12-2013 to change the theodolite and improve the thunder strike protection. BH went there a year later for the same reasons. Significant upgrade of the electrical system has been done. There is, over the years, a slowly increasing noise level, mainly during summer periods, likely due to greenhouse flower growth activities nearby. No simple solutions are possible to overcome this problem. Absolute measurements are now made twice a week.

**DRV:**

The Dumont d'Urville magnetic observatory has been running without major difficulties. Some major improvements have been achieved on recent years (new theodolite, 1HZ acquisition system).

Regular visits at the magnetic observatory are made in order to maintain the data quality and to check the observatory operations achieved by a IT technician on site for a year.

**DMC:**

The Dôme C magnetic observatory has been running on a overwinter basis since 2005. However, some major difficulties arise as the observer sometimes cannot achieve the absolute measurements. Some major improvements have been made on recent years, the last one (11-2015) being the rejuvenation of the global electricity network in the two shelters. Regular visit at the magnetic observatory are made in order to maintain the data quality and check the observatory operation achieved by a IT technician on site for a year.

**IPM:**

BH made the last visit to the observatory on the 22-05-2013 for general maintenance and training of the local staff for absolute data acquisition. A slow degradation of these data

quality was observed from November 2014 on. The theodolite finally became unusable from August 2015. There have been difficulties to exchange the theodolite with one in working order. These have been resolved in March 2016. The data acquisition chain shows otherwise only minor data gaps although there is noise during day times due to the airport traffic. Karina Peña (observer) visited us in spring 2015.

**KOU:**

BH, and XL visited this observatory the last time in April 2014 for general maintenance and rebuilding the shelter containing the electronics. They also changed one of the magnetometer. Typically 98% of the 1-second data are available over the last years. Absolute measurements are made once a week, by contract with a local company that is allowed to work on site. Costs for this service are covered by CNES. Environmental constraints are significant, with high hydrometry and high temperatures. Real time connection is made by GSM that proves to be reliable. We think about using this technology on other places. A visit is planned for 2016 for rebuilding the absolute measurement shelter.

**LZH:**

No visit has been made to this observatory for several years. The GPS time reference has been lost from the 06-03-2013 to the 10-07-2014. The slow drift of the clock system precluded us to identify the problem early. Precise timing has been recovered for the period from the 06-03-2013 to 19-03-2014 by comparison with the Chinese acquisition system. However, after the system reboot on the 19-03-2014 the time drift was too fast for an accurate time stamp recovery to be possible. We note that the data are becoming noisy due to urban activity growth. Information about a possible move of the observatory was received but has been postponed due to the difficulty in finding a proper site. Decision has to be made if contributing to the new observatory is worthwhile, since Chinese scientists have all the required expertise and technology to run an observatory at INTERMAGNET level. We observe nonetheless that data provided by Chinese instruments in Lanzhou observatory are not of good quality to match INTERMAGNET requirements..

**MBO:**

The M'Bour observatory provides high quality data, and absolute measurements are made generally more than 5 times per week. There was a significant loss of data in 2013 (10%). KT therefore visited the M'Bour observatory last, in December 2013, to upgrade significantly the acquisition system. The observatory has then been running without major difficulties since: less than 2% of the data have been lost per year, due either to rare interruptions of the acquisition system associated with electric power shortage, or to failure of the data transmission system. To secure the near real time data flow from M'Bour observatory, a doubling of the data transmission system is planned (GSM).

**PAF:**

The Port-aux-Français magnetic observatory has been running without major difficulties. Some major improvements have been achieved on recent years, the last one ( 04-2016) being the change of the theodolite).

Regular visits at the magnetic observatory, in close cooperation with the seismological observatory, allow to maintain the data quality and to check the observatory routine operations achieved by a IT technician on site for a year.

**PHU:**

As in DaLat observatory, thunderstorms are major problems in PhuThui. The observatory was severely damaged in 2013 by thunder strike, and 55% of the data were lost that year.

XL visited the observatory in December to restart it. In 2014, the observatory was hit again and three months of data were lost in 2014. BH visited the observatory to restart it again. The observatory was struck by a thunderstruck again the 22-05-2015 at 14h00. The full observation set up was damaged. BH visited the observatory in July the same year but fail to restart the observatory. A mission is planned in May to rebuild entirely the acquisition system, and refurbish the building. Lack of "on the shelves" equipment is the main reason of this delay. A new system of thunder strike protection has been studied and will be installed on site. When available, data from this observatory are of good quality.

**PPT:**

The data acquisition chain has been upgraded in this observatory in 2009 that is providing since 1 Hz data. Real time connection is available since November 2011. There is nearly no data loss. The last visit to the observatory was in 2013 with an upgrade of the instruments and acquisition systems. Absolute measurements are rare at this observatory, well below the INTERMAGNET standards (typically once par month). Absolute data measurements were particularly sparse in 2015, and alternative solution where considered, as buying an automatic system, or moving the observatory to another place where alternative observer would agree to take regular measurements. However, the absolute building has been refurbished on site in October/November 2015, and very regular, acceptable quality, absolute measurements are available since beginning of 2016.

**TAM:**

No visit to Tamanrasset observatory has been possible in recent years due to access restriction imposed by French and Algerian authorities. The last visit to the observatory was in 2005. However the observatory is well maintained in working order, and if necessary upgraded, by local staff. Absolute building has been partially renovated in November 2015. Typically, three absolute measurements are made per week in this observatory. 1 Hz data have been available since 2010, and near real time data distribution has been in place since March 2011. There is practically no loss of data. Difficulties of data transmission occurred in 2015, limiting access to near real time data. Doubling of the data transmission system is under study.

**TAN**

The magnetic observatory of Antananarivo was totally destroyed in 2008. No data were acquired between 2009 and mid-2015. The re-installation of the Antananarivo observatory outside the city ($\sim$ 60 km/4 hours from Antananarivo) was initiated on 2015, indeed, due to political instability in the country a mission was not possible before this date. The energy supply system by solar panels and the variometer vault were installed. In the forthcoming months, the absolute measurement shelter and operations will be settled.

# 4 Activities

The former Scientific Council made a series of recommendations after the October 2013 meeting. In order to follow these recommendations we started a series of activities that we report below:

**Recommendation 1:** Management

Establishing a clear timeline with identified deliverables is difficult because our main task is to maintain the network of observatory in working order, and therefore to respond to unexpected interruptions of the data acquisition chains. Since the highest priority is given to this task, and given the limited work force available, long term developments and projects

are often difficult to maintain. We have nonetheless revised the rough schedule presented in the strategic plan (Chulliat & Chambodut, 2013). It can be seen in Figure 4. The main changes are on tasks (2d) and (3a). In the first case we replaced the planned installation of GNSS receivers by the installation of variometer stations. This choice is justified below (see recommendation 6). The second change – pushing forward the development of a scalar magnetometer in place of the vector magnetometer, is motivated by the need of replacing the ageing instruments in place in the observatory network. We still plan to develop three axial vector magnetometers, but with a lower priority.

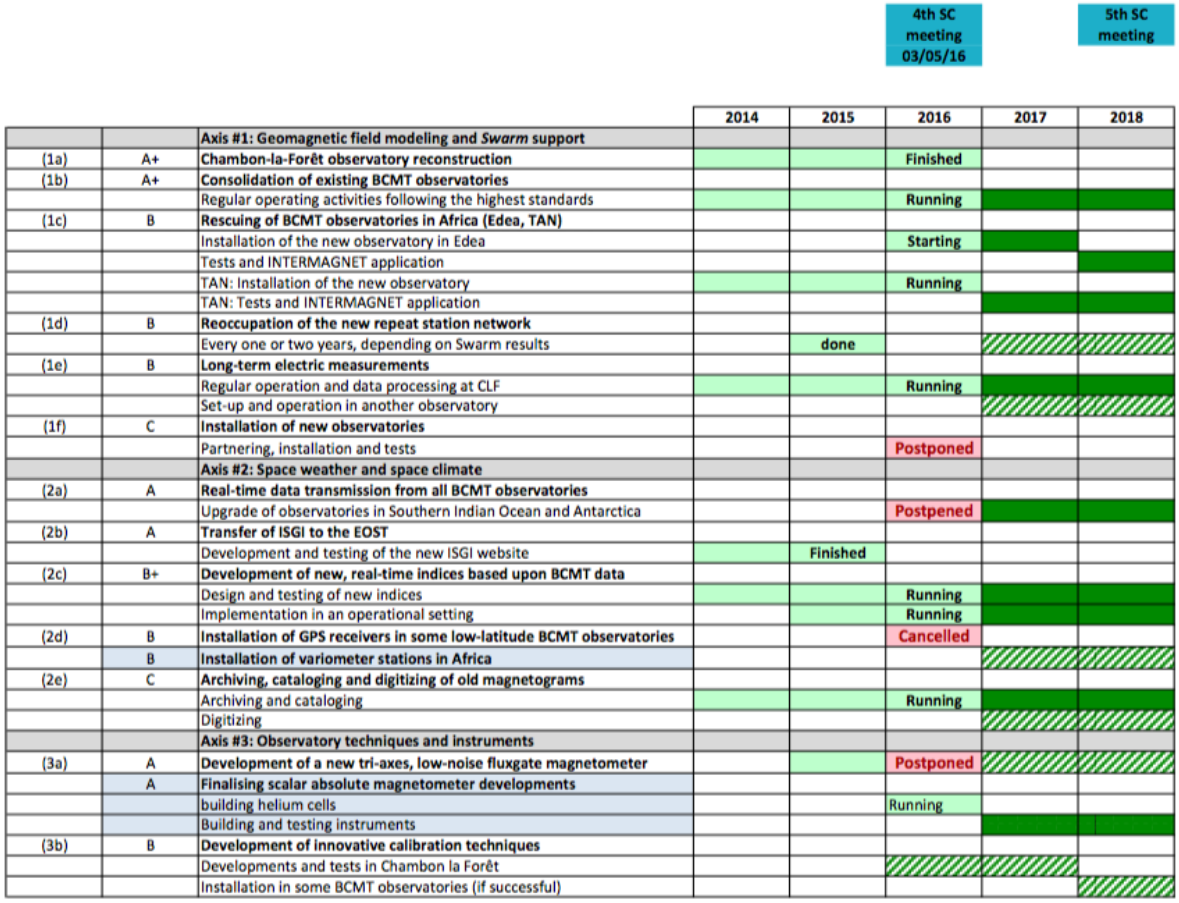


Figure 1: **Timeline update.** In light green are shown past activities, in red activities that have been cancelled or postponed. In dark green are displayed planned activities, whereas hashed area are associated with work we would like to start, but that highly depend on staff availability. In light blue are highlighted activities that were not planned in Chulliat & Chambodut (2013).

**Recommendation 2:** Staff management

Xavier Lalanne will retire at the end of year 2016. There is no possibility to hire a successor for his position prior to that date. The application to open a new position will be made during the year, and will be supported by IPGP with an high priority level. A new scientist is required in EOST (a Physicien-Adjoint) to get a similar configuration as between 2006 and 2010. This also corresponds to the recommandation of the "Haut Conseil de l'Evaluation de la Recherche et de l'Enseignement Supérieur" (HCERES) for EOST. Magnetic observatory management is a time consuming task and Aude Chambodut, in

charge of the service, is also making on top of her teaching responsibilities, the observatory data processing and some missions. This work load results into delays in delivering final definitive data to the community.

**Recommendation 3:** Flooding in CLF

To overcome the flooding of CLF observatory three new shelters have been built. The main instruments of the observatory have been moved to their new locations. Positions of the new pillars have been precisely established. The shelter heating systems allow to maintain the instruments at a nearly constant $25^oC$ temperature. We hope to be able to run in parallel three acquisition chains. A software solution has been setup that allow switching instantly from one acquisition chain to another, so that near real time data are always available. Real time data are for now still provided through an "EarthWorm" process, originally developed by USGS, but alternative solutions are under study. Ultimately we plan to fully reorganise the data management chain in IPGP. Final step of these operations is to install a permanent water pumping solution to maintain the architectural heritage of the original vault. This building will be no more used for magnetic measurements.

**Recommendation 4:** Transferring and cataloguing archives

IRD archives have been transferred to Chambon la Forêt. The archive facility has been built and the cataloguing and transfer of IPGP and IRD documents is in progress. A person was recruited part time to achieve this task.

**Recommendation 5:** Near real time data

Outside Borok and Lanzhou observatories where the local national organisations impose a 24 hours delay in the distribution of magnetic data, all other IPGP observatories are now providing near real time data. These data are distributed to NOAA and the French Air Force. The Indian Ocean observatories are not yet providing data in real time, but a solution has been found to resolve the difficulties and first steps have been made toward this goal for a completion within the next two years.

**Recommendation 6:** Installation of GNSS receivers

Installation of GNSS receiver has been planned in the strategic plan (Chulliat & Chambodut, 2013), but not with very high priority. However, we failed to secure the funding to support such an activity for years 2015 and 2016. On the other hand, we have been in contact with scientist and engineers in CNES that are interested in developing their own network of GNSS stations over northern Africa. Therefore, there is no benefit in pursuing further our original plans. Rather, we work towards organising a collaboration between CNES, BCMT and CRAAG (Tamanrasset observatory) to have a first location where GNSS and magnetic data are available. The next step is to set up a network of magnetic variometer stations at other places where GNSS data are acquired. A possible new location for such a set up is the N'Djamena airport (Tchad). This area is situated under the equatorial electrojet and therefore a variometer station at this place will serve the monitoring of the electrojet activity that is no further recorded accurately in Addis Ababa observatory. First contact have been made in this direction. Equipments originally planned for installation in Djibouti may be used there.

**Recommendation 7:** Edéa observatory

Due to lack of manpower, the installation of a new observatory in Edea (Cameroon) has not advanced significantly. The agreement has been signed in December 2012 between IPGP and the "Institut de Recherche Géologique et Miniére (IRGM)". The possibility to install an observatory in Benin has been studied but appears to be less practical. The

necessary material for building the observatory is available and ready to use in CLF. A first mission has been planned for June 2016 to define precisely the observatory location and make the first contact to prepare the area. A second mission for the pillars and heavy infrastructure is planned for the end of 2016. Final set up should follow in early 2017. First data should be distributed soon after.

**Recommendation 8:** INTERMAGNET

Three IPGP staff are currently involved in INTERMAGNET activity and management. Gauthier Hulot is in the executive council, Benoit Heumez is in the operation committee to bring his expertise in data quality. Virginie Maury is in the same committee regarding the IT and Paris GIN infrastructure.

**Recommendation 9:** Repeat station network

Data have been acquired over the full French repeat station network in late spring 2015. Data have been processed and are distributed on the BCMT portal. It is planned to produce an up-to-date model of the lithospheric field over France by June 2016.

**Recommendation 10:** ISGI Website

The ISGI Web site has been launched on June 2015 for the IUGG general assembly.

**Recommendation 11:** ISGI Scientific council

By decision from the CNRS-INSU, the BCMT and ISGI are now seen as two independent observation structures (two distincts SNO). Organisational aspects of ISGI are no further under BCMT responsibilities as ISGI is getting its own governance body appointed by IAGA.

**Recommendation 12:** Relationship with IRD

No more researchers of IRD are involved in geomagnetic observations. IRD is still a BCMT partner for running the M'Bour observatory and is providing technical support for the installation of Edéa observatory.

**Recommendation 13:** Relationship with BRGM

The BRGM is the French geological survey. Due to changes in the IPGP observatory management nothing has been done regarding contact with BRGM. On the other hand, since IPGP has a leading role in the developing the World Magnetic Anomaly Map (WDMAM), we will contact Jérôme Dyment to have a concerted approach on this subject.

**Recommendation 14:** Contact with CNES and INSU

We are in close contact with Mioara Mandea, head of the solid Earth scientific program in CNES, and also we have contacted Eric Humler, recently appointed head of the solid Earth science program in INSU. Through these contacts we hope to ensure that geomagnetism is considered in any plans to establish new bodies supporting long term observations.

**Recommendation 15:** Replacement of Arnaud Chulliat

Arnaud Chulliat left IPGP in February 2014. Vincent Lesur was foreseen to take the position but that has not been possible before September 2015. Xavier Lalanne overtook the responsibility of the IPGP magnetic observation service from February 2014 to September 2015.

# 5 Conclusions

The network of observatories under the responsibility of the French observation service is large and spread all over the world. The remoteness of some observatories and/or administrative difficulties, make difficult a rapid response to failing acquisition chains or instruments. That explain partly the large gaps that may occur in the time series of some observatories. The overall level of funding is acceptable and allows to maintain the network in working order. The main weakness of the service is linked to the lack of engineers and technicians.

In IPGP, we try to mitigate this issue by providing a processing software to the institutions hosting the observatories, so that they can process the acquired data locally to derive by themselves cleaned quasi-definitive or definitive values. Ultimately, we hope that the foreign institutions will be able to run their observatory independently. However, a significant amount of software development is necessary to progress along these lines. We think that filling Xavier Lalanne position after he retires, is absolutely necessary if we want to maintain the network. We are therefore actively involved in this process that is supported by IPGP management.

In EOST, the available man power for processing and maintaining the observatory network is decreasing year after years leading to significant delays in producing and distributing final clean data sets. This task, that is normally done by engineers of technicians, is left to the leading scientist, Aude Chambodut, reducing significantly her time dedicated to scientific studies. Replacement of J.J. Schott, that left for retirement in 2010, is necessary for a better exploitation of observatory data.

Regarding the development of activities inside the BCMT, we follow three different axes.

- We aim at providing near real time data with minimum amount of data loss. In EOST first steps have been made to install near real time connections with remote observatories. These will not be available before end of 2017. Most of IPGP observatories are providing data in near real time, but data gaps exist in the time series and progress are necessary.

- We try to develop the network in view of space-weather application. In particular, IPGP is trying to develop its network in equatorial Africa that is for now made of only two observatories (M'Bour, and AAE), but Edea observatory should soon be operational. We would like also to install a series of variometer stations nearby the equatorial electrojet, possibly paired with GNSS receivers from CNES.

- The installation of long term electric measurements in Chambon-la-forêt is providing useful data. A possible development is to install similar devices, either at other observatories, or in alternative places in France. We have however to make sure that these data will be used in science studies.

We hope that the scientific council will be able to give us his opinion on these strategic developments in order to organise our activities for the coming years.