

THE BRAZILIAN NETWORK FOR CONTINUOUS MONITORING OF GPS (RBMC), AN ACTIVE GEODETIC REFERENCE NETWORK

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ABSTRACT

The Brazilian Network for Continuous Monitoring of GPS (*Rede Brasileira de Monitoramento Contínuo do GPS - RBMC*) is an active geodetic reference network. Users can employ the observations collected at these stations to position any new GPS survey referred to the Brazilian Geodetic System. It consists of nine permanent GPS trackers, operated by IBGE in cooperation with other federal/state organizations. Two of the stations (Brasília and Fortaleza) also belong to the International GPS Service for Geodynamics (IGS) network, while the remaining seven are integrated into this service through observations, thus contributing to the densification of the IGS framework. All stations are also part of the South American Geocentric Reference System (*Sistema de Referência Geocêntrico para a América do Sul - SIRGAS*) network. The RBMC information is available to the user community that needs GPS L1 & L2 carrier phase and code reference data for post-processing, as well as for quasi real-time positioning applications. This paper will describe the day-to-day automatic operations and how to access its products, concluding with future perspectives such as the expansion of the network into the Amazonian region (6 stations) and to the south and northeastern portions of Brazil (one station in each area).

INTRODUCTION

The Brazilian Network for Continuous Monitoring of GPS (RBMC) is one of the first active geodetic reference networks in South America. IBGE (Fundação Instituto Brasileiro de Geografia e Estatística), as the institution responsible for geodetic activities in Brazil, presented the first proposal for the project in 1991 (see FORTES, 1993, 1996a and 1996b). After some changes, in order to keep up with the state-of-art of GPS technology, now RBMC consists of nine permanent GPS stations, two of which are IGS stations: Brasília (BRAZ) and Fortaleza (FORT). The remaining seven stations have been established, between December 1996 and July 1997, by IBGE in cooperation with EPUSP (Escola Politécnica da Universidade de São Paulo) and other Brazilian institutions, and sponsored by FNMA (Fundo Nacional do Meio Ambiente). Those seven stations will be referred to in this paper as "IGS-SIR" ones, as IBGE is contributing to IGS densification, sending the corresponding data to the SIR IGS Regional Network Associate Analysis Center (RNAAC), located at DGFI (Deutsches Geodätisches Forschungsinstitut), Germany. Figure 1 shows the current RBMC configuration, with two IGS stations, the seven IGS-SIR ones, and future stations.

STATION DESCRIPTION

Each station is materialized by a centering forced device, specially designed by IBGE for RBMC, which is set up in a very stable structure of the corresponding building. The IGS-SIR stations are equipped with TRIMBLE SSI GPS receivers, each with 9 L1 and L2 full wavelength channels, able to also measure pseudo-range on L1 and L2; immunity to radio interference; choke ring antenna; 10 Mb of memory; and backup batteries for 16 hours of operation. In addition, there is a PC computer which is used for local and remote operation of the station (see next item) and an uninterrupted power supply (UPS). Detailed specifications of the station can be found in FORTES (1997).

OPERATION

The IGS-SIR stations of RBMC are operated in an automatic way, based on procedures developed at IBGE, while the IGS stations (BRAZ and FORT) follow the procedures established by JPL and USGS, respectively.

The major steps of the automatic operation procedure for the network stations are : closing the previous observation session file and opening the new one at 00 h00 m UT; executing a batch file on the station microcomputer at 05h00m UT (02h00m Rio de Janeiro time) to accomplish download data from the receiver memory, data format transformation, preliminary quality check using the QC program (GURTNER, 1994), compression of the files using PKZIP program; and downloading the ZIP file to the RBMC control center, located at IBGE Department of Geodesy's headquarters, in Rio de Janeiro, at 06h00m UT (03h00m Rio de Janeiro time), using the communication software pcANYWHERE32 for Windows95 combined with telephone lines or Internet access, when available. The computer at the control center connects to each station, sequentially, and commands the file transfer.

With the above procedure it is expected that all data collected during a day is available at the control center in the next morning, before working hours. The operation also includes the remote control of the stations, from the control center, in order to allow full access to the GPS receiver.

Concerning the IGS stations, the RINEX observation files of BRAZ and FORT are regularly downloaded from JPL and CDDIS (Crustal Dynamics Data Information System) databases, respectively, and made compatible with the others in terms of name and compression utility used.

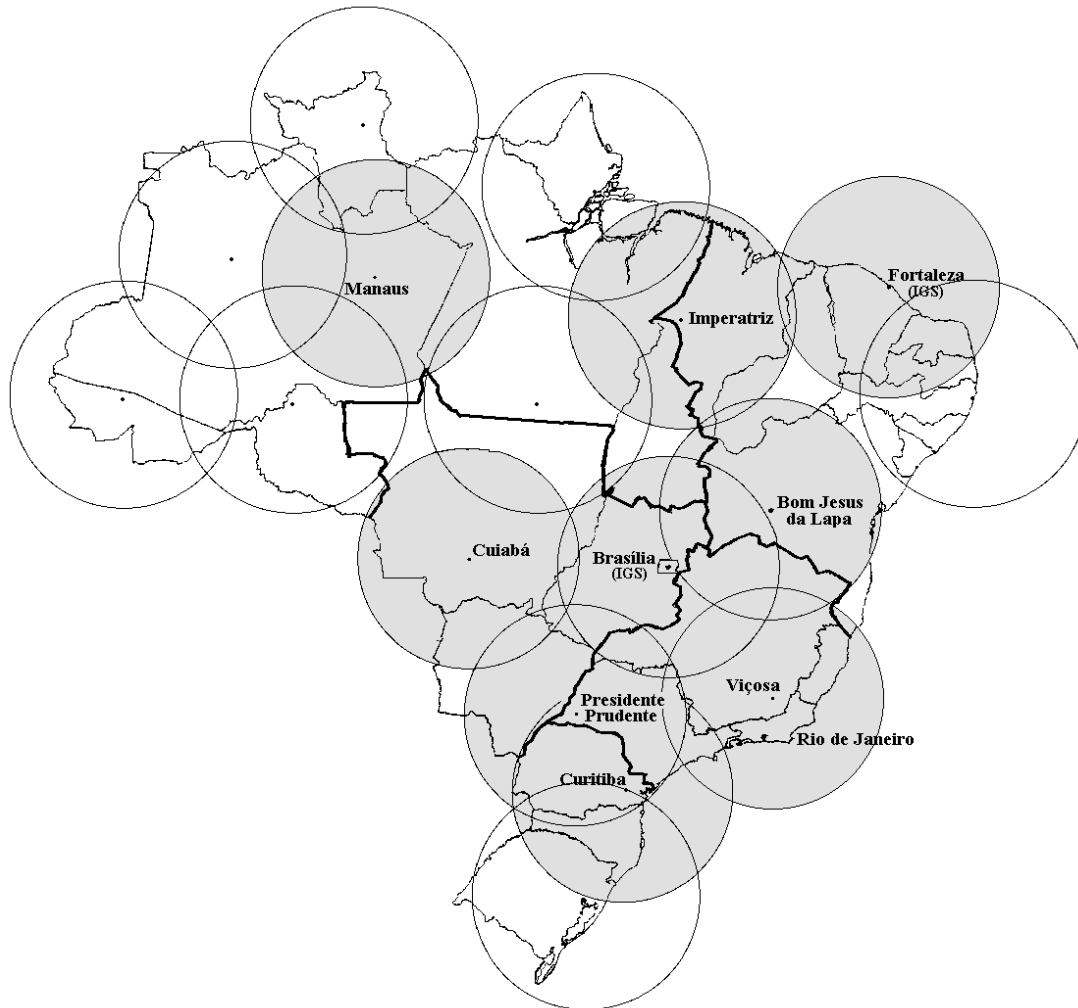


FIGURE 1: RBMC stations. Center of a gray circle represents a RBMC station. Center of a transparent circle represents a station proposed for future densification. Each circle has a 500 km radius

PROBLEMS

The RBMC operation has been very successful, despite its recent start. The only exception occurs at the Imperatriz station (the last one set up), which is experiencing serious communication problems. For the remaining six IGS-SIR stations, Table 1 shows the percentage of data loss. The proposal is to provide data collected at each station during all days of the year and the expectation is to get closer to 0% of data loss after the first year of operation.

Another problem is related to the automatic file transfer from the stations to the control center. In some cases, it fails due to the poor quality of the telephone lines in Brazil. However, this does not imply in data loss, as the file stored in the local computer and in the receiver memory (in the later case, for some days only) is then downloaded manually to the control center during the working hours.

PERSPECTIVES AND CONCLUDING REMARKS

The next step of the project will involve the densification of the network in the Amazon region (6 stations), and in the Northeast and South regions (one station in each) (see Figure 1). It is also planned to install barometers and thermometers at each station, in order to support meteorological applications, as suggested by Duan et al. (1996).

It is important to emphasize that, as all RBMC stations belong to the SIRGAS Reference Network (IBGE, 1997), all GPS positioning in Brazil using them as reference will be automatically integrated into that new system.

It can be inferred from what was stated on this paper that Brazil has now a modern active geodetic reference network based on GPS.

TABLE 1: Percentage of data loss by Dec 31, 1997, for six IGS-SIR stations of the RBMC network

	PARA	UEPP	BOMJ	MANA	VICO	CUIB	TOTAL
operating days	383	378	314	246	223	195	1739
days lost	4	12	30	25	6	8	85
% of data lost	1	3	10	10	3	4	5

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