

# Fortaleza Station Report for 2015 and 2016

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**Abstract** This is a brief report about the activities carried out at the Fortaleza geodetic VLBI station (ROEN: Rádio Observatório Espacial do Nordeste), located in Eusébio, CE, Brazil, during the period from January 2015 until December 2016. The total observed experiments consisted of 183 VLBI sessions and continuous GPS monitoring recordings. About 92% of VLBI recorded data was transmitted through high speed network.

## 1 General Information

The Rádio Observatório Espacial do Nordeste, ROEN, located at INPE facilities in Eusébio, nearly 30 km east of Fortaleza, Ceará State, Brazil, began operations in 1993. Geodetic VLBI and GPS observations are carried out regularly, as contributions to international programs and networks. ROEN is part of the Brazilian space geodesy program, which was initially conducted by CRAAE (a consortium of the Brazilian institutions Mackenzie, INPE, USP, and UNICAMP) in the early 1990s. The program began with antenna and instrumental facilities erected, with activities sponsored by the U.S. agency NOAA and the Brazilian Ministry of Science and Technology's FINEP agency.

ROEN is currently coordinated by CRAAM, Center of Radio Astronomy and Astrophysics, Engineering School, Mackenzie Presbyterian University, São

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Paulo, in agreement with the National Institute for Space Research INPE. The activities are currently carried out under an Agreement of Cooperation which was signed between NASA—representing research interests of NOAA and USNO—and the Brazilian Space Agency, AEB, and which was extended until 2021. Under the auspices of the NASA-AEB Agreement, a contract was signed between NASA and CRAAM, Mackenzie Presbyterian Institute and University to partially support the activities at ROEN. In 2014, the contract was renewed for five more years.

The counterpart of the operational costs, staff, and support of infrastructure are provided by INPE and by Mackenzie.

## 2 Main Instruments

The largest instrument at ROEN is the 14.2-m radio telescope on an alt-azimuth positioner. It is operated at S- and X-bands, using cryogenic radiometers. The system is controlled by the Field System, Version 9.11.6. Observations are recorded with a Mark 5A system and transmitted through a high speed network either to the U.S. (WACO and Haystack correlators) or to the Bonn correlator in Germany at rates of about 220 Mbps. The 1 Gbps link was accomplished in 2007. It integrates and is sponsored by the Brazilian Research Network—RNP. One Sigma-Tau hydrogen maser clock standard is operated at ROEN. GPS monitoring is performed within a cooperative program with NOAA (USA). There is a Leica System 1200 installed at the station that operates continuously. The collected data are provided to the NOAA/IGS center and to the Brazilian IBGE center. ROEN has



**Fig. 1** 14.2-m radio telescope.

all basic infrastructures for mechanical, electrical, and electronic maintenance of the facilities.

### 3 Staff

The Brazilian space geodesy program is coordinated by one of the authors (PK), who is Brazil's AEB representative in the NASA-AEB Agreement. The coordination receives support from the São Paulo office at CRAAM/Instituto and Universidade Presbiteriana Mackenzie, with administrative support from Valdomiro M. S. Pereira and Lucíola Russi. The Fortaleza Station facilities and geodetic VLBI and GPS operations are managed on site by Dr. Antonio Macilio Pereira de Lucena (INPE), assisted by Eng. Adeildo Sombra da Silva (Mackenzie), and the technicians Emerson Costa (Mackenzie) and Francisco Renato Holanda de Abreu (Mackenzie).

## 4 Current Status and Activities

### 4.1 VLBI Observations

In the years 2015 and 2016, Fortaleza participated of geodetic VLBI sessions described in Table 1.

**Table 1** 2015 and 2016 session participation.

Session Type	Number of Sessions
IVS-R1	73
IVS-R4	74
IVS-T2	9
R&D	14
CRF	6
OHIG	7

### 4.2 Operational and Maintenance Activities

The summary of activities performed in the period is listed below:

1. Repair and maintenance of the following equipments: cryogenic system, Mark IV acquisition system, Mark 5A recorder, antenna mechanical and electrical systems, angle encoders system, and receiver telemetry.
2. Replacement of one Sigma-Tau maser power supply unit.
3. Restoration and painting of the antenna.
4. Repair of electrical motors and gear boxes of antenna drives.
5. Renewal of electrical structure of main building.
6. Repair of the angle transducer spare unit.
7. Operation and maintenance of geodetic GPS (NOAA within the scope of NASA contract).
8. Operation and maintenance of power supply equipment at the observatory (main and diesel driven standby).
9. Transferring of recorded data through high speed network.

### **4.3 GPS Operations**

The IGS network GPS receiver operated regularly at all times during 2015 and 2016. Data were collected and uploaded to IGS/NOAA.