Instituto Geográfico Nacional Argentino (IGN-Ar) Associate Analysis Center Report

Facundo Nahuel Barrera, Natalia Cañas, Micaela Carbonetti, Sergio Cimbaro

Abstract This report briefly presents a description of the Instituto Geográfico Nacional (IGN) VLBI Analysis Center and its activities from 2023 to 2024. Since April 2020, the National Geographic Institute of Argentina (IGN-Ar) has been operating as an IVS Associate Analysis Center, with the purpose of enhancing its involvement in the operational production of geodetic products. Recent achievements as well as future plans are presented.

1 General Information

The IGN Analysis Center is the agency in charge of VLBI processing within the Research Center for Applied Geodesy (CIGA). It is supported and operated by the National Geographic Institute (Figure 1) in Buenos Aires, Argentina.

IGN-Ar is the institution in Argentina responsible for the determination of geodetic reference frames. In 2005, the IGN developed and began to operate the GPS Data Scientific Processing Center (CPC-Ar) with the purpose of updating the National Geodetic Reference Frame Argentine Geodetic Positions (POSGAR). The IGN oversees the development and maintenance of the Argentine CORS Network (RAMSAC), the National Leveling Network (RN-Ar), and the National Gravimetric Network (RG-Ar). Furthermore, CPC-Ar has been associated with the Geocentric Reference System for the Americas (SIRGAS) as an Official Processing Center, beginning its contributions to Working Group 1 in 2011.

Fig. 1 National Geographic Institute of Argentina.

The installation of the Argentine-German Geodesy Observatory (AGGO), a joint project between the National Council for Scientific and Technical Research of Argentina (CONICET) and the Federal Agency for Cartography and Geodesy of Germany (Bundesamt für Kartographie und Geodäsie, BKG), gave new impetus to the national geodetic community by being the first Argentinian co-location point of multiple geodetic techniques such as GNSS, SLR, and VLBI. In 2017, IGN developed CIGA aiming to process geodetic data obtained at AGGO and provide solutions for different international services such as IVS [1], ILRS, and SIRGAS.

In 2018, the VLBI AGGO antenna became part of the IVS observing program [2]. The temporal evolution of the antenna coordinates with respect to reference coordinates as shown in Figure 2. In 2020, IGN-Ar began submitting the results of 24-hour session processing to IVS.

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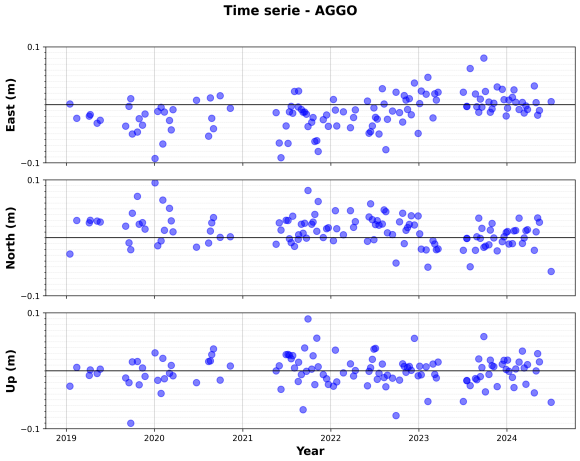

Fig. 2 Temporal evolution of the position of AGGO.

2 Activities During the Past Years

The primary activities of the IGN VLBI group have focused on the routine processing of 24-hour sessions in order to estimate all Earth Orientation Parameters (EOP) as well as station coordinates, station velocities, and radio source positions. All available 24-hour and 48-hour sessions in vgosDb format were processed promptly upon their release to the repository, and the resulting products have been made accessible to the IVS via FTP. In addition, we continued the reprocessing of historical data, having completed the analysis of all sessions from 2013 to the present.

During 2023 and 2024, the IGN VLBI group has maintained a sustained effort to strengthen the IGN Analysis Center through specialized training and targeted studies. As the only center of its kind in Latin America, we have recognized the importance of promoting the technique within the region to foster broader engagement and interest. To this end, we have presented our work at various conferences and scientific meetings related to VLBI, highlighting the significance of the technique, our results, and the progress achieved. In particular, we participated in the *4th Geosciences for Engineering Conference* (November, 2023), the *66th Annual Meeting of the Argentine Astronomical Association* (September, 2024), the *Outreach Session of the National Committee Session of the International Union of Geodesy and Geophysics* (October, 2024), and the *SIRGAS 2024 Symposium* (November, 2024).

The academic impact of our processing center has also been reflected through student research. In this regard, a member of our VLBI staff, Facundo Nahuel Barrera, completed his undergraduate thesis in Geophysics based on data processed at our center [3]. His work, entitled '*Performance of the VLBI Station AGGO in the Determination of Earth Orientation Parameters: Current Status and Future Prospects*,' illustrates the contribution of the IGN Analysis Center to academic training and the development of geodetic research in the region.

3 Staff

The National Geographic Institute has approximately 200 employees. Its responsibilities include contributing to the maintenance of international, regional, and national geodetic networks; production and dissemination of knowledge and geographic information on the Argentine Republic; and management, production, and publication of geospatial information under international standards and norms.

Members who are contributing to the VLBI Analysis Center are listed in Table 1 (in alphabetical order).

Table 1 Staff members.

Name and Email	**Function**
Barrera, Facundo Nahuel [fbarrera@ign.gob.ar]	Operational data analyst
Cañas, Natalia [ncanas@ign.gob.ar]	Operational data analyst
Carbonetti, Micaela [mcarbonetti@ign.gob.ar]	Coordinator of CIGA group and Operational data analyst
Cimbaro, Sergio [scimbaro@ign.gob.ar]	Director of Geodesy Department since 04/2024
Etchegoyen, María del Rosario [metchegoyen@ign.gob.ar]	VLBI group assistant
Guagni, Hernán [hguagni@ign.gob.ar]	Director of Geodesy Department up to 03/2024
Mejía, Alan [amejia@ign.gob.ar]	Website and database maintenance

4 Current Status

The VLBI group at IGN generates daily solution files (DSNX) containing an estimation of 24-hour Earth Orientation Parameters and site positions, as well as their covariances and decomposed normal equations.

Moreover, results with a 48-hour epoch per session are generated in order to get two EOP offsets. These offsets are estimated at midnight before and after the session. Thereby, our solutions are ready to be integrated into the IVS combination effort.

Currently, IGN-Ar uses the VieVS scientific software (Vienna VLBI and Satellite Software), developed by Vienna University, Department of Geodesy and Geoinformation [4]. We apply the following models and international standards:

- Earth Reference Frame: ITRF2020
- Celestial Reference Frame: ICRF3
- Troposphere Mapping Function: VMF3
- Oceanic Loading Model: TPX07.2
- Polar Drift Model: LINEAR IERS2019
- Antenna Thermal Deformation Model: Nothnagel
- Atmospheric Loading Model: GSFC
- Precession/Nutation Model: IAU 2006/2000a
- A priori EOPs: IERS C04 20
- High Frequency EOP Model (HF-EOP): Desai & Sibois (2016)

We usually compare our results with products from different analysis centers as well as with the IERS combined solution in order to validate their reliability. Figures 3 to 6 illustrate the comparison between IGN and IERS EOP C04 solutions for the main Earth Orientation Parameters: polar motion (XPO, YPO), UT1-UTC, LOD, and celestial pole offsets (dX, dY).

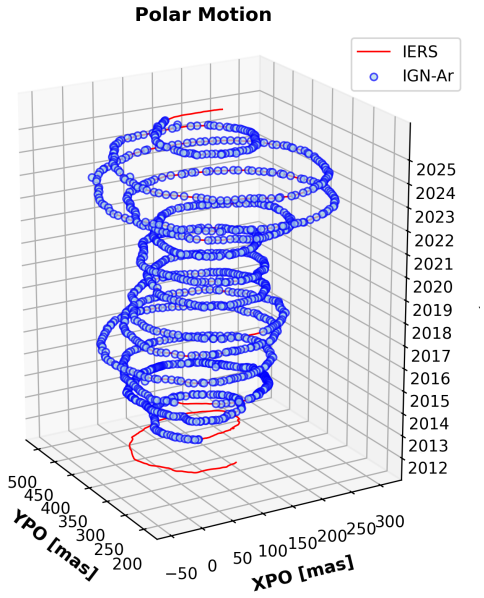

Fig. 3 Difference between polar motion XPO-YPO calculated by IGN and IERS (EOP C04 series).

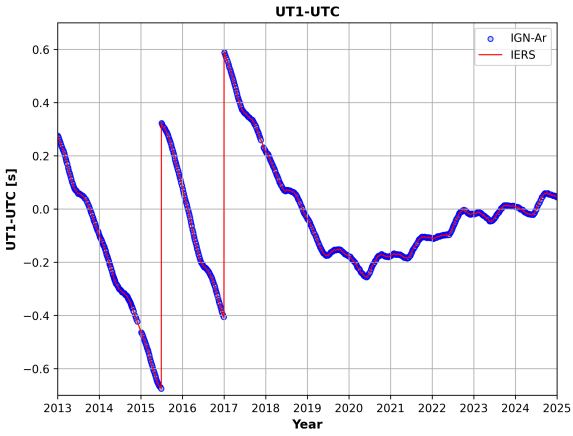

Fig. 4 Difference between dUT calculated by IGN and IERS (EOP C04 series).

5 Future Plans

The medium-term goals of the IGN-Ar VLBI group include:

- Completing the historical reprocessing of VLBI sessions,
- Generating global solutions,
- Initiating the processing of Intensive sessions, and
- Strengthening collaboration and comparison with other IVS Analysis Centers.

Looking ahead, IGN-Ar plans to continue with the routine analysis and submission of 24-hour sessions to the IVS, with the scope progressively extended to Intensive sessions. In addition, the VLBI group aims to produce its own global solution on a regular basis. Beyond the continuous improvement of the VLBI Analysis Center, new geodetic research activities will also be undertaken. At the same time, efforts will be devoted to further promoting the technique and fostering the advancement of scientific research within the region.

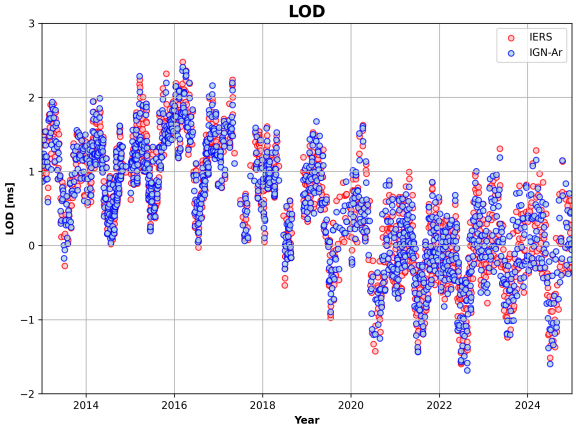

Fig. 5 Difference between LOD calculated by IGN and IERS (EOP C04 series).

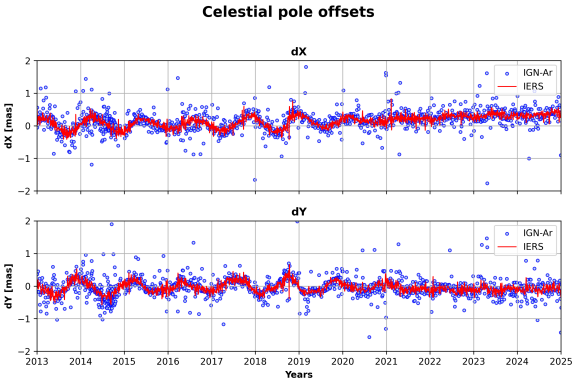

Fig. 6 Difference between celestial pole offsets (dX,dY) calculated by IGN and IERS (EOP C04 series).

Acknowledgements

The IGN-Ar VLBI group gratefully acknowledges the institutional support of the *Consejo Nacional de Investigaciones Científicas y Técnicas* (CONICET) and the *Federal Agency for Cartography and Geodesy of Germany* (BKG), whose collaboration with the National Geographic Institute of Argentina has been essential to strengthening the AGGO project and to advancing the development of geodetic research in the region.

References

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