Achievements and Prospects of the RAEGE Analysis Group

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Abstract Established within the RAEGE project, the Analysis Group was formed in 2021. Comprising collaborators from the National Geographic Institute of Spain (IGN), Yebes and Santa Maria RAEGE observatories, and the University of Alicante (UA), the group promotes VLBI analysis activities, facilitates knowledge exchange, and enriches research horizons within the RAEGE project. Focusing on VGOS and Intensive data processing at RAEGE stations, our efforts encompass end-to-end data processing. This autonomy enables rapid tests, yielding comprehensive assessments and swift results. Key projects include the comparative analysis of different data analysis software, with a special emphasis on VGOS data processing, multi-technique analysis, and the ongoing study of gravitational deformation of antennas. The group evaluates station performance, conducts Intensive test observations, and delves into the computation and processing of historical VLBI data with varying mathematical parameters, among other topics. The work has resulted in contributions to international conferences, showcasing a commitment to advancing geodetic accuracy.

Keywords RAEGE, Analysis, TRF, CRF, VLBI

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1 Introduction

The RAEGE (Atlantic Network of Space and Geodynamic Stations) project is a collaborative effort between the government of the Azores and the Spain government, aiming at expanding the understanding of Earth's dynamics through geodetic and astronomical observations. The network consists of observatories located in the Azores (Santa Maria and Flores) and Spain (Yebes and Gran Canaria) (see Figure 1). Currently, Santa Maria and Yebes stations are fully operational (see Figure 2 and Figure 3). A dedicated analysis group was established within this framework to focus on VLBI analysis and related techniques. This group includes researchers from collaborators from the National Geographic Institute of Spain (IGN), Yebes and Santa Maria RAEGE observatories, and the University of Alicante (UA).

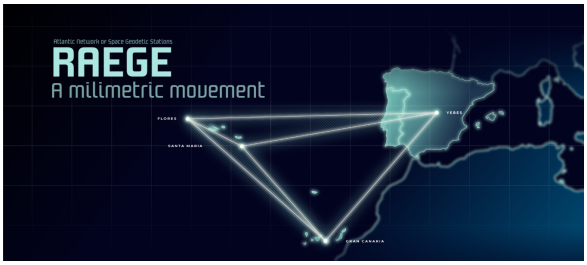

Fig. 1 RAEGE Network—Santa Maria and Flores in the Azores, and Yebes and Gran Canaria in Spain.

Fig. 2 Operational RAEGE Station Yebes (RAEGYEB).

Fig. 3 Operational RAEGE Station Santa Maria (RAEGSMAR).

2 Objectives

The RAEGE Analysis Group was formed with the following primary objectives:

- **Promotion of VLBI Activities:** To enhance VLBI analysis activities within the RAEGE project and facilitate their integration with other geodetic techniques.
- **Knowledge Exchange:** To foster collaboration among international research groups, sharing expertise and methodologies.
- **Research Enrichment:** To broaden research horizons by exploring new approaches and technologies in geodetic analysis.
- **International Collaboration:** To strengthen ties with global research institutions, enhancing the group's impact on the broader scientific community.
- **VGOS and Intensives Data Processing:** To improve data processing capabilities at RAEGE stations, particularly focusing on VGOS and Intensive sessions.

3 Research Activities and Current State

The group employs a combination of empirical analysis, simulation studies, and Intensive observation sessions to achieve its research objectives.

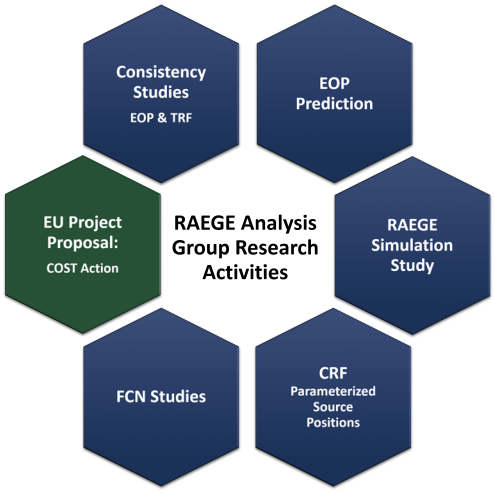

Fig. 4 The RAEGE Analysis Group research activites.

Some of the current research activities and current state are (see Figure 4):

- **Test Intensive Observations:** The group conducted test Intensive observations between the Seshan, Ishioka, Yebes, and Santa Maria stations. The goal of these sessions is to compare different UT1 sessions and assess the impact of Radio Frequency Interference (RFI).
- **Enhanced VGOS Data Processing:** At RAEGE stations, VGOS data processing capabilities have been significantly improved, enabling more accurate and efficient analysis.
- **Earth Orientation Parameters (EOP) Prediction:** Using machine learning algorithms and updated nutation models to predict EOPs.

- **Terrestrial Reference Frame (TRF) Consistency Studies:** Evaluating the impact of different TRFs and processing parameters on EOP computation, with a specific focus on UT1 and Polar Motion.
- **Free Core Nutation (FCN) Analysis:** Developing new models for FCN using celestial pole offsets estimated by VLBI, potentially replacing conventional models and improving accuracy. The development of new strategies for modeling FCN has shown promise in improving the accuracy of VLBI-derived celestial pole offsets, with potential accuracy improvements of up to 20%.
- **Parameterized Source Positions:** By applying the multi-adaptive regression splines (MARS) algorithm, the group has been able to mitigate source position variations, allowing for the inclusion of 'unstable' sources in the geodetic datum.
- **Artificial Intelligence in Geodesy (AI4GEOD):** The RAEGE Analysis Group is part of an EU project proposal (COST Action) aiming to investigate the application of AI to enhance data prediction accuracy and reliability in geodetic products.

4 Future Prospects

Looking ahead, the RAEGE Analysis Group plans to expand its research into several areas. The group aims to explore further integration of VLBI with techniques such as GNSS and SLR to improve the accuracy and reliability of geodetic measurements. Another focus will be on refining predictive models by using advanced algorithms and more comprehensive data sets. In addition, the group will continue to investigate optimal configurations for the RAEGE network to enhance data quality and reliability. Research into detecting and modeling climatic signals in geodetic data is also planned to be pursued, with the hope of providing valuable insights into the impact of climate change on the Earth's dynamics.

5 Conclusion

The RAEGE Analysis Group has established itself in geodetic research, with significant contributions to VLBI analysis, EOP prediction, and the integration of AI in geodesy. The group's work is paving the way for more accurate and reliable geodetic products, which are essential for understanding and responding to changes in the Earth's dynamics. Continued collaboration and innovation will be critical as the group moves forward with its research agenda.

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