

Status of AFREF Project

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Abstract

The African Reference Frame (AFREF) project is divided in sub-regional entities as North (NAFREF), West (WAFREF), East (EAFREF), Central (CAFREF) and Southern (SAFREF). The AFREF status of and planned activities will be summarized, and in particular the current NAFREF situation as result from NAFREF workshop held in Rabat in October 2003.

I. Introduction

AFREF Project aims at providing a modern continental reference system for Africa, fully consistent and compatible with the International Terrestrial Reference Frame (ITRF). Among the divers benefits of having a unified geodetic reference system for Africa, we can mention, in particular, the necessity of planning meaningful and cohesive development projects, establishing mapping and environmental programs and resolving international boundary disputes. For more details about AFREF, the reader may refer to the report summarizing the AFREF activities during the past 4 years, prepared by Wonnacott (2003). Because of its easy use and low cost, the Global Positioning System (GPS) and other GNSS systems are the main tools to be used in the implementation of AFREF Project. The project was initiated by a joint effort of the former commission 10 of the International Association of Geodesy (IAG) and the International GPS Service (IGS). An official letter describing the AFREF rational and soliciting contribution to the project was prepared by R. Neilan and C. Boucher and widely distributed in 2001. The IGS Central Bureau (IGS CB) continues to support the project and useful information could also be found at the IGS CB web site (<http://igscb.jpl.nasa.gov>).

2. AFREF and the IAG

Within the current Commission 1 structure of the IAG, AFREF is being one of the 6 regional entities of the sub commission 1.3 dealing with regional reference frames. The main objectives of sub-commission 1.3 are:

- Develop specifications for the definition and realization of regional reference frames
- Develop and promote operation of GNSS permanent stations
- Encourage and stimulate the emerging development of the AFREF project
- Encourage and assist, within each regional sub-commission, countries to re-define and modernize their national geodetic systems, compatible with the ITRF

The African continent comprises more than 50 countries, each one having its own priorities and difficulties. Therefore a sub-regional structure is being proposed for more efficiency and progress. These regional entities are: NAFREF (North), SAFREF (South), CAFREF (Center), EAFREF (East) and WAFREF (West). To realize AFREF objectives, permanent and semi permanent GNSS stations are necessary for the backbone and the long term maintenance of AFREF. The permanent stations would ideally belong to the IGS global network, facilitating thus the AFREF linkage and compatibility with the ITRF. Densification per country would then be necessary and could be achieved through repeated campaigns.

3. North African Reference Frame (NAFREF)

Six northern African countries joint their effort to establish a common reference frame (NAFREF), being the northern part of AFREF. These countries are: Mauritania, Morocco, Algeria, Libya, Tunisia and Egypt. For that purpose, 3 workshops were held; in Tunis (May 2000), Algiers (May 2001), and Rabat (October 2003). At the last workshop, a protocol of agreement was prepared and proposed to the six countries for endorsement, focusing in particular on the establishment of a common GPS pilot project to initiate the cooperation between the 6 countries.

4. Current Space Geodesy in Africa

The currently operating space geodesy sites are illustrated in Figure 1, underlying the four techniques (VLBI, SLR, GPS and DORIS).

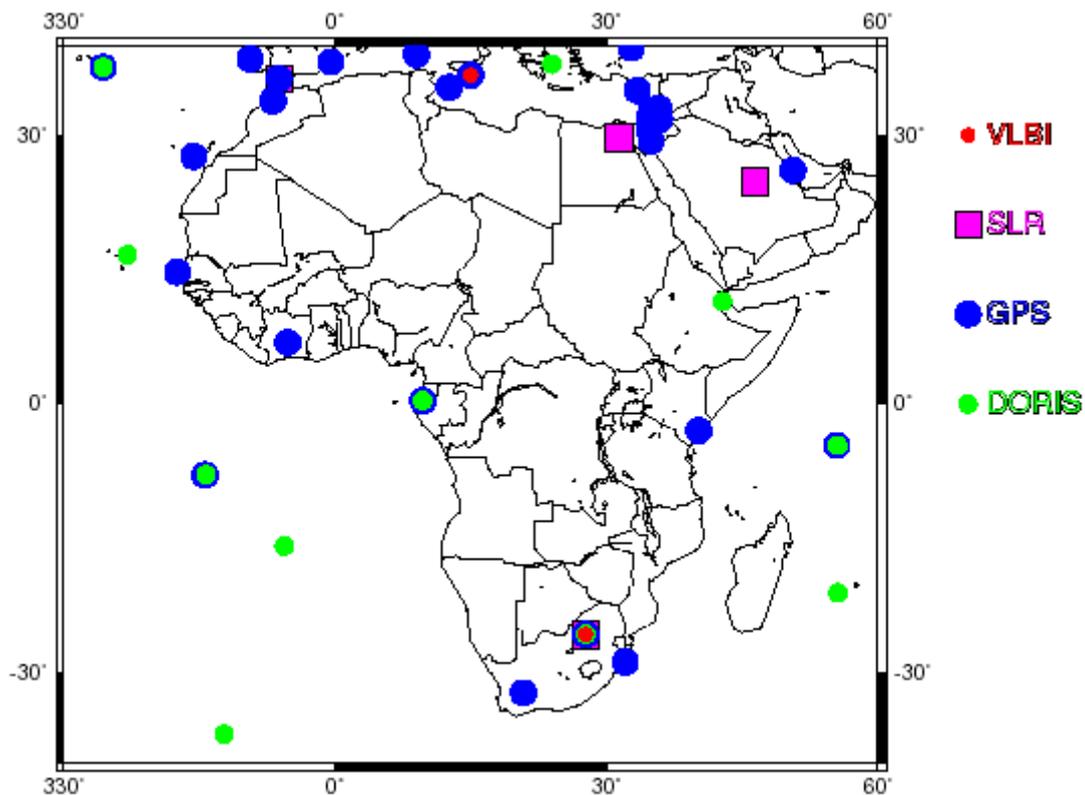


Figure 1. Currently operating sites in Africa

Due to the small number of space geodesy sites in Africa, its kinematics is not accurately known. However, as result of a multi-technique combination based on time series of station positions, a global plate motion model, including African plate, has been estimated. Figure 2 depicts the velocities of the selected sites used in this estimation. For the particular case of Africa, 5 GPS sites and 3 DORIS sites were selected. The results of this estimation show that the relative rotation pole between Africa (Nubia) and Eurasia is located about 25° south of the predicted location by NUVEL-1A model. Moreover, the magnitude of the relative angular velocity of these two plates is about 50% slower than NUVEL-1A prediction. More space geodesy observing stations are therefore needed to confirm and refine these preliminary geophysical results .

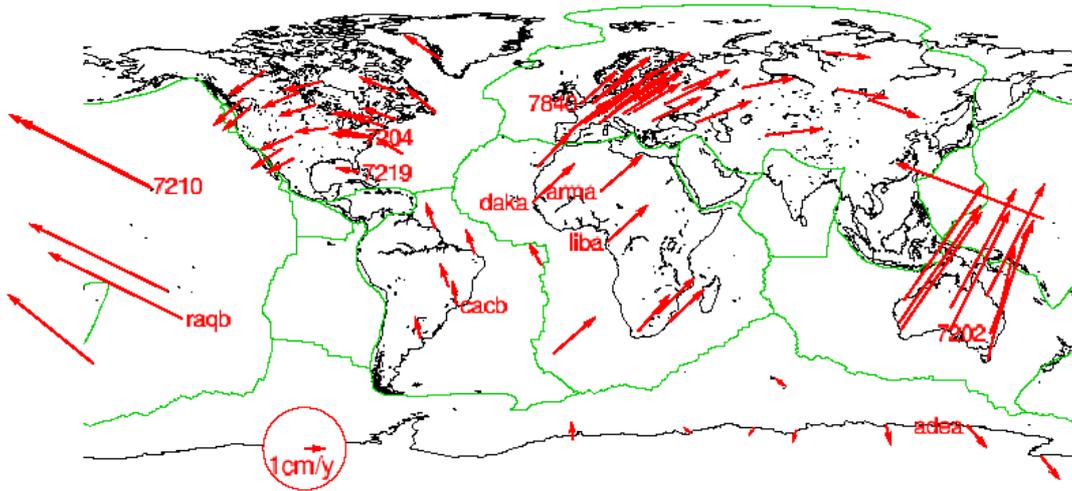


Figure 2. Selected velocities used in plate motion estimation

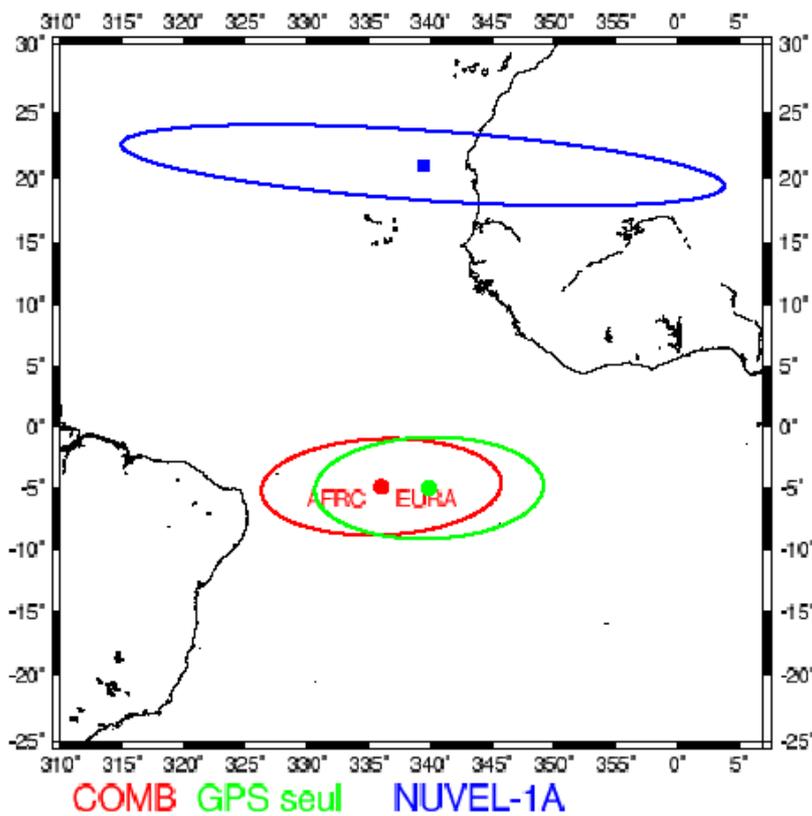


Figure 3. Location of relative rotation pole between Nubia and Eurasia plates

5. Conclusion

During the past few years, several meetings related to AFREF and its northern component NAFREF emphasized the interest and importance of the AFREF project. It becomes clear now that in order to

make progress in this project, we need to install permanent and/or semi- permanent stations to be used as a backbone to AFREF. Repeated GPS campaigns are also needed for AFREF densification in all the African countries. Contribution and expertise of outside countries and organisations are key elements of the needed success of the AFREF project.

6. References

Wonnacott, R. Report to the International Association of Geodesy for the period 1999-2003, A Continental Reference Frame for Africa (AFREF), Southern and East African Components (SAFREF and EAFREF).