ABSTRACT

AFREF (African Reference Frame) is an effort carried out by the international community, in particular by the African countries, to establish a continental reference system that will serve as the basis of the future national reference networks based on the modern geodetic spatial techniques, in particular on GNSS (Global Navigation Satellite Systems) fiducial points.

We discuss here the approaches used to compute AFREF. This solution intends to be a test case for the methodologies to be adopted for the computation of the first official solution for AFREF. AFREF is realized by simultaneously computing the accurate positions of an extended set of CORS stations distributed by the entire African continent. The computation is based on the latest realization of ITRS (International Terrestrial Reference System), ITRF2005, by aligning the continental solution into this global frame at a defined epoch (1st May 2008).

AFREF is fixed to a certain epoch in order to be the backbone system that will allow every country to realize its national system efficiently and directly consistent with the national realizations produced by the neighboring countries. To respect the dynamics due to the existence of several tectonic blocks, AFREF is fixed to the Nubian plate and the differential motions with respect to this block for stations located outside this plate are computed.

This first solution is being produced by combining two individual solutions produced using two different software packages. The issues rose during the data acquisition, data processing and solution combination processes will be thoroughly discussed by the involved partners at the AFREF project in order to establish the methodologies for the computation of the first official AFREF solution.

I. SURVEY OF CORS IN AFRICA

2. SELECTION ISSUES

SOUTH AFRICA CASE

3. SELECTED AFREF08 SITES

4. METHODOLOGY PROCESSING STRATEGIES

ROLE OF TECTONICS

5. AFREF08 SUMMARY

The final solution for AFREF will be estimated by combining two different solutions computed using at least two different software packages. Currently, this is already ensured by the commitment of RCMRD/IDL and HartRAO to produce individual solutions using GIPSY and GAMIT processing software packages, respectively. The computation of these two independent solutions guarantees that possible biases due to particular methodologies or models used by the two organizations and/or by the software packages can be detected and corrected. It is also acceptable that in the future, additional organizations can produce more individual solutions using various other software packages (e.g., BERNESE). However, for the first AFREF solution, the two available solutions will provide the necessary redundancy.

The final product provided by each group will be a set of coordinate positions with respect to ITRF2005 for the AFREF stations included in the AFREF solution. This set of positions will be computed by combining daily solutions into an unique combined (weekly) solution. There are two main reasons to perform this step:

- The extended combined position solution is more expensive to produce than the daily solution as it requires the storage of a large data site (plus the tectonic motions in negligible), since daily solutions can be identified and removed during the combination phase.
- The daily operation can provide a more realistic quantification of the (combined) position solution consistency than the value derived from the daily solution formal uncertainties (which are too optimistic).

The coordination of the solutions (submitted using SINEX files) will be carried out now by using GIPSY tools. However, it is planned to use the CATDR software in the future. Ideally, both solutions must be very similar and the weighted average position would be sufficient to obtain the final position for each site. However, due to the different approach used for processing the mapping phase, some small systematic differences can exist between sites. Any significant difference between the solutions will be identified and analyzed. If necessary, the recomputation of the positions will be operated in order to solve any software-related problems.

The AFREF solution will not only be formed by a set of coordinate positions. In fact, it is necessary to consider the relative tectonic motions due to the tectonic structure of the African continent. Africa is split in two major plates plus a few more tectonic blocks, where continuous deformation exist causing differential motion between stations on the different blocks. The problem is more acute in Eastern Africa, where the Nubian (western) and Somali (eastern) tectonic blocks are moving apart at a rate of 6-7mm/yr.

AFREF will be a static set of stations positions that will be used as the backbone of the continental reference frame by realigning the pedestal of stations that will allow the various National Survey Agencies to further develop the AFREF network. Consequently, the positions of the AFREF stations cannot vary in time in order to maintain the consistence among the different deformations at the stations which will be carried out in a different epoch. However, the relative motion of stations located in different tectonic blocks physically vary with time. This must be considered when such stations are used as reference stations to realize reference frames in different epochs.

Nata will be considered as the reference plate for AFREF. This implies that AFREF will be stationary with respect to the Nata block. All AFREF stations located in Nata will have no motion associated. However, for the stations located in the other blocks, in particular in Somalis, relative motions have to be computed in order that these stations can be used as reference stations in the future.

The AFREF08 solution is formed by a set of tectonic blocks that will be used to provide information on the tectonic activity at each block. This information is necessary for the realization of reliable reference stations at regional and national levels.

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