



IGS

A D D I T I O N A L C O N T R I B U T I O N S

AFREF – Southern and East African Components

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There are over 50 countries in Africa practically all of which are considered as developing nations and each with its own difficulties and challenges. With each country having its own geodetic reference system, one of these challenges as a continent lies in the inability of African countries to plan meaningful and cohesive development projects which rely heavily on a sound and uniform continental geodetic reference frame. Such a framework will be used to develop uniform mapping programmes, monitor a variety of environmental changes, provide a consistent navigational reference system and provide a common reference frame to resolve international boundary disputes.

The African Geodetic Reference Frame (AFREF) is conceived, therefore, as a unified geodetic reference frame for Africa. It will be the fundamental basis for the national three-dimensional reference networks fully consistent and homogeneous with the International Terrestrial Reference Frame (ITRF). When fully implemented, its backbone will consist of a network of continuous, permanent GPS stations such that a user anywhere in Africa would have free access to and would be, at most, 1000km from such stations. Full implementation will include a unified vertical datum and support for efforts to establish a precise African geoid, in concert with the African Geoid project activities.

In March 2001 a meeting of representatives from 8 African countries was held in Cape Town in conjunction with the Conference of Southern African Surveyors (CONSAS). In addition to these country representatives, delegates from the IGS/IAG, EUREF and NIMA attended the meeting which was intended to inform countries of the project and to gauge the level of interest that countries had in the project. The following is a summary of the main outcomes of this meeting:

- The project must be run under the IAG banner;
- The project will be best carried out on a regional basis, for example North, South, East, West and Central Africa;
- GPS is the obvious tool for the project which can be divided into a number of stages namely, the establishment of a fundamental network of permanent or semi-permanent GPS stations (1 or 2 per country) for inclusion into the IGS network, the densification of the permanent network with short campaigns using 4 or 5 GPS receivers simultaneously occupying, where possible, monuments with coordinates in the current national system and, finally, the calculation and adjustment of coordinates in the new system;
- The unification of the coordinate systems must include the vertical component and;
- One of the major points was that this project must be driven by the African national mapping agencies right from the start to be able to learn more about the new technologies. Technical and scientific expertise and assistance from non-African countries and agencies will be requested through the IAG/IGS and other sources.

In both 2001 and 2002, the AFREF project was presented to a number of IAG representatives at meetings held during the European Geophysical Society (EGS) General Assemblies held in Nice, France to sensitize the broader geodetic community and gain wider support for the project within the IAG.

In July 2002, an application for funding in support of AFREF was submitted to ICSU by IUGG on behalf of the IAG. The main thrust of the application lay around the provision of technical assistance and capacity building and the transfer of skills through workshops, seminars and short training schools. Although the application was not accepted, some sound objectives for AFREF were formulated which will be carried forward, namely:

- To define the continental reference system for Africa and establish and maintain a unified geodetic reference network as the fundamental basis for the national 3-d reference networks fully consistent and homogeneous with the global reference frame of the ITRF;
- To realize a unified vertical datum and support efforts to establish a precise African geoid, in concert with the African Geoid project activities;
- To establish continuous, permanent GPS stations such that each nation or each user has free access to, and is at most 1000km from such stations;
- To provide a sustainable development environment for technology transfer, so that these activities will enhance the national networks, and numerous applications, with readily available technology;
- To understand the necessary geodetic requirements of participating national and international agencies and;
- To assist in establishing in-country expertise for implementation, operations, processing and analyses of modern geodetic techniques, primarily GPS.

The 4TH UN / USA Regional Workshop on the Use and Application of Global Navigation Satellite Systems (GNSS) was held in Lusaka, Zambia in July 2002. Representatives from 21 African and 2 Middle Eastern countries and the IAG/IGS among other international organizations attended the workshop. The main recommendations from the workshop relating to surveying and mapping issues were:

- African Continental Reference System (AFREF)
 - that the AFREF project be endorsed by the UN/USA Workshop;
 - that GPS be the primary tool to achieve the project objectives;
 - that African nations and organizations commit to the project;
 - that international partners such as the IAG and the IGS commit their support to the project and;
 - that the AFREF project solicits the resources to procure and support the GNSS technology and network infrastructure and to promote training courses for capacity building for GNSS.
- Standards and specifications
 - that all GNSS systems must operate in an identical reference frame and coordinate system such as the ITRF (AFREF will be based on the ITRF) and;
 - that the internationally accepted standards and procedures of IAG (through ITRF and IGS), ISO/TC 211 etc be used throughout.

An organisational structure for the implementation, management and execution of the AFREF project was also proposed at the Lusaka workshop with the overall project falling within the United Nations Economic Commission for Africa (UNECA) Committee for Development Information (CODI) and that the IAG and IGS take on a technical and scientific advisory role in the project.

In December 2002, the Regional Centre for Mapping of Resources for Development (RCMRD) based in Nairobi, Kenya, convened one of its regular two yearly meetings in Windhoek, Namibia to discuss various matters at the Technical Committee (TC), Governing Council (GC) and Ministerial levels. Since the RCMRD brings together the heads of the NMO's of East and Southern African countries to discuss matters of mutual interest, a planning workshop for AFREF of these countries was convened prior to the RCMRD meetings. Perhaps the main outcome of this meeting was the commitment to the project shown by the participating countries to the extent that a document called "The Windhoek Declaration of an African Geodetic Reference Frame (AFREF)" was prepared and agreed upon by the represented countries. In addition, a number of potential sites for permanent GPS base stations were proposed. (See Figure 1 for map of potential GPS base stations). In May 2003 the "Windhoek Declaration" was formally adopted by CODI and AFREF became a formal project within CODI. AFREF was also formalized as a Sub-Commission within the IAG in July 2003.

There has been a lot of discussion, debate and hard work surrounding the AFREF project since 2000. Many organizations and individuals have expressed interest and strong support for the project including the IAG. A major challenge for the next four years will be to maintain and even increase the momentum and enthusiasm for the project particularly among African countries. The time has come to put all the resolutions into action and it is trusted that the IAG and the IGS will play a pivotal scientific and technical role in these actions during the next four years.

Existing and Proposed GPS Base stations for East and Southern Africa
December 2002



Figure 1. Map of proposed Permanent GPS Base Stations in Southern and East Africa