Windhoek Declaration on An African Geodetic Reference Frame (AFREF)

Executive Summary

A uniform coordinate reference system is fundamental to any development project, application, service or product that requires some form of geo-referencing. All countries in the world have established some form of geodetic reference systems that are used for national surveying, mapping, photogrammetry, remote sensing, Geographical Information Systems (GIS), development programs, and hazard mitigation (earthquake studies, fault motion, volcano monitoring, severe storms, etc.). But these strictly national reference frames are inadequate for regional initiatives. With the national approach, boundaries between countries often conflict with each other, increasing the risk of conflicts and even war. Projects, such as those relating to environmental management, transportation and trade are difficult, and sometimes impossible to plan and execute because the maps and other geographic information used are inconsistent with each other. The objectives set out by African Heads of Government in the New Partnership for Africa's development (NEPAD) cannot be achieved because the priority areas cannot be undertaken without adequate geographic information products. The need to establish such a unified reference frame is therefore urgent.

The concept of a unified reference frame has been recognized since the 1980s and the African Doppler Survey (ADOS) project was intended to provide it. The ADOS project ended in 1986 without fully achieving its objectives. Several factors were responsible for the failure of ADOS, including the difficulty in satisfying the simultaneous observations required by the Doppler Satellite technology used at the time. Current positioning technology based on the Global Positioning System (GPS) is easier to use and more precise. It is also more readily available and there is more expertise in Africa than was the case with the Doppler technology.

Other regions of the world have also embarked on unified reference frames, notably, EUREF in Europe and SIRGAS for the Americas. These reference frames are based on establishing a network of permanent GPS stations, tied to the global network of the International GPS Service. Adopting the same technology and standards will be of great benefit to Africa. In line with the objectives of NEPAD, Africa will be fully integrated into the world network, allowing it to tap into several global data and information resources, especially in the area of geographic information.

The concept is, therefore, to establish a network of permanent GPS stations such that a user anywhere in Africa would have free access to, and would be at most 1000km from, such stations. This frame will be the fundamental basis for the national three-dimensional reference networks fully consistent and homogeneous with the International Terrestrial Reference Frame (ITRF). The approach to be adopted is that of continental coordination with national implementation. For practical effectiveness, an intermediate coordinating structure is proposed at the sub-regional level, resulting in sub-regional reference frames: NAFREF (for North Africa), SAFREF (for Southern Africa), CAFREF (for Central Africa), EAFREF (for East Africa) and WAFREF (for West Africa), all still conforming and compatible with IGS/ITRF specifications. Following the principle of national implementation, countries will be expected to maintain and secure the stations, undertake field campaigns and submit the data to designated regional data centres. Already, the Hartebeesthoek Radio Astronomy Observatory (HartRAO), a national facility of the National Research Foundation (NRF) of South Africa, is an IGS data centre and will play a key role in the implementation of AFREF. It is noted that countries may not be fully self-sufficient in terms of the resources required to establish and maintain such a station. Also some countries may have more

responsibilities than others. Assistance may therefore be sought for such countries from other African countries that have more capacity and from the international community.

Introduction

The Regional Centre for Mapping of Resources for Development (RCMRD) based in Nairobi, Kenya, convenes regular meetings to discuss various matters at the Technical Committee (TC), Governing Council (GC) and Ministerial levels. One such series of meetings was held in Windhoek, Namibia, between 9th and 17th December 2002 hosted and organised by the Surveyor General of Namibia. The TC meetings are normally attended by the heads of the National Mapping Organisations of countries contracting to the membership of RCMRD.

Since the March 2000 meeting of the Global Spatial Data Infrastructure (GSDI) held in Cape Town, South Africa, numerous talks and discussions have been held regarding the concepts and principles of a unified African Geodetic Reference Frame (AFREF). The need for AFREF had been well debated at these discussions and it was felt that the time was ripe to commence the planning for the implementation of the project. The opportunity, therefore, was grasped to hold a workshop prior to the TC, GC and Ministerial meetings in order to start putting plans in place for the implementation of AFREF.

The Government of Namibia agreed to host the workshop from 6th to 8th December, and the RCMRD agreed to sponsor the additional accommodation costs of the heads of National Mapping Organisations (NMO's) from contracting members of the Centre. Invitations were sent to the heads of the NMOs, not only to the contracting members of RCMRD, but also to all African countries. Regional and international organisations were also invited as observers. Seven contracting member States, one observer country and the United Nations Economic Commission for Africa (ECA) attended the Workshop. A list of attendees is attached.

The workshop reviewed the Africa Doppler Survey (ADOS) of the 1980s and received reports of recent discussions on AFREF that have been held at various fora. Participants presented the status of various projects in their countries that were considered relevant to the AFREF concept. It was agreed that a declarative document should be produced, outlining the concepts and principles of AFREF, which will be the basis of awareness activities and relevant project proposals in future. A subcommittee was tasked with producing the first draft. That draft was discussed and amendments made to it to produce this document dubbed the "Windhoek Declaration on An African Reference Frame".

What is AFREF?

The African Geodetic Reference Frame (AFREF) is conceived 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.

Rationale and Justification for AFREF

A uniform coordinate reference system is fundamental to any development project, application, service or product that requires some form of geo-referencing. All countries in the world have

established some form of reference systems that are used for national surveying, mapping, photogrammetry, remote sensing, Geographical Information Systems (GIS), development programs, and hazard mitigation (earthquake studies, fault motion, volcano monitoring, severe storms, etc.). The national coordinate systems are based on reference figures of the Earth, many of which were determined by astronomical observations. These figures of the earth have now been found to be inadequate for controlling surveys using modern techniques based on satellite technology.

The astronomical coordinate systems were usually based on a local origin or datum point, which restricts their use to a particular country, making cross-border or regional mapping, development, and planning projects very difficult. In some instances, more than one datum had been used within one country, making it difficult to cross-reference location information from different parts of the country. One of many areas where a global coordinate system is required is in aviation. Aircrafts need to have the origin and destination airports in the same coordinate system for navigation purposes. In terms of International Civil Aviation Organisation (ICAO) requirements, the positions of National airports have, therefore, been defined on a global co-ordinate system called the World Goedetic System of 1984 (WGS84). Modern positioning technology based on Global Navigation Satellite Systems (GNSS), especially the Global Positioning System (GPS), give three-dimensional coordinates based on the reference ellipsoid. While it is not impossible to relate such coordinates to the national reference frames, the mathematical manipulation involved is not trivial, and requires great care. Many countries are, therefore, updating their national reference systems to be compatible with the International Terrestrial Reference Frame (ITRF), which has been officially adopted by the International Association of Geodesy (IAG). The WGS84 (World Geodetic System 1984) reference system of the GPS, which is widely used by the aviation and several other communities, is now virtually identical to the ITRF at the centimetre level. The proposed African Geodetic Reference Frame (AFREF), which will be part of this international system, will facilitate development planning and enable African countries to tap into global spatial data resources for use by planners and decision makers.

Development Needs for AFREF

The main objective of the New Partnership for Africa's Development (NEPAD) is "to eradicate poverty in Africa and to place African countries, both individually and collectively, on a path of sustainable growth and development and thus halt the marginalisation of Africa in the globalisation process" (Paragraph 67). Developed by African leaders, NEPAD is based on national and regional priorities and development plans for the continent's renewal. One of the priority areas is a focus "on the provision of essential regional public goods (such as transport, energy, water, ICT, disease eradication, environmental preservation, and provision of regional research capacity), as well as the promotion of intra-African trade and investments. The focus will be on rationalising the institutional framework for economic integration, by identifying common projects compatible with integrated country and regional development programmes, and on the harmonisation of economic and investment policies and practices" (Paragraph 95). These exemplary priority areas require maps and other geographic information products for effective planning and efficient implementation of relevant and appropriate projects. As a result of the importance of geographic information, the science and technology platform of NEPAD includes an objective to "promote cross-border co-operation and connectivity" and an action to "establish regional co-operation on product standards development and dissemination, and on geographic information systems (GIS)" (paragraphs 145-146).

Geographic information products provide the link between all activities and the places or locations where they happen. Everything that happens, actually happens somewhere. Our plans are therefore not complete without the information about the location where the plans will be implemented. Traditionally, this information has been presented as maps, but with information and

communication technologies, they are now manipulated in digital form using GIS. In this digital form, it is easier to incorporate more information into the decision making process and to involve the community, another key objective of the NEPAD process.

The foundation of all mapping and geographic information system is the spatial reference framework. The majority of users of maps and other geographic information products would not usually interact with the spatial reference framework. However, without the spatial reference frame, surveyors and other mapping and planning professionals will not be able to produce maps and other geographic information products on which all planning is based.

Traditionally, every country has maintained its own spatial reference frame. This approach results in maps of neighbouring countries not edge-matching properly at the borders. Apart from increasing the potential for misunderstanding and conflicts, this situation makes it difficult for countries to share information and to make joint plans. Information on one country's maps could not be easily referenced to that on another country's maps. As we move towards more regional integration, and adopt regional approaches to peace and security, environmental management, trade and industry, we need maps that are continuous across national boundaries.

The plan of implementation of the World Summit on Sustainable Development (WSSD) at paragraph 119.septies recommends as follows:

> Promote the development and wider use of earth observation technologies, including satellite remote sensing, global mapping and geographic information systems, to collect quality data on environmental impacts, land use and land-use changes, … through urgent actions at all levels [in order] to:
>
> (a) Strengthen cooperation and coordination among global observing systems and research programmes for integrated global observations, taking into account the need for building capacity and sharing of data from ground-based observations, satellite remote sensing and other sources among all countries;
>
> (b) Develop information systems that make the sharing of valuable data possible, including the active exchange of Earth observation data;
>
> (c) Encourage initiatives and partnerships for global mapping.

This recommendation and others relating to community access to information cannot be implemented without a regional spatial reference framework on which to base all these information products.

The second meeting of the Committee on Development Information (CODI), a statutory organ of the United Nations Economic Commission for Africa (ECA) was held in Addis Ababa in September 2001 under the theme "Development Information for Decision Making." Among the resolutions of the Geoinformation subcommittee is the need for a regional spatial data infrastructure that includes an African geographic database. A spatial data infrastructure (SDI) is an enabling framework for the cooperative and participatory production, management and dissemination of geographic information. It enables decision makers and the general community to find what spatial information products exist, where they exist, how to get access to them and how to use them. This arrangement facilitates the participation of everybody in the decision making process, a key goal of the NEPAD process.

Scientific Needs for AFREF

The realization of AFREF has vast potentials for geodesy, mapping, surveying, geoinformation, natural hazards mitigation, earth sciences, etc. Its implementation will provide a major springboard for the transfer and enhancement of skills in surveying and geodesy and especially GPS technology and applications. The traditional geodetic techniques based on best-fitting (local) datum has serious limitations in terms scientific applications due to its inability to provide sufficient knowledge of the earth's centre and its gravity field.

The international framework, of which AFREF will be part, is a prerequisite for many multi-disciplinary applications. The International GPS Service (IGS), a service of the IAG, supports a number of projects and applications dependent on the robust reference systems that are thriving at both global and regional levels. The classic IGS products, based on the global network provide information to generate global plate motion maps, enable strain and fault motion monitoring for earthquake hazard research and support dense regional GPS arrays. This fundamental reference system can further increase the understanding of complex earth science systems and assist and facilitate the solving of regional and global problems.

Besides the establishment of a uniform modern reference system for Africa, a key outcome of the AFREF project will be the conversion of all national surveying and mapping products to the same common reference system. A practical outcome of this will be the ease with which cross-border and regional geo-referenced projects can be carried out. In addition to scientific project applications, this will include projects for the development of agricultural schemes, road, rail, power line construction or eradication of disease, hazard mitigation, etc.

Satellite positioning techniques have the potential for long-term climate monitoring, ground-based weather forecasting, long-term sea level trends at the millimetre level, low-earth orbiting satellites with on-board GPS receivers which will contribute to much greater understanding of the earth's gravity field and atmosphere, ionospheric mapping and research, precise timing and time transfer, etc.

With a uniform geodetic system throughout the continent, the applications of GPS promise increasing benefit to society through greater understanding of earth science systems. GPS is used in many locations to monitor crustal deformation, such as earthquakes, volcanoes, tectonic motions and subsidence along coastal regions.

Previous Efforts on Unified Geodetic Datum

The concept of a unified geodetic datum for Africa is not entirely new. An effort was made in the 1980s to establish a unified datum using satellite techniques. The African Doppler Survey (ADOS) project started in 1982 and was completed in 1986. Its main objectives were:

a) to provide zero-order control for future geodetic networks for mapping control, and

b) to provide control for datum unification and strengthening.

The project was planned by the IAG and implemented under the coordination of IAG-Commission for Geodesy for Africa, African Association of Cartography (AAC), and the United Nations Economic Commission for Africa (ECA). The Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), now the Regional Centre for Mapping of Resources for Development (RCMRD) based in Nairobi was the executing agency. Field observations were carried out under bilateral agreements between the African countries and international geodetic organizations in Europe and North America.

When the project ended in 1986, 300 zero-order Doppler points had been established and spread out in about 45 countries of the continent. However datum unification objective was not met. The reasons for this important objective not being met included:

- A computational requirement of the Doppler satellite technique was that all observations for the network should be carried out simultaneously. This requirement created logistical difficulties due to the size of the continent and the number of countries involved. It was therefore not possible to carry out all the field observations set out in the programme.
- Some member countries did not fully understand the rationale for the project, resulting in a lack of motivation to participate in the project.
- The project was planned entirely by the IAG and international geodetic experts, without much input from African experts, which alienated the latter from full participation and support.
- The procedures of the Doppler system were not fully understood by some of the field crews used, resulting in some of the field observations not meeting required standards.
- The execution of the project in some countries was predicated on obtaining bilateral support that did not materialize.

In spite of the above problems, the ADOS project provided valuable lessons, among them the proof of the concept that such a unified continental datum is feasible. Conditions now exist for such problems to be avoided. To start with, the technology has changed. The GPS, which will be used for the implementation of AFREF, is easier to use than the Doppler, and the IGS data processing procedures do not require all network points to be observed simultaneously. Observations can now be carried out separately and later processed as part of the network. This reduces the difficulty of planning for field logistics and simplifies the field operations. The expertise now exists in Africa for the planning and execution of the project. These African experts who are more familiar with the exigencies of the physical and bureaucratic environments have been the ones explaining the concept to their governments and doing the design and planning.

Another potential success factor of the current planned project is that the GPS points need to be located at sites with power and telecommunication facilities. Such points are more accessible and convenient for observations than the locations of the ADOS points.

Similar Regional Reference Frames

EUREF is the common geodetic reference frame for Europe. Permanent tracking stations form the backbone of the EUREF network, which are densified at the national level using local campaigns of finite duration. The main components of the network are permanent GPS stations, Operational Centres, Local Data Centres, a Regional Data Centre, Local Analysis Centres, a Regional Analysis Centre and a Network Coordinator. The creation of EUREF took advantage of the existence of various components, adding the network coordinator function to coordinate activities that were already on-going in member countries. EUREF is the European regional component of the Global Network of IGS. As such it delivers free-network solutions from EUREF local analysis centres to IGS for the maintenance of the International Earth Rotation Service (IERS).

SIRGAS (Sistema de Referencia Geocentrico para Americas del Sur) is the equivalent organ for the South American countries. It was initially established in 1993 during the International Conference on the Definition of a South American Geocentric Datum, sponsored by the IAG, Pan-American

Institute of Geography and History (PAIGH), and United States Defence Mapping Agency (DMA), now National Imagery and Mapping Agency (NIMA). The objectives of the project were:

- To define a reference system for South America;
- To establish and maintain a reference network;
- To define and establish a geocentric datum.

The conference adopted the ITRF and the concept that the reference network should be of precision compatible with up-to-date positioning techniques, mainly those associated with the GPS. The 57 stations that form the SIRGAS reference network were observed during a 24-hour GPS campaign in 1994. This reference network included eight IGS stations that were already functioning in South America, providing the tie between the SIRGAS reference network and the IGS global network of permanent GPS stations. The project has since been extended to include all the Americas (North, Central, South America and Caribbean) with a GPS campaign in May 2000 covering the entire area.

Broad Plan of Action

A flexible approach can be implemented to accomplish the continental reference system for Africa, due to the permanent global infrastructure of the IGS. First, permanent GPS stations within Africa are or can be linked to the highly consistent daily processing of the IGS. A sparse number of these currently exist on the continent and provide a backbone of precise control – it would be clearly beneficial to increase the number of permanent IGS stations within the African area. Secondly, additional stations are required for the regional densification, such as establishing national GPS networks through either permanent or semi-permanent stations, or through campaign style or single point measurements with mobile GPS receivers.

In contrast to previous GPS network observations where it was important to have an entire network observed simultaneously, it is no longer necessary to do so, though it may be desirable for relating epoch measurements. Through the continuity and permanency of the global GPS infrastructure, observations taken at one time can be linked to observations taken at subsequent locations and times with little degradation of accuracy. In fact, given the vast extent of Africa and logistical difficulties of coordinating between more than 50 nations, a more regional approach tied to a robust fiducial continental network seems more feasible and prudent. Realizing a *permanent* fiducial network throughout the continent is a top priority.

All subsequent analysis and results can be based on the precise products and orbits produced by the IGS to position stations in the ITRF, as well as providing the basis for transformations between ITRF and any national geodetic datum. By following IGS/IERS recommendations and conventions, centimetre level three-dimensional positioning can be obtained within this framework.

It is envisaged that regionalization of AFREF will follow an approach that consists of three major phases:

a. The establishment of a framework of permanent or semi-permanent GPS base stations throughout the region that will become part of the worldwide IGS network of stations. These stations are to established at approximately 1000km intervals and must comply with the internationally accepted standards for permanent GPS base stations as set out by the IGS. Such standards set out the requirements relating to items such as receiver and antenna types, monument foundation and structure, data structure and format and so on.

b. The densification of the network of permanent base stations, largely on a country-by-country basis, to determine the relationship between the national geodetic system and the ITRS, and to refine the transformation parameters necessary to relate the national systems to a common ITRF. Each country's own requirements for the densification will depend on the current status of the geodetic network in the country. Countries will however be strongly advised to adhere to international standards recommended by the international geodetic and surveying community.

c. The third and equally important phase of the project will be to address the development of a more refined geoid model for Africa and the definition of a common vertical datum for the continent. Without a refined geoid model and uniform vertical datum, the benefits of GPS as a positioning tool for regional, sub-regional and cross-border mapping, planning, engineering and other applications will be severely restricted. A major portion of this phase is the collection and scrutiny of suitable gravity and levelling data and the final modelling of a geoid. The unification of national land levelling networks will follow from this. This phase of the project can run parallel to the two phases described above.

Countries will be expected to actively participate in the planning, management and execution of field campaigns, and in the processing, computation and interpretation of the observations in all phases of the project, through the national mapping organizations. They will also be expected to maintain electrical and communication facilities at the continuous permanent stations, and arrange for the delivery of requisite data sets to the data centres. The approach to be adopted is that of continental coordination with national implementation. However, for practical effectiveness, an intermediate coordinating structure will be introduced at the sub-regional level following the United Nations division of Africa into five North, West, East, Central and Southern African sub-regions. AFREF will therefore be broken down into sub-regional reference frames, NAFREF, SAFREF, CAFREF, EAFREF and WAFREF, all still conforming and compatible with IGS/ITRF specifications.

As many of the skills required to implement the network are very often not available in the countries of the region, a great deal of emphasis will be placed on the building of capacity and the transfer of related knowledge to the National Mapping Organizations. It is envisaged that the international geodetic community will assist with such skills transfer. The conversion of current national and regional mapping products and services to the new ITRF based national geodetic networks will follow from AFREF.

A key element of AFREF is the Hartebeesthoek Radio Astronomy Observatory (HartRAO), a national facility of the National Research Foundation (NRF) of South Africa. HartRAO is the only multi-techinique space geodetic facility on the continent. It operates a number of GPS stations that contribute to the IGS, along with Very Long Baseline Interferometry (VLBI) instrumentation, which provides a critical link for the global VLBI network. VLBI is the only observational source of UT1 and is the key relation between the celestial and terrestrial reference systems, a necessary component of the AFREF geodetic initiative. HartRAO also operates a Satellite Laser Ranging (SLR) station, GLONASS (the Russian based satellite positioning system complementary to GPS) receiver, and a DORIS station of the French system. HartRAO is also a Regional Data Centre for Africa in the IGS structure.

Much has already been achieved towards realizing the aims and objectives of AFREF. Since 2000 numerous meetings and workshops have been held to sensitize national mapping organisations throughout Africa and the international geodetic community to these aims and objectives. In addition, a number of countries have already converted, or are in the process of converting, their national reference frames to an ITRF based system. Some have also installed permanent GPS

receivers or network of receivers and are in the process of building up a pool of relevant expertise for AFREF related projects.

Resource Requirements

Because of the "plan regional, implement national" approach, it is important to consider what resources are likely to be required. The resources needed to implement and maintain AFREF can be categorized as follows:

- **Personnel and institutional resources at the national and regional levels.** Personnel are required at different levels and at different skills. There is a need for geodesists and geophysicists to design and plan the optimal location of the main AFREF points for the continent, and the national densification points, taking into consideration existing points and other facilities. Surveyors and other field operators are needed to observe the short-term campaigns. The observations have to be computed and analysed. At the regional and sub-regional levels, there is need for coordination of the network activities.

- **Positioning equipment for field observations.** AFREF participants will be expected to use up-to-date positioning equipment, mainly GPS of appropriate precision for the global network. These will include receivers and other ancillary components. It should be noted that for the permanent continuous stations, the equipment will be permanently installed at the sites and would not be available for other surveying campaigns. For the short-term periodic observations required for national densification, appropriate equipment will be required. In making provisions for these components, consideration should also be given to continuous servicing, maintenance and replacement costs. This consideration also applies to all equipment components.

- **Computing resources for processing and analysing the observations.** The permanent computing stations will need dedicated computers and storage peripherals to hold the data before sending it to data/analysis centres. Software packages are required for the processing of GPS observations and other computations. In the second phase of AFREF, software and expertise will be required for the re-computation and adjustment of national coordinate products to the new reference system for the surveying, mapping and scientific communities.

- **Communications and connectivity.** Communications and network connectivity are essential components for the successful implementation of the reference network. AFREF being part of the global network, there will be constant need to upload and download data to and from designated data centres and IGS centres and for the monitoring and control of remote stations. This is an especially important consideration in selecting the permanent continuous stations.

A primary difficulty encountered in efforts to date has been a lack of resources to bring the appropriate people together for detailed project planning and development of the international cooperation, as well as a general lack of resources for the capital equipment costs and training. Venues for the organizational meetings have been generally planned in an ad-hoc manner in conjunction with related meetings, resulting in insufficient time to develop in-depth dialogue. Discussions will continue to take place mostly in this manner as opportunities arise at scheduled conferences and meetings. Resource considerations should therefore include provision to formalise and enable serious project formulation, and the ongoing coordination once the project starts.

Possible Areas of Assistance

Looking at the resource requirements, and in view of the local implementation approach, it is expected that some countries may not be completely self-sufficient with all the resources needed to implement and maintain at least the first phase of AFREF, viz, the establishment of the fundamental 1000km spacing points. It should also be noted that AFREF being a continental (in fact a global) resource, countries that will be required to maintain the main AFREF points will be bearing some additional costs, and may require assistance. Possible areas of this assistance are tabulated below.

Possible areas of deficiency	**Possible sources of assistance**
Capacity building in the areas of geodesy, surveying, mapping and geo-information.	Countries in the region with more personnel might loan staff for short-term assistance; scholarships to undertake training in universities in the region and overseas; short-term personnel assistance from overseas.
Positioning equipment, including GPS receivers of adequate precision for the global network.	Receivers for the short-term periodic campaigns may be exchanged with other African countries. For the permanent stations, assistance could be sought from Africa's development partners to procure the equipment. Also African countries could arrange group discount through the project to reduce the cost of the equipment.
Computing equipment, including software.	Group discount arrangements and assistance from the international community.
Communications.	International community.

The Declaration

Recognizing that:

1. The implementation of the goals of NEPAD, and other international initiatives such as the World Summit on Sustainable Development and the UN Millennium Declaration require maps and other geographic information products as a foundation of planning the relevant activities;

2. The issues to be dealt with require regional approaches, and therefore the maps should be continuous across national boundaries;

3. The foundation of these maps and other geographic information products is a spatial reference framework;

4. Regional and global collaborative approaches to the provision of geographic information and earth observation data will be more cost effective to African countries;

Participants at the workshop hereby declare:

1. To support and commit to the principles and concepts enunciated in this document.

2. To present and explain the AFREF concepts and principles to their respective governments and organisations to gain the latter's support and commitment.

3. To present and explain it to the various organizations and agencies listed below.

Recognizing that:

4. The Economic Commission for Africa has been involved in the on-going efforts to establish a unified geodetic reference framework for Africa;

5. The Committee on Development Information (CODI) of ECA is an effective organ for coordination of activities in the area of development information, including geographic information;

6. CODI-Geo is comprised of national policy makers responsible for the production, management and dissemination of geographic information, including the maintenance of the spatial reference framework;

7. The decisions and recommendations of CODI are presented to the ECA conference of Ministers;

The workshop:

1. Implores the ECA to continue its support for the principles and concepts of AFREF.

2. Requests the ECA to accept the principles and concepts of AFREF and present them to the next meeting of CODI for approval and recommendation to its members for implementation.

Noting that:

1. The African Union is the umbrella organisation coordinating regional and continental political and economic activities in Africa;

2. These regional activities require the ability to cross-reference information across all places on the continent, thereby requiring a common reference frame for the geographic information components;

The Workshop therefore requests the African Union to accept the principles of AFREF and encourage its members to participate in its implementation.

Recalling that:

1. The successful implementation of AFREF depends on the application of the Global Navigation Satellite Systems (GNSS), and in particular the Global Positioning System (GPS);

2. The UN Office for Outer Space Affairs (OOSA) is the coordinating body for the peaceful use of space, including GNSS

3. AFREF has been presented and discussed at OOSA-sponsored workshops and its importance for the development of Africa accepted;

The Workshop therefore requests OOSA to support the principles and concepts enunciated in this document and assist in its implementation.

Recalling that:

1. International Association of Geodesy (IAG) is the main supporter of the concept of unified regional geodetic reference frames all over the world, such as EUREF, SIRGAS and more recently AFREF;

2. IAG and its service organizations, in particular the International GPS Service (IGS) assisted in the implementation of SIRGAS;

The workshop therefore requests the IAG/IGS to continue supporting the AFREF concept and assist in its implementation.

Noting:

1. The support of bilateral and multi-lateral development partners in the implementation of similar projects in particular the African Doppler Survey (ADOS);

2. That material and intellectual needs of AFREF will continue to be extensive;

The workshop therefore requests Africa’s bilateral and multi-lateral development partners to support AFREF and assist in its implementation.

Appendix: List of Participants

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