



Distribution: General

E/ECA/GiSS/09/14

15 December 2014

**UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL**

Original: English

ECONOMIC COMMISSION FOR AFRICA

Unified African Geodetic Reference Frame (AFREF)
Expert Group Meeting

Tunis, Tunisia
08-09 December 2014

African Geodetic Reference Frame (AFREF)

**Expert Group Meeting:
Standard Processing Strategy for the first Official Computation**

Report 4.0

1. Introduction

1. The African Geodetic Reference Frame (AFREF) was conceived as a unified geodetic reference frame for Africa, fully consistent and homogeneous with the International Terrestrial Reference Frame (ITRF). This will be the fundamental basis for the national and regional three-dimensional reference networks. The reference frame will be composed of a network of points where precise observations will be continuously recorded and used to define a Terrestrial Reference Frame, resulting in a best-fit datum over Africa.
2. The AFREF will link all national reference frames. The network would be at such a density that positioning professionals (surveyors, engineers, environmentalists, agriculturalists, mineral prospectors, etc) would always be within a reasonable distance of at least one such control point any place in Africa, with relevant parameters freely available to practitioners.
3. In the first phase, the programme aims that there be at least one reference station in every country which is in compliance with the International GNSS Service (IGS) standards and guidelines. In the second phase, the programme will increase the network density to where no user will be more than 500 km from a control point any where in Africa.
4. The realization of AFREF has vast potential 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 across the continent. Critically, it will provide a single reference where all spatially enabled information and applications to be able to work in concert across Africa.

2. Justification and rationale

5. Currently each African country has its own national geodetic reference frame against which all mappings and other geoinformation products are referred. These reference systems are often based on local datum, restricting their use to a single country and make it difficult to accurately represent cross-border features on (sub) regional maps. It is also almost impossible to accurately track cross border, continental & global functions, i.e. transport, communications, poaching, climate change etc. and to define international borders.
6. Traditional geodetic techniques to determine a best-fitting (local) datum have serious limitations in terms of technical and scientific applications due to their inability to link with modern observing systems in particular Global Navigation Satellite Systems (GNSS). Moreover, several differing methodologies for computing geodetic transformation parameters have been employed across the continent.
7. Many factors and applications are no longer limited to the extent of a country's national boundaries. Therefore, the need to develop regional and national expertise for implementation, operations, processing and analyses of modern geodetic techniques is now critical. The United Nations Economic Commission for Africa, the African Union Commission and the AFREF International Steering Committee are organizing in early December 2014 an expert group meeting on "Standard Processing Strategy for the first Official Computation". This will

provide stakeholders with an opportunity to identify a standard processing strategy for the first official computation of an African reference frame (at least a set of static coordinates based on ITRF), as well as to agree and adapt the first official coordinates of AFREF.

8. Besides the establishment of a uniform modern reference system for Africa, a key outcome will be the conversion of all national surveying and mapping products to the same common reference system and frame. This will make them interoperable, which they are not currently.

9. The workshop was convened as a pre-conference event to United Nations Global Geospatial Information Management for Africa initiative (UN-GGIM: Africa). The workshop was attended by about 27 participants who reviewed critical technicalities of computing a common new reference frame for AFREF, as well as discussing lessons to be drawn from various experiences. List of participants is attached in Annex 1.

3. Meeting Opening

10. The meeting was opened by Dr. Hussein Farah (RCMRD), the Chair of the CODIST-GEO Working Group on AFREF who welcomed the delegates, gave the background to the workshop and presented the aims and objectives of the workshop. He also chaired the morning session.

11. Mr. Andre Nonguierma from ECA made a short presentation on the meeting agenda which was adopted after discussion and amendment to commence with the sessions initially schedule on day 2 of the meeting.

4. Objectives and expected outcomes

12. The main aim of the meeting was to provide the steering committee members a formal opportunity to review and assess AFREF current status and its future development. Dr. Hussein Farah (RCMRD) the current Chair of CODIST-GEO Working Group on AFREF gave a brief status report and future development of AFREF covering the following points:

- Updates on the status and on-going activities of the AFREF Project;
- Project objectives and milestones;
- Status of existing station locations and additional IGS stations in the global network to be included in the network for the computation purpose;
- The standard processing strategy for official computations of an Africa's reference frame (at least a set of static coordinates based on ITRF);
- Adoption of the first official static coordinates for AFREF; and
- The future development of AFREF especially the management structure.

13. It was expected that the EGM can recommend any action required to support member States efforts in the refining of the transformation parameters from the different geodetic reference figures of the Earth, datum and co-ordinate systems in Africa to a common reference system.

5. Unfolding the meeting

14. The workshop featured formal technical presentations, reports from selected countries, experience on best approaches and methodologies to compute the future AFREF solutions.

5.1. AFREF Current Status

15. Dr. Hussein Farah reported briefly on the current status and progress of AFREF Programme. Although, the progress in implementing AFREF has been slow, it is pleasing to acknowledge that many countries including Burkina Faso, Benin, Niger, Ghana, Rwanda, Ethiopia, Cote d'Ivoire, Mozambique, Angola, Nigeria, Botswana, Namibia among others are taking the steps to establish national network of GNSS reference stations.

16. Algeria has reported that the country is planning to set up more than 200 new reference stations across its territory.

17. Burkina Faso reported that the country has established a network of nine CORS with the support of US Government through the Millennium Challenge Corporation (MCC). Based on this network, a new, ITRF 2008 compliant official coordinate system was adopted in 2012.

18. Cote d'Ivoire reported that the country base station located in Yamoussokro is in compliance with IGS standards and is available for inclusion in the AFREF Network. It was reported that data from this station was used in the first static computation.

19. Egypt reported that there is an ongoing effort to densify the national network of GNSS stations. Egypt is drafting a proposal to establish a national Operational Data Centre (ODC) that can also serve the purpose for AFREF. The representative of Egypt requested that the International Steering Committee write a letter of support to the Government of Egypt for the establishment of the Egyptian ODC.

20. Ghana reported that the first phase of the Geodetic Reference Network (GRN) for Ghana has been operational since 2007 under the Government of Ghana, through the Surveying and Mapping Division of the Lands Commission of the Ministry of Lands and Natural Resources. The GRN solution based on the ITRF05 epoch 2007.39 now comprises of 8 CORS was coordinated with IGS stations NKLG and MAS1. The established Geocentric Coordinate System has served as the backbone of the Ghana's Land Administration Project. It has entered the second phase in which plans are advanced to cover the country with over 30 more CORS, providing an active network to more areas of the country. This system has been used mainly in surveying and mapping projects, making it necessary to adopt a new projection system called Ghana Transverse Mercator (GTM). Other users benefiting from this network include mining companies, research institutions, universities, utility companies and many others. Although Ghana is preparing for such, this donor-funded project is yet to make its technical contribution to international organizations like AFREF and IGS.

21. Nigeria reported that the country has established 16 AFREF CORS stations under the National Mapping Agency (The Office of the Surveyor General of the Federation, OSGoF).

There is also one IGS Station, upgraded to a multi-constellation receiver station, established by the National Space Agency (NASRDA) at the Centre for Geodesy and Geodynamics (CGG). A GNSS Data and Analysis Centre is being established at the CGG under NASRDA. The National Mapping Agency initiated the computation of the Transformation Parameters for Nigeria. The provisional results are being awaited.

22. RECTAS reported that the centre has established a base station in 2007 that is still functional and receiving data at the moment. The COR Station has been used for training and capacity building of professionals. It has also been used by surveyors to established control points for cadastral surveys and mapping projects.

5.2. AFREF Management

23. The Executive Working Group (EWG) on the African Reference Frame (AFREF) programme was established in 2003 to oversee the implementation of the project. The Working Group comprised the recognized specialized centres and organizations on geoinformation, namely RECTAS, RCMRD, AOCRS and five African countries representing each of the five sub-regions. This working group plus the Chair of the International Association of Geodesy, Sub Commission on Reference Frames, Africa (SC 1.3d), the International GNSS Service (IGS) (ICG) and the Hartebeesthoek Radio Astronomy Observatory (HartRAO) constitute the International Steering Committee on AFREF (ISC-A).

24. A. Nonguierma (ECA) reported on the current structure. AFREF Management Structure. Following a meeting of the Steering Committee in 2012, a new management structure was proposed to align with the AU steering machinery. It comprises the following:

- Joint Secretariat administered by AU Department of Human Resources, Science and Technology (AU/HRST) and ECA's African Centre for Statistics (ECA/ACS).
- Technical Advisory Working Group (current CODIST-Geo Working Group on AFREF)
- AFREF Scientific Advisory Working Group (current Science and Technology Advisory Group)

25. H. Masheleni (AUC) presented the areas where it would be possible to integrate the AFREF programme into the African Union ministerial machinery:

- STC on Agriculture, Water and infrastructures
- STC on Finances
- STC on transport and transboundary infrastructure and Energy
- STC on Education, Science and Technology

26. The discussion that ensued underscored that the programme requires political buy-in to obtain the financial support it needs. The meeting was of the opinion that Education, Science and Technology will be the most appropriate niche to house the programme within the structures of the African Union Commission (AUC).

27. The meeting formally agreed on the revamping of the AFREF management structure, but in ensuring that it fits into the UN-GGIM: Africa operative activities. The participants further tasked ECA, AUC and RCMRD to refine the organigram of the management structure to highlight the political, operational and technical elements. The organigram should show how

the technical side fits into UN-GGIM: Africa and its link to Global Geodetic Reference Frame (GGRF).

28. AFREF Network Coordinator. The meeting discussed and agreed upon a need for a Network Coordinator and the terms of reference should be developed for the preparation of a Call for participation to appoint a suitable agency to fill that role. Recommendation was made that ECA, AUC and RCMRD review where the Coordinator should best be positioned.

29. Africa Representative to IAG. The current representative of Africa to IAG (Richard Wonnacott) reaches his last term in the position in July 2015. Therefore, Africa should be prepared to identify and propose an individual who will be chairing the IAG Sub-Commission 1.3d (Africa). The proposal for candidacy should be examined in July 2015. The meeting recommended that AFREF must identify and propose a suitable person (African) to be representative of AFREF into IAG. This is however subject to the approval of IAG and AAG.

30. Data Policy. The meeting discussed the option to develop a data sharing policy for AFREF network of GNSS stations. It was agreed to follow the IGS Data Policy guidelines and/or Open data initiative.

31. Partnership. Current and potential ties with various partners at global, regional and national level were reviewed. Among others, synergies were promoted with AfricaArray, AMMA and Scintillation Network Decision Array (SCINDA). The meeting agreed to propose to AfricaArray to have AFREF representative.

32. Capacity building. The meeting reviewed some of capacity building activities being implemented by various institutions. Recommendation was made to take full advantage of the numerous opportunities that exist in the continent or abroad, including but not limited to, RCMRD, RECTAS, the African Regional Center for Space Science and Technology Education in English (ARCSTEE), IGN-France and JICA. Egypt informed of their fellowship programme to support young geodesy scientists and fellows with accommodation and hands-on training provided that tickets are borne by other partners.

5.3. Technicalities

33. Mr. Richard Wonnacott presented the status of the Operational Data Centre (ODC). The ODC in the Chief Directorate National Geospatial Information (South Africa) was established by the Committee on Development Information Science and Technology (CODIST) in 2009 to archive GNSS data from permanent Continuously Operating Reference Stations (CORS) across the continent. Currently, there are approximately 70 permanent GNSS base stations submitting data to the ODC. The data can be browsed and downloaded at: <http://www.afrefdata.org> or <ftp.afrefdata.org>. He highlighted that there is a critical gap of distribution of the processed sites in Central Africa, the Sahel region and North Africa. Among the many issues arising from the ODC operation is the lack of coordination in establishing GNSS stations in the continent.

34. Mr. Rui Fernandes (SEGAL) made a presentation focused on the current status of existing stations that can be incorporated in the AFREF network. Currently there are 267 sites with available data. Many of these stations have, however, been discontinued or for which data is not freely available. He further underscored the network requirement to install stations in

accordance with the IGS Standards and Guidelines. The IGS criteria for site selection and equipment are well described and can be found at (<http://www.igs.org>). In terms of AFREF, it is important to stress the fundamental requirements for existing and new stations to be included in the network. Each station should comply with at least the following criteria:

- (a). Continuously operating (No end of operation foreseen);
- (b). Reliable Internet access (Data transfer after few hours of acquisition);
- (c). Data to be publicly and freely available (no restrictions on data distribution);
- (d). Installation according to IGS standards (stable monument, self-centering mounting device, use of receivers and antennas for which type calibrations are available, any local ties very well determined, etc.);
- (e). Best possible distribution of stations (Current objective: no more than 1000 Km between AFREF core stations); and
- (f). One station per country is desirable.

35. The meeting agreed that the ISC must provide countries with the optimum location and number of sites to be considered.

5.5. The Global Geodetic Reference Frame

36. Mr. Zuheir Altamimi delivered a presentation on the Global Geodetic Reference Frame (GGRF). The rationale for a GGRF includes among others:

- i) Georeferencing and positioning applications;
- ii) Unification of geodetic/mapping applications. In July 2013, the United Nations Committee of Experts on UN-GGIM endorsed the creation of a Working Group to develop the draft text for a United Nations General Assembly resolution on the Global Geodetic Reference Frame and a global geodetic roadmap. The Working Group has achieved the following:
 - a. formulation of the WG TOR;
 - b. elaboration of the Concept Note on GGRF;
- iii) organization of a briefing Sessions of UN diplomatic missions in New York;
- iv) adoption of the draft resolution by the UN-GGIM CE in August 2014.

The resolution will be submitted to the United Nations General Assembly in early 2015.

37. The participants agreed that the AFREF ISC must write to the NMAs requesting them to liaise with their national Diplomatic Mission in NY so they can support the GGRF. The meeting further recommended that the ISC should pass a resolution through UN-GGIM: Africa urging member States to fully support and participate in the GGRF.

38. The GGRF is global geodetic infrastructure which includes instrumentation, monumentation, publically available data base of GNSS and other measurements and computations including reference station positions based on the International Terrestrial Reference Frame (ITRF).

5.6. Computation

39. Dr Zuheir Altamimi, Research Director at Institut National de l'Information Géographique et Forestière (IGN, France), presented a paper describing different ways of realizing regional reference frames, fully consistent with the International Terrestrial Reference Frame (ITRF). He proposed general guidelines on how to optimally realize a regional reference frame using IGS data and products and its rigorous alignment to the ITRF. There are three main cases/options to realize a regional reference frame:

- i) the station positions at a given epoch ie a static reference frame which can be updated frequently;
- ii) the station positions and minimized velocities; and
- iii) the station positions and deformation model.

He further outlined the different approaches that could be adopted to realize the AFREF reference frame, taking into account the user requirements and applications. The first one is the *Static Frame* which needs to be updated from time to time. The second approach is the *Kinematic Frame* which is defined through transformation parameters wrt ITRF, e.g which, in the case of AFREF, will co-move with the Nubian plate.

40. The discussions that ensued showed that from a scientific point of view, the Kinematic Frame approach is the optimum, while from a practical point of view the Static solution is easier to implement. Apart from East and North Africa, there is minimal intra-continent movement over and above a steady North East drift of approximately 25mm per year. The Static solution could be the best for Africa at this moment. The participants agreed that an interim solution should be adopted: to start with Static to learn from it and slowly move to the Kinematic one in the coming years. The meeting further recommended to:

- Prepare a comparative table between Static and Kinematic outlining their comparative advantages and disadvantages. Drs. Altamimi and Fernandes volunteered to assist; and
- Develop a document defining the AFREF reference frame. Dr Altamimi expressed his willingness to contribute.

41. Mr. Richard Wonnacott presented the interim results of independent solutions being developed by various African scientific teams: HartRAO, Ardhi University, Directorate of Surveys and Mapping of Tanzania and SEGAL (University of Beira Interior, Portugal). The following table presents the parameters used by each independent solution.

	Processing Centre			
	Ardhi University Tanzania	HartRAO South Africa	SEGAL (UBI/IDL) Portugal	Div Surveys and Mapping Tanzania / Australia
Software used	GAMIT / GLOBK 10.5	GAMIT / GLOBK 10.5	GIPSY-OASIS	GAMIT / GLOBK 10.5
Epoch rate	30 SEC	30 sec	30 sec	30 sec
Final Orbits	IGS Final	IGS Final	JPL Precise	IGS Final
Earth Rotation Parameters	IERS2010	IERS2010	IERS2010	IERS2010
IAU nutation model	IAU 2000	IAU 2000	IERS Conventions	IERS Conventions
Elevation mask	0 deg	10 deg	7.5 deg	10 deg
Ocean loading model	FES2004	FES2004	FES2004	FES2004
Tropo Model Dry Wet	GMF GMF	GMF GMF	VMF1GRID Estimate	GPT2 GMF Estimate
Ionospheric models			2 nd order ionospheric correction	2 nd order ionospheric correction
Ambiguity solution	Wide-Lane LC	Wide-Lane LC	Yes	Yes
Number of stations processed				
1. Week 1717	82	80	86	86
2. Week 1718	85	79	85	86
Number of IGS control stations				
1. Week 1717	40	40	37	48
2. Week 1718	42	40	37	48
General			Tide models: WahrK1 PolTid FreqDepLove OctTid	

42. The preliminary results of the independent solutions show:

i) an internal precision as follows

WRMS in East, North and Up, per Analysis Centre and per week show very little significant differences

Solution	# Sta	Week 1717			# Sta	Week 1718		
		E	N	U		E	N	U
HartRAO	80	1.4	1.0	4.9	79	1.2	1.1	5.0
DSM	84	1.2	0.9	3.9	86	1.2	1.0	3.8

Ardhi 75 1.0 0.9 3.4 77 0.9 0.8 3.4

SEGAL 87 1.3 1.7 6.7 85 1.3 1.8 6.0

And

ii) an accuracy of aligned to ITRF 2008 using 42 global reference stations as follows:

	E	N	U
	mm	mm	mm
Week 1717:	2.9	3.2	7.4
Week 1718:	3.0	3.4	7.6

43. The challenges arising from the research studies include :

- i). the lack of understanding or resources by NMA;
- ii) the lack of political buy-in; and
- iii) the recurrent political instability and security in many areas of the continent.

44. The meeting requested the ISC to send letters to North African countries to request their good will in releasing some of their GNSS stations into the AFREF Network in order to fill the current gap. The participants further requested the ISC to develop a terms of reference for the calls for participation for data analysis, data combination and at least one additional Operational Data Centre.

6. Recommendations

45. The presentations were enriched with comments and responses to questions. As a result of the discussions and debates, the workshop participants endorsed the following recommendations.

Domains	Responsibility	Recommendations	Remarks
Management Structure	<ul style="list-style-type: none"> • ICS 	<ul style="list-style-type: none"> • Translate the management of AFREF as a mini IGS with Data Centres, Analysis Centres and a Combination Centre. 	
Network of GNSS Stations	<ul style="list-style-type: none"> • Member States 	<ul style="list-style-type: none"> • Reinforce the commitment of member States to continue to establish more Network stations • Local institution to support the hosting of the stations for maintenance and distribution of the data. 	
	<ul style="list-style-type: none"> • ISC 	<ul style="list-style-type: none"> • Provide countries with the optimum location and number of sites to be considered • Make a call of participation for countries to select a subset of reference stations from their national networks to be part of the AFREF Network. 	

Domains	Responsibility	Recommendations	Remarks
Data	<ul style="list-style-type: none"> • ISC 	<ul style="list-style-type: none"> • Issue calls for participation for Data Centres, Analysis centres and Combination Centres. The calls should include the TORs and requirement for the Centres. • Develop guidelines for computation strategies by Analysis Centres • 	
	<ul style="list-style-type: none"> • ISC 	<ul style="list-style-type: none"> • A Call for Participation for the establishment of at least one additional Operational Data Centre 	
	<ul style="list-style-type: none"> • Member States 	<ul style="list-style-type: none"> • All African countries to release data freely and openly if not for all national reference stations then at least a subset of those reference stations for AFREF and other global users. 	
Computations	<ul style="list-style-type: none"> • Member States 	<ul style="list-style-type: none"> • Accept and adopt the combination of the results of the four computations made by the AFREF analysis centres. • 	
	<ul style="list-style-type: none"> • ECA 	<ul style="list-style-type: none"> • Publish the coordinates in ECA website 	
	<ul style="list-style-type: none"> • ISC 	<ul style="list-style-type: none"> • Publicize that the coordinates are publicly available. 	.
		<ul style="list-style-type: none"> • Develop a conceptual document defining the AFREF reference frame. • Prepare a comparative table between Static and Kinematic outlining their comparative advantages and disadvantages • 	Dr Altamimi is willing to contribute Drs. Altamimi and Fernandes volunteered to assist
	<ul style="list-style-type: none"> • Scientific Teams 	<ul style="list-style-type: none"> • Develop a formal academic paper to be published in a peer review journal. 	
GGRF	<ul style="list-style-type: none"> • Member States 	<ul style="list-style-type: none"> • Recommendation to member States to support the UN-GGIM GGRF 	
	<ul style="list-style-type: none"> • UN-GGIM: Africa 	<ul style="list-style-type: none"> • Resolution requesting member States to fully support and participate in the GGRF 	

46. Finally, the workshop drafted one resolution for consideration by UN-GGIM: Africa. The resolution is as follow:

The Expert Group Meeting

- Recognizing the great progress made in establishing the AFREF geodetic framework,
- Noting that there are several GNSS-based projects relevant to AFREF,
- Considering the need to develop strategies for incorporating additional permanent stations in the AFREF network,
- Considering the need to process free and openly available GNSS data to publish a set of co-ordinates fully consistent with the ITRF,

- Acknowledging the draft UN GA resolution on the Global Geodetic Reference Frame (GGRF)

Recommends the African Union Commission:

- To facilitate the political buy-in translated into policy and financial support to the implementation of the AFREF programme.

Recommends the Economic Commission for Africa:

- To continue assisting in the promotion, establishment and realization of the African Reference Frame (AFREF),
- To assist in the elaboration of a data policy which will enable member States to provide GNSS data for use by the geospatial information community at large.

Recommends Member States (NMA or any other mandated agency):

- To commit to put national geodetic datums together, so that all spatial information from individual countries can be readily assembled into a unified regional geodetic reference frame.

Recommends the AFREF Steering Committee

- To publish calls for participation (CfP) to establish Data Centres, Analysis Centres, Combination Centre and Network Coordinator.

Recommend UN-GGIM: Africa

- To consider AFREF as one of the key pillars of the UN-GGIM: Africa.
- To ensure that AFREF is fully linked to the Global Geodetic Reference Frame (GGRF).
- To encourage the member States to support the draft UN GA resolution on GGRF.

47. It is expected that the resolutions once adopted under UN-GGIM: Africa will become work actions for the Steering Committee and member States on AFREF.

7. Conclusion

48. There was active contribution by the participants in the meeting, highlighting issues such as the need to answer the question of “Who is logging GNSS data in Africa”: where are these stations; what standards have been used for establishment of stations; where is data being archived; what data is being archived; what data policies are in place; what plans are in place for establishment of new stations?

49. The workshop closed with Messrs Nonguierma and Farah thanking ECA, the AUC for their financial and logistical support, all the presenters for their instrumental technical inputs, the session chairs and all the participants for their valuable contributions to the meeting’s success and their contribution to drafting the recommendations.

Annex 1: Meeting Agenda

Time	Monday, 08 December 2014		
10:00 – 11:00	AFREF Session 1 : Progress Report Venue: Room: Salle Carthage Chair: H. Farah Rapporteur: R. Wonnacott, ECA	Welcome remarks	H. Farah (RCMRD)
		Adoption of Agenda	A.Nonguierma (ECA)
		Matters arising from October 2012 meeting	R. Wonnacott (NGI)
		AFREF Current Status	H. Farah (RCMRD)
		Regions activities report	WAFREF, NAFREF, SAFREF, CAREF, EAREF
11:00 – 11:20	Coffee Break		
11:20 – 13:00	AFREF Session 2 : Management Venue: Room: Salle Carthage Chair: M. Salah Rapporteur: R. Wonnacott, ECA	AFREF Management Structure : <ul style="list-style-type: none"> • Steering Committee • Regional Representation • Scientific Advisory Working Group 	A.Nonguierma (ECA)
		<ul style="list-style-type: none"> • Network Advisory Committee • Network Coordinator : Terms of Reference • Appointment of AFREF representative on IAG Working Group on Regional Dense Velocity Fields 	R. Wonnacott (NGI)
		Partnership : Collaboration with other groups	H. Farah (RCMRD)
		Data Contribution and Dissemination Policy	R. Wonnacott (NGI)
		Alignment of AFREF with the AU steering machinery	H. Masheleni (AUC)
		Lunch Break	
14:30 – 15:30	AFREF Session 3 : Technicalities Venue: Room: Salle Carthage Chair: Richard Wonnacott Rapporteur: ECA	Network of Permanent GNSS reference Stations <ul style="list-style-type: none"> • Ordnance Survey Donation • Trimble Donation 	A.Nonguierma (ECA) H. Farah (RCMRD)
		<ul style="list-style-type: none"> • Status of Operational Data Centre (ODC) • Data processing and Provisional station co-ordinates 	R.Wonnacott

		<ul style="list-style-type: none"> • Review location of existing stations • Determination of gaps & optimum location 	R. Fernandes
		Skills development and capacity building	H. Farah (RCMRD)
15:30-15:50	Coffee Break		
15:50 – 17:00	AFREF Session 4 : Way Forward Venue: Room: Salle Carthage Chair: H. Farah Rapporteur: R. Wonnacott, ECA	Others matters arising Wrap-up	R. Wonnacott (NGI)

Time	Tuesday, 09 December 2014		
10:00 – 11:00	AFREF Session 5 : Global Geodetic Reference Frame Venue: Room: Salle Carthage Chair: Richard Wonnacott Rapporteur: ECA	Presentation of GGRF Discussions on implications for AFREF	Dr Vanessa Lawrence
11:00 – 11:15	Coffee Break		
11:15 – 13:00	AFREF Session 6 : Computation Venue: Room: Salle Carthage Chair: Richard Wonnacott Rapporteur: ECA	Standard processing strategy for the first official computation of an Africa's reference frame. Review alternative computation methods and develop guidelines for the computation.	Zuheir Altamimi Richard Wonnacott
13:00-14:30	Lunch Break		
14:30 – 15:30	AFREF Session 7 : Computation Venue: Room: Salle Carthage Chair: Richard Wonnacott Rapporteur: ECA	Presentation of the findings of the independent solutions	Ludwig Combrinck Saria Elfuria Rui Fernandes Joseph Dodo
15:30-15:50	Coffee Break		
15:50 – 17:00	AFREF Session 8 : Way Forward Venue: Room: Salle Carthage Chair: H. Farah Rapporteur: R. Wonnacott, ECA	Wrap-up Way Forward Concluding Remarks	Zuheir Altamimi R. Wonnacott (NGI) R. Gray (ECA)

Annex 2: List of Participants

S/No.	Country	Title	Contact Name	Functional Title	Organisation	Mobile	Phone	Email
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