

# **IOC/GLOSS**

## **Technical Expert Visit to Mauritania, Cameroon and Republic of the Congo**

**17-29 October 2005**

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## 1. Schedule

The survey of West Africa covered the period from Tuesday 18 October to Friday 28 October 2005.

Mauritania	Nouadhibou	18-21 October
Cameroon	Kribi and Limbe	21-24 October
Republic of the Congo	Pointe-Noire	24-28 October

## 2. Objectives

Determine the location of existing tide-gauges.

Determine suitable locations for new tide-gauge instrumentation for the GLOSS/OdinAfrica program.

Assess provision of mains electrical power, telephone lines, security and systems future safety.

Location and details of geodetic survey bench marks near the tide gauge.

Contact details of port and research station staff associated with the project.

Photograph each site and collect any relevant information.

### **3. Additional material**

#### **Refer to various documents associated with this report:**

Site photographs (numerous scanned / digital files)  
Extensive list of contacts, word and pdf files.

With additional documents for:

#### **3.1. Mauritania:**

Admiralty Charts for Nouadhibou and Nouakchott (scanned)  
Nouadhibou Port plan (scanned).  
Ministry of Rural Development and Environment Brochure (scanned).  
Follow up report from IMROP concerning benchmarks at Nouadhibou Port.  
Follow up correspondence from Subsea7 UK Ltd concerning Nouakchott Port.

#### **3.2. Cameroon**

Chart of Cameroon dated 1927 (scanned)  
IRAD maps for Kribi and region (Scanned)  
Organisation and functioning of the Specialised Research Centre for Marine Ecosystems (CERECOMA) - in French and English  
Follow up report from IRAD concerning Sonara oil refinery / jetty at Limbe.

#### **3.3. Congo**

PDF file Plan for Pointe-Noire Port  
Photographs of the SHOM Technical GPS survey in 2003.

## **4. Mauritania**

### **4.1. Introduction**

Nouadhibou is the site of the two main incomes to the economy of Mauritania, fishing industry and iron ore export. The iron ore is transported by a 2 km-long train from the quarries/mines to the ship terminal. This is on the Eastern side of the Peninsula Cape Blanc at Cansado, Nouadhibou, refer to [www.snim.com](http://www.snim.com)

Oil production offshore from Nouakchott is initially expected in early 2006. Nouakchott Port and Port de L'Amitié (10 km South of Nouakchott) handles the container shipping and the oil industry vessels.

A large fleet of fishing vessels (50+) lies in the natural harbour of Peninsula of Cap Blanc at Nouadhibou, with vessels from several nations. However at the time of the visit October 2005, a 3-month fishing ban was in force to allow stocks to replenish. Large fish market and canning plants in Nouadhibou. Exports by road and sea. The fishing is abundant with the strong upwelling bringing nutrients to the surface waters. Mauritania is one of the most productive fisheries regions in the world.

Nouadhibou and Nouakchott are approximately 470 kilometres apart with a single carriageway fast road. No petrol-gas stations or services exist between the two towns.

Only one day (Wednesday 19<sup>th</sup> October) was available at Nouadhibou. On Thursday 20<sup>th</sup> October formalities required a meeting with the Minister for Culture at Nouakchott to discuss the issues of potential flooding of Nouakchott coastal region which is very low in elevation.

## 4.2. IMROP

### Institut Mauritanien de Recherches Océanographiques et des Pêches Mauritanian Research Institute for Fish and Oceanography

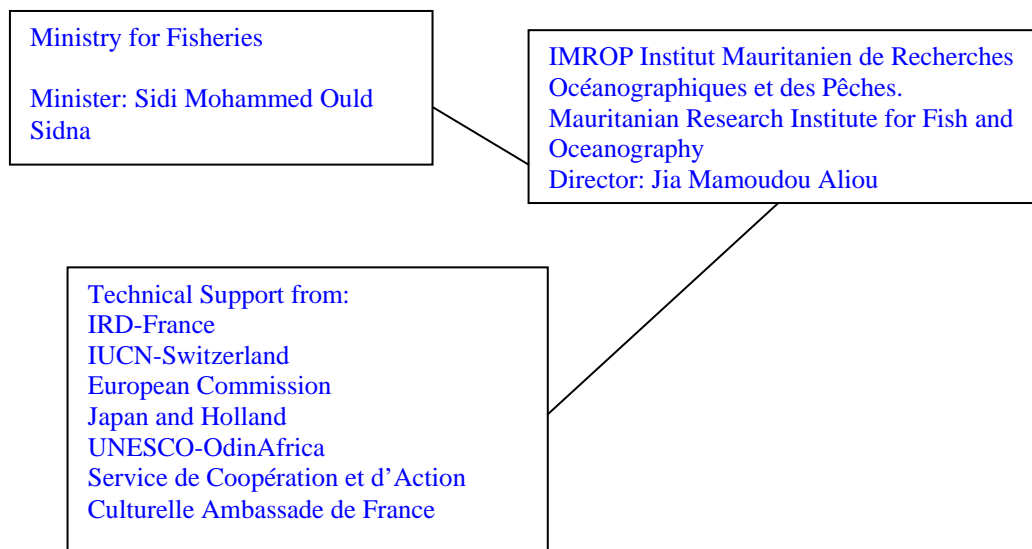


Figure 1. IMROP Structure.

IMROP has the primary task of research into fishing stocks and identifying fishing grounds to improve sustainable catches. They have assistance from L'Institut de Recherche pour le Développement (IRD) with a large IRD Regional Centre at Dakar, Senegal and IRD head office in France. French scientific / technical staff work at IMROP and assistance is from IRD (France), IUCN (Switzerland), Holland and previous Japanese aid.

IMROP has 3 centres in Nouadhibou and a new small administration office in Nouakcote built by the Japanese Government's aid program. With two research vessels, one deep-sea and one for shallow water.

In August 2005, the Mauritanian Government changed and this has meant several changes at senior government and Minister level.

The previous director of IMROP, **Sidi Mohammed Ould Sidna** is now Minister of Fisheries. The new director of IMROP is **Jia Mamoudou Aliou**, as of September 2005.

The French technical director of IMROP for the past 10 months is **Pierre Labrosse** with the French technical counsellor **Christophe Breuil** for the past 3 months.

**Hamoud Taleb** is the IMROP Physical Oceanographer and accompanied me on the survey of the port.

**Cheikh Ibrahim Sakho** acted as translator. Cheikh works at the IMROP Library / Communications Centre.

**Mohamed Mafoud** is the IMROP OdinAfrica co-ordinator and fisheries researcher. He has a dedication office for the OdinAfrica program (Figure 2).

No technician was available to determine his skills or suitability to assist with the tide gauge system.

**Pierre Labrosse**, Technical Director to IMROP, did express interest in obtaining / buying further tide-gauge systems for IMROP. GLOSS can provide further advice on this proposal.



Figure 2. From right: Hamoud Taleb, Cheikh Ibrahim Sakho and Mohamed Mafoud.

### 4.3. Existing Tide Gauge

There is an old OTT-Hydrometry R16 tide gauge on the Southern side of Nouadhibou port jetty (Figure 3). This is no longer working and is likely that it was for the purpose of tide predictions and construction at the port. The number of the gauge is 20.250 41388.

The top door hinge is broken. The location of this R16 gauge is surrounded by materials for fishing and ship repairs and is not suitable for a new gauge due to this activity and potential damage (Figure 23, Appendices and port plan files and photographs).

A tide-gauge benchmark TGBM is located beneath the R16 gauge with the letters RA? (Figure 4). No information on the elevation is available. No charts from the R16 gauge were available.

OTT has been contacted to find the details of the owners of the R16 gauge. This may lead to information on the benchmark and the vertical height elevation.



Figure 3. Nouadhibou Port Ott R16 Tide Gauge (no longer used).



Figure 4. Tide Gauge benchmark-bolt in concrete surface with letters RA.

#### 4.4. Nouadhibou Port

The Director / Head of the maintenance service department at Nouadhibou Port is **Alioune Ould Samoury**. Following a meeting at the port, he escorted me to the port jetty with IMROP staff. The General Director was absent from the port during my visit.

This is a busy fish port with over 50 large vessels lying offshore and along the fishing quay from Mauritania, Korea and Japan, etc. An oil supply vessel was alongside the Eastern arm of the jetty during the visit.

Nouadhibou - jetty is suitable for a tide gauge but security may be an issue with no obvious security guards, barriers or gates to port. However the port offices overlook the Jetty. The preferred location for a new tide gauge is only 240metres from the offices (Figure 5 and 23). Security lights exist on the jetty at the Southern light tower (Figure 6).

The port Director of Maintenance was very helpful (French/Arabic language only). He can assist with providing electrical power supply. But no suitable technician was identified to service the tide gauge so any major maintenance could require a visit from IOC. However it is very likely that cleaning of the solar panels can be arranged through IMROP or port staff.



Electrical power is available on the port jetty and is supplied to ships through a large service duct on the Northern side of the Jetty. The existing services in the duct are covered in loose sand. It is possible to run a power cable along this duct protected in suitable galvanised steel / heavy-duty nylon protective conduit. The Director of Maintenance is able to provide the power connection and staff to provide this.

This jetty is the only suitable site for a tide gauge as fishing vessels berth along the North – South orientated long fishing quay and unload catches into the warehouses / trucks. On the Southern quay there is expected to be alterations to the quayside and is used by customs / military vessels.

The plans of the port are dated 1988 and show the depths around the jetty and fish quayside (Figure 23).

#### **4.5. New Tide Gauge Location**

Two suitable locations are on the jetty. One on the NorthEastern corner (Location 1) (Figure 5) and one at the Southern end (Location 2) (Figure 6). Both will have access to electrical power. The depth of water is sufficient for stilling well and pressure transducers. IMROP staff can determine the exact water depth when required. The port plan indicates 6 metres in depth at Location 1 and 8 metres at Location 2.

The small jetty is in constant use with small boat repairs, and berthing of larger vessels as seen in the photographs. Vehicles access the jetty. However no vessels moor alongside the North side of the jetty hence the preference for Location 1.

The reason why no vessels moor alongside the Northern edge of the jetty is unclear but I expect it is related to the service duct, which runs along this edge. There is a mooring dolphin just off the NorthEastern edge of the jetty (Figure 23).

Solar panels will need to be situated high enough to avoid theft but allow for cleaning in the dusty environment.

Permission to build a small cabin has been granted and could be of concrete block or aluminium. The port Maintenance Manager would prefer the Northern facing Location-(1) where no vessels moor and site the hut /equipment raised up above the service duct so no damage is caused to the services.

If the cabin was made of concrete block a small tower could be fixed on top to house the solar panels, antennas and Kalesto radar gauge sensor away from arms reach.

The Director of IMROP has agreed to negotiate with the port concerning costs of the construction of a small cabin and does not see this as a problem.

The jetty is visible from the administration offices and port entrance. No guards were seen on driving into the port and no security gate/barriers. The light tower at the Southern end of the Jetty is in poor condition and would need replacing soon and would therefore not be suitable to attach solar panels or satellite telemetry antennas. The jetty is in constant use.



Figure 5. Location 1. Preferred site on North side of jetty for a tide gauge (to right of the IMROP staff).



Figure 6. Location 2. Alternative location for a tide gauge at the Southern end of the jetty.

#### 4.6. Nouadhibou Airport Meteorological Station (Asecna)

The visit to the Meteorological Station (ASECNA) at Nouadhibou airport was to find out if there was any geodetic/survey benchmarks but none existed. These benchmarks are often used to provide a height reference for the airport run way to allow pilots to height their aircraft altimeters. The mercury column barometers have an elevation at the base of 4.58metres. This elevation is used on the daily weather reports submitted to WMO. This value has been used for 40 years. However a more recent survey for the airport (no details available) gives the height as 2.81metres for the mercury barometers. The airport continues to use 4.58 metres as they have been given no instructions to change and no explanation as to the difference in the two heights.

We discussed the GLOSS program and instrumentation with the Director **Ahmedould Sid'ahmed**. With regards to a mini meteorological station combined with the tide gauge; the Met office Director would find the data very useful. No marine met-data is presently available for flight operations or reports to WMO.

The tide gauge would have the added benefit of providing a mean sea level elevation, which could be transferred to the airport Meteorological Office by geodetic levelling. This would also be of benefit to WMO and the Civil Aviation Authority as a correct elevation can be established for the airport barometers and airport runway apron/surface.



Figure 7. Airport mercury column barometers with WMO reported elevation at column base as 4.58m above sea level.

#### **4.7. Meeting with Minister of Culture.**

The Minister of Culture, Sport and Young People, **Madam Mehla Mint Ahmed** is also the President of the UNESCO Mission to Mauritania. The Minister was until recently with the Ministry of Foreign Affairs.

The Minister's chief technical advisor was in attendance at the meeting. The Minister expressed great interest in the OdinAfrica /GLOSS program as Nouakchott has some environmental issues related to the low elevation of the city and potential coastal flooding.

**Moustapha Mohammed** and **Meimine Saleck**, Co-ordinators of the Green Belt from the Department of Rural Development and Environment showed me the environmental issues of the coastal region of Nouakchott.

At Nouakchott, high saline ground water is evident with areas of exposed ground water and wind blown erosion of coastal sand dunes protecting the low-lying regions of Nouakchott (see archive photographs).

They expressed a need for sea level observations and a GLOSS tide gauge at Nouakchott to assist with this work.

There is a port at Nouakchott with Port de L'Amitié 6 km further South, it is unconfirmed that a tide gauge exists there and would be sufficient for these needs. No visit to Nouakchott Port or Port de L'Amitié was possible.

#### **4.8. Nouakchott Port / Port de L'Amitié**

There is a port at Nouakchott for ships and oil exploration vessels. Ten kilometres South of Nouakchott is the newer Port de L'Amitié the commercial port of Nouakchott. It is possible that this may provide a suitable location for a GLOSS tide gauge.

A port hydrographic office does exist at Port de L'Amitié. I have established a contact with Subsea7 Ltd, a UK based oil /offshore operator based in Aberdeen, UK which operates from Nouakchott. There is also an unconfirmed report that a tide gauge already exists at Port de L'Amitié. Follow up correspondence is now on going with Subsea7 (UK) Ltd to establish further details.

#### **4.9. Conclusions**

The old AOTT R16 tide gauge location at Nouadhibou Port is not suitable for a new gauge due to boat repairs and general small boat activity, mooring ropes, generators and people working around this site.

The proposed site (Location 1) on the NorthEastern corner / elbow of the jetty has sufficient water depth, away from harbour traffic as protected by the high kerb running along the service duct. The jetty structure is a concrete surface with vertical steel shuttering extending 6 metres to the seabed. No vessels moor alongside this Northern side of the jetty.

The tide gauge would help to identify upwelling events as signalled by the tidal surge. This could have significant benefit to the local fishing industry and economy.

A follow up report has been requested from IMROP to provide some additional information from the Nouadhibou Port and the Géodésie Travaux Publics / Mauritania Survey Department on local benchmarks.

Security and maintenance issues have not been resolved or details of any port hydrographic survey department at Nouadhibou that can assist with the project.

Hamoud Taleb the IMROP Physical Oceanographer would be ideal to continue working with this GLOSS project. However a GLOSS training course in French would be needed with GLOSS literature in French. Alternatively a UNESCO / IMROP funded English language course for concerned IMROP staff would be very useful, i.e. for Hamoud Taleb and Mohamed Ould - El- Mahfoud.

I have an unconfirmed report that a tide gauge exists at Nouakchott Port de L'Amitié and that a port hydrographic office is based there. Details of both are forthcoming with a follow up correspondence with SubSea7 (UK) Ltd.

For logistics, security and maintenance Nouakchott Port de L'Amitié may prove to be the more suitable location. Furthermore a previous history of tidal data at Nouakchott Port de L'Amitié will help GLOSS establish a longer time series for analysis.

## **5. Cameroon**

### **5.1. Introduction**

Kribi and Limbe are picturesque coastal villages with many holiday visitors. Cameroon harbours at Limbe and Kribi are very small. Douala is the major port for Cameroon and second largest town. Yaounde is the capital.

Kribi is a Francophone region where as Limbe is in an Anglophone region. The countryside is in general very fertile with dense tropical forest cover. Large government owned banana and rubber plantations are situated on the road to Limbe. The good road to Kribi was built with German aid 10 years ago. This road runs through dense forest of mango, papaya, banana trees, large bamboo and various tropical hardwood trees, crossing the River Sanaga and other rivers.

The major rivers provide hydroelectricity, sufficient for the all the countries needs.

Mount Cameroon (4095m) a semi active volcano is just 20km North from Limbe with dramatic forested hills, valleys and ridges running to the sea.

Good roads exist between Douala, Limbe and Kribi. Busy markets exist on the roads leaving Douala and can cause some delay in journeys. The bridge over the River Wouri at Douala is undergoing repairs and results in a traffic tail back with delays of up to an hour. The drive to Kribi is 2 hours and 1 hour to Limbe from Douala with no traffic delays.

## 5.2. IRAD Institut de Recherche Agricole pour le Développement

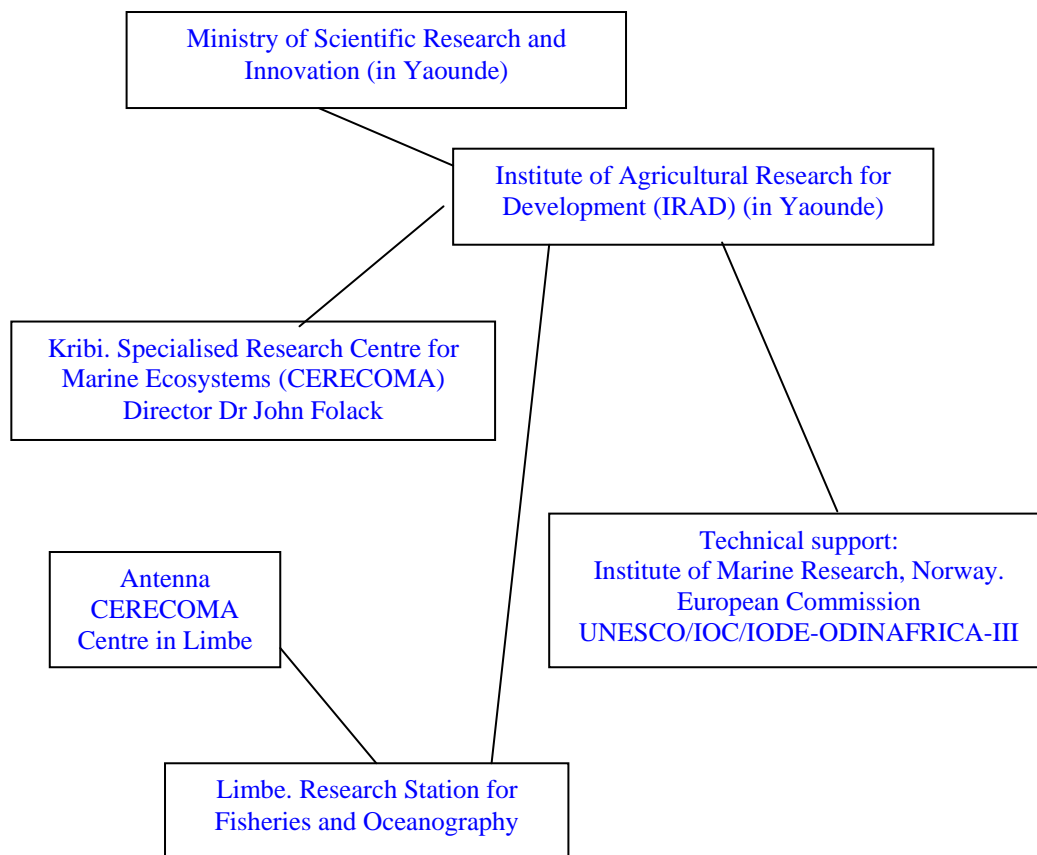


Figure 8. Part of IRAD Structure with regard to Marine Science. Note: apart from structure mentioned above IRAD has 5 other research centres for agricultural research with 2 specialised research centres in Njombe and Dibamba concerned with Plantain crops and Palm Oil Research respectively.

Kribi is the location of the Institut de Recherche Agricole pour le Développement (IRAD) Specialized Research Centre for Marine Ecosystems (CERECOMA).

IRAD has another centre at Limbe, with marine science /fisheries research staff and the Antenna/branch CERECOMA Centre.

IRAD is funded from the Ministry of Scientific Research and Innovation based in Yaounde the capital of Cameroon.

As the visit was on a weekend the two IRAD centres were closed and most staff were absent.

IRAD has no dedicated website as yet. A search on the Internet gives more information concerning the Agriculture, Forestry and Fisheries activities of IRAD in Cameroon.

### 5.3. Kribi

Kribi is a small coastal town with the small port and busy artisanal fishing activities. There are numerous hotels along the coast catering for the visitors. The coastline is very picturesque with palm trees over hanging the beaches. The port is situated 300metres from the mouth of the river Kienke that runs through Kribi.

### 5.4. Kribi Port

The visit to the port was on Saturday when the offices would normally be closed, however the **Port Commander David Metou** had scheduled a meeting to discuss the Gloss/Odin Africa program and a site for a new tide gauge.

The port has good security with a gate and guard. Guards patrol the buildings around the port. Several small cargo vessels were in the process of unloading.

Kribi harbour is within the narrow fast flowing river Kienki, so not really suitable for a GLOSS tide gauge as the river level would introduce a bias in the tidal heights.

Dredging is often required to maintain the navigation channel.

A new deep-water port is proposed for Kribi in 2 years time, 5 km South of Kribi and would be ideal for a GLOSS tide gauge. This would be adjacent to the offshore oil terminals now used to export the oil piped from Chad.

It is important to realise that when the new port is built in 2 years time 5km South of Kribi, the port / harbour office and infrastructure will close at Kribi and move to the new port according to Commander **David Metou**. Kribi harbour will then be used only for recreational sport fishing and local artisanal fisheries use. If there is no port office or small cargo vessel traffic, I expect the dredging may discontinue and the river mouth / entrance may silt up. There is already a sand bar across the entrance to the river with small breaking waves (Figure 9). If a tide gauge were proposed for Kribi I would recommend waiting until the new port is constructed.

Marlin/sport fishing is an important industry at Kribi Port with expensive charter and private fishing boats. There is a large number of small artisanal fishing canoes on the Southern side of the River Kienke from the port. A small rock fill harbour basin is provided for these fishermen.

With reference to the photographs, the River Kienke is in full flood as at this time it is the rainy season with several heavy rain showers throughout the day. The tide level is low at the time of the photographs (Figure 10).

Small vessels carry cargo to/from the port. Large hardwood tree logs are an important export cargo. The small barges (Figure 10) transport the wood to larger ships offshore or along the coast.





Figure 9. Mouth of the River Keinke, 300m West from Kribi Port



Figure 10. Kribi Port quayside, River Kienke and the road bridge.

### **5.5. Existing Tide Gauge at Kribi**

The only sign of a tide gauge at Kribi is a recently painted benchmark (Figure 11) and an old visual tide staff. We were unable to determine the reason why the benchmark was recently painted. I expect it is related to recent hydrographic charting of the river for dredging operations when the survey vessels echo sounder depths are corrected for tidal variations.



Figure 11. Kribi Port tide staff with the benchmark in yellow paint (top right)

## **5.6. Limbe**

### **5.6.1. Limbe Port**

The small port with a short single jetty has had little use since 1976 according to local port staff. Large warehouses and rail tracks were once used to handle cargoes. But the port at Douala is now more suitable.

At Limbe the main use of the port jetty is the small ferries running along the coast to Nigeria.

Small boat repair sheds are now semi derelict and in need of repairs. Several old vessels lie alongside the jetty with some wrecked.



Figure 12. Limbe Port jetty with Limbe town on the left.

### 5.6.2. IRAD Office at Limbe

The office overlooks the bay and is a spectacular location with the semi active volcano Mount Cameroon (4095m) 20km to the North East. The office is on the Western edge of Limbe town close to the Sonara refinery/port.

The staff members met at Limbe where **George Yongbi Chiambeng** a marine ecologist who works closely with the Institute of Marine Research of Norway and participates in an annual fisheries cruise on the Research Vessel Dr Fritjof Nansen.

I also met with **Mr Angwe Ayamama Collins**, the national co-ordinator for WP2 who is a marine pollution specialist (MSc. Marine Pollution, Southampton 1985).



Figure 13. (L-R) John Folack, George Yongbi Chiambeng and Angwe Ayamama Collins at IRAD Limbe.

### 5.6.3. Sonara Oil /Petrol Refinery and ship tanker terminal

Sonara is a private company at Limbe and the site is an oil refinery and ship terminal for export/import of oil/petrol and refined products (Figure 14).

Angwe and John Folack are to follow up with a independent report on the suitability of Sonara Oil / Petrol Terminal for a tide gauge location. This site has high security and two jetties. One is concrete and the second is under construction.



Figure 14. Sonara jetties and ship, next to the Oil Refinery at Limbe.

### **5.7. Douala Port / River Wouri**

The port at Douala is 24km inland from the Atlantic coast and is located on the River Wouri, which is fast flowing in the rainy season. Sand banks and accumulation of sediments in the port channels is a problem requiring dredging. The chart indicates existing tide gauges along the river /port channel (see photographs for Kribi).

### **5.8. Conclusions**

Kribi Port is not really suitable for a GLOSS tide gauge. The only possible site for a tide gauge is on the port quayside, which is on the river Kienki. This river is only 50 metres wide and shallow 3-4 metres. Dredging is required to maintain the navigation channel. A sandbank extends across the river mouth from the Southern shoreline. The port is about 300metres from the river mouth. The river water levels would introduce a bias in the tidal data and not be representative of the adjacent oceanic tides.

If a tide gauge is still required for Kribi, I suggest waiting for 2 years until the new deep-sea port is built 5km South of Kribi.

John Folack is to investigate the possibility of a suitable site for a tide gauge South of Kribi, where the Chad Oil pipeline terminates. There are offshore mooring platforms for ships allowing them to load crude oil. A jetty on the shore may exist for maintenance vessels / tugs and provide a site for a tide gauge?

Limbi Port has been neglected since 1976. The issues here are poor security and potential damage from old cargoes piled up on the very small jetty. The jetty is used for passenger ferries to Nigeria and therefore numerous passengers use the jetty.

The most suitable site found so far is at Sonara Oil/Petrol refinery just 2-3 km West of Limbe. This has a long jetty for tankers and high security. A follow up report is being prepared by IRAD on this option. If Sonara can provide a location this would make an excellent joint project for IRAD/Sonara and GLOSS.

Douala Port is well inland on the River Wouri and not suitable for a GLOSS tide gauge. In the rainy season rivers are in full flood carrying sediments and trees down river. So damage to a tide gauge is possible. The river Wouri at Douala requires dredging to maintain the navigation.

## 6. Republic of Congo-Pointe-Noire

### 6.1. Introduction

Pointe-Noire is the major port for the Republique of the Congo. Brazzaville is the capital city.

The port of Pointe-Noire is very busy with container vessels, large fishing boats and oil exploration vessels.

The industrial port with oil exploration /supply vessels/offices and warehouses is situated on the Eastern side of the bay away from the commercial port and is adjacent to the IRD compound. This industrial port has high security.

### 6.2. IRD Institut de Recherche pour le Développement

The IRD Centre at Point- Noire is funded from IRD France and the Congo Ministry of Environment based in Brazzaville.

The IRD centre has chemical laboratories for analysis of food, water, plants and soils. With additional departments for Oceanography, Food / Plant Microbiology Laboratory, Library, Internet suite and administration offices <http://www.congo.ird.fr/>.

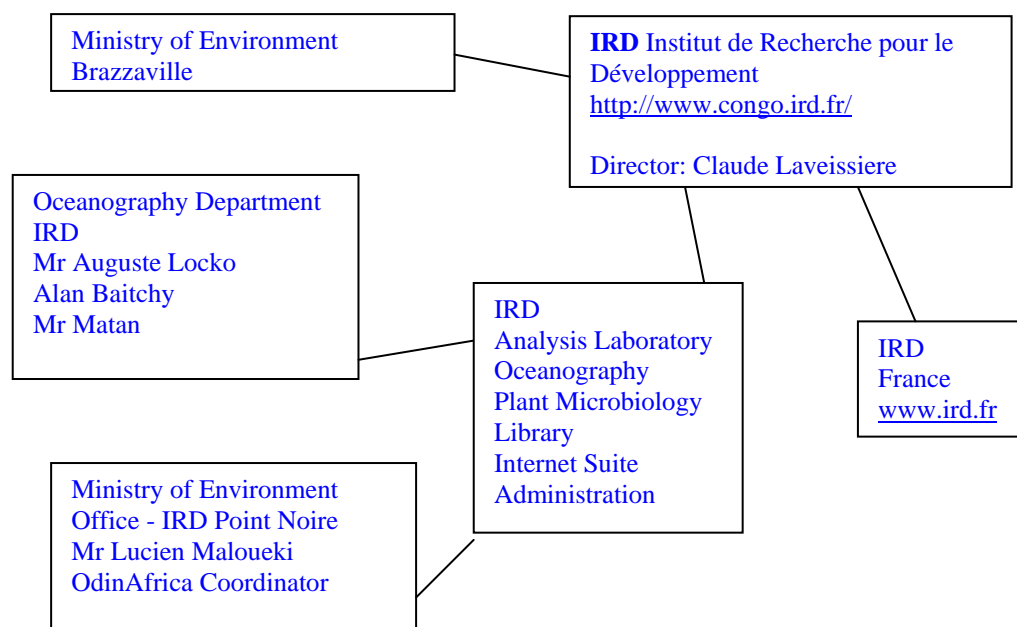


Figure 15. IRD Structure

### 6.2.1. IRD Oceanography

IRD has an Oceanography laboratory with three staff members, 3 computers and various items of oceanographic and sampling equipment. Aanderra current meters, salinometers, reversing thermometers and seawater sampling bottles.

**Mr Auguste Locko** is the IRD Physical Oceanographer. Auguste is an IRD staff member and in charge of the marine observation program. He used to collect the data from the old R16 tide gauge and digitise the charts.

**Alan Baitchy** is a young Phd student assigned temporarily at the Oceanography laboratory.

**Mr Matan** is the laboratory equipment technician.

The Oceanography department has good contacts with the Port Hydrographic Department. Auguste Locko worked with the port staff on the old OTT R16 tide gauge.

**Mr Lucien Maloueki** is the National OdinAfrica co-ordinator. He is a marine biologist / oceanographer. Lucien is on detachment /assignment from the **Ministry of Environment** based in Brazzaville, which has an office at IRD Pointe-Noire.



Figure 16. IRD Oceanography Staff. (L-R) Lucien Maloueki, Alan Baitchy, Auguste Locko

### 6.3. Pointe-Noire Port Authority

The port has a well-established Hydrographic Department, which carries out charting operations concerned with navigation and dredging operations. They have a dedicated charting office and computer office. The Hydrographic Office is a sub section of the Department of Equipment and Infrastructure ([www.congoport-papan.com](http://www.congoport-papan.com)).

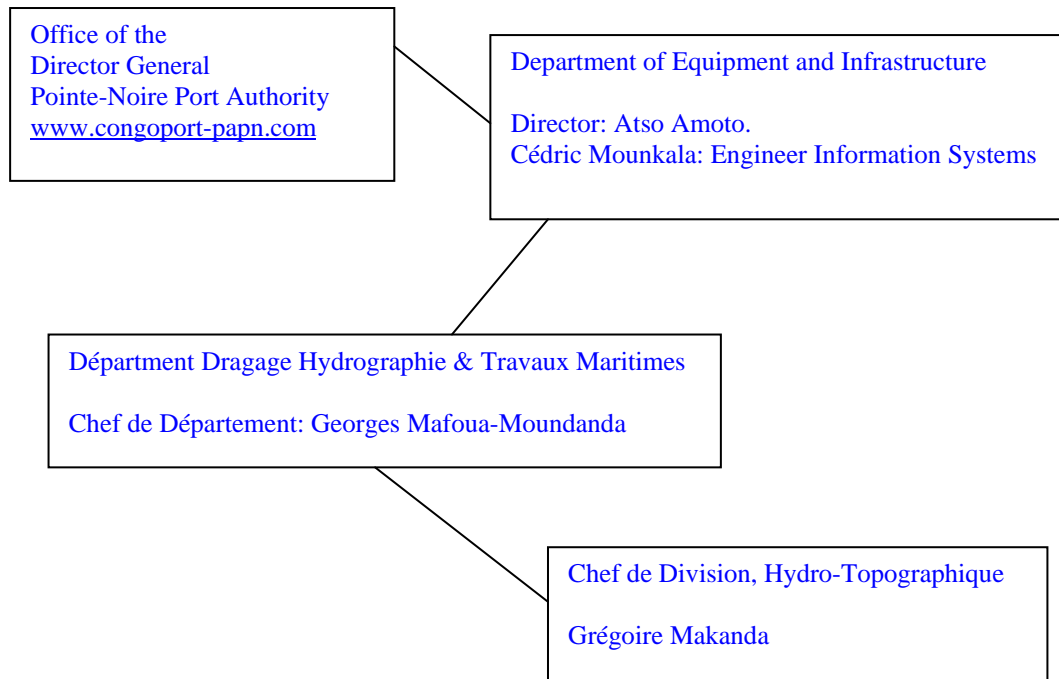


Figure 17. Port Structure

To install a GLOSS tide gauge, written permission is necessary from the port. A letter should be sent to The Director General and copied to the Director of Equipment and Infrastructure at Pointe-Noire Port Authority.

The port hydrographic department needs daily tidal heights to correct their hydrographic survey echo sounder depths for tidal variations. This is a fundamental task in charting the sandbanks and channels in the port, vital for ship navigation and dredging operations.

Their concern is that if the Internet access to the tidal data is not available for a technical reason locally at the port or within GLOSS then they could not complete their work.

To display /record daily tidal heights from the tide gauge via radio telemetry then a dedicated PC computer would be required. They asked if IOC could provide this PC or the specifications of the PC system.

I have confirmed with OTT–Hydrometry UK Ltd that this is possible with the second RS232 output on the tide gauge LogoSens Station Manager used for radio telemetry radio up to 24km, GSM telemetry or PSTN telemetry. Dedicated OTT software (Hydras 3) on a PC computer can be used to log, print and display the data.

They need to be sure that a days echo sounding by boat can be corrected using tidal heights, if the data is unavailable via the Internet.



These issues can be discussed between GLOSS / POL and the port hydrographic department.

Access to the port entrance has good security and an official letter or pass is required to enter.

Service Hydrographique et Océanographique de la Marine (SHOM) from France, surveyed the port in 2003 with an extensive Global Positioning System GPS survey and assessment of the ports navigation aids. These reports contain useful information and should be obtained from SHOM for IOC/GLOSS.

**Grégoire Makanda** is the Chef de Division, Hydro-Topographique. He is very familiar with charting operations and the location of the survey bench marks for the tide gauge.

**Cédric Mounkala** is the Information Systems /Software Engineer.

The department has three NEC Pentium 4 desktop systems networked with Internet access and large CRT screens for CAD. Autocad is used to map the port. They also have a Wild T1 theodolite and Wild NA2 level for land surveying. However the NA2 level does need repair/service. Grégoire Makanda is investigating the options of repair or replacement. They also have full hydrographic charting capability.

Pointe-Noire and the port electricity supply has erratic voltage fluctuations and cut outs, not ideal for electrical equipment. Voltage stabilisers are an essential requirement for all office and household equipment.

### **6.3.1. Port Tide Gauge**

The existing Tide Gauge hut (Figure 18) is made of concrete and could be used for another tide gauge. However there are a number of concerns.

There was an attempt to break into the hut. The stilling well pipe is steel and is very corroded. The stilling well pipe appears to be supporting the hut and if the pipe weakens with corrosion the hut could collapse. The area around the hut has severe sand accumulation. This is supposed to be dredged in November 2005, to a depth of around 12 metres on the South of the jetty and 10m on the North side.

The tide-gauge hut was built in 1956, as was the jetty to the tower at the port entrance (Figure 19).

The alternative location at the port harbour entrance is solid concrete and high enough to be away from waves. However the approach is along a 140 metre jetty only 1 metre wide. The portion to walk along is only 0.7m wide and would require care when carrying equipment. Alternatively a small vessel /boat could be used from the port as there is a landing stage with steps.

There is a security hut near the old tide gauge hut with an armed guard. However if the electricity supply fails then security lights will not work. It would be very easy for a small boat to access the port light house /proposed tide gauge site in darkness.

No other site was offered or suggested by the port authority as suitable for a tide gauge. All other areas are very busy with shipping activity, fishing boats and large container ships.

The sand accumulation around the old tide gauge and jetty will be dredged in November 2005 to a depth of 12m on the South side and 10m on the North side. At present the sand is about 1 metre below the water surface (Southern side) at the old tide gauge hut.

The quayside will be extended by 50 metres towards the old tide gauge hut but they await funding. This extension will not reach the tide gauge hut (refer to port plan. pdf file).



Figure 18. Old Tide Gauge Hut with sand build up on either side of jetty.



Figure 19. Proposed new location for the Gloss Tide Gauge. This is 140 metres from the old tide gauge hut at the port entrance for ships.



Figure 20. The navigation light tower and existing solar panel at the port entrance.



Figure 21. Interior of the navigation tower with electrical junction box and tower ladder.

#### **6.4. Conclusions.**

The old OTT R16 tide gauge hut is presently sound but may suffer structural failure if the stilling well continues to corrode.

The proposed location at the port entrance on the navigation light tower is suitable for a radar gauge or pressure gauge.

There is a risk of theft of solar panels, but if they are positioned high on the existing concrete tower then they may be safer. There is already a solar panel on the top of the tower for the navigation light, which has survived for several months.

The existing concrete cabin could be used or new concrete cabin built for the tide gauge. I suggest using the existing cabin at the port entrance navigation tower but repair/replace the exterior doors, provide external security lighting with motion sensors. Use a galvanised steel tower/frame on the South side of the roof to support the radar gauge elevated over the water, as this will put the sensor above arms reach.

With the resources of IRD, SHOM, LEGOS and the Pointe-Noire hydrographic department the prospects for a new tide gauge are very possible.

## **7. General Conclusions**

### **7.1. Tide Gauge Installation**

I would recommend that SHOM-Service Hydrographique et Océanographique de la Marine [www.shom.fr](http://www.shom.fr) assist with the tide gauge installations in Mauritania and Congo. It would be essential for the installation team to speak fluent French. Without a translator on hand to deal with port access, port staff and general logistics you would probably double the length of time required to install the system.

Alternatively the manufacturers Aott could assist as they have staff in France see [www.ottfrance.com](http://www.ottfrance.com) and in Southern Africa [www.ott-hydrometry.com](http://www.ott-hydrometry.com)

Other wise the staff at LEGOS in Toulouse could assist as they have installed and operate the tide gauge at nearby Sao Tome. Laurent Testut would be a first point of contact at LEGOS.

### **7.2. Solar panels**

Solar panels are a very desirable item for powering TV/radio, therefore theft is very likely according to oil exploration people in based Congo. Expect the same in Mauritania and Cameroon.

### **7.3. French Version of GLOSS Manuals/Training Courses**

Senior and junior staff at IRD-Congo Pointe Noire and IMROP-Mauritania expressed need for GLOSS manuals and training course in 'French' as few speak English and therefore would not benefit from a English language version.

West Africa, from Morocco to Congo, speaks mainly only French. In the case of Mauritania and Congo, few staff at the research centres speak any English.

Alternatively, provide an English language training program for the concerned staff.

## 8. Appendices

Figure 22. Details of the Pointe-Noire Port Navigation Light Tower. (A suitable location for a new tide gauge). Measurements in metres.

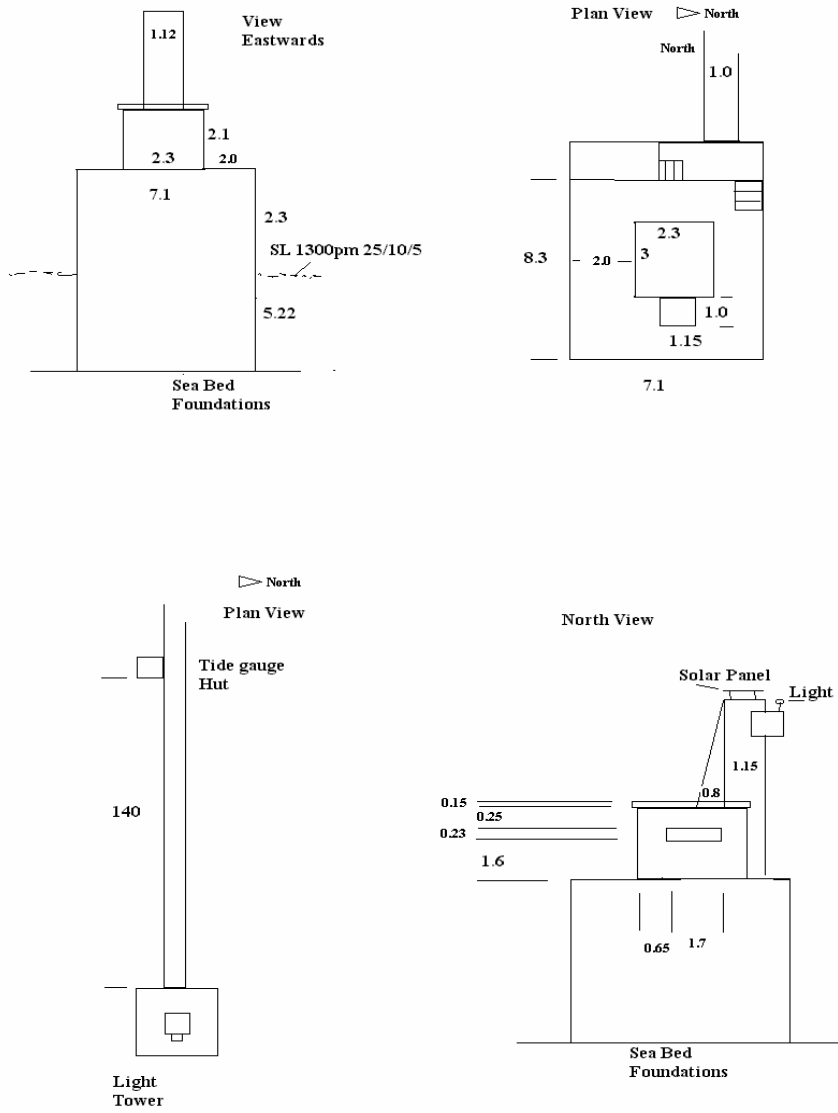
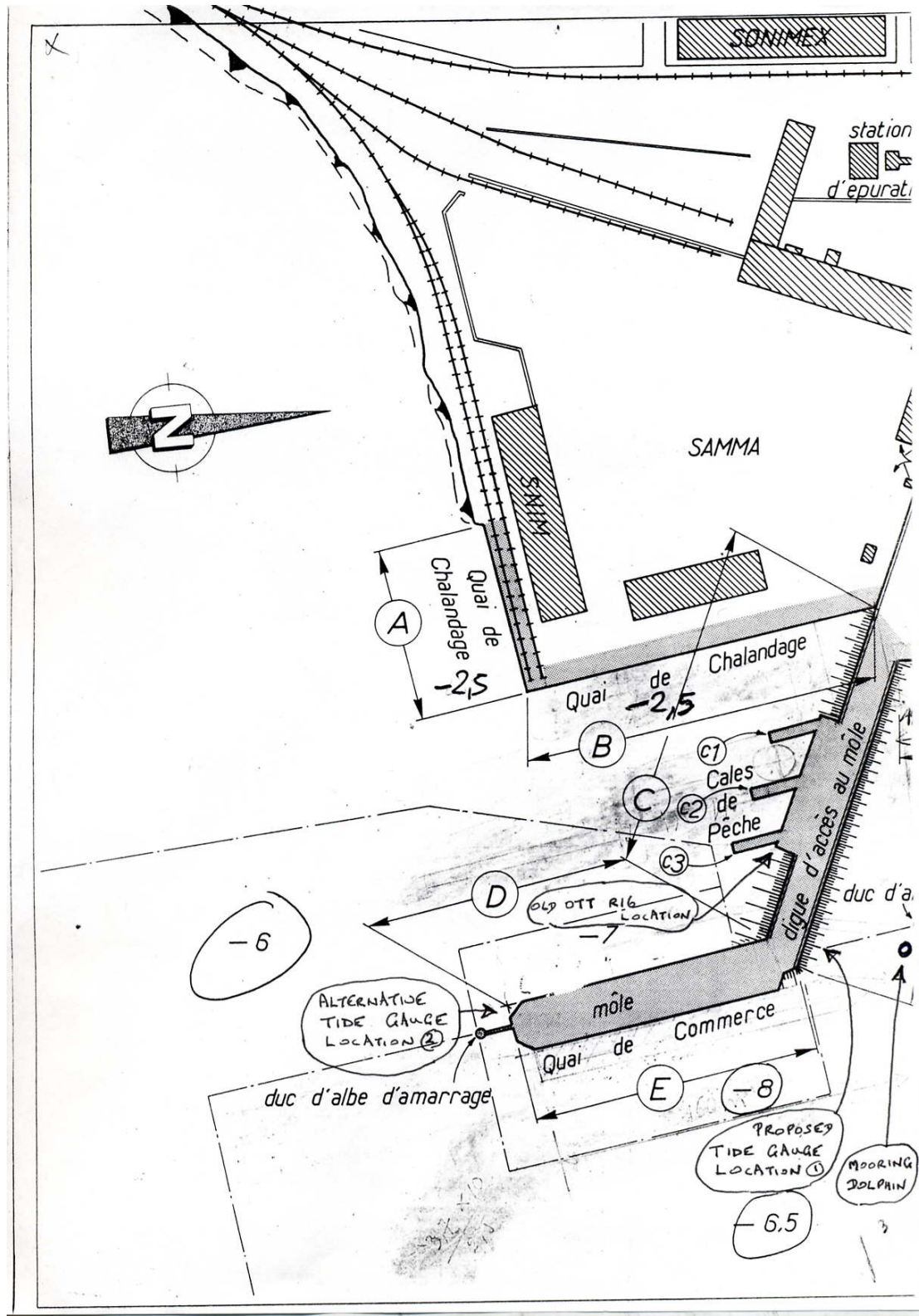


Figure 23. Nouadhibou Port plan / jetty (refer to additional scanned jpeg files).



## 9. References

IOC Manual on sea level measurement and interpretation Volume 4: An update to 2005. Draft version.

Woodworth, P. et al. 2003. Measuring progress of the Global Sea Level Observation System. EOS Transactions, American Geophysical Union, Vol.84, No.50, 16 December 2003. Page 565.

Scharringhausen, B.H. 1988. West Africa Survey Report. UNESCO, IOC, GLOSS.  
[www.pol.ac.uk/psmsl/reports.gloss/scharringhausen](http://www.pol.ac.uk/psmsl/reports.gloss/scharringhausen)

Global Sea Level Observation System (GLOSS)  
[http://gosis.org/goos/GLOSS\\_program\\_overview.htm](http://gosis.org/goos/GLOSS_program_overview.htm)

Centres associated with GLOSS  
[www.pol.ac.uk/psmsl](http://www.pol.ac.uk/psmsl)  
[www.soest.hawaii.edu/UHSLC/](http://www.soest.hawaii.edu/UHSLC/)  
[www.ntf.flinders.edu.au](http://www.ntf.flinders.edu.au)

OdinAfrica  
<http://ioc3.unesco.org/odinafrica/>

Window Volume 16 Number 1 August 2005 IOC  
[www.odinafrica.net](http://www.odinafrica.net)

GLOSS Training  
<http://www.pol.ac.uk/psmsl/training/>

Philip Woodworth, POL, UK. Comparative test of a bubbler and Ott Kalesto radar gauge at Liverpool  
<http://www.pol.ac.uk/psmsl/reports.gloss/ge8/presentations/wspresentations.html>

OTT kalesto gauge radar sensor  
<http://www.ott-hydrometry.de/english/cmshome.htm>

Travel Information  
[www.fco.gov.uk](http://www.fco.gov.uk)

Medical / Vaccinations  
[www.masta.org](http://www.masta.org)



## **Cameroon**

Cameroon The Bradt Travel Guide. Ben West. 2004  
ISBN-10: 1 84162 078 5. [www.bradtguides.com](http://www.bradtguides.com)

## **IRAD, Cameroon**

<http://www.gpa.unep.org/igr/Reports/CAMEROON.htm>  
<http://www.iita.org/about/cameroon.htm>

## **Mauritania**

Iron Ore Mining at Nouadhibou  
[www.snim.com](http://www.snim.com)

## **Republic of the Congo, Pointe-Noire**

IRD  
<http://www.congo.ird.fr/>  
[www.sleeping-sickness.com](http://www.sleeping-sickness.com)

Pointe-Noire Port  
[www.congoport-papn.com](http://www.congoport-papn.com)

## **Services / Resources**

SHOM [www.shom.fr](http://www.shom.fr)

OTT Hydrometry Ltd  
[www.ottfrance.com](http://www.ottfrance.com)  
[www.ott-hydrometry.com](http://www.ott-hydrometry.com)

IRD France  
[www.ird.fr](http://www.ird.fr)

International Hydrographic Organisation (IHO)  
Technical experts visit concerning hydrographic capacity building in West Africa.  
Safety of navigation and oil shipments from West Africa.  
[www.iho.shom.fr/REG\\_HYD\\_COM/EAtHC/EAtHC8/Workshop/TW-5A-E\\_WAAT\\_Report.pdf](http://www.iho.shom.fr/REG_HYD_COM/EAtHC/EAtHC8/Workshop/TW-5A-E_WAAT_Report.pdf)