National Report of Senegal
To
GLOSS GE X Tenth Session of the GLOSS Group of Experts
5 - 8 June 2007, Paris, France

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1. Introduction.

Senegal is located in West Africa, along the Atlantic Ocean, between latitudes 12° 20' N and 16° 20' N. It has a territorial sea of 198,000 km^2, almost equal to the area of the country (196,722 Km^2), with 718 km of coast.

1.1. Meteorological conditions:

The meteorological regime in the Senegalese region depends on the position of the Inter-tropical Convergence Zone (ITCZ). If the ITCZ is located south of Senegal, we have a dry climate and the trade winds blowing from north-west. When it is at the latitudes of Senegal, the climate is more humid and winds blow from south-west. It happens to have the ITCZ north of Senegal, and then the winds are mainly from south. The displacements of the ITCZ are shown on). They occur between 6 N and 21 N. The extreme positions are reached in January and in August figure (Rebert, 1981; Portolano, 19881).

The circulation in low altitude in West Africa is a result of the interaction between four pressure field.(1) The anticyclone of Azores and of Saint-Helene are permanent maritime systems. (2) The anticyclone of Libya (Maghrebian) and the saharian depression are seasonal continental systems. But the Senegalese coast is mainly under control of the anticyclone of Azores (Rébert, 1981).

The intensity of the winds is linked to the pressure gradient between the Anticyclone of Azores and the inter-tropical depression, with the effect of the depressions located on the Sahara and Sahel zones. At a time scale of a day, the displacements of the ITCZ are very complex and can be of many degrees of latitude in a few days. That explains partly the high variability of the mean daily winds at the coast (Portolano, 1981).
and atmospheric circulation:

The Senegalese coast is under the influence of three major air masses). (1) The continental air masses characterized by a high temperature and a high daily variation. It covers the major part of the country but is found at the coast just from December to February. (2) The marine air mass is cool and humid. it is a polar air coming fro North and maintained cool by the cold Canary current and by the coastal upwellings. (3) The southern air mass is observed in Senegal only during the rainy season (May to October in the south part and July to September in the north part of the country). It is a polar air from the southern hemisphere, becoming warm and humid because of the influence of the warm equatorial waters of the Atlantic (Rébert, 1981).

1.2. Oceanographic characteristics.

The Senegalese region is characterized by two marine seasons: a cold season from December to May (period of trade winds and coastal upwelling processes) and a warm season from July to October (warm waters cover the whole continental shelf). November to December and May to June are transition periods. Offshore, there are two main surface circulation features: (a) north equatorial current (westward with cold waters), (b) equatorial counter current (eastward with warm and salty waters). On the continental shelf the circulation is meridional. There is a southward current (with cold waters) from November to May, named “Canary” current, and a northward current (with warm waters), from June to August *(Diaw, 1982)*..

Coastal waters are constantly renewed during the year by upwelling processes. Locally, the direction of the coast, the shelf topography and the wind fluctuations, produce important space and time modifications of this circulation which is, moreover, influenced by circulation offshore.

Upwelling near Senegal exhibits common features of upwelling areas of eastern boundaries of oceans. The alongshore circulation consists of an equatorward surface current and a poleward undercurrent. The cross-shore circulation is constituted by a seaward surface flow and a shoreward compensation layer just below the thermocline. Upwelled water masses are bounded seaward by a surface front associated with an intense equatorward jet. This front migrates transversally according to upwelling activity.

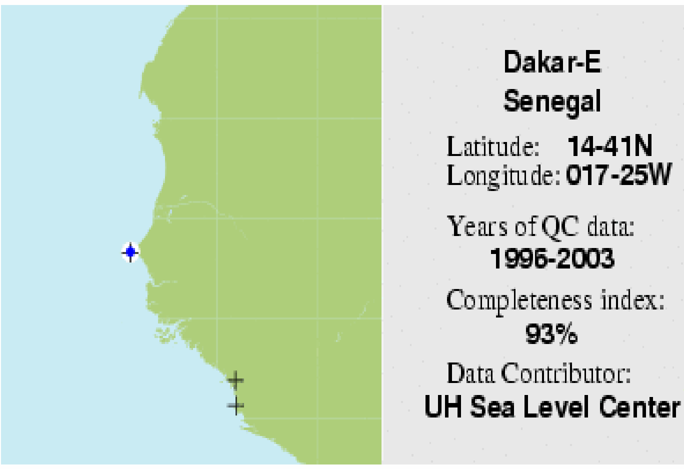
Toure [1990] found that the beginning of the upwelling in the Bay of Goree (in Dakar) is always characterized by relatively important vertical velocities. There is a good correlation between winds and vertical velocities.

There are important energy exchanges between ocean and atmosphere and the thermal balance is strongly positive, the atmosphere heating the ocean*(Diaw*, 1983). Wide thermal oscillations appear during the migration of the inter-tropical front; they may be explained by Rossby waves and by topographic waves *(Rébert, 1983).* During the cold season, the evaporation is minimum. The turbulent heat exchange with the atmosphere is low and is directed from air to water. The net surface heat budget is maximum. The centres of upwelling constitute active poles of interaction between ocean and atmosphere where you have the maxima of sensible heat fluxes, of the effective sea radiation and of the heat budget. There are condensation phenomena in the air. During the warm season the evaporation is very high. The turbulent heat exchanges are negative and so, directed from water to air. Thus, convective motions occur in the atmosphere. The surface heat budget reaches its lowest.

The existence of a circulation with two currents flowing in opposite directions (seaward and southward in the surface layer, shoreward and poleward in subsurface layer) and the exchanges between these two layers in terms of mixing or migration of organisms allow the recycling of nutrients and of phytoplankton inside the coastal zone. The consequences of this recycling on the biological production are very important*(Roy, 1990; Binet, 1988).*

2. Sea level measurements and data.

The sea level measurements where made by ORSTOM (France) since the colonial period, and more recently by NOAA (USA).



The data are available on site of University of Hawaii sea Level Center.

The Dakar pressure gauge records consist of two parts.

2.1. The first part.

It is of four separate segments:

Dakar-A: 24 Dec 1982 - 12 Dec 1983
Dakar-B: 12 Dec 1983 - 09 Jan 1985
Dakar-C: 30 May 1986 - 16 Dec 1986
Dakar-D: 16 Dec 1986 - 24 May 1989

Station: Latitude: 14 40.0N
Longitude: 017 25.8W

For these four segments the contributor is **ORSTOM (IRD)**,
LOP Museum, 43-45 rue Cuvier, 75231 Paris Cedex 05, FRANCE
Original Data: digital
Instrument Type: Aanderaa WLR5 (bottom-mounted pressure gauge).
Digitized Interval: one hour
Present Data: Hourly, daily, and monthly values.
Time Reference: GMT (hours 00-23) Space-filler Flag :-9999
The depth of the instrument in the water was about 8 meters.
Reference Level: Due to the nature of the bottom-mounted pressure gauges, no link could be established between the zero of the gauge values and fixed points on land.
Also, tide staff observations or the like were unavailable.
This series has no long-term reference level.

The series was broken into segments because level jumps could be identified at the time of instrument replacements.

Due to the tendency for pressure gauge sensors to drift, it is beneficial for investigators to know the time span of each instrument deployment (time/date as yyyy/mm/dd/hh(GMT)):

Series	start		stop
Dakar-A	1982/12/24/13	-	1983/01/25/10
Dakar-A	1983/01/25/12	-	1983/03/17/15
Dakar-A	1983/03/17/17	-	1983/05/16/10
Dakar-A	1983/05/16/11	-	1983/07/20/10
Dakar-A	1983/07/20/11	-	1983/12/12/10
Dakar-B	1983/12/12/11	-	1984/04/30/11
Dakar-B	1984/04/30/12	-	1984/10/04/11
Dakar-B	1984/10/04/12	-	1985/01/09/12
Dakar-C	1986/05/30/15	-	1986/12/16/15
Dakar-D	1986/12/16/23	-	1988/09/21/01
Dakar-D	1988/11/11/10	-	1989/05/24/10

2.2. Second part.

It is of one segment (updated: 22 Feb 2005):
Station : Dakar-E
Latitude: 14 40.6N
Longitude: 017 25.2W
Span of data: 01 Jan 1996 - 07 Jun 2003
Contributor: **UH Sea Level Center**, University of Hawaii at Manoa, Honolulu, Hawaii 96822 USA. For the pre-1999 data: **National Ocean Service (NOS)**, National Ocean and Atmos. Administration (NOAA): N/OES22, SSMC4, STATION 7109, 1305 East West Highway, Silver Spring, MD. 20910-3233.
Original Data: digital
Instrument type: Aquatrak acoustic gauge, NOAA. Next Generation Water Level Measuring; responsibility resumed by UHSLC in 1999
Digitized Interval: six-minute (each sampling is three-minute average).
Present Data: Hourly, daily, and monthly. Time Reference: GMT (hours 00-23) Space-filler Flag :-9999.
Reference Level: All heights have been referred to the station tide staff zero which is linked to fixed bench marks.

3. Restoration of the Dakar station.

With the ODINAFRICA Program (WP2) the Dakar station is being restored this year. The new material will be housed in the NOAA tide gauge site.

Figure 1: The NOAA tide gauge site inside of the entrance of the Dakar port

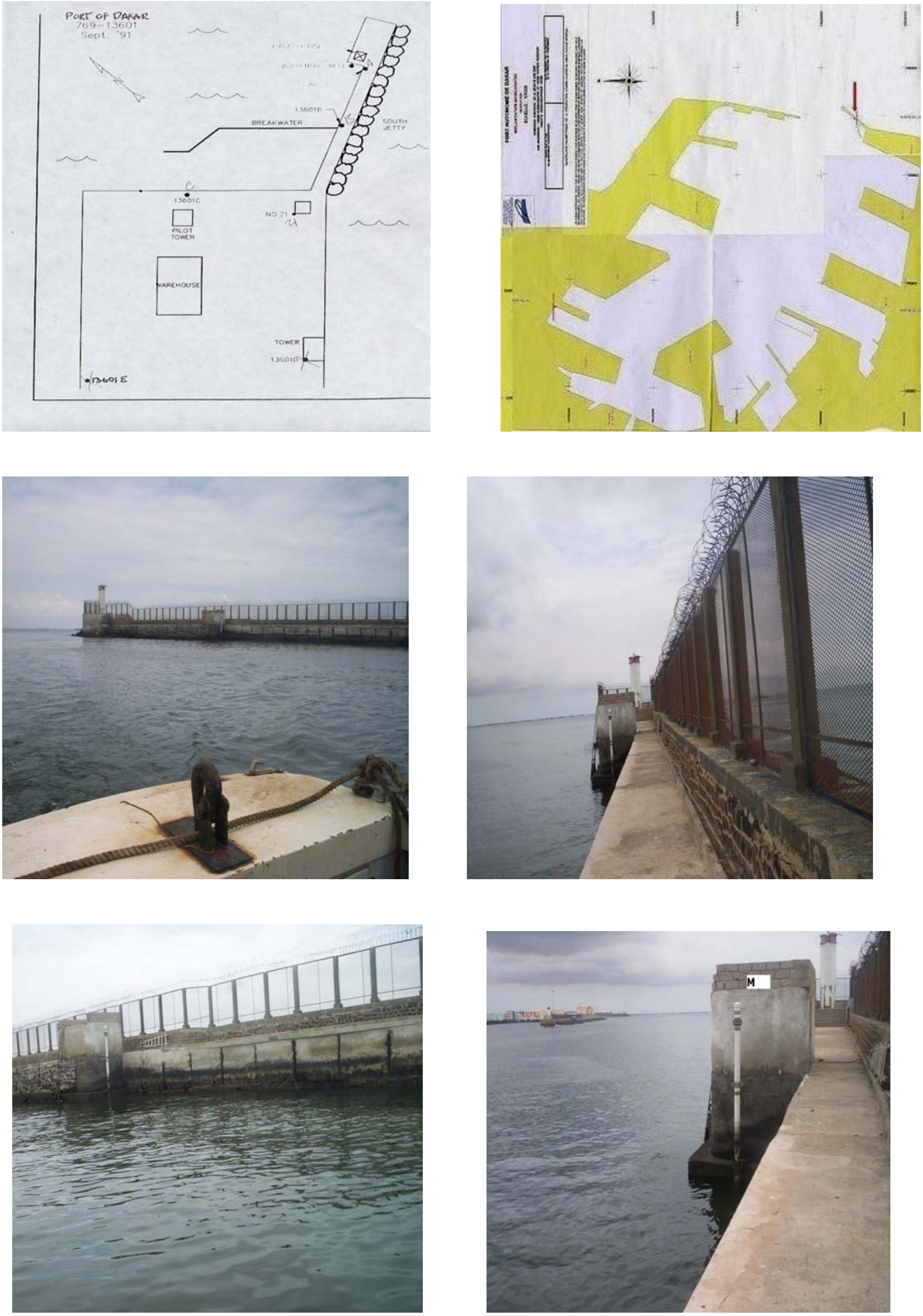


Figure 2: The old station NOAA equipment.