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GLOSS

NATIONAL REPORT ON SEA LEVEL OBSERVING ACTIVITIES

COTE D'VOIRE

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Ivorian tide gauges status

The Ivorian tide gauges are installed at Abidjan and San Pedro ports for basically practical applications (figure 1). This includes coastal engineering, in which sea level data are needed as instantaneous levels, as well as statistics of extreme levels over long periods. Short-term measurements are needed for ship movements in harbors and ports, and for the operation of sluices and barrages.

Five float tide gauges were initially installed in Abidjan and two in San Pedro ports. Only one float tide gauge is now operational in Abidjan port and one in San Pedro port (October 2011).

Station Name	Location Lat	Lon	Responsible Organisation	Type of gauge/ Manufacturer	Data span	Mode of Transmission	Remarks
Abidjan - Apponte ment	***05 15'N***	***04 W***	*Port Autonome d'Abidjan*	*A OTT*	*1951*	*Non real time*	*Paper form – many gaps*
San Pedro	**4°4'00''N**	**6°6'37''W**	*Port Autonome de San Pedro*	*A OTT*	*1986*	*Non real time*	*Numeric form - many gaps*

Description of Abidjan and San Pedro stations

Map of tide gauges network in Cote d'Ivoire

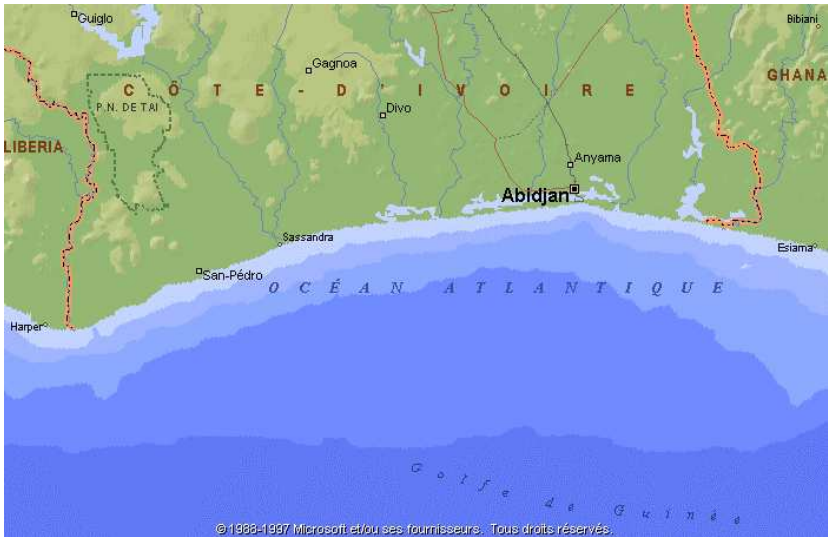

Figure 1: Location of the tide gauge stations along the Ivorian coast.

Technology employed in the Cote d'Ivoire tide gauge network

The Ivorian network is based on the old stilling well gauge technology (AOTT). It becomes difficult to find spares for the maintenance of such equipment now. So, there are many gaps in sea level datasets because of the lack of the maintenance on time.

Overview of the data availability / Addresses of the data banks

San Pedro: The San Pedro harbor is located in the South West part of Cote d'Ivoire. This port was created in 1978.
Data are available in numeric format from 1986 to 2002 and from 2005 up to September 2011 at San Pedro Hydrographical service.
Abidjan: sparse data are available on University of Hawaii Sea Level Center Website.
http://uhslc.soest.hawaii.edu/uhslc/htmld/0230A.html

Data from 1990 up to now is available on paper form at Abidjan hydrographical Department. Recently the datasets from January 2008 up to September 2011 have been digitized. The digitization of the hourly data is progressing well.
Note that a tide gauge housing has been built during the ODINAFRICA program. This site is still available.

Human capacities

The Cote d'Ivoire scientific capacity in tidal analysis and sea level data interpretation is available. Students from University of Cocody are trained each year in order to increase the capacity in sea level prediction based on T_TIDE and SLPR2 sofwares. There is still limited capacity in the tide gauge installation. The maintenance of the Ivoirian tide gauges is under the control the technicians from the ports authorities.

Sea level data processing.

Ten years monthly sea level data derived from San Pedro tide gauge have been processed. The datasets contain many gaps. The tide was extracted from the raw data by using the Demerliac Filter. Figure 2 represents the evolution of the monthly mean sea level.

Tide	frequency	amplitude	Amplitude error	phase	Error of phase	Signal-to-noise report/ratio
MSF	0.0028219	0.0005	0	205.48	70.59	1.10
*O1	0.0387307	0.0403	0.016	16.81	26.45	6.40
*P1	0.0415526	0.0344	0.016	7.99	31.20	4,60
*K1	0.0417807	0.1040	0.018	0.92	10.28	34
***M2**	**0.0805114**	**0.3488**	**0.078**	**166.39**	**12.92**	**20**
*S2	0.0833333	0.1303	0.074	162.04	35.69	3.10
K2	0.0835615	0.0355	0.049	184.44	105.65	0.53
M3	0.1207671	0.0111	0.012	33.81	63.89	0.92
SK3	0.1251141	0.0100	0.012	103.40	73.85	0.71
M4	0.1610228	0.0038	0.006	173.16	108.53	0.40
MS4	0.1638447	0.0032	0.005	217.06	115.38	0.39
S4	0.1666667	0.0042	0.006	255.12	86.97	0.50
2MK5	0.2028035	0.0026	0.005	244.31	119	0.33
2SK5	0.2084474	0.0030	0.005	212.23	99.15	0.38
M6	0.2415342	0.0022	0.002	271.18	72.01	0.88
2MS6	0.2443561	0.0012	0.002	306.12	116.08	0.29
2SM6	0.2471781	0.0023	0.002	332.17	67.63	0.93
3MK7	0.2833149	0.0023	0.003	235.74	102.69	0.44
M8	0.3220456	0.0019	0.003	340.23	97.52	0.44

Main constituents at San Pedro site (harmonic analysis).

Constituent	Constituent name	Amplitude	Phase/deg
M2	Principal lunar, semi diurnal	0.2482	28.9841042
SSA	Solar semi annual	0.1072	0.0821373
S2	Principal solar, semidiurnal	0.0876	30.0000000
K1	Sun-Moon angle, diurnal	0.0791	15.0410686
N2	Principal lunar elliptic	0.0556	28.4397295

Main constituents at Abidjan port (harmonic analysis)

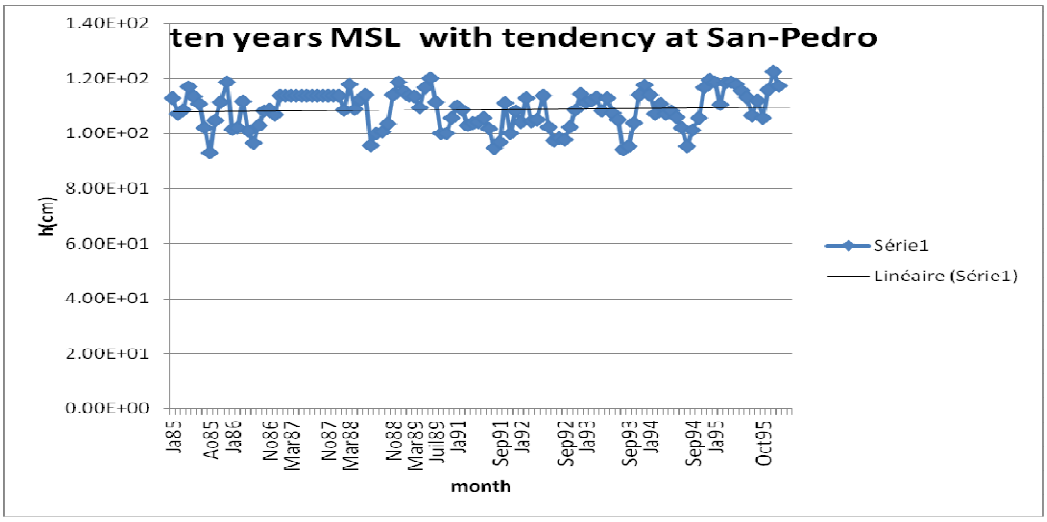

Figure 2: Evolution of ten years monthly mean sea level at San Pedro port.

Coastal erosion along Ivoirian coasts.

Rising sea level also lead to greater erosion. Cote d'Ivoire coastal length is about 1034 km. The Ivoirian coastal zone is experienced erosion as most of the West African coasts. Most of the industrial, commercial, residential, educational and military facilities are concentrated in Abidjan. A recent study shows that the rate of erosion is about 0.5 ~ 3.6 m/year. Abidjan appears in the top of the twenty list of world port cities for the high population exposure to coastal flooding in 2005 (Sally Brown et al., 2011). Figures 3 and 4 show the vulnerability of the Ivoirian coasts due to the erosion.
Figures 5 and 6 represent the change of the shoreline from 2007 to 2009 at Abidjan and San Pedro coasts). They represent respectively 15 m and 3 m at Abidjan and San Pedro coasts.

Figure 3: Coastal erosion at San Pedro (source: S. Yao).

Figure 4: Coastal erosion near Abidjan (source: S. Yao)

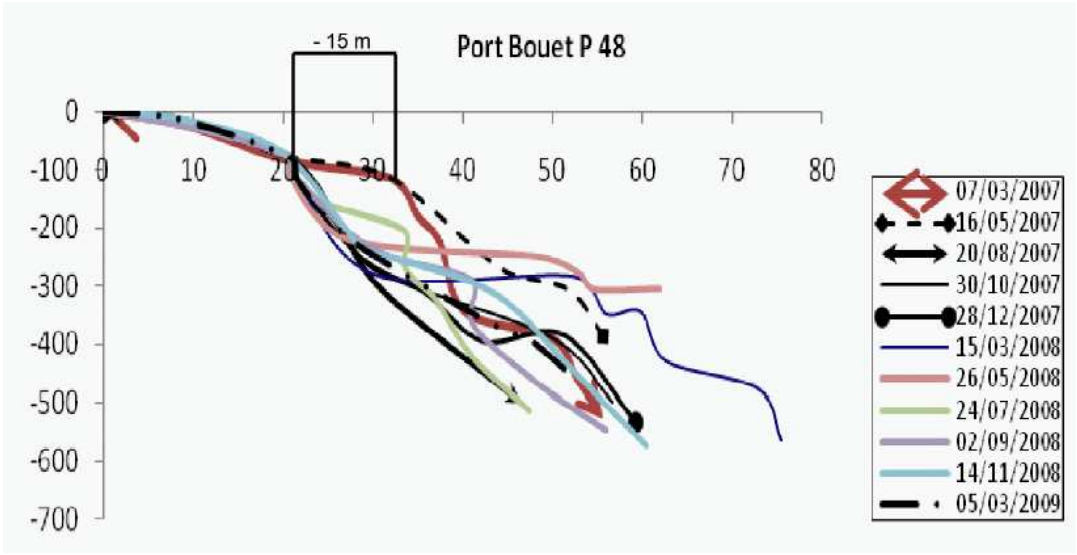

Figure 5: Coastal profile at Abidjan (from March 2007 to March 2009, shoreline change during this period: - 15 m, source S. Yao)

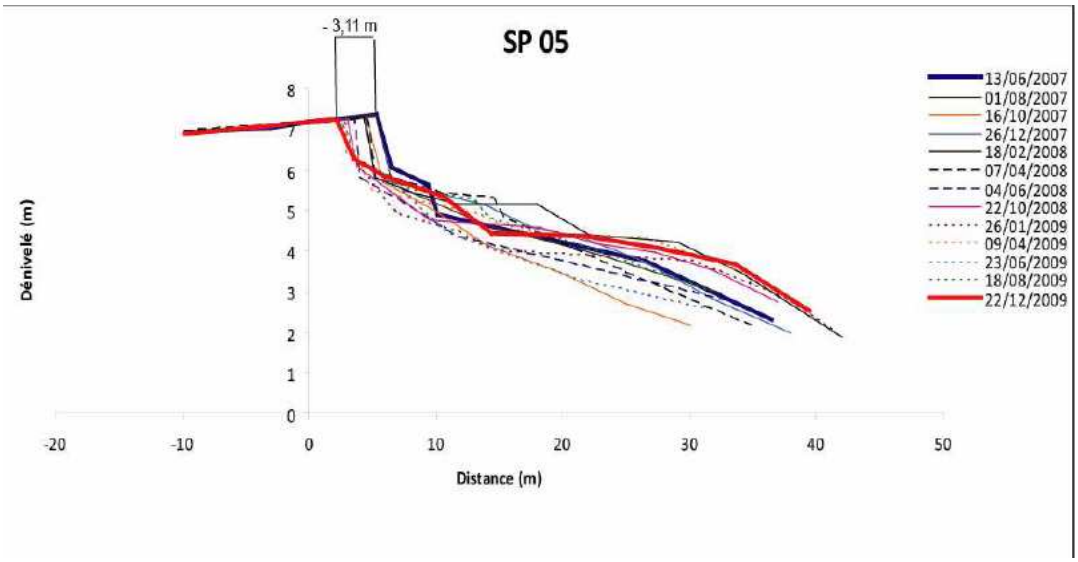

Figure 6: Coastal profile at San Pedro (shoreline change from June 2007 to December 2009: -3.11 m, source S. Yao).

Future installation

Abidjan Hydrographical Department has acquired three pressures gauges and the pre-installation is in progress since a July 2011. Four technicians have received a training course for the installation and maintenance of the equipment (EOPM tide recorder, manufacturer VAISALA oyj). The installation of the equipment will take place before the end of December 2011.

Figure 7: Components of the EOPM tide recorder

Conclusion and recommendations.

Currently, issues to sea level in Cote d'Ivoire are not well understood by policy makers, hence making it difficult for them to realize the importance of having a sea level data on real time and share these data with the GLOSS community. Sea level data have been acquired since 40 years, however most of these data are in paper form. A comparison should be done between the data acquired by the old equipment and the new one to be installed.