

Capacity building program in oceanography and applications in West Africa: goals, achievements and present status

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General context:

West Africa is an area highly vulnerable to climate change, particularly with respect to variations in precipitation and water resources linked to the African monsoon and sea level rise. West Africa is also very poorly equipped to contribute to scientific analysis dedicated to these issues, i.e. climate, water resources, coastal erosion, fisheries, coastal pollution and ports management.

In order to respond to the demands made by scientists in the region and to the priorities of the international program AMMA (“African Monsoon Multidisciplinary Analysis”: 2002-2009; see <http://www.amma-international.org>) and of the regional program PROPAO (French acronym for “Regional Programme of Physical Oceanography in West Africa”; 2007-2010; see http://www.nodc-benin.org/PROPAO/propao_en.html), a regional doctoral program, dedicated to physical oceanography and its applications, has been initiated in 2008 in Cotonou (Benin).

Goal: initiate a new generation of scientists/engineers/teachers, specialist in oceanography/meteorology/climate/coastal environment etc. in Africa.

Presentation of the doctoral formation:

The Regional Master 2 « Physical Oceanography and Applications » (RMPOA) has been launched in September 2008 at the International Chair (UNESCO) of Mathematical Physics and Applications (ICMPA) of the University of Abomey Calavi (UAC), Cotonou, Bénin (see: <http://www.cipma.net/>).

It has been made possible through the support by the French “Institut de Recherche pour le Développement” (IRD) and the close involvement of the University Paul Sabatier (UPS, Toulouse, France). From 2009, the project also benefits of the additional support by the French oil company TOTAL.

All courses are in English and French, provided by professors, scientists and engineers from ICMPA, UPS/LEGOS, IRD and TOTAL. This program is open to all African students having a good background in Mathematics or Physics. About 10 students (from Benin, Togo, Ghana, Côte d’Ivoire, Nigeria, Senegal, Cameroon) attend this program every year. Every student is awarded some financial support by the program.

Established in a UNESCO Chair, diplomas are provided both by the Universities of Cotonou (Benin) and Toulouse (France).



Picture of the 2008-2009 students at ICMPA

Courses and training:

- **Courses :** Computing; fluid mechanics; statistics; waves theory; Introduction to Physical oceanography/climate; remote sensing; ocean dynamics; chemistry and biochemistry; met-ocean sciences for offshore industry; advanced dynamics; biology; sedimentation and coastal transport; numerical modelling; statistics applied to climatology.
- **Training periods :** 5/6 months period: May-September/October; generally supervised at a distance with local assistance or in regional laboratories.
- **Formation at sea** (if possible, depending upon logistical aspects and vessel time) during yearly Pirata cruises in the Gulf of Guinea from Cotonou (achieved in 2009 and 2011).

Scientific works carried out during M2 training periods :

All training period work is dedicated to scientific topics related to tropical Atlantic and Gulf of Guinea, ie priority for the regional countries, and related to various regional (ODINAFRICA, LMEs...) or international (PIRATA, AMMA, TACE/CLIVAR) programs.

Example 1:

Analysis of in situ current and hydrological data from EGEE/AMMA and PIRATA cruises off Benin.

This study revealed an eastward undercurrent (bellow the Guinea Current) never documented until now, named the Guinea UnderCurrent (Figure 1).

This work is carried out using results of numerical simulations (MERCATOR) in order to understand the origin, fate and variability of this particular current.

This flow could be a non-permanent feature and linked to a continuation of the North Equatorial UnderCurrent in the Gulf of Guinea in boreal spring/summer.

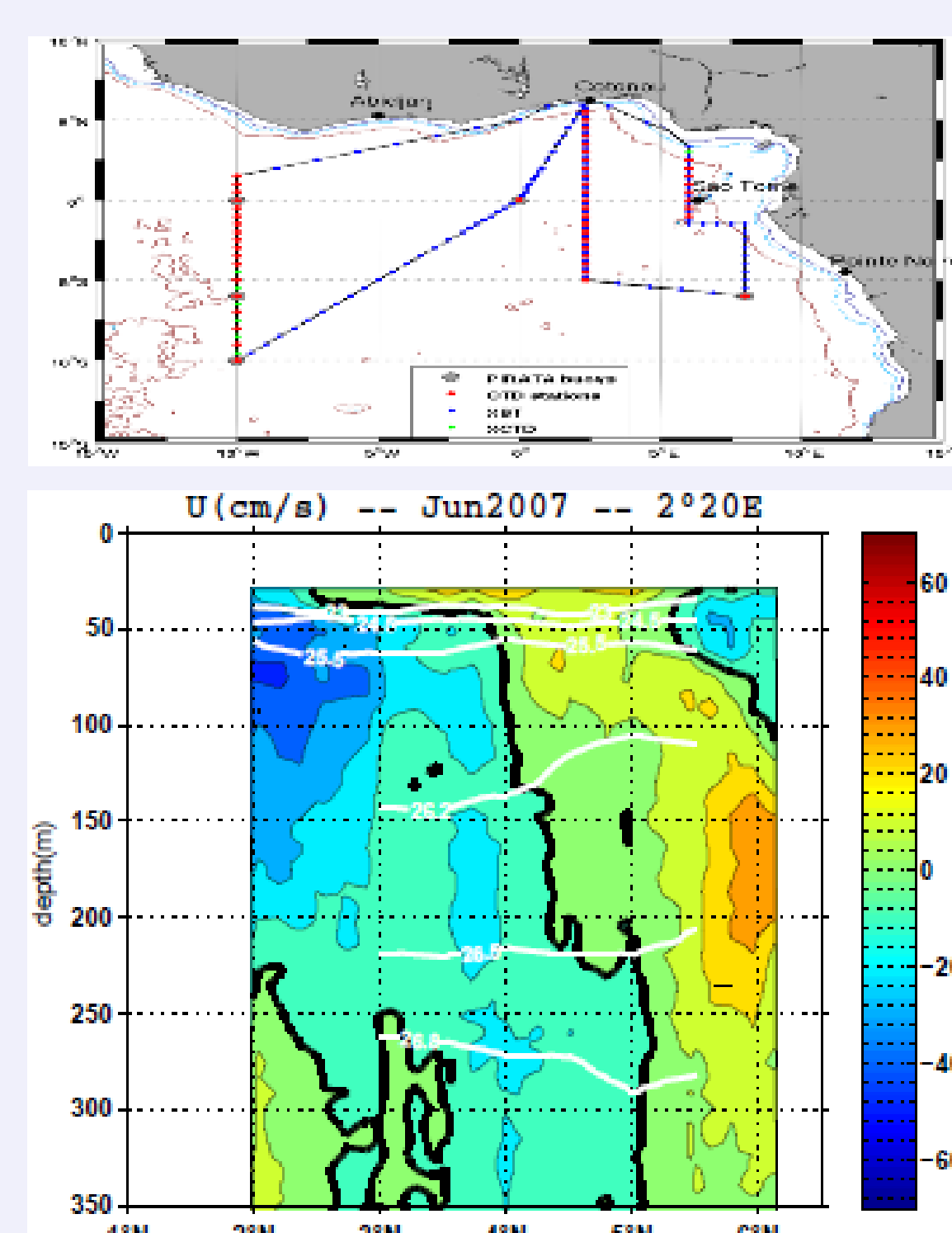


Figure 1: top) Map of the EGEE 5 cruise carried out in June 2007 in the Gulf of Guinea; bottom) Vertical section of the zonal component of the current at 2°30'E off Benin in June 2007.

Example 2:

An ADCP mooring at 10°W-0°N allows the description of the Equatorial Under Current variability (Figure 2a).

A wavelet analysis (Figure 2b) shows different periods of variability, at 13-18 days and 30-45days, corresponding to Rossby-gravity waves and tropical instability waves respectively, in agreement with previous studies (Bunge et al., 2006; Athie de Velasco, 2009).

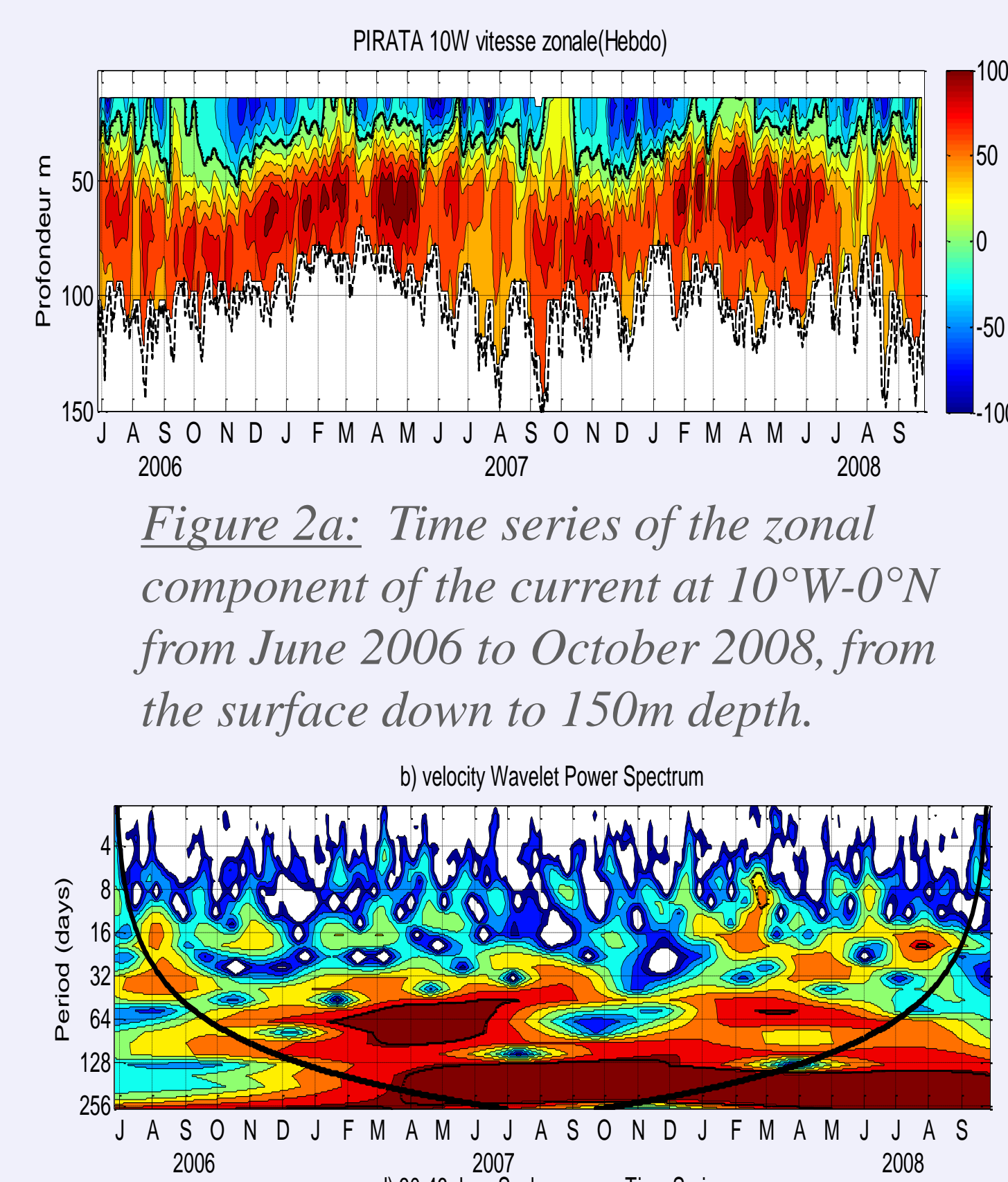


Figure 2a: Wavelet analysis of the maximum zonal velocity of the Equatorial Under Current at 10°W-0°N.

Example 3:

The sea breeze is an important meteorological phenomenon in controlling the weather in coastal regions, atmospheric pollution, etc. Detailed analysis of coastal winds at Cotonou (Benin) shows that the sea breeze is strongly influenced by the West African monsoon. Sea breezes occur on about half the days during non-monsoon season (November - February) and its strength is greater during the monsoon season (June-August) (Figure 3).

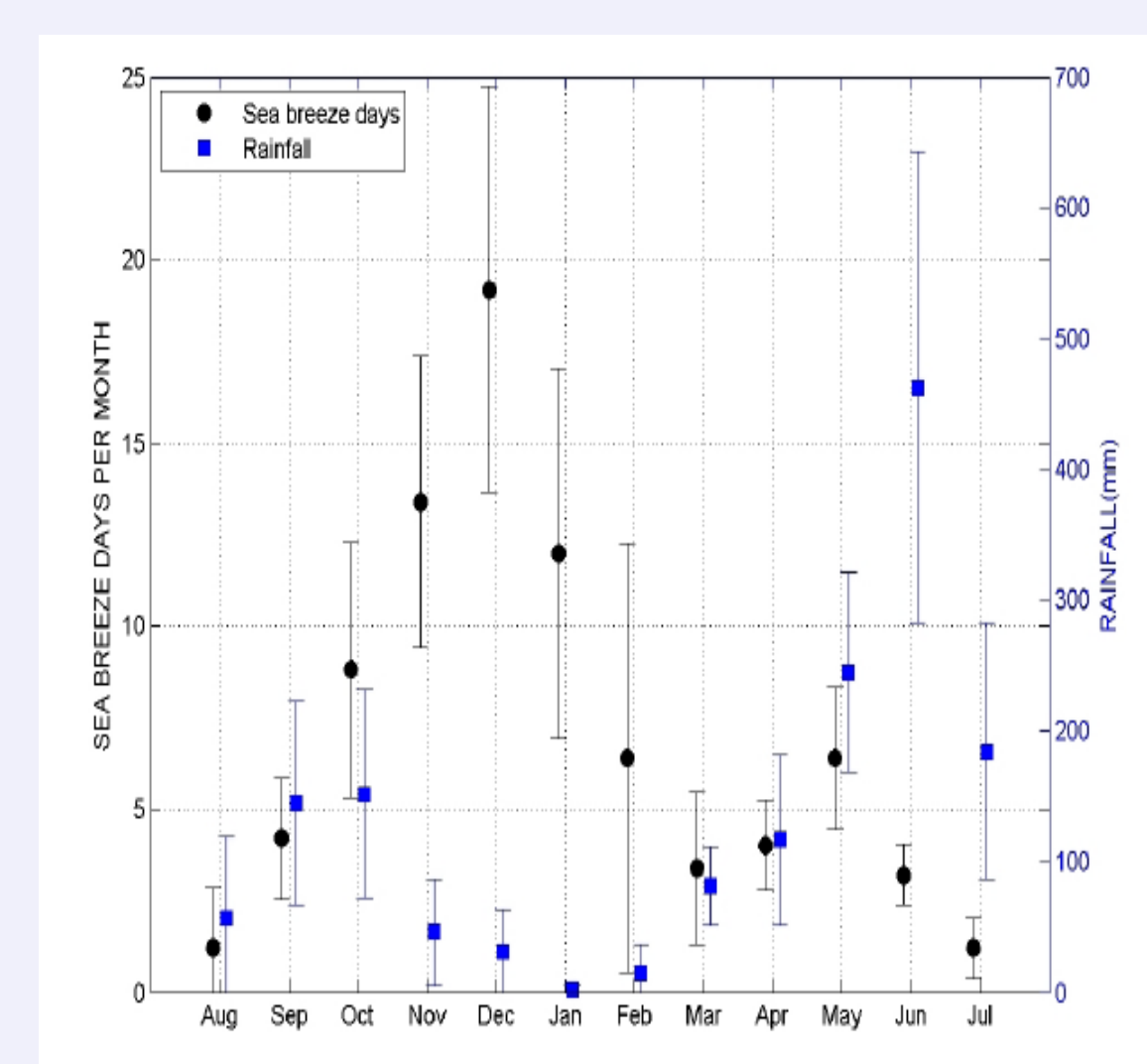


Figure 3: Mean monthly frequency of occurrence of sea breeze days and range for the period 2006-2010 at Cotonou (Benin). Blue squares : mean monthly rainfall with rms bars; Black dots: number of sea breeze days per month with rms bars.

Major successes:

- This regional Masters course is the only one dedicated to physical oceanography and applications in Africa and constitutes a unique opportunity for high quality education in Physical Oceanography for the region.
 - At the present time, up to 8 students are carrying out a PhD (2 in Grenoble/France, 3 in Cotonou/Benin, 1 in Recife/Brazil, 1 in Toulouse/France and Cotonou/Benin, 1 in CapeTown/South Africa and Cotonou/Benin)
- => One way to better involve Africa in international science and observational networks.

Major issues:

- Funding resources in order to ensure the sustainability of the doctoral formation and training at ICMPA UNESCO Chair on the long term.
- At mid term, providing courses and training by regional teachers or scientists
- Finding PhD and grants for future students.
- Adding a training course for engineers dedicated to data acquisition/validation.

