Multifrequency acoustics measurements during the PIRATA FR25 cruise in the Eastern Tropical Atlantic Ocean

Jérémie HABASQUE[1], Bernard BOURLÈS[2], Eric MACHU[3], and Patrice BREHMER[1]
(contacts: jeremie.habasque@ird.fr ; patrice.brehmer@ird.fr)
(1 IRD-LEMAR, 2 IRD-LEGOS, 3 IRD-LPO)

Acoustic tools allow a simultaneous acquisition of quantitative and qualitative data at different spatio-temporal scales, providing information about biotic and abiotic ecosystem components. For the first time in 18 years history, the PIRATA-FR25 cruise allowed to get such measurements in the Eastern Tropical Atlantic, from Cape-Verde islands to the equator and in the Gulf of Guinea (Figure 1).

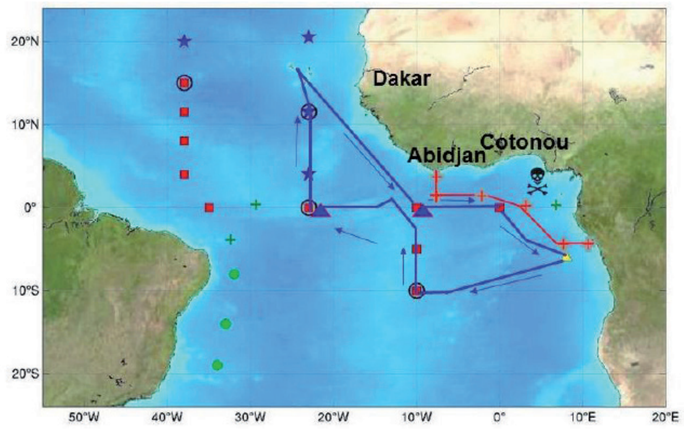

Figure 1: PIRATA FR25 cruise trackline (blue line)

CONTEXT

The PIRATA program is mostly in charge of the maintenance of a 18 meteo-oceanic buoys network in the tropical Atlantic, that implies yearly oceanographic cruises. PIRATA-France, in charge of the Eastern part of the network, carried out its 2015 cruise for the first time on-board the R/V THALASSA, equipped with an acoustic sensors. This allowed acoustic measurements all along the trackline (Figure 1). Such measurements are of particular interest in the Eastern Tropical Atlantic Ocean, where are encountered specific patterns as the oxygen minimum zones « OMZ » (Figure 2), sea surface temperature fronts (Figure 3.a) and contrasted sea surface salinity patterns (Figure 3.b). Such contrasted environment is expected to impact pelagic organism spatial organization, the planktonic biodiversity, as well as upper trophic level marine organisms.

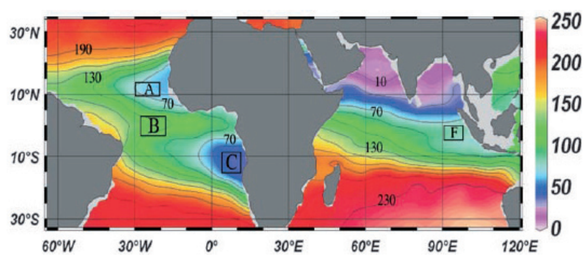

Figure 2: Climatological mean dissolved oxygen concentrations (µmol kg-1 shown in color) at 400 m depth contoured at 20 µmol-kg-1 intervals from 10 to 230 µmol kg-1 (black lines) using Ocean Data View software (Stramma et al., 2008);

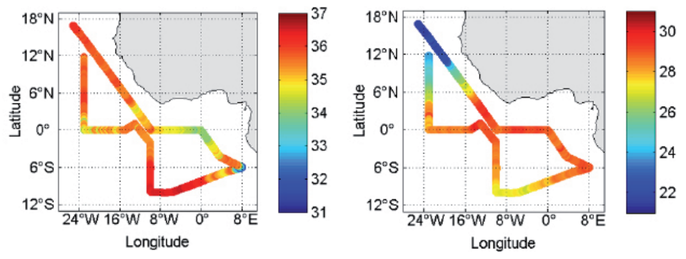

Figure 3: a) Sea surface temperature; and b) Sea surface salinity along the PIRATA FR25 trackline as measured from the R/V THALASSA thermosalinograph (courtesy Jacques Grelet, IRD-Imago).

DATA

Sounder : **Simrad EK60**
Frequencies: **18, 38, 70, 120, 200 and 333 kHz**
Vertical range : **0 – 1000m**
Calibration: **Yes**
Scatters groups : **fish and zooplancton**

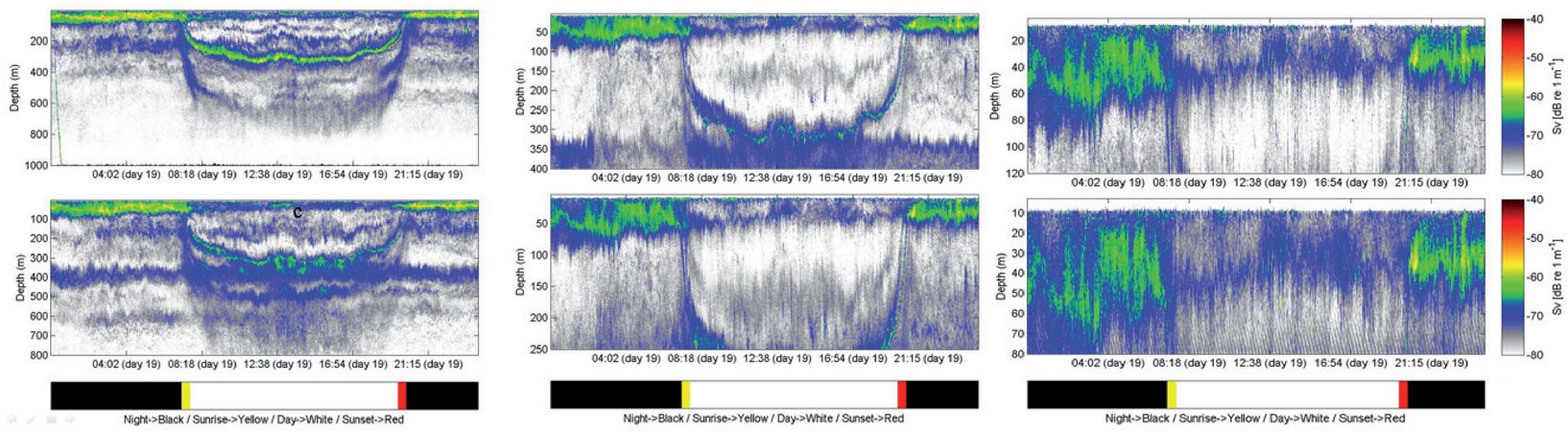

Figure 4: Volume backscattering strength (Sv) echo-integrated onto 1m layers over 0,1nmi ESDU (elementary sampling distance unit) with a -100dB threshold , from 9m depth (i.e. transducer depth + offset) down to 1000m depth for frequency 18kHz (from 2015/03/19 at 00h01 to 2015/03/20 at 00h03).

VERTICAL ORGANIZATION OF MICRONEKTON

Organization of the micronekton layers could be described including diel vertical migration (DVM) taking into account hydrological parameters and currents vertical distributions. Figure 4 clearly illustrates the biomass vertical migration along a 24h period and Figure 5 a) shows the biomass distribution superimposed on vertical temperature profile. The strong correlation between Sv and temperature gradient would allow us to extract thermocline depth for the whole survey Figure 5 b).

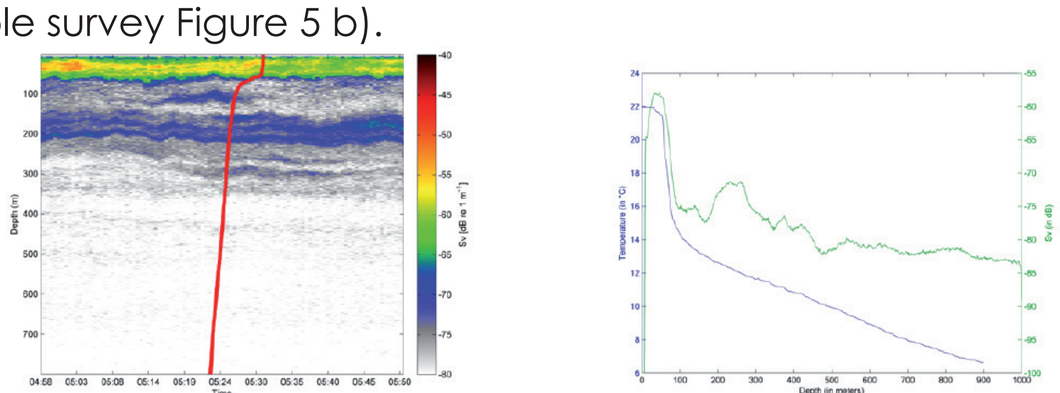

Figure 5: a) Echogram data from Simrad EK60 (date: 2015/03/19 from 04h58 to 05h50) and XBT profile (same date at 05h25) for frequency 18kHz.b) Mean Sv profile (in green) vs temperature profile (in blue).

HOW CURRENTS SHAPE ORGANISMS DISTRIBUTION

Multi frequencies acoustic data will allow characterizing the micronekton layers according to equatorial zonal currents system, as for example along the equator in the Gulf of Guinea (between 10°W and 0°E, Figure 6).

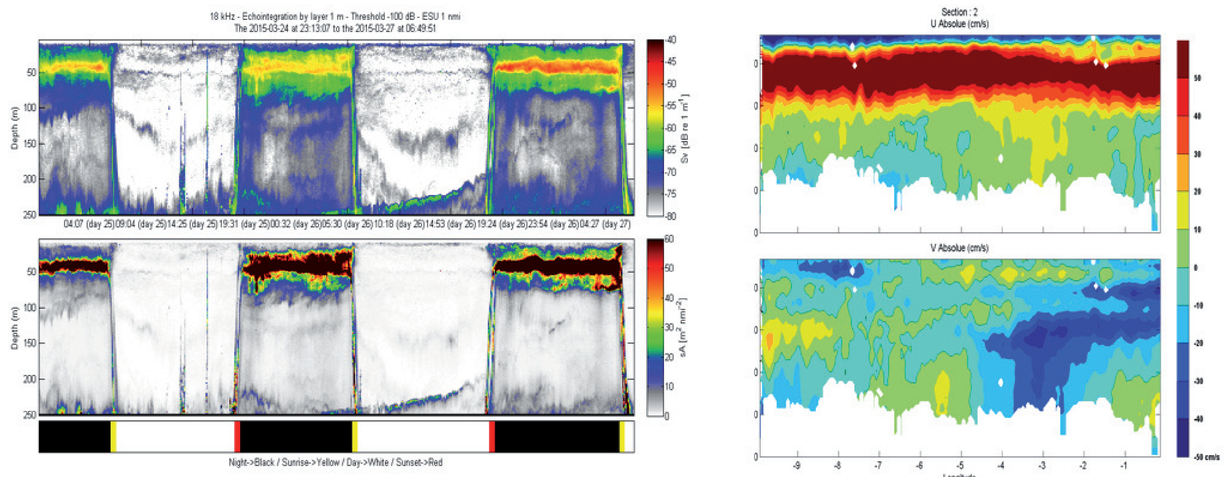

Figure 6: Equatorial section between 10°W & 0°E
- Left: acoustic data echointegrated for frequency 18 kHz.
- Right: zonal (up) and meridional (down) components of the currents

PERSPECTIVES

Such preliminary work using acoustic data will be carried out again during the next PIRATA cruises if conducted from the R/V THALASSA or any other RV equipped with active fisheries acoustics sensors. At this time it is planed for March-April 2016 during the PIRATA FR26 cruise, to use the RV Thalassa. Then, some sections at 10°W, 0°E and 6°S could be done with CTD-O2 profiles every ½°, to directly investigate OMZ impact on e.g. micronetktonic organisms and remineralization processes. Such data, in addition to other "classical" measurements carried out during the cruise (currents from S-ADCP, thermosalinograph, temperature profiles, surface fluorimeter, ...) will allow several kinds of studies in the general framework of PREFACE, AWA and PIRATA programs, in e.g. oceanography, biogeochemistry, marine ecology as well as fisheries

ACKNOWLEDGMENTS

Authors thank Jacques Grelet, Gaëlle Herbert, Karine Abel-Michaux and Fabrice Roubaud, for their contribution to the several data sets acquisition and first treatments. This work have been carried out in the frame of i) the European Commission's project Preface; seventh Framework Programme (2007-2013) – Cooperation (ENV.2013.6.1-1: Climate-related ocean processes and combined impacts of multiple stressors on the marine environment); under Grant Agreement number 603521; ii) the experimental program PIRATA « Prediction and Research Moored Array in the Tropical Atlantic » that has been launched in the framework of the international program CLIVAR (CLImatic VARiability and predictability) and implies scientific teams from three countries: France (IRD, Météo France, with contributions by IFREMER, Observatoire Midi-Pyrénées/Université Paul Sabatier and CNRS/INSU), Brazil (DHN and INPE) and USA (NOAA/PMEL); iii) the AWA project that is funded by BMBF and IRD and includes LEGOS, LEMAR and LPO IRD joint research units.

IRD Institut de recherche pour le développement