A Novel Autonomous Observation Platform for Multi-Disciplinary Investigations at the Cape Verde Ocean Observatory (CVOO)

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Abstract

In order to investigate the spatial and temporal variability (daily, seasonal and inter-annual) of CO_2 and O_2 air-sea fluxes and their underlying processes, a dense network of observations is required. For this purpose, the Cape Verde Ocean Observatory (CVOO) provides a unique infrastructure. Information thus obtained also links biological productivity and atmospheric composition.

To expand these capabilities, a novel “virtual mooring” approach for high resolution measurements, based on a modified NEMO profiling float, is pursued. This Profiling Float was equipped with O_2 and pCO_2 sensors for the first time, in order to collect daily depth profiles (0-200 m) in the vicinity of the ocean site. Data access and remote control is provided through Iridium satellite telemetry. Recalibrations and redeployments are carried out every 1-3 month.

First, we present the new developed instrument and the innovative *in situ* and real-time approach behind.
Second, we show the inter-disciplinary scientific objectives which will benefit from this approach as a result of the intensive partnership between IFM-GEOMAR and INDP during the last years.

Instrument Design

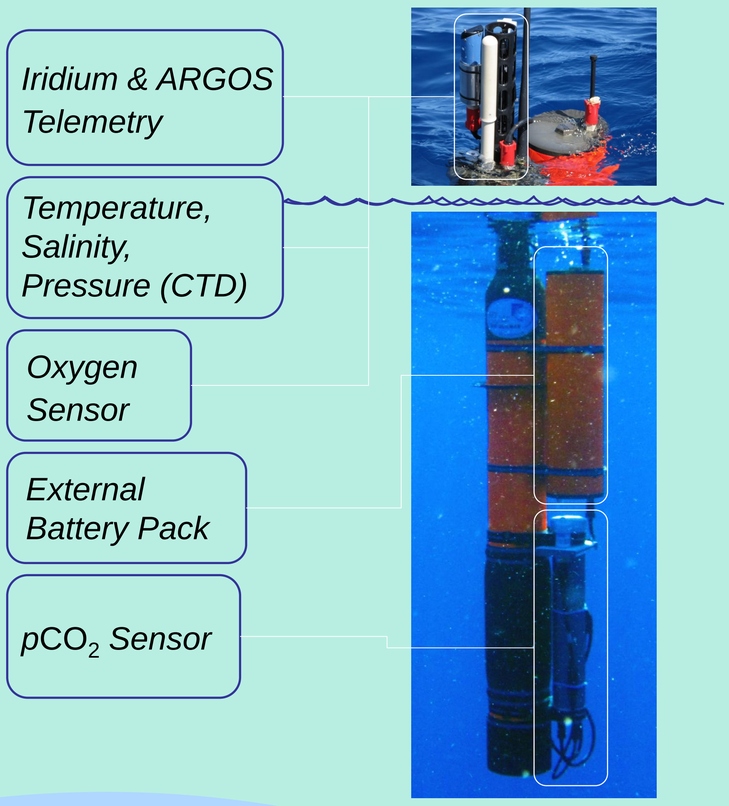

Fig.1

[Fig.1] An autonomous instrument was developed which is capable of conducting high resolution measurements of biogeochemical parameters in the water column.

This profiling float is the first of its generation which can perform combined *in situ* pCO_2 and O_2 measurements. Data are transmitted in real-time via a satellite link to shore.

An operator on land can access the instrument via remote control and mission commands can be adjusted. Regular recoveries and redeployments of the float enable this device to be used for different investigations.

Float missions – Past Deployments and Recent Operations

[Fig.2] During the last 3 years the instrument has been tested and operated mainly around São Vicente Island. The float was subsequently developed to its final design and functionality and quality of observations increased sig-nificantly.
Locations of measurements (recent mission shown on the map) allow detailed analysis of CO_2, O_2, temperature and salinity data for different regional purposes (see below).

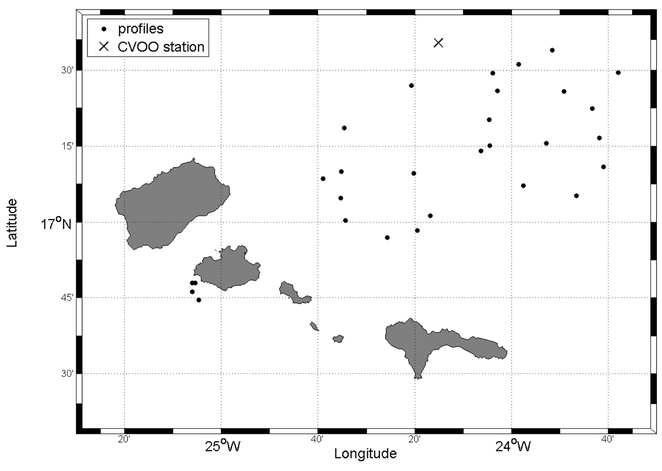

Fig.2

Field Operations – Deployment, Recovery and Maintenance of the Float

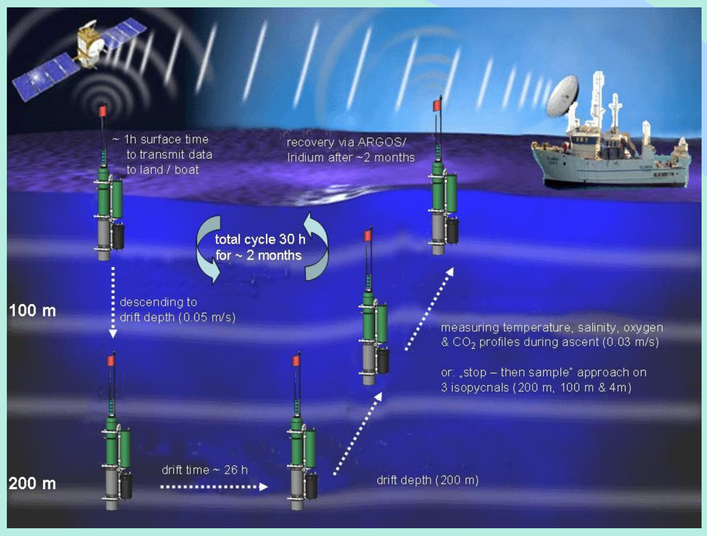

Fig.3

[Fig.3] Measurements during the upcast (200 – 0 m depth):

Salinity [S],
Temperature [T],
Pressure [P],
Oxygen [O_2],
Carbon Dioxide [pCO_2]

After approx. 2 months the system needs to be recovered. Maintenance and calibration of the sensors are carried out in the lab at INDP.

Assessment of Air-Sea Gas Fluxes for CO_2 and O_2

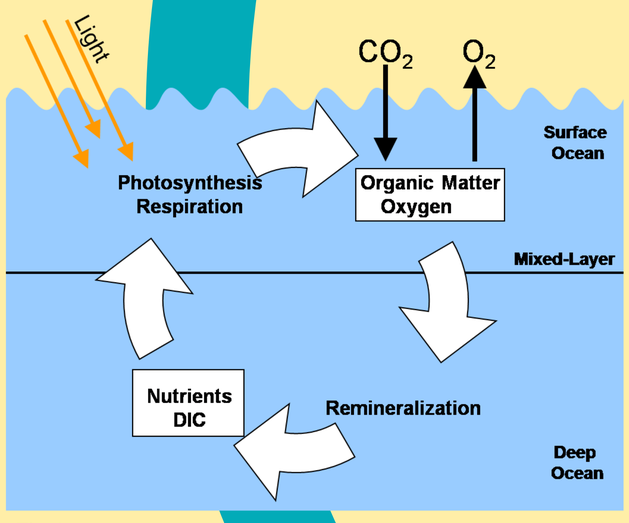

Fig.4

[Fig.4] The exchange of biological relevant gases between the ocean and the atmosphere undergoes several processes in the ocean (e.g. primary production, respiration). Depending on environmental conditions fluxes of O_2 and CO_2 are being effected by those and result in complex patterns on different timescales (e.g. daily, seasonal and inter-annual).

[Fig.5] Since Feb. 2007 six floats equipped only with oxygen/CTD sensors have been deployed between Mauritania and Cape Verde. In addition, recent operations with the pCO_2/O_2 floats (200 m profiling depth) were also included into this remarkable dataset.
[Fig.6] The map presents the overall distribution for O_2 air-sea fluxes between Feb. 2007 and Nov. 2009. Observations of CO_2 fluxes will be available soon, provided by the new pCO_2 float during the most recent mission (Nov. ‘10 – Jan. ‘11, Fig. 2).

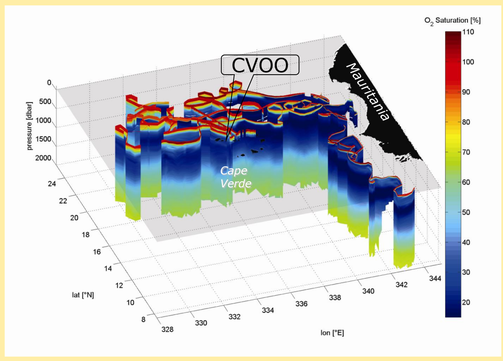

Fig.5

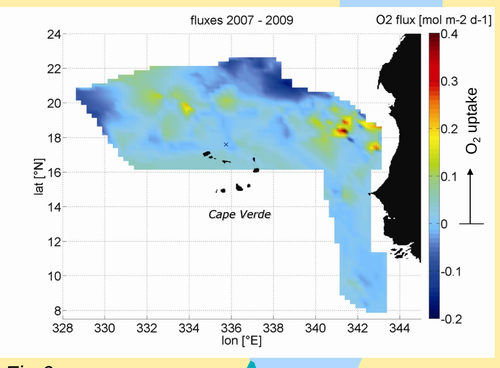

Fig.6

Investigating local fish populations

[Fig.7] High resolution data in the vicinity of the islands obtained by the profiling float (CO_2, O_2, temperature and salinity) will be used in order to determine relationships between the chemical/ physical water properties and compare those with the distribution of small and large pelagic fish around the archipelago.

Fig.7

[Fig.8] Relationship between fish production and sea surface temperature (*SST*) adapted from a study around the Indonesian archipelago (Nahib et al., 2010*)*. Data show a decrease of *SST* which was followed by an increase of catches.
The distribution of small pelagic fish depends on the water temperature within the mixed layer and below. In case of significant changes this might bias the common local pelagic communities.

[Fig.9] Data measured during the most recent float mission in November and December 2010 northeast off São Vicente. Vertical as well as horizontal patterns will be used for local studies on pelagic fish populations.

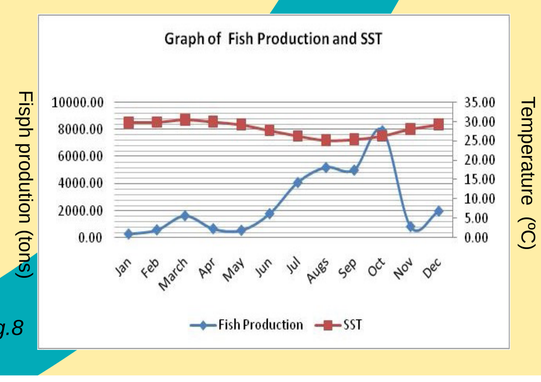

Fig.8

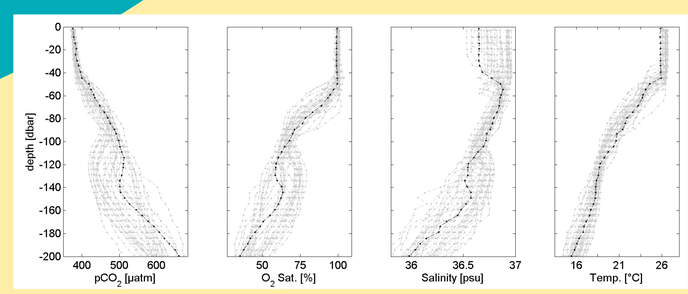

Fig.9

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