UBEST

Understanding the biogeochemical buffering capacity of estuaries relative to climate change and anthropogenic inputs

Report 3

Field campaign UBEST1:

Ria Formosa - May 30-31, 2017

Partners

LNEC LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

UAlg UNIVERSIDADE DO ALGARVE

Funding

FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

PTDC/AAG-MAA/6899/2014

Authors:

Alexandra Cravo[1], José Jacob[1], Alexandra Rosa[1]

[1]**Universidade do Algarve**

June, 2017

Abstract

This report provides a general characterization of the first field campaign of the project UBEST, representative of spring conditions, performed in the Ria Formosa on May 30-31, 2017. This campaign was accomplished in seven stations covering the entire coastal lagoon. *In situ* measurements of temperature, salinity, pH and dissolved oxygen were carried out in each station and water samples collected to determine the concentration of nutrients, chlorophyll *a* and total suspended solids.

The achieved data will contribute to better understanding of the global functioning of the Ria Formosa under a seasonal approach that will be continued and to anticipate its susceptibility to future scenarios of anthropogenic inputs and climate change, using numerical hydrodynamic and biogeochemical models.

Keywords: Field campaign, Ria Formosa, *in situ* measurements, water samples, physico-chemical parameters

Table of Contents

Table of Figures

Table of Tables

1. Introduction

This report provides a brief characterization of the first field campaign of the project UBEST - Understanding the biogeochemical buffering capacity of estuaries relative to climate change and anthropogenic inputs (PTDC/AAG-MAA/6899/2014). This project aims at improving the global understanding of the biogeochemical buffering capacity of estuaries and its susceptibility to future scenarios of anthropogenic inputs and climate change, to effectively support the short and long-term management of these systems. UBEST scientific goals will be achieved by the deployment of "observatories" in two Portuguese case studies: the Tagus estuary and the Ria Formosa, a coastal lagoon. These case studies were selected due to their ecological and economic importance both locally and regionally and, simultaneously, due to their very distinct physical and morphological characteristics, which will facilitate the generalization of the conclusions.

The first field campaign, campaign UBEST1, was performed in the Ria Formosa between May 30 and May 31, 2017, aiming to be representative of spring conditions. This field campaign covered the entire area of the Ria Formosa and included the collection of physical, chemical and biological data during one semidiurnal tidal cycle (~12.5 h).

The report is organized in 2 chapters besides the present Introduction. The location of the sampling stations and a general description of the field and laboratorial work performed are presented in Chapter 2. Chapter 3 presents a brief evaluation of the field campaign.

2. Description of the field campaign

2.1 Sampling stations

To cover the entire lagoon, seven stations were selected (**Error! Reference source not found.**) including the different water bodies (WB) of the Ria Formosa, as described by APA (Agência Portuguesa do Ambiente). Five stations were located in the main channels, although at inner areas and comprise: station 1 – Bridge of Faro Beach representative of Ria Formosa WB1; station 2 – Cais do Combustível that represent the Ria Formosa WB2; station 3 – Fuzeta representative of Ria Formosa WB4; station 4 – Tavira under the influence of freshwater input that represents the Ria Formosa WB5; and station 5 – Cacela also located in the Ria Formosa WB5. Stations 6 at the Olhão channel and 7 at the Faro-Olhão inlet are representative of the most external area of Ria Formosa. The last one will also be used to characterize the adjacent oceanic conditions.

Figure 2.1. General overview of the study area and location of the sampling stations: 1 – Bridge of Faro Beach; 2 - Cais do Combustível; 3 – Fuzeta; 4 – Tavira, 5 – Cacela; 6 – Olhão channel; 7 – Faro-Olhão inlet. The stars correspond to the location of 4 pressure transducers: Bruce's Yard (PT1); Cais do Combustível (PT2); Deserta Island (PT3); and Quatro Águas de Tavira (PT4).

The coordinates of the sampling stations and the sampling periods considered are indicated in Table 2.1.

Table 2.1. Coordinates of the sampling stations and sampling period.

Station	Latitude	Longitude	Period of sampling
1 – Bridge of Faro Beach	37.009001	-7.993699	May 30, 08:16 – 21:07
2 – Cais do Combustível	37.002754	-7.921186	May 30, 07:26 – 20:25
3 – Fuzeta	37.050767	-7.742030	May 30, 07:00 – 19:35
4 – Tavira	37.116308	-7.628722	May 30, 07:39 – 20:15
5 – Cacela	37.153973	-7.553397	May 30, 06:54 – 19:25
6 – Olhão channel	36.998081	-7.841326	May 31, 07:45 – 20:45
7 – Faro-Olhão inlet	36.971926	-7.871217	May 31, 08:50 – 21:45
PT1 – Bruce's Yard	37.021122	-7.945661	May 29 – June 1
PT2 – Cais do Combustível	37.002755	-7.921182	May 25 – June 2
PT3 – Deserta Island	36.965858	-7.871014	May 24 – June 1
PT4 – Quatro Águas de Tavira	37.115725	-7.629700	May 26 – June 2

2.2 Team

The team that participated both in the field campaign and laboratorial work is listed in **Error! Reference source not found.**.

Table 2.2. Team of the field campaign UBEST1.

Station/Laboratorial work	Name	Institution
1 and 2	Alexandra Rosa	UAlg Team member – CIMA
	David Gago	*1
	Rodrigo Castro	*1
	Catarina Coelho	*1
	Mariana Fernandes	*1
	Cátia Correia	*2
	Ana Teresa Viegas	*1
	Ana Rita Viegas	*1
	André Matos	*2
	Jokin Echezarreta Pérez	*1
3	José Jacob	UAlg Team member – CIMA
	Danny Brito	UAlg – student and technician
	Gonçalo Sousa	*1
	Gustavo Xufre	*1
	João Zêzere	*1
	Michael Silva	*1
	Eloah Garcia Rosas	*1
	Cristina Cruz	*1
	João Cunha	*1
4 and 5	Alexandra Cravo	UAlg Team member – CIMA
	Luana Castilho	*2
	David Gago	*1
	Rodrigo Castro	*1
	Sara Cardeira	*2
	Laura Pacho	*1

Station/Laboratorial work	Name	Institution
	João Zêzere	*1
	Miguel Amado	*1
6 and 7	José Jacob	UAlg Team member – CIMA
	Alexandra Rosa	UAlg Team member – CIMA
	Luísa Bon de Sousa	UAlg Team member – CIMA
	Danny Brito	UAlg – student and technician
	Cátia Correia	*2
	João Cunha	*1
	Ana Teresa Viegas	*1
	Gonçalo Sousa	*1
	André Matos	*2
Only laboratorial work	Filomena Rita	UAlg team member– technician
	Ana Patricia Nascimento	*2

*1 –Volunteer collaborator – UAlg student;
*2 –Volunteer collaborator – Former UAlg student.

2.3 Field work

The UBEST1 campaign was conducted on two consecutive days (May 30 and 31). During the first day the stations 1, 2, 3, 4 and 5 (Figure 2.2, Figure 2.3, Figure 2.4, Figure 2.5 and Figure 2.6) were sampled with the support of one car from the University of Algarve, one rented car and several personal cars that allowed the transport of the team members and collaborators, and the sampling material and equipment. In the second day, to survey the stations 6 and 7 (Figure 2.7 and Figure 2.8), closer to the adjacent coast to the Ria Formosa, a boat with a skipper was rented all day (from 6:30 to 22:00) and the transportation of team, material and equipment was done using one car from the University of Algarve and personal cars from the team members.

In this campaign, four YSI multiparameter probes were used, two from UAlg and two from LNEC, for *in situ* measurements of water temperature, salinity, pH and dissolved oxygen (concentration and saturation %). Previously to the field survey, all the sensors of the four YSI multiparameter probes were calibrated using the same calibration solutions. A 5 L Niskin bottle and/or a sampling cup of water were used for the water samples collection for further determination of chlorophyll *a* (2 L), nutrients and total suspended solids concentrations (1 L). At each station, measurements and sampling of water were carried out every two hours along a complete semidiurnal tidal cycle (~12.5 h), at surface for those station where the water column is shallower. At Tavira, due to the potential influence of freshwater input and at other stations with deeper water columns (>4 m), to identify if water stratification occurred, *in situ* measurements were performed along the water column, every 1 m and water samples were also collected at both the surface and the bottom levels. After water collection, the samples were placed in thermal containers to preserve their quality until further treatment in the laboratory.

To study the physical conditions and circulation patterns within the Ria Formosa lagoon, the sea level height was measured by four pressure transducers (two Level TROLL, one Infinity and one DIVER) located in different sites (Figure 2.1).

Figure 2.2. Sampling station 1 – Bridge of Faro Beach.

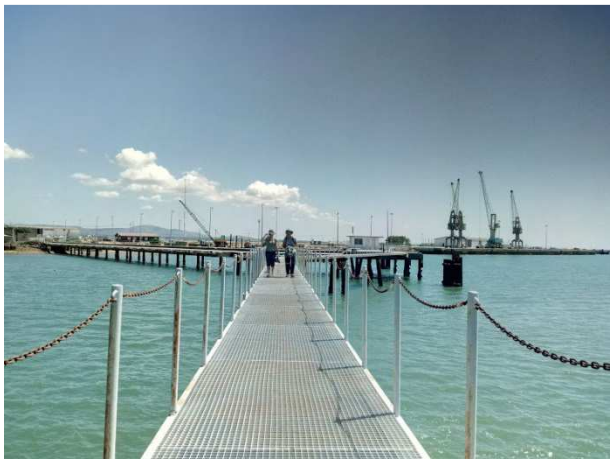

Figure 2.3. Sampling station 2 – Cais do Combustível located in the Port of Faro.

Figure 2.4. Sampling station 3 – Fuzeta.

Figure 2.5. Sampling station 4 – Tavira.

Figure 2.6. Sampling station 5 – Cacela.

Figure 2.7. Sampling station 6 – Olhão channel.

Figure 2.8. Sampling station 7 – Faro-Olhão inlet.

2.4 Laboratorial procedures

The water samples collected at the different stations were processed in the laboratory of the University of Algarve, with the support of the team members and several volunteer collaborators. The water samples were filtered with specific filters for suspended solids (0.45 µm porosity, cellulose acetate, Gellman) and chlorophyll *a* (0.7 µm porosity, GF/F, Whatman) determination. The dissolved oxygen concentration was also determined based on the Winkler method to confirm the data acquired *in situ* (Figure 2.9).

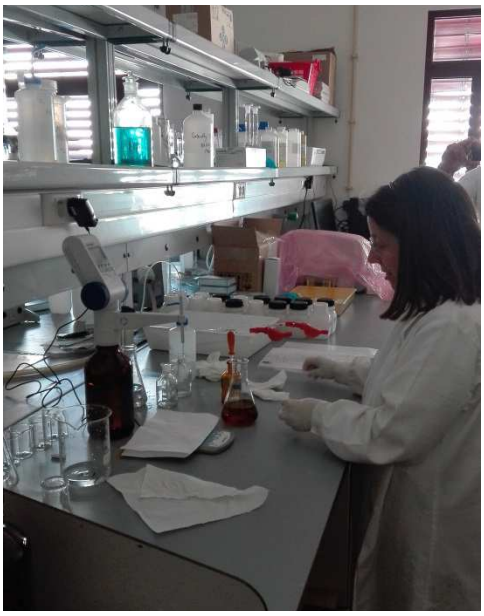

Figure 2.9. Laboratorial analyses for oxygen concentration.

The GF/F filters will be further analyzed to determine chlorophyll *a*, while the filtered samples through the 0.45 µm porosity filters will be used for the determination of nutrients concentration (nitrate, nitrite, ammonium, phosphate and silicate). Both type of analyses will be based in spectrophotometric methods as described by Lorenzen (1967) and Grasshoff *et al*. (1983), respectively. For the determination of the total suspended solids concentrations a gravimetric method was applied as specified in APHA (1992).

3. Evaluation of the field campaign

The UBEST1 campaign was successfully accomplished, with the proposed objectives achieved. The experience acquired in this campaign representative of the spring season will serve to improve the planning of the next campaigns, particularly that of the summer to be held next September.

Data on *in situ* characterization under the appraised spring conditions allow to confirm that at all the seven sampling sites in the Ria Formosa the water column was vertically homogeneous, without apparent stratification in terms of temperature, salinity, pH and dissolved oxygen.

Further chemical analyses will be run regarding the determination of nutrients and chlorophyll *a* concentration, while sea surface height data acquired from the pressure transducers will be also processed.

Acknowledgments

This work was funded by Fundação para a Ciência e a Tecnologia project UBEST – Understanding the biogeochemical buffering capacity of estuaries relative to climate change and anthropogenic inputs (PTDC/AAG-MAA/6899/2014).

The third author is funded by Fundação para a Ciência e a Tecnologia in the scope of the project UBEST (PTDC/AAG-MAA/6899/2014).

The authors would like to thank to all volunteers for their support in the UBEST1 campaign, Capitania de Olhão for providing boat transport for the exchange of team elements on the Olhão channel and Faro-Olhão inlet stations, APS – Ports of Sines and Algarve Authority for the authorization to sample in the Cais do Combustível and for the pressure transducer installation, Clube Náutico de Tavira, Estaleiro de Nave Pegos and António José Brás for the support in the installation of the pressure transducer in Quatro Águas de Tavira pier and in the Bruce's Yard, respectively, and to Mr. Alves for the installation and removal of the pressure transducer in the Deserta Island pier.

References

APHA (1992). *Standard Methods for Examination of Water and Wastewater*. 18th Edition. American Public Health Association. Washington DC.

Grasshoff K, Erkhardt M and Kremling K (1983). Methods of Seawater Analysis*. Verlag Chemie*, New York, 419 pp.

Lorenzen C (1967). Determination of chlorophyll and pheopigments: spectrophotometric equations. *Limnology and Oceanography*, 12(1961), 343–346.