UBEST

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

Report 5

Field campaign UBEST3:

Ria Formosa - October 25-26, 2017

Partners

LNEC LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

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Abstract

This report describes the third field campaign of the project UBEST, representative of autumn conditions, performed in the Ria Formosa on October 25-26, 2017. This campaign was performed in the seven stations sampled in the last two campaigns, which cover 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 further determine the nutrients, chlorophyll *a* and total suspended solids concentrations.

The data acquired in this campaign will contribute to better understand the global functioning of the Ria Formosa under a seasonal approach that will serve to anticipate its susceptibility to future scenarios of anthropogenic inputs and climate change, using numerical hydrodynamic and biogeochemical models.

Keywords: Field campaign, autumn conditions, Ria Formosa, *in situ* measurements, water samples, physicochemical parameters

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1. Introduction

The project UBEST - Understanding the biogeochemical buffering capacity of estuaries relative to climate change and anthropogenic inputs (PTDC/AAG-MAA/6899/2014) 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. The seasonal campaigns are one of the components of the Ria Formosa observatory and this report describes the last field campaign performed in 2017, campaign UBEST3. The third campaign was performed in the Ria Formosa between October 25 and October 26, 2017, to be representative of autumn conditions. This field campaign covered the entire area of the Ria Formosa and included *in situ* measurements and water collections every two hours during one semidiurnal tidal cycle (~12.5 h).

The report is organized in 2 chapters. The location of the sampling stations and a general description of the field and laboratorial work performed are described in Chapter 2. A short evaluation of the field campaign is present in Chapter 3.

2. Description of the field campaign

2.1 Sampling stations

A field survey was carried out in October, including seven stations, like in the two previous campaigns, to comprise the different water bodies (WB) of the Ria Formosa, as described by APA (Agência Portuguesa do Ambiente) (**Error! Reference source not found.**). Five stations were located in the main channels, although at inner areas: station 1 – Bridge of Faro Beach representative of Ria Formosa WB1; station 2 – Cais do Combustível that represents 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 outer area of Ria Formosa (WB3). 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	October 25, 07:00 – 20:15
2 – Cais do Combustível	37.002754	-7.921186	October 25, 07:40 – 21:20
3 – Fuzeta	37.050767	-7.742030	October 25, 07:00 – 20:00
4 – Tavira	37.116308	-7.628722	October 25, 07:00 – 20:00
5 – Cacela	37.153973	-7.553397	October 25, 07:02 – 20:00
6 – Olhão channel	36.998081	-7.841326	October 26, 07:00 – 20:40
7 – Faro-Olhão inlet	36.971926	-7.871217	October 26, 07:40 – 20:10
PT1 – Bruce's Yard	37.021122	-7.945661	October 23 – 27
PT2 – Cais do Combustível	37.002755	-7.921182	October 23 – November 3
PT3 – Deserta Island	36.965858	-7.871014	October 23 – 31
PT4 – Quatro Águas de Tavira	37.115725	-7.629700	October 24 – 31

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 UBEST3.

Station/Laboratorial work	Name	Institution
1 and 2	Alexandra Rosa	UAlg Team member – CIMA
	Ana Rita Viegas	*1
	André Matos	*2
	Andreia Ovelheiro	*2
	Gustavo Xufre	*1
	Michael Silva	*1
	Miguel Amado	*1
3	José Jacob	UAlg Team member – CIMA
	Danny Brito	UAlg – student and technician
	Bruno Silva	*1
	Laura Pacho	*1
	João Cunha	*1
	Jokin Echezarreta Pérez	*1
	Micaela Justo	*1

Station/Laboratorial work	Name	Institution
4	Cátia Correia	*2
	João Zêzere	*1
	Daniel Pimenta	*2
	Micaela Justo	*1
	Miguel Amado	*1
5	Alexandra Cravo	UAlg Team member – CIMA
	Diana Silva	*1
	Diana Muñoz	*1
	Luana Castilho	*2
	João Fernandes	*1
6 and 7	José Jacob	UAlg Team member – CIMA
	Alexandra Rosa	UAlg Team member – CIMA
	Danny Brito	UAlg – student and technician
	Luísa Bon de Sousa	UAlg Team member – CIMA
	André Matos	*2
	Catarina Coelho	*1
	Cátia Correia	*2
	Diana Silva	*1
	Diana Muñoz	*1
	João Zêzere	*1
Only laboratorial work	Filomena Rita	UAlg team member – technician

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

2.3 Field work

The UBEST3 campaign was conducted on two consecutive days (October 25 and 26). 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 material and equipment for the samples. In the second day, to sample the stations 6 and 7 (Figure 2.7 and Figure 2.8), the most external stations of 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 carried out using one car from the University of Algarve and personal cars from the team members.

In this campaign, *in situ* measurements of water temperature, salinity, pH and dissolved oxygen (concentration and saturation %) were taken using the same multiparameter probes used in the last two campaigns, two from UAlg and two from LNEC. Before the campaign period, all the sensors of the four YSI multiparameter probes were calibrated using the same calibration solutions. Water samples were collected for further determination of chlorophyll *a* (2 L), nutrients and total suspended solids concentrations (1 L), using a 5 L Niskin bottle and/or a sampling cup of water. At each station, measurements and water samples 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 (< 3 m) and where stratification of the water column was not recorded in the data obtained in the previous

campaigns. At Tavira (the station with the highest potential to be influenced by freshwater input), to verify if stratification occurred in the water column, during the period of high influence from the river, *in situ* measurements were performed in the first sampling hour and at low tide, every 1 m along the water column and water samples were collected at both surface and bottom levels. The water samples, after collected, were transported to the laboratory in thermal containers to preserve their quality until further treatment.

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.

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

2.4 Laboratorial procedures

The water samples were processed in the laboratory 1.76 of CIMA - 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 (Figure 2.9). The dissolved oxygen concentration was also determined based on the Winkler method to confirm the data measured *in situ*.

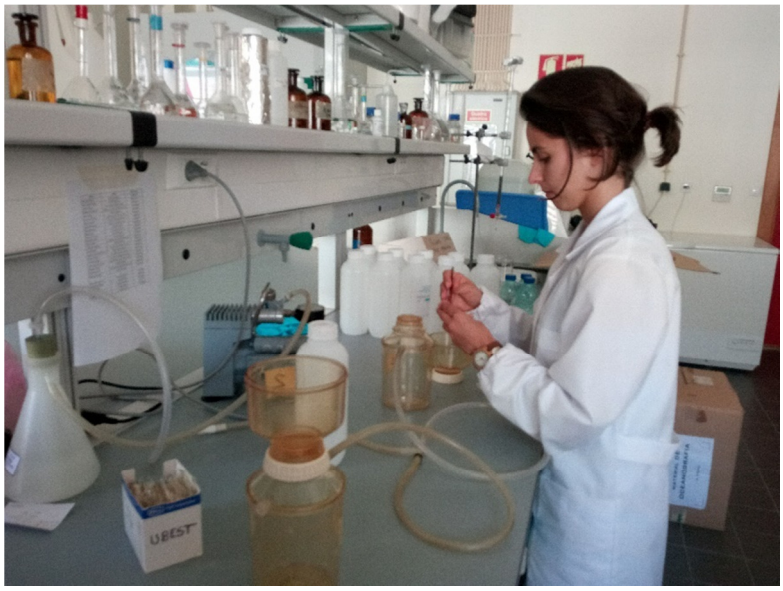

Figure 2.9. Laboratorial analyses for suspended solids concentration.

The filtered water samples through Gelman filters (0.45 µm porosity) were used for the determination of nutrients concentration (nitrate, nitrite, ammonium, phosphate and silicate). The concentrations of nutrients and chlorophyll *a* were based in spectrophotometric methods 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 described in APHA (1992).

3. Evaluation of the field campaign

The UBEST3 campaign performed in Ria Formosa coastal lagoon was successfully accomplished and the objectives achieved.

The chemical analyses for the determination of nutrients and chlorophyll *a* were performed with success and the variation of the sea level acquired form the pressure transducers was also processed. Water temperature was around 20ºC at all stations, except at Cacela, where the values were maximum, due to its shallowness. Extreme values were also observed there for dissolved oxygen (60-180%). Salinity was typical of oceanic waters (> 36), and the lowest value was found at station 4 (Tavira) around low water, when the contribution of the Gilão river apparently was higher. This contribution was also reflected in the absolute maximum of nitrate concentration, found for the three campaigns. In general, the nutrient and chlorophyll *a* concentrations were lower than in the Summer campaign. The maximum of chlorophyll *a* was registered at the western edge of Ria Formosa, at Bridge of Faro Beach (station 1) and Cais do Combustível (station 2), located in an inner area, where the concentrations were in the range of 1.5-2 µg/L.

The data acquired in the UBEST3 campaign, representative of autumn conditions, together with the last two campaigns representative of spring and autumn conditions, will contribute to better understand the spatial and temporal variability of the physicochemical parameters and further to validate the numerical hydrodynamic and biogeochemical models used to simulate futures scenarios of climatic changes and anthropogenic inputs.

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