# IX Simpósio sobre a Margem Ibérica Atlântica
# IX Simposio sobre el Margen Ibérico Atlántico
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# Chemical characterization of Ria Formosa under Summer conditions of 2017

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***Summary:*** *Global changes are expected to have impact on the ecological and economical services provided by coastal lagoons. Ria Formosa is the most important coastal lagoon on the south coast of Portugal. Under the framework of UBEST project, the present work aims to characterize the chemical variability of Ria Formosa water bodies under Summer conditions, along a semidiurnal tidal cycle. Field measurements and samples were undertaken at 7 stations covering all water bodies. Results showed a marked spatial variability, with greater ranges at the edges of the lagoon than at the boundary station. Temperature, salinity, phosphate and silicate were maximum at the edges, with the maximum range of dissolved oxygen at the eastern edge. Globally, chlorophyll-a and nutrients concentrations were relatively high, due to an upwelling event recorded during the campaign. This process supplied nutrients to the coastal zone, increasing its availability within the lagoon and further enhancing its biological productivity.*

***Keywords:*** *Coastal lagoon, Ria Formosa, nutrients, chlorophyll-a, dissolved oxygen*

Coastal lagoons are very dynamic and complex systems located in the land-ocean boundary, with high ecological and economic importance. However, due to their location, these systems are extremely vulnerable to anthropogenic pressures and climatic changes. Global changes can influence water quality (e.g. availability of nutrients, chlorophyll-*a* and dissolved oxygen), ecosystem dynamics (e.g. buffering capacity) and consequently ecological and economical services. The UBEST project aims to improve the global understanding of the biogeochemical buffering capacity of Ria Formosa, as one of the study areas, and its susceptibility to future scenarios of anthropogenic inputs and climate change. Located in the south coast of Portugal, Ria Formosa coastal lagoon is delimited by 5 islands, 2 peninsulas and 6 inlets. These inlets are interconnected by a complex network of channels, allowing the permanent water exchange with the ocean and the water recirculation within the lagoon. In terms of hydrodynamics, this system can be divided in three different sectors: eastern, central and western sectors. However, concerning the water circulation and human pressures – in terms of the Ecological Status classification under the Water Framework Directive –Ria Formosa is divided into 5 water bodies (WB) (Fig. 1; Ferreira *et al*., 2005). In the scope of UBEST project, one of the objectives was to characterize the seasonal variability of Ria Formosa water bodies. In the present study, we characterize the variability of the chemical parameters in stations representative of these 5 water bodies, during a complete semidiurnal tidal cycle, in the Summer season of 2017.

A field survey was carried out in September, including 7 stations to comprise all the WB (Fig. 1): western end (WB1); innermost area, highly influenced by human pressure (WB2); main channel connected to the main inlet (WB3); region with lower anthropogenic pressure (WB4); area influenced by a permanent freshwater source (WB5-R); eastern edge (5) and boundary station (BS). *In situ* measurements were taken and samples were collected every two hours during a complete semidiurnal tidal cycle (~ 12.5 h) at each site. *In situ* measurements of temperature, salinity, pH and dissolved oxygen (concentration and saturation %) were measured using multiparametric probes at surface/bottom levels. Water samples were collected using 5 L Niskin bottles to determine the concentration of nutrients, chlorophyll-*a* and suspended solids. Four pressure transducers (PT) were also installed in different sites to measure the variation of the sea level height.


*Fig. 1. Location of the water bodies delimited with different colors (WB), the sampling stations (green circles) and the location of the deployed pressure transducers (yellow stars).*

Data clearly demonstrate the spatial variability patterns in the lagoon, as well the tidal influence on the

selected parameters (Fig. 2). Globally, the highest spatial variability was found at both the edges of the lagoon, in contrast to the BS. Additionally, those parameters varied in antiphase with tidal height, reaching the maximum values during the ebb period. At BS, the lowest water temperature, around 18 °C (Fig. 2 a) was low for Summer, a behavior induced by an upwelling event that occurred previously and during the campaign, as confirmed by the records in the PT deployed close to WB2 and captured by the SST satellite images. This oceanographic process is frequent in the south coast of Portugal, particularly when westerly winds dominate (Relvas and Barton, 2002). Salinity (Fig. 2 b) was typical of oceanic waters (> 36), except at the WB5-R, due to the influence of Gilão river, particularly during the ebb period. The oxygen percentage (Fig. 2 c) was generally higher than 80%, except at the eastern edge (WB5), where the values ranged extremely between 37 and 153 %. There, the minimum was recorded at the beginning of the day (minimum photosynthesis) and maximum during middle afternoon, when the solar radiation and photosynthesis is more intense, and the water column depth is minimum. In general, nutrients showed an increase around low tide, when the dilution effect by tide is minimum. Nevertheless, this pattern was not observed for nitrate at BS (Fig. 2 e) that depict the highest concentrations during the flood period, confirming the occurrence of the upwelling event in the coast, which supplied this nutrient into the lagoon. However, the maximum nitrate concentration was found at the stations WB4 and WB5-R during low tide (~ 2 µM), typical for the Summer season. Ammonium (Fig. 2 d) had the highest concentrations at the stations associated with higher anthropogenic pressure (WB2 and WB5-R) and at the eastern region (WB5). There, the amounts reflect the increased concentrations of organic matter in decomposition. Silicate and phosphate (not shown) also showed the highest concentrations at the edges of the lagoon (WB1 and WB5), where the remineralization of organic matter and the diffusion from the sediments to the shallow water column can be promoted. Chlorophyll-*a* (Fig. 2 f) showed high concentrations for this season, reaching maximum values in WB1 and WB2 (~ 3 µg/L) leading to a decrease in nutrients concentration, despite the increase of nutrients availability due to the upwelling event.

In summary, the edges of the lagoon, shallower and with more restricted circulation, are characterized by having extreme values and highest variability when compared with the BS. In general, chlorophyll-*a* and nutrients concentrations were high for this season of the year, which was not anticipated, but this result was due to an upwelling event that occurred concurrently to the campaign. This oceanographic process, occurring in Summer supplied nutrients from the adjacent ocean to the Ria Formosa, increasing its availability within the lagoon and further enhancing its primary productivity, resulting in an increase of chlorophyll-*a* concentrations

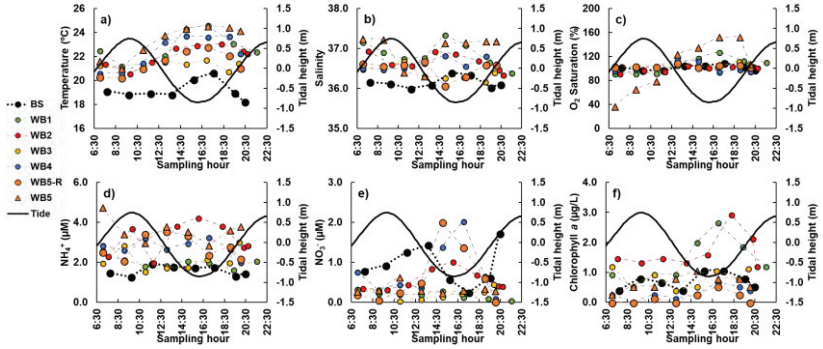


*Fig. 2. Variability of temperature (a), salinity (b), oxygen saturation in % (c), ammonium (d), nitrate (e) and chlorophyll-a (f) at each station during the semidiurnal tidal cycle performed in Summer.*

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