

Land-sea boundary as a reference for analysis of environmental changes: *Sinking particle fluxes of metals and organic matter in a mesotrophic pristine coastal system*

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In a nutshell

The pristine and mesotrophic Ria of Barqueiro (NW Iberian Peninsula, North-East Atlantic) is a paradigmatic ria (non-upwelling) where the sinking particle fluxes are not a direct result of upwelling (offshore ria) or continental loads (low river flow). This equilibrium may be disturbed by climatic changes. The magnitude of vertical fluxes of particulate metals (Al, Cd, Co, Cr, Cu, Fe, Ni, Pb, V and Zn), as well as POC, PON and Chl-a, were evaluated at the middle of the ria at 20m depth (Jan/08 to Jan/09), by

means of a multi-trap anchored to the sea-bottom (24h period). The obtained results also showed a high seasonal variability of the studied metals. Scenarios of (i) increased rainfall and (ii) north wind prevalence suggest a rise in the sinking of Al, Cu, Ni and V (river) or Co, Fe, and Pb (upwelling), respectively. The overall aim of this study is within the frame of the priority research themes of the Land-Ocean Interactions in the Coastal Zone program (LOICZ, 2005).

SPM, POC, PON, Ch-a, and trace metal fluxes from the water column to the sediments

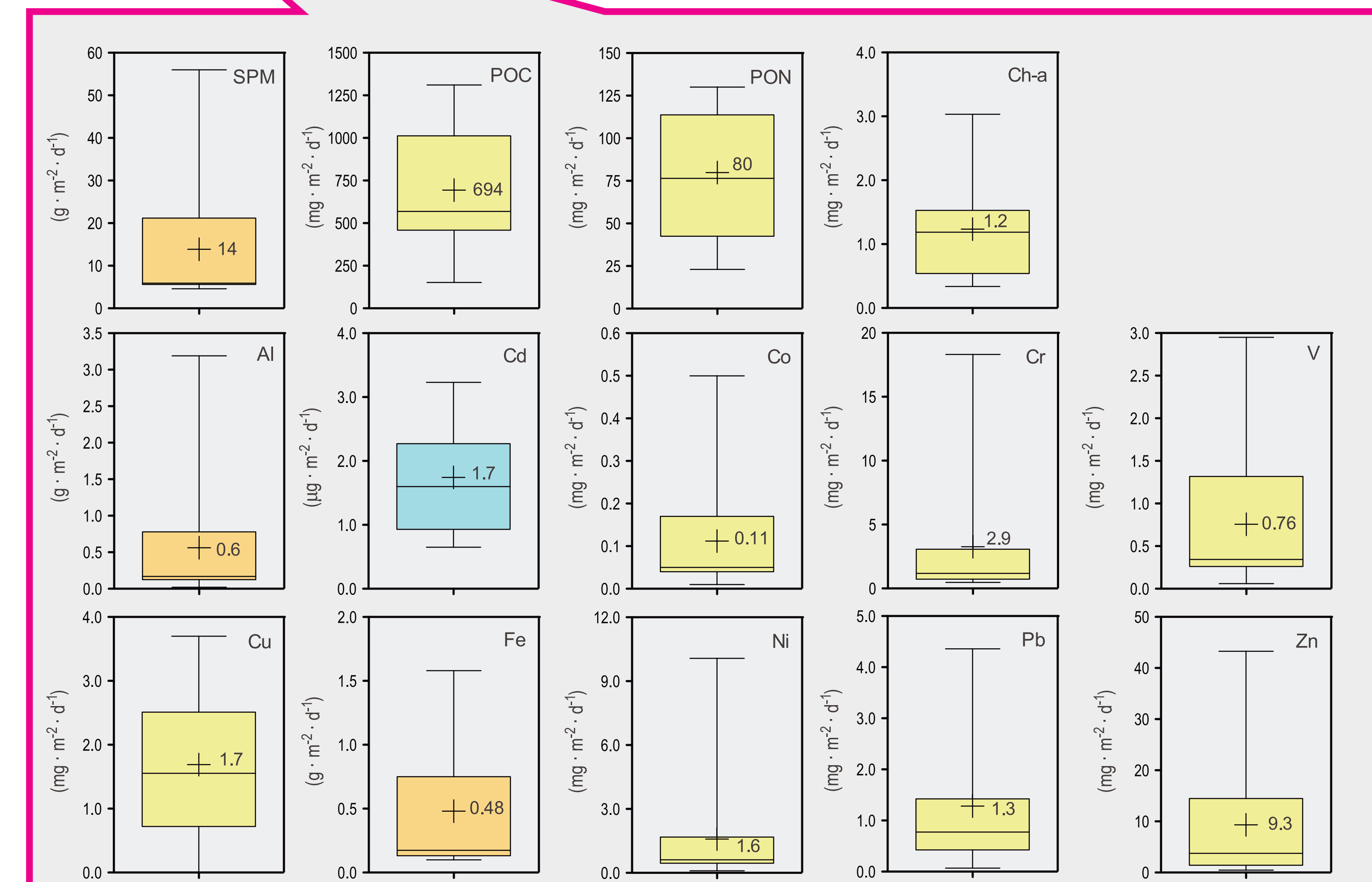


Fig 2. Box and whisker plots of SPM, POC, PON, Ch-a, and trace metal fluxes from the water column to the sediments of the Ria of Barqueiro during 2008. Boxes are plotted in different colours according to the scale of the Y-axis. Horizontal lines correspond to the median and the edges of the boxes of the 25th and 75th percentiles respectively. Whiskers show the minimum and maximum values and the cross represents the mean value.

General Background

Biogeochemical cycling of substances in coastal zones under land-ocean interactions is strongly conditioned by fluxes into, through, and out of rivers and the phytoplakton activity. Coastal and shelf areas account more than 50% of the primary production in the world's oceans and 80% of free sinking particles to the sea floor (Berger et al. 1989). Therefore, it is widely known that estuaries are natural traps for trace elements, however, dynamics of those entrapment process still have to be studied and understood. Between

the coastal system types in the land-sea boundary are the rias. The rias are coastal inlets formed during the Flandrian Transgression by the drowning of a former river valley, and are characterized by irregular coastlines and exposed rock platform (Goudie 2004). The rias located at the NW Iberian Peninsula are characterized by a high seasonality, that affects the hydrographic and biological processes (Ospina-Alvarez et al. 2014) and may influence the magnitude of vertical fluxes from the column water to the sediment.

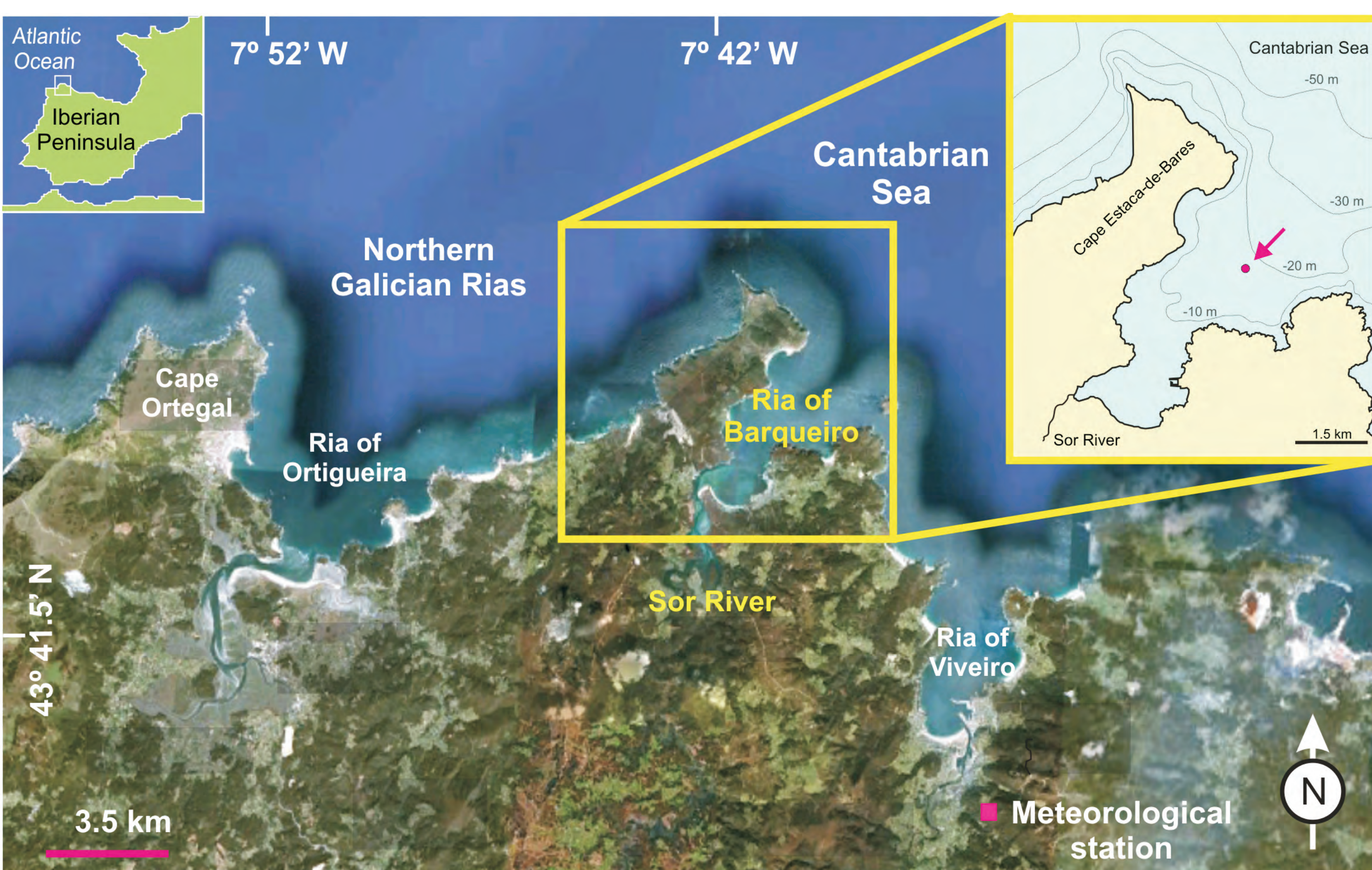


Fig. 1. Map of the Ria of Barqueiro (Western Cantabrian Sea). Circular mark (right frame) shows the location of the sampling station

Study Area

The Ria of Barqueiro, open to the north with a SW-NE orientation, is located on the western boundary of the Cantabrian coast next to Cape Estaca-de-Bares, the northernmost point on the Iberian Peninsula (Fig. 1). The Ria has an area of 10 km² and a mouth-depth of 27 m. Tides are semidiurnal with

a range of 2-4 m. Marine processes control the dynamics in the middle-outer zone of the Ria, but in the inner or estuarine zone, where the Sor River (19.3 m³·s⁻¹ of average flow in 2008) runs into, the fluvial processes have a greater influence. Primary production of this ria is 280 gC m⁻²·yr⁻¹.

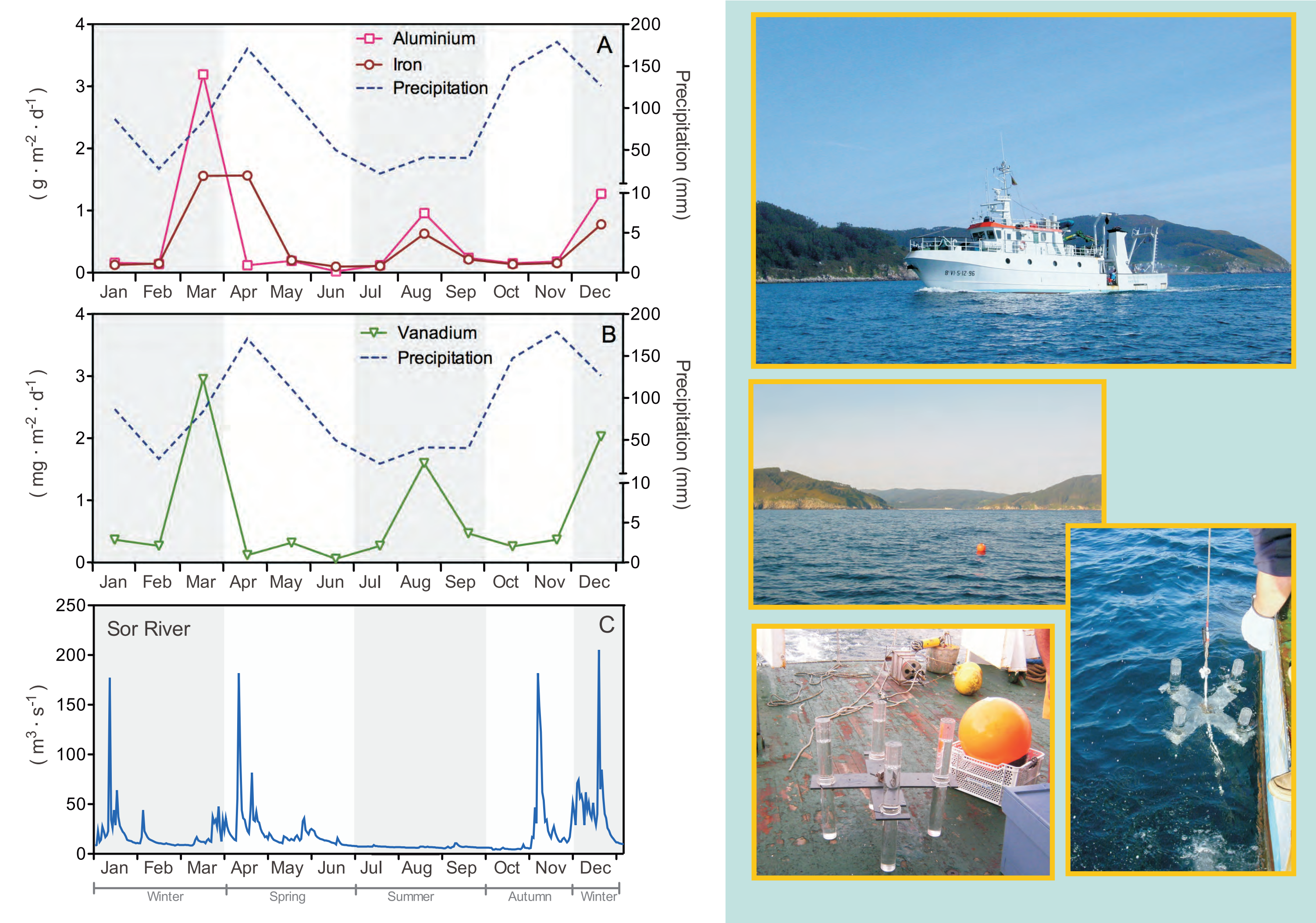


Fig 3. (a, b) Annual evolution of mean flux rates of aluminium (a) and vanadium (b) at the Ria of Barqueiro during 2008. Left axis (continuous line) corresponds to the metal fluxes of settling particles from sediment traps. Right axis (broken line) corresponds to monthly total precipitation (mm) in the study area, data from 'Penedo do Galo' Station, Regional Weather Forecast Agency - METEOGALICIA. (c) Daily flow (m³·s⁻¹) of Sor River during 2008. River flows provided by Augas de Galicia (Consellería de Medio Ambiente-Xunta de Galicia). Seasons correspond to the oceanographic periods (winter, spring, summer stratification, autumn) according to Ospina-Alvarez et al. 2014.

Take-Home Message

- ✓ The obtained results showed a high seasonal variability of the studied metals.
- ✓ Scenarios of (i) increased rainfall and (ii) north wind prevalence suggest a rise in the sinking of Al, Cu, Ni and V (river) or Co, Fe, and Pb (upwelling), respectively.
- ✓ There is a predominance of sea and atmospheric sources on land influence in the sedimentation fluxes in the middle-outer zone of the Ria of Barqueiro. It may be a consequence of the recently described non-upwelling pattern of the Northern Galician Rias (Ospina-Alvarez et al., 2014).

