

Long-term assessment of climate induced regime shifts in coastal areas

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Abstract

Resilience has become an important theoretical context for interpreting the sustainability of socio-ecological systems because of its applicability to socioeconomic and environmental systems under changing conditions, regardless if changes are slow and less perceptible. Estuarine and coastal ecosystems around the world are constantly changing in response to combined effects of climate drivers and human activities, and many of them may be approaching critical thresholds threatening their healthy functioning and services they provide. However, shifts from one ecological stable state to another can last for long periods, making long-term studies necessary to understand the real nature of these transitions.

Estuaries contain sediments that preserve the signature of multiple processes acting upon the coastal system. These records can therefore provide valuable palaeoecological data covering decadal to millennial time-scales and overcome the lack of long-term monitoring data required to investigate these processes. We have collected sediment cores from shallow, near-coast sites in the Sado estuary that provides a natural archive of environmental change since the early Holocene. The Sado Estuary is the second largest estuary in Portugal, with an area of approximately 24,000 ha. It is a mesotidal system, well mixed and generally well oxygenated, with a salinity variation depending on the annual precipitation and river flow. Most of the estuary is classified as a natural reserve but it also plays an important role in the local and national economy. Tidal marsh habitats cover about 30% of the total area. The Sado estuary is a good example of a site where human pressures and natural values coexist each other.

Using a combined spatial and temporal approach, this work aims to study ecological resilience and regime shifts in this part of the SW Portuguese coast. Thus, we study the sedimentary infill of a number of tidal marshes located in the Sado estuary to assess variability in both sensitivity and exposure to sea level rise (SLR) at a local scale. Site-specific accretion and wetland elevation change are quantified, and temporal trends understood to produce reliable projections of the effect of SLR. Empirical time-series of tidal data and coeval sedimentological records obtained from the study sites regarding wetland response and sea level changes are used to assess past trends that can inform future scenarios of wetland changes and responses. Contemporary data and multiannual to millennial reconstructions provide insights on patterns and drivers of abrupt environmental change in response to SLR and yield important information on the average state and natural variability of the coastal system. We expect that our results will provide information on the long-term development and patterns of variability of the Sado estuary in relation to socio-cultural activities, which is vital to understand and mitigate the

effects of global change on coastal ecosystems.