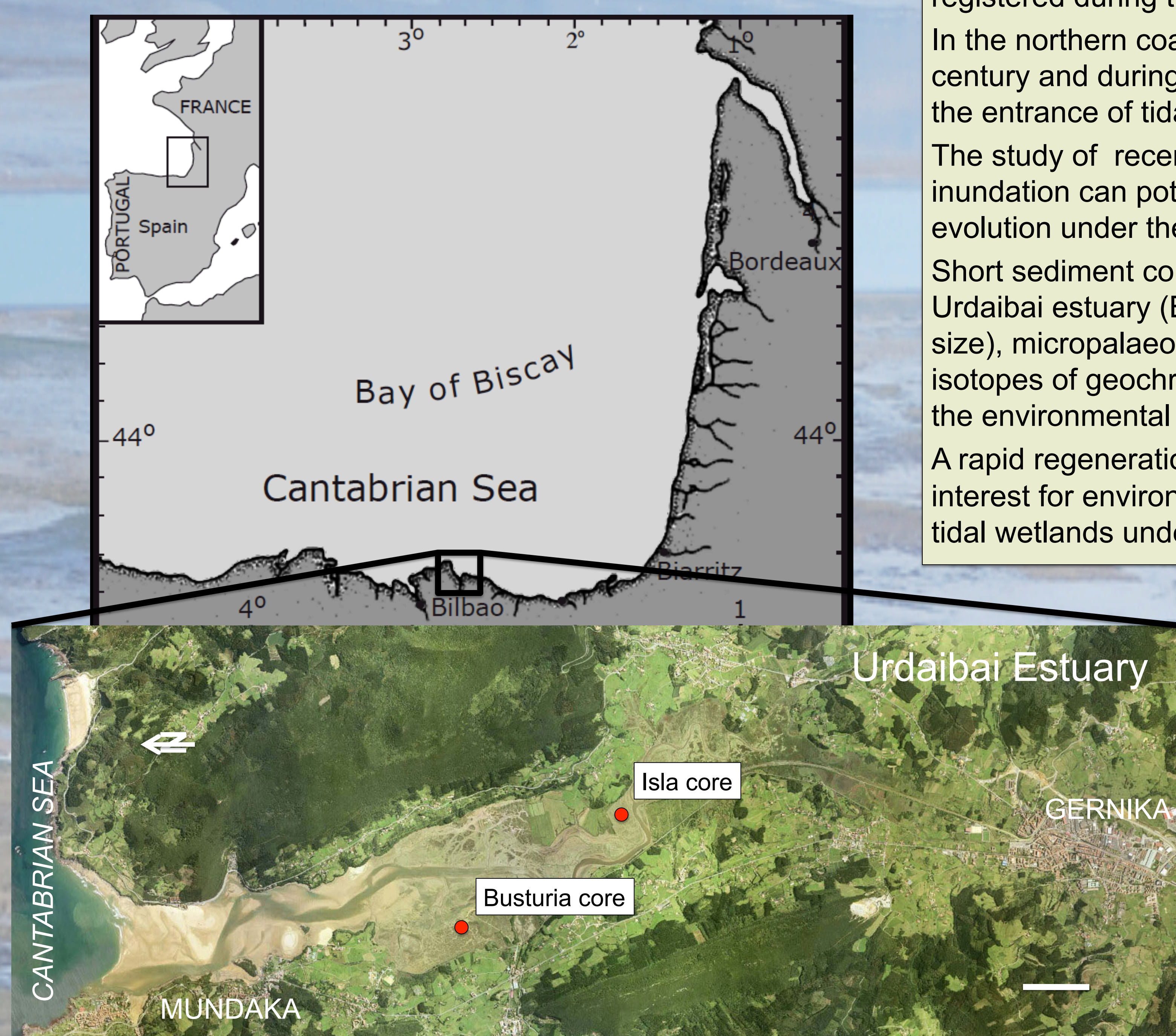


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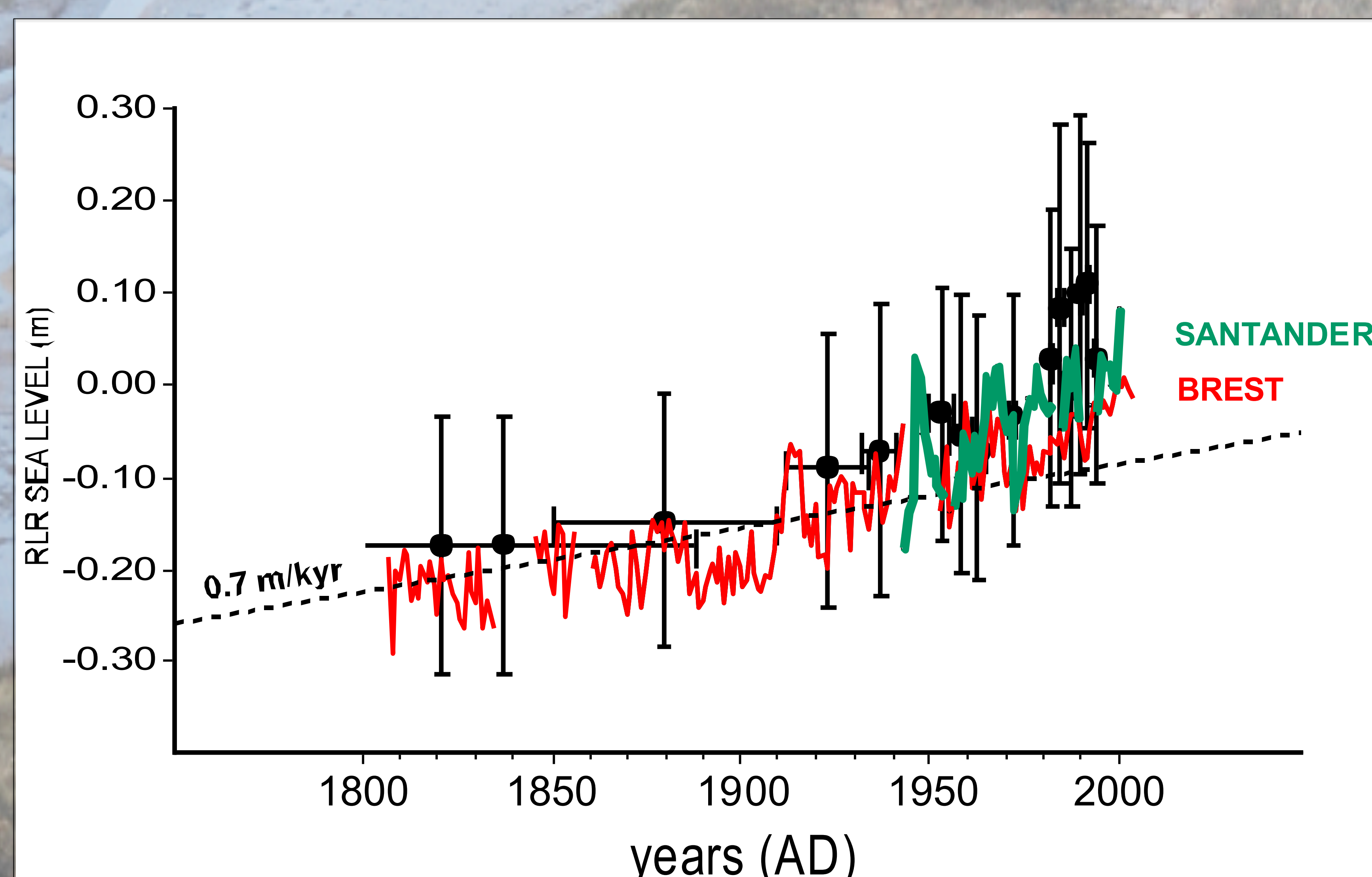
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1 Geographical location



Geographic location of the Busturia and Isla cores obtained from the Urdaibai Biosphere Reserve (Basque Country, northern Spain). Horizontal scale bar represents 1 km.

2 Sea-level rise



Sea-level trends from tide gauges and geological data. Black dots represent sea level index points obtained from salt marshes from the Basque coast (northern Spain). Red and green lines represent the nearest tide-gauge records from Santander and Brest. The dashed line represents the sea level through the Holocene. Modified after Woodworth *et al* 2011.

Abstract

The recent sea-level rise rate reconstructed using microfossil-based transfer functions and instrumental records from tide gauges in northern Spain is 1.9 ± 0.3 mm/yr during the 20th century, which is three to six times higher than the sea-level rise rate registered during the last 7000 years (of 0.3-0.7 mm/yr).

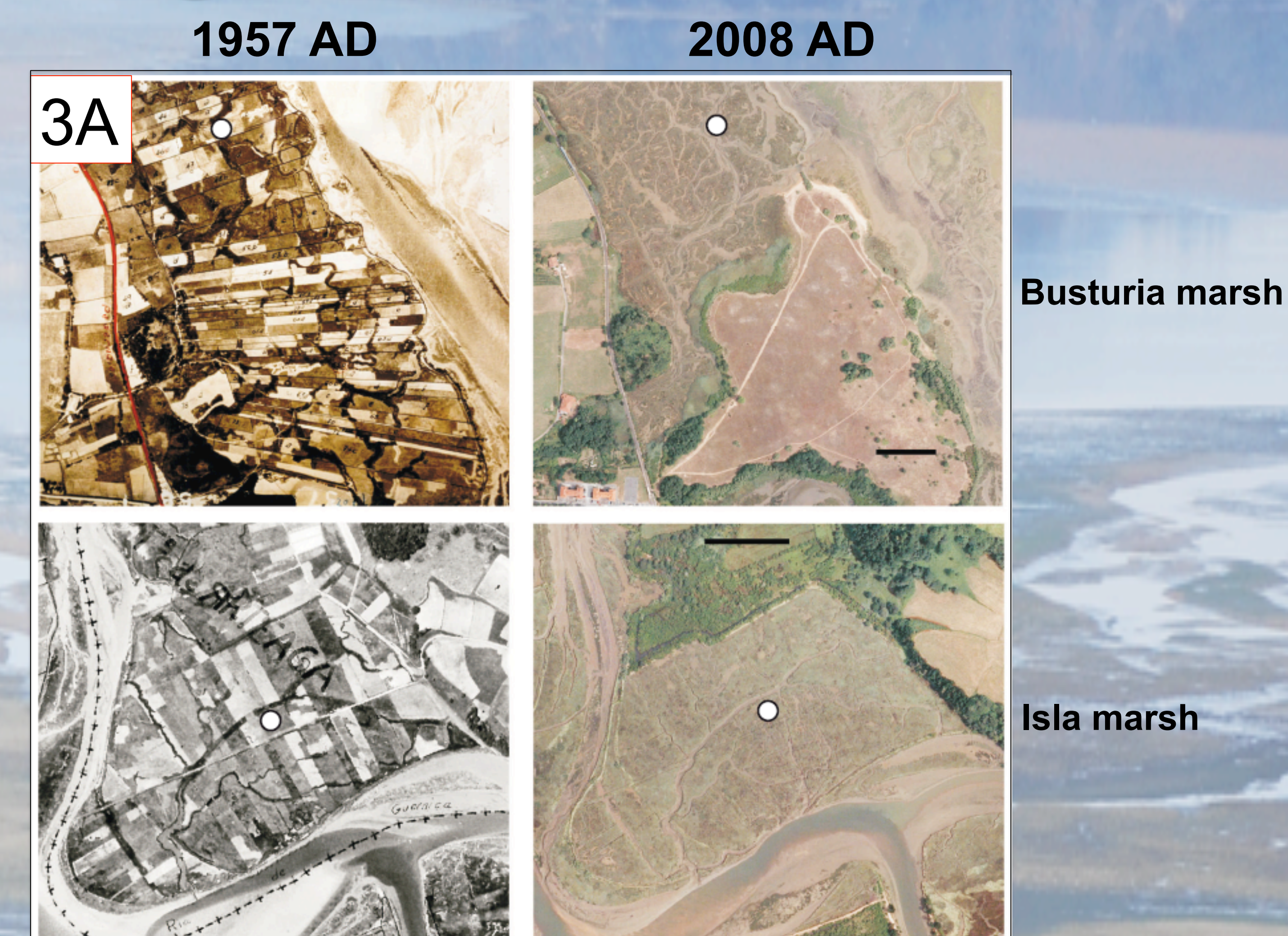
In the northern coast of Spain the reclamation of salt marshes was initiated in the 17th century and during the 1950s these reclaimed areas were abandoned which provoked the entrance of tidal, estuarine water and allowed their natural regeneration.

The study of recently regenerated coastal wetlands over time in response to tidal inundation can potentially provide us with key information of future trends of coastal evolution under the current climatic scenario of accelerating sea-level rise.

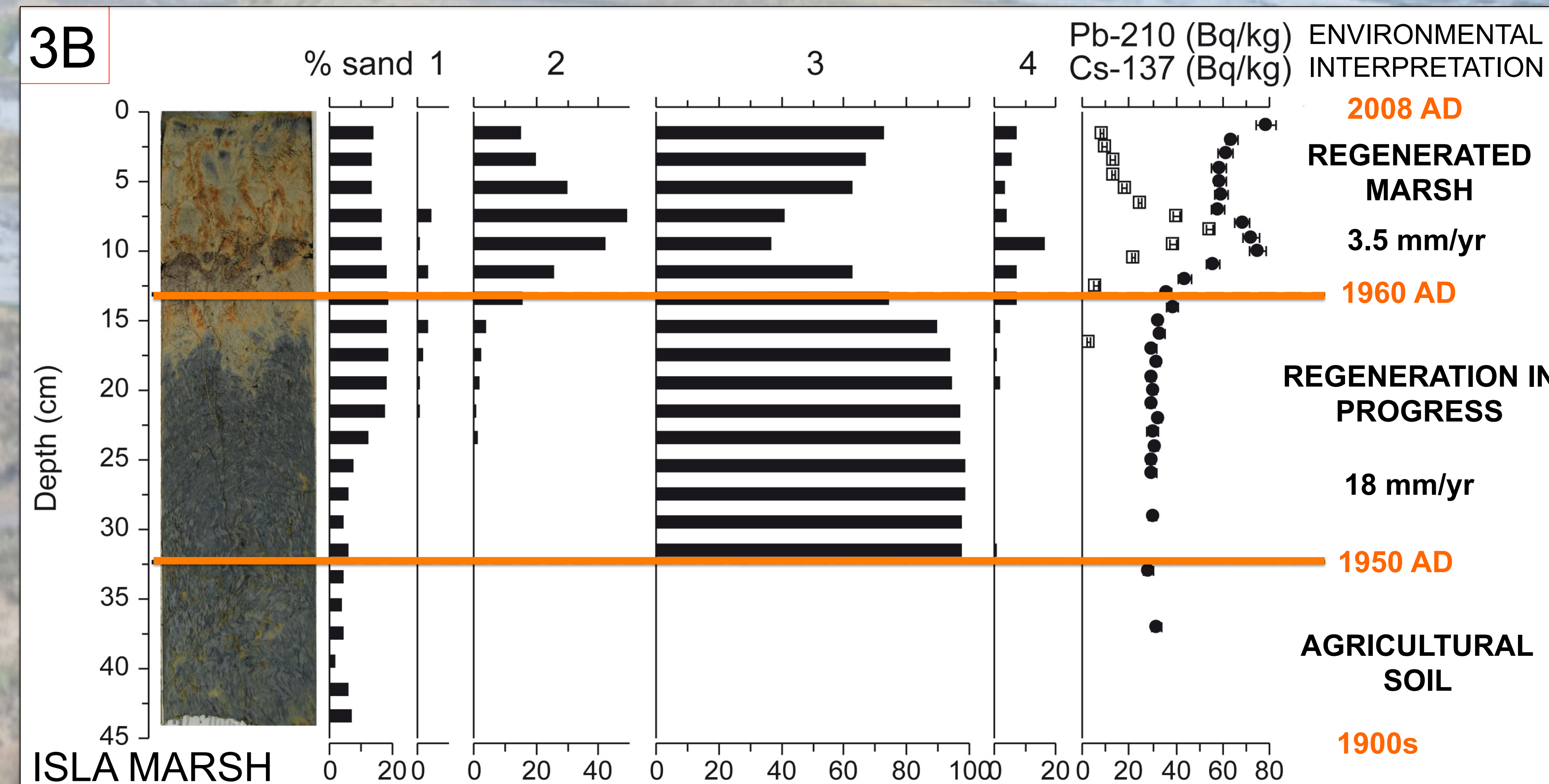
Short sediment cores were taken from recently regenerated salt marshes in the Urdaibai estuary (Basque Country, northern Spain) where sedimentological (grain size), micropalaeontological (benthic foraminifera) and geochemical (radioactive isotopes of geochronological interest) analyses were performed aiming to reconstruct the environmental transformation process of this coastal area.

A rapid regeneration process (less than 10 years) has been observed which is of great interest for environmental management of modern coastal areas by restoring them to tidal wetlands under the current sea-level rise scenario.

3 Natural regeneration



Historical and recent aerial photography of the studied salt marshes in the Urdaibai estuary, showing position of the cores in both historical (1957; left side) and modern (2008; right side) photographs: Busturia (top pictures) and Isla (bottom pictures). Scale bar represents 100 m. Modified after Cearreta *et al* 2011.



Core photograph, sand content (%), main foraminiferal species (1: *Arenoparrella mexicana*; 2: *Hormosina moniliforme*; 3: *Jadammina macrescens*; 4: *Trochammina inflata*) and total ²¹⁰Pb (dots) and ¹³⁷Cs (squares) concentrations (Bq/kg) in the Isla salt marsh core (Urdaibai estuary). Derived ages and sedimentation rates are indicated. Modified after Cearreta *et al* 2011.

Conclusions

Rapid natural salt marsh regeneration during recent tidal inundation of previously reclaimed agricultural areas has been observed in northern Spain. These environments accrete sediment very fast to reach equilibrium with the tidal frame. Under the current scenario of sea-level rise, the rapid restoration process would represent a valid adaptation measure to be favored in suitable coastal areas. This process is of great interest for environmental management of coastal zones, particularly in those areas where extensive reclaimed land is still present and could be easily restored to tidal wetlands.