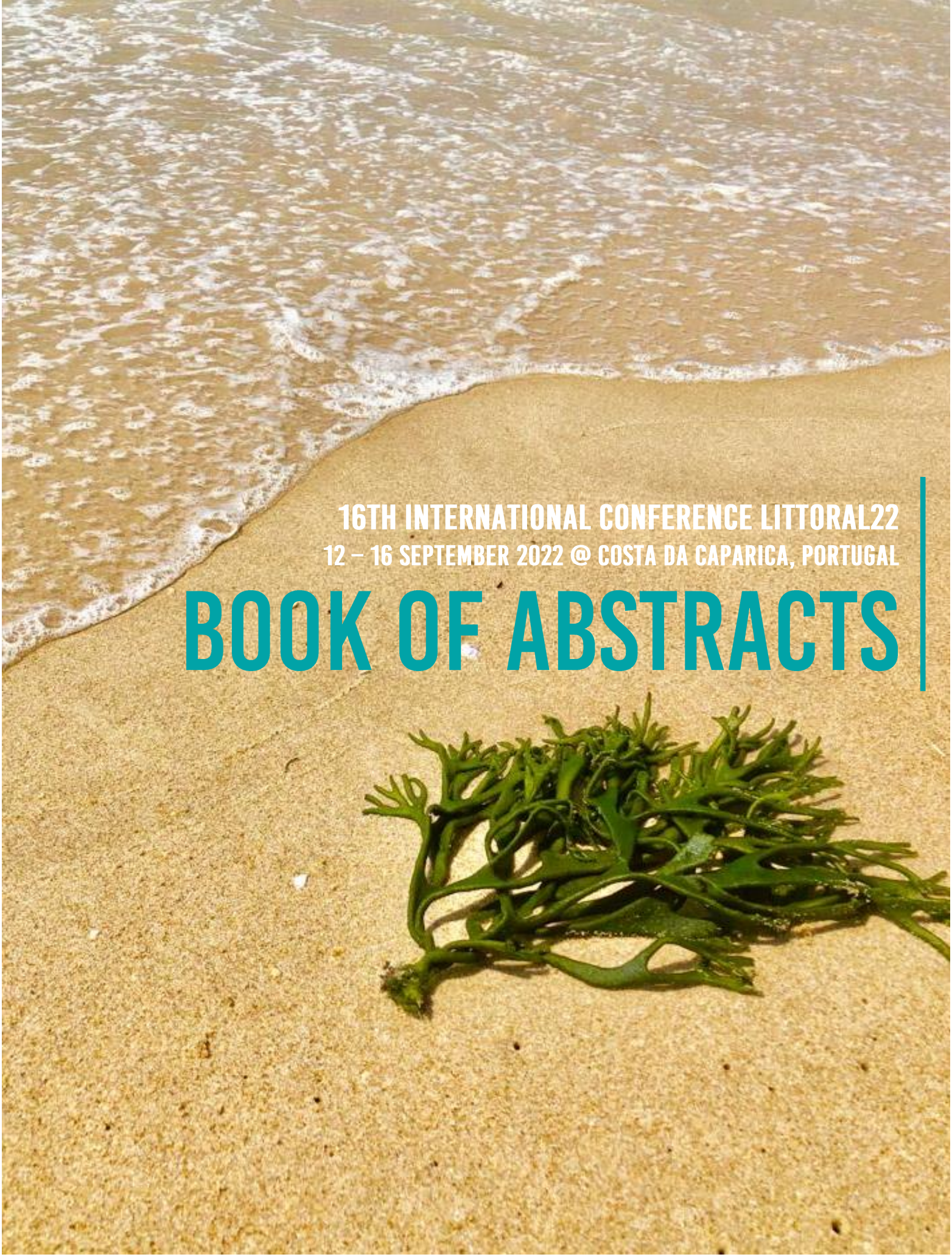

16TH INTERNATIONAL CONFERENCE LITTORAL22

12 – 16 SEPTEMBER 2022 @ COSTA DA CAPARICA, PORTUGAL

BOOK OF ABSTRACTS

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ADAPT OUR COAST FOR A SUSTAINABLE FUTURE

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December 2022

Susceptibility and exposure to sea level rise in the Sado estuary and in the Arrábida coastal zone

Thursday, 15th September - 10:30: (Costa Azul Room) - Accept for Poster

Prof. José Zêzere [1], Prof. Sérgio Oliveira [1], Prof. Susana Pereira [1], Prof. Raquel Melo [2], Dr. Pedro Santos [1], Prof. Eusébio Reis [1], Prof. Ricardo Garcia [1], Prof. Jorge Trindade [3], Dr. Rita Morais [1], Prof. Jorge Rocha [1]

1. *Centro de Estudos Geográficos, Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa; Associate Laboratory TERRA,* ***2.*** *Centro de Estudos Geográficos, Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa; Universidade de Évora,* ***3.*** *Centro de Estudos Geográficos, Instituto de Geografia e Ordenamento do Território, Universidade de Lisboa; Universidade Aberta*

1. INTRODUCTION

Sea level rising is a major driver of three climate hazards in the Sado estuary and in the Arrábida coastal zone: estuarine flooding, coastal flooding and cliff retreat.

In this work, the susceptibility to estuarine flooding, coastal flooding and cliff retreat is assessed for the present and at the end of the century, for the SSP2-4.5 and SSP5-8.5 emission scenarios. The exposure of people and assets to the considered climate hazards is assessed for both the current climatic conditions and those projected for the end of the 21st century.

2. METHODS

The susceptibility to present-day estuarine flooding was assessed based on the delimitation of the 100-year return period flood in the Sado estuary, produced by the National Laboratory of Civil Engineering (LNEC), whereas the susceptibility to current coastal flooding and cliff retreat was based on data provided by the Portuguese Environment Agency (APA) that supported the Espichel - Odeceixe Coastal Zone Program (POC).

The areas affected by coastal flooding were identified considering the coastline dynamics and evolution over the last decades, the ongoing sea level rise, the storm surge and the wave runup in storm conditions (Silva et al., 2013a, 2013b). Although the overwash, promoted by runup, will not cause a permanent flood, it is considered in this work because it will directly affect exposed people and property, particularly in urban areas. As a rule, a flood elevation of 8 metres above mean sea level was used as a reference, considering the variation in mean sea level, the maximum astronomical high tide, the maximum-recorded storm surge and the wave runup. This value is in line with those obtained for the coastal zone of Sintra and Cascais municipalities' (Marques et al., 2009; Taborda et al., 2010).

The areas susceptible to cliff retreat were identified taking into consideration the inventory of 86 landslides (rockfalls and shallow slides) that were inventoried based on aerial photo interpretation and field surveying, along the coastal cliffs between the Cabo Espichel and Setúbal. In addition, susceptibility to cliff retreat considers the risk zones adjacent to the cliff face, provided by the APA, defined according to the geological and geomorphological characteristics of the cliffs (Penacho et al., 2013a, 2013b; Marques et al., 2013).

The susceptibility evaluation of estuarine flooding, coastal flooding and cliff retreat by the end of the 21st century considers the projections provided by NASA and the IPCC, which indicate sea level rises along the Portuguese coast of 0.59 m and 0.79 m, respectively for the SSP2-4.5 and SSP5-8.5 climate scenarios. The modelling provided by the Coastal Risk Screening Tool of Climate Central [https://coastal.climatecentral.org/] (Kulp and Strauss, 2019) was also considered, adding the local effect of moderate flooding with 10 % annual exceedance probability to sea level rise (Muis et al., 2016).

The assessment of exposure to sea level rising was carried out for roads, railway, residential buildings, resident population and strategic, vital and/or sensitive facilities. The road and railway networks were obtained and classified from the Open Street Map Geofabrick. Residential buildings were obtained from the Portuguese

Building Georeferencing Base (BGE). The resident population *per* building was estimated by dasymetric crossing between the BGE and the respective 2011 Census tracts (Garcia *et al*., 2016). The location of strategic, vital and/or sensitive facilities was provided by the City Halls of Setúbal, Sesimbra and Palmela.

3. RESULTS

The area affected by current estuarine flooding covers 1378 hectares of predominant marshland together with low elevation areas that follow the mouths of the tributary streams on the right bank of the Sado river. This is the case of the Livramento stream, which has a subterranean course in the lower part of the city of Setúbal. The projected estuarine flooding for the end of the 21st century increases by about 80 % with respect to the current one and will not differ significantly depending on the climate scenario (3566 ha in SSP2-4.5 and 3626 ha in SSP5-8.5). This increase will affect densely urban areas on the riverfront of the city of Setúbal.

The coastal flooding currently affects the narrow constrained sandy beaches along 44.3 hectares in the Arrábida coastal zone. The area susceptible to coastal flooding projected for 2100 increases by more than 100 % in relation to the present and will not vary substantially depending on the climate scenario (88.64 ha in SSP2-4.5 and 89.55 ha in SSP5-8.5). The projected scenarios will affect the central low part of the urban area of Sesimbra village.

Coastal cliffs are the dominant coastal system in the Arrábida chain. Currently, coastal erosion and cliff retreat affect 714.23 hectares along the Arrábida coastal zone. The area projected as susceptible to coastal erosion and cliff retreat in 2100 will increase about 40 % with no measurable differences between climate scenarios. In 2100, the total dangerous area will cover 992.45 hectares, which includes the area currently subject to coastal erosion and cliff retreat.

Currently, there are 94 residential buildings and 110 inhabitants exposed to the considered hazardous processes in the Sado estuary and along the Arrábida coastal zone. There is only one strategic, vital and/or sensitive facility exposed. In addition, exposed roads and railways account for 12.9 km and 0.2 km, respectively. These features will increase to 764 residential buildings and 1902 inhabitants by the end of the century for the SSP2-4.5 scenario, considering present occupation. In this climate scenario, the number of strategic, vital and/or sensitive facilities exposed will increase to 22, and the exposed roads and railways will increase to 31.9 km and 7.8 km, respectively. In SSP5-8.5 scenario, the exposure will be higher by the end of the century, with 894 exposed residential buildings and 2204 exposed inhabitants. In line with these features, there will be 34 exposed strategic, vital and/or sensitive facilities, and the exposed roads and railways will increase to 33.7 km and 8.3 km, respectively.

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