
ARTICLES

GENERATION OF A DIGITAL GALICIAN GREAT SCALE SHORELINE USING PHOTOINTERPRETATION AND DYNAMIC SEGMENTATION

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I. INTRODUCTION

Any study focused on coastal areas, whatever their objective is (land management, conservation, infrastructures, etc), requires a previous definition of a clear boundary between land and sea. A legal definition of the coastline for the entire Spanish territory was established by the «Ley de Costas 22/1988». However there is lack of common criteria of application for the different disciplines studying the littoral, which implies the existence of very different shorelines, though not necessarily excluding among them.

To draw a shoreline using GIS it is essential to select a definition to be followed. The simplest definition is the one that understands the coastline as the physical interface between land and water (Dolan, 1980). However, this definition is not sufficiently accurate or operational in order to digitize it. The method will depend of the type of data available (satellite imagery, aerial photography, video images...), as well as its resolution.

Boak and Turner (2005) published a review of shoreline digitizing studies, where they presented different methodologies and the most commonly used indicators. These authors include: i) «high water line» (HWL) defined as the wet/dry limit caused by the high tide; ii) «mean high water» (MHW) determined by the intersection of the coastal profile with a specific vertical elevation, defined by the tidal constituents of a particular area, in this case mean high water; and iii) methodologies based on the application of image-processing techniques to extract proxy shoreline features from digital coastal images that are not necessarily visible to the human eye.

The aims of this study are:

- 1) Digitalization of a detailed and accurate coastline of Galicia, through the use of a Geographical Information System (GIS) to be used as a cartographic base for scientific studies on the coastal area, thus addressing the lack of a detailed coastline in this region.

2) Development and publication of a methodology detailing the indicator employed, its definition and the criteria followed during the drawing, which will be useful for future digitalization work. With the aim of sharing the generated information, the digitalized coastline, its derived layers and the methodological report will be available for users, establishing the base for a future common and collaborative cartography which will be constantly updated.

3) Division of the digitalized coastline according to the type of physiographic coastal unit (beach, cliff, marsh, estuary, artificial structures) through dynamic segmentation, which allows for coastal characterization, useful for coast management, as well as showing the great potentiality of this tool for dynamizing digital information.

II. METHODOLOGY

1. Material

To draw the shoreline, orthophotos of the coastal zone were used (flight scale 1:18000 and scanning resolution 14 μm). The final orthophotos were corrected with a digital terrain model (5 m scale) and present a 0.5 m resolution (pixel size). All digitization work was carried out using ArcGis 9.2.

2. Methods

Once the spatial information used for the digitation was established, the next step was to define the indicator to be used. For this study, the «high water line» (HLW) indicator was chosen, describing it as the wet/dry limit and interpreting it as the line defined by the difference in colouring that marks the reversal of the tide (lines of the last high tide). Because of the characteristics of the Galician littoral, the use of other indicators as the limit between the foredune and the backshore, usually identified because of the presence of vegetation (Ojeda, 2000), was discarded. The work scale was established in 1:750, making a compromise between the accuracy of the resulting line and the effort invested in the digitizing.

Regarding the criteria used for digitization, five main coastal types were established: artificial structures, rocky coast, sandy coast, marsh and estuary; for each type, the specific criteria for drawing were defined. However, in the process of line drawing, the geomorphologic heterogeneity of the Galician coast forced to define new criteria, which were not considered in the main typologies. All these cases were included in a library of criteria, so that for each «point of the line» a protocol already established was followed. This helped to speed up the process and to minimize the error. In addition, a sixth coastal type called «particular cases» was established.

In order to include complete information of the coastal area, islands and islets were included in the drawing when its were bigger than 15m in this eje. The criteria followed in its digitization were the same that those used in the land area, already included in the library of criteria.

From the original digitalized shoreline several derived lines were established which are suitable for use in other specific studies.

III. RESULTS AND DISCUSSION

The main outcome of the digitization process was to obtain digital geographic information of the Galician coast, composed of several vectorial layers and a library of criteria. The shoreline of the Galician coast, digitized in the present study, covers from Tomiño (41°57.0'N, 8°44.9'W) to Ribadeo (43°27.56'N, 7°5.0'W), with a total length of 2272.22 km, taking into account the scale used (1:750) and including brackish water areas. Applying dynamic segmentation to this line 2565 fragments were obtained, representing a total of 1365.50 km of rocky substrate, 246.59 km of sandy substrate, 389.58 km of estuaries and marsh zones and 269.33 km artificial substrate.

In addition a vectorial layer was created with 1127 islands and islets, which represent a total of 347.7 km of coast. A derived shoreline that marks strictly the wet/dry limit was generated, leaving out parts of brackish water with a length of 1915.64 km. Moreover, marsh and estuary areas were identified along the coast, covering a total area of 5607 hectares. While developing the present work, a detailed library was created, which reflects general criteria established for each category and specific cases that arise during drawing, as well as the protocol followed in each case.

All outcomes, digital cartography as well as the library of criteria, are published for open access and use on the website <http://gis.recursosmarinos.net>, with a Creative Commons 2.5 licence in the option Share Alike (<http://creativecommons.org/licenses/by-sa/2.5/es/>).

