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Seven good practices for the environmental licensing of coastal interventions: Lessons from the Italian, Cuban, Spanish and Colombian regulatory frameworks and insights on coastal processes

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ABSTRACT

Environmental licensing is the regulatory procedure that enforces the environmental impact assessment (EIA) of human activities inside a given country. Despite worldwide acceptance of EIA as a valid tool, its application in coastal environments is still too diverse and limited regarding the specificity of the natural processes influencing the shore. This paper compares the Environmental Licensing Procedure (ELP) of four countries, focusing on the activities that could affect the coastal geomorphology. The acquisition and validation of information were done through interviews with EIA representatives in each country, who signalized the official documents of environmental licensing and coastal management to be considered in the documentary review. The results present those differences and similarities among ELP stages in each country, based on the principles of the International Association of Impact Assessment and the national documents analyzed. In sum, 59 interventions associated with human uses and activities in the coastal zone were compared according to the prescriptive character of the environmental licensing in Italy, Spain, Cuba and Colombia. The natural processes influencing coastal geomorphology were also analyzed within the technical criteria included in the official guidelines for the EIA, finding a generalized weakness in processes associated with geochemical courses on coastal environments. By way of discussion, seven good practices are illustrated, according to their pertinence to the impact assessment of the coastal zone: 1) The integration of screening and scoping; 2) Evaluation focusing on the environment rather than the intervention; 3) Binding the coastal zone delimitation; 4) Institutional articulation; 5) Accreditation of environmental consultancies; 6) Official guidelines by types of environment; 7) The integration of environmental geographic information. Finally, general conclusions to assist EIA practitioners operating in the four countries and recommendations to lead further research are provided, introducing a novel process-oriented approach for ELP.

1. Introduction

Despite environmental impact assessment (EIA) being widely accepted, the procedure regarding coastal interventions is not entirely homogeneous among different countries and even different regions within the same country (Li and Zhao, 2015; Zhang et al., 2013). As a demonstration, a compared analysis of the EIA regulatory framework in four countries, two European (Italy and Spain) and two Latin American (Cuba and Colombia), is presented in this article. Italy presents a federated system, while Spain is semi-centralized. The other two are centralized, but have different political ideologies. The issues addressed here include interventions which are not regulated but affect the coastal zone, and those which are regulated but disregard the importance of coastal processes. Consequently, this article seeks to identify, compare and synthetize good practices for improving a specific component of the EIA, the Environmental Licensing Procedure (ELP), from the regulatory framework of four countries exposed to numerous coastal interventions.

In fact, several human interventions are affecting coastal environments as built structures and land use changes derive into coastal instability, armoring, ecosystem malfunctioning and, in the main, disruption of the natural balance (Frihy, 2001; Cooper and Pilkey, 2012). Even though most coastal geomorphological changes are attributed to projects directly installed on the littoral, human transformation of watershed also plays an important role in the assessment (Anfuso et al.,

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2011; Restrepo et al., 2016). This situation exemplifies the highly dynamic and interconnected character of coastal environments, where natural flows of energy and materials from highlands, lowlands and marine areas overlap in space, as do their management challenges (Vallega, 1999).

In this context, coastal geomorphology results from the interaction among natural processes and human transformations acting on the environment (Alcántara et al., 2014; Correa et al., 2005). As Cavallin et al. (1994) state, the relationship of geomorphology with human interventions works in two directions: first, the morphometry of the locations needs to be suitable for a project or activity, but also geomorphological hazards can pose a risk to the integrity and functioning of interventions; second, the project's infrastructure and operation present threats to the geomorphological assets of the area and its surroundings. Likewise, coastal interventions have a strong geomorphological bias as they are framed by diverse processes influencing coastal morphology (i.e. Geological, Geochemical, Climatic, Eolic and Biogenic) (Pranzini, 2008; Masselink and Hughes, 2003). As a result, the measurement of impact on geomorphological resources, assets and processes could be a useful approach, albeit difficult to apply, for the environmental impact assessment and control (Rivas et al., 1997; Frihy, 2001).

In consequence, environmental licensing is a tool for controlling the effects of human interventions through a regulatory framework because legal and administrative arrangements are necessary to ensure the EIA legitimacy in every country (Wood, 2003). According to the International Association for Impact Assessment (IAIA), the EIA is a "process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken" (IAIA and IEA, 1999). Meanwhile, the environmental licensing is understood as the documental or bureaucratic procedure that enforces EIA implementation. While environmental impacts are alike everywhere, regulations are restricted to national jurisdictions, and every country has its own particularities and limitations. For instance, the Colombian EIA regulation has been reported as ineffective due to a limited scope, inadequate administrative support and insufficient control mechanisms (Toro et al., 2010). Meanwhile, the longest administrative timing among European countries has been reported in Spain, where the scope definition of Environmental Impact Statements (EIS) has been voluntary since 2013 (Fuentes-Bargues, 2014; Enríquez-de-Salamanca et al., 2016). On the other hand, the decision making during environmental licensing procedures in Italy faces difficulties in transparency and effectiveness, which have led to strengthening mechanisms for proactive public participation and the provision of official guidelines (Bassi et al., 2012; Del Furia and Wallace-Jones, 2000). Lastly, the experience in EIA procedures in Cuba is rarely found in the scientific literature, however, the regulatory framework of this country presents an additional compelling argument for this paper, regarding the definition of coastal interventions.

Among the four countries, Cuba is the most explicit when determining coastal interventions. The Decree-Law 212/00 distinguishes at least 15 activities or facilities typical of the coast, which means those whose location cannot be other than the coastal zone (article 15). The Spanish coastal law (2/2013) also refers to a similar categorization by singularizing three types of interventions: creation and regeneration of beaches, promenades, and wastewater treatment facilities (article 44). The definition of coastal interventions in Italy is not explicit in the legal code, although a thorough document was recently prepared by a group of national experts to establish clear guidelines for assessing erosive phenomena and their environmental aspects (MATTM-Regioni, 2017). Furthermore, guidelines related to the protection of coastal habitats in the Liguria Region (Italy) distinguish nine types of coastal works and four types of coastal activities within the criteria for environmental protection. On the other hand, Colombia does not make such a distinction despite having two national policies for coastal areas (CCO, 2007; MMA, 2000).

The former precisions indicate distinct levels of awareness in the importance of coastal environments among the four countries. Still, none of them incorporate coastal interventions as a category within the administrative structure of the environmental licensing. This reveals a weakness in conventional EIA procedures, as the assessment concentrates on interventions and omits the specificity of the socio-natural environment. Given the inter-connected character of coastal environments, many interventions outside coastal boundaries still influence their morphology. Therefore, coastal interventions hereafter would be understood as all types of interventions affecting the coastal zone.

Lastly, many studies comparing countries use EIS as the contrasting subject through documentary review of study cases for specific types of interventions (Barker and Wood, 1999; Canelas et al., 2005; Bassi et al., 2012). For example, Guerra et al. (2015) analyze the need for implementing a mandatory EIA procedure for three types of marine interventions in Portugal through the comparison of 12 EIS's within seven countries with important maritime commercial zones. This kind of comparison is only possible when case studies are very specific or narrow because the universe of human activities and types of environments is too broad for a single research project. On the contrary, the comparison made here is focused on EIA legal codes, analyzing the Environmental Licensing Procedure (ELP) and Terms of Reference (ToR) for EIS preparation within geomorphological criteria addressing coastal processes. Finally, the conceptualization of good practices was inspired in the conceptual approach of Morgan (2017), who defines best practices as a form of knowledge used for specific ends and recognizes the character of best practice materials as narrative (examples and case studies), institutional (legal and administrative processes), or technical (substantive and practice-focused).

2. Methods

Stemming from the heterogeneity of the ELP of coastal interventions in the four countries analyzed, semi-structured interviews were conducted in the period from April to October 2017 with representatives of Italian, Spanish, Cuban and Colombian public administrations along with other agencies engaged in the ELP at various levels. A total of 19 interviews were conducted on representatives of public administration both at the national and regional government level, and representatives of scientific research bodies advising EIA procedures. Appendix I shows the full list of interviewed organizations with a brief description and reasons for the choice.

Because of their role or involvement, these people were expected to give the full picture of the current legal and policy practices, and the challenges for environmental licensing in their respective competencies. The topics of discussion in the interviews were:

a. Their role within the institution.
b. Competencies and activities within EIA in the coastal environment.
c. Technical criteria for validating project's influence areas and characterizing the environment.
d. Existing regulations and guidelines to orient environmental licensing and coastal management practices.
e. Information systems designed for EIA procedures and monitoring criteria for project's follow-up.
f. Existing challenges or good practices related to the EIA and follow-up of projects and human activities.

Information coming from the transcribed interviews was integrated with other documentary evidence, such as legal acts at the international, national and regional levels, other types of policy documents (e.g. local plans and programs), and official guidelines for EIS elaboration. The EIA representatives interviewed in each country signalized the official documents of environmental licensing and coastal management to be considered in the documentary review. The whole review was registered in matrices to reconstruct practices in ELP and coastal management. Appendix II gathers all documents reviewed.

For the comparative analysis, the flow of the procedure in the environmental licensing of each country was extracted from their respective legal codes. Furthermore, types of coastal interventions under ELP in each country were analyzed according to the prescriptions established in their respective regulations. An additional comparison was made from the guidelines formulated and adopted by each country, circling around technical criteria for environmental characterization within the elaboration of the EIS. The guidelines used for this comparison correspond to projects or activities to be emplaced on the shoreline, such as shore protection structures, beach nourishment, dredgings and ports. This approach was selected to enrich the relation of technical criteria with the natural processes influencing the coastal morphology, using Prothero and Schwab (2013), Pranzini (2008) and Morton and Pieper (1977) as conceptual references. Finally, the discussion regarding good practices for the environmental licensing of coastal interventions is based on EIA materials of institutional and technical character among the four countries (Morgan, 2017).

3. Results and analysis

3.1. Environmental licensing procedures

The conceptual reference used for comparing the stages of environmental licensing among countries are the operating principles of EIA best practices, defined by the IAIA (IAIA and IEA, 1999). Seven of the ten operating principles were considered common stages of the licensing procedure, using a specific flowchart symbol for each stage (Fig. 1). The other three principles (Impact analysis, Mitigation and impact management, and Evaluation of significance) were gathered under the label *Valuation of environmental impact,* since they are not considered a procedure stage themselves. The shape and color in the flowchart of the IAIA are the references to recognize the analogous stage followed by each country, as well as the indication of the order in which the EIA takes place. The stages for each country were determined by the recognition of the IAIA practices, the name of specific procedures and the responsibilities of parties involved in each country as specified in appendix III.

The Cuban procedure comprehends only five of the reference stages, within which scoping, EIS preparation and follow-up are distributed in two stages each, while screening and alternative examination stages are not included. The two stages of EIS preparation take place in different moments because some environmental licenses do not require an extended EIS; therefore, this second study is requested only when the area of interest is not widely characterized with the former EIS's or the complexity of the project requires it. The ELP in Spain presents a similar configuration to the Italian flowchart mainly because both countries are bound to apply the European Union Environmental Impact Assessment Directives (2011/92/EU and 2014/52/EU). Last, the Colombian flowchart comprehends all the IAIA stages except the screening, because there is no structured procedure to decide whether certain interventions require undergoing a full EIA procedure or not. Instead, the licensing procedure in Colombia starts with the environmental alternative diagnosis, which is a separate environmental analysis to select the alternative that must apply a conventional EIA.

In addition, there are some features in Fig. 1 representing similarities among the four countries. Two highlighted figures in the flowcharts of Italy and Cuba indicate that both countries incorporate the same practice of articulating the proposed intervention with territorial planning strategies (i.e. urban, coastal, basin). A second feature emphasized is the dotted lines within the stages of EIS preparation at Italy and Spain, indicating that the examination of alternatives is inside the structure of the EIS documents in both countries. Finally, all of the flowcharts stress the practice of consulting the public or communities concerned by using bold letters in the stage of each procedure where it takes place or is more relevant.

3.2. Types of interventions subjected to environmental licensing

Coastal interventions and their compliance with the ELP in each country are summarized in Table 1, according to the competence level

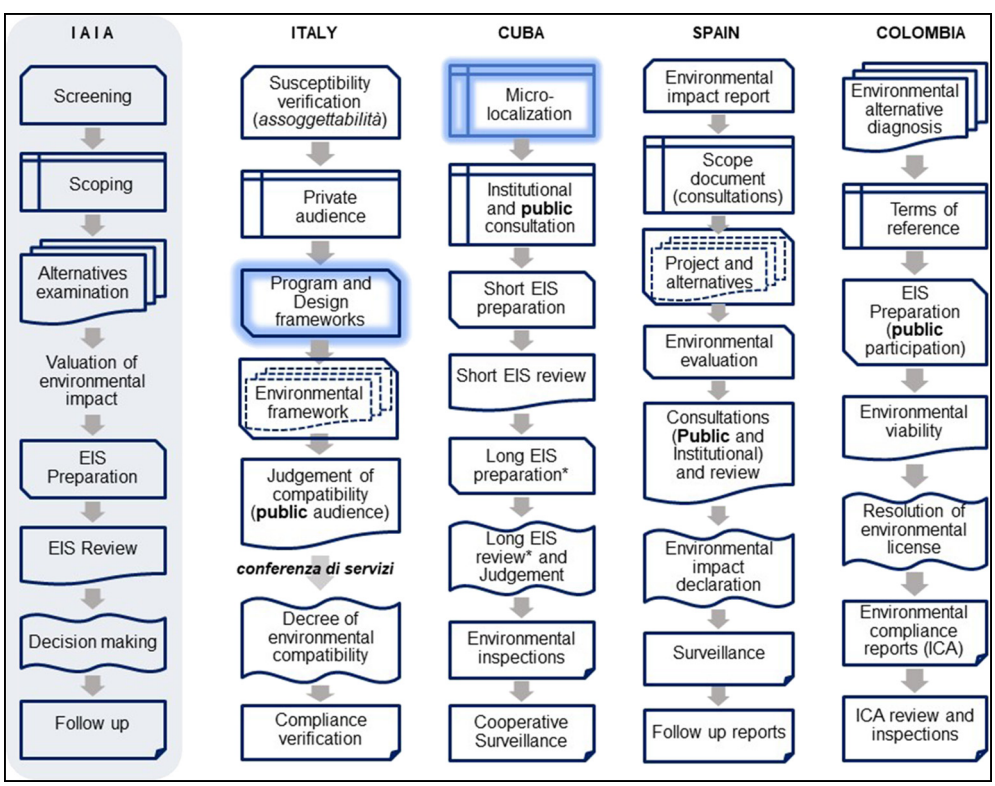

Fig. 1. Licensing procedure in Italy, Cuba, Spain and Colombia within the IAIA framework. (*Stages that take place only if the environmental authority requires it).

Table 1
Type of intervention in the coastal zone subject to EIA procedures in Italy, Cuba, Spain and Colombia.

Intervention with effects on the coastal zone		IT	CU	SP	CO
Edifications	Low-density settlements	R*	Ø	N*/R*	Ø
	High-density settlements	Ø	R	Ø	Ø
	Palatial settlements	Ø	Ø	Ø	Ø
	Luxury settlements	Ø	Ø	Ø	Ø
	Sun and Beach Tourism	R*	R	N/R	Ø
	Military installations on land	R*	Ø	Ø	Ø
Works of shore protection and control	Breakwaters and artificial reefs	**R***	Ø	**N*/R***	**N**/R
	Groins	**R***	Ø	N*/R*	**N**/R
	Walls	**R***	Ø	N*/R*	**N**/R
	Walks and ridges	Ø	Ø	Ø	**N**/R
	Beach nourishment	**R***	Ø	**N*/R***	**N**/R
Marine navigation and facilities	Inlet navigation channels	Ø	Ø	Ø	Ø
	Public Docks	Ø	Ø	Ø	Ø
	Luxury settlement with pier	Ø	Ø	Ø	Ø
	Sun and beach tourism with pier	Ø	R	Ø	Ø
	Deepwater ports without shelter	N*/R*	N	N/R	**N**
	Shallow water ports without shelter	N*/R*	N	Ø	R
	Sheltered ports	N*/R*	N	N/R	**N**
	Fishing ports	Ø	N	N/R	**N**
	Naval military installations	Ø	Ø	Ø	Ø
	Internal Maritime Transport	N*/R*	Ø	N/R	Ø
	Marinas	N*/R*	N	Ø	Ø
	Cruise tourism	N	Ø	Ø	Ø
Linear infrastructure	Roads, double roads, highways, bridges	N/R*	R	N*/R*	**N**/R
	Railways and facilities	N/R*	R	N*/R*	**N**/R
	Tunnels	Ø	Ø	Ø	**N**/R
	Airports and runways	N*/R*	N	N*/R*	**N**/R
	Electric lines and facilities	N*/R*	R	N*/R*	**N**/R
	Basic sanitation pipes	N*/R*	R	N*/R*	Ø
	Conduction of fluids through pipelines	N*/R*	N	N*/R*	**N**
Basic sanitation facilities	Desalination plants	Ø	Ø	N*/R*	Ø
	Solid waste exploitation and disposal	R*	R	N*/R*	**R**
	Submarine emissary	Ø	Ø	Ø	Ø
	Wastewater treatment plants	R*	Ø	N*/R*	R
Extensive land use and livestock	Farming	R*	N/R	N*/R*	Ø
	Golf course	Ø	N	Ø	Ø
	Mariculture	Ø	N/R	Ø	N/R
	Aquaculture	R*	N/R	N*/R*	N/R
	Thematic parks and camping	R*	Ø	N*/R*	N
Extractive activities	Exploration and mining	N/R*	N/R	N*/R*	**N**/R
	Exploration and extraction of hydrocarbons	N*/R	N	N*/R*	**N**
	Marine dredging	Ø	Ø	N*/R*	**N**/R
	River dredging	Ø	Ø	N*/R*	**N**/R
Drainage basin alterations	Transfer of basins	N/R*	R	N*/R*	**N**/R
	Underground water movement	R	Ø	N*/R*	Ø
	Irrigation districts operation	R*	R	N*/R*	**N**/R
	Changes in land use	Ø	R	N*/R*	Ø
	Modification of channels	Ø	Ø	N*/R*	**N**/R
	Dams and reservoirs	N/R	R	N*/R*	**N**/R
	Installations in fluvial causes	Ø	Ø	N*/R*	N/R
	Hydroelectric terminals	N/R*	Ø	N*/R*	R
Industrial and energy installations	Offshore platforms	Ø	Ø	N*/R*	Ø
	Geothermal plants	N	Ø	Ø	N/R
	Wind power plants	N/R*	Ø	N*/R*	**N**/R
	Solar energy plants	Ø	Ø	N*/R*	Ø
	Transformation and storage of fossil fuel	N/R*	N/R	N*/R*	**N**
	Manufacture	N/R*	N/R	N*/R*	**N**/R
	Geological storage	N*/R	Ø	N*/R*	Ø
	Thermoelectric plants	N*/R	N/R	N/R	**N**/R
Σ Interventions under either competence for EIA		21	7	41	24
Σ Interventions under national competence for EIA		2	9	–	7
Σ Interventions under regional competence for EIA		15	12	–	4
Σ Interventions of non-compulsory national EIA		36	43	18	28
Σ Interventions of non-compulsory regional EIA		23	40	18	31
Σ Interventions subject to national screening		13	–	35	–
Σ Interventions subject to regional screening		30	–	35	–

IT = Italy; CU = Cuba; SP = Spain; CO = Colombia; N = national competence; R = regional competence; Ø = not licensing required. * = Project subject to a screening for the national or regional competence; bold letters mean interventions with ToR or guidelines.

and procedure complexity indicated in the legal codes. The structure of coastal uses and activities proposed by Botero et al. (2014) was adapted to categorize the main types of projects that can be emplaced on the coastal zone or can influence coastal processes even outside the shoreline (i.e. River basin). The distinction between the national and regional competence of environmental licensing depends on certain characteristics of the project or activity. Therefore, Table 1 marks the shared competence with the letters representing both national and regional, and differentiates the screening stage with the asterisk on the corresponding competence. As an example in Italy, the type of intervention "thermoelectric plants", included in the annexes of the Italian Decree 104/2017, reveals that thermal plants with total power higher than 300 MW are subject to national competence. Meanwhile, plants with total power between 300 and 150 MW go under regional competence, and those between 150 and 50 MW follow a national screening.

Total sums in Table 1 show that 36% (n = 21) of coastal interventions undergo an ELP at a national or regional level in Italy, while another 36% are not under compulsory EIA or must follow an EIA by either competence exclusively (29%; n = 17). Regarding Cuba, 12% (n = 7) of interventions can be processed at a national or regional level, while the 36% (n = 21) must undergo an ELP exclusively under one competence, being the majority at the regional level. The Spanish regulation makes no explicit distinction regarding competence level because such distribution depends on the sectoral body that confers the utmost authorization; therefore, 69% (n = 41) of intervention are considered under national or regional competence, while the remaining 31% (n = 18) are exempt of ELP. Lastly, Colombia sums 41% (n = 24) of interventions regulated by either national or regional level, whereas 19% (n = 11) are subject to an exclusive competence, being the majority at the national level; the remaining 40% (n = 24) are exempt from environmental licensing. Briefly put, Spain has the highest percentage of types of interventions under the ELP, closely followed by Italy and Colombia, while Cuba presents the highest proportion of projects or activities exempt from ELP.

An additional analysis regards the coverage given by the EIA regulations within gross categories of coastal interventions. Percentages pictured in Fig. 2 refer to the portion of interventions subject to ELP by category in each country. This means, for example, that three out of a total of six types of interventions in the category of *Edifications* are subject to environmental licensing in Italy, comprising coverage of

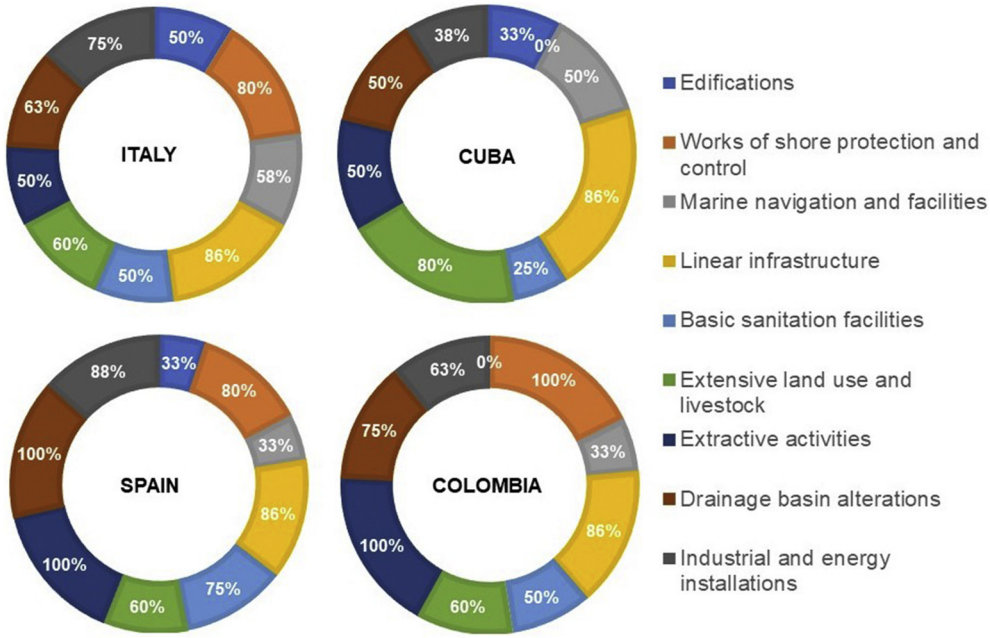

Fig. 2. Proportion of interventions with an effect on the coastal zone by country and category.

50%. In the same category, Cuba and Spain each equal 33% of the interventions regulated, all sharing the typology of 'sun and beach tourism' with Italy. Such projects in particular are associated with important impacts on the coastal zone, especially when poor land planning is also reported (Davenport and Davenport, 2006; Burak et al., 2004; Jennings, 2004). On the other hand, Colombia makes no direct mention of these types of edifications, despite the increasing amount of real estate developments and resorts along the Caribbean Coast in the last years (Cochero and Manjarrez, 2014; Rangel-Buitrago et al., 2012). It is worth mentioning that Spain and Italy present differences even though they both transposed the same EU directives, meanwhile Colombia and Cuba are similar despite holding different political ideologies.

The category of interventions about *shore protection and control* presents the highest regulation coverage in Colombia, the second highest in Italy and the third highest in Spain. This great level of awareness is consistent with the extensive lists of impacts (such as coastal armoring, intensification of erosion processes or deterioration of coastal scenery) associated with such interventions, (Pranzini et al., 2015; Rangel-Buitrago et al., 2017). Meanwhile, Cuba includes none of this intervention in their environmental licensing framework, since shore protection structures are considered environmental contraventions (Law 200/1999). Moreover, Cuba is the only country that includes golf courses in the ELP, which are common interventions in coastal areas, also linked to sea, sand and sun tourism.

On the other hand, interventions in the category of *extractive activities* are included in all four countries, and their influence on coastal processes is when they trigger subsidence trends (Morton and Pieper, 1977). Regarding the category of *drainage basin alterations*, Spain is the one with full coverage, followed in order by Colombia (75%), Italy (63%) and Cuba (50%). Although interventions in this category tend to be geographically far from the coastal zone, they matter due to the link of physical processes modeling watersheds. Finally, the category of *industrial/energy installations* is also barely associated with effects in the coastal zone unless the intervention is emplaced directly in this environment, which is a very probable situation. Their coverage in the EIA regulation of Italy, Spain and Colombia is above 50%, while Cuba is below this threshold.

3.3. Criteria for characterization of the coastal environment

Perhaps one of the major decisions within the environmental licensing is to define which criteria must be used to characterize the natural system. Stemming from the review of the regulatory framework and technical guidelines for EIS preparation, a detailed categorization of criteria influencing processes linked with coastal morphology was done, and several findings were extracted and represented in Fig. 3. Appendix V gathers the resulting categorization in the four territories with reference to the guidelines reviewed in each one. Some criteria may be found in more than one process because criteria description and reference to their controlling mechanisms often relates to several kinds of processes. Cuba is not included in the comparison because, unlike the other countries, environmental authorities have not formulated or adopted official guidelines for EIS preparation. Additionally, the Italian region of Liguria was included in the analysis as a separate territory since their own guidelines are different from the ones adopted by the national authority. This was not the case for the other two Italian regions interviewed (Emilia-Romagna and Tuscany), whose authorities refer to the same national guidelines prepared by ISPRA,[1] the technical and scientific advisor of the Italian Ministry of Environment regarding EIA competences.

Initially, three processes related to hydrodynamic controls (erosion, deposition and sediment transport) present the highest frequency of references within reviewed documents, mostly due to the bias of the guidelines. Documents selected for analysis focus on projects or activities linked to shore protection structures and marine works, therefore the studies lean on the stability of littoral sediments. The processes that follow in frequency are biogenic sediment fixation and the geomorphological sediment output; the latter is linked to sediment losses from the littoral balance such as submarine canyons or channels (Pranzini, 2008; Correa et al., 2005). Criteria sorted by these two processes also stress controlling mechanisms for the stability of littoral sediment, which is the utmost purpose of the interventions for which the analyzed EIS guidelines are formulated.

Processes related to physical/chemical courses (sediment formation and weathering) and global climatic phenomena (sea level changes)

[1] Italian acronym of the Higher Institute for Environmental Protection and Research

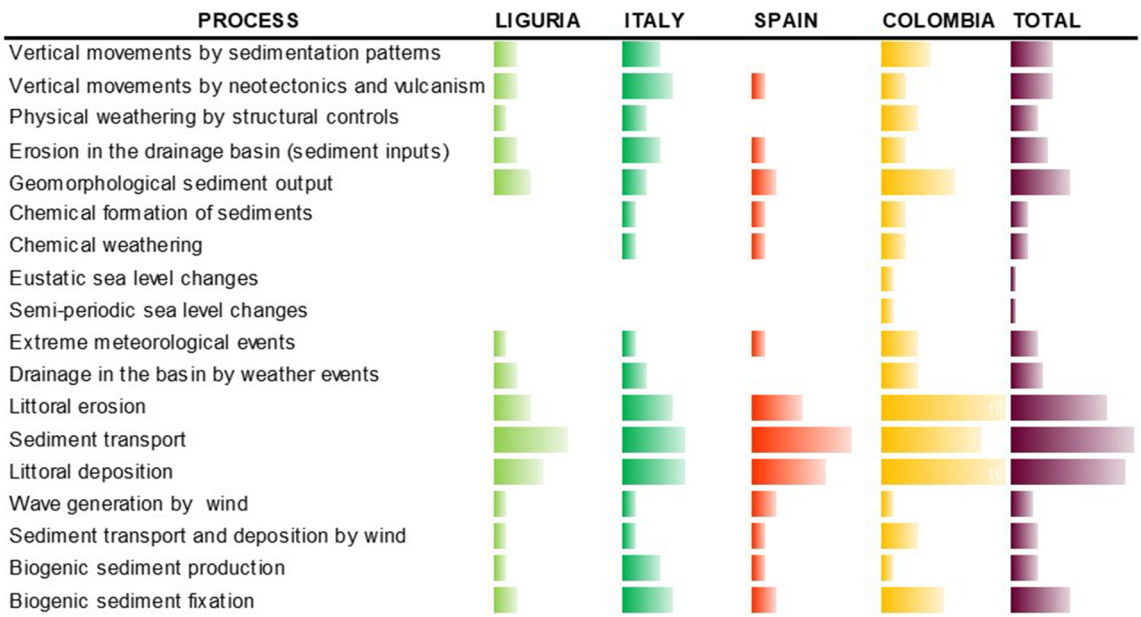

Fig. 3. Frequency of technical requirements for the EIS preparation of coastal protection works by territory according to a scheme of natural processes influencing coastal morphology.

present the lowest frequencies. The pattern in the former group can be attributed to limited scientific and technical knowledge regarding transformation rates and measurement techniques in the coastal context (Rivas et al., 1997). This situation evidences a need to address applied research about the influence of natural processes on coastal dynamic for EIA purposes. On the contrary, the low frequency of the latter group of criteria is owing to the local character of EIA, in which global phenomena are left in the background because they transcend the context of the influence area (Hapuarachchi et al., 2016). This situation reflects an additional mistaken approach where the EIA dismisses global scale phenomena because the impact of projects lacks magnitude and intensity at this gross observation level. However, the relevance of global processes relies on the environment-project relationship, rather than project-environment, as a good precautionary EIA practice involves the management of risks to which the intervention would be naturally exposed (Cavallin et al., 1994; Joseph et al., 2015). Nevertheless, coverage of processes influencing coastal morphology is different in each territory, being Colombia the only one with the highest number in all criteria. Spain presents the lowest coverage missing 28% of the processes, followed by Liguria with 22% of its processes disregarded, while Italy only misses 2 (11%) within the technical criteria considered.

An additional element worth mentioning is the Italian document '*Guidelines for the Preparation of the Environmental Monitoring Project (PMA) for Works Subject to EIA Procedures*' (ISPRA, 2015), in which references are systematically given to orientate the sampling of technical criteria for environmental monitoring at different project timings: before (characterization of the environment), during and after (operation). Most of the criteria proposed in this document are described according to the minimum lapse of observation, spatial coverage and suggested techniques. This is the only document of its kind within the guidelines found among the four countries analyzed; no other official document of ToR gives such a level of technical detail to orientate the environment characterization and monitoring.

4. Good practices for environmental licensing of coastal interventions

Good practices were extracted from the systematic analysis of similarities and differences among the four countries and further contrasted with acknowledged international good practices. As stated in the introduction, Morgan (2017) was the main reference for good EIA practices, complemented by Joseph et al. (2015), who reviewed existing literature on the best practices of environmental assessment, synthesized guidance from additional relevant literature in other fields and identified 74 good EIA practices. The following seven good practices are filtered from this catalog, according to the experiences of the four countries and how such experiences highlight the practices that favor the specificity of the coastal environment along the ELP.

4.1. The integration of screening and scoping stages within the ELP

According to Joseph et al. (2015), screening and scoping improve the quality of the EIS and latter stages of environmental assessment and decision making. As an example, Guerra et al. (2015) reported the integration of the screening and scoping stages within 12 case studies of interventions in the marine environment of eight countries. Italy and Spain integrate the screening through the lists of projects subject to these pre-assessments because it is transposed by the EIA European Directives, whereas Colombia disregards this initial review at any level (Bassi et al., 2012; Fuentes-Bargues, 2014). Even if Cuba does not have a distinction of interventions subject to screening, this stage can be considered embedded in an advanced stage of the EIA procedure rather than a preliminary review. The requirement of an extended EIS from the environmental authority, when the area of interest has not been previously characterized by other projects or activities, is a way to impose a detailed review for potentially acceptable interventions in Cuba.

Still, effective screening requires thresholds and criteria, in addition to a list of activities, to determine if an intervention needs to be evaluated (Jay et al., 2007; Wood, 2003). A good EIA practice relying on Earth Science can be inspired by the European model. Both Italy and Spain singularize coastal zones and wetlands into the specific areas that represent a sensitive location for intended projects; therefore, this may account for detailed scrutiny according to the EIA regulation. The amendment of the EIA Directive of 2014 has complemented this geographical approach with riparian areas, river mouth and marine environments (Lonsdale et al., 2017). Such precisions insinuate the need for defining the susceptibility of such specific environments to the effect of human interventions, by considering the particularities of their physical-natural processes.

Additionally, Section 3.1 marked the public involvement as a good practice when setting criteria and relevant issues for the EIS elaboration, which comprehend the scoping stage. It has been proven that early consultations with the public improve the quality of EIS's because proponents can identify all potentially impacted receptors and collect information about the local environment (Barker and Wood, 1999; Lonsdale et al., 2017; Del Furia and Wallace-Jones, 2000). Furthermore, residents of coastal areas treasure empirical knowledge about the hydrodynamics and long-term processes modeling the zone where they have lived for decades, as highlighted by Correa and Gonzalez (2000). Therefore, local communities' observations could orientate the environment characterization and possible forecasting by highlighting the more pertinent elements for the impact assessment.

In consequence, Spain and Italy include a public information procedure to collect observations and complaints from the individuals affected before approving any environmental license and especially for defining the level of detail required in the assessment (Bassi et al., 2012; Enríquez-de-Salamanca et al., 2016). On the other hand, Cuba and Colombia do not prioritize public consultation in the scoping process because the former relies on the concept of public administrations, and the latter backs on terms of reference, which is the most explicit definition of scoping (Joseph et al., 2015).

4.2. Evaluation focused on the environment rather than the intervention

The analysis in Section 3.2 stresses that EIA procedures should be aligned by the type of environment affected (rather than the type of intervention to be developed), and this is partially reinforced in some of the regulatory frameworks studied. Among the four countries, Cuba is the only one that makes real distinctions about the kind of environment where an intervention is projected. In brief, Article 19 of Decree-Law 212/2000 establishes that projects and activities within the coastal and protection zones undergo compulsory environmental licensing. More specifically, within the list of interventions subject to environmental licensing in resolution 33/2015, three statements specified restrictions defined by the coastal environment rather than the characteristic of the intervention itself. As an example, permanent facilities in cays (a coastal environment) are always subject to environmental licensing, as well as any facilities located in their protection zone.

Allusions to the location in the regulatory framework of Italy and Colombia, related to natural protected areas rather than the kind of intervention, already exist. However, such precision does not detail the coastal zone context because it comprises natural parks in Colombia, be it marine or terrestrial, and indistinctive sites of interest for the European Community according to the Habitats Directive (92/43/EEC). On the other hand, within the criteria conceived for the screening procedure in Italy and Spain, specific attention is given to the carrying capacity of some marine and coastal environments, although there is no methodological reference for such estimation. Loro et al., (2014) developed a method for estimating territorial carrying capacity in the context of EIA; however, it is not specific for coastal environments. In the main, it is worth highlighting that the emplacement of projects in coastal environments increases the magnitude of the environmental assessment regardless of the characteristics of the intervention within European procedures.

4.3. The inclusion of the coastal zone delimitation in the environmental licensing

An important activity in the generic impact assessment is related with the definition of the projects' influence area because this is the geographical limits of the measurements for characterizing the environment, estimating the effects of the intervention and implementing the environmental monitoring program (MAVDT, 2010). In consequence, consideration of coastal dynamic principles in the definition of the intervention's influence area could be considered a good practice based on Earth Sciences. Despite the lack of uniformity for setting coastal boundaries within countries (Milanes, 2018), the schemes of Cuba and Liguria can work as technical bases for defining the influence area of an intervention in the coastal zone. Both systems have a complementary effect since they address the cross-shore and longshore delimitations of coastal segments respectively. Colombia is the only country that specifies influence area delimitation in their ToR, requiring an iterative exercise for adjusting the final influence area from preliminary definitions segmented by the group of components (biotic, abiotic, socioeconomic). However, technical criteria specific to coastal environments are not detailed in the Colombian EIA guidelines.

Spain and Italy define the coastal zone from the boundaries of the maritime public domain, which correspond to the land portion shaped by marine action (Lami et al., 2010). Overall, both European countries make these boundaries known to the public, while the public domain delimitation and acknowledgment in Colombia are restricted to the National Maritime Authority (DIMAR by its acronym in Spanish). In Cuba, criteria for the limits of coastal and protection zones are set in Decree-Law 212/2000, according to coastal geomorphological features (dune, lagoon, swamp, cliff or river mouth) and hydrodynamic trends (riverine tidal influence and historic sea-flooding). In this sense, Cuba sets a technical reference for framing the reach of the impact of human interventions in the coastal zone. However, it is insufficient because the limits offshore are too wide for impact assessment purposes since they set it as the insular platform (usually 100 to 200 m. water depth). In this regard, the local experience of the Liguria Region represents both the technical complement of delimitation criteria and the example of practice in ELP. Liguria has sectorized its coast to support the environmental licensing of coastal protection works by setting three levels of longshore delimitation: physiographic units, intermediate units (*paraggio*) and littoral cells. When the EIS is elaborated or reviewed, the Coastal Marine Environment Protection Plan is a binding reference that defines all physiographic units, *paraggio* and littoral cells, which are also mapped and costless available online.

Finally, EIS preparation guidelines for coastal defense works and sand nourishment in Liguria and Colombia requires the framing of the intervention within similar analysis units, such as watersheds, littoral or coastal cells, environmental coastal units, ecosystems or territorial units. The advantage in the Liguria Region is the availability of a predefined coastal delimitation considered for EIA procedures, which can be configured as a relevant good practice in Earth Sciences. The Emilia-Romagna Region also has a pre-defined delimitation of littoral cells, established in a robust program for managing shore erosion; however, this information system is not binding in the EIA procedure (Montanari and Marasmi, 2014). All in all, the described practices of Liguria Region and Cuba poses good references on how technical criteria, scientifically proven, are introduced in the regulation that orient EIA procedure.

4.4. The institutional articulation in the ELP

The ability of organizations involved in the environmental licensing to achieve their interests and objectives largely determines the performance of the EIA (Kolhoff et al., 2018). Therefore, the articulation of the institutions involved in consulting procedures contributes to an integrated assessment and control of human perturbations in the environments. The fragmented approach conventionally used for characterizing the environment and assessing the impacts implies a competence distribution among several agencies and institutions involved in the components of soil, water, atmosphere, biota and society. If the environmental impact evaluation, monitoring and control are not coordinated by type of environments (i.e. coasts, highlands, continental water, submarine, fluvial), institutions in charge of each environmental component must be represented in the EIA procedure. Among the four countries analyzed, the institutional articulation has proven important in the stages of screening, scoping and follow-up.

Section 3.1. signalized that all the four countries conduct

consultations with public administrations during the initial stages of the EIA procedure; the institutions considered in each country are listed in appendix IV. It is interesting to notice that only Cuba and Spain specify a list of institutions whose consultation is compulsory, according to their EIA legal code, being the former the longer of the two. The character of compulsory institutions in Cuba suggests that consultancies mainly verify technical viability and sufficiency of existing facilities to absorb the demand of a new activity in terms of supplies, human health, security and risk management. In Spain, half of the compulsory agencies are responsible for the management of hydraulic, terrestrial and maritime domains, which favors the coastal zone. Concerning Colombia, mandatory institutions to consult during EIA are not established, although this country has a pool of organizations that could be involved in such procedures within the National Environmental System (SINA by its acronym in Spanish). SINA comprehends five scientific institutions, one of them with special relevance to marine and coastal environments.

Institutional articulation may also optimize environmental licensing through the verification of the environmental compliance reports of licensed projects. This means that the assessment of management measures and its monitoring programs is distributed among the entities involved in the consultation procedures instead of only being reviewed by the environmental authority. This is the case of the cooperative surveillance in the Cuban system. It also happens in the Italian system, where the project executor presents the evidence of environmental prescription directly to the institutions assigned in the license for the verification. This mechanism ensures that the most suitable technical staff review the outcomes of the parameters assessed, because every institution masters their specialties (biodiversity conservation, maritime domain, water supply, sanitary pollution, geological hazards). At the same time this implies a challenge in terms of integration of an environmental compliance judgment, because the concepts are spread among the entities consulted; therefore, a higher level of coordination and awareness of institutional competences is required. As a second positive side, this practice overcomes the limitations that technical staffs of environmental authorities usually have when facing the follow-up of interventions in a variety of environments.

4.5. Accreditation of environmental consultancies for conducting EIS

Consultants have a key role in good EIA practices as they hold the most practical knowledge, and because they also face the challenge of maintaining good relationships with their clients and at the same time a good professional reputation (Kågström, 2016). Therefore, accredited impact assessment staff is a legal and procedural incentive, considered to be a good practice because it ensures accurate and high-quality assessment without bias (Joseph et al., 2015). Within the four countries analyzed, Cuba is the only one where consultants in charge of EIS elaboration are periodically certified by the Ministry of Science, Technology and Environment (Chapter VII of Resolution 132/2009). This is a meritocratic certification, rather than merely procedural, since it is supported by scientific requirements and selective experience.

During the accrediting application in Cuba, consultancies need to submit a list of projects or activities, for which the entity is considered competent, and demonstrate experience in the field of environmental sciences. Evidence of such requirements is post-graduate courses taught and/or scientific publications made by the consultant team. Another requirement relevant to this argument is the demonstration of technical potential for EIS elaboration through the list of duly qualified specialists employed for carrying out these studies. In this regard, Italy and Spain limit the EIS assessment and review to competent experts, which should force authorities to have sufficient expertise in projects and environments under licensing (Lonsdale et al., 2017). In the main, EIA analysis in Italy, Spain and Colombia focus on the limitations and challenges of environmental authorities for controlling EIS quality, while Cuba addresses the issue by certifying consultancies with standards of scientific-technical support and selective experience.

Therefore, ensuring the aptitude of experts preparing the EIS of coastal interventions through a certification could be considered a good practice in which Earth Sciences are relevant. Moreover, such aptitude needs to rely on the scientific and practical experience of the consultancy in the particularities of the coastal environment and its natural processes. In this regard, the Cuban experience encourages a solid articulation of cutting-edge scientific knowledge with the ELP.

4.6. Pertinent official guidelines for sensitive EIA stages according to types of environments

The most sensitive EIA stage requiring orientation is the EIS elaboration. Guidelines in this stage are important because they set the pillars for characterizing a perturbed environment and defining the coverage of the impacts. Additionally, guidelines allow the impact valuation to be normalized with other interventions in the area through a validated assessment methodology; but they also participate in the design of the management plan through the definition of follow-up parameters. Thus, the availability of comprehensive guidelines for applying impact assessment methods has been considered a good EIA practice in other studies (Joseph et al., 2015). Among the countries analyzed, Cuba is the only one without guidelines, having only the indications about the EIS content in Chapter III of Resolution 132/2009. However, in all four countries, this legal indication concerns the structure of the document rather than details about characterizing the environment, methodologies for defining the influence area and evaluating impacts, or parameters for monitoring (Toro et al., 2010; Bell et al., 2017). Regarding the structure of the EIS content, some differences among countries have been found. For instance, the Spanish framework is still missing the element of risk management, whereas the amended EIA directive (2014/52/EU) and the other three countries include the risk to accidents, disasters and climate change in the assessment and decision making.

Colombia stands out in terms of quantity of guidelines because up to 2017 the ministry of environment has published three manuals for the institutional EIA procedure (MMA and SECAB, 2002a; MMA and SECAB, 2002b; MAVDT, 2010) and another 40 ToR for environmental studies of projects and activities. Although the guidelines analyzed in Section 3.3. were downloaded from the website of the ministries of environment of Colombia, Italy, Spain and the Liguria Region, it was not verified precisely how extensive is the list of guidelines in Spain and Italy because these documents are not gathered in a single repository, as the national environmental licensing authority of Colombia do (ANLA, 2017). Despite of this, Section 3.3 already revealed that EIS guidelines in Colombia are exhaustive because they include a very extensive list of information requirements. However, such exhaustiveness may lead to redundancies due to the conventional segmentation of criteria by components rather than processes. Therefore, this cannot be considered entirely as a good EIA practice for coastal interventions because management principles stress that it is better to be more pertinent than exhaustive (Vallega, 1999).

Another sensitive stage in the environmental licensing linked to official guidelines relates to the follow-up, despite being conceived during the EIS preparation. Drafting monitoring programs to verify the environmental compliance is a constant recommendation for ELP, which should be legitimated in legislation and guidelines to scope the follow-up (Bassi et al., 2012; Elliott, 2011). In this regard, Italy is the only country that fulfills this good practice because it establishes standard survey, monitoring methods and interpretation references, as suggested by Lonsdale et al. (2017). While Liguria has criteria for monitoring shore protection works and periodical beach nourishment at the regional level, the guideline of ISPRA (2015) applies for any kind of intervention because it is structured by environmental components or ambits. The structure of this last national guideline defines specific methodological indications for six ambits and a list of parameters that

can be used in the monitoring program according to the purpose of the follow-up stage. In summary, these criteria are the closest experience resembling the good practice of focusing EIA guidelines on the kind of environment rather than the type of intervention.

4.7. The integration of environmental geographic information

Another good EIA practice, normally associated with the follow-up stage, is recording the outputs of monitoring activities for future environmental assessment and implementing data management platforms for this purpose (Joseph et al., 2015; Bassi et al., 2012). EIA practitioners in the four countries analyzed use information services for characterizing the environment during the EIS preparation and, possibly, as data supply for the monitoring program. Still, authentic good practices in Earth Sciences resemble the data model enforced in Colombia for presenting the geographical information of projects along the ELP.

Of the four countries, Colombia has the most advanced environmental information system through the National Geographic Environmental Data Storage Model, created and updated by the National Agency of Environmental Licensing (ANLA) since 2012 (Resolution 1415/2012; Resolution 0188/2013; Resolution 2182/2016). Such integration of the information has allowed the implementation of a strategy for estimating the synergic effect of interventions with overlapping influence areas, called *Regionalization* (Solarte, 2017). Geographic products and services derived from this strategy are still restricted to the internal staff of the environmental authorities, aiming to support decision making and optimizing EIA procedures. Despite these advantages, the data storage model is not sufficient for coastal environments because the attributes established in the structure do not address current information gaps in the marine-coastal context. For example, less than 10% of the feature class in the data structure is gathered in two data sets under the names of *Biotic-Continental-Coastal* and *Marine*. This reflects Colombia's ongoing need for a better understanding of coastal processes in EIA procedures for pinpointing the complex dynamic of the land-sea interphase.

In the cases of Spain, Italy and Cuba, the integration of environmental information for EIA purposes exhibits only initial levels of implementation. At European level, the Inspire Directive (2007/2/EC) aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies. However, the interviews in Italy and Spain reported no protocol of spatial data validation or integration within this directive, which indicates that its institutionalization has not penetrated effectively into the local environmental management level. In Spain, EIA representatives mentioned the existence of a geographic information system where many layers are compiled, however, only environmental authorities can consult it and the specificity in marine and coastal issues is cataloged as poor. In Italy, the 21 regional environmental protection agencies (ARPA/APPA) and ISPRA are configuring a network to integrate the monitoring and control of environmental quality within the Italian territory. This National System for Environmental Protection (SNPA by its acronym in Italian) was created as an attempt to recover the control and homogeneity of what is done in every region. Finally, EIA practitioners in Cuba can only consult isolated information that has not been synthesized due to an incomplete database. However, the office of the Ministry of Environment in the Matanzas Region is testing a computerized system, called *SARGAE*, designed to systematize the environmental information and obligations of projects in situ. The program would generate a report with the environmental diagnostic, which in the future will be linked to the information system of the competent environmental authority.

5. Conclusions

Four countries have been compared for the first time according to EIA best practices and their application in their respective environmental licensing on the coastal zone. As an innovative approach, the comparison included ToR and guidelines, apart from the EIA legal code of each country, because studies so far have only concentrated on EIS and legal approaches. The main findings regard the identification of strengths and shortcomings of Italian, Cuban, Spanish and Colombian ELP. According to critical interventions and pertinent criteria for characterizing processes influencing the coastal morphology, a set of seven good practices were conceptualized.

The study enhances the importance of technical criteria in defining coastal boundaries to scope environmental impacts and gauge the effect of interventions on natural processes. These suggest a changing approach in the way impact assessment is performed, by shifting from a fragmented-oriented analysis with environmental components to a process-oriented analysis of natural flows within a kind of environment and its neighboring connections. In this sense, geomorphological processes play a core role in identifying, assessing and monitoring the influence of human interventions on coastal environments.

Improvements that might be redressed by implementing the suggested good EIA practices include the provision of official methodological guidelines for EIS elaboration, articulation of EIA information systems and accreditation of environmental consultants to homogenize good practices in Earth sciences for the Italian procedure. In Cuba, the provision of official methodological guidelines for EIS, articulation of information systems for EIA procedures and the proactive participation of the public within the scoping and screening stages are suggested. On the other hand, Spain could improve the availability of official methodological guidelines for EIS elaboration, articulation of information systems for EIA procedures, criteria definition for influence area and accreditation of environmental consultants. Lastly, Colombia needs to improve the ELP by integrating a screening stage, binding the coastal delimitation for scoping the influence area of interventions, accrediting environmental consultants and articulating institutions during the follow-up.

In consequence, a new perspective with respect to the conventional environmental licensing scheme is suggested. Procedures and guidelines must be oriented by types of environments rather than types of interventions because the characteristics of impacts are better correlated to natural processes than to project design. In the end, these designs are adaptable, while natural processes are inherent to the kind of environment. In addition, geomorphological processes present engineering challenges to the human interventions, in terms of risk management, and frame the character of the environmental impact.

All in all, the seven good practices defined in this study are recommended as principles to homologate the environmental licensing of interventions with influence in the coastal zone. Further research should be done around the definition of coastal susceptibility to the effect of human interventions and its articulation with territorial planning instruments; it will greatly optimize the environmental assessment, monitoring and control of projects, built structures and activities. Moreover, methodological approaches for estimating territorial carrying capacity of human intervention in the coastal zone shall be investigated, with the goal of complementing the assessment stage during ELP.

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Appendix A. Supplementary data

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