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Editorial

Coastal Dynamic and Evolution: Case Studies from Different Sites around the World

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Received: 4 October 2020; Accepted: 9 October 2020; Published: 12 October 2020

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Abstract: In recent decades, coastal areas have experienced a progressive increase in erosion and flooding processes as a consequence of the combined effect of natural factors and strong human pressures. These processes are particularly evident on low-lying areas and are expected to be exacerbated by the ongoing climate change, which will impact the littorals both in the short term, by affecting the duration and frequency of storms, and in the long term, by inducing variation in the sea-level position. In this context, this Special Issue is devoted to collecting geomorphological studies on coastal dynamic and evolution by means of multidisciplinary research methodologies and investigations, which represent a very useful set of information for supporting the integrated management of coastal zone. The volume includes 14 papers addressing three main topics (i) shoreline characterization, dynamic and evaluation; (ii) coastal hazard evaluation and impact assessment of marine events; and (iii) relevance of sediment collection and analysis for beach nourishment. Case studies from Russia, Italy, California (USA), Morocco, Spain, Indonesia, Ireland and Colombia are shown in the Special Issue, giving to the reader a wide overview of coastal settings and methodological approaches.

Keywords: coastal dynamics; coastal landscapes; coastal evolution assessment

1. Introduction

The present-day coastal landscape is essentially the result of the interaction among different factors, including the geological frame as well as continental and marine factors. The geological frame includes stratigraphic and tectonic assets of an area and usually determines the formation of cliffed coastlines or low coastal plains. Coastal plains show different landforms whose formation and evolution is strongly linked to continental and marine factors as sediment supplies from the land (e.g., streams and rivers) and the ocean (due to marine and aeolic processes), and the destructive action of marine energetic factors such as waves and currents. In the long term, sea level position variations acquire great importance in landscape formation and evolution [1,2]. As a result of the above-mentioned processes and factors, the coastal area shows a great variety of morphological forms ([1,3] Figure 1).

Furthermore, the coast, because of its location at the interface between land and water, represents the transitional zone between aquatic and terrestrial ecosystems and hence presents an intrinsic environmental value due to its high level of biodiversity that, at many places (e.g., at coastal areas with mangrove swamps and dune areas), supports the provision of several ecosystem services and related functions essential for human well-being too [4,5]. Last, coastal area represents a zone for recreational, cultural and industrial activities [6]. Hence, since ancient times, the coastal zone was characterized by a very high human occupation and, at present, coastal areas have become more densely populated than the hinterland and exhibit higher rates of population growth and urbanisation. Various studies estimated the population living in the coastal zone, and the most recent data show that about 10% of the world's population (ca. 600 million people) lives in low elevated coastal areas [7] and, according to Neumann et al. [8], this trend is expected to increase. Specifically, in their study [8], projections for coastal population densities under different economic and development scenarios for the year 2030 and 2060 were evaluated and then compared with the population abundance in 2000. The mentioned study also predicted that, under the "worst conditions" scenario characterized by low political governance and high global economic growth, an increase in population from 625 million (in 2000) up to 949 and 1388.2 million people could be expected in 2030 and 2060, respectively. In view of the high social, economic, and natural characteristics and related benefits, the sustainable conservation of coastal areas, as well as their integrated coastal management, are a worldwide issue [9]. To these aims, the 2030 Agenda for Sustainable Development defined, among the newly established 17 Sustainable Development Goals (SDGs), a specific one on the conservation and sustainable use of the oceans, seas and marine resources (SDG 14) [10]. Two specific targets of this goal (14.21 and 14.52) are devoted to address coastal areas and related ecosystems. Further targets under SDG 14 as well as targets under other goals, though not explicitly referred to coastal areas, are implicitly relevant for coastal areas and for the protection, conservation and management of coastal ecosystems and resources [9]. In this context, a crucial role is played by sensitivity/vulnerability and risk analysis studies, which allow for the evaluation of coastal proneness to hazardous processes such as erosion, flooding, and submersion, as well as potential coastal resilience capacity at global [11–13], regional [14–18] and local [19–24] levels. A key element in the risk evaluation procedure is represented by the assessment and damage evaluation of the natural and anthropic assets located in the areas prone to be affected by marine processes.

Figure 1. Examples of common coastal landforms. Source: authors.

2. Coastal Dynamic and Response Modalities

The strong link between forms and processes is the main characteristic of the coastal morpho-dynamic system [25]. As already introduced, the evolution of a sandy coastline is a function of highly dynamic processes acting at different spatial and temporal scales. Concerning coastal processes that occur at small scales, as in the case of storms, they generally result in rapid erosion (at a time scale of hours/days), followed by accretion that usually takes place during weeks and months, leading to negligible net change over time scales of a few months or at an annual scale [11]. Coastal changes due to the impact of hurricanes are also rapid, but recovery can take a long time, e.g., years [26]. On the contrary, if a consistent reduction of sediment supply occurs and persists for several years (i.e., at a medium-term time scale), chronic erosion processes are triggered, with consequent negative impacts on natural and anthropic assets (Figure 2). It is worth noting that, in recent times, coasts are particularly exposed to the consequences of intense erosion process mainly induced by human-related activities, both along the littoral and inland in the main watershed, which represents an additional pressure on the natural occurrence of the erosion process. Anthropic structures built along the shores of the world age back to ancient times and include different kinds of structures, such as harbours, breakwaters, and fish tanks. Nowadays, they are widely used as geo-archaeological proxies for measuring relative sea-level variations and coastal landscape evolution during the mid-late Holocene [27–31]. In more recent years, anthropic structures are mainly represented by engineering structures aimed at protecting coastal assets (both natural and anthropic) from erosion and flooding processes. Too often, these structures have generated increasing erosion processes in the adjacent zones, moving downdrift the problem without solving it and the generating causes [32–35].

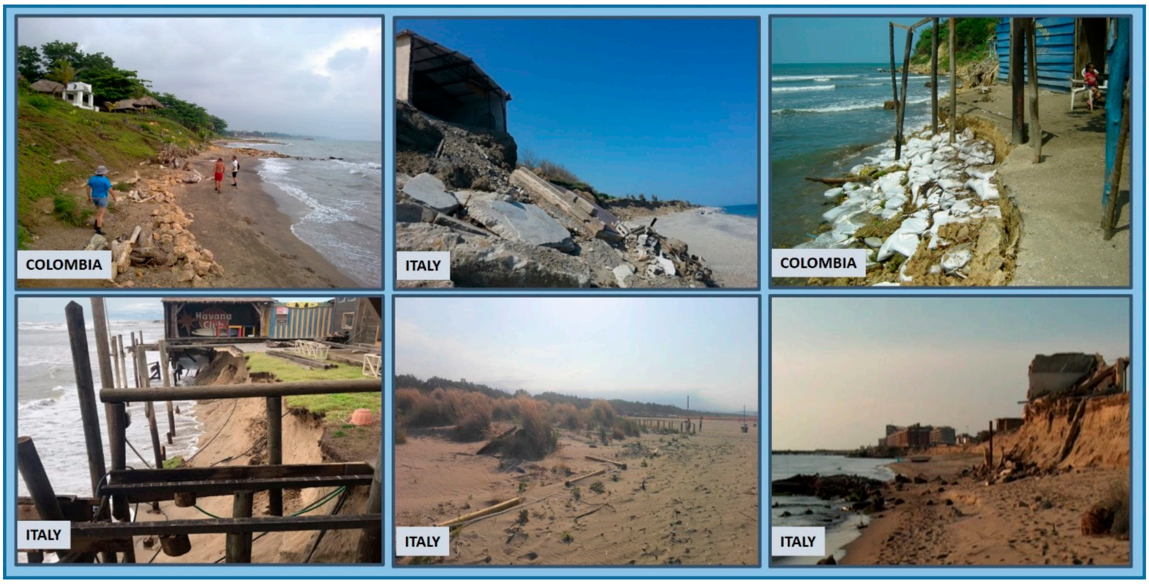

Figure 2. Examples of chronic erosion along low coastal areas in Italy and Colombia. Source: Giorgio Anfuso, Angela Rizzo, Gianluigi Di Paola.

As a result of natural processes and human influences/actuations, coastal areas are facing intense erosion worldwide [11,36,37]. A qualitative study published at the beginning of 1980s [38] provided an assessment of erosion rates for sandy beaches at the global scale. It was estimated that 70% of them are eroding. More recently, Luijendijk et al. [11], based on the available optical satellite images captured since 1984, have provided a quantitative overview of the state of the world's beaches. Twenty-four percent of the world's sandy beaches are eroding at rates exceeding 0.5 m/y, and about 7% of the beaches experience erosion rates that can be classified as severe with rates up to 5 m/y. Furthermore, erosion rates exceed 5 m/y along 4% of the sandy shoreline and are greater than 10 m/y for 2% of the global sandy shoreline.

Concerning changes at large spatial and temporal scales, coastal environments shift landward or seaward as a consequence of marine transgression or regression, which cause the submersion or the emersion of coastal landforms, respectively. Conceptually, different geomorphological coastal responses can be identified as overall consequence to the combined effect of sea level changes and sedimentary processes along low-lying areas: (i) coastal submersion/rapid shoreline retreat is observed when sea level rise rates are very high and it is not balanced by sedimentary processes; (ii) coastal erosion/shoreline retreat is observed when the sea level rise rates are high and sedimentary processes allow the development and the adaptation of the coastal environments; (iii) coastal equilibrium is observed when sedimentary processes balance the sea level rates and the system is characterized by a dynamic equilibrium and (iv) and coastal progradation/shoreline advance is recorded when coastal sedimentary processes prevail on the sea level rise rates. This phenomenon is considered a marine regression.

The variation in the sea level position is not the only impact of climate change. It also affects the frequency, intensity, and persistence of climate extreme processes (such as storms, precipitations, etc.), with consequent impact on the occurrence of intense coastal storms and flood events [39,40], i.e., to favour specific and chronic erosion and flooding processes. A wide set of studies published in recent years are focused on the evaluation of the expected increasing impact in zones prone to be flooded as consequence of the sea level rise [16,20,22,41–43], storm surges [44–48] and their combined occurrence [12,49]. Very recently, global projections of extreme sea levels and resulting episodic coastal flooding over the 21th century have been assessed and mapped in Kirezci et al. [49]. The results of the mentioned paper show that the mean inundated area evaluated accounting for the future sea level is expected to increase in a range of 35–50% by the end of the century compared with the present conditions, while 0.5–0.7% of the world land area will be at risk of episodic coastal flooding by 2100 from a 1 in 100-year return period event, with an increase of 48% compared to present day.

Since the sea level-related hazard is expected to increase as a consequence of future climate scenarios, these analyses are carried out by accounting for future projections of sea positions based on both semi-empirical [50–53] and model-based methods [54,55] that provided global estimations of the expected increases in sea levels under different scenarios of an increase in temperature linked to the increase in the concentration of climate-altering gasses and their representative pathways (RCPs). Nevertheless, in order to obtain a regional estimation of the future sea-level position, the local contribution of land movements due to regional geological processes (tectonics and isostasy) have to be considered too [56,57]. Finally, a very local evaluation is obtained by adding vertical ground displacements mainly due to natural and human subsidence as a consequence of sediment compaction [58,59].

In this context, multidisciplinary research and integrated investigations aimed at the identification and evaluation of the variation of several coastal features—which include the present-day geomorphological, natural and anthropic settings such as the presence of a dune system, the main sediment composition, the recent shoreline trend and the presence of defence structures, as well as the identification of the position of ancient sea-level stands—represent a key step to define the proneness of coastal sectors to potential negative marine impacts and their capacity of coping with them. At the same time, the assessment of future coastal evolution by means of the estimation of future scenarios of sea-level positions in a climate change context can be considered as a way forward regarding the reduction of coastal risks and the definition and implementation of suitable adaptive strategies aimed at increasing the intrinsic resilience of the coastal stretches. This latter aspect is in line with the most recent international requirements and strategies for addressing climate adaptation and risk reduction challenges. At the European level, the Strategy on Adaptation to Climate Change [60], which is aimed at making Europe more resilient and minimising the effects of unavoidable climate change, has stressed the concept that coastal zones are particularly vulnerable to the impact of sea-level rise, challenging the climate resilience and adaptive capacity of coastal societies.

3. Overview of this Special Issue

This Special Issue is intended at providing a number of new geomorphological studies focused on coastal dynamics and evolution across the world. The volume includes 14 papers concerning shoreline and/or dune system morphological changes at different time scales and in a context of climate change scenarios, obtained from different kinds of operational models/instruments and field studies as well as surveys and observations by means of aerial photos and satellite images. Specifically, papers included in this SI can be grouped into three main categories:

3.1. Shoreline Characterization, Dynamics and Evaluation

Eight papers belong to this category and provide information concerning the characterization and evolution at different spatial and temporal scales of a great variety of coastal environments, including mangrove swamps (along the Caribbean coast of Colombia), and sandy and rocky coasts and dune ridges in coastal sectors located in Russia, Italy, California (USA), Morocco and Spain. A further paper included in this category is aimed at eliciting key concepts determining the aesthetic appeal of coastal dunes and forests. In this case, the example of the Curonian Spit (Lithuania) is described. The following papers are included in this category:

- Nicu et al. [61]. *Shoreline Dynamics and Evaluation of Cultural Heritage Sites on the Shores of Large Reservoirs: Kuibyshev Reservoir, Russian Federation*.
- Mammì et al. [62]. *Mathematical Reconstruction of Eroded Beach Ridges at the Ombrone River Delta.*
- Griggs et al. [63]. *Documenting a Century of Coastline Change along Central California and Associated Challenges: From the Qualitative to the Quantitative.*
- Taaouati et al. [64]. *Influence of a Reef Flat on Beach Profiles Along the Atlantic Coast of Morocco.*
- Villate Daza et al. [65]. *Mangrove Forests Evolution and Threats in the Caribbean Sea of Colombia.*
- Molina et al. [66]. *Dune Systems' Characterization and Evolution in the Andalusia Mediterranean Coast (Spain).*
- Mattei et al. [67]. *New Geomorphological and Historical Elements on Morpho-Evolutive Trends and Relative Sea-Level Changes of Naples Coast in the Last 6000 Years.*
- Urbis et al. [68]. *Key Aesthetic Appeal Concepts of Coastal Dunes and Forests on the Example of the Curonian Spit (Lithuania).*

3.2. Coastal Hazard Evaluation and Impact Assessment of Marine Events

Four study cases analyse the impact of different marine processes, such as storms (in the Tordera Delta, Spain), sea-level rise (in the Jakarta Bay, Indonesia), and tsunami (along the Ionic Sicilian coast, Italy), as well as the impact of a specific post-tropical cyclone, on the Northern coast of Ireland. The following papers are included in this category:

- Sanuy et al. [69]. *Sensitivity of Storm-Induced Hazards in a Highly Curvilinear Coastline to Changing Storm Directions. The Tordera Delta Case (NW Mediterranean).*
- Yahya Surya et al. [70]. *Impacts of Sea-Level Rise and River Discharge on the Hydrodynamics Characteristics of Jakarta Bay (Indonesia).*
- Anfuso et al. [71]. *Spatial Variability of Beach Impact From Post-Tropical Cyclone Katia (2011) on Northern Ireland's North Coast.*
- Lo Re et al. [72]. *Tsunami Propagation and Flooding in Sicilian Coastal Areas by Means of a Weakly Dispersive Boussinesq Model.*

3.3. Relevance of Sediment Collection and Analysis for Coastal Nourishment

Two papers are included in this section. The first paper is focused on the analysis of differences in sand composition and colours between natural and artificially nourished beaches in Southern Mediterranean Spain. The second paper deals with the analysis of the influence of different sieving methods on the estimation of sand size parameters to determine suitable sediments for beach nourishment, with exempla from the Southern Atlantic coast of Spain. The following papers are included in this category:

- Poullet et al. [73]. *Influence of Different Sieving Methods on Estimation of Sand Size Parameters.*
- Asensio-Montesinos et al. [74]. *The Origin of Sand and its Colour on the South-Eastern Coast of Spain: Implications for Erosion Management.*

4. Conclusions

The high variability and dynamics of coastal morphologies and landforms require the application of tailored approaches for the assessment of local changes in the short, medium, and long term. The evaluation of the present morphological changes in coastal areas and their comparison with the past conditions lies in the identification of specific indicators in terms of beach erosion rates, dune and foredune extent variation, etc. Such variations can be considered as proxies for hazardous processes, i.e., chronic erosion processes, temporary flooding and permanent inundation, which could be exacerbated by ongoing climate change.

The analysis of local dynamics, as well as the identification of the main drivers triggering these hazardous processes, represent therefore a key point for the definition and implementation of suitable management actions aimed at reducing human- and climate-induced risks on coastal zones. For ensuring the effectiveness of coastal management actions as well as the suitability of the implementation of adaptive solutions to expected changes, it is fundamental to take into account the uniqueness of each coastal area to provide site-specific and tailored solutions. In this context, mapping and zoning of the areas prone to be impacted by hazardous processes as well as the assessment of the potentially exposed natural and anthropic assets represent the most appropriate operational approaches to provide detailed information and reduce the potential impacts.

In conclusion, by proposing different case studies from different coastal areas of the world, this Special Issue contributes to increasing the dissemination of specific knowledge at the transnational level favouring the exchange of results between researchers, promoting in this way the exploitation of assessment methods and approaches.

Author Contributions: The authors led the development of the Special Issue and contributed equally to the preparation of this manuscript. Conceptualization: A.R. and G.A.; writing—original draft preparation: A.R. and G.A.; writing—review and editing: A.R. and G.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Masselink, G.; Gehrels, R. *Coastal Environments and Global Change*; John Wiley & Sons: West Sussex, UK, 2014; p. 448.
2. Kelsey, H.M.; Bockheim, J.G. Coastal landscape evolution as a function of eustasy and surface uplift rate, Cascadia margin, southern Oregon. *Geol. Soc. Am. Bull.* **1994**, *106*, 840–854. [CrossRef]
3. Davidson-Arnott, R. *An Introduction to Coastal Processes and Geomorphology*; Cambridge University Press: Cambridge, UK, 2010; p. 458.
4. Reid, W.V.; Mooney, H.A.; Cropper, A.; Capistrano, D.; Carpenter, S.R.; Chopra, K.; Dasgupta, P.; Dietz, T.; Duraiappah, A.K.; Hassan, R.; et al. *Ecosystems and Human Well–Being: Synthesis*; Millennium Ecosystem Assessment: Washington, DC, USA, 2005.
5. Maes, J.; Teller, A.; Erhard, M.; Liquete, C.; Braat, L.; Berry, P.; Egoh, B.; Puydarrieux, P.; Fiorina, C.; Santos, F.; et al. *Mapping and Assessment of Ecosystems and Their Services. An Analytical Framework for Ecosystem Assessments under Action 5 of the EU Biodiversity Strategy to 2020*; Publications Office of the European Union: Luxembourg, 2013; pp. 1–58.
6. Fabbri, P. (Ed.) *Recreational Uses of Coastal Areas: A Research Project of the Commission on the Coastal Environment, International Geographical Union (Vol. 12)*; Springer Science & Business Media: Heidelberg, Germany, 2012; p. 287.
7. McGranahan, G.; Balk, D.; Anderson, B. The rising tide: Assessing the risks of climate change and human settlements in low elevation coastal zones. *Environ. Urban.* **2007**, *19*, 17–37. [CrossRef]

8. Neumann, B.; Vafeidis, A.T.; Zimmermann, J.; Nicholls, R.J. Future coastal population growth and exposure to sea-level rise and coastal flooding-a global assessment. *PLoS ONE* **2015**, *10*, e0118571. [CrossRef] [PubMed]
9. Neumann, B.; Ott, K.; Kenchington, R. Strong sustainability in coastal areas: A conceptual interpretation of SDG 14. *Sustain. Sci.* **2017**, *12*, 1019–1035. [CrossRef] [PubMed]
10. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. UNGA Resolution A/RES/70/1. Resolution Adopted by the General Assembly on 25 September 2015. Available online: https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_70_1_E.pdf (accessed on 10 October 2020).
11. Luijendijk, A.; Hagenaars, G.; Ranasinghe, R.; Baart, F.; Donchyts, G.; Aarninkhof, S. The state of the world's beaches. *Sci. Rep.* **2018**, *8*, 1–11. [CrossRef]
12. Kirezci, E.; Young, I.R.; Ranasinghe, R.; Muis, S.; Nicholls, R.J.; Lincke, D.; Hinkel, J. Projections of global-scale extreme sea levels and resulting episodic coastal flooding over the 21st Century. *Sci. Rep.* **2020**, *10*, 1–12. [CrossRef]
13. Kulp, S.A.; Strauss, B.H. New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding. *Nat. Commun.* **2019**, *10*, 1–12.
14. Nicholls, R.J.; Hoozemans, F.M.; Marchand, M. Increasing flood risk and wetland losses due to global sea-level rise: Regional and global analyses. *Glob. Environ. Chang.* **1999**, *9*, S69–S87. [CrossRef]
15. Molina, R.; Manno, G.; Re, C.L.; Anfuso, G.; Ciraolo, G. A Methodological Approach to Determine Sound Response Modalities to Coastal Erosion Processes in Mediterranean Andalusia (Spain). *J. Mar. Sci. Eng.* **2020**, *8*, 154. [CrossRef]
16. Aucelli, P.P.C.; Di Paola, G.; Rizzo, A.; Rosskopf, C.M. Present day and future scenarios of coastal erosion and flooding processes along the Italian Adriatic coast: The case of Molise region. *Environ. Earth Sci.* **2018**, *77*, 371. [CrossRef]
17. Rangel-Buitrago, N.; Anfuso, G. *Risk Assessment of Storms in Coastal Zones: Case Studies from Cartagena (Colombia) and Cadiz (Spain)*; Springer: Dordrecht, The Netherlands, 2015; p. 63.
18. Anfuso, G.; Martinez, J.A. Assessment of coastal vulnerability through the use of GIS tools in South Sicily (Italy). *Environ. Manag.* **2009**, *43*, 533–545. [CrossRef] [PubMed]
19. Rizzo, A.; Vandelli, V.; Buhagiar, G.; Micallef, A.S.; Soldati, M. Coastal vulnerability assessment along the North-Eastern sector of Gozo Island (Malta, Mediterranean Sea). *Water* **2020**, *12*, 1405. [CrossRef]
20. Di Paola, G.; Alberico, I.; Aucelli, P.P.C.; Matano, F.; Rizzo, A.; Vilardo, G. Coastal subsidence detected by Synthetic Aperture Radar interferometry and its effects coupled with future sea-level rise: The case of the Sele Plain (Southern Italy). *J. Flood Risk Manag.* **2018**, *11*, 191–206. [CrossRef]
21. Rizzo, A.; Aucelli, P.P.C.; Gracia, F.J.; Anfuso, G. A novelty coastal susceptibility assessment method: Application to Valdelagrana area (SW Spain). *J. Coast. Conserv.* **2018**, *22*, 973–987. [CrossRef]
22. Aucelli, P.P.C.; Di Paola, G.; Incontri, P.; Rizzo, A.; Vilardo, G.; Benassai, G.; Buonocore, B.; Pappone, G. Coastal inundation risk assessment due to subsidence and sea level rise in a Mediterranean alluvial plain (Volturno coastal plain-southern Italy). *Estuar. Coast. Shelf Sci.* **2017**, *198*, 597–609. [CrossRef]
23. Anfuso, G.; Gracia, F.J.; Battocletti, G. Determination of cliffed coastline sensitivity and associated risk for human structures: A methodological approach. *J Coast. Res.* **2013**, *29*, 1292–1296.
24. Özyurt, G.; Ergin, A. Application of sea level rise vulnerability assessment model to selected coastal areas of Turkey. *J. Coast. Res.* **2009**, *51*, 248–251.
25. Cowell, P.J.; Thom, B.G. Morphodynamics of coastal evolution. In *Coastal Evolution: Late Quaternary Shoreline Morphodynamics*; Carter, R.W.G., Woodroffe, C.D., Eds.; Cambridge University Press: Cambridge, UK, 1994; pp. 33–86.
26. Meyer-Arendt, K. Grand Isle, Louisiana: A historic US Gulf Coast Resort Adapts to Hurricanes, Subsidence and Sea Level Rise. In *Disappearing Destinations*; Jones, A., Phillips, M., Eds.; CABI: Wallingford, UK, 2011; pp. 203–217.
27. Morhange, C.; Marriner, N. Archeological and biological relative sea-level indicators. In *Handbook of Sea-Level Research*; Shennan, I., Long, A.J., Horton, B.P., Eds.; Wiley & Sons, Ltd.: West Sussex, UK, 2015; pp. 146–156.
28. Vacchi, M.; Ermolli, E.R.; Morhange, C.; Ruello, M.R.; Di Donato, V.; Di Vito, M.A.; Boetto, G. Millennial variability of rates of sea-level rise in the ancient harbour of Naples (Italy, western Mediterranean Sea). *Quat. Res.* **2020**, *93*, 284–298. [CrossRef]

29. Pappone, G.; Aucelli, P.P.; Mattei, G.; Peluso, F.; Stefanile, M.; Carola, A. A Detailed Reconstruction of the Roman Landscape and the Submerged Archaeological Structure at "Castel dell'Ovo islet" (Naples, Southern Italy). *Geosciences* **2019**, *9*, 170. [CrossRef]
30. Aucelli, P.; Cinque, A.; Mattei, G.; Pappone, G.; Rizzo, A. Studying relative sea level change and correlative adaptation of coastal structures on submerged Roman time ruins nearby Naples (southern Italy). *Quat. Int.* **2019**, *501*, 328–348. [CrossRef]
31. Mattei, G.; Troisi, S.; Aucelli, P.P.; Pappone, G.; Peluso, F.; Stefanile, M. Sensing the submerged landscape of Nisida Roman Harbour in the Gulf of Naples from integrated measurements on a USV. *Water* **2018**, *10*, 1686. [CrossRef]
32. Molina, R.; Anfuso, G.; Manno, G.; Gracia-Prieto, F.J. The Mediterranean coast of Andalusia (Spain): Medium-term evolution and impacts of coastal structures. *Sustainability* **2019**, *11*, 3539. [CrossRef]
33. Williams, A.T.; Rangel-Buitrago, N.; Pranzini, E.; Anfuso, G. The management of coastal erosion. *Ocean Coast. Manag.* **2018**, *156*, 4–20. [CrossRef]
34. Pranzini, E. Coastal erosion and shore protection: A brief historical analysis. *J. Coast. Conserv.* **2018**, *22*, 827–830. [CrossRef]
35. Manno, G.; Anfuso, G.; Messina, E.; Williams, A.T.; Suffo, M.; Liguori, V. Decadal evolution of coastline armouring along the Mediterranean Andalusia littoral (South of Spain). *Ocean Coast. Manag.* **2016**, *124*, 84–99. [CrossRef]
36. Vousdoukas, M.I.; Ranasinghe, R.; Mentaschi, L.; Plomaritis, T.A.; Athanasiou, P.; Luijendijk, A.; Feyen, L. Sandy coastlines under threat of erosion. *Nat. Clim. Chang.* **2020**, *10*, 260–263. [CrossRef]
37. Mentaschi, L.; Vousdoukas, M.I.; Pekel, J.F.; Voukouvalas, E.; Feyen, L. Global long-term observations of coastal erosion and accretion. *Sci. Rep.* **2018**, *8*, 1–11. [CrossRef]
38. Bird, E.C.F. *Coastline Changes*; A Global Review; Wiley: Chichester, UK, 1985.
39. IPCC. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2013; p. 1535.
40. IPCC. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007*; Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2007.
41. Antonioli, F.; Falco, G.D.; Presti, V.L.; Moretti, L.; Scardino, G.; Anzidei, M.; Marsico, A. Relative Sea-Level Rise and Potential Submersion Risk for 2100 on 16 Coastal Plains of the Mediterranean Sea. *Water* **2020**, *12*, 2173. [CrossRef]
42. Antonioli, F.; Anzidei, M.; Amorosi, A.; Presti, V.L.; Mastronuzzi, G.; Deiana, G.; Marsico, A. Sea-level rise and potential drowning of the Italian coastal plains: Flooding risk scenarios for 2100. *Quat. Sci. Rev.* **2017**, *158*, 29–43. [CrossRef]
43. Nicholls, R.J.; Cazenave, A. Sea-level rise and its impact on coastal zones. *Science* **2010**, *328*, 1517–1520. [CrossRef]
44. Viavattene, C.; Jiménez, J.A.; Ferreira, O.; Priest, S.; Owen, D.; McCall, R. Selecting coastal hotspots to storm impacts at the regional scale: A Coastal Risk Assessment Framework. *Coast. Eng.* **2018**, *134*, 33–47. [CrossRef]
45. Rahmstorf, S. Rising hazard of storm-surge flooding. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 11806–11808. [CrossRef] [PubMed]
46. Castelle, B.; Marieu, V.; Bujan, S.; Splinter, K.D.; Robinet, A.; Sénéchal, N.; Ferreira, S. Impact of the winter 2013–2014 series of severe Western Europe storms on a double-barred sandy coast: Beach and dune erosion and megacusp embayments. *Geomorphology* **2015**, *238*, 135–148. [CrossRef]
47. Guisado-Pintado, E.; Jackson, D.W.T. Multi-scale variability of storm Ophelia 2017: The importance of synchronised environmental variables in coastal impact. *Sci. Total Environ.* **2018**, *630*, 287–301. [CrossRef] [PubMed]
48. Li, K.; Li, G.S. Vulnerability assessment of storm surges in the coastal area of Guangdong Province. *Nat. Hazards Earth Syst. Sci.* **2011**, *11*, 2003–2011. [CrossRef]

49. Vousdoukas, M.I.; Mentaschi, L.; Voukouvalas, E.; Verlaan, M.; Jevrejeva, S.; Jackson, L.P.; Feyen, L. Global probabilistic projections of extreme sea levels show intensification of coastal flood hazard. *Nat. Commun.* **2018**, *9*, 1–12. [CrossRef] [PubMed]
50. Kopp, R.E.; Kemp, A.C.; Bittermann, K.; Horton, B.P.; Donnelly, J.P.; Gehrels, W.R.; Rahmstorf, S. Temperature-driven global sea-level variability in the Common Era. *Proc. Natl. Acad. Sci. USA* **2016**, *113*, E1434–E1441. [CrossRef]
51. Rahmstorf, S. Modeling sea level rise. *Nat. Educ. Knowl.* **2012**, *3*, 4.
52. Rahmstorf, S. A new view on sea level rise. *Nat. Rep. Clim. Chang.* **2010**, *4*, 44–45. [CrossRef]
53. Rahmstorf, S. A semi-empirical approach to projecting future sea-level rise. *Science* **2007**, *315*, 368–370. [CrossRef]
54. Church, J.A.; Clark, P.U.; Cazenave, A.; Gregory, J.M.; Jevrejeva, S.; Levermann, A.; Merrifield, M.A.; Milne, G.A.; Nerem, R.S.; Nunn, P.D.; et al. Sea Level Change. In *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2013.
55. Giorgi, F.; Lionello, P. Climate change projections for the Mediterranean region. *Glob. Planet. Chang.* **2008**, *63*, 90–104. [CrossRef]
56. Rovere, A.; Furlani, S.; Benjamin, J.; Fontana, A.; Antonioli, F. MEDFLOOD project: MEDiterranean sea-level change and projection for future FLOODing. *Alp. Mediterr. Quat.* **2012**, *25*, 3–6.
57. Lambeck, K.; Antonioli, F.; Anzidei, M.; Ferranti, L.; Leoni, G.; Scicchitano, G.; Silenzi, S. Sea level change along the Italian coast during the Holocene and projections for the future. *Quat. Int.* **2011**, *232*, 250–257. [CrossRef]
58. Matano, F.; Sacchi, M.; Vigliotti, M.; Ruberti, D. Subsidence trends of volturno river coastal plain (northern Campania, southern italy) inferred by sar interferometry data. *Geosciences* **2018**, *8*, 8. [CrossRef]
59. Teatini, P.; Tosi, L.; Strozzi, T. Quantitative evidence that compaction of Holocene sediments drives the present land subsidence of the Po Delta, Italy. *J. Geophys. Res. Solid Earth* **2011**, *116*. [CrossRef]
60. European Commission. *An EU Strategy on Adaptation to Climate Change*; The European Commission: Brussels, Belgium, 2013.
61. Nicu, I.C.; Usmanov, B.; Gainullin, I.; Galimova, M. Shoreline Dynamics and Evaluation of Cultural Heritage Sites on the Shores of Large Reservoirs: Kuibyshev Reservoir, Russian Federation. *Water* **2019**, *11*, 591. [CrossRef]
62. Mammì, I.; Rossi, L.; Pranzini, E. Mathematical Reconstruction of Eroded Beach Ridges at the Ombrone River Delta. *Water* **2019**, *11*, 2281. [CrossRef]
63. Griggs, G.; Davar, L.; Reguero, B.G. Documenting a Century of Coastline Change along Central California and Associated Challenges: From the Qualitative to the Quantitative. *Water* **2019**, *11*, 2648. [CrossRef]
64. Taaouati, M.; Parisi, P.; Passoni, G.; Lopez-Garcia, P.; Romero-Cozar, J.; Anfuso, G.; Vidal, J.; Muñoz-Perez, J.J. Influence of a Reef Flat on Beach Profiles along the Atlantic Coast of Morocco. *Water* **2020**, *12*, 790. [CrossRef]
65. Villate Daza, D.A.; Sánchez Moreno, H.; Portz, L.; Portantiolo Manzolli, R.; Bolívar-Anillo, H.J.; Anfuso, G. Mangrove Forests Evolution and Threats in the Caribbean Sea of Colombia. *Water* **2020**, *12*, 1113. [CrossRef]
66. Molina, R.; Manno, G.; Lo Re, C.; Anfuso, G. Dune Systems' Characterization and Evolution in the Andalusia Mediterranean Coast (Spain). *Water* **2020**, *12*, 2094. [CrossRef]
67. Mattei, G.; Aucelli, P.P.C.; Caporizzo, C.; Rizzo, A.; Pappone, G. New Geomorphological and Historical Elements on Morpho-Evolutive Trends and Relative Sea-Level Changes of Naples Coast in the Last 6000 Years. *Water* **2020**, *12*, 2651. [CrossRef]
68. Urbis, A.; Povilanskas, R.; Šimanauskienė, R.; Taminskas, J. Key Aesthetic Appeal Concepts of Coastal Dunes and Forests on the Example of the Curonian Spit (Lithuania). *Water* **2019**, *11*, 1193. [CrossRef]
69. Sanuy, M.; Jiménez, J.A. Sensitivity of Storm-Induced Hazards in a Highly Curvilinear Coastline to Changing Storm Directions. The Tordera Delta Case (NW Mediterranean). *Water* **2019**, *11*, 747. [CrossRef]
70. Yahya Surya, M.; He, Z.; Xia, Y.; Li, L. Impacts of Sea Level Rise and River Discharge on the Hydrodynamics Characteristics of Jakarta Bay (Indonesia). *Water* **2019**, *11*, 1384. [CrossRef]
71. Anfuso, G.; Loureiro, C.; Taaouati, M.; Smyth, T.; Jackson, D. Spatial Variability of Beach Impact from Post-Tropical Cyclone Katia (2011) on Northern Ireland's North Coast. *Water* **2020**, *12*, 1380. [CrossRef]

72. Lo Re, C.; Manno, G.; Ciraolo, G. Tsunami Propagation and Flooding in Sicilian Coastal Areas by Means of a Weakly Dispersive Boussinesq Model. *Water* **2020**, *12*, 1448. [CrossRef]
73. Poullet, P.; Muñoz-Perez, J.J.; Poortvliet, G.; Mera, J.; Contreras, A.; Lopez, P. Influence of Different Sieving Methods on Estimation of Sand Size Parameters. *Water* **2019**, *11*, 879. [CrossRef]
74. Asensio-Montesinos, F.; Pranzini, E.; Martínez-Martínez, J.; Cinelli, I.; Anfuso, G.; Corbí, H. The Origin of Sand and Its Colour on the South-Eastern Coast of Spain: Implications for Erosion Management. *Water* **2020**, *12*, 377. [CrossRef]