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EXPRESSION OF LITTORAL DYNAMICS FROM BEACH CRESCENT CHARACTERISTICS: CASE OF THE BEACHES OF SAN-PEDRO, FRESCO, VRIDI, PORT-BOUET, ASSOUINDE (IVORY COAST)

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ABSTRACT

The physical characteristics, in particular the length of the sequence of crests and troughs, the height of the crests and the depth of the troughs in beach crescents were studied with a view to using them as an indicator of the intensity of coastal sedimentary dynamics. Five long-shore coastal sections: San-Pédro, Fresco, Vridi, Port-Bouët and Assouindé were used as bases for this study. Topographic surveys at the level were carried out at the upper of the beach in the preferred area for crescents over lengths ranging from 89.5 m to 380.4 m. The longshore morphology of these various beaches consists of a succession of crests and troughs. The average length of crest succession ranges from 133.5 m to 36.2 m. That of the troughs ranges from 142.56 m to 29.30 m. The sites with the shortest average crests sequences also have the shortest average troughs sequences. The heights and depths measured relative to the altitude of the starting point are between 3.53 cm and 79.48 cm and between 0 and -75.74 cm, respectively. The sites where the highest crest heights occur also have the shallowest trough depths. Sediment loads per unit area are higher on the coastal sections that show a small average succession of troughs or crests. This comparison is conducted across all five sites studied. Sediment loads are higher on 3/5 of the sites with the biggest crest heights or the deepest troughs.

Keywords: Sedimentary dynamics, Longshore Morphology, Beach Crescent, Crest Height, Depth Of Troughs, Sediment Load.

1 INTRODUCTION

Coastal areas are, in the world, preferred places for building homes, industry, commerce, and leisure. Thus, 20 percent of the world's population lives within 30 km of the coast [1]. In Côte d'Ivoire, an analysis of data from the 2014 general population census and the study by [2] reveals that 30.87% of the population lives along the coast. The rapid and increasing urbanization of the Ivorian coastline is linked, among other factors, to the proliferation of hotel complexes along the coast. More than 8% of the national PIB is generated by coastal tourism [2]. These complexes are, however, exposed to a major coastal risk, which is erosion. These complexes are, however, exposed to a major coastal risk, which is erosion. This risk, although natural and even in its context of being worsened by climate change, can have reduced effects if we first did a scientific assessment of the quality of the coastal dynamics before choosing the development site. Isn't the geomorphological configuration of the beach an indicator of the quality of coastal sediment dynamics? This study is carried out to help project owners on the coast and all users of coastal areas make informed choices when setting up their site. The longshore morphology in the direction parallel to the shore consists of a succession of crests and troughs whose shapes resemble those of a crescent. Isn't the analysis of characteristics, especially the length of crest or trough sequences, the height of crests, and the depth of troughs, indicative of the intensity of shoreline sediment dynamics? This study will focus on linking the altered surfaces to these characteristics in order to determine the quality of the dynamics.

2 METHODOLOGY

2.1 Location of the Longshore Monitoring Profiles

The coastal areas studied are: San-pedro, Fresco, Vridi, Port-Bouët, and Assouindé (Figure 1).

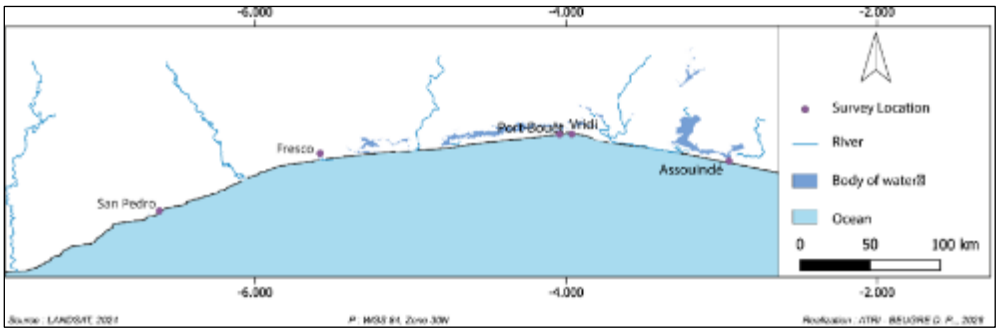


Figure 1: Areas studied along the coast of Côte d'Ivoire

2.2 Topographic survey protocol

The knowledge of the longshore beach morphology is obtained by profiling at the worksite. The crescent are located on the upper foreshore. So, this part was used for topographical surveys. The survey was conducted using the method described by [3].

Table 1: Summary of locations, dates, and lengths of beach sections surveyed during the topographic survey campaigns between 2023 and 2026.

Coastal Cities	Dates and Length surveyed		
San-Pedro	11/02/2026 160,6 m	17/04/2026 176,5 m	
Fresco	23/12/2025 89,5	15/04/2026 101,1 m	
Vridi	13/03/2025 155,8 m	15/05/2025 142,5 m	
Port-Bouët	24/01/2024 212,7 m	27/02/2024 251, 2 m	20/05/2024 228,2

Assouindé	25/11/2023 345,2 m	27/02/2024 336,8 m	20/05/2024 380,4 m

It involves parking in the direction of the identified profile. Then, measurements are taken at points with morphological subtleties (changes in slope) up to a given distance. The lengths surveyed range from 89.5 m to 380.4 m. The total of the campaigns is summarized in Table I. The altitude levels are reported taking into account the starting point of the topographic surveys. So, high (crest) and low (trough) levels are identified on the longshore profile.

2.3 Parameters analyzed in the longshore topographic survey

Crests and troughs are identified on each report. The distances between them are calculated. An average is calculated for the length of the succession of crests and troughs across all report at each site. The heights of the crests and the depths of the troughs are calculated based on the initial reference system for the elevation at the starting point of the longshore survey at each site. An average is calculated for the heights and depths over the monitoring period.

2.4 Longshore sediment transport load

Profile data collected on different dates are overlaid on the same graph. Thus, we can observe the various resulting morphological variations between two consecutive surveys. Calculating the area defined by the morphological difference between two consecutive surveys gives the sediment load. All consecutive states from the follow-up period are superimposed two by two. Since the lengths of the surveys for each state and the various sites are not uniform, the calculated loads are adjusted per unit length for each state and each site. An average of the loads is taken over the follow-up period at each site. The loads resulting from the reshaping are calculated by applying the triangle or trapezoid formula to the beach profiles.

((G(x)-f(x))+(G'(x)-f'(x)))/2*dx. Where G is the recent state of the profile and f is the previous state. The calculated area represents a surface sediment balance over the monitoring period.

3 RESULTS

3.1 Analysis of longshore morphologies

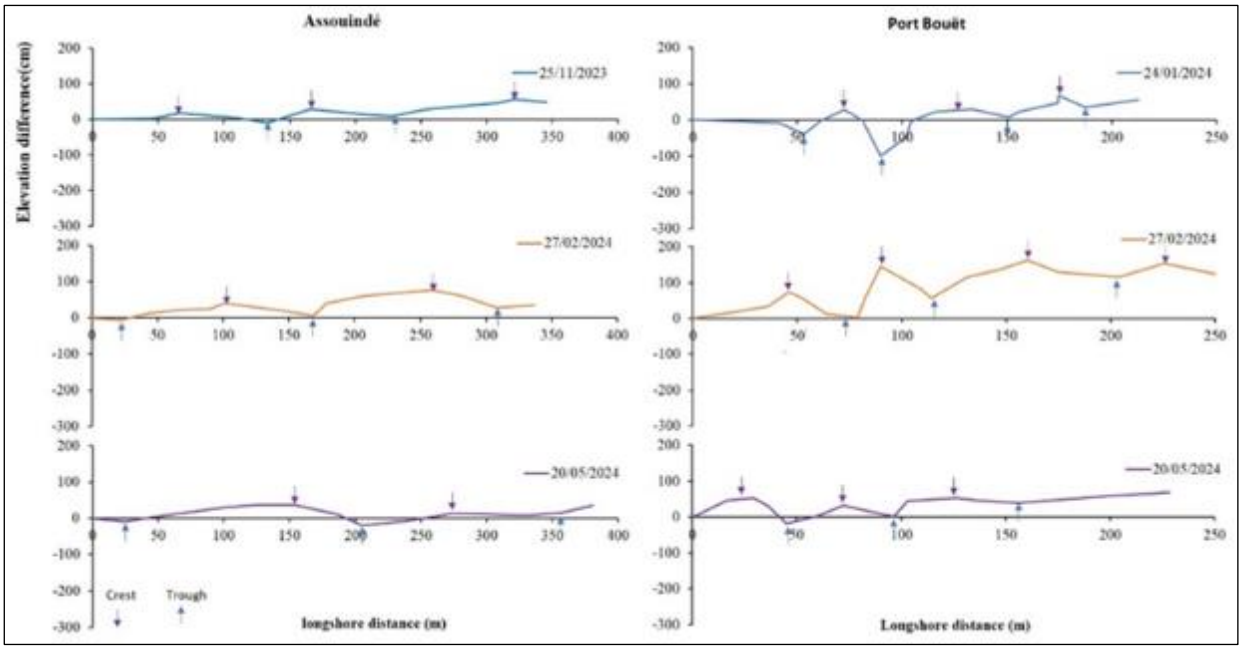


Figure 2: Longshore morphological face at Assouindé and Port-Bouët

An analysis of the longshore morphology along the survey routes in November 2023, February 2024, and May 2024 at Assouindé reveals an alternating pattern of crests and troughs whose morphological configuration resembles that of a crescent. Between two or three crests or troughs are counted on these courses, whose lengths range between 336.8 m and 380.4 m (Figure 2). On the Port-Bouët route, where the lengths range between 212.7 and 251.2 m, the same morphological setup, made up of alternating crests and troughs, is observed. There are between 3 and 4 crests or troughs on the January 2024, February 2024, and May 2024 routes (Figure 2). The Vridi routes of 155.8 m and 142.5 m

on 13 March and 15 May, 2025, the Fresco routes of 89.5 m and 101.1 m on 23 December, 2025, and 4 April, 2026, and the San-Pedro routes of 160.6 m and 176.5 m on 11 February and 17 April, 2025, all show paths made of alternating crests and troughs. The longshore morphology, practically at the boundary between the upper and mid foreshore, usually marked by a change in slope , consists of an alternation of crests and troughs defining beach crescents (Figure 3).

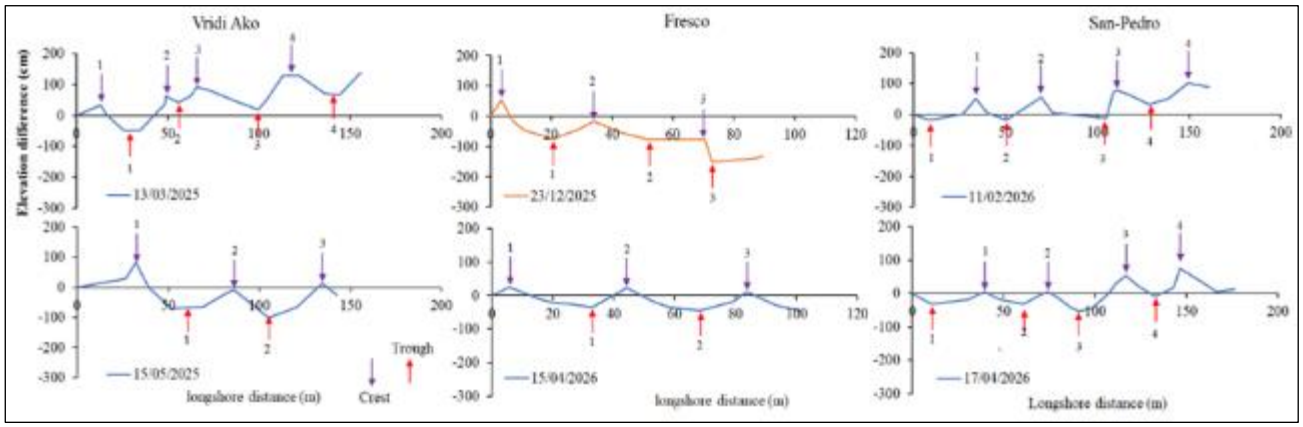


Figure 3: Longshore morphological pattern at Vridi, Fresco and San-Pedro

3.2 Crest succession distance

The average distance between successive crests along the coastline from East to west ranges from 133.5 m at Assouindé to 36.2 m at Fresco. This last city has the shortest distance between two consecutive crests. The Port-Bouët and Vridi areas have average crest succession lengths of 55.08 m and 42.52 m. The average distance between crests in San-Pedro is 37.07 m. Analysis of these succession distances indicates a nearly decreasing order from Assouindé to San-Pedro that is, from east to west across the study areas (Figure 4).

3.3 Troughs succession distance

The average distance between consecutive troughs ranges from 142.56 m to 29.30 m between Assouindé and Fresco. These values are the extremes. At Port-Bouët, the average distance between troughs is 53.95 m. It is 51.61 m in Vridi and 40.28 m in San Pedro. The analysis of distances between successive troughs shows a decrease from Assouindé to Fresco (figure 4), then an increase from Fresco to San-Pedro. This setup is the same as the one described by the average distance between the crests.

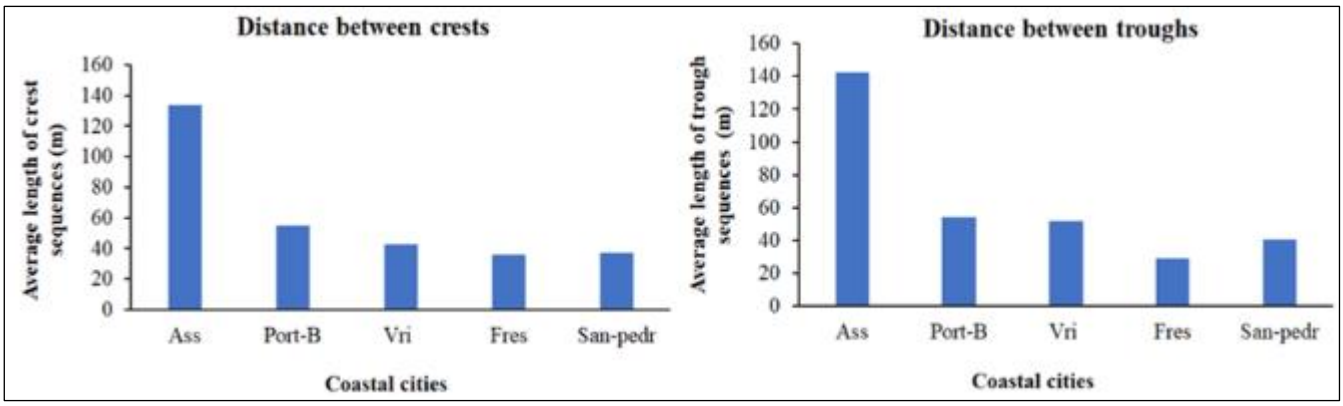


Figure 4: Average length of crests and troughs.

3.4 Average depth of the troughs

The average trough depths range from 0 at Assouindé to -75.74 cm at Fresco**.** The Assouindé coastline has the shallowest troughs, while Fresco's has the deepest ones. Port-Bouët is the only one with a positive average trough value, unlike Vridi, Fresco, and San-Pedro, where the average is negative (Figure 5).

3.5 Average height crests

The crests heights range from 3.53 cm in Fresco to 79.48 cm in Port-Bouët (figure 5). The coastline of Fresco has the lowest trough depths and the highest crest heights. Port-Bouët has the highest crests.

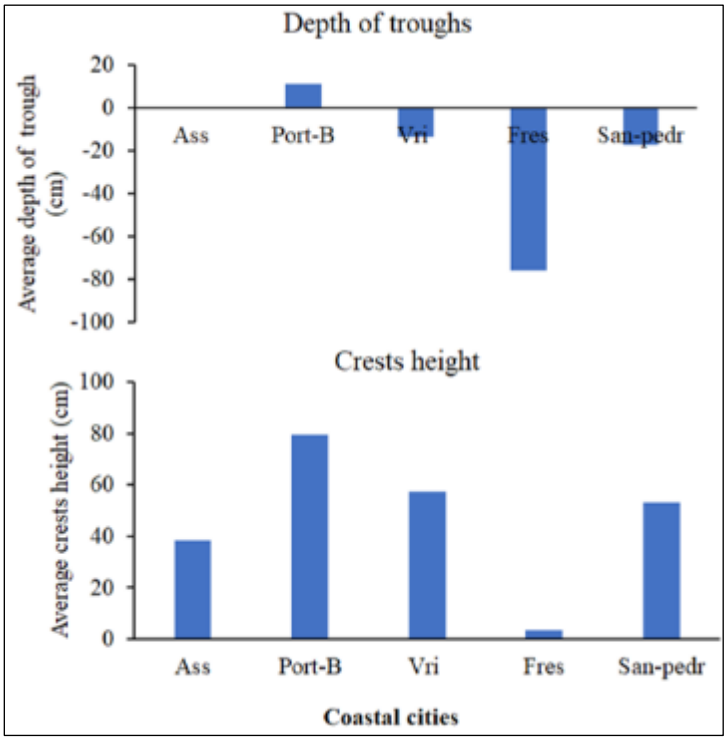


Figure 5: Average depth and height of troughs and crests

3.6 Reworked area per unit of length

The average longshore-reshaped area ranges from 0.16 m^2 in Asouindé, where it is lowest, to 0.64 m^2 in Vridi, where it is highest (Figure 6). The setup shows a steady increase from San-Pedro to Vridi, so from west to east, and then a decrease from Vridi to Assouindé, also from west to east (figure 6).

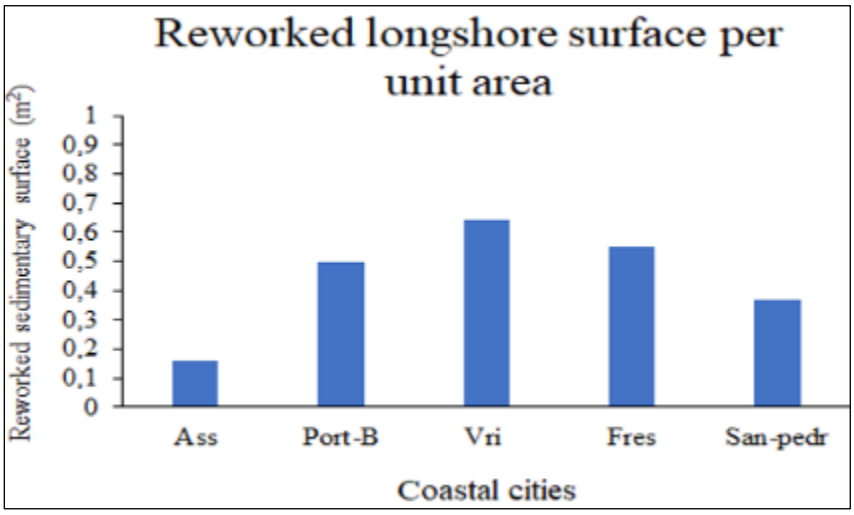


Figure 6: Longshore area reworked per unit of surface

3.7 Sediment load and correlatable physical parameters

Of the 5 sites studied, 4 exhibit parameters for average trough depth and average crest height that can be correlated (Figure 7). The deep average troughs have low average crest heights. For the average distance parameters of the succession of crests and troughs, all 5 sites show a correlation. The smaller the average distance between the troughs, the smaller it is between the crests too (figure 7). The average distances between troughs and crests range from 30 to

60 meters at 4/5 of the sites. The highest sediment loads (0.5 to 0.64 m^2) are found on beaches with the shortest distances between troughs and crests (between 30 and 60 m) (Figure 8). In fact, the smaller average values for the succession of crests and troughs practically indicate a high prevalence of vrests and troughs. The strong presence of these elements becomes an indicator of high sedimentary activity. Alone, the Assouindé beach at the far east of the coast shows an average length of sequences of troughs and crests of 142.56 m and 133.6 m, respectively. It also shows the lowest average sediment load (0.16 m^2). The average heights and depths of crests and troughs, correlated with the load, are less satisfactory. 3/5 of sites show a correlation (figure 9). Sediment loads per unit area increase as crests heights rise at three sites. This behavior is the same for the average trough depth parameter, where the loads also increase as the trough depth increases (Figure 8).

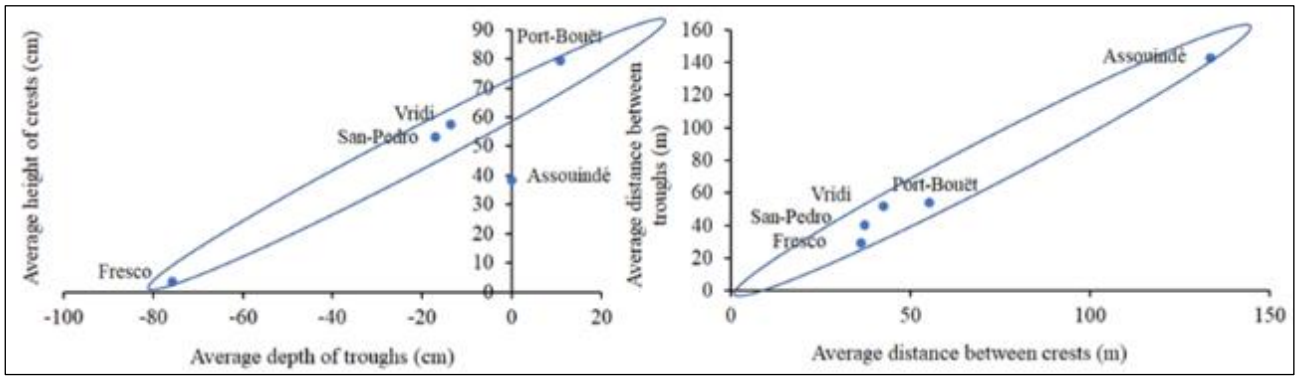


Figure 7: Correlatable Physical Parameters

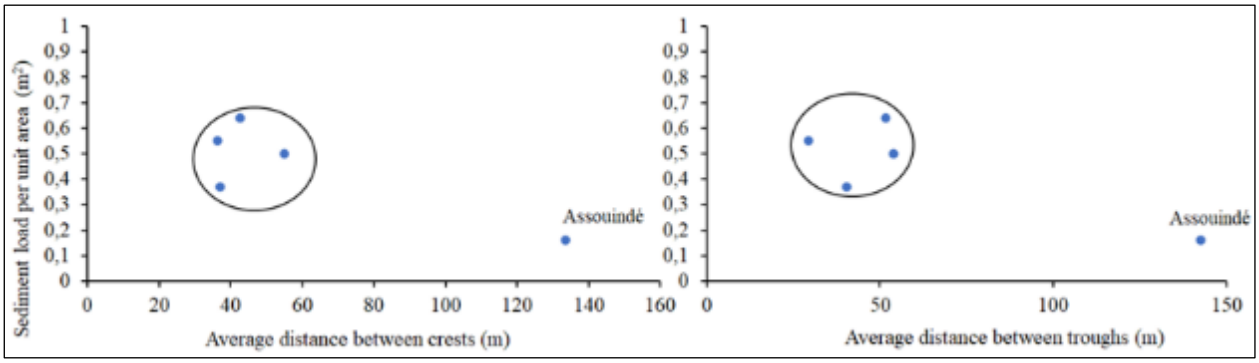


Figure 8: Correlation between sediment loads and the average distances between troughs and crests.

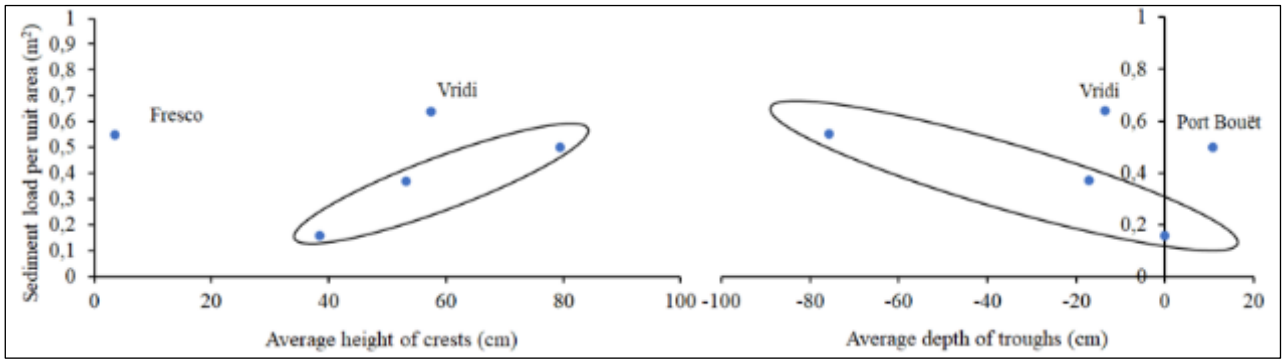


Figure 9: Correlation of sediment loads with the average heights and depths of troughs and crests.

4 DISCUSSION

The presence of beach crescents as rhythmic figures of sediment accumulation has been recognized by several authors and described on the coast of the Iroise Sea by [4]. She described a single block of beach crescent on the upper beach with a rhythm evolving between 27 and 31 m. In this study, the average elevation of the crests and troughs that define the crescents ranges from 133.5 to 36.2 meters or from 142.5 to 29.30 meters. The long shore morphological face was described by [5] on the coastline of Port Bouët Bidet as a succession of crests and troughs. It is this same type of

longshore morphological structure that is observed in this study, which examined five other distinct coastlines, including Assouindé, Port-Bouët Lighthouse, Vridi Ako, Fresco, and San-Pedro. The description of the longshore geomorphological configuration of Truc Vert Beach (Aquitaine Coast) by [6] shows a beach consisting of a succession of beach crescents alternating between crests and troughs. This configuration without taking the characteristics into account is the same as that described for the coastal sections studied. Given its accessibility and the variety of research methods available, the shoreline is often considered an indicator of the beach's overall sedimentary dynamics. However, [7] demonstrated significant inconsistencies between trends in foreshore sediment budgets and the actual dynamics of the shoreline. Thus, this study examines the characteristics of beach crescents to illustrate the dynamics of the foreshore. The sediment loads obtained correlate well with the frequency of occurrence of the crests and troughs of beach crescents.

5 CONCLUSION

The longshore geomorphological face consists of a succession of beach crescents characterized by alternating crests and troughs at the five sites studied. The average length of these crests ranges from 133.5 m to 36.2 m. As for the troughs, their average length ranges from 142.56 m to 29.30. The highest values are found in Assouindé, and the lowest in Fresco. These two parameters show a clear correlation: The shorter the average length of the crests, the more the average length of the troughs tends to decrease. The longshore sediment loads per unit area over the different monitoring periods vary between 0.64 m^2 and 0.16 m^2. The highest value is obtained at Vridi and the lowest at Assouindé. Correlating the loads with the average succession of crest and troughs gives the same result. The strongest loads are found on sites where the average spacing between crests and troughs is small. The average crest heights and trough depths are also correlated and mean that a small crest height corresponds to a deep trough and vice versa. However, the correlation between loads and the average heights of crests and troughs is less satisfactory.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

There is no conflict of interest.

REFERENCES

[1] Union internationale pour la conservation de la nature (UICN), (2015). Climat : vers un dérèglement géopolitique ? Rapport d'information n° 14 (2015-2016).D´eborah Idier, J´erˆome Thi´ebot. Dynamique des cˆotes sableuses et ph´enom`enes d'auto-organisation. Geosciences, 2013, pp.36-45. <hal-01062224>D´eborah Idier, J´erˆome Thi´ebot. Dynamique des cˆotes sableuses et ph´enom`enes d'auto-organisation. Geosciences, 2013, pp.36-45. <hal-01062224>D´eborah Idier, J´erˆome Thi´ebot. Dynamique des cˆotes sableuses et ph´enom`enes d'auto-organisation. Geosciences, 2013, pp.36-45. <hal-01062224>D´eborah Idier, J´erˆome Thi´ebot. Dynamique des cˆotes sableuses et ph´enom`enes d'auto-organisation. Geosciences, 2013, pp.36-45. <hal-01062224

[2] Gohourou F, Ahua E. A, Gnanbe D. R, Desse M. (2022). Fonctionnement, dynamique et structuration de l'espace littoral en Côte d'Ivoire. Territoires d'Afrique, 2022, Dynamiques des façades et planifications terrestres maritimes en Afrique, 12, pp.77-87.

[3] Ibe A.C., Quelennec R.E. (1989). Methodology for assessment and control of coastal erosion in West and Central Africa. UNEP Regional seas Report and studies 107p.

[4] Dehouck A. (2006) Observations et conditions d'apparition des croissants de plage sur le littoral de la mer d'Iroise, Norois, 201 pp7-16. doi.org/10.4000/norois.1732.

[5] Saimon A. A. Mathurin, Touré M, Gbegbe M, Kouakou A. M. (2026). Caractérisation des processus morpho-sédimentologiques sur un estran adossé à un trait de côte stable : cas du secteur littoral de Port-Bouët Bidet (Abidjan, Côte d'Ivoire), Geotrope, n°01, 2026, pp 35-49.

[6] Déborah Idier, Jéroôrme Thiébot (2013). Dynamique des côtes sableuses et phénomène d'auto organisation. Géosciences, 2013, pp.36-45.

[7] Brunel C, Certain R, Robin N, Raynal O, Aleman N, Barusseau J-P. (2014). L'évolution du trait de côte : un bon indicateur de la dynamique sédimentaire de l'avant côte ? Le cas du Languedoc-Roussillon. XIII ème Journées Nationales Génie Côtier – Génie Civil, Dunkerque, 2-4 juillet 2014, DOI:10.5150/jngcgc.2014.029. pp 265-272.